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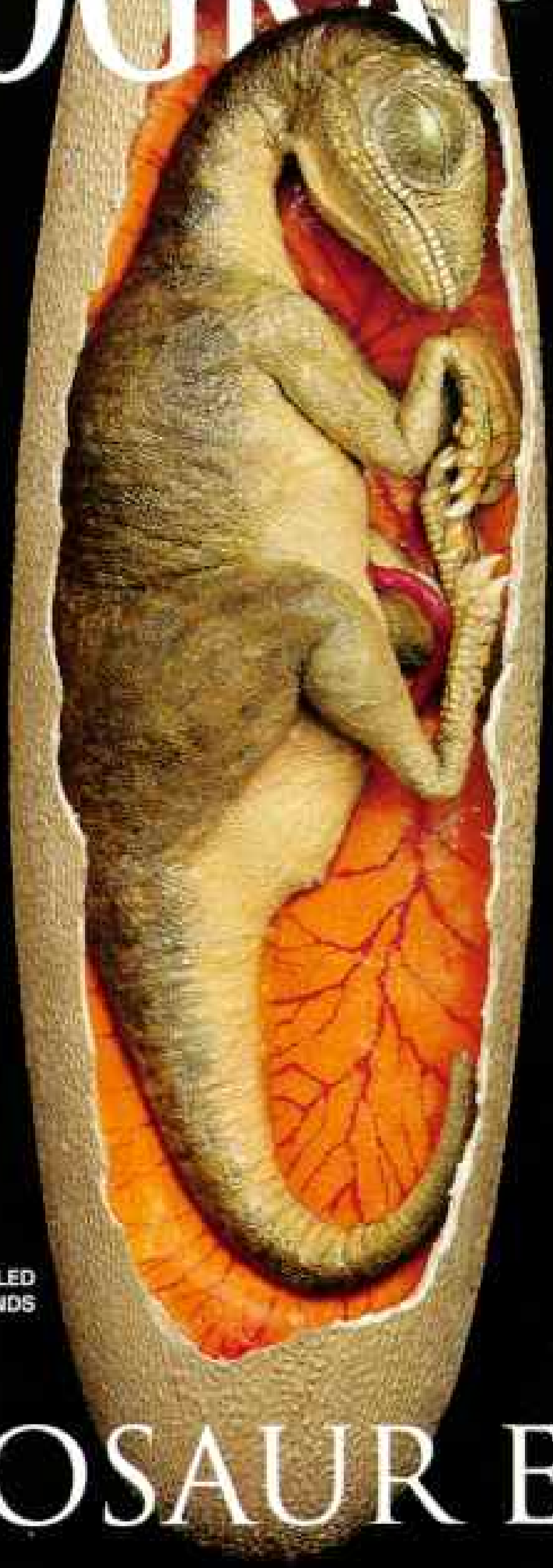

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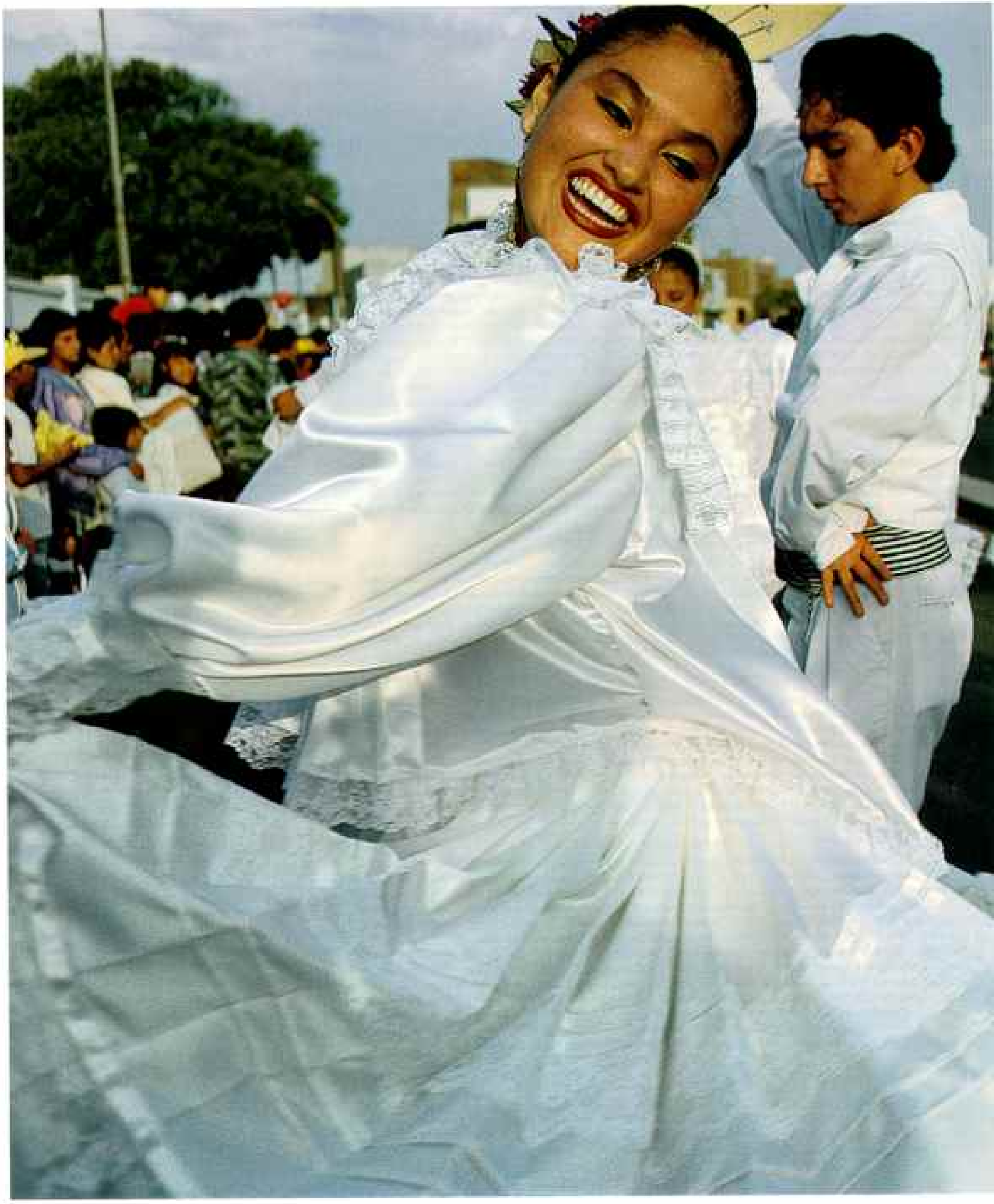


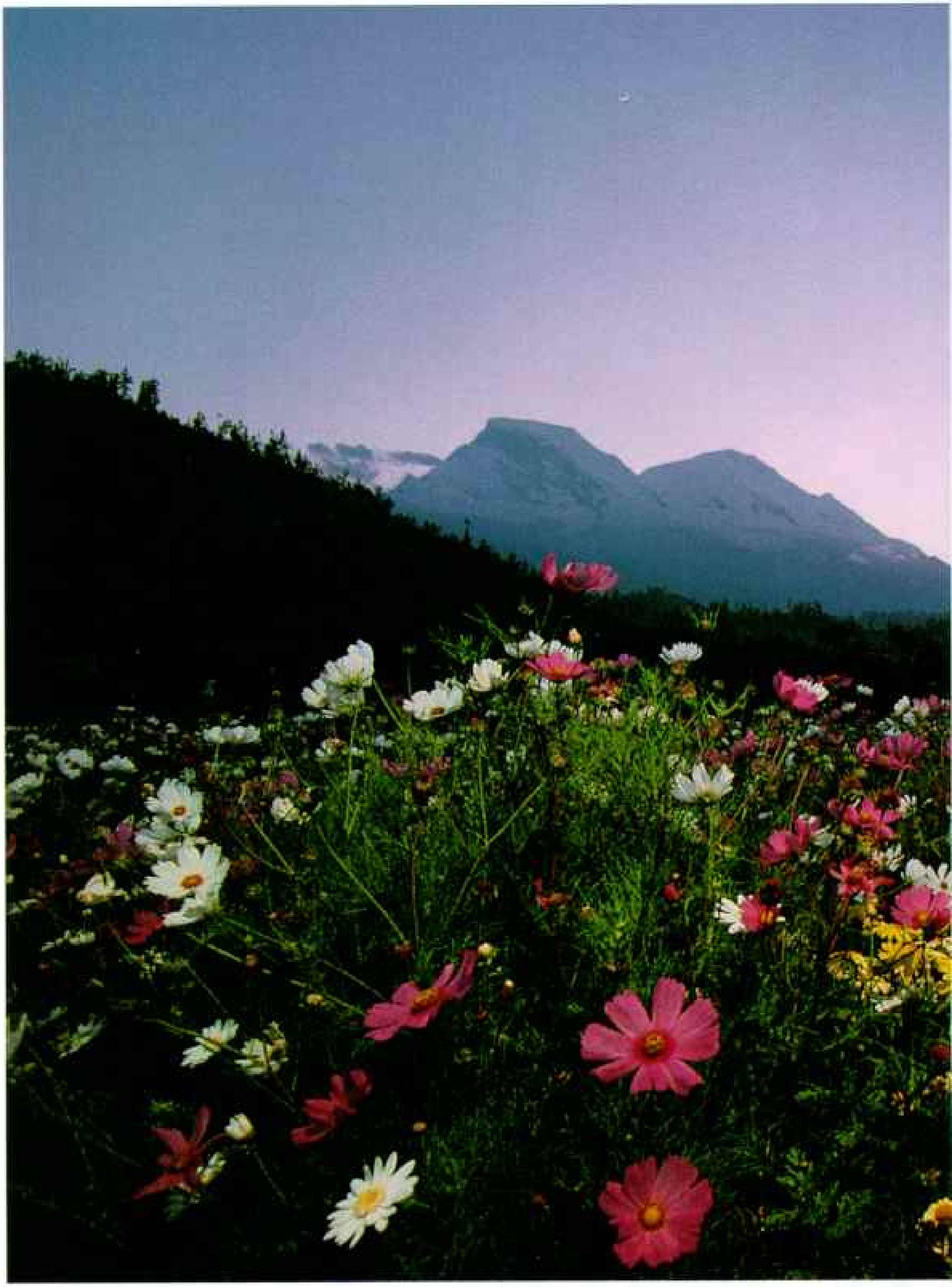
Peru

By JOHN McCARRY

Photographs by WILLIAM ALBERT ALLARD
NATIONAL GEOGRAPHIC PHOTOGRAPHER

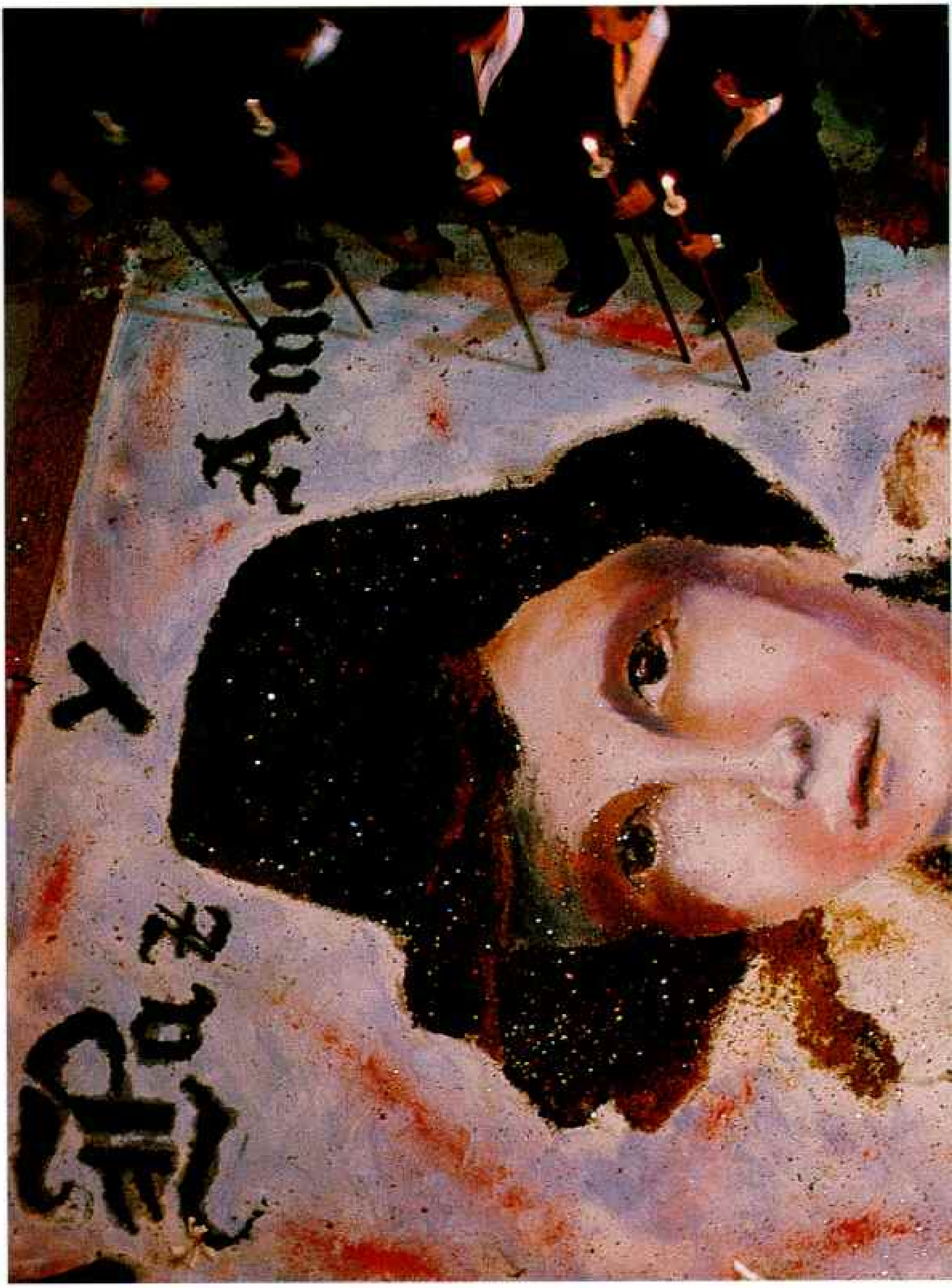
Swirling and stomping, marinera dancers celebrate the arrival of spring at a September festival in the coastal city of Trujillo. Peru too is rejoicing: After decades of financial chaos and civil unrest the country is resuscitating its economy—and its spirit.

Begins Again



A carpet of wildflowers and a few surviving palms mark the former site of the town of Yungay, buried in 1970 when an earthquake triggered an avalanche

of ice and mud. The most destructive quake ever to hit the Western Hemisphere killed 70,000 people in this Andean region and left 500,000 homeless.



"Peace and love" pleads a shepherdess from a street mural during a Holy Week procession in Ayacucho, birthplace of the savage Maoist insurgency

called the Shining Path. Some 30,000 Peruvians died between 1980 and 1993 amid gunfire between the government and the now subdued guerrillas.

The daily catch comes ashore on the Pacific sands near Santa Rosa thanks, in part, to the Peru, or Humboldt, Current. Flowing north from the

Antarctic, the cold current nourishes one of the world's largest fisheries, which in turn nourishes the Peruvian export economy.

Driving across the Mantaro Valley, high in the Peruvian Andes, in a battered old pickup truck, Alberto Fujimori lifts a hand from the steering wheel and waves at some people waiting at a bus stop. Recognizing the President of Peru, they wave back with cheerful cries of "*¡El chinito!*"—Little Chinaman," their affectionate nickname for this energetic, enigmatic, immensely popular son of Japanese immigrants.

I have joined the president to watch him inaugurate three schools and a road. It is down this road that we are now speeding, one of many Fujimori has rebuilt in regions like the Mantaro Valley. Fujimori drives the way he does most things: swiftly, confidently, and with Zen-like concentration.

We pass pretty artichoke fields and farmhouses with roofs of terra-cotta tiles, remnants of a time when Peru was a stronghold of Spanish colonialism—a brutal legacy Peruvians have found hard to shake. Gazing out the window at the pastoral landscape, I find it difficult to imagine that only five years ago this was Shining Path country, a killing ground controlled by one of the world's most murderous guerrilla movements. "You know, John," Fujimori says in fluent, though accented, English, "if you had come here then, you would have been killed."

Me—not him. As Fujimori explains it, "I went to many places in Peru when they were still controlled by the guerrillas. I wanted to show the people I was not afraid of the terrorists. Nothing ever happened to me. I have a lucky star." Fujimori looks over at me in the passenger seat; I can see in his eyes that he is being serious.

Fujimori's luck seems to have rubbed off on this country of 24 million people, a nation geographically divided against itself into desert coast, Andean spine, and Amazonian jungle. Six years after Fujimori's storybook rise to near-absolute power, Abimael Guzmán, the fanatical leader of the Shining Path guerrillas who terrorized Peru in a Maoist insurgency that killed tens of thousands, is behind bars serving a life term without parole. More than 3,400 Peruvians died from political violence in 1990; last year the toll was 527, and the government's crackdown on terrorism continues.

Under the previous regime inflation was soaring and basic services such as electricity and water were unavailable in much of rural Peru. Now the country has one of the fastest growing economies in the world and an ambitious program to rebuild roads and schools destroyed or neglected during the years of conflict.

Not surprisingly, Fujimori, a political independent who likes to call himself the "general manager" of Peru, was reelected to a second five-year term last year by a two-thirds majority over Javier Pérez de Cuéllar, former Secretary-General of the United Nations and a member of the white elite

"I don't make a speech," says President Alberto Fujimori of his weekly excursions outside Lima. "I just say hello, then, 'I can do this; I cannot do that.'" Within weeks of his exuberant jig with the ladies of Alis, residents of the remote sierra community had electricity for the first time ever. Fujimori's self-styled brand of "direct democracy" won him an easy reelection in April 1995.

that has ruled this essentially Indian nation since the Spanish conquest. But voting in 1990 for this political unknown—then head of Peru's agricultural university—was, as one Peruvian put it to me, "like jumping into an empty swimming pool." No one knew what to expect. In office Fujimori implemented an austerity plan, known as Fujishock, to reduce tariffs and slash ministerial budgets. The government has been selling off state-run enterprises that were losing millions of dollars a day. And in April 1992 the president staged his notorious Fujicoup when, with the backing of the military, he dissolved the congress, suspended the constitution, and assumed near-dictatorial powers to fight government corruption and the Shining Path guerrillas.

Critics call the Peruvian president "authoritarian." Ironically, this is what his supporters call him too. "A sense of authority is exactly what we've lacked in Peru," said Alejandro Guerrero, an influential TV reporter. "Peru was sinking. The congress was accomplishing nothing. At the time of the coup, the Shining Path was six months from capturing the country."

Yet even some of the president's most devoted fans may now be having second thoughts about just how far Fujimori's authority should go. Their confidence surely must have been shaken last June when he signed into law a blanket amnesty for soldiers and police accused of massacres and other

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JOHN MCCARRY, a Washington, D.C., journalist, last wrote for NATIONAL GEOGRAPHIC on Bombay (March 1995).

Peru

Once described as a beggar sitting on a gold bench, cash-poor Peru holds vast natural resources. Land reform and nationalization of industry helped send the country into a financial tailspin in the 1970s; in the 1980s only the illicit cocaine trade flourished. Fujimori's recovery plan is privatizing mining and oil industries and has taken austerity measures that busted a 7,600 percent inflation rate to 10 percent.

AREA: 496,225 sq mi. **POPULATION:** 23,881,000. **CAPITAL:** Lima (metro pop. 7 million). **RELIGION:** Roman Catholic. **LANGUAGES:** Spanish, Quechua, Aymara. **LITERACY:** 89%. **ECONOMY:** Mining, petroleum, fishing.

Showing its strength during a parade in Lima, the military is the iron fist behind Peru's democracy. It helped crush the Shining Path and backed Fujimori when he temporarily disbanded congress and suspended the constitution in 1992.

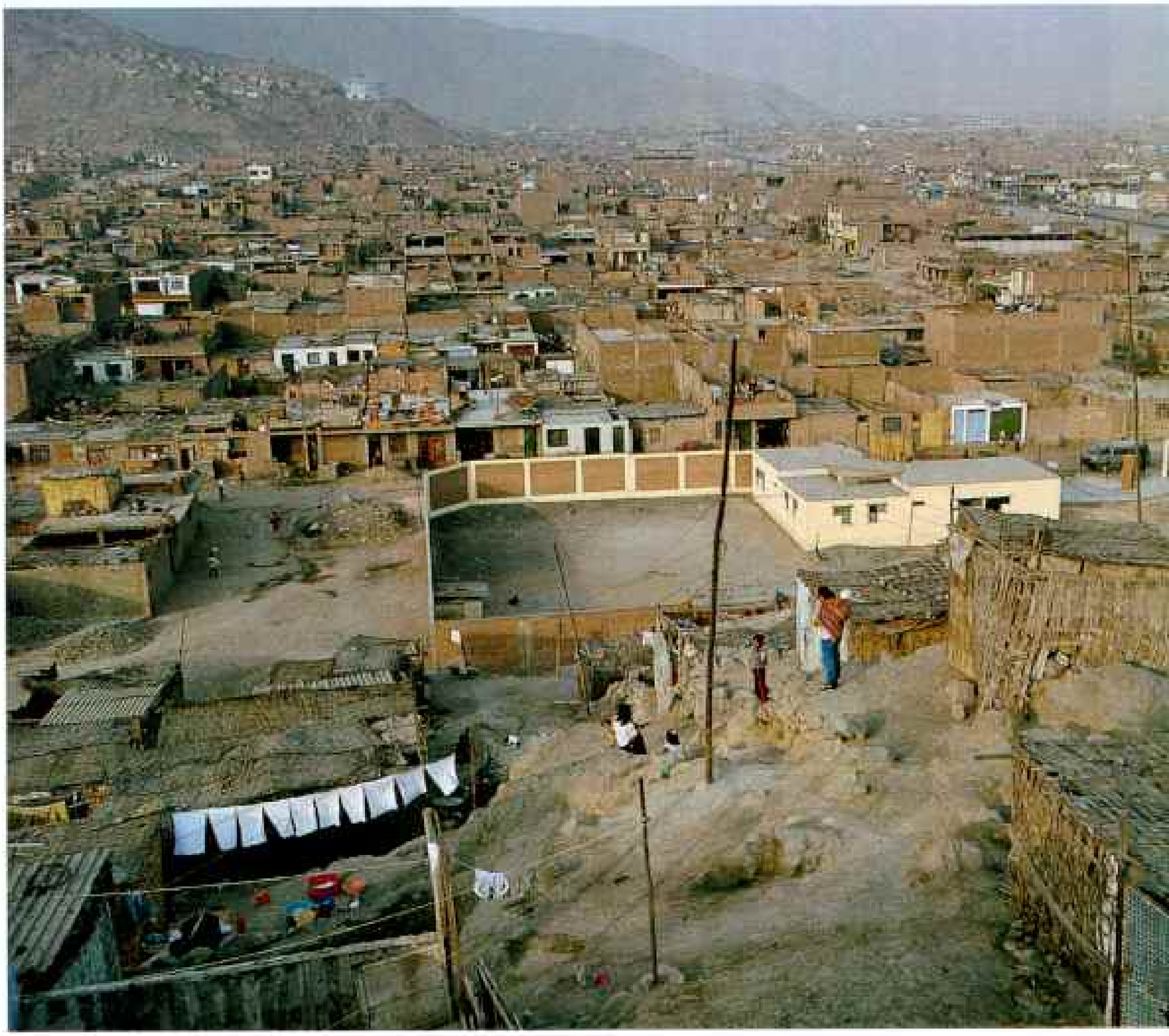
human rights violations during the past 15 years. Opinion polls showed 60 percent of Peruvians opposed the amnesty.

DESPITE MISGIVINGS about Fujimori's human rights record, most Peruvians today appear to be delighted with the sense of order—the peace—he has brought to their lives. You can feel it—in the easy smiles of strangers, in the jaunty rhythm of passersby, in the lingering crowds at the sidewalk cafés of Miraflores, an upscale Lima neighborhood with clean streets and card-operated public phones on the street corners.

My first day in Peru, I went to Miraflores to witness a celebration for peace: a rally that had been organized to protest a border skirmish with neighboring Ecuador over a bit of potentially oil-rich rain forest, an event that grabbed headlines in February 1995. This being South America, I looked about suspiciously for tanks and adolescent soldiers with automatic weapons and unreadable eyes. But all I saw were a couple of cops eating ice-cream cones and young mothers with baby carriages.

The well-heeled residents of Miraflores seemed to be more in the mood for a party than a protest march. And why not? No longer fearing Shining Path terrorism, smartly dressed young people crowded the streets, flirtatiously eyeing one another; the pavement, once carpeted with bomb-shattered glass, was strewn with flowers; guitar music filled the air.

When the music ended, the speeches began. I half-expected to hear some fiery rhetoric, but what I heard instead was the mayor cheerfully saying, "Ecuador is not our enemy. Poverty and underdevelopment are our



enemies. Let's unite to fight them, not our beloved brothers in Ecuador!"

Everywhere that day I saw the Peruvian flag, from every public building, from every private home. Red and white. The city—the whole country, I would later discover—was aflutter with these two colors. I remarked to the woman standing next to me in the jubilant Miraflores crowd that Peruvians seemed awfully patriotic. Her happy, open face suddenly darkened. "We never used to be," she grimly replied. "You never, ever used to see a Peruvian flag. For the first time in a long time we are proud to be Peruvians."

Peruvians have a lot to be proud of: Their Indian heritage reaches back into civilizations preceding the Inca Empire by more than 2,000 years. Some three dozen distinct tribes still inhabit the Peruvian jungles east of the Andes. Offshore, Pacific waters teem with fish; the mountains and jungle hold vast reserves of copper, zinc, lead, silver, and gold, as well as oil and natural gas; the irrigated valleys of the desert coast have some of the most favorable conditions in the world for large-scale production of fruits and vegetables. These rich resources have been largely neglected or mismanaged. Now Peruvians appear to be anxious to make up for lost time.

During the 1940s and '50s Peru's economy grew steadily. By the end of the 1960s, however, the rising tide of fugitives from the impoverished sierra could not find jobs in Lima. Urban unemployment soared. Then, in the 1980s, there was another explosion of migration as poor peasants from the Andes flooded the city in a desperate attempt to flee Shining Path guerrillas.

In 1960 Lima was a picturesque, if somewhat colonialist, enclave of nearly two million people. Today the city founded by the conquistador Francisco Pizarro is a cacophonous metropolis of seven million people, drawn here from all over the country.

Many of these new Limeños take to the streets, entering what is known in Peru as the "informal economy." Made up of street sellers—called *ambulantes*—and backstreet sweatshops, this sector today represents half of all employment in Peru.

I MET DAGOBERTO MIRANDA, veteran ambulante, in a bazaar of alleyways and suffocating crowds behind the presidential palace. Here some 2,500 stalls sell everything from local fragrances poured into French cologne bottles to Amazonian fishing spears. Miranda, who sells blue jeans, told me he was *mishi canca*, Quechua for "grilled cat," meaning he's from the Ancash region of the Andes where the residents once ate cats. An orphan, he came to Lima when he was 12.

"When I arrived here," Miranda said, "I had only a little money, so like everybody else, I went around to the different

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Lima's poor flock to the country's largest maternity hospital, where about a hundred births a day swell Peru's population. The government promotes family planning despite protests from the Catholic hierarchy. Overpopulation and rural migration exacerbate poverty in Lima; some 2.6 million people subsist in shantytowns that ring the capital, many of them without electricity or running water.

For her 15th birthday—a special event called a quinceañera*—Mariana Lengua Balbi (below, at left) celebrates with a few of the 300 friends invited to her home in Lima. "Actually," she says, "my party was smaller than most." Bodyguards attended too—a prudent precaution in a city plagued by kidnappings. Safely ensconced, the elite meet in the members-only lounge of Lima's racetrack.*

shops and bought whatever was cheapest—toothbrushes, handbags, underwear. With this stuff, I'd walk around the city, hanging out at traffic signals and waiting for the light to turn red so I could sell to people stopped in their cars. It was a tough life out there in the streets; there was a lot of discrimination against people like me. The police would beat us with sticks, take away our goods. Sometimes they'd even come after us with tear gas and water cannons."

Fujimori's government sees men like Miranda in a different light: as potential taxpayers. Efforts are being made to "formalize" the informals by issuing them deeds to their homes and businesses, which they can use as collateral against bank loans to expand their businesses legitimately.

The epicenter of this activity is Gamarra, a manufacturing zone near Lima's wholesale food market. Thirty years ago a few ambitious migrants settled there, where they started churning out cheap garments to be sold by ambulantes on the city streets.

Today Gamarra is a throbbing neighborhood of workshops, where 50,000 people—almost all of them migrants—produce clothing for 10,000 minuscule retail outlets here.

David Matías pays $70 a month for 12 square yards in a building that is a honeycomb of tiny workshops just like his. Matías, 25, owns four sewing machines and has rented a fifth, on which he, his wife, and associates were

An Andean highway echoes a glorious past when the Inca Empire boasted a 14,000-mile network of roads that conquistador Juan Botero Benes said

"excels the constructions of Egypt and the monuments of Rome." Today Peru strives to build an infrastructure to knit the nation together once again.

Children clamp their ears to mute the screams and squeals of pigs at an Ayacucho slaughterhouse. Butchers dispatch the swine, and mothers fill buckets with blood to make sausages typical of the region.

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busily stitching school uniforms for the beginning of the school year.

Besides his seasonal work, Matías has a couple of ongoing projects. "I bought a whole bunch of little tags from Brazil that say 'Made in U.S.A.,' " he said, wiping his brow with the back of his hand. "I sew them into these bolero jackets that I'm making for about $1.50 apiece, which I then sell to a shop in Miraflores for $6 each. People are snapping them up."

Juan Infante, the 28-year-old editor of a magazine called *Gamarra*, said, "Peru is about finding your own way, doing your own thing. If you want things to happen, you've got to make them happen."

It's not exactly as if Peruvians have a choice: Fujimori has been able to raise the country's cash reserves from less than zero to 6.5 billion dollars partly by restructuring the hideously mismanaged government-assistance programs of his predecessors. But Peru's grassroots capitalists appear to be thriving without the state's help. And as migrants fight for a place in the economy, they may be rebuilding the country in their own image. María

Rostworowski, one of Peru's leading authorities on pre-Columbian history, told me, "With migration, Peru is once again becoming an Andean country."

TO SEE HOW THE EFFECTS of migration have reached beyond the capital, I drove a hundred miles south from Lima down the Pan American Highway, past empty, drifting dunes, to a coastal hamlet called Santa Sofía Fortaleza. Only 30 to 90 miles wide, Peru's desert coast cradles more than 50 fertile valleys, all irrigated by rivers that flow from the Andes. Santa Sofía lies along one of these rivers, an oasis rising from a sandy wasteland.

José Coronado and his wife, Zeferina, moved here from a very poor village in the southern Andes called Huancarama, which in Quechua means "talking mountain." As Shining Path guerrillas gained strength in the sierra, many other people from Huancarama followed. The day I visited Santa Sofía, Zeferina and her sisters were celebrating the arrival of their mother, Salomé, who had finally left the talking mountain to come live with the family.

José and his neighbor Alberto ceremoniously unearthed the *pachamanca*, keeping alive a tradition transplanted here from the highlands. In Quechua, pacha means "earth" and manca means "pot," which pretty much describes what it is: a hole in the ground lined with hot rocks for cooking food.

The men first struck a layer of yams and potatoes and cassavas as they lifted a sheet of banana leaves with their shovels. The women leaped into the hole to collect the vegetables in plastic buckets. The men lifted another sheet of banana leaves, and the women gathered the meat that lay beneath—rough-cut chunks of well-done beef.

The men sat at a long table; the women on stools and chairs that had been placed in a semicircle beneath the only tree in the huge, sandy courtyard. Bottles of beer were opened and passed around, one at a time, first to the men, and then to the women. José, who was seated at the head of the long table, was the first to receive each bottle. He first poured some onto the ground—"for our mother the earth," he explained—and passed the bottle, along with a single glass, to his brother Francisco.

After about a dozen bottles of beer had been passed around, the men got up from their table and joined the women under the trees. Salomé, a tiny woman doubled over with arthritis, was seated at the apex of this circle of family members. Perched on a short wooden stool, her back against a stone wall, she was dressed in the fashion of most Andean women—a bowler hat that was too small for her tiny head and a skirt with voluminous petticoats that reached just above the knee. She too was drinking from the communal glass of beer, but unlike us she did not speak; she merely gazed with expressionless, black eyes into the faces of four generations.

José Coronado's 15-acre plot at Santa Sofía—protected from evil spirits by a human skull blessed by a spiritual healer—was once part of a colonial hacienda. Even though Peru was loosed from Spanish rule by Simón Bolívar and José de San Martín in 1821, a small elite continued to control most of the country's resources until 1968, when a general named Juan Velasco Alvarado staged a coup d'état, taking over key industries and expropriating coastal plantations belonging to wealthy landowners. Velasco turned the country's

haciendas into state-controlled peasant cooperatives modeled on those in Cuba.

Fujimori undid all that. Under him the Agrarian Bank, a government enterprise that had been giving out subsidized loans, was closed. Now, in an effort to encourage Peru's farmers to look after themselves, the government is issuing individual land titles for plots in the old cooperatives. With this land as collateral, people can apply for private loans at a competitive interest rate to improve their farms.

I asked José if his family was happy with the government's agricultural policy. He replied, "It's better because we own our own land." But was it difficult to survive without government subsidies? Draining a glass of beer, his brother Francisco looked thoughtful for a moment, then said, "Of course. But we never got any help from the state, not even when all of this was a cooperative, because the leaders of the cooperative would pocket the money from Lima that was meant to help us. The truth is we've always been on our own."

SELF-SUFFICIENCY also prevails in the eastern foothills of the Andes in places like Quillabamba, a jungle town 3,000 feet above sea level about a ten-hour drive from Cuzco, 75 miles away. The road to Quillabamba takes you across the cornfields of the Sacred Valley, in the heart of the Inca Empire; across the sluggish Urubamba River, past the red-tile roofs of farmhouses and the alpacas grazing on the mountainsides; then into a lush world of tropical forests and metal-roofed shacks.

Coca is one of the principal crops in Quillabamba. Although thousands of farmers in the Huallaga Valley to the north illicitly grow coca to be chemically transformed into cocaine by the big Colombian cartels, here in Quillabamba many farmers legally sell the coca they cultivate on their small plots to the state-run National Coca Enterprise, which markets the leaf for legal domestic consumption.

Most of Peru's indigenous people both chew the coca leaf and brew it as a tea, just as they have done for at least 3,500 years. In its raw form, the coca leaf contains less than one-half of one percent of the alkaloid cocaine. A mild stimulant, its effect on the user is more or less equivalent to that of caffeine.

A 1961 UN treaty, however, prohibited international commerce in the leaf except for use in pharmaceuticals and as a flavoring agent. It called for a ban (never enforced) on coca-leaf chewing by 1986.

In Cuzco, Percy Paz, an anthropologist and coca expert, told me, "For the people of the Andes it is essential to come together and chew coca before praying, because if you do not, God will not hear you." Coca is chewed at marriages and funerals, before a son goes into the army or to Lima to find work.

Ana Mejía, one of those who grows the crop legally, took me through a plot of 150 coca plants in orderly rows on a near-vertical mountainside behind her small house, two hours up the mountain from Quillabamba. Expertly keeping her balance, Mejía picked three leaves from one of the plants and held them with the fingers of her right hand. Demonstrating a rite

The women of San José de Ticllas once had only knives to defend themselves if attacked by Shining Path guerrillas, who burned down the local school. Peru's military gave guns to this village, which hasn't been attacked since.

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called *kintu*, she turned the leaves in the direction of the mountains before us and blew gently upon them. "Apu Urusawya," she murmured in Quechua, calling the spirit of the largest mountain. She turned her body slightly, and, blowing again upon the triumvirate of leaves, intoned, "Apu Santo Domingo," calling the spirit of the second biggest mountain on the horizon. She then stuffed the leaves into her mouth and started chewing.

Mejía practices kintu every morning before working her land, so the mountain spirits, which are male, will coax the earth, which is female, to release bounties into her hands. Mejía explained to me, "It is very dry up here. The only thing that can really grow well is coca. I do grow some coffee too, but that you can only harvest once a year. Coca, on the other hand, you can harvest four times a year. It's only with the money we make from coca that we are able to live."

Face of an Indian, faith of a Catholic: A marcher in a Good Friday procession in Ayacucho reflects Peru's historic mix. The Spaniards, who conquered the Indians in the 1500s and condemned their beliefs as devil worship, tried to replace local gods with Catholic saints. Many Indians, though, simply welcomed Jesus and the saints into their traditional pantheon.

The colonial buildings of Cuzco—more than 11,000 feet above sea level—rest on the foundations of Inca temples and palaces. Spanish conquistadores marveled to find a thriving metropolis with grand stonework and paved streets.

A law passed in 1978 prohibits the planting of new coca plants, though the old ones remain legal so long as they are harvested for domestic use. The police, Mejía said, sometimes inspect people's lands to see if anyone has defied the prohibition.

INSENSITIVITY TO NATIVE PRACTICES has a long history in Peru. In 1531 Francisco Pizarro, an illiterate Spanish soldier, set sail from Panama with 180 men and 37 horses to conquer Peru for its gold. Seven months after his arrival Pizarro went to Cajamarca to confront Atahualpa, the Inca, or ruler, of an empire that stretched 2,500 miles down the continent's west coast—and a direct descendant of the sun god. Atahualpa was easily taken prisoner. Though he gave the conquistador a vast amount of gold and silver in exchange for his release, the Inca was garroted—after being baptized.

Even after the total subjugation of Peru was accomplished in 1572 and most of the Inca's gold and silver treasures had been found and melted down, rumors persisted that somewhere beyond the Andes lay a land so rich in gold that its king, whom the Spaniards came to call El Dorado, or the Gilded Man, bathed in gold dust. The myth of El Dorado was probably passed on to the Spaniards by the Inca, who had their own legend of a city of gold in the jungle called Paititi.

