

VOL. 171, NO. 5



MAY 1987

NATIONAL GEOGRAPHIC



At Home
with the
Arctic
Wolf 562

UKRAINE 595

CHERNOBYL—
ONE YEAR AFTER 632

NEW ZEALAND:
THE LAST UTOPIA? 654

THE CAPTIVATING
KIWIFRUIT 683

WHEN AN OLYMPIC RECORD has been set, a great vintage wine produced, or a scientific breakthrough announced, you can be sure the event happened because a lot of factors came together at one time and place.

Such a moment came this past year at the First World Symposium on Maya Epigraphy in Guatemala City. For as long as scholars have studied the ancient Maya, they have puzzled over the meaning of their strange hieroglyphs. Then before the assembled scholars a 21-year-old Princeton University sophomore stood up and read an inscription on a ceramic pot written in the Maya language of the fifth century.

How had the young man broken the code after so many had failed? Was he psychic?



MAYA GLYPH FOR CACAO

Hardly. As the son of National Geographic writer Gene Stuart and staff archaeologist George E. Stuart, David Stuart has grown up in a household fascinated with Maya culture. For 12 years he's been absorbed in the mystery of the glyphs. Three years ago he received a MacArthur Foundation grant of \$120,000 to further his studies.

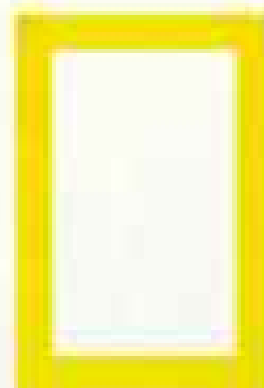
Aided by computers and the input of dozens of colleagues, David and other scholars had been closing in on the meaning of the glyphs. Then three years ago Dr. Richard Adams discovered one of the first undisturbed Maya tombs to be found in 20 years. Among its archaeological treasures were pots and plates containing residues of the original contents.

At the symposium, jointly sponsored by the Guatemalan Institute of Anthropology and History, the Tikal Association, and the National Geographic Society, that rare but critical combination of hard work, good luck, and brilliant analysis fused to make history. David's studies told him the glyphs on one pot from Dr. Adams's site revealed not only that it belonged to a noble under the patronage of the ruler of Río Azul, but it was for holding cacao. Two months later Dr. Adams announced the results of analysis of the dried residue by the Hershey Foods laboratory. It was indeed cacao.

For everyone who was at the symposium and all scholars concerned with the Maya, it was like hearing the bells, whistles, and cascade of coins of a jackpot on a slot machine. David had hit an epigrapher's jackpot. A lot of work by a lot of people had come together at one time and place. The mysterious Maya will never again be so mysterious.

Wilbur E. Garrett

EDITOR



NATIONAL GEOGRAPHIC

MAY 1987

At Home with the Arctic Wolf 562

In Canada's far north, wildlife biologist L. David Mech and photographer Jim Brandenburg win the trust of a wolf pack and record the behavior of the elusive animals at remarkably close range.

Ukraine 595

Fifty million Ukrainians struggle to maintain their language, their religious faith, and their sense of identity in a Soviet republic larger than France. But they tread a fine line, senior writer Mike Edwards and photographer Steve Raymer report.

Chernobyl—One Year After 632

Mike Edwards and Steve Raymer visit the region of the world's worst nuclear-power accident to learn what really happened and what the long-range consequences may be.

New Zealand: the Last Utopia? 654

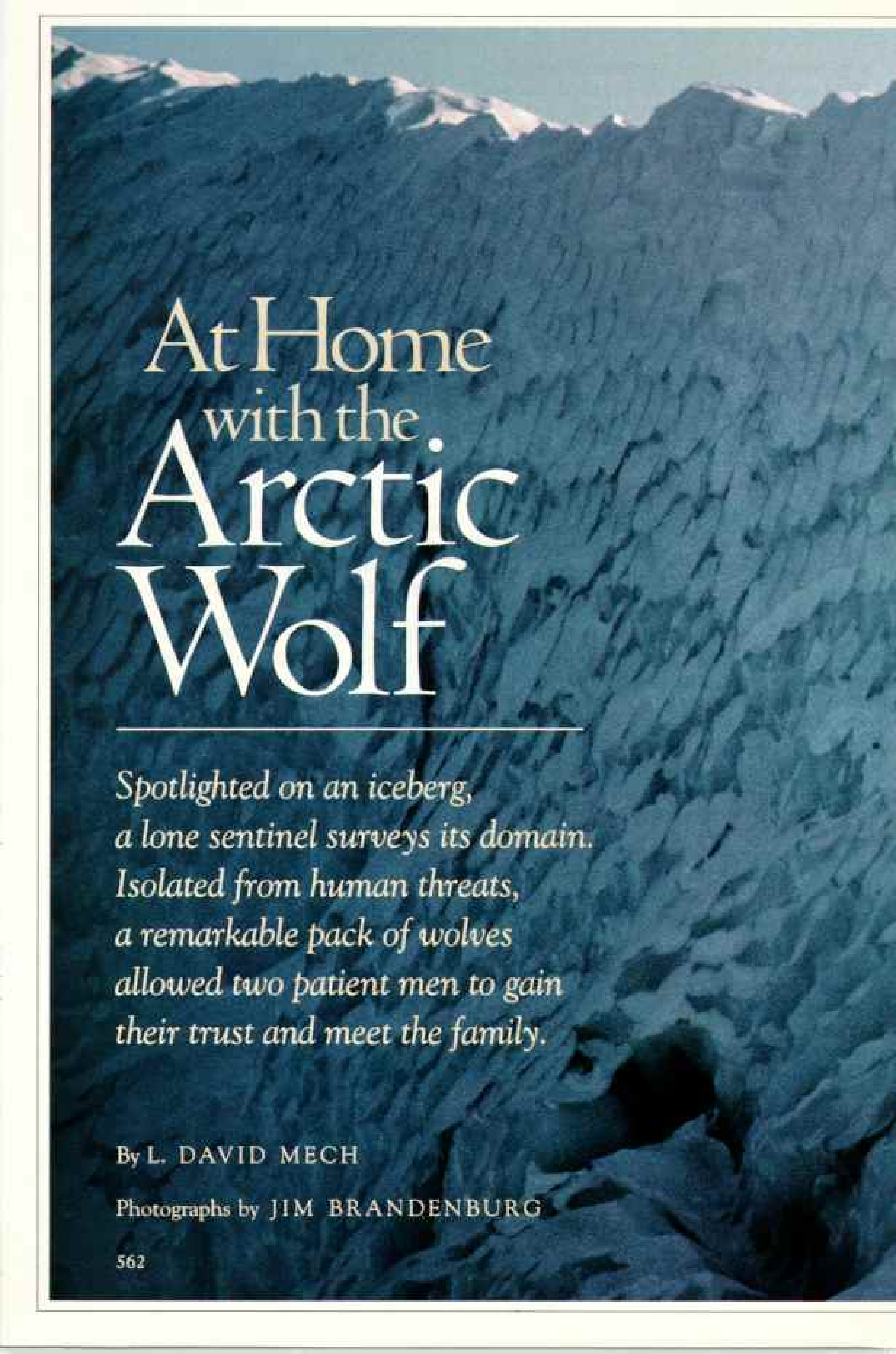
In this scenic isolated nation, where sheep outnumber citizens, New Zealanders are grappling with world problems in a thoroughly modern way, according to Robert P. Jordan. Photographs by Kevin Fleming.

The Captivating Kiwifruit 683

What's homely on the outside, jewel-like on the inside, and can be served sliced or poured? Noel D. Vietmeyer and photographer Jim Brandenburg describe New Zealand's "hairy berry" that has taken the world by storm.

COVER: *Denizen of the high Arctic, the male leader of a wolf pack checks the shallows for food. Photograph by Jim Brandenburg.*

THE NATIONAL GEOGRAPHIC MAGAZINE
IS THE JOURNAL OF
THE NATIONAL GEOGRAPHIC SOCIETY
FOUNDED 1888

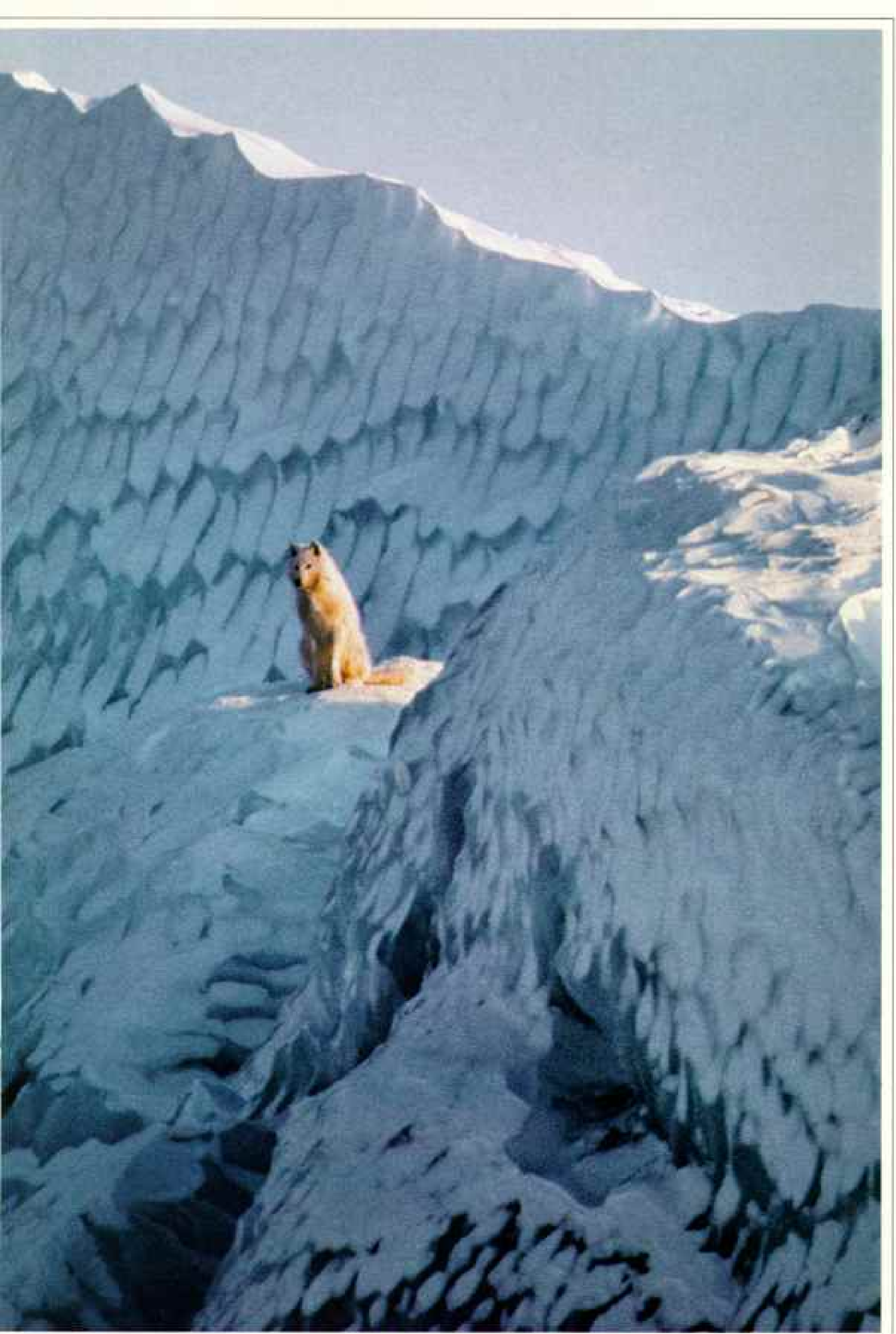


At Home with the Arctic Wolf

*Spotlighted on an iceberg,
a lone sentinel surveys its domain.
Isolated from human threats,
a remarkable pack of wolves
allowed two patient men to gain
their trust and meet the family.*

By L. DAVID MECH

Photographs by JIM BRANDENBURG





Only the
mountain has
lived long
enough to listen
objectively to
the howl of
a wolf.

—ALDO LEOPOLD, 1949

The aphorism of wilderness philosopher Leopold speaks to politics and patience, both familiar to author Mech. In 1958 he began tracking wolves in Isle Royale National Park in Lake Superior and now works for the U. S. Fish and Wildlife Service in Minnesota, where he has fought many battles over wolf conservation. Like all wolf biologists working in the woods, he has circled in aircraft for thousands of frustrating hours, aching to observe wolves in the treeless Arctic.

Last year in northern Canada, Mech got his wish. So did Minnesota native Brandenburg, for 18 years a compatriot and veteran wolf photographer. Together they located a pack of arctic wolves led by this proud creature (left), termed the alpha male. For weeks the men kept a rock-bottom profile—sometimes prone and whining—to reassure the wolves. Eventually they got their reward: the den.

WHEN WOLVES—usually shy and unapproachable—steal your sleeping bag, urinate on rock cairns meant to scare them off, and strew your belongings across the tundra, what do you do?

In my case, I count my blessings.

As a field biologist, I have just experienced the highlight of a lifetime. Hundreds of miles north of Hudson Bay, in the heart of Ellesmere Island, more than a thousand miles from the nearest city, I have trekked a snow-bound valley surrounded by wolves—and gained with them an unparalleled intimacy.

I'll never forget the scene—seven arctic wolves, each one big, white, and excited, milling around not 50 feet from me. This delighted me, for in a quarter of a century studying wolves in the wild, I had only rarely seen them at close quarters from the ground.

The clan of canine company welcomed me just after I had discovered their den and six pups, the hideaway sheltered beneath a sun-warmed ledge of weathered rock. After all the years of hiking, planning, hoping, and dreaming, I had finally scored the big one.

Nature made this den, a cave undercutting a bluff of beautiful orange-beige sandstone. There aren't many rock caves in the region, and I suspect this den has been used for more than a hundred years.

Watching wolves around a den has been many a biologist's fondest objective. Ever since Adolph Murie, in his classic *Wolves of Mount McKinley*, described observing wolf pups at a den in the early 1940s, researchers have attempted to build on his work.

Along came Farley Mowat's novel *Never Cry Wolf* and the motion picture made from it, a fanciful account of a hapless government biologist living near a northern wolf den. For the general public the theme romanticized the idea of spying on the intimacies of the wolf's homelife.

The possibility had long gnawed at me; there were myriad questions that couldn't be answered by circling around in an aircraft, the wolf biologist's usual approach to these elusive animals. Now that I had found these wolves at their den, could I become accepted enough to work right among them?

As long as I had studied wolves, I had known that in the high Arctic—north of 75° north latitude—the arctic wolf, *Canis lupus arctos*, showed relatively little fear of people, presumably because the creatures haven't been much harassed by hunting. In the barren polar regions, game is so scarce and conditions so severe—total darkness cloaks land and sea for almost four months of the year—that even the Inuit seldom hunt the inland regions. The only human outposts here are military and research bases, weather stations, and oil and mineral exploration camps. Wolves hanging around such outposts grow pretty habituated to mankind, but usually on such a casual level that their basic behavior remains natural.

I thought of all this when I flew to the Arctic in the spring of 1986 on a writing assignment, one not specifically concerned with wolves. Photographer Jim Brandenburg and I were traveling through bleak Ellesmere Island when we came upon this special pack of arctic wolves.

The landscape is quite smooth—pebble-strewn slopes tilting down to hollows and flats; hummocks and ditches that characterize permafrost terrain. Vegetation in the region is sparse. Heather, sedges, and grasses partially clothe the barren, rolling hills and shallow valleys. In April snow covers all.



The wolf's northern stronghold

The gray wolf's cry once echoed from coast to coast and far south into Mexico. Amid persecution and loss of habitat, the wolf has made its stand in the north woods and Arctic tundra. Canada has some 50,000, with 4,000 to 6,000 in Alaska, 1,200 in Minnesota, and a few elsewhere in the U. S.

Perhaps 17 subspecies of the gray wolf remain in North America, including the white arctic wolf, *Canis lupus arctos*. It ranges north of latitude 75°, a silent vastness it still has largely to itself.

Although Mech's pack knows the scent of man from visits to lonely installations such as weather stations, he feels that their basic behavior is unaffected. He hopes to prevent the pack's harassment by leaving its location undisclosed—somewhere on Nebraska-size Ellesmere Island.

Soon after we spotted the first wolves, we found that they liked to frequent a particular iceberg just offshore. Even at 3 a.m. the rays of the April sun, destined to shine continuously for the next four months, softened the bite of minus 30°F air.

ONE NIGHT as I rounded a jagged corner of the gigantic ice chunk, I spied the wolves heading away. I lay on my belly and began whining as loud as I could. With my heavily insulated wind suit, face mask, and sunglasses, I'm not sure if I really resembled a seal. But one of the inquisitive wolves approached within 150 feet, and that was thrill enough for me.

During this spring visit Jim and I tried different ways to approach the wolves, hoping they would get used to our presence. Every chance we got, we introduced ourselves to the pack, careful never to frighten them. When we detected a degree of acceptance, we tried to prolong the interaction, seeking always to reinforce the trust that seemed to be developing.

After several days and nights we noticed that the wolves were beginning to take us for granted. With continuous daylight and nowhere to hide in that naked landscape, the animals had to come to terms with us or keep running away. Just before we had to leave on other commitments, we considered ourselves fully accepted, in fact almost befriended, by the pack.

When I returned in July (alone, at first), it took a solid week of searching to locate the pack's den, the chamber where they raise their pups. During that time I seized every opportunity to renew my acquaintance with the pack. Fortunately they accepted me as though I had never left.

When at last I stood before the wolves at their den—their family sanctuary—I knew that I must avoid any hint of hostility. If my approach worked, I would be able to observe wolves and their pups close up in a



*E*ars, eyes, and noses at attention, three of the pack's six pups focus on a bird outside their den in a rock outcrop. Here about seven weeks old in July, the pups have begun to venture short distances with the pack's seven adults. For them, the pups are the center of the universe, communally fed, reared, and defended.

The men knew the pack had accepted them one day when the adults, although aware of human presence, left the pups unguarded. For weeks the men observed the den from a few hundred feet away, and sometimes much closer—impossible in wooded terrain.

way never achieved before. For now, I knew I must be patient and retreat. A tall, stark white, smooth-furred wolf that I later learned was the alpha male, or pack leader, rushed around excitedly with raised hackles, barking coarsely at me as if to reinforce my caution. Because my arrival had seemed to upset the pack, I hastily climbed back up the hill, but the wolves swarmed around me not more than 30 to 50 feet away. I was exuberant.

As a wolf biologist for the U. S. Fish and Wildlife Service, my regular job is studying wolves in Minnesota. I've radio-tagged hundreds of them and observed them from the air since 1968. However, I have never had the opportunity actually to live with a wild pack and get a subjective feel for its functioning, nor has anyone else that I know of.

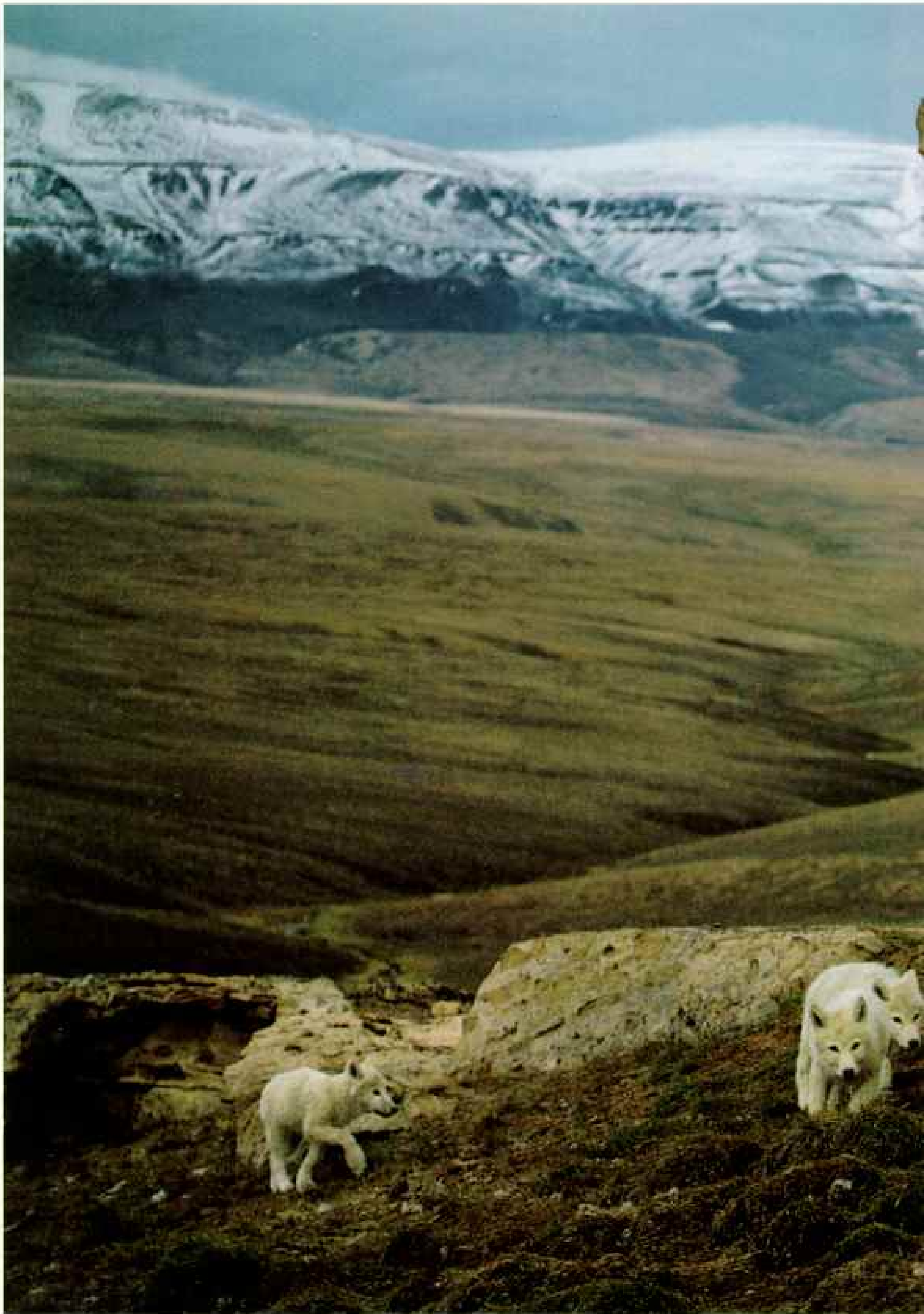
Next day I approached the den from the opposite direction. I crept toward the crest of a broad open hillside about 200 yards across from the rocky outcrop overhanging the den. Lying prone on a foam pad and pulling it with me, I inched along with mounting excitement. Finally I peeked over the top.

One, two, three, four, five, six little beige bundles, together with all seven sprawled-out adults, punctuated the green tundra hummocks just east of the den rocks. The pack had not abandoned the den!

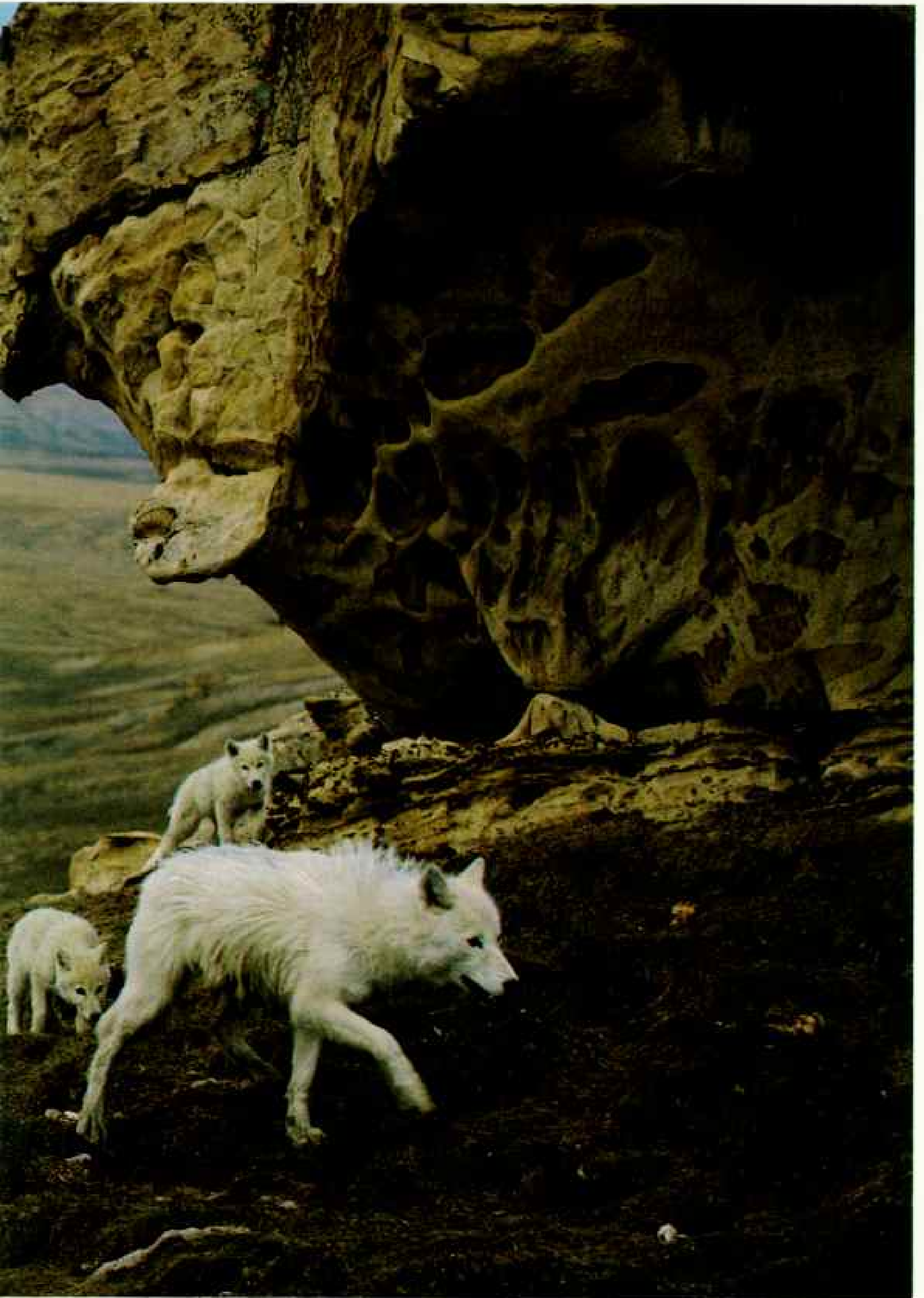
The pups appeared to weigh about 15 pounds each, and I judged them to be around five weeks old. After half an hour, six of the adults struck out up a valley to my right and were soon out of view.

Presently the mother wolf decided to take the pups for a walk—and headed right up toward me. I couldn't retreat without being seen, so just lay as still as possible. As the little caravan approached to within about 30 yards, the adult suddenly became very alert and excited. But I was not the cause. Something made me turn my head. The rest of the pack had come up silently behind me to within 50 feet. One came to within ten!

I could only lie still, while the female hurried her pups back down the



Inquisitive little fuzzballs gambol beside the den with a yearling male that the author named Scruffy, who at times served as a baby-sitter while the rest of the pack hunted. Permafrost makes dens



extremely difficult to dig, and old bones of musk-oxen, caribou, and arctic hares surrounding this cave suggest that wolves have used it for at least a century.

hill. Suddenly a gust of wind whisked off my furry hat and it blew away. A wolf dashed over and trotted off with it, followed by his pack mates.

