DOUBLE MAP SUPPLEMENT: ATLANTIC CANADA

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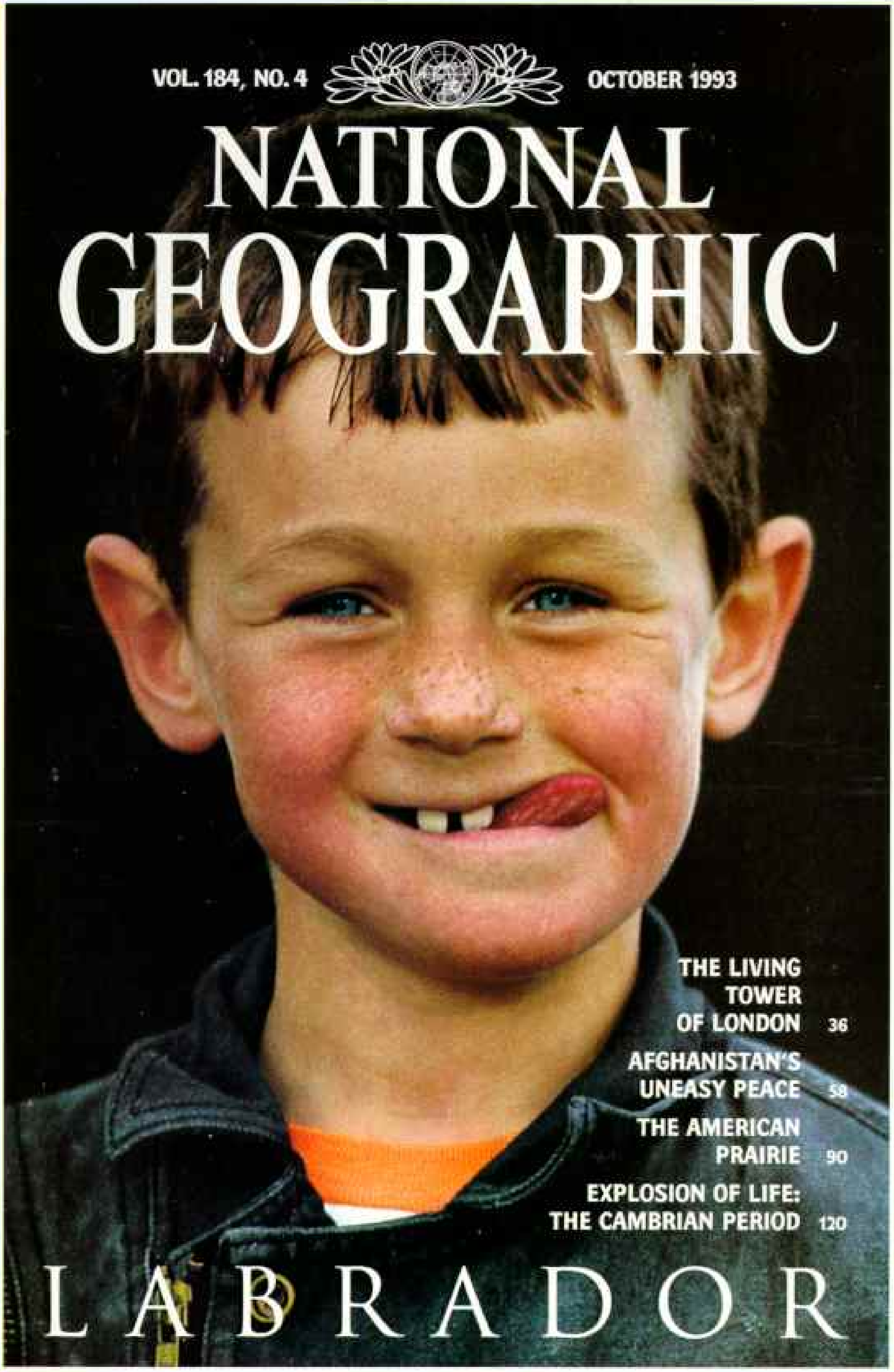

LABRADOR

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COVER: Ten-year-old Perry Campbell is still years away from tough choices about staying or leaving his isolated village of Mary's Harbour in Labrador. Photograph by Richard Olsenius.

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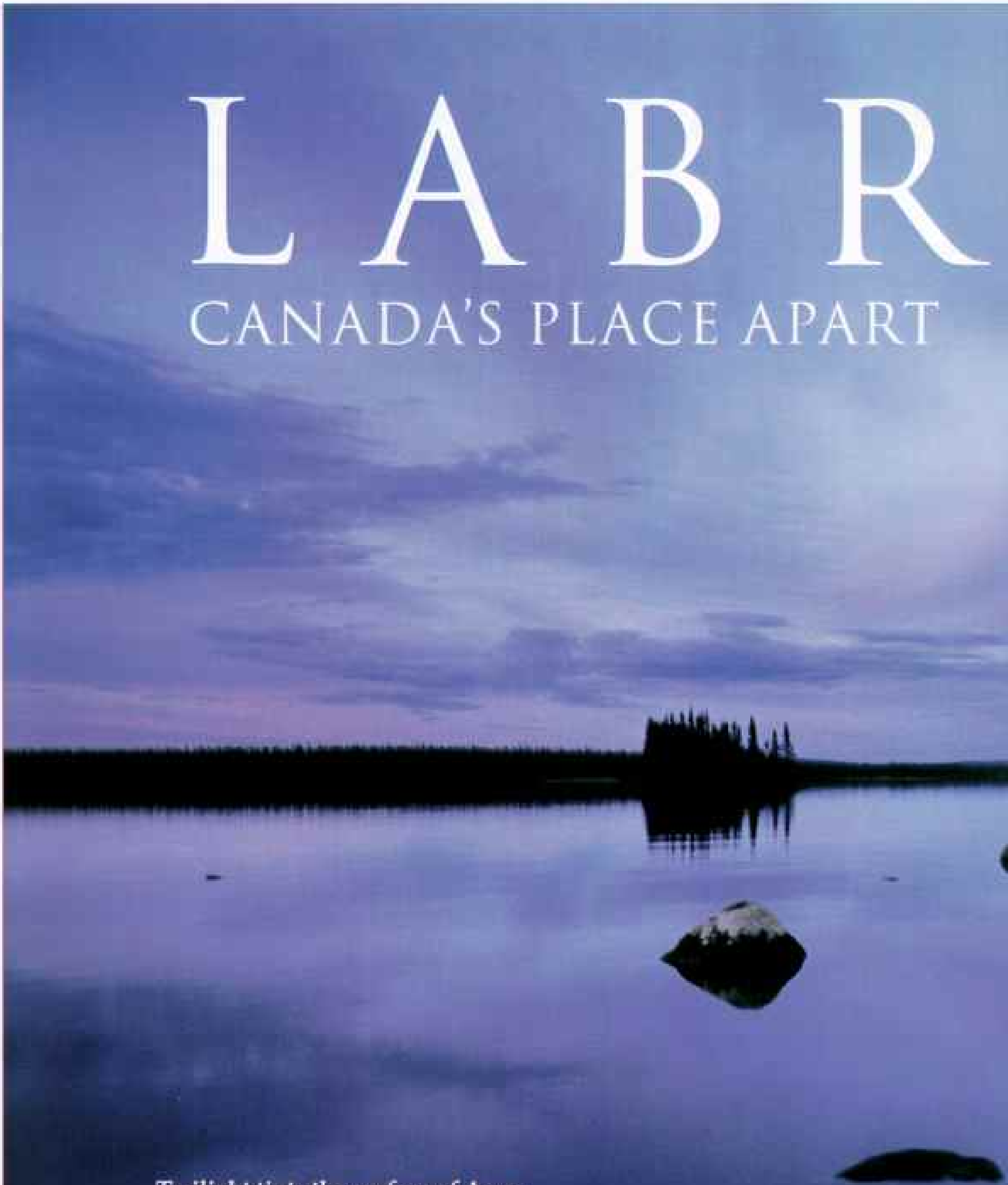
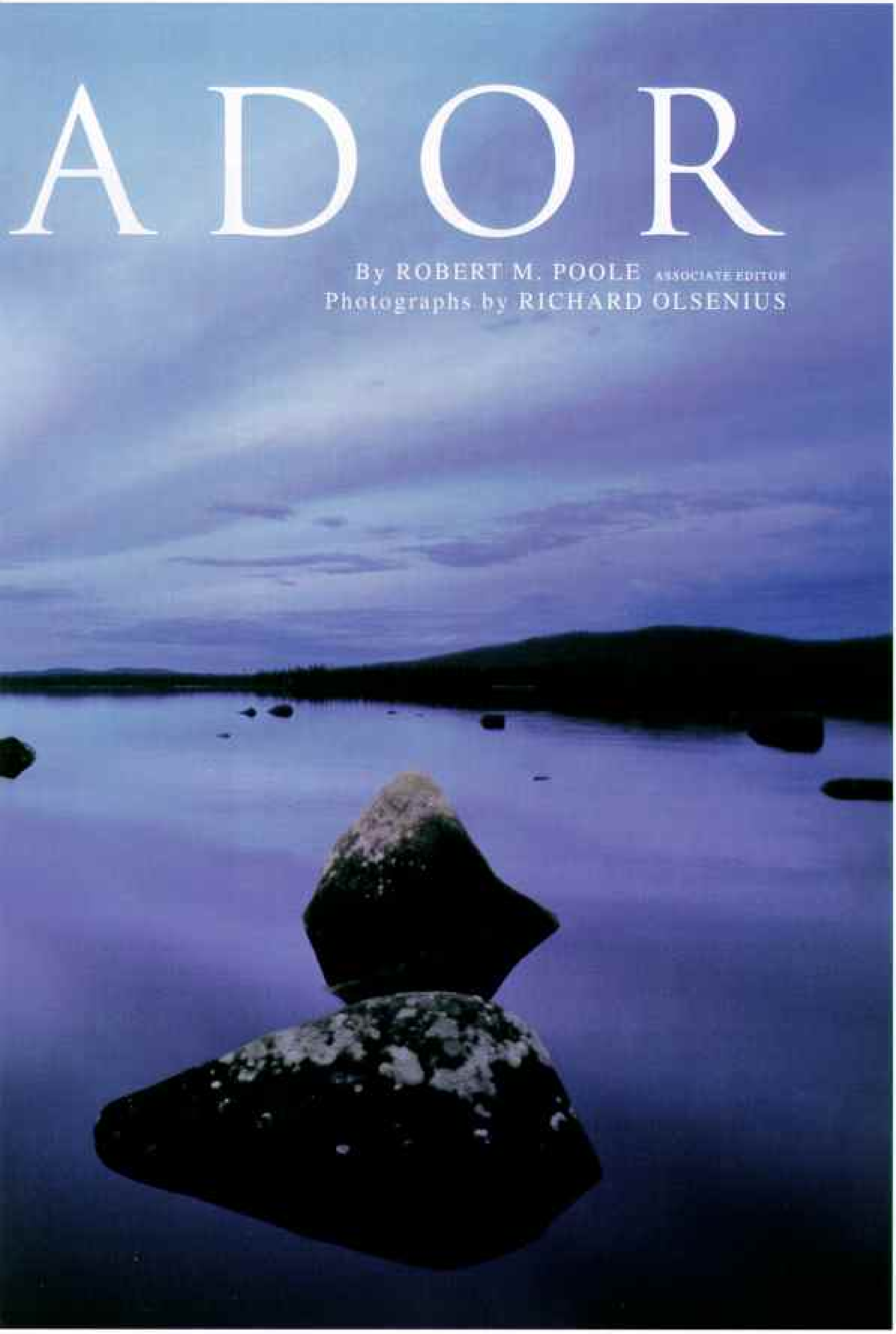
CANADA'S PLACE APART



Twilight tints the surface of Anne Marie Lake in Labrador's desolate interior. Awash in hard-edged beauty, Canada's far northeastern corner remains a land barely rippled by time.

A DOR

By ROBERT M. POOLE ASSOCIATE EDITOR
Photographs by RICHARD OLSENIUS



"This is one of the few challenges left in a world of wimps." —JACK COOPER, Outfitter

WHEN THE SHIP arrived at Paradise River, Derm Wakeham stuck his head outside to test the Labrador summer. He got a slap of cold wind and rain in the face. Wakeham, the assistant purser on M.V. *Taverner*, dashed back inside the heaving ship. "Paradise River!" he cried. "If this is paradise, I'd hate to see hell."

As a regular visitor to Labrador, Wakeham knew what to expect, but he seemed less than enchanted with the Canadian wilderness that lies east of Quebec and north of the Island of Newfoundland in a forgotten corner of the continent. For centuries travelers took one look at this rocky coast and sailed on.

"Worthless country," said Bjarni Herjolfsson, a Norseman who is supposed to have seen Labrador in A.D. 986.

"Fit only for wild beasts," said Jacques Cartier, who visited in 1534 while probing for a northern route to Asia. "This must be the land God gave to Cain."

"The most extensive and dreariest wilderness I have ever beheld," said John James Audubon, who came to paint birds in 1833.

Few people, in short, have had a kind word for this harsh land, where ice can choke the seas in mid-July and the temperature falls to minus 50°F in the long winter. Perhaps because of its bad reputation, Labrador remains essentially as Cartier and Audubon saw it, an inaccessible and austere land of rumpled black mountains, tea-colored rivers, and soupy green bogs. Only one gravel highway, known for its potholes and washouts, links Labrador to the outside world.

"When I drove the Labrador highway to Goose Bay a lot," said Francis Clarke, a resident of Churchill Falls in central Labrador, "I got so I could patch a gas tank faster than most people could change a tire." Francis's comment would be a complaint anywhere else. In Labrador, where people don't like things too easy, it's a boast.

Only 30,375 people live in Labrador's 112,000 square miles, which makes it one of the most sparsely populated regions of Canada (map, page 9). Four settlements hold more than half those people: Labrador City and Wabush, adjoining towns carved out of the western wilderness in the 1950s and '60s, where iron-ore mining is the major business; Churchill Falls, a town founded in 1967 on the site of one of North America's largest hydroelectric projects; and Happy Valley-Goose Bay, built during World War II as an airfield, now used by German, British, and Dutch fighter pilots for low-altitude training. Aside from a sprinkling of fishing settlements along the coast, the rest of Labrador is lonely country, patrolled by polar bears and wolves,

"A lot of people would think it'd be a lonely place, but we don't think twice about it," says 89-year-old Phoebe Rich, who toughs out her summers with son Gus at a fishing camp near Rigolet—a village accessible only by boat or plane. Descended from robust Inuit and Scottish stock, Rich tackles her daily chores with aplomb despite two eye lens implants and leg pains. "When you get old, you can't just sit down," she declares. "You gotta keep busy."

foxes and caribou, black bears and ptarmigan. And it is home to some of the toughest and most resourceful humans you will find anywhere.

"If you survive here, you are entitled to live by your own standards," said Doris Saunders, a Labradorian who edits *Them Days* magazine, which collects stories about life on this hard edge of the North American continent.

"This is one of the few challenges left in a world of wimps," said Jack Cooper, an outfitter who introduced me to the pleasures of Labrador seven summers ago, when I went to fish for brook trout at his camp on Anne Marie Lake, south of the Mealy Mountains.

For me, a citybound angler who spent more time fishing in imagination than water, Jack's place was like paradise found. The only way in or out is by chartered aircraft, which brings you down in a chain of lakes and rivers where a grand silence fills every wrinkle of the landscape. You often hear the fish, splashing out of the water to grab mayflies on the wing, before you see them. These brook trout—sequestered from overfishing and pollution—are among the largest in the world, averaging more than five pounds each. They look unreal, with thick black backs, fiery red bellies, and neon spots of

Disappointment their only catch, Guy Rumboldt and his son Chris return empty-handed from a long day of hauling nets off Indian Cove, a port that cod and salmon built.

Waves of fog break at the foot of Labrador's craggy northern coast. Eons of uplift and glacial scouring have exposed rock from the basement of earth's history—some formations date back almost four billion years.

yellow and orange, like the creation of an overeager taxidermist.

I still recall every detail of the July evening I caught my first one. Loons squealed across the lake. I sat in a canoe with a friend and a fishing guide, and the three of us watched the water, as flat and black as polished marble. Then the marble shattered, a telltale ring forming where a cruising trout popped through for a fly. As the rings moved toward our canoe, I stood with my fly rod, flicking a Yellow Humpy in the trout's path. The fish grabbed it, and I was into a wild trout, a six-pound female that bent my rod double and made my knees wobble long after she had been netted and set free again. From that moment I was hooked.

Year after year I have returned to pursue brookies in Labrador's long twilight, and I have grown to love the land God gave Cain. So it was with a touch of apprehension that I set out in a recent summer to explore more of this country, worried that knowing too much might spoil it all.

WITHIN A WEEK of landing, I learned that the Trans-Labrador Highway was being resurfaced and improved, which would bring more traffic from populous Quebec; that utilities were planning yet another big hydroelectric project on the Churchill River, which had already been dammed once, flooding hundreds of acres and forever changing Labrador's vast central plateau; that Indians and Inuit were engaged in an acrimonious land dispute with fellow citizens, which raised questions about development in Labrador; that the iron-ore mines and fishing industry were in a slump, worsening unemployment where jobs are too scarce already.

CANADA'S DESOLATE CORNER

As early as the 16th century, riches from the sea drew European fishing fleets to Labrador, where the icy but nutrient-rich Labrador Current collides with the warm Gulf Stream, nurturing cod, salmon, herring, mackerel, and whales. Recent overfishing has greatly reduced many fish stocks, prompting strict moratoriums.

A rough-hewn magnet for Innu Indian caribou hunters, coastal Inuit, Basque whalers, hardy Moravian missionaries, and British fishermen, Labrador has long been a testing ground for human grit. Today, however, new challenges face the 30,375 residents of this Colorado-size chunk of Newfoundland Province. As iron-ore mining declines and crucial salmon and cod fisheries collapse, the government is banking on sportfishing and ecotourism to cure Labrador's economic ills. The draw? Majestic fjords, trout-laden lakes, spruce barrens, and—in the words of Victorian explorer Mina Hubbard—"a strange wild beauty . . . which buries itself silently in the deep parts of one's being."

"We got one salmon last year. One salmon! We pray that there's fish this year." —GEORGINA ALLEN, Fisherman's wife

"It's all we've got—you give that up and that's everything," says Georgina Allen of her family's backbreaking bond to the sea. Joining her father, Jerry Decker, for a summer of gill netting off Ice Tickle Island, Georgina's clan still hews to a crusty tradition endangered by Labrador's dwindling migrations of salmon. More than half the region's salmon fishermen have turned their backs on the tide and sold their licenses to the government.

And the separatist spirit of neighboring Quebec, a province threatening divorce from Canada, had seeped over into Labrador. Although formally part of the province of Newfoundland since joining the Canadian confederation in 1949, Labrador has always been a place apart, separated from Newfoundland by rough seas and temperament, and by the Labradorians' sense that they carry little political weight in distant St. John's, the provincial capital.

"The provincial government looks at Labrador as so small we don't matter," said Darrel J. Brenton, the mayor of Labrador City. "They just throw us a tidbit now and then."

A FEW PEOPLE even talk about Labrador seceding from Newfoundland to seek status as a separate territory. "At least that way the revenues from Labrador's iron ore, hydropower, and fish would stay in Labrador," Doris Saunders told me. Secession may be a remote dream, but it is clear that many Labradorians see themselves as a breed distinct from Newfoundlanders.

"I would hope that if I ever said I was a Newfie, someone would gutshoot me so I'd die a slow and painful death," she joked. Some people wear their hearts on their sleeves. Doris seemed to wear hers all over, in a sweater patterned after the Labradorian flag. It had a spruce twig over the heart and stripes of white, green, and blue representing Labrador's eternal snow, land, and water. That flag, which is different from the flag of Newfoundland, fairly depicts the look of today's Labrador, where getting around is still something of an adventure. Fog stalls flights, floods smash bridges, ice delays sailings. Nature rules.

Traveling here, you learn to rely on bush pilots like Clayton Pilgrim. The first time I saw Clayton, with his gambler's mustache and a many-zippered jumpsuit, he was bent over a dock in Goose Bay, gassing up a battered single-engine floatplane with "Labrador Airways" emblazoned on its fuselage. Clayton stood up and began to swear with great flourish at the mosquitoes and blackflies, which tortured him as they do anyone who ventures outdoors during Labrador's brief summer.

Someone complimented Clayton on his immaculate cowboy boots, but didn't he worry about getting them wet? "No sweat," said Clayton, smiling to reveal a gold tooth. "I've been a bush pilot for some years. I do not get my feet wet. Let's go."

We went. I was traveling with photographer Richard Olsenius; Barbara Kitowski, a transplanted Yankee now working as an outfitter in Labrador; and Louie Montague, a trapper and woodsman. We were heading for

a few days of camping at Seal Lake, a part of central Labrador few visitors ever see. Although this part of the interior was familiar to the Indians who roamed it for thousands of years, Labrador's heart was still unmapped territory when Leonidas Hubbard, Jr., came up from New York City to explore the north country in 1903.

Hubbard, a young assistant editor for *Outing* magazine, planned to cross the wilderness as no explorer had, canoeing from the village of North West River to Ungava Bay. He hoped his journey would fill in the blank spots on the map and secure his fame.

Our plane shuddered as Clayton changed direction and the turbulence tossed us around. Clayton ignored it, steering us north along the shore of Grand Lake, where Hubbard had turned into the unknown, up the Susan River, accompanied by a friend, Dillon Wallace, and by George Elson, a Scot-Cree guide from James Bay.

"That turn right there was Hubbard's fatal mistake," Louie shouted over the plane's engine. "A *terrible* mistake." He pointed to the map unfolded across his knees, showing me how the Susan petered out in a plateau hemmed in by mountains, while the Naskaupi River, at the top of Grand Lake, led to Seal Lake and the interior. "That's the

Beached fish, beached men: Salmon netter Roy Spearing (right) displays the reward of a long days' toil. Such meager returns leave fishermen like Walter Bolger (above) unemployed. "She's finished," Bolger says of Labrador's fishery.

river he should have followed," Louie said, tracing the Naskaupi northward with his finger toward Ungava Bay.

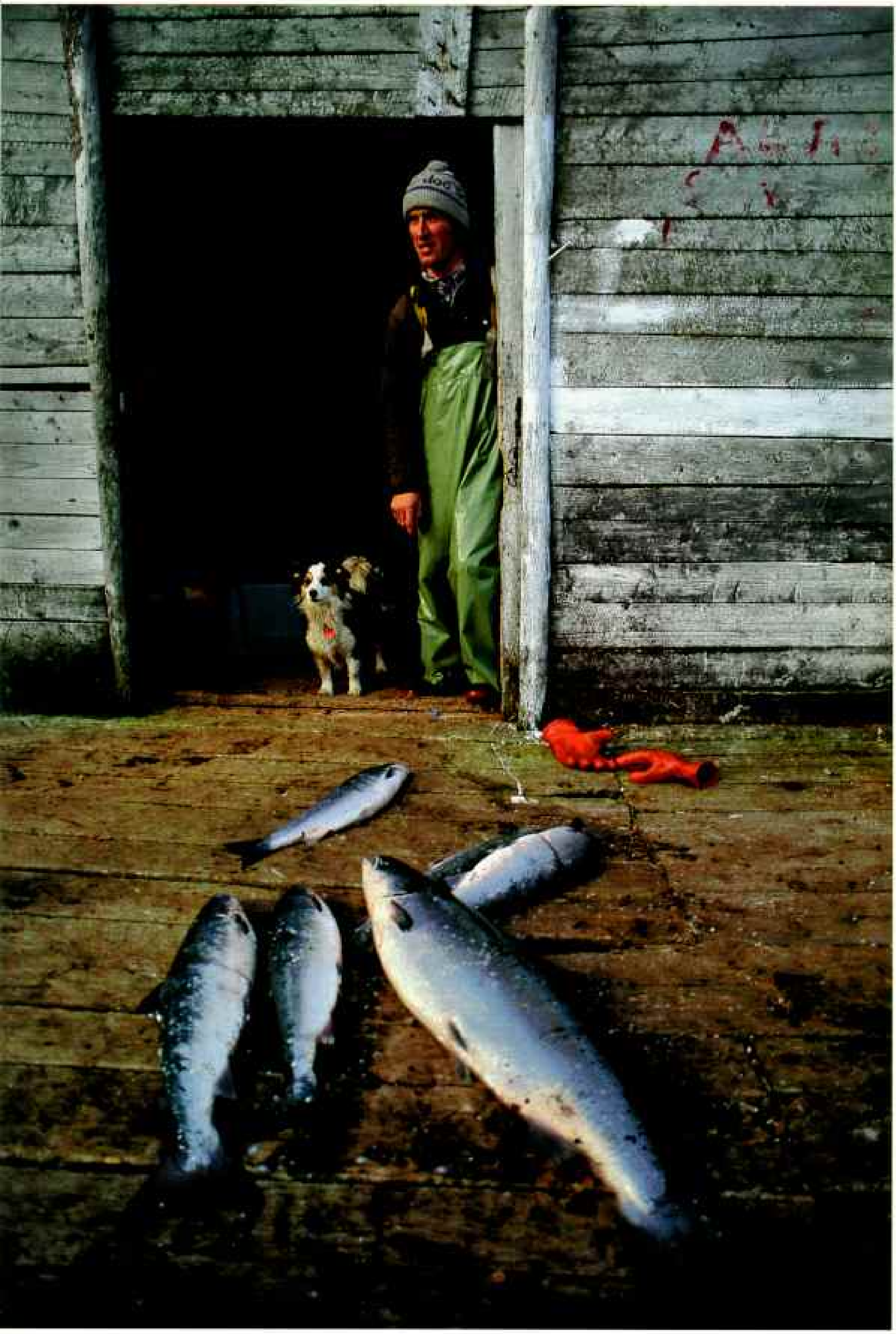
Hubbard eventually found himself stranded in the middle of Labrador, exhausted, low on food, with winter coming. He collapsed on October 18, unable to continue. He sent his companions for help and settled in his tent to wait and write: "Tonight or tomorrow perhaps the weather will improve so I can build a fire, eat the rest of my moccasins and have some bone broth. . . . I am not suffering. I am sleepy. I think death from starvation is not so bad. . . ."

A search party found him dead in his tent two weeks later, covered by fresh snow. Poor Hubbard achieved the fame he sought, though not in the way he intended.

I felt some kinship with him, a fellow tenderfoot lured north, as he put it, into "a great unknown land right near home, as wild and primitive today as it has always been."

Louie tucked his map away and turned his back to the black hills passing below, where he has worked for half a century. "Hubbard wasn't really prepared," said Louie, who knows what it takes to survive in Labrador's bush. "If you're not prepared in this country, if you let up just one time and make a mistake, she'll get you. Hubbard didn't bring enough food. He didn't bring the right clothes. He didn't know this country. That's what killed him."

Clayton dropped toward Seal Lake and brought us down so skillfully that I could not tell where air ended and water began. We taxied toward a beach and, a few feet from shore, untied the canoe we had lashed to one of the plane's floats. Into it we loaded our gear—a few days' supply of food, a trapper's stove, four tents, an ax and a saw, some fishing gear—and sloshed ashore. Clayton



"If you survive here, you are entitled to live by your own standards." —DORIS SAUNDERS, Historian

disappeared into the sky. The sound of his engine melted with distance, and the world filled with silence. Then we noticed that the beach was stamped with bear tracks in all directions.

Barbara and Louie studied the tracks and eyed each other. Louie shrugged. "They probably won't bother us," he said.

He was right. We spent our days at Seal Lake peacefully, fishing for lake trout, exploring the rivers and brooks in our canoe, pleased to find that the land was little changed from what Mina Hubbard saw nine decades ago. Mina, the young widow of Leonidas Hubbard, returned to Labrador in 1905 to finish the journey that killed her husband. Accompanied by George Elson and three other guides, she crossed more than 550 miles of the barren country from North West River to Ungava Bay in just 61 days. When word of her achievement reached the world, people were skeptical: "She cannot have carried out her original intentions," wrote one reporter. For one "so frail in appearance," wrote another, "it is scarcely possible to credit the . . . journey which she has just completed." But she had, and she wrote of her adventures in *A Woman's Way Through Unknown Labrador*. This became our guide to Seal Lake.

We sat around at night, reading Mina's words out loud, marveling at her toughness and her good luck, poring over maps that carry names she gave to the surrounding landmarks. Rain sputtered on Louie's tent, where we gathered for meals. Waves lapped the beach. The stove crackled. Louie told trappers' tales. Barbara smoked her pipe. We stared out through the tent flap at a fog that blotted out the mountains and all sense of time. It was easy to picture Mina, an upright Victorian figure in a long skirt, skimming by our camp in a canoe, impatient to finish the business her husband had started. Yet she always paused to admire the beauty of the countryside.

"Seal Lake in the calm of a summer day, with the summer sunshine upon it, and the beautiful Labrador sky above, is altogether lovely," Mina wrote. "When the day's journey ended I had seen so much that was beautiful, and so varied in its beauty, that I felt confused and bewildered."

We took our canoe north on a drizzling June morning to explore where Mina probably wrote those words, on a broad beach at the eastern end of Seal Lake. We went ashore to a clearing where Indians had camped recently. Mina Hubbard's beautiful beach now looked like a dump, littered with rusted cans, beer bottles, charred logs, empty shotgun shells, bird feathers. A piece of cardboard from a Froot Loops carton sloshed at the water's edge.

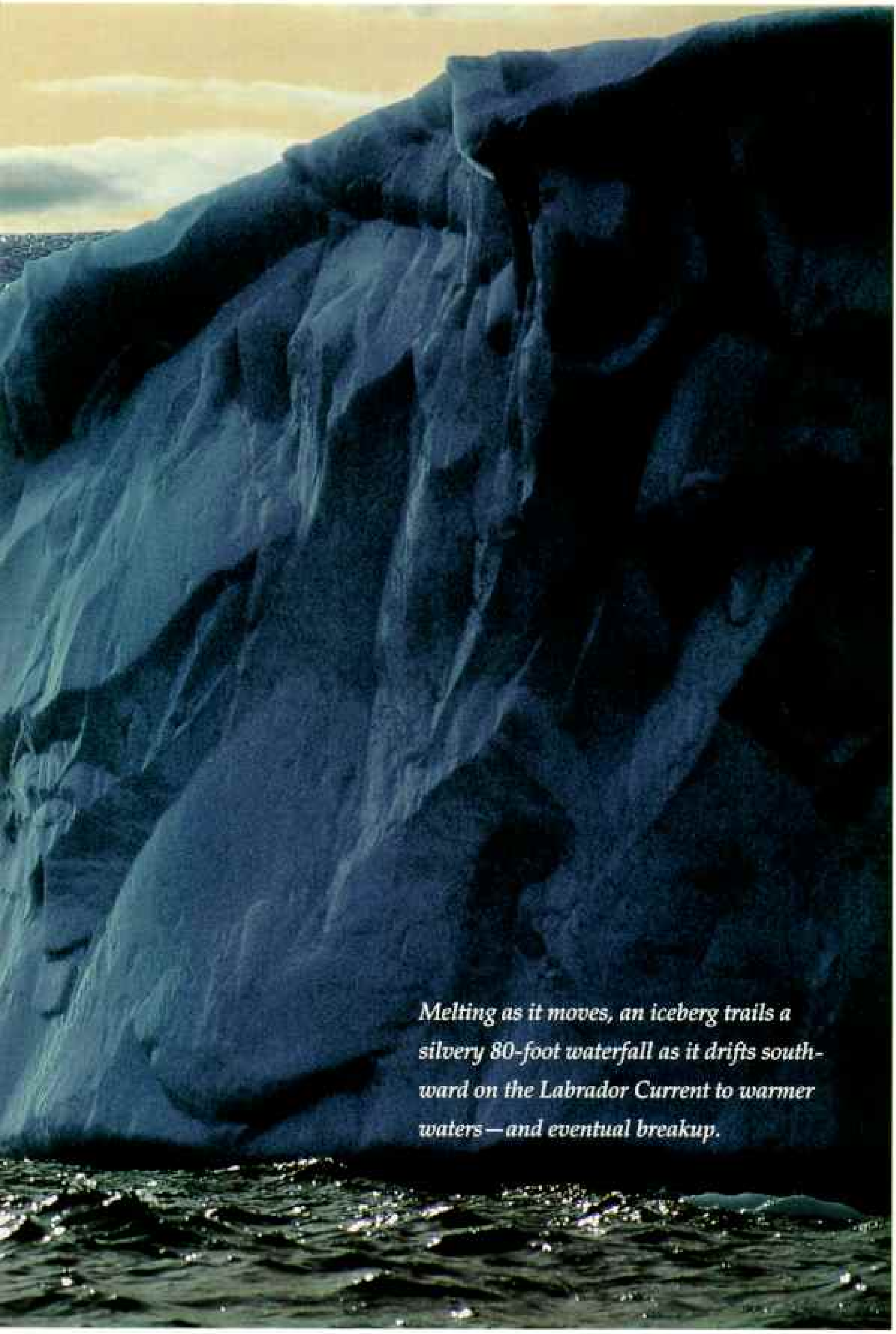
A makeshift swing helps pass a summer afternoon for cousins Stacey and Martin Rumboldt, who use the waterfront sheds of isolated Indian Cove as their playground. Raised on sea salt, woodsmoke, and numbing seven-month-long winters, children in coastal Labrador villages boast a grown-up pluck. "It has to breed hardness," proudly asserts one Labradorian. "I think there's an independence and self-reliance in the kids here."

FEW LABRADORIANS criticize such behavior openly, but many privately wonder what will happen if the Canadian government grants control over most of Labrador to its 1,500 Innu Indians. (Although the names sound similar, the Innu are unrelated to the Inuit, who live along Labrador's northern coast. In fact, the two groups fought each other long ago. Like the Innu, the Inuit also claim rights to Labrador's lands and resources.)

The Innu, formerly known as Montagnais Indians in central Labrador and as Naskapi in the north, all belong to the Algonquian family, which includes native peoples from South Carolina to the fringes of the Arctic.