It is a most durable legend. Deep in the tropical forest that covers 60 percent of Peru, I met Juan Carlos Rosado, who came out here in the 1970s to look for Paititi and instead found Puerto Maldonado, a haphazard town surrounded by a hazy, low-slung landscape.

Hawking bread and candied apples, street-side vendors like these in Ayacucho have long flourished in Peru's "informal economy." Recent reforms are giving these entrepreneurs legal rights—and a tax bill.

The smell of things both living and dead mixes in the heavy air of this port on the Madre de Dios River, a muddy tributary of the Amazon. Although Puerto Maldonado was founded at the turn of the century, most of its residents came here only after a road connected it to the sierra in 1966—a road to facilitate the modern search for gold. The city looks like a U.S. frontier town from the Old West, with dirt roads and saloons and shops that advertise "We Buy Gold."

Juan Carlos Rosado is the proprietor of one of these shops, a simple room with a concrete floor and wooden walls decorated with pictures of half-naked women. Rosado buys more than a hundred pounds of gold a month from prospectors working in the jungle in places with names such as El Condenado (the Condemned), El Infierno (Hell), and Travolta (after the star of *Saturday Night Fever*).

Leaning back on a wooden stool, Rosado recalled that when he first came here, gold was in such abundance you merely had to brush against a tree and your clothes would be covered with gold dust. Prospectors from all over Peru flooded this largely unpopulated land. "It was survival of the fittest, plain and simple," he said.

The Amazonian rain forest—Peru's Wild East—has attracted thousands in this century who are seeking not just gold but cheap land. Farmers here have big plots, usually around 75 acres, as compared with about one acre in the sierra. Wandering around Puerto Maldonado's tiny river port, where cedar launches called *peque-peque* for the sound of their engines carry oil and groceries to remoter communities upstream, I fell into conversation with

Fernando Camatico, a skinny young man in baggy swimming trunks. Camatico came here 14 years ago. He has 12 acres in the forest on which he grows oranges. He had come into town, as he did on most days, to sell them in the market. I asked him if oranges grew well there. "Too well," he said. "I grow far more than I can ever sell. Usually most of my oranges just sit and rot. We feed mangoes to our pigs. The problem is that there are too many people growing fruit here, so the prices are very low. And we have no way to get them to other markets because there are no roads to get them there."

Puerto Maldonado is connected to Cuzco, in the Andes, by a road in such appalling condition that it can take as long as 15 days to make the 200-mile journey. Earlier in Quillabamba I had met up with Genaro Callapiña, a veteran truck driver. Leaning against his 20-ton rig, Callapiña told me that he had just driven in that morning from Cuzco on another road with a load of cement. He had tried to drive to Puerto Maldonado to pick up some Brazil nuts but had to turn around halfway there because of an avalanche in a high Andean pass. "Some of my friends are still stuck up there," he said. "They'll probably be there for days."

Until quite recently, getting "stuck" on a Peruvian road was not uncommon. In 1990 only 15 percent of Peru's 43,500 miles of roads were passable. The rest had either been destroyed by the Shining Path or simply disintegrated because of neglect. Fujimori's government has been able to rehabilitate 2,500 miles of Peru's principal highways. Roads, of course, bring all kinds of things with them—both good and bad. A road connected the jungle city of Pucallpa to Lima in 1943, and while access has been a boon for many Andean people, it has been a mixed blessing for the indigenous Amazonian tribes.

Blessings are decidedly mixed downstream from Pucallpa at Puerto Callao, a seasonal market on Yarinacocha, an oxbow lake that was once part of the Ucayali River. There, on a muddy beach, I watched women flip bananas on a grill while men sold yucca and fish from tarps spread on the sand. A small building on stilts rose from the water, a hand-painted sign above its entrance announcing, *"Jehová es mi pastor."* Next to it a bar, also on stilts, was playing a raunchy song from a tape recorder.

Because I was an obvious foreigner, the women descended upon me almost as soon as I stepped out of the car. The Shipibo Indians live along the Ucayali and its tributaries in small villages of thatched platform houses. The diminutive women who swarmed about me had long black hair and bowl-cut bangs. On their arms were dozens of necklaces strung with wooden beads, seeds of all sizes, and the shells of tropical nuts.

These women were from a place called San Francisco, an hour away by peque-peque on the other end of the lake. They come to Puerto Callao looking for tourists to sell their handicrafts to. Although they all own land on which they grow bananas, they do not have a surplus to sell. So they make

The sun god, says an Inca legend, created a man and a woman, gave them a golden staff, and sent them to civilize a savage world. Today a heavenly beam lights a hut near Cuzco, capital of the Inca Empire.

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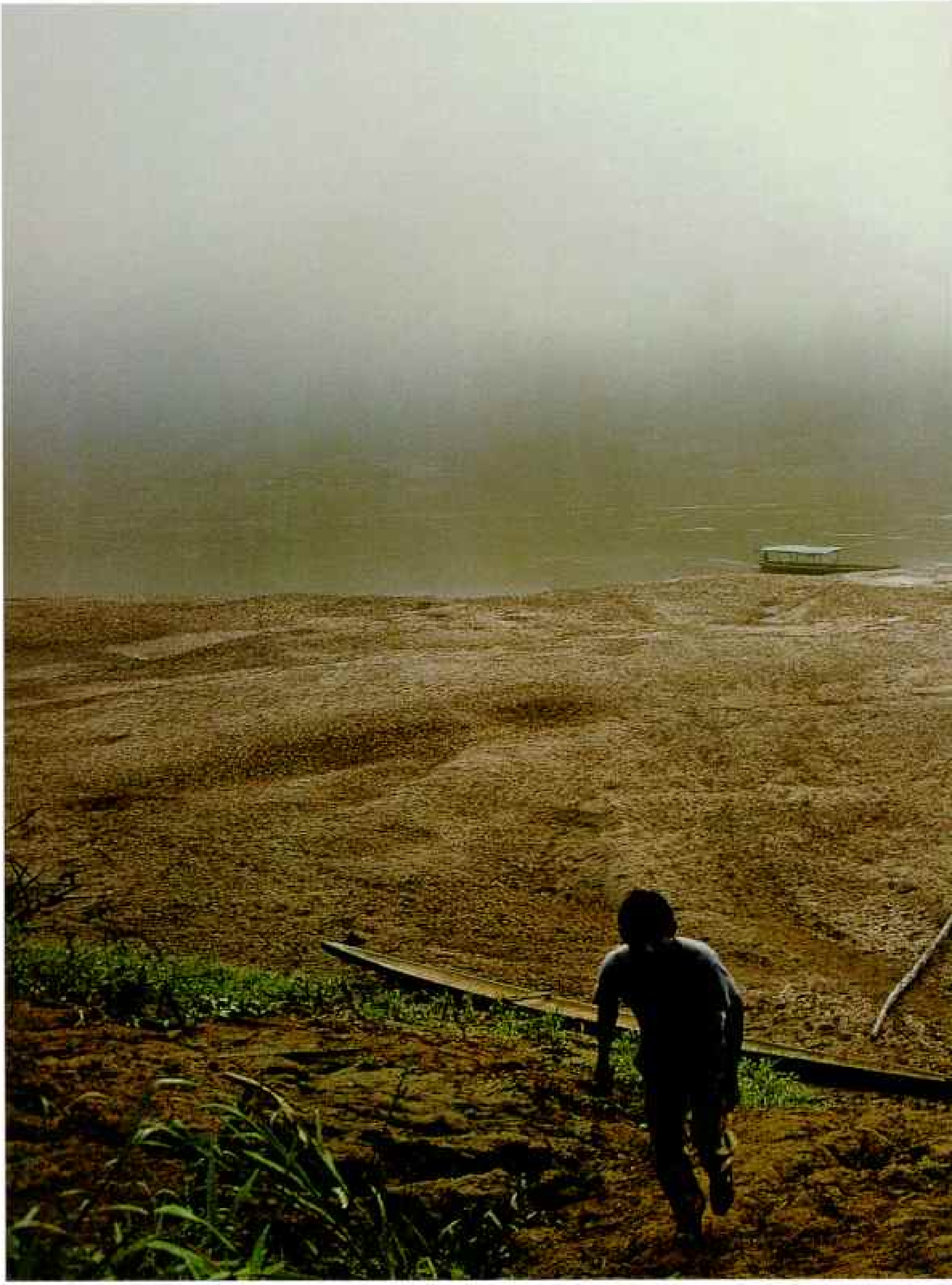
necklaces, painted cloth, and ceramic bowls to earn cash to buy kerosene and soap for their households. Unfortunately, there are not many tourists.

WHILE TOURISTS may not be coming to the rain forest in numbers the local people would prefer, they are heading in droves to Machu Picchu. No longer worried that they will be killed by terrorists, credit-card-wielding Americans and Europeans and Japanese are traveling again to Peru—a development that delights this cash-strapped country.

Machu Picchu was unknown to the modern world until 1911, when Hiram Bingham, a Yale history professor whose expeditions were later funded by the National Geographic Society, stumbled across its grass-covered terraces and tumbledown walls. The lost city has been almost entirely excavated and reconstructed, yet even now little is understood of Machu Picchu.

Camels of the Andes, alpacas provide wool and meat to the Indians of the sierra. Llamas, their larger, less delicate kin, are raised as beasts of burden as well.

Domesticated more than 5,000 years ago, alpacas graze on tender greens growing among tough highland grass.



Mists rising off mudflats of the Tambopata River fade into the Amazonian jungle, part of a 3.7-million-acre "extractive" reserve near Puerto Maldonado.

By encouraging ecotourism and sustainable harvest of Brazil nuts and rubber, the government hopes to stem deforestation that denudes 860,000 acres a year.

It is not surprising that the Spaniards never found it. From below, one would hardly guess that cradled in the lofty peaks was a city of such sophisticated design. I took the first morning bus up and wandered through the ruins. Although it appears to have been built as a citadel, Machu Picchu has a number of structures suggesting that the city was built as much for ceremonial purposes as for strategic ones. I paused in one building identified by some modern astronomers as the Temple of the Sun. A deep groove, carved into the surface of a massive rock altarpiece, is precisely aligned with the rising point of the sun on the morning of the June solstice.

A hotel has been constructed at the entrance to Machu Picchu, and when it began to rain, I went there to drink a cup of coca tea. It was there I met—quite by chance—Juan Víctor Núñez del Prado, an anthropologist on the faculty of the University of Cuzco, and Alberto Villoldo, a Cuban-American author and medical anthropologist who has spent the past 25 years writing about Peru. Núñez and Villoldo were leading 22 people from the U.S. and Europe on a package tour to study the mythology and healing traditions of the Andes.

Núñez and Villoldo, who are students of Andean mysticism, explained that while Western mysticism is an endeavor to save your soul in another world, Andean mysticism is meant to solve problems in this one. Villoldo elaborated, "The mysticism of the Andes is wholly grounded in the earth. It's an entirely practical belief system. For the Inca, if spirituality did not help you grow corn, it was pointless."

Through their investigations, Villoldo and Núñez made contact with native priests in a community called Queros, high in the central Andes. Known as *pacos*, these holy men believe themselves to be descendants of Inca who fled to this place at the time of the Spanish conquest. From their lofty sanctuary, generation after generation of pacos are said to have preserved the essential cosmology of the Inca.

The Inca were great prophesiers. Villoldo cited a legend that before the arrival of Pizarro and his men, a prophecy was made that an invasion of bearded, metal-breasted beings that were half man, half beast would come here to turn the universe upside down. After a long period of darkness caused by these foreign creatures, the Inca Empire would re-create itself.

According to Villoldo, the pacos have shared with Núñez and him a prophecy that foresaw the end of this period of darkness, when a new era known as *pachacuti* would be heralded by changes in the mountain landscape. The pacos say they started seeing changes—lagoons drying up, condors disappearing—in the 1970s. By the September 1990 equinox the changes had reached a "critical mass."

Villoldo leaned forward. He held my gaze with an intense stare. "Think about it," he said. "It was on July 28, 1990, that Alberto Fujimori was first inaugurated President of Peru. An unknown, he emerged to lead this country at a time of total darkness. Now think about the word pachacuti. Pacha means 'earth' and cuti means 'change,' or 'turning over.' Would

Scars from an earthquake mar an Inca wall in Cuzco, where pleas to Christ as the Lord of the Tremors often go unheard. Yet Peruvians still pray for peace amid shake-ups—natural and man-made—that never seem to end.

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anyone disagree that Peru has undergone an extraordinary transformation?"

Probably not. But is it the fulfillment of prophecy or simply the gradual struggle by which Peruvians are rebuilding their nation, pulling away from the legacy of colonialism, leftist military dictatorships, and terrorism?

I think about President Fujimori (who had not heard about the pacos' prophecy), for whom lucky stars and building roads go hand in hand. Fujimori's own brand of practical mysticism has struck a resonant chord among Peruvians, exhausted as much by the utopian rhetoric of former leaders as by the savage nihilism of the Shining Path.

And I think about the words to a hit song by a Lima rock group, sons of migrants from the sierra:

We're heading for the top....
We're gonna wear out a lot of shoes to get there. □

BY **JANE ELLEN STEVENS**
PHOTOGRAPHS BY **MARIA STENZEL**

Exploring Antarctic Ice

Suspended above a frozen frontier, scientists fish for the secrets locked away inside Antarctica's winter sea ice, a vast white armor impenetrable to seafaring explorers for centuries. Today, on icebreaking vessels specially equipped for rough voyages, researchers can explore icescapes more complex—and flowing with life—than they previously thought possible.

Stopped cold, the 7,600-ton icebreaker *Nathaniel B. Palmer* grinds to a halt at its southernmost point in the Ross Sea, 1,300 miles from the South Pole. Sifting for clues about the formation of the sea ice, scientists drill into it like archaeologists on the trail of a lost civilization, analyzing its crystal structure, salinity, snow cover, and other characteristics.

THE TEMPERATURE is 1°F, not very cold for this part of the world, and a moderate breeze ruffles the fur around the hoods of our regulation-issue bloodred parkas. It's our first day out on the ice, and with a dozen other people I am shoveling snow from a frozen ocean that stretches to the horizon like a white desert.

I hear a radio crackle with the voice of second officer Michael Watson. Like a plantation manager supervising his field hands, Watson eyes us through binoculars from the bridge of the *Nathaniel B. Palmer*. "Greg, be advised that there's a crack from the bow that's crossing the end of your line." Watson refers to the marker line along which we are digging holes to measure the snow and ice thickness.

"Roger that," says Greg Packard, the marine projects coordinator. "We'll keep an eye on it."

The skies, which dawned a clear, blazing blue, have grayed. Watson's disembodied voice emerges again from Packard's radio: "Greg, be advised, a section of ice under the ship's starboard wing just buckled and it's filling with water."

"Roger that."

As I push the shovel into the snow, a hairline crack streaks from the ship's bow a hundred yards away right past the tips of my boots. I point it out to Martin Jeffries, our chief scientist. Jeffries, a 37-year-old glaciologist from the Geophysical Institute of the University of Alaska Fairbanks, has 14 years' experience with Arctic and Antarctic sea ice.

"Watch it," he advises.

The icy landscape looks solid enough, but just two feet below my white rubber boots lies 12,000 feet of frigid water. Padded with 20 pounds of clothes, I might survive in the water a few minutes—if I had the presence of mind to inflate my life vest.

Suddenly Packard shouts a warning. The crack at the end of the line is widening. We stop digging and, in the silence, hear Watson's calm voice: "Greg, the pool under the wing is getting deeper."

Jeffries doesn't hesitate. "Get back to the ship!" he yells.

We seize shovels, tape measures, ice corers, and sledges and shuffle across the floe as fast as we can. The buckled section of ice is now a large pond from which seawater pours onto the rest of the floe like a mountain stream. As we gather inside the ship, the flat ice we stood on with all the confidence of explorers on newly conquered land begins disintegrating.

"Rats!" Jeffries says. Then relief swells his voice: "Thanks to all for coming in alive."

We're at day seven of a fifty-day international scientific expedition that will take us 8,400 miles through the winter sea ice encircling Antarctica. It is early August, and a little more than a month from now the ice will reach its greatest expanse—twice the area of the entire United States. The ice appears and disappears every year. Beginning in March, the Antarctic autumn, it grows rapidly—at a rate of 22 square miles a minute—to an average

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JANE ELLEN STEVENS has written numerous popular articles about science and technology. This is her first GEOGRAPHIC story. MARIA STENZEL's photographs also appear in this issue's "David Thompson: The Man Who Measured Canada."

A thin white shell compared with Arctic ice, which reaches ten feet thick, Antarctica's pack averages only about three feet. "Working on the ice definitely sends shivers down your spine if you think about it too much," says chief scientist Martin Jeffries (above, second from right).

thickness of three feet. By October, the middle of spring, it is melting twice as fast.

With me on the *Palmer*, a privately owned research icebreaker under contract to the National Science Foundation (NSF), are 35 men and 7 other women. It's my second voyage on the ship; this year, as a science journalist with an NSF fellowship, I've signed on as a working member of Jeffries's group of ten researchers. We're as zealous as Nathaniel B. Palmer himself, the American seal hunter who in 1820 was one of the first people to see Antarctica.

We are divided into five teams, three charged with recording the physical properties of the sea ice and snow and two with monitoring the atmosphere and ocean water from aboard ship. By the end of the voyage we had made tens of thousands of observations, which will help scientists assess the impact of the winter sea ice on life in the Antarctic and on world climate—a role now believed to be far greater than previously suspected.

Jeffries hoped to collect data all the way across the Ross Sea to the Ross Ice Shelf, but thickening ice at 70° south turned us back. Still, we did encounter what he'd found there on a previous expedition: a mysterious belt of mostly congelation ice—long, columnar crystals more typical of the calmer Arctic Ocean than the small, irregular frazil crystals that predominate in churning Antarctic waters. Jeffries doesn't *(Continued on page 46)*

1. STORMY SEAS
Born from the world's roughest oceans, Antarctica's giant floes bagin as frazil ice (see below) in cold, turbulent water.

2. GREASE ICE
As winter approaches and temperatures fall, small crystals clumped together by wind and waves congeal into greasy-looking slicks.

3. PANCAKE ICE
Spun around by violent waves, grease ice fragments and thickens into free-floating disks, some reaching eight feet in diameter.

Metamorphosis at Sea

FRAZIL ICE
An eight-inch-long core sample shows crystals set in chaotic patterns. This is frazil ice—a telltale sign that water froze quickly in a storm-tossed sea. As it freezes, frazil ice also traps minute organisms.

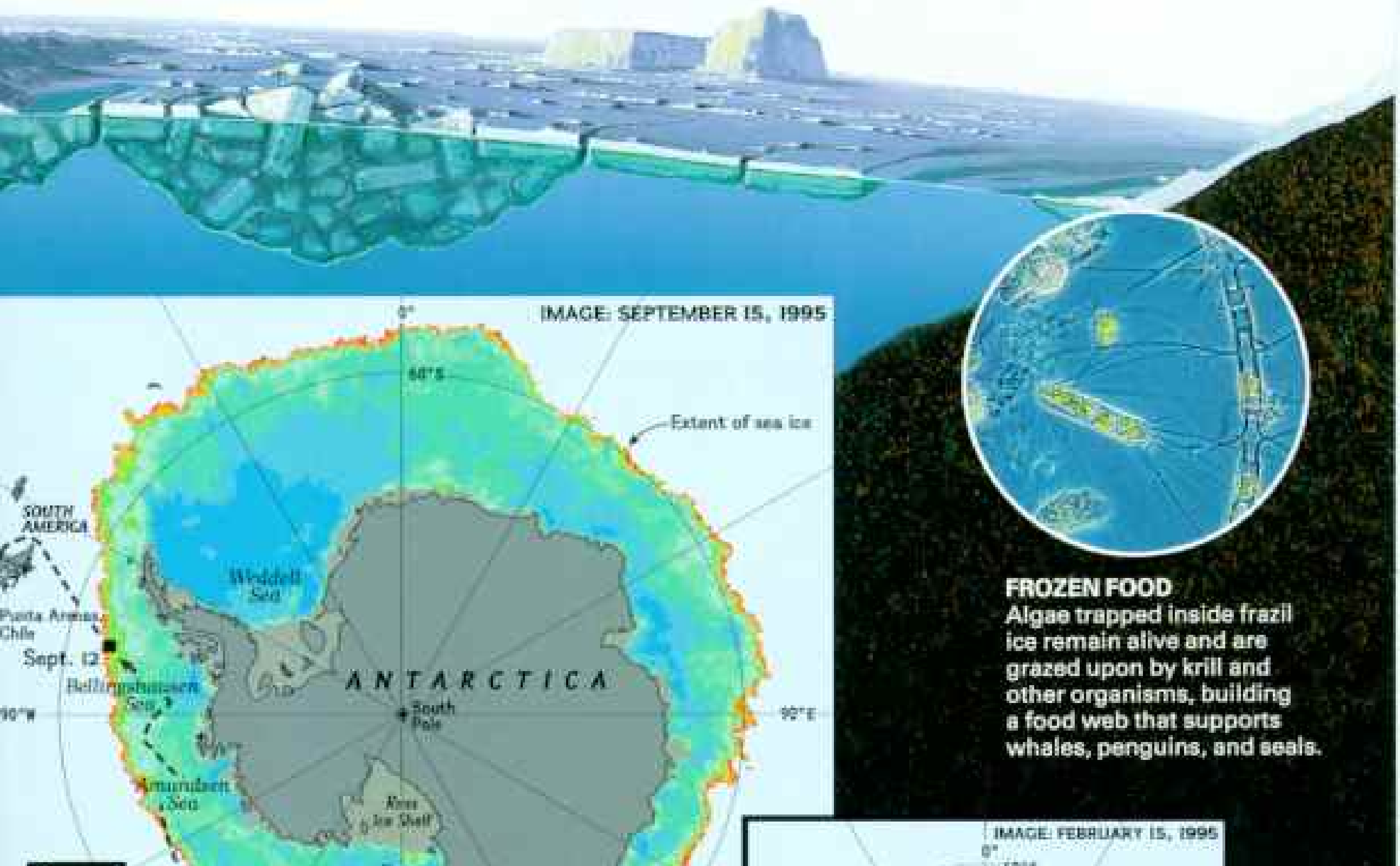
CONGELATION ICE
Slender, uniform crystals, known as congelation ice, are typical of the more placid Arctic. Here, in Antarctica, they form beneath frazil ice after the sea has frozen.

Dubbed the "greatest seasonal event on earth" by one scientist, Antarctica's annual freeze-up covers seven million square miles—an area twice as large as the United States. This frosty lid over the southernmost oceans is thought to produce much of the world's coldest, saltiest water, which seeps out of the ice as it crystallizes. More dense than its surroundings, the frigid brine then sinks to the ocean floor, where it is borne by currents to the tropics. But this phenomenon, while generating an ocean circulation crucial for the world's climate, is easily disrupted. Some experts fear that if the earth warms or cools too much, the ice may shrink or swell. Information gathered on research cruises may provide critical clues.

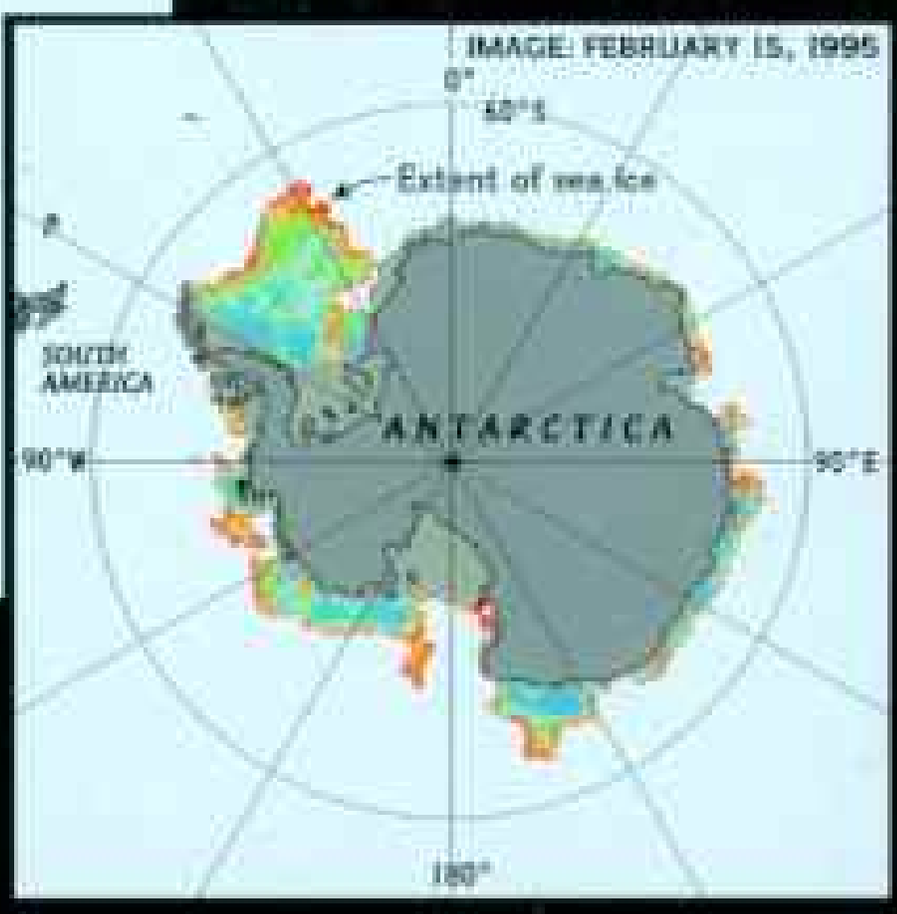
PAINTING BY WILLIAM H. BOND

4. SEA-ICE SHEETS
As winter deepens, pancakes enlarge and crowd against one another, calming the waves and concealing the ocean underneath.

5. ICE FLOES
Blanketed by snow, pancakes cement into floes, which buckle as they ram against one another and slide around icebergs.



FROZEN FOOD
Algae trapped inside frazil ice remain alive and are grazed upon by krill and other organisms, building a food web that supports whales, penguins, and seals.



THE EBB AND FLOE OF SEA ICE
The *Nathaniel B. Palmer* embarked for Chile before the ice reached its greatest breadth (above), as shown in a satellite image that reveals ice concentration. At the peak of summer (right), the ice is much reduced.

The underside of ice is revealed in this rare glimpse from below, showing yellowish clouds of algae illuminated by stabs of sunlight. To survive in this frigid environment, the minute plants inhabit a labyrinth of unfrozen brine channels. Krill nibble at the bottom of the ice all winter and in turn support a sea-ice ecosystem.

(Continued from page 41) know what the 500-mile-wide phenomenon signifies. Another puzzle at the end of the earth.

"When I was a girl, I wanted to be an astronaut," 39-year-old Barbara Hurst-Cushing, one of the researchers, told me. "This is the closest I'll come."

Indeed the departure of the *Palmer* from Lyttelton, New Zealand, was a logistic exercise akin to the launching of a space shuttle. About half a million gallons of diesel were pumped into the fuel tanks, and enough food for a year was lowered into the hold. Duplicates of all engine parts were stored on the ship, which is equipped with machine, carpentry, and electronics shops. The *Palmer* sails without a physician or a dentist, so we had to pass thorough physical and dental exams. Luckily, I'd already had my wisdom teeth out; otherwise they'd have been pulled.

In my small cabin I stowed a few mystery novels, a poster of a tropical beach, my favorite Motown and Rachmaninoff tapes, and a stash of candy bars and sodas. During the voyage our only contact with the outside world would be e-mail—no newspapers, no magazines, no TV, not even radio. Some members of the crew—including the Texan chef—avoided going on deck and never even contemplated stepping onto the ice. "Too damn cold," growled the chef.

To avoid confusion that might arise from gaining or losing days when we crossed the date line, we switched to a system of "Julian days," in which the days of the year are numbered sequentially. So there were no more days of the week—not that it mattered much, because every day was a workday. There was no such thing as a weekend on the sea ice.

MARTIN JEFFRIES and his fellow scientists call this ephemeral frontier the "Antarctic winter sea-ice ecosystem"—a dull name that doesn't even hint at the dangers and mysteries that kept all but a handful of humans away until a decade ago. Science began nibbling at the winter sea ice in 1974, but it was not until 1986 that the first research ship, the German icebreaker *Polarstern*, ventured deep into it. People criticized that expedition as foolhardy and unnecessary: The ice had trapped or crushed every ship that had gone in, and everyone assumed the place was a wasteland.

Yet the researchers on the *Polarstern* found life in abundance. Penguins, seals, and seabirds appeared out of nowhere on their way to no known place. They were fatter than those observed in summer. Even the sea ice itself seemed to breathe, opening into what looked like rivers meandering through a snowy prairie and then, without warning, closing again.

Since that pioneering voyage, only ten other scientific expeditions have explored the winter sea ice, seven of them on the *Nathaniel B. Palmer*. The information collected so far shows that the ice is vital for the proliferation of life throughout the southern oceans. In winter, algae living in the ice provide a rich pasture for krill, tiny shrimplike creatures that are a staple food of larger animals such as whales. Dust particles blown in from distant landmasses are trapped in the ice. In spring when the ice melts, algae—perhaps fertilized by iron in the dust—bloom in the meltwater.

But we don't yet know, for instance, why the sea ice varies in thickness, structure, and distribution from one area to another or how changes in its mass affect ocean currents and climate. We don't know exactly how algae in the ice survive the winter, and we know hardly anything about the winter lives of the millions of Adélie and emperor penguins, Antarctic and snow petrels, and Weddell, crabeater, and leopard seals.*

Solving these "whys" requires hours of tedious work, observing and measuring to first sort out the "whats" and "hows." How thick is the sea ice? How much snow covers it? How much of the ice is flooded with seawater? What is the temperature of the snow and ice? What kinds of crystals are present? Our expedition will help answer these questions.

After the ominous incident our first day on the ice, we push south in the Ross Sea along longitude 180°, the date line, meandering between yesterday and today through a world that will disappear two months from now. The *Palmer* makes 60 nautical miles—one degree of latitude—every 24 hours, and four days later, on Julian day 220, we reach 69° south. At 9:30 a.m., as a neon orange rim appears along the horizon, we make a stop to collect atmospheric and oceanographic data.

I join Jennifer Simmons, a graduate student in atmospheric science from the University of Alaska, on deck. She ties a small package of sensors to a helium-filled balloon that will

*See "Emperors of the Ice," by Glenn Oeland, in the March 1996 NATIONAL GEOGRAPHIC.

Plowing through channels, or leads, in the ice, saves the ship's captain time and fuel. Pried apart by ocean currents and howling gusts of wind, leads sometimes meander for miles, like highways scraped clear after a snowstorm.

transmit temperature, atmospheric pressure, and humidity readings to a shipboard computer. We watch the balloon rise straight up, shrinking to a white speck and fading from sight, even as the falling air pressure makes it expand. I imagine what we must look like from that height—an orange speck in the whiteness—and find no comfort in the thought that we're the only humans in the Ross Sea, an area half the size of Europe. At 14 miles up, after carrying out its mission, the balloon bursts.

Meanwhile on the starboard side of the ship, in the Baltic Room, the oceanographic team lowers a rack of 24 bottles through a huge door in the hull to take samples of seawater down to a maximum depth of 5,000 feet. Small changes in salinity, temperature, density, and oxygen content reveal two well-defined layers—information researchers need for tracking ocean currents, which affect climate.

The *Palmer* shudders and plows ahead again. With its shallow draft and rounded bow, the ship rides over the ice, breaking it into pieces the size of small cars that thump and screech against the hull from bow to stern.

"It's like riding a sheet of tin being dragged by a truck over a gravel road," says Johnny Pierce, the chief engineer. I envision sitting in a garbage Dumpster while the Dallas Cowboys whack it with sledgehammers. When the *Palmer*'s twin propellers, which are 13 feet in diameter, chew up blocks of ice, the entire ship vibrates like an unbalanced washing machine.

Jeffries and Capt. Joe Borkowski meet on the bridge, a glass-enclosed structure 80 feet wide, to choose the ice floe for our afternoon's work. The lanky, British-born Jeffries, who is prone to impatience but masks it with subtle humor, paces the bridge, scanning the ice from behind tinted glasses. As chief scientist he decides where the *Palmer* should go, while Borkowski, a hulking Southerner with football in his past, drives the ship with a veteran's lazy touch. They judge the thickness of the ice by eyeballing the pieces upended by the ship, and they check the edges of floes for cracks.

Borkowski nudges the ship into an egg-shaped floe half a mile long. "OK, Doc?"

"Looks good, Captain," says Jeffries, who then huddles with the lead researchers to plan

Work goes on despite a stinging blizzard, as researchers delve into the frozen sea to take samples and readings. "What a day that was!" recalls Barbara Hurst-Cushing. "It was so windy I kept getting knocked off my feet."

the layout of the marker lines. He decides on a cross section that seems most representative of the floe's rumpled topography.

Today is an ice researcher's idea of heaven: clear blue skies, minus 4°F, a breeze that invites us to inhale deeply the planet's cleanest air. The three members of the snow team, led by Kim Morris from the University of Alaska, drag a sledge piled with equipment down the gangway and onto the floe. I follow them and squint in the glare of the sun, which is intensified by the unbroken whiteness.

They dig through the snow to the surface of the ice, making a pit about one and a half feet deep. Then they sit, virtually motionless, examining the snow layers. They carefully place snow samples into plastic bags for later analysis in the lab. It takes more than an hour to complete the work, and they're grateful that a fierce wind isn't tearing at their notebooks.

Before scientists can begin to understand how fluctuations in the winter sea ice help regulate climate, they need to know both the thickness of the snow and how well the snow insulates the ice beneath it. In the Arctic, the ice grows to eight or ten feet thick. But here in the Antarctic, a blanket of deep snow, wave action, and ocean currents that propel the ice into warmer waters prevent it from reaching much more than three feet. The insulating capacity of snow varies with its crystal structure: Wet snow crystals are poor insulators, while dry snow is more efficient.

After snow lands on the ice, the crystals change shape as the weather seesaws between the cold, dry spells that prevail when the wind blows out from the continent of Antarctica and the warmer, wetter spells that come with snowstorms rolling in over the ocean. When snow at the surface is colder than at the base, water vapor migrates from the warmer grains to the colder ones. This causes the warm grains to coalesce into large hoar crystals. Researchers have found more than eight different types of snow crystals in the Antarctic.

I CONSIDER MYSELF LUCKY to be part of the snow and ice thickness team: Our time is vigorously spent. With shovels, four of us begin digging holes a yard apart along the 164-yard (150-meter) line. Even though the snow is fluffy and only about a foot deep, I soon work up a sweat. Five emperor penguins slide toward us on their white-pillowed bellies, push themselves up with their beaks, and spend the rest of the afternoon studying us.

The next job is to drill small holes through the ice itself. Each time I haul out the gas-powered drill, seawater spouts through the hole like a geyser. (We employ gas-powered machinery as little as possible to keep pollution to a minimum.) We then use a measuring stick to record the depth of the snow and tailor's tape attached to a weighted piece of string to measure the thickness of the ice. There's an irony in sailing to the Antarctic in a ship that costs more than $25,000 a day to run so we can work with a wooden stick and a piece of string.

At 3 p.m., three hours after we began shoveling, we trudge back to our warm metal cocoon—a daily routine that hardly ever varies. This evening, though, I pause at the gangway. The sun, huge and vermilion as it drops toward the western horizon, is framed by sun dogs, rainbows of brilliant color that appear when ice crystals are thick in the sunlit air. In the east a stark white moon rises against a cerulean sky. The penguins, their white necks streaked with the colors of the sun, are standing on their heels, the tops of their feet tucked under their bellies for warmth.

If day 220 was tolerably comfortable, there are times on the ice when the windchill drops to minus 50°F, and the wind, blinding us with snow that turns the *Palmer* into a dim ghost ship, sucks the life heat from our fingers and toes so they ache and grow numb. Sometimes the floes are partly submerged under a burden of several feet of snow, and I find myself sloshing ankle-deep in water—a disconcerting reminder of the thinness of the skin between me and eternity.

When Jeffries, who leads the four-member ice-coring team, needs extra help, I take turns twisting an auger to collect cores from three spots along the line. After a hundred twists, putting a little body English into each as I hum a Motown tune to set a rhythm, I'm ready to toss off my parka. Jeffries takes the temperature of the first core and cuts it into four-inch sections with a small saw. Back on the ship, he melts the sections to measure their salinity and oxygen isotope levels—information that reveals how much of the ice comes from fallen snow that has melted and refrozen. Later this information may help scientists understand how the ice and snow affect climate.

Ricardo Jaña, a researcher from the Chilean Antarctic Institute in Santiago, tucks the second ice core into a long tube. Every evening he

Keeping watch as others sleep, ship's mate Robert Verret stands night duty on the bridge, scanning a radar screen for leads. The *Palmer*'s technology also warns of maritime hazards such as icebergs, one of which appears, spotlighted, through the ship's window.

and Jeffries cut a core like this into thin slices in one of the ship's laboratories and look for differences in crystal structure. They can use this knowledge to map the varied geography of the sea ice, much as early terrestrial explorers distinguished deserts from swamps and mountains from plains.

Evenings on the *Palmer* are less active but no less productive than the days on the ice. We pass the hours transferring data from our notebooks into computers, repairing equipment, and running experiments. We also find time for the occasional game of darts or chess. But as the journey progresses and isolation begins to weigh, we spend more time on e-mail, our only connection to family and friends.

THE SHIP RAMS THE ICE, stops, slides back, and rams again. Back and ram. Back and ram. It's day 224, and for the past three days we've been stopped at 70° south. Jeffries faces a dilemma. If he pushes on toward the Ross Ice Shelf as he had planned, he risks wasting fuel and precious time. However long it takes to get in, it will take that long to get out. The ice here is four to five feet thick, with ridges of nine feet, and the weather changes so quickly we also risk being trapped without warning. Jeffries decides to change course. You can't fight Antarctic sea ice, he says. "You've got to go with the flow." We will retrace the route he took the year before, northeast through the frozen Amundsen and Bellingshausen Seas.

Minke whales off the bow! The word goes out at dawn on day 227, a morning so gray no horizon divides sky from ice. I run to the bridge and see two minkes, gray-black and about 30 feet long, break a hole in the thin, frozen sheet, then submerge. Out of the mist a dozen or so Adélie penguins scuttle single file across the ice to the hole and, like kids at a swimming hole, mill around before jumping in. They pop back out and spy another hole made by the minkes farther on. Again they rush over, inspect the hole, and plunge in.