AFTER I HAD WATCHED with satisfaction the mother and another adult leading the pups back to the den, I located my hat where the wolf had dropped it, picked it up, and headed back to camp to await Jim Brandenburg's arrival.

He flew in by Twin Otter, the aerial workhorse of the high Arctic that can land almost anywhere there are stretches of gravel, or on smooth ice.

"Did you find the wolves?" Jim asked.

"You'll never believe it," I blurted. "Den . . . pups . . . ten feet away . . . chance of a lifetime!" I babbled away, trying to tell the whole story in one burst of words to the only other person around, someone who could fully appreciate what I had stumbled on. More than 15 years before, I had met Jim in Minnesota, camped near a deer carcass he had planted on a frozen lake hoping to lure wolves to his camera. Jim was as obsessed

with trying to photograph wolves as I was with studying them.

Jim wanted to visit the den at once. We found the pack in the midst of a move (it proved temporary) from the first den to another rock cave about an eighth of a mile away. The adults detected us, left the pups, and trotted over to within a hundred feet. They seemed not at all upset by our presence.

Jim and I withdrew.

When we returned three hours later, no wolves were in sight. Then Jim motioned ahead. There, only about 80 feet away, the same color as the rocks and powdery soil, was a furry pile of snoozing pups. No adults. We grinned at each other. Now we knew for certain that we had been accepted. The pack had grown so indifferent to us that they had left their pups outside the new den with not a single adult on guard.

My plan had worked. During the next several weeks Jim and I made a good start at answering many questions about the behavior of wolves in the high Arctic.

Now that we felt at ease with the wolves, we decided to move in with them. We relocated our tent within a quarter mile of the den. We could spend almost all our time with the pack in close encounters of a very satisfying kind. This posed logistical problems, however. Wolves are relentless raiders, so we had to cache all our food in a rock pile away from the tent. When we were in residence at camp, we had little trouble keeping these sociable wolves at bay by simulating their doglike barking. (Howling is the other major expression in the wolves' vocal repertoire.)

To ward off the wolves whenever we left camp, we built several tall rock cairns about 20 feet from the tent and flew colored plastic streamers from their tops.

"Might as well scare 'em with this, too," said Jim as he adorned the



Enduring signature, a wolf's tracks compressed into snow remain in relief after the constant polar wind erases softer drifts around them (left). As if awakening from the long, dark winter, a wolf stands suffused with sunlight in April (right), shortly after the sun begins to shine continuously at this Arctic latitude.

Although little is known of how these wolves survive the months of extreme testing, they probably profit from winterkill, scavenging carcasses such as musk-oxen. Breeding begins in late March, and after a two-month gestation pups are born in late May. Soon, with ravenous mouths to feed, the pack becomes a hunting machine operating at peak efficiency to provide a sustaining supply of meat.

dome of our tent with an old bleached wolf skull he had found nearby.

Despite these precautions, when we were away visiting the wolves at the den, their hunting parties, passing our camp, stopped off to chew the side of my backpack and strew our toilet tissue over the tundra. They urinated on our rock piles.

Once, from my lookout above the wolves' den, I happened to glance toward our campsite just as a delegation of four animals laid siege to our tent. One of them forced its nose through the drawstring-tightened port-hole. A few moments of tugging and yanking—and out popped my red sleeping bag. The pack was ecstatic. I let out a loud, sharp hoot and the wolves spun away.

By that time we were able at close quarters to identify each adult pack member. We also had sexed them by their urination postures. I believe

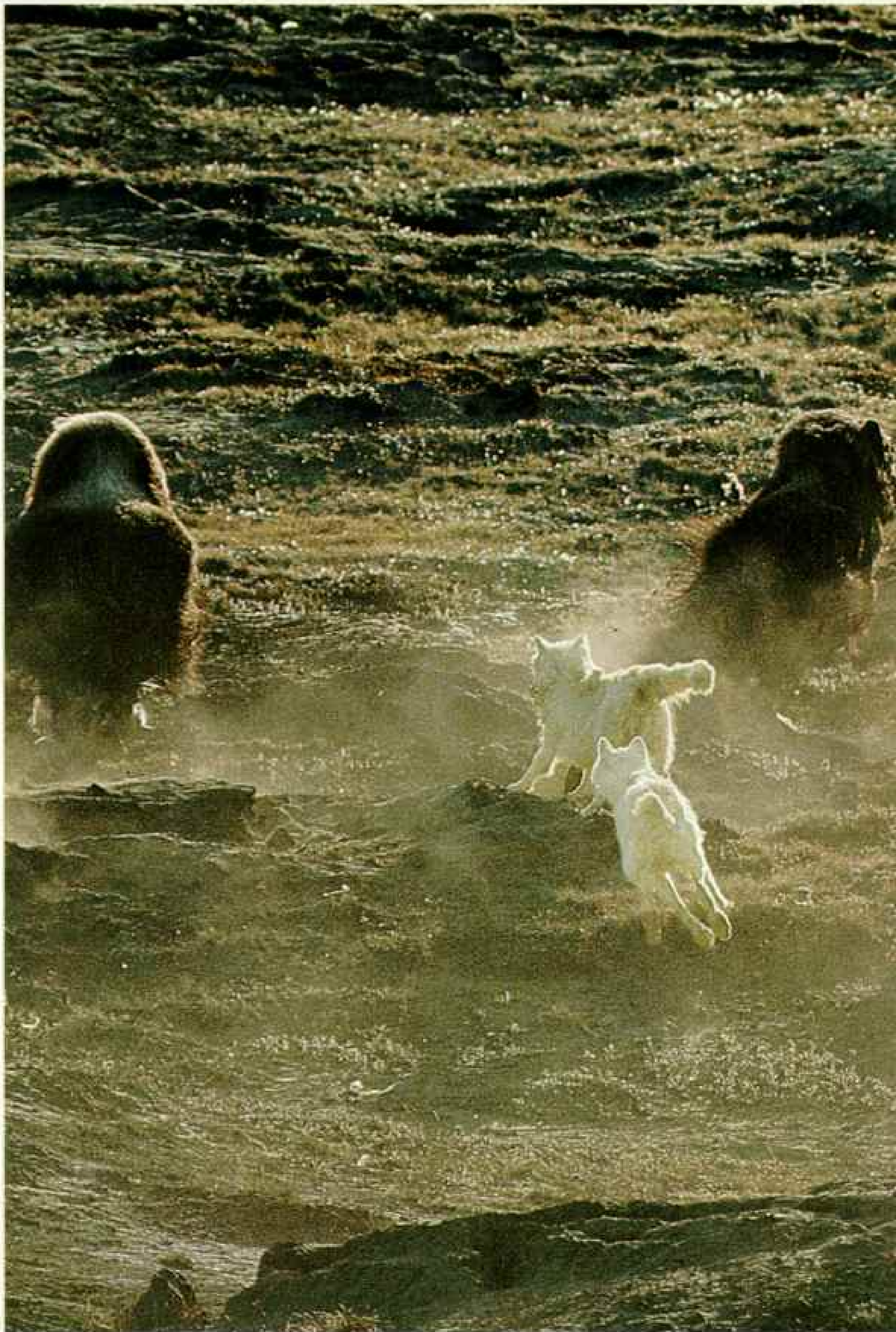


the one guilty of breaking and entering at our campsite was the yearling male we called Scruffy.

Readily recognizable was Mom, the pups' mother. She, like the other two females, was shorter legged than the males, with a bony pelvis, her unkempt fur grayish rather than pure white. The rear half of all three females' backs was darker than the front half. One of them, Mid-Back, was particularly dark in this area. The third female, Shaggy, generally had more fur shedding off than the other two.

The adult males had already shed for the summer. All bore dirty masks, perhaps from thrusting their muzzles into tunnels in the tundra in search of lemmings. The one with the darkest smudge we named the Lone Ranger. A male with a fist-size chunk of skin missing behind his left shoulder became Left Shoulder.

The third adult male was the alpha, or pack leader. He sometimes walked with a limp. This wolf's behavior—as I expected—was distinctive. He was the only one that on occasion would lift his leg when urinating. He was clearly in charge during important happenings and was highly protective of the pups. Probably the (Continued on page 578)







In an electrifying sequence, seven wolves target three musk-ox calves guarded by 11 adults—whose hooves could crack a wolf's skull. On a flat arena the wolves casually approached their quarry. The musk-oxen bunched in a semicircle, hindquarters pressed together, protecting the calves. A long standoff deteriorated as a single ox broke ranks, and the herd scattered into small groups that grew increasingly nervous while wolves darted among them. They skirmished until finally the whole herd panicked and fled in a cloud of dust, with the wolves in hot pursuit (preceding overleaf).

One wolf tests the group (above, far left), trying to separate a calf, right foreground, from an adult. Protecting their calves, a group of oxen try to reorganize (above left), but to no avail. Soon the alpha male wolf closes in (left), although another wolf puts on a burst of speed and grabs the calf first (above right). Within a few furious moments the pack had caught and killed all three calves, including one that stirs competition among the predators (right).



(Continued from page 571) father of these pups, the alpha male would have a strong genetic stake in defending them.

Generally males and females in a pack each form a dominance hierarchy, or social order, and it is the higher ranking animals that breed. Most members of a wolf pack are related, since a pack is formed when two adults mate and produce pups. Some of the offspring may stay with the pack for as long as four years, and possibly longer, sometimes bearing the young themselves. Normally one female each year has pups.

OUR PACK'S territory appeared to extend over a thousand square miles, with a radius of more than 18 miles. In the unfruitful high Arctic, it takes that much country to support enough vulnerable prey that the wolves can catch—musk-oxen and arctic hares primarily, but also Peary caribou, lemmings, seals, ptarmigans, and other ground-nesting birds. We counted a minimum of 183 musk-oxen in only part of our pack's territory.

The orbit of these wolves' wanderings includes a government outpost. The hungry, inquisitive animals scavenge at its dump, and thus inevitably have some contact with humans. This may well have played a part in our acceptance by the pack.

Feeding six rapidly growing pups puts heavy pressure on the providers. Each day the adults set out on the hunt between about 3:30 p.m. and 10 p.m. on clear days, or between 2 a.m. and 11 a.m. on overcast ones. Further research may explain this timetable. Perhaps the wolves' internal clocks are cued by the sun, guidance missing on cloudy days.

The basic pack routine was little different from that of wolves anywhere: sleep, bouts of play and social interaction lasting up to two hours, a daily hunt by most of the adults, and feeding the pups whenever possible.

With pups as young as these, we observed, feeding is mostly by regurgitation, the youngsters wildly begging to be fed. Most often it was Mom or Scruffy that fed the pups. Sometimes we saw adults bring bones, chunks of meat, or whole hares home to feed the pups. On the other hand, they occasionally seemed to "bring home the bacon" just in a mood of showoffishness.

Another aspect of the adults' relations with the pups intrigued me. Although the adults were highly possessive, protective, and playful with the pups, they were always "pinning" them, that is forcing them to lie still with their necks to the ground. Why? Probably to suppress, until it could safely be indulged, the instinctive assertiveness that each wolf seems born with.

Of course the pups were constantly pinning each other too. Play fighting allows each pup to test and hone its competitive skills, and this is extremely important. Although pack functioning seems a model of cooperation, especially during the tranquil summer period, the basic selfish, aggressive spirit of every living thing lurks constantly beneath. At no time was this more apparent than after the wolves made a kill.

From the moment of the happy realization that the wolves accepted us, Jim and I knew that if we could ever join them on a hunt it would crown our understanding of their nature.

"I know we're going to be able to watch these guys chase musk-oxen," Jim declared at the end of our spring trip.

When we returned in July and found the

(Continued on page 584)



Good hunters must also be lucky, like a pair scavenging a musk-ox carcass (above) they had discovered intact. Other staples include hares, lemmings, ptarmigans, and the diminutive Peary caribou.

Wolves work hard on the hunt and make up for it by sleeping about 12 hours a day. In a soft depression dozes Scruffy (right), named partly for his flaky personality.



*S*mall call of the wild rises as a pup practices its howl, an important part of the pack's complex social system. Vital for the pups is learning to get food. Adults sometimes deliver meat whole or in chunks but usually regurgitate partly digested meals to the young. Food may come directly from a kill or from a hole where it has been cached.

When an adult returns to the pups, they race to it while whining and wagging their hindquarters. With ears back, they crouch and lick



rapidly at the mouth of the adult. It eventually regurgitates, and the pups compete frantically. A female called Mid-Back (below, at left) is thus mobbed. Yet at her mouth is another adult—perhaps carryover behavior from its youth that now signifies submission, although further study is needed.

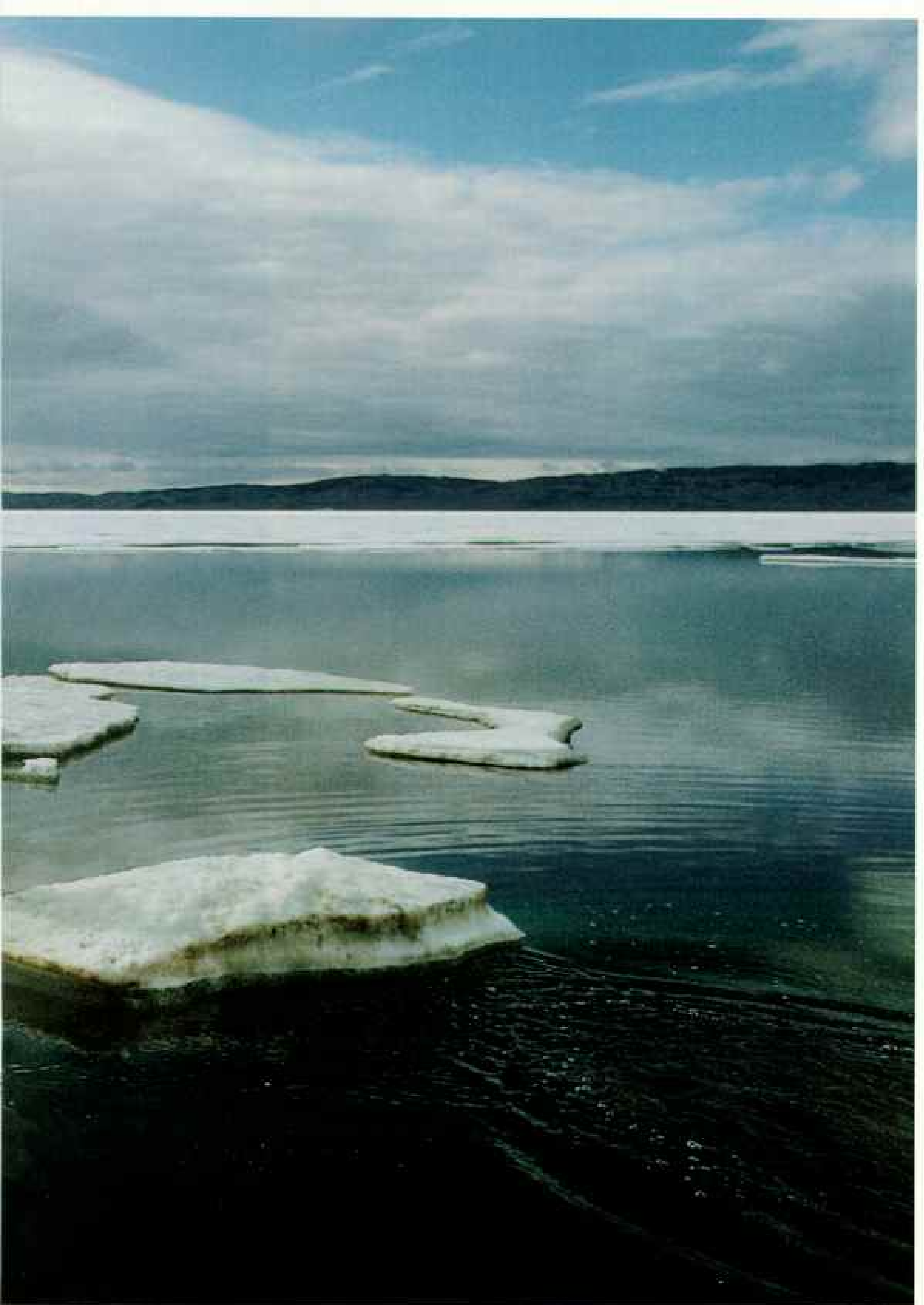
Soft and serene is the image of the mother of the pups, named Mom (right). The author suspects that another wolf recently succeeded her as the pack's alpha female.







In a shimmering fjord the alpha male bounds across ice floes, patrolling the threshold of his territory about three miles from the den. Pack members sometimes wash off in the shallows



after a kill and regularly scan the nearby beach for dead fish and marine mammals. Live prey also surface here earlier, during spring breakup, when seals haul out onto the ice.

(Continued from page 578) wolves still friendly, our hopes rose. From any high spot on the barren grounds we could scan hundreds of square miles. Musk-oxen are very dark and arctic hares white. Both usually travel in easily visible groups. Thus we were able to watch our wolves hunt both hares and musk-oxen.

The most memorable hare hunt I saw was also atypical. At 4:09 one morning late in July, Mom suddenly looked up from her long snooze and stared momentarily at a white form atop a hill about a quarter mile away. She arose and trotted straight toward an adult hare. But surely, I thought, the wolf can't hope to catch that hare. It had every advantage of position and time warning. Still, the hare stuck tight as Mom labored over the hummocks and up the hill. Finally, with the wolf about 50 yards away, the hare bolted.

I told you so, I thought. Mom made a token dash, slowed, and then nosed around where the hare had been. Suddenly the ground burst in front of her, and several young, gravel-colored hares sprang away. The wolf instantly chose the one streaking straight downhill and nabbed it at the bottom.

Had the wolf seen those camouflaged young hares from a quarter mile away? Or did she know, from the behavior of the adult hare, that they were there?

WITH MUSK-OXEN, of course, the wolf's problem is not to catch them but to kill one without incurring injury itself. Male musk-oxen may weigh 600 pounds, and females 400, and they associate in formidable herds of as many as 30. Calves in summer weigh about a hundred pounds. When defending calves, adults squeeze together in a tight line or semicircle in front of them, or in a circle with the calves inside. With blows from their forward-curved horns or heavy hooves they are known to kill wolves.

Our problem was to get close to both musk-oxen and wolves during a confrontation. As the season advanced, our hopes of witnessing a kill began to fade.

Until a day in mid-July.

On lookout at the den in midmorning, we noticed a herd of 11 adult and three calf musk-oxen a mile and a half away. Approaching slowly from the east, the herd picked its way across the uneven terrain, scrounging its summer diet of willows, grasses, and sedges. At times their burly forms would disappear in a hollow, only to reappear as dark blotches here and there.

By 5 p.m. the musk-oxen were only a mile away, so we divided our attention between them and the wolves, which were lazing away the day on the back side of our observation ridge.

"You know, Jim," I said, "if the wolves spot that herd and head over there, the whole thing might be finished before we're packed up. What say we take a chance and get into position near the herd just in case?"

"Just what I was thinking," replied Jim. "The most we have to lose is a night's observation here."

We immediately headed for the herd. The musk-oxen were feeding and resting on a half-mile-wide flat between two creeks. The terrain, while generally level, consisted of a number of polygonal hummocks 20 to 50 feet wide separated by troughs in the turf several feet across and a yard or so deep.



The Arctic turns its other cheek and spreads a bed of cotton grass for a drowsy wolf. After the two-month-old pups left the den, they rendezvoused here, about two miles away, while the adults hunted.

In summer, dominance rituals are almost playful, as when Mid-Back (right) asserts herself over another female. But in winter, with hormones coursing, such displays become intense.





Sheepish wolf. Scruffy ventures too close to a long-tailed jaeger's nest and gets dive-bombed. The precocious yearling was an assiduous baby-sitter. Once the author watched him awaken while



the pack slept, retrieve an old fox carcass—a favorite toy—and deliver it to the pups. As they began killing it for the hundredth time, Scriffy wandered off and went back to sleep.

We caught sight of wolves moving about on the den ridge a mile away. Soon after we positioned ourselves near the herd, some of the wolves seemed to head in our direction. Then they vanished.

About 7:30 p.m. all seven adult wolves appeared, threading their way diagonally down a hillside to our right. They had spotted the musk-oxen! The wolves moved very deliberately at their usual five-mile-an-hour pace. They seemed interested but not really excited. Then it came to me that this was nothing special for them.

The wolves approached the herd quite casually. The musk-oxen drew together and faced them. Each adult ox continually shifted its rear end around slightly, pressing against its neighbor. The wolves stood and watched from ten feet away, with Scruffy hanging back. Soon most of the wolves lay down, but now and then individuals got up and paced about.



The musk-oxen, however, took the situation seriously. They stood facing their adversaries, with heads lowered and calves pressed to their flanks. Wolves prowling around behind the herd seemed to unnerve the musk-oxen. The oxen groups spread apart, and the wolves walked between them. There was skirmishing, when an individual musk-ox would charge a wolf.

This maneuvering seemed to excite the wolves, and they became more active. The unevenness of the terrain may also have played a role: When a musk-ox fled, it was forced to maintain its footing without stumbling while carrying its great weight on spindly legs in and out of the tundra troughs.

THE PACE INCREASED, and soon the wolves started darting in and out among the frantic musk-oxen. The shaggy oxen would turn and charge with lowered heads. Through our lenses the scene grew more chaotic: fourteen musk-oxen, seven wolves, all in a swirling, confused, dusty mass.

Although I have watched wolf packs chasing moose, deer, and caribou, it was always from an airplane, where I was clearly a spectator. Here

Bared teeth mean dinner, not danger, for pups when an adult gives that response to their food-begging stimuli (left), regurgitating shortly thereafter. Mom and Scruffy spent the most time at the den and did most of the feeding. Scruffy nabs a mouthful of arctic hare (right); hares average eight pounds and are an important summer food source.

Scruffy once went hareless when Mid-Back strode defiantly into the den site with a hare in her mouth, flaunting it to the pack. She lay down at a favorite resting spot and proceeded, amid the limelight, to devour her catch. Scruffy lay beside her, groveled, pawed fetchingly at her, entreating. As the last stiff, furry hind foot began to disappear down her throat, he confronted her and nosed the foot in one last desperate beg. The foot disappeared.

we were in the thick of things, participants in a primeval scene. And the wolves streaking among those massive musk-oxen were not just wolves: They were Scruffy, Mom, Mid-Back, the alpha male, Left Shoulder, Shaggy, and the Lone Ranger. I was certain we would see one of them killed or maimed. The herd was reluctant to run far, so the attack turned into a localized harassment, back and forth across the flats, up and down the troughs. It's hard to say how long the skirmishing went on. We completely lost track of time. Eventually, the herd panicked.

"We're going to see a kill!" Jim shouted prophetically.

Thirty seconds later the alpha male and Mom closed in on a calf. Mom grabbed the animal by the right side of its head. The alpha male latched onto its nose. The rest of the pack quickly gravitated to the successful pair and their quarry, while the calf's mother joined the stampeding

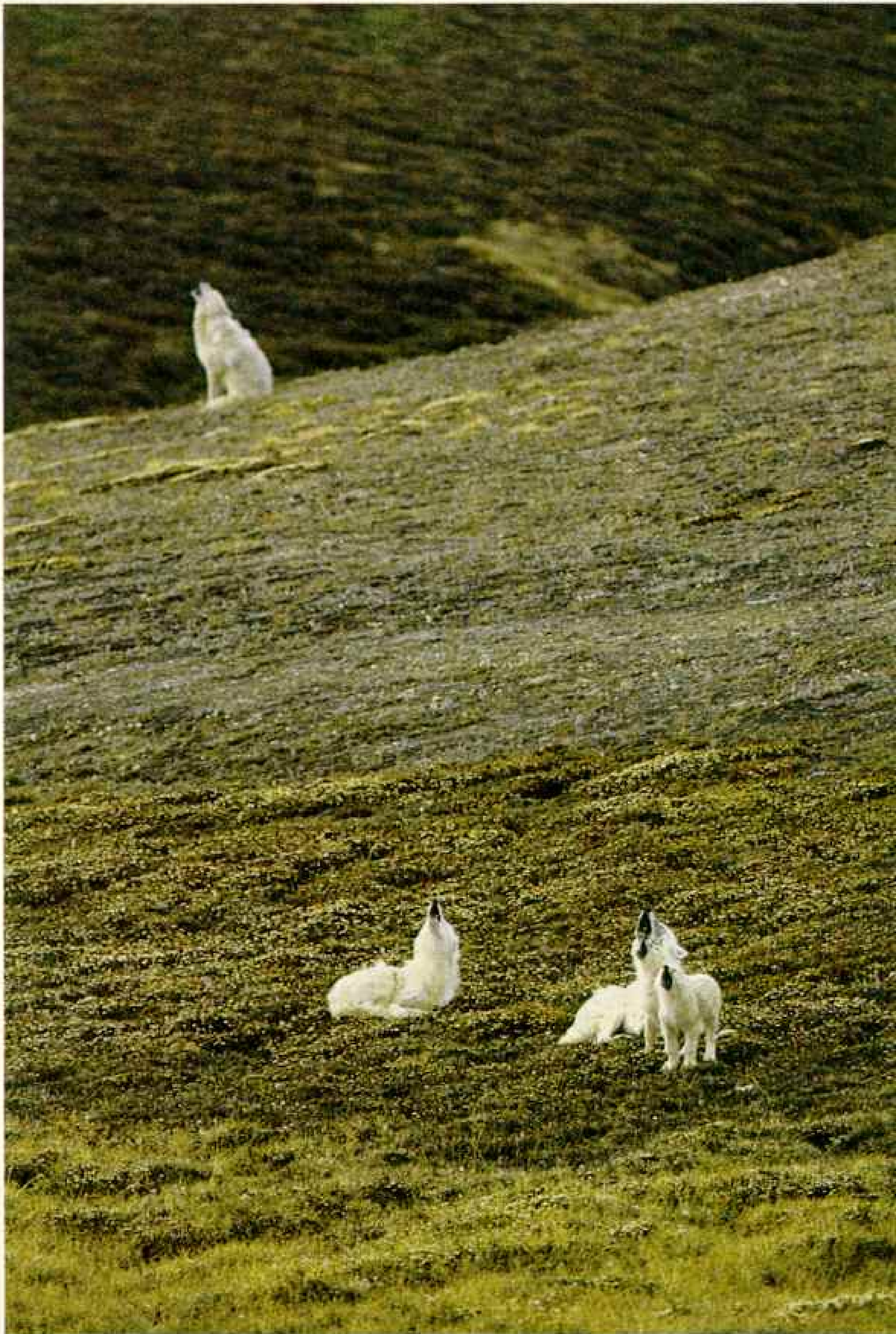


herd. The struggling calf dragged the six wolves locked on its head and neck down a slope.

Then, suddenly, Left Shoulder, who had the hindmost grip on the calf's right side, let up and rushed off after the herd fleeing toward the creek bottom. Mid-Back, who had the last hold on the calf's other side, left to join him. They hit the second calf crossing the creek.

The herd turned right and rushed down the creek bed a hundred yards to a river. More wolves left the first calf, while Mom and the alpha male, the original claimants, held their grip. The calf was no longer on its feet, and soon the male left. In the distance the remaining 12 musk-oxen, including the third calf, were fleeing up a high bank toward a plateau. The calf and a couple of adults fell to the rear.

