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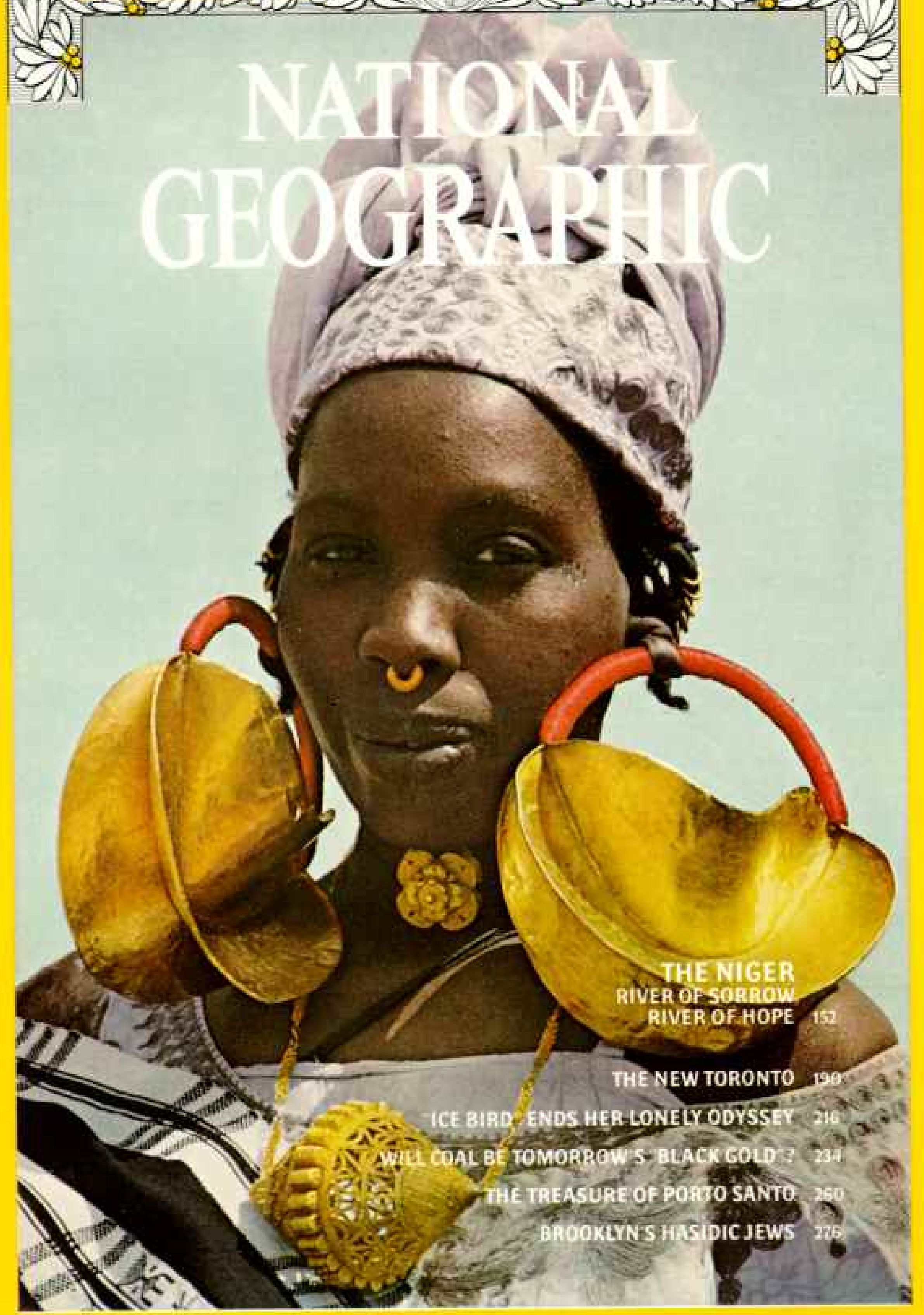

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NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 148, NO. 2

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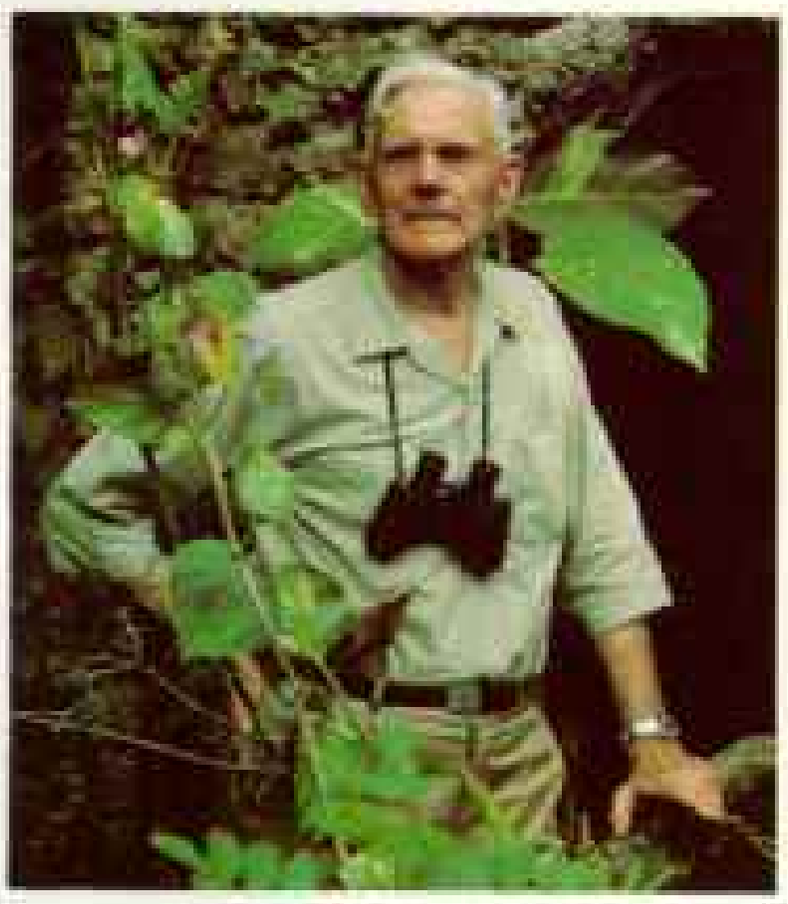
THESE ARE THE DOG DAYS, that period of sultry weather when the Dog Star, Sirius, rides in the sky before sunrise, a celestial symbol of deep summer and its long, apparent pause in nature's cycle of regeneration. In my own garden the biological clocks of flower and bird tick quietly toward the anticipated climax of the harvest and the busy events that precede migration.

The biosphere, that thin shell of earth, air, and water where life on our planet abounds, is a single fabric of being; in every tiny niche a kind of life has anchored and survived —from tiny organisms that spend their lives forever seeking the sunlight to strange fish that move in eternal darkness.



ALEXANDER WETMORE IN THE PANAMA JUNGLE

How badly has the intervention of man damaged this fabric? By the prevention, or killing, of forms of life that are inconvenient or hostile to him, by the encouragement and protection of forms of life that are useful or desirable to him, man has made basic alterations in the world's life pattern. But the eventual result is anything but clear. Many scientists regard chemical intrusions upon natural processes as a doomsday machine, while others regard them as no more disturbing than the violent acts of nature itself. Committed partisans and vested interests shake every fact until it trembles in the mind.

NATIONAL GEOGRAPHIC frequently ventures into this arena, drawn there by articles on natural history that describe the impact of substances like DDT upon individual species, such as the osprey and the Cooper's hawk. We stand behind what we print as accurate portrayals of the findings of working scientists. We let the data speak for itself—to those who believe the evidence is incontrovertible, and to those who believe it ambiguous.

Fortunately, where our bird articles are concerned, we have had over the years the sage advice and counsel of Dr. Alexander Wetmore, dean of American ornithologists and for the past 42 years a valued member of the National Geographic Board of Trustees. He has lost count of the creatures and the features that bear his name, but the total must be well over fifty. They range from a glacier in Antarctica to a tropical bat that he ran across while in a Central American jail. Alex was a welcome guest, not a prisoner; the tiny village had no hotel.

There was especially long and warm applause this spring when Alexander Wetmore received the highest honor we could bestow—the National Geographic Society's Hubbard Medal. I asked him at that time how man ought to treat his home, the biosphere. He said, "Treat it as though you had been given a miracle for a present."

Gilbert M. Grosvenor

COVER: *A fortune in hammered gold and gleaming filigree adorns a Fulani woman of Mali. Photograph by Georg Gerster.*

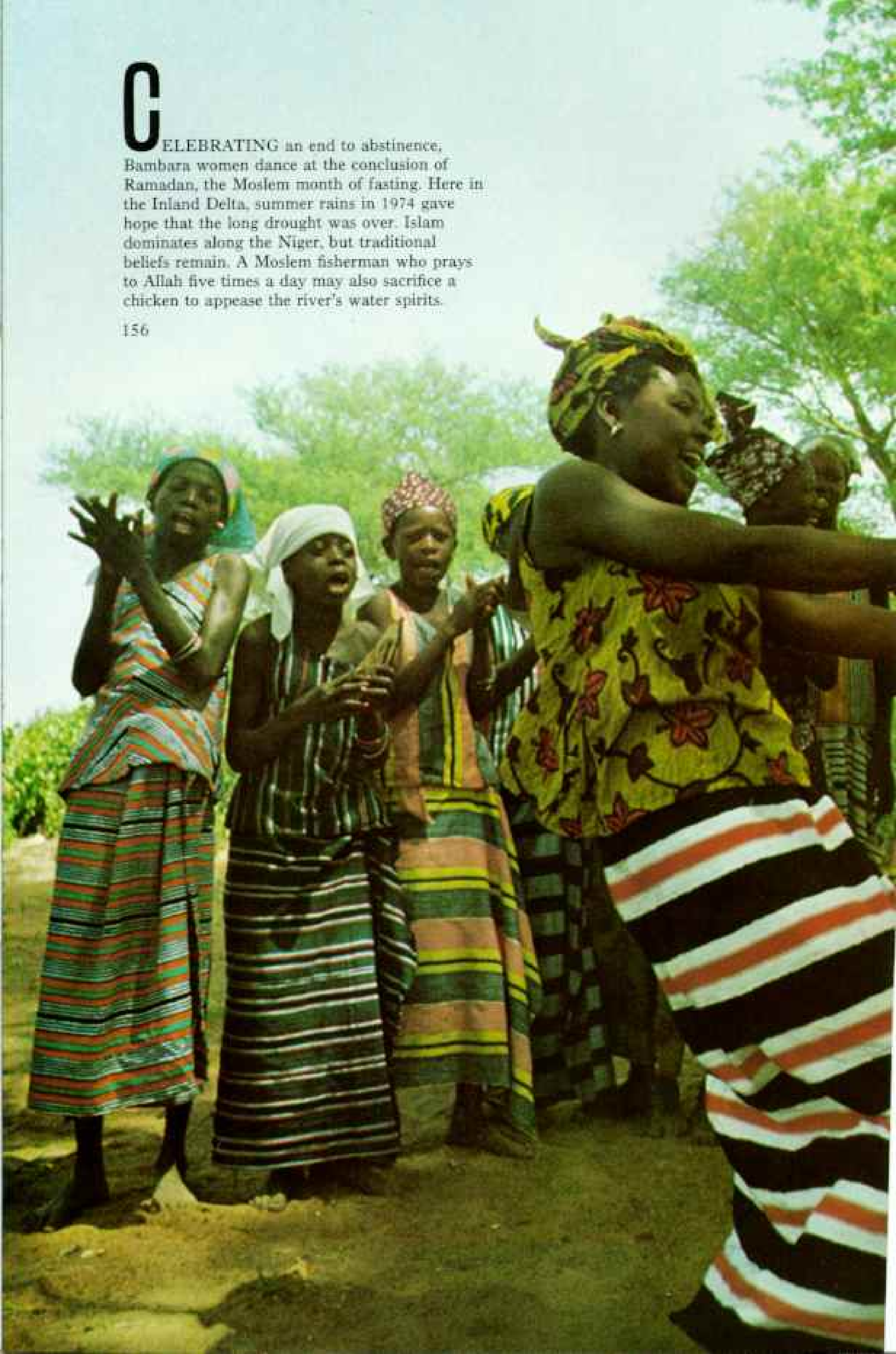
River of Sorrow, River of Hope

ARTICLE AND PHOTOGRAPHS BY
GEORG GERSTER, Ph.D.

NIGER RIVER BOUNTY, clusters of sorghum fill the bowl of a Fulani woman in Mali. To millions of West Africans the river brings comfort when flowing in abundance, misery in time of drought. Its dual nature may have inspired a village artist to paint a Niger god (**above**) with two serpents as river symbols.

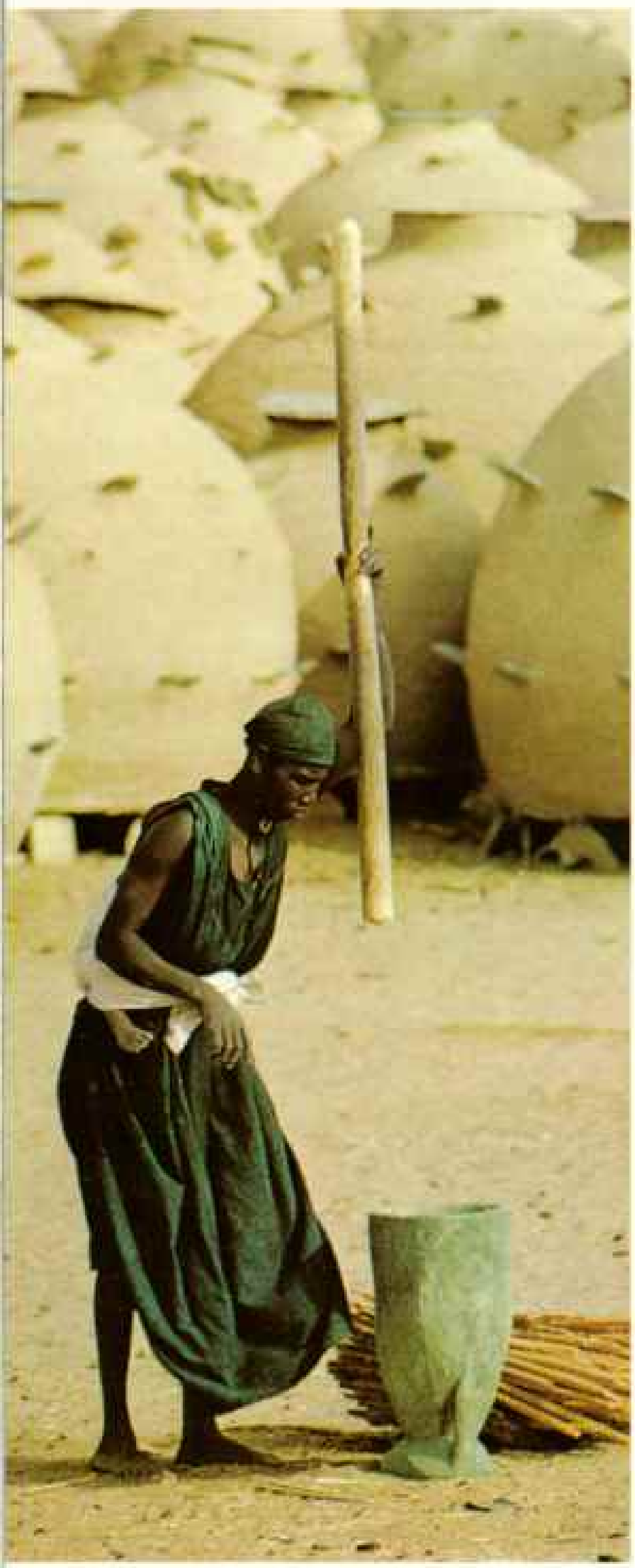
HIGH-WATER transfusion brings life to the arid Sahel country of lower Mali. The Niger in fall broadens into a 20-mile-wide moving lake within a lowland called the Inland Delta. Spring rains in Guinea's tropical highlands trigger a flood that fills the delta at the beginning of the dry season five months later, creating a vast cornucopia of inundated paddies, millet fields, and rich breeding grounds for fish. Farmers, herders, and fishing folk along the river trade with each other in an almost cash-free exchange of protein staples. When the system broke down in the recent drought, tens of thousands died of starvation or hunger-related diseases. The Niger's failure to flow with its usual benevolence dried up pastures, cut the fishing catch in half, and left riverside grainfields bone dry.

CELEBRATING an end to abstinence, Bambara women dance at the conclusion of Ramadan, the Moslem month of fasting. Here in the Inland Delta, summer rains in 1974 gave hope that the long drought was over. Islam dominates along the Niger, but traditional beliefs remain. A Moslem fisherman who prays to Allah five times a day may also sacrifice a chicken to appease the river's water spirits.



PEGBOARD of garden plots fans out from a shimmering well that taps an underground water table at Timbuktu in Mali. Bearing water in a goatskin bag, a farmer fills one of the bowl-like depressions that harbor plantings of vegetables or tobacco (**above**).

Attempts to introduce modern irrigation along the Niger often bring complications, rather than more food. Canals and reservoirs confuse time-honored agreements on land and water ownership, and hasten the spread of waterborne disease-causing parasites. Pressure to grow cash crops instead of food for neighborhood use further threatens to upset the fragile balance of local trade.



WHEEL OF GOOD FORTUNE takes shape in an Inland Delta field as harvesters stack millet spikes in a cylindrical pile for drying. Threshing is done to meet daily needs; the spikes are beaten with sticks to dislodge the shotlike grain, a dry-climate staple. A toss in the air (**above**) separates "the chaff which the wind driveth away," a process at least as old as the Biblical admonition. After being pounded into flour (**left**) and mixed with water, millet is eaten as a pasty gruel or patted into cakes and cooked. Hivelike mud granaries store future rations; protruding stones are steps that lead to the openings at their tops.

Although recent rains produced this ample crop, famine still looms elsewhere in the stricken area. In desperate hunger, many farm families ate the seed normally reserved for the following year's planting.

River of Sorrow, River of Hope

MOUSSA TRAORÉ, chief official of Sendégué, a village on the Niger River in Mali, treated me to a lunch of rice and fish. He told me he was the husband of two and the father of four—and that he, a devout Moslem, expected to enlarge (and, of course, feed) his family until it numbered four wives, allowed by the Koran, and thirty or more children.

"I pity today's young men to whom a family is one wife and two children," he said.

Through the window I glimpsed dry cracked earth. The farmers of Sendégué had waited in vain for the annual rains and flood upon which life in the Niger's basin depends. "How do you dare?" I asked. "Hard times are ahead."

My host shrugged off the warning: "The lean years will soon pass."

At the time—a little more than two years ago—I thought him frivolous. But as I journeyed along the Niger, following most of the 2,600-mile semicircle the river describes through West Africa, I learned that many of the people living on its banks accept the river's fateful fluctuations as dispassionately as he did.

My warning seemed fully justified, when, in the months after our lunch, the grip of the drought tightened in a broad belt below the Sahara; it meant hardship for millions. But events also bore out my host's optimism. When I revisited the Niger last fall, ample rains and a near-normal flood had watered the fields of rice and millet, and greened the herdsmen's pastures.

"Never forget," Moussa Traoré had prophesied to me, "today we may suffer from the river god's wrath, but tomorrow his mercy will shine again."

Draining a basin of 430,000 square miles—a diverse area almost twice as large as Texas—the Niger is a veritable river of life for West Africa. It originates in the lush tropical highlands of Guinea, less than 200 miles from the Atlantic Ocean. A gentle gradient coaxes it northeastward into Mali through acacia-studded grasslands, and then into the Sahel, the brown and blistered area between desert and savanna (map, page 166).

Then, beleaguered by dunes, it swings to the southeast, entering the Republic of Niger, for a while forming the boundary between that republic and Dahomey. In Nigeria it reenters steaming jungle once more, reaching the Atlantic through a maze of swamps and estuaries—a delta unrivaled in Africa for size and complexity.

River Gods and Secret Treasure

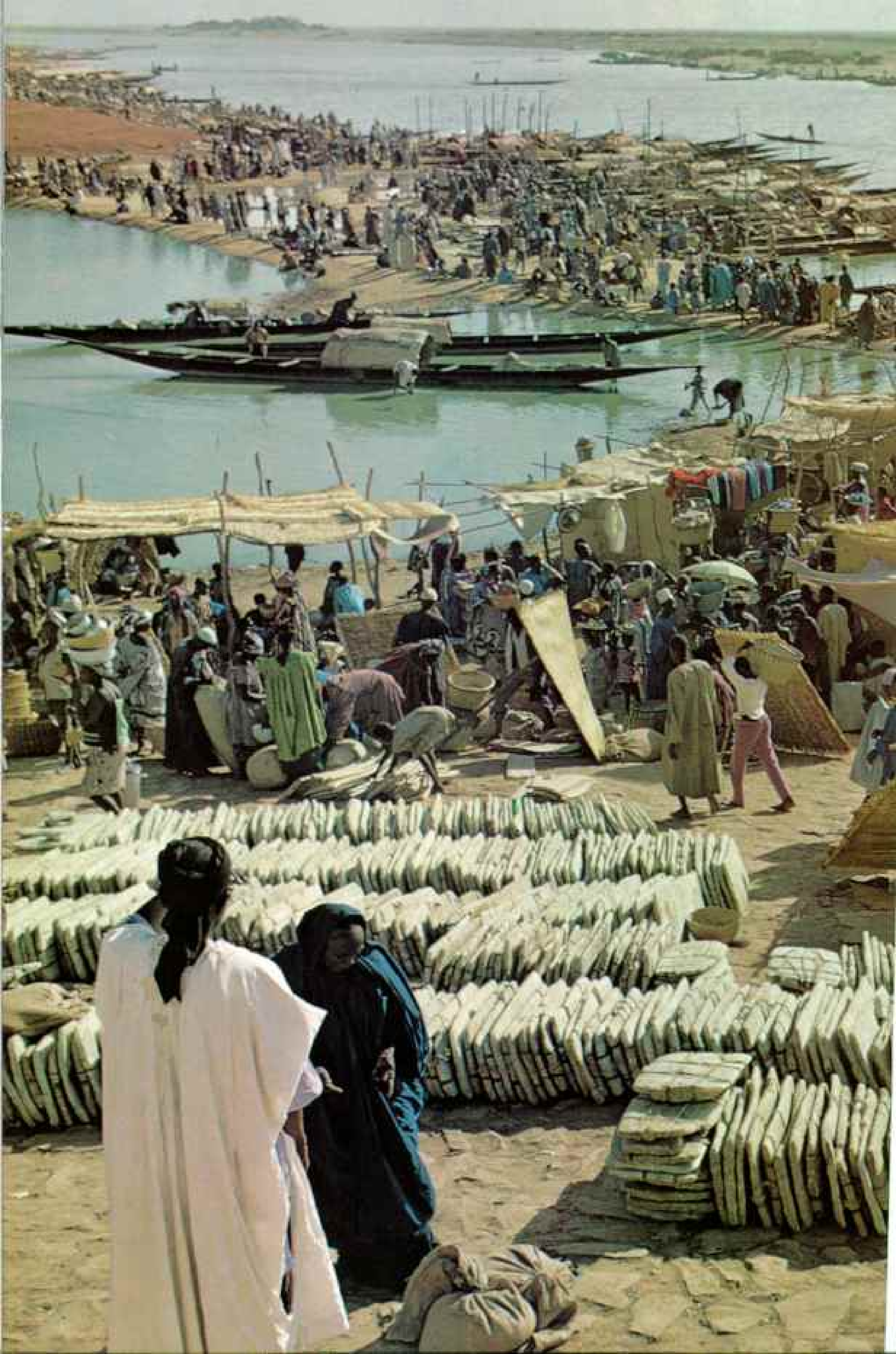
Powerful and wealthy empires flourished along the Niger before Europe had emerged from the Middle Ages. In the 14th century the Empire of Mali controlled a 1,500-mile stretch of the river.

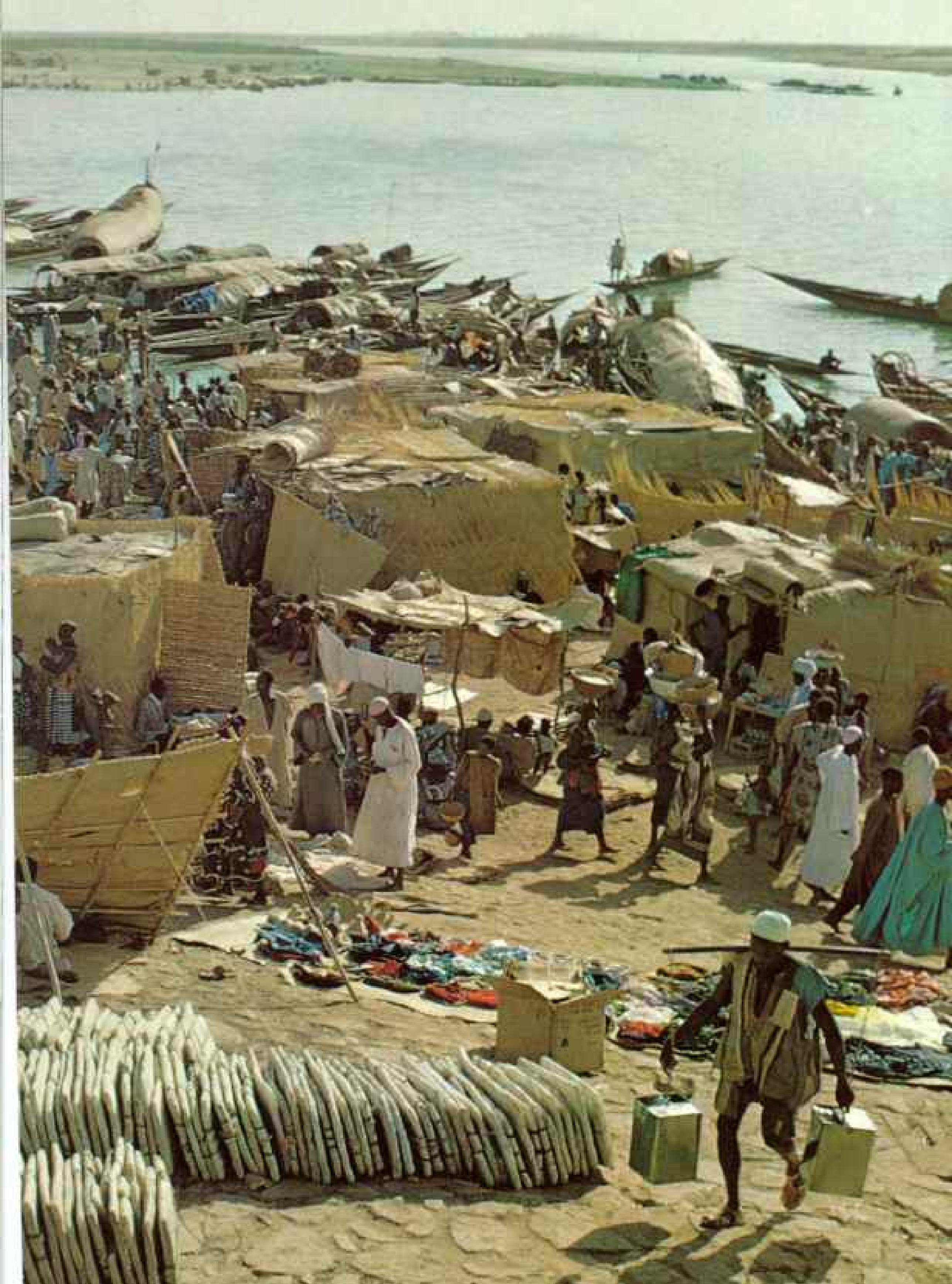
It was in Kangaba, the village that had been the last capital of the ancient realm, that I saw a representation of the river god who, as Moussa Traoré had reminded me, dispenses both wrath and mercy. The painting on the exterior wall of a round mud house with a thatched roof depicted the god and two serpents. One twined about him; the other approached beguilingly (page 152).

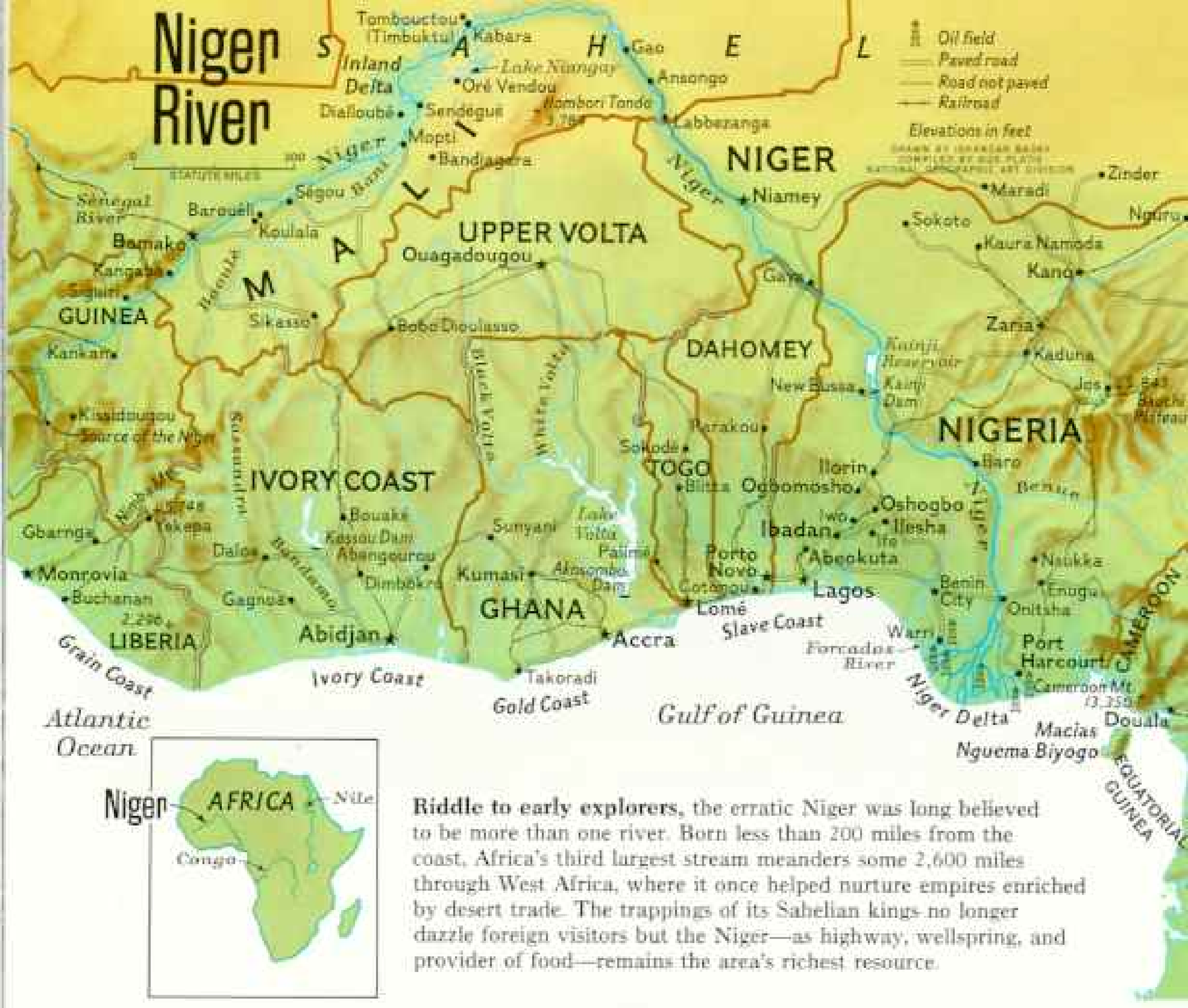
"The river god, dispensing bounty, that's what it shows," an old man explained vaguely.

The house is sacred, and no stranger may enter. Restored every seventh year in a holy ritual, it is said to hold treasures brought from Mecca centuries ago by a Malian ruler. I think these were known to the villager who spoke with me. He was of the Malinke people, heirs to the old empire, and he traced his lineage back to the *griots*, bards to the Malian kings. In spite of my prodding, he would not reveal anything. "Instant death," he warned, "befalls anyone who knows and speaks—the spell of an age-old curse."

STACKED LIKE LUMBER, salt enough for an army surrounds a ship's cook preparing a presumably well-seasoned meal in a river pirogue. Once, salt was a cargo so precious that 12th-century traders reportedly exchanged it for twice its weight in gold. Camel caravans still carry slabs from the Sahara to the Niger, where they are transported upriver to the market at Mopti, Mali (pages 164-5). Amid canopied canoes and straw-mat stalls, spices, pottery, cloth, grain, salt, and dried fish are bartered and sold.







Riddle to early explorers, the erratic Niger was long believed to be more than one river. Born less than 200 miles from the coast, Africa's third largest stream meanders some 2,600 miles through West Africa, where it once helped nurture empires enriched by desert trade. The trappings of its Sahelian kings no longer dazzle foreign visitors but the Niger—as highway, wellspring, and provider of food—remains the area's richest resource.

Silence was his answer, too, when I asked him to explain the symbolism of the serpents. But a local agricultural instructor—a practical man—gladly offered his interpretation. "The two serpents," he told me gravely, "mean gold and tobacco."

Placer gold from the upper Niger and Sénégal Rivers made ancient Mali fabulously wealthy. In 1324, when a free-spending Malian monarch, Mansa Musa, stopped in Cairo on his pilgrimage to Mecca, the price of gold in Egypt reportedly plummeted.

"The river god in the painting is warding off the serpent of gold," the instructor explained. "Today the government prevents the Malinke from mining gold." These people must forgo their old happy-go-lucky ways for serious farming, he added soberly—plainly adapting the symbols to his own design.

So the gold of the Malinke today is green—tobacco, introduced by the government as a cash crop. And once again, despite drought, the Malinke appear to have struck it rich. Young villagers scurry about on motor scooters and bikes—token signs of the new gold rush—puffing pipes, cigars, and cigarettes. And the river, as of old, plays its role: Water from the Niger, lifted by irrigation pumps, nourishes the leaf.

Curiosity Killed a Courageous Scot

"Niger who?" quipped a tobacco farmer when I appraised his harvest as a gift of the Niger. "For us," he refuted firmly, "the river is Joliba."

That is one of several names bestowed on the river by the people who live along its banks. Though all have essentially the same meaning, "great river," they conspired to confuse explorers. For many years the Niger was thought to be two or more rivers.

In the 18th century the African Association of London sent the Scotsman Mungo Park to learn the truth. Trekking inland from the

coast, he struck the Niger in mid-course in 1796. By one account, after sailing down half of the river on his second expedition in 1805, he seemed likely to reap the big prize—the discovery of its outlet—when natives ambushed him at Bussa, near modern Nigeria's New Bussa. He drowned trying to escape. In 1830 the English brothers Richard and John Lander removed all doubt; they sailed down the Niger to the Atlantic.

Refugees Flock to Ebbing River

Even in an ordinary year the Niger fluctuates from raging flood to quiet stream. But in recent years the river remained, even in the usual flood season, at perilously low levels. It shrank to a disastrous low in 1973, as gauged at Bamako, Mali's capital.

The drought stretched across sub-Saharan Africa, from Senegal to Ethiopia, banding the continent with famine. In the Niger countries, desperate nomads, sometimes leaving children, old people, and animals behind, flocked to an all-but-dry river, imposing themselves upon the already distressed sedentary population. Only a large-scale infusion of international aid halted mass starvation. All along the Niger's big bend, refugee camps sprang up. Camels as well as four-engine C-130 transports of the U.S. Air Force joined to haul more than a million tons of food grains to the people.

During that time of drought, I accompanied hydraulic engineer Gaoussou Koita from Bamako to his post at Mopti, a day's drive downstream in the so-called Inland Delta. Gaoussou taxed my imagination with tales of the Niger's might. In an ordinary year, he explained, the river begins to swell from heavy rains falling in Guinea in the spring. By early fall the floodwaters have spread over the Inland Delta, creating a labyrinth of lakes and lagoons that stretches for 250 miles northeast to Timbuktu, that legendary city whose name still connotes end-of-the-world remoteness.

As Gaoussou talked, we drove through parched scrubland. Wherever we could see the Niger, it was a mere trickle.

What a surprise in the fall of 1974 when I traveled the same road! Now the Niger flashed through swales of emerald grass. Stalks of sorghum and millet drooped under the weight of the grain. Markets were resplendent with produce. At noon in one village, young women whirled to a frantic drumbeat, celebrating the end of Ramadan, the Moslem month of fasting—and what they hoped was the end of a much longer fast as well (pages 156-7).

"We have turned the corner," a jubilant farmer told me. He was stripping the bark from a rejuvenated baobab tree, to use in making rope. "This was the second drought I have lived through," he said, recalling a similar disaster in the 1940's, and added with every optimism, "I probably won't live long enough to experience the next one."

Like most river people who have watched the Niger fall and rise over the decades, he held a cyclical view. He would have disagreed vehemently with some experts who believe the Niger's recent improvement will be short-lived because of changes in global weather patterns. Needless to say, officials of many governments and relief agencies are keeping a special watch on the annual rainfall this summer.

Projects of grand design are already being planned to counter the effects of future droughts, as well as overgrazing and overpopulation. Assessing grazing resources from orbit, satellites will supply valuable data for range management. But grass-roots solutions also are being tried.

I accompanied Jeff Dick, a Peace Corps volunteer, to the village of Koulala. Under his supervision the villagers chopped up nine tons of millet stalks and pennisetum grass, packed it into a pit, and sealed it with palm leaves and earth. When reopened six months later, the silage would provide food for two oxen and three cows over the dry season.

The concept of silage is new here; grasses sprout in abundance after the rains, but much withers to waste. Jeff exulted over the success of the effort. "Farmers in my area have dug more than twenty silos themselves," he said.

Inland Delta a Vast Fish Farm

The Inland Delta's gentle slope—only three inches in a mile—encourages the river to tarry, meander, and create a dawn-of-time landscape, with water and land undivided. The delta becomes a great sponge, storing the Niger's flood and releasing it slowly for its 1,500-mile journey to the sea.

In the assessment of fisheries expert Arno Meschkat of the United Nations Food and Agriculture Organization, the Inland Delta is potentially "one of Africa's, if not the world's, most enormous inland fishery resources." When the water rises, fish leave the

bed of the river, scatter over an area the size of New Jersey, spawn, and grow fat on the aquatic pastures. As the water recedes, the fish struggle back to the main channel, falling prey to spear, net, and trap.

But poor flood years and overfishing have cut into fish reproduction. "Sometimes twenty men hardly sufficed to lift one trap full of fish, and twice a day at that," said an elder of the Bozos, a people known for their skilled fishermen. "But now," he added sadly, "all we do is patrol our traps every three or four days for a few pounds of fish each time."

The Bozos showed me a fish equipped to survive drought conditions. This species of lungfish, *Protopterus annectens*, is able to remain behind on dried-up land. Curled up in a protective cocoon of mud and mucus, breathing with its lungs, it waits—if necessary for several years—until the water returns. Then it switches over from lungs to gills. The Bozos, however, doubted my explanation of the fish's survival technique. One insisted, "He falls from heaven with the first rainstorm of the season."

Capitaine a High-ranking Fish

I accompanied Bayon Dienapo, head of a fishing cooperative, on an inspection tour of his fiefdom. He was obviously a ranking Bozo, and I addressed him jokingly as *mon capitaine*. The pun pleased him, for capitaine is also the name of the Niger's biggest fish, *Lates niloticus*, the Nile perch.

Being a "big fish," however, made Bayon no less vulnerable to the river's fluctuations. "In three consecutive years I planted 20 acres of rice on the floodplain, but all I got were withered stalks," he lamented. "This year for the first time I did not plant, for lack of seed and faith. And then the Niger came back in strength. Unfortunate man that I am!"

But no one can remain pessimistic for long in the market at Mopti, the delta's commercial hub. Its everyday haggle swells at the mid-week market day to a pandemonium of noises and colors (pages 164-5). On the riverbank I squatted with women bargaining for brown balls of dried onions from Bandiagara, and mingled with Arab traders hawking marble-like salt slabs from Taoudenni, in Mali's desert hinterland. And as I watched pirogues disgorge the Niger's fish, it was easy to overlook the decline from plenty to penury.

French Bread for an African Bone

In a good year Mali's catch of fish from the Niger and its tributary the Bani totals about 185,000 tons. Some of this moves through the processing complex in Mopti, built under the supervision of André Szabo, a Romanian-born Israeli who works for the United Nations. Proudly André gave me a tour of cold-storage rooms and smoke ovens. We paused in a nearly-completed restaurant where diners can sample smoked capitaine, a delicacy vying with smoked salmon.

André is ever on the lookout for new species for canning, and he let me be the first "customer" to try *Alestes macrolepidotus*. It was handed to me straight from the oven with the promise that it tasted "something like herring." The privilege was painful, for I half-swallowed a bone.

André rushed me to a baker's shop, driving through the market throngs at ambulance speed. Never before had I such kind words for the colonial legacy from the Seine. French bread, baked by an African, did the trick.

After the rains many farmers looked forward to bumper crops of rice, millet, and sorghum—but then they had to worry about losses to weaverbirds and locusts. They fought their own battle against the birds with slingshots and scarecrows, while an international control team went after the locusts by poisoning their breeding grounds.

More than a hundred miles northeast of Mopti, I traveled over many lake beds that were dry despite the new rains. But beneath

IN LINE WITH THEIR FAITH, reverent Moslems bow for midday prayers at the mud mosque in Mopti. Protruding wooden beams provide permanent scaffolding for constant repairs. Fanatic Berber converts to Islam made forays into West Africa in the 11th century, but proselytizing traders were mainly responsible for the spread of the religion. Today the numerous spires and fluted walls of mosques mark an important unifying force along most of the Niger's five-nation course.

the dusty soil, there was plenty of water left. Cattle, sheep, and goats of the Fulanis, largest of the ethnic groups in the Inland Delta, orbited around improvised wells. Having heard reports of heavy livestock losses, I found this a startling sight. Obviously some of the Fulanis—known in French-speaking Africa as the Peul—had outwitted the drought.

These people have long been pastoralists who move with the seasons. Along the Niger, however, they have compromised. Young herders, sons or servants, roam with the cattle, while parents and owners remain in their villages of dome-shaped huts, thatched with straw and lined with mats.

Among the young Fulani herders at one well I recognized Amadou Vide, whom I had met at the village of Dialloubé before the drought. There we had watched a *traversée*, a mooing, shouting chaos of horns and swirling sticks. Young men swaggered past the grandstand and proudly displayed to officials and admiring girls their livestock, while a long line of amber-bejeweled maidens swayed to the music of flutes.

During a traversée, herds are driven past a checkpoint so authorities can control the drive to verdant pastureland. Dates for each traversée are set months ahead to prevent a wild rush. A festive air reigns in Dialloubé when the herds pass the official grandstand.

I asked Amadou whether the wives of wealthy cattlemen had sold their golden finery when the drought ravaged the herds.

"Times were bad," he said, "but they never got *that* bad. Many of us took refuge in camps, but others drove the herds to pastures far south, where there was forage and water."

Not all animal owners in the Inland Delta fared as well as these Fulanis. I found empty corrals at Oré Vendou, a village of sedentary Bambara farmers. The villagers reported the loss of all donkeys, camels, oxen, cows, sheep, and goats. Fortunately, the grain harvest has always sustained the Bambaras. "We also have planted peanuts," said their leader. "The proceeds from those we will use to again build up our herds."

On my return to Mopti I met Boubou Diarra, a dealer in African art. To him the low water had been a boon. It meant greater mobility for his scouts on motorbikes, who combed the countryside for treasures. And hard times had lowered the resistance of owners. He let me glimpse that day's catch: wooden masks, bronze figurines, and an ancient terra-cotta statue, certainly a museum piece. Gleefully he pounded his pocket, which bulged with telegrams—buying offers—from the United States and Europe.

