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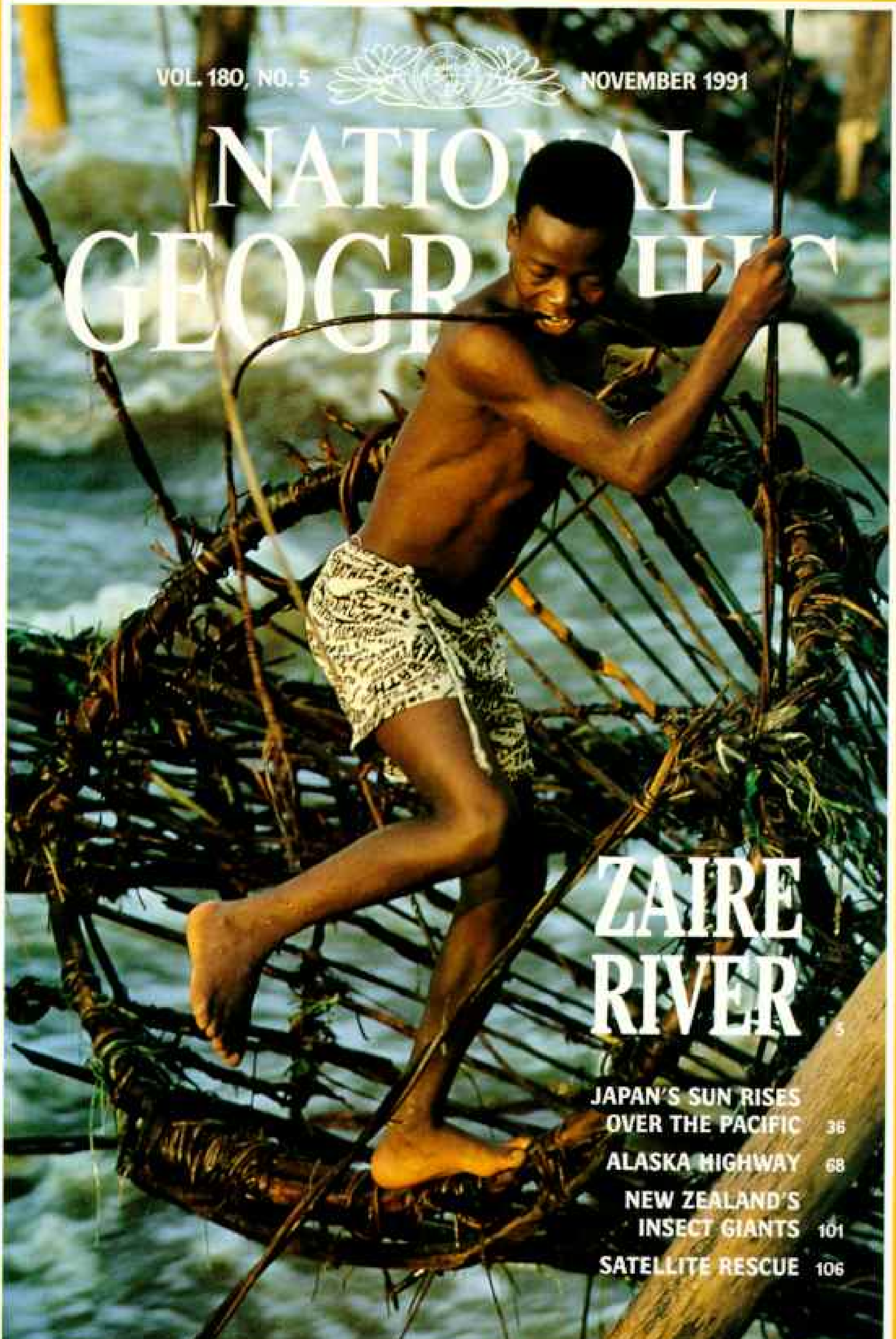

ZAIRE RIVER

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COVER: A young fisherman balances on his snare trap, suspended above rapids on Africa's Zaire River. Photograph by Robert Caputo.

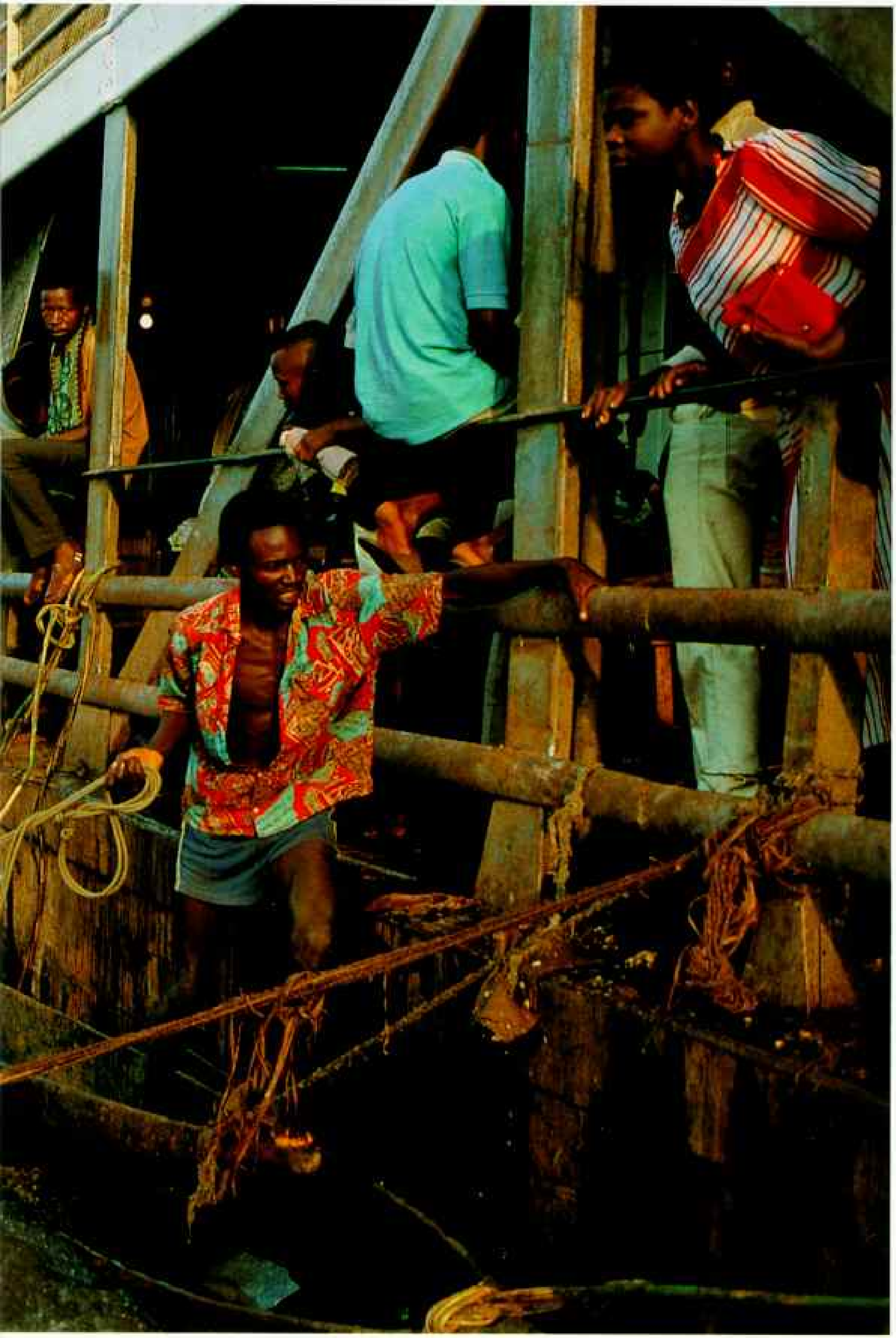

LOKELE

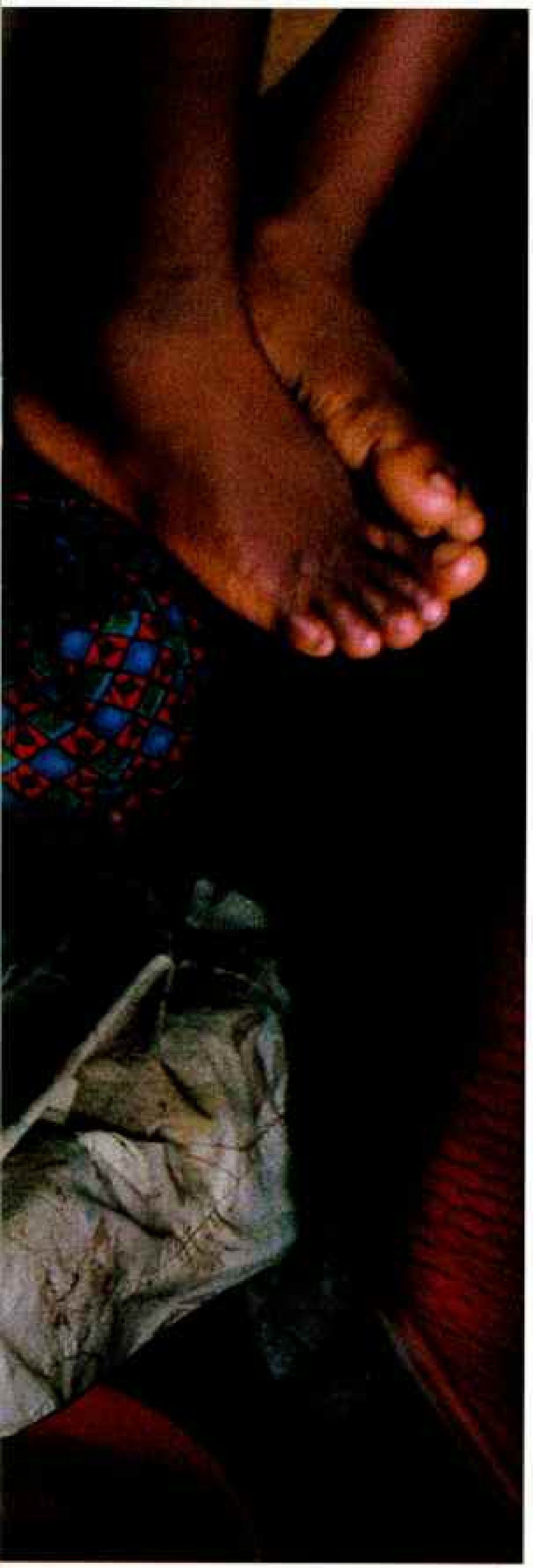
LIFELINE
FOR A NATION

ZAIRE RIVER

Article and photographs by ROBERT CAPUTO

It's unreliable and often dangerous. Still, the *Colonel Ebeya* always draws a crowd. In the heart of Africa on a river once called the Congo, thousands pack the "pusher" and six barges (overleaf), where a fully stocked mobile market includes a live crocodile. To this town-in-tow comes a cross section of the river and nation named Zaire.





CAPTAIN KILUNDU KATIANDA checked the heavily erased and penciled-in course on his ancient chart and peered through his binoculars, looking for channel markers among the distant islands clotting the surface of the river. A stocky, middle-aged man, Captain Kilundu has sailed the Zaire River and its tributaries for 23 years, and though he rarely wears his blue uniform and white cap, he sits in his oversize chair at the helm of the *Colonel Ebeya* as captain, mayor, and judge. Yet of all the authority figures I encountered during my nine-month journey along the river, Kilundu was easily the kindest and most understanding, and I often sought him out for information, and for companionship.

"This is not just a boat," he said. "It is a social service. There are no roads here and very few other boats. This boat is the only market, the only pharmacy, the only clinic, and the only bar for hundreds of miles. We bring the town to the people."

The view from the bridge showed a town in itself: The boat was augmented by the six double-deck barges it pushes, jammed with more than 5,000 people, making the ungainly flotilla one of the largest towns on the 1,077-mile stretch of river between Kinshasa, the capital, and Kisangani. Lashed by vines to the boat, 150 or so pirogues, huge hollowed-out hardwood trees from the forest brooding in the background, waved in the current like suckerfish attached to a great shark.

Aboard Captain Kilundu's fleet, women washed clothes, children, and themselves in water drawn by lowering powdered-milk cans over the sides. They plucked chickens, butchered monkeys, pounded plantains, and cooked for their families in the passageways. People slept and made love in sweltering, dark second- and third-class cabins crowded with bundles of merchandise and smoked meat. Those hundreds of passengers without cabins packed the gangways and rooftops, spreading sleeping mats wherever there was space, napping, playing cards, and gathering in the bars to chat and pass the time. Barbers

There's precious little quiet on the* Colonel Ebeya, *a floating town that never sleeps. Yet amid the clamor of the boat's markets, kitchens, engines, and bars—and shouts from an occasional fistfight—a little girl manages to curl up for a nap.

and tailors practiced their crafts. There were even a couple of photographers who made portraits of fishermen, accepting deposits for prints to be delivered on the return voyage.

People joyously greeted long-unseen friends and haggled over the price of river rats. On one roof young men practiced karate; on another a choir rehearsed for Sunday Mass. The boat police arrested a thief. Having no brig, they handcuffed the hapless fellow to the air conditioner outside my cabin; his wails and rattling chains accompanied the bleating of goats and sheep and the squealing of a pig tethered there—a Congo lullaby.

THE ZAIRE RIVER cuts an enormous arc through the heart of the African continent—"an immense snake uncoiled," Joseph Conrad wrote, "with its head in the sea . . . and its tail lost in the depths of the land." Lying almost entirely within the country of Zaire, the river flows 2,700 miles from the headwaters of the Lualaba, crossing the Equator twice, draining the vast rain forest nestled in the Congo Basin. (Some consider the Chambeshi River the source, adding 200 miles to the Zaire's length.) Countless tributaries lace the forest, feeding the waters that make the Zaire, at ten million gallons a second, the most powerful river, after the Amazon, in the world. This river system offers more than 8,500 miles of navigable waterways, an unparalleled network of virtually maintenance-free highways reaching into every corner of the country and beyond.

There was little activity the first few days out of Kinshasa; we were too near the city for trade. The first-class passengers on the "pusher" and the second-class passengers on the upper decks of the barges arranged their belongings and made themselves as comfortable as possible for a voyage that might last from 12 to 30 days, depending on how often the flotilla ran aground or broke down.

"This boat is our life," a fisherman named Basese told me as he dumped two small trussed crocodiles onto the deck. "Without the boat we have no way to sell what we can catch and grow, and no chance to buy the things we need."

I asked him what he would do on the boat.

"I will sell these crocodiles to a *commerçant*, and my wife and my brothers will sell the fish we brought. Then we have to buy many things, like string so I can make a new net. After that we will all go to the bar so we can drink a cold beer."

"How long will you stay on the boat?"

"We will try to go soon, but sometimes these commerçants don't want to give us enough money, so we have to talk with them a long time. They are very clever. They know the longer we bargain, the farther we get from home. Even from here it will take us more than 15 hours. . . . Do you want to buy them?" he asked, pointing to the reptiles writhing on the deck.

"No, thanks."

The farther we moved from Kinshasa, the busier the boat became. After a few days the corridors became virtually impassable: Makeshift tables loaded with soap, salt, sugar, fishhooks, medicines, and bread crowded one side of each narrow passageway; screaming traders jammed the other. I squeezed through and stepped onto a deck smothered with squirming, seven-foot-long catfish, giant eels, and masses of unidentifiable bottom fish with bulbous lips and whiplike feelers. They had come from the murky river churning below us. A ten-foot crocodile, trussed to a pole, had been dumped under the tables. His jaws were bound with cordlike lianas, but he watched the bare toes that squished past in the blood, diesel fuel, and fish slime with revenge glistening in his green eyes.

The traders leaned over the boat railing, yelling at the hunters and fishermen who arrived, nonstop, in their pirogues. One group of men hurled the fresh carcass of a male sitatunga antelope onto the deck amid the clamoring merchants. Others scaled the railings laden with tortoises, clawless otters, pangolins, monitor lizards, parrots, giant forest pigs, snakes, bats, and baskets of caterpillars. White-nosed monkeys were passed from hand to hand, their tails tied around their necks so they could be toted like furry purses.

Bundles of smoked fish and game meat were stashed everywhere, adding their own particular aroma to the bouquet of roasting palm grubs and the stench of the latrines. Amid the cacophony of traders haggling, babies crying, pigs squealing, roosters crowing, and butchers' machetes thumping, I heard the terrified screams of an infant

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Author and photographer ROBERT CAPUTO has been covering Africa for the past 20 years. His most recent article for the magazine was "Uganda—Land Beyond Sorrow" (April 1988).

PASSAGE INTO THE UNKNOWN

Once called "the river that swallows all rivers," the Zaire thwarted 15th-century Portuguese explorers who meandered past mangroves (above) but were stymied by rapids near Matadi. Not until the 1870s, when Henry Morton Stanley traveled downstream from Nyangwe, did the river begin to reveal itself to Western eyes.

Camped out and crammed into every available space, third-class passengers on the barges tolerate discomfort, lack of privacy, and the boat's uncertain schedule. With only two

dilapidated, government-operated riverboats still working the thousand-mile route between Kinshasa, the capital, and Kisangani, these passengers are among the lucky: They got aboard.

black mangabey monkey tied atop a bundle of charred flesh that probably included its mother. Dead and alive, salted and smoked, the fruits of the forest and river were brought in an unceasing stream to the great movable market heading up the mighty Zaire River.

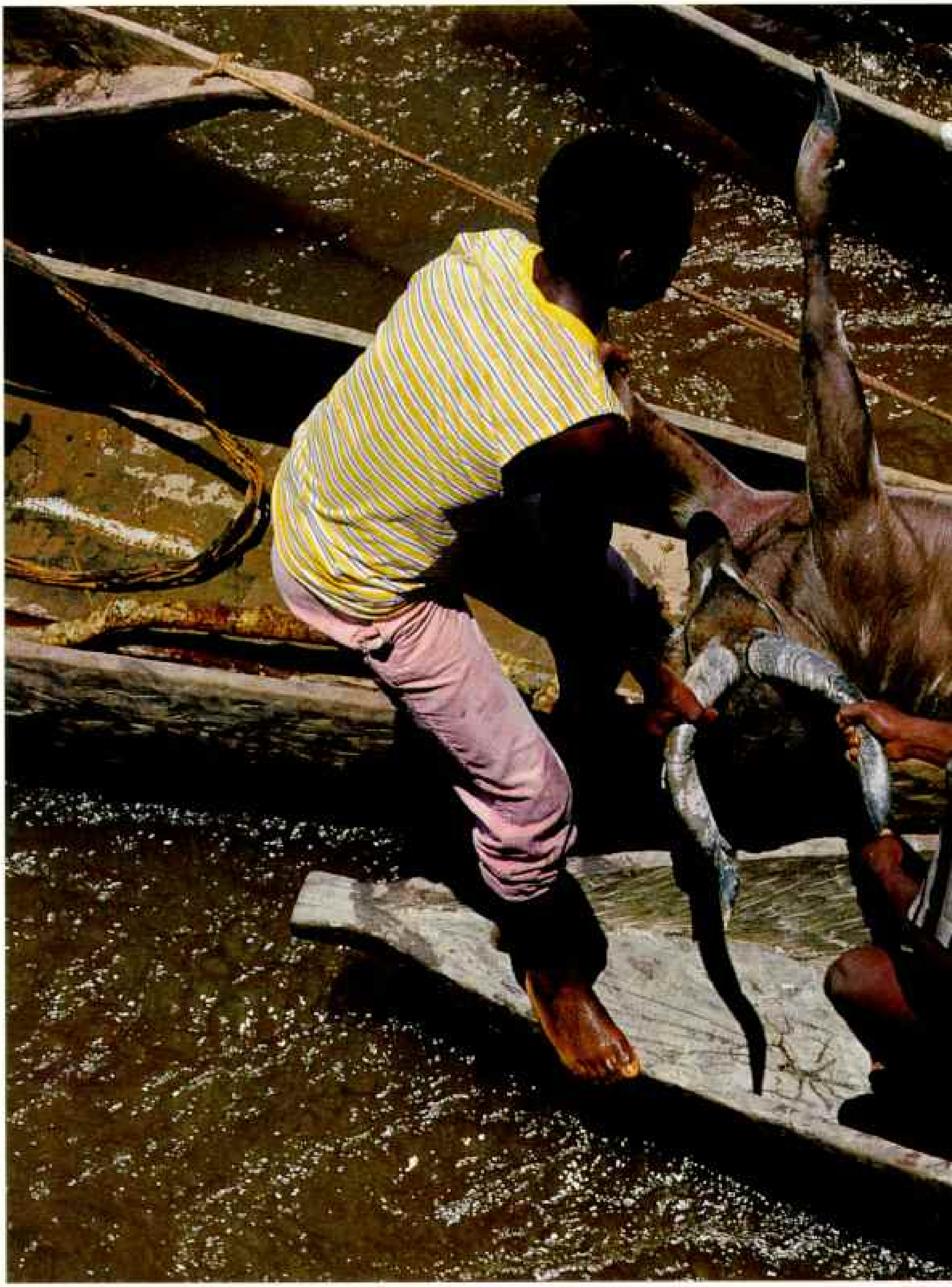
THE FOREST of the Congo Basin has been called one of the lungs of the world. Fed by as much as a hundred inches of annual rain, incubated by the fierce tropical sun, the teeming forest—which covers much of the basin's 1.5 million square miles—is a fecund world. Scientists estimate that a typical four-square-mile patch of tropical forest might contain 750 species of trees (a comparable area of temperate forest might hold ten). Leaving out insects, whose number no one can even guess, the same bit of forest may also hold 1,500 species of flowering plants, 125 of mammals, 400 of birds, 100 of reptiles, and 60 of amphibians. And these are merely the known species. The people of the forest rejoice in the abundance of their hunting grounds.

But such luxuriance also breeds fear. The

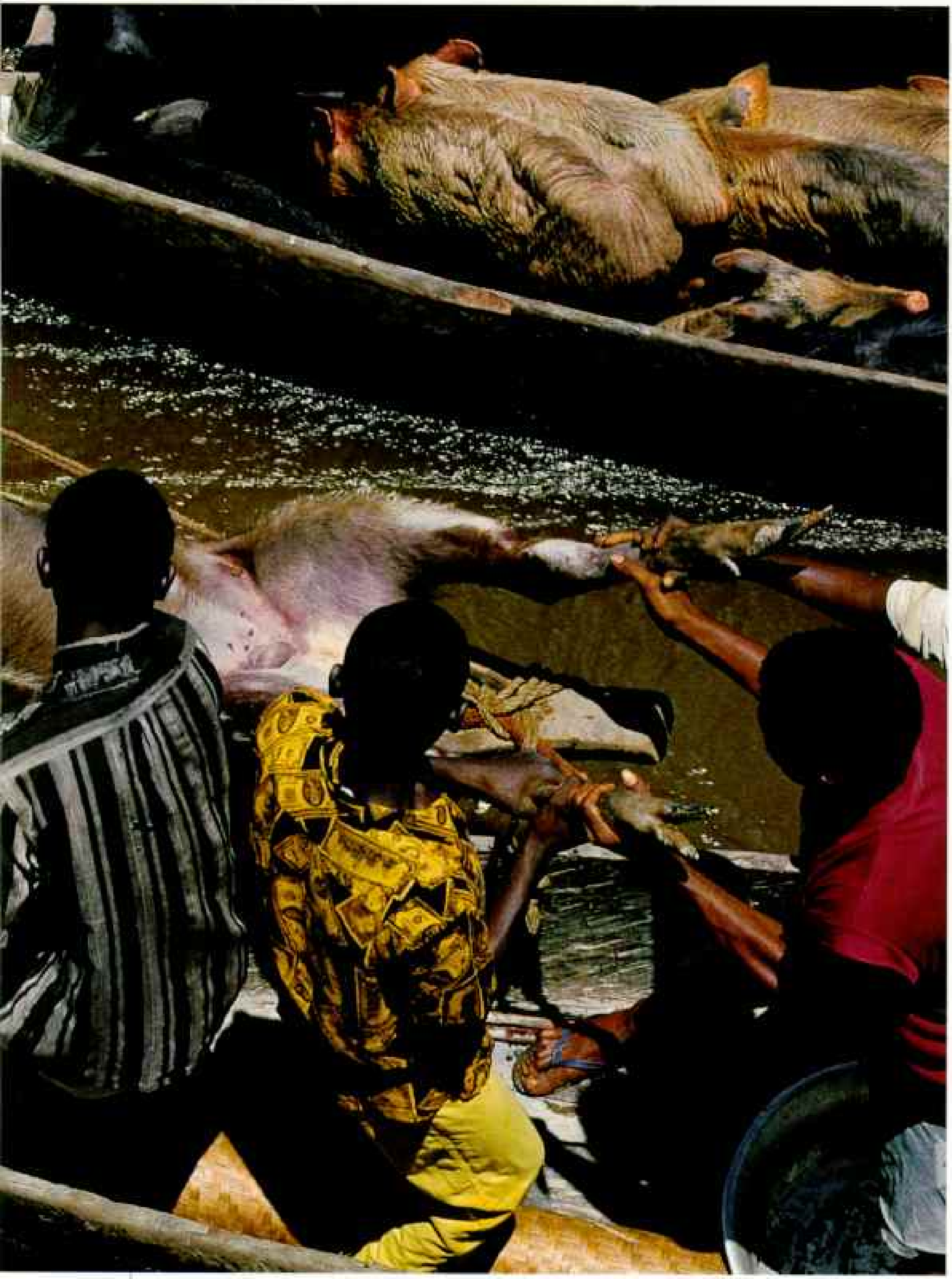
The daily routine—drawing wash water and plucking a bird for dinner—is not neglected on the boat, and neither are the rules. During one overnight sweep, security police flushed out 145 stowaways, who then either paid the ticket price plus a penalty or had their heads shaved with a hand-held razor blade. With no brig on board, police must wait until reaching the next town to throw the bareheaded freeloaders in jail.

Bantu peoples, the vast majority of Zaire's 200 or so ethnic groups, migrated into the forest a scant thousand years ago. They cling to their villages in small clearings hacked into the forest edge and enter that darkened world—where the senses are crowded and unseen creatures slither and crawl—with trepidation. The very fertility that sustains their lives constantly threatens to overpower them. Most towns I saw in Zaire are returning inexorably to bush. Only the implacable forest and the steady stream endure. All seems possible, all seems futile.

From the 18th century to 1971 the river was called the Congo, a name with connotations both noble and base. The Congo nurtured glorious kingdoms where music and art flourished. But along the riverbanks the Arab and European slave trades were at their most brutal. In one of the darkest chapters of the European colonization of Africa, Leopold II, King of the Belgians, exploited the region—nearly 80 times larger than his own country—as his private domain. For Joseph Conrad, who sailed the river during Leopold's time, the Congo was an *(Continued on page 20)*

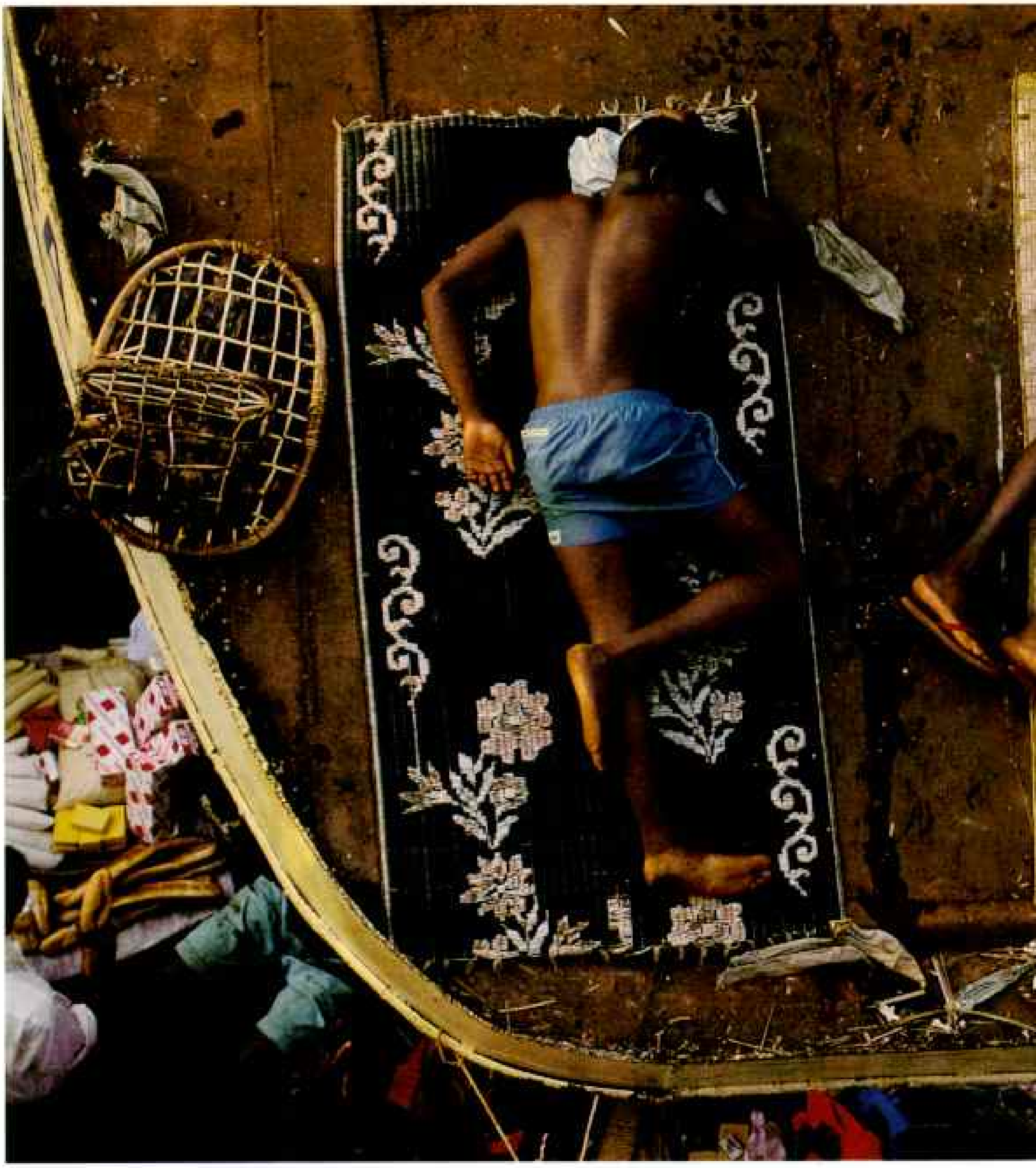


Just slaughtered, a sitatunga antelope will fetch top dollar at Colonel Ebeya's *bargeside market, where merchants aboard pay a premium for fresh meat. Those*



hunters who can afford it outfit their wooden pirogues with outboard motors, but most must paddle furiously to catch up with the boat. It may not return for weeks.

Every day is market day at Colonel Ebeya's emporium, where gangways overflow with the stuff of commerce. Forest people sell crocodiles, manioc, snapping turtles, woven baskets, and antelope (left). The salesmen then become shoppers, buying everything from bread, salt, sugar, soap, medicine, and fishhooks to secondhand clothes, plastic shoes, digital watches, and audio tapes. During a late afternoon break in business, passengers stop at the communal kitchen for a bowl of beans and rice (below). Others savor more exotic fare, including white-nosed monkey stew. A passenger holds a dead monkey beside the boat's smokestack to singe off the animal's hair (above).



artery into the heart of darkness. The *Colonel Ebeya* showed that the river's recent history was tinted with many of the same dark hues.

WE HAD LEFT KINSHASA on a Thursday afternoon—a week late, but that was not unusual. The city, home to three to five million people (nobody knows for sure), marks the beginning of the river's long navigable curve into the interior. In the old days, I was told, boats sailed from both Kinshasa and Kisangani every Monday, passing each other in mid-river. But the voyages have become less and less frequent.

Built in the mid-fifties, the fleet of pushers has suffered greatly from a lack of maintenance. One by one the boats have fallen to ruin and joined the hundreds of rusting wrecks littering the riverbanks. By the time I left Zaire, only two boats still functioned. Public transportation between the capital of Zaire and its fourth largest city had been

"The air was warm, thick, heavy, sluggish. There was no joy in the brilliance of the sunshine." So wrote Joseph Conrad about this river in his 1902 novella "Heart of Darkness." Today the air and time hang heavy over passengers who nap and play cards. For Sala Mosongowindo, the boredom is

just a cost of doing business. For four years she has taken the boat to Kinshasa, where she buys baby clothes to bring back and sell in Kisangani, her hometown. To defray travel costs, she sells manioc to hungry passengers.

reduced to one voyage about every six weeks.

The only other way to get from Kinshasa to Kisangani is by plane, but the fare is far beyond the reach of all but a tiny fraction of Zairians, so competition for passage on the boat is intense. The potholed street leading down to the docks that Thursday was jammed with cars, trucks, merchandise, and thousands of people. Policemen whipped the prospective passengers with wide, webbed belts, forcing them to pass through a metal cattle chute. Pickpockets worked the crowd. I found it prudent to hire four of the gendarmes to carry my gear and usher me through the mayhem.

The sun was wickedly, prickly hot, and my cabin an inferno. The metal shutters on the windows had been welded closed, so there was no air inside and no light save a bare bulb in the ceiling that, like the air conditioner, worked only intermittently. Not that there was much to see besides the stained

walls, broken linoleum, bare wires where there had once been lamps, and the most enormous cockroaches I've ever met.

Being deluxe, the cabin had a bathroom, but it hadn't seen scouring powder for quite some time, and I needn't describe it in any great detail. Suffice it to say that thick, brown river water occasionally issued from the tap into the stopped-up tub but not into the sink or toilet.

Still, I was traveling in relative luxury. First-class passengers—mostly military officers, civil servants, boat-company employees, and their families—spilled out of small cabins with shared bathrooms into the passageways and even camped in the crawl space above. Everyone else had to put up with terrible crowding and the fetid latrines of the barges.

Third-class cabins and passageways on the barges' lower decks were occupied by merchants who virtually lived afloat. "This is my cabin, which I share with five others. And this space here in the aisle is only for me," a merchant named Malu told me. We were sitting on the barge *Bangala* surrounded by his bundles of used clothing. "It is very hard to get a place on the barges, but when you get one, no one else can have it. I have had the same place for two years, going up and down the river on every trip."

"For me it is nine years," a man named Ludingo called out. "For others even longer." He was setting out drugs on his little table: tetracycline, Flagyl, antimalarials, vials of penicillin powder, hypodermic needles, and piles of brightly colored capsules.

I asked Malu how it was possible for the hundreds of merchants to make a living when they all seemed to sell the same things.

"There are very few jobs, so people have to become traders to feed their families," he replied. "Like me—I was at university in Kinshasa for three years, but I ran out of money and couldn't finish my degree. I tried

A comforting hand seems to get the brush-off from a traumatized baby chimpanzee, whose mother was shot and eaten by a forest hunter who then hoped to sell this orphan as a pet. Asking price: $13 U. S. Cute and entertaining when young, pet chimps often end up chained to trees or abandoned when they grow too big and strong to be kept at home.

Missing a channel marker, these barges slammed into a sandbar. It would not be the last time. The wooden channel markers that dot the shoreline are gradually made obsolete by the river's

to find work, but I have no relatives who are big men, which is the only way to get a job. So I trade. I buy used shirts from the market women in Kinshasa and sell them along the river. If I do this for maybe five years, I hope I can have enough money to finish my studies.

"This trade is OK," he went on. "The fishermen have to spend all their money on the boat. They have no reason to take it back to the village—nothing to do with it there. And if they keep it, they lose it."

While I was in Zaire, there was daily erosion of the currency—and daily inflation. In one two-week period, the money in my pocket lost almost half its value. For workers in the towns the nightmare of frozen wages and skyrocketing food prices means few can survive on their salaries. On the boat, money had become virtually irrelevant in an economy that has returned to one of almost pure barter.

"Even we merchants can't hold the money," Malu explained. "When we reach Kisangani, I hope to have none of these shirts and no money either—just fish and

shifting bottom, forcing navigators to rely on memory, intuition, makeshift charts, and trial and error. After a three-day delay, the pusher managed to drag the barges free to try, and err, again.

meat to sell. Then, as fast as I can, I buy potatoes and beans, and that is my stock to sell in Kinshasa and again buy shirts."

One morning I climbed up to the bridge, normally a haven of calm but now an utter madhouse. During the night the boat police had swept through the barges and arrested those they caught without a ticket, 145 in all. The stowaways—who either couldn't or wouldn't pay—were crowded on the bridge, awaiting trial. Some, mostly women with small children, were released. The rest had their heads shaved so they could be identified and taken off to jail at the next town. Most of these were very upset young men; many pleaded and wailed. Others, according to Wanga-Walek, the head of the police, "don't mind too much. They don't have money to pay, but for the price of five or six days in jail they get a ride to town. It is worth that price to them."

Captain Kilundu, having dispensed justice, regarded his domain calmly. "I hope you are not disturbed by this problem," he said. "We try to keep some order. Last night we had 4,210 paying passengers on the boat.

Caterpillars and palm grubs fresh off the riverboat cover a table in Kinshasa's central market (above, and above right). With its enormous natural resources—especially deposits of copper, cobalt, diamonds, zinc, and tin—Zaire could be one of Africa's wealthiest nations. Yet it remains one of the world's ten poorest, crippled by a huge foreign debt, skyrocketing inflation, and inept government. "The monetary system should be changed," declares one disgruntled citizen who dismisses the government's many so-called reforms. "Freedom and good living standards are what's most essential," says another.

That doesn't include all those without tickets we didn't catch, and then, of course, the hundreds of fishermen. And it does not include the handicapped, who travel for free on public transportation. There are many polio victims on the boat. And those children, the *abandonnés* we call them."

The captain pointed to the dozen adolescent boys who were bathing beneath a tap on the roof of the barge in front of us.

"Those boys have run away from home in Kinshasa because they have nothing to eat there. They are always on the boat, scrounging for food, scraping it from the pots in the kitchens. If we arrest them, they only cause more trouble—anyway, they are too hard to catch. So I put up with them. Where else can they go? It is very sad."

"We call the pusher Europe," one of my

fellow passengers told me. "Life here is okay. Second-class we call China; too many people, but still the situation is not so bad. Third-class we call Zaire, where life is only to be endured."

THE BOAT IS, in fact, a perfect microcosm of the country. Zaire is immensely rich in minerals and has an agricultural potential so great it could easily feed itself, as well as much of the rest of Africa. But the wealth has disappeared, and the per capita income is a mere 170 dollars a year. President Mobutu Sese Seko Kuku Ngbendu wa za Banga ("the always victorious warrior who is to be feared") is reportedly one of the richest men in the world, his personal fortune estimated as high as five billion dollars. Just recently the World Bank reported an unexplained 400-million-dollar shortfall in the export revenues of the government-owned mining company. After 26 years of Mobutu's regime the stories of corruption, thievery, and abuse one hears in Zaire strain credulity, but the evidence is all too real.

A tiny elite cruises the decrepit roads of Kinshasa in new Mercedes-Benzes. The phone system doesn't work, so the Kinshasa rich talk to each other on enormously expensive cellular phones—*the* status symbol. It is impossible to phone anywhere else in the country, but that doesn't matter to the elite—the rest of Zaire hardly exists for them. They shop and educate their children in Europe.

