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INTO THE HEART OF GLACIERS 70

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Make-believe war erupts with the intensity of a real one as Asmat men with tipless arrows storm an "enemy" village. Part of a weeks-long ceremony to honor the dead, the mock attack mimics a traditional headhunting raid. With tribal warfare now banned by Indonesian authorities, the Asmat and most of the other 250 ethnic groups in Irian Jaya turn to feasts and rituals to keep their warrior culture alive.

IRIAN JAYA

Indonesia's Wild Side

Ignored for centuries, the island of New Guinea was like a lost world, where Stone Age tribes practiced cannibalism and ferns grew to giant size (right). In the 1960s Indonesia laid claim to the western half, later naming it Irian Jaya—"victorious hot land." Despite modern efforts to tame the land and pacify the people, an unyielding wildness remains, etched in the face of an aging Asmat warrior (above).

By THOMAS O'NEILL NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by GEORGE STEINMETZ

IN A LAND CALLED IRIAN JAYA, on the island of New Guinea, clouds pile up like bales of fleece and, by midmorning, smother the tops of the mountains. That is why pilots prefer to take off at dawn, especially when they are flying small planes to the highlands of the remote interior.

The sun had hardly begun to paint the mountain walls the morning I arrived in the central highlands. As our pilot brought us down, birds erupted from the forest canopy, and we could see a wave of dark-skinned people massing along the edge of a narrow grass landing strip.

It was not so long ago that these Yali tribal people would have fled in terror whenever a plane buzzed over one of their thatch villages. They would have slaughtered their pigs, so the airborne invader could not take them, and hidden their children deep in the forest.

Since those early exploratory flights, many planes have followed, bringing missionaries and soldiers, teachers and prospectors into the lush mountain sanctuary. But no longer do the Yali scatter. As our Cessna bounced down in the village of Angguruk, the mob of onlookers grew, people charging in from the hillsides as if joining an attack. No arrival is trivial here. The modern world was paying another dramatic visit, and from the solemn looks on the people's faces it was hard to know whether the Yali consider this world their friend or their enemy.

Irian Jaya, occupying the Indonesian half of New Guinea, is one of the wildest, most isolated frontiers on earth. It was on this airstrip, cleared by missionaries from Europe, that the Yali in the early 1960s feasted on prisoners they had taken in a raid on a neighboring people. A decade later another highland tribe killed and ate a mission preacher and a dozen of his assistants, all deemed guilty of stealing land or taking liberties with local women.

Cannibalism, once practiced by many New Guinea tribes, is now officially taboo in Irian Jaya. Traditionally it was tied to a tribal justice system—punishment for theft or murder—or served as revenge against an enemy, whose powers were absorbed when the body was eaten. Now tribal warfare is outlawed as well. These are only two of the momentous changes that the Indonesian government has introduced in its forceful quest to modernize its most undeveloped province. The challenge is daunting: How does one make Indonesians out of people emerging only now from the Stone Age?

For several days I hiked in the mountains from one Yali village to the next. I slept rough on the dirt floors of metal-roofed schools or

Far from the forest, a group of native dancers, their traditional feathers replaced by synthetic frills, hustle through Jayapura, capital of Irian Jaya and a boomtown for settlers drawn to Indonesia's largest, most undeveloped province. The dancers were bused in for a rare visit by President Suharto, who hopes more Indonesians will migrate to Irian and develop its vast spaces. A street mural depicts an idealized version of a homesteaders' town.

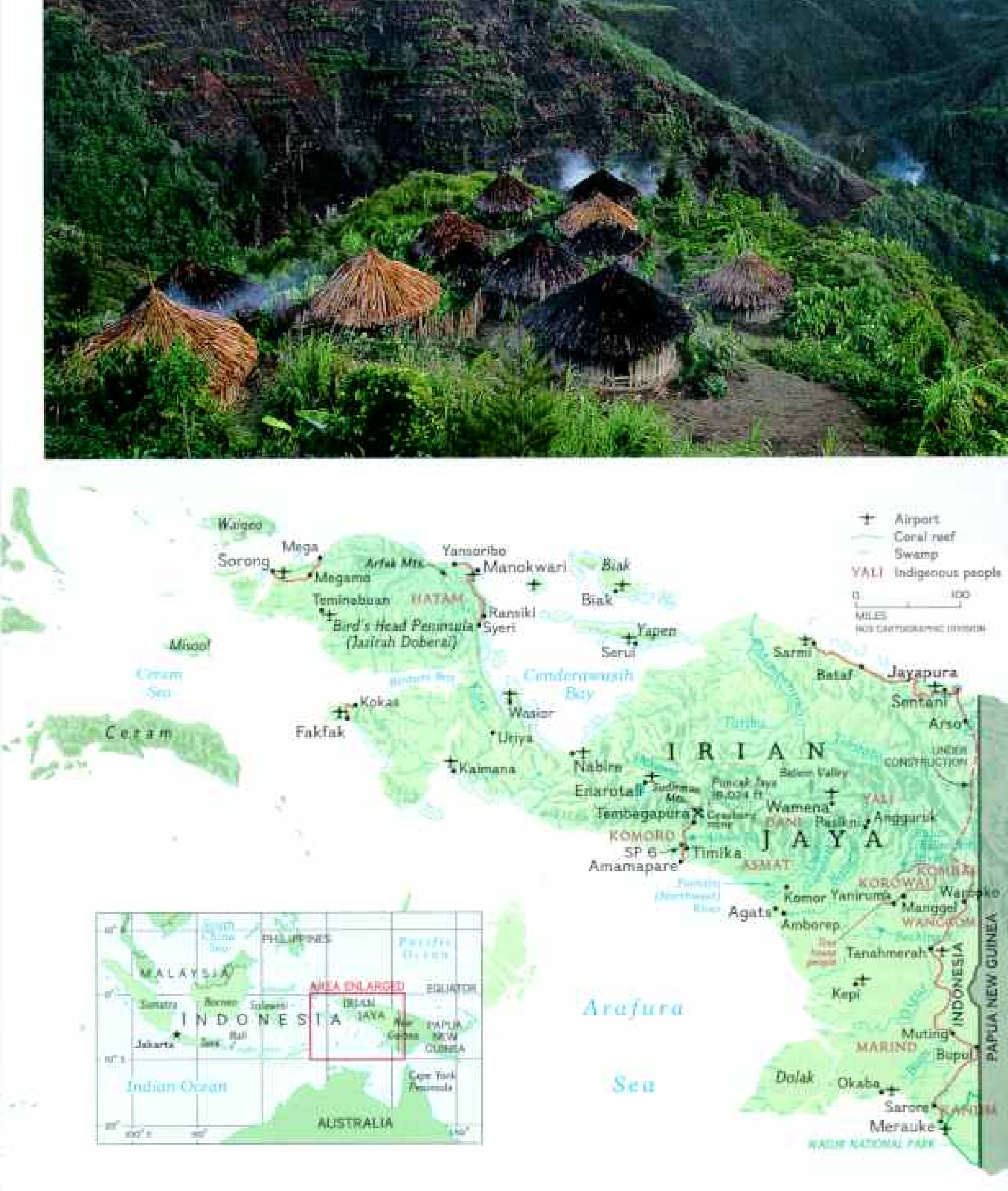
Photographer GEORGE STEINMETZ became intrigued with Irian Jaya when visiting Papua New Guinea for his first GEOGRAPHIC assignment, "The Quest for Oil," in the August 1989 issue.

inside smoky, pig-scented huts. On the rain-slicked trails I lost track of the century. People passed in traditional garments—women in grass skirts with tree-fiber bags hanging down their backs, men with loops of rattan encircling their midsections and long thin gourds sheathing their penises. "*Wake*," they shyly called in greeting.

In the larger settlements the time is closer to now. At the vegetable market in Angguruk, half-naked women shivered in the dawn cold as they negotiated deals over sweet potatoes, beans, and sugarcane—paying with paper money, not with the cowrie shells that served as currency when the missionaries came. On nearby hillsides men cleared steep garden plots with steel machetes; the stone ax is no longer used. At the church clinic a nurse treated children for malaria, the leading killer in this equatorial land.

In the village of Pasikni, I met Korpun, a grizzled, slow-moving man. At 50 he was one of the few elders in this settlement of three dozen thatch dwellings. "I have never left these mountains," Korpun said to me through an interpreter. He was standing outside the men's meeting hut, where a string of jawbones from past pig feasts clinked in the wind like porch chimes. "I was always frightened by the wars on the outside. Now they have stopped, but I am too old to leave."

Pasikni's schoolteacher, a young man from the capital city of Jayapura, told me that Korpun had voted in the last national election, as though doing that had bestowed on him the status of modern citizen. This is what the central government wants to believe. Yet for the rest of my trip I would wonder how much, and at what sacrifice, the 20,000 Yali and the rest of the indigenous Irianese could fundamentally change. You don't easily take the forest out of the people.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IRIAN JAYA
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Bird's Head Peninsula
(Jazirah Doberai)
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Seru
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The world beyond the mountain wall is largely unknown to a Yali village in the central highlands (left). Tangled swamps and cloud-veiled mountains locked away much of the land until the 1950s, when Christian missionaries began hiking and flying into the interior. Formerly a Dutch colony, Irian Jaya was absorbed by Indonesia in 1963 and later made its easternmost province. Roads, mines, and migrant camps are now prying open this last great wilderness of the Asian Pacific.

"So, what if I stole one of Korpun's pigs?" I asked the teacher before leaving.

"Oh, he'd probably kill you, but at least he wouldn't eat you anymore."

IRIAN JAYA entered the era of future shock in 1963 when Indonesia took control of Dutch New Guinea, later making it the country's 26th and largest province. The raising of the national flag climaxed the long struggle of Indonesia to oust the Dutch from the last of their East Indies colonies.

For the Indonesians it seemed to matter little that the people of New Guinea belonged to the Melanesian culture of the South Seas—that they had animist beliefs, a pig-based economy, a tradition of headhunting and cannibalism, and hardly anything in common with the Asian, predominantly Muslim culture that prevailed throughout the rest of the new nation. Indonesia, which had declared its independence in 1945, said it was staking a historical claim.

Granted sovereignty by the United Nations, Indonesia now possessed the western half of the largest tropical island in the world. Its leaders named the territory Irian Jaya—"victorious hot land." The island's eastern half, administered for a time by Australia and the United Nations, became an independent state—Papua New Guinea—in 1975.

Irian Jaya remains much as it always was, a realm of rain forest, swamps, and cloud-snagged mountains reaching to heights of 16,000 feet. Environmentalists call Irian the last great wilderness of the Asian Pacific.

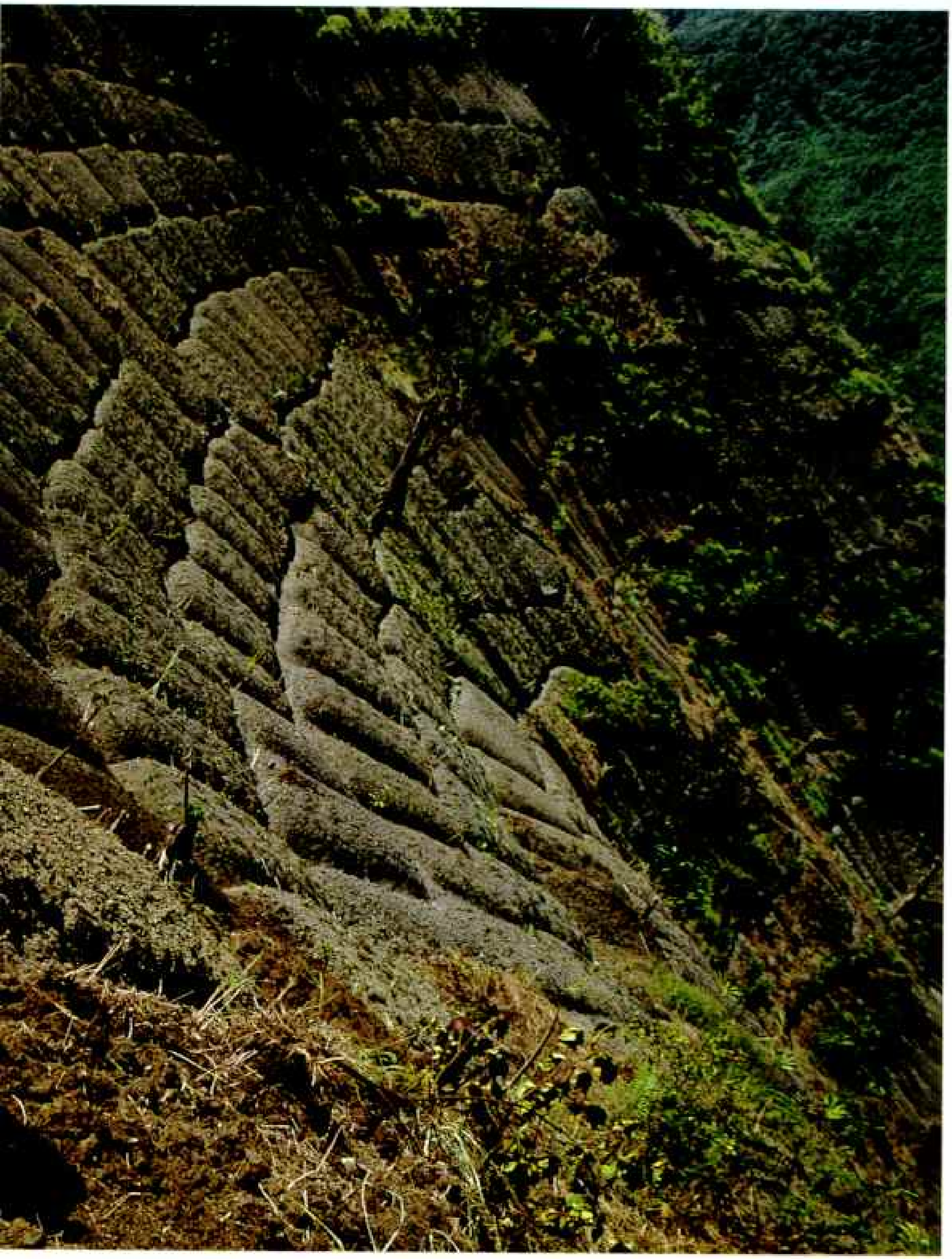
The human population is sparse: only 1.9 million people in an area the size of California, which has 30 million. Some 250,000 of them are recent migrants from other parts of Indonesia. More than a million of the others are tribal inhabitants, collectively called Papuans, from a Malay word meaning "frizzy haired." Many Papuans—both here and across the border in Papua New Guinea—still live as hunter-gatherers or subsistence mountainside farmers, grouped in small clans. Until the 1970s the men were warriors as well, taking part in a nearly constant round of revenge-driven tribal wars.

The outside world little knew of this sweltering land until World War II. In 1944 Allied troops led by Gen. Douglas MacArthur dislodged Japanese forces after a series of ferocious battles along the northern coast and in caves on the nearby island of Biak. Westerners too young to remember the war may know of this territory as the place where the American Michael Rockefeller vanished during an art-collecting expedition in 1961. His canoe overturned off the south coast, inhabited by the headhunting Asmat, and he was never seen again.

The Asmat are just one of many peoples in a wilderness Babel. Linguists have documented some 250 languages, half of them spoken by fewer than a thousand individuals each. In some places, villages less than a day's walk apart have their own distinct speech.

The indigenous Irianese peoples did not embrace their new rulers. In the 1970s and '80s the Indonesian Army crushed an independence movement; thousands of Irianese died. A small band of separatist guerrillas, the Organisasi Papua Merdeka, or Free Papua Movement, still operates near the Papua New Guinea border, some of its members armed only with bows and arrows. The movement includes former students and civil servants

Subsistence is an uphill climb for a Yali farmer who uses a modern shovel to break ground for additional sweet potato beds. Staple food of highlanders, sweet potatoes are raised on ever steeper slopes as the population swells with the end of clan hostilities and the coming



of modern medicines. Missionaries introduced metal tools in the early 1960s, passing out axes and machetes to people who at first fled from the "white ghosts." As recently as 1968, Yali killed and ate two missionaries who had destroyed village fetishes.

Clothes don't make the man in Dani society; for these elders, taking shelter during a storm, status derives from the number of wives and pigs each possesses. To encourage the Dani to cover their nakedness, the government in the past air-dropped dresses and trousers. In truth, highland people are very modest. Men wear gourds to hide their penises, and women, such as Yali at a clinic in Angguruk (bottom), wear leaf "modesty aprons." To avoid the ridicule of newcomers and in order to attend school, many native Irianese now don clothes when visiting a town.

and army deserters. Most supporters of independence have either fled to Papua New Guinea or keep their sympathies to themselves.

Today Indonesia exerts iron control; political dissent is a criminal activity. But a deep-seated cultural conflict festers. "While we believe we are descended from the forest," one Irianese told me, "most Indonesians believe that devils live in the forest and that the forest must be destroyed."

With its feverish economy and the world's fourth largest population (200 million), Indonesia can't afford to lose Irian Jaya. It sees the province not as one of the world's last sanctuaries of biodiversity but as a huge depot of natural resources. Rain forests, with their valuable timber, blanket 85 percent of the territory. Rich deposits of copper and gold have been found in the mountains, pockets of oil in the lowlands.

Indonesia also sees Irian as elbowroom. With more than half the nation's population jammed onto the island of Java, one of the world's most crowded places, the central government has already moved at least 200,000 settlers to transmigration camps in Irian Jaya. It is also building towns, roads, schools, and airports. Some 50,000 other migrants have come to Irian on their own. It has become Indonesia's "wild east"—a land of opportunity where, more often than not, the native people are found to stand in the way.

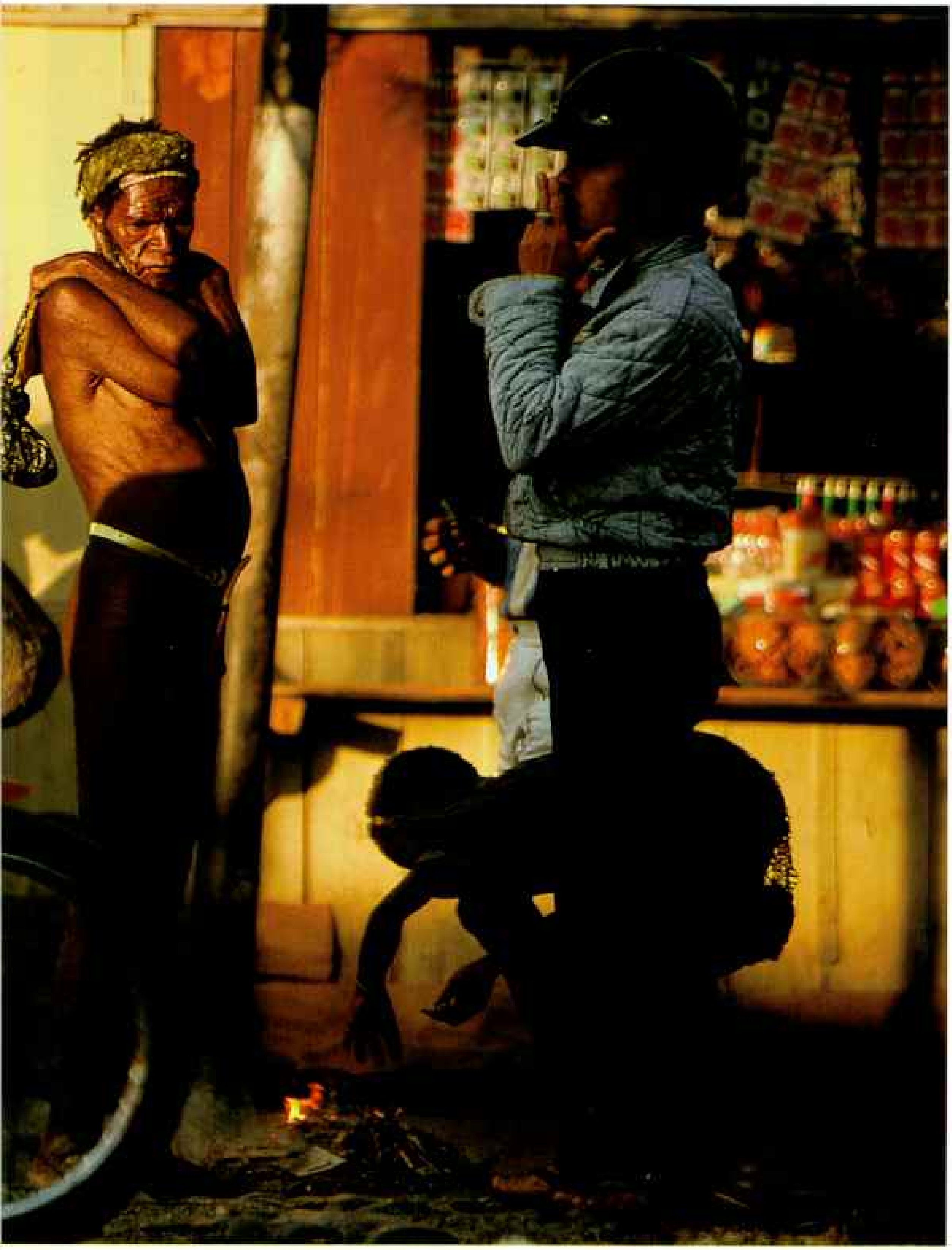
DURING THE MONTHS I traveled in this young province, I searched for places and situations that might augur its future. How would the land and its people—natives and newcomers—adapt to such enormous change? What I found—from a mining town built beneath a glacier to a cluster of tree houses hidden in the jungle, from a Sunday prayer session in a longhouse to holiday crowds sunbathing in the province's first national park—was a world turning upside down.

Early in my journey I discovered that the long reach of the Indonesian government has yet to pull in all the Irianese. In the humid lowland forests south of the central mountains live tribal groups largely untouched by the outside world. A Dutch Protestant missionary, Gerrit van Enk, reported in 1991 that after more than ten years of toil near the upper Becking River, his church had failed to baptize a single member of the Korowai people.

To reach this untamed region, known as "the hell of the south," I first stop in Jayapura, the steamy provincial capital on the north coast, two and a half degrees below the Equator. Like all visitors to the interior, I have to call at the central police station to pick up a travel permit. A number of areas are closed to outsiders for security reasons. And even in those that are open, the police and the army try to keep close track of travelers.

After receiving my papers, I charter a missionary plane—the workhorses of the Irianese transportation system—to fly to Yaniruma on the Becking River. A space hacked out of the forest by Dutch missionaries, Yaniruma is a settlement of several tribes and a gateway to Korowai country. As we fly south, the Cessna's shadow glides over the emerald weave of the forest. Here and there a stream curls like a snake through the vegetation. The pilot breaks my trance by shouting "Korowai."

On the outside looking in, a Dani hugs himself against the evening chill as traffic sweeps past in the highland town of Wamena. Related to the Australian Aborigines, the Papuan tribes of Irian Jaya, with their forest-based culture and animist beliefs, appear to have little



in common with the new settlers, many of them Muslim city dwellers.
A few Dani are growing rice in order to join the market economy.
Others are leading tourists on treks. Yet, says a glum local missionary,
"I don't see how the Indonesians and the Irianese can ever truly mix."

To thundering accompaniment, geologists from the Freeport-McMoRan company descend into a gorge to collect ore samples. For a barefoot porter on a mountaineering expedition, reaching the glaciers on Puncak Jaya is equally adventurous. At 16,024 feet, Puncak Jaya is the highest peak in Southeast Asia.

Looking down, I see a giant tree house built with sticks and leaves. Perched on a massive tree trunk almost 50 feet off the ground, it looks like some kind of huge nest tucked into the forest canopy. It is thought that the Korowai build these tree houses to defend themselves against attackers. But Paul Michael Taylor, a Smithsonian Institution anthropologist, suggests that the Korowai also live in trees to stay dry. Watermarks indicate that it is an area of heavy flooding.

The plane circles, but we can't see anyone on the ground. "If they're in there," says the pilot, "they're probably afraid to come out."

When we skid to a stop on the homemade dirt runway at Yaniruma, 30 miles farther on, the settlement chief comes forward with a grin, equating the sight of a foreigner with the prospect of gifts. He is less than imposing. Skin flakes on his legs, arms, and chest, and a sour citric smell lifts off him. He is afflicted with an ailment locally called cascado, a kind of ringworm. A topical cream could clear up the problem, but in Yaniruma such medicines are nonexistent.

While the chief goes off to find a canoe and paddler for me and my interpreter, Julie Campbell, a seasoned Irian traveler, the villagers gradually melt back into their huts. I walk to the mission house, nearly hidden behind a veil of red bougainvillea, and find it locked and empty. The Dutch missionary, van Enk, used to live here, but the Indonesian government has not renewed his visa. I later learn that the government, in the name of self-sufficiency, wants all 200 or so non-Indonesian church people—be they Dutch or American, Protestant or Catholic—out of Irian Jaya by the turn of the century unless they take out Indonesian citizenship.

At dawn the next day I set off upriver in a hollowed-out tree trunk with my guide, van Enk's former assistant Kristian Wandenggei of the Wanggom tribe to the east. I hope to get a closer look at the Korowai tree house people. Singing hymns, Wandenggei poles the dugout through the tea-colored water while I watch birds—kingfishers darting from the riverbanks, flocks of hornbills skimming above the treetops, their wings

A mountain laid bare, the 13,000-foot-high Grasberg mine contains the largest single gold reserve in the world. Operated by U. S.-based Freeport-McMoRan, the open-pit behemoth straddles the lofty spine where the Pacific and Australian tectonic plates collide, a zone of

great mineral wealth. Freeport has recently identified an additional 75 sites in the highlands for possible drilling. While a boon to the national economy, the mining giant has met fierce opposition from tribal groups who claim tailings have caused the flooding of their lands.

sounding like runners panting for breath.

The banks sprout wild breadfruits, bananas, and a host of palm trees, all tangled up with hanging vines. As the heat of the day intensifies, the river's green walls vibrate with the ringing of cicadas. Then the river grows shallower, forcing us to push the dugout over rocks. It is the dry season, something hard to fathom in a place drenched with more than 200 inches of rain a year.

We sleep that night in a new settlement called Manggel. The government, intent on controlling the semi-nomadic Korowai, has begun a campaign to move the tribe out of the forest and into towns. Manggel, at this point in its history, is nothing more than a dozen shabby huts and a chapel with chicken droppings on the floor. A recently captured cockatoo with clipped wings shrieks its unhappiness from a thatch roof.

Laid out like row crops, cabins colonize a plot freshly cut from the rain forest. This settlement, designated SP 6, is the new home of hundreds of formerly landless peasants, volunteers in the national transmigration program. To ease crowding on the islands of Java and Bali, the government offers five acres, a year's worth of rice, and a one-way air ticket to anyone who will move to an undeveloped region. Thus far it has sponsored some 200,000 transmigrants to Irian. On their first day in SP 6, a young Javanese couple take stock of their raw surroundings.

THE NEXT DAY we pick up a young Korowai to show us the way to the tree houses. Ekimale wears a few strips of rattan around his waist and a long hornbill's beak over his penis. He has filed one of his bottom teeth to give himself a wicked grin.

After several slow-motion hours on the water, Ekimale signals where to pull up the canoe. We follow him into the forest, as hot and close as a summer attic, and presently come to a tree house just as a family and two small hunting dogs file out of the bush. Startled, the woman and boy duck behind the man. Slowly he approaches us with bow and arrows gripped in his hand.

He is a short man, not even five feet tall. A circle of welts embroiders his stomach. These are Korowai beauty marks, made by pinching the skin with hot wooden tongs. He wears blue shorts, a sign of outside contact. His wife wears only a grass skirt. From both sides of her nose, almost like insect feelers, protrude the thin bones of a bat's wing. The child is naked except for a necklace of small cowrie shells.

Will the hunter see us as trespassers and attempt to drive us away from his home? I stand ready to retreat. Then Wandenggei holds out a peace offering of tobacco. The man takes it and smiles. His family is returning from a hunting trip, he says in rapid Korowai, which is painstakingly translated into Indonesian by Wandenggei and then into English by Julie Campbell. The wife, Ilun, reaches into a net bag and pulls out two young live pigs. Flayabere, her husband, says that the sow escaped in the forest, leaving the young behind to be captured.

I ask Flayabere if I may climb up the notched pole and look inside his house. He shakes his head no. What is up there? Dutch missionaries familiar with the area, as well as Paul Taylor from the Smithsonian, suspect that the Korowai still practice cannibalism. Flayabere may keep human bones inside, but it is far more likely that he was simply unwilling to let an outsider invade his home.

With his wife and child withdrawn up the tree, Flayabere begins to eye us more with fascination than suspicion—as an exotic species that has strayed into his territory. He explains that eight people—two families—live inside the tree dwelling. "Now the pigs will live with us too," he says, "until we kill them for food. Maybe then we will move to another

hunting ground and build a new house."

But will they ever move to a settlement?

"We don't want to leave the forest," Flayabere says. "My wife is afraid of town, and I don't like that the houses are so close together. I don't like that a stranger gives orders and tells us what to do."

I wonder how long they can resist. When Wandenggei hands over more tobacco, salt, and a bag of fishhooks—in exchange for bananas and roasted sago, a breadlike staple made from the pith of the sago palm—Flayabere looks stunned at his fortune. Wandenggei has perhaps started a conversion—not to the church but to the benefits of settlement living.

POINTING the Irianese toward the promised land has preoccupied missionaries for well over a century. So it is something of a miracle that no more than a few have been killed by hostile tribesmen or died as a result of, as one account puts it, "the rather prosaic martyrdoms of malaria."

It used to be that missionaries frightened the native peoples. Now many churches are filled on Sundays. I join the congregation one day in the Baptist church in Wamena, a town of 17,000 in the central highlands. Inside an airy, whitewashed space, several hundred Dani tribesmen, crammed together on benches and on the floor, sway trancelike as a native deacon, trained by the missionaries, thunders from the pulpit.

"On earth your grass may dry out," the Dani churchman, casual in an open-necked shirt, calls out. "Your river may dry out. But in heaven it is always good. There is no fighting. You don't have to hunt or garden. Everything good comes to you."

Afterward, the men in T-shirts and split-open athletic shoes and the women in their river-washed blouses stand outside blinking in the sun. Tendrils of smoke rise from hillsides being burned off to prepare the sweet potato gardens. It is planting season. Heaven will have to wait.

For most of the missionaries in Irian, saving souls remains the task at hand. But in the buggy coastal swamps to the south, home to the Asmat, a handful of American priests and brothers have taken on a more ambitious mission: They want to save a culture as well.

Most of the Roman Catholic missionaries belong to a small order, the Crosiers, headquartered in St. Paul, Minnesota. They came to the Asmat region in 1958, replacing Dutch priests. Gradually they developed a new approach to missionary work, inspired by the reforms of the Second Vatican Council in the mid-1960s. They saw themselves not as authority figures but as counselors who, in their own way, would go native to help the Asmat hold on to home and tradition.

The Asmat culture was almost destroyed in the 1960s when the Indonesian government, spurred by reports of headhunting, tore down the men's longhouses, outlawed feasts and carvings, and sanctioned commercial logging in the Asmat's forest.

The Crosiers set about collecting the forbidden carvings and incorporating Asmat ritual into their services. They acted as peacemakers between warring villages, and between the government and its new subjects.

Eventually the Crosiers persuaded the authorities to lift the bans on artwork and

Tossed up like driftwood, a shantytown with a mosque lines a riverbank in the sweltering capital of Jayapura. This city of 310,000 looks good to hordes of unskilled laborers who come to Irian to find jobs in logging, fishing, and peddling merchandise. Some go from rags to riches. As an Indonesian writer notes, they "arrive by ship, sleep rough in marketplaces, relieve themselves on river banks, then return home by air." When officials from Jakarta, the national capital, visit to remind their distant subjects that they are part of Indonesia, Scouts (above) dutifully wave the flag.

festivals. Since then the culture has fitfully revived. But nothing, the priests admit, not even the church, has filled the void left by the elimination of warfare and headhunting, the forces behind most Asmat traditions.

WHEN I FLY INTO AGATS, the region's administrative center, the Asmat world is under a cloud—a real one. Brushfires in the Cape York Peninsula of Australia, 500 miles across the Arafura Sea, have left a smoky haze over the southern swamps. My pilot is lucky to find a hole in it.

At Agats the Crosiers maintain a museum of Asmat art, and it is not hard to tell the old pieces from the new. The original collection, from the museum's opening 20 years ago, holds trophy skulls, bone daggers, stone clubs, 20-foot ancestor poles, and tall battle shields covered with stylized figures of praying mantises and other headhunting symbols. The current work features sculptures of sweet-tempered families fishing or collecting sago.

"The art is becoming secular," says Catholic Bishop Alphonse Sowada in his art-filled quarters. "Now when they sell it, they feel it's worthwhile. They can say"—and here the bishop, a bespectacled figure in shorts and flip-flops, straightens up and pounds his chest—"We are the Asmat!"