Most likely the whales are feeding on krill, and the Adélies are probably tagging along to exploit the ready-made fishing holes. Penguins, seals, and birds such as snow petrels

also use natural cracks in the ice to feed and, in the case of minke whales, to breathe.

That the great, shifting expanses of ice around us, utterly devoid of soil and rooted plants, support any life at all—let alone in such profusion—seems impossible. André Belém, a graduate student from the University of Rio Grande in Brazil, offers me a dramatic insight when he shows me a test tube in which he has melted a small chunk of sea ice. "Look," he says in amazement. A thick yellowish sludge of algae floats in the bottom. "There's more life in there than in the water of an estuary."

Indeed algal concentrations in the sea ice are among the highest ever recorded in any ocean. As the ice grows, the crystals snag algae. Channels winding among the crystals bring seawater—and nutrients—to the algae, which lure krill and krill larvae to the bottom of the ice floes, where they graze like tiny cows.

ONE DAY during our last week I climb with Jim Cooper, the electronics technician, to the top of the science mast, 130 feet above the ice. As he rubs the frost off the satellite receivers and meteorological sensors, I look down at a quilt of ice floes spreading to the horizon under the clear blue sky. Smoky wisps curl up around the ship like genies—ice crystals forming as water vapor from the lead we're gliding through encounters the colder air.

This transfer of heat from water to air is expressive of a much grander redistribution triggered by the sea ice: the streaming of cold water from the Antarctic toward the Equator. As seawater around Antarctica freezes, it squeezes out cold, dense brine, some of which sinks to deeper water then moves north. It eventually mixes with warmer water, rises, and begins flowing back toward Antarctica.

Cold and remote, a pale moon rises from behind an iceberg in the Bellingshausen Sea near the end of the *Palmer*'s journey. Like ancient astronomers perusing the heavens or astronauts in space, scientists gain from every encounter with this icy realm, still so little understood.

One place where this warmer water comes to the surface is the Weddell Sea. On a *Palmer* expedition there two years ago, scientists measured the heat flow from a 38,000-square-mile area at 20 watts per square yard—enough energy during the austral winter to power every U.S. household more than 20 times over.

What disruptions would occur if a warming or cooling trend were to shrink or expand the winter sea ice? Presumably ocean currents would shift, perhaps causing drastic shifts in climate. The *Palmer*'s next two winter voyages will look into such questions.

Our last working day, Julian day 254—Monday, September 11—is typically dreary and windy. After watching the crew hoist the gangway for the last time, I stroll to the stern deck and stare at the ice around me as the *Palmer*'s engines rumble to life.

I have grown to love this cold, strange place with an intensity that I could never have anticipated. Such a reaction may seem odd to those who have never heard the sigh of ice floes jostling on the swells or watched the vapors curling up out of a lead or felt the knife blade of an Antarctic gale. Alighting here briefly, like a bird of passage, I have come to see this transient frontier not as a harsh place but as a living creature that nurtures a multitude of other lives. Yet no humans can ever live here. We can't conquer it, settle it, even own it. The winter ice belongs only to itself. □

California Desert Lands

A Tribute to Sublime Desolation

By MICHAEL PARFIT
Photographs by PETER ESSICK

Gilded with moonlight, Joshua trees in full flower at the Mojave National Preserve stand as if petitioning the sky for rain. It rarely falls, though conservationists' prayers were answered in 1994—after 20 years of politicking—when Congress set aside millions of acres in southeastern California for parks and wilderness areas. They include such wonders as the 1.4-million-acre Mojave, with the largest Joshua tree forest on earth, and Eureka Sand Dunes (overleaf) in Death Valley National Park. Swept by fierce wind eddies, the sands rise 700 feet from the desert floor.

Until recently this desert
in the southeastern third
of the Golden State was
considered its wasteland.
. . . It was just the blazing
desolation you had to cross
to get from Los Angeles to
Las Vegas, the blank space
on the map that denies
Arizona the sea.

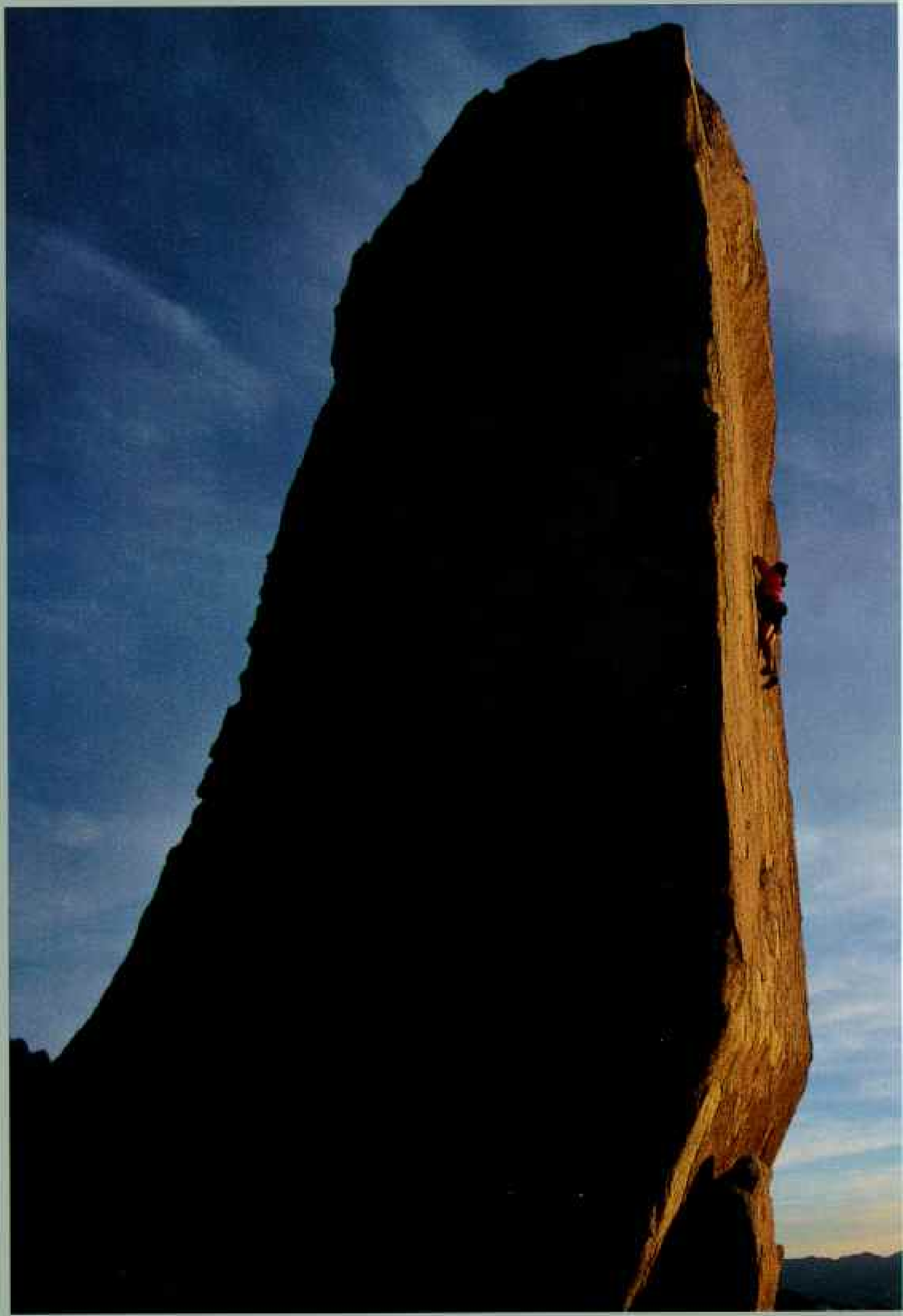
"Perhaps the desert is no more than a

Set against the grandeur of a landscape as sparsely populated as any in the country, traces of humans seem poignantly fleeting. Stone etchings (above) were carved by Mojave and Chemehuevi Indians, who traveled these harsh lands for millennia, leaving only unintelligible graffiti to serve as clues to their way of life. Though rock art may have some religious meaning, archaeologists believe petroglyphs like these, found at many sites in the Mojave Preserve, are also clan symbols marking territories, water, or trails.

magnifying lens," wrote a historian,
"something that enables man to write
large whatever he truly is."

Hot springs and campfire sparks add up to a mellow evening for weekend campers (above) visiting the Saline Valley section of Death Valley National Park, where facilities include nature's own hot tub (big enough for 20) and a ramshackle outhouse equipped with a seat belt.

The spirit around this desert campfire was as ephemeral as the stars winking back from a pitch-black sky. Roger Benge, playing the guitar, says what you sing here "is personal, about your feelings." One of those heartfelt lyrics, grafted onto a popular country music tune, starts: "Hot springs aren't easy to find, and they're harder to hold, . . ."



When you leave haste to
the truckers and get
down on the dirt and
the sand and the stone,
the desert is a place
of striking contrasts,
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and long silence.

With death-defiant bravado, climbers dubbed this slab of instant vertigo Headstone Rock—one of 4,000 routes in Joshua Tree National Park that draw climbers from around the world. For Dee Dee Kelly, halfway up the hundred-foot pinnacle, such an ascent is a "stress reliever."

Gen. George Patton's soldiers called it the place God forgot. Training for terrible work here in 1942, they went desperately thirsty; their skin blistered and cracked. They pretended to kill, and a few died; then they went away and won battles in North Africa.

But this place was never forgotten by God, only by California. Until recently this desert in the southeastern third of the Golden State was considered its wasteland: no endless beaches, no surf, no redwoods, no grand agriculture, no incandescent cities. It was just the blazing desolation you had to cross to get from Los Angeles to Las Vegas, the blank space on the map that denies Arizona the sea.

That's changed, dramatically. After two decades of work started by a small band of people who loved a land that others scorned, huge chunks of the California desert have been added to the systems of protection we use to honor our most precious landscapes. Two national monuments—Joshua Tree and Death Valley—have been upgraded to national parks. The 1.4-million-acre Mojave National Preserve, previously a Bureau of Land Management scenic area, has been added to the National Park System. And 69 new wilderness areas have been created. In one sweeping bill called the California Desert Protection Act of 1994, Congress tripled federal park and wilderness acreage in this part of the state to a grand total of 9.2 million acres—a patchwork almost as large as Massachusetts, Connecticut, and Rhode Island combined.

It was an extraordinary act, but the place itself is extraordinary. It is tedious only from the interstate, where it's hidden by its very vastness. When you leave haste to the truckers and get down on the dirt and the sand and the stone, the desert is a place of striking contrasts, of ruggedness, of delicacy, of big noise and long silence.

The best way to see the California desert is on dirt roads and trails, either in hiking boots or on something with four-wheel or four-hoof drive. So not long ago I threw my boots, a pack, a spare tire, a five-gallon gas can, and a six-gallon water jug into the back of an open Ford jeep made in 1941 and headed out across the desert.

The guys who put a big-block Chevy engine in my jeep also painted it the fluorescent green used by the Euclid heavy-equipment manufacturing company, so I christened the vehicle "Euclid." Its transmission rattled, and its muffler leaked glorious thunder, but the jeep was strong and good-hearted. Looking at

Off-limits to the off-road set, the land in the foreground, near Brawley, was designated wilderness by Congress, a move aimed at preserving natural ground cover, which dune buggies and other four-wheel drives have severely damaged across the road. The 1994 legislation included compromise on the issue of vehicles, but some drivers are still irked by all the regulation.

MICHAEL PARFIT, a frequent contributor to the magazine, lives in Montana and covers most of his outdoor assignments by small plane. He and southern California native PETER ESSICK also collaborated on the Special Edition on Water (November 1993).

Saving "wasteland" for posterity

Vast tracts of desert—9.2 million acres in all—were included in the California Desert Protection Act of 1994. It elevated Death Valley and Joshua Tree National Monuments to national park status, adding 1.3 million acres to Death Valley and 234,000 to Joshua Tree, and created the Mojave National Preserve and 69 new wilderness areas.

maps of sand washes and big rocks, I figured I would need all the heart it could give. As it turned out, the one who lost his heart to this extreme place was me.

THE PROTECTED LANDS run from the border of Mexico a full 350 air miles north. So I began in Brawley, California, down near the border. For the first 200 miles the land I crossed was virtually unoccupied by people. Only those who serve tourists live in Joshua Tree National Park. Until I reached the Mojave, I spent my time alone, getting to know the desert, which remains free of humans for good reason. Summer heat can melt roads and dry out a person in hours—the temperature has reached 134°F; 120° is routine. Water is scarce. The scenery is stark.

"It is stern, harsh, and at first repellent," wrote John C. Van Dyke, a university professor, librarian, and art critic, in 1901. Just before the turn of the century he drifted through these Southwest deserts with only a pony and a dog—for almost three years.

Van Dyke came to love the place. "But what tongue shall tell the majesty of it," he wrote, "the eternal strength of it, the poetry of its wide-spread chaos, the sublimity of its lonely desolation! And who shall paint the splendor of its light!"

Van Dyke's entire kit—rifle, food, bedroll, and homemade moccasins—weighed less than 50 pounds, and, best of all, his journey had no structure or itinerary. He set the standard for desert wanderers.

Everyone I met in the desert was an exaggeration of type: The

desert scientist, tall, lanky, amiable, distracted by his thoughts, delighted to plunge hip deep into salty muck with a small net, fascinated with brine shrimp. The rancher, grizzled, bowlegged, polite, and shy, who talked beside a shack on which were mounted a row of steer skulls. An elderly woman who ran a country store and post office—a place with all the paint windblasted off its boards—who spoke engagingly of cleaning up after wrecks on the road.

It was as if the splendid light and the sublime desolation silhouette people as well as land. "Perhaps the desert is no more than a magnifying lens," wrote a historian, "something that enables man to write large whatever he truly is."

Pull it out and destroy it! Those are the instructions given student volunteers (above left) who help control the spread of tamarisk trees in Joshua Tree National Park. Imported from the Mediterranean at the turn of the century for erosion control, the thirsty tamarisk thrives in the desert by stealing water from nearby native plants such as Engelmann's hedgehog cactus (above).

EUCLID roared northeast out of Brawley, but the jeep's assertive bawl was soon blown away by a mighty desert wind, and I learned something right away: This place isn't just wilderness because Congress said so. It's wild all on its own.

The desert was a wall of sand, blowing. It seethed. It hissed and sizzled, scoured at the jeep's flamboyant green and stung my face.

I drove out of the sand toward abrupt mountains. Built from below by the tearing apart of plates of the earth's crust and shaped by the rough caress of wind and water, the land here is made of row after row of solitary north-south mountain ranges arranged like the backs of grazing dinosaurs. The dinosaurs graze on salt: The rugged humps are divided by long gravel slopes leading to basins, some many miles wide, in which salt left by the evaporation of ancient lakes lies blazing back at the sun.

At a place called Milpitas Wash, I left blacktop and slowed on the dirt. It was as if all the colors of the desert took on a richer hue: the deep red-browns of the hard-packed gravel called desert pavement and the subtle gray-greens of mesquite and paloverde. Now that I was close enough to see them, flowers emerged like sun from a cloud: clusters of blue lupines, low patches of evening primroses, tall white desert lilies, the deep red tufts of Indian paintbrush.

I crossed wash after sandy wash, past a gray forest of smoke trees and a clump of ruins and wrecked trucks where people once scraped up desert gravel to sell as ornamental ground cover in cities, past exclamatory ocotillo bushes, which, in full flower, looked like bursts of spiny radiance shooting right up out of the earth, edged with spurts of dark red flame.

I camped on soft sand under a mesquite tree. In morning's splendid sunrise the old jeep raced up a pass and burped and clanked down the other side toward the Coxcombs, a new piece of Joshua Tree National Park that is wild and almost untraveled.

A few weeks earlier I had searched for desert tortoises near here with a small park research group. The tortoise is the most famous

A snow squall dusts cream-colored flowers on Joshua trees in the Mojave. Named for the Old Testament prophet who raised his arms to God, Joshua trees need eight to ten inches of precipitation a year, twice what

reaches the preserve's lower elevations. The trees grow only in the moister and cooler uplands; once or twice a year snowstorms soften this spiky world, then melt swiftly away.

of a variety of local wildlife—jackrabbits and kangaroo rats, burros and bighorn sheep, coyotes and bobcats, hawks and burrowing owls, beetles, tarantulas, and rattlesnakes—that you're not likely to see. Most of these creatures are nocturnal and shy, so watching for them requires patience and a good pair of binoculars. In the open desert, wildlife has to blend rather than hide. On several occasions I nearly stepped on lizards that had frozen in place as I approached. Each one lay as if dead until I almost crushed it, then dashed off in a puff of dust. But the tortoises were even more elusive. We didn't find a single one.

Slowness rewards the desert traveler. Not only do you get less heated if you slow down but you see more too. Park ecologist Jerry Freilich, who studies the tortoise, told me how he noticed all the action at ground level when he sat in the sand one day to check on his research equipment. "The ground was crawling with life!" he said. "All kinds of little dramas of the insect world. It's not just scenery; it's a living fabric of animals and plants and soils."

The tortoise may end up being what keeps that fabric alive. It's the California state reptile, it's on the endangered species list, and it's one of the reasons for all this protection. The grasses and shrubs it eats can be damaged by development or off-road vehicles, and many human activities, like dumping trash, attract one of the reptile's mortal enemies, the raven, which eats baby tortoises. The people of California—possibly embarrassed because the animal on the state flag, the grizzly bear, has vanished from the state—have rallied to save tortoise habitat. There were many other reasons to protect this landscape—rare dune grasses, burrowing owls, and desert bighorn sheep—but the role the tortoise played in the politics of the protection act was so important that someone hauled a tortoise all the way from California to sit on President Bill Clinton's desk as he signed the act.

"It's an umbrella species," Freilich told me. "In my heart of hearts I don't know if it deserves endangered status or not. That's what I'm working to find out. Meanwhile, so many other species are going to benefit from the protection it gains."

I ended up seeing more tortoises in the desert than any other animals except cows and burros. Once, in a period of 15 minutes, I saw three tortoises rambling down a road. As I approached, each of the first two tortoises closed up shop and became an intricately plated rock, but the third continued on its way, its long neck twisting this way and that, picking up its feet in a curiously quick and fastidious way, as if it didn't like getting sand between its toes.

A lonely strip of dust transects the Mojave Preserve, gliding over gullies carved by runoff from hard winter rains. Broad and smooth, this "highway" is about as good as roads get in a land of shifting sand and flash floods. Backcountry tracks are notorious for wrecking tires, mufflers, headlights, radiators, and patience.

"Take along spares of everything," author Parfit suggests, "including an extra car."

A JET BLASTED OVERHEAD: gray thunder on the fly. The California desert sky is used by the armed forces for aerial practice, and though the jets are restricted to a certain distance above parklands, that doesn't mute them much. They sound like the concentrated fury of all the beasts of war. Yet they seemed to fit this rough and wild place. And when I met a few of the pilots from the Naval Weapons Test Squadron, sure enough, they were top guns: sharp young guys, quarterbacks and linebackers from prairie towns of 5,000, doing something very exciting that they were sure was good and right. I loved their jargon. "Roger that," they'd say. "Let's bingo on outta here."

Under sporadic cover of F-18s, I bingoed on up to the Mojave

Preserve, past yet another salt lake, another range of mountains newly wrapped in official wilderness designation, and a sidewinder on the road.

It was oddly curled on the sand. It didn't move even for Euclid's roar. I stopped. It arched away a few feet, leaving characteristic S tracks. I saw what had kept it moored: It had been wrapped tightly around the dead body of another sidewinder. I always thought it only myth that rattlesnakes came back to dead mates. Maybe not.

Hard landscape, bad roads. Now the jeep's battery started only about one try of three. I parked on a hill and climbed high into the Granite Mountains, crossing most of the ecosystems of the Mojave Preserve—creosote bush to Joshua tree forest and eventually to an aerie at almost 6,000 feet, rimmed with golden rock, where I dozed in cool sunlight, awash in the aroma of piñons.

Driving up a straight road toward a wall of convoluted gray stone called the Old Dad Mountains, I saw in the distance what looked like a layer of brown stratus clouds floating against somber foothills—560-foot-high Kelso Dunes.

Photographer Peter Essick and I hiked up into Kelso Dunes at sunset, just after a spring storm. Light, wind, clouds, and moisture madly painted a scene full of color and movement. As always, the desert exaggerated. "The reds are all scarlet," wrote Van Dyke, familiar with this flamboyance, "the yellows are like burnished brass, the oranges like shining gold." The sky thrashed about with its great brush of wind, creating impossible delicacy in mere moments, then tearing the canvas and flinging it over its shoulder and painting again. I sat on the dune like a kid on a beach,

staring at the raging beauty. There was only the sound of a distant train, the camera's urgent click-click-click, and Peter's breath growing ever shorter as he rushed around: artist chasing artist across sand and sky.

MOJAVE IS DIFFERENT from the other parks, not just because you can hunt there. In Mojave a few people still live on the land: ranchers, miners, striking individualists like Dennis Casebier. Casebier is the Mojave's unofficial historian, a former military physicist who lives far back in the east Mojave. I came rattling into his place under a sign that said "Study the Past" and rang a huge bell to get his attention.

Casebier is known for his vigorous opposition to the transfer of the Mojave to the Park Service. (He's not alone. Congress recently passed a bill—so far stopped by presidential veto—that would return all funding for the Mojave Preserve to the Bureau of Land Management.) The new preserve superintendent told me that people who live here will not be forced to leave, but when I asked Casebier about that, he smiled cynically. "Does a robin lay blue eggs?" he asked, not giving me a chance to answer. He thinks the

Toting a ranch-size wrench, Howard Blair maintains some 60 miles of pipe that bring water from springs and wells to cattle on his 400,000 leased acres in the Mojave. Even so, grazing cattle may have to walk miles to the nearest trough for water—an adaptation not all can make. A cow not bred to this life, Blair says, will produce "a little bitty hair ball of a calf."

pressure of new regulations on mining or ranching or road use will gradually push people out.

Like everyone in the desert, Casebier seemed larger than life. The exaggerated quality in him I truly admired was his sense of history and the extraordinary way he honored it. On the walls of his library were more than 500 bound volumes, oral history interviews he has conducted with many of the people who live here or did once. And when we got away from politics and talked of the past, all cynicism was gone. He spoke of the days of Indians, miners, cattlemen, of those who worked the railroads when there was a small town every 20 miles, and those who worked Route 66 when there was a mom-and-pop service station almost as often. He spoke of the Depression, when a lot of people came here from cities because "it was better to be on the desert eating jackrabbits and beans and scratching at the rocks." He talked about a man he'd interviewed who had been a three-pound preemie back in 1901. How had they taken care of such a fragile life back then? The tiny boy had been wrapped in towels and put in a pan on the back of the wood-burning stove.

Casebier looked up at his wall of interviews. Behind those plain covers were homesteaders, ranchers, housewives, a desert dweller who owned 50 dogs, a scientist doing a thesis on sidewinders.

"I loved these people," he said. "And now they're gone."

The inevitable tide of human change—economics, age, death, opportunities elsewhere—had moved these people, not the new preserve.

Yet those who once lived here haven't forgotten this place, as I would soon find out. I left Casebier to his remarkable work and drove mile after mile on the old track known as the Mojave Road, used for more than a century. Opposite Pinto Mountain I stopped at a clump of old cottonwood trees around two stock tanks. This was a historic site called Government Holes, but history was more alive here than I expected. A pickup was parked in the shade, and a man stood beside the trees. I left my jeep poised on a slope and went to talk to Glenn DeVoge, 70, a retired railroad worker. He had lived here 60 years before and had returned, as he does regularly, just to see the place.

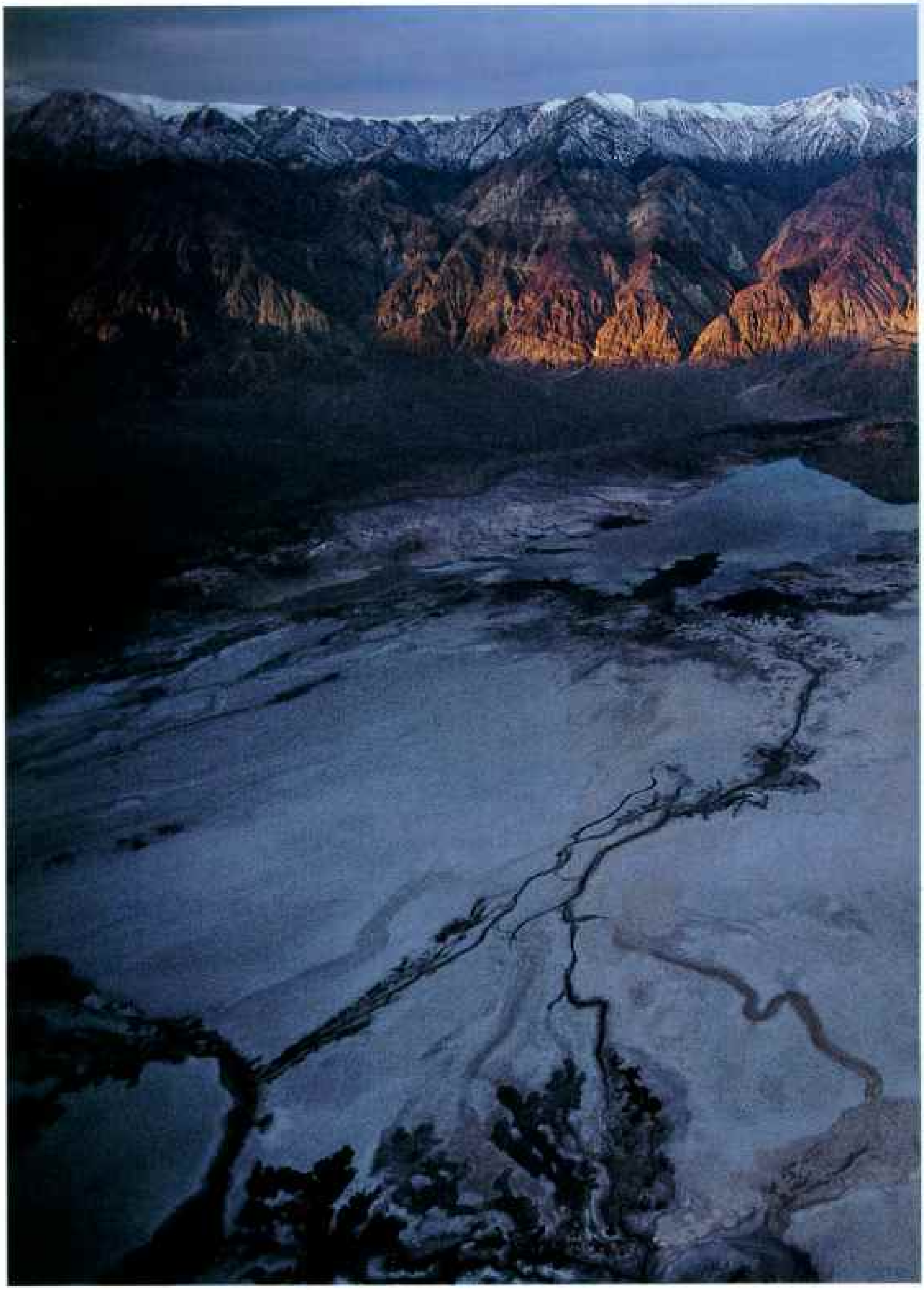
"The house was right there," he said. "Was two men shot in it before we lived in it." He didn't seem lonely for the past, just friendly with it. "Me 'n' Fred Marshall—he was an Indian—used to swim in that tank, 'til we got caught."

His mother was in the pickup. She was 90 but not frail.

"My husband ran a horse through my clothesline over there," she said, pointing at an empty space. "I chased him with the ax."

"Same old trees," said Glenn, watching them bend in the dry wind.

The stock tanks, the small house, the children roaming the desert, the young housewife with a clothesline and an ax. This way of life is just about gone from America. I thought of Casebier's wall of stories about this desert when it was home. You can try to protect a piece of land, as the desert act does, from being overrun by development, from being torn up by off-road vehicles, from the ravages of irresponsible mining or ranching, but you can't save a human way of life no matter what you do. It doesn't keep under glass. No wonder Casebier is rushing to record it—some of it evaporating on



Paved with salt, the aptly named Saline Valley is so hemmed in by mountains that snowmelt, with no escape, collects in the basin and evaporates. By summer it's gone, leaving a residue of salt.

Beyond the flats, canyon trails in the snowcapped Inyo Mountains are so steep that they're dangerous to hike without ropes: Some climb 10,000 feet in only four horizontal miles.

its own and some of it, as Casebier believes, killed by rules or policies that are the by-products of our haste to protect other things.

"It seems like everybody who loves the desert sees it change and doesn't like it," Casebier had said. "So that becomes our lot."

THERE ARE STILL A FEW GRAVES in Death Valley National Park. They're about all that's left of the old ways—the graves and some borax carts and a hokey picture of an old prospector on the wall of a café in Stovepipe Wells. But there's something almost forgotten and nearly finished that is hidden in one of the new pieces of this park—a very strange chunk of land called the Saline Valley.

Euclid worked hard and suffered hard on the 40-mile dirt road that led into the park. At one bad wash crossing there was a sign: "Road Damaged." Under it someone had scrawled "No kidding!" By the time we climbed the wall of rock at the edge of the Saline Valley, the old jeep seemed beat-up and weary—or maybe that was me.

I had driven up out of Panamint Springs, through a savanna of Joshua trees that looked as if it ought to have giraffes in it, past an array of bullet-battered signs—"Warning: No Fuel or Services"—and up a serpentine sidehill road. Finally I looked over a lip of rock into this extreme valley.

Most valleys are long and gentle; water comes in, a river goes out. But the Saline Valley is a deep place completely surrounded by mountains, a pit with a floor of salt. Weird. It's a bowl of white fire, it's the cupped hand of a dragon, its walls are weathered stone

claws. Its floor is a thousand feet above sea level, its edges go to more than 10,000. There's no natural way in, no easy way out.

A small band of people live here—or did. Many of them are leaving. They live according to the old rules of the desert: no rules at all. Most hang out in a few rustic campgrounds by hot springs in the northeast side of the valley. They call themselves just by first names and a description: Mammoth Bob, Lizard Lee, Bird Bob, Major Tom, Miner Tom, Chili Bob. They don't own land here; they camp for months, years at a time. Many of them go naked all the time; a Park Service sign at the edge of a camp says "Clothing Optional." They have fun just living: There's a seat belt in the outhouse.

"Clothing Optional" boasts a sign at a Saline Valley campground entrance. For part-time resident Harry Webb, here playing with his dog while friends from Germany soak in a spring-fed pond, this means clothing never—at least when the weather's warm. Webb doesn't mind noise from the Navy jets (above) that train overhead, but he has a warning for those who think this place is benign: "Don't mess with the desert," he says. "It's a hot, cold, and hard place." He smiles: "I love it."

Chili Bob, who was named after a memorable pot of chili he once made for his friends, lives in a trailer near some old thirsty tamarisk trees. He's been in the Saline Valley since 1980. He is skinny and burned dark by sun. His home is surrounded by old wire, bags of beer cans, a refrigerator or two, lumber, a surfboard. "These people lay in a lot of supplies," Dennis Casebier had said. "To a person from San Francisco it might look like an eyesore. But people who suffer from self-reliance aren't necessarily defective."

Chili Bob may not be the ultimate desert rat, but he's probably one of the last. He sat on his steps with a beer. He had a disability pension. How much did he live on? I asked.

"If you don't count the beer and wine? Just food and propane?" he asked. He rolled a cigarette. "Less'n a hundred a month." A big black dog, Jude, with a bandanna around her neck, lay in the shade.

"You could say they didn't fit in society well," Casebier had said about the same kinds of folks in his neighborhood. "Or you could say they wouldn't tolerate it. They'd say that you guys are the ones who are all screwed up for submitting to it."

I asked Chili Bob about changes that will come because of the valley's inclusion in the park. The first signs of the park's presence have been a dog-leash law, a requirement that trailers be moved off public land, and, most critical, a 30-day-per-year limit on camping. Though Chili Bob is one of the few people in the community who live on private land, he will be affected by anything that happens to his friends.

"The new park ranger's name is David," Chili Bob said. "He wants to be known as Big D." He spoke scornfully. In this desert your name chooses you, not the other way around. Chili Bob was waiting to see how the ranger would enforce the new rules. "We don't know when D day is going to be," he said.

He smoked. "When I first came out here," Chili Bob said, "you customized yourself to the desert. Now they customize the desert

At one bad wash crossing there
was a sign: "Road Damaged." Under it
someone had scrawled "No kidding!"

Chewed up with bullet holes, a road sign reading who knows what welcomes you to the land of scorched earth—a bleak expanse of Death Valley National Park. Once nobody cared if you shot up signs here or got lost in a stony canyon. This was a wasteland. The California Desert Protection Act confirms that such places have value. The solitude they offer is sublime—and ever more precious as humans crowd into cities far from these empty skies.

to the people." A Navy jet came by. It was very strange. You couldn't see the jet, but the sound moved down the valley—a tearing, a scratching, then a long, low rumble: the dragon breathing up in a canyon.

"IT'S THE FIRST TIME IN MY LIFE I've been without regimentation," said Harry Webb, better known as Touch-and-Go Harry. He's been living on and off in the Saline Valley almost as long as Chili Bob: 14 years. I talked to Harry one day while he watered a small lawn beside a hot-spring tub. He wore a straw hat and running shoes; that's all. "It seems like I'm really a free American here. It's a happy thing for me."

But it had started to change. Harry shrugged. "Now I've got my dog on a leash," he said, "so regimentation is starting again."

I asked a Park Service spokeswoman if the coming of the park would change the unique qualities of the place. "The Saline Valley is a sensitive issue. We don't want to ruin it," she said, sliding off the question. Yet the kind of freedom Harry and Chili Bob had is as fragile as dune grass or tortoise habitat. Like wolves, wild human beings require independence and solitude—which a park, with its rules and its floods of tourists, cannot maintain. Harry knew change was inevitable. When someone complained that I would call attention to the valley by writing about it, Harry shook his head.

"Hell," he said. "It belongs to the people. Give 'em a map." He strolled around the little oasis, pouring warm water on shaded grass. "Nothing as nice as this spring ever happened to me," he said. "It's been a good 14 years."

I drove out of the Saline Valley in pitch dark. The road got worse. No kidding! Saline Valley's new park status may attract more tourists, but they'd better be ready for broken axles. Old Euclid began to come apart. The brake pedal hit an electric wire—shower of sparks. Fixed that. Smell of gas—fuel line leaking. Fixed that. Rain began; no windshield wipers. Used a hand squeegee. Another shower of sparks—battery cable rubbing against metal seat. Fixed that. Sudden tremendous noise—I thought it was a jet. It wasn't. A rock had broken a hole in the exhaust pipe.

Couldn't fix that. I shut the engine down. I got out and looked for the desert and listened. The darkness was full of rock; the silence was sand and salt. Even hiding in the shadow of the earth, the desert was too big to describe. "I can tell you something of what I have seen," John Van Dyke wrote, "but I shall never be able to tell you the grandeur of these mountains, nor the glory of color that wraps the burning sands at their feet. We shoot arrows at the sun in vain; yet still we shoot."

I knew how he felt. I put in earplugs to muffle the noise of the broken pipe and drove on and on. In the rain the air smelled of sagebrush. About midnight a shining, ghostly thing emerged from the darkness. It was a road sign. It marked the edge of the park, the end of the wild desert where Euclid and I had traveled for so many good miles.

I got out and fixed the brake lights, both broken by the road. But that was just an excuse to tarry. Finally I pushed the jeep down a little hill, started it up with a roar, and left the sign, and a piece of my heart, behind in the desert. □

BY RICHARD CONNIFF

PHOTOGRAPHS BY JODI COBB
NATIONAL GEOGRAPHIC PHOTOGRAPHER

MONACO

IT WAS THE FIRST DAY of the Grand Prix, and just outside the Hôtel de Paris the needle-nosed Formula 1 race cars roared through the winding streets of Monaco. They whined. They spat fire. Each time a car blew by, the capillaries in my brain stood on end, did a frantic boogaloo, and fell back in a heap. The cars hurled past the belle époque buildings at the Place du Casino. Bronze angels and nude limestone voluptuaries, being deaf already, looked down in delight.

I slipped back into the calm of the hotel, and my eye locked on a diamond the size of a strawberry. It was on the hand of my new friend, a countess who lives in a suite at the hotel. I told her I was in need of *bouchons pour les oreilles,* literally "corks for the ears," and asked how she was enduring the races. She

Evening dress in Europe's poshest principality can be formal at a palace Philharmonic concert or "beach" at a disco theme party. But style—from discreet ostentation to flashy glitz to corporate pinstripes—is ever on display.

beamed. "I *love* the noise! You can feel how these men are wonderful."

In Monaco no one does anything by half measures. It is a tiny, intensely developed Mediterranean nation dedicated to the principle of fabulous excess. Monaco is where the rich, the famous, the nouveaux riches, and the infamous all come to shelter their wealth from taxes and show it off for one another.

The countess, for example, was wearing the ring, three long strands of pearls, a gold bracelet of elephants joined trunk-to-tail, diamond earrings, a brooch, and a large gold pin holding her broad-brimmed hat in place. She was smoking a cigarette taken from a gold case. Her first husband collected Impressionists, she said, but her own tastes are simple: "I like jewels." She stays at the Hôtel de Paris partly for the refractive possibilities of the light flooding in through the lobby windows. "I want people to see my jewels," she said. She was as happy as a child. "I like them to gleam."

This is how it's meant to be in Monaco, where everything that glitters is, if not gold, probably diamonds. "Does he still have the Jaguar with the matching dog?" I heard a woman inquire one day. "It was a Morgan," her friend replied. "Cream colored."

I asked one of them to teach me some French, and the phrase that came dancing gladly to her lips was "*Il a du fric*—He's loaded." I, on the other hand, couldn't even open a savings account. Three different banks gently advised me that they had a $100,000 minimum.

"NATIONAL GEOGRAPHIC?" a British banker asked me one morning. "Why aren't you in Papua New Guinea?" I started to lay out my idea that every nation has its own anthropology and that the native customs of Monaco are at least as exotic as those of any other hill tribe. The banker latched onto this idea instantly. "I go to this nightclub called Jimmy'z, and it's like a ritual. Every night they play the same songs, and the same girls jump up and. . . ." But he was leaping ahead of my story. To explain any natural hierarchy, it is necessary first to lay out the habitat.