For most of Zaire's 35 million people, the story is different. Boat service elsewhere on the river has nearly ceased. The railroads around the many rapids, built during Belgian

colonial times, run infrequently, if at all, because they have no fuel. All but a few miles of roads have fallen to ruin. Government schools have no books and few capable teachers; the sparse hospitals and clinics have no drugs, laboratories, or equipment. Barely a cent has been spent on maintaining, let alone improving, what was once a decent infrastructure. Commerce has ground to a virtual standstill.

The people along the riverboat's course are the lucky ones. They still have some trade. In the hinterland, huge rubber and cotton plantations are returning to bush. Coffee beans and other crops go unharvested because trucks can no longer reach the villages. Rural people who once knew commerce, who once could afford shoes for their children and could dream of a better life, are reverting to subsistence living. In one remote village the people rub sticks together to make fire, because they can no longer get matches.

"We've become mean, but we're not really like that," a woman named Marie told me as we stood at the railing of the boat during a heavy rainstorm. Like many Zairians, she had gone back to using her original Christian name as a way of showing displeasure with Mobutu, who banned Western names in 1972. On the barge roofs, people huddled under pieces of torn plastic; they had no other shelter from the driving rain. "We are a rich

Rusting in peace, an abandoned riverboat might stand as a monument to the policies of President Mobutu, who amassed enormous personal wealth while the nation's infrastructure collapsed. Without reliable road, rail, and river transportation to move their produce to market, farmers in remote areas are often forced to let their crops rot.

country, but they have stolen everything. To treat your people like this, you have to be a devil. Look at how the people suffer. We are good people trapped in a terrible system. We are like this boat. A few travel first-class, and everybody else suffers."

THE RIVER IS DIVIDED into three parts. For the first 1,300 miles from the source it is called the Lualaba. It flows due north, draining the upland savannas of mineral-rich Shaba Province. Navigable reaches are interrupted by thunderous rapids and gorges with names like Portes d'Enfer (Gates of Hell). In one immense valley the Lualaba spreads out in a sheet of lakes and swamps choked with papyrus and reeds, seasonal home to hundreds of thousands of people attracted by abundant fish.

At Kisangani the river, now called the Zaire, begins its long, easy curl through the central forest. As it bends around toward the southwest, the river widens to nine miles, its glassy waters dotted with myriad islands. Kinshasa lies at the head of Livingstone Falls, actually 220 miles of cataracts and rapids where the river crashes through the Crystal Mountains, the western rim of the Congo Basin. The ocean port, Matadi, lies at the foot of the falls.

Now called the bas fleuve (lower river), it once again spreads out, wide and deep enough for oceangoing ships to sail down the final hundred miles to the Atlantic. But the river doesn't stop there. The current is so strong that its brown waters are hurled nearly a hundred miles into the sea and have gouged a 4,000-foot canyon in the ocean floor.

WHEN WE NEARED MBANDAKA, once known as Equator Station, the entire town was waiting for us.

"This is a very important place for me," Malu called out as he bundled up his shirts. "If I'm lucky, I can sell as much here as on the whole rest of the trip."

Malu and the other merchants who could afford it jumped into pirogues with little outboard motors to race ahead of the boat. They were after prime retail space on the boulevard that ran along the riverbank.

Mbandaka is typical of provincial towns in Zaire, if somewhat larger than the other two that lay along our thousand-mile route. It looked as much like a ghost town as a heavily populated place possibly could. A corner of the brick cathedral had caved in; government offices melted back into the red equatorial earth.

"No one cares," Marie said, gazing at the forlorn town. "It is the same all over the

country. The officials in the towns are from somewhere else, so they don't care about development. They just take whatever they can get for themselves before they are sent to another post."

By the time I got ashore, the market had moved from the boat to the town. The merchants had spread their wares along the corniche and the road that led away from the river, and both streets were crammed with customers.

In midafternoon the boat horn blew, and Malu and the other merchants scrambled back aboard. Fishermen who had paddled downstream to await the boat in town tied on to be towed back up to their homes. Captain Kilundu maneuvered past empty warehouses and rusting, once grand paddle wheelers lining the shore, and we pulled out into the stream. The next town was 300 miles away.

AS THE DAYS PASSED, the river appeared just as it had to Conrad a hundred years ago: "Going up that river was like traveling back to the earliest beginnings of the world," he wrote, "when vegetation rioted on the earth and the big trees were kings. An empty stream, a great silence, an impenetrable forest."

At times the forest was distant, looming hazily beyond the islands. When the boat hugged the bank, the forest towered above us, a green and serried wall. That it was unimaginably rich was easily apparent—ample evidence of its bounty arrived without cessation in the pirogues. Even above the engines I could hear sounds in the forest, and I glimpsed fish eagles, herons, and other birds fleeing at our intrusion. But it was impossible to see into the forest. Its enigmatic face and the murky waters of the river were opaque, Conrad's "implacable force brooding over an inscrutable intention."

Time seemed to stand still, a notion reflected in the local language, Lingala. The words for yesterday and tomorrow are the same. There is now, and there is all other time in both directions. Our boat, so big and full of life, seemed pitifully insignificant as it struggled against the current in the shadow of the forest.

One night a thunderstorm unrolled across the sky. First here, then there, the bombs of thunder burst and flashes of light silhouetted the massive thunderheads. Brilliant streaks of lightning raced about: Single, jagged strands and then forks, multilimbed stars revealing 200-foot trees rising to meet them on the horizon.

Commerce became even more intense as we progressed. Fish became fewer, and more monkeys, antelope, and other animals Zairians refer to collectively as "bush meat" made their way aboard. I spent hours leaning on the railing, watching the pirogues come and go. They got bigger and bigger, some single trunks able to carry more than 50 people. Stretched out ahead of the boat to the horizon, the pirogues lay in wait, their positions perfectly outlining the meandering channel the fishermen knew well.

As the flotilla approached, the men and women standing in the pirogues paddled like fury, trying to match speed with the boat. At the last moment a lead oarsman would throw down his paddle, grab the liana tied to the bow, and jump into one of the pirogues already in tow. I saw several miss their chance. They could then do nothing but watch the boat steam away. Many pirogues capsized during the maneuver, hurling the people and six weeks' worth of hunting and fishing into the river.

Even before the pirogues had tied on, merchants leaning over the rails would toss baskets or pieces of cloth onto the fish or meat they wished to claim. Though the competition to buy was fierce—goods bought on the river were sold in the towns for three to five times more—the merchants seemed to collude on prices. The farther we got from any town, the less they paid and the more they charged. The only thing that came down in price was the bread we had brought from Kinshasa, rather stale by now but nevertheless popular with the fishermen: a taste of the city.

Most of the passengers got their meals from communal kitchens on the barges: Bread and tea for breakfast, a late afternoon bowl of rice and beans or manioc greens. On the pusher we were served rice and a chunk of usually gray (once even green) meat.

It seemed absurd to eat frozen pork and beef when you were tripping over fresh fish. The reason, of course, was that the entire crew was buying all the fish they could lay their hands on, and they weren't about to waste on us what they could sell for a huge profit at the end of the voyage. To make room for the fish, they needed to empty the

No map marks this island or hundreds of others like it scattered across Lake Kisale in southeastern Zaire. The island is actually a reed-and-papyrus thicket that grows during the dry season and serves as a second home for fishermen and their families. Living on this spongy, lattice-like deck for several months at a time, they catch and then dry or smoke the fish before returning to their home villages, far upriver from Zaire's commercial mainstream.

cold stores of the company-bought meat.

I ended up buying my own fish and giving it to the cook to prepare. Once I also bought a small crocodile, which was light and tender and surprisingly unfishlike in flavor. Visiting with people on the barges, I was often invited to join in the meals they prepared on charcoal braziers: Plantains, dried caterpillars, a whole roasted baboon, or white-nosed monkey stew.

The monkey tasted a little strange, but I attributed that to my queasiness about eating something that had fingers. Only much later did I discover the reason for the peculiar flavor. One day, I saw a man climb onto the roof and hold a freshly killed monkey up to the smokestack exhaust—an ingenious way to singe the hair off.

A CERTAIN ENNUI SETTLED over the boat as the voyage dragged on, and tempers began to wear thin. Fights broke out. One altercation between a fisherman and a soldier had rather serious consequences. The soldier had refused to pay for a cup of palm wine he'd gotten from the fisherman, who then proceeded to hit him. Other soldiers and fishermen soon joined in. But the fighting fishermen escaped in their pirogues, so the frustrated soldiers grabbed a poor guy who just happened to be from the fishermen's village. After knocking him unconscious,

"They catch an enormous amount of fish by means of the poles and conical baskets," wrote Stanley in 1877 of fishermen at Boyoma Falls, a series of rapids just upriver from Kisangani. Today a boy uses the same time-tested technique. With quick footwork and a watchful eye, he scampers over to check a trap that hangs from scaffolding erected at the base of the rapids.

they handcuffed him to the nearest railing.

Perhaps in retaliation against the fishermen, but more likely because the crew got a bonus if the boat made the voyage on schedule and the 150 or so pirogues lashed to the sides slowed us down, the boat was then steered right up against the riverbank.

Pandemonium ensued. Branches whipped the decks, carrying off clothes hung there to dry. Fishermen rushed for their pirogues, desperate to free them before they were crushed between the boat and shore.

The air was filled with shouts and screams and cracking wood. Many pirogues capsized and went floating off. Dozens of people jumped overboard to pursue them or to join their families in ones that had been saved.

But in maneuvering so close to the bank, one of the boat propellers hit a pirogue or a submerged tree root. The drive shaft was broken. Captain Kilundu was upset; he had been off duty and had not authorized the move. We stopped to assess the damage, then limped along on the sole remaining propeller, our already slow pace against the current now reduced by half.

As the days passed, fish and bush meat ceased flowing to the boat, replaced by baskets, wooden stools, chairs, and mortars and pestles. Drums of palm oil arrived, along with sacks of manioc and fruit. Domestic pigs, chickens, and goats filled the pirogues. We were leaving the wildness of the central forest and nearing Kisangani.

IT IS AN OLD PLACE, the settlement at the foot of the rapids that halt navigation, where trade is forced off the river and links up with land routes to the east. Henry Morton Stanley camped here; Arabs made it a depot for slave caravans to the Indian Ocean. It was the Inner Station where Conrad's Mr. Kurtz confronted the horrors of his limitless power and corruption. Here the newly independent country was bathed in the blood of the Eastern Rebellion. It is the end of the line.

We neared Kisangani in the afternoon, but too late to enter the port, so we poked our nose into the wall of the forest to wait out the night. I could see the lights of our destination glimmering only a few miles upstream.

The transformation of the boat was complete. The tables of manufactured goods with which we had left Kinshasa were bare. All the soap, salt, sugar, fishhooks, and drugs had been absorbed into the forest. Now the boat was part barnyard, part warehouse for smoked and dried meat. Even the throbbing engine room was crammed with baskets of

"The Indus, the Ganges, the Irawaddy, the Euphrates, the Nile . . . the Amazon—I think of them all," wrote Stanley, "and I can see no beauty on their shores that is not excelled many fold by

blackened flesh. The boat reeked of farm and abattoir; every surface was sticky.

Some of the merchants couldn't wait to get a jump on the competition and loaded their fish and meat into pirogues bound for town. But rumors of trouble arrived with the pirogues. The roads to the east were washed out. None of the trucks that carried beans, potatoes, and other produce from the eastern highlands had gotten through for more than a month, and there was little food in Kisangani. The townspeople were eager for the boat and its supplies to arrive but didn't want to see their scant produce carted off to Kinshasa. A demonstration was planned for when we docked in the morning. It was also politically motivated, I was told. There had recently been anti-Mobutu demonstrations in Kinshasa and many provincial towns.

"It is good," Marie said that final night. "Maybe we can force Mobutu to change."

Our conversation was interrupted by a tinny voice, the kind I'd swear could only issue from a television. It did. One of the first-class passengers, an army officer, had set up a TV outside his cabin. Not many

the natural beauty of this scenery." Living at that thin edge between river and rain forest, these villagers—and the people of Zaire—still wait for their boat to come in.

Zairians can afford televisions, and reception is limited to a few major towns. A crowd of merchants gathered around the TV set, listening and watching carefully, eager for the news. They would carry what they learned back down the river and distribute it, along with their wares, into the forest.

I moved to the stern. In the distance another storm was brewing, lightning striking the primeval rain forest, the thunder distant but distinct. The newscaster's voice drifted across the water and was lost in the rustle of unseen life behind the nearby forest wall. Fishermen and their families, trading done, climbed into their pirogues and slipped quietly away with the current, drifting down the river that stretched into the darkness.

The boat would soon follow. It was the end of my journey. For Captain Kilundu and for Malu and his fellow merchants, Kisangani was just a turnaround, one brief stop in their ceaseless voyage along the great golden sweep of the Zaire River. □

A National Geographic EXPLORER film on Robert Caputo's journey will be broadcast December 1 at 9 p.m. ET on TBS SuperStation.

From the catbird seat of modern Tokyo, members of Japan's *shinjinrui*, or new human race,

Japan's Sun Rises

By ARTHUR ZICH

have much to ponder: Following their parents' economic miracle, where next will they take Japan?

Over the Pacific

Photographs by KAREN KASMAUSKI

Surrounded by modest million-dollar houses and other hyperinflated real estate, the skyscrapers of Shinjuku Ward (left) rise to spectacular heights in price. At one billion dollars (U. S.), the spired twin towers of Tokyo City Hall, at center, may be the world's most expensive public building. Coping with the competition and congestion of their huge city, some Tokyoites seek relief in "mind gyms," where music and goggles with pulsing lights help reduce stress.

"WELCOME TO THAILAND—Mitsubishi." The sign, on a billboard just outside Bangkok's Don Muang International Airport, was the first of many like it I saw entering Thailand, merely one of many Asian countries where Japan's economic influence is booming. More Japanese signs lined the expressway into the city: Nissan, Sharp, Sony, Canon, and Mazda. Cars and trucks from Toyota, Honda, Isuzu, and Daihatsu stood bumper to bumper in the crowded city streets. Motorcycle cops rode Yamaha and Kawasaki bikes. And neon signs atop department stores blazed Daimaru, Tokyu, and Sogo—all Japanese brands.

It seemed as if the events of half a century ago had been magically rewritten. In the summer of 1941 the Imperial Japanese Army had muscled its way into Thailand—the prelude to World War II in Asia and, for Japan, as devastating a defeat as any nation ever suffered. But the hands of time had not turned back. The signs were symbols that Japan was on the move again—not only in Thailand but also in Australia, Malaysia, and all across the region of the world Japan once chose to call its Greater East Asia Co-Prosperity Sphere. As before, Japan's own internal compression factor was a prime motivating force—too few resources and too many people in too little space. But this time Japan came in peace, with the promise of prosperity and profit for all—its only weapon, seemingly limitless quantities of a near-almighty yen.

The era of *endaka*—powerful yen—began on an Indian summer Sunday in September 1985 when James Baker, then U. S. secretary of the treasury, and the finance ministers of Great Britain, West Germany, France, and Japan emerged from New York City's elegant old Plaza Hotel and read a joint communiqué. In the dry language of international finance they declared: "Some further orderly appreciation of the main nondollar currencies against the dollar is desirable."

In plain English the United States sought the help of the other major industrial powers in lowering the value of the dollar to reduce its trade deficit. In return the U. S., the world's biggest marketplace, pledged to keep its trade doors open. In effect it was expected that U. S. exports would come to cost less; foreign imports, more—and Japan, as the nation with the strongest currency and the largest array of products sold in the U. S., would feel the pinch the worst.

Moseying down a video trail, a greenhorn equestrian learns to ride on an electric horse in a studio in Nagoya. Short on space and time, the Japanese pursue their leisure with the same ingenuity they apply to their work.

Exactly the opposite happened. The Plaza Accord, as it was called, had little impact on U. S. deficits or industry. Japan tightened its belt, loosened its abundant domestic savings, and made some painful but necessary economic adjustments. Within a year the island nation found itself soaring toward an undreamed-of level of cash-rich prosperity.

The yen's buying power doubled. Japan's per capita income hit $17,500 a year—second highest in the world. Land values soared. A square foot of Tokyo real estate sold for the equivalent of $2,000; a simple wood frame home for 1.5 million dollars. Japan's Economic Planning Agency calculated that the market value of the nation itself, a California-size archipelago, was four times greater than that of the U. S.

Primary exports to Japan	
F	Foodstuffs
Ma	Machinery
Me	Metals
N	Natural rubber
T	Textiles
W	Wood
C	Coal
P	Petroleum
O	Other fuels

Japan imports eight tons of food, fuel, wood, and other raw materials for every ton of manufactured goods it exports.

SOVIET UNION

MeWC

SEA OF OKHOTSK

SAKHALIN

Harbin

$3.07 exports

$3.00 imports

HOKKAIDO

Sapporo

Total trade volume between Japan and the United States is $141.3 billion

40°

Shenyang

Pyongyang

NORTH KOREA

SEA OF JAPAN

Beijing

Tianjin

CHINA

TPE

Seoul

Taegu

SOUTH KOREA

TMeF

Pusan

$16.57 exports $12.99 imports

HONSHU

JAPAN

Nagoya

Tokyo

Yokohama

Osaka

Chita

SHIKOKU

KYUSHU

$8.46 exports $11.16 imports

Nanjing

Wuhan

Shanghai

Chongqing

Yangtze R.

EAST CHINA SEA

PACIFIC OCEAN

Guangzhou

Taipei $15.41 exports

TAIWAN

EMaT

TROPIC OF CANCER

$0.49 exports

MACAU (Port.)

HONG KONG (U.K.)

FMa

Hanoi

LAOS

Vientiane

Yangon (Rangoon)

THAILAND

FN

Krung Thep (Bangkok)

VIETNAM

CAMBODIA

Phnom Penh

Ho Chi Minh City

SOUTH CHINA SEA

LUZON

$2.38 exports

Manila

PHILIPPINE SEA

NORTHERN MARIANA ISLANDS (U.S.)

PHILIPPINES

MeF

Guam (U.S.)

MINDANAO

PALAU (U.S.)

FEDERATED STATES OF MICRONESIA

Kuala Lumpur

Penang

MALAYSIA

WO

Johor Bahru

SINGAPORE

FMa

SUMATRA

Bandar Seri Begawan

BRUNEI

Bintulu

MALAYSIA

Kuching

BORNEO

Barito R.

EQUATOR

INDIAN OCEAN

Jakarta

JAVA

Surabaya

CELEBES

INDONESIA

NEW GUINEA

PAPUA NEW GUINEA

Port Moresby

Japanese investment, 1989 (million U. S. dollars)

- Above 1,000
- 401-1,000
- 101-400
- 0-100
- Manufacturing region (selected)

Mineral resources

- Bituminous coal
- Petroleum products
- Bauxite
- Iron ore

Arrow width reflects total trade volume (imports plus exports) between countries. Figures are in billion U. S. dollars.

Darwin

Cairns

Port Hedland

Ophthalmia Range

Mt. Whaleback

NORTHERN TERRITORY

QUEENSLAND

Blackwater

Brisbane

Gold Coast

AUSTRALIA

WESTERN AUSTRALIA

MeCF

SOUTH AUSTRALIA

NEW SOUTH WALES

Sydney

Perth

Adelaide

Canberra

VICTORIA

Melbourne

TASMANIA

120°

140°

Lambert Azimuthal Equal-Area Projection, with "magnifying glass" effect centered on Japan.

NGS CARTOGRAPHIC DIVISION

The yen at work

Nearly devoid of natural resources, Japan is now awash in one commodity: money. In 1985 central banks of the Western powers, led by the United States, allowed the Japanese yen to rise to its natural market level relative to the dollar. Though the move was intended to curb Japanese exports, it backfired. The Japanese cut costs, streamlined management, and more than held their own in foreign markets. Meanwhile the Japanese yen doubled in value, along with Japanese real estate and all other yen-based assets. Japanese banks saw the value of their holdings rise to astronomical heights. Yet still the exports grew.

Armed with a newly powerful currency, Japanese companies are shifting foreign investments to their Asian neighbors, many of whom fell under Japanese military rule during World War II. Today, as memories of Japan's often brutal occupation dim, the Land of the Rising Sun is winning back its old colonies by purely economic means. Its neighbors get the capital, technology, and skills to modernize, while Japan obtains cheap labor for transplanted industry along with millions of new customers for manufactured products.

Yen rolled out from Japan like a tsunami—to the U. S., Europe, and the rest of Asia. Japan became the world's biggest creditor nation. Then the world's biggest aid donor. And then one of the world's biggest foreign investors. In 1986 Japanese investors pumped 21 billion dollars into holdings abroad; in 1988, 47 billion dollars more. In 1989 Japan's direct overseas investment rose by 67.5 billion dollars—making it third among the world's investor nations.

Today Japan, with a population less than half that of the U. S., boasts an economy almost two-thirds as large—and gaining. The sudden infusion of wealth has sent reverberations across Japanese society. And the Pacific Rim is changing with it. Asian economic output now accounts for 22 percent of the combined gross national products (the total value of goods and services) of the world.

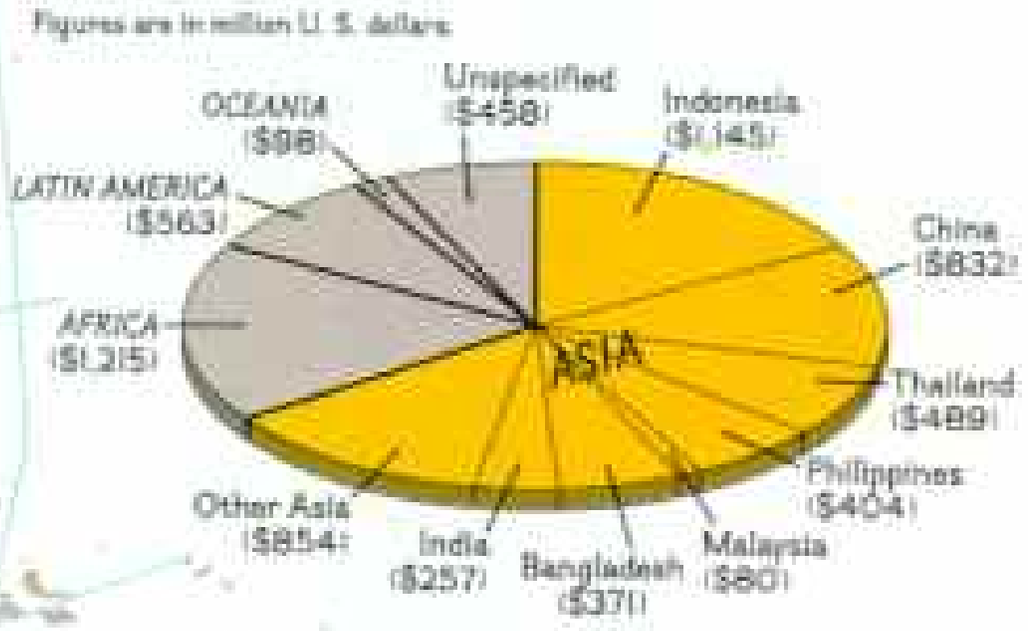
"The old image of sweatshop Asia turning out cheap, shoddy products is dead," says Daniel I. Okimoto, a Stanford University political scientist and an expert in this field. "Asia has become one of the world's leaders in manufacturing excellence—and Japan is the locomotive pulling it into the future."

I WENT TO JAPAN to witness this colossus firsthand. Then I traveled on, to Thailand, Australia, and Malaysia, to assay Japan's presence there. What I found was new economic power emerging across Asia under the leadership of Japan.

In Japan the old imperial order that had led the nation through the war finally ended four years after endaka began, with the death of Emperor Hirohito. In 1989 a new emperor, Akihito, was enthroned, and a new imperial age began. The Japanese call the new era *Heisei*—peaceful achievement.

"Tokyo is like a nuclear pile," a Japanese friend told me. The outside keeps pressing in. The center grows denser and denser. Extraordinary heat and energy are created—and the result is money. The Japanese have squeezed an economy the size of France's into 783 square miles. It's like stuffing all the functions of Washington, D. C., Los Angeles, and New York into one American city.

Since the end of World War II, when Japanese government and industry joined hands to rebuild the nation, Tokyo has again served as the seat of government, politics, business, and finance; the center of fashion, culture,



Where Japan gives aid

Since 1985 Japan has more than doubled the amount of aid it sends overseas, joining the ranks of world leaders in overall giving. In 1989 Japan's direct foreign aid (chart above) totaled more than 6.5 billion dollars (U. S.), most of it bestowed upon Pacific neighbors.

and communications. Greater Tokyo—meaning the city proper, its port, Yokohama, and the suburban prefectures of Saitama, Chiba, and Kanagawa—contains less than 4 percent of Japan's land area but fully one-fourth of its 123 million people.

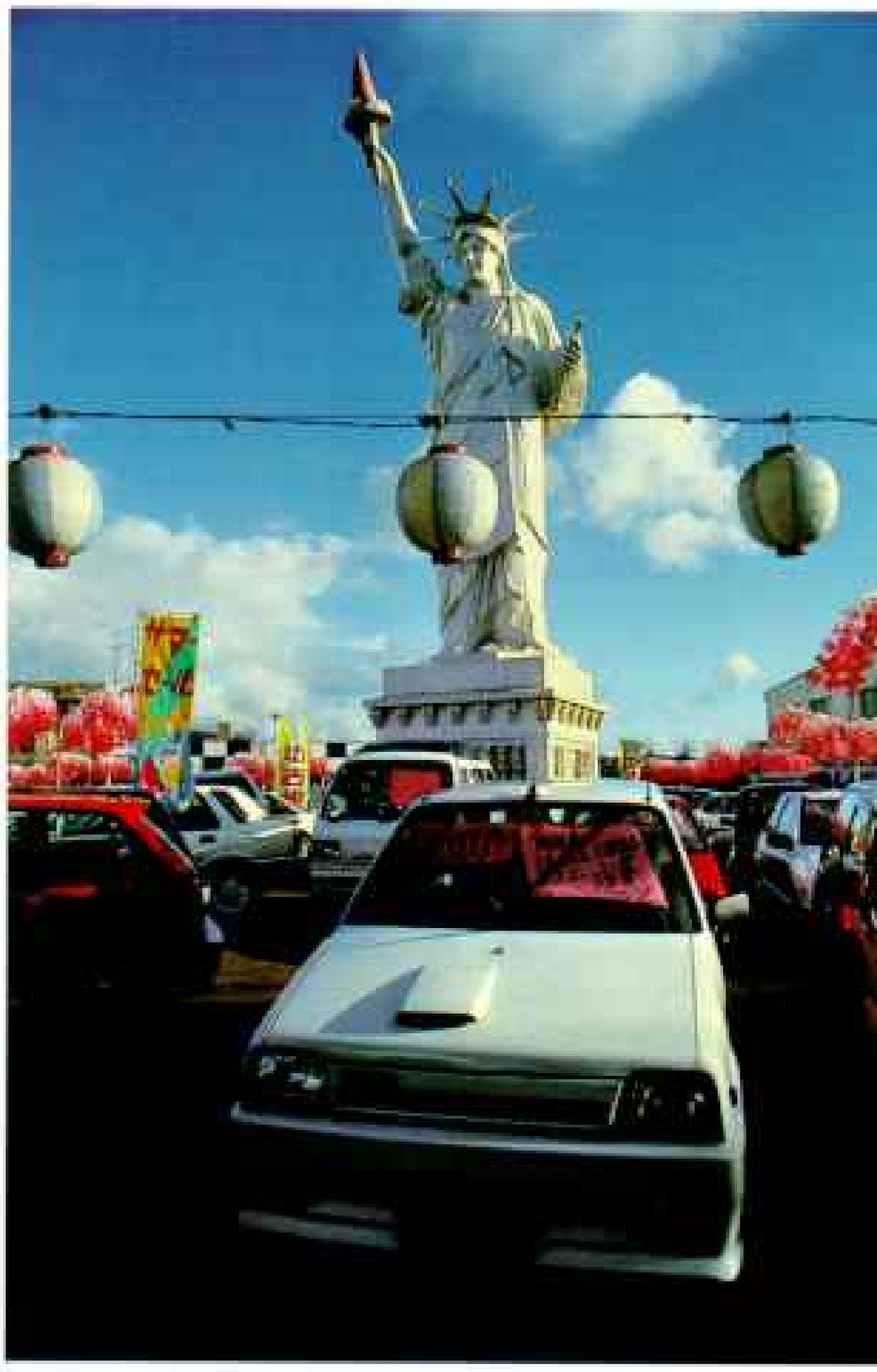
Its expressways, built on a radial pattern dating from the 18th century, are so overloaded that traffic often grinds to a halt for 30 to 40 miles outside the city, as I learned during the 60-mile taxi ride from Narita International Airport to my Tokyo hotel. The trip took 3½ hours and cost $140.

There seems no end to Tokyo's congestion, no time of day when the city slackens pace to catch its breath. By 8 a.m., three million commuters are coursing through train and subway stations, joining 12 million residents of Tokyo proper on their purposeful way to work. They pour out of the whistle-clean train stations and into the stolid old stone buildings of Marunouchi district, the most expensive real estate in the world; the crackling electronics jungle of the Akihabara district; the tangle of towers now standing over Shinjuku Ward—including the new billion-dollar, 65-story Tokyo City Hall, one of the world's most expensive public buildings.

THE SALARYMAN (white-collar worker) who works 6-day weeks and 16-hour days is still a social fixture. Subways still advertise $25-a-night "capsule rooms" offering communal showers and morgue-like drawers for low-cost overnights close to the office. And advertisements for Regain!, a popular, supposedly restorative vitamin potion, still ask the question, "Can you work and fight 24 hours a day, salaryman?"

One rush-hour morning at Shinjuku Station, the city's busiest, I got swept away in a pedestrian torrent of salarymen flowing in the opposite direction, and I was carried the distance of a city block before I could work my way free.

At 6 p.m. Tokyo's human tide begins to turn. Among the departing legions is Jutaro "Jerry" Shikata, 41, international account manager for Union Pacific Railroad, an arm of Kawasaki Shipping Line. He is homeward bound to his wife, Keiko, 39, his two boys, his aging parents, and a mortgaged two-story house in suburban Hachioji, one hour and 15 minutes to the west. Like many a Tokyo salaryman, Jerry finds himself caught between an old and a new Japan—and is feeling prosperity's pinch.



"Send us your cars": A model of America's Statue of Liberty at a used-car lot in the city of Oita makes an apt promotion symbol, since it was Japan's penetration of the U. S. auto market that helped clinch its great postwar recovery. Though Japan's momentum seems unstoppable, stock and bond traders—like Michiro Urano at Daiwa Securities (opposite)—recently weathered a downturn in profits, linked with a spate of corruption charges.

ARTHUR ZICH, a frequent contributor to the magazine, wrote about Botswana in the December 1990 issue. KAREN KASMAUSKI's photographs of Japanese women appeared in the April 1990 GEOGRAPHIC.

"We couldn't afford separate residences," Jerry told me as the train jostled us home for dinner one night. "Fortunately, my parents owned their house and land. So we razed their house and rebuilt it as a two-family dwelling."

The whole family met us at the door with formal bows and all the delightful fuss that accompanies Japanese hospitality. We left our shoes in the *genkan* (entry hall) and stepped into a traditional *tatami* room, where I saw the *butsudan*, the family altar. Jerry's mother opened its fine old lacquered doors to show me the pictures and the tablets of their ancestral dead. Then she bowed devoutly, said a prayer, and we retired to a very Western living room, its coffee table laden with sushi and frosty Kirin beer.

"Japan was a small country, closed to the world," the elder Shikata, a retired official in the Ministry of International Trade and Industry, recalled over dinner. "After the war, Japan was in chaos. There was regret, suffering. There were no rich then, only poor. We pulled together, worked hard, geared our economy for export, poured money into production. Now, we're prosperous, and we're bringing that prosperity to others. And that's what we should be doing!"

Upstairs, Ryotaro, 15, was hunched over his schoolwork. The schools are where Japan's extraordinary work ethic begins. City tots as young as three attend special prep schools designed to get them into elite kindergartens. The school week includes Saturday classes, and summer vacation is limited to six weeks. "The public-school system hasn't changed much since I was in school. He's being indoctrinated!" Jerry said. I thought of the aphorism *Deru kugi wa utareru:* "The nail that sticks up gets hammered down."

BUT NAILS HAVE BEGUN to stick up. Increasingly the salaryman wants more from life than to work and fight. Young Japanese workers are demanding higher pay, shorter hours, and greater benefits. More and more of them are asking to examine a would-be employer's *yutori*—a corporate comfort index, calculated by a government ministry, that factors in work hours, vacation time, wages, and office ambience.

"Our elders, who knew the war, are slowly dying off," Hidehiko Sekizawa, executive director of the Hakuhodo Institute of Life and Living, a major think tank, told me. "Our postwar people—the Beatles generation—are workaholics, but wondering why. The young? These are the *shinjinrui*—new human race. They don't know what it is to be poor. And they're the richest generation in Japanese history."

Improved health care, diet, and living conditions have extended the average life expectancy for a Japanese female born today to 82 years; for a male, to 76—the highest in the world. Japan's working women, 26 million strong, constitute 40 percent of the labor force. In their numbers, and growing assertiveness, they are clearly establishing their own priorities.*

*Deborah Fallows wrote (April 1990) of Japanese women assuming key roles outside the home.

Ancient traditions endure in corporate dress, as Shinobu Tosaki, the new president of Kawasaki Steel (left, at right), and Yasuhiro Yagi, the new chairman, receive respects paid by associates at a Tokyo hotel. Japanese culture confers sacred status on parents and superiors.

Deities of Shintoism, Japan's oldest religion, are often petitioned for material blessings, as witnessed by the divine "insurance policies" bestowed on new cars by priests at Shinto shrines.

Like a tide of human lava, light-bearing hikers ascend Mount Fuji on an all-night pilgrimage to

view the sunrise. In both business and leisure, a collective spirit imbues Japanese life.

Muslim schoolgirls admire Malaysia's national car during a visit to the Proton Saga assembly plant in Shah Alam. Though built largely of Japanese parts, the car has become the nation's symbol of success. To tap Malaysia's low labor costs, Japanese conglomerates are building industrial parks all around Kuala Lumpur. At an air-conditioning factory owned by Matsushita, Malaysian managers learn *Nippon-do*, the "Japanese way."

MALAYSIA

Hoping to soon join Asia's NIEs (newly industrialized economies), it has hitched its star to Japanese capital and technology.

One measure of these priorities can be found in a phenomenon the Japanese know by the English letters OL—for office lady. A man whose job it is to know the OL well is Yamato Shiine, 49, the rumpled, savvy editor in chief of *Hanako*, one of Tokyo's magazines for smart young women.

"The OL will change our way of life," Shiine told me. "According to our surveys she is 27 years old, an only child, and a university graduate. She earns more than $2,000 a month and lives with her parents rent free. Her mother cooks for her and does her laundry. Commuting and taxes leave her about $11,000 a year to spend on anything she chooses. She dresses in the latest style, travels abroad, is altogether more cosmopolitan than the men her age. If she marries, she'll continue to work, contrary to tradition. She's one of the world's best customers, and with income rising, she's going to get even better."

Wondering how closely a real-life OL-to-be conformed to the stereotype, I had lunch with Saki Taguchi, a 19-year-old psychology major at Tokyo's Waseda University. Saki lived with her parents, commuted by train 45 minutes each way, and looked forward to a career in advertising or TV programming. Did she plan to marry? I asked.

"If I have a profession, marriage could be part of my life," she said, and added firmly: "But not the whole of it. My life is mine."

What about love? I inquired. She smiled a smile older than her years.

"Before marriage, love is the whole pizza pie," Saki said. "After, it's just a slice."

The country Saki's children inherit will be vastly different from the one her elders know. The transformation is already under way.

LEISURE TIME, once anathema, is looked on more and more as a source of profit rather than loss. A proliferation of theme parks has followed on the success of Tokyo's Disneyland. At Tokyo Roof, an amusement park temporarily situated in a onetime railroad yard near Tokyo's Ginza, I took a heart-stopping ride down an icy Alpine road; free-fell from an imaginary airplane inside a giant, fan-powered wind silo; and played golf at Pebble Beach, teeing off into a photographic projection of the first fairway and watching my ball, now a spot of light on the sensitized screen, bounce hopelessly into the rough. "We Japanese want it all and want it now," Tokyo Roof producer Kyoichi Iwahori explained with a smile. "But we haven't the time or the space."

Colossal construction projects may offer both. One solution, visionaries say, is to build

up rather than out. Takenaka, the builder of Tokyo's "Big Egg" domed stadium, plans for a 33-billion-dollar "vertical megastructure" called Sky City—a stack of 14 mini-cities surrounding an atrium that would rise 3,400 feet, two and a half times as high as New York's World Trade Center.

But the biggest undertaking of all is a redevelopment scheme some 300 miles west, on the broad Kansai plain. Kansai's economy is larger than that of Canada, yet the region has long languished in Tokyo's shadow—and Kansai leaders are determined to languish no longer. As Osamu Uno, chairman of the Kansai Economic Federation, put it, "The modern history of Japan has been the centralization of Tokyo. The 21st century will be the age of Kansai."

Kansai's *gurando* design embraces a total of 822 projects including a new international airport on a man-made island in Osaka Bay; a science city housing advanced-research institutes for telecommunications, science, and culture; and the world's longest suspension bridge—the Akashi Straits Bridge, linking coastal Kobe to the island of Shikoku. All told, the cost is expected to exceed 35.5 trillion yen (257 billion dollars U. S.).

"Kansai is the biggest project in the whole world," said Hiroyuki Gohda, a manager at the Center for the Industrial Renovation of Kansai. "It will link Japan to the other nations of Asia's Pacific Rim."

WITH LABOR AT A PREMIUM and crowding a constant problem, many Japanese firms are relocating abroad, for lower costs and cheap labor.

"I see the countries of Southeast Asia at various stages of the same course Japan took in recovering from the war," Mamoru Tabuchi, thoughtful chairman of Mitsui & Company (Thailand), told me in Tokyo.

Tabuchi, in fact, is counting on it. In the past four years Mitsui has committed some 85 million dollars to Thailand. With more than a hundred joint ventures ranging from sugar mills in the northeast to the construction of a massive petrochemical facility on the eastern seaboard, Mitsui is the biggest Japanese

For Japan's insatiable timber market, Malaysian hardwoods rumble from the island of Borneo. Under fire for rain forest destruction, some loggers have had to halt operations.

Favored shore for Japanese vacationers, Queensland has also become a magnet for Japanese investors, who are building hotels in the resort region known as the Gold Coast (above). A thousand miles north in Cairns, Shuji Yokoyama (right, at left), chairman of Daikyo Incorporated, surveys a new golf course, part of one billion dollars in development the company is spending to capture the tourist dollar—and yen.

AUSTRALIA

A marriage of convenience mates this resource-rich continent with resource-poor Japan. Though Aussie egos may bristle, the yen has come to the aid of their economy.

enterprise in the country. "A nation seeking industrialization must have a sizable population, stability, and people willing to work hard to improve their standard of living," Tabuchi told me. "Thailand does. I fully expect that what happened in Japan will happen in Thailand."