The next day I boarded the *Liberté*, then one of three passenger ships that plied the Niger in Mali for several months each year when the water was high enough. Soon after my trip she was retired. We were bound for Gao, 500 miles downriver. Third-class passengers bartered for food in a frenzy of last-minute trading; meal service would be available only on the upper deck, inaccessible to them during the four-day journey.

Riverboat Runs on "Allah's Time"

Registering with the purser, I inquired about the ship. She was put into service in 1928—"the year of your birth," he answered, glancing at my passport. "I'm sure you'll understand that her hull is slightly rotten."

The *Liberté* was born a paddle-wheeler, but her wheels and engine were removed to spare her from vibration. So she now suffered the indignity of being towed by a tug.

At each of the frequent stops, frantic trading resumed. Soon the *Liberté* fell behind schedule. Landings projected for daytime came at dusk; Kabara, the port of Timbuktu, was reached in the dead of night. The purser brushed aside passenger complaints. "Our time," he consoled, "is Allah's time. . . ."

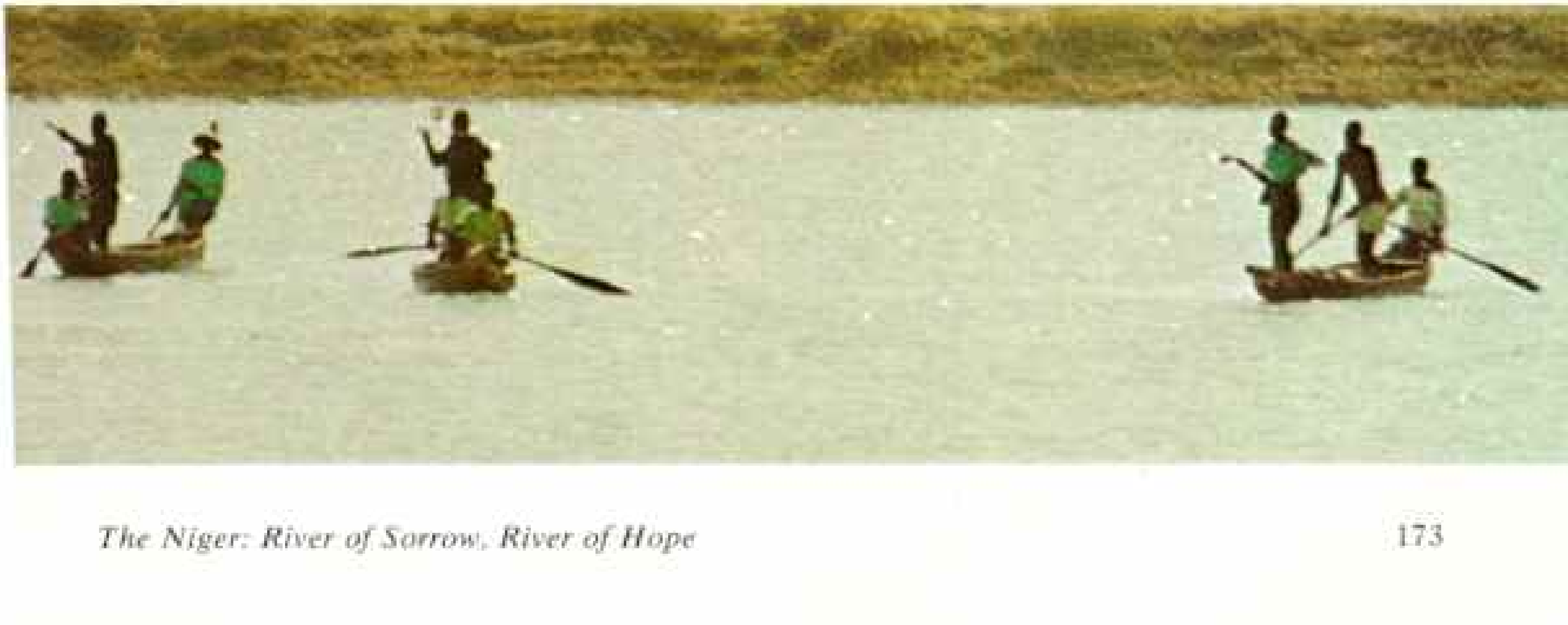
Along the shore Fulani huts gave way to the mat-covered homes of the Songhais, shaped like tortoise shells. They clustered with adobe houses around mud-walled

DUST MAKERS, cattle urged on by Fulani herdsmen move toward traditionally allotted pastures in the Sahel of Mali. The annual *traversée* carries them past a government checkpoint for taxation and migration control. Overgrazing in some areas has hastened the encroachment of desert.

While crops grow along the river, herdsmen move to open range. Then, after grasses dry up and the harvest is in, they return to graze their cattle on the stubble. The arrangement provides farmers with fertilizer and dairy products, and herdsmen with pasture and grain.

MOBY DICK OF THE RIVER, an enraged hippopotamus surfaces near Ansongo, Mali, as a Sorko hunter poises to launch another harpoon. Pierced but undaunted by some three dozen of the razor-sharp points, the hippo withstood attacks for three days, swamping several pirogues (**below**) before it was finally shot with a rifle.

Condemned as a danger to river traffic, the animal was butchered and the meat distributed to local villagers. Sorko spear hunting dates from about the seventh century, but with government efforts to protect the Niger's hippos, crocodiles, and manatees, most hunters have turned to net fishing or agriculture.



mosques that spiked the sky with minarets. Cattle and horses grazed on the river's marshy rim. Beyond the marshes rose the dunes.

The Niger is of old a cultural meeting place for nomadic Africans such as the Tuareg, caravanners of the desert and herdsmen of the Sahel, and agriculturalists like the Songhais. One day my cabin neighbor, an aloof Tuareg *marabout*, or holy man, began to lecture his fellow passengers, all Songhais, on racial differences. To me, he looked dark enough, but he fiercely argued his white supremacy.

"The black race," he proclaimed, "suffers the curse of Ham." According to the marabout, Ham, one of Noah's sons, defied his father's orders that men should not "know" animals on the Ark. Chastised for his carnal sin, Ham turned black. Some Moslems have tied the genealogy of all black people to Ham.

My haughty neighbor would not budge from his position even when another passenger, Koran in hand, proved that the holy book of Islam sustained none of his claims. His stubbornness, together with his debating skill, incited them to tumultuous protest. I retreated to the bridge just in time to learn an appropriate local legend.

Solid Evidence of Quarreling Family

Downstream two rocks jutted from the navigable channel, one lighter in color than the other. As we approached them, the chief helmsman grabbed the wheel from his aide and while shooting the rapids began to tell me the story of Sorgo and Kabio.

"Just relax," he said when he saw my alarm. "Even with my eyes closed I could steer this boat. So why shouldn't I talk when driving?"

Sorgo and Kabio were half brothers, sons of a Songhai woman's two marriages, one to a Tuareg, the other to a Songhai. The sons feuded, poisoning the peace between the two peoples, who finally met for battle. Throwing herself between the factions, the mother of Sorgo and Kabio besought the river god to turn her quarreling sons—and herself—into stone.

"There she is," said the helmsman, pointing to a third rock, less conspicuous than the two others. Then he tossed a handful of rice into the Niger to propitiate the river spirit, and perhaps to ensure that it remain without prejudice.

Drought Makes Refugees of Nomads

The *Liberté* turned around at Gao, a city of 15,000, once the capital of the Songhai Empire which rose after the decline of the Malinkes in the 14th century.

"Nowhere else in my country did the specter of famine loom larger," Capitaine Koké Dembéle, governor of Mali's Sixth Region, told me in Gao. "The drought wiped out entire herds and drove the nomads from the hinterlands."

In this region 29 riverside camps had sheltered as many as 65,000 refugees, the majority Tuareg. Donated food kept many from starving.* At the first sign of promising rains, however, the camps had begun to empty. In the fall of 1974 the compound at Gao held 169 newcomers—orphans recently gathered for schooling and adoption. But only 61 persons remained of the 14,000 who had lived here at the peak of the drought. Most of those who lingered were old persons, unable or unwilling to move.

Ahmed Ag Oumalha, a Tuareg, whiled away his time sipping tea and eating up the three-month food supply the government had given him. What was he waiting for?

"Seeding, planting, harvesting—how wonderful," he scoffed. "What do I know about seed and soil? All I know is camels and cattle. All I want is my animals back."

Tuareg herdsmen who lived in the Sahel were among the people hit hardest by the

*Victor Englebert described the plight of the Tuareg in the April 1974 GEOGRAPHIC.

EARMARKS OF WEALTH among the Fulanis, giant gold ornaments festoon a woman at Dialloubé; a head strap often helps support the heavy earrings. As a family's fortunes increase, more gold may be hammered onto the jewelry. Gleaming filigree—an art form along the Niger—harks back to an age when West African monarchs cornered the bulk of the continent's known gold supply. One 11th-century Ghanaian king reportedly possessed a nugget so large that he tethered his horse to it.

drought. Some families split up, a son or another relative taking their animals far south in search of grazing lands while other family members survived in the refugee camps. Other Tuareg lost all their animals. For many of these, the drought may have ended the traditional nomadic life-style.

I met some of the former refugees in the marginal lands between the river and the high desert. They were Bellas, once serfs to the Tuareg, but now integrated into the tribes. They were harvesting *fonio* and *cram-cram*, wild grasses with nutritional grains. Most of the people had no beasts of burden or cattle.

But large numbers of goats—seemingly drought-resistant—roamed the countryside, feeding on roots, leaves, and shoots. When I called them "despoilers of the earth," one Bella rose to their defense. "Allah be praised for every goat," he said. "Where would our children be today without goats' milk?"

Hippo Battles Harpoons and Magic

In Gao I learned of a forthcoming hippopotamus hunt. Occasionally the government issues a permit to kill a hippo that ambushes the pirogues of fishermen and market-goers. Usually a rifle is used, but this time a caste of the Songhais known as the Sorkos volunteered. Praised along the river for their virtuosity with the harpoon, these former hippo hunters longed to test their old skills.

At Ansongo I joined a group of at least fifty Sorkos poised for the battle against one hippo. They had rounded up a dozen pirogues. Harpoons and spears, honed to razor sharpness, glinted in the sun. The hunters had decided not to poison the tips so the villagers could safely eat the meat.

Leather pouches dangling from the necks of the men held verses from the Koran, the most potent of charms. Poured into the river to appease the resident spirit, the blood of a hen tinged the water red. From each pirogue came the incongruous cheeping of a chick, a good-luck mascot.

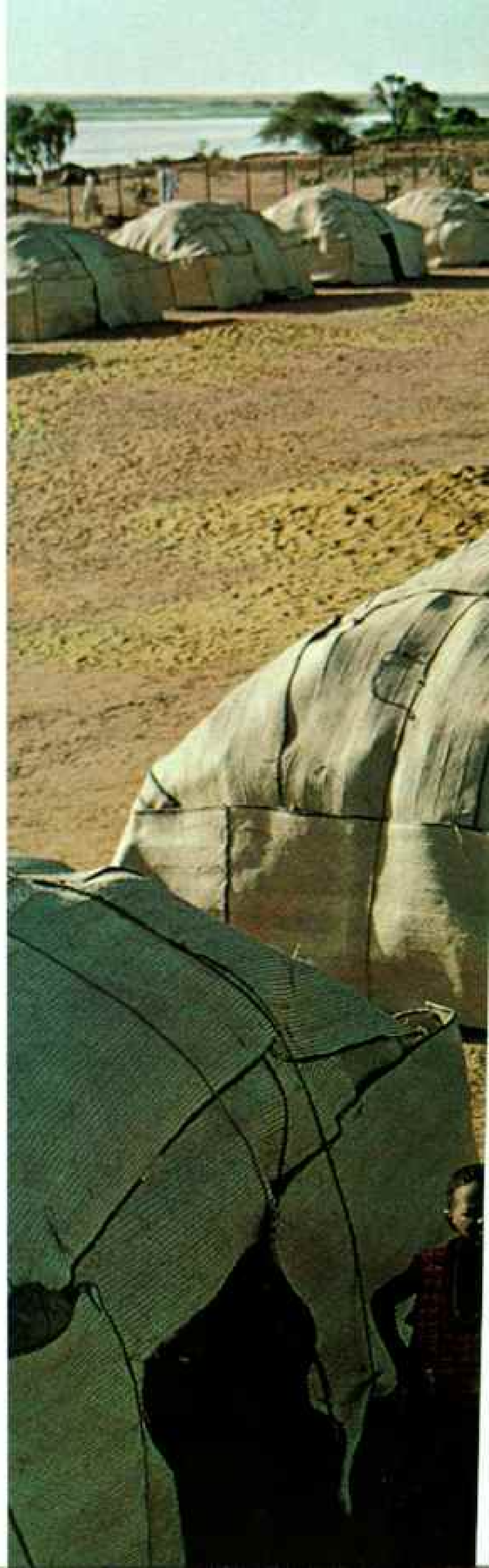
When we sighted the hippo, the Sorkos returned to shore for more magic. Their leader performed a ritual, throwing stones, as one would dice, in the sand. Then he murmured a protective spell over the kneeling men. Further, he insisted we pay homage to the *do*, the local mistress of the water.

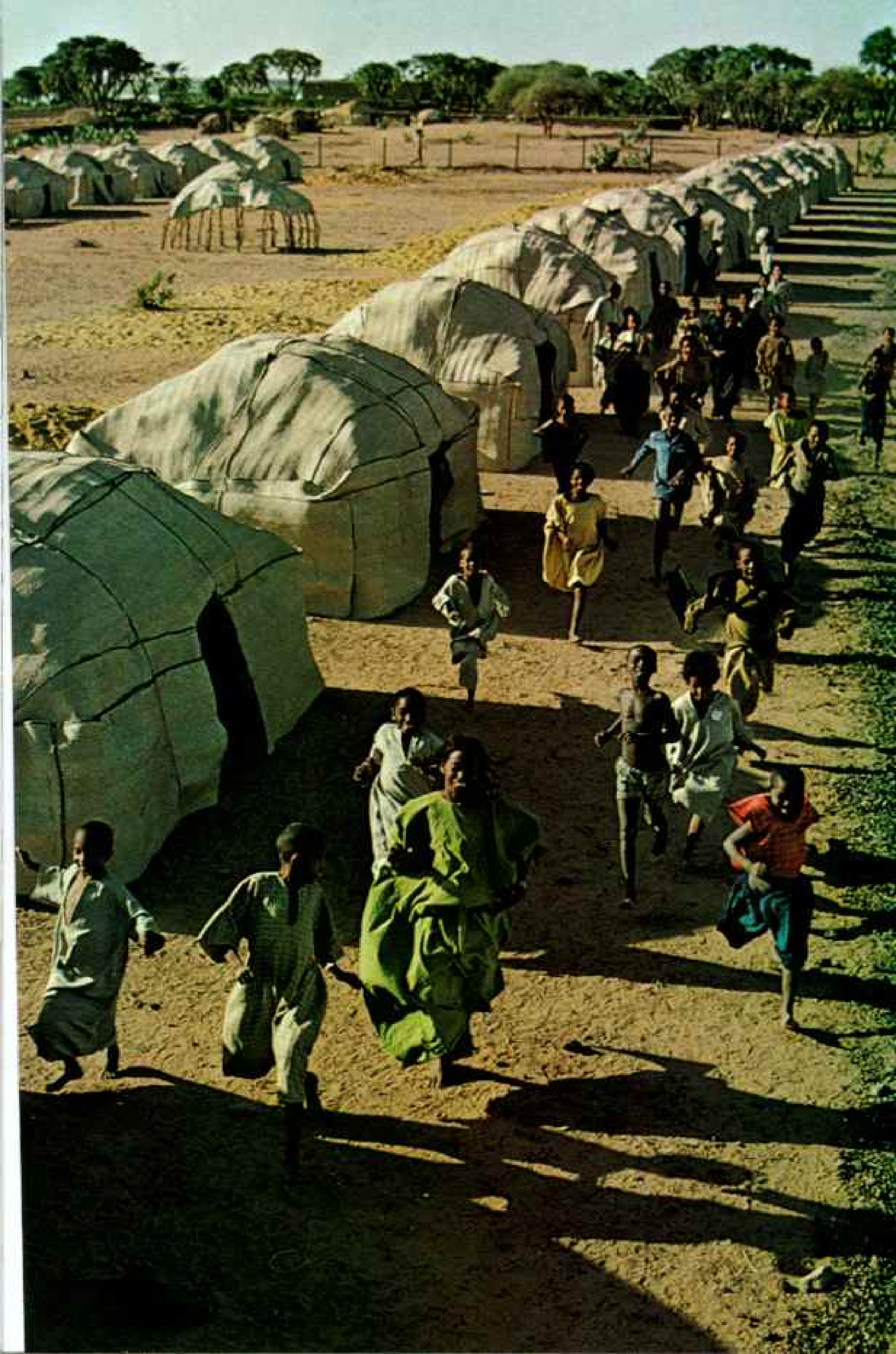
Rituals ended, we again took to the river. After several misses, a harpoon pierced the

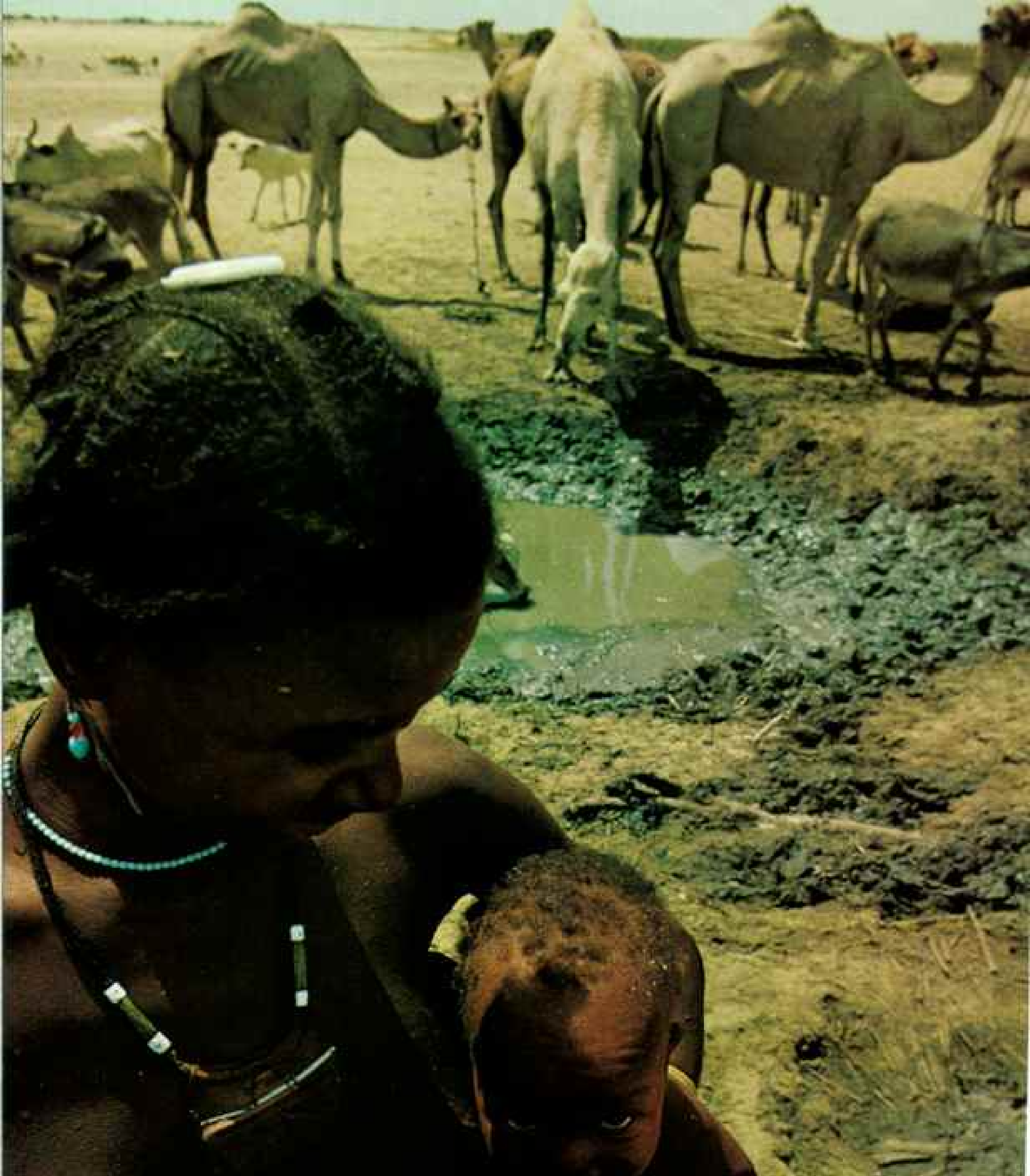
DRAB SKELETON of its former self, mazelike Timbuktu quietly bakes on the edge of the desert (**facing page**). In its streets a woman adds a dash of color as wind flares her loose-fitting *boubou* (**above**). The city that came to symbolize the uttermost end of the world was the center of a thriving society before commerce began to shift to the coast in the 16th century. While trade marched between the Sahara and the Niger basin, Timbuktu flourished at the crossroads, a tree-studded metropolis and seat of learning.

FAMINE'S LIVING VICTIMS: the children of the Sahel (**right**). Orphans of the drought race past the mat lodges of a refugee camp on the Niger's banks at Gao, Mali. Estimates have placed the drought-related death toll at 100,000, but the exact number will never be known. Moreover, the living may remain scarred by malnutrition; medical authorities believe that protein deficiencies in children can result in brain damage.

Hardship fails to dull the fashion sense of two traditionally coiffed girls at Barouéli village near Ségou (**above**). Hair wrapped with twine creates a series of small hoops on one, while the other wears closely woven braids—"corn rows."







hippo's hide. Shouts of triumph rang out—prematurely. Diving, the hippo surfaced under one of the boats, spilling the crew. The men swam to other pirogues (pages 172-3).

Moments later, the hippo slammed into our craft, which rose out of the water and plunged back with a smack. Water poured in. My five companions, not quite so surprised as I, dived overboard and frantically swam away. There I sat, alone, braced for the next attack.

It never came. The tortured hippo chose to vent his fury on a third pirogue. With one bite, he neatly snapped it in half.

All magic had failed; the first day's efforts were disastrous. Plaintively, the Sorkos showed me their broken harpoons. "Our weapons are gone," they wailed.

"So are mine," I replied, pointing to a heap of soaked cameras and ruined film. Being brothers in misfortune set my comrades to laughing. They praised the equanimity with which I stayed aboard the boat, using the word "courage" for behavior that, in truth, sprang from sheer lack of imagination, and ignorance concerning the rage of a hippo.

The spectacle lasted three days. I got out my spare cameras and the Sorkos acquired a fresh supply of harpoons. Despite more magic, more pirogues went down. Only after a rifleman reinforced the men did the unfortunate hippo meet his end.

Drought Helps Topple a Government

Downstream in the Republic of Niger the drought had political consequences: The military seized the government, accusing the civilians of bungling relief efforts.

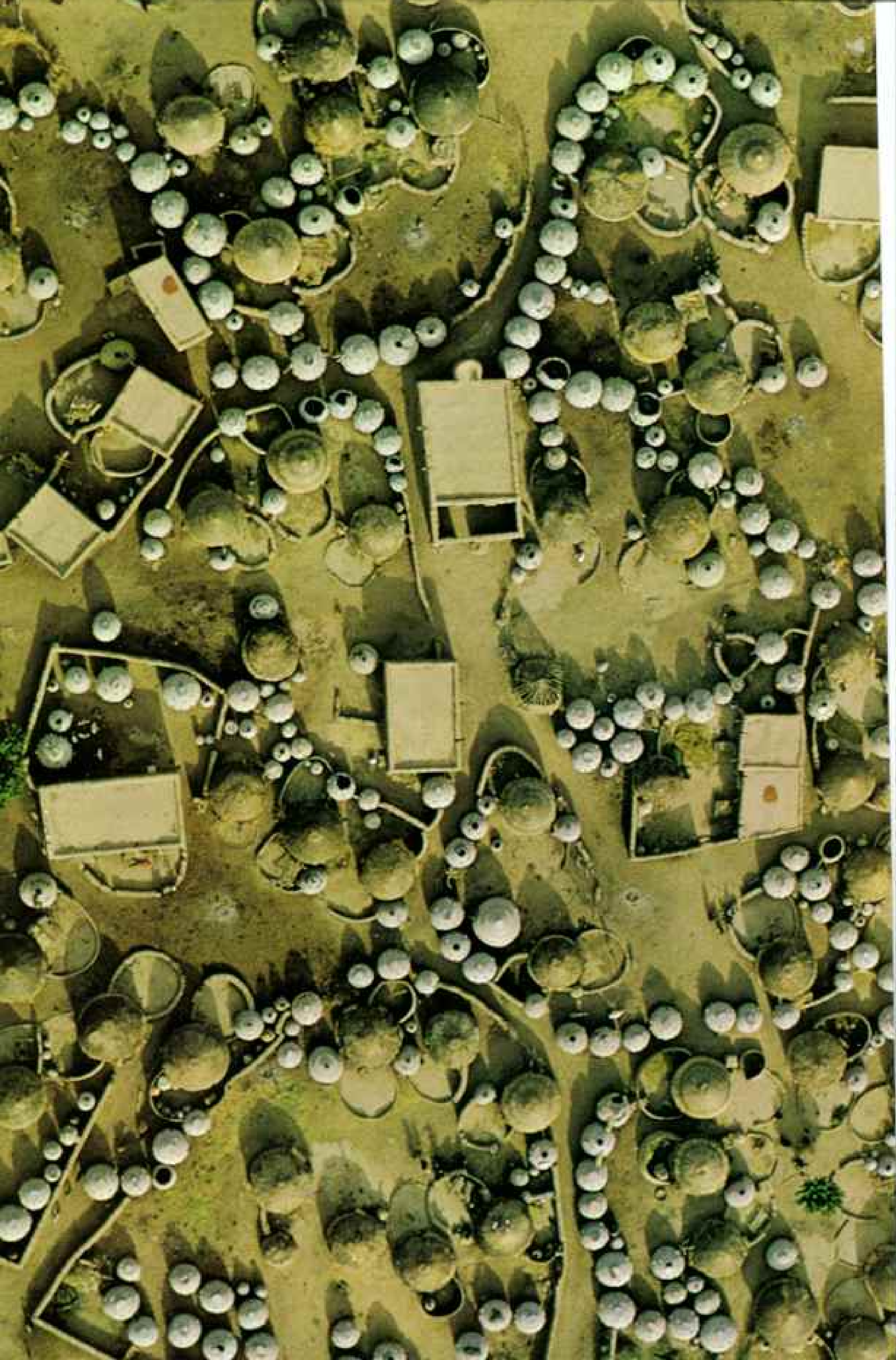
Niamey, the republic's capital, teemed with experts—mostly Europeans, Americans, and Canadians—who had been grappling with the drought. After the redeeming rains they helped reseed pastureland, dig wells, and stock food for another emergency. They advised farmers on boosting millet production, taught herders improved methods of animal husbandry, started a reforestation program, and built roads to open up the hinterland.

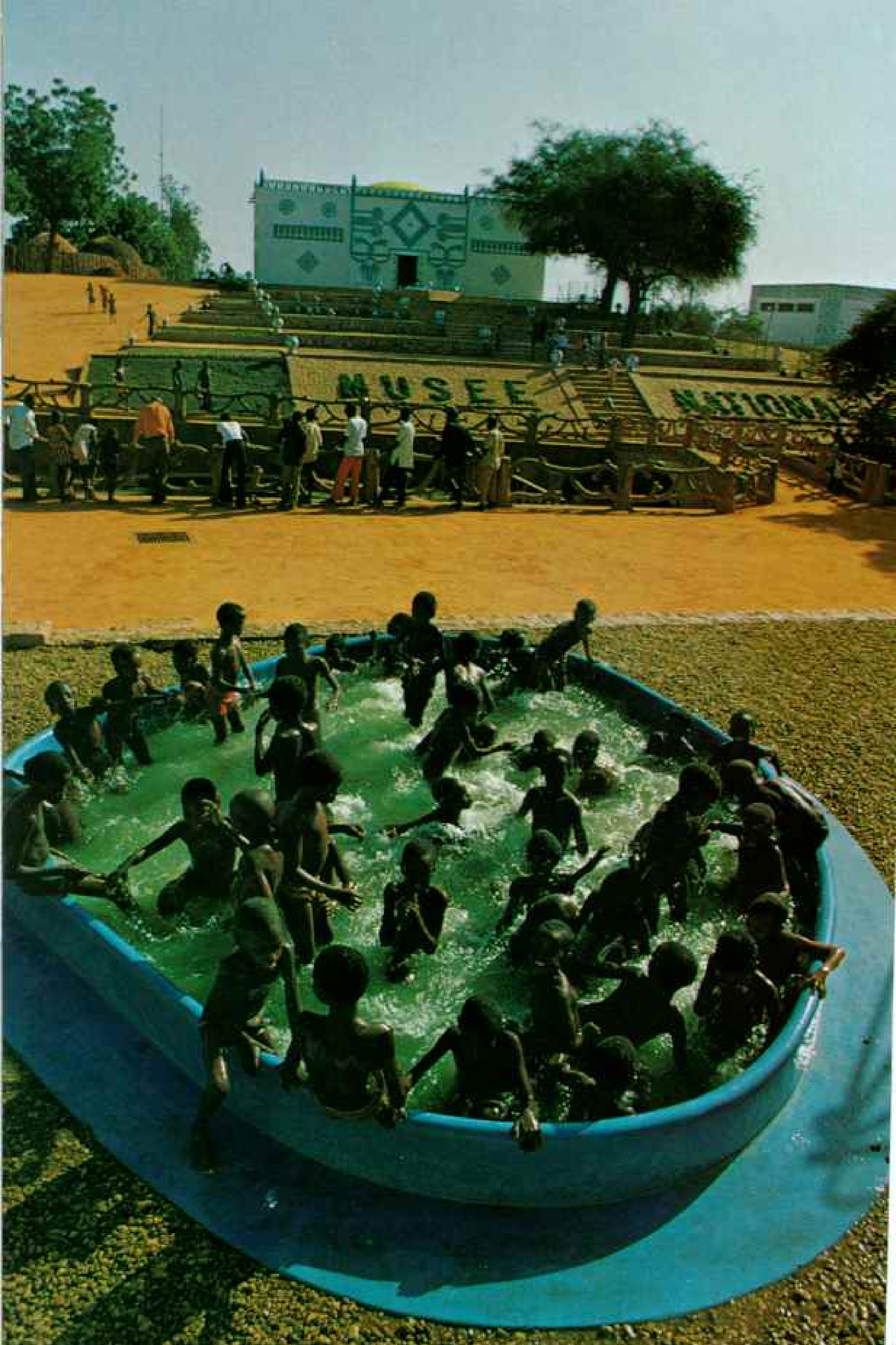
I found the new government reluctant to allow journalists to see the recovery effort; travel outside the capital was restricted. "The drought is over," one high official told me, "so let's not even talk about it anymore."

The last refugee camp in Niger, holding some 8,000 Tuareg from Mali, had become an international issue. Mali's defense minister had told me that the Tuareg were welcome

DISASTER exacted a high price from the nomadic Tuareg and Bellas. At Mali's once-abundant Lake Niangay, a Bella tot (**facing page**) drinks water from a murky hole also used by livestock, an invitation to disease. Scratching for morsels of food, a woman sweeps up kernels of *fonio*, a wild grain (**above**).

Hunger and the death of their livestock forced many Tuareg to settle in refugee camps—a painful experience for the free-living nomads. They scorn the high-density living of villages like Labbezanga near the Mali-Niger border (**following pages**) where white granaries loop like pearls around family compounds.




MUSEE
NATIONAL

to return to their homeland, but that the Niger Government prevented their return. In Niger I heard that the Tuareg refused to leave, fearing discrimination in Mali because of their clashes with the government in the 1960's. All my attempts to talk with the displaced tribesmen failed. Since then, most of the refugees have returned home.

Canadian Conqueror Comes by Tug

In December 1972 I had attended Republic Day festivities in Niger, where I heard a strange pronouncement: "Cordeau is at the gates of Gaya." A young Tuareg uttered this remark from atop his camel, which he had maneuvered into the crowd of spectators at the day's camel races. His comment seemed to announce the coming of a conqueror. But who was Cordeau?

A conqueror he indeed turned out to be. I learned that François Cordeau, a Canadian shipping expert, was approaching Gaya, near the republic's border with Nigeria, in command of three specially designed barges and a tug. Shipyards in Quebec had built the vessels under a Canadian loan to the republic.

Making his way up from the Atlantic delta, Cordeau was attempting to open a route from the sea; landlocked Niger had never known the full benefits of river commerce.

Bertrand Dejean, deputy director-general of Niger's River and Maritime Transportation Company, explained: "River transport will cut shipping costs on imports of fuel oil and exports of peanuts, cotton, and cattle. Our livestock will no longer lose half their body weight walking to foreign markets."

Before the turn of the century, when the French were colonizing West Africa, they envisioned the Niger as *le Nil français*. But the "French Nile" remained only rhetoric. Grandiose agricultural projects failed, and cultural differences between the French colonies and British Nigeria cut the river in two.

In fact, only a rough track today follows the river from Niger into Nigeria. To reach the Kainji Dam, I flew from Niamey to Lagos, Nigeria's capital, then doubled back by car for 350 miles.

A five-mile-long barrier of concrete and rock fill built mainly for power production, Kainji Dam forms a reservoir covering nearly 500 square miles. Eventually using as many as 12 turbines, Nigeria will export power upriver to the Republic of Niger, further bridging the gap between the two nations.

MODERNITY rears a high-rise profile in Niamey, Niger, as car and camel share the street below. Youngsters splash in a pool at the National Museum (**facing page**), where craft shops, a zoo, and displays of regional architecture acquaint citizens with all sectors of Niger.

THE RIVER'S OTHER LIQUID GIFT, oil, was discovered in the Niger Delta two decades ago. The rich deposits made boomtowns of ports like Warri (**above**), and will help fund a 48-billion-dollar plan for nationwide modernization by 1980. Nigeria was second only to Canada among oil exporters to the United States in 1974. Although local labor has always dominated the unskilled jobs, such as those on drilling platforms (**right**), a government decree now requires foreign oil companies to fill a majority of administrative and technical positions with Nigerians as well.

Locks provide for the passage of river vessels.

Kainji Reservoir flooded historic Bussa, where explorer Mungo Park died. So the Bussawa—descendants of those who may have done him in—moved to New Bussa, a 15-minute drive from the dam. I went there to visit their chieftain, Alhadji Musa Muhammadu Kigera III, Emir of Borgu.

"This river runs high with hope," the emir proclaimed. "In spite of the setbacks caused upriver by the drought, much has happened to let our people know a better day is coming. For instance, the great dam that you saw."

Later that morning, as I wandered about New Bussa taking photographs, I was stopped by a plainclothes policeman. His accusation: I had taken a picture of the police station. My denial was doubted.

HE: "You might be a saboteur."

I: "Do I look like a saboteur?"

HE: "Does a good saboteur look like one?"

He had me in a corner, and I was only too glad when he accepted my proposal to go back to the emir's palace. Though the emir has no say over the federal police, he wields tremendous influence locally.

Before entering the audience hall, the policeman removed his shoes as a mark of respect. When, after the emir had settled the matter and dismissed us and the officer wanted to put them on again, a palace guard grabbed the shoes and threw them out through the gate, as if to say, "So much for your suspicious nature!"

Delta Swamps Yield Precious Oil

From the apex of the Niger Delta south, dry land, overgrown with dense forests and still virgin in spots, gives way to a seasonally inundated zone. Here, sweet-water swamps with stands of raphia palms gradually merge into tidal swamps of brackish ooze, where mudskippers thrive under the arching roots of mangroves. The Niger, fingering through a thousand creeks, meets the sea in a dozen estuaries. Currents drift sand and mud across the river mouths, sealing them again and again to navigation.

It is in this swampy world that the Niger runs, in the emir's words, "high with hope." For oil extracted from the river delta has already made Nigeria among the world's top ten producers. Revenues in 1974 were more than eight billion dollars.

Nigeria needs the money. Her population stands at 80 million—largest in Africa—and

the average income until recent years was about $100 a year. But slow implementation of government programs compounded by the recent civil war made it difficult to put the oil profits to work.

Exploration Dries Up or Bogs Down

Oil operations began on dry land, then moved to the tidal mangrove swamps, and finally challenged the seasonally inundated freshwater swamps—in that order of ascending difficulty.

"The mangrove swamps are difficult enough," said Roger White, a civil engineer with Shell-BP, the Anglo-Dutch concern that pioneered oil production in Nigeria. "But the freshwater swamps—a pain in the neck! When it's dry, you can work, but the channels are too shallow to get there. And when you can get there in the rainy season, you can't work because you bog down.

"Every stick in this wilderness seems to be privately owned," Roger continued. The oil companies pay virtually by the inch for their access roads and canals. In Warri, the offices of London-trained barristers and solicitors, vying in number with the multitude of beer halls and betting places, settle litigation

among the prospective recipients of the real-estate windfall. "For a piece of raphia jungle, we sometimes pay more than for an equivalent plot of prime farmland in Europe," Roger said.

Nigerians like the swamp-dwelling Ijaws have good reasons for attaching a price tag to each raphia palm. Leaf stalks furnish poles and rafters for houses, while leaves supply thatch matting and fiber for brooms.

"A tidy house, that's what the raphia gives us," an Ijaw told me. "And a merry house, too." He was alluding to *kaikai*, a type of "white lightning" distilled from the fermented sap of the palm. He added, however, that in the Ijaw language, in which words typically have more than one meaning, kaikai also means "headache."

I made several attempts to visit a kaikai distillery, but failed. Kaikai producers shun the curiosity of authorities and discourage visitors from inspecting their forest hideouts. Only when I had made friends with an Ijaw did I attain my goal.

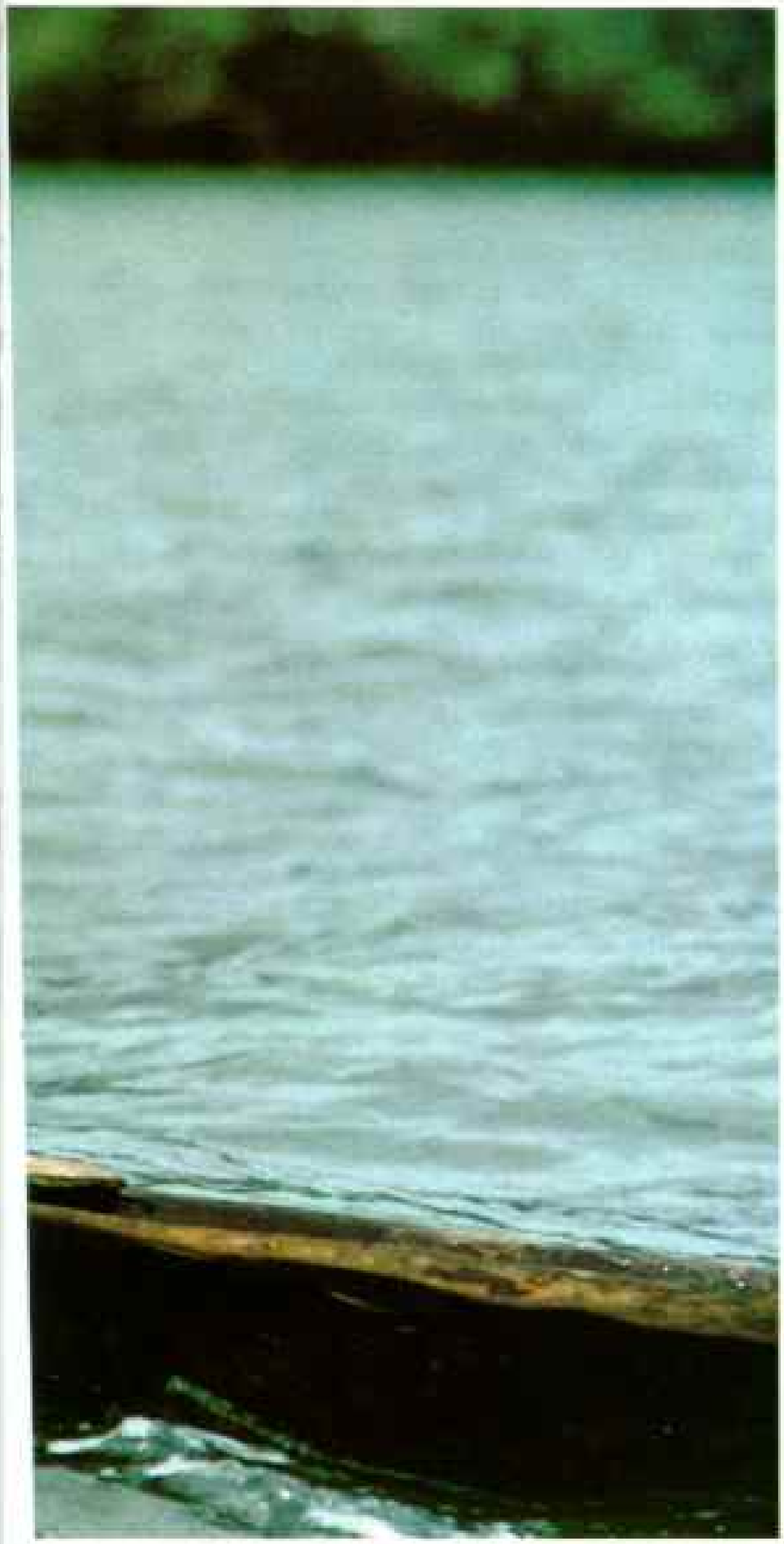
From the Forcados River we trekked inland, over a path strewn with raphia leaves as long as 60 feet, largest in the plant world. The singing of a tapper, collecting sap high in the palms, guided us to the distillery. On a platform, logs burned under a drum, heating sap. Steam from the boiling concoction ran through water-cooled tubing and condensed, filling a jar with kaikai, drop by drop.

Fiery Toast to the Niger

Assuming I was an oil man, the chief distiller complained that taking oil out of the ground would hurt his business. I tried to convince him that the raphia palm lives on water from the inexhaustible Niger, not on oil, but he retained his doubts.

Rain began to pelt down, and before he offered me shelter I became soaked to the skin, longing momentarily for the searing deserts and blistered lands I had earlier traveled along the upper parts of the river. I was cold.

Then my new-found friend dipped a glass into the jar and handed it to me with a grin. "From the great river," he said. It went down like fire. □



PILOT AND PROTECTOR, an Ijaw mother paddles her canoe in the Niger Delta. After extended contact with Europeans, many Ijaws turned from fishing and farming to making palm oil for trade. Now, some distill *kaikai*, liquor made from the raphia palm. With modernization, more changes await them. Nigeria's new oil wealth may bring better education and health care for their children, and dams built upstream may provide more electrical power.

Canada's Dowager Learns to Swing

By ETHEL A. STARBIRD

Photographs by
ROBERT W. MADDEN
BOTH NATIONAL GEOGRAPHIC STAFF

By honoring the past, Toronto builds a future where old dwells in harmony with new. Instead of razing the city's Edwardian houses, like those reflected in the window of this Markham Street antique shop, developers restored many of them—often within sight of ultramodern skyscrapers. As a blueprint for growth evolved, so did Toronto's life-style, influenced by immigrants who have been flooding the city since World War II.

THE PORTLY NEW YORKER picked up his briefcase and prepared to deplane in Toronto. "Would you believe it: This is my fifth trip up here in a month.

