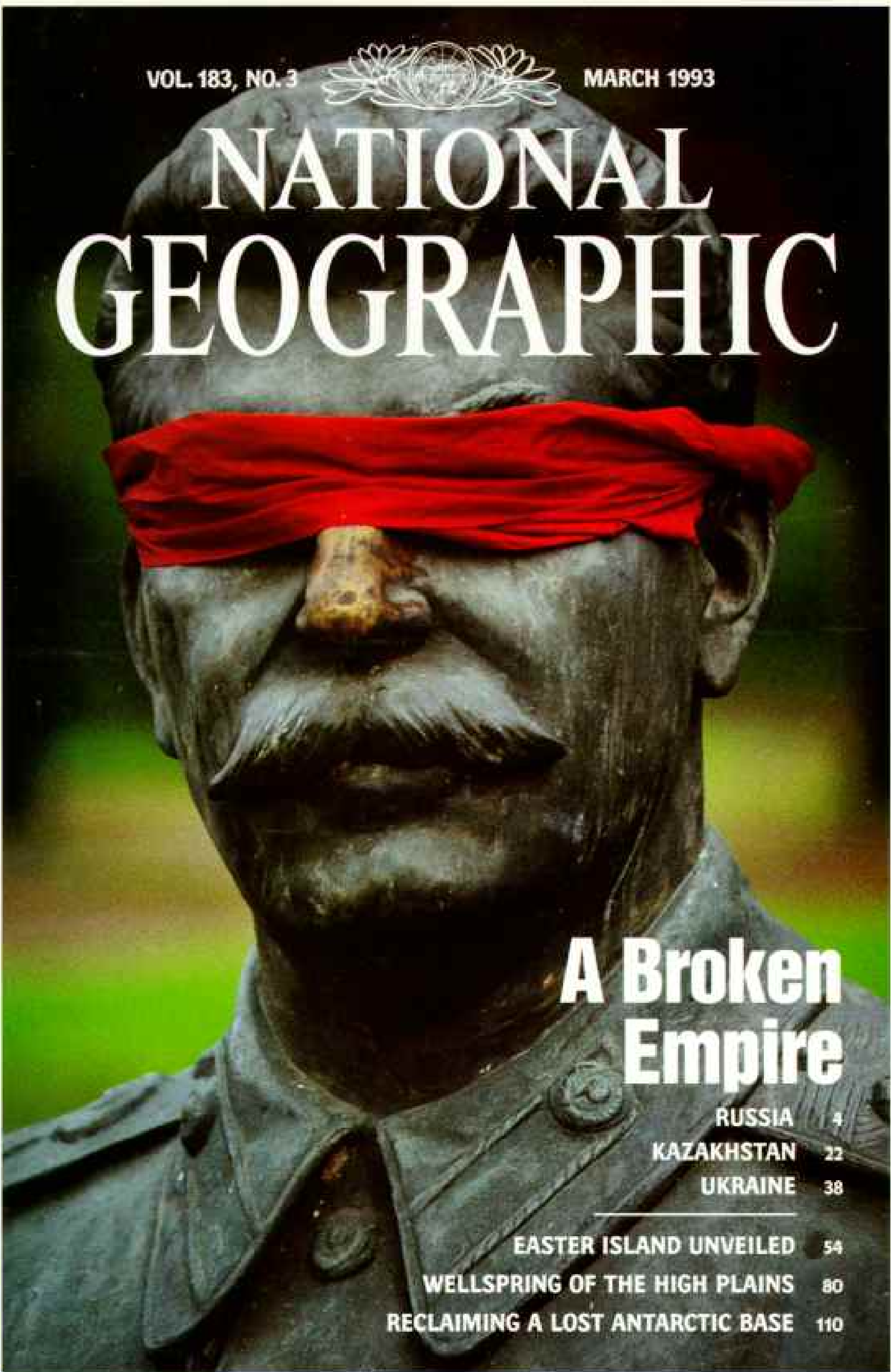


DOUBLE MAP SUPPLEMENT: FORMER SOVIET UNION

VOL. 183, NO. 3

MARCH 1993



NATIONAL
GEOGRAPHIC

**A Broken
Empire**

RUSSIA 4

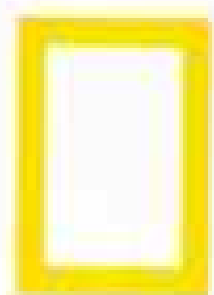
KAZAKHSTAN 22

UKRAINE 38

EASTER ISLAND UNVEILED 54

WELLSPRING OF THE HIGH PLAINS 80

RECLAIMING A LOST ANTARCTIC BASE 110



NATIONAL GEOGRAPHIC

MARCH 1993

A Broken Empire ²

By Mike Edwards Photographs by Gerd Ludwig



Russia

Inflation, pollution, shortages—and unprecedented opportunities—mark the chaos that has followed the Soviet collapse.

4

Kazakhstan

Emerging from Russian domination, Kazakhstan bears a horrible legacy: the consequences of Soviet nuclear testing.

22

Ukraine

Fiercely nationalistic, Ukraine warily eyes its worrisome neighbor, Russia, even as the two share remnants of Soviet military might.

38

Double Map Supplement: The Former Soviet Union

Easter Island Unveiled

*By Richard Conniff
Photographs by Bob Sacha*



Haunting stone statues scattered over this remote Pacific island are mute testimony to a 1,500-year-old culture that has been transformed by contact with the outside world.

54

Wellspring of the High Plains

*By Erla Zwingle
Photographs by Jim Richardson*



The Ogallala aquifer, a remarkable subterranean water source, was once thought inexhaustible. Now it suffers from overuse, challenging the inventiveness of those who depend on it.

80

Reclaiming a Lost Antarctic Base

*By Michael Parfit
Photographs by Robb Kendrick*



An eight-man expedition restores the first permanent U. S. station in Antarctica. East Base, neglected since 1948, now stands as an international historic monument.

110

COVER: A statue of Stalin, blindfolded by a child, survives in a Moscow park—but only in pieces, much like the dictator's once powerful empire. Photograph by Gerd Ludwig.

♻️ *Cover printed on recycled-content paper.*

FOR MEMBERSHIP INFORMATION CALL 1-800-638-4077

AFTER THE SOVIET UNION'S

ABroken

By MIKE EDWARDS ASSISTANT EDITOR

Photographs by GERD LUDWIG

IN THE DISTANCE concrete pillars rose crookedly, like unsteady drunks. At my feet lay a sliver of airplane skin. I picked up a handful of gravel—porous stuff, like cinders from a furnace.

"How long is it safe to stay?" I asked the colonel. "About three hours," he answered, casually checking the millirem flashing on his radiation meter.

We had set out that morning by helicopter from Kurchatov in the numbing emptiness of northeastern Kazakhstan. Until recently that small city, secret citadel of the Soviet atom, appeared on no maps save those of intelligence agencies and, undoubtedly, U. S. bomber pilots.

The big Mi-8 chopper bore a red star, and Col. Samat Smagulov wore a crisp Soviet uniform—though both chopper and colonel were relics of a dead regime. After the 40-minute flight from Kurchatov we put down by a crater in which water pooled darkly.

As the colonel described events at this now moribund test site, I couldn't help thinking of boys playing in a sandpile. The Red Army and Soviet scientists had built five-story buildings, military bunkers, and three bridges. On and near the bridges they had placed tanks, planes, automobiles, and a freight train. They brought in sheep, dogs, and birds. And then they blew it all up with a 20-kiloton nuclear device.

That was August 29, 1949, the day the Soviet Union exploded its first atom bomb and became a superpower.

The fallout from that explosion descended on unwary Kazakh villagers 60 miles away. We shall come to that tragedy.

Nowhere does the collapse of the Soviet Union seem more profound than at this test site and at Kurchatov with its sophisticated laboratories. Today independent Kazakhstan claims all, with the laudable intention of giving peaceful employment to the hundreds of scientists who worked not only on weapons but also on such projects as a tiny nuclear reactor to power a spacecraft to Mars.

But like all the nations born of the Soviet collapse, Kazakhstan is broke. Another colonel, who tested antiradiation drugs on dogs and monkeys, says disconsolately: "We are not accustomed to being unemployed."

So scientists at Kurchatov solicit work like capitalist salesmen: "Maybe we could do an environmental study for your company . . . design your computer system . . . assist with radioactive waste disposal."

I roamed Kurchatov at sunset. It was pleasant, its buildings hidden in trees. Families strolled the quiet streets. "No cars," I noted. "No gas," a man said.

I spent much of last year wandering among the shards of the shattered empire. The three Baltic republics had begun to break away from the world's largest nation well before the bumbled Communist Party coup of August 1991. Besides Russia, that left 11 republics to test—some joyously, some timidly—the uncertainties of independence. Nine have re-merged into the

COLLAPSE

Empire

Commonwealth of Independent States, so far a mere shell.

I chose three to follow: Russia, shrunken in prestige, wrestling ineffectually to beat its swords into plowshares; Kazakhstan, blessed with natural resources but troubled by pollution and ethnic division; and Ukraine, which bolted like some fierce caged beast, only to be snared again by its former party bosses.

"We aren't afraid any more," said a woman in a Ukrainian village. Repression has ended—the greatest blessing in these worlds turned upside down. Religion thrives. A chorus of dissonant political voices is heard. Minorities that suffocated under the Soviet system, especially in the 1930s and 1940s, when Joseph Stalin was dictator, seek unaccustomed sunshine.

Inevitably, most of the new nations are run by ex-communists; who else has governing experience? And graft—the lubricant of the old system—has burgeoned. Failing to flag a taxi in my Moscow neighborhood, I sometimes rode in an ambulance; there was a hospital nearby, and the drivers were moonlighting.

More serious is "illegal privatization"—grand theft. State property belongs to everybody and, seemingly, to nobody. A farm boss told me he had taken the farm's fruit-processing plant for his own. "I need protection for the future," he said.

The future? It is too soon to speak of it in these wobbly nations. They are at Genesis. Revelation is beyond mortal sight.



TOO YOUNG TO REMEMBER STALIN'S HORRORS, A RUSSIAN GIRL PLAYS WITH A DISCARDED STATUE OF THE FORMER DICTATOR AFTER 1991'S FAILED ANTIDEMOCRACY COUP. FOUR HEADY MONTHS LATER, THE U.S.S.R. WOULD BE HISTORY.

RUSSIA

Playing



by New Rules



Shadowy sentry stands guard as his partners sell shots of homemade wine to snow-flecked Muscovites in Krasnopresnenskaya Square. As Russia begins to come out of hibernation after seven decades of strict Soviet central planning, moonshiners such as these from the fertile Caucasus—four days by car from Moscow—are free to travel and run their own small businesses. But with the unraveling of the Soviet Union, long-festering ethnic tensions have burst open: Many street vendors endure racially tinged taunts from Russians and occasional police warnings to move along.



From socialists to socialites: Members of Moscow's emerging class of entrepreneurs, or biznesmeny, swirl across the floor at a lavish holiday ball held to raise money for local orphanages. Most Russians have gotten poorer since



the collapse of communism. Yet enough businessmen have parlayed import-export savvy into riches to support dances like this one, where admission equaled five months' wages for a Russian factory worker.

RUSSIA

IN A GREAT OLD GLASS-ROOFED HALL, recycled from post office to post-communist bazaar, I joined a clutch of young men, mostly jeaned, who alternately watched Kirill Kirsanov and a flashing tote board.

"Your proposals, gentlemen," Kirsanov beckoned, and then he began to auction off Russia, piece by piece.

First, a big Kamaz truck, used, asking price 1.7 million rubles, about \$13,000 at last July's exchange rate. Next: five Zhiguli automobiles. Then a consignment of tires, each worth a factory worker's monthly salary. A broker waved his numbered card and the tote board flashed a sale. Across the room another auctioneer hawked barbed wire and 12 tons of aluminum ingots.

A sawmill, a fire truck. . . . Even state farms and government agencies try to raise cash at the Russian Commodity and Raw Materials Exchange, or *birzha*, a primitive version of the Chicago Mercantile Exchange (no pork bellies yet).

The military even offered to sell a MiG-29. Asking price: 23 million dollars. There were no takers, I am told, though 20 brokers nibbled. A few years ago the CIA would have paid five times that.

The *birzha* is just a couple of blocks from the headquarters of the KGB, whose minions in former times would have arrested the brokers as obscene speculators. But there are few rules now, except the rules of survival, for Russia, centerpiece of tsarist majesty and Soviet might, is for all intents bankrupt. That was a nonconcept, unthinkable, under the Soviet regime. Now. . . .

"It appears I may become bankrupt," said a private farmer, Vasily Nazarov, trying to survive on a small tract outside Moscow. A wiry fellow with a dark beard, Vasily is probably as tough as they come; he had fought the Lenin's Beacon Collective Farm for three years to get his land. One good potato harvest had enabled him to buy a tractor. Last year he

hoped to add a truck. But when I saw his fields, the potato plants were wilting in a drought, and he was barely scraping through.

In Magnitogorsk, a hellfire city 850 miles east of Moscow, where uncountable stacks pour smoke and flame, workers phoning in to a radio talk show demanded to know: Is the world's largest steel mill bankrupt? They had reason to ask, for the Magnitogorsk mill had missed three months of paydays.

When I put that question to director Anatoly Startsev, he said, "The balance of debts is positive." Which means this gigantic stinkpot was owed more than *it* owed. Could it collect? Not likely; "factory" today usually means "deadbeat." When Russians were issued vouchers last year with which to buy stock in privatized industries, they found many to be like Magnitogorsk: a chancy investment.

THE SWANKEST OFFICE I've seen in Moscow—glossy black furniture, soft lighting—belongs to Konstantin Borovoy. He toyed with a computer. Perhaps urgent calculations preoccupied one part of his brain while another part conversed with me.

His is an awesome brain; mathematician and computer whiz, he fathered the *birzha*, as well as a software company, firms that invest in diamonds and gold, and 20 more enterprises.

During the 1991 communist coup attempt Russian President Boris Yeltsin was saved, in part, by fax machines and pizza to go—and by Konstantin Borovoy.

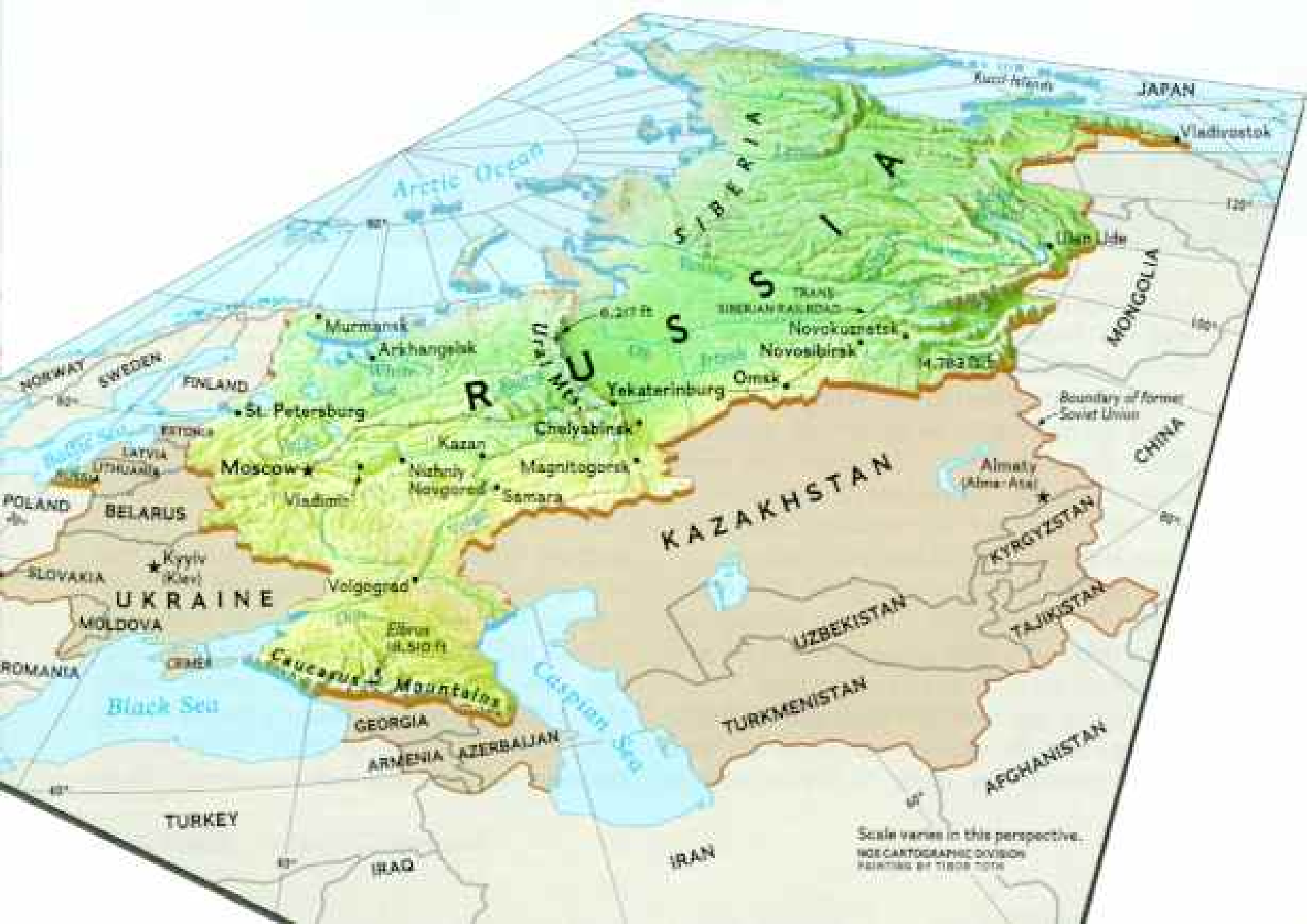
The hard-line communist plotters moved to take over the government on August 19, having detained Soviet President Mikhail Gorbachev in Crimea, where he was vacationing. As radio and TV announced that Gorbachev was "ill," Yeltsin holed up in the Russian White House, the parliament building, two miles from the Kremlin.

On the first day of the coup, few Russians knew that Yeltsin was resisting. To proclaim



Icon of a system that controlled many aspects of daily life but let air, water, and land pollution run unchecked, a steel plant in Novokuznetsk belches thick smoke into the Siberian sky (left). "We've inherited an ecological disaster," says Boris Yeltsin, president of the sprawling Russian Federation. Every major river in Russia is polluted, one-fourth of the drinking water is unsafe, and 35 million people live in cities where the air is dangerous to breathe.

Russian officials blame air and water pollution for the precarious state of the nation's school-children—only a quarter of whom are in good health. The toxic environment has taken its toll on the elderly as well. Life expectancy has fallen in recent years and is among the lowest in Europe.





his defiance, he sent faxes to Borovoy's office and the birzha. Brokers copied them and spread leaflets around the city.

Citizens streamed to the White House and threw up barricades as tanks took positions. Enter Borovoy again. "I bought two truckloads of sausage," he told me. That was to feed the defenders, the *barrikadniki*. Moscow's Pizza Hut sent over carloads of pizzas.

"The KGB came to arrest the Xerox machines," Borovoy said, "but we already had taken them to a safer place." An impish grin crossed his face. "I was like a partisan."

A former mathematics professor, Borovoy declares that the millions earned by his companies interest him little. "I like to work in

the empty place," he said. He sees a vacuum, fills it with an enterprise—say, a TV production company—and moves on. He still lives in the same modest three-room flat he occupied as a professor.

What does interest him, passionately, is this: "I want to live in a normal country. A very common country." He hopes Yeltsin may yet deliver a "normal" Russia, with free enterprise and the right to buy and sell land.

Some Russians believe it's more likely that Yeltsin will be the victim of a "gray revolution," swallowed up by the anti-reform lobby of old-line industrial managers that surround him. "It's not easy to work with them," Borovoy said of these conservatives. "They



Using his wits to earn some pocket change, a young Muscovite wipes clean a cabdriver's windshield. The city's streets are full of children hawking newspapers and soft drinks—or converging on cars, spray bottles in hand. They have their pick of dirty windshields. Drivers wary of thieves remove their wiper blades, reinserting them only in heavy rain.

dollars. He offers five rubles more than the bank. Yuri works for a syndicate that mops up hard currency with which to buy used cars in Japan—worth double the price in car-starved Russia. A policeman watches casually as we talk. He seems to be there to protect Yuri.

A “NORMAL COUNTRY,” according to Viktor Anpilov, leader of the Moscow-based organization Laboring Russia, would assure “justice for all the people” and strive to achieve classless communism. There would be no Borovoy.

I first heard Anpilov at a communist rally where speakers screamed that Yeltsin and Gorbachev are “Judases . . . traitors!” who sold out empire and party. At 46 Anpilov is younger than most of those choleric gentlemen, but he can thunder with the best. For example: “The Yeltsin fascist dictatorship has ruined the socialist society, the real bastion of peace in our world!”

Over coffee one day he told me of his reverence for Lenin, this “cleverest man.” Like many in the anti-Yeltsin camp Anpilov is both dedicated communist and intense Russian nationalist. It shames him that Russia must “go begging all over the world” for aid. “That is the fate of slaves, and we are a free people.”

It also offends him that Russia is being washed by “this dirty river of Hollywood.” (The man has a point; the cinemas are full of Western porn and violence, though not all comes from Hollywood.)

Anpilov's Russia would again be the centerpiece of the Soviet Union, with all the republics back in the fold. “We still have an image of one united country in our hearts,” he said. “To truly abolish the Soviet Union, you will have to destroy several generations of people who grew up with this idea.”

His view has a following; many army officers, for example, yearn for the return of Soviet power. But Anpilov apparently has not met the Ukrainians and Kazakhs I've met.

Only a few thousand people showed up for

all say they've changed a lot, but they still have a communist mentality.”

Around Moscow I encountered legions of would-be Borovoy. The city has become a vast bazaar, raw capitalism oozing from its sidewalks and Metro stations—or any place a huckster can find a crowd.

The goods are cheap: dresses from Turkey, tape players from some Hong Kong factory no one has ever heard of. But there is more to buy than Moscow has known in decades—if you have money.

Increasingly this is a city of haves and have-nots, mocking the old notion of egalitarianism and also mocking the law. In front of a bank an engaging crook named Yuri solicits my





A grateful pensioner enjoys a hot meal at one of Moscow's 70 soup kitchens (above), where the poor converge. Basic food prices shot up as much as 500 percent when state controls were lifted in January 1992. Bread and butter are still free, however, at Vladimir prison (left).

the communist rally I attended. Three years ago the anticommunist reformers, or democrats, could muster 100,000—before the pain of reforms and 1,000 percent inflation gave “democrat” a bad odor.

Only about 200,000 defended Yeltsin at the White House in 1991—this in a city of nine million. The masses sat out the coup fight and, so far, are sitting out the aftermath.

“I don’t know anything about them—it doesn’t concern me at all.” This was the answer of a pensioner, Galina, when I asked what she thought of the changes that have descended on Moscow: striptease shows, gambling casinos, thriving mafias.

Galina was my neighbor when I took a Moscow flat last year. Like most of the people who sat outside in the afternoon, chatting or playing dominoes, she did not read newspapers or watch the news on TV.

Said another of the coup: “I thought, what will be will be. We cannot do anything.”

And cynical Vladimir added: “Everything has collapsed—so what?” The Russian patience, reinforced by decades of Soviet-engendered fear, is amazing.

THE PRUDENT TRAVELER in the former Soviet Union carries soap and toilet paper, because hotels may not have any. A light bulb is a good idea. And about two pounds of rubles. The government eased my burden when it issued 5,000-ruble notes (worth \$40 in July but only \$12 in December).

Thus equipped, I set out for Nizhniy Novgorod, 250 miles east of Moscow on the River Volga. It reverted to its old name—“down-river Novgorod”—a couple of years ago; under Stalin it was Gorkiy, honoring the writer Maxim Gorky, a native son.

I checked into the Oktyabrskaya, formerly a hotel for party bosses, now taken over by the city government. The marble lobby was as cold as a Russian winter, but the basement held a revivifying sauna and pool.

A major producer of armaments, including MiG fighters, “Nizhniy” was long closed to foreigners. That denied us the sight of a charming city, a junior St. Petersburg of pilasters and columns, spreading round the walls of an ancient citadel, or kremlin.

In the lingering fire of a July sunset the Volga seems to possess its own incandescence, glowing silver, then rose, finally mauve. Puttering tugs send soft wakes across this liquid rainbow. It’s so innocent that you’d never guess what’s around the bend.

“Absolutely the last one,” swore the security officer who escorted me through the Krasnoye Sormovo shipyard on the city’s northern edge. In a huge shed by the river I beheld a fat black cigar lying clutched in a forest of scaffolding. This cigar had a conning tower.



A babushka takes the fledgling market economy into her own hands in Moscow's Lubyanskaya Square. When selling goods on the street was suddenly made legal last year, Russians crowded into major thoroughfares



to peddle used household wares and any new items they could get from middlemen or crooked store managers. Moscow authorities soon restricted the tollkuchki, or "push markets," because streets had become impassable.

The Soviet Navy received more than a hundred diesel submarines from this yard. That much its director told me. He would not admit it also built nuclear subs, though that's no secret. They went from Nizhniy up the Volga, then by canal to the Baltic or White Seas.

Huge metal ribs on a rail car led me to suspect there's a nuclear sub still under construction—probably inside a hangar-size building that was closed to me. "Please don't put me in a difficult situation," the director answered when my interpreter, Ludmila Mekertycheva, pressed him. "I have told you all I can."

I sympathized with this short, taut man, Nikolai Zharkov, for his problems extend far beyond observing still strict security rules.

Russia is shrinking its military forces. So new work must be created—not found, *created*—for the shipyard's thousands of designers and its "golden hands," skilled welders of titanium alloy and fitters of stainless-steel pipe.

Enter now the Wave, a washing machine about half the size of the one in your basement and only semiautomatic. But in a country where all appliances are scarce, the Wave

beats bending to wash clothes in the bathtub.

Shipyard workers already have been recycled to a Wave assembly line. "We produce 280 a day," said chief engineer Sergei Surkov.

I glanced across the factory floor and saw enough Waves to make a sea. "Storage is overfilled," said Surkov.

Herewith one bedevilment of upside-down Russia: They shall beat their submarines into washing machines, making Waves that people want but can't afford. The Wave costs nearly two months' pay for a factory worker.

Shipyard director Zharkov showed me a catalog of other things he'd like to make: small freighters, oil-field pumps, even plastic buckets—all needed. He was hoping the government would lend him half a billion rubles to keep going. (In fact he got slightly more.)

AT AN ARMY BASE on Nizhniy's edge, a booming drum summoned conscripts to assembly. On the concrete parade ground the young men slouched in shapeless khaki fatigues, certainly not looking the stuff of a superpower.

The 31st Tank Division was lucky to have them. "Conscription has been sabotaged," a major had told me in Moscow. He meant that youngsters are widely ignoring the draft, which calls for 18 months' service. The shortage is so acute that Moscow's antiaircraft missile batteries are said to be severely undermanned.

I wandered into the officers' quarters (it's incredible how open Russia has become). On the stairways were baby carriages and strollers. I knocked on a door and met Yelena, a frustrated, angry officer's wife. She lives with her husband,

a major with 17 years of service, and two sons in two single-man dormitory rooms. She cooks in a community kitchen down the hall.

"She's lucky to have *two* rooms," another wife volunteered.

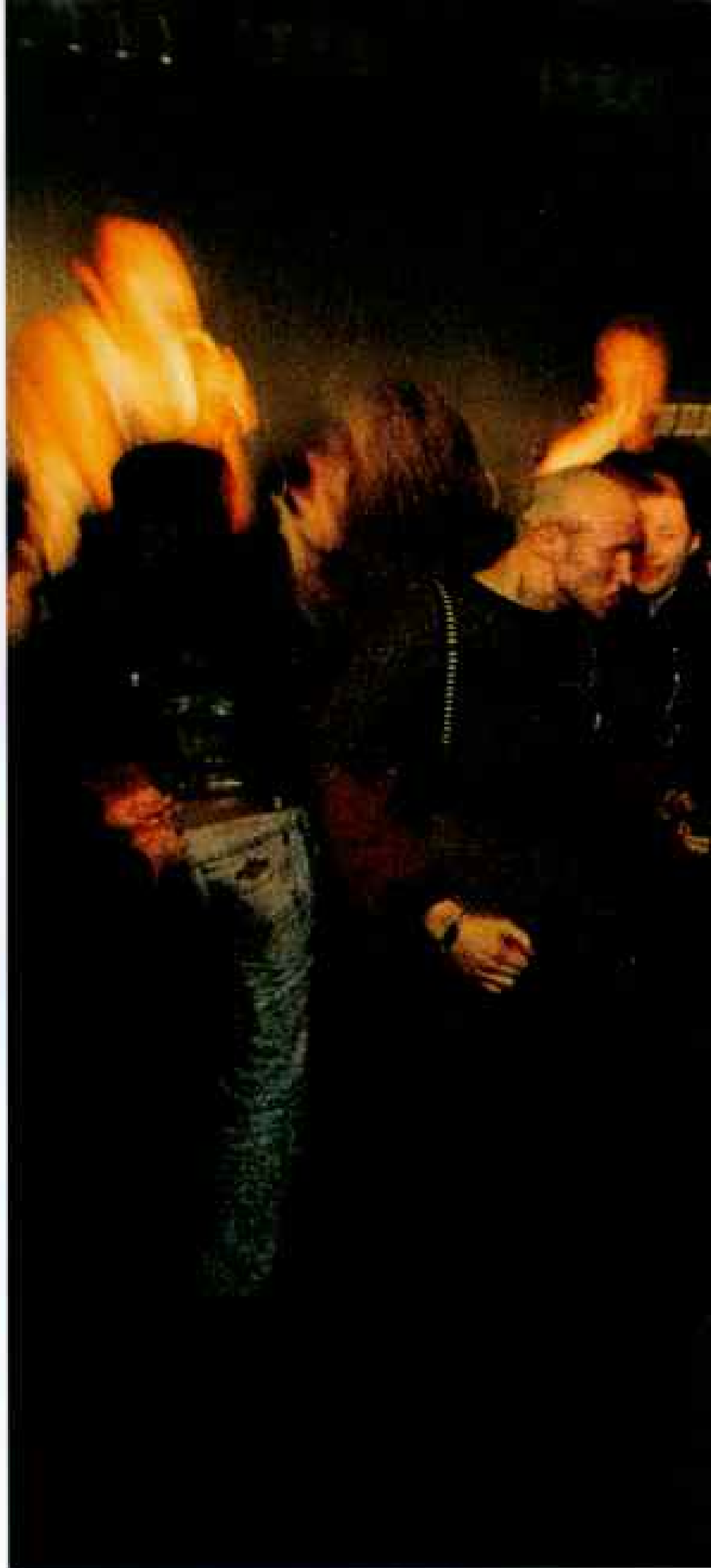
When Gorbachev decided to withdraw Soviet troops from Eastern Europe, the 31st was comfortably ensconced in Czechoslovakia. "We had to get out in two months," a



While foreigners and rich Russians flock to St. Petersburg's Scientific Cosmetic Center for low-cost tummy tucks and breast lifts (above), a small victim of Russia's health-care system teases a doctor with a toy gun at Hospital 21 in Volgograd. Like this boy, hundreds of Russians have contracted the AIDS virus in hospitals because of sloppy sterilization procedures and chronic shortages of disposable needles.



Hired Hitler! An actor paid to mingle with the guests at a chic Moscow party proves that democracy includes the freedom to exercise bad taste. Real-life thugs beat each other up while listening to punk music at St. Petersburg's Tam-Tam club (right), where promoter Seva Gakkel sighs, "I'd rather they come here for a good time than assault people on the subway."



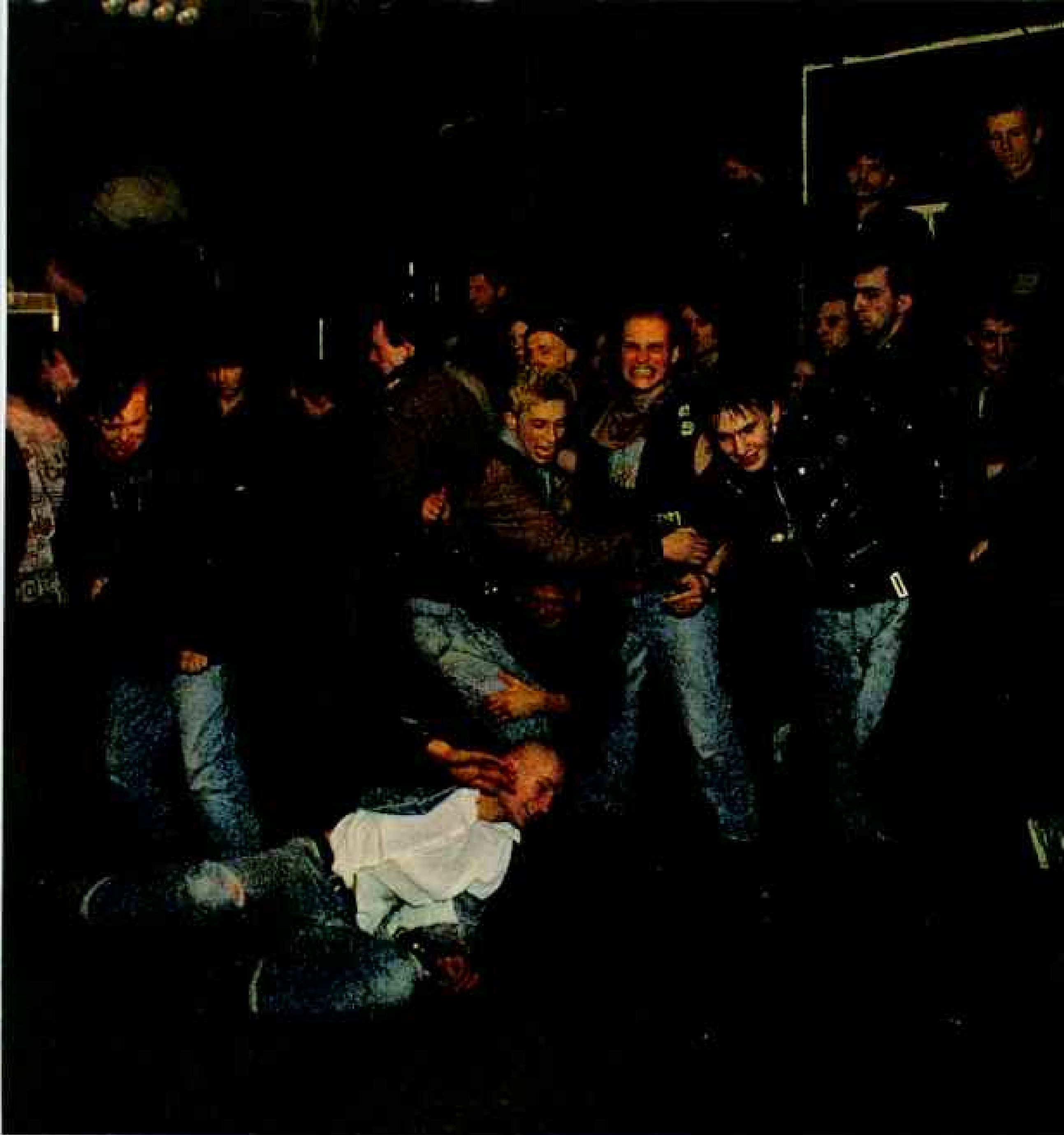
colonel said. "And nothing was ready for us here—no accommodations for families."

Nizhniy, like all Soviet cities, suffered from a housing shortage of its own. So 1,800 officers with wives and children were crammed into sanatoriums, hotels, and youth camps. Now, with the Soviet breakup, thousands of other officers and their families are streaming back to Russia from the former republics.

Yelena's husband, Mikhail, hasn't decided whether he will stay in the army. "First we must get an apartment," Yelena said. "Then we'll decide on the future."

Inflation has eroded an officer's pay to a pittance. "When we go to the market, about all we can do is look," said a colonel's wife. "My husband gets 5,000 rubles a month." That was a factory worker's wage. Hence morale is plunging, and the army is said to be losing some of its best officers. Some have banded into a union, offering support to any politician who will commit to improving their lot. "But under no circumstances would the army replace a constitutional government," a major insisted.

Not everyone thinks that's true.



FROM NIZHNIY I took a slow overnight train 200 miles farther east to Kazan. This is the capital of the autonomous Republic of Tatarstan, a part of the Russian Federation. The train bored through a corridor of birch and pine interspersed about every 15 minutes with a village.

Each of these openings revealed, in the evening light, patches of cabbages, beets, onions, and tomatoes. Rural Russians learned long ago not to depend on the larger system, tsarist or socialist. Some even grow their own tobacco. For them, Moscow's chaos is on Mars.

Morning brought to my window a mosaic of tawny grain and emerald grass. Geese were up early, gagging toward water—though not ahead of the redoubtable *babushki* leading calves to pasture.

By the tracks brush had been newly cleared. At a station a woman swept. I was always surprised by the sight of work under way. With the ruble nearly worthless and all in confusion, I expected people to just melt away from their jobs. But Russians go on. Russia goes on.

Ivan the Terrible marched from Moscow and captured Kazan in 1552, annexing the

territory of a Tatar khan. The Tatars, a Turkic people, part of the Mongol Golden Horde, have not forgotten.

Last fall militant Tatars solemnly commemorated their ancestors' defeat to stir sentiment for independence from Russia. The government of Tatarstan has a less cataclysmic but still far-reaching goal: true autonomy. Either way, Tatarstan would challenge Moscow's historic proclivity to dictate.

From a low hill at one end of Kazan, the citadel that Ivan built after his triumph looks toward a cityscape arrayed with minarets and domes. Gnarled Russian women prove their devotion by climbing 42 steps to pray in the newly reopened Cathedral of Sts. Peter and Paul, which dates from the 18th century.

A few blocks away I peer into what was once the Haymarket Mosque, named for the activity that took place in its square. Taken from the Tatars in the 1930s, it housed a school for builders until 1991. A sign still exhorts, "Bring the decisions of the 27th Congress of the Communist Party into life!" Inside, all is scaffolding and dust, for now it's the mosque that's being brought again to life.

There's much shuffling of real estate these days. In Kazan the headquarters of the outlawed Communist Party has been taken over by the Tatarstan parliament. The young vice chairperson of that body, Zilya Valeyeva, seemed out of place in her huge communist-style office. In such caverns I'm accustomed to old bosses dispensing boilerplate.

"We want to stay friendly with Russia," she told me, "but we are determined that Tatarstan will be sovereign." Local control of education, culture, courts, the economy—that's the goal of a constitutional amendment the parliament approved last November, declaring Tatarstan a sovereign state "associated" with Russia. Russia calls itself a federation and has long pledged autonomy to political entities like Tatarstan within the Russian boundaries. In reality Moscow has dictated even street names.

Tatarstan's economic strength emboldens its government; this republic the size of West Virginia produces oil and manufactures trucks, helicopters, and plastics.

Adjoining Tatarstan are two other Turkic republics, Chuvashia and Bashkortostan, stirring in militant Tatars the dream of union. Could a territory of nine million people embedded in Russia exist independently or even

autonomously? Not easily, I think. Russian nationalists protested last year when Yeltsin seemed ready to return the minuscule Kuril Islands, taken from Japan in 1945.

In any case, Russia's 130 other minorities will closely watch events both in Tatarstan and far to the south, where the Chechen people also claim the right to go it alone.

Tatars make up 48 percent of Tatarstan's 3.7 million population. Russians are 43 percent. The ratio is close, but the Russians are worried. In the long run biology may be decisive: The Tatar birthrate is 40 percent higher than the Russian, and efforts to revive Tatar ways, especially the language, will surely erode Russian influence. "We could become bastards without a culture," said one Russian.

These matters were far from the minds of the newly minted young businessmen—Russian and Tatar—with whom I passed a liquid Sunday by the Volga. They were enjoying a handsome dacha that formerly pleased a party boss. We ate Volga fish, sweated in a sauna, revived in cold showers, and toasted interminably. "Being in Russia is good!" a young executive exclaimed, raising his vodka. "But being here is better!"

BACK IN MOSCOW I walked around the Russian White House. I had been there after the victory, when the rich graffiti of the defenders were still scrawled across the gleaming marble. Some of the graffiti suggested things that could be done with artillery shells to the posteriors of the coup plotters. But there were noble sentiments too—"This is for you, Your Majesty Russia." And, "We shall be tired after the victories only if tomorrow does not promise anything."

The graffiti are long gone, of course. So is the excitement so palpable after the three nights of the *barrikadniki*. Many Russians are indeed tired, beaten down by life's daily punishments. And even optimists (there are a few) realize that a "normal" Russia will not come to pass for years.

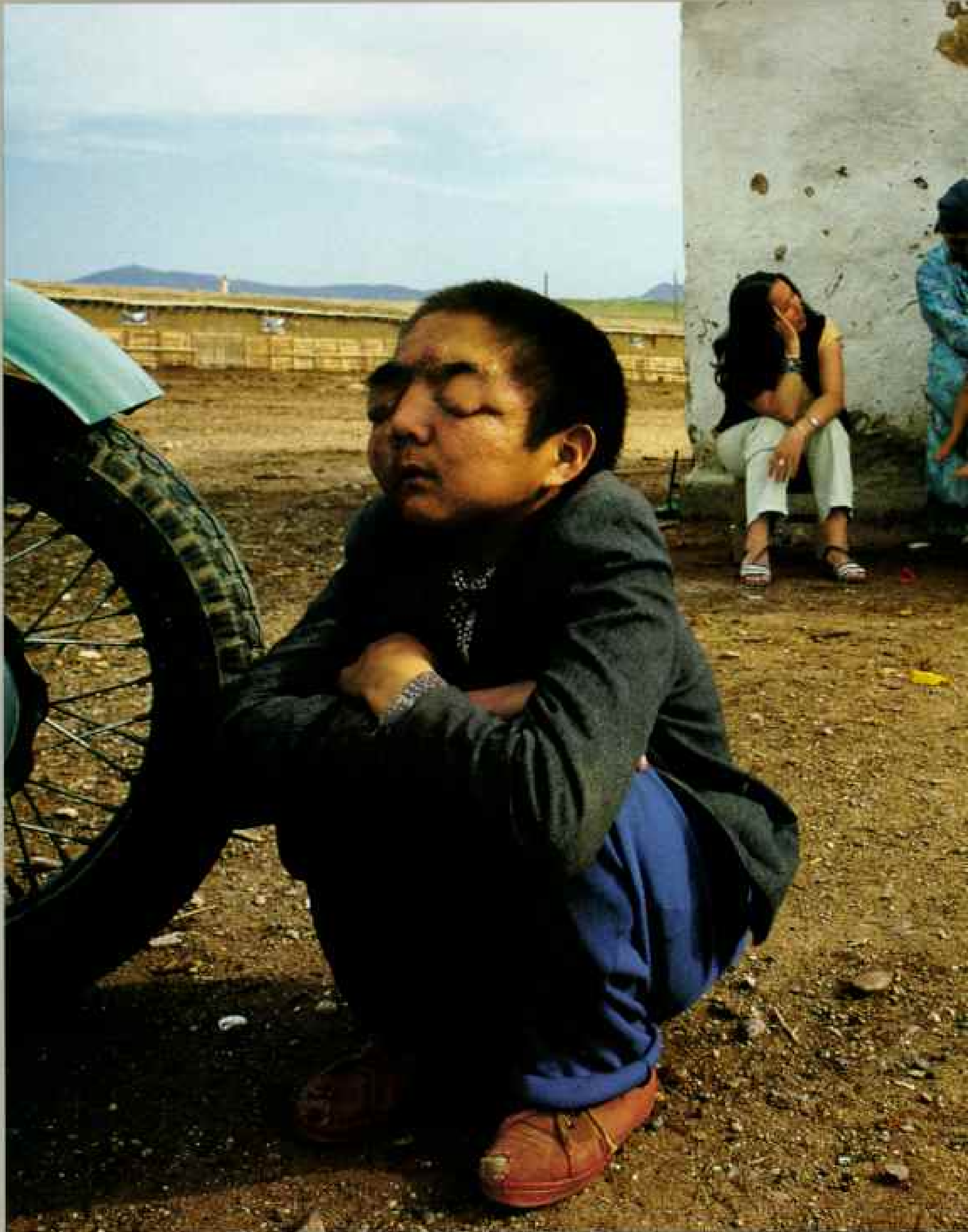
If at all.