"Those old names—Montagnais and Naskapi—were given to us by other people," explained Peter Penashue, president of the Innu Nation. "We call ourselves Innu, which simply means 'the people.' "

Given the speed of change in the outside world, it is hard to remember that Penashue's people were still living as nomads just 30 years ago, when they moved from tents to houses in Sheshatsheits and Davis Inlet, their two primary settlements. Unemployment and alcoholism run high in both of these places, where the suicide rates are far above the norm for Canada.



Melting as it moves, an iceberg trails a silvery 80-foot waterfall as it drifts southward on the Labrador Current to warmer waters—and eventual breakup.

"It was nice to see the men come from the nets with a smile on their faces." —GEORGINA ALLEN, Fisherman's wife

"We're still in transition," Penashue told me in his office at Sheshatsheits, an Indian word meaning "river narrows." "We haven't really found our place in your world. My generation was the first one born in this community. My father and mother were still very much suffering from the move. Their lives were just falling apart. A lot of fighting. Father spent a lot of time in jail, Mom a lot of time in the hospital. It's a pattern you see all through everybody's lives here," he said, pointing a thumb over his shoulder toward the outside, where the street was gouged with potholes and littered with trash.

Was he suggesting that his people take to their nomadic life again?

"You can't bring back what we've already lost. We just want to take control of our lives, instead of being dependent on government resources," he said, expressing hope that the Innu land claims will give them dominion over their ancestral territory, or at least some compensation for the loss.

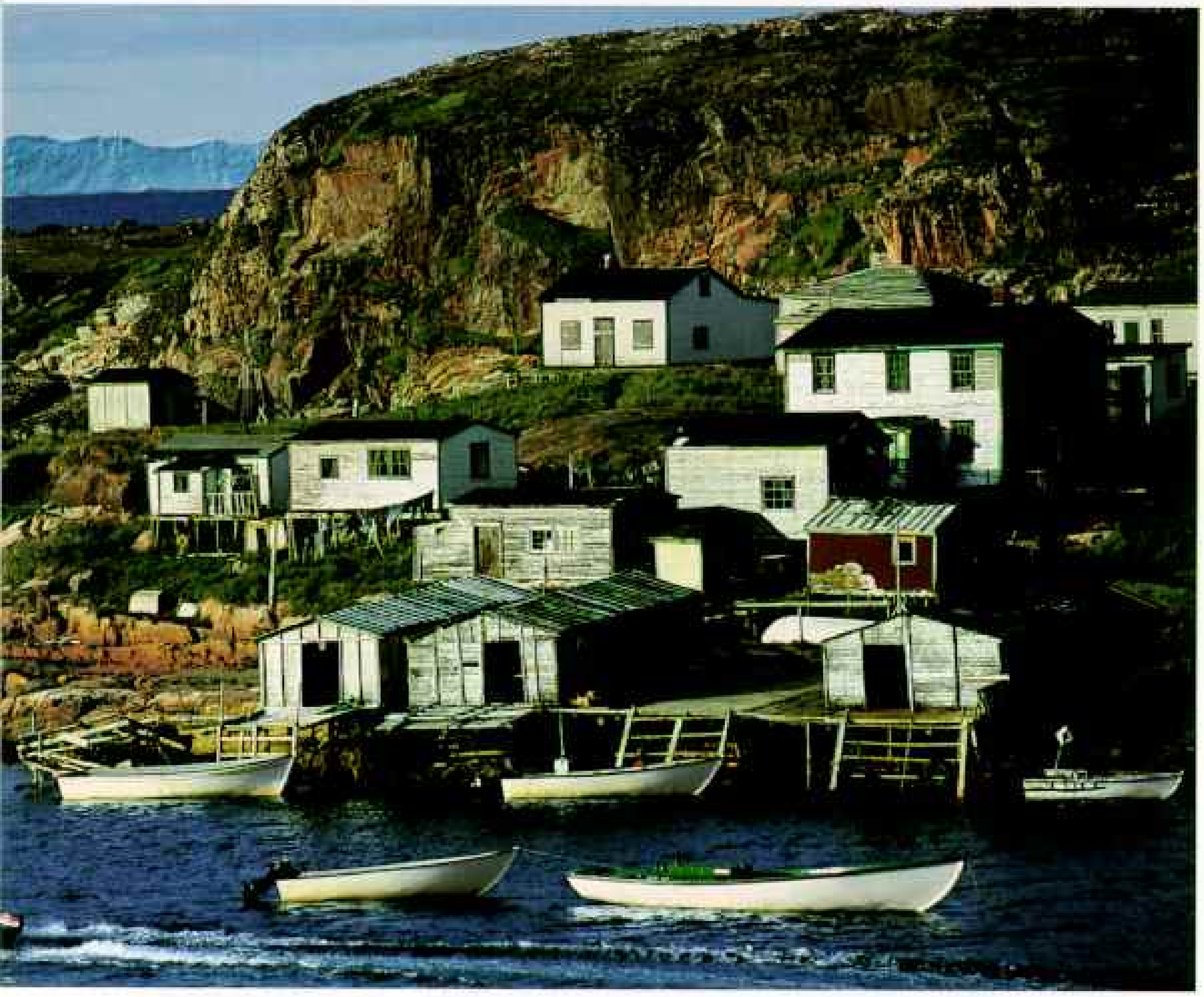
All of a sudden, it seems, everyone wants a piece of this land, which has gone virtually untouched during 9,000 years of human habitation. It began with Paleo-Indians, who were followed by Maritime Archaic Indians by 6000 B.C. The first Eskimos appeared in 2000 B.C. Other groups followed, including today's Inuit. Among the first Europeans to stay were Basque whalers, who seasonally occupied Labrador's south coast in the 16th century,* followed by waves of French, English, Scots, and a few Scandinavians; they came for the fur trade—and for the abundant coastal fisheries first celebrated, and perhaps exaggerated, by explorers in the 15th century. One of them, Sebastian Cabot, wrote of cod schools so thick that "they sumtymes stayed [the] shippes."

The days of abundant cod are long gone, but Labrador has other riches increasingly attractive to outsiders and natives alike. Mining companies are exploring the western end of Seal Lake for copper. Geologists are scouring the interior for gold and other precious minerals. Quebec and Labrador are arguing over the fair price of hydropower generated in Labrador and sold in Quebec. An Austrian timber company wants to cut the forests around Cartwright.

Sunlight whitewashes houses at Battle Harbour, an 18th-century fishing port now largely abandoned to the sea. To provide social services to far-flung fishermen and their families, the government relocated hundreds of remote communities during the 1960s—leaving the coastline dotted with ghost towns. The home of Labrador's first telegraph station and Anglican church, Battle Harbour is being restored as a historic site.

"This country has just gotten too accessible," said Derek Blake, who traces his ancestors to one of Labrador's old Inuit clans. We stood on a ship headed for the coast as night came on, and watched a florid sky go black. Derek sighed. He recalled the days when nobody gave a hoot about coming to Labrador, and the few who did had to slog through on their own muscle, by canoe or

*See "Discovery in Labrador: A 16th-Century Basque Whaling Port and Its Sunken Fleet," NATIONAL GEOGRAPHIC, July 1985.



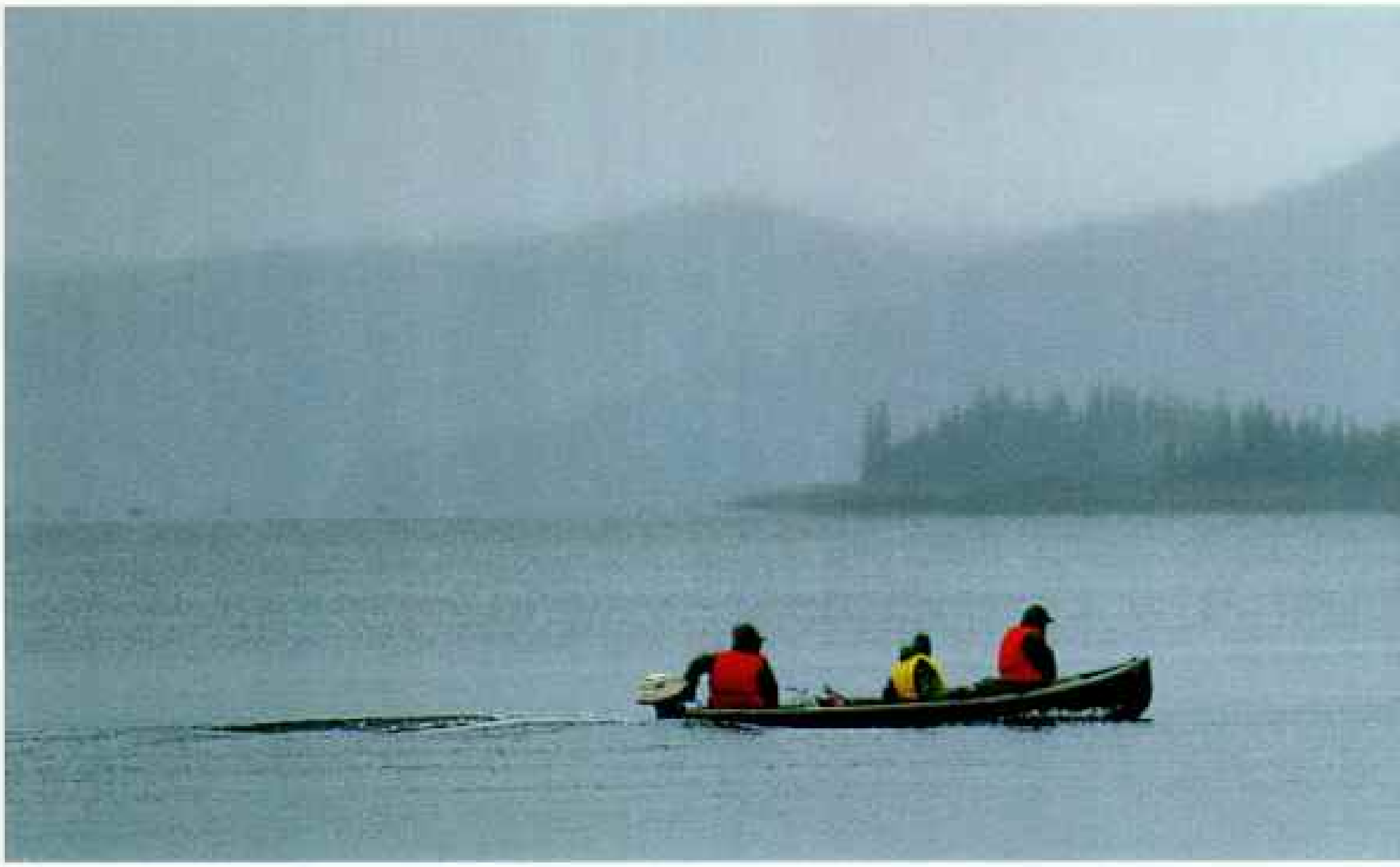
on snowshoes. "I hope we develop in a way that leaves this land just as it is," he said.

I was reassured to hear his sentiments echoed all over Labrador, where people have been involved with the land and sea for so many generations that they cannot imagine life apart from the wild country.

BY THE FIRST WEEK in July, you still couldn't tell it was summer in Paradise River. The temperature was in the 40s when Derm Wakeham and I arrived with a boatload of others aboard *Taverner*. But there were other signs of the changing season: Ice was breaking up on the south coast, bringing Atlantic salmon up from the sea, followed by commercial fishermen.

For Labradorians, this seasonal migration is known as "shifting out," a time when whole families pick up and move to their summer fishing stations, traveling on vessels like *Taverner*. A few years back, Wakeham told me, so many fishermen packed such vessels that some had to be turned away. "Now we're lucky to have 20 or 30," he said, looking down the vacant passageway.

The drop in *Taverner*'s business matched what seemed like an alarming decline in fish stocks. Both major commercial species—cod



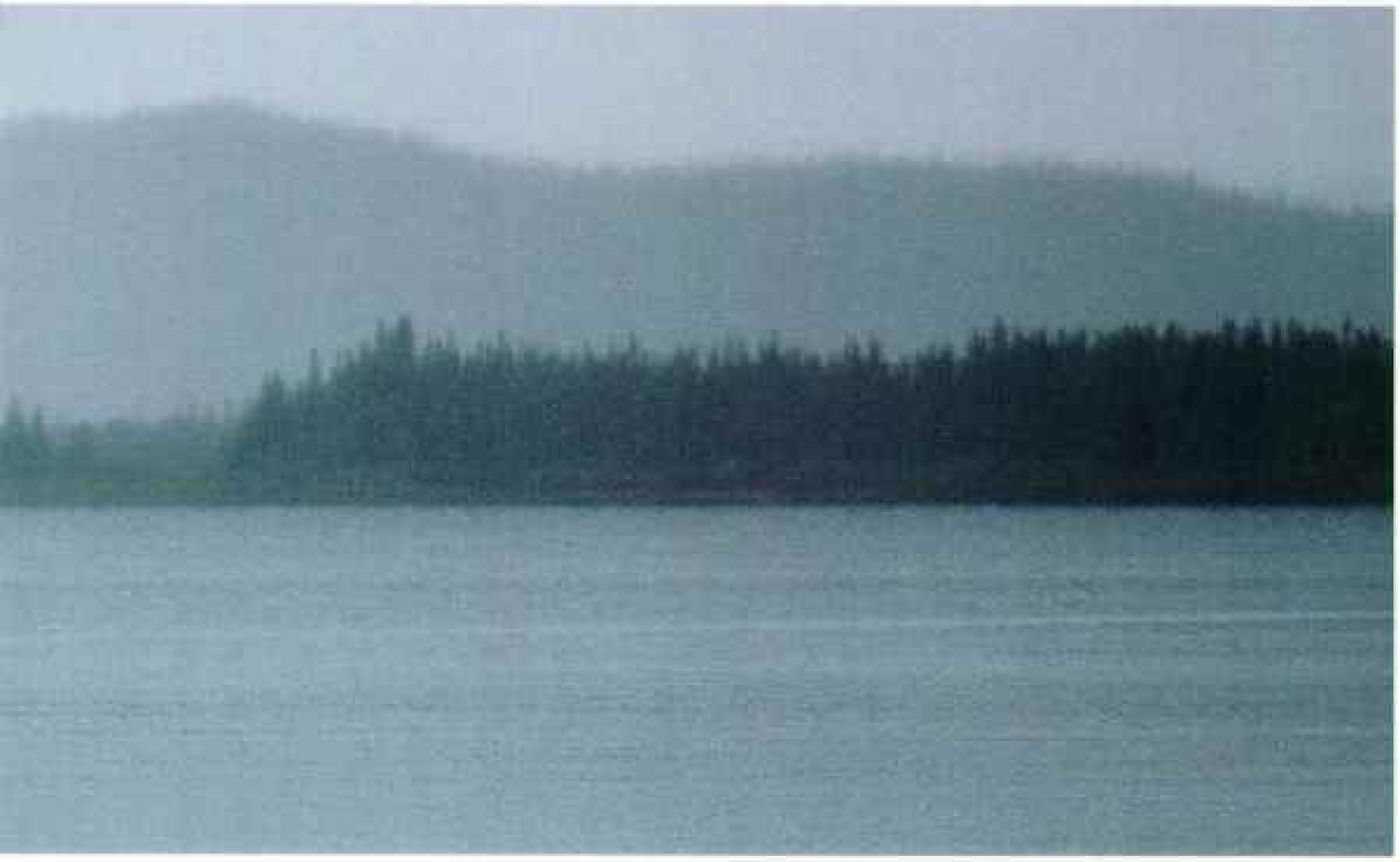
Veiled by a dreamy rain, visitors tour Seal Lake—one of the thousands of waterways covering a quarter of Labrador. Sportfishing draws tourists from the U. S. (below) who come to stalk "big red"—world-class brook trout. "A two-pounder would raise eyebrows anywhere else," remarks one fishing outfitter. "We don't even mention anything under three pounds."

and salmon—were in trouble, so passengers spoke with an added note of concern this year. "Too many people fishing," said a man bound for Bluff Head Cove.

"Too many seals eating fish," said a woman headed for Spotted Island, for centuries an area rich in cod. "Too many foreigners dragging the bottom with their nets," she said, drawing on a cigarette and eyeing me as if I might be a suspect.

"Are you fishing this summer?" I asked.

"No, we've retired," she said. "We're



going back home, as we calls it, because that's where we comes from, near Domino."

"Looks like you got out of fishing just in time, eh?"

"You're right there," she said. Her husband merely blew smoke at a sealed porthole and looked away. "We didn't catch a single cod last summer," she said. "They should have put a stop to it years ago."

WELL, NOW THEY HAD. The day before, the Canadian government announced a two-year moratorium on commercial cod fishing for most of Labrador and Newfoundland. The goal was to stem the decline of cod stocks, but at great human cost: Some 26,000 cod fishermen and plant workers were suddenly out of jobs, in a place where unemployment already runs at 20 percent.

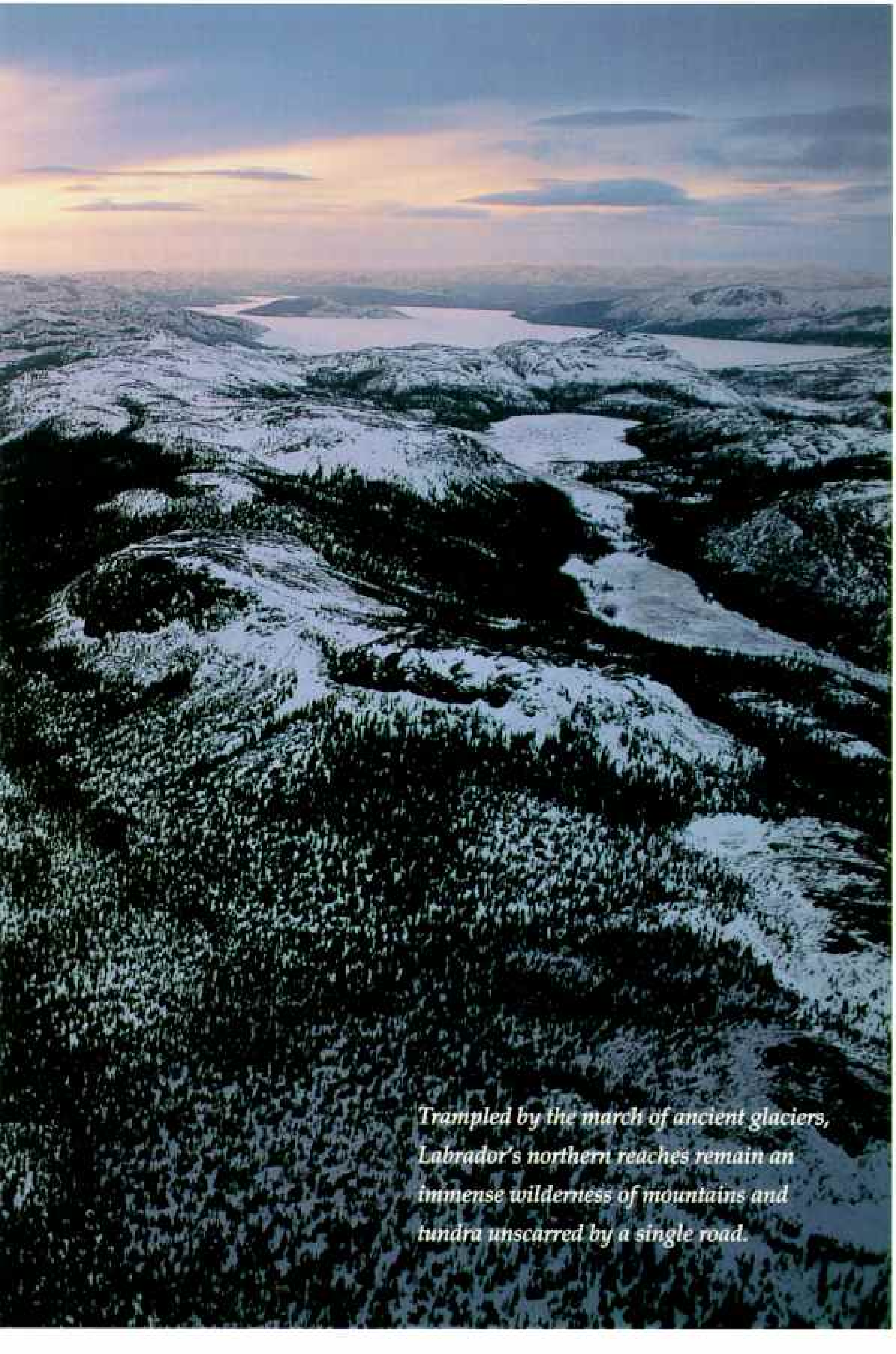
To ease the cod crisis, the federal government agreed to pay these newly unemployed up to $406 (U. S. $317) weekly for ten weeks. That helped for now, but the moratorium was a warning that the commercial fishermen themselves might become an endangered species unless they could switch to more plentiful crabs, arctic char, and scallops.

So this summer run on *Tavernier*, once a journey of hope, would be the last for many fishermen, who boarded the big ship with their dories loaded and their nets neatly stowed and disembarked in the middle of nowhere, heading for summer stations at Venison Tickle, Packs Harbour, Black Tickle, Grady Harbour, and points south.

By the time we got to Ice Tickle, it was dark and gusting. While *Tavernier* paused between two rocky headlands smeared with snow, a white boat came out of the mist to meet us. The dory's skipper, Kenny Allen, pulled alongside, as his wife, Georgina, their two children, and a golden retriever named Sparky clambered down *Tavernier*'s gangway to join him. Earlier Georgina had told me about last year's disastrous salmon fishing. "We got one salmon last year. One salmon! We *pray* that there's fish this year," she said, squeezing her eyes shut to emphasize the word.

And if there aren't?

"Then we'll find something else to make by. Or maybe we'll move. We don't want to, because the fishing is our ancestry. The old folks say there'll be a lot of salmon this year. I hope they're right." Despite the rain, Georgina's family was all smiles now, setting out together for a new season. She shouted goodbye over the wind: "I'll write you and let you hear how we did fishing." Kenny gunned the motor, and they disappeared in the fog.



Trampled by the march of ancient glaciers, Labrador's northern reaches remain an immense wilderness of mountains and tundra unscarred by a single road.

"I had seen so much that was beautiful, and so varied in its beauty, that I felt . . . bewildered." —MINA HUBBARD, Explorer

I went off to explore other parts of Labrador that summer, but I never forgot the image of Georgina's family in the rain, full of hope. I wondered if they had caught any salmon, if the prices were good, if this would be their last season. Months later, I heard. Georgina, true to her word, sent me a letter. It was good news. The Allens had netted 600 salmon. The prices were good. "It was nice to see the men come from the nets with a smile on their faces," she wrote. And next year? The Allens would stick with it—and pray for salmon.

Most other fishermen were quitting. Last year, in an effort to conserve salmon stocks, the Canadian government began paying commercial fishermen up to $50,000 each to leave the business. The hope was that less competition would help the few fishermen who remained. And it would save salmon for the sportfishermen, who spend millions of dollars in Atlantic Canada each year pursuing what many consider to be the king of game fish. By the end of 1992 Canada's salmon buy-out seemed to be working. In Labrador some 60 percent had taken the payments and abandoned their nets. On the Island of Newfoundland, where there is a five-year moratorium on commercial salmon fishing, 96 percent had turned in their licenses. The salmon needed a rest, I knew, but another part of me was rooting for the diehards like Georgina. It was painful to imagine their fishing stations abandoned to the elements, like other settlements I had seen up and down Labrador's coast, where the doors of empty cabins slapped in the wind and forsaken anchors rusted in the marshes.

THE NORTHERN SEABOARD is dotted with ghost towns at regular intervals—Killinek, Ramah, Okak, and Zoar among them—all built by Moravian missionaries from Europe, who established outposts of Christianity among Labrador's Inuit beginning in 1771. But, faced with rising costs and the inconvenience of maintaining scattered settlements in the wilderness, the church had closed many such missions by the 1950s.

To get a sense of what it was like in an old Moravian village, I invited Jessie Ford and Christine Baikie to join me for a flying visit to Hebron, an outpost built in 1831 but now long deserted and no longer a regular stop for ships. We went by helicopter.

It had been 50 years since Jessie, a woman in her 60s, had visited Hebron. "Oh, it used to be so nice," she said, standing in the sanctuary of the old Moravian church where she and her sister worshiped so long ago. Water dripped through the church's roof and puddled the floor, but Jessie and Christine chattered away, happy to be girls in Hebron again. They found the hooks in a doorjamb where their father had hung a swing for them. They paused at a window where they used to watch the water. They remembered how the men sat on the roof of the church in the dark at Easter and played the old familiar hymns on brass instruments before the whole village woke up and walked through the snow to the cemetery for a sunrise service.

Jessie looked all around her, blinking. "All the people who lived here in them days is dead now."

"Everybody was real friendly," said Christine. "Anybody who got a caribou or partridges shared them. When someone died, it was felt by the whole community, like it was one of your family, you know?"

"Would you want to come back to live here?" I asked.

"Yep," said Jessie.

"I wouldn't mind it," said Christine. "It was a wonderful place. No drinking. No drugs. No kids fighting."

"I do wish the kids today could live like we did," said Jessie.

"Yeah, but you'd never get 'em to live here," said Christine.

"Too quiet, I suppose," said Jessie.

"Too boring," said Christine.

The problem with living in the middle of a wilderness like Labrador is that, except for single-industry towns like Happy Valley-Goose Bay, Churchill Falls, and Labrador City, there are few places to work. Many

Caribou moss—not snow—carpets the ground between black spruce trees in the cold-bitten north country. Large pockets of the spongy ground cover, actually a lichen, can grow almost a foot deep, cushioning the weary steps of outdoorsmen.

young Labradorians thus face the prospect of going outside for work or staying home and taking welfare.

"I'd like to stay, but it doesn't look too likely," said Brad St. Croix, a 16-year-old who was standing in line outside a video arcade in Labrador City. "Nothing to do."

"Everybody thinks this place will be gone in ten years," said Dexter Gilbert, an eager youth in a Boston Bruins cap. He had graduated from high school just two days before and wanted to stay. But he worried about a job. The iron-ore mines were declining, plagued by a worldwide slump, and if they went, so did Lab City.

"It's bad for these kids," Barbara Kitowski said. "They love this place. Their souls are in the villages where they grew up, but they have to go away to find work, and have all kinds of problems on the outside. They can't adjust to the pace, so then they come back and can't make a living."

I saw what she meant in Nain, a predominantly Inuit village in Labrador's far north, where youths walk around looking bored and vacant. Some drink to pass the time, but a larger problem is solvent abuse, sniffing the fumes from gasoline to get high, according to Mounties stationed there.

"This is the worst time of year," said K. G. Coakley, a constable of the Royal Canadian Mounted Police. "It's too late in the season for people to get out on their snowmobiles and still a bit early for their boats," Coakley said. "So they stay inside and get depressed." That problem is shared by young and old in Nain.

"Yeah," said W. R. Mooney, another constable. "Just a couple of weeks ago we had an armed standoff with a guy who blew his brains out in front of us."

"Most of the cases that we investigate—

"I'd like to stay, but it doesn't look too likely. Nothing to do." —BRAD ST. CROIX, Teenager

shootings, assaults, fighting—are related to alcohol," Coakley said.

IN THE REST OF LABRADOR, unemployment is a problem; in Nain, where the jobless rate pushes 80 percent, it is epidemic. Inuit, who have long been fiercely independent, now struggle with the settled life. "It's a hell of a lot better now than it was in the 1940s and '50s, probably 100 percent better," said Toby Andersen, director of land claims for the Labrador Inuit Association. "But we are still living far short of the Canadian standards, in terms of health care, education, and housing. Housing is one of the biggest problems—just up the road here we've got a three-bedroom house with 20 people living in it, despite the provincial government's promise that it would provide adequate housing for us. Things are better, but it's like we're chipping away at a big cement wall with a little chisel. We have to fight tooth and nail for everything that most Canadians take for granted."

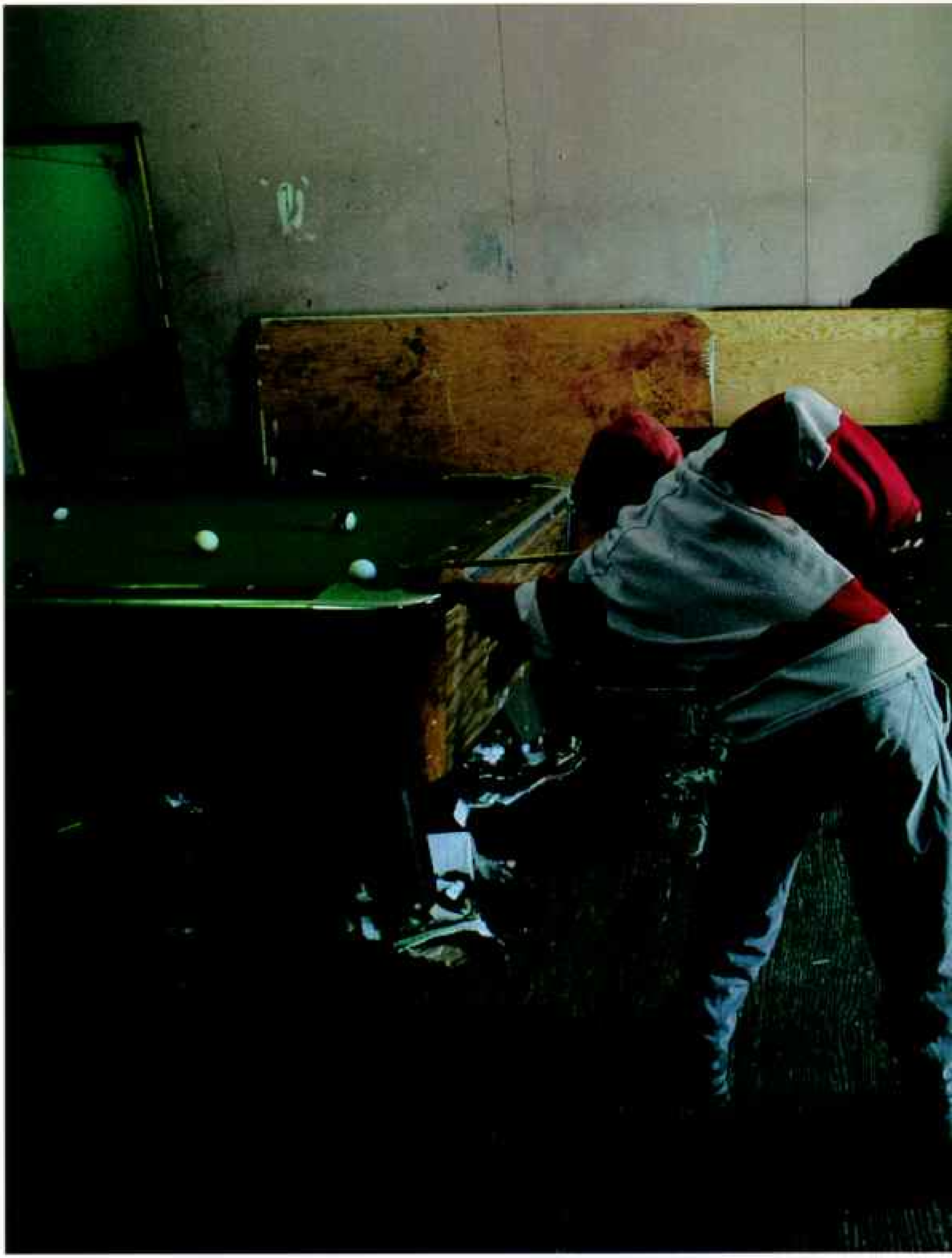
Yet there are Inuit success stories. Fran Williams, whom I visited in Nain one evening, is one. "We're nothing if not adaptable," she explained. "We've survived in a harsh country through sad times, and I am optimistic that we will continue." Fran's mission is to keep the Inuit language, Inuktitut, alive. Through the radio and television broadcasts of the OKalaKatiget Communications Society, she supervises 20 hours of broadcasting each week. She lit another cigarette in a vain attempt to keep the mosquitoes at bay and spoke of what makes you Inuit.

"We still have very strong family connections. We never look into the future more than a day or two. Going out on the land—hunting and fishing—that's a part of our life that will never die out. Nobody expects to go back to the way we used to live, but we can have parts of it—caribou, char, bakeapple berries, salmon—that's all we need."

The remarkable thing is that any vestiges of their culture survive at all. Many of the missionaries tried to wipe out indigenous religion. But one missionary stands out for his gentleness and sympathy toward all Labradorians—Wilfred Grenfell, an energetic doctor who first visited the Labrador coast in 1892 on behalf of the Royal National Mission to Deep Sea Fishermen. For 40 years he served the sick and the poor, traveling by dog team and by the hospital ship *Strathcona*. He helped reduce the incidence of tuberculosis, scurvy, rickets, and beriberi and established a string of regional nursing stations and hospitals that bear his name today.

Walking through Nain one evening, I could see how the Inuit still rely on the old ways: Slabs of arctic char dried on wooden racks in a backyard, sealskins hung on a

Grand Central station for gossip: Teenagers swarm a video arcade in Labrador City, a one-industry town where iron mining is king—for now. More than 12,000 people here depend on the Iron Ore Company of Canada (lower right) for their economic survival. But world demand for ore is shrinking, and production has been drastically scaled back. "For the kids it doesn't look good," admits a mine official. "We're dropping more than we're hiring."



Taking aim against boredom, an Innu teenager shoots a solitary game of pool at a youth center in Davis Inlet—an impoverished community of once nomadic caribou hunters and their kin, now wracked by gasoline sniffing and suicides.

"We're nothing if not adaptable. We've survived in a harsh country through sad times." —FRAN WILLIAMS, Inuit leader

clothesline, caribou antlers guarded the door of a shed. Down by the docks, people tinkered with boat engines and scraped paint, getting ready for seal hunting and another season of char fishing. Groups of men and women stood on the pier, chatting as their neighbors loaded rods and rifles into boats.

Up the hill, the bell was tolling for an evening service at the Moravian church, an old wooden building sagging on its foundations. I slid into a back pew and listened as the congregation sang old German hymns in Inuktitut, led by a man in a gray sweatshirt with a tattoo on his forearm. His name was Amos, and he had the calm dignity of a natural leader, steering the 50 or so worshipers through songs that sounded mournful and beautiful at the same time. Two cultures blended in the music, drifting in the rafters, spilling out over the wooden houses of town.