"'You own the company,' my wife tells me, 'so send someone else for a change.' I tried it —with my sales manager. A real good man. He never came back."

Such is the danger of doing business in today's Toronto, home of rapid riches and solid fortune, of vibrant pace and quiet challenge. For this once-sedate city has become a rival to reckon with: worldly, wealthy, personable, and relatively problem free.

Long known as "the good" and "the dull," Toronto began in the late 1940's to reject its role of drab stepsister to Montreal, then the darling of the dominion. A set of happy circumstances hastened its transformation.

The St. Lawrence Seaway opened the city's Lake Ontario port to ocean commerce. Newly discovered nickel, silver, and uranium deposits to the north keyed an economic upsurge. Investment money poured in from across the border. With a third of Canada's purchasing power and a fourth of its population concentrated within a hundred-mile radius, Toronto became the nation's new financial and industrial center. Cinderella had come to the ball.

Symbol of the heights to which Toronto has risen is the CN (for Canadian National) Tower, a stiletto of concrete and steel that soars more than a third of a mile above the downtown area (pages 193 and 202-203). Malachy Grant, an amiable Irishman who directs the project's design and construction, led me up a series of ladders to the highest deck.

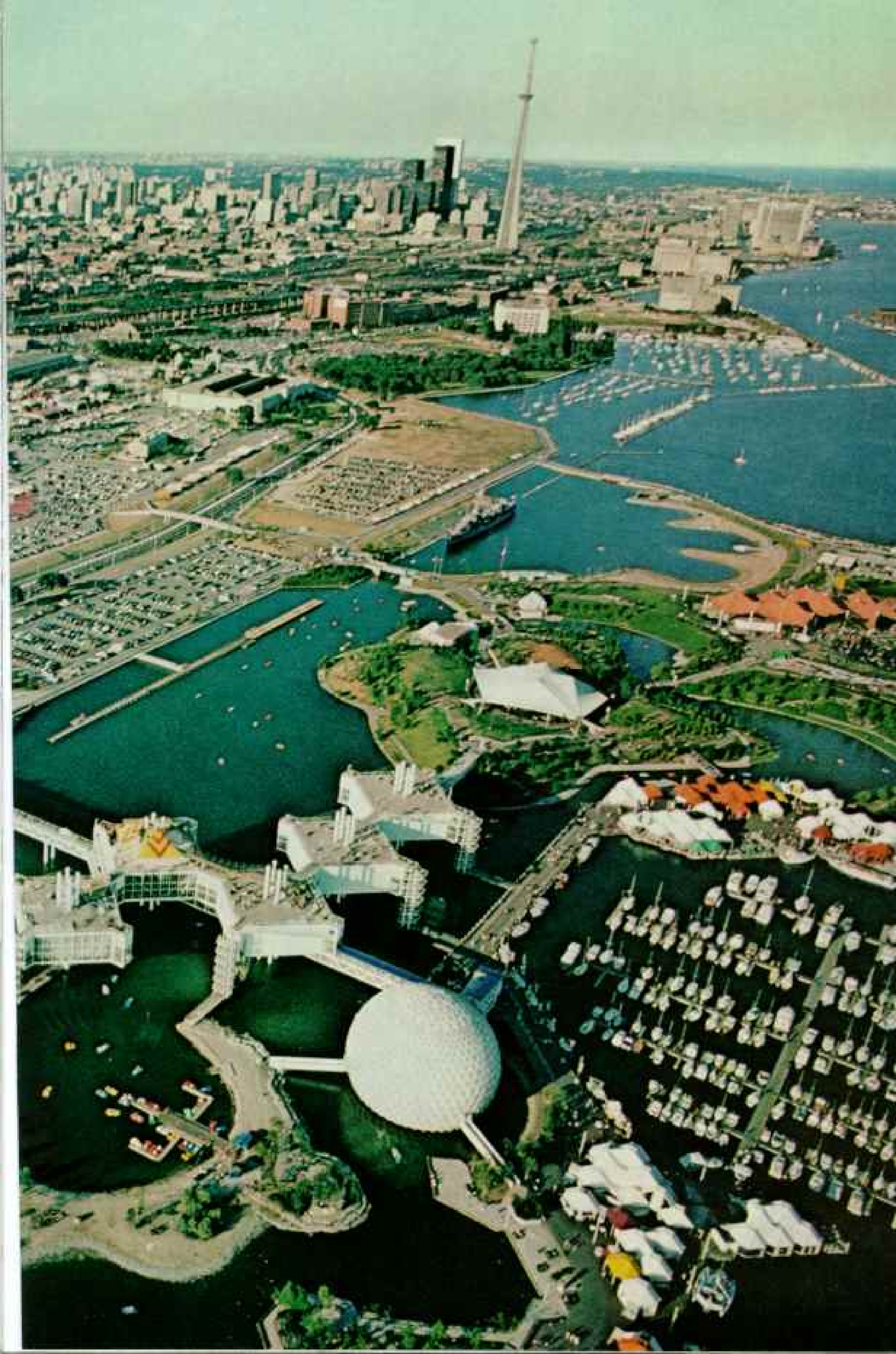
"The final section will be a 335-foot communications needle. When it's in place this will be the loftiest free-standing structure in the world."

From our vantage point we could see all 244 square miles of metropolitan Toronto, and well beyond. Scored by streams, ravines, and two major rivers—the Don and Humber—the megacity shelves gently to the lakefront, where only freezing weather slows a flow of cargo ships. In other directions, Metro—as Toronto's six-borough government is called—finally fades into farmlands.

Within this perimeter skyscrapers sprout like unruly clumps of witchgrass above low-level neighborhoods largely camouflaged by trees. An extensive patchwork of parks preserves a green *(Continued on page 196)*

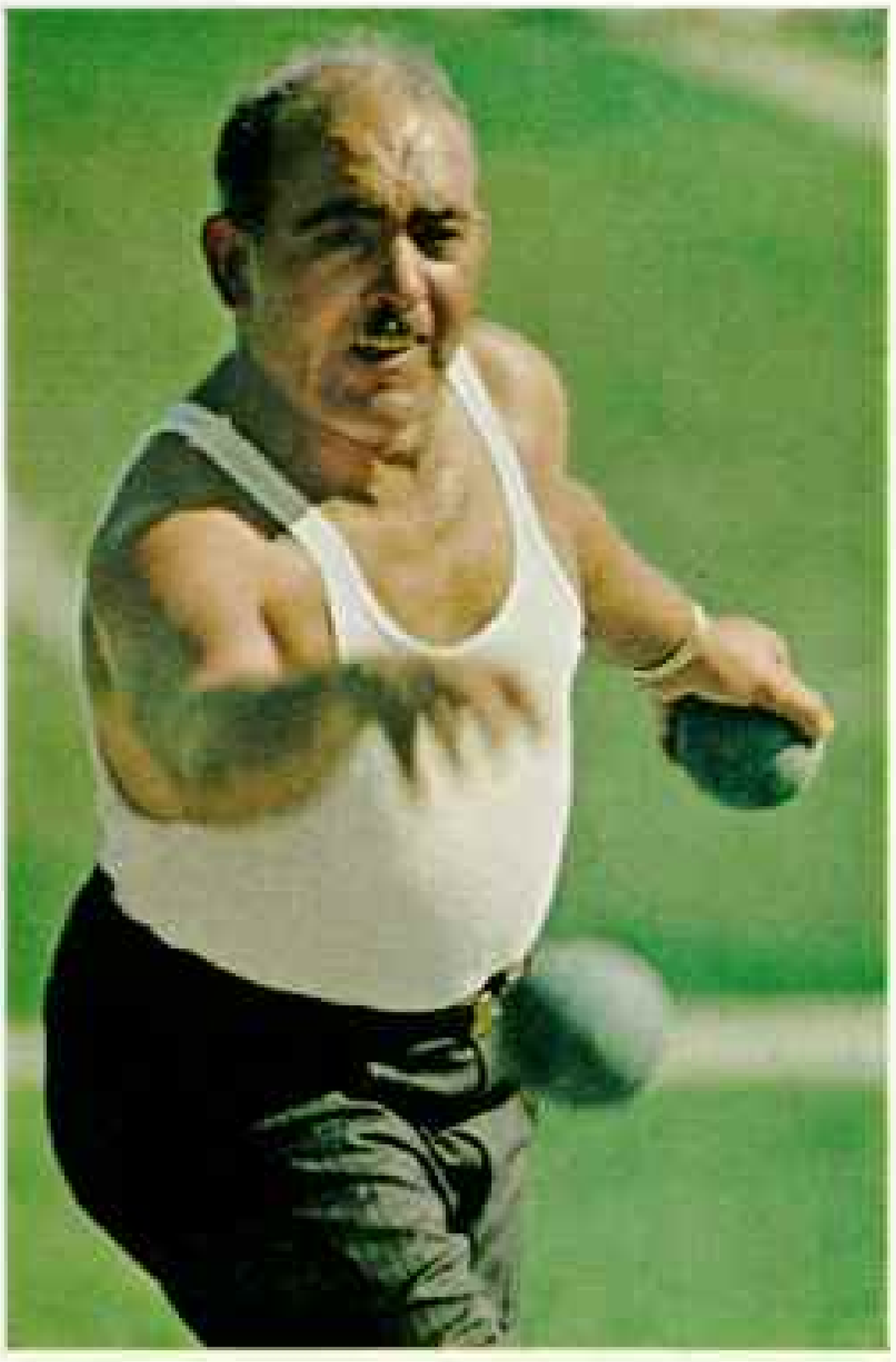
Toronto quests for elbowroom along Lake Ontario's northwestern shore. Ontario Place, foreground, packs a 96-acre recreation world on man-made islets and elevated pavilions. Its globe-shaped Cinesphere splashes movies across a six-story screen; a crowded marina attests to Toronto's love of boating. Catwalks link the complex to another crowd pleaser, the land-based Canadian National Exhibition. Downtown, the record-setting CN (Canadian National) Tower dominates the skyline, a dramatic symbol of Toronto's spectacular growth (pages 202-203).

Established as a French fur-trading post in 1750, Ontario's capital has more than doubled her population, to 2.3 million, in the past 30 years. That growth makes Toronto Canada's second largest city, next to Montreal, and thirteenth largest in North America. Recent concern about such expansion has led to limits on downtown high rises.




Sirgoi's

PACE OF THE CITY *slows to a stroll in Yorkville, a four-block downtown preserve of smart shops, gourmet restaurants, and art galleries. Developers liberated Yorkville in the late 1960's, carving elegance from a seedy drug-culture hangout.*



Open-door policy in recent years has welcomed immigrants to Toronto from throughout the world. To reach the city's 71 ethnic groups, many of whom live in vibrant urban enclaves, one radio station broadcasts in 30 languages, including Hindustani. Park benches are popular in any language (**top**). Tuned to a calypso band, a dancer (**facing page**) swings at Caribana, the annual West Indian festival. A game of boccie (**above**) engrosses one of the city's 350,000 Italians.

look that the boroughs further encourage by planting trees without charge, even on private property.

Visible beneath the bare branches of winter were the many ethnic neighborhoods that give the city its special character and attest its appeal as a new home for Old World immigrants, and for those from the Americas as well. Some 50 percent of Metro's 2.3 million people were born outside Canada. Since World War II, outsiders have been flooding in at an average rate in the last decade of 15,000 to 20,000 a year.

In many ways Toronto today resembles the New York City of half a century ago. However, New York then sought to blend diverse cultures into one big stew, while Toronto finds more nourishment in a mixed salad, where each minority retains its own distinctive flavor.

Pros and Cons of a Cultural Mix

Tougher immigration laws have begun to slow entries; the present point system favors those with education, essential skills, experience, a guaranteed job, and knowledge of French or English, the country's two official languages. But support is growing for even stiffer rules.

"We couldn't have progressed so far so fast without our New Canadians," one lifelong resident told me. "However, we're beginning to feel the pinch of unemployment and rising welfare costs. To continue as mother of the world would only invite more headaches."

But Johnny Lombardi sees no reason to stop the input—at least of Italians, who already number 350,000, a figure only slightly less than the population of Venice. Something of a padrone-without-portfolio, he spends a good deal of time in Italy recruiting new candidates for citizenship.

"My father came over when he was 18 and doesn't remember much about the old country. To him Michelangelo could be a soccer player. I never saw Italy until after World War II, but now I'm hooked on my heritage."

He watched me mangle an unwieldy meatball sandwich at his combination grocery store and lunchroom on College Street in the heart of the Italian district.

"Immigrants have made this a cosmopolitan city; you see their influence everywhere. Like Italians, many don't want to assimilate; we prefer to stay in our neighborhoods, close to our own schools and churches."

Like a European village square, a park in the Italian section draws young and old (**above**) to an impromptu concert. By providing a common meeting ground, local parks help communities within the city retain their identities. "We're the only big Canadian city that hasn't lost its neighborhoods," boasts Mayor David Crombie.

Upstairs Johnny's radio station CHIN speaks to Torontonians in 30 languages, and further stimulates ethnic solidarity by sponsoring such special events as Oktoberfests, Italian festivals, and international picnics.

Gordon Sinclair, now 75, is a rarer type of Torontonian than second-generation Johnny; his forebears arrived early in the 19th century. Irreverent and opinionated, his candid views aired regularly over station CFRB have made him one of the most popular radio commentators in Canada.

It was Sinclair who, in 1973, won a huge following south of the border when he berated the world for failing to appreciate U.S. assistance to nations in need. He punched home the point with strong words: "Can you name me even one time when someone else raced to the Americans in trouble? . . . I'm one Canadian who is damned tired of hearing them kicked around." He had chosen, as he frequently does, to swim against the tide: Anti-American feeling was running strong then—and still is.

No Tears for the "Good Old Days"

Torontonians have learned to expect the unexpected from their irrepressible Scot. Hardly an eyebrow raised when, at 73, Sinclair posed for a magazine cover wearing only shoes, socks, and a modesty-saving sporran.

This puckish, award-winning newscaster remembers the city before minorities became the majority—and likes it better now. Hoisting his feet to his desktop, he tilted his chair and told it as it was.

"Believe me, those good old days were a bore. There wasn't a decent restaurant in town and almost no public entertainment. Anglo-Saxonism prevailed: We lived by the Puritan ethic that assumed anything fun must be sinful.

"Everyday life was dreary enough, but Sundays were murder. Everything but the churches shut down tight. Eaton's even drew its curtains to prevent the small enjoyment of window-shopping on the Sabbath."

Staunch Methodist Timothy Eaton, who in 1869 launched Canada's largest department-store dynasty from the corner of Yonge and Queen Streets, would shudder at the change. For a lot more than show windows are now undraped along Yonge, Toronto's liveliest thoroughfare.

A few blocks north of its gilt-edged financial district, loudspeakers hawk strip joints,

Experts laughed when a Slovak immigrant named Stephen Roman bought claims near a "mined-out" region of northern Ontario. But the spunky former assembly-line worker laughed last. He became owner of the world's largest uranium mine, and a millionaire before he was 30. At Romandale, his 1,200-acre farm outside Toronto, Roman raises prize Holsteins and lives in a lavish home he designed himself.

X-rated movies, and massage parlors. Anytime is carnival time on this midway of novelty shops, kinky boutiques, pubs, sidewalk hucksters—and Sam the Record Man.

His three-floor fiefdom just north of Dundas Street offers cut-rate prices, boasts the continent's largest stock of titles, and proclaims: SAM HAS EVERYTHING—ALL HE HAS TO DO IS FIND IT. With more than 100,000 different records and tapes, what owner Sam Sniderman has the most of is personality.

One war has ended but another lies ahead for Philadelphian Charles Campbell, who fled to Toronto six years ago to avoid Viet Nam. His new foe: limited job opportunities, caused by growing unemployment in Canada. Qualified to teach, Campbell had to take a job as a shipping clerk. Maryanne Campbell, here with their Canadian-born son, works for *Amex-Canada*, a magazine for Americans in exile. Canada's expatriate community, once estimated at 70,000, has dwindled to perhaps 30,000. "There's still quite a clan in Toronto," says Ms. Campbell.

I found "Canada's king of canned music" midstage in his marketplace, thriving on personal contact and the steady ring of cash registers. "Hey, Tony, fill up the racks; we're not selling empty wall space."

Toronto and Sam have been good to each other. His store has spawned nationwide franchises that gross millions. By way of thanks, he and his attractive wife, Eleanor—who operates a recording company for Canadian talent—launched and then helped build the University of Toronto's present classical-record library into one of North America's finest. Sam receives many requests to serve his beloved city—and turns down few.

One customer, unable to recall a title, hummed a snatch of song in Sam's ear. "Sure, sure, sweetheart! *I've Got A Crush on You.*" The lady looked startled. "Try Gertrude Lawrence upstairs or Sinatra two aisles down."

As I left, he pointed to a yards-long banner overhead: WHEN YOU COME TO SAM'S DON'T FORGET TO SEE THE REST OF TORONTO. I promised him I'd do my best to oblige.

Bustling Town Has Time for Courtesy

The phenomenal growth in this section of the city mirrors Toronto's expanding role as Canada's economic heartland. Major corporations from lands around the world have offices here. Some 6,200 industrial plants in and about the city account for a fifth of all manufacturing in Canada.

Toronto fabricates more metal, makes more electrical products, processes more food and beverages than any other place in the country. Industrially diverse, its factories turn out just about everything from airplanes to computer components. The centripetal force of all this activity has also made Metro the publications and communications capital of English-speaking Canada.

Despite the pressures of success, Torontonians remain an unusually polite and tolerant people. The taxicab industry sets the tone with a billboard message: "Courtesy deserves a tip; discourtesy does not."

In an amazing testimonial to trust, the Royal Ontario Museum has displayed priceless art treasures in unguarded outdoor showcases since 1968 without suffering any loss or damage.

And on New Year's Eve, McGuinness Distillers Ltd. rents the entire public transit system and invites revelers to ride free instead of driving. Since the program started three

years ago, not one traffic fatality has marred its hours of prepaid travel.

Even at normal fares (40 cents each or three tokens for a dollar), 70 percent of all Toronto commuters prefer Metro's fast and frequent public transit to the frustrations of clogged highways.

The excellent network combines a cross-shaped subway system with streetcars and busses, speeding patrons to any point within Metro for a single fare with liberal transfer privileges.

"Making public transportation pay for itself only leads to rising rates and declining use," one official told me. "We spend whatever we must to give good service at low cost, and ridership keeps climbing. It's certainly more sensible to entice people out of cars than to go on building roads."

Trying New Paths in Government

Toronto seems more willing than many cities of similar size and complexity to move in new directions.

Twenty-three years ago the overall area was fragmented into 13 autonomous municipalities, each with its own way of doing things. Tax rates and resources differed; so did the quality of services. Postwar growth magnified many common problems, but jurisdictional prerogatives prevented their solution.

These faults were largely corrected in 1953 with a two-tier concept of government that continues to attract worldwide attention and strong popular support at home.

The top tier was Metro, the six-borough Metropolitan district that includes Toronto city. Metro supplies such areawide essentials as police, public transit, welfare, water, expressways, school financing, and sewage and garbage disposal. Boroughs run their own schools, street and public-health programs, water distribution, refuse collection, and fire protection. To prevent a buildup of bureaucracy, mayors and other top vote-getters elected to administer the boroughs also form the council directing Metro affairs.

This overlapping leadership does not preclude split-level disagreements. One of the stormiest at present revolves around future development and how best to relieve a critical housing shortage. Even those provocative signs that say BACHELOR FURNISHED—INQUIRE WITHIN have become a rarity.

Hardest hit of Metro's boroughs is the city of Toronto itself, where a third of the people already live and many more would settle if there were room. What makes it more of a magnet than other boroughs? Young art student Diane Cunningham, herself a suburbanite from Vancouver, voiced the general view:

"Crime has dried up a lot of cities, but we have so little here that the streets are safe day and night. But mostly, it's the variety and vitality downtown. Go a few blocks from anywhere and there it all is—galleries, museums, markets, concerts, theaters,

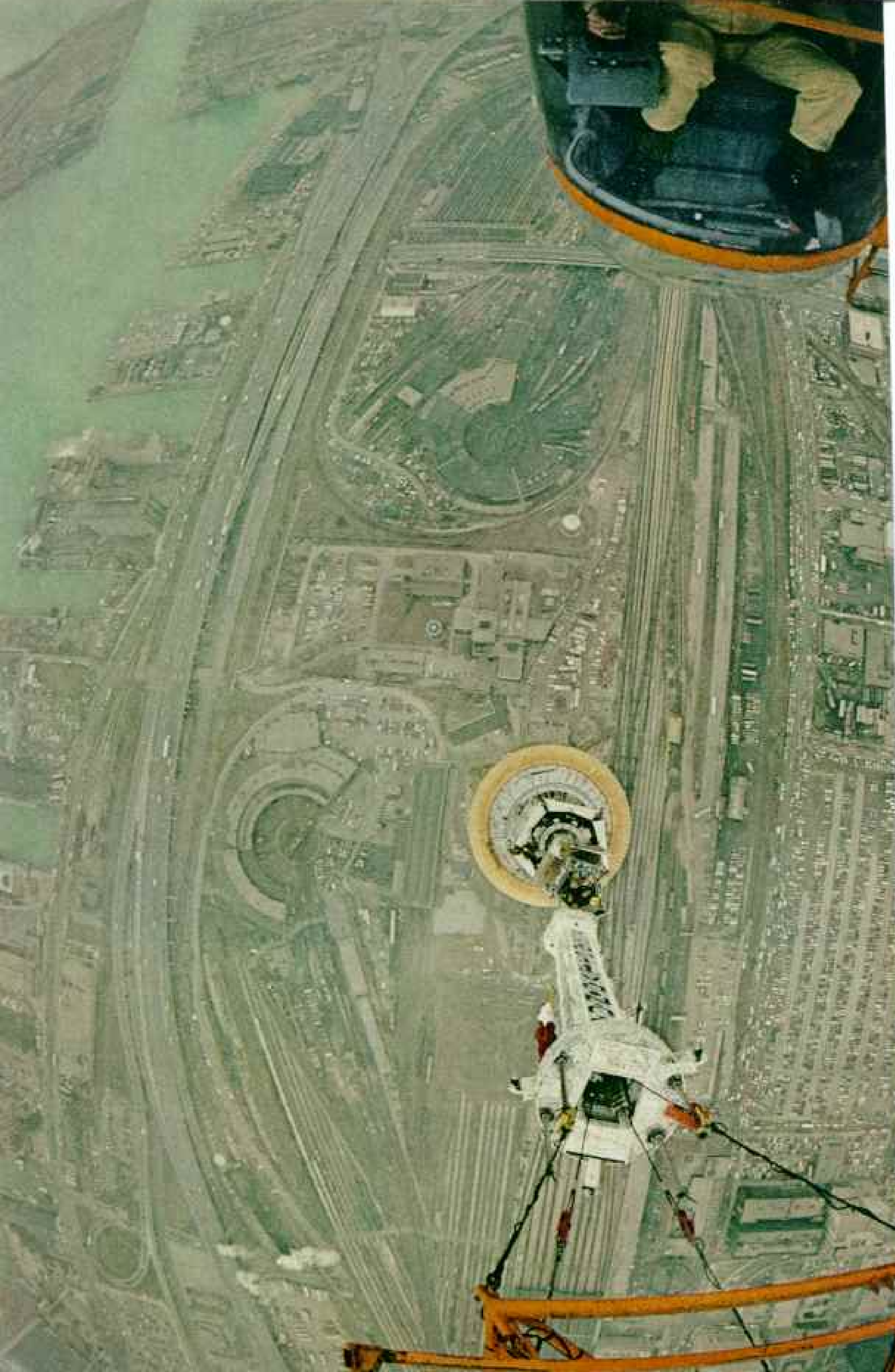
In a salute to memory, a Scottish veteran honors Canada's colors at the annual Canadian National Exhibition. His tartan tie tells his clan—Royal Stuart—and medals over his heart bespeak his valor. Scots helped the English settle Toronto during the 19th century. Their descendants stage bagpipe band contests during the exhibition's Scottish World Festival, with pipers coming from as far away as New Zealand. The exhibition's three-week extravaganza, billed as the largest of its kind in the world, begins in mid-August.

ALL BY STEVE RAYMER, NATIONAL GEOGRAPHIC PHOTOGRAPHER

Getting to the point: How do you crown the world's tallest free-standing structure? High-flying workers at the CN Tower use a helicopter, shaving five months off planned construction time. Carrying the topmost section of the radio-TV mast, the crane-equipped copter whirls into position (**left**). Then it hovers while a "backseat pilot," perched in a bubble under the craft's nose (**right**, foreground), deftly lowers the 32-foot section to ironworkers.

Squinting into a surveyor's theodolite, Ross McWhirter (**below**), *Guinness Book of World Records* coauthor, verifies the height of the 40-million-dollar tower—1,815 feet *and* five inches. That height is exceeded by only a handful of structures, including a 2,119-foot radio mast near Plock, Poland, all of which rely on external cables for support.

When the tower opens early in 1976, glass-faced elevators with a view outside will whisk sightseers on a thrilling ride to the "sky pod," a seven-story restaurant-observation area.



Venerable but bankrupt, the Royal Alexandra Theatre was facing demolition when discount-store entrepreneur "Honest Ed" Mirvish bought it and restored its lost splendor (**right**). Now road shows at the Royal Alex expand Toronto's already glittering range of cultural offerings: local theater and opera, an outstanding symphony, and a lively jazz scene.

Outside the theater, a couple pauses for roses from a flower girl. Because crime is relatively rare, Toronto's streets are still considered safe—a boon to nightlife.

shops, marvelous restaurants—just name it."

To prove her point, Diane was my guide one night for a sampling of Toronto's fare. We moved afoot and without fear through a wide range of entertainment from a star-cast show at the gracious Royal York Hotel to beer-hall bedlam at the Brunswick House, where every night is amateur night and anyone with a yen to perform may do so.

With so much going on downtown, space to do it all became a problem, and developers reached skyward. High-rises began to blot out delightful low-profile neighborhoods, many of ethnic and historic significance.

With Toronto's livability endangered, preservation-minded Mayor David Crombie

and his City Council in 1973 imposed a two-year moratorium in the city center on all building higher than 45 feet. The Province of Ontario ruled the ban illegal. So Crombie retaliated by withholding permits, with rare exceptions, for anything over that ceiling.

But the problem remains: how to accommodate growth without destroying the delicate balance that makes this one of the most civil and civilized cities in the Americas.

The Chinese have already lost ground to expansion in the downtown core, retreating west along Dundas Street as massive projects like the new City Hall erode their holdings.

"Some shift was inevitable," the lovely Jean Lumb told me as we lunched at her Kwongchow Tavern on Elizabeth Street. Popular and persuasive, she has been instrumental in forestalling efforts to move her close-knit community elsewhere.

"We Chinese have an inherited feeling of family—of togetherness—that would be lost with relocation or dispersal. We do not stay here for selfish reasons. This is where we've always been, the center of our culture, the only place our old people know.

"Toronto is like a family, too. Big, exuberant, and certainly not all alike. But we have much to give each other." She pointed to the chopsticks I was using instead of a fork. "Already you have accepted something of our ways. A small thing, yet it pleases us both."

Within a few blocks of Jean's restaurant, some 10,000 of Toronto's 20,000 Chinese perpetuate traditional trades and customs. Behind windows festooned with glazed ducks and spareribs, I watched butchers deftly shave pork slices thin as rice paper with cleavers hefty enough to disjoint an ox.

Across the street Wing Sing & Co. mass-produces millions of bean sprouts in tiers of trays. Farther on, I followed Sunny Lee into the back room of Far East Food Products to witness the evolution of the fortune cookies on which his fortune depends. Some of the best shows in this town are not behind theater marquees.

Agent Changes Sides Once Too Often

Around Beverley Street, on the trailing edge of Chinatown, educational and social centers cater exclusively to Italians, Poles, Austrians, Jews, and those with the greatest seniority *in situ*—Canadian Indians.

From the ancestors of this dwindling band came the name Toronto and its multiple-choice translations: "carrying place," "trees in the water," "place of plenty," "gathering place." Actually, all applied. Located on a well-worn portage trail between Lakes Huron and Ontario, the site long yielded a rich bounty in pelts from lands drowned and overrun by beaver.

Frenchman Étienne Brûlé, the first European known to have invaded this happy hunting ground, arrived in 1615 as an agent of Samuel de Champlain. Loyalty was not Brûlé's long suit: He later consorted with the British, then with the Hurons, to whom he eventually appealed more as delicacy than diplomat. They ate him.

A few Iroquois dropped by and lingered, trading furs for firewater with Dutch and British. The Missisaugas, Algonquin Indians who moved in early in the 1700's, were still around when the French finally established an outpost here at mid-century. And they remained after the French burned their own settlement in 1759 and decamped to avoid certain capture by the British.

These resident Missisaugas adjusted readily to the British regime, happily accepting $4,000 in cash and goods for an area one and two-thirds times the size of Metro. Still, colonization lagged until 1793, when John G. Simcoe, the first Lieutenant Governor of Upper Canada (as opposed to French-speaking Lower Canada down the St. Lawrence River), laid out a village called York, overlooking the lake.

"The old shoreline is now about two blocks inland," I learned from John Jursa of the Toronto Harbour Commission. "We've already recycled enough rubble from demolitions and dredgings to create 2,000 acres of additional land. This has given us room to build 45 new ship berths, and a chance to convert a good deal of the commission's former port property into parks."

Due largely to embargoes, shortages, and a drastic drop in coal shipments, tonnage and traffic figures have declined since 1969. But with traditional optimism, Torontonians continue to upgrade harbor facilities, gearing them for recreation until business improves.

Yankees Found Toronto Unhealthy in 1813

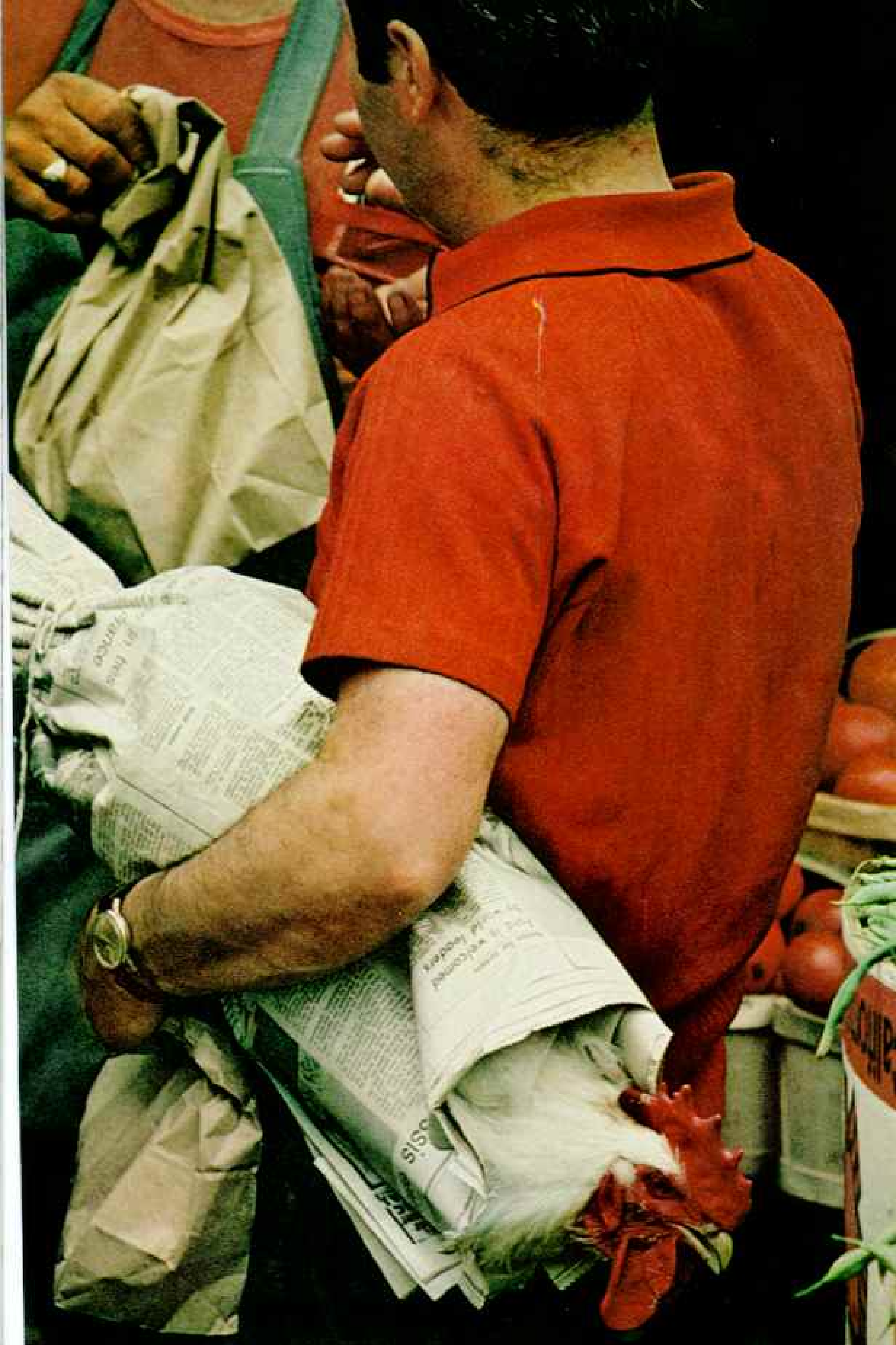
A police boat carried us past Ontario Place, a unique summer playground that seems to float above three islets also made from fill (pages 192-3).

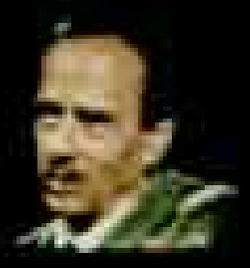
"The beach just beyond is where you Americans landed to seize our city back in 1813," John Jursa said. "When our main powder magazine exploded at Fort York, the blast set off a barrage of boulders that was more effective than our guns in killing enemies." The toll included Gen. Zebulon Pike, for whom Pikes Peak is named.

During their four-day occupation, U. S. troops engaged in considerable arson, which was later repaid when British troops burned the White House in Washington. Legend holds that the mansion's name derives from the whitewash used to cover the scorches.

A long, sandy spit shields Toronto's harbor from the south; in 1858 a storm-carved channel severed most of it from the mainland. "The Island" flourished until well into this century as a resort colony for such Torontonians as the Massey brothers—actor Raymond and statesman Vincent.

Guess who's coming to dinner? At colorful Kensington Market, vendors from a dozen nations peddle a boggling array of merchandise, ranging from Romanian pastries to live rabbits, geese, and doves. To experience the outdoor market's full flavor, shoppers should haggle over prices—it's customary.





Bulldozers ended that era by clearing most of the property for a multipurpose park available to all for a 75-cent ferry ride. In summer swarms of visitors boat over, little realizing that several hundred year-round cottagers at the east end are waging a desperate battle to save their Metro-owned leasehold lots from further park expansion.

I visited the island in early December to see what off-season life was like—away from stores, cars, cinema, or medical services—in modest frame houses clustered so close that a sneeze in one may elicit a *gesundheit* two doors away. Razor-sharp winds raised a haze of powder snow along the pathways; ice was forming fast in the lagoons, herding resident Canada geese into shrinking corrals of open water. I took cover in the schoolhouse, where a group of mothers had gathered.

Good Place for Kids to Grow Up

An islander for 17 years, English-born Maureen Smith would rather fight than switch: "This is the best of two worlds: an exciting city at our doorstep and a peaceful existence out here. We learn to get along with less, but I think we're better for it. Everybody lives pretty much on the same scale, regardless of income. And we help each other out—with errands, repairs, and supplies if anyone comes up a little short. To me, that's what our society should be and seldom is."

Yvonne Stein, a striking young island matron, agrees: "Our kids grow up oriented to the outdoors. They make their own fun and lots of it. The Metropolitan Council wants to uproot us and level our homes—all 252 of them. We think our neighborhoods are as worth saving as any in Toronto."

Whatever the outcome, Norman Symonds won't have to leave here until he wants to: He lives on an aging 35-foot sloop moored at an island marina. But one day he may want to; when everything aboard is shipshape, he intends to sail wherever whim and wind will take him.

The bearded composer was working on a new score at a small foot-pump organ in his wheelhouse when I dropped by: "It's a symphony I call *Big Lonely*. That's how Depression hoboes described Canada. After traveling 25,000 miles of it recently, I found the name still fits. I feel about my country much as Sibelius must have about his when he wrote *Finlandia*."

In drawing inspiration from the Canadian

Huffing and puffing for science, Flora Ward helps University of Toronto researchers study the effects of exercise on the elderly. A secretary at the 45,000-student school for 39 years, she faithfully runs four days a week, even though retired. Preliminary findings indicate that reasonable exercise adds to the years of useful physical activity.

Put the brakes on growth before Toronto "goes the way of many American cities," warns University of Toronto Professor Marshall McLuhan (**facing page**). The communication theorist, here at a Canadian Broadcasting Corporation television studio, calls Toronto "the last great city not yet devastated by progress."

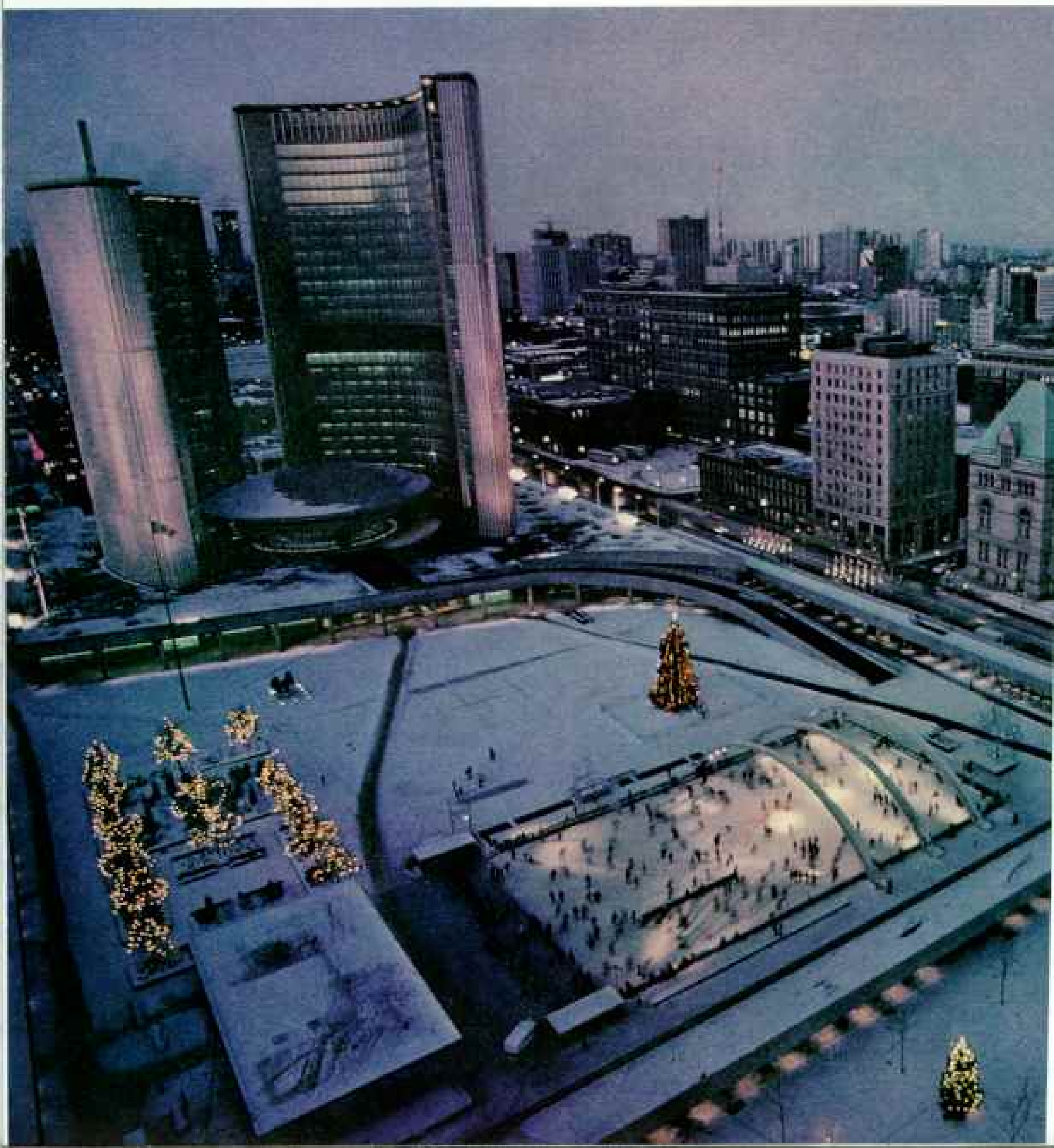
collage, Norman sustains a movement started early in the century by Toronto's "Group of Seven," whose paintings of North Country scenes are among the most admired in the nation today. And novelist Mazo de la Roche set her popular *Jalna* series close to this city where she was born. However, Torontonian Arthur Hailey reached farther afield to find the settings for his best-selling books, *Hotel* and *Airport*.

I doubt that any savant 20 years ago could have predicted Toronto's present involvement with the arts. The National Ballet of Canada and the Canadian Opera Company are headquartered here; so is an excellent symphony orchestra that Walter Susskind conducted for almost a decade.

Everyone seems absorbed in something creative: music, writing, art, the theater. Toronto has done much lately to encourage this trend by giving homegrown talent a greater chance for exposure. The phone book lists 26 "off-Broadway" playhouses and more galleries than some cities twice its size.

"Messy Sells Better Than Neat"

But this is still very much a city of shopkeepers, among whom Edwin Mirvish reigns as Barnum of the bargain trade. Keystone of his kingdom is "Honest Ed's," a cluttered,



clamorous, cash-and-carry madhouse on Bloor Street West and Bathurst.

Kooky signs almost conceal its walls inside and out. One warns: DON'T FAINT AT THESE PRICES, FOLKS! THERE'S NO ROOM TO LIE DOWN. Anyone brave enough to try it risks being run over by roller-derby contestants or marathon dancers, for Ed pumps plenty of pizzazz into his promotion.

By fusing showmanship with salesmanship, ignoring all costly customer services, and moving high volume at low prices, this messiah of mass selling has parlayed a cubbyhole dress shop into one of Toronto's most amazing success stories.

"Fill a need, keep things simple, buck the trend," Ed called over his shoulder as we plowed through throngs and jumbled piles of everything. "Messy sells better than neat."

Behind one counter, a statuesque Jamaican slipped a $9.99 evening sheath over her street clothes. "Try-on rooms waste space; merchandise doesn't," said Ed. "Things get a little informal here when bathing suits come in."

