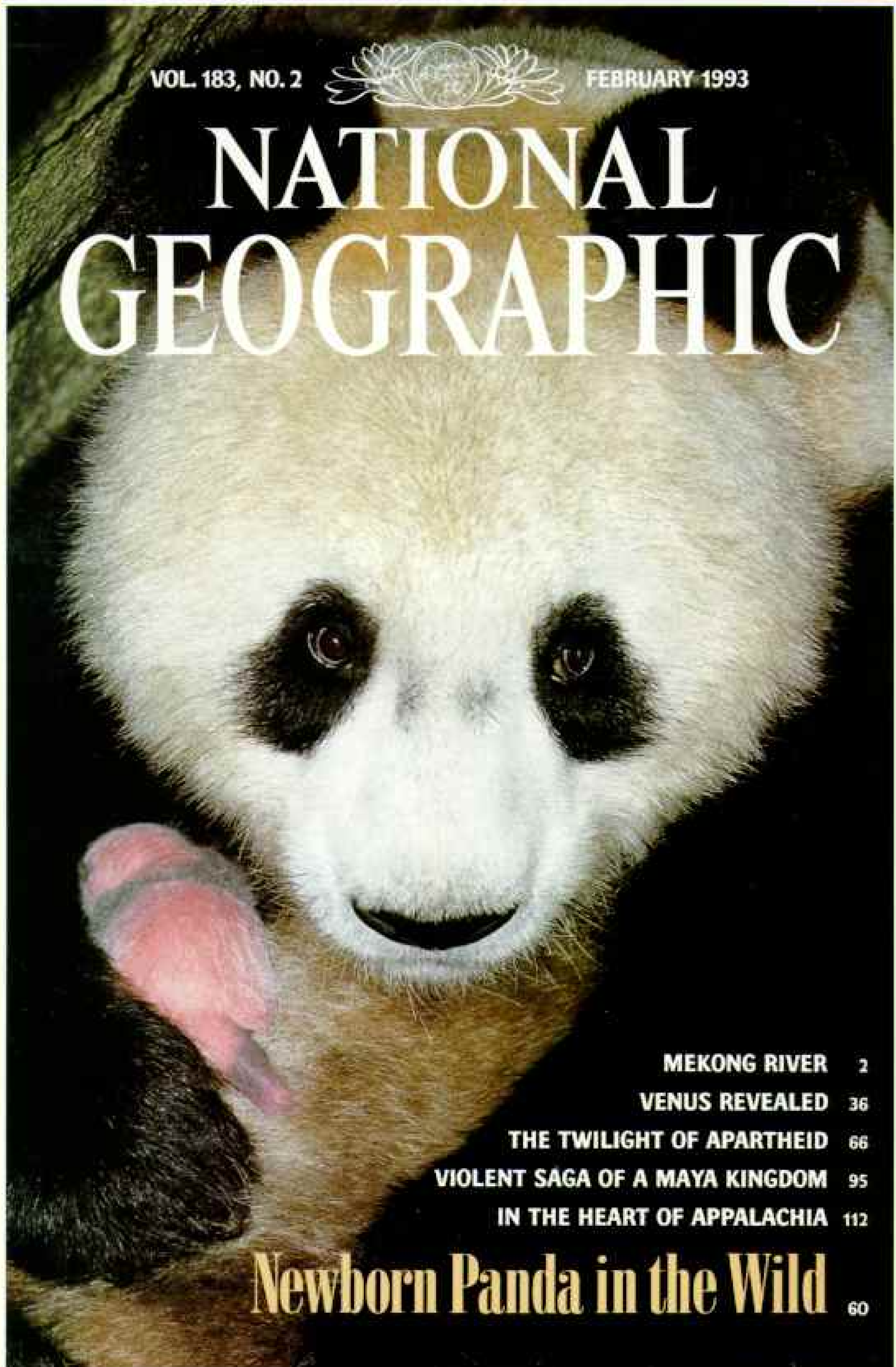

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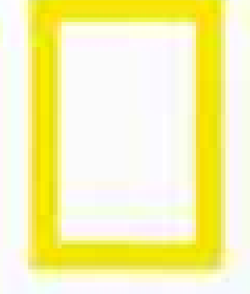
SEE "KEEPERS OF THE WILD" WEDNESDAY, FEBRUARY 17, ON PBS TV



NATIONAL GEOGRAPHIC

FEBRUARY 1993

Mekong River

By Thomas O'Neill
Photographs by Michael S. Yamashita

The killing fields of Southeast Asia are still. Along the region's major river—flowing 2,600 miles from China to Vietnam—development attests to the hopes of six nations.

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Venus Revealed

By William Newcott
Images by NASA/JPL

Piercing the thick sulfuric clouds of our sister planet, the Magellan spacecraft maps in unprecedented detail a superheated world of impact craters and lava flows.

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Newborn Panda in the Wild

Text and photographs by Lü Zhi

Close-up photographs chronicle the first days of a cub named Hope, born in the mountains of China to one of the last 1,200 giant pandas in the world.

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The Twilight of Apartheid

By Charles E. Cobb, Jr.
Photographs by James Nachtwey

Free at last—almost—the black majority in South Africa faces a new hurdle: bloody political infighting among the very groups that led the struggle for equality.

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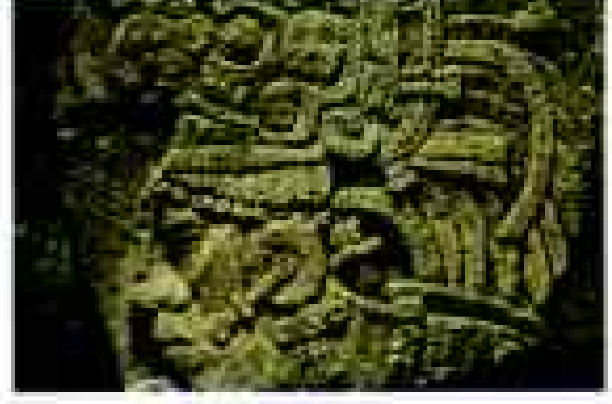
Violent Saga of a Maya Kingdom

By Arthur A. Demarest
Photographs by Enrico Ferorelli



Landmark excavations in the rain forest of Guatemala uncover fortified cities abandoned in the ninth century, shedding light on the collapse of Maya civilization.

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In the Heart of Appalachia

By Jeannie Ralston
Photographs by Karen Kasmauski

Faced with layoffs in the coal mines and a general shortage of jobs, the people of central Appalachia fight to turn their lives around and rebuild their region.

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COVER: Hinting at its adult markings, a panda cub burrows in its mother's chest days after its birth in the Qin Ling mountains of central China. Photograph by Lü Zhi.

Cover printed on recycled-content paper.

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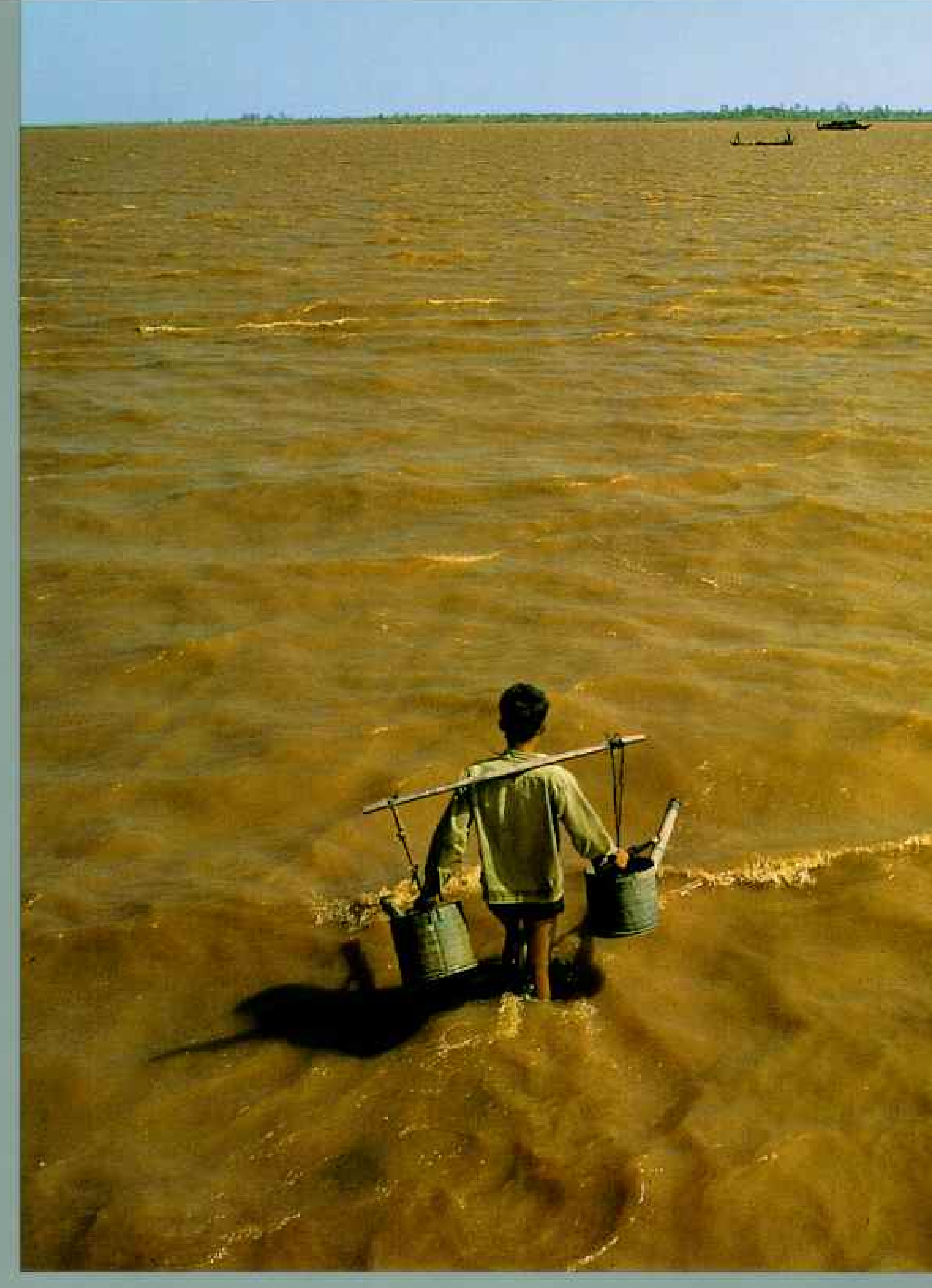
THE MEKO

A haunted river's season of peace

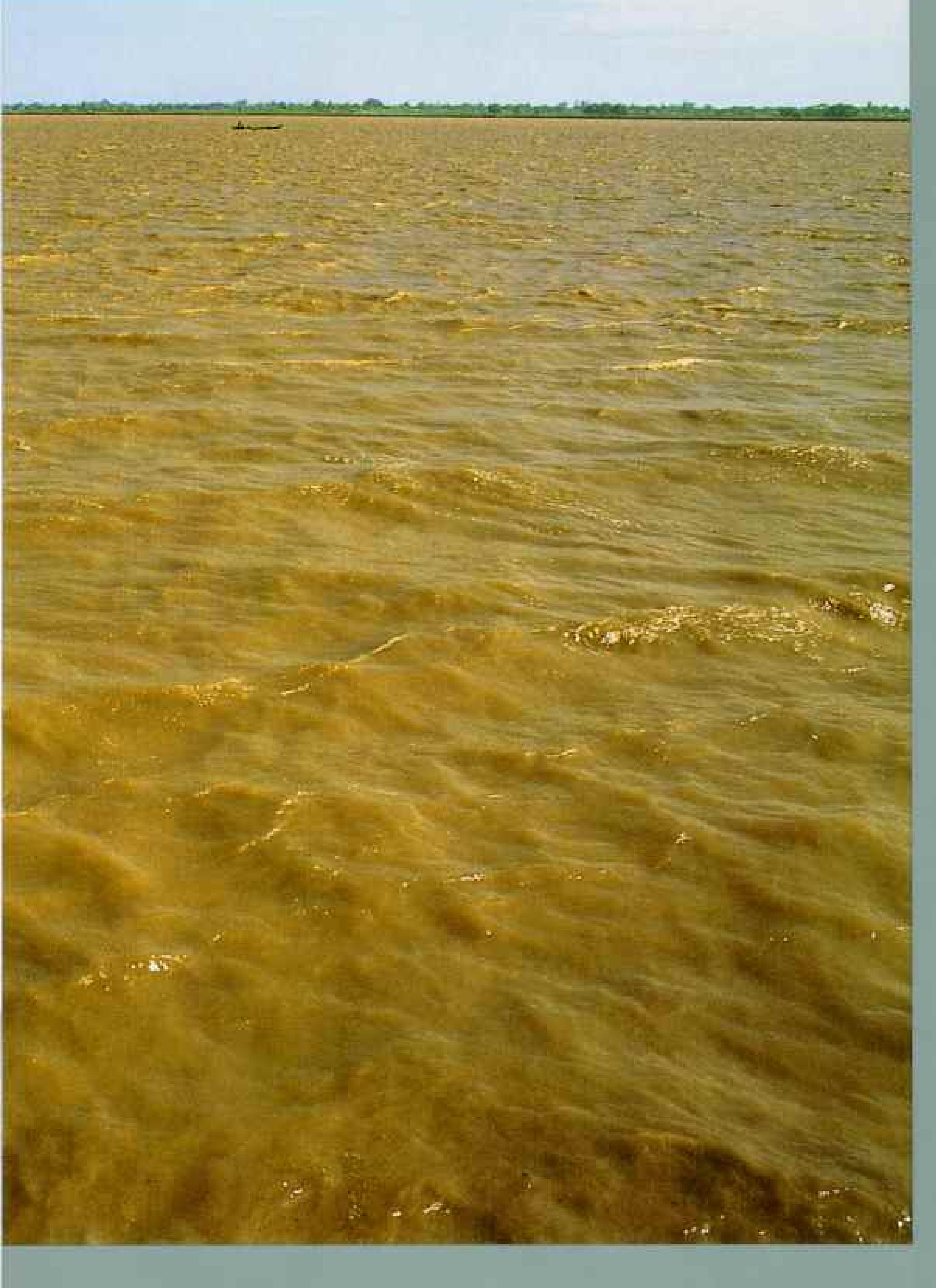
N G

By THOMAS O'NEILL
NATIONAL GEOGRAPHIC EDITORIAL STAFF
PHOTOGRAPHS BY MICHAEL S. YAMASHITA

FROM ITS REMOTE ORIGINS *in western China to its teeming delta in Vietnam, where boats mob a canal on market day, the Mekong River travels a turbulent, often troubled path. With the waning of war in Southeast Asia, hopes again rise along what has been called the "river of evil memory."*



A FRONTIER OF SWIFT, *silt brown waters, swollen by monsoon rains, opens up before a Cambodian farmer fetching water for crops. Mighty of flow but modest in its uses, the 2,600-mile Mekong, with few bridges and no industrial centers, remains the least developed of Asia's great rivers.*



PROSPERITY BEGINS AT HOME *for Nguyen Van Gang, who raises 27,000 catfish beneath his floating house in Vietnam. Daily he and his daughter open a trapdoor in the living room and fatten the fish for market with handfuls of cooked mush. A stereo and electric clock advertise his success.*

FREE ENTERPRISE BLOOMS *in the Vietnam delta town of Can Tho, where peddlers sell everything from snakes and blue jeans to vivid marigolds. New trade pacts between Mekong nations and land reform in Vietnam and China help fill markets with once scarce goods.*

AT 15,000 FEET on the Plateau of Tibet in China there was nowhere to hide. The snow flew like arrows. The Tibetan herder Meiga, spurring his horse through the storm, searched in vain for a cleft in the earth to shelter us. When visibility dropped to near zero, all we could do was stop and bunch up the horses. Huddled together, heads bowed, we let the storm beat on us.

"A good sign," Meiga said, lifting his dark, high-cheekboned face to the pummeling flakes. "When you approach a holy mountain, the weather is supposed to change suddenly. The river's beginning—it is not far now."

Waiting out the squall, chewing on a piece of dried yak meat offered by Meiga, I thought about what it had taken to come this far, and how much farther there was to go.

My goal was to travel the length of the Mekong, the world's 12th longest river—and the seventh longest in Asia. It begins somewhere in this snowy place and ends 2,600 miles away in the warm shallows of the South China Sea off the coast of Vietnam. It was to be, I knew, a long and difficult journey.

To reach this place, I had traveled a thousand miles by old army jeep from Xining, capital of China's Qinghai Province. The crude, rutted roads had climbed higher and higher, until at 15,000 feet the last road ran out just north of the Tibetan border. There, by a frozen river, stood two great black tents of yak herders. Photographer Mike Yamashita and I pitched our own tents close by.

The herders had watched us arrive, and that afternoon invited us into a tent. It was a dim, smoky place with sleeping blankets piled on the sides. There were Meiga; his wife, Daji, whose long headdress was hung with coral, turquoise, shells, and silver coins that jangled as she moved; six children; and Daji's brother-in-law, Bucairen, old and toothless.

Daji served us a doughy, pancake-like bread made from barley flour. Bucairen poured cups of scalding salted tea. We asked him about the Mekong's source.

"There are two sources," he said, stoking a fire of yak dung, the eye-watering smoke escaping through a hole in the roof. "There is the mountain source, high on a glacier. No one goes there. And there is the spiritual source, behind a holy mountain."

Meiga added: "We herders believe that a spirit named Zajiadujiawangzha—we call it a dragon—inhabits the holy mountain and keeps safe the source of the waters. We believe that if you drink the source water, you will live a long life. Animals drink it too. This river is the blood that runs into our bodies." He agreed to take us to the holy source, 25 miles to the north, the next morning.

At dawn we saddled up, fingers numb from cold. We rode short, stocky Mongolian horses, their long manes scattering in the wind. Meiga galloped ahead of us. He made a dashing figure on his ginger horse, a silver brooch pinned to his black headband and a pearl-handled dagger stuck in the belt of his sheepskin coat.

We rode in silence except for the crunch of hoofs on frozen grass and the chiming of bells on the reins. The plain was ringed to the southwest by the sharp, snow-doused peaks of the Tanggula, a range running along the Tibet-Qinghai border. Beyond that mountain wall lay the glacial source of Asia's longest river, the Yangtze, which flows the breadth of China for 4,000 miles. And then the snowstorm struck with the suddenness of an ambush.

Now, as we sheltered behind our horses, I wondered if we would have to turn back. Then the storm lifted, as suddenly as it had come, leaving a bruised gray sky. We rode another hour, coming to a solitary, cone-shaped hill.

"The holy mountain," Meiga said. He reached into a saddlebag and pulled out a stack of colored papers printed with Buddhist scripture. He shouted and flung the prayers high into the air and watched happily as the wind carried them off.

It would soon be my turn to holler. We rode behind the mountain and found in a shallow draw a sheet of ice some 300 yards long—shaped like an hourglass. Crouching down on the frozen surface, I could hear below a trickle of water. It was the beginning notes of the Mekong. Mike and I were, as far as I can discover, the first Western journalists to hear them.

I followed the ice until the water broke free and curled off across the desolate landscape. All of us, horses and humans, bent down to drink to our long lives. My shout was of the finest, rarefied breath.

From its source, the Mekong travels about half its length in China; then it borders or moves through Myanmar (formerly Burma), Laos, Thailand, Cambodia, and Vietnam. I would find it called by many names: River of Stone, Dragon Running River, Turbulent River, Mother River Khong, Big Water, the

Called the "sacred source" by local herders, a frozen stream high on the Plateau of Tibet in China's Qinghai Province marks the westernmost headwaters of the Mekong. Come to offer prayers, Meiga, a Tibetan herder, searches for a campsite out of the wind.

Nine Dragons. Along it empires, kingdoms, and colonial realms have risen and fallen; successor states have been plunged into war and bloodshed. Death and hardship are its legacy.

THROUGH IT ALL the Mekong has remained wild and free, moving to immemorial rhythms: the monsoon, the flood, the giving of its waters to nourish the lands and people along it. For all its length, it has spawned only one metropolis, one dam, few bridges, and no industrial complex.

But this, I would discover, is changing. For the first time in half a century the guns—or most of them—are silent. Governments, long isolated and with impoverished populations, are cracking open their borders and seeking foreign capital and development. The Mekong has a role to play; it may be harnessed, changed, wild no more; so too the lives of the people along it.

When I next saw the river, a hundred miles downstream in the dusty town of Zadoi, dozens more arteries from the high mountains had transformed the icy trickle into a hundred-foot-wide torrent of clay brown water.

My jeep, its springs broken, limped into Zadoi one afternoon, the driver bullying bicyclists and yaks out of the way with his horn. The town consisted of a scattering of mud-brick dwellings and a few grim, barrack-style government buildings.

Old women shuffled along with prayer wheels spinning in their hands. Young men lounged at an outdoor pool hall. They laughed as a small clot of men carrying shovels were herded along the road toward prison after a day of roadwork.

A town official apologized for the lack of amenities and recreational activities. However, he added, 75 percent of the houses had TV sets. Each evening the satellite dish picked up two channels from Beijing. I slept in a government rest house. The room had five beds, a coal stove, and a cement floor. Because of a

power failure I read with a small flashlight.

The next day I headed for the 500-year-old Zao Qin monastery located a few miles downstream, nestled on a mountainside. I was met by a monk in a heavy purple robe.

The compound, he told me, held 50 monks who study the precepts of Lamaism, a form of Mahayana Buddhism practiced by Tibetans. The monastery, like others, had been boarded up for ten years during China's Cultural Revolution and was reopened in 1979.

As we approached the study hall, a man with a wispy white beard hobbled toward us with a cane. He was the master lama, Tudinangjia. He had entered the monastery at age 8, had become master at 29, and was now 70.

Many of the young monks followed us into the study hall. With their shaved heads, dirty faces, and curious expressions, they suggested the innocence and shyness of Boy Scouts.

Tudinangjia settled himself cross-legged on a low platform. His eyes looked young and luminous. He told us that the monks' day begins at dawn; they read scripture, study various disciplines, pray. The master's task was "to love people, to master the scriptures, to memorize them so you can teach."

As I was escorted down the hill, I asked a monk what would happen to old Tudinangjia when he dies. "The master will be cremated. The other monks will have sky burial," he said. In sky burial, he explained, the body is broken into small pieces and left on the ground for vultures to consume. "It is our belief that a monk should make his body a gift to another living creature."

He pointed across the monastery grounds. Five or six mangy gray vultures were greedily picking over bones. "Yak bones," he said. "We feed the vultures so they stay here. Then they are ready when we are ready."

I LOST TRACK OF THE MEKONG for the next 500 miles. Chinese officials withdrew permission for me to travel through Tibet and the northern third of Yunnan Province. This area holds the river's most spectacular stretch; it tumbles through canyons two miles deep.

The authorities, I learned later, ordered the detour because they did not want foreigners to witness the concentration of troops ordered into the region or any antigovernment demonstrations that might break out. The

White water for its first thousand miles, the Mekong, known in China as the Lancang Jiang, or "turbulent river," seethes through a canyon in Yunnan Province. Downstream rises the new Manwan dam, the first and only hydroelectric station on the river.

A river with promises to keep

OVERSHADOWED by a half century of war, beginning with World War II battles along the Burma Road in China and climaxing with a 1991 peace accord in Cambodia, the Mekong figures brightly in the region's plans. Free-flowing trade has resumed between capitalist Thailand and communist Laos. In 1994 a bridge will link the two countries for the first time.

The United Nations-sponsored Mekong Committee has proposed a series of dams for the lower river, though the specter of large population resettlements may sink the scheme.

Cambodia plans greater exploitation of the rich fisheries of Tonle Sap near Angkor, the seat of the ancient Khmer Empire.

Vietnam, still recovering from wars with France and the United States, envisions new irrigation projects to increase its store of rice.

occasion for possible unrest: the 40th anniversary of communist China's takeover of Tibet.

When I resumed my travels in Yunnan, I found the river difficult to follow. Roads kept away from it. The few tracks that did venture toward the water usually ended on a cliff overlooking rapids. When I gained a glimpse of the river 20 miles west of the large lead-mining center at Lanping, the water poured furiously between steep 3,000-foot-high canyon walls.

The Chinese have strung simple bridges across it. At one spot the bridge was nothing but a steel cable. I watched adults and children from a nearby village attach themselves to slings and slide like acrobats over the white water.

The oldest of the half dozen vehicular bridges over the Mekong—all of them in China—stands at Baoshan, near Myanmar. It is the battered, metal-floored Gong Guo Bridge, erected in the 1930s as a key link on the Burma Road, the mountainous backdoor supply route into China during World War II.

Chinese officials believe that the bridge serves as a link for drug traffickers bringing heroin into China from Myanmar. No checkpoint was in sight; the police wait instead at mountain passes. In an hour I saw only two antique trucks rumble across.

SOME 125 MILES DOWNSTREAM from the bridge rises the lone dam on the Mekong. I had been traveling along a narrow, bamboo-fringed road, my driver slowing occasionally to pass a barefoot hunter with a flintlock rifle, when suddenly a concrete wall 35 stories high rose from the riverbed between two mountains.

Its front and back were cobwebbed with scaffolding on which hung the tiny figures of workers. Forty-foot-high tunnels—the floodwater channels—bore through the mountainside. The river itself had been led like a leashed dog into a sluiceway where it leaped and foamed against its confines.

This was the Manwan dam. In 1995, when completed, it is expected to provide 1,500 megawatts of power for new mines and industries near Yunnan's capital, Kunming.

"This river is like a rich mine," said site boss You Wan Long. "The volume of water is enormous." Over the next three decades China hopes to build eight more dams on the Mekong to spur development in one of its most backward regions. The reservoirs would extend like stepping-stones for 300 miles, from the China-Laos border to the north.

At Jinghong, some 30 miles from China's southern border, I realized I had reached the tropics. The market was flush with papayas, coconuts, and pineapples. Women of the Dai ethnic group wore the colors of butterflies and birds—bright orange, blue, pink.

Villagers, instead of fearing or ignoring the river, now welcomed it. Boys cannonballed into the river from a high bank. Women rinsed clothes and soaped their hair in it. Some filled their sarongs with air and floated in the sun-warmed shallows with the ease of lily pads.

At Jinghong one evening I joined the tide of bicyclists who headed to the Mekong bridge to cool off in the river breezes. Beneath us men and boys plied the river on inner tubes, gathering driftwood they would sell in town.

"In this part of the world," said my government guide, Mr. Ai Zhen, "nothing is wasted." Exactly so, I thought. In China the Mekong too must work; its days as a wild and turbulent river are coming to an end.

Leaving China, the Mekong slides between Myanmar and Laos, serving as the border, then touches Thailand. Here—where these three countries meet—lies the heart of the fabled Golden Triangle, where most of the world's opium is harvested and processed. It has long been an area of warlords and armed mule caravans carrying bales of opium paste.

When I reached Sob Ruak, a Thai hamlet on the Mekong at the very center of the triangle, I found not mule caravans but big, shiny buses and European tourists. On the hillside stood two resort hotels; a third was under way on the Myanmar shore.

The Thai military had pushed the drug refineries and mule trains out of the area. To replace the opium economy, tourism. Visitors fly from Bangkok to Chiang Rai, 40 miles south of Sob Ruak. They then bus here. Between November and May—the dry season—the two resort hotels are fully booked.

"It's the infamy of the place that draws them," said Marc Cremoux, the dapper French manager of the Baan Boran, one of the hotels. "I hear my visitors say, 'This is where the drugs come from.' That gives this destination a buzz. People think they're having an adventure, even if they are staying in a five-star hotel and riding in air-conditioned buses."

Crime, or at least the aura of it, still pays.

Drifting away, a Hmong farmer prepares another bowl of opium, a ritual pleasure in the Golden Triangle, where the Mekong borders Thailand, Laos, and Myanmar. This lawless highland region supplies the bulk of the world's heroin, an opium derivative.

FROM THE GOLDEN TRIANGLE, the Mekong plunges east into the jungle highlands of Laos, becoming once again a wilderness river. Laos is the size of Great Britain but holds only four and a half million people. It is mountainous, forested, historically poor, and isolated. The Mekong is its door to the world.

Laos has been governed since 1975 by the Pathet Lao communist party, which recently began to soften its hard line. The river border with Thailand has been opened once again; free enterprise and foreign investment have been allowed. But Laos is still nervous about Western journalists.

One of the few places the Laotian government permitted me to visit on the Mekong was a riverside shrine in the north where statues of Buddha outnumber the humans who pass by in a month. The 7,000 statues inhabit the Pak-Ou caves, two ragged openings on the lower face of a limestone scarp, 20 miles upriver from the old royal capital of Louangphrabang.

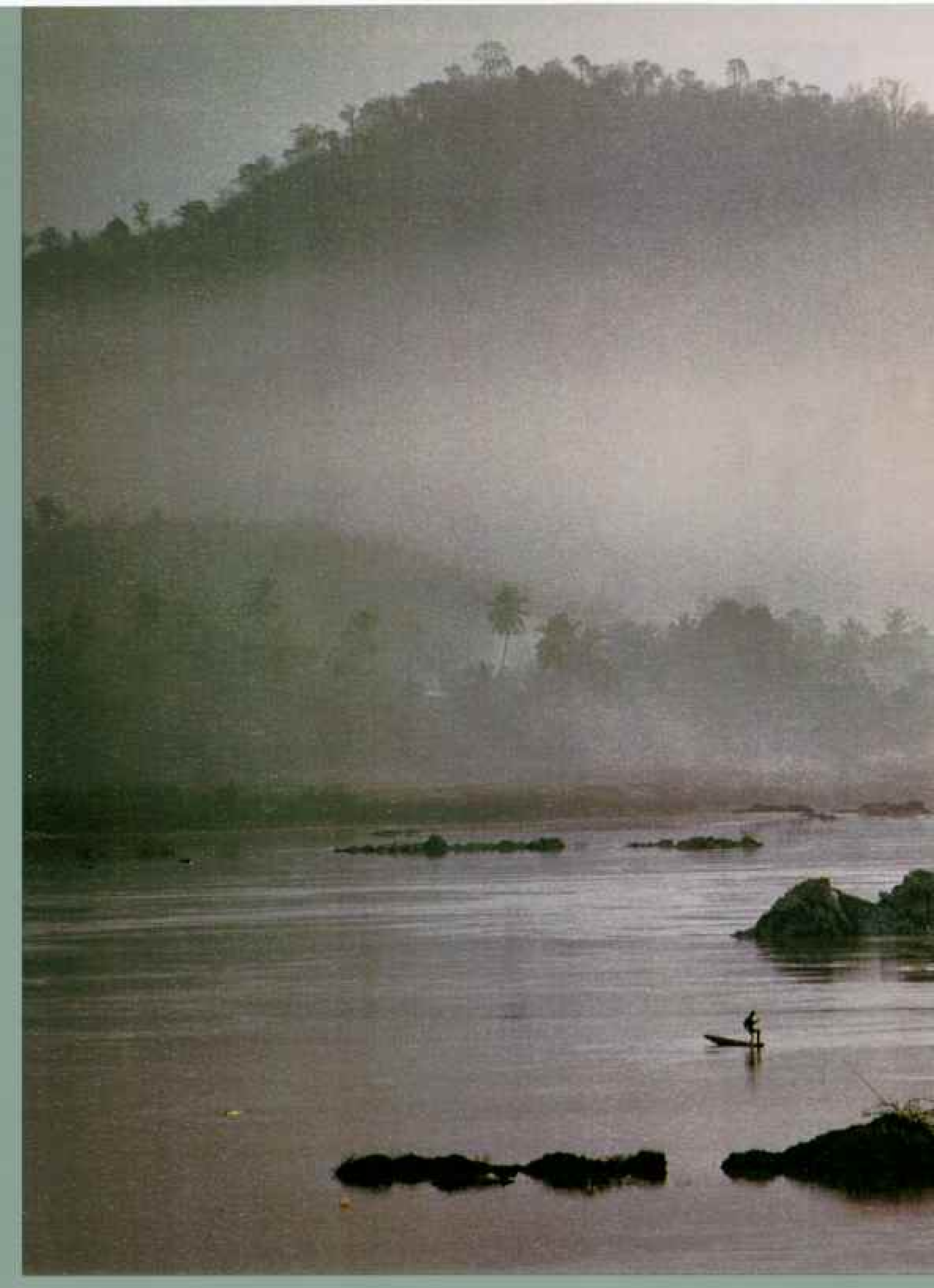
Our boat pulled ashore, and I followed my young government guide, Thong Chanh, up the steep stairs. We entered a cool, musty dimness. Hundreds of Buddhas, most no taller than two feet, stood on ledges facing the Mekong; erect and still, they seemed like a huge choral group ready to launch into song.

Chanh took off his baseball cap in their presence. "The people of Louangphrabang started bringing these statues here in the 16th century when the capital was under attack," he said. "Ever since then, during Pi Mai, our New Year's festival in April, villagers have come back with flowers and perfumed water to clean the statues."

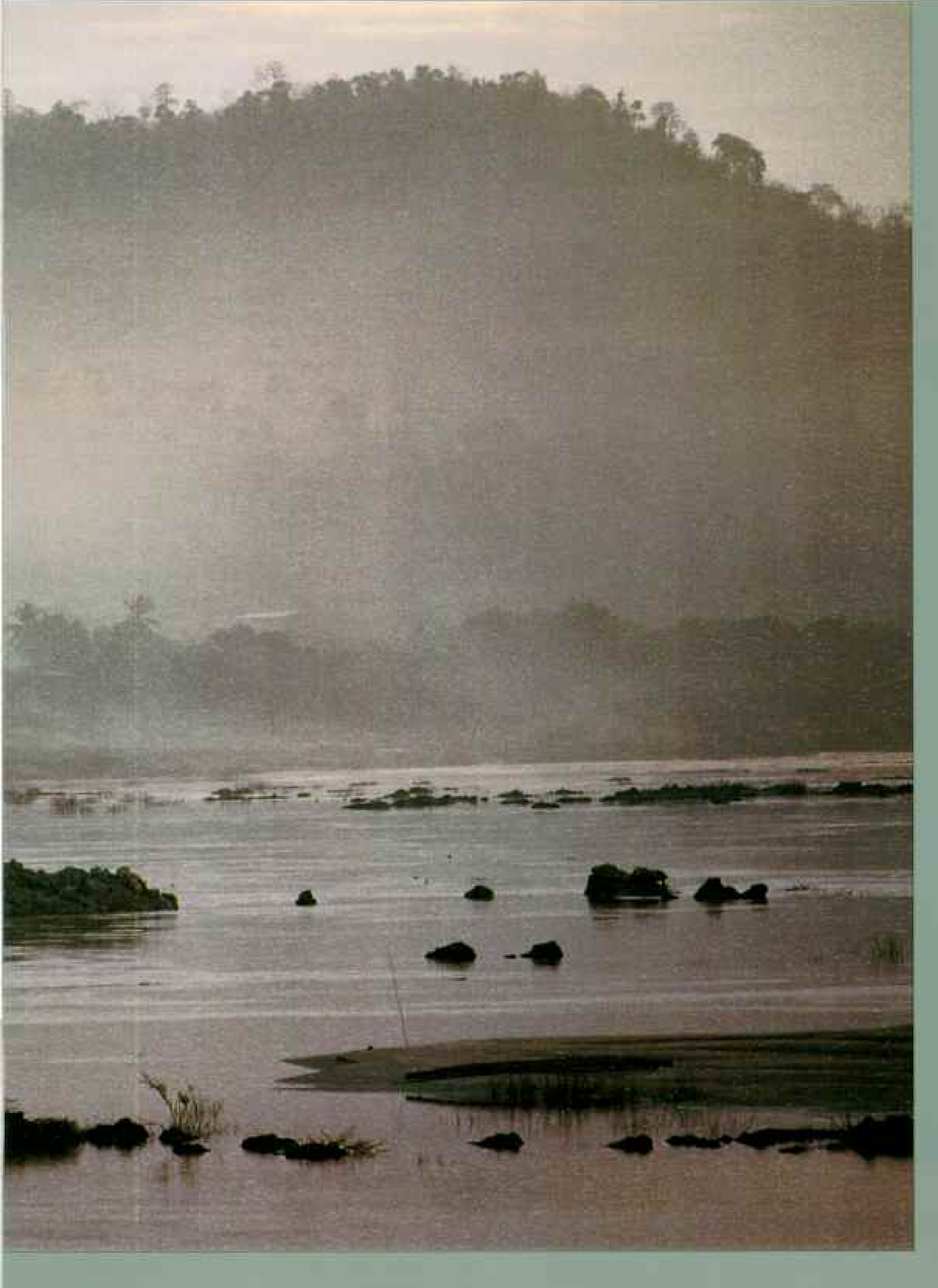
Most of the statues were chipped or cracked and covered with cobwebs and dust. Still, the combined force of all those benign Buddha smiles seemed to shower the brown river below with a sense of peace, something I rarely felt anywhere else along its restless path.

On the boat trip back, Chanh suggested we visit his childhood village of Ban Don. When we reached it, villagers on the riverbank were hoeing and watering wispy green plots of onions, peanuts, potatoes, corn, and cabbage. But the soft sound of hoes striking the ground was quickly replaced by the banging of metal on metal. "This is a village of blacksmiths," Chanh said as he hurried up a dirt lane.

He found his 70-year-old father squatting



GUIDED BY FIRST LIGHT, *a fisherman plies the rock-studded Mekong on the Laos-Thailand border. In the dry season of November to May, when the river may drop 40 feet, exposed rocks and the lack of channel markers prevent even smugglers from navigating after dark.*



under a lean-to, pounding a heated slab of steel into a machete blade. Silvery flecks of metal glinted on his chest and back. "I must make ten blades today," the old man said. "People will be coming from the interior soon to buy them so they can cut their wood, bamboo, grass, and rice."

Chanh's mother, hearing our voices, emerged from a dirt-floored house. She thrust her wrinkled face only inches from Chanh's and slowly smiled. "It's you," the near-blind woman said. She ordered a daughter to fix *kao nom kok,* rice pancakes sprinkled with coconut. The mother then sank to the ground near her husband and began filing a blade.

"They work so hard every day," Chanh said. "Even the fishing is poor this year." Chanh pulled his cap lower. "Maybe someday I can help them. But I have so little too."

Two hundred miles downstream from the old royal capital, the Mekong emerges from the interior once again to form the border with Thailand. Another hundred miles downriver lies the modern capital of Vientiane. It is a modest, earth-colored city of some 125,000 people. Its buildings are mainly one story. I liked to walk by the river in the mornings, watching the armada of small ferries moving between Vientiane and the Thai port of Nong Khai, a few miles downstream. Laotians jammed each boat, clutching empty suitcases and folded bags on their way to Nong Khai, returning with suitcases and bags bulging with the wondrous, modern things they had bought. It has been like this since the border opened to free trade in 1989. A bridge will join the two countries in 1994.

The ferries quit at noon for two hours so the Laotians, to the bemusement of the hustling Thais, can take a siesta. At two o'clock the streets come alive again with motorbikes and pedestrians. The English words "Import-Export" are emblazoned on signs hung everywhere in the city's commercial district. Since the ban on foreign investment was lifted in 1987, some 225 joint ventures—mostly clothing factories and trading companies—have been established, mainly with Thai capital.

The dream of 19th-century French explorers to use the Mekong as a trade route to China was dashed on obstacles like Khone Falls, a six-mile chain of cataracts in southern Laos. Migrating fish make the passage, including the pla buk, or giant catfish. It grows to nine feet and can weigh as much as 650 pounds.

Chanthao Pathammavong, president of Lao Intertrade Company, Ltd, does business with a Lao flavor. She asks guests to remove their shoes, and she wears the *sin,* the traditional wraparound skirt.

"We have so much to learn," says the 45-year-old woman, who once worked at the

state-run central bank. "We must deal with quality control, property laws, long-term loans, market research. We're allowed now to make profits, but the government still takes 45 percent—that's quite high."

A street-level showroom displays her wares—air conditioners, photocopiers, water pumps—all imported from Thailand. Her exports are salted water buffalo meat and cow hides for a tannery in Thailand.

Like many Laotians, she worries that Thailand—with its population of 56 million and its dynamic economy—will overwhelm her country. "We don't want to import all our lives," she told me. "We prefer to build an independent economy, but it will take a long time."

All Laos has to sell abroad, experts believe, is hydroelectric power. Most of the Mekong's energy potential lies within that country.

Recently a United Nations-sponsored development agency in Bangkok, the Mekong Committee, resurrected plans for the construction of four giant hydroelectric dams on the lower river. The first under consideration would be the Pa Mong Dam, 12 miles upstream from Vientiane. The dam would cost 2.8 billion dollars. Its reservoir would submerge the land and homes of 60,000 people.

Thai critics say the dams would disrupt flood cycles and fish migrations—and that the number of villagers uprooted is unacceptably high.

The decisions will be made by the members of the Mekong Committee—Laos, Thailand, Cambodia, Vietnam, and perhaps China, which has shown some interest in joining.