Then—I couldn't believe it—far away on the hillside ran another wolf, either Shaggy or Mid-Back. She was after the third calf! The calf was running close to the flank of an adult, the other adult 15 feet behind. The wolf caught up at the top of the hill and grabbed the calf from the right. The alpha male arrived and joined the female wolf. The calf kept struggling and dragged both wolves back down the hill to the river. More members of the pack joined the fray, and the calf fell.





*I*n a wilderness concerto, the wolves awaken in the wee hours of morning and one by one lift their voices to a never setting July sun.

Mom, upper left, arose first and strolled to each of the adults, giving the males a perfunctory prod with her nose but fully awakening another female, Mid-Back. Mom moved about a hundred feet away, looked back at the lethargic adults, sat, and threw back her head. She began a howl, faintly at first, but the keen ears of the pups, lower right, soon picked it up.

And then no one could sleep through the amateur exuberance of the pack's peanut gallery, as six strained, intertwined sopranos chorused an urgent message to Mom: "We're hungry!" Afterward, the other adults joined in, and the pups rushed them excitedly. The adults stiffly arose, stretched, socialized briefly, and then followed Mom as she pranced northeast over the heathery hillside to begin the day's hunt.

But the job was not done. Frenzy fell away from the wolves, and they became intent and businesslike. No greetings. No socializing. They reminded me of firemen springing into action to put out a fire. It seemed the wolves' goal was to remove as much from the kills as they could as quickly as possible. Each wolf treated the others as competitors. Each would feed for 20 minutes to almost an hour, then sneak off furtively and regurgitate into a cache dug with paws and covered over by sweeping pushes with the nose. Several waded into the river to drink. Mom and Scruffy took loads of meat up to the den right away, and others did later. The alpha male stayed near the kills for hours.

Within two days there wasn't a shred of bone or hair left at any of the kills. The pack had devoured or cached some 300 pounds of prey, and much of it was already transferred to the growing wolf pups. For days the



pack delivered food to the pups from the caches, and the pups grew and changed noticeably.

The musk-oxen herd was gone, having headed miles away to the vicinity of other groups, many of which still possessed calves. Back at the wolf den the adults rested a great deal and socialized more than we had ever seen before. A struggle had been won, and now it was time for celebration.

FOR US it was time for grateful philosophizing. With good luck, the availability of this pack will continue to offer a bonanza of knowledge. In years to come, my students and I will continue to study this free-roaming wolf family.

Wolves still inhabit Alaska, most of Canada, northern parts of Minnesota, Wisconsin, and Michigan, and a few are recolonizing northwestern Montana and perhaps Idaho. However, of all this area, and probably in all of the wolf's Eurasian range, this pack may be the only one amenable to extended, close-up study.

Over the years we had tried, in every way we could devise, to observe and photograph this fascinating carnivore in the wild, but we had captured mere glimpses compared with the intimate association we had just enjoyed. Here in this bleak and beautiful northern expanse, we had gained the ultimate in intense, rewarding experience: sharing the lives of high Arctic wolves. □

After-dinner toy, the feather of a gull (left) is captured by a youngster near the den dining area. Such play has a serious side, familiarizing the pups with the kinds of prey they will stalk on their own. Ground nesters make easy targets for young hunters, although birds account for a tiny portion of the adult diet.

A bouquet of arctic poppies seems to tempt the alpha male (right), stuffing something more interesting in the grass.

Mech and Brandenburg will return to see what more this pack can teach them. Mech hopes to continue building upon the work of Adolph Murie, whose wolf studies during the 1940s in Mount McKinley National Park remain a benchmark. Murie, who also spied on wolf dens, wrote, "It was an inexhaustible thrill to watch the wolves simply because they typify the wilderness so completely."





The land of sweeping steppes and hard-riding Cossacks now burgeons with vast grainfields and industrial cities, a prime component in the Soviet Union's economic machine.

UKRAINE

By MIKE EDWARDS

Photographs by STEVE RAYMER

BOTH NATIONAL GEOGRAPHIC STAFF

*Why do you boast,
you sons of a destitute Ukraine?
That you walk well in a yoke,
even better than your fathers did?*

—TARAS SHEVCHENKO,
UKRAINIAN POET, 1845

A BROODING BRONZE VISAGE peers down at me in a park in Kiev. Yesterday a wedding couple paid tribute at this statue of Taras Shevchenko, leaving a bouquet of chrysanthemums. The visage seems the more somber for the blooms now half-frozen at the feet.

I see your deep dark frown, Taras, you who wrote with volcanic anger of Russian tsars and their Ukrainian lackeys, you who bore the torch of Ukrainian nationalism a century ago. But I cannot see your thoughts. So, let me try to guess.

Born a serf, you cried out against the injustices endured by your countrymen. So I think you must applaud a system that proclaims full employment and social equality. And, yes, I think you would thunder at the shortcomings—as you would thunder at those in my country.

Surely it pleases you that the Ukrainian

language endures, that poets employ it with more freedom than you did—although the breath of Russian is hot on its neck.

And you must rejoice that Ukrainians are still so full of life—see them dance at weddings!—and that even Russians sing Ukrainian songs. Maybe you even remember the one I heard, the one that has a Cossack rider saying, with double entendre:

Greetings to you, girl.

Come and water my horse.

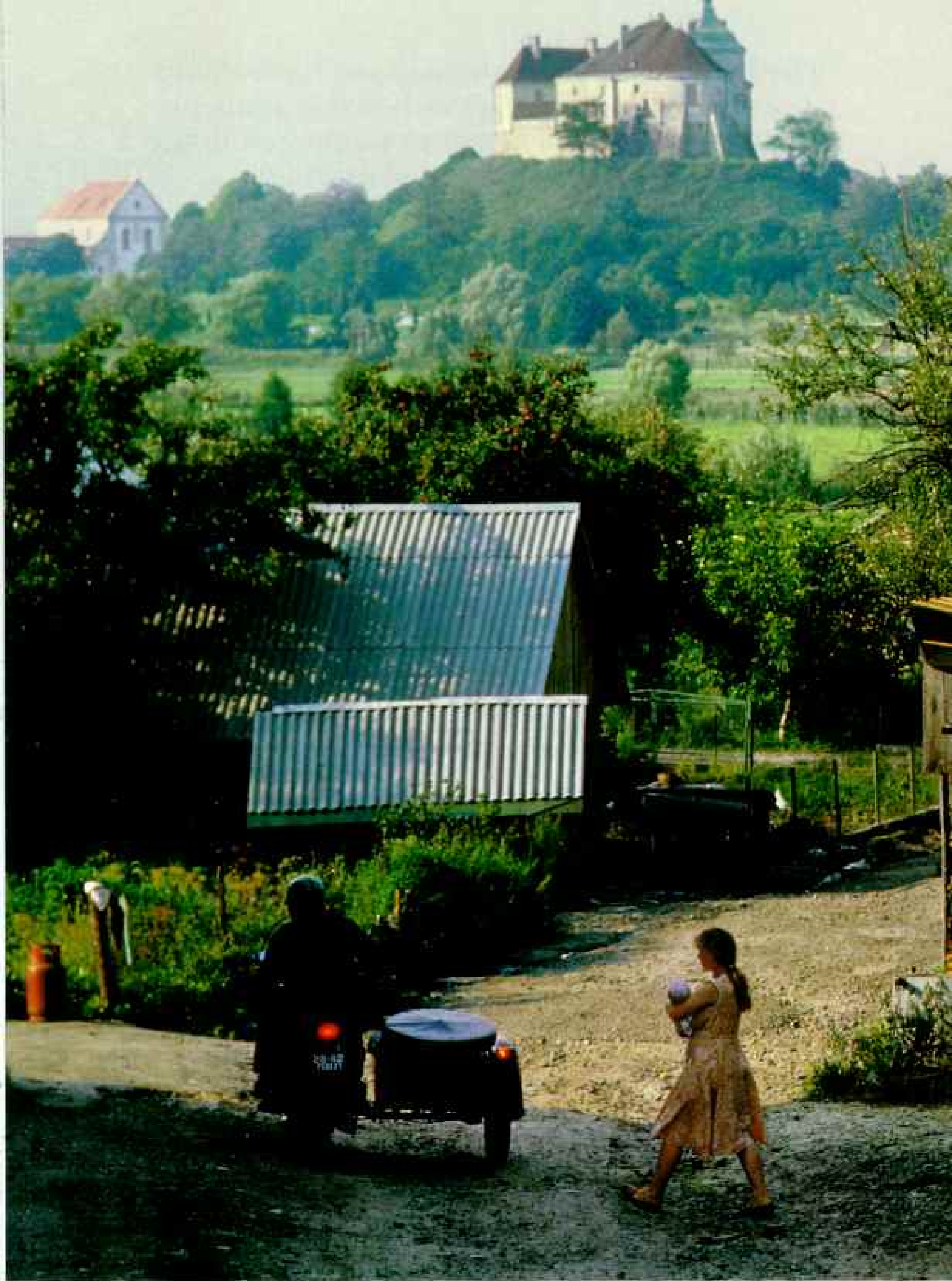
A hard question, Taras: Do you weep because your Ukraine did not achieve independence? This is the question that compels people to tear you in half. For your cries against inhumanity, the Soviet Union lauds you as a "revolutionary democrat." Expatriate Ukrainians, those who fled in the Stalin years and later, still regard you as freedom's voice. Are you both, Taras? Perhaps.

I gazed at Taras Shevchenko's statue on a November Sunday. All around the city citizens raked leaves, which trucks bore away for burial. For seven months breezes had tainted the trees with radiation from Chernobyl, 80 miles north. (See the article beginning on page 632.)

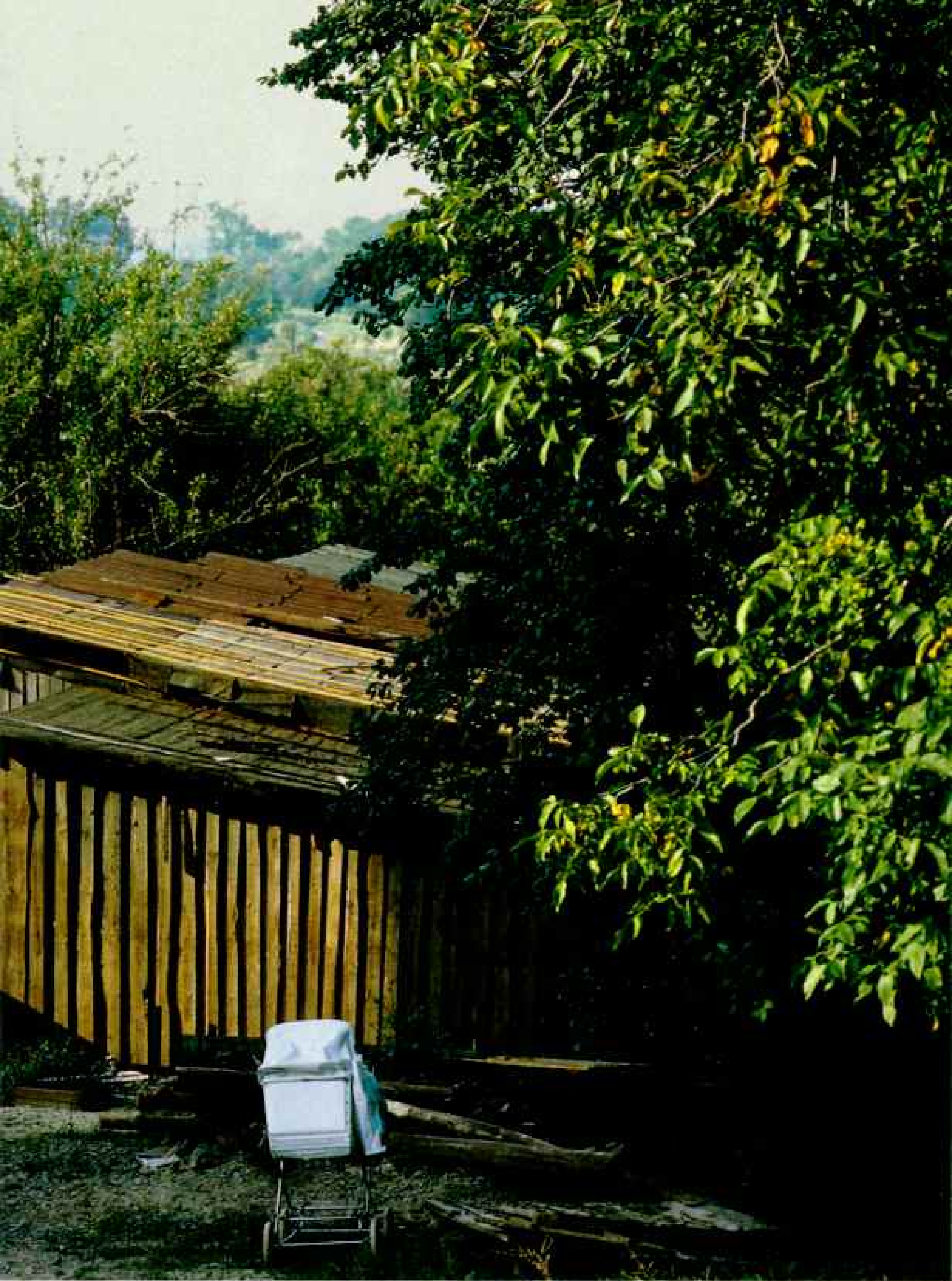
But some citizens—about a thousand—were in the

(Continued on page 602)

Stepping out for their first day of classes, children destined for School 119 in Odessa carry flowers to their teachers. The sashes of two youngsters announce in Russian their status as first graders. Though some schools hold classes in Ukrainian, others, including School 119, teach mainly in Russian, reflecting continuing Russification of the society.



Guardian of a time gone by, Olesko Castle rises above farmland east of Lvov.



Begun in the 14th century when Poland ruled western Ukraine, it is now a museum.



Dock space is precious at the busy port of Odessa on the Black Sea—the U.S.S.R.'s southern access to world shipping lanes. Passenger ferries and hydrofoils carrying



sightseers berth near oceangoing freighters that might be off-loading sugar from Cuba in exchange for vegetables and powdered milk.

Pounding heels reverberate as dancers of the Veryovka Ukrainian Folk Choir rehearse in Kiev.

Formed in 1943 in the city of Kharkov, shortly after its liberation from Nazi Germany, the choir today is composed of more than 100 singers, dancers, and instrumentalists. Garbed in the traditional costumes of Ukraine, they have toured countries in Western Europe and South America, as well as Canada and China.

Ukrainians preserve a wealth of folk music and art, including exquisitely embroidered clothing and tapestries. The art of Easter egg painting is known worldwide.







(Continued from page 595) Cathedral of St. Vladimir, Russian Orthodox, witnessing what surely is among the gaudier services in all Christendom. The priests were robed in golden brocade and crowned with jeweled miters; incense and the swelling voices of two choirs filled the air. Some parishioners lighted candles as they sent up their prayers; they kissed icons, kissed the coffins of two revered metropolitans, kissed the golden cross in a priest's hand.

Old people, especially the old women,

bent and shabby, formed the greatest part of this congregation. But I also saw men and women of middle years, better dressed, a few children—even a couple of soldiers. Nonbelievers allege that many come only for the spectacle. And cynics contend that this dazzling service is allowed just so the Soviet Union can present a facade of tolerance.

But I saw people praying.

Ask a priest, as I asked several, to explain the relationship between church and state, and he responds diplomatically: "Normal."



(One, more forthright, said: "Normal for a socialist country. And much better than in Albania.") A law book of restrictions curbs the church; it is forbidden to proselytize and to instruct minors. To believe openly is to exclude oneself from the Communist Party and its potential benefits, such as job advancement. Many churches have been razed or converted to museums and concert halls; in Kiev, third largest of Soviet cities, just 22 houses of worship exist for the 2.4 million citizens. And 27 museums.

Most Ukrainian of cities, Lvov has held to its heritage despite domination for 650 years by Poles, Austrians, Germans, and others—and, since World War II, control by Moscow. The architecture of this cultural center near the Polish border echoes its European ties, but many of the shoppers here in Market Square still speak Ukrainian, a language that is heard less frequently in other urban areas.

Ukraine

Known as the Breadbasket of the Soviet Union, Ukraine—slightly larger than France—makes up less than 3 percent of the U.S.S.R. but is home to nearly a fifth of its population.

Except for the Carpathian Mountains on the western border and the Crimean Mountains, the Ukrainian Soviet Socialist Republic consists largely of flat, rich land called the steppe. Huge coal and iron deposits have led to heavy industrial development, especially in the Donbass (Donets Basin) and Krivoy Rog regions. The late 1970s saw intensive development of nuclear power. Five plants, including Chernobyl, now augment more traditional energy sources, and more are planned.

With such wealth, Ukrainian land has long been a target for conquest (maps below). Ukraine enjoyed a brief period of independence following World War I, before the Soviets took control of most of the land in 1920. Joseph Stalin persecuted Ukrainian patriots and is accused of engineering a famine to enforce collectivization and eliminate nationalism. In 1932-33 at least five million perished in Ukraine.

World War II increased the flow of emigration that began in the 19th century. Today some 2.5 million persons of Ukrainian heritage live outside the Soviet Union, 1.5 million of them in the United States and Canada.



Land of Many Masters



ca. A.D. 1000 To consolidate his rule over Kievan Rus, a loose confederation of Slavic peoples in eastern Europe, Vladimir the Great in 988 adopted Christianity from Byzantium. He forcibly converted his subjects as a means of binding a culturally diverse population.



1569 After conquest by the Mongols in the 1200s, much of Ukraine in the 1300s was seized by Lithuania. With the formal union of Poland and Lithuania in 1569, Poland asserted increasing control before being pressed by the tsardom of Muscovy and the Ottoman Empire.



1649 Peasants fleeing Polish domination formed Cossack communities under military leaders called hetmans. After a revolt led by Bohdan Khmelnytsky, the Cossacks in 1649 formed their own state, continued fighting the Poles, and entered a pact with Muscovy in 1654.



1880 At its farthest extent, the Russian Empire included 85 percent of Ukraine, obtained in the 18th century following the partition of Poland and acquisitions from the Ottoman Empire. Partition also put western Ukraine under Austrian rule.



1919 After the Russian Revolution toppled the tsar in 1917 and Austria-Hungary fell, Ukrainians declared independence, which ended in 1920 when the Bolsheviks prevailed. The western territories were divided among Poland, Czechoslovakia, and Romania.



1939-1942 In 1939, after the German-Soviet Nonaggression Pact, the U.S.S.R. annexed most of western Ukraine from Poland. Following the German invasion of the Soviet Union in 1941, all of Ukraine came under Nazi occupation. Soviet rule was restored after World War II.



Working to learn, young women at a vocational school attached to a tractor factory in Kharkov operate a drill press (left) one day a week. In the same school math students operate rudimentary computers. Moscow seeks to place 500,000 new computers in Soviet high schools by 1990.

"We do not have a count," replied Father Ivan Chernenko when I asked the size of the St. Vladimir flock. No priest in any other church ever answered the question either. ("We do not have a five-year plan for church membership," one declared.)

No doubt priests fear that they will provoke official wrath if they seem to be bragging about growth. Nevertheless, Father Ivan told me that fifty to a hundred children are baptized every week at St. Vladimir's. "Some of them leave the church," he conceded, "and come back only when they are old. Some become atheists." And the Baptists, courting trouble by their aggressiveness, "probably catch some in their webs."

"Ukraine" means frontier; hence many Westerners say *the Ukraine*. (Some expatriate Ukrainians dislike the construction, since it implies their homeland is merely a region.) Like the 19th-century U. S. frontier, much of Ukraine was once (say, 450 years

ago) a vast, nearly peopleless realm. Open land, mostly steppe, reached a thousand miles from the Carpathian Mountains in the west to the Rivers Don and Volga.

In Shevchenko's century (and until 1918) it belonged to Russia and Austria-Hungary. In earlier times Poland and Lithuania possessed large parts; the Mongols, Tatars, and Ottoman Turks carved off slices.

In the 17th century Ukrainian Cossacks—very much frontiersmen, in the Daniel Boone mold—wrought a short-lived independent state. In the chaos that followed the 1917 Russian Revolution and the collapse of Austria-Hungary, freedom was again in the air. Some Ukrainians wanted to cling to Russia, but free governments sprang up in Kiev and the western city of Lvov (Lviv, as Ukrainians spell it). The westerners then united with the Kievans in 1919.

Though Lenin had promised to recognize an independent Ukraine, the Red Army invaded. The free forces also faced Polish troops and anti-Bolshevik White Russians. There were battles and massacres. But by 1920 most of Ukraine was Bolshevik ruled, destined to become a Soviet republic. A western area with eight million people went largely to Poland, with pieces to Czechoslovakia and Romania.

So, one must ask: What, despite shifting boundaries, holds together the 50 million people of this realm larger than France? Language, yes, and old songs about Cossacks and love, and a body of literature (especially poetry), and a few art forms. Ukrainians excel at embroidery, and created exquisitely decorated Easter eggs until the Communists frowned.

And one thing more: faith. The people of the Ukrainian Soviet Socialist Republic are among the most devout in the Soviet Union. How many believe? By one guess, half. The number who attend services is only a small



fraction. But behind them is a thousand years of tradition.

In the tenth century Vladimir the Great, Scandinavian descended, ruled a loose federation called Kievan Rus, peopled mostly by Slavs.* Historians disagree as to whether "Rus"—from which comes "Russia"—was a Slavic name or came with Vladimir's traders and soldiers. In any case, Vladimir learned about Christianity from Byzantium and in Kiev fastened the faith upon what is today the Soviet Union.† Tradition says he baptized a horde in the Dnieper River in 988, a millennium ago next year.

IT IS TIME to amend that geography-text description, Breadbasket of the Soviet Union. Hard by Ukrainian grainfields rise big cities, five with a million or more people. They pour 35 percent of Soviet steel. Ukrainian factories produce automobiles, aircraft, locomotives,

tractors, computers. Ukrainian mines yield nearly a third of Soviet coal, half of the iron ore, as well as manganese and titanium.

Western experts say many Soviet industries are inefficient and the bureaucracy glacial. These problems have been vigorously attacked by General Secretary Mikhail Gorbachev. Curiously, I did not often hear praise of his campaign. Perhaps, as some Soviet-watchers say, Gorbachev is not yet in full control. But I did see signs of progress: for example, factories retooling so that computers can run lathes and drills, and students working computer keyboards, although their model was primitive.

During our two months in Ukraine, photographer Steve Raymer and I were offered access to areas where Intourist rarely takes

*See "Viking Trail East," by Robert Paul Jordan, in the March 1985 NATIONAL GEOGRAPHIC.

†Merle Severy wrote of "The Byzantine Empire" in the December 1983 issue.

anyone; Steve was permitted to photograph the modern steel mill at Krivoy Rog (Kryvyi Rih in Ukrainian), for example (pages 624-5). But an interview usually was a committee exercise, with a guide, a couple of bureaucrats, maybe even a reporter from TASS, the news agency, listening in. Local officials monitored my conversations with clergy. In a realm with a long policing record, this does not make for spontaneity.

But when I met Ukrainians out of official earshot, they sometimes said things like this: "The greatest enemy of the Soviet Union is not the United States—it is bureaucratism." Sometimes they complained about shortages—coffee almost disappeared last fall—and about the bribes occasionally required to, say, get a daughter enrolled in college. I add, however, that a woman told me of

improvement in that sphere; she had not had to pay rubles to get clean sheets for her hospitalized husband. Some citizens were positive about life. "My wife and I are content," a professor said. "Our salaries are good. We can buy everything we desire."

FIRST THINGS FIRST. And, despite industrialization, the first thing in Ukraine, the most awesome and enrapturing thing, is the steppe, wide as forever, its horizon blotted by nothing bigger than a haystack. In eastern parts one looks in vain for a hill while standing in what seems a tranquil sea of *chernozem*, black earth. In the silvery afterglow of summer nights the only sound in a village is the happy honk of geese being driven to water by a *babushka* in scarf and printed dress.



This is the timeless Ukraine that émigrés see in their hearts.

"My wages are beautiful—I mean, I make good money during the harvest," said Vitaly Lurn, a lanky fellow with eyes as blue as the chicory flowering at roadside. On the Skovoroda Collective Farm, about an hour from Kharkov (Kharkiv), he was at the wheel of a truck. Beside him a combine was taking a four-row bite from a cornfield. "I make 360 rubles a month [about \$540 at the official exchange rate] driving this truck," he said. "When I drive the combine, it's 500 rubles." This includes extra pay according to the tonnage harvested. "The only thing about money is, no matter how much you make, you never have enough," Vitaly added. I said I knew the feeling.

For years Ukrainians fled farm drudgery.



Two-thirds lived on farms in 1940; it's one-third now. Factories were glad to get these transplants; because of the terrible losses from famine in the 1930s, World War II, and the low birthrate, labor was in short supply. To stanch the farm outflow, policymakers improved wages and housing. Vitaly earns as much as a factory worker and lives in a three-bedroom home. Many city dwellers now look enviously at their rural cousins.

With 20,000 acres of land, 500 cattle, and 17,000 pigs, the Lenin Collective Farm near the city of Poltava in eastern Ukraine is a big producer: pork, milk, sugar beets, buckwheat, fruit. Chairman Ivan Ropavka runs it by radio when driving his Volga automobile. He told me: "Ten or fifteen years ago it took 1,200 people to work this farm. Today we have 734 working. One person used to milk eight or ten cows; now it's 35 or 40 with machines."

He introduced me to a red-cheeked grandmother. Alexandra cares for 650 pigs by pushing buttons. She pressed one to start food on a conveyer; the pigs made a Pavlovian rush to the troughs. "When they get used to you, they come and scratch against your legs," she said. "I feel sorry for them because I know what's going to happen to them."

Mechanization is still below Western standards, however. Some of the harvest is lost to primitive storage and transport facilities. One day a radio broadcast cited several farms for delinquencies ranging from failure to construct needed buildings to harvesting too late. No doubt the lesson was: Comrade Gorbachev will not tolerate laxity.

Fedir Morhun, an intense, hard-driving man—and a Gorbachev stalwart—acknowledges the problems. As we drove, he spied two combines in a cornfield. "It's going to take three days to finish that field," he said angrily. "What if it rains tomorrow? Why didn't the manager send out more combines?" I wouldn't want to be that manager,

Collecting cattle on a collective farm near Kharkov, a young cowboy rides his horse bareback. The Soviets are increasing their efforts to improve the Ukrainian cattle industry. In a move to improve dairy herds, Holstein semen is being imported from the U. S.

for Fedir Morhun, the party boss of Poltava Oblast (a supercounty), can dispatch the negligent to faraway places.

Poor leadership and poor use of fertilizers concern Mr. Morhun. A further problem: "In our oblast the specialists were mistreating the soil." Then he launched a lecture on the *plug-ploskoriz*, the flat-cutting plow. Its horizontal blades shear instead of biting deep. "Land plowed this way is not subject to wind erosion, and the moisture stays in the soil," he said. After seeing such plows in Canada, Mr. Morhun arranged to have Soviet models made. "But I took a lot of criticism. The agricultural scientists were wedded to the old plow."

IN SPITE OF PROBLEMS, including periodic droughts that compel grain purchases abroad, Ukraine makes a huge contribution to the Soviet dinner table. On the average it produces 26 percent of the wheat, 32 percent of the corn, 58 percent of the sugar beets, 22 percent of the cattle, 27 percent of the hogs. Not bad for a republic with only 2.7 percent of the land.