To observe Sunday services, Asmat style, I hire a motorized dugout to take me 60 miles up the broad, chocolate-brown Unir River to the village of Komor. The smoky overcast seems to silence both forest and river. A few men with their families paddle their dugouts along the bank under the awning of overhanging trees. I populate the river with my imagination, recalling accounts of Asmat war parties, 12 standing warriors to a canoe, slicing through the water, the chant of *"Whuh! Whuh! Whuh! E-e-e-e-e-e-e!"* booming off the forest walls.

I am greeted at the Komor pier by Father Frank Trenkenschuh and a crowd of chattering children, women suckling babies, and men eyeing my gear to see if I have brought tobacco. The men are tall for New Guineans, averaging five feet six inches, and muscular. Their clothes hang on them like tattered flags.

Father Trenkenschuh stands six four, with a head of glowing white hair. Villagers call him Wasan, or "jungle man." His fellow fathers know him as Trenk.

Trenk stirs up a wake of children as he leads me through the palm-shaded village of a thousand people, its thatch houses and rickety walkways raised on poles above the reach of flood tides. We stop at the Catholic church, the most unusual one I've ever seen. Trenk and the villagers have modeled it after the traditional men's house. Fire pits and ancestor poles line one wall of a large open shed. The altar is fashioned from a huge, oval-shaped tree trunk. On a wall hangs a crucifix; Christ is wearing a crown of feathers.

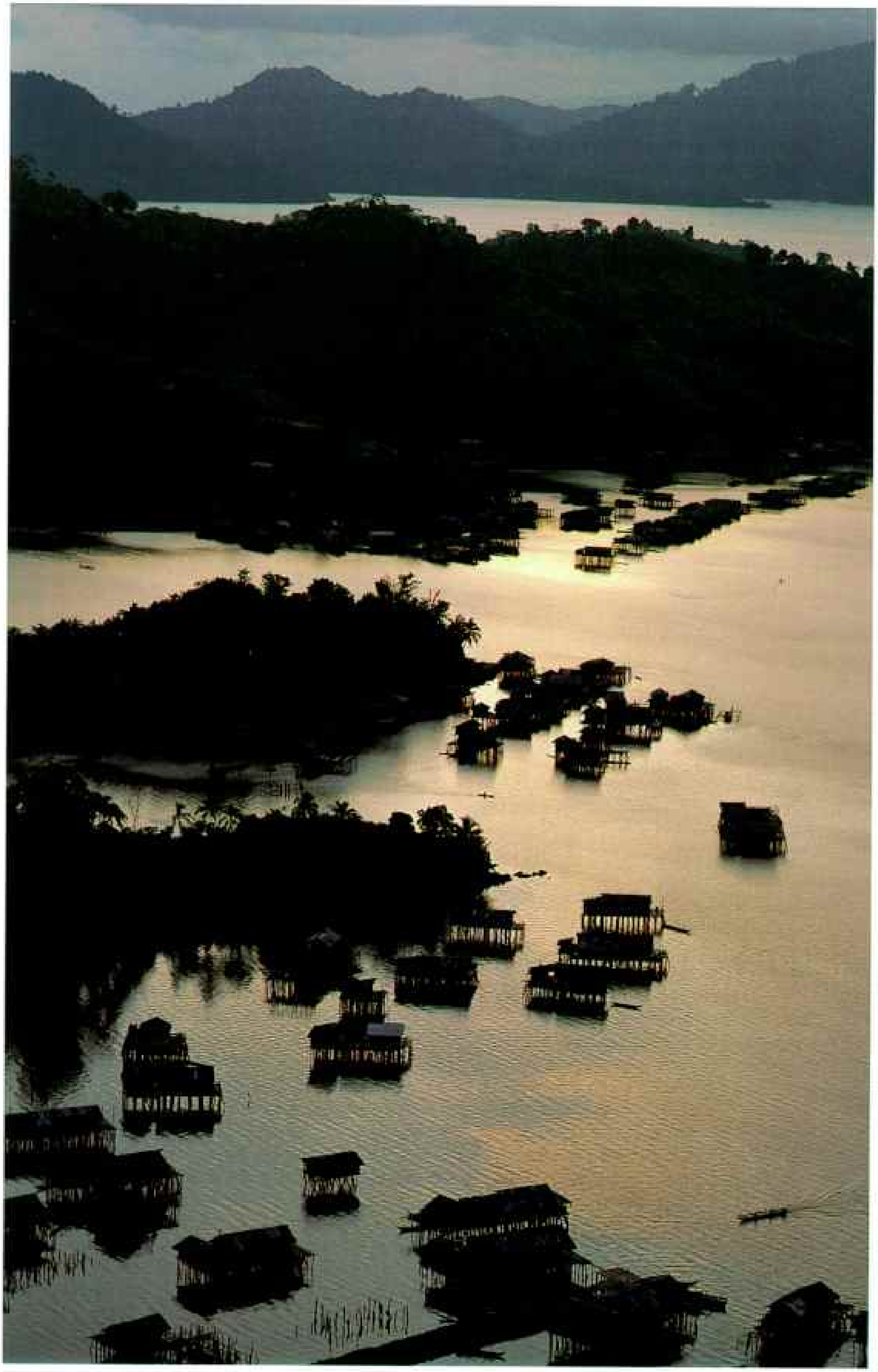
Asmat beliefs and Catholic theology make an unlikely fit. "The Asmat believe that when they killed and ate a person, they became that person and absorbed his skills," says Trenk, an anthropologist who has spent 27 years with the people. "This is similar, of course, to the Catholic belief that we eat the body of Christ to become Christ. So I say, 'Look, you don't have to go out and kill. You now have Christ.'" The 55-year-old priest shoots me a mischievous glance: "What are Catholics, after all, but ritualistic cannibals?"

The next morning, Sunday, Trenk produces a decent chime as he hammers on a brake drum to call the villagers to prayer. The informal service is held not in the church but in the men's longhouse on the riverbank. About a hundred men and women sit on the floor inside. Many of the men have painted their bodies and stuck egret feathers in their headbands. One old man wears a dagger made from a cassowary shinbone.

They drum, dance, and pass out hunks of roasted sago as gestures of sharing. Two men read from a Bible translated into the Asmat language. The day's message: Love thy neighbor. Trenk sits proudly in back with a mug of coffee. But on the walk back to his house, he speaks of limits: "We can stretch our minds as far as possible," he says, "and still we can never see the world as the Asmat do."

Loving thy neighbor doesn't come naturally to societies in which killing an enemy is often the only acceptable way to resolve a conflict. In Jayapura, Edith Hansen, an accountant for

A stilt village off Yapen Island probably looks little different from when Portuguese explorers sailed the north coast in the 1500s. Javanese traders preceded them, swapping porcelain and cloth for pearls, bird of paradise plumes, and slaves.



To connect with his flock, Father Vince Cole dresses in native garb—tooth necklace and fur headband—as he preaches in an Asmat village. A member of the Roman Catholic Maryknoll order, Cole urges the Asmat to "find God in the natural world."

an American missionary group and a 30-year veteran of Irian life, explains:

"Clan loyalty is powerful. If you don't fight, you can be branded a coward, a traitor. The young people grow up hearing their elders talk about the great wars. Then they want to go out and fight too."

WITH ITS PROTECTIVE VEIL of isolation now torn away, Irian Jaya by small increments is starting to look and feel like the rest of multi-ethnic Indonesia. One day in Jayapura I watch a new, German-built inter-island ferry, the *Ciremai*, unload its human cargo of 2,000 passengers: contract laborers from Java, prostitutes from Sulawesi with lips and nails freshly painted, itinerant peddlers, government workers, soldiers, a group of law students from Cenderawasih (Bird of Paradise) University here, returning after a required three-month work program in the countryside. One student removes his Sony Walkman long enough to say, "It's difficult to find jobs anywhere else in Indonesia. Here there are more chances."

To take a look at a transmigration settlement, I hire a taxi to drive me south on primitive forest roads to reach the marshy bottomland of the Tami River Valley. Thousands of trees have been felled in this place that not long ago had no name on a map. It is now Arso 12, one of the newest settlements.

The remains of the forest are burning when I arrive. Everything looks raw—the ground gashed by bulldozer tracks and heaped with smoking tree trunks, rows of whitewashed cabins thrown together, as if from a kit, with wooden planks and sheets of zinc. A new Indonesian flag flaps to an anthem of rasping chain saws and crackling flames.

I stop at house 104, its number drawn in black marker on the front wall. Sobir, his clothes stained with sweat, has been stabbing at the dull brown earth with a pitchfork. His teenage son, wearing a conical straw hat, peers out from a window square. "I am going to grow rice and after that soybeans," Sobir says, panting from exertion. "I came a week ago from West Java with 20 other families. The government is giving me two hectares [five acres] of land, tools, clothing, and food for a year. At home I was a peasant with no land. Here I want to stay."

As we speak, a policeman rides by on a bike, a rifle slung from his shoulder. The police are here to protect the thousand or so new settlers. Guerrillas of the Free Papua Movement have attacked other Arso settlements, claiming that the land—a people's hunting ground—has been taken with little or no compensation.

The old-growth forest is coming down in other parts of Irian as well, much of it to feed Indonesia's export-driven timber industry. In Asmat country I woke up once to an empty village, the families having left on a logging expedition. Indonesian agents come up the rivers and contract with the Asmat to cut hardwoods

and send the logs down the rivers in huge rafts. Steamers bear the logs off to other parts of Indonesia to be milled into plywood.

Though the Asmat traditionally revere trees, lately they have developed a reverence for money. Cutting trees, a logger can earn 3,000 rupiahs—about U. S. $1.30—per stump and put the money away to buy radios and new clothes or send his children to school in Agats. Recognizing the importance of paydays in his village, Pombai, an Asmat leader in Komor, was nonetheless worried. "Our people need things from the outside. I can't pretend not," he told me in his family's hut. "But can't we find a way to provide them without cutting down our forest?"

THE GOVERNMENT has marked off great chunks of Irian Jaya for resource development. John Rumbiak, a young Irianese community-development worker in Jayapura, listed them for me. "The French are looking for uranium in the Bird's Head Peninsula," he said. "The Australians are surveying the Korowai region for gold. The British and Americans are looking for natural gas and oil in the lowland forests. And the Japanese are logging the mangrove swamp in Bintuni Bay. Irian Jaya is becoming the Siberia of Indonesia, a reserve of raw materials."

The biggest "X" on Irian's treasure map marks the mining concession of Freeport Indonesia, a unit of the New Orleans-based company Freeport-McMoRan. Each day on average 7.2 million dollars' worth of copper, gold, and silver is dug out of its Grasberg open-pit mine in the Sudirman Mountains of the central highlands. The site is spectacular. The pit lies just downhill from a glacier near the summit of 16,024-foot Puncak Jaya.

Shivering in a cold wind—who thinks to bring a down jacket to New Guinea?—I watched trucks with tires ten feet high haul out ore that would be processed into a gray concentrate of copper, gold, and silver. The mix, piped in slurry form down the mountain to the private seaport of Amamapare, is dried and shipped to smelters around the world. Everything is jumbo size: the workforce of 17,000; the gold—an estimated 40 million ounces, the biggest single gold reserve in the world; the copper deposits—28 billion pounds.

Beautiful pinups, bird-wing butterflies are dried before being shipped abroad and sold for as high as $350 a pair. With the aid of the World Wide Fund for Nature, Hatam people from the Arfak Mountains raise the valuable pupae in their forest gardens.

Freeport signed its first Irian contract, gaining rights to 24,000 acres, in 1967. Since then it has become the biggest foreign taxpayer in Indonesia. A new contract gives Freeport access to nine million acres in the central range—an area one and a half times the size of Vermont.

"This is elephant country," said Freeport's Pete Doyle, using the geologist's term for terrain with extra-rich deposits. At the company's exploration office in the lowland town of Timika, Doyle uncovered a map of the new concession, where geologists have identified 75 target areas. As George Mealey, president of Freeport-McMoRan, tells me later, "Someone will be mining here for the next century."

A feast of beetle larvae, an Asmat delicacy, awaits villagers from Amborep, who have gathered to celebrate the carving of four new ancestor poles, or *bisj*, commissioned by a German art collector for $1,500. In the past the Asmat used bisj to remind themselves of

ancestors whose deaths they needed to avenge. To end the fighting, Indonesian authorities banned Asmat festivals and burned their carvings. Today the Asmat, supported by Catholic missionaries, carve once again to keep their history fresh and to earn cash.

That frightens some people. Highland villagers have claimed that Freeport drove them off their traditional lands. The Komoro people on the coast say mine tailings in the Aikwa River caused flooding that ruined their sago palm stands. Provincial legislators and community activists complain that Freeport hires too few Irianese, only 10 percent of the workforce, while Indonesians from elsewhere in the archipelago get the bulk of the jobs.

Tensions between the mining company and the local people dramatically worsened not long after my visit when soldiers on mine property killed a number of demonstrators. Freeport denies any involvement.

In response to complaints, Freeport has improved its environmental testing, begun health-care and work-training programs, and helped start some small local businesses. Still, in elephant country, it is the little people who get trampled.

IN LESS THAN stampede numbers, tourists are discovering Irian Jaya. A few thousand, mostly Europeans, arrive each year to hike in the Baliem Valley or cruise along the Asmat coast. "Visit timeless Stone Age tribes" is the come-on of tourist brochures.

But tourists may want to read the small print: The timeless days of Irian Jaya are over. The Indonesian government has said that it will not allow Irian to become a "human zoo," glassed off from change. And, for the most part, the Irianese themselves wish to modernize. Beneath the confusion and suspicion, most native people appear willing to accept schools and clinics and new laws—as long as they themselves control some part of their lives, such as land rights.

The map of Irian Jaya is changing as well. The province's first north-south road is under construction. It is expected to open dozens of transmigration settlements. Perhaps most

Once mortal enemies, still fierce competitors, Asmat from neighboring villages race dugout canoes on the Pomatsj River. Despite such peacefulness, the tribes of Irian Jaya find themselves fighting for cultural survival as Indonesia pushes ahead to assimilate its last frontier. Tribal leaders fear that migrants, now about one-eighth of Irian's 1.9 million population, will someday overwhelm the already marginalized indigenous people. It's time now, says a priest in Asmat country, for the Irianese "to unify and together face the outside world."

dramatic of all, the Indonesian government, even as it signs over large areas to development, has carved out an enormous nature reserve system that covers one-sixth of the province—at least on paper.

Plans call for a marine park among the coral reefs of Cenderawasih Bay in the north; a national park along Irian Jaya's longest river, the Mamberamo, also in the north; and, as the crown of the system, Lorentz National Park, covering 3.7 million acres between the glaciers of Puncak Jaya and the mangrove swamps of the Arafura coast. The boundaries are still being drawn for Lorentz (named after Dutch physicist and explorer H. A. Lorentz), but Wasur National Park, on the southeast coast abutting Papua New Guinea, is open and receiving visitors.

I entered Wasur on the back of a mud-spattered motorbike driven by Ian Craven, an adventurous Englishman with the Switzerland-based World Wide Fund for Nature. The fund is assisting the province with its parks and forest protection, and until his death in a plane crash several months after my visit Ian was supervising the start-up of this park, Irian's first.

At the entry post he saluted a local Kanum man proudly sweating in a new green park uniform. "Three of my most important staffers were poachers," Ian said over his shoulder. "I even waited for one to get out of jail. They know this park best."

The park protects a million acres of savanna, lowland forest, swamp, and white-sand beach. Nearly the size of Everglades National Park in the United States, Wasur differs in that some 2,500 people live within its boundaries. Most are Kanum and Marind tribesmen, their territories protected by the park agreement. Wherever we traveled in the park, we met them: men with bows and arrows hunting deer (introduced a century ago by the Dutch), women preparing sago alongside creeks, fishermen checking nets.

More than 400 bird species—60 percent of New Guinea's total—gather here, from solitary kookaburras and ostrich-like cassowaries to flocks of parrots and pelicans. On the wind-whipped mudflats of the Arafura Sea, rafts of stilts, sandpipers, curlews, and other waders lifted off at our approach, blurring the horizon with their numbers. In a wet, swaying prairie, pairs of Brolga cranes bobbed and curled their long gray necks. The sonorous *ooom ooom ooom* of the Papuan frogmouth, a large nocturnal bird, chanted us to sleep, and in the morning the thumping of wallabies, small kangaroos, passing in the forest wakened us.

Ian and I emerged from the forest on the Catholic Feast of the Ascension, a national holiday. Hundreds of immigrant Indonesians from the nearby city of Merauke had chosen to celebrate the day by strolling the beach just inside the park entrance. Ian was overjoyed at the sight. "When I announced that a park was coming here, most Indonesians thought I meant a zoo. I think they are beginning to understand what they've got."

We watched the happy visitors dip their toes in the warm water. Perhaps someday they would get beyond the beach, test the depths of the park, visit the tribal villages, hike in the forest. Someday maybe a few will pound their chests and shout, "We are Irianese!" □

Irian Jaya's People of the Trees

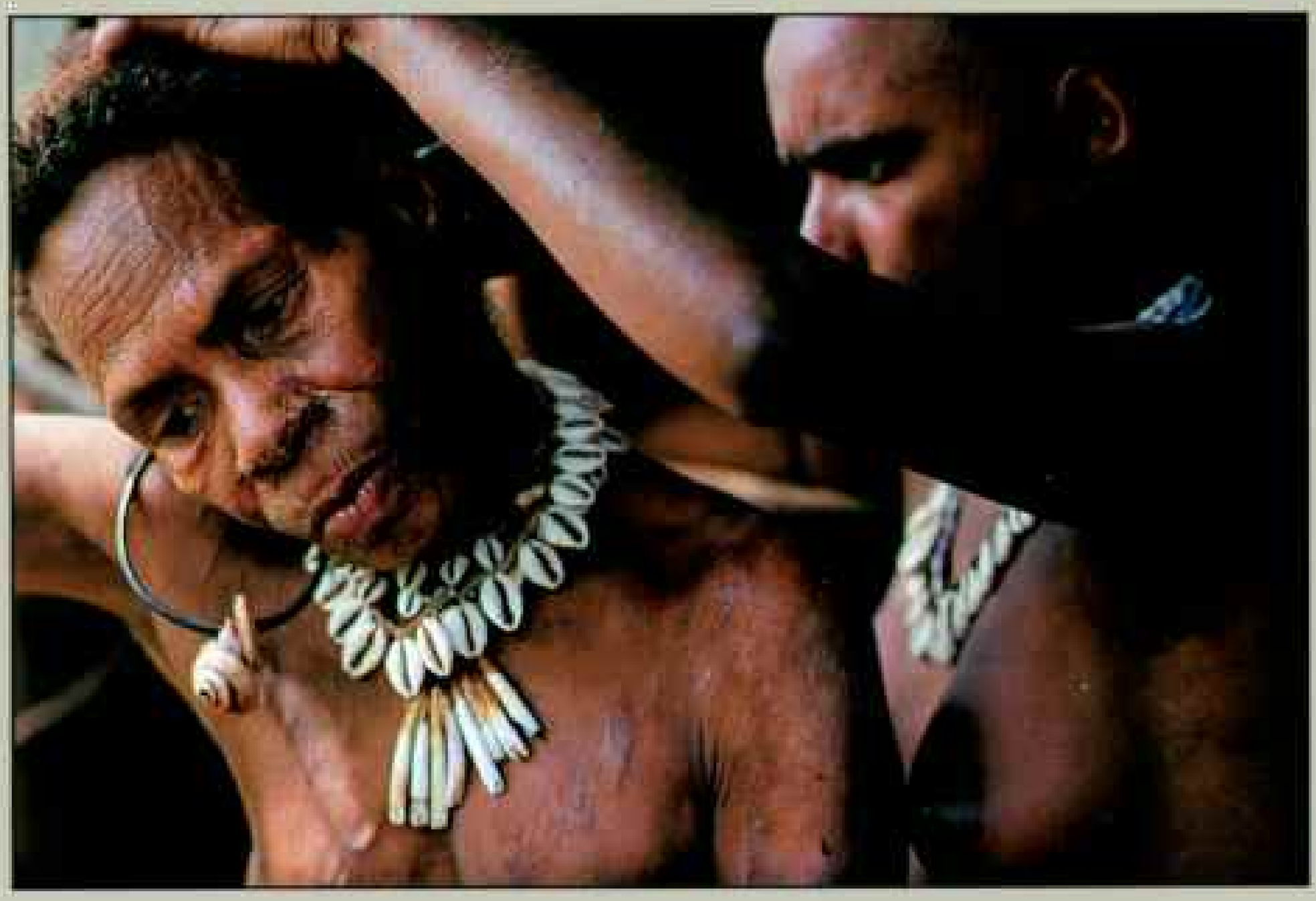
Article and photographs by GEORGE STEINMETZ

Houses of Irian Jaya's Kombai and Korowai people are built as high as 150 feet for a reason—"to see the birds and the mountains and to keep sorcerers from climbing my stairs," says Korowai tribesman Landi Gifanop. One of his homes (left) is now abandoned. Tree people live in tight-knit clans and hunt game like cassowary (above), whose meat, bones, and feathers will all be put to use.

I WAS EATING a lunch of tinned biscuits and tea when a shrill cry rose from the far side of the clearing. I glanced up just as two naked men burst into view and came dashing toward us, fitting large barbed arrows to their bows. Our porters halted them, bows drawn, just yards away. Angry words flew, then quieted as my interpreter offered them gifts and greetings. I soon learned that they were father and son, that we were the first outsiders they had ever seen, and that they had intended to kill us. This was my introduction to the tree-dwelling Kombai people of Irian Jaya.

Two years later I was back, slogging through a swampy 600-square-mile tract of forest inhabited by perhaps 3,000 Korowai, one of Irian Jaya's 250 indigenous tribes. The Korowai are neighbors of the Kombai. The two peoples' material culture, including tree houses, is nearly identical, but their languages are very different. Both cultures are endangered as Indonesia continues its efforts to settle the Irian Jaya backcountry. I had returned to document their lives before they were changed forever.

Because their territory appears devoid of petroleum, precious



Three brothers relocated their families from the tall house they shared to separate lower ones. They considered the move safe because tensions between them and rival clans had recently been reduced. Roughly cleared land around the new houses is planted in taro, tobacco, sweet potatoes, and bananas.

In preparation for a feast, Khaaef, about 30 years old, has her head shaved by a teenage girl using a razor of split bamboo.

minerals, or commercially valuable trees; the Korowai were largely ignored by outsiders until 1977. Then Johannes Veldhuizen and, later, Gerrit van Enk came as missionaries of the Reformed Churches in the Netherlands. Their study of the Korowai went well—Gerrit and a colleague will soon publish an ethnographic study—but after 15 years they had not won a single convert to Christianity. This was due partly to Gerrit's approach ("We must behave like guests, not invaders") and also to a Korowai belief that contact with a *laleo*—a bad spirit that could be getting around in the guise of a white man wearing clothes—would destroy their world.

On my second visit I was determined to travel beyond what Johannes and Gerrit call the pacification line, the shifting and often indistinct border between those Korowai who have had direct contact with outsiders and the upstream clans, known as *betul*, or true, Korowai, who refuse it. Traveling in this tangled country is a slow and torturous business. It took Johannes, Gerrit, our porters, and me two days to cover the ten miles from the dirt airstrip at Yaniruma to the pacification line.

Gerrit, meanwhile, had found an emissary to lead us across the frontier to a settlement of the Sayakh clan. When we arrived, we were told that the Sayakh's women, children, and old people had been killed by a sorcerer. As we moved about the settlement, the young men watched us intently. When Gerrit asked one of them what he was thinking, he replied, "What do you mean, what am I thinking? You are here." While the Sayakh were amused by my forest clumsiness and my bathing—they called me "white-round-round" for the rear view they had of me—they showed little interest in who we were. Or so it seemed. We later learned that no sorcerer had killed the Sayakh. They were hiding from us in the tree houses.

We now had other problems: The messengers we had sent out to make contact with betul clans had either failed to return or reported that their relatives would not permit us to visit. Our last chance was Baleamale, one of our porters, whose elder brother lived upriver.

WE WENT BY CANOE, a hard push against a rain-swollen river, and made only two miles in four hours. Led by Baleamale, we secured the canoes, then set off overland until we reached a crude clearing. On the far side was a low tree house, where a group of men had gathered, including Baleamale's brother. He clutched a bow and arrows in one hand and a massively barbed arrow in the other, which was shaking uncontrollably. Gerrit tried to calm him. The man wanted to kill us, he said, but didn't want to damage relations with his brother. "Why are you here?" he demanded. "There is no food for you. It would have been better if you had kept far from here."

We made a fast retreat, nervously returning the next morning. Baleamale's brother was less threatening on our second visit—and even let Johannes give his daughter an injection for her disfiguring skin disease—but soon he was again demanding that we leave. It was late in the day, he explained, and we might be attacked when it grew dark. He had been willing to listen to us, but he warned that the upstream people would not be so hospitable. So we withdrew again as night fell, spending the tense hours until dawn at the camp we had pitched uncomfortably near the Korowai clearing.

We had not succeeded in documenting the lives of the Korowai far beyond the pacification line, but neither had we changed them by entering their world, the classic dilemma of first contact.

Wispy smoke curls within a beam of afternoon light in a Kombai tree house, where families, dogs, and piglets all live together. Men and women generally keep to zones defined by separate hearths, and intimate relations are not allowed inside. The roof and walls of the

house are made from sago palm fronds. Fires are built on mud-covered rattan-strip lattices set over holes in the floor. A dangerous fire can be cut away and dropped quickly. Bones and shells are kept in the rafters for use in toolmaking and as mementos of clan feasts.

Everyday life among the Kombai and Korowai includes toting a family hunting dog up the house ladder (left) or starting the household's cooking fires by rubbing wood with a rattan string (below). If the clan is lucky, it may find a sago palm log yielding a delicacy —the grubs, or larvae, of the scarab beetle.

The sago palm is both a building material and the tree people's primary source of food: Its pith is beaten to a pulp, moistened, and strained to make a dough.

It is also an essential component of the infrequent sago grub festivals, which are planned for months and scheduled according to phases of the moon. A stretch of forest is cleared and a longhouse built around a sacred pole. Sago palms are carefully cut, split, tied, and left to rot so the beetles can enter to lay their eggs. After two months the grubs are collected for roasting and eating. When all the invited guests have arrived, the feast begins with chanting and dancing, often continuing through the night.

The next morning the host clan performs rituals invoking fertility and growth, especially for young boys and sago trees. After dozens of separate stages of preparation, celebration, and closing, the festival is over. Old antagonisms have been eased, alliances made, and the tree people's world renewed.

Tightroping on roots and armed with specialized arrows for killing birds, fish, reptiles—and humans—Korowai hunters search for the day's food. As the environment is short on sizable game, success is unlikely, and insects are more commonly eaten than cassowaries.

Domesticated pigs are reserved for dowries or settling disputes.

The lives of the Korowai are hard and their view of the world spare: Humans live in the inner zone; the dead inhabit an outer zone. Beyond lies the great sea where all will perish as the world ends. □

BY RICHARD CONNIFF

Tex

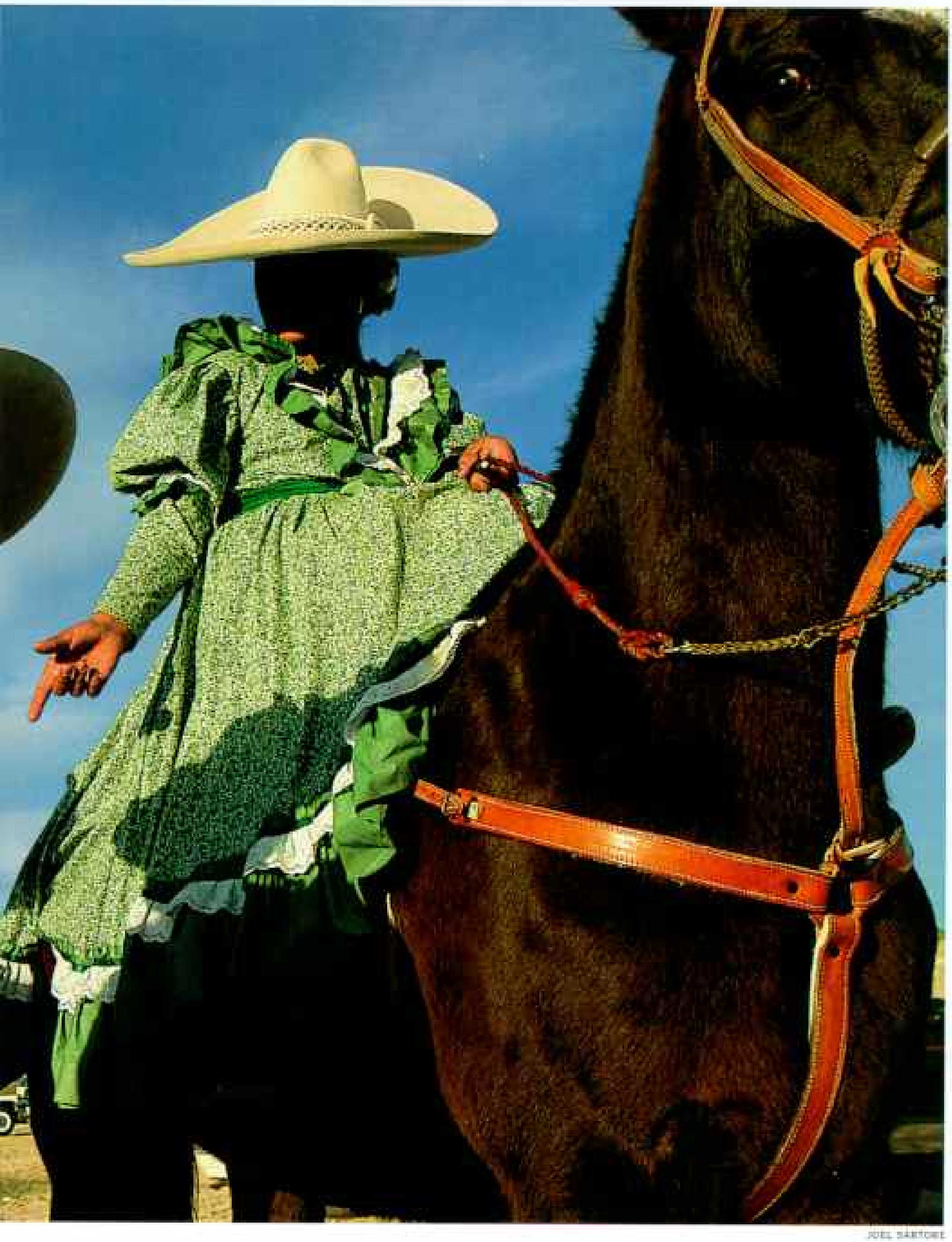
The winding border along the Rio Grande both

IN TRADITIONAL MEXICAN DRESS, THE ESCARAMUZA ESPUELAS DE ORO—THE GOLDEN SPUR EQUESTRIAN DRILL TEAM—PRESERVES THE OLD WAYS AT A FESTIVAL IN ITS HOMETOWN, EL PASO, TEXAS.

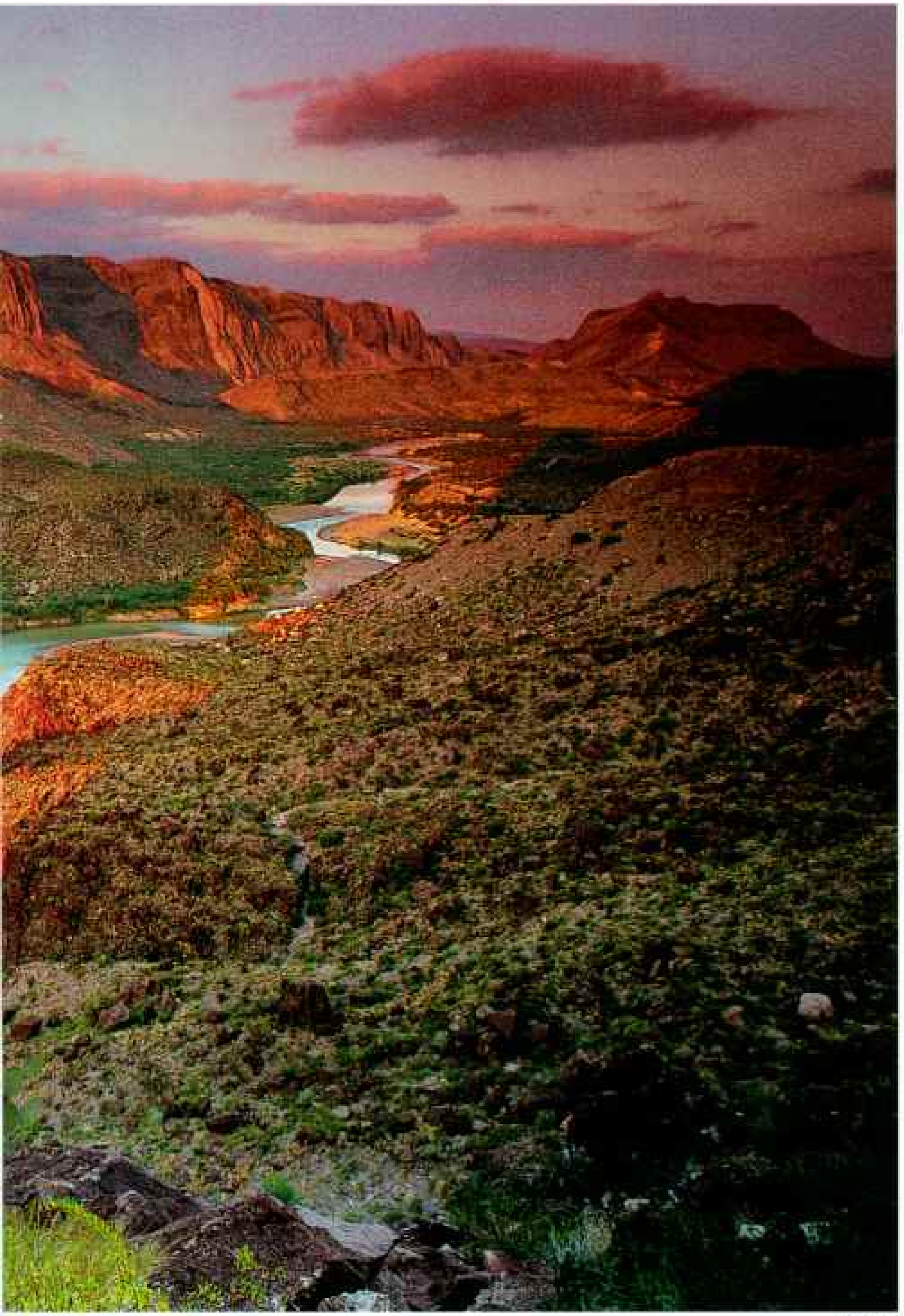
Mex

PHOTOGRAPHS BY BRUCE DALE
AND JOEL SARTORE

divides and unites two fast-changing worlds.