IF YOU LEAVE the church and go north of Nain, beyond the limit of permanent settlement, you pass the tree line and enter a wild land of sparkling fjords and enormous caribou herds, a place where some of the rocks have been dated at 3.6 billion years, which makes them among the oldest on earth.

With a couple of local men, I set out to explore this region, traveling from Nain in a 24-foot cruiser. It was early summer, but ice still pressed the coast, which made for tense traveling. We inched through a maze of floes that glowed turquoise and silver. They grumbled as we brushed past. Leads opened and closed all around, reminding me of what happened to the English explorer John Knight in 1606. Searching for the Northwest Passage, Knight got stuck in ice off the coast of Labrador—same place, same time of year—and went ashore, where he disappeared, probably killed by Inuit hunters. No danger of that these days, but it did appear that we were sailing for trouble. A few hours out, our radio sputtered and died. A few hours after that, we stopped for lunch and learned that some of our bottled food was spoiled. We finally came to a wall of ice that seemed to stretch forever across our path. The boat's captain, a transplanted Scot named Tom Goodwin, scrambled atop the cabin to look things over. He dropped back on deck with a thump. "That's it," he said, reversing the engines and turning us south again. Frustrated, he slowly shook his head. "Labrador!" he growled, making the word sound like an incurable disease.

"Nobody really lives off the land these days," said Douglas Blake, up to his shins in snow on a January morning. The temperature was stuck somewhere around zero, and the ice on Grand Lake was frozen four feet thick. But since the sun was shining and

"The only time I see my husband is when the weather's bad," jokes Mary Katherine Gregoire, an Innu whose family spends part of each summer in the forest, hunting near Davis Inlet. Locked in a bruising land battle with authorities, many Innu are demanding hunting and fishing rights over huge areas of Labrador.

At their administrative center in Nain (lower right), the Inuit are pursuing similar claims against the government.

Keeping an ancient appointment with springtime, caribou migrate across Labrador's frosty uplands, bound for remote calving grounds. The George River herd—an estimated 400,000 animals—makes up one of the largest caribou populations in North America.

"If you're not prepared in this country, if you let up just one time . . . she'll get you." —LOUIE MONTAGUE, Retired trapper

Racing a dying sun, snowmobilers roar across the frozen Churchill River; within minutes the world will disappear in a gathering fog. Never predictable, often spellbinding, Labrador offers up its ethereal brand of beauty to those who live by its rugged terms. "It's very, very quiet up there," observes a veteran trapper intimate with its wild, unbroken horizons. "And good God, you can go, and go, and go."

Douglas had some days off coming to him, I finally prevailed upon him to take me into the bush.

Like a few other Labradorians, Douglas still traps animals on occasion, but more as a diversion than a necessity. "The last man who trapped full-time quit a couple of years ago," said Douglas, whose own trapping lines loop a hundred miles north from North West River, up the southern shore of Grand Lake, up the Beaver River, and back down the lake's northern shore.

Blakes have trapped along this lake for generations. Douglas's ancestors did it on snowshoes; we used snowmobiles, driving on the frozen lake, dismounting every few miles to see if anything had wandered into his traps, baited with bits of fish.

Douglas paused beneath a white spruce so big you couldn't get your arms around it. He reached into his coat, produced a small bottle and gave me a whiff. Peppermint oil. "There's some scent from beaver glands in there too," he said, sprinkling a few drops on a stick that he put on the ground. Concealed in the roots a few feet away a leg-hold trap was staked to the spruce. "The scent brings the animal over to investigate, then he smells the bait. Then, with any luck . . . ," said Douglas, snapping his fingers to complete the sentence.

"What are you hoping for?" I asked.

"Marten, fox—maybe a lynx." He led me through the frozen brush to our snowmobiles. "I'd be surprised if we got a lynx. Nobody's seen one around here since the big forest fire in 1985." And even if a lynx turned up, the skin would fetch only $85 or so, down from the $800 range of the 1980s. That was before the recession, and before animal-rights activists made fur unfashionable.

"So why are we out here?"

"Better than being inside," Douglas answered. He was right. The air was sharp, the mountains muffled in snow, the blue sky shining as if newly made. We zoomed along the ice, all alone, bumping over cracks and pressure ridges, checking traps.

"Nothing here," Douglas said from the bushes. "Nope," he said, farther up the lake. Nothing. Nothing. Nothing. Then we found a luckless Canada jay, which had blundered into a marten trap and broken its neck. Back on the machines.

Nothing. Nothing. Nothing. Then wolf tracks. They looked bold and purposeful, heading straight up the shoreline. Douglas, who works as a wildlife officer for the provincial government, guessed that five wolves formed this pack. "Fresh tracks," he said. We followed until one set of tracks peeled off from the others and headed toward shore, straight for the traps. Then the tracks stopped cold, 20 feet short of the traps, and I

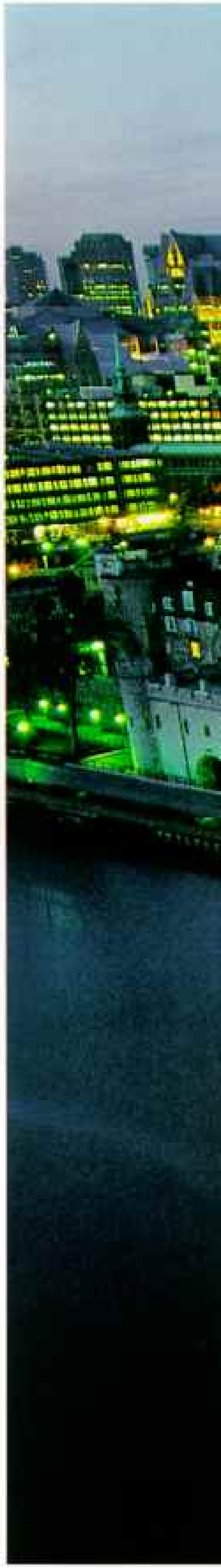
could picture the big animal sniffing the air, catching the warning scent, doubling back to join the others.

Twenty stops later, the day ended at twilight, with one dead jay to show for it. I was thawing by a cast-iron stove, which popped and sizzled in Douglas's one-room cabin. Here, near the northwest end of Grand Lake, Leonidas Hubbard had disappeared up the Susan River all those years ago.

"We'd be starved like Hubbard too if we were living off the land," said Douglas, mopping up the last bit of grouse stew with a hunk of bread. "It's one of those lean years," he added, reminding me how the natural cycle works in Labrador, scarce years followed by fat ones, followed by scarce again. Hubbard had hit a scarce one.

I thought of him and all the others I knew now—Jack, Doris, Georgina, and Louie among them—who loved Labrador as I did, despite its stinginess and harsh edges. You had to put up with a lot, but Labrador's unexpected fits of generosity made the trouble worthwhile, as on this January night. Dark closed like a lid on the mountains, shutting out the world, and the stars blazed to life in a sky suddenly too small to hold them. All of Labrador seemed to glow under a crust of snow, looking empty and beautiful. □

THE LIVING TOWER OF LONDON



Grim cornerstone of British history, the Tower is both crown jewels treasure-house and notorious execution ground. For 900 years it has also embraced a thriving community of soldiers and their families. Some 150 residents, including Charlie Anderson, five, and Yeoman Warder Joseph David, call the Tower home.

By WILLIAM R. NEWCOTT
NATIONAL GEOGRAPHIC EDITORIAL STAFF
Photographs by JONATHAN BLAIR

Mint

Metals were assayed and coins of the realm minted for 500 years, beginning in the late 1200s, in the outer ward area called Mint Street.

Henry VIII's silver four-penny coin was produced in the Tower—possibly in the recently discovered mint in Legge's Mount.

Prison

Sir Walter Raleigh planted tobacco here while an inmate. He and other jailed celebrities (below) helped immortalize the Tower as prison, a role secondary to other official uses.

Sir Thomas More
Former Chancellor
Beheaded 1535

Princess Elizabeth
Future Queen
Prisoner 1554

William Penn
Pennsylvania Founder
Prisoner 1668

Zoo

Henry III first displayed leopards and a polar bear in the 1200s. The collection grew; James I baited his lions with dogs in the 1600s. The Tower menagerie was moved to the new London Zoo in 1835.

Palace

The Wakefield Tower housed Edward I's sumptuous throne room in the 13th century.

PAINTING BY NATIONAL GEOGRAPHIC ARTIST WILLIAM H. BOND
CONSULTANT: GEOFFREY PARNELL, KEEPER OF TOWER HISTORY

Eras of royal construction: Who built what when

- 1066–1100 — William I–William II
- 1189–1216 — Richard I–John
- 1216–1272 — Henry III
- 1272–1307 — Edward I
- 1307–1377 — Edward II–Edward III
- 1509–1547 — Henry VIII
- 1600–present

Fortress

In 900 years, not a day has passed without soldiers in the Tower. The 15th-century Wars of the Roses saw the king's Tower cannon battle rebels across the Thames.

Vault

The crown jewels have been on display in the Tower since the 1600s. Security was tightened after Thomas Blood's 1671 attempt to steal them from the Martin Tower.

Chapel

Medieval spiritual haven, the Chapel of St. John in the White Tower was no refuge for the Archbishop of Canterbury in 1381. Peasant uprisers dragged him out and killed him.

St. Edward's Crown and the royal orb and scepter were Blood's targets.

Tower of London
STOREHOUSE OF HISTORY

The Caesars were there first. At the southeast corner of the old wall that once surrounded the Roman city of Londinium, William the Conqueror began work on the White Tower about 1078. Like growth rings on a tree, the complex grew concentrically as subsequent kings further fortified the site. Still officially a royal palace, the Tower has not been principal home to a monarch since Henry VII died in 1509. His son Henry VIII preferred life upriver in the more fashionable Whitehall Palace but deemed the Tower a perfect accommodation—and final resting-place—for his enemies.

Banners of Henry VI's loyalists and the White Rose rebels

THROUGH A CROSS-SHAPED arrow slit the River Thames was barely visible, obscured by gathering darkness and the Tower of London's low outer wall.

I balanced uncomfortably on a roughly hewn ledge in a star-shaped stone chamber. Ten paces across the room was a solid wooden door, without even the tiny barred window I'd expected in a medieval prison cell. Of course, I was free to open it and leave this cell at any time. But I had decided to spend the night, to get a sense of what it was like to be imprisoned here, confined by stone walls and chased by an inescapable chill.

That was how it was for Sir Thomas More. He lived in this room for most of the 15 months he spent in the Tower, refusing to acknowledge Henry VIII as head of the church in England.

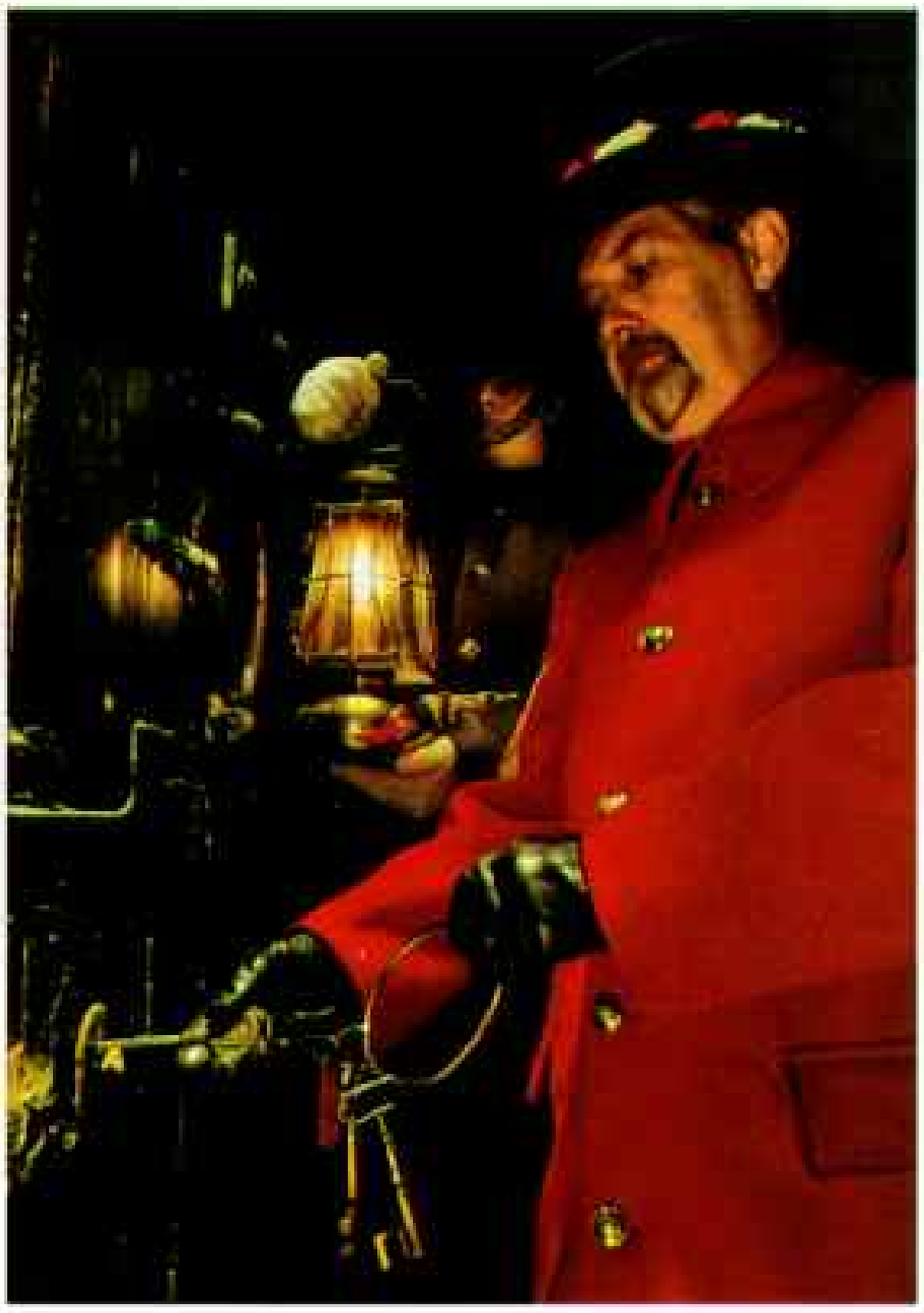
"I am dying already," wrote More six months before his death. Then, on July 6, 1535, he walked to the executioner's block.

As I watched the shadows lengthen inside More's cell, the vaulted ceiling disappeared into darkness. I moved from one arrow slit to another. The night air swirled with sounds of humanity—the Tower has some 50 families living in it still—but my cell's tiny openings, some 20 feet above the ground, hid all signs of life from view.

I heard a woman talking about supper arrangements. At the main gate, just below, friends laughed and said good-byes. At regular intervals, the click of a sentry's boots passed, first in one direction, then in the other.

Photographer JONATHAN BLAIR has covered nearly 30 stories for the GEOGRAPHIC, most recently "Between Monterey Tides," in the February 1990 issue.

Executions on Tower Green shielded victims from the curious; now more than two million people a year tread the spot (left) with yeoman warder—or "beefeater"—guides.



A handful of visitors witness the nightly Ceremony of the Keys. Chief Yeoman Warder Norman Jackson rehearses the ritual with a new batch of army regulars stationed at the Tower.

Minutes before 10 p.m. I heard the sentry shout his challenge to the chief yeoman warder, who had just locked the gates in the nightly 700-year-old Ceremony of the Keys: "Halt! Who comes there?" was the muffled cry. "The keys." "Whose keys?" "Queen Elizabeth's keys."

How often More and other prisoners of the crown must have heard those jangling keys and dreamed of freedom. By my only source of light, a dim sliver squeezing through an arrow slit from a sentry post lantern, I read from his *Dialogue of Comfort*, written within these walls, of his "joyful meditation of eternal life in heaven that we shall win with this short temporal death."

I'd brought along two blankets. I threw one on the floor, lay down, and wondered if More ever looked forward to another morning in the Tower. I pulled the blanket to my chin and made a pillow of a jacket. On the ceiling the shaft of light through the arrow slit projected a perfect cross.

My sleep was dreamless, as if within these dank walls all dreams had been used up long ago.

"HENCE WITH HIM to the Tower," declares King Edward in Shakespeare's *Henry VI, Part 3*. The Bard's Elizabethan audiences knew exactly what that meant, and all that it implied.

The 12-acre complex of buildings known as the Tower of London was not erected as a prison, nor were any formal jail facilities ever built in it. Yet since construction began about 1078, some 1,700 prisoners have been hurled into its basements, locked in its towers, or, for those of influence, opulently housed in its most comfortable rooms.

Beneath a Spanish chestnut ceiling dating from the reign of Henry VIII, the wedding of a beefeater's son begins in the Chapel Royal of St. Peter ad Vincula (opposite). Henry's queen Anne Boleyn, beheaded on May 19, 1536, lies under a floor memorial, here covered with roses like those delivered anonymously each year on the anniversary of her death.

One day I leafed through the list of prisoners, drawn from the archives. For every Thomas More, Walter Raleigh, or Anne Boleyn there were hundreds of other unfortunates who passed through the gates to an ominous unknown.

"1241: William de Marish. Conspiracy against Henry III. Locked in chains, then disemboweled and quartered."

"1441: Margery Jourdayn. Treason, witchcraft and sorcery. Burned . . . as a heretic."

"1502: Sir William de la Pole. Rebellion against Henry VII. . . . held in the Tower, almost 38 years."

"1746: Lady Teresa Traquair . . . became a voluntary prisoner . . . to be with her husband."

The Tower is today, and has always been, dominated by the original structure at its center, the 90-foot-high White Tower begun as a palace stronghold by William the Conqueror. Some of its stones William had brought from Normandy.

The monument now draws some two million tourists each year. But few notice the long lines of private homes built against the inner face of the 13th-century outer wall. Here live most of the 41 yeoman warders, better known as beefeaters. Some say the nickname, coined in the 1670s, has to do with an early responsibility of testing the king's food to protect him from poisoning.

"You never really forget you're living in the Tower of London," said Chief Yeoman Warder Norman Jackson, looking very unbeefeater-like in a jacket and tie, sharing his umbrella as we sought a lunch spot outside the Tower. He and his wife, Beryl, have lived in their outer-wall home since 1977.

"The accommodations are comfortable, but not large by any means," said Jackson. He held me back as, like countless London visitors, I looked the wrong way before crossing the street. "If you're out past midnight, you must report at the guardhouse for that night's password to gain admittance. And, of course, you have a couple of million tourists wandering through your neighborhood all year."

From a window table at the Tower Thistle Hotel, Jackson fixed a steely gaze at storm clouds rushing over the Victorian fantasy of Tower Bridge. Troubled days lay ahead for his men. Longer working hours were the immediate concern, and there were rumblings about cutbacks.

I wondered what Edward VI would have thought. It was during his reign, in 1550, that the Tower warders were made extraordinary members of the Yeomen of the Guard, an elite corps of 200 that served as his personal security force. In the ensuing centuries the yeoman warders have been bodyguards, Tower jailers, and, for the past 300 years or so, tour guides with a flair.

When the Duke of Wellington became constable of the Tower in 1826, he was unimpressed with what had become a ragtag contingent.

"He decreed that all yeoman warders must be 'deserving, gallant, and meritorious,' " Jackson told me. "Today they must be senior noncommissioned officers with at least 22 years of service and a Long Service and Good Conduct Medal."

I hesitated to ask the obvious question: When will a prospective yeoman warder arrive at the Tower with her husband in tow? "There's nothing to bar a woman," he said, "so long as she's

got a good damn strong voice that can be heard by 200 people at once. But I can honestly say that no woman has ever applied for the job.

"When she does, I suppose we'll have to make some alterations to the uniform."

ON TOWER GREEN, the Tower of London's tree-shaded village square, I watched a beefeater recite the litany of those who lost their heads on that tranquil plot of ground. Standing above his listeners on a black wooden block, he embodied the mixture of pride and pain the British draw from their history.

The first official execution on this spot was an informal affair. At an otherwise routine meeting in the White Tower one day in 1483, the future King Richard III declared Lord Hastings a traitor, ordering him dragged outside and his head cut off on a log. Hastings was buried beneath the floor of the Tower's church, St. Peter ad Vincula. Over the next century and a half his bones would mingle with those of other enemies of the crown.

Sitting alone in the back row of the chapel, I envisioned the grim post-execution routine, the wooden doors swinging open and workmen clanging in with their spades, dragging the decapitated body by the heels. (The heads were usually displayed on London Bridge.) A large floor stone or two was raised, a hole dug. Some quicklime to hasten decomposition, a bit of refilling, and the stones were replaced. After a few centuries of this, the floor was so jumbled that a complete restoration was ordered by Queen Victoria.

Henry VIII, king from 1509 to 1547, was responsible for many of those burials. The 1533 coronation of Queen Anne Boleyn was occasion for one of the Tower's first gun salutes; three years later she was the first reigning queen to be executed inside the Tower. Adultery was the charge, failure to give Henry a son the reason.

Anne's last request was to be dispatched with a sword, rather than an ax. Doubtless she knew the ax was a messy method. Henry granted Anne's wish and sent to France for a swordsman. She was pleased with the choice.

"I have heard say the executioner was very good," she told a friend. With a hearty laugh she added, "And I have a little neck."

Sir Walter Raleigh eventually lost his head; still, he must be considered one of the Tower's great survivors. A swaggering and popular nobleman, Raleigh was also a shameless self-promoter who made his share of enemies. Despite flimsy evidence, he was implicated in a plot to overthrow King James I in 1603. Sentenced to death, Raleigh was instead jailed indefinitely.

"In that Tower . . . I have suffered so much adversity," he declared at the end of his life, though by sheer audacity he spent many of his 13 years there living in relative luxury. He arranged to have an additional floor inserted in his Bloody Tower quarters and brought in his wife and son. He grew tobacco in his garden and turned a henhouse into a chemical laboratory. In his spare time he wrote his *History of the World*.

Raleigh himself became one of London's chief tourist attractions. At the same hour each day, crowds gathered at the riverfront to see the prisoner, in black velvet coat and lace cap, stride a wall-top terrace known today as Raleigh's Walk.

Wielding partisans and wearing swords at their sides, beefeaters (above) are sworn to defend the monarch. Her initials are embroidered in gold on their 15-pound state dress uniforms, worn only on solemn occasions. A reproduction—with a plush bear inside (left)—is available at the gift shops for $1,500. Shipping is extra.

Gray on gray, Thames mist swirls down Water Lane (right), just inside the Tower's outer wall along the river. The Thames once lapped against the wall at right and the round Lanthorn Tower—which, tradition says, served as a lighthouse until Edward I filled in this area in the late 1200s. He also built the outer wall, which stands behind the beefeaters' pub and its unmarked portals. In later years the Lanthorn Tower housed

prisoners, who may have passed the time creating intricate wall carvings. Such stones of sorrow line the walls of the Beauchamp Tower (above), where scores of carvings, some brought from other parts of the Tower, are displayed.

I walked that terrace one sunny afternoon. To the northwest I could make out the bank and insurance buildings that power the pulse of today's London, towers of glass and steel where modern Raleighs wheel and deal in executive suites.

Raleigh's luck seemed to turn in 1616, when he persuaded James to look beyond his rancor and let him head an expedition to South America in search of gold. But when Raleigh returned empty-handed, James threw him back into the Tower and reinstated his death sentence. When his time finally came, Raleigh was aged and sick. As he approached the executioner's block, a flash of his old wit returned: "This is a sharp medicine," he said, examining the blade, "but it is a sure cure for all diseases."

MOST OF THE TOWER'S residential areas are strictly off-limits to visitors. But some homes, like those of the Tower's resident governor and his two deputies, stand directly on the bustling inner ward.

"I'll never forget finding two confused-looking Canadian women in my front hall one afternoon," recalls Deputy Governor David Anderson. "They thought our home was part of the tour. My wife and I were surprised, but we did the civil thing: We asked them to tea."

The Tower truly comes alive after the daily crunch of visitors has departed. One by one the warders and their families reclaim their village, walking their dogs, hitting golf balls, playing tennis in the now filled, grass-covered moat, or perhaps bending an elbow at the local pub.

Until the middle of the 19th century the Tower supported several pubs within its walls. Today the unmarked Yeoman Warders Club, tucked against the outer wall on the Tower's river side, is the sole survivor. Just about all the beefeaters will stop in at least once before closing time. As many other invited guests soon discover, I found that my money was no good there.

The knights are always young at a Tower educational program, in which students wear actual medieval battle gear. They also try on replicas of the crown jewels. Master Jeweler Henry Phillips (top) has the annual honor of cleaning the real thing. Here he polishes the Imperial State Crown's 2,800 diamonds—including the world's second largest, set in the headband.

Waxing keeps Henry VIII's armor like new after 470 years (above). Scientists designing NASA space suits reportedly studied the joints in Tower armor.

"You'll not be goin' home tonight," warder-in-training Ray Bruce warned me, elbowing his way to the bar. "What are you drinkin'?"

"Diet Coke," was my pitiful reply.

His eyes narrowed. "Not bloody likely."

Well, I kept on with my fizzy drinks, as they call them in London, but I sensed that the beefeaters were disappointed with me.

You might expect the beefeaters to be talked out after a day on duty, but few of them can abide conversational lulls. In fact, all seemed to be talking at once, each parade-ground voice rising above the next, one hand holding a glass and cigarette, the other gesturing to add emphasis to what most often turned out to be an old military story.

"They'll be soldiers till they die," said one Tower wife, pressed into a corner of the club with a knot of other women. Nearly all beefeaters' spouses have jobs outside the Tower, most in London's financial district.

"It's funny," she told me. "We women leave here every day and widen our horizons, and it's the men who stay home. A lot of these chaps have become almost institutionalized."

Today 150 people call the Tower home; at its height several times that number lived behind the walls. Many served in the monarch's household or worked in the mint; others were state prisoners. Most, though, were soldiers.

The soldiers are still there, primarily to protect the Tower's chief attraction, the crown jewels. A handful of army regulars put in a day or two at a time, staying in the imposing Waterloo Block, built in 1845 to accommodate a thousand men.

By day the soldiers wear scarlet uniforms and tall bearskin hats, pacing their beat or standing at ease by the black wooden guard boxes. At night they patrol the darkened Tower in green battle fatigues, toting automatic rifles and demanding the password from anyone out for a stroll.

"I think the password is the oddest part of living here," Karen McGrath told me as we sipped tea in the dining room of her family's home on Tower Green. "The first few times they came out of the dark and asked me, I just stood there with my mouth open."

Karen, her mother, and two brothers live with her father, Dr. John McGrath, the Tower physician. Tradition holds that his predecessors were responsible for resuscitating torture victims. That may be fact, it may be fable. Both are hopelessly intertwined in the Tower of London.

Untangling history and myth is the job of Geoffrey Parnell, the Keeper of Tower History. He's an archaeological historian—a position that

sometimes puts him at odds with the beefeaters' favorite stories. They call him Geoff the Dig.

"For example, there's the house on Tower Green where they've always said Anne Boleyn stayed before her death," said Parnell. "In fact it hadn't been built yet. Most of the yeoman warders are open to new information, but I've met one or two who have dug their heels in."

History and tradition also collide head-on in the Bloody Tower. Ushering reverential tourists to its base, the beefeaters never fail to relate the grim genesis of its name: the deaths of the two young princes, supposedly on the orders of their uncle, Richard III. Shakespeare, and before him Thomas More, blamed Richard, contending that his henchmen smothered the boys

Banquet in a basement is a formal affair as Prime Minister John Major is feted in the White Tower cellar, where in Tudor times the mere sight of torture implements was often enough to draw a confession. For Yeoman Warder Ray Bruce and his wife, Marj, every meal is cozy (left). The hallway in their outer-wall flat doubles as a dining room.

in what was then known as the Garden Tower.

But as I stood beneath the tower hearing one beefeater after another tell the story, I was struck with their caution. The word "allegedly" occurred more often than on a TV news crime report. Chalk up another one for historian Parnell: The fact is no one can be sure just what happened to the boys. After their arrival at the Tower in 1483 they were declared illegitimate and ineligible for the crown. The princes were then seen less and less frequently, until finally no one saw them again. Two small skeletons were found buried under the White Tower stairs 191 years later, but they cannot be positively identified, and nobody has been able to pin the deaths on Richard.

"You make a flat statement about Richard III's guilt," I heard Norman Jackson warn a new yeoman warder, "and you can bet someone will call you on it."

"OF COURSE," your mind tells you at first glimpse of the crown jewels, "they are all fake." But they aren't. Displayed behind thick glass, the crowns and scepters are arranged in a blinding series of still lifes. The more spectacular pieces, including the Imperial State Crown and Imperial Crown of India, are embedded with thousands of diamonds each. But my eyes were drawn—or perhaps averted by glare—to the simple St. Edward's Crown, with its plain gold surfaces and semiprecious decorative stones. Dating in its present form from the reign of Charles II, it is used only at the climax of the coronation ceremony and illustrates the importance of this collection to Britain's heritage.

There is no insurance on the jewels. "They're priceless," curator Bob Melling told me. "Beyond the metals and stones, how do you put a price on antiquity, on the fact that every king and queen of England has worn them?"

In 1671 the crown jewels were kept in the Martin Tower—the tower farthest from the main gate—and it was there that the only attempt to steal the jewels was made. An Irish adventurer named Thomas Blood—who liked to be called Colonel Blood—disguised himself as a clergyman and befriended the keeper of the jewel house. He arrived one morning with three friends, asking to see the jewels. As the keeper unlocked the door, the foursome overcame him and ran off with St. Edward's Crown and the royal orb.

The thieves made it out the Tower gate, but three of them—including Blood—were captured with their loot along the wharf outside.

Blood, as brazen as Walter Raleigh before him, told his captors he would speak only to King Charles II. He did just that, and emerged not condemned but with a pardon and a 500-pound-a-year pension thrown in.

Why? Some say that Charles, strapped for cash, was in on the plot to steal and sell the jewels.

LIKE MOST TOWER HOMES, there is no need for a lock on the Queen's House. It is technically the sovereign's home at the Tower—an official palace—but no member of the royal family is known to have slept there. It is the residence of Maj. Gen. Christopher A. Tyler, Resident Governor.

"I have the shortest commuting journey in London," said the governor. Retired from the army four years ago to take this, his final military post, he and his wife, Sue, live upstairs in the Queen's House, and he is at work the minute his feet hit the floor each morning.

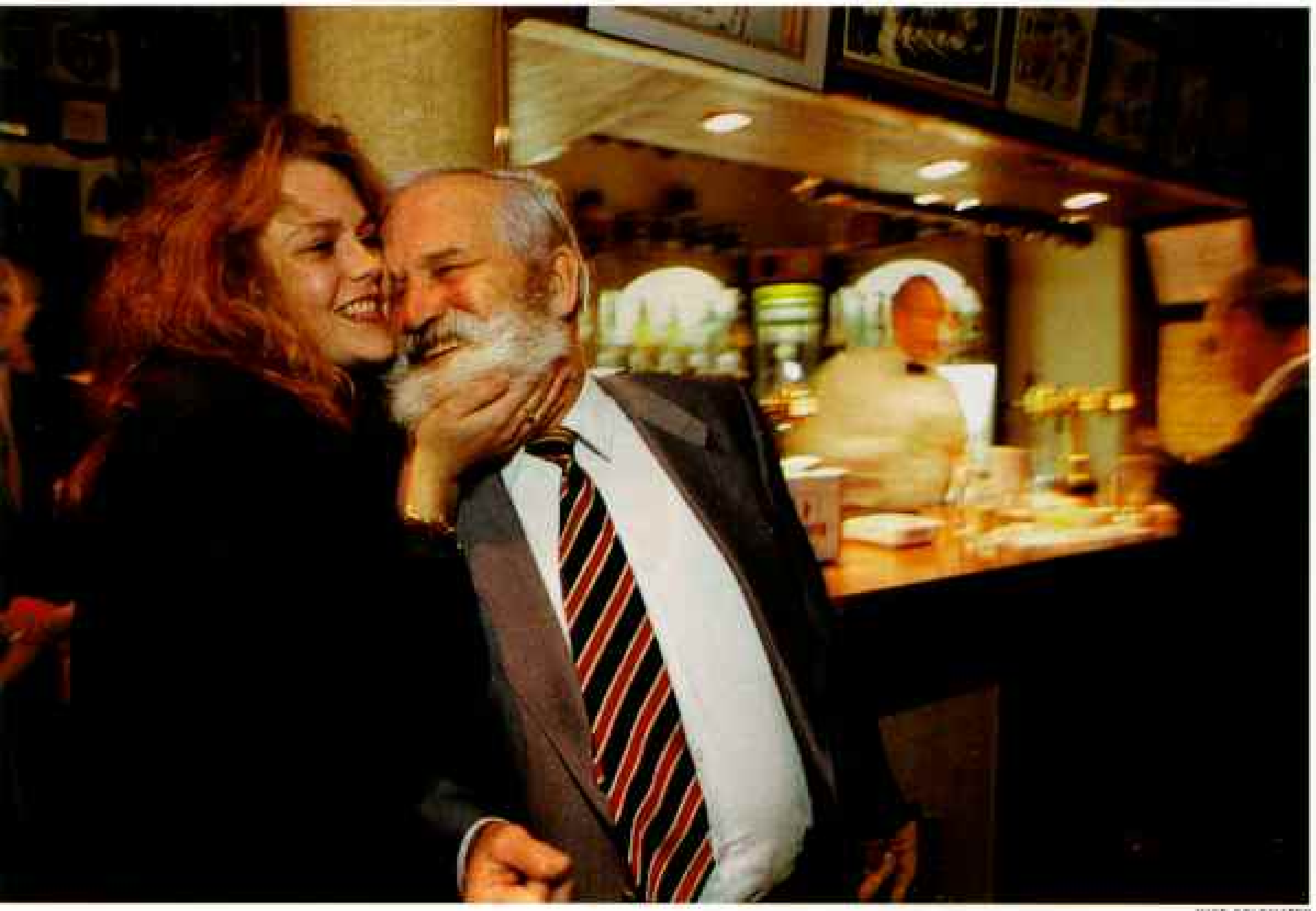
Tyler welcomed me into his ground floor office. Outside a wide window, river buses plied the Thames. Hanging on one wall was the ceremonial ax carried in processions by the Tower's jailer. When yeoman warders were responsible for prisoners, the jailer carried that ax in front of an accused returning to the Tower from court at Westminster. If the blade faced the prisoner, he'd been condemned to be executed.