It is, therefore, hard to imagine starvation here. Yet there are innumerable accounts of it—of at least five million people perishing in 1932-33. I have heard some of these stories. In Chicago an elderly man remembered watching his grandmother's slow death. Having no valuables, his mother made a cross of wax and placed it upon the old woman's breast in the coffin. A famished neighbor snatched the cross and ate it.

Western historians blame party boss Joseph Stalin, who feared Ukrainian separatist tendencies. Having forced the peasants into collective farms despite their stubborn resistance, he imposed impossible production quotas. Police and party brigades bore off everything edible. While the famine raged, the Soviet Union was selling grain abroad. More than half a million tons were exported in 1932, and in 1933 shipments even increased by a third. Émigré Ukrainians call this the "unknown holocaust"; the republic's borders were sealed, and few accounts of suffering reached the outside.

Stalin's hand lay heavily upon Ukraine in other ways. He destroyed the intelligentsia in the 1930s—Shevchenko would not have survived—and nearly destroyed religion.

Fedir Morhun would not let me leave his oblast without making a pilgrimage to the hometown of Nikolai Gogol. Though Ukraine born and using Ukrainian themes, he made his mark writing in Russian—and is even called the father of Russian realism. Critics regard the novel *Dead Souls*, a biting look at feudalism published in 1842, as his greatest work.

Gogol's home, now a museum, is a low, rather modest wooden building. Beside it is a pond, and beside that, a rock. Tradition holds that Gogol wrote while seated upon



Private enterprise fills the Bessarabskaya market in Kiev, capital of Ukraine. Recent reforms make it easier to grow and sell produce and flowers from small private plots.

Improved agricultural practices are a major interest of Fedir Morhun (right), Communist Party secretary for Poltava Oblast and a staunch supporter of Mikhail Gorbachev.





it—probably gazing out, as I did, upon still water, geese, and willows.

For Mr. Morhun, Gogol's stories provide special pleasure because many are peopled with Cossacks. "I'm proud to be one of these people," he said. "They were independent, never subject to landlords."

Many were runaways from serfdom. The empty steppe of Ukraine, particularly the area *za porohamy*, beyond the rapids on the lower Dnieper, became their stronghold. The Zaporozhians, as they are known, were a fractious lot, hunters, farmers, and freebooters, governed by a *hetman*—chief-tain—of their choosing.

Polish landlords expanded into Cossack space in the 17th century, and antagonism grew. It was fed by religious fervor. Cossacks were fierce adherents to Byzantine Orthodoxy, the faith of Kievan Rus, while most landlords and officials embraced Roman Catholicism. An uprising began in 1648. Hetman Bohdan Khmelnytsky scored several victories against the Polish Army.

In 1649 a Cossack state, called the Army of Zaporozhia, came to be. But in 1654 Khmelnytsky made a fateful turn, one his successors regretted. Needing help, he made a pact with Tsar Aleksei of Russia (then Muscovy). War between Russia and Poland now devastated Ukrainian lands—while Russia subverted the hetmans.

Cossack independence received a further blow in the decisive battle of the Great Northern War, between Russia and Sweden. It took place in 1709 in Mr. Morhun's backyard, beside Poltava city. Sweden's king, Charles XII, was supplied with Cossack regiments by Hetman Ivan Mazepa, who hoped to win freedom. But Charles lost to Peter the Great, and the Cossack regions were swallowed by imperial Russia.

Winners get to write history, and the Soviet Union writes large in celebration of the "reunification" of Russia and Ukraine, these lands that share the heritage of Kievan Rus. Western historians still debate whether Bohdan Khmelnytsky's pact with Aleksei was a military alliance or submission. The poet Shevchenko would vent his wrath thus:

... *Bohdan!*
You've ruined derelict Ukraine . . .
Aleksei's faithful friend,
You gave them all, . . .

I LIKE SOVIET TRAINS. You learn things on them. For example: "The Ukrainian language is like Italian. It has soft syllables that you can get your tongue around. Russian is harsher." With that, my informant, white-maned Vasha, let fly with his robust baritone. I'm sure he was heard three cars away.

Vasha had simply appeared at my compartment, drawing parcels from a bag. Soon I was sampling his kielbasa and potent home



A star of mercy and the Mother of God appeared to save the monastery at Pochayev and its magnificent Cathedral of the Assumption (facing page) from 17th-century Turkish invaders, a Ukrainian hymn relates. Hoping for more miracles, pilgrims flock to the monastery, some sleeping on the steps (above), others taken in by nearby churches.

brew. In truth he was much more attentive to my interpreter, Tania D'Avignon, an American who has a deep love for Ukraine, where she was born. In any case, Vasha now had an audience, captive.

Love songs in Ukrainian, a bit of *Faust*—Vasha had quite a repertoire. We rocked along in full-throated tremolo for a couple of hours, while I meditated on this language that stubbornly hangs on.

Ukrainian and Russian are akin, like Portuguese and Spanish. Yet writers perceive an important difference. Yuri, an escapist novelist, told me: "I use Russian for detective stories because it is rational. I write science fiction in Ukrainian because it is

poetic—it is better for describing a place and time from your imagination."

The tsars banned Ukrainian in the 19th century, and under the Poles in this century it fared only a little better. The Soviets let the language flourish in schools and publications in the 1920s, but Stalin's mistrust later led to a policy of "Russification." Ukrainian was often supplanted by Russian in universities (where it is widely used today), and Ukrainians found that many books in their language were printed in small numbers.

Nevertheless, Ukrainian remains the dominant tongue in rural areas. Vitaly, the truck driver I rode with, speaks Ukrainian at home. The local school teaches in it.



(Some classes are also taught in Russian.)

It's different in big cities. "This place is Russian," said a musician, Sergei, in Khar-kov. Sergei's group is homogenized. "The guitar player is Ukrainian, another is Jew-ish, the leader is Armenian, and I'm half Ukrainian, half Russian." The band plays an hour of Ukrainian songs, then switches to Russian rock, with occasional excursions into Stevie Wonder and Glenn Miller.

Ukrainian cities have long heard other tongues: Russian, Yiddish, Polish. Under the Soviets, factory workers summoned from near and far further diluted Ukrainian, though major cities have Ukrainian news-papers and TV shows. Russian dominates

Kissing the cross signals the end of services at St. Vladimir's Cathedral in Kiev, a Russian Orthodox church. Although most attending are elderly, many children are baptized each week.

Couples must wed at civil ceremonies, but customs are kept. In the Palace of Rituals in Lvov attendants bring decorated Ukrainian bread (top left).

Only one Jewish synagogue remains in Kiev, and it has no rabbi. Saturday services are sparsely attended, mostly by elderly men (bottom left), although officials place the Jewish population at 260,000.





commerce and science; at a biology conference, only two of 55 speakers used Ukrainian. Bureaucrats need not know it.

"Don't worry," said Misha, a teacher of Ukrainian. "If it hasn't died out by now, it never will." Others do worry.

ANOTHER TRAIN took me far southeast to Donetsk, city of 1.1 million, nestled in hills of mine waste and furnace slag. Twenty-two mines riddle the subsurface. My hotel was named Shakhtar—"coal miner." I hasten to add that Donetsk is a pleasant metropolis. It was nearly destroyed in hard fighting between the Red Army and German troops in 1943. The rebuilders left abundant open space and graced the streets with birches, maples, and roses.

Before letting me enter the Socialist Donbass, a mine named for a newspaper, chief engineer Ivan Nikitin made me empty my pockets of anything that could spark. Like many other mines in the Donbass, the Donets Basin, this one is gassy with methane.

In an elevator we dropped like rocks, 2,200 feet down. Soon Mr. Nikitin wriggled into drift H-10, barely four feet high. More and more, Donbass miners are attacking skimpy seams, some less than a yard thick; most of the easy coal has been extracted. We duck-walked for half a mile, me banging against the roof supports.

Ahead, presently, other helmet lamps shone, and we saw eyes gleaming in grimy faces. Viktor, Anatoly, and Roman were preparing to start up the big cutting wheel that slices off the anthracite. This seam of ancient swamp, once two miles wide, has been Viktor's workplace for 15 years.

Why keep such a nasty job? "The pay, for one thing," he said. With production bonuses he may earn more than 500 rubles a month, 200 more than a factory foreman.

People say pretty girls come to Donetsk hoping to marry a miner. "We already have plenty of our own," Anatoly said loyally.

Viktor added, "The money isn't the only thing. My father and grandfather were coal miners. We're a dynasty."

Ivan Nikitin noted: "Eighty percent of our workers are from mining families. It seems we Slavs like to do dangerous things." Maybe that's why many Ukrainians who came to the United States in the 19th century took jobs in Pennsylvania coalfields.

Some Donets coal goes west to Zaporozhye (Zaporizhia). A Cossack fortress once stood over the Dnieper rapids there. But I saw no rapids. A great concrete dam—first on the river—drowned them in the 1930s. With electricity, coal, and Krivoy Rog iron ore, Zaporozhye hummed with industry.

This city too was reduced to rubble in 1943 during the "Great Patriotic War." It is easy, after hearing a few such accounts, to understand why the war remains entrenched in the Soviet consciousness.

It was particularly hideous in Ukraine, which bore the brunt of the German drive to Stalingrad and the Red Army counter-offensive. The republic lost 7.5 million people, including almost four million civilians killed and 2.2 million taken to Germany as laborers. Cities, towns, and thousands of villages were devastated.

Among industry officials I met, Vladimir Sulyz stands out. Forty-five, tennis-trimmed, he was a man in cool control. The Soviets would rather show a visitor something up to date. But Vladimir let me visit the steel mill called Zaporozhstal, where he is party boss, even though most of the developed world would call its equipment junk.

This outdated equipment, however, has a good track record. A sprawling mess of foundries and infernos, Zaporozhstal pours five million tons of steel a year and provides numerous fringe benefits—dachas, a fine sports complex—for its 18,000 workers.

"But we've reached the limits of what we can do with this equipment!" Vladimir shouted that inside an enormous furnace shed, where tons of scrap were being shoved into flaming caldrons.

A staggering sum—800 million rubles—will be spent for new machinery. Many processes will be computer directed. Production will increase by a million tons while the labor force shrinks by a quarter. This last is

Fashions universal to young people of the 1980s garb a couple strolling a waterfront park in Odessa. The teeming international port brings in thousands of foreigners—and foreign goods—which influence Soviet culture.

МОЛОЧНИ ПРОДУКТИ



A cheery cow and a sign in Ukrainian advertise "milk products" at a state-operated dairy store in Lvov. "Bring your own bottle" is the rule, since there is a shortage of containers, including bags for the produce market.

Moderate dairy prices are set by Moscow, but with long lines and short supplies many customers turn to the private sector. At a collective farm in eastern Ukraine (below) farm workers are allowed to keep one or two cows and sell the milk. Some ride bicycles to the pastures to herd the animals to the milking shed.



important not just for economic reasons. Not everyone wants to be a grimy steelworker; Zaporozhstal is short 1,600 hands.

IN ODESSA they tell this story: On a train a passenger asks, "Are you from Odessa?" And the stranger answers, "Why? Has something been stolen from you?"

Socialism has tamed Odessa, but its citizens relish the whiff of crime and intrigue that lingers from the past, when it was a haven for thieves and runaway serfs.

It's in Ukraine, but it isn't Ukrainian. Too many other peoples—Greeks, Armenians, Bulgarians, Italians, Jews—washed up from the Black Sea. Not to mention Russians. Look at the Krasnaya Hotel, and you think of Viennese opulence. Look at the balconied apartment buildings, butterscotch and sky blue, and you think of Mediterranean ports. Lucky for Odessa that its downtown survived the war.

One of every three workers makes a living on the water. Odessa handles 30 million tons of cargo a year; another 22 million tons turns over at the nearby port of Iljichevsk. Sugar arrives from Cuba, tobacco from Bulgaria, coffee from Brazil, pipe from Japan. The ports send tractors to Laos, machinery to India, powdered milk to Cuba.

From the passenger quays the 192 Potemkin steps, named for an imperial Russian battleship whose crew mutinied in 1905, rise to a shady promenade. A wiry woman named Polina sweeps them every morning. "I work about four hours. Listen, I could keep two more jobs if I wanted."

Long lines on sidewalks usually lead to crates of tomatoes, onions, or grapes. The Soviet distribution system is limited; Odessa's vegetables, or sausage or chicken, come largely from nearby farms. When tomatoes are ripe, you get tomatoes. When the crop is finished, you eat cabbage. But prices are good: tomatoes for a dime a pound. And the system guarantees that a cucumber will taste like a *cucumber*. Dietitians may worry, but I never saw a Ukrainian who looked underfed. Alas, the figures of some middle-aged women suggest the opposite.

In a neighborhood of old apartment buildings, I went to a Baptist service and found the church packed with young adults. In his

Shape up and slim down are watchwords throughout the Soviet Union, including Ukraine. On a Kiev street, a young woman stops at one of many scales (below); she will pay the attendant two kopeks.

Chestnut trees grace a cobblestone street in the heart of Kiev, third largest city in the U.S.S.R.



sermon the preacher lamented that Baptists have no control over what is taught to their children in school. A woman in my pew leaned over to say: "I was not brought up to be religious. But when my daughter's school required her to write a paper on atheism, I went the other way." Soviet schools teach that atheism is a virtue.

Later the preacher told me the Baptist faith attracts young people "because we have the living word—we explain the Bible in the language of the people." By contrast, the Orthodox Church liturgy, sung in Old

Church Slavonic, is more ritual than spiritual. Inspired by German Protestants a century ago, the Ukrainian Baptist faith claims 250,000 and is believed to be growing.

The preacher added, "We are like good neighbors with the government—there are no contradictions." Baptists not belonging to officially sanctioned churches have been vigorously disobedient, however. Keston College, a British institution that monitors religious affairs in Eastern Europe, last year named 95 Ukrainians imprisoned for such trespasses as unauthorized services



and proselytizing; 48 of these are Baptists.

To Soviet citizens Odessa means black ooze and waters laced with sulfur, copper, and other elements. On doctor's orders 300,000 people come every year to immerse themselves at 60 sanatoriums. Labor unions usually pay most of the costs for their members' treatment.

Arthritis, arteriosclerosis, skin diseases, even sterility: You name the affliction, and the sanatoriums offer a treatment. It might be a regimen of baths in water that is slightly radioactive, water laced with pine extract,

or in mud dredged from Black Sea lagoons.

In the Anchor Sanatorium a brawny nurse named Luda had my tub ready. It contained a black, sulfur-smelling soup of 55 gallons of water and 44 pounds of mud. To get into the tub, I had to walk bare across the room in front of Luda. Bless her, she didn't laugh.

The mixture was warm and buoyant. During the course of the bath Luda checked my pulse to make sure my system wasn't shocked by the treatment. Actually, I was enjoying it.

WHEN FREEZING RAIN falls in Moscow in October, many a bureaucrat tries to imagine the "velvet season" in the Crimea, when the air is warm and the sea soft, when plane trees are shafts of gold, when vineyards are scarlet corduroy.

Hence a mechanic, Mikhail, seemed fortunate indeed as he sunned on the pebbled beach near Yalta. "I come every year," he

said. "You wouldn't know I was 69, would you?" Another Mikhail, last name Gorbachev, also frequents the peninsula, relaxing in the swimming pool at his dacha.

New sanatoriums and hotels rise over this rocky, southernmost coast of Ukraine. The Crimea hopes to lure tourists from Western Europe, an official said. I said resorts in the West rely on four S's: sand, sea, sun, and sex. "We lack only sand," he replied.



On a Sunday Soviet visitors trooped through Livadia Palace, built for a tsar. They listened to a lecture about the final days of World War II, then gazed into a long ballroom. The table there is not the one at which President Franklin D. Roosevelt, Prime Minister Winston Churchill, and Premier Stalin sat in February 1945, but guides say it is an exact copy (page 627). Stalin gets no more recognition than the two others of

the war's Big Three; a large photograph shows them surrounded by aides.

In eight secret sessions they fashioned agreements on finishing the war and ordering the peace—including agreements that have made Yalta, in the minds of some U. S. conservatives, a buzzword for “sellout.”

Much of the controversy centers on Poland. Churchill and Roosevelt (who was ill and died two months later) were lax in dealing with Stalin on Poland's future, critics charge, thus encouraging Stalin to conclude that he had a free hand in Eastern Europe. Other students of Yalta contend that the advancing Red Army made sovietization of Eastern Europe inevitable.

Ukraine was much affected by one of the Polish decisions. At Stalin's insistence Poland lost approximately the same territory that the Soviet Union had occupied in 1939 under a short-lived peace pact with Nazi Germany. A bizarre preface to the war, the pact allowed a sizable chunk to be taken from eastern Poland by the Soviet Union when Germany invaded Poland from the west. Some of this area was heavily Ukrainian, though many Poles dwelled there.

The conference also allotted Ukraine its own seat in the United Nations (along with Byelorussia) to assuage Stalin's fears that the U.S.S.R. would be outvoted. Thus in New York today there is a Ukrainian UN Mission—Moscow-controlled, of course.

At the time of the conference the Crimea had been de-peopled of its 300,000 Tatars, who were accused of collaborating with the Germans. As punishment, Stalin deported them to Soviet Central Asia.

The Soviet government exonerated the Tatars in 1967. But the people have never been allowed to return to the Crimea, a Tatar bastion since the 1400s.

A few have managed to get back, however. For example, Yusef. I met him in



Mother church of Ukraine, the Cathedral of St. Sophia in Kiev is now a museum. The 11th-century church was built by Yaroslav the Wise, whose father, Vladimir, brought Christianity to Eastern Slavs in 988. Baroque cupolas were added in the 17th and 18th centuries; the original brickwork is revealed where the stucco has been stripped away.



Bakhchisaray, where stands the last palace of the Muslim Tatar khans, with two slender minarets rising from its mosque. Yusef never asked his father about the stories of collaboration. "I was not sure I wanted to hear." At any rate, he said, "In every war some people take the other side."

The Crimea has no mosque for Yusef and other Muslims. "I only hear the Koran read at funerals. Only the old men know it."

THE AEROFLOT PLANE that took me west to Lvov, in what was Poland until 1939 (and Austria-Hungary before 1918), banked over a superhighway and high rises. Modernity, however, has not entered the city core, which escaped damage in the war. Baroque facades, even an occasional Gothic buttress, suggest a European city of, say, 1800.

This is the fount of Ukrainian emotion. The Soviet reordering of western Ukraine began in 1939; some businesses were nationalized, priests arrested. It was not finished until after World War II. The way people walk, with a little more dignity, and the way



Heading for the showers, a miner wears the grime of a six-hour shift (top left) in one of the anthracite coal mines that honeycomb the Donets Basin, producer of nearly a third of Soviet coal. Among the highest paid of all industrial workers, miners pay a price. A health-care facility (left) tests a miner for bronchitis and black lung.

In the rich iron field adjoining the basin, a modern steel mill at Krivoy Rog (right) is a model for streamlining other plants in the heavily industrialized Dnieper River region.



they talk, with a little more verve, tell you that pride is here. Curators' eyes shine as they show collections of delicate embroidery, decorated Easter eggs, even old Bibles. Ukrainian is widely spoken, and for almost everyone this city is called, with Ukrainian softness, Lviv.

And religion endures, with Ukrainian strength. The churches include anomalies: two Roman Catholic parishes that are still permitted to function, with sermons in Polish. In old St. John's—full on a Sunday—I observed the congregants. Some crossed themselves the Roman Catholic way, left breast, then right. But many crossed themselves right to left. "Some people are praying in Polish," said a man leaving the service, "while others of us pray in Ukrainian."

I had thus found remnants of a faith that in 1939 counted four million members. Those praying in Ukrainian and crossing from the right were often called Uniates; their church, founded in 1596, blended Orthodox customs and Roman Catholicism. Adherents in the West today are called Ukrainian Catholics.

Stalin abolished the church in 1946, accusing its clergy, as he had the Tatars, of collaboration. He probably feared its streak of Ukrainian patriotism. Metropolitan Josyf Slipyj and hundreds of priests were imprisoned; some were murdered. The Vatican rejects the accusation against Slipyj, though some priests, knowing the Soviet view of religion, surely welcomed the Germans.

Quite a few Uniates, say Vatican sources, still attend true Uniate services—underground, served by closet priests.

While permitting some churches to function, the Soviet Union mounts an intense campaign against religion. In a former church in Lviv, the Museum of Religious History and Atheism offers the Communist view of faiths. It is a house of horrors. A diorama shows a priest presiding over a torture chamber, supposedly in Poland. Pentecostals writhe in another diorama. There is something to offend almost every believer. Naturally a photograph of a Uniate priest conducting a service for German soldiers is prominently displayed.

"The Germans ruined us," said an elderly



citizen. "They came in, and people were confused. Some fought on one side, some on the other. They wrecked us. Then the Russians came and took the land. They said they were just going to take from the landlords, but they took the little farms too."

Some of those smallholdings are today part of a superfarm named Hammer and Sickle, where I went one day. With 11,600 acres, it supports 1,200 families. Its chairperson, Zinaida Lozhovska, a buxom grandmother—and tough enough to string barbed wire—has earned a reputation for taking good care of her workers. They enjoy urban amenities: dry cleaner, beauty parlor,

restaurant. In a dairy building, a sauna soothes tired milkmaids.

To the gentle countryside around Lviv—even on Mrs. Lozhovska's superfarm—horse-drawn wagons lend an antique flavor. Farm managers encourage their use; as a tractor driver acknowledged, "Horses don't eat gas." Perhaps nostalgia plays a part. Many a western Ukrainian remembers when peasants owned land, when it was said, "There is no peasant without a horse."

I listened to three oldsters recalling those times. One said: "My father had two horses, one pig, one cow—that was nothing. I went to school barefoot with a piece of stale bread.



The difference between then and now is like earth and sky."

Asked another bluntly: "But are you happier now?" The reply was a mumble.

IF MOSCOW is New York, Kiev is San Francisco: brighter and gentler, without self-conscious pretense. It feels good to walk in Kiev. Off the main stem, Kreshchatyk, chestnut trees shade stately buildings that survived the war.

To their credit the city fathers have lavished gold leaf, a tsar's fortune of it, upon nearly all the domes that rise over former religious structures. Functioning churches

have their gilt as well. The government seems to treasure what is left: gaudily baroque St. Andrew, ancient St. Sophia, the vast monastery called Pecherska Lavra, and others. They are the essence of Kiev. They are also, in their emptiness, very sterile.

I also give the city good marks for the graceful way it is transforming its old quarter by the river, the Podol. A moldy assortment of warehouses, factory buildings, and flats will soon look grand. Buildings with architectural value are being renovated; those without are being supplanted by low apartment buildings, styled to blend with the old.

What Kiev needs, alas, is a new breed of



Swallow's Nest, a neo-Gothic castle built around 1900, commands the Black Sea and the resort of Yalta, site of the 1945 conference between Stalin, Roosevelt, and Churchill. The Allied leaders met in the White Hall (above) of the former tsar's Livadia Palace. The round conference table is a reproduction.

Splash-dancing kids keep time with their kicks as a woman plays traditional Ukrainian melodies in a day-care center tucked away among high-rise apartments in new Kiev. The old city lies across the Dnieper River on the west bank. Under new policy, these four- and five-year-olds can begin school at age six, a year earlier than before.

restaurant worker. "When you go out to dinner, you take a bottle of wine, a sausage, and bread," a Kievan said. "So you don't starve while you're trying to get in a restaurant." He and I tried three one night. The first was closed. At the second the *maître d'* said the restaurant was full, though I saw empty tables. At the Bratislava Hotel my friend finally talked our way in. It took 20 minutes. In the huge dining room I counted 23 empty tables. Most had not been cleared. Restaurant help expects to perform minimally—one serving a night.

IN THE PODOL a mournful scene takes place: service at Kiev's only synagogue. I saw no more than 40 persons, nearly all so aged that I winced watching them labor into their overcoats.

Officials say 260,000 Jews dwell in Kiev, but this count is based only on parentage. The synagogue's chairman and vice chairman disagree on how many attend services on Yom Kippur. One said 10,000 throng the street outside; the other said 25,000. My guess is that the majority of Kiev's Jews haven't attended in years, if ever.

A nonworshiper reminded me that the elderly Jews of Kiev who chose not to flee before the Germans were murdered. He said that when he returned from Kazakhstan after the war "there were no grandparents left, and they were the people who passed on the traditions." Altogether, 600,000 Ukrainian Jews were slaughtered.

Before the war many Jews had embraced Communism, seeking escape from second-class citizenship. Discrimination undoubtedly caused others to abandon their faith, although I met Jews who declared they had never been mistreated. Thousands left in the 1970s, when emigration was easier.

The synagogue has no rabbi—they say a candidate is studying in Vienna—and no



classes in Hebrew or the Old Testament. "Nobody is complaining," said Mikhail Katz, president of the community, "which is proof of our efficiency."

It is a sorry situation. This synagogue will die unless it can enlist people (and if the authorities will allow it to) like a young woman I met. From a divided home, she understood only a few words of Yiddish and nothing of dogma. "I want to praise," she said, "but I do not know how."

One day I went to the flat of a man who today is called *shestydesiatnyk*, a "sixtier." Writers, artists, theater people, and others of the intelligentsia, the active sixtiers number in the hundreds in Kiev, with a fair body of sympathizers.

In the post-Stalin thaw in the early 1960s, they briefly whiffed intellectual freedom.



My friend, whom I call Boris, was among the luckier ones; he did not go to prison. But his career was blunted, and today he earns less than a factory worker.

I also heard of the *sixtiers* from Nadia Svitlychna in New York, who emigrated after serving four years for "anti-Soviet agitation and propaganda." An editor, she believes she was tried to threaten more important *sixtiers*, one being her brother, Ivan, a literary critic. Eventually he served a 12-year sentence, suffered a stroke in prison, and today lives paralyzed in Kiev.

The movement was about "freedom and creativity," Nadia said. Bands of *sixtiers* were active in several other Soviet cities. In Ukraine, she said, "People started looking at their own culture, their history." Some were critical of what they perceived as efforts to

Russify the culture, and other government policies and decisions.

Perhaps concerned that the movement might reach the average worker, the authorities clamped down. In 1965, at the premiere of a Ukrainian film in Kiev, writer Ivan Dziuba went to the stage and attempted to read out the names of a number of creative people who had been recently arrested. Sirens—perhaps fire alarms—drowned him out. In the audience, someone cried: "All against tyranny stand up!" This may have been the poet Vasyl Stus, who was to die in a labor camp. Some stood.

About 20 persons were arrested, but the movement went on. Crowds gathered at Shevchenko's statue to read his poems.

More arrests followed in the 1970s. Gatherings at the statue were banned. A young



ВЭТА МЕНОВАНЕ РОССО АМЕРИКАН ВАНДИ С КАСОС
НА СХРАМАТЕНАНИ БОЛ САНДИС ТРАНДИ РОССО



artist was found murdered. Ivan Dziuba recanted, winning pardon from a five-year sentence. The authorities cracked down on the Ukrainian group that sought to monitor Soviet compliance with the Helsinki human rights accords. "Today," my friend Boris said, "dissidents are like animals in a zoo"—literally caged, or closely watched.

AT THE WRITERS' UNION, an elegant old Kiev residence, I had a conversation about the 1960s with three men. Oles Honchar, novelist, is the grand old man of the literati. Yuri Shcherbak writes magazine articles and books. Ivan Drach is one of the three most respected Ukrainian poets published today.