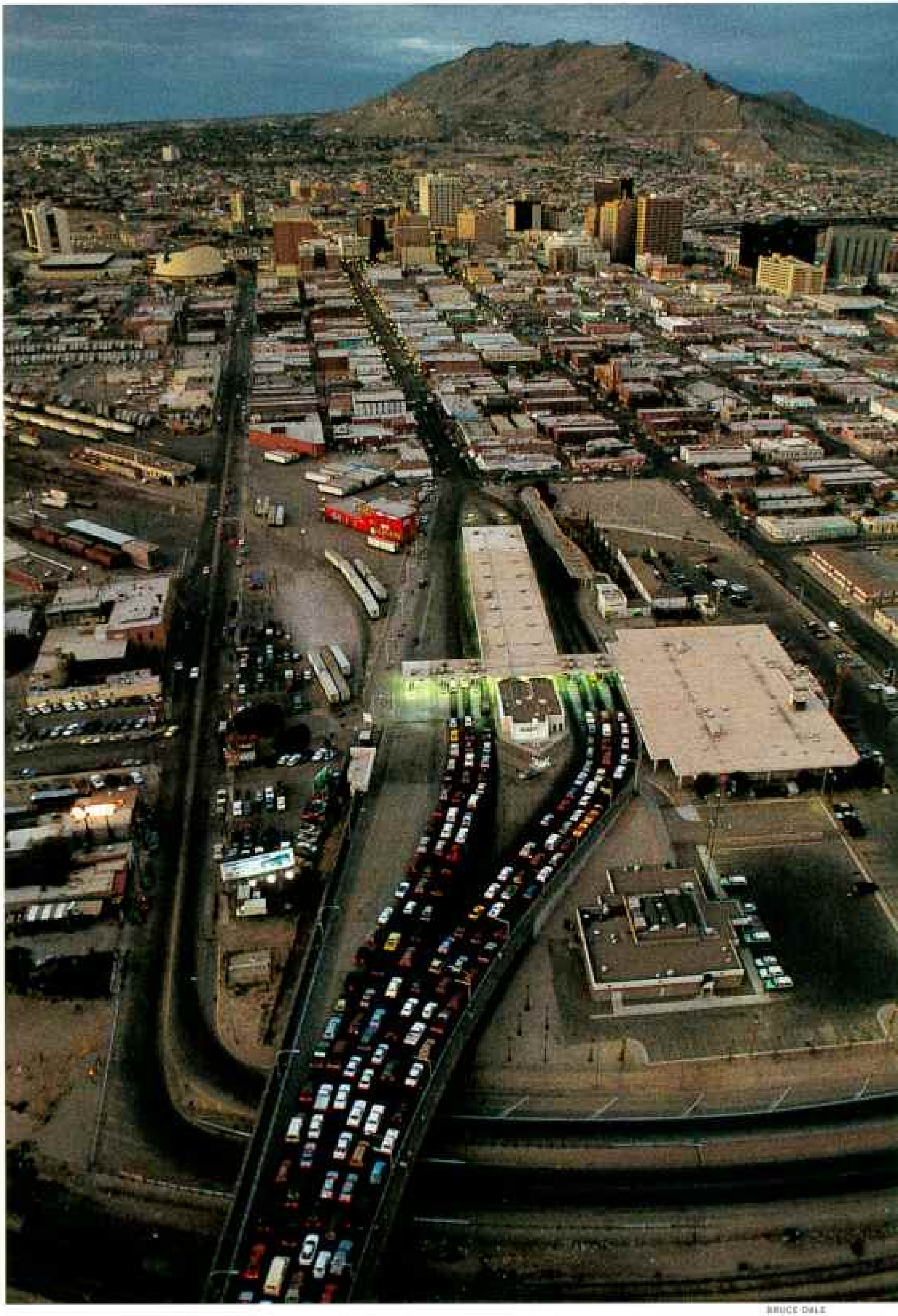


JOEL SARTORE



BRUCE DALE

Snaking through a desert garden, the Rio Grande separates Mexico, at left, from Big Bend Ranch State Park in Texas. Such splendid isolation alternates with sprawling and often squalid urban development along the river's 1,250-mile course between two nations.



BRUCE DALE

IT WAS EARLY EVENING in a gritty Rio Grande border town when we stopped at the house of the local *curandero*, or spiritual healer. Over the front door faded yellow paint flaked off a concrete figure of Mother Goose. On the radio in the kitchen, Ricky Nelson sang, "Hello, Mary Lou, good-bye heart." The curandero was a short, slight old man in loose-fitting sneakers. His right eyelid was scarred almost shut as if with a hot poker. Tinsel hung from the rafters, and one corner of the room was dark as a bank of shrubbery, with artificial flowers and images of the Blessed Virgin and a host of saints.

The curandero asked us if we had any particular problems we wished him to address, mental disorders perhaps, or marital difficulties. Something lurid seemed called for. I told him that my computer was giving me carpal tunnel syndrome, and he nodded, like a priest in the confessional doomed to hear only the more insipid sins. I had come with a local couple, and the curandero asked all three of us to stand for the ritual cleansing. Swiping a small bronze crucifix back and forth, he muttered a rapid incantation seeking divine protection for us against armed assaults on the highway, animals that might attack us, witches, sorcerers, wars, storms.

"Comprehensive coverage," one of my companions remarked, and on our behalf the curandero invoked the spiritual aid of 11,000 sainted virgins. He clasped our heads by front and back and, with a flourish of the wrists, drew out all our maladies and evil spirits. Then he clapped his own hands together to chase them away, puffed once at the small of our backs, and called on the wind to carry off our burdens.

Comprehensive coverage against unknown danger. The cleansing power of a strong wind. An unburdened heart. By all accounts these are good things to have for surviving on the Rio Grande border. It is in many ways a troubled region, shaped by forces well beyond local control, most recently when the Mexican peso devaluation jolted economies on both sides. Drug traffickers pass through with tons of South American cocaine and marijuana, bringing violence and corruption. Illegal immigrants scramble across endlessly to grab a piece of the American dream laid out before them on television. Blue-chip companies set up shop just south of the border for the magical combination of Third World labor costs and overnight delivery to U. S. markets. Anything anybody doesn't want—toxic wastes, up to a hundred million gallons of raw sewage a day, corpses from drug deals gone bad—tends to end up in the river itself and become part of the next town's drinking water.

Yet away from the cities, the river winds through a landscape of stillness and beauty. Clouds spread out in loose, motionless rows, their underbellies pink with the reflected desert. Creosote bush and deep-rooted mesquite grow in sparse clumps with, here and there, a stalk of creamy yucca flowering voluptuously. In far, empty places, I forgot the ugliness of the cities and plunged into the river up to my chin to drift beneath the smooth limestone bluffs and watch the kestrels soaring overhead.

The Rio Grande drops down from the mountains of Colorado and turns eastward at El Paso, Texas, and, at least in theory, it divides two countries as it flows for the next 1,250 miles through pucker-dry landscape down to the Gulf of Mexico. But like any watering hole in a desert, the chalky green waters of the Rio Grande do not separate so much as they unite. The river sustains a string of desperately troubled twin cities: El Paso-Ciudad Juárez in the cowboy West, then, after a long stretch of backcountry around Big Bend National Park, the truck-stop sprawl of Laredo-Nuevo Laredo, and finally the exuberant farm-and-factory culture of "the valley"—from McAllen-Reynosa down to Brownsville-Matamoros near the Gulf of Mexico.

Flying over El Paso one Sunday morning, my pilot, a shrewd, affable West Texas lawyer named Malcolm McGregor, pointed down at a country club estate of plush green lawns, red tile roofs, and crystalline swimming pools. We passed over a mansion backing up onto the Rio

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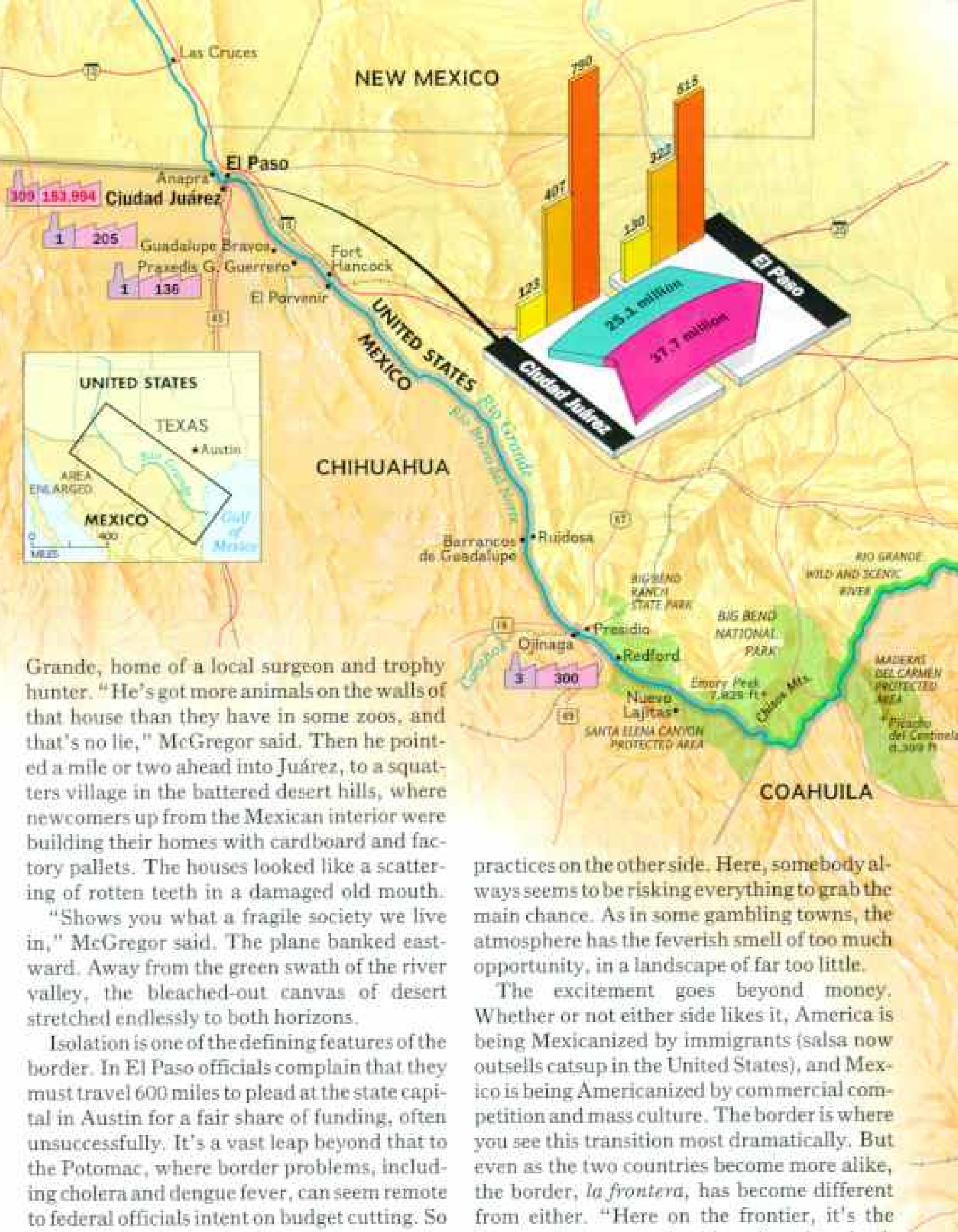
RICHARD CONNIFF wrote "Ireland on Fast Forward" for the September 1994 GEOGRAPHIC. Photographer BRUCE DALE retired from the staff last year after 30 years. JOEL SARTORE often chronicles American life for the magazine.

A river of traffic backs up at a border crossing as motorists drive from Mexico into El Paso on a Saturday night. Upwards of 40,000 vehicles pass through the city's ports of entry each day as citizens of one country travel to the other to work, shop, or visit family and friends.



Grande, home of a local surgeon and trophy hunter. "He's got more animals on the walls of that house than they have in some zoos, and that's no lie," McGregor said. Then he pointed a mile or two ahead into Juárez, to a squatters village in the battered desert hills, where newcomers up from the Mexican interior were building their homes with cardboard and factory pallets. The houses looked like a scattering of rotten teeth in a damaged old mouth.

"Shows you what a fragile society we live in," McGregor said. The plane banked eastward. Away from the green swath of the river valley, the bleached-out canvas of desert stretched endlessly to both horizons.

Isolation is one of the defining features of the border. In El Paso officials complain that they must travel 600 miles to plead at the state capital in Austin for a fair share of funding, often unsuccessfully. It's a vast leap beyond that to the Potomac, where border problems, including cholera and dengue fever, can seem remote to federal officials intent on budget cutting. So the people of the border, the *fronterizos*, make do with what little they've got and at times depend more on the other side of the river than on the mother country.

As on no other international border on earth, the First and Third Worlds mingle here, each with something to tantalize the other, each with its entrepreneurs keenly attentive to the shifting prices, laws, and enforcement practices on the other side. Here, somebody always seems to be risking everything to grab the main chance. As in some gambling towns, the atmosphere has the feverish smell of too much opportunity, in a landscape of far too little.

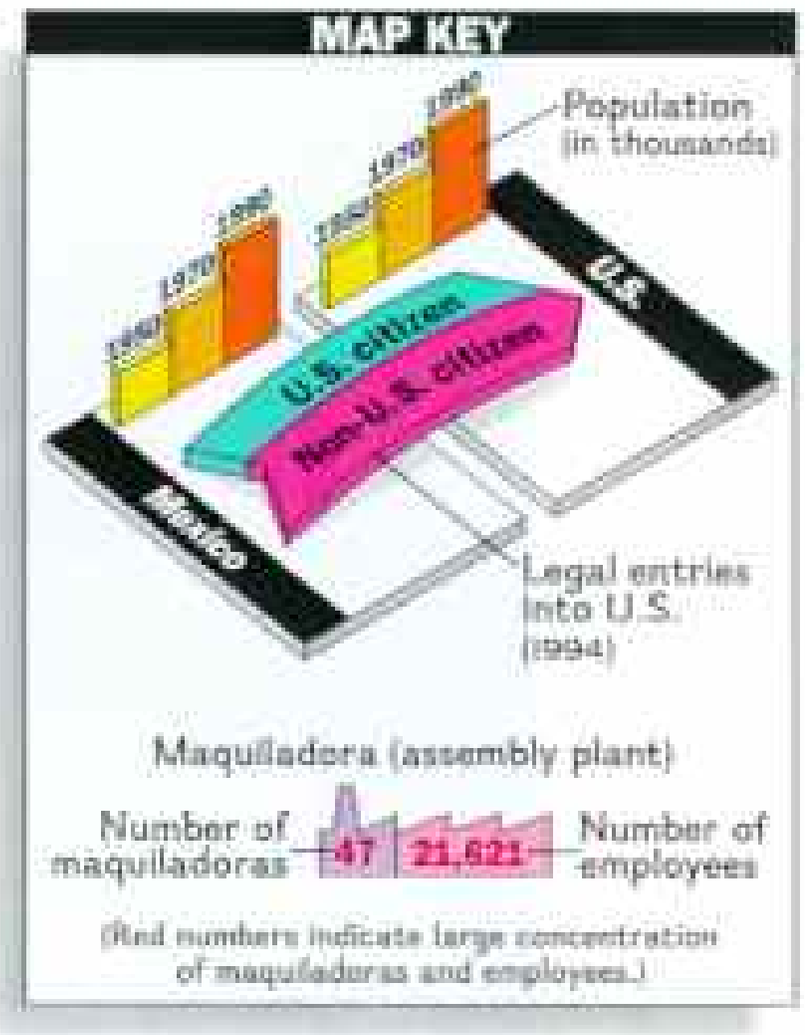
The excitement goes beyond money. Whether or not either side likes it, America is being Mexicanized by immigrants (salsa now outsells catsup in the United States), and Mexico is being Americanized by commercial competition and mass culture. The border is where you see this transition most dramatically. But even as the two countries become more alike, the border, *la frontera*, has become different from either. "Here on the frontier, it's the frontier that counts," said an American bush pilot, never licensed, who spent his career flying for a Mexican rancher. "The rest of the country can go to the devil."

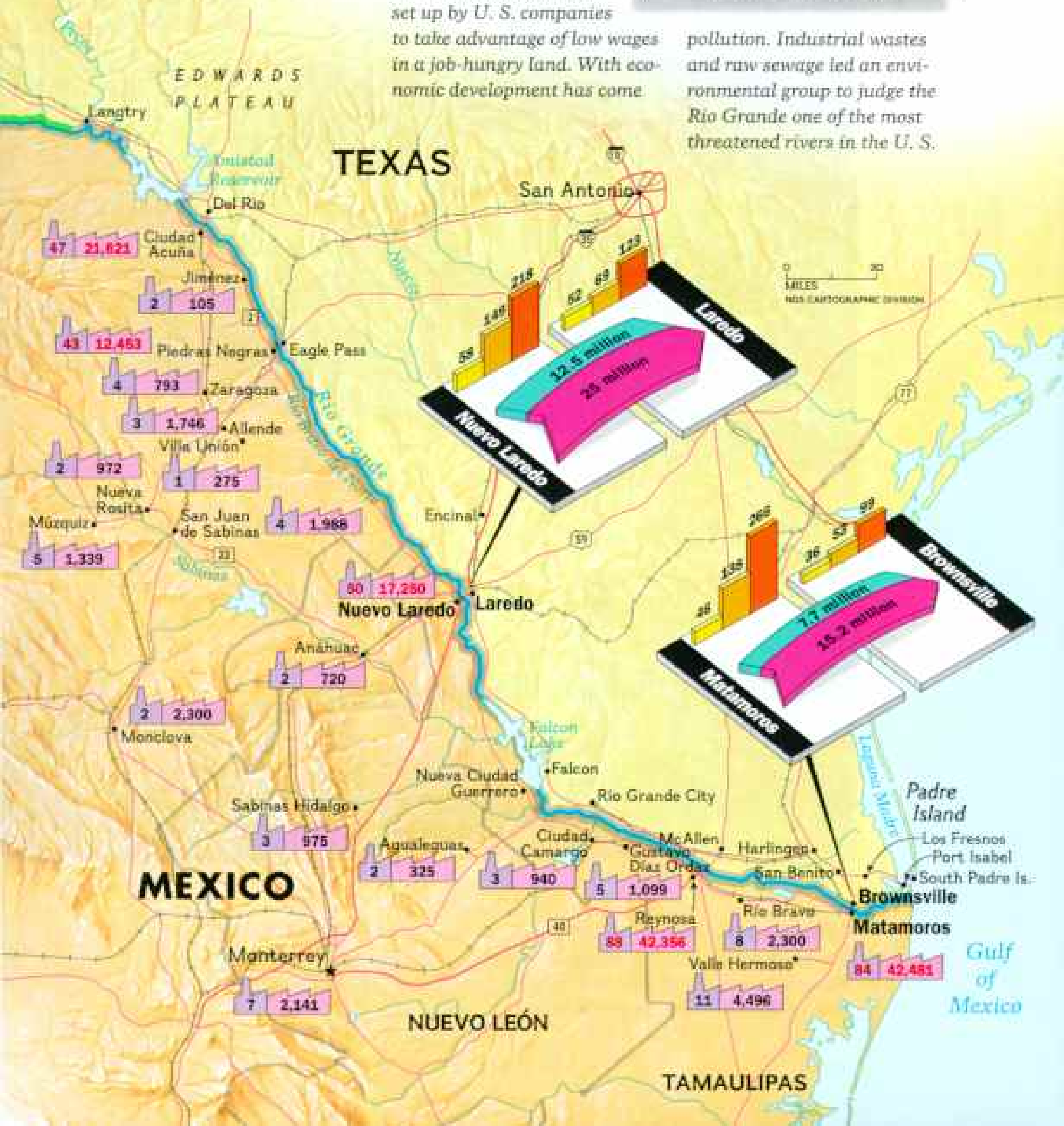
In the past both the U. S. and Mexico have tended to return this sentiment. But the Rio Grande border is now the center of the biggest free-trade deal in history. The North American Free Trade Agreement, or NAFTA, is just

A Restive Frontier

Though Mexico lost the region to the United States in the 19th century, the Texas border country never surrendered its Mexican culture. Mexican food and music and the Spanish language seem as at home there as they do south of the Rio Grande, known as Río Bravo del Norte in Mexico.

The border sees hundreds of millions of legal crossings each year, and the volume is growing, mostly due to brisk trade sparked by reduced tariffs under the two-year-old North American Free Trade Agreement (NAFTA). Lured by the hope of finding work, countless other Mexicans cross illegally. U. S. presence in Mexico consists mainly of the maquiladoras, or assembly plants, set up by U. S. companies to take advantage of low wages in a job-hungry land. With economic development has come pollution. Industrial wastes and raw sewage led an environmental group to judge the Rio Grande one of the most threatened rivers in the U. S.





Gaudy come-ons speak in two tongues in Laredo, Texas, where 94 percent of the residents are of Hispanic origin and 75 percent are bilingual. Pedestrians use a walkway after crossing from Nuevo Laredo, Mexico, on the Gateway to the Americas Bridge.

JOEL SANTORE

"Winter Texans" enjoy the Fun N Sun Resort in San Benito, one of many border communities with growing retiree populations. Every fall George Weir, at left, and his wife arrive from Illinois in their travel trailer. "Florida was getting too crowded and too expensive," he says.

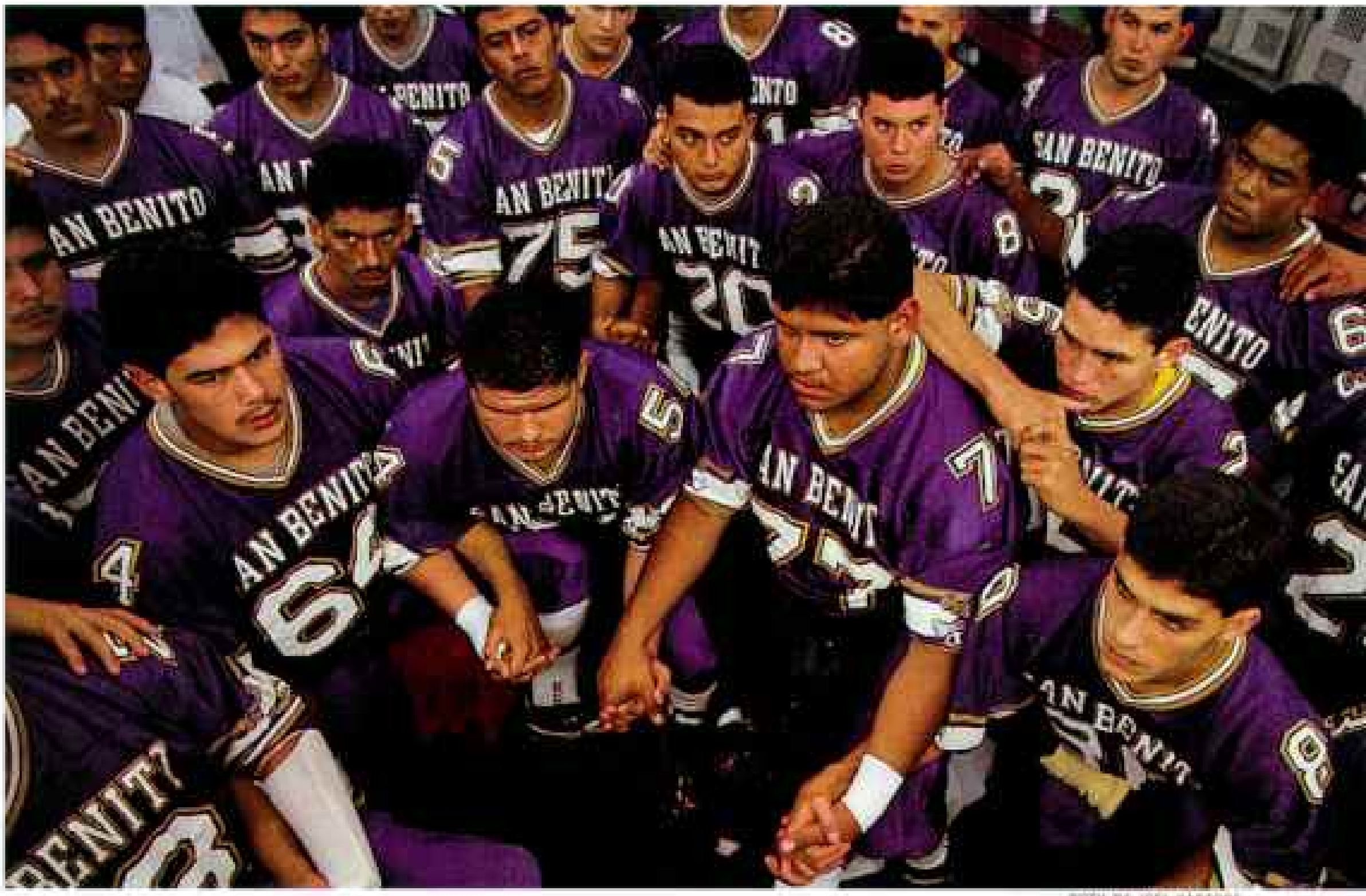
two years old, and no one really knows yet what it will mean. The border is where they will find out first.

EARLY ONE MORNING I drove out from the town of Presidio, in the mountain country of Big Bend. A farmer worked his fields in the dark, by the headlights of his tractor. Down the road a ray of sunlight caught on a high orange escarpment across the river, and dawn came seeping down the mountainsides. River and road unwound before me down the valley, undulating like dancers, sometimes in parallel, sometimes apart. A wiry stand of ocotillo appeared in silhouette out of the darkness. Old fronterizos still cut down the thorny canes, called devil's walking sticks, to use as fence slats. The severed slats can reroot themselves in the sand, and the fences sometimes sprout leaves after rain, which is the kind of persistence the desert demands.

The border has never been an easy place to get by, much less to get ahead. In spring the winds of Lent turn the air to dust. In winter the blue norther knifes through to the marrow. Once, in summer, I made the mistake of leaning on a metal fence at midday, and lurched back with red welts on both forearms. "The surface temperature here has been measured at up to 186°," a local advised me. "We don't lean on fences much." Often rain just gives up and evaporates before it reaches the ground.

In Langtry, downriver from Big Bend, I met up with a rancher named Jack Skiles. He fit the desert landscape, tall and lean, his skin without thickness, just the barest covering for his bones. "I love the country along the Rio Grande," he said, looking out over the sandy soil and the bare limestone rolling away underfoot. "Its soul is exposed.

"If I can't see into the distance, it just boogers me," he said. He pointed to the cliff top across the river. Over there, he said, an elderly Mexican woman showed up in 1946 intending to walk to Chicago to see her daughter. Instead, waiting out the winter, she starved to death in a cave. "There's lots of tales of misery and woe along the Rio Grande," Skiles said,



BOTH BY JOEL SARTORE

Psyching up, the San Benito High School Greyhounds huddle for meditation before battling their arch rivals from Harlingen, Texas. In Mexico, soccer reigns. But American football rules in Texas, including San Benito, where 98 percent of the 2,200 students are Hispanic.

"because it's such a harsh, dry old country."

Skiles led the way up a slope nearby, to a broad, high cave scooped out of the limestone bluffs. "Everything we're walking on is human debris, brought in by the Indians," he said. He bent down to the cave floor and, from an eroded slope, picked up a plug of coarse plant fibers. "Here's sotol," he said. He indicated pointy clumps of the plant still growing in the opposite wall of the canyon. "The Indians used to bake it. It has a high sugar content. So that's a cud that's been baked and chewed. It's bound to be a thousand years old."

Humans have been tinkering with the environment along this stretch of the Rio Grande for millennia. A little farther up the canyon is a spot where early inhabitants, known to archaeologists as the Pecos River People, managed, without horses or bows and arrows, to round up herds of bison and stampede them over the cliff. Near the bottom of the bone pile there, archaeologists have counted the remains of 120 animals of an extinct species of giant bison, driven off the cliff 10,000 years ago. "I bet this dang canyon was covered with strips of meat drying. I bet they ate off it for a year," Skiles said.

He pulled from fine ash a thin bone fragment from some ancient meal. The ash in the cave was eight feet deep. "Can you imagine how many fires they built to get this much ash?" Skiles asked. "So they probably had this area pretty much denuded." On the way back out, Skiles cut off a lechuguilla leaf and stripped it down to its dry, thorny central point, with a few tough threads of fiber trailing behind. When he was a boy, he said, he once helped a Mexican ranch hand use a lechuguilla suture like this to stitch up a wounded horse. I tested the sharp point of the needle and drew blood. There were probably other needles just like it buried in some cave hereabouts from as far back as humans have struggled to make a living along the Rio Grande. But the sense of continuity was an illusion, because the border has seen environmental tinkering over the past 30 years on a scale unimaginable in the previous 10,000.

"LOOK, LOOK, LOOK!" Laurance Nickey exclaimed one day in El Paso as we drove past dirt-floor shacks with primitive pit toilets out back. Nickey is director of the El Paso City–County Health and Environmental District, a retired pediatrician, a stout, hearty Baptist father of seven, and he nurses a reservoir of outrage over the ramshackle subdivisions known as *colonias*. More than 300,000 newcomers to the Texas side of the border live in these colonias, in houses they often build from scraps. "Why do people have to live like this?" Nickey asked. "This is America! This is the 1990s!"

But by then I'd been to the colonias on the Mexican side, and what I saw here looked like progress. When Nickey pointed out a tar-paper shack, I noticed the plywood and stud framing underneath. I saw the pitched roof going up, and the American-style spacing of the houses. The owners were among the poorest people in America, and yet they had taken a leap up onto the bottom rung of the ladder. "You should have visited here first," Nickey said finally. "What *must* these people have come from, that they are enamored of their present circumstances?"

They have come, of course, from Mexico. One evening, a few miles away, on the slopes of a municipal dump in Juárez, José and María Ribera and their children and grandchildren were out gleaning aluminum cans from that day's deliveries of kitchen wastes, used diapers, and discarded fish carcasses. The dump was on a high plateau overlooking a panorama of the Rio Grande. The setting sun lit up the ragged peaks behind them and the office buildings across the river in El Paso.

José Ribera's four daughters had moved here from the Mexican state of Durango, and he and his wife followed when their farm failed. "Why Juárez?" I asked, and one of the daughters replied, "The *maquiladoras* are here." The maquiladoras, or assembly plants, have flocked to the border since Mexico created a duty-free industrialized corridor for them in 1965. The program has had the intended effect of producing jobs, even in the middle of Mexico's current economic crisis. For American companies the peso devaluation has made it much cheaper to do business here now. But because no one planned for this growth, new workers set up house in whatever fringe areas they can find.

All of José Ribera's daughters found assembly-line jobs. They also became single mothers. The family of 12 was living now in a two-room house at the dump. On the slopes where the houses huddled together, spalls of broken bottles, crushed cans, and old shoes came endlessly to the surface. The dust boiled off the unpaved streets. On the fences multicolored plastic bags shuddered in the wind.

But Ribera was a *campesino*, a stoic, a reader of Scripture. Gleaning garbage did not embarrass him. He was simply doing what was needed; the money from scrap aluminum would help buy milk for the youngest baby. Heading home with a sack of empty cans on a stick over his shoulder, his straw hat battered down around the rim, with his family trailing behind as if from an outing, Ribera was a portrait of 19th-century pastoralism dropped rudely onto the brink of the industrial world.