It hasn't happened yet. Enormous disparities still exist between prosperous Bangkok and the largely impoverished countryside. Still, in 1989 Japan invested 1.2 billion dollars in Thailand, more than it had in the previous 35 years combined. Some 30,000 Japanese, representing more than 900 Japanese companies, have descended on the Land of Smiles, bringing with them 300,000 sorely needed jobs and powering overall economic growth at an average of 10 percent a year.

In the process they have propelled the once somnolent Southeast Asian nation to the brink of that most coveted Third World status, NIE-dom, meaning newly industrialized economy.

One of NIE-dom's quintessential symbols is automobile production. The Thai auto market is 95 percent Japanese. In 1989 Toyota, already the leader in Thailand's passenger-car sales, opened a new eight-million-dollar assembly plant, its third, on the outskirts of Bangkok. I toured the airy, 194,000-square-foot facility and watched a new Toyota vehicle roll off the assembly line every 3.6 minutes.

"This is the largest auto plant, with the most modern technology, in Southeast Asia," Toyota Thailand Director Kazushige Nagura told me proudly.

But automobiles are just one measure of the Japanese presence. "Last year," said Hisahiko Okazaki, Japan's ambassador to Thailand, "we had a new factory opening every four days. This year there'll be 120 more. And 500 more are in the pipeline, due to arrive in the next few years." He sighed. "And I'm supposed to attend all these openings."

The problem is that the vast majority of these factories—82 percent of Thailand's gross industrial output—lie in or around Bangkok. According to the Thailand Development Research Institute Foundation, they dump some 1.26 million tons of toxic waste into the city's watercourses each year, all but a fraction of it untreated. Since the cars, trucks, and motorbikes still burn leaded gas and since lignite, a dirty-burning coal, is still used to generate electricity, the city swelters in a blue haze of polluted air. With the

nation's agriculture stagnant, and peasants pouring in to search for jobs, Bangkok's population now exceeds seven million people.

"Road transport is impossible; Klong Toey, Bangkok's port, a mess," said Vissut Sethaphut, senior vice president for research and planning at Siam Commercial Bank.

In the dry comfort of a glass-bottom boat, Japanese tourists enjoy a fish-eye view of the Great Barrier Reef off Queensland. Last year more than 500,000 Japanese visited Australia, adding to the boom in regional air travel.

"We can't get raw materials in. We can't get finished products out. We're at a stop."

To ease pressures on the capital, some two dozen industrial estates have been built in outlying areas in the past two years, and more are planned. Biggest of them all is a colossal Japanese-built, light- and heavy-industry port complex two hours' drive from Bangkok called the Eastern Seaboard Development Project—at 1.5 billion dollars the Thai government's largest undertaking ever.

Centerpiece of the project is the 356-million-dollar National Petrochemical Corporation, which produces hydrocarbon gases for petrochemical and plastics plants next door. National's 328-foot-high distillation towers glinted in the sun from a long way off. Bougainvillea cascaded down the driveway's flanks. Jiravich Nathalang, secretary to the vice president of operations, led me through the reinforced-concrete computerized control bunker. I asked him what the Japanese presence meant to the Thai economy. He responded as if in disbelief that anyone would ask. "It means this plant. We employ 600 to 800 people. We save our economy about 400 million dollars a year by reducing imports. And we've only just begun."

Why is all this taking place in Thailand? It's more than just the cheap land and labor. "Thailand, like Japan, is Buddhist. And a monarchy. And a civilized country with a government that respects contracts and leaves business alone," Ambassador Okazaki explained.

"We're easy to get along with," Narongchai Akrasanee, director of the Thailand Development Research Institute Foundation, added. "For 700 years we've been an inland trade route, a land bridge between north and south. We are mixed, like the Americans. Our identity is cultural not ethnic: We're Thai, Indian, Malay, Chinese—name it. There is no racial discrimination here. The Thai people rarely have strong feelings about anything."

THEY HAVE SURELY DEVELOPED a fondness for things Japanese. Japanese is taught in Thai schools. Japanese comic books delight Thai kids. Japanese cartoons animate Thai TV. Siew-National, a joint venture with Matsushita, claims at least one color TV set in every upland village serviced with electricity.

"We send buses to the distant villages to demonstrate our products," Maevadi Navapan, Siew-National chairwoman, told me. "It's like your old-fashioned Wild West medicine shows. The whole side of the bus opens up to color TVs." Among the favorites: a series called *Ku Kum (A Couple's Fate)*, recounting the World War II romance of a Thai girl and a Japanese soldier.

A hit tune from a Thai pop rock group sums it up: "Samurai Ma Leew—The Samurai Have Arrived." But this time they brought golf clubs, not swords—and the Thais have taken up the game as well. Some 73 golf courses have been built so far, and at least 59 more are under construction or in planning, including an 800-million-dollar development called the Kaeng Krachan Golf

& Country Club in Phet Buri Province. With three world-class courses, 4,000 luxury homes, and a 400-room hotel, Kaeng Krachan promises to be the largest golf complex in all Asia.

To be sure, the new Japanese invasion is not universally applauded. Thai economists worry about a trade deficit that has increased nearly sixfold since 1985. Others charge that Japanese firms are reluctant to promote Thais to management positions or share high-tech discoveries.

"In general, Japanese firms prefer to control management," says Nobuko Ichikawa, a former consultant at the Thailand development foundation, "at least partly out of the necessity to protect advanced technology."

Other Thais still harbor bitter memories of the war. "My family doesn't use Japanese products," Juanjai Ajanant, an economist at Chulalongkorn University, told me. "We still remember the Japanese rape of Nanjing." Others find the Japanese to be simply standoffish and exclusive.

"They're not friendly," said a driver I had engaged to take me around in his 18-year-old Ford. He closed his eyes to gesture like a person brushing a fly off his nose. "They go like that. It means, 'Don't bother me.'" And indeed, on Thaniya Road—better known as Little Ginza—non-Japanese are told at nightclub doors that they are not welcome.

Still others are concerned about the sheer size, presence, and potential influence of Japanese investment. "You Americans don't compete enough with the Japanese," said former Prime Minister Chatichai Choonhavan. "I don't want our children speaking only Japanese. I want them to speak English."

Yet none can deny the progress that Japanese capital has brought to an impoverished land. Vinit Suwanprasit, 46, and his wife, Lakana, 39, two employees of National Thai Company's dry-battery factory outside Bangkok, brought it down to human terms over a dinner of fried chicken, spicy fish, pork, and vegetables at their home.

"I like the Japanese," Vinit told me with a smile. "Where would we be without them?"

Vinit and Lakana started on National's assembly line some 20 years ago and worked their way up through the ranks. Today Vinit is deputy manager of dry-battery production. Lakana is an assistant section chief of the TV department. They own a seven-room home with a bright red Nissan in the carport, boast a company health plan and seven days' paid vacation a year, enjoy a National color TV and stereo in the living room and a National refrigerator in their kitchen.

Innocents abroad, a Japanese couple encounter Santa Claus at Dreamworld, a theme park in southern Queensland. With the yen's high exchange rate, Japanese often find it cheaper to vacation overseas than at home.

If it weren't for the Japanese, Vinit might still be planting rice in Lopburi Province, where he grew up as one of six children in a dirt-poor farming family, and Lakana might be scraping by in a poverty-stricken section of the city where she was raised.

THICKSET AND IMPECCABLE, Shunichi Yamazaki, 48, CEO of Carat International Inc., climbs aboard a 50-million-dollar jet, parks his shoes in the genkan near the door, and settles back with calculator and work sheets for his twice-a-month flight from Tokyo to Australia. Somewhere over the Pacific, he removes his suit and tie, slips into a *yukata* (robe) and stretches out on the floor, Japanese style, for a nap. "Customs inspectors are always baffled when we land looking so relaxed," he said affably.

Yamazaki is one of a growing army of Japanese investors, entrepreneurs, and occasional wheeler-dealers targeting Australia's real estate and resorts, its cattle industry and coal mines. In 1985 Japan's total investments in Australia amounted to more than 11 billion dollars. By 1990 the figure was close to 32 billion dollars. In those five short years Japan became one of Australia's largest investors.

Australians don't exactly welcome the Japanese with their customary "G'day" and "No worries, mate!" For many the memory of the war lives on. Furthermore, Japan's relentless, profit-tuned efficiency often mixes poorly with Australia's easygoing life-style. And more than a few Australians worry about erosion of their proud, independent heritage. As a cabbie told me in a seaside resort town, "I can't stomach the idea of a young Aussie pedaling rich Japanese around in a pedicab." We saw just that before the ride was over.

But Australians cannot afford to turn away Japanese capital. While the economies of Southeast Asian nations have boomed, the Lucky Country has fallen on unlucky times. In proportion to its economy, Australia's 17-billion-dollar deficit is one of the largest in the industrial world, and rising. The economy has been plagued by excessive imports, chronic inflation, and a high-priced, inefficient labor force.

"WE'RE A COUNTRY with First World aspirations and a Third World economy," Senator John Button, Australia's Minister for Industry, Technology, and Commerce, told me in Canberra. "For 20 years the nations of Asia have worked on their economies, and now they're starting on their life-styles. During that time, we worked on our life-style—and now we're starting on our economy."

Japanese investors hope to put the two together—to turn a profit out of sun and surf by providing luxury resorts for their well-heeled vacationing countrymen. Last year Japanese tourists numbered more than 500,000—almost a fivefold increase since endaka began.

The biggest spender is Daikyo Group, with some 550 million dollars in hotels, golf courses, condos, and casinos along a fabulous 40-mile beachfront south of Brisbane called the Gold Coast, plus more than 320 million dollars in acquired property and new development around the northern Queensland city

Scooping 60 tons of iron ore at a bite, a giant shovel works the open-cut mine at Mount Whaleback. The potential steel from ore in Western Australia's Ophthalmia Range would be enough to make a billion Toyotas.

of Cairns. With the Coral Sea before it and rain-forested mountains at its back, Cairns recalls Hawaii 50 years ago. And an international airport makes this paradise and the Great Barrier Reef just seven and a half hours from Tokyo.

Along with a couple of hundred Japanese tourists, I boarded a giant catamaran called *Great Adventures* for a day's cruise to the reef. We stopped at Green Island, a lush little tropical sanctuary, then sailed on to snorkel among the gaudy fish that inhabit the reef's great coral jungle.

"What's the attraction?" I asked a honeymooning couple. The groom beamed and stretched his arms wide. "Open spaces!" he said expansively. Daikyo, I learned later, had just purchased *Great Adventures*.

On a 300-mile journey to the sea, a 240-car ore train from the Mount Whaleback mine crosses the

vast scrubland of Western Australia toward Port Hedland. About half the iron ore will go to Japan.

Invoking the aid of a higher power, Buddhist priests help Japanese and Thai corporate officials launch a new scaffolding factory. Thousands of such joint ventures—particularly in electronics manufacture—have made Thailand itself an Asian "tiger," successfully stalking Western markets. The rise of consumer goods in Thai culture is seen at an ethnic Chinese funeral in Bangkok, where papier-mâché appliances are offered up for the afterlife.

THAILAND

Japanese capital and know-how have helped turn this Buddhist country into another Asian dynamo. But at a price: cultural disruptions and rampant pollution.

The spending worries Aussies like Jock Izatt, who came to Cairns in 1936 and has watched the sleepy seaport change.

"The population was 7,000 when I came here," he told me on the front porch of his seafront bungalow. "It's 45,000 in the city now, and 40,000 more within a hundred-mile radius. There are two 747s daily, bringing in hundreds of Japanese at a clip. There are schools sprung up teaching bar service and how to be a waiter."

Izatt gazed out over the water. "My plot here had a valuation of eighty thousand Australian dollars [$63,000 U. S.] in 1989. Last year it was revalued at $225,000. That means $60 a week in taxes. I've owned this block for 40-odd years, but I'm not going to be able to live here much longer." He sighed. "I can't be bitter. I drive a Japanese car, watch a Japanese TV set. And we can't stand in the way of progress—as long as we don't lose our own identity in the process."

A similar predicament faces Australia's cattlemen. Japan took advantage of a combination of factors—a slump in the worldwide cattle industry and a rise in the yen against the U. S. and Australian dollars. So three years ago when Japan agreed to open its doors to imported beef, conditions were perfect for Japanese investors to enter the U. S. and Australian markets. They found no dearth of ready clients. "Mate!" one resigned Australian cattleman explained, "We're talking trillions of yen."

"The beef industry here is at least one-third Japanese right now," Morris Binstead, a big, white-thatched man many call the "father of the Australian cattle industry," told me at a cattlemen's conference in Melbourne.

Nowhere has that interest been greater than in Queensland. A rolling rangeland with more than a third of the national herd, Queensland is locally known as the Texas of Australia. There, in Beenleigh, at Teys Bros. Pty. Ltd., one of the state's largest exporters to Japan, I talked to Allan Teys, the firm's courtly, confident chief executive officer.

"Our fear is that Japan will tie up the industry so that profits will be made in Japan, not here—and that a lot of Australian firms will be squeezed out."

IT WAS the annual Christmas party at central Queensland's South Blackwater coal mine. The shrimp were on the barby, steaks and chicken on the serving platters; a veritable cannery of good Australian beer lay icing in the barrels. The miners, in shorts

and T-shirts, their wives in summer dresses, waged a furious tug-of-war, while the kids queued up for Santa Claus, whose snow-white beard kept dipping into his lager.

South Blackwater, one of several mines under Australian-owned QCT Resources Ltd., employs just 385 workers. But the mine

Doing it his way, a Japanese businessman lets loose with a song at a bar in Bangkok specializing in *karaoke*. The popular fad of singing to recorded accompaniments is but the latest of Thailand's many Japanese cultural imports.

represents a link in an economic chain that is critical to the nation, and the workers I met there reflected the ambivalence that Australia's miners seem to feel about Japan.

For Australia is the world's largest exporter of coal. And Japan, the world's largest importer, buys almost half of what Australian mines export. Over the past five years, coal has accounted for more than 20 percent of Australia's total exports to Japan, a sum in excess of two billion dollars a year.

"QCT's mines produce some of the world's best coking coal," said Clive Hildebrand, mining engineer, Rhodes scholar, and QCT's managing director. We were flying in a Cessna he had chartered to take us to the party. He told how Japanese came in with the capital to finance development seven years ago. "Japan created our market. Without them we wouldn't have a market."

Chris Rawlings, South Blackwater's managing director, told me another side. "We're the most efficient supplier of coking coal in the world. But the Japanese say, 'You must increase your efficiency—and pass the benefits to us.' They'll go to a struggling mine and say, 'We'll give you extra tonnage if you drop your price.' Then they'll turn the coin and say, 'If you don't, we'll drop your tonnage.' But they are loyal to long-term suppliers like us.

"We can become more efficient," Rawlings went on. "But we're in a squeeze. Costs are rising—the returns are not."

Rawlings's boy got his present from Santa and pranced before his dad. Rawlings hugged the boy, gazed at the festivities around us, and shrugged helplessly. "What're we gonna do?" he asked. "If it weren't for the Japanese, we wouldn't be here."

AT MALAYSIA'S National Museum in Kuala Lumpur, between an old-fashioned bullock cart and a ricksha, stands a small white automobile with a crescent moon emblem on its hood. A plaque in front reads: "This National Proton Saga . . . the first . . . was completed on Thursday, 18 April, 1985 at 2:30 p.m."

That an ordinary motorcar should occupy such a prominent place among the nation's keepsakes is a measure of the pride Malaysians take in their "national car"—the first car more or less wholly built by a Southeast Asian nation. It is now one of Malaysia's biggest industries. The Proton Saga is a symbol of the commitment that Prime Minister Datuk Seri Dr. Mahathir Mohamad made to economic development. It is also a symbol of how a country's best laid plans can go hopelessly, almost unimaginably wrong, and then, miraculously, right themselves again.

The saga of Proton Saga goes back to 1981, when Dr. Mahathir first proclaimed "Look East," a policy aimed at transforming the tropical, onetime British colony into a modern industrial state, breaking the economic grip of local Chinese, who compose a third of the population, and turning the Malay majority into hardworking economic achievers.

Then the 1985 recession struck. "Saga came on-line in the worst economic times in 32 years," Steven Wong, senior fellow at

Malaysia's Institute of Strategic and International Studies, told me. In 1988 the national car lost millions of dollars. The factory was operating just three days a week. Management, shot through with inexperienced political appointees, was such a mess that Malaysia's minister of finance publicly suggested it should "do what the Japanese do, and commit hara-kiri."

To forestall that dire outcome, a management team from Mitsubishi replaced Proton Saga's Malaysian directors, and the picture changed. The car began selling briskly. Today most cars sold in Malaysia are Proton Sagas, and there is a four-month backlog on deliveries. But the question remains: How much of the car really is built in Malaysia? "The official figure is 67 percent," a source close to the project told me on the promise of anonymity. "Twenty-two percent is closer to it. But cite that to a government official, and he'll get very red in the face."

The difficulties of the Proton Saga venture had a cooling effect on both sides. But Bangkok's congestion and rising labor costs coupled with Malaysia's superior road and port facilities have many Japanese investors talking about Malaysia as the "new Thailand."

In 1989 Japanese firms invested 393 million dollars in the Muslim nation—not much by Thai standards but more than ten times what they had invested in Malaysia in 1985. And the figures for the first six months of last year outstrip that. The outskirts of Kuala Lumpur, west coast Pinang, and southernmost Johor Baharu are dotted with new industrial parks turning out everything from Japanese refrigerators and color TVs to computer components and semiconductors—all seeking to imbue their workers with *Nippon-do*, the "Japanese way."

To get a sense of what that was, I drove out one morning to the Shah Alam industrial site outside Kuala Lumpur to visit the Matsushita complex. With nine plants and more than 2,000 employees, Matsushita is the biggest Japanese electronics outfit in Malaysia. Out on the production line blue-jacketed workers joined in morning calisthenics, then bowed to one another and sang the company song, which exhorts workers to "create a new Malaysia" and "produce forever general appliances for the people."

"They try to get you to love the company," Rosita, 20, a production-line worker from Negeri Sembilan, told me at a large, comfortable hostel for women workers.

This song's for you, Thailand. While a singer croons, a Japanese company displays color TVs in a recently electrified town. With millions of potential customers to plug in, Japanese manufacturers follow the kilowatt trail.

"They give cash incentives to work harder. Everybody gets a birthday present. They have an annual dance, with a drawing where you might win a bicycle. And if you go four months without being late or absent, you get a Tupperware dish."

Industry advisers get more than Tupperware. "There are annual seminars in Tokyo. Five-star hotels even the Japanese don't go to. One-hundred-thousand-yen dinners," said Shamsul Amri Baharuddin, political scientist at Universiti Kebangsaan Malaysia and frequent adviser to Japanese firms.

"FOR SURVIVAL of the human species, we must re-create the natural environment. If I fail in this, I must commit hara-kiri!" The speaker was Akira Miyawaki, director of the Institute of Environmental Science and Technology at Yokohama National University and newly appointed special adviser to the Mitsubishi Environmental Affairs

Department. He was telling me about Mitsubishi's 124-acre reforestation project outside Bintulu, in the east Malaysian state of Sarawak on the island of Borneo.

I could only wish him well. But for all the project's PR appeal, it may be too little far too late. Japan imports more than half of all the tropical timber cut in the world. More than half that total comes from Sarawak—which often leaves great swatches of the island looking like a moonscape.

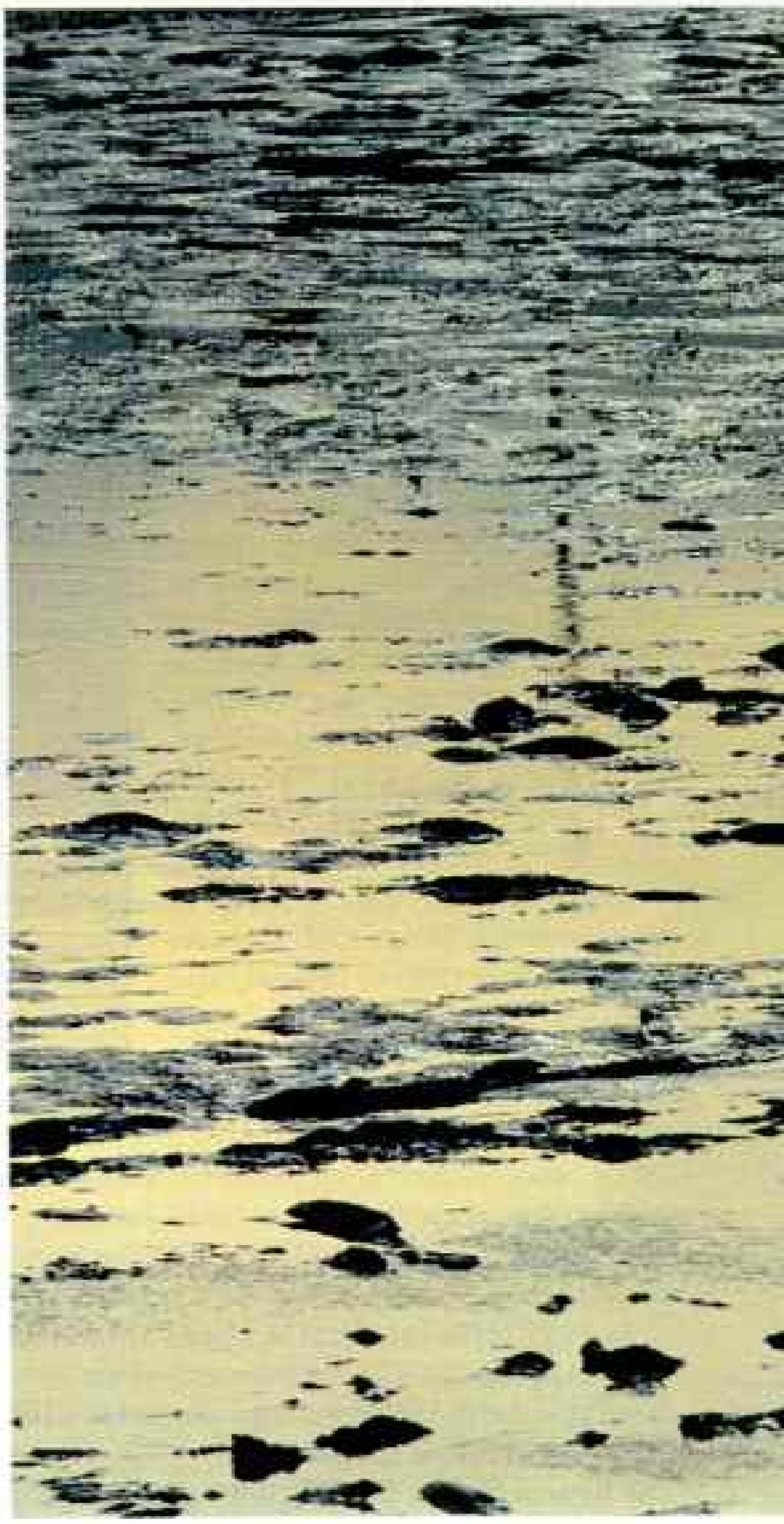
"There are about 100,000 people here directly dependent on timber for their livelihood," Datuk Amar James Wong, Sarawak's minister of tourism and environment, told me in his office in Kuching. "In terms of state revenue, timber—next to palm oil and petroleum—is our biggest source of income." It is also, as the minister readily acknowledges, a major source of Wong's personal revenue. "I started the timber market here," he said with pride. "And I'm still at it."

"The problem is that the Penans, a tribal people, claim the forests belong to them, which by law is not true," said Leo Chai, Sarawak director of forests. But didn't these people migrate into Sarawak from other parts of Borneo long before there was a nation called Malaysia?

"Yes," he replied. "And they have rights under *adat*—customary law—to land they cleared before 1958. But they have no other right to land unless decreed by the government." But the Penans never cleared land, I pointed out. "True," he agreed. "Anyway, there are only 300 or so who are still nomadic. The others have been settled. We aren't forcing them. If we leave them alone, they'll intermarry with other tribes and their identity will degenerate. Besides, a cash economy has been introduced. They must have means of earning cash to live." What do they do, I asked? He sighed. "That's the problem. Most of them produce nothing."

Some 125 miles up Sarawak's Baram River, in a government-built longhouse at a village called Batu Bungan, on the edge of the Gunung Mulu National Park, I heard the Penans' side. My guide and translator, Thomas Ngang, 35, was born and raised as a member of the Berawan tribe. His father was a close friend of a late great Penan chief. The people welcomed us and hunkered down to speak their minds.

"We can't adapt to this life," said Yuk



Usang, the mother of the current chief, a woman who looked to be in her 80s. "But we have no choice, because the jungle has been destroyed." Lusing Jeluman, a wiry middle-aged man, explained: "There's no food for wild animals, and so no food for us. The wild fruits have been destroyed. I plant rice, but it doesn't come up. I don't know how to grow it. We drink water polluted by upriver logging camps. We're sick. When we were in the jungle, we never thought of getting sick!"

I asked what they missed the most. Lusing's wife, Le Min Cheng, replied wistfully, "Wild shoots, the animals. Wild leaf for weaving. The open sky, the cool jungle canopy—and our freedom!" Then Lusing said

Aquaculture farms in southern Thailand help feed Japan's appetite for Black Tiger shrimp, while producing much of the foreign exchange needed for further development.

something I shall never forget: "You see, we Penans didn't live in the jungle. We *were* the jungle."

The boat back downriver was both crowded and bizarre. The decks were stacked with durians, Southeast Asia's foul-smelling sweet fruit. Below was a sweating crush of humanity so thick that one could hardly breathe, plus all the vagrant carryons that could be stashed in aisles, racks, or under seats. Plastic flowers adorned the cabin trunk. A VCR up front blasted kung fu movies at earsplitting volume in Chinese, English, and Malay. The elderly lady beside me was covered with tattoos. She munched ripe rambutans and watched in fascination as American wrestling's "Nasty Boys" wreaked havoc on the "Southern Boys."

Suddenly, over the din, there came a high-pitched *beep-beep-beep*, and a shouted *"Moshi moshi!"*—Japanese for "Hello!" For a moment I sat stunned and disbelieving. Then, leaning over the seat in front of me, I had my awe and fear confirmed. A Japanese timber merchant, in golf shirt and Calvin Klein jeans, was calling his office on a cellular phone. □

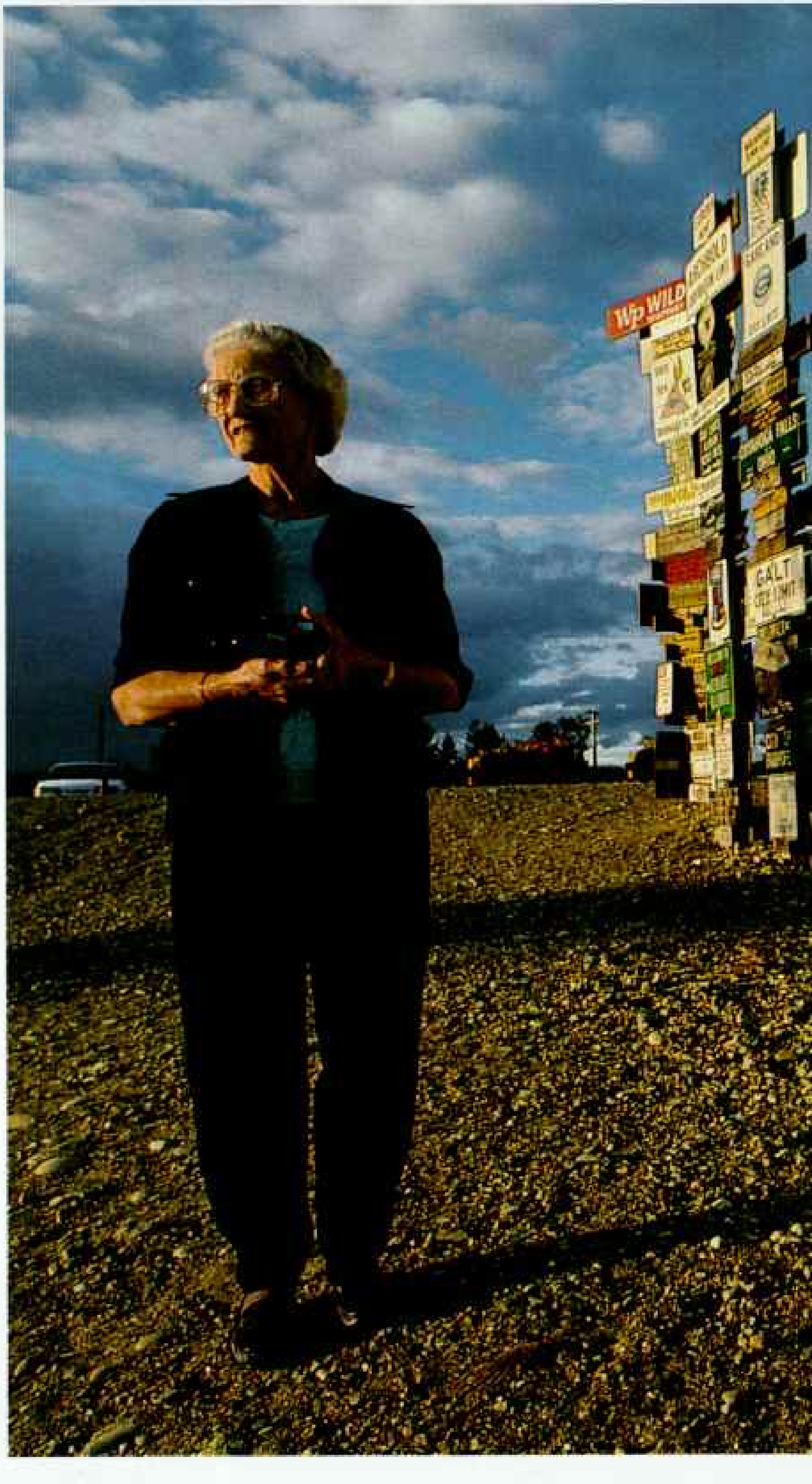
ALASKA HIGHWAY

WILDERNESS ESCAPE ROUTE

Article and photographs by
RICHARD OLSENIUS

The magnetic north draws dreamers and settlers on a pilgrimage along the Alaska Highway. At times hopes and reality collide head-on. Yet day or night, in snow or dust, the procession of searching headlights passes on.

"I've waited my whole life to come up here," says Lillian Nedohin, 70, a tourist from Alberta who searched among 12,000 signs at Watson Lake, Yukon, and found the name of the small town—Rycroft—where she grew up. The Signpost Forest started during the road's construction and has grown for 50 years. One contingent brought a sign from Jacksonville, Florida, then had to hang it upside down because the arrow pointed north.




FOURTH CREEK ROAD
ZONE 82
VOLYN ALTA
INFORMATION CENTRE
SASKATOON
SASKATCHEWAN
CAMBRIDGE, MN
FOR SALE
MARION CITY MT.
EILEEN & ROGER

"THE MATCHES ARE UNDER THE MOOSE."

Neil Sorken looked up from his coffee in the Summit Lodge café and waved helpfully toward the colossal stuffed moose head looming over the counter. I nabbed a pack, stuffed it in my bag for possible emergency use later, and went back to my chili.

When you've put in a little time on the road, "under the moose" doesn't strike you as a particularly strange remark. But time doesn't seem so little out on the Alaska Highway. You'll be lucky if this twisting, two-lane road lets you go as fast as 50 miles an hour along the tortuous 1,500 miles between Dawson Creek, British Columbia, and Fairbanks, Alaska (map, pages 78-9). This is equivalent to driving from New York City to the middle of South Dakota, and the map, littered with settlements with cheerful names like Fireside and Champagne, gives no hint of the immense stretches of wilderness that surround you on the way to the next cup of coffee, the next human voice.

The landscape changes, even if the road does not. You head north from Dawson Creek through rolling, fertile farmland. Toward Fort Nelson, fields give way to vast tracts of evergreens through which you ascend till you attain Summit Lake, where the stark peaks of the Rockies rear up. Beyond Whitehorse come glimpses of the soaring grandeur of the Wrangell and St. Elias ranges, and eventually gleam the bright lights of Fairbanks. Although there are variations in terrain, my most persistent memory is of infinite forest and muskeg—the wet, mossy, poorly drained ground that can suck a vehicle down to its axles and keep it there till kingdom come.

Prelude to a 1,500-mile odyssey, rolling farmland flanks the road near its southern end in Dawson Creek, British Columbia. Much of this land was cultivated even before the arrival of the highway. Grain, livestock, and poultry thrive despite winter temperatures of minus 40°F.

Civilization is only intermittent (one day I drove four hours and never once saw another vehicle in my rearview mirror). Yet I found that this very isolation creates an intense bond among the people who live along the highway, accepting the hardship in the conviction that it makes possible a life fundamentally better than the one they left behind in the comfortable, complicated world down south. I regard them with awe, but I still can't make up my mind whether they're crazy or not.

Fifty years old next year, the Alaska Highway (first dubbed the Alaska-Canada Military Highway, or Alcan) was hacked out of virtually trackless bush in a mere eight months, just after Pearl Harbor made a West Coast invasion seem probable. Until then the primary means of access had been by water. Even after

RICHARD OLSENIUS, a Minnesota native, has driven the Alaska Highway "both ways" several times. His last story for the GEOGRAPHIC was on the Northwest Passage, in the August 1990 issue.

the Klondike gold rush of 1898 brought the first great influx of newcomers, life had continued to maintain its peaceful pattern in harmony with the seasons.

When this prodigy of engineering opened in November 1942, its impact was irreversible. Loggers, miners, truckers, and dreamers of all descriptions began to swarm northward. "If it weren't for this road," one logger said frankly, "we wouldn't be here." And so the highway almost immediately acquired a certain mystique, like other fabled routes to adventure, an epic embellished, rather than diminished, by actual experience.

Summer traffic reflects summer diversions, with a noticeable increase in gleaming RVs full of tourists who love the road for itself, and not for where it will take them. Winter traffic dwindles down to the basics—commercial vehicles hard at work. But year-round there is a steady if small contingent engaged in some voyage of discovery, launched in the most unpromising vessels: battered cars or vans stuffed to bursting with clothes, gadgets, and children, windshields scarred by flying gravel, frequently with one dead headlight whose filaments finally took one jolt too many. Under the streaks of gritty mud you can sometimes make out the defiant bumper sticker: "We drove the Alaska Highway. Yes, damn-it, both ways." Whether coming to settle or just passing through, lured by the mirage of freedom and a fresh start (or retreating south, disillusioned and defeated), many people just drive grimly on, pausing only for the briefest necessary stops. That's too bad. For they never glimpse, beyond the gas pump, the hidden, self-absorbed, strangely beautiful world of those who, in their own way, have reached their destination.

Within 250 miles, farms give way to a view that burns itself into memory: endless stands of evergreens cut by a ribbon of road. Asphalt covers most of the roadbed, and repair crews work daily. But cars still suffer "Yukon windshield"—pocks and cracks from flying gravel.

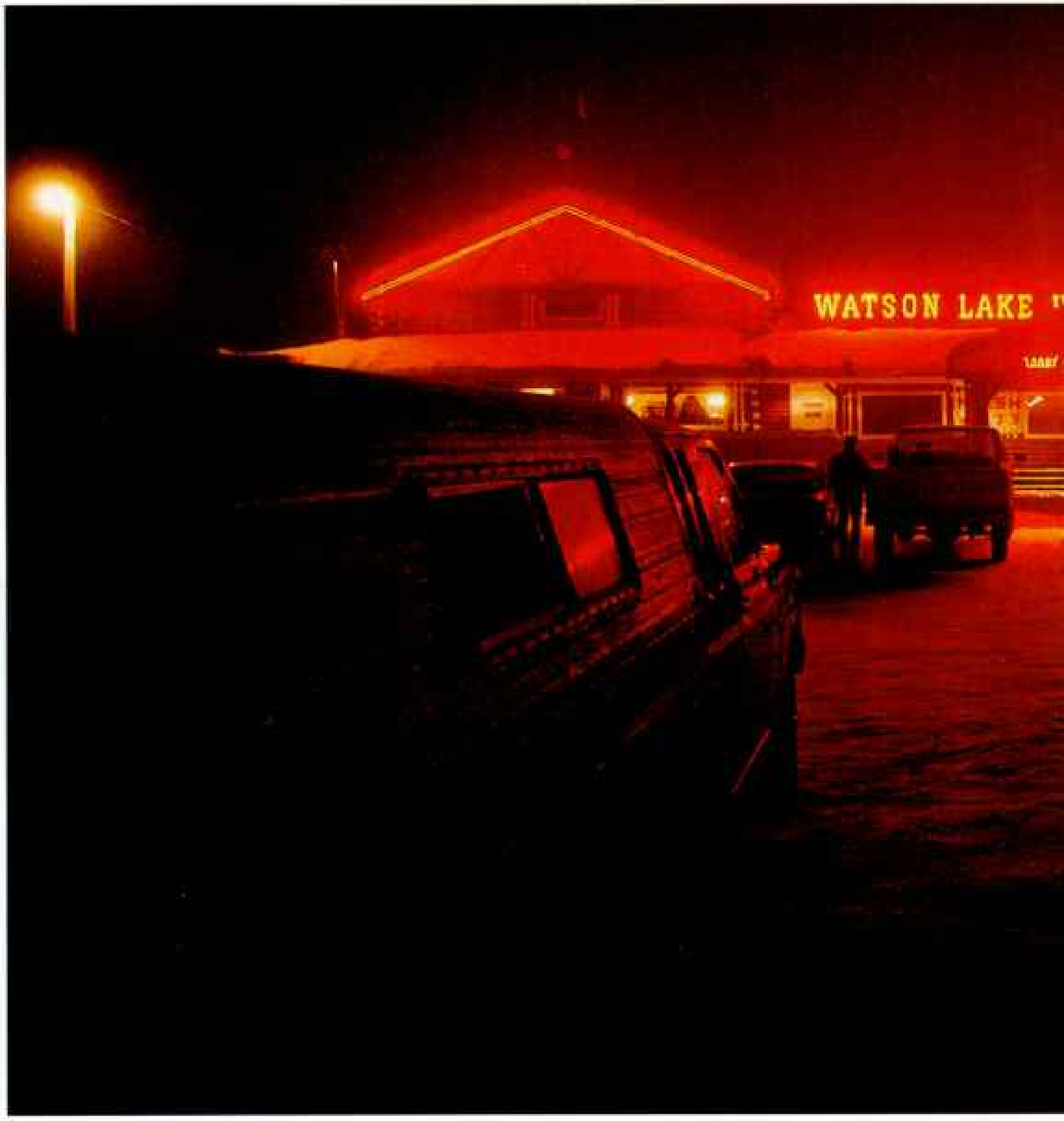
THE CALL OF THE WILD is still alive and echoing. I suddenly had the strange notion, as I drove northwest along the bare, windswept ridge between Liard River and Watson Lake, that this territory is exactly like New York City: The region exerts the same kind of powerful attraction in drawing people who are either running away from something or toward it.

"It's the freedom," 27-year-old Deb Wild told me in Fort Nelson. "There's less laws. And you don't even need a watch. The farther north you go, the more laid-back it is."

"You don't have to pretend," said Marvin Taylor in Whitehorse. "People accept you the way you are."

"A slower pace of life," mused Carolyn Scherck in Lower Post. "A cleaner world. People are much more genuine, more caring about their neighbors."

That's the positive side. Out in the wilds there clearly is a



"Lots of pretty women come in here, but they just pass through," says cook Brian Boser at the Liard River Lodge in British Columbia.