The real has become surreal in Russia, with the future as hard to predict as the next move in these St. Petersburg artists' rooftop performance. "All Russia is our orchard," wrote Anton Chekhov nearly a century ago, but the move to capitalism is bearing fruit slowly—leaving Russians sometimes hungry yet still hopeful.

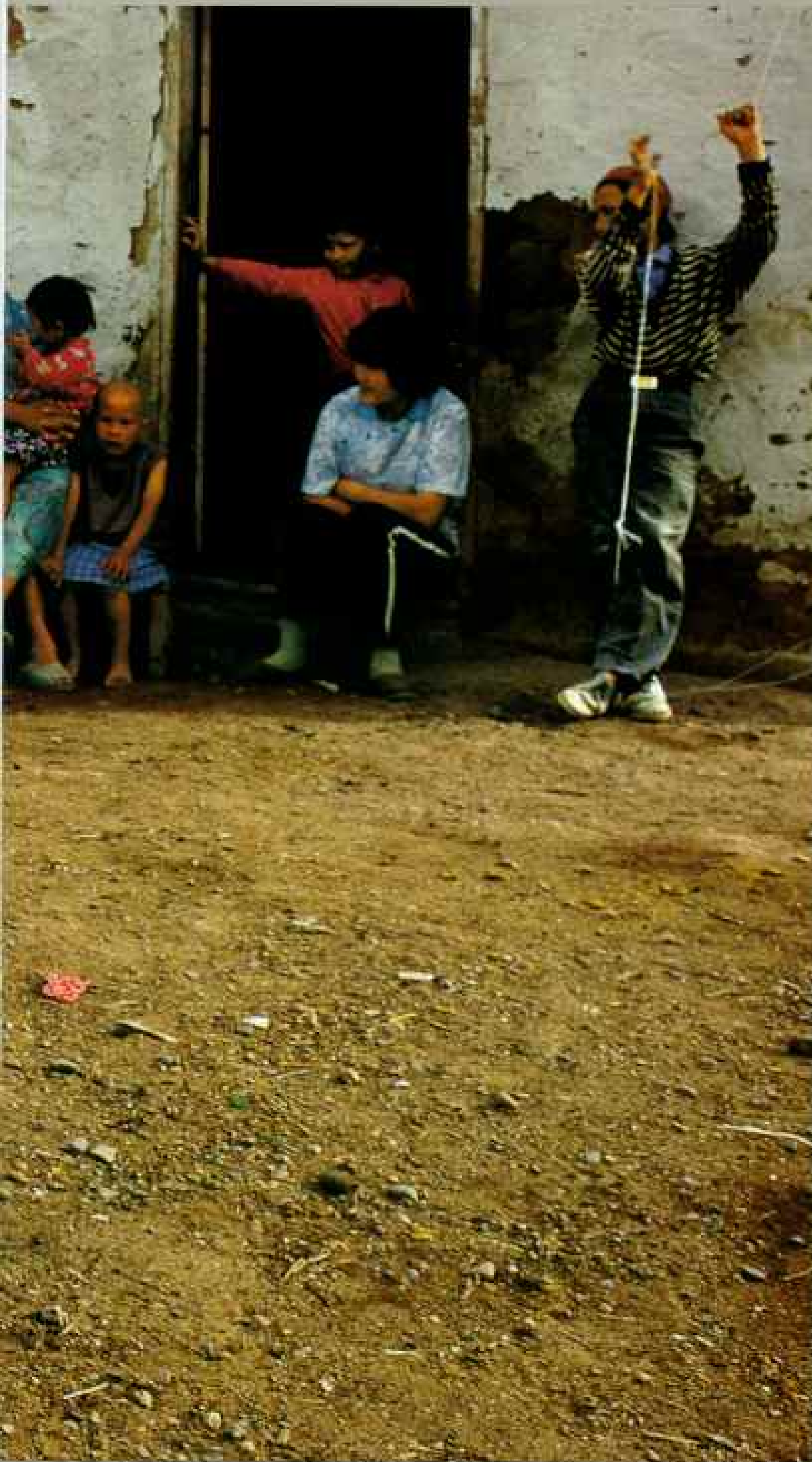


KAZAKHSTAN

Facing

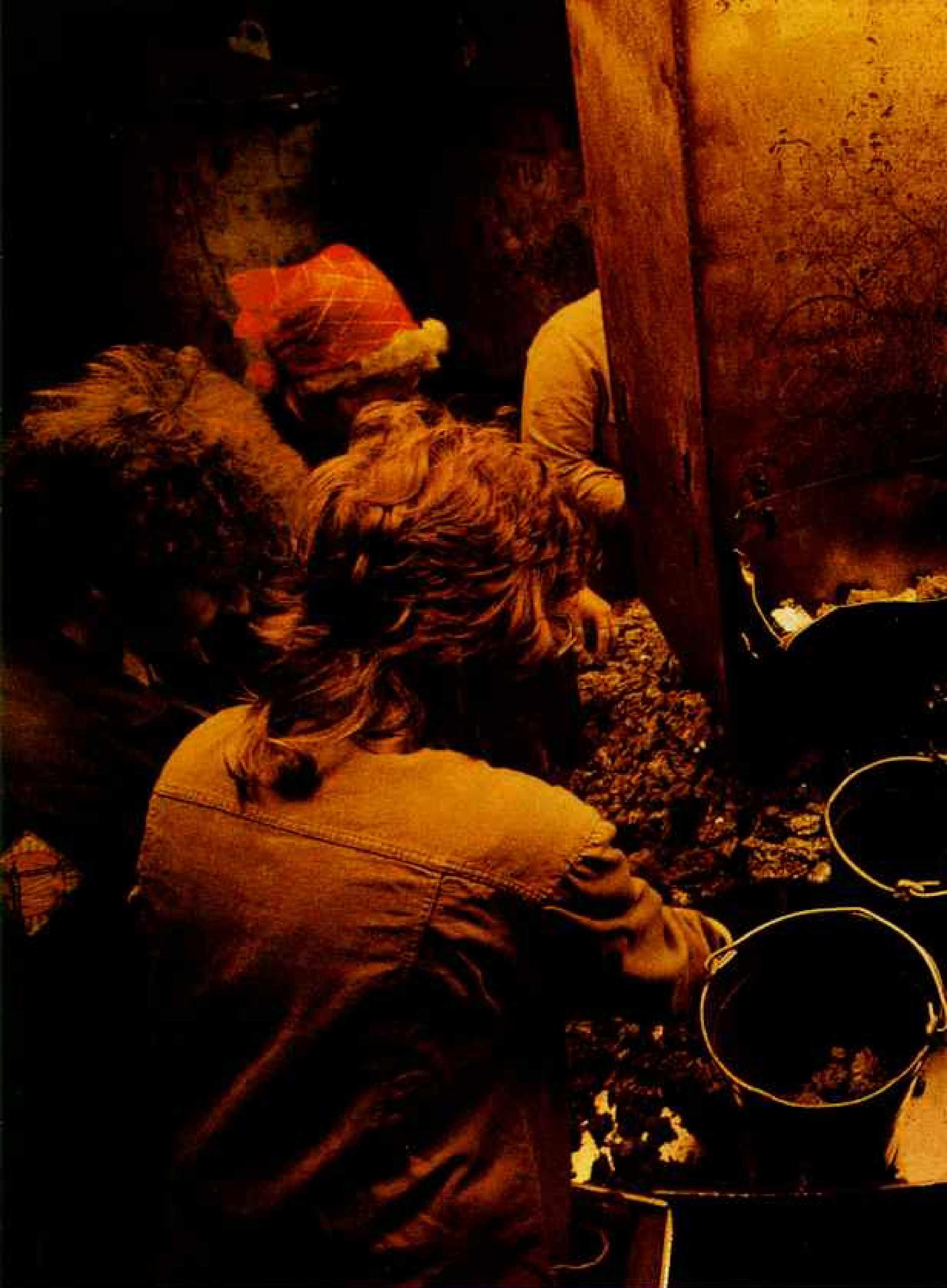


the Nightmare

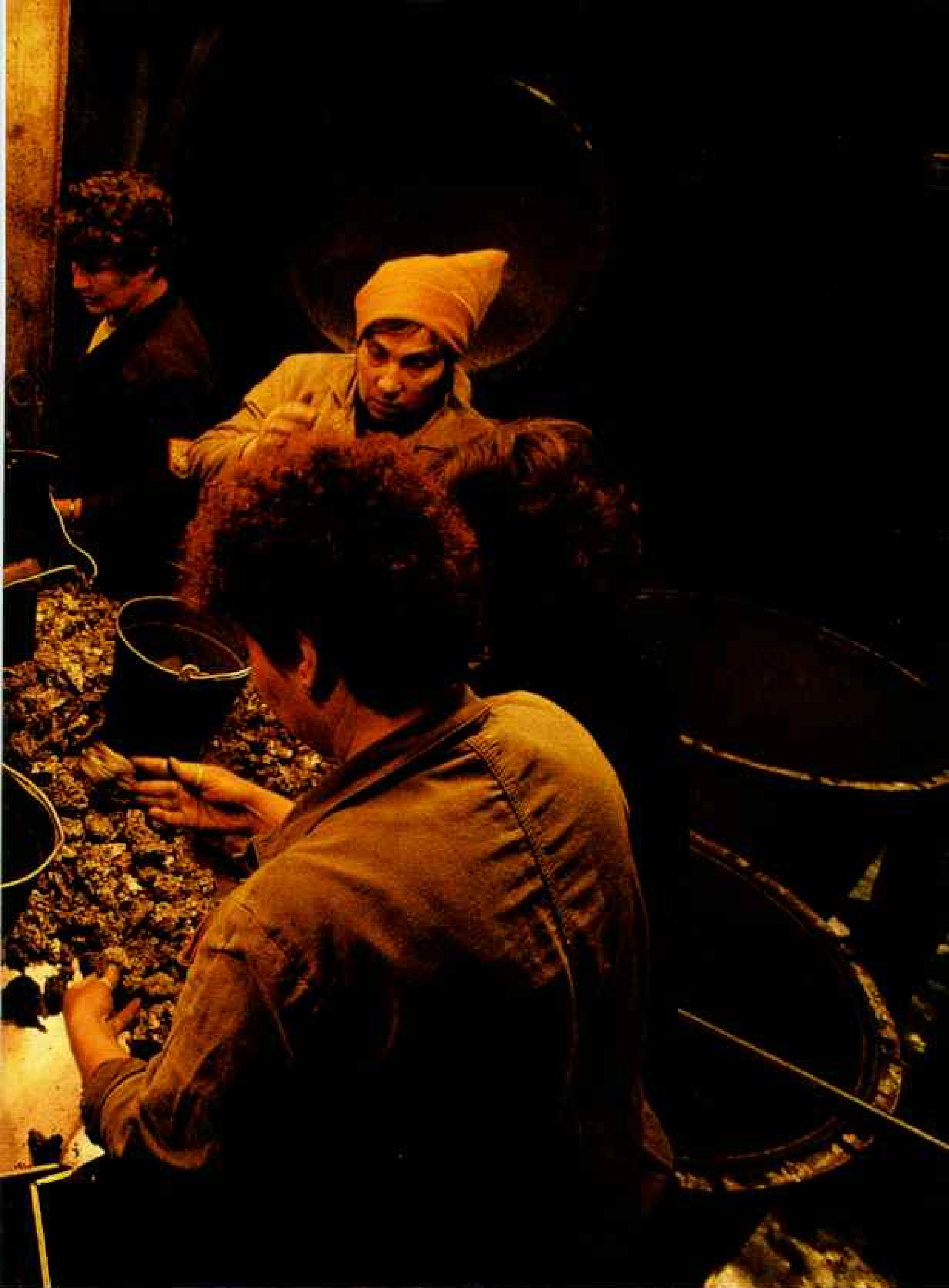


Blind and disfigured from birth, 13-year-old Berik Syzdykov lives downwind of the old Semipalatinsk test site in northeastern Kazakhstan, where inhabitants attribute a plague of birth defects to nuclear fallout. Between 1949 and 1989 nearly 500 nuclear devices were detonated here. Close enough to see the mushroom clouds of early above-ground explosions and to suffer the consequences of both those and lethal ventings from later underground tests, thousands have paid a grisly price in the Cold War.

After 70 years of Soviet rule, the Kazakh people, descendants of Turkic tribes and the great Mongol hordes that once ruled over Russia, have reclaimed their sovereignty and begun to exploit their immense natural resources.



Mostly Russians, workers at an ore plant in Oskemen sort chunks of raw titanium, a metal vital to the aeronautics industry. Though their cities were industrialized by Stalin beginning in the 1930s, Kazakhs have been slow to



leave the land for factory work. With independence, however, they were quick to take control of their new government and are avidly restoring their long-subordinated language to dominance.

KAZAKHSTAN

KAZAKHS SING BALLADS about men like Marat Imashev. I found him on a lonely plateau where the wind tasted of sage. He stood near his domed yurt, made of felt carpets over poles, and regarded his charges: 650 sheep. Here too were his horse and his moving vans: two camels.

The *shaban*, or shepherd, is to Kazakhs what the cowboy is to Americans: a folk hero, wandering free under blue sky. In song the shaban begs his sweetheart not to forget him while he roams to high pastures. On Kazakhstan's new national emblem the centerpiece is a *shaneraq*, the wooden wheel that knits together a yurt frame.

Marat had been on the move for a month and still had 60 miles to go—two weeks of travel—before his flock would nibble mountain grass. "I know the way without a map," he said. "Kazakhs have been grazing sheep on this plateau for centuries."

A romantic job? "All you see is dust and rain and snow," said another shaban, sun-fried Yerlan, whom I met on another day. He commenced a recital of woe: "My wife, my son, and I all tend sheep, and together we earn only 1,500 rubles [less than \$5] a month. I have a family of eight to feed—eight!"

Yerlan spoke in Russian, but now two other shabans scolded him in raspy Kazakh. A friend translated for me: "Why complain to the American? He can't help you. And don't tell him we haven't been paid for six months."

That exchange telegraphed both Kazakh pride and Kazakh plight. In this vast republic, one-third the size of the United States, nationhood arrived with formidable problems. The old Soviet economic system—which linked ore-rich Kazakhstan with factories in Russia and Ukraine—has broken down, and no new system has been devised. Like Russia, Kazakhstan is scourged by inflation and unemployment. Many rural families are large like Yerlan's and send sons to the cities to look for work that isn't there.

Independence also means that there will be no Soviet help for victims of nuclear testing or for cleaning up the staggering aftermath of resource exploitation directed by Moscow. "But even in former times we couldn't really hope that help would come from Moscow," ecology chief Marash Nurtazin told me. "Kazakhstan was just a Soviet colony."

Zinc and lead smelters and a uranium-processing mill have polluted cities in eastern Kazakhstan. In the southwest the shrunken Aral Sea remains a health problem. The culprit there is cotton farming. Once the rivers Syr Darya and Amu Darya fed the sea abundantly, but their waters were diverted to irrigate giant cotton fields. Pesticides and fertilizers ran off the land into irrigation ditches and the Aral.

As the surface area of the sea shrank by more than 40 percent, the pesticides and fertilizers that had accumulated on the seabed were exposed. Winds deposit these residues on villages, where, scientists say, the people have suffered damage to their immune systems. Throat cancer, hepatitis, and respiratory diseases have become serious problems.

Aeroflot's night plane from Moscow brought me over Alma-Ata, Kazakhstan's capital, as the sun enflamed the glaciated teeth of the Tian Shan. Few cities have a more dramatic backdrop. "Almaty," I should probably start saying, for Kazakhstan is cleansing itself of Russianisms. The name translates tranquilly: "apple place."

That seems a misnomer today, for the capital teems with foreign businessmen: oil and gas developers from U. S. and European firms; Chinese trade delegations; and Italian engineers from Fiat, which may assemble a small car for the Central Asian market.

This is heady stuff for Kazakhstan, long hidden beneath the Soviet umbrella. The government welcomes capitalists, yet Lenin lives. He flings a great bronze arm over a tulip bed amid a complex of buildings that trumpeted Soviet might. In government offices his visage



Helping to build a nation, thousands of Kazakhs are returning to their ancestral home from neighboring Mongolia, where many of their forebears sought refuge after the Bolshevik Revolution. Living in traditional yurts on the northern steppe, this group awaits livestock from the government. Long outnumbered by Russians in their own land, Kazakhs have now surpassed them, accounting for 40 percent of the country's 17 million people, compared with the Russians' 38 percent. More than a hundred minorities make up the remainder.







From China and points east, new fashion has filled the freewheeling kiosks of Alma-Ata, the capital, with exotic fabrics (above). Though goods are now plentiful, customers with sufficient cash for the high prices are not. Meanwhile, in state-run shops, like that at Rozovka, choices are few but cheap.

still peers down on bureaucrats who were solid communists only yesterday.

"We learned that Marxism and Leninism don't work," a parliament deputy conceded, "but we can't erase the past in one day."

When the Soviet cage swung open, Kazakhstan stood blinking like a long-confined and uncertain prisoner. Though Kazakhs

welcomed release from Moscow's control, a strong independence movement did not exist. "Politics? It's not our business," said the shepherd Yerlan. That's changing, however.

WHO ARE THE KAZAKHS? One answer: A formerly nomadic Turkic people with Mongol features, the result of the conquest of Genghis Khan and his dynasty. Another definition, from a friend: "If a man cannot name his ancestors for seven generations, he is no Kazakh." When Kazakhs were nomads, it was important to know whether a prospective bride met on the steppe was too closely akin. Today this recitation endures as a badge.

Before communism the Kazakhs were Muslims; they are becoming so again. They favor the moderate Sunni sect. "I wouldn't like to see my daughter suffering under a veil," said an imam.

One more definition of Kazakhs: A people heavily Russianized, whose surnames are Turkish, Arabic, or Persian with a Russian ending, *ov*, *ev*, or *in*. For example, Kumarov, the surname of one friend of mine; his first name is Toktarkhan.

The Kazakhs began to come under Russian control in the 1700s. The tsars sent Cossacks, tough European frontiersmen, to set up outposts and protect trade routes to Asia. More serious was Russian hunger for Kazakh pastures. Some khans accepted Russian encroachment; others fought stubbornly. At the end of the 19th century swarms of landless Russians and Ukrainians poured in and began to plow the grasslands.

After the 1917 Russian Revolution the Kazakhs attempted to break free, but by 1920 they belonged to Moscow and Bolshevism. When forced farm collectivization began in 1929, many villagers slaughtered their animals rather than deliver them to the communists. If they didn't kill the animals, guerrillas often did it for them. Here as in other republics, teachers and holy men were sent to the gulag or the firing squad. Kazakhs believe as many as three million died, most from famine.

For many peoples of the Soviet Union, Kazakhstan became, like Siberia to the north, a great corral into which suspected enemies of the state were driven.

For example, Maria Zähler, who still remembers the knock in the night in autumn 1941 in Ukraine and the Soviet soldiers telling



her to be ready to leave with her five children the next morning.

Soft and grandmotherly, 83 years old, Maria welcomed me to her home in Charsk in northeastern Kazakhstan. It is a neat, pleasant house, although, as in most rural towns, it lacks plumbing.

"My Russian is not good," she apologized. In Ukraine she had not needed Russian, for she lived in a prosperous, self-contained village of Germans whose ancestors were invited to Russia by Catherine the Great in the 1700s. Such villages speckled Ukraine and Russia. When Nazi troops invaded the Soviet Union in 1941, Stalin deemed the Soviet Germans untrustworthy.

With other villagers, Maria and her children—the youngest just three weeks old—were loaded into railroad cattle cars. "My husband was not there," she said. The German men had been taken to dig trenches for the Red Army. She received only one letter from him and does not know his fate.

"We were on the way for about six weeks." Many trains filled with uprooted people were chugging east. "When the train stopped, we would try to cook, but all of a sudden the command would come, 'Immediately to the cars!' My youngest child died of hunger. I didn't have breast milk, and we had nothing to feed a baby except dry bread." Maria cried now.

"A lot of people died. When we stopped, the



Europe bound, Jacob and Stazel Rosa Becker rejoice in the village of Ivanovka. Like many of Kazakhstan's one million ethnic Germans, they are headed for Germany—home of their ancestors, who were invited to settle Russia's hinterland by Catherine the Great. In 1941, as German troops invaded Russia, Stalin shipped most of them to Siberia and Kazakhstan.

become more politicized to safeguard their interests. They form ethnic “movements”—pressure groups—as well as political parties.

For Russians there is Yedinstvo—Unity—led by bluff Yuri Startsev, a geologist. He warns that unless there are two official languages, “Russian speakers will not be involved in the government, and all documents will be in Kazakh.” He bristled at my suggestion that Russians have long felt superior here, the “elder brothers,” as Kazakhs once called them, but I think it is true.

Russians fear the Kazakh movement Azat—Liberation—whose leader is round-faced, mustached Sabetkazy Akataev. Sabetkazy quoted a proverb to me: “If you are friendly with a Russian, take care to have an ax with you.” He would close the border with Russia and develop trade with other Asian nations. Kazakhstan’s Russians can stay, he said—“We just do not want them to interfere with the revival of Kazakhstan.”

President Nursultan Nazarbayev has tried to deal evenhandedly with the diverse population—succeeding so well that militant Kazakhs call him “our Russian president.”

Government officials insist the one-language law will be gently introduced, with only persons having contact with the public, such as airline ticket clerks, required to speak Kazakh at the outset. But the issue festers, abetted by Russian nationalists who make speeches demanding that Moscow protect Russians living “abroad.” Russia’s reach is long.

IT WAS ABOUT TEN on a summer night when I reached Tselinograd, 600 miles northwest of Alma-Ata. It sits in the aching infinity of the Central Asian steppe, the land stretching as flat as a tabletop.

Tselinograd: Virgin Lands City. Nikita Khrushchev made this the center of his campaign to achieve Soviet self-sufficiency in grain beginning in 1954. Trainloads of Russians, Ukrainians, and Byelorussians arrived with tractors to violate 60 million acres of

soldiers gave us spades to bury them. But today we don’t know where the graves are.”

Hundreds of thousands of Ukrainians, Poles, Balts—even Koreans in the Soviet Far East—heard the terrifying knock in the night. In Kazakhstan today Kazakhs are 40 percent of the population of 17 million; Russians, 38 percent. Germans number a million. Or did; many have recently migrated to Germany.

It seems to me the Kazakhs will dominate. They control the government and have declared Kazakh the sole official language—even though Russian is more commonly used here and is more useful in global affairs.

These developments are worrisome to Kazakhstan’s various peoples, who have



A homey decor meant to ease children's fears gives cold comfort at Semipalatinsk Diagnostic Center. Each day dozens of young patients undergo batteries of tests to determine radiation damage. Doctors at the facility are



convinced that their region's frequency of cancers and other maladies is primarily due to fallout from the nearby nuclear test site. Some suggest that radiation-impaired immune systems have led to a kind of nuclear AIDS.



pasture. For government offices, builders raised columned edifices; Khrushchev wanted temples in his citadel of progress.

The vodka flowed in those days, and so did idealism. "It seemed that if we only did a little bit more, and a little bit more, we would find ourselves in paradise," Viktor Mikhailov remembered. "We thought we were bringing the future to this country."

He hesitated, then said: "This life has been wasted. The system gave us hope, but then the system vanished. And the people say now, 'Why did you come here? You spoiled our pastures. We had a lot of sheep. Now we have no place to herd them.'"

And then he began to cry.

Khrushchev's Virgin Lands program rarely met the targets of the official five-year plans. "We didn't have enough machinery," recalled a *brigadir* of combines. "We'd start harvesting in August and quit when the snow came, then try to pick up the rest the next spring." Storage was an afterthought—"Sometimes we just piled the grain in the fields."

Winds blew away much of the soil's essential humus. After Premier Khrushchev was ousted in 1964, the campaign lost momentum. Today several million acres of grain lands are again grasslands, and Tselinograd is called again by its old Kazakh name, Aqmola—"white tomb."



Atomic Lake, as it is known locally, shimmers in the midday air 65 miles southwest of Semey. To create a reservoir, a shallow underground device was detonated here in 1965. Large amounts of radiation were vented, exposing the downwind population. Over the years, the Soviets used scores of nuclear devices for other "peaceful" purposes like diamond mining and stanching oil-well fires.

also played a role in Murat's mechanical aggrandizement. "And now we're rich," he exulted. "We bought combines for 17,000 rubles. Now they sell for more than a million."

Not only is equipment expensive today, it is also scarce; production of tractors and combines has plummeted. A new farmer would have to borrow a fortune to buy equipment, and interest can be as high as 120 percent.

The Iskakovs were lucky to live in a region where local officials tolerated the notion of private farming before inflation and shortages made success nearly impossible. Murat leased 2,100 acres from the Red Flag State Farm in 1989 and borrowed 800,000 rubles, repaid last year. Now he's planning a barn.

We retired to a yurt, sitting on mats at a low table laden with bread, sour cream, sausage, and koumiss, fermented mare's milk, a Kazakh specialty. "We decided to go on our own for the future of our children," Murat said. "Their attitude toward land will be very different from what you see on the state farms. They'll be good farmers." They will be able to inherit the lease, but the land cannot be sold. Kazakhstan's ex-communist lawmakers can't yet countenance total capitalism.

In Kazakhstan and elsewhere, practical bureaucrats—they do exist—want to dismantle the inefficient state and collective farms (the former a state enterprise, the latter a pooling of private lands, seldom voluntary). But how?

Some farm bosses believe cooperative effort is a possible answer: a big farm cleaved into three or four smaller ones, each owned by shareholders. Unfortunately, the farms have few real farmers but a legion of support troops—administrators, bookkeepers, veterinarians, dentists. How can all these share in the dissolution? How can a dismantled farm continue to pay pensions to retirees?

And many families will not readily give up their benefits: children's day care, a month's vacation. On one farm I visited, the workers do not go to the fields until 11 a.m. Imagine

A SUCCESS STORY. Out on the ironed-flat steppe I met Murat Iskakov, Kazakh, private farmer, at a farm that didn't look like a farm. There was no barn yet, not even houses for Murat, his four brothers, and their families, all partners in this enterprise.

But the equipment! Five combines, five tractors, trucks, and wagons—plus horses. "At first, when we sold cattle or wheat, my family would say, 'Let's give ourselves more salary,'" Murat told me. "I said, 'No, if we're going to be on our own, we have to have a lot of machines.'"

This was partly because Soviet machines break down. Peasant possessiveness probably

that, Iowa! "People had to be forced into collectives," another man said. "Maybe they'll have to be forced to leave them."

EXPLOSIONS at the Soviet nuclear test site in northeastern Kazakhstan sometimes cracked walls in towns 50 miles away. The earth shook 470 times during these tests, according to army officers at the nuclear headquarters town of Kurchatov. President Gorbachev, heeding protesters, declared a moratorium in 1990.

"Only 116 explosions were in the air," a colonel told me, "the rest underground. Only two had a major effect on the environment."

It is a disputed claim. "The people were rabbits for experiments," declared Kazakhstan ecology chief Nurtazin. "It was a crime . . . it was fascism."

Villagers told me they were examined without explanation by military doctors. An old man named Ilya said: "They took me to a hospital in 1969 and tested my blood and so on. But they never told me anything. The only good thing they did was plug my

tooth." His yawn revealed a flash of silver.

People became more and more concerned, but their demands for information were ignored until 1989, when a commission of health experts and citizens reported high rates of chromosome damage and stillbirths in the region. Their report forecast increases in leukemia and thyroid cancer.

From Kurchatov I traveled east to Dolon, a fretful village of dirt streets centered on a neglected church. It is 60 miles from ground zero of the first Soviet atomic explosion, in August 1949. Army scientists say a last-minute change in wind direction caused Dolon and other villages to be drenched with fallout from that bomb.

Ludmila Shakhvorostova doesn't remember a brilliant flash in the sky—she thinks she must have been inside her home. But the blast may have caused her life's tragedy.

Mrs. Shakhvorostova, 63, a solid woman, weary of countenance, brought chairs so we could sit in her yard. Now and then one of her boys peered around the house. Boys? Anatoly and Aleksandr are men—but children still.

Anatoly speaks a little. Aleksandr is a lifelong mute.

"The doctors never gave me an explanation," she said. "Anatoly was born in 1956. I realized when he was about three that he wasn't right, that he couldn't speak as he should. Aleksandr was born in 1958. When he was about a year and a half old, I started noticing that he too was retarded."

"It was really hard. When other kids started to school, I used to cry every morning looking at my kids. I prayed to God, I appealed to people, doctors—nobody helped."

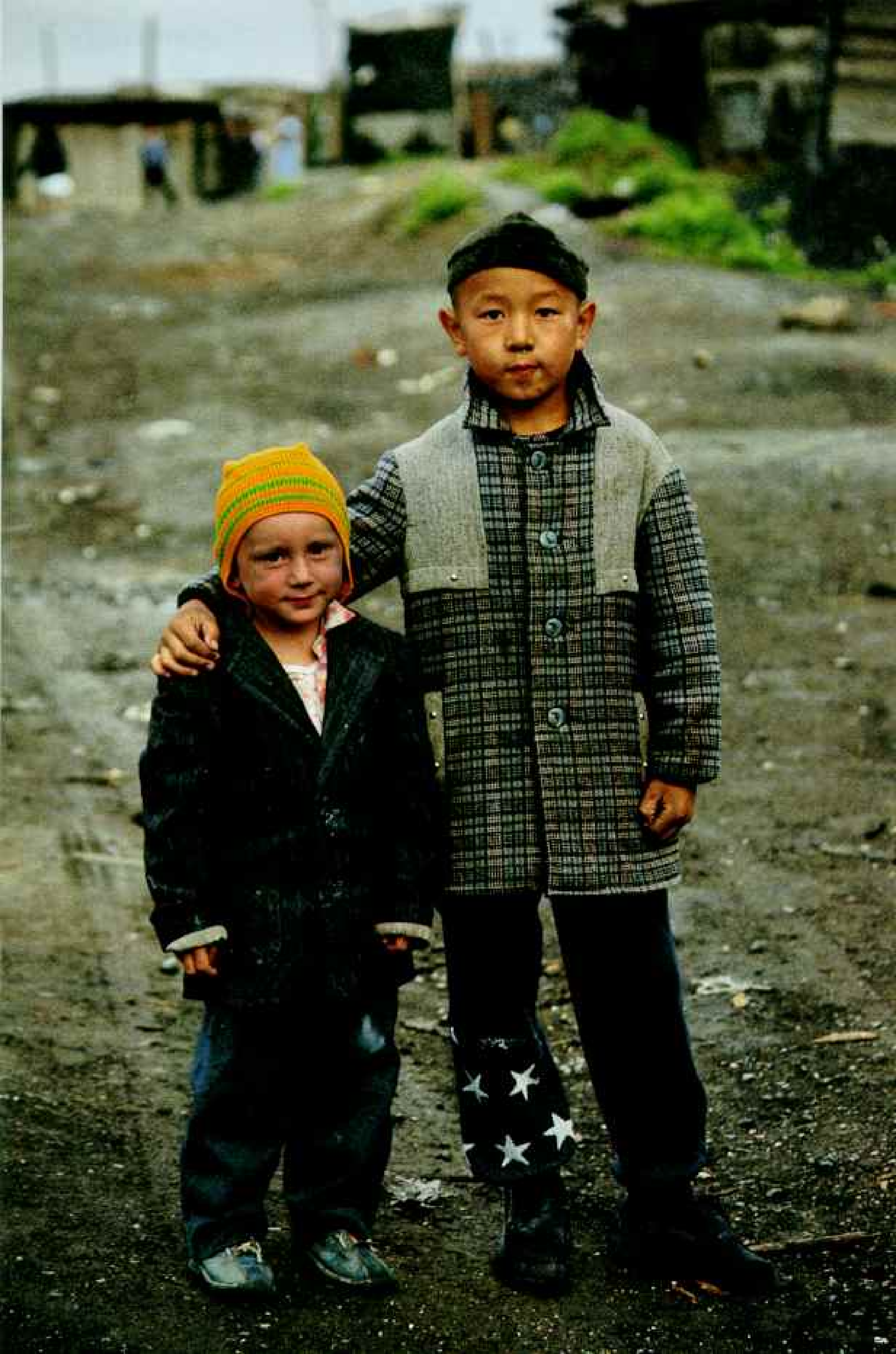
She composed herself and wiped her tears. "You have to be strong," she said. "You can't lie down and die."

According to the health commission report, the number of children born with defects in districts near the test site has risen by some 150 percent. A village official said there are at least four other families in Dolon with retarded children.

Mrs. Shakhvorostova lives on Lenin Street.

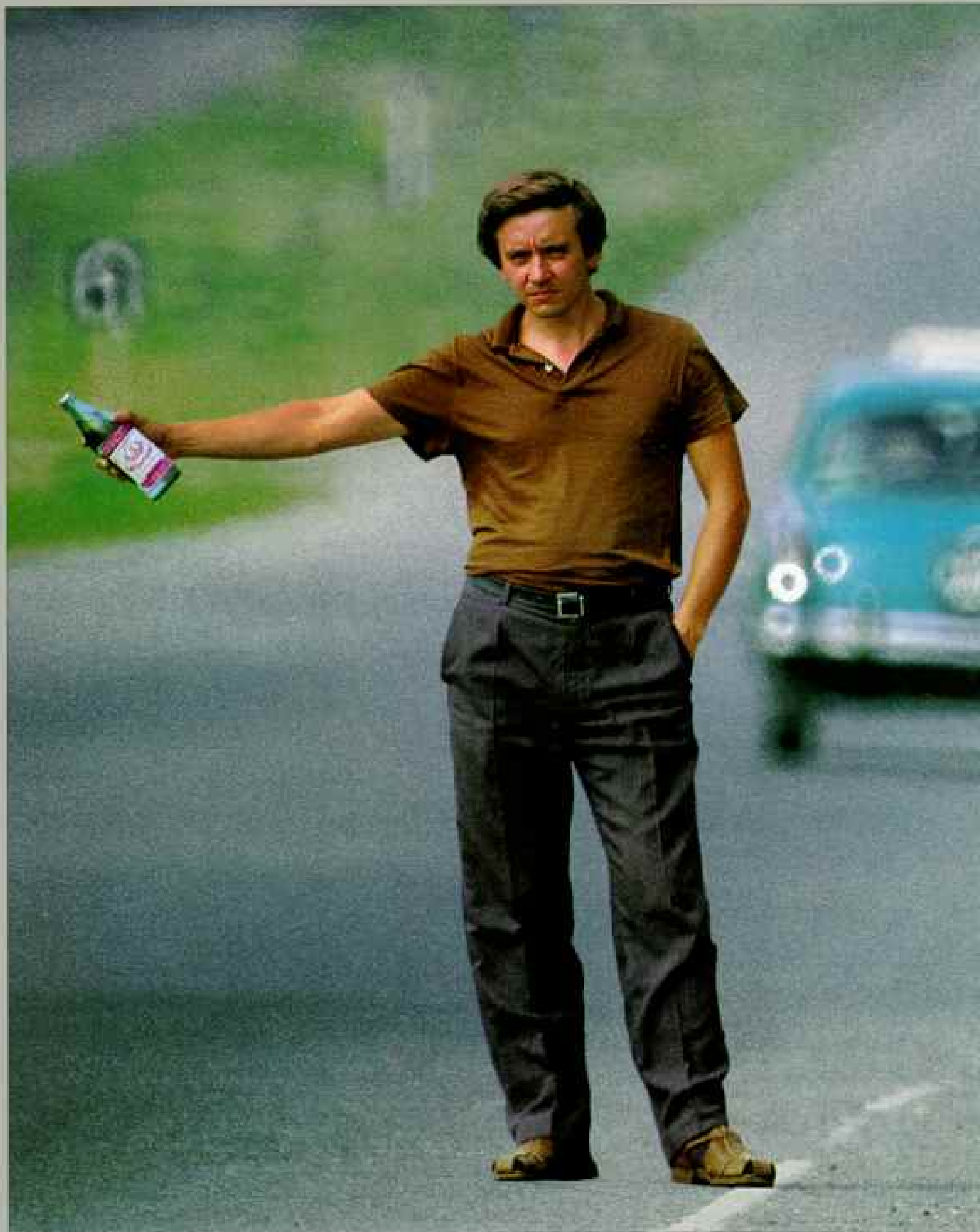


Following steppe tradition, Kazakh deer breeders harvest the spring antler crop for export. Dried and powdered, blood-filled antlers are thought by Koreans and Chinese to yield powerful medicinal effects. Russians have long viewed their Kazakh neighbors as "little brothers." In Semey a Kazakh boy extends big brotherly affection to a Russian friend.



UKRAINE

Running



on Empty

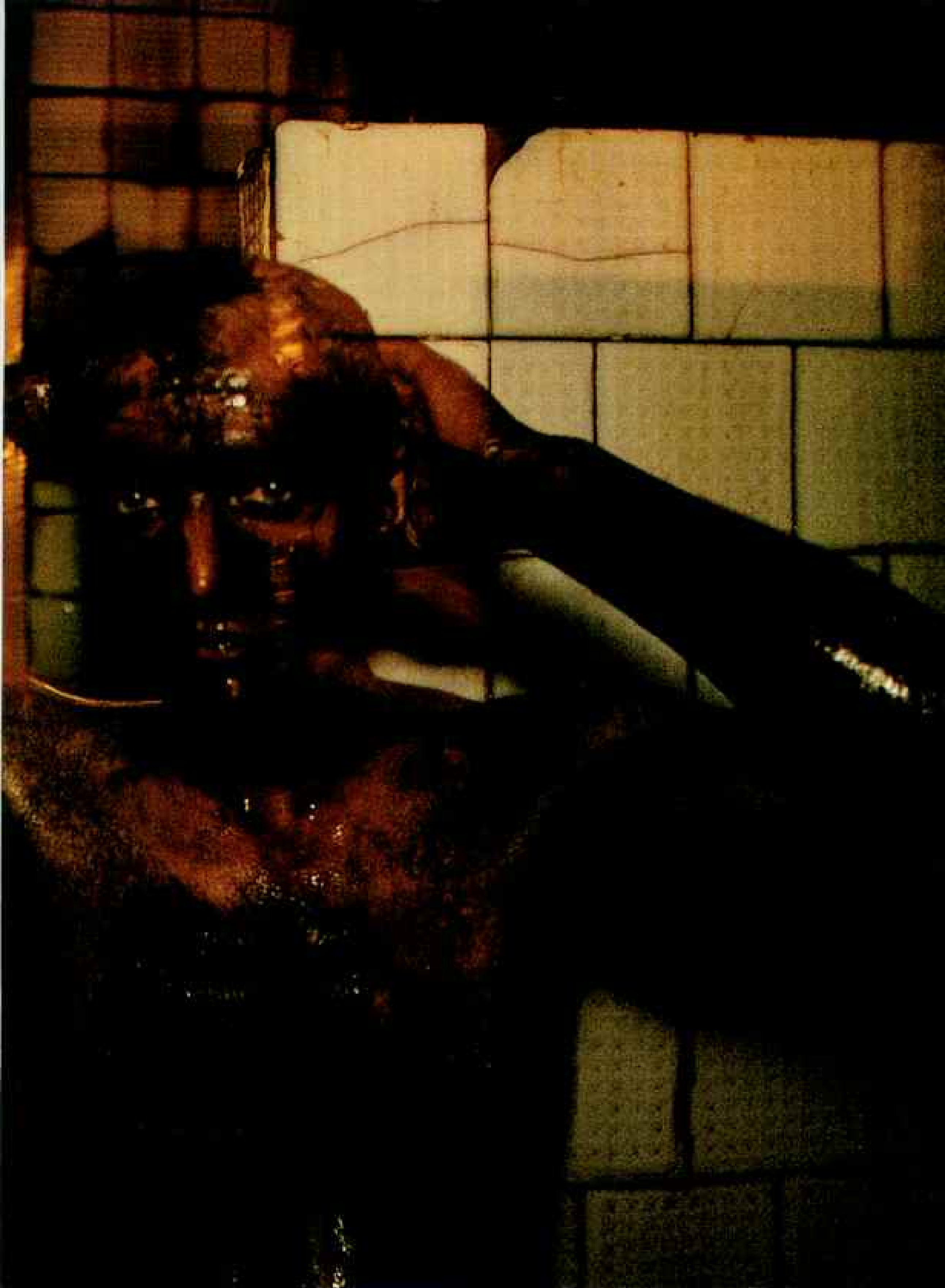


As their economy sputters, Ukrainians, from consumers to government purchasing agents, are resorting to the economics of barter to survive the hardships of forging a market economy. On a highway near Kiev, where gas is dear and vodka plentiful, a stranded motorist offers one for the other.

While taking a more cautious approach than the Russians in privatizing their economy, Ukraine's increasingly nationalistic leaders have few qualms about confronting their powerful Slav cousins to the north. Fearful of resurgent Russian imperialism, Ukrainians are determined to maintain an independent military and, at least temporarily, control of the nuclear weapons on their soil.