Mr. Honchar stressed that the 1960s was a complex time. "There was a new wave of very talented people, and even older writers opened up more. Literature was rising to a higher scale, it was more humanitarian."

I asked: Was it necessary to put poets in jail? Ivan Drach observed obliquely: "The war with the bureaucrats was always there. We had it then, and we still have it."

Now 50, Mr. Drach was for a time among the sixtiers. He wrote (as he still does) with abilities I never can match, and he helped poetry move from boilerplate socialist themes. He also got into trouble for a poem that thus recounted a death:

*. . . officially by his own hand,
during the black terror of thirty-seven.*

This refers to a time of police violence. Criticized, Mr. Drach made revisions. Later he earned government favor. The two writers I met with him also enjoy it.

But writers are speaking out more these days. Mr. Drach has complained that the Ministry of Culture ignores Ukrainian dramatists and has forgotten a promise to commission plays on issues. At a writers' congress last year Mr. Honchar passionately declared that "our beautiful language . . . has asserted for itself the right to live."

The Soviet Union has seemed to loosen,



slightly, its clamp on dissidents and artists. In Ukraine a theater director banished in the 1960s was welcomed back. A jailed poet was released, then several religious leaders and human rights advocates. It was announced that Mr. Honchar's book *Sobor (The Cathedral)*, which criticizes the destruction of cultural monuments, will reappear after a long lapse.

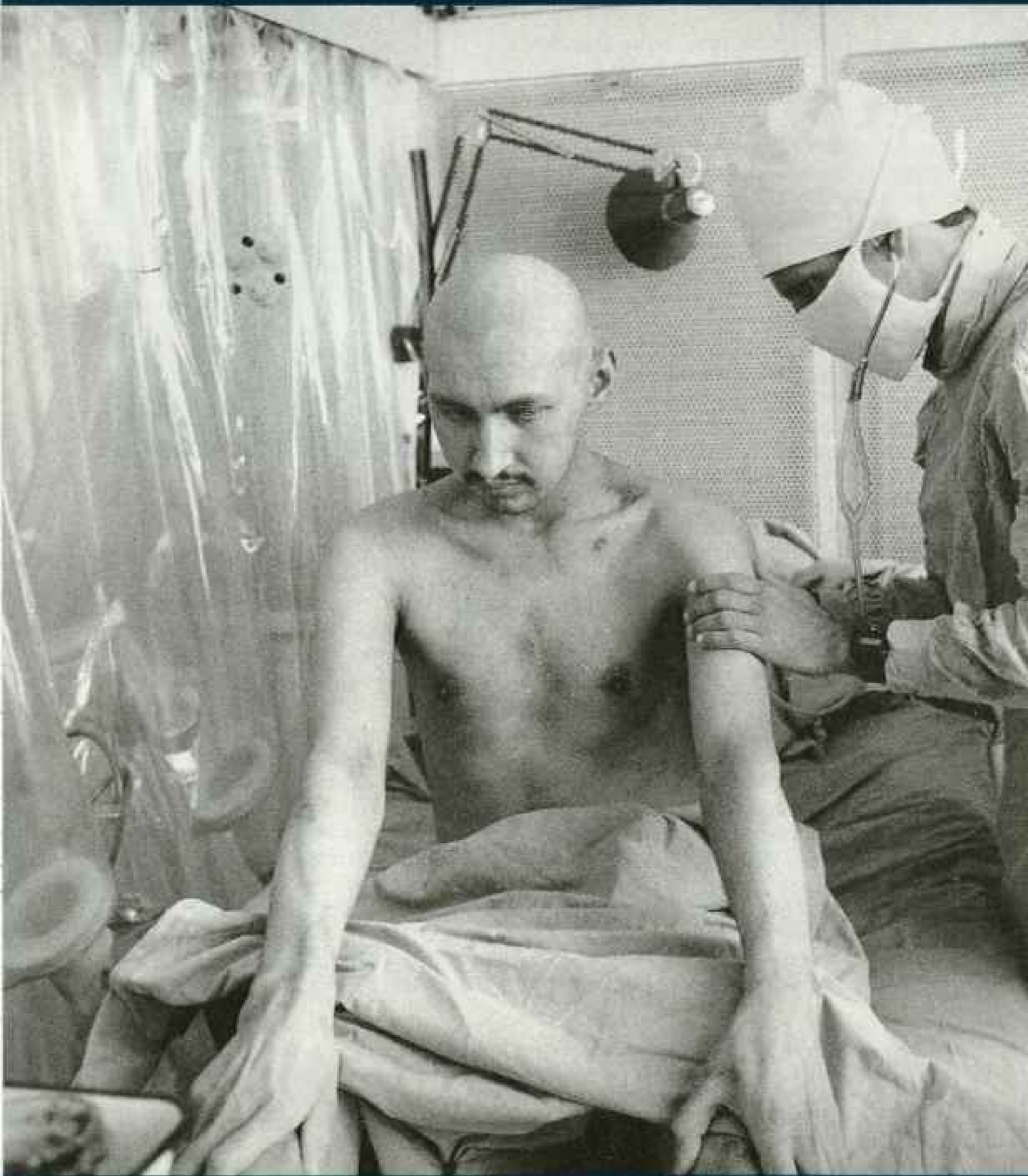
For Ukrainians this is heady stuff. Priests and poets have been, and are, important figures for them. The recent events are signs that another thaw may, just *may*, be at hand. This time, will the authorities countenance the fruits of intellectual freedom? Will Ukrainians be able to look deeper into their history, where much remains obscure? Will their language be enshrined as a cultural monument, as Oles Honchar asks?

We shall see, Taras, we shall see. □

"In commemoration of the reunion of Ukraine and Russia" is written in both languages on this monument raised during Kiev's 1,500th birthday in 1982. The Soviets count reunification from 1654, when independent Cossacks made a pact with the tsar. The poet Taras Shevchenko condemned them for giving away the homeland. A woman reads beneath his bust (above) at the museum near his grave site in Kaney.

Chernobyl—

By MIKE EDWARDS
NATIONAL GEOGRAPHIC SENIOR WRITER



One Year After

Photographs by STEVE RAYMER
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Paintings by PIERRE MION



East and West join forces to save victims of the worst nuclear power-plant accident of all time. As Soviet physician Alexander Baranov looks on, U. S. bone-marrow specialist Dr. Robert Gale examines patient A. Tormosian, who absorbed heavy radiation while fighting the fire at Chernobyl. Eight months after his bone-marrow transplant, the recovering patient (above) says good-bye to Gale, at right, and a Soviet doctor.

COURTESY ROBERT GALE (ABOVE RIGHT);
VLADIMIR VYATKIN, NOVOSTI PRESS AGENCY

THE AIR SMELLED of scorched metal, and to breathe without a mask was to cough.

Helicopters swung low on quick bombing runs, dropping sacks of lead, boron carbide, sand, clay, dolomite. Their target was a tangle of machinery and pipe, visible through a gaping hole in a 70-meter-high (230-foot) building.

On the ground moved a veritable army, hastily and desperately assembled. In white garments, with masks and caps, many looked like physicians dressed for the operating room. Army personnel carriers, their armor augmented by slabs of lead, rumbled to and fro on deadly serious taxi duty.

Now and again buses passed, removing the people of whole villages. In the nearby city of Pripyat, where 45,000 people had lived, laundry still hung on clotheslines, and a carnival carousel spun empty in the wind. An elderly woman departed her home carrying only her identity card, her spectacles, and her house key. Though she might never see her house again, she locked the door.

At times some of the people in this frantic scene paused to think of fellow workers—firemen, a doctor, two paramedics, a woman guard—who were rushed to hospitals in the early hours of April 26, 1986.

I describe the nightmare at the Chernobyl Nuclear Power Plant as it was a year ago, on, say, about the second of May. With four working reactors and two more being built, Chernobyl was to be one of the most powerful nuclear power stations in the Soviet Union. At 1:24 on the fateful April morning, one or possibly two explosions blew apart reactor No. 4—the worst reported accident in the history of the harnessed atom.

The blast(s) knocked aside a thousand-ton lid atop the reactor core and ripped open the building's side and roof (painting, pages 646-7). Reactor innards were flung into the night. These included several tons of the uranium dioxide fuel and fission products such as cesium 137 and iodine 131, as well as tons of burning graphite. Explosion and heat sent up a five-kilometer (three-mile) plume laden with contaminants.

A radiation detector in Sweden gave the world the first bad news—the Soviet Union did not acknowledge the disaster until April 28, two days after it happened. In much of Europe the reaction was fear and chaos: civil defense teams called up, fresh produce and milk banned as contaminated. News agencies reported that thousands might already be dead. Over ten days clouds traveled northwest from Chernobyl, then south and east, depositing contaminants from Scandinavia to Greece. Presently, they caused a tiny increase in radioactivity in California.

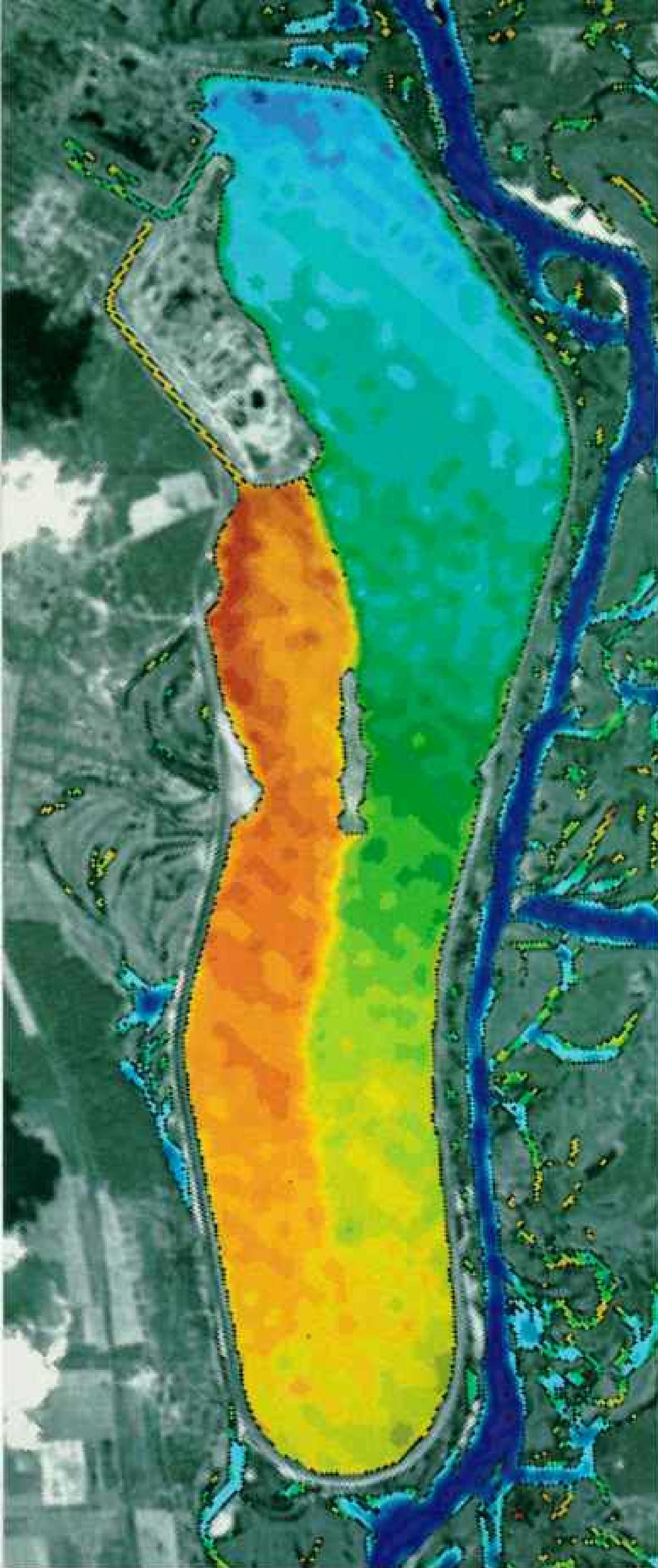
By Soviet accounts, 50 megacuries of the most dangerous radionuclides were released—millions of times more than the 17 curies freed in the Three Mile Island mishap in Pennsylvania in 1979—plus 50 megacuries of chemically inert radioactive gases.

In the republics of Ukraine and Byelorussia, 116,000 people were evacuated, most from a zone within a 30-kilometer radius of the power station. Others were removed from hot spots farther distant where radioactive particles came to earth.

Soldiers toiled alongside miners and bulldozer operators to try to stanch emissions from the stricken reactor and ejected debris. A second urgent task was to prevent contamination of the Pripyat River. This leads to the Dnieper, (Continued on page 640)

In the aftermath of disaster the seething wreckage of Chernobyl's No. 4 reactor is tested for radiation from a helicopter on June 2, 1986. In the early hours of April 26 a series of operator errors unleashed a power surge that blew the roof off the power plant and triggered a partial meltdown of the core's fuel.





Showcase of the Soviet nuclear power program, the Chernobyl complex is seen four days before the accident in a satellite image (left), at the head of its cooling pond.

With four 1,000-megawatt reactors on-line and two more under construction, Chernobyl was conceived as one of the world's greatest concentrations of nuclear power production.

A mosaic of different temperatures, as seen in this color-enhanced view, the pond reveals normal operations as warmer water (red) is discharged from the plant outlet. Circulating in a counter-clockwise direction, the water cools (blue) before reentering the plant at the inlet channel.

On May 8, twelve days after the accident at reactor 4, lack of a temperature gradient in the 12-kilometer-long pond indicates a cessation of normal operations (below).



BOTH FROM USGS DATA CENTER WITH LANDSAT 5 DATA FROM EOSAT COMPANY



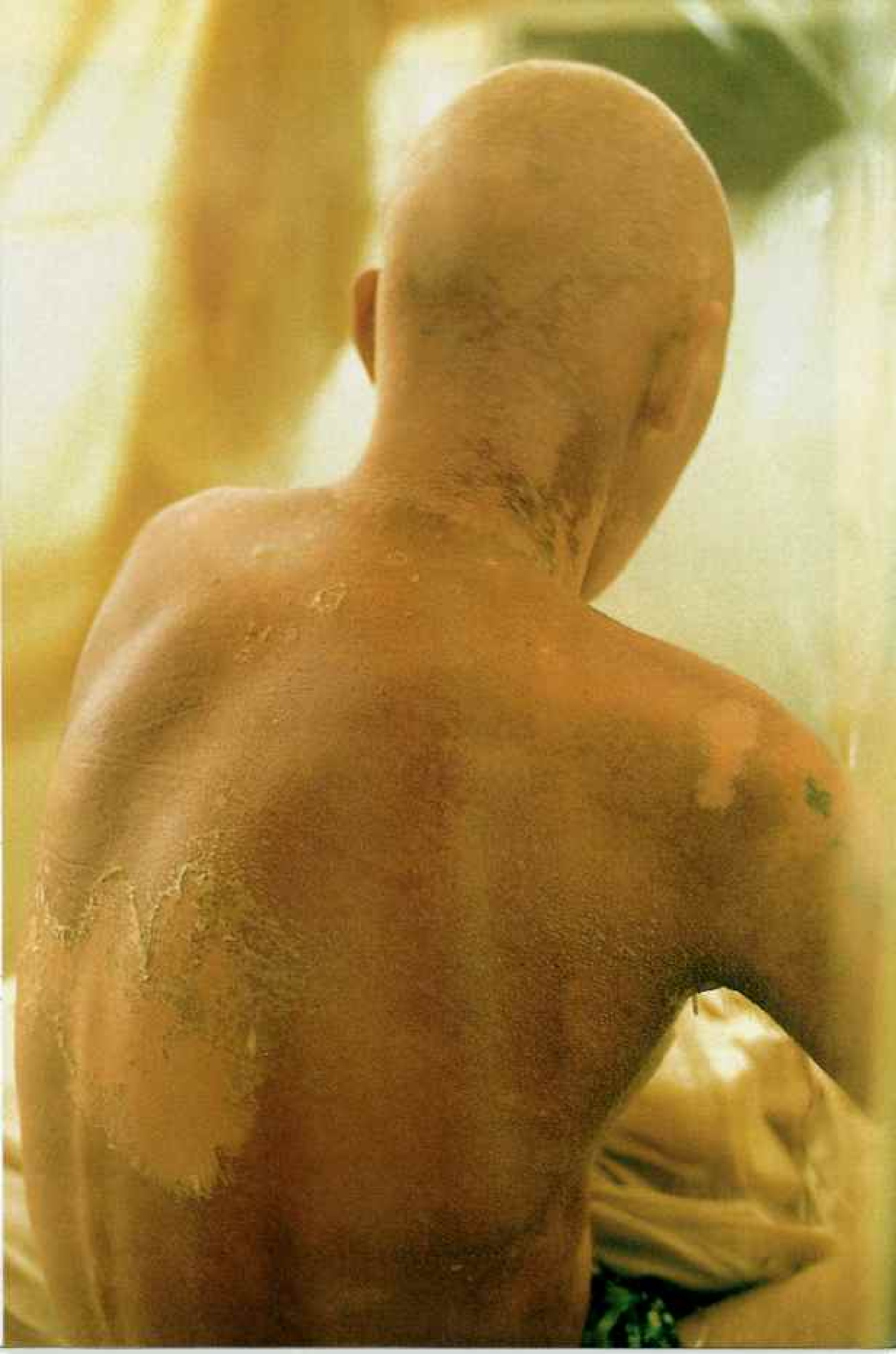
FROM USGS DATA CENTER WITH DATA FROM SPOT IMAGE CORPORATION AND LANDSAT DATA FROM EDEAT COMPANY (ARROWS)

Eye of the storm, reactor 4 is seen as a red "hot" spot (A) in a composite satellite image (above) of April 29, 1986, after the reactor's graphite core has been burning for three days. Under the same roof with the stricken reactor is Chernobyl reactor 3. Also visible is the building (B) holding reactors 1 and 2, along with the probable construction site (C) for reactors 5 and 6.

Although radioactive deposition on the surrounding environment was uneven, the government evacuated 116,000 inhabitants within 30 kilometers of the reactor (right). They were all resettled initially outside this zone, the center of which is expected to remain uninhabitable for years to come.



NCE CARTOGRAPHIC DIVISION





Badges of heroism, radiation burns on a Chernobyl fireman (left) foretell his unsuccessful struggle for survival. All told 31 have died in the Chernobyl accident. Hardest hit were the local fire-fighting units that attacked the flames on the roof of reactor 4 in a frantic but successful attempt to prevent the flames from spreading to an adjoining reactor. Thousands of other civilian and military personnel risked their lives and futures to engage in one of the greatest peacetime mobilizations in history.

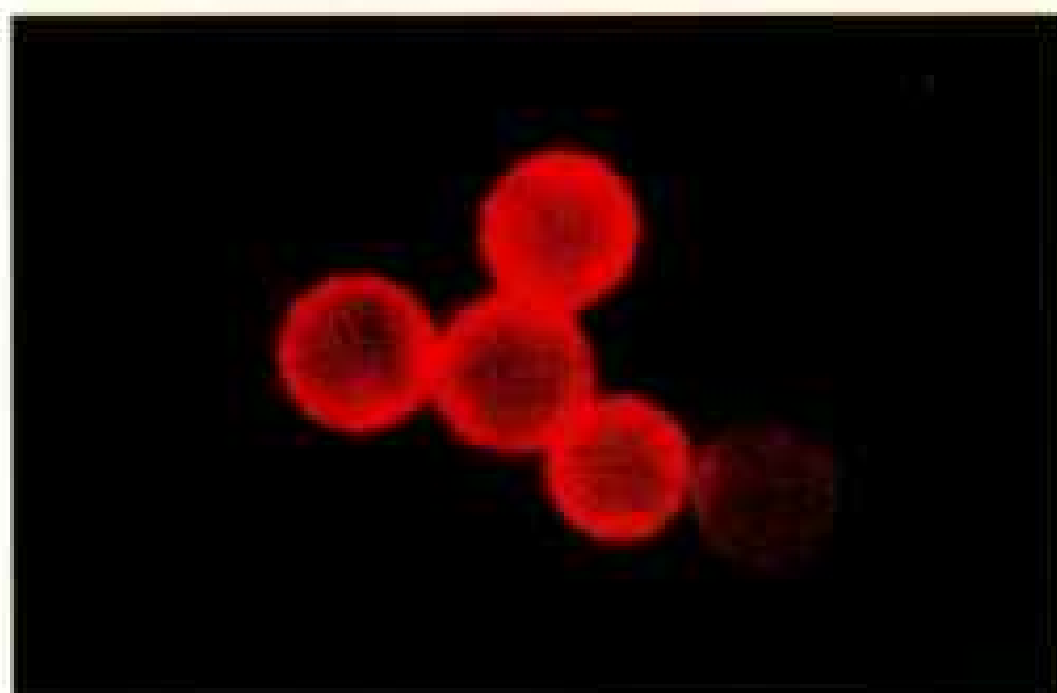
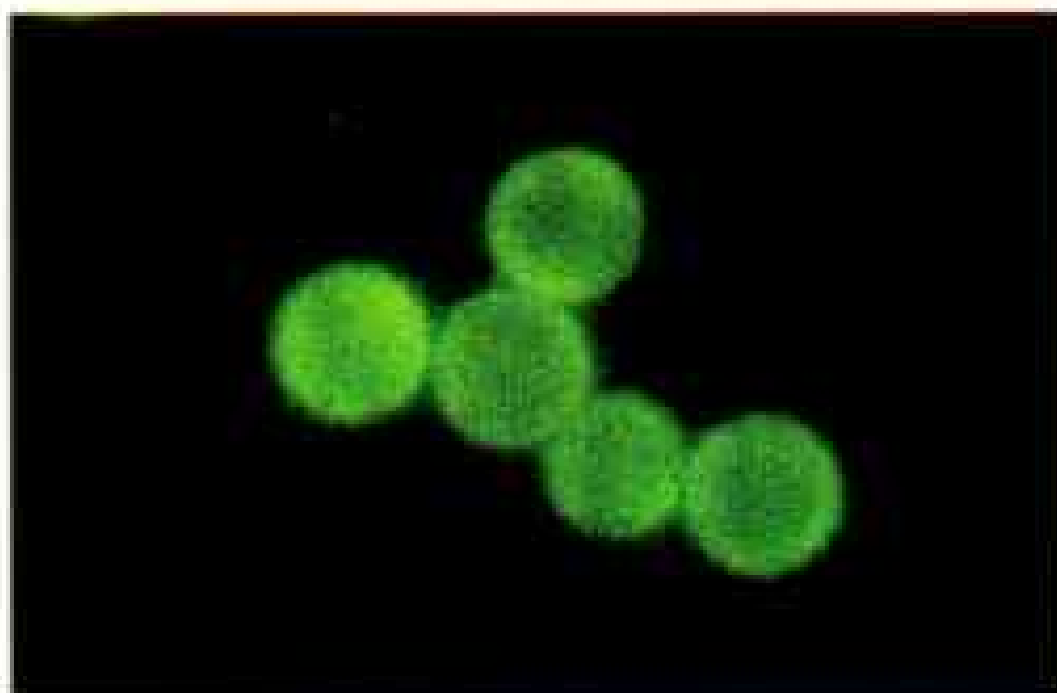
Suiting up with protective coveralls and masks, workers (above) prepare to clean up the roof of the damaged reactor (right), where the radioactive debris was so potent it fogged the photographer's film. It took more than six months of round-the-clock shifts to encase the damaged reactor in concrete and decontaminate the surrounding area.



ROBERT SALK (OPPOSITE), IGHK ROŠTIN, WONDETI PRESS AGENCY (TOP AND ABOVE)



GEORGE WATCHBACH, LAWRENCE LIVERMORE NATIONAL LABORATORY (BOTTOM)



(Continued from page 634) water source for Kiev, 130 kilometers south. Finally the reactor building and part of the adjoining turbine hall would be enclosed in a sarcophagus of concrete and steel, thus to remain, presumably, for centuries (pages 648-9).

The cleanup effort, nearly complete now, will be recorded as one of the most frantic projects of peacetime, rivaling even projects of wartime. Western authorities estimate the cost in billions of dollars.

Thirty-one persons are dead thus far, all were at the power plant. "The Soviets had a lot going for them," said Dr. Brian Sheron, a safety expert with the U. S. Nuclear Regulatory Commission. "It was late at night, so people were sheltered. It wasn't raining. The plume rose very high, so to some extent the immediate vicinity was spared."

Western experts, using the limited data the Soviet Union has provided, estimate that 24,000 people among the 116,000 evacuees received fairly serious radiation doses of about 45 rem. In general, 5 rem is considered acceptable for a nuclear-plant employee in a year, with 25 rem (the total countenanced for Chernobyl cleanup workers) an allowable once-in-a-lifetime dose. "In the final analysis it came down to which way the wind was blowing," said Dr. Robert Peter Gale, the U. S. bone-marrow-transplant specialist who has been much involved in the Chernobyl aftermath. Most of the people who received serious doses lived along the route of the wind-borne poisons and were not immediately evacuated.

Among these were residents of Lelev, a village nine kilometers (5.6 miles) from the plant. In the thyroids of Lelev children, radiation measured as high as 250 rem, the result of ingesting iodine 131. Before being

Supercooled blood from Chernobyl helps Dr. Ronald Jensen (top) and colleagues at California's Lawrence Livermore National Laboratory develop a blood test for radiation exposure. Monoclonal antibodies bind to normal red blood cells, causing them to fluoresce green and red (lower two photos)—unlike the damaged fifth cell (bottom). The Chernobyl victims had greater numbers of these variant cells in their blood.

evacuated, the children may have drunk milk contaminated with this fission product, which travels from grass to consumer in two or three days.

Also, Soviet experts calculated that the villagers received a high dose of external radiation, 25 millirem per hour, from contaminants in the air. These people, the experts concluded, were seriously affected because they dwelt in wooden houses. The people of Pripyat, only three kilometers (two miles) from the power plant, in general received smaller doses; their concrete apartment buildings provided better protection.

Using limited Soviet data, scientists forecast that the next few decades will bring 100 to 200 cancer deaths among the 24,000 evacuees who were seriously dosed by Chernobyl—not even a blip on the cancer tables.

When it comes to forecasting deaths beyond the 30-kilometer (20-mile) zone, however, scientists disagree widely. For the western Soviet Union and the rest of Europe, estimates range from 5,000 to 75,000 Chernobyl-caused deaths. A scientist opposed to nuclear power claims that "280,000 cancer deaths cannot be excluded."

Though frightening and costly, Chernobyl may yield valuable information. Until now physicists have had to rely largely on theoretical analyses when pondering a cataclysmic nuclear mishap. Experts hope to learn from the cleanup as well, especially from the entombment. And oncologists—those who study tumors—may discover much more about the relationship between radiation and cancer.

I ADMIRE the thousands of cleanup workers. No doubt there were conscripts whose enthusiasm extended only to the double pay. But the majority, from what I have been told, bravely confronted their unseen, potentially lethal enemy. I think of Valery Legasov, first deputy director of the Kurchatov Institute of Atomic Energy in Moscow, who arrived on the day of the accident and remained for weeks, never wanting to learn his own radiation exposure as shown on laboratory-processed film badges. When I met him in December in Moscow, he still did not know, "and my subordinates dare not tell me."