THE PRINCIPALITY OF MONACO is a 2.5-mile-long strip held snug against the Mediterranean by the steep, cup shape of the Maritime Alps. At its widest point, it stretches little more than a half mile from the sea.

Foreigners make up more than 80 percent of Monaco's official population of 30,000. They flock to establish residence here because it has neither income nor inheritance taxes. So the pressure on real estate is intense. The buildings rise from below the waterline, up the faces of cliffs and over every

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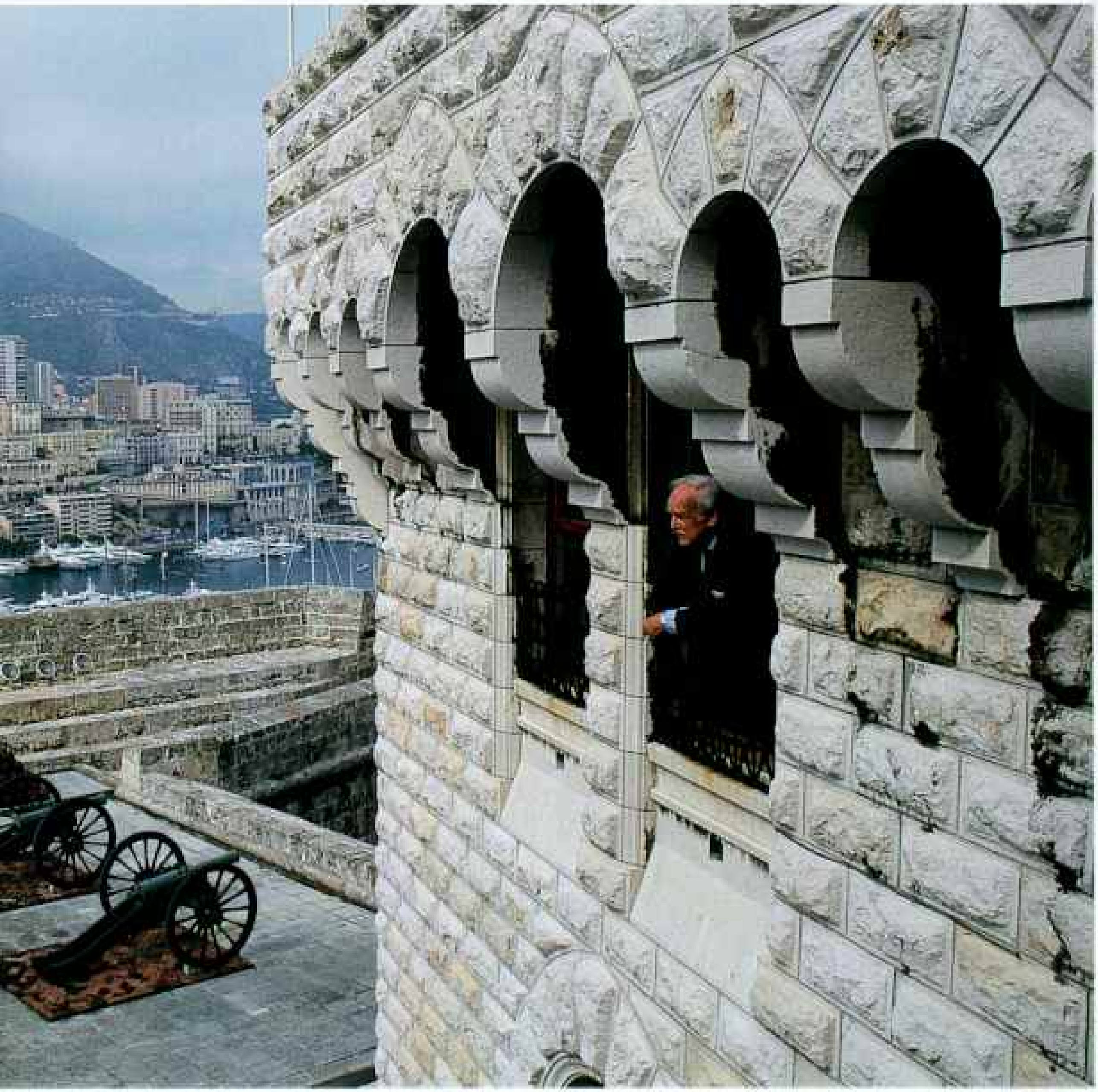
Writer RICHARD CONNIFF, a frequent contributor, lives in Connecticut.

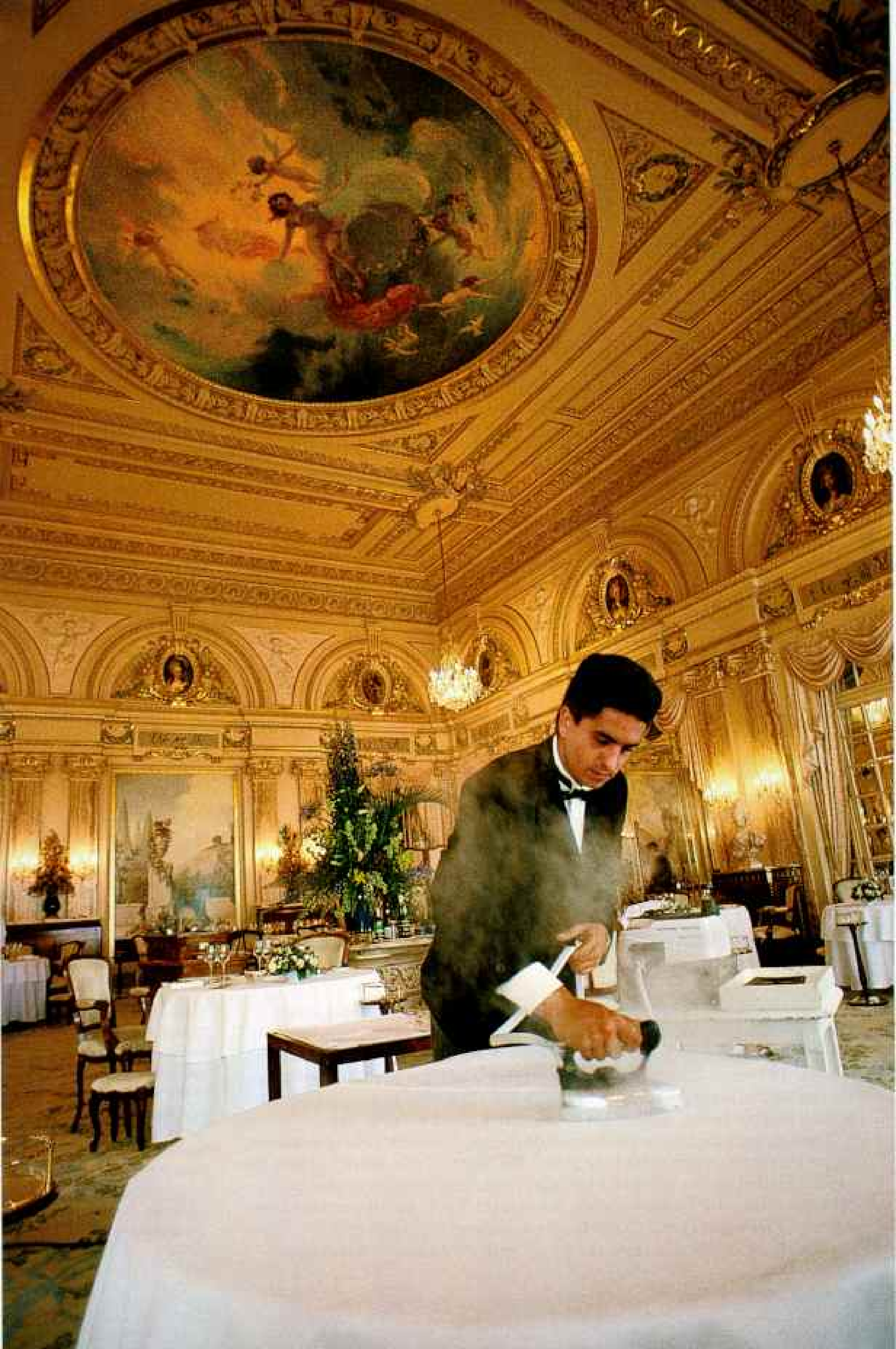


remotely buildable swale and saddle of land. There is so little open space that new buildings have their lawns on the roof. Construction cranes pivot overhead, supplanting ornate 19th-century villas with concrete apartment towers. The result is an odd architectural mix: From the port Monaco resembles an amphitheater, and the sold-out crowd consists of seven-foot-tall basketball players dating demure old ladies with Chanel evening bags.

The box seats high up at the corners of the amphitheater belong to Monaco's elite. On the north side of the port is the Monte Carlo district, where the casino, lighted up at night like a birthday cake, first brought wealth to Monaco in the 19th century. On the south is the Rock, an Alpine ridge from which the palace of the Grimaldi family dominates the landscape.

Everything in Monaco begins and ends with the palace. It is a natural

The builder prince, Rainier III surveys his realm from his palace tower. Symbol of the world's oldest reigning dynasty, begun in 1297, Rainier has reclaimed land from the sea and brought nonpolluting industries to expand the economy.



In Monaco no one does anything by half measures.

It is a tiny, intensely developed Mediterranean nation dedicated to the principle of fabulous excess.

cliff-top fortress. The Grimaldis, originally from Genoa, first got inside when a 13th-century forebear posed as a Franciscan monk, then slaughtered the guards who opened the gates to give him alms. The family shield still features sword-bearing Franciscans over the motto "*Deo Juvante*—With the Help of God."

"We've been here 700 years, the Grimaldis have," said Prince Rainier III, when we met one afternoon at the palace. "So it must have been a good system for it to have survived so long." He was talking about the strength and continuity of monarchy, an important topic for him now as the time draws near for the next generation to assume power.

Rainier, who has been sovereign since 1949, is a grandfatherly figure, shy, with soft blue eyes. He spoke with a formal British accent, one thumb against his temple, his fingertips stroking his brow pensively, a bit like the elderly Citizen Kane. He is best known for his marriage to the American actress Grace Kelly, who is still revered in Monaco 14 years after her death in a car crash. Their marriage and every indiscretion of their children, Caroline, Albert, and Stephanie, have been chronicled endlessly in *People* and *Paris Match*. Meanwhile, relatively unnoticed, Prince Rainier himself has gone about his business more like an entrepreneur than a monarch, shrewdly and sometimes ruthlessly reshaping the family business that is Monaco.

"I've always tried," he told me, "to get away from the image of not being taken seriously—'Oh, it's a fun place, a gambling joint.' And we have gotten away from that, by attracting various industries."

This is a message that gets delivered over and over. Gambling contributes only about 5 percent of government revenue—down from almost half when Rainier took power. Tourism still brings in substantial revenue from a value-added tax on hotel rooms and $985 Louis Vuitton dog carriers. But Monaco has also become a manufacturing and financial center. The playground for the rich is now the unlikeliest industrial enclave in postindustrial Europe.

Jean-Pierre Campana, director of commerce and industry, is a zealous proponent of this change. In mid-interview, he pulled out a small windup device from his desk. It was a shaver, he said, designed for the U.S. Skylab program of the early 1970s. "It was made in Monaco. Still works," he added, sending it whirring under his chin.

Monaco now employs a workforce equal to its total population, a remarkable achievement anywhere. But it's almost miraculous considering that for many of Monaco's residents work is a vague abstraction, somewhere out there with astrophysics. The workforce, Campana said, generally commutes from France and Italy, bound for factories making automotive parts, pharmaceuticals, and other goods.

"Where do you hide these factories?" I asked, not having noticed any.

Campana swiveled around, opened the blinds, and pointed to the buildings across the street, which I had mistaken for apartments: "There," he said. "And there. And there." The factories were tucked away all around the Fontvieille neighborhood, on the southern side of the Rock. Beyond the waterfront apartments and the harbor chockablock with yachts, Fontvieille

The most minute of wrinkles are banished from tables at the Louis XV restaurant, opened in 1864 to sustain royalty and millionaires who flocked to the adjacent Casino de Monte-Carlo. Happily ever after, high-stakes excitement and exclusivity have drawn the wealthy to Monaco—also a haven from taxes and, recently, crime.

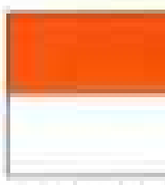
was an incognito industrial district. One glassy building nearby housed an electronics plant employing 600 workers, a subbasement sewage-treatment plant, and, at street level, a little restaurant called the Patio—all fitted together as snugly as pieces in a three-dimensional puzzle.

"Monaco is paradise for an engineer," said René Bouchet, whose job is to make it all fit and, when it doesn't, to steal new land from the sea or the mountains. Fontvieille, for instance, didn't exist before 1972. It is the centerpiece of a jetty-and-landfill campaign with which Prince Rainier has enlarged his national territory by one-eighth. Among other projects, Bouchet is now planning Fontvieille 2, with tile-roofed apartment houses standing on pylons like offshore oil platforms. It will cost 1.5 billion dollars.

As we headed out for a drive in Bouchet's car, tourists were ambling in a park across the street. "Those people don't know it," he said, "but they're walking on the roof of the jail. It's underground, built into the face of the cliff," not a dungeon, of course, but a modern jail suitable for that national menace, the parking-ticket scofflaw.

We took one of the roads that tunnel into the mountain, then, halfway through, made a sharp turn and descended beneath the foundations of the city. At the bottom a big reptilian machine on tractor treads was quietly nosing out one end of a new tunnel. "We have to do a lot of different work without people being able to hear the noise," Bouchet said. "Because people are paying crazy rents here not to be disturbed." The crazy rents are also the force that drives the work: The purpose of this tunnel is to relocate 1.7 miles of unsightly railroad line, freeing up ten acres of land—at the cost of 25 million dollars an acre. Bouchet surveyed the tunnel by the dust-filtered light of the fluorescent bulbs mounted on the walls. "The unseen Monaco," he said.

MONACO



AREA: 0.76 sq mi. **POPULATION:** 30,000 (5,000 citizens, 1990). **LAND USE:** Urban 100%. **ETHNIC MAKEUP:** French 47%, Monegasque 16%, Italian 16%, other 21%. **LANGUAGE:** French (official), Italian, English, Monegasque. **RELIGION:** Roman Catholic 95%. **ECONOMY:** Tourism, light industry, banking.

The world's second smallest state, after Vatican City, Monaco maintains independence as a constitutional monarchy through a treaty with France.

BUT NO ONE GOES TO MONACO to be among the unseen. So I adjourned that night to a bar called Sass Café, where I promptly ran into the British banker, who had been contemplating the anthropology all around him: "Here you have the tribal mating ritual. Everyone out on display. Lots of plumage. Lots of cross-fertilization."

"You sound like David Attenborough," I said.

His hands, up at his sides, dropped open like trapdoors, to indicate the brightly clad woman on the next barstool. "And here," he said, in a hushed natural history presenter's voice, "is the black-and-white-striped, red-collared bar duck."

The buildings rise . . . up the faces of cliffs and over every remotely buildable swale and saddle of land. There is so little open space that new buildings have their lawns on the roof.

In the mirror opposite I noticed a sleek man with a mustache preened out past the corners of his mouth. He was in profile, like a character in a Toulouse-Lautrec painting. He held up his gold lighter and, loving every gesture, stroked the flame around the tip of a fat cigar, then moved about the bar greeting his many acquaintances. Everyone was rich and beautiful. I had made my perilous descent into the underworld and was safely back in the glittering *über*world of trophy wives and international arms dealers.

The banker sipped his drink and had second thoughts. "We're all the same beast, with or without the Cartier," he said. "You can mess around with the signs and symbols, but it all comes down to the same thing as the monkey's red arse, which is, 'Pay attention to me.' "

But he was being disingenuous. The signs and symbols are everything in Monaco, and the opportunity to flaunt what you've got is almost a constitutional right. Monaco goes to extraordinary lengths to ensure that it remains the one place on earth where a woman can not only wear her best diamonds but also safely wander home with them at 4 a.m.—or leave them on the seat of the Bentley, with the keys in the ignition and the engine on, and find everything there in the morning.

There is, in truth, no such thing as unseen Monaco. One day at police headquarters I watched two officers in front of a tall bank of color television monitors. Every ten seconds each screen displayed a new view of Monaco from one of the 81 police surveillance cameras positioned around town. The police in their white peaked caps are also everywhere on the streets, politely saluting members of the public and inquiring into the business of anyone who doesn't fit in.

What the 350 police on the street don't know, they can usually find out via radio from the 150 back at headquarters. "If we had a robbery and an hour later we arrested the robbers," the director of police said, "I wouldn't be congratulated. I'd be asked how it happened in the first place."

Reflected glory of the casino's belle époque facade joins the neighboring Hôtel de Paris, a member of first rank among *grande dame* hotels. "You enter the legend," says a devotee, at a hotel that has been host to the famous from Caruso to Madonna.

OF ALL THE THINGS THAT GLITTER HERE, none gets polished with greater care than the reputation of Monaco itself, the idea being to foster a sense of total security. I began to notice that when people drove across the invisible border into France, they locked their doors. When they crossed back, they unfastened their seat belts. It was as if nothing bad could ever happen within the magic boundaries of the principality.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Up and out of the race goes a Formula 1 car disabled in the Monaco Grand Prix, whose course usurps city streets. Standby cranes wait for trouble—typically efficient for a city-state that insists on events running smoothly, though not quietly. "The noise is tremendous," says a resident. "The whole principality is eating and drinking Formula 1. We're crazy about it. It's a very Latin thing."

The other side of this bargain is that when something bad does happen, no one talks about it. Perfection is almost mandatory, so along with all the messiness of human life elsewhere, Monaco also shuts out public dissent. "Here you can speak your mind, if you don't use your name," one man joked. "But if you write that, it will cause the Third World War. A lot of very good people have been chased from here because of some small stupidity. This is a country, not a city. The prince is the head of state, so everybody is very careful not to do something that would offend him."

People are also closemouthed because their residence in Monaco is often a legal fiction. They keep an apartment for tax purposes but actually live elsewhere. Monaco requires that people who hold residence cards spend six months of the year there, and asks them to prove it at renewal time by presenting their lease and recent utility bills. But even Prince Rainier acknowledged that some people simply pay the concierge to run up the phone bill or turn on the lights.

One evening at dusk a full golden moon rose over the Mediterranean. A mile or so out a three-masted yacht drifted along, its white sails picking up the color of the moon. The clouds were night blue on their undersides. Floodlights lit up the elaborate arches and balconies of the Casino de Monte-Carlo and the opera house, and when a seagull flew over, its belly was momentarily a burnished gold. Everything was quiet. I looked up at a 21-story building nearby and counted just six apartments in use on the ocean side; all the others had their metal shutters rolled firmly down. It was one of those nights when Monaco feels like a ghost town for the rich.

A real estate agent later explained to me that investors often buy up apartments and leave them vacant on the theory that real estate in a fashionable tax haven is a sure bet. A decent one-bedroom apartment starts at $600,000. She also showed me an empty apartment renting for more than $20,000 a month. It had pink marble floors, pink silk wall coverings, and a burled walnut door with a steel core, that little extra measure of security for people who have lived elsewhere with the fear of being kidnapped. When she turned the key in the lock, six dead bolts sprang out on the latch side, six on the hinge side, and one up top. "You are inside the safe," she said.

With an eye for finer things, a U.S. couple shops on a yacht during the annual "Show Boats International" gathering of private luxury vessels. Tightly policed, Monaco is a place where "I could walk home naked and not be bothered," asserts one well-to-do lady.

But the empty apartments may also be symptomatic of Monaco's unspoken problems. One day I wandered into a shop and struck up a conversation with a customer. "People have left because they don't like the quality of life here," he said. "That's why you see so many empty apartments around. It used to be a community of residents. Now it's more a community where people come to work, an industrial town." He stopped and made the usual cautionary remark. "Don't put my name on this, or I'll get thrown out of the country." Then he went on talking. "The music of Monaco is the jackhammer. They can't stop knocking down the nice buildings and putting up the ugly ones. They think Monaco is special, but they don't notice that it's disappearing.

I had made my perilous descent into the underworld and was safely back in the glittering *über*world of trophy wives and international arms dealers.

"Why do we have to have industry?" he asked. "Why do we have to have more apartments? What are we trying to become, another Nice or Genoa? What's the ultimate purpose? To make more money? For what?"

I PUT SOME OF THESE QUESTIONS to Prince Albert, who will succeed his father and determine what Monaco is to become. On the surface the two men are dramatically different. Prince Rainier is steeped in European tradition and keeps an engraving on the wall outside his door depicting the last royal victims of the French Revolution. Just upstairs, his son's vestibule features a framed certificate that Albert Grimaldi once visited some "dad-burned" western cow town and a photo of Albert throwing a football.

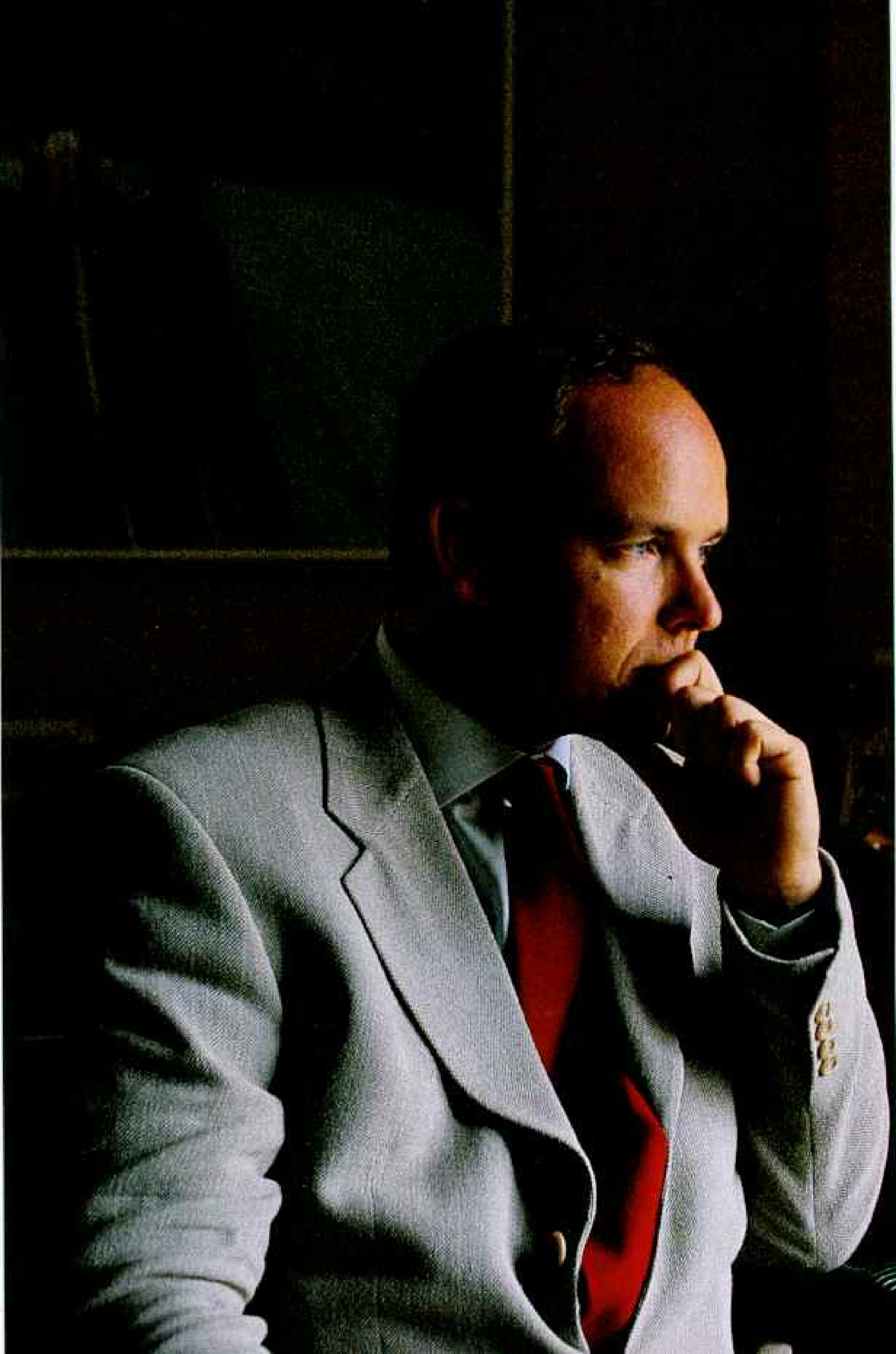
Having spent childhood summers and his college years in the U.S., Albert is an Americanized prince. He visits the U.S. regularly to represent Monaco's interests, to serve on the International Olympic Committee, and to run cattle with pals in the Texas hills. The best-known business that he has encouraged in Monaco is a saloon called Stars 'N' Bars, which features "U Peel 'em Shrimp" and a band that jumps up on the bar when it plays "Born to Be Wild." At 38, Albert is tall and thin, with a domey, balding forehead. His round, tortoise-shell eyeglasses suggest a certain Clark Kent awkwardness. Journalists make him uncomfortable, and he squirmed and fidgeted in his seat all through our interview.

The standard line on Prince Albert is that he is having too much fun to settle down—or to rule. If he were free, he admitted, he would be a teacher or a coach; his happiest work experience was as a counselor at a camp in New Hampshire. But he is obliged to become the sovereign prince.

"Yeah, I have to," he said, one foot rocking on its heel like a metronome. "But I care enough about the place to want to help its development, and when the time comes, I'll be there." I experienced a brief vision of a feudal principality ruled by a fun-loving, summer-camp-counselor manqué. But Albert suggested that the difference between father and son may be a matter of style more than of substance. His father has never acted in the traditional European manner, he said. "He had a vision that no one else here had."

I pushed him mildly, asking how he felt about the wall of undistinguished apartment buildings that has sprung up behind Monaco's only beach. "It's sad to see old buildings go, and there is a certain character that's disappeared

Grown-ups' toys pack the harbor during Grand Prix week, when prime slips cost $5,000 a day. The port has played a leading role in marine science through the Oceanographic Museum established by Albert I, Prince Rainier's great-grandfather.



A prince in high gear

Prince Albert will become the 32nd Grimaldi to rule Monaco. "When I was six or seven, I wanted to be a soldier or a cowboy," but now "I do 300 official meetings a year."

He has captained Monaco's Olympic bobsled team and practices starts on a dry track in summer. An enthusiast of the nightlife that drives the social whirl of Monaco's younger jet set, Albert goes onstage to sing with a band at a popular night spot, Stars 'N' Bars.

That name recalls a strong American connection created by the marriage in 1956 of Prince Rainier and Grace Kelly, one of Hollywood's leading ladies. Since Princess Grace's death in 1982, Albert's sister Caroline has filled her mother's role as patroness of arts and charities.

I spotted a demure Asian woman . . . hemmed in by four bodyguards. . . . sending over drinks to the locals, who buzzed furiously about whether . . . she was, as rumored, a princess.

in that area," Albert conceded. But he added, "It's very difficult to halt that kind of growth and real estate opportunity." The idea wasn't to become another Nice but to avoid being another Beaulieu, the little town down the coast "where nothing happens." He talked about plans for development as "our mission statement" and promised no drastic changes.

Monaco would continue on its idiosyncratic course, expanding, shrewdly adapting. If Monaco now sometimes seems more like an address than a place, Prince Rainier has nonetheless secured its prosperity for the foreseeable future. The wealthy of the world want this last refuge too much, and there are too many of them, for it to be anything less than a metropolis.

Offstage, a ballerina relaxes during rehearsal at the Académie de Dance Classique Princesse Grace, established with Grace's patronage in 1975. "Beauty is very important to us," says founder Marika Besobrasova, "but also discipline." Should Monaco ever require a new motto, that dictum would suffice.

It was time for Jimmy'z disco. At 1 a.m. there were five Bentleys, three Rolls-Royces, and six Ferraris lined up in a neat hierarchy by the entrance, and too many Mercedes to count. It was an ordinary Saturday night. My guide palavered with the local chieftain. We were soon seated at one of the tables reserved for regulars, by a low wall overlooking a pond.

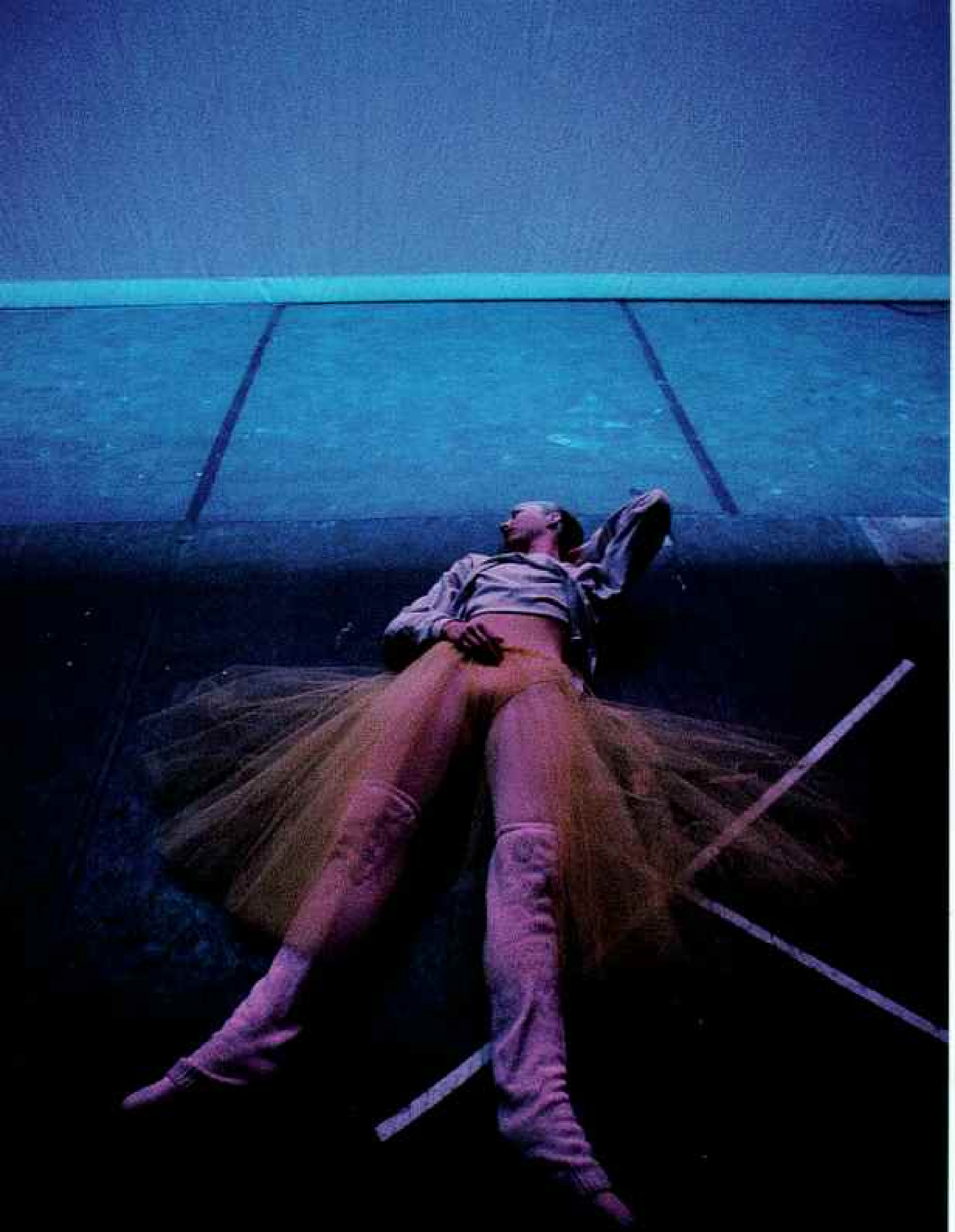
The windows had been rolled away for the night, so the room was open to the air. A bridge led across the pond to a garden on the other side. When the weather is right, the roof also rolls away on a track, so the waterside tables are under the stars. At Jimmy'z, a glass of champagne costs $40. But champagne is practically Monaco's national beverage, and a glass of mineral water was only two dollars less, so staying sober did not pay.

I sipped my drink, and faces began to materialize out of the darkness. The British banker went sweating past, intent as a great white hunter on some unseen quarry. I discerned the hierarchy of tables radiating out from the ones reserved for Prince Albert and his friends. I recognized a real estate tycoon and a Saudi oil magnate. A woman in a sheer bodysuit jumped up on stage and gave a learned demonstration of primate mating-display behavior.

Later I found myself on the vaguely psychedelic dance floor. All around me the cream of European civilization, representing an inordinate share of the human wealth and beauty of the planet, jostled, and glistened, and went crazy for a song with the refrain "Don't want no ugly mothersucker."

I spotted a demure Asian woman in a white silk dress, passing by with delicate steps, hemmed in by four bodyguards. She was giving a small party on the other side of the pond and sending over drinks to the locals, who buzzed furiously about whether she was Chinese, Japanese, or Thai and whether she was, as rumored, a princess. No one knew, and it was necessary ultimately to fit the whole thing in the tribal hierarchy: "She's nobody in Monaco," a woman explained. "Anybody who's anybody sits on this side at Jimmy'z."

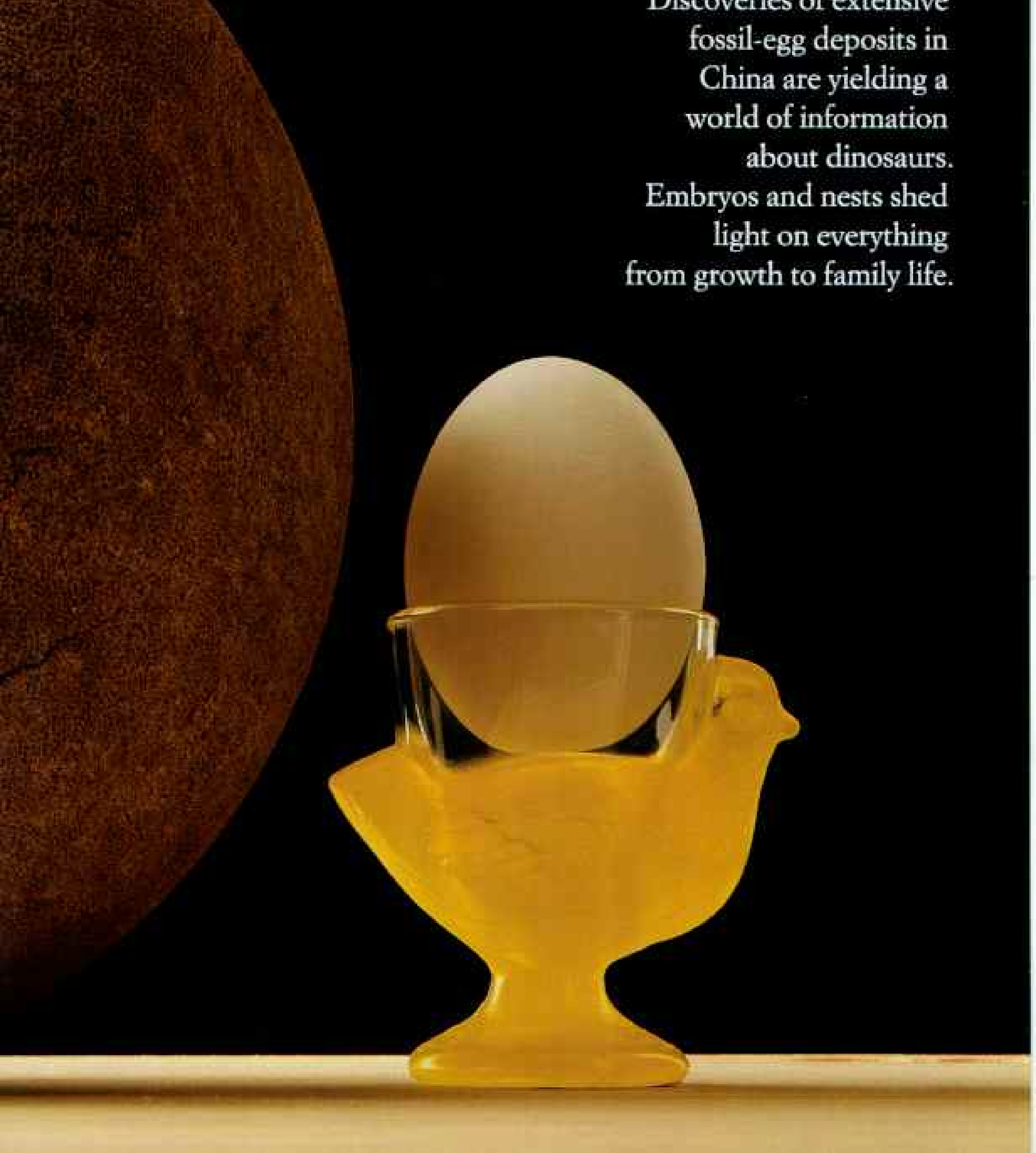
Soon after, I caught my plane home, happy to be nobody in Monaco, content that I would never have the kind of money it takes to seek haven there. And yet I loved the idea of the place, the way I love the idea of wilderness or of mountaintops in Papua New Guinea. It's not for me, maybe, but in this world of diminishing wonders it pleased me that—in a land far away, from a time long, long ago, by the grace of God and the House of Grimaldi—a culture as tiny and exotic as Monaco can still flourish on this earth. □



● Eons before the chicken came the dinosaur egg—big, round, and in this case cracked, probably by the pressure of overlying strata before it fossilized.

THE GREAT DINOSAUR EGG HUNT

Discoveries of extensive fossil-egg deposits in China are yielding a world of information about dinosaurs. Embryos and nests shed light on everything from growth to family life.