It is a somber reminder of the Tower's darker side. I was surprised to learn that the Tower's last victim was executed as recently as 1941, shot as a German spy. Josef Jakobs, a sergeant in the German Army, had parachuted into England earlier that year, injuring his leg when he landed. Jakobs was seated in a chair where yeoman warders park their cars today and shot to death by an army firing squad.

The chair, reportedly a brown Windsor type with its rear supporting rails shattered, is locked somewhere in the Tower. And there it will stay, if the governor has his way.

Explaining his reasons for keeping the chair out of view, Tyler said, "You see, it is my job to preserve the dignity of the Tower of London. I feel to put the item on display would be just too sensational, too much."

The floors of the Queen's House creak with history. Here in the council chamber Guy Fawkes—after persuasion on the rack in a White Tower chamber—confessed to trying to blow up Parliament in the Gunpowder Plot of 1605. And here, for four days during World War II, Hitler's



MIKE GOLDWATER

"I'll never shave my beard. Makes me look like the beefeater I am!" vows Cedric Ramshall, enjoying a farewell hug at his Yeoman Warders Club retirement party. Wall plaques have been left at the pub by military regiments and police associations the world over. Until recently, beefeaters were authorized by London police to make arrests.

right-hand man Rudolf Hess cooled his heels. He had been apprehended in Scotland after bailing out of his Messerschmitt Bf 110 on a solo mission to negotiate a deal with the British government.

"BIRDIES!" A four-year-old boy dashed up the long stone staircase beside the White Tower, barreling full speed toward a pair of foot-tall black ravens standing on the top step. The birds, facing each other in seeming conversation, turned their heads toward the oncoming child and, in unison, released a ragged squawk that stopped the youngster cold.

"Bad birdies!" was all the little boy could muster as the feathered pair hopped off.

With a diet including raw meat, the black scavengers are the true beefeaters of the Tower—six official ravens and two on reserve.

"There is an old legend that should the ravens leave the Tower of London, the White Tower would crumble and the monarchy would fall," Yeoman Warder David Cope told me.

As Ravenmaster, Cope's responsibilities include clipping the birds' wings so they cannot flee. It is absolutely painless; Cope trims back the feathers under only one wing.

"That causes less lift on that wing, so the best they can do is fly in an arc."

Ravens are a protected species in Great Britain, and the Tower has its own breeding program. When the first Tower-grown raven hatched in 1989, children around the country submitted names. The winner: Ronald Raven.

"Unfortunately, Ronald had to be discharged," said Cope. "He kept biting people."

The unthinkable happened during my month at the Tower: Jackie the Raven, clipped wing and all, got a hold of a favorable wind and was last seen gliding toward London's traffic-choked business center. There was discomfort among the Tower folk; no one really wanted to talk about it.

That day I sat on a Tower bench scanning a Fleet Street newspaper, blaring with headlines

Last prisoners of the Tower, ravens have their wings clipped under supervision of leather-gloved Ravenmaster David Cope (below), whose prior service included 22 years with the Royal Marines. Though starlings often swarm around the White Tower, the ravens must be grounded to prevent, as legend warns, the fall of the British crown.

about the threatened British pound and a scandal involving the Duchess of York.

"You see," said a warder looking over my shoulder. "And that's with just one bird gone."

I FOUND NO GHOSTS in the Tower. If ever a place should be haunted, it should be this one, with so much of its history written in blood. But given every opportunity, the residents I asked could at best relate halfhearted second- and third-hand tales of Tower specters.

"I knew a fellow who. . . ." "They say that on some nights. . . ." "Two ladies from America told us. . . ."

Showing me around the Queen's House, Sue Tyler smoothed the covers in one bedroom. "Every time I come in here, these covers are rumpled," she said. "I used to think the housekeeper was having a lie down, but it happens even when she's gone."

A ghost? Sue doesn't speculate, but like most Tower residents she won't rule it out.

There is a sort of ghost at Dr. McGrath's house, says his daughter, Karen. "Overnight guests dream about an old woman sitting in a chair next to their bed. In their dream the people reach out to touch the woman, who disappears."

There are tales of Anne Boleyn walking across Tower Green "with 'er 'ead tucked underneath 'er arm," in the words of an English music-hall ditty. But if anything haunts the Tower, it is a tragedy still vivid in the minds of a few residents.

It was July 17, 1974. A summer crowd packed the basement of the White Tower, milling among the cannon and other armaments on display. There, in a chamber measuring 70 by 30 feet, a terrorist bomb exploded.

"I was working at the main gate," recalled Yeoman Warder Cedric Ramshall. "I heard the explosion. Police cars and ambulances came screaming to the Tower, trying to get through the masses that were trying to get out.

"Several of the beefeaters and other members of the staff were very quickly into the basement to rescue people, even though it was thought there might be a second bomb."

One woman was killed. Thirty-six others were injured. The tragedy led to airport-like security at the Tower's gates. Cedric was philosophical about it: "After all, this is a fortress, you know."

My last day at the Tower was a good one. Jackie the Raven had been found—in a woman's yard on the opposite side of the Thames. The woman had tried to feed Jackie, who obliged by biting her.

After visitors left that night, the newest yeoman warder, Ray Bruce, was sworn in. At the Yeoman Warders Club his colleagues filled tankards with port from a George I pewter punch bowl and toasted him. Their traditional cry, "May you never die a yeoman warder," dates back to the bad old days when a retiring beefeater could sell his post for 250 guineas. But if he died in office, the constable of the Tower made the sale—and kept the fee.

As the sounds of celebration echoed from the club, I crossed the moat one last time. On Tower Bridge I looked back at the fortress. A rush of taxis and trucks rumbled by me. Along the black water a river bus ferried bleary-eyed office workers to their riverside condos. Behind the medieval walls, a bell tolled.

It was ten o'clock. And all was well. □

AMID THE RUBBLE OF WAR, A STRONG-WILLED PEOPLE BEGINS ANOTHER ORDEAL—

Afghanistan's

REBUILDING HERAT AND OTHER CITIES SAVAGED BY YEARS OF SOVIET BOMBS.

Uneasy Peace

COVERED HEAD TO HEEL *in the traditional chadri, shoppers in Kabul signal Afghanistan's return to fundamental Islam. Until 1959 women were pressured to conceal their bodies from all but close relatives; by the time women won*

the right to vote five years later, the chadri was becoming rare in major cities. Today's leaders urge women to wear the full-length garment, although Western fashions are still for sale in the bazaars.

ENEMIES IN WAR *join forces in Afghanistan's national army, as bearded mujahidin, holy warriors, train with clean-shaven Afghan communists, whose government lasted until April 1992. The Soviet Union withdrew its troops in*

February 1989 after a decade of war killed 15,000 Soviets and a million Afghans. Thousands more have died in recent battles among mujahidin. "We're still fighting," a soldier said, "to bring peace to Afghanistan."

By RICHARD MACKENZIE
Photographs by STEVE McCURRY

THE DRIVER grasps the wheel of the rattling old Russian-built taxi, accelerates, and steers wildly around potholes and what few pedestrians are left on the streets of Kabul. We are driving through the capital of Afghanistan, where rival gangs of *mujahidin*, or Islamic guerrillas, are fighting for control. For a decade the resistance confounded the Soviet military, forcing the invaders in 1989 to withdraw from the country. Now in the spring of 1992 the guerrillas are turning their weapons on one another.

Gunfire sounds up ahead toward big, grassy Pashtunistan Square. The pounding of heavy arms echoes through tall pines around the park in the once grand Shar-i-Nau neighborhood. Tanks blast the marbled presidential palace. Smoke rises from the smoldering, deserted barracks of the presidential guard.

In the backseat of the careening cab, my friend Ramazan frowns. "This is ridiculous," says the wizened, bankrupt, 45-year-old restaurant owner. "This is no place to be. We

can't tell one mujahidin group from another. Half the gunmen are just street thugs. We are going to die."

We would not be out here at all if I had not gotten a call saying the house I am renting has been looted. We are on our way to check the damage. This is only my second week back in Afghanistan. Since 1985 I have made a half dozen trips here as a journalist, traveling in the mountains with the guerrillas, whose fierce determination I have come to respect. Now, days after the collapse of the communist regime, it sickens me to see Kabul, the ultimate goal of the mujahidin, reduced to anarchy at their own hands.

In the hours before the mujahidin closed in, it seemed as if every worker and shopkeeper and barrow merchant in this city of 1.5 million tried to flee to the suburbs. They packed into buses or clung to the back of pickup trucks in human pyramids. Those who couldn't ride ran. Cars full of soldiers from the Afghan Army, some stripped down to their T-shirts, joined the galloping masses. At one secret-police center, I watched men I assumed to be agents back up a truck, fill it with rugs and office furniture, and drive off in a cloud of dust.

Now we pass empty bazaars, long lines of dilapidated little shops with their shutters drawn and locked, and empty, impersonal government buildings. We turn onto a dusty, unpaved side street just wide enough for the taxi. After we bounce 50 yards or so, four men with rifles and a rocket-propelled grenade launcher step out to block our way.

"Halt," says one with wild eyes and matted hair. "Get over here. A boy is dying."

The gunmen hustle us toward a teenager lying on the ground in front of an empty fruit-and-vegetable stand, its striped, blue-and-white awning torn and snapping in the wind. The boy's left leg has been blown apart just below the knee by a rocket explosion. His lower leg hangs by shreds of flesh. The bone glares white in the blood. Quickly I take off my leather belt and cinch it tightly around his thigh to stop the bleeding. Together we lift him into the back of the taxi. His face is ghostly. His eyes roll back. He tries to speak but makes only a gurgling sound.

We head off toward the hospital of the International Committee of the Red Cross, the only medical facility in the city still operating at full strength. There we hand the boy to orderlies, who rush him to a triage area. And that is the last we ever see of him.

THE RUSSIANS ARE GONE, *but rifle-toting snipers such as these Uzbek from northern Afghanistan still prowl the terraces of Kabul. Warring mujahidin groups, divided mainly along ethnic lines and supported by Iran, Pakistan, or Saudi Arabia, began jockeying for position in the new Afghan government soon after the communists fell. Within four months their shells and rockets had damaged the capital more severely than had the war between mujahidin guerrillas and the Soviet-backed communist regime.*

In the confusion we have not learned the boy's name. We have no way of asking whether he will live or die. I look for him later in the corridors of men, women, and children with bullet wounds, gaping shrapnel holes, and limbs mangled by land mines. But it is hopeless. He has been swallowed up by the chaos.

ADD HIM TO THE LIST of war casualties. A million Afghans killed. Two million driven from villages. More than five million made refugees in Pakistan and Iran. In all, half the nation's people are dead, disabled, or uprooted.

"The war mutilated our homeland," says Muhammad Eshaq, historian and former mujahid. "It destroyed everything. You cannot set off dynamite inside a house and not expect the windows to be broken."

The trouble began with a family quarrel in 1973. Zahir Shah, the last Afghan king, was overthrown by his envious first cousin and brother-in-law, Muhammad Daoud, who disbanded the monarchy and declared himself president. Five years later he and his family were killed in a coup by the underground Afghan Communist Party.

Irreconcilable with Afghan ways, communism never gained the support of the people. Instead the communists inspired the uprising by the mujahidin, who were well armed by the United States and Saudi Arabia with weapons smuggled in from Pakistan. In October 1979 Prime Minister Hafizullah Amin had his boss, President Noor Muhammad Taraki, smothered with a pillow. The killing took Soviet leader Leonid Brezhnev and his colleagues by surprise. Fearful that a client state was on the verge of collapse, in December the aging "cold warriors" ordered the Soviet Army to invade.

The Soviets installed Babrak Karmal, a banished former Afghan ambassador and party leader, as president. Yet even with the help of 115,000 Soviet troops, including elite special forces, Karmal in seven years could not defeat the mujahidin. In May 1986 Mikhail Gorbachev replaced Karmal with the chief of the secret police, Dr. Najibullah (like many Afghans, he has only one name). A program of national reconciliation was announced.

But it was too little too late. Frustrated by the continuing conflict, which was costing the Soviets ten billion dollars a year, Gorbachev in November decided to cut his losses and withdraw Soviet forces. Two years and a few months later the last Soviet troops were gone.

President Najibullah's position became increasingly untenable. As the situation imploded, he tried to escape. At 2 a.m. on April 16, 1992, he and a small group were stopped by Afghan militiamen as they tried to enter the airport in four blue-and-white vehicles with UN flags flying.

"We are under orders. No one leaves or enters the airport," a young captain told him. Najibullah said he just wanted to see his wife and children, who had already fled to India. But the captain did not budge.

"A lot of people would like to see their families," he replied coldly. He turned the president away. Later that morning, Najibullah took sanctuary in a UN office building in Kabul. The communist era was over.

THE AFGHAN PEOPLE will not soon forget the abuses at the hands of the communist regime. Conservative estimates place the number of "disappeareds," or people dragged away by the secret police and never seen again, at 35,000 or more.

Many were taken to the Pul-i-Charkhi prison, a stone fortress outside Kabul's eastern suburbs, which rises from a bleak plain like a ghost ship on a dead sea. Built by Czechoslovakia in the mid-1970s, it holds as many as 20,000 inmates—perhaps the largest prison in south Asia. It was also, say human rights groups, a place where torture and atrocities were practiced for more than a decade.

On the eve of what would have been the 14th anniversary of the communist coup, I drive out to the prison, where I find a scene of madness. Sadar Muhammad, an Interior Ministry colonel, is struggling to maintain control of the prison's criminal wing while at the same time trying to empty it, under orders from the dreaded secret police (known as KhAD), as a gesture of goodwill toward the populace. But inmates, confused by rumors, are on the verge of rioting. A fire truck stands ready at the huge steel gates.

RICHARD MACKENZIE, editor-in-chief of Global News Service, based in Washington, D. C., is an authority on Afghanistan who has made numerous treks across that country in the past eight years. STEVE MCCURRY's photographs of the Afghan frontier appeared in the June 1985 NATIONAL GEOGRAPHIC. His most recent story for the magazine was on Sunset Boulevard in the June 1992 issue.

TRAMPLED BY INVADERS *since the rule of Cyrus the Great in the sixth century B.C., Afghanistan served as a trading crossroads between the Middle East and the rest of Asia. Kabul (above) became the capital 28 years after the founding of the modern state in 1747. Swarming with refugees during the Soviet occupation, Kabul has since seen a third of its 1.5 million people flee mujahidin rockets.*

AREA: 251,773 sq mi. **POPULATION:** 16,500,000. **RELIGION:** Sunni Muslim (84%), Shiite Muslim (15%). **LANGUAGES:** Dari, Pashtu. **PER CAPITA INCOME:** $220. **LIFE EXPECTANCY:** 42 years. **LITERACY RATE:** 29%.

BRICK BY BRICK, *residents of the southern city of Qandahar—until recently Afghanistan's largest city after Kabul—are rebuilding homes leveled by war, using bricks of soft mud fired in conical kilns outside town. Such kilns are*

working overtime in most major cities: Two million refugees have returned to Afghanistan from Iran, Pakistan, and other points abroad, and their reconstruction efforts depend on a steady supply of bricks.

"You can go in there if you want," Sadar tells me. "But you must swear I warned you not to go. None of my men can go with you."

I enter the exercise yard of Block 3, and a crowd presses against me.

"Is it true that they are letting people go? This is not a trick?" asks Zar Alam, a slight, soft-spoken, but intense 28-year-old, who, like most of the others, is wearing pajama-style tribal clothing.

It is true, I say, then make my way to the political side of the prison, where I discover Col. Ali Ahmad, a KhAD official, still in his office.

"This heat is unbearable," he says, sweating profusely in his heavy, brown woolen winter uniform, buttoned to the neck. "But headquarters has not yet given the order to switch to our summer uniforms." He neglects to mention that the head of KhAD committed suicide the day before.

Mopping his brow, the colonel leads the way through low, dark concrete halls to the eight-by-ten-foot cell of 29-year-old Muhammad Arif. Shuffling to his feet, Arif bows a little to the colonel, then stands rigid. He is serving four years for "economic sabotage," he says.

"What does that mean?" I ask.

"Economic sabotage," he repeats.

"But what did you do?"

"I don't know," he says, looking sideways at the colonel.

In another cell, built for 30, I find 72 prisoners, their double bunks crammed together. One inmate gives me a pendant in the shape of a bird, intricately carved from a black stone with fine white veins. The bird's wings are swept back. It is soaring free. Walking out of the cell, I hold the trinket in my palm and feel tears welling in my eyes.

"May I ask you a favor?" says a senior

UP TO THEIR ANKLES *in mud, villagers near Qandahar clear accumulated silt from a karez, or underground irrigation channel. Farmers impatient for water to flow can turn to the country's most lucrative crop, the opium poppy, which thrives on little moisture. No water at all is needed by gardener Hesamuddin, who pots plastic flowers (above) in the shells of Soviet bombs before placing them along the streets of Kayan.*

prison official as I walk to my car. He is clean-shaven and dressed in a KhAD uniform. "I would be grateful for a ride back to Kabul for myself and an inmate who has just been released." He nods at a younger man with a bushy beard and flowing cotton tribal clothes, who is clutching his few possessions wrapped in a *pattu*, a flimsy blanket with fringes at each end. "He is my nephew. I am taking him home with me," the official says. As we drive, the young man stares hard at the first grass he has seen in 11 years.

All across the country Afghans are going home. From the rolling wheat fields of the northern steppes to the imposing deserts of the south, from the mountain gorges of the east to the endless plains of the west, refugees are returning to places, outside the capital, that are tranquil for the first time in 14 years. They are coming back to pick up the pieces.

"We spent eight years in a camp in Pakistan," says Abdul Ansari, a 43-year-old teacher holding his three-year-old daughter with one hand and with the other a bar on the roof of the bus from the airport to Herat in northwestern Afghanistan. The bus is no more than a truck with a steel-plated box on the back. Inside the cage some 30 of us sweat and sway as the vehicle bounces along an asphalt road built by the Soviets but ruined by their tanks. Majestic pines stand sentry along the road. Beyond them, bare yellow plains shimmer as they reach northeast to mountains.

"That time in Pakistan was eight years longer than I wanted," Ansari says. "Three of my children were born there. I was so happy to leave. My children need to be back here. Perhaps I can teach again."

Herat, an ancient city near the border with Iran that rose to prominence about 1500 B.C., has been razed and rebuilt countless times over the centuries. It fell to the Achaemenid armies of Cyrus and Darius 500 years before Christ. A century and a half later, Alexander the Great built a major city here. Arab invaders brought Islam to the region in the mid-seventh century A.D. When the inhabitants resisted the Mongol hordes of Genghis Khan in the 13th century, he was said to have killed all but a dozen people. Russia and the British in India vied for control of Afghanistan during the 19th century—the "Great Game" popularized by Rudyard Kipling. British troops fought three wars with the Afghans and lost each time.

For sheer destruction, however, no invaders of the past approached what the Soviet Union and the Afghan communist regime did to the modern city of Herat during the 1980s.

"Believe me when I tell you that 24,000 people were martyred in one day," says Muhammad Ismael Khan, a former army officer turned mujahidin leader. A learned, gentle man, with a graying beard and a rakish black-and-white turban, he describes the day in March 1979 when some 200,000 people converged on the city to demonstrate against the rising communist movement in Kabul. "The Soviet-backed regime met the protesters with brutal force, and the demonstration became a riot. Armed with knives and machetes, mobs tracked down 60 Soviet advisers and their families and killed them all. They carried some of their heads through the streets on poles."

The Kabul regime, backed by fighter bombers based in the Soviet Union, began the revenge immediately. Muhammad Shah, a former history student turned guerrilla, takes me out into the city to show me the results. For mile after mile, we drive past inconceivable devastation. A community that once held 150,000 people looks as if it has been hit by a nuclear bomb. Three-fourths of the buildings are flattened to rubble. Bomb craters the size of swimming pools yawn on one side of us. Hills of mud or concrete that once were homes squat on the other. At many of the sites flags flutter on sticks to announce that the family that lived there never was dug out.

"If we were walking, we could not see it all in a month," Muhammad Shah says.

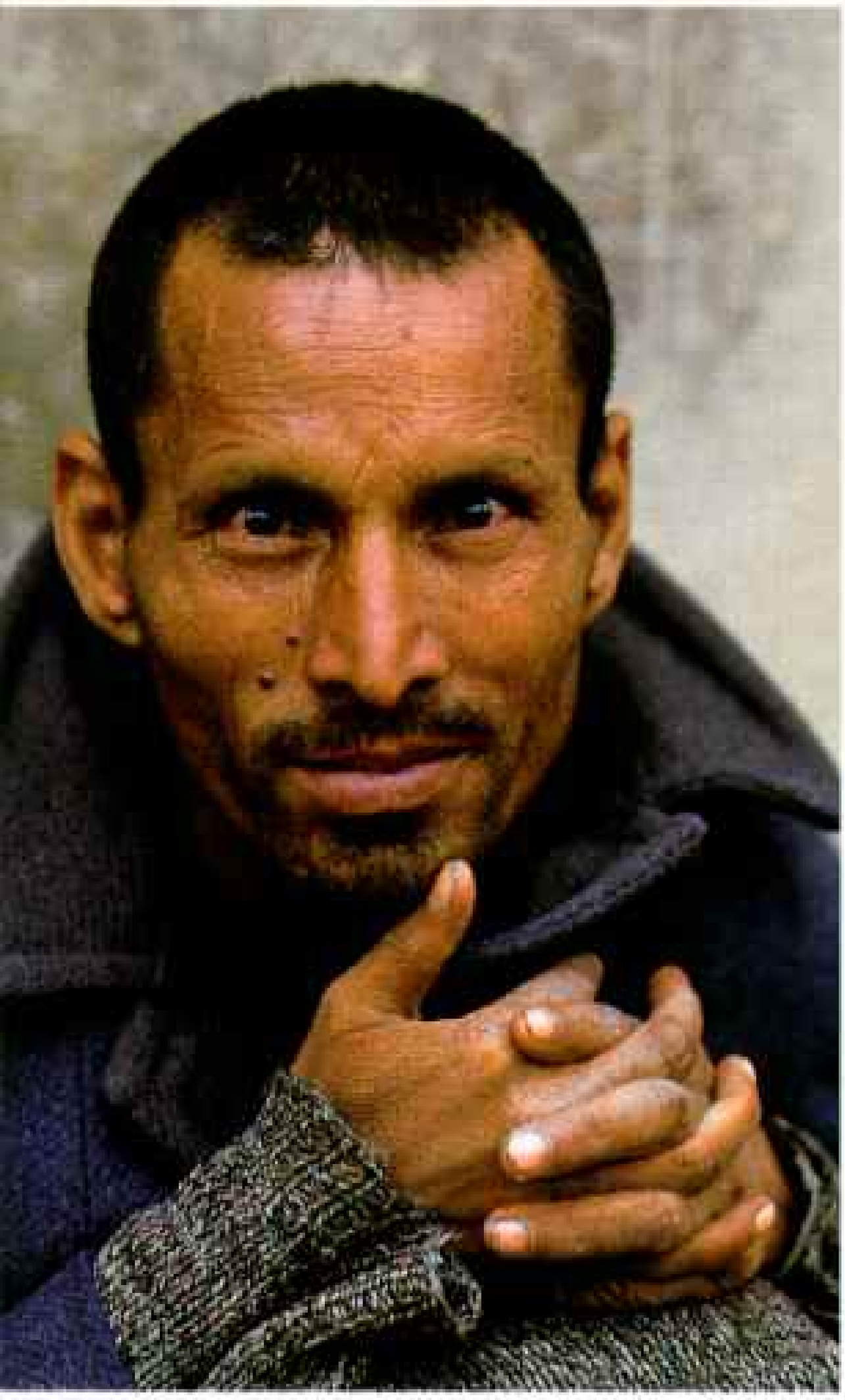
ON THE WEST SIDE of town, a man named Azimi and eight friends are working a labor of love. They are clearing out the place where a mosque once stood. While some dig and haul out earth and trash, others pack mud bricks to be baked in the sun. Leaning on his shovel, Azimi offers an enthusiastic, gap-toothed grin.

"I love what I am doing," he says, his skin and clothes covered with dirt. "This is for God and for Herat. We hope to have the mosque ready for prayer before winter."

Four young men in camouflage, former mujahidin, squat beside large rocks near what was left of the famed Timurid minarets in northern Herat, symbols of the lost wealth of Islamic culture. Built in the 15th century by Queen Gawhar Shad, the minarets—there were once ten of the elegant towers—soar above the ruins of a complex that included a mosque, hospital, covered bazaar, and madrasah, or Muslim school.

"There were more books in this madrasah

GRAZED BY A STRAY BULLET, *two-year-old Muhammad Abdul Waheed recovers at Karte Seh Surgical Hospital in Kabul. Bullets rained down as jubilant mujahidin celebrated by firing into the air when the communists left Kabul. The factional fighting that ensued filled beds in Karte Seh and other Kabul hospitals with civilian casualties—some, like Muhammad, the victims of guns shot randomly. Says weary administrator Gul Muhammad: "All the patients here are just waiting for the fighting to stop."*

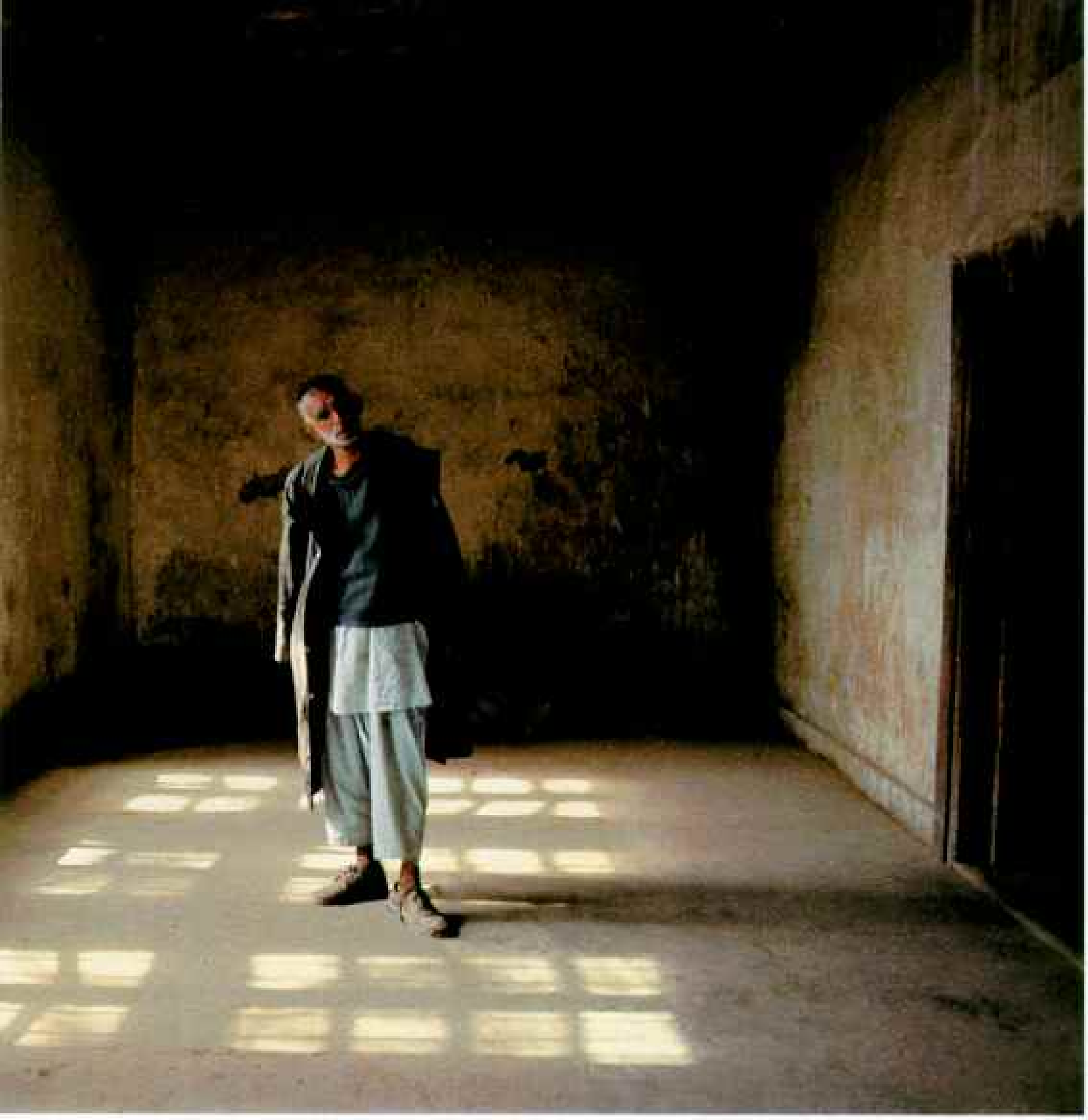


WAR'S TOLL ON THE PSYCHE *is etched on faces at Marastun, a shelter for the mentally ill in Kabul. Afghans tell of relatives gone mad from years of dodging bombs or being forced to fight alongside Soviets against the mujahidin. Patients here are kept off the streets—sophisticated psychiatric care is unheard of—but not always out of danger from rocket fire. The most basic medical services are stretched thin in Afghanistan, one of the world's poorest countries even before the war.*

than in all the rest of Afghanistan," Muhammad Shah boasts.

The men are painting the rocks red to mark an area planted with land mines by the communists—a common problem all over Afghanistan. The Soviets mined parks to restrict the movement of city people. In the country they mined fields to prevent farmers from growing crops for guerrillas. They dropped mines from aircraft into valleys and mountain passes, and mined the sides of roads to prevent ambushes. "They say there could be as many as 30 million land mines left in Afghanistan by the Russians," a former mujahid tells me. "No one really knows."

Earthquakes and earlier wars collapsed several of the Timurid minarets, which were covered in rich blue tiles. By the late 1970s, only six still stood. Four and a half now remain, bare of their tiles, rising out of the tall



weeds and minefields like charred fingers.

"This was once a beautiful park where people came for picnics," Muhammad Shah says, pointing to a weed-infested field beside the minarets. Walking ahead, he swings the artificial limb where his left leg was before he lost it to a mine three years ago. "We will make it beautiful again. *Inshallah*—God willing."

IN CONTRAST to the rubble in Herat, the city of Taloqan bustles with life. Men stroll and children play in a big green park in the center of this dusty community of 30,000 tucked into the brown hills of Takhar Province in northern Afghanistan. At the window of a government building a handyman, holding little nails in his mouth, replaces a cracked pane. A girl in a quiet neighborhood fills a battered aluminum bucket with water from a public well, then disappears behind a wall into her mud-brick house.

Like Kabul, Taloqan was occupied for a decade by the Soviet Army and forces of the communist regime. When the communists were driven out of this area in 1988, two mujahidin leaders vied for control in a struggle that in part reflected a rivalry between clans and regions. Half the city was seized by Ahmad Shah Massoud, the mysterious, charismatic military commander of Jamiat-i-Islami, or Society of Islam, a guerrilla group based in the northeastern provinces, where the Tajik are the largest ethnic group. The other half was grabbed by Gulbuddin Hekmatyar, the extremist, anti-Western leader of Hezb-i-Islami, or Party of Islam, one of six major groups

CLINGING TO SLIM HOPE, *a desperate mother searching for a son missing in action waits outside the presidential palace (left) as a sympathetic guard tries to arrange a meeting for her with officials. The formal authority of President Burhanuddin Rabbani, in the portrait, doesn't always translate into order in the streets of Kabul, where a mujahidin fighter (above) parades a looter to jail. Guns abound in Afghanistan, in part the result of three billion dollars in U. S. wartime aid. Washington now wants to buy back antiaircraft missiles, fearing that mujahidin will use them to help install strict Islamic governments in the Middle East.*

aspiring to represent the Pashtun, the ethnic group dominating the south. After many bloody weeks, Massoud's forces prevailed.

Today the only guns to be seen in Taloqan are on a poster at the movie house for a forthcoming film starring Sylvester Stallone. Mujahidin who visit the city are barred from bringing in their weapons.

"If they want to come in here to have some ice cream or to meet some friends, they must leave their weapons at the base," says Jalili, a policeman wearing tribal dress.

As soon as the fighting stopped, the citizens of Taloqan began forming committees. They did it with abandon. There were committees for every imaginable need from education to health care, from power supplies to mine clearance. Yet before they could rebuild a future, they had to overcome past ethnic animosities.

At a meeting of the Committee for Reconstruction, a dozen men sit on cushions in a big room with pale green concrete walls at provincial headquarters. The older men sit in front on burgundy carpets, with the younger men in back. Their faces tell the story of Afghan history, of the invaders who shaped its ethnic diversity. Some have the dark skin and shrewd eyes of bygone Mongol invaders. Others wear the warrior-like scowl of the Pashtun, while some have the thin, aquiline noses of Tajik scholars.

On the agenda today are questions of aid for returning refugees, repairs to the power plant, and the state of a bridge on the outskirts of town.

"If we don't do something about it soon, someone is going to fall through it and drown in the river," explains one committee member of the bridge. "How will you feel then?"

"I don't care how many people use it or where it is; it must be repaired," grumbles another. "Have you seen it?"

"I wouldn't walk across it myself," barks a third.