New Life for a Doomed Theater

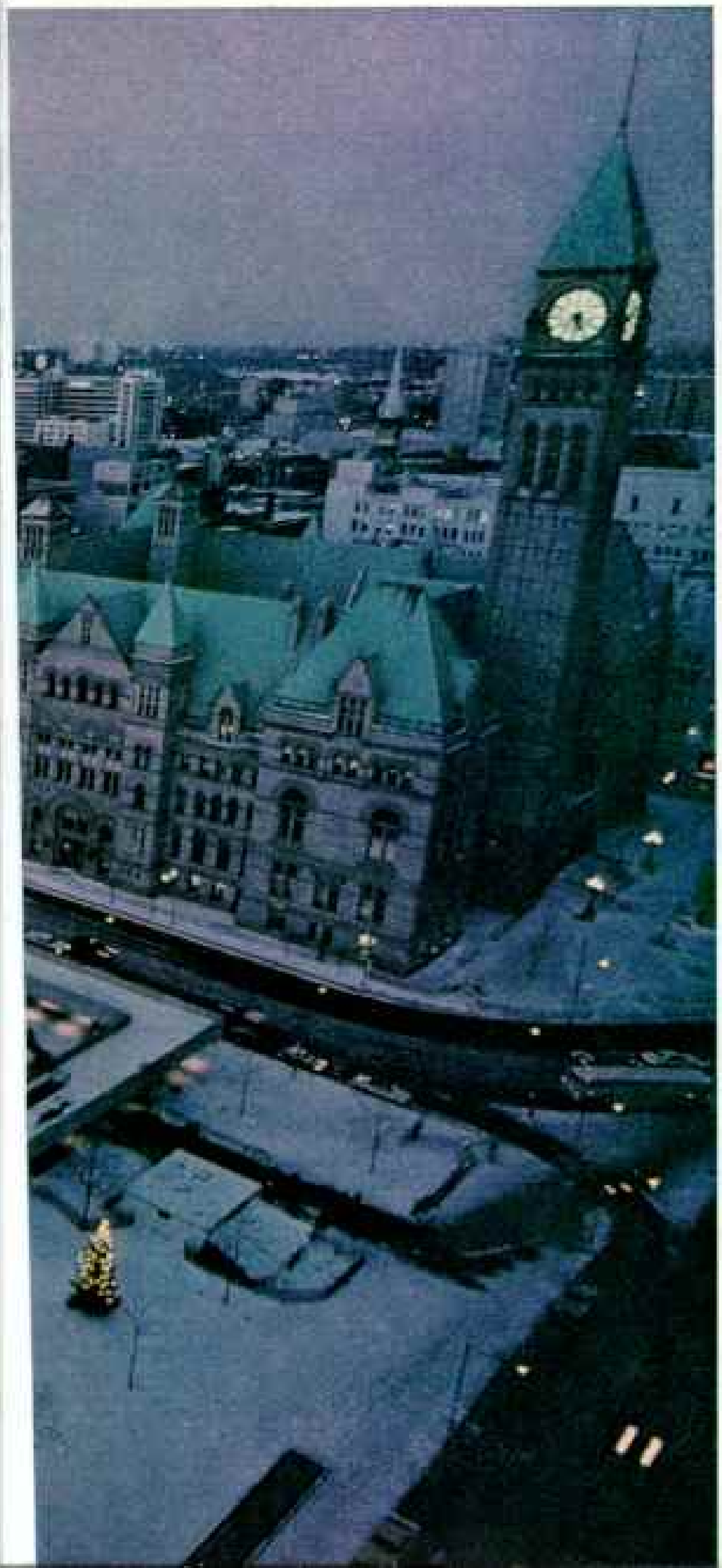
Surprisingly urbane and soft-spoken, Edwin Mirvish refuses to chain out, sell out, or incorporate. But he has branched out.

When the magnificent old Royal Alexandra Theatre on King Street West was threatened with demolition, no one offered to come to its rescue. Except Mirvish, who purchased the 68-year-old landmark, restored its Edwardian elegance, and has managed to turn a profit on it ever since (pages 204-205). "A lot of people who wouldn't be caught dead with an Honest Ed's shopping bag now call me a patron of the arts."

To feed the crowds of theater-goers, Ed crammed a warehouse next door with ornate Victorian bric-a-brac and began offering an inexpensive menu that listed only three entrees, all of them beef. "Because of the city's large Catholic population, I was warned to add fish or fail. But I stuck with my steers; it was the Pope who finally changed his mind."

Fill a need! Keep it simple! Buck the trend! Today, Ed's Warehouse and Old Ed's, a facsimile restaurant down the street, serve as many as 5,000 dinners daily.

Ed arrived in Toronto by way of the States; Sam Sniderman the Record Man is a native son. The Depression foreshortened their schooling; from early jobs at little pay both reached middle age as millionaires.



Twilight mellows a hurrying city on the eve of a new year. The twin-towered City Hall, rising behind skaters at Nathan Phillips Square, provides both a home and a symbol for Toronto's government. Its designer, Viljo Revell, was selected in an international competition that drew 520 entries. Alive with people, music, and art shows the year round, the popular square fulfills one meaning of the city's Indian name—a "gathering place." Castlelike City Hall from bygone days raises its clock tower at right.

Toronto has produced many of their kind, and others are in the making. Kensington Market, a boisterous open-air bazaar a few blocks west of Chinatown, may nurture some with the rags-to-riches dream. For here young clerks learn hustle and a style of selling highly tinged with Mirvishness.

Stores and sidewalks overflow with wares from everywhere: crates of fresh produce, live poultry in cages, strings of aromatic sausages, sacks of beans, stacks of rummage, eels in tubs, wheels of cheeses.

Once a Jewish stronghold, the market has recently become predominantly Portuguese. But Greek, Spanish, Italian, and West Indian merchants add other exotic ingredients to a lusty international brew.

A mile and a half away, somewhat tidier but more-vocal vendors of meats, fishes, fruits, and vegetables tenant St. Lawrence Market, a grand old ark grafted onto the face of Toronto's first City Hall, built in 1844.

Fortunately, the market survived a wave of municipal "improvements" that destroyed many architectural gems. Among the victims: a similar structure on the opposite corner of Front and Jarvis Streets now replaced with a barnlike hall designed in "shopping-center modern."

But market days continue in the new hall much as they have since 1803, when a lieutenant governor first reserved the site as a Saturday market for regional farmers who must—and the rule still stands—raise at least 75 percent of what they sell.

Oliver Shank, a spry, wry septuagenarian

Awaiting the day she'll walk like others, Lisa Shoomin gets a bedside school lesson at the Hospital for Sick Children. Detective work by doctors at "Sick Kids" uncovered the reason Lisa and some other Indian children walked with a limp—all were carried in infancy on cradleboards that caused hip deformities. An operation devised by Dr. Robert B. Salter, the hospital's chief of surgery, corrects the problem.

from nearby Markham township, has worked a family stand since he was hub-high to a buggy wheel. That was some sixty years ago; he isn't much taller now.

"My son Willis and daughter Helen and my sister Nancy over there stage-managing squash, we usually leave home by two in the morning to get set up for six o'clock opening. Makes a long day, but people are a nice change from talking to cows all week."

I pointed to a dozen jars of honey pyramided between carrots and onions. "You keep bees, I see."

"Well, poor years I keep bees, good years they keep me. You almost never get two good years in a row, so the bees and me break about even. The light honey comes from clover, the dark from buckwheat. I'd only planned on clover; that's what most people want. But a neighbor sowed some buckwheat and my bees took to dining out.

"This building? Ugly thing, isn't it? But at least it's heated. Some days the old one got so cold you could hear eggs cracking ten stalls away."

Hockey Fans Ration Their Cheers

When temperatures drop, Toronto is swept by an annual epidemic—skate fever. Residents of all ages and aptitude wobble, waltz, and whirl with what seems endless enthusiasm around scores of outdoor rinks.

Sidewalks and subways bristle with hockey sticks, for the energies of a tremendous number of youngsters focus on Canada's national sport and on playing their way to a place with the pros. Most would like to play for their idols—the Toronto Maple Leafs.

Club vice-president William O. Ballard and I watched a capacity crowd fill Maple Leaf Gardens. "We've had a trying year on the scoreboard but not at the box office. Our season tickets for all 16,500 seats, priced at an average $320 each, were sold out in advance." Loyalty to the Leafs is a habit not easily shaken.

"Are you someone important?" a lad with an autograph book asked Bill.

"Not me, fella. You'll find them all down there on the ice." However, 26-year-old Bill is an important sports figure. He and his father, H. E. Ballard, own controlling interest in the Gardens, the Leafs, a farm team in Oklahoma, and an expansion franchise from the National Basketball Association.

The crowd exploded with an unexpected burst of applause. A puck, lofted into the stands by a Leaf forward, had been deftly fielded by a little old lady. Deaf to the pleas of a locust swarm of kids that she part with her precious souvenir, she blew the sting from her fingers and went back to watching the game.

This impromptu performance drew the loudest response of the evening. I commented on the quiet. It would be banned in Boston, where silence at a Bruins' match is tantamount to treason.

"Our fans are not your usual buffs," Bill explained. "Most of the men here have played a lot of hockey and against some highly skilled opposition. Their wives grew up with the sport. They appreciate its subtleties and don't want to miss a move. You can't follow such hectic action and still engage in a lot of partisan rhubarb." As if on cue, Leaf fans gave a hearty cheer for a brilliant scoring drive—by the opposition.

Creating a Climate for Fame

Less closely identified with Toronto than the Leafs are such gifted hometowners as Walter Huston, Beatrice Lillie, Lorne Greene, Raymond Massey, and Gordon Lightfoot. Their road to fame led them away from their native city, a route future headliners may not have to take.

"There just weren't enough opportunities for them to gain recognition around here," a coffeehouse guitarist said. "But that's beginning to change in a big way. We're developing a lot of our own outlets now—films, telecasts, recording companies, original stage productions."

A plaque at University Avenue and Elm Street identifies the birthplace in 1893 of Gladys Marie Smith, who first appeared on stage in Toronto at the age of 5. Shortly thereafter she moved on to Broadway, where she changed her name to Mary Pickford.

The building now standing on the old Smith home site has achieved as much renown as "America's Sweetheart." For it houses one of the most remarkable medical centers anywhere—"Sick Kids," as Torontonians fondly call the Hospital for Sick Children. Founded a hundred years ago in a decrepit dwelling on Avenue Road, it has emerged as one of the largest and most innovative pediatrics hospitals in the world.

Pablum may not have as many friends as peanut butter, but it was developed here.

There's never a dull moment at the novel Ontario Science Centre, where hundreds of exhibits challenge young visitors to learn by doing. Static electricity gives one young lady a hair-raising experience (**left**), while a would-be astronaut (**right**) chalks up flight time aboard a lunar-module mockup. At other exhibits, computers play ticktacktoe and laser beams slice through bricks.

Major collections of ancient Chinese artifacts and the sculpture of Henry Moore highlight two other Toronto attractions, the Royal Ontario Museum and the Art Gallery of Ontario.

As we made rounds one morning, Dr. Robert B. Salter, chief of surgery, told me of an operation Dr. William T. Mustard had devised to correct a once-fatal heart defect in blue babies.

The spirit throughout Sick Kids is upbeat, the atmosphere anything but clinical. Patients and staff dress in cheery pastel colors; parents go and come at will, helping to care for their children. And even toddlers are allowed a great deal of room for roaming.

Dr. Salter has developed an orthopedic procedure for correcting various hip disorders, including dislocations particularly prevalent among Canadian Indian children. Three-year-old Elizabeth Sakanee, a solemn, wide-eyed Indian child from northern Ontario is one of these.

Immobilized by a postoperative cast, she shared her cot with a solemn, wide-eyed doll wearing an identical cast. As Dr. Salter jollied her into a smile, an aide snapped her picture. A print would be sent home to her family to reassure them of her recovery.

As I left through the main lobby, a mother was trying valiantly to quiet her sobbing son. I looked sympathetic. "Oh, don't you fret about him," she said. "He's just mad because he has to go home."

I later joined police officer Larry McCoy for a look at the law-enforcement side of Toronto's nightlife. In his patrol car we covered a beat that stretches some five miles from lakeside Cherry Beach to the ultraposh reaches of Rosedale, where "You don't move to Rosedale, my dear, you're born there."

In between lies a mixed bag known as Cabbagetown, once the habitat of Irish laborers whose gardening preferences supposedly gave the district its name. Modest row houses go these days for outlandish prices, mostly to middle-income young marrieds who don't mind investing heavily in renovation for a center-city address.

Now, About That Missing Sales Manager

On Jarvis Street the former mansion of the Masseys, who made millions in farm machinery, keeps company with charitable missions and dollar-a-night hostels. We cruised Larry's division on a Saturday night when dives and drifters were going full blast. Despite the hubbub, one old man—obviously susceptible to challenge—slept beneath a sign that urged DRINK CANADA DRY. Even in this, the seamiest segment of the city, our most urgent call during the shift was to cool down a noisy party.

"This doesn't mean we don't have our troubles," Larry said. "We do: rapes, robberies, beatings, the whole bit. But for its size, Toronto must be one of the safest cities in North America. "After all," he grinned, "nobody's perfect."

"By the way, how's your missing persons bureau?" I asked.

"Good. Got someone special in mind?"

"As a matter of fact, yes. A sales manager from New York."

I'd sure like to know how he did it. □

"Ice Bird" Ends Her Lonely Odyssey

ARTICLE AND PHOTOGRAPHS BY
DAVID LEWIS

THE GENTLY HEAVING PACK with its captive icebergs glittered under the low sun and stretched away to infinity west and south. The glaciated wall of the Antarctic mainland to the east towered thousands of feet above the masthead. It was December 12, 1973, and *Ice Bird* and I were immovably beset in the ice of Penola Strait —35 miles south of Palmer Station and 6,100 nautical miles from Sydney, the port we had left 14 months before.

Only 15 hours earlier the heavy pack that had been unseasonably investing Palmer Station had magically vanished before a fresh northeaster, giving me the chance to embark on the long homeward voyage and complete the first single-handed circumnavigation of Antarctica.

I intended not to head for home at once, but to sail initially in the opposite direction—as far south as conditions would allow, for I had suffered too much in getting to Antarctica to be satisfied with a fleeting visit. My objective was the British base at the Argentine Islands, 40 miles south, whose last radio message had reported navigable conditions. *Ice Bird* was within five miles of her goal when the trap was sprung. The pack snapped shut, obliterating every lead.

This initial setback was galling. But as I waited, cold and alone, I recalled all the help I had received from the men at Palmer Station, and I was heartened. I had arrived there on January 29, 1973, and by the time the battered, dismasted

Challenging a white wilderness, the author steers *Ice Bird* through Antarctic waters off Palmer Station. In 1972 he sailed the 32-foot sloop to the bottom of the world, barely surviving the ordeal, which he described in the December 1973 GEOGRAPHIC. Now, in his repaired and refitted vessel, he dares earth's stormiest seas once more in a bid to be the first man to sail alone around the Antarctic Continent.

ALBERT P. GIANNINI

wreck of a yacht had been hoisted out of the water to wait out the long Antarctic winter beneath a mantle of snow, a stout—but very short—mast had already been constructed out of timber donated by a U. S. supply ship. When spring arrived, the mast was fitted with spreaders and fully rigged. Torn sails, rusted engine, sprung hatches, battered stove, and useless bilge pump were all mended; the split cabin coach roof welded; a new self-steering mechanism installed. The hull was chipped, sanded, and painted. The radio transmitter alone had been damaged beyond repair.

The refit, which would have daunted a first-class yacht yard, had been completed in only 63 days by dint of the entire Palmer Station crew's sacrificing every minute of their scant leisure time—and in about the bleakest environment on earth.

Two drums of yellow bichromate paint completed *Ice Bird*'s transformation from a near wreck into a vessel fit to venture where no single-hander had ever gone before.

"Please don't call her the 'Yellow Submarine,' " I begged. "I have had quite enough of being under water." Actually the yacht looked very smart, her paintwork being topped off by her name in bold letters and a big penguin on either bow.

My frostbitten fingers, except for crumbling nails, had stood up remarkably well, but my feet were less satisfactory. I hit upon the idea of short daily barefoot walks in the snow to improve their circulation. I took them in private, to avoid ridicule. All went well until a morning when the ramp between the buildings was covered with fresh snow. One of the crew burst in to breakfast.

"There's *footprints* in the snow! Proper footprints, I mean with *TOES*." He pointed accusingly at me. "It has to be Dave. No one else could be that crazy."

AFTER SO MUCH preparation, was I to let these fine men down simply because the worst ice season in ten years had won the first round? I determined to do all I could, even inch by inch. But not until high tide on the second day at sea did the pack loosen a fraction. I began to maneuver bit by bit past the ice cliffs and bergs; the movement was infrequent and agonizingly slow. After three more days *Ice Bird* was still entrapped.

Then everything changed for the worst. Shortly after eight on the morning of December 16, a freezing fog rolled away and the sun

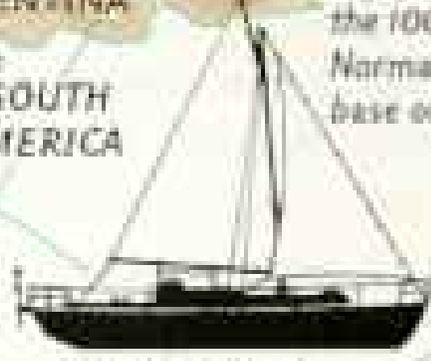
Dismasted and grievously battered, *Ice Bird* undergoes repairs at Palmer Station. The "floating coffin," as one of Lewis's friends called the sloop, needed a complete overhaul and refurbishing following the 6,100-mile, 103-day voyage of 1972. Happily, the author found warm hearts and willing hands among United States personnel assigned to Palmer.

Volunteering spare time, the men helped Lewis scrape and chip the hull and apply coats of yellow paint; weld the cabin; mend sails; repair the engine and other equipment; and—most important—construct and install a new mast (**below**).

PATRICK D. SMITH (FACING PAGE) AND KENT YATES

Wind-driven waves hammer an eight-foot-long dent in the steel sloop and rip a six-inch split in her cabin. Hurricane-force winds twice capsize the yacht. Dr. Lewis finally improvises a mast from the 11 1/2-foot boom and sails into Palmer Station's harbor January 29, 1973 — 6,100 nautical miles from Sydney.

Seaworthy again, Ice Bird sets out from Palmer December 12, 1973, with a new 23 1/2-foot mast. On a sightseeing detour to visit other bases on Antarctic Peninsula (detail map below), Dr. Lewis sees penguins and seals frolicking beneath 3,000-foot ice cliffs. A gap in a line of bergs grounded on the 100-fathom line lets him identify Normanna Strait and reach the British base on Signy Island, where he resupplies.



Already a veteran after three solo crossings of the Atlantic and a round-the-world catamaran voyage, Dr. Lewis departs Sydney, Australia, in Ice Bird, October 19, 1972. Her original mast is 36 feet tall.

Crippled by a storm February 24, 1974, Ice Bird suffers yet another dismasting 6 1/2 weeks out of Signy. Fishing pieces of wood from the sea, Dr. Lewis again jury-rigs a mast and sets sail for Cape Town, South Africa, abandoning hope of making Australia.

Island's white glare illumines a midnight sky (**right**) shortly after sunset. Rays of light bent by the atmosphere strike an island and make it appear to glow, producing an optical illusion known as looming. At the same time, low-hanging clouds reflect the island's bright image to create what is called an iceblink.

Another such iceblink helped Dr. Lewis locate the South Orkney Islands, where he made a landfall at the British station on Signy.

broke through, melting the snow that had fallen on deck during the night. The yacht was still heavily beset, but this was not the cause of my consternation. The familiar Penola Strait landmarks had vanished. It took a moment to recognize the bastions of Lemaire Channel ahead and to realize that the whole pack had drifted a good five miles north since the evening before. The past days' efforts had been more than wiped out, and the steadily changing bearing of the land confirmed that the drift was continuing.

There was only one possible decision, as the log records. *In view of the drift of the pack am abandoning Argentine Islands objective. Will try to return along Lemaire and go to Almirante Brown.* The names are confusing. Argentine Islands in the south is a British base; Almirante Brown on Paradise Harbor is an Argentine one.

BY 1 P.M. the situation had not altered materially, though Lemaire Channel was closer. The glittering floes revolved slowly in the sunshine, gradually opening up short, narrow leads. Some, in defiance of the bright sunshine, were freezing over.

I had hoisted the genoa staysail to catch the faint southerly breeze, and the motor was pumping away, wasting precious fuel in the near-unnavigable pack. It occurred to me that the obvious thing to do was to get out and push. I stripped off my quilted anorak and clambered onto the snow-covered ice.

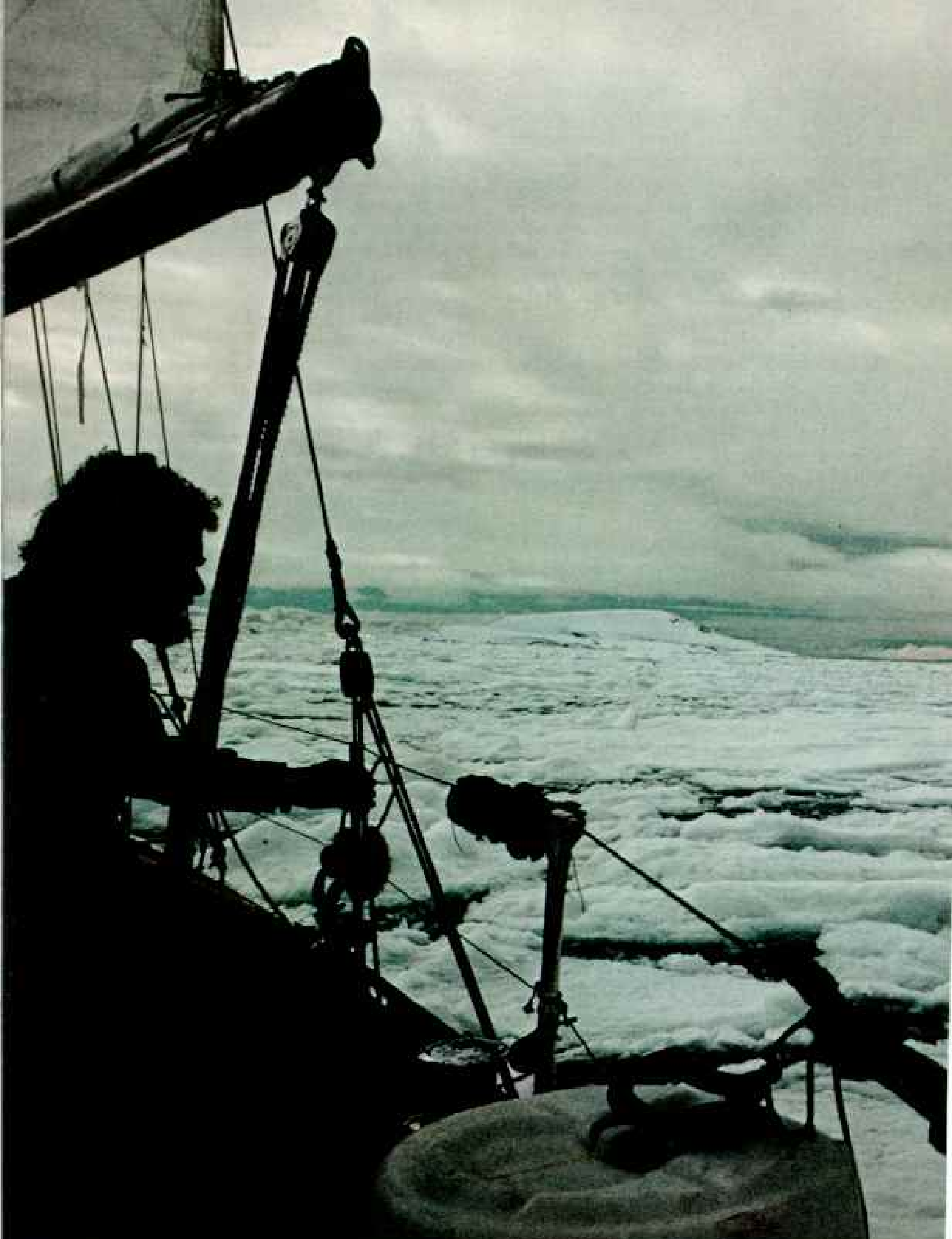
Two o'clock, three o'clock came and passed, and I was still pushing. After guiding the bow into an opening, I would put my shoulder to the stern, or else grip one of the stanchions and haul and shove from alongside. Occasionally I found it easier to pole from on deck with the boat hook. Transient puffs of wind bellied out the genoa to add their quota. We seemed not to be getting anywhere until I noticed that a group of frozen-in berglets, which had been some distance ahead, had fallen a long way astern.

I began to congratulate myself, but soon paid the price of foolish pride. I was pushing, hunched over, from astern when the floe on which I was standing split and slid away so suddenly that I was barely able to retain my balance on its rocking remnant. An ominous lead of dark water opened between me and *Ice Bird*. I watched in dismay as the lead widened rapidly and *Ice Bird* receded.

How to get back? With an effort I held down incipient panic and studied the situation more carefully.

My floe came to rest against the side of a newly formed polynya, or patch of clear water in the pack. Would any of the nearby floes bear my weight? Not worth the risk; they all looked rotten. Therefore my floe must somehow be induced to go back.

There being nothing to paddle with, I lay down gingerly on my back near the edge of the floe, put both feet against its dubious neighbor, glanced round to confirm that the angles were right, and shoved off hard. The floe slid forward sluggishly, gyrated, and came to rest at the edge of the polynya again, but a little bit nearer *Ice Bird*. After the third push



Searching for water in a land of ice, Lewis zigzags through openings in Penola Strait, where floes could slam together and crush his sloop. As *Ice Bird* nudges the

unstable pack, her master keeps sharp watch on an iceberg that towers above the low Argentine Islands. But another unavoidable danger awaits—entrapment (following pages).

the floe floated up to the hull. I grasped the stern rail as if it were my salvation (as indeed it was), and clambered aboard.

Ice avalanches were coming off the cliffs ahead, and I devoutly hoped that no unpredictable vortex would set us over beneath them. *Ice Bird* reentered Lemaire Channel, through which she had passed with such high hopes four days earlier. The pack's density was much more variable and, once inside the channel, its drift speeded up.

Worries about being trapped, ground down by the irresistible pack, or bombarded by ice avalanches now began to fade. The pack swept steadily on, while tiny waves rippled along the hull as the wind wafted across increasingly frequent polynyas. Once again I fell under the spell of Lemaire's grandeur.

No more than half a mile across, it was flanked by 3,000-foot walls. Sun-warmed rock buttresses ribbed the dazzling snowfields of the eastern wall, but on Booth Island the westering sun had already cast the hanging glaciers into purple shadow.

IT SEEMED but a moment before we were rounding the final bend in much looser pack. The motor could now be started and used with advantage. Half an hour later I hoisted the mainsail to make full use of a stiffening breeze. The ice became progressively more scattered as the mountain walls fell back on either hand, Cape Renard came abeam to starboard, and *Ice Bird* emerged into the relatively open waters of Bismarck Strait.

Shutting off the engine and with many a glance at the chart, I ran on under sail. By midnight Bismarck Strait had been left behind, and we had entered Gerlache Strait. I was very tired, but the hollow boom of swells rolling into caverns worn in the icebergs along the track spelled out a clear warning of the need to remain alert.

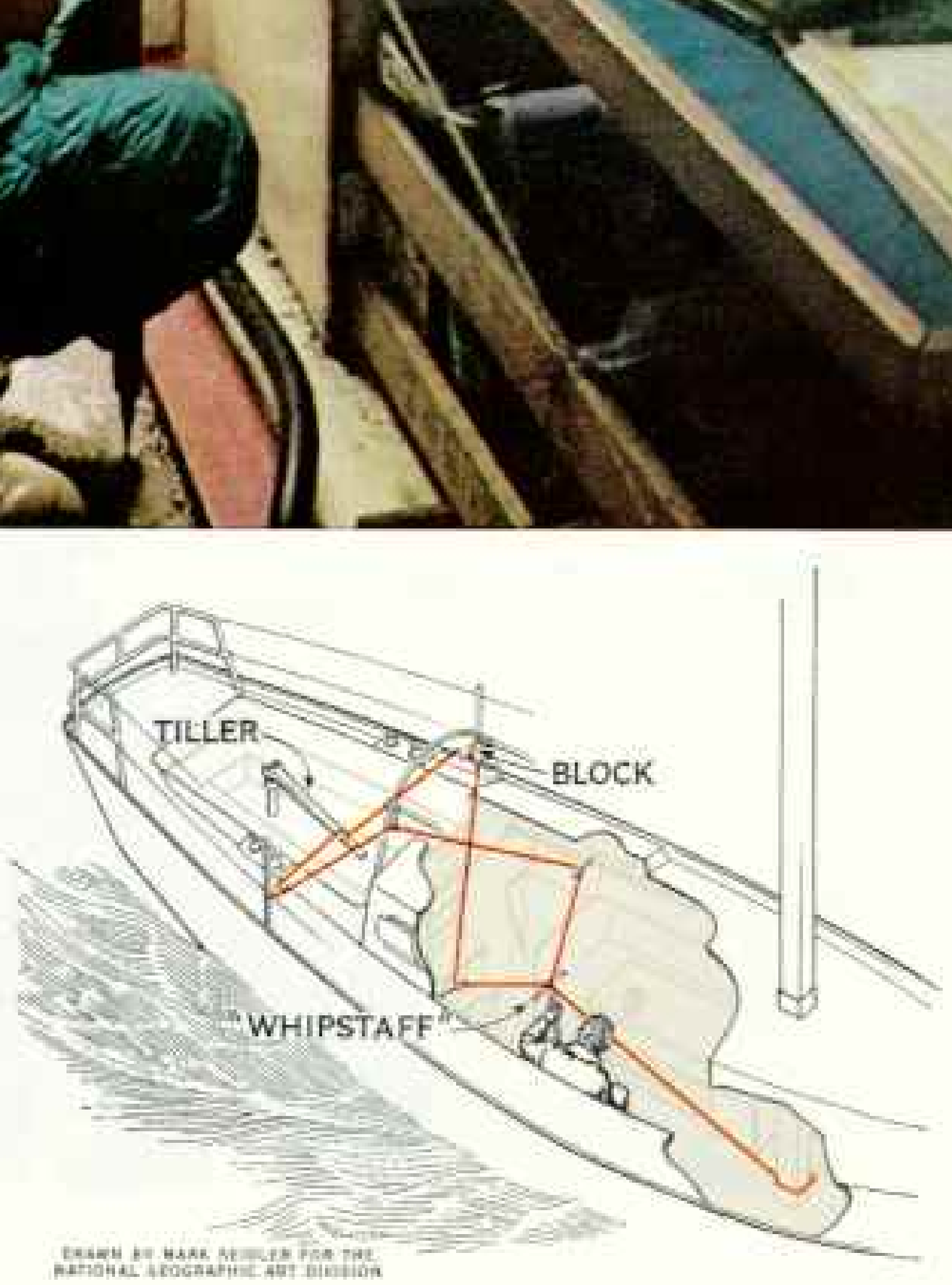
It was 5 a.m. before we came to Almirante Brown which, unlike Palmer, stands on the Antarctic mainland itself (map, page 220). I thankfully coasted past the sleeping base, wondering where to tie up. Yes, there was a jetty on which a bearded figure was standing. I swung the helm hard over, unforgivably neglecting to look over the side and check that it was deep enough for the yacht's six-foot draft. There came a grinding crunch under the keel, a series of bumps, and *Ice Bird* stopped abruptly. After surviving all the dangers of the pack, she had run hard aground.

Man overboard! Trapped by pack ice in Penola Strait, Lewis scrambles out (**above**) and tries to push *Ice Bird* to freedom through narrow leads. Otherwise, miles from help, and without radio, he is doomed. Then, shortly after snapping his own picture with a self-timer, another near disaster strikes. The ice on which he stands breaks off and begins to carry him away from the boat. Only by stretching out on his back and shoving with his feet against other floes can Lewis urge his raft back to the sloop.

"Worst ice season in ten years" is the report and the truth of it sinks home as, inch by inch, Lewis pushes (**right**). Finally the pack ice breaks up enough to free *Ice Bird*.

Catastrophe again threatens: A gale smashes Dr. Lewis's self-steering device. He will have to stay on deck and risk freezing or improvise a way to steer from within the cabin. Copying the whipstaff used in Columbus's time, the sailor fashions this makeshift contraption with lines that link a pivoting ice ax with the outside tiller.

"Difficult, inefficient, tiring," grumbles Lewis, who spends some 15 hours a day manipulating the ax handle. Though it deprives him of freedom, it spares him from the raging elements. To sleep, however, he has to let go . . . and take his chances.



DRAWN BY MARK SEIDLER FOR THE NATIONAL GEOGRAPHIC ART DIVISION

This ignominious predicament was of short duration. The bearded one, who turned out to be the mechanic and whose name was Armando, had by now been joined by two companions. All three jumped down into a perilously rocking dory and rowed gaily out to my rescue.

"*No problema—el mar está subiendo,*" Armando remarked. *Subiendo* sounded suspiciously like "subsiding," but his gestures soon reassured me. The word for falling was *bajando*, not *subiendo*. The tide was rising, and we could safely drop the anchor and go ashore to breakfast in the certainty that *Ice Bird* would float off with a little help in her own good time.

During three days at the base I took advantage of the relatively open water to test and adjust the self-steering gear. One afternoon *Ice Bird* conveyed a lively party of Argentine scientists on a social visit to the Chileans, whose base, Gabriel Gonzalez Videla, was located five miles across Paradise Harbor in the middle of a penguin rookery.

Despite the relaxed and pleasant atmosphere of Almirante Brown, the shortness of the summer season forbade delay. I decided to sail in the morning, but an unexpected fault in the tiller head took the good-natured Armando so long to repair that it was 6:30 p.m. before my new friends called "*Vaya con Dios,*" and I motored regretfully away. The date was December 19.

THE REMAINING HUNDRED MILES of Gerlache Strait were a nightmare. There were no anchorages, so what little broken sleep I got was by lowering sail and letting *Ice Bird* drift—crunching through small ice and with luck missing anything larger. To make matters worse, a squally head wind was laden with driving snow. Though at first my heart missed a beat at every creak of the mast, it stood up very well to the stresses of beating to windward against short, steep, breaking seas when I got under way again.

Two shopping days till Christmas, I wrote in the log on the 23d. The yacht had emerged into the more open water of 200-mile-long Bransfield Strait—and into impenetrable fog. It lifted on Christmas Eve just long enough for me to identify and skirt volcanic Deception Island in the South Shetlands, but soon closed in again.

On Christmas Day I sat fogbound and becalmed off an ice-sheathed promontory of King George Island, within sound of surf breaking against ice cliffs and the periodic thunder of ice avalanches. The Russian base of Bellingshausen could not have been far away, but it might as well have been on the moon as far as I was concerned.

For fear of blunting my vigilance, I dared not take more than one glass of Argentine wine with my modest Christmas dinner of corned beef and crackers. The day's final log entry is a rather sour *Good-bye Christmas.*

NEXT DAY a strong westerly dispersed the fog and drove *Ice Bird* so far up the strait that I squared away for the British base of Signy in the South Orkneys, 400 miles away across the mouth of the notoriously ice-choked Weddell Sea. The crossing was rough. A gale broke the jaws of the gaff, and I had to double-reef the mainsail, thus reducing its area to what the short mast could carry. Constant overcast, mist, and snow showers precluded sextant sights, and only the fortunate sighting of iceblink, the reflection on cloud of ice-covered sea or land (page 221), through a break in the mist on January 3 enabled me to locate the Orkneys.

All that night and the following day we worked our way through the mist. Ice became increasingly abundant, and early in the afternoon we crossed a line of large bergs. Beyond them, despite the mist, I counted more than fifty others. This could be nothing else than the 100-fathom line, the point at the edge of the continental shelf where huge bergs commonly ground in 600 feet of water.

Something about the way a group of chinstrap penguins were clustering on a small berg aroused my curiosity. As we got nearer, I could see the reason for their evident determination to remain exactly where they were—in the center of the berg twelve feet above the sea. A leopard seal was swimming round and round their refuge, raising its powerful head out of water and emitting low roars of hungry frustration.

A few uneasy hours of darkness (for the nights were now drawing in) spent drifting among the monstrous bergs were followed by a dawn opaque with falling snow. A cloud-wrapped wall of ice and rock soon appeared dimly, but did nothing to help me locate Normanna Strait, between Signy and larger Coronation Island, the passage that led to the base. It was then that I thought of calling to my aid the bergs themselves.


ICE BIRD

I recalled that the chart showed a pronounced indentation of the 100-fathom line close west of Signy, deep water extending as far inshore as the mouth of Normanna Strait. The shallower margin ought to be outlined by big grounded bergs and the indentation should be relatively clear of ice.

I scrambled up on the boom to seek confirmation. Sure enough, there was a mile-wide ice-free corridor to starboard, leading in toward the land. *Ice Bird,* aided by the brisk following wind that had sprung up, was soon speeding along it. It was not yet midday when the anchor splashed down at Signy base.

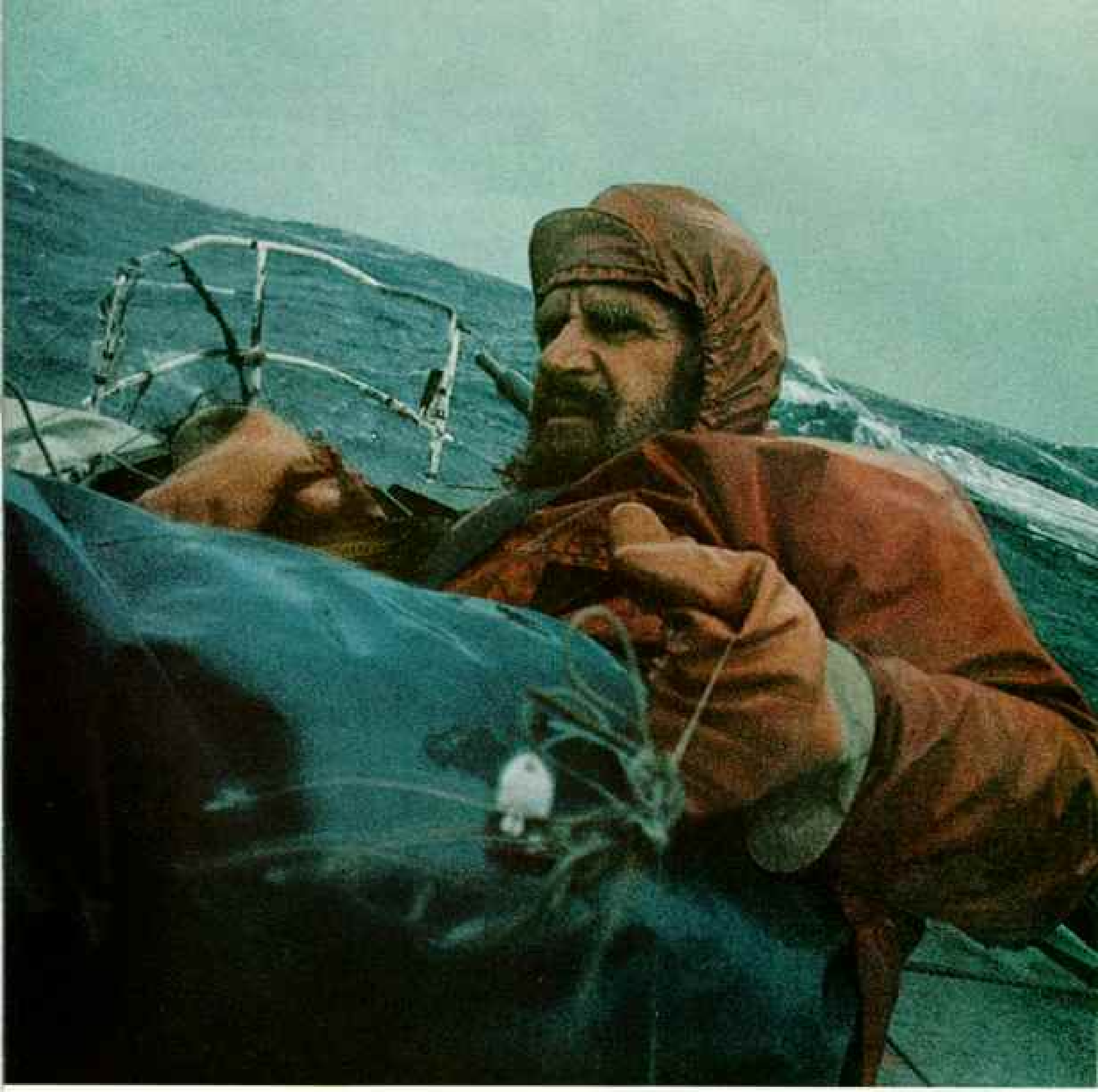
The British Antarctic Survey personnel were every bit as helpful as the Americans and Argentines had been. Most were mountaineers and highly trained in the techniques of polar survival. Racks of skis, crampons, ice axes, Aqua-Lungs, and wet suits testified to the active life of the base. My dirty clothes were whisked away to be laundered, water cans were refilled up to *Ice Bird*'s full capacity of 56 gallons, the rigging was tightened, and sailing trials were held.

WHILE AN EASTERLY GALE with heavy snow kept me weatherbound, I received some unwelcome intelligence by radio from the Royal Research Ship *John Biscoe*. She was encountering an enormous concentration of bergs in otherwise relatively ice-free waters off South Georgia.

The season was abnormal, I was warned; I might have to reroute north of the South Sandwich Islands, a detour that would lengthen the voyage to Australia possibly by thousands of miles. The fact that more than a thousand bergs could be counted from the hill above Signy added point to the warning.

I sailed on January 8, 1974, feeling forlorn and insignificant, in dread of loneliness, fearful of ice and storms; above all, tormented by

Enemy waves swoop in for the kill, tossing the steel sloop like a chip of wood. After monotonous weeks of creeping eastward has come terror. Maniacal winds roar out of the north. Then calm, dead silence. *Ice Bird* is moving through the eye of a cyclone. Emerging, she is hit by monstrous waves and winds of more than 80 knots. The sloop rolls upside down, then rights herself, snapping the mast in two. Once again the courageous sailor finds himself in stormy Antarctic seas with no way to hoist sail. PAINTING BY NOEL SICKLER



His face a mirror of the bitter fight for survival, Lewis strives to overcome discouragement as he hauls in wreckage of the mast. For three days he works to improvise a mast out of his boom. Raising it, he heads for Cape Town, South Africa, 800 miles to the north. His gamble to be the first man to circumnavigate Antarctica by himself is lost, but not his determination to become the first man to sail there and return single-handed.

uncertainty as to the morality of tempting providence by again putting my life in pawn. The base's full complement gathered on a high bluff to wave good-bye. That little group, growing smaller by the minute as *Ice Bird* ran before the wind, would be my last contact with humankind for who could say how long. Then the bergs hid the men from view, and I was utterly alone.

A WEEK OUT FROM SIGNY a gale had me running the gantlet of wave-lashed bergs in a desperately dangerous gamble. I attempted to steady the ice-sheathed yacht by a sea anchor composed of motorcar tires

and a dinghy anchor that was trailing astern. *It's Russian roulette—here's hoping,* I wrote in the log. *Ice Bird* survived, but her precious self-steering gear did not. Either the warp of the sea anchor or a piece of floating ice shattered it beyond repair.

My worst fears were realized. For the next 2½ weeks, despite my northerly route, icebergs surrounded us like trees in a thick forest. Dense fog, lasting as long as 36 hours at a stretch, was the order of the day. Sleep could only be had at the expense of precious mileage, nor could I risk keeping under way during the lengthening nights. So every evening at dusk I reluctantly brought the yacht as close to a halt as possible by lowering the headsail. Not that this procedure was altogether foolproof, as I learned in the early hours of one dismal morning, when the sound of surf abruptly awoke me.

Within seconds I was in the cockpit, barely conscious of the wet snow under my stockinged feet, struggling to cast off maliciously tight tiller lashings. *Ice Bird* had drifted down toward the weather side of a berg, which was now scarcely a dozen yards away. Only the backwash from the swells reflected off the perpendicular facade had kept us off it. Feverishly I paid out the mainsheet, put the helm hard over, and jibed clear with scant feet to spare. I was shivering when I went below again, and not with cold.

After changing my sodden socks and switching on the radio receiver for a time signal, I took a stiff drink and felt better. Then I returned to my bunk, this time, however, to doze more lightly and maintain a more frequent lookout. Sound sleep and safety, it seemed, would be incompatible as long as bergs remained numerous.