Despite their reputation, the maquiladoras—at least the ones I was allowed to visit—look like any new factory in the U. S.,

Spiky leaves of aloe will be turned into ointments, cosmetics, and beverages after the harvest at Forever Aloe Plantations near Harlingen. Three out of four of the company's workers are resident aliens, Mexican citizens with green cards allowing them to work in the U. S.

On the 130,000-acre Callaghan Ranch near Encinal, Texas, smiles come easy to ranch hands washing up after a day of branding cattle. The three vaqueros—Miguel Elisondo, left, Pedro Cruz, and Miguel's son, George Elisondo—are also resident aliens.

BOTH BY JOEL SARTORE

Gunmetal sheen of sundown bathes craggy terrain where the Rio Grande cuts a tortuous path. The 801,000-acre Big Bend National Park on the U. S. side, at right, is now complemented by Mexico's Santa Elena Canyon Protected Area, created in November 1994.

BRUCE DALE

Top seamstress Rolanda Vásquez Hernández assembles sweatshirts at the Nova/Link plant, a maquiladora in Matamoros, Mexico, adding her work to a mountain of finished garments. She meets or exceeds 100 percent of her production goal, as evidenced by the sign above her station.

big air-conditioned structural-steel buildings, clean and well equipped. At one plant I watched a digitally controlled automatic screwdriver assemble the pieces of a brass valve, with a pneumatic hissing and popping, and another machine chamfer and hone the rough edges. The workers are mostly young and female. The women dress nicely for work, with ribbons and barrettes in their hair. "These kids are high school and college age. We cater to them," the owner told me. "They're here looking for a boyfriend or girlfriend. This is probably the best place they'll be as far as having a clean rest room and a decent place to stay." Their wages are the best many in Mexico's booming young population can earn, though the peso devaluation has cut the average pay from $50 to $30 a week.

Following the crowded busloads of workers home from the factories one afternoon, I wound up in a Juárez colonia called Anapra. Children here are four times more likely to die before their first birthday than their neighbors—often their cousins—in El Paso. "Lack of hygiene," a resident explained. "We don't have sewerage and things like that." Cholera appeared in 1993 in Juárez, raising the potential for a deadly cross-border epidemic. As we talked, a crew arrived to train local leaders in water purification and hygiene. The program was begun by the University of Texas at El Paso with seed money from the U. S. Environmental Protection Agency for colonias on both sides of the border. It was one positive result of the Rio Grande's notoriety in the press, but the federal money will run out this spring.

Water comes to Anapra by truck, and the commercial dealers go only to those who can pay. "Before they teach us to treat the water," a woman in one house joked, "they should deliver the water." Instead, the city of Juárez announced that it has no intention of installing waterlines for the estimated 10,000 people in Anapra, because it hopes to redirect growth to more suitable areas.

And yet electric power lines were being strung from utility poles the day I visited. Where the power lines hadn't quite reached,

BOTH BY JOEL SARTORE

Day's end brings a rush for the bus at Pebac, a Matamoros maquiladora that makes components for vehicle air bags. It is unclear what effect NAFTA, with its gradual elimination of tariffs, will ultimately have on the maquiladoras—or on the border area as a whole.

spliced wires and extension cords, called *diablitos*, or little devils, for pirating electricity, snaked away on the surface, through yards and across entryways and streets, to houses throughout the neighborhood. At one house an 11-year-old named Fernando was reconnecting a diablito to the electric box at the side of the house. Someone had stolen their wires in the middle of the night, he said. His mother came around the corner then and introduced herself. Her name was Elizabeth Luna, and she was trim, short, dark-haired, with a sweet, thoughtful manner. She had been living in Anapra for two years, having moved up with her husband from the interior in search of work.

The one escape from poverty for thousands of families is to go to Mexico's urban centers, where economic power is increasingly concentrated, or to the North—the border—and this is true even for someone like Elizabeth Luna, who would be a pillar of the community in my New England town. She was now the proprietor of Estanquillo Eli, or Eli's Little Shop. She liked it on the border, she said. "*Trabajo, trabajo*. I work, work, work—work really hard, and I can earn enough to have savings." I asked her what her great dreams were, her goals. She replied, "I would like to have water and light and electricity."

Her son Fernando, who wore a White Sox cap and a rental-car company T-shirt, was busy now chipping bright shards off a block of ice for his mother's shop. When he paused, I asked him in turn about his dreams. "I want to go to school in El Paso," he said, "to study computer engineering."

"WE HAVE two very powerful cultures coming to terms with each other every day on the banks of this river and creating a new culture," Enrique Madrid told me when I visited him in the West Texas town of Redford, where his family has owned land since 1876. "We have a new language, a new cuisine, a new music." Madrid is a creature of the border, Hispanic and married to an Anglo, fluent in both cultures, but not, it seemed to me, wholly comfortable in either.

The cultural blending he spoke of is everywhere along the Rio Grande: I could hear bilingual rhythms even in radio commercials that pitch "*un* Quarter Pounder *con queso*" or "Oshkosh *y mucho mas*" between bursts of "*la música* heavy duty." I could see it at a roadside stand in Mexico called Giggling's *Exquisitos* Hot Dogs, where motorists don't say "*estacionar el coche*," meaning to park the car, but "*parquear el carro*."

Madrid had the idea that Mexicans would gradually infuse plainspoken Americans with their humor, their romance, their emotional expressiveness. "For instance?" I asked.

"Americans refer to a very handsome man as a hunk," he replied. "It could be a hunk of cheese or a hunk of rock. Mexicans call a very handsome man a *mango*, because a mango is a really sensual food. It won't be very long before American women will be referring to Robert Redford as a mango."

Next day I was rafting through Santa Elena Canyon at Big Bend, where the Rio Grande turns deeply southward to find a low point through the Rocky Mountains. One of the other passengers was a Texas-reared Cajun woman with a languid way of drawing out a word into all its potential syllables. She remarked on the difficulty of finding bars in south Texas "where the men speak English." So as the day passed, I tried Madrid's idea on her.

"Mango," she said, lingering over the word—*maa-ynn-go*—and letting a momentarily sublime expression turn up the corners of her mouth. She took a quick pull on her cigarette. "Not Robert Redford," she said. "I don't like my fruit that ripe."

Clearly, the Mexicans would have their work cut out for them. But I found something like the new culture Madrid was talking about when I got to a Mexican-American heartland known simply as the valley.

In the final 150 or so miles of river basin the air gets thick, the sky clouds up, and the skeletal desert landscape of the upper Rio Grande fleshes out into broad, black alluvial plains. Palm trees appear, and their dry brown fans clatter in the wind off the Gulf. In summer the harvesters pile up huge blocky bales of pima cotton. In winter the sugarcane grows in dense thickets 12 feet tall.

This area has been predominantly Hispanic since Spanish colonial times. But perhaps because their Mexican neighbors are so close, and yet so different, people in the valley often

Caged in a U. S. Border Patrol vehicle, a ten-year-old boy is driven back to his hometown of Matamoros after sneaking into Brownsville, Texas.

Beneath International Bridge in the same city, a group fords the Rio Grande to enter the U. S. illegally. Men commonly remove their trousers, since wet clothing is a tip-off. For many illegal aliens, the border is a revolving door. Photographer Joel Sartore observed the woman at right cross—and be apprehended—three times in one day. With deportation the only risk, many Mexicans see the border not as a deterrent but as a challenge.

act more American than most ordinary Americans, *mas tejano* than the Texans.

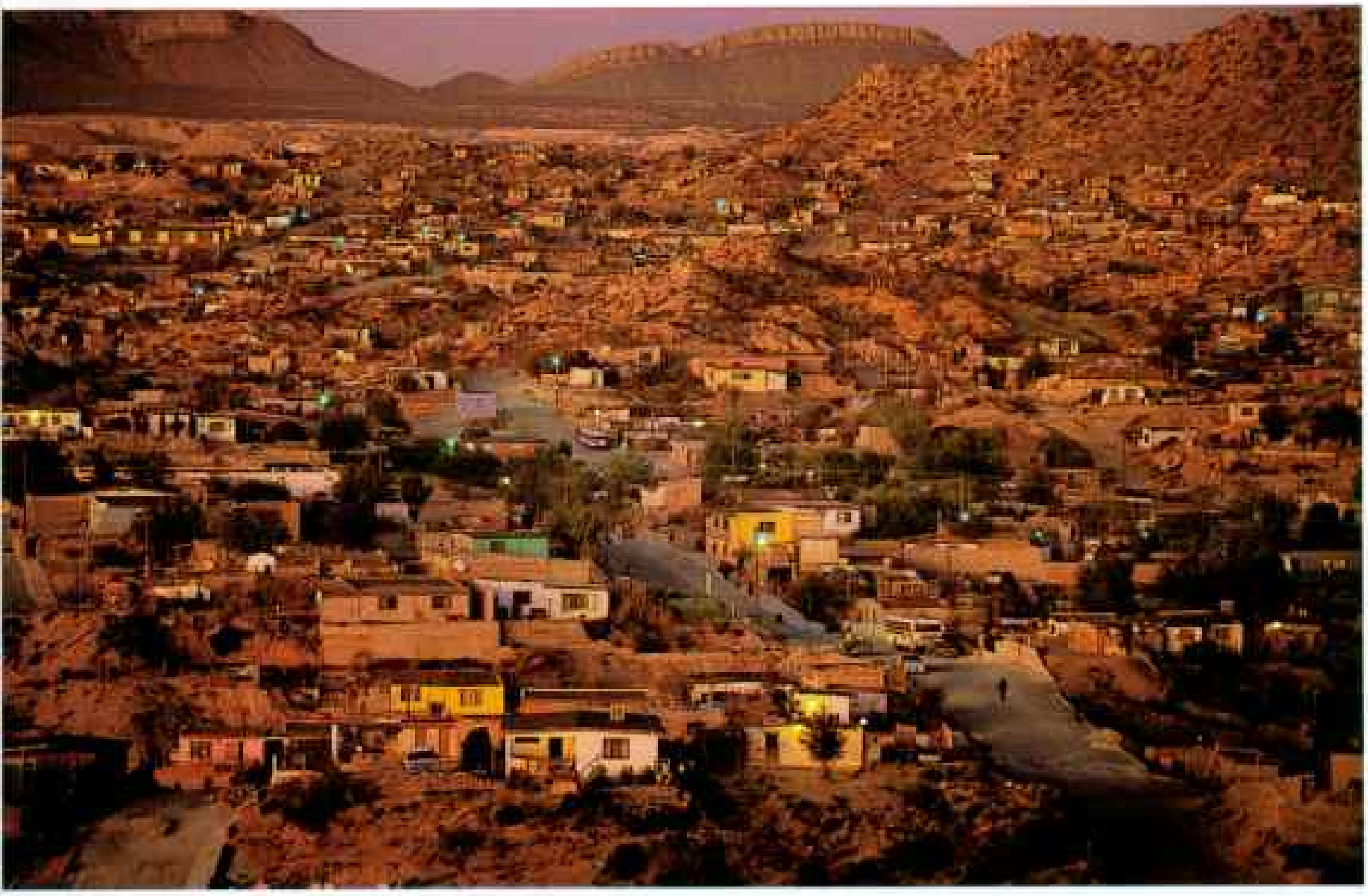
On a windy Friday night, with clouds whipping across a fingernail-sliver of moon, I went out to the high school football stadium in Harlingen, Texas. The sky was a faded turquoise in the west, indigo in the east. A good night for the Battle of the Arroyo, an epic, annual struggle between the Harlingen Cardinals and the San Benito Greyhounds. Harlingen is the larger of the two towns and has a banner announcing that it is an All-America City. San Benito has a stronger Mexican identity and a deeply ingrained sense of gridiron defeat, not having beaten Harlingen since 1967.

In the packed stands, husbands who grew up in San Benito sat across the field from their wives who grew up in Harlingen. A fan named Rey Avila boasted that he's missed only three

BOTH BY JOEL SARTORE

Teeth clenched as tightly as his hands, a bull rider tests his grit at a jaripeo, or rodeo, near Nuevo Lajitas, Mexico. The event went on until dark. "I couldn't see a thing," says photographer Bruce Dale. "But I could hear the gate open and the thump of bodies as they hit the ground."

BRUCE DALE



Dawn sends a workday wake-up call to Ciudad Juárez, with 1.5 million residents Mexico's fourth largest city. Job seekers routinely sneak into nearby El Paso, then, at dusk, walk nonchalantly past U. S. border patrolmen unconcerned with Mexican nationals returning home.

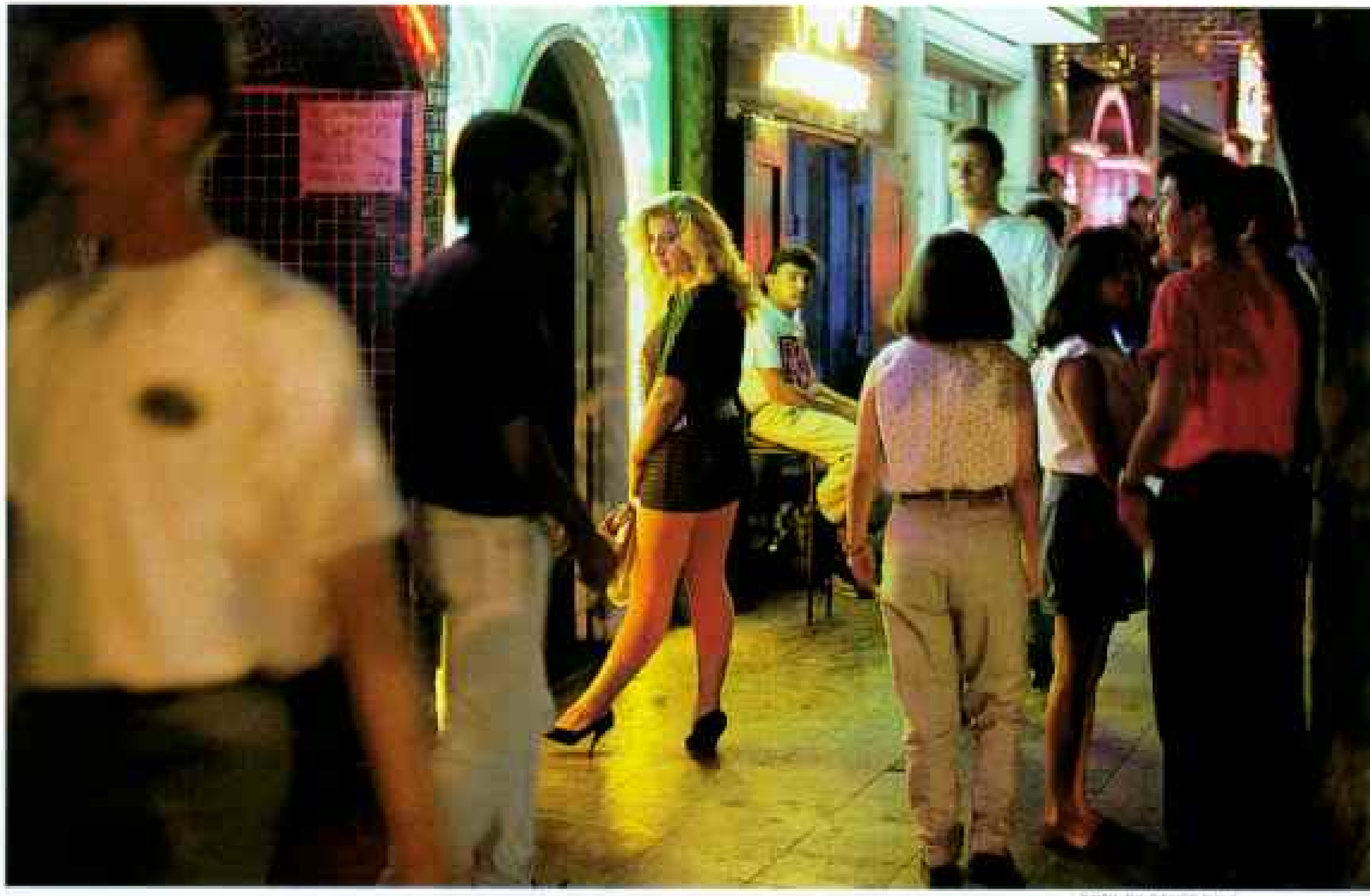
San Benito games since 1954. Aurora, his wife and San Benito High School sweetheart, apologized that she wasn't wearing the team colors. She'd come straight from her job at a jewelry store in Harlingen, where it might have offended customers. "You have to respect the battle," she said.

Apart from almost every face in the stands, the players on both teams, and the vast pantheon of band members, cheerleaders, mascots, and the Dancing Belles, there was nothing especially Hispanic about the event. This was pure Texas Friday night football.

"You have a chance to make history," the San Benito coach said, as he sent his team clacking and rumbling out of the locker room. They came back at halftime leading 21-7, full of bravado. "This game is not over," he warned. "We need to score two more times." "Four more," a player yelled. But with a sickening inevitability known to all teams with long losing streaks, the Greyhounds never scored again. The game ended in a 21-21 tie.

Only then did the evening turn ethnic. Back home, over bowls of tripe soup called *menudo*, the entire valley tuned in to a local Spanish-language radio show called *Football Scorecard*. The host is Mr. Ni-fu-ni-fa, so named for the melodic, derisive way he announces that a local team has scored nothing, *nada*, *ni-fu ni-fa*. Between scores he plays ballads called *corridos* celebrating local football rivalries. "The Los Fresnos Falcons say they're dangerous," one such corrido advised. "But they're really pigeons, delicious when cooked on the grill and served with salt and pepper."

Then, in Spanish or English or both at once, the spin doctors of Friday night football phoned in to reshape history. "You can douse the votive candles now," a San Benito fan told Harlingen. How much, he wondered, did they pay the witches this time? Another San Benito fan was less fatalistic: "You beat everybody else, Harlingen. But you didn't beat San Benito, and you're never going to beat us again." Perhaps he lit a votive candle of his own. A year later, after 27 seasons of humiliation, San Benito rose up to smite Harlingen, 15 to 6.



BOTH BY BRUCE DALE

Nighthawks haunt the streets of Juárez, which attracts millions of U. S. visitors with nightclubs, horse and dog racing, and bullfights. A more permanent influx has come with droves of new maquiladora workers from the interior with nowhere to live but jerry-built shacks.

ON NOVEMBER 20, 1993, a Saturday, the U. S. Senate voted NAFTA into law, joining Canada, Mexico, and the United States as trade partners. The same day, in the Mexican city of Juárez, a municipal worker scooped a water sample from a sewer collection point near the Rio Grande. The city was on the trail of a mystery. That Saturday was the anniversary of the Mexican Revolution, a major national holiday. No one was expected to be working, least of all the government's meager band of environmental watchdogs. But city workers in Juárez had noticed that wastewater samples from industrial areas seemed to get more toxic, not less, on weekends and holidays. On a test scale where a reading of four or above is highly toxic, that day's sample from collection point N-5 measured 4,110.

"So we said, 'Oh, come on, what's happening here?' " Francisco Núñez recalled. Núñez heads the city's sanitation department. He is an unimposing figure, pear-bodied, soft-spoken, with a beleaguered way of laying his head to the side, one eyebrow raised, as if perpetually on the brink of a sigh. To environmentalists he is Mexico's best hope for cleaning up the pollution on his stretch of the border. The day we met, he was armed with overhead transparencies, and he outlined his agenda in graphs, flow charts, and maps.

I was on the brink of sighing too. I thought I had a pretty good idea what was happening at collection point N-5, and also what Mexico was likely to do about it. Mexico didn't have the know-how or the will to regulate U. S. and Asian high-technology manufacturers, and the companies knew it.

But Francisco Núñez was still talking: A few months after the reading at collection point N-5, he had invited representatives of seven assembly plants to a meeting. He gave them the same methodical outline of his agenda, and, like me, they reacted at first with impatience. He reminded them that dumping toxic wastes is illegal in Mexico.

Núñez showed the seven companies a map indicating that all of them drained into

collection point N-5, as did at least 30 other companies. To narrow the field of suspects, he said, the city's new water-quality laboratory had screened the test sample using mass spectrometry and gas chromatography. One or two eyebrows went up around the room. These advanced techniques had detected extraordinarily high levels of trichlorofluoromethane and toluene, solvents used in the electronics industry. Then, like a detective unfolding a solution, Núñez told his listeners how he had followed a paper trail to identify exactly which companies in the area used these chemicals. By now his listeners had stopped drumming their fingers. Núñez slipped one more transparency onto the projector. It was a graph listing their company names next to neat little check marks in the boxes under toluene and trichlorofluoromethane. The room went silent. Finally, one of the seven exclaimed, "But this is First World technology! I can't believe *you guys* have the technology."

"Now they are very cooperative," Núñez said, allowing himself a brief smile. "Before they were trying to step on us. But now we're working together to solve the problem. It's good for Mexico, and it's good for the U. S."

At one industrial park I visited later, the Mexican government had actually shut down eight plants for pollution. The change in attitude is due partly to NAFTA, which requires each country to enforce its own environmental standards, and partly to national pride. "They just got tired of being in every photograph with dead dogs and orange goo in the canal," was the way one Texas environmentalist put it. "We haven't lost the border yet. There are good things going on too."

BRUCE DALE

Long reach of the Queen Isabella Causeway stretches for 2.5 miles from Port Isabel on the Texas mainland to the resort of South Padre Island. Curved to withstand hurricanes, the span crosses Laguna Madre just north of where the Rio Grande meets the Gulf of Mexico.

A vacation home on South Padre is often the dream of a Texan in a modest tract house. To many a Mexican that house is a palace compared with the crumbling shacks they've thrown up around border cities. The border itself has loomed like a bridge—closed to some, open to others—on the road to a better life.

How liberalization of trade will ultimately change the border remains open to debate. It has been a tumultuous start. The first year of NAFTA, trucks were backed up carrying American products south. The second year, Mexican goods, suddenly much cheaper, have been backed up heading north. The flow of jobs and cross-border shoppers has also undergone a tidal shift and will perhaps shift again. The day I visited Enrique Madrid, he argued that la frontera represented the beginning of a unified North American state. But others on the border worry that even as the agreement brings the two nations closer, its benefits will ultimately bypass them for distant cities like San Antonio and Monterrey. For the border, NAFTA could mean more 18-wheelers passing through and a boom only in the population of displaced Mexicans seeking new homes.

NEAR THE END OF MY TRIP I flew out over the last few miles of the Rio Grande with Buddy Ude, known among pilots in Brownsville as La Gaviota—the seagull—because of his penchant for flying low and slow and also for landing on beaches. He pointed the 1946 Piper Cub down toward the Gulf, and as we drifted over the endless oxbows in the river, he yelled back, "Now we're in Mexico" and "Now we're in the United States." Even at an altitude of 75 feet it was hard to see much difference between the two.

In the backseat I was mulling over the things I had seen on both sides of the river, the effects of human population growth and international business competition. When I was a child, most American companies would have been ashamed to have their workers living in the conditions I had seen in the colonias. Now it was routine, a simple fact of business survival in the world marketplace. A maquiladora manager could even argue that it was admirable: "If we were to close today, where would these people go? What would they do? Who would feed them?" I wondered if the world will have changed again, this drastically, by the time my own children have grown up.

The plane was circling over the salt flats near the mouth of the river. Ude was looking for evidence of the twin outposts of Bagdad, Mexico, and Clarksville, Texas, which once stood here. "This is where cotton was shipped during the U. S. Civil War," Ude said, "and Bagdad became a helluva big city. They say it looked like a forest for all the ships anchored here." But a hurricane wiped the mouth of the river clean in 1867, and there was nothing left now but sand dunes and prickly pears.

Below us the narrow river entered the Gulf of Mexico and released its burden of sediment washed down from the Rocky Mountains, from the hunting grounds of the Pecos River People, from the colonias and the maquiladoras. The chalky green waters of the Rio Grande tumbled together with the surf, then vanished into the vast jade sea. Maybe in another century Bagdad and Clarksville would rise again in an industrialized border zone of new twin cities. Or maybe the winds of free trade would sweep across the entire continent, and the border would become only another river valley in a vast integrated state. Ude headed the plane back to Matamoros and Brownsville. On the banks of the Rio Grande, all the possibilities lay spread out below us. □

INTO THE HEART OF GLACIERS

Photographs by CARSTEN PETER

More than 300 feet straight down, an ice shaft swallows rappelling adventurers in the Greenland ice sheet. A new breed of explorer is discovering that cave systems in slowly crawling glaciers are just as diverse and challenging as their stationary underground cousins.

Heights of the Depths

Making their way up and across a cave, explorers hone their ice-climbing skills in southern Germany.

Specially designed screws for belaying in ice enable Stefan Geissler (above) to reach this point, some 50 feet above the cave floor.

In the same cave on a later expedition, Daniel Jehle uses ice axes to climb massive ice stalactites. Meltwater from the surface dripped through tiny fractures and into the cave, where cold air froze it into huge icicles. The yellowish beam of Jehle's carbide light, mounted on his helmet, will be needed when he reaches the cave's depths. But often, depending on the thickness of the ice, the caves are filled with refracted sunlight—a deep blue glow radiating from the walls—far from the bright cave entrances.

For more than ten years, German photographer Carsten Peter has been exploring and photographing glacier caves in Europe and Greenland. Unlike terrestrial caves, they change seasonally at the whims of flowing meltwater and the unimaginable pressures that torture the insides of the glaciers. "They are the chameleons of caves," says Peter. "They change all the time."

Cold Crossing

An ice-covered lake—too fragile to walk on—lies hundreds of feet down in a Greenland ice shaft. French caver Samuel Keller has traversed the 60-foot-wide lake on a rope anchored in the ice walls. A caver on the opposite wall, having lowered himself by a line from the ice shaft's mouth, is about to follow. Meltwater, running down the walls, fills the shaft faster than the water escapes through submerged tunnels. By the next day rising ice water had swallowed the traversing rope.

Galleries of Ice

Beyond sunlight, American Diana Gieti ascends a narrow ice shaft within a cave system in Greenland. No water drips down the rock-hard ice walls, as below-freezing temperatures prevent melting.

Each autumn explorers return to Greenland after summer melting has created new caves and the annual rush of meltwater is subsiding.

Not only water forms glacier caves. Rising heat from geothermal springs melts an Iceland glacier from the inside out, creating a bowl-like chamber (above). Layers of ice, marked by bands of volcanic ash, form a monstrous "eye" that casts its frozen stare on caver Arne Kaiser.

Long spikes are a must to keep explorers from slipping on the ice. Despite its solidity, within months a glacier cave's contours may be changed by the relentless movement of the glacier and by water flow or heat. "As often as I return," says Peter, "I have never entered the same glacier cave twice."

TAKING AN ICY PLUNGE IN PATAGONIA

SANDRO IRSARA, LA VENTA; ROBERTO RINALDI, LA VENTA (RIGHT)

Treading Lightly

Last year, a hemisphere away from Carsten Peter and his teams, an Italian expedition, lead by glacier expert Giovanni Badino, took glacier cave exploration one step further. They donned dry suits and went diving in the water-filled chambers beneath the glaciers of Argentina's Patagonian Andes.

Near the face of Moreno Glacier on Lake Argentino, the team hiked for six hours (above), gingerly sidestepping hidden crevasses. Finally they reached an area that was flatter and smoother. Even there the explorers had to be careful not to break through thin cave ceilings. Many caves lie mere inches below the surface (opposite), and, unlike this dry one, some conceal rushing streams that could doom an unwary hiker.

"We nearly lost one of our companions that way," recalls team member Antonio De Vivo. He, along with Badino and glacier cave specialist Tullio Bernabei, organized the month-long expedition, which found one of the longest glacier caves yet measured: 3,400 feet.

SANDRO IRSARA; ROBERTO RINALDI (RIGHT)

Going With the Flow

"The ice is blue, the water is blue—it is very difficult to tell the difference between ice and water," says De Vivo. A flashlight helped diver Matteo Diana define the walls of a narrow channel (right).

Even with their low-temperature suits, in water 90 feet deep and barely one degree above freezing, the divers could stay under just a few minutes at a time. Twice the air valves on their breathing devices froze in the open position.

Trying to follow the twisted path of a shallow stream, the expedition released fluorescent dye into the flow (above). They traced the dye as it moved in and out of several caves for one and three-quarters miles before losing track of its path. Nearly five miles from its starting point, the colored water exited the glacier beneath the surface of Lake Argentino.

"We tried to dive down there too," reports De Vivo. "But with ice masses the size of skyscrapers falling from the glacier, that turned out to be an invitation to suicide." □

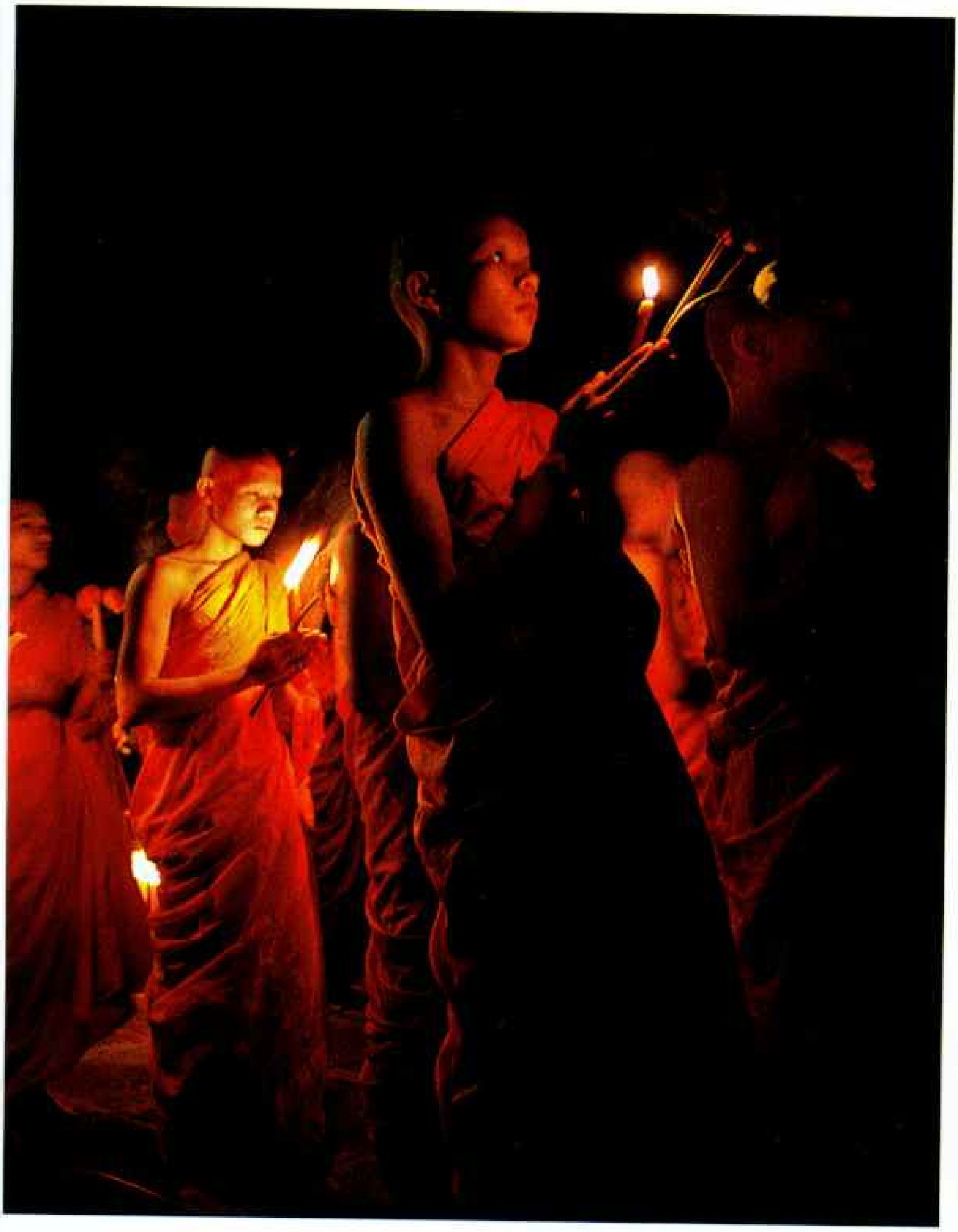
WILLIAM R. NEWCOTT
EDITORIAL STAFF

Buddhist soul of the Thai people finds expression with candles, incense, and lotus blossoms at Bangkok's Marble Temple, built at the turn of the century by King Rama V, who ushered the nation into the modern world.

Most Thai men don monks' robes for some period of their lives in a society noted for continuity and harmony—and now coping with new stresses as an economic tiger of the Pacific Rim.

The Many Faces of

Thailand



By NOEL GROVE

Photographs by JODI COBB
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Jade islands cup emerald anchorages on Thailand's west coast, developed since the 1970s as an international playground. Tourism has fed Thailand's boom, but the cost has been runaway growth, pollution, and deforestation, now slowed by a ban on commercial logging. Here on Ko Phi Phi Le, part of a national park, damage to the island and reef has led to limits on day-trippers.