CROWDING INTO THE TRUNK *while adult relatives ride up front, boys in Kabul settle in for an open-air taxi ride across town. The mosaic of their faces reflects the ethnic mix of both Kabul and the nation: Afghanistan's main*

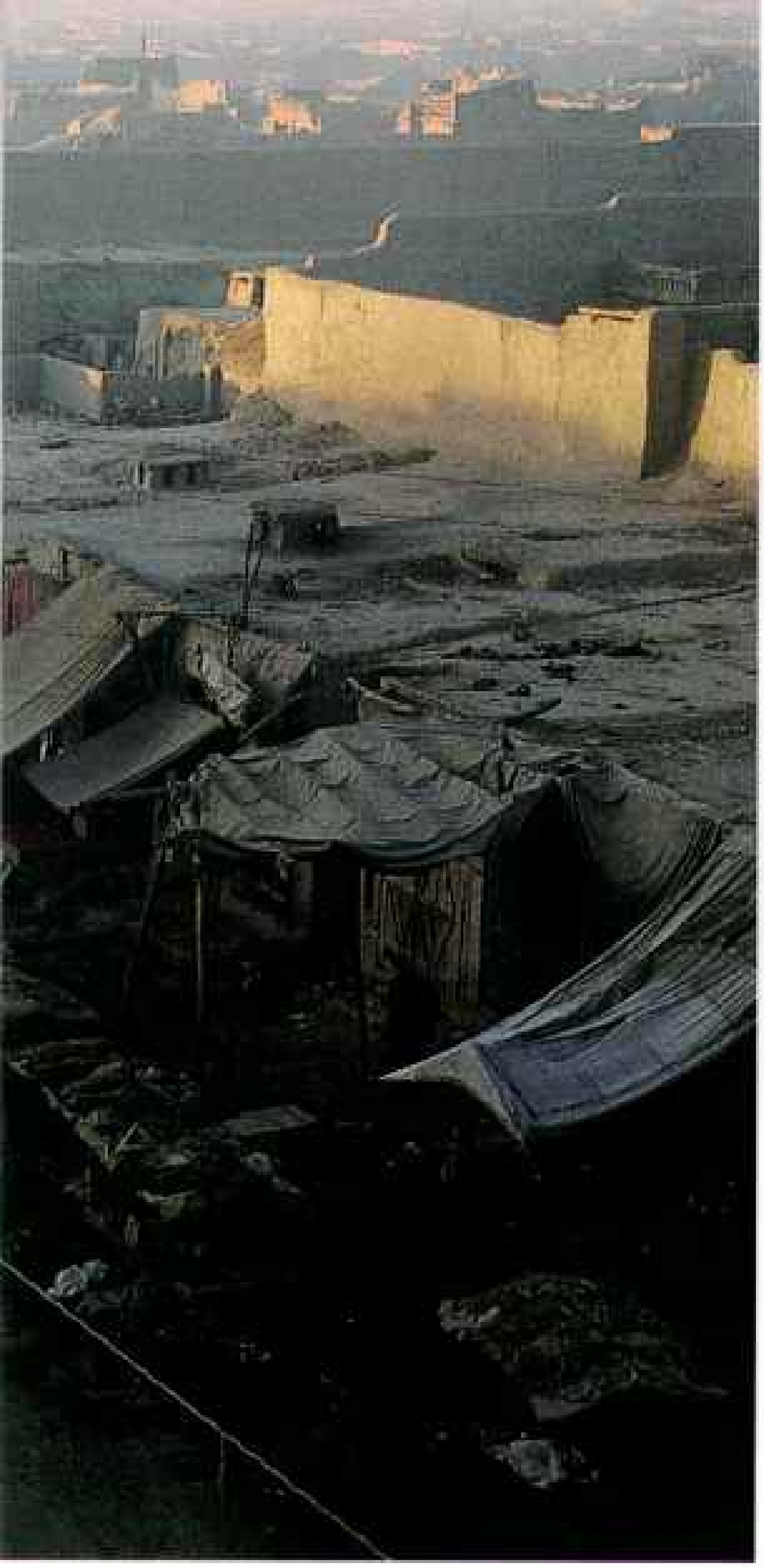
groups are the dominant Pashtun and the Tajik, Uzbek, and Hazara, but many Afghans count residents of the capital—where intermarriage is more common than elsewhere—as a people apart, the Kabulis.

They are all talking at the same time. This is how decisions are traditionally made in Afghanistan. The council form of governing is the glue that has held the country together since Ahmad Shah Durrani came to power in 1747. He conquered cities from Herat to the Indus River, creating the modern nation. Afghanistan has never been more than a patchwork of isolated regions separated by mountainous terrain and differences in language and religion. When the communists tried to reshape the country into a centrally run state like the Soviet Union, they were turning their backs on centuries of Afghan history.

"We have to show people in other parts of Afghanistan as well as the Muslim and the Western worlds that we can work together," says Muhammad Hasham, director of mine clearing in Taloqan. "We hope councils such as this can provide a model."

As I walk down the main street one afternoon, I pass a half dozen old men at a sidewalk restaurant, their headdresses marking different clans. Several of them smile, asking me to join them for tea. I thank them but keep walking. It is the 14th offer of tea I have received today. We are only 150 miles from Kabul, where rival groups are still killing one another. Yet it seems like another planet.

"May you not be tired," the oldest man



MUFFLED FOOTSTEPS *accompany the dawn in dusty Qandahar, historic home of Afghan kings. Since the war ended, feuding mujahidin groups have centered their battles in Kabul, freeing the provinces to begin recovery. Later in the day shoppers will crowd the ramshackle bazaar stalls on this street.*

says, raising an aged hand. "God bless you."

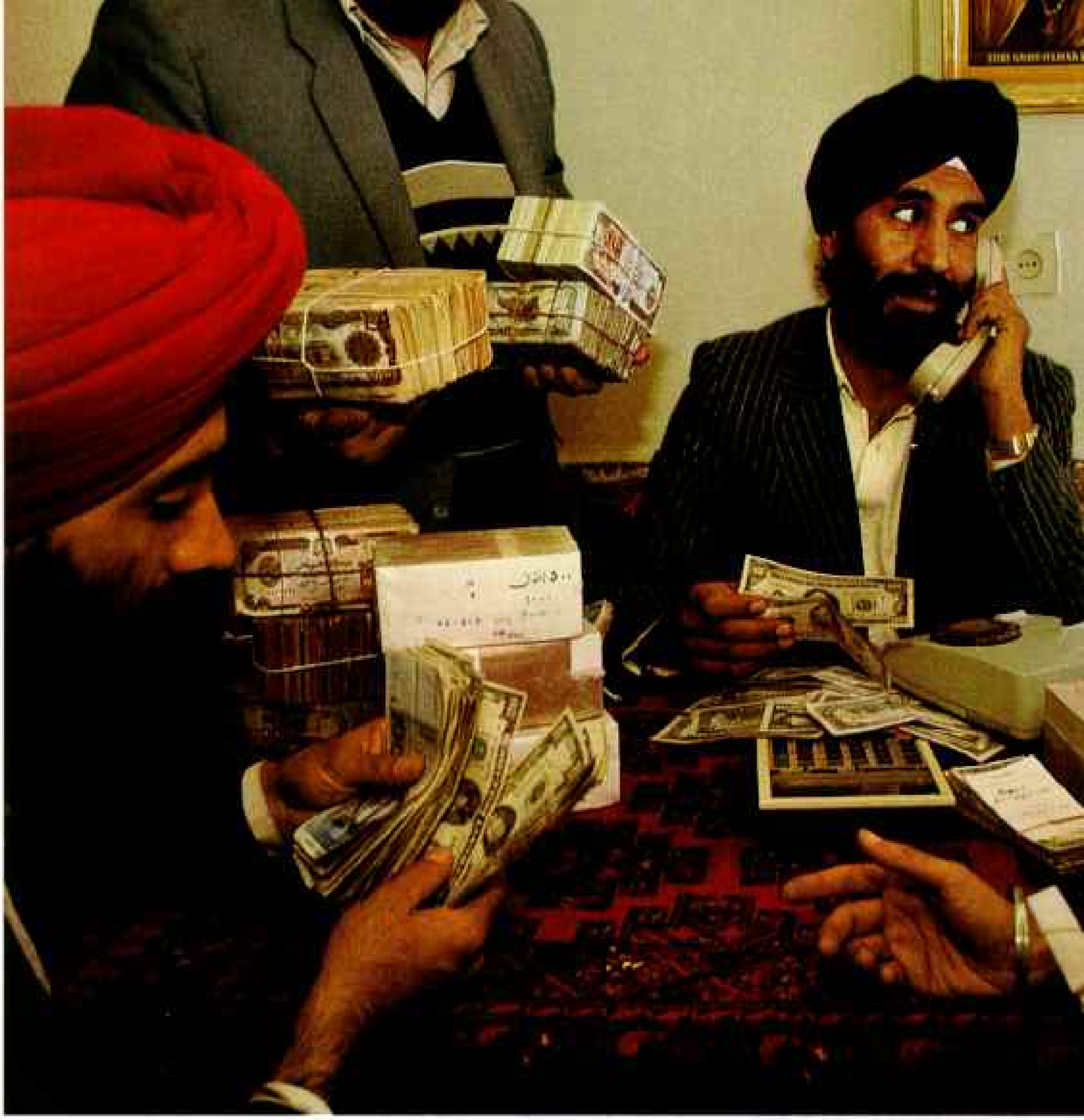
I stop to lean against a willow tree. A bamboo birdcage with a canary hangs from a branch. Above the shops across the street, the sky glows crimson and yellow with the setting sun. To the west I see the faint outline of a crescent moon. The peaceful sound of a muezzin, calling the faithful to prayer, fills the air. At Herat I had seen what Afghanistan has lost. Here I perceive hope. If the people of Taloqan can iron out their differences and lay a foundation of trust, then so can residents of Qandahar in the endless southern desert, or citizens of bombed-out Jalalabad in the east, or even survivors of the chaos in Kabul.

I FIND MORE SIGNS OF HOPE in the rugged Panjshir Valley. The roar of the mighty Panjshir, or "five lions," envelops us as we drive our jeep through the narrow, mountainous valley. My companions are an unlikely crew: a former Afghan Army sergeant and three former mujahidin. We are on a journey to find peace, chase ghosts, and exorcise a few demons.

The Panjshir, like other waterways in northeastern Afghanistan, cascades from the Hindu Kush, whose peaks tower 15,000 feet or higher. But no other valley matches the strategic importance of the 70-mile-long Panjshir, which points straight down at Kabul like an arrow. For that reason, the Soviets launched nine major offensives in the Panjshir from 1980 to 1986 in a vain effort to destroy the elusive mujahidin.

The guerrillas in our group are former members of an eight-man squad from the Panjshir Battalion of the front led by Ahmad Shah Massoud. Their squad leader, a self-effacing 26-year-old named Nasrullah, is heading home to the village of Hambia halfway up the valley. Nineteen-year-old Ashraf, who looks as though he has stepped from the pages of a Banana Republic fashion spread, is also returning to Hambia. His combat fatigues are always clean and pressed. His boots seem never to gather dust. The third, 29-year-old Faizuddin, has seen the worst. As a teenager he was tortured by the secret police and dragged off to Pul-i-Charkhi prison. Released after 18 months, he returned home to the village of Qalacha in the lower Panjshir Valley to find that both his elder brothers were dead. One was shot and killed while resisting arrest. The other died when Soviet soldiers tied a mine to his stomach and exploded it.

Only Nasrat, the 30-year-old former Afghan Army sergeant, is not going home. His journey up the Panjshir is an anguished search for his lost brother, who was stationed at Peshghur in a garrison overrun by mujahidin.



PROFITING FROM ISLAM'S STRICTURES *against trading money, Sikhs and Hindus run currency-exchange kiosks in Kabul, where trader Varian Singh (above) even cashes personal checks drawn on U. S. banks. Afghan bride Hasina Muhammad Sayed wears green, the traditional Islamic color of hope, for her wedding to Sharif Muhammadzai, while a cameraman capturing the moment for relatives abroad preserves tradition with a modern touch.*

Nasrat is hoping to find some hint that he is alive, perhaps being held prisoner.

"To this day our mother refuses to believe that he is dead." Nasrat says. "Every week she washes, presses, and folds his clothes along with the rest of the household laundry. I do not think her heart can take it much longer."

Remnants of the war litter the landscape as we drive. The rusty wreckage of one Soviet tank is surrounded by a field of wheat. Another tank lies submerged in the river, its nose and gun pointed up as if gasping for air. There are countless more.

At the end of the first day we reach the house of Nasrullah's parents in Hambia. Inside, Nasrullah and his father, Muhammad Amin, sit cross-legged on long cushions lining the walls of the common room, staring at each other. Nasrullah's mother has made pink-and-white covers to celebrate Id al-Adha, a joyous Islamic festival. For 20 minutes Nasrullah and his father do not speak. They

just sit, smiling and absorbing each other by the glow of hurricane lamps.

"After all these years my family can be together again," Muhammad Amin says finally. "I have waited for this day for so long. I have prayed for this day. I have dreamed about it. I wondered if it would ever come."

The night is punctuated with visits from friends and neighbors. All simple farmers and all men, they come one after another to hug Nasrullah and sit for half an hour or so to pepper him with questions.

"Have you seen my son?" one asks.

"What are those fools doing in Kabul now?" another asks.

"Did they really release everyone from Pul-i-Charkhi?"

The next morning Ashraf and I go strolling in the hills. Two fat cows plod up a slope ahead of us. For the first time, the lad is not carrying his automatic rifle or the weight of ammunition. He stops and breaks off a piece of an acacia bush, smelling its exquisite fragrance. We talk about what will happen to young men like him, a whole generation of Afghans who have known nothing but war.

"I just want to come back here and work in the fields," Ashraf says. "I wouldn't care if I never see Kabul again. This is my country."

Ashraf stares off toward Safid Kuh, the "white mountain" on the border with Pakistan that is mantled in snow all year. The valley here is about a mile wide. Bowing poplar trees line the banks of the river. The floor of the valley is covered with square plots of farmland in differing shades of green. A gentle wind

comes from the northwest, rippling fields of wheat like ocean waves.

We wander down to the road, where scores of Kuchi, nomads who have crisscrossed Afghanistan for centuries, are driving sheep north for summer grazing. Irrigation canals destroyed in the Soviet attacks again gurgle with fresh water. As the animals sweep by, Ashraf leans over and picks up a newborn lamb and hugs it.

Back at the house Nasrullah bows and kisses his father's hands.

"I will be back soon," he says. "But first I have a promise to keep." With Ashraf and Faizuddin, he has vowed to take Nasrat, the former army sergeant, to look for his brother up in Peshghur.

Late in the afternoon of the second day we drive into Peshghur, a shady outpost where the valley narrows. We enter the town with some trepidation, not knowing what we will find. As we drive past the ruins of the garrison where Nasrat's brother was last seen alive, it becomes obvious that the fighting was gruesome. The former sergeant stares out the window, then starts to tremble. Finally, he slumps forward, sobbing, and buries his face in his hands.

No one in the jeep speaks. Then, from his seat beside Nasrat, Ashraf wraps his arms around his former enemy's shoulders, pulling him to his chest. He holds him, and Nasrat weeps softly for the next 15 minutes.

At what was once a mujahidin base in Barak, Nasrullah takes Nasrat to meet a red-bearded mullah who is the keeper of the books of prisoners.

"They have all long since been released," he tells Nasrat and takes him by the arm to a shed beside the house, where Nasrat frantically searches through the lists of those who lived to be prisoners. His brother's name is not there. The mullah offers tea. Nasrat tries but cannot drink. "Go home and pray," the mullah says.

After dinner at a smoky tea shop that night, Faizuddin, the former torture victim, takes Nasrat out for a walk in a grove of trees. A full moon lights the natural park, and the scent of juniper wafts in the air.

"Give it up," Faizuddin says. "Your brother is gone, and you are only tormenting yourself. I know from my own experience that the past must be buried. You must live for the future. The past will kill you."

That night, Faizuddin and Nasrat begin a lasting friendship. What Faizuddin does not tell Nasrat is that he took part in the attack on the Peshghur garrison.

POKING THROUGH RUBBLE *for precious stones, emerald miners work a tunnel in the Hindu Kush mountains, 70 miles northeast of Kabul. Gem dealers say Afghan emeralds are among the world's most beautiful and could earn much needed cash for reconstruction. But primitive and dangerous mining techniques, such as using explosives from leftover Soviet bombs to blast away limestone, destroy much of the cache.*

I THINK ABOUT THESE MEN often in my travels throughout Afghanistan. They symbolize the nation's challenges. If they can come to grips with one another, then anything is possible.

I recall the words of historian Muhammad Eshaq. "This was not a war of brother against brother," he told me, "but of right against wrong. We accept all our brothers now."

On a summer evening shortly after a new Islamic government took power, I go for a walk with Commander Muslim, chief of security to Defense Minister Ahmad Shah Massoud. A dignified, broad-shouldered man, Muslim wears a soft smile on his round face. We stroll behind Massoud's house, the former guesthouse of President Najibullah, laughing at the trash still piled up from the days when communism reigned. One box used to hold Highland Cream Scotch Whisky. Another crated Arkhi, "The Original Mongolian Vodka."

"There won't be much of that with this Islamic government," he says with a chuckle.

As he speaks of the future, the 32-year-old Afghan gets a distant look in his eyes. He is worried, he says. Can the new leaders restore law and order? Can they guarantee the safety of the capital? Can they rebuild the country?

He stoops to pick up an empty, rusting pilsner beer can and tosses it onto a trash heap.

TANKS BECOME TOYS *in Qandahar, site of intense fighting during the war. Most souvenirs are much more deadly: More than ten million mines, scattered by Soviets and mujahidin alike, litter the landscape. UN mine clearers say they'll*

be working for years, perhaps decades, and may never finish the costly job. Besides maiming and killing, mines render useless much of the country's arable land, slowing the rebirth of agriculture.

THEIR FAITH INTACT *after years of bloodshed, nomads face west toward Mecca from the desert near Qandahar to offer the fourth of five daily Muslim prayers. Belief in God's mercy and compassion, a key component of Islam, will serve Afghans well as they return home from years of exile and fighting to begin the arduous task of rebuilding their stricken land.*

"I do know this," Muslim says. "Since the day we took Kabul, we have had mujahidin groups backed by Iran fighting groups backed by Pakistan fighting groups backed by Saudi Arabia and God Almighty knows who else. If the foreigners would just leave us alone, I promise you we would be a lot better off."

IN THE LAST DAYS of my visit, even Kabul begins to revive. At the shoemakers bazaar, dozens of merchants with dusty gray beards sit cross-legged tending to customers. Glorious burgundy carpets hang in the shopwindows of Chicken Street, which got its name from a poultry market that has long since moved. Blossoms and bouquets are still sold on Flower Street, but so are caviar and cornflakes and Pepsi-Cola from Dubayy.

Yet even now there is danger here. As my friend Ramazan and I stand on a city street one morning waiting to buy bread, a shot rings out and Ramazan falls into my arms. He has been shot in the leg.

Ramazan is lucky. The bullet does little damage. But we argue in the car as I drive him from the hospital to his small mud-brick cottage in an impoverished northwestern suburb.

"Why would anyone want to shoot you?" I ask, frustrated.

"Who knows. This is a lawless place."

"Then why do you stay here?"

"Where would I go? I have to protect my family. What would I do?"

"You should think about the future."

"I can't afford to. It's hard enough trying to stay alive today, never mind tomorrow."

The same could be said about Afghanistan. The days that follow are fraught with peril. The economy has been obliterated. The interim government in Kabul is paralyzed. Across the country, schools, hospitals, and mosques must be rebuilt.

The next year would bring terrible bloodshed to Kabul. As Defense Minister to President Burhanuddin Rabbani, Ahmad Shah Massoud would battle to hold the ancient capital, but his arch rival, Gulbuddin Hekmatyar, would launch wave after wave of rocket and artillery attacks. More than 6,000 civilians would die. One fragile cease-fire after another would be broken. Sections of Kabul would be reduced to rubble.

I am wondering about Afghanistan's future as I stand in the hallway outside Massoud's office on the palace grounds. I am waiting for the former guerrilla leader to finish a meeting with the Russian ambassador before rejoining

Massoud to discuss how he hopes to forge law and order from the soup bowl of scorpions that is Kabul. Someone tugs at my sleeve.

"Would you like some tea?" asks an aged, bent little man. His white beard hangs over his tribal shirt.

"Yes, please," I say. He takes me by the hand and leads me down the hall to a closet-size room, where water is boiling in a big, blackened old pot. Cups, teapots, and sugar bowls are stacked high on the shelves.

"Did you come to Kabul with the mujahidin?" I ask.

"Oh no, I came long before then," he says. "I was making tea in this room before you were born." He was the official tea server, he says, not only for the last king, Zahir Shah, but also for President Daoud, President Taraki, President Amin, President Karmal, President Najibullah, and now for Ahmad Shah Massoud.

"Then you must have seen many changes," I say. "What is the hope for this country?"

"Things will be difficult," he says. "When you look out into the streets, you can see the damage done by the war. But you cannot look into the souls of the people to see what has happened there. I've seen many people come and go. We are Afghans. We have always survived. We will survive again." □

THE AMERICAN PRAIRIE

Roots

By DOUGLAS H. CHADWICK

Photographs by JIM BRANDENBURG

Bison again drift across Dakota rangeland, yet their historic prairie home remains at risk. The onetime sea of grass survives only in spotty patches, its ebb forcing the native wildlife to adapt, flee, or perish. Renewed hope stirs as advocates push for preservation.

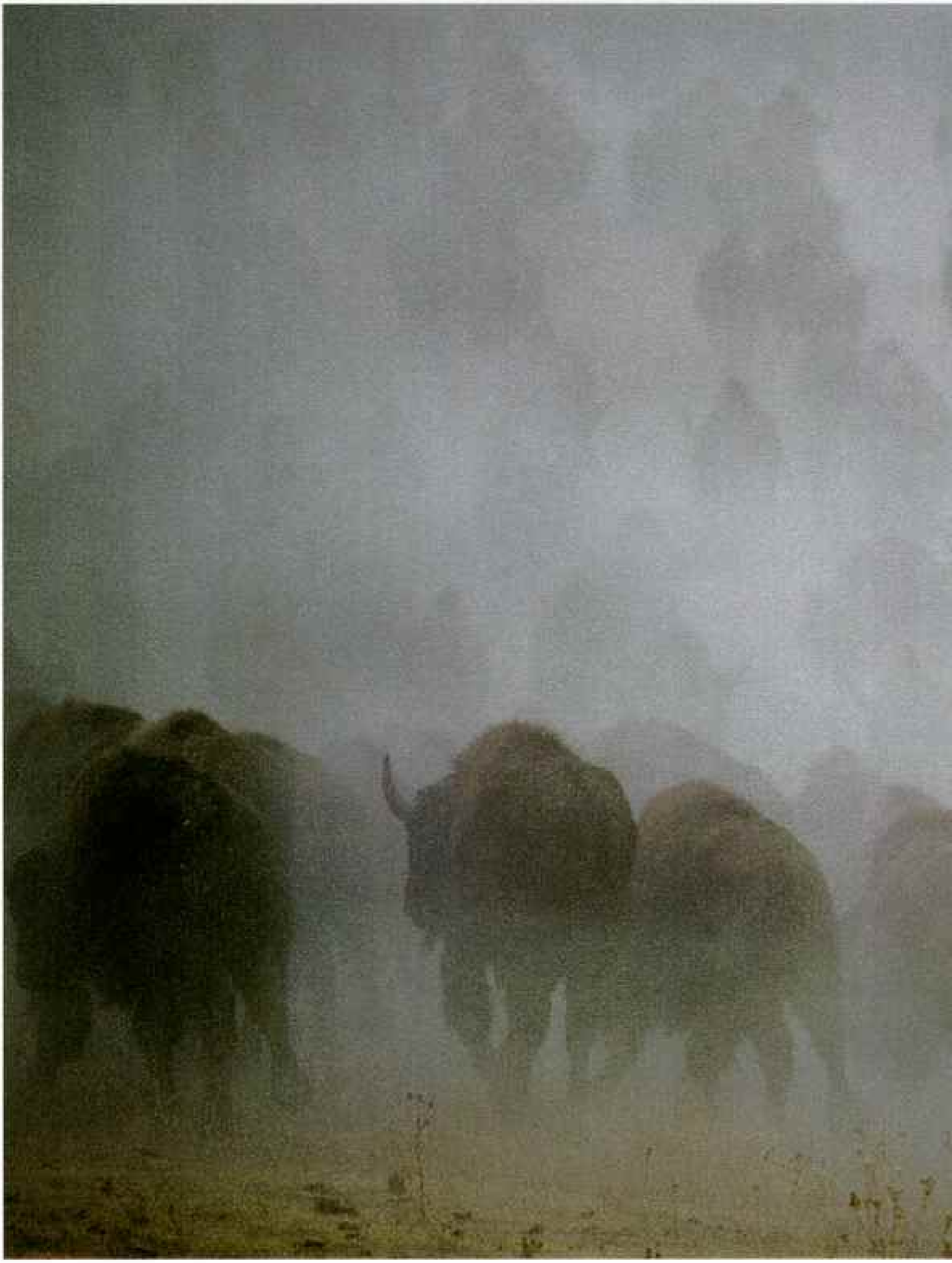
of the Sky

It was June, and all the hills and the wind were green, and in among the dark mounds of female bison were little red calves. Most of the herd lay bedded along a knoll. Young males stood in clusters toward the outskirts, occasionally pairing off to spar, while older bulls stayed alone on the fringes, dust bathing around prairie dog mounds. Antelope bands sailed by like shafts of sunlight through the gathering clouds. Suddenly, briefly, it poured rain. I would swear the drops are bigger out here on the prairie than anywhere else. But then look at the size of the sky they come from.

Eventually the herd stirred and followed an older female across a valley. I dropped down off my vantage point on a ridge to see what they had been grazing and then discovered that one bison remained behind—a calf, lying in a small depression. I backtracked and waited. Before long a female broke off from the herd and came galloping back to the calf. She licked its face and nudged it, then turned to go, calling for the baby to follow. It barely lifted its head. Again she trotted over to lick and gently prod the calf; again she turned to leave, grunting for it to come *(Continued on page 98)*

Recalling windblown puffs from a sod-house chimney, the

ethereal prairie smoke, or torch flower, flutters in a remnant of Minnesota tallgrass.



Their bodies brewing a cloak of fog, bison on the Houck Ranch in

JIM BRANDENBURG, MINDEN PICTURES

South Dakota shift to a new pasture. Some 3,500 bison roam the spread's 93 square miles.

A bruised September sky spits lightning over tinder-dry big

bluestem on a tallgrass preserve in Oklahoma—land prone to tornadoes and prairie fires.

(Continued from page 91) along. She must have repeated this 20 times. The other bison were moving farther away by the minute, and still the baby showed no signs of getting up.

The mother grew frantic, trotting one way and then the other, torn between her maternal urges and her desire to be with the herd, which in female bison is overwhelming. Finally, the mother issued a loud bellow and raced off to rejoin the group, now more than half a mile distant. Not long afterward, the young one struggled to its feet and hunched a few steps forward, stopped, staggered a ways, stopped again, and bleated at the empty hillside. It acted too hurt to move farther. The calf lay down, having covered maybe 30 yards, and put its head on the ground. I guessed it would be coyote food before long.

The bison herd was long out of sight and dusk was gathering when a single animal came racing across the grasslands from the far horizon. It was the mother. She nuzzled the baby and urged it up, tossing her head as if to show the way. Although the calf never rose, its mother was still there as darkness fell, the rarest of sights: a female bison miles from her herd. I will never know how their story ended. By the next morning both were gone.

I was in Wind Cave National Park, South Dakota, where the Black Hills roll out onto the beginning of the Great Plains. I rolled down with them, beginning a yearlong journey to explore North America's prairies—not the culture that settlers imposed upon this part of the world but what remains of the original wild realm. I wanted to learn about the true nature of the place we call the heartland. I discovered a story that arises from the soil and keeps circling back to it.

THE GREAT PLAINS are built from sediment washed out of the Rockies over millions of years, mixed with rubble from continental glaciers and windblown deposits of silt, sand, and clay known as loess. Resting on the former bed of a shallow inland sea, the Great Plains slope gradually downward for 800 miles from the feet of the mountains to the Mississippi Valley. The Rockies helped form the prairies in another sense as well. Ever since the mountains began rising some 60 million years ago, they intercepted the flow of moist air from the Pacific and dried out the interior, favoring the dominion of grasses over trees.

Three distinct belts of prairie developed. In the immediate rain shadow of the Rockies lies the shortgrass prairie, scraped by wind and dominated by the most drought tolerant of prairie grasses, buffalo grass and blue grama; they rise little more than six to twelve inches high. The easternmost third of the Great Plains, watered by an average of 30 inches of rain annually, yields tallgrass prairie characterized by Indian grass, switchgrass, and, above all, big bluestem; in a good year they tower six to twelve feet high, growing half an inch or more a day. Between is the mixed-grass prairie, with elements of both the shortgrass and tallgrass belts, combined with midsize grasses such as little bluestem, needlegrass, side oats grama, and wheatgrass.

Together, they once formed the greatest grasslands on earth, stretching unbroken across nearly a quarter of the lower 48 states along with portions of southern Canada. They nourished an estimated 60 to 70 million bison—which had a combined weight greater than

DOUGLAS H. CHADWICK, a wildlife biologist and frequent contributor, is the author of *The Fate of the Elephant*. JIM BRANDENBURG, a two-time winner of the Photographer of the Year award, grew up on the Great Plains.

Scouring a mixed-grass meadow, a rare swift fox hunts at twilight. "They seem to float on the prairie," says photographer Jim Brandenburg. The cat-size animals can sprint 25 miles an hour. Less sly than their brethren, swift foxes are endangered by trapping, habitat loss, and routine poisoning of prairie dogs, a favorite quarry.

that of all the men, women, and children alive in the U. S. and Canada today—along with perhaps 50 million pronghorn antelope. And millions of elk and deer. Plus plains grizzlies and buffalo wolves. Not to mention the host of smaller creatures: an estimated 5 billion prairie dogs, for instance. Half the ducks on the continent were incubated in the prairie pothole region—and still are.

Walt Whitman called prairies "North America's characteristic landscape." As long as pioneers followed paths beneath the dark canopy of eastern forests, they were among habitats not terribly different from those of Europe. But as they pushed west, the meadows grew wider, drier. The woodland thinned to copses. Finally the shadows of the last trees fell away, and the travelers were out—out where no limit had been set on how far or how much the eye can see. Out where you begin to feel you are traveling on the bottom of the sky, and the largest of the hawk family, the ferruginous hawk, often nests on the ground for want of a branch; where, for the same reason, lark buntings and longspurs soar up to make their territorial call on the wing, and the meadowlark sings a song that is a distillation of daybreak—a pure, yellow burst, a breastful of glory-coming-over-the-rim-of-the-earth notes. Here is where most pioneers encountered the New World. Here they first gained an idea of its true size and separate destiny.

A THREADBARE QUILT

The North American Prairie

ALBERTA
SASKATCHEWAN
MANITOBA
CANADA
U. S.
ONTARIO
PRAIRIE POTHOLE REGION
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WISCONSIN
MICHIGAN
WYOMING
IDAHO
NEBRASKA
IOWA
ILLINOIS
INDIANA
OHIO
UTAH
COLORADO
KANSAS
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
NEW MEXICO
OKLAHOMA
TEXAS
ARIZONA
Theodore Roosevelt National Park
Rapid City
Badlands N.P.
Black Hills
Wind Cave N.P.
Buffalo Gap National Grassland
Valentine
Niobrara Valley Preserve
Valentine N.W.R.
Fort Niobrara N.W.R.
Houck Ranch
Blue Mounds State Park
Sand Hills
Shirley Basin
Medicine Bow
Fort Collins
Manhattan
Konza Prairie Research Natural Area
Flint Hills
Pawhuska
Tallgrass Prairie Preserve
Wichita Mts. Wildlife Refuge
Fort Sill
Chicago
Batavia
Fermi National Accelerator Laboratory
Gulf of Mexico
U.S. MEXICO

Sweeping for a thousand miles between eastern forests and the Rocky Mountains, the prairie was an unbroken meadow, blown by what writer Wallace Stegner called "the grassy, green, exciting wind, with the smell of distance in it." Within a century this thriving ecosystem—that once covered a ninth of the continent—was plowed under. Concerned citizens, conservationists, and government agencies are working to save pieces of this distinctive landscape by adding to the 10,000 square miles of protected area shown.

Prairie lands
- Historic
- Present

Protected prairie with significant acreage
- National grassland
- Other federal land
- The Nature Conservancy and cooperators
- State or provincial land

(Small symbol 640 to 10,000 acres; large symbol more than 10,000 acres)

0 200 MILES

NGS CARTOGRAPHIC DIVISION

PRESENT PRAIRIE DATA PROVIDED BY [illegible] DATA CENTER AND MANITOBA CENTRE FOR REMOTE SENSING

Converted to pastures and croplands, this biological powerhouse in the heartland underwrote America's rapid growth, spurred its industrial revolution, and came to feed not only the U. S. but much of the world as well. Yet in the westward rush, people failed to save even one fully representative community of the native plants and animals that defined the core of the continent. To see thriving grasslands full of great beasts, Americans go on safari in Africa.

But natural communities are made of much more than the large and familiar creatures that attract most people's interest. Recognizing that obscure life-forms often prove the most valuable to research, medicine, and the health of ecosystems, modern conservation biologists emphasize the need to preserve biological diversity. Termed biodiversity for short, it is defined as the full variety of life, large and small alike, and all the processes and interactions that sustain it. This is where North America's long-overlooked prairies have lately drawn all kinds of attention. For even though they lie broken into pieces, those fragments still hold a whopping share of the continent's wealth of species.

Crisscrossing the Great Plains, I found vital patches of native prairie scattered from Texas to Alberta. Each proved well worth getting to know in its own right, and each still stored parts of the old pattern—clues to how we might some day be able to restore a meaningful example of our grandest wild heritage.

A long-horned grasshopper pauses on a gentian in the Vermont Cemetery near Chicago. Insects plagued early settlers, some of whose bones lie in this 1.3-acre plot of rare virgin prairie. Novelist Ole Rölvaag wrote of an 1870s attack on South Dakota settlers by grasshoppers, which "flared and flittered around them like light gone mad. . . . The whole place was a weltering turmoil of raging little demons."