I SOON FOUND that even wakefulness was no sure safeguard. That very afternoon, while I was preoccupied with working out a sight and *Ice Bird* was moving slowly to windward, in no apparent proximity to any of the scattered bergs, one of them crept up on us. Some change in the yacht's motion must have warned me to rush on deck, because the face of the berg was towering right above us.

Again, only the waves reflected back on themselves from its weather aspect were holding us off. This time I needed to back the staysail to bring the yacht's head round. For one agonizing moment the bow hung poised over an icy underwater ram, then the backwash, rather than my own maneuver, swung her. First bow, then stern, cleared that green wall with no more than six inches to spare.

Day after day an unholy combination of fog and ice now persisted. Unending vigilance was demanded. On two occasions the fog into which I was staring took on, in my tired eyes, the semblance of a wall of pale ice across our path. Both times it needed a moment for me to realize that that was exactly what it was, and then there was barely room to slam over the tiller and turn away.

The dragging hours at the helm or at the rudder lines in the absence of the self-steering

gear took their toll of my strength. If only there were an inside steering wheel! Then came the inspiration. Columbus never saw a steering wheel in his life. Ships in those days were steered by a whipstaff. Could I not improvise one? I set to work at once. An ice ax, fitted in a hole bored in a cabin floorboard, provided the whipstaff pivot. It was connected by a spider's web of lines to the outside tiller (diagram, page 226). I scribbled a single comment in the log: *Oh Columbus.*

But it worked.

THE LAST BERGS were seen on February 1 at 52° 21′ S. Monotonous weeks ensued as we crept slowly but steadily eastward. This northerly route was long, but at least it should avoid the tracks of the worst gales. I had forgotten that this was no normal year.

The first intimation that something out of the ordinary was on its way was the plummeting of the barometer on the evening of February 23, six and a half weeks out from Signy. Before the 24th was an hour old, a severe northerly gale was upon us.

By 3 a.m. it was at its full force-9 fury. By 6:30 there was scarcely a breath of wind at all. I was terror stricken.

This was the dread eye of the storm; the deceptively quiet vortex in a cyclone, whence few small boats have emerged. The lull would end abruptly in a storm of unimaginable ferocity from the opposite quarter.

The huge waves, released from the weight of the wind, reared skyward in toppling pyramids that almost stood *Ice Bird* on end. The stillness was uncanny. I made sure that the sea-anchor warp was free and that the storm jib was hard-sheeted. Then I waited.

At half past eight the expected line squall screamed out of the southwest at an initial velocity of 50 knots, or force 10. An hour and a half later it was blowing a consistent 70 knots (force 12) and gusting to 80 knots (force 13), the top of the anemometer scale. Force 12 is a hurricane.

Fear and dread. God help us, I wrote, and put the log away.

The violent storm continued unabated. The anemometer needle came hard up against the 80-knot stop more frequently than ever until the wind wrecked the instrument altogether.

After the storm that dismasted *Ice Bird*, Lewis laid his boom in the mast step (**left**), lengthened it with the gaff, and raised his makeshift rig with the mainsheet. Friendly breezes brought wounded *Ice Bird* into Cape Town's Table Bay (**right**), its jury rig a masterpiece of make-do.

Lewis had completed one of the epic voyages—11,000 miles from Australia to Antarctica to South Africa. The cost: six and a half months of his life—months that spared him neither loneliness nor weariness, but gave him the triumph of having endured.

Exhausted from the effort, the intrepid sailor turned *Ice Bird*'s tiller over to his son, 26-year-old Barry Lewis, who refitted the sloop and, alone, sailed her home to Sydney, Australia—a mere 6,600-mile jaunt. Like father, like son.

National Geographic, August 1975

The seas grew steadily higher and broke ever more furiously. I crouched over my whipstaff, eyes glued to my wind-direction indicator—the strip of vibrating sailcloth outside the dome. We were running downwind at an angle to the enormous, heavily breaking seas.

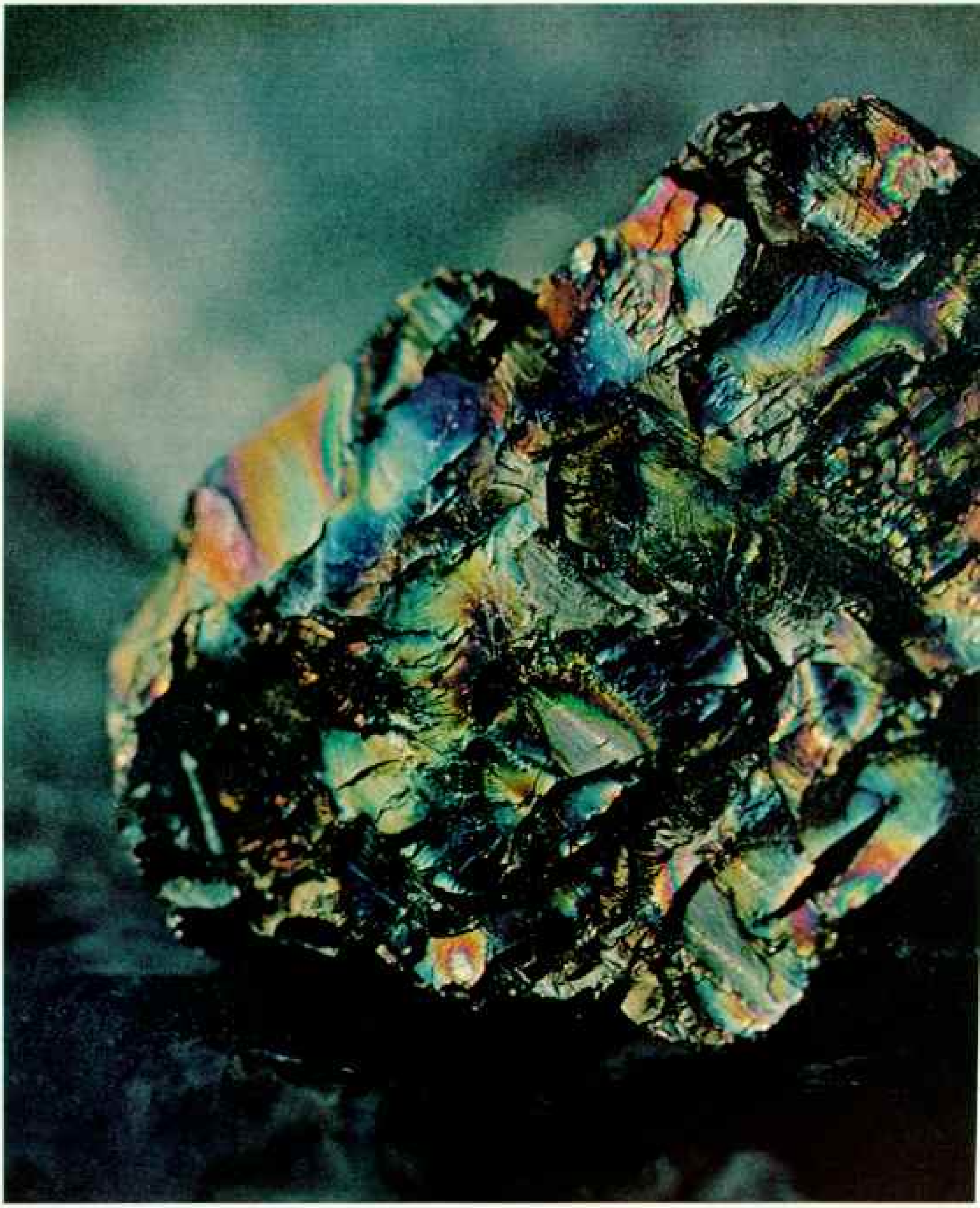
CRASH! My world was submerged in roaring chaos as a mighty hand rolled *Ice Bird* over and upside down (painting, pages 228-9). I slithered round the side of the cabin as she went, and ended up in a heap on the ceiling. Then the yacht righted herself by rolling back upright the same way, and I slid back with her. It was 4:15 p.m.

I could see from below that the backstays had gone; there was little doubt as to what I should find on deck. The mast had broken midway between the foot and the spreaders, and the pieces were floating alongside. I salvaged what I could and made sure that the remaining wreckage was well clear of the rudder and the propeller. Down below, there was not much damage. Very little water had got in. But dejection and disappointment threatened to overwhelm me. It needed all my willpower to put them aside and to set about making positive plans. Australia could be ruled out, for it was nearly 7,000 miles away. Cape Town, 800 miles to the north, was now the obvious destination.

AS I HAD DONE the season before, I improvised a mast out of the boom, but this time lengthened it by lashing the gaff to it and securing the two spars by oversize hose clamps originally intended for camera clamps. Once again I hoisted the mast upright by means of the mainsheet. Three days after the accident we were under way for Cape Town.

On March 20, three and a half weeks after the dismasting, ten weeks and 4,000 miles from Signy, the battered little sloop motored into the Royal Cape Yacht Club marina under the startled gaze of a score of incredulous yachtsmen.

Ice Bird had successfully breached the sea's farthest frontier by being the first vessel to convey a lone man to Antarctica and back to an inhabited country—and even if it was not the one originally intended, I can tell you that it looked more than welcome. □



Nugget of "peacock," a variety named for its iridescence, glows with the gifts of acid and mineral leaching. As oil prices soar and gas reserves shrink, Cinderella coal, long shunned as a dirty fuel, offers new promise—if we burn it cleanly and restore the earth we tear it from.

Will Coal Be

By GORDON YOUNG

NOTHING IN MY EXPERIENCE had prepared me for this alien place. The miner's lamp on my hard hat punched only a dim, shifting circle in blackness so intense that it seemed to impede my progress as I walked. Incredibly, the timbers that shored up the tunnel ceiling seemed to be still struggling to live; they dangled pale, snaky fungus that brushed against my face.

The muffled thud of an explosion traveled back on the wet subterranean wind. Moments later I could see bobbing pinpoints of other headlamps at the mine face, as workers moved in to gather up the shattered coal.

This was their everyday world. Five times a week they picked up their lunch boxes and came down here to work their shift—while an energy-hungry nation burned coal with little thought of where it had come from.

Coal: a source of energy that could fuel our factories and autos and airplanes for centuries—an energy source that dwarfs the one lying beneath the Middle East's sands.

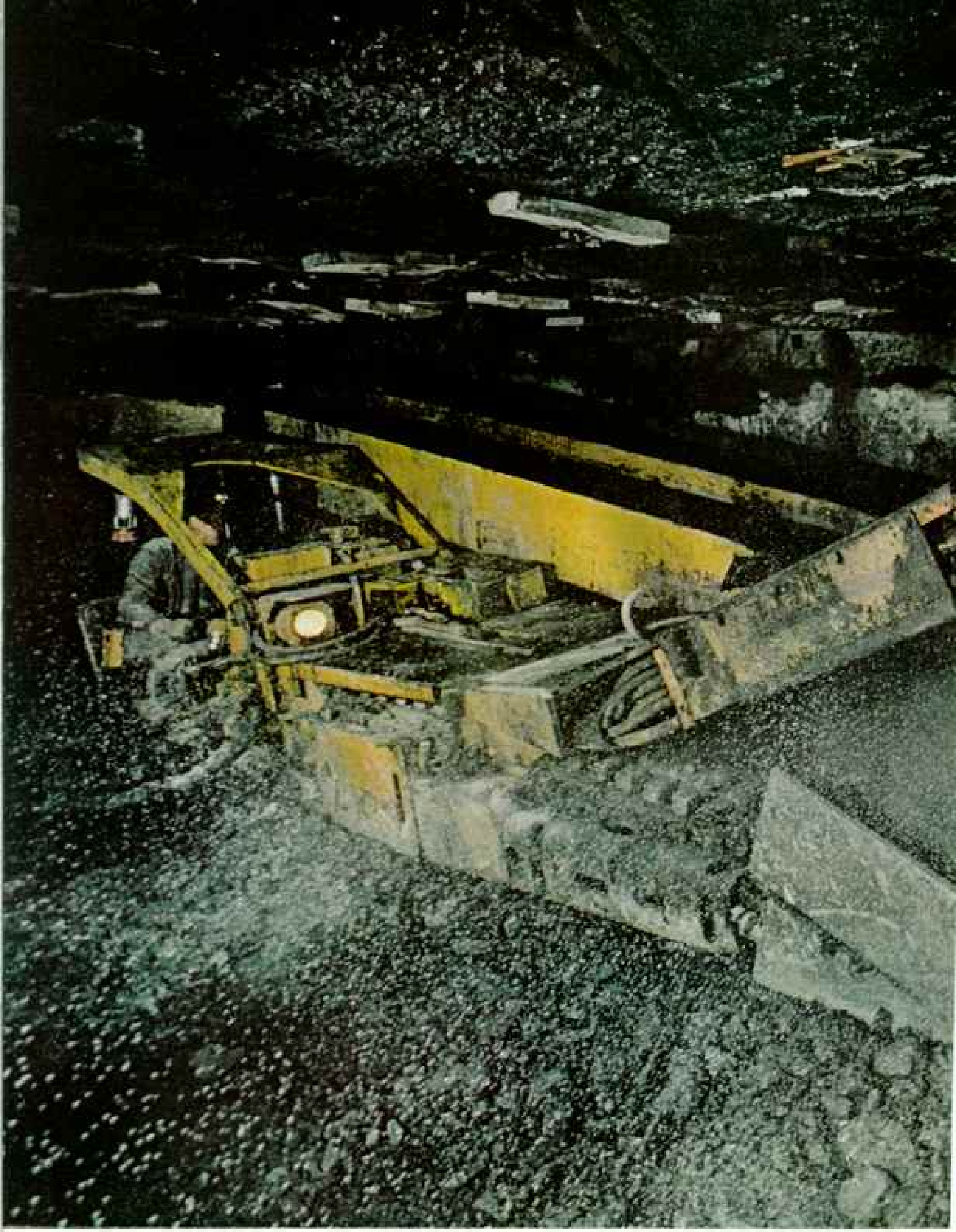
Coal: an estimated 3.2 trillion tons of it. Layered seams of anthracite down to a thousand feet or more in Pennsylvania. Bituminous deposits that stretch from Pennsylvania to central Alabama. And more in Indiana, Illinois, Iowa, Missouri, Kansas, Oklahoma, and Texas. Vast lignite beds in the Dakotas and in Montana. Sub-bituminous fields in Wyoming, Alaska, New Mexico, and Arizona. We live atop a treasure trove of energy!

But even the 217 billion tons economically recoverable with present technology is not easily won. And if it were, our cars and planes cannot use solid fuel. The factories can, but coal stains our skies. How, then, can we use it to feed our energy hunger?

It can be made to burn cleanly and sulfur-free. It can be converted to a gaseous or a liquid fuel. A full century ago, "coal gas" fueled street and home lights. Four decades ago a liquid fuel derived from coal kept Germany's Luftwaffe aloft and its tanks and trucks moving. Certainly, old, familiar coal can become

Tomorrow's "Black Gold"?

Photographs by JAMES P. BLAIR NGS STAFF



Steel snout of a subterranean monster chews eight tons of bituminous coal from a six-foot seam each minute. The machine, called a continuous miner, does the work of ten men 539 feet underground in Pennsylvania. A curtain of water sprayed over the rotating bits helps blanket coal dust that otherwise could become as explosive as gunpowder and,

to operator Ted Dobransky's lungs, just as deadly. Beneath the bits the machine's lobster-like arms scoop the loosened coal onto a conveyor, behind the machine at left. From the mine the coal travels to nearby Pittsburgh to be processed into coke, which will fire blast furnaces of the Jones & Laughlin Steel Corporation, owner of this mine.

"**Where the danger is double** and the pleasures are few," as a folk song by Merle Travis laments, Illinois miners hear a safety lecture 150 feet down in their inky world. Sheathed in glass, the flames of safety lamps on the table will flare up to warn of lethal amounts of methane; the tiniest bare flame or electrical spark can ignite the gas, touching off an explosion. But more often, miners die not with a bang but one by one, crushed by falling rock or machinery. Accidental deaths in U. S. mines have claimed an average of 3.6 men every day since 1889.

Servant to a machine, Bob Meckley is forced to his knees by the low roof of a Pennsylvania seam as he feeds overflow into the maw of a continuous miner (**left**).

a chief energy servant once again. At a cost.

Begin to research the subject and you run into complexities. The first is coal itself—formed from a collection of buried, once-living plants subjected to varying amounts of heat and pressure through the ages. The hard anthracite coals, resulting from the greatest pressure, are 86 to 98 percent carbon; they burn with fierce heat. Soft bituminous coals, 69 to 86 percent carbon, have more pollutants, and they generally put out less heat.

Individual attitudes about coal are just as complex. Black diamond to some, an environmental disaster to others, coal has a checkered history. It has made millionaires of many men, widows of many more women. Trouble in the coalfields has included exploitation by coal operators and bloodshed by vengeful Pennsylvania miners who formed a secret society, the "Molly Maguires."

Oil Made Coal an Energy Stepchild

There are other paradoxes. Last fall I drove the hundred miles from Harrisburg, Pennsylvania, to Scranton. Beneath me along much of the way, for at least a thousand feet down, were layers of low-sulfur coal. Anthracite's price had more than doubled within a year. And yet most of the mines were closed.

Puzzling. For an answer, I went to Charles Kuebler, chief of the U. S. Bureau of Mines' Environmental Affairs Field Office in Wilkes-Barre, Pennsylvania.

"When the U. S. industrial revolution began," he said, "hard coal replaced wood as a convenient heating fuel. Then, during the past 50 years, coal was gradually displaced as oil made inroads into the market. Anthracite production dropped from 100 million tons a year in 1917 to about seven million nowadays. Once there were 315 large anthracite mines in this state; now we have only 70 small ones, all of them above water level."

Water level was the key. For when a shaft penetrated below the water table, it needed constant pumping. As the coal market shrank, the pumps stopped, one by one.

"Each time a mine was abandoned and allowed to flood," Mr. Kuebler pointed out, "the next mine down the slope had an increased water load to handle, and the mine operator down there, faced with mounting expenses, would give up, too. It's like knocking down a row of dominoes."

In 1955, with federal and state aid, pumps were set to work in 33 abandoned mines to

clear them, thus protecting the working mines. But then, five years ago, another obstacle confronted mine operators: State environmental regulations forbade them to drain the acidic mine water into streams.

"Sure there's a demand for anthracite," Mr. Kuebler said. "But coal operators want a guarantee that the demand will last before they spend millions pumping out more abandoned mines and developing water treatment. No one—not even the U. S. Government—can give them that guarantee."

One fairly large anthracite mine is still in operation: the Kocher Coal Company's mine at Valley View, Pennsylvania. Since its main shaft is bored almost horizontally into a hillside, the surface water that percolates down into the mine flows out by gravity.

Robert Rissinger, company president, greeted me with hospitality that was tempered with caution. "We're glad to have you here," he said. "But this isn't going to be a condescending 'miners-with-dirty-faces' type of story, is it?"

Assuredly not. Soon I was decked out in coveralls, boots, and a hard hat equipped with a battery-powered light. Accompanied by tall, taciturn Sam Klinger, mine foreman, I entered an eerie world.

"Anthracite seams don't run level," Sam said. "From the tunnel, we're cutting upward into almost-vertical veins, so we can't use digging machines; just air drills and explosives."

Bright Idea Guards Miners' Lives

Hooked to Sam's leather belt was a lantern designed not for illumination but for safety.

"If that little flame gets smaller, we're running short of oxygen," Sam said. "If it flares up, the methane concentration is building."

Only the locomotives, the miner's lights, and the telephone system were battery powered; most of the machinery was driven by air pressure—even the booster fans that blew a constant moist breeze into our faces.

"This is a gassy mine," Sam commented, "so we don't want electrical things sparking down here." I nodded earnestly in the darkness and peered at the safety lantern on his belt. The little flame glowed serenely behind its safety screen.

At long last the wet wind was at our backs, and we began the mile-and-a-half trip toward daylight. Miners with dirty faces indeed! I hereby tender my humble and sincere respects to the giants who work down there.

Anthracite beds are also strip-mined; in fact, strip-mining accounts for 48 percent of total production. Most anthracite seams, though, have an undulating wavelike pattern, and only the top of the wave is usually taken; following a seam as it dips increases the problem of removing overburden. Bituminous miners have a simpler task with their well-behaved seams. Even underground they can use sophisticated, powerful machines.

Shared Hazards Nurture Pride

But no coal miner has an easy job. It is hard, man-killing work—the nation's most hazardous occupation—with ever-present dangers of fire, explosion, rockfall, and black-lung disease. Yet I have never met a miner who did not feel pride, and a sense of belonging to his work.

One man put it this way: "Let's say you're on a seven-man crew. You're looking out for the half dozen other men, and each of them is looking out for you. Nobody breaks the circle. Nobody feels alone."

Above ground that sense of interdependence has helped the American miner in the 150-year battle to improve his lot. And battle it has been—gunfire crackling in the streets of Matewan, West Virginia, in "bloody Harlan" County, Kentucky, and elsewhere.

It was not all one-sided. A century ago the Molly Maguires—a secret society of anthracite miners bent on reprisals against the bosses and armies of company police—operated in Pennsylvania's coalfields. The elderly widow of a miner once told me where I could still find evidence of the violence: "You go put a shovel to the shoulder of Sandy Hill Road outside of town, and you'll dig up some of the victims."

But the Molly Maguires were infiltrated by a private detective in the pay of a coal operator. A series of trials followed, and 20 alleged Mollies were hanged in Pennsylvania. On the wall of a cell in the Carbon County Prison there is a handprint. Legend claims that it was made by a Molly Maguire awaiting execution for murder, and that it will last through eternity, proclaiming his innocence.

I have seen the famous handprint, and as a point of interest now pass on the account given me by a poker-faced guard: Neither washing nor repainting that wall has succeeded in erasing the magical sign.

Coal has cost us more than hardship, money, and lives. Its extraction has scarred

the face of this planet. When old mine workings collapse, the land cracks and sags—"subsidence," it is called. Banks of culm (waste material from a mine, intermixed with coal lumps once considered too small to sell) sometimes catch fire by spontaneous combustion.

One burning culm bank smolders on a hill overlooking Shamokin, Pennsylvania—and there are 29 other burning anthracite banks and mines in the state. Attempts to extinguish such fires have often failed; some have been burning for decades. A seam in an Australian mountain has been smoldering for at least a thousand years.

Burning or not, culm banks and abandoned strip-mine wastepiles offend the eye. At Scranton, Pennsylvania, I was heartened by an old stripped area that had been turned into an attractive park. But face-lifting the 125-acre area had cost a million dollars.

Coal Quest Leaves Ugly Souvenirs

In bituminous-mining regions, the soft-coal waste, or spoil, becomes "gob," but gains no beauty with another name. And strip mining is even more prevalent there.

Nowhere have I seen a more discouraging sight than the moonscape I looked down on from a light plane flying over eastern Tennessee. The steep-sided hills had been layered with coal seams. Strip miners had girdled the hills with roads, then cut inward after the coal (page 252). They simply bulldozed the waste into banks on the hillsides—where rain or snow would soon wash it down, killing vegetation and clogging streams with silt. When the mining machines rumbled away, the ruined mountain was left barren and ugly.

During my fieldwork for this article, the United States Congress passed (and President Ford twice vetoed) a bill to control coal surface-mining and to reclaim abandoned "orphan banks" such as the ones below me. Even so, such steep-sided hills pose a special problem; erosion tends to wash seeds away before they are firmly rooted.

There is a lot yet to do. Unreclaimed coal-stripped land in the U. S. occupies an area larger than Rhode Island, and each day more than 400,000 pounds of sulfuric acid leaches into our streams from strip mines.

Coal companies are very conscious of their corporate images. "Don't curse us for the sins of old-timers," they say, "look at what we're doing today." I did look, in western Kentucky. There the Peabody Coal Company, the largest in the nation, operates 14 of its 47 mines.

With affable Jim Whitney, director of the company's public-relations staff, I roamed stripped areas that had been reclaimed. They were well vegetated—but Jim would hardly have steered me to anything less than the most successful reclamation efforts.

One area had been turned into an idyllic miniature forest. A quarter of a century ago, before there were any mandatory reclamation laws, three coal-mine operators formed the Kentucky Reclamation Association; this was one of its projects, and it showed what good management, time, and nature can do.

On a spoil bank being reclaimed I met an agronomist, Dr. Richard Barnhisel of the University of Kentucky, busy inspecting his tiny "farms." Each measured 16 by 33 feet; each had received different treatment. They had been fertilized in varying amounts, and had been seeded with different crops.

"All the plants are local—fescue, alfalfa clovers, et cetera," Dr. Barnhisel explained. "If you can't get anything to grow except an exotic species, you're doing something wrong.

"Even just roughening the ground with a disk helps," he added. "There's a water-runoff problem, and tiny furrows hold the rain until the ground can absorb it."

In the U. S. many reclamation efforts have failed simply because the reclaimers had only a vague idea of what the land needed. Peabody's struck me as a reasonable effort. But I ended the tour with a nagging suspicion. The reclaimed areas beyond view of the road—what did *they* look like?

A plane ride gave me the answer. The view was perhaps a shade less scenic, but certainly no moonscape.

Paradise Lost—But Not to Coal Company

During my Kentucky stay, a television camera crew turned up to see Jim Whitney, and their request nearly shattered his composure. "We want to film the place where Paradise was, before 'Mr. Peabody's coal train hauled it away.'"

Jim rolled his eyes skyward, and stifled a sigh. All the restoration work that Peabody had done, and now that folk song again! The song—"Paradise," by John Prine—accuses the company of using "the world's largest shovel" to ravage Muhlenberg County, where the town of Paradise lay, and hauling it away.

Paradise, in fact, was ultimately bought and razed by the Tennessee Valley Authority to

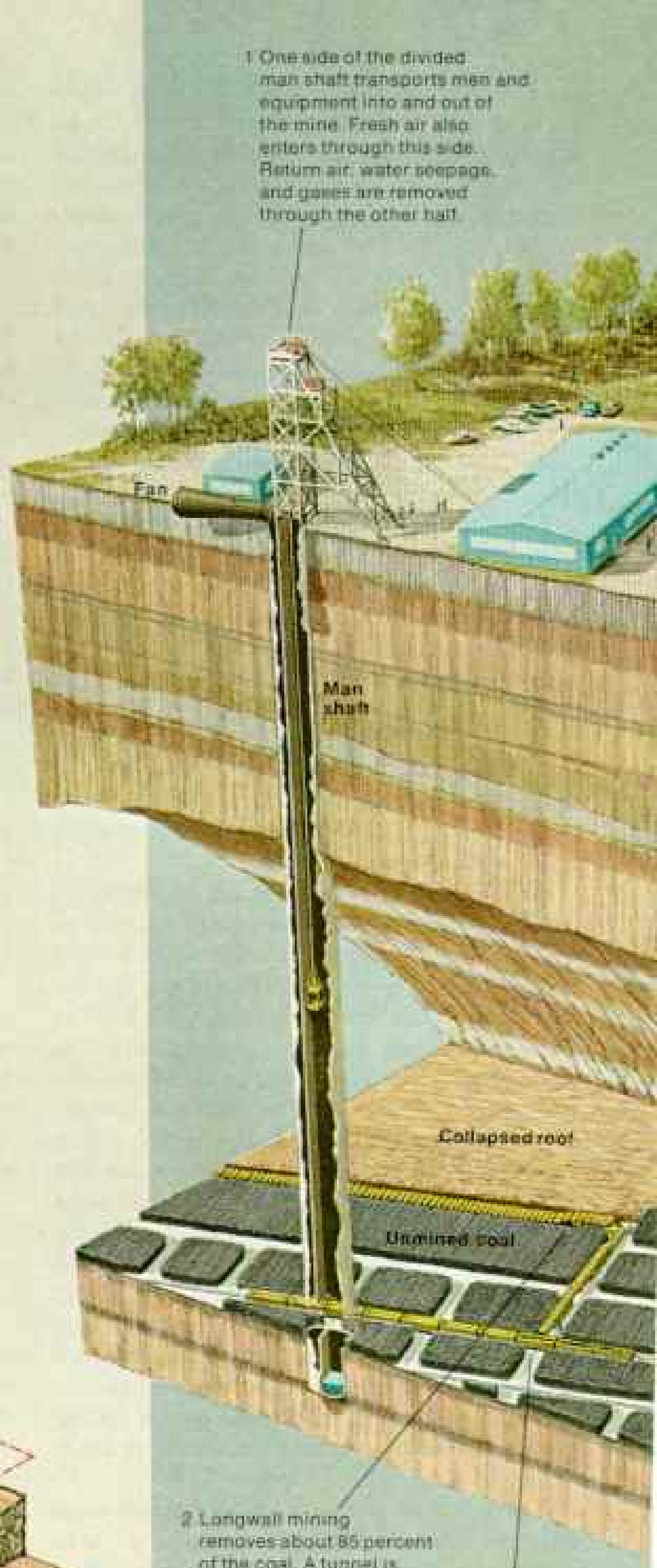
New chapters in an old struggle: getting the coal out

WOMEN, CHILDREN, dogs, and ponies once labored to haul the "cole" dug by early English miners. Today small crews using earth-gobbling machines can rip out thousands of tons on each 8-hour shift.

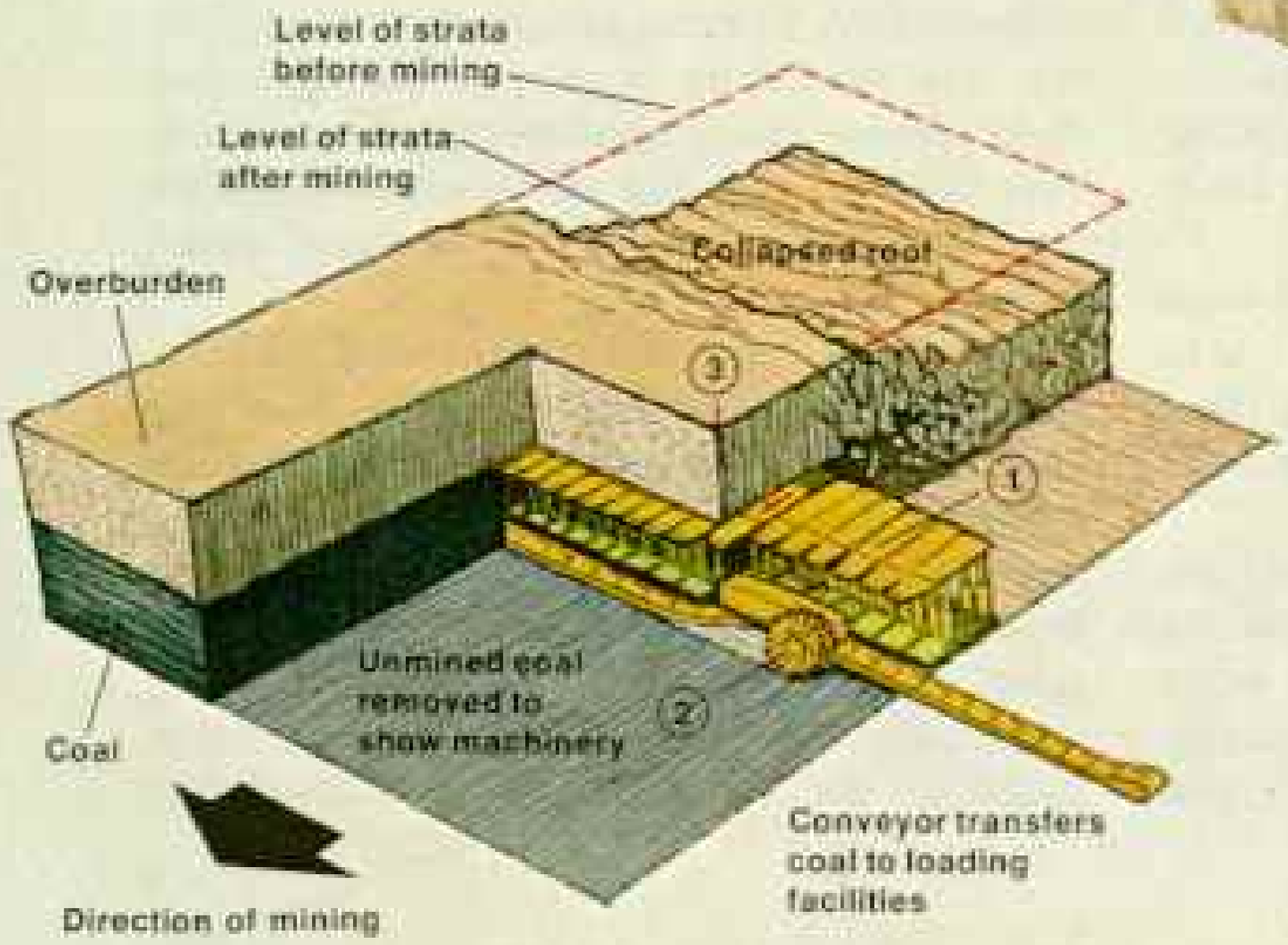
The U. S. possesses 3.2 trillion tons of coal—a fourth of the planet's known reserves—but currently only about 7 percent is feasibly recoverable. Two thirds of that lies deep underground, and the drawing at right shows a popular method of getting it to market: Build a self-contained coal-processing plant right over the mine to clean, sort, and ship the mineral. (Intermediate rock strata are omitted to show mining operations.)

The standard U. S. technique, room-and-pillar mining, leaves huge columns of coal to support the roof of the seam. The more efficient longwall method, now increasing in popularity, mines the "room" in stages, the roof collapsing behind as work progresses.

NATIONAL GEOGRAPHIC ARTIST LLOYD K. TOWNSEND



Shaving off coal like a meat slicer in a delicatessen, longwall mining (BELOW) relies on the use of hydraulic chocks (1). As the coal layer is sliced from the side of the tunnel by the whirling shearer (2), the chocks move forward to brace the newly unsupported overburden (3). The roof of the area vacated by the chocks is then allowed to collapse.



11 Loading bin, fed by the underground conveyor belt, can pour 4,000 tons of coal an hour into hopper cars, filling a 100-car train in 2½ hours.

10 From the transfer house, elevated conveyor belts dump the assorted sizes of coal chunks into separate piles to accommodate different consumers' needs.

9 Processing plant cleans, washes and dries the coal, separates remaining rock and clay from it, then sorts it into different sizes and passes it along to the transfer house. A typical plant extracts 25 tons of waste from 100 tons of the raw material, leaving 75 tons of pure coal.

8 Dumped from the skips, coal is separated from rock and sent by elevated conveyor to the processing plant or to a storage pile atop the underground conveyor. That conveyor can transfer the raw coal as needed to the railroad loading bin or to the processing plant.

Raw coal

Underground conveyor

Hoist house

Roof bolter

Shuttle car

Continuous miner

Skip shaft

4 Mining machinery, used ideally, combines productivity with safety. Continuous miner removes the coal; roof bolter drives steel rods into the roof, binding its thin layers into one solid piece to keep rock from falling.

5 Room-and-pillar technique carves out, on an average, only half the coal, leaving columns to support the roof. Large blocks will be reduced as mining advances.

6 Groundwater, collected in sumps throughout the mine, is piped to the main shaft for removal. If free of acid, the water can be used as is in the processing plant above. If not, it must be treated, though some mines still discharge it directly into streams.

7 Buckets called skips, loaded from storage hoppers, hoist coal up the skip shaft to the processing plant at a speed of 30 feet a second. In emergencies, they also haul men.

make room for expansion of its Paradise Steam Plant. Mr. Peabody's coal train was not the culprit in this case. The TV people filmed a dragline and a few seeded spoil banks, then departed.

With a hard hat and headlamp, I prowled Peabody's Alston No. Four Mine, and discovered that underground miners of hard coal or soft all have their own particular hell.

In Pennsylvania the men had been hacking at anthracite directly overhead. Here in Kentucky the bituminous seam lay dead ahead, but clearance was low. Miners worked in a perpetual crouch, or on their knees.

This seam was just over four feet thick. I walked stooped and crablike, one hand steadying my hard hat, the other almost dragging in the coal dust. All the while, in the swirling dust and dancing lights of miners' lamps, I yearned for the luxury of full headroom.

Mechanized Monsters Devour Seams

At the face of the seam squat machines were at work. One, with a long chain-saw snout, sliced a horizontal gash in the seam near floor level. Another drilled holes for explosive charges. We retreated, and after a muffled thud signaled that the charge had fired, a lobsterlike monster wheeled up. Its extended claws gathered in the shattered coal like a gambler scooping in chips from the center of a table.

From there, with a nearly permanent crick in my neck, I followed the coal as it flowed by shuttle cars and conveyor to the surface, at the rate of 6,000 tons a day.

Nearly 90 percent of the world's coal deposits lie in three countries: the Soviet Union, the United States, and the Peoples Republic of China. Western Europe, less blessed to begin with, has been using its coal for more than a thousand years.

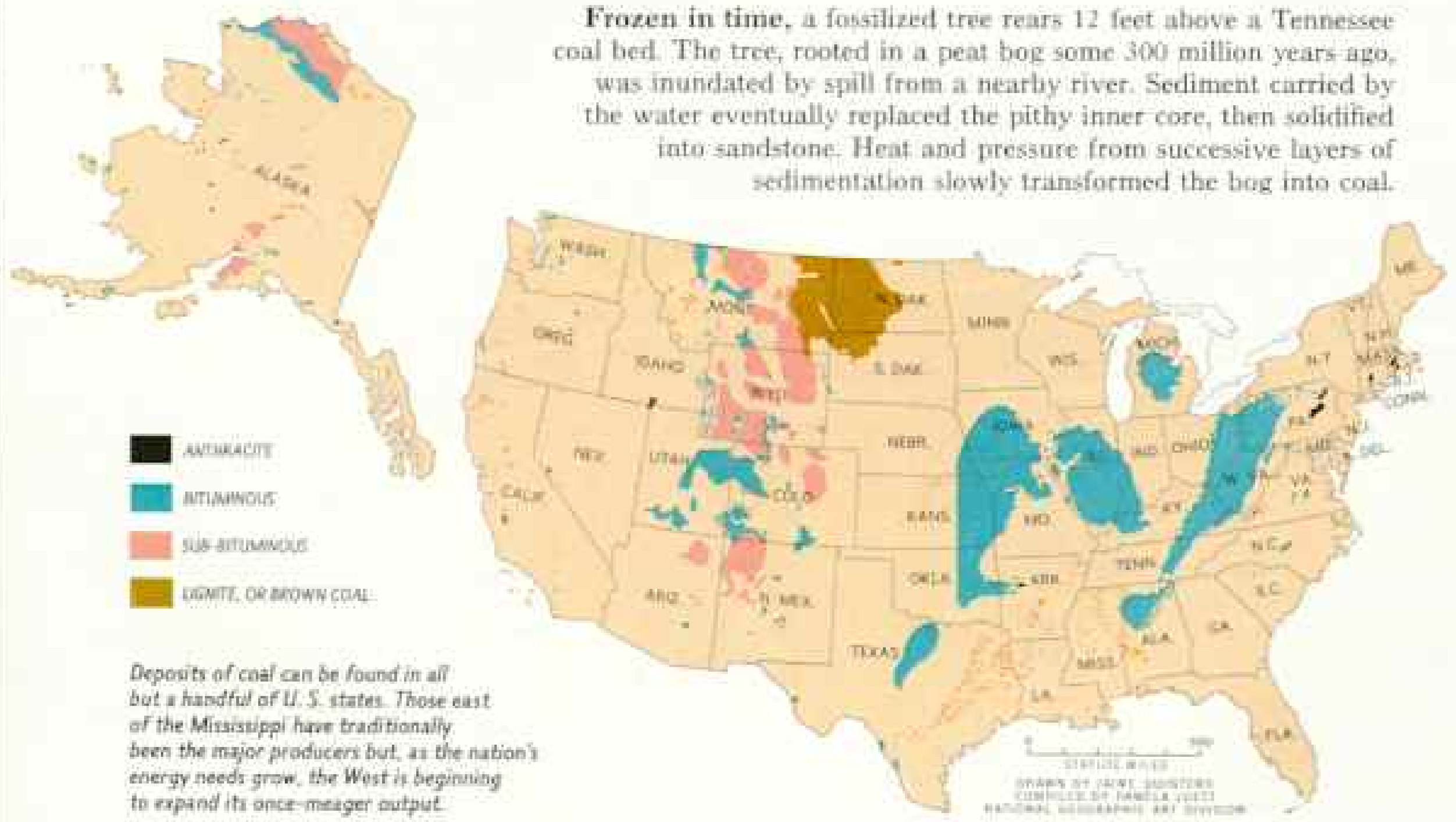
Most U. S. deep mines use the room-and-pillar method, taking part of the coal and leaving the rest as roof-supporting pillars. Roughly half the deposit is recovered.

Europeans, though, get out about 85 percent of their coal by utilizing a longwall system. Two parallel tunnels are bored into the seam, then connected at the far end with a crosscut. From that point, mining proceeds back toward the entrance, taking everything between the two tunnels. As they progress, the miners use a controlled-caving method to collapse the mined area behind them.

Strip mining, too, differs in Europe; land is limited there, and by law must be carefully reclaimed. In Germany's Ruhr Valley awesome machines as much as 650 feet long scoop off the topsoil and lay it aside. Later it will be put back and seeded.

However admirable, the system can't be utilized everywhere. In the United States most coal seams are overlain with strata of rock, which must be blasted loose. But certainly Europe's attitude toward reclaiming the land can be emulated.

Frozen in time, a fossilized tree rears 12 feet above a Tennessee coal bed. The tree, rooted in a peat bog some 300 million years ago, was inundated by spill from a nearby river. Sediment carried by the water eventually replaced the pithy inner core, then solidified into sandstone. Heat and pressure from successive layers of sedimentation slowly transformed the bog into coal.



Deposits of coal can be found in all but a handful of U. S. states. Those east of the Mississippi have traditionally been the major producers but, as the nation's energy needs grow, the West is beginning to expand its once-meager output.

Muddy tongue of coal slurry (**below**) laps from a revolving rod mill, which crushes the fuel and mixes it with water. In an unusual transportation method, the Black Mesa Pipeline Company pumps the mixture 273 miles from Arizona to southern Nevada, where the water is centrifuged out and the coal is burned in a power plant.

Piping coal, though cheaper than building new railroads,

uses large amounts of scarce western water. The Black Mesa plant gulps 2,000 gallons a minute from deep wells.

For now, the iron horse pulls the heavy end of the nation's coal load, 67 percent. In Norfolk, Virginia, hopper cars laden with "clean" low-sulfur coal (**right**) wait to fill foreign freighters. Sixty million tons were exported last year.

Using low-sulfur coal doesn't necessarily guarantee less air pollution. Some low-sulfur types give off so little heat that twice as much must be used to produce the same heat as yielded by "dirty" high-sulfur coal—thus polluting as much.

NATIONAL GEOGRAPHIC PHOTOGRAPHER
EMORY KRISTOF (RIGHT)

Virtually all the anthracite and most of the bituminous coalfields in the United States lie east of the Mississippi River. Farther west are vast sub-bituminous and lignite deposits (map, page 244). Those beds of lower-grade fuels might solve our energy shortage—but only at great cost.

Consider some of the complexities. Although both lignite and sub-bituminous coal are low in sulfur pollutants, they burn with low heat value. Shipping east by rail might cost more than the coal itself. Much of the land covering the coal deposits is fragile, with little topsoil and little moisture. The seams are thicker than in most eastern fields—a hundred feet or more in places—but the reclamation problems are immense.

Once the coal is out of the ground, how should it be shipped to faraway industry? By rail? Or by burning it in a power plant at the mine's front door and transmitting the electricity? Or by piping a slurry of water and pulverized coal? Or possibly by turning it into gas or liquid and sending it by pipeline? The first two solutions are the usual methods; the third and fourth are just getting underway.