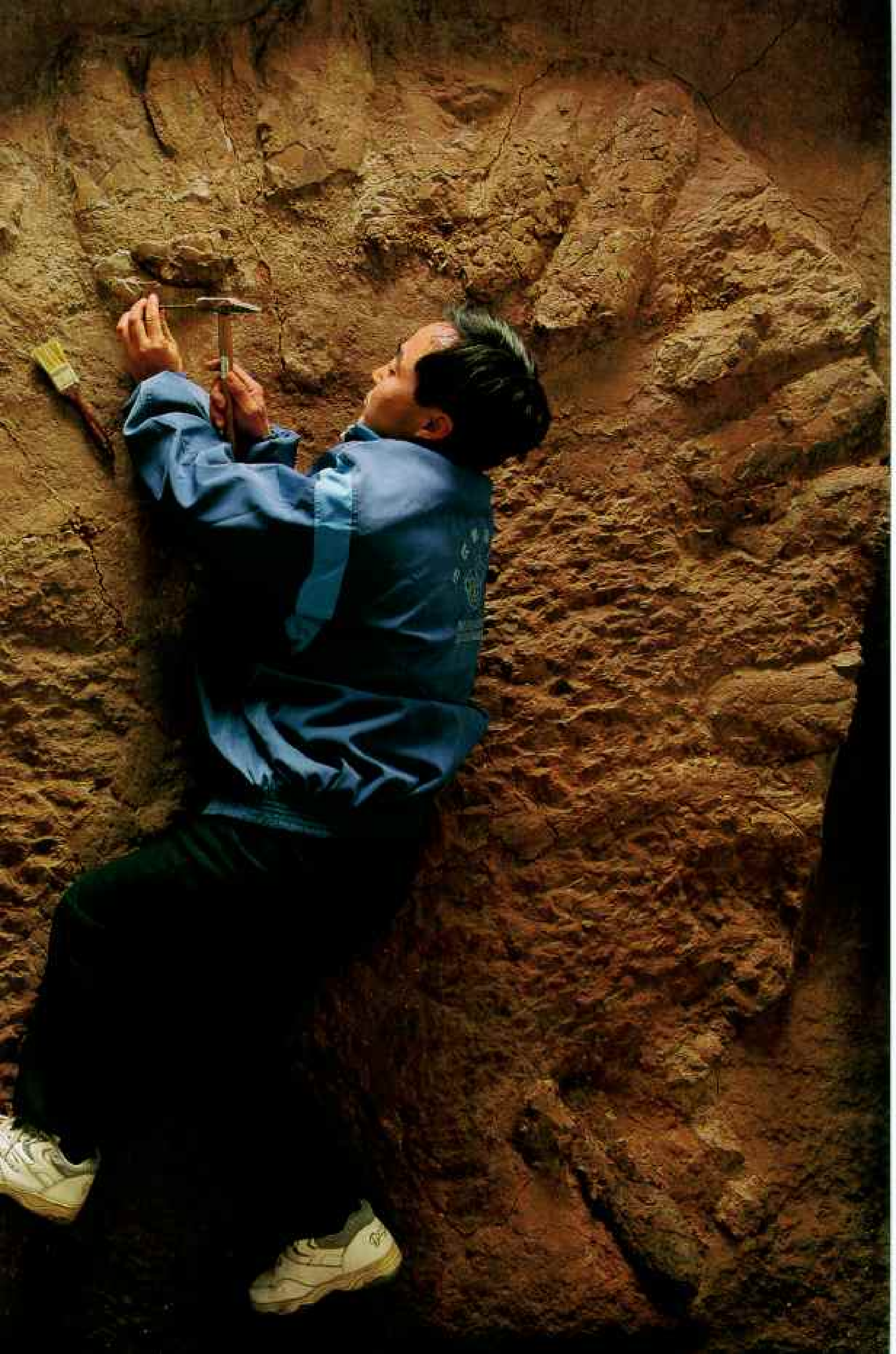
UNHATCHED TREASURES

● Giant halo of eggs (right) astonished scientists with its size after a Chinese farmer found it on a hillside. Hoping to determine age and species, paleontologist Chai Zhongqing chips away at the surrounding matrix at the Institute of Cultural Relics in Nanyang, China. Believed to be the largest nest yet found, the matrix is studded with 26 exposed eggs; more may be locked inside.

Another trove contains eggs of a therizinosaur (below), which lived in the Cretaceous period, between 110 million and 65 million years ago. More than ten feet in length, these long-clawed plant-eaters were related to meat-eaters like *Tyrannosaurus rex.*

Because the tops of eggs

usually broke off during hatching, fossil clutches are normally excavated from below. Unscrupulous diggers have been known to glue pieces together and sell them as whole eggs. For scientists, breakage is a boon—embryos were preserved only when the eggs were cracked before the yolks and whites decomposed.




NORTH AMERICA
(37 sites)
SOUTH AMERICA
(12 sites)
EUROPE
(39 sites)
ASIA
(109 sites)
AFRICA
(2 sites)

BY PHILIP J. CURRIE
PHOTOGRAPHS BY LOUIE PSIHOYOS

Red dust swirled as our van lurched up China's Green Dragon Mountain on a ride so jarring a door fell off. I didn't mind. I was preoccupied by the ovoid shapes I kept seeing. Surely too numerous to be fossils, I thought. Yet when we stopped, my fingers felt the unmistakable textures of dinosaur eggshell—not just single eggs but entire clutches. One egg was even used as a building stone!

Soon villagers crowded round our party. Through narrow streets lined by humble homes, children led us to still more eggs. Over the eons geologic forces endowed this region of central China with a great bonanza: fossilized eggs of incalculable scientific value and substantial monetary worth.

In 1991 a farmer discovered eggs while building a foundation. Villagers began selling eggs to collectors for a dollar apiece, a significant sum in backroads China. Soon even small eggs were fetching $1,200 in North America. A nest of ten eggs was auctioned for $78,000, part of a buying frenzy fanned by reports of purchases by celebrities such as director Steven Spielberg. Alarmed Chinese officials cracked down. Eggs were deemed "national treasures," and customs officers seized thousands. Some smugglers went to prison.

DINOSAUR DISCOVERIES

Articles in this series reveal the latest insights into the world of dinosaurs. Much of the research was supported by your Society.

It's not just an egg that makes my paleontologist's heart beat faster. It's the chance that one will contain an identifiable embryo. Only an embryo can positively establish a dinosaur's species, something that has been done only half a dozen times.

The study of embryos could reveal more about the link between the dinosaurs and their descendants, the birds. It could determine whether some dinosaurs were warm-blooded and how carefully they protected and nurtured their eggs and young. The most intriguing idea—cloning a dinosaur from DNA, a scenario featured in the book and movie *Jurassic Park*—is also the most outlandish.

● Tedious chore of measuring eggs occupies the author on Green Dragon Mountain in Hubei Province, China, where egg indentations mark the rock. Though eggs have been found at 199 sites worldwide, major deposits are few (left). The fragile eggs were easily broken and then dissolved in groundwater. Most of those that did fossilize go unrecognized by the untrained eye.

PHILIP CURRIE is curator of dinosaurs at the Royal Tyrrell Museum of Palaeontology in Drumheller, Alberta. Photographs by LOUIE PSIHOYOS appeared in our January 1993 dinosaur article and will illustrate a story on Africa's dinosaurs in next month's issue.

RECOVERED LOOT

● Wrested from criminal hands by customs officers, 175 eggs of various species are watched over by paleontologist Dong Zhiming at the Institute of Cultural Relics (above). Housed in spartan quarters, the meagerly funded institute was set up because of the sheer volume of eggs. Authorities confiscated some 3,000 eggs from smugglers in 1993 alone and hired locals to guard deposits.

After a chance meeting on a ski lift, fossil dealers Florence and Charlie Magovern (right) teamed up in marriage and business. In their Boulder, Colorado, workshop they stand behind a clutch of eggs believed to be therizinosaurs. Charlie rests his hand on an egg of an unknown species from Argentina. Before the

Chinese government's crackdown, the Magoverns traveled to China and legally bought dinosaur eggs from dealers licensed by that country's Bureau of Industry and Business. Prices have stabilized, and the Magoverns sell eggs on the open market for $150 to $1,400. But, says Florence, "we reserve all the really good stuff for museums."

A major egg and nest site was discovered in 1923 in Mongolia by an American Museum of Natural History expedition. A team sponsored by that museum and the Mongolian Academy of Sciences made another startling find in 1993: an *Oviraptor* fossil seated atop an egg clutch, which they view as the first direct evidence of parental care by dinosaurs.

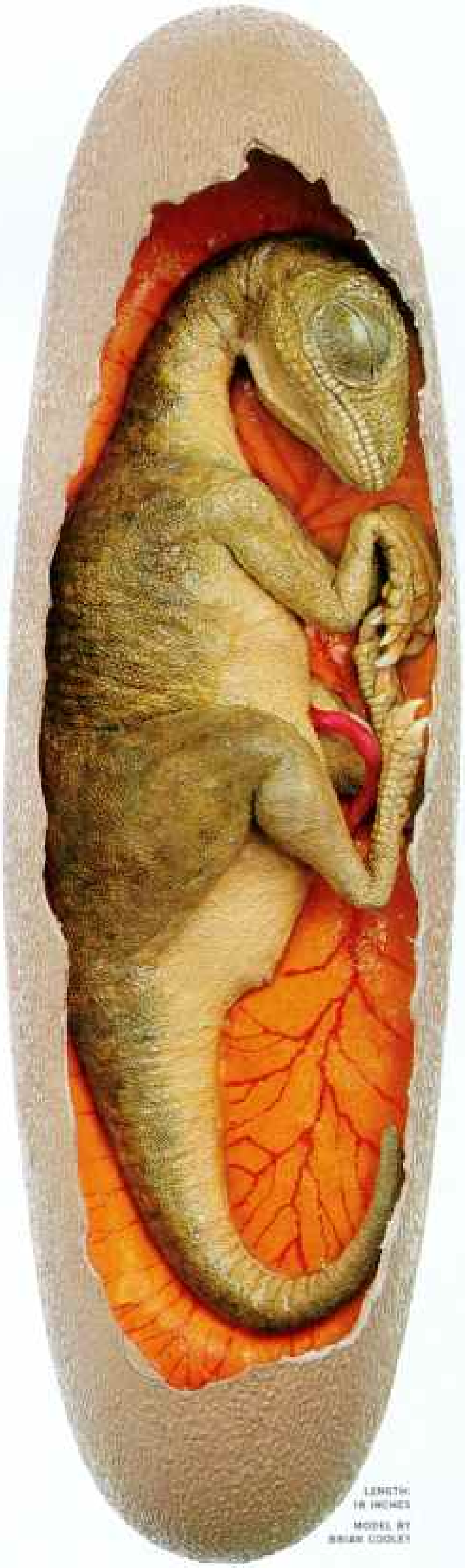
FROZEN FORMS

● King-size eggs (left) carry a name to match: *Macroelongatoolithus xixiaensis* is the largest known dinosaur egg. The name reflects its elongate shape and discovery in Xixia Basin. Names of such "oospecies," or egg species, are used when an egg lacks an embryo and has not been linked to a known animal species. Other criteria—size, shape, texture, and pattern of airholes—are used to assign oospecies names.

Most embryos are jumbles of bones that separated and fell to

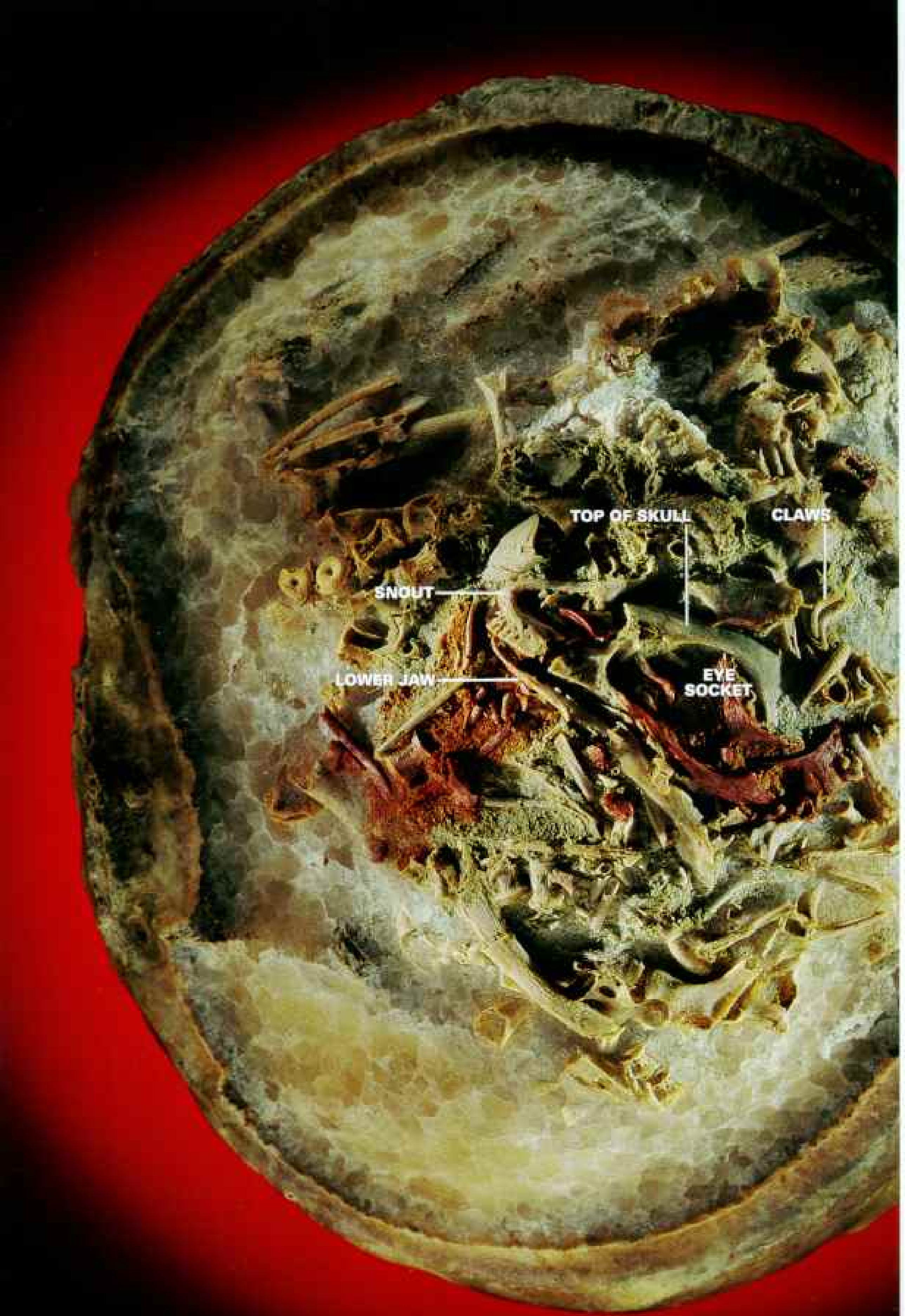
the bottom of the egg as connective tissue degenerated. An extremely rare, mostly articulated embryo (above) somehow stayed intact. It is currently thought to be a therizinosaur, although the shape of the egg differs from that of other therizinosaur eggs.

A model of the embryo (right) lies curled in its egg, its umbilical cord funneling in nourishment from blood vessels spread throughout the yolk.



LENGTH:
1.8 INCHES

MODEL BY
BRIAN COOLEY


TOP OF SKULL
CLAWS
SNOUT
LOWER JAW
EYE SOCKET

DIAMETER: 3.5 INCHES
MODEL BY BRIAN COOLEY

SNAIL-PACED WORK

● Curled in prebirth slumber, a model (above) portrays how a therizinosaur embryo might have appeared before it died and its bones became dis-jointed. The fossilized embryo (left) was prepared by Terry Manning (right), a Leicester, England, fossil dealer and paleontological technician. After drilling tiny holes and studying shell structure to determine which eggs might contain embryos, he places them in a dilute solution of acetic acid, which eats away matrix at a rate of only 1/2000 of an inch a day. When bone is exposed, he saturates it with liquid plastic, then resumes the bath. Preparations can take more than a year.

LIKE OAKS FROM ACORNS

● Hungry beeties bored tunnels as they ate their way through what is thought to be an egg yolk after it mummified but before it fossilized (above). If truly a dinosaur yolk, it would be among only two known to exist. Under magnification, the yolk revealed what its preparer, Terry Manning, believes are fat globules (right).

Small eggs often produced gargantuan adults—and at impressive growth rates. Measuring about three inches long, the embryonic upper leg bone of a hadrosaur found in Alberta (facing page) would have ballooned to four feet within a few years.

Can DNA be extracted from dinosaur eggs? Success was reported by a team led by molecular biologist Chen Zhangliang (below, at left) at the College of Life Sciences at Peking University, where he works with paleontologist Zhang Yun. But some scientists remain skeptical. While DNA may well have been isolated, they say, it has not been proved it was from a dinosaur.

Meanwhile, three of Manning's eggs are being studied by an interdisciplinary team of scientists at North Carolina State University at Raleigh. They report that analysis of bone phosphates revealed a sampling of atmospheric oxygen from the time the eggs were laid some 75 million years ago. Further studies could reveal more about the animals' reproduction, diet, and whether some were warm-blooded.

FACTS AND FANTASIES

● Midwife to a new species, paleontologist Jack Horner relaxes with models of a hatchling and adult *Maiasaura* at Montana State University's Museum of the Rockies in Bozeman (facing page). At a rock shop in 1978 Horner chanced upon a coffee can full of tiny fossils. Those bones led to the discovery of *Maiasaura*, or "good mother lizard." It is one of the few dinosaur names with a feminine suffix and speaks to the substantial amount of time Horner believes that *Maiasaura* mothers devoted to protecting eggs and nurturing young.

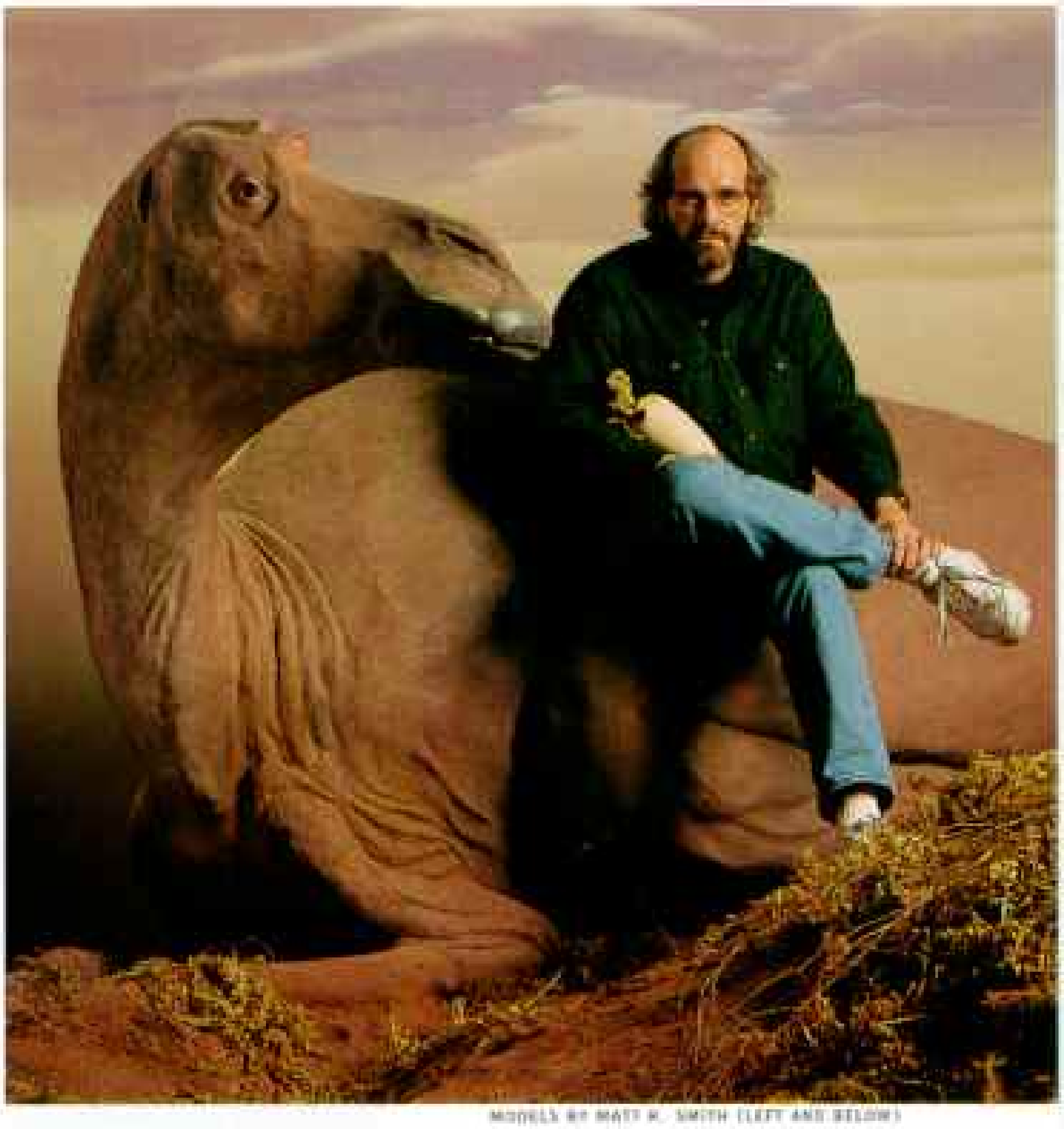
Looking like a cousin to E.T., the extraterrestrial of movie fame, a model of *Bagaceratops*

emerges from its five-inch-long shell (left). Found in Mongolia, this plant-eater had a short parrot-like beak and grew to a little more than four feet long.

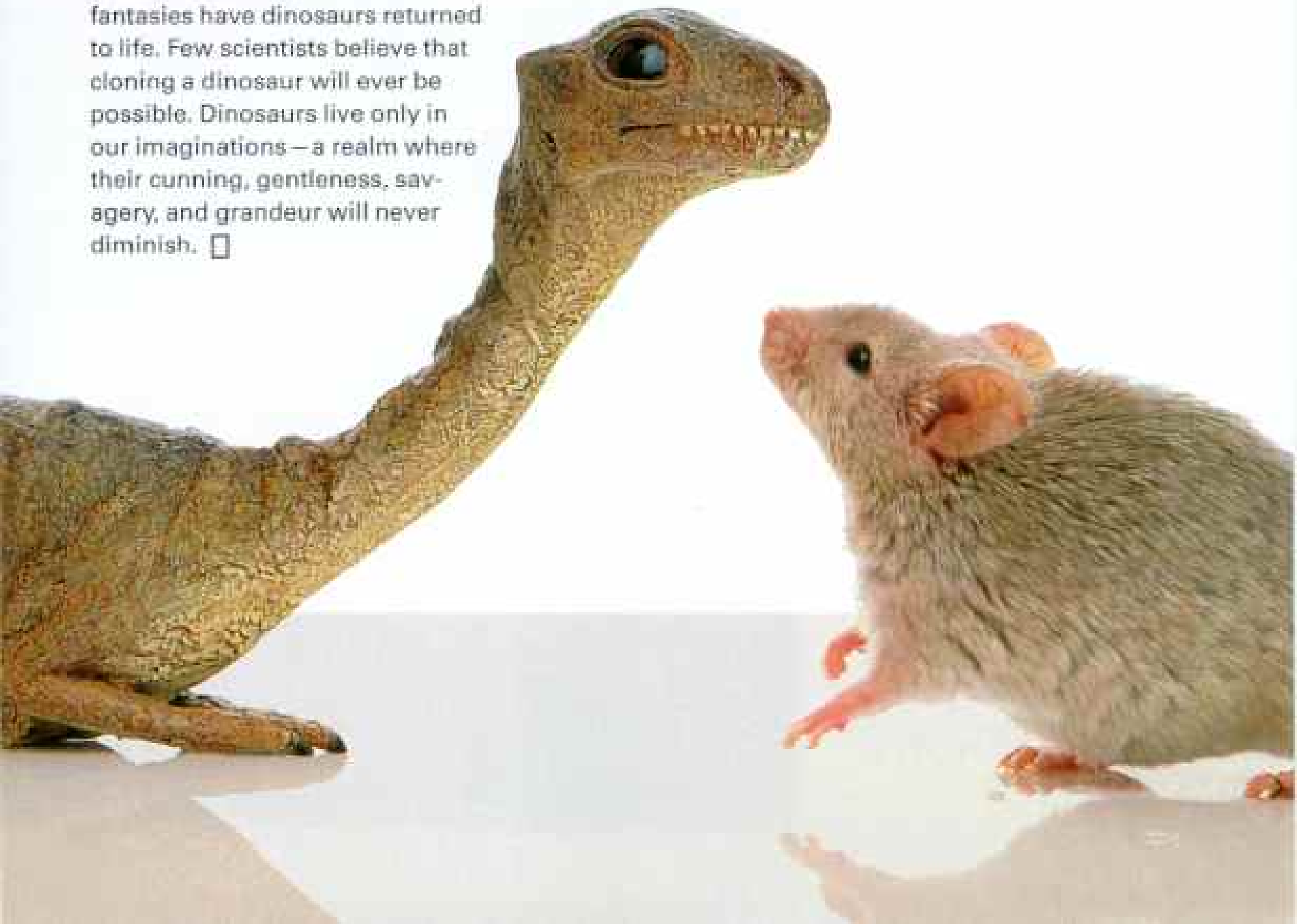
Below *Bagaceratops, Hypacrosaurus,* a herbivore native to Alberta and Montana, grew from this 23-inch hatchling to exceed 25 feet. It developed a broad, duck-like mouth and a bony, rounded crest atop its head.

The pitfalls in naming species were demonstrated by *Mussaurus,* the "mouse lizard," shown as an 11-inch hatchling in model form (below). Among earth's oldest dinosaurs, this plant-eater of southern Argentina thrived 210 million years ago, during the Triassic period. When first discovered, skeletons of young dinosaurs were named for their small size. It was later determined that *Mussaurus* adults actually grew to exceed ten feet in length.

Such models will have to satisfy us, for only in fictional fantasies have dinosaurs returned to life. Few scientists believe that cloning a dinosaur will ever be possible. Dinosaurs live only in our imaginations—a realm where their cunning, gentleness, savagery, and grandeur will never diminish. □



MODELS BY MATT K. SMITH (LEFT AND BELOW)



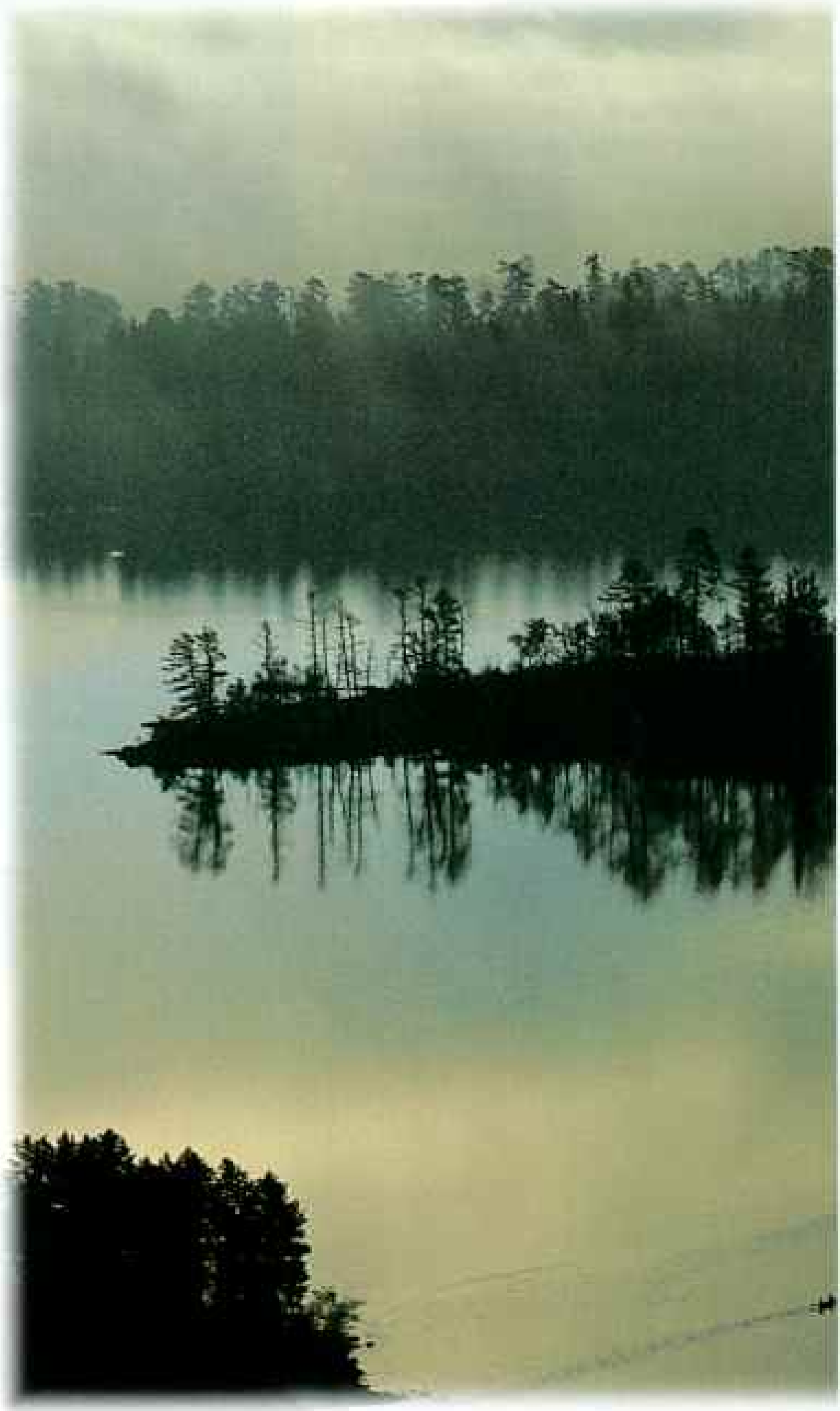
The Man Who Measured Canada

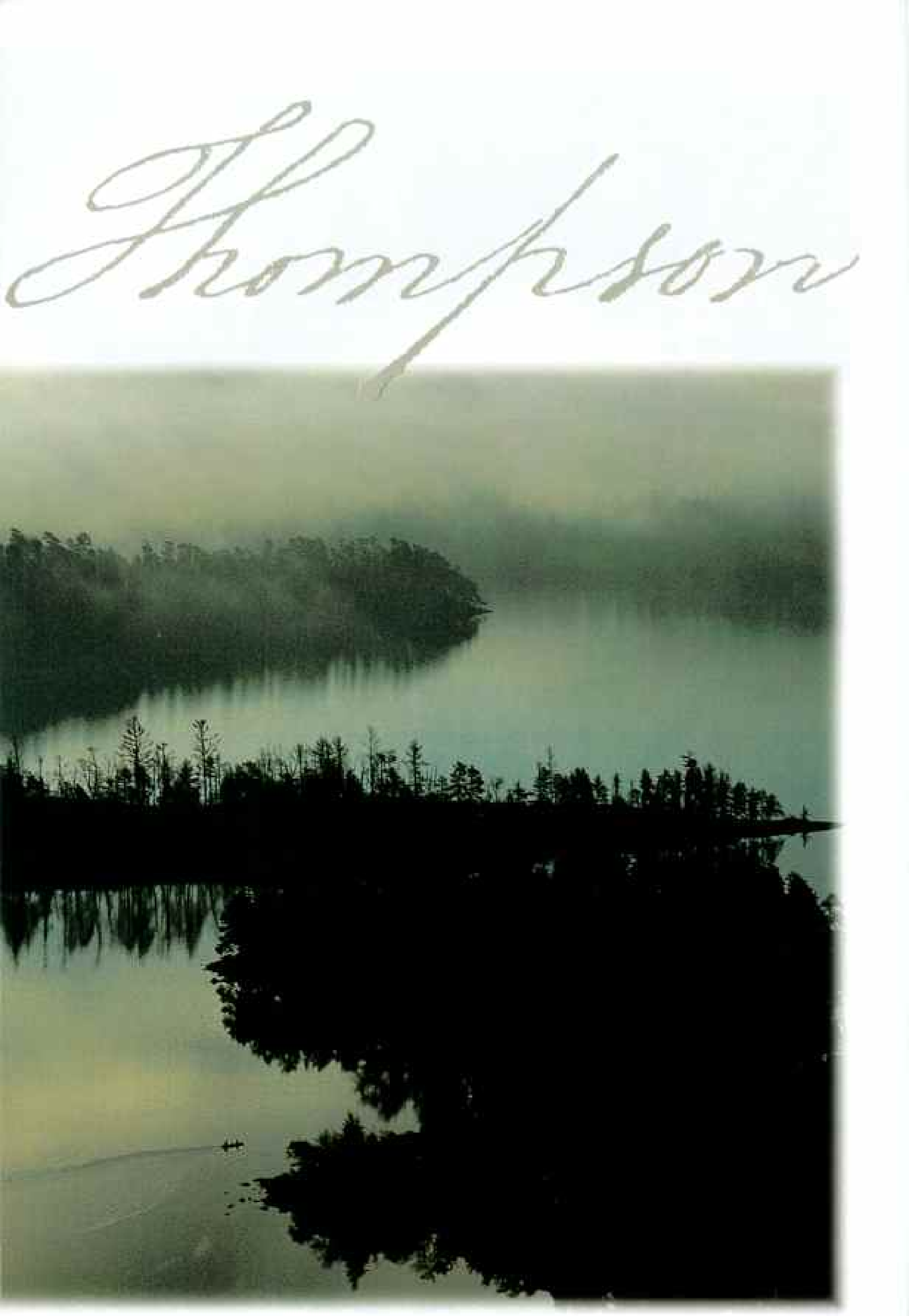
As misty as an autumn morning, the history of David Thompson eludes memory, even in his own country. Almost on his own this pathfinder filled in the empty map of early Canada. A prodigious explorer, he surveyed much of the Canadian-U.S. border, which threads Lac la Croix (right) in the boundary waters between Minnesota and Ontario.

BY PRIIT J. VESILIND
NATIONAL GEOGRAPHIC SENIOR WRITER

PHOTOGRAPHS BY
MARIA STENZEL

PAINTINGS BY
GREGORY MANCHESS




Thompson

"Never heard of him," says Leon Charles, a young Cree and guide for our ten-day canoe trip in the Canadian wilderness. We're bouncing down a dirt road north of Missinipe, Saskatchewan, canoes strapped to our van, spewing a plume of dust into the fringe of the primordial forest that once cloaked North America.

David Thompson, I insist, Canada's most prolific explorer—the fur trader and surveyor who almost single-handedly mapped the nation's vast, unknown interior 200 years ago. He covered 80,000 miles by foot, horseback, dogsled, and canoe, defining a fifth of the continent, compiling 77 volumes of journals about its geography, biology, and ethnography. Equipped only with a brass sextant and a courageous heart, he made maps that rival images gleaned from today's satellites. He was, some think, the world's greatest land geographer.

Leon shrugs politely. This "white man's history" rings no bells.

Thompson, I tell him, made Lewis and Clark look like tourists. He should be one of Canada's most heroic figures. But "David who?" is what I often heard as I followed Thompson's restless life. No good biography, no photograph, not even a painting exists of the man. A smallish western river, a lonely highway, a town in Montana bear his name, but little else.

It's true that Canada does not readily fashion heroes. Its founders were those who refused to rebel. Its westward march was orderly, fueled by business opportunities, not buccaneering passion as in the United States. Native Americans were colleagues in the fur business, not obstacles to expansion. There were no six-guns, no massacres, no Davy Crocketts.

"Thompson's sin was that he was only successful," Ian MacLaren, a

HIGHWAYS AND DEATH TRAPS, CANADA'S WILD RIVERS OPENED THE WAY FOR THOMPSON'S EARLY EXPEDITIONS. WHILE SCOUTING A ROUTE TO LAKE ATHABASCA, HE ALMOST DROWNS WHEN HIS CANOE TUMBLES OVER A FALL. HIS NATIVE GUIDES WATCH HELPLESSLY AS HE STRUGGLES FOR CONTROL.

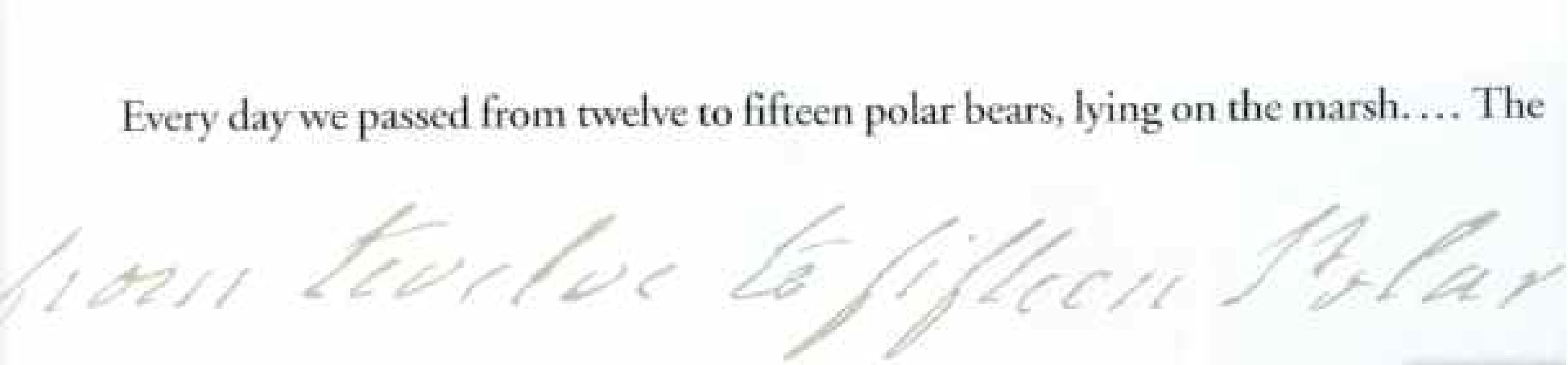
professor of Canadian studies at the University of Alberta, told me. "There was no disaster, no horror story. He wouldn't have made good TV."

Yet Thompson was the quintessential North American, a "mapmaker of the Canadian mind," as Victor Hopwood, a Vancouver scholar, says. He was an intellectual nurtured in the wilderness, a man who served the British scientist's eccentric obligation to bring order to the unknown, but he was humbled by the spirit and grandeur of the land.

At least some of Thompson's anonymity was his own doing. He was a difficult man who took satisfaction in being the outsider—a white man among Indians, a Welshman among Scots, a pious man among the colorfully profane French voyageurs. He disdained the spotlight and discouraged casual friendships. He was no self-promoter, and thus when he wrote the narrative of his life, his *Travels*, he could find no publisher.