"We haven't decided on Pa Mong yet," an official of the Lao National Mekong Committee told me in Vientiane. "There are many problems. But it's difficult for us to export agricultural or timber products, and very easy to export electricity. We have a big market at hand—Thailand. I don't see any other way to get currency."

THE MEKONG exits Laos spectacularly, foaming and plunging through a six-mile-long run of cataracts known as Khone Falls. As the river descends into Cambodia it changes. No longer as taut and muscular, it becomes a hefty, broad-backed river, two to three miles wide. The landscape too has flattened out, and tributaries—the Kong, the San, the Srepok, the Krieng—swell the river's volume.

When I first talked with government officials in Phnom Penh, capital of Cambodia, they were reluctant to allow me to travel on the Mekong, especially in the north. Forces of the Khmer Rouge, the dreaded political party that ruled the country for four blood-drenched years, were raiding villages.

These forces had signed a peace accord, but they were still armed. During the reign of the Khmer Rouge a million Cambodians, or one-eighth of the population, perished through killings or enforced hardship.

But I persisted, and the officials relented, and so I traveled a northern stretch of the Mekong in a speedboat—"the better to dodge bullets." The officials with me all carried pistols in pockets or briefcases. The boat driver had an AK-47 at his feet.

It was a lonely stretch, with villages 20 or 30 miles apart. There was no traffic, except for a few ferries, the passengers swinging listlessly in hammocks. Downpours came and went, washing off our sweat.

Then, on a hot afternoon, we felt a fresh breeze hitting our faces, and wavelets began to bump the boat. The wind had changed. The monsoon that blows constantly from the Indian Ocean from May to September now yielded to the drier, cooler monsoon from Mongolia. The rainy season was over, a new planting season heralded.

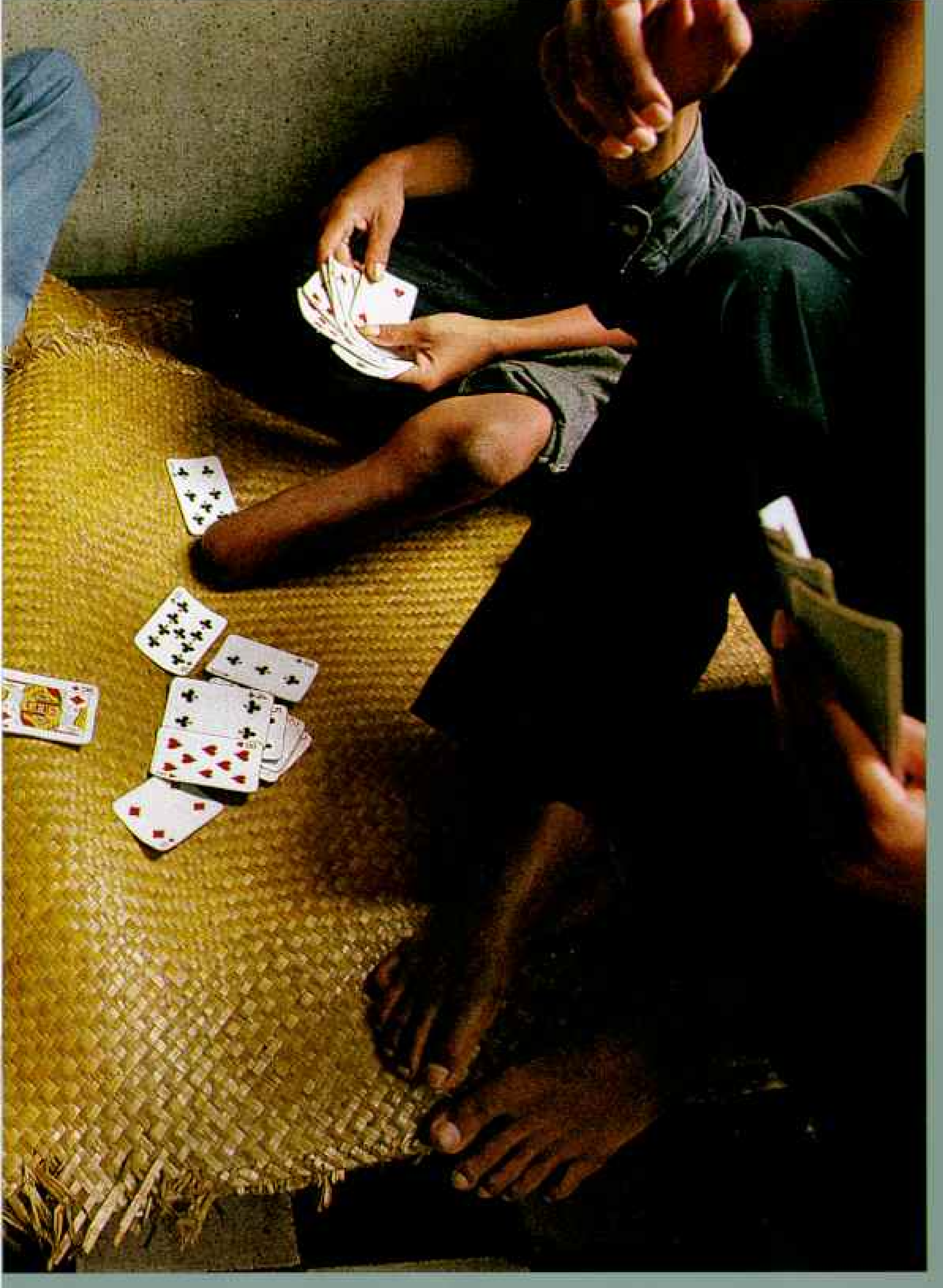
Fish had begun their annual migration northward. From a village, men and women came down to wade in the river and to harvest these migrants with scoop nets. The small, silvery fish flashed as they appeared in the nets.

The villagers chattered with excitement: "Now the crabs and frogs will taste better," said one. "Even the thunder sounds different," said another. For the moment, caught up in nature's drama, pistols, AK-47, even the Khmer Rouge were forgotten.

But Cambodia works hard not to forget the dark days of the Khmer Rouge. In the city of Kompong Cham, 50 miles northeast of Phnom Penh, a local official took me to see its "killing field." All large- and medium-size towns in Cambodia have a killing field; they are the places where the Khmer Rouge rounded up enemies and murdered them.

We drove to a hilltop pagoda and walked down to a field choked with brambles. "There were more than 300 mass graves here," the official said. "The large ones held between 150 and 200 people. The Khmer Rouge gathered people from all *(Continued on page 24)*

LUCKY TO BE ALIVE, *soldiers who lost legs to land mines convalesce at a military hospital in Phnom Penh, Cambodia's capital. Though rebel factions and government troops have agreed to a truce after more than a decade of war, hundreds of thousands of mines still blight the land.*



INTIMATE WITH THE RIVER, *sisters bathe in the warm, waste-polluted waters off the Phnom Penh embankment. Shacks and rusty freighters share the riverfront with luxury hotels and prostitute-thick discotheques. With 950,000 people, Phnom Penh is the Mekong's largest city.*

around and brought them here. They could have been intellectuals, government officials, rich businessmen, or just people difficult to deal with. They were blindfolded, put in a line, and then beaten with steel pipes, axes, and sticks, until they died.

"There were thousands of people killed here. We removed ten oxcarts of bones." Walking through the brush, I could see bits of bone and clothing on the ground. It was terrible. I half-expected the birds in the trees to stop chirping and begin screaming with human voices.

A shed at the edge of the field held skulls, heaped on the floor like fallen bricks. "Let's leave," said Men Saman, my escort from Phnom Penh. Memories overwhelmed him: "All I can think of is eating insects and lizards, of always being hungry. And then I start thinking of my brothers and sisters who died of starvation. I don't want to be here."

PHNOM PENH, a city of 950,000, looked worn and bedraggled, like a thing left out too long in the rain. The walls of its once elegant French-style villas and balconied shop fronts are scabby from mold and disrepair. A bridge blasted apart during fighting in 1972 remains blasted apart. The docks hold rusting freighters with no goods to carry.

When the Khmer Rouge marched into the city in April 1975, they promptly emptied it of its people, sending them to labor farms, prisons, or death. Now city and country try to rebuild. A peace agreement was signed in 1991 between the government, the Khmer Rouge, and two other guerrilla groups. Elections were set for May 1993. Twenty thousand United Nations peacekeeping forces would arrive to help preserve the fragile truce.

In 1991 the government also stopped describing itself as communist and began to privatize the economy. There were signs of change. The country's beloved Prince Norodom Sihanouk returned to the royal palace. A Singaporean freighter rode at anchor, stacked with new Japanese cars. At the new Hotel Cambodiana businessmen from Japan, Singapore, Thailand, Malaysia, and other Asian nations arrived to seek deals.

I was interested in the resurgent life of the city. Phnom Penh, I discovered, is movie mad. The lines outside the theaters on Achar Mean Boulevard, the main thoroughfare, spill out to block traffic. One matinee idol is Khay Praseth, star of *Naughty Boys*. His handsome, sleepy-eyed face moons down from posters all over the city. I met him as he rehearsed for his newest romance at a villa on the city outskirts.

"I never stop," Khay told me, as he applied makeup. "I've made probably a hundred films in the past three years." Seeing my astounded look, he said with a bored voice, "Yes, when I walk outside, most everyone recognizes me, especially the girls." The interview is cut short. Khay must hop into a bed and be surprised by an invisible girlfriend . . . or something like that. I didn't get it clear.

One afternoon I wandered onto "English Street," a block of weathered two-story buildings not far from the royal palace. Between five and six o'clock on weekdays the street fills with teenagers on bicycles and motor scooters. They come straight from school in their uniforms of white shirts and dark pants or skirts. They gather under signs reading "Essential English Lessons Offered Here."

One lad explained: "We don't want to speak French like our parents. Now it's English . . . the language of business."

I followed two dozen students up steps into a room filled with desks. Lizards played tag on the walls. The teacher was a skinny young man, Ney Youda, a journalist. He had been offering this course for two years.

With his charges bent over their tattered textbooks, Ney Youda read in fractured English a story called "Margaret Priestley's Birthday Morning." He had barely begun when the single light bulb flickered off, throwing the room into blackness. No one groaned. Two girls stood up and by feel lit oil lamps on the wall.

For the next hour, as the class learned about a prim British schoolgirl and her special day, the electricity would come back on, but never for more than a few minutes. "It's like this every night," Ney Youda said. "Last year we had no electricity at all. But please, now you teach us something."

Taken by surprise, I groped for a phrase. The words "the pen is mightier than the sword" leaped to mind. I scrawled it across the blackboard. What did it mean, the young people asked after they had repeated it several times. "That books can teach you things that guns cannot," I answered. Thinking of the killing fields, I wondered if I was convincing.

Then the hour was up. Each student

Rise and fall of the Mekong is a yearly upheaval in southern Cambodia, compelling its people to live on stilts. In 1991 one of the worst floods in memory arrived. The river rose 25 feet, and thousands of acres of paddy fields were ruined. Yet a stilt house—and its precious antenna—stood safely in the drowned landscape. Four months later the water had retreated, the fields revived by a coating of fertile silt.

dropped 150 riel—a few cents—onto a desktop and hurried home, perhaps a few new words closer to leading a better life.

Phnom Penh's streets are often crowded, but the largest crowds appear on Prachem Ben, the Buddhist Day of the Dead. In torrid heat, cars, scooters, and bikes headed toward the city's wats. Outside the main temple of Wat Ounalom, near the riverfront, my guide Men Saman explained the observance: "All the dead come to the pagodas on this day to find their families. If the relatives can't be found, they will be scolded by the spirits and won't be successful in business."

We passed the outstretched hands of beggars, many of them former soldiers crippled by land mines in the countryside; there were also children, driven from their villages by summer floods that had turned the southern part of the country into a great pond.

We followed people, mostly women in dark sarongs and white blouses, into the temple. They carried canisters of rice and bowls of bananas, chicken, fish, bread, and eggs. In the cool, high-ceilinged sanctuary they laid the food at the feet of monks who intoned the names of the dead and said a prayer for each.

With all the dead that needed to be recognized, I had expected a sorrowful atmosphere. Yet many families, after making their offerings, spread themselves out on the temple floor and, under the sweet gaze of the gigantic Buddha, ate and talked as if at a picnic in the park. On the temple steps, laughing families posed for photographs. An elderly woman, catching my eye, cried out, "Eat, eat," and offered me

AT A CROSSROADS OF WATER, *boats flock to a floating market along the banks of Phung Hiep in Vietnam. In the flat, steamy delta, where more than a fifth of Vietnam's 69 million people crowd, 2,000 miles of streams and canals rival the total length of the Mekong.*

A fine-feathered cargo of live ducks heads to market at Can Tho along one of the delta's few hard-top roads. During the flood season, vehicles weave around endless patches of drying rice, the roadbeds serving as the only high ground.

a bowl of fish curry. I shared her food, after which she said in farewell, "May you live a long life." It was, of course, an old and traditional Cambodian blessing, but after all I had seen and heard about the Khmer Rouge years, it pierced my heart.

FOR MORE THAN 2,000 MILES the Mekong had seemed an aloof, single-minded river, rushing with a minimum of twists and turns toward the sea, only lightly touched by the communities scattered along it.

In Vietnam, the river luxuriates and sprawls. It enters the country in two channels, which the Vietnamese call the Tien Giang (Upper River) and the Hau Giang (Lower River). As it traverses the vast and soggy delta—15,500 square miles—it divides again. By the time it empties into the China Sea, it has seven branches. Two others silted up over the years, but the Vietnamese, mindful that the number nine is auspicious, still call the river here the Cuu Long, or Nine Dragons.

Countless small streams and canals feed into and out of the dragons; the length of the delta waterways is estimated at 2,000 miles, nearly the length of the river itself. These are the main streets, back roads, and irrigation canals of the delta. Rarely are they empty. Vietnam is the most densely populated country in Southeast Asia, and more than a fifth of its 69 million people crowd into the delta. They supply Vietnam, the world's third leading rice exporter, with almost half its crop.

I reached the town of Phung Hiep, in the delta's midsection, on market day. Seven channels meet here, and from all seven came pirogues bearing bananas, coconuts, papayas, pumpkins, bitter melons.

The small boats, each steered by a person standing in the stern and working a set of oars, nimbly glided up to larger boats where merchants, scales at the ready, bargained for the produce. Like a litter of puppies mobbing their mother, the little boats jockeyed for position. Most of the pirogues were handled by women, their faces shaded by conical straw hats. Clustered together they looked like a field of mushrooms on the water.

"Why so many women?" I asked my interpreter, Niem, as my own boat darted to and fro to keep out of harm's way. "They have the patience to bargain," he said. "Look how they move around, seeking the best price."

A mile down one canal I stopped to visit a farm. The boatman pulled into a bank tufted with palms. Before jumping from the boat, I rolled up my pant legs. I had learned that the ground is always wet in the delta. Niem and I slopped through mud and tightroped across a slippery plank before we reached the modest wood-and-stone homestead of Lu Van Hanh.

Hanh had just come in from his rice fields and had been hoisted onto a bed by one of his sons. Both of Hanh's legs were missing from the thigh down. When he saw me glance at his stumps, he said, "I can work as well as any man. I can climb my fruit trees. I don't have to walk; I have dug canals around my fields so I can row a small boat to reach them. Then I push myself around on a board."

Hanh lost his legs fighting as a soldier in the South Vietnamese Army in the delta. "My past wasn't held against me by the government," he said, referring to the victorious communist regime. "They even gave me loans, because they saw how hard I work."

That government was interested in restoring agricultural production to the delta after the war. It encouraged resettlement. Then in the 1980s it abandoned collective farms to allow peasants to lease property for private use. Production boomed.

Hanh's four acres yield three crops of rice a year. The Mekong not only irrigates his land, it also refreshes the soil with silt in floodtime and fills the ditches that hold his shrimp. Last year Hanh harvested 650 pounds of shrimp.

"I came with only empty hands," said Hanh. "After the war this was a wasteland. I had to prepare the fields and dig canals. At that time I was the poorest man in the area. Now I have caught up with most people, and even excel some of them."

NEARLY TWO CENTURIES AGO, in the time of Emperor Gia Long, a scholar from the royal court in Hue journeyed to the region of the Plain of Reeds, a forest of wild grasses and mangrove trees in the northern part of the delta. Returning, the scholar reported: "You must beware of the crocodiles . . . leeches . . . ghosts and spirits." Ghosts remain in the Plain of Reeds, some from what the Vietnamese call "the American war," in which four million people, or a tenth of Vietnam's population, were killed or wounded.

"The Plain of Reeds was an ideal hiding place," said Muoi Nhe, recently retired as governor of Dong Thap Province. He had been a Viet Cong officer and lost an eye to a grenade blast.

We were traveling by boat at night; we had planned to drive, but floods washed out the roads. The pilot steered cautiously, slipping past fish traps dimly lit by gas lamps.

"We were not afraid of anything but chemical warfare," Muoi said. "Then we were helpless." Trying to flush out the Viet Cong, the American forces dug canals to drain the swamps, then sent in planes raining napalm and herbicides to destroy the covering foliage.

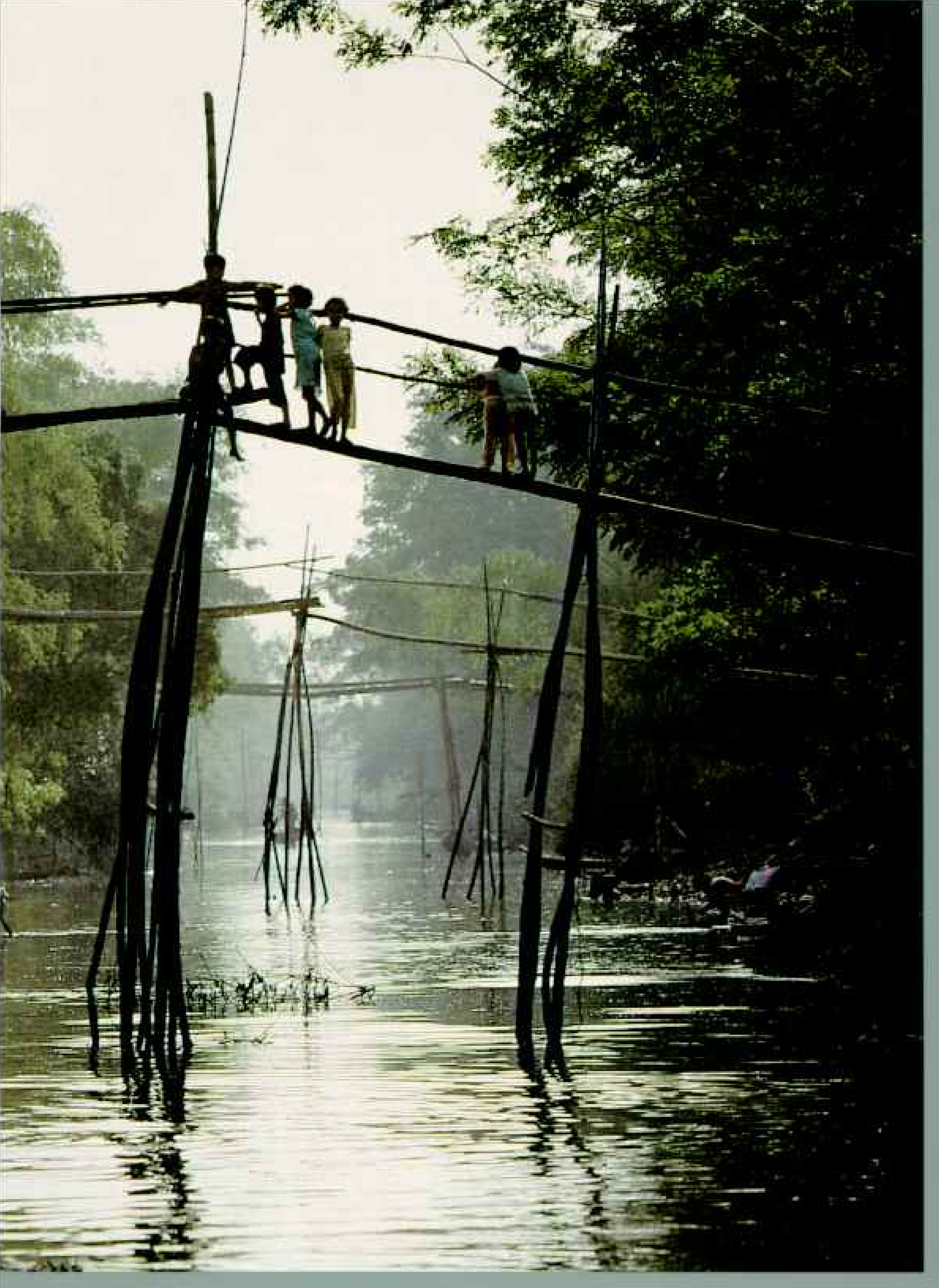
"After the war the Plain of Reeds was still a wilderness, but a poisoned one," Muoi Nhe said. He described how as governor he had ordered the forest replanted and dikes rebuilt to return water to the area.

The next morning in the Tram Chim bird preserve, funded in part by American conservation groups, I saw some of the results of the recovery effort. I was joined by Vo Quy, of the University of Hanoi, a leading ornithologist and conservationist.

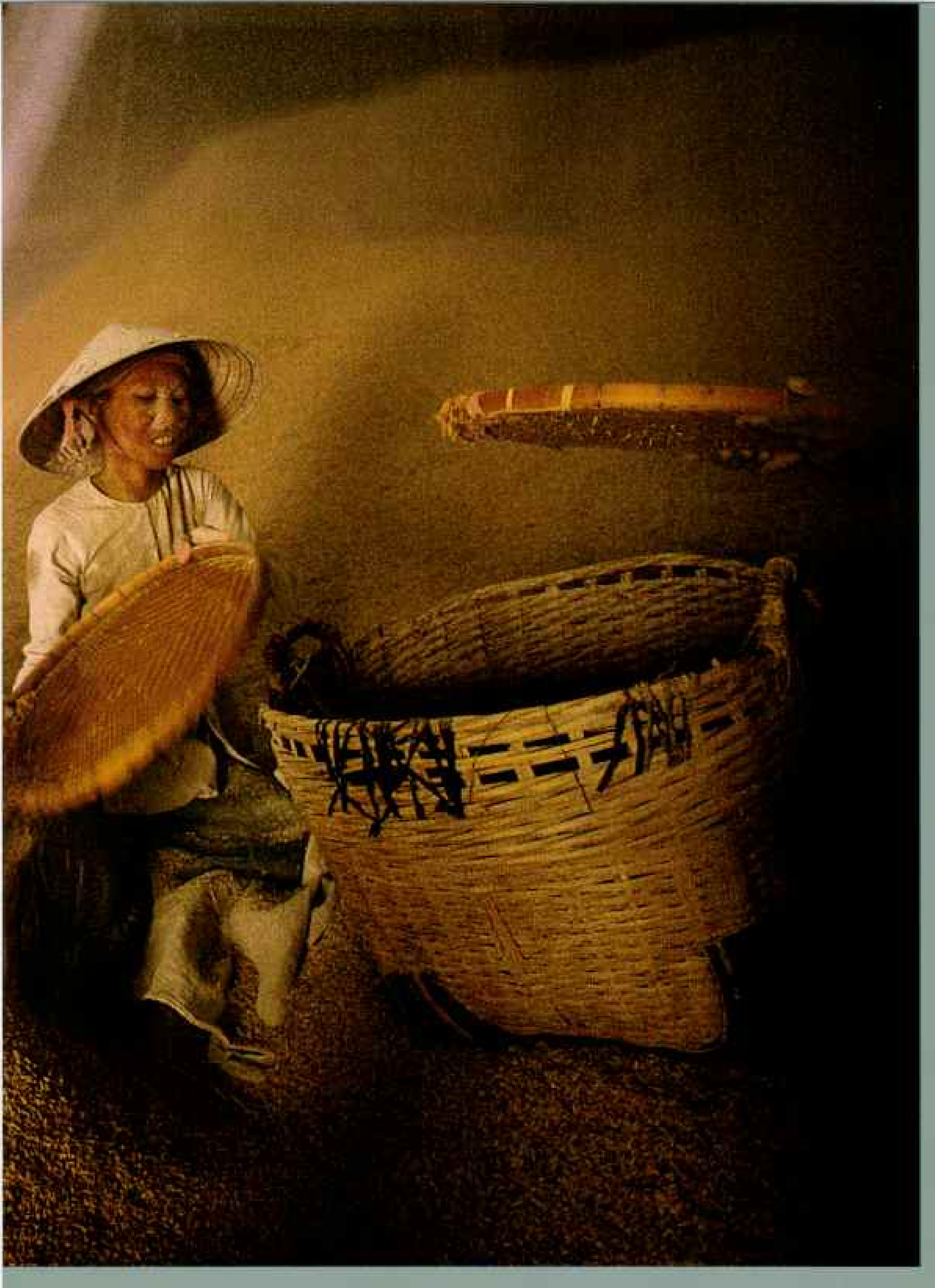
Our dugout glided through a thick bed of reeds, startling gray herons to flight. Dr. Vo Quy pointed to long lines of ducks scrawling overhead, then cupped his ear at a kingfisher's squawk. "Beautiful," I said.

"Yes," he replied, adding that I should return in two months, in January. Then the eastern saurus cranes would have arrived, the last flock in Southeast Asia. A thousand of the five-foot-tall, red-headed cranes now spend the dry season in the forest, eating reeds and fish. They are, he said, "for Vietnamese, a symbol of longevity." *(Continued on page 34)*

SPINDLY BRIDGES *of mangrove and bamboo, lashed together with vines, connect homesteads hidden behind the dense foliage along a canal. During the French and U. S. wars, the delta—with its maze of waterways and expanses of jungle—became a redoubt of guerrilla resistance.*



HARD-PRESSED FAMILIES *sift through the waste products of a rice mill in Soc Trang to find bran for animal feed and husks for cooking fuel. Poverty stalks the delta even as its natural fertility has allowed Vietnam to become the world's third leading rice exporter.*



The herbicide Agent Orange was used by the U. S. forces from 1962 to 1970 to destroy hiding places used by communist troops. It contained dioxin, a chemical now known to be injurious to humans. The contaminant remains in riverbed silt and in the bodies of delta inhabitants.

Vietnamese scientists believe that the increased occurrences of birth defects, miscarriages, various cancers, and nervous-system disorders stem in large part from exposure to Agent Orange. American experts caution that the Vietnamese studies are preliminary and not conclusive. But they have found elevated levels of dioxin in test groups.

For some, the scientific argument is meaningless. In the town of Ca Mau, a noisy, newly built-up place in the southern peninsula of the delta, I was introduced to Lam Nhac Trung, 61, a slight, bespectacled man whose dark eyes seem to grip the listener.

A member of the Chinese community, he makes a living doing calligraphy for other Chinese families in the town. His shop is on the Ganh Hao River, a tentacle of the Mekong. He led me into the back room and motioned toward his 25-year-old son, Khung.

The young man lay on a cot. His body was emaciated and bent into a clawlike shape. His tongue hung from his mouth, his voice only a moan. I stared at his hands. They were beautiful, long, slender, the color of alabaster. His mother had painted the nails red, so that something looked nice.

His father could not remember the year disaster struck—was it 1968 or 1969?—but he'll never forget that day: A large plane came flying over his village, trailing four rows of reeking white smoke that coated the earth.

"Within hours the grass and vegetables began to droop," recounted Trung. "Seven days later all the leaves on the trees had fallen down. My four children, who had been playing outside, came down with fevers. Within two years they were all dead, except Khung.

"He was only a few months old when it happened. But for the past 15 years he can't turn over or go to the bathroom by himself. He almost died last month. There are no modern medicines; I must get traditional ones."

Medical experts familiar with Khung's condition believe that it stems not from Agent Orange but from some other cause, but so pervasive and traumatic was the spraying in the delta that many inhabitants continue to blame it for their disfiguring diseases.

"I want my story told," said Trung. "Someone must be able to help the innocent who have suffered from the war."

Khung began to make gagging noises. His father went and turned him over. He pulled a thin blanket over the twisted-up body, covering everything but the beautiful hands.

AT CA MAU I WAS ONLY 35 miles from open water. I had wanted to ride to the sea on an oceangoing vessel from the port of Can Tho, but government officials denied my request. Now I decided to try it from Ca Mau, in the southern reaches of the delta.

Niem, my interpreter and also my overseer, managed to rustle up a vessel, a 70-foot wooden cargo boat powered by a truck engine. The prow bore eyes painted on each side, the better to see one's way.

Our voyage led us through the U Minh—the "forest of darkness." I was told that the war had denuded the forest, it had been replanted, and that now it is threatened again. A steady stream of boats, large and small, passed us, each laden with wood cut from the forest.

Farther south patches of the forest had been clear-cut, and the raw ground sliced into ditches for shrimp farming. The Japanese, it seems, cannot get enough of *tom xu*, the three-inch tiger shrimp from Vietnamese waters.

The surge of shrimp money has created a boomtown in what was a fishing village, Nam Can. We put into shore and found that life centered around Shrimp Factory Number 29, a state-run processing plant. We arrived at quitting time. Some of the 830 employees were streaming out of the gates. Wages average, I was told, 300,000 dong, or about $25 a month, nearly twice the national per capita income.

Nguyen Truong Giang, 29, vice director of the plant, described its impact on the area. "We've got motels, restaurants, a junior and senior high, and the national power line just reached us! The population of the district has almost doubled, to 82,000."

Nam Can has the look of a boomtown. At night prostitutes in tight dresses hang around the hotel beer garden. Shrill pop music jumps from radios. Young men drift along the waterfront looking for excitement.

There is danger. One morning at the shrimp factory I watched as 700 women in identical white smocks cleaned the shrimp at

Deep in Vietnam's U Minh forest, an extensive mangrove swamp once withered by defoliants, woodcutters seek trees for the foreign market. Just as the forest has healed, so do the people of the Mekong look to the cure of peace.

metal tables. Suddenly their work was interrupted—all had to stand and watch a video on AIDS prevention. Some cases had appeared in town, a manager told me. That night the scenes were the same—in a boomtown, AIDS is just another risk of frontier living.

SOUTH OF NAM CAN, I smelled salt in the air and tasted it in the spray from our prow. But before reaching the sea, Niem decided that our boat must stop at a police checkpoint.

Four policemen came aboard. They said we could approach the mouth but not enter it. They gave no explanation. I was disappointed but not surprised. Traveling on the Mekong had been chancy from the beginning. In every country but Thailand access to the river by Westerners is restricted. Maybe the Mekong makes governments nervous. The powerful river is something they cannot control.

We got within a quarter mile of the river's mouth, close enough to see the congestion of fishnets, to run aground on sandbars, and to glimpse the Gulf of Thailand beyond. Then the police ordered the captain to turn back.

Twilight came as we headed back to Ca Mau. Giant fruit bats swept across the darkening sky. Night herons flew toward the mud flats. Soon we fell into a slow current of boats, joining fishermen, timber cutters, schoolchildren, marketgoers, all sharing in the age-old rhythm of travel on the Mekong.

With darkness it was almost possible to forget the shadows of war and turmoil that have fallen so often across these ancient lands, and to imagine instead the waters of the Mekong flowing like a bright dragon—a benign, powerful, life-giving spirit—through the heart of Southeast Asia. □

Venus Revealed

By WILLIAM NEWCOTT
NATIONAL GEOGRAPHIC EDITORIAL STAFF

Images by NASA / JET PROPULSION LABORATORY

She yielded her secrets reluctantly. Our nearest neighbor, the planet Venus—nearly identical to Earth in size and density—veils herself in clouds and a crushing atmosphere. Now radar images from the Magellan spacecraft reveal with unprecedented clarity the planet's fractured plains, volcanoes, and crumpled landmasses.

ADDITIONAL IMAGE PROCESSING BY DAVID P. ANDERSON, SOUTHERN METHODIST UNIVERSITY

WELCOME TO VENUS. As if gliding some four miles above the alien landscape in an aircraft, we behold a vista 600 miles wide at the horizon (right). Below us lies a volcano, Sapas Mons. Hundreds of miles away, beyond a vast lava plain, towers five-mile-high Maat Mons, another of the planet's thousands of volcanoes.

This remarkable perspective was created from radar data sent back by the Magellan spacecraft and processed using advanced computer technology. It is better than being there. Were our planet-hopping aircraft actually to brave Venus's atmosphere, piercing the thick clouds of sulfuric acid that blanket the planet, we'd be incinerated by temperatures similar to those in a self-cleaning oven.

It is infinitely unlikely any earthling will ever take one small step for man on the surface of Venus. In its first two years of operation, however, Magellan has given us a more detailed and complete image of Venus than we have of our own ocean floors.

Magellan's international group of scientists was led by Stephen Saunders of Caltech's Jet Propulsion Laboratory in Pasadena, California, and Gordon Pettengill of MIT, head of radar studies. Along with others on the project team, they drew together billions of bits of data at JPL to bring Magellan's images to life. The data are not only unlocking secrets about Venus but also helping scientists understand more clearly the geologic forces that shaped our own planet.

Pure science aside, Magellan images like this one kindle a sense of wonder that only the discovery of a new world can inspire. For a tantalizing moment, peering over a Venusian ridge, we are indeed explorers. In that instant we can feel a surge of awe not unlike what Spanish conquistadores must have experienced when they stumbled upon the Grand Canyon.

A LONG LOOK

Traditionally called our sister planet, Venus might be more an unruly twin—rent by rift valleys, scarred by comets and asteroids, and blackened by seas of hardened lava. Two mosaic views revealed by Magellan (left) seem light-years from our lush home planet. Yet the tortured surface was probably formed by volcanic and deformation processes similar to those that produce landforms on Earth.

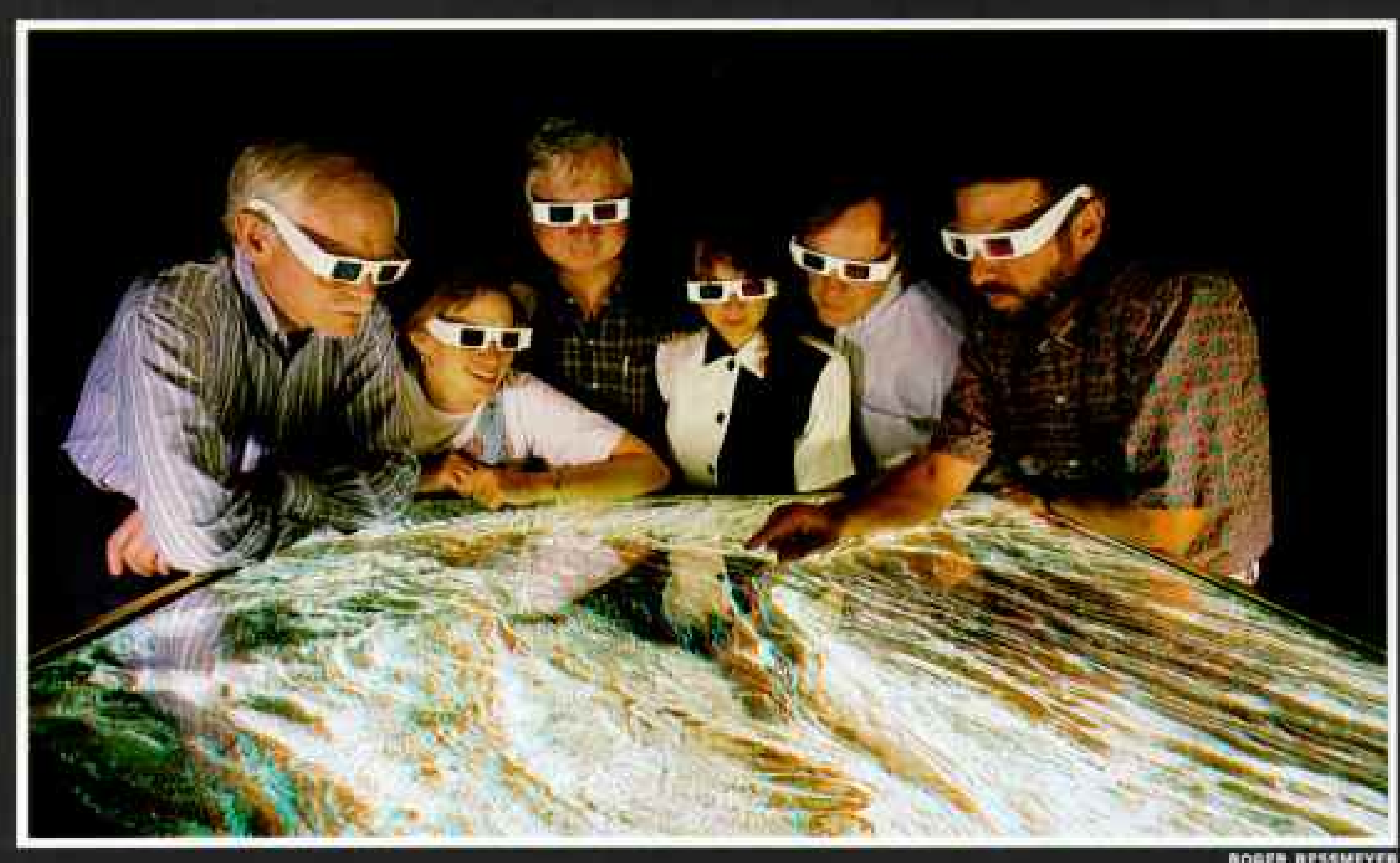
A 1,550-mile-long swath (below) shows a wide variety of formations in Aphrodite Terra, a continent-like region about the size of Africa. At far left, hills and valleys not unlike the Basin and Range area of Nevada and Utah—formed by stretching and failure of the surface—give way to a smooth, dark lava plain.

The curved network of fractures that starts between the globes and sweeps across most of the panorama is a rift zone, where subsurface forces are pulling the crust apart. It is interrupted by a sharp black band, a gap in Magellan data.

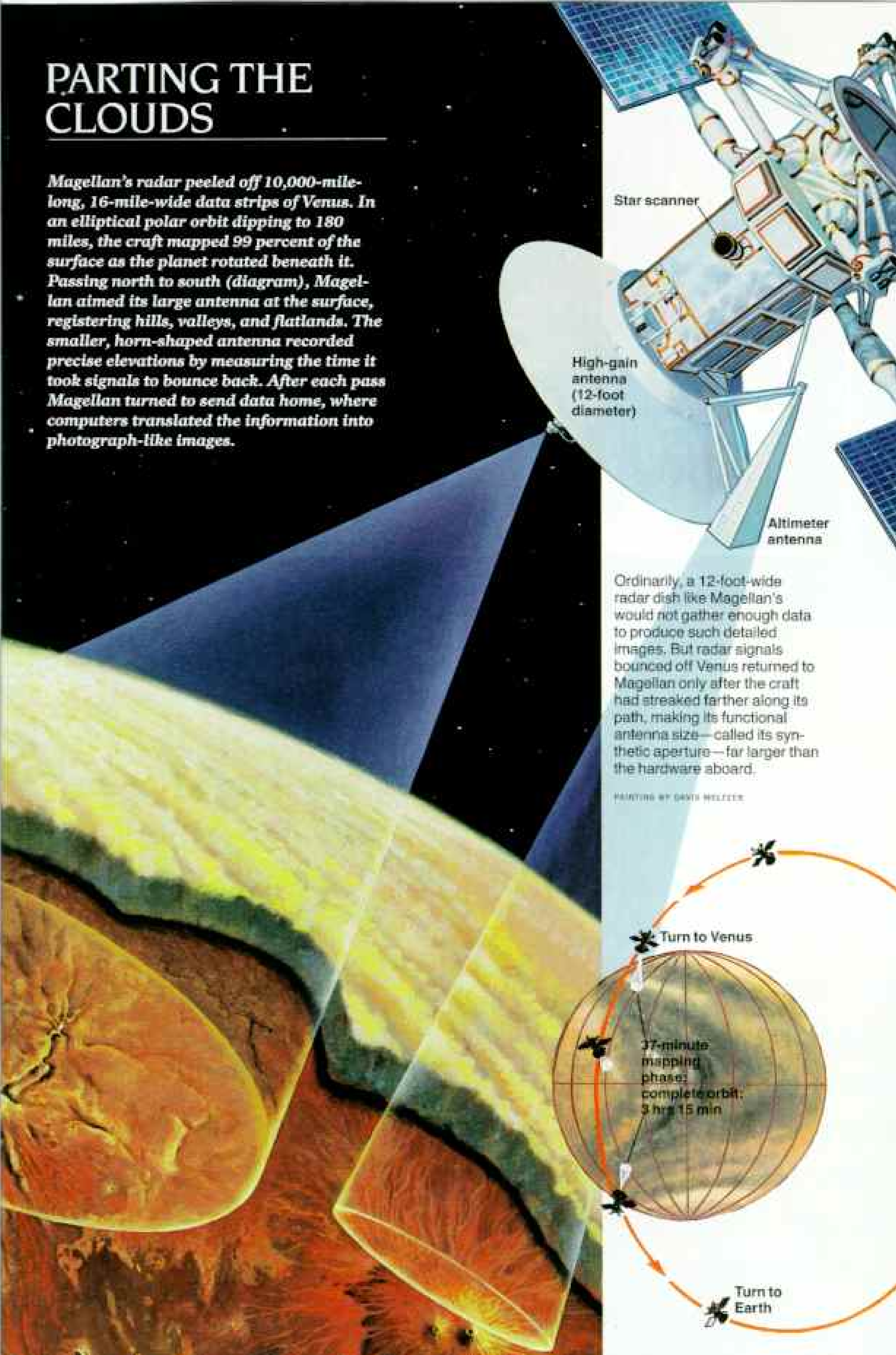
Halfway to the next data gap, just north of the rift zone, diagonal hills provide evidence of the opposite phenomenon—compression. These hills are in an area of complex, deformed terrain called tessera. At far right is another dark lava plain.