Although he's on the main route to Alaska, owner Gene Beitz seldom sees tourists twice. "They usually take a different road back or catch a ferry down the coast."

degree of interdependence and altruism uncommon in cities. "A local businessman had a head-on collision," Father Marcel Vogel told me in Haines Junction. "He suffered burns over 70 percent of his body. The community got together and put on a dance, with dinner and drinks. Out of a town of 500 people, they made $6,000 clear to help him. So much of what happens in the Yukon is spontaneous. If it's a good idea, it really flies."

People usually tell you they came up here for peace, independence, solitude. They eventually discover that these can be elusive, even oppressive. Father Marcel, a gentle soul in a hulking, 300-pound frame, confessed that he had struggled with the hours of lonely driving between his scattered parishes till he decided that the trips were bound to be "very good for my prayer life."

Then there is the climate. Summers can be glorious, but the

Setting a neon blaze in evening mist, the Watson Lake Hotel is a beacon for weary drivers year-round. While many hotels and gas stations shut down in mid-September after the tourist season, a few stay open for truckers and for the constant flow of military personnel to and from northern bases.

winters are unfathomably cold. And there's no defense against the endless hours of darkness. The effect is now termed seasonal affective disorder, but old-timers simply call it getting "bushed."

"Sometimes I find I can't shut up," says Carolyn Scherck. "You'll be going along feeling great," Fred O'Brien, a Burwash Landing newcomer told me, "then all of a sudden you'll be bawling your eyes out."

The isolation inevitably impels people to turn to one another, and what all these tiny settlements add up to is one very strung-out small town. "You live life under a microscope," said the waitress at the Mountain View Motor Inn. Wherever I stopped, at this roadhouse or that general store, the news was bound to be fresh—either gleaned from CNN via satellite dish (newspapers are scarce) or, even better, the latest gossip, rumors, updates on the daily dramas of life.

"The truckers are the best telegraph there is," Richard Hair told me at Contact Creek. But it was unsettling too, as if a person living in Chicago could routinely expect people in New York to be chattering the next day about the fight he'd had with his wife or what the doctor had told him about that little growth.

Laden like Marley's Ghost, a weary trucker drags tire chains that have fallen off his rig near the 4,250-foot Summit Lake pass in British Columbia, the road's highest point. Months after tourists leave, truckers roll on, fighting fatigue and the whims of weather. "It's a challenge to drive this road," says bus driver Hans Henriksen. "But when there's a full moon, you could keep on forever."

"The smaller communities are anything but simple," Father Marcel remarked as we sped down the icy, twilit road toward his home base at Our Lady of the Way in Haines Junction. "The inner workings are complex, and a lot of it's unwritten." And it can take a surprisingly long time to fit in. "A quarter to a third of the people move every two years," he said. "So one of the first questions they ask you is, 'How long are you going to be up here?' That is, 'Is it worth making an investment in you?' And the first year, of course, it's simply 'Are you tough enough to stay here?' "

And despite the romantic myth, this small-town scrutiny makes it pretty hard for fugitives from the law to lose themselves in the frozen north. "They're usually caught," shrugs Marvin Taylor. "People can detect them very quickly." Or, as a Mountie put it, "People still believe that we don't have faxes and satellite communications and that they can disappear. We know everyone who comes up here."

ONCE THEY GET HERE, what do they do? There is a short-term, seasonal, transient population of loggers, oil explorers, and miners, people making the most of their few productive months each year. Logging, for instance, is a winter job, because the melting snow turns the access roads across the muskeg into bottomless bog, as the highway construction crews discovered to their grief. On the other hand, placer gold mining is summer work, to make full use of the rivers. There are the classic wilderness types—guides, outfitters, part-time trappers. There is a small but steady stream of military personnel transferring to their next posting. An assortment of people earn a living by serving the tourists: running the gas stations, restaurants, shops, RV parks. Most of them, beneath a very hard crust, are visionaries at heart. There are even a number of settlements, such as the 200-member Whitestone Farms in Delta Junction, with clearly religious overtones.

Sunup near Liard River reveals a rolled-over truck—and a dead driver, one more on a highway that claimed 22 lives in 1990.

"The thing about these accidents, there's never any witnesses," says a police investigator. "Sometimes it could be a vehicle that forces you off the road, and they never come back. Or it can be just plain tiredness, people trying to go too far too fast."

The towns are never large; apart from Fairbanks, the biggest is Whitehorse, which as the capital of the Yukon boasts plenty of bureaucrats, pushing the city total to 20,500. The more typical settlements are a mere conglomeration of houses clustered around some form of gas station/hotel/café/general store. In Watson Lake one building efficiently houses the post office, library, and liquor store. Unlike the earliest days (when a trip along the highway bore a greater resemblance to a Himalayan trek than a road trip), you rarely go more than 50 miles without reaching some small outpost, but it is still the better part of valor for a long-distance driver to carry a supply of food and, in winter,

ALONG THE ALCAN

Plunging through the wilderness like a determined prospector, the Alaska-Canada Military Highway (Alcan) was built at eight miles a day during World War II to counter any invasion by Japanese forces—who thanked workers in a propaganda broadcast for opening a way for their own troops. Rather than forging a more direct route to Alaska, planners linked existing airfields at Fort St. John, Fort Nelson, Watson Lake, and Whitehorse.

AIRPORT
Fairbanks
M 1502
EIELSON AIR FORCE BASE
FORT WAINWRIGHT
YUKON TRAINING AREA
YUKON-CHARLEY RIVERS NAT. PRES.
FORT GREELY
Delta Junction
M 1422
Though the official northern end of the highway, Delta Junction is just a stopover on the way to Fairbanks.
ALASKA HIGHWAY
4238 m
Tanana
3155 m
Tok
M 1314
ALASKA HIGHWAY
YUKON
U.S.
CANADA
1873 m
RICHARDSON HIGHWAY
TETLIN N.W.R.
Beaver Creek
M 1202
Copper
Wrangell Mts.
4996 m
WRANGELL-ST. ELIAS NATIONAL PARK AND PRESERVE
White
Donjek
Kluane
KLUANE GAME SANCTUARY
ALASKA
YUKON TERRITORY
Burwash Landing
DALTON TRAIL
KLONDIKE HIGHWAY
Fiftieth-anniversary events will include a 1,500-mile pack-mule trek, a vintage military convoy, and a ribbon-cutting reenactment near Kluane Lake.
Kluane Lake
KLUANE NATIONAL PARK
Mt. Logan
5951 m
19524 ft
Haines Junction
M 1019
2149 m
Champagne
Lake Laberge
2062 m
Whitehorse
M 918
During the Klondike gold rush, prospectors boarded riverboats in Whitehorse.
MOUNTAINS
2382 m
Teslin
Teslin Lake
KLONDIKE GOLD RUSH NAT. HIST. PARK
Skagway
Haines
Atlin
COAST
ATLIN PROV. PK.
2470 m
GLACIER BAY NATIONAL PARK AND PRESERVE
Juneau
ADMIRALTY ISLAND NAT. MON.
BRITISH COLUMBIA
ALASKA
0 75 km
0 75 mi
NGS CARTOGRAPHIC DIVISION
PAINTING BY JOHN A. SOPER

UNPAVED ROAD BECOMES A MUD PIT IN THE SPRING THAW OF 1943. NATIONAL ARCHIVES

A CREW DIGS OUT OVERWORKED BULLDOZERS WHILE BUILDING AN APPROACH ROAD IN JUNE 1942. COURTESY WALTER E. WASON

Park, monument, wildlife refuge
Military property
M 1523 Traditional milepost
Oil field
Gas field
Mining area
Logging area
City (over 10,000)
Town
Road stop
Ferry

YUKON TERRITORY
NORTHWEST TERRITORIES
NAHANNI NAT. PARK RESERVE
Liard R.
7033 ft
Watson Lake
Contact Creek
YUKON TERRITORY
BRITISH COLUMBIA
M 535
Swift River
Lower Post
1378 ft
Fireside
LIARD RIVER HOTSPRINGS PROV. PARK
Liard River
Cassiar
Muncho Lake
MUNCHO LAKE PROVINCIAL PARK
Toad River
M 300
Fort Nelson
Summit Lake
4635 ft
1395 m
STONE MT. PROV. PARK
Mackenzie Mts.
ROCKY MOUNTAINS
MT. EDZIZA PROV. PARK
SPATSIZI PLATEAU WILDERNESS PROVINCIAL PARK
TATLATUI PROV. PK.
KWADACHA WILDERNESS PROV. PARK
ALASKA HIGHWAY
Fort St. John
Dawson Creek
ALBERTA
BRITISH COLUMBIA
MISTY FIORDS NAT. MON.
Williston Lake
Peace

Creation of the road was a joint U. S.-Canadian project. After the war Canada assumed ownership of the 1,200 miles east of the Alaska border.

When equipment sank in the soggy ground between Fort Nelson and Liard River, builders laid log bases up to two miles long, then piled on a roadbed of soil and gravel.

Though they still serve as local addresses, old mileposts are history. Metric Canada has set "kilometreposts."

Dawson Creek, where equipment could be sent by train, was chosen as the highway's southern end.

Three seasick years as a boat hand in the North Atlantic told Yvon King (right) that he had to find another job. One look at the pay stub of a roughneck on oil fields near the highway convinced him "that's where the gold is." Now, after 11 years, he's left the fields for other work. "I'll have more time with my kids," he says—a concern not necessarily shared by roughneck regulars ogling a dancer named Sam at Eddie's Hideaway in Fort Nelson.

warm clothes. (It could be a long wait for help if you get stuck.) Stock up on cassette tapes too if you don't intend to improve your prayer life, because many empty hours can pass beyond the reach of any radio station.

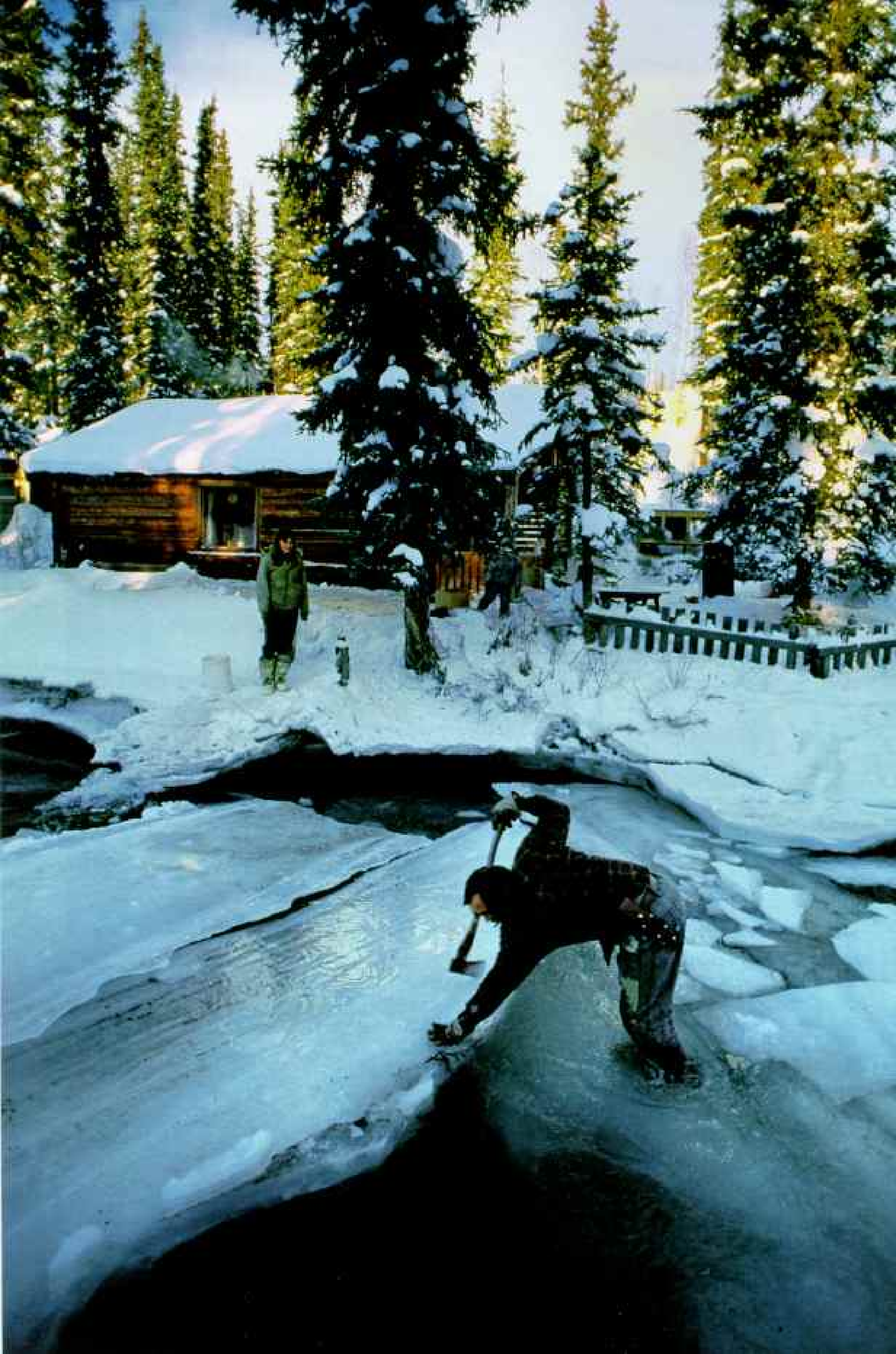
Wherever you stop, you'll be bound to meet someone who exemplifies some variation on the theme of escape. There was the secretary who came up from Ontario on her vacation 11 years ago and just never went home, the man who left his job selling insurance in Toronto to become a logger, the Vancouverite who abandoned his tugboat and started trapping; even the woman who sold me gloves had the unmistakable gleam in her eye that said "northern convert."

At Contact Creek I met Richard and Dennie Hair. Seven years ago they and their three children kissed Kissimmee,

Florida, good-bye, lured by the outdoor life and the slower pace of the north. Now they run the gas station/café at Contact Creek, the point where the first two construction crews met. They are the total habitation there, and that suits them fine.

"Yeah, we gave up that rat race," Richard says. "Mickey Mouse." One night during their first winter the temperature dropped to minus 71°F. Richard rescued 21 people whose cars had quit; then as they were all jammed into the café trying to sleep, the diesel fuel gelled and the generator quit. If they hadn't had enough firewood on hand, "There would have been a lot of frozen people," Richard says with characteristic northern nonchalance. The Hairs love it here. The kids went back to visit their grandparents in Florida and couldn't wait to get home.

There is Johnny Friend (yes, that is his real name), a figure



out of the wilder passages of Robert Service and Jack London. Diminutive, gruff, obstinately unmarried, he came up to Watson Lake in the late forties to work with the road crews and stayed to open a garage. Since then Watson Lake has burgeoned into a decent-size tiny town, straggling along the highway with several gas stations, two schools, three restaurants, a few hotels and motels, a tiny airport, and the much touted Signpost Forest, started by a homesick soldier on the construction crew who tacked up a sign showing the distance to his hometown. The wall of signs now tops 12,000 left by visitors from all over the world, from Brno, Czechoslovakia, to Dumplin, Tennessee.

OVER THE YEARS, Johnny Friend has become something of the town's tutelary deity. At 71, he's still working at least part-time, and you can find him most evenings at the bar in the Watson Lake Hotel, with a bottle of Carling Black Label in one grease-steeped hand and a Cuban panatela jammed into the convenient gap between his front teeth. In addition to being a brilliant mechanic, he was the founding coach of the local baseball team. They've even named the hockey arena after him, though he doesn't mind pointing out that the lights on the sign ought to shine more brightly.

He was also for a time the town's self-appointed mortician. "I was at a funeral, and they forgot to bring the rope to lower the coffin," he reminisced. "Everybody stood by the grave while I drove back to town to get some rope, and I decided then and there that I was going to take charge of the burials around here.

"They found an old trapper dead in his cabin once, rigor well set in," he went on. "I used my road grader to fit him into the casket. Yep, I had to bend him some to fit him in."

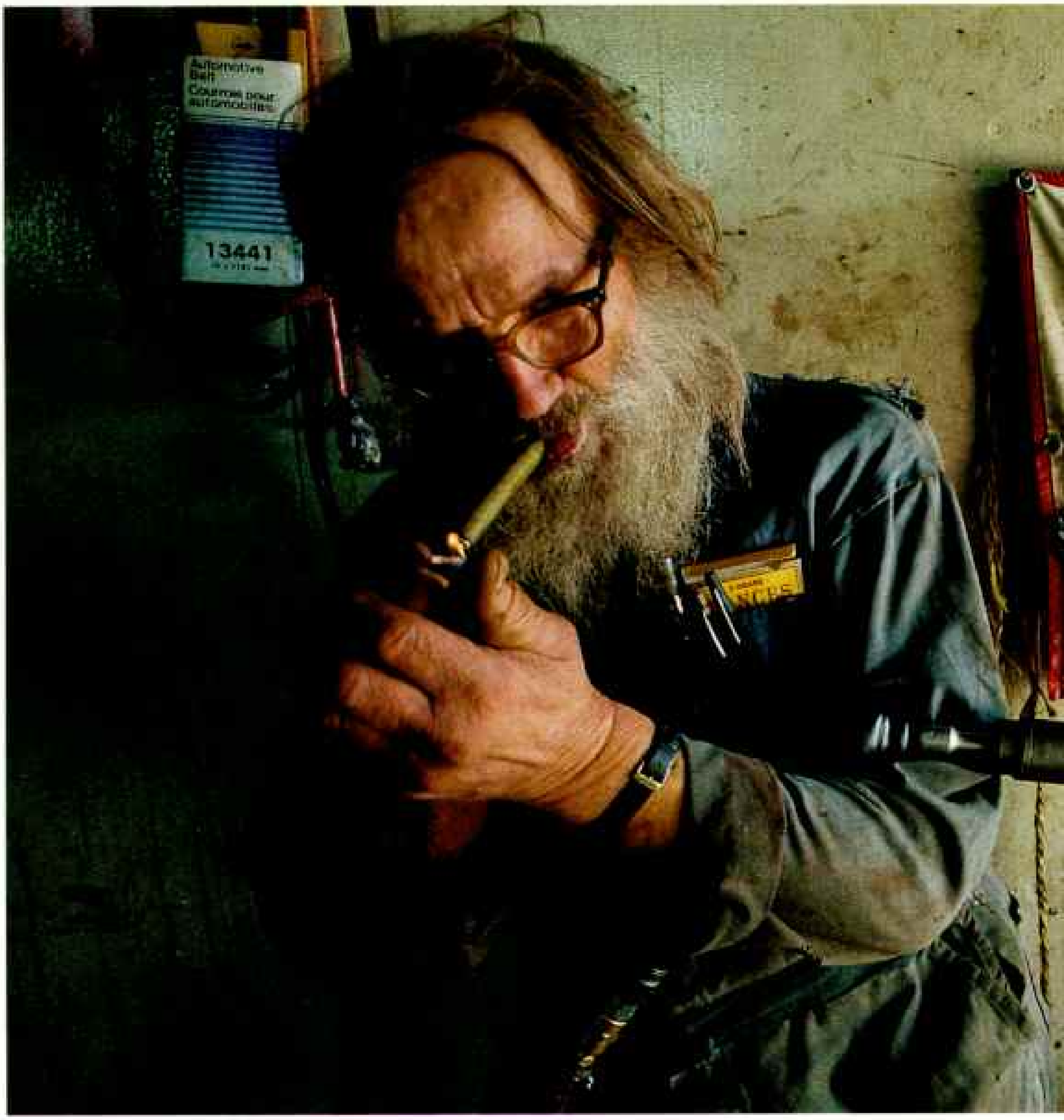
He's watched the highway bring change. "There's no comparison between the people here now and the way it was," he states flatly. "Before, you knew everybody. If somebody had a bit of bad luck, you didn't make a big hoop-de-do about it. Now people start organizing. And they're not as free and easy. And we got too many churches. There's four for sure right here, and that's way too many for a couple of thousand people."

His business has changed as well. Continual road upgrading is better news for the drivers, but worse news for the mechanic. In addition to the usual mishaps, early travelers could count on having to replace several tires, and possibly the gas tank would be punctured by gravel. Today there are fewer hazards from the road itself, but this "new fandangled stuff" they're putting in cars—like computer circuitry—stymies him.

And while the locals like to believe they've seen it all, the

"The cold is our friend—without it, there'd be a lot more people up here," says privacy-loving Richard Dix. He takes an ax to ice threatening a bridge outside the isolated Yukon cabin near the Alaska border where he and wife Jennifer are raising two daughters.

One welcome visitor is Doug Twiss, who drives the ten miles from Beaver Creek for kerosene-lit chess.

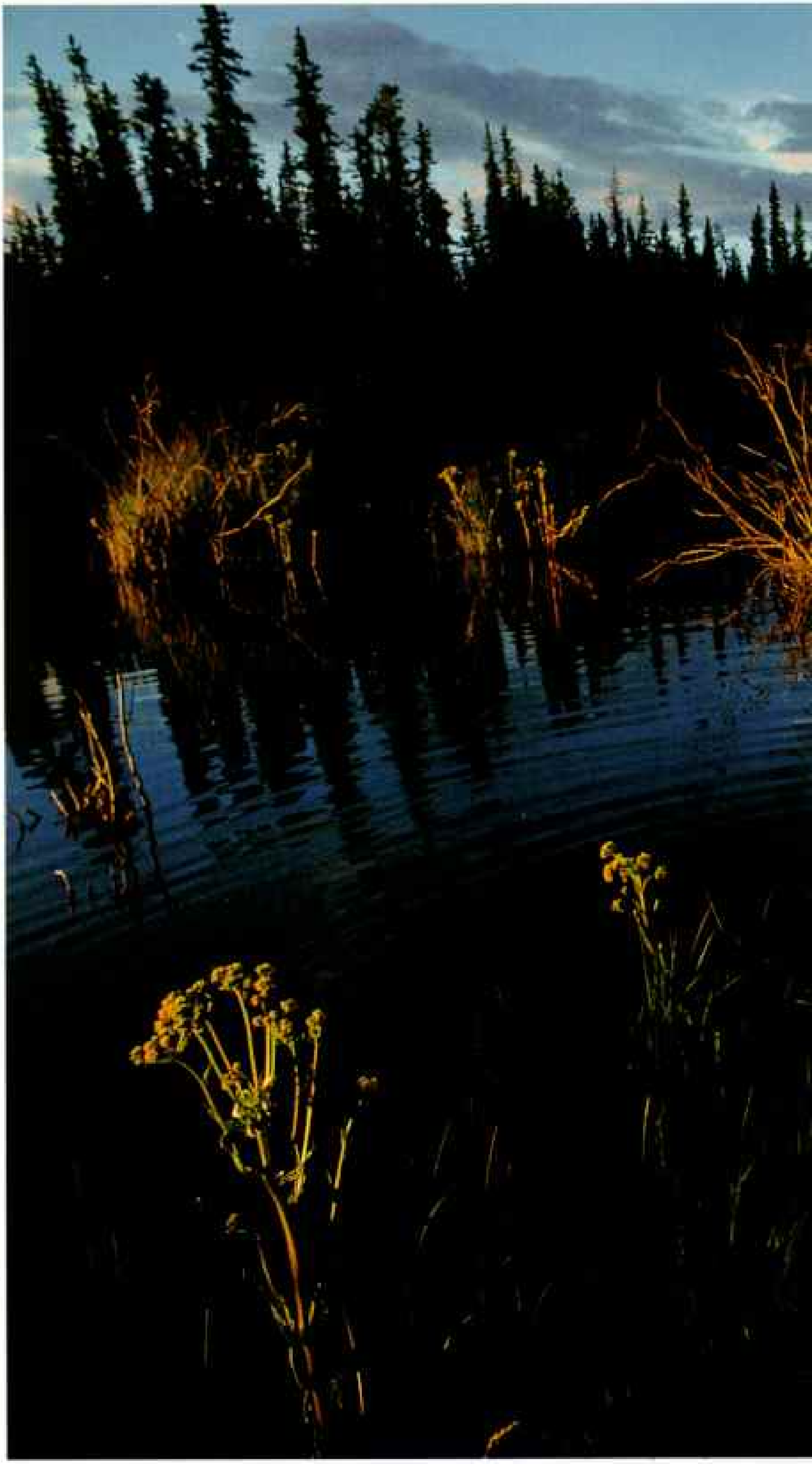


"I don't go south much," puffs Johnny Friend. "Everyone down there is in a big hurry to go nowhere." Before building his Watson Lake garage in 1953, he worked on highway crews. "It was wicked, just one lane in places. If you met someone, sometimes you had to back up a half mile."

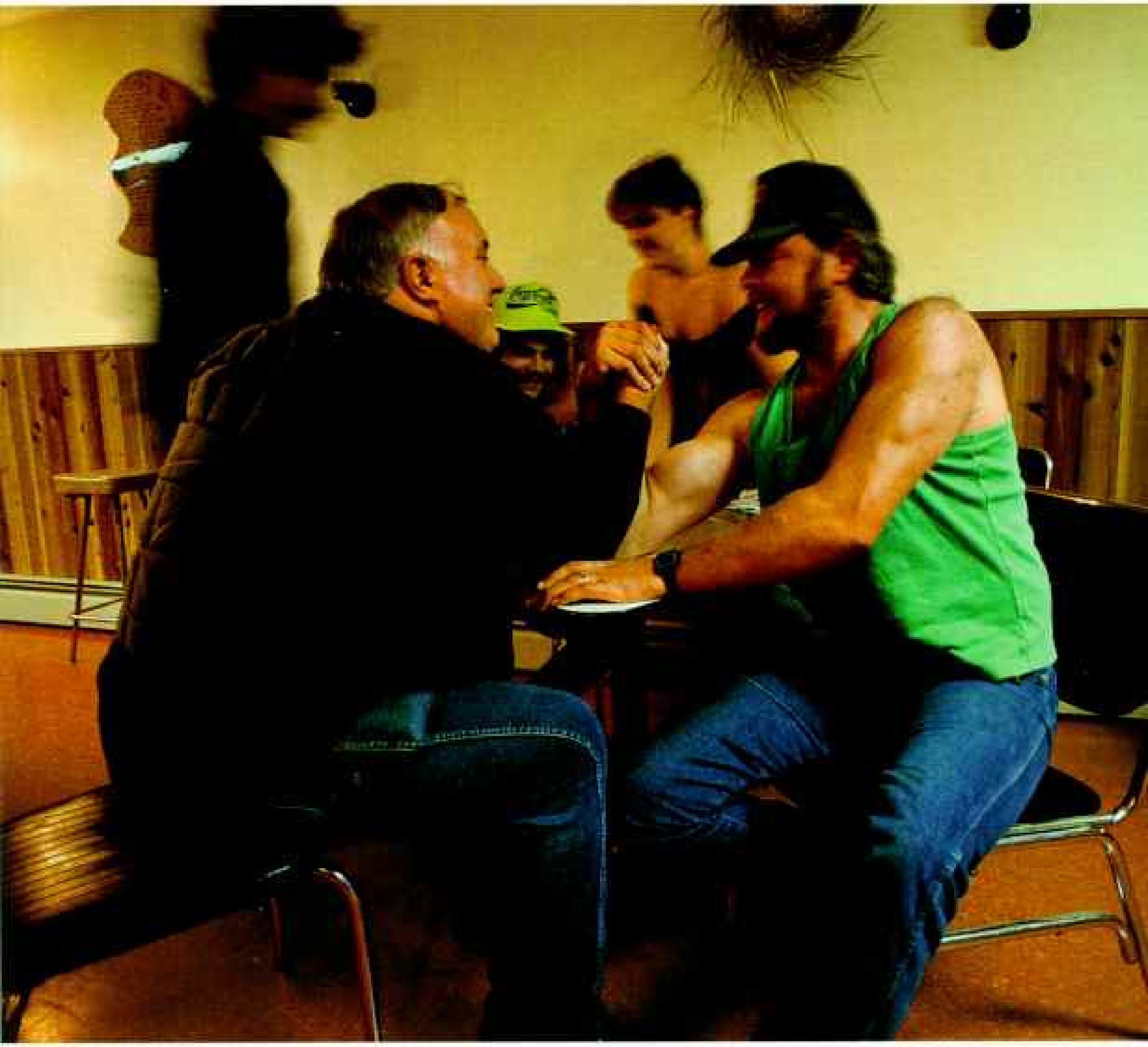
appearance of a new type of tourist has got them all flummoxed. As if it weren't hard enough just to drive the road, now there are people showing up on bicycles. You'll crest a hill and suddenly there's a biker pedaling away, laden down with high-tech mountain gear, face clenched in a rictus of concentration. I once saw 30 of them go by. Who would do that? You never get to know who they are; it's like looking for a raven's nest: You see them all the time, but you never see where they go to bed at night. I believe some of them have tents. A lot of them, especially the loners, appear to be Japanese. I was told that nowadays the Japanese are really getting motivated to take trips offering remote experiences in the north.

Yet the highway seems to be able to comfortably accommodate parallel worlds, and I heard them in counterpoint one

Rigors of the road were too much for an old Volkswagen: Student Andy Rittenberg and a mechanic push it into a Fort Nelson garage. Improved surfacing has made travel on the highway less traumatic for vehicles, but sometimes motorists have to wait weeks for parts.



Washing a day's dust from his face after a horseback trip up the Yukon's Dalton Trail, Benson Billy and his nine-year-old son, Dion, share a moment on land that was the unchallenged domain of their ancestors. Recent agreements with Canada will return 16,000 square miles of the Yukon to native peoples.



morning in the Watson Lake Hotel coffee shop over my usual bracing-for-the-road eggs, bacon, toast, coffee, and short stack of flapjacks. At one table was a foursome of sleekly clad skiers; at another, a quartet of well-worn men clearly from a local service station, each engrossed in their special concerns: "If it's really warm, it'll be snow, not ice. . . ." "Turned the valve off and discovered the pump. I heard about that for a month and a half. . . ." "Who are the locals that are hotshots? . . ." "That aluminum is stronger than it looks. You can take a moose on at 50 miles an hour and never leave a dent. . . ."

Everyone is willing to tell you his story, but it's understood that literal truth is not as important as presenting it with panache. And I was surprised to find that, unlike people in the more teeming parts of the world, northerners are generally disinclined to delve too deeply into personal questions. This may be partly because the questioner isn't too keen on having to reveal that much about himself in turn.

After days of driving, you begin to recognize your fellow trekkers, and it's almost unavoidable that you will fall into casual conversation. The highway, naturally, is a major topic: road conditions, scenery, animals, breakdowns, though hardly ever the weather (after all, what can you say—"It's really cold"?). If you're in the bar or café first, you watch them wander in with the glassy eyes and clumsy feet of five-hours-straight driving. If you're the one to join the crowd, they're usually staring dully into their steaming coffee cups or into the distance beyond their beer bottles. I soon learned not to bad-mouth anyone, because there was a very good chance I'd be running into him again somewhere along the road.

The highway can take it out of you. The world is so empty out there that you zero in like a heat-seeking missile on anything that moves. Watching a car approach is entertainment. You can rarely even see the hamlet you've spent hours anticipating because there are so few vantage points; the houses just suddenly appear, around a curve, beyond the trees. I actually drove through Fort Nelson watching for Fort Nelson, because I thought it was going to have a downtown instead of being a smallish, motley string of gas stations, restaurants, and bars. It is more like a supply station for the myriad logging crews, though glimpses of more permanent life can be had, like the sign in the launderette for the battered wives support group.

Voice in the wilderness, Father Marcel Vogel faces local reluctance to attend services at the three missions he pastors between Haines Junction and Beaver Creek. "Most come north to get away from rules," says Vogel, a former California gas-station owner.

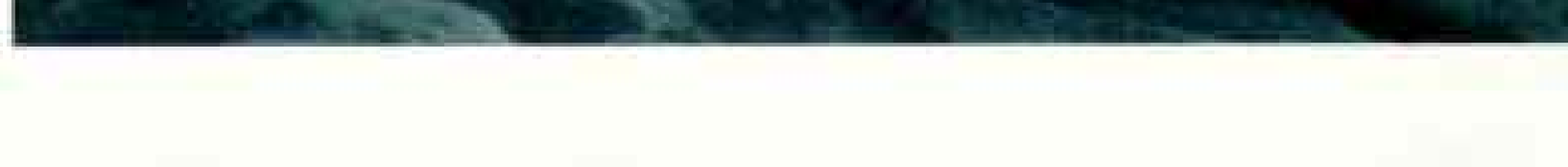
Between Masses he accepts a challenge from "BJ" Bjorn, at whose wedding he recently officiated.

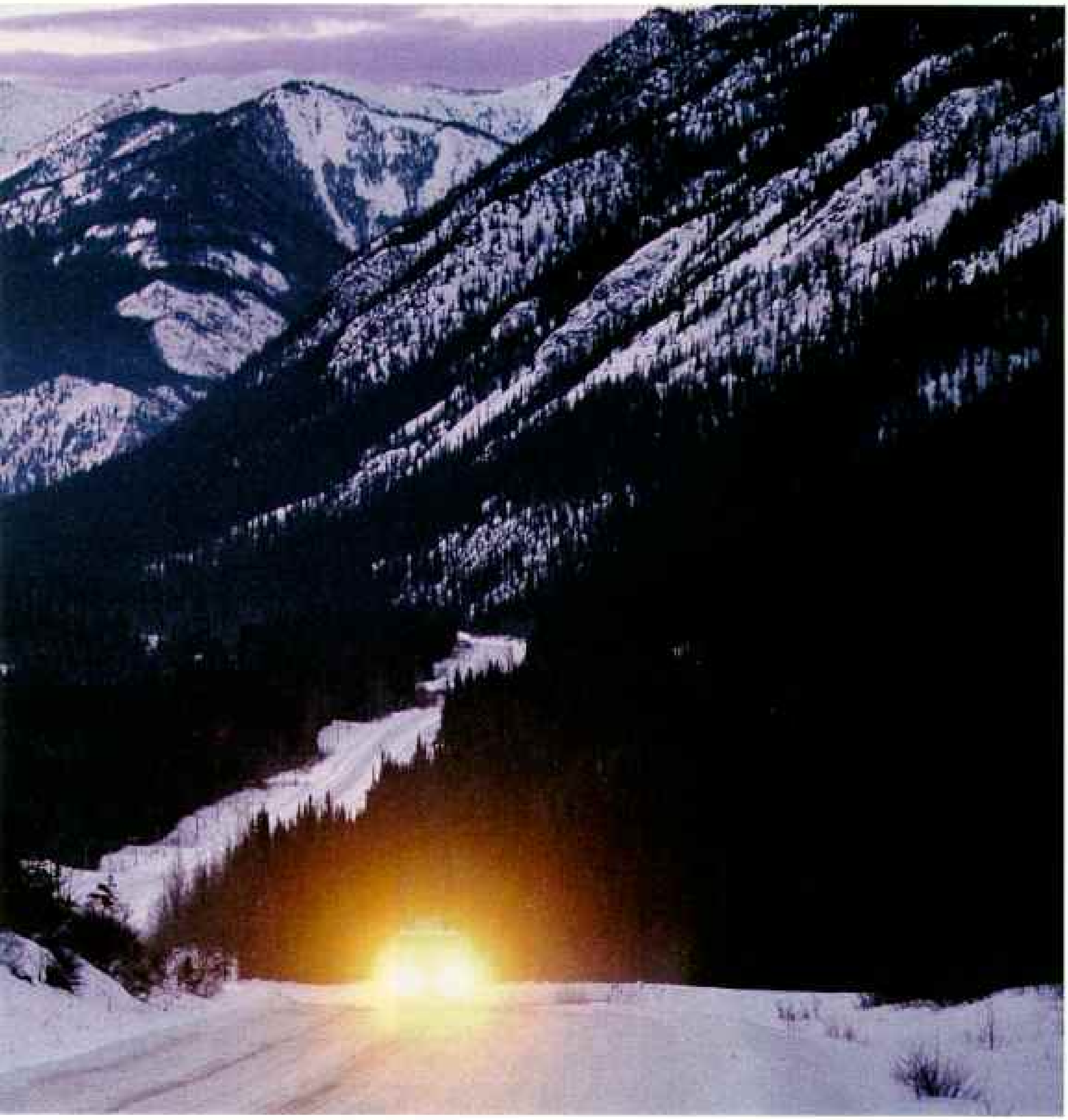
EVEN THOUGH you can rarely go very fast, concentration is crucial, though difficult to sustain. You soon achieve a delicate mental balance, for while the monotony of the empty road can erode your attention, you have to stay sufficiently alert to protect yourself from a slick patch, a disappearing shoulder, a curve with no guardrail (which is to say, most curves).

If you let your mind wander, the road will jump up and bite you; I learned that lesson one gray, tedious afternoon when my mind drifted a bit. In three seconds I had "taken the ditch" and was sunk axle deep in snow as solid as concrete. That's how you learn that the road's hazards aren't only in the surface but in your attitude, and I treated the highway with much more respect after that.

And yet I came to love the driving too, as my senses sharpened. I would hear the musical crinkling of ice on the car roof as I drove; I noticed how wearily the old snow clung to the spruce branches and how the violet mountain ranges were draped with luminous snow-scrims of fugitive pink at sunset. In the summer I came to discern the tiniest variations in the forest green and watched for coyotes, moose, and caribou along the verge—not to mention standing pensively in the very middle of the road.

Jets of steam melt ice in a streambed that runs under the highway just east of the Alaska border. All winter road crews battle ice sheets that creep across the highway like miniature glaciers. Other hazards include frost heaves, which raise pavement as water freezes below.





Winding through mountains that stretch from New Mexico to the Arctic Ocean, a southbound car beacons its approach along the highway south of Liard River. A hundred miles behind lies Contact Creek, where construction crews working feverishly from north and south met in 1942.

And I would remember that the emptiness of the road had its advantages too. Not to put too fine a point on it, it's safer to be alone on the road than to face oncoming traffic. A big truck throws up a blinding white cloud of snow, or the rush of its passing can make you swerve just a little where you'd really rather not. And the mind of the average tourist on wheels will almost always be anywhere but on the road.

"It's a challenge to drive this highway," Hans Henriksen, a Greyhound bus driver, told me over coffee in Fort Nelson. "But when you get used to the run, it's really the easiest, because you don't have the traffic.

"I would ten times rather meet a big truck than a tourist," he said fervently. "Then it's just the highway you have to negotiate with. They're not tourists; they're terrorists."

WHEN ACCIDENTS HAPPEN, they can be ghastly—another accepted topic of general discussion. Collisions with animals, sideswiping just-barely-too-wide trucks (tankers, flatbeds loaded with timber, or "muffins" of lead-zinc), sliding off the road and somersaulting down the embankment—any calamity is compounded by the isolation. It might be hours before the accident is even discovered, more hours before a passerby can reach a place to summon help, and even longer before the ambulance or helicopter can come. If the weather is bad, help may never arrive.

Near Liard River I came upon the aftermath of an accident. At the Liard River Lodge, a helicopter belonging to a private company was just taking off with an injured mother and daughter; another daughter was standing there crying in the arms of the lodge waitress. The details were a little confused, though there was more information than is usually available at accident sites where the cause is long gone and the wreckage is generic. Apparently the woman had been driving to Alaska to meet her husband. Time was short, and she'd pushed herself too hard. Exhausted and confused, she'd slid off the road and rolled over.