I used these *Travels*, spare but powerful accounts of virgin North America, as a guide to explore virtually unchanged segments of Thompson's trail, from Hudson Bay to the Rockies, to the mouth of the Columbia River and back to a quiet hamlet near Montreal. I found that he was not a mellow man. He wore out everyone around him. "A fine day," his log entries often started, even though it might have been 30 degrees below zero, with the north wind chewing on his tent poles. He challenged me to see things as he saw them, with optimism, with a fresh, relentless clarity. And he stirred in me that most North American of compulsions: to set forth, to see what lies beyond the next bend in the river.

Every day we passed from twelve to fifteen polar bears, lying on the marsh.... The



THERE ARE SIX OF US, with three canoes. Leon will paddle with Maria Stenzel, our photographer. Artist Greg Manchess will share a canoe with trip leader Colin Gilchrist, from Horizons Unlimited outfitters in Missinipe. Jim Davis, an old friend from Swarthmore, Pennsylvania, will labor as my sternman.

Two floatplanes dump us partway down the Fond du Lac River, by a sand beach swarming with blackflies, where the air is acrid with smoke from forest fires. The Fond du Lac, bright and pure, cascades northwest through a sandy basin to Lake Athabasca. Thompson passed through here in 1796, searching for a quicker, eastern route to the lake, then the hub of the northern fur trade. We make camp on a carpet of reindeer moss, cranberries, and moose scat. Between us and our goal, the Chipewyan, or Dene, settlement of Black Lake: 130 miles of timelessness.

We are perched on the rim of the Canadian Shield, the elevated granite skirt that clamps around Hudson Bay, little changed since Thompson's day. He was the first to define this land of stunted pine and birch, wolverines and eagles; he called it "muskrat country" for its lack of big game and impoverished soil and considered it uninhabitable by white men.

"The whole is a wretched country of solitude," wrote Thompson, "which is broken only by the large gull and the loons."

The next day clouds roll from the northeast, dragging chill August winds and stinging rain into the Athabasca Basin. We plunge quickly into the first rapids, into stacks of icy foam that slap against our bows and soak us. Thompson knew this white water well. He too heard the whisper of the roar before the bend, scanned the dance of whitecaps, and saw the river drop like smooth paper shredding on the rocks. He too bent his knees against the thin shell of a canoe as water raged beneath, viscous as muscle.

Some 30 French and native workers normally accompanied Thompson on his trading treks. But his journey to Athabasca was pure exploration, and he was able to recruit only two callow Dene, Paddy and Kozdaw. Together they headed north from Fairford House, a trading post on the Churchill River, paddling into Reindeer Lake.

"Our chief dependence, next to good Providence," he wrote, "was on our net and gun."

Thompson had already spent half his life in the wilderness. At 14, fresh from London's Grey Coat charity school, he had stepped off a supply ship at Churchill Factory as an apprentice clerk for the Hudson's Bay Company (HBC). The year was 1784, and Indian canoes, heavy with furs, were arriving daily from the interior. For weeks the campfires burned around the stockade, ptarmigan roasting, brandy flowing. Then the ship, packed with furs and whale oil, turned back for England, escaping before the ice stiffened.

By November four-inch-thick rime had formed inside the buildings, and as Thompson wrote, "All of our movements . . . were for self-preservation. The cold is so intense that everything in a manner is shivered by it; continually the rocks are split with a sound like the report of a gun."

A city boy, Thompson exulted in the wilderness. He found noisy glory in migrating geese and took pleasure in the details of grouse feathers. He was not

Indian rule is to walk past them with a steady step without seeming to notice them.

—HUDSON BAY, 1785

POLAR BEARS WERE A COMMON SIGHT ON THE ICY SHORES OF HUDSON BAY, WHERE THE YOUNG WELSHMAN BEGAN HIS CAREER AS AN APPRENTICE FUR TRADER. "FROM THE END OF OCTOBER TO THE END OF APRIL," HE WROTE, "EVERY STEP WE WALK IS IN SNOWSHOES."

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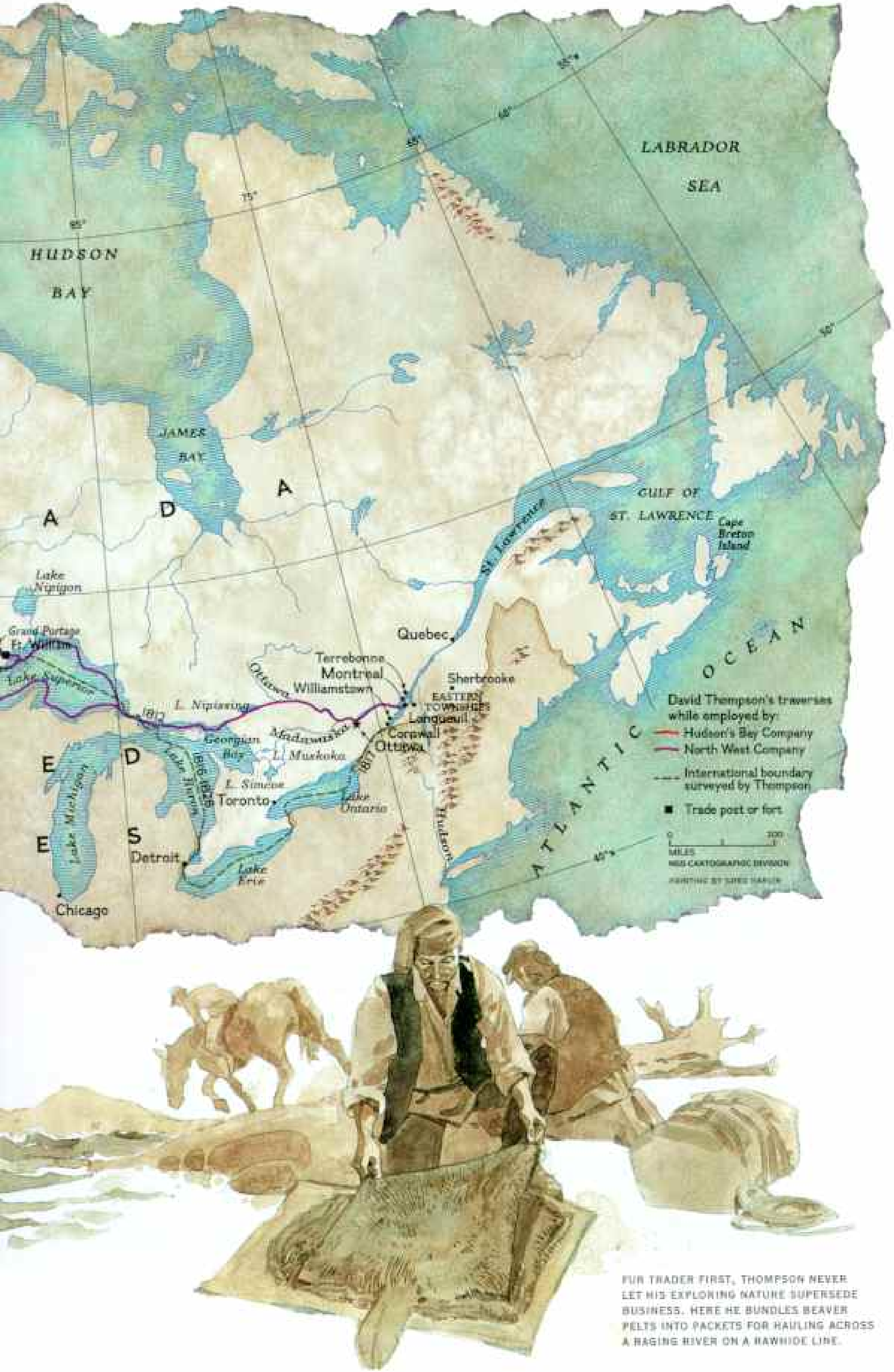
only bitten by mosquitoes, but he also examined, under a magnifying glass, the precise way they bit him.

I FEEL NO CURIOSITY TOWARD MOSQUITOES, only malice as they dive-bomb my ears in early morning. Colin, first to leave his tent, finds wolf tracks on the beach. "A small one," he says, smiling. It must have padded toward our cookfire, sniffed at the remains of freeze-dried stew, and wisely turned away.

The river is stretched smooth as gelatin today, and the rapids become trails of flashing sunlight that obscure rocks and ledges until we are dangerously upon them. Thompson and his Dene guides traveled naked from the waist down, so their clothes would be dry after a day of dragging their heavy canoe through the white water. Though our canoes are light and our gear is made of quick-drying polypropylene, *(Continued on page 122)*

Thompson's Travels

The map of western Canada was mostly blank in 1784 when 14-year-old David Thompson arrived at Churchill Factory—a trade depot for the Hudson's Bay Company's fur empire. A company mentor taught him the craft of surveying, and Indians the art of survival. Most of his explorations were done after 1797, when he joined the rival Montreal-based North West Company, which allowed him greater rein. In 1807 he discovered the source of the Columbia River. Later in life he assisted the commission that established the border between Canada and the U.S. By foot, by canoe, and by horse, he covered more than 80,000 miles. The meticulous journals he kept along the way were the source for his *Travels*, written in his old age.



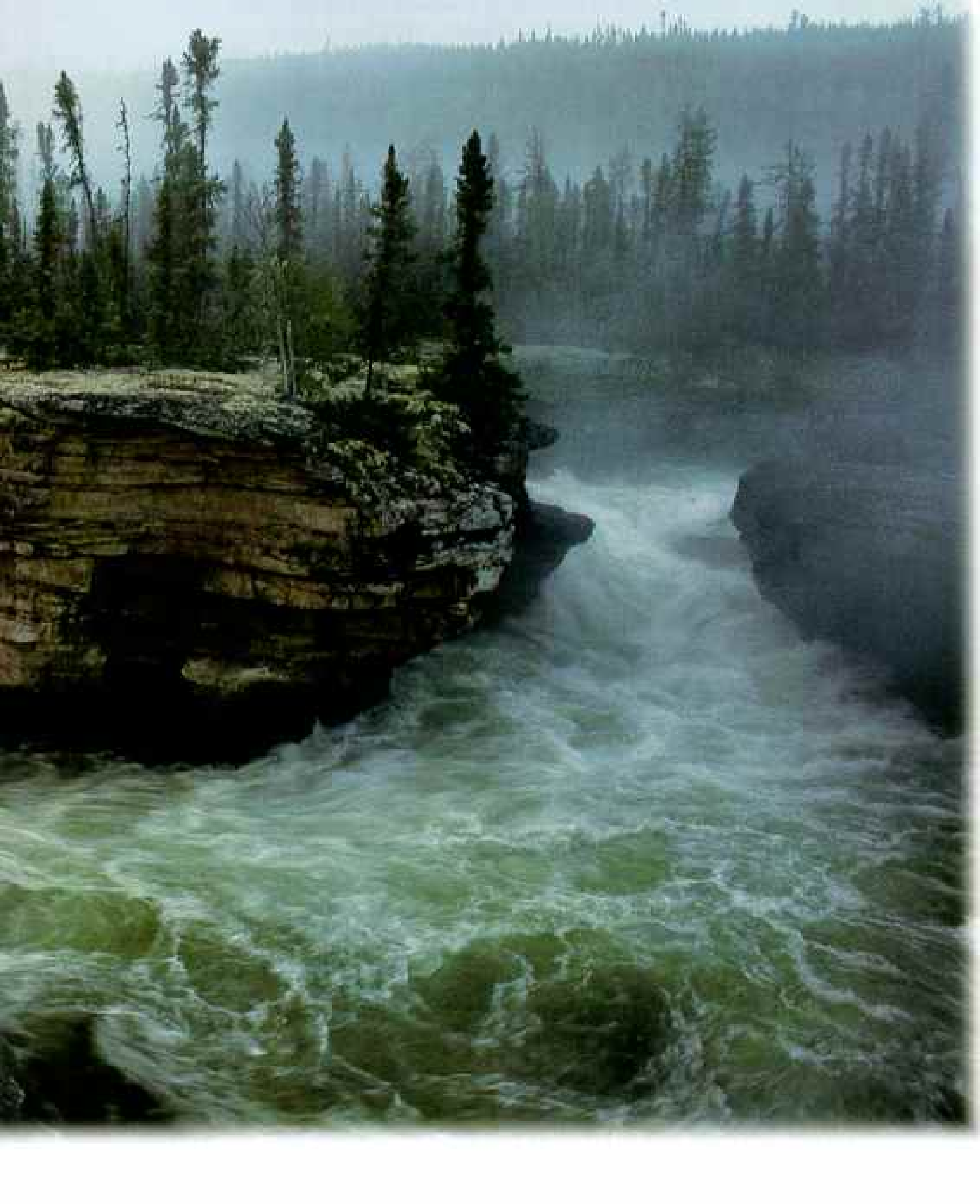
FUR TRADER FIRST, THOMPSON NEVER LET HIS EXPLORING NATURE SUPERSEDE BUSINESS. HERE HE BUNDLES BEAVER PELTS INTO PACKETS FOR HAULING ACROSS A RAGING RIVER ON A RAWHIDE LINE.

The deep roar of the torrent, the hollow sound of the falls, with the . . . frowning

AS PRISTINE NOW AS IN 1796, THE REGION AROUND ATHABASCA LAKE WAS THE FOCUS OF THOMPSON'S LAST SURVEY FOR THE HUDSON'S BAY COMPANY. THE FALLS ON THE FOND DU LAC RIVER SO MOVED HIS NATIVE GUIDES THAT THEY LEFT OFFERINGS FOR ITS SPIRIT, OR MANITOU.

hills form a scenery grand and awful, and it is well named the Manito Fall.

—LAKE ATHABASCA, 1796



"For we all believe the Great Spirit speaks to you in the night when you are

my feet stay soaked, for the rapids attack in quick succession; one troll of a ledge hides beneath the flow and catapults our canoe over sideways to the current like some random hunk of driftwood. The river falls under us like a trapdoor, and I scrape desperately with my paddle, catching only air.

"Paddle, paddle, paddle!" Jim yells as we pinball among the boulders. We do not swim that day, but a few fuses blow among my nerves.

Thompson first took to the rivers in the summer of 1786, joining a 33-member fur brigade headed for the Canadian prairies, where the HBC hoped to undercut the rival "pedlars from Montreal," the North West Company, and gain the loyalty of the powerful Piegan Indians and other Blackfeet. The 17-year-old spent the second winter in the tepee of Saukamappee, an old Cree living among the Piegan, who filled his soul with history.

"We were anxious to see a horse, of which we had heard so much," Saukamappee told him. "At last, as the leaves were falling, we heard that one was killed by an arrow shot into his belly. . . . Numbers of us went to see him, and we all admired him; he put us in mind of a stag that had lost his horns, and we did not know what name to give him. But as he was a slave to man, like the dog, which carried our things, he was named the Big Dog."

When Thompson was 18, he broke his leg and was left to heal at a remote Saskatchewan trading post. There he met Philip Turnor, the HBC's premier surveyor, and voraciously absorbed mathematics and practical astronomy from the master. He began a daily journal and never moved another uncharted mile without fixing the position of key landmarks and trading posts, points that became the framework for his maps of North America.

Thompson later carried a sextant and a set of charts and tables wherever he went, more like a British sea captain than a trader. Because he had no ocean, he used a small pan into which he poured mercury, creating an artificial horizon to reflect sun, moon, and stars. In his kit were two thermometers, drawing instruments, and foolscap-size paper.

To his companions Thompson seemed a magician. They often saw him gazing for hours into the skies and called him Koo Koo Sint—the Man Who Looks at Stars. "I told them it was to determine the distance and direction from the place I observed to other places, [but] neither the Canadians nor the Indians believed me. Their opinions were that I was looking into futurity."

TODAY I CHECK MY OWN INSTRUMENTS: air temperature 52°F; water 61°. I had learned the rudiments of celestial navigation for this trip and take a sextant reading at noon, as Thompson always did. Delicately, delicately, I squint into the telescope of the instrument. I must bring the image of the sun down, with parallel mirrors, to meet the image of the sun that is reflected in the water of my artificial-horizon tray. And I must mark the exact second they meet, to begin my calculations for latitude. But my hand shakes, and blackflies nip my skin.

Latitude 57°16′12″. I'm miles and miles off, according to our map. It's humbling. Thompson's calculations were within a mile of modern fixes.

On our fifth night we hunker down in a stand of spruce by Brassy Rapids,

looking at the moon and stars, and tells you of what we know nothing."

—WITH THE NAHATHAWAY, 1792

and Leon lands a 15-pound northern pike, a jagged-tooth predator that Thompson called "the water wolf." I ask Leon how he'd cook the pike if he were by himself. He cuts a green pine stick and jams it up the fish's mouth, and, without gutting it, props the pike over the fire like a hot dog.

The Cree, known as Nahathaway in Thompson's time, never had much use for fish. "Nothing but sad necessity can compel a Nahathaway hunter to carry away fish, and angle for them," Thompson wrote.

In contrast, the Dene, who still occupy the same northern forests, found fishing honorable. "A peaceable people, abhorring bloodshed," Thompson wrote of the Dene. "The Nahathaways look on them with a sort of contempt; being themselves too much inclined to war."

All this is news to Leon, a Cree traveling into Dene territory for the first time. But he is young and borrows my copy of the Thompson manuscript to ponder in his tent.

We ride the Fond du Lac until it empties into Black Lake over Burr Falls, a wicked, twisting hose of water that we scan for soft spots but in which we see only possibilities of disaster. The half-mile-long portage past the falls is burned from the forest fires, the earth still smoking. I haul the canoe over it as if performing penance.

That night the aurora borealis curls in celestial rapids, roiling above the glow of our campfire like river dreams. "Sometimes there would be a stillness

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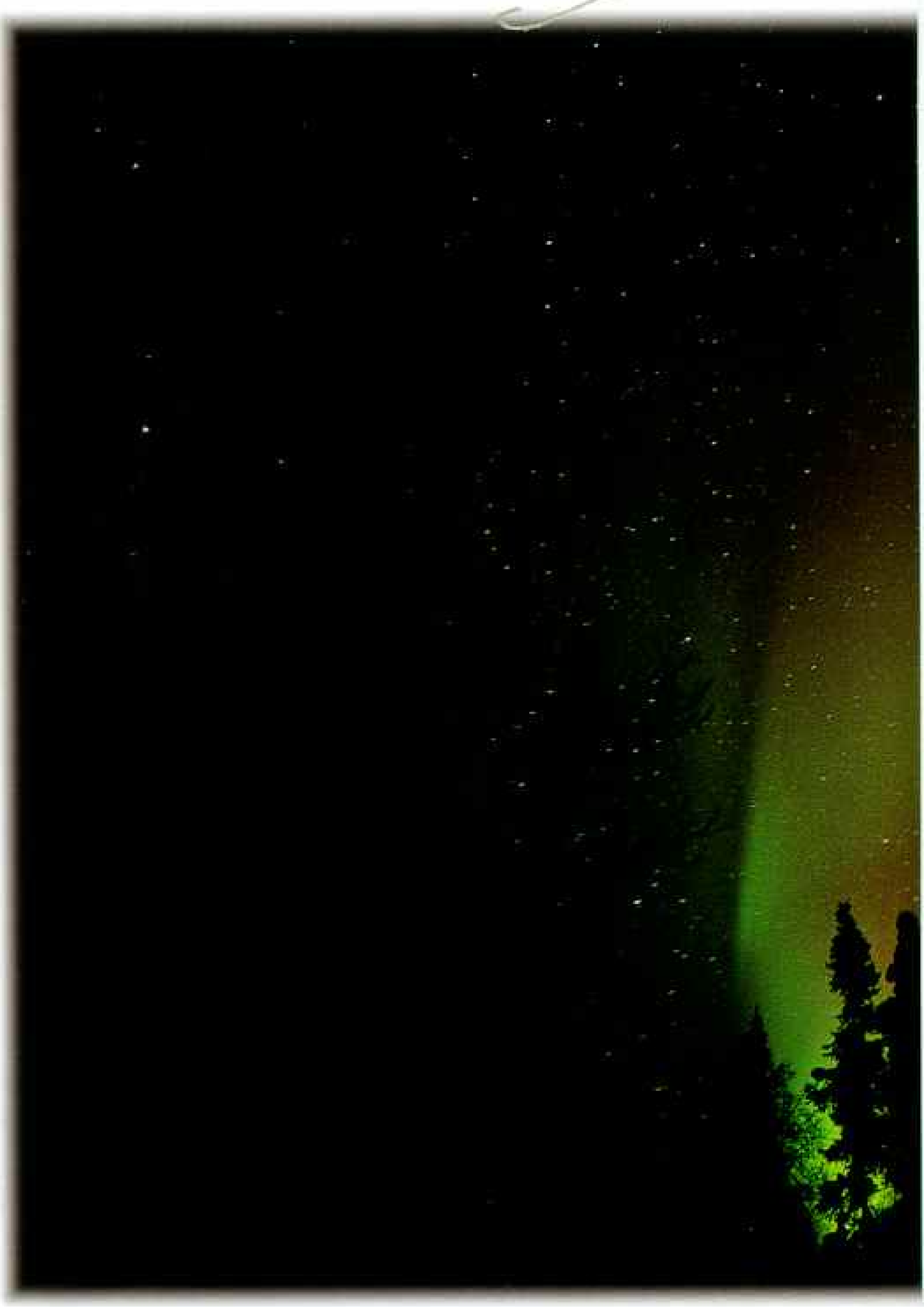
A STARGAZING THOMPSON TRIED TO EXPLAIN LONGITUDE AND LATITUDE TO HIS FRIENDS, WHO REGARDED HIM AS A SHAMAN. "THEIR OPINIONS WERE THAT I WAS LOOKING INTO FUTURITY." WITH HIS SEXTANT AND HOURS OF TRIGONOMETRY HE OBTAINED STARTLINGLY ACCURATE RESULTS.

The whole heavens were in a bright glow … and their brightness was often such



EXCITED BY SOLAR WIND, PARTICLES IN THE IONOSPHERE LIGHT UP THE ARCTIC SKY WITH AN AURORA BOREALIS OVER NORTHERN SASKATCHEWAN. WINTERING THERE, THOMPSON WROTE: "IN THE RAPID MOTIONS OF THE AURORA, WE WERE ALL PERSUADED WE HEARD THEM. REASON TOLD ME I DID NOT."

that with only their light I could see to shoot an owl at twenty yards.

—REINDEER LAKE, 1796

One of my horses nearly crush[ed] my children to death from his load being badly put

FAMILY MAN THOMPSON SELDOM TRAVELED WITHOUT HIS OFTEN PREGNANT WIFE, CHARLOTTE, AND THEIR PASSEL OF KIDS—13 BY THE YEAR 1829. IN THE OREGON COUNTRY, HE NEARLY LOST HIS YOUNGEST CHILDREN WHEN A PACKHORSE BOLTED.

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of two minutes," Thompson wrote of the northern lights, and then, "The dogs howled with fear, and their brightness was often such that with only their light I could see to shoot an owl at twenty yards."

In a rainstorm it takes us two days to paddle across Black Lake, but we arrive at last in the new Dene settlement of 1,500. Our canoe trip is finished; the floatplanes will arrive next morning to take us out. Thompson had no such escape. For him the tougher journey lay ahead, back upstream. His logbooks record that hardship was routine. Only the occasional pike netted, a rabbit snared, and the daily miracle of fire coaxed from flint and steel sustained the little party.

We walk up the hill with cramped legs, to see how the Dene live today.

"NEVER HEARD OF HIM," says Dan Robillard, flashing a smile. Dan, the band chief at Black Lake, tells us that many Dene are returning now, that not just money but also nostalgia for the land brings them back: "We used to follow caribou all year-round. Now we just fly a charter airplane to the [Northwest] Territories in spring and shoot them. I've got two freezers full of meat."

As Thompson predicted, no white community presses the Black Lake

on, which I mistook for being vicious; I shot him . . . and rescued my little ones.

–EXPLORING THE UPPER COLUMBIA, 1807-1810

Dene; the nearest connecting road is more than 80 miles away. Yet Black Lake is growing, even prospering, partly from a treaty settlement that compensates the Dene from uranium-mine leases. The town just built an 18-million-dollar school.

About 80 Dene still trap for lynx, marten, wolf, and fox, as well as beaver, and although prices have fallen in recent years, they have found an alternative market. "The Chinese," says Robillard. "They want us to send them 3,000 pelts a month."

We fly back high above the coiled river, over windfallen trees in piles like pickup sticks and swaths of forest burned down to the naked granite. I watch the wounded landscape gliding underneath, thanking Providence that we had made it without mishap. Thompson wasn't quite so lucky. He and his Dene guides continued 20 miles to the tip of Lake Athabasca itself but concluded that the entire route was too shallow and hazardous for freight canoes.

Misfortune struck on their return journey back upriver, when Kozdaw and Paddy were tracking—pulling the canoe with a rope around dangerous falls—while Thompson sat aboard and steered. The Indians stopped to argue about which side of a birch tree to take the line. The canoe drifted and took a sheer to the strong current: "In an instant the canoe was precipitated down the fall (12 feet) and buried under the waves," Thompson wrote, "and when I arose among the waves, the canoe came on me and buried [me] beneath."

Thompson's foot was ripped open by the rocks. Most of the clothes, food, gear, and weapons were lost, although Paddy retrieved the sextant box. "It was now [that] our destitute condition stared us in the face; a long journey through a barren country without provisions . . . almost naked, and suffering from the weather; all before us was very dark."

Wearing pieces of their cotton tent for warmth in a cold summer, the unhappy trio was reduced to near starvation in a week and raided an eagle's nest for food. Weak with dysentery from the eagle fat, they finally stumbled upon two tents of Dene, who gave them broth.

Thompson had surveyed another great swath of the northland, but his trip was a dead end for the HBC, and the bosses were not impressed. He was welcomed by a curt note from headquarters: Stop exploring and concentrate on business.

THOMPSON'S SOUL must have fared poorly behind a desk or cramped behind a counter, trading furs for pots and pans and blankets. A year later, after two full tours with what he later termed the "mean and selfish" Hudson's Bay, he walked out the door and joined the rival North West Company at their summer summit at Grand Portage on Lake Superior.

Thompson was only 27 but already possessed with a messianic energy that burned out lesser men around him. The Nor'Westers pronounced him the company astronomer and surveyor and hustled him off to fix the locations of North West posts to determine if they fell north or south of the 49th parallel, the new boundary between British America and the United States.

He was also to explore the Mandan villages of the upper Missouri Valley

and, incidentally, to locate the headwaters of the Mississippi, which had been a border point set by the Jay Treaty of 1794.

He did it all in ten months, driving himself and his entourage through sub-zero blizzards by dogsled, covering 4,000 miles of mostly uncharted territory, and earning the respect of Alexander Mackenzie, the company partner who had already forged routes to the Pacific and the Arctic Oceans. Thompson's trip should have taken two years, Mackenzie marveled.

To his freewheeling new partners Thompson must have seemed a sanctimonious pain in the stern. He refused to use alcohol as a trade item, and his partners goaded him for his piety. He often read to his illiterate men from the Bible, in French, as they smoked clay pipes by the campfire.

He grew to value the spiritual life of Native Americans. The Cree believe that "the earth is also a divinity, and is alive," he wrote. "If it was not alive it could not give and continue life to other things and to animated creatures. The forests, the ledges and hills of rock, the lakes and rivers have all something of the manito [spirit] about them."

And he did not hesitate to take a "country wife." Charlotte Small was nearly 14 and the daughter of a Cree and HBC trader Patrick Small. Charlotte's first child, Fanny, was born two years later; 12 more followed.

Intermarriages among whites and natives were accepted on both sides, even encouraged as kinship ties. The rival fur companies competed to cement such relations, then reached farther inland, hoping to keep one jump ahead of the others. By 1800 they were probing the Rocky Mountains.

The boundary between British America and the U.S. at that time extended from Lake Superior only to the Continental Divide. The rich Oregon Country beyond was claimed by both nations, and the British traders grew alarmed when Lewis and Clark left to survey the U.S. West, using one of Thompson's maps to get through Mandan country. In 1806, to press British interests, Thompson was sent to Rocky Mountain House near today's Calgary, Alberta, to find a practical passage across the Rockies for fur-laden packhorses.

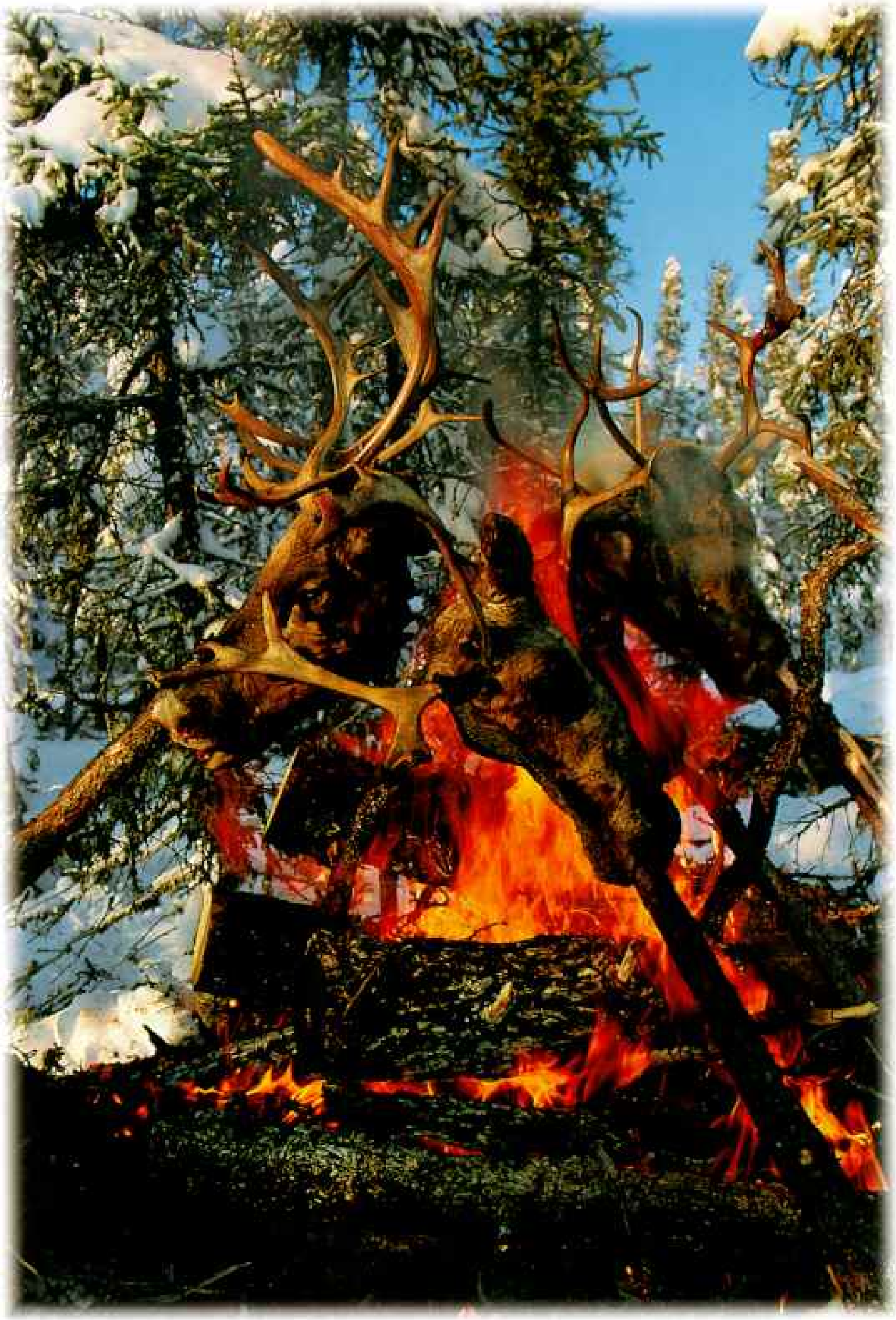
I DRIVE NORTH FROM CALGARY to test firsthand the great continental barrier that challenged him. On this summer day the prairie that Thompson predicted would, "in time, become the abode of Mankind" is in flower. Highway 11 cuts through a slice of countryside buttered with yellow canola fields and tufted with aspen, their trunks gathered like schoolgirls in stockings.

Near the town of Rocky Mountain House, on the North Saskatchewan River, only two stone chimneys remain of the old trading post, and to the west the land toughens up. David Thompson Highway cuts through pine woods so desolate that the car radio zips through the seek format like a hummingbird finding no flower to alight upon. The air is spiced with woodsmoke, and the mountains shake out slowly like bears awakening.

Thompson wrote about these Rockies with a romantic heart: "The imagination was apt to say, these must once have been liquid and in that state, when swelled to its greatest agitation, suddenly congealed and made solid by power omnipotent."

But the massif was huge and hostile beyond the ken of Europeans, and the Nor'Westers suddenly had enemies. The Piegan, angry that traders had supplied guns to the Kootenay, their rivals across the mountains, harassed exploratory expeditions. When the Piegan in 1807 were drawn south to help avenge the death of two Blackfeet at the hands of Lewis and Clark, Thompson hurried up the Saskatchewan and crossed the mountains through a Kootenay route now known as Howse Pass, 80 miles northwest of Banff.

As usual, the family was in tow. "One of my horses nearly crush[ed] my



A BACKWOODS DELICACY, CARIBOU HEADS ARE ROASTED AFTER A HUNT BY DENE IN UPPER SASKATCHEWAN. THOMPSON AND HIS INDIAN COMPANIONS ONCE COMBINED MATHEMATICS WITH NATIVE RECKONING TO CALCULATE THE SIZE OF AN IMMENSE CARIBOU HERD AT 3,564,000.

My men were the most hardy that could be picked out of a hundred brave hardy

CUT OFF AT HOWSE PASS BY PIEGAN INDIANS IN 1810, THOMPSON AND HIS MEN WERE FORCED TO FIND AN ALTERNATE TRADE ROUTE ACROSS THE ROCKIES. MAKING THEIR OWN SNOWSHOES, THEY SWITCHED GEAR FROM HORSES TO DOGSLEDS AND CROSSED ATHABASCA PASS IN THE DEAD OF WINTER.

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children to death from his load being badly put on," he wrote, "which I mistook for being vicious; I shot him on the spot and rescued my little ones."

He reached the Columbia but didn't know it; the river deceived him because it flows incongruously north for 200 miles before looping back southwest to the Pacific. For the next four years Thompson explored the Columbia's tributaries into what is now Idaho, Montana, and Washington.

Competition for the Oregon Country escalated in 1810. The ships of John Jacob Astor's Pacific Fur Company had rounded Cape Horn and were sailing north to establish the Columbia Basin as American territory, land that British Canada felt was part of its fur fiefdom. Thompson was sent to claim the watershed, but the Piegan again blocked Howse Pass and terrorized the expedition. Thompson fled, hastily, and Astor's men were first to arrive at the mouth of the Columbia.

Thompson's detractors have claimed he was a coward for not fighting the Piegan and that he cost the British their claim to the Oregon Country. Most historians now say there was no "race to the sea," as this final chapter of the fur trade was known, that the British were more interested in business than in dominion.

With a heavy heart Thompson had struggled north to the Athabasca River in today's Jasper National Park, determined to find an alternate route to Howse Pass. It was late fall, and he had spent 19 days building snowshoes and dogsleds for a thrust up the Athabasca and its tributary, the Whirlpool, to the cut in the mountains now known as Athabasca Pass.

men, but the scene of desolation before us was dreadful, and I knew it.

—ROCKY MOUNTAINS, 1811

men, but the scene of desolation

ON A CHILLY JULY MORNING I set off from Jasper on a four-day packhorse trip up the Whirlpool to trace this part of Thompson's journey. David Flato, our trail guide, and Tom McCready, a wrangler, outfit three horses, and we clatter on an old logging road into forests of melancholy spruce. The trail cuts from forest shadow to meltwater bogs and into sunlit halls of aspen where elk browse. It meanders along wind-raked gravel flats where the river separates into icy ribbons. A drizzling rain moves in to obscure Scott Glacier, a gray tongue flopped mightily between snowswept peaks. It's 48°F.

Thompson and his crew struggled up the Whirlpool in four exhausting days, the dogs wallowing through the snow on the frozen riverbed, while the hunters scoured the barren land ahead for vagrant game. Morale was low, the men surly, and each was daily eating eight pounds of pemmican—dried buffalo meat mixed with fat and berries. Thompson was disgusted. "One of my men named DuNord beat a dog to death," he complained.

On our second morning, July 4, we awake to more rain and the muffled bells of our horses, hobbled for the night. Tom cocks his ear to a low rumble: "Avalanche!" he says. "Chunk of ice tore loose." That afternoon we skirt a rough slope where pine trees have been freshly decapitated. Thompson, too, had seen pines "cut clean off as with a scythe."

Athabasca Pass arrives gently as a U-shaped meadow on a jumble of fresh quartzite blocks. The horses wade through meltwater to three small tarns. One pond is the Committee's Punch Bowl, named in honor of the London board of the Hudson's Bay Company; its chilly outlets flow both to the Pacific and the Arctic Oceans.

The pass, wrote Thompson, "was to me a most exhilarating sight, but . . . the scene of desolation before us was dreadful, and I knew it. A heavy gale of wind, much more a mountain storm, would have buried us beneath it. . . . My men were not at their ease, yet when night came they admired the brilliancy of the stars, and as one of them said, he thought he could almost touch them with his hand."