And I cite the firemen who answered the

alarm. They found 30 fires burning, most ignited by graphite, the material that moderated the fission process in the reactor. "All of them clearly realized what was in store," said a fire chief who himself received radiation and fire burns. They climbed to roofs to do their duty, extinguishing all the fires except that in the reactor by 5 a. m.

Most of the 31 fatalities were firemen exposed to radiation. Among the others were construction workers engaged in building the fifth reactor and the aforementioned physician and paramedics, fatally dosed while aiding the fire fighters. Other firemen were among the 203 persons removed to hospitals with acute radiation syndrome. About 500 were hospitalized altogether, including bus drivers who evacuated residents.

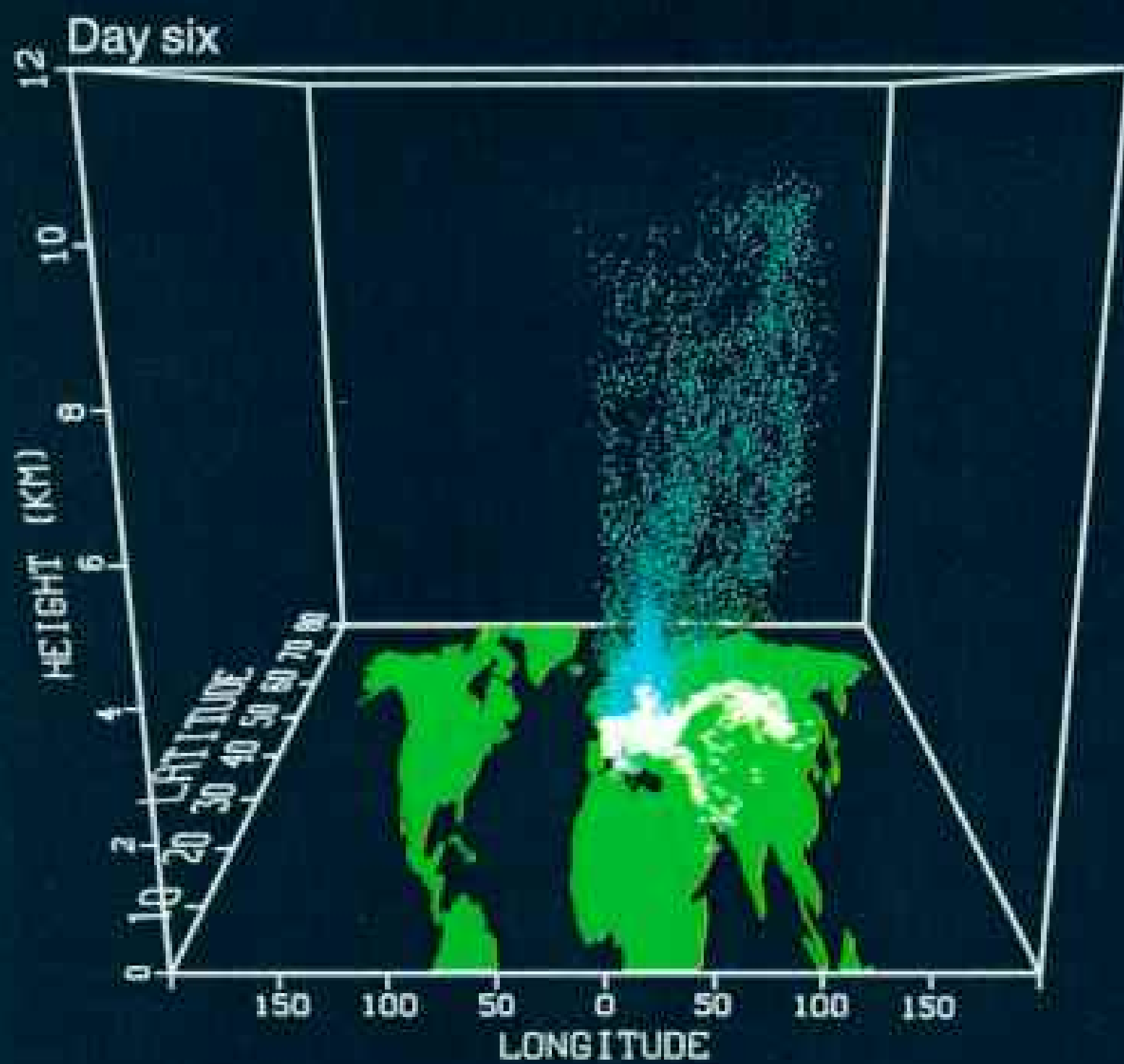
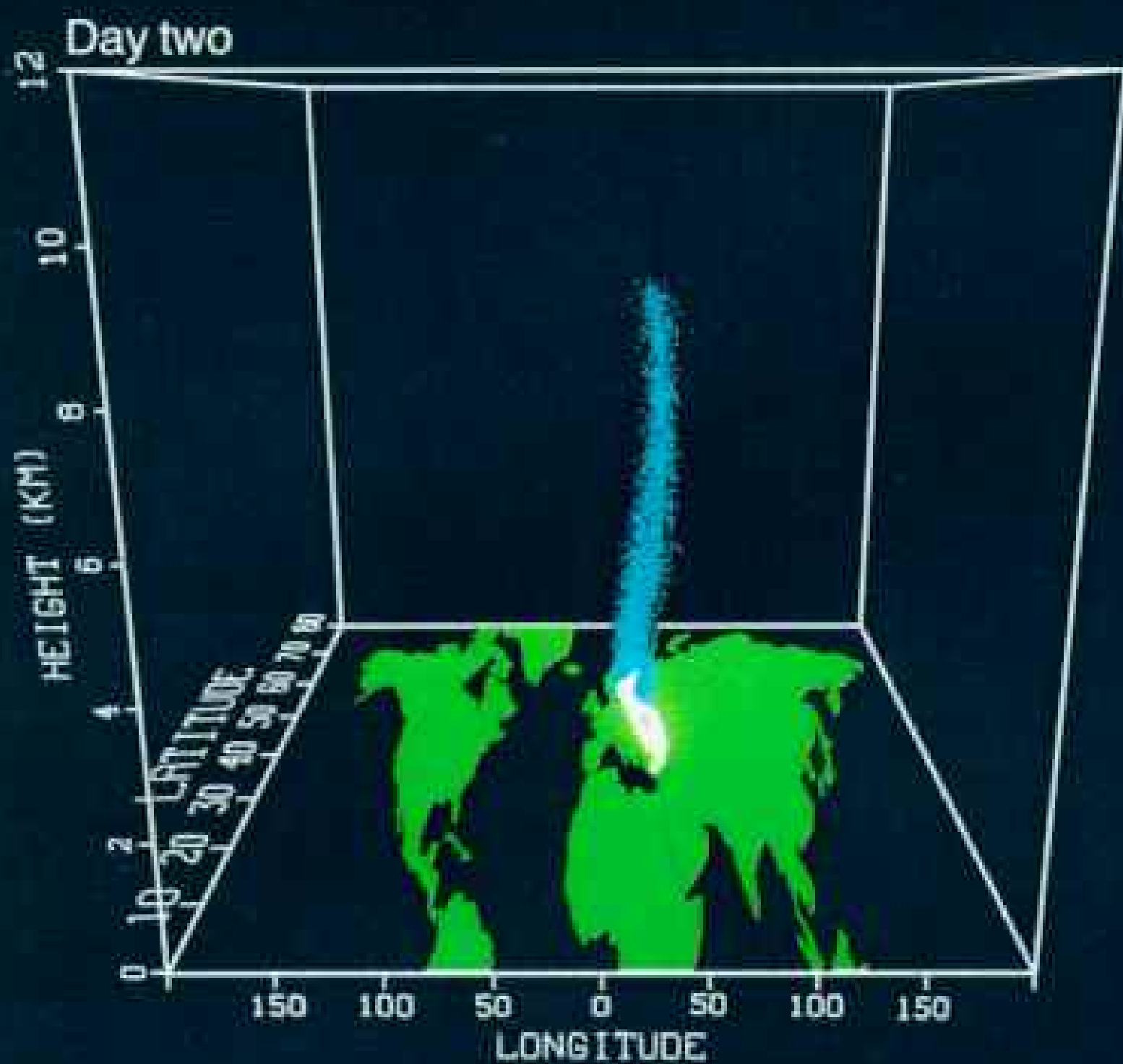
At full power the RBMK-1000 reactor, the type at Chernobyl, yields a thousand megawatts of electricity, enough to light Toledo, Ohio. It has a tricky characteristic: At low power, it becomes extremely unstable. "But only if all the safety systems are shut off," insists nuclear scientist Legasov.

This, according to the Soviets, is exactly what happened. To conduct a generator test that required a power reduction, the operators disconnected several emergency systems, even ones designed to shut down the reactor if it went out of control.

Evidently the operators were hurrying. Perhaps they were complacent; Soviet experts say the Chernobyl station was reliable. At a world conference of nuclear scientists in Vienna, held by the International Atomic Energy Agency (IAEA), the Soviets disclosed that these bunglers (two of whom are believed to have died in the accident) were not supervised by a reactor specialist. Moreover, the test, only casually planned, had not received requisite approvals.

Power zoomed to a hundred times operating maximum. Dr. Sheron says this surge had the explosive force of a ton of TNT. Fuel rods shattered. Hot fuel heated a vast head of steam, which blew the reactor apart.

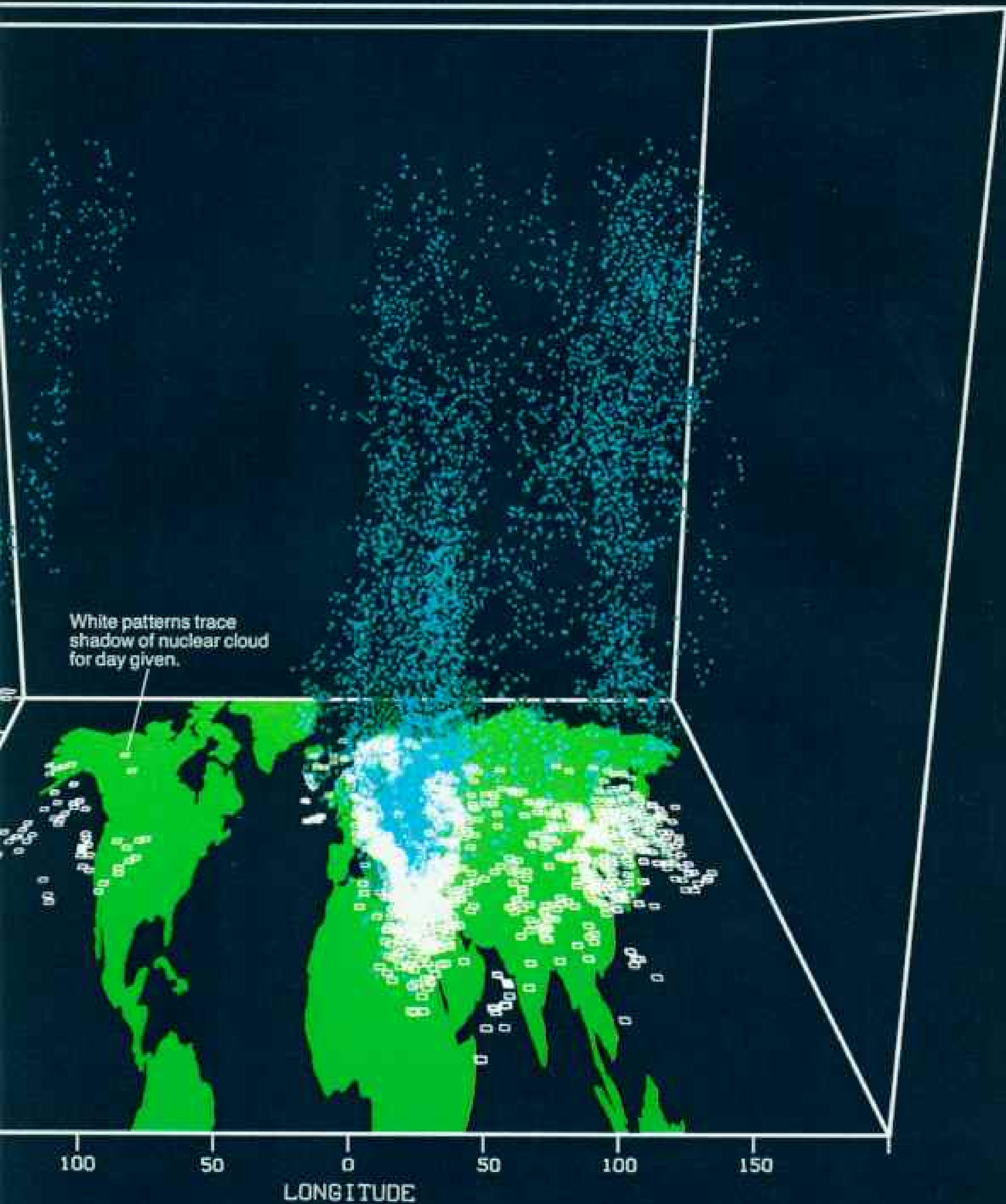
Some witnesses thought a second explosion occurred two or three seconds later, perhaps caused by hydrogen released when steam oxidized the zirconium cladding of the fuel rods. "But I don't think anybody is sure about that," commented Dr. Morris Rosen, the American who is the IAEA's safety



Computer-generated graphs, based on meteorological observations and measurements of radioactivity, show the dispersal of radioactive clouds produced by the Chernobyl reactor accident. Acted on by winds, atmospheric turbulence,

gravity, and various surface effects, the clouds are seen here for day two (top left), day six (bottom left), and day ten (right).

The initial cloud rapidly split, with one arm extending over Europe and the other over Asia, with subsequent movement



across the Gulf of Alaska to the west coast of North America. Scientists estimate that nearly half the reactor's iodine 131 and cesium 137—the two worst radiation hazards—were released into the atmosphere. Inhabitants of a region

from the western U.S.S.R. into Scandinavia may have received dosages in excess of 10 millirem (see radiation terms, page 645). Most people in central Europe received between 1 and 10 mrem, while those in the U. S. received a fraction of a mrem.

PAUL H. GUDIKSEN, ROLF LANGE, STANLEY L. GROTCH, LAWRENCE LIVERMORE NATIONAL LABORATORY

director. "If there was a second one, they've told us they don't know what it was."

Since the accident, the world nuclear community has spent much time debating the safety of RBMKs. These reactors evolved from a design that produced plutonium for nuclear weapons, though there has been no indication that plutonium was being obtained at Chernobyl. Fifteen RBMKs were operating in the Soviet Union; most of the 40 other power reactors are similar to those in the United States.

Some critics declare the RBMK design defective. Others say that they should have Western safety features: stronger shielding around the reactor ("What they had was a tin can," said one critic) and a strong containment building. They say these might have kept the debris within the structure. Others, however, doubt that such a

powerful blast could have been contained.

The accident the Soviets feared was a pipe break, Dr. Rosen said, and for that kind of trouble "the reactor was designed well." Operating rules were expected to prevent a disaster in the unstable low-power range. "They had restrictions that you cannot believe would ever be violated. What happened is almost inconceivable."

Mr. Legasov says of the disconnection of safety systems: "It was like airplane pilots experimenting with the engines in flight."

The accident sent "a shock wave through the Soviet nuclear community that told them they must increase safety," declared Hans Blix, IAEA director general. "They are determined to continue with nuclear power [which provides about 10 percent of Soviet electricity], but they realize that they must significantly increase discipline and

The politics of radiation soured trade relations between Europe and some Third World countries this past winter, after many European food exports turned up with questionable levels of radioactive contamination. Impounded on its way to a buyer in Egypt, a trainload of powdered milk in Cologne (below) was found to contain 16 times the radioactivity permitted in West German markets. Other contaminated products included Italian wheat, Polish potatoes, and Dutch butter.

KEVIN BOSSU, SYGMA



safety, as was done at Three Mile Island."

Numerous changes have been made in RBMKs to guard against a recurrence. Operators have been retrained. And the Soviets have announced that no more RBMK-1000s will be built after completion of the seven or so now under construction—a decision that some Western physicists cheer.

After the explosion some areas around the damaged building were so radioactive that workers, even in protective gear, could remain only a few minutes. Hence, waves of crews, ferried by armored personnel carriers, took turns at the same task in a day.

All about the core, helicopter-delivered "bombs" piled up: lead to seal and shield the vault; boron carbide to absorb neutrons; dolomite to generate carbon dioxide to smother burning graphite; sand and clay to cut off oxygen and filter radionuclides.

Mr. Legasov feared that the 5,000 tons of deposited materials would literally sink the reactor, contaminating groundwater. Miners were summoned to tunnel beneath the building and reinforce it with concrete.

NEWSPAPERS OF THE DISASTER came tardily to Ukrainians, just as it had to the rest of the world, and the initial announcements offered scant detail. Residents of western Ukraine first learned of rising radiation levels from Polish radio stations. Hearing that an iodine solution was being distributed to Polish children to prevent thyroid damage, some drank iodine from the medicine cabinet—and wound up in hospitals.

In Kiev, according to Soviet sources, the radiation doses registered .5 to .8 millirem per hour early in May, considerably above "background" levels but not an amount that most scientists consider dangerous in the short term. Elementary schools were closed and arrangements made for thousands of children to go to Young Pioneer camps far from the city. There was a panicky rush for airline and train reservations. "At least three people were trying to get every seat," a mother remembered. Unable to get transportation for her daughter, she locked the girl up at home for two weeks.

When I visited homes in Kiev, I found wet cloths at the doorways—to clean radioactive dust from shoes. Kievans were advised to

bathe frequently and wash their windows and walls. Water trucks rinsed dust from streets and sidewalks several times daily. Rough-and-ready remedies came into fashion. Drink vodka to flush out radiation, some counseled. No, said others; red wine is better. Or garlic.

Some of the city's chestnut trees bloomed a second time in the summer—maybe, alarmed people said, because of radiation. More likely, the trees responded to hot days and the abundant water. Children played "radiation," thrusting sticks at parked cars as if they were Geiger counter wands.

Humorists emerged, offering this chicken Kiev joke: To cook the bird, just hold it out a window a couple of minutes. When the Kiev soccer team, Dynamo, beat a good Scottish team in the fall, fans said it was because Dynamo was uranium powered.

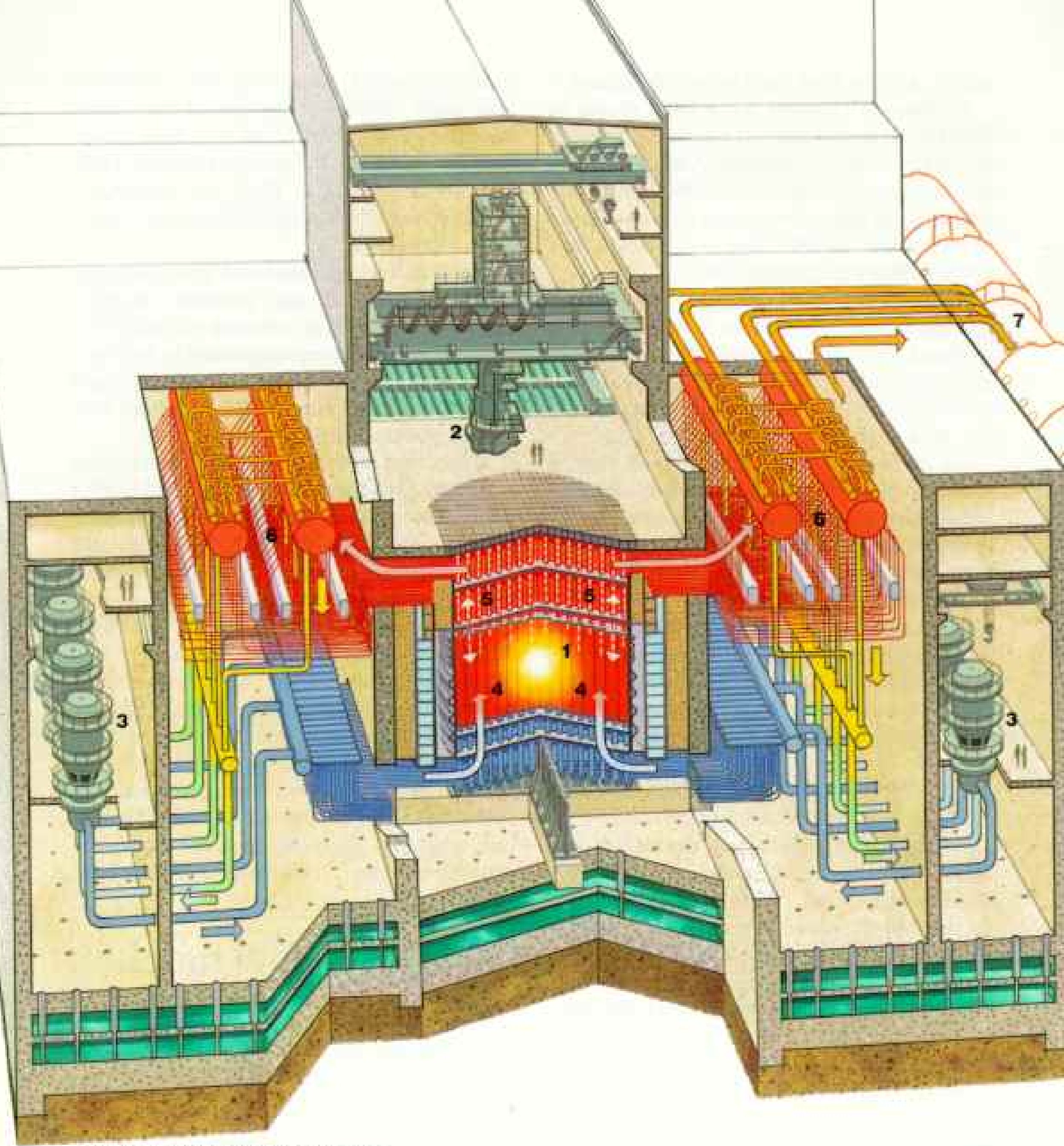
Equipment assembled at Chernobyl included remotely controlled bulldozers and cartlike robots that could detect radioactivity and transport the hot debris. "But we learned that robots are not the great remedy for everything," Mr. Legasov told me. "Where there was very high radiation, the robot ceased to be a robot—the electronics quit working." Remote-controlled bulldozers proved more *(Continued on page 650)*

A dose is how much?

RADIOACTIVITY—emission of nuclear particles and rays by unstable atoms, or radionuclides, as they decay and ultimately transmute into more stable forms. It is measured in curies. One curie equals 37 billion disintegrations a second.

DOSE EQUIVALENT—a measure of radiation absorption by the body and usually stated in rem or sieverts (1 Sv = 100 rem). An acute dose of 600 rem will usually result in death within 60 days.

BACKGROUND RADIATION—derives from natural sources, such as cosmic rays and radon gas, and from man-made ones, such as atomic testing. In the U. S. this averages some 100 millirem (mrem) a year. Since earth's atmosphere filters cosmic rays, exposure increases with altitude. A New York-to-Paris flight exposes a passenger to about 5 mrem, a chest X ray to 20 mrem.



A CHRONOLOGY OF DISASTER

25 April/1:00 a.m.

Electrical engineers assume control of the reactor to test a generator's capacity to power emergency systems as it coasts after steam is shut off. Control rods are lowered into the core, and the thermal-energy level drops from normal 3,200 megawatts (MW) to 1,600 MW. Demand for power delays the test. At 2:00 p.m. the emergency core-cooling system, which would draw power and affect test results, is shut off. This is the first of many safety violations.

25 April/11:10 p.m.

Monitoring systems are adjusted to low power levels, but the operator fails to reprogram the computer to maintain power at 700 to 1,000 MW. Power falls to the dangerously low level of 30 MW. The majority of control rods are withdrawn to increase power, but xenon has built up in the fuel rods. This by-product absorbs neutrons and "poisons" the reaction. In a further breaching of safety standards, virtually all control rods are withdrawn. Power climbs and stabilizes briefly at 200 MW.

26 April/1:03 a.m.

To ensure adequate cooling after the test, all eight pumps are activated. The combination of low power and high flow necessitates many manual adjustments; the operators turn off emergency shutdown signals.

26 April/1:22 a.m.

The computer indicates excess reactivity, but operators are under pressure to complete the test; they reserve the possibility of rerunning the test by blocking the only remaining trip signal just as it is about to shut down the reactor.



DRAWING BY BOB ARISTOTELI/STYLING BY WILLIAM W. BIRNIE

What went wrong

BALANCING ACT of technical delicacy, managing any nuclear reactor hovers between the reluctance of nuclear fuel to sustain a chain reaction and the ferocity of an uncontrolled “event.” Though unstable at low power, the RBMKs at Chernobyl are proven producers; 13 are still in use in the Soviet Union.

Neutrons released by splitting atoms must be slowed to speeds at which collision with uranium nuclei is more likely. Thus an important part of any reactor is the moderator, which surrounds the nuclear fuel, slowing neutrons to maintain the reaction. Unlike most reactors in the United States, which use water as a moderator, the RBMK-1000 uses a massive column of graphite blocks at the reactor core (1). Unlike its U. S. counterparts, which must shut down and open up reactor pressure vessels to replace spent fuel rods, the RBMK-1000 can be refueled during full operation by an overhead robot (2). Mirror-image systems loop water from pumps (3) to the reactor core where it passes through an array of some 1,600 zirconium-alloy tubes filled with uranium dioxide fuel (4). The reaction is paced by neutron-absorbing boron in control rods (5). A mixture of steam and water streams from the core to the separator drums (6), which direct steam to the turbines of the electric generators (7) and hot water back into the loop.

Beginning the afternoon of April 25, 1986, engineers more familiar with turbine generators than reactors blocked safety circuits and entered the dangerous territory of “positive reactivity feedback,” where a small increase in power causes a larger increase, then larger, and then . . . tragedy.



26 April/1:23 a.m.

The test begins, and power starts to rise. At this dangerously low power level any small increase in power triggers an even larger increase. Water expands to steam and absorbs fewer neutrons; the power rises faster. Facing catastrophe, operators begin insertion of all control rods. The rods, however, have five meters of graphite at their ends; the additional moderator and the water it displaces speed the reaction.

In the next four seconds power surges to 100 times the reactor’s capacity. The uranium fuel disintegrates, bursts through its cladding, and comes into contact with cooling water. An enormous steam explosion shears 1,600 water pipes, flings the reactor’s cap aside, blows through the concrete walls of the reactor hall, and throws burning blocks of graphite and fuel into the compound. Radioactive dust rises high into the atmosphere on a plume of intense heat.