A bar worker on Phuket's nightlife strip begins her shift with a respectful pause before a spirit house, found at both homes and businesses. Tolerance of prostitution has translated into a sex industry serving intercontinental clientele. The specter of AIDS stalks the nation; some 800,000 citizens are HIV-positive, and one in three prostitutes may be infected with the virus.

NIKORN PHASUK, a Bangkok policeman who is also known as Plastic Man, steps onto a stage of asphalt under the glare of a blazing sun. He crouches, then retreats with mincing footwork as he coaxes vehicles toward him with fluid arm gestures, part of an artful ballet he uses to keep traffic rolling, no small feat in the city that may have the most congested streets in the world.

As the last motorist accelerates by, the officer stabs a white-gloved hand toward the heart of the city in a gesture that ends in a pirouette. Below dark sunglasses his teeth flash in a full grin, one that commuters irked by delays cannot help but emulate.

"It relieves the tension, makes everybody less serious, and it's fun," Nikorn said. "And traffic seems to move faster."

As he walked me back to my car, he held hands with a Bangkok journalist who had stopped by. Such intimacy, while common among Asian men, might be hard to imagine in New York City. But this was Thailand, where most actions seem choreographed for gentleness, and smiles are the expression of choice.

My three visits to Thailand have been decades apart. Each time I found a Bangkok I scarcely recognized and fewer and fewer trees in what used to be a lush, tropical countryside.

In 1973 a boatman took me in his long, slender craft for a leisurely tour of the *klongs*, or canals, that once gave the city the reputation of Venice of the East. We cruised to a floating market where other boats held a rainbow of peppers, melons, and oranges from outlying farms. We stopped at a waterside shack where the boatman's wife bathed a toddler in the canal and his teenage daughter gave me a sun-bright smile.

When I returned in the early 1980s, many of the klongs had been filled to widen streets, but traffic was worse. Some Thais worried about widespread logging, but vast forests still remained. During my most recent trip I noticed that freeways had been built to relieve congestion, but cars still crawled. The few remaining canals had turned into stagnant pools of green scum. By midmorning, heat rising from hundreds of idling engines gave the city's new prosperity the look of a shimmering mirage.

Outside Bangkok as well, the scenery had changed dramatically. I visited a forest ranger who often patrols plowed ground, as Thailand's woods give way to farms. By official reckoning, just 25 percent of the original forest cover remains.

"Only 16 or 17 percent is healthy," said Pisit Na Patalung, head of the World Wildlife Fund for Thailand. "Any land

Polished as tin soldiers, Royal Guards ride to the Grand Palace protected from Bangkok's grimy air.

Not afraid to dirty its hands, the Thai Army has often held power since a 1932 coup inaugurated a nominal constitutional monarchy. Eight coups have followed.

In 1992, after soldiers massacred pro-democracy demonstrators, King Bhumibol Adulyadej, Rama IX, held a televised

NOEL GROVE, a NATIONAL GEOGRAPHIC staff writer for 25 years, now freelances from his home in Middleburg, Virginia.

audience. Rival political leaders knelt and received stern advice "to desist from confrontation and to embrace conciliation."

Civilians now head the government, and democracy is supported by a growing middle class. Yet the much revered king is no toy monarch. His agricultural and irrigation projects have reached every part of the nation.

not privately owned, the government calls 'forestland.' "

But some things have not changed over the years. There was still Thai optimism in the face of unpleasantness, and even in numbing traffic jams, drivers rarely sounded their horns.

"At such times, we meditate," explained a Thai friend, smiling and pressing his hands together. "It is the Buddhist way."

Buddhism, Thailand's dominant religion, encourages a temperament steeped in serenity and gentleness, traits readily apparent among the Thais. Something about this Thai way attracts visitors from around the world. Tourists annually bring in more than five billion dollars in foreign currency, the biggest single contributor to foreign reserves that now exceed 30 billion dollars. They come to see the Emerald Buddha in old Bangkok and the golden stupa at Wat Phra That Doi Suthep near the northern city of Chiang Mai, where holy relics of Buddha are said to reside. Visitors bargain for silk and gems, ride elephants through forests, and relax on the beaches of Ko Phuket and Ko Samui. Foreign men come to see Thailand's beautiful women and to enjoy a thriving sex industry.

Mae Salong (Santikhiri)
Tanao Ra.
Chiang Rai
Mae Hong Son
Phayao
Nong Hai
Wat Phra That Doi Suthep (temple)
Chiang Mai
Nan
BURMA (MYANMAR)
Doi Inthanon 2,565 m.
Lampang
Phrae
Loang Prabang Range
LAOS
VIETNAM
Vientiane
Nong Khai
Uttaradit
Loei
Udon Thani
Nakhon Phanom
Mekong
Sukhothai
Tak
Mae Sot
Phitsanulok
Rangoon
I S A R N
Khon Kaen
T H A I L A N D
Nakhon Sawan
Khorat
Bua Yai
Nakhon Ratchasima (Khorat)
Ubon Ratchathani
Mun
Warin Chamrap
Three Pagodas Pass 935 ft
Chao Phraya
Lop Buri
Plateau
Dangrek Range
Ayutthaya
Kanchanaburi
Bangkok
Thon Buri
Prachuap Khiri Khan
Samut Songkhram
Chon Buri
Khao Ang Ro Nai Wildlife Sanctuary and Forest Reserve
Phetchaburi
Si Racha
Tonle Sap
Andaman Sea
Pattaya
Rayong
Chanthaburi
Sattahip
U Tapao
Hua Hin
Trat
CAMBODIA
Ko Chang
Phnom Penh
Gulf of Thailand
Chumphon
Isthmus of Kra
Ko Samui
Surat Thani
Nakhon Si Thammarat
Ko Phuket
Phuket
Ko Phi Phi Le
Trang
Phatthalung
Songkhla
Pattani
Hat Yai
Sadao
Yala
Narathiwat
Strait of Malacca
Sungai Kolok
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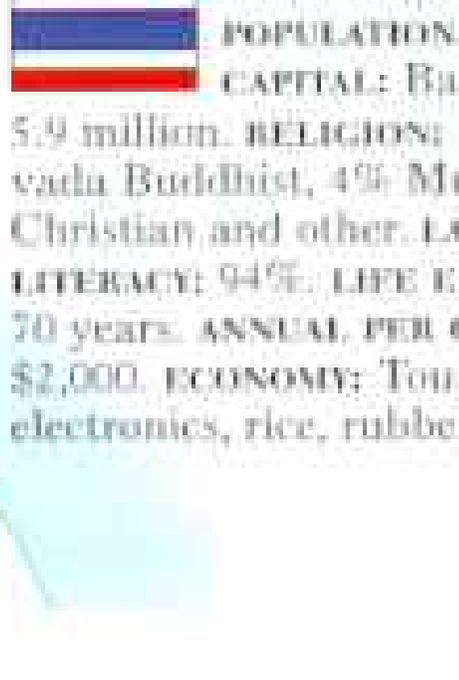


AREA: 198,457 sq mi. **POPULATION:** 60 million. **CAPITAL:** Bangkok, pop. 5.9 million. **RELIGION:** 95% Theravada Buddhist, 4% Muslim, 1% Christian and other. **LANGUAGE:** Thai. **LITERACY:** 94%. **LIFE EXPECTANCY:** 70 years. **ANNUAL PER CAPITA INCOME:** $2,000. **ECONOMY:** Tourism, textiles, electronics, rice, rubber.

"A nice country in a bad neighborhood," a U. S. diplomat describes Thailand, formerly called Siam, whose rulers have walked a fine line of independence while colonialism and warfare engulfed countries on all sides. Although still predominantly rural and agricultural, Thailand has begun to gain on such regional powerhouses as South Korea and Taiwan. Light industry, particularly computer manufacture and assembly, leads the way.

Open-arm business policies attract legitimate industries as well. Japanese and Americans have invested in plants that assemble cars, computers, and costume jewelry.

"About a third of our capital investment is from foreign sources," said Staporn Kavitanon, director general of the Board of Investment. "We are an open society that has always learned from outsiders." The Thais have learned well. Their nation has become an economic tiger of the Far East, with steady growth over three decades.

In 1973 I stayed in the four-story Erawan Hotel, then one of the tallest buildings around. Small lizards skittered over the moist walls like leaf shadows. Today the new Erawan stands 22 floors high and has a disco and a gym. In a huge glass lobby filled with trees, Thais, Americans, Japanese, and Germans make deals to the clink of spoons on china cups. The sidewalks outside are filled with young workers striding to their offices.

Thailand's economic success is most obvious in the cities, but it filters into the countryside as well. Where families once tended small paddies just outside Bangkok, large tractors now groom the sweeping fields of commercial farms. Many farms have given way to golf courses in the past decade. On quiet side roads where I once slowed for water buffalo, I now dodged motorcycles piloted by young Thai men in love with speed.

THE GENTLE THAI WAY ENDURES. A smile from a *farang*, or foreigner, to any Thai usually elicits a similar response. Tourists quickly learn the Thai greeting, the *wai*, for they encounter it often: a steepling of the hands, a slight dipping at the knees, and a soft smile.

"Thais don't have a chip on their shoulder where outsiders are concerned, maybe because they've never been a colony," said Tom Seale, director of the U. S. Chamber of Commerce in Bangkok. We talked in a restaurant over chicken baked in peanut sauce and fish spiced with coriander. "Except for a few dialects, they all speak the same language, they revere their king, and they are proud of their history," Seale said. "There is a settled feeling here that has contributed to their success."

The Thais' proud history began with their exodus from China. In the 13th century they fled south in great numbers to escape the Mongol war chief Kublai Khan. The powerful Khmer, who then dominated much of Southeast Asia, referred to these people as Syamas, or Siamese, the name for aborigines who lived in scattered forest settlements.

But the Thais were no primitives. They set up kingdoms in Khmer territory at Sukhothai, in today's northwest Thailand, and at Ayutthaya, 50 miles north of the present capital. Today at Ayutthaya empty temples and pitted stupas are all that remain of a once grand city. The Burmese destroyed the ancient Siamese capital in 1767, forcing Thai leaders to a riverside settlement called Thon Buri, now part of Bangkok. Fifteen years later a fierce leader named Chakri, who helped drive the Burmese out of the country, was declared king. His descendants have reigned over Thailand ever since.

The ninth Chakri king, Bhumibol Adulyadej, may be one of the most beloved monarchs in the world. Photographs of King

Aeries for the eagles of commerce rise above the welter of Bangkok, where no one escapes the clotted horror of a daily citywide traffic jam that lasts for hours—contender for the title of world's worst gridlock.

Even so, newcomers still flock to the capital, whose official population count approaches six million. "The actual population may be twice that," asserts Bangkok Governor Krisda Arunvongse Na Ayutthaya.

Bhumibol and Queen Sirikit adorn every house and business. Although a coup in 1932 removed the royalty from day-to-day governance, the king's wish is still treated as a command.

THAILAND'S NEWFOUND SUCCESS makes many Thais uneasy. "Bangkok, my poor Bangkok," lamented Satharn Pairaoh, a film producer, as we drove past a half-demolished, three-story building making way for yet another skyscraper. "We're beginning to look like any other city. And look at the people on the sidewalks and on motorbikes. Now everybody is hurrying, hurrying, money on their minds."

The cash economy that marks Thailand's economic boom also lies at the core of its greatest problems. Prostitution, drugs, deforestation, pollution, overcrowding—all can be traced to a yearning for the quick baht (about four U. S. cents).

Nowhere is this more apparent than in the drug trade. Fortunes made from the sale of opium and heroin grease the economy and help build some of those Bangkok skyscrapers. Drug money corrupts officials who should be enforcing antidrug laws.

But there are faint signs of progress: While these drugs still flow through Thailand, it is no longer a major producer. Opium poppies once covered hillsides in the north. That crop has all but disappeared, thanks to strict laws and alternate agricultural opportunities for opium farmers.

In one of the former growing areas I drove up a steep road to the village of Nong Hoi, where the king had begun a new agricultural project. The hills were now lined with lettuce, cabbages, and strawberries, and in the village, baskets of produce awaited transport to local markets. A pickup truck pulled up in a cloud of ocher dust, and villagers jumped out with more vegetables.

"The government built the road to our village, brought us electricity, and gives us advice about growing our crops," said the driver, 21-year-old Jong Phirote. "We made more money growing opium, but our lives are better now."

The harvest of narcotic plants has dramatically decreased, but the harvest of death has not, according to an agent of the U. S. Drug Enforcement Agency, which works with the Thai police and military to stanch the continuing flow. "Half the opium produced in the world comes from poppies grown in Burma, then shipped out through Thailand," he said. "From that opium comes more than half the heroin on American streets."

We spoke in whispers in the lobby of a northern hotel, where DEA agents and their Thai counterparts were planning an ambush of a drug chieftain on a remote road the next day. "The government says it will execute him if he is captured," the agent told me, "but I doubt it. They're Buddhists, you know."

Even the peace-loving Buddhists are affected by Thailand's new pace. "Modern life makes a virtuous existence very difficult, even for monks," said Sulak Sivaraksa, a Bangkok author. "A hundred years ago monks handled many of the social responsibilities—hospitals, education, moral training. Now the rich go to government universities or to schools abroad. They are losing the Buddhist teachings, and the monkhood is losing its identity. Some monks began smoking—calling it medicine—and taking drugs and opening bank accounts. The noble truths of

Sailors ashore cruise the fleshpots of Phuket's Patong Beach and other ports in the skin trade. Hordes of visitors fly in on heavily promoted "sex tours." Less visible but more widespread is business catering to Thai clients. Though the law forbids the industry, enforcement focuses on serious abuses such as child prostitution. In poverty-ridden areas girls are sometimes sold into sexual servitude by relatives.

Buddhism are being ignored, such as lack of greed and the importance of suffering and humility."

Noble truth is often in short supply in the lives of young Thai prostitutes, who enter the world's oldest profession because they can earn as much as five times the national per capita income of $2,000 a year.

Walking along a thoroughfare called Patpong, in the heart of Bangkok's famed sex district, I entered a smoky establishment where 15 young women in bikinis danced on the bar to disco music. None appeared to be older than 25. Western and Japanese men sipped overpriced beers and quietly appraised the writhing merchandise.

I invited two of the women to dinner at a restaurant far from the bar, offering to pay their fees just to hear their stories. The younger one, Keng, was quiet and timid. But Yuey, her companion, spoke freely in broken English. She had a sixth-grade education, had married at 14, and had two daughters, age eight and four. Separated from her husband, she worked in Patpong, she said, because she could make 15,000 baht ($600) a month.

I asked Yuey if she worried about AIDS. She replied yes, that she asked her customers to use condoms, but some refused. Her AIDS tests had all been negative. Some of her friends were not so lucky. Much of the money she made went for the schooling of her eldest daughter. "I no want her be same as me," she said.

By many measures, Yuey and Keng are the fortunate ones. They entered the sex trade willingly. Some young rural women are sold into prostitution or tricked by employment agents who make false promises of legitimate jobs with high wages.

South of Chiang Rai, I met a woman who had barely eluded the net. The comfortable, wooden homes in her village seemed

elaborate for rice farmers. Their incomes, I learned, were augmented by family members sending home wages from city jobs. This young woman had hoped to do the same for her parents.

"They were poor, and I wanted to help," she said. "So when I was 14, I began caring for a couple's children in another province. One day a woman came to my employer's house and asked if I wanted to go to Bangkok and take care of children, at nearly twice my salary. She took me there and left me in an apartment house, locked in a room. Another woman came and told me I was to entertain male guests. I knew what that meant. I managed to call my brother who works in Bangkok, and he bought me away from them for 3,000 baht."

Now she was content to remain home, sharing the small profits she made from running a noodle stand with her family.

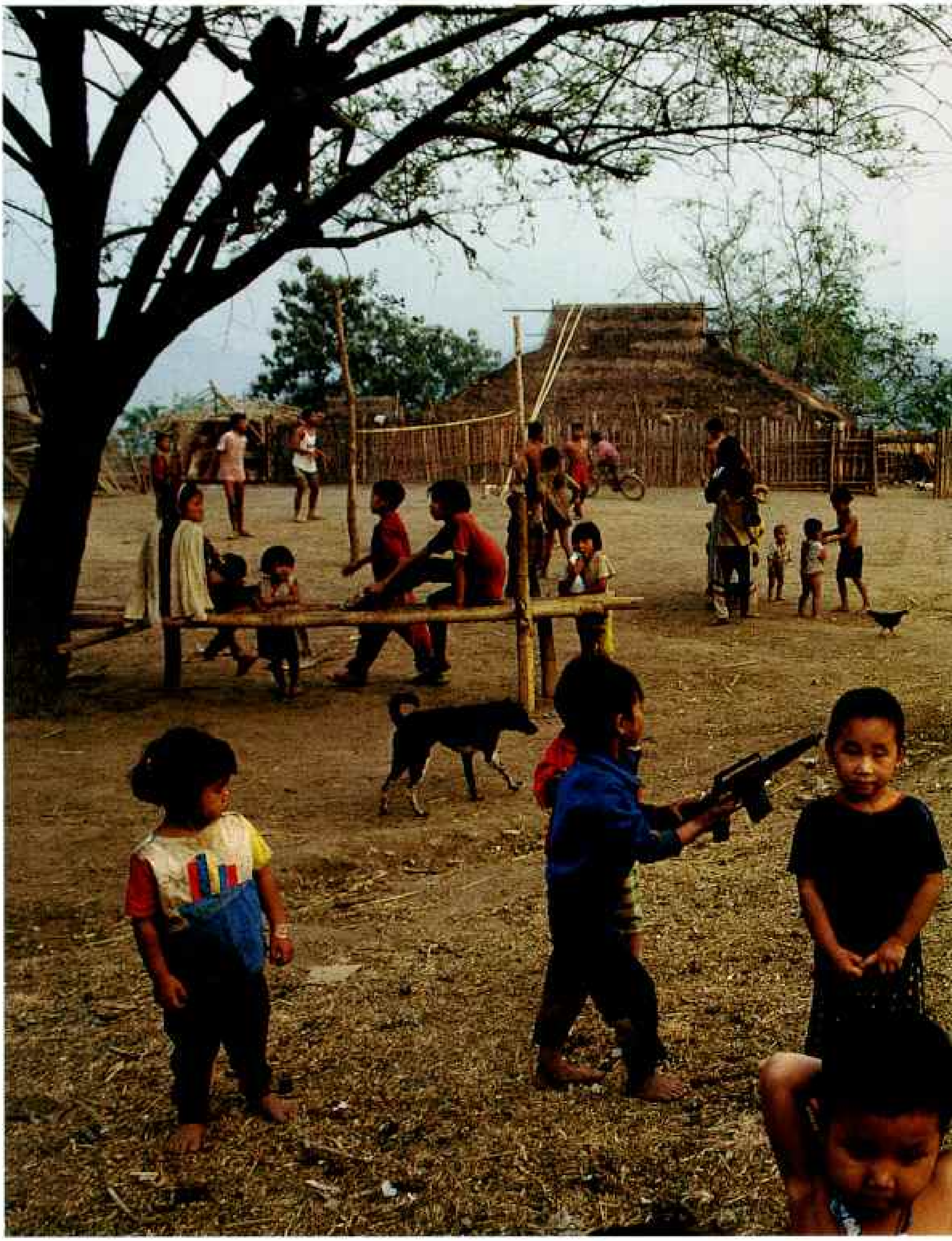
"The girls most vulnerable are those whose parents cannot afford to send them past the compulsory sixth grade of school," said Chakrapand Wongburanavart, a sociologist. "Three more years of school give girls the maturity and skills to resist being drawn into bad situations."

To help educate village girls, Chakrapand has established a scholarship fund. "So far we have 1,500 scholarships," he said. "Thais know that young girls entering prostitution may be condemned to an early death by AIDS."

Thailand's first AIDS case was reported in 1984. Ten years later there were more than 20,000, though many health authorities believe the actual number is much higher. And the disease continues to spread, mainly because of prostitution. In the Chiang Mai area, one of every two prostitutes tests positive for the human immunodeficiency virus (HIV), which leads to AIDS; in Bangkok, one in four does.

A mother's vigil will soon end in northern Thailand, where AIDS incidence is highest. Noi Kamsai nurses 35-year-old Sawong, having already lost one son to the disease.

"We see AIDS going beyond sex professionals and into families," warns AIDS clinician Dr. Samajarn Wijarnpreecha. Education programs headed by Mechai Viravaidya, nationally famous as "Mr. Condom," have sharply reduced the rate of new cases.



A schoolyard still draws a crowd at dusk in an Akha village near Mae Salong in northern Thailand. Its founders fled civil war in Burma 30 years ago. Hill tribes make up a mélange of settlements and cultures, totaling perhaps half a million people, many displaced from other countries. The Akha villagers qualify for citizenship, and the school teaches six grades in the Thai language.

Mechai Viravaidya is one Thai who may have saved thousands from the disease. As chairman of the Population and Community Development Association in Bangkok, he has led a campaign for family planning and safe sex so successful that he is now known nationwide as Mr. Condom. In a reverse compliment, many Thais now refer to a condom as a "mechai." Since 1974, to help educate his countrymen about contraception, he worked with schoolteachers and conducted festivals heavy on gimmickry—condom relay races, condom inflation contests, key chains with condoms encased in plastic with the notation, "In emergency, break glass."

"We wanted to desensitize the talk of contraception," Mechai said, "and put education about family planning and AIDS prevention in the hands of the people."

Partly as a result of his efforts the Thai annual population growth rate dropped from 3.2 percent in 1972 to 1.2 percent today, one of the world's sharpest reductions.

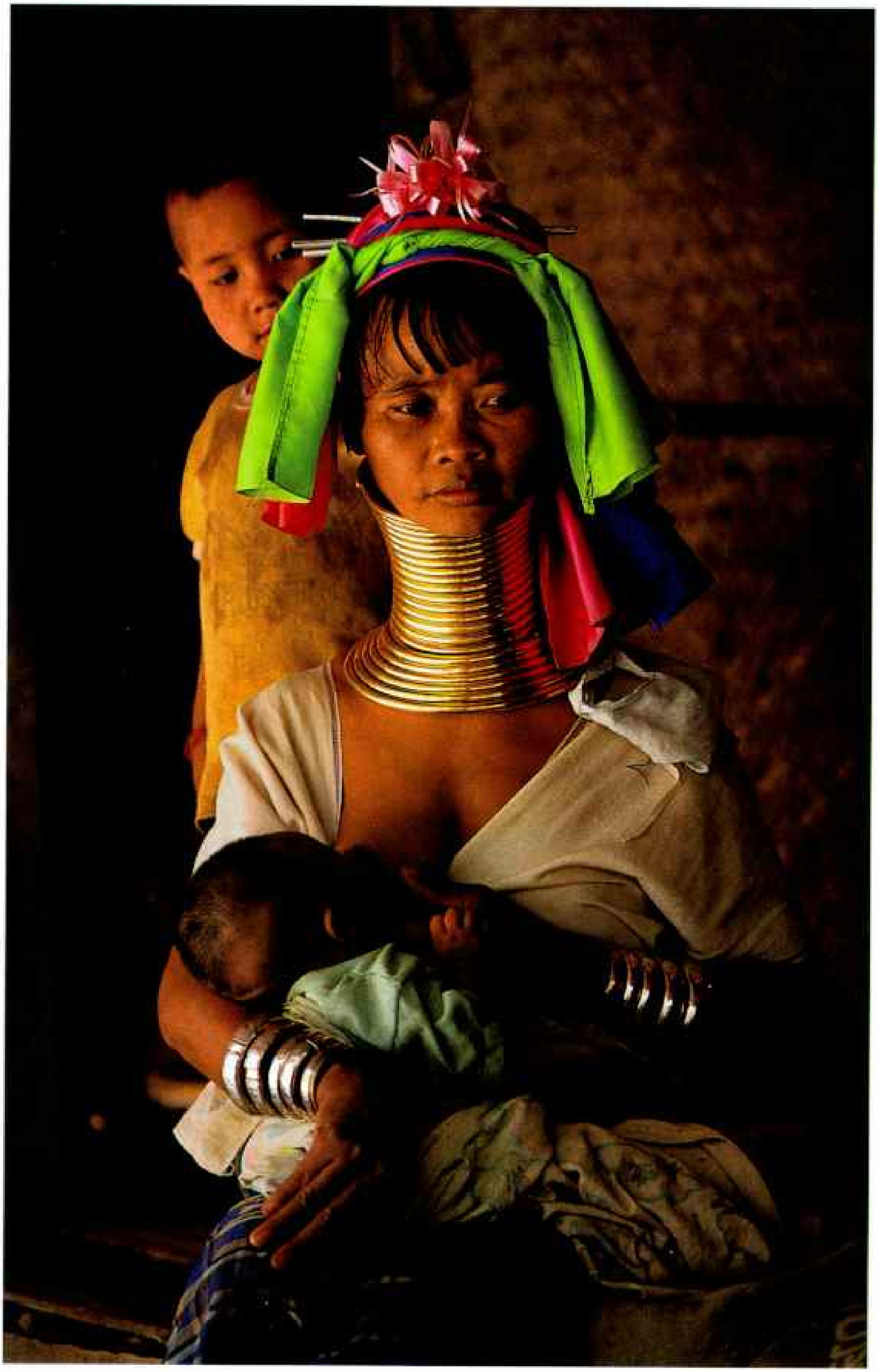
Mechai has also turned his energies toward revitalizing rural areas. Many of Thailand's problems can be found in cities, where villagers often go to find work. He encourages successful companies to pass on their management skills to small cottage businesses in villages, to keep the countryside populated.

The government offers incentives to draw industries to the countryside as well, but rural migration continues. Young women especially are drawn to five-dollar-a-day jobs in the cities and live in crowded dormitories so they can send money home. Whole families sometimes end up in Bangkok's slums. Even there, I found Thais dealing with despair in distinctive ways.

A dying custom of the Padaung people, some of whom have found refuge in northern Thailand from war in Burma, dictates that young girls are fitted with brass neck rings to ward off evil spirits. Over the years the weight of added rings crushes collarbones and ribs. Now tourist dollars impel long-necked women in Thailand to again collar their daughters.

DARK, STINKING WATER lapped at the rickety walkway I carefully negotiated through a makeshift city of scrap housing, built over a Bangkok swamp. Yet the dwellings I visited had been swept clean, their occupants' shoes carefully lined up outside the entryways.

I met a woman who prepared snacks to sell on the street for a meager income. Another stitched together inexpensive shoes. An elderly couple who once worked as laborers in central Thailand had come here ten years ago with the dream of making more



money. Now too old to work, too poor to return to their native village, they live out their days in the slum. "At least people take care of us here," the woman said.

"My husband and I make about 3,000 baht a month, and it is not enough to leave this place," said a younger woman tending an infant. I lingered at her doorway, and a small crowd gathered. I asked if crime was a problem. No, there was little to steal. Violence? They were much more afraid of fire in the flimsy houses, which were stacked one against the other.

"People here help one another," said one woman. "If someone has no food one day, others share. It makes life bearable."

Every monkey has its day at Lop Buri's ten-course Monkey Feast. The event began in 1989 as a thank-you from hotelier Yongyuth Kitwatananusont to the animals, which he says have been lucky for his family. Hundreds of monkeys emerge for the occasion from the ruins of a Khmer temple, where for centuries they have eaten well on offerings from the faithful.

Thais absorbed Khmer influences after migrating from China and carving a kingdom out of Khmer domains in the 13th century. Today 14 percent of the Thai people are assimilated ethnic Chinese.

A FEW MILES AWAY in an equally squalid section called Klong Toey a woman known as the "slum angel" tries to make life there more bearable by providing education to the poor. In the neatly painted, four-story school that doubles as her headquarters, Prateep Ungsongtham Hata, 43, explained how she came by her calling. "My parents were fishermen on the coast and lost everything in a storm, so they moved here in search of opportunity," she said. "Growing up, I worked on the docks to pay for my education and become a teacher. I thought I wanted to leave and teach rich people's children. But when I looked at slum children and knew how difficult their lives were, I had to do something to help."

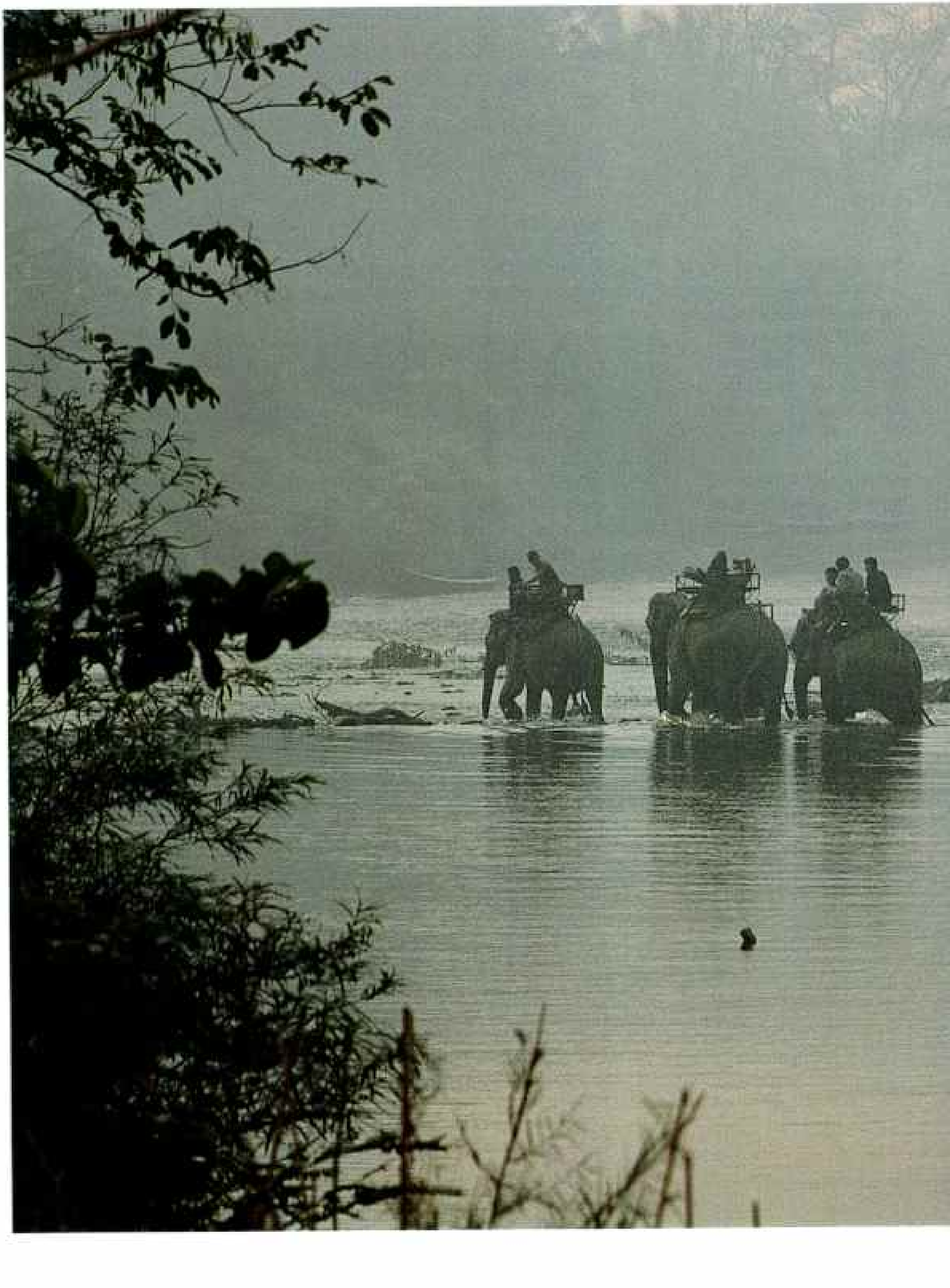
When Prateep was a teenager, she opened a school in her home and successfully fought an attempt by developers to evict some of her neighbors. She won grant money and set up the Duang Prateep Foundation, which means "flame of enlightenment." Today the flame burns in more than a hundred slums with schools, drug education, and health programs. Most of her staff of a hundred are slum dwellers themselves.

"Klong Toey is now a developed slum, with water, electricity, and a sewage system," she said, "but, still, people who live here feel they are in a lower class. The young feel trapped; we have a problem with glue-sniffing."

Many Thais like Prateep are working to improve young people's chances for better lives. "My biggest concern is education," said Arsa Sarasin, head of Padaeng Industry, a large zinc-smelting company that has spent more than a million U. S. dollars on education and training for the poor. "We need an able workforce to continue to develop. Businessmen often think of investments in land and factories, but they forget about the most important investment of all, in people."

Few Thais recognize this more than Pira Sudham, a novelist who is as well known for his generosity as he is for his writing. Pira drove me to his native village in the northeastern region of Isarn, where he spent his boyhood tending water buffalo. Every so often along the way he stopped to hand out bottles of cooking oil and fish sauce to poor farmers.