As the image shows, Venus's landscape has a sweeping flow to it. At a temperature of 900°F rocks and even landforms tend to bend as well as fracture.

The Magellan team created three-dimensional views by juxtaposing images taken from different angles during subsequent passes over the same terrain. Cardboard-framed glasses (right) like those used for old 3-D science-fiction movies are standard viewing equipment. Observing this particular version of "It Came From the Planet Venus" are, from left, James Head, an expert in planetary geology and volcanism; Ellen Stofan, deputy project scientist; Stephen Saunders; Annette deCharon, planning specialist; Eric De Jong, perspective image expert; and Jeffrey Plaut, research associate.



ROGER RESSMEYER



PARTING THE CLOUDS

Magellan's radar peeled off 10,000-mile-long, 16-mile-wide data strips of Venus. In an elliptical polar orbit dipping to 180 miles, the craft mapped 99 percent of the surface as the planet rotated beneath it. Passing north to south (diagram), Magellan aimed its large antenna at the surface, registering hills, valleys, and flatlands. The smaller, horn-shaped antenna recorded precise elevations by measuring the time it took signals to bounce back. After each pass Magellan turned to send data home, where computers translated the information into photograph-like images.

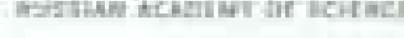
Ordinarily, a 12-foot-wide radar dish like Magellan's would not gather enough data to produce such detailed images. But radar signals bounced off Venus returned to Magellan only after the craft had streaked farther along its path, making its functional antenna size—called its synthetic aperture—far larger than the hardware aboard.

Propulsion module

Solar array

Magellan was not the first spacecraft to visit Venus—far from it. Over the past 31 years the former Soviet Union has been the most active, sending more than 20 probes to Venus. Several landed and survived long enough to take pictures and chemical measurements.

The Soviet Union's 1983 Venera 15 and 16 missions—which included Magellan team members among their international guest investigators—yielded numerous radar images. Lakshmi Planum of Ishtar Terra, in Venus's northern hemisphere, showed up as a distinctly pear-shaped plain (right, top). This Venera image, registering objects two-thirds of a mile or more wide, was a remarkable accomplishment. Yet just seven years later technological advances, along with a better observation angle, enabled Magellan to transmit data with resolution down to 360 feet (right, bottom). Venera data helped Magellan scientists plan their mission, as did the U. S. Pioneer Venus Orbiter, launched in 1978, and decades of ground-based observations.

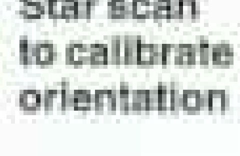


Magellan mapped Lakshmi Planum early in its mission. This continent-like region is ringed by mountain belts. The slopes are steepest at the right of the image, where Maxwell Montes, one of the highest mountains in the solar system, rises to 39,000 feet. Rough terrain, especially at high elevations, and steep slopes facing the radar are highly reflective and appear bright in Magellan's images. Flat, smooth regions, like lava plains, reflect less efficiently back to the spacecraft and appear dark.

As views became ready for study at JPL, the Magellan team returned the hospitality shown previously by Soviet researchers and hosted several guest investigators from Russia.

Magellan was 20 years in the making, requiring the experience and dedication of hundreds of scientists and engineers. With NASA facing a budget crunch in the early 1980s, spacecraft designers began a "garage sale" search, looking for parts from other projects that they could put to use. Finally, with an antenna from an unused Voyager craft, a computer left over from Galileo, and bits and pieces from other missions, Magellan was launched aboard the space shuttle *Atlantis* on May 4, 1989. Sixteen months later it began its historic mapping of Venus.

Second data playback to Earth



Star scan to calibrate orientation

First data playback to Earth

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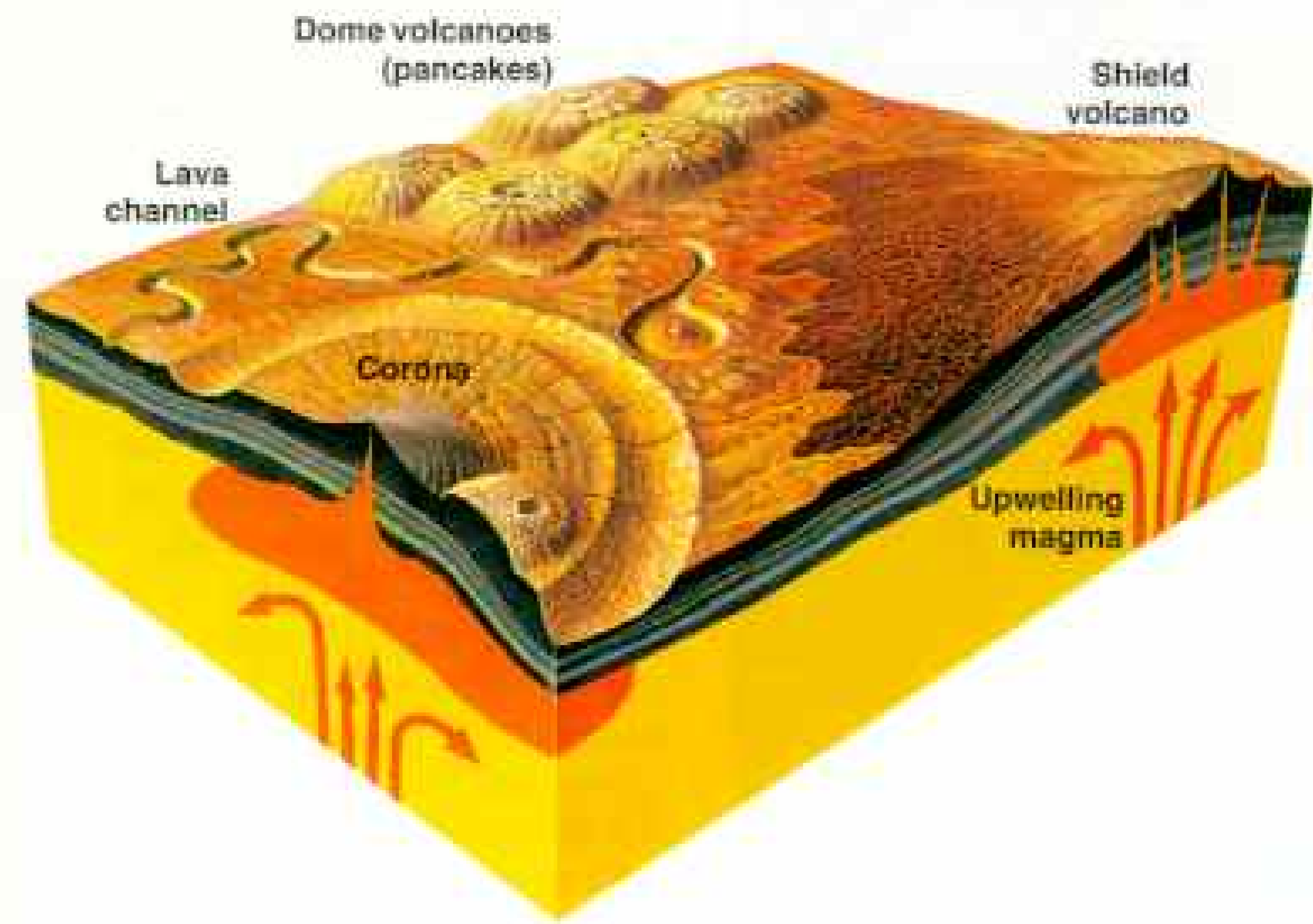
MILES

VOLCANISM

More than 80 percent of Venus is covered with lava flows and plains and other volcanic features. It is easy to see why: The planet has 430 volcanoes 12 miles or more in diameter and tens of thousands of smaller ones. Magellan saw arachnoids (left), which are surrounded by spiderweb-like fractures. Similar to other circular features called coronae, arachnoids most likely form when magma rises to just below the surface, causing the ground to bulge and fracture. Cooling and retreat of the magma result in collapse of the center.

Meandering north of Aphrodite Terra is a channel (below) a mile wide and 4,225 miles long. Probably etched into the rocky crust by molten lava, it would reach from New York to Rome.

THE FIRES BELOW



structures, caused by lava oozing through the Earth's crust and cooling as it spreads in a circular pattern.

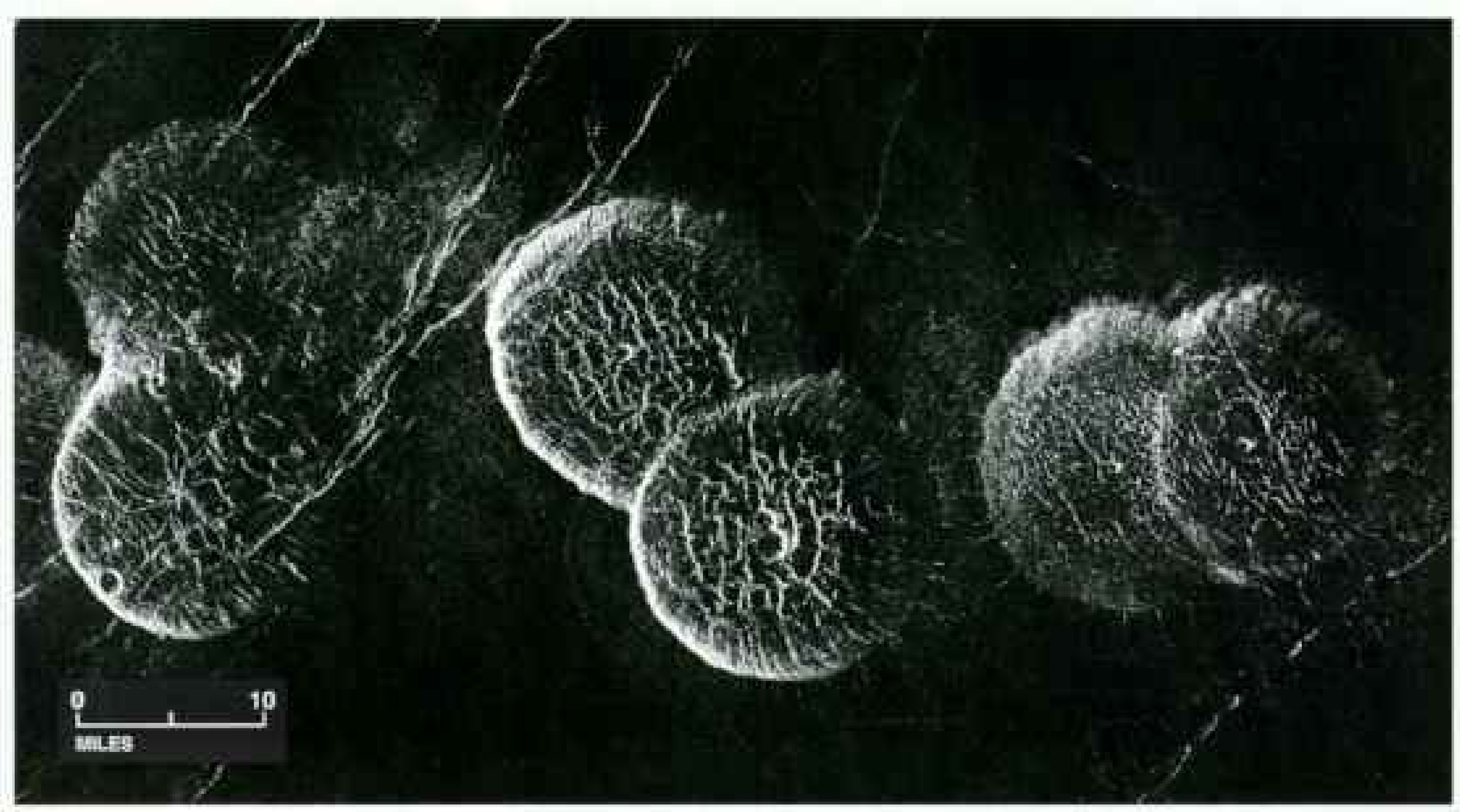
The difference is that on Earth volcanic landscapes are soon overgrown with plants and eroded by wind and water. On lifeless Venus a lava structure will stay pristine until altered by another geologic event. For example, newer pancakes look much the same as the ones on which they are superimposed.

Thus in studying Venus, geologists can look at our own planet's complex volcanic history, minus the effects of time.

Venus is a smorgasbord of volcanic formations (diagram). Heat generated by radioactive decay in the planet's interior creates pockets of molten rock. The temperature, composition, and gas content of the magma determine whether the resulting lava has the viscosity of motor oil or toothpaste. And that helps determine the size and shape of the formations.

Among the regions of Venus that resemble Earth is the vast highland area called Beta Regio. Here Devana Chasma (facing page), a rift valley, has torn apart an impact crater as the crust ruptures and spreads. Straddling the rift at lower left is the volcano Theia Mons. A similar relationship between tectonic and volcanic processes is seen on Earth along the East African Rift System.

Seemingly overcooked in the Venusian oven, so-called pancakes—steep-sided volcanic domes—(below) are not as alien as they might seem. The state of California is dotted with similar



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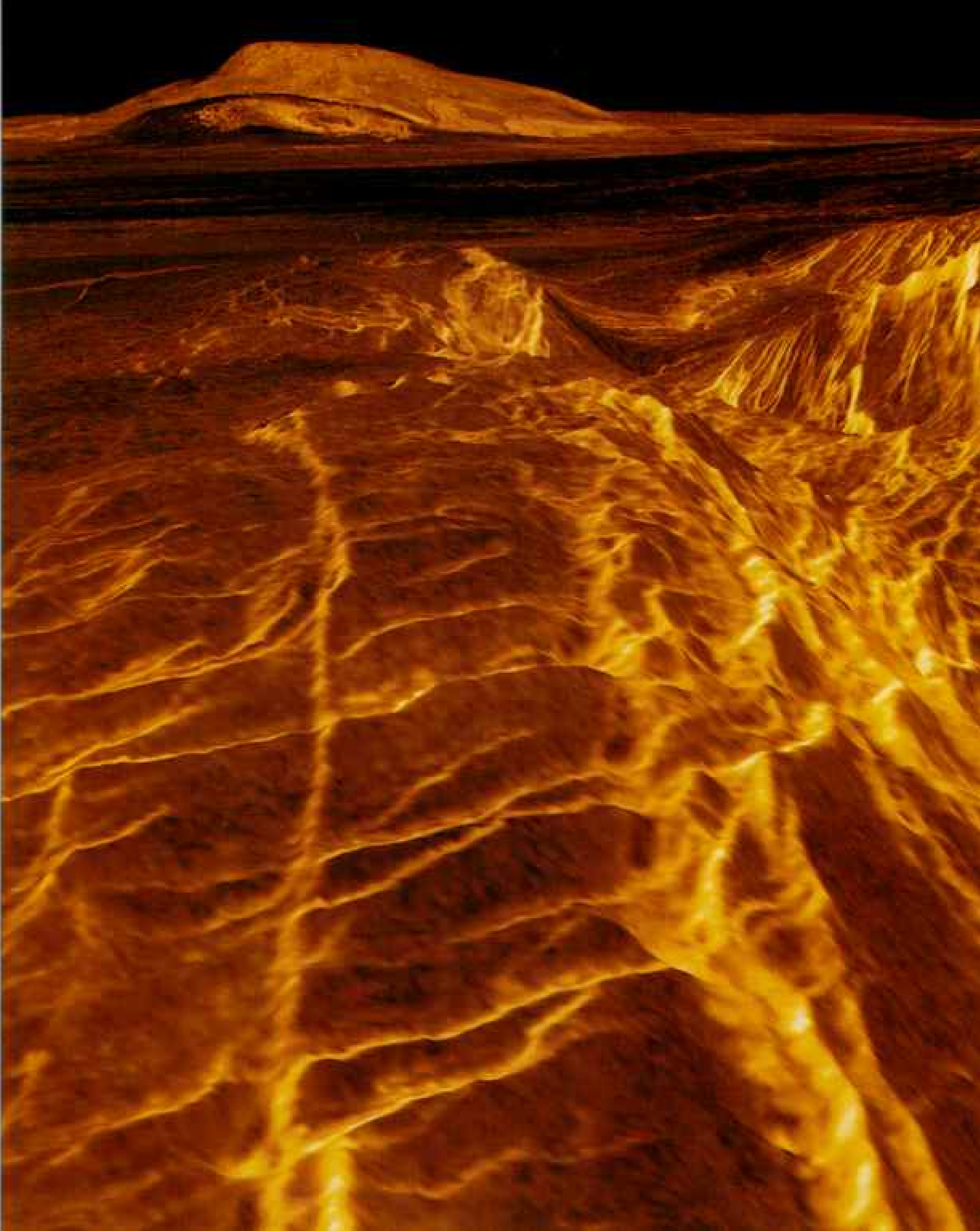
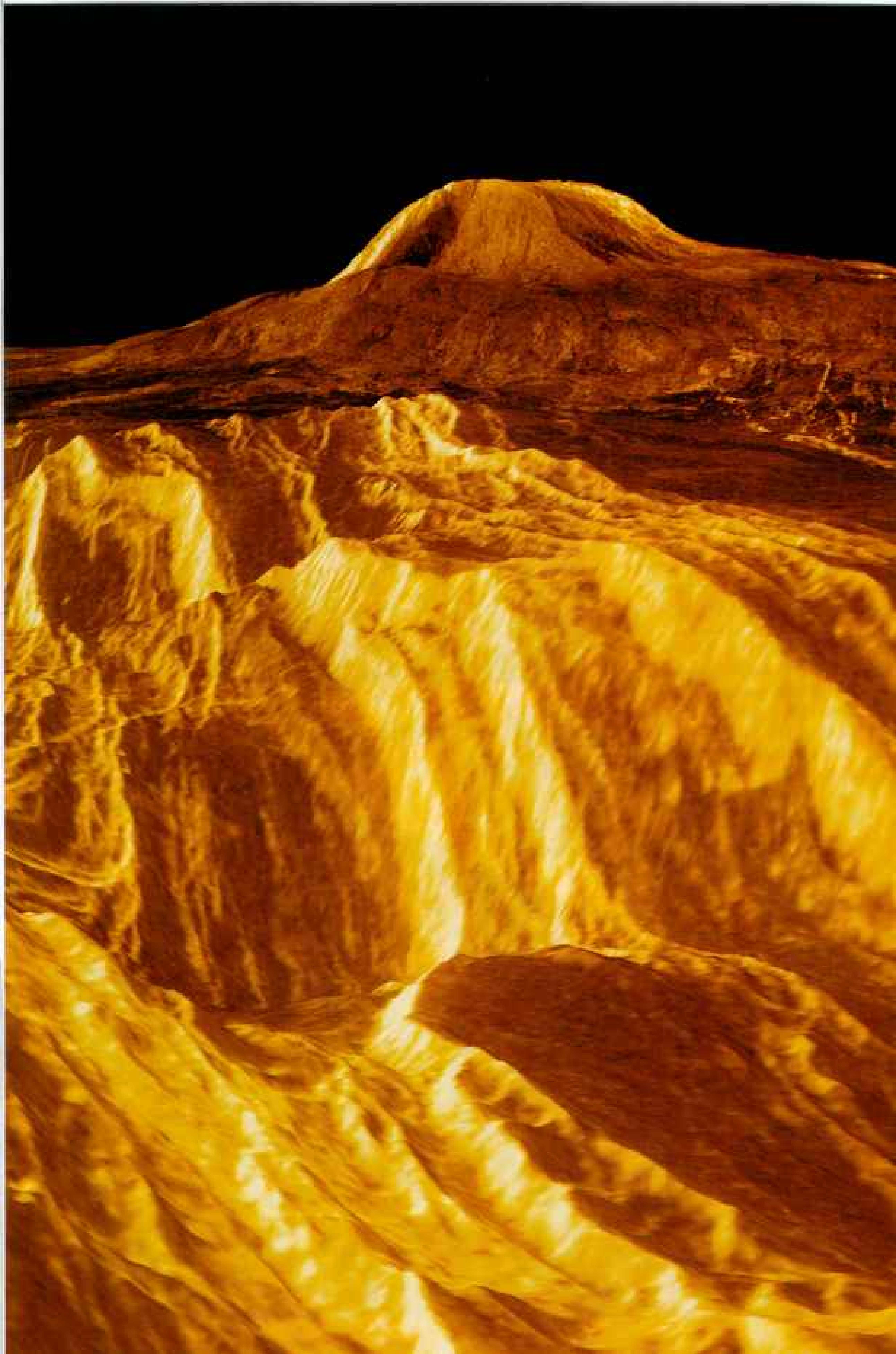
MILES

We are standing on the brink of a rift valley that cuts across a great lava plain between two-mile-high Sif Mons, left, and Gula Mons, a half mile higher. Each volcano is about 200 miles across. Elevations here and in the perspective on pages 37-39 have been exaggerated by computer to emphasize subtle differences in relief. This technique is also used by oceanographers to create ocean-floor maps. The orange tint approximates the color the human eye would see as a result of sunlight filtering through Venus's cloud cover, based on Soviet lander observations.

ADDITIONAL IMAGE PROCESSING BY ERIC DE JONG, JEFF HALL, MYCHE MCAULEY, NASA/CALTECH/JPL



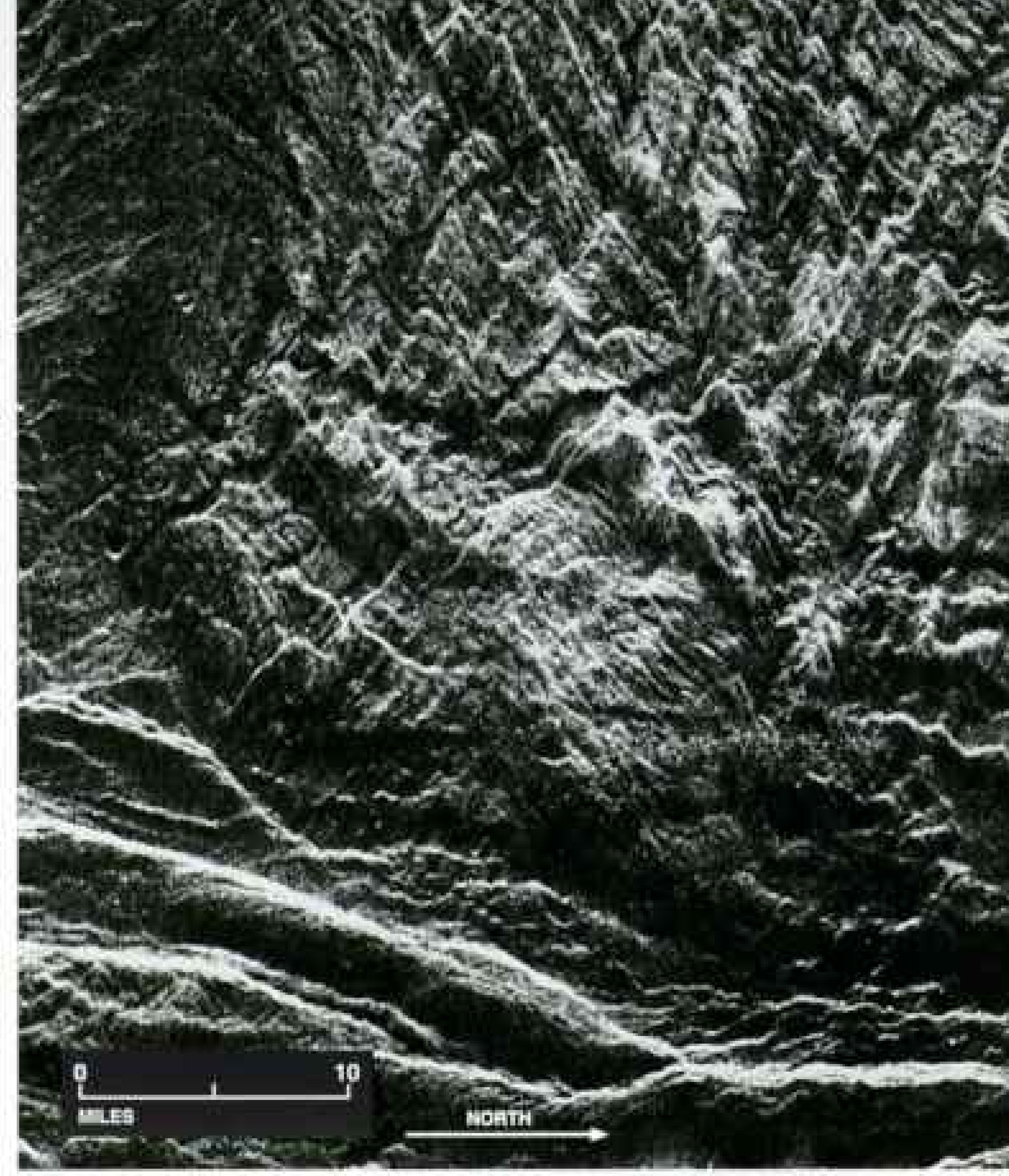


TECTONICS

Along with volcanism, tectonics has shaped the face of Venus. On Earth tectonics involves lateral movements of crustal plates, creating the Himalaya and deep-ocean trenches (diagrams). Magellan has shown that Venus has its own, more localized style of tectonics.

Both planets have vast churning reservoirs of hot material beneath their crusts. On Earth lava often emerges from the mantle through mid-ocean ridges, creating a new, spreading seafloor. The seafloor subducts under the continents, generating volcanoes and deforming the continental margin.

Venus also has mantle upwelling, which forms highlands such as Beta Regio. Hot-spot volcanoes and coronae also form over mantle plumes. Similar hot spots on Earth formed the Hawaiian Island chain and are responsible for the thermal activity at Yellowstone. Upwelling can also cause the crust to rupture and spread, forming rift valleys with steep sides and sunken floors.



EARTH

Hot-spot volcano
Spreading center
Upwelling in mantle
Subduction of oceanic crust
Upthrust mountains
River
Ocean

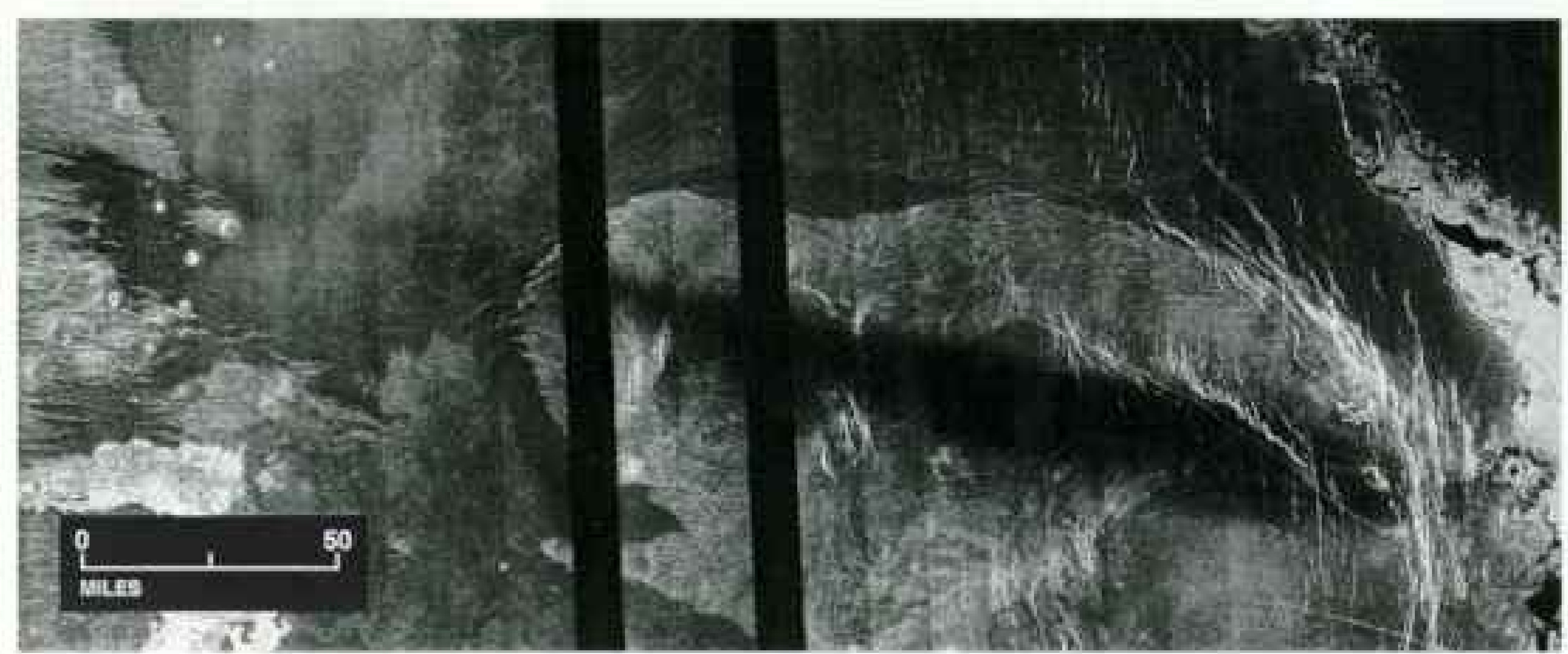
PAINTING BY DAVID MELTZER

Overall, plate tectonics on Earth is a dramatically horizontal process, creating whole ocean floors and moving continents. On Venus the movement is thought to be largely vertical. Volcanoes and highland regions arise over mantle upwellings, while sinking regions may form mountain belts due to thickening and compression of the crust. The eastern slope of Freyja Montes (left) in Ishtar Terra has undergone uplift and compression but is now fracturing as portions of the crust collapse under their own weight.

The lack of surface water and strong winds means that Venus's features are largely preserved between periods of volcanic or tectonic activity.

That's good news for scientists who study mountains here on Earth. Erosion from rain, wind, and glaciers, as well as breakdown from the freeze-thaw cycle, have long since removed the outer layers of our oldest mountain chains, leaving only their cores. Thanks to Magellan's images we can get some idea of how Earth's great mountain ranges would appear in the absence of erosion.

RAIN OF METEOROIDS



Bull's-eye marks the spot where an asteroid or comet slammed into Venus near Aphrodite Terra (facing page). The impact created a huge crater and a spectacular debris pattern 230 miles long.

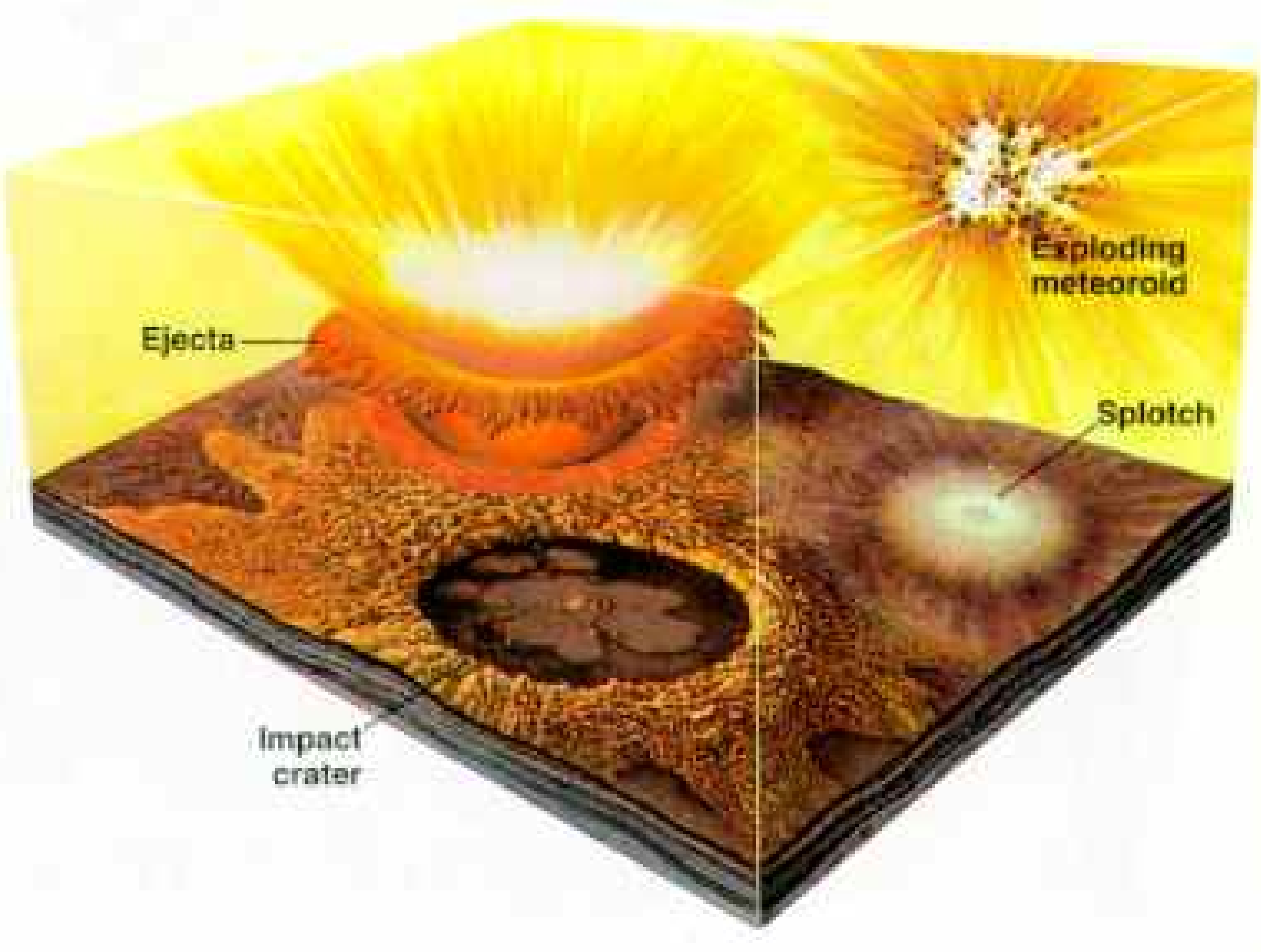
Upon impact, ejecta is thrown out of the crater, but it does not go far because of the planet's intense atmospheric pressure. As surface rocks melt because of the heat of impact and the high surface temperature, the resulting flow spreads out and lines valleys in its path.

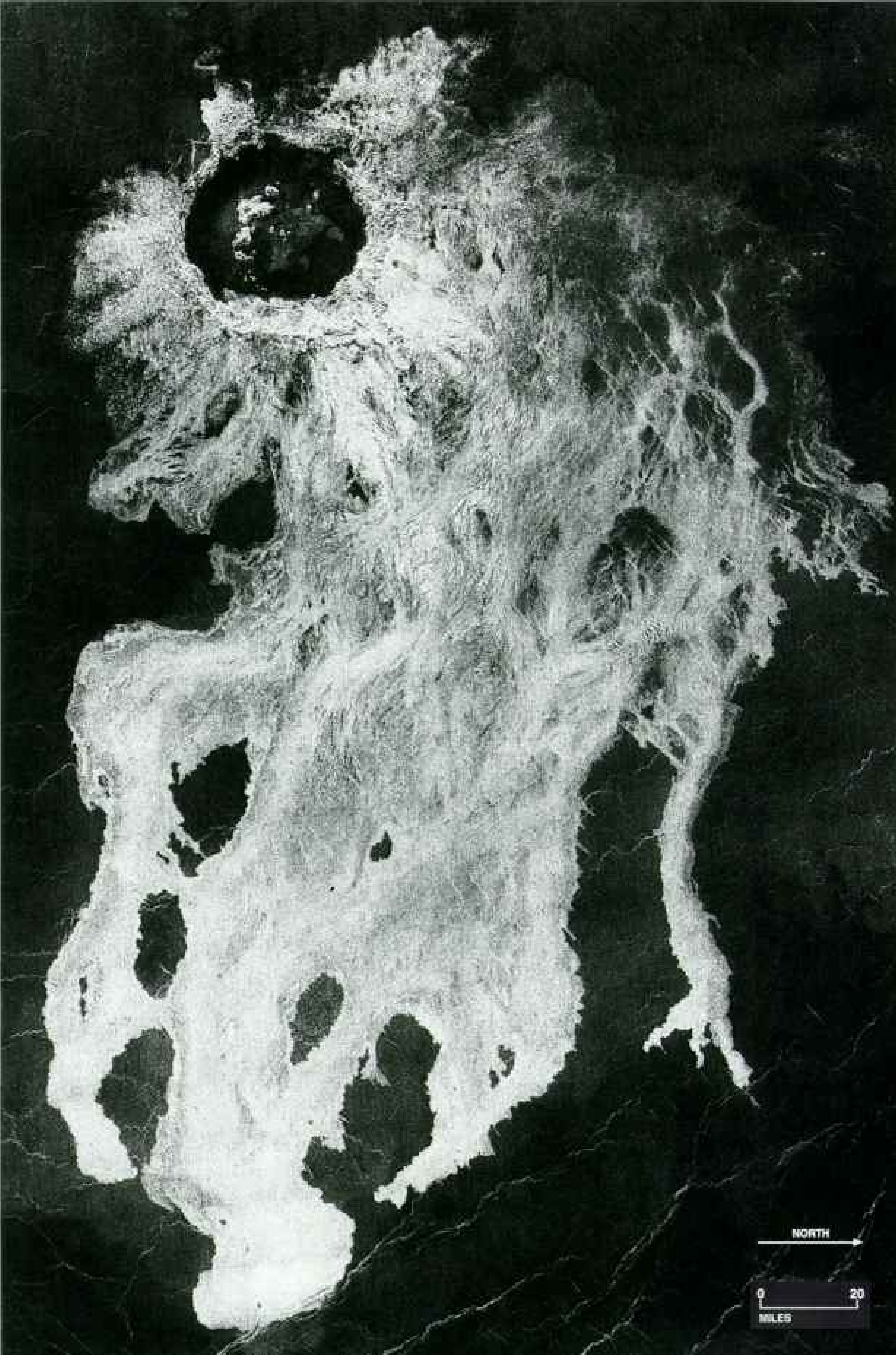
Following impact (diagram), large objects leave craters much like those found elsewhere in the solar system, often with flat floors and central peaks. Smaller meteoroids explode in the thick atmosphere before ever reaching the ground. The resulting blasts have left bizarre, craterless impact marks, called splotches, visible to Magellan's sensitive radar.

One 200-mile-long dark area (above) is believed by many scientists to be an example of this unusual phenomenon. It could be the result of an object's entering Venus's dense atmosphere at a very low angle and leaving a long shock path. Several craters at the eastern end of the streak may be from the remains of the incoming object.

Magellan data show that meteoroids have been a major cause of the patchiness of Venus's veneer of sediment. The tremendous force of a body hitting the surface at several miles a second and the resulting violent winds quickly accomplish what the slow-moving surface winds do barely at all: break up surface rock and redistribute it. Sand dunes, in fact, are visible in some Magellan images.

Scientists have a good idea of the number of impact craters that should appear in a given time and are thus able to estimate the age of Venus's surface. Magellan has logged more than 800 impact craters, which indicates a surface age of about 500 million years—relatively young as planets go.




NORTH
0
20
MILES

0
100
MILES

REWORKING THE SURFACE

Everywhere on Venus is evidence of the complex interplay of volcanic, tectonic, and impact processes (left). A large corona is rimmed by fractures and faults, while remnant pieces of jumbled tessera, at right, stand high above the plains. Low-lying areas here in the Lada Terra region of the southern hemisphere have been filled in with molten rock. Like giant handprints in concrete, two impact craters leave signatures on a lava plain to the right of the corona.

Also in Lada Terra, a flow of lava from the Ammavaru Caldera has broken through a ridge of hills 185 miles to its east (right). Lava flowing through this small breach created a plain the size of Kentucky.

The irony is this: Much of the surface of Venus is covered with lava, and tens of thousands of volcanoes have been identified. But planetary scientists have yet to find a "smoking volcano," evidence of current eruptive activity on the surface, in part because Magellan's radar was not designed to detect atmospheric plumes.

When was the last major episode of volcanism? Some scientists say the long process of resurfacing is a constant cycle taking place at random spots around the planet as individual volcanoes rumble into action. But if this is so, then why has lava spilled into just 4 percent of the impact craters?

Most experts now think that the crust of Venus may have been flooded during widespread volcanism that ended about 500 million years ago.

Such global resurfacing may have occurred when crust became weakened by intense heat and was dragged down into the mantle.

What theory will finally prevail? Gravity studies by the Magellan team may help settle the question. In addition, American and Russian space scientists are already huddling in the hope of putting another lander on Venus in a joint mission to try to find out.