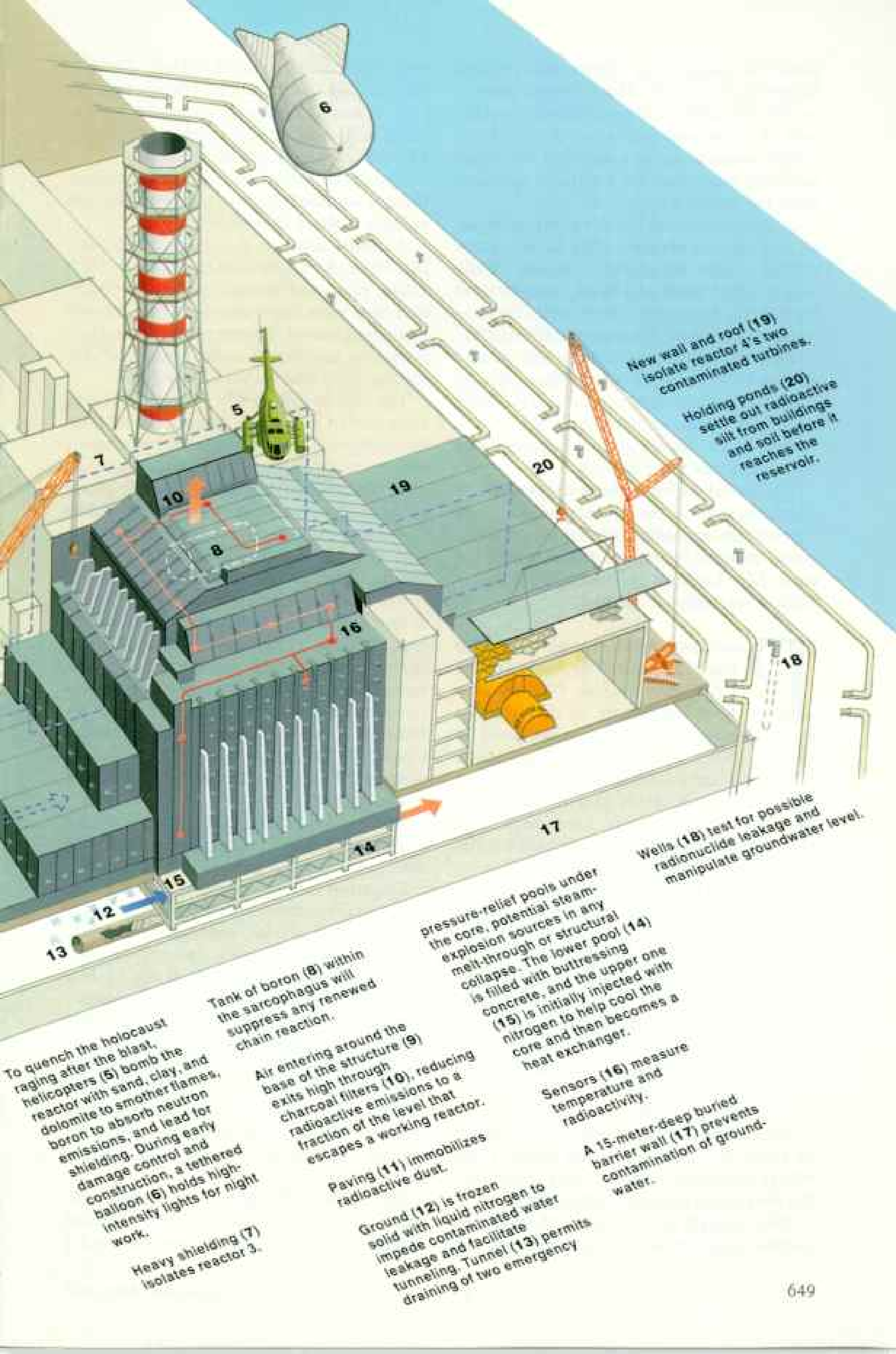


TASS (ABOVE), ROBERT GALE

Entombing the inferno

BLACK AND SOMBER, the sarcophagus that seals away reactor 4 (above) must safely contain its dangerous bones for hundreds of years before nuclear decay quiets its radioactive core. Cleanup is thorough as the power complex is cleaned, washed, and painted, and the surrounding land is scraped and primed for new life. Work crews commute to the site in radiation-resistant armored personnel carriers (below). Agronomists plan for shallow-root crops in the countryside, new towns are built for power-plant workers, and construction on two new reactors continues.





New wall and roof (19) isolate reactor 4's two contaminated turbines.

Holding ponds (20) settle out radioactive silt from buildings and soil before it reaches the reservoir.

Wells (18) test for possible radionuclide leakage and manipulate groundwater level.

13

To quench the holocaust raging after the blast, helicopters (5) bomb the reactor with sand, clay, and dolomite to smother flames, boron to absorb neutron emissions, and lead for shielding. During early damage control and construction, a tethered balloon (6) holds high-intensity lights for night work.

Heavy shielding (7) isolates reactor 3.

Tank of boron (8) within the sarcophagus will suppress any renewed chain reaction.

Air entering around the base of the structure (9) exits high through charcoal filters (10), reducing radioactive emissions to a fraction of the level that escapes a working reactor.

Paving (11) immobilizes radioactive dust.

Ground (12) is frozen solid with liquid nitrogen to impede contaminated water leakage and facilitate tunneling. Tunnel (13) permits draining of two emergency

pressure-relief pools under the core, potential steam-explosion sources in any melt-through or structural collapse. The lower pool (14) is filled with butressing concrete, and the upper one (15) is initially injected with nitrogen to help cool the core and then becomes a heat exchanger.

Sensors (16) measure temperature and radioactivity.

A 15-meter-deep buried barrier wall (17) prevents contamination of ground-water.

useful for scraping up rubble and scalping the ground of topsoil. Many chores, however, still demanded conventional equipment, and the conventional man. A bulldozer whose operator sat in a shielded cab often achieved more than the bulldozer operated from 140 meters away.

In midsummer the reactor building began to receive an overcoat, with three on-site mixing plants supplying concrete. Walls rose a meter thick and more, around steel frames. By November the monster was entombed. The structure was studded with instruments to measure radiation and seismic devices to detect sinking or shifting. Radiation, Mr. Legasov told me, is "one hundred times lower than permissible values."

Echoed Dr. Rosen after a January visit: "It's now a safe place to work."

The Soviet engineers hope to start up the adjoining reactor, No. 3, this year. Reactors 1 and 2 are running; their crews are daily bused to work from outside the evacuated zone. Mr. Legasov believes units 5 and 6 might eventually be finished.

PAVEL PAVLENKO, a slight man with thinning sandy hair, recalls of the Chernobyl region: "There is a beautiful nature in that place—water, forest, berries and mushrooms to pick. . . . We had everything—dogs, cats, chickens. I had a German shepherd, named Lessy, the most clever dog a man could have. I kept her 12 years. I was born there and brought up there. After 50 years it is difficult to settle down somewhere else."

But when I met Mr. Pavlenko, a cowherd on a collective farm, he seemed to have settled down pretty well, in a new village, on a new collective, with shiny new furniture, and a new cat that snoozed on a chair as we talked. He even had new wealth—14,500 rubles (\$21,750 at the official exchange rate), which the government paid him for the loss of his house and belongings. "I'm going to buy a car," said Mr. Pavlenko, who never had owned one.

With his wife and two sons he had dwelt 12 kilometers from the power plant. Their village was to the southeast and apparently did not receive a serious radiation dose.

They brought out only some photographs and the bright linens that Ukrainian women

embroider. Lessy was left behind. Also Vasha, his cat. Evacuation officials forbade pets. "I was always fond of cats," Mr. Pavlenko said. And, he reminded me, "A dog is a friend—a member of the family."

The government—possibly overreacting, though we don't know—sent hunters into villages to shoot abandoned animals.

A similar fate awaited the farm animals. Mr. Pavlenko's collective trucked out 2,000 cattle, pigs, and horses—only to discover that they were contaminated. The animals were slaughtered. The meat went to market; evidently, health authorities concluded that radioactivity had not yet affected it.

The 560 people of Mr. Pavlenko's farm were settled in Fasova, almost 100 kilometers southwest of their former home, where a construction collective built 150 houses in 45 days. Such feverish work went on in many villages. Thousands have since returned to their former homes, which were found to be safe. Officials say the 30-kilometer evacuation zone will shrink to just ten kilometers.

Mr. Pavlenko declared that his new house of four rooms is much better than his former one. "It's like a city house," he said. It has central heat; his wife cooks with gas now instead of coal. And there is the fat bank account to ease transition pains. "I wouldn't return if I had the chance," Mr. Pavlenko vowed. "I feel better here." This comment pleased the several officials who sat in as I talked with him.

But I know that in other villages people wept even as they were being presented with their new homes.

Disputes about Chernobyl will simmer for years. Was the destruction of millions of dollars' worth of fruit, vegetables, and milk necessary in Western Europe? "Overreaction" is Dr. Rosen's answer. Some nuclear proponents contend that the emergency measures were largely political—a ruling party did not want to appear unconcerned for the welfare of its citizens. The accident exposed wide variations in what nations considered to be acceptable contamination levels. Milk that could not be sold in Austria wound up in Brazil. Some Asian nations refused European fruits.

Dr. Richard E. Webb, the nuclear engineer who calculated 280,000 possible deaths, holds that cesium contaminated a

European area nearly as big as Texas. IAEA scientists say that, while figures have not been compiled, contamination in Western Europe was spotty.

Dr. Rosen calls Chernobyl "an unacceptable accident—but tolerable for society." He argues that smoking and radon gas in homes are more serious threats than nuclear accidents. Like many nuclear scientists, he maintains that if nuclear plants were replaced by generating plants burning coal or oil the health effects would be more serious. "They give off sulfur dioxide, nitrous oxide, particulates, carbon dioxide."

One reason for the wide variation in projected Chernobyl deaths is lack of firm evidence that X dose of radiation causes cancer.

"At one extreme of the cancer curve," said Dr. Gale, the U. S. physician who helped treat Chernobyl victims, "we assume that if you don't get any extra radiation, you don't have an increased cancer risk. And we know from studies of the Hiroshima victims that a high radiation dose is associated with a

certain risk of cancer. We need to know the shape of the curve in between. Does every little bit more radiation confer greater risk, or is there a threshold below which there is no increased risk, but beyond which the risk increases substantially?"

Scientists hope that the 116,000 evacuees will be monitored for the next three decades or so. Soviet officials have indicated that they will undertake a study.

And help has been offered by Dr. Gale and his patron (to use an old-fashioned word), Dr. Armand Hammer. They make an interesting pair: Gale 41 and boyish in appearance, soft-spoken, totally immersed in medicine; Hammer an indefatigable 88, the industrialist who travels in a private jet and enjoys the company of the rich and powerful. Yet they share traits. Both are physicians and both, to my mind, share an outlook that is wide and humanitarian.

When he heard of the accident, Dr. Gale, who heads the International Bone Marrow Transplant Registry and the transplant



At a radiation checkpoint outside Kiev, a civil defense worker tests incoming cars with a Geiger counter, eight months after the accident. Those with excessive radiation were washed before entering the Ukrainian capital. Although fallout in Kiev never posed immediate danger, most of the city's children were sent to Young Pioneer camps for the summer, and Kievans were advised to shower frequently.



team at the School of Medicine of the University of California at Los Angeles, thought his skill might be needed. Bone marrow, the source of blood cells, is seriously affected by gamma radiation.

Dr. Gale telephoned Dr. Hammer. The latter has long been regarded by the Kremlin as its capitalist friend. He engaged in business deals with the Soviet Union in the time of Lenin and today, among other projects, is a partner with the government in a huge fertilizer works near Odessa. Dr. Hammer sent a message to Mikhail Gorbachev, the Soviet leader, offering Dr. Gale's help—and offering to bear all costs. Soon Dr. Gale, followed

by three other physicians and a million dollars' worth of equipment, was en route to Moscow, where the team performed ten transplant operations.

LAST FALL, as he returned from one of several subsequent journeys, Dr. Gale brought blood samples from evacuees and cleanup workers. Studies of these samples, he hopes, will validate a simple test to determine the radiation dose received by the evacuees. The cleanup workers constitute a control group; their radiation dose is known from the film badges they wear.



Uprooted from the disaster zone, a Ukrainian couple (left) have only their cherished wall hangings to remind them of their abandoned home. Thousands were resettled in or near Kiev, some in houses (below) built in 45 days. Experts say only time will reveal the consequences for Chernobyl's hapless neighbors.



After reacting with certain antibodies, normal blood cells fluoresce red and green when passed through a laser. Cells mutated by radiation may show only green or only red, but not both. The number of abnormal cells, it is hoped, will be an indicator of radiation dose. If the test works, it will be much cheaper and easier than the chromosome analysis used in the past to determine dose. The tests are being conducted by Dr. Ronald Jensen at Lawrence Livermore National Laboratory in California, which is, ironically, a nuclear weapons laboratory.

Ultimately, said Dr. Gale, the responsibility for caring for Chernobyl's victims is

the Soviet Union's. "They have to be in control. We can't take it out of their hands. But we can help them, and I believe we should.

"We may have more at stake than the Soviets do as we follow the consequences of Chernobyl. We live in a society where the citizens will ultimately decide whether they want nuclear energy. The Soviet people don't at present have this choice. I am also certain that the Soviets will not forget that we offered this help in their time of need. They have a long memory for the good and the bad—very long. Someday it will work to our benefit, perhaps to the benefit of all mankind." □



As robust and self-reliant as their country, farmer Peter Elworthy and

New Zealand:

By ROBERT PAUL JORDAN
FORMER SENIOR ASSISTANT EDITOR

Photographs by KEVIN FLEMING



his sheepdog Rikki make backcountry rounds in a 1939 Tiger Moth.

the Last Utopia?

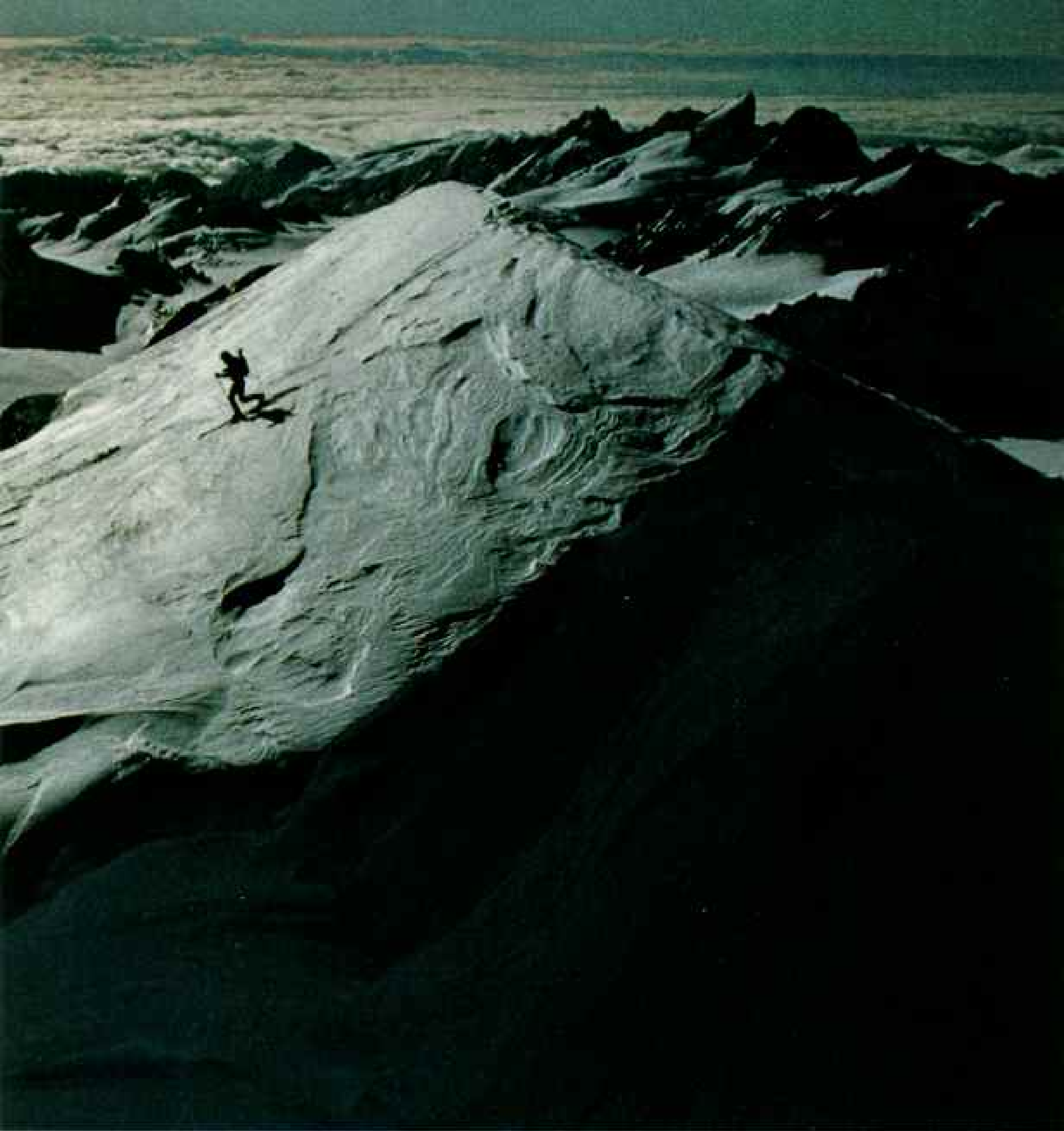


NEW ZEALAND. The incomparable natural glories of this small sea-locked country and the luxury of her location deep in the South Pacific sent Rudyard Kipling into raptures. Long ago the British author sang: "Last, loneliest, loveliest, exquisite, apart . . . the Happy Isles!"

Kipling's paean, I have learned, still rings true except in one regard. Happiness, like time, is transient. New Zealand, one of the world's first welfare states, practices a be-

nevolent socialism. But these are hard times for many as the government performs drastic surgery on an overextended economy.

The nation has always depended on farm exports. When subsidies abruptly ended in 1985, hundreds of farmers had to give up, unable to meet loan payments. Land values dropped by half in some places. Severely depressed prices for sheep—upwards of 70 million huddle on the countryside—brought another large headache. Interest rates as high as 25 percent plagued city dwellers too,



especially the owners of expensive, heavily mortgaged homes.

Anywhere I traveled, people were worried. Some were searching out new ways to make a living. Many fell back on inborn optimism. New Zealand was founded on hope: the hope of her Polynesian discoverers a millennium past and of British colonists in the mid-1800s. "She'll be right," I was often told. It will take time, but things will work out.

The country consists of two large islands,

The rest is all downhill for a skier dropped off by helicopter on a South Island mountaintop near Mount Cook, New Zealand's highest peak. Many skiers prefer the drier conditions found in these Southern Alps to the volcanoes of the more temperate North Island. The difference between the two islands goes deeper still: Geologically, they are microcontinents riding separate, colliding tectonic plates.



New Zealand's port of gold gleams at the end of a rainbow. Auckland, the country's bustling commercial center and most populous city, thrives on its container port, which handles nearly seven million tons of cargo each year. Some 40 percent of New Zealand's exports are shipped to the country's three major trading partners, Japan, Australia, and the United States.



a much smaller third one, and numerous islets (map, page 663). The history and rugged independence of her 3.3 million citizens are shaped by the vast moat of open ocean that insulates them. Australia lies more than a thousand miles away; 4,500 miles of water separate the islands from South America. The closest neighbor, New Caledonia, lies some 900 miles northward.

I SPENT WEEKS moving up and down this marvelous conglomeration of mountains and brooding volcanoes, green hills, plains, and sun-washed beaches. One constant kept me company: a pervasive sense of isolation.

It suffused subtropical North Island with hints of distant emerald isles, and whispered of Antarctic ice far across ocean wastes beyond the South Island's heel. It nagged from a rampart of snowy, glacier-hung alps as awesome as Switzerland's, and rode a deserted track to a sheep, cattle, and deer station remote enough that mail and supplies arrive only once a week. To me it was a haunting phenomenon. To the people of these places it is of no moment.

To be isolated does not mean isolationist. In every way New Zealand is a world citizen, relying on international trade, deeply concerned about disarmament issues and—like many other Pacific nations—strongly antinuclear. During my stay the government's denial of port access to nuclear-armed or nuclear-powered ships led the United States to suspend its defense obligations to the country under the 35-year-old ANZUS alliance.

As you might expect, large areas of the country are virtually unpopulated, notably the mountain reaches. In surprising fact, though, considering New Zealand's reputation as a land of lavish scenic beauty and huge sheep farms, more than 80 percent of the people live in urban-suburban settings along the coast and in the lower hills. A station in the outback can be run with few hands, and sheep farming generally is a family affair.

The cities wear the stamp of assertive self-awareness, self-esteem. Their distinctive characters, I noticed, point up the sharp time lags between the North and South Islands. Broadly speaking, North is town,



South is country. One is modern, the other old-timey.

AUCKLAND, on the North Island, dominant in business and trade, exudes vitality and showy grace. One in four New Zealanders lives in and around this money-hustling clone of California-style commercialism.

On a bright morning I paid a visit to Dame Catherine Tizard, Her Worship the Mayor of Auckland. From her 15th-floor suite in the city's administration building, we looked beyond the sprawling metropolis to harbors filled with sails and merchant ships.

In quiet, candid terms she described

Auckland as a city on the make, gobbling up agricultural land on the outskirts, noisy and materialistically minded. Problems? Huge physical size, the cost of providing services, increasing violence.

"This city—and this country—are no longer different from the rest of the world," declared Dame Cath (as the press tags her). "We used to think that we were small, isolated, and insular and the ways of the world didn't impinge on us. This is a very confusing time to be a New Zealander."

For decades Auckland has lured ambitious southerners. And in recent years thousands of Pacific islanders—Samoans, Tongans, Fijians, and others—have come



seeking a better life. They and the native Maori combine to make Auckland one of the largest Polynesian cities in the world.

It is said that by 2000 every third or fourth New Zealander will have a Polynesian ancestor. Only a generation ago the country still served as Great Britain's farm; many fondly called England "home" whether they had ever been there or not. Few feel that way any more. A nation of Pacific people is building, centering on Auckland.

"The word is 'change,'" said Warwick Roger, editor of the city's hard-hitting *Metro* magazine. "New Zealand has been asleep for years. Now it's awakening. Younger people are in charge, people born after

Coming-out party for "Kiwi Magic" (above left), New Zealand's entry in the 1987 competition for the America's Cup, draws a crowd to the streets of Auckland en route to the sailing race. Joining the parade, teams of marching girls (top) are a tradition dating from the early 1900s. Each team wears a distinctive uniform as it executes precise routines in local and national contests. But for passion and participation no sport beats rugby, the national pastime. Little ruggers (above) are the foundation of a nationwide club system that claims some 200,000 New Zealanders as members.

World War II. Parliament's average age is 44. Mark you, Auckland is a world city to become. The North Island is the future. The farther south you go, the farther you go into the past."

I moved south, to Wellington at the bottom of the North Island. No slow motion here. British colonists founded it in 1840, dreaming of a utopian agricultural community. Who has time to remember? Wellington bustles importantly as the very model of a small administrative capital.

Government buildings rest center stage in a steep amphitheater beside a splendid, windswept harbor. Overseeing all this, handsome homes stairstep up the hills. Several hotels were rising when I visited, with care being taken to meet earthquake safety requirements. Like San Francisco, which it somewhat resembles, Wellington straddles a fault in the earth's crust. The Pacific rim of fire extends all through New Zealand.

As is the inevitable lot of any seat of government, some citizens eye it warily. "There's a feeling," a politician told me

wryly, "that Wellington is a great monolithic octopoid that is going to thwart them."

ON THE SOUTH ISLAND, Christchurch and Dunedin cling to their heritage, proud and attractive anachronisms. Stiff-upper-lip Christchurch, service center of the breadbasket Canterbury Plains, is known as "the most English city outside England."

Settlers handpicked by the Church of England stepped ashore in 1850. Here I admired lovingly tended lawns and gardens, stately colonial architecture, the winding Avon River, and a stern old neo-Gothic cathedral looming over the square. But what was this vulgar manifestation of *lèse-majesté*? Queen Victoria's heroic statue wore a beer can atop her regal head.

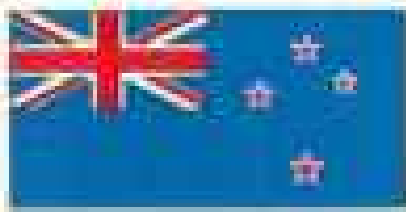
A veteran journalist named Les Bloxham, travel and aviation editor of the *Christchurch Press*, showed me about. He said: "Christchurch is like your smaller mid-western cities: conservative, with a slower way of life. There is mistrust of Auckland.



Frozen assets of international trade, lamb carcasses bound for export are stacked in refrigerated warehouses in Bluff, on the South Island. John Cooper loads a shipment to be exchanged for oil with Iran, a major trading partner. A Muslim butcher on the premises slaughtered the animals according to ritual.

New Zealand

One of the last lands on earth to be inhabited by man, New Zealand was settled by seagoing Polynesians perhaps 1,000 years before Dutchman Abel Tasman arrived in 1642. Later Capt. James Cook claimed it for Britain and marveled at the



islands' many indigenous species, which include a flightless bird called the kiwi—now a nickname for citizens. Despite their historical role as sheep farmers, 84 percent of today's Kiwis live in urban-suburban areas; one in seven is Polynesian. Rising crime, poverty, and unemployment hamper government plans to streamline an elaborate welfare state.



South Pacific Ocean

Tasman Sea

AREA: 269,057 sq km (103,883 sq mi).
 POPULATION: 3.3 million. ETHNIC GROUPS: European, 81%; Maori, 13%; other Polynesian, 3%. RELIGION: Anglican, 24%; Presbyterian, 18%; Roman Catholic, 15%.
 LANGUAGES: English, Maori. LIFE EXPECTANCY: 75 years. LITERACY: 99%.
 PCI: \$5,940 (U. S.). MAJOR CITIES: Auckland, 820,700; Wellington (capital), 325,700; Christchurch, 299,400. ECONOMY: Agriculture: meat, dairy products, wool. Industries: food processing, forest products, machinery, transportation equipment.

The South Island has only a fourth of New Zealand's population. But it's not a rat race down here. A lot of us would never think of moving. If you're young though, and want to get on—more money, a better future—well, you'll join the drift north."

Scottish-born Dunedin, hub of a rich farming region and a port, ranks as the country's most important university center. The name is Gaelic for Edinburgh; Dunedin is called "the Edinburgh of the South." It was settled by Presbyterians in 1848.

A statue of poet Robert Burns gazes from the city's octagonal heart. Some streets bear Scottish names as, of course, do many people, and a trace of the Scottish burr visits the ear. You are sure to hear someone say "A wee bit. . . ."

During nearby gold strikes beginning in the 1860s, Dunedin flourished as the infant nation's most important city in many ways. Memory of this lingers, but little remains of the vigor. Pleasant, relaxed Dunedin declines little by little.



Youth wears many faces in Auckland, from upwardly mobile professionals of European and Maori descent (opposite) to Pacific islanders (above) who move to New Zealand in search of opportunity. They join with the native Maori to earn Auckland the nickname "capital of Polynesia."

"We're a stable, home-centered, provincial city," said the Reverend Dr. Jack Somerville, retired chancellor of the University of Otago. "We don't have the clout because we haven't got the numbers. A lot of Aucklanders imagine that coming down here is like a journey to the South Pole."

IN MAY—late autumn here—I flew from the South Island across choppy Foveaux Strait to a serenely beautiful forested speck called Stewart Island.

Snug in their sequestered world, Stewart Islanders give little consideration to time's passage or the mainland's problems. "Lonely? That's the whole point," my seatmate remarked as we deplaned. "This is a place where you can get away from it all."

Well, not quite. TV has intruded, and the old manual telephone system is being replaced. (Remember? Two long rings and a short for the Scotts, one long and a short for the Bryants.) I registered at the South Sea Hotel, an aged hostelry of 30 rooms where a gong summons guests to meals.