When we reached the village, children crowded around the car. A small girl carefully scrawled her signature on a piece of paper pressed against an oxcart, then proudly presented it to Pira. "When they can sign their name, I open a bank account for them to be used only for schooling or medical needs," he said. From his seemingly bottomless wallet came money for the



Elephants in the mist carry tourists through Thailand's forest, shrinking home of tigers and working elephants' wild kin. Elephant keepers turned to tourism after the 1989 ban on logging left them unemployed. Only a quarter of the country's enormous virgin forest remains intact—a loss that many scientists believe is producing an ominous drying trend in Thailand's climate.

oldest woman in the village, for a poor man rebuilding his house, and for the wife of a young man dying of cancer.

Driving through another village, Pira grew angry at the sight of a scalped hillside, once part of a forest reserve but now dotted with houses. Stopping at the headman's house, he posed as a buyer, and we were led to a dusty field. Tractors and bulldozers sculpted plots with terraces and ponds for vacation homes. The developer did not own the plots he was selling. Because of corruption and loopholes in land title laws, forest reserves are not protected. The result is the rapid destruction of Thailand's wildlands. Wildlife is suffering too, as it runs out of places to hide.

ONE OF THE LAST LARGE CHUNKS of lowland forest in Thailand is the Khao Aung Ru Nai Wildlife Sanctuary and Forest Reserve, a three-hour drive east of Bangkok. Similar reserves are scattered around the country. In this 200,000-acre tract roam the remnants of wild species that were once known all over the country: Asian elephants, large oxen called gaur, barking deer, and tigers. Five freshwater crocodiles, once believed to be extinct, were found recently in a stream here.

A soft-spoken ranger named Pongsak Ponsena led me down a trail to a salt lick, where elephants had left tracks in the mud. Cicadas rasped in the brittle leaves of the dry season, and a cluster of stingless bees hummed softly just above our heads. But during our wanderings we came across the smoking embers of a brushfire that sanctuary workers had extinguished. "Two days ago someone started ten like this," said Pongsak.

Squatters light the blazes to degrade the forest so the government will give the land to them for farming, I was told by an official in the Royal Forestry Department. They then sell it to large commercial farmers, who plant eucalyptus and other species that dry out the soil and harbor little wildlife. "It is done in collusion with some of our public officials," he admitted sadly.

Even with such loss, there is some progress. The World Wildlife Fund's Pisit Na Patalung has seen his country become a member of CITES (Convention on International Trade in Endangered Species). "We are no longer a center for trafficking animals out of the Far East," he told me.

"The law prohibiting further logging is much violated, but at least it passed. The problem is, Thais see water as water, forest as forest, and don't think of it all as a living organism."

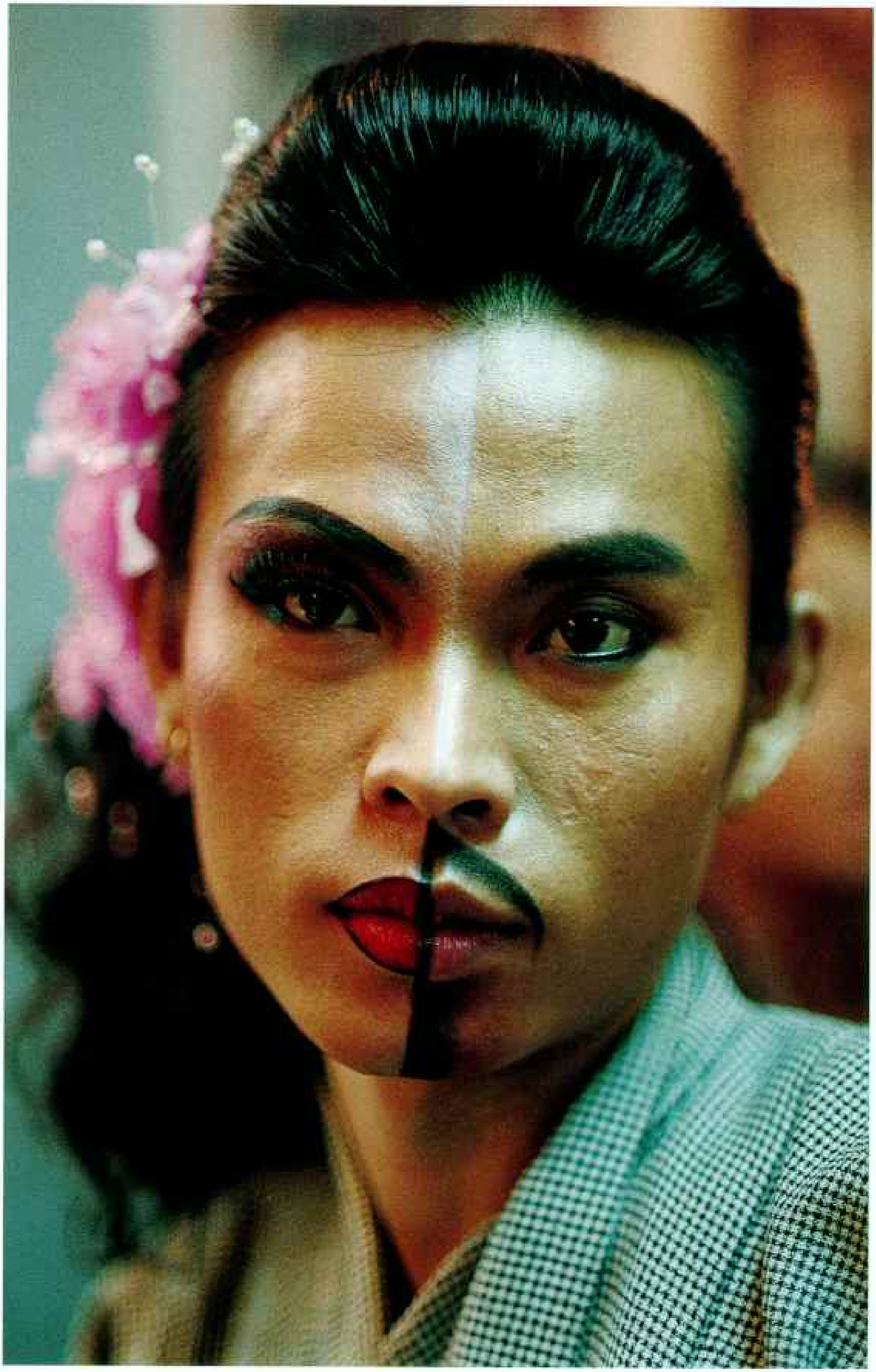
Thailand is experiencing many of the same problems facing other newly developed nations. More than most it appears to be facing up to its problems. A nation where despair cannot win in the slums surely cannot lose elsewhere.

I remember a morning spent with Rotjana Phraesrithong, a 30-year-old assistant to Prateep Ungsongtham Hata, the slum angel. Rotjana led me through labyrinths of poverty reeking of garbage, but she talked only of new schools and of a new class in traditional dance. How did she stay so upbeat?

"Prateep says if we do not have problems, we do not grow," she answered. "The serpent must leave behind its old skin as it grows. In the same way, we must confront our problems and shed them, so they do not imprison us." □

Exotic, reverent, modern, pastoral: Thailand indeed wears many faces. Wide acceptance is given to all, including a *katoey*, a transvestite at an upscale Pattaya cabaret featuring male performers.

Questions of identity can only become more intense as Thais merge their spirit world with the world of commerce, where they will have need of luck and guidance in the company of virtual tigers and fiber-optic dragons.



WIDESPREAD AS RAIN
AND DEADLY AS POISON

Our Polluted Runoff

BY JOHN G. MITCHELL
SENIOR ASSISTANT EDITOR

PHOTOGRAPHS BY PETER ESSICK

Fouled by the grease, oil, and litter of a North Carolina parking lot, rainwater flows toward an open drain, then straight to area streams. Because it pours off the land and not from municipal or industrial pipes, such runoff—called nonpoint-source pollution—is largely unregulated and insidious, accounting for up to 80 percent of the degradation of U. S. waters. Taming this problem is now a national goal.

A SPREADING STAIN

"Anything that goes into the ground will get into the Lost River," says Kentucky hydrologist Nicholas Crawford. Standing near an old well, he uses harmless fluorescent dye to map the course of the underground river through a karst, or limestone, aquifer. Because karst is so porous, pollutants like spilled oil from a construction site (above) quickly seep into the river below.

OLD-TIMERS NAMED the lake Torch, acclaimed its turquoise beauty, and boasted that it ranked among the best and brightest of all the inland waters of the world. A glacier-carved gem it was, sparkling on the northwest shoulder of Michigan's Lower Peninsula. That's the way I remembered it. But on this day there would be no torch-bright sparkle, only a sky like slate, a wet wind out of the west, and onshore rain running down to the lake in gray rivulets.

We watched the rain from the cab of Jack Norris's truck, parked at the end of a gravel road, lakeside near the little resort town of Bellaire. Not quite an old-timer himself, Norris had brought me here from his own place a few miles north, also lakeside, to test our memories. His test: To see if he could describe how the lake had changed over half a century of his being here. My test: To see what I recalled, after 50 years, of one summer at a boy's camp long gone from the maple woods beside this road. I told Norris that I could remember this adolescent mud puppy from southern Ohio, me, peering over a canoe gunwale straight down through 40 feet of crystalline water, the cobbled lake bottom as sharply etched as if it had been pressed beneath a plate of glass.

"It's different now," Norris said. "Still pretty clear in the deeper water. But now there's that gray stuff at the edge of the lake. It's a precipitate caused by too much algae. You know it's there when you step in the lake to go swimming and around each footfall is a puff of silt, and you say, 'Gee, that wasn't there when I was a kid. What's going on here?' "

What's going on here is going on almost everywhere in the United States today. Poison runoff, it's called, or "nonpoint-source" pollution to distinguish it from those visible and traceable source points—the discharge pipes of industry and the outfalls of municipal sewage-treatment plants—that are regulated under the Clean Water Act. By limiting or requiring *(Continued on page 113)*

Photographer PETER ESSICK was a major contributor to the GEOGRAPHIC's Special Edition on Water (November 1993). This marks his ninth assignment for the magazine.

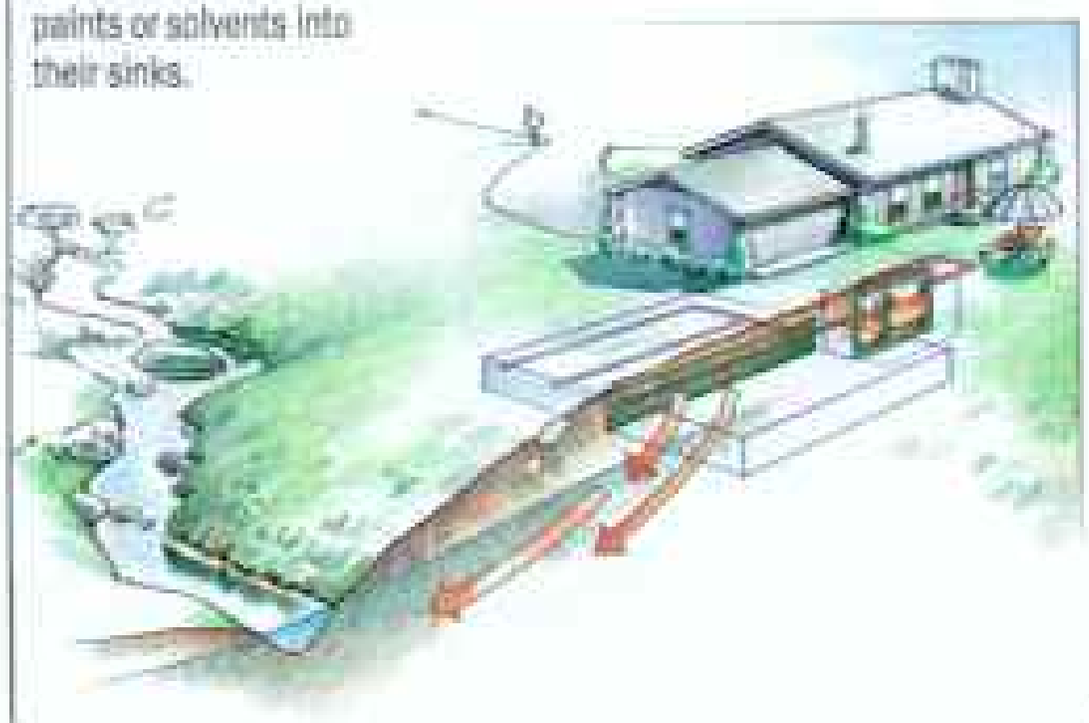
WHAT GOES UP . . . Vaporous plumes from cars and smokestack industries, such as this coal-burning power plant on the Ohio River, are well regulated as sources of air pollution—but can act as furtive water polluters. Airborne sulfur and nitrogen mix with rain, contaminating waters from Puget Sound to the Chesapeake Bay. Mercury and other toxics are known to taint fish.

Learning to tread softly

"Our success is that we still have trout in the streams," says Maureen Kennedy Templeton, drain commissioner of Michigan's Grand Traverse County, which has launched intense efforts to protect rivers and streams in areas like the Mitchell Creek watershed (below). This once rural basin is growing fast as retirees, families, and businesses are lured by its beauty. With them comes pollution. Here's how the creek is coping:

SEPTIC SEEP
Like a full sponge, aging septic drain fields—which treat sewage by slow filtration—and overloaded sludge-holding tanks can leak bacteria, nitrates, and liquid poisons into groundwater. Homeowners with septic systems are urged to pump tanks every two years and avoid pouring paints or solvents into their sinks.

LEAFY BUFFERS
Lacking a cushion of wetlands, streams can still be partly shielded from runoff. The county calls for a 50-foot setback from lakes and creeks and asks landowners to plant waterside shrubs to trap sediments, slow flow, and provide shade and wildlife habitat.



NATURAL FILTERS
Key to a healthy watershed, low-lying wetlands trap runoff and filter its harmful sediments through natural vegetation. Grand Traverse County requires a 25-foot setback from wetlands and has persuaded many landowners to donate wetland acreage for protection.

ON THE FARM
As suburban sprawl intensifies, few farms remain near Mitchell Creek. Many of the hangers-on help protect the watershed by using a light touch with pesticides and fertilizers, fencing livestock away from streams, and recruiting benign bugs to eat crop-killing pests.

WHEN THE SKY FALLS
Though this watershed is free of smokestacks, lakeside breezes bear the acidic cargo of incinerators and industries from Chicago and Green Bay, as well as nitrogen from car exhaust and phosphorus from windblown soil. Mercury has made fish from inland lakes unsafe to eat.

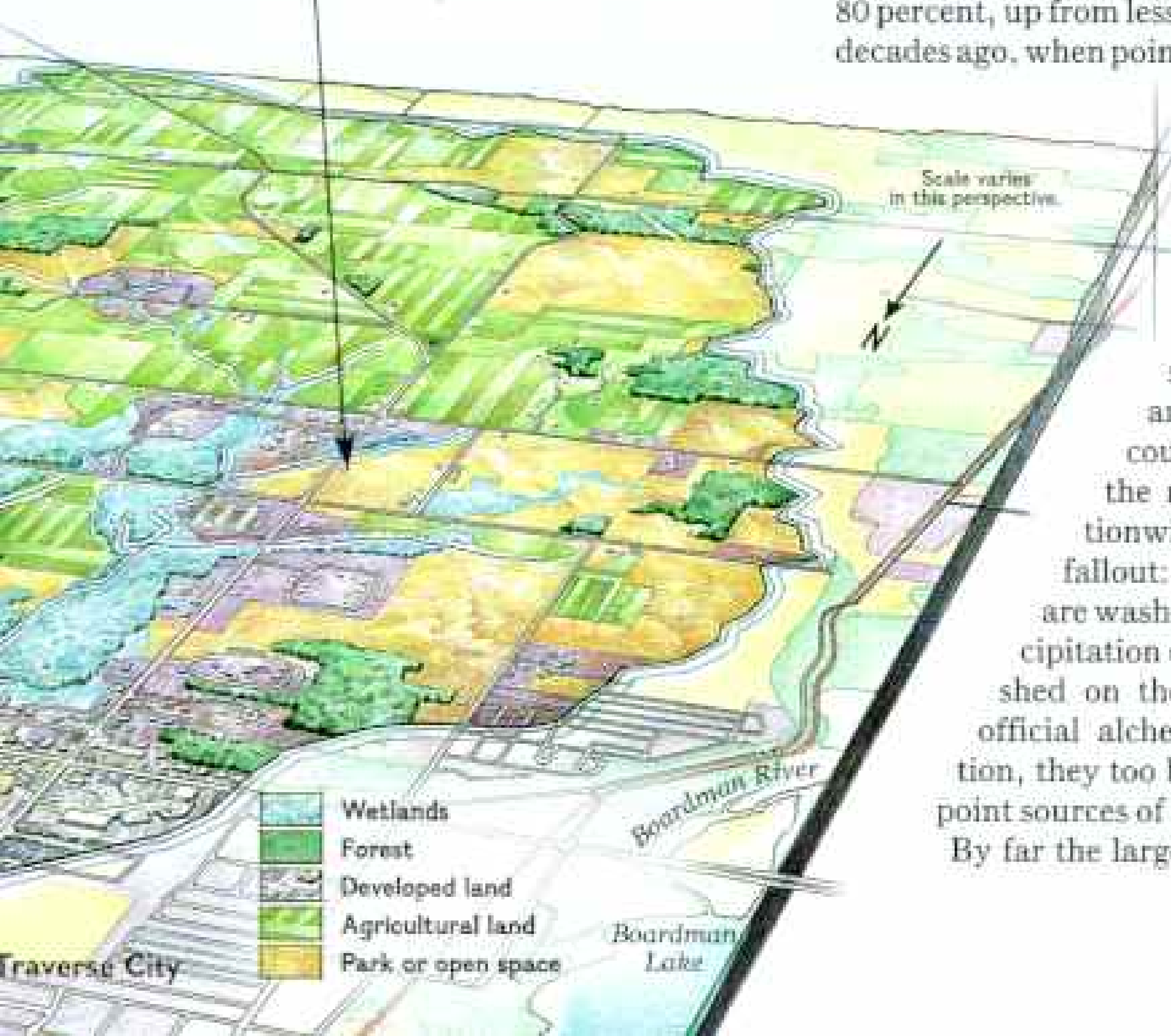
ART BY C. BRUCE HUNTER

CONSTRUCTION
Before driving a nail, builders navigate a slew of rules. Depending on the job, they must control soil erosion with filter fences, steer rainwater away from exposed dirt, build sediment basins, and plant protective buffers.

URBAN OOZE
It's a watershed's worst nightmare. As fields are paved for roads and parking, rainfall speeds faster off the land. This torrent picks up stream-choking debris, causes floods, scours banks, and prevents the slow filtration needed to recharge groundwater tables.

SEDIMENT TRAPS
Now required by law at all large development sites near Mitchell Creek, ponds built to catch storm water control runoff—and provide a serene setting for the odd duck. Some ponds are two-tiered: one with an impervious lining to trap settling gunk and a second that allows rainwater to slowly seep into the aquifer.

FOREST FRIENDLY
Though thick with trees, the Mitchell Creek watershed has no active logging. Elsewhere in the nation, logging can cause serious sediment problems for streams as dirt pours off clear-cut slopes and access roads. Loggers on federal land leave greenways along streams and cut selectively so roots can trap runaway soil.



treatment of industrial and municipal discharges, this federal act has cleaned up a lot of water in the 24 years it's been on the books, and it is likely to go on doing that unless the 104th Congress, in the mood for regulatory rollbacks, weakens its enforcement.

But this other kind of pollution, which can also make water unsafe to drink or to swim or fish in, remains largely unregulated, because its sources are as numerous and diverse as the population. In fact, hardly anyone stops to think about poison runoff even though practically everyone helps produce it. Here's how:

Rainfall, snowmelt, or irrigation runoff moves across the land. The water picks up whatever people have left in its path—residues from the production of food, the manicuring of yards, the use of motor vehicles, the construction of roads and buildings—and, following gravity's directions, transports these contaminants to the nearest stream, lake, estuary, or aquifer.

At Torch, about 20 miles long and almost 300 feet deep, the runoff is mostly residential, loading the lake with nutrients from septic systems and fertilized lawns. Excess nutrients promote the growth of algae. Decaying algae can steal oxygen from other life-forms, such as fish. People like Jack Norris step into a lake and notice puffs of silt around each footfall.

Estimates are sketchy as to poison runoff's share of the total water-pollution problem in the U. S.; some put its contribution as high as 80 percent, up from less than half the total two decades ago, when point sources were spewing out most of the contaminants. Urban and suburban storm-water flows—what the rains sweep from our streets and driveways and parking lots—account for a large part of the nonpoint problem nationwide. Another part is fallout: When air pollutants are washed from the sky by precipitation or dusted into a watershed on the wind, then, by the official alchemy of federal definition, they too become vested as nonpoint sources of water pollution.

By far the largest share of the runoff

problem, however, belongs to agriculture: 44 of the states report groundwater contamination caused by runoff from farms and ranches.

As I would discover in the course of visiting a few of those states, sediments, organic matter, and bacteria flow from our fields and pastures by the ton—an average of five tons an acre a year if we're counting just the soil eroded from croplands. Besides choking aquatic life in the recipient waterways, the sediments deposit piggyback traces of fertilizer, herbicides, and insecticides too.

Half the nation's drinking-water wells are reported to contain nitrates unleashed, for the most part, by agricultural fertilizers; excessive nitrates can deplete oxygen in the bloodstreams of infants and result in a kind of slow suffocation known as blue-baby syndrome. Herbicides that are suspected carcinogens have left their spoor in the tap water of scattered communities coast to coast. Livestock wastes have tainted municipal water supplies. In 1993 runoff carried a parasite called cryptosporidium to the drinking water of Milwaukee, Wisconsin, sickening thousands of people and killing a hundred who suffered from immune-system deficiencies. Manure was among the suspected sources.

One would think an incident such as that might paste the runoff problem on the public conscience, much as Ohio's Cuyahoga River helped inspire point-source regulations when industrial wastes set that riverine sewer on fire in 1969. But for runoff awareness—no such

BAYSIDE BLUES
A telltale finger of smoky brown points to the entry of Mitchell Creek, which carries sediments into Michigan's Grand Traverse Bay. Offshore, dark splotches of submerged algae and rooted plants feed on phosphorus, a nutrient that hitchhikes in with sediments. Water quality hasn't suffered yet. But if unchecked, decaying plants can suck oxygen from the bay, harming aquatic life.

luck. One recent poll found that when it comes to fixing responsibility for dirty water, most respondents still believe that all the culprits sit in corporate boardrooms, while farmers and homeowners vie for the title of Mr. Clean.

Not that I expected to encounter such misinformed attitudes in northern Michigan. On the contrary, I had come here because this region already possessed a reputation for recognizing its runoff problems, and I hoped it might somehow provide a cautionary showcase for the rest of the nation. Each one of us is a citizen of a watershed, wherever we may live. But none of us—in Michigan or Maine or Montana—can break bad habits and mend behaviors enough to become a part of our watershed's solutions until we understand how and why we are a part of its problems. So I selected Torch Lake and the neighboring tributaries, all of which flow into Lake Michigan's Grand Traverse Bay. For here, as in other parts of the country where growing human numbers and urban development stack up against once pristine waters, a high-quality resource is at imminent risk, and with it the economic future of the entire region.

THE GRAND TRAVERSE BAY watershed embraces almost a thousand square miles on the eastern shore of Lake Michigan, just a hop, skip, and jump below the Straits of Mackinac. The regional hub is Traverse City, once a Victorian gingerbread logging town snugged at the foot of the bay but now a vibrant resort community with Bauhaus-modern motels and shopping plazas sprawling in every landward direction. Add to this urban core dozens of villages and rural townships scattered across parts of five counties, and you're looking at a watershed population of 90,000—not counting as many as two million tourists drawn to the region throughout the year.

"We're the number one tourist destination in the whole Midwest," a local booster bragged the day this tourist first checked in. I had just checked out a copy of the *Traverse City Record-Eagle*. The lead story reported that, in a national survey, Traverse had scored eighth among the top ten "best retirement places." Both revelations would support a comment I heard later from Michael Stifler of the Michigan Department of Environmental Quality. "We just wanted people to come up here for a weekend," said Stifler, "but now they're staying for the rest of their lives."

The major attractions tend to be water dependent: boating, bathing, and fishing on the big bay itself, more than a hundred inland

ponds and lakes, and many miles of trout streams, including the blue-ribbon Boardman River. In the rolling sand hills east of Torch Lake there are snowmaking ski resorts to pick up the slack in the winter doldrums. Sprinklers keep a dozen golf courses glistening green. And all this water—at least the part that isn't sopped up by evapotranspiration—sooner or later runs and seeps to the bay, bearing many of the pollutants that people have left in their wake.

It is not the kind of pollution that always leaves an immediate, visible stain. The bay is still blue. The streams appear to run clear between fern-festooned banks. As a result, reports of trouble in Eden have taken some people by surprise. That was certainly the case a decade ago when a study commissioned by the Michigan United Conservation Clubs held "explosive development" in the Grand Traverse region responsible for "degradation of virtually all natural resources," including groundwater in some areas. But there was little lingering skepticism when, a few years ago, a handful of local organizations established the Grand Traverse Bay Watershed Initiative to enlist the public in a grassroots effort to save the bay and its tributaries from poison runoff. The Initiative now numbers more than a hundred groups.

And now? "We're getting out the message," says James Haveman, executive director of the Northwest Michigan Resource Conservation & Development Council and one of the Watershed Initiative's founding fathers. "But if we can't change the way people live their everyday lives, none of it's going to make one bit of difference."

GETTING PEOPLE TO CHANGE what they don't know they're doing is a tall order, Jack Norris was telling me that rainy morning at the edge of Torch Lake. Wading, you can curse the gray silt swirling around your ankles, but what exactly do you change if you can't see how it got there in the first place?

One thing a person could change, if he happened to occupy one of the older lakeshore vacation homes converted to year-round retirement living, is the septic system, or at least the frequency with which the residual sludge is pumped out of the septic tank. "A lot of these systems around Torch are older than we are," said Norris. "Some septics are just a 50-gallon drum, sunk in the ground, and now, instead of weekends and summers only, they're getting use 365 days a year. The old systems just can't handle it."

Poking around the lakeshore roads, I could see that many of the older homes and their septic systems were situated about as close to the water as structures can get without falling in or running afoul of some skimpy setback ordinance. If enough of these septics failed, how long would it take for a lake like Torch to choke on the runaway nutrients?

For the answer to that I headed for the village of Torch River to call on Bill Weiss, an environmental engineer who serves as resources consultant to a couple of the lake associations allied with the Grand Traverse Bay Watershed Initiative. Weiss had been out on the bay in the rain all day and was warming himself by his fireplace.

"It's the sponge effect that worries me," he said. "Our sandy soils are excellent for taking up phosphorus. They act like a sponge. The soils pick up a certain amount of phosphorus until you reach a point where that sponge is full. It can't absorb any more." Weiss cudgeled the fire with a poker and said, "We're sitting on a 50-year time bomb, and we can't reverse it. We can't turn off these sponges once they're full and nutrients are still flowing into them. When plumes of nutrients hit the lake, they grow phytoplankton, and more phytoplankton decreases the transparency of the water, and there goes Torch Lake."

Phosphorus and nitrogen from lawn fertilizers are also invading the lakes and streams of the watershed. You can't see these nutrients either, at least not with the naked eye. What you can see are all the green lawns. They are ubiquitous. They are of great concern to Pete Bruski, erosion-control inspector for the Grand Traverse County Drain Commissioner's Office.

"To most homeowners," Bruski told me as we toured the Mitchell Creek area on the east side of Traverse City, "if a little's good, more is better." He was speaking of the turf-greening chemicals that some people apply to their lawns every four to six weeks. "I guess you've noticed they do a tremendous amount of fertilizer sales around here. With higher property values around the bay and along the edge of any water, people kind of expect to have that manicured estate look. They're not about to switch over to natural ground cover

BANK DEPOSITS

Armed with shovels and hoes, a prison crew applies topsoil and native plants to restore an eroded bank of the Boardman River, a major tributary of Grand Traverse Bay. Tromped by hikers and fishermen, the worn slopes dump sand into this blue-ribbon trout stream, suffocating spawning grounds and altering flow. New shrubs and grasses planted at some 65 sites now help block a thousand tons of sand a year from entering the Boardman. "Old-timers have seen the river coming back," says project director Steve Largent.

Tidier banks cause other problems. Lush lawns—like those fronting nearby Kids Creek (above)—can spill excess fertilizer and pet wastes into streams unless homeowners plant shoreside buffers.

and let brush grow up to buffer the water. It just isn't going to happen."

Bruski and I were standing at the mouth of Mitchell Creek, where it empties into Grand Traverse Bay. Offshore we could see dark green mats of algae and aquatic plants undulating in the shallows like giant, tethered manta rays—a legacy of the creek's nutrient load.

Bruski's other big concern—for the lower Boardman River, downtown, as well as for Mitchell Creek—is the toxic freight that storm-water runoff carries from such impervious surfaces as the parking lots of malls and shopping strips. Here is a kind of behavior that may never change, for how do you get people to stop running errands in motor vehicles made of metal and powered by fossil fuel? Asphalt and concrete catch it all: the oil, the grease, the poisonous lead, the fish-tainting mercury, the zinc, the copper, and the fallout from grinding engine parts, rusting exhaust systems, abraded brake linings. Then comes the storm and away it goes, though not always directly down creek and river to Grand Traverse Bay. The big malls and commercial strips are now obliged by county ordinance to provide retention basins to catch the runoff long enough for the heavy metals and toxic sediments to settle out. (The owner of a basin is expected to scoop up accumulated sediments from time to time and truck them to a landfill willing to accept the material; invariably the landfill is in somebody else's watershed.)

"We're just delaying the time it takes for that water to get into the streams," says Maureen Kennedy Templeton, the county drain commissioner. "And there are still so many areas, so many places, that don't have *any* storm-water retention at all."

There is another side to the problem, a side apart from the blue-water amenities that, for better or worse, seem to drive this thriving

TRAGIC HARVEST

"I'd like to get out of here," says Rita Lorta of McFarland, California, a farm community whose children suffer a cancer rate three times the national norm. Rita's daughter Rosalinda—raised in nearby Delano and seen here in a family photograph—died in 1980 of a rare cancer at age three. Some residents blame such deaths on the insecticides and herbicides sprayed on surrounding crops and suspected of poisoning local air and water. State and federal health officials found no link. Community members have asked the EPA to investigate further.

Farther north, farmers irrigate crops with water from the San Joaquin River (below). Many have begun using sprinklers and sediment basins to cut water use and the runoff of soil bearing evils like residual DDT.

vacation-and-retirement economy. It happens to take the form of a white blossom that bursts each May upon hundreds of thousands of trees, upon a hundred hillsides beside the bay. Traverse City, in case you didn't know it, is the Cherry Capital of the World. Nearly half the nation's crop of tart cherries comes off these hills, more than a hundred million pounds a year, most of it destined to satisfy the national appetite for cherry pie. And, before changes brought improvements in many of the growers' management practices, the nurturing of this prodigious crop tended to produce an uncertain amount of poison runoff too.

GOOD PRACTICES put money in your pocket. That's the way Dave Amon was telling it when I stopped by his orchard on a high sand ridge northeast of town. Amon is a second-generation cherry grower. He nurtures 200 acres of trees, using trickle irrigation to bottle-feed fertilizer directly to each tree, instead of broadcasting the fertilizer, which tends to ratchet up the quantity needed for coverage, not to mention the leftovers leaching out toward the lake. And pesticides? Yes, there has to be some use of pesticides because of the insects that attack the cherries. But now growers like Amon are attempting to reduce pesticide use by managing the bad bugs with good ones. "The good eat the bad," said Amon. "As long as the good bugs are more numerous than the destructive ones, you don't have to spray."

Listening to Amon's plain talk about the prospects of this practice called IPM, for integrated pest management, I realized that if water consciousness was beginning to change our behavior anywhere, it was not in the cities or the suburbs but right where the problem looms largest nationwide—down on the farm.

I had already observed some signs of change

while visiting a number of agricultural regions, apart from northern Michigan's, where the produce, the practices, and the problems are a whole shade different from those of Dave Amon and the Grand Traverse watershed. I had wanted to find out if dairy farmers in Oregon were changing enough to help save a world-class estuary from choking on polluted runoff, so I paid a visit to Tillamook Bay. And I wanted to see how farmers are trying to take the erosive sting out of furrow irrigation in drier country than Michigan's, so I had gone to California's San Joaquin Valley.

THIS IS CROWS LANDING, California, hard by the San Joaquin River and just down the road from Patterson, the Apricot Capital of the World. (Take that, Traverse City.) The apricots almost get lost among all the almonds, walnuts, mixed melons, dry beans, peas, tomatoes, broccoli, cauliflower, spinach, and sugar beets. Two hundred square miles of irrigated orchards and fields roundabout, with produce valued at more than a hundred million dollars a year, and all of it within the metes and bounds of the West Stanislaus hydrologic unit. The unit is a study area the U. S. Department of Agriculture has set up to see if something can't be done to reduce a hemorrhaging of soil into the San Joaquin River. Something has to be done because—no thanks to furrow irrigation—each year the West Stanislaus area loses as much as a million tons of sediments to the river, much of it laced with the active residues of yesteryear's pesticides.