Downtown Whitehorse, capital of the Yukon Territory, is but a short dogsled ride from Lake Laberge, styled "Lebarge" by poet Robert Service in "The Cremation of Sam McGee." The poem's frigid warning: "The Arctic trails have their secret tales/That would make your blood run cold."

Precious moments passed while the pilot of the helicopter—which lacked medical equipment or even stretcher space—sought permission from provincial authorities to transport the victims. Eventually he flew them to Muncho Lake; an ambulance helicopter took them the final leg to the hospital in Fort Nelson, where the daughter died. Who knows if she could have been saved with quicker response? Anyway, I never heard any more. You get used to that too.

In Beaver Creek, I met outfitter and taxidermist Doug Twiss. A few years ago he was crossing the highway on his snowmobile and didn't see the Porsche coming; it was seven hours before he got to a hospital. "I could be dead now," he says philosophically, "so I don't bitch too much about the wooden leg."

"The people at the lodges probably save ten lives a year, helping the helpless," Neil Sorken said at Summit Lake. "There's an amazing amount of people come up this highway that are broke." Or desperately unprepared. Gene Beitz at the Liard River Lodge remembers the sub-zero night a passing trucker found an 80-year-old man in his brand-new Volvo stuck in the ditch without even an overcoat. He probably wouldn't have lasted another hour. Turns out he'd had a monumental fight with his wife and stormed out of the house, vowing he was gone for good. "We thawed him out eventually," Gene recalls, "and he got back in his car and kept right on going."

But will the old pioneer spirit of helping out actually help you? On the one hand, Gene and his wife, Anne, don't go to bed without leaving a note on the front door for possible midnight arrivals: "Come on in, take any room you find open." They expect to get paid in the morning, and they always have been. This isn't unusual. But then again, Neil Sorken and his wife, Heather, still talk about the young man, supposedly down on his luck, who volunteered to do odd jobs in return for his room and board. Three weeks later he absconded with Neil's winch, his logging chains, some jewelry, and a bottle of rye. "You want to help somebody, but you get scared," Neil shrugs. "Your faith in human nature goes to hell. Then a woman with three kids will show up, and you can't help it." He pauses. "That young man was real nice."

THE INDIANS have also found the highway to be a mixed blessing. I try to imagine the shock the Tlingit trapper felt who went out to tend his trapline as usual in the winter of 1942, and when he got back to his village later that year, there was a highway through it. Tom Smith in Teslin, whose father used to run the trading post, remembers the sudden arrival of thousands of white and black soldiers and support personnel detailed to build the road. "We were excited by the highway," he says, "it was almost like a festival," but soon new diseases, especially influenza, decimated the village.

Tucked away south of the highway, Atlin is not quite a one-horse town: At least two dozen range free on the main street. Born in a gold rush that saw 25 million dollars' worth of gold extracted locally, Atlin and its 500 residents hang on, thanks to hunting camps and salmon fishing as well as prospecting.

But some were quick to see the better side. "To me it's a big gift," says 79-year-old elder Elijah Smith in his soft, dignified way. He worked for an outfitter before the highway came through, when it took ten days over the old pack trails to cover the hundred miles between Whitehorse and Haines Junction. On the highway I made the same trip in two and a half hours. "A lot of good things were given to people," he says. "Now they're all condemning the white man for coming, but a lot of the old-timers appreciate what the white man brought. Old John, one of our hunters, he sure enjoyed what the white man brought in. He was one of the top runners; no gun, nothing, just run the animal down with a bow and arrow. If he didn't run it down, they didn't eat." Old John died before the highway came, Elijah said, but like the other old-timers he would have welcomed it.

In Denetia Elementary School on the reservation at Lower Post, a native settlement near Watson Lake, the children are grappling with the notion of opportunity.

Drawn from the Kaska and Tahltan tribes, the children have

"I shot the bear, but I can't really say whose bullet killed it," says Maryland native Leonard Beecher. He was in a posse that hunted down the 1,100-pound, ten-foot grizzly that had been killing dogs near his gas station 20 miles from Haines Junction.

"We had to turn it upside down and sideways to get it in here." The bear will soon stand in a store he's building, to the disappointment of his children and wife Brenda.

the advantage of belonging to a settled, relatively prosperous community where they know everyone. "I've never felt any discomfort or prejudice," says white teacher Lynn Coutts. She and Carolyn Scherck teach classes ranging from kindergarten to seventh grade. "The native people are extraordinarily tolerant and forgiving; I've found that to be universally true."

But the teachers can see pitfalls ahead. Alcohol is one (as it is for plenty of whites, as well). Lack of self-esteem. Lack of any viable goals. Limited opportunities for employment. Frustration, domestic violence, even suicide show the cracks in the community. Support groups are beginning to form among the women. The challenges stretch far beyond the schoolroom. "The children should all succeed," says Lynn. "But they will probably have to leave Lower Post to do so." And most of them will undoubtedly stay right there, unwilling or uncertain how to avail themselves of more.

Still, the classrooms are sunny and colorful, with computers, plenty of globes, and plenty of laughter. "What a blessing these kids are smart," Lynn said. "So *that* potential is unlimited."

"If they're shown that there are many doors open to them,"

Carolyn added wistfully, "if they could see, 'Yeah, I don't have to be limited.' "

I'm not sure of the statistical odds facing these children, I thought as I drove away, but with teachers like this, the larger world that came up the highway eventually ought to offer more promise than threat.

THE ASPECT OF PROMISE remains the most powerful and enduring appeal of the north. Maybe it's based on the illimitable sense of space and the way it overwhelms most of our trivial preoccupations, revealing clearly, perhaps for the first time, what really matters.

I had moments of unforgettable clarity along the way. There was the night at the Liard River hot springs when, surrounded by silence and snow, I floated in the steaming sulfurous water and watched the northern lights. I think back on the night I watched the tiny figures of a local curling club play on the frozen surface of Watson Lake, while a bonfire blazed on the shore and wisps of laughter drifted away into the sable dome of the sky.

One evening on the way to Swift River, I saw a waterfall of light spilling over a colossal bank of clouds; just past Champagne I heard the sound of a bell clanking around the neck of a black horse as he patiently pawed through the frozen grass. These were moments when it seemed that humans, so tiny in the vastness, could also have their place.

He got his nickname, Punch, as a hockey coach, but now Ernie McLean battles mother earth for her gold near Atlin. Dumping tons of gravel down the sluices of his "shaker," he and a handful of employees are lucky to extract a few flecks—although he is proud to show off some prized finds (above). How much gold in a ton of gravel? "Up to 18 dollars' worth," he says.

And I would get to thinking about the people for whom the road had opened so much, people with plenty of vices who still manage to embody some antique virtues like "fortitude," "hope," and even "romance."

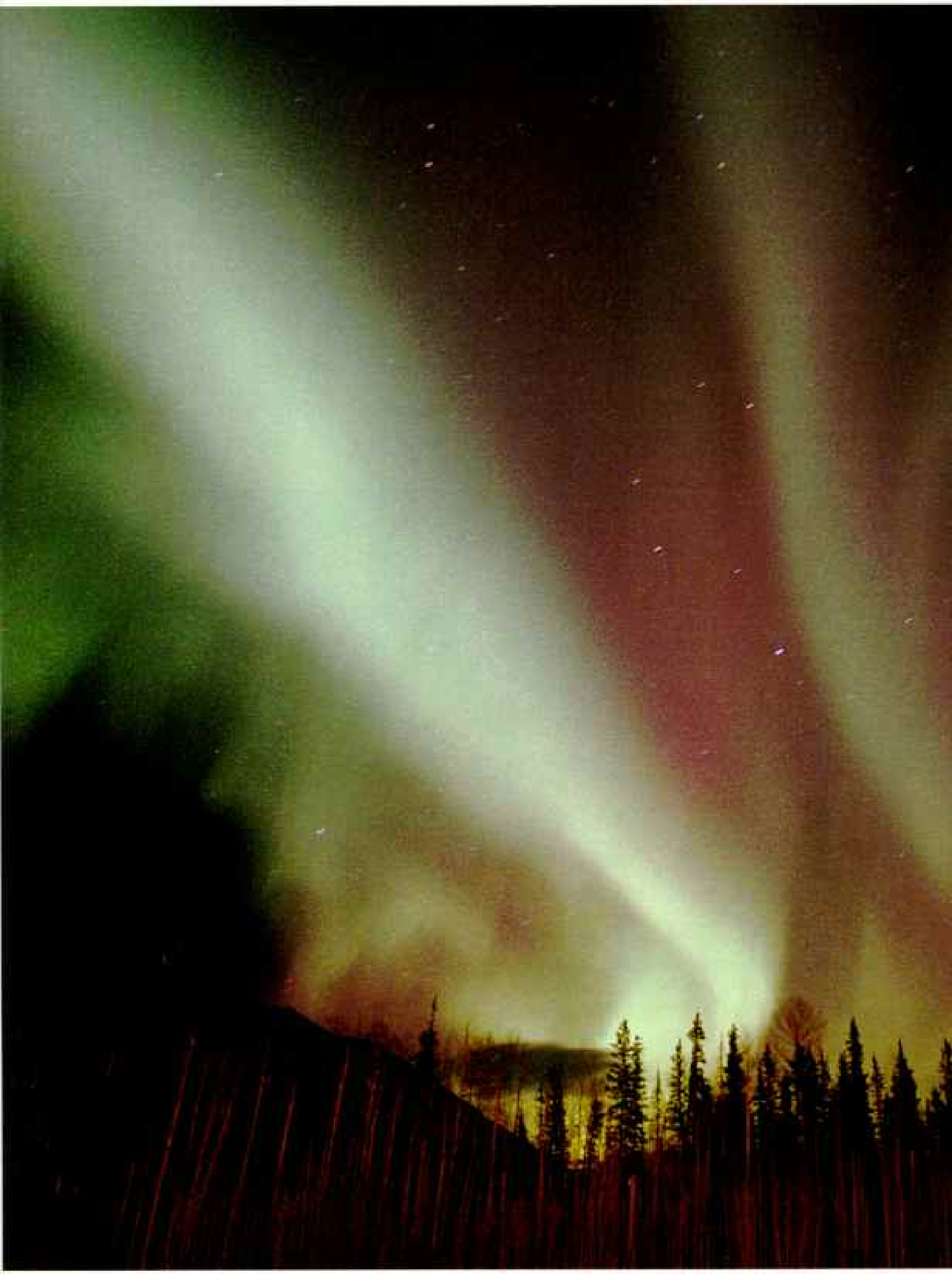
"The north is like a melody in your mind," said Marvin Taylor in Whitehorse. "You can hear it, but you can't sing it."

And I would remember Zina Ekdahl, a Finnish artist who had moved here from Toronto. Divorced, with a grown daughter, after years of sidewalk exhibitions in New York, she found her way north, eventually marrying a Finnish logger. They live in the woods by the Yukon River, in an immaculate wooden house that he built. Now she trains a pack of racing sled dogs, raises chickens and ducks, sells the vegetables and bedding plants from her garden, and looks forward to those particular days when the deep drifts of new snow beckon them from their sauna.

We sat in her kitchen drinking strawberry tea while she heated a caldron of beef fat to mix with the dogs' dinner. She was talking about how she'd left the city in search of adventure.

"Did you find it?" I asked. "Or is there still more you want?"

Her windburned face always glows, and she gave me a quizzical smile. "What more could there be?"



Sheets of hypnotic shimmer, northern lights over Liard River flicker the promise of adventure, beauty, and human drama up ahead. It's a half-century-old promise that the Alaska Highway has seldom failed to deliver on for the stout souls who drive and live along its length. □

Wetas—New Zealand's Insect Giants

Text and photographs by
MARK W. MOFFETT

HANDFUL of legs and spines, a giant weta from Little Barrier Island devours a carrot. About as big as a house mouse, this *Deinacrida heteracantha* weighs in at two-thirds of her species' record 2.5 ounces. The largest of the ten species of giant wetas beat most of the world's biggest insects in weight and bulk, but not all the so-called giants reach this size.

New Zealanders call all their wingless, cricket-like insects wetas. Little changed in 200 million years, they are among New Zealand's oldest native life-forms.

Smaller than some of the giants but still imposing, an alarmed tree weta—*Hemideina crassidens*—kicks at entomologist Simon Pollard in a primal rain forest on South Island.

THE END IS NEAR for a tree weta, *Hemideina crassicruris*, caught on Stephens Island by a tuatara (left), a dinosaur relative that lives only on isolated islets off New Zealand. In the absence of native mammalian predators, evolution of island birds and insects has often produced awkward, flightless creatures like kiwis and wetas.

Common in much of the country, most tree wetas have adjusted to changes brought by human colonization. But habitat destruction and introduced predators, especially rats, have generally reduced giant wetas to main-island enclaves and offshore islands (map).

One giant species discovered near Mahoenui in 1963 and still unnamed finds protection in gorse bushes brought from Europe (top right). Surprised in the open, another Mahoenui giant scares away a mouse by lashing out with its spiny back legs—a defense many wetas use.

MOST WETAS live in lowland forests, but the mountain weta, *Hemideina maori*, thrives beneath rocks above the tree line. University of Canterbury entomologist Peter Johns has uncovered one and looks for more (left) in Mount Cook National Park, one of several South Island areas that harbor this species.

The rarer *Deinacrida heteracantha* is found only on Little Barrier Island, a restricted-access nature reserve. Retired island ranger Alex Dobbins (above) takes a close look at one of these giants. Known to the native Maori as wetapunga, they once also inhabited the northern part of North Island.

Government efforts to protect these and other endangered wetas have included tailoring conservation strategies to the needs of individual species. "We don't have giant pandas in New Zealand; we have giant wetas," says Johns, explaining the growing interest in these insects. "It's just great to have something that's different." □

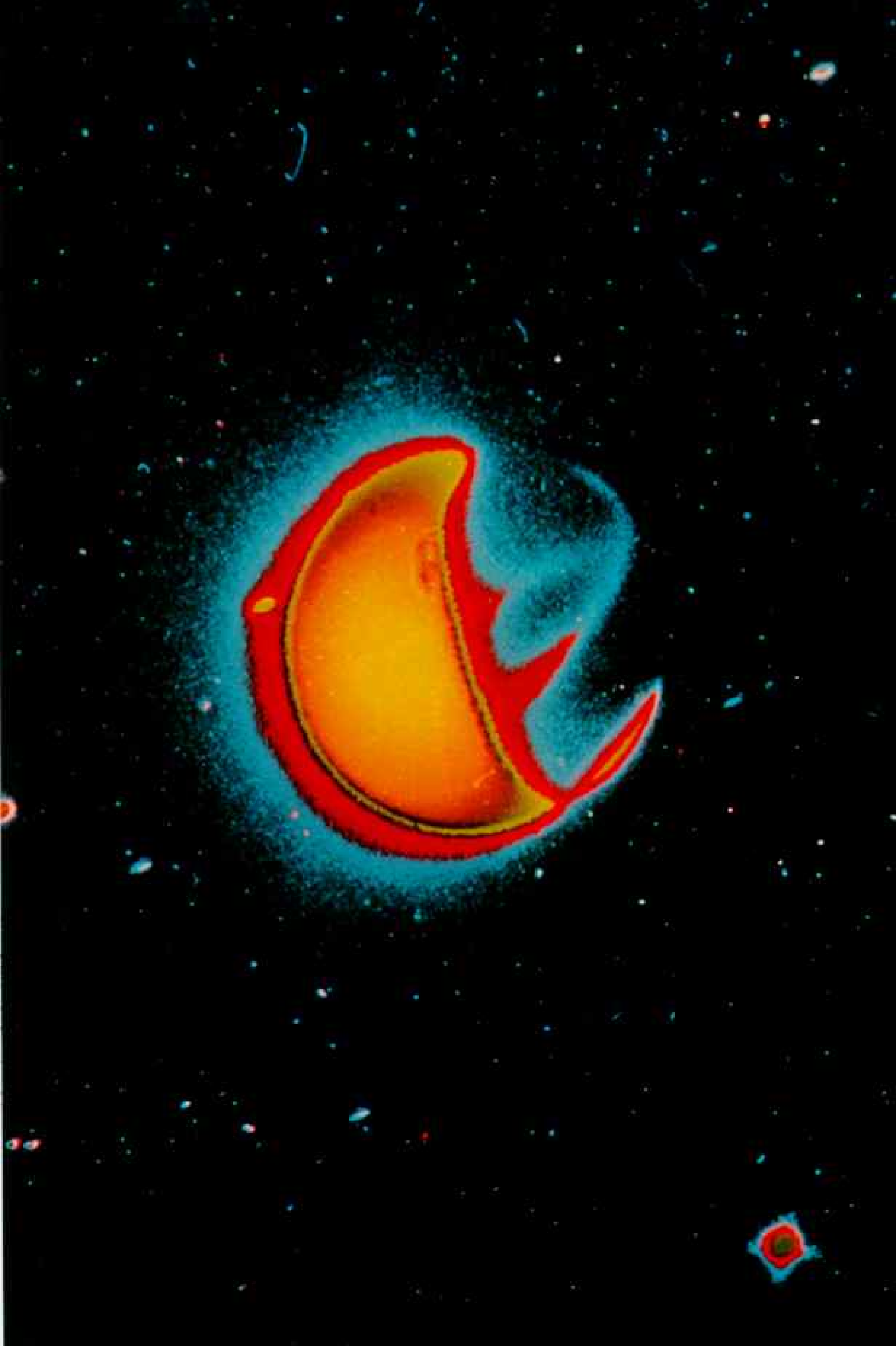
SATELLITE RESCUE

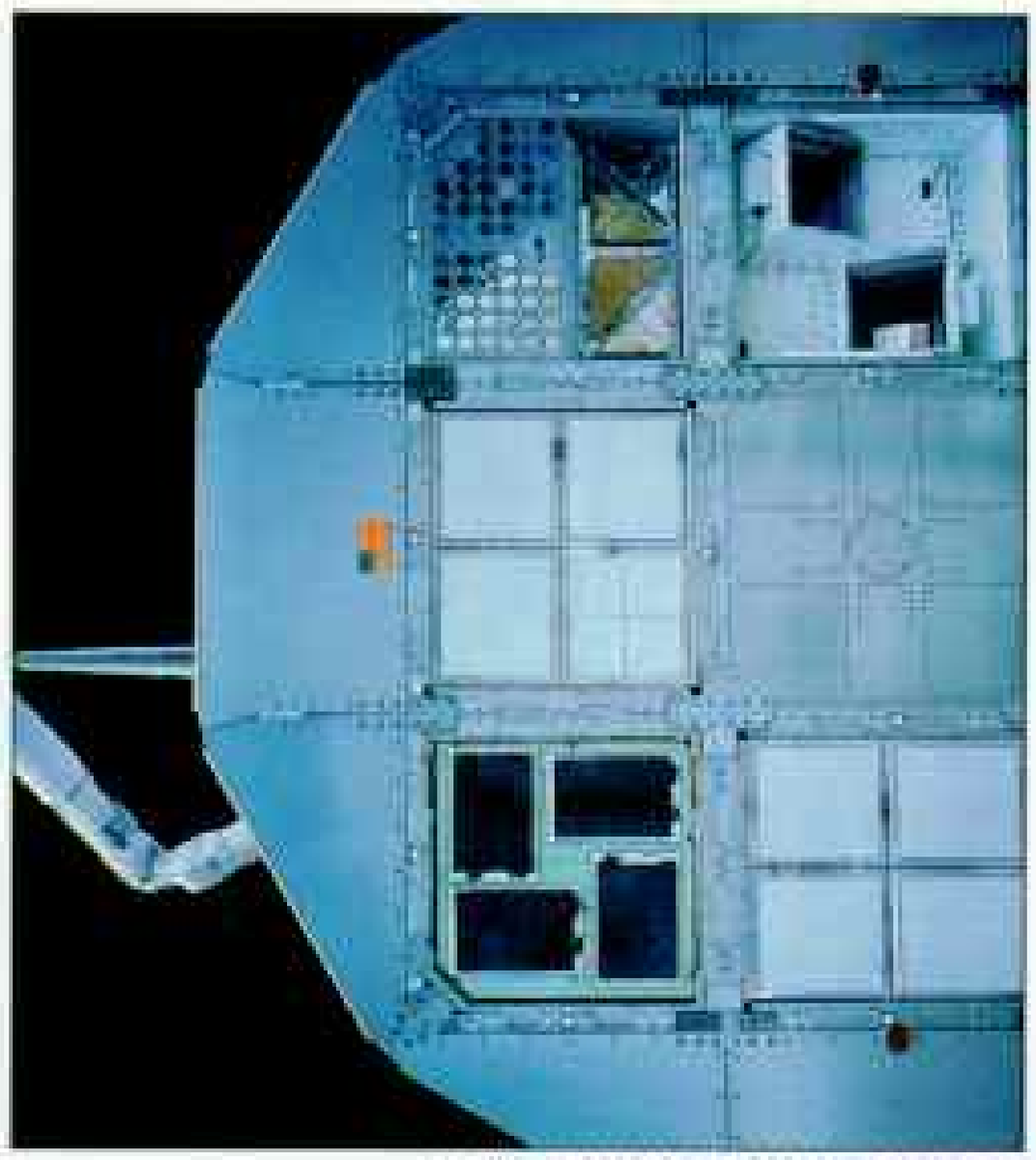
By THOMAS Y. CANBY
SENIOR ASSISTANT EDITOR

Photographs by
JON SCHNEEBERGER
NATIONAL GEOGRAPHIC STAFF

Orphan in orbit, the Long Duration Exposure Facility (LDEF) comes within reach of the shuttle *Columbia*'s mechanical arm after a million-mile, 17,500-mile-an-hour pursuit. Snatched from a decaying orbit weeks before it would have plunged into earth's atmosphere and burned up, this experiment-packed satellite contained nearly six years' data on the space environment useful in designing future spacecraft, such as space station *Freedom*.

DANIEL C. BRANDENSTEIN, STS-32, NASA





NASA/NAVAL RESEARCH LABORATORY (OPPOSITE) NASA STS-41C (ABOVE LEFT); NASA STS-32

TWO HUNDRED FIVE MILES above Baja California, the shuttle *Columbia* hurtles eastward seemingly out of control: flying upside down and backward at 17,500 miles an hour, cargo doors agape.

Two hundred feet below, a battered satellite wearily circles earth. Big as a bus and weighing 11 tons, it is known as LDEF (pronounced L-deaf), for Long Duration Exposure Facility.

The National Aeronautics and Space Administration sent up LDEF in April 1984 as an unmanned laboratory for studying the little-known environment of space. Among its 57 experiments are millions of tomato seeds, placed on board to test the effects of long-term radiation on living tissue; 12.5 million of them are destined to captivate millions of young might-be scientists across the nation and abroad.

According to the original plan, after a year in orbit the satellite would ride a shuttle back to earth so scientists could pore over its priceless payload. But shuttle schedules slipped, then came the *Challenger* tragedy, and LDEF was stranded in orbit.

Then the sun erupted in violent storms. These heated and expanded earth's atmosphere, which reached out, slowing LDEF in orbit so it sank earthward. By January 1990 the satellite was falling fast, by half a mile a day. Within weeks it would incinerate in the atmosphere like a giant shooting star.

With it would perish a treasure of scientific data about the evolution of the universe (perhaps even clues to the origins of life), valuable tests of materials in space, and alarming evidence that drifting man-made debris now threatens orbiting spacecraft.

Thus *Columbia*'s rescue mission. But why fly upside down and backward?

"It took a special maneuver to capture LDEF," recalls mission commander Daniel C. Brandenstein at the Johnson Space Center (JSC) in Houston, Texas. "We had to approach without allowing the exhaust of our steering jets to contaminate sensitive experiments. The best way was by descending on our back" (page 114).

As the shuttle closed in, astronaut-engineer Bonnie J. Dunbar gently guided a 50-foot arm toward the satellite's grapple, a metal rosette with a spike at the center. Three crossed wires settled over the spike; she pulled a trigger, snapping the snare shut. LDEF was captured.

Watching, Brandenstein was awed by the

Halos of atomic oxygen surround the earth in a color-added ultraviolet image (left) taken from the moon in 1972 by the crew of Apollo 16. On the left side, changes in color from gold to blue signify decreasing levels of atomic oxygen as earth's atmosphere thins toward space; on the right the changes indicate diminishing sunlight. Created when solar ultraviolet light splits oxygen molecules into individual atoms, this highly reactive gas—along with radiation, meteoroids, temperature changes, and man-made debris—threatens orbiting spacecraft. Pristine when deployed (above left), LDEF was stained and tattered upon retrieval (above right), reflecting the effects of those hazards.

SPACE SEEDS TEACH PUPILS DOWN-TO-EARTH SCIENCE

Proud crop of young experimenters, D'Ann Douglas's first-grade class in Beaumont, Texas (top), lines up with tomato plants they grew from some of the 12.5 million tomato seeds flown on LDEF. About 140,000 seed kits were sent to 64,000 teachers and their 3.3 million students worldwide.

The class's first space tomato (left) came from the plant grown by André Valmore (above, at right, inspecting seeds). Later, Douglas and her class get a kick watching a videotape of André's interview with a local television station. As it turned out, space seems to have had little effect on the seeds. Even so, Douglas points out: "We were very careful not to eat our science projects—no matter how delicious they looked."

D'ANN DOUGLAS (TOP AND FAR LEFT)

"I couldn't bear to throw the little seedlings away," admits Park Seed Company research director Jim Alston (above, at left), examining space tomato plants with company chairman William J. Park. Supplier of the 12.5 million tomato seeds flown on LDEF, the South Carolina firm later tested germination rates of 2,000 seeds. About 85 percent germinated—the same rate as earth-based control seeds. Surprisingly, radiation levels 5,000 times that on earth did almost no damage to the seeds, though one plant sprouted variegated leaves (middle).

Satisfied with their safety, 16-year-old Rod Neugebauer feeds a space tomato to his hog, My Lady, which, after eating them by the snoutful, won a prize at the 1990 California State Fair.

RON BREAZEALE, PARK SEED (MIDDLE); JAMES A. SUGAR, BLACK STAR (BOTTOM)

beating the satellite and its experiments had taken from the destructive forces of space: radiation, fierce erosive matter, and the pelting of meteoroids and tiny fragments of space hardware. Small craters riddled the side panels, sunshields hung in tatters, and pieces of experiments drifted beside it, including a small solar panel.

Following a night landing at Edwards Air Force Base in California, the shuttle and its space-worn cargo flew piggyback on a NASA 747 to the Kennedy Space Center in Florida.

THE SHUTTLE had already disgorged LDEF when I caught up with the satellite at Kennedy. It lay like a stricken beast inside a cavernous clean room. Like doctors performing an autopsy, 50 white-clad figures swarmed around it, encased except for their eyes in white bunny suits, hoods, and booties to avoid contaminating the experiments.

I suited up with aerospace engineer Robert L. O'Neal. Now officially retired from NASA, O'Neal had supervised the assembly of LDEF at NASA's Langley Research Center in Virginia in the 1970s and early '80s. "We put it together for 14 million dollars; NASA had trouble believing that anything so inexpensive was fit to fly. I'd almost lost hope of its recovery when I left in 1988. I admit I cried when it came down."

LDEF's attendants were moving with elaborate care, as if they might cause the satellite pain. O'Neal explained:

"Nothing like LDEF has stayed in space for so long—nearly six years—and been brought back," he said as we passed through a cleansing vacuum chamber and approached the recumbent hulk. "Until now we've been short of concrete evidence about the effects of the space environment. Most of our information about low earth orbit has come from theoretical calculations and simulations. LDEF has measured this environment, even brought samples back to earth.

"Thus the care to record every detail."

Working beside LDEF, a team of four technicians slowly removed the trays that lined the ends and 12 sides of the satellite. Each of the trays held one or more experiments. The quartet recorded the torque required to loosen each bolt—important information in building and repairing America's space station *Freedom*, long embattled politically but now scheduled to be occupied by 1999.

Like a giant plant pod, LDEF carried a total of 14.5 million seeds of 106 different species, ranging from marble-size lotus seeds to tiny African violet seeds, a million to the ounce (far more valuable by weight than gold). Five out of six sealed canisters held the 12.5 million tomato seeds, most of them bound for classrooms around the country in time for fast-approaching spring planting.

Seeking to stimulate student interest in space science, William H. Kinard, project manager during LDEF's formative years, had enlisted the cooperation of the Park Seed Company of Greenwood, South Carolina, along with NASA's Educational Affairs Division. Now would come the second phase of the experiment.

Packets of tomato seeds were piled high for mailing when I visited Park Seed. "We're getting out 140,000 kits," said Jim Alston, the company's director of research. "Each includes space seeds, regular seeds for comparison, and NASA instructions about planting and reporting the results. This could involve three million students and teachers—one of the largest school projects ever."

How had the seeds fared in space?

"Radiation detectors indicate they took about 5,000 times the dose they would have received on earth," said Alston. "We're expecting to see a fair number of mutations from genetic damage."

Two other canisters had openings that exposed their seeds to the desiccating vacuum of space. He expected them to be damaged.

But almost 50 percent germinated. "I'm astonished. It hints that some could have survived drifting through space—great food for thought for exobiologists who believe earth was seeded by life from other spheres."

By midsummer, results of the school plantings were flowing into NASA headquarters in Washington, D. C., and into a special processing office at Oklahoma State University in Stillwater.

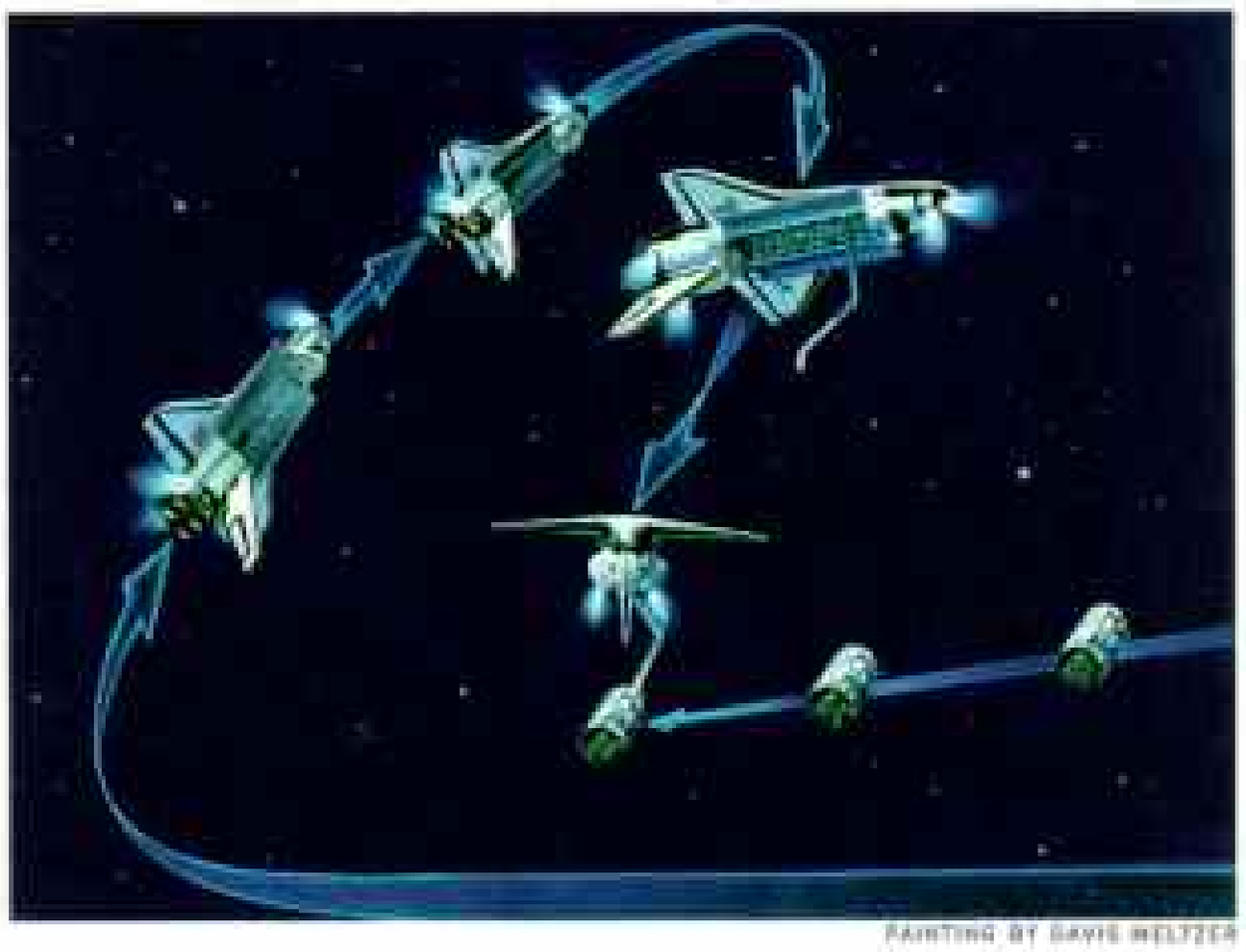
"I've heard some tales of woe," said Nelson Ehrlich at Stillwater. "Gerbils ate the seeds, school break-ins scattered them, the grounds keeper mowed down the plants, people shied away for fear of 'killer' tomatoes—totally unfounded, of course. But most of the gardens are coming along just fine. In fact, many are getting better growth with the space seeds. I believe one secret is TLC—a lot of

DELICATE TOUCH BRINGS LDEF BACK TO EARTH

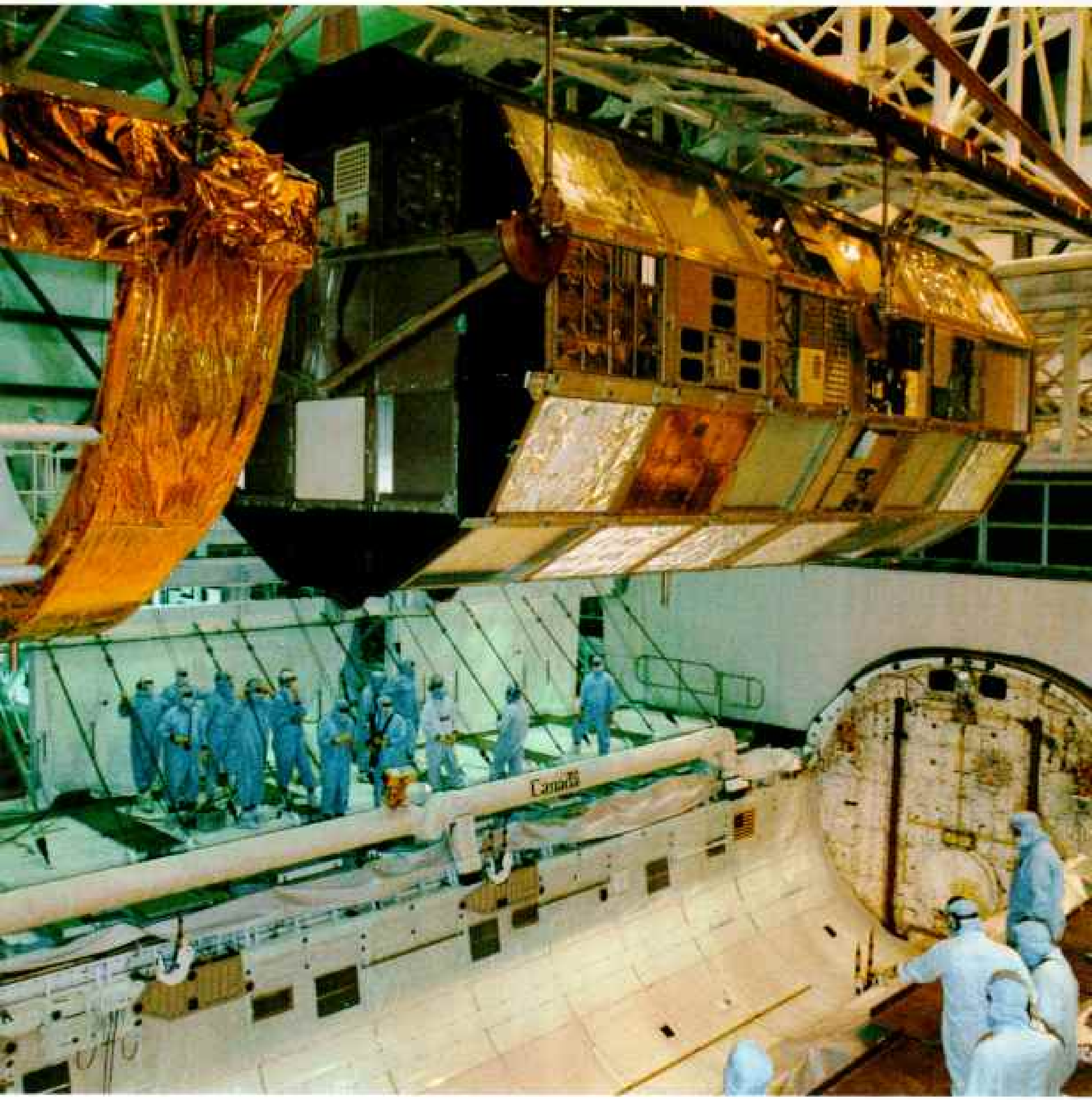
Puncturing the cloud deck on January 9, 1990, space shuttle Columbia *(left) streaks toward its rescue of LDEF. Five astronauts, including G. David Low, Daniel C. Brandenstein, and Bonnie J. Dunbar (below, left to right), executed a delicate maneuver never before tried in orbit (painting). Passing beneath LDEF, the shuttle circled upward and, in an inverted position, descended and grappled the satellite with its mechanical arm. This prevented steering-rocket exhaust from contaminating LDEF's sensitive experiments. Before being placed in the cargo bay, LDEF was painstakingly photographed to record all visible damage.*

Mission accomplished and back on the ground, LDEF is hoisted from Columbia *in the Orbiter Processing Facility at the Kennedy Space Center, Florida (right). Clean-room conditions are maintained to protect LDEF's experiments.*

MICHAEL L. COATS, NASA (LEFT); NASA STS-32 (ABOVE)



PAINTING BY DAVIS MELTZER



tender loving care for the space plants."

No such unscientific bias tainted the tomato patch of D'Ann Douglas and her first graders at Sallie Curtis Elementary School in Beaumont, Texas. Balancing scientific rigor with a spirit of adventure, this dedicated educator was using the project to teach her charges not only about botany but also about space, zoology, and the satisfaction of work well-done.

"Our principal, Elijah Moye, and I dug the garden," Douglas explained. "That was too hard for the children. They made the hills for the plants, using spoons and sandbox shovels. We recorded each step in our scrapbook, *The Great Space Tomato Adventure*.

"Our first space tomato appeared on June 20, on André Valmore's plant," she said. "Two weeks later we held a tomato party. We pulled weeds, and the local television station filmed André with his tomato.

"As the tomatoes ripened, birds pecked at them. We put up a scarecrow and covered the plants with netting. Without the birds, enormous hornworms started devouring the plants. The kids saw a lot of ecology."

I found the scarecrow sagging at his post

MIDSIZE TRAY
Part of this tray measures effects of long-term space exposure on optics and electronics.

SHALLOW TRAY
Aluminum plates register impacts from man-made debris and meteoroids.

DEEP TRAY
Collection of interstellar gas may add to understanding of the origin of the universe.