Indian Land Harbors Vast Deposits

In northwestern New Mexico recently, I battled the twisting, dusty roads of the nation's largest strip coal mine, driving past raw, upended hills and the black iron latticework of dragline booms jutting into the blue desert sky. It was an outsize, somehow brutal, effort to get out the coal.

The Navajo Mine lies within the Indian reservation. Most of the workmen are Navajos, and the tribe gets a royalty on each ton taken out. The coal takes a 30-minute train ride to the stockpiles of the Four Corners Power Plant, then pours into the boilers in a black torrent, 25,000 tons a day.

One of the nation's largest power plants, Four Corners has a generating capacity of more than two million kilowatts, for use in California and the Southwestern States. A few years ago the plant's sooty smoke plume could be seen 75 miles away. But I was told that the towering stacks now have scrubbers and precipitators to take out more than 99 percent of the sky-blackening fly ash, as well as much of the sulfur.

Inside there is the usual quota of generators and control panels. Outside I saw a series of three-story cubes made of quarter-inch steel, part of the fly ash-removal system. They had been installed only two years earlier. But already the sulfuric acid had eaten irregular holes through the steel sides. Steam squirted out haphazardly, like something from an old animated cartoon.

Times were hard and unemployment high when the Navajo Tribal Council signed the first contract with the mine. It hasn't worked out too badly, from an economic point of view. Reclamation? I was hard put to tell which land had been reclaimed and which still awaited restoration.

Gasification Proposals Eyed Warily

But now the Indians face a new decision. Two companies want to build several plants on the reservation to convert coal into gas. Energy officials in Washington, anxious to relieve the fuel crunch, encourage the project.

The plants probably will be built, considering the pressures. But not recklessly; the Indians are studying the environmental and sociological problems very carefully.

In a Farmington, New Mexico, motel I attended a seminar convened to explore the impact that the plants would have. Six Navajos and ten "Anglos" had gathered to pool their talents. Environmentalists, sociologists, legal experts, researchers, all had something to contribute.

Would the plants soak up too much of the San Juan River? Could Farmington cope with the flood of construction workers? Where would displaced Navajo sheepherders go? Question after question was assigned to the participants for study.

Harris Arthur, the Navajo who had organized and chaired the meeting, pointed out that time was short. "We need to get the answers to the Navajo Tribal Council before it's time to sign anything. If we aren't ready then, we'll just have to stall until we have the information."

Stall? How? Harris shrugged his shoulders and grinned. "Well, we could tie the whole thing up in hearings. That's better than shooting arrows at the companies, isn't it?"

If they're built, the plants will be improved versions of 14 plants in operation in other countries. All use a process called "Lurgi," which was first developed in Germany in 1933, and which produced a low heat-energy gas. The new plants add a separate step that boosts that gas's methane content to the same level as in commercial natural gas—more than 90 percent.

Newer methods are in the offing. Scientists are already hard at work developing gasification processes that would not only increase efficiency and reduce costs, but also require less coal for the same amount of gas.

I saw some of those efforts at the HYGAS pilot plant in Chicago (right). Operated by the Institute of Gas Technology, HYGAS is a project cosponsored by the Federal Government's Energy Research and Development Administration and the American Gas Association.

The HYGAS technique, relying on a chemical reaction between coal and hydrogen, produces in the original gasification a product higher in methane content than is possible using the Lurgi method. Then, as part of the overall process, the gas is cooled, rinsed, chemically scrubbed, and passed through a nickel catalyst to impart even more methane. The result is SNG, substitute natural gas so pure it can flow directly into the nation's natural gas pipelines.

Commercial gasification plants, though, would need an estimated seven to ten million gallons of water daily—more than a pound of water for each pound of coal converted. That's an awesome requirement, especially in the arid West.

So, once again, a paradox: too much water in Pennsylvania's anthracite mines, too little in the western coalfields.

Energy or Food the Choice?

And, once again, complexities. "Which is more important," asked Karl Limvere of the North Dakota Farmers Union, in Jamestown, "the food crisis or the energy crisis?"

My best answer was a noncommittal shrug. "Look," Karl said. "We get about 14 inches of rain a year in the coal region—enough to make the land good for livestock and wheat."

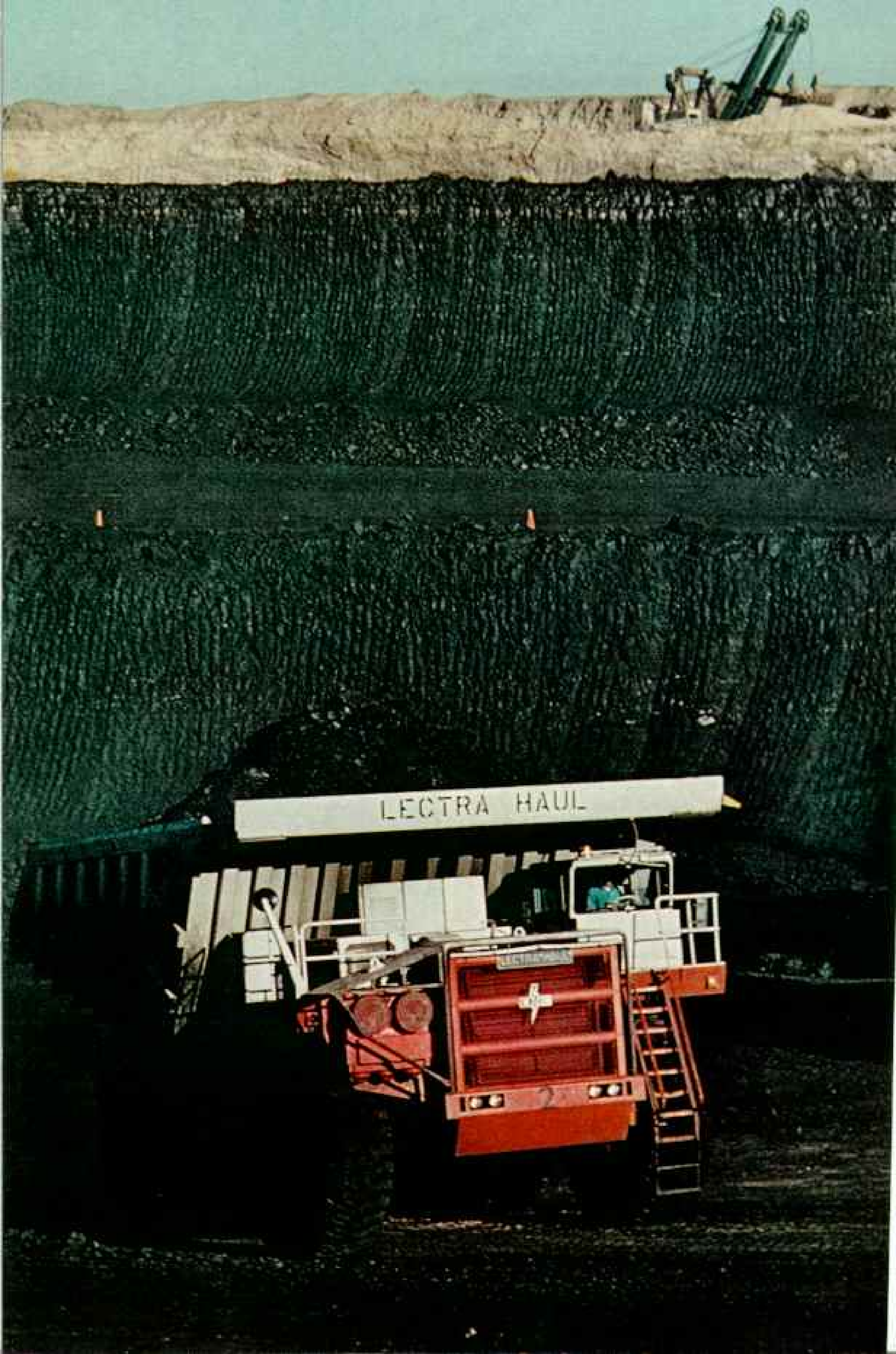
And what about the coal beneath broad fields and grazing lands? The simple answer —just mine it, reclaim the land, and go back to the old ways—was too simple.

"We have a saline-seep problem out here," Karl explained. "The clay under the topsoil has a high sodium content. If the land is disturbed by mining and refilling the pit, sodium can leach right into the topsoil and kill vegetation. And we don't know that the land could ever be restored if that happened."

I interviewed Julius Orth, a farmer near Beulah, North Dakota, where strip mining has been in progress for more than fifty years.

Squeezing gas from coal, the HYGAS pilot plant in Chicago mixes the fuel with hydrogen under high pressure and temperature to produce a substitute natural gas. Commercial plants of this type may warm cities nationwide—but not for at least a decade.

The great western coal rush draws mandwarfing machines like these (**following pages**) to strip a 70-foot seam in Wyoming. Western coal, once spurned as "very low-grade fuel or very high-grade dirt," can now produce high-grade gas in plants like the one shown above. The once-only harvest of coal alarms Great Plains farmers and ranchers, despite mine companies' promises to restore any damaged land.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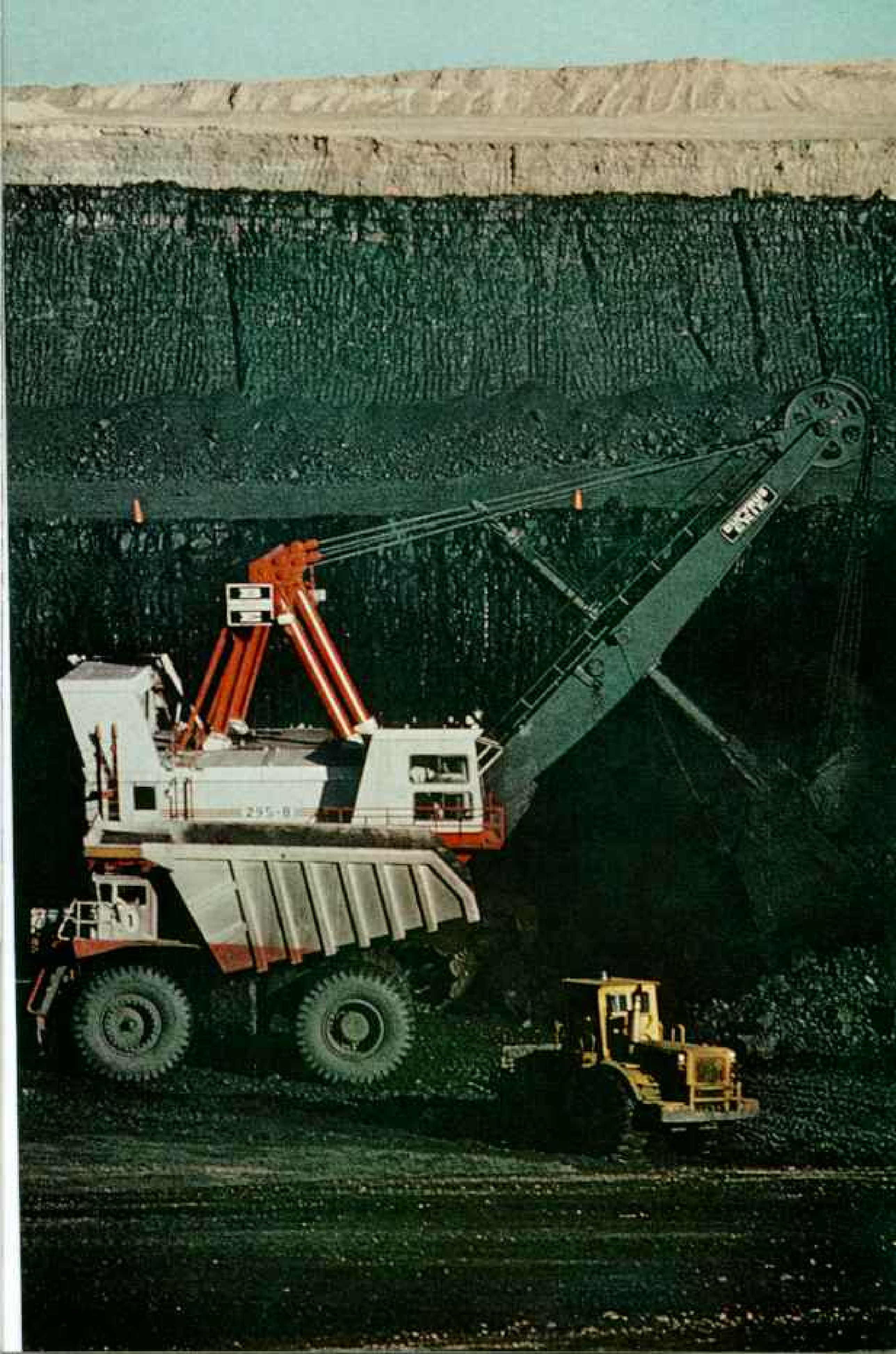


"The only reclaiming around here was started about three years ago," he told me. "It doesn't look bad now, but we'll have to wait to see if the sodium leaching will ruin the land."

Mr. Orth's 1,200 acres are in wheat and in livestock pasturage, and there is coal below. He loves the land, but he is a practical man. "The coal was put there for man's use," he told me, "but it's a one-crop harvest. We should mine it in the way that causes the least damage, so cattle and wheat can come back in a few years."

Farther west, near Hanna, Wyoming, the Energy Research and Development Administration hopes to avoid the problem of reclamation entirely. Project engineers are burning coal in the ground, and tapping the gas, which could run a power turbine. They are trying hard to coax their subterranean fire to burn more fiercely to gasify all the coal. The attempt is part of ERDA's overall research effort to turn coal into a clean, economical fuel.

Paul R. Jordan, an ERDA public affairs officer, outlined the effort. "We furnish much of the funding for half a dozen pilot plants; three involved in gasification, the other three working on ways to liquefy coal.

"It takes twelve, maybe thirteen years to go from the laboratory just to full-scale commercialization," Mr. Jordan explained. "Add another several years before the developed process will have a real impact on the fuel shortage. That's why we're into so many processes at once, trying to find the right answer without wasting time. Chances are, the new plants will be based on elements from a number of different pilot plants."

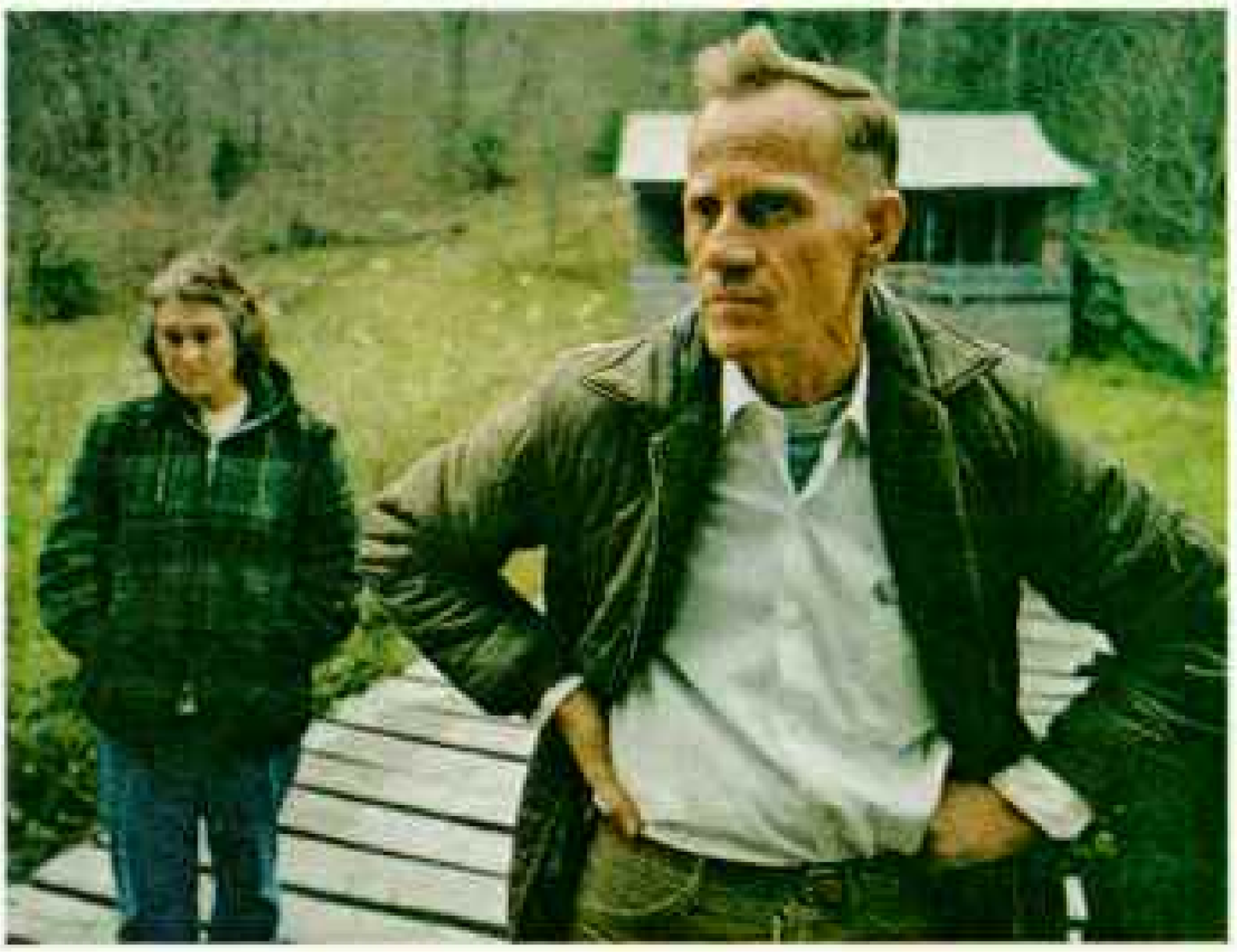
But will those plants be producing a gas or a liquid? Believers in "hydroliquefaction" point out that liquid coal can be shipped not only by pipeline but also by oil tanker, and that it can be stored in unpressurized tanks until needed. Those prospects especially appeal to oil companies that have obtained rights to extensive coal reserves held by the government.

Research Held Up by Oil Finds

Germany managed to liquefy coal during the 1930's and 1940's, but the process was much too expensive for a peacetime economy. Shortly after World War II a modified version of the German technique was tried in the United States; even then the U. S. hoped to make the nation self-sufficient in fuel. The process worked, but the cost was high. Before the technique could be improved, development of the vast oilfields in the Middle East spelled an end to the program.

Heat, pressure, hydrogen enrichment, and sulfur removal: Those are steps that all gasification and liquefaction techniques have in common. And all, unfortunately, require large amounts of fresh water.

Engrossed in the well-ordered world of technology, I found it easy to lose sight of the fact that coal's journey from earth to energy begins with the miner. His experience, his muscle, his courage make the journey possible. And for that he pays a price. In Beckley, West Virginia, I talked with Dr. Donald Rasmussen, whose *(Continued on page 258)*



Decapitated, a mountain falls victim to strip mining in Tennessee (**facing page**). Bulldozers peeled the peak of Red Oak like an orange, then ripped off the top. If graded and replanted, the mountain may green again, but erosion will still inundate nearby farms for years.

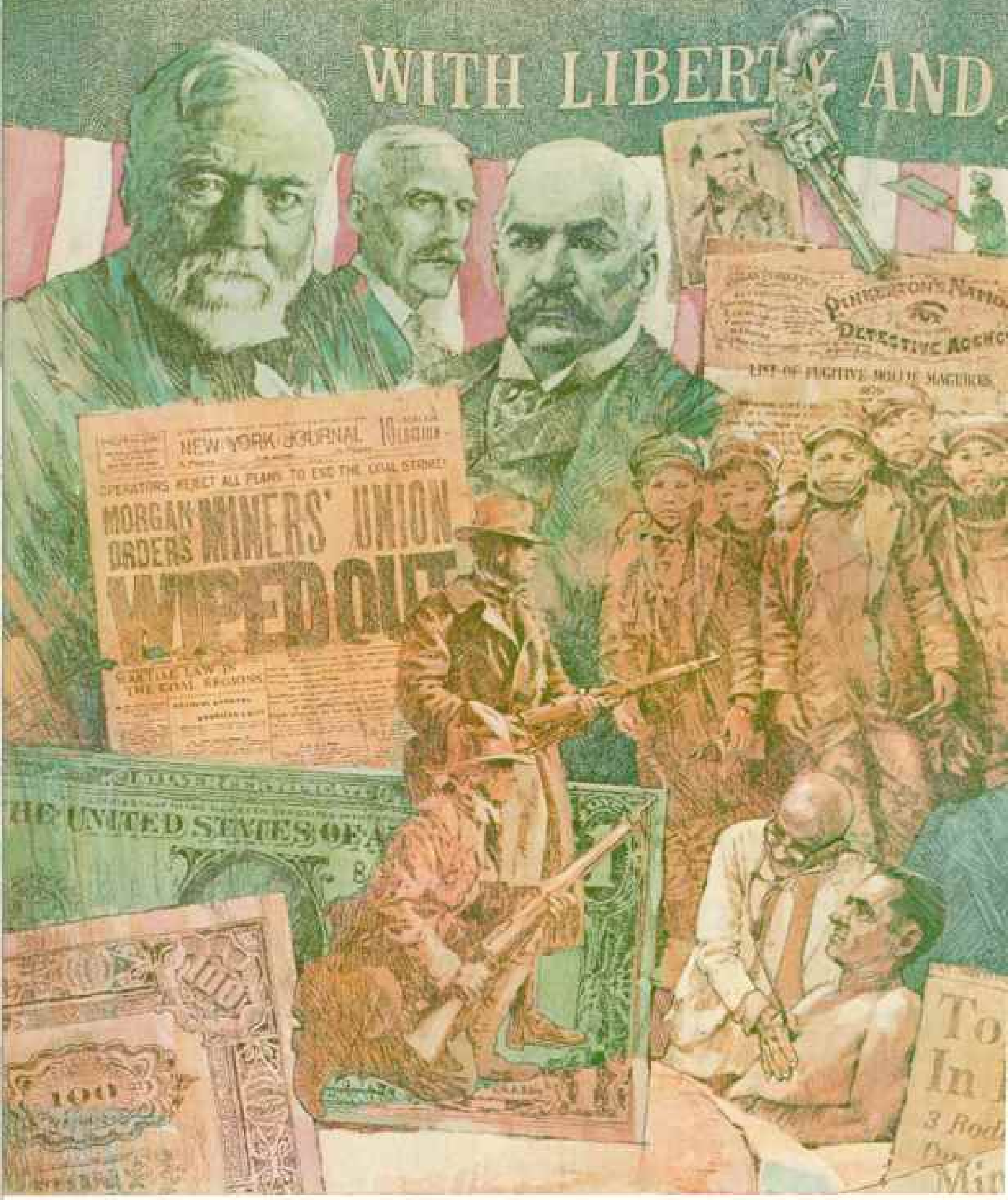
Not giving an inch, Thomas and Lorene Halcomb drove employees of a strip-mining company, seeking right-of-way, from the family's Kentucky farm (**left**). "If they hadn't left, I'd have wrapped a chair around their heads," Tom growled.


F.N.S.

Fifty killing years in the mines of Kentucky have left their mark on Claude Hall, 78 (**left**), a victim of the miner's most insidious curse: "black lung." The coal dust he breathed day after day congested his air passages and now chokes him to death, slowly but surely. Here, Carolyn Schuessler of the Frontier Nursing Service pounds his chest to help clear his smothered lungs. Some 215,000 similarly disabled miners receive compensation for this misery; about 4,000 of them die every year. But today exposure to excessive levels of dust has been markedly reduced by use of improved ventilation systems and dust-dampening sprays.

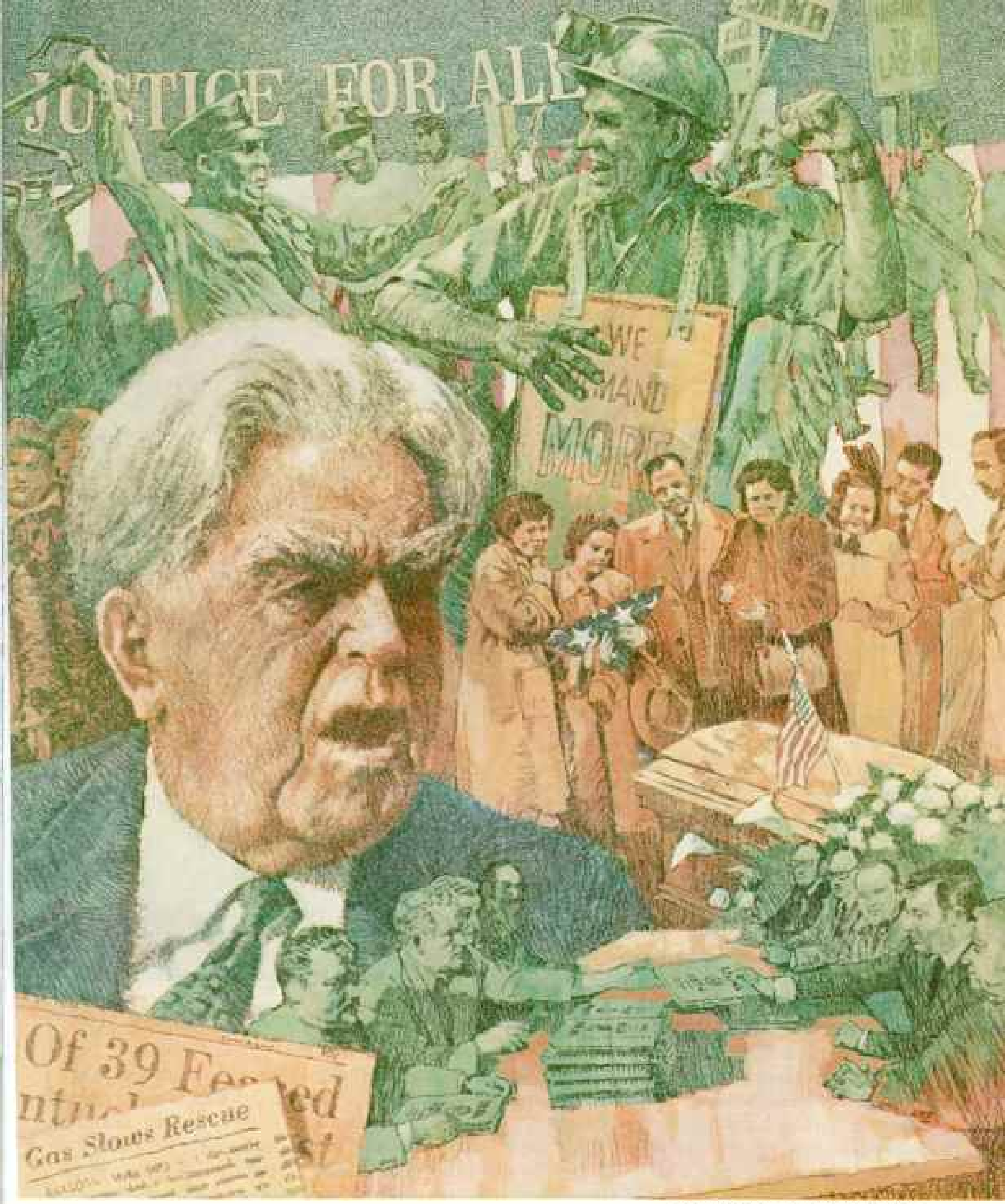
"King Coal" has been both bane and boon to Kentucky. Deep-mine operators built and ruled hundreds of camps like Hardburley (**above**), creating thousands of jobs. Later, when the strippers moved in to claim their subsurface mineral rights and replace men with machines, they left scars of hatred in these close-knit communities. One June morning ten years ago, on a ridge near Honey Gap, a 79-year-old squirrel hunter named Dan Gibson decided he'd had enough. To protect his stepson's land—he was fighting in Viet Nam—Dan, with his .22-caliber rifle and a "No Trespassing" sign, held off a strip-mining company's bulldozers and a band of lawmen. Folks said he was crazy, but he won. The company decided to go somewhere else.

Coal remains a friend to many Kentuckians, though. In Harlan County, work underground means a comfortable home on "God's Half Acre" for Paul and Jean Presley (**below**). "I've worked 29 years in the deep mines and I've loved every minute of it," says Paul, who now earns $47 a day.



Coalfields ran red in the late-19th and early-20th centuries as miners fought millionaires for "the just fruits of our toil." Like Oliver Twist, they dared to ask for more from such despised corporate owners as Andrew Carnegie, Andrew Mellon, and J. P. Morgan, upper left. Miners demanded an end to conditions that paid children only pennies for long, grimy hours in the mines. Some coal barons marshaled professional detectives, amateur thugs, and state militia, who broke the strikes of "the men in the pits" with bullets and billy clubs. Pennsylvania miners claimed an eye for an eye through a secret order, the "Molly Maguires."

In 1890, the battle cry "Organize!" gave birth to the United Mine Workers of America. From their midst rose a Zeus-browed giant named John L.



NATIONAL GEOGRAPHIC ARTIST LLOYD K. TOWNSEND

Lewis. Miners worshiped him. President Truman said he wouldn't appoint him dogcatcher. John L. agreed, adding, "The President could ill afford to have more brains in the Dog Department than in the Department of State." Lewis raged against conditions that spawned disasters like the explosion in December 1951 that killed 119 miners in West Frankfort, Illinois. Though he led his miners to many triumphs, the Lewis legacy of iron-fisted control later bore ugly fruit when UMWA president W. A. "Tony" Boyle was convicted of ordering the 1969 murder of rival Joseph A. Yablonski, whose wife and daughter were also killed. Today reform leader Arnold Miller has given his constituents the one thing Lewis and his successors denied them: the vote.

Pondering the future, brothers Wayne and Tim Farabaugh study last year's United Mine Workers contract, the first ever ratified by the rank and file. Both voted "aye"; both like mining, but both agree, "I wouldn't want my son to do it."

laboratory is devoted to diagnosing the effects of coal-mine dust on the lungs.

"One in three miners in this area has respiratory problems," he told me. "The 'black lung' diseases include chronic bronchitis, asthma, emphysema, coal workers' pneumoconiosis, or a combination. The first two can be reversed, the others only arrested."

Nearby, some of his patients were having blood samples taken to aid in diagnosis. I talked with one of them, a man who had worked in the mines for 18 years. He was short one finger and one eye from mine accidents, and his answers came in wheezes.

Would he go into the mines again, if time were turned back 18 years? He guessed that he would, he said, for it wasn't a bad life.

New Methods Make Mines Safer

Thanks to federal regulations, mine dust is better controlled now. Tunnel walls are powdered with limestone to reduce combustibility, and the cutting heads of machines are sprayed with water as they chew into the coal.

In "space suits" tested by the Environmental Protection Agency and a coal company in a West Virginia mine, men could work safely even in high concentrations of dangerous gases. In fact, such concentrations, by displacing oxygen, would minimize the chances of fires or explosions. Miners worked efficiently in the garb but were restricted in range by hoses connected to their suitcaselike breathing apparatuses.

One coal digger, though, gave me a personal objection to the idea: "If I'm down there when the ceiling bolts start to pop, I wouldn't appreciate any unprintable space suit slowing me down on the way out!"

The militant Molly Maguires are history. Today a miner's future depends on the give and take at contract-negotiating tables. Prior to 1974 top officials of the United Mine Workers controlled the final decision, but now copies of any agreement go out to all local UMW chapters, and the miners themselves vote on whether or not it should be accepted.

"This is the first time we can look at a contract and say that it's *our* contract," a local union official in West Virginia told me.

He paused to stare at the wall, where hung a picture of the late John L. Lewis, for 40 years the indomitable and revered president of the United Mine Workers. The great John L., with a hard hat topping his bushy mane and his jowls smeared with coal dust. Miners with dirty faces.

"Outsiders really don't know us," the union man continued. "They just don't know what it's like down there. We go into court to get a safety law changed, and that judge doesn't know us. He's never worked down there, so he has to sit up on his bench and guess

what it's like. And he really can't know."

That is the final complexity. So many people, each in his own world, judging the acts of those in other worlds. Deep miners and strip miners, coal operators and conservationists, land-loving ranchers and government officials faced with an energy crisis.

The bill so strongly opposed by President Ford, for instance, calls for an end to strip mining in national forests and orders miners to restore any land they strip "to its original contour." The President feels these restrictions could reduce coal production by as much as 27 percent and eliminate an estimated 36,000 jobs. An Interior Department official, however, claimed the number of jobs would actually be increased because of the required reclamation projects.

Enough of complexities and paradoxes. In my lifetime this nation has experienced the traumas of World War II, Korea, and Viet Nam, and it has survived. In coal, we own a source of energy that exceeds the more publicized one in the Middle East. Even if we triple our coal production, there is at least a century's worth of fuel down there. We must simply decide how best to use it.

And a century will give us time enough to learn new ways to tap the sun and the wind and the atom. □

The Treasure of

I CAN SCARCELY BELIEVE IT, but the treasure chest is real. And full. As I touch the box to make sure I am not dreaming, the silver bars gleam with a radiance undimmed by two and a half centuries of burial beneath the Atlantic Ocean.

There are a hundred bars altogether, most of them stacked inside the chest and perhaps two dozen that have tumbled through the rotted front panel. My diving partner Louis Gorsse and I exchange glances: There is no mistaking the smile behind his face mask.

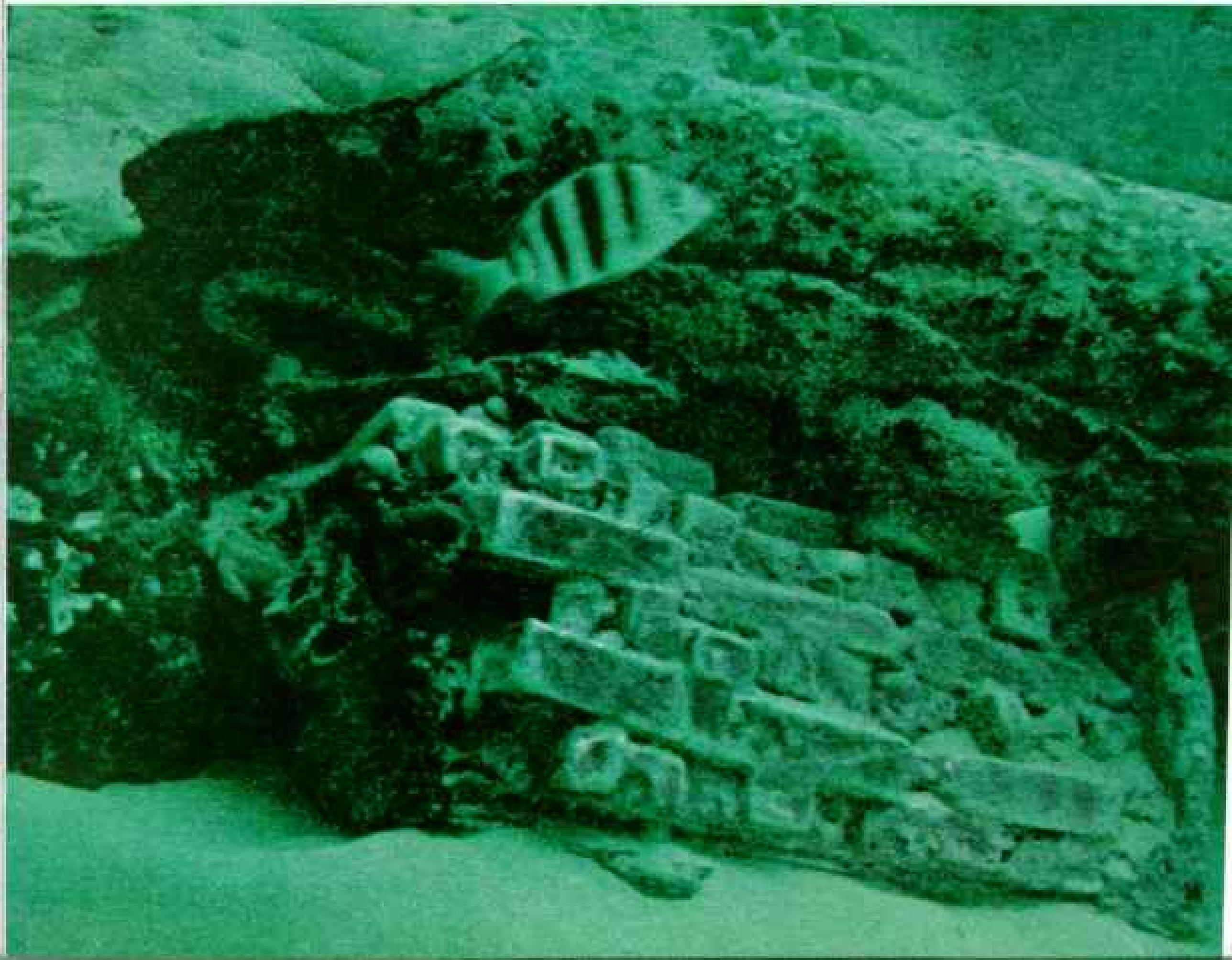
Louis and I have good reason to smile, for the bars are unique among the world's known sunken treasures. No one, to my knowledge, has seen anything like them in modern times. They are a particular form of ingot once cast by the Dutch East India Company for trade with the Orient, where the bars were melted down, usually for conversion into coins.

Now, with eyes glued to the chest, my thoughts turn to the man who has brought us here. As surely as if he had led our expedition, John Lethbridge is responsible for our success. He was the first to get at the treasure, and spent five years of skilled and daring work trying to bring it all up. I have followed his career with admiration nearly all my professional life. He died more than two centuries ago.

Treasure Intended for Island Trade

The story of the silver bars goes back to the year 1724, when a proud new vessel, *Slot ter Hooge*, left the Netherlands for Batavia in the Dutch East Indies with three tons of silver ingots and four chests of coins in her holds.

Slot ter Hooge (Castle of Hooge—a site in today's Belgium) belonged to the Dutch East India Company, that giant conglomerate of the 17th and 18th centuries that enjoyed many of the powers of a sovereign state. Like



Porto Santo

By ROBERT STÉNUIT

Photographs by the author and WILLIAM R. CURTSINGER

A fortune in silver ingots, stacked in the remains of a worm-eaten chest, lies beneath a cannon off the isle of Porto Santo in the Madeiras. Two and a half centuries ago the Dutch East Indiaman *Slot ter Hooge* spilled her precious cargo here after foundering in a furious storm.

Detective persistence, crowned by luck, led the author to a probable site. Then the first coin was recovered, a silver *dubbelstuiver* (**above**) of 1724, bearing the name and coat of arms of Zeeland Province—proof that he had found the prize.

its counterparts, the British, French, Danish, and other East India Companies, the Dutch concern held an absolute monopoly on trade with its country's overseas colonies, and it wrung every last guilder out of the concession. Huge profits resulted from successful voyages of the company's vessels. *Slot ter Hooge*'s journey, though, was not a success.

Off the coast of Portugal the Dutch East Indiaman encountered a fierce Atlantic gale and was driven helplessly off course toward the Madeira Islands. In a savage finale the storm flung *Slot ter Hooge* ashore at night on the small island of Porto Santo, disemboweling her on the rocks and strewing her precious cargo across the floor of an inlet. Of her 254 passengers and crew, only 33 survived.

In the national archives at The Hague, Netherlands, I had come across a report of the *Slot ter Hooge* wreck made by her first lieutenant, Baartel Taerlinck, to the Dutch

WILLIAM R. CURTSINGER (ABOVE)

COURTESY BRITISH MUSEUM TRUSTEES

Tips from a tankard

MONTHS OF RESEARCH in the Dutch archives at The Hague convinced the author that an 18th-century English diver, John Lethbridge, had retrieved much, though not all, of *Slot ter Hooge*'s treasure. But the documents failed to establish the ship's precise location.

Fellow wreck-hunters in London showed the author engravings copied from a silver tankard that had belonged to Lethbridge. One (**top**) showed Porto Santo, with a foundered ship in a north-coast bay. "*Slot ter Hooge*," concluded Mr. Sténuit, "as surely as if an X marked the spot."

The other engraving (**above**) depicted a cylinder being lowered into the water. This was Lethbridge's "diving machine," a wooden tube ringed with iron hoops (**facing page**). Peering through a glass plate, Lethbridge could work for several minutes at a time before being hauled topside, where fresh air was pumped into the cylinder, and water drained out.

consul at Lisbon, the capital of Portugal and thus of the Madeira Islands. The report gave details of the wreck and listed the ship's precious cargo: 15 chests of silver bars; others containing Spanish pieces of eight and Dutch silver coins; and a *grote quantiteijt* of valuables belonging to the officers and passengers aboard the ship.

The consul had added a hopeful note—salvage was indeed a possibility, even with the primitive diving apparatus of that day. "I know not," he wrote, "how well acquainted the Dutch are with the machines, but the English are most certainly capable of fishing all [the treasure] up . . . the depth being 10 to 12 fathoms [60 to 72 feet]."

Puzzles Prompt Deeper Research

I was instantly fascinated by *Slot ter Hooge* as a modern salvage prospect. My many years of exploring wrecks of the Spanish Armada had come to a successful conclusion.* My interest now turned to the historic East India trade of the 17th and 18th centuries. Yet there were several unanswered questions about *Slot ter Hooge*. Exactly where, for example, was the fateful spot on Porto Santo Island on which the ship had come to grief? What was the character of the sea bottom there, and how had it changed in the course of two and a half centuries?

Even more vital was the question of 18th-century salvage from the ship. Dutch East India Company records indicated that the Englishman John Lethbridge had been hired to retrieve *Slot ter Hooge*'s lost treasure. Lethbridge, a Devonshireman and a technical genius of his day, had developed a remarkable "diving machine"—a wooden barrel in which he could descend and work as deep as 60 feet (right).

Had Lethbridge been successful at Porto Santo? The records did not say. When I requested further documents on the subject, the record keepers in The Hague shook their heads. "Lost or destroyed," they replied sadly, "or perhaps lying somewhere among our millions of still-uncataloged documents. No one can say if they will ever turn up."

With that I put *Slot ter Hooge* aside for other projects, though thoughts of her often recurred. I was intrigued not merely by the possible treasure, but also by its connection

*The author described his dramatic discovery and salvage of a Spanish Armada wreck off Ireland in the June 1969 NATIONAL GEOGRAPHIC.

ALL BY WILLIAM R. CURTSINGER

Bay of grief for *Slot ter Hooge*, Porto do Guilherme (**left**) yielded her treasure grudgingly. Sténuit and his mates spent six months on the site, a third of that time waiting for calm seas.

The divers vanquished another foe—sand—with an air lift (**left, lower**), a device that literally vacuums away sand deposited and rearranged by storms. A metallic *klonk* announced the finding of the first silver bar.

The team also recovered a host of other shipboard items. A diver (**below**) releases a brass cannon that will be buoyed to the surface by inflated bags.

with my longtime hero, John Lethbridge. And I was eager to learn more about the handful of European companies that monopolized the East Indian trade during the 17th and 18th centuries. They had profoundly affected the course of history by introducing modern colonialism.

I began devoting winters to the study of records in The Hague and other European cities, and summers to exploring undersea wrecks they documented. Then, through one of those incredible coincidences I have come to associate with the diving profession, *Slot ter Hooge* suddenly turned up again.

I was visiting fellow wreck-hunter Rex Cowan and his wife, Zélide, at their home in London. Zélide is Rex's researcher and an able historian in her own right. Our discussion turned to our 18th-century predecessors—"wrackmen," or "silver fishers," as they called themselves—and their fantastic feats of underwater salvage with extremely primitive gear. Lethbridge was the most notable among them.