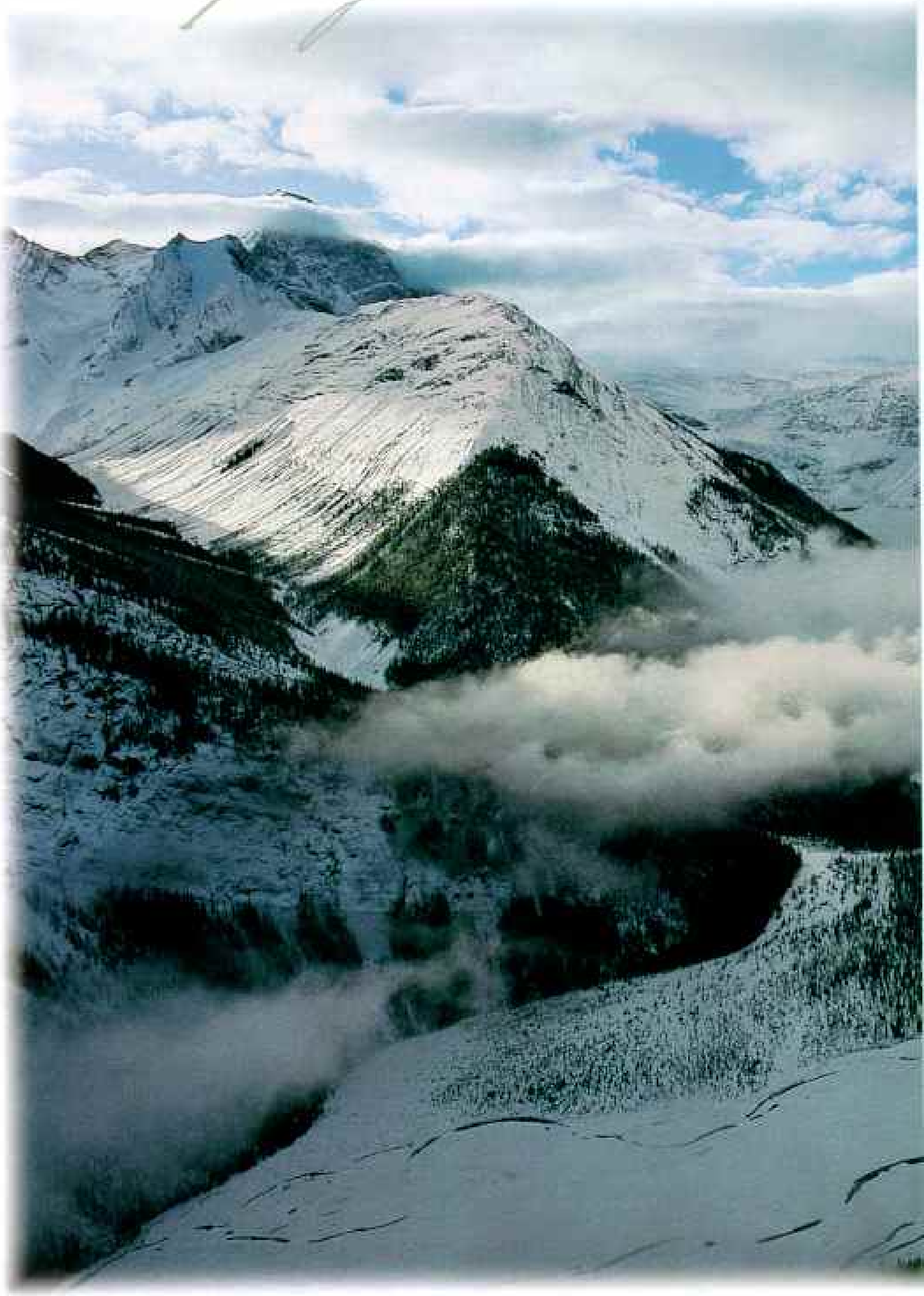
Thompson had found what Alexander Mackenzie and others had failed to find: a safe, navigable route to the western coast. For more than seven decades, until the Canadian Pacific Railroad threaded the mountains farther south in 1885, Athabasca Pass carried the bulk of the continent's fur trade.

Thompson's expedition reached the Columbia in 15 days, but the crew rebelled against Thompson's relentless pace. Five men turned back, and he was forced to winter at Boat Encampment by the hairpin turn the Columbia makes around the head of the Selkirk Mountains. Then he detoured toward established posts in the tributaries to recruit more men. When he reentered the main stem near Kettle Falls two months later, he stuck a British flag into the stern of his canoe, and at a rest stop he posted a notice, formally taking possession of the land for King George III.

"We continued our journey, amused with the seals playing in the river," and on July 15, 1811, "we arrived at Tongue Point, which . . . brought us to a full view of the Pacific Ocean." Fort Astoria of the United States, built two months earlier and manned by two former North West Company clerks,

Many reflections came on my mind; a new world was in a manner before me, and

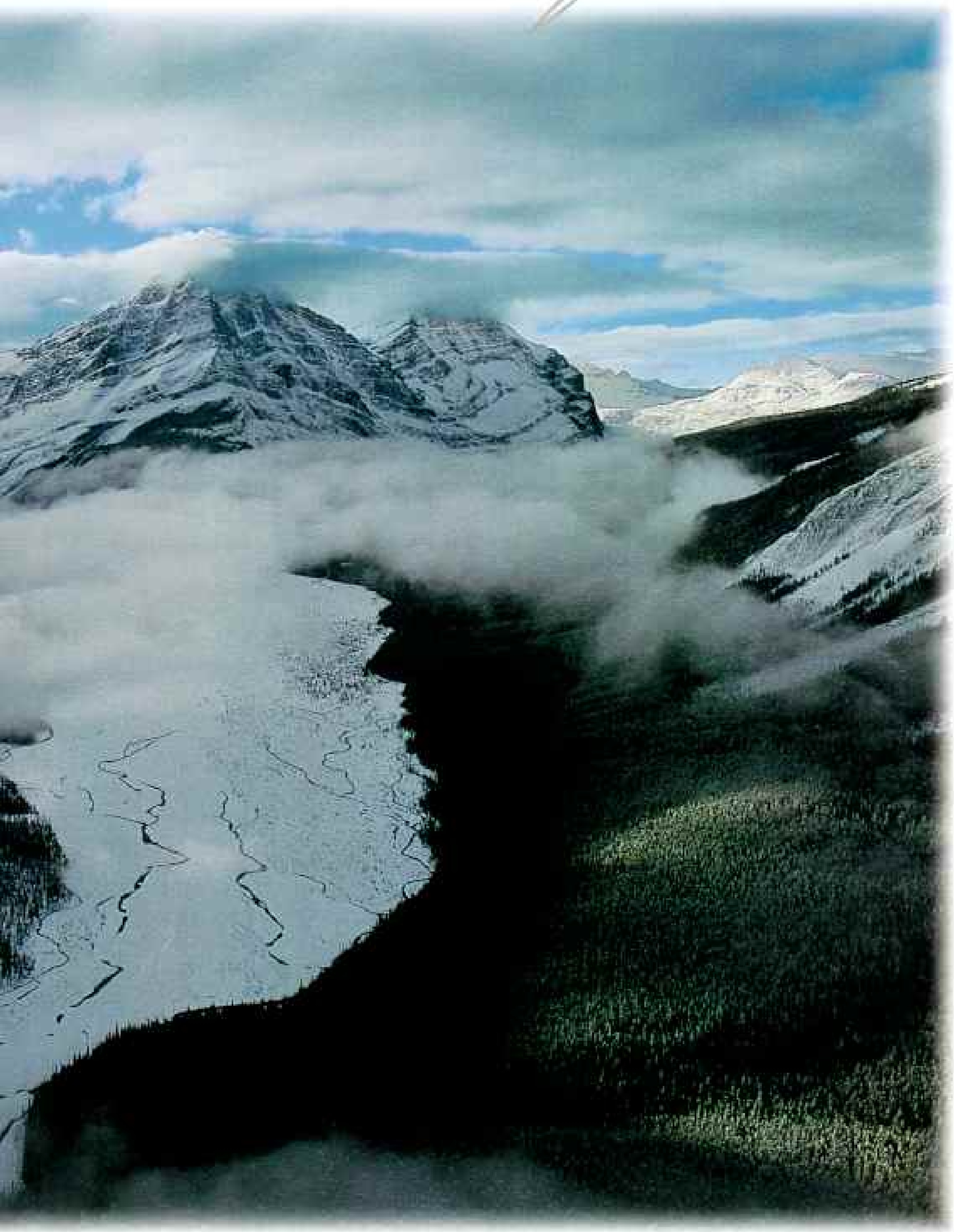
, and my object was b



WINTER CORRIDOR TO THE CONTINENTAL DIVIDE, A FROZEN RIVER LEADS UP TO ATHABASCA PASS IN THE HEART OF JASPER NATIONAL PARK. CROSSING IT ON JANUARY 10, 1811, THOMPSON SOON ACHIEVED HIS GOAL, REACHING THE MOUTH OF THE COLUMBIA AND THE PACIFIC ON JULY 15.

my object was to be at the Pacific Ocean before the month of August.

—ATHABASCA PASS, 1811



By almost innumerable astronomical observations have determined the positions

received him "politely." The question of territorial claims was not resolved until 35 years later.

On his return upriver Thompson became the first to have explored the entire course of the Columbia. He flattered the Indians, to deprive the Astorians of as many customers as possible. But many of the natives had finally realized that a swift erosion of their own culture followed in the Europeans' wake. For the next three decades violence plagued the region.

THOMPSON NEVER AGAIN WENT WEST. In 1812 he settled in Terrebonne, near Montreal, and in two years completed his monumental, detailed ten-by-six-foot map of western Canada. Now in the Archives of Ontario, in Toronto, it was the definitive map of that region for more than 50 years.

While many traders simply left their native families in the bush, Thompson had his children baptized and his marriage solemnized in church. He settled at age 45 in Williamstown, Glengarry County, in today's Ontario, a retirement town for Nor'Westers, mostly Highland Scots.

I arrive at Thompson's old house in Williamstown under stars so lucid that I feel the old magician himself has conjured up the sky. He could talk for hours about the grandeur of the cosmic mechanism, if he could find someone to listen. Even here, in the company of colleagues, Thompson was the outsider—"that Welshman."

"He was not part of the Highland web of kinship," says David Anderson, who gives tours of the classic Georgian home, where he lives with his family. "And he wasn't a socializer."

And Thompson was not content to retire. He became a British representative to the International Boundary Commission from 1816 to 1826, and he surveyed the Ontario section of the U.S. border. Thompson farmed and invested, poorly, in a potash works and a blacksmith shop. He tried to set up businesses for his sons, but they, like his men, did not live up to his expectations. He failed to collect debts and was forced back to work.

At age 67, Thompson surveyed the Muskoka region of southern Ontario to find an alternate canal route to avoid the Great Lakes. He trekked from Georgian Bay to the Ottawa River in a cedar canoe, through today's Algonquin Park, and through lakes now strewn with vacation cottages.

He forwarded his other maps to the British government in 1826, but when the British negotiated for the Oregon Country and Thompson offered firsthand knowledge, he was ignored. He chafed under the slights.

"He was a humble man, and he didn't have a hustler's mind," said Stanley Landell, Thompson's great-great-grandson, a retired businessman in Orillia, Ontario. "Everyone knew . . . here was this chump."

Destitute, Thompson and Charlotte went to live with their daughter Eliza and her husband, Dalhousie Landell, in the Montreal suburb of Longueuil. He had sore feet and a collection of slippers, and in 1848 he was led, blind, to a doctor who relieved him of scleritis and a cataract. At 76, he still found the power to weave journals and memory into his *Travels.* His daughter Mary recalled that he would relive his adventures as he wrote, and, "we would hear

of the mountains, lakes, and rivers . . . on the northern part of this continent.

—WILLIAMSTOWN, ONTARIO, 1815

The Mountain Lake

him laugh heartily over them with tears streaming down his cheeks."

He died in 1857, ten years before Canada became an independent nation. Fifty years after his death the unfinished manuscripts were retrieved and edited by J. B. Tyrrell, a Canadian geologist, and published by the Champlain Society in 1916. Since then, scholars have worked to retrofit Thompson into history as one of North America's founding fathers.

At the Mount Royal Cemetery in Montreal, Section C, Lot 507, an unkempt juniper pushes against the pedestal of a marble column scarred by acid rain. Metal rods protrude from where a bronze sextant had once been attached to its top. "Look who's buried here," I tell John Kalina, a mechanic at the cemetery for some 30 years. He squints at the inscription:

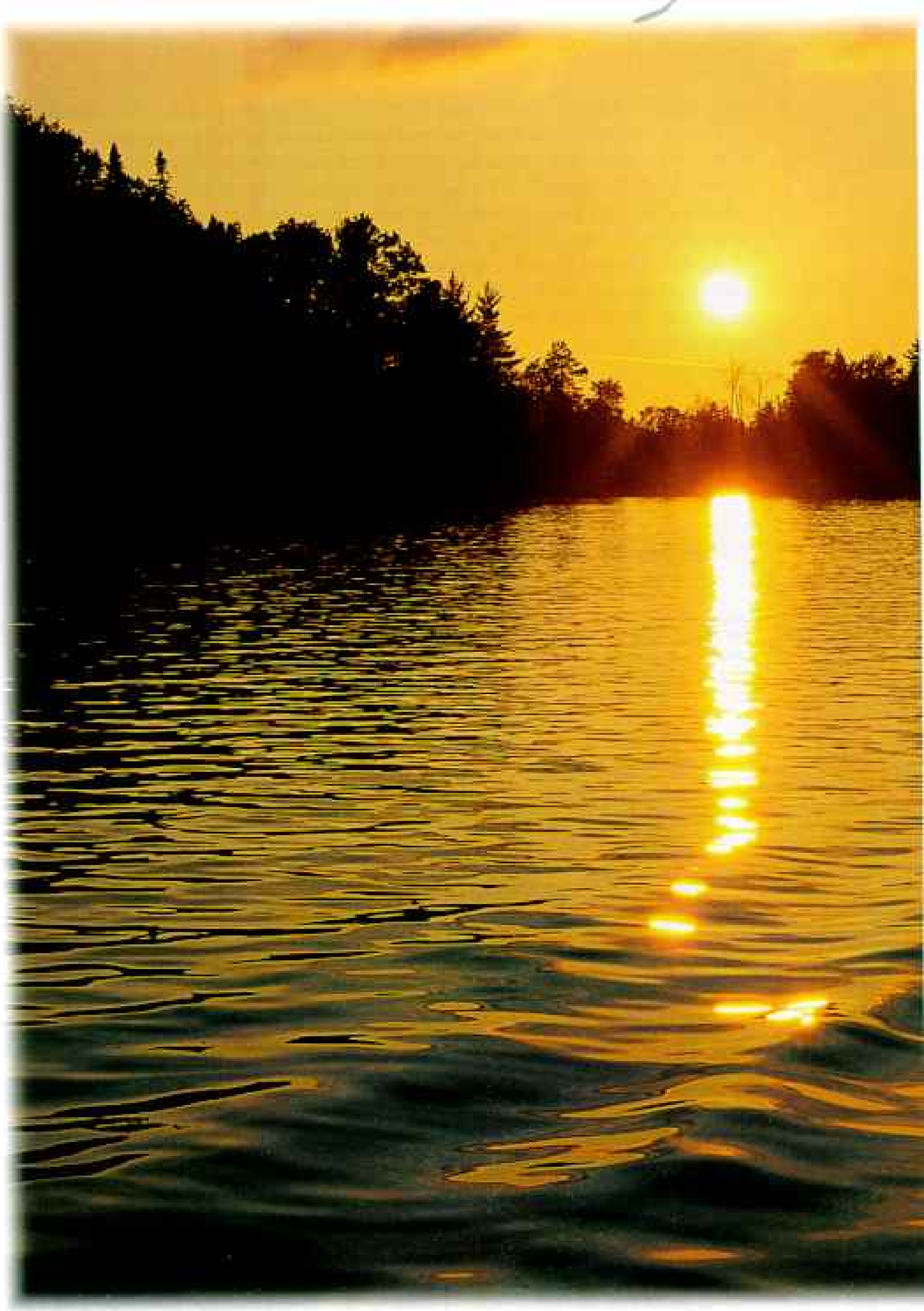
DAVID THOMPSON 1770-1857
To the memory of the greatest of Canadian geographers, who for 34 years explored and mapped the main travel routes between the St. Lawrence and the Pacific.

"Never heard of him," he says.

AFTER 28 YEARS IN THE BUSH, THE BACKWOODS ASTRONOMER TURNED CARTOGRAPHER AND SPENT THE NEXT 30 YEARS PERFECTING HIS GREAT MAPS OF WESTERN CANADA. THOUGH MUCH COPIED, THEY EARNED THOMPSON A PITTANCE, AND HE WAS FORCED BACK TO SURVEYING TO SUPPORT HIMSELF.

ART CONSULTANTS: VICTOR HOPWOOD AND SEAN PEARS

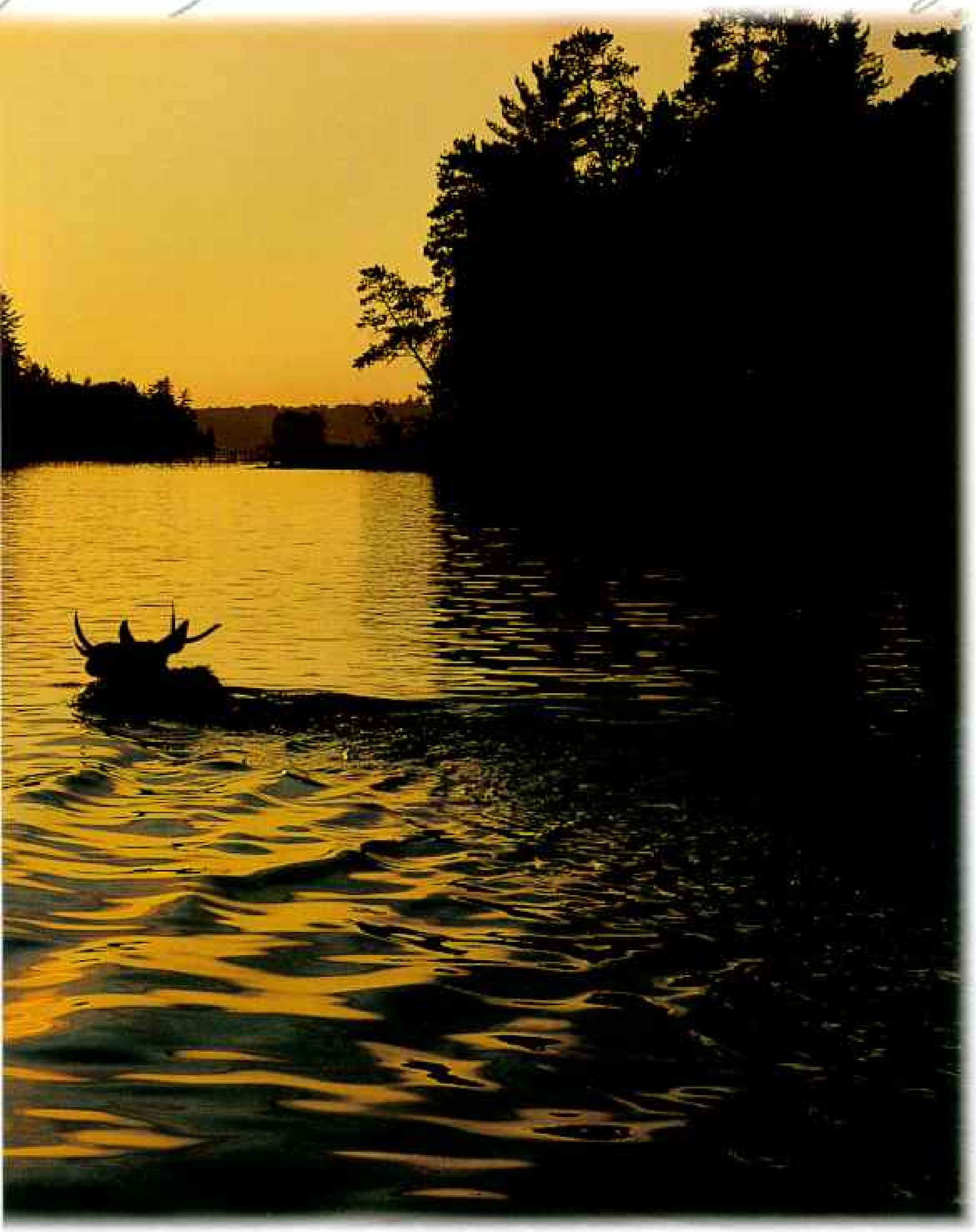
The first in order is the moose deer, the pride of the forest, and the largest of all



EDUCATED BY EXPERIENCE, THOMPSON ALSO BECAME AN ACCOMPLISHED NATURALIST, FILLING HIS JOURNALS WITH COPIOUS NOTES ON CANADA'S WILDLIFE. A MOOSE, A LAKE, AND AN ONTARIO SUNSET CAN STILL EVOKE THE LOVE OF NATURE THAT LURED HIM TO CHART A CONTINENT.

the deer.... His sagacity for self preservation is almost incredible.

—WITH THE NAHATHAWAY, 1795



FLASHBACK

CLIFTON ADAMS

■ FROM THE GEOGRAPHIC ARCHIVES

Sweating It Out in California

Taking the heat in a "sweatbox" was thought to remedy over-indulgence in the 1930s. The booth, its curved translucent shell roof diffusing the burning sun, was the rage in the stylish Palm Springs resorts at the edge of the California desert.

Moving west to Hollywood to complete his southern California coverage for the November 1934 issue, our staff photographer Clifton Adams received instructions from his editor to find a movie star "with whose name scandal had not been connected." Adams replied, "The only actress out here who hasn't indulged in scandal seems to be Minnie Mouse."

This photograph was never published.

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The way that guy saw into our future, he ought to do horoscopes on the side.

When the Wallingfords spoke with Allstate Agent Jim Parolin, he suggested they could save on their homeowners insurance by adding smoke detectors, a fire extinguisher and deadbolt locks. Three weeks later, while Louise was pulling an apple pie from the oven, she heard her husband scream. He was working on his car in the garage when the engine caught fire. Louise rushed in with the new fire extinguisher, her husband put the fire out, and the car and house were safe. **For the Wallingfords—**

Being in good hands is the only place to be.™

Allstate Agent Jim Parolin of Merrimack, NH, predicts the next time Louise bakes one of her famous apple pies, he'll just happen to be in the neighborhood.

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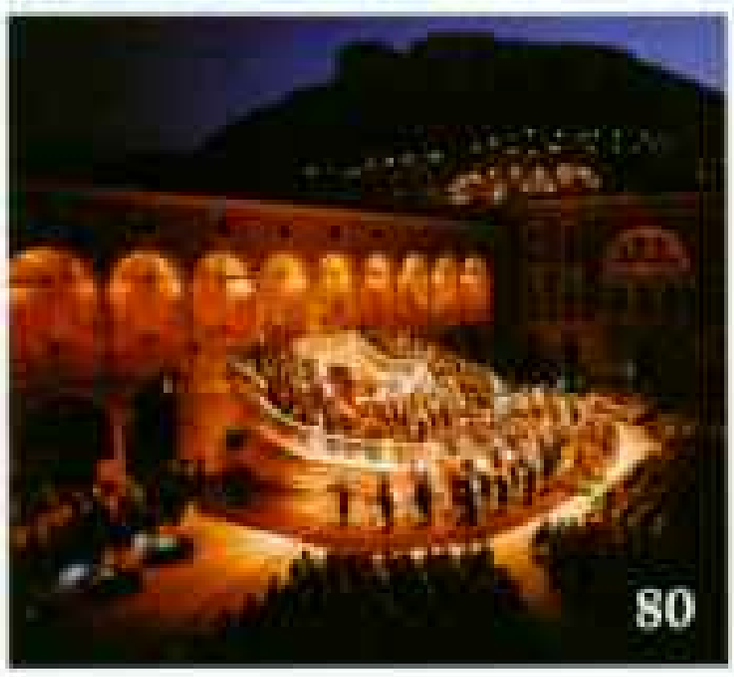
NATIONAL GEOGRAPHIC

MAY 1996



2 **Peru Begins Again** *Bankrupt and beset by terrorists in 1990, Peru today enjoys a new sense of national spirit.*
BY JOHN McCARRY PHOTOGRAPHS BY WILLIAM ALBERT ALLARD

36 **Exploring Antarctic Ice** *Scientists probing the continent's winter skirt of sea ice find clues to global climate.*
BY JANE ELLEN STEVENS PHOTOGRAPHS BY MARIA STENZEL

54 **California Desert Lands** *Powdery dunes, Joshua tree forests, and searing rockscapes are now under federal protection.*
BY MICHAEL PARFIT PHOTOGRAPHS BY PETER ESSICK

80 **Monaco** *Tax haven and playground of Europe's ultrarich, this tiny Mediterranean principality embodies luxury and privilege.*
BY RICHARD CONNIFF PHOTOGRAPHS BY JODI COBB

96 **The Great Dinosaur Egg Hunt** *Scientists hit paydirt in their search for insights into the family life of dinosaurs.*
BY PHILIP J. CURRIE PHOTOGRAPHS BY LOUIE PSIHOYOS

112 **David Thompson** *Fur trader and naturalist, this unheralded explorer discovered the headwaters of the Columbia River—and mapped the heart of Canada.*
BY PRIIT J. VESILIND PHOTOGRAPHS BY MARIA STENZEL
PAINTINGS BY GREGORY MANCHESS

Departments

Behind the Scenes
Forum
Geographica

Flashback
On Television
Earth Almanac
On Assignment

The Cover

Extraordinary fossil finds in China enabled Brian Cooley to model a dinosaur embryo in its 18-inch-long egg. Photograph by Louie Psihoyos

Cover printed on recycled-content paper.

NATIONAL GEOGRAPHIC

Behind the Scenes

SUSIE BRIMBERG, HOT (BELOW); MARIA STENZEL

Gone South

A CHAIN SAW CAME IN HANDY when photographer Maria Stenzel covered Antarctic ice. "We used it to cut this hole [above]; I stuck a camera on a pole through it and prayed it would work." It did (see pages 44-5).

Maria spent 50 days last summer aboard the research ship *Nathaniel B. Palmer*, a journey, though difficult, she likens to visiting Antarctica by limousine. After accompanying researchers on their daily rounds on the ice, "I'd stay on deck to catch the last of the light," she remembers. "I'd think about how hard it had been for early explorers like Shackleton. Then I'd smell the cook's chocolate-chip cookies baking and realize how lucky we were."

It's in the Cards

HOW DO WE keep track of every subject touched on in the GEOGRAPHIC? For a hundred years our Indexing Division detailed who and what appeared in each issue on three-by-five cards—700,000 of them—dating back to the Society's beginnings (right).

"The old card catalog took up an entire room of its own, and researchers had to come to *it*," says Indexing's Bryan Knedler.

Now it comes to them; staff can access a new, easy-to-update system from their own desktop computers.

The cards, though part of Society history, will not be missed. Says Bryan, "We spent a lot of time filing!"

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WILLIAM ALBERT ALLARD (ABOVE); WOLFGANG SCHILLER

A Peruvian Reunion

HIS TEARS broke our hearts when Eduardo Condor Ramos appeared in the March 1982 issue. The Peruvian shepherd's flock had been killed by a car just before photographer Bill Allard arrived. Members sent donations to replace the sheep; extra money was used to fund local schools. Returning to Peru for this issue, Bill looked up Eduardo, now 23, who with his wife sells truck mud flaps in Cuzco. Here Bill shows them the photograph our readers can't forget.

Sticking With Us

POLAR EXPLORER Will Steger's first exposure to the Society came at age ten in Richfield, Minnesota, when he swapped his new hockey stick, a Christmas present, for a sled-load of a neighbor's old GEOGRAPHICS. "Willy didn't much like hockey," remembers his mother, Margaret. "But he loved photography, and he loved those magazines. We became members soon after that."

Bee Ready for the National Geography Bee

AN ANIMATED MASCOT named BuzzBee (below) cheers displays of geo-genius in the Society's newest computer game, GEOBEE. The software, for ages ten and up, poses questions from previous National Geography Bees. The final round of this year's National Geography Bee airs on TBS, Wednesday, May 29, at 8 p.m. ET.

—MAGGIE ZACKOWITZ

DIGITAL ALCHEMY, © NGS

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Goodfellow's Tree Kangaroo (*Dendrolagus goodfellowi*) **Size:** Average length of head and body, 59 cm; tail, 70 cm **Weight:** Approx. 10 kg **Habitat:** Mid-montane forest in New Guinea **Surviving number:** Unknown

Photographed by D. Parer & E. Parer-Cook

WILDLIFE AS CANON SEES IT

Goodfellow's tree kangaroos are fairly solitary by nature, but a mother and her offspring remain close together for a year or more until the young joey is self-reliant. First venturing out of its mother's pouch at about eight months, the joey begins to explore its surroundings, springing tentatively from branch to branch, eating leaves and fruit, and curling up to sleep in the fork of a tree. As adults, tree kangaroos move skillfully, using their strong tail for balance and padded feet and long claws for climbing. Threatened by ongoing encroachment even in areas once considered inaccessible, these arboreal marsupials are disappearing from the rain forest due to hunting and habitat loss. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

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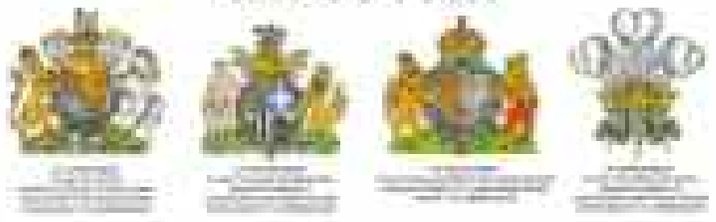
DISCOVERY



Always use your seatbelts. SRS/airbags alone do not provide sufficient protection.

Forum

Neandertals

I found myself chuckling while reading the engrossing article on Neandertals (January 1996). I think that my siblings and I may harbor Neandertal genes. We all inherited an occipital bun, a bulge at the base of the skull typical of classic Neandertals, from my father's side of the family, who came from Lithuania. Being of European extraction makes it possible for me to have Neandertal ancestors. Perhaps Neandertals and modern humans did more than coexist for 10,000 years. If we could extract DNA for comparison with modern humans, that would solve part of the riddle of what happened to the Neandertals and where we got our bumps.

BERNARD J. LANE, SR.
Pleasant Garden, North Carolina

The hyoid bone, mentioned as a key in determining the presence of speech in Neandertals, is present in most mammals. More important is the position of the voice box, or larynx. Through vocal-tract reconstructions, some authorities believe that the Neandertal larynx was higher and resembled that of nonhuman primates and human infants. Their speech-producing capabilities were most likely somewhat limited phonetically.

KENNETH R. SETZER
Miami, Florida

The "virtual Neandertal" on page 15 bears a strong resemblance to a rock engraving from La Marche, a 16,000-year-old site in France, shown in the October 1988 issue on page 448. Although late Pleistocene artists did often distort human representation, might we be seeing in this engraving something close to portraiture and a verification of the University of Chicago reconstructions, even though Neandertals were thought to die out around 30,000 years ago?

THOMAS HAMEL
Morgan Hill, California

If the Neandertals lacked the tools with which to sew clothing in Ice Age Europe, they certainly must have been quite hairy. If they were hairy and underdressed, of course the modern humans would have nothing to do with them!

PATTY BUTTER
Brooklyn, New York

If Neandertals lived just below the advancing glaciers, they had to keep warm. An animal skin is an excellent cold-weather insulator. However—and please note this to your illustrator—it insulates best when the fur is on the inside.

RICHARD A. LANDGRAFF
Long Beach, California

Why not extrapolate clothing styles from the Inuit? Loincloths are not in keeping with a near-Arctic environment, even in summertime.

AMY M. CARMAN
Albany, New York

With only cut marks on a skull as evidence, the case for cannibalism is unpersuasive. The only veritable evidence of cannibalism would be the presence of human tissue in coprolites (fossilized feces). Still, I envy the archaeological team that was able to walk the same soil as the Neandertals of 30,000 years ago.

KIMBERLEY KATANIK KURIS
Mississauga, Ontario

The *Edmund Fitzgerald*

The author states that the ship "vanished without one signal for help." I was a marine radio operator in Thunder Bay, Ontario, working the midnight shift on November 10, 1975. I received a transmission from the captain of the freighter *Manitoulin*, which was entering the harbor, asking me if I had heard anything about the *Edmund Fitzgerald*. Several hours earlier in towering seas the *Manitoulin* had heard the *Fitzgerald* issue a safety call, a lesser call than an SOS, meaning something is amiss and anyone hearing the call should stand by. This safety call would indicate that the crew of the *Fitzgerald* knew they were in some danger immediately before they went to the bottom, which may tend to favor one theory over another as to precisely why and how this ship sank.

TOM BURK
Keewatin, Ontario

My dad was a cook on many ore boats, including the *Fitzgerald*. When the season was over, he stated that he was glad he was off that ship. During storms it would creak and groan like no other ship he had been on. He said someday it was going to break in half and sink.

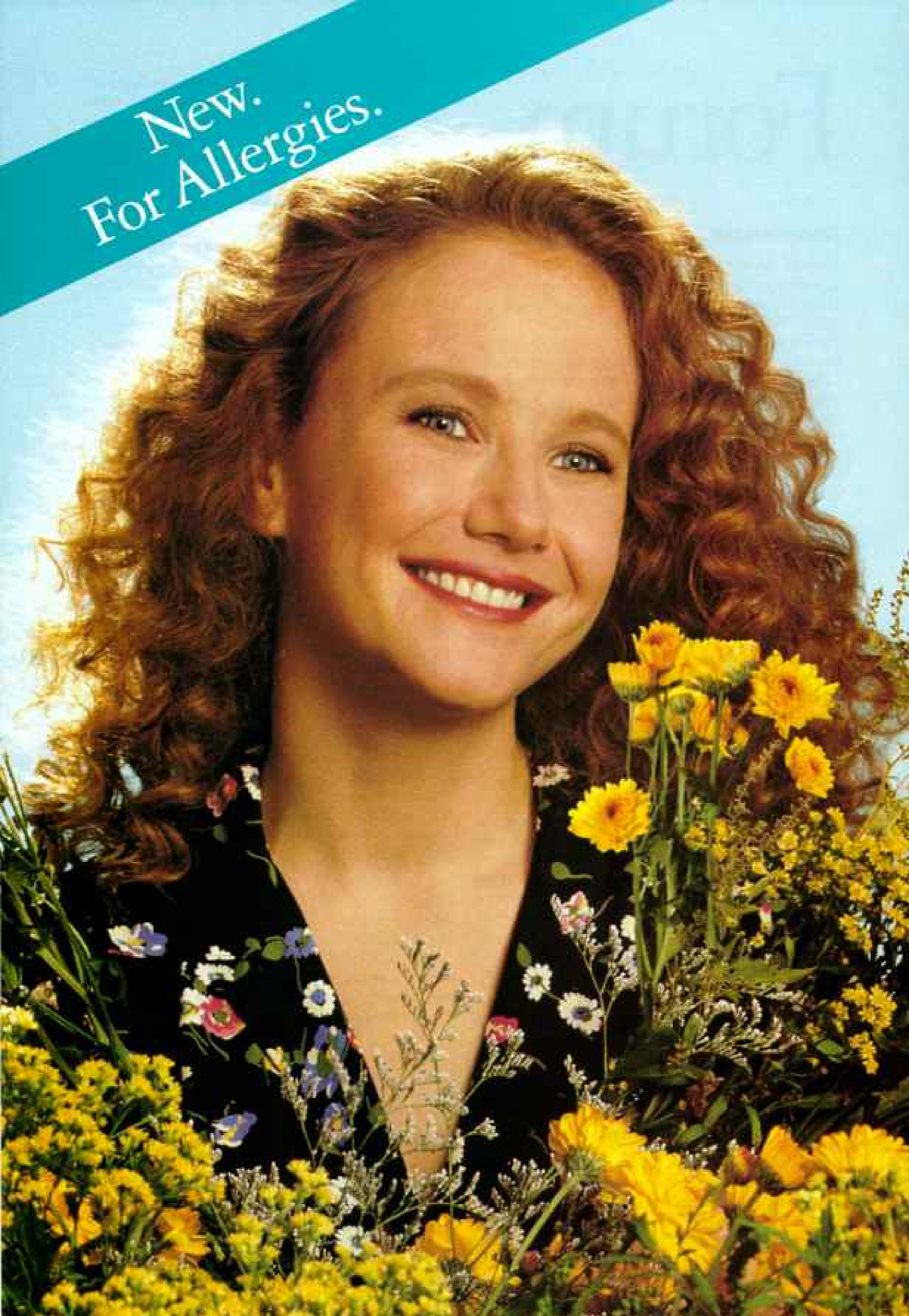
PAUL DETTLAFF
Crandall, Georgia

I don't consider the loss of the ship a mystery. During World War II a number of tankers broke in two, some at dockside. In the case of the *Fitzgerald*, bow and stern were lifted by 30-foot seas, while 26,116 tons of taconite pellets were pushing down. Below a certain temperature a crack can run around the circumference of a hull faster than the eye can follow; it can start with a sloppy weld. I think a crack popped and ran around the hull of the *Fitzgerald*. In a trice the ship disappeared from radar. A brittle failure busted the hull, and the *Fitzgerald* was lost.

BENJAMIN T. ROGERS
Embudo, New Mexico

The article opines on page 38 that the ship's slamming into the bottom caused the midsection to disintegrate. Not so. The ship was tearing apart due to pounding in rough seas, and it took on water. Shifting cargo and increased stress amidships separated the bow and stern. The stern, now blunt with

New.
For Allergies.