IT'S TOO LATE for Audubon's bighorn, a subspecies of bighorn sheep that once ranged as far east as Nebraska, inhabiting the rugged breaks cut into the northern plains by the Missouri River and its tributaries. Overhunting and diseases from livestock had wiped out the last by 1925. However, Rocky Mountain bighorns transplanted into South Dakota's Badlands National Park during the 1960s took hold and now range into the countryside next door. A band of ewes and lambs was feeding atop a height called the Pinnacles Overlook as I passed by on my way to a part of the park known locally as the Sage Creek Wilderness. At 64,144 acres, this stretch of mixed grass is the largest protected roadless area left on the American prairie.

I drifted for days through Sage Creek's hills and flats. My tent was a tiny silhouette against the boundless horizon. Everything else seemed at once near and impossibly far away. Prairie perspective—it can make you feel exposed and insignificant or open you up. I stretched. I watched breezes run through the grass and breathed in the almond scent of antelope that swung by to look me over. I spent more time imagining shapes in the passing clouds than

I had since I was a boy. I opened, wider with each passing hour.

The wilderness may be a fine place for peaceful contemplation. But one morning big winds sent the clouds stampeding across the sky. Lark songs were flying everywhere, the butterflies were out in force, and I ended up racing around whooping and swinging a fine-mesh net, startling mule deer up from the juniper-scented draws. I had joined volunteers from the park taking part in an annual butterfly survey sponsored by the Xerces Society. It keeps track of the whereabouts and welfare of these showy insects. Such information can help track changes in the butterflies' habitats.

Although prairies may be grasslands in terms of sheer volume of vegetation, about three out of every four plant species found there are wildflowers. Prairies are blossom lands and, thus, butterfly lands. We netted skippers, satyrs, whites, blues, sulfurs, and red admirals with crimson bands on their dark velvety wings. Park naturalist Joe Zarki held up another type, a painted lady whose wings were bleached and tattered. "A traveler," he observed. "Hard trip from wintering grounds down south." What we really wanted to record was a regal fritillary. "This fritillary has become endangered," Joe told me. "Its larvae feed on native species of violets that have grown rare as the prairie was plowed under." Rarer still is the western prairie fringed orchid, which may wait years before putting forth its first pure, white, elaborately sculpted petals.

During weeks of traveling around, I searched many a wild pasture for the threatened plant without success. I did find *Echinacea*—the purple coneflower, or black sampson—and took a bite of the root. Plains Indian shamans would rub root extract on their hands, then walk through camp lifting boiling meat out of pots to impress everybody. Theatrics aside, this member of the sunflower and daisy family was used by many tribes to treat ailments from ordinary colds to snakebite. In laboratory tests the plant does show anesthetic, anti-inflammatory, and antibiotic properties and increases the resistance of cell cultures to viruses, including flu and herpes. One promising compound it produces appears to stimulate the immune system. Another serves as a natural insecticide.

On their fall migration south, snow geese soar over the prairie pothole region in North Dakota. The pocked wetlands—formed by blocks of melting ice left by retreating glaciers—are a rest stop for migratory birds and incubate half the continent's ducks. Much of this vital habitat has been drained for cropland.

ALTHOUGH EVERY PLANT AND ANIMAL on the prairie contributes to its biodiversity, prairie dogs create special hubs of life within the shortgrass and mixed-grass belts—particularly black-tailed prairie dogs, which form the most densely packed colonies among North America's five prairie dog species. "We've found 134 different kinds of vertebrates associated with black-tailed towns in western South Dakota," Dan Uresk, of the U. S. Forest Service in Rapid City, explained. "Naturally, a lot of them are predators: prairie falcons; golden eagles; ferruginous, swainson's, and red-tailed hawks; coyotes; and badgers." From time to time you'll see a coyote hunting with a badger, one waiting by an escape hole while the other digs into the main burrow entrance.

Smaller creatures—from cottontails to deer mice—find homes of their own within the prairie dogs' complex of tunnels. So does a unique subcommunity of dung beetles, rove beetles, and fly larvae. Burrowing owls rear their young there. Rattlesnakes crawl in to hibernate together in a slithery pile, forcing their hosts to plug that section of tunnel and dig another. Think about it. If you were out on the prairie with no shelter from the blazing sun or *(Continued on page 109)*

BOTH JIM BRANDENBURG, MINDEN PICTURES

A GRASS MENAGERIE

Towns of the black-tailed prairie dog (1) lure multitudes. More than a hundred species of vertebrates live in or near mounds that dot western shortgrass and mixed-grass prairie.

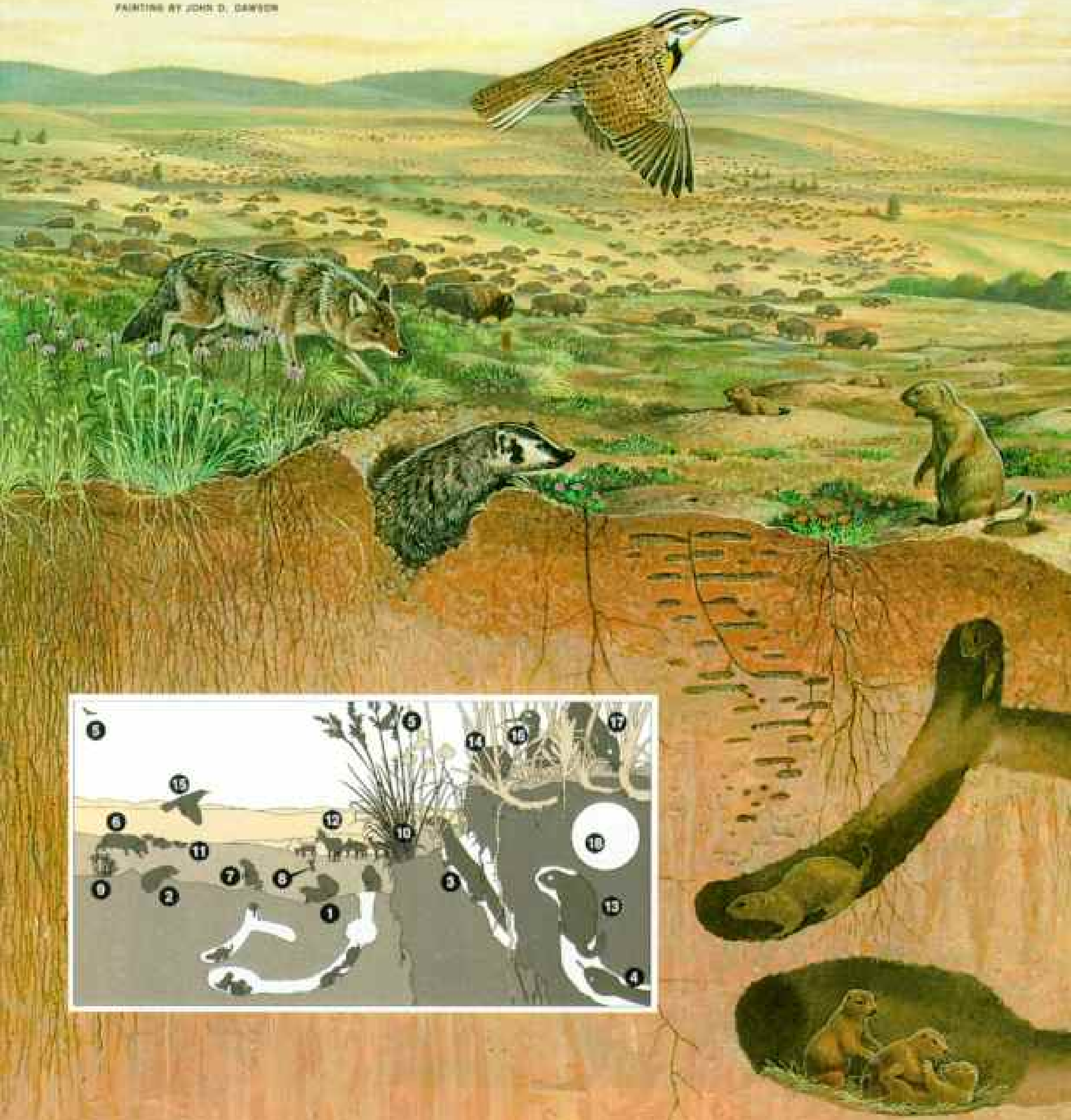
Many come for a meal. Prairie dogs are prey for badgers (2), and occasionally weasels (3) and rattlesnakes (4). These invade burrows and may flush the rodents into the clutches of hawks (5) or stalking coyotes (6). A complex pattern of barks enables prairie dogs to warn of attacks (7) or signal an all clear (8).

Their landscaping draws more benign company. Constant pruning of grasses such as blue grama (9) and little bluestem (10) spurs nutritious shoots that draw bison (11) and pronghorn antelope (12). Vacant burrows house thirteen-lined ground squirrels (13) or prairie voles (14). Topside, western meadowlarks (15), upland sandpipers (16), and lark buntings (17) compete for insects.

The soil also teems. Mites, nematodes, and microscopic protozoans and fungi (18) aerate and enrich soil and help supply nutrients to roots.

Undisturbed, prairie dog towns can last for centuries.

PAINTING BY JOHN D. DAWSON



(Continued from page 102) winter blizzards, where might you go? Underground, where the temperature stays mild and there are convenient apartments in the form of the prairie dogs' turning bays and various chambers. Listening chambers near the burrow entrance. Dry chambers, built to escape floods from heavy rains. Nest chambers.

The largest prairie dwellers hang out around prairie dog towns as well. That's where I looked to find bison and antelope in spring and early summer. Vegetation on soils aerated by prairie dog digging and fertilized by their droppings is among the first to green up, and the rodents' habit of clipping it short so they can see better

JIM BRANDENBURG, MINDEN PICTURES

Russet wands of big bluestem—trademark of the tallgrass prairie—shield and nourish a white-tailed doe grazing in autumn.

On close-cropped western terrain, a ferruginous hawk houses its young in a ground nest of needlegrass and fringed sage. North America's largest hawk swoops on wings spanning nearly five feet.

keeps plants in the nutritious stage of early sprouting for some time.

I, too, found myself strongly drawn to these natural metropolitan areas and could soon interpret many of the dozen different calls black-tailed prairie dogs make. Members of the same extended family, or coterie, would greet one another with an exchange of kisses followed by grooming, then stand up on two legs and survey their surroundings. While the pups wrestled with their littermates, somersaulting among scarlet globe mallow and star lilies, long-legged burrowing owlets looked on from the top of abandoned mounds with unblinking eyes like jewels set in a statue. When bothered, the owls clacked their beaks; when scared, they fled down the hole and hissed a perfect imitation of a rattlesnake's warning rattle.

Upland sandpipers stalked bugs all over town, and ornate box turtles turned over bison droppings for their share of the colony's extra insect life, then retired to resting spots in the tunnels. Elsewhere in the labyrinth, toads and tiger salamanders escaped the midday heat after breeding in the shallow ponds of nearby buffalo wallows.

On South Dakota's Buffalo Gap National Grassland, one of 20 such areas administered by the Forest Service, I passed an afternoon watching swift foxes. Five of them rested around the mouth of their den. They looked swift—small and lithe, with streamlined muzzles.

One was pouncing after frogs and moths. "They also take a lot of grasshoppers," said Ryan Tompkins. Ryan was studying these little-known, night-wandering foxes with the help of radio collars. "Still, half of their diet is small mammals."

Swift foxes are yet another species generally found around prairie dog towns. That's part of their problem. Ranchers and government agencies have teamed up in a campaign to poison prairie dogs on both private lands and public domain such as national grasslands. Why? In part, because rodents eat grass stockmen want for cows. Already decimated by earlier trapping and poisoning programs aimed mainly at coyotes, swift foxes are now in danger of vanishing.

Prairie dogs seldom remove more than 7 percent of the forage from a typical pasture, and that loss is largely made up for by higher protein in the variety of vegetation spread through their towns. Cattle put on about the same weight whether prairie dogs are present or exterminated. And still the poisoning campaign continues at taxpayer expense. Go figure. Figure hard, because prairie dogs have already been reduced by more than 90 percent nationwide, with the Utah prairie dog threatened and the Mexican prairie dog endangered. Mountain plovers, which like to nest where prairie dogs mow the grasses short, look bound for the endangered list. So do burrowing owls and perhaps ferruginous hawks. As for the predator that almost exclusively hunts prairie dogs, the black-footed ferret, it disappeared from the wild in 1987. That year biologists captured the last of 18 surviving ferrets from the high prairie near Meeteetse, Wyoming, and eventually succeeded in breeding them in captivity.

ONE FINE SUMMER DAY I rented a canoe in Valentine, Nebraska, and set off down the Niobrara River past gallery forests of bur oak, hackberry, cottonwood, wild grape, and buffalo berry. I would lift my paddle and listen to the notes of lazuli buntings and flycatchers hidden among the boughs, to the whisper of the prairie waterway sifting sands with its currents, and the *splish* of painted turtles slipping off banks into the flow. In the evening, thunderheads the color of wild roses bloomed across the sky, lit from within by lightning, while fireflies danced up and down the river's lush banks, lighting a leaf at a time.

"There where the stream of water separates. There on the island's point, where stand tree clumps, where once great herds of buffalo started from. There I stood," goes an Indian song, as I recall it. "I stood surprised and rejoiced. For there were the buffalo, like threads covering the earth. There they were, there they were. . . ." A couple of hundred of them anyway, braiding along a hill the next day where the river flowed past the Fort Niobrara National Wildlife Refuge.

Like nearby Valentine National Wildlife Refuge, Fort Niobrara was set aside in Nebraska's Sand Hills, a 265-mile-wide deposit of sand sprawled smack in the center of the nation. It is the largest dune formation in the Western Hemisphere and the largest tract of relatively undeveloped mixed-grass prairie left in North America. Though too loose and easily eroded to farm, the ground wears a surprisingly thick, well-woven coat of native plants, among them prairie sand reed, sand bluestem, and sand lovegrass.

Having been part of the Badlands butterfly brigade, I now hooked up with what I called the Midwest mouse masters, a team from the National Ecology Research Center in Fort Collins, Colorado. Odd

Light from a stark winter sun refracts through airborne ice crystals to form twin sun dogs over a frigid North Dakota prairie. Below, relentless winds—which often howl uninterrupted at 35 miles an hour—sculpt eerie shapes in drifted snow. As the seasons shift, temperatures on the plains can swing 140 degrees.

JIM BRANDENBURG, MINDEN PICTURES

that it would be 1992 before anyone got around to seeing exactly what wildlife lives on a national wildlife refuge. But that's what the mouse masters were doing—making the first complete inventory of mammals at Fort Niobrara and Valentine as part of a pilot project to study biodiversity on federal refuges. They led me through the countryside, setting traps for the likes of bushy-tailed woodrats and short-tailed shrews, moles and pocket gophers. The survey team expected to tally four different species of pocket mice alone.

The next evening when I dropped by camp to see their haul, I found the crew sitting in the shade of a box elder, combing out the fur of freshly stuffed specimens with toothbrushes. "*Arrooooooo!*" cried research assistant Ernie Valdez, holding aloft a tiny rodent with a pale silvery pelt. "A grasshopper mouse—the wolf of the mouse world. This is the most carnivorous of its kind. It eats more insects than seeds. It even eats other mice caught in our traps. The critter howls at the moon too." Well, it shrieks in the middle of the night to proclaim its territory. Which, I suppose, is not really so different from what wolves do.

The last wolves were wiped out of southwest Oklahoma not long after the last bison and elk. Yet when I visited the 59,020-acre Wichita Mountains Wildlife Refuge near Fort Sill at summer's end, I found

both the bison and elk back home on the range. And it was a range with big bluestem so thick and high I could barely make out the tallest buffalo's hump. Here were herds all but buried by their food supply. An acre of good tallgrass unfurls ten acres of leaf surface to catch the sun and produces at least 5,000 pounds of forage a year. Cattle put on two to three pounds of weight each day they feed in such pastures. At last the astronomical numbers of buffalo reported in frontier times made sense to me. All those tales of scouts riding past a single herd for days on end; of market hunters shooting until their barrels overheated, pouring water from canteens to cool them, shooting some more, urinating on the gun when the water ran out, and still shooting.

The elk tended to linger near the groves of post oak and blackjack oak scattered through this grassland. Then Bobbie and Sandy Lewis and Katherine Hunt, volunteer guides from a group of natural history enthusiasts called the Association of Friends of the Wichitas, made squeals and bugles through the special pipes they carried. Within minutes rutting males were trotting in to shake their gleaming antlers and sing challenges in return. Three coyotes stood together on a knoll, shifting their gaze between us, the elk, and a flock of scratching, strutting wild turkeys—also reintroduced into the area. White-tailed deer grazed nearby. Golden eagles and turkey vultures wheeled over a gentle slope of auburn grasses, marking what may have been a kill.

Seated with other tourists on the Friends of the Wichitas' bus, I began to realize with amazement that I was on a safari on the American savanna. I had to squint a bit and blur my vision to ignore human sign, such as confining fences, and pretend that a lot of missing species were hidden somewhere within the grass. Just the same, the place offered a powerful glimpse of what was and could be once again. The refuge is trying to restore prairie dogs. Perhaps one day a few wolves will be reintroduced somewhere back into the prairies as well. Perhaps one day we will begin to connect one isolated patch of prairie to the next.

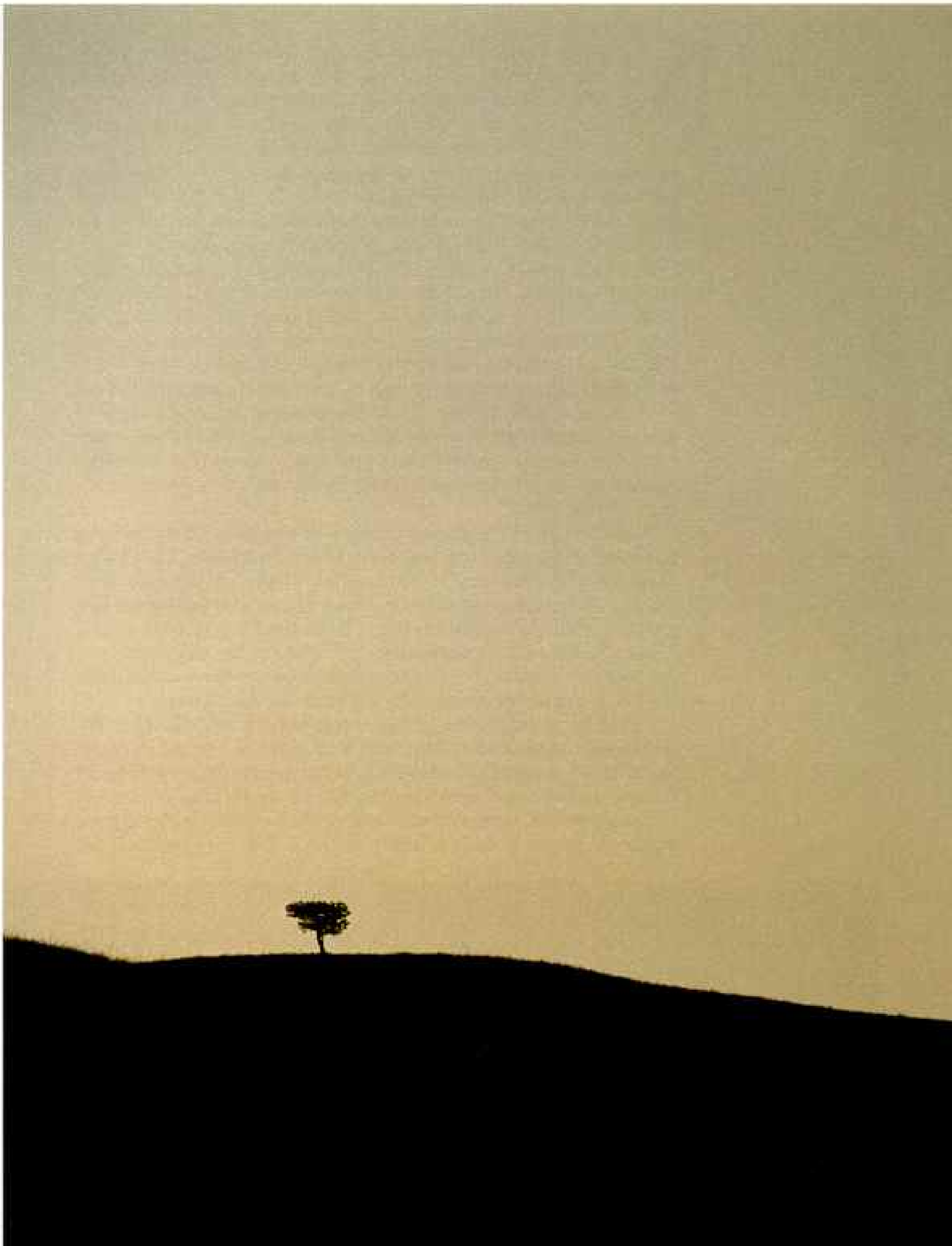
Eyes fixed in a permanent stare, the short-eared owl of the prairie—which nests on the ground—must twist its head to scan for prey or to spot hawks attacking from above. Cottontails too are a target for hawks as well as for coyotes and bobcats, yet this one yawns during a meal of wheatgrass, ready to dart safely to a nearby prairie dog burrow.

NOT FAR NORTH, near Pawhuska, Oklahoma, the privately financed Nature Conservancy recently purchased a 30,000-acre cattle ranch in the Flint Hills to create a tallgrass-prairie preserve. This will be by far the largest unbroken expanse of tallgrass yet set aside. The Conservancy plans to remove all fences except a stout one around the perimeter, then build a herd of 1,800 bison and see if the animals can reclaim at least a bit of their old free-roaming ways. To keep the grassland in prime condition, the Conservancy plans to periodically set selected areas ablaze.

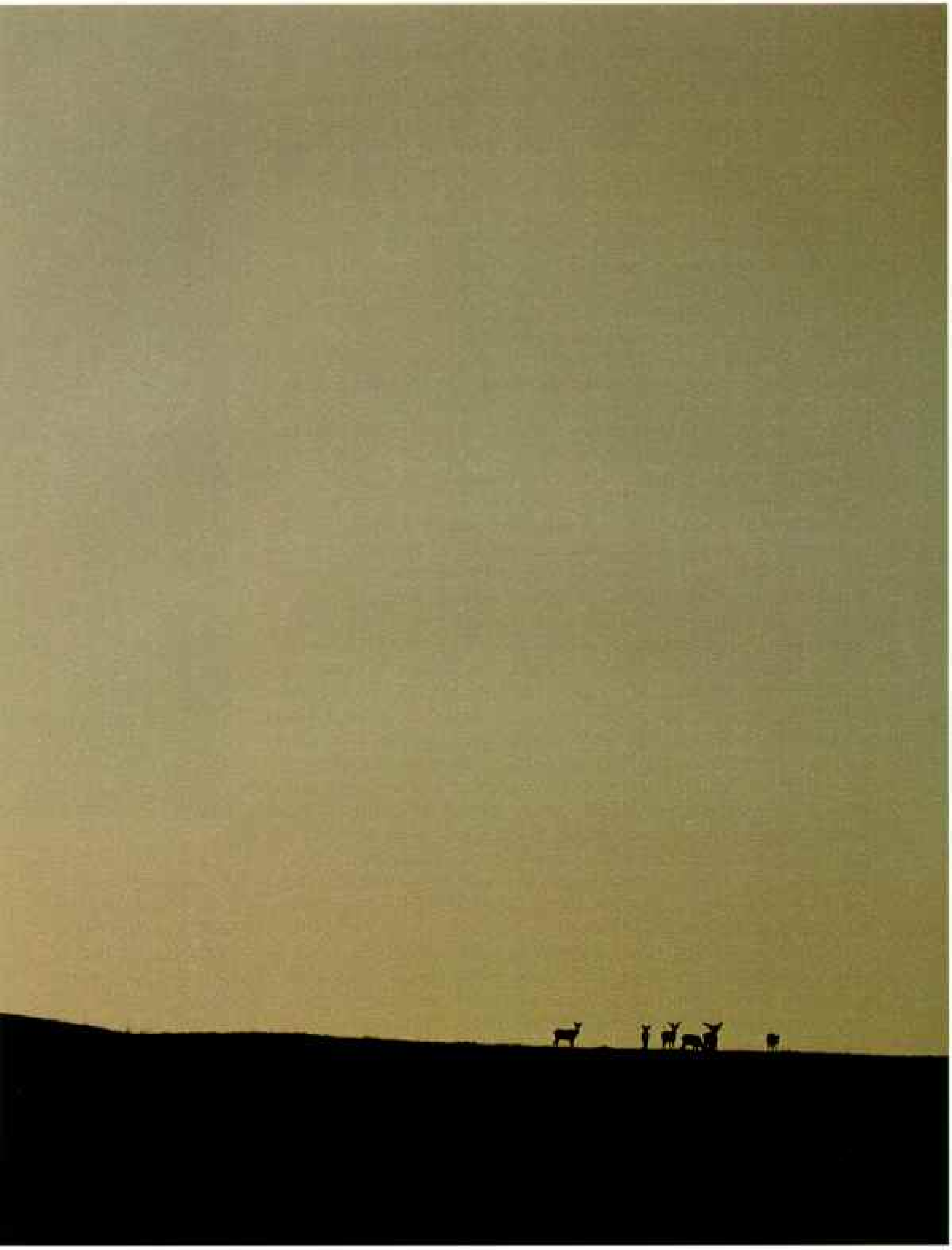
I looked over the property with Dick Whetsell, a volunteer rangeland adviser who worked much of his life managing a large cattle outfit. Parts of the reserve hadn't burned for a couple of years, and already the mat of dead grass underfoot was so thick that it made hiking across the prairie like wading through snowdrifts. Except that these drifts buzzed with grasshoppers, and prairie chickens burst out of them from time to time. Dick dug through the thatch until he reached ground level. It was as cool and damp as a cloud forest down there. He showed me Scribner's panicum, a grass that flourishes under the shelter of others and stays green through the winter, providing valuable fodder.

"An intact piece of tallgrass prairie will host somewhere between 200 and 400 species of native plants," Dick informed me. "It's a wild garden. Each week from April through September, about a dozen new kinds of flowers come into bloom. Once the layer of dead grass gets too thick, though, it starts to choke off the smaller grasses and wildflowers. Meanwhile, woody plants—they like shade and moisture—can gain a foothold in the sod and spread. If you go long enough without fire, much of this countryside will be covered with trees."

The easternmost prairies that once reached across Missouri, Iowa, and Illinois into Indiana, Ohio, and Kentucky are a prime example: What hasn't succumbed to the plow has been overgrown with forest because people have been fighting fire for more than a century. Indians feared it, for a wall of flames roaring across sun-dried grass higher than your head is a terrifying force. But they regularly set



Alone pine and huddled American elk share the horizon in a



South Dakota dawn. Once abundant grasslanders, most elk have retreated to the forests.

blazes in order to lure game to the tender new sprouts that always emerged within days after a burn.

Grasses wouldn't have conquered the heartland if they couldn't handle the lightning sparks shot out of all those summer storms roaming prairie skies. Or if they couldn't outlast dry years when the clouds just streak by like a broken promise. Nor would grasses have become the most widespread type of vegetation on earth during the reign of mammals if they hadn't devised ways to cope with grazing and trampling. Chomping them off can actually stimulate growth—as anyone who mows a lawn all summer long has probably suspected. If anything, fire encourages even stronger growth and boosts the production of flowering stalks and seeds. When drought sears the land, it only hands the hardiest grasses an extra advantage.

The secret to such success lies where so much of the prairie dog community thrives: underground. Almost two-thirds of the total vegetation of grasslands is protected within the soil. Most plants grow from their tips to add length. By contrast, grass grows from its base, emerging from a bud at, or just under, the soil surface, where sensitive growth tissues remain safe from the elements and hungry herds.

If placed end to end, the roots and root hairs beneath a square yard of tallgrass can stretch 20 miles. Most are packed into the top ten inches of dirt, creating sod so dense settlers used it like bricks to build houses. Additional roots extend 10 or even 15 feet deep in some species, letting the grasses sip the last trace of water in parched times.

Much of the biodiversity of the tallgrass prairie unfolds beneath the surface as well, but you have to refocus your vision to find it. "You've got to come see my 'todes," said ecologist Tim Todd of Kansas State University at Manhattan. I thought we were going to look at amphibians where he does his fieldwork, on the nearby Konza Prairie Research Natural Area at the northern tip of the Flint Hills. Instead he took me to a microscope in his lab and began showing me minuscule roundworms. Nematodes. Tim put in a slide of a predatory species with formidable teeth—the wolf of the nematode world—then a squirming selection of plant-eating nematodes. "A square foot of prairie soil holds something like half a million of the plant-eaters," Tim told me. "Given their high metabolism and the rate at which they consume food, nematodes—not bison—have probably always been the dominant plant-eaters of the prairie."

If you go from nematodes to earthworms (which rival bison in terms of total weight per acre on a typical range), harvester ants (whose subterranean colonies turn over as much soil as the earthworms), insect larvae, mites, and other tiny inhabitants of the root tangles, the big beasts wandering overhead no longer seem quite such a dominant part of the community.

Fingers of fire, set deliberately, sear 6,000 acres of the Tallgrass Prairie Preserve in Oklahoma. Grasses thrive after fire, which kills shrubs and trees, releases nutrients into the soil, and stimulates growth. Called red buffalo by Indians, prairie fire "sounds like a thundering herd," says preserve director Harvey Payne.

YOU'D BEST BE ENTHUSIASTIC about micro-wildlife by the time you get to the eastern tallgrass region. People haven't left room for much else. The prairie has become little more than a ghost, something glimpsed out of the corner of your eye around graveyards and old railroad rights-of-way. Illinois, for example, has barely 3,500 acres left—less than one ten-thousandth of the 37 million acres of tallgrass pastures settlers found waiting within the Prairie State.

Driving past endless miles of row crops and countless new housing developments in northern Illinois, I felt forced to confront the future.

And the future had all its edges squared off. I was wondering how long the spirit can stay free in a cornered landscape, when there suddenly appeared an unruly thatch of wildness in the outer suburbs of Chicago. Not a large one but enough to give hope that diversity can continue to flourish. Called the Vermont Cemetery, this patch is little more than an acre in size and, in a striking example of the stability of topsoil held by prairie sod, stands fully a foot higher than the surrounding cornfields.

A self-confessed prairie partisan named Bob Betz opened the gate, saying, "I came upon this place 30 years ago in my travels to find the last pockets of prairie before they disappeared. People were trashing it fast. My friends and I built this chain-link fence with money out of our own pockets. I've come in periodically ever since and burned to knock back invading shrubs. And look! Look who's here! *Aster azureus*—blue-sky aster. Heart-leafed golden alexanders. Compass plant—see how the leaves point north and south? Here's wild quinine. Rattlesnake master—another medicinal plant." This professor from Northeastern Illinois University at Chicago was almost running now, hurrying over graves and the burrows of Franklin's ground squirrels. He pointed with both hands and yelled back at me: "Shooting stars!

False dragonhead gentian. A couple of prairie lilies. Another *Silphium*—prairie dock. Prairie phlox."

In 1975 Bob started planting seeds from this and similar hiding places in a plot of old farmland covering 450 acres. He wanted to see if he could rebuild a prairie from scratch on a large scale. What made the project doubly intriguing is that the farmland lay within the particle accelerator ring of Fermilab—the Fermi National Accelerator Laboratory, in the Chicago suburb of Batavia. All that came up were common weeds. Bob kept planting. And then, right there in the nucleus of what looks like a space colony, amid giant metal tubes and hissing vats of liquid helium, the tallgrass rose in splendor with its attendant wildflowers. A short while ago quite a stir was raised in this enclave of physicists when a badger moved into the newborn prairie.

With Fermilab's blessings, Bob is now overseeing prairie restoration on hundreds of additional acres outside the ring. And in 1989 the Department of Energy declared the site a national environmental research park. Bob's enthusiasm is plainly contagious. Enlisted to

help prepare the new grassland, some of Fermilab's grounds crew have turned into prairie partisans in their own right, spouting Latin plant names and volunteering to collect seeds by hand in their spare time. They led me into a room where a portion of their harvest had been spread out on the floor to dry, awaiting spring. All at once I was ankle-deep in silken tassels, wild grains, fluff, and burs, and overwhelmed by scores of pungent fragrances. I knelt and plunged my hands into future prairie. It felt like a meadowlark's song.

LIKE MOST LEFTOVER PRAIRIE of any size, the 1,500 acres now protected as Minnesota's Blue Mounds State Park was just too tough to plow. The terrain is an outcrop of pink Sioux quartzite—with some of its exposed rock edges rubbed smooth by millennia of itchy buffalo—rising above a sea of corn. One piece of the park had been cultivated for corn and soybeans, though. Walking beside Ed Brekke-Kramer, a Minnesota Department of Natural Resources ecologist, I found a tongue of wild plants extending from the hillside into the old field. The prairie was restoring itself. Leading the way were big bluestem, stiff goldenrod, and leadplant, a legume with especially tough, fibrous roots. Indians called it buffalo bellow, because it flowers during the July-August rutting season. After John Deere's steel plow began to replace the cast-iron plow in 1837 and pioneers were finally able to bust the prairie sod, leadplant became more widely known as the devil's shoestring.

I passed from the prairie onto the former cropland. Thunk. It was like stepping from a cushion onto concrete. The prairie had been sweetening the earth as it advanced, turning compacted, miserly dirt into soft loam full of tiny life-forms distributing riches. I even found western prairie fringed orchids at Blue Mounds. To keep illegal collectors from nabbing them, the park staff had marked their location with cryptic signs on fenceposts: so many steps north, then this many east. . . .

Continuing my search for treasure, I swept a spotlight beam across a white-tailed prairie dog colony in Wyoming's Shirley Basin, near the lonesome town of Medicine Bow. But there were only frost crystals gleaming on June grass and low sagebrush and, above them, the November night wind and cold stars. What I was looking for were flashes of green fire. Jackrabbit eyes appeared, reflecting red as coals. Then came eyes the right color but too big and high off the ground. Pronghorns. Just as I was about to give up and sleep, twin green sparks came darting and bounding between the prairie dog burrows. I had found a black-footed ferret in the wild.