Specter from the depths, a coal miner scrubs down after a day in the pits outside Donetsk. Strikes by the Donets Basin miners in 1989 helped discredit the Soviet regime. Though relatively well paid, they risk gas explosions



and face frequent equipment breakdowns to extract Ukraine's high-grade coal. One miner, it is estimated, dies for every million tons of coal mined —ten times the fatality rate of underground coal miners in the United States.

UKRAINE

AT LAST, into the sunshine. Through leafy Kiev they marched, men and women in the twilight of life, hoisting long-forbidden banners and singing long-forbidden songs: "Don't retreat from the battle, young man... Ukrainian partisan, don't give up your position."

They were survivors of a chaotic, hopeless little war fought in western Ukraine amid the larger struggle of World War II. Much of the area was Poland in 1939, when Hitler and Stalin seized and divided that nation. Caught between the two great powers, these Ukrainians defended their homeland against both, ambushing German occupation forces, then turning on the advancing Red Army. Some fought the Soviet regime until the 1950s.

Many paid dearly: long terms in labor camps, then empty existence as unforgiven enemies of Soviet power. Josyf Ivaniuk, who joined the Ukrainian Insurgent Army when he was 19, spent 12 years in Arctic Siberia.

Another marcher was Kataryna Syshylayeva, a small, gray-haired woman, quite proud that she once gave a false tip to the Gestapo, thus luring six truckloads of Nazi troops into a Ukrainian ambush. Later she spied on the Red Army. Sentence: 15 years in the gulag, plus 15 more in exile.

Now, in independent Ukraine, these oldsters validated their shattered lives, marching and singing and hearing the adulation of a crowd. "Glory to the heroes!" people shouted.

The celebration is still going in Ukraine. "Independence—I would give my life for it," exclaimed Kataryna, who'd already given 30 years in Siberia.

The celebration's still going, but the band's been playing out of tune. With freedom achieved, Ukraine's ardent independence movement, Rukh, splintered. Ukraine's first elected president, Leonid Kravchuk, once the republic's chief communist ideologist, fell back into the arms of his old party chums and stifled the development of private enterprise,

while continuing generous subsidies to state-owned industries. Inflation galloped at 30 percent a month, and the *kupon*, a temporary currency issued to replace the sinking ruble, sank even faster. By last fall, with Ukraine an economic catastrophe, control was handed to a blunt-spoken new prime minister, Leonid Kuchma, who told white-elephant industries the free ride was over.

It has been frustrating for a nation that long wanted to go it alone. But Ukraine remains determined to go that road—with a big stick.

JUST OUTSIDE KIEV I entered what seemed to be a village, with quiet, shady streets and plain, rather seedy buildings. Then I saw the MiG-25 interceptors, shouldered by embankments.

The red star was still on these needle-nosed twin-engine craft. A big job is ahead for stencilers, for Regiment 23234 is today a unit of the Ukrainian air force. Ukraine intends to maintain a military of about 250,000 men (compared with Russia's planned 1.2 million). It also demands a share of the former Soviet Black Sea Fleet.

"We can be in the air in 12 minutes," a colonel said. We went to the ready room, where Soviet pilots once waited round the clock to scramble against an invader. It was homey: beds, TV, chess set, samovar, fish tank.

I was introduced to Maj. Aleksandr Karaev, who wore gray coveralls. A siren sounded, and he grabbed his helmet and oxygen mask. Ground crewmen readied a MiG, peeling a cover from the cockpit and pulling protective cones off the four missiles. Karaev trotted out, climbed aboard, and soon the engines roared. Less than eight minutes had elapsed. In four more he would have been airborne, if fuel were not so precious.

I asked Karaev if he understood Ukrainian. "Da," he answered with a weak smile, but he couldn't understand my Ukrainian interpreter, Tania D'Avignon. Regiment 23234



Defender of a new nation, a soldier on a base outside Kiev guards one of the Soviet aircraft "nationalized" by the new regime. Fuel shortages keep the jets mostly grounded. By the year 2000, Ukraine plans to cut its 650,000 men in arms to 250,000—still a formidable military.



Their loyalties in limbo, submarine crewmen test the equipment on one of the Black Sea Fleet's old diesel subs in its home port, Sevastopol. Unable to agree on the fleet's ownership, Russia and Ukraine have put the matter on hold until 1995, leaving some 200 vessels under joint command.

will keep its Russian pilots at least until more Ukrainians are trained, several years hence. Karaev and his commanding officers are Russians who signed loyalty oaths to Ukraine.

"It's complicated," Karaev said, looking away at his MiG. "I had a motherland on one scale, and that scale has diminished. So I decided, this is my home. I've served ten years in Ukraine. My family is here."

Said another Russian: "It's too late to change my life. If I go back to my homeland, I have nothing. Here I have an apartment."

One thing Major Karaev wanted me to know about Russia: "We don't regard our brothers as foes."

Which raises a question. Russia is Ukraine's most worrisome neighbor. To some Russian nationalists, Ukraine is Russia. Would the Russian officers now serving Ukraine really fight for it, particularly against their motherland? Let's hope we don't find out.

I LIKE TO WALK in Kiev. To stroll off Khreshchatyk, the main street, past buildings painted in pastels and shaded by chestnuts, is to feel an Old World softness that Moscow seldom matches. Over all gleam the domes of ancient churches.

Ukrainians and Russians share a heritage in Kiev, where Christianity took root among their ancestors. But these Slavic brothers went separate ways. Ukrainian sentiment for freedom from overlords—Polish and Russian—grew in the 19th century around the impassioned poetry of Taras Shevchenko. The language developed its own Kiev-like softness; in Ukrainian, "Igor," for example, becomes "Ihor."

I didn't find on Kiev's streets a great bazaar like Moscow's. Ukrainian free enterprise is often dispensed from a suitcase by such men as Bohdan, pioneer of a modern Silk Road.

Bohdan flies 4,500 miles to Vladivostok, on Russia's Pacific coast, then travels by bus and train to Harbin, where Chinese merchants eagerly await the dollars he's brought (no kupons, please). He stuffs two suitcases



with goods to brighten Ukrainian life—silk blouses, shiny embroidered synthetics.

"When everything's sold, I've earned maybe \$500," Bohdan told me.

New prime minister Kuchma promised to ease the crushing taxes—much worse than Russia's—that made it all but impossible for entrepreneurs like Bohdan to succeed in a registered business. Kuchma also promised to speed up privatization. Alas, Ukrainians say, many viable state enterprises already have been plucked by opportunistic bosses; such is the near-lawless climate that prevails.

Among factory managers there is certain to be much maneuvering to preserve government subsidies. The Antonov aviation design



bureau, for example, expects funding for an ambitious project, a 350-seat airbus.

Anonymous buildings on the fringe of Kiev domicile this 10,000-employee enterprise, a specialist in transport craft. Its last creation was the six-jet Mriya, or "dream," the biggest thing in the air, with wings that would span a football field. It carries twice the payload of a Lockheed C-5A.

"Our airbus will cost less than the European Airbus," predicted marketing director Viktor Bolgak, who hopes to find foreign customers.

"And we will sell it for as much as we can," declared a design chief.

Under the Soviet system Antonov only drew

plans and tested; assembly was farmed out. For the airbus, Antonov hopes to take over an idle factory and become builder as well. But first, Ukraine has to give Antonov the money.

ABOUT 60 MILES NORTHWEST of Kiev I stopped in Bober. The grass was waist-high and tree limbs brushed my head. On the floor in an empty house were a family's old letters, a shoe, a jacket.

Bober was evacuated four months after the accident at the Chernobyl Nuclear Power Plant on April 26, 1986. But even now my radiation meter ticked in a frenzy. The radio-nuclides that fell on Bober—30 miles from Chernobyl (Ukrainian Chornobyl)—included



long-lived cesium 137 and strontium 90. This spot will be unsafe for centuries.

The faulty No. 4 reactor in the Chernobyl plant lies in seething rubble beneath a steel and concrete sarcophagus built after the accident. The safety of this shield is in doubt, however, and experts are debating further measures, possibly a second cover—a daunting project for a bankrupt nation.

The Chernobyl anxiety goes on, in contaminated villages where people still live in fear and uncertainty.

Just four miles from Bober, the hamlet of Maryanivka, home to some 300 people, is an island amid contaminated fields. At the edge of the village a sign prohibits agriculture in those fields. "But only six feet from the sign it's supposedly all right to have a garden," a woman said. "I don't know what to believe. Nobody tells us the truth. Everything is contaminated in the whole area, but they tell us everything is fine."

After the accident, 135,000 people were evacuated within a 20-mile radius of the power plant. But fallout rained much wider; parts of Ukraine 180 miles away were affected.

The radionuclides descended unevenly, heavy in one place, lighter elsewhere. Outside the 20-mile zone, authorities made rough judgment calls, evacuating some villages, such as Bober, but leaving others intact, such as Maryanivka, even though radiation exceeded norms. The housing shortage was a factor.

Farm worker Vasyl Chyl-ya has mixed feelings about leaving Maryanivka. He told me: "I'm scared for my children [ages 21 and 18]. Natalia has fainting spells. She and Viktor both have headaches. But I was born here. You live a life of respect, you have friends. People share happiness and tragedy. If you take all of us and throw us around, two or three in different villages, we lose everything."

No one knows how many deaths the accident caused. Ukrainian health officials say thousands have died; Western experts believe such figures reflect the tendency of local health

workers to blame nearly every death on Chernobyl. By one Western estimate, the toll will be 5,000 to 10,000 over decades. Whatever the true figure, the curse of Chernobyl will be upon independent Ukraine for generations.

"JESUS IS TSAR OF UKRAINE," placards proclaimed on a Saturday in the smoggy city of Donetsk, 360 miles southeast of Kiev. In Lenin Square, by a massive statue of the Bolshevik, a Swedish evangelist was launching a Jesus Festival.

To others in Donetsk, Lenin remains god. Following socialist tradition, brides and grooms on their way to the wedding hall stop at the statue to lay flowers, for luck. By noon I counted 20 bouquets.

This city of slightly more than a million is the hub of an industrial region centered on the Donets Basin, or Donbas, coalfields. Here dwell many of Ukraine's 11 million Russians, 22 percent of the republic's population. These Russians have a different view of Ukrainian independence. "We were strong when we were the Soviet Union," a woman said.



Toking up, young members of Kiev's underground art scene indulge a habit (above) supplied through backyard marijuana plots. Besides an explosion in drug use and street crime, both Ukraine and Russia are witnessing a New Age storm of psychic healing. In his Kiev kitchen, where he often treats alcoholics, Tolya Brus uses hypnosis and "bioenergy" to heal his wife, Larisa, badly bruised by muggers.

More than a million faithful paid respects last August to Josyf Cardinal Slipyj at St. George's Cathedral in Lviv. His remains were flown from Rome, where he died in exile in 1984. A national hero, Cardinal Slipyj spent 18 of his 92 years in gulags for championing Ukrainian independence and church autonomy.

"But now we don't amount to anything."

Some Russian leaders in the Donbas want to make the region autonomous, distancing themselves from Kiev's power and Ukrainian nationalism. Ukraine already has offered autonomy to Crimea, hoping to forestall any Russian design to reclaim it. This historic peninsula jutting down into the Black Sea had been—after the Bolshevik Revolution—attached to Russia, then, since 1954, to Ukraine.

Its rocky headlands and dark forests are beloved by both peoples. Newly rich entrepreneurs favor the waters at Yalta, where, I duly report, topless bathing has become stylish.

Assuredly no one loves Crimea more than the Tatars who have returned to their homeland from Central Asia. Stalin deported the Crimean Tatars in 1944, accusing them of collaborating with the Germans. Today some 200,000 have come back, and their villages are everywhere. They arrive, simply take some land, and tap into local power lines.

Nationalist elements in Russia also want Crimea back. Russian control of it and the Black Sea Fleet would mean Russian dominance in that area.

I didn't have the right papers to be admitted to Sevastopol, the fleet's home port, near the southern tip of the peninsula. It is still technically closed to foreigners, but things have gotten careless. At the checkpoint outside the city, soldiers waved my taxi through without examining its passenger.

So there I was among elegant columned buildings, the fleet's headquarters, in a city prickly with radar antennas. Among the more than 200 vessels, one source says, are two small carriers, three cruisers, and 28 submarines. Officially, Russia and Ukraine have agreed on joint administration until 1995. Unofficially, there's a little war going on.

In the fleet headquarters a Russian officer said: "If the fleet is divided, the balance of power will be upset." Capt. Andrei Grachev wasn't thinking of the balance with U. S. forces; he referred to the Islamic nations to the south. "Iran, Iraq—you Americans know



what a threat those can be." Trouble can be expected even from Turkey, he added.

"Propaganda," scoffed Ukrainian Capt. Mykola Savchenko. I met him in what once was a school for junior officers. This modest campus—no columns, no harbor view—is the Ukrainian naval headquarters. He contends that Russia is trying to keep the fleet so it can keep Sevastopol and, with it, Crimea.

Ukraine's port is nearby Balaklava, reached by a road that skirts the ground where the Light Brigade made its famous charge in the Crimean War in 1854. But Ukraine has only patrol boats in Balaklava and shares this rock-girt tongue of water with the Russians. Four Russian subs were in the port.



Ukraine commands only two of the fleet's large ships and has signed up only 6,000 of its 70,000 personnel. Undoubtedly there's more Ukrainian sentiment; people ashore sometimes see the blue-and-yellow Ukrainian flag hoisted on a ship—only to be hauled down. Russia seems to be winning this little war.

“I WANT TO KNOW what it's like to be a free man,” Vasyl Speiko said. In a meadow in western Ukraine he was pitchforking fodder to his father atop a rick. At age 35 he had left the Bukovyna Collective Farm to take his own piece of land. Tractorless and truckless, he asked for 12 acres—all he could handle with a horse and

wagon. “I know the risks,” he said. “But it's probably in my genes to be a private farmer.”

How much land did your family own before collectivization? I asked. The answer came like a shot from Vasyl's father: “Thirty-five acres of cropland and 26 acres of woods.” Farmers were corralled for the collective in 1948. My guess is, the father has thought about his lost patrimony every day since.

It was sunset, and Vasyl was anxious to finish. “Tomorrow is Annunciation Day, a holy day. So I can't work—it would be a sin.”

To try to make a living off only 12 acres is, surely, problematic. But western Ukrainians have proved to be determined folk: survivors. In them the springs of freedom run stronger



A crowd of resolute Russian Orthodox parishioners near Kiev queue up to collect holy water from a spring about to be blessed by the metropolitan of their church. The Orthodox faith was imposed upon Ukraine's Catholics by



a Soviet regime at once atheist and Russian chauvinist. Now Catholicism is resurgent in western Ukraine, while the east, with its 11 million ethnic Russians, remains mainly Orthodox or not affiliated with any sect.

Toughening up for a hard peace, bodybuilders at Hydropark in Kiev pump iron on a makeshift gym made of old tank parts and other army discards. After 70 years of Soviet strongman rule, Ukrainians will need more than muscles to see them through the moral and political tests of building a new nation.

than in Kiev or the east. And they are the most religious of Ukraine's peoples.

Among the Soviet abuses after World War II was the forcible merger of the Ukrainian Catholic Church, passionately nationalistic, with the Russian Orthodox Church. Though hundreds of priests were shot and others sent to the gulag, this Eastern Rite church (also called Greek Catholic) survived underground.

Seven years ago when I first visited Lviv, the most Ukrainian of Ukrainian cities, its ro-coco cathedral, St. George's, was Russian Orthodox. Today it is again Ukrainian Catholic.

"Serving here is like being beside a person who has awakened from a nightmarish sleep," said the Reverend Kenneth Nowakowski, a Ukrainian Canadian assisting at St. George's. "When I came in 1991, people were lined up outside every day. I thought they wanted me to do something for them, but they only wanted to talk. About how they had suffered—just to be heard for the first time."

Most of the 2,000 Catholic parishes have been surrendered by the Russian church. Hundreds of Orthodox priests have come over; some were crypto-Catholics all along.

The Russian church, tainted by association with Soviet power, has nearly vanished from most of western Ukraine.

TADANI is an hour's drive northeast of Lviv. In a simple house on a dusty street, Ivan Mychajlyshyn recalled that in the guerrilla war of the 1940s "the front was right here. The Muscovites [Soviet forces] came during the day, and our boys [the partisans] were here at night." On a wall hung a photo of a pretty young woman, Ivan's cousin Stefa, a partisan courier who was captured by the Soviets and, raped and beaten, died in jail. In Tadani's cemetery I saw a tombstone remembering four persons in one family who died in 1946—Soviet sympathizers murdered by partisans. "One family in every two or three lost someone," Ivan said.

"We can talk about these things now,"



added his niece Olha. "We don't have to be afraid any more."

Life in Tadani revolves around cows. Take them to pasture in the morning; bring them back in the afternoon. Water comes from wells. Trenches were dug for a water system, but then the collective farm ran out of money.

"Nobody wants to stay there," said Ivan's son, Ihor, who grew up in Tadani but fled to Lviv. "The people who know how to farm are the old ones. People like me might go back, but we don't know how to work the land. Anyway, there's hardly any equipment."

Many Ukrainian villages are like Tadani: declining, poorly equipped to take advantage of freedom's possibilities.



FRESH PAINT ON WOOD TRIM, crumbling masonry patched, flowerbeds weeded — Vyzhnytsya had never looked so good, I'm sure.

It's in the foothills of the Carpathian range, near the Romanian border. People paint their houses blue because that's tradition, and they build small roadside shrines because a stranger might like to stop and pray.

I went to Vyzhnytsya for a festival of the Hutsuls—Ukrainian hill folk. In their mountain fastness the Hutsuls hear music in tumbling streams and in the wind—or see it in the eyes of a pretty girl.

To a stage in the sports field they came, one group after another, dressed in bright

embroidery that would have stretched for miles, to strum balalaikas and banduras, to squeeze accordions, to dance and sing. "This is my life, I love it," said Mykhailo Klym, a block of a man. To his lips he put a flute-like *sopilka*, and out flowed a music-picture of sunlight in a forest clearing.

It occurred to me as I sat on the grass listening that freedom has made Ukrainians feel good about themselves. Confirmation soon arrived in the form of a rock band (Hutsul music sounds fine on an electric guitar). Name of group: the Proud Hutsuls.

Pride. Maybe it will help the Ukrainians through the long struggle of nation building that lies ahead. □

EASTER ISLAND



UNVEILED

BY RICHARD CONNIFF

PHOTOGRAPHS BY BOB SACHA

Stony sentinels, carved centuries ago by Polynesian craftsmen, gaze over one of the most isolated places in the world. With their land depleted by overuse, islanders now draw on a renaissance of their culture to attract visitors and income.



SHOULD YOU FIND YOURSELF someday seated with your legs over the edge of a cliff on the coast of Easter Island, you may notice, after a time, that the horizon bends not merely out ahead of you, as it does off any coast, but all around, encircling you. The clouds arch forward from the other side of the planet, and the ocean is almost pregnant in its curvature. You begin to get a sense of where you are: on a rock in the center of a vast circle of sea.

The nearest major population center in Polynesia, Tahiti, is roughly 2,600 miles west across the Pacific. In the opposite direction, it is about 2,300 miles to Chile, of which Easter Island has been a part since its annexation in the 19th century. Hence this grassy triangle of volcanic outcrop has been called the most remote inhabited island in the world.

What I felt, sitting on that cliff one evening, wasn't merely isolation. I had spent the day wandering on horseback with Felipe Teao, a 73-year-old fisherman whose zeal for island lore was largely untainted by its potential for attracting tourists. We had traveled past petroglyphs, earth ovens, human bone fragments, and obsidian flakes. We had passed the huge stone statues, called *moai*, for which Easter Island is famous. They lay everywhere along the coast, toppled onto their foreheads from the *ahu*, or ceremonial platforms, where they once stood shoulder to shoulder, backs to the sea, lording over each clan's narrow territory with jutting jaws and coral eyes. Teao had also pointed out a few boat-shaped *ahu* with their landlocked prows rising toward the sea, as if hungry for the world or for escape from the universe defined by the *moai*.

I had an eerie sense of having dropped in on the remnants of an improbable biological experiment, on roughly these lines: Take 50 or so people, move them thousands of miles from home to a small island with no terrestrial mammals and only about 30 native plant species, make water scarce and agriculture marginal, minimize the chances for escape or outside influence, and check back after, say, a millennium to see what results.

To glance at the treeless hills of the island now, you might not expect much. Yet local legend records that at a crescent beach called Anakena (map, pages 60-61), two large voyaging canoes provisioned with crops and poultry arrived under the command of a chief named Hotu Matu'a, whose descendants still inhabit the island and regard him with disarming familiarity. (Teao could point out, among other things, the rock Hotu Matu'a used as a toilet.) Researchers generally date the coming of settlers at about A.D. 400. In time this meager band of colonists would grow to perhaps 7,000 people. They would parcel up the island into small territories and ultimately turn on one another in the drawn-out paroxysms of societal and environmental collapse. Throughout, the islanders put their mark on every surface of the landscape, while the landscape in turn shaped their souls.

Having spent his life exploring Easter Island and eking out a living from it, Teao was one of the few islanders left to know it with that old intimacy. As we scrambled under rock overhangs to



Grass skirts catch the wind as islanders, who call themselves Rapa Nui, welcome a tour group. The greeting is an innovation that stems from a heritage borne by Polynesian ancestors who sailed voyaging canoes across the Pacific.

Connecticut-based journalist RICHARD CONNIFF, whose most recent article for NATIONAL GEOGRAPHIC was "Blackwater Country" (April 1992), frequently writes on subjects of cultural complexity. BOB SACHA last covered the "Search for Columbus" (January 1992).



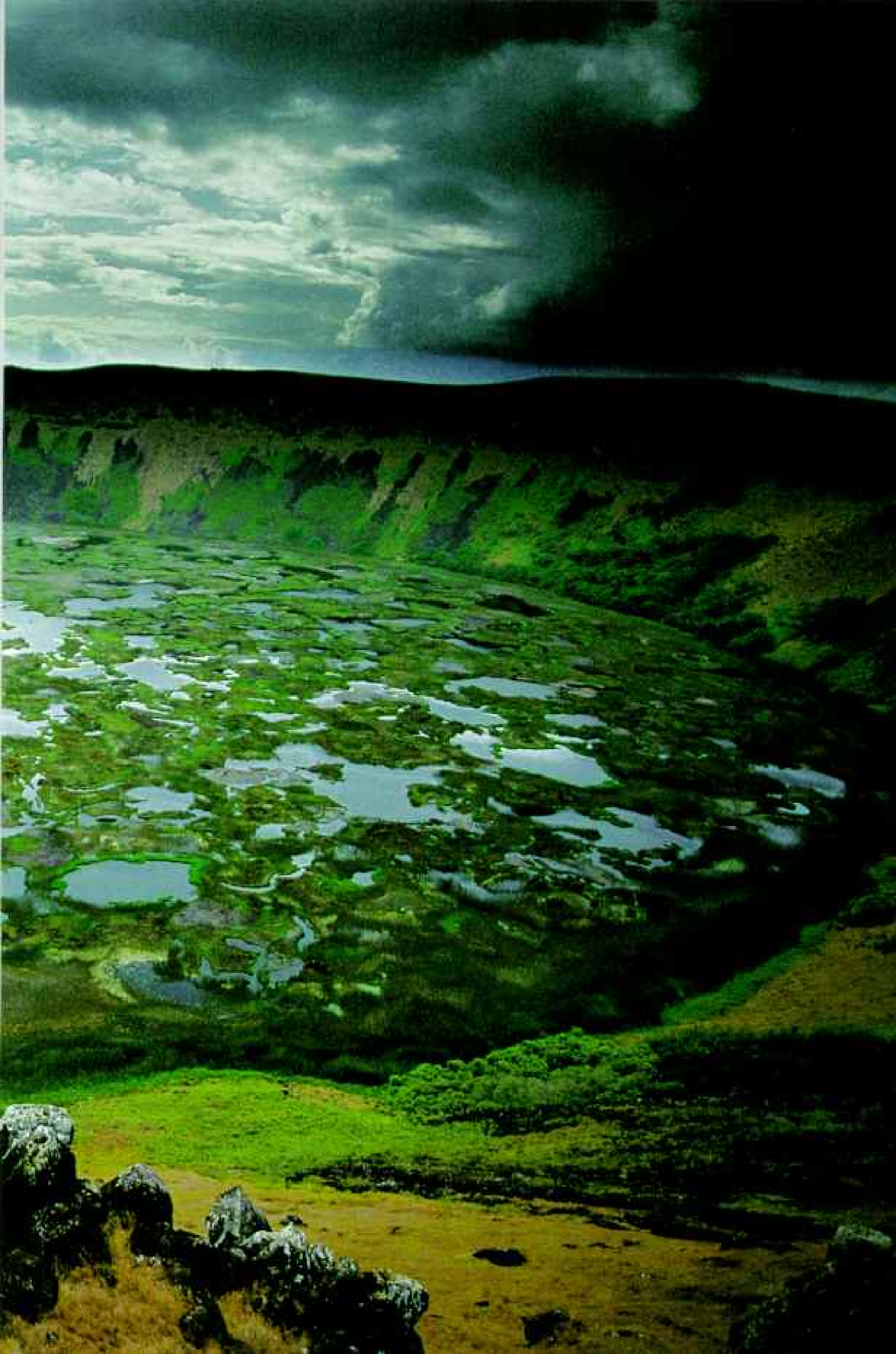
inspect petroglyphs, he recounted fragments of its bloody history. "Warriors used to be able to name any place where they killed a rival," he said at one point. Then he told a story about an inept warrior who killed only one enemy but cleverly butchered the corpse in four different places, naming each place after a body part. The names made Teao laugh with macabre admiration, shrewd exploitation of limited resources being an essential trait on the island.

"I was diving at La Perouse after a storm," he remarked another time, "when I saw a skeleton come washing out with the tides, so I knew there had to be a cave there. . . ." What I felt listening to Teao wasn't so much the isolation of Easter Island but the richness of local knowledge and culture that isolation had produced.

Few archaeological sites in the world are as impressive as Easter Island, and none have evoked as much speculation or as much nonsense. The speculation has often turned on the premise that the Polynesians who still inhabit the island, people like Felipe Teao, could never have produced the solemn and imperturbable moai. Nor, to this way of thinking, could a "primitive" people transport



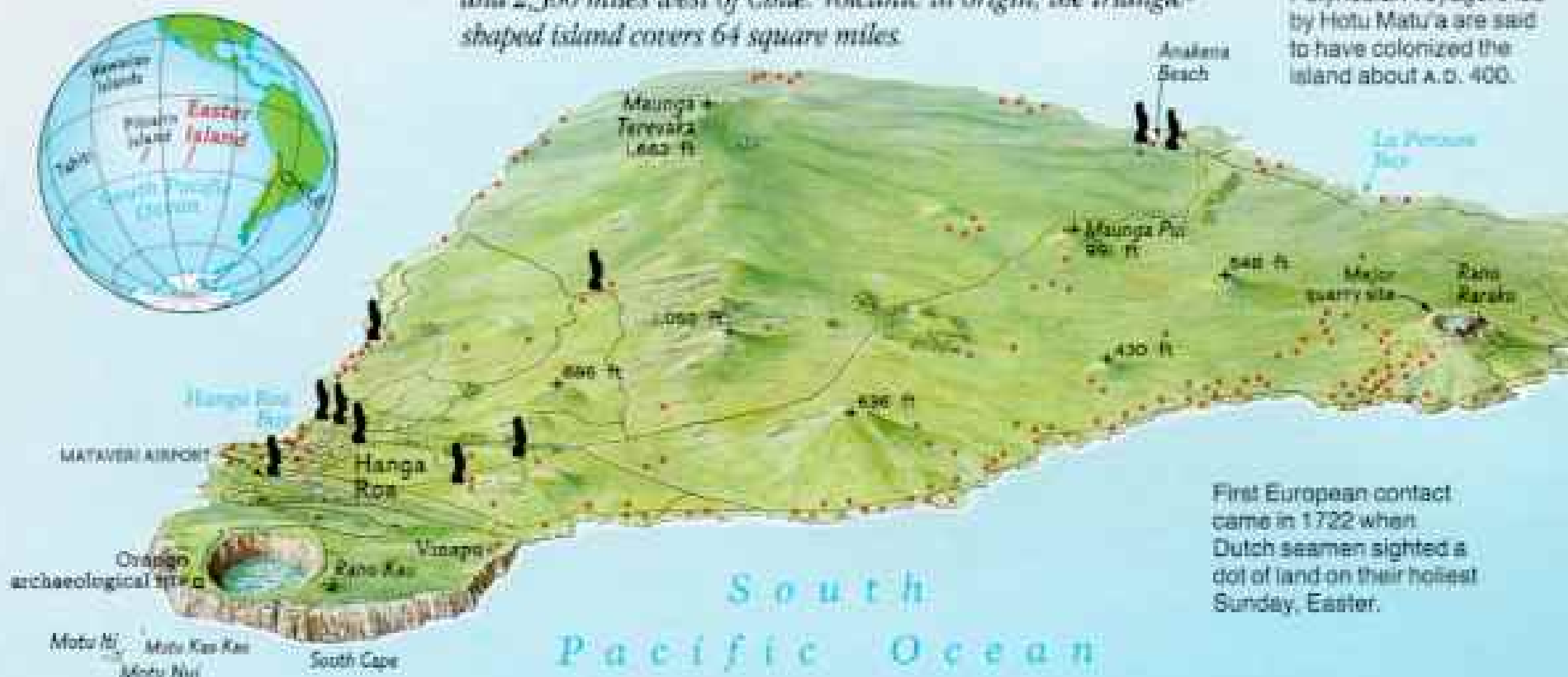
*A mosaic of reeds and grasses
in the caldera of Rano Kau
mottles a lake that was once
a main water supply. Now it
supports avocados, oranges,
and bananas. Says Javier
Labra, an island official,
"The water is muddy but still
drinkable."*



EASTER ISLAND

Remote Easter Island sits 1,400 miles east of Pitcairn Island and 2,300 miles west of Chile. Volcanic in origin, the triangle-shaped island covers 64 square miles.

Polynesian voyagers led by Hotu Matu'a are said to have colonized the island about A.D. 400.



a 15-ton stone statue—much less hundreds of them—across the rock-stubbed landscape from the inland quarry at Rano Raraku to ahu along the coast.

One best-seller deemed it more plausible to attribute the giant statues to extraterrestrials equipped with antigravity machines (who inexplicably carved with stone picks). Somewhat more persuasively, author Thor Heyerdahl has argued in a series of books that the skilled stone carvers came from South America. In his view, Polynesians supplanted them little more than a century before Europeans discovered the island on Easter Sunday in 1722.

Heyerdahl's expedition in 1955-56 remains the watershed for world perceptions of Easter Island in this century. His team of researchers launched modern archaeology on Easter Island, and Heyerdahl, still acclaimed for having sailed the balsa raft *Kon-Tiki* from South America to Polynesia, won eager and enduring acceptance among the general public for his idea of the islanders' South American origin. But archaeologists have since accumulated ample evidence indicating that the founders of Easter Island's civilization were indeed Polynesians, and that their culture, including the great stone statues, was rooted solidly in Pacific island traditions.

Teao and I stopped for the night at a cave overlooking the northwest coast. The clouds above the rounded horizon of the mid-Pacific were puffy and placental, suffused with red by the setting sun. Teao set out breaded hooks from the rocks and came in with a mess of *nannue*, fish with succulent white flesh. We talked about old families and ancient beliefs. It seemed to me that local knowledge, ingenuity, and a Polynesian





Taking the measure of a moai, icon of chiefs and gods, UCLA archaeologist Jo Anne Van Tilburg proceeds with her investigations—more than ten years of documenting most of the island's one thousand statues. Using statistical analysis and computer imaging, she and colleagues from the University of Chile hope to answer questions that have perplexed many: Who carved the statues and why, and how were they transported?

Easter Island Unveiled

knack for colonizing even the most inhospitable oceanic rock were the reasons the descendants of Hotu Matu'a survive today. I spread out my sleeping bag on the cliff and went to sleep to the sound of waves rolling in from nowhere.

TWO OR THREE TIMES A WEEK NOW, a commercial 767 touches down from the mainland, the squeal of rubber on concrete reiterating the end of the island's ancient sequestration. For much of this century Easter Island's calendar was divided loosely in half, six months spent preparing for the arrival of the annual supply ship and six months spent recounting the foibles of its passengers. For the islanders, regular air service represents liberation from old constraints.

For visitors, on the other hand, especially for those who cling to the illusion of an island floating outside the currents of time, it can be unsettling to peer from the window of the plane and spot a row of glistening monuments, like moai, only to recognize them on closer inspection as fuel storage tanks.

Modernization has brought 640 hotel and guesthouse beds, 530 motor vehicles, the telephone, and the fax machine to Easter Island. Almost all the island's 2,800 residents now live in the small town of Hanga Roa on the southwest coast, colonial authorities having moved the islanders there from their traditional territories in the 19th century. At night the phosphorescent blue of television sets, attended with something like devotion, illuminates the windows of the modest, one-story houses. Amber streetlights break up the mid-ocean gloaming. After the television station signs off at midnight, the discotheques come to life, and tourists mingle with islanders drinking pisco and Coke under the gaze of Day-Glo moai. The air reverberates almost till dawn with "Bette Davis Eyes" and a disco version of "Nothing Compares 2U."

The transformation of Easter Island dates from 1965, when a young schoolteacher wrote an open letter of protest to the Chilean government about conditions on the island. At that point, sheep far outnumbered people and had more freedom of movement; they grazed over almost 90 percent of the island. The islanders, known as Rapa Nui (a name of 19th-century origin meaning people of "Great Rapa"), were officially confined to Hanga Roa.

Islanders were rarely permitted to travel then, in part because of the parish priest's concern about the corrupting influence of the outside world. Their suppressed appetite for this influence was such that one islander born during World War II was nicknamed for the Führer ("Hola, Hitler," an acquaintance calls, and tourists' heads spin), while another was called London for the BBC shortwave opener, "This is London." The lure of freedom caused islanders in open fishing boats to sail away from the island nine times during the postwar years, most of them in the 1950s, when the Chilean Navy ruled with the help of occasional public floggings. Unaided by navigational equipment, three boats, including one piloted by Felipe Teao, ended up elsewhere in Polynesia, and a fourth on the Chilean coast; five disappeared.

The schoolteacher's protest led to the end of military rule and won Easter Island the civil status of any other community in Chile—along with the attendant bureaucracy imported from the mainland, apparently in part to guarantee a solidly Chilean

In antiquity's workshop, some 400 moai in various stages of completion rest on Rano Raraku's slopes, where American guide Peter Alden (below) adjusts his whimsical hat.

Rapa Nui carvers chipped at soft volcanic tuff with heavy stone picks to shape the moai, ancestor figures with powers to mediate between the people



and the gods. Workers used sledges, wooden rollers, and bark ropes to haul finished statues along special roads. They then erected them on ahu, or stone platforms.

For centuries some of the ahu were used as burial chambers. Niko Haoa (left) peers for remains beneath an ahu whose statue has tumbled.



presence. The start of regular air service in 1967 created a tourist industry, and the old cashless society of families sharing the work of farming and fishing began to break apart, replaced by the colder logic of commerce.

"Things are getting better, but people have gotten worse," said Jorge Edmunds, one evening over tea at the Hotel Victoria, which he owns. At 72 Edmunds was balding and urbane, in silver-rimmed glasses. "The old family union is gone," he said. In the old system, large extended families lived close together in compounds, cooperating to the extent that a woman with many children might give her newborn to a less fortunate sister. "Now each one is for his own convenience. Except for a few families that have stayed together: the Pakaratis, the Edmundses." Someone else at the table raised an eyebrow, the Edmunds family being among the most modern in its business interests. "A little," he admitted. "No mucho."

Another businessman then began eagerly chronicling improvements since the 1960s, when few houses had running water, much less telephones. But his tone also shifted subtly to ruefulness. "People were in the streets. Washing. Singing. It was a feast."

Few modern islanders would go back to that time, but they talk about it still with a sense of loss, and, like people recollecting a distant childhood, the conversation often turns on the powerful memory of food. Sheep were available for the taking in the 1950s, and chickens were as common as pigeons in a city park. Parties at which the meat was heaped in pyramids loom large in memory. "People used to go with carts to get food!" said Kiko Pate, the church choir-master. "You can't imagine how beautiful it was."

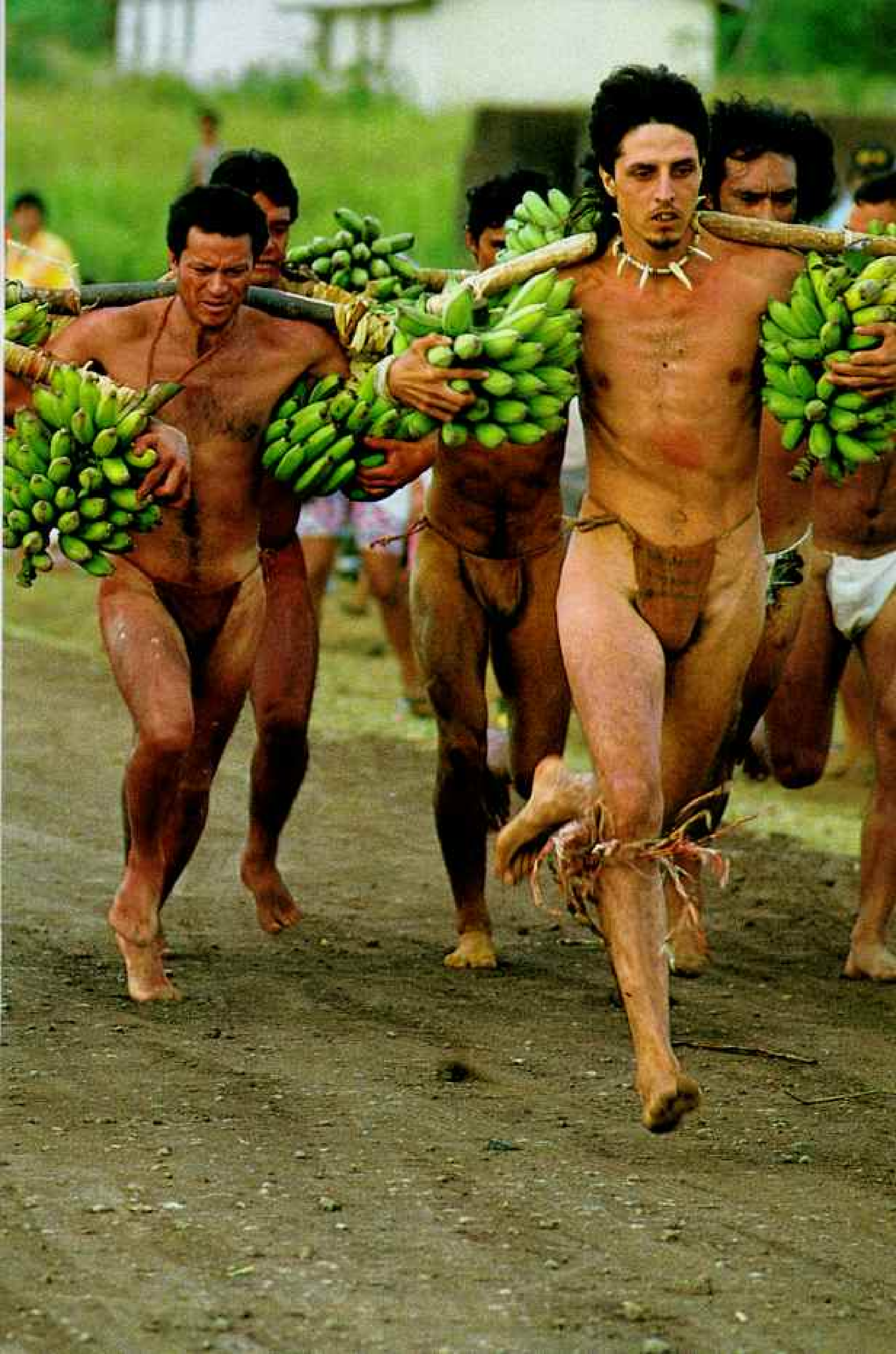
The sheep are gone now, fishing has fallen off, and agriculture is out of fashion (as well as being more difficult due to introduced pests). Baked bread is replacing the sweet potato as a staple food, and even chickens, which the Polynesians brought from Southeast Asia halfway around the world, arrive frozen from the mainland. "Now," Pate said, "everything is money, money."

The sense of diminishing food is a handy symbol for the less tangible sense that spiritual sustenance is also diminishing as the Rapa Nui culture becomes watered down. Government workers and their families from the mainland, who account for nearly a quarter of the population, often serve as scapegoats for this change. "If you have a major, you have to have a captain," one islander said. "If you have a captain, you have to have a lieutenant." Thus with no serious crime, 30 uniformed officers and six investigators from the mainland poke around the island, and the solitary Rapa Nui among them is regarded by some as an informer. ("Just like his great-great-grandfather," Felipe Teao remarked, recounting a nasty piece of treachery committed by the policeman's family more than a century ago.)

But a certain outside influence was a cultural necessity for Easter Island. Rapa Nui incest laws are strict, and with everybody tracing their ancestry back to the same 30 or so couples who survived 19th-century Peruvian slave raiding and epidemics, legal romance had arrived at an impasse. A woman in her mid-40s told me that she grew up with only two eligible marriage partners on the island, both walleyed. For 15 years she has been seeing a man with whom she has a common ancestor in the past century, she said, and her



Deadly clan rivalries of past times have become friendly competition as runners race with heavy loads during Tapati Rapa Nui — Rapa Nui Week. Successful teams win points for girls vying to be crowned festival queen.





Painted from topknot to toe in the red pigment held sacred by her Rapa Nui ancestors, 13-year-old Kovira Avila Pakarati participates in a reenactment of the landing of Hotu Matu'a. A thousand and more years before Columbus, the Rapa Nui believe, the chieftain loaded canoes with artisans and crops and set out from "a great island to the west." After weeks at sea his party came ashore to settle Easter Island.

Kovira and other celebrants paddle along the coast in decorated boats to Hanga Roa, the island's only town. On landing, they chant, they dance, and they sing the songs of their forebears in the shadow of the moai.

elders still hiss their phrase for incest: "Eating your own blood!"

Understandably many islanders seek mates outside the community, often resting their hopes on the "Easter Island passport," a catch phrase for their own exotic appeal in the eyes of wealthy tourists. In 1991 one such islander became the first HIV-positive Rapa Nui.

Mixed marriages abound. The children grow up in an atmosphere of freedom and safety. They surf on the big rollers of Hanga Roa Bay or draw circles in the dusty red streets for pitching marbles. Some of them work beside their elders in traditional pastimes. But like their parents they look increasingly to the outside world.