As usual in scientific endeavors, new understanding has given rise to new, more intriguing questions.

ATLAS OF VENUS

It took just one day for Magellan to map 84 percent of the planet's surface—that is, one Venus day, equal to 243 days on Earth. The past few Venus days have also been eventful for earthbound scientists, as they process data to create topographic maps like this global view (above), the most detailed ever of the planet.

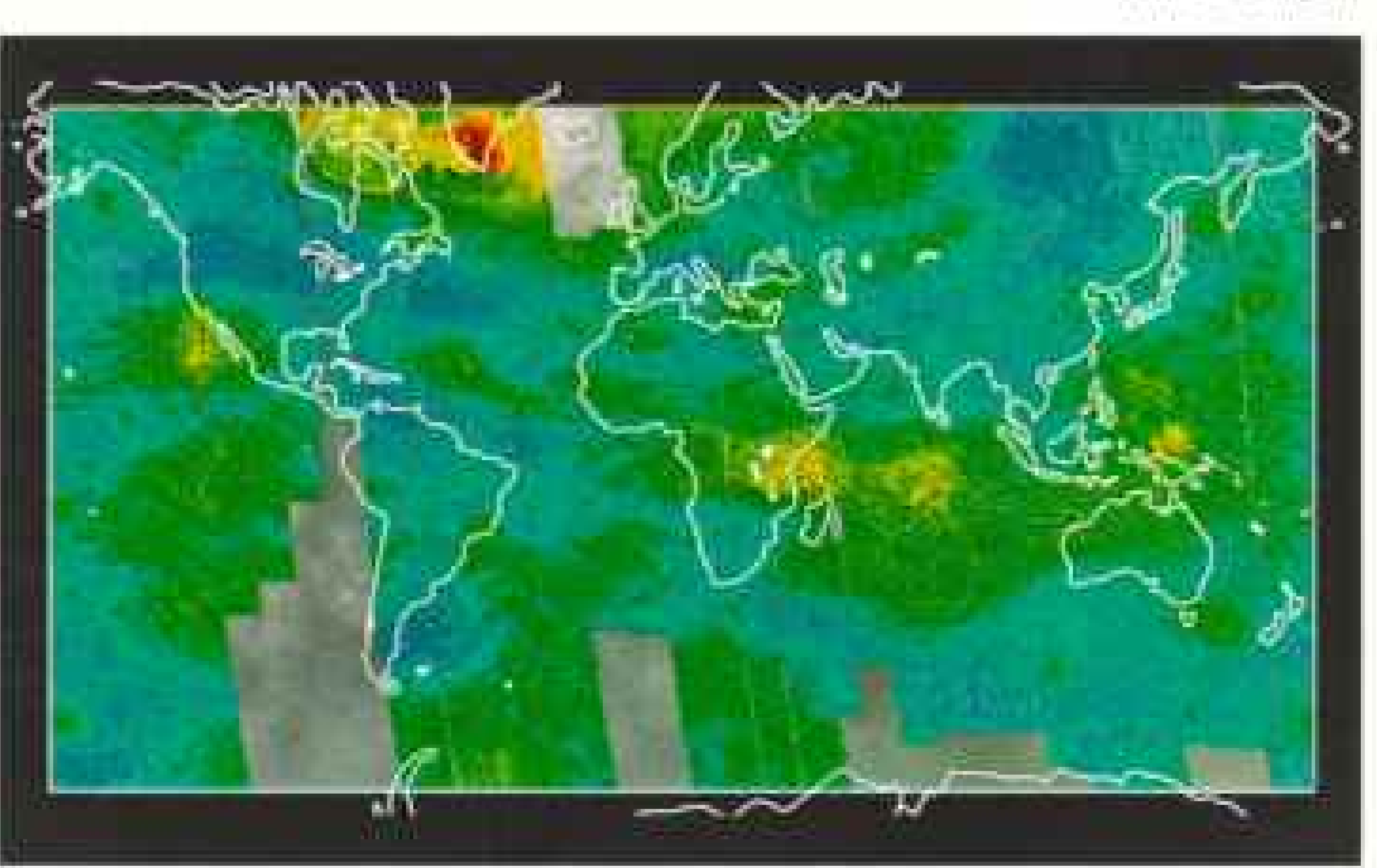
The image shows Venus's highest peaks in red, with descending altitudes in yellow, green, and blue. Magellan's altimeter collected the data for the image. Gaps are filled in with lower resolution data from earlier missions.

Venus's similarity in size to Earth makes it possible to superimpose on it outlines of the continents of our home planet (opposite). At last Venus seems to recapture some of her claim to sisterhood with Earth. Four

PETER G. FORD, MIT

highland regions, rising from the depths of the expansive plains, register as continents to our terrestrial eyes—reminders of how strikingly similar yet how awesomely different these two worlds are.

We are not through with our cloud-shrouded relative. Sibling or cousin, Venus as revealed by Magellan will challenge our thinking about our own planet for decades to come. □



A FIRST LOOK

Newborn Panda in the Wild

TEXT AND PHOTOGRAPHS BY LÜ ZHI BEIJING UNIVERSITY

PAN WENSHI

PROFESSOR PAN WENSHI stood at my door in Beijing with a big smile on his face.

"I have very good news," he declared, clutching a telegram. I guessed at once that Jiao Jiao, a nine-year-old giant panda we had been tracking by radio collar, had given birth.

A rare chance to observe a newborn panda in the wild! We rushed to buy train tickets to our research area in the mountains of southern Shaanxi Province. Within 48 hours Professor Pan and I were peering into the half-light of the new mother's den. We saw Jiao Jiao—Double Charm. But where was her cub?

I strained for a closer look, but carefully, remembering how fiercely Jiao Jiao had once attacked a female panda that had wandered into her range. I imitated the relaxed sighs of wild pandas. Jiao Jiao sniffed. Perhaps she remembered me and knew I meant no harm. I reached out to her (above).

Then I heard a delicate sound, between a puppy's whimper and a foal's whinny. Jiao Jiao shifted, and the cub, pink and fragile, wriggled up mother's chest and disappeared behind a sheltering paw. About the size of a hamster, the cub was just 10 or 11 days old, yet distinctive markings showed through its baby fuzz (right).

We called the cub Xi Wang—Hope—because it offers hope for the future of pandas.

NAPPING IN A TREE, Hu Zi, or Little Tiger, waited for Jiao Jiao's return from foraging during the late spring of 1990. Probably her first cub, Hu Zi was born three years before Xi Wang. Pandas typically give birth to only one cub at a time, at least two years apart.

With my Beijing University colleague Professor Pan I have spent several years tracking Jiao Jiao and 12 other pandas. Our study area is in the Qin Ling mountains, home to some 230 of the world's remaining pandas. The rest, perhaps 1,000, live in mountains to the southwest.

The Qin Ling, reaching to 12,359 feet, form a natural haven for pandas, shielding them from cold air that sweeps down from Siberia. From the southeast, monsoons provide ample rain and warmth for the growth of bamboo, their primary food.

Harsh climate and steep terrain have limited human settlement. Though timbering is done here, China's government recently agreed to establish a new panda reserve, which would limit clear-cutting operations.

By observing the behavior of Jiao Jiao, her cubs, and her mates in this natural setting, we made some discoveries: We learned that, like true bears, panda mothers sometimes fast after giving birth. We saw Jiao Jiao stay with Xi Wang continuously, not feeding or defecating for 25 days. This suggests that zoos might rethink how they feed new panda mothers, so as not to disrupt natural behavior.

We found that Jiao Jiao and Hu Zi stayed together two and a half years, about a year longer than most researchers thought was the norm.

Jiao Jiao finally chased her son off in March 1992, after she came into heat and mated with Xi Wang's father.

Suddenly on his own, Hu Zi, who had once seemed so confident under his mother's protection, was tentative and unsure of himself. He seemed wary as he moved into new territory neighboring his mother's.

There we soon found Hu Zi keeping close to a larger male, for whom the clumsy young panda posed no threat. We called it hero worship.

Hu Zi, who had spent years learning from his mother, now passed hours watching and following the more experienced male, who roamed the forest as if he owned the place.

Her son gone, Jiao Jiao would soon give birth again.

SO MUCH WAS NEW, and so much was surprising—but then we had not observed a newborn panda this young in the wild before.

Jiao Jiao cradles her new baby, Xi Wang, about the same way humans cradle theirs. Her huge palm supports the infant, which seems to look upward (below), although those young eyes will remain closed for another three weeks. The distinctive markings of a panda are already evident, determined by skin pigmentation, not by the color of infant fur.

A panda mother pays total attention to her infant. When Xi Wang makes noises of distress, Jiao Jiao changes positions and gives comfort with little pats, much the way a human would.

Jiao Jiao licks her baby frequently (opposite). Her maternal touch soothes the young one, which emits soft squeals of contentment. More important, perhaps, Jiao Jiao consumes all the infant's wastes—whose smell could attract predators, such as the lethal mink-like yellow-throated marten.

Given that Jiao Jiao was so protective, we were excited that she finally allowed us to touch her. Of course we didn't want to treat her like a domestic animal, but that moment was a real reward for all our efforts.

The truly serious threats are not from natural predators, but from poachers, loss of habitat, and genetic isolation of the remaining wild giant panda populations. Some groups may be too small for effective reproduction—the dangers of inbreeding are great. So I have come to the United States to do advanced research in genetics at the National Institutes of Health. I hope what I learn will help build a future in the Qin Ling where pandas will thrive in the wild.

At 25 days, when Xi Wang looked like a stuffed toy, a teddy bear, Jiao Jiao went out to forage. Finally Professor Pan had a chance to examine the young panda closely, and that gave us our biggest surprise.

It's a girl!

We are delighted to have a female to study alongside her brother, or half-brother, Hu Zi.

We had carefully monitored his development. By five months he was walking. By his first birthday, while still subsisting on Jiao Jiao's milk, he weighed 55 pounds. A month later he started eating bamboo, and five months after that he tipped the scales at 110 pounds—a small version of his 175- to 200-pound mother.

How will Xi Wang develop—both physically and socially—in comparison? We can hardly wait to see. Her immediate future looks promising. She increased in size rapidly, reaching more than nine times her birth weight in 36 days.

Despite all the problems ahead for pandas, we will remember why we gave that tiny, pink infant her name. □

Statue-still and covered with clay, Xhosa youths break from hunting on the South African veld during a rite of passage into manhood.

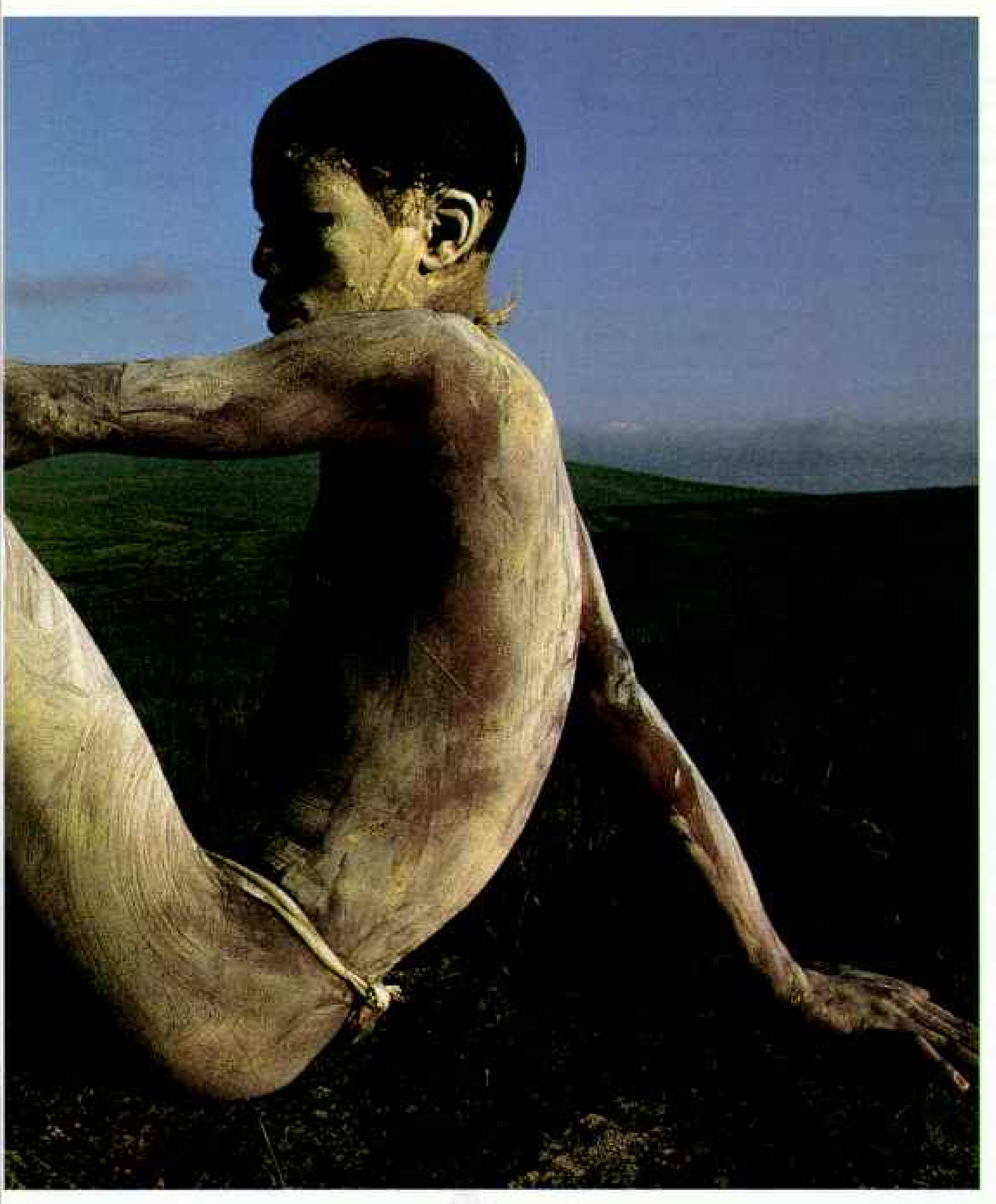
The peaceful landscape fades upon their return home, as blacks strive to overturn apartheid—a system of separateness and white rule. Although that goal is in sight, the struggle has increasingly given rise to fighting among rival black political groups. At the same time, talks between black and white leaders come down to this: Can the races share equally in a country so divided?

By CHARLES E. COBB, JR.
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by JAMES NACHTWEY

THE TWILIGHT

LIFE IN BLACK



OF APARTHEID

SOUTH AFRICA

A river of garbage and sewage overflows common ground in a squatter camp in Alexandra, one of some 60 townships—including the group of 32 known as Soweto—that ring predominantly white Johannesburg.

Living in flimsy shelters of corrugated metal and discarded wood, Alexandra's perhaps 50,000 squatters get by without heat, electricity, or plumbing.

Squatter communities were illegal under apartheid laws. But urban white South Africa let them grow because they represent a ready source of labor for which no services need be provided.

HE WAS ABOUT 30. I did not get his name. A brief eulogy summed up his life: "He started schooling in 1966. In 1973 he started working. By the time of his death he was unemployed. He died leaving one son, a brother, a sister, and his parents."

His and seven other coffins lay before the platform stage in Soweto's Jabulani Stadium. The families had volunteered their dead to represent the thousands killed in bitter fighting in South Africa's black townships between supporters of the African National Congress (ANC) and the Inkatha Freedom Party.

All morning people poured in, filling 10,000

seats and packing the stadium grounds. Songs of South Africa's black struggle rang out. *Toyi-toyiing*, the high-stepping dance patterned on guerrilla marches, kept a steady beat. Speech after speech addressed the deep bewilderment resonating within the funeral gathering, as in much of black South Africa: We have fought apartheid; how can we be fighting one another?

The elegiac strains of "Senzeni na?" an old hymn now a freedom song, began to fill the stadium. "What have we done?" its repeated refrain asks. It seemed a deep reaching into the soul, each voice anchoring to the belief that they would find strength in unity.

Now the hearses crept toward the coffins, which were flanked by an honor guard standing silent with clenched fists raised in the air.

A helicopter hovered overhead. Police in armored vehicles watched nearby. As we left the stadium for the ten-mile walk to the cemetery, South African photographer Peter Magubane remarked, "If it were before, we'd now be smelling tear gas."

Since 1990, with the release of ANC leader Nelson Mandela and other political prisoners and the unbanning of black political organizations, a "new South Africa" has become the watchword. Signs segregating black and white facilities are gone. The Population Registration Act, which legally pigeonholed people as white, black, Asian, or Coloured, is off the books. At this funeral ANC deputy president Walter Sisulu proclaimed, "We have reached the last mile of our struggle."

But even as a post-apartheid society seems in sight, "the last mile" is proving to be a twisting, difficult course. In three visits to South Africa over two years, I would see hopes rise and fall again and again.

South African blacks—75 percent of the population—still cannot vote. To draw up a new nonracial constitution that would give them that right, 19 organizations—a dozen of them black—sent some 200 delegates to the Convention for a Democratic South Africa in December 1991. Tense but hopeful from the beginning, the talks collapsed in June 1992, with everyone blaming everyone else for the bloody escalation of violence in the townships. The ANC accused President Frederik W. de Klerk's white National Party of allowing it.

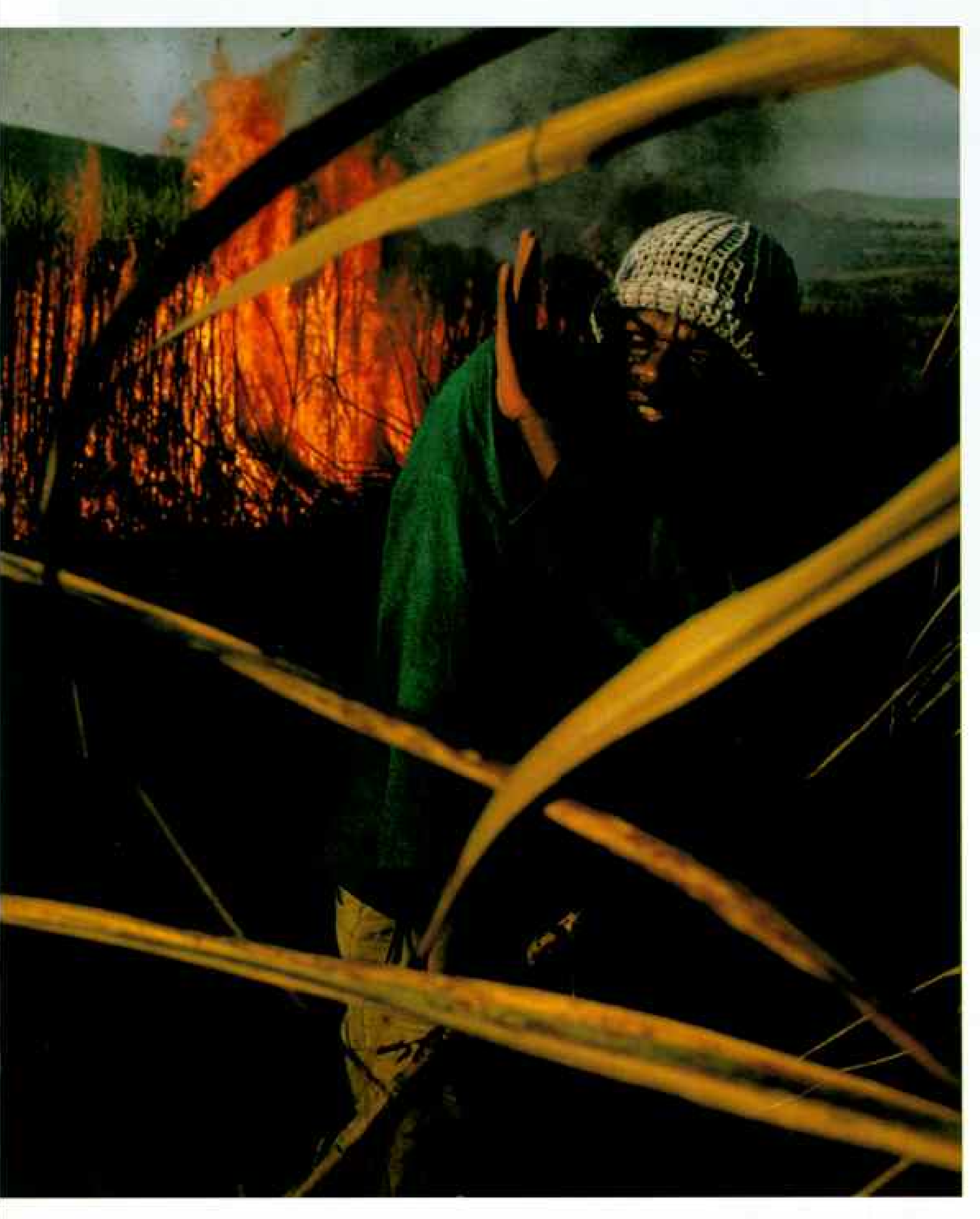
By September terrible loss of life brought the parties together again. Everyone agreed that the talks had to resume and the fighting had to stop. But no one agreed on what was causing the violence. Tribalism is the easy answer.

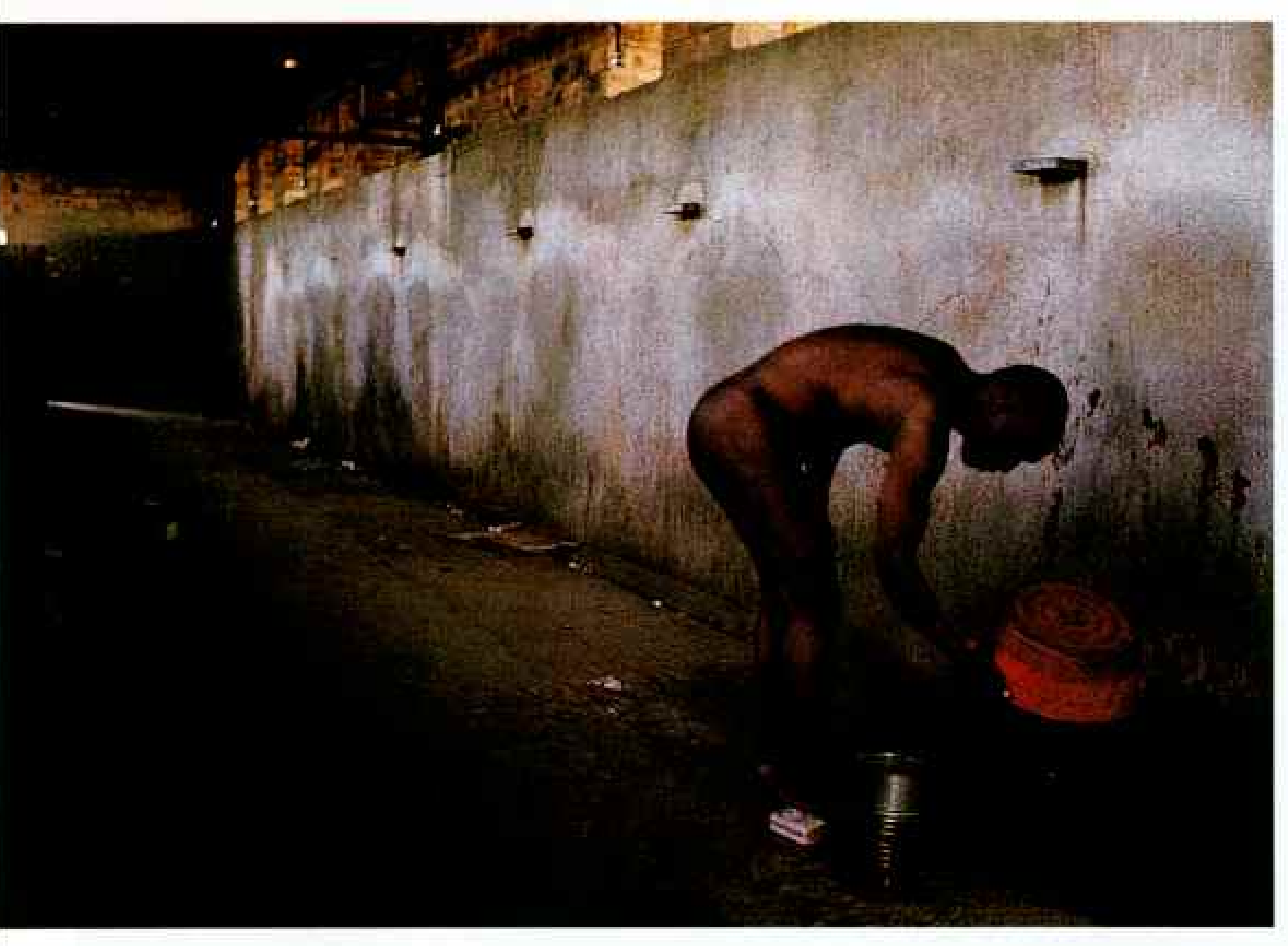
"That's a lie!" says Archbishop Desmond Tutu. "In Soweto we have lived harmoniously. I am Xhosa. I have a Zulu family on one side. A Swazi family there. A Mopedi over there. A Motswana there. If we quarrel, it is because you have a new suit and I am jealous. We have never quarreled in Soweto because of tribalism."

To the Reverend Allan Boesak, an ANC leader from Cape Town, "township violence is a legacy of apartheid—a system that is violent in itself. But there was a dangerous glorification of the armed struggle; we romanticized it. Our kids grew up with the idea that you are only a hero in the struggle if you are willing to kill someone. It's destroying our soul."

Flames blast from sugarcane in Natal as leaves are burned off to make cutting easier.

Like most of South Africa's industry and agriculture, sugar production is supported by the labor of blacks, who earn about 40 rand ($14) a day. Many are migrant workers, who are housed by cane growers in all-male hostels and often do not return to their families until their nine-month contracts expire. More than a million blacks are employed as agricultural contract workers throughout South Africa.





The floor is slick and littered where a migrant worker showers off sweat and grime at Soweto's Dube Hostel.

Unwelcome in the townships, hostel dwellers—men crammed into tiny rooms—are prime recruiting targets for the Inkatha Freedom Party, Zulu rival of the African National Congress (ANC). Infiltration by agents of Inkatha has turned hostels into flash points of township violence. Wielding traditional weapons, Inkatha members—who have enjoyed good relations with the government—rally at a Soweto stadium.

And so for black South Africans freedom still lies many angry miles away.

BLACK SOUTH AFRICA is arguably the most complex community in Africa: A population of 30 million people, half urban, half rural; forced by law to live in homelands of artificial tribal divisions but also proud of tribal traditions; definable in terms of the most oppressive legislation in Africa but just as definable in terms of resistance to oppression.

Despite dire headlines, black South Africans manage much normalcy in day-to-day living. Babies are born, families raised, weddings and birthdays celebrated. There is work and play, warmth and love.

"I am oppressed by this government, yes," a Soweto vendor told me, "but I am not oppressed. I have life; I have hope for better."

The subtlety of his distinction reflects what I saw across South Africa: blacks refusing to be defined only as victims of apartheid.

"Apartness," the literal meaning of the Afrikaans word *apartheid*, is the underlying philosophy that has guided South Africa since the National Party came to power in 1948.

Scores of laws have regulated every aspect of life according to race. Consider this instruction to the Paarl Liquor Licensing Board in 1960: ". . . in all cases, glasses for whites and nonwhites are to be washed separately and kept apart. Separate cloths must also be used for drying the glasses and be kept apart."

As recently as 1981 a cabinet minister observed: "When 90,000 blacks have to walk over the same bridge as 1,000 whites, unpleasant

incidents can occur. It might be a solution to give each his own bridge."

An important part of the grand design of apartheid is the "homelands." A 1959 act stripped blacks of South African citizenship, maintaining that each black person belonged to a "nation" set up for his tribe. There, blacks were told, they could develop their own cultural values without coming into conflict with the white nation. Today four homelands are recognized by South Africa (and no other country) as "independent," each with its own head of state and legislature (map, page 75). Six are non-independent.

Nearly half of all blacks live full-time in the homelands. Those residing elsewhere are "migratory citizens," living on farms, in townships, or in migrant-worker hostels far enough away from white population centers to reduce their threat to white supremacy but near enough for whites to use their labor. Thus was born Soweto, an acronym for South Western Townships, 15 miles from Johannesburg.

Thirty-two townships make up Soweto, now South Africa's largest metropolis, crammed with more than three million people. It has monumental problems but also a robust life that undermines the premise of apartheid every day.

IT WAS AN AUGUST MORNING, midwinter, when I first visited Soweto. Nothing hinted that I would come to enjoy and admire this community. Smog from thousands of charcoal and kerosene stoves draped the drab matchbox houses that seemed to stretch endlessly. The air's chill added to the sense of urban aimlessness. I could not figure out where I was going, for Soweto streets have no names. An address is merely a house number. You count . . . and ask often of the clusters of young men who seem to be everywhere.

Soweto has no developed civic center, just two movie houses, two swimming pools, and a few uninviting parks. Back-room businesses called *spazas* are everywhere and sell everything: toiletries, confections, meats, even medicines.

Though Soweto is shanties and horse-drawn carts, it is also upscale houses and BMWs. The city has developed a sizable middle class, and some of those spazas are earning big money. An energetic street life quickly embraces you.

Schoolteacher Simon Nhlapo was working in the middle of the street when I met him, blowing cadences with a whistle to see children safely across the intersection in front of Belle Higher Primary School.

"This will be a very busy street today," he told me. "It's Friday, and those with cars go shopping. We've been negotiating with the city council to put up robots [traffic lights], but it takes a long time."

I walked with him to his home, ten minutes from the school. Number 9263B is a typical Soweto dwelling of four rooms with a corrugated metal roof on an unpaved street. Living with Simon and his wife, Gladness, are two daughters, Joyce and Cynthia, and two grandchildren, Bheki and Nomnikelo.

"From America?" Gladness asked excitedly, clasping her hands across her breast. We settled down for tea in a sitting room that also serves as a dining room, a TV room, and, beneath the dining-room table, as space for 17-year-old Bheki to sleep. A Zulu shield hangs on the wall. Simon is Zulu; Gladness is Swazi.

Shy at first, nine-year-old Nomnikelo rested her head on my lap as Simon and I talked. His hands moved with the elegance of a mime.

Like most adults in Soweto, Simon sees the young spinning out of control. "Broken homes," Simon sighed. "It's the worst disease in Soweto. Children from broken homes can do as they please."

He also relates the problem to the youth-led 1976 Soweto uprising and the school boycotts of the mid-1980s. They protested the mandatory teaching of Afrikaans—the language of the ruling party—and a number of programs that locked blacks into inferior education.

The vehemence of these protests stunned parents. Schools were burned; fighting became vicious. To punish backsliders in the fight against apartheid, teenagers introduced the grisly practice of "necklacing," placing a gasoline-filled tire around a person's neck and lighting it.

"When they burn down the schools, that means no future," Simon told me with dismay. "I say to them, education comes first, freedom comes next."

Still, he speaks with a certain pride that students confronted police and army. One student leader, sought by police, dressed in his sister's clothes, using tennis balls for breasts. "He even answered the door. 'No,' he told them, 'he hasn't been seen here for days.' " Simon laughs as he tells this, a deep laugh from inside his belly—a laugh that enjoys the laugh.

But Simon wonders how much lost ground can be recovered. Last year barely a third of Soweto high school students taking final exams passed them. The disparity in white-black expenditures is still wide—three and a half times more is spent to educate a white child. Across the street from Simon, 13-year-old Kabelo Chaane pleaded with me: "Please help me go to school somewhere. I can't learn here." He wants to be a doctor.

Where do Sowetans think South Africa is headed? One man predicted small changes piling atop small changes. The result: a society more changed than anyone thought possible. "Now they're talking to you differently in the stores," he told me. "Once it was 'Yah, my boy, what do you want?' Now it's 'Good morning, sir. Can I help you?' Our freedom won't come overnight. A step here, a step there, another step over here. . . ."

FIVE A.M.—and Simon's house is up. His daughter Joyce has to catch a train by 7:15. Every weekday Soweto explodes into Johannesburg as train after train empties blacks into the city. On this tidal wave Joyce and I wash into the busy streets. By eight we are at Transvaal Diamond Cutting Works Group, where she polishes diamonds.

Before 1980 jobs like Joyce's were reserved for whites. Why the change? The manager held up a small diamond he called a *melle*. "We're working with these nowadays. There wouldn't be profit in doing these with white workers." They are paid more.

Joyce has since lost her job—the factory moved—and finding another is difficult in the current economic doldrums. The recession falls heaviest on blacks, whose unemployment rate approaches 50 percent. Two-thirds of all blacks live below the poverty line.

Ironically, economic realities cracked apartheid as much as did political pressures. There are not enough whites to do what whites had reserved for themselves. The National Manpower Commission expects a shortage of 228,000 university graduates by the year 2000. So the 8,000 black graduates a year are an important source of educated employees.

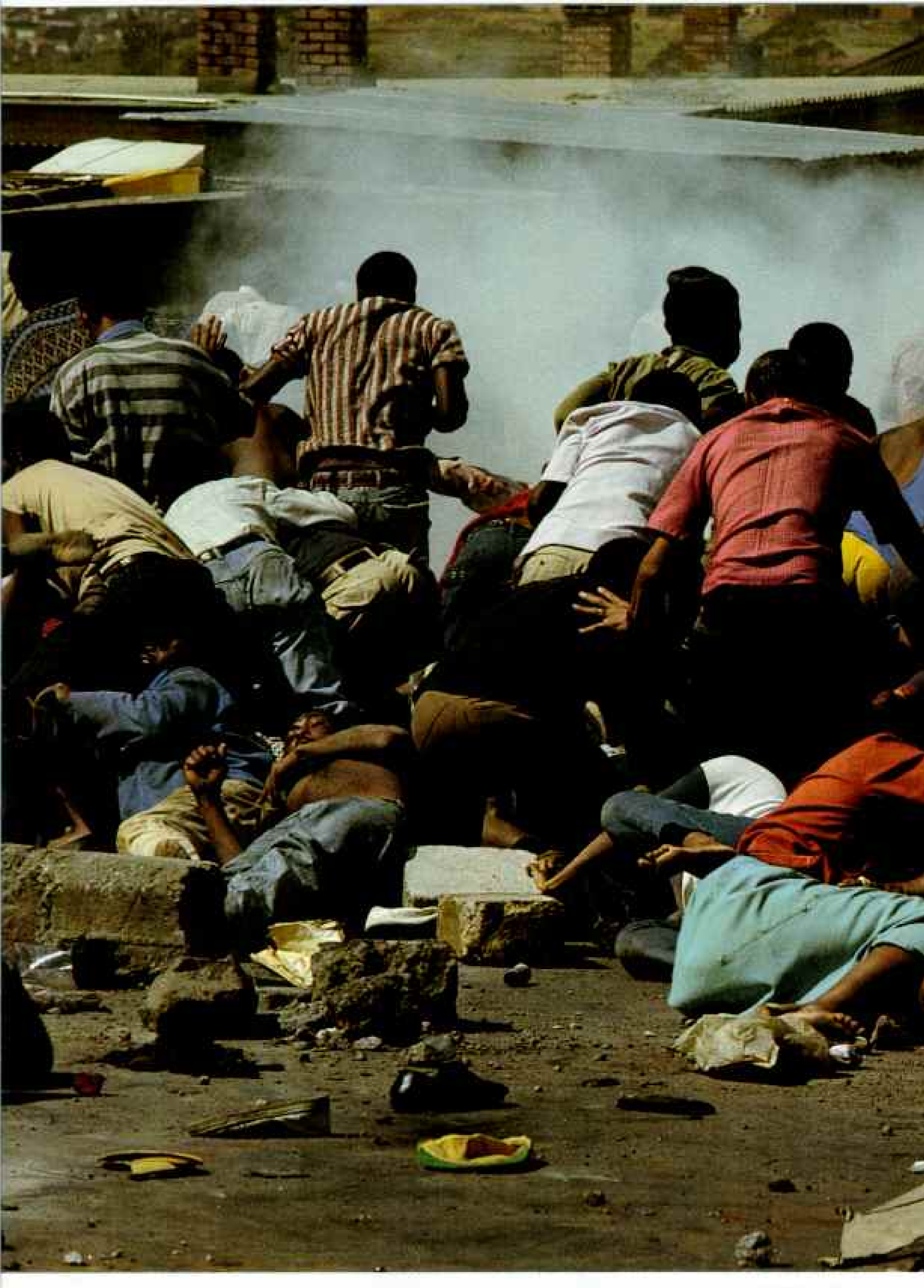
"The government became increasingly frustrated by demographic forces it could not control," says John Kane-Berman of the South African Institute of Race Relations. "Also, black people found ways to bypass laws that restricted their ability to exert economic pressure. The legal right to strike, for example, was given to black workers for no other reason than that they just went out on strike and the government judged that stopping them would be too costly.

Urging followers never to give up, ANC president Nelson Mandela extends words of encouragement to the people of Phola Park, a squatter camp near Johannesburg racked by violence.

Since his release in 1990 after serving 27 years in prison for anti-apartheid activities, Mandela has emerged in the eyes of many blacks as something of a messiah—the one they would choose to lead them as the first black president of a new South Africa.

Following the repeal of most apartheid laws in June 1991, the ANC and other organizations began talks with the government on a multiracial interim administration, voting rights for all nonwhite South Africans, and a new constitution that would bring the homelands back into a united South Africa.

The homelands are ten tribe-based reserves set aside for blacks to remove them from South African political life and deny them national citizenship. The four homelands that have accepted so-called independence still rely heavily on the South African government.



Panic-driven Alexandra residents trample one another as they rush into a cloud of tear gas while fleeing police bullets. The unarmed crowd had marched to protest violence against township residents by men from

a nearby hostel. Despite recent political pressure to avoid the use of lethal force during such gatherings, security forces were responsible for the death of more than 140 township residents in 1992.

Dazed and bleeding, 13-year-old Steven Digwamaje was felled by a blast of bird shot when police broke up a protest by Soweto's Dobsonville residents against local hostel dwellers. The boy—guarded by an officer of the national Internal Stability Unit until an ambulance arrived—lost the use of an arm.

Not so lucky were 32 Bruntville residents massacred by a group from the local hostel. Friends gather to dig graves and pay their final respects. More than 6,000 people have died in black factional violence in the townships in the past two years.

"White people also quietly undermined apartheid. Employers illegally hired skilled black artisans, and private schools and *technikons* ignored racial restrictions and quotas."

A CLEAR SIGN of apartheid's crumbling: Johannesburg, officially a white area as late as 1991, is full of black residents. Black yuppies are stockbrokers, accountants, and managers. Black secretaries, clerks, and workers are vital to the city.

The Hillbrow district buzzes with integrated nightlife until all hours. Journalist Arthur Maimane, returning after a 32-year exile in London, remarked when invited to dinner in Yeoville, an arty neighborhood, "The only blacks who went there in my day were domestic servants."

Recalls entrepreneur Richard Maponya, now living in one of Johannesburg's most expensive suburbs: "I moved here in 1984 to provoke the government. I did not hide my presence, and I thought they would remove me." But the government closed its eyes: International sanctions were hurting the economy, and the real estate market was desperate for customers.

Maponya is one of South Africa's leading businessmen, black or white. He set up the first clothing store in Soweto, and today his multimillion-dollar Maponya Group includes a BMW franchise, a supermarket, a car rental agency, and 23 other companies.

He described his beginnings, 40 years ago, selling surplus clothing door-to-door. "I introduced the idea of 'pay while you wear.' When they got paid, they paid me.

"Then I applied for a license to open the first

retail store in Soweto, but they said selling clothing was a white man's business."

Maponya went for help to a young lawyer named Nelson Mandela. Mandela said, "Let's take them on."

They won an initial victory of sorts, Maponya told me, chuckling at the absurdity. "I was allowed to sell daily necessities like bread and milk, but if they found me selling asparagus they would take my license, because that was considered a luxury."

FROM THE BALCONY of his hilltop condominium 33-year-old Siphiwo Ralo, a CBS cameraman and one of the country's many upwardly mobile blacks, looks out at the winking lights of Johannesburg. It's not a view he would have expected to have when he was growing up.

Watching TV crews cover protests when he was a teenager lit Siphiwo's ambition. "I began to appreciate the guys with the cameras, all over the place, getting shots so full of life."

He worked his way up in a business that is hard for anyone to break into, learning video through an internship at the government-owned South African Broadcasting Corporation. He earned 260 rand (then worth about $300) a month and sent a hundred home to his family in Port Elizabeth.

"But there was a stigma attached to working for SABC. Friends stopped speaking to me, because I was working for the government. I was seen as a stooge, a traitor, a collaborator. But technical colleges were not admitting blacks."

Several jobs down the road CBS saw his footage of a protest and offered a job. I asked how he felt being a black South African covering his country for American television.

"I'm a journalist and do my job," he replied. Then, digging a little deeper into his South African self: "Pictures are more powerful than assault rifles."

Objectivity? "It's a clear-cut situation," he said. "A majority is being ruled by a minority."