Crows Landing is named for John Bradford Crow, who came overland in the 1860s, by wagon train from Missouri, to farm wheat and barley along the river's alluvial flats. Norman Crow is a great-great-grandson. He grows walnuts, seed onions, and dry beans and says he is willing to try anything that will reduce the loss of soil from his land. He plants cover crops of barley between his walnut trees to hold the soil in place during irrigation. For his 110 acres of dry beans he has rented, at considerable expense, a mobile sprinkler system for the preplanting soak. This will save him tons of soil that would otherwise be lost by furrow irrigation to the tailwater ditches and the San Joaquin. Tall, rawboned Norman Crow, at the edge of his bean fields, bends down to pick up a clump of dark brown loam. "This is what God gave us to work with," he says, crumbling the soil in his fingers. "This is my livelihood. I can't afford to lose it."

And this is Tillamook Bay on the blue Pacific, just over the evergreen Coast Range from Portland, Oregon. Unofficially, Tillamook could be called the cheddar cheese capital of the West. And once upon a time, this bay was the best little oyster bed in Oregon. Then something happened—and some people blamed it on poison runoff.

The Tillamook County Creamery Association is made up of some 175 dairy farmers working herds of Holsteins and Guernseys and Jerseys in perennially green pastures hemmed between the mountains and the bay. Most of the milk from these cows is made into Tillamook cheese, and a very good cheese it is at that. Forty million to fifty million pounds of it are shipped across the U. S. and overseas each year. Unavoidably, in the process of providing for all that cheese, the cows also provide half a million tons of waste, in the form of both urine and manure—and this in a land where annual rainfall averages 90 inches. When sustained rainfall swells the five rivers running through the pastures to Tillamook Bay, state agriculture officials shut down the bay's commercial oyster and clam beds, lest contaminated shellfish enter the marketplace. (Four small municipal sewage plants are also believed to contribute to the problem.)

Encouraged—in some cases compelled—by state and federal agents to slow the flow to the bay, dairy farmers have built manure sheds, concrete containments, and underground liquid storage tanks to hold the wastes from the rainy days. Then, during dry times, the manure can be trucked to the pastures and spread as fertilizer. "Sure," says Jesse Hayes, one of the oyster growers, "the dairy farmers will tell you they've spent thousands of dollars on containment tanks. But when a tank is full, it's not a containment anymore. Where's the waste going to go, if not into Tillamook Bay?"

But Rudy Fenk, who runs 200 milkers on his farm beside the Trask River, says: "Look. We've come a long way in the last ten years, and we still have a way to go. We've just got to keep working at it."

The way to go will be a long one—for Tillamook, for the West Stanislaus, for Grand Traverse Bay, and for the country. So far, the effort to control poison runoff has relied almost entirely on voluntary compliance rather than

UNEASY NEIGHBORS

It's a cow's life around Tillamook Bay, Oregon, where 25,000 dairy cattle produce Tillamook cheddar. They also unload some 300,000 gallons of waste a day. Exposed manure can wash into the oyster-rich bay with the region's copious rains—as can overflow from municipal sewage treatment plants. Most dairy farmers have built storage tanks or covered sheds to curb runoff. Still the bay is closed to shellfish harvesting 50 to 90 days a year because of suspected contamination.

That development has oyster growers like Mike Harris (below, at left) fuming. While some blame the dairy farms, Harris faults regulations that interrupt his harvest. "All the market we had is gone," he says. "It's frustrating."

BULL'S EYE
Cattle make tracks for a sinkhole pond—common in karst areas—near Bowling Green, Kentucky. Sinkholes' porous soil is often compacted by farmers so the holes will hold water. Such sinkhole ponds can benefit aquifers by allowing slow filtration of water contaminated by fertilizer, pesticides, manure, and algae. The problem: These ponds are prone to collapse, dumping foul contents directly into groundwater.

TRICKLE-DOWN SOLUTIONS

Monument to the glory days of gold mining in Central City, Colorado, this massive tailings pile weeps caustic tears with each rain. Its runoff carries zinc, iron, copper, and lead into streams that feed the North Fork of Clear Creek, now largely devoid of life because of heavy-metals poisoning.

Adjacent to several casinos, the pile does serve one useful purpose: a platform for a gamblers' parking lot. The pavement cap cuts tailings runoff.

Solutions to the problem of tainted runoff start with people like 14-year-old 4-H volunteer Meredith Burris (below). She stencils a drain in North Carolina to show that the trash dumped here goes untreated to the Catawba River. "People just don't know," she says. But they're starting to learn.

regulatory enforcement. Just educate the people, the advocates of this approach argue, and the people will do what is right. But will everyone? "Education alone won't do it," says Pete Bruski, the Grand Traverse County erosion-control inspector. "Of course we have to encourage people to do their part. But we have to have regulations too, because when it comes down to the uses of private property, the landowner too often thinks that good practices apply to everyone else but him."

And Peg Comfort, a Torch Lake resident and an educator at the Bellaire Middle School, says: "We look at a watershed, but we don't understand that there have to be limits. There has to be a limit to how many people can live on the land around these lakes.

"If you want quality, it means saying No. You have to learn when to say No."

To be sure, there are some harmful practices that enforceable regulations could not reasonably curb. It is not very likely, for example, that government could ever effectively halt the widespread practice of do-it-yourself rural people who change the oil in their motor vehicles, then dump the old oil on their driveways to hold down the dust. But a local government could enact zoning regulations to limit the human density around a lake—a step that at least one township abutting Torch Lake still refuses to take.

And then there is this lingering problem in the atmosphere, for what goes up the smokestack as regulated air pollution ultimately

comes down again as nonpoint-source, unregulated water pollution. Much of the fallout on the Grand Traverse region floats in from power plants, incinerators, cement kilns, and other sources scattered from Chicago west to Salt Lake City. The dirty rain contains dioxin and PCBs (polychlorinated biphenyls). Dioxin is said to be carcinogenic and is emitted in the process of incinerating municipal, medical, and hazardous wastes. PCBs can likewise be cancer causing. Though Michigan outlawed all industrial uses of PCBs two decades ago, the substances are still found in some products that end up in incinerators upwind of Lake Michigan and Grand Traverse Bay.

One bright and sunny afternoon, under scattered powder-puff clouds, I stood on a bluff overlooking that bay and, closer in, the northernmost end of Torch Lake. Only a thin strand separates the two. The blues of one are indescribably different from the blues of the other, and the colors of both seem always to be changing under the passing clouds.

So how—I was thinking—how will the colors stack up, say, 50 years from now? I expect both lake and bay, from this distance, will still appear blue. But on closer inspection will thick mats of algae undulate in the shallows? Will PCBs still settle to the deeps? Or might it be possible once again for an unpoisoned rain to fall, for the rivulets to run clear, for a pilgrim in a canoe to trace, with his eyes, a configuration of unsilted cobbles on the lake bottom, 40 feet down? □

The Fractured Caucasus

By MIKE EDWARDS
ASSISTANT EDITOR

In today's world, local upheavals often have global consequences. Thus, when events warrant, we will publish "In Focus," a concise guide to the peoples and regions behind the headlines.

—THE EDITOR

TO GLIMPSE THE LANDSCAPE of the region called the Caucasus, on Russia's southern flank, is to imagine Eden. Beneath the icy summits of its mountain range, grapevines and pomegranate trees hang gravid with fruit. But here too are rubbled cities and phalanxes of roadblocks, manned by militias and Russian troops bristling with arms.

Territorial disputes, a thirst for independence, and exploding nationalism afflict the Caucasus' new nations, would-be nations, and ethnic enclaves. The Chechen war that began at the end of 1994, when Russia sent an army to quell that region's secessionist government, was the latest of numerous conflicts that erupted after the Soviet Union collapsed in 1991. Tens of thousands of people have died, perhaps 45,000 in Chechnya alone, and almost two million more have fled as refugees.

Caucasia (as it is also known) is volatile in part because it is dauntingly complex, with at least 50 ethnic groups and nationalities spread like a crazy quilt across a California-size territory. These peoples range from the six million Turkic Azerbaijanis, the predominant inhabitants of Azerbaijan (newly independent, along with Georgia and Armenia), down to groups like the Ginukh, numbering 200. The Ginukh are members of a complex family of indigenous Caucasians—some 40 groups, including other little-known peoples such as the Akhwakh and Lak, many of them crowded into the mountainous Russian republic of Dagestan. They evolved a babel of languages in their isolated valleys and cling to these tongues today. Many, like the Chechens, are Muslim and, worrisome to Moscow, look favorably toward the Middle East.

Ivan the Terrible started Russia's southeastward expansion in the 1500s. Over time Russia gained warmwater ports on the Black Sea and farmlands yielding great bounty; Caucasia's cherries and apricots gladdened the citizens of Moscow and St. Petersburg at the end of the long northern winter. There was oil too from Azerbaijan and the Caspian Sea. But the price was steep: multiple wars with Persia and the Ottoman Empire, which claimed parts of the Caucasus region, as well as the detetrmined resistance of many of the Caucasian peoples.

Resistance was particularly stubborn in the 19th century among

Winds of war blow through a wintry pass in the Caucasus Mountains, where Azerbaijani government soldiers load antitank missiles to use against rebels from the Armenian enclave of Nagorno-Karabakh. Since the breakup of the Soviet Union in 1991, ethnic and territorial disputes have exploded throughout the Caucasus, a stronghold of nationalistic fervor.

PETER BLAKELY, SABA

Her mother killed, her home destroyed, a woman wails in Groznyy after Russian bombs hit the capital of the breakaway Chechnya region. Many residents fled to the mountains.

PAUL LOWE, MAGNUM

the mountaineers—the Chechens, Circassians, Avars, and others. For a quarter of that century a Muslim imam, Shamil, led a holy war against the Russian "infidels." The tsar's troops fell by the thousands. Even after Shamil surrendered in 1859, the Chechens often rebelled. They were, and are, Caucasia's most obstinate freedom seekers.

Besides fighting the Russians, the inhabitants of Caucasia war among themselves. Though they have often lived in peace, the end of ironfisted Soviet control unleashed old grievances.

Armenia and Azerbaijan have battled for the region of Nagorno-Karabakh—within Azerbaijan but populated by Armenians. Georgia has failed to impose its will on the Abkhaz, who also seek freedom. In another conflict Georgia tried to suppress the Ossetians, a people descended from nomads from north of the Black Sea; their territory arcs across the Caucasus Mountains into central Georgia.

The Ossetians also clashed in the north with the Ingush, in still another fight for land. The seeds of this confrontation were sown in 1943-44, when Joseph Stalin exiled the Ingush and three other Caucasus peoples to Central Asia and Siberia. They were accused—with no foundation—of collaborating with Germany during World War II. When allowed to return in 1957, the Ingush found Ossetians in possession of much of their territory. Other exiled groups were similarly deprived. Not surprisingly a hatred of Moscow lingers among these "punished peoples," as they have been called.

Russia clearly intends to keep a grip upon its turbulent southern border, especially to shore this flank against regionally powerful Turkey and Iran. Also, Russia wants a slice of the profits from the oil and gas of the Caspian Sea basin. But to control the Caucasus, this powder keg clothed in orchard and vineyard, will not be easy.

The factions of the Caucasus

Three major powers, three new nations, and more than 50 ethnic groups jostle for room, influence, and independence in the snow-capped neck between Eurasian seas. Once the restless southern tier of the Soviet Union, the heart of the Caucasus is now one of the world's most critical and contentious junctions.

1 ARMENIA-AZERBAIJAN: In a savage war now almost eight years old, Christian Armenia and Muslim Azerbaijan fight for control of Nagorno-Karabakh, an Armenian pocket within Azerbaijan. Both economies are in shambles. (15,000 dead, more than one million refugees)

2 ABKHAZIA-GEORGIA: A 1992 uprising by the Abkhaz in northwestern Georgia drove most ethnic Georgians from the territory. Despite a shaky cease-fire, Abkhazia refuses to let Georgian refugees return and remains virtually autonomous as Russian soldiers patrol the border. (7,000 dead, 200,000 refugees)

3 CHECHNYA-RUSSIA: Russia sent troops into Chechnya in 1994 to squelch the independence movement of a people with a centuries-long tradition of resistance to invaders. The capital, Groznyy, has been devastated; guerrilla war continues in the rugged mountain terrain. (45,000 dead, 120,000 refugees)

4 SOUTH OSSETIA-GEORGIA: The region of South Ossetia proclaimed its independence in 1990 and sought to join with North Ossetia. Russian, Georgian, and Ossetian peacekeepers now patrol. (2,000 dead, 43,000 refugees)

5 NORTH OSSETIA-INGUSHETIA: Russia imposed a state of emergency to curb violence after the Ingush attempted to reclaim lands occupied by Ossetians while the Ingush were exiled in Central Asia. (261 dead, 60,000 refugees)

KRASNODAR KRAY

STAVROPOL KRAY

RUSSIA

Maykop

ADYGEA

Cherkessk

Pyatigorsk

KARACHAY-CHERKESSIA

Sochi

Nalchik

KABARDINO-BALKARIA

INGUSHETIA

Nazran

NORTH OSSETIA

Vladikavkaz

Black Sea

Sukhumi

ABKHAZIA

SOUTH OSSETIA

Tskhinvali

Kutaisi

AJARIA

Batumi

TBILISI

GEORGIA

Gyumri

ARMENIA

YEREVAN

AZERBAIJAN

TURKEY

Russian peacekeeping troops patrol the Enguri River between Georgia and the hotly contested enclave of Abkhazia. Of the former Soviet republics in the Caucasus, only Azerbaijan has no Russian military bases.

A Fortress of Languages

A refuge since the last period of Eurasian glaciation, the Caucasus region has been a gateway for travel, trade, and conquest. Yet even as regional and imperial powers have for centuries contested for influence, the Caucasus has remained a redoubt of peoples whose identities are tied to the 50-some languages they speak, as grouped in major families (below). The persistence of the enduring identities of ethnic groups has been aided by the rugged terrain and by societies whose loyalties are to clan and family as much as to nation or region. Past attempts, especially by the former Soviet Union, to assimilate or dominate the Caucasians have been largely futile.

ALTAIC

Turkic

1 Azerbaijani (6,273,000)
2 Balkar (71,000)
3 Karachay (278,000)
4 Kumyk (251,000)
5 Nogay (77,000)
6 Turkmen (18,000)

NORTHWEST CAUCASIAN

Abkhaz

7 Abaza (58,000)
8 Abkhaz (96,000)

Circassian

9 Adygey (Cherkess, Kabardin) (658,000)

NORTHEAST CAUCASIAN

Dagestani

10 Agul (14,000)
11 Akhwakh (5,000)
12 Andi (9,000)
13 Archi (1,000)
14 Avar (501,000)
15 Bagvalal (4,000)
16 Bezhita (Kapuchi) (3,000)
17 Botlikh (3,000)
18 Budukh (1,000)
19 Chamalal (4,000)
20 Dargwa (282,000)
21 Ginukh (200)
22 Godoberi (2,500)
23 Hunzib (400)
24 Kaitata (5,000)
25 Khaidaq (28,000)
26 Khinalug (2,000)
27 Khwarshi (1,000)
28 Kryz (6,000)
29 Kubachi (3,000)
30 Lak (92,000)
31 Lezgi (367,000)
32 Rutul (15,000)
33 Tabasaran (78,000)
34 Tindi (5,000)
35 Tsakhur (19,000)
36 Tsez (Dido) (7,000)
37 Udi (6,000)

Nakh, Vaynakh

38 Batsbi (Tsova Tush) (3,000)
39 Chechen (732,000)
40 Ingush (197,000)

SOUTH CAUCASIAN

Kartvelian

41 Georgian (3,479,000)
42 Mingrelian/Laz (300,000)
43 Svan (35,000)

INDO-EUROPEAN

Armenian

44 Armenian (4,208,000)

Greek

45 Greek (183,000)

Iranian

46 Kurd (302,000)
47 Ossetian (509,000)
48 Talysh (21,000)
49 Tat (23,000)

Slavic (includes Krasnodar and Stavropol)

50 Russian (8,645,000)
51 Ukrainian (408,000)

Three Empires

The Ottoman, Russian, and Persian empires fought brutal wars over the centuries to dominate the Caucasus. Current borders were drawn by a series of post-World War I treaties and by Joseph Stalin when he was People's Commissar of Nationalities under Vladimir Lenin.

One of Russia's least urbanized regions, Dagestan is home to about 40 ethnic groups and a profusion of languages in its isolated valleys. Bounded by war-torn Chechnya, Georgia, and Azerbaijan, it has largely escaped ethnic or political violence. □

DEVRIETTMANN

■ FROM THE GEOGRAPHIC ARCHIVES

An ill wind

A cloud of the insecticide DDT billows over the beach—and beachgoers—in 1945 as part of a mosquito-control program at New York's Jones Beach State Park. Used in Europe to ward off bug-borne disease during World War II, DDT was once hailed as a miracle product. This photograph was published in the October 1945 GEOGRAPHIC article "Your New World of Tomorrow." But by the time "tomorrow" came, evidence showed that birds from sprayed areas accumulated high levels of DDT, damaging their ability to reproduce. Other research pointed to the chemical as a human carcinogen. Use of DDT was banned in the United States in 1972.

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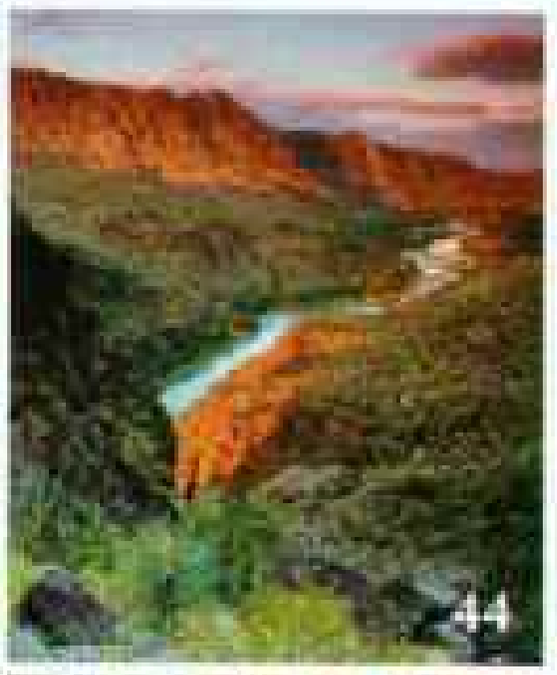
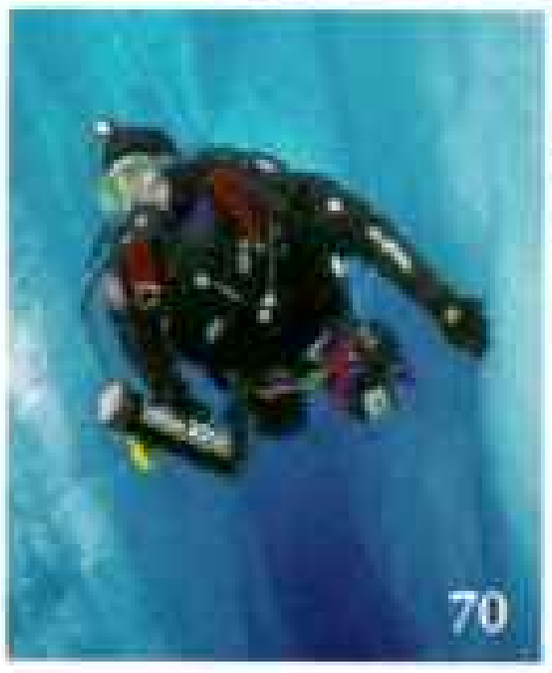
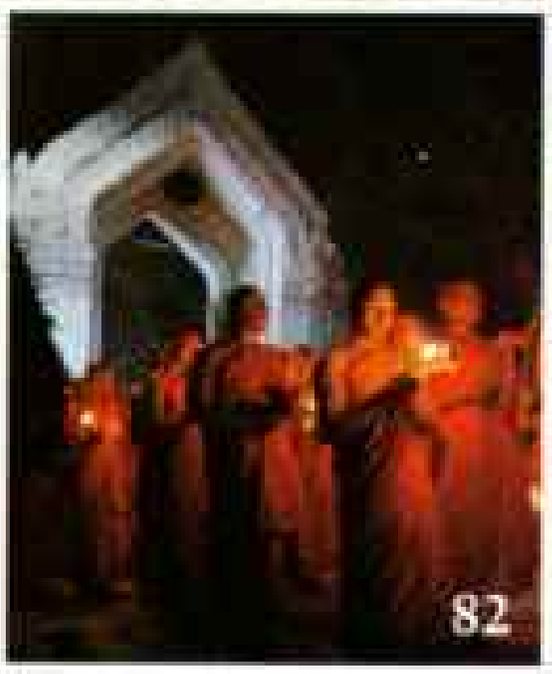
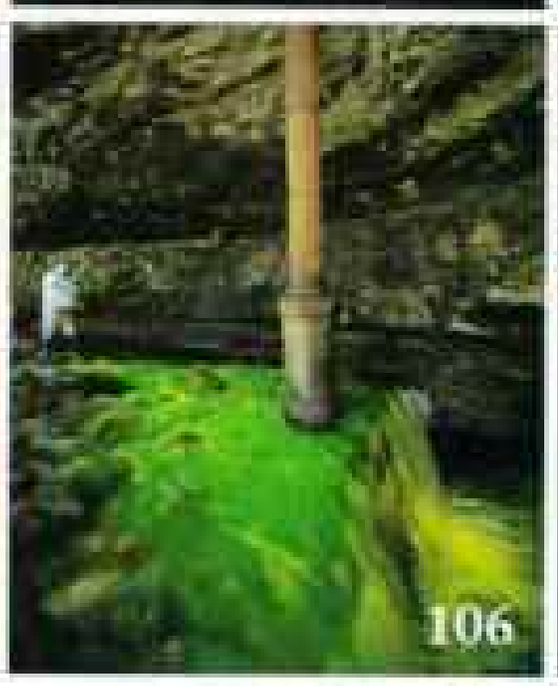
NATIONAL GEOGRAPHIC

FEBRUARY 1996









The Cover

American caver Diana Gietl ascends a cramped ice shaft in Greenland. Photograph by Carsten Peter

Cover printed on recycled-content paper.

When I was just a kid, my bike was the freedom to explore.

When I was a teenager, my motorcycle gave me

And in my 20's, a beat-up convertible was a

Now it's my son

Designed for the Individual


Space Runner


Space Wagon


Space Gear

the open road.

ticket to heaven.

who is *free* to dream.

So here I am.

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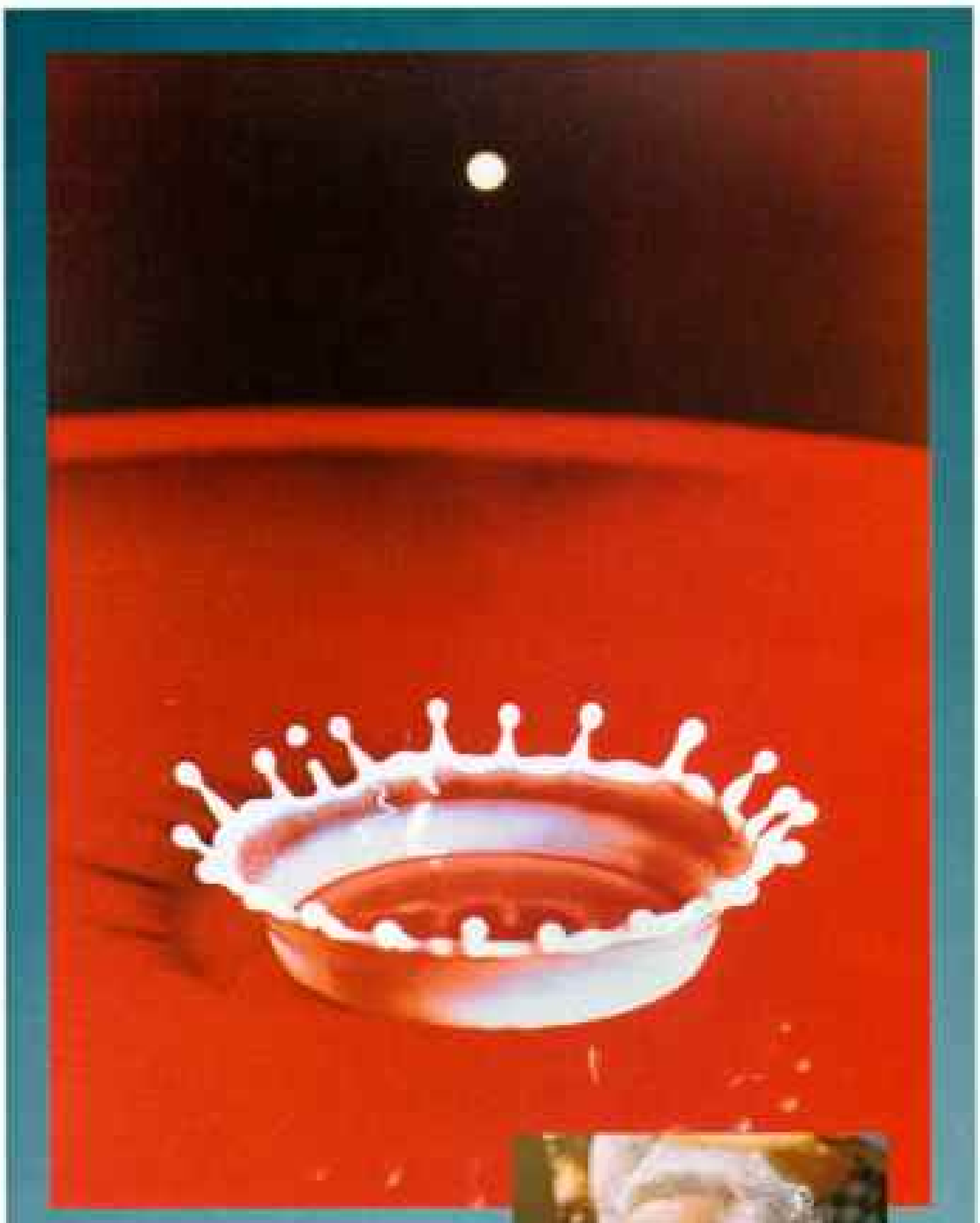
Behind the Scenes



Making a Splash

HELPING US SEE in a new way, photographic pioneer Harold "Doc" Edgerton froze time—and milk drops (above)—with his invention of the intermittent flash, or strobe. He was also mentor to former staffer Bruce Dale, who photographed him for the October 1987 GEOGRAPHIC. Last July Bruce traveled to Doc's hometown of Aurora, Nebraska, for the opening of the Edgerton Educational Center, attended by his widow, Esther (right). "The place is like an MIT for 12-year-olds," says Bruce. The Society contributed blowups of famous photographs to the new museum, which sponsors science camps and teacher training along with exhibits based on Doc's work.

BRUCE DALE

Can't Live With 'Em . . . or Without 'Em

"I'VE ALWAYS kept my GEOGRAPHICS in a closet," says 38-year member Janet Thornton of Glendale, California, "but it was overflowing." Jan contacted the Society about donating her collection and got Bill Siglin's name. He teaches at the Navajo school in Teec Nos Pos, Arizona. "I integrate the GEOGRAPHIC into almost everything I teach," he says. Jan shipped 380 pounds of magazines to Arizona for the students' new project: making their own index.

Says Jan: "Now I can keep getting the GEOGRAPHIC!" She does have an empty closet to fill.

DANNY GERMAN

■ WEIGHTY ISSUE

Twelve GEOGRAPHICS take up about four inches of shelf space and weigh ten pounds. The annual press run takes 585 miles of shelf space and weighs more than 90 million pounds.

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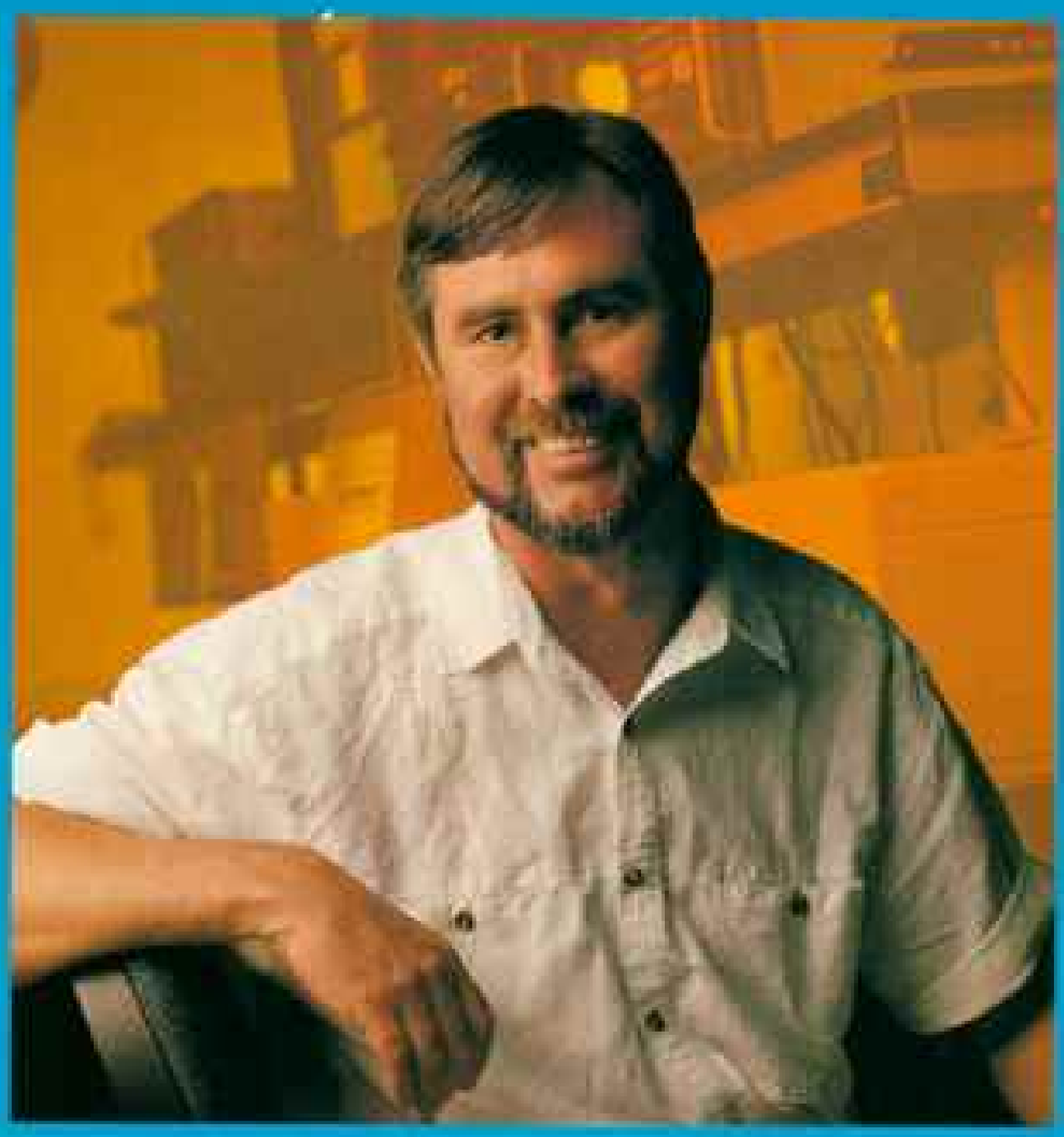
Designing new products is all about pre-empting questions.



Let's make things better.

George Ellis, Video Application Engineer
Sunnyvale, USA.

How do I know what people want before they ask for it? That's easy. It's my job.

I'm George Ellis and I work in the Product Concept and Application Laboratory at Philips Semiconductors, California. My team and I design application boards, used as a model for how the products will work.