Many of today's parents were among the first Rapa Nui educated on the Chilean mainland in the 1970s, and having been ridiculed for their ignorance of Spanish, they are busily sparing their children the same fate. As a result, only one schoolchild in four now speaks Rapanui as a first language, down from three in four just 15 years ago. The grade school, which used to punish children for speaking their language, has responded by incorporating the island culture for the first time into its curriculum, with the help of a new textbook series in the Rapanui language. Some elders balk at the notion of culture as homework on an island where the culture once seeped from the very stones. Many modern parents, on the other hand, regard the local school as inferior. If they can afford it, they ship their children off to schools on the mainland, where they may have a better chance of succeeding in the modern world.

THE FIRST TIME I VISITED THE PAKARATIS, one of the few families where children still grow up in the oral tradition, I met Amelia Tepano Ika, the materfamilias. A lively, toothless old woman with gray hair pulled back in an orange bow, she came out into the yard bent over her bamboo cane. Sitting in the shade of a *miro tahiti* tree, Amelia demonstrated *kai kai*, the traditional cat's cradle game of patterns formed with a loop of string around the fingers, accompanied by song. A great-granddaughter, just in from school, dropped a pink plastic Mickey Mouse lunch box on the grass and, taking out a loop of string to shape on her own fingers, stood behind and mouthed the words of the songs (pages 70-71).

Amelia picked out strands with her lips to bring order to the pattern and said that, over time, she had passed on 300 or 400 of these games to the young girls in her family. The string no longer moved smoothly on her stiffened fingers. Leaning against her, the great-granddaughter, whom Amelia had taught, began to reteach her, reaching in to adjust the strings or filling in the words when the old woman stumbled. Both of them formed a web of triangles, symbolic of their sex, and chanted about how the most beautiful woman on the island used to be chosen during an annual feast at the ceremonial site called Orongo. For a moment the culture lived in two voices together, one growing stronger, the other more frail.

I went out one day with Eva Pakarati, of whom an acquaintance had said, "She lives on another island, the old island." That island persists in *el campo*, the countryside, to which the islanders retreat when they tire of living with cars and discotheques and among neighbors who know their histories back to Hotu Matu'a. Eva, who was 61, went there daily, to gather seashells to string into





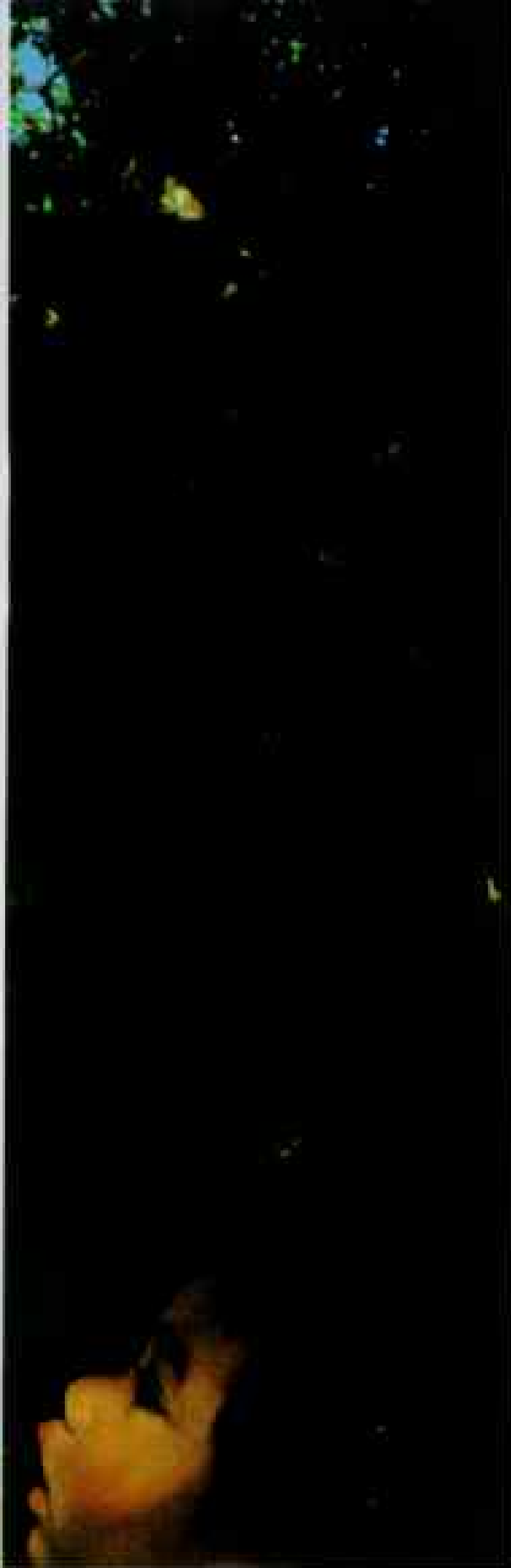
Vital forces of ancient gods seem to possess a painted reveler at a dance following a memorial parade of boats. On his abdomen he wears the concentric circles of Makemake, creator god of the Rapa Nui.



necklaces for the tourist trade or to eat fish with her sisters. She crossed the wet rocks by the sea with her light cotton skirt gathered up and flip-flops on her feet, effortless and agile as a girl.

Eva recollected traveling the island as a child with her father, who stopped at each prominent rock and made her repeat legends word for word as if they were part of a catechism. The sense of place was ingrained in her in a way almost unfathomable to an American. We passed a *komari*, a vulva etched in the stone. Representations of male or female genitals are found everywhere on the island, carved with characteristic candor as talismans of a family's reproductive strength. Eva flicked the ash of her cigarette at it as she strode past. "Our relative," she said.

The old familial territories of *el campo* afford the islanders a sense of being profoundly at home, the offspring of this *komari* and of this piece of earth. For some the appeal of family caves remains especially strong; in 1987 an old man set off hoping to climb into his cave and die there in the belly of his homeland (his body was



Tales of the old are preserved for the young as Amelia Tepano Ika and her great-granddaughter practice kai kai, storytelling with string illustrations and chants. As most Rapa Nui children speak only Spanish, kai kai helps them learn the ancestral language as well as their traditions.

recovered in open country and given a Christian burial). Another islander I talked with could remember being rushed out to his family cave as a child when the cry, "*Ko te miro! A ship!*" was shouted from house to house across Hanga Roa. He was hidden just as children had been during two turbulent centuries of sporadic visits by slave and merchant ships. Even in the 1930s, he said, some people "thought they were going to be killed by every ship that arrived."

Along with the possibility of refuge, the sense of danger also persists in the countryside. *Aku aku*, good and evil spirits, are still thought to guard old family territories. Eva led me past their images carved into the flat rocky boundaries between clans. I saw nothing at first. Then the clouds shifted and the shadows changed, revealing sharks, skulls, octopus-like women, and other creatures. Eva told a story about a sister who found an ancient wood statue in the countryside one day and took it home. She died soon after, said Eva, having offended the spirits of the land.

AT SUNSET it was placid on the reed-fringed lake in the middle of the crater called Rano Raraku. Great stone statues stood on the slopes below the cliffs where they were carved, basking like sunbathers on the deck of a ship. Wandering along the cliffs, I could see across the low, western edge of the crater, to where a smoky haze drifted through the blue cinder cones at the other end of Easter Island.

The crater walls were inhabited by about 400 statues in various stages of completion, embedded in the stone where they were carved, face up, face down, canted over on one shoulder, so close together that visitors contemplating one moai often realize with a start that the grass they are standing on has grown up in the angular eye socket of another. As the evening light changed, nondescript rock walls suddenly revealed themselves before me as fully formed moai, the green lichen no longer obscuring the tubular noses, flared nostrils, and pursed lips. Walking alone here was like tiptoeing among sleeping giants.

Over the sound of the breeze on the cliff top, lifting and falling like human breath, a distant thudding reached me and grew louder. Spooked, I turned and saw two unsaddled horses gallop through a break in the opposite crater wall, trailing veils of dust. A hawk-like caracara soared watchfully over the rim of the crater and descended to perch on the brow of an upright moai. Then it was quiet again.

Here Thor Heyerdahl was inspired to write, "One thing is certain: This was not the work of a canoe-load of Polynesian wood carvers who set to work on the bare rock faces when they landed merely because they could find no trees to whittle." On the contrary, at Rano Raraku, Heyerdahl and his team found some of their most impressive evidence for his argument that the culture came from South America: A petroglyph carved on the torso of a half-buried moai depicting a three-masted ship, which Heyerdahl considered a South American type, and the reeds in the crater lake, which he said had been introduced by South Americans, who used them for building just such ships.

Heyerdahl depicted Easter Island's civilization collapsing in racial conflict in which statue-carving Long Ears from South America were annihilated by menial Short Ears from Polynesia. Or



Preaching against television and nightclubs, Father Luis Riedl delivers a sermon on the feast day of the Immaculate Conception. Missionaries from Chile introduced Christianity in the 1860s, and today most islanders are Roman Catholic.

as Heyerdahl put it, "with the arrival of the genuine Polynesians, all cultural life came to an abrupt end."

The public embraced the ideas of the swashbuckling "Señor Kon-Tiki." Archaeologists, on the other hand, detected cultural bias in Heyerdahl's disparagement of Polynesians, and they began to pick holes in his argument. The three-masted ship, they said, was less likely to be a South American reed boat than a European square-rigger, like several others carved around the island after 1722. Moreover, the reeds themselves failed the test for importation by South Americans; pollen analysis demonstrated that they had been growing in Easter Island's crater lakes for at least 30,000 years.

The most comprehensive reply to Heyerdahl's arguments was the Easter Island Archaeological Survey, a cooperative Chilean-American effort begun in 1968 and now nearly completed. Survey teams sketched, mapped, and measured 19,000 features on the island, among them 240 ahu, 886 moai, 2,536 earth ovens, and



Mixing European tradition with a novel touch, a Chilean groom removes his Rapa Nui bride's garter with his teeth. Since most islanders are related and local incest laws are very strict, many Rapa Nui seek mates from the mainland.

3,244 house foundations representing 15 centuries of occupation.

The results do not exclude the possibility of South American contact, but they make Polynesian origin far more likely. For example, Heyerdahl singled out one ahu, called Vinapu, and likened it to the stonework of Tiahuanaco, "the mightiest ruins in South America." But Tiahuanaco was the crowning achievement of an empire, while the ahu of Easter Island stood at the heart of local villages. Survey archaeologists found a far greater resemblance to the stone altars with raised slabs or posts common throughout Polynesia. Easter Island ahu differed from the general Polynesian pattern chiefly in that the human figures that stood on them were so large and sophisticated.

Heyerdahl's work also provoked a reconsideration of Polynesian voyaging. In 1976 a crew of Pacific islanders, organized by Ben Finney of the University of Hawaii, sailed a replica of a traditional double canoe from Hawaii to Tahiti and back. Apart from



demonstrating the practicality of such a trip, Finney was interested in the strength of the Polynesian voyaging spirit.

The Polynesians were adept explorers and colonizers, and experience earlier in the Pacific had taught them that the best way to escape war or famine was to sail east, to windward, in search of new islands. They were apparently willing (as was Felipe Teao in the 1950s) to set out despite strong odds that they would not reach land.

Finney has estimated their probable rate of failure. While routine among colonizing species in the animal world, it is appalling for humans: Assuming that ten canoeloads of explorers, traders, and would-be colonists from different islands disappeared every year, with 25 people in each, 500,000 people may have died over the 2,000 years of Polynesian voyaging. And once, 50 people got to Easter Island. The archaeological survey has found no evidence to suggest that anyone else reached the island between the arrival of these first colonists and discovery by Europeans or to support the



Forging up Matunga Pui's slope, Zorobabel Pati will plant banana shoots with his digging pole. Slash-and-burn farming probably led to devastation of native forests and to soil erosion. Despite new cultivation, much of the island is barren of crops.



notion of a clash between two cultures. Easter Island after A. D. 400 appeared to be a closed system with its own cultural evolution.

To get some hint of what the founders of this grand biological experiment faced, I went out one evening with Gerardo Velasco, a government agronomist with a passion for the botanical life of his adopted island. Velasco led the way over a cliff and down across huge pitted blocks of black volcanic rock; the sea crashed in below us and pitched a fine drifting mist overhead. At the foot of the cliff, he pointed out perfect cylindrical holes, some of them two or three feet in diameter, where the shape of ancient tree trunks had been preserved in the lava that flattened them.

"There's no doubt that these were palm trees, from the pattern of the bark there," Velasco said, "and then these tubes are so perfectly cylindrical."

Easter Island was, in fact, forested for most of its history, its present appearance to the contrary. Settlers gradually cleared the forest to plant the taros, yams, sweet potatoes, bananas, sugarcane, and paper mulberries they carried with them in their canoes. Wood, along with stone, also served as the artistic material in which the colonizers took their Polynesian heritage and slowly shaped it into the unique art of Easter Island.

Island carvers also quickly recognized the sculptural possibilities and relative permanence of the soft volcanic tuff from Rano Raraku, and the great epoch of carving moai and raising them on ahu began. Researchers explain this artistic flowering partly in terms of increasing mastery over the new environment: For a clan to produce a moai meant that it was able to maintain its carvers at Rano Raraku, to manufacture ropes from tree bark for lowering the statue from the cliff face, to cut down tree trunks for the sledges and rollers used in transporting the statue, and to feed scores of people as they hauled the statue home from Rano Raraku.

But Polynesians did not merely manipulate the environment; they sometimes destroyed it, and the island archaeological record is rich with species they caused to become extinct. On Easter Island, researchers believe that the growing population and rapid deforestation for agriculture and for the moai cult drove ancient rivalries to a high pitch, which in turn accelerated the rate of environmental destruction. Clans sometimes toppled their own aging statues to build bigger, better ones, their surfaces polished with coral. The new moai testified to the enduring strength of the clan. This monumental competition apparently continued until depletion of island resources made it insupportable, and the clans turned on one another in warfare and cannibalism. Legend records that the last palm was cut down during conflict in the 19th century.

AN AIR OF BLOODY HAVOC still hangs over the landscape from the period after 1500. While some of the moai have been resurrected by archaeologists, most still lie with their bases propped on the front edge of the ahu and their heads in the dirt. They peer at their neighbors from empty eye sockets, as if asking whether it is safe yet to get up again. In places they are littered like corpses after a battle: a broken head, thrown backward in the sand, with only the gaping nostrils exposed to the air or a figure buried in displaced rocks, with a green tendril feeling its way across the cheekbone.

Sunday catch, a prize yellow-tail, lights the smile of Ruben Figueroa—and tempts one of his cats. The shoemaker, who moved to Easter Island from Chile in 1975, fishes with his friends on weekends from the island's rocky cliffs. Islanders rely on fish such as tuna, yellowtail, and mabi mabi as a prime food source.

Nor does the island want for human remains. I crouched down one afternoon to peer under a low rock overhang, and as I balanced there, my eyes adjusting to the darkness, I realized I was staring at a human skull, rolled on its side, its front teeth missing. I moved aside some debris and found the jaw lying nearby in a litter of ribs and femurs. It had the rounded "rocking chair" jawline characteristic of Polynesians, a trait anthropologist George Gill at the University of Wyoming recently identified in 48 percent of the Easter Island skulls he studied.

Physical evidence of cannibalism also occurs, along with legends that generally have to do with hunger rather than ritual, as if rival clans constituted a sort of free-ranging delicatessen. The evening I



climbed Rano Raraku, I paused among the monumental statues on the outside slope and looked out to Motu Marotiri, a high black pedestal of rock rising out of the sea off the southeast coast. I was haunted by the notion that the same deforestation that caused Rapa Nui civilization to cave in on itself had probably also cut off escape: No large trees meant no canoes capable of long-distance voyaging. Legend recalls that islanders frightened of rival clans swam out and sought refuge crowded on the barren rock of Marotiri. Even there the warriors organized raids to kill them and carry their corpses back to the main island, to be eaten.

For me the most disconcerting and unexpected aspect of Easter Island was the penetrating sensation at that moment that this brilliant civilization could have collapsed into such desperation. What happened to the Rapa Nui suggested that uncontrolled

growth and the impulse to manipulate the environment past the breaking point were not merely aspects of the industrialized world; they were the human condition. Thus the biological experiment on Easter Island went fatally awry.

WHEN THEY TALK ABOUT their heritage today, the name the Easter Islanders themselves invoke with greatest esteem, after Hotu Matu'a, is William Mulloy, a little-known archaeologist at the University of Wyoming who first came to the island with Heyerdahl. After a brief flirtation with the South American hypothesis, Mulloy began the research that produced persuasive evidence of the culture's Polynesian roots. He launched the archaeological survey and oversaw careful restorations, rebuilding stone houses and resurrecting toppled moai. Mulloy's work offered the islanders, for the first time in centuries, a glimpse of what they had been at the height of their civilization. His work gave the islanders a Rapa Nui identity to cling to in the face of the final influx of the outside world. "By restoring the past of his beloved island," a memorial plaque declares, "he also changed its future."

About Heyerdahl, on the other hand, the islanders tend to be ambivalent. His book *Aku-Aku* turns on his discovery that the islanders had secret family caves in which ancient stone carvings were still hidden, some of them, in his view, hinting at South American antecedents. By the power of his personal *aku aku* and the prestige of science, Heyerdahl persuades the superstitious natives to open the caves to him and sell the contents.

As I talked with the islanders, though, it turned out that they had their own version of events. "Thor knew I was a very good carver, and he came to see me," said one of them, a businessman now, in gold-rimmed glasses and a blue button-down shirt. "He asked me to take out of my cave all the ancient objects that I had there. I told him that I didn't have anything, but he insisted that I did."

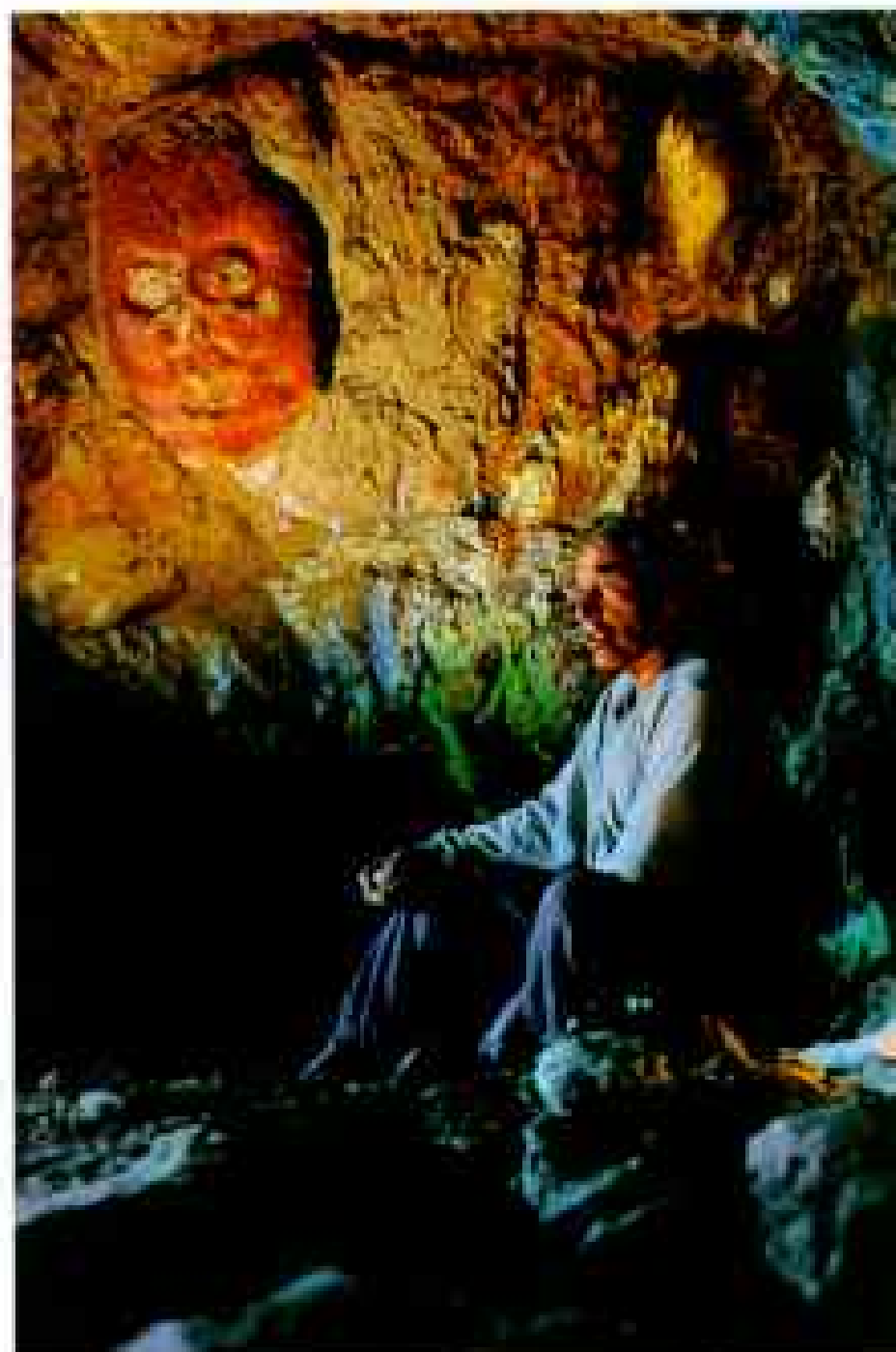
I went away thinking about something another islander had said on the question of gullibility: "Thor Heyerdahl didn't trick the people here; they took advantage of what he wanted." They carved objects "to fit what he wanted to believe about the island."

Heyerdahl argues that he could distinguish between the fake carvings and the authentic ones.

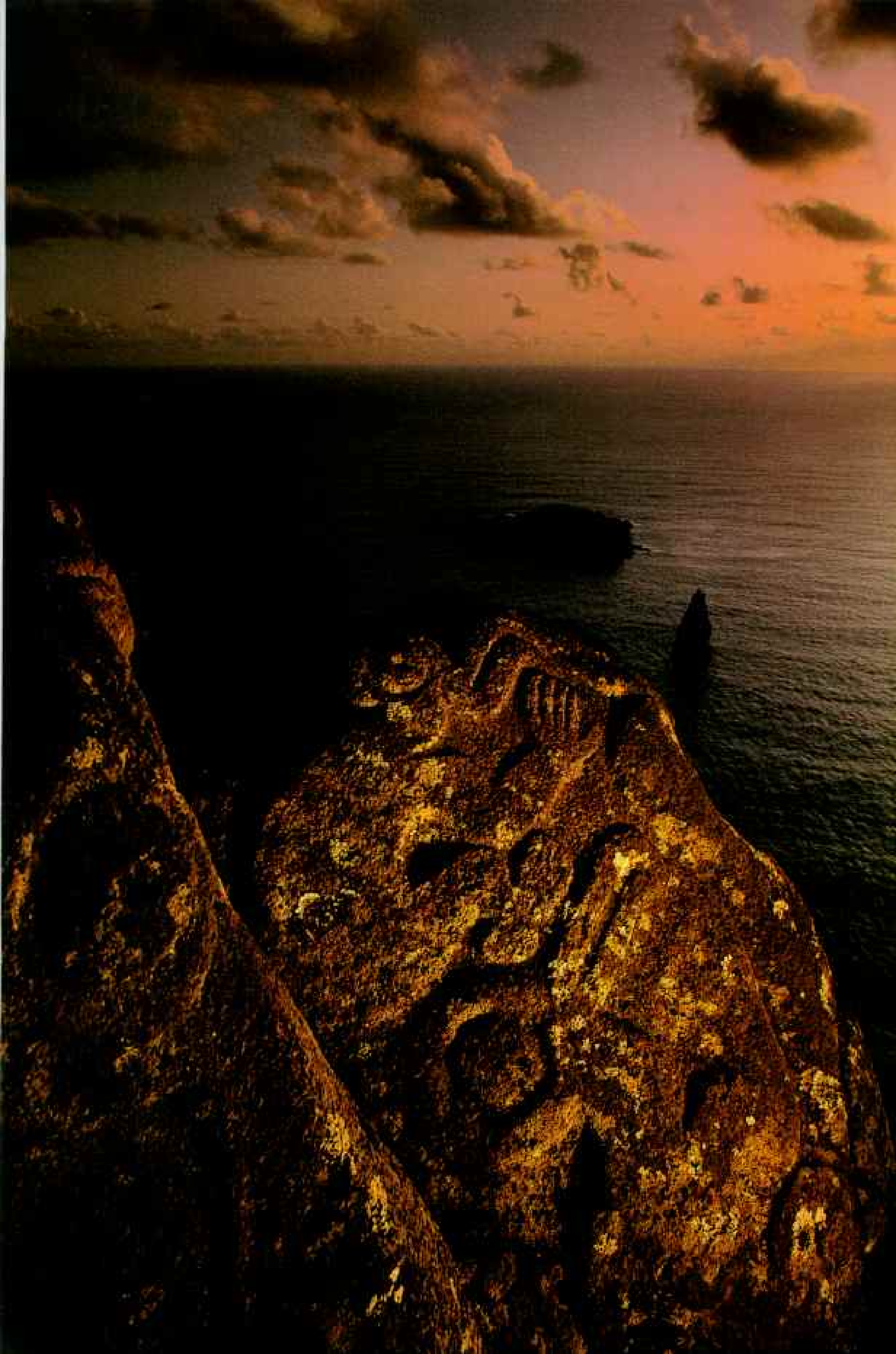
But the same islander reminded me that the Rapa Nui have a 1,500-year-old civilization. They have adapted and endured through settlement, warfare, famine, cannibalism, slave raids, smallpox, leprosy, military rule, and now tourism. Their lives are testimony that there is still strength in the confines of the island, and that they remain ingenious enough to exploit its limited resources, however circumstances may change. They know who they are and where they live.

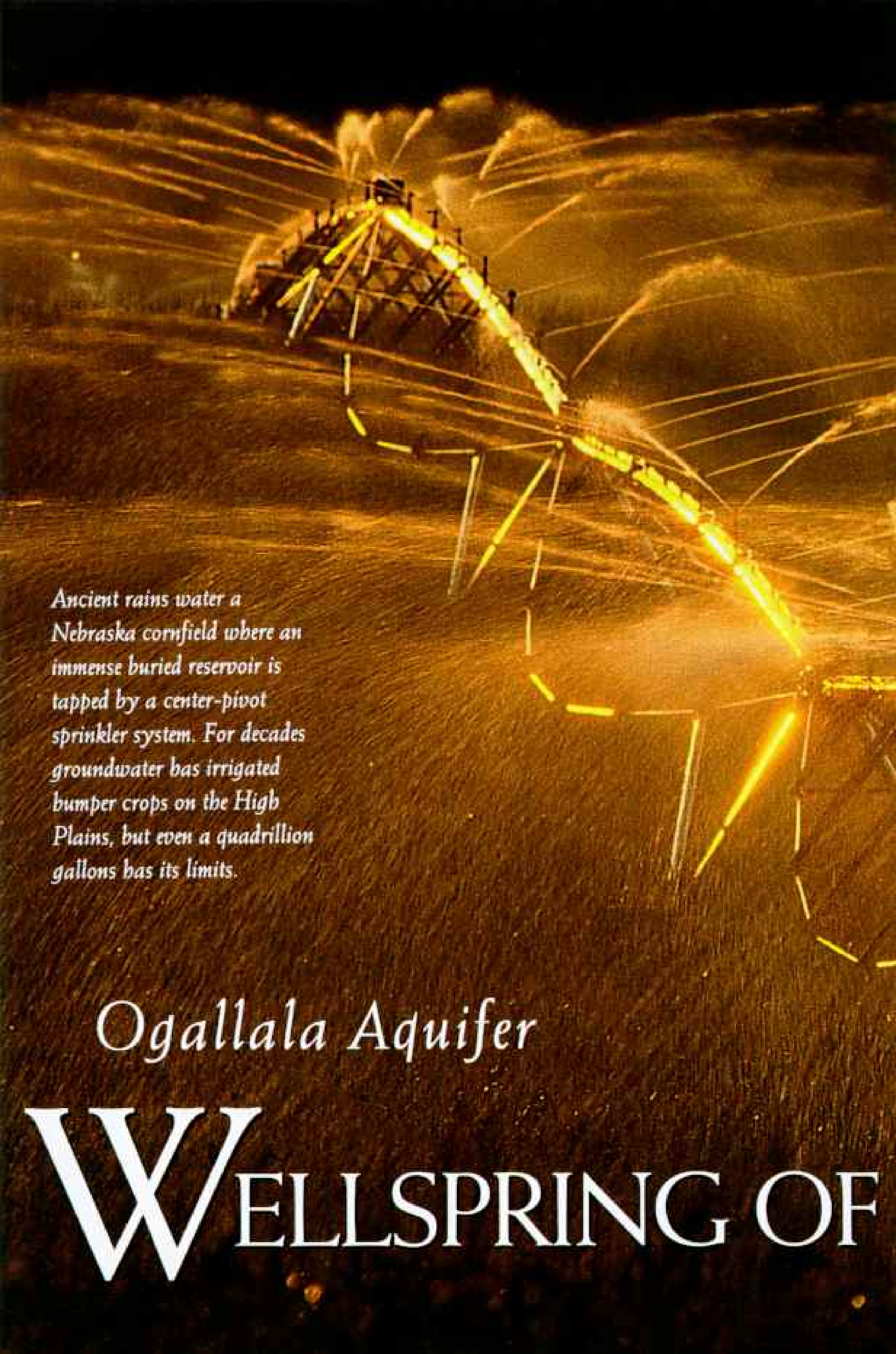
"We have our history," said one. "We have our culture. We speak the Polynesian language." He smiled benignly. "If you brought a South American Indian here, he would starve." □

Perched on Orongo's cliffs, a petroglyph (right) recalls the ancient birdman cult. Each year the island chief whose representative retrieved the



first egg of the sooty tern from nearby Motu Nui was named birdman. Contenders waited in caves like this, where a painted image glares above islander Felipe Teao. "My grandfather used to come here," he says. "I come back to honor him."





*Ancient rains water a
Nebraska cornfield where an
immense buried reservoir is
tapped by a center-pivot
sprinkler system. For decades
groundwater has irrigated
bumper crops on the High
Plains, but even a quadrillion
gallons has its limits.*

Ogallala Aquifer

WELLSPRING OF



THE HIGH PLAINS

By ERLA ZWINGLE
ASSISTANT EDITOR

Photographs by JIM RICHARDSON



"DEAR ERLA: I KNEW A MAN ONCE, WHO TOLD ME I HAD BETTER WATCH OUT FOR THE OGALLALA—THAT 'SHE' WOULD GET TO ME. I DIDN'T, AND 'SHE' DID, YOU SAW THAT." TEX REEVES AT TEXAS TECH MAY BE THE ONLY GEOLOGIST WHO

has actually fallen in love with a layer of rock—or at least written a letter confessing it. Even after decades of drilling, this taut, sunburned, laconic professor can verge on rhapsody. "It's not something inanimate," he tried to explain, almost unwillingly. "When you drill through the Ogallala, you can feel the vibrations change. When that rock comes out of the ground and it's got a little water in it, it smells so good. She's a beautiful lady. . . ." This Ogallala is clearly something out of the ordinary.

The ancient buried erosion of the Rocky Mountains comprises several aquifers (collectively called the High Plains aquifer) that stretch beneath 174,000 square miles from Texas to South Dakota. The Ogallala makes up about 80 percent of the High Plains aquifer, and the two names are commonly used interchangeably.

The Ogallala's sediments are soaked with the accumulation of countless rains and snows: a quadrillion gallons of water. This is enough to fill Lake Huron, but the Ogallala is not a lake, nor is it, as some once supposed, an underground river. This aquifer, North America's largest, is more like a titanic underground sponge, and by now it has in some way "gotten to" millions of people.

Within living memory this immense supply of water has transformed the very acres that blew away in the Dust Bowl of the thirties into an agricultural phenomenon. Because of Ogallala water, Nebraska can add 700 million more bushels of corn to its annual crop; Kansas can fatten three million more head of beef cattle; Texas can produce two million more bales of cotton. Wheat, grain sorghum, alfalfa, soybeans (not to mention drinking water for man and beast)—20 billion dollars each year in food and fiber, a vital portion of our annual foreign exchange—rest upon a seemingly inexhaustible reservoir of water.

But now the specter of drought—this time not from above but from below—has returned to haunt the plains. Parts of the aquifer are being depleted, primarily by farmers with powerful irrigation equipment, faster than rain can replenish it. Northwest Texas already boasts some 50,000 irrigation wells; outside Lubbock, a sign advertises a company with the ominous name "Sahara Irrigation."

If the aquifer were completely drained, it would take up to 6,000 years to refill. But quantity is not the only topic worrying the denizens of the morning coffee shop; there is quality. Groundwater in rural areas is generally untreated, and contamination, some of it decades old, is beginning to make its appearance. The old saying that the earth will cleanse any passing

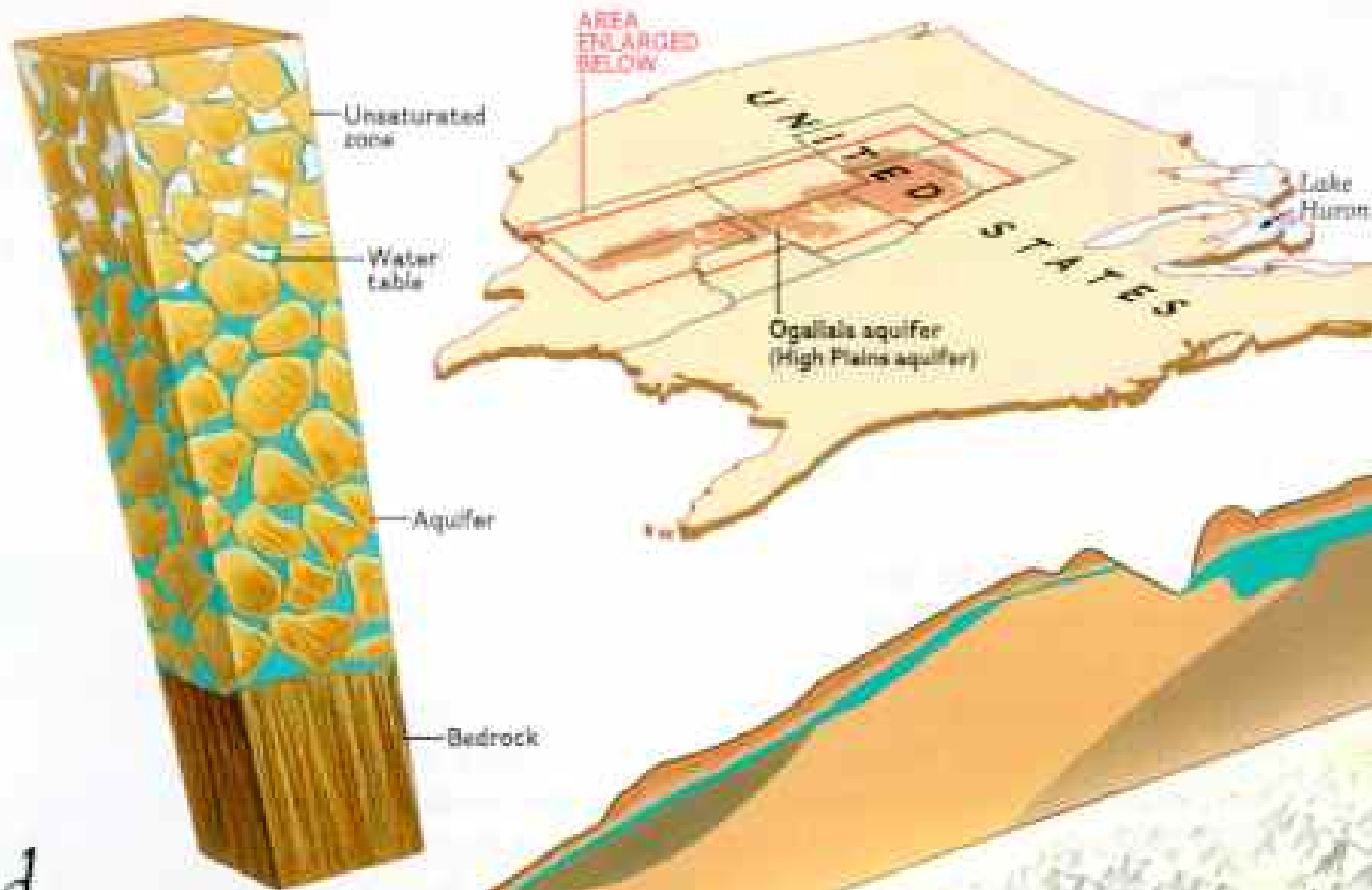
(Continued on page 88)



AQUIFER ZEALOT, geologist Tex Reeves studies a fragment of the Ogallala near Lubbock, Texas. Sediments in the sandy cliffs washed downstream from the Rocky Mountains between 17 and 3 million years ago, filling with rainwater and snow-melt. The aquifer's water bubbles to the surface on the Haythorn ranch in Nebraska's Sand Hills (facing page), where Lonnie Smith stacks hay with draft horses. They tread more lightly on the naturally wet meadowland than tractors do.

Aquifer close-up

Like a bucket full of wet gravel, an aquifer consists of a porous medium filled with water trapped by a bedrock bottom. Precipitation and surface streams recharge the supply. Most Ogallala water has been held within the formation for a few millennia.



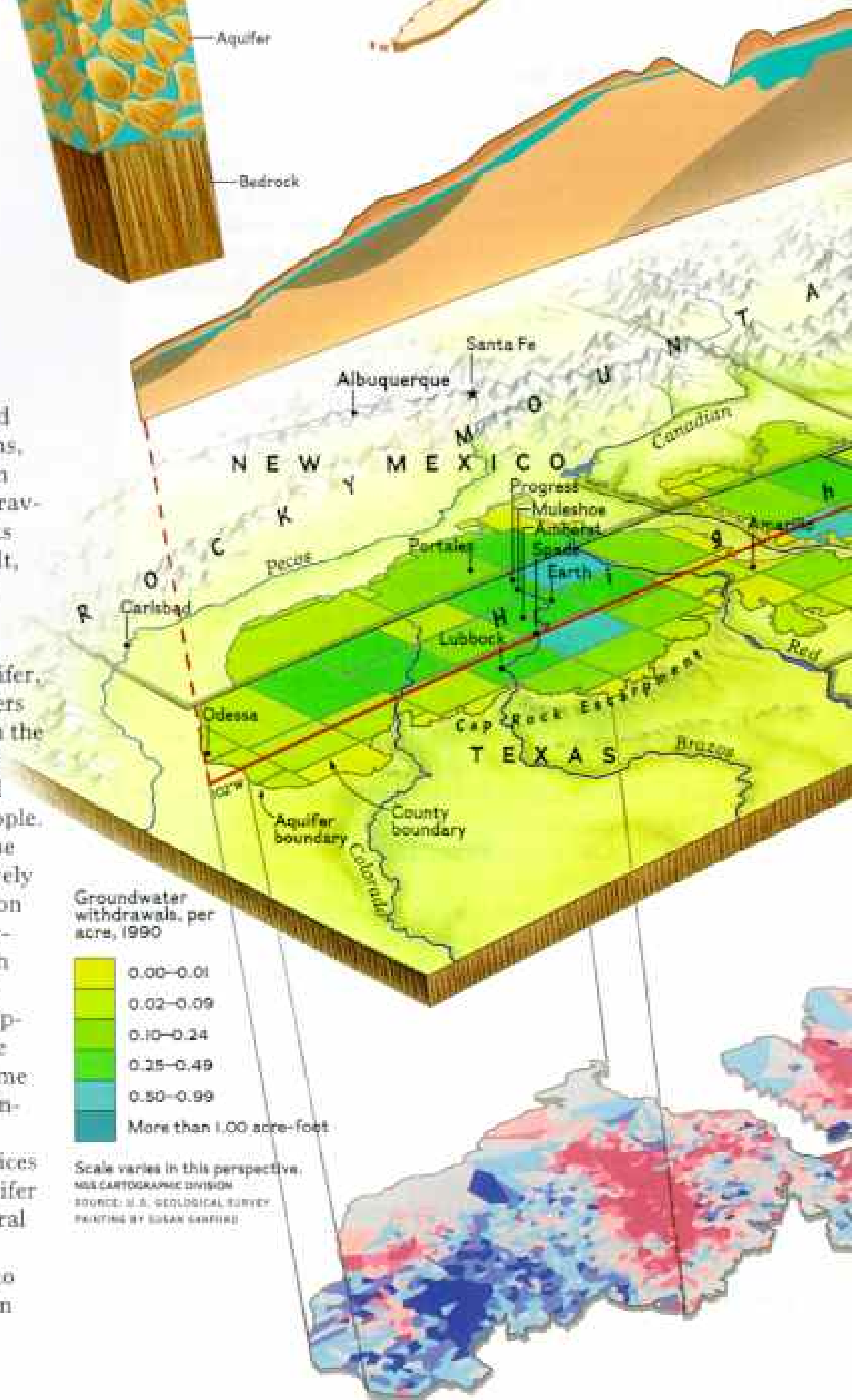
The great underground sponge

OVER EONS, rain eroded the Rocky Mountains, washing downstream millions of years' worth of gravel and sand. Those sediments soaked up rain and snowmelt, holding enough water to fill Lake Huron.

While the Ogallala is the region's most abundant aquifer, geologists have mapped others above and below it and term the total supply the High Plains aquifer. The names are used interchangeably by most people.

Not until the 1950s was the Ogallala aquifer first massively tapped by advanced irrigation technology, including center-pivot sprinkler systems, each designed to water about 130 acres. After 20 years of pumping, a resource that had once seemed infinite began, in some places, to look like a well running dry.

Better management practices are easing fears that the aquifer will be depleted within several generations. Still, in most regions pumping continues to remove more water than rain can replace each year.