About three million South Africans are classified as Coloured—of mixed ancestry. They can vote, as can Asians, for members of a nonwhite chamber of the national legislature. Siphiwo Ralo's friend Yasmin Furmie, like many young people, refuses to call herself Coloured, though Sotho and East Indian mix in her family tree. She says "so-called Coloureds," when she uses the term at all.

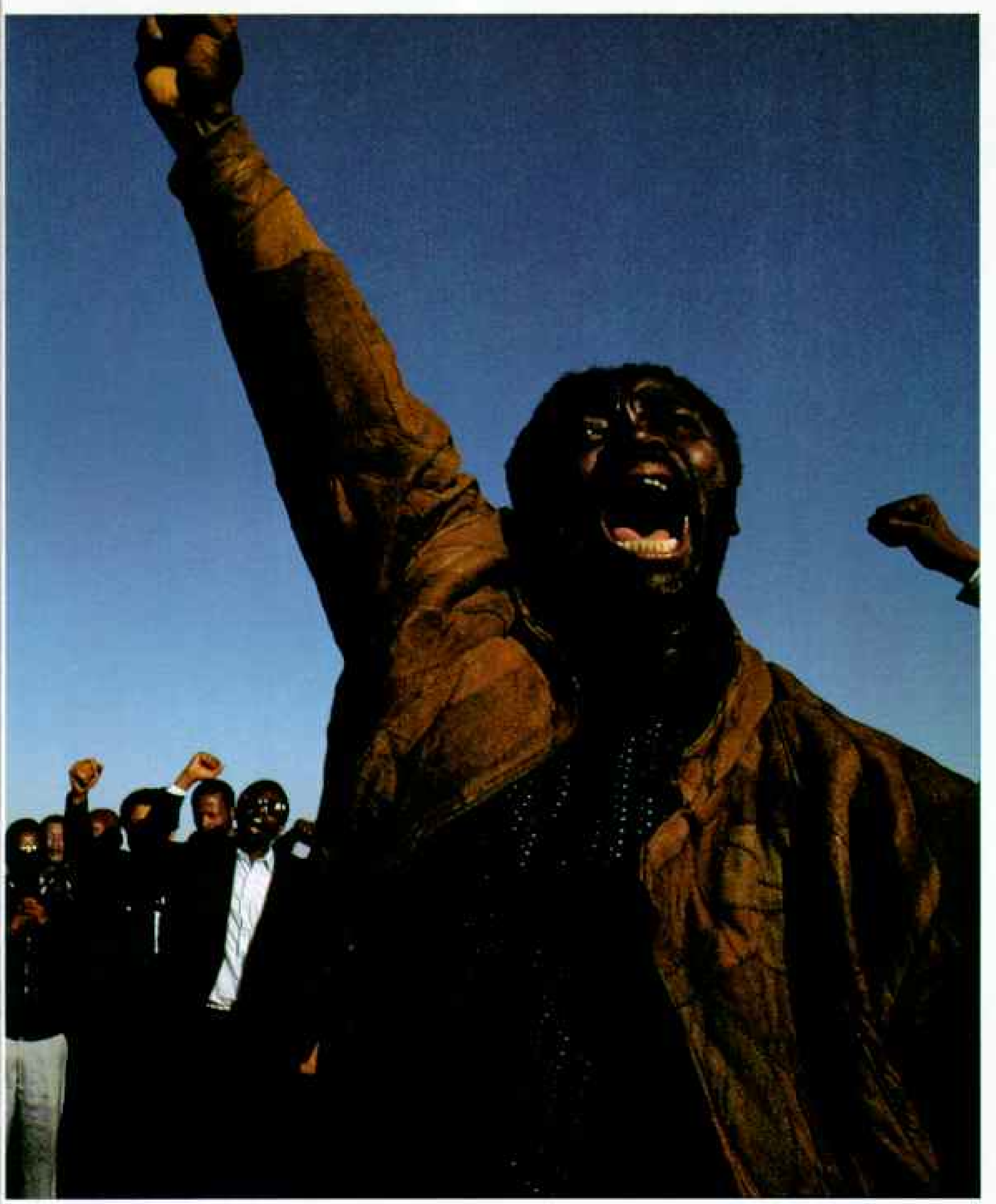
Changing attitudes in self-definition came out of the "black *(Continued on page 84)*

Fists pound the sky as a group of bus drivers mourn yet more black victims of violence in South Africa.

Out of anger and frustration, Michael Khoeli leads the funeral party in singing the black national anthem to commemorate his best friend, co-worker Isaac Monke.

Monke and two companions were shot in the head when a group of men broke into his Sebokeng home.

Unable to learn any motive for the slayings, Khoeli later lamented, "I am very depressed. Why were these people killed?"



Black hopes, black dreams

Siphiwo Ralo

"South Africa is full of fertile stories, and I want to be part of telling them," says Siphiwo Ralo, a CBS television cameraman who is among a growing number of upwardly mobile blacks. As a new South Africa unfolds, he pushes his hopes even higher. "I want to make films. This country is a gold mine for features."

Simon Nhlapo

"My granddaughter once asked why she must go to school every day," says retired teacher Simon Nhlapo. "I told her she must go so that she will grow up to be somebody. I have great hopes for the children, but change takes time."

Walter Sisulu

"Despite the violence, I am confident that we are making progress toward a brighter, non-racial South Africa," says Walter Sisulu, deputy president of the African National Congress. Every member of his family has at one time been imprisoned for anti-apartheid activities.

Zaniwe Tsapa

Uneducated at 41 years of age, Zaniwe Tsapa is resigned to her life as a domestic worker but wants more for her children. Almost all her salary as a farm cook in the Orange Free State goes toward their education.

Fiki Jokweni

"There is no time to relax," says Fiki Jokweni. The machine operator has spent as long as 11 months at a time working in distant white-owned gold mines. Now unemployed, he spends his days looking for work at home in the Transkei.

ALL BY DAVID C. TURNLEY

Razor wire cordons off Soweto's Fox Lake subdivision, later abandoned because of violence provoked by Inkatha hostel dwellers next door.

Security forces, who failed to protect the homeowners, are widely believed to be in league with Inkatha; some are even thought to have supplied hostel dwellers with AK-47s and grenades, used to terrorize Inkatha's rivals. People in the townships—many of whom support ANC—fight back, setting in motion a cycle of death and retaliation.

consciousness" movement at the beginning of the 1970s. Many blacks, Coloureds, and Asians, lumped together as "nonwhite," came to resent that label. As Steve Biko, a leader of that movement before he was killed in police custody, put it: Students saw "nonwhite" as *non*-something, "which implied that the standard was something, and they were not that particular standard."

Even so, Yasmin said that her relationship with Siphiwo sometimes raised eyebrows. "Overseas I am seen as a black woman, and here they say, 'Oh, she likes black men.' "

A former fashion model, Yasmin studied social work in Australia, where her parents now live, and returned to Johannesburg in 1989. She specializes in arranging alternatives to prison. Almost all her clients are white.

As Yasmin and I came out of court together one September morning, we spoke with a black woman seated on a bench. Her son had been in jail awaiting trial since April. Yasmin told her where to get help. "The black kids don't know about these services. The white kids have the attorneys, the money, the information. The courts say, 'It's just a black kid. He can go to jail.' "

As I MOVED AWAY from the large cities, I also seemed to be leaving the new South Africa. As Siphiwo Ralo told me, "What you see in Johannesburg isn't what you'll see in Krugersdorp."

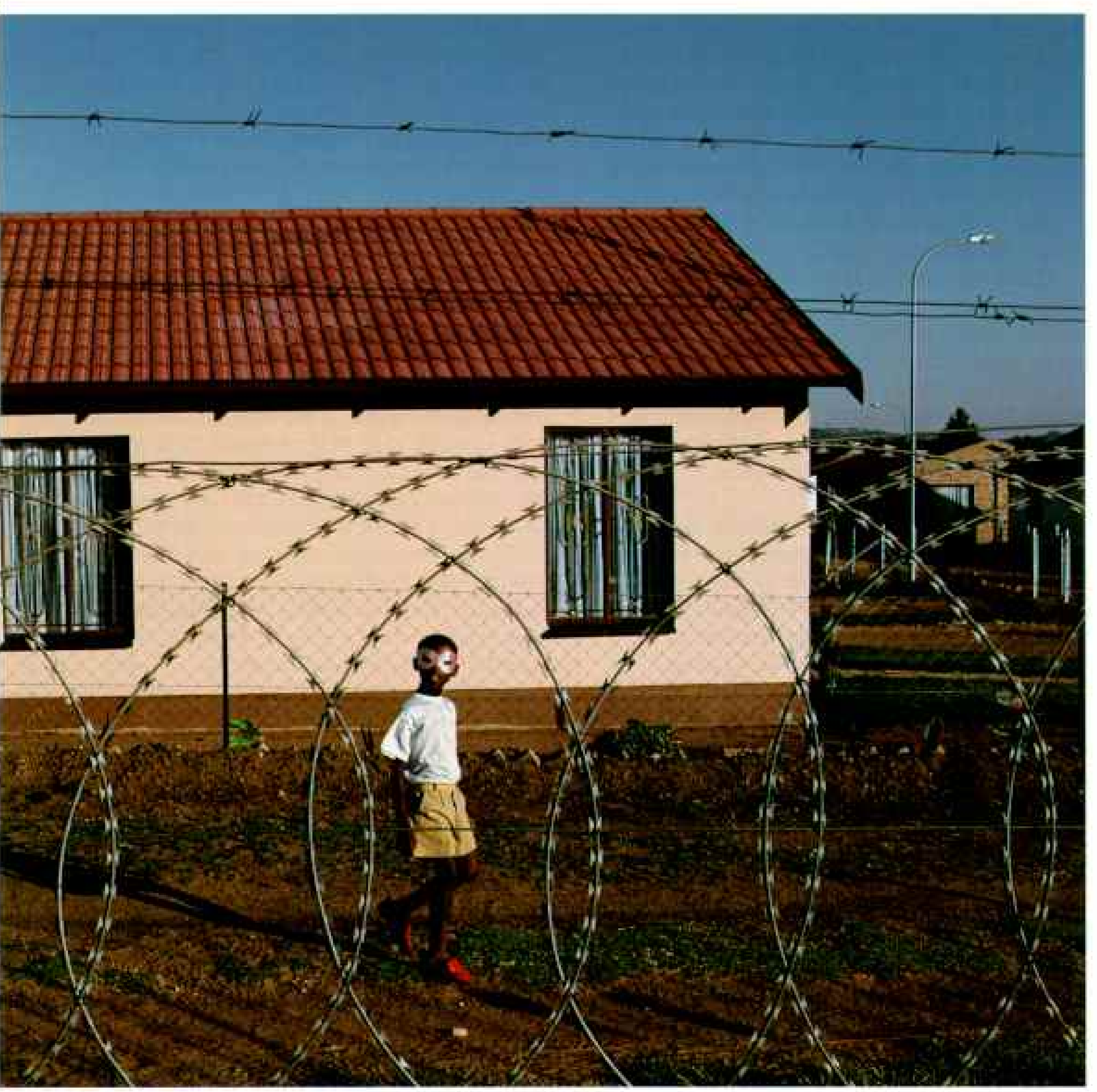
There are no black-owned condominiums in the small towns that form the farming heartland of the Afrikaner realm in the provinces of the Transvaal and the Orange Free State.

Afrikaners—"the white tribe"—descend from Dutch settlers who first arrived in South Africa more than 300 years ago. Trekking inland, they conquered the arid, unforgiving land after defeating the Africans long settled on it.

In the Orange Free State their huge farms are dotted with stumpy hills called *koppies*. The emptiness is an illusion; 13 million people live in rural South Africa, 90 percent of them black.

A chilly rain outside was turning to snow as Zaniwe Tsapa, a Griqua, washed a week's worth of dirt and labor from her husband's overalls, pounding them with a rock. Twice she threw out the muddy water and refilled the basin from a hand pump.

Every day she is up before dawn and back home at dark. She is a cook on the farm of an Afrikaner couple, J. P. and Iona Botha. Their 20,000 acres near the town of Trompsburg are



dedicated to wool. Zaniwe's cinder-block house is one of ten in the farm's worker compound, spartan, without electricity, but not shabby.

I saw on Zaniwe's face what I had come to call "the look." All the women farm workers have it in the half hour or so before sunset. They sit outside looking straight ahead, their expression unfocused and impenetrable. It seems their gaze curves back into their innermost, weariest selves.

I asked Zaniwe what she would most like to do. She shrugged: "I am an uneducated woman." For herself she sees nothing beyond the farm. For her children, however, not this life. Almost all she earns goes for their schooling in town. "I want my children to be educated."

J. P. Botha's great-grandfather—the first Jacobus Philippus—was one of the "trekkers" who moved from the cape into the interior. J. P. is increasingly mechanizing the farm. "My father grew up with oxen. He knew nothing of tractors until 1949," says J. P.

The Bothas are proud of the conditions for their black workers. There is even a primary school. Iona likens their farm—and South African society itself—to a zebra. "One part is black, one part is white. If the animal is destroyed, it's not just the white or black part."

Afrikaners express something like this often. Without doubting their sincerity, I saw that

they find it difficult to think of blacks in the same human terms as they think of themselves. It's not hate; it is culture, deeply rooted in the settling of the land, the frontier wars, their small numbers, and isolation. It is far more subtle than a deliberate insult. One day before heading into Trompsburg, I remarked to a local Afrikaner that I understood that only a few hundred people lived there.

"Yes," she replied, then paused. "And 5,000 blacks."

Like many whites, the Bothas fret at the speed and drama with which change is unfolding. But they cling to the belief that a changed South Africa will be better. "It's going to take a long time coming," says J. P., "but if they take it step by step, it must come out right."

ALMOST TWO MILLION blacks work as migrant laborers. More than any other commodity, gold connects the rural black homelands to industrial South Africa. A 300-mile-long gold-bearing deposit, the Witwatersrand complex, arcs beneath the Transvaal and the Orange Free State, making the country the world's largest gold producer. Blacks digging the Rand work on contracts of nine to twelve months.

Extracting the gold is no easy matter. The seams are narrow and the mines so deep that rock bursts—the shattering of the earth's crust under stress—pose a grave danger.

Descending into a Transvaal mine with Sam Molaudzi, who trains new workers, I could walk upright for a time. But then we had to scrabble through narrowing tunnels, buttocks dragging, feet slipping on loose, wet rock. I felt lost in the shrinking bowels of the earth.

There I met Fikelephi Jokweni. "Fiki" had one day to go on his nine-month contract with Rand Consolidated Gold Mines. I watched as he crouched to drill holes for dynamite. Other men squatting in a narrow corner broke up rock with sledgehammers. The depth, the roar of a jackhammer, the heat, and the closeness oppressed me. I could see how the pressures beneath the surface fueled the boiling tensions above ground. At the end of a grueling workday, miners like Fiki are not greeted by wives and family. They return to all-male hostels, often squalid.

This mine's hostel seemed well kept, yet Fiki, age 30, shared a room with 15 others. Each man shook his hand the day he left for home. Each said: "Go well home, and live well, and come back again."

It was raining the next morning when Fiki got off the all-night bus near Flagstaff in the Transkei homeland. Men from the mines bring home not only money but also supplies that are hard to find in their impoverished corners of rural South Africa. Fellow passengers helped Fiki unload four chairs and a table, a 50-kilogram bag of beans, loaves of bread, and candy.

Ordinarily he would have bargained for a taxi van or walked the 30 miles to his village, Mgodini. But I had driven behind the bus with Sam Molaudzi, who had agreed to serve as my interpreter, and it seemed only right to take Fiki the rest of the way.

I am glad we did. A reporter in South Africa sees so much rage that moments of love seem especially magic. Fiki, who knows no English, was suddenly speaking excitedly in Xhosa. "He says stop, it's his wife," explained Sam.

Fiki flung open the door and raced down the muddy road. From the opposite direction, coming out of the mist, was his wife, Mabala. They just stood there looking at each other—nine months had been a long, long time.

Mgodini is a classic Transkei community: cattle grazing, children playing on ox-drawn sleds used for hauling harvests, thatched rondavels with mud and manure walls tucked amid rolling green hills. It can be so beautiful and gentle that it hardly reveals its distress. But cattle and goats have overgrazed, and wind and rain have gullied the land.

Today was to have been the first day of plowing, but rain prevented it. The village was celebrating the event anyway, passing around pails of homemade beer in a rondavel next to the home of schoolteacher Vina Nofika Makwabasa. "If we don't drink the beer, it will spoil," she explained. Woodsmoke stung my eyes.

"There is no work here and no money," Vina

The Zulus call them *malunde,* street children. They huddle for warmth and protection on Johannesburg's sidewalks, sleeping off exhaustion and intoxication from sniffing glue. They beg and steal for food and video games. For affection and a few rand, many sell their bodies.

Private agencies and churches provide the only services available to these runaways, who frequently end up in jail, or worse. As many as 15,000 outcast children, some as young as three years old, live on the streets of Johannesburg.

Springing to the sky from a trampoline, Soweto children escape for a while the weight of violence.

Each day they head for the same lot, where owners park the trampoline during warmer months. For a few cents a child gets ten minutes of bounce and twirl.

If they go to school at all, black children in South Africa each year face shortages of teachers, textbooks, and even chalk. In townships plagued by violence, end-of-year test results have been particularly low.

said. "Of all the men you see, only one is working." I counted 23 men.

How about a new South Africa? I asked.

"We don't know if it will be better or worse," one man replied. "We hope it will be better." A headman added: "We do not see the jobs yet."

Subsistence is the way of life here. The fields yield corn, beans, and squash. "We plow and reap only to eat, not to sell," the headman said.

A clucking chicken careered about the big cooking hut while I talked to 27-year-old Mabala Jokweni. While Fiki is away, she looks after the house, their two children, their cattle, and their land. Would it be easier if Fiki were home all the time? I asked her. No, she replied, surprising me. Her reason was revealingly precise: "We live under the monetary system."

Mabala's head drooped a little. She had as much as said: We live by a system designed for the benefit of whites.

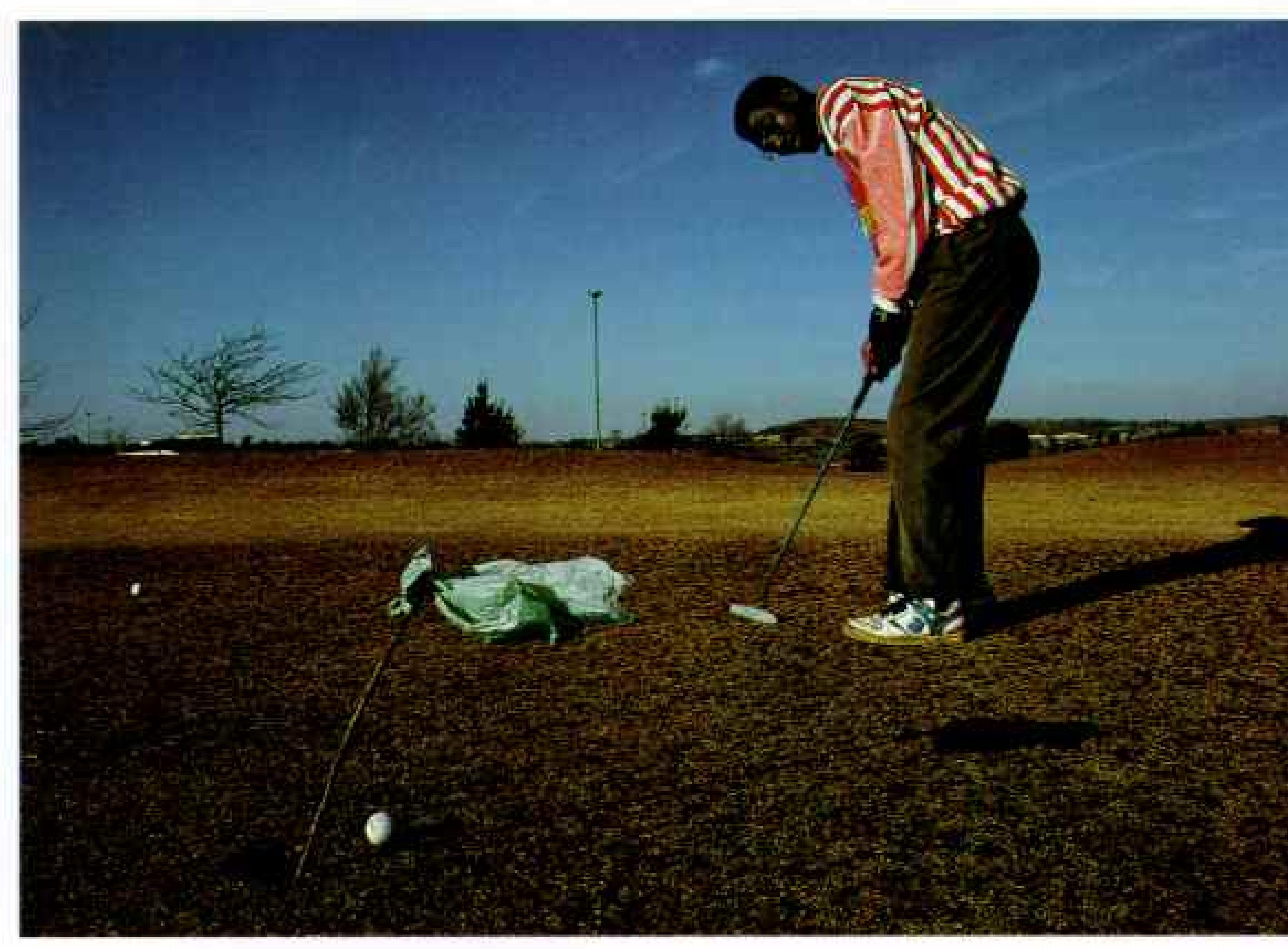
WHITES kept the best land for themselves when partitioning the homelands. Crossing from Natal into KwaZulu—Zululand—the difference in the land quality is striking. As in the Transkei, Zulu men migrate to work in the mines or in the nearer sugarcane fields of Natal.

It was in KwaZulu that the nature of today's violence first took shape. In the early 1980s KwaZulu leader Mangosuthu Gatsha Buthelezi brought new life to a relatively obscure Zulu cultural organization called Inkatha. Centered in Natal, the revived Inkatha primarily attracted rural, traditional Zulus. Younger, urban Zulus preferred political organizations such as the United Democratic Front (UDF), closely associated with the then banned ANC.

In 1984 fierce fighting between UDF backers and Inkatha broke out. The conflict, almost entirely among Zulus, was part political, part generational, part town versus country. Later it emerged that covert funds from the government helped finance Inkatha. That fact, charges the ANC, is proof enough that the government has encouraged violence.

By 1990, when Inkatha became a political party, more than 6,000 people had been killed, almost all Zulus. And the fighting leaped cross-country to the townships outside Johannesburg as Inkatha organizers began membership drives in the hostels housing alienated Zulu workers.

Township violence centers on hostels. On one of my visits to the township of Vosloorus on the East Rand, I counted nine dead outside a hostel. In front of the hostel hundreds of headbanded



"I want to compete in the Olympics," says Louis Phiri (above). Each day he practices golf, a proposed Olympic medal sport, at the Soweto Country Club, marking the holes with a stick and a plastic-bag flag.

Gaby Magomola (left, at center), head of Inter-Africa Group, and board director Vladis Servus, at right, consult with a client. The Johannesburg company serves the growing black middle class by helping businesses win contracts with larger white firms.

men, presumably Inkatha supporters, brandished spears and hatchets—Zulu weapons later banned by the government except for ceremonial use. Many of the township residents wore the ANC colors: green, gold, and black.

On a side street a crowd began to rock my car. "Press!" I yelled. The rocking stopped. One of the youths leaned in. "Do you have any extra petrol?" he asked, holding a soft-drink bottle in one hand and a rag in the other—the makings of a Molotov cocktail.

Vosloorus residents said Inkatha bands had launched the attacks. Hostel dwellers claimed they had been assaulted. Members of each side told me the same thing: "I'll revenge."

The ANC recently concluded that a climate of "violence for the sake of violence" prevailed within its own organization, a finding ANC president Nelson Mandela called "a matter of grave urgency." Mandela and Inkatha president Buthelezi have both pledged to campaign against the factional fighting, and last November they agreed to resume talks. Meanwhile the violence continues, and the innocent are often in the way.

Crime as well as political violence has risen. Killings and brutality accompany holdups and hijacks. Going to visit a neighbor after sundown can be risky. Soldiers are patrolling the townships more often, but rarely at night, when the streets are most dangerous.

What is the role of white soldiers in township violence? President de Klerk denies it, but there are indications that black violence is being encouraged by right-wingers within the South African security forces who are hostile to black-white rapprochement.

This was reiterated by the Goldstone

"Ukubusisa—Bless you." Two women of a Zulu sect pray over another member after casting out evil spirits. Gathering Sunday mornings on the shore of the Indian Ocean at Durban, congregants blend African and Christian rituals to heal the ills of followers. Members believe that blessed water empowers the soul, helping them to prosper, maintain their health, and survive the remnants of apartheid—whose effects may take generations to wash away.

Commission, a panel created to investigate the violence. While laying most blame on ANC-Inkatha rivalry, the commission also pointed to "a police force and army that for many decades have been the instruments of oppression by successive white governments."

I asked ANC deputy president Walter Sisulu about de Klerk's inability or unwillingness to control radical white security forces. He replied: "The day the government wants to, it will."

WALTER SISULU, more than anyone else in the upper echelons of the ANC, is the one to whom the rank and file bring their problems. Few families mirror the black political struggle in South Africa as closely as his. His wife, Albertina, and all eight children have been jailed, exiled, or persecuted. Walter is 80 now and white-haired. Before his release in 1989 he spent 25 years in prison.

"I still have to get used to our being able to gather as a family again," son Zwelakhe Sisulu, editor of the *New Nation*, told me. Just months before, his brother Jongumzi had been released from prison after five years.

Albertina is deputy head of the ANC Women's League. In 1963 she and son Max, then 17, spent 90 days in jail. Then she was under house arrest for ten years. Her almost regal bearing does not contradict a motherly warmth. "Everybody calls me mama," she said when I met her at their modest house in Soweto.

Albertina was not active in politics until she met Walter. "You are marrying a married man," a friend told her. "This man is married to the nation."

"I was born in poverty," said Walter. "I was born oppressed, and I resented it from childhood. And my choice was this one: I will fight it." He worked in a bakery, crushed stones at a mine, and sold real estate before becoming secretary general of the ANC in 1949. "We used the slogan 'Freedom in Our Lifetime' then, but it didn't seem realistic."

Why, I asked Walter, did the government decide to talk with the ANC?

It's a practical matter, he said. "They are concerned that the white man's power is not forever, that it's a passing phase. They want to be a part of the forces shaping the future. They are thinking of their children's future."

A majority of whites today agree that South Africa has no future without blacks as full members of society. With most apartheid laws struck

from the books, the country is gaining worldwide acceptance—the welcoming back of its athletes to the Olympics and other international competitions is but one indication.

But even as day-to-day society becomes desegregated, the issue of black political power remains unsolved. As Trevor Tutu, son of the archbishop, told me: "I can imagine the Nationalists' stance in the next election. It's no longer a question of would you allow this man to marry your daughter, but would you allow this man to run the country?"

If black and white parties can continue to talk and negotiate a new constitution, an interim government could exist by 1994, when the current constitution mandates an election.

Who would win such an election is not clear. The ANC probably would get the majority of black votes, yet they could be defeated by a coalition of the white National Party and Inkatha.

What is clear is that for any negotiation to succeed, the violence must stop. Says Aggrey Klaaste, editor of the *Sowetan:* "The violence is confusing to us. When the violence comes, everybody stops thinking."

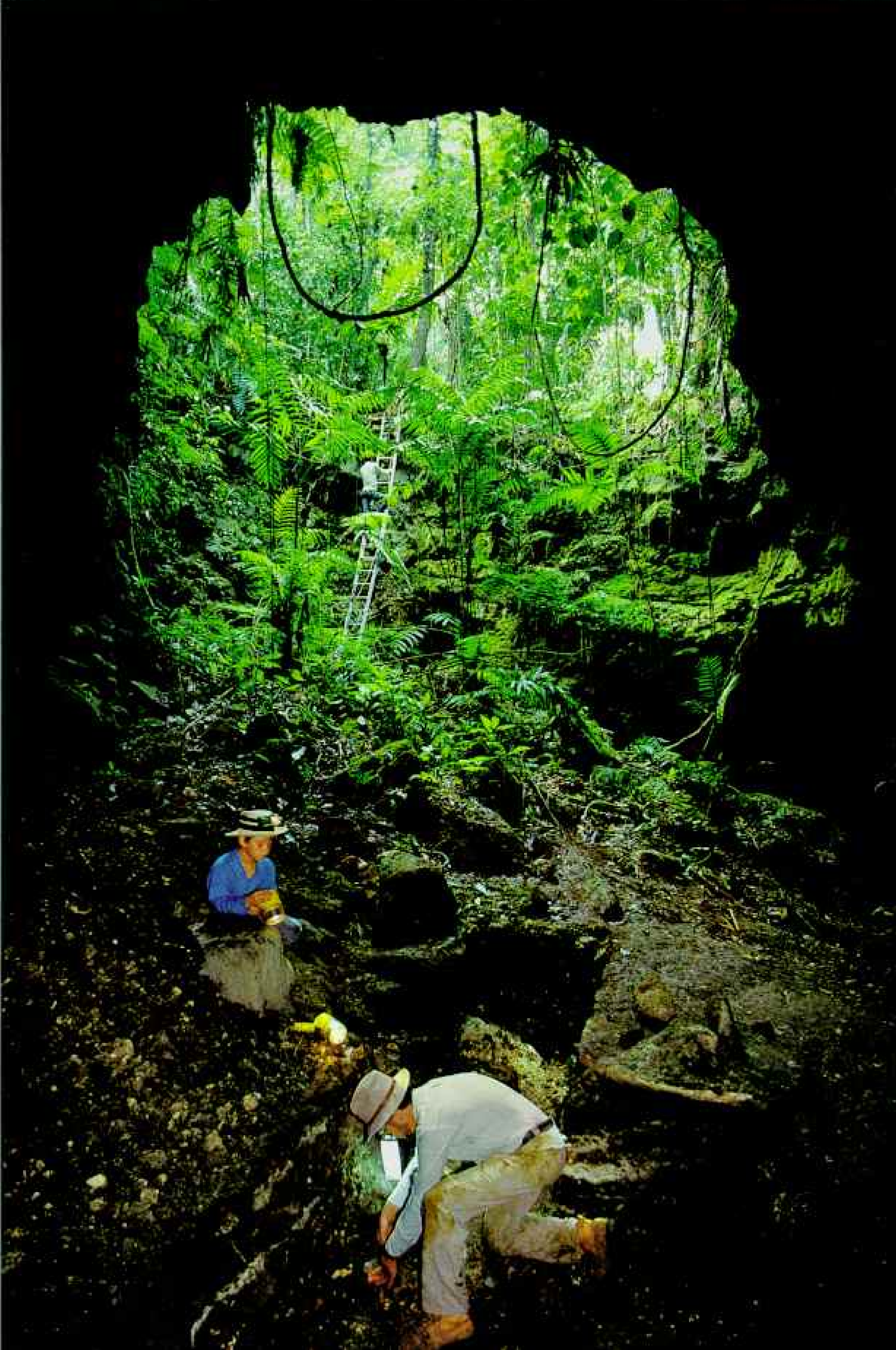
Like so many, he expresses hope for the country's nonracial future. "I'm not saying black power, I'm saying South African people power. In the end we will have to run this country together. We know that." □

His ferocity undimmed by time, a Maya warrior-king is portrayed twice life-size on a stela carved in A.D. 731. He was vassal to a more powerful king, known as Ruler 2, of Guatemala's Petexbatun region, where excavations are uncovering clues to the fate of Maya civilization.

THE VIOLENT SAGA OF A MAYA KINGDOM

By ARTHUR A. DEMAREST

Photographs by ENRICO FERORELLI



In the Petexbatún rain forest of remote northern Guatemala, shaded by towering mahoganies and cedars, archaeologists and laborers were carefully scraping more than a thousand years of dirt from a massive stone stairway inscribed with Maya hieroglyphs. Sweat soaked through their shirts and glistened on their faces, and the buzzing of insects filled the air. The thud of distant mortar fire was a reminder that a local band of revolutionary guerrillas was beginning one of its frequent dusk assaults on a Guatemalan Army base a few miles away.

But the workers ignored these distractions. They were in the process of uncovering a clue to one of the greatest mysteries in archaeology: Why did the lowland Maya civilization—which 2,000 years ago developed the most complex writing system in the New World, built majestic temple pyramids and palaces, and mastered astronomy and mathematics—suddenly collapse in the ninth century A.D.?

For the past four years I've supervised a team of 40 scientists and more than a hundred laborers as they unearthed such finds as this hieroglyphic stairway in the ancient Maya city of Dos Pilas. We've been able to piece together a remarkable story of Dos Pilas and the Petexbatún kingdom it once ruled, a story that I believe may help explain why the Maya vanished: In a span of only a few hundred years the kingdom rose, expanded, and collapsed as a succession of kings changed the rules of Maya conflict by moving from limited combat to widespread, internecine warfare.

In the end the Petexbatún's desperate citizens barricaded themselves in their cities, and the kingdom broke up into several warring territories. After the mid-ninth century A.D. the record of life in the region is silent. The people of the Petexbatún stopped erecting monuments, carving hieroglyphic texts, making pottery. Their once splendid cities lay in ruins, their fields and villages abandoned to the jungle.

The stairway was a spectacular find. Five limestone steps, about 20 feet wide, each with two rows of pristine glyphs carved like little puffy pillows on the risers, climb to the base of the royal palace near the main plaza.

I watched the ornate symbols appear on the steps as the dirt was brushed away. We couldn't work fast enough—everyone was anticipating the next glyph. Stephen Houston and David Stuart, epigraphists from Vanderbilt University, crouched beside me and ran their hands over the stone, as if hoping for some direct, tactile communication with an ancient Maya scribe.

"It's a shell star—a war glyph. It's another war they're talking about," Stuart said, pointing to a glyph some 1,300 years old.

Within minutes they decoded many of the glyphs and grasped the principal narrative—an account of the battles of the first ruler of the Petexbatún, whom we call simply Ruler 1, against his brother at Tikal, the great Maya city some 65 miles northeast of Dos Pilas.

Later Stuart summed up the inscription: "It begins by talking about the 60th birthday of Ruler 1, that he danced a ritual dance. As you read down the steps, the glyphs give a historical sequence to his reign. We think Ruler 1 left Tikal and started a splinter kingdom at Dos Pilas. There's an emblem glyph—which is like a political title—for Tikal, and both brothers claimed

Arthur A. Demarest, Centennial Professor of Anthropology at Vanderbilt University in Nashville, Tennessee, is director of the Petexbatún Regional Archaeological Project. Enrico Ferorelli's photographs last appeared in the September 1992 Geographic.

A Maya dynasty is born

Dos Pilas and then Aguateca rose, capitals of a new dynasty founded in 645 by a prince who had left Tikal but kept its emblem glyph (above). He and his successors engaged in limited raids, then in territorial conquest, finally ruling a realm of more than 1,500 square miles.

Archaeologist James Brady (facing page) with the author's son Andrew examines one of many caves at Dos Pilas, where Maya made offerings to gods of the underworld.

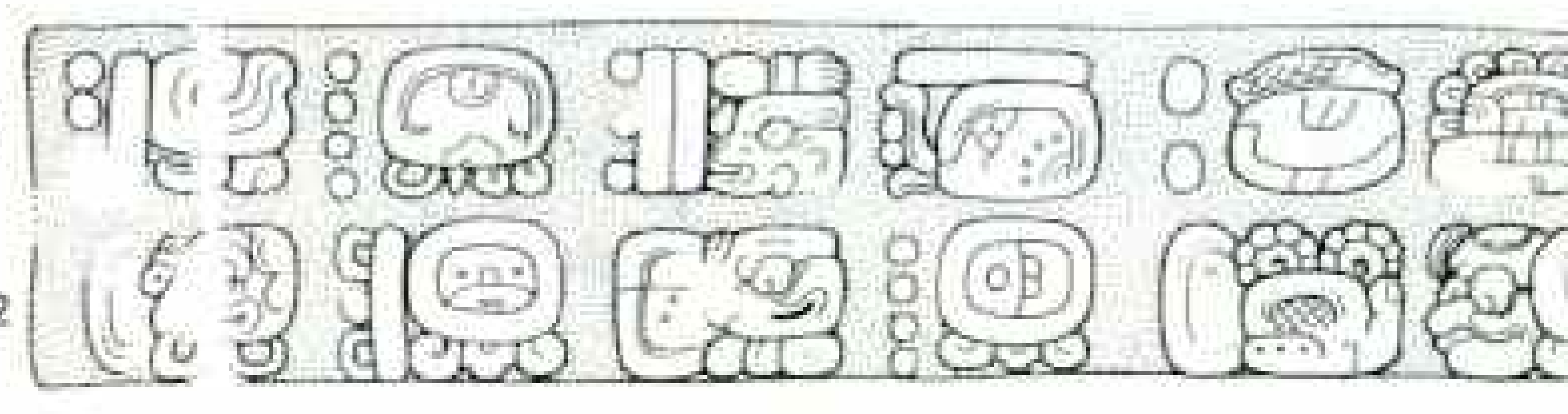
it. Ruler 1 was defeated, but then there was another war. This time Dos Pilas won."

Although the glyphs told us about the origin of a dynasty, what was more intriguing was a stone wall built on top of the stairs during the kingdom's fall. Less than a hundred years after memorializing their founder, the people of Dos Pilas threw a wall up over his monument in what must have been a desperate attempt to protect themselves.

"It's really a poignant piece of archaeology," Stuart says. "Here you have a celebration of the rise of a kingdom. To have this wall built right over it is the final irony."

I FIRST CAME to Dos Pilas in 1986, while investigating the final epoch of the Classic period of the lowland Maya (A.D. 250 to 900). I visited a rustic camp where Stephen Houston and Kevin Johnston, then graduate students at Yale, were mapping the site and studying its stelae, or carved stone monuments. They had just stumbled across an exciting clue—defensive walls encircling the center of Dos Pilas, suggesting that the city had been besieged.

"The walls were constructed very late," says Houston. "They didn't look contemporary with



The hieroglyphs on the stairway at Dos Pilas are read left to right, top to bottom, in blocks of four. One of the five risers (above) identifies Ruler 1 (J,1 and I,2) as a ball player (L,1). A bundle of hair (L,2) appears in the glyph for Tikal and the new dynasty.

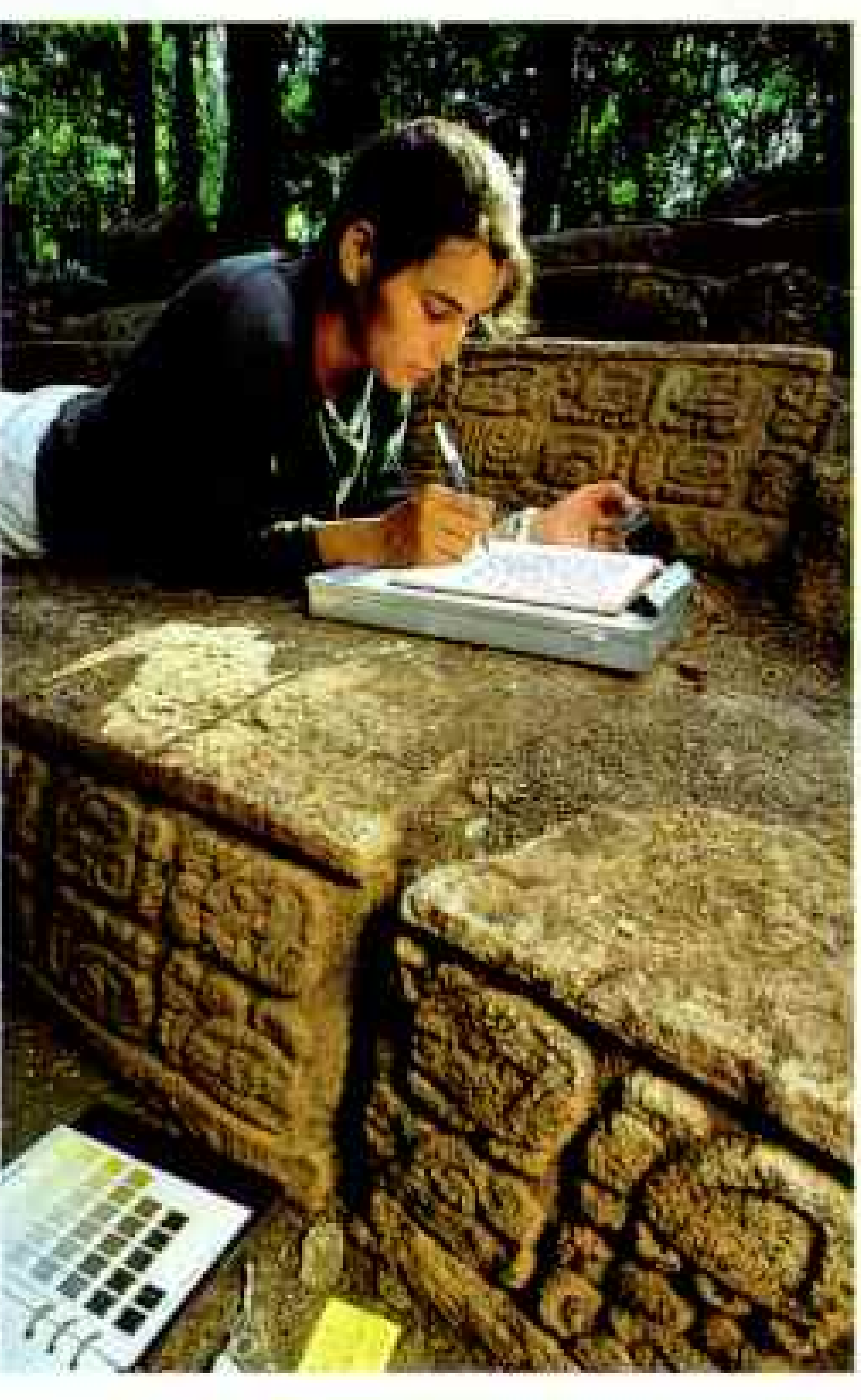
A unique record of civil war and fratricide came to light during excavations of the Dos Pilas palace of Ruler 1, supervised by the author, at far left. Glyphs on this stairway speak of intrigue to epigraphists David Stuart, with notebook, and Stephen Houston, behind Stuart.