In autumn 1991 the Wyoming Game and Fish Department released 49 young captive-bred ferrets in Shirley Basin. Another 90 were turned loose in 1992. Some dispersed and have not been located since. Some starved. Coyotes and badgers dined on many others. Perhaps no more than 20 of these masked members of the weasel family were still alive out on the high prairie at 1992's close. Nevertheless, they included animals born in the wild to members of the first group released.

Working by headlamp, Bob Oakleaf, the department's nongame species coordinator, held up a wild-born ferret he had caught to examine and mark with dye. Earlier he had captured several of those born in captivity. The wild-born one's reactions were much sharper, its fur thicker. Its weight was good, and its eyes were bright and clear. Like the American prairie, this animal was ready to roll. □

A stolid bison at Blue Mounds, Minnesota, stares westward, where huge herds once roamed. Advocates propose returning as much as 140,000 square miles to bison and grass—a dream signaling that the prairie and the life it supports are valued as more than relics of a lost past.

Long thought to be headless shrimp, these fossils proved to be the claws of a Cambrian predator, *Anomalocaris*. An intact specimen (right, shown life-size) was unearthed by a Canadian team in 1991.

THE CAMBRIAN PERIOD

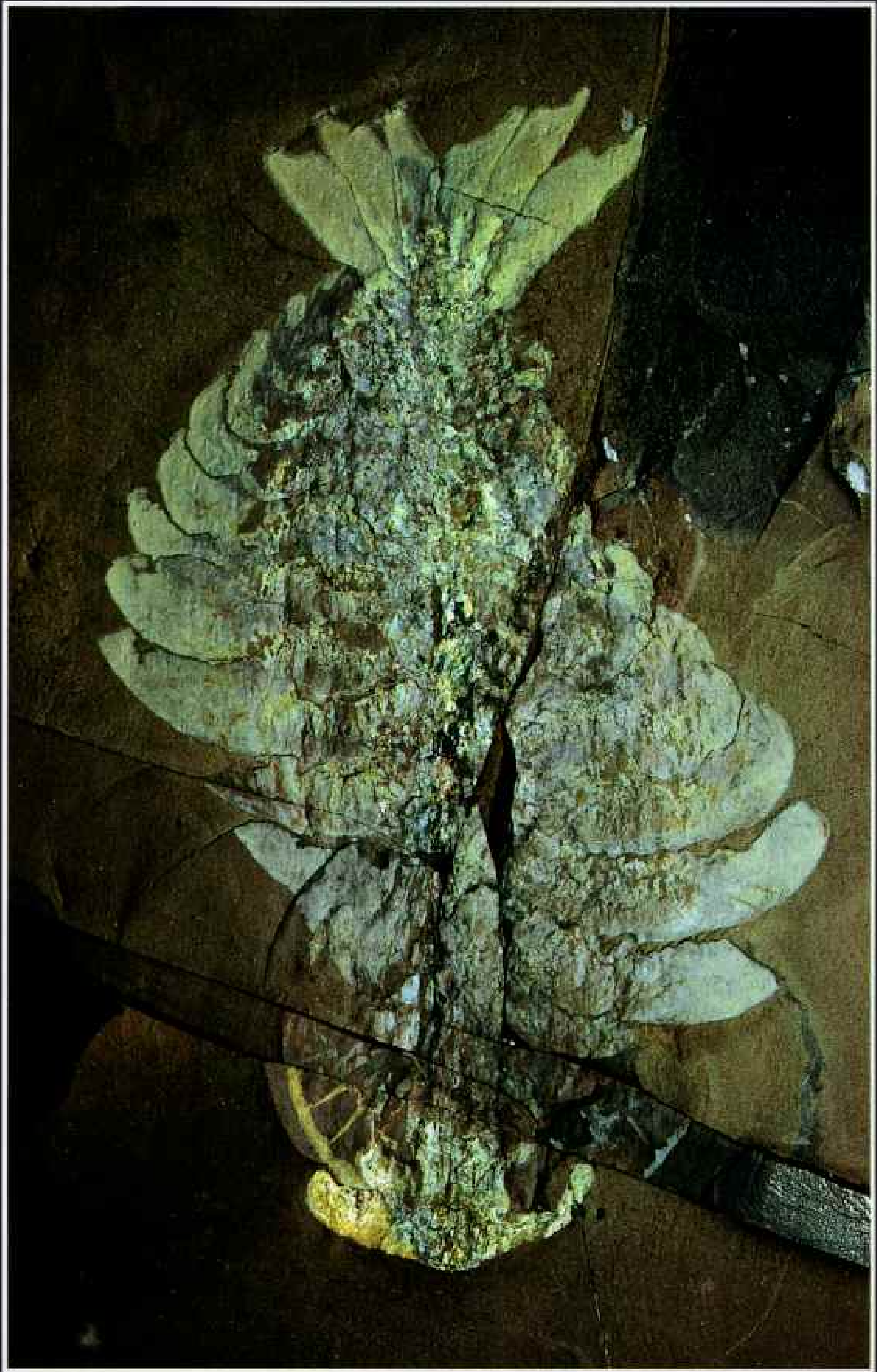
Explosion of Life

By RICK GORE
SENIOR ASSISTANT EDITOR

Photographs by O. LOUIS MAZZATENTA
SENIOR ASSISTANT EDITOR

More than half a billion years ago the world's first monster appeared. With bulging eyes and fearsome grasping claws, *Anomalocaris* (right) cruised the seas during the geologic time period known as the Cambrian. Its mouth was a nightmare of hard plates and teeth. Its body, looking like a cross between a stingray and a lobster, could grow to three feet in length—giant for its time.

For millions of years animals had been simple—mostly anemone-like creatures or worms. Then in a geologic blink of about ten million years, virtually all the phyla, or groupings based on body design, of animals alive today came into being. Perhaps encouraged by an increase of oxygen in the seas, this Cambrian explosion was the greatest burst of animal evolution the planet has ever known, and new fossil finds are highlighting its details.



A new world of predators and shells

When *Anomalocaris* (1) hunted early Cambrian seas, the continents were barren, but the seafloor was a hotbed of new creatures. Animals had just evolved the ability to secrete shells, build skeletons, move agilely—and prey on one another. New discoveries in China, portrayed above, reveal myriad forms of animals. Most were arthropods, the phylum of today's crustaceans, insects, and spiders.

Using sensory antennae, the trilobite-like *Naraoia* (2) scuttled in search of prey, perhaps the buried carnivorous worm *Maotianshania* (3). *Fuxianhuia* (4) may have used tiny eyes on stalks to hunt. Spine-tipped appendages of *Jianfengia* (5) may also have held sensors. The clawed legs of *Luolishania* (6), a creature with traits of both worms and arthropods, suggest that it preyed on the abundant sponges such as *Leptomitella* (7) and *Halichondrites* (8).

Predation, a new behavior

PAINTING BY MARVIN MATTELSON

In the Cambrian world, encouraged animals such as *Hallucigenia* (9) to evolve defensive spines. Its cousin *Microdictyon* (10) developed armored plates along its sides. Young *Microdictyon* may have fed upon the carcass of the umbrella-shaped *Eldonia* (11).

Facivermis (12), a worm with five pairs of tentacles near its head, and anemone-like *Xianguangia* (13) thrived, as did many burrowing bivalved brachiopods (14). Cambrian seas also contained the shrimp-tailed *Waptia* (15) and the bizarre tulip-shaped *Dinomischus* (16), which belongs to no living phylum.

200 MILLION YEARS AGO — 100 MILLION YEARS AGO — TODAY

DINOSAURS EMERGE — AGE OF MAMMALS BEGINS — HOMINIDS APPEAR

Mining Cambrian secrets in Canada's Rockies

STANDING ON A LEDGE that was once 250 feet underwater, Canadian paleontology students Ben Wheeler and Kevin Brett (below, at left) crack through the fossil-laden rocks of the Burgess Shale amid the glaciated mountains of British Columbia. The formation was created some 515 million years ago by mud slides that swept shallow-water Cambrian creatures over a marine cliff and buried them almost instantly, explains paleontologist Desmond Collins of the Royal Ontario Museum. Turned to rock, "they have been thrust up here for our delectation and puzzlement," says Collins, who each summer leads a team of students up the old Burgess Pass trail to free more fossils.

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The Burgess fossils reveal what the Cambrian explosion wrought. Rising oxygen levels in the seas may have helped trigger the unprecedented spurt of diversity. The increase in oxygen enabled sluggish

Precambrian animals to behave more energetically. It may also have helped in the manufacture of collagen—the protein building block of connective tissue, cartilage, and, eventually, bone.

The rapid burial of the Burgess creatures preserved soft parts and innards, which usually decay or get eaten before fossilization begins. The shale thus contains not only the relatively common hard-bodied creatures of the Cambrian but also fossils of its rarely found soft-bodied animals.

Though discovered in 1909 by the eminent geologist Charles D. Walcott (below right), the Burgess was long neglected. Since the mid-seventies, however, Collins's team has found numerous new creatures at different levels in the rock, including pieces of several varieties of the monster *Anomalocaris*. So far the team has found five distinct animal communities, each from a different environment, that were buried at different times over several million years. Collins sees little evolutionary change among these animals, which indicates that by Burgess times the explosive phase of the Cambrian was spent.

"New fossils found in China and Greenland look very much like the Burgess animals," says Collins. "Yet they are up to 15 million years older."

Moreover, new radiometric dates indicate that the Cambrian had begun barely ten million years before the Chinese fossils lived. Therefore, the modern animal groups emerged almost at once—making the Cambrian explosion appear to be the big bang of zoology.

SMITHSONIAN INSTITUTION

Charles D. Walcott (above), head of the Smithsonian Institution from 1907 to 1927, discovered the Burgess Shale while traveling by horseback with his family on a summer field trip. Cracking open a slab of shale that had fallen across a trail, Walcott found a delicate crablike creature he named *Marrella*. Realizing the site opened a unique window on early animal life, he shipped more than 60,000 specimens back to Washington, D. C., between 1909 and 1919.

Weird wonders surface to provoke questions and controversy

BURGESS SHALE specimens lay hidden inside the drawers of the Smithsonian Institution's Museum of Natural History for decades until their rediscovery in 1966 by University of Cambridge paleontologists Harry Whittington and Simon Conway Morris (right, at left), shown with a projected image of a *Marrella*.

Charles Walcott had described many of the Burgess fossils as early versions of animals that are still around today—arthropods, jellyfish, and worms. But when Whittington, Conway Morris, and their colleague Derek Briggs took a second look, they saw a world of astonishingly unfamiliar creatures.

The fossils revealed perplexing animals such as *Hallucigenia* (right). Walcott had called it a worm; Conway Morris thought it looked more like an image out of a hallucinogenic fantasy and named it accordingly.

The Cambridge team found at least 14 other animals they could not classify in any known phylum. *Nectocaris* had a head resembling that of a shrimp but a body reminiscent of a fish. Around the mouth of *Odontogriphus*, a gelatinous, oval-shaped, two-and-a-half-inch-long swimmer, a row of tentacles sprouted.

Later Conway Morris recognized that the eel-shaped "worm" Walcott had named *Pikaia*, after nearby Pika Peak, had an incipient spinal column, the hallmark of all vertebrates, from fish to mammals. *Pikaia* was reclassified as the oldest known respresentative of our own phylum, Chordata.

Yet for scientists it is the weird wonders that have stirred the most excitement. They have also stirred the most controversy.

"They are unique," says Harvard paleontologist Stephen Jay Gould, "as different from each other in body design as any modern phylum is from another."

These strange animals underscore the role of chance in evolution. Our ancestor *Pikaia*, Gould notes, was not abundant in the Cambrian and could easily have become extinct. Would vertebrates have ended there?

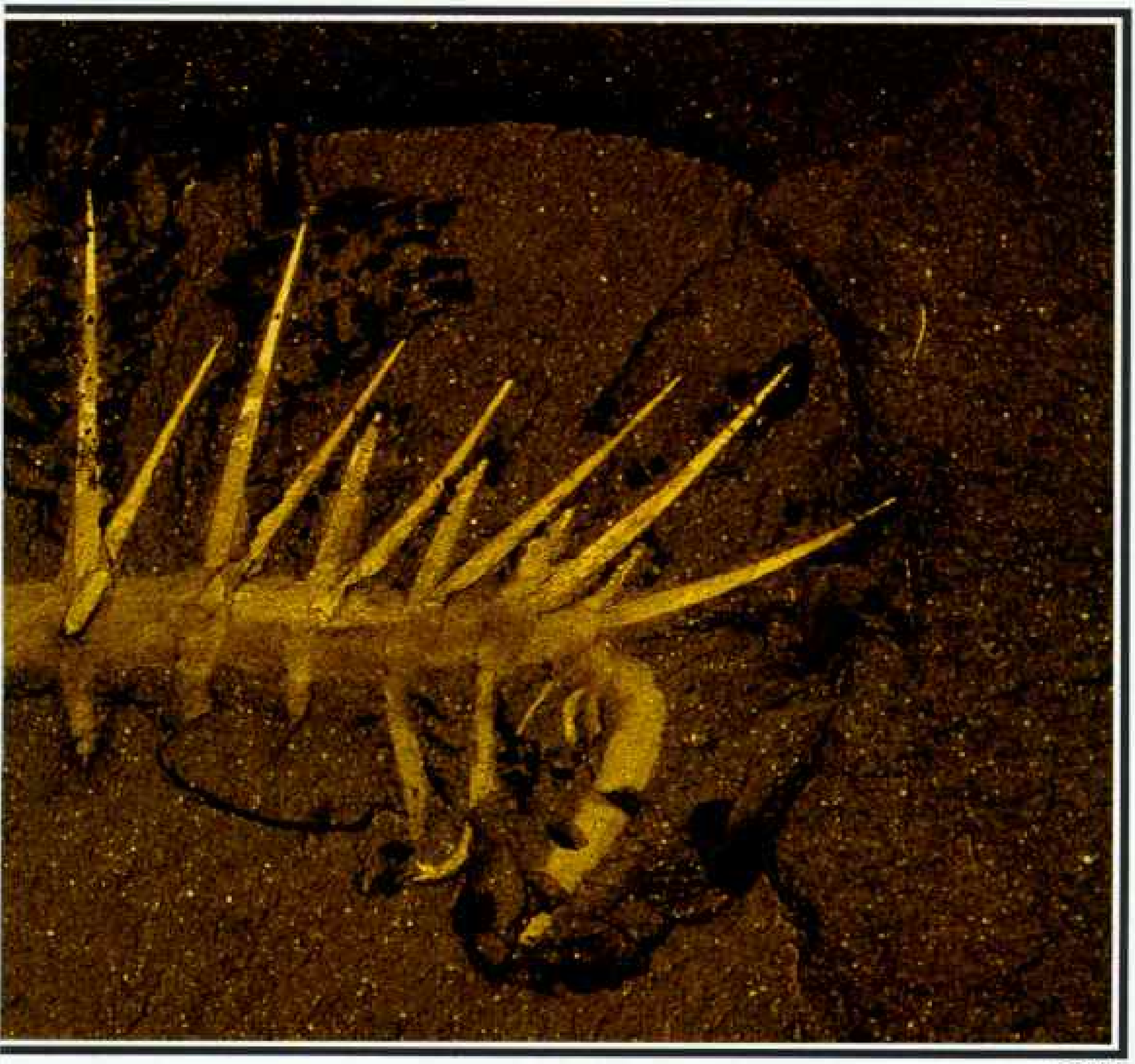
Gould: "Wind back the tape of life to the early days of the Burgess Shale," he says. "Let it play again from an identical starting point, and the chance becomes vanishingly small that anything like human intelligence would grace the replay."

Other scientists heatedly reject this idea.

"Similar environmental conditions on the planet will cause different animals to find the same biological solutions," says Conway Morris. "There are a limited number of ways animals can do things. Rewind the tape of life and the likelihood of me, Simon Conway Morris, standing here is infinitesimally small. But I'd say that the odds of an upright, two-legged, introspective organism with binocular vision being here are rather high."

Hallucigenia, the Burgess Shale's most famous fossil oddball (below), seems less strange since Swedish researcher Lars Ramsköld found a second set of legs hidden behind the animal. Before, scientists thought it walked on its stiff spines. New Chinese specimens confirm the true nature of the tiny, still peculiar beast, portrayed at right with both spines and legs.

PAINTING BY KAM MAK



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Life's parade quickens

The bizarre and beautiful creatures that came out of the Cambrian starting gate shared a long Precambrian history. Earth's first fossils, single-celled bacterial filaments, appear in rocks about 3.5 billion years old. However, another two and a half billion years passed before the metazoans, or multicelled animals, emerged. Recent comparisons of genetic material common to all living cells indicate that metazoans diverged from bacteria, fungi, and algae between 800 million and a billion years ago.

At first probably small enough to live between grains of sand, animals remained biological underachievers for hundreds of millions of years while earth went through a long episode of continental rifting and a series of ice ages. So severe was the climate that about 600 million years ago glaciers near the Equator reached sea level.

Not until after those ice ages did most metazoans actually appear in the fossil record. Known as the Ediacara fauna, they were typically sluglike bottom dwellers or gelatinous blobs that lived passive, low-energy lives. Some may have belonged to a separate kingdom of life that became extinct when the Cambrian's advanced animals erupted into the world and began to colonize countless open niches. Suddenly in the primordial seas everything was possible.

4.6 billion years ago
Earth forms, its gravity pulling in countless meteorites. As the molten crust cools, oceans condense but are too hot for life.

4 billion years ago

Key to Cambrian animals

- Chengjiang fauna, China, 530 million years ago
- Sirius Passet fauna, Greenland, 525 million years ago
- Burgess Shale fauna, Canada, 515 million years ago
- x Left no known descendants beyond the Cambrian

Anomalocaris ● ● x
Possible arthropod. Up to 40 in

Odontogriphus ● x
Unclassified. 2.3 in

Pikaia ●
Chordate. Ancestor of fish, reptiles, mammals. 1.5 in

Facivermis ● x
Unclassified. 1 in

Burgessochaeta ●
Annelid worm. Early earthworms. 1 in

Amiskwia ● x
Unclassified. 0.75 in

Opabinia ● x
Unclassified. 2.5 in

Ottoia ●
Priapulid worm. 3 in

Wiwaxia ●
Polychaete worm or mollusk. 1.75 in

Ayshaeia ●
Possible arthropod. 2 in

3.9 to 3.5 billion years ago
Life originates as single-celled organisms. The dense atmosphere is primarily carbon dioxide.

3 billion years ago

2.8 to 2.5 billion years ago
Photosynthesizing bacteria pump large amounts of oxygen into the atmosphere. An ice age grips the polar regions. Bacteria become more complex.

2 billion years ago

2.1 to 1.9 billion years ago
Oxygen builds. Large single-celled organisms appear. Multicelled life originates.

1 billion to 600 million years ago
Animals evolve but remain tiny. Geologic and climatic trauma grips the planet. Oxygen surges, reaching levels that can support large, complex animals of the Cambrian explosion.

1 billion years ago

Precambrian/ Cambrian boundary
ca 540 million years ago

Sponges
Still present in oceans.

Ediacara fauna
The first metazoans.

Xianguangia
Unclassified. 2 in

Dinomischus
Unclassified. 0.8 to 4 in

Brachiopods
Still present in oceans. 0.4 to 4 in

Halkieriids
Possible mollusks. 2 in

Hyolith
Possible mollusk. 1.5 in

Unnamed
Arthropod. 7 in

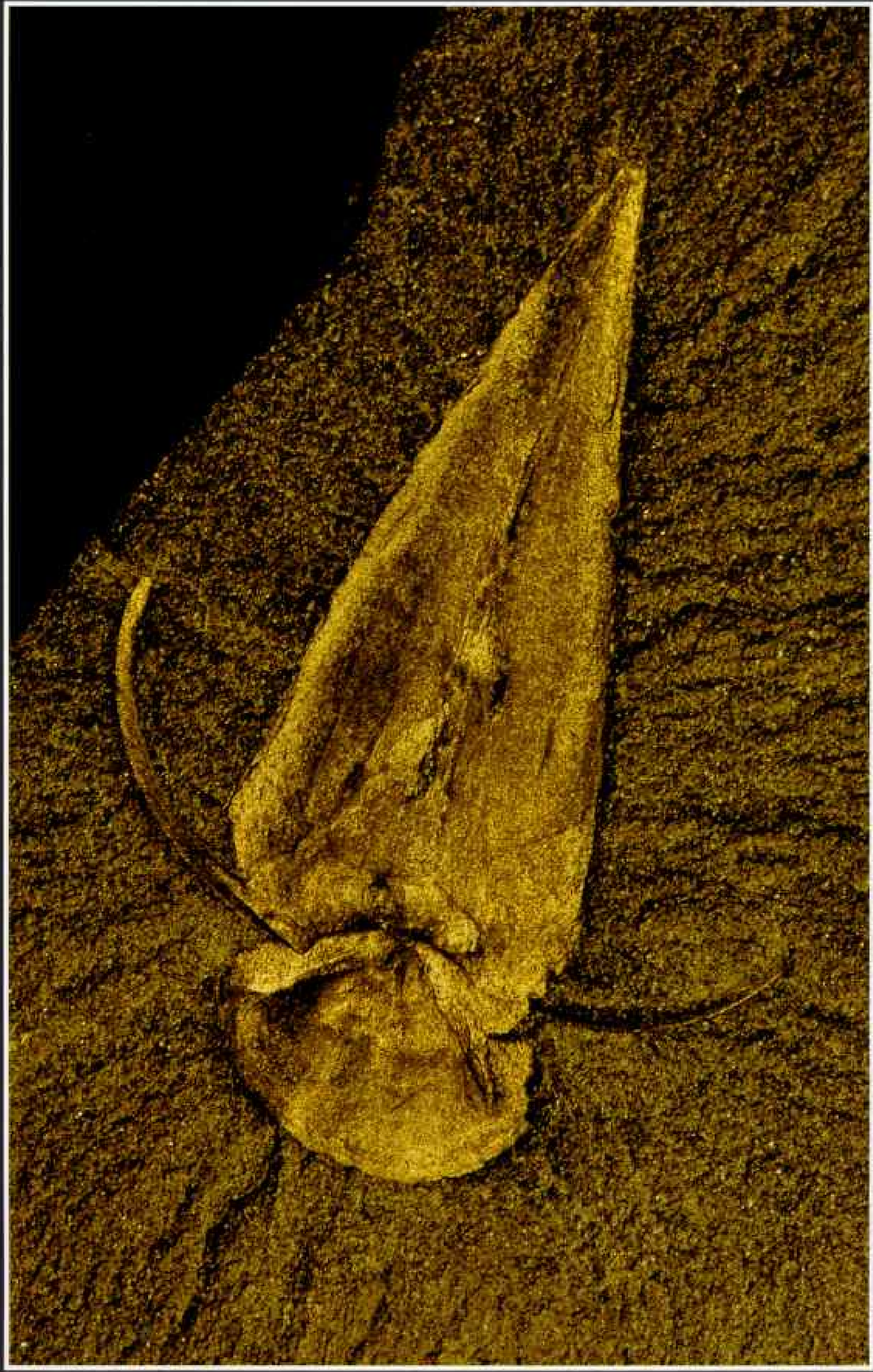
Eldonia
Possible echinoderm. 4 in

Canadaspis
Arthropod. Early crustacean. 3 in

Sanctacaris
Arthropod. Forerunner of spiders, scorpions. 4 in

Trilobite
Arthropod. Up to 27 in

PAINTING BY NATIONAL GEOGRAPHIC ARTIST CHRISTOPHER A. KLEIN



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PAINTINGS BY KAM WAR

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Predatory tactics trigger a Cambrian arms race

ENCASED in shell armor, the inch-long hyolith at left had evolved complex musculature that let it open and close its lid as modern snails do when they retreat into their shells. Two curved, whisker-like appendages helped support its shell on the muddy seafloor, where it probably fed on detritus in the muck.

Hyoliths were among many Cambrian creatures for which the ability to secrete shells led to new body designs, ways of feeding, and methods of protection from predators.

The hyoliths' pointed ends and whiskers, for example, made them difficult to swallow—but not too difficult for the carnivorous worm *Ottoia* (top left), which snapped up prey with its whiplike proboscis.

An *Ottoia* from the Burgess Shale (bottom left) was preserved at its moment of death with three hyoliths lodged in the end of its gut. Each hyolith was positioned blunt end forward, indicating that the *Ottoia* could reorient its prey before swallowing it.

"They were clever predators," says Smithsonian paleontologist Douglas H. Erwin.

Predation probably encouraged the Burgess Shale creature *Wiwaxia* (top and bottom right, shown life-size), to evolve an armor of overlapping scales.

Scientists have not decided whether *Wiwaxia*, which grazed on the seafloor, was a protomollusk or an early type of segmented marine worm known as a polychaete. Like some polychaetes, *Wiwaxia* had sharp spines, broken off in this specimen. Those spines made its body larger and more difficult—not to mention more painful—to swallow.

Life in the Cambrian was an ever escalating arms race, and new offenses followed new defenses. *Wiwaxia*'s spines probably caused its predators to make their own evolutionary leaps—such as bigger mouths or improved hunting strategies.

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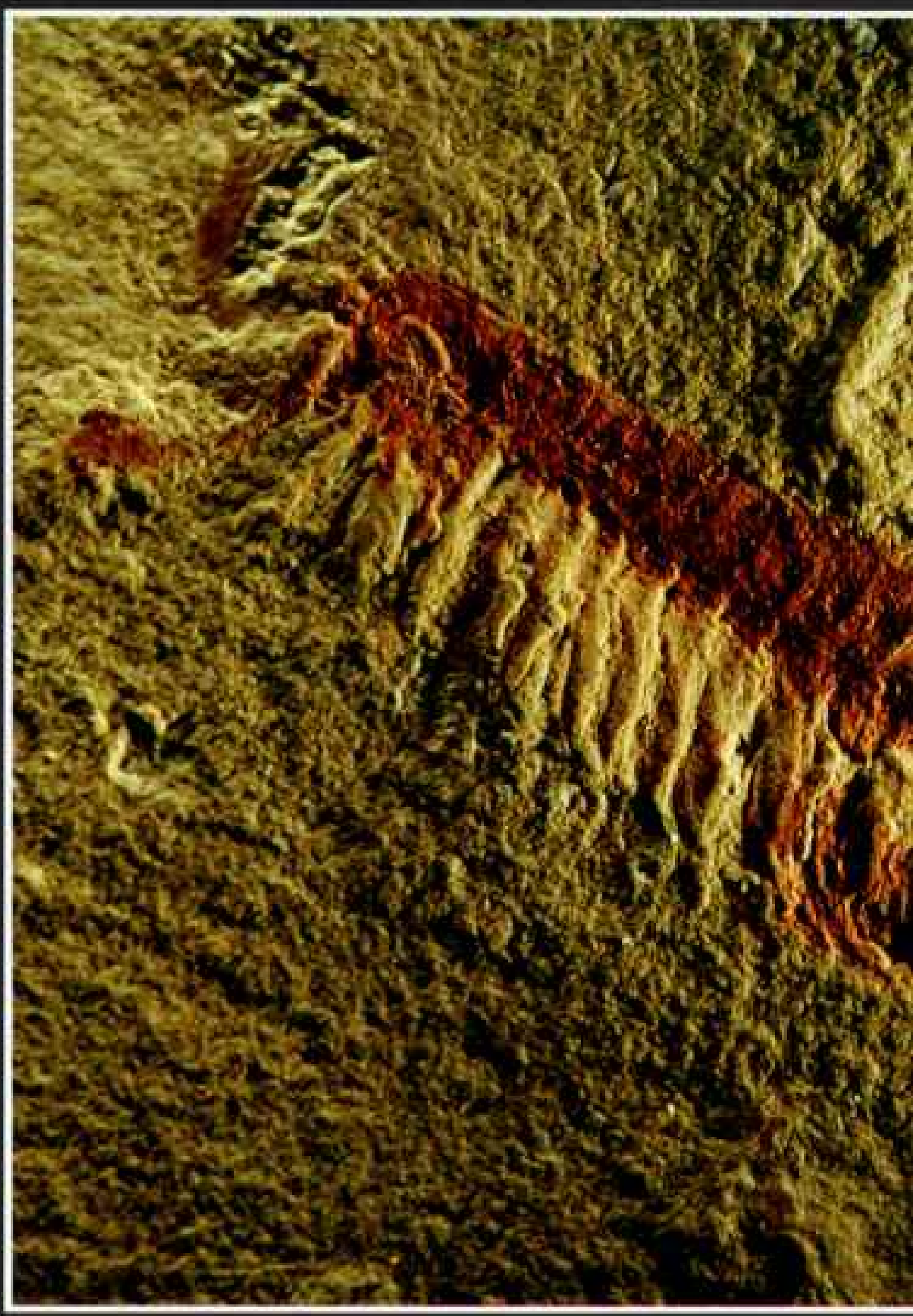

Dazzling new enigmas emerge from a Chinese mountain

"THE ROCK was still wet. The animal was glistening, like it was still swimming," recalls Hou Xianguang. As a graduate student in 1984, Hou was surveying the rocks of Maotian Hill, near the town of Chengjiang in Yunnan Province, when he came across an unusual fossil arthropod.

"My teachers always talked about the Burgess Shale animals. It looked like one of them. My hands began to shake."

Hou had found a *Naraoia* like those from Canada. However, Hou's animal was 15 million years older than its Burgess relatives. The *Naraoia* was not alone. Over the past decade a team led by Hou's colleague Chen Junyuan of the Nanjing Institute of Geology and Palaeontology has excavated more than 10,000 specimens from the Maotian site (far right).

These so-called Chengjiang animals, including a *Naraoia*-like specimen (top right), are among the world's most beautifully preserved soft-bodied animals. They lived only ten million years after the Cambrian began and testify to the speed of evolution then. Already such animals as the arthropod *Jianfengia* (center) had advanced body designs.

Reddened by oxidation after being exposed to air, the fossil reveals *Jianfengia*'s battery of legs and the food-gathering appendages near its mouth, which made it a mobile, aggressive predator.

The most celebrated Chengjiang fossil is *Microdictyon* (top left). Nine pairs of oval shell

0.6 INCHES

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1 INCH

plates of unknown function line its body. Scattered single plates had been found elsewhere around the world, but scientists thought they were in themselves tiny shell animals.

Other Chengjiang jewels include tulip-shaped *Dinomischus* (bottom left). A stem attached it to the seafloor, while filaments in the cup filtered particles of food from the passing current. An oversize "petal" extends from the cup.

The Chinese site also has yielded early brachiopods (middle right) from a still common phylum of bivalved mud dwellers.

Animal traffic churns an ancient seafloor

MOMENTS in Cambrian time frozen along the shore of Sweden's Lake Vänern show that the seafloor began to teem with complex animal life more than half a billion years ago. The shallows of the lake (left) expose horseshoe-shaped burrows made by animals that lived clustered together at depths of 30 to 150 feet.

In a nearby mine at Lugnås, University of Uppsala graduate student Sören Jensen (below) examines fossilized burrows left by a small sea animal amid ripples in the ancient seafloor. Developing different modes of movement, such as burrowing or swimming, enabled animals to diversify.

Jensen sees evidence of a trilobite attack (above) imprinted in the sandstone along the lakeshore. The fossil shows scratch marks left as the trilobite sensed a burrowing worm and dug down to grasp it. Sand quickly filled in both the scratch marks and the burrow, creating a mold of the moment. "This is one of the earliest clear evidences of predation," says Jensen.

Trilobites, like other Cambrian creatures, were evolving eyes and a variety of sense organs. Legs were another critical invention. The jointed legs of the hard-shelled trilobites, the period's most commonly preserved fossil, did more than move the animal. They may have borne its gills.

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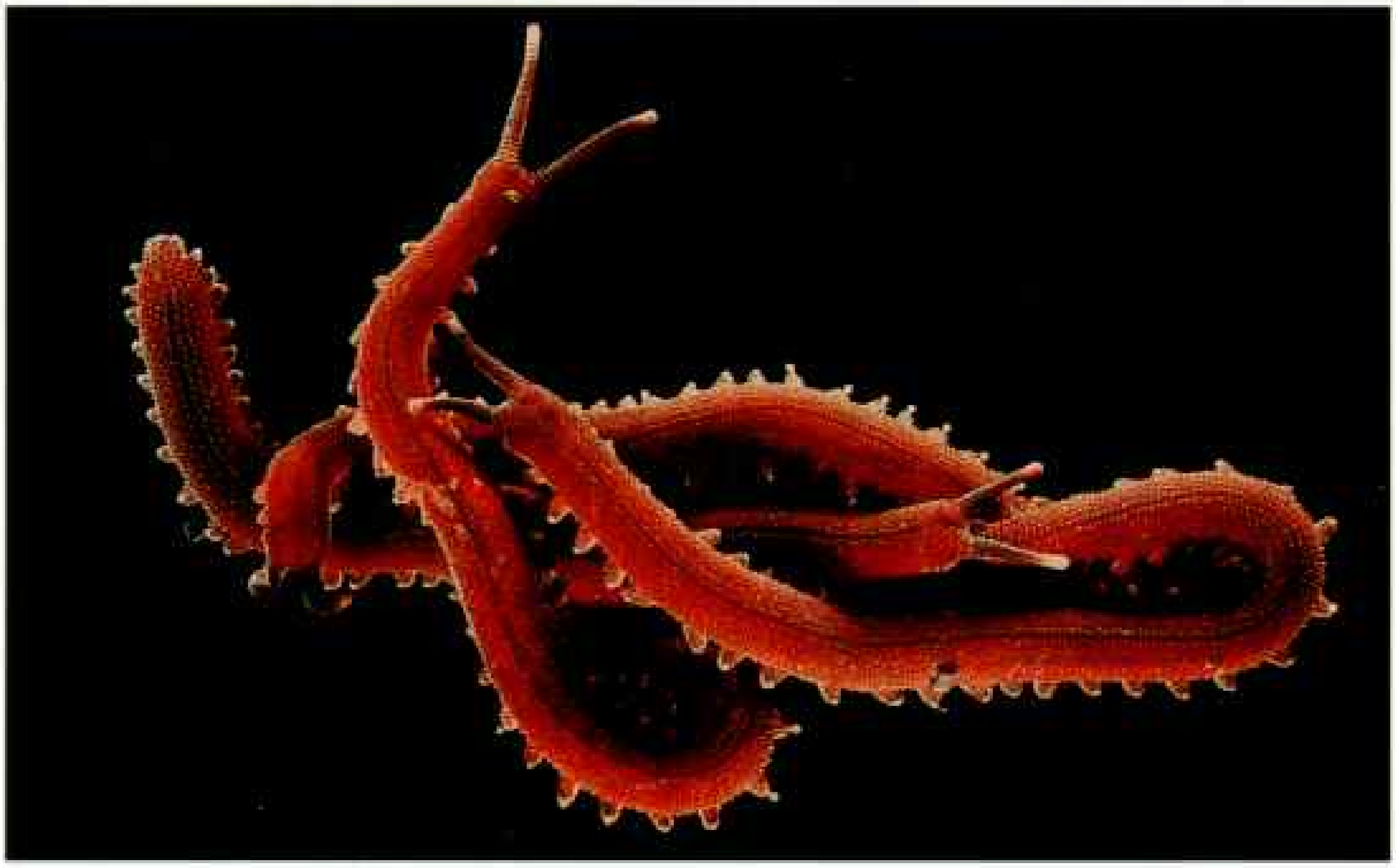

Living fossils hint at the antiquity of complex behaviors

STILL THRIVING after all these years, four onychophorans (above), mysterious holdovers of the Cambrian explosion, intertwine their multilegged bodies. Related to such Burgess Shale oddballs as *Aysheaia* (top), these animals—also known as velvet worms—became land dwellers some 250 million years ago but survive today only in dark, moist habitats such as the leaf litter blanketing the floor of a Costa Rican forest.