Feet above sea level

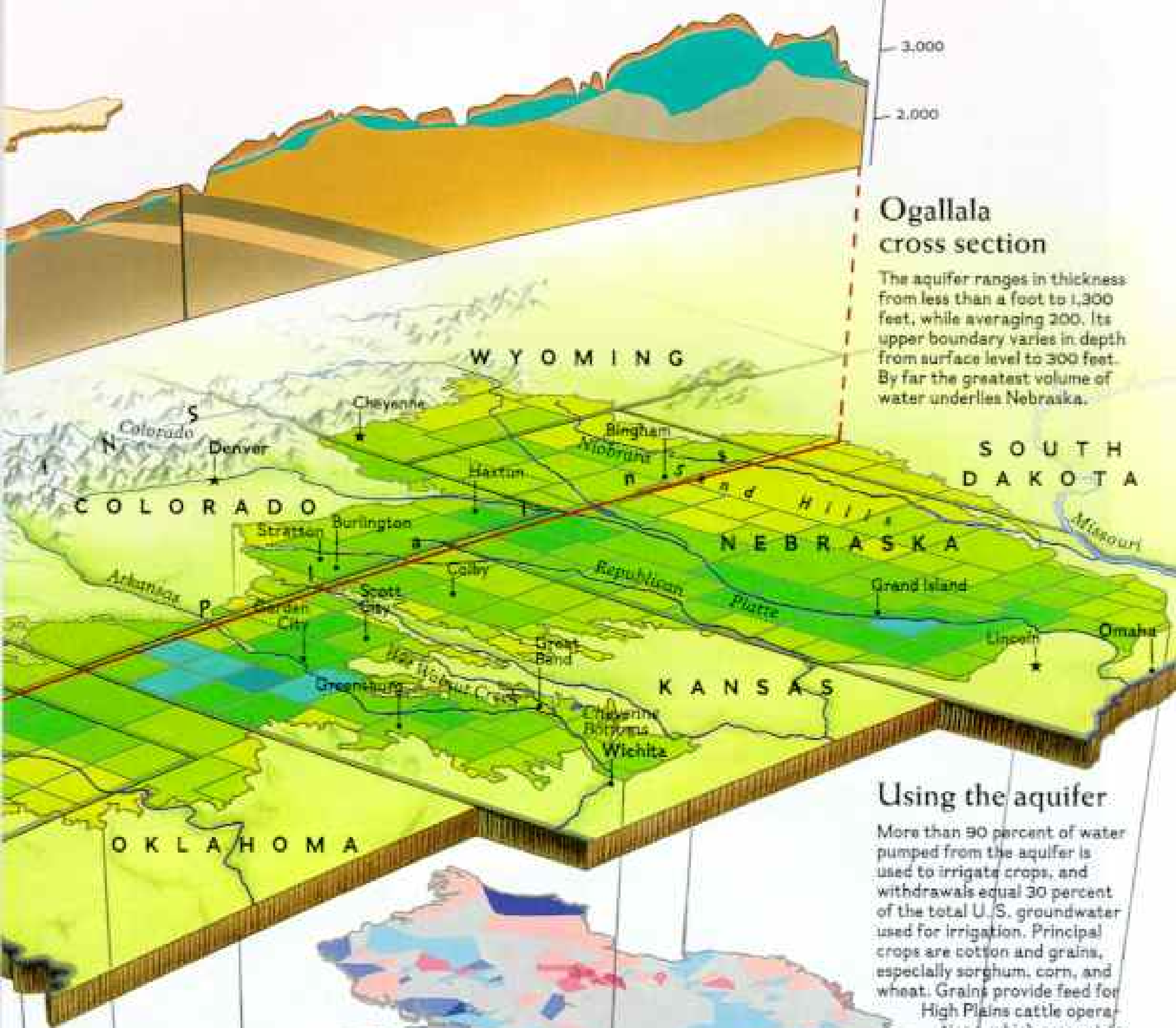
4,000

3,000

2,000

Ogallala cross section

The aquifer ranges in thickness from less than a foot to 1,300 feet, while averaging 200. Its upper boundary varies in depth from surface level to 300 feet. By far the greatest volume of water underlies Nebraska.

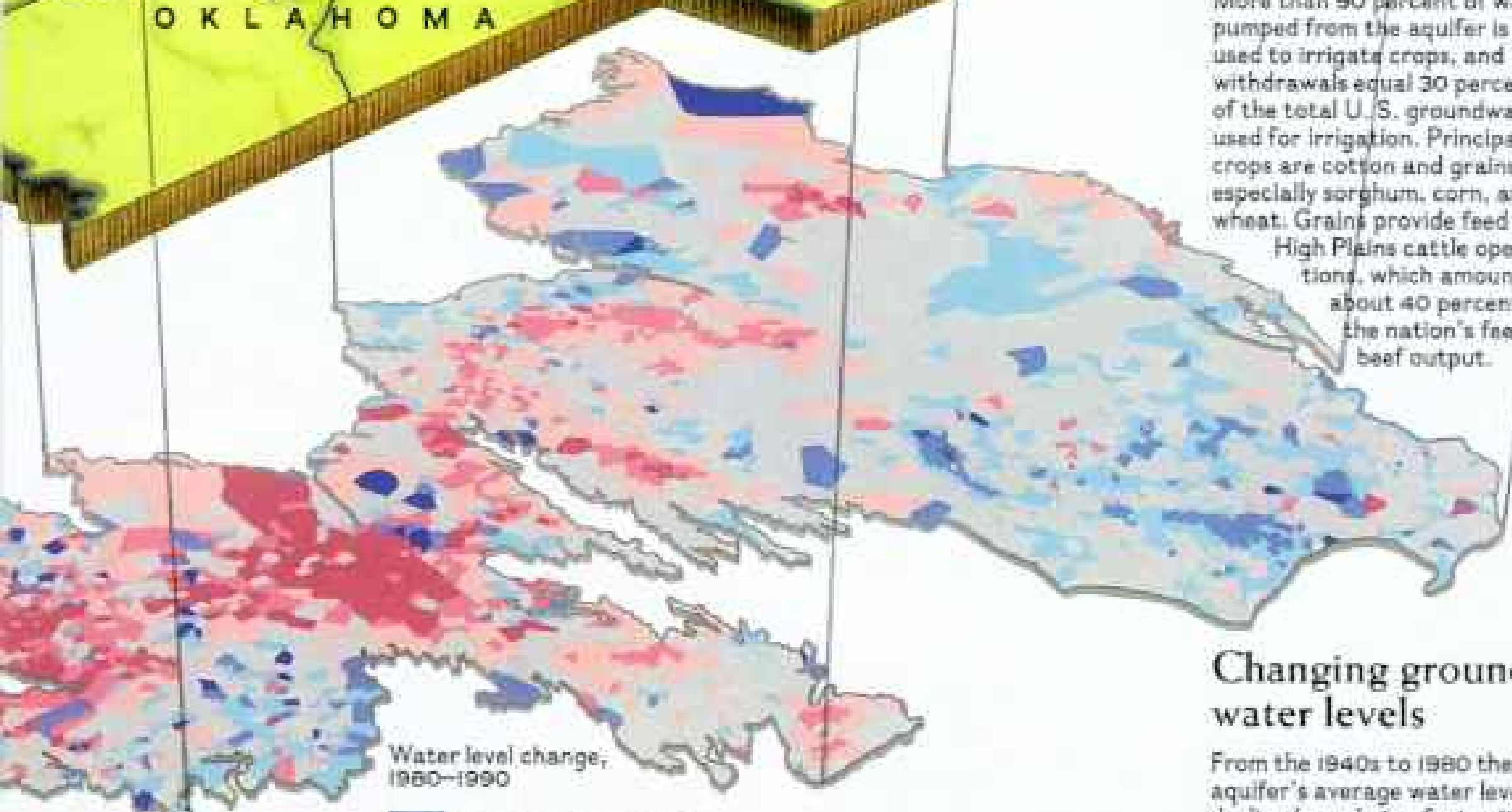


Using the aquifer

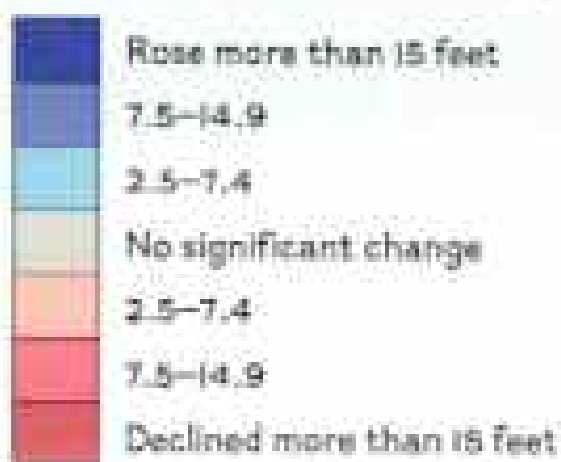
More than 90 percent of water pumped from the aquifer is used to irrigate crops, and withdrawals equal 30 percent of the total U.S. groundwater used for irrigation. Principal crops are cotton and grains, especially sorghum, corn, and wheat. Grains provide feed for High Plains cattle operations, which amount to about 40 percent of the nation's feedlot beef output.

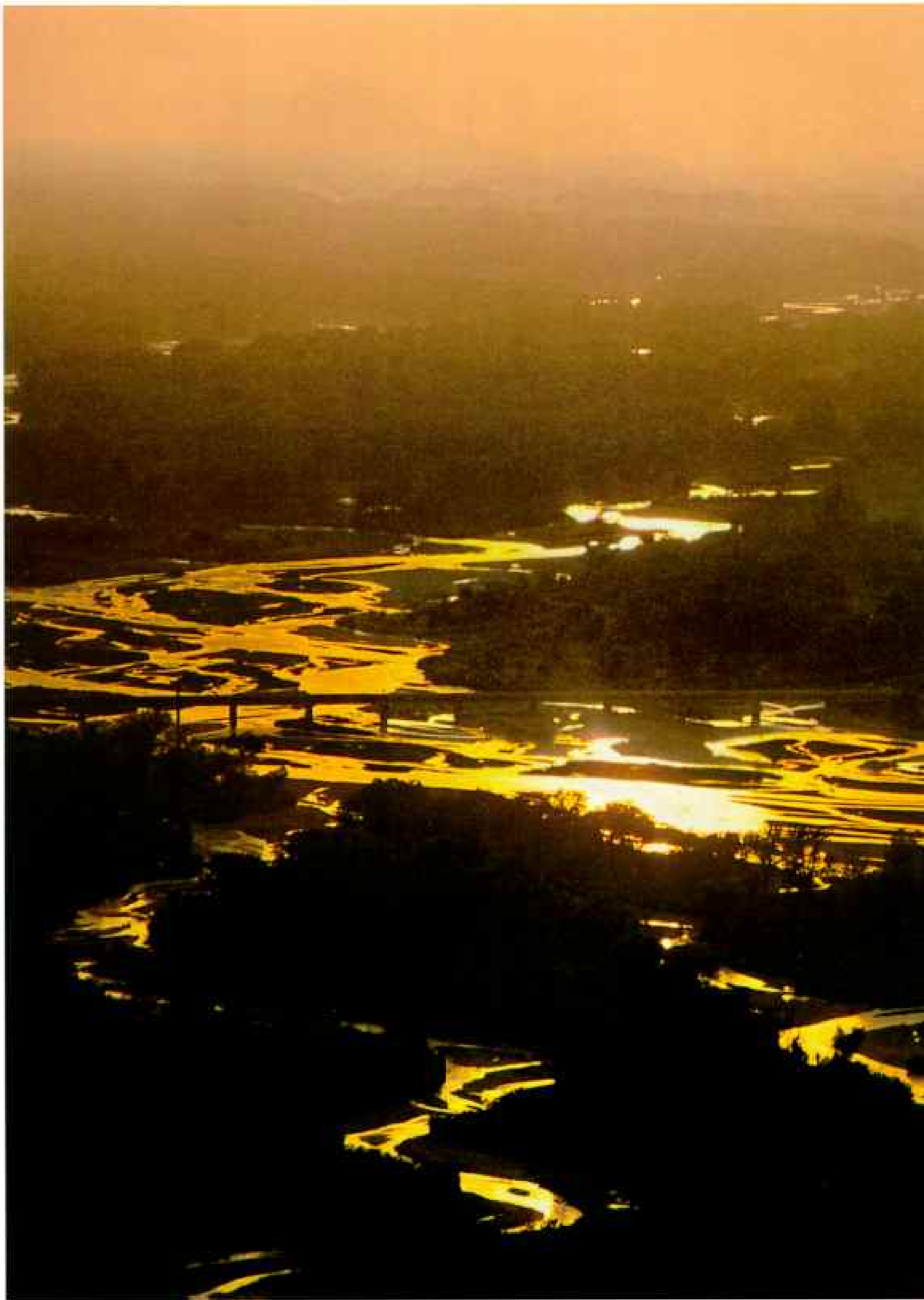
Changing groundwater levels

From the 1940s to 1980 the aquifer's average water level declined nearly ten feet, with declines exceeding 100 feet in some parts of Texas. During the 1980s the level declined only an additional foot — a result of increased rain and snow, water management, and new technologies. Still, serious depletion continued in parts of Kansas and Texas.

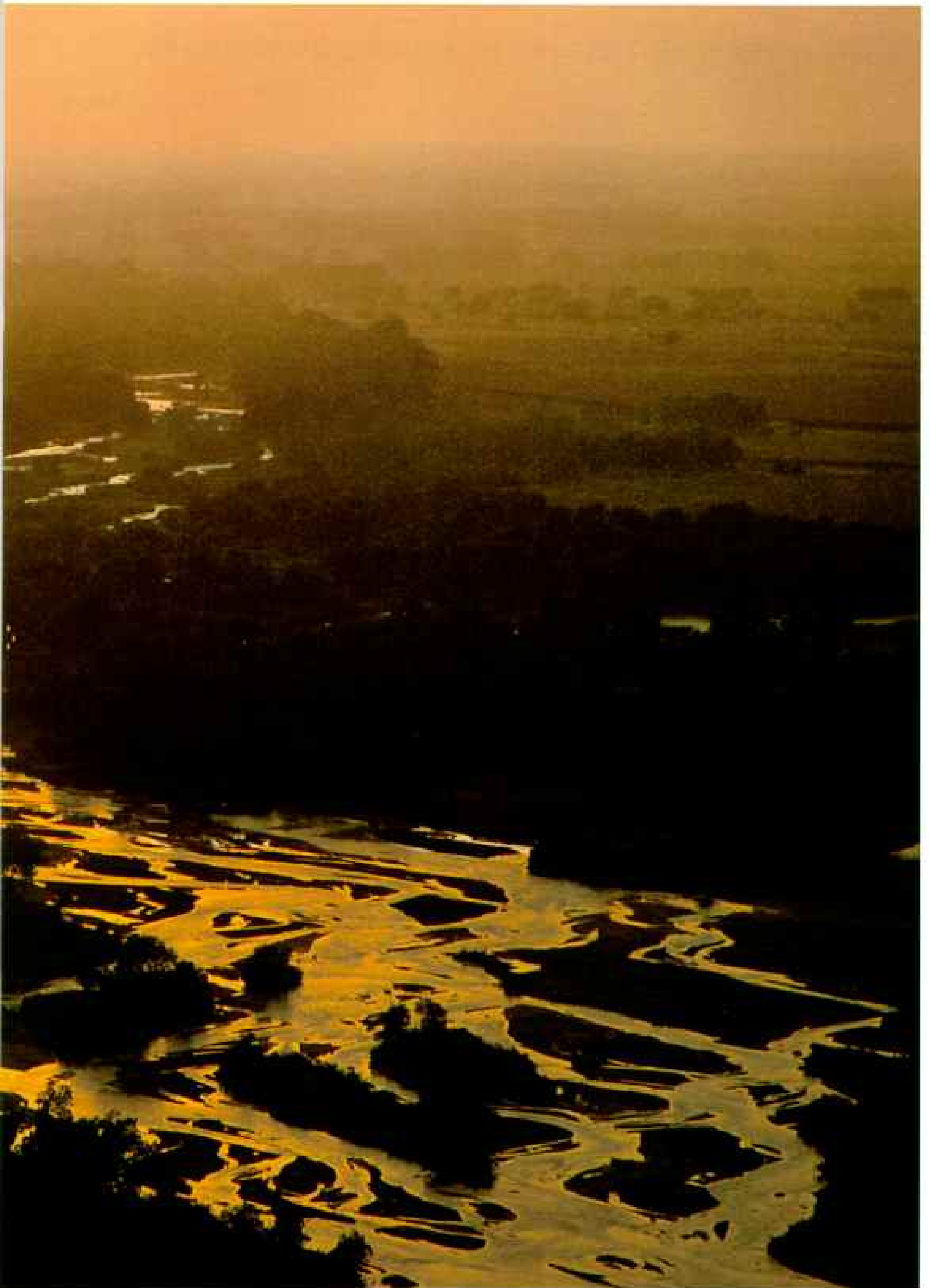


Water level change, 1960-1990





BRAID OF GOLDEN THREADS, the Platte River courses through Nebraska, a state that uses more groundwater than any other except California and Texas. Here groundwater and surface water mingle and recharge each other. But both face heavy demand: Dams as far



away as Colorado and Wyoming control the Platte's flow to meet the needs of irrigators, which can lower the water table. Pumping groundwater can diminish the river. This interdependence has only recently been recognized and is beginning to affect water laws.

"WATER IS THE GLUE THAT HOLDS THIS REGION TOGETHER."

— Vance Ehmke

pollution is not proving true. Ninety-five percent of America's fresh water exists underground. One expert has said that this country has accessible well-water reserves 20 to 30 times greater than all surface-water supplies. Thus groundwater is a major resource for people across the country, urban and rural alike, and we are only just beginning to learn that it is precious. In the High Plains the stakes may be highest of all. A Kansas farmwife observed with a tinge of tension, "It's kind of exciting times right now."

THE STORY of this remarkable resource is the story of the people who use it, and how the Ogallala in its silent, powerful way is compelling their attitudes about it to advance. "In the thirties, you watched the corn burn up," one Nebraska woman recalled. "Then comes this amazing irrigation knowledge and the scope of the aquifer, and you realize you can make it rain all the time. How can you tell people that isn't right?"

The people of the plains are beginning to see that their decisions about water are actually decisions about their lives. And in a region built by hardy folk who have made a fetish of self-reliance, the radical notion has developed that the water is not simply personal property but a collective resource whose future depends on everyone — and vice versa. As Vance Ehmke, a Kansas farmer, plainly puts it, "Water is the glue that holds this region together."

It is difficult for city dwellers along the humid coastlines to imagine the intense intimacy that rural people in arid regions feel for water. It isn't common, but it isn't unusual either, to hear someone speak of it with almost religious fervor.

"Something in me is completely awestruck by it," said Susan Seacrest, founder and president of the Nebraska Groundwater Foundation. "Some people get it looking at the stars, or listening to a Beethoven sonata. Even if the Ogallala weren't threatened, it deserves our reverence."

With only a little imagination, you can see the Ogallala everywhere, transmuted into myriad forms, from the filet mignon at Dreisbach's Steak House in Grand Island, Nebraska (275 gallons of water sitting right there on my plate, I calculated), to the sales tax rung up at the local seed store. You can see it too through the ingenious technology that has tapped it: the ranch windmill, the town water tower, and the ubiquitous center pivots, those metal pipes a quarter of a mile long that spray water in circles over the fields. "That's why I love groundwater," Seacrest said happily. "Because it's *everything*."

But the Ogallala is a memorable sight in itself. The first time I saw it was a gusty, late winter morning in the undulating vastness of Nebraska's Sand Hills. I clambered down a steep, tussocky hillside. At the bottom was a brisk little river, and not far from its bank was a smallish still pool. I crouched on the soggy fringe and looked into its depths. It wasn't still. Surging blithely upward, as if from tiny

WARM MEMORIES of her prairie childhood enfold Jean Mitchell in her Kansas windmill quilt. The windmill pumps water to fill the water tank, while the only tree, "a snag of a willow," grows nearby. One of her father's white-faced Herefords muses amid the sunflowers and daisies, butterflies and birds.

"After Sunday school, we'd go out to the pasture to count the cattle," she remembers. Best of all, "after the cattle had been accounted for, we would take a watermelon from Momma's garden and cool it in the water tank by the windmill." Without a windmill to tap the groundwater, few farmers could have survived or prospered for long.





CORN REGIONS in the High Plains, where harvest festivals like the one in Haxtun, Colorado (left), draw the generations together. Young Michelle Hadeen shares a float with a model grain elevator and with farmer Mark Gueck, who has won first prize for the fourth year in a row for the "best looking" corn.

Michael Dwiggins heads off to kindergarten in central Nebraska through a sea of corn. To irrigate their corn, the Dwigginses must pump out 20 inches of water yearly, about 600,000 gallons for each of their 1,100 acres. Much of the crop is destined to fatten cattle in feedlots.



concealed nozzles, were little columns of water that left continually shifting pyramids of fine sand on the bottom. This is it.

Most of us have at least a dim awareness of groundwater; words like "artesian well," "water table," and "springs" remind us of subterranean sources governed by gravity and various hydraulic principles. It may be complicated, but there isn't anything particularly magical about it. Yet kneeling there I felt strangely touched by this silent, undemonstrative little pool constantly brimming from an inconceivably huge, invisible supply. I touched it back. It was warm.

"**W**ATER—IT'S SUCH A DRY SUBJECT if you're not really interested in it." That was a deadpan hydrologist in Kansas; he's used to watching polite smiles freeze. But to my astonishment, the moment I reached the High Plains I found myself in the teeming central chapters of an epic tale that has been unfolding across an epic landscape for nearly two centuries.

I was driving one Sunday afternoon through eternity; that is, the expanse of southwestern Kansas, where the sky grips the horizon and there is nothing to stop the wind, and the scarce roads are so straight it's like driving across a sheet of graph paper. Tumbleweed bounces stupidly across the road, and the land seems wild and empty.

But the land isn't wild. There are grain elevators, railroad tracks, the silvery fingers of irrigation sprinklers stroking the filmy green of winter wheat, the doggedly bobbing dinosaur heads of scattered oil wells, hay stacked like huge loaves of bread, cattle staring off into space. People may be sparse, but their handiwork is everywhere. Don't be fooled by all the fresh air and sunshine: This isn't "landscape" any more than an office or a factory is.

From the earliest days of exploration, it was clear that the plains were going to present some very particular challenges to settlers: Water was the key. Native Americans had been masters of accommodation to the climate's fluctuations. Then as now, the annual rainfall is sufficient, but it can be maddeningly unpredictable. As early as 1820 a member of Maj. Stephen H. Long's expedition to the region reported, "I do not hesitate in giving the opinion, that it is almost wholly unfit for cultivation, and of course uninhabitable by a people depending upon agriculture for their subsistence."

The fact that the area was almost immediately dubbed the Great American Desert did not deter the waves of farmers, lured by the government's offer of cheap land and the wild promises of the railroad companies. Eternally optimistic sodbusters cherished the delusion that "rain follows the plow." It doesn't.

But in the 1850s no less a figure than Jefferson Davis, then secretary of war, prophesied that wells could be the answer. "If artesian water could be obtained," he wrote, "and flow upon the surface . . . a country which will otherwise remain a desert forever, would be made the habitation of many."

Wes Robbins in Burlington, Colorado, is working the soil angle. Tall, courtly, Robbins remembers the dust storms of the thirties; he was four years old when one "big old cloud came through" Muleshoe, Texas, and whirled away much of his family's farm. "I knew there had to be a better way to farm those fragile soils. They didn't blow till we plowed them out. We've got to keep them protected."

The connection between water and soil is something like that



"THERE WAS A SURVEY THAT ASKED HOW MUCH WATER WE SHOULD SAVE. THE ANSWERS RANGED FROM 100 PERCENT TO ZERO."

—Wayne Bossert

FINGERPRINT OF FORTUNE, a Kansas alfalfa crop is harvested in whorls left by a center-pivot irrigation sprinkler.

Although advances in technology have enabled record crops, they have also begun to overdraw the aquifer's account. Wells like the one supplying this sprinkler can pump more than a thousand gallons a minute—24 hours a day—throughout the three-month growing season. Rainfall replenishes only a small fraction of that amount.

In parts of Nebraska and Kansas, state regulations now require that meters be installed on each well to monitor the flow and to enforce pumping limits.

between air and lungs. How much water you need depends on how effectively your soil uses it; by the same token, how easily the aquifer can be replenished, or recharged, is determined by the soil texture.

Robbins has worked for the U. S. Soil Conservation Service for nearly 30 years. For the past seven he's been preaching better ways to retain moisture in the soil. Better retention immediately means less pumping; after all, water is a heavy substance to lift hundreds of feet up to the surface, and with fuel costs rising, water conservation is being recognized as economic good sense. While some plains farmers still resist change—unconvinced it's necessary, unable to afford the cost of new equipment, determined to reject advice from outsiders—more are like Stanley Miller in Amherst, Texas, who told me flatly, "I pretty much got religion where conservation is concerned." Some farmers are even beginning to define their harvest not in terms of bushels per acre but as value per acre: money spent, money earned. "Assuming water equals money," one man said, "which it does."

Robbins makes it sound simple. If the soil gets the right amount of moisture (whether rain, snow, or irrigation water) and at the right time, then you won't need to pump so much. In turn, less water will be wasted in runoff and evaporation, and the plants, growing in soil that's sufficiently moist but not sodden, will use the water more efficiently, producing a good crop with less irrigation.

Or no irrigation at all: There is a method, which is as old as agriculture itself, called dryland farming, though it isn't dry. It just means shrewder use of the available moisture, and even a moderately skilled farmer can save both money and groundwater. More and more farmers are turning back to it, but it's not always an easy sell.

"Farmers had no idea how much moisture they had," Robbins was relating in his calm, we-can-all-understand-this manner. "The mentality of the farmer is, 'I want to be sure.' There was just a lot of total ignorance about irrigation. We put water on the soil too often. Wet soils will not take water—dry soils do. But for 30 years the equipment dealers had been telling them to speed up the center-pivot rotation. They'd end up harvesting in December because the mud kept them from harvesting earlier.

"People were testing wells to determine how much they were pumping," he recalled in his baritone drawl. "But I said they could test every well and we won't know anything more than how much they were pumping that day. We've got to start managing it better. First thing I did, I used gypsum blocks to monitor soil moisture."

Robbins goes out and, if he can persuade a farmer to try it, gives him the gypsum blocks the first year for free and shows him how to use them. These simple devices, each containing two electrodes, are buried one foot apart, one foot to four feet deep. As the soil gains or loses moisture, the current between the electrodes gives a number reading on a meter. Then you know if the soil needs more water.

Tim Pautler, in Stratton, Colorado, doesn't mind giving his

testimony. With the information the gypsum blocks gave him, he's been able to manage all his resources better. "I take the water I used to waste," he says, "and I raise another 120 acres of corn with it." He had a well pumping a thousand gallons a minute and was watering 120 acres; now he's reduced his pumping to 800 gallons a minute and is watering 240 acres. "That's exactly what the gypsum blocks have done for me."

Robbins also tirelessly explains the many ways of conserving moisture, primarily by leaving the harvested crop stubble in the field (what is called reduced tillage, or no-till, or residue management). A foot of soil can hold one to three inches of moisture, and the stubble helps retain it by shielding the crop from the wind and sun. The stubble has an unkempt look that can upset a farmer used to giving his field a real close shave, at least until he begins to notice the results: less soil erosion and yields equal to or even higher than before. Even irrigators are taking a look at this approach, eager to save on fuel by pumping less.

"I'm just like an old minister that makes the circuit looking for a congregation," Robbins says in his imperturbable way. "I tell people, 'Billy Graham doesn't get everyone in the stadium to convert. But he keeps giving revivals.' I'm a preacher. Preachers are concerned about saving souls, and I'm concerned about saving soils."

WALLACE AND KATHLEEN ROBINSON didn't just want to drink their water; they wanted to listen to it too. Their Spanish-style farmhouse outside Scott City, Kansas, sits atop vast featureless corrugations of wheat; in summer, the sun and wind can be searing. So they built a fountain in the atrium, and now their house ripples with the musical voice of the Ogallala. I stood in the entryway and felt myself smile. It seemed like such a frivolous little sound, but its cheerfulness was also refreshing.

Though water out here is occasionally compared to gold, it's one of the few resources whose value is inherent. It is the basis of human survival. Yet groundwater, though it exists in its own particular universe and according to its own laws, is still connected with the hydrologic cycle, the circulation of water from earth to sky and back again as precipitation. "You cannot manage groundwater by itself," Wallace Robinson was telling his neighbors 15 years ago. "If you really want to get a handle on the problem, you've got to manage the atmosphere, the surface, and the groundwater."

Lee Reeve outside Garden City, Kansas, doesn't need gold; he has water. And he has not let it remain buried in the ground, like the biblical talent. No sir, it's out there earning its keep.

Reeve is the fourth generation to operate what is now the Reeve Cattle Company. Despite the cowboy boots and jeans, he's essentially a manager, and his thoughtful manner masks a passion for making the most of every resource that would do the old pioneers proud. He's well on his way to developing a near perfect system for using his water.

Reeve's 4,500 acres stretch across the austere, scrubby sand hills of southwest Kansas, where the ceaseless wind distributes far away the acrid aroma of his feedlot. Reeve has enough Ogallala water to pump a thousand gallons a minute from each of some 30 wells to irrigate his corn and alfalfa, most of which he feeds directly to the 17,000 head of cattle being fattened for slaughter.

Well aware of a national surplus of grain, Reeve decided to build an

BEEF BY-PRODUCTS can imperil groundwater. Like all major feedlots, the Ingalls Feed Yard in southwestern Kansas (right) protects groundwater by lining its runoff pits with clay to prevent wastes from leaching out. Western Kansas fattens three million cattle annually, a feedlot concentration matched only by Texas and Nebraska.

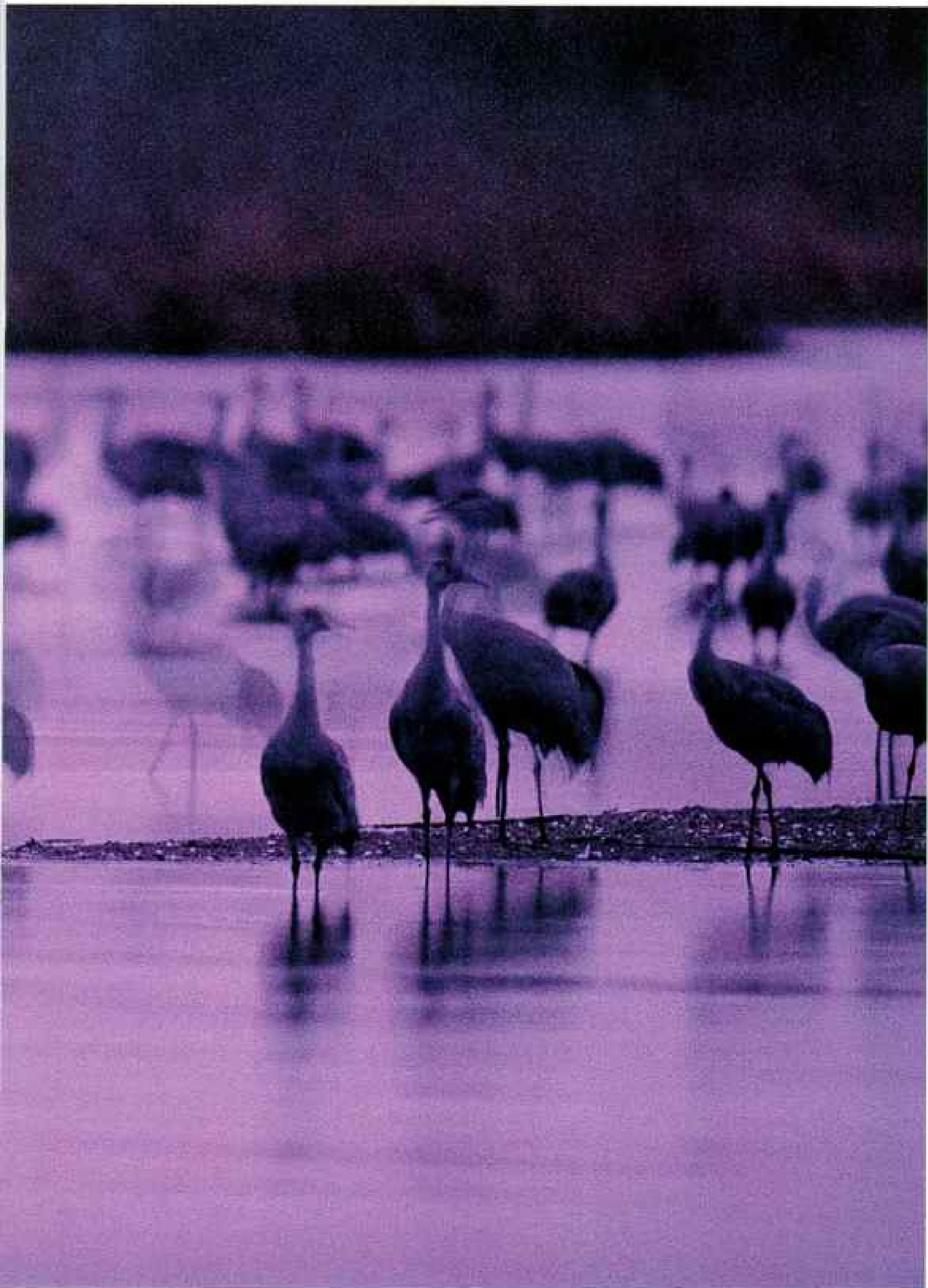
Treated wastewater from the IBP beef-processing plant in Finney County, Kansas, lies in lined holding ponds before being recycled onto cropland through irrigation systems. The ponds, tinted by red algae, are sprayed as needed to control flies and gnats.







FOR TEN MILLION APRILS sandhill cranes have flocked to the High Plains on their annual migration. Spring rains and snowmelt feed Nebraska's Platte River, which feeds the birds—with snails and other creatures that provide nutrients critical to production of



viable eggs. Farmers need the water too, and dams and canals have interrupted the flow, putting birds at risk. Throughout the region scores of migratory bird species, including the endangered whooping crane, are struggling for their share of the rivers and wetlands.

ethanol plant. It produces about seven million gallons a year, which he sells for fuel. In 1992 many cities began cleaner automobile emissions programs, and as ethanol is one of two possible additives used to create the cleaner burning oxygenated fuel, Reeve has expectations of doing very well.

Then there is the leftover 90-degree water from the ethanol cooling coils. So in 1988 he decided to build tanks to raise a delectable



PLUMES OF EXCESS soak the road and farmer David Shiers's all-terrain vehicle in central Nebraska. The aquifer here is so full and so close to the surface that it's cheaper for farmers to irrigate by flooding than by sprinkling.

If this field runoff had drawn complaints, the negligent party could have been cited for wasting water. Where profit counts and habit talks, conservation is a tough sell. "I guess we do waste water we could save," says Shiers. "But the costs don't weigh out economically, especially when corn's only \$1.97 a bushel."

warmwater fish called white tilapia, and now produces a couple hundred thousand pounds of fish a year in what amounts to just another kind of feedlot. And the water keeps on moving, from the tanks into a pond and back onto the fields.

"That's the trend for the future," Reeve said as he scrunched across the wet sand between the tanks, "to use the by-products of one system for the inputs of another. That's one reason to conserve water: because you're conserving everything else."

An energetic man in his prime, Reeve is convinced that the prosperity of the region will depend on new ideas and a larger viewpoint than a person's own individual success. He employs 35 workers, but that's not many compared with the supply. "It's damn hard to bring any kind of development to a rural area," he says emphatically. "It takes a concerted effort. What we all need to do is use our basic resources for everybody's benefit. Logically, the only way to have the development that rural America needs is to develop from within."

"There was a survey that asked people how much groundwater we should save," said Wayne Bossert, the regional water manager in Colby, Kansas. "The answers ranged from 100 percent to zero. It's unbelievable."

You can describe your water supply as the number of gallons being held in storage beneath your land. But how much you really have is determined by how easily you can pump it out. The Ogallala aquifer's

water-bearing sediments can vary from clay to sand to actual boulders; the thickness of the water-saturated sediments ranges from less than a foot to 1,300 feet, and the top can lie virtually at the surface or as deep as 300 feet.

Dick Henkle, a professional well driller in Garden City, Kansas, has educated many a baffled client. "In most areas of the Ogallala the problem is not finding areas with water," he explained, "but in



finding how it will yield the water. We're interested in how permeable it is. Second, what is the grain size and the uniformity of size? The rounder the grains and the more uniform, the better the flow will be."

Another way to define your supply is to identify what you want to use it for. "When it becomes uneconomical to extract the water for use in agriculture, people will say it's exhausted," says Don Ethridge, a professor of agricultural economics at Texas Tech; "but there's plenty of water still there and it's quite affordable for nonagricultural uses."

HOWEVER YOU LOOK AT IT, the future of the region will be determined, down to its tiniest detail, by the water. Thus to discuss the Ogallala is to recalculate your needs into a seemingly endless list of pluses and minuses.

By the end of the seventies, though, farmers and geologists alike could not ignore a pattern of declining local water levels. In 1982 the Department of Commerce undertook a study of the entire region; it predicted unvarnished disaster. At that time there were more than 15 million irrigated acres in the High Plains, pierced by some 150,000 irrigation wells, with virtually no regulation or restraint. Kansas had already pumped 38 percent of its total supply. Groundwater levels in northwestern Kansas were dropping an average of one foot a year.

The report forecast that by the year 2020, at the then prevailing rate

SIMPLE NOZZLES may help balance the aquifer's savings account. Called LEPA, low-energy precision application, the system uses less energy and less water than conventional, higher pressure sprinklers.

The system also emits larger drops. They resist evaporation, so that as much as 98 percent of the water dispensed reaches the crop's roots. In this application, LEPA-controlled water irrigates George Andrews's winter wheat outside Burlington, Colorado.

"We're really concerned about the Ogallala," says Colorado soil conservationist Wes Robbins. "And we're doing something about it."

of usage, the water levels in the Ogallala aquifer would have fallen 23 percent. (Texas alone would have pumped out two-thirds of its total.) In some places the Ogallala's "overdraft" (which means the same for water as it does for your checking account) had reached 95 percent—or, as one writer explained it, for every gallon of water pumped out, a teacupful was being replaced by natural processes. Some rough estimates put the aquifer's annual overdraft at an amount nearly equal to the natural flow of the Colorado River.

"If you'd done this story then," one Kansan declared, "there was absolute panic."

THE GOOD NEWS, though no one realized it then, was this: "In the High Plains," according to Susan Seacrest, "there's no gap between the people who can make a difference and those people who take the risks. You have a very teachable moment."

One day in 1984 this Lincoln, Nebraska, wife and mother of three read about a study linking the high incidence of lymphoma to corn production—corn fertilized by nitrates that were leaching into the Ogallala. She decided to learn more. Now she says, "It was like I was born again with groundwater."

Slight, stylish, and utterly irrepressible ("My husband would like to make a sign: Do Not Ask This Woman About Groundwater"), Seacrest has clearly found a natural outlet for her ebullience. First, she organized the Nebraska Groundwater Foundation, a nonprofit educational group. Having a master's degree in education, she was convinced that nonpartisan information would be the strongest force for change in a state where water is a very contentious issue—Nebraska is the third largest groundwater user in the nation. The foundation

sponsors symposia and other educational programs, including a monthly newsletter that goes to 5,000 experts and laymen; she lobbies legislators; she nags editors. "This is the marvelous resource that just gives and gives and gives," she'll say in her headlong way. "Let's give something back. The great joy—my life—is groundwater."

Then in 1989 she put on the first Children's Groundwater Festival and really struck what well drillers call good pay. That year 1,500 Nebraska schoolchildren came. The next year there were 2,500. "For 1993 we had 8,000 sign up. That's a lot of potential corn farmers."

"The big problem is that the subject's so technical," she admitted. We were drinking tea one afternoon in her pastel living room and trying to let the answering machine take the calls. "People need a shortcut. So when I put the festival together, I wanted to have programs that would be accurate and fair, but also be creative and attractive."

One March day I joined the teeming throng pouring out of yellow buses into a school in Grand Island, Nebraska. There was more going on than I could possibly keep up with. I watched an entomologist, working as "Mr. Magic," do tricks. (He pushes a yellow silk scarf into



WATER'S TERRIFIC FUN for six-year-old Allison Pettit and her friends splashing in a livestock tank in Bingham, Nebraska.

Diving into the Ogallala on a trash and treasure hunt (facing page), Tom Fletcher retrieves somebody's long-ago glasses, one of countless items that have fallen, or been chucked, into the Big Well in Greensburg, Kansas. Hand-dug in 1887 to provide water for steam locomotives, the well hits the water table at 94 feet.



EDUCATION ABOUT WATER IS THE KEY: "A WORRIED GRAND-CHILD IS WORTH FIVE VISITS FROM A REGULATORY OFFICIAL."

—Susan Seacrest



his fist. "This scarf is the pesticides. They look like they've gone away" — empty palm — "but they're really still there," and he pulls it out again.) I joined a group clustering around a hydrogeologist as he operated his soil probe; bringing up a plug of playground earth, he described soil types and how they affect the aquifer. I stopped one blond little girl and asked what she was holding. "An aquifer," she replied. Sure enough, just over there children were making their own aquifers: Take one clear plastic glass and fill with assorted layers of gravel and sand, according to how you want your water to behave.

Eventually the day ends, the buses depart, and I am mulling over my lessons. The children seemed to simply absorb them; they reminded me of the story Seacrest tells about her little girl. One night they went to a football game. "The rain started; it was really pouring down," she told me. "But my daughter didn't mind. She said, 'Mommy, our team is behind. But the groundwater is recharging.'"

There are other signs of hope. "What people have done is substitute capital for water," is how agricultural economist Don Ethridge puts it. "They invest money in water-conservation technology."

Most people are beginning to accept that they will have to strike some sort of balance with nature; the debates center on defining where that balance should be. Continual improvements in irrigation

AQUIFER POWER comes alive with a tabletop model run by Nebraska students at summer camp. By adding water and pumping it out, they can see how water behaves in different layers of sediment.

"Polluting" drops of red dye—which could represent anything from pesticides to a dry cleaner's carbon tetrachloride—form a tinted plume that can spread into neighboring wells, lakes, and streams.

Because groundwater can flow from 2 to 50 feet a year, contamination may remain undetected for generations.

No one has yet discovered an inexpensive means of cleaning groundwater. But experts agree: The best way to protect the water is to avoid polluting it in the first place.

equipment are dramatically increasing efficiency; one of the most popular is a modification of the center pivots. Called LEPA (low-energy precision application), this refinement involves hanging hoses from the pipe with nozzles dangling from them, which aim the water at low pressure directly onto the soil. This relatively inexpensive device cuts evaporation rates as much as 98 percent.

There are also new restrictions on the amount of water that can be pumped. Parts of Kansas, Texas, and Nebraska now put various limits on the spacing between new wells. ("A lot of people have been chafing under that," geologist Jim Goeke told me in Nebraska. "That's sort of like telling them they can't pack a gun.") Some areas of Nebraska have also mandated a five-year limited allocation of water and required meters on the wells. Metering is a very touchy issue, smacking as it does of the hated outside interference. Some people question the reliability of the meters. Others, such as Lee Reeve, are convinced that meters will lead to taxes. But accurate meters are one of the few ways to establish exactly how much water is being withdrawn.

Conservation schemes are becoming more creative. Some Kansas and Nebraska towns have devised a trade: The farmers provide fresh water to the towns, while the towns supply treated wastewater to the farmers' fields (and sometimes to local golf courses and cemeteries).