PAINTING BY DAVIS MELTZER; NASA STS-41C (INSET)

AN EXPERIMENT MACHINE

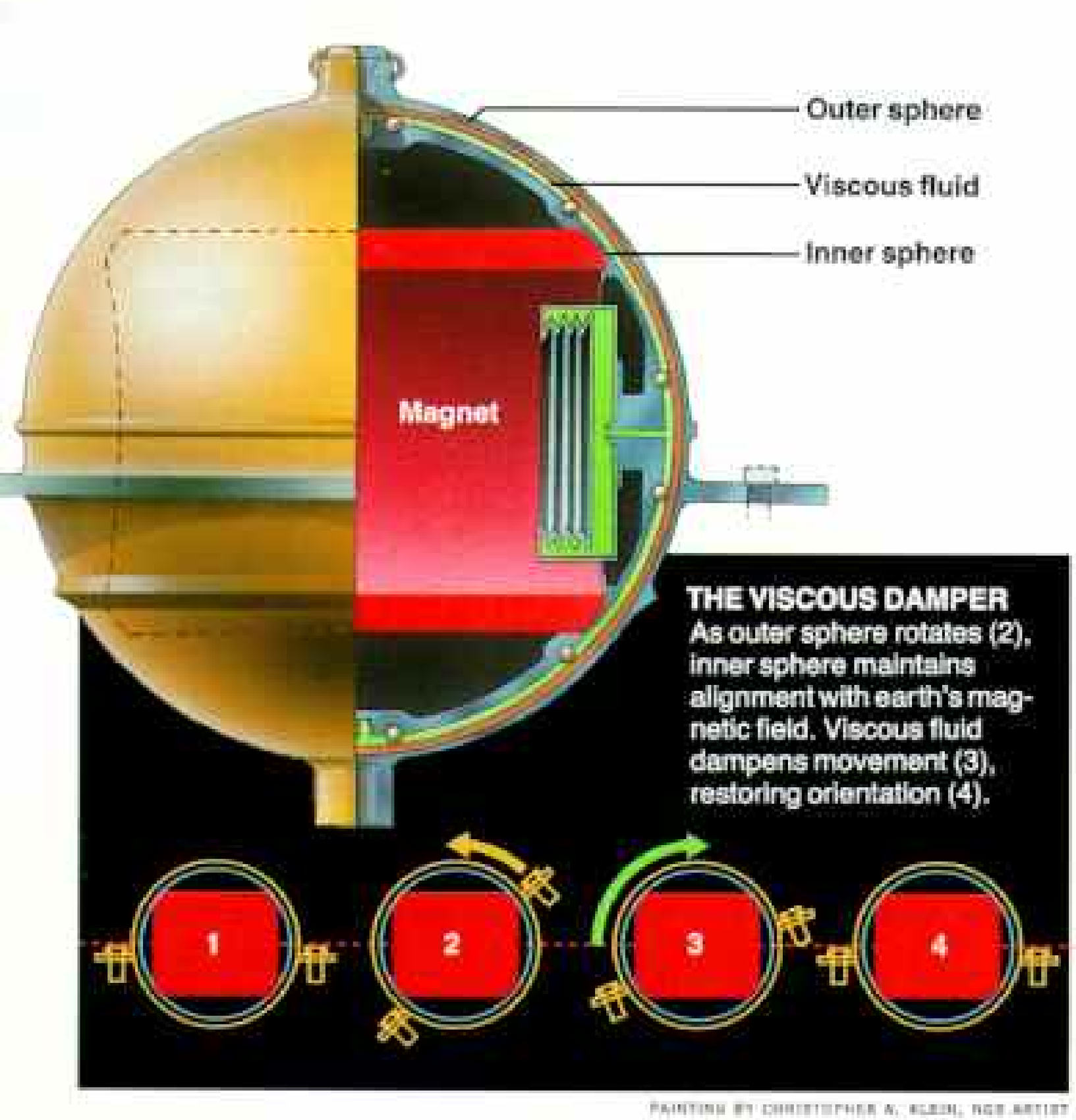
PLACED IN ORBIT on April 7, 1984 (left, bottom), LDEF tested the effects of long-term exposure on spacecraft materials, components, and systems. Its 12-sided, 30-foot-long aluminum frame provided an open grid on which 86 experiment trays of varying sizes were secured. In all, 57 experiments (some required several trays) containing 10,000 test samples flew on LDEF, representing the work of scientists from the U. S. and eight other countries.

Lacking a propulsion system, LDEF relied on gravity to hold a fixed position perpendicular to earth. Because one end was 30 feet closer than the other to earth's center of gravity, a slightly higher gravitational pull kept that end pointing earthward. Precise placement of the trays by weight kept the spacecraft from spinning.

A unit called a viscous damper (below) minimized other movement. The damper consisted of two aluminum spheres—an outer sphere anchored to the satellite and a freely rotating inner sphere containing a magnet. Any disturbance in LDEF's orientation caused opposing motions between the spheres, as the outer sphere moved with the spacecraft and the inner sphere remained aligned with earth's magnetic field. Friction in the viscous fluid between the spheres dissipated kinetic energy, keeping LDEF stable.

As a result, scientists are able to determine the direction from which the experiments were struck by meteoroids and other particles; this, in turn, helps reveal their origins.

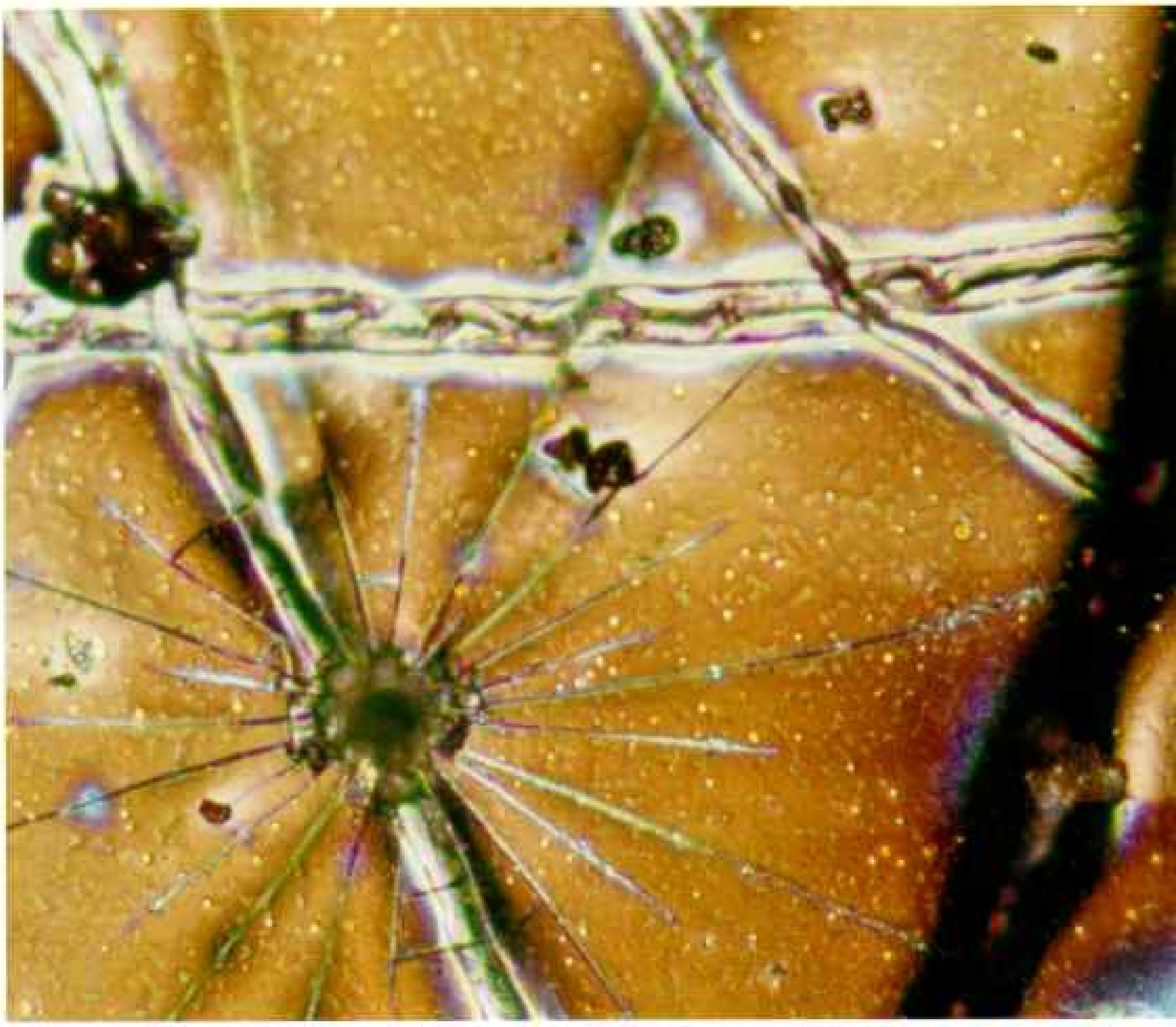
PAINTING BY DAVID WEITZER



PAINTING BY CHRISTOPHER A. KLEIN, NGS ARTIST

Two trays on LDEF's space-facing end record cosmic rays—charged particles arriving from space—in one of several such experiments. These particles can disrupt a spacecraft's electronics and cause computer malfunctions. Each tray (above) contains four modules consisting of a thin upper stack of plastic sheets (A), an aluminum honeycomb lid (B), and a thick bottom stack (C).

As a cosmic ray penetrates the stacks (D), it leaves a damage trail. When processed in a laboratory, the sheets reveal cone-shaped pits (E). Analysis of cone shapes shows the particle's arrival direction and speed as well as the element it comes from.



when I visited torrid Beaumont late that August. But the enthusiasm of Douglas's pupils was unwilted.

First to arrive that day was André, proud as Punch to have grown the earliest space tomato. In filed his classmates, each finding a little chair at one of the low tables. At each place their teacher had set out a small microscope for examining the seeds and leaves.

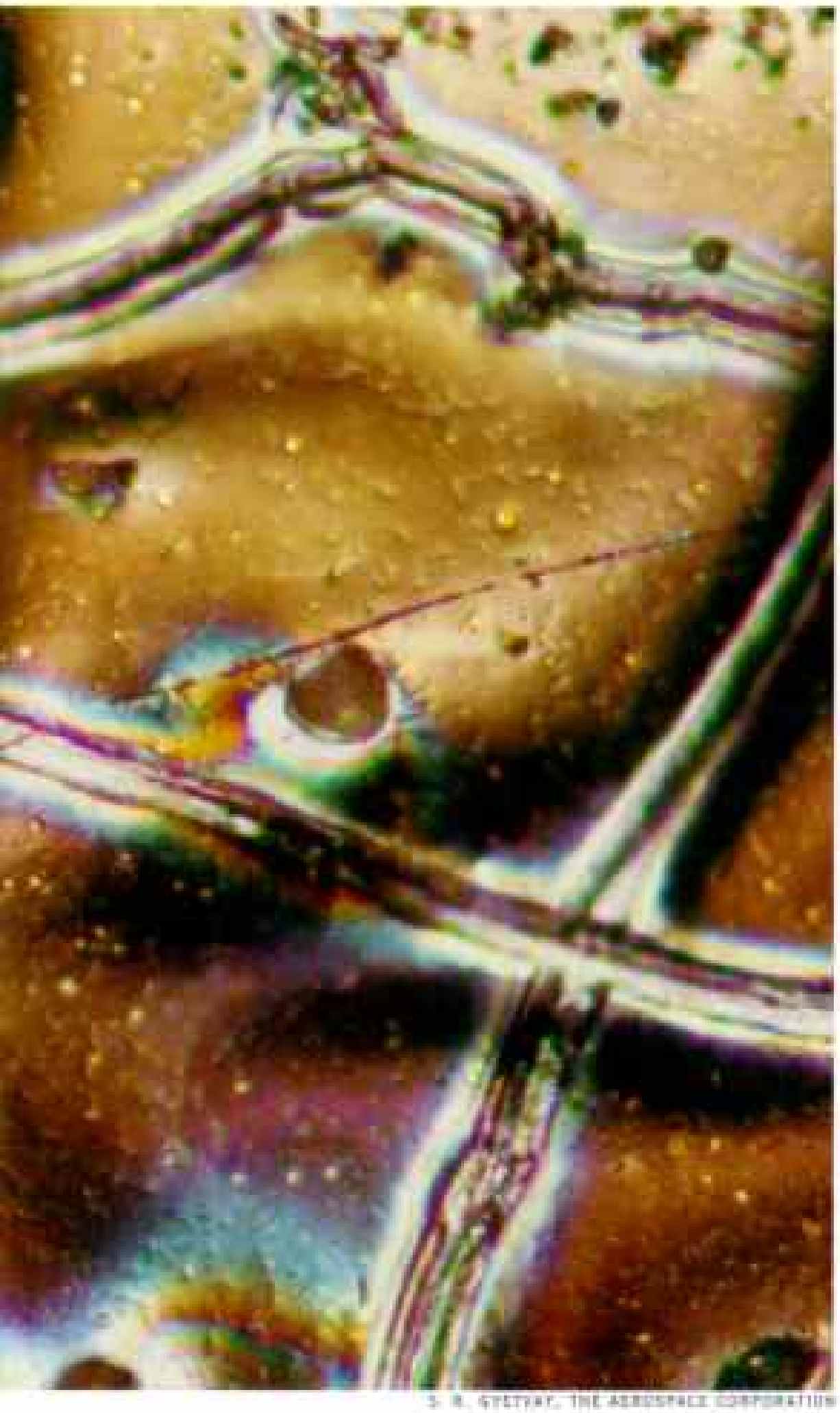
Later we filed outside to gather leaves and fruit; seeds from the space tomatoes would be planted by next year's crop of first graders. I saw no obvious mutations. Not so with young Matt Roberts, busily picking his leaves: "Mrs. Douglas! The space leaves are longer and thinner!" But his "space" leaf was a blade of crabgrass—not the first time a budding scientist has seen observation bow to reality.

I revisited South Carolina, and Jim Alston and I inspected Park Seed's space garden. Its thousand space-seed plants represented 40 species, and almost all were thriving. "Don't let the kudzu grab you," he warned, referring to the South's rapacious weed. "Space didn't faze the pest."

He pointed out five likely mutants. A blade of zoysia grass showed yellow instead of green, and a flowering polygonum wore variegated, or striped, leaves, as did a cornstalk and a tomato plant.

His fifth mutant was another tomato plant, grotesquely deformed. "Just take a look at those leaves! They're all gnarled, and the plant hasn't branched as it should. And see the calyxes—the green, petal-like growths around the flowers? They're way too long, like a witch's fingernails."

The massive tomato project produced surprisingly few mutants. "We've heard from about 9,000 teachers around the country," said Ehrlich of the Oklahoma collection office. "They indicate only a handful of suspects.



S. R. SYSTAT, THE AEROSPACE CORPORATION

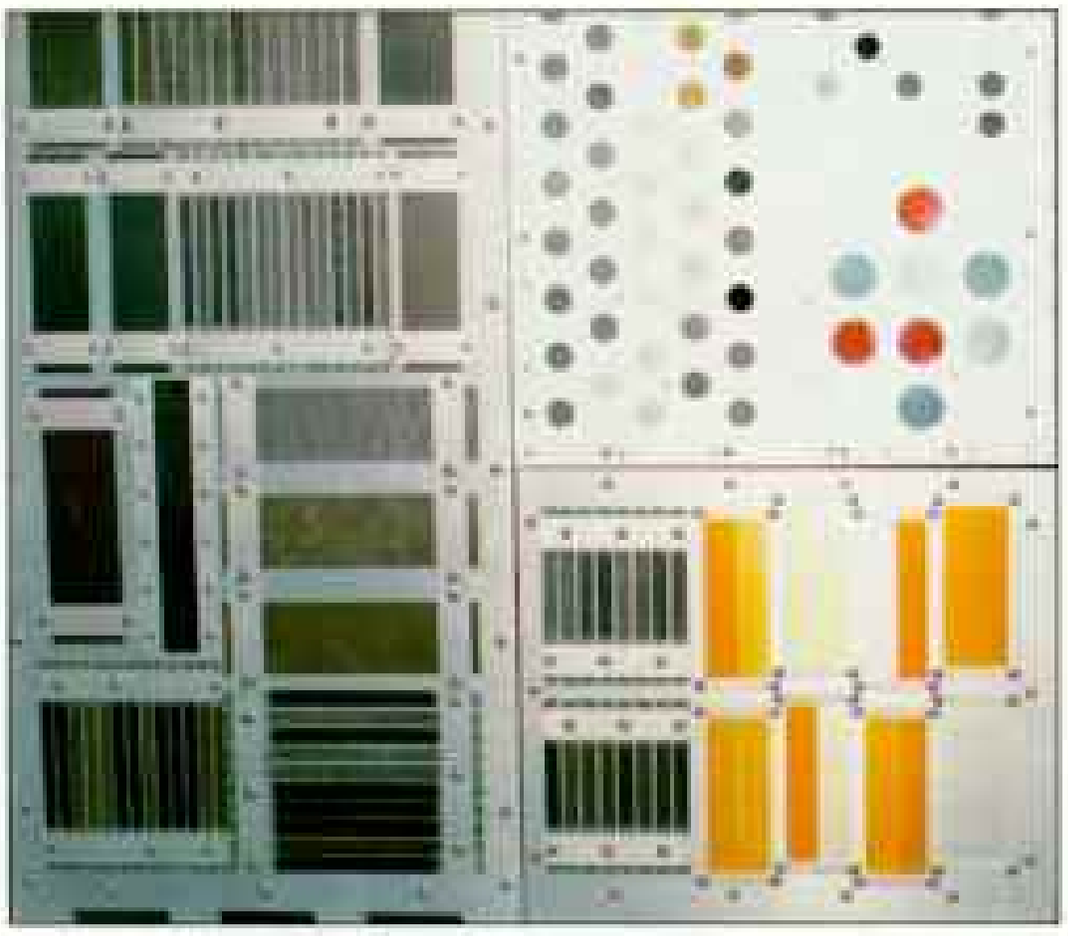
Space seems to be a surprisingly benign environment for seeds."

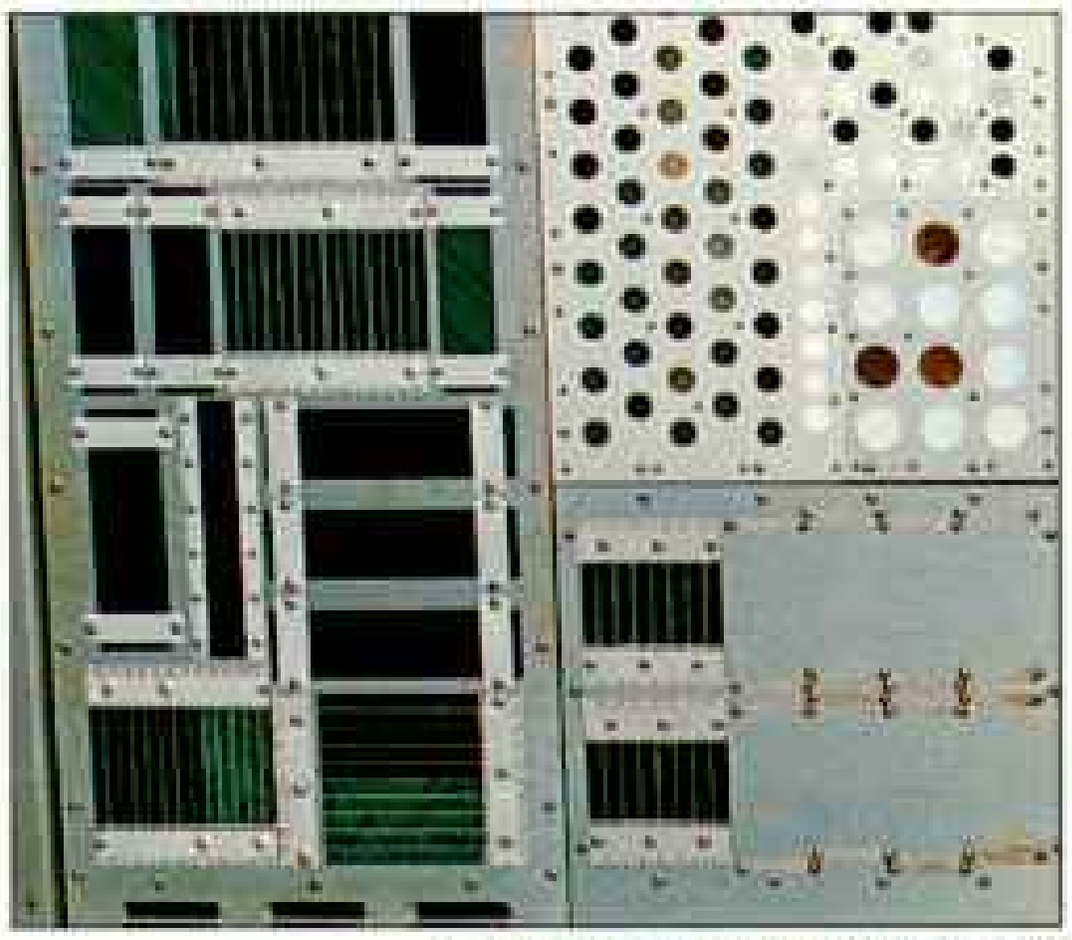
Some of the space tomatoes, moreover, scaled the heights of tomatodom. Six specimens took a blue ribbon at the Kansas State Fair in Hutchinson. A hog named Blanch, fed partly on space tomatoes, won first prize in her class at the livestock show in Turlock, California.

Space mutations could be a bonanza for an LDEF experimenter who produces African violets in Nashville, Tennessee.

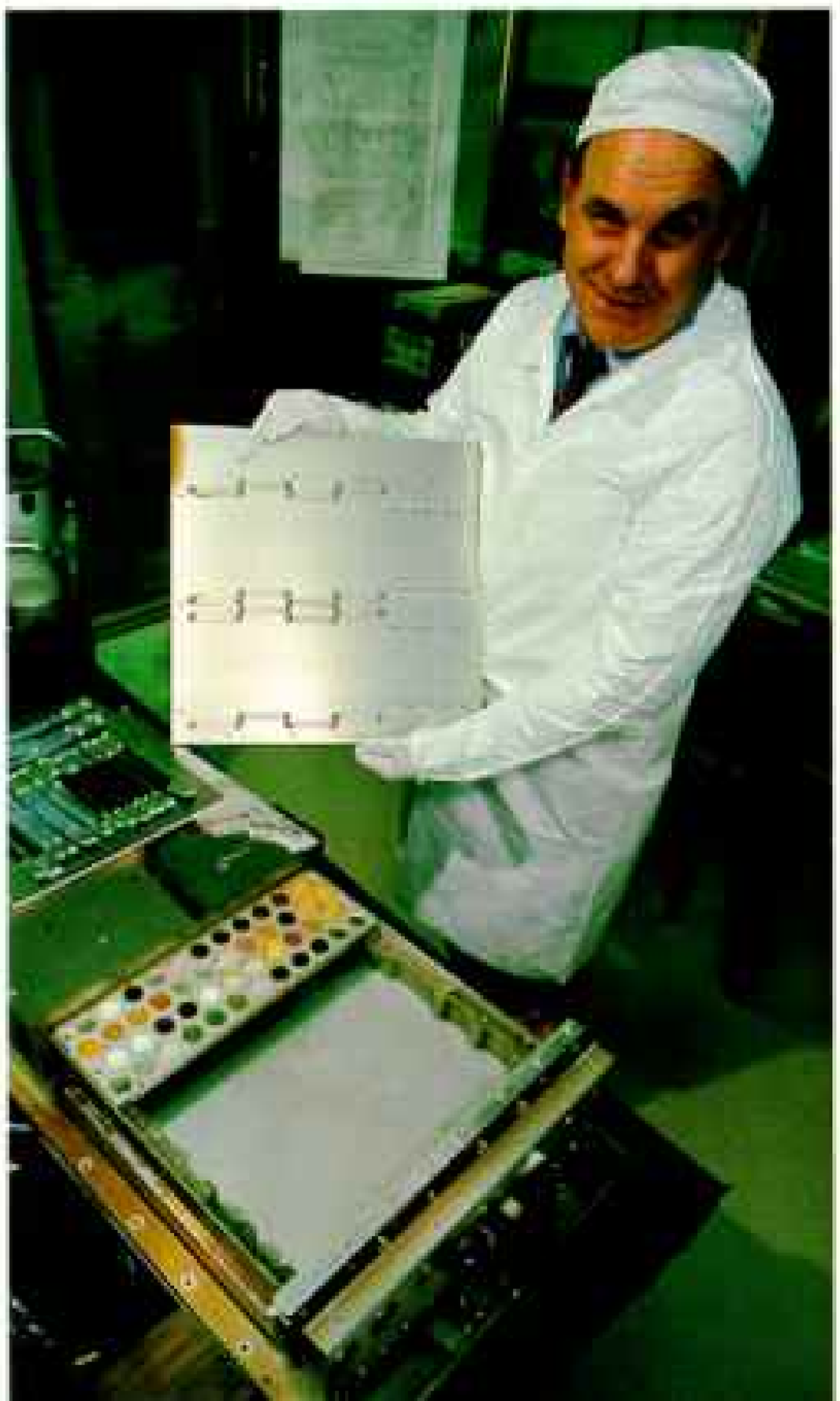
"Of the 20,000 African violet seeds that flew on LDEF," said horticulturist Reinhold Holtkamp, Sr., "I'd have bet anything that not one would germinate after so long. But 5,700 did, and far quicker than earth seeds. And most bloomed a month and a half earlier than normal. Why? Maybe the radiation thinned or perforated the seed coats, allowing the sprouts to emerge sooner. Whatever the

A microscope reveals the shattering hypervelocity impact of a tiny particle on a sample of silicone rubber (above left), whose glassy outer surface of silicon dioxide was formed by exposure to atomic oxygen. Looking for signs of penetration, meteoroid specialist Michael Zolensky (top) lifts the top layer of a thermal blanket that covered an experiment designed to detect cosmic rays (art, page 117). Many of the blankets were torn during LDEF's mission—the result of temperature fluctuations called thermal cycling—exposing the underlying plastic sheets to meteoroids and man-made debris. Zolensky arranges cutout squares from several layers to show the trail made by one such particle (above). Analysis of penetration holes and residual debris will determine the particle's size and composition.



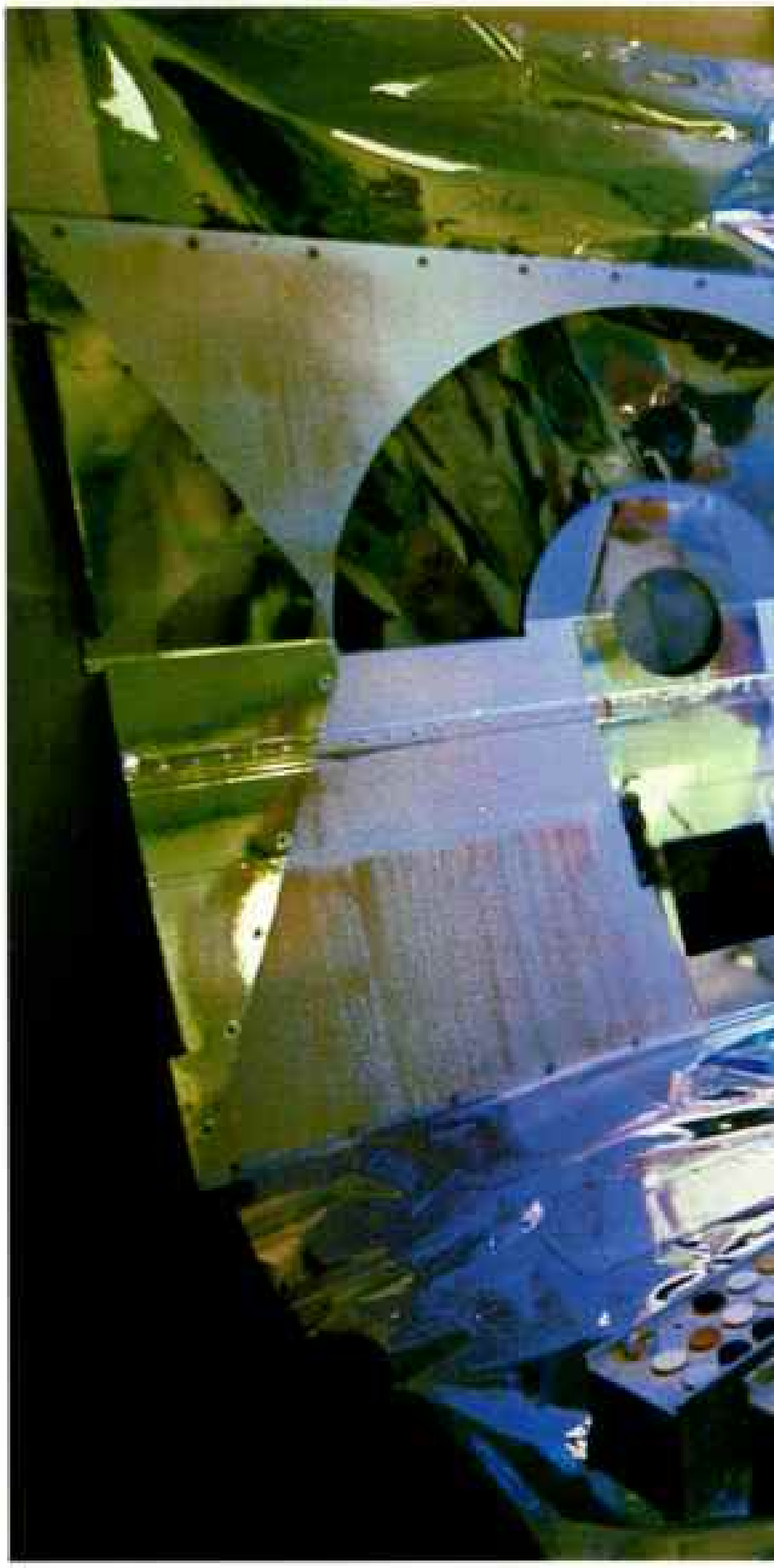


LANGLEY RESEARCH CENTER, NASA (BOTH ABOVE)



"LDEF was originally intended for a one-year mission," explains Wayne Slemp of NASA's Langley Research Center, "so we made the film strips thin." Referring to the yellow plastic strips visible in a preflight photograph (left) but missing after LDEF's recovery (middle), Slemp displays the panel that once held the strips: "We suspect that atomic oxygen just slowly eroded them away."

Slemp's experiment tested various thermal-control coatings, plastic and resin films, and composites—materials being considered in spacecraft design. "We were trying to look at the total space environment to see how the materials would fare against the synergistic effects of thermal cycling, solar ultraviolet



National Geographic, November 1991

radiation, vacuum, and atomic oxygen," he says. "So far we haven't been able to duplicate that environment on the ground."

"Thermal control of a satellite is heavily dependent on the thermal properties of the external coatings," explains Don Wilkes (below, front), who, with James Zwiener of the Marshall Space Flight Center, examines coating specimens under ultraviolet light, which readily reveals any changes or damage caused in space. A photograph above Zwiener's shoulder shows how samples were mounted in a revolving, battery-powered carousel, whose cover plate—made of silvered Teflon over aluminum—rests against the wall facing them. Exposure to space degraded all but two side sections that were covered during the flight.

"It went hot and cold every 90 minutes for six years," says Wilkes, referring to orbital periods of night and day. As a result many samples cracked, peeled, and discolored—changes that affected their ability to reflect or emit heat. Atomic oxygen and meteoroids also damaged many specimens. "It gives us better confidence in a lot of materials, but we also know some materials not to use," comments Zwiener. Wilkes sums up: "It's very important that you maintain thermal control within the design limits of a spacecraft. If you don't, you can get hotter and hotter and finally burn up something—either electronic components or, in the very worst case, your crew."

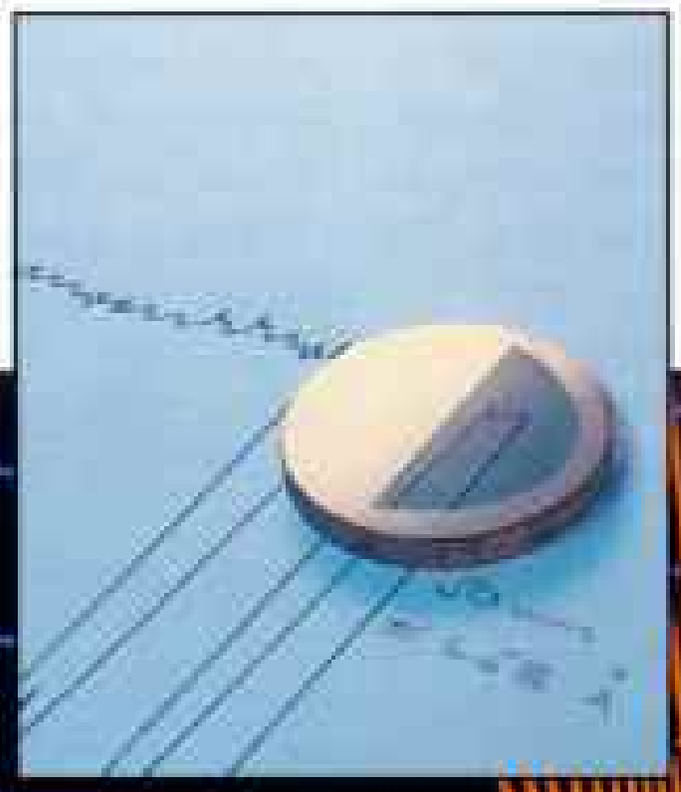
HAZARDS OF LOW EARTH ORBIT

MAN-MADE DEBRIS

A minuscule paint chip caused this pit in one of *Challenger*'s windows in 1983. Such orbiting debris number in the billions, posing a risk to spacecraft.

ATOMIC OXYGEN

Eroder of the exposed D-shaped portion of this copper-covered glass disk, atomic oxygen makes up more than 90 percent of the thin atmosphere in low earth orbit.



RADIATION

Etched plastic reveals an ion trail. As orbiting spacecraft pass through a dip in the inner Van Allen radiation belt, charged particles bombard electronic gear.

500 km

100 km

South Atlantic anomaly

METEOROIDS

A micrometeoroid's impact crater shows why spacecraft must be shielded. Depending on their size, mass, and speed, meteoroids can do slight or extensive damage.

JOE STANCAMPIANO, R&S STAFF (CENTER RIGHT); UNIVERSITY OF KENT AT CANTERBURY (RIGHT); PAINTING BY DAVID MELTZER

reason, if we can commercialize a quick-growing space strain, we can save both time and money."

UNLIKE the durable space seeds, LDEF itself took a battering. Thousands of tiny craters pitted its surface, seemingly sprayed by shotgun blasts. Many resulted from meteoroid damage, but analysis of the strike patterns indicates that more than half resulted from collisions with man-made space debris.

"LDEF has forced us to face up to the formidable litter hazard in space," said debris specialist Donald J. Kessler of JSC.

Radar surveys indicate the presence of 150,000 orbiting objects half an inch in diameter or larger—each big enough to smash a fist-size hole through most spacecraft structural materials. Particles only a tenth that size—but big enough to cripple the Hubble Space Telescope—number perhaps a million. Sunlight glinting from the pervasive clutter is bright enough to interfere with the viewing of ground-based astronomers.

The problem attracted attention in 1983 when commander Robert Crippen detected a pit two-hundredths of an inch deep in one of the shuttle *Challenger*'s windows. It had to be replaced. Since then other collisions have necessitated the replacement of 17 more windows, at $50,000 each.

"The object that damaged *Challenger*'s windshield," said Kessler, "was a minute fleck of paint the size of a grain of table salt. There probably are billions of pieces like that up there."

The debris is mostly broken-up space hardware: spacecraft, rocket stages, even nuclear reactors. Ten years ago the United States took the lead in reducing littering, followed by Japan and the European Space Agency. The Soviet Union, historically a major offender, has also followed suit. Still, the hazard grows. Without drastic action by the turn of the century, the busier orbits could become unsafe for use.

Space-station designers have read LDEF's message.

"LDEF confirmed that we need to shield the most vulnerable areas with bumpers," said Sally A. Little, head of a NASA team translating LDEF research into space-station design. The light foil bumpers designed by engineers at JSC capitalize on the tendency of

small, high-velocity projectiles to shatter on contact with thin outer layers of material, protecting the structural surface beneath.

LDEF brought back unique information about the direction from which space projectiles arrive. To achieve this, the satellite had to be unusually stable.

While in orbit LDEF stood rigidly erect with respect to earth, as if standing on an orbiting shelf. "Most satellites are stabilized by spinning or by reaction-control jets," explained Bob O'Neal, the Langley engineer. "LDEF relied on gravitational attraction instead. Its earth end, which was 30 feet closer to the center of the earth than its space end, received an ounce more gravitational pull. This slender thread held the 11-ton spacecraft steady."

"The satellite's stability," said Herbert A. Zook, a cosmic dust theorist at JSC, "enabled the investigators to map the direction of approach of meteoroids and space debris. This impact pattern will be similar for the space station. Confining the heavier shielding to susceptible areas can save thousands of pounds of material—perhaps a shuttle load. That's a saving of tens of millions of dollars in launch costs alone."

IN ITS ROLE AS TEST BED for the space station, LDEF carried aloft 10,000 samples of materials: plastics, composites, optics, alloys. A few, largely plastics, vanished—devoured by space radiation and eroded by impacting atoms. Others showed a wide range of vulnerability. For all, a fierce enemy was atomic oxygen.

"Atomic oxygen is the predominant substance from 100 miles to 350 miles high," said Bruce A. Banks of NASA's Lewis Research Center in Cleveland, Ohio. "It forms when ultraviolet radiation from the sun strikes oxygen molecules in the upper atmosphere, causing them to dissociate into individual atoms.

"Atomic oxygen is incredibly reactive. Its erosiveness was intensified by the fact that LDEF was colliding with the atoms at four miles a second. The final two weeks of LDEF's flight, when it plowed into the dense atomic oxygen of the upper atmosphere, caused more damage than the entire first two years.

"The solar panel that was floating free had been bonded to a sheet of a plastic, Kapton," said Banks. "Atomic oxygen destroyed it. Now we see that a Kapton sheet planned for the space station's solar panels could vanish completely in four months. We'll have to shield the Kapton, probably with the kind of glass films we tested on LDEF."

Even Teflon met its match.

"Teflon's vulnerability surprised us," said Banks. "Tests conducted on the ground and in short shuttle flights had been misleading. The oxygen atoms ate into LDEF's Teflon thermal blankets until they looked like shag rugs."

When materials were eroded away, they often became floating contaminants. "In many cases the materials vaporized and deposited elsewhere on the satellite," said Roger C. Linton of NASA's Marshall Space Flight Center in Huntsville, Alabama. "This could be serious if they smudged sensitive optical surfaces, like the space telescope mirrors, or disrupted critical thermal balances."

LDEF took its worst beatings when space elements attacked in concert. "Often a meteoroid or debris particle dug a crater, and then the gnawing of atomic oxygen or ultraviolet radiation made it larger," said Michael J. Meshishnek of the Aerospace Corporation, which flew 1,200 samples of materials.