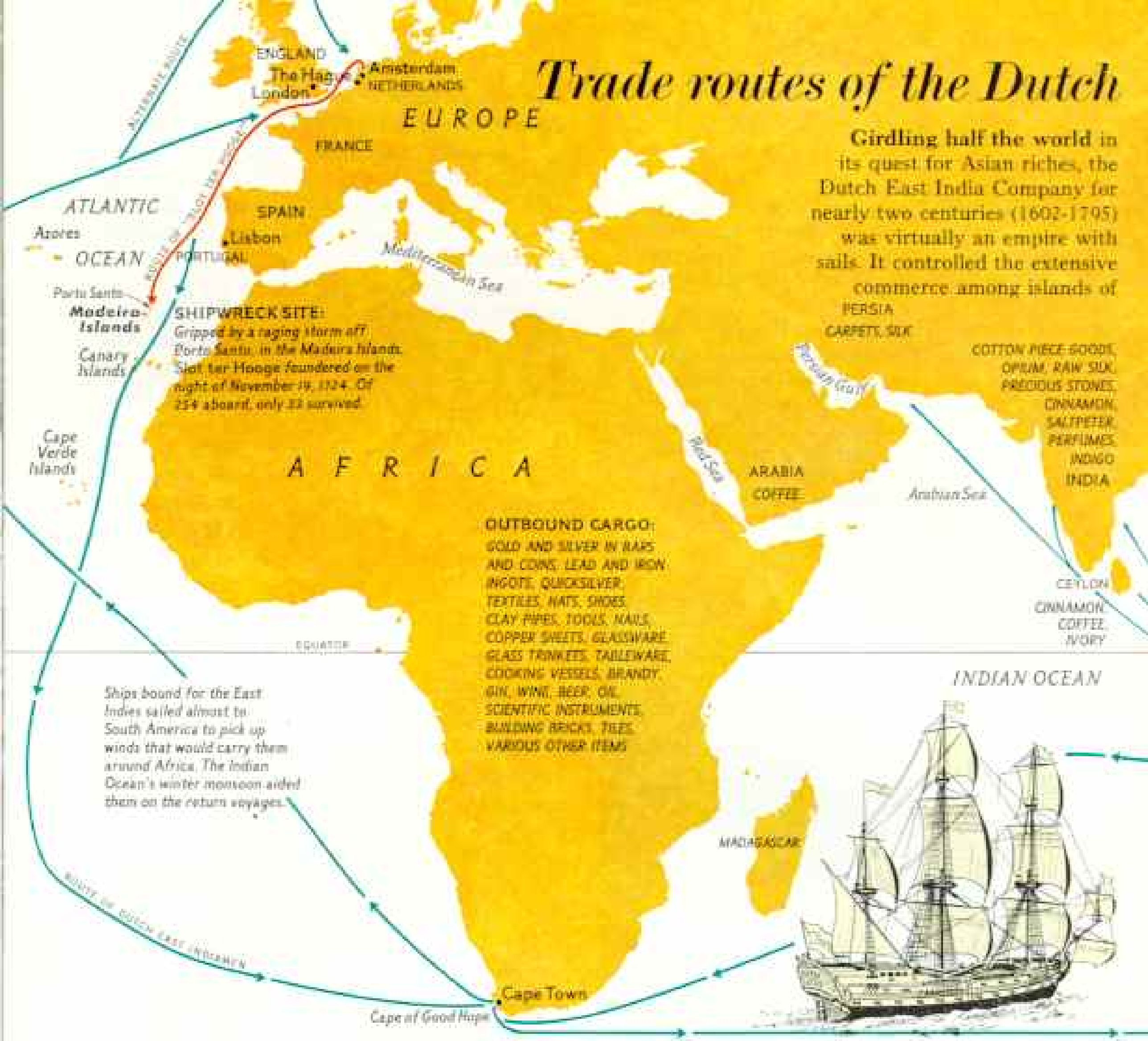
With a flourish Rex generously produced a monograph that Zélide had recently uncovered. It was an extract from the proceedings of a Devonshire learned society in the year 1880. I will always be grateful to Rex for his kindness in showing me the document, for it was to lead me directly to *Slot ter Hooge*.

Cup That Cheered Still Cheers

The paper dealt with a 17th-century silver tankard that has since been lost but whose engravings were carefully copied. One side of the tankard bore a coat of arms and a monogram that the writer of the report had deciphered as belonging to John Lethbridge. Opposite the crest there appeared a boat full of men with a large cylindrical object—plainly Lethbridge's diving barrel—suspended alongside.

Besides the illustration, the tankard bore an engraved map of an island with a sinking ship pictured in one of its bays (page 262). The inscription read, "PORTO SANTO ISLAND LAT. 33 N. LON. 5." If ever there was an authentic treasure map, I was looking at it, though the bearings were inaccurate.

Suddenly the search for *Slot ter Hooge* was on. With a copy of the engravings supplied by Rex, I flew to The Hague, where the Dutch Government transferred ownership of the long-dead vessel to me in return for 25 percent of any proceeds from salvage.



At the National Library of Portugal in Lisbon, I matched the bay in the engraving against 18th- and 19th-century charts. I found it under its present name, Porto do Guilherme. Disclaiming any right to the wreck, the Portuguese Government issued me an exclusive license to recover and export any treasure I found.

A Final, Fortunate Coincidence

Yet there was still the nagging question of Lethbridge's long-ago salvage attempts and what remained of the original treasure. Here again luck played a decisive part: During one of my habitual visits to the national archives in The Hague, I checked through the latest inventory of colonial documents. This time the missing records of *Slot ter Hooge*'s salvage came to light. The final piece in the puzzle suddenly fell into place.

The story was all there, in the records of Chamber Zeeland, the Zeeland Province member group in the Dutch East India Company that had owned *Slot ter Hooge* and commissioned her salvage. The contract with Lethbridge had been drawn in 1725, less than a year after the ship had met her death on the rocks. Under the terms of the contract, Lethbridge was to be paid a basic fee of ten pounds sterling a month plus his expenses, with bonuses to be left "to the generosity of the Directors of the Chamber Zeeland."

Lethbridge, it developed, had been highly successful. On his first expedition to Porto do Guilherme he had recovered 349 of the 1,500 lost silver bars, most of the pieces of

eight, 9,067 Dutch guilders' worth of smaller coins, and two cannon.

"The rest," Lethbridge assured his employers, "I will fish, too, and easily, if I would be lucky enough to have 20 or 30 days of calm weather next year."

He obviously got them, for on his second expedition Lethbridge recovered silver bars and coins listed on the records "in the value of 190,000 Gulden [guilders]." It was a staggering sum, more than half the value of *Slot ter Hooge*'s entire treasure.

From there the harvest went gradually downward. After a pause of five years Lethbridge returned with his barrel to Porto do Guilherme in 1732, but the results were disappointing. According to the records the company's entire share of treasure that year scarcely filled "*een kisje* [a small chest]."

Lethbridge made two more attempts, in 1733 and 1734, with modest results. "Mr. Lethbridge," the report concluded, "came back with less than one could have hoped for, but still with a reasonable success. . . ."

The picture was now as complete as history could make it. Adding together all the treasure that Lethbridge appeared to have recovered, I estimated that between 100 and 251 silver bars still remained somewhere beneath the waters of Porto do Guilherme. In addition there were undoubtedly a good many silver coins left, as well as some of the *grote quantiteijt* of personal valuables. It was time to go and see for myself.

New Adventure Attracts Old Comrades

I quickly signed up a team for the expedition, beginning with my old friend and fellow diver on many wrecks, Louis Gorsse. We were joined by another friend, Belgian diver Alain Fink, and by two experienced French divers, Michel Gangloff and Roger Perquin.

The National Geographic Society contributed generous financial support, and another old friend joined in the venture. Henri Delauze, president of the leading French undersea engineering group known as COMEX, once again opened his checkbook and his well-stocked warehouse to me.

It was May when the five of us arrived on Porto Santo. We found it charming, almost Biblical in its simplicity and unhurried pace. A steady ocean breeze filled the sails of the old-fashioned windmills scattered among wheat fields and flower-carpeted meadows. The millers watched us pass and smiled as only those can smile who are strangers to inflation, oil shortages, and pollution.

A brief reconnaissance from the 400-foot cliffs towering above Porto do Guilherme on the island's north coast confirmed *Slot ter Hooge*'s grave site—the inlet matched that on the tankard. I saw at once how 221 sailors and passengers must have met death at the foot of that monstrous amphitheater of rock (page 264). Under the lash of a northeast gale, those who escaped drowning in the terrible seas found themselves trapped by the sheer cliffs, where injuries and exposure took their toll. The wonder was that as many as 33 managed to survive.

We set off next morning in our inflatable diving boat from the beach along the island's south coast. Reaching Porto do Guilherme

after an hour's voyage, we dropped anchor in 60 feet of beautifully clear water. The first one into diving gear, I went over the side to check the set of our mooring—and promptly discovered *Slot ter Hooge*'s anchor! Months of research had paid off at last. We had dropped our small grapnel directly on top of the great cast-iron anchor, its massive flukes rusted and coated with weeds.

It seemed a happy omen. We set out to survey the floor of the inlet, dividing it into five sections. Mine was the least promising, the shallow area nearest shore. Lethbridge, I felt, would have found anything worthwhile so near the surface, and I was right; my search yielded nothing.

The others fared better in the deeper water offshore. "Lots of wreckage in my area," Louis reported as we surfaced. "It's strewn around the base of some sheer rocks." Alain was next. "Two large half-buried iron cannons, for a start," he announced. And from Michel: "All sorts of things in my section—guns, lots of cannonballs, and some large metal rings that I can't quite make out."

The second dive proved even more rewarding. As I surveyed my teammates' sections, I came across a variety of other items, including a brass swivel cannon with the breechblock nearby, a scattering of both round and bar shot in at least three calibers, wine bottles with their corks still secured by twists of copper wire, several rudder pintles, and masses of rough yellow bricks often used by Dutch East Indiamen as ballast.

Michel's large metal rings proved to be heavily encrusted iron hoops for brandy casks that I had noted on the ship's manifest but that had long since rotted away.

We had expected no wooden fragments of the ship and found none, though they might well be buried together with treasure in wide pockets of sand among the rocks. If I had realized then how deep some of the pockets ran, I would have been far more concerned at the job ahead of us.

BOTH BY ROBERT STENUIT

Shorthand of commerce, this symbol stamped on silver ingots (**above**) meant *Verenigde Oostindische Compagnie Middelburg Zeeland*—United East India Company, Middelburg, Zeeland. The circular rose symbol on the bars is probably an assay mark. The divers removed more than nine feet of sand to reach the chest crammed with ingots (**left**).

Weather Dictates a Recess

Toward the end of the day the first genuine piece of treasure came to light. Under a broken wine bottle I found a small silver coin, its markings obscured by a film of tarnish. Back aboard the boat I rubbed away the film and held the discovery up for my companions. One side bore a shield with the swimming-lion emblem of Zeeland and the mark, "2 ST," identifying the coin as an old Dutch piece known as a *dubbelstuiver*. The other side was even more revealing, for it bore the imprint, "ZEE-LAN-DIA," and the fateful date 1724 (page 261).

"Right on the nose," Louis remarked happily as we turned for home. "It looks as if Chamber Zeeland expected us."

That night a strong northwest wind blew up, barring us from the wreck site with heavy onshore swells. For the next five days we were completely shorebound, a condition that was to plague us on and off during the following five months. After one particularly long stretch of bad weather, I tried to cheer my colleagues up.

"After all," I pointed out, "Lethbridge needed calmer seas to use his barrel than we need to dive, and look at all the treasure *he* recovered."

ROBERT STEWART (ABOVE) AND WILLIAM R. CURTSINGER

If money could talk, the silver recovered from *Slot ter Hooge* might coin new footnotes to the history of Dutch seafaring. "We found an incredible variety," says the author. "Spanish pieces of eight, ducatoons, tiny dubbelstuivers." Minted primarily in Mexico City, the pieces of eight—pesos worth eight reals—were the internationally accepted currency of the age.

Seven monarchs are represented in the collection (partly shown above), which includes this 1704 ducatoon bearing the likeness of Spain's King Philip V (**left**), whose puffy profile seems to belie his sobriquet *El Animoso*—The Spirited One. A mounted knight gives another ducatoon (**left, center**) its name: *zilverijder*—silver rider.

Like undersea shoppers, a rainbow wrasse and a Guinean puffer (**far left**) seem to examine coins fused into a lump.

"Yes," replied Alain glumly, "and it took him all of five summers to do it."

During good weather our spirits soared, for Porto do Guilherme soon opened its treasure chest to us. As veteran salvage divers we were attuned to the small irregularities on the seafloor that amateurs often overlook and that just as often provide clues to concealed artifacts. In such ways we located veritable "veins" of silver coins imbedded in natural-looking mounds of concretion, a hardened mixture of metallic salts and other minerals with sand, rock fragments, rotted wood, and similar debris (page 270).

Elsewhere the rankest amateur would have had no trouble recognizing a small fortune. Atop a large flat rock we came across a hundred or more whitish-silver coins, arranged as artfully as in any coin dealer's display.

Coins imbedded in concretion were usually in good condition, and we harvested beautiful guilders and ducatoons, including "silver riders"—the latter nicknamed for their image of a knight on horseback. Coins lying loose in the sand were generally corroded, while those lodged upright in rocky crevices often had razor-sharp edges from constant honing by movement of the sand.

An Air Lift? Of Course!

Other treasures had spilled from *Slot ter Hooge*'s ruptured hull. Before long we had a sizable collection of brass pins with delicately worked heads, copper buttons, silver shoe buckles, musket balls, clay pipes, and two beautifully engraved brass tobacco-box lids (pages 274-5).

We soon came to recognize our principal enemy—sand. Where it had accumulated in pockets and ravines among the boulders, there was nothing to do but dig through it to see what lay beneath. We had brought along a small hydraulic jet with an 80-foot hose to blast away the sand, but the jet worked only in shallow deposits. Deeper pockets simply kept caving in as we excavated, to our own frustration and to the delight of small fish that swarmed around us, nibbling frantically at the tasty crabs and fat marine worms thus exposed.

"We're fighting a losing battle," I acknowledged to Louis Gorsse one evening after a month on the wreck site. "We're not *removing* sand, we're simply rearranging it. Our only hope is an air lift."

But where to obtain such a sophisticated undersea tool in the remote Madeiras? An air lift essentially is an underwater vacuum cleaner that sucks up material along with water and by means of a long hose deposits it some distance away, avoiding the problems of cave-in and of obscuring the work site with clouds of sand.

Once again luck was with us, in the form of an amiable genius named João Borges. João works for the Department of Tourism for the Madeira Islands, with headquarters at the capital city of Funchal. When I presented my impossible problem, he fairly beamed, as though I had merely asked for the name of a good local restaurant.

"An air lift, but of course," João replied, and within days we had the air compressor and all necessary parts—delivered to Porto do Guilherme by friends of João's aboard a landing barge complete with crane.

Bars Elude Searchers—for a While

Now the pace quickened magically, as our undersea vacuum cleaner devoured tons of sand and spewed it out well beyond the work area (pages 264 and 268). Our collection of artifacts grew steadily to include *Slot ter Hooge*'s remaining rudder pintles, an apothecary's brass mortar, an unusual glass pestle, a complete set of measuring weights, and even a small bit of gold in the shape of a beautiful little cuff link.

But still no silver bars.

Night after night I went over my calculations, matching *Slot ter Hooge*'s cargo manifest against what Lethbridge had brought up. Invariably I arrived at the same answer: There were at least a hundred ingots, and possibly as many as 251, somewhere beneath the waters of Porto do Guilherme. I simply could not have made an error. Or could I? It was Alain who supplied the answer.

On a day in mid-August when I had remained ashore to wrestle with paperwork, Alain was taking a turn below at the air lift. The machine suddenly gave off a muffled *klonk!* and there it was—a six-by-two-inch silver bar, with the familiar Chamber Zeeland monogram stamped in the center.

It was Louis's idea to gift wrap the find and present it to me that night without a word. Celebrations followed, punctuated by the popping of corks from champagne bottles long reserved in hopes of such a moment.

Examining the bar, I noticed a small stylized rose punched into the metal, probably

a guarantee of the ingot's fineness (page 269). The bars Lethbridge recovered had been melted down like all the others, so this one was unique—if not in the world beneath the sea, certainly in the world above it.

The remaining ingots could not be far from Alain's initial find, and we narrowed our search area to a circular patch of sand some hundred feet in diameter. Within a matter of days ingot number two emerged from the sand as the air lift continued to burrow deeper beneath the inlet floor.

At the ten-foot level Louis uncovered ingot number three, attached to an enormous lump of concretion that revealed the outline of other bars inside. I judged that the lump contained as many as eight more bars. I was wrong—the total was 25.

We continued to battle the weather, chafing at time lost ashore, but there came a day below the surface of Porto do Guilherme in early September when I felt someone tap on my shoulder.

I turned to find Louis, his eyes narrowed in that particular smile I have come to recognize so well over the years. Following him across the inlet floor, I came upon the chest crammed with the neatly stacked silver bars, lodged beneath an iron cannon against a vertical rock wall (pages 260-61). The sight was dazzling, and I could only stare at what amounted to the ultimate triumph. Lethbridge, I felt sure, would not have begrudged it to us.

Unseen Visitors Rifle Chest

I refused to allow the chest and bars to be moved until they could be properly photographed, exactly as we had discovered them. That night I cabled the British Broadcasting Corporation in London to send a longtime friend and expert underwater cameraman, Marc Jasinski, from Belgium to do the job. They cabled back that Marc would arrive at Porto Santo within a few days.

Meanwhile we invited a few diving friends from Madeira to inspect the chest, and I took a number of photographs of it. As it turned out, they were the only authentic record we were to have, for Marc never saw the chest intact. He arrived on schedule at Porto Santo, together with rough weather that roiled the bottom of Porto do Guilherme, ruling out camera work.

After several days the storm abated, and we bundled Marc and his equipment aboard the boat, reaching the inlet once more in calmer weather. I went over the side first to clear away any debris from the chest and found that someone had saved me the trouble: Not only was there no debris but no chest—it had been smashed, and all but 15 silver bars removed. The only clue was an orange snorkel tube lying nearby, plainly not one of our own.

My astonishment turned to anger, less at the thieves than at myself for insisting on a proper record of the treasure and forgetting that what is history to some is dollars and cents to others.

Mother Proves the Ultimate Threat

No one on Porto Santo was either skilled or dishonest enough to have removed the bars, so suspicion fell heavily on a group of young divers from Madeira Island, whose boat had recently been seen off Porto Santo.

Within a day or two we felt sure that the 24-year-old leader of the group had the bars. Lacking absolute proof, I tried diplomacy. Friends of mine approached the leader's young wife: Did she really want her husband to be jailed and the family dishonored? As we later learned, she rushed to her spouse in tears and threatened him with the direst punishment: If he did not stop playing the fool and return the bars at once, she would tell—oh, horrible thought—his mother!

Back came the bars, and no more was said. Luckily for the young man, he had been able to dig the treasure up in his backyard late at night and sneak it past the authorities—meaning mother—to be delivered secretly to the doorstep of a Madeiran official.

Our work now was quickly drawing to a close. Although more of *Slot ter Hooge*'s remains still lay beneath the waters off Porto Santo, it became increasingly difficult to find them. We had worked the well-defined pockets of sand among rocks in the inlet and had reached the edge of a featureless submarine desert stretching out to sea. Salvage there was purely a matter of chance, and a poor one at that.

Our underwater map with the location of all our recent discoveries provided a graphic view of *Slot ter Hooge*'s last moments. Driven helplessly toward shore by the gale, she had fetched up initially on fangs of rock at the western side of the bay's entrance. There she had burst open and perhaps even capsized, spilling the first of her cargo, mostly heavy stores: brick-and-tile ballast, lead pigs,

casks and bottles, cannons and ammunition.

Torn free of the rocks, she had drifted eastward to the opposite wall of the bay, emptying more cargo, including treasure, as she went. And finally in a massive cleft of rock she had died, broken up and scattered like chaff across the inlet floor, sharing her last agony with all but a few of those aboard.

In documenting *Slot ter Hooge*'s death, I felt, we had shed new light on the great trade between Europe and Asia during the 17th and 18th centuries. Our finds represented an extensive sampling of cargoes aboard Dutch East Indiamen bound for the distant Orient. It remained now for me to analyze the finds for deeper insight into a vital chapter of maritime history.

One morning in Porto do Guilherme I

Prizes from the wreck include (1) ballast bricks, (2) tableware, (3) navigation dividers, (4) spigots, (5 and 6) a sword knuckle bow and grip, (7 and 8) nesting weights and container, (9) a brass ornament, (10, 11, and 12) fragments of a porcelain plate, a stoneware jug, and

made a last underwater tour of the wreck site, watching my teammates finish up their work. My thoughts turned again to John Lethbridge two and a half centuries before, and to a similar decision he must have made to abandon work at last and turn for home. He had left us our portion of *Slot ter Hooge's* treasure, and it seemed only right to follow his example by leaving something for future wrackmen: Perhaps a hundred silver bars remain hidden in the sweep of sand at the bottom of Porto do Guilherme.

I glanced up toward the blue surface 60 feet above me and to the sky beyond. There John Lethbridge, the greatest of all wrackmen, was surely smiling at our success.

"Thank you, sir," I said in farewell. "Thank you for your thoughtfulness." □

glazed pots, (**13**) a collection of clay pipes, and (**14**) a mortar and pestle. In the center are (**15**) gleaming tobacco-box lids, (**16**) a knife handle, (**17**) a trigger guard, (**18**) a cannon priming wire, (**19**) a crushed pewter bowl, (**20**) unidentified objects, and (**21**) a metal bushing.

ROBERT STENUIT

MAYBE we should have parachuted in. That would have seemed much more appropriate somehow for two travelers dropping out of one world into another. Instead, mundanely, photographer Nathan Benn and I took the subway, boarding on Manhattan's lower East Side and emerging ten minutes later into a setting that looked for all the world as if some errant stagehands had mixed the scenery for two different plays—one about a decaying tenement neighborhood in today's Brooklyn, the other about a pre-World War II rural Jewish village, or *shtetl*, of eastern Europe.

"Welcome to Williamsburg in Brooklyn," Nathan said. "Or to Satmar in old Hungary. It depends on how you look at it."

Passing shopwindows hieroglyphed with square-block Hebrew letters, we entered the

The Pious Ones

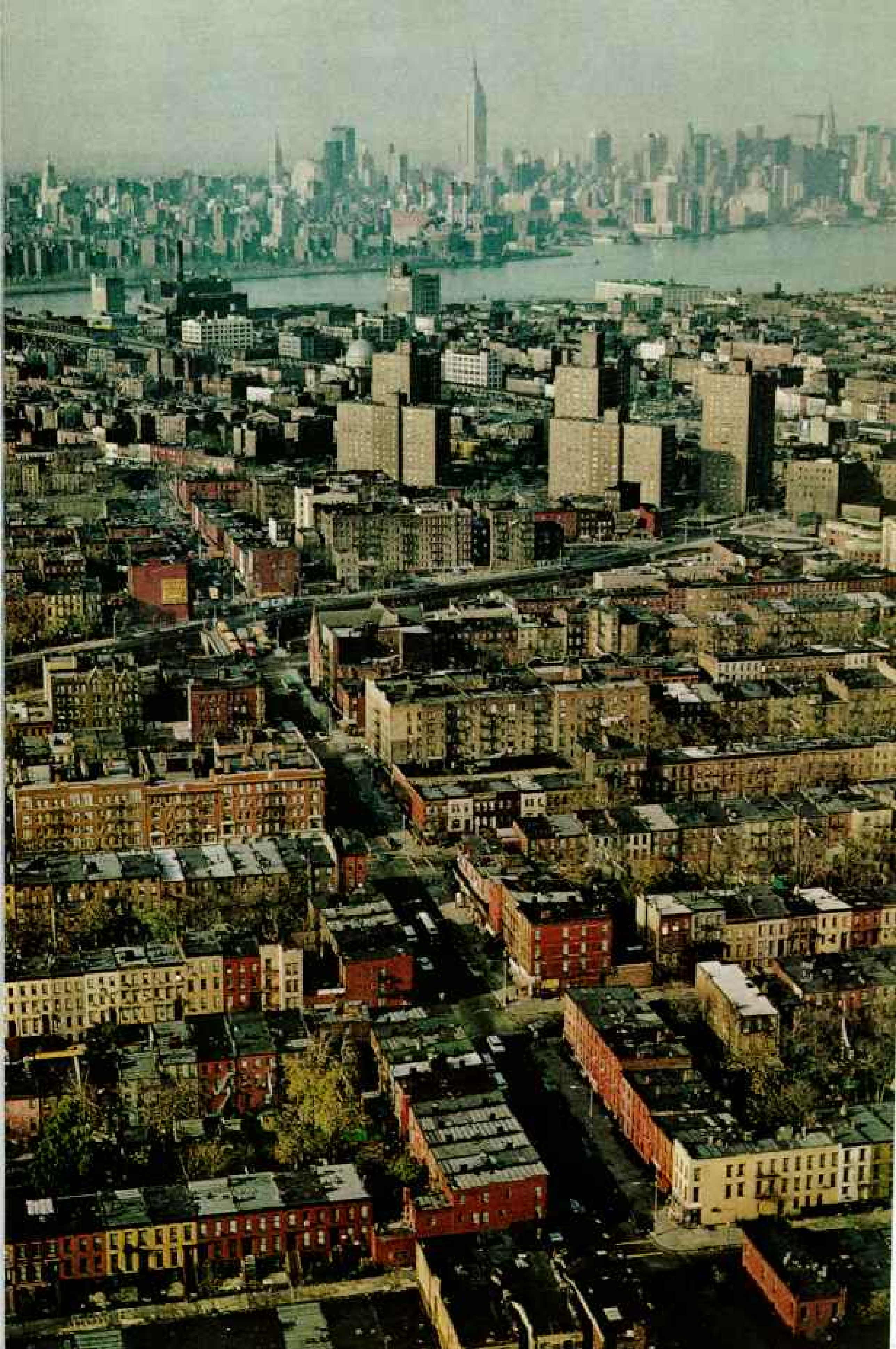
By
HARVEY ARDEN
NATIONAL GEOGRAPHIC STAFF

Photographs by
NATHAN BENN

Absorbed in prayer, an ultra-orthodox Hasidic Jew wraps himself in a prayer shawl while communing with God in a small synagogue in Brooklyn. He sustains an extraordinary way of life that the Hasidim—"pious ones"—zealously pursue in the midst of America's largest city.

extraordinary world of Williamsburg's Hasidic Jews, or Hasidim—meaning "pious ones." Here, wedged amid Brooklyn's ethnic hodgepodge, sprawls a 40-block enclave of ultra-orthodox Judaism, where most of the men wear flowing beards and dangling earlocks in accordance with God's command in the Book of Leviticus 19:27: "Ye shall not round the corners of your heads, neither shalt thou mar the corners of thy beard."

Their clothing, derived from styles long worn by Jews in eastern Europe, is a striking study in monotone—black or dark-toned suit, wide-brimmed black hat, white shirt buttoned at the neck, no tie. "It may seem plain to you," one Hasid told me, "but to me it's beautiful!" On Sabbaths and holidays the married men don great sable-trimmed hats called *shtreimels*, giving them a noble, almost regal air as they stride along.



The women, not limited to their menfolk's color scheme, wear modish but distinctly modest garments as they push their baby carriages and strollers along Lee Avenue (page 295). Only after you've been told are you likely to notice that most of them are wearing wigs. Often styled in the latest coiffure, these are worn to conceal their real hair—which is cropped after their wedding and henceforth hidden from men's eyes as prescribed by a centuries-old tradition.

Here, a single subway stop from Manhattan, children learn Yiddish as their native tongue, and rarely if ever see a television show or movie, or read a novel. Nor for that matter are they likely to drift into delinquency, experiment with drugs, or rebel against the value system of their elders.

For here the *mitzvahs*, or commandments, which God on Mount Sinai charged His chosen people to obey, are honored as rules of living with a devotion so vibrant that the tablets of the law might have been carried down by Moses to Lee Avenue this very morning.

To these Brooklyn streets after World War II came several thousand Hasidim, remnants of a widespread movement within Judaism that flourished in eastern Europe from the mid-1700's until—but only until—the Nazi catastrophe. The survivors arrived in America and Palestine with blue concentration camp numbers tattooed on their forearms and the searing horror of Hitler's death camps branded on their souls.

HOPING TO GET A GLIMPSE of the famed Hasidic *tzaddik*, or spiritual leader—the Satmar Rebbe, Yoel Teitelbaum—Nathan and I hurried to reach the Satmar *bes medresh*, or house of study and prayer, before sunset. Already a fireball sun had tangled itself in the cables of the nearby Williamsburg Bridge. Before us stretched an almost surreal perspective of venerable Brooklyn brownstones, their storefronts already shuttered against the gathering blue dusk of this fast-approaching Rosh Hashanah, the Jewish New Year.

"A few minutes more on the subway and we'd already have broken the law," Nathan said. "The *Jewish* law, that is, against traveling or working on a Sabbath or religious holiday. For an Orthodox Jew to ride a subway or even to push the buttons on an elevator is forbidden. And put on your yarmulke, too." He referred to the *(Continued on page 284)*

"... I have been a stranger in a strange land." EXODUS 2:22

Outpost in the Diaspora, Brooklyn's Williamsburg neighborhood (**facing page**), just across the East River from Manhattan, became a refuge after World War II for thousands of east European Hasidic Jews—survivors of the Nazi holocaust. Transplanted to America, the scorched but still living tree of Hasidic faith blooms anew in Brooklyn. Down streets where Yiddish is heard more often than English, a Hasid (**above**) hurries along to begin another day dedicated to the service of God.

"Take heed unto yourselves, lest ye forget the covenant of the Lord your God. . . ." DEUTERONOMY 4:23

Her brother's keeper, a Hasidic girl pulls a sibling from the lures of the profane world. Distractions such as movies, television—even watching "outsiders" at checkers—are shunned by most Hasidim, whose lives pivot on strict observance of Orthodox Jewish law and ritual. Males wear earlocks to fulfill God's command: "Ye shall not round the corners of your heads. . . ." (LEVITICUS 19:27)

"Behold, I have taught you statutes and judgments. . . . teach them thy sons. . . ." DEUTERONOMY 4:5, 9

Learning God's wisdom—and a bit of man's—students at a Hasidic *yeshivah*, or academy (**above**), spend most of a dawn-till-dusk study day poring over the huge tomes of the Talmud, the vast exposition on Jewish law and custom. Conforming to New York State requirements, Hasidic youths also learn a modicum of "English"—meaning not only the English language, which many first learn at school, but also such subjects as math (**right**) and social studies.

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CES TRUE

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20 + 37 ▷ 50
40 + 45 ◁ 90
30 + 30 □ 60
40 +) 60

60 + 23 □ 90
70 + 37 □ 100
30 + 42 □ 70

8 > 6
6 < 8

skullcap traditionally worn by Jews. "The Hasidim wear them all the time—even when they're sleeping."

I later inquired of a Hasidic acquaintance why he wore his yarmulke even when he went to bed.

"Because a Jew covers his head as a sign of his respect for God," he answered. "And—tell me, please—am I not still a Jew when I'm sleeping?"

From the pocket of my coat I extracted a black skullcap and stopped before a shop-window to position it on my head. At that moment a Hasidic lad, a beardless copy of his dark-clad elders, came to a sudden halt in front of me, eyebrows raised.

"You should be ashamed!" he admonished, his earlocks quivering. "Do you mean that you put on your yarmulke only after you've gotten here? Are you a Jew only when you're in Williamsburg?" Eyes flashing darkly, he hurried off down Lee Avenue. I shrugged with a sense of utter helplessness. It would not be the last time that the admittedly unorthodox quality of my own Jewishness would be brought into open question by zealously observant Hasidim.

Though I had become bar mitzvah—a "son of the commandment" or a "man of duty"—at age 13, I had only occasionally attended a synagogue since then. Certainly I had no sense of obligation to follow all of the multitude of mitzvahs, or commandments, that God had charged the Jews of Moses' time to obey in fulfillment of their covenant with Him. To the Hasidim, however, these mitzvahs are as important today as they were in ancient times.

No fewer than 613 such mitzvahs are enunciated in the five books of Moses comprising the Torah, or Pentateuch. They range from the Ten Commandments and such sublime moral precepts as "thou shalt love thy neighbour as thyself" to so technical a regulation as "neither shall a garment mingled of linen and woollen come upon thee."

These latter two mitzvahs, seemingly worlds apart in significance, appear in consecutive verses of the Book of Leviticus (19: 18, 19). The Hasidim hew as strictly to the latter as to the former. To heed and safeguard the 613 mitzvahs, plus literally thousands of other laws and traditions that have evolved from them over the millenniums, becomes the very fulcrum of their daily existence.

REACHING the Satmar bes medresh, Nathan and I elbowed our way through a dense crowd of Hasidim toward a large inner doorway. Squeezing up as far as we could, we stood on tiptoe and peered into the main prayer hall, a great room into which, I later learned, some seven thousand people had been packed. All were utterly absorbed in prayer, faces adrip with mingled sweat and tears of ecstasy, lips murmuring impassioned prayers at a furious pace, bodies rocking and swaying and trembling with emotion—turning that huge prayer hall into an echo chamber of the spirit reverberating with passion for God.

The Satmar Rebbe himself, leading the prayers at the front of the room, was completely blocked from our view by adoring crowds of Hasidim. A Hasid later explained to me why he tries to get physically near the

"Thou shalt not. . . ." A glinting tear of remorse burns the cheek of a Hasidic youngster being admonished for some transgression by fellow students in the hallway of a *cheder*, or school for young boys. Such mutual chiding among peers discourages nonconformism and helps to bring about a strict adherence to the dos and don'ts in the prodigiously complex Hasidic code of behavior.

Rebbe: "The Rebbe's soul," he said, "is closer to God than other men's. We get as near to him as we can so that our prayers will be carried up to heaven with his, like sparks rising up with a great flame."

Not until my next visit to Williamsburg did I actually get a clear view of the Rebbe. This was at the annual celebration of his escape from the Nazis, an observance combined with a fund raising for the Satmar parochial school system, which serves thousands of Hasidic children.

Once again I found myself in the midst of a great crowd of Hasidim. All were amurmur with expectation of the Satmar Rebbe's arrival. A sudden commotion erupted around a side entrance of the hotel ballroom where the celebration was being held. All eyes turned in that direction.

Preceded by aides, who created an aisle for him through the vast throng, the Rebbe himself now entered—a slender patriarch with flowing white earlocks and a graceful tuft of white beard curled on his black-suited breast like new-spun silk. His face, untouched by the pandemonium around him, radiated an almost visible glow of spirituality that seemed to be reflected in the faces of his disciples.

At the sight of the revered tzaddik, the entire congregation rose to its feet in a single body and exploded into a rhythmic wall-rattling chant, which crescendoed until it seemed the room could contain not another decibel. At this point the Rebbe, with the slightest batonlike motion of one index finger, brought the runaway chorus of thousands to an instantaneous halt. Even the echoes seemed to die at once.

Now, through the loudspeakers, came the Rebbe's voice—the merest pin-scratch on a slate of silence. Yet that parchment-thin, otherworldly voice was instantly compelling. His disciples, many rocking and swaying as if in prayer, hung on each word as he thanked God for liberating him from the Nazis and for enabling him to be here with his beloved Hasidim. He spoke of the crucial importance of educating their children in Hasidic schools and reminded them that charity, which made such education possible, was one of the noblest of virtues. He then sat back, a benign expression lighting his face, and allowed his aides to take over the fund-raising activities (following pages).

THERE WAS A TIME, before a stroke weakened him some years back, when the Rebbe—now approaching 90—would have discoursed at greater length. His disciples recall how, on the Festival of Simchas Torah—"Rejoicing in the Torah"—he would dance for hours through the night with the holy Torah scroll cradled in his arms.

"He's as famed for his scholarship as for his saintliness," one Hasid told me. "Once, when I was a boy, I climbed a tree outside his window to see if it was true he often studied all night long. Well, there he was, in the middle of the night, bent over a volume of the Talmud, his finger at his temple, studying. A true saint he is!"

If the adulation of his devotees seems somewhat extreme to the outsider, one must understand the pivotal importance of this charismatic man in both their private lives and their collective history.

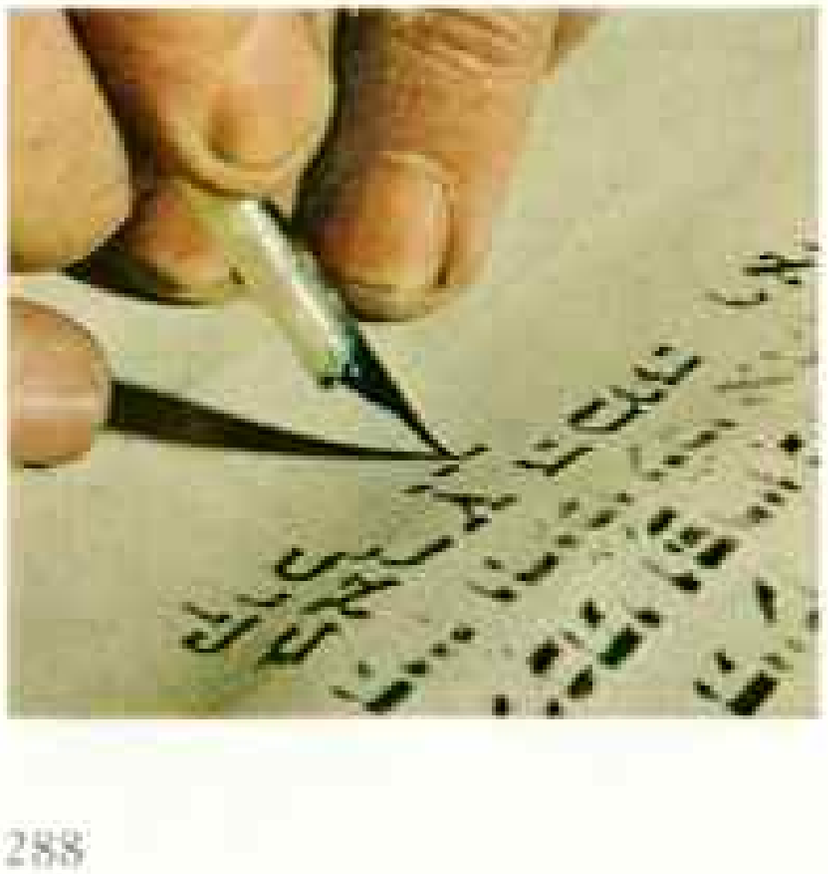
But on Purim it's OK. Two Hasidic lads step out of the rain to light up a smoke during the holiday of Purim. On this traditional day of merrymaking, good-natured mischief reigns. Youngsters puff cigarettes and don costumes, while their elders—winking at usual restraints against excessive alcoholic consumption—down frequent glassfuls of wine or slivovitz, a fiery plum brandy.

The master and his disciples: At a yearly celebration of his 1944 escape from the Nazis, the white-bearded Satmar Rebbe, Yoel Teitelbaum (**above**, seated), gathers with some of his many thousands of followers. Renowned for his saintly ways and intellectual brilliance as well as for his militant anti-Zionism, the Rebbe is the guiding light of both religious and secular affairs among the Satmar Hasidim.

The enormous braided loaf of bread, or *challah*, on the table before him will be divided and eagerly shared by hundreds of Hasidim—the merest crumb from the master's table being passionately sought after.

Feet and souls equally animated (**right**), a group of Hasidim at a wedding celebration dance and chant for hours on end in an ever-mounting outpouring of spiritual joy and devotion. The Baal Shem Tov, a mystic who founded Hasidism in eastern Europe in the mid-1700's, imbued his followers with just such a sense of joyful worship and ecstatic love of God.

ROY ROSCH, NEW YORK DAILY NEWS (ARCHIVE)



"And I have filled him with the spirit of God . . . in all manner of workmanship." EXODUS 31:3

"One chases after a living when not chasing after God," a Hasid told the author. A cutter and polisher in Manhattan's diamond district (**above**) brings much-needed cash into Brooklyn's Hasidic enclave. Many work at jobs created by the community's special religious requirements. Deft fingers of a ritual scribe (**left**) keep busy lettering Torahs—the first five books of the Bible—and various religious articles.

Long before World War II he was already a famed tzaddik in eastern Hungary, becoming spiritual leader of a Hasidic community centered in the town of Satmar—today a part of Romania, and spelled Satu Mare. This region came under the Nazi jackboot late in the war, by which time the vast majority of eastern Europe's Hasidim—perhaps 500,000 or more, no one knows even roughly how many—had been systematically annihilated with millions of other Jews. Then, in 1944, the Satmar Rebbe and his followers, along with most of the rest of Hungarian Jewry, were dispatched to death camps.

Even in that living hell he and his Hasidim strove to fulfill what mitzvahs they could. One of the first cruelties inflicted by the Nazis was the shearing off of their beards and earlocks. The Rebbe, it is told, pretended to have a toothache and concealed both beard and earlocks beneath a large bandage. Miraculously, the Nazis took no notice.

The bribing of Nazi officials enabled a trainload of Jews, including the Satmar Rebbe, to escape to Switzerland. Soon after, the Rebbe went to Jerusalem. There, however, his ideas failed to jibe with those of the Zionists who were working to set up the yet-unborn State of Israel. The government of the Promised Land, the Rebbe adamantly insisted, must be founded not by men but by the Messiah himself. To this day he declares that the present State of Israel usurps the soil of Zion and actually delays the coming of the Messiah.

Such a militantly anti-Zionist attitude—not shared by all groups of Hasidim—has raised the blood pressure of many Israelis and pro-Zionist American Jews.

LEAVING JERUSALEM in 1946, the Satmar Rebbe came to the Williamsburg neighborhood of Brooklyn, already a bastion of American Orthodox Jewry that had become a haven for displaced European Jews after the war. Though many of Williamsburg's newly arrived Hasidim had not been the Rebbe's immediate disciples before the war, they found in his presence a spiritual magnetism that could pull together the shattered pieces of their lives.

"When we arrived," one Hasid told me, "we had nothing. We were dazed, hopeless, without any direction or center in our lives. The Satmar Rebbe, may he be forever blessed, gave us that direction, gave us a center. He instilled in us a new hope and restored our belief in the world—and in ourselves."

Starting from scratch, the Rebbe laid the foundations of a new Satmar Hasidic community; its membership today numbers in the tens of thousands. Other Hasidic rebbes, too, settled in Williamsburg and nearby Brooklyn neighborhoods—most notably the Lubavitcher Rebbe, whose following in Crown Heights has attracted thousands of American Jews. These Brooklyn communities and the various groups in Israel comprise the largest concentrations of Hasidim in the world.

Transplanted to America, a new tree of faith began growing—and blooming—in the streets of Brooklyn.

I once asked my Satmar friend Moishe Green: "Who will take the Rebbe's place when, God forbid, he leaves this world?"

He answered: "We don't think about it. Only the Messiah himself can replace so great a tzaddik as the Rebbe. My own belief is that, before the Rebbe leaves us, the Messiah will come to Brooklyn and lead us home to the Promised Land."

SUCH DEEP-SEATED BELIEF in the redeeming powers of Hasidic rebbes traces back to the 18th century to the founding father of Hasidism, Israel Baal Shem Tov, one of the most extraordinary and luminous figures in the millenniums-long history of Judaism. A poor and unpretentious man, a native of the Carpathian Mountain region, he brought to the poverty-wracked, pogrom-plagued Jewish masses of Poland and the Ukraine a spiritual message of transcendent joy and hope.

Inveighing powerfully against the often-arid emphasis on religious scholarship that had come to dominate Jewish spiritual life in his time, he proclaimed that even the most unlearned Jew could experience a direct communion with God through ecstatic worship and a truly joyful keeping of the mitzvahs. What mattered was not so much the loftiness of one's intellect as the purity of one's soul, however humble. Love of God, he taught, could be expressed as well through spontaneous singing and dancing as through formal prayer and scholarship.