Dos Pilas was built by renegade nobles from the great Maya center of Tikal, 65 miles away. Tikal's ruler, Shield Skull—likely the brother or half brother of Ruler 1—waged war against his sibling but in 679 was captured and killed. The stunning upset established the power of the breakaway kingdom.

Its next king, Ruler 2, like his cousin, Ruler A of Tikal, embarked on a monumental building program.

In contrast to earlier raids principally for sacrificial victims, Rulers 2 and 3 set out on wars of conquest. By 761 Dos Pilas itself had come under siege.

As Vanderbilt graduate student Stacey Symonds (below) excavated a defensive wall, she discovered the hieroglyphic stairway beneath it. Here she records color tones of glyphs on step four (bottom).



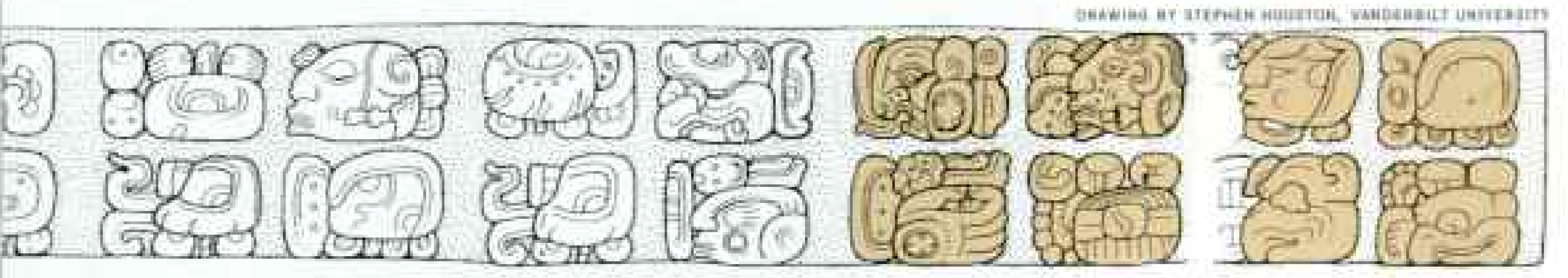
the other architecture. There were some very grubby looking structures and huts in the middle of the main plaza." It was like finding a squatters' village on the White House lawn.

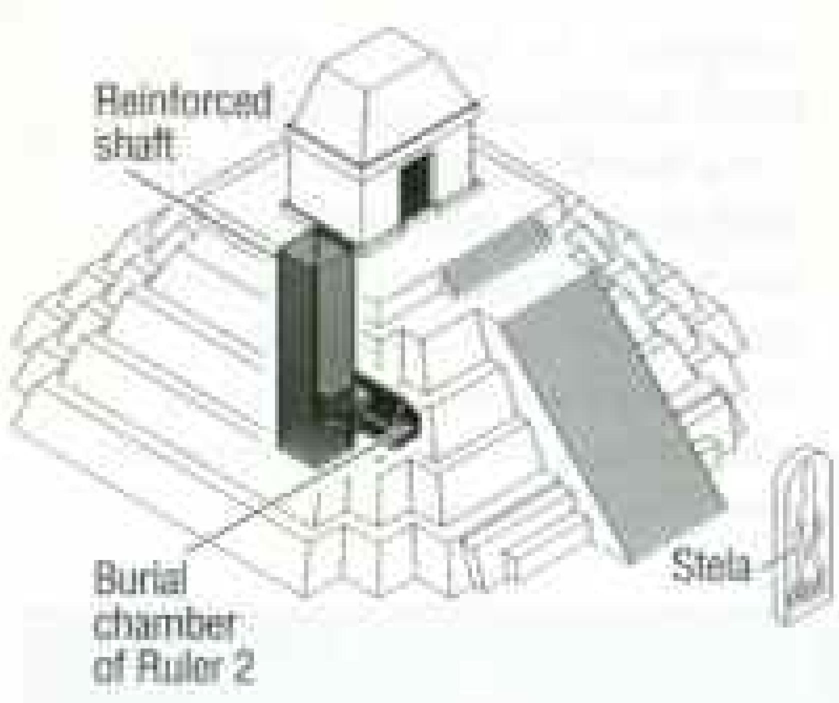
Why did the people of Dos Pilas build defensive walls, which are rarely found at Maya sites? Was warfare more intense in the Petexbatún than elsewhere in the Maya world? And, if so, how might such warfare have caused the kingdom's demise?

To answer these questions, I assembled a team of scholars from around the world—not only archaeologists and epigraphists but also ecologists, geographers, architects, ethnologists, geologists, bone pathologists, artists, botanists, and others.

In 1989 we began to construct our own small town at Dos Pilas, which takes its name from two nearby springs. Thatch-roofed launches motored south from the town of Sayaxché on a two-hour trip up the Petexbatún River, bringing us metal roofing, heavy generators, computers, and other supplies. Then, from a portage at Lake Petexbatún, mules with gaunt bodies weakened by bites from vampire bats pulled our provisions for five hours through dense rain forest to the camp. In a few months we had a kitchen, dining hall, medical clinic, and

DRAWING BY STEPHEN HOUSTON, VANDERBILT UNIVERSITY





Glyphs point to a hidden tomb

A stela dedicated to Ruler 2 that stood before a temple pyramid in the Dos Pilas plaza tells of his burial within. Seeking the tomb, the author's team sank a reinforced shaft 30 feet to bedrock (above). Tunneling sideways, they pierced a masonry wall and found a chamber with a stone vault on the verge of collapse. Inside the author brushed the detritus of nearly 13 centuries from the skeleton of a robust male, Ruler 2 (right). Bone analysis confirmed that his death date could have been 726, as given by glyphs. The tomb also yielded shell mosaics from a headdress, a jade necklace and bracelets, and bloodletting instruments for rites to nourish the gods.

The dead king's successor, Ruler 3, extended his sway through marriage and warfare. He wed a royal lady from Cancuén and gave her a fine palace (page 102, note 4). And in 735 he subdued Jaguar Paw-Jaguar, lord of Seibal, a conquest illustrated in a broken stela (facing page) at Dos Pilas. Attired in warrior regalia, Ruler 3 stands over the naked and bound royal prisoner, whose city of Seibal was to remain subjugated for the next 60 years.

fully functioning lab complete with computer and drafting workstations. With support from the National Geographic Society, the Institute of Anthropology and History of Guatemala, Vanderbilt University, and several other organizations, scientists began studying thousands of potsherds, scores of monuments, bone fragments, spearheads, trash heaps, and miles of fortifications of Dos Pilas and the half dozen Petexbatún cities it once dominated.

ALTHOUGH scholars long regarded Maya society as a network of ceremonial centers ruled by peaceful priest-kings, advances in decoding hieroglyphs have changed our view, revealing a central role for battle and human sacrifice. Images and hieroglyphs on monuments, murals, and pottery show evidence of limited, ritualized conflicts. Warriors, who dressed in elaborate costumes, captured royalty from rival cities for sacrifice. Usually the captive would be ritually bled, tortured, and decapitated.

On a stela from Dos Pilas, for instance, Ruler 3 wears jaguar-skin boots and a mask of a war deity. From his neck hangs a human skull. Beneath it an owl crowns the head of a jaguar, symbols of war and death. Under his feet, below a band of glyphs, crouches the naked king of Seibal, a Maya city about 15 miles east of Dos Pilas. The glyphs on the stela say Ruler 3 captured him in 735 and brought him back to be sacrificed.

These customs were violent, but there was relatively little destruction of the society, because the warriors killed few people and seldom destroyed cities.

The second and third rulers of Dos Pilas changed traditional warfare when they set forth on campaigns of expansion. Ruler 2, who reigned from 698 to 726, and Ruler 3 rapidly gained control of one of the largest territories of any lowland Maya kingdom. By Ruler 3's death in 741 the hegemony of Dos Pilas had spread more than 1,500 square miles from near today's Guatemala-Mexico border to the base of the highlands to the south, encompassing the Pasión River, a major Maya trade route.

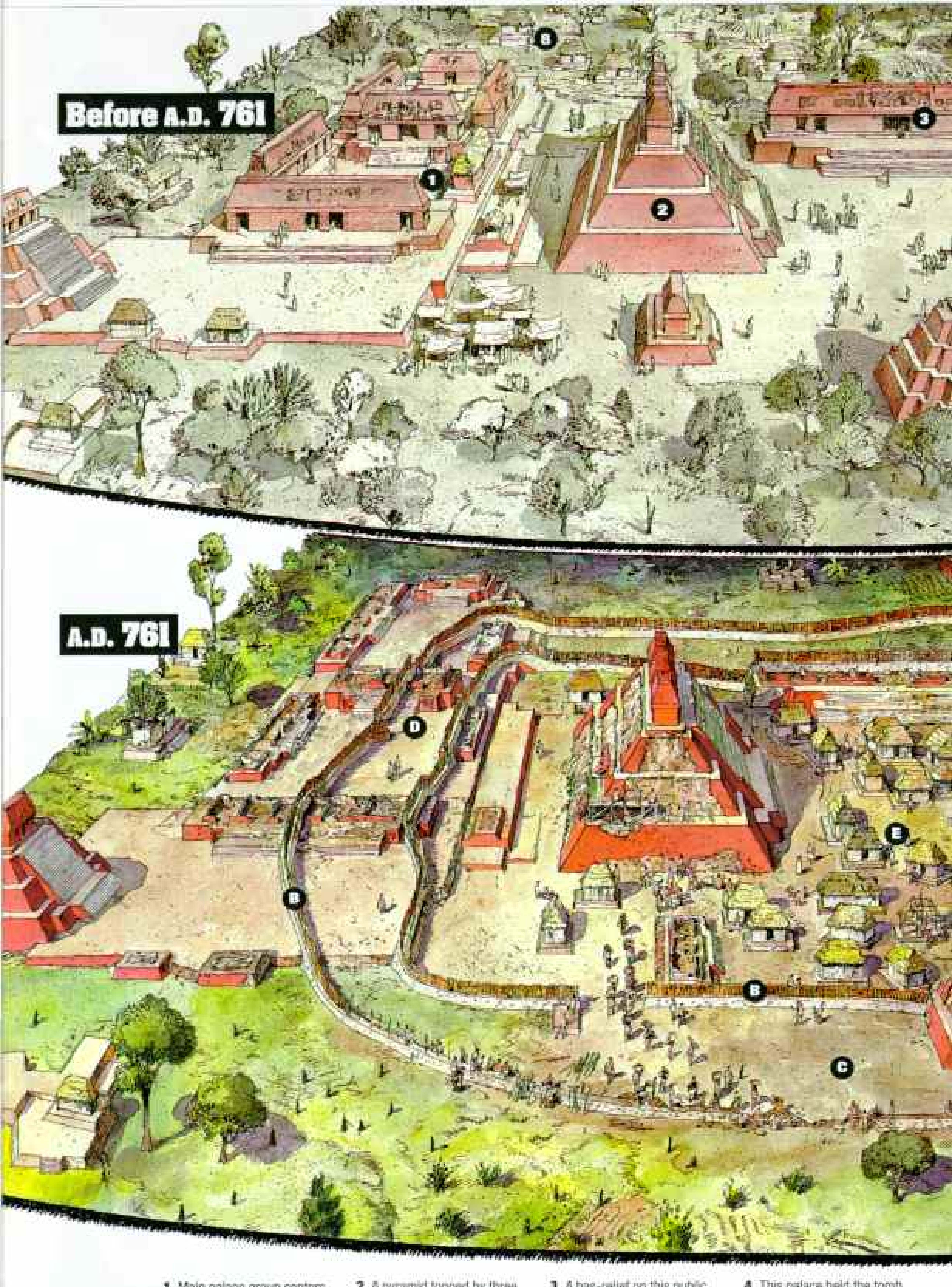
Along the kingdom's northern and eastern reaches canoes traveled the Pasión River, carrying such exotic goods as jade and obsidian from the highlands and shells and stingray spines from the Caribbean.

At the height of the kingdom these riches poured into Dos Pilas. In our second season hieroglyphic clues from many places led us to some of that wealth in royal tombs, temples, palaces, and caves. Beneath the forest of the Petexbatún lies a honeycomb of limestone caves where all social classes practiced rituals to honor their gods and ancestors. Clusters of broken pots, beautiful polychrome vases, and human bones cover the floors.

On the east side of the main plaza of Dos Pilas, in front of a small, steep temple, there is a stela with the likeness of Ruler 2. Dedicated by his successor, it tells of the birth of Ruler 2, his accession to the throne, his conquests, and his death and burial. That much had been deciphered years ago by Peter Mathews, an epigraphist from the University of Calgary, and only a few puzzling glyphs remained to be read. It was Stephen Houston and David Stuart who realized that the glyphs said the king's tomb was in the main plaza, perhaps inside the temple just behind the stela.

A RESEARCH PROJECT SUPPORTED IN PART BY YOUR SOCIETY

It took us four months to dig a 30-foot shaft into the temple,



1 Main palace group centers on the ornate residence of Ruler 1 with its hieroglyphic stairway (pages 98-9).

2 A pyramid topped by three temples containing hieroglyphic panels rises 60 feet over the main plaza.

3 A bas-relief on this public building shows a conference of kings; a stairway has hieroglyphs now too eroded to read.

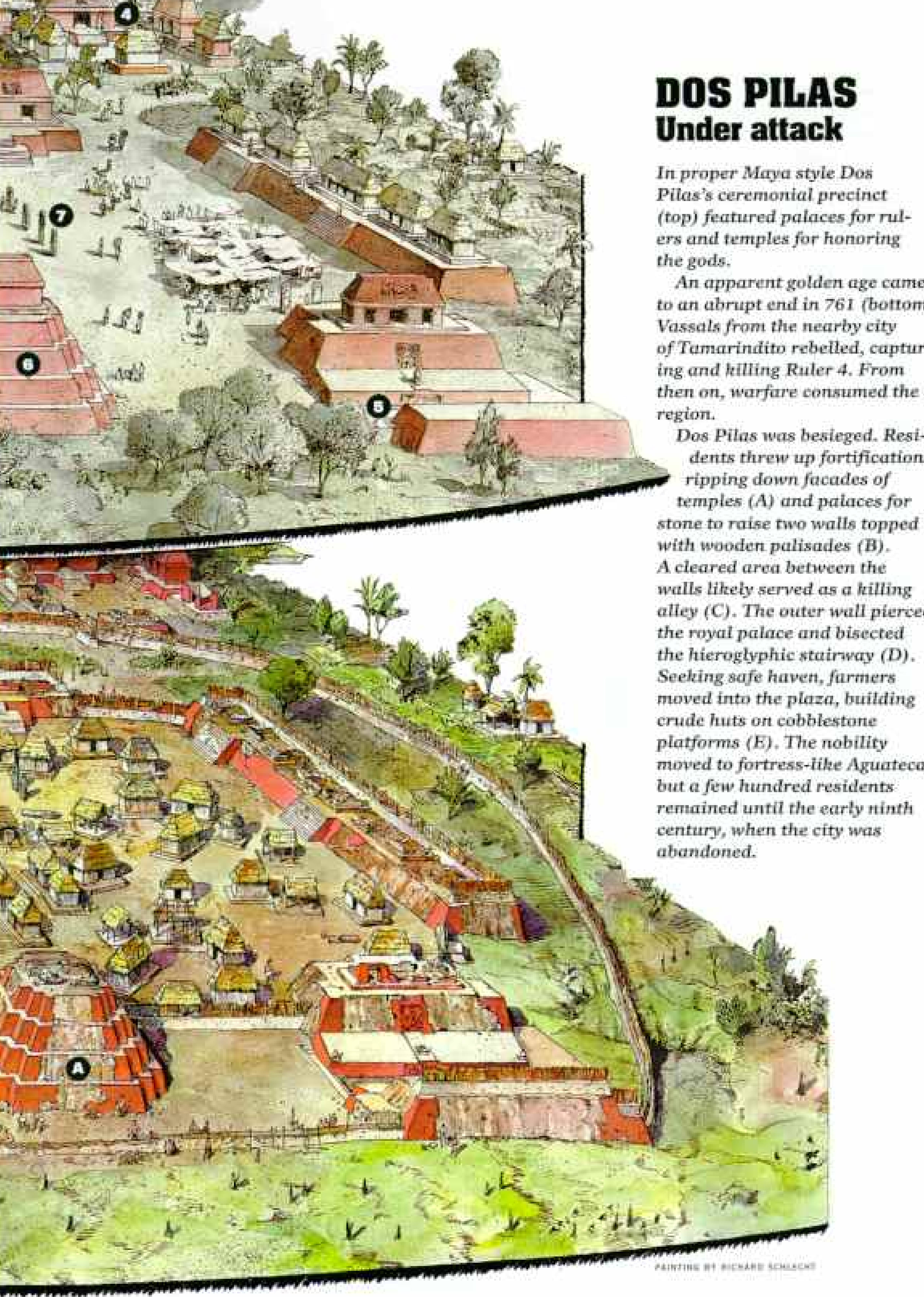
4 This palace held the tomb and funerary throne of the queen of Ruler 3, a daughter of royalty from the city of Cancuén.

DOS PILAS
Under attack

In proper Maya style Dos Pilas's ceremonial precinct (top) featured palaces for rulers and temples for honoring the gods.

An apparent golden age came to an abrupt end in 761 (bottom). Vassals from the nearby city of Tamarindito rebelled, capturing and killing Ruler 4. From then on, warfare consumed the region.

Dos Pilas was besieged. Residents threw up fortifications, ripping down facades of temples (A) and palaces for stone to raise two walls topped with wooden palisades (B). A cleared area between the walls likely served as a killing alley (C). The outer wall pierced the royal palace and bisected the hieroglyphic stairway (D). Seeking safe haven, farmers moved into the plaza, building crude huts on cobblestone platforms (E). The nobility moved to fortress-like Aguateca, but a few hundred residents remained until the early ninth century, when the city was abandoned.



PAINTING BY RICHARD SCHLECHT

5 A ball court with its own temple is decorated with carved panels of a spear-bearing ruler.

6 A temple pyramid covers the tomb of Ruler 2.

7 Huge limestone stelae in the plaza memorialize the exploits of rulers and link them with key dates of the Maya calendar.

8 Residences of petty nobles and farmers are densely scattered outside the royal precinct.

which was a dangerous pile of loose rubble with a veneer of stone. We worked day and night to find the tomb before the onslaught of the rainy season. When we hit bedrock, I was ready to give up but decided to give it one more shot in case we had misjudged the placement of the shaft. We tunneled sideways and after only a few days hit a wall of obsidian flakes. I knew then that we'd found it.

Raúl Aldana, a small, wiry Maya on our team who was known as the Rat Man for his ability to squeeze through tight spaces, crawled into the chamber through a small hole we had cut in the wall. We handed him wooden beams to prop up the ceiling. The next day we could enter safely.

"It was a summer afternoon, and rays of sunlight shone through the temple when we entered the funeral chamber," recalls Juan Antonio Valdés, my co-director and the director of archaeological studies at the University of San Carlos in Guatemala City. "We lit candles and burned incense, praying for permission from the buried king to disturb his eternal sleep.

"But no sooner had we opened the tomb than the sky completely darkened, and a violent thunderstorm broke. I'm not superstitious, but the force of the storm made me wonder if we had released the fury of the dead."

Inside, we found the king. His skull had been crushed by rocks, but the rest of the skeleton was intact. Remnants of a shell mosaic headdress depicting monster faces lay scattered around the floor. A heavy jade necklace rested on his chest, and jade bracelets encircled his wrists. Near his pelvis was a stingray spine, a symbol of high office that was used for genital bloodletting—a ritual in which a Maya king would pierce his foreskin, dripping the blood on pieces of bark paper that were burned as an offering to the gods.

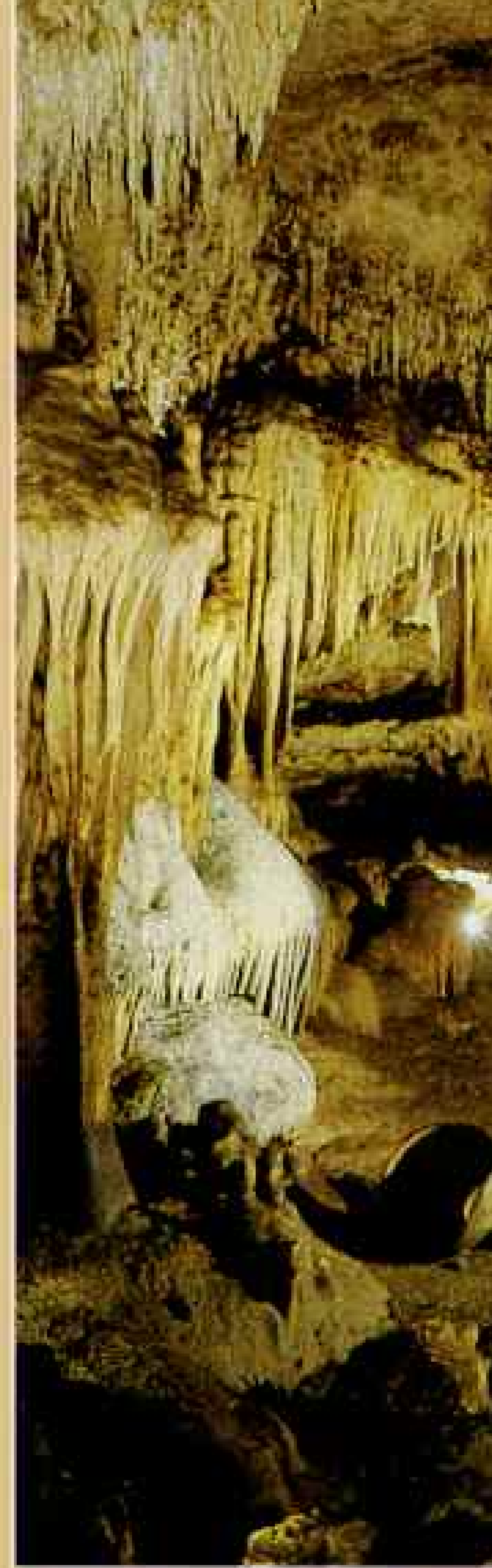
But more important than the tomb's riches were the hieroglyphs on its fine pottery that suggest Ruler 2's extension of the influence of Dos Pilas. From the texts on stone monuments we know he gained control of other cities through marriage and political alliances.

Ruler 3 went on to wed a royal lady from the city of Cancuén and, after conquering Seibal, he dominated the entire region. He traveled to the cities of Tamarindito, Aguateca, Seibal, and others to perform ceremonies and quell unrest. After Ruler 3 died in 741, Ruler 4 took control, living mostly at Aguateca—by then a twin capital—which rests on a limestone bluff high above Lake Petexbatún.

IN 761 something went wrong. According to the hieroglyphs we deciphered, the kings of the Petexbatún had overextended their domain. There had been hints of trouble for more than a decade: Ruler 4 had spent much of his 20-year reign racing from one end of the realm to the other, performing the bloodletting rituals, leading battles, and contracting alliances. He used every technique to sustain the kingdom, but to no avail.

Then the city of Tamarindito threw off the yoke of Dos Pilas. Hieroglyphs at Tamarindito tell us that its warriors attacked the capital and killed Ruler 4.

We know that about that time the citizens of Dos Pilas made a valiant last stand. In desperation they ripped stones from the facades of the temples and monuments, including the tomb of Ruler 2 and the hieroglyphic stairway. They tore down much of the royal palace to build two walls topped with wooden palisades around the central palaces and temples. We believe the



Underground treasury for the gods

Vast quantities of the trade goods that flowed into Dos Pilas and much of the tribute paid to its kings ended up underground—offered by the Maya to their gods. This alcove in the Cave of Blood may have been especially sacred, says archaeologist Brady (above), who discovered unusual polychrome vessels there.

One vase (left) bears the spots of the jaguar god of night and the underworld. Some pots had held incense; most had been broken.

This cave and others yielded thousands of potsherds, jade axes, obsidian and chert blades, mirrors made of polished iron pyrite, and bone awls and needles. A pile of skulls and numerous skeletons point to human sacrifice. After analyzing the artifacts, Brady will transfer them to Guatemala's Institute of Anthropology and History.

AGUATECA
The last capital

Twin city to Dos Pilas, Aguateca was fortified on a plateau above Lake Petexbatún, as rulers escalated warfare against neighboring city-states.

Capitalizing on natural defenses formed by an escarpment and a deep chasm, the builders ordered palisaded walls to encircle temples and royal residences, nearby fields, even the paths down the escarpment to the main water supply (below). Vanderbilt graduate students Chris Beekman and Takeshi Inomata explore the chasm (left).

Despite its defenses, the fortress proved vulnerable. In this re-creation attackers bridge the chasm with logs. The settlement was overwhelmed sometime after 790, the date recorded on its last known stela.

Some residents may have joined the victors; others may have moved two and a half miles north to Punta de Chimino and continued to fight on.

PAINTINGS BY RICHARD SCHLECHT

warriors stood behind the inner wall, using the space between the two walls as a killing alley. One of my students, Joel Palka, found dozens of spearheads there, as well as a pit of skulls outside the outer wall.

In the main plaza the remaining few hundred people crowded into a village of crude huts in the shadow of temples from the earlier epoch of grandeur. One wall runs through the center of the former palace of Ruler 1.

Another small group apparently held out less than a mile away, atop a 125-foot-high pyramid known as El Duende. Three concentric walls encircle the massive structure.

The surviving nobles deserted their citizens and fled to Aguateca, where they erected stelae proclaiming themselves the new rulers of the kingdom.

"The dynasty chose Aguateca as its final capital because of its defensive location," explains Takeshi Inomata, a Vanderbilt graduate student from Tokyo, who is excavating that site.

"Aguateca is on top of a very steep escarpment near a chasm that's about 200 feet deep. It's surrounded on three sides by natural defensive features, and the Maya constructed extensive walls around the city."

Unlike the citizens of Dos Pilas, the people of Aguateca held out for about 50 years by using palisades, wooden suspension bridges, and killing alleys—all along the chasm. But eventually they stopped building houses and making pottery. Sometime in the early ninth century A.D. the Aguatecans disappeared.

Two and a half miles north of Aguateca the remains of another fortress called Punta de Chimino sit on a peninsula thrust into Lake Petexbatún. Toward the end of the eighth century the inhabitants dug three great moats into the base of the peninsula.

"They had to cut deep into limestone bedrock," says archaeologist Claudia Wolley of the University of San Carlos. "The moats made the peninsula an island fortress. The largest moat is 460 feet long, 100 feet wide, 30 feet deep, and surmounted by a 30-foot-high wall."

By the end of the eighth century more walls enclosed the villages and fields, and the fortified cities of the kingdom resembled those in medieval Europe.

Each time I go to Aguateca, I stand on top of the bluff, on the edge of the deepest part of the gorge. From there you can see almost all of what was once the Petexbatún kingdom. And always before I leave, I pick up a stone and drop it into the chasm. I never hear it land.

In the heart of greenness a natural clearing provides the site for the research center of the Vanderbilt University Petexbatún Regional Archaeological Project (facing page). Building materials, computers, and lab equipment come in by boat and mule.

Excavating the El Duende temple pyramid, Guatemalan archaeologist Héctor Escobedo (above) uncovered a cache of dedicatory offerings: eccentric flints and bloodletting tools.

AS I WRITE these words in the spring of 1992, mortar fire sounds in the distance. As always the guerrillas fail to overrun the army base, and as night falls, the jungle once again provides a refuge.

I can smell the acrid scent of burning wood. Kekchi Maya colonists from the highlands are burning the forest so they can sow their *milpas*, or fields. An estimated 100,000 acres disappear each year in the Petén region, and some scientists say the forest may last only another generation.* Guatemalan and international agencies try to stop the devastation but must also consider the farmers' need for land.

One of the greatest achievements of the lowland Maya civilization was its ability to maintain dense populations in a fragile rain forest environment. Today the rain forest is being annihilated by a population only

*See "Maya Heartland Under Siege," in the November 1992 issue.

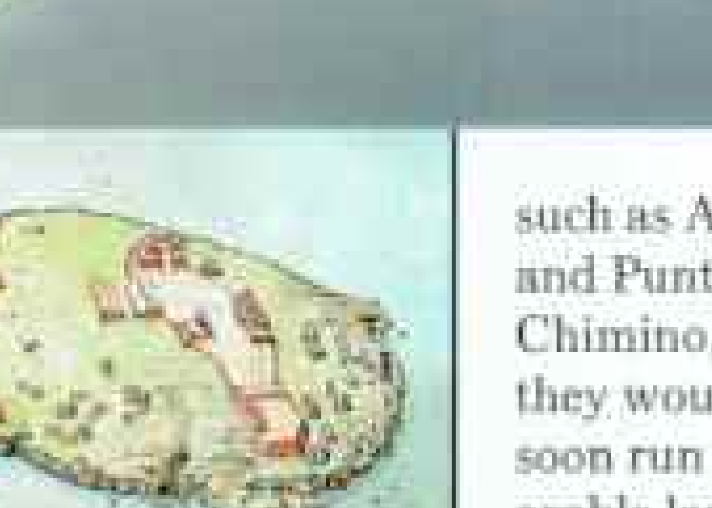
PUNTA DE CHIMINO
Final outpost

A peninsula became an island as defenders of the Lake Petexbatún port dug three moats across the neck of land in the eighth century. The largest measured 460 feet long. Some 50,000 cubic yards of bedrock were removed, much of it carried up a cliff (left) to build defensive walls on the heights.

On the tip of the newly created island (below), a walled wharf protected a canoe landing for resupply of food and water. But apparently an enemy proved too strong or conditions too harsh, for the outpost was abandoned in the 800s.

Excavators have located other fortresses and walled villages nearby, supporting the author's theory that this region collapsed in intense warfare.

Scientists continue to investigate the environment, nutrition, architecture, and trade of the ancient Maya to learn about the civilization's rise and fall.



PAINTINGS BY RICHARD SCHLECHT

a fraction the size of the Classic Maya's. How did the ancients succeed where we cannot today?

"They understood limitations of their environment," says Nicholas Dunning, a geographer from the University of Cincinnati. They cleared only small patches of forest, leaving the tallest trees standing to provide shade and enrich the soil, planted a variety of crops, and terraced hillsides to prevent erosion.

Of course, the Maya lacked the tools to cut down the larger trees. Yet some of the Maya who live in the rain forests today, the Lacandón of Mexico for example, use the same farming techniques as their forebears. Most of the peasants cutting the Petén now, however, come from the highlands and have never farmed in tropical forest. One of the goals of my project is to teach them the techniques of the ancient Maya.

Many scholars have argued that the Maya civilization simply outgrew its environment, exhausting the soil and creating environmental and economic stress. But another possibility is that intensive warfare forced the Maya, at least in the Petexbatún area, to move close to fortresses such as Aguateca and Punta de Chimino, where they would have soon run out of arable land.

We found long stretches of defensive walls around fields and agricultural terraces along the edge of the escarpment of Lake Petexbatún. Perhaps farmers were limited to fortified areas near cities that could provide protection, thereby forsaking traditional agricultural practices that had successfully sustained them for hundreds of years.

Perhaps siege warfare was ultimately too costly for their civilization. The wars must have disrupted trade routes, upset population distribution, destroyed crops, and killed young Maya farmer-warriors, exacting a huge economic price.

Over the next several years we'll study ancient pollen from lake-bottom core samples to detect changes in the environment, analyze the bone content of human remains to look for changes in nutrition, sift middens of trash to see whether the Maya diet changed as a result of the collapse.

ANOTHER research season draws to a close. About a hundred Kekchi Maya from the nearby village of Nacimiento gather in our camp on Sunday for a special ritual. Smoke from the burning forest drifts overhead. Dressed in their finest embroidered cloth, men, women, and children surround the village elders, who begin giving speeches thanking us for our help and friendship. One of the elders, Don Cristóbal, holds a sheet of parchment and begins to read a list—a generator, books for their children, a radio, a doctor's visit to a sick baby, and so on—and I realize they had kept careful note of every gift we had given them.

"You have come from afar," says Don Cristóbal, lifting his craggy face toward the sun. "You have come without your families to work in this dangerous place, looking for ancient things. So we must bring you our blessing; we must bring you into our own family."

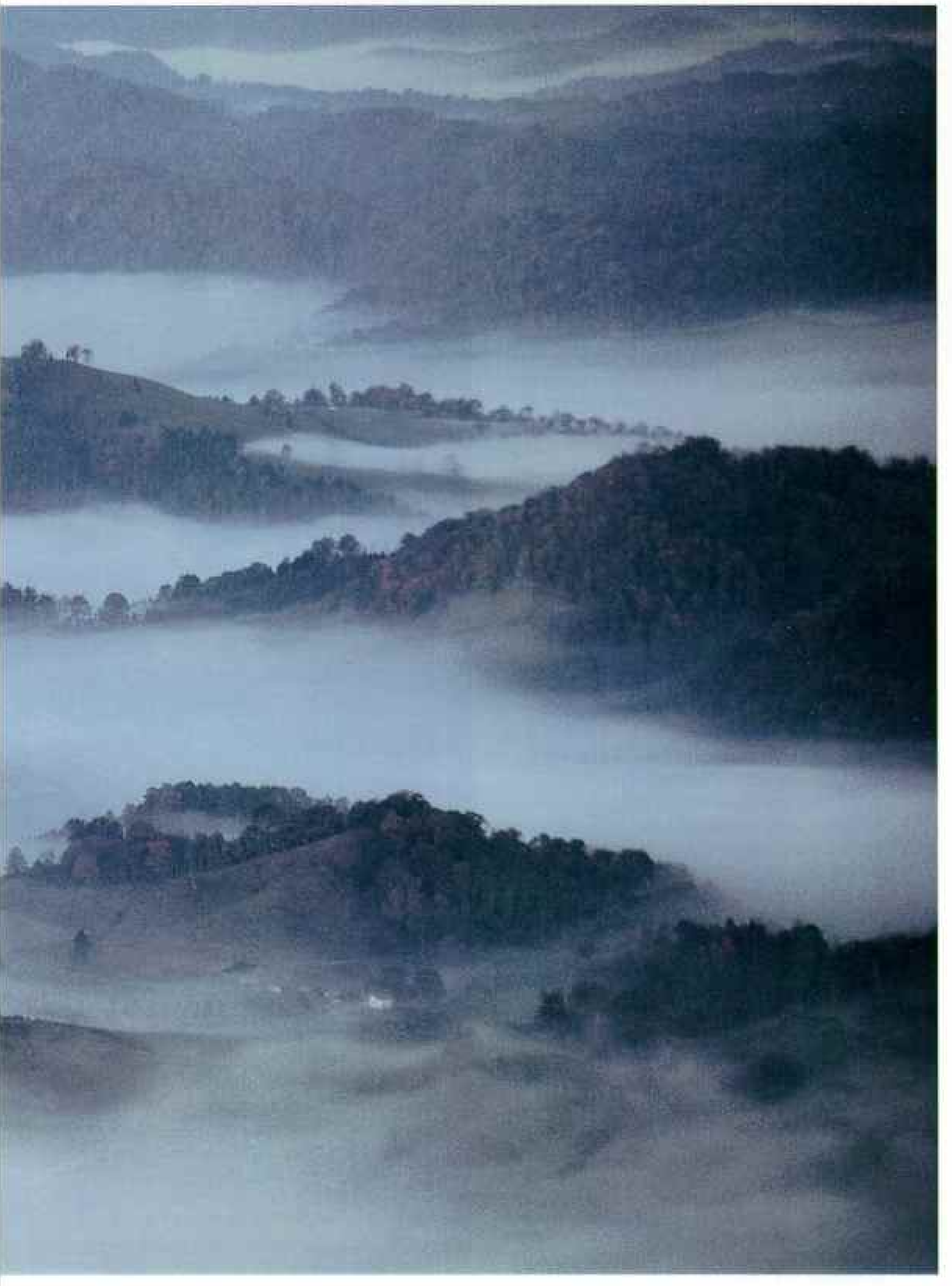
Perhaps the people of Nacimiento have offered us a gift we can never repay. ☐

In the Heart of Appalachia

Where the War on Poverty was never won and pride in heritage was never lost, Iree Bowling quilts and plants beans to sell for fertilizer money. As for the rifle: "It never killed nothing but one snake."

By JEANNIE RALSTON
Photographs by KAREN KASMAUSKI

A batting of fog tucks the valleys of Russell County, Virginia, in morning comfort. In the 18th century, farm families of Scotch-Irish and German descent moving south from Pennsylvania settled the hollows of the Appalachians, one of America's oldest mountain ranges.



IT IS HARD TO KNOW APPALACHIA. Plenty of people think they do. I thought I knew it before I left my home there, in Kingsport, Tennessee, for the Northeast ten years ago. I knew it as a place that was lush and moody in the summer. Mist clung to the green mountainsides, and the creek beds I waded in to search for salamanders were filled with the scent of honeysuckle. In autumn, slopes and ridges teemed with maples, dogwoods, and oaks—with color that set the land on fire. I remember hiking to Abrams Falls in Virginia with my girlfriends to swim in a chilly pool under the potent column of white water and sitting on a friend's farmhouse porch at dusk listening to rain fall on the roof.

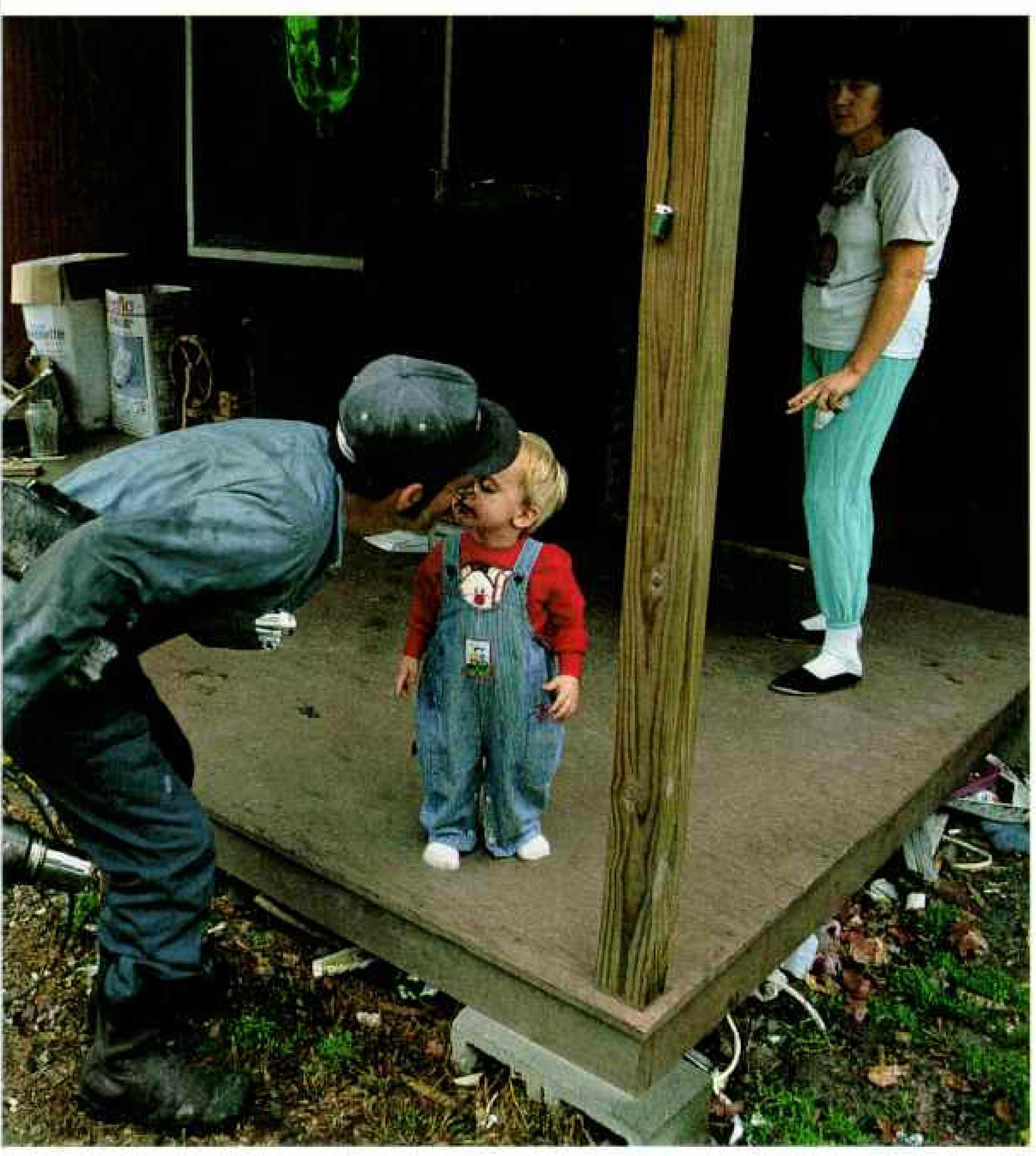
But more than anything, central Appalachia was a place to leave as soon as possible. From an early age I thought nothing much happened in those forgotten counties of Kentucky, West Virginia, Virginia, and Tennessee (map, page 119). It seemed as though there was only coal mining, tobacco growing, and poverty.