Despite the abuse LDEF took from space, most experts felt reassured. "Structurally the satellite remained sound," observed Kinard of Langley, the project's chief scientist. "Most of its systems worked well. It's telling us that you can build a space station if you use precautions."

When LDEF was a gleam in Kinard's eye more than two decades ago, he saw it as a far different craft.

"I'm a meteoroid man, or I was before LDEF absorbed my life," he recalled. "So was Bob O'Neal. We envisioned LDEF as a simple, large surface area, placed in orbit to record and capture interplanetary dust. Then we got into the materials and seeds. But we still brought back the largest sample of data on meteoroids and man-made debris and a lot of information on radiation in space."

These data promise to add chapters to the books on astrophysics and radiation.

You and I know meteoroids as flaming meteors—shooting stars. But for scientists these particles of cosmic dust hold secrets to the creation of the solar system.

Each day an estimated 50 tons of interplanetary debris plunges into earth's atmosphere. At least a dozen times a year this drizzle

JOHNSON SPACE CENTER, NASA (DEGON, ALL)

In his laboratory at the Johnson Space Center (JSC) in Houston, Texas, Friedrich Hörz stands with his back turned to a "gun" that uses compressed hydrogen to accelerate tiny glass projectiles to speeds approaching those of particles in space. The projectiles shatter as they penetrate thin foil targets and, forming high-speed debris clouds, splatter onto inked aluminum "witness" plates, several of which Hörz examines. Close-ups show characteristic debris-spray patterns made by varying the size of the projectile and the thickness of the foil. Such laboratory analysis helps Hörz to determine the sizes of particles that penetrated materials on LDEF. This knowledge will lead to improved shielding design for future spacecraft.

becomes a freshet as earth's orbit sweeps it through a meteor shower, debris left by comets as they shot past the sun. "This is when we see so many shooting stars—tiny particles burning up in the atmosphere about 60 miles high," explained Friedrich Hörz of JSC.

"Most cosmic dust is the remains of comets and asteroids, in proportions we still debate. If we fully understood the chemistry of the dust, we could learn much about the processes that went into the formation of the solar system. The major planets can't tell us this because their material was totally altered in the cooking process of their creation."

For two decades scientists have been striving to capture cosmic dust. Every few weeks a NASA aircraft soars to 60,000 feet to seine the stratosphere for particles.

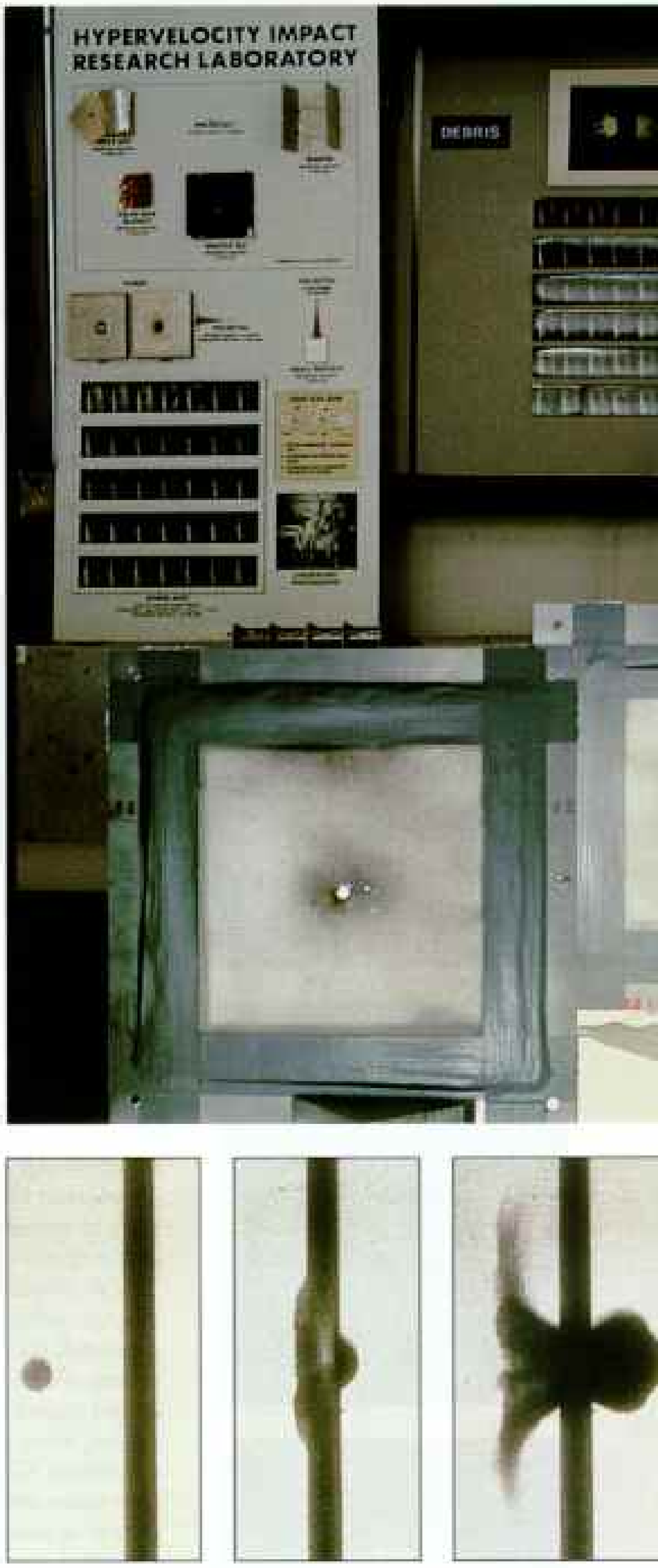
But the stratosphere is not a tidy place. "The aircraft samples include particles wafted up from volcanoes or forest fires," said Michael Zolensky of JSC. "And the cosmic material undergoes a certain sorting: Slow-moving asteroid particles survive better than the faster moving cometary matter." Analysis of meteorites—meteoroids that have fallen to earth—can yield similar clues about the solar system.

LDEF trapped pristine samples of cosmic dust. The particles lodged in exposed sheets of soft aluminum and solid gold sent up by Hörz and Donald E. Brownlee of the University of Washington in Seattle (the 17 pounds of gold will eventually be recycled). "We placed some of the sheets on LDEF's trailing edge so dust would collide at lower relative speed," said Brownlee. "The collectors gave us particle fragments that appear totally unmelted."

INVESTIGATORS believe LDEF's crannies may hide an even greater prize: particles of interstellar dust from beyond the solar system. Telescopes reveal it in the heavens in vast dark clouds. Studies of meteorites have yielded four types of these grains; other kinds could have returned with LDEF.

The coveted interstellar particles may lie among cosmic dust in capture cells sent up by Washington University in St. Louis, Missouri. Here Ernst Zinner is analyzing dust particles for their isotopes, measured by the number of protons and neutrons in the atoms' nuclei.

"Isotopes of elements are made by known, often cataclysmic, processes," said Robert M. Walker, also of Washington University, a



"You have to design your shield for the most probable threat you expect," says Jeanne Lee Crews, standing with Burton G. Cour-Palais at the Hypervelocity Impact Research Laboratory at JSC. Their "multishock" concept for shielding spacecraft uses several layers of

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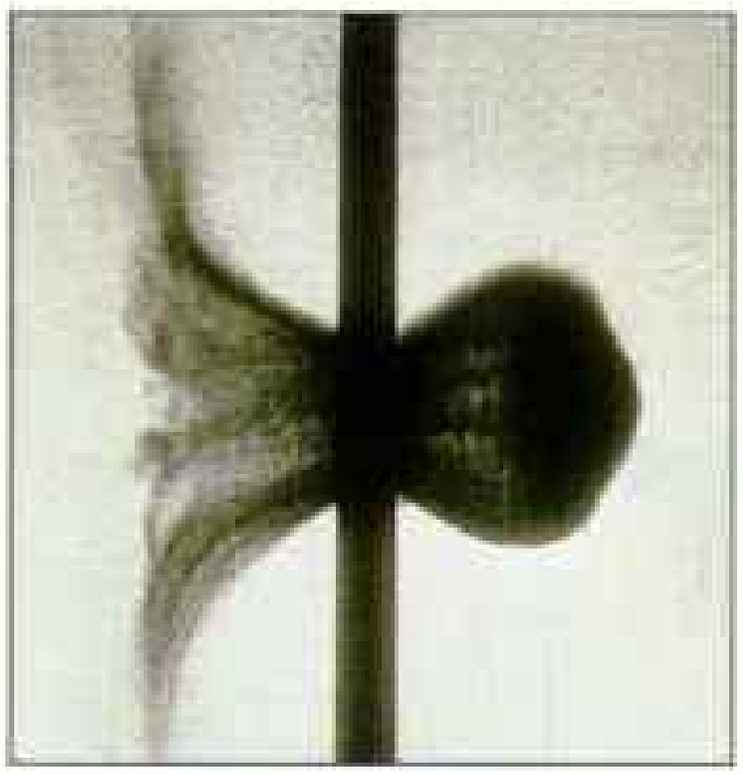
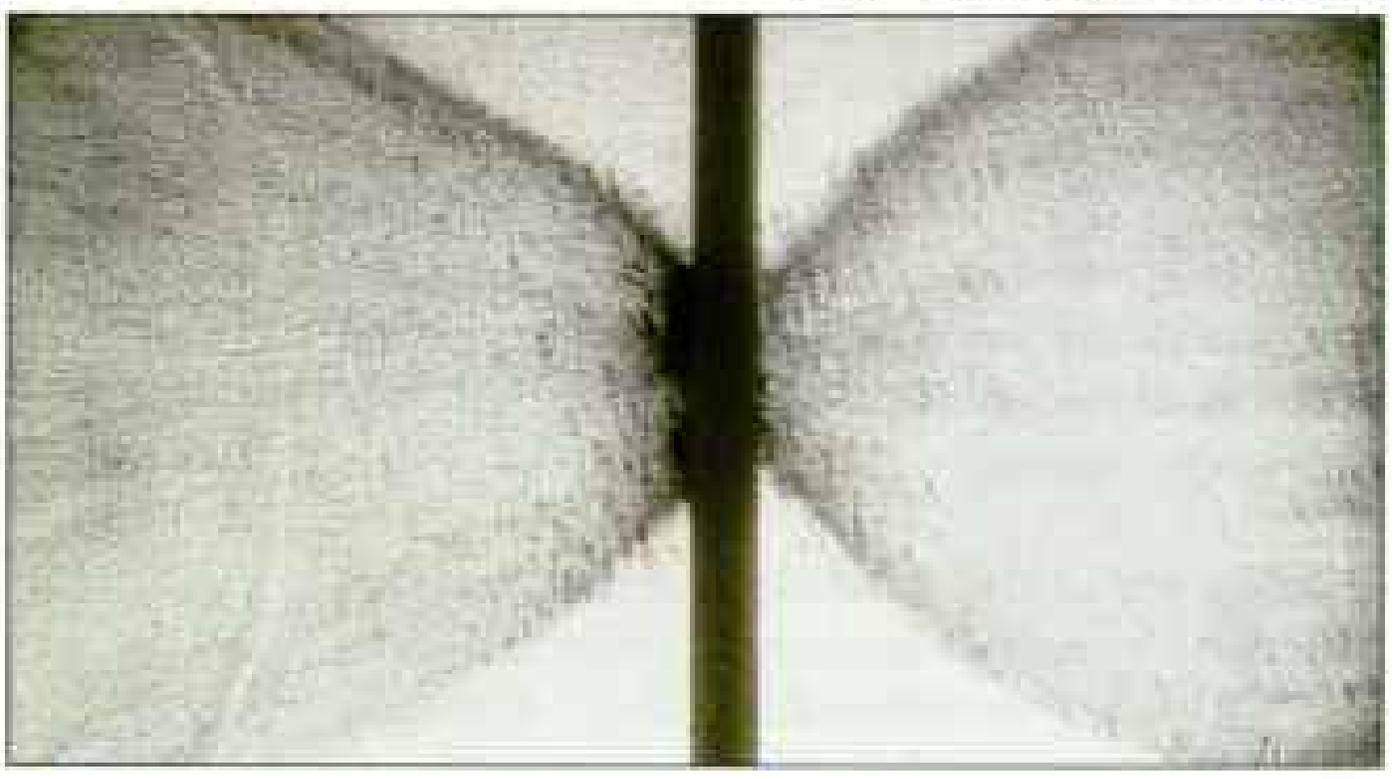




lightweight ceramic-fabric "bumpers" to repeatedly shock a projectile to such high energy levels that it melts or vaporizes before it can penetrate a spacecraft's walls. A high-speed camera records a hypervelocity impact on a conventional shield, a single aluminum bumper (sequence above). Most of the projectile moves forward as a potentially damaging debris cloud, while some material is ejected backward. In the multishock method, after the cloud penetrates four bumpers, it harmlessly hits an aluminum plate (top, at right).

co-investigator with Zinner and a pioneer in analysis of cosmic particles. "If we measure the distribution of isotopes in the dust, we can identify the kinds of stars that made them."

Appreciation of the mysteries hidden in isotopes has escalated since the detection in 1987 of minute particles of interstellar diamond in Australia's famous Murchison meteorite.

"Isotopes in the diamond and in silicon carbide grains," said chemist Edward Anders of the University of Chicago, "tell us that the ancestral solar system formed in part from the debris of carbon-rich stars, primarily those known as red giants."

LDEF brought back an even more elusive substance than interstellar dust: interstellar gas. This tenuous mix of atoms, ions, and molecules, along with the dust grains, forms the interstellar medium, whose total mass constitutes a major part of our galaxy.

"We have gas atoms whose angle of arrival confirms they're interstellar," said astronaut-physicist Don L. Lind of Utah State University in Logan, who worked with scientists from the University of Bern in Switzerland. "Like the interstellar grains, the gas atoms are matter actually recovered from outside the primordial cloud that spawned the solar system. These atoms are from a corner of the galaxy we've never had access to before." They, like the dust, are being analyzed for the messages of their isotopes.

"Interstellar dust and gas could also help us understand more about the beginnings of life," said Zolensky of JSC. "Some meteorites carry amino acids, the precursors of life. Studies of comet Halley and of interstellar clouds reveal the presence of the biogenic, or life-producing, elements. A chance to examine interstellar matter in the lab could help resolve whether some building blocks of life initially came from space."

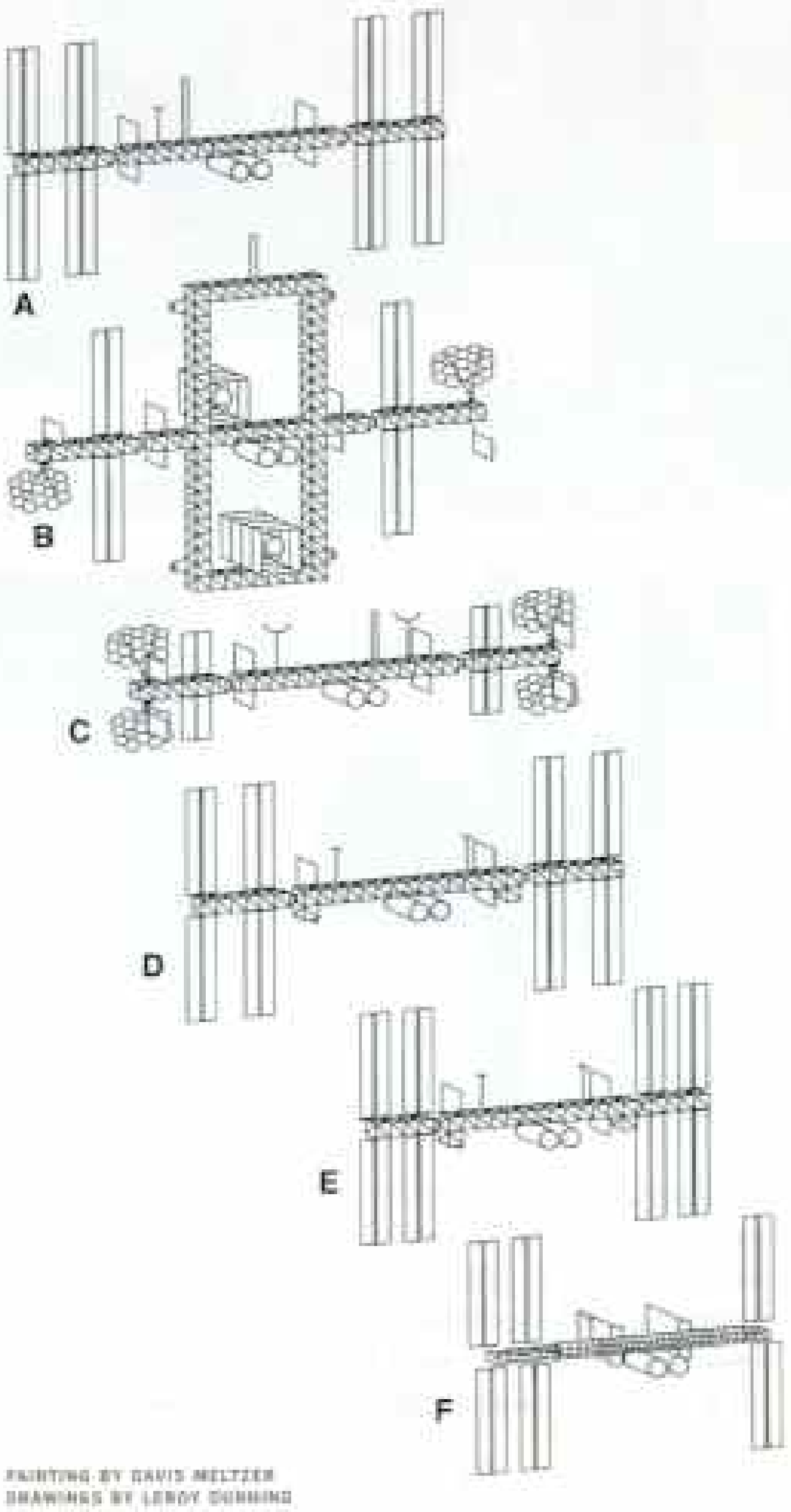
RADIATION RESEARCH made possible by experiments on LDEF relates in part to astronaut safety. Orbiting above earth's shielding atmosphere, astronauts endure high radiation levels as part of the job; their allowable annual dosage is ten times that for a worker in the U. S. nuclear power industry. All know the potential for cataracts, cancer, abnormal fetuses.

In 1958 U. S. satellites discovered the Van Allen belts, bands of intense radiation caught in the lines of force in earth's magnetic field.

SHRINKING THE SPACE STATION

Budget battles, design reviews, and debates about manned-versus-unmanned space exploration have meant delays and design changes for space station Freedom *(below, A to F, and right) since its authorization in 1984. The latest configuration (F) represents a 30-billion-dollar station, whose assembly is slated to begin in 1995 with the first of 18 shuttle flights. It will end in 1999 when* Freedom *is scheduled for continuous occupation.*

*Selecting materials that can last 30 years or more—*Freedom*'s projected lifetime—has been made easier as a result of data collected from LDEF. Important changes have already been made to coatings on* Freedom*'s radiators (1) and solar arrays (2) and to the material used for its trusses (3). So when—or if—*Freedom *finally flies, the spirit and science of LDEF will be on board.*



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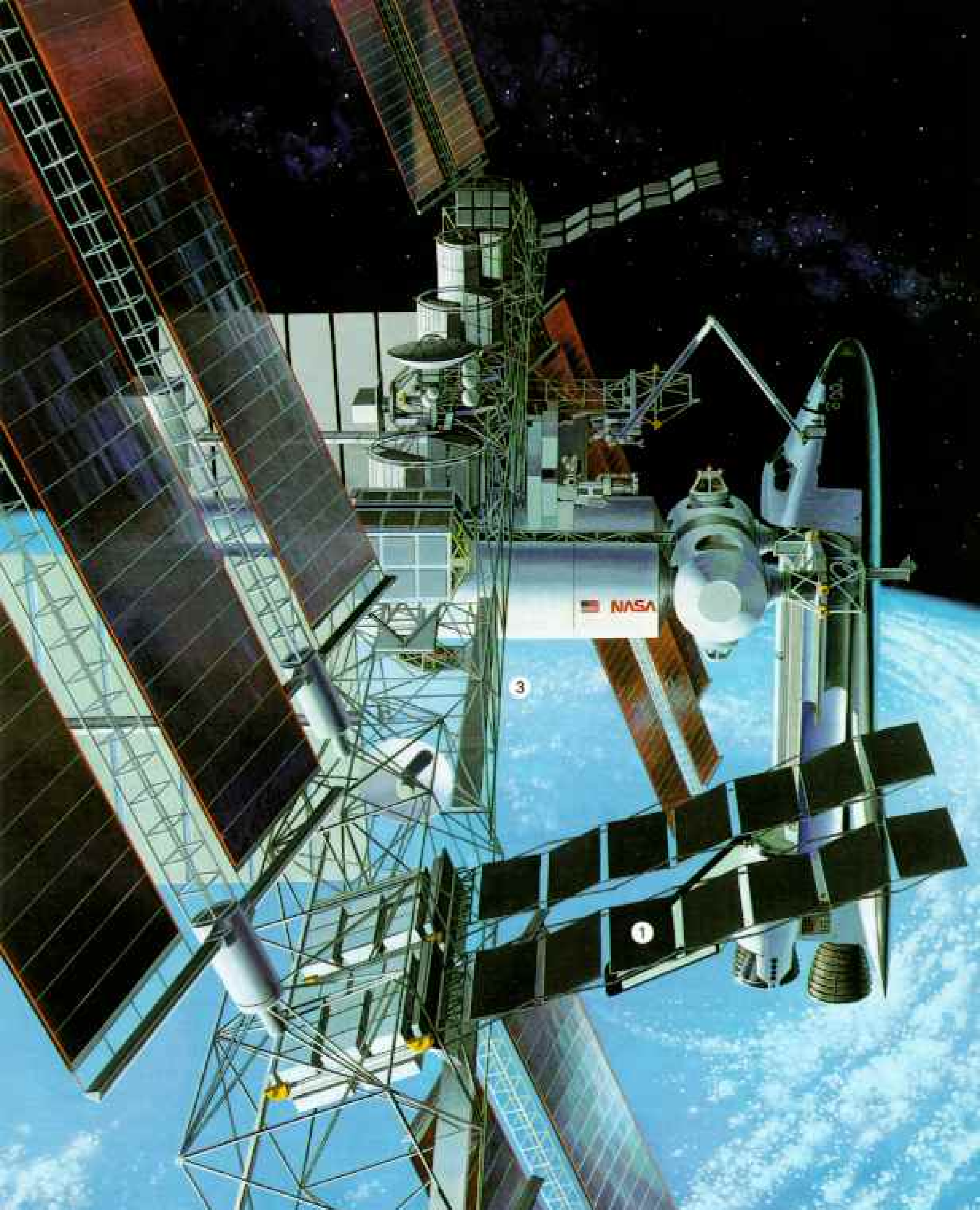
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Since then other spacecraft have been sent aloft to map the radiation hazard in low earth orbit—the road traveled by all manned missions and eventually by the space station. But worrisome unknowns have persisted. LDEF is dispelling many of them.

One intensely irradiated region is of special concern. "The dangerous radiation," said Thomas A. Parnell of the Marshall Space Flight Center, "focuses at a point above southern Brazil called the South Atlantic anomaly. Here earth's magnetic field bends the inner Van Allen belt so low that transiting spacecraft are bombarded by swarms of atomic particles, largely protons and electrons.

"Like LDEF, the space station will travel through the anomaly. That's why LDEF's findings are valuable. They give the first precise long-term measurements of the radiation's intensity and destructive capability."

These measurements, like those of debris and meteoroids, will save millions in construction of the space station. "Before LDEF, uncertainty about space radiation meant designing against worst-case possibilities," said Eugene V. Benton of the University of San Francisco, whose experiments gathered the data. "Now we know that *Freedom*'s electronic circuitry does not require costly hardening against different types of radiation."

A steady rain of ultraviolet radiation pounded LDEF's experiment panels, boiling off plastics, eating away paints. Also, protons smashed into structural metals and shattered their atoms, converting iron into radioactive manganese, nickel into radioactive cobalt, so that LDEF itself became mildly radioactive. It became a giant dosimeter. "Measurements of its radioactivity," said B. Alan Harmon of NASA Marshall, "allow us to determine the intensity of space radiation that caused it."

Much of this radiation results from the impact of cosmic rays. Coming largely from our Milky Way galaxy, these high-velocity particles collide with atmospheric atoms, producing protons. The protons flit between the magnetic poles, dipping low on their journey to create the South Atlantic anomaly.

With their large electric charge, cosmic rays themselves pose a radiation hazard. "They can easily penetrate spacecraft," warned James H. Adams of the Naval Research Laboratory in Washington, D. C. While no lives have yet been threatened, such impacts have disabled space electronics on many satellites.

Astrophysicists are intrigued by cosmic rays. This is because they, like cosmic dust and interstellar gas, can yield secrets of the universe—secrets of the origins of the chemical elements, which astrophysicists have struggled for generations to understand. In more than 50 canisters holding plastic sheets stacked like pages of a book, LDEF brought back the distinctive penetration tracks of cosmic rays—each the identifying footprint of an element.

"Cosmic rays are the nuclei of the elements," explained Alexander Thompson of Ireland's Dublin Institute for Advanced Studies, which with the European Space Agency conducted LDEF's largest cosmic-ray experiment. "About five times a second an atomic particle released by a cosmic ray passes harmlessly through your head. An airline passenger is hit by many more.

"Cosmic rays themselves, however, are destroyed on penetrating the atmosphere and can't be studied on earth. Our experiment will enable us to determine the relative abundances of heavy elements in space and the stellar processes by which they were created.

"LDEF GIVES US the first significant sampling of heavy, radioactive elements—including uranium—listed in the periodic table as the actinides. If we're lucky, we could even record new, superheavy elements, now only theorized to exist."

One radiation discovery on LDEF has already jarred scientists' understanding of vertical circulation in the atmosphere.

"As LDEF passed through the upper atmosphere," said Gerald J. Fishman of NASA Marshall, "it surprisingly swept up atoms of radioactive beryllium 7. This isotope of beryllium is created primarily in the lower atmosphere, when cosmic rays strike atoms of oxygen and nitrogen. Detecting it in the upper fringes of the stratosphere challenges our concepts of particle transport in the atmosphere."

LDEF leaves an important legacy. "It ranks among the most elaborate scientific efforts ever," said Dr. Kinard. "Its information about the space environment will keep hundreds of scientists and engineers busy for a decade."

Not bad for a beat-up old satellite that almost cost too little to fly. □

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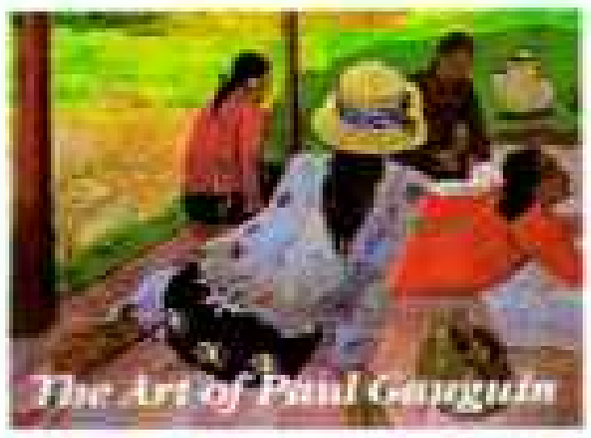

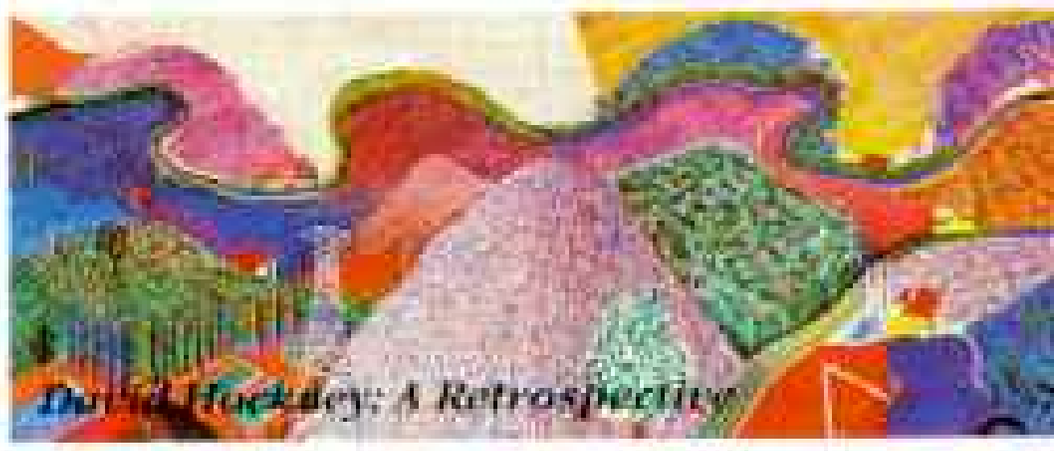

be seen and heard. And just as importantly, they help audiences across

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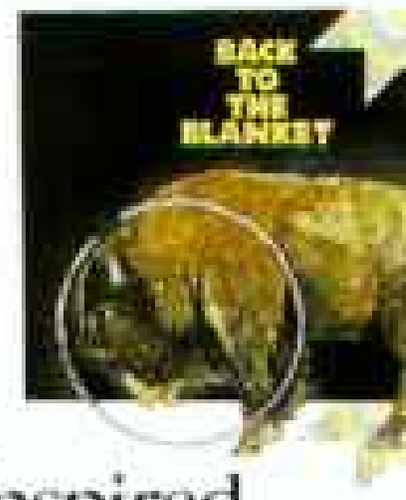
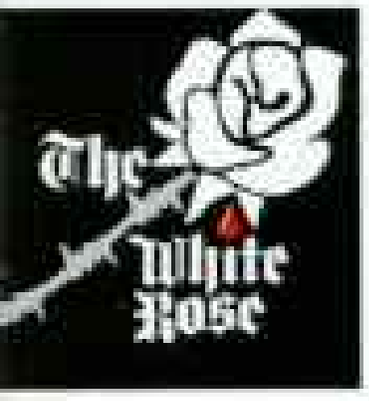
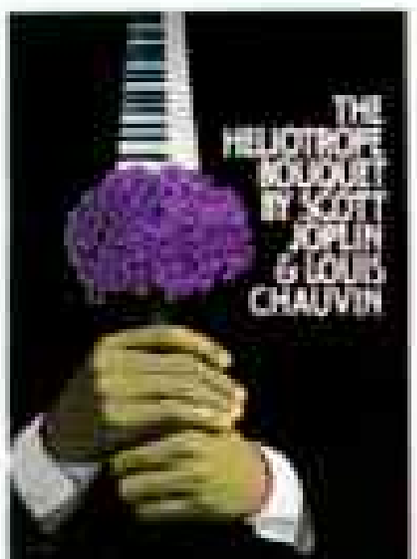
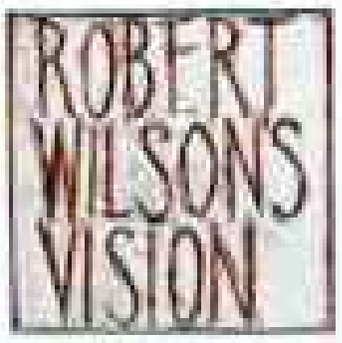
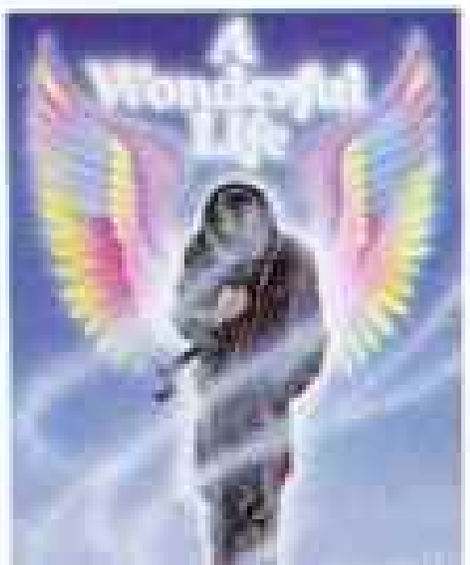


the country to be provoked and challenged, enlightened and inspired.









AT&T

Report from the President

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Clues to the Life of a Lost Settlement

They came to Virginia from England in 1619 to be part of a new colony. But their dreams were shattered by an Indian massacre, and memory of their settlement was lost.

They called their community Wolstenholme Towne. It was the headquarters of the Martin's Hundred plantation.

Ivor Noël Hume, retired archaeologist for the Colonial Williamsburg Foundation, told the story of these doomed settlers—and the mysterious artifacts they left behind—in the June 1979 and January 1982 issues of this magazine. Now a permanent exhibit, "Discovering Martin's Hundred," has opened in a new museum at the site, seven miles from Colonial Williamsburg.

Conceived by Noël Hume, the exhibit is one of discovery. It details the painstaking techniques that allow archaeologists to take a few buttons, rusty nails, and pieces of

COLONIAL WILLIAMSBURG FOUNDATION

pottery and re-create a community.

"Archaeology is a detective story, so we present our evidence in the form of clues," Noël Hume explains. "We show the visitor how we used those clues and how we arrived at our conclusions."

There are one-of-a-kind artifacts on display: a reconstructed gabled coffin, the top of a still, an unusual 17th-century helmet (above). A small theater and a video about the excavation and reconstruction of the helmet were funded by your Society.

There are also vivid paintings by Richard Schlecht, some of which appeared in the GEOGRAPHIC articles and others, like the one of the settlement fort (top), that have never before been published.

I was honored to speak in June at the opening of the museum, built with a generous grant from the Winthrop Rockefeller Charitable Trust. My father, Melville Bell Grosvenor, was an avid follower of the excavations, which were aided by grants from the Society's Research and Exploration Committee.

I encourage you to visit the museum during your next trip to Colonial Williamsburg. You will come away with a new respect for those early colonists and for the archaeologists who bring them back to life.

Gilbert M. Grosvenor

National Geographic, November 1991

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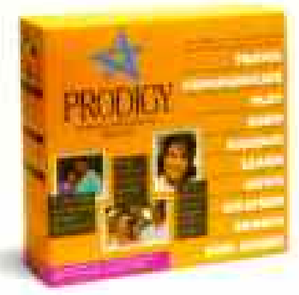

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The Russian Past Reclaimed in City Names

Voters in Leningrad (above) chose in June to reestablish their city's original name—St. Petersburg—given in 1703 by Tsar Peter I (the Great) to honor his patron saint. If approved by the Kremlin, this would be the third change in 77 years. During World War I, patriots "de-burged" the Germanic name, replacing it with the Russian equivalent, Petrograd. The 1917 Revolution put the Bolsheviks in charge, and they renamed Petrograd for Lenin, founder of the Soviet state, after his death in 1924.

More than a dozen other Soviet cities have reassumed their old names, or plan to. Gorkiy, for the Marxist writer, is again Nizhniy Novgorod. Andropov, for Mikhail Gorbachev's predecessor, is Rybinsk. Sverdlovsk, for one of the executioners of the royal family in 1918, wants to readopt "Ekaterinburg," for Catherine the Great.

More important, undoubtedly, is a proposal to replace "Socialist" with "Sovereign" in U.S.S.R., making it the Union of Soviet Sovereign Republics.

MARK HOLMES, NGS

Stacked African Mosques Chart a Course to Mecca

On the small Indian Ocean island of Pate, archaeologist Mark Horton of the British Institute in Eastern Africa has found the earliest substantial evidence of the spread of Islam to sub-Saharan Africa—and an intriguing puzzle.

"I removed the floor of an abandoned mosque, went down to an earlier mosque, removed that floor, went down to an earlier mosque, and so on. We found the remains of eight mosques one atop the other."

And successive mosques point more precisely to Mecca, which happens to lie almost due north (360°).

The increasing accuracy, Horton believes, reflects refinements by Muslim navigators traveling from Arabia. Sailing south down the Red Sea with favorable winds, they could easily keep track of distance and direction. But when they turned east into the Gulf of Aden, they had to cross the wind in repeated course changes more difficult to calculate.

As generations logged their voyages, builders made use of the improved knowledge to align new mosques more truly toward Mecca.

National Geographic, November 1991


WE DRESSED IN SILENCE.
AND DROVE.
UNTIL FOUR LANES BECAME TWO.
TWO BECAME ONE.
AND ONE BECAME A TUNNEL
LINED WITH TREES AND STARS.
AS WE WALKED IN, SHE SAID SOMETHING
TO THE PIANO PLAYER.
NEXT THING,
I HEAR THIS SONG WE USED TO LOVE.
SHE TAKES MY HAND. WE DANCE.
AND SOMETHING THAT WAS THERE BEFORE,
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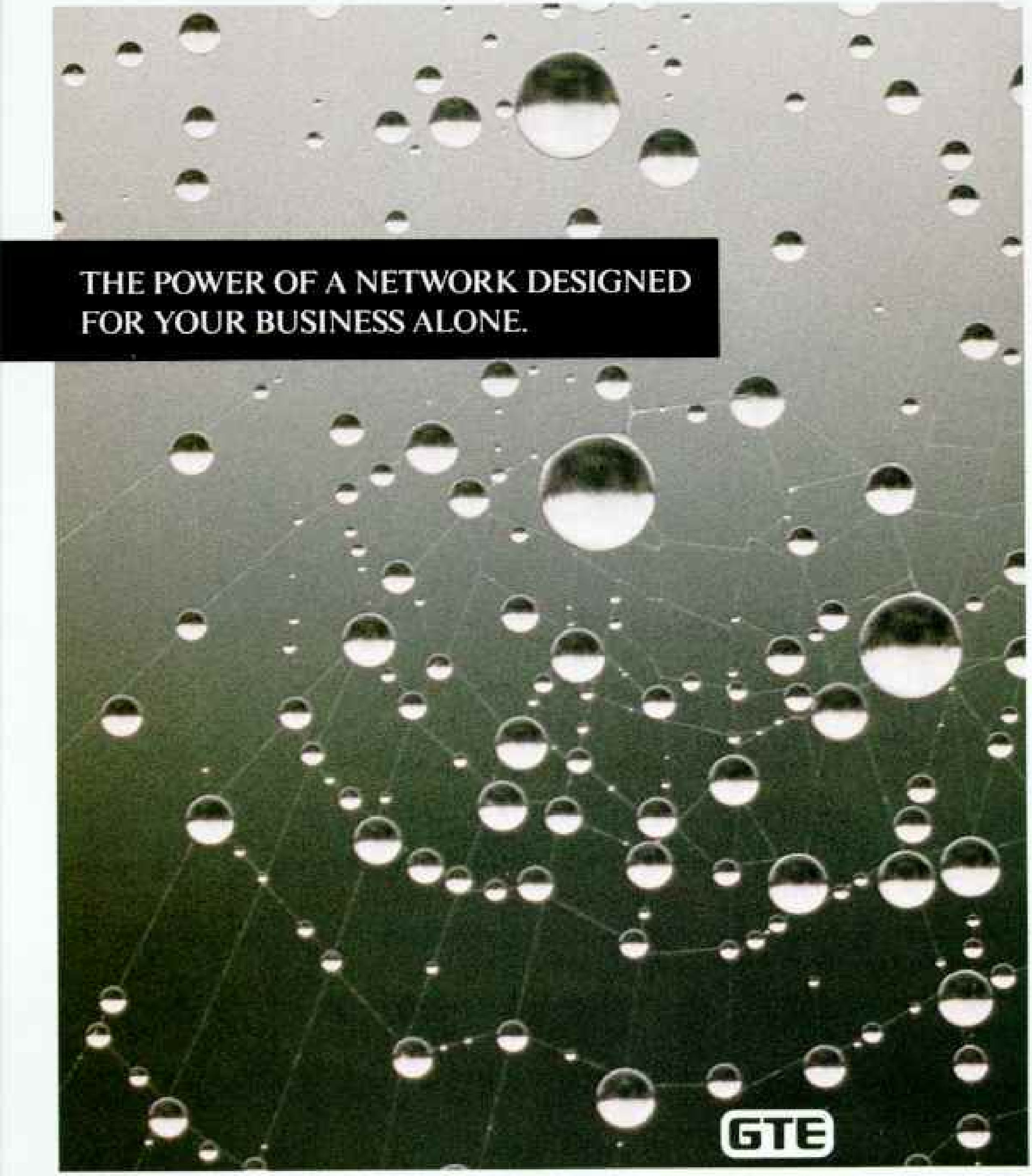


THE POWER IS ON

Geographica

Monkeys Star as Research Role Models

"They have a nice life here," says research psychologist Peggy O'Neill. "No famine, no disease."