In Scott City, Kansas, water manager Keith Lebbin has been spending the past 18 years pursuing a cloud-seeding and hail-reduction program over 11 counties. Any inch of rain that falls is one inch of groundwater that can stay in the ground. And up in Colby, Kansas, Wayne Bossert is dedicated to promoting a somewhat controversial but highly logical approach to conservation called zero depletion, a fancy name for a simple idea: To gradually and voluntarily pump less water according to a plan based on your estimated supply. Don't wait till it all runs out and then try to figure out how to manage. Ideally, you'll adjust your rate of withdrawal to match the rate of natural recharge.

"It's a plan to stabilize water tables at their current levels," Bossert explained one ice-encrusted morning when planted fields were just a fantasy. "It's an attempt to land our 'economic aircraft' with some sort of plan, rather than dolly along until our fuel runs out."

Lots of people think this notion is some kind of fantasy. I'm still not sure why.

ALL THESE PAINSTAKING ADVANCES are beginning to pay off. In many areas, rates of decline have slowed; in some, the declines have stabilized; in a few spots, even in hard-pressed Texas, the water table is actually rising again. Persuasion rather than compulsion is the secret. Susan Seacrest declares, "A worried grandchild is worth five visits from a regulatory official." Wes Robbins agrees. "The gallons we've saved and the kilowatt-hours we've saved is not the story," he told me. "It's *how* we've done it. We've led these horses to water—we didn't drive 'em."

Of course, laws can also play a useful part in the process of persuasion. "In the early days the politicians were reluctant to regulate," Seacrest says. "But now they realize that's not realistic."

Legislation may be a necessary tool, but if not carefully designed it could easily hinder as much as help protect the aquifer. There is already such a welter of laws that apply to so many different aspects of



SMILING THROUGH, Floyd Wright has converted 50 of his Kansas acres from corn to sunflowers, which don't need irrigation and whose snack seeds and oil can sometimes earn a higher profit too.

Dryland techniques, which rely on the moisture available from rain and snow, enable farmers to save water—as well as money for irrigation equipment and the energy to run it. Yet some provisions in federal farm laws make it unprofitable to switch to less thirsty crops. Sunflowers are one happy exception.

groundwater that I suspect it may be impossible to obey them all. Interestingly, the only three states that have framed comprehensive groundwater-protection laws are outside the High Plains — Arizona, Minnesota, and New Jersey. Still, there is a growing consensus among water managers and users that the current laws could be more effective if there were more people and funds to enforce them. Better coordination between agencies couldn't hurt either.

As to future needs, the tremendous variation in water supply and use across the Ogallala dictates that the most useful laws will have to be framed in local rather than national terms. Communities want to solve their problems, but not using rules that apply to somebody else.

Unfortunately the general rule throughout the region (with local variations) remains "Use it or lose it." In Kansas if a farmer doesn't pump a certain amount over a three-year period "without due and sufficient cause," he could lose his legal right to the water. And without the legal right, he can't have the water. Water manager Keith Lebbin objects to that. "What is 'due and sufficient cause?' If you don't want to use your well, you should get a pat on the back."

Farmers who might prefer to save water by turning from the infamously thirsty corn to less water-intensive crops such as wheat, cotton, or grain sorghum are often thwarted by the farm laws that control crop subsidies. "You can't just wake up one morning and decide you're going to raise canola," Wayne Bossert told me. "We've had 50 irrigators in here saying, 'I wouldn't be raising corn if the government didn't make it more profitable to grow it.'"

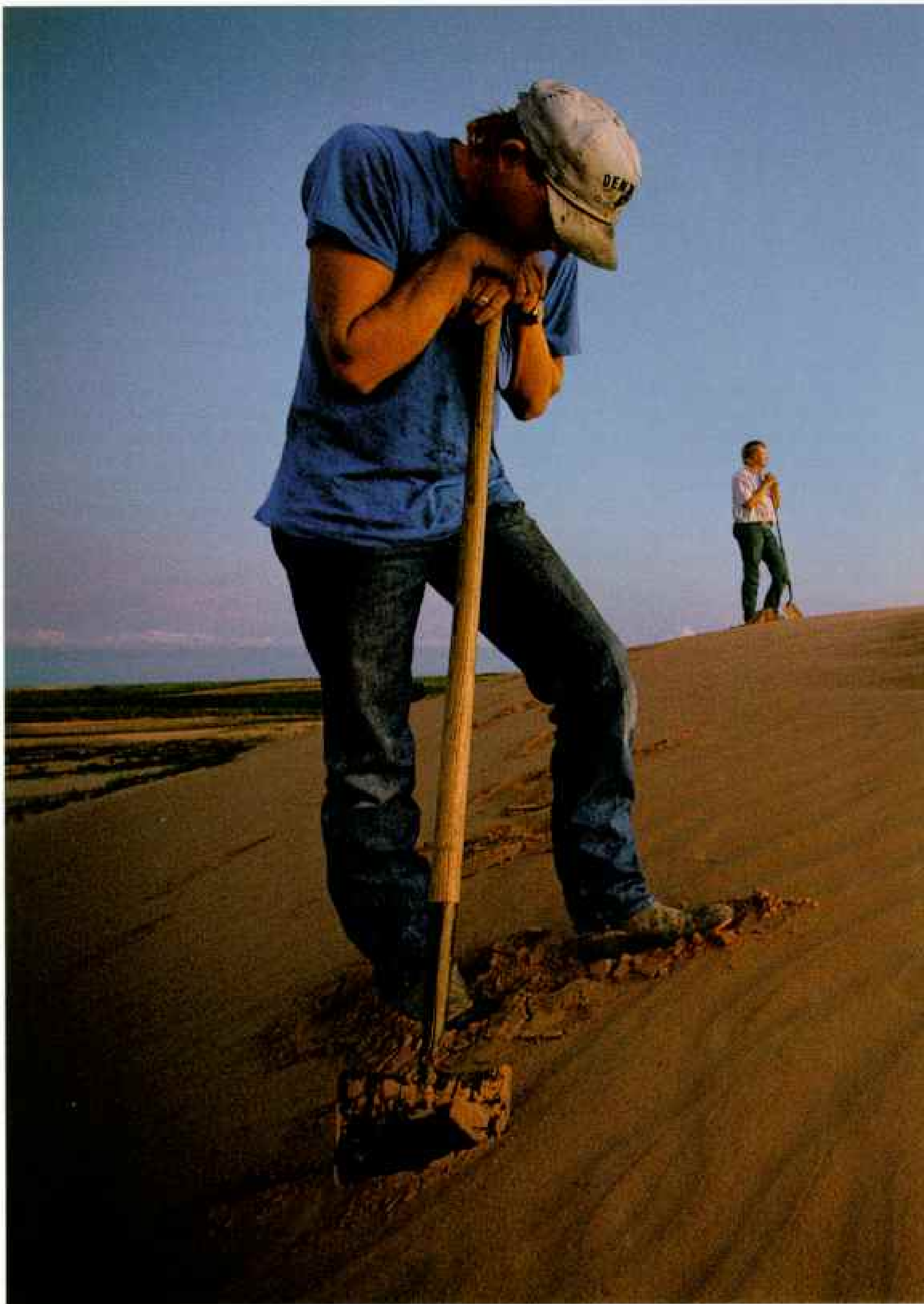
Frustration among farmers can be intense; at every turn the economic forces exert their pressure. "I have a brother-in-law in Nebraska," a Kansas man told me. "He was a dryland farmer. You know why he's irrigating? Because back in 1979 a banker told him, 'You've got to put in an irrigation system, or we won't loan you the money to buy the land.'"

And although agriculture uses more than 90 percent of pumped Ogallala water, farmers are beginning to rebel against all the criticism from outsiders. The average American uses 5,240 gallons of water a month, and it's exasperating for a farmer, who considers he's producing something of value with his water, to be lectured by cityfolk who can't be bothered to turn off the faucet while brushing their teeth.

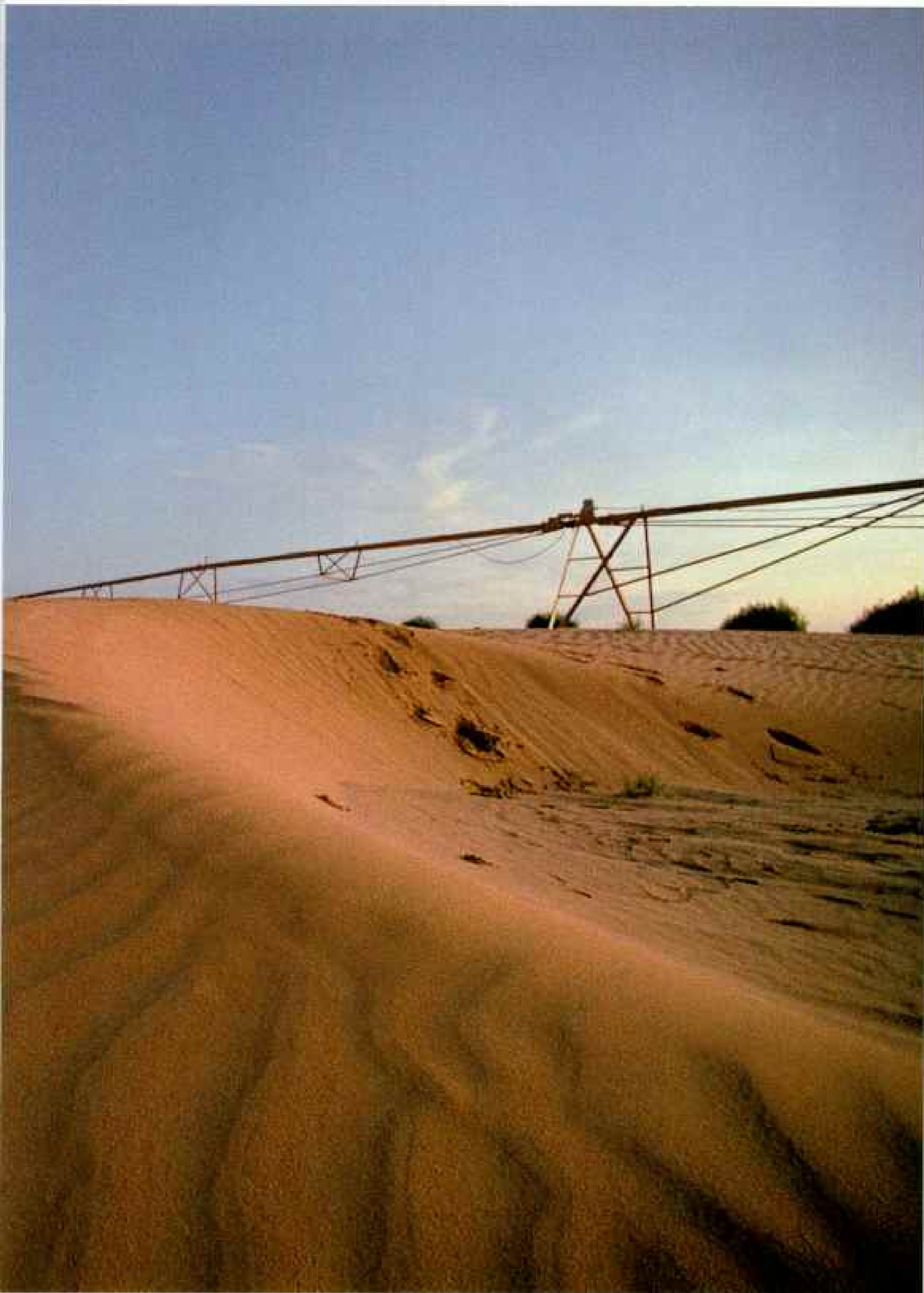
"The solutions will have to be long-term," as Susan Seacrest admits, "because the problems were created in the long term."

EVEN THE DUCKS ARE STRUGGLING. So are the sandhill cranes, white-fronted geese, least terns, piping plovers, and the more than one hundred species of other birds whose own survival is linked with the groundwater. "We have six endangered species; two of which are likely to become extinct in the state in the near future," zoologist John VanDerwalker told me bluntly in Grand Island, Nebraska. "We used to have 50 species of fish; we've lost 21. This is an environmental disaster area."

One frigid Nebraska spring dawn I huddled in a blind on the banks of the Platte River. On the icy sandbars the cranes were huddling too. Beneath the pale, nacreous clouds, their intermittent early cries sounded small and mechanical. Mergansers and mallards swept by on the current, feeding, while a young eagle made tentative swoops that cast handfuls of cranes into the sky for a moment before they subsided again into clusters. I was there to witness the great moment when they



HOPE HAS ALWAYS RESTED ON WATER in the High Plains. Yet good soil management is equally important to successful farming. Having left water problems behind them in Texas, Chris and Donny Meiwes have another problem on their new farmland near



Portales, New Mexico. They struggle to dig out an abandoned center-pivot sprinkler buried by drifting sand. Plenty of water is also buried here, but unless they can maintain a good cover crop of wheat or oats, this fragile soil will simply keep blowing away.



begin the day, taking to the sky in their thousands, but they didn't want to move yet. Too cold.

The great migratory flyway passes directly over the High Plains, and millions of birds every spring and fall depend on the rivers and wetlands that feed and are fed by groundwater. Wells and dams inevitably disturb the natural rising and falling of the rivers; there are fewer sandbars for safe nesting, and less food.

"The normal cycle here is for the water levels to start to rise in mid-February," VanDerwalker explained. "Rising groundwater is warm, so it thaws the soil early. Bacteria and small invertebrates have to start growing in mid-February for the birds to benefit. Frogs and toads have to have standing water for their reproductive cycle. And the sandhill crane can't produce a viable egg without animal protein. You can feed them corn and they'll look good, but they won't produce a live egg—they must have the nutrients from snails and other invertebrates.

"This is an incredible example of the dynamics of God's creation. But without the water, it doesn't work."



VEINS OF LIGHTNING herald rain that feeds the Ogallala. In Nebraska's Sand Hills, storms can pour 20 inches onto the porous soil yearly, and a quarter of it will soak down into the aquifer.

All across the Ogallala, conservation is the key to a future in which enough water will be left in the aquifer's account. That realization is growing like corn. Says soil conservationist Wes Robbins: "We're all trying."

Dams for irrigation and energy have reduced the river's average annual discharge through central Nebraska by 70 percent, and the schedule for releasing the water is virtually the reverse of flows the birds need. Yet the birds have come to present their own economic argument, as bird-watchers and duck hunters are beginning to counter the traditional needs of the farmers. Even some of the farmers—whisper it not—are beginning to speak up for the birds.

Outside Great Bend, Kansas, last spring the sky was silent except for the echoes of an impending lawsuit. Cheyenne Bottoms Wildlife Area, which contains 13,000 acres of wetlands, is a critical habitat for the endangered whooping crane and a crucial nesting area for the cinnamon teal, green-winged teal, American wigeon, and canvasback. Up to five million different water birds and shorebirds stop here every spring. But a drought had turned the ponds that ought to have been swarming with life into empty, cattail-choked savannas, and the state's chief engineer had ordered some local farmers to reduce their irrigation pumping by 60 percent to allow the aquifer's water to recharge.

But the irrigators were fighting back. They insisted that the bottoms had always depended much more on rain and water diverted from Wet Walnut Creek than on groundwater, and furthermore, they didn't believe that the connection between groundwater and surface water had been proved. They felt they were being punished for something that was beyond their control.

It came as a shock to this region where farmers' needs have traditionally come first that the judge ruled against them and upheld the pumping limit. The prophetic words of one manager had been fulfilled—this decision was indeed "a very precedencing thing as to how we're going to manage water."

Is it possible to use a dwindling resource equitably? We must learn. "In the future," Susan Seacrest says firmly, "nobody's going to be able to have it all their own way. We're *all* going to have to learn to negotiate and compromise."

WHEN I THINK OF THE OGALLALA—and I think of "her" often now—I hesitate between weeping and rejoicing. I remember the way the water came chattering and bustling out of a spring in a Kansas hillside, how it hurtled from the end of an irrigation pipe over a north Texas wheat field. I recall its clean, sharp taste.

And I think of the magnitude of the water, and all the needs and desires that rest upon it. There are so many people who appreciate its value and its vulnerability, but whose best intentions can be so hard to fulfill. "We must have pioneers," Wes Robbins said in Colorado, "and that's what I look for."

"It's a very humbling situation to be in," geologist Jim Goeke admitted with a philosophical smile, "because the more you find out, the more complex it gets. But what's that old saying—we're confused on a much higher level."

Out on the Texas plains an immense spring moon poured its light over floating fields of cotton and wheat and alfalfa, upon sleeping hamlets named Earth and Spade and Progress. As I drove, I was thinking of Tex Reeves, who loves the watery rock for itself and not for anything it can do for him. "I hope I die on the drill rig," he'd said to me. "Just roll right off the escarpment into the Ogallala." □



Buffeted by a freezing wind, archaeologist Noel Broadbent surveys the remains of historic East Base — the United States' first permanent toehold in Antarctica, surrendered to the cold in 1948. A team of experts has partly restored the site as a monument to polar exploration.

Reclaiming a Lost Antarctic Base

By MICHAEL PARFIT Photographs by ROBB KENDRICK



IT WAS AS IF we had sailed across a reach of the universe and come upon an old space station, once occupied by generations of explorers and now abandoned to the solar wind. The only difference was that the reach we had crossed was the gulf of storms south of Cape Horn, known as Drake Passage, and the abandoned station was on a tiny pile of rock called Stonington Island, lodged between ice and sea in a remote corner of Antarctica.

Snowdrifts embraced three old buildings, the remains of the first permanent United States base in Antarctica: East Base, which was built in 1940 and closed down in 1948 after two historic expeditions. The place was deserted but not silent: The wind howled, bits of ice washed noisily on the stony beaches, and the glaciers near the island grumbled and thundered, dropping icebergs into the sea. But it was eerie nevertheless. It had been such a busy little place, alive with human purpose and the excitement of discovery.

Noel Broadbent pushed gingerly on a door, as if he might disturb ghosts. Noel, an archaeologist for the National Science Foundation's Division of Polar Programs, was the leader of our four-week expedition. We were a gang of eight: Noel; Bob Weaver, an architect and hazardous-waste expert; Mark Melcon, a carpenter; Doug Hilborn, who cooked for us; and two British assistants, Dave Routledge and Ben Hodges. Photographer Robb Kendrick and I had been invited along to chronicle the expedition and to provide grunt labor.

East Base has recently been named an international historic monument by the 39 nations that administer the continent under the Antarctic Treaty of 1959. The base achieved that status because of the exploration conducted from here and because it is the place where women first wintered in Antarctica. We had been sent by the National Science Foundation, by plane and ship from South America, to make East Base worthy of its designation: to clean up and repair the old buildings, to collect and catalog its artifacts, and thus to honor an unsung—but important and dramatic—

MICHAEL PARFIT has written about Antarctica in a book, *South Light*, and numerous articles. His story on Route 93 appeared in the December 1992 *GEOGRAPHIC*. Photographer ROBB KENDRICK contributes to many national publications. His most recent article for the magazine was "Gatekeepers of the Himalaya," also in the December issue.



period in the history of Antarctic exploration.

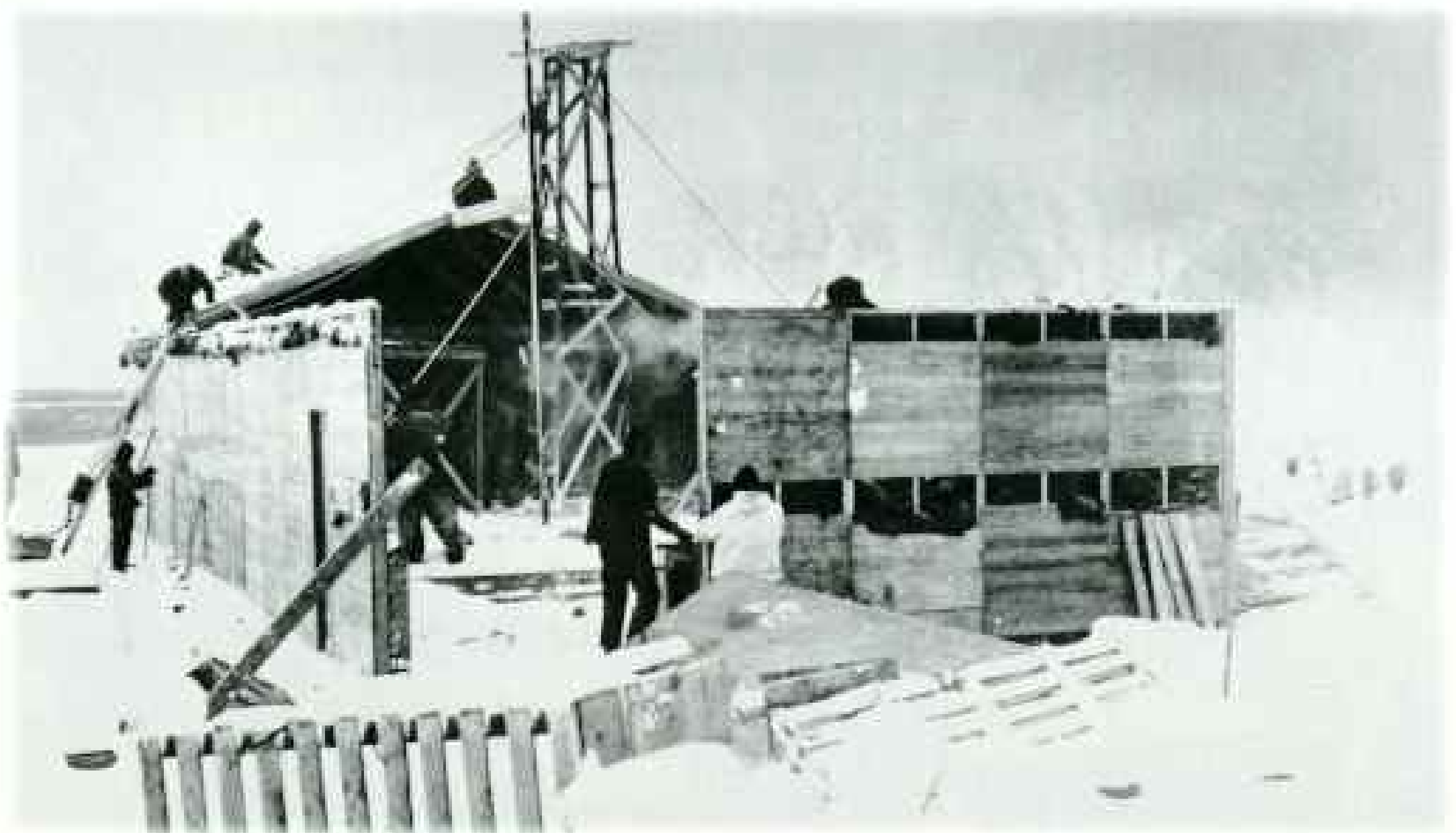
The door swung open. Noel stepped in. But there was nothing to be troubled but solitude. The wind murmured in vents. Light from a broken skylight slanted on a dusty floor. On the floor was an empty box and an anvil. On a shelf was a map.

It was a weather map, printed in 1939 for recording weather patterns. It bore the familiar shape of Antarctica, except that near East Base's location the outlines of the coast were dotted—a cartographer's device for saying "nobody knows." Noel grinned. There it was: a symbol of why people had come here.

Antarctic expeditions were funded by individuals and governments for the same reasons they have always supported explorers: economics, a hunger for resources, and nationalism. (About the time East Base was built, a pilot for Nazi Germany was dropping stakes bearing swastikas elsewhere on Antarctica.) But the debt-ridden financial histories of many explorers are evidence that those who



Ghost town in a ghostly landscape, East Base's three surviving buildings stand abandoned on Stonington Island off the Antarctic coast. The remote settlement bridged two eras in polar exploration by merging epic dogsledding journeys with technical advances in aviation. Seven years after its construction in 1940 (below), it also housed the first women to winter on the continent. Vacationing where explorers once struggled, occasional polar tourists stop there today.





Architect Bob Weaver checks the East Base bunkhouse for structural damage caused by British seal-butchering operations in the 1960s and '70s. Decades of wind-driven snow has hardened into a five-foot-thick scab of ice inside the building, where base founder Richard B. Black (seated at far end of table, below) toasted the winter solstice in 1940.



actually went into the far reaches of the world were drawn more by curiosity than by greed.

“If I had the chance to go to the end of the universe for six months, even knowing it was death,” one of the men who had come here told me, “I would go, for the beauty of it.”

Others had said similar things. To prepare for this trip, I read half a dozen books that described or touched on Stonington Island’s history and interviewed more than a dozen people who had lived here during the early expeditions. (“I can’t believe we’re historical objects,” one of them said.) Their current vitality reminded me of a characteristic our group did not share with the early explorers: youth. They were ambitious, idealistic; they did not live far from their childhood dreams.

THE EARLY HISTORY of East Base is dominated by two men who were similarly driven: Richard Black and Finn Ronne, a Norwegian immigrant to the United States whose father was part of the support team for Roald Amundsen’s South Pole expedition. Black and Ronne were first and second in command of the 26-man, U.S. government-sponsored expedition that built East Base. That expedition was hastily evacuated in 1941 as World War II loomed. But Ronne didn’t forget East Base. In 1946 he put together a private expedition with 23 members, including the first two women to winter in Antarctica—his own wife, Edith “Jackie” Ronne, and Jennie Darlington, wife of pilot Harry Darlington. His team arrived in early 1947 for one more year of exploration, sharing the little half-mile-long island with a group of British explorers.

The men and women who lived on Stonington led hard and dangerous lives, but they didn’t get much glory. The glamorous feats had already been done—the South Pole had been conquered on foot in 1911 and by plane in 1929. But most of the 5.5 million square miles of Antarctica remained unknown. It still had to be staked out, measured, and outlined on charts—the slow, methodical piecing together of the mosaic of information that slowly brings unknown territory into the human world.

By the time Ronne’s team left East Base—which would never be lived in again—most of the fundamental exploration was done. British teams continued to work from Stonington almost continuously until 1976, but by 1948 most of the last uncharted coastline of the



At world's end

Two U.S. expeditions used East Base as a headquarters in 1940–41 and 1947–48. By air and dogsled they charted one of the last blank spots on the continent: the Antarctic Peninsula’s fog-veiled coastline.

continent had been mapped, and the mountains of the Antarctic Peninsula had been shown to be geologically similar to the Andes. Perhaps most important the explorers at East Base had finally proved Antarctica was all one continent, laying to rest a persistent theory that it was divided by a frozen sea.

To us the dates ran together. The artifacts we found in the buildings or out on the rocks were mingled among the expeditions. So as we suffered under the same easterly gales they had written about and as we settled into a similar way of life of cold hard work and sound sleep, living in one of the British buildings, we came to think of the people of Stonington’s history as colleagues, people we might converse with at dinner or meet as we slogged against the wind from one hut to the next.

The beauty that surrounded Stonington was a common thread in all the books, in all my interviews, and in every moment of our daily lives. Being on that island was like living inside a roofless ruined cathedral built of marble and aquamarine, among thunderstorms that rained silver. To the east the luminous

Don't forget the long underwear: Curt orders fill an East Base blackboard during evacuation of the camp, just months before U. S. entry into World War II. Departing the base in a biplane, expedition staff carted off a live petrel and—in a suitcase—seven husky pups.



HERBIL W. BRYANT

blue ice of the glacial cliffs faced us, and above them long white slopes of the glaciers rose to peaks of black stone crowned with ice.

On calm days the sea was a sheet of shine scattered with decaying icebergs, and along the shoreline thousands of little broken bits of brash ice, moving in an imperceptible swell, gurgled and sang. Then the island's most common summer gale, an easterly the residents of Stonington called "the Fumigator" (among less printable names), would begin in the high air in towers of lenticular clouds above the mountains, pour silently down the glaciers, blurring their edges in a slow, imperial cascade of blowing snow, then hit us suddenly with salt spray and cold.

"THIS IS the famous archaeological dental pick you've been reading about," Noel said one morning, whacking at a mound of ice with a crowbar.

If the setting was unusual, our archaeology was downright strange. Instead of sifting soil, we pounded on ice. Everywhere that snow could get into the buildings there were little

indoor glaciers. We moved 20 tons of ice out of the East Base bunkhouse, then Bob Weaver lifted a piece of old floor and found a case of Noxzema and a spool of thread.

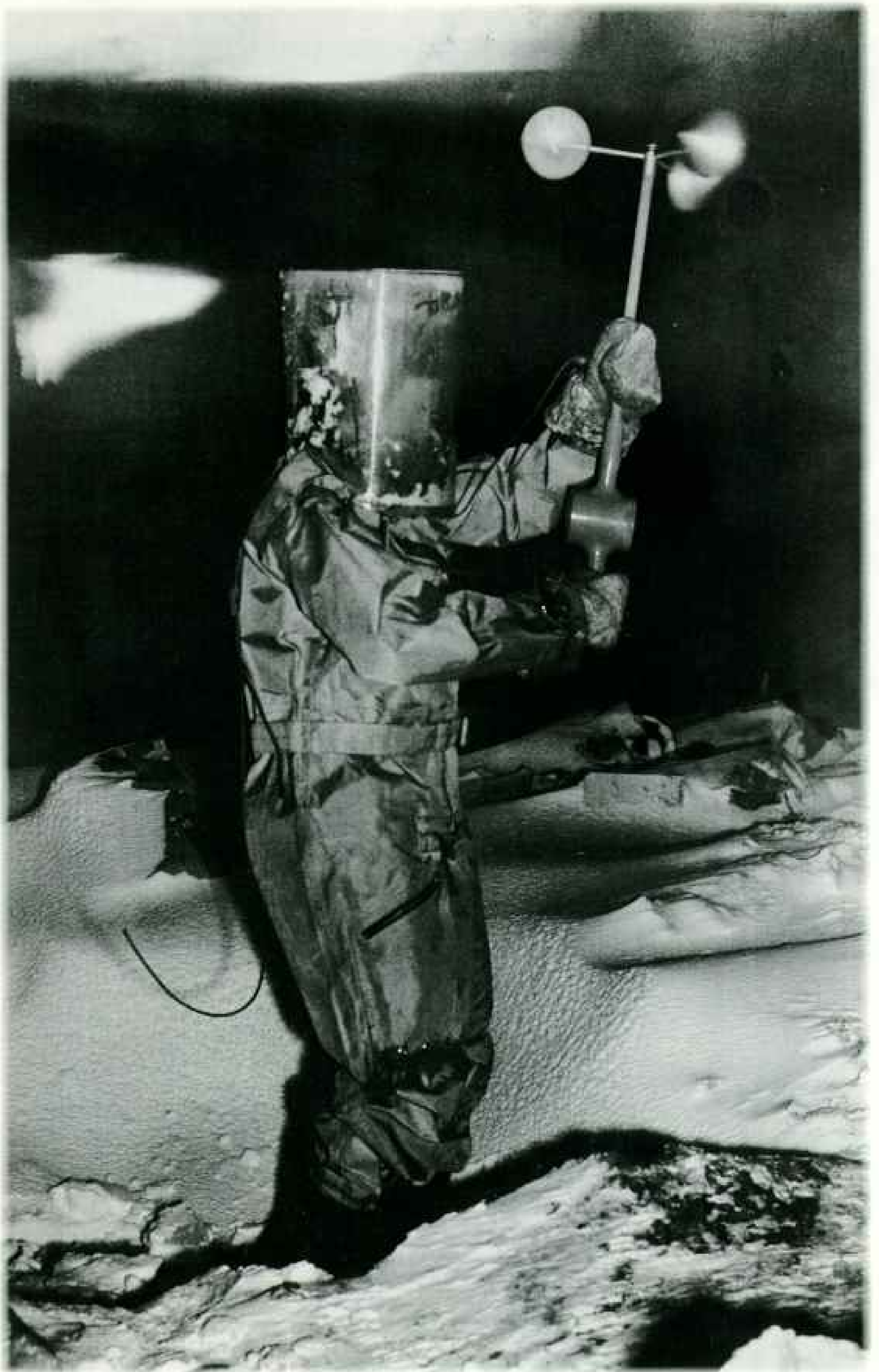
As I well knew, leaning on my shovel, life here was dominated by hard labor. With the prospect of beauty, exploration, glory, and mystery planted in their hopes, the young men and women who lived on Stonington spent much of their first months in tedium, preparing for the short summer season when weather and light allowed exploration. They packed trail bags. They killed seals and rendered blubber for dog food. They repaired their aircraft. They sewed, and sewed, and sewed. Jimmy Lassiter, a hot young Air Force pilot in 1947, told me that he spent more time at a sewing machine making equipment bags and flags to mark the trail than he ever did at the controls of his plane.

Our own work was similarly slow. Bob Weaver and our carpenter, Mark Melcon, braced walls, filled holes in roofs and floors, and put plexiglass in broken windows. Noel dug carefully at the heaps of debris outside the buildings where the residents had dumped anything they didn't want. And as fragments of the past began to accumulate, we tagged them. We stored them. Some would go home with us, but most would be left on display in one of the East Base buildings for occasional visitors: a razor, a jar of hair tonic, boxes labeled "Vitamins Plus." A toy balloon. Cases of medical supplies. A dozen boots of different sizes. A cork used as a pincushion. A Mormon text, *Joseph Smith Tells His Own Story*. A chess bishop. An eight of clubs.

We found strips of movie film with faces of forgotten stars; life here had had many of the trappings of civilization. Both Black and Ronne believed in keeping their teams busy through the winter: As well as preparing for the exploration season and taking care of the dogs, they took meteorologic and seismic data, recorded tides, and killed and skinned specimens of seals, penguins, and seabirds to take home to museums. But they also indulged in modern entertainment. This perplexed some of the men who, in their great zest for adventure, had expected a more spartan life.



"Every day as the snow melted, new things would pop up," says National Science Foundation archaeologist Broadbent (above, at right), who led seven other workers in digging out snow-clogged East Base during the brief Antarctic summer of 1991-92. Though located in the continent's "banana belt," where temperatures can reach a balmy 59°F, the crew still endured sudden 60-knot winds and cold snaps of minus 30°F with wind chill. At one point the team was poisoned by carbon monoxide from a cooking stove. "We felt a real kinship with the past," Broadbent recalls. "We suffered the same dangers, the same cold and isolation." Starting up from a pile of base artifacts, a Mormon text (left) perhaps gave spiritual comfort on some long gone winter night.



"Here we are, 26 hardy explorers marooned by the ice in the desolate land of perpetual snow and blizzards, reduced to making popcorn and fudge, playing bridge, watching movies," one member of Black's expedition remarked to a friend, who put it in his diary.

The Fumigator visited regularly. When it hit, the early residents of East Base would put *The Hurricane* on the movie projector and open the door. We just hid from it in buildings, but sometimes, feeling not so old ourselves, we played with its power. One day, hood close around my face, I was toiling against it toward our hut and almost ran into Mark Melcon. He was standing on a ridge, his arms outstretched, leaning his full weight into the wind, and wolf-howling with delight. "Sixty knots!" he shouted. "That's what it takes to hold you up!" I tried the same thing, minus the howls, whereupon the wind died abruptly and I fell on my face in the snow.

AT TIMES LIKE THESE the people of Stonington occasionally turned to strong drink. They brought very little alcohol to Antarctica, so expedition members made moonshine out of dried fruit fermented with baker's yeast. On special occasions during the 1940-41 expedition, biologist Herwil Bryant rationed out the alcohol from his bottles of preserved specimens. After a while, drinking became known as "draining a fish."

Draining fish did not help the loneliness, which was as common here as cold. I know it well. I have been more deeply lonely in Antarctica, a place I love as much as any on earth, than anywhere else. Maybe it is sharpened, like every sense in this place of extremes, by the violence of the wind and the poignant pale lightness of the calm days' blue silence.

"I had a terrific yearning for you this afternoon, Jean," physician Don McLean wrote in

Armored in a homemade plastic helmet against bone-piercing cold (facing page), a meteorologist gauged wind velocity for the 1947-48 expedition led by Norwegian-born explorer Finn Ronne. Polar researchers debate whether heavy glacial melting in some parts of Antarctica today is linked to global warming. An ice-and-snow ramp that glued Stonington Island to the mainland in the 1940s (below) has receded to show the island's true shape.



RONNE ANTARCTIC RESEARCH EXPEDITION (TOP); CHRISTOPHER P. LUSH

his diary in early 1947, addressing his girlfriend. "It was like a long, deep choke. . ."

The early explorers had regular radio contact with the outside world. They used Morse code and shortwave voice transmissions to send out official messages and news releases. We sent our reports back to Washington via Palmer Station over the shortwave. Palmer had a regular "mail" linkup, in which personal messages were passed over the radio, and



RONNE ANTARCTIC RESEARCH EXPEDITION

"I didn't want the sensationalism; I had a job to do," says Edith "Jackie" Ronne, 73, of her 1947-48 stay in then all-male Antarctica. One of the first two women to winter on the continent, Ronne filed dozens of news stories via radio for explorer-husband Finn (above, at right), who died in 1980. Some 400 women now follow her footsteps every year in the U. S. Antarctic Program.



we did much the same, using the long-distance shortwave connections of late night to call home on the ham channels.

"I love you! OVER!" photographer Robb Kendrick would shout into the mike to his future wife while the rest of us pretended not to listen. We teased him coarsely and envied him silently.

Until the days of Stonington the only acceptable place for women in Antarctica was in explorers' dreams. Today women's year-round presence in Antarctica is well established. But when Finn Ronne announced to his crew during the trip south in 1947 that his wife, Jackie, and Harry Darlington's wife, Jennie, would spend the winter as part of the East Base team, there was consternation.

"I was very much aghast at taking the women," the physician, Don McLean, told me. "I thought it would add a new problem, an emotional problem."

In spite of objections Finn took the women. But the dire fears of the men did not materialize; most of the expedition members I interviewed seemed glad the women had gone with them after all. "The women completely paid their way," Pete Peterson, the physicist on the 1947 expedition, told me at his office in San Francisco. "Their presence didn't cause friction. It was a charm."

THESE YOUNG MEN were indeed charmed, particularly when it came to luck. All their mishaps had happy endings. Some of the events were so unlikely they could only have happened in a place where the laws of real life were suspended.

In the spring of 1947 one expedition member fell 50 feet off an ice cliff. Thin ice broke his fall, and he survived with minor frostbite. Later in the same year pilot Chuck Adams stepped out of his airplane with the engine running, tripped and fell forward into the whirling propeller. He came to a moment later with a minor scalp wound, put a rag on it, and flew back to base to get it sewed up.

One night in July 1947 a group was watching *The Buccaneer* at East Base. Suddenly the door behind the screen opened, and a man walked, dazzled, into the light. It was one of the youngest members of the American team, 21-year-old Bob Dodson.

"Simultaneously," Jennie Darlington later wrote, "all of us were struck by a sense of disaster."

"Pete's down a crevasse," Dodson said. It was dark that July night. It had been dark since June. Walking toward camp after their tent had been shredded by a gale, Dodson and the East Base physicist, Pete Peterson, had been crossing what looked like smooth snow when Dodson stopped to tie his bootlace. He heard no cry, no scream. When he looked up, Peterson was gone. There was only a small round hole into a chasm of ice.

Tumbling, Peterson ended up landing headfirst. By the time he stopped, where the walls of the crevasse narrowed, 120 feet down, he may have been going 50 miles an hour. But his shoulders and backpack caught and jammed before he hit his head. He wasn't hurt, but he felt as if he was in a vise.

"It was like torture," he remembered when I interviewed him. "I think I passed out every now and again. I thought: 'Well, this is fate, and it has befallen me.'"

Above, men searched in faint moonlight. By the time they found the hole, it had been 12 hours since Peterson fell. A sledge was braced across the hole. The British doctor, Richard Butson, was lowered by pulley into an eerie cavern of blue shadows.

Twenty feet down Butson saw blood on the ice. He shouted at Peterson. No reply. He could see his body wedged far below. Halfway down he shouted again. A voice came floating up. "Here I am."

Butson had to take off his own pack and parka just to get into the narrow space where Peterson was jammed. He tied a harness around Peterson's thighs, and the men above pulled. At first Peterson didn't budge. Finally he went flying up with such a jerk Butson thought the rope had pulled Peterson's leg off. Yet when they got Peterson back to camp, they found not even one broken bone.

DANGER AT STONINGTON was not just physical. It was a small community under the stress of isolation. Because these characteristics are still part of Antarctic life, psychologists often study human interaction here. They would have loved East Base, not only because it was isolated but also because of the conflicts that developed there, notably between Finn Ronne and some members of the team.

"Ronne was the kind of guy you'd go to hell and back with," declared Larry Fiske, a member of Ronne's expedition, when I talked with



WILLIAM H. LETADY

"With only a paper-thin wall between us and 19 others," Jennie Darlington noted in her memoir, "it has been, at times, like living in a men's locker room." Married just weeks to Ronne—expedition pilot Harry Darlington, the young polar recruit, then 22, proved her mettle by shuttling supplies by dogsled. Today the couple remain adventurous—spicing their lives with sailing, farming, and travel.





Matches, vitamins, jars of malted milk, and dried fruit spill from a supply cache found as it was left by the 1940 expedition. "Some of the food looked good enough to eat," says Noel Broadbent. "If we had gotten stuck there, we could probably have survived on the stuff." Freeze-drying winds and a near-total absence of bacteria also kept discarded clothing intact and 1939-vintage



magazines readable after more than 50 years. One memento was more poignant: a dog skeleton found huddled among the food boxes. The husky, Broadbent believes, may have escaped the expedition's rushed attempts to humanely kill dozens of sled dogs during the base's emergency prewar evacuation—a desperate move meant to spare the abandoned animals from slow starvation.



Staking out a dirty job, worker Ben Hodges plants a warning sign near an East Base dump containing five-gallon cans of human waste. Workers covered the site with stones to discourage tampering by occasional cruise-ship visitors. Most hazardous materials were removed, including the corroding battery from a tracked vehicle and old medicines.



him at his home in New Hampshire. "But when you got back, you'd know that's where you'd been."

When Ronne was giving lectures, raising money, and recruiting his team, he was utterly charming: a man of humor and enthusiasm. In Antarctica he became disciplined, rigid, intolerant. "Finn couldn't understand modern American youth," Peterson told me in San Francisco. "And he couldn't outwit it."

American youth was relaxed, ebullient, independent, hard to control. Ronne wanted strict discipline and devotion to duty. He ran his expedition with an iron hand. He reviewed every incoming or outgoing radio message. At first he forbade the men to socialize with the nearby British base. He banned alcohol except on rare occasions.

Ronne's style of leadership so angered and frustrated the young physician on his expedition, Don McLean, that once when the two men were hiking on a nearby island to look for snow petrel nests, McLean thought of pushing Ronne off a cliff. "I never came so close to killing anybody in my life," McLean told me.