Any pride I did have in Appalachia dampened as I learned to become ashamed of it. Living in the North, I heard plenty of comments about incest, ignorance, and bare feet. But years later, during weeks of traveling among the people of central Appalachia, I discovered just how wrong the old stereotypes are, and I realized I had never known Appalachia. There was much that surprised me when I returned to what is perhaps the most unappreciated region of the country.

Many Appalachians are reaching out to solve their problems and rebuild their region. I went back to rediscover my home and to take a look at men and women trying to turn their lives around. I found that despite a decade of mine layoffs contributing to an unemployment rate estimated to be as high as 30 percent in some counties, despite the draining off of the population as families look elsewhere for work, and despite a paucity of quality health care, education, housing, and public services, there is much to be proud of.

Free-lancer JEANNIE RALSTON, born and raised in Tennessee, has written for *Life* magazine, the *New York Times*, and other publications. This is her first assignment for NATIONAL GEOGRAPHIC. KAREN KASMAUSKI's photographs last appeared in "Japan's Sun Rises Over the Pacific," in the November 1991 issue. Her interest in Appalachia began when she worked as a volunteer for Tennessee community groups in the mid-1970s.

Along the southeastern edge of Kentucky, Dan and Juanita Wright (above) live a simple life in a secluded mountaintop compound they share with 50 members of their extended family. Dan, a 54-year-old father of seven who has mined coal for 37 years, still plows his fields with a mule. On a brisk October afternoon Dan rewarded the old mule with a clump of Red Man tobacco for working his



Off to join a few other men working the evening shift a mile underground at a coal company's small "truck" mine, Dan Wright kisses grandson Phil Junior good-bye at home on the family's mountain in Letcher County, Kentucky.

With times bust in the coal industry, many of the large unionized "train" mines have shut down or leased parts of their operations to local outfits.

garden, which sat in front of a row of trees speckled with flaming orange foliage. He looked out over a ridge that runs along the Kentucky-Virginia border at a vista of mountains resembling a sea of massive waves frozen against the hazy sky. I grew up on the other side of these mountains, never seeing the ugliness that marred this view: Deep, brown gashes gouged the hillsides—scars left from strip mining.

"That's why we fought so hard," said

Dan, sliding his black cap back on his head. " 'Cause the strip jobs already about destroyed everything."

Dan was referring to the Wrights' battle against a natural gas company called Equitable Resources Exploration. A few years back the company wanted to drill on nearby land where it owned mineral rights. The Wrights feared that any drilling and development would disrupt their peaceful life and ruin

a road the family had built—a steep gravel road with curves that turn back on themselves like folds of ribbon candy.

To protect their property, 15 Wright women spent a day sitting cross-legged across the road, blocking an 18-wheeler with a bulldozer from reaching the site. After a month of legal skirmishing, during which the Wrights' cause attracted the support of a strong citizens group, Equitable backed off.

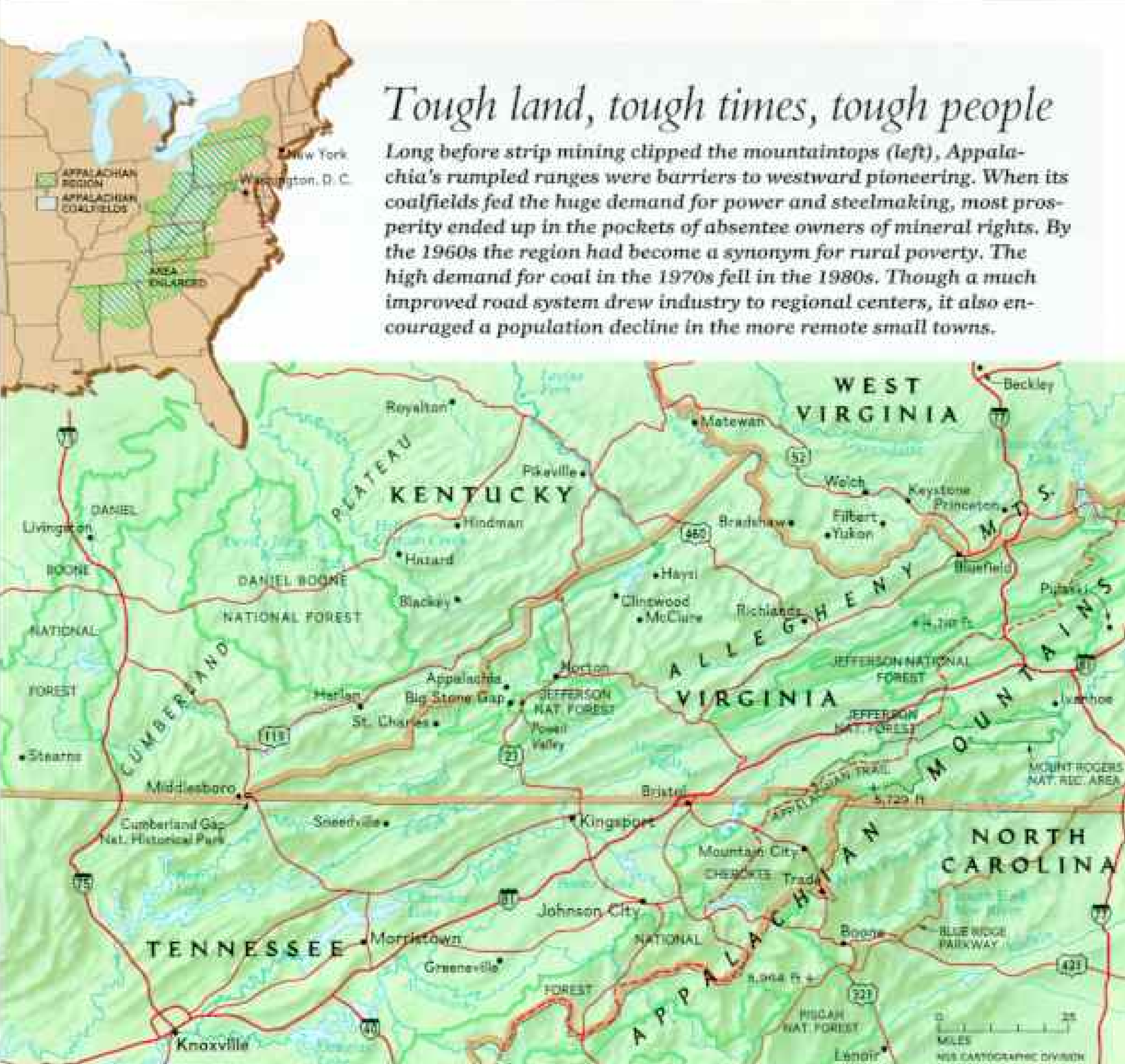
"We didn't know we could accomplish what we did," said Juanita, a roundish woman with squinty, merry eyes. "Someday my grandbabies may say, 'My grandmommy stopped a bulldozer,' " she continued. "I love to climb around in the woods, and I want my grandbabies to do the same thing."

On the paneled wall above her head hung a bird's-eye photo of the Wright homeplace. Above that, a framed poster of an American flag proclaimed, "These Colors Don't Run," an appropriate description, I thought, of this family's gritty spirit.

I was only three years old when President Lyndon Johnson toured Appalachia in 1964 to launch his War on Poverty. America was in the midst of discovering this region and its heartbreaking paradox: some of the poorest people in the country, just a few hundred miles from the nation's capital, living on top of some of the richest mineral deposits in the world. Their per capita income was about three-fourths the national average, and a quarter of them lived in substandard housing.

"Much of the wealth produced by coal and timber was seldom seen locally," a report from the President's Appalachian Regional Commission noted. "It went downstream with the great hardwood logs; it rode out on rails with the coal cars; it was mailed between distant cities as royalty checks from nonresident operators to holding companies. . . . Even the wages of local miners returned to faraway stockholders via company houses and company stores."

Beginning in the late 19th century outside



Tough land, tough times, tough people

Long before strip mining clipped the mountaintops (left), Appalachia's rumpled ranges were barriers to westward pioneering. When its coalfields fed the huge demand for power and steelmaking, most prosperity ended up in the pockets of absentee owners of mineral rights. By the 1960s the region had become a synonym for rural poverty. The high demand for coal in the 1970s fell in the 1980s. Though a much improved road system drew industry to regional centers, it also encouraged a population decline in the more remote small towns.

companies, including the U. S. Coal and Coke Company and the International Harvester Company, followed the rich veins of coal through the mountains, buying up land and mineral rights (for as little as 25 cents an acre) from people who lived in isolated hollows and along creeks they had christened with such colorful names as Hell for Certain and Devil's Jump. The locals often had little idea of the valuable things hidden in the earth. The wording of the deeds, which allowed the mineral owner to extract coal by any method "deemed necessary or convenient," would come back to haunt their offspring. Beginning in the 1950s, coal companies deemed surface—or strip—mining necessary and convenient, and until recent legal changes restricted the rights of mineral owners, Appalachians lost land, homes, and even family cemeteries to the bulldozer.

A 1981 landmark survey conducted for the Appalachian Regional Commission—the federal agency that led the War on Poverty—looked at the ownership of 20 million acres of land and mineral deposits in 80 Appalachian counties. Nearly three-fourths of the surface acres and four-fifths of the mineral acres beneath were held by absentee owners, including such corporations as U. S. Steel, Georgia-Pacific, and Occidental Petroleum.

"The economy has been out of the control of the local people," says Ron Eller, director of the Appalachian Center at the University of Kentucky. "It has been controlled by absentee owners whose interests are in coal, which limits alternative use of the land. You

Sam jumps for Jose Lopez and neighbors chat of an evening in Filbert, West Virginia. When a U. S. Steel subsidiary ran nearby mines, the houses belonged to the company, which sold them in 1971. Some went for more than $5,000; some went for less.

Bob, the Belgian, and Clyde, the Percheron, haul Earl Wallace's sled during the last of the tobacco harvest on his hundred-acre farm near Trade, Tennessee. Spot used to be a cattle dog, but "I run over him with my truck, and he ain't worked much since," says Wallace.

The tobacco is cured for two months before going to market. Another smokers' crop, marijuana, is burned by agents (below left) after raids in Kentucky.

can't build on it to increase the tax base."

Despite obstacles to development and diversification, the Appalachian Regional Commission tried to stimulate the economy by building roads. Roughly two-thirds of the six billion dollars spent since the agency's inception in 1965 has gone to roads, with more than 2,000 miles of pavement laid across the undulating terrain to attract businesses to regional centers like Hazard, Kentucky, and Norton, Virginia. The roads drew commerce, health care, and culture but also had an unintended side effect: They drained business from the far-flung small towns.

I was amazed as I drove up the stretch of Highway 23 from Kingsport, Tennessee, to Norton. I had driven this way years ago, up what was then a snaking two-lane route, past flimsy shacks clinging to the mountainsides like cats to tree trunks. Now the road is a four-lane highway. Along the way I saw plenty of the standard consumer icons—Ramada Inn, McDonald's, Wal-Mart. Many were in shopping centers on flat, treeless spaces I later learned were reclaimed strip-mining land. I could have been anywhere in the U. S., if it weren't for the rows of mountains rising all around.

CENTRAL APPALACHIA, it seemed, had finally caught up with the rest of the world—at least along the major roads. But I got a different image once I left them, driving back into the hollows, past stone-filled creeks and kudzu-covered trees reminiscent of giant topiary. I drove by rusting coal tipples, gaunt towers from a way of life that is almost dead, and by shuttered company stores with fading signs for Coca-Cola and Frigidaire. I passed impromptu flea markets, clearings on the side of the road where parked cars were piled with dishes and old clothes for sale. Near Keystone, West Virginia, I stopped to ask a bony woman why she was selling the jeans and T-shirts stacked on the hood of her blue Camaro. She would not tell me her name and looked away when she replied, "We need some extra money." Her husband, a coal miner, hadn't worked in a year and a half.

With the jobless rate soaring, many people in Appalachia make a living any way they can. "It's hard to make it every month. It takes every dime I can get," said Russell Blackburn, 58, a former factory worker whose last steady job was seven years ago. Blackburn has managed to raise seven sons—two of whom still live with him and his wife in their three-bedroom trailer in Livingston, Kentucky—by taking on odd jobs, such as

mowing lawns and making willow chairs.

In a good month Blackburn brings in $500; in a winter month, as little as $200. In addition he receives $260 a month in food stamps. "Without them I don't know how we'd hardly get by," said Blackburn in a deep, unhurried voice. "It used to kind of bother me to take them, but then I got to thinking about the tax dollars I paid in my lifetime. I figure if anyone's eligible for them, we are.

"I ain't never going to give up," he added proudly. "I just keep good hopes and do the best I can. I figure that's all anyone can do."

I COULDN'T HELP BUT LOOK UP. Sunk low in a sandbox-size tram, 440 feet underground in a coal mine in McClure, Virginia, I kept my eyes on the rock ceiling as we rattled through three and a half miles of moist tunnels. Occasionally I spotted frightening domes in the roof, created when boulders worked loose and smashed to the floor. For hours I remembered how one miner said such a boulder could "mash you flatter than a belt buckle."

Billy Gene Mullins, the miner driving the tram, tried to reassure me. He pointed to a dirty white powder the color of a New York City snowfall covering the tunnel walls. "That's rock dust; it's spread on the walls to keep the explosive coal dust down," he explained gently.

After a while Mullins rolled the tram to a stop behind a line of supply cars waiting to be unloaded. Clad in miners' work clothes—coveralls and knee-high rubber boots—we climbed out and slogged through ankle-deep black muck.

Near a glistening coal seam, we stopped to chat with six miners who were eating lunch in the stark light of a single electric bulb.

"You can call me a subterranean fossil-fuel, metallurgical, mechanical, and electrical engineer," said Joe Harrison.

"That translates into grease monkey," said Kellis Barton, his cheek swollen with a wad of chewing tobacco.

"Kellis wears out his right shoe before his left because of the extra weight of that chew," said another miner.

Then the men laughed easily and turned back to their sandwiches and coffee.

On our way back to the mouth of the mine, the ease I felt after listening to the miners' banter was disturbed when Mullins slowed the tram and whispered, "That's where it happened." He turned his head to the right,

When McDowell County Apparel in Bradshaw, West Virginia, put out word that it was opening a factory to sew sweatshirts (right), hundreds applied for work. A few dozen were hired. Most have stuck with it and have seen their pay rise.

In Floyd County, Kentucky, the Little Red School Bus (below left) sponsored by the Christian Appalachian Project helps residents prepare for high school equivalency certificates and a better chance at a job.

shining the light from his silver hard hat on a large, rectangular hole in the wall. "It," Mullins told me, was an explosion, probably caused by a buildup of methane gas, that killed seven miners in 1983.

Minutes later the whooping of an alarm broke the underground quiet. An exhaust fan, which draws dangerous gases out of the mine, had broken down. The now grim-faced Mullins rushed our car to the elevator shaft, where a disembodied voice urgently ordered a subordinate to "get them out of there."

Later, safe above ground, I was told this was the first evacuation of the McClure mine in four years. I thought I had experienced the anxiety miners must feel every day, but I was wrong. As the smudged-faced workers stepped off the elevator, lugging their black lunch pails, I saw few signs that the normal routine had been broken. "You've got to have nerves of steel to be a coal miner," said one of the men as he calmly pulled a cigarette from behind his ear. "Coal miners don't panic till the last minute—when it's too late."

The men and women who descend into the mines every day are reluctant to acknowledge the hazards they face. Denny Kimberlin, from St. Charles, Virginia, hasn't worked in three years because he injured his back on the job. Yet he says, "You see a lot more people killed and injured driving." Maybe so. Certainly mining became safer as it became more mechanized, but over every mining community there still hangs the threat of losing a loved one at any time.

Myrtle Mullins, Billy Gene's wife, recalled the agony of waiting to hear if her son had survived the McClure explosion. "Oooh, it like to kill me, worrying if he was alive. It turned out he was in another section," she said solemnly as we sat on the peaceful front porch of her baby blue, double-wide mobile home. In a garden on a hill above the trailer, stalks of cane swayed in the light summer breeze wafting down the hollow.

Mullins quickly switched our conversation to her fear of being home alone. "I don't know why," said the mother of five grown children as she clasped her hands in her lap. "I know nothing's gonna bother me out here. But I'll hear someone on the porch and think is that one of the kids or is it. . . ." Mullins doesn't need to finish the sentence.

"People do focus on tragedies here," said Ron Short, a local Roadside Theater playwright whose works capture the joys and anguish of Appalachian life. "They talk about them because it's their way of dealing with them. They've seen a mine roof fall; they've seen people killed. That is living with fear."

These days there is fear for jobs as well. Coal miners have always needed nerve to endure coal's boom-and-doom cycles; they learn to wait out a layoff until better times return. But the downturn that started after the soaring seventies—when coal was in heavy demand because of oil shortages—shows no sign of reversing. (Between 1980 and 1990, coal-mining jobs in the region declined from 147,000 to 88,000.) This is in large part because of technical innovations such as longwall mining, where a steel plow

is mechanically pulled back and forth over a face of coal hundreds of feet long. As the coal is mined, the roof falls in on a hydraulic support system. This highly efficient process is one reason coal companies can produce record tons of coal with an ever shrinking work force.

Meanwhile, some mining conditions remain terribly difficult. One old-timer described how he and his fellow miners "crawl around like crawdaddies" in tunnels only as high as kitchen counters. Many men, especially the young ones, have decided the risks aren't worth the benefits. "If I know'd then what I know now, I wouldn't 've got into mining," said Lacy Griffith, a 48-year-old miner and part-time Pentecostal preacher from Yukon, West Virginia. Black lung, an emphysema-like disease brought on by years of breathing coal dust, causes him to lose his breath during his emotional sermons.

When I met Griffith, a muscular man with a Ronald Reagan pompadour, he was sitting in a black-lung clinic learning the proper way to breathe to make his symptoms more bearable. "I'm a big hunter, and I used to be able to run up the side of a mountain," said one man wistfully. "Now it takes me a whole day." Carl Hicks, a 58-year-old school-bus driver, said he left mining because he "thought it was better living at $10 an hour than living at $15 an hour and dying."

WHEN I ARRIVED at the McDowell County Courthouse, Jeffrey Allen, a serious, bantam-size man, was standing on the steps of the tan Romanesque building that overlooks the narrow streets of Welch, West Virginia. In a gray October twilight 30 people encircled Allen for a prayer vigil. "We're on the steps where Sid Hatfield was shot some odd years ago trying to find justice in McDowell County," said Allen, a minister from nearby Keystone. Hatfield was the chief-of-police for the town of Matewan who was assassinated here in 1921 for joining union sympathizers in the massacre of seven detectives hired by the coal-mine operators. "There *is* justice in McDowell County," Allen went on, "and that's what we're fighting for."

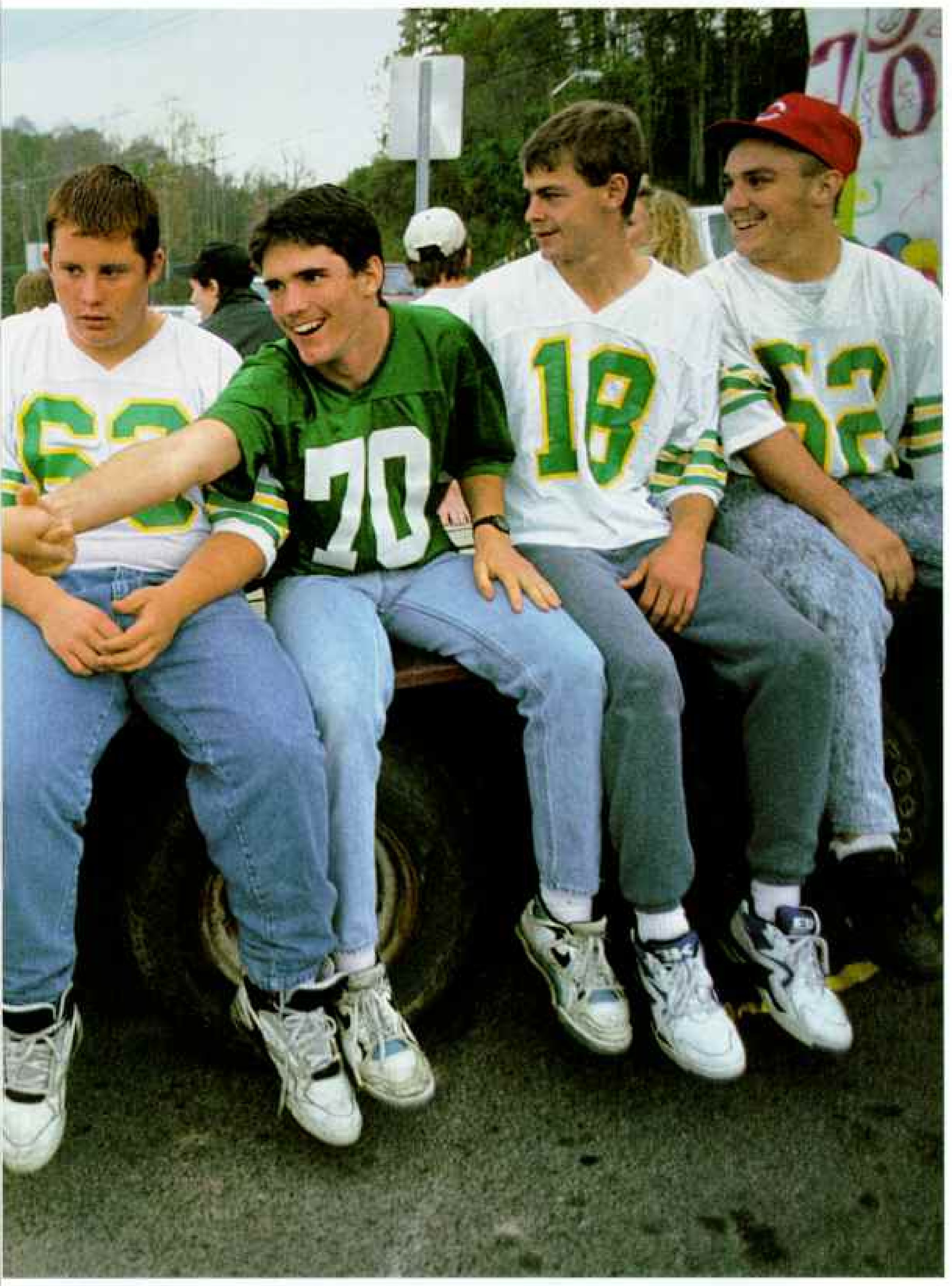
Allen and his group called Team Effort Against Ruining Southern West Virginia (better known as TEARS) were fighting the opening of a landfill that could bring in up to 10,000 tons of garbage a day, much of it from out of state. Such a haul would make the landfill among the largest in the country, receiving about two and a half times more

Want a washboard, horseshoe nails, a little local history, or a friendly earful on organizing for community action? Come to the C. B. Caudill store in Blackey, Kentucky, and talk awhile with owner Joe T. Begley, who's sorry things have got to the point where "everybody needs an attorney to help you trade pocketknives."

For an earful of "old-time string music" come to the Reids' store near Mountain City, Tennessee. You might hear Dexter, Junior, and Doyle (right). It's free, except for your sodas and chips.

C.B.CAUDILL

Sharing a laugh before homecoming, cheerleader Dana Fleming and tackle Ben Mullins gear up for Clintwood High's game against Ervinton's Rebels. Graduates will face "fourth and long" to find jobs; in their Virginia county, unemployment pushes 20 percent.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18

The twist and shout of prom night may transform the high school in Stearns, Kentucky, into a club filled with glamorous women, but the guys still hang back on the far side of the gym. Attending solo or in a group saves more than dinner-date cash. The pressure of dating is off.

Big Stone Gap, Virginia, sets aside a street so Christie (below left, at center) and friends can cruise up and down the town in their cars on weekends.

garbage a month than the state produces. "Companies came in and raped our land, and now the only thing they can do with it is dump garbage on it," declared one crusader. "It's the worst hillbilly joke."

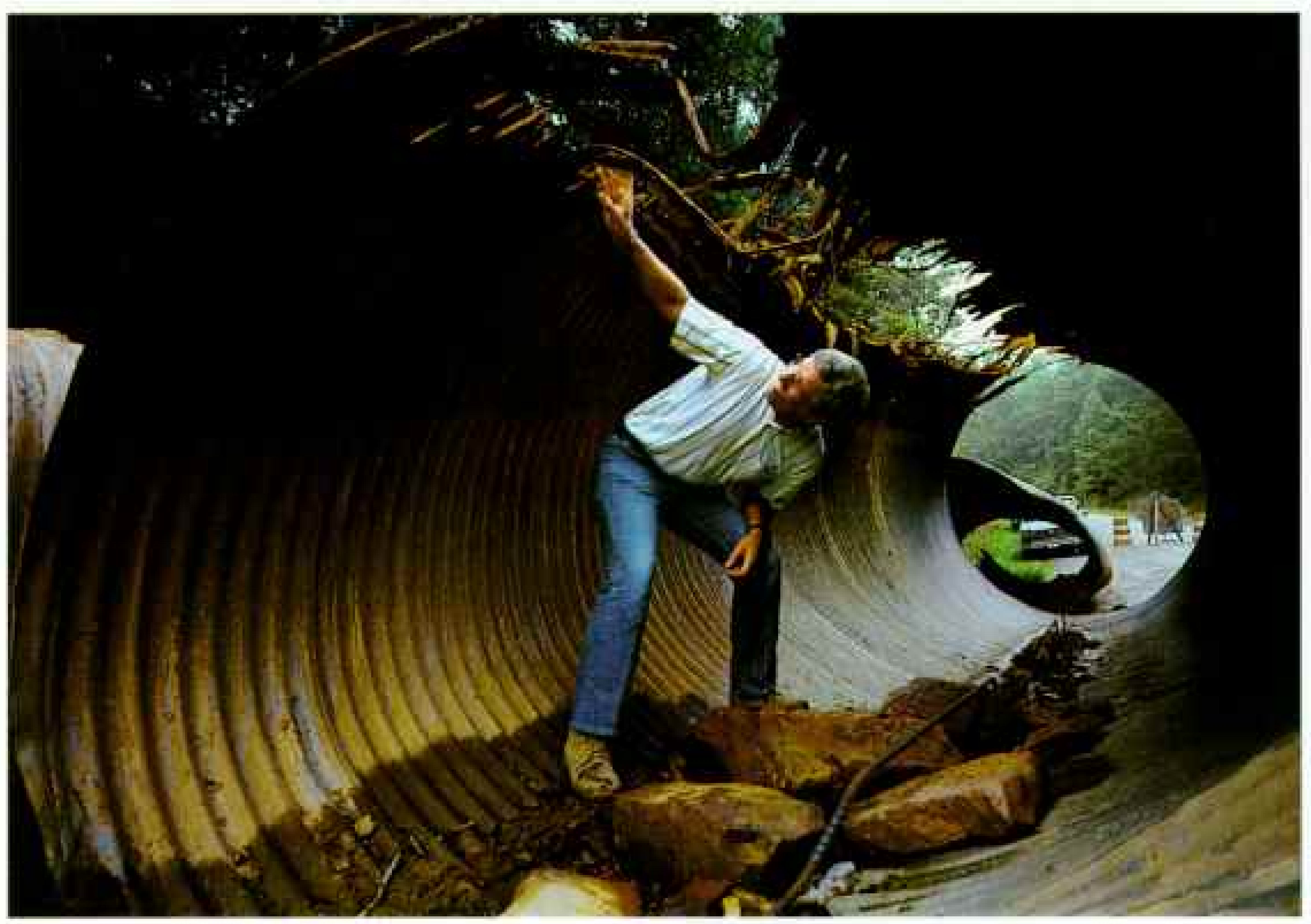
Six weeks before the candlelight vigil, I had stood on the courthouse steps watching 50 protesters wave pro-landfill signs. They desperately wanted the landfill for the employment it would bring. "All garbage stinks," one of the demonstrators told me. "But out-of-state garbage pays a lot better." The landfill developer pledged 330 new jobs for this county with a 15 percent unemployment rate. The activists also wanted the landfill for the money it would pump into the county (the developer promised to pay a fee for every ton carted in). McDowell, which was at one time the leading coal-producing county in the nation, doesn't have a modern sewage-treatment facility, and the developer promised to build one.

But TEARS decided the jobs at the landfill weren't worth the environmental risks or the humiliation of filling the deep hollows of West Virginia's southernmost county with someone else's trash. The West Virginia Legislature agreed; it voted to limit the tonnage landfills could accept. For the time being the developer has scrapped the landfill plans.

"It's a sad day when a community sees the only way to grow is through a dump," noted a doctor from a neighboring county. "That's not growth or development."

BUT WHAT KINDS OF JOBS should be brought in to replace those lost in coal and at what price? This issue deeply divides the region. Many people think any employment is better than none, but there are those who bemoan the lack of jobs while criticizing the ones to be had. They are determined to think long term and hold out for good jobs—jobs, with health benefits, that pay more than minimum wage in industries that don't damage the environment.

One of the most ubiquitous industries in central Appalachia is textiles. Every little town has a sewing factory or is hoping to get one. These factories, which usually offer minimum-wage jobs, few if any benefits, and breakneck production schedules are among the most common employers now that coal is on the wane. They are not the kinds of jobs a man who has earned $15.84 an hour, the average wage of a union coal miner, can easily accept. Consequently, women—wives of coal miners—take these jobs. With wives earning money, generally for the first time,



the traditional family order in a very traditional society can often crumble.

For some communities, sewing factories are the only hope, and many towns go to great lengths to attract them. Last fall I visited Maxine Waller, president of the Ivanhoe Civic League in Ivanhoe, Virginia, a cluster of white clapboard houses set in knobby farmland. The league was formed in 1986 so the community could find solutions to the economic devastation caused when the town's two main employers, National Carbide and New Jersey Zinc, closed down. Waller was approached by a representative of A & Z Apparel who wanted to know if she would like to start a sewing operation in a building the league has a lease on.

When Waller asked what she could do to help the project along, the rep responded, "Get 20 people who can sew and give me free rent for a few months." When she asked what benefits workers would receive, he spread his hands and shrugged. "Working here in Ivanhoe," he answered. "Hey, I'm only trying to help your community." Waller agreed to the terms.

"We're not taken in like we were before, but we let them think they're doing us a favor. We know sewing jobs are not forever, but we're going to get what we can while we can," said Waller, a large, gruff woman who speaks with the passion of one who has only recently discovered her life's mission. "We're looking at the big picture. Let the sewing factory come, but I'll guarantee you I'll have some type of educational program in there."

Posted on the glass door of the Old Dominion Power Company in Appalachia, Virginia, was an advertisement for Wise County's Coal Appreciation Days: "Coal: Now and for the Future." Coal certainly was the past on the strip of street that passes for downtown. Back in its heyday, in the forties, swarms of people would come in from surrounding coal camps. "You couldn't walk through the street on a Saturday night," said James Clark, the retired principal of the local elementary school.

On the late September afternoon I visited this town of 1,994, I had no such problem. The liveliest place was Abie's Gun and Tackle Shop, where two men were inspecting a hunting bow. Walking down the empty street, I passed a thrift shop, Ada's Attic. A mountain politician once told me that you can tell a town is dying when thrift shops take over storefronts. Ada's Attic was closed. So were a nearby furniture store and several

other shops. Past a restaurant and an open thrift shop, I came to the UMWA local, where a sign in the window asked people to wear green ribbons for the unemployed. I didn't see anyone in town wearing green ribbons. But then, I hardly saw anyone at all.

At the end of the street, just in front of the railroad tracks, was the Appalachia Town Office, where I met Bobby Dorton, the town manager. Despite the sign I saw earlier, Dorton said that Appalachia hopes to rely on tourism for its future. "We can capitalize on being mountain people and generate money through the years when coal is no longer our support," Dorton said. "If we can create the myth of Appalachia being the past center of mountain life, then we can reap the benefits from the only thing we have to sell, the name Appalachia." The town might open an exhibition coal mine and certify visitors as honorary Appalachians.

Unfortunately, it will be some time before tourism ever generates the jobs coal did. Generally motels don't have the kind of amenities travelers expect. There isn't a central airport, and interstates run only along the region's periphery.

DR. GRADY STUMBO has good reason for wearing Reeboks at his clinic in Hindman, Kentucky. Wearing the wrong shoes for such a pace, I struggled to keep up as he scurried from one examining room to another, reading charts and scribbling notes. He turned toward his assistant and told him to give one of the patients a flu shot. "She says she doesn't have any money," he said, "but give it to her anyway."

The lean, boyish-faced Stumbo is one of only four full-time doctors in Knott County (population 17,906). This county is critically short of physicians, as are two-thirds of the counties in eastern Kentucky. But for 19 years Stumbo has done his best to improve care by offering his patients a pay-what-you-can plan. The 47-year-old Stumbo drastically discounts fees—sometimes they're as low as five dollars per office visit—but at least 20 percent of his patients still cannot pay.

Stumbo also sees patients at a nearby hospital and nursing home, and his scrambling seems to have paid off. Despite being one of the poorest counties, Knott's infant mortality rate is one-third the state's average.

The chairman of the state Democratic Party, who has twice run for governor, Stumbo helped bring the first state psychiatric hospital to eastern Kentucky and established one of the only family-practice residency programs in central Appalachia at the University of Kentucky's Center of Excellence in Rural Health in Hazard.

Central Appalachians believe it makes a difference when doctors are natives, because they speak the language of the people. They know about home remedies, such as bloodroot for copperhead bites, and instinctively comprehend the people's stresses. "You understand the culture. It has a tremendous impact; there's immediate acceptance," said Stumbo, who grew up poor in a neighboring county. "And people can see their children

Fisheries biologist Jim Miller (above left) helped diagnose the cause of a culvert pipe's rusting out in only nine years: acid drainage from mining operations.

Tammy Prater's problem in Royalton, Kentucky, is to get around another kind of pollution. With no well and no access to county sewage-treatment facilities, she must haul and boil stream water for cooking and for bathing son Joshua.

becoming doctors and coming back and taking care of their own."

AFTER THE FOOTBALL TEAM scored another touchdown, the Powell Valley High School band rose in the metal bleachers and sent a raspy, uneven rendition of "Great Balls of Fire" up into the September air, which had turned unexpectedly frosty that evening. I was sitting beside the band in the middle of a lively group of recent Powell Valley graduates, including Eric Phillips, an 18-year-old who was leaving in two weeks for the Army. "Unless you're real smart, the military is the best way to get out and get an education," he said. It may also be a better job than he could hope for in Wise County, Virginia, where at least 12 percent of the people are out of work.

"When I was in school here, most of the guys in my class couldn't wait to leave high school and find a job in the coal mines," said Preston Potter, a sociology teacher at Powell Valley in Big Stone Gap, Virginia. "Why should they stay in school when they could make more money than their teachers in the mines?"

When I asked his class who planned to work in the mines, not a hand went up. Still, there is a lingering belief among some central Appalachians that to be educated is to "get above your raisin'," a favorite mountain expression for anyone with too much pride. The result is a high dropout rate that has only recently begun to decline.

Most of the teenagers I talked to reminded me of myself 15 years ago. All they spoke of were the various escape routes they were charting. Many choose the military. Others head off to college or to cities outside the region to stay with their relatives who have already made the exodus. And inevitably, a good number who dream of leaving never do.

By and large, the smartest, most ambitious young people leave Appalachia to "enrich other communities while leaving us impoverished," a school counselor told me. Donna Owens, a high school drama teacher in her hometown of Haysi, Virginia, empathizes with her students' urge to flee. She had the same yearning when she was 18. "It's tough growing up here and not liking where you're from, how you talk, who you are," said Owens, a stylish woman with a mane of wavy blond hair. "I thought if I could just change, the world will accept me. I wanted to be a city girl." Owens went to Washington, D. C., where she stayed for two years until a song on the radio reminded her of home. It didn't take her long to move back.

In her class she teaches an indigenous kind

"She's always been there when I needed her," says Juanita Wright of her mother-in-law (above right). Now it's her turn to help 90-year-old Lula down to the garden on the Wrights' Kentucky homeplace, where Juanita can look out and see nine houses, all of them family.

Family: Plenty of toddlers and fiddlers and cousins and hot dishes arrive each August at a reunion in the Jack Dutton Cemetery near Clintwood, Virginia.

of drama—storytelling. "I want to show them how important it is to understand and appreciate their family and their culture," she said. "At first the class complains, 'Oh, these are like the stories I hear at grandpa's.' I say, 'That's part of who you are.' Storytelling keeps the past alive."

I wish someone had encouraged my interest in my home. I might have been more like Tiffany Waller, who doesn't seem at all the type who will ever deny where she's from. The 15-year-old daughter of Maxine Waller, Tiffany works with the youth council of the Ivanhoe Civic League, which has been raising money to build its own radio station. Tiffany and a friend wrote a fight song for the cause, based on the popular country tune "I'm Gonna Be Somebody," by Travis Tritt.

Clicking her fingers and jumping from one foot to the other while a boom box played the original song, Tiffany sang unselfconsciously in the dining room of the Waller home. "We're gonna be somebody; one of these days we're going to break these chains." Her mother sat at the table, nodding her head in time to the music. "We're gonna be somebody someday; you can bet your hard-earned dollar we will."

"Tiffany is me without restrictions," her mother told me that night as she lay on her bed, staring at the ceiling. "She's not afraid to say she's Appalachian and be proud."

As Waller was telling me how she worried about reaching all "the young 'uns falling through the cracks," Tiffany stuck her head into the room to remind her she needed a dress ironed for school the next day. "I'm going to bed," she announced.

"Well, kiss me good-night," Waller commanded. Tiffany bounced past me, bent over the bed, and pecked her mother's cheek. "Hey," Waller shouted, breaking into a laugh and grabbing Tiffany's wrist, "you're gonna be somebody!" □

No more strains of "Rocky Top" float over the tobacco harvest on the Lewis farm in Mountain City, Tennessee. Matthew "just didn't like to march," so he's dropped the saxophone. Last year's crop started poorly but ended well. Or as the "old folks say," according to Matthew's mother, Arlene: "It came out of the kinks."

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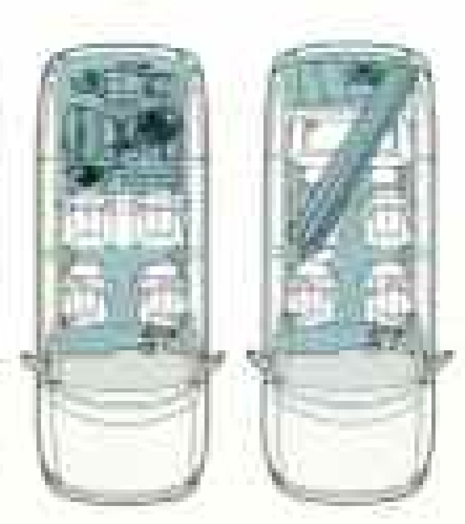

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Forum

Our Disappearing Wetlands

Your informative article (October 1992) provides the message that needs to be heard in states where wetland protection laws are viewed as just another government mandate to deprive landowners of their rights.

TIMOTHY R. E. KEENEY
Commissioner of Environmental Protection
Hartford, Connecticut

Wetlands provide habitats to myriad migratory birds that use them throughout their annual cycles, linking places as distant as the Arctic Circle and Tierra del Fuego. Many wetland-dependent species will not benefit from conservation programs in the U. S. unless concerted efforts are made in Canada and Latin America as well.