For a time this passionately mystic approach to religious life aroused the bitterest opposition of the Orthodox establishment. Some of the early Hasidim were excommunicated. Yet the movement spread like holy

"...the Lord shall give you... flesh to eat, and... bread to the full." EXODUS 16:8

Consecrating each act, Hasidim see the table as a kind of altar, and the food served thereon as a form of offering. A *shochet,* or ritual slaughterer (**above**), dispatches chickens with one painless flick of his razor-sharp blade, as prescribed by Jewish dietary laws. At the table a Hasid intones a blessing while cutting bread (**facing page**). Salt is ever-present on the table to conform with the commandment: "with all thine offerings thou shalt offer salt." (LEVITICUS 2:13)

wildfire, inflaming the hearts and minds of vast numbers of east European Jews, learned and unlearned alike. It was a genuine democratization of Jewish religious life, making the deepest spiritual experience accessible to the many as well as to the few.

After the death of the Baal Shem Tov—a title meaning, roughly, "Master of the Good Name"—his closest disciples established a number of Hasidic communities, where the fervor of his teachings continued to burn bright. These leaders became known by the title *rebbe*—a designation not to be confused with *rabbi,* though both mean "my master" or "my teacher." Any pious and learned man may become a rabbi, but only the rarest of individuals has the transcendent qualities required of a rebbe.

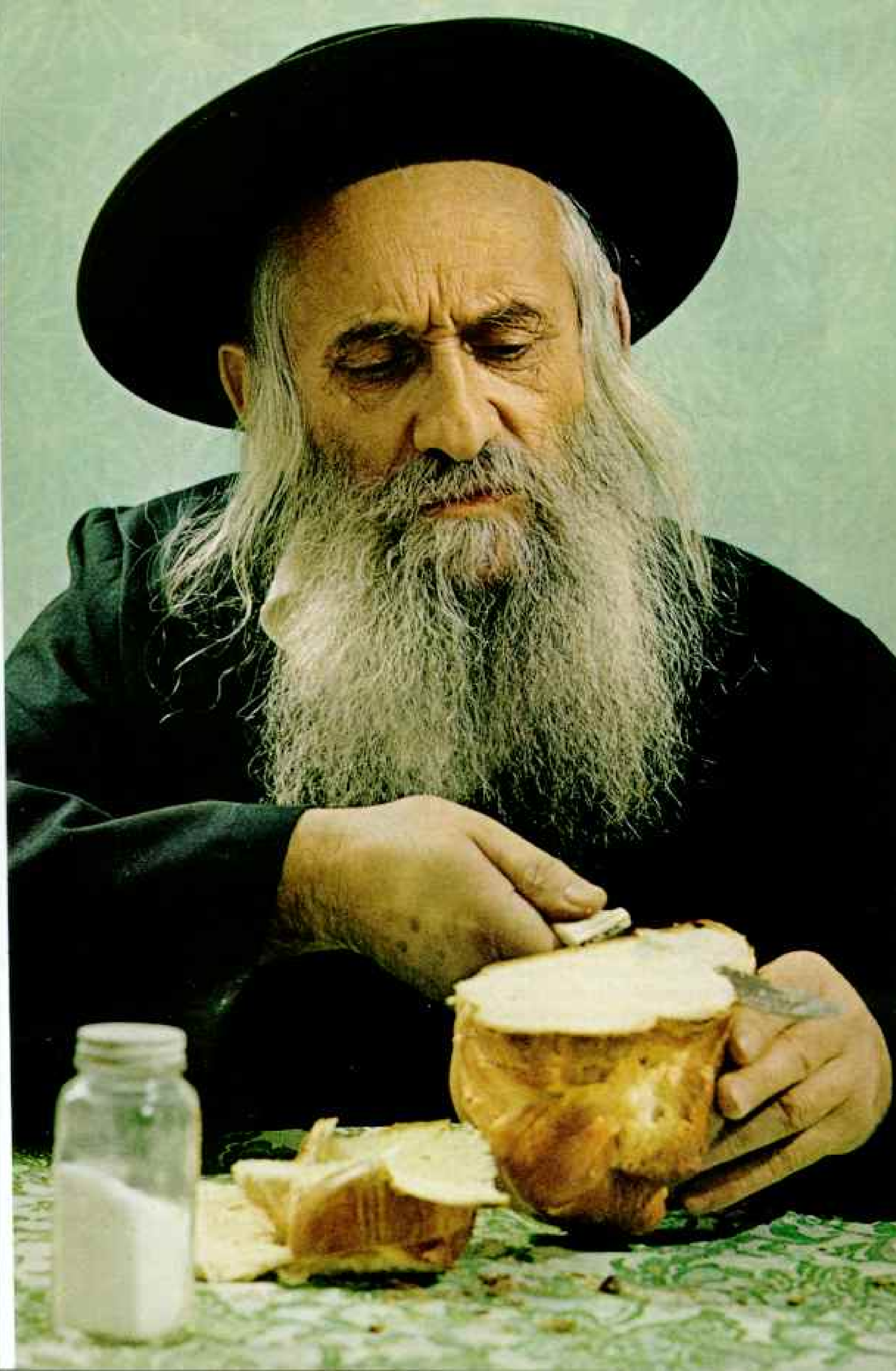
IN TIME—and this has often been criticized by outsiders—the leadership of Hasidic communities became largely dynastic, usually being passed from a rebbe to one of his sons. The community's loyalty to the rebbe is easily transferred to the offspring. On some occasions, in the absence of a suitable direct heir, a son-in-law or an especially eminent disciple is chosen.

The modern Jewish writer and philosopher Martin Buber devoted a great deal of his life's work to collecting tales concerning the various Hasidic rebbes. His two-volume *Tales of the Hasidim,* a monument of scholarship, mirrors both the charm and the profundity of Hasidic thinking.

Though Hasidism has unquestionably evolved since the time of the Baal Shem Tov, becoming more formalized in its rituals—some critics would even say rigidified—I found its original message of joyful communion with God still ringing loud and clear in the streets of Brooklyn.

I recall one night being swept up in the ecstatic revels of a group of rabbinical students. For hours, to the sour strains of an improvised trumpet-and-accordion band, they snake-danced in a great writhing, singing, chanting mass that seemed to become more and more energized as the minutes throbbed along. Joining in, somewhat reluctantly at first, I put my hands on the shoulders of the Hasid in front of me and allowed myself to be swept along on that mounting black wave of communal ecstasy.

At one point I found myself swaying beside Moishe Green, whose forehead was pearled



with sweat. His eyes glowed. "You see," he breathed, "we aren't just dancing. We're soaring to God!"

Even in a milieu where the spiritual predominates, the rent must be paid and groceries bought. The Baal Shem Tov himself often worked at humble jobs, and his followers in Williamsburg frequently do likewise.

THE HASIDIC MODE OF LIFE, with its wide range of behavioral and educational restrictions, makes holding many kinds of well-paying jobs extremely difficult. You often see bearded Hasidim with dancing earlocks and sweating brows driving pickup trucks, heaving crates, working as clerks or storekeepers. Many work in Manhattan as diamond cutters and merchants—bringing much-needed cash into the financially pinched Williamsburg community. Hasidic women as well as men work in the "needle trades," manufacturing garments for firms often owned by Orthodox Jews.

"We are part of the capitalist society," Rabbi Albert Friedman, a community leader, said. "We take jobs that do not interfere with our way of life. Yes, we have some wealthy men whom God has blessed with financial success, and they share—are expected to share—with the others."

A great many Hasidim work in jobs that fill the exacting and specialized needs of the community. Meat, for instance, must not be simply kosher but *glat* kosher, that is, kosher beyond any conceivable question. The Hasidim frankly distrust any food that they themselves have not subjected to the most rigorous conformance with Jewish dietary law.

Hence, most of the food consumed by the Hasidim is prepared with fastidious care within the community itself. Ritual slaughterers dispatch cattle and chickens according to ancient laws. Stores feature "Jewish milk" from dairies supervised by observant Jews. Wheat for the Passover matzo, or unleavened bread, is guarded with unceasing vigilance from the time it is harvested and milled until it comes piping hot and crisp from glowing bakery ovens in Williamsburg. If so much as a single drop of water comes in contact with the flour before it is used—hence allowing it to leaven however slightly—the entire batch is rendered useless for Hasidic consumption. This extraordinary care in food preparation has great appeal for other Jews, and some non-Jews as well. Outsiders' purchases of Hasidic

"I have built an house of habitation for thee. . . ." II CHRONICLES 6:2

Home for the Hasidim is another temple. Young girls in a Hasidic household (**above**) skylark over a coloring book while their father, a rabbi, characteristically pores over a volume of the Talmud. These youngsters are among the 13 of the rabbi's second marriage; he lost his first family at Auschwitz.

Not burdened with Talmudic studies, Hasidic girls have time to absorb more of "outside" culture than boys. At girls' schools run by the community, they learn practical skills like sewing (**right**).

foodstuffs help buoy the community's economy.

You'll find no doctors or lawyers among the Satmar Hasidim, since they don't acquire the education needed for the professions. Besides, going to college is frowned upon—a waste of time in a life devoted to the study of the Torah and its vast exposition, the Talmud.

AT THE AGE OF 3, a boy has his first haircut, leaving him with shaven crown and untouched earlocks. Next he is taken to the bes medresh. There a dab of honey is placed on an aleph—first letter of the Hebrew alphabet—in the Torah; his finger is placed on this, and then on his lips, to show him that the study of God's law is sweet. Thus begins a lifetime "toiling in the Torah."

Teenage boys often arrive at their school, or *yeshivah*, to begin study at five in the morning and, what with a day of study and prayers, don't arrive home until eight in the evening. A few hours in the afternoon are spent on what the Hasidim call "English"—meaning not just the English language, which many children first learn in school, but all the curriculum required to meet minimal New York State educational requirements, subjects such as math, history, and geography.

"The plain fact is," I was told, "many parents would rather their children didn't learn any more 'English' than necessary."

Said another Hasid: "Constant study of the Torah and Talmud sharpens the mind to a phenomenal degree. Some of our boys have become computer programmers—a profession requiring keen logical skills."

You see them studying, usually in pairs, the great tomes of the Talmud spread before them on desks or tables. Rarely do they use a pencil while studying, instead storing in their minds endless passages of Jewish law and tradition. Some go on to be ordained as rabbis, but, in actual fact, relatively few of Satmar's scholars are needed for rabbinical posts. Most marry in their late teens or early 20's, study for a final year or so full time—if the family can afford it—then find a job. For the rest of their lives they will spend much of their free time on Torah study.

"Think what they might do if all that study were directed to some worldly purpose," I remarked to a non-Satmar Hasid knowledgeable about the outside world.

"I suppose so," he said. "After all, look at Freud, Marx, Einstein—all Jews who made their mark on the non-Jewish world. To me, however, they would have been much better off studying in a yeshivah. What a waste of three fine Talmudic minds!"

Hasidic girls get a much more rounded education, by American standards, than the boys. Not encouraged to study the Talmud, they need learn only the traditional practices required of a Hasidic housewife in running a completely orthodox home. Hence, they have vastly more time for worldly studies, and in speech, manner, and appearance often seem more Americanized than the men.

The pivot of their lives is the home, which in Williamsburg usually means modest quarters in an elderly apartment building, a brownstone, or a housing project. Even in the dimmest basement apartment, there shines an inner sunlight, a glow of *Yiddishkeit*. To this sanctuary of feminine order and arrangement, the men and older boys often come rushing home from work or study for a hastily gulped meal with the family, then fly out again into the night for evening prayers at the bes medresh.

On the Sabbath, of course, all this hubbub comes to a serene standstill, and the woman's role as queen of the household comes to the fore. As wife and mother she lights the Sabbath candles—an act of utmost sanctity that leaves no doubt as to her vital position in the family. Often, when not tied down to little ones, she takes a job to supplement the family income. On the occasions when women attend the bes medresh, the balcony is set aside for them. A latticed screen separates them from the menfolk, who are not supposed to be distracted from their prayers by the presence of the opposite sex.

If their lot seems a far cry from women's liberation, I found few complaints. "Nothing is more satisfying than a Jewish life lived in the Hasidic way," one housewife told me.

WITH NATHAN BENN one afternoon I knocked at the door of the basement apartment of a Hasidic friend, a rabbi —and thoughtlessly extended my hand in greeting to his wife.

"Oh, no," she said, stepping back. "I can't shake hands, I'm sorry. Please take no offense." I had forgotten that Hasidic women do not touch men other than their husbands and close relatives. Even between a man and wife, it is exceedingly rare to see an overt display of affection.

Later we sat down with the family to a wondrous meal of chicken soup and gefilte fish, boiled chicken and whitefish, potato *kugel*, and so on—an archetypal Jewish feast. The rabbi intoned a sequence of blessings in a marvelously moving cantorial tenor. As we ate, we imbibed deep draughts of Talmudical lore along with frequent glassfuls of fruit-flavored Mayim Chaim—a brand of kosher soda pop whose name means "water of life" or "living water."

At one point in the meal, Nathan poured himself a glass of Mayim Chaim. Seeing my glass nearly empty to his right, he swiveled the bottle around and started to fill it. The entire family gasped.

"That is not done, Nathan!" admonished the rabbi. "It is simply not done!"

"But what did I do?" Nathan asked.

"Oh . . . well . . . after all, Nathan, how could you know?" said the rabbi evasively.

"Know what?" Nathan pleaded.

"Please," said the rabbi, "we talk no more about it. The subject is finished."

"She looketh well to the ways of her household, and eateth not the bread of idleness." PROVERBS 31:27

Doting Hasidic mothers turn a street corner into a happy hubbub of exclamations over a friend's offspring. In accordance with a centuries-old practice, most Hasidic women have their hair sheared upon marriage, thereafter covering their heads—as have these women—with wigs and kerchiefs.

With that, he lapsed into Yiddish, refusing to discuss the matter further.

Later, recalling the incident to another Hasid, I demonstrated how Nathan had poured my glass of Mayim Chaim.

"Stop!" he cried. "Don't do that!"

"Do what?" I asked.

"The way you're pouring the bottle, turning your hand backward like that . . . it's how one performs the ablutions when washing the dead! We never make such movements in normal situations."

Once again I had run headlong into the multifarious rituals that at times seem to surround the Hasidic way of life like a spearpoint fence, making entrance difficult for outsiders, and egress no easy thing for the Hasidim themselves. Yet, in the eyes of the Hasidim, each spearpoint in that fence safeguards the fulfillment of their holy covenant with God. Their adherence to every last punctilio of religious law is no mere rote act but a conscious fulfillment of God's command, bringing about the sanctification of even the smallest acts of everyday life.

WITH THE OUTSIDE WORLD, the Satmar Hasidim seemed to me to live not so much side by side as back to back. I recall one afternoon approaching on the street a Roman Catholic nun whose church, with a largely Spanish-speaking congregation, stands almost incongruously in the middle of Williamsburg's Hasidic neighborhood. When I asked her about her experiences with the Hasidim, she simply shook her head. "I have lived in this parish for 13 years," she said, "but never has a Hasid come up and spoken to me. Not once. They don't even catch your eye."

Police detective Nino Marano, whose beat has been Williamsburg for years, told me: "The Hasidim rarely bother other people, and would just as soon other people didn't bother them. We've had periodic trouble—fights between Hasidim and other ethnic groups. But you rarely see a Hasid who starts the trouble—though they often seem to attract it just by being so different and standoffish. Once a Hasid made insulting remarks when I ticketed his truck for a parking violation. Another Hasid reported the man's conduct to the *bes din*, the religious court, where the Hasidim prefer to handle their own civil infractions. Hearing the case, the rabbis berated the man and he apologized. I was much more satisfied than if he'd been hauled before a civil judge."

Nearly all Hasidim take pride in becoming American citizens, which allows them to vote. "We are often the swing vote in local elections and political affairs," Rabbi Friedman told me.

Although the Satmar Hasidim share to some degree in community funds made available by various government agencies—they pay taxes, after all, like everyone else—they

"Ye shall dwell in booths seven days." LEVITICUS 23:42

Fire-escape sanctuaries, *sukkahs*, or "booths" (**facing page**), recall the Israelites' abodes during the flight from Egypt. After fixing his sukkah's roof, a Hasid descends by way of his neighbor's ladder. Interiors may be richly decorated (**above**). Here family members dine during the Festival of Booths.

"I place my soul within His palm before I sleep. . . ."
HEBREW SIDDUR, OR PRAYERBOOK

Day ends as it began, with prayer. A Hasidic youngster caps off hours of study and prayer with—of course—more study and prayer. Throughout the day he wears a *tallis koton*, or "little prayer shawl," as prescribed by Mosaic law. The garment's fringes, like those of the larger shawl worn by married men at morning devotions, are a constant reminder of the 613 divine commandments in the Torah—the Hasid's ageless guide to God's law and daily living.

prefer self-help to reliance on outsiders. They not only run their own school system out of Satmar funds, but also operate a walk-in clinic, a nursing service, an emergency first-aid and ambulance service, a private community bus service, a summer camp system, an employment agency, and a free-loan society. They very definitely care for their own.

Recently they have also established a small self-contained community for a few hundred Hasidim at Monroe in New York's Orange County—about an hour's drive upstate. Does this signal a mass exodus from the inner city? Probably not, at least for the near future. Immediate plans for the Monroe complex envisage a community of perhaps 250 families. "We are not running away," Rabbi Friedman explained. "We are simply growing."

While I toured a Satmar school for girls, the principal, Rabbi Naftali Hertz Frankel, pointed out how reverently the children repeat the Pledge of Allegiance.

"Almost all of them are the grandchildren of concentration camp survivors," he said. "They *know* how much America and its freedom means. To them, the Pledge of Allegiance is almost a kind of prayer."

TAKING LEAVE of Williamsburg, I stopped off to say good-bye to a bearded old Hasidic friend at the tiny Xerox shop he manages on Lee Avenue.

Between running off copies for customers, he spoke of his first family—all killed in the concentration camps—and of the blessings of raising a second family in "a nice Yiddish place like Williamsburg."

The green light of the Xerox duplicator flickered on his gray beard and earlocks. I recalled an old Jewish tale I had heard about Hanoch the shoemaker, as one of the 36 legendary "secret tzaddikim," or holy men, who—unbeknownst even to themselves—help sustain the universe with their piety.

Hanoch, goes the legend, uttered praises of the Lord with each stroke of his tack hammer. Watching my Hasidic friend reel off another batch of Xerox copies, I conjured up the image of him, too, as one of the secret 36, uttering praises to God each time he pushes the "print" button on the Xerox machine for another copy.

It was one last indelible image to carry with me as I took the subway from Williamsburg to that other world in Manhattan. □

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A new crop of prizes . . .

FEW MAGAZINES have more awards to their credit than NATIONAL GEOGRAPHIC; in some staff members' offices, citations and certificates literally cover a wall. Five times so far, in this continuing success story, 1974's skillfully meshed combinations of text, captions, and pictures have won critical acclaim. For the best reporting on Asia in any medium (including newspapers, magazines, and TV) came the prestigious Overseas Press Club of America Award for a perceptive portrait of rarely visited North Korea. Lonesome roads and rugged trails of Nevada inspired a sensitive article that earned the Spur Award of the Western Writers Association. The exciting re-creation of a Polynesian migration in "Wind, Wave, Star, and Bird" drew an award from the Pacific Area Travel Association for the best general-interest article. The top writing award in the magazine category of the Aviation/Space Writers Association went to an extraterrestrial story—"Skylab"—and "The Incredible Universe" won the association's Robert S. Ball Memorial Award for excellence in writing on the subject of space. Such is the extraordinary journalism for which the GEOGRAPHIC strives. You can share the results with your friends by nominating them for Society membership on the form below.

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FORD GRANADA

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In the late 1800's, Union Oil co-founder Wallace L. Hardison helped transform the semi-desert land of Santa Paula Valley into one of California's richest agricultural areas.

Rich, bountiful western soil. But like many western soils, it has a high clay and silt content. After watering, this fine silt dries into a cement-like layer atop the moist, fertile soil, much like the field on this page. Farmers call it "crusting."

Many seedlings die because they cannot penetrate this crust. Those that survive grow slowly and mature at different times. Harvesting becomes a very complicated process and the yield is smaller.

And that's why Walter Roth, Carl Pilat and their research team at Union Oil spent four years working on the problem.

Their solution was a solution. A bio-degradable latex solution that mixes with water and is sprayed at the same time and by the same machine that plants the seeds. It forms a porous, plastic film over the seedbed which binds the soil particles and prevents crusting. Months later, when its job is done, the anti-crustant blends back into the soil, leaving no residue. The result is a more consistent, bountiful yield similar to the field on the right.

Not stopping there, Union Oil's researchers developed a white anti-crustant that protects seeds from "sunburn" and a black anti-crustant that protects seeds from cold. These products are available from the PureGro Company, a subsidiary of Union Oil's wholly owned Collier Carbon and Chemical Corporation.

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Today, the pioneering Spirit of 76 is men like Roth and Pilat, turning seed-killing ground into life-giving soil.

Coal. A relic of yesterday? Or our fuel for today and tomorrow? Reason will support either view.

Some people link coal to the past. To a yesterday of smoke-filled air, soot, dirty streams, ashes. The blackened, hollow-eyed faces of miners. Coal, at the century's turn was a dirty fuel. That's one reason why oil and gas took its place. In 1910 coal provided 90% of our energy. Today only 18%.

Many believe our oil and gas will be gone early in the next century. True, they say, there are great reserves. Oil shale. Tar sands. But present extraction methods require huge amounts of capital and tremendous volumes of water. That, plus environmental protection requirements, limit our ability to meet oil needs from these sources. Other energy sources seem equally undeveloped and far away in time. Time may be running out.

What can we do? We need oil and gas. Not only for fuel, but for petrochemicals, pesticides, plastics, rubber products. But the plain fact is our supplies won't last forever.

Fortunately, we do have an alternative fuel: coal. Coal is abundant. Quickly available. And we have the technology to mine and convert it at acceptable economic and environmental cost. And it's versatile. Coal can supply us with chemicals for industry and fuels for transportation. Much the same as oil and gas.

Coal is not only a basic fuel, but it can buy time to develop additional energy sources and do the necessary research to perfect nuclear technology.

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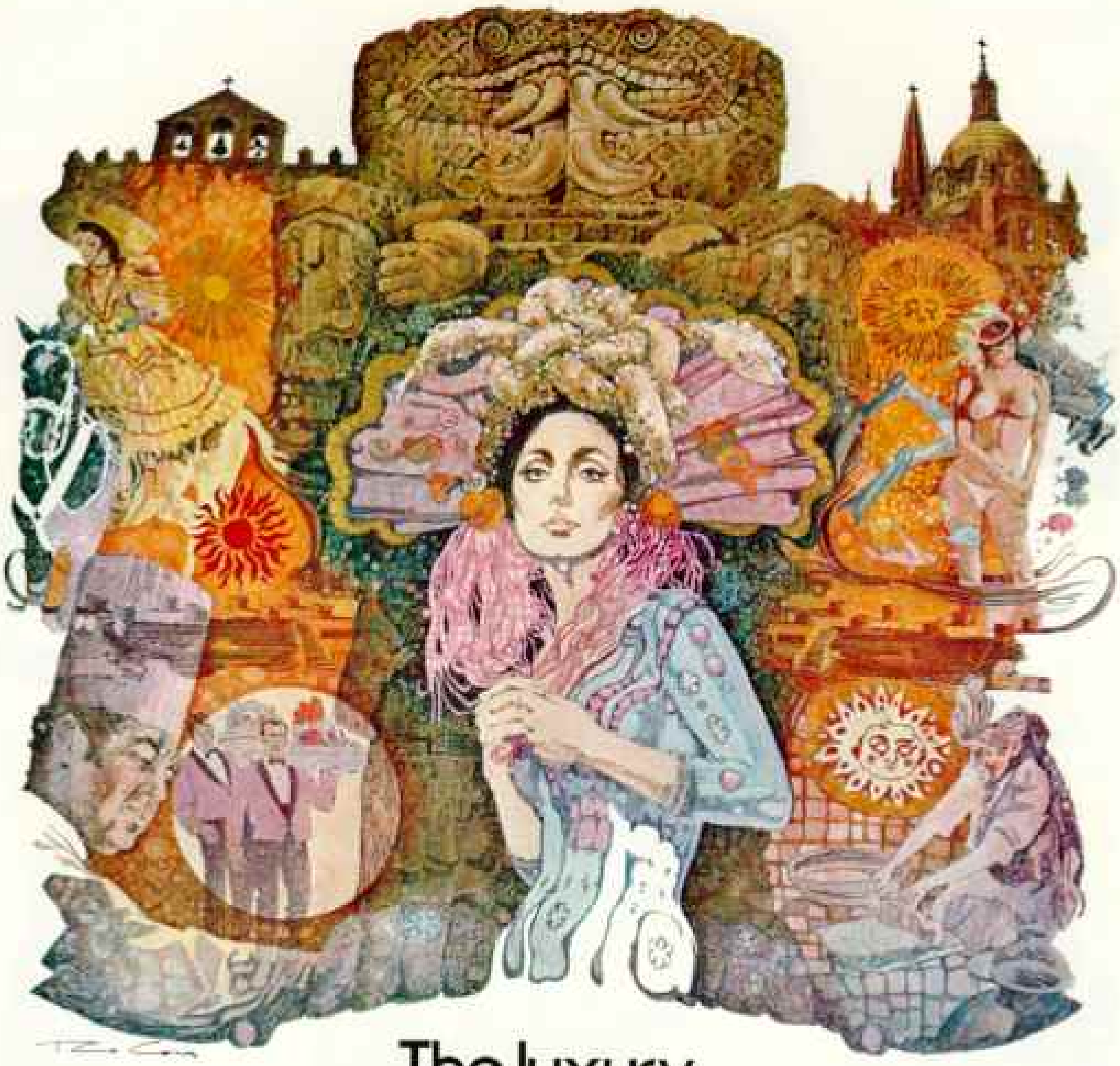

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The new Minolta XE-1. The camera you've been waiting for.

If you've thought of purchasing a camera during the past year or two, you've probably been looking at the new wave of 35mm electronic SLR's that have appeared on the market. But maybe you've held off because some offer one feature, others offer another.

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There isn't much room on a sledge. Wally Herbert's Rolex had to earn its place.

Up to three generations ago the Polar Eskimoes thought they were the only people on earth. Now, inevitably, their culture is changing. Wally Herbert set out for North-West Greenland in 1971 with his wife and baby daughter, to spend two years filming the hard, hunting life of this isolated tribe while it was still possible.

Wally Herbert travelled more than 3,000 miles by dog sledge over glaciers and frozen sea. He wore his Rolex all the time. From his previous trips to the polar regions he knew it was utterly dependable. In fact he claims that without it he would not have found his way across the Arctic Ocean via the Pole in 1968–69.

The case of the Rolex Oyster is smooth, polished and timelessly elegant. But Wally Herbert can tell you that it's extremely tough.

You'll see no seam around the Oyster case. It's one solid piece of 18ct. gold, platinum or stainless steel. The patented Rolex winding crown has an extra strength too, screwing down into the case rather like a submarine hatch, providing a complete impenetrable seal against dirt and water.

The Polar Eskimoes still believe that they alone are real men—'inuit', proud hunters of bear and walrus. To share even part of their lives needed courage and persistence.

Wally Herbert once said about his work: "You should always try to do more than your share." The Rolex craftsmen feel that this has always been their watchword, too.

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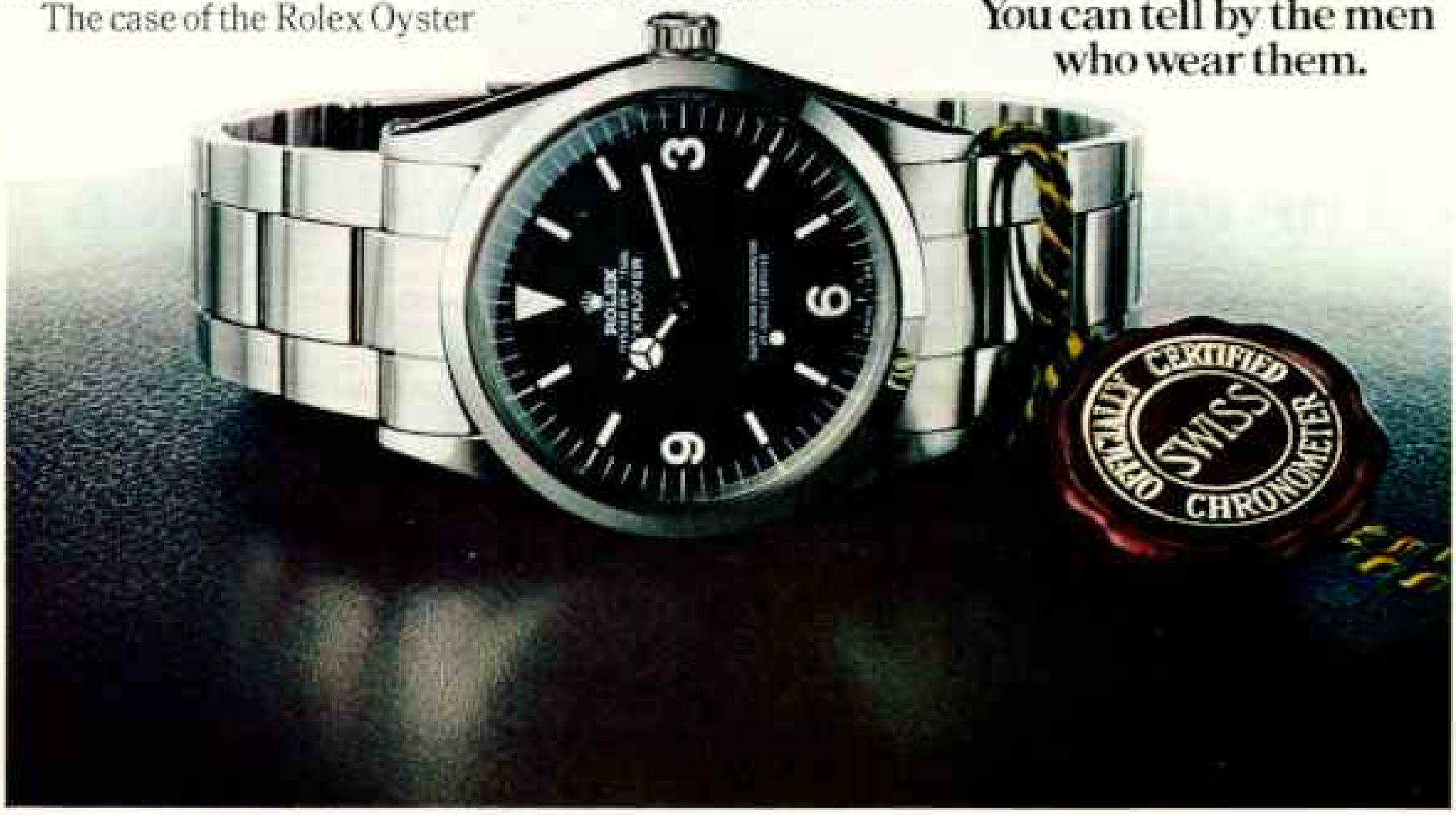

Pictured: The Rolex Explorer in stainless steel with matching bracelet.

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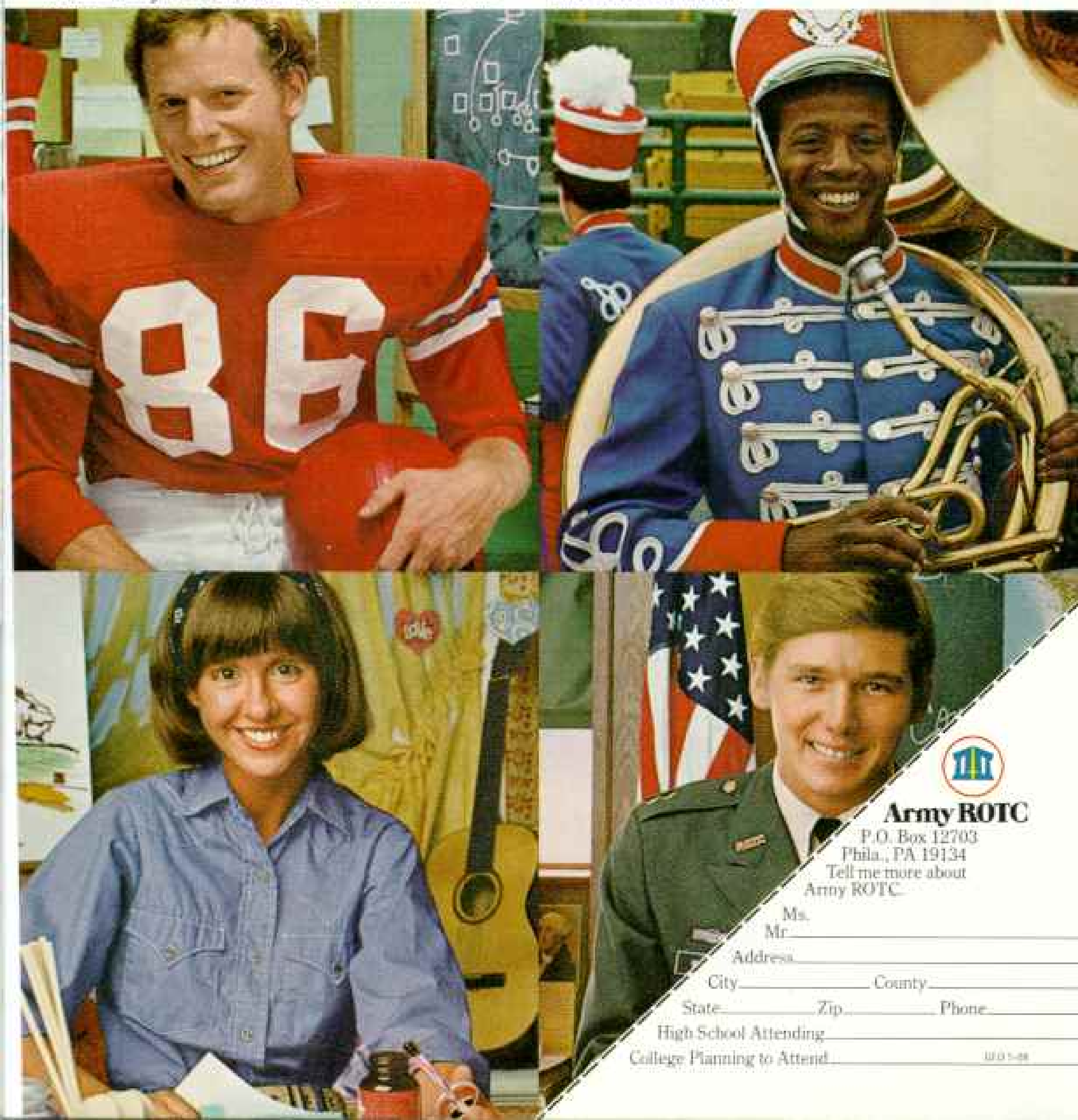

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Is time running out for the mighty condor?

Profile from the past, the Andean condor has changed little since prehistoric times. Beady red eyes, hooked beak, and white ruff mark the female. The paler-eyed male wears a crinkled crest. Giants among birds that fly, condors soar on wings spanning as much as ten feet. Leaping from cliffs, condors ride updrafts to three-mile altitudes, attaining speeds of 35 miles an hour. Wings flap sparingly, mainly for takeoffs and landings. Andean condors haunt coasts and mountains from Colombia to Tierra del Fuego, feeding mostly on carrion. Once plentiful, their numbers decrease as humans encroach on their wild domain.

Hunters bag them for trophies. Guardians, hired to protect guano birds on Peru's offshore islands, wantonly slaughter condors on the mainland. One village ceremony also takes a grisly toll. A captive bird is swung from arched poles, and Cashapampa's fist-swinging horsemen pummel it to death. A man bites its tongue out, then others tear the creature apart for talismans. The rite, now meaningless, apparently began with the Spanish, who symbolized destruction of the Inca's pagan culture by killing condors. Their cousins, the few surviving California condors, cling to dwindling mountain retreats. Readers keep tabs on these and other endangered species by regularly turning to the pages of NATIONAL GEOGRAPHIC.

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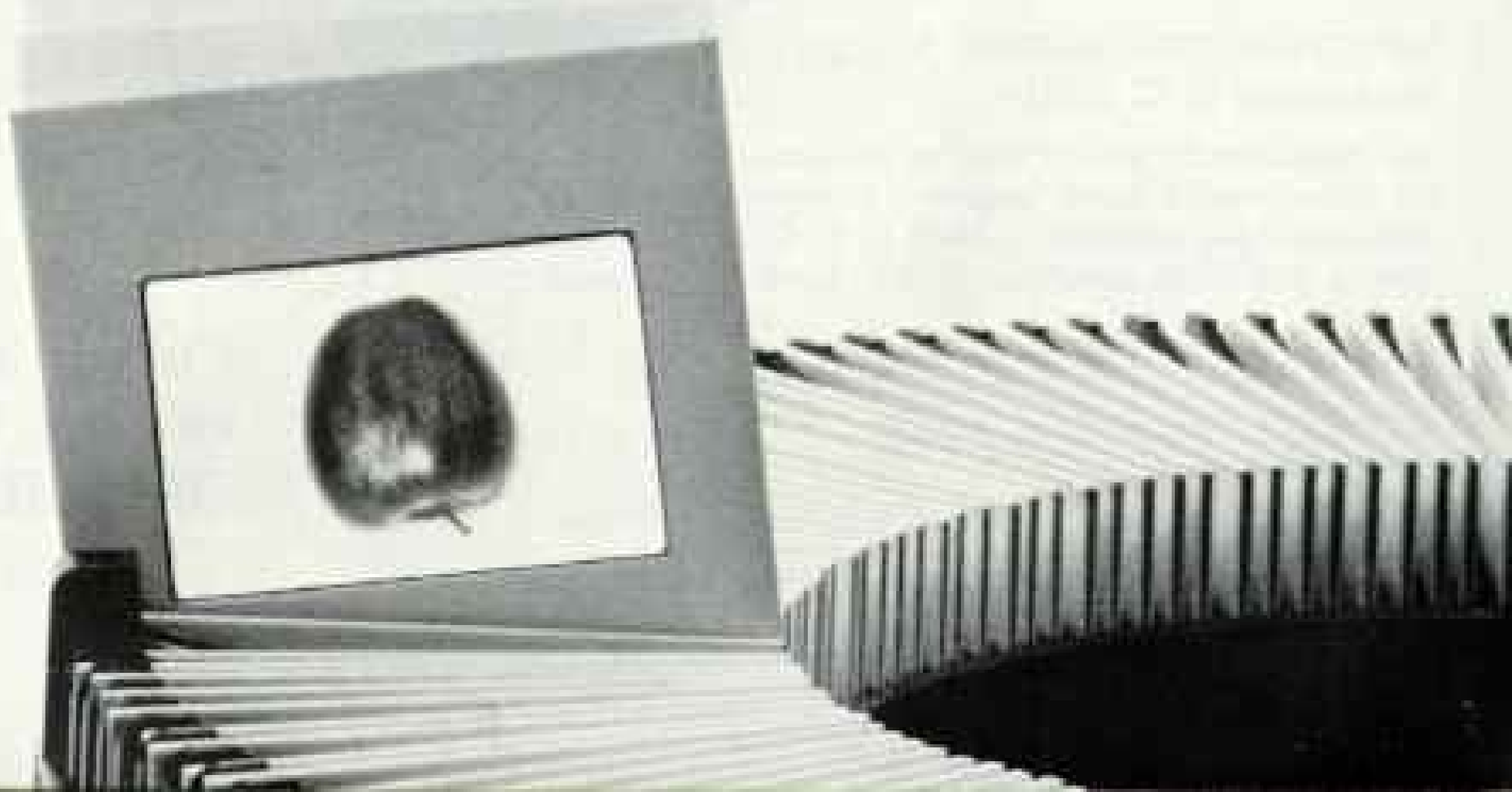

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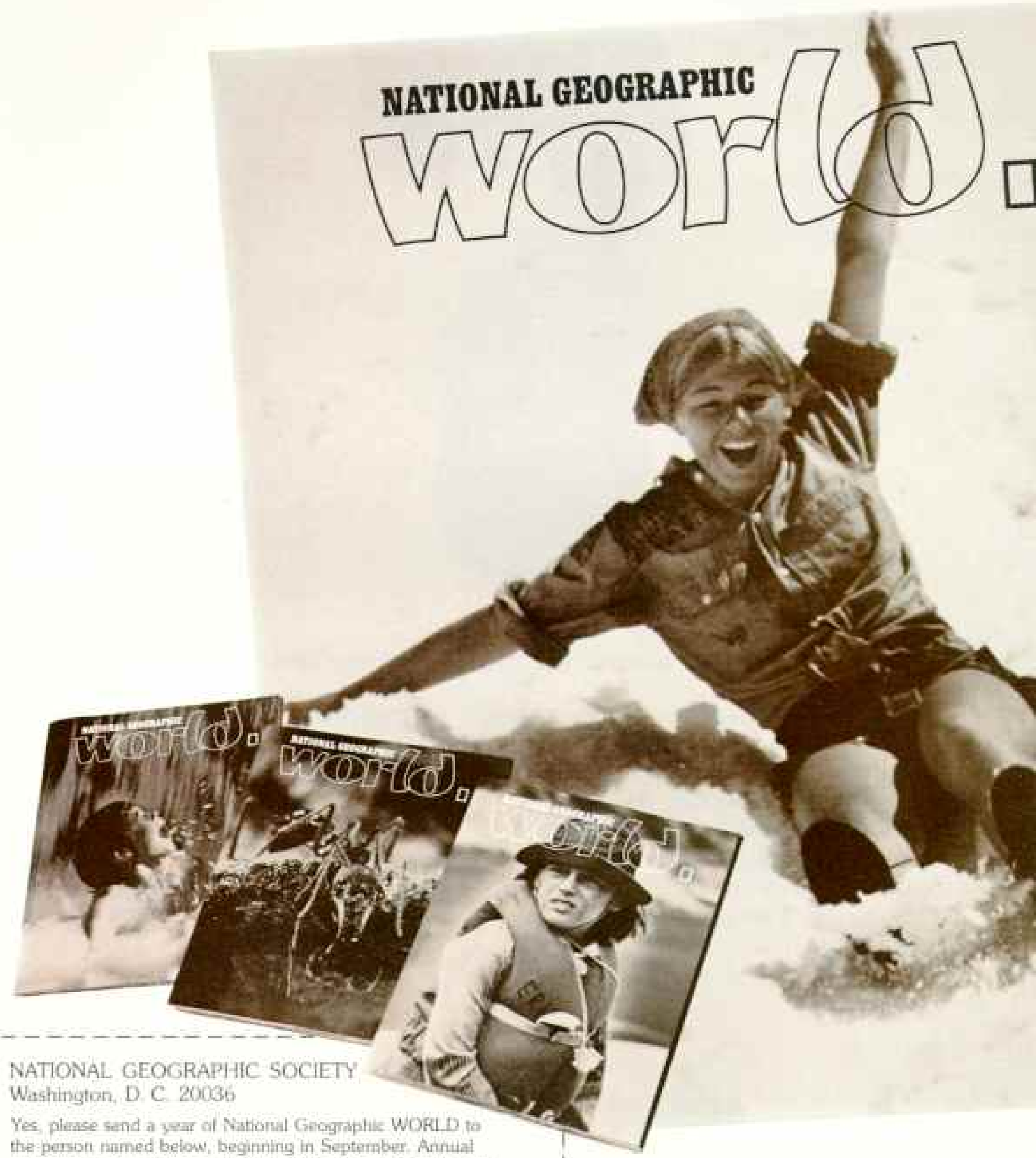

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