Don McLean started calling his bunk space "Pitcairn Island," the place Fletcher Christian and his companions lived after the mutiny on the *Bounty*. Mutiny was actually discussed but never attempted.

"Ronne could not achieve a close human relationship with any of his troops," Peterson said to me. "But I thought he was right and American youth was wrong. I made up my mind I'd be with Finn. I would have been with Captain Bligh."

Peterson admired both Ronne and Bligh for their sense of mission. And their mission was the one thing we couldn't share: exploration.

TO US EXPLORATION was a source of endless interest. We were like little children fascinated by something unfathomable in the adult world—shaving or war or automobiles. I often found myself staring up the long windblown slopes and crevasse fields of the glacier to our east, trying to visualize men and dogs disappearing into the snow smoke along that forbidding horizon. It seemed impossibly brave.

The journeys were prodigious. Ronne and a biologist named Carl Eklund left Stonington on November 6, 1940, and returned January 28, 1941—84 days on the trail. They sledged a total of 1,264 miles, one of the longest journeys

on foot in Antarctic history, mapping as they went. They left home with 24 dogs and returned with 7.

The flying was not as grueling but was just as dramatic—and dangerous. The sky was a volatile brew. Updrafts and downdrafts over the mountains could be treacherous even on clear days. Black's 1940-41 expedition had only one aircraft: A big, lumbering twin-engine Curtiss-Wright Condor biplane. Having only one plane was in itself a risk: If the plane crash-landed somewhere, there was no second plane to go find it. Nevertheless, the plane went out on repeated photographic journeys over the mountains and ice plateaus of the interior.

Although fame did not follow the young men and women of Stonington back to civilization, the dreams of adventure and exploration that brought them here were abundantly realized. But by its nature, discovery could not be repeated.

Ben Hodges, one of the two assistants from the British base, had come here in 1961, only 13 years after Ronne, but he envied the earlier explorers. They had done the real thing.

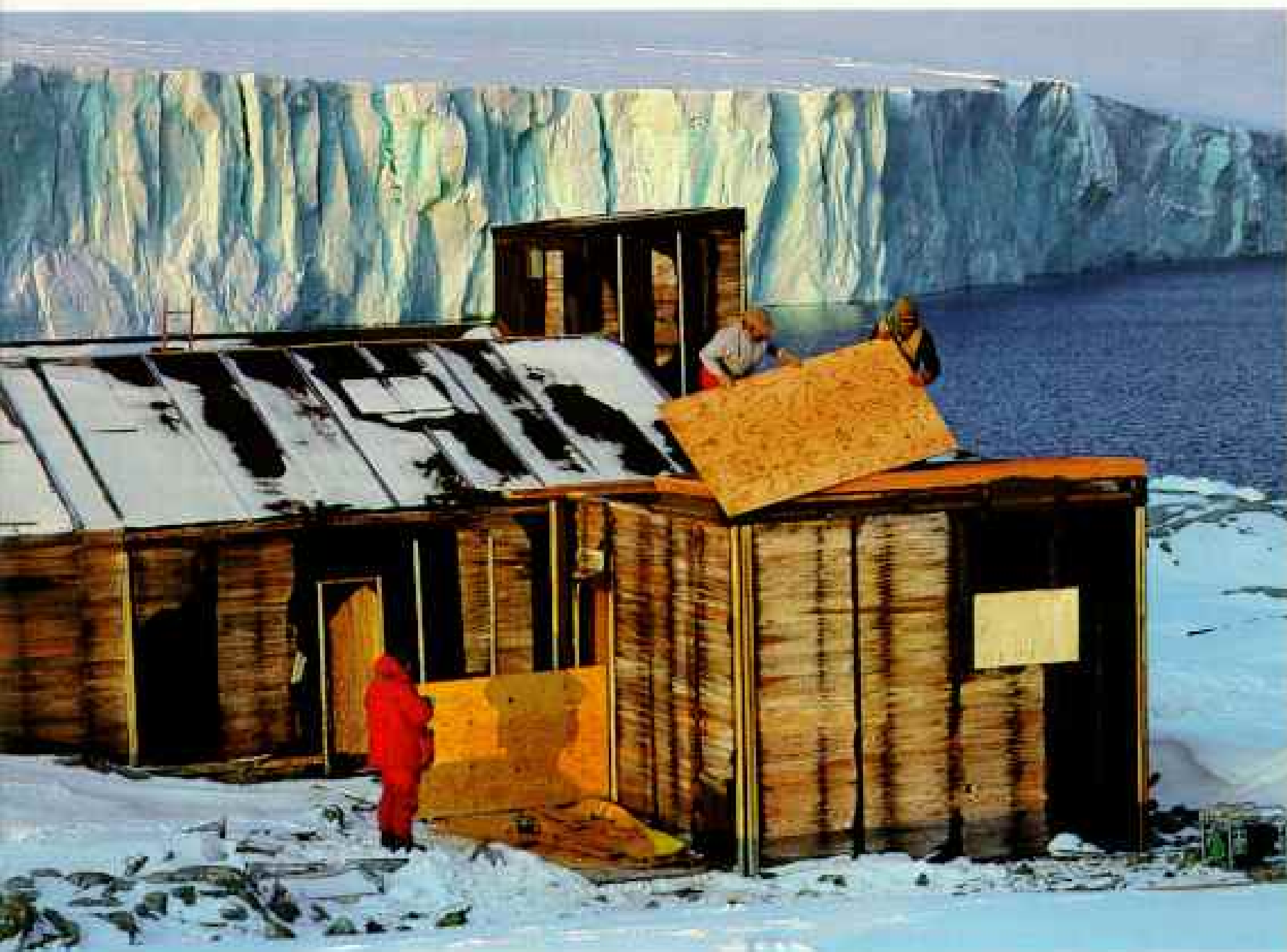
"I was on the fringes of it," he said one night as we sat around the stove draining fish. "And I'm proud. But I wasn't a pioneer. I'm happy, but not content. I'm still restless. I think about that Kipling poem: 'Something lost behind the Ranges. Lost and waiting for you. Go!'"

OUR TIME ON STONINGTON drew to an end in a week of calm days, which helped us finish our work. We created what must be one of the most remote museums in the world—a collection of artifacts in the base's old science building, with an interpretive plaque. We covered dumps with rocks and prepared hazardous materials for removal. But the weather was too good for Ben.

"I'd like the ship not to be able to get in at first," he said. "I'd like a storm. I'd like the hut to vibrate."

Only in Antarctica would such a wish be granted. The familiar Fumigator wind blasted down the glacier the next day. Mark Melcon howled. Ben grinned. The hut vibrated. The ship could not get in.

Our storm was nothing compared with what Black and his team had faced. In March 1941 when the ship came for them, they were thoroughly frozen in. The ship could get no closer than a hundred miles. With the



"By the time World War II ended . . . ," Finn Ronne wrote a year before his death, "only one section of our planet remained a mystery: the Antarctic." Racing against the long polar night, workers re-roof Ronne's East Base hut, preserving for all nations the echoes of that mystery.

breath of the World War hot in his face, Black decided to try to use his big biplane to ferry men to an island near the ship.

On that desperate trip men were ordered to leave everything behind except survival gear. This meant the loss of most scientific samples—with one large exception. On its second and last ferry trip the plane staggered into the air after a terrifying takeoff run on the glacier east of the island. As the faces of the 14 men inside regained their normal color, the biologist, Herwil Bryant, fumbled with the bundle of survival clothing on his lap. From within emerged the beak, the head, and the blinking eyes of a live giant petrel—a bird the size of a turkey, with a six-foot wingspan.

The men cheered. The biologist had cheated authority and had saved one bird for science.

Bryant's giant petrel made it to the National Zoo in Washington, D. C., and lived for about a year. And in a way the biologist and the bird were symbols of what the exploration of

Antarctica—and the rest of the globe—was soon to become: the domain of science. Stonington may have been a last outpost for drawing the raw shape of the earth, but it was just a beginning in our efforts to understand it.

THE FUMIGATOR WIND ENDED. We boarded the ship in a sudden luminous calm. As if the captain shared our reluctance to leave, the ship stayed anchored offshore while night fell. In the early morning darkness the clank of the anchor coming up woke me. I went to the bridge and turned the searchlight toward the island.

A privilege to live here, a sadness to leave. I swung the light over the old buildings, now left alone with our small efforts to honor their history. The spot caught the plexiglass we had put in the windows. The windows shone. And for a while it looked as if the lights were on at Stonington and there was still something lost and waiting behind the ranges. □

IT STILL HAS FOUR TIRES AND THE
STEERING WHEEL IS ON THE LEFT.

OTHER THAN THAT, EVERYTHING ELSE
HAS CHANGED FOR THE 90'S.



FORD ESCORT

A WHOLE NEW
BALL GAME FOR
SMALL CARS

A NEW CAR.

When we decided to completely redesign Escort for the 90's, every component was carefully examined to see what we could do to make it better. The result was an all-new Escort.

A NEW WAY TO BUILD IT.

Our efforts toward improving Escort extended all the way to

the assembly line. We found ways to improve our procedures and increase worker involvement in the manufacturing process. The goal behind these efforts... improving the quality of every Escort we build.

A NEW WAY TO BUY ESCORT

Our innovative thinking didn't stop with the way we build Escort.



We've also made it simpler to buy an Escort. Because you can get four different LX models for the same, low price. Choose the three-door, the four-door sedan, the five-door or the wagon. All equipped with air conditioning, AM/FM stereo, power steering, power mirrors and more. Four Escorts. One price. It's that simple.

All this innovation is aimed at one goal...increasing the satisfaction of our customers. It seems we're hitting our mark, because Escort has more repeat buyers than any car in its class.

Buckle up-- together we can save lives.

**HAVE YOU DRIVEN
A FORD LATELY?**



THE PRESIDENT'S REPORT ON THE Education Foundation

Students and Teachers Explore With Marco Polo

The sea has long held a special allure for me, so I must admit to being a bit envious of 35 youngsters and teachers who spent two weeks last summer studying the geography of Egypt and cruising the Mediterranean Sea as part of a National Geographic Society-U. S. Navy program.

Project Marco Polo puts teams of educators and students aboard Navy survey ships, where they study oceanography and experience



different cultures at ports of call.

For a week before they set sail, the group toured Egypt and learned about the Navy's medical programs to fight diseases in Africa.

Then, on board the U.S.N.S. *Chauvenet*, students launched weather balloons, collected data for nautical charts, and took sediment samples from the sea bottom. The crew taught the youngsters navigation, knot tying, and how to spell their names with signal flags (right).

"The sea was so clear," recalls Brant Oliphant, who learned to use a sextant during the voyage (above). The 13-year-old seventh grader from Juneau, Alaska, added that "at home the water's murky because of silt that runs off the glaciers."

After gathering plankton in nets and examining the minute creatures under a microscope, Brant, who had planned to be an architect, now says, "I might really want to be a naturalist."

For nearly three years the Oceanographer of the Navy, Rear Adm. Geoffrey Chesbrough, and I have been working hard to make Marco Polo a model example of how two



BOTH BY PAT LANZA

very different organizations can join forces to enhance geography education.

The first Marco Polo trip was to Indonesia. Next came a voyage to waters off the east coast of Japan. Last year's trip, starting in Egypt and ending in Greece, involved teacher-student teams from Alaska, California, Michigan, Minnesota, and North Carolina.

The most important work comes after the explorers return home: They share their experiences with

others, speaking before school assemblies and local service clubs.

I hope we'll see many more Marco Polo voyages. Both the Society and the Navy eagerly look forward to broadened support for the program—from other agencies, foundations, and corporations. Such sharing of resources will ensure Marco Polo's future as a unique tool for spreading geography education.

Silbert Browner

Mrs. Johnston's Science Class: Just Add Water.



It's that easy, thanks to a 31-foot, two-masted Bolger Gloucester schooner these students built themselves.

The project is the brainchild of Therese Johnston, a science teacher at George Washington Junior High in Alexandria, Virginia.

"I wanted to involve them in something that extended beyond the classroom," explains Therese, "something that would be meaningful throughout their lives."

That's why the building of the boat is just the beginning. These students, thanks to their conservation-minded teacher, are passionate about protecting and preserving the environment. Their goal is to use the schooner to study the effects of pollution on the nearby Potomac River.

"This project has really empowered my students," says Therese. "They believe that they can effect change, that they can make the world a better place."

For helping launch her students into a lifelong fascination with science, State Farm is proud to present Therese Johnston with our Good Neighbor Award, along with a \$5,000 contribution to her school.



STATE FARM INSURANCE COMPANIES
Home Office: Bloomington, Illinois

Good Neighbor Award

Geographica



BRIND HEIST

last September: 144 hours, 23 minutes. *Double Eagle II* set the old mark, 137 hours, 6 minutes, in the first successful transatlantic balloon crossing (*GEOGRAPHIC*, December 1978); one of its pilots was the late Ben Abruzzo, Richard's father.

Bradley and the young Abruzzo, both from New Mexico, were flying aboard a helium-and-hot-air craft called *Team U.S.A.*

An Aerial Assault to Save Desert Elephants

Only 80 elephants survive in the Kaokoveld Desert of Namibia, one of two deserts in Africa where elephants make their home (*NATIONAL GEOGRAPHIC*, January 1992). When a game worker found the carcass of an anthrax-stricken elephant in the Hoanib River last summer, officials feared that the bacterial disease could wipe out the entire Hoanib herd. They mounted a rescue that bore all the hallmarks of a military attack.

An airplane spotted the quarry and called in a helicopter. From the hovering chopper a crew fired barbless, vaccine-filled darts, inoculating 19 of the elephants (above). Months later the inoculated animals

showed no indications of illness.

Previously unknown in the Kaokoveld, anthrax is common elsewhere in Africa, sometimes spread by water contaminated by infected animals. The disease claims 20 to 30 elephants yearly in Namibia's Etosha National Park, despite an inoculation effort there. With drought drying up many water holes, officials worried that the Hoanib River herd would become dependent on a lone infected source of water.

A New Balloon Record, Tribute to a Father

Completing the first balloon voyage from North America to Africa, Richard Abruzzo and Troy Bradley notched a new endurance record for balloon flight

in the first transatlantic balloon race, which began in Bangor, Maine (below). Knowing that balloons from Belgium and Great Britain had already landed in Europe and that Dutch and German teams, jolted by violent storms, had ditched at sea, they maintained their southeast track. They settled in the dry red dirt east of Casablanca, Morocco, after their instruments ran out of battery power, severing communication links. A throng of curious people gathered to greet them, and the Moroccan Air Force helped the pair stow their gear and fly out.

Richard Abruzzo, 29, says he is proud of the records set by his father, who died in a 1985 plane crash. "That we were able to break one of his records made this achievement special," he says.



You hold your child's hand when she crosses the street, you won't let her climb to the top of the jungle gym and you make her wear a life preserver in the kiddie pool.



Have we got a minivan for you.



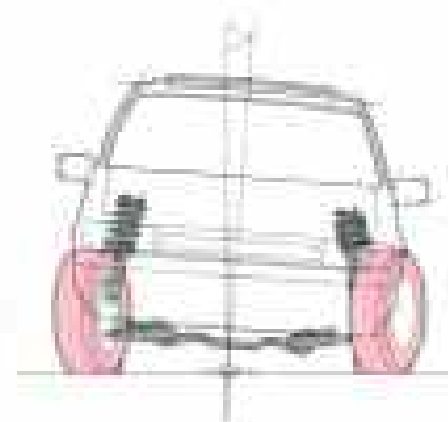
*Think of us as very over-protective parents. The Nissan® Quest® is one of the few minivans to meet 1993 Federal passenger-car safety standards.**



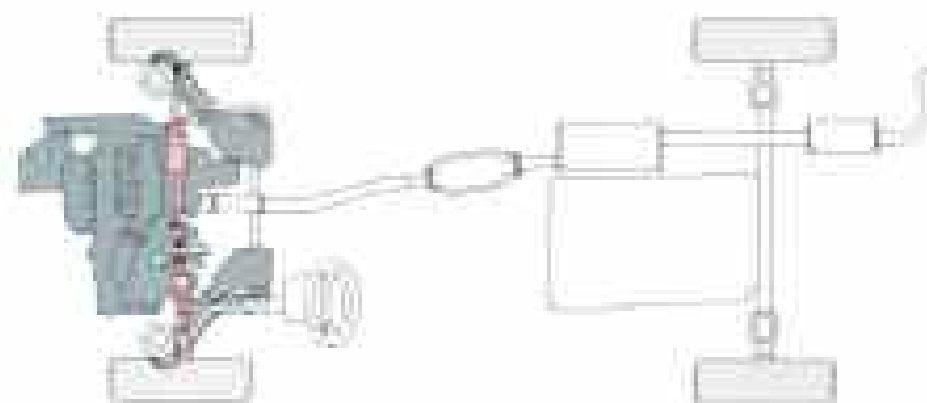
Front cornering lamps provide added side-view illumination when turning at night.



At Nissan we believe the more durable a car is, the safer it is. For instance, to test its durability, the Quest logged nearly one million miles.



We took a very level-headed approach to safety. A front stabilizer bar helps keep the Nissan Quest level during cornering or lane changes.



By placing the engine weight over the drive wheels, our sophisticated front-wheel drive provides added traction.

Nissan Motor Corporation in U.S.A. Smart people always mind the fine print. And they always wear their seat belts. *Except models with privacy glass.



Did we mention the Nissan Quest comes with its own body guards? Steel side door guard beams provide added protection in case of a side impact. And pillar/roof reinforcements increase body rigidity.



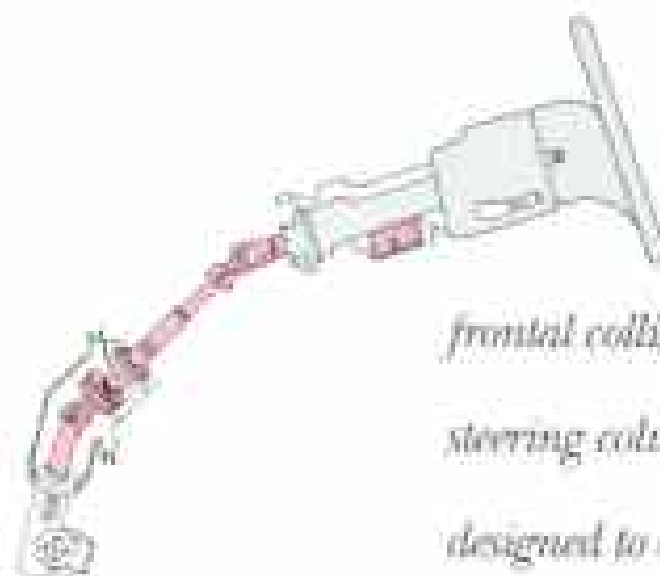
When it comes to braking we didn't stop with our power-assisted brakes. An optional 4-wheel anti-lock braking system is also available.



To us concerns about safety are automatic, which is why we've included front automatic motorized shoulder belts. And 3-point seat belts are found in outside positions in second and third row seats.



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



A few items on the Nissan Quest are actually designed to break down. In a frontal collision, the steering column is designed to collapse to help prevent it from intruding into the passenger compartment.

The New Nissan Quest



It's time to expect more from a minivan.

Drive a Quest by remote control.

All you need to drive the new
Nissan Quest minivan is a VCR.

Return the coupon or
call 1-800-NISSAN-3 and we'll
send you Quest Drive. An
exciting driving experience
on videotape, featuring
remarkable innovations
your whole family will
appreciate. Free.

But, hurry. These
tapes may go faster
than the minivan itself.

*The New Nissan
Quest*



*It's time to expect more
from a minivan.™*

1-800-NISSAN-3, ext. 124



Yes. Please send me a free
Quest Drive videotape.

Name _____

Address _____

City _____

State/Zip _____

Phone _____

We have (number) ____ vehicles.
They are (make, model, year)

The vehicles I am considering
include (make, model, year):

For additional information, please
call 1-800-NISSAN-3, ext. 124.

Quest Drive, c/o PCCI
P.O. Box 91-1190
Commerce, CA 90091-1190



MARIA STENZEL WITH LARRY D. RIMNEY, NPS STAFF

Museum's Labels Now Carry Corrections

What's the problem with this diorama in the National Museum of Natural History in Washington, D. C.? A sign explains: "The images of the female and young lions sitting turned away from the [zebras] are misleading, it is the females who do the hunting."

A label for a lineup of stuffed animals in the Hall of Mammals carries the disclaimer: "The display does not indicate how the African Great

Plains big game mammals interact with other animals and with plants; it does not describe the Great Plains ecosystem."

A museum proclaiming that its own exhibits are wrong? Yes. Recent scientific research has overturned ideas common when the mammal exhibits were installed in 1960. The museum wants to root out errors and biases. "We use these 'dilemma' labels to get new data in without tearing these beautiful exhibits out," says the museum's associate director, Robert D. Sullivan.

"We're trying to say that the science they're showing is flawed." It's not merely being trendy, he insists, but ensuring that the exhibits are accurate, balanced, and fair.

When Windsor Castle Was Just a Timber Fort

A massive stone edifice that symbolizes the British royal family, Windsor Castle began around A.D. 1070 as a wooden stockade built by William the Conqueror on a bluff in the middle Thames Valley. "It's a day's march from London, on an ideal spot for a fortress," says J. Brian Kerr of English Heritage, who heads excavations at Windsor.

Recently, as engineers made plans to stabilize the castle's Round Tower, Kerr's team discovered remains of that first timber stockade: its well and several postholes that suggest a circular line of defense. They also learned that the immense tower, undamaged in last November's fire, rose in the late 12th century on the foundations of an even larger stone keep built around 1110. Kitchen residue and pottery sherds help chart additions to the castle, the largest in Britain.

Fish With Heaters to Warm Their Brain

Any homeowner knows it takes less energy to heat a single room than to warm an entire house. Some fish follow the same principle: They save energy by heating just their head.

While most of the world's 30,000 bony fish species are cold-blooded, a handful of large ocean-dwelling fish, like the tuna, are fully warm-blooded. But the billfish—including marlin, swordfish, and sailfish—don't need to heat their entire body to adapt to changes in water temperature. A mass of muscle attached to each eye (inset) adjusts the brain's temperature as the fish swim through varying ocean depths.

"The billfish have built a furnace out of muscle," says Barbara Block of the University of Chicago, who

studies the seagoing space heater. A swordfish, shown here, endures temperature variations of as much as 60°F, spending half its time in deep, cold water, the rest near the surface. Thus it can dine on a wider selection from the oceanic cafeteria. "It's a classic case of adaptation," says Block. "With more niches to exploit, there's a greater variety of food available."

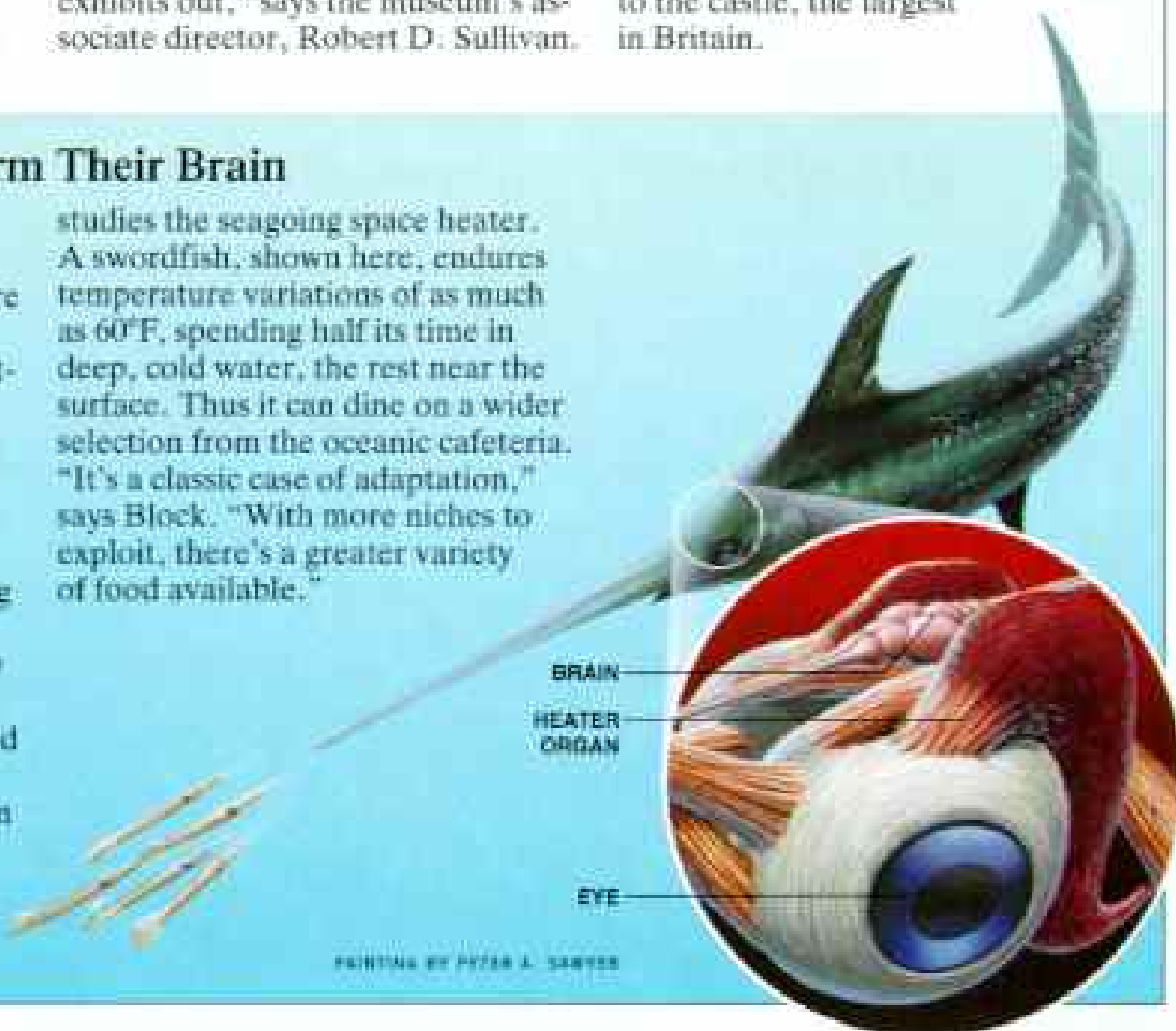


ILLUSTRATION BY PETER J. SARRIS



**“Ask your doctor about
the Nicoderm patch.”**

Available by prescription only.

NICODERM[®]
[nicotine transdermal system]



Geographica



MARK S. MOHR (BELOW RIGHT); DAVID DOUBILET



NEO CARTOGRAPHIC DIVISION

Monterey Bay Waters Gain Protected Status

Deeper than the Grand Canyon, larger than any park in the lower 48 states, a 5,312-square-mile section of California coastal waters has become America's 11th marine reserve: Monterey Bay National Marine Sanctuary.

The state first proposed sanctuary status in 1977 to ban oil, gas, and mineral exploration and to protect the bay's array of marine life—from seabirds to sea otters (above), from algae to whales (*GEOGRAPHIC*, February 1990). But heated battles among environmentalists, business interests, and federal, state, and

local agencies caused delays.

The discharge of pollutants in the sanctuary will be strictly limited. So will airplane overflights, the use of jet skis, and the taking of marine mammals, seabirds, and sea turtles.

A 94-square-mile area west of San Francisco, where dredges deposit their spoils and the city dumps treated sewage, was excluded from the reserve.

Belated Honors for the Buffalo Soldiers

A bronze horseman unveiled last summer at Fort Leavenworth, Kansas, pays homage to the U. S. Army's black troops who helped win the West.

The "Buffalo Soldier" recalls the Ninth and Tenth Cavalry and the 24th and 25th Infantry, regiments formed after the Civil War and composed of volunteers commanded by white officers. In the 1880s one-fifth of all cavalymen were African Americans. The Cheyenne called them Buffalo Soldiers—apparently because they thought the hair of the soldiers resembled that of the sacred buffalo—and the men proudly adopted the name. Twelve of the soldiers won the Medal of Honor for service in the West.

Colin Powell, the first black chairman of the Joint Chiefs of Staff, had suggested a monument in 1982 when he was stationed at Fort Leavenworth. He found the regiments were forgotten but for the names of two alleyways. Carlton Philpot, a black

Navy commander who teaches at the post, formed a committee in 1989 to fund the statue, created by black sculptor Eddie Dixon.

"We want to put the words 'Buffalo Soldiers' into the encyclopedias and history books," Philpot says.

A Minoan Precursor to Classical Greek Art

Crafted from hippopotamus teeth and once dressed in gold garments, this 20-inch-high statue of a young runner is helping specialists redefine the art of the ancient Minoans.

A team led by archaeologists L. H. Sackett and J. A. MacGillivray found the shattered statue while excavating at Palaikastro, Crete. It was carved just before Greek invaders overran the Minoans about 1450 B.C.

Traditional views of the Minoans emphasized their peacefulness and development apart from Greece. But researchers recently have discovered large Minoan fortifications. This statue—similar to later Greek boy-gods in motion—suggests that the Minoans prefigured the realistic art styles and myths of the Greeks by a thousand years.

—BORIS WEINTRAUB



L. SCHWAB, BUFFALO SOLDIER MONUMENT COMMITTEE



SABLE The front-wheel-drive sedan with standard dual air bags* and available anti-lock brakes. Named three times to *Car and Driver's* Ten Best list.



CAPRI A 16-valve, twin-cam ragtop with front-wheel drive and something many of its competitors lack: a back seat.



COUGAR XR7 The classic American touring coupe with classic Mercury appointments and more interior room than anything in its class.

All Of The

No matter what you're looking for, Mercury is the answer.

**Except models with privacy glass the in window tinting. †Included in package. ‡MSRP.



VILLAGER The minivan that drives like a car. And the only one that meets all federal car safety standards and has standard four-wheel anti-lock brakes.**



TRACER Why have a small car when you can have a small Mercury? So well equipped it has automatic transmission and air conditioning at no charge!†



GRAND MARQUIS Mercurys don't come any roomier or any plusher. And this one comes with standard dual air bags*†

Above.

 **MERCURY**
ALL THIS AND THE QUALITY
OF A MERCURY

For a free catalog, call 1-800-446-8888

Forum

Sense of Sight

Your article in the November 1992 issue touched many hearts and minds, particularly down under. Our Australian of the Year for 1990 was Fred Hollows, an ophthalmologist who first declared war on widespread blindness among Aborigines in the outback. His work led to the training of teams to work in Eritrea, Nepal, and Vietnam. Vietnamese refugees here are so impressed that they have buried political resentment to contribute funds for his work in their homeland.

AVICE LAMBERT
Wingham, New South Wales

Not mentioned in your article is Helen Keller International, an organization committed to the prevention of blindness, sight restoration, and rehabilitation programs in the developing world. Throughout Latin America tens of thousands of cataract surgeries are performed every year at a low cost of \$45. Around the world we assist blind children to develop fundamental skills. Our programs demonstrate it is possible to achieve Helen Keller's dream that every individual live an independent and productive life.

JOHN M. PALMER, EXECUTIVE DIRECTOR
*Helen Keller International
New York, New York*

Is sight really "our most precious sense"? Not according to Helen Keller, who found "after a lifetime in silence and darkness that to be deaf is a greater affliction than to be blind. . . . I have imagination, the power of association, the sense of touch, smell and taste, and I never feel blind, but how can I replace the loss of hearing?"

EDWARD D. DONOVAN
Nashua, New Hampshire

James Perley Storer tells of his joy of being able to access information without relying on sighted people (pages 28-9). For 30 years Choice Magazine Listening has provided free tapes of high-quality magazine articles, literature, and poetry for people who are unable to read because of blindness or other physical impairments. To listen, the subscribers can obtain a special tape player—also free—from the Library of Congress.

LYN DOBRIN
*Choice Magazine Listening
Port Washington, New York*

We had decided not to renew, because it seemed that all you could write about was environment and animals. The article on sight changed our minds.

AGNES LERCH
Rockville, Maryland

In 1985 a team led by David Newsome tested giving zinc to slow the progress of macular degeneration. The tests were well controlled, and the group with the extra zinc had about half as many cases of worsening eyesight.

RAY GROGAN
Honolulu, Hawaii

The National Eye Institute has begun a nationwide study investigating whether zinc and certain vitamins can forestall macular degeneration and cataracts. Until the study is complete—around the year 2000—the jury is out on zinc. Meanwhile, doctors advise against taking large doses without supervision, warning of possible toxic effects and complications.

During the Sino-Japanese War we lived in a hamlet in Yunnan, China. All the villagers, including months-old babies, were infected with trachoma; most of the old were blind. Why? I solved the riddle very soon. Each morning the women fetched well water and filled a washbasin. First the grandparents washed their faces, then the parents, finally the children. All with the same water. So the dread disease spread. At a party in my garden, I explained the problem to all the women and told them to use small washbasins, change water for every person, and give everyone his own washcloth. When we moved away five years later, all infants born after my party were free of trachoma, and even the condition of the old had improved.

BARDINA LIU
El Centro, California

Radial keratotomy is a comparatively simple procedure, and new laser technology may reduce whatever risk there is even further. I was severely nearsighted for over 30 years. My RK at 48 years of age in 1985 resulted in near-20/20 vision in both eyes. The joy of being freed from glasses and contacts cannot be appreciated by anyone who never has had to wear them.

G. MICHAEL YOVINO-YOUNG
Oakland, California

Portugal's Sea Road to the East

When I was raised in a large Portuguese community in the San Francisco Bay area, the golden age of Portuguese history with all the stories of adventure, heroism, and achievement was passed on to me as it has been for the past 500 years. That is, from father to attentive son. The Portuguese age of discovery has an integral role in world culture and history. Merle Severy's article brings to light how and why the Portuguese accomplished this.

EMMANUAL DA COSTA
Corvallis, Oregon



© 1993 American Plastics Council

A very important half-second, though.

But while the lifesaving benefits of automotive air bag systems are well-known,

keep food fresh and safe. And shatter-

resistant plastic bottles. • To learn more about how plastic can make a world of

Some Benefits Of Plastic Last For Only Half A Second.

what isn't well-known is that many components, including the bag itself, are all

made of plastic. • Of course, plastic makes a lot of things safe. Like packaging that keeps medical equipment sterile.

And harmful medicines out of the hands of children. Plastic wraps and trays that

difference in our lives, just call 1-800-

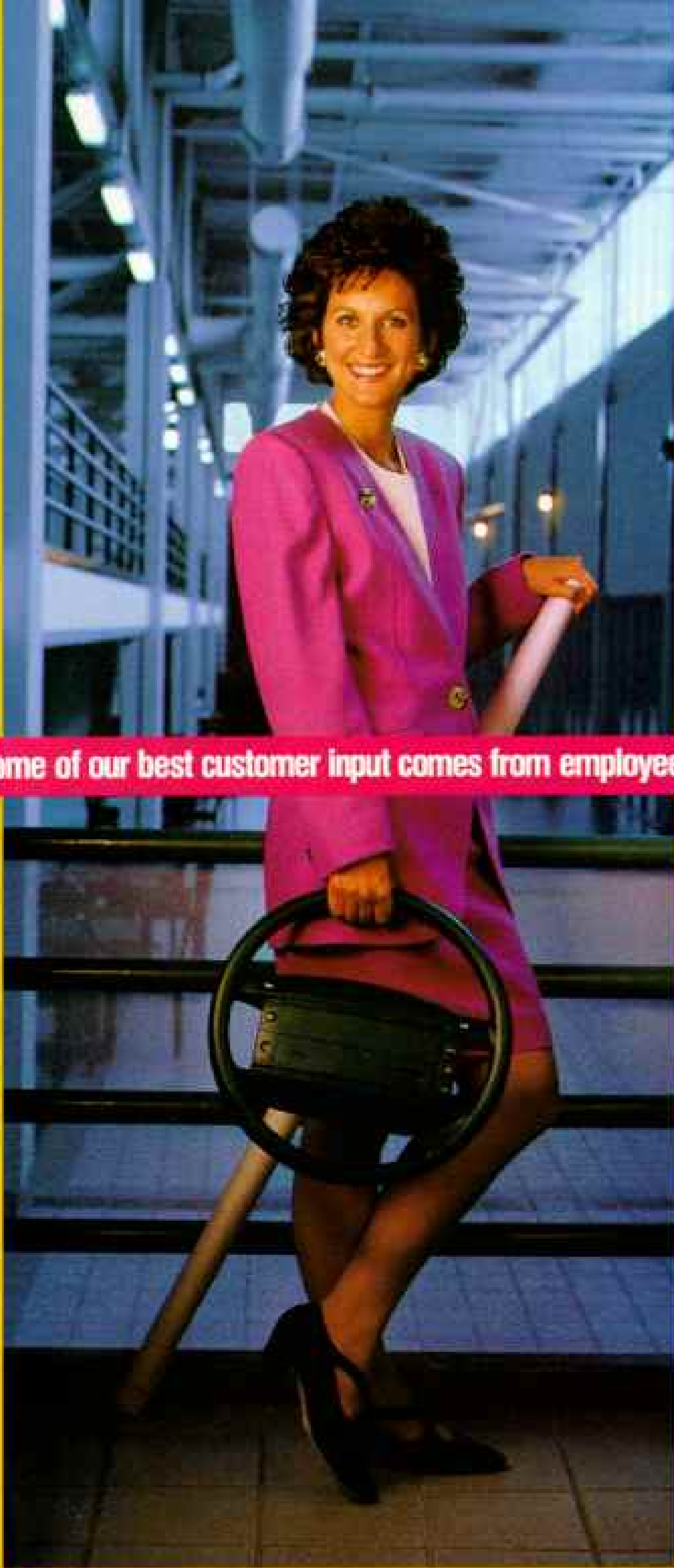
777-9500 Ext. 45, and the American

Plastics Council will gladly send you a free booklet. • Because even though some

benefits of plastic, like the air bag, may

last a mere split second, it may be one your family will remember for a long time.

TAKE ANOTHER LOOK AT PLASTIC.



Susan Pacheco-Baker,
Ford Mechanical Engineer

"Some of our best customer input comes from employees."

Because our employees are customers too, they want the same thing in a car or truck as you do. So at Ford Motor Company we encourage everyone, in every area of the company, to share their ideas. And it's this kind of thinking that has resulted in vehicles like our Ford Explorer having one of the highest customer satisfaction ratings in the industry. People know a good idea when they see it.



Ford • Lincoln • Mercury • Ford Trucks

QUALITY IS JOB 1. IT'S WORKING.

Rockin' up—Together we can save lives.

Always hold an original Ford Motor Company official repair card.

You state that after the Portuguese were expelled, Japan turned in on itself; this suggests there was no Western influence for the next 200 years. However, the Dutch kept a post on Dejima island in the harbor of Nagasaki until 1854, when Japan was opened to world trade. From this contact the Japanese got a knowledge of Western medicine and maps. The Japanese still use many Dutch words, especially in the medical field. Recently the Japanese rebuilt Dejima as it was during the Dutch years and opened a museum there.

JOOST L. REMMERSWAAL
Hoog Soeren, Netherlands

Martin Behaim deserved a mention. He made the world's oldest surviving globe, now in the German National Museum in Nürnberg. While living with the Portuguese, Behaim impressed John II with his knowledge of navigation and claims to have joined a Portuguese expedition down the African coast in 1485. This voyage may have inspired some illustrations that decorate his globe.

RONALD HILTON, PRESIDENT
*California Institute of International Studies
Stanford, California*

Discoveries by the Portuguese included what are now little-known remnants of the British Empire in the South Atlantic. Ascension and St. Helena were discovered by navigator João da Nova Castella in 1501 and 1502 and Tristan da Cunha by Adm. Tristão da Cunha in 1506. St. Helena, with its equable climate, abundant water, and lush fertility, was the greatest prize. Although these islands have a population of less than 7,000, they have a rich, well-documented history.

CHARLES B. FRATER
London, England

Eagle Recovery

I am pleased at the success the Sutton group has had in repopulating the southern bald eagle. However, I wonder if man in his desire to assist mother nature isn't ultimately ensuring her demise. Although great care has been taken to eliminate human imprinting, it seems impossible to re-create the environment that these chicks would face in the wild. We have eliminated "survival of the fittest," and we may have implanted a genetic time bomb.

LARRY BERGSTROM
Graham, Washington

Maya Heartland Under Siege

The pace and extent of the assault on the Petén's forest is indeed frightening. Last September en route to the spectacular ruins at Tikal, I was shocked by the smoldering remains of recently cleared forest that stretched up to and beyond the national park boundary. Sadly, declaring a reserve on paper doesn't necessarily ensure its protection.

ROBERT MANN
Norwood Green, England

Frank Miller's use of a global positioning satellite (GPS) receiver to find his location in the Maya Biosphere Preserve (page 106) is an excellent application of this technology. New, ever smaller units allow this portability and accuracy. However, GPS receivers do not bounce signals off passing satellites. They are passive receivers, like your AM/FM radio. They receive the signals simultaneously from several moving satellites and calculate the receiver's latitude, longitude, and altitude, and the time.

DON DERRINGTON
Santa Rosa, California

The nine-child Burgos family on page 96 tells the story underlying the destruction of tropical forests. Guatemala's population is increasing by more than a quarter million each year. For many, subsistence farming is the only way to survive, and clearing trees is the only way to obtain land for food production. Food shortages are inevitable in Latin America if growth rates do not come down.

KEITH C. BARRONS
Bradenton, Florida

Catskills

As a hiker, I was disappointed that no mention was made of a premier recreational activity in the Catskills. Hikers have access to many miles of marked hiking trails, unmarked woods roads, and some 35 peaks over 3,500 feet. The Long Path uses several trails on its way from the George Washington Bridge to its terminus north of Windham High Peak. Traditional hotel use may be changing, but the lure of walking through woods, by streams, and to lofty summits remains and is being discovered by more walkers every year.

STELLA GREEN
Woodcliff Lake, New Jersey

The wonderful article by Cathy Newman really spoke to me. The western North Carolina mountains that have been home to my family for eight generations are dealing with the same problems and opportunities. I am most saddened to see our countryside and communities being culturally and socially diluted to accommodate a "rustic mountain retreat" for someone from Florida. I am 33 and a third-generation dairy farmer. Dad and I milk 60 cows and are the only full-time farmers left in the little valley of North Cove. It's a gloomy thought that I will probably be the last to milk the cows, cut the corn, and put up the hay on our place. My children likely couldn't afford not to sell out to some flatlander after I have gone.

TERRY E. ENGLISH
Marion, North Carolina

Letters should be addressed to FORUM, National Geographic Magazine, Box 37448, Washington, D. C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.