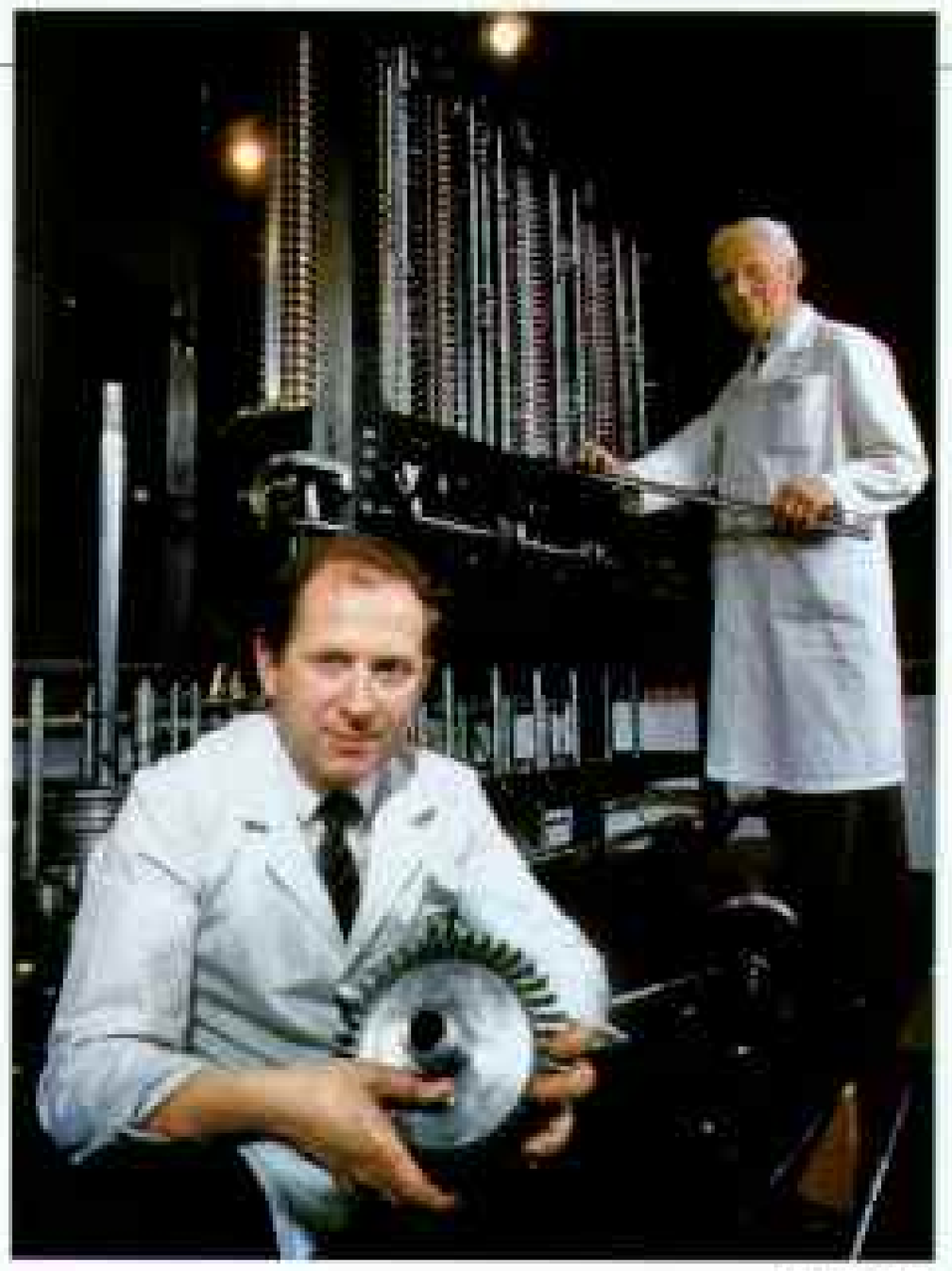
"They" are 30 rhesus monkeys with free run of a five-acre rural compound at the National Institutes of Health Animal Center outside Washington, D. C. Young monkeys splash in a pond while older family members—some of them retirees from careers in indoor laboratories—bask on banks nearby.

The lives of these primate loafers have a serious purpose: to make life easier and more interesting for their laboratory kin and to give insight into aspects of human behavior. As the animals play in the outdoor setting, researchers learn how to provide similar diversions for monkeys confined to cages.

O'Neill monitors the monkeys as part of behavioral, genetic, aging, and nutritional studies that employ no invasive techniques. "One of our interests is the psychological well-being of captive primates," she says.

O'Neill's work at the center has helped improve primate care in other government-funded research facilities—and more. Lessons learned from the monkeys could be valuable in developing standards of care for human children.

ROBERT CAPUTO



PETER ARDITI

Computer Whiz Honored —150 Years Late

In the mid-1800s Britain's bankers, surveyors, engineers, and other number crunchers faced a crisis. The published mathematical tables they consulted were often riddled with errors from having been calculated and typeset by hand.

To solve this problem, Charles Babbage, an English mathematician and inventor, designed several calculators that automatically computed and printed the tables. But he never saw them built. His devices were doomed in part by high production costs, bad management, and his own knack for antagonizing influential people. Prime Minister Robert Peel huffed: "What shall we do to get rid of Mr. Babbage and his calculating machine?"

But his genius was not forgotten. Harold Aiken, a 1940s pioneer in electronic computers, once said, "If Babbage had lived 75 years later, I would have been out of a job."

In celebration of Babbage's 200th birthday, the National Museum of Science and Industry in London has constructed one of his calculating engines. "Difference Engine No. 2," built by Barrie Holloway and Reg Crick (above), has 4,000 parts (gears, racks, cams, and levers), measures 11 by 7 by 1.5 feet, weighs more than three tons, and is powered by a hand crank.

Roll Out the Buckyballs!

What is round, spins more than a hundred million times a second, and is named after a famous architect?

A buckyball!

Discovered in a laboratory amid sooty residue of condensed carbon, the buckyball is a strong, symmetrical molecule composed of 60 carbon atoms—the third known pure form of that element, along with graphite and diamonds. It is called buckminsterfullerene to honor Buckminster Fuller, the architect, engineer, and inventor whose geodesic domes anticipated the molecule's soccer-ball look.

With its potential as a connecting molecule in millions of compounds, the buckyball has triggered "a feeding frenzy among theorists," says Richard E. Smalley of Rice University, one of the discoverers of carbon 60.

MELVIN L. PRUETT, LOS ALAMOS NATIONAL LABORATORY

Chemists are touting future uses: lubricant, superconductor, cancer treatment. To mass-produce buckyballs, a process was recently developed using an arc of electricity in a vacuum chamber to vaporize graphite rods. When more companies begin applying this process, costs are expected to fall. "But for now," says Smalley, "buckyballs ain't cheap." The price for a gram of pure carbon 60: as high as $6,000.

National Geographic, November 1991

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Geographica

LIONEL DELEVINGNE, TIME MAGAZINE

Fuse Blows on Canada's Giant Hydro Project

Quebec's James Bay hydroelectric project, one of the largest in the world (GEOGRAPHIC, March 1982), is tied up in Canadian courts while provincial and federal officials debate the environmental impact of its second phase. Up against nation and province are Cree Indians, who believe their way of life is threatened by road building, development, and the flooding of an additional 650 square miles of native territory.

"The governments seem more concerned with the technical and legal aspects of the development than with the concerns of native peoples," says Cree Chief Robbie Dick.

So the delay is little comfort to the Cree, who fear their culture will collapse under outside influences. "Once a road is there, it opens the door for mining and tourism," Dick says. The Cree have already seen adverse effects of damming. Mercury levels are rising in fish, a Cree staple, from new reservoirs that cover mercury-bearing rock. Health advisories have even been issued for some fishing areas.

Rather than rely on government assistance offered in exchange for land, the Cree prefer to keep their isolated territory. "What good are programs if there's no land left?" Dick wonders.

NGS CARTOGRAPHIC DIVISION

Brother Adam Battles the Bee Killers—Again

In the early 1900s a Benedictine monk provided salvation to Britain's dying honeybees. The culprit was *Acarapis woodi*, a mite that reproduces in a bee's respiratory system, obstructing its breathing tubes.

Brother Adam, now 93, started at Buckfast Abbey, Devon, "in 1915 when I fell ill and the Abbot suggested I take up beekeeping as not too strenuous work." He bred a mite-resistant strain that has helped keep Britain largely free of the pest.

Then in 1984 the disease appeared in the United States, destroying as much as 80 percent of the stock in some commercial hives. Who to call? Brother Adam.

The self-taught geneticist and two assistants tend 14 apiaries spread throughout Devon. Last year 14 mite-resistant queen bees from his hives were flown across the Atlantic. They are now being bred by government scientists in hopes of replenishing U. S. stock.

Yet Brother Adam can take little time for ease. "With 320 bee colonies, it is certainly no recreation!"

Riddle of the Ancient Dog Cemetery

Archaeologists in Israel have found the largest dog cemetery known from the ancient world. Seven seasons of excavation at Ashkelon have so far uncovered a thousand burials, spanning about 50 years of the fifth century B.C. "The numbers and concentration are exceptional," says dig director Lawrence Stager, professor of archaeology at Harvard University. Each dog—from puppies to elderly adults—was carefully placed on its side in a shallow pit, legs flexed.

At the time of the burials Ashkelon was a port city of the Persian

JAMES WHITFIELD, THE LEON LEVY EXPEDITION

Empire, inhabited by peoples from around the eastern Mediterranean. Stager speculates that the dogs were revered as part of a Phoenician healing cult, and apparently they roamed a sacred precinct until dying of natural causes.

"There have been all kinds of theories proposed, and every year we manage to abandon many of them," says Stager. "But we can still say that the burials are extraordinary, and the dogs were obviously quite important to the people living here or they would not have bothered to treat them with such care."

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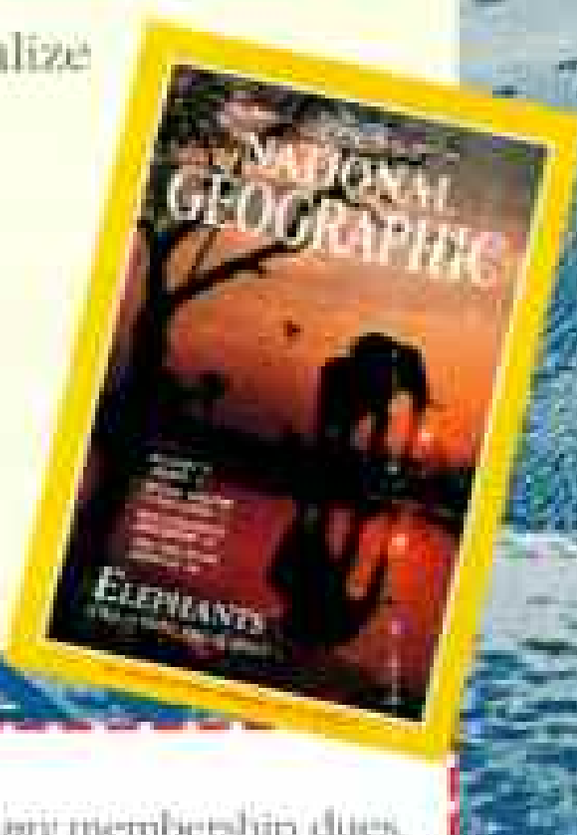

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Forum

Wyeth Family

In the July 1991 issue Richard Meryman presents fresh material on a family whose customary media exposure is a rehash of previous sources. I have a sense of being at home in N. C. Wyeth's familiar classic illustrations. The continuing, amazing impact of his and Carol's personalities on their freethinking, individualistic descendants is as shining a testimony to them as is the art. If I were a teacher of child development, your article would be required reading.

DAWN TALLMAN
Warren, Ohio

When the Wyeths speak about art, I listen to everything they say—except what Henriette said about men being more powerful and better painters than women. I realize that she was probably raised in an era when this was the prevalent idea. We have long since discarded such generalizations about talents and intelligence of people of different races. When are we going to do the same concerning gender?

LINDA TEULING
San Juan, Texas

Recently at a banquet for summer interns given by the Du Pont Company in Wilmington, Delaware, I sat with a man whose name tag read "Nat Wyeth." It was Andrew's brother. He explained that his father felt science and engineering require the same sort of creativity as art and that his father had encouraged him to become an engineer. From your article I now realize the tremendous influence N. C. had on his family, and the origin of Nat Wyeth's comments that evening become clear.

DANIEL A. GREEN
Moylan, Pennsylvania

London Docklands

I agree more than ever with Prince Charles's criticism of Docklands development (page 46) after reading your article. I have more than 40 years of ties with London, including 16 years of residence. Aside from historic sites, London will more and more resemble New York City—a tragedy for one who loved it so much.

ROBERT LEE GROSS
Bainbridge Island, Washington

How ironic that the students of George Green's School are so despondent about their opportunities in London's Docklands. When my ancestor George Green endowed the school in 1828, he did so to give the children of workers chances they couldn't get any other way. Olympia & York's "adoption" of the school continues a fine tradition that the great commercial interests in the docks should look after their own. I salute them.

FRANCIS MCINERNEY
Dobbs Ferry, New York

Erla Zwingle states that nobody really knows how the name Isle of Dogs came about. It takes its name from the royal kennels established here in the reign of King Charles II whilst the Court was at Greenwich.

IRIS APPLIN
London, England

This is certainly one of the most popular explanations. However, no documentary evidence exists for this or any other theory about the name.

London's Docklands museum preserves a long wooden wand that was an important safety item. When the notorious "pea souper" fog descended over the waterways, Dockland police who knew the maze like the back of the hand would fan out, blowing whistles every few yards. Stranded dockers were found and formed into a "crocodile." Testing the ground ahead with this fog stick, the policeman would lead his charges along wharves and over narrow bridges to safety. The last pea souper I recall was in 1952. That killed so many people it helped spark a clean-air act, and London lost the fogs laden with coal smoke and grime.

RAY DUDLEY
Walthamstow, England

It is only fitting that some people from Docklands should be wearing tattoos. The word "Britain" is derived from "Pritani," a Celtic word for a marked or tattooed people.

LARRY VIGON
Chicago, Illinois

Remembering the Blitz

Your article conveyed the atmosphere of those days very well. Throughout the war I lived in the London suburb of Wimbledon, which had its share of bombing. Few people who watch the tennis championships on the Centre Court today realize that during the Blitz it was used as a mortuary.

NORMAN PLASTOW
Wimbledon, England

As a matter of interest the dark figure silhouetted in the photograph on page 77 is Sir William Stephenson, the man called Intrepid. His contributions toward winning the war were among the foremost. He was Churchill's personal representative to President Roosevelt and head of British Intelligence in the United States. His team of "Baker Street Irregulars" broke the secrets of the German Enigma code machine, a major factor in

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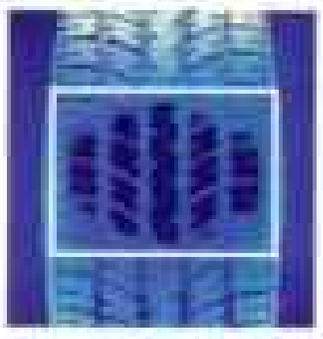

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the Allied victory. An excellent book on his life and the secret intelligence war is *A Man Called Intrepid* by William Stevenson (1976).

PETER D. SLAP
Phoenix, Arizona

I was in the RAF in London during the Blitz and can identify your unknown pilot with bull terrier (page 74) as Flt. Lt. W. A. Smith of the 229th Hurricane Squadron. Smith was the complete dog lover. Later in the desert in Libya, rather than leave his very large dog Pluto behind, he coaxed it into the tail section of his Hurricane and took off for base, an entirely irregular operation.

W. A. MATTHEWS
Hereford, England

I am a person who lost family on both sides. Should you not in all fairness "remember" some of the other cities that were destroyed? From a historical as well as human point of view, it should be noted that the fatalities on English soil pale next to those suffered in the bombing of German and Japanese cities. At least 60,000 people died in Dresden, 50,000 in Hamburg, 100,000 in Tokyo.

ALVIN T. HUDEC
Victoria, British Columbia

Beneath Arctic Ice

The excellent article in your July issue made only too clear the fragility of this delicately balanced ecosystem. I propose a campaign to have the whole

Arctic declared by the United Nations a zone in which no oil exploration is permitted and in which no military activity is allowed.

JOE BARBER-STARKEY
Brentwood Bay, British Columbia

China's Youth

As a 17-year-old college student, I was struck by deep emotion reading the article by Ross Terrill. We American students must not forget that we have been blessed with a democratic government, quite unlike China. How sad it is that some who are born into freedom never realize what a tremendous sacrifice it is to rebel against a repressive higher authority. Those Chinese youths attempted to gain freedom not only for themselves but also for future generations. Those who survived the hellish turmoil should not be forgotten.

ANNE MARIE HILSCHER
Victoria, Texas

I read your riveting article during the peak of the heated debate over "most favored nation" status for China. One need only see the picture of two men being readied for execution to conclude that any action by our government that hints of the slightest acceptance, approval, or tolerance of the current Chinese regime is an obscenity.

PAUL J. BOUDREAUX, SR.
Silver Spring, Maryland

One victim on pages 114-15 is not anonymous. The man on the right, according to Amnesty International, is Zhou Xiangcheng. His execution—some spectators found it entertaining—is well-documented.

SLOBODAN KRUCICAN
Bern, Switzerland

Amnesty International tells us the other man is Wang Guiyuan. The two were found guilty of setting fire to vehicles during rioting in Chengdu.

I came to the U. S. from Shanghai in 1990. Many students have expressed their loss of hope for their own and the nation's future. A feeling prevails that China's past is worthless. Some even think it is the evil root of today's tyranny; and that Chinese traditions could be discarded into a trash can. That view has been supported by well-known Chinese scholars. The fact is that China's unique culture and long history have been fertile in producing new ideas. We young Chinese should never relinquish our culture, such as "boring" Beijing opera (Do some of them think Madonna's music exciting?), without which we would not be differentiated from the rest of the world.

SHEN YONG
Richmond, Indiana

China Map

Your cartographer labeled Dongbei as Manchuria. I traveled that area in 1976 and at that time, at least, to have referred to it as Manchuria would have been to lower the ambient temperature well below freezing.

JOHN P. RASTELLO
Nueva Andalucia, Spain

Manchuria, which has imperialistic overtones to many Chinese, is the region's historic name. Dongbei, an unofficial name, means northeast and refers to the three northeastern provinces.

China was—and at present is—an imperialist country. It is not a nation but an empire, whether ruled by a "son of heaven" or a chairman. Tibet was always an independent country, in early days as a kingdom and in later times as a monk-ruled country. Tibet was under Chinese imperial occupation for two short periods, during the Yuan and Qing dynasties. Mao Zedong "liberated" Tibet from the Tibetans to settle Han Chinese in Tibet. Mao may be a great man to the Chinese people, but to all neighboring countries he was another "son of heaven."

TARUN ROY
Richmond, Virginia

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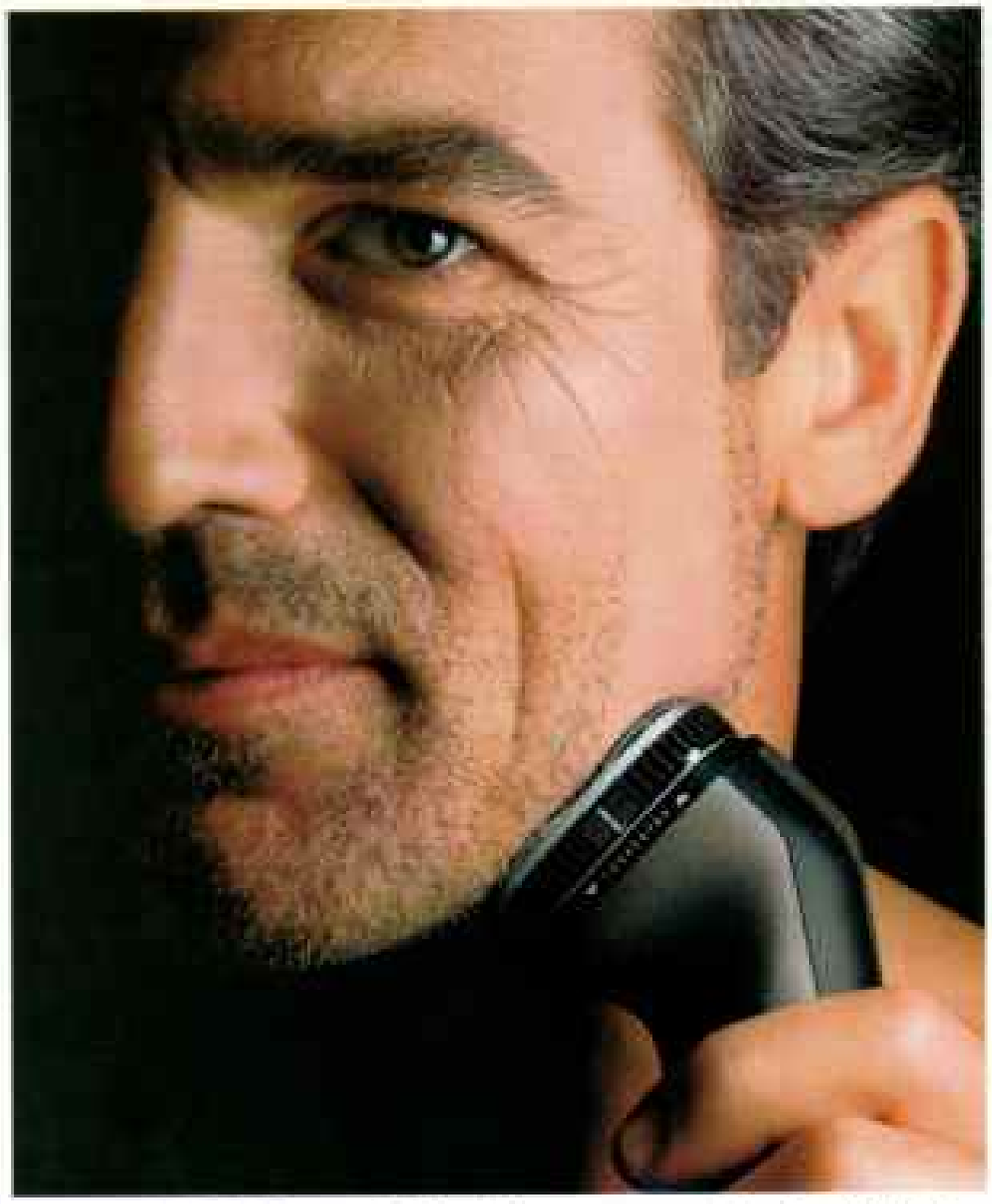

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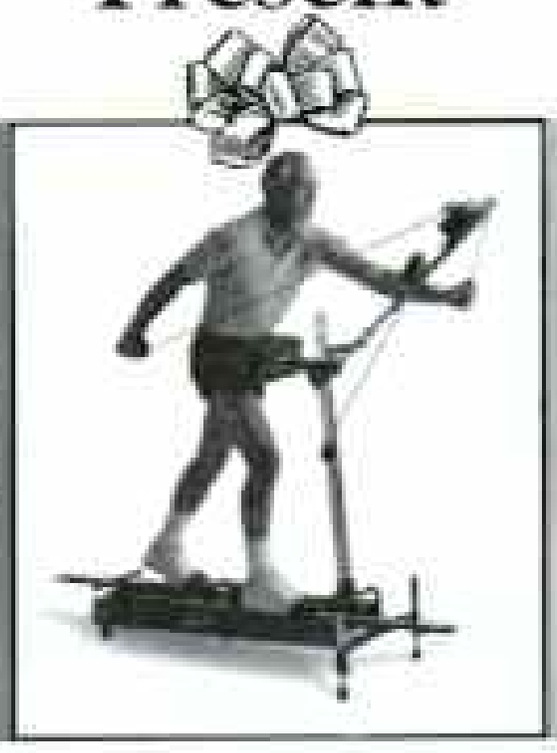

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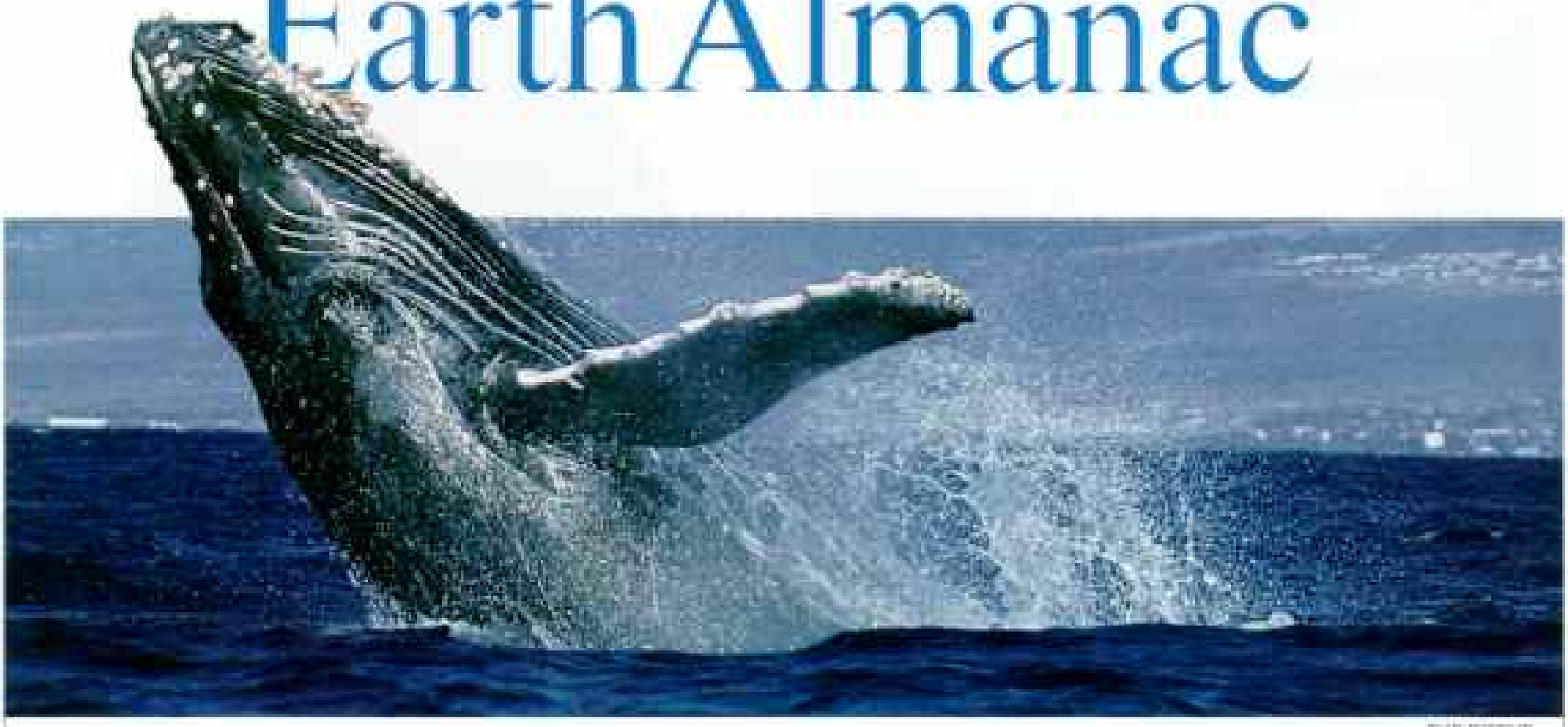

FLIP NICKLIN

Peaceful Winters Ahead for Hawaii's Humpbacks

Whale watchers on Maui will likely be shoulder to shoulder this winter. Humpbacks are returning to the shallows.

Noisy "thrill craft" such as jet skis and powerful parasailing boats that tow daredevils hanging from parachutes are now banned from Maui's coastal waters between December 15 and May 15. That's when some 500 humpback whales migrate with their calves from Alaska.

The whales normally loll close to shore. "In 1979, 80 percent of the females and calves came very close, near the surf line," says biologist Deborah Glockner-Ferrari. "But by 1988, when thrill craft had become really popular, almost all of them stayed out to sea. Last year, when the ban took effect, the number rose to 13 percent. We don't know for sure, but shallow water is probably important to the mother's lactating ability."

Illegal Wildlife Trade—A Case for the Kids

A macabre show-and-tell exhibit is appearing in schools such as Cub Run Elementary in Centreville, Virginia (right). The children can handle elephant ivory, a stuffed hawksbill turtle, a black coral necklace, tortoise jelly, and a purse made from a whole dwarf crocodile—about two dozen items total. The lesson: how such illegal products can wipe out wildlife.

The Suitcase for Survival program, sponsored by various U. S. conservation groups and government agencies, aims to help save endangered species by teaching schoolchildren about the international black market, a billion-dollar-a-year industry. An array of illegally imported animal products, selected from the tons seized by the Fish and Wildlife Service, was packed into 40 suitcases and donated to zoos that trained teachers in a dozen cities to use the kits in their classrooms.

Legal Net Thrown Over Beleaguered Butterfly

An inconspicuous little butterfly that hardly lives up to its flashy name—Mitchell's satyr—has fluttered into the limelight. Overzealous collectors are jeopardizing it. Last June the U. S. Fish and Wildlife Service used an emergency rule to immediately declare the butterfly endangered.

Collectors have always prized the hard-to-find species, which lives in southern Michigan and northern Indiana. "There are only 15 sites left," says Fish and Wildlife biologist Ron Refsnider, "so unscrupulous people will want this species even more." Armed with the new rule, an enforcement agent turned away two collectors who had driven six hours to a Michigan marsh where *Euptychia mitchellii* survives.

LARRY WEST

SUSIE BROOKS

National Geographic, November 1991

Finally, a VCR everybody and his dog can program.

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WILL STEGER, AP/WIDE WORLD

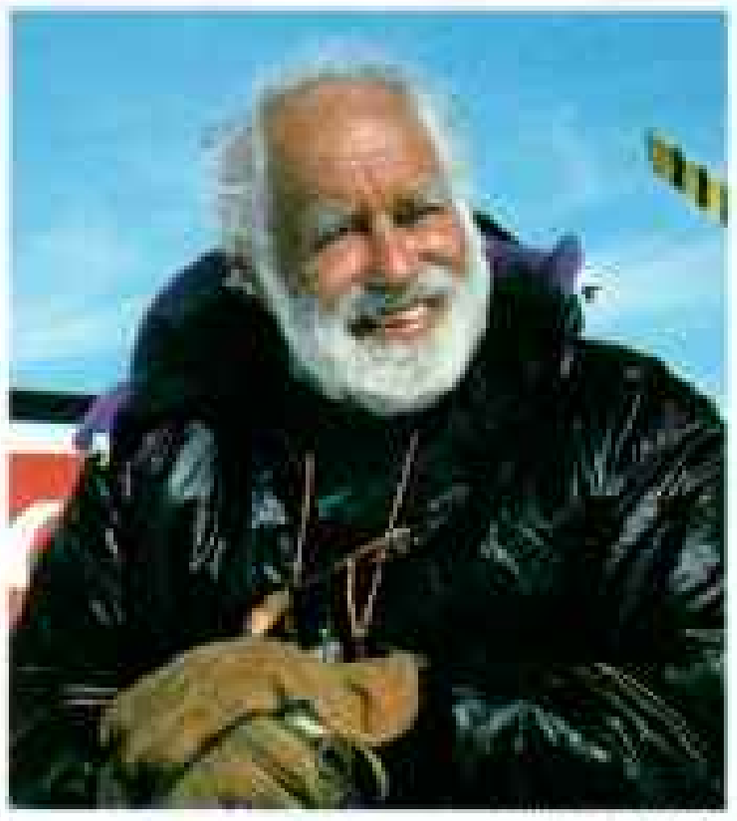
New Antarctic Compact: Dog Has Had Its Day

"Dogs shall not be introduced onto land or ice shelves, and dogs currently in those areas shall be removed by April 1, 1994." Those cold words, tucked into a new Antarctic agreement, spell the end of the trail for huskies like these on Will Steger's team making the first traverse of the continent by dogsled last year (NATIONAL GEOGRAPHIC, November 1990).

Time and technology have rendered working dogs in the Antarctic superfluous. Only Britain, Argentina, and Australia still keep camp dogs at their scientific stations. The impending ban stems from fears that dogs could spread disease to indigenous seal populations. Crabeater and leopard seals were recently found to carry antibodies against canine distemper—meaning that somehow the animals had already been exposed to the virus.

Carsten E. Borchgrevink, a Norwegian, became the first to use dogs in Antarctica in 1899. Dogs also helped Robert Scott, Ernest Shackleton, and Roald Amundsen make known an unknown continent.

But there may be one last dog trek, quite literally for old times' sake. Norman Vaughan (above right) served as a dog handler on Richard Byrd's 1928-1930 expedition, making him part of the first American team to use dogs in the Antarctic. Now Vaughan wants to



LOUIS R. SAPIENZA

be part of the last. He hopes to return with dogs in 1993—at the age of 88—to climb Mount Vaughan, a 10,302-foot peak named for him, although he will need a special permit to do so. Vaughan figures that he and his team will travel a thousand miles by dogsled, carrying instruments to measure air pollution.

"I'm promoting the idea that old people should throw away their armchairs," Vaughan declares. "I'm having a marvelous, adventurous life." An ardent aviation buff, he recently journeyed to Greenland as part of a group that excavated from more than 250 feet of ice one of two B-17 bombers that crashed during World War II.

Recycled Cans Aid Mining, Raise Objections

Dutiful allies of the earth, San Franciscans have hauled ten million steel cans to the curb since the city's recycling program began in 1989. But a ruckus has been raised by the Utah destination of most cans—the world's largest open-pit copper mine (below).

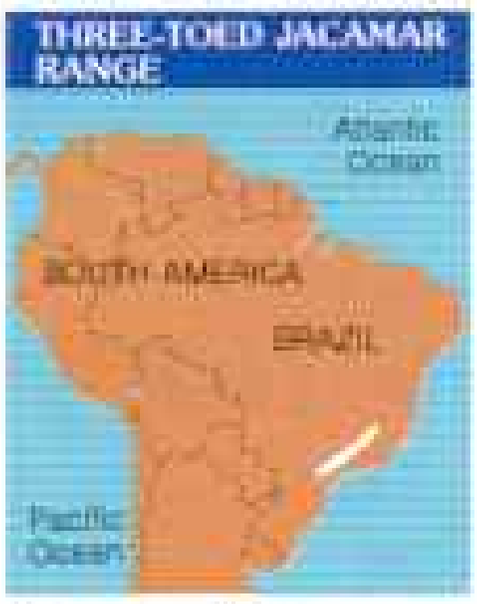
The cans are shredded to make an iron-rich solution that separates copper out of the poorest grade of copper ore. This enables the 2.5-mile-wide mine to produce an extra 6,500 tons of metal a year.

Thus recycling "is actually helping a destructive process—open-pit mining," argues John McCaull of Californians Against Waste. Amy Perlmutter, San Francisco's recycling coordinator, counters: "The process reduces the rate at which mining takes place." As the issue is sorted out, both sides urge the public to keep the cans coming.

ROYCE BAIR, THE STOCK SOLUTION

National Geographic, November 1991

WILDLIFE AS CANON SEES IT



Three-toed Jacamar

Genus: *Jacamaralcyon*
Species: *tridactyla*
Adult size: Length, 16cm
Adult weight: 18g
Habitat: Open woodland near rivers in southeastern Brazil
Surviving number: Unknown
Photographed by Luiz Claudio Marigo

A three-toed jacamar watches attentively for a butterfly or other flying insect to pass by. Upon seizing its winged prey in flight, the jacamar returns to its hunting perch to eat and then wait again. Very little is known about the ecology of the three-toed jacamar. And with its habitat diminishing, studying this unique bird becomes increasingly important to its survival. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Color images, with their unique ability to reach people, can help promote a greater awareness and understanding of the three-toed jacamar and our entire wildlife heritage.

NATURE

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This program is funded, in part, by Canon U.S.A., Inc.

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Nuclear energy means cleaner air.

On Assignment

RICHARD OLSENIUS (ABOVE); JULIE HOSHER

The call of the north has always appealed to native Minnesotan RICHARD OLSENIUS, but even he was not prepared to fall in love with the remote, frigid Alaska Highway.

"This is no longer a godforsaken stretch of road—it's a link between friends," says Richard, who traced the 1,500-mile highway for seven months, through winter and summer, to capture its many moods.

"I'd never call this highway dramatically beautiful. On the surface it's plain, but after you get to know it, the beauty begins to show."

Providing story and pictures for this issue brought lasting friendships with several highway residents. One favorite stopping-off spot was the Dix family's hand-built Yukon homestead, which overlooks an ever changing stream (above) often frequented by beavers and moose.

Previously, Richard photographed the Northwest Passage for the GEOGRAPHIC (August 1990), but he has also ventured to more steamy climes, as when he chronicled Cambodian refugees in Thailand.

After 20 years on the Africa beat free-lance writer-photographer ROBERT CAPUTO knows his assignments are more than just a job. "It's an addiction," he admits. "I'm addicted to the thrill of the unexpected. That's why I keep traveling."

And travel he has—to more than two dozen African nations, including Egypt, Sudan, Namibia, Tanzania, Uganda, and Burkina Faso.

For his fifth GEOGRAPHIC article Bob explored Zaire for nine months. "It was the hardest place that I've had to work in terms of bureaucracy," he says, recalling the six exasperating weeks he spent coaxing a press permit out of government officials. "They don't like Western journalists, because most write stories about how horrible the government is."

Arrested for shooting pictures in Kinshasa (his permit didn't satisfy local police), Bob persevered. Finally, proper pass in hand, he boarded a boat bound up the Zaire River, where he befriended a baby chimp offered for sale as a pet (left).

The nomadic life has its drawbacks, says Bob, a nominal resident of Washington, D. C. "It's hard on friendships, a bit of a sailor's life." But not one he's ready to give up. "After I'm home for a few months, I start to get itchy."

A few days after filing his story, Bob headed back to Africa.

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