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(cetirizine HCl) tablets

BRIEF SUMMARY

ZYRTEC™ (cetirizine hydrochloride) Tablets For Oral Use (FOR FULL PRESCRIBING INFORMATION, CONSULT PACKAGE INSERT) **CONTRAINDICATIONS** ZYRTEC is contraindicated in those patients with a known hypersensitivity to it or any of its ingredients or hydroxyzine. **PRECAUTIONS** Activities Requiring Mental Alertness: In clinical trials, the occurrence of somnolence has been reported in some patients taking ZYRTEC; due caution should therefore be exercised when driving a car or operating potentially dangerous machinery. Concurrent use of ZYRTEC with alcohol or other CNS depressants should be avoided because additional reductions in alertness and additional impairment of CNS performance may occur. **Drug-drug Interactions:** No clinically significant drug interactions have been found with theophylline at a low dose, azithromycin, pseudoephedrine, ketoconazole, or erythromycin. There was a small decrease in the clearance of cetirizine caused by a 400 mg dose of theophylline; it is possible that larger theophylline doses could have a greater effect. **Carcinogenesis, Mutagenesis and Impairment of Fertility:** No evidence of carcinogenicity was observed in a 2-year carcinogenicity study in rats at dietary doses up to 20 mg/kg/day (13 times the maximum recommended human dose on a mg/m²/day basis). An increased incidence of benign liver tumors was found in a 2-year carcinogenicity study in male mice at a dietary dose of 16 mg/kg/day (6 times the maximum recommended human dose on a mg/m²/day basis). The clinical significance of these findings during long-term use of ZYRTEC is not known. Cetirizine was not mutagenic in the Ames test, and not clastogenic in the human lymphocyte assay, the mouse lymphoma assay, and the *in vivo* micronucleus test in rats. No impairment of fertility was found in a fertility and general reproductive performance study in mice at a dose of 64 mg/kg/day (26 times the maximum recommended human dose on a mg/m²/day basis). **Pregnancy Category B:** Cetirizine was not teratogenic in mice, rats and rabbits at doses up to 96, 225, and 135 mg/kg/day (or 40, 180, and 216 times the maximum recommended human dose on a mg/m²/day basis), respectively. There are no adequate and well-controlled studies in pregnant women. Because animal studies are not always predictive of human response, ZYRTEC should be used in pregnancy only if clearly needed. **Nursing Mothers:** Retarded pup weight gain was found in mice during lactation when dams were given cetirizine at 96 mg/kg/day (40 times the maximum recommended human dose on a mg/m²/day basis). Studies in beagle dogs indicate that approximately 3% of the dose is excreted in milk. Cetirizine has been reported to be excreted in human breast milk; use of ZYRTEC in nursing mothers is not recommended. **Geriatric Use:** In placebo-controlled trials, 186 patients age 65 to 94 years received doses of 5 to 20 mg of ZYRTEC per day. Adverse events were similar in this group to patients under age 65. Subset analysis of efficacy in this group was not done. **Pediatric Use:** Safety and effectiveness in children under 12 years of age has not been established. **ADVERSE REACTIONS** Controlled and uncontrolled clinical trials conducted in the United States and Canada included more than 6800 patients, with more than 3900 receiving ZYRTEC at doses of 5 to 20 mg per day. The duration of treatment ranged from 1 week to 6 months, with a mean exposure of 30 days. Most adverse reactions reported during therapy with ZYRTEC were mild or moderate. In placebo-controlled trials, the incidence of discontinuations due to adverse reactions in patients receiving ZYRTEC 5 mg or 10 mg was not significantly different from placebo (2.9% vs. 2.4%, respectively). The most common adverse reaction that occurred more frequently on cetirizine than placebo was somnolence. The incidence of somnolence associated with ZYRTEC was dose related, 6% in placebo, 11% at 5 mg and 14% at 10 mg. Discontinuations due to somnolence for ZYRTEC were uncommon (1.0% on ZYRTEC vs. 0.6% on placebo). Fatigue and dry mouth also appeared to be treatment-related adverse reactions. There were no differences by age, race, gender or by body weight with regard to the incidence of adverse reactions. Table 1 lists adverse experiences which were reported for ZYRTEC 5 and 10 mg in controlled clinical trials in the United States and that were more common with ZYRTEC than placebo.

Table 1. Adverse Experiences Reported in Placebo-Controlled United States ZYRTEC Trials (Maximum Dose of 10 mg) at Rates of 2% or Greater (Percent Incidence)

Adverse Experience	ZYRTEC (N=2834)	Placebo (N=1612)
Somnolence	13.7	6.3
Fatigue	5.4	2.6
Dry Mouth	5.0	2.3
Pharyngitis	2.0	1.9
Dizziness	2.0	1.2

Due caution should be exercised when driving a car or operating potentially dangerous machinery.

In addition, headache and nausea occurred in more than 2% of the patients, but were more common in placebo patients. The following events were observed infrequently (less than 2%), in 3982 patients who received ZYRTEC in U.S. trials, including an open study of six months duration; a causal relationship with ZYRTEC administration has not been established. **Autonomic Nervous System:** anorexia, urinary retention, flushing, increased salivation. **Cardiovascular:** palpitation, tachycardia, hypertension, cardiac failure. **Central and Peripheral Nervous Systems:** paresthesia, confusion, hyperkinesia, hypertonia, migraine, tremor, vertigo, leg cramps, ataxia, dysphonia, abnormal coordination, hyperesthesia, hypoesthesia, myelitis, paralysis, ptosis, twitching, visual field defect. **Gastrointestinal:** increased appetite, dyspepsia, abdominal pain, diarrhea, flatulence, constipation, vomiting, ulcerative stomatitis, aggravated tooth caries, stomatitis, tongue discoloration, tongue edema, gastritis, rectal hemorrhage, hemorrhoids, melena, abnormal hepatic function. **Genitourinary:** polyuria, urinary tract infection, cystitis, dysuria, hematuria. **Hearing and Vestibular:** earache, tinnitus, deafness, otitis media. **Metabolic/Nutritional:** thirst, dehydration, diabetes mellitus. **Musculoskeletal:** myalgia, arthralgia, arthrosis, arthritis, muscle weakness. **Psychiatric:** insomnia, nervousness, depression, emotional lability, impaired concentration, anxiety, depersonalization, paranoia, abnormal thinking, agitation, amnesia, decreased libido, euphoria. **Respiratory System:** epistaxis, rhinitis, coughing, bronchospasm, dyspnea, upper respiratory tract infection, hyperventilation, sinusitis, increased sputum, bronchitis, pneumonia. **Reproductive:** dysmenorrhea, female breast pain, intermenstrual bleeding, leukorrhea, metrorrhagia, vaginitis. **Reticuloendothelial:** lymphadenopathy. **Skin:** pruritus, rash, dry skin, urticaria, acne, dermatitis, erythematosus rash, increased sweating, alopecia, angioedema, furunculosis, bullous eruption, eczema, hyperkeratosis, hypertrichosis, photosensitivity reaction, photosensitivity toxic reaction, maculopapular rash, seborrhea, purpura. **Special Senses:** taste perversion, taste loss, parosmia. **Vision:** blindness, loss of accommodation, eye pain, conjunctivitis, xerophthalmia, glaucoma, ocular hemorrhage. **Body as a Whole:** increased weight, back pain, malaise, fever, asthenia, generalized edema, periorbital edema, peripheral edema, rigors, leg edema, face edema, hot flashes, enlarged abdomen, nasal polyp. Occasional instances of transient, reversible hepatic transaminase elevations have occurred during cetirizine therapy. A single case of possible drug-induced hepatitis with significant transaminase elevation (500 to 1000 IU/L) and elevated bilirubin has been reported. In foreign marketing experience the following additional rare, but potential severe adverse events have been reported: hemolytic anemia, thrombocytopenia, orofacial dyskinesia, severe hypotension, anaphylaxis, hepatitis, glomerulonephritis, stillbirth, and cholestasis. **DRUG ABUSE AND DEPENDENCE** There is no information to indicate that abuse or dependency occurs with ZYRTEC. **OVERDOSAGE** Overdosage has been reported with ZYRTEC. In one patient who took 150 mg of ZYRTEC, the patient was somnolent but did not display any other clinical signs or abnormal blood chemistry or hematology results. Should overdose occur, treatment should be symptomatic or supportive, taking into account any concomitantly ingested medications. There is no known specific antidote to ZYRTEC. ZYRTEC is not effectively removed by dialysis, and dialysis will be ineffective unless a dialyzable agent has been concomitantly ingested. The minimal lethal oral dose in rodents is approximately 500 times the maximum recommended clinical dose on a mg/m² basis and the liver is the target organ of toxicity. **DOSAGE AND ADMINISTRATION** The recommended initial dose of ZYRTEC is 5 or 10 mg per day in adults and children 12 years and older, depending on symptom severity. Most patients in clinical trials started at 10 mg. ZYRTEC is given as a single daily dose, with or without food. The time of administration may be varied to suit individual patient needs. In patients with decreased renal function (creatinine clearance 11-31 mL/min), patients on hemodialysis (creatinine clearance less than 7 mL/min), and in hepatically impaired patients, a dose of 5 mg once daily is recommended. Cetirizine is licensed from UCB Pharma, Inc.

Manufactured/Marketed by
Labs • NBO • Pfizer • Roerig • Specialty
U.S. Pharmaceuticals Group

Marketed by
UCB Pharma

NY, NY 10017
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C1019A94DC Issued December 1995

shifting cargo and under power, turned turtle on the way down. The separation of 200 feet could not be caused by impact, especially with water pressure at the 530-foot mark (17 atmospheres). Indeed, this pounding-tearing explanation explains debris scattered over three acres.

ALEXANDER D. KERR, JR.
Chicago, Illinois

Utah

In an otherwise informative and balanced article author Donovan Webster states that Brigham Young's "This is the place" pronouncement is legend (page 57). In fact, accounts of an eyewitness, Wilford Woodruff, with whom Young rode the last leg of the journey, do confirm the authenticity of Young's statement.

NOLAN DOXEY
Frankfurt, Germany

The article mentions the tolerance Mormons express toward non-Mormons but does not mention the Mormon Church's goal of transforming all humans (dead and alive) into Mormons.

ROBERT E. LINGLE
El Paso, Texas

Before readers pull up stakes and head for St. George to retire, urge them to bring along enough cash to pay for their new residences perhaps twice over. Movement of unstable soils in St. George and Santa Clara is causing severe damage to the new homes. Water seeping underground into the new housing developments saturates subsurface "blue clay," causing it to swell and lift the houses, cracking walls, foundations, and driveways. No warning is given to newcomers.

JOHN DOMBEK
Santa Clara, Utah

As I write this, smog from Salt Lake City reaches as far as Logan, 70 miles to the north. Population is exploding, the crime rate is rising, and housing prices are spiraling insanely upward.

Utah's median family income is in the bottom half of national statistics. The state also consistently ranks low in outlays for mass transit, public safety, and environmental protection, and per pupil education spending perpetually contends for last place. As a lifelong resident of Utah, I can assure you that while Salt Lake City is not Los Angeles, it is just as assuredly not Oz.

GLADE V. HADDEN
North Salt Lake, Utah

Dispatches From the Arctic Ocean

This Arctic trip was supposed to call attention to environmental issues, but the article called attention only to the rigors and rewards of Arctic adventuring. The earth's empty places do not exist as a proving ground for humans. So the human spirit is indomitable. So what?

The river guide interviewed in the Utah article found out what a mistake using wild places for pleasure can be. "All those people on the water at one time, it makes me sad," says Ken Sleight. All these people on the ice sheets, it makes me mad.

JILL MACKENZIE
Minneapolis, Minnesota

Thanks to the efforts of this bold team of adventurers, who made their perilous journey under the constant threat of shifting ice and raging blizzards, we got to see more of what it's like up in the unknown of the Arctic.

PAUL REID
Riverstown
County Cork, Ireland

Center of the Earth

Thank you for the fascinating article "Under Our Skin: Hot Theories on the Center of the Earth." The theory illustrated in Athanasius Kircher's engraving of winds fanning subterranean reservoirs of fire goes back much further than 1665. A 645-verse, pseudo-Virgilian didactic poem titled "Aetna," probably from the first century A.D., is largely devoted to the same.

ROGER HARMON
Basel, Switzerland

You glossed over what seems to be the most fascinating new theory about the inner core of the earth, that it is probably one giant iron crystal, not "iron crystals" as stated in the illustration.

PEGGY L. ROSTRON
Phoenix, Arizona

Earth Almanac

Your dispassionate commentary on the Asiatic black bears shows a tendency to steer around ethical issues. These bears spend most of their lives in cages so small they can't turn around, and the bile extraction is painful. It may be legal in China, but that doesn't make it right. The practice is inhumane, and the Chinese and Taiwanese should be castigated for it.

KEN G. BREALEY
Burnaby, British Columbia

Forum

I am writing to assure readers that the University of Hawaii Institute for Astronomy will continue to protect unique natural and cultural features of Mauna Kea. A letter in the January 1996 Forum suggested the contrary. Dr. Steven Montgomery, who has studied the *wēkiu* bug, told us it is not endangered. The State Historic Preservation Division confirms the observatories have not damaged historic or religious sites.

ROBERT McLAREN
Associate Director
Institute for Astronomy
Honolulu, Hawaii

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

1996 Motor Trend

Caravan o

It could have been any one of dozens of thoughtful new touches that put the new Dodge Caravan over the top in the minds of the Motor Trend *editors.*

Maybe it was the available driver's side sliding door. Or the way Easy Out Roller Seats™ make removal and reinstallation a snap. Might have been the quiet. Or the ride. The handling. Safety features like the standard driver and front passenger airbags. Or the magic way the new Caravan can turn in a smaller circle even though it's longer. Then again, maybe it was simply all that room and comfort for people, and

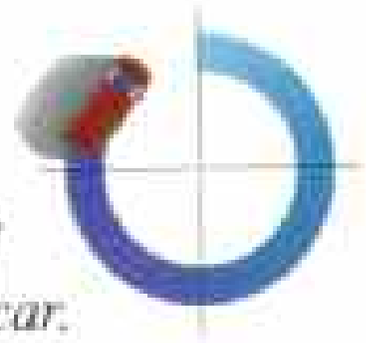
f the year.

Grand Caravan LE

all that versatile, flexible space for cargo.

Whatever it was, all of us here at Dodge are very proud and happy about this singular honor, made all the more special by one remarkable fact:

For the first time ever, the Motor Trend *Car of the Year is more than a car. It's a Caravan.*



The New Dodge Caravan

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ASHLEY STEPHENSON

Chief Horticulturist of England's Royal Palace Gardens, retired.

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when I was put in charge of the Royal Palace gardens.

My mission was to further enhance their beauty. That was when
I first used Miracle-Gro. The results it achieved were outstanding.

I'm still using Miracle-Gro, although today,
the only garden I'm enhancing is my own.

Ashley Stephenson

MIRACLE-GRO

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Now For Snoring, Too.

NATIONAL GEOGRAPHIC

Geographica

ETIENNE FOLLET, FOLLET VISUELS; SAM KITTNER (BELOW)

Vulture Museum Gives a Bird's-Eye View

NOW YOU DON'T have to climb 2,500-foot slopes in the French Pyrenees to see the threatened griffon vulture up close. A museum in the tiny village of Aste-Béon (above, at far left) features television monitors showing images taken by cameras mounted on the heights. Since the museum opened in 1993, some 85,000 visitors have watched the birds fly, feed, even hatch their eggs.

The museum was created by Augustin Médevielle, who was a ten-year-old shepherd in 1959 when two ornithologists arrived to study the vultures. The work of brothers Jean-François and Michel Terrasse intrigued the boy.

The cliffs became part of a 200-acre reserve in 1974; the vulture population rose from 10 breeding pairs to 103 pairs in 1995. Médevielle grew up to be village mayor and raised four million francs ($800,000) to build the museum to honor his beloved birds.

Relics of the U.S. Capitol: On Hold

TUCKED AWAY in a Washington, D.C., park, the stones resemble ruins of a long-lost civilization. Stone balusters and ornate carvings litter a storage area near blocks stacked 12 feet high.

These are remains of the original east portico of the U.S. Capitol, removed in 1959 when the east front was extended 32½ feet and replicated in Georgia marble. Officials brooded about what to do with the old stones until the Architect of the Capitol persuaded the National Park Service to give them a home for five years, with five-year extensions as needed. They've been needed.

These pieces constitute the last source of sandstone quarried at Aquia Creek, Virginia, for the Capitol and the White House, says Capitol historian William C. Allen. When masons recently repaired the White House exterior, they came here for material.

W

I

MOMS AND FORD AGREE.
EVERY KID DESERVES FIVE STARS.

S

T

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N D

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A R

BOB HALLINEN, ANCHORAGE DAILY NEWS

Second Temple Replica May Lie Under Church

IT'S A TALE OF LOVE, religion, and politics from the fourth century B.C.: Manasseh, brother of a Jewish high priest, wed Nicaso, daughter of Sanballat, a ruler of the rival Samaritans. Jewish officials told Manasseh to end the marriage. To keep him, Sanballat built a replica of Jerusalem's Second Temple—center of Jewish life—and made him high priest.

Israeli archaeologist Yitzhak Magen, excavating a sacred Samaritan site on Mount Gerizim in the West Bank, thinks he has found the replica, burned by Judaeans in 113 B.C. Under the remains of a Byzantine church (below), he discovered coins, bones of sacrificed animals, an altar, religious inscriptions, a gold amphora, and a gate similar to a Second Temple gate described in a Dead Sea Scroll.

SHLOMI AMAMI

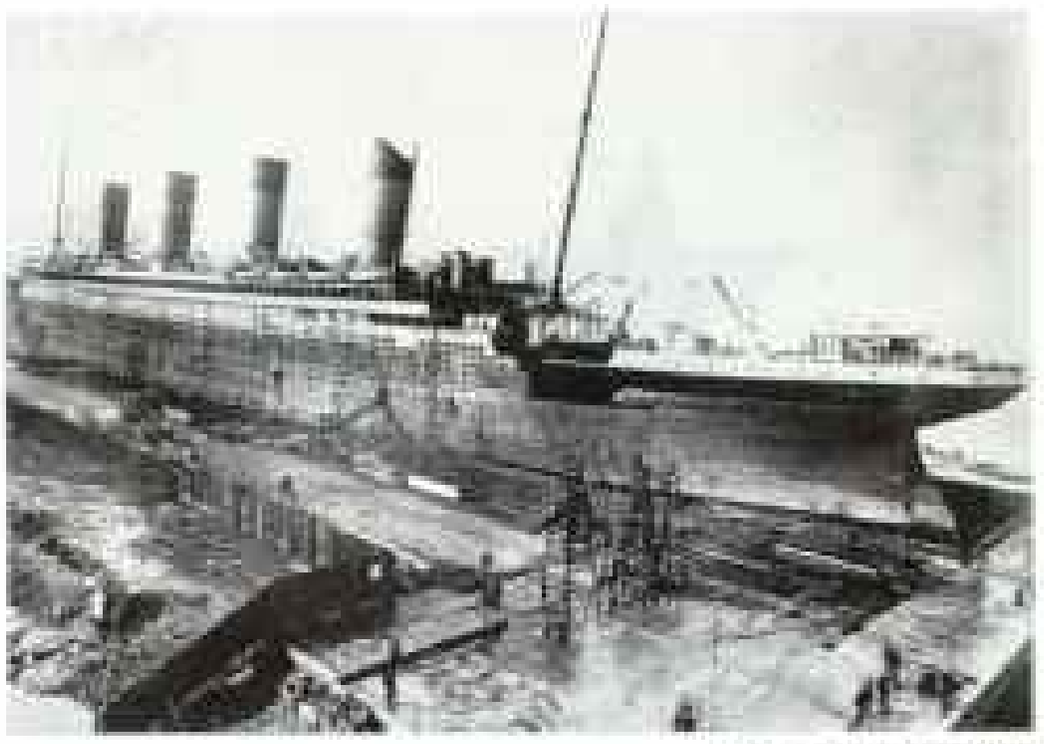
Moose on the Loose Cause Accident Woes

COLLISIONS BETWEEN moose and motor vehicles became so common in Scandinavia that Saab and Volvo redesigned their cars to withstand impact with the massive animals. Now such encounters are rising in North America as moose populations grow and more people drive into moose habitat. Moose-vehicle accidents rose in Maine from 150 in 1981 to 658 in 1994. An increase was also seen in New Hampshire, Alaska (above), Newfoundland, and British Columbia, among other places.

"There's a ten times greater likelihood of being injured by hitting a moose than by hitting a deer," says John E. Sutton, Jr., of the Dartmouth-Hitchcock Medical Center. He led a study by New England doctors that urges U.S. automakers to follow the Swedish lead. It suggests improved windshields and sturdier forward-roof supports.

Titanic's Sinking: A Test of Metal

WORKERS at a Belfast shipyard preparing *Titanic* for her doomed maiden voyage used steel far more brittle than today's steel. When the liner struck an iceberg, that brittleness caused it to sink quickly.



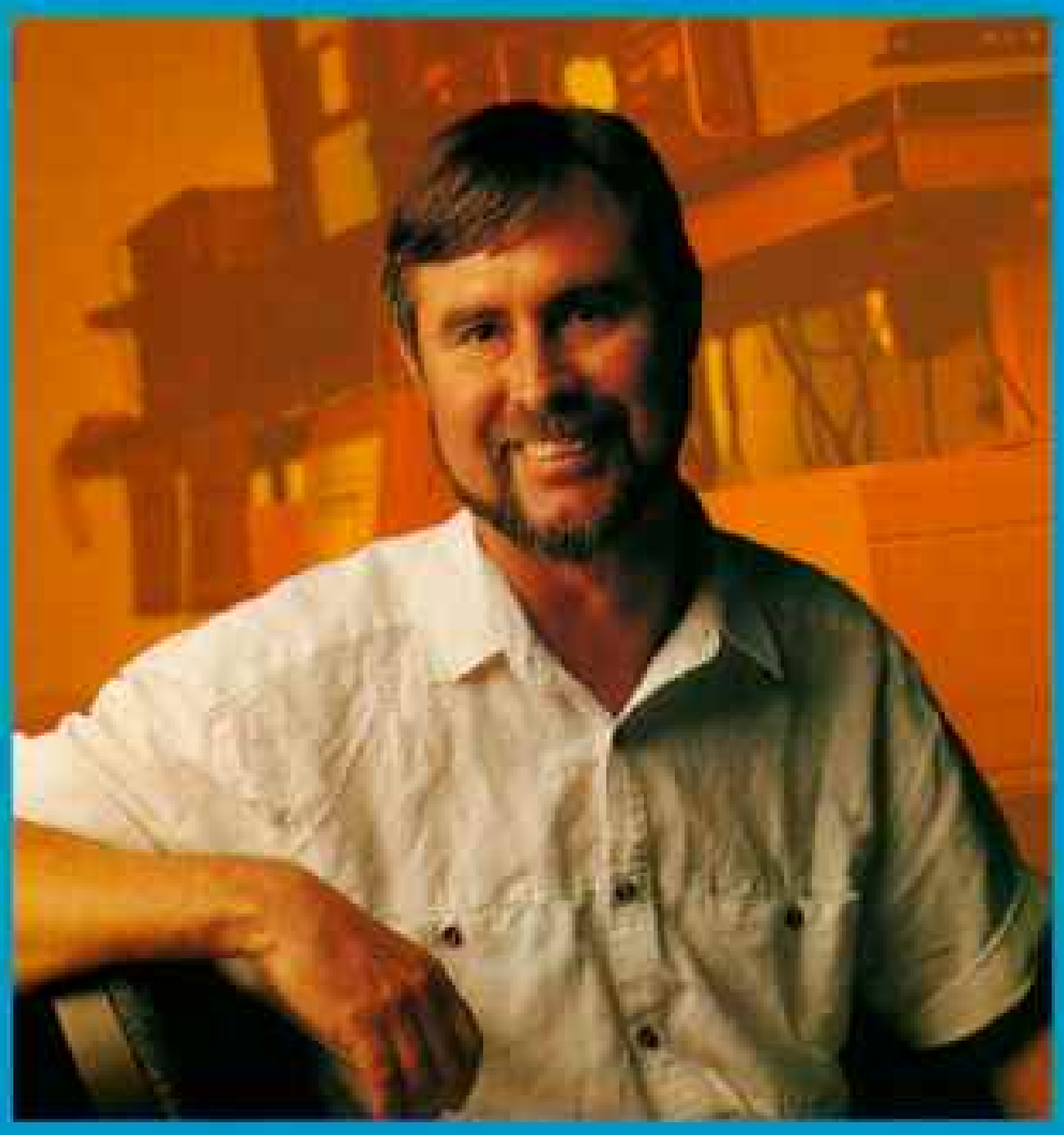
UPI, CORBIS-BETTMANN

This conclusion is based on tests of a dinner plate-size piece of *Titanic*'s hull brought up during a 1991 expedition. The steel, thought to be the best of its time, was high in sulfur and only a fourth as strong as modern ship steel, according to Canadian geologist Steve Blasco. The impact caused the steel to snap.

Robert Ballard, who found *Titanic* (GEOGRAPHIC, December 1985), calls this "an interesting footnote" but stresses that poor seamanship caused the collision that led to the sinking.

—BORIS WEINTRAUB

Designing new products is all about pre-empting questions.



George Ellis, Video Application Engineer, Sunnyvale, USA.

Let's make things better.

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

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*183-horsepower V6 engine standard on 4Runner Limited and 4Runner SR5 models. **Standard on 4Runner Limited, optional on 4Runner SR5.

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NATIONAL GEOGRAPHIC

On Television

■ SPECIAL, MAY 15, 8 P.M. ET

The Arctic Light and Strange Sights

LIKE A CLUSTER OF GHOSTS, beluga whales gather where ice meets open water, haunting the polar sea. The National Geographic Special "Arctic Kingdom: Life at the Edge" brings viewers to a world seldom glimpsed—the Canadian high Arctic during spring and summer. Here, under a never-setting sun, life exults. From clouds of plankton to the rare bowhead whale—at 60 feet the Arctic's largest animal—the film explores one of the last great sanctuaries in its season of resurrection.

DOUG ALLAN

■ PROGRAM GUIDE

National Geographic Specials "Arctic Kingdom: Life at the Edge" NBC. May 15, 8 p.m. ET

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

National Geography Bee TBS. May 29, 8 p.m. ET

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

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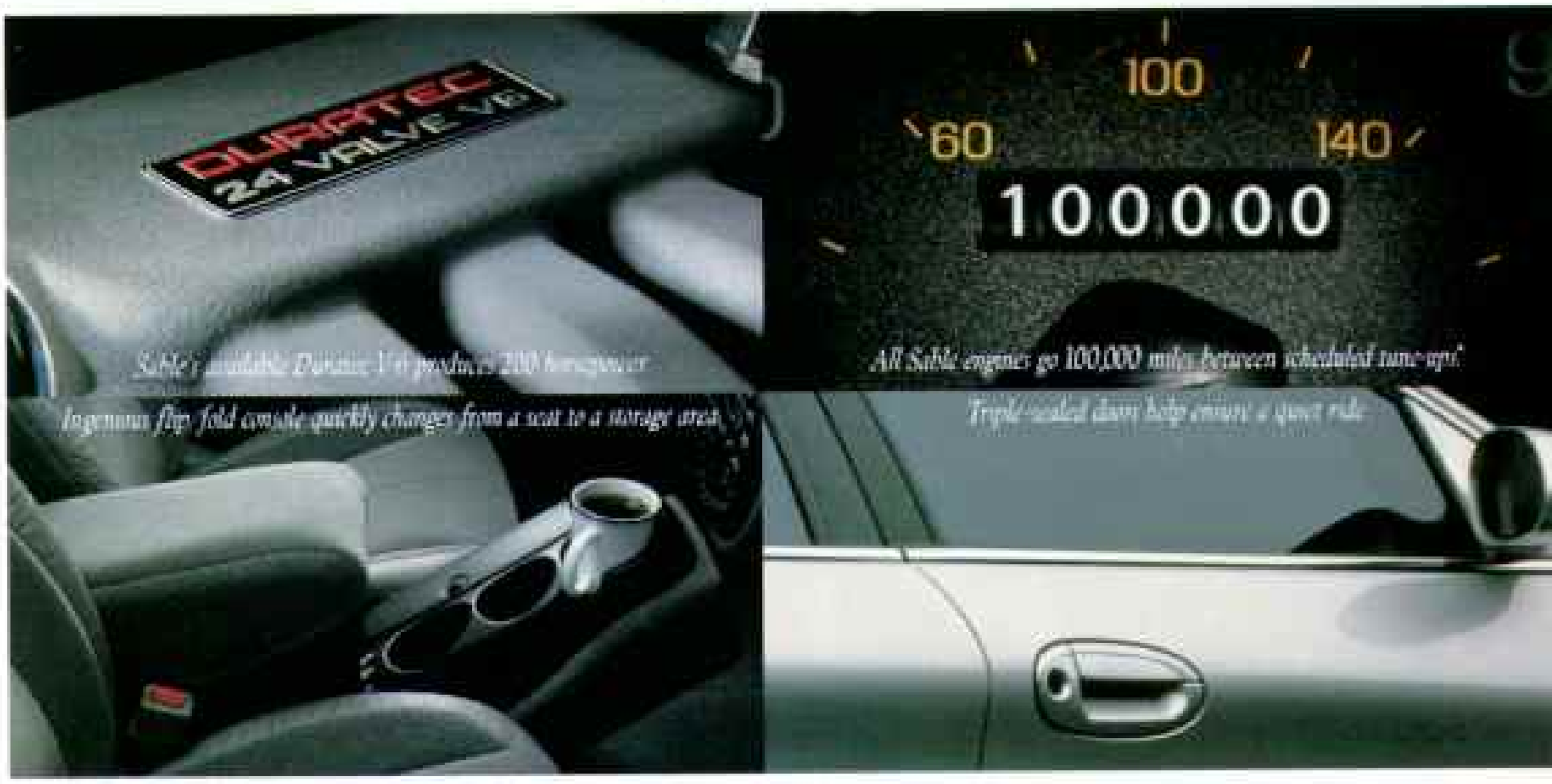
It used to be some stretch of the imagination to think a station wagon could ever deliver the ride, handling and comfort of a sedan. But now it's as simple as imagining yourself in the all-new 1996 Mercury Sable wagon. Sable wagon has a lot in common with Sable sedan — the incredible feeling of solidity, the rewarding and precise road manners and an engine that goes 100,000 miles between scheduled tune-ups* But Sable wagon adds a few twists of its own, like an available rear-facing third seat, a lockable storage

Imaginatio



Sable's available Duratec V6 produces 200 horsepower

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Mercury Sable LS Wagon

area and 818 cubic feet of cargo room within its handsomely styled shape. If you've never considered owning a wagon but you always find yourself in need of more space, call 1 800 446-8888 to learn more about Sable wagon (or enter *http://www.Mercuryvehicles.com* for Internet access). Or visit a Mercury dealer. One test drive and you might find it easier than you think to imagine yourself in the all-new Mercury Sable wagon.

†Under normal driving conditions with more fluid than empty.

Mercury

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IN A MERCURY

n Stretched.

NATIONAL GEOGRAPHIC

EarthAlmanac

JAMES A. SUGAR

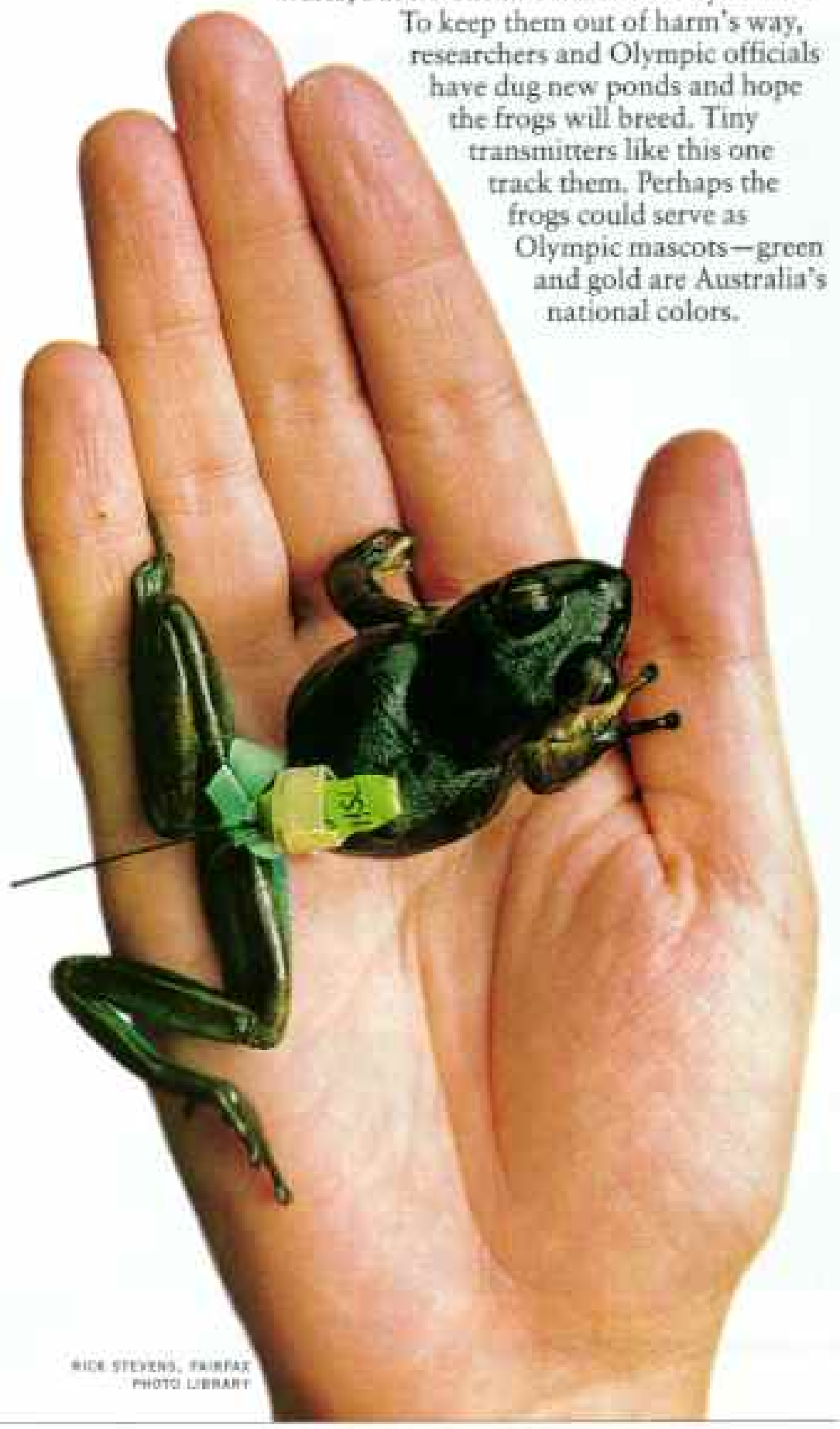
Catching Salmon Fever

A NEAR-RECORD haul of chinook salmon last summer delighted northern California anglers like Gil Nickles, claiming his prize on the Pacifica pier. Why such a windfall here, when salmon are woefully scarce in Oregon and Washington waters?

Improved over the past decade, California's hatchery program produces 35 million salmon smolts a year. Most chinook caught last year were hatchery bred. Two factors boosted the 1995 run. "After these salmon were born in 1992, heavy rains swelled rivers, and many fish made it to the sea," says Alan Baracco of California's Fish and Game Department. Then, warm Pacific water turned cold, providing abundant nutrients for the young salmon. Off the coast, anglers hooked 400,000 of them, more than double the average. Commercial fishermen caught another 630,000. This year Baracco expects average numbers—perhaps half a million total.

Rare Frog Creates an Olympian Challenge

GREEN GAMES: That's what Sydney, Australia, has promised to host for the Summer Olympics of the year 2000. Solar energy will partly power the athletes' village; recycling will be emphasized. But on part of the site, a 40-acre brick pit, a living impediment has surfaced, and officials are ready to croak. Breeding in the pit are endangered green-and-golden bell frogs, between 200 and 300 of them. Most of the little amphibians live in New South Wales, but no one knows how many are left. To keep them out of harm's way, researchers and Olympic officials have dug new ponds and hope the frogs will breed. Tiny transmitters like this one track them. Perhaps the frogs could serve as Olympic mascots—green and gold are Australia's national colors.



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Lost and Found: Tibet Red Deer

NOT SEEN IN THE WILD since the 1940s, Tibet red deer, or shou, have been rediscovered in Tibet's alpine meadows about 75 miles east of Lhasa, the capital.

George B. Schaller of the Wildlife Conservation Society and Chinese colleagues Wang Xiaoming and Liu Wulin found more than a hundred red deer there last October. In 1988 Schaller was in Lhasa and saw four captive stags on display. "That's what led me to believe there were still some in the wild," he recalls. The red deer had been heavily hunted for meat and for body parts sold as medicine. "The Tibetan government is very concerned about these animals," says Schaller. Guards patrol the area, and a reserve may be created for the newfound red deer.

GEORGE B. SCHALLER

Greening of the Czech Republic

A PASSION FOR HIKING has long kept Czechs on the move—their national hiking club dates from 1888. Partly inspired by our June 1990 article "Greenways: Paths to the Future," Czechs and Austrians have created the Czech Greenway, a 250-mile-long network of trails between Vienna and Prague.

Traversed by foot, bicycle, horseback, or canoe, the system connects medieval castles and towns with the countryside. Inviting summer visitors who crowd big cities to wide-open spaces, it winds through Moravian wine country and Bohemia's beer gardens. Czech history and culture survived decades of communist rule; now, as capitalism emerges, preservation is one of the project's goals. "We're telling the local people, 'Your towns and villages can serve as alternatives to cities drawing masses of tourists,' " says Lubomir Chmelar, director of Greenways/Zelené Stezky. This month the nonprofit group will again offer its tours; last year several hundred hikers took part, many hoofing it for eight days.

NGS CARTOGRAPHIC DIVISION

CARL R. SAMS II

Singing a Tricky Tune

WITH ABOUT A HUNDRED NOTES in the species' repertoire, male indigo buntings are super songsters. "But some songs are better than others," says Robert B. Payne. He and his wife, Laura, both University of Michigan ornithologists, have been listening for 20 years.

The birds live in "neighborhoods" where the adult males sing a distinctive song, different from others not far away. Within each group some males improvise variations—and may become role models for young outsiders seeking to win their own territory in the neighborhood. The newcomer may copy an old pro's tune to drive away competing males. Although their elders may approve, such initiative does not help them win a mate, Payne says. Perhaps females crave more than crooners. —JOHN L. ELIOT

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NATIONAL GEOGRAPHIC

On Assignment

JODI COBB, NGS

■ MONACO

Of Print and Princes

HIS FIRST JOB in journalism was writing obituaries in New Jersey, but author RICHARD CONNIFF (above, at left) has found livelier subjects farther afield. His GEOGRAPHIC articles include Ireland, Easter Island, and now Monaco. Prince Rainier "loosened up when I put away my notepad," he says. The two discussed matters large and small: whales, a special interest of the prince's, and insects, the subject of Dick's new book, *Spineless Wonders: An Invertebrate Odyssey*.

■ CALIFORNIA DESERT LANDS

Of Bare Facts and Photography

CLOTHING WAS OPTIONAL, but contract photographer PETER ESSICK opted for it (below, at left) while recording life in a Saline Valley hot spring. The desert is special to the California native. "In high school I camped in Death Valley with a four-by-five view camera and Ansel Adams's *Basic Photo* series. One of my first published photos was of a Joshua tree in the snow," says Peter. Returning after almost 20 years "gave me a chance to reflect on my personal growth."

MICHAEL PARFIT

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