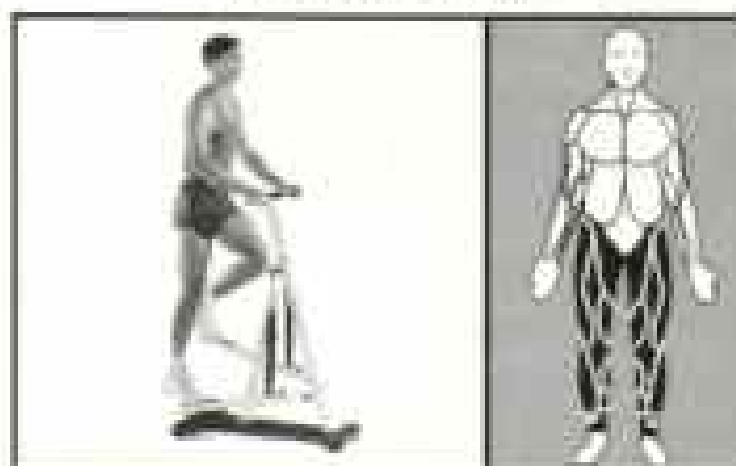
Only NordicTrack gives you a total-body workout.



Lower-body only

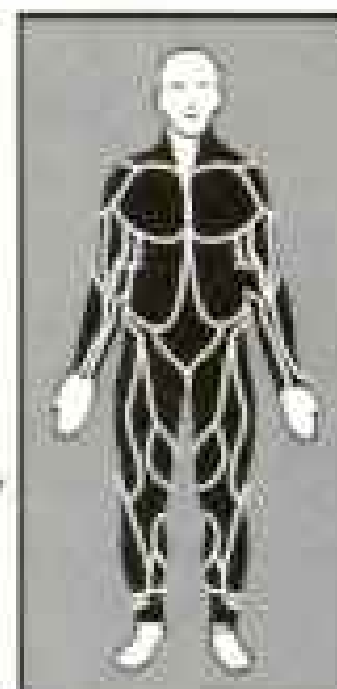
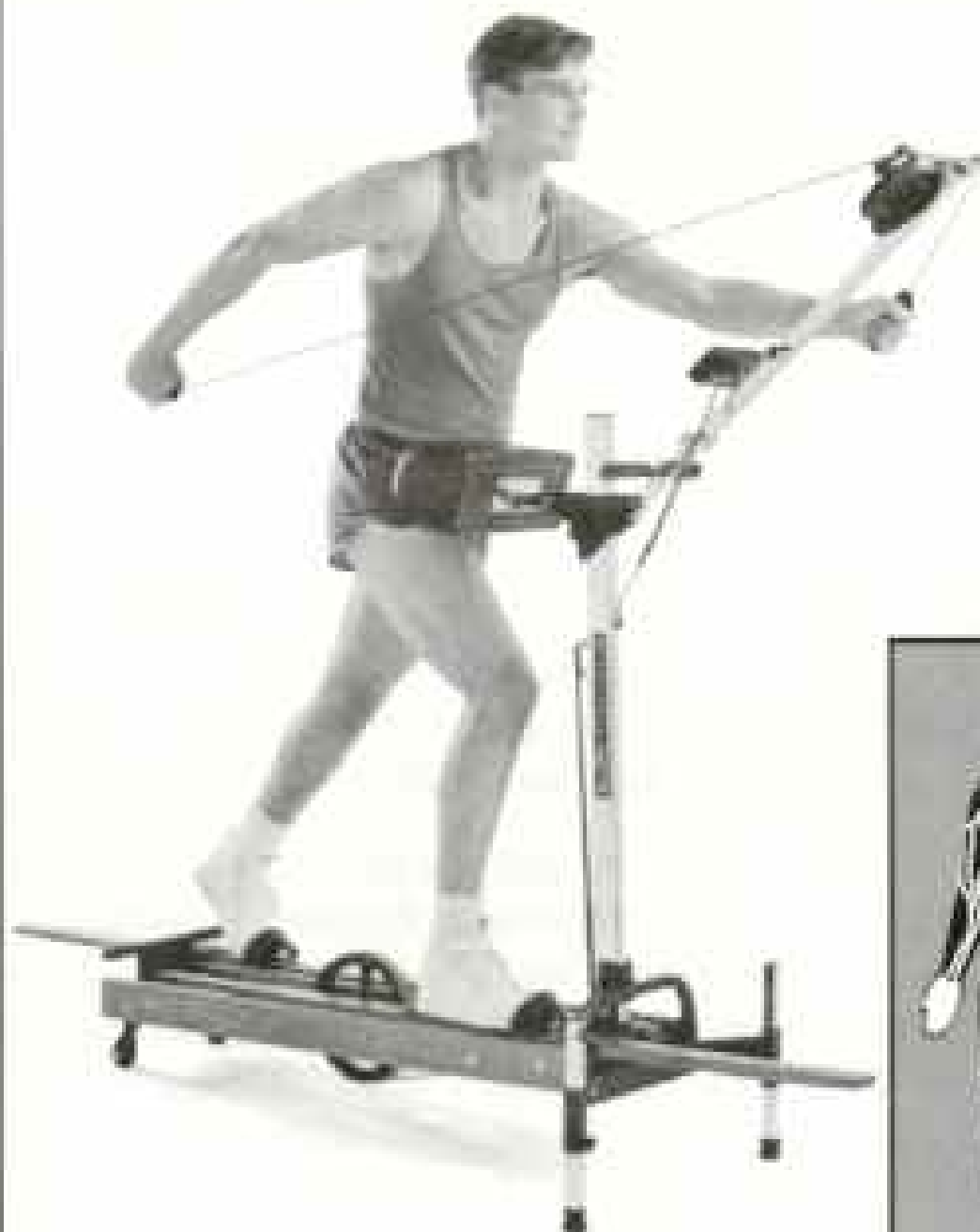


Lower-body only



Lower-body only

NordicTrack: "The World's Best Aerobic Exerciser"



Total-body

Exercise bikes, treadmills and stairsteppers don't give you half the workout NordicTrack does.

Most in-home exercisers completely ignore the muscle groups in your back, chest, shoulders and arms.

But a NordicTrack® exercises **all** the major muscle groups in **both** your upper and lower body.

That's why it's more efficient at elevating your heart rate to the fitness-building level. And why it burns more calories. Up to 1,100 per hour.

Don't settle for less than a total-body workout.

Get on track with NordicTrack.

30-day in-home trial

Models priced from \$299⁹⁵ to \$1,299⁹⁵

NordicTrack
A CML Company

Call for a **FREE VIDEO**
and Brochure

1-800-328-5888 Ext. 245C3

or write: NordicTrack, Dept. 245C3
104 Peavey Road
Chaska, MN 55318

Name _____
Street _____
City _____ State _____ Zip _____
Phone () _____

Prayer to the Great Spirit



Plate shown smaller than actual size of 8" in diameter.

The American Indian Heritage Foundation Museum proudly presents its first-ever collector plate by world-renowned Western artist Paul Calle.

It is a ritual as old as the land itself. The Sioux warrior, in perfect harmony with the forces of nature, summons the Great Spirit to look with favor on the people—to provide for, and protect them.

Only an artist of rare talent and vision could capture the mystery and drama of this centuries-old ceremony. Paul Calle, whose works are eagerly pursued by knowledgeable collectors of Western art, is such an artist.

"Prayer to the Great Spirit" is crafted in fine porcelain, then hand-numbered and bordered in 24 karat gold. This imported Limited Edition collector plate also bears the artist's signature mark on its reverse side.

Priced at just \$29.50, it will be closed forever after just 45 firing days. Available exclusively from The Franklin Mint, Franklin Center, PA 19091-0001.

A Limited Edition Collector Plate.
Hand-Numbered and Bordered in 24 Karat Gold.

Please mail by March 31, 1993.

The Franklin Mint
Franklin Center, PA 19091-0001

Please enter my order for Prayer to the Great Spirit, by Paul Calle. I need SEND NO MONEY NOW. I will be billed \$29.50* when my plate is ready to be sent. *Limit: one plate per collector.*

*Plus my state sales tax and \$2.95 for shipping and handling.

SIGNATURE _____

ALL ORDERS ARE SUBJECT TO ACCEPTANCE

MR/MRS/MISS _____

PLEASE PRINT CLEARLY

ADDRESS _____ APT. # _____

CITY/STATE/ZIP _____

TELEPHONE # (_____) _____

© 1993 FM 15208-0THH-102

Satisfaction Guaranteed. If you wish to return any Franklin Mint purchase, you may do so within 30 days of your receipt of that purchase for replacement, credit or refund.

THE BURNING MUST STOP. NOW!

The world's rain forests are burning. And a wealth of wildlife is trapped in the fire's path.

Rain forests occupy just 2% of the earth's surface. Yet, these rain forests are home to half of the planet's tree, plant and wildlife species. Tragically, 96,000 acres of rain forest are burned every day.


You can help stop this senseless destruction. Right now you can join with The National Arbor Day Foundation, the world's largest tree-planting environmental organization, and support



Rain Forest Rescue. When you join, you will help establish natural rain forest barriers to stop further burning and support on-site conservation management plans to protect threatened forests.

Each and every second, a rain forest area the size of a football field goes up in smoke. You'd better call now.



 The National
Arbor Day Foundation

Call Rain Forest Rescue.
1-800-255-5500

NATIONAL GEOGRAPHIC MAGAZINE

GILBERT M. GROSVENOR, *President and Chairman*

WILLIAM GRAVES, *Editor*

Associate Editors

WILLIAM L. ALLEN, ELIZABETH A. MOIZE, ROBERT M. POOLE

SENIOR ASSISTANT EDITORS

ROBERT BOOTH, *Production* • ALLEN CARRIBELL, *Art* • RICK GORE, *Science*

DAVID JEFFERY, *Legends* • THOMAS R. KIDWELL, *Photography* • ROBERT W. MADDON, *Imaging*

O. LOUIS MAZZATENTA, *Cover/Center* • CONSTANCE H. PHILIPS, *Layout and Design*

JOHN J. PUTMAN, *Microvideo* • LESLEY B. ROGERS, *Research* • W. ALLAN ROYCE, *Illustrations*

JUAN F. SALAS, *Cartography* • MARY G. SMITH, *Research Grant Projects* • GEORGE E. STUART, *Archaeology*

EDITORIAL

ASSISTANT EDITORS: Judith Brown, Mike Edwards, William S. Ellis, Alice J. Hall, Jane Vessels, Peter T. White, Eric Ziegler. **SENIOR WRITERS:** Thomas J. Abernethy, John L. Emswiler, Noel Gross, Bryan Hodgson, Michael E. Long, Joel L. Soverlin, Fritz J. Venzel. **SENIOR EDITORIAL STAFF:** Dan Bell, Charles F. Cobb, Jr., Larry Kohl, Peter Miller, Cathy Newman, Jennifer Reek, Cliff Tapp, Meg Nottingham Walsh, Boats Weintraub. **PRODUCTION:** John L. Mcintosh. **EDITORIAL STAFF:** Cassandra Franklin-Barbajosa, Thomas O'Neill, Oliver Payne, Peter L. Parsons, A. R. Williams. **RESEARCH:** Michaeline A. Sweeney, **ART DIRECTOR, SENIOR RESEARCHERS:** Carolyn H. Anderson, Pamela M. Beauchamp, Kathy B. Maher, Barbara W. McConnell, Joanne E. Peters, Abigail A. Tipton. **RESEARCHERS:** Judith F. Bell, Sheila M. Green, Jen Heidebrecht, Anne A. Jamison, Michael Kenna, Amy E. Keeney, Christopher Scaparra. **LEGENDS:** Victoria C. Duchesneau, Margaret G. Zuckowitz. **PLANNING COUNCIL:** Mary McPeak

ILLUSTRATIONS

PHOTOGRAPHERS: Kent J. Kihlstrom, **Assoc. Director**; Susan A. Smith, **Art Director**; Sam Abell, Joseph H. Bailey, James P. Blair, Victor R. Bowtell, Jr., Josh Cobb, Bruce Dale, Emory Kristof, Joseph D. Lavenburg, George F. Mobley, James L. Stanfield, **Technical**; Claude E. Petros. **ILLUSTRATIONS EDITORS:** William T. Dowditt, **Assoc. Director**; Larry Nightwandler, **Assoc. Director**; David L. Arnold, Dennis R. Dineck, John A. Echave, Bruce A. McIlfresh, Robert S. Patton, Elie S. Rogers, Jon Schneberger, Susan Weichman; **Kathy Murra**. **LAYOUT AND DESIGN:** David Griffin, **Art Dir.**; **Topography:** Betty Claxman-DeAilly, Douglas M. McKenney. **ART:** Mark R. Holmes, **Art Director**; William H. Bond, Christopher A. Klein, **Artist**; Karen E. Gibbs, Hillel J. Hoffmann, David W. Woodruff. **RESEARCH, ENGRAVING AND PRINTING:** William W. Smith, **Designer**; Janet C. Evans, **Art Director**; Judy L. Garvey

CARTOGRAPHY

Senior Assoc. Director: John F. Dorr; **Assoc. Directors:** Marguerite B. Hamaker, Alice T. M. Rothlis, Leo B. Zabriskie, **Art Dir.:** Harold A. Hanson, Harry D. Kaufman. **Geographer:** Ted Dachsena. **Map Editors:** Charles W. Gotthardt, Jr., **Supvr.:** Thomas L. Gray, Etelka K. Horvath, Gus Platts, Jon A. Sayer. **Designers:** Charles W. Berry, John A. Bunker, Robert E. Pratt, Nancy Schweickart, Sally S. Summersell. **Researchers:** Doreen T. Bevington-Attard, Arthur J. Cox, Russ M. Emerson, Barbara P. Holland, Linda R. Kriets, Günther G. Kybos, David B. Miller, Dorothy A. Nicholson, Juan J. Valdés, Andrew J. Walsh, Susan Young. **Production:** Roland R. Nichols, Thomas A. Wall. **Supvr.:** Iskander Balaj, Ellen J. Landman, James E. McClintock, Jr., Stephen P. Wells, Alfred L. Zebarth. **Computer Services:** Kevin P. Allen, Richard W. Bullington, Charles F. Case, Martin J. Golden, Jonathan E. Kant. **Specialists:** Edward J. Holland, Charles L. Miller, Richard K. Rogers, Elia Sabban, Douglas A. Strobel, Ronald E. Williamson

EDITORIAL SERVICES

ADMINISTRATIVE: Bunta M. Swash, **Asst. to the Editor:** Elaine Rice Ames, Barbara D. Case, María Teresa Corrales, Sandra M. Danc, Lillian Davidson, Marina Domeyko, Carol L. Dumont, Neva L. Fuik, Eleanor W. Habue, Ellen E. Kahlberg, Katherine P. McGowan, Kathy Strader, Charlotte S. Valeri. **Travel:** Ann C. Judge. **RESOURCES LIBRARY:** Susan Fifer Canty, **Director**; David C. Beveridge, Adlene T. Drewes, Carolyn Locker, Marta Strada. **Illustrations:** Maria A. Mulvihill, **Director**; Eudora L. Babayak, L. Fern Dame, Carolyn J. Harroon, William D. Perry. **Picture Requests:** Beverly May Anne McMillan, **Director**; Ann E. Hubbs, Marnie M. Smith. **Correspondence:** Joseph M. Blamm, Jr., **Director**; Lee Smith. **Indexer:** Julene M. Bluen, Anne K. McCain. **Translation:** Kathryn A. Dean. **COMMUNICATIONS:** Steve Raymer, **Director**; News Service; Joy Aachenbach, Mexico Crisis, Donald J. Frederick, Donald Smith, Robert C. Radcliffe. **Radio:** Dale A. Petroskey, **Vice Pres.**; Public Affairs; Mary Jeanne-Jacobson, Barbara S. Moffet, Susan S. Norton. **ARCHIVAL:** Joanne M. Hess, **Asst. Vice President and Director**; Jon H. Larimore, **Tech. Dir.**; Ronald S. Altman, Scott A. Brader, Robert O. Fliegel, Paul Gorski, P. Andrew van Dorem

ADMINISTRATION

ASST. VICE PRESIDENTS: Joyce W. Graves, **Asst. to the President**; Carolyn F. Clewell, Joseph S. Fowler, Douglas E. Hill, Robert E. Howell, Thomas E. Kulikovsky, Carol E. Lang, Richard A. Meehler, Jimmie D. Prodenore, James G. Schmalzer, Peter F. Woods. **ASST. TREASURER:** Richard T. Moreland, Dorothy M. Wagner. **ASST. to the PRESIDENT:** Richard E. Pearson, **Diplomatic and Civic Affairs:** Karen L. Handlberger, Karen S. Marsh. **ACCOUNTING:** Michael J. Cole, Larry E. Dowdy, Laura L. Leigh, Stephen R. Vick. **ADMINISTRATIVE:** M. Jean Vile, **Business Manager**; Mary L. Blanton, Robert V. Koenig, Myra A. McLellan, Jennifer Mossley, Joyce S. Sanford, Mela Stewart, Frank M. Twigger, R. Miles White, Janet C. Yates. **CONVERTERS:** Scott Bolden, Warren Burger, William L. Chewing, Curtis L. Conway, Jr., Fred R. Hart, George F. Harbs, Ronald C. Kline. **EDUCATIONAL SERVICES:** Robert L. Graham, Christopher D. Mignano, Wendy G. Rogers. **EXPLORERS HALL:** Nancy W. Beers, Richard McWilliams. **GRADUATE EDUCATION DIVISION:** Robert E. Duff, **Asst. Vice President and Director**; Mary Lee Elden, J. Joe Ferguson. **HUMAN RESOURCES:** Shirley N. Wilson. **MEMBERSHIP SERVICES:** Barbara M. Davis, Carol A. Hatck, Kathleen V. Howard. **PROMOTION:** Joan M. Anderson, Virginia A. Bickham, James V. Bullard, Robert L. Feige, Charles F. Herrmann III, Deborah A. Jones, Charles T. Kuehland, Lucy J. Lowenthal. **PURCHASING:** Thomas L. Fletcher. **FOREIGN EDITORS:** Robert W. Hernandez, **Director**

PRODUCTION SERVICES

QUALITY: Frank S. Oberlin, **Asst. Vice President**; Bill M. Aldridge. **PRE-PRESS:** Geoffrey T. McConnell, Martin D. Anderson, Billy R. Barnett, David H. Chisman, Phillip E. Phule, Bernard G. Quarick, John R. Reap. **PHOTOGRAPHIC:** Lee William S. Petrim, Alfred M. Yee. **PRINTING:** Hans H. Wagner, Joseph M. Anderson, Sherrie S. Harrison. **ADMINISTRATION:** Joan S. Simms, Judith S. Sider

ADVERTISING

Joan McCraw, **Vice President and Director**; Debra J. Grady, **New York Manager**; Peggy Dutch, **Detroit Manager**; J. Scott Crystal, **Western Manager**; Philip G. Reynolds, **Special Accounts Manager**; Laurie L. Katsche, **Chicago Manager**; Michel A. Boutin, **International Director**, 90, Champs-Élysées, 75008 Paris, Washington; Margaret S. Boston, **Promotion**; Sarita L. Moffat, **Operations**; Renee S. Clapper, **Research**; Gail M. Jackson, **Production**

TELEVISION

Timothy T. Kelly, **Senior Vice President**; Todd Bertram, **Marketing/Distribution**; Susan Berke, **Business Affairs**; Julia Main, **Development**; Tim Simon, **Executive Producer**; Lowell Soffer, **Finance**; Patricia Ong, **Film Library**; Kathleen F. Teret, **Publicity**; Yeorgos N. Lampathakis, Marjorie M. Moxney, Nola L. Strewberry. **EDUCATIONAL FILMS:** Sidney Platt, **Director**; Donald M. Cooper, **Assoc. Dir.**; Suzanne K. Poole, Carl E. Ziehe

EDUCATIONAL SERVICES OF THE SOCIETY

ADMINISTRATIVE: Stephen J. Hubbard, Carolyn W. Jones. **BOOK DIVISION:** William R. Gray, **Vice President and Director**; Margry G. Dunn, Charles Kogod, **Assistant Directors**; John G. Agnone, Greta Arnold, Leah Bendavid-Né, Jody Bell, Jane H. Buxton, Victoria Cooper, Richard M. Crum, Mary Dickinson, Susan C. Eckart, Karen P. Edwards, Ron Fisher, Patricia F. Frakes, Mary Ann Harrell, Camilla E. Hill, V. Gayle Jones, Susi B. Kehl, Ann N. Kellall, Marianne R. Koszmas, Artemis S. Lampathakis, J. Edward Lanouette, Bonnie S. Lawrence, Rebecca Lescoe, Sandy F. Litherman, Tom Mellum, H. Robert Morrison, Elizabeth Newhouse, Melanie Patt-Curser, Barbara A. Payne, Thomas B. Powell III, Cynthia Ramsey, Lyle Rosenthal, Cindy Ross, Margaret Sodeen, Gene S. Stuart, Penelope Timbers, Jennifer C. Urquhart, Richard Wan, Marilyn Williams. **MAGAZINE DIVISION:** David P. Johnson, **Director**; **Printer:** Richard Busch, **Editor**; Paul Marne, **Managing Editor**; **World:** Pat Robbins, **Editor**; S. Minsham Tejada, **Managing Editor**; Ursula Vonder, **Art Dir.**; Charles E. Herron, **Senior Illustrations Editor**. **INTERNATIONAL MEDIA:** George A. Peterson, **Vice President and Director**; Jimmie Abernethy, Julie V. Agnosc, David Beacom, Rick Bounds, Mince P. Bradsher, James B. Caffroy, Carolyn Hatt, James Hiscott, Jr., Turner Houston, Betty G. Kotcher, Louise C. Millikan, Lee Olney, Linda Rinkson, Barbara Sober. **PUBLICATIONS ART:** John D. Gaert, Jr., **Director**; Virginia L. Buz, **Assoc. Dir.**; Peter J. Balch, Gary M. Johnson. **MANUFACTURING:** George V. White, **Director**; John T. Dunn, **Assoc. Dir.**; Robert Messer, Gregory Storer



NATIONAL GEOGRAPHIC SOCIETY

"For the increase and diffusion of geographic knowledge."

The National Geographic Society is chartered in Washington, D. C., as a nonprofit scientific and educational organization. Since 1890 the Society has supported more than 4,500 explorations and research projects, adding to knowledge of earth, sea, and sky.

GILBERT M. GROSVENOR, *President*

Senior Vice President

MICHELA A. ENGLISH

ROBERT B. SIMS

Vice Presidents

SUZANNE DUPRÉ, *Corporate Counsel*

H. GREGORY PLATTS, *Treasurer*

PAUL B. TYLOR, *Secretary*

H. LANCE BARCLAY, FREDERICK C. GALE,

DONNA L. HASSLINGER, JAMES F. KELLY,

JONATHAN W. LANDERS, GEORGE E. NEWSTEDT

BOARD OF TRUSTEES

GILBERT M. GROSVENOR, *Chairman*

OWEN K. ANDERSON, *Vice Chairman*

LLOYD H. ELLIOTT, *Vice Chairman*

JOE L. ALLBRITTON

Chairman, Regis National Bank

THOMAS E. DOLOER

Chairman, Executive Committee, Bell Atlantic

FRANK BORMAN

Chairman and C.E.O., Patten Corporation

LEWIS M. BRANSCOMB

Kennedy School of Government, Harvard University

J. CARTER BROWN

Director Emeritus, National Gallery of Art

MARTHA E. CHURCH

President, Hood College

MICHAEL COLLINS

President, Michael Collins Associates

GEORGE M. ELSEY

President Emeritus, American Red Cross

MICHELA A. ENGLISH

WILLIAM GRAVES

A. LEON HIGGINBOTHAM, JR., *Chief Judge*

for the Third Circuit, U. S. Court of Appeals

JOHN JAY ISELIN

President, The Cooper Union

TIMOTHY T. KELLY

J. WILLARD MARRIOTT, JR.

Chairman and President, Marriott Corporation

FLORETTA DUKES MCKENZIE

Former Superintendent of Schools, District of Columbia

PATRICK F. NOONAN

President, The Conservation Fund

NATHANIEL P. REED

Businessman-Environmentalist

B. FRANCIS SAUL II

Chairman and C.E.O., B. F. Saul Company

ROBERT C. SEAMANS, JR.

Department of Aeronautics and Astronautics, MIT

TRUSTEES EMERITUS

ROBERT L. BREEDEN, WARREN E. BURGER,

CRAWFORD H. GREENEWALT, CARYL F. HASKINS,

ALFRED J. HAYNE, MRS. LYNDON B. JOHNSON,

WM. MICHESNEY MARTIN, JR., LAURANCE S.

ROCKEFELLER, FREDERICK G. VOSBURGH,

CONRAD L. WIRTH

RESEARCH AND EXPLORATION COMMITTEE

Barry C. Beatty, *Vice President and Chairman*

FRANK C. WHITMORE, JR., *Vice Chairman*; ANTHONY R. DE SODIA,

Editor, Research & Exploration; STEPHEN S. SLETTER, *Secretary*;

H. J. DE BLA, *University of Miami*; WILLIAM GRAY, GILBERT M.

GROSVENOR, BETTY J. MCGEE, *Southwestern Institution*; DAVID

FRONTEL, *Cornell University*; PETER H. RAVEN, *Missouri*

Botanical Garden; EDWIN W. SMIDER, CHARLES H. SODENACK,

University of Colorado; JOHN H. STEEL, *Woods Hole*

Oceanographic Institution; GEORGE E. STUART, GEORGE E.

WATSON, RICHARD S. WILLIAMS, JR., *U. S. Geological Survey*;

HOWY T. WISSOT, *University of Michigan*

EDUCATION FOUNDATION

Betty Elinor, Patricia A. Unkle

Automobile of the Year - 1993
Automobile Magazine
 "With standard driver and passenger air bags, excellent adjustable three-point belts, and Chrysler's clever integrated child seat system, these vehicles have the best all-around safety restraint system on the market." - *Popular Science*
Car and Driver's "Ten Best" - 1993
 "1993 Design and Engineering Award" - *Popular Mechanics*
 "...rides, handles, and holds the road like the best of the contemporary imports." - *Automobile Magazine*
 "The feel of the switch gear is sublime. Turn signals, wipers, and lights move like silk, and are silent and feel expensive." - *Car and Driver*
 "...comfortably quiet and luxurious at cruising speeds and aggressively powerful on the high-speed laps." - *Motor Trend*
 "...the Vision... is a warning to the current Japanese and European sports-sedan leaders." - *Road & Track*
 "...the subtly styled Eagle Vision keeps pace, everything - German, Japanese, or American - that's out there in the same price range." - *Automobile Magazine*
 "...a car that anticipates rather than reacts to the competition." - *AutoWeek*
 "...lithe and agile, beyond the-horizon cars." - *Motor Trend*



IT'S NO WONDER WE'VE BEEN SHOWERED WITH PRAISE.

A Division of the Chrysler Corporation. 

EAGLE VISION. NOT INTENDED FOR THE GENERAL PUBLIC. 

700 3E16

See limited warranties, restrictions, and details at dealer. For more information, call 1-800-JEEP-EAGLE.

*Seat belts should always be worn.

PREVIA



IT CAN KEEP A MOUNTAIN ROAD FROM BECOMING AN UPHILL BATTLE.

You've got all the kids, their friends, and you're loaded up with camping gear. And here comes one of those steep mountain roads you used to dread. But you're in a Toyota Previa—with a powerful, twin-cam, 16-valve engine and amazing handling—so you're not worried anymore. But a weekend camping with six kids? Well, that's another hurdle altogether.

"I love what you do for me."

 **TOYOTA**



THE ONLY VAN TO MEET ALL PASSENGER CAR FEDERAL MOTOR VEHICLE SAFETY STANDARDS* WITH AN AIR BAG.

*Except models with optional privacy glass due to window tinting. Call 1-800-GO-TOYOTA for a Previa brochure and location of your nearest dealer. Buckle Up! Do It for those who love you. © 1992 Toyota Motor Sales, U.S.A., Inc.

On Television



RICK WEST

On the Menu: the Giant Tarantula of Amazonia

It could comfortably span a ten-inch dinner plate. It's hairy. Its fangs are almost an inch long. It's the largest arachnid on earth. And the Piaroa Indians, among other tribes, consider *Theraphosa leblondi* (above) delicious.

In central Venezuela, on the northern edge of the Amazon rain forest, filmmaker Nick Gordon and scientific adviser Rick West chronicle for the first time the natural history of this goliath. Later they join the Piaroa for a spidery feast.

Before a hunt a shaman in a headdress adorned with a beeswax replica of a tarantula invokes the blessing of spirits.

By twitching a vine in the tarantula's burrow, imitating the movement of an insect, a hunter lures the ground-dwelling giant from its lair. He pins it to the ground with two fingers and, carefully gathering up its eight legs, tucks the spider into a bundle of leaves.

The spiders are kept alive until just before cooking. Once the

barbed hairs are singed off, the legs and thorax are barbecued. They taste, Gordon and West report, much like shrimp.

The Piaroa even use the spiders' fangs—as toothpicks.

"Giant Tarantulas of the Lost World" airs March 28 on EXPLORER, TBS SuperStation, 9 p.m. ET.



LEVIN ARTHUR-BERTHARD, PETER ARHOLD

Lions and Hyenas—Forever Enemies

Baring teeth that will become deadly weapons, a young spotted hyena yawns. By the time it is old enough to hunt, it

will have been exposed to a long-standing blood feud.

For generations, rivalry with lions has gone beyond competition for food. Hyenas bedevil lions; lions torment hyenas. Their ancient war on the Savuti grasslands of Botswana is waged, for the most part, under cover of darkness.

Traversing Savuti in a vehicle crammed with cameras and lighting gear, Dereck and Beverly Joubert, a husband-and-wife filmmaking team, spent three years observing the animals. With strategic lighting—and with endless patience—they were able to capture scenes of raid and counterraid.

"Night after night we sat with the animals, gradually moving in closer and closer," recalls Beverly. It was not always easy for the Jouberts to witness their struggles.

Now available on home video, this 1992 National Geographic TV Special vividly documents the fierce clash between the two predators.

"Eternal Enemies: Lions and Hyenas," a selection of National Geographic Video Club; U. S. and Canada only (1-800-343-6610).



Recently, an independent research firm compared the new



\$13,000* *Nissan Altima* against the \$26,550** *Lexus ES 300* to determine which car's body panels

were put together with a higher level of precision.

The results were astonishing. Thanks in part to Nissan's state-of-the-art robotic body assembly system and over 3500 precision welds, the *Altima's* tolerances between body panels proved to be every bit as accurate as its strato-

spherically priced competition's. In fact, the *Altima* is built with such precision that it had an average gap difference of just .018 inches***

What does this mean in layman's terms?

It means the doors fit snugly, the trunk shuts soundly and the hood closes perfectly. It also

*Nissan Motor Corporation U.S.A. Smart people always read the fine print. And they always wear their seat belts. *M.S.R.P. for 1997 Nissan Altima XE excluding taxes, title, license, destination charges and options. **M.S.R.P. for 1992 Lexus ES 300 excluding taxes, title, license, destination charges and*

If you were impressed
when you saw Lexus do this test,
wait until you read this.



means the car offers such structural soundness that squeaks and rattles are virtually nonexistent.

Slide inside the *Nissan Altima*

cabin and you'll see that we let nothing slip through the cracks. The seats have been specially tailored to offer remarkable sup-



port. Every control has been thoughtfully placed to assist the driver. All four doors have been triple-sealed to help keep out moisture. And noise is so minimal that at 55 mph, the *Nissan Altima*'s cabin is actually quieter than a BMW 325i^{***}

But while the *Altima* delivers total comfort, you can rest assured you won't fall asleep at the wheel. A 150-horsepower engine offers exemplary responsiveness, while its suspension is yet another Nissan engineering marvel. On a slalom course the *Altima* can beat an Acura Legend L Sedan^{***}

Call us at 1-800-NISSAN-3, ext. 604, and find out more about our amazing new car. You'll discover that an automobile that's put together well needn't put you well into debt.

The New Nissan
Altima



It's time to expect
more from a car.[™]

options. ***Based on independent tests conducted by UNAC. Body panel tolerances based on average gap consistency. Other claims certified by AMCJ for 1993 Nissan Altima SE or SE in 1992 competitive vehicles. Slalom comparison based on course completion time. Interior quietness based on decibel level at 55 mph.

Earth Almanac



REXFORD E. WENZEL, ANIMALS ANIMALS

With Bloodshot Eyes, Lizard Repels Enemies

It's not an old wives' tale. The tough little lizards that kids have always called horny toads really can unleash a six-foot blast of blood through their eyes. The phenomenon was first described as far back as 1871. Now scientists are asking new questions about this bizarre defense weapon of some species of horned lizard (genus *Phrynosoma*). Which predators do they use it against? And is there something special about the blood?

The lizard pumps blood into a sinus between the eyeball and the skull, then fires. But why would a blast of blood deter a foe already hungry for blood? "We're fairly sure there's a compound in the blood that tastes bad to certain mammals, but we don't know what it is yet," says Arizona herpetologist Wade Sherbrooke, who with colleague George Mendenhall conducted experiments over two summers.

In ten trials, a lizard squirted every time it was harassed by a yellow Labrador, Dusty. But when the researchers themselves mimicked Dusty's behavior, the creatures seldom squirted. Nor do they shoot blood when attacked by two other adversaries, roadrunners and grasshopper mice. The researchers plan next to test two wild canines, foxes and coyotes.

Home Remedy Beats Ozone-eating CFCs

Sometimes, when all else fails, common sense prevails. That's what Ray Turner used. The Hughes Aircraft Company engineer opened his icebox and found a way to reduce chlorofluorocarbons (CFCs), which harm the earth's ozone layer. An estimated 18

percent of all CFCs used go into making electronic circuit boards.

Before a board can be soldered, it must be cleaned with a flux, which then must be removed. To meet squeaky clean military standards, Hughes, which produces circuit boards, had long used a heavy resin flux. The only solvent approved to remove it contained the nasty CFCs.

In 1989, after an inspector nearly cited the company for improper CFC storage, Turner sought to eliminate the necessity for CFCs by



PETER D. BETHORN, HUGHES AIRCRAFT COMPANY

inventing a safer flux, one that didn't need such a strong solvent. "What better place to look than my refrigerator?" he says. First he tried cleaning a penny, as if it were a circuit board, with vinegar. The solder wouldn't stick. Next, lemon peel. No luck. Finally, a drop of lemon juice. "The solder stuck! I was jumping for joy, soldering everything that didn't move."

His homespun idea was dubbed "Turner's Crazy Flux." The U. S. Navy has approved a version for use on submarine components.

FeatherWates[®] Light As A Feather



LensCrafters

FeatherWates[®] Bring You Lighter Weight For Greater Comfort

Exclusive FeatherWates[®] offer a higher standard of comfort in eyewear because they are dramatically lighter than ordinary glasses. And LensCrafters, America's leading one-hour eyewear store, has the technology to custom-craft your "light-as-a-feather" glasses in about an hour. Experience the comfort of glasses you will hardly know you're wearing.

Call 1-800-522-LENS (5367) for your nearest LensCrafters.

FeatherWates[®]



**Lighter Weight,
Greater Comfort
In About An Hour**

LENSCRAFTERS

Better Fit For Greater Comfort In About An Hour[™]



Earth Almanac

From the Amazon, Face of a New Species

Adorned with zebra-like stripes and furry ear tufts, a new primate species has been found in Brazil's central Amazon. Weighing less than half a pound, the monkey was christened the Rio Maués marmoset (*Callithrix mauesi*) for its discovery on the Maués River by Swiss primatologist Marco Schwarz. He first saw the marmoset in April 1985, but it was not recognized as a new species until last October, when it was formally described in a paper by Schwarz, Brazilian ecologist José Márcio Ayres, and primatologist Russell Mittermeier, president of Conservation International.

"To find a new tropical beetle is not surprising," says Mittermeier, "but primates are well known and well studied—yet we're still finding new ones. It's extremely exciting, and it shows how little we know about tropical diversity."

He adds that the marmoset does not appear to be endangered, because its Amazon territory is not currently being developed.



STEPHEN NASH,
CONSERVATION
INTERNATIONAL

This is the third new monkey discovered since 1990 in Brazil, which is home to the most primate species in the world—68.

Knock on Wood: Help for Birds in Peril

To carve out a nest, most woodpeckers find a nice dead tree and turn their bills into jackhammers. Not so the red-cockaded woodpecker (*Picoides borealis*), whose picknickety nesting habits—along with widespread clear-cutting in the U. S. Southeast—landed the bird on the endangered species list in 1970. For its home this bird needs a living pine tree, and an old one too, aged 80 or more, with enough dead heartwood to excavate. And that can take months, even years.

In 1988 a federal judge in Texas ordered the U. S. Forest Service to stop clear-cutting within 4,000 feet of red-cockaded woodpecker colonies in that state. After negotiating with conservationists, the Forest Service agreed to limit clear-cutting near colonies in national forests throughout the Southeast.

"Now the prospect for the bird's recovery is excellent," says Doug Honnold of the Sierra Club Legal Defense Fund.

Other efforts include those of the military at Fort Bragg, North Carolina, site of about 130 woodpecker breeding groups. Hoping to expand the population,

officials have limited development on the Army post and joined an effort to restore woodpecker-friendly habitat on adjacent state and private lands.

Britain's River Robots Stand Pollution Duty

Electronic detectives named Sherlock and Merlin are blowing the whistle on British water polluters. These two robots, developed by the National Rivers Authority (NRA) about two years ago, are deployed when inspectors find a suspicious discharge or when a citizen files a complaint. Sherlock, consisting of two boxes, sits on a riverbank with a probe in the water. Merlin, a drum, rides at anchor in open water—here on the River Avon (below).

Twenty Sherlocks and six Merlins are now on call, measuring dissolved oxygen, acidity, temperature, and turbidity. Their findings have helped convict several farm and factory owners. "Some farmers make their own ammonia fertilizer to spray on crops," says NRA's Paul Williams. "After a heavy rainfall we find high levels of ammonia. We use the robots' evidence in confronting the offender." When a dispute goes to court, a convicted offender may be fined as much as \$30,000.

—JOHN L. ELIOT



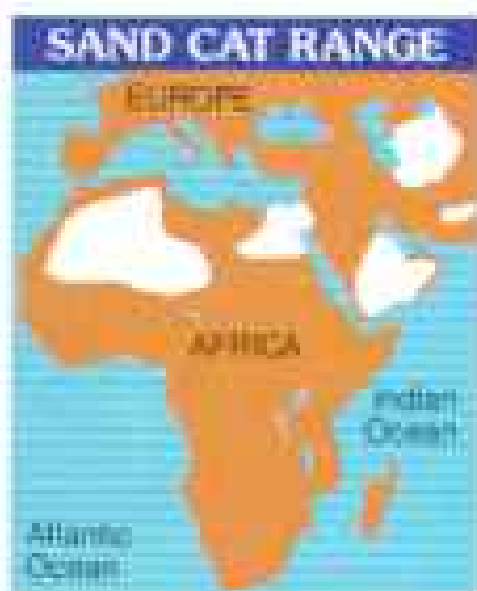
C. C. LOCKWOOD, BRUCE COCKMAN



NATIONAL RIVERS AUTHORITY



WILDLIFE AS CANON SEES IT



Sand Cat
 Genus: *Felis*
 Species: *margarita*
 Adult size:
 Length, 45 - 57 cm;
 tail, 28 - 35 cm;
 stands 26 cm
 Adult weight: 2 - 3 kg
 Habitat: Deserts in
 north Africa and
 southwest Asia
 Surviving number:
 Unknown
 Photographed by
 Alain Dragesco

A sand cat barely skims the surface as it strides effortlessly across a Saharan dune. Fur padding between the toes prevents it from sinking in fine sand and protects its feet from burning. This adaptation enables easier travel for this mother sand cat in her wide-ranging search for a gerbil or lizard to feed her young waiting in the den. The sand cat is rarely seen in the wild, and few have lived beyond a year in captivity. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Color images, with their unique ability to reach people, can help promote a greater awareness and understanding of the sand cat 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.



On Assignment

In the company of giants, freelance photographer Bob Sacha checks his light meter and waits for sunset on Easter Island.

"It is extraordinary to be alone with these huge *moai*," Bob says. "They seem to exert spiritual power. Under a full moon they just swell out of the darkness at you. It's strange: I seem to be in a phase of following spirits."

The New York-based photographer recently scoured the Americas for clues to ancient peoples who used the sun and stars to select the sites and orientation of their sacred places (GEOGRAPHIC, March 1990). "I get an incredible feeling being outdoors in these places," says Bob. In another assignment he searched for the spirit of Christopher Columbus before his epic discoveries.

Bob, whose first GEOGRAPHIC assignment resulted in a cover photograph of the Statue of Liberty for

the July 1986 issue, inherited his interest in cameras from his father, a retired educator and enthusiastic amateur photographer in Buffalo, New York. A summer photography course led to a high school job covering sports for a local newspaper. After graduating from Syracuse University, Bob worked for the *Philadelphia Inquirer*.

"I've always had a lot of people who were good to me," he says. "And I've been fortunate to be in the right place at the right time."

Bob found himself in the right place at the wrong time during his Columbus coverage. He and his interpreter were overlooking Genoa, Italy, from a hilltop when a group of policemen showed up and pointed machine guns at them. "This was during the gulf war when everyone was on edge; I guess they thought we were terrorists. They wouldn't even let us reach into our jackets for

IDs. After tense minutes of explanation, we were finally released."

The most interesting place Bob has ever visited, he says, is always the next one. "When I hear about a place, my imagination takes over. Then the trick is, can I get this sense of wonder, a kind of spirituality, into the film so people looking at the magazine can feel it too. That's the challenge of a place like Easter Island—to reach people who will never be able to go there. It really makes me nervous."

Close to home, Bob and writer Regina Schrambling, his longtime companion, recently traveled through 12 states to record the harvesting of crops, like cranberries, that are strictly seasonal. Their book, *American Harvests*, will be out in a few months. "I approached the book the same way I do other projects: I work hard without ever believing it is hard work."



BOB SACHA

TO PROVE THE NEW JENN-AIR WALL OVENS
HAVE LARGER INTERIORS,
WE CONSULTED THIS PANEL OF EXPERTS.



There's big news at Jenn-Air Because

our new wall ovens now offer you the largest

interior cooking space of any 24" and 27"

combined radiant/convection ovens.

These Jenn-Air wall ovens offer fast, even,

three-rack baking and fit cooking and baking pans that some other ovens can't. Turkeys, rib roasts and other

oversized items are no problem in our ovens, which are up to 25 percent larger than some other wall ovens.



The new Jenn-Air wall ovens—with more room and greater baking flexibility, you

don't need an expert to tell you

that anyone who owns one is one smart cookie. For

a brochure showing the Jenn-Air line and the name

of your nearest dealer call 1-800-JENN-AIR.

JENN-AIR

THE SIGN OF A GREAT COOK.



*Jenn-Air
4850/2200*