Their probable ancestor *Aysheaia* may have clung to sponges with its tiny, branching claws. Sharp protuberances around its mouth probably punctured those sponges, letting *Aysheaia* suck their juices.

Modern onychophorans have evolved strong jaws but still use variations on the stab-and-suck strategy. Before dining, however, they spit immobilizing glue at their prey.

Onychophorans are among the few animals other than mammals with placentas. Most species, including *Epiperipatus biolleyi*, give live birth (below).

"Onychophorans keep their secrets well," says specialist Hilke Ruhberg of the University of Hamburg in Germany. Still, their secrets—like those of their Cambrian cousins—are being lifted from dark places into the light. □

WILDLIFE AS CANON SEES IT

Dalmatian Pelican
Genus: *Pelecanus*
Species: *crispus*
Adult size: Length 160 – 180 cm; wingspan, 290 – 345 cm
Adult weight: 9.5 – 13 kg
Habitat: Marshes and lakes in southeastern Europe and central Asia
Surviving number: Estimated at less than 1,500 pairs
Photographed by Konrad Wothe

Distinct with curly head feathers, Dalmatian pelicans nest in one of the few breeding sites remaining of their once vast range. Largest of all pelican species, these expert fishing birds numbered millions within the Danube delta alone. Today they face continuing habitat loss, pollution and conflict with fishermen, who see the birds as a threat to their livelihood. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Photography, both as a scientific research tool and as a means of communication, can help promote a greater awareness and understanding of the Dalmatian pelican and our entire wildlife heritage.

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Forum

Iceman From the Copper Age

I read with fascination and sadness the June 1993 article about the 5,000-year-old Iceman. My late husband was born in a Tyrol village in northern Italy near Bolzano. He often told me about the beauty of Lake Garda, the Brenner Pass, Bolzano, and the Alps. As a young man he used to go out for weeks at a time, sleeping in the open, while he collected wood and grass for animals at home. He was a short man, five feet three inches, and when I saw the Iceman, I was reminded of my husband, who had the same features. I wonder if he was one of my husband's ancestors.

GREGORIA COVI
Bronx, New York

The article mentions the "mystery" of tattoos in places normally concealed. As a medical student I was exposed briefly to nomadic folk medicine. Tattoos were often made over a painful area of the body to reduce symptoms there. Given the Iceman's wanderings, he may have twisted an ankle, sprained his back, or torn a knee ligament. Thus, these tattoos may have been made by a shaman or healer to reduce pain. Given the evidence that the Iceman used fungi to treat infections, we may infer a crude familiarity with antibiotics and analgesics, still useful for hikers and travelers today.

DANIEL B. CARR, M.D.
Massachusetts General Hospital
Boston, Massachusetts

Tattoos serve as adornment, symbols of belonging, or marks of ownership. The first two are usually in exposed areas and are ornate. The small parallel lines, like the large ones on the sheep on pages 39-40, could denote ownership. The Iceman may have been a slave or convict. How high he was and how ill equipped suggest he was running away. He would not be allowed to have weapons and probably gathered them just before he escaped.

GLENN GAARDER
Ramona, California

Many researchers in archaeology and ancient religions agree there is much evidence that early European cultures worshiped a goddess or goddesses of birth, regeneration, and death. In the artist's rendition of a burial rite (page 65), it would have been just as appropriate to portray a priestess.

KAREN ROCKEY
Lock Haven, Pennsylvania

Of the various identities suggested for the Iceman, that of shepherd can surely be discounted. If I were from a Copper Age sheep-farming community, I would not use grass for a cape or stuff my shoes with it for warmth. I would use wool. Also, is it possible the Iceman died clutching his ax and bow higher up on the glacier, and snow and ice shifted his remains into the hollow, much as glaciers deposit rocks?

MARK RUMSBY
London, England

Decline of Songbirds

For years we have noted a diminution in the number of painted buntings and lately of towhees at our home and of ovenbirds in the country south of Charleston. Your article supplies answers to many questions related to the lamentable disappearance of so many songbirds. It obviously took considerable effort to compile all the data, and from this reader many thanks to you, the author, and the photographer.

JOHN M. HORLBECK
Mount Pleasant, South Carolina

Living for 15 years in an urban-rural transition zone, my experience is that the pet cat boom is a far more serious factor than is commonly acknowledged. The other clever killers are members of the same family as crows, including the eastern blue jay and the vicious Steller's jay, which—sadly for British Columbia—was adopted as the provincial bird. People are evidently charmed by the jays' looks and the crows' intelligence but ignorant of their gang warfare against songbirds.

A. NEIMERS
Bowen Island, British Columbia

If a beautiful butterfly is caught in a large spider's web, should the butterfly be freed and the spider go hungry? An arachnid fan would think not. We offer seed to all birds; our favorite is the cowbird because it has a beautiful song. I was repulsed at the thought of thousands of cowbirds in Texas being killed. Nature is too complex to murder birds for any reason.

FLORENCE B. KOLVITES
Mountaintop, Pennsylvania

We take exception to the article. We have never seen so many songbirds in our entire lifetime as in this past winter and spring in Wisconsin. These included cardinals, nuthatches, chickadees, finches, and titmice. Of course we feed them generously, as do our neighbors, and maybe this makes a difference.

We were disturbed to read that the Minnesota Legislature appropriated $500,000 to study what has happened to the songbirds. The money would be better spent on bird food and feeders.

ROY AND BETTY BIERMAN
Iron River, Wisconsin

Living between the Brule River State and Chequamegon National Forests, I have watched with sorrow destructive logging practices and the decline of songbirds. Three weeks ago 40 acres were logged on private property across from my home. As I surveyed the damage, my dog helped herself to baby birds strewed on the ground. My feeder is dominated by grackles and brown-headed cowbirds, and I haven't seen a grosbeak in weeks. The wilderness for me is dead.

BARBARA RESHESKE
Iron River, Wisconsin

Chesapeake Bay

I would like to take issue with the statement that eels come only from the Sargasso Sea. About 45 years ago, while working in the Bowie, Maryland, area, several crew members and I meandered down to a stream and saw swarms of baby eels, about one to two inches long. We tried to catch some in our hands. They would swim over a slab of concrete in the stream, so we could positively identify them as eels. This stream was feeding into the Patuxent River, which feeds into the bay.

RAYMOND W. SHERMAN
Annapolis, Maryland

You observed young eels that spawned in the Sargasso Sea. As tiny elvers they ride currents to the estuaries and streams where they mature.

Visiting the Chesapeake with my eighth-grade class this spring, I really felt its beauty and realized its importance to the environment. I hope that other people who aren't fortunate enough to live on its shores experience it as I did before it is gone.

REIL CELBA
Shorewood, Wisconsin

Corn

I enjoyed Robert Rhoades's article "Corn, the Golden Grain," but noted that nowhere is the difference between field and sweet corn discussed. We planted sweet, or garden, corn for family consumption behind our Kentucky farm home. Field corn was raised on multi-acre plots solely for feeding hogs and cattle.

TADD WAGGONER
San Francisco, California

Why is it that most Americans eat wheat bread, while corn tortillas are considered "ethnic" food? For centuries corn was maligned as a food suitable only for Indians, while Europeans who could afford to would eat wheat, which was the high-status grain in Europe. Both corn and wheat were grown at the Spanish missions of California and northern Mexico, but corn was grown primarily to feed Indian converts.

ROBERT H. JACKSON
Spring, Texas

Mention should be made of the contributions of Earl N. Bressman, a co-worker and co-author with Henry Wallace in developing corn hybrids. Under the auspices of the Pan American Union and Nelson Rockefeller, Bressman established the Inter-American Institute of Agricultural Sciences near Turrialba, Costa Rica.

CAROL BRESSMAN SMOLSKY
Des Moines, Iowa

The photograph on page 102 of Booker Noe, Master Distiller Emeritus of Jim Beam Brands Co., in Clermont, Kentucky, was misidentified as a distiller in another company. Our company, the oldest operating in Kentucky, was founded in 1795 by Jacob Beam, a farmer who utilized the family corn crops to produce his bourbon whiskey. Booker Noe is his great-great-great-grandson and has been making bourbon whiskey for more than 40 years. Last year we purchased three million bushels of corn in Kentucky and Indiana and shipped more than seven million cases of bourbon worldwide.

NANCY T. LINTNER
Jim Beam Brands Co.
Deerfield, Illinois

Bangladesh

Meaningful cooperation between Bangladesh, India, and Nepal would solve most of the region's water-related issues. Bangladesh has proposed a plan for flood control, irrigation, navigation, and hydroelectric power by harnessing Himalayan water resources for the benefit of the riparian countries. But after talking with India for 21 years, Bangladesh has gained little success in obtaining her rightful share of water. Political cooperation within the region could lead to better control of resources and better economic conditions for millions of people.

MOHAMMED G. KABIR
Parsippany, New Jersey

An encouraging sign came last April at the annual summit meeting of the South Asian Association for Regional Cooperation, when the leaders of India and Bangladesh discussed ways to share water.

Regarding the feature on flooding in Bangladesh, there was no discussion of the effect of recent denuding of the Himalaya, from which much of the floodwater comes.

EDWARD VAN EGRI
San Francisco, California

There is little evidence that deforestation in the Himalaya has worsened flooding in Bangladesh.

Letters should be addressed to FORUM, National Geographic Magazine, Box 37448, Washington, D. C. 20013-7448, and should include the sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.

Geographica

You Can Huff and Puff—These Straw Houses Last

Building a new house? Tired of expensive, traditional materials? One alternative conjures up pioneer days: bales of straw. But straw's not strong enough, you say. Remember the big bad wolf in "The Three Little Pigs" blowing down a house of straw?

You've drawn the wrong moral, says Matts Myhrman, who with his wife, Judy Knox, heads the Tucson-based Out On Bale (un)Ltd. He says any material can be used badly. The moral is "Don't let a pig build your house."

Straw bales stacked and held by wooden or steel pins (right), plastered on the inside and stuccoed on the outside, are bug resistant, fire resistant, and sturdy.

Straw houses go back to the late 19th century on Nebraska's treeless plains, where farmers turned leftovers from the harvest into building materials. Most straw-bale houses have vanished, one eaten by a cow. But about 15 remain, the oldest a 1903 home near Alliance.

PHIL SCHERMEISTER

At least 85 new-style straw structures have been built in the United States since 1940. One satisfied convert in New Mexico, Stephen MacDonald, chose straw walls because of "poverty and fear of the heat." He cites the super insulation provided by 20-inch-thick walls: "My six-year-old house has required little heating and no cooling."

"Mini-mammoths" Survived Longer

A dwarf mammoth sounds like a contradiction in terms. But dwarf woolly mammoth remains found on Wrangel Island, a hundred miles off the Siberian coast, are even more confounding: These pint-size beasts lived 6,000 years after woolly mammoths became extinct elsewhere.

Russian scientists studying teeth learned they were about 30 percent smaller than the average woolly mammoth's. That suggests these animals were, at most, six feet tall at the shoulder, compared with about ten feet for full-size mammoths, which disappeared 10,000 years ago.

Andrei Sher, a member of the Russian team, thinks the island's drier climate allowed grassy vegetation favored by mammoths to persist even after the wet mainland turned to forest and mossy tundra. "But the dwarfs lived on the border of extinction, so even a minor climatic change could kill them in a few years," Sher says. Another possible cause for their demise: the arrival of hunters on the island.

Other mammals on isolated islands evolved dwarf forms, perhaps because of limited quantities of food or the absence of predators.

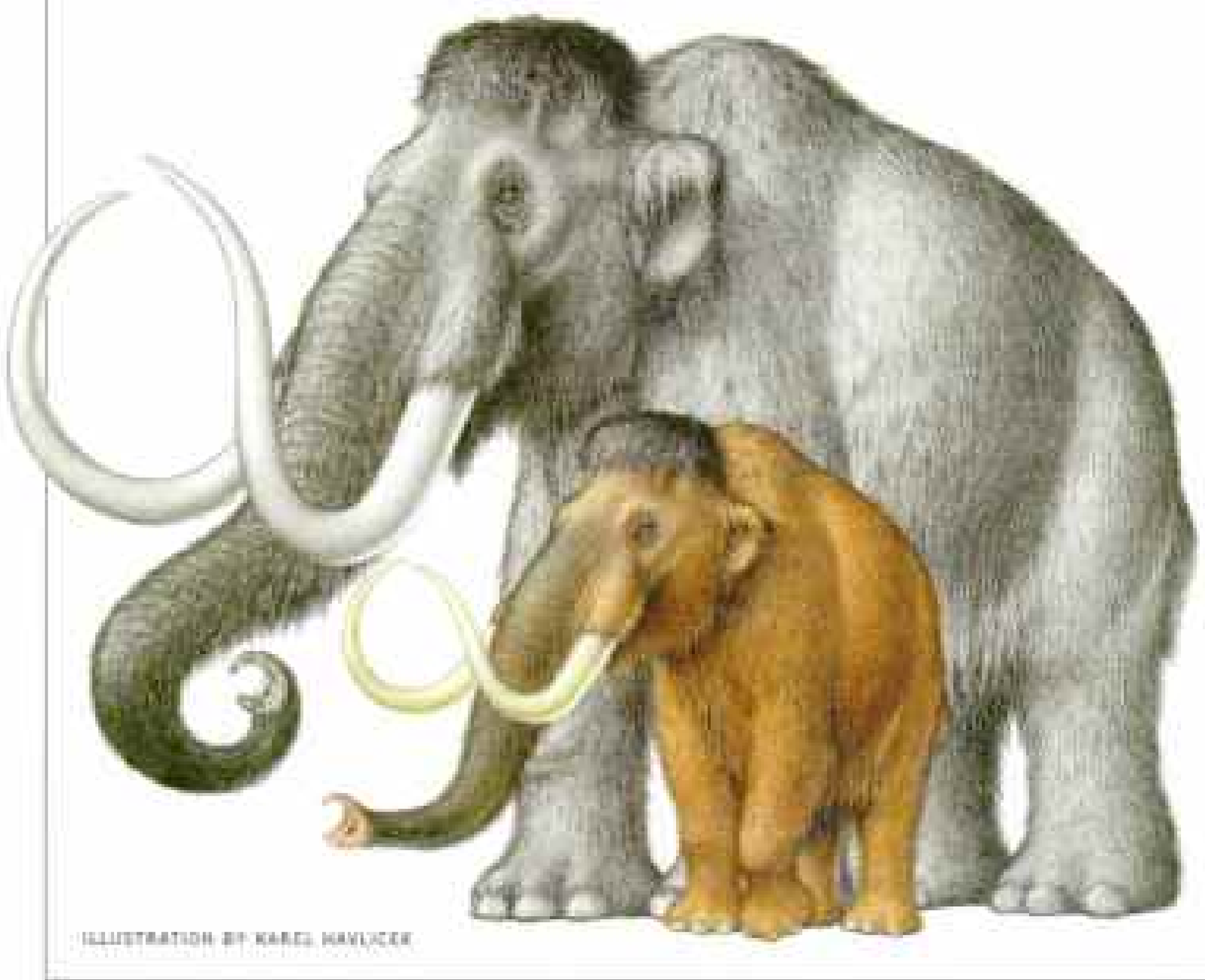

ILLUSTRATION BY KAREL HAVLICEK

National Geographic, October 1993

Geographica

Comet on a Collision Course With Jupiter

Resembling a string of Christmas lights, a comet that recently broke apart near Jupiter may be heading for a spectacular crash with the solar system's largest planet.

Astronomers say there is a very good chance that the remains of the comet will hit the far side of Jupiter around July 23, 1994.

"Nothing similar to the predicted collision has ever been observed," says Daniel Green of the Smithsonian Astrophysical Observatory.

Scientists speculate that the 20 fragments of the comet could cause

DAVID JEWITT AND JANE LUU

dramatic explosions in Jupiter's turbulent atmosphere, create a new feature similar to the famous Great Red Spot, or simply be swallowed by the gaseous planet.

Using a Palomar Observatory telescope last March, Carolyn and Eugene Shoemaker of the U. S. Geological Survey and their colleague, David Levy, first spotted the fuzzy elongated object.

They alerted fellow skywatchers, and a few hours later, using an electronic-imaging telescope at the University of Arizona, astronomer James Scotti discovered that the comet was broken into several pieces, evidently the result of an earlier encounter with Jupiter's gravitational forces. Even before they learned of the possible collision, astronomers were excited: never before had they seen a comet produce so many pieces. The old record was eight.

JOHANNES KEIL, C.A.T. MEDIENPRODUKTION

Living a Roman Soldier's Life, the Hard Way

Rome's armies ranged through the far reaches of Europe, inspiring fear and awe as they extended Roman rule two millennia ago. Today Marcus Junkelmann (above, bearing a standard) and a handful of colleagues are reliving the ways of those soldiers, riding on horseback in Roman garb over the Alps, along the Danube, or, as here, beside the Mediterranean at Italy's Circeo National Park.

"When you do something in practice, you find out things you didn't know," says Junkelmann, a German historian and author. He goes beyond the study of artifacts and drawings to learn the feel of a saddle, the heft of a shield.

Last summer he followed Roman frontier walls for 300 miles along the Danube, "to see how the horse, the saddle, and the man survive."

Junkelmann has experienced several perils common to the Romans. A horse fell on him, breaking his shinbone. And once, when he fell from a horse, he landed on a javelin that pierced his neck. "It was almost deadly," he says laconically.

Third Eye Leads a Lizard Home

W. A. CHAPPELL, ANIMALS ANIMALS

To Yarrow's spiny lizard, home is where a third eye on top of its head directs it. Left to its own devices, the eight-inch-long lizard can almost always find its home range in the rocky canyons of the southwestern United States and northern Mexico. Biologists Barbara Ellis-Quinn and Carol A. Simon of New York's City College confirmed this homing ability by surgically implanting radio transmitters in 42 lizards and tracking them after they were released 500 feet from their territories. No problem. But when the scientists covered the third, or parietal, eye, the creatures wandered aimlessly.

The parietal eye, a sensory organ connected to a gland in the brain called the pineal, perceives sunlight but cannot focus as the lateral eyes can. "The lizard determines where it is in relation to the sun at a particular time of day," says Simon. To confirm this, the biologists shifted lizard body clocks ahead six hours by keeping the reptiles in the laboratory for a week under artificial light. After release, the lizards oriented relative to where the sun would be in their artificial day and headed in the wrong direction.

National Geographic, October 1993

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Geographica

Stone Age Art Discovered in Norway's North

High in the Arctic, on the island of Sørøya off the northern coast of Norway, a team of archaeologists has uncovered 6,000-to-8,000-year-old rock carvings of reindeer (above), bears, elk, whales, a boat with a line dangling a halibut, and even humans—the most northerly collection of rock art yet known.

A hundred incised carvings were found during excavations of sod houses at Slettnes, almost 300 miles north of the Arctic Circle. Team leader Charlotte Damm of the Tromsø Museum believes the art resulted from coastal and inland peoples coming into contact. "The animals were probably totems, and the carvings may have symbolized alliances between peoples," says Damm.

The early Stone Age hunters and fishermen who made the carvings probably inhabited the coastal Slettnes site in the summer. The team also excavated arrowheads, blade knives, scrapers, a large cooking pit that may have been used for the extraction of seal or whale oil, and scattered bits of red ocher—perhaps used to color the images.

Mastodon's Gourd Meals Dash Dispersal Theory

Gourds were introduced to the southeastern United States by early peoples who migrated north from Mesoamerica about 7,000 years ago.

At least that's what scientists

RENE HOWE, FLORIDA MUSEUM OF NATURAL HISTORY

thought until divers excavating in the Aucilla River in northern Florida found wild gourd seeds they believe were eaten by a mastodon 12,500 years ago.

"It looks like humans found gourds in Florida when they arrived," says S. David Webb (above) of the Florida Museum of Natural History.

Museum archaeobotanist Lee Newsom identified seeds of the wild gourd, *Cucurbita pepo*, some found in what appears to be mastodon dung. Funded by the National Geographic Society, the scientists have been excavating remains from the late Pleistocene epoch since 1983.

"The Florida landscape at the time was much drier than it is now, and the river was a place where animals came to drink," reports Webb. "Continuing work is expected to shed light on the extinction of the mastodon."

Discovering Custer's Last Plants

Veronica Masson's job at the New York Botanical Garden Herbarium may seem tedious: cataloging dried plants from donated collections. But as she sorted 16,000 specimens from Wabash College in Indiana, a notation—"Custer's Expedition 1874"—startled her. Masson soon turned up 40 plants collected on a venture led by Lt. Col. George A. Custer into the Black Hills of South Dakota.

The 1874 expedition to site a new fort included 1,000 soldiers, a 16-piece brass band, two miners, and A. B. Donaldson, a botanist who made the first plant collections in the interior of the Black Hills. His notes described a valley whose "floral decoration is the very richest." The lupines, geraniums, sunflowers, and flax he gathered are still common today. He also recorded "a long and peaceable interview" between Custer and a Sioux hunting party—just two years before Custer's encounter at Little Bighorn.

—Boris Weintraub

TROMSØ MUSEUM (TOP); IRA BLOCK

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On Television

GEORGE D. DODGE AND KATHLEEN M. DODGE

Dreaded Kiss of the Black Widow Spider

"I was having trouble breathing. The pain was getting so intense. . . . I was starting to have severe headaches," recalls Bryan Chadd of Phoenix, Arizona, who unwittingly took a female black widow to bed with him. Bitten near the heart, he endured a body-racking bout with her poison.

The tangled web of encounters between the femme fatale with the red hourglass tattoo on her belly and her victims is the stuff of EXPLORER's "Bite of the Black Widow"—spooky fare for arachnophobes on Halloween night.

This highly venomous lady often devours her paramour after mating, then keeps the spiders coming: She produces a series of egg sacs, each coddling hundreds of future spiderlings in the silken ball (above). A few weeks later the neighborhood's spider population explodes.

Black widows are found in every U. S. state except Alaska. They thrive in the hot climate of the Southwest—especially in cities like Tucson and Phoenix, where irrigated lawns attract insects, the spider's prey. Lurking in dark, sheltered places, black widows concentrate in numbers up to a hundred times as high as in the surrounding Sonoran Desert.

Only the female threatens human beings. A chemical-warfare specialist, she injects a neurotoxin that attacks millions of points in the body where nerves meet muscles, causing the muscles to seize up in a massive charley horse that may last for days. Children, the elderly, and those with high blood pressure may have a more severe reaction, though death is rare—a comforting thought.

Is there a remedy? The film drops in on one family, the Kristensens, whose business is to "milk" black widows of their venom—the key ingredient in making an antivenin, the only known antidote. Using the venom collected from 28,000 spiders, a pharmaceutical company stirs up one giant batch of antivenin—enough for the whole country—every five years.

Meanwhile, the hatched spiderlings are riding the wind on a silken thread, an action known as "ballooning." Where they land is entirely up to chance.

"Bite of the Black Widow" airs October 31 on EXPLORER, TBS Superstation, 9 p.m. ET.

Pouches and Punches: Life in a Kangaroo Mob

Is the young kangaroo below (A) nuzzling her mother in fond greeting or (B) licking drops of saliva and half-digested grass from her mother's face?

Scientists agree that (B) is correct, though they can only speculate about the biological advantage. Yet such winsome poses helped endear kangaroos to filmmakers Jan Aldenhoven and Glen Carruthers. The Australian wife-and-husband team spent a year living among a mob of 60 eastern gray kangaroos in a remote valley in New South Wales, where each day they went walkabout with these intriguing marsupials. Their film, "Valley of the Kangaroos," brings into focus memorable real-life animal characters.

JAN ALDENHOVEN

Columbine is the distracted, forgetful mother, and Jaffa is her joey, often left alone in a dangerous world. The watchful Eucalypt teaches Sunshade to dive into her pouch at first alarm. Cedar, the boss roo, spends his days checking on fertile females and sizing up his main rival, Ursid, who bides his time. It's a kangaroo soap opera.

"Valley of the Kangaroos" is an October selection of the National Geographic Video Club.

Earth Almanac

JOEL SARTORE

Alligators Are Back, in the Wild and on the Farm

They have proved to be as tough as their hides. American alligators were wiped out in parts of the Southeast by unchecked hunting and habitat loss. The species was declared endangered in 1967. With protection and successful management programs, gators staged a spectacular comeback and by 1987 were considered recovered throughout their range. They now number perhaps three million, most in Florida and Louisiana, and are again legally hunted.

Meanwhile, demand for their meat—trendy cuisine in chic New Orleans restaurants—and for hides to be used in shoes and purses has created a lively industry in farmed alligators, including this toothy twosome. Many Florida-raised gators are growing bigger, faster, and tastier, says Paul Cardeilhac, a University of Florida veterinarian. He has improved farmed alligators' diet, adding red meat to their standard fish fare, which increases fertility and improves their flavor. A special breeding pond includes deep areas to encourage mating and secluded spots for females to nest.

"We've quadrupled the alligators' reproductive rate, doubled their growth rate, and reduced mortality from 35 percent to about one percent," says Cardeilhac. And success breeds conservation: "Now there's a lot less reason to take an alligator out of the wild."

CYNTHIA CHEAR, KENETECH CORPORATION

Wind Power Yields Clean Energy, but Birds Beware

Wind blows with gusto through California's Altamont Pass, turning huge blades to generate electricity. Some 7,000 wind turbines cover 80 square miles of hills east of San Francisco. This wind farm makes a million megawatt-hours of power a year, equivalent to San Francisco's household demand. But the environmentally correct machines can be lethal to birds. A few hundred birds of prey, including federally protected golden eagles, die each year when they fly into blades and towers.

To find a solution, Kenetech/Windpower, Altamont's largest operator, has launched a two-year, two-million-dollar research program. "We've seen the problem, and we're getting out ahead of it," says the company's Bill Whalen, former National Park Service director.

To find out how the towers affect birds' flight patterns, the program involves sending homing pigeons through Altamont. Other tests may include painting blades and causing the turbines to emit sound to see if birds will keep their distance.

National Geographic, October 1993

DAVID CLARK (BOTTOM); BELINDA WRIGHT

A Cunning Cat That's at Home in the Water

Domestic cats love fish, but most get theirs out of a can. In Asia a stealthy predator twice the size of a house cat often crouches on a streamside ledge, peers fixedly at the water, lunges, and—with a swipe of its paw—flings up a finny feast and catches it in midair.

The fishing cat *(Felis viverrina)* is one felid that seems to love water, living amid streams and marshes of Nepal, India, Sri Lanka, Thailand, and parts of Indonesia. Its secretive ways probably help keep it safe from poachers.

The cat's fur is layered, with a luxurious inner blanket next to its skin to keep it warm and dry. Growing through this protective lining, a second layer of longer hairs forms the external coat. Partly webbed front paws boost the cat's swimming prowess. Besides preying on fish and other aquatic life such as crabs and mollusks, these aggressive hunters, which may weigh more than 30 pounds, also bring down land animals larger than themselves: goats, calves, even dogs.

New Computers Sleep on the Job to Save Energy

Personal computers (PCs) are energy misers individually, but they have spread like electronic wildfire to 70 million in the U. S. With their printers and monitors they now devour as much electricity each year as Oregon state.

To cut consumption in half, new "green" computers are being developed by more than a hundred PC firms and computer-chip makers and promoted by the Environmental Protection Agency. When left on but unused for more than a few minutes, they power down to a standby—or sleep—mode, reducing energy use by as much as 80 percent. At a keystroke the PCs return to full power.

If turned off at night, the new PCs should use an average of $17 worth of electricity a year, compared with $105 for an older model left on continuously. Brian Johnson of the EPA ran a survey at the agency's Washington, D. C., headquarters and found that 40 percent of the PCs were left on all night—a situation quickly addressed by memo.

Songbird's New Tune for Endangered Species Act

It mews like a kitten, but the coastal California gnatcatcher has made a thunderous statement with far-reaching implications for the Endangered Species Act. Because the birds have dwindled to about 2,500 pairs in the U. S., last spring they were declared threatened in a novel compromise that seeks to preserve not only the birds but also a variety of other species in their ecosystem.

The agreement settled a battle

B. "MOOSE" PETERSON

between southern California developers and conservationists. Most gnatcatchers nest in San Diego, Orange, and Riverside Counties amid lucrative real estate, some of it on the ocean. Land where gnatcatchers and perhaps 50 vulnerable species of animals and plants live will be set aside for preserves, but builders will be allowed to bulldoze other small parts of the birds' range.

"If the plan works, it has promise for similar situations," says Joel Reynolds of the Natural Resources Defense Council. "It reduces confrontation. And it may eliminate dealing with what developers dread—the 'species of the month.' "

—JOHN L. ELIOT

National Geographic, October 1993

On Assignment

RICHARD OLSENIUS

Between a rock and a hard place, Associate Editor ROBERT M. POOLE (above, at left) and free-lance photographer RICHARD OLSENIUS ate quickly while hiking near Nain, Labrador. Wind howled around the boulder where they huddled; icy mist whipped their faces. And this was July.

It was Labrador's wildness that first attracted Poole, who on seven occasions had flown to the region's interior for fishing vacations. Battling trout provides a head-clearing break for the man responsible for all manuscripts published in the GEOGRAPHIC, both free-lance and staff. Before joining the magazine in 1989, he had been a newspaper reporter in Winston-Salem, North Carolina, a political reporter in Washington, D. C., and an editor with the Society's Book Division.

But fish are never far from Poole's thoughts. "I do my best fishing at my desk," he says, contemplating battles won and lost and those to come. He looks forward to returning soon to Labrador "to store up memories against the coming winter."

Richard Olsenius has not always been as lucky as he was in Labrador, where he caught a seven-pound lake trout on his first try. He once landed an internship at *Look* magazine the same week it ceased publication.

The Minnesota native divides his time between photography and composing music, often packing a keyboard on vacations. "Music," he says, "like photography, is a way to interpret the places you've been."

STEVE McCURRY

Afghanistan is one of the places free-lance photographer STEVE McCURRY has been—a lot. On his 14th visit since 1979, McCurry was threatened, shot at, and arrested. One night armed robbers broke into his hotel room and locked him in the bathroom while searching unsuccessfully for cameras he had hidden elsewhere in the hotel. Later, he and his interpreter were held up by bandits on the road to Kabul. The only shooting Steve likes to do is with a camera, so he hired armed bodyguards, here taking tea with the photographer.

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Geoguide

The American Prairie

• Drought, fire, and grazing each help in some way to maintain the North American prairie. How do these often destructive forces play a positive role? In what ways have human beings interfered with these natural forces and with what results?

• The map on page 100 shows the original extent of the North American prairie and the grasslands that exist today. What has happened to the land on which prairie no longer grows? What has happened to the size of the animal populations that once lived there? What animal species no longer survive on the prairie?

• In his article "Roots of the Sky" Douglas H. Chadwick likens prairie dog towns to "natural metropolitan areas" and describes how these communities sustain other prairie dwellers. Make a list of the animals mentioned in the article. Then put a check by each animal you think might benefit, directly or indirectly, from living near a prairie dog town. In what ways do these animals benefit?

• On a patch of lawn, lay a 12-foot-long piece of string in a circle. Carefully count all the different plant species you find within the circle—grasses, weeds, flowers. In a similar-size sample of tallgrass prairie, you might find between 15 and 20 kinds of plants. If you drew a picture showing the diversity of vegetation in an uninterrupted stretch of tallgrass prairie, how many different kinds of plants would you need to include?

• Early settlers used sod as bricks to build houses on the treeless prairie. Using a blunt kitchen or garden utensil, dig up a six-inch-square piece of sod from an inconspicuous section of lawn. Try to extract the piece with roots intact. How does the thickness of your sod compare with the six-inch-thick prairie sod? What accounts for the difference? Put the piece of sod back and water it thoroughly.

NEW GROWTH SOON REPLACES VEGETATION BEING CONSUMED BY FLAMES (ABOVE) ON A TALLGRASS PRAIRIE PRESERVE IN OKLAHOMA. IN MINNESOTA'S BLUE MOUNDS STATE PARK A THREATENED WESTERN PRAIRIE FRINGED ORCHID BLOOMS (LEFT). A YAWNING COTTONTAIL (BELOW) RESTS IN THE PRAIRIE DOG TOWN IT CALLS HOME.

ALL BY JIM BRANDENBURG

USE THIS GEOGUIDE PAGE ALONG WITH THE ARTICLE "ROOTS OF THE SKY" IN THIS ISSUE TO HELP CAPTURE THE INTEREST OF YOUNG READERS AND STIMULATE DISCUSSION WITH THEM. GEOGUIDE IS FEATURED FOUR TIMES A YEAR.