GONZALO CASTRO
Wetlands for the Americas
Manomet, Massachusetts

Here in the coastal area of Georgia, as much as 40 percent of the "wetlands" classified in the 1989 manual fulfill none of the usual functions of wetlands in preserving water quality and providing habitat for endangered plants and animals. In Savannah, for example, an unused airfield was classified as a wetland. Little wonder the outrage of property owners at senseless regulation with no regard for private property rights or recompense for the loss of value.

PHILIP E. HODGKINS
Savannah, Georgia

When the wetlands delineation manual was revised in 1989, the definition was expanded to include areas where water is present for 7 days at a depth of 18 inches below the soil surface. This allows federal agencies to wrap their regulatory arms around millions of acres of land not previously thought to be wetlands. I am a farmer, and I do understand the value of true wetlands and the need to preserve them. However, the cost of preservation should not lie solely at the feet of private property owners.

LARRY BODTKE
South Haven, Michigan

In Connecticut we've begun an effort to restore 11 coastal marshlands cut off from tidal flow by railroad causeways laid a hundred years ago. The U. S. Army Corps of Engineers, Environmental Protection Agency, Fish and Wildlife Service, Department of Transportation, and Amtrak have joined agencies in my state in an unprecedented pool of talent to bring these areas back to life.

JOSEPH I. LIEBERMAN
U. S. Senator from Connecticut
Washington, D. C.

Another factor in the degradation of our wetlands is the proliferation of nonnative weeds. Many were introduced for noble causes, such as erosion control, wildlife habitat, and improved landscaping. The exotic species all too often outcompeted native plants, which supply diverse food and habitat for wildlife. Salt cedar in the Southwest, for example, dries up wetlands and lowers the water table. Control is possible using integrated management plans that incorporate chemical and mechanical means. Long-term biological control, introducing pests from the plant's native range, may be promising, but there are concerns about introducing yet another nonnative.

RICHARD D. VOTH
Agricultural Group, Monsanto
St. Louis, Missouri

Geronimo

I commend David Roberts for his article and also recommend Eve Ball's book *Indeh: An Apache Odyssey* (University of Oklahoma Press, 1988). It gives the Apache side gleaned from interviews with descendants of Cochise, Mangas Coloradas, Chato, Chihuahua, Geronimo, and others.

RALPH A. FISHER, JR.
Silver City, New Mexico

Many of the American troops who pursued Geronimo were members of the Tenth Cavalry, a black regiment. An excellent account written at the time by Lt. John Bigelow, Jr. [and illustrated by Frederic Remington], *On the Bloody Trail of Geronimo*, has been republished (Westernlore Press, 1986).

JOSEPH OAKES
Los Altos, California

Ironically, the name that struck fear in the hearts of U. S. Army soldiers on the frontier evoked bravery in the hearts of U. S. Army paratroopers during World War II. They yelled "Geronimo" as they jumped. In 1940 members of the original 501st Parachute Battalion allegedly saw a movie at Fort Benning, Georgia, in which Geronimo escaped from the cavalry by leaping from a cliff to safety, yelling his name in defiance. Today the name even appears on a regiment's crest.

PATRICK H. GRAVES, JR.
Huntsville, Alabama

Those persons who attended Oklahoma A&M College (now Oklahoma State University) over 50

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years ago will remember Mildred Imach, a relative of Geronimo's. She was a member of our graduating class of 1941. She was stunningly attractive: tall, graceful, with chiseled features, and hair worn in a braided knot on the back of her neck. She played the violin in the college symphony orchestra. A picture of Mildred on page 68 prompted me to phone her. She is currently chairperson of the Fort Sill Apache, a position of responsibility that involves much traveling. Thanks for enabling me to renew a friendship of long ago.

MARJORIE JOHNSON MORSE
Manhattan, Kansas

Bering Sea

The description of the Bering Sea's Siberian coast understates the degree to which the rich natural resources of this area are being abused. In early August 1991, I joined a small group paddling foldboats along this coast, stopping to enjoy the hospitality of a Chukchi reindeer herder. We found evidence of damaging practices everywhere: Tundra scarred by tracked vehicles, nets full of live and rotting fish strung across the mouths of streams, headless bodies of walrus. In one bay the stench of whale carcasses slaughtered for food for a fox farm forced us to retreat.

Conservationists must ensure that proposals to create an international park/biosphere reserve do not become lost in the disintegration of the Soviet Union and the pressures for commercial advantage.

TOTTON P. HEFFELFINGER
San Francisco, California

The description of the World War II battle to retake Attu Island from the Japanese does an injustice to those of us who participated. The attack was not carried out by 16,000 men who "stormed ashore." Our landing force of about 2,450 sneaked ashore at 2 a.m. Our green troops had no combat experience, no mountaineering training, and no experience in Arctic conditions. We had just completed a summer of desert warfare training in the Mojave Desert.

GERHARD LESSMAN
Chino, California

The rest of the 16,000 men came ashore during the next few days.

I was misquoted on page 83 as saying that the crab population collapsed as a result of overfishing. This implies either excessive greed by fishermen or poor management by the regulatory authorities, neither of which is the case. The collapse is probably the result of a natural population decline.

WILLIAM ARON
Alaska Fisheries Science Center
Seattle, Washington

We regret that your correction was inadvertently omitted from final copy.

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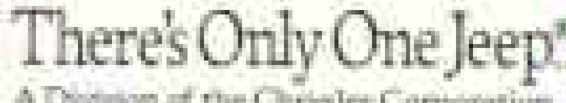

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Your story is all wet about Vitus Bering. He was not the first to sail east from Asia to discover America. In 1732 Ivan Fedorov and Mikhail Gvozdev, aboard the *St. Gabriel,* crossed the Bering Strait and followed the coast to Seward Peninsula, Alaska. In 1741 Bering knew about that voyage; in fact, he recruited many of the men who had made it. He did not die of scurvy but, as evidenced by his remains found by Danish archaeologists in 1991, more likely of hypothermia or gangrene.

O. W. FROST
Anchorage, Alaska

The Bolshevik Revolution

The famous photograph on page 112 was taken by my great-uncle, Capt. Tommy Turner of Geraldton, Western Australia. During World War I he accompanied Comdr. Locker Lampson and a British armored-car detachment sent to assist Russia. The commander was summoned to Petrograd by the tsar and went off to the Winter Palace, down the road to the left of the picture. Great-uncle Tommy went into the Crédit Lyonnais Bank to cash a check. When he heard the sound of shots, he leaned out the window and took the picture. The photograph was originally published as showing the "start" of the Russian Revolution.

JONATHAN C. B. RAMSAY
Nassau, Bahamas

The credits for historical pictures are often disputed. The Lenin Museum believes that this photograph was taken by Viktor Karlovich Bulla.

I would draw your attention to one of the central characters of the revolution, Nikolai Bukharin, a Bolshevik theorist second only to Lenin. A great orator and extremely likable, he was elected to the Central Committee in 1917, a member of the Politburo in 1924, and president of the Communist International in 1926. He virtually co-ruled Russia with Stalin from 1925 to 1928. Stalin became impatient with the slow rate of industrialization and forced Bukharin to resign in 1929. He had Bukharin executed in 1938.

Bukharin was a humane person whose policies were based on obtaining the loyalty and support of the peasant class. Gorbachev modeled much of *glasnost* politics after Bukharin's ideas of the 1920s and forced the rescinding of the criminal charges against Bukharin in 1988. It is interesting to ponder what the U.S.S.R. would have been like had Bukharin had his way.

JEFFREY W. FOLEY
Stuttgart, Germany

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Geographica

SHAWN G. HENRY, SABA; RÜDIGER WEHNER, ZOOLOGISCHES INSTITUT, UNIVERSITÄT ZÜRICH (BELOW)

Vermont Park Honors Conservation Pioneers

Vermont now boasts its first national park. Established in August 1992, Marsh-Billings National Historical Park in Woodstock preserves 555 acres of wooded land and the boyhood home of George Perkins Marsh, a 19th-century diplomat and businessman who wrote what has been called "the intellectual bible of the Conservation Movement."

Marsh argued in his 1864 classic, *Man and Nature*, that Americans were heedlessly destroying wilderness and should replant forests to repair the damage. "We have now felled forest enough everywhere, in many districts far too much," he wrote.

Frederick Billings, who bought the 1805 house and property in 1869, put Marsh's theories into practice. A reforestation pioneer, he planted thousands of white pine, Norway spruce, and European larch on the slopes of Mount Tom, site of the Woodstock estate.

Billings's granddaughter Mary and her husband, conservationist Laurance S. Rockefeller (above), donated the home and woods for the park, which is not yet open to the public. A Rockefeller endowment will pay for maintenance; the couple retain a lifetime right to live in the home.

Desert Ants Venture Out in the Heat of the Day

"Mad dogs and Englishmen," wrote playwright and composer Noël Coward, "go out in the midday sun." So do silver ants of the Sahara.

When temperatures in the central Sahara reach 115°F, many insects succumb to the blazing heat. But hundreds of silver ants (*Cataglyphis bombycina*) pick that very moment to pour out of their nest holes and dash about for as long as half an hour in search of the corpses. Even these speedy, long-legged scavengers—the world's fastest insects for their size—can't stand the heat for long; periodically they seek high ground for relief, climbing atop sticks of dried vegetation, where the air is slightly cooler.

If temperatures pass 128°F, the ants become disoriented, lose their coordination, and begin to stumble around. They are walking a "thermal tightrope," says Rüdiger Wehner, a Swiss biologist who has been tracking the silver ant and its closest relatives to learn how they navigate (NATIONAL GEOGRAPHIC, June 1991).

There's another good reason the ants emerge at midday to forage. That's when their chief predator, a lizard, can no longer take the heat and retreats underground.

Swiss Tunnels to Bore the Alps

The Alps already resemble Swiss cheese—riddled by dozens of road and rail tunnels. Now Switzerland is planning two more trans-Alpine railway tunnels to handle the increased cargo anticipated in a unified Europe. One will burrow 19 miles through the Lötschberg region. The other will run 31 miles through the famed St. Gotthard massif and will pass beneath two older shafts. Only the 33.5-mile Seikan Tunnel in Japan is longer. Unlike earlier shafts that were drilled through the middle of the mountains, thousands of feet up, these new ones will carry freight and high-speed passenger trains through the base of the central Alps.

"They will be as flat as if the Alps did not exist," says a planner.

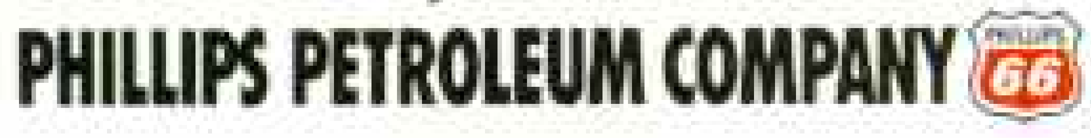
It was an unlikely alliance.

But when five state governments, two wildlife conservation groups and one energy company came together, 32 species of threatened wildfowl secured a brighter future.

The partnership called itself The Playa Lakes Joint Venture. Its mission, to enhance and protect the wetlands resource of the Playa Lakes region critical to wildlife.

Boosted by grants from private landowners, state wildlife agencies in Texas, Oklahoma, Kansas, New Mexico and Colorado, with the U.S. Fish & Wildlife Service and Ducks Unlimited, Inc., matched donations from Phillips Petroleum to protect vital avian breeding and migrating habitats. Habitats that with resources and restoration could slow the dramatic decline of millions of ducks, geese and cranes from lack of water.

It was an unlikely alliance. But when five state governments, two wildlife conservation groups and one energy company came in with concern and came out with solutions, it seemed more inspired than unlikely, after all.



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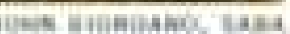

JOHN GIORDANO, SABA

DONALD WHITCOMB, THE ORIENTAL INSTITUTE (COINS BELOW); JOHN GIORDANO, SABA

Manhattan Slave Burials: Viewing a Forgotten Past

A newly discovered 18th-century slave cemetery, buried beneath an alleyway in lower Manhattan, is providing a treasure trove of information about how the first black residents in New York City lived and died.

Excavators found what early maps call the Negro's Burying Ground when they investigated a site cleared for a 34-story federal office building. "It's like finding lost volumes of African-American history," says Daniel Pagano, the city's urban archaeologist.

Physical anthropologist Michael Blakey of Howard University expects to learn from the more than 400 skeletons exhumed where the slaves came from, what they died of, even how African burial practices survived in the New World. "Several skulls had ornamentally filed incisors that can tell us which culture in Africa the slaves belonged to and their status," he says. "And chemical traces in teeth and bones should reveal a diet of meat or grain that can be keyed to particular regions in Africa."

Construction of the building was halted by protests from Congress, the city, and the black community until plans for a pavilion that would have covered the cemetery were eliminated. A memorial or museum will honor the dead, whose remains will be reinterred. Says activist and musician Noel Pointer, "The bones of our ancestors have risen again to remind us of the pain and promise that is the African-American journey in America."

Gold Coins Hold Clues to Medieval Travelers

"They look as if they just came out of the mint," says Donald Whitcomb, an archaeologist at the University of Chicago, of the cache of 32 gold coins he found near a city gate in the Jordanian port of Aqaba. But they are about a thousand years old, and their discovery sheds light on 11th-century trade and travel in the Middle East.

Most of the coins were minted at the town of Sijilmassa in Morocco, some 2,500 miles to the west. Ayla, as Aqaba was then called, was a stopover for Muslim pilgrims on the way to Mecca. It also lay on a trade route that linked China, the Middle East, and Europe, a fact attested to by the glazed ceramics and porcelain pieces found at the same site.

"The 11th century was a terrible time for Ayla," says Whitcomb, who has excavated there since 1986. "It came under Egyptian domination, there were Bedouin revolts, and an earthquake split the city." A traveler, possibly a pilgrim or a trader, may have buried his coins during one of those traumatic events.

R. C. KELLY, PHOTO RESEARCHERS

Avian In-laws Harass Young in a Good Cause

Talk about annoying in-laws! White-fronted bee-eaters are clannish, monogamous birds that nest in cliffs on the savannas of Kenya. Often when a young pair is ready to mate for the first time, the male's father barges in. He hangs around, begs food, blocks access to the breeding chamber, even chases the female. The son leaves his bride and returns to his parents' nest.

There is method to this apparent madness. When the son goes home, he helps his parents excavate a new nest chamber, incubate their eggs, and find insects for newborns. All this helps his clan of up to 17 members survive, especially if the rains fail, causing a dearth of insects and the death of chicks. The more helpers, the more young survive, report Stephen Emlen and Peter Wrege, Cornell University zoologists.

Meanwhile the jilted female bee-eater remains in her nest. Soon her mate rejoins her, and after they breed the next year, he can harass *his* young.

—Boris Weintraub

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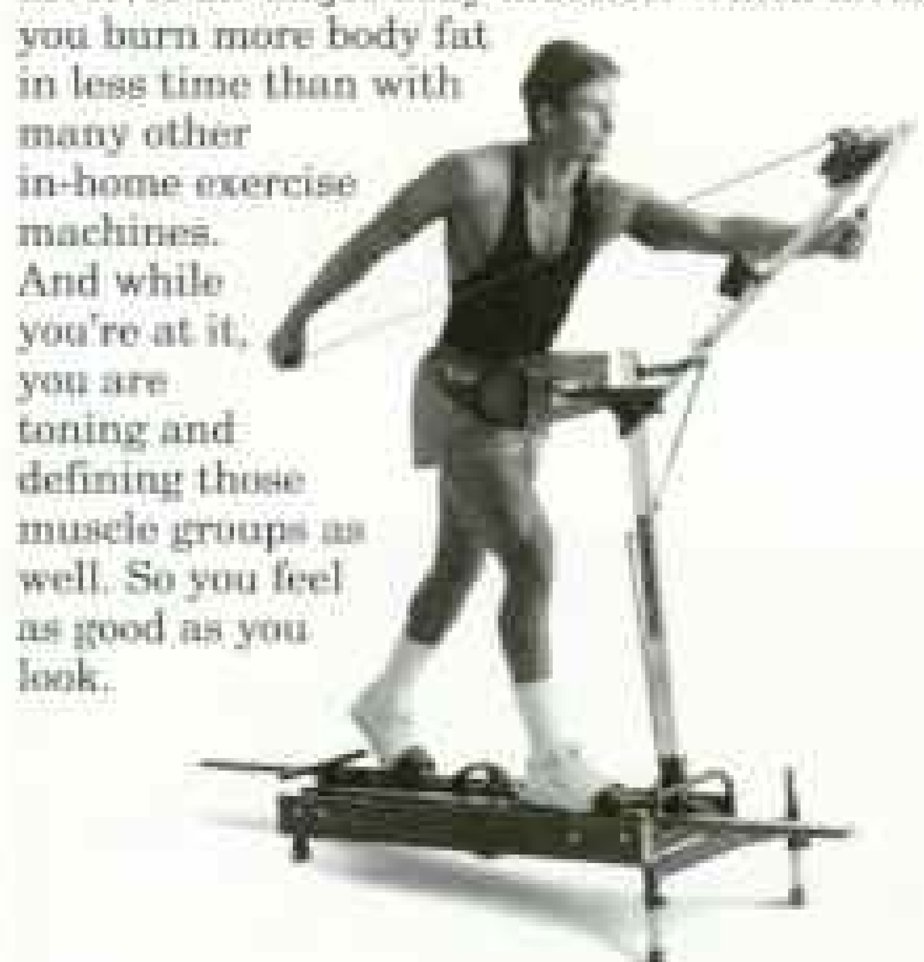

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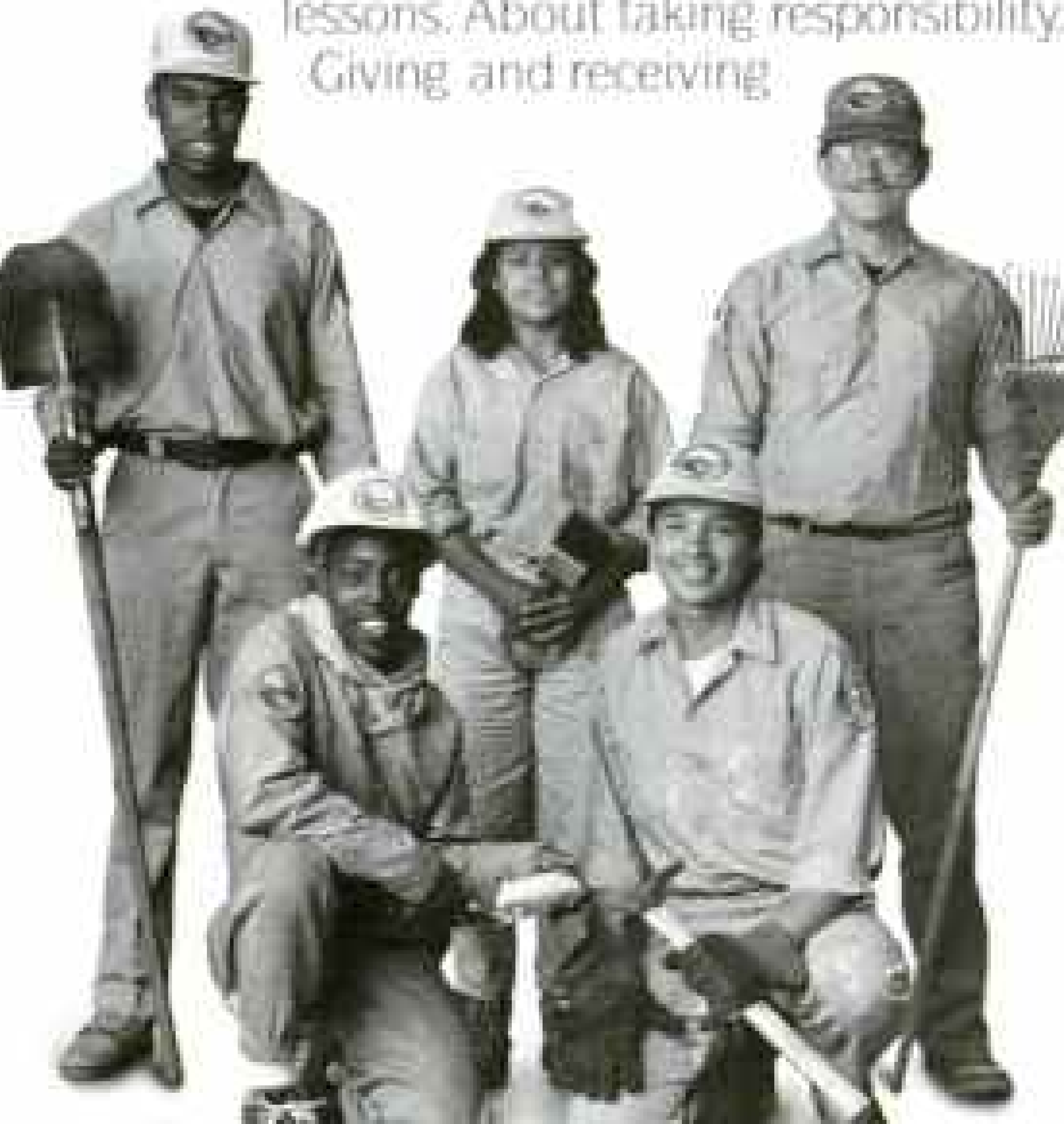

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To find out more about the SFCC, write Robert Burkhardt, Executive Director, SFCC, Building 111, Fort Mason, San Francisco, CA 94123 or call 415-928-7322.

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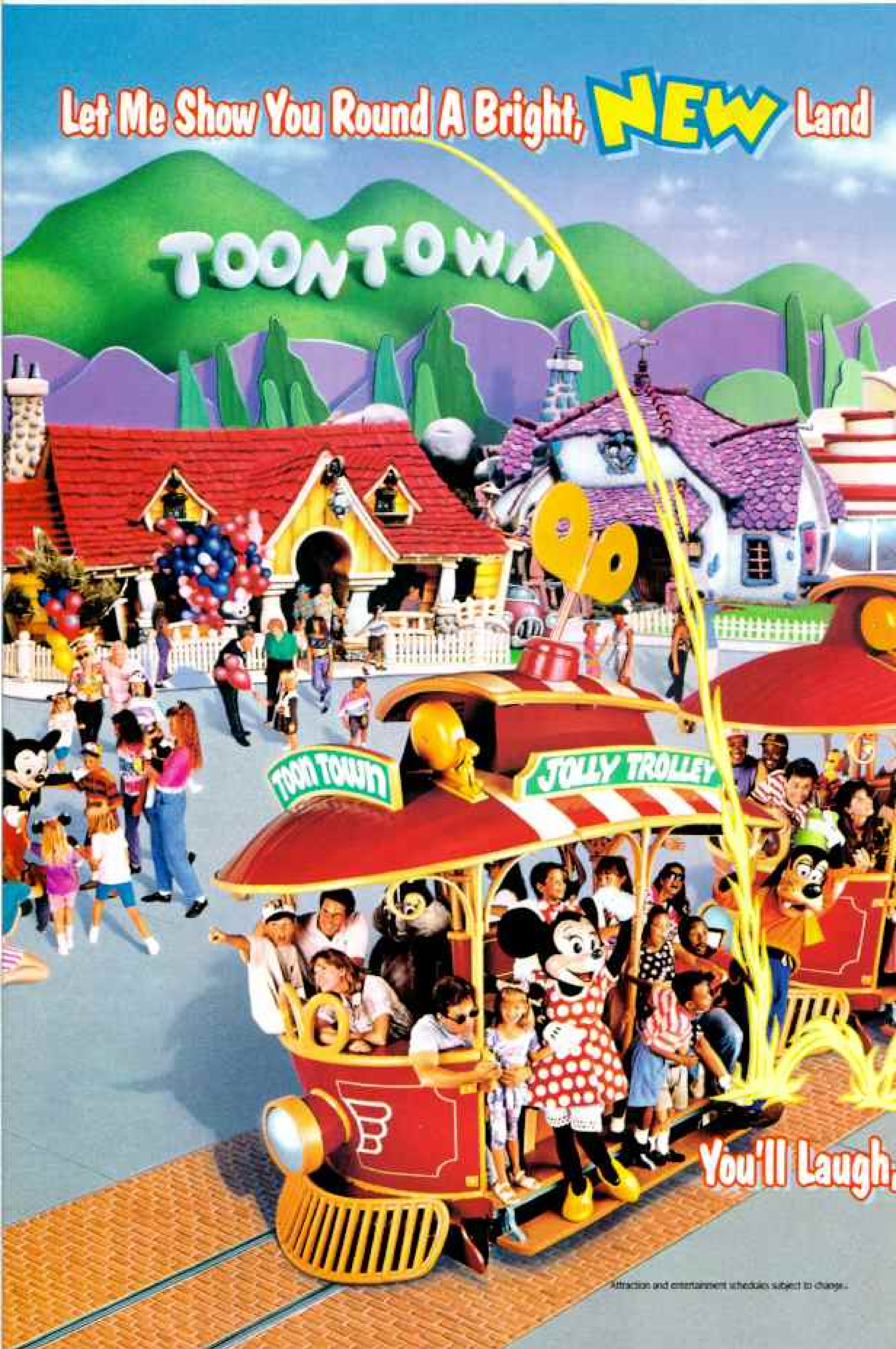
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WILDLIFE AS CANON SEES IT

Okinawa Rail
Genus: *Rallus*
Species: *okinawae*
Adult size: Length, 30 cm
Adult weight: Approx. 380 g
Habitat: Dense evergreen hill forest on northern Okinawa Island
Surviving number: Estimated at 1,000 – 2,000
Photographed by Choji Gima

The flightless Okinawa rail roosts at night on sloping trunks where it can quickly escape disturbance or a predatory attack by jumping to the ground and running away. The rail spends the day on the forest floor eating insects and lizards, and is never far from water for bathing and preening. Discovered in 1981, this endemic island bird is threatened by continued deforestation. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Photography, both as a scientific research tool and as a means of communication, can help promote a greater awareness and understanding of the Okinawa rail and our entire wildlife heritage.

Watch "NATURE" on PBS, Sunday 8:00 p.m.
This program is funded, in part, by Canon U.S.A., Inc.

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On Television

Animal Guardians: Profiles in Compassion

Reunited after 12 years, onetime zookeeper Margaret Cook and the now grown orangutan Pumpkin share a touching moment (below). When Cook learned that young primates in her care had been sold to dealers—a practice now discouraged—she quit her job and began a decade's quest to find them. Pumpkin, after years of inadequate care, had found refuge at a wildlife sanctuary near San Antonio, Texas.

Eight stories of dedication to the conservation and welfare of animals form the focus of the new NATIONAL GEOGRAPHIC Special "Keepers of the Wild," produced by award-winning filmmaker Allison Argo.

"I grew up in the theater," said Argo, who debuted on her parents' stage at age two. "So I have always been drawn to strong characters. When I began this film, I asked, 'Who are the heroes?' "

Such heroes include Andy Lodge, rhino protector in Kenya; Sue Barnard of Atlanta, passionate advocate for bats; Jack Castor, for 40 years caretaker of the San Francisco Zoo's Lion House; and Quentin Bloxam, one of the guardians of the few remaining members of the species *Partula mirabilis*—a snail.

Their example reminds us that on a human-dominated planet, fellow animals depend on our stewardship.

"Keepers of the Wild," Special on PBS, February 17, 8 p.m. ET.

STEVEN PUMPHREY

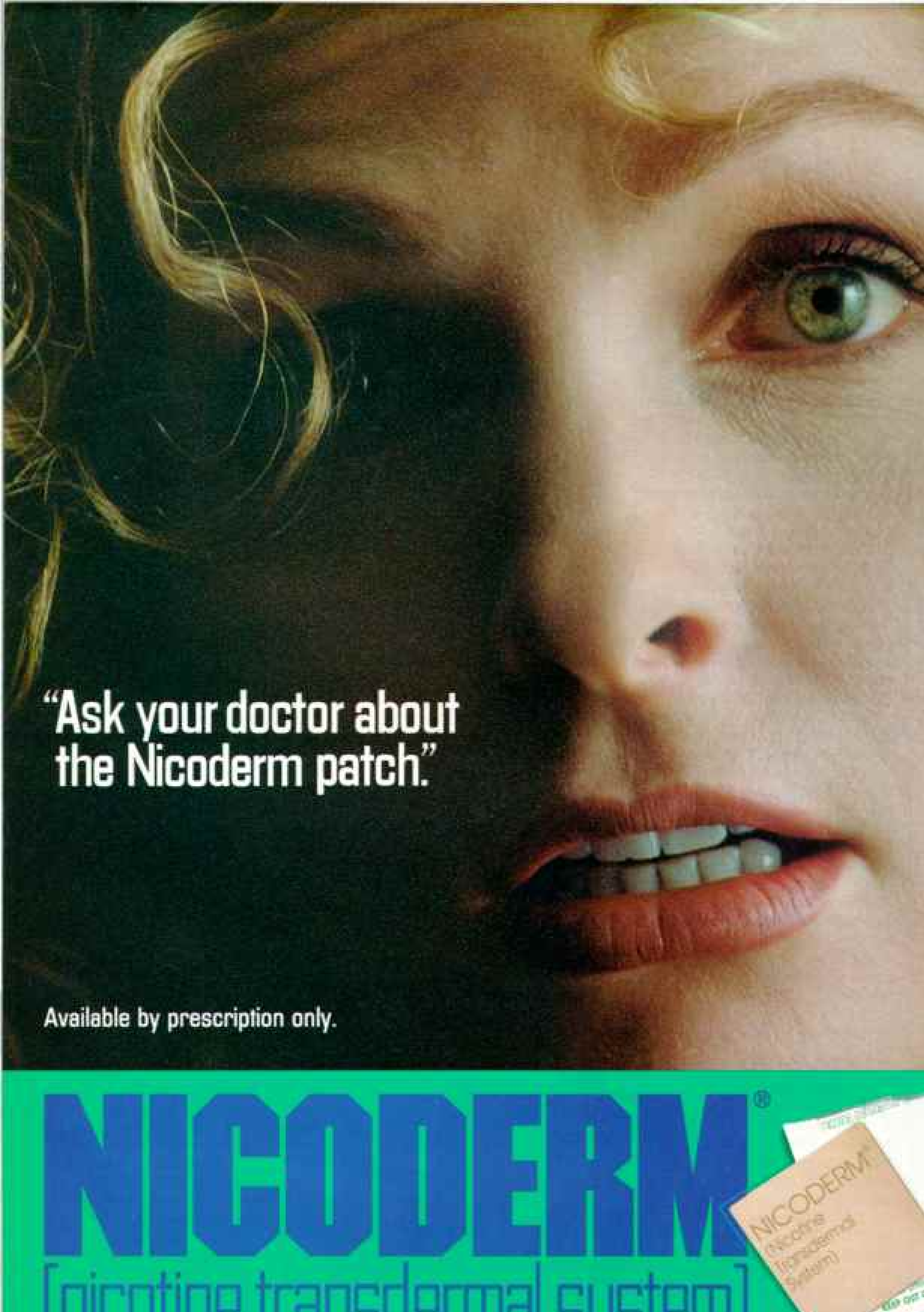
NEIL RETTIG PRODUCTIONS

Face-to-Face With the Harpy Eagle

Most powerful bird of prey, the harpy eagle (above) has a wingspan of more than six feet, talons the size of bear claws, and an attack speed of about 50 miles an hour. Filmmaker and naturalist Neil Rettig wore a helmet and bulletproof vest to document the nesting habits of this rare bird deep in Guyana's rain forests.

For his EXPLORER film "Flight of the Harpy Eagle," coproduced with Steve Burns and Kim Hayes, Rettig spent ten hours a day for six months in a four-by-six-foot blind, marking the transformation of a nestbound chick to a fledgling. Based largely on Rettig's research, the Guyana government is considering creation of a reserve for the harpy eagle, at risk from habitat destruction in much of its range—Mexico to northern Argentina.

"Flight of the Harpy Eagle" airs February 28 on EXPLORER, TBS SuperStation, 9 p.m. ET.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Earth Almanac

In Zimbabwe, Oxpeckers Aid Ticked-off Wildlife

Against an onslaught of blood-sucking ticks plaguing impalas (right) and other mammals in Zimbabwe's game parks, biologists have enlisted the help of an old friend—the red-billed oxpecker. The birds, which feed voraciously on engorged ticks, are being reintroduced to curb the pests, which weaken the resistance of wildlife to potentially fatal diseases such as red water.

Oxpeckers—also called tick-birds—were once widespread in Zimbabwe's highlands in a classic symbiotic relationship with rhinos, buffalo, giraffes, sable antelope, eland, and warthogs. They fed on the parasites that fed on those animals and even hissed when danger threatened their hosts.

But the highland oxpeckers were wiped out by poisonous chemicals in cattle dips used by ranchers to kill ticks. A safer dip now being used on cattle cannot readily be used on free-ranging wildlife. So the oxpeckers are being returned from the lowlands to tick-infested parks in highland cattle country—many of them, ironically, converted from financially strapped cattle ranches. Chris Foggin, veterinarian in charge of the program, says that about 120 of the birds have been pressed into service in the past two years.

NIGEL DENNIS, NATURAL HISTORY PHOTOGRAPHIC AGENCY

Sparking Efforts Against Battery Pollution

A nation in love with gizmos, the United States beeps and blinks with a billion electronic toys and portable appliances, powered by the 2.5 billion household batteries purchased each year. More than 90 percent of these are single-use batteries that contain toxic metals such as mercury. Because of collection problems, very few of these batteries are recycled. Instead, their harmful contents may leak from landfills or—more likely—fall to earth from incinerator stacks.

Cadmium from rechargeable batteries accounts for half the 3.6 million pounds of toxic cadmium in solid waste discarded by towns and cities each year.

Mercury from single-use batteries annually makes up 88 percent of some 1.4 million pounds of mercury in urban trash.*

*Latest available EPA estimates from 1986 (cadmium) and 1989 (mercury)

CHRISTOPHER A. KLEIN, NGS

Efforts at remedies involve both positives and negatives. Most new single-use batteries are designed to work with little or no mercury. Many states have drafted new laws requiring safe battery disposal or recycling. And concern is generating interest in rechargeable batteries, which now garner about 10 percent of the annual 3.3-billion-dollar market and have already lightened landfills.

Used in equipment like power tools and camcorders, these batteries can be recharged 300 to 1,000 times. But most are nickel-cadmium rechargeables, which have an environmental glitch of their own. Not only is cadmium highly toxic, but manufacturers have often sealed the batteries inside their products. As these appliances are discarded, hundreds of tons of cadmium a year go with them into the environment. Ten states have now passed laws requiring that all rechargeable batteries be easily removable to facilitate recycling.

Meanwhile, a new rechargeable and less toxic battery using a nickel-metal hydride instead of cadmium is in the works.

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HAVE YOU DRIVEN A FORD LATELY?

Earth Almanac

Most Native Americans Just Say No to Dumps

One million American Indians live on some 300 reservations totaling 56 million sparsely settled acres. They need jobs. They need income. Meanwhile, each year 130 million tons of the nation's waste keeps piling up in glutted landfills.

But to contractors eager to dump waste on Indian lands, most Native Americans say: Not in my reservation. Although scores of tribes have been approached, only a few have said yes. Despite tempting rewards, most agreed with Mississippi's Choctaw (right), who rejected a hazardous-waste dump their chief supported. The same thing happened in Rosebud, South Dakota, where the Sioux overrode their chairman and turned down a landfill that would have been the nation's largest. "My non-Indian friends say about land, 'Here today, gone tomorrow.' Their roots are in Europe," says Ron Valandra, a project opponent. "But we are Native Americans, and it's not the same. Our ties to the land are deep."

BARBARA R. KASCHER, CLARION-LEDGER, JACKSON, MISSISSIPPI

RICHARD AND JULIA KEMP, SURVIVAL ANGLIA

As Forests Fall, the Iberian Wolf Dwindles

The Iberian wolf hangs on in Portugal and Spain—with help from its friends. Only about 200 of the wolves *(Canis lupus signatus)*, a subspecies of the gray wolf, survive in Portugal. There, deforestation and sheepherders' poisons have taken a grim toll. Some 2,000 of the wolves live across the border in Spain, where more deer are available as prey.

Before the wolf was fully protected in 1989, about 20 wolves were shot, trapped, or poisoned in Portugal each year, says Robert Lyle, who administers the Iberian Wolf Recovery and Study Centre north of Lisbon. Nevertheless, some killing continues, and he fears that the animals could vanish from Portugal in a decade. At the center, which Lyle has run since 1988, he and volunteers care for a pack of five wolves, plus two additional pairs. These may one day create founding stock to restore the Iberian wolf in the wild—if attitudes change and sufficient habitat exists.

"We expect to have pups this year for the first time," Lyle reports. Only the center's members, numbering nearly 1,000, may visit. "Our wolves are wonderful ambassadors for their own cause," he adds. The project is supported by the Born Free and Bernd Thies Foundations and Britain's Wolf Society.

Plant Turns It On—and Off—to Lure Pollinators

Plants can be wily in attracting insects, but *Anchomanes difformis*, an African member of the arum family, is downright shocking. With an internal switch, it literally turns on the heat.

When the plant flowers, it produces a foot-tall structure called a spadix (right, in a cutaway view). Generating heat within its tissues, *Anchomanes* warms the spadix with extraordinary regularity. The organ reaches about 104°F, says Danny Beath, a botanist who has studied the plant in Ghana. He noted that specimens there switched on between 2 and 2:30 p.m. and shut off between 5 and 5:30 p.m. The heat releases a sweet aroma that attracts small beetles—probably the plant's main pollinators—into its flowers. Yet the mechanism can backfire. The beetles lay their eggs on the spadix. The larvae hatch and may eat the flowers.

DANNY BEATH

—John L. Eliot

Dr. Karen Strauss, environmental engineer, with son Luke and daughter Jenny

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Much Ado About

Mushrooms

Fungus is big business in Pennsylvania, where mushrooms are the major cash crop. Some 350 million pounds of the familiar commercial mushroom (*Agaricus bisporus*), almost half of last year's U. S. harvest, came from the state, much of it from the Kennett Square region.

Mushrooms don't just pop up. From spore to store their cultivation takes at least ten weeks and a lot of work.

A mushroom may cast millions of spores, though in the wild only a very few will grow to maturity. For the cultivated mushroom, life begins in a laboratory, where the microscopic spores are germinated, producing a net of fibers called the mycelium. Technicians place tiny plugs of the fibers on sterilized millet seeds for ease of planting. They are then incubated and sent to a mushroom farm. There, workers in windowless buildings spread compost eight inches deep in beds, pasteurize it, and then cast the seeds by hand. Computers control heat and humidity. In two to three weeks the mycelium mats the compost. Peat moss is layered over the mycelium; the room temperature is then suddenly dropped to 60 degrees and the humidity raised to 95 percent. The shocked fibers cluster to form pinhead-size mushrooms. Five weeks after planting, the first of several harvests pokes through.

Damp conditions are facts of life for the mushroom worker. And compost dust in the air can cause a respiratory ailment known as "mushroom worker's lung."

Poor housing and low pay were once the reward for long hours in the mushroom houses. Many laborers were illegal Mexican immigrants living in camps hidden in the countryside. But the Immigration Reform and Control Act of 1986 granted amnesty to most, and advocacy groups have helped achieve better conditions. Now, as legal residents, some workers rent apartments and send their children to school, while others save enough to visit their families in Mexico regularly.

"Necesitamos piscadores," reads a sign in front of one mushroom company, "We need pickers." The land of the Pennsylvania Dutch has made room for a new ethnic group: the Pennsylvania Mexicans.

WILLIAM H. BOND, NGS

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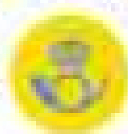

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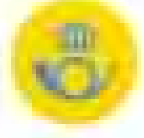

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On Assignment

"There was no place in the world I wanted to go to more than South Africa," says CHARLES E. COBB, JR., at left, a staff writer at the GEOGRAPHIC since 1985. Charlie had followed South African issues since he watched the Sharpeville massacre on television in 1960. "The gradual disappearance of apartheid is the best story in the world today, although it has been overshadowed by events in what were Yugoslavia and the Soviet Union."

In the past, foreign reporters had difficulty in South Africa, especially with security officers whose job it was to keep reporters out. "I didn't have those problems," Charlie recalls. "The Afrikaners are anxious to show that they are changing. I'm interested in how people—like miner Fiki Jokweni [at right]—make the transition from one condition to another. It is fascinating to see a society on the cusp of change."

DAVID C. TURNLEY

The first Western journalists to reach the headwaters of the Mekong River in China, THOMAS O'NEILL (below, at right) and photographer MICHAEL YAMASHITA found even greater satisfaction in exploring the delta in Vietnam with ornithologist Vo Quy. "I expected to find scars from the Vietnam War," Tom says, "but what I saw were newgrown forests, huge flocks of returning birds, and curious, welcoming people."

For Tom, a 17-year veteran with the Society, access wasn't easy. "The Chinese are frightened of the rapids, the Cambodians are worried about being shot by the Khmer Rouge, the Laotians are suspicious of Westerners. Yet when I convinced people to take me out, they loved that sense of freedom that comes with traveling on the water."

MICHAEL S. YAMASHITA

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