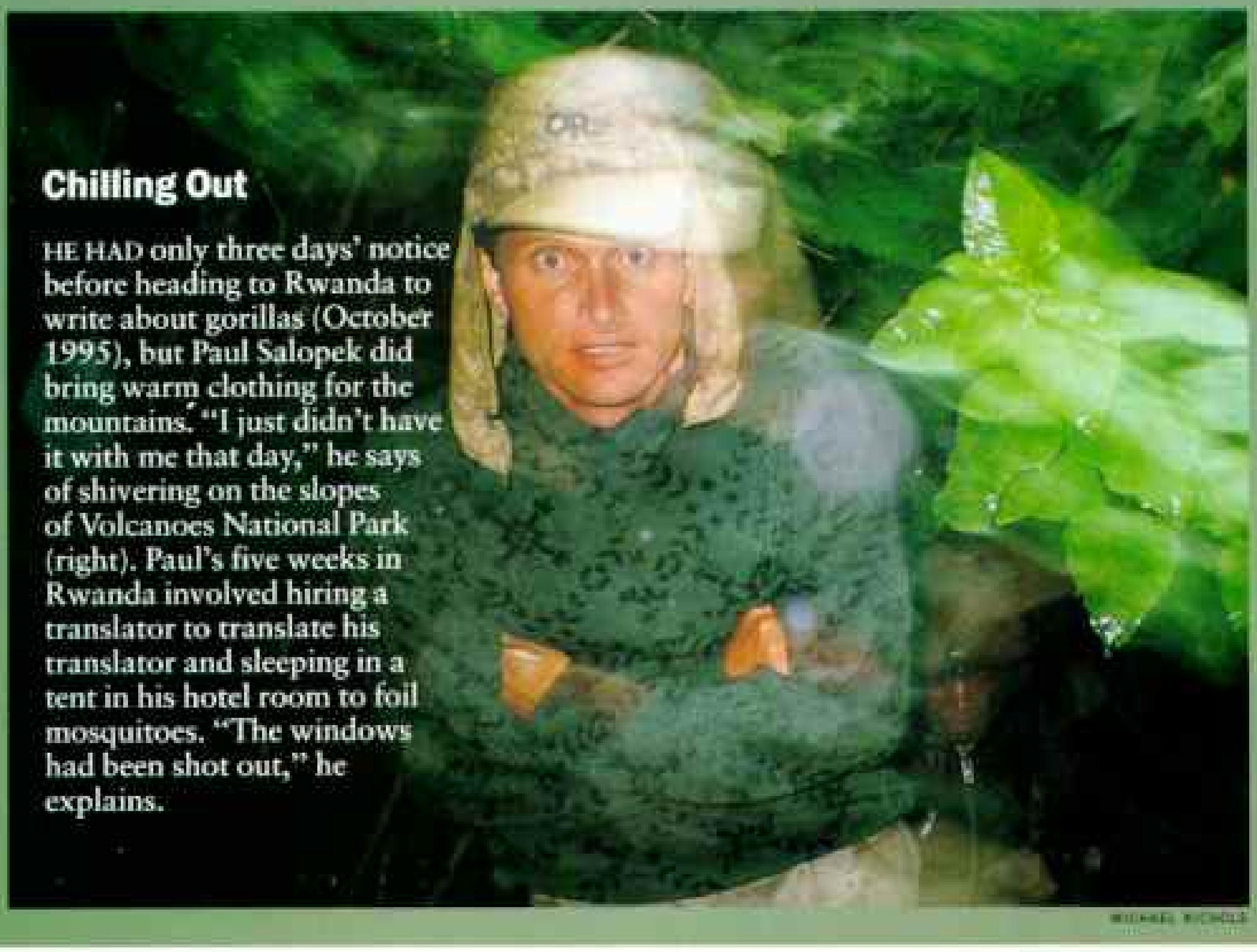
Customers who use our application boards are themselves designers and engineers who often adapt the product to their own needs.

With our Technical Support Centre, we can listen to those needs. We keep the technical needs of each customer on a database. Then, we use this information to refine products, or even invent new ones.

It's like a continual conversation. They ask questions, we reply. And like many conversations, you don't always need to wait for a sentence to end before you make your reply.

PHILIPS

PHILIPS



Chilling Out

HE HAD only three days' notice before heading to Rwanda to write about gorillas (October 1995), but Paul Salopek did bring warm clothing for the mountains. "I just didn't have it with me that day," he says of shivering on the slopes of Volcanoes National Park (right). Paul's five weeks in Rwanda involved hiring a translator to translate his translator and sleeping in a tent in his hotel room to foil mosquitoes. "The windows had been shot out," he explains.

Hot at Work

OUR RESEARCHERS often work feverishly to be sure GEOGRAPHIC copy is accurate, but Kathy Maher literally did so in Nicaragua. While on assignment in that country she contracted dengue fever from a mosquito bite, but even with a 104°F temperature kept up work over the phone. "I paid my doctor, at her request, in a scarce commodity—toilet paper!"

Is There a Doctor in the Tower?

WHEN Nick Newcott, 11, caught the mumps in London, his dad Bill, who was writing the Tower of London article (October 1993), took him to the Tower physician, whose predecessors are said to have revived torture victims. The doctor prescribed bed rest for Nick.

CYNTHIA S. NEWCOTT

■ LOCAL FLAVOR

Our staff often try new foods on assignment, but sometimes the new foods try them, including:

Cobra-bile wine: Writer Tom Abercrombie in Canton

Beetle larvae: Picture editor Susan Welchman in Irian Jaya

Goat fetus: Photographer Jodi Cobb in Yunnan

Ant soup: Photographer Mark Moffett in Beijing

Muskrat tail: Editor Bob Booth in the Yukon

—MAGGIE ZACKOWITZ

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Think locally. Act globally.

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In the developing world, over 4,000 children die from measles every day. This figure is just the tip of the iceberg. Because not every child who catches measles, dies of measles. It can lead to child malnutrition as well as vitamin A deficiency, in itself responsible for over 100,000 deaths a year. All it takes is one single vaccination to immunise a child. Not only will it prevent measles and the subsequent malnutrition but it will also reduce the chance of diarrhoea and pneumonia. Both killers in their own right. And the vaccine for all of this costs just seventeen cents a child. But this is only one example of how cheap it is to save a child in the developing world. Some diseases cost even less to treat. The capsules which will save the sight of a child suffering from Vitamin A deficiency are only seven cents.

And ten cents is all it costs for the vaccine against diphtheria, whooping cough and tetanus.

So far, UNICEF has helped inoculate about three quarters of the children in the developing world, saving two million young lives every year.

But we're not only interested in saving children in the short term. We spend money on education, on nutrition and on supplying fresh drinking water to children and adults alike.

MEASLES IS STILL KILLING THOUSANDS OF CHILDREN EVERYDAY.

THE CURE IS IN YOUR POCKET.

An important part of UNICEF's support comes from voluntary contributions.

So please give what you can to help us save a childs life.

For further information on the worldwide activity of UNICEF (United Nations Children's Fund), or to make a donation, please call your local UNICEF National Committee or contact UNICEF GCO, UNICEF House, 3 United Nations Plaza, New York, NY 10017, USA. Attention: Bonnie Berlinghof.

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Giving children a future.

Forum

Information Revolution

I'm no computer slouch, but I have to say that the "Information Revolution" (October 1995) scares the hell out of me. It is another way that humans are avoiding friends, family, and their own thoughts. Patience is obsolete. We are a world of frenetic, harried people. Aside from the benefits to the medical and scientific fields, technology has become the opiate of the masses. People aren't living; they are gathering information.

DANA C. BROGAN
Waterbury, Vermont

Though the attention span of a true TV zombie might be limited to seconds, we who grew up with SimCity and Civilization [CD-ROM games] have developed an intuitive grasp of complex systems and an ability to out-concentrate those generations who thought the rules of Monopoly or Scrabble were difficult. People on the Internet read and write large amounts on a daily basis. And far from replacing "skin" [human contact] with silicon, we have added a new circle of friends from different countries and cultures to those we talk, work, and play with on a daily, face-to-face basis.

SCOT W. STEVENSON
Essen, Germany

As a 13-year-old student, I disagree that we have an insatiable hunger for electronic stimulation. Here in Singapore, where the level of technology is as good as anywhere, the average child watches about two hours of TV a day. Discipline, not TV, is the problem. If a child is disciplined, he/she will not watch too much TV when it is time for work.

HAO
Singapore

When I saw the word DIGITAL highlighted in blue on the first page, I could not resist pressing it again and again. Of course, nothing happened. Hypertext only works on a computer. Still, in true cyberfashion I jumped around and skimmed and read bits and pieces of the article. For better or worse, computing is fostering a nonlinear literacy.

BOB SIENKIEWICZ
Encinitas, California

I strongly disagree with the author's premise that computers spawn an unwillingness to read anything of substantive length. Since connecting with the Internet, I've never read as much, researched as much, questioned as much, or contemplated as much. I just do it much faster now.

MARK MASTROCINQUE
East Northport, New York

In the past few years I lost the art of writing letters, thanks to the worldwide efficient telephone networks. Now with e-mail I find myself writing letters frequently. What an extraordinary opportunity for the public to participate and be heard.

AJIT DAMLE
Fargo, North Dakota

By the time my two-year-old son, Alexander, goes to a university, no doubt he will be able to access all the world's information via his wristwatch. What is so bad about that? Wasn't it Albert Einstein who said, "Never memorize something that you can look up"?

SCOTT DENNIS
Long Beach, California

Major newspapers openly select political candidates, and rarely do we see a journalist covering several sides of a story with equal aggressiveness. The Internet changes that. Forums for discussion have changed the way our government works and the way information travels from person to person. If a major paper says one thing, you can bet that someone on the Net will challenge it.

DAVID A. CORNELSON
Chicago, Illinois

Mountain Gorillas

Your article on the gorillas was heartwarming and encouraging. In 1991 my wife and I were on our way from Kigali, Rwanda, to Goma, Zaire, and had the pleasure of visiting Rosamond Carr (page 75), surrounded by the beautiful gardens of *Gorillas in the Mist* fame. She welcomed us with open arms and asked us to stay for tea. It's not surprising that she poured her heart into helping the Rwandan orphans. Africa needs people like her to provide some sense of stability in the midst of chaos.

ROBERT JACOB
Gray, Maine

Geisha

I know and love Kyoto, where the geisha are an integral and loved part of the community. Like the city itself, the geisha and maiko are a successful blend of modernity and tradition. Incidentally, the ladies of Kyoto themselves dress in superb kimonos for special city events, creating a unique display of color and beauty.

WILLIAM DOBREE CAREY
London, England

Fiji

As a returned Peace Corps volunteer, I have been anticipating an article on this beautiful country since I came back to the States five years ago. I lived with Indians, but I know one aspect of native Fijian life that is essential to learning about Fiji. The Fijians don't just come from a certain village or island—they deeply, spiritually identify with the land, their *vanua*, where they were born.

I wish you had included photographs of street scenes and soccer games and school carnivals with Fijians of all ethnic backgrounds, who are working

very hard to reestablish bonds shattered by the political upset—which was certainly not in any way a "polite" venture.

KAY ALYSON JONES
Iowa City, Iowa

I lived in Nagelewai for two years as a Peace Corps volunteer and learned, like Roger Vaughan, that "nothing is simple in Fiji." Fijians disdain someone *vucesa* (lazy) who is not a contributing community member. They esteem the foreigner who joins in the work and are forgiving of bungled attempts to do so. I rarely could keep up with the other women in their day-to-day tasks; I could never see the prawns they easily scooped out of streams or keep a wood fire fueled during the rainy season. Joining in communal activities is part of Fijian life, and no Fijian would see it as contributing work for upkeep.

DONNA A. GESSELL
Dahlonega, Georgia

I am a third-generation East Indian from Fiji. After independence in 1970 decision-makers—with only a handful of Fijian graduates from overseas universities—were faced with a daunting task of governing the 300-island nation.

A 96-year British reign had established a school system segregating indigenous natives and East Indians, which gave birth to the inevitable coups in the 1980s. The British colonial system also left a historical legacy of divide and rule. The majority of Fijians are Methodists; the Indians are Hindus. This religious schism further negates mutual leadership roles for both races.

SILAS P. SINGH
Springfield, Illinois

Early in World War II we took combat aircraft—B-25 medium bombers—to Nadi airfield near Lautoka for modification prior to entering combat on Guadalcanal. Fiji's beautiful climate and openly friendly people have always remained fixed in my mind. Their grand smiles and "Bula, Joe" greeting made it easy to keep those memories alive. I wish all Fijians a lasting peace.

WAYNE J. GUIDRY
Sun City West, Arizona

You should have "dived deep" into the lives of Indians and recorded their stories about their loss of basic human rights under Sitiveni Rabuka.

NANDA K. SOLOGAR
Red Deer, Alberta

Saving Britain's Shore

Author Alan Mairson asks, "Why does such a rugged coast, and coastlines in general, evoke warm feelings in so many people?" As if in answer, Gavin Maxwell, who describes his life on the isolated West Highland coast of Scotland in his book *Ring of Bright Water*, states, "For I am convinced that man has suffered in his separation from the soil and from the other living creatures of the world . . . he must still, for security, look long at some portion of the earth as it was before he tampered with it."

Today, as we continue to encroach on places of wild beauty, this theory is all the more pertinent.

PENELOPE A. VASQUEZ
Boca Raton, Florida

It's always more fun to read about a topic when authors add a little about themselves or express their own feelings. I really like this article, especially since we just vacationed in California and were able to see the ocean from Point Reyes. How much less our trip would have been if we had no access to the parks and waterways.

GINNY HUGHES
Bay City, Michigan

Mexico's Desert Aquarium

I live and work as an English teacher in Torreón, 150 miles from Cuatro Ciénegas, "Mexico's Desert Aquarium." Although neglected by tourists, this region possesses a stark desert beauty and contains other interesting places: the dunes of Bilboa, the hanging bridge and abandoned mine of Mapimi, the cool colonial beauty of Saltillo, and the irrigated oasis of La Laguna.

ALLAN WALL
Torreón, Coahuila, Mexico

I had hoped the article would focus on the need to protect and conserve the Cuatro Ciénegas Basin, clearly a site of hemispheric (if not global) scientific and ecological significance. I fear the article is a vandal manual for globe-trotting pleasure seekers—that the fine map and aerial photograph will be used to find, then frolic in, crystal clear waters heretofore largely unknown and out of harm's way. I hope I am wrong.

DAVID H. RISKIND
Austin, Texas

I fell in love with the place when my uncle first took me to the Mesquites River (pages 90-91) when I was a kid. Nobody who has been there will forget the majestic lunar landscape. But please do something to help stop nearby cement factories from extinguishing the amazing dunes surrounding the *pozas*.

EDGAR AMADOR
Skillman, New Jersey

Cuatro Ciénegas is also known as the Australia of America, because of its unique biodiversity.

AARÓN DE LEÓN LINARES
Eagle Pass, Texas

Forum

Is there any reason why in the Forum section you cannot provide the date when an article appeared?

MARTIN H. WEBSTER
Del Mar, California

All letters in Forum refer to the issue cited in the first letter (in this case October 1995) unless otherwise noted.

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

Michael Wong had the urge to be compacted.

Michael Wong of Creative Pacific had a vision. A computer work station that squeezed component space down to nothing while, at the same time, increasing productivity.

So he went to Taiwan where an interesting company, Plustek, showed him its newest idea: a color fax machine, color photo copier, scanner and OCR, all designed in a one-button unit no larger than a shoe box.

Creative Pacific decided to sell it in Australia, but in 30 other countries it is marketed as the Scanfx, the world's most complete multi-function scanner.

Scanfx is a perfect example why companies today like IBM, Hewlett Packard, Apple Computer and AT&T are heading for Taiwan. The attraction for them is INNOVALUE: innovation in design and manufacturing techniques which gives added-value to leading edge products.

Innovalue produced the first low-cost carbon fiber bicycle. And a new sophisticated PC video and audio editor for less than four hundred dollars.

In Taiwan, you'll find Innovalue in so many product areas. Perhaps yours. It is not just products, but ideas and especially value that are VERY WELL MADE IN TAIWAN.

Selected Taiwan products carry this Symbol of Excellence. It is awarded annually by an expert panel of judges only to products which excel in quality and innovative design.

TAIWAN.
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internet http://www.tptaiwan.org.tw

Plustek's versatile Scanfx workhorse occupies very little space next to another National Award winner, Twinhead's 5Rm Note-book computer.

NATIONAL GEOGRAPHIC
Geographica

Death on a Mountain: Risk Is Always Present

"I DON'T THINK about death," Alison Hargreaves said after reaching the top of Mount Everest last May. "I climb because I love mountains."

Three months later the highly regarded 33-year-old British climber died descending from the 28,250-foot summit of K2—one of seven victims of a storm on the peak that climbers consider harder than Everest. It was the worst year on K2 since 1986, when 13 mountaineers perished.

The K2 deaths—and six on Mount McKinley and four on Mount Rainier last summer—bring a reminder of climbing's perils. Weather and avalanches are the biggest hazards, along with errors in judgment, such as adhering to a rigid schedule and trying to please others, says Jed Williamson, editor of the annual *Accidents in North American Mountaineering*. Some climbers are dissuaded by fatalities; others press on.

"Climbers like to believe they are in control," says Michael Kennedy, editor of *Climbing* magazine. "But sometimes it comes down to a roll of the dice."

"I've been practicing this day for nearly ten years," said James Ballard, Hargreaves's husband, when he learned of her death. In October he and their two children journeyed to the foot of K2 in Pakistan to honor her.

ALISON HARGREAVES COLLECTION

A Face on Freedom's Road

SCULPTED IN CLAY and hidden for nearly a century and a half in the basement of a Syracuse, New York, church, this haunting image recalls the struggle against slavery waged by the Underground Railroad (GEOGRAPHIC, July 1984). For that network of abolitionists who aided fleeing slaves, Syracuse served as a station en route to Canada. The Wesleyan Methodist Church housed an active abolitionist congregation; its pastor Luther Lee bragged, "I passed as many as 30 slaves through my hands in a month."

Recent renovation of the church led to the discovery of seven faces, three with distinct features. They were carved into the walls, probably by escapees awaiting their final dash to the border, says Syracuse University anthropologist Douglas Armstrong, whose excavations confirm their pre-Civil War origin.

IRA BLOCK

TERRY PAWSON VIEW EMIRATES BUSINESS CLASS, LONDON HONG KONG, 12TH AUGUST 1998

Terry Pawson, award-winning architect, on Emirates (award-winning airline).

Le Corbusier said "A house is a machine for living in", and Emirates clearly thinks that much the same applies to an aircraft. Flop in your comfy armchair (9B), relax in front of the T.V. (6-channel personal video), enjoy a couple of drinks (Veuve Clicquot, Chateau St Aubin, small port), make the odd call (with the on-board satellite phone).

So do I feel at home? Not exactly. At home I am unlikely to be offered canapés, a choice of three first dishes and four tempting main courses, and a basket of exotic fruit by a smiling beauty in crisp red and cream uniform, no matter how good a maid Gilly is in.

Life is good.

As even Le Corbusier might have said, after a flight on EK 088.

Terry Pawson

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The Map Is in the Mail

TWO BIPLANES wing their way across a U. S. map on a 1926 stamp issued eight years after regular airmail delivery began. A strip of Romanian stamps bears a third-century A.D. road map for the Roman province of Dacia. A 1937 Argentine stamp reveals a new boundary with Chile. Henry Hudson appears on a British stamp with a 1592 map he may have used on his explorations.

Merging geography and philately, nearly 200 stamps acquired by Californian Allan Lee are on view at the Smithsonian Institution's National Postal Museum in Washington, D. C., in an exhibit called "Maps on Stamps." Lee became intrigued by such stamps in Italy during World War II. He donated his collection to the Smithsonian Institution in 1977.

The exhibit spans the globe. A Lebanese stamp shows Phoenician trade routes, an Italian stamp follows Marco Polo to Beijing, and stamps from Caribbean nations celebrate the voyages of Christopher Columbus.

A Moving Mystery in Death Valley

PERRY MASON might call it "The Case of the Roving Rocks": On a Death Valley lake bed of baked clay, flat and hard as an airport runway, long tracks suggest that great stones, like this hunk of dolomite, move about. Geologist John Reid, Jr., of Hampshire College in Massachusetts thinks he has found the explanation for the California conundrum in a rare meteorological sequence. When a winter rain inundates the lake bed and the surface of the water turns to ice, wind sends the ice sheets—with the rocks locked within them—skimming over the shallow water. Even with modest winds, the ice sheets can drag rocks weighing up to 700 pounds and deposit them as far as a thousand yards away. Winds alone, says Reid, cannot push the rocks around the basin—called the Racetrack—as earlier researchers had suggested (GEOGRAPHIC, January 1970).

JOHN REID, JR.; JANE BURTON, BRUCE COLEMAN (RIGHT)

Reid and his research team found that "the rocks are passive passengers: They do whatever the ice does."

Vole Marks the Trail to Its Own Destruction

HOW DO EURASIAN KESTRELS find their main prey, the small, lemming-like rodents called voles? Finnish researchers have shown that the falcons use their ability to perceive ultraviolet light—which is invisible to humans—to spot trails of urine and feces, by which voles mark their territory. The Finns offer the first experimental evidence that raptors use this ability to locate their prey.

Because local vole populations in northern Europe crash every few years, Eurasian kestrels must regularly seek new feeding grounds. "The trails captured kestrels' attention, in the lab and in the field," says Jussi Viitala of the University of Jyväskylä's Konnevesi Research Station.

—BORIS WEINTRAUB

Hallmark

Ever notice how you find this on the back of things that mean the world to you?

Kerguelen Tern *(Sterna virgata)* **Size:** Length, 33cm; **Weight:** Approx. 125g **Habitat:** Inshore waters, plateaus and valleys on the islands of Prince Edward, Crozet and Kerguelen in the southern Indian Ocean
Surviving number: Estimated at 2,500 breeding pairs
Photographed by André Fatras

WILDLIFE AS CANON SEES IT

On rugged volcanic islands in the Indian Ocean, small colonies of Kerguelen terns nest inland on high plateaus or in valleys. A single egg is laid in a shallow scrape of moss, and both parents share in the rearing of their lone chick. Though terns usually catch fish over the breakers and kelp banks, during the breeding season they also eat spiders and insects found near the nest. The Kerguelen tern inhabits scattered archipelagoes that sustain some of the richest communities of seabirds. Feral cats are a serious threat on some islands. Other parts of this fragile ecosystem remain intact but in need of preservation. 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.

THE INSTITUTE OF CANCER RESEARCH

A tiny step forward.

The Institute of Cancer Research, in partnership with The Royal Marsden NHS Trust, is one of the largest Cancer Centres in the world, with a continuous dedication to the prevention, diagnosis, treatment and care of cancer.

Recently, a Section of Paediatric Oncology was set up to undertake increased research specifically into Childhood Cancers and provide the specialist training for doctors and nurses involved in the care and treatment of children, about 1,200 of whom develop cancer every year in the UK.

A vigorous programme includes genetic studies and new methods of reversing drug resistance — a tiny step in working to conquer cancer.

Other important progress includes the discovery of the location of a second breast cancer predisposition gene, a study of new nursing techniques such as breathing

retraining, anxiety management and pacing to enable lung cancer sufferers to lead more independent lives in their own homes, and the development of an ambulatory infusion pump which delivers chemotherapy in automatic, measured doses.

Looking to the future, it is crucial to attract the best scientific brains and provide them with the education and practical training in subjects relevant to the study of cancer. It is especially encouraging that this year the number of student applications, from around the world, for education and training at the Institute has been the highest ever.

But how can you help the Institute to be at the leading edge of research? By making a donation now ... giving an annual donation ... or by making a legacy in your will. Any one of these methods would contribute to our work in Cancer Research; by helping to support our projects of today and training the scientists of tomorrow.

Gifts to charities do not attract Inheritance Tax. The Institute is a charity recognised by the Inland Revenue as being exempt for taxation purposes (Ref: XR9964).

For more information and a copy of our Annual Report, please contact The Institute of Cancer Research, by phoning or writing to the Legacy Officer, 17A Onslow Gardens, London SW7 3AL – Telephone 0171 352 8133.

Each day ... and everyday

WORKING TO CONQUER CANCER

THE INSTITUTE OF CANCER RESEARCH

NATIONAL GEOGRAPHIC

On Television

CAROL HUGHES

■ SPECIAL, FEBRUARY 7, 8 p.m. ET

Hippos and Crocs Share a Crowded Pool

SAFER ON A LIVING ISLAND than swimming with its own kind, a young crocodile basks on the back of a tolerant hippopotamus (above). A new National Geographic Special, "Last Feast of the Crocodiles," chronicles the struggle for survival of animals gathered at a watering place shrinking in drought.

As South Africa's Luvuvhu River evaporated, filmmakers David and Carol Hughes trained their cameras on a large, deep pool, one that had never been known to go dry.

Their film captures the unexpected amity between the pool's two largest inhabitants. A mother hippo, for instance, places her baby in the midst of a croc feeding frenzy—where it stands untouched. As the drought continues, thirst drives other animals—birds, baboons, impalas—to risk death at the jaws of the crocs. Eventually they are all victims when the pool runs dry.

STEVEN POMPAREY

■ EXPLORER, FEBRUARY 4, 9 p.m. ET

Besides Your Pet, Do Animals Think?

SCIENTISTS had largely dismissed the idea of animals employing intelligence of a high order. Yet, as the EXPLORER feature "Animal Minds" shows, humans need only an open mind to see that our furry, feathered, and finned friends are thinking.

Alex, an African gray parrot, solves a counting and logic problem posed by behavioral biologist Irene Pepperberg (above). With a vocabulary of about a hundred words, Alex demonstrates an uncanny capacity to use words with understanding.

Creative dolphins? Resourceful dogs? Deceitful mantis shrimp? Self-aware chimpanzees? "Animal Minds" reveals that the more we learn about our fellow animals, the more we realize that we may not be alone on earth as beings capable of rational thought.

■ PROGRAM GUIDE

National Geographic Specials
"Last Feast of the Crocodiles"
NBC. Wednesday, February 7, 8 p.m. ET

National Geographic EXPLORER
TBS. Sundays, 9 p.m. ET

Children's Programming
Really Wild Animals
CBS. Saturdays, 12:30 p.m. ET

National Geographic Videos and Kids Videos Call 1-800-343-6610.

NATIONAL GEOGRAPHIC

EarthAlmanac

CHRISTINE AND MICHEL DENIS-HUOT

Hippos Sinking in a Quagmire of Problems

"The broad-backed hippopotamus
Rests on his belly in the mud;
Although he seems so firm to us
He is merely flesh and blood."

Even 75 years ago T. S. Eliot saw the hippo's vulnerability. Today poachers and loss of grassland habitat are steadily reducing the hippo's numbers.

Ranging south of the Sahara, only about 160,000 of Africa's hippos remain, according to zoologist Keith Eltringham of Cambridge University. Eastern Zaire harbors some 30,000, including this wallower. Only about 7,000 survive in West Africa, where human expansion is eating up hippos' grazing land.

After a 1990 trade ban on elephant ivory, poachers increasingly have sought hippo teeth as a legal substitute. More than 30,000 pounds of hippo teeth were exported from Africa in 1991, nearly double the previous year's total. The trade now will be regulated under the Convention on International Trade in Endangered Species.

Trout Disease—a Turn for the Worse

BIOLOGICAL BOMB: Since the 1950s a malady called whirling disease has invaded U. S. fishing streams, frequently attacking rainbow trout. A parasite deforms young fish, which often chase their tails before dying, hence the name. However, brown trout seemed resistant, a measure of solace to fly-fishing organizations.

But in 1994 Peter Walker (right) and his surprised colleagues in the Colorado Division of Wildlife found young brown trout in the upper Colorado River suffering from whirling disease. The specimen at left is afflicted, the other is not.

GAYLAN WAMPLER

Who Will Care for Orphans of Primates Killed for Food?

GRISLY ENTRÉE, a gorilla hand was offered to photojournalist Karl Ammann in a makeshift restaurant in the Republic of the Congo. The dismembered silverback had arrived on a logging truck. "The owner said the roasting would take several hours," says Ammann. "A good excuse to leave."

Since 1988 Ammann has investigated the illegal trade in primates sold as meat in central and western Africa. Villagers have long hunted "bush meat" to augment a meager diet. But commercialism has taken over, Ammann says: "Logging roads make it so easy for poachers to penetrate the forest and kill primates." In Cameroon he saw monkeys called guenons (left), shot by a cyclist who hoped to sell them to a truck driver.

In Congo alone poachers claim up to 3,000 chimps and 600 lowland gorillas a year—leaving hundreds of orphans. Some 50 chimps cared for by the Jane Goodall Institute may have lost their parents this way. In five other orphanages in Congo, Cameroon, Gambia, and Zambia, volunteers look after nearly 200 chimps, gorillas, and other primates. But the sanctuaries are full.

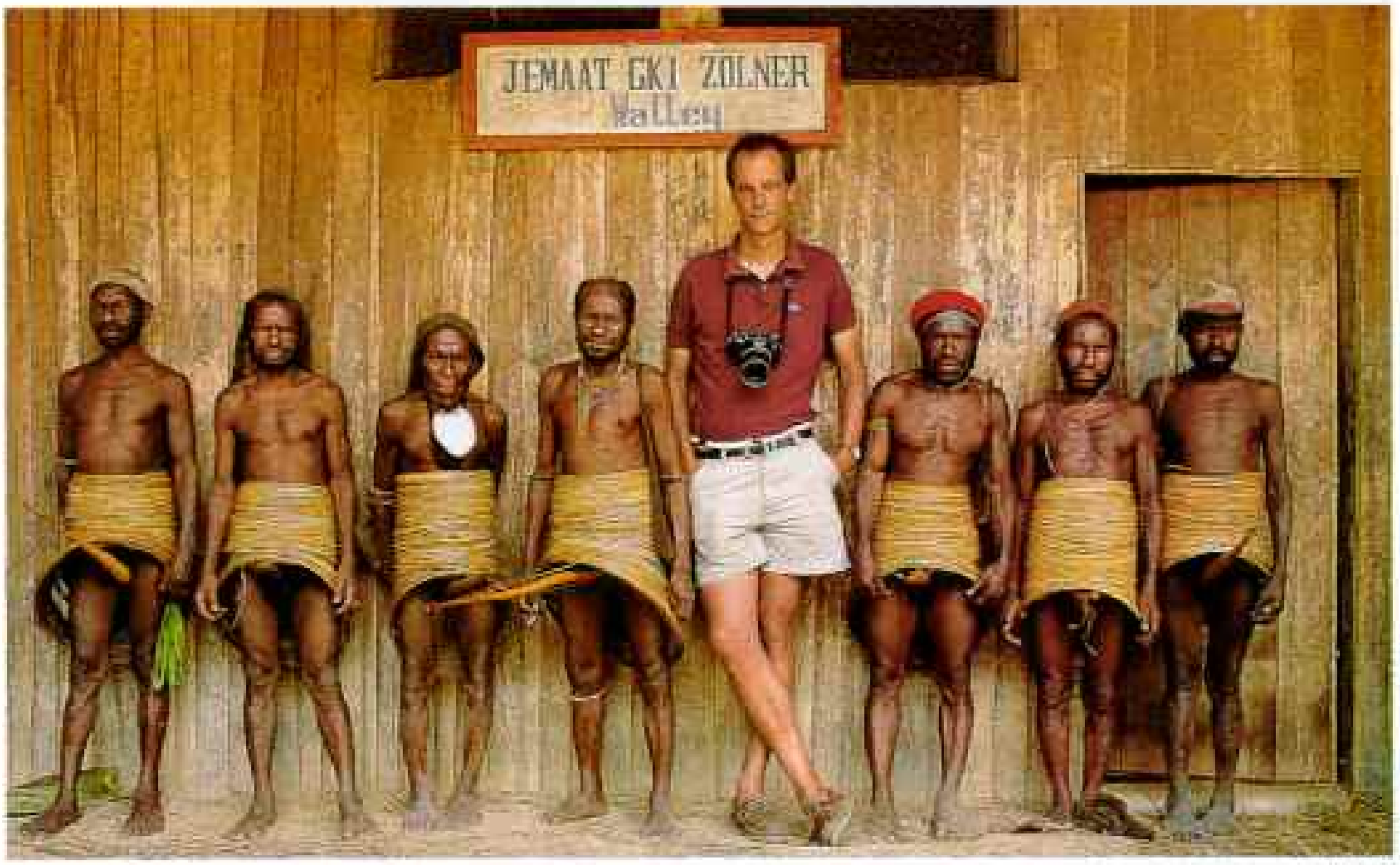
"Hundreds of other illegally held chimps are scattered around the countryside, most in deplorable conditions," says Ammann. "The situation is out of hand."

—JOHN L. ELIOT

KARL AMMANN (TOP AND MIDDLE); MICHAEL NICHOLS

NATIONAL GEOGRAPHIC

On Assignment



BILL BATZ

■ IRIAN JAYA

Not on the Menu: George du Jour

"THEY CALLED ME Long Pig in Irian Jaya," remembers six-foot-two-inch freelance photographer GEORGE STEINMETZ, who joined a group of Yali tribesmen—wearing rattan hoops and modesty gourds—after a church service in the village of Walley. "But that's what they call anyone who looks tasty. The Yali were cannibals before their conversion to Christianity about 20 years ago."

George underwent a conversion of his own around that time. "Before I got my degree in geophysics at Stanford University," says the Los Angeles native, "I dropped out for a while to hitchhike around Africa. I found I was taking a lot of photographs—the kind I'd always seen in the GEOGRAPHIC. Then I finally realized that I didn't want to be a geophysicist!"

■ THAILAND

Neck and Neck

BUYING A SCARF woven by a Padaung woman was as far as staff photographer JODI COBB would go for neck accessories while shooting in northern Thailand. "Unfortunately the neck-ring deformities have become a tourist attraction," says Jodi. "I'm fascinated by notions of feminine beauty held by different cultures. Photography is a good way to point them out." And Jodi has—in her articles and in a 1995 book she photographed and wrote: *Geisha* (Alfred A. Knopf).

KIM GOLD

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