After lunch I strolled about Oban township, fronting on Halfmoon Bay. Most of the island's 500 or so residents cluster here. People don't bother to lock their doors, and they leave keys in cars. "I'd say there'd have to be about 80 cars," mused a townsman. "Mind you, I don't say they all go." There are a dozen miles of roads, eight of which are tarred. The island itself covers 674 square miles and is largely a nature preserve.

Phillip Smith, who is 43 and a fourth-generation islander, welcomed me. As we sat over coffee and cake in his comfortable house above the bay, he told me that he descends from a whaler and shipwright out of Nantucket—one "Yankee" Smith, who remained here and took a Maori wife.

In his turn, Phil Smith also wrests a living from the sea, like nearly everyone else. And like many of his countrymen he follows the life of a subsistence farmer, keeping a few goats and hens and a bounteous vegetable garden. An occasional deer provides meat for the table; deer are so plentiful and pestiferous throughout New Zealand that they are fair game and extensively hunted. Their numbers are being reduced.*

*See "Red Deer and Man," by T. H. Clutton-Brock, in the October 1986 NATIONAL GEOGRAPHIC.

STEWART ISLAND fishermen harvest and export "crayfish" (rock lobsters), mouth-watering blue cod, the delicate paua (abalone), and grouper. Phil does none of the above. He comanages the New Zealand Salmon Company's farm about an hour's boat trip into the hostile ocean. Salmon farming is a relatively new and growing industry in New Zealand and a good example of the effort to diversify.

"Fishing's not what it used to be," he told me as a few other passengers and I boarded his 43-foot launch. "I was happy to go into salmon." On a dismal, dripping afternoon we donned rain gear, and the old vessel headed into a fractious sea.

In one area of the farm, by a bush-covered islet in Big Glory Bay, I counted 28 sea pens in two parallel lines. Gingerly I walked along the slippery causeway between them, curious to see how salmon are grown. Simple enough, I decided, but not easy.

Hardworking sea farmers place king salmon fingerlings in large cages made of

netting. They make certain that rotating dispensers toss pelletized food to the fish every five minutes during daylight hours. Invading seaweed requires arduous net changing every two to six weeks. The men put in five days and nights at this, berthed aboard a headquarters ship, followed by five days in port. After 18 to 24 months, when the salmon weigh four to seven pounds, they are harvested. Within 48 hours they go on sale in Japan and western U. S. markets.

As we returned to Stewart Island, the weather suddenly worsened. Adventure lost its appeal for me. Gale-force winds lifted up a high, violent sea and spun a layer of froth that clung just above the blue-black water like a shroud. At the helm, peering through pelting rain, Phil nosed our threshing boat into the troughs of horrendous waves. "She's smokin'!" he yelled, pointing to the ocean's eerie blanket. "Those are 60- or 70-knot winds." Beside me a fellow passenger lurched chalk-faced onto a bunk, wretchedly seasick.



Living off the sheep's back is the popular view of rural life in New Zealand, where sheep (facing page) outnumber people more than 20 to 1. Kiwi farmers are world leaders in wool exports and near the top in meat production. Yet a host of economic woes brought on by high inflation, government belt tightening, and lost overseas markets have forced many farmers to experiment with other livestock.

On Ernie Wilkes's Angora goat farm near New Plymouth, veterinarian Danny Hajdu and seven-year-old Christopher Wilkes (below) implant a surrogate mother with eggs taken from a purebred Angora doe. The offspring will be in demand for breeding stock. The best mohair can fetch as much as seven times the price of sheep's wool.



Next day Phil came to the hotel to see me off. Morning wore golden dress. "Not many days we don't get a spit of rain," he said, "and not a day when the sun doesn't break through. Good luck back in New Zealand."

NEITHER Stewart Islanders nor big city sophisticates are typical New Zealanders. Provincial people are, Prime Minister David Lange informed me. One afternoon in Wellington I called at his office in the executive wing of the government center, named the "Beehive" for its startling conical design. A large man with ready laugh and rapier wit, Mr. Lange seated me across his desk and dashed off an incisive sketch.

"Provincial people," he began, "are a good barometer of how basic New Zealanders think and live. They wash their cars on Saturday, probably have their kids to Sunday School, belong to a club, drink in a pub, work, get very worried about their future, worry about law and order." The briefest of pauses.

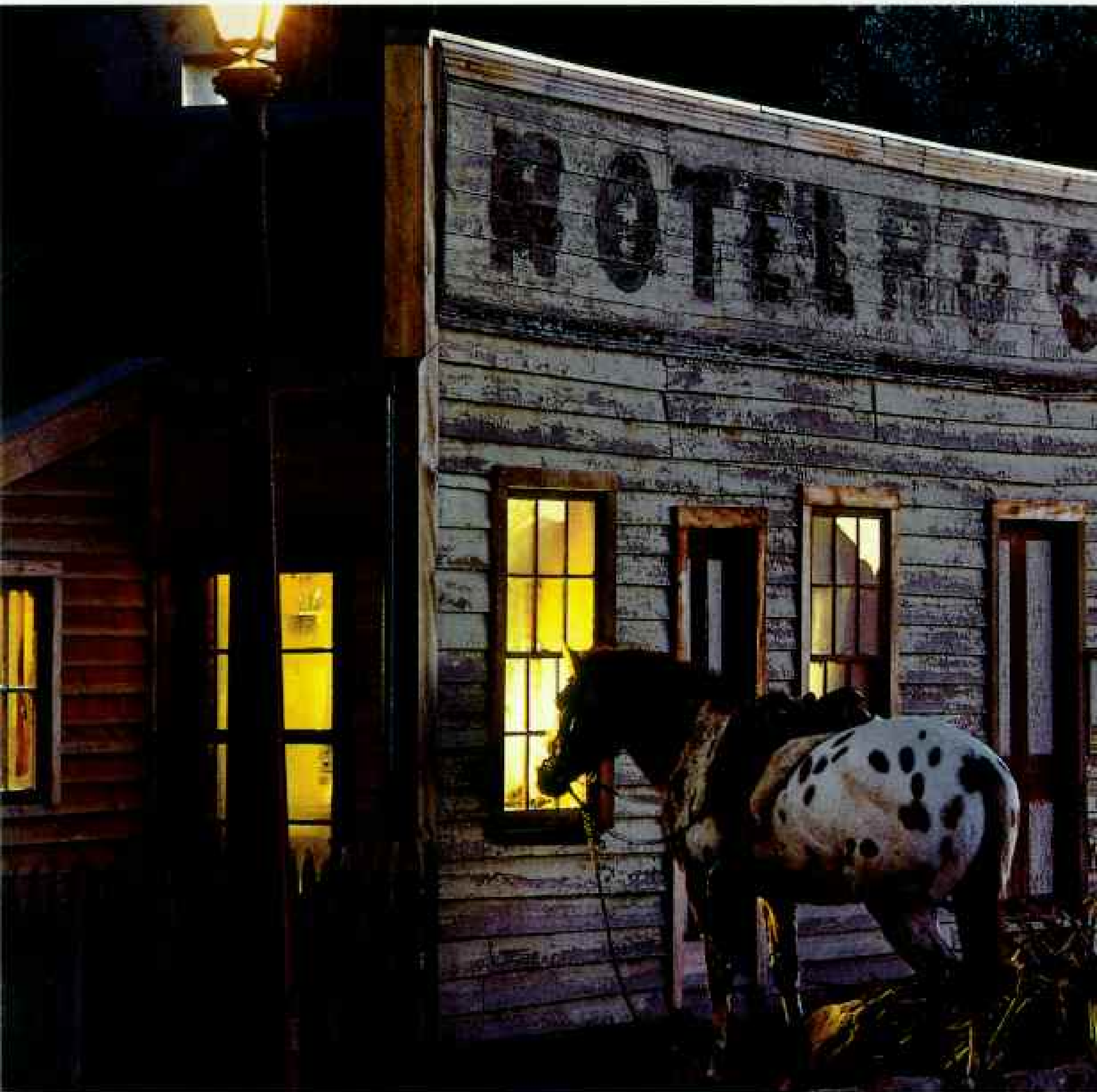
"They generally have a world view nothing like that in the city: Africa a continent of deep suspicion, South America absolutely unknown, Australia beer and surf guards, the U. S. as Disneyland, 'Hill Street Blues,' 'Dallas,' and 'The A-Team.' They observe images which come to them constantly from abroad—but basically get by organizing their own lives, watching the 6:30 news."

The prime minister, a lawyer in private life, summed up: "They are pretty self-reliant, and sporting, if not in actual participation, then certainly as passionate watchers. They have a very basic sense of social justice."

Seem familiar? New Zealanders reminded me time and again of middle and western Americans and, even more so, the English. Don't be misled. They know very well who and where they are. The colonial bonds to Great Britain have been severed, though affection and some of the trappings remain. A parliamentary democracy, the nation is an independent member of the Commonwealth with Queen Elizabeth II as chief of state. Rugby is the national sport. Cricket is highly popular.

As recently as 25 years ago, Great Britain bought more than half the country's exports,





chiefly meat, wool, and dairy products. Today that trade adds up to only 9 or 10 percent, and three other markets are bigger—Japan, Australia, and the United States, all Pacific-rim countries. In total, products are shipped to more than 120 countries. The nation increasingly is a richly endowed world trading partner in the South Pacific.

ABOUT THE SIZE of Colorado, New Zealand rises from the sea nearly equidistant from the Equator and the South Pole. The islands extend a thousand narrow miles. Nowhere are you more than 80 miles from the ocean.

Once there was much more to it. This bit of earth belonged to Gondwanaland, the

vast southern continent that existed a hundred million years ago. As the landmass broke up, the fragment that was to become New Zealand drifted toward its present position. Geologists say that the drift continues, at the rate of a few inches a year.

Cut off from the rest of the world for an eon, a unique flora evolved, including some of the oldest plant forms. Three-fourths of the flowering plants grew nowhere else. No mammals existed except two species of bat. Without predators, flightless birds developed: the ten-foot-high moa, finally hunted to extinction; the weak-eyed, long-beaked kiwi, now the country's endearing emblem; the bumptious weka; and others.

Only yesterday, which is to say a handful of centuries past, the ancestors of today's Maori arrived from the eastern Pacific in great sailing canoes. With them came rats and dogs for food.

Astounded by the vision confronting them, these Polynesians saluted their discovery as Aotearoa—"long white cloud." How immense their new home must have seemed after the small tropical isles they had put behind forever. In gratitude they made another poetic name: Tiritiri o te Moana—"gift of the sea."

Their descendants had the gift of the sea to themselves until relatively recently. In 1642 the Dutch navigator Abel Tasman, first European to sight New Zealand, sought unsuccessfully to come ashore. The Maori killed four of his men and drove him away. Tasman called his landfall Staten Landt. Soon it was renamed Nieuw Zeeland, for a Dutch province.

Time was running out for the Maori, as with the American Indians when Europeans set foot on Plymouth Rock. Capt. James



Rush for gold on the South Island brought thousands of prospectors to the Cardrona Valley in the 1860s. The end of the rush made a ghost town of Cardrona, but the era lives on in the restored facade of its hotel (left), now a favorite refuge for skiers visiting nearby slopes.

Near Motueka, at the northern end of the island, Verena Gruner (above left) cleans flagons for apple juice made by Graham Downs cooperative farm, a commune of 30 people.



Cook landed in 1769. Whalers, sealers, traders, and missionaries soon followed.

In 1840 British sovereignty was proclaimed. Maori chiefs signed a treaty pledging fealty to the crown for a guarantee of their land rights. But cruel conflicts erupted between natives and the *pakeha*—the whites. In time much of the best land fell into pakeha hands, by fair means or foul.

Ever since, Maori have been encouraged, or coerced, into becoming brown-skinned pakeha. Today about one New Zealander in eight is Maori. Sadly, many young people have lost their cultural roots in the cities,

and some have found trouble. Glue sniffing, which is not illegal, plagues downtown streets. According to police, motorcycle gangs are dealing in hard drugs, particularly in Auckland and Christchurch. Half of the country's prison population is Maori.

Many Maori leaders are speaking out, some in cold anger, in a resurgence of Maori culture and traditions. Their voices are heard, and they are educating the pakeha. The nation is trying to come to terms with biculturalism and bilingualism. Two peoples, New Zealanders all, are slowly rubbing the rough edges off one another.



Capital city Wellington presides over New Zealand's parliamentary democracy from the northern shore of Cook Strait. Settled in 1840, the city is noted for steep hills, earthquakes, and gusting winds. "You can always tell a Wellington man," goes an old joke, "by the way he grabs his hat coming around a corner."

New Zealand's rolling stock rates with the most decrepit anywhere. No matter. People pamper their cars. They must last a long time; the cost of a new one is prohibitive for many. In Queenstown, unwinding, I found a sympathetic listener. "New Zealanders are nice people," he reflected, "until they get behind the wheel."

Tourism ranks foremost as a growth industry, which compelled me to this mecca. Queenstown rests on the shore of crystalline Lake Wakatipu, superbly sited beneath a backdrop of 7,000-foot mountains called the Remarkables. Like resorts throughout the country, it offers hotels and shops and ready access to sports and excursions.

Here in New Zealand you can choose your pleasure. Ski-planes and helicopters will lift you year-round to ski runs down glaciers, or during the winter season to nearby slopes. Fishermen arrive from around the world to test lakes and rivers; trout weighing six or eight pounds are not unusual.

If hiking the backcountry appeals, you can choose pristine paths from the top to bottom of New Zealand. Queenstown recently laid out a new one—the Greenstone Valley Walk. It follows an ancient Maori trail along alpine valleys, beside lakes, over river flats, and through evergreen beech forests. The hike takes three or four days.

Bigger things, I found, may be in store for this part of the world—much bigger. Queenstown, and New Zealand for that matter, were surprised to learn last year that a 325-million-dollar (U. S.) resort development is planned on Lake Wakatipu. The first stage calls for as many as 140 chalets, a shopping complex, an international-class 300-room hotel, an airport, and a four-million-dollar championship golf course designed by Arnold Palmer.

In a joint venture of New Zealand and U. S. interests, the sponsors also have purchased a neighboring 37,000-acre sheep and

ONE DAY in the spacious little South Island city of Invercargill, I picked up a rental car and charged—the normal pace of New Zealand traffic—about 125 miles north to Queenstown. To this American, driving on the left side of narrow, two-lane mountain highways was always thrilling, especially with the added fillips of tailgating, falling rock, relentless oncoming high beams on the blackest of nights, and, once, a raised, clenched fist.

It astonished me to see how much speed drivers coaxed from their steeds, for surely

cattle station. It is expected to continue operations while guests use it for hunting, fishing, riding, and other outdoor activities.

THIS SWANK ENCLAVE should pour millions of dollars into Queenstown and the country. But up at the head of Lake Wakatipu nothing much is likely to rub off on the lonely old community of Glenorchy. It did once, before the gold play ran out, and again when miners were honeycombing the overhanging mountains for scheelite, a source of tungsten. When I stopped by, the most action

I could find was a game of darts at the pub.

I went around to Ted Barnett's bungalow and knocked, knowing that he has dug, blasted, and shoveled scheelite for close to half a century. A hardy 70, white haired, he is the last old-timer. We talked in his tidy kitchen. Snow had sealed his mine.

"To get there," he said, "I go up the mountain as far as I can in a Land-Rover, then a small tractor, then a ropeway across a gorge to the shaft. My hut is at the entrance. The tunnel runs around 2,000 feet. I go in at eight, work to five or six, have my tea. Sometimes I work nights—whatever I feel



like. I don't have a helper. There's nobody to annoy me. Weekends I come down here."

Ted Barnett stood. "When the snow is gone, I'll go back up. Not much money in it, what with costs going up. It gets in your blood."

I thanked Mr. Barnett and drove off. To live in Glenorchy is to choose your place and abide in peace, far from the daily torments of a contentious world. But not to be out of touch, not so long as there is television and the friendship of books.

A block or two away I stopped beside a small, one-room building. Marjory de

Life in the "wop-wops," or backcountry, means fence tending at daybreak for James Innes (below left), who raises sheep, cattle, and red deer on his 35,000-acre ranch, Haldon Station, on the South Island. The 60-mile fence is made for high-jumping deer, raised primarily for breeding stock. Innes's nine-year-old son Andrew (below, at left) and nephew Dougal make up the entire student body at the ranch's school, taught by Rhonda Faulks, whose husband is stock manager.



The great escape from his broiler shed doesn't faze Ron McCarroll, manager of the Bounty Park Chicken Farm near Invercargill. In fact, he says the mural by a local art teacher has made the building a landmark. And for marketing Tau Tau—a Maori word used as a poultry brand name—"it's extra good, actually."

Malmanche was unlocking the district library, which opens from 2:30 to 3:30 every Friday afternoon. It dates from the 1890s. Books lined the walls floor to ceiling. There are 20 subscribers.

"The Country Library Service van comes from Christchurch three times a year," she told me. "You can request books. Most everybody turns up when the van comes."

RETURNING to Queenstown, I caught a ride to Dunedin with Ralph Brown, an American-turned-New Zealander who is part owner of several hotels and operates a high-country station. He first came 20 years ago, approved of what he saw, and settled here in 1976.

"I like the outdoors, the free and easy lifestyle," he told me. "I live on a lake. I fish in my backyard. I can be skiing in eight minutes. New Zealand is about the way, I think, most people would like to see America operate. We have a very strong people-to-people liking of the United States. Our antinuclear policy is not anti-American."

As we drove, I took the opportunity to inquire about New Zealand's socialism. Who gets what? Ralph Brown ticked off a short list. Unemployment benefits continue until you find work. You may retire at 60 on an income equal to as much as 80 percent of the average New Zealander's pay. Medical care, including hospitalization and medicine, is essentially free. "If we have an accident on the road"—he glanced at me—"the government pays for our treatment."

"Did you say *our* treatment?"

Yes, he said, he did.

To help pay for such programs, a value-added tax of 10 percent was levied last October. Income tax was reduced, however, and now ranges from 15 percent of taxable income of \$9,500 to 48 percent of income



above \$38,000. (The New Zealand dollar is worth around 55 cents U. S.)

We headed into the Alexandra district, a region noted for cherries, apricots, peaches, plums, apples, and pears. Much of this fruit is exported, all of highest quality. When the orchards bloom in September and October, the Clutha River Valley is an Eden of color.

Ralph pulled over at a roadside market. No attendant was on hand, only a sign: "Put money in the slot. Thank you." Driving on, we feasted. An appetizer of blackberries and raspberries; sweet, tangy apples and plump grapes for the main course; a choice of



nectarine, plum, or pear for dessert. There are times, I told Ralph as we parted, when the highways are a downright pleasure.

I MADE MY WAY NORTH along the ocean and turned west at Timaru, pointing for the Mackenzie Country's wide-open spaces. Beyond rolling foothills spread the South Island's snow-covered roof, the Southern Alps, presided over by 12,349-foot Mount Cook—"cloud piercer" to the Maori. Presently I swung down a deserted gravel track, proceeded 35 lonely miles, and pulled up to Haldon Station. Had

it been Thursday, I might have seen the mail-and-supply truck.

Minutes later owner James Innes landed in his Cessna. "I'm up and down the country just about every day of the year," he said. "If I have to drive, I don't go. I don't have the time to waste."

Haldon Station is not a traditional high-country run, because James Innes stands as one of New Zealand's leading innovators. True, on his 35,000-acre station he does look after 20,000 sheep, 1,200 beef cattle, and about 4,000 deer. That's for starters.

His three helicopters capture deer in the



wild, lift skiers to mountain slopes, transport oil and mineral explorers and foresters. One of the breeding programs he directs, involving 30,000 Hereford cows throughout the South Island, produces superior cattle. He has budgeted a million dollars for university research into deer stress and disease, and a blood-testing program to detect tuberculosis—potentially the deer industry's most serious problem—has been developed. New Zealand's 3,000 deer farmers cater to growing markets abroad for venison.

"I'm always on the lookout for new ideas," James, who is 37, declared. "I'll show you my latest one." We churned down the road a short distance and suddenly halted—a piece of paper, odious sight, was littering the ground. He picked it up. "I run a tight operation," he said. "We must make a good impression on people who come here to spend a lot of money. I don't allow my men to smoke, grow beards, or have long hair."

We parked atop a hill, got out, and looked down on the shore of Lake Benmore. James Innes swept an arm. "We're going to build a world-class lodge there. It won't be big, only about 20 units. But I expect it will be the most expensive place in New Zealand."

James hurried back to the station's office complex to ship out a \$10,000 ram to an Arizona buyer. I spent a few minutes sipping coffee with his wife, Belinda, in their commodious home. Friendly and soft-spoken, she is the mother of three sons, two away at boarding school and the third to leave home soon at the age of nine.

Belinda said, "I spend a lot of time entertaining visitors who come to look at the funny people living at the end of nowhere." She laughed. "We do have a lot of guests from

Cascading vegetation frames a climber descending into a cave (left) carved from North Island limestone by underground streams near Te Kuiti. The South Island's Moeraki Boulders (right), spherical lime salt concretions formed on the seafloor millions of years ago, have eroded from cliffs thrust up by tectonic action.

The Wairakei Geothermal Power Station taps a 450°F underground volcanic steam field (above right). Four percent of New Zealand's electric power comes from geothermal sources.



overseas. They have to take us as they find us. Social life? Sometimes we have a party in the office conference room. There may be 40 friends from all around.

"I started a stock-market investment club a while back. There are ten members, ladies on the station. No men. Definitely no men. We want to do our own thing. We meet once a month, and so far we're doing fine. Last year our return was 56 percent."

RELUCTANTLY I resumed my northward journey, crossing Cook Strait by ferry to the North Island and driving up the west coast into Taranaki Province, one of the nation's most intensive dairying regions. People here spend their lives in thrall of an inspiring vista. For miles around, the countryside is dominated by Mount Egmont—Taranaki is its Maori name—whose volcanic cone rises far above sea-level pastures in perfect symmetry.

Another compelling sight stands beside the sea beyond New Plymouth, the province's service center. This is the mammoth, billion-dollar-plus Synfuel project, the world's first natural-gas-to-gasoline plant. His Royal Highness the Duke of Edinburgh officially opened it last year.

Conceived at a time when New Zealand, with very little oil of her own, was paying almost prohibitive import prices, the project seemed an excellent and needed investment. As a spokesman said to me, "When the loans are paid off in 1996, it will be like hitting the jackpot." New Zealand owns 75 percent of Synfuel.

Unfortunately, Synfuel's profitability nose-dived when oil prices fell. For the present it is an expensive white elephant.

For a change of pace, I continued north to Rotorua, a special city whose geysers, hot springs, and pools of boiling mud have lured sightseers for more than a century. Some 800,000 visit every year; many if not most of the 140,000 U. S. tourists pause to enjoy the geothermal wonders—including elaborate hot mineral-water pools featured by hotels and motels.

I too. But Rotorua has a problem. The subterranean kettle pot is running out of steam. For years residents have tapped into the hot water and steam to heat their homes.





"No nukes" is the message New Zealanders send with their annual demonstrations on Hiroshima Day, August 8 (left). Prime Minister David Lange (above), here riding a roller coaster with his daughter, Emily, near Auckland, recently barred U. S. nuclear ships from New Zealand ports. The United States responded by suspending its defense agreement under the ANZUS treaty, leaving New Zealand's armed forces, including men on the Pukaki (right), to shoulder the nation's military burden with Australia as its closest ally.



Industrial plants and commercial establishments have sunk their own bores. Now geothermal activity has declined; water levels and temperatures have fallen. Not long ago the government intervened with a conservation plan that closed down some bores. Those that remain must be granted licenses.

Quite another attraction proved more compelling to me. On a peerless afternoon I tested the Rotorua Golf Club's Arikikapakapa course. Its short but cunning 18 holes proved as formidable as its name, and I came away rebuked. Golf's devotees are

legion in New Zealand; courses dot the hilly countryside. Surely here is another measure of a truly civilized society.

BESIDES CREATING a volcanic landscape of cones and craters, nature's fiery past helped foster yet another wonderment in this region that Cook named the Bay of Plenty. Over the centuries, showers of ash built up the soil. Basking in a warm and sunny climate, blessed by plenty of rain, these fertile coastal lowlands today produce a



Touching fifty generations of Maori ancestors, Canon Wi Huata of Hastings chants the history of his family carved on the Rangi Huata, or "heavenly spear," for his six-year-old grandson, Hemi. Keeping Maori culture alive is vital during this time of growing racial tension in New Zealand, says the Anglican priest. "Every race has a contribution to make to the glory of God."

cornucopia of succulent berries—especially the phenomenally popular kiwifruit. Since the 1950s New Zealand has become by far the leading exporter, and 65 percent of the country's kiwifruit crop comes from here. (See "The Captivating Kiwifruit," following pages.)

Here again, I learned, New Zealanders are diversifying. "A great deal of research and development is going into other fruits," a packing company manager told me. "We're only in the infancy of exporting persimmons for the Japanese market. And our avocados are going to Australia."

Add this to the list: the embryonic industry of shipping cut flowers, principally orchids and daffodils, by air to U. S. and northern European markets.

Amenities all. Yet another—wine—slowly attracts world attention. Wine is produced in several regions where temperature, rainfall, and sunshine result in top-quality grapes. In recent years several New Zealand wines have won gold and silver medals in international competitions.

NOW IT CAME TIME for me to seek out New Zealand's northern tip, so to say farewell. I drove from Auckland, making stops along the way. One was the town of Russell, on the magnificent Bay of Islands.

When Charles Darwin and H.M.S. *Beagle* set anchor here in 1835, this place was notorious far and wide as Kororareka, hellhole of the Pacific. Darwin detested it. Along the shore, grogshops and brothels tended to deserters and escaped convicts. Whaling ships put in for fresh food and water; drunken sailors lashed themselves wrist to wrist and fought with knives to the death.

"The very refuse of society," declared Darwin. He and his shipmates contributed 15 pounds toward the construction of an Anglican church. Nearby, the first capital of New Zealand was established; a year later it was transferred to Auckland and then to Wellington.

Russell grew on Kororareka's bones. I found it making a living at oyster farming in the tidal flats, commercial fishing, and tourism. Anglers worldwide long have esteemed it as the gateway to fine deep-sea fishing. It is a pretty and pleasant town.

I WALKED UP a gentle rise to the austere church, New Zealand's oldest. Early on in its 150 years a cannonball came skipping from the bay; the church bears the wound in its side. In the graveyard lie many men who followed the sea, Americans among them.

"George B. Sherman, Second Officer of Sloop 'Lancaster,' New Bedford," began a faded inscription without a date, "was suffocated while smoking ship . . . 28 years 14 days."

Smoking ship? The Reverend Peter Rynd, retired dean of Suva Cathedral, Fiji, and devoted assistant rector of the church ("We do love it and care for it") told me what had happened to George Sherman. "They would burn sulfur down below to kill the rats and ward off the plague."

New Zealand's colonial history was born at this place and confirmed a short distance away at Waitangi. Here on February 6, 1840, Maori chiefs and pakeha leaders signed their historic—and still controversial—treaty. The anniversary is the country's national day.

On another dazzling day I headed my car northward until the road ran out, the last road you can travel, at a rocky point overlooking the tumultuous embrace of Tasman Sea and Pacific Ocean: Cape Reinga.

A lighthouse stands sentinel here, sometimes in futile warning. Sunken ships lie beneath that wild world—combers look to be curling a furious 10 feet high, but they are 20. Few tourists have come this day; bus after bus arrives in season. Below, as far as you can see, then much farther, runs Ninety Mile Beach, to the eye absolutely straight, devoid of humanity, lonely and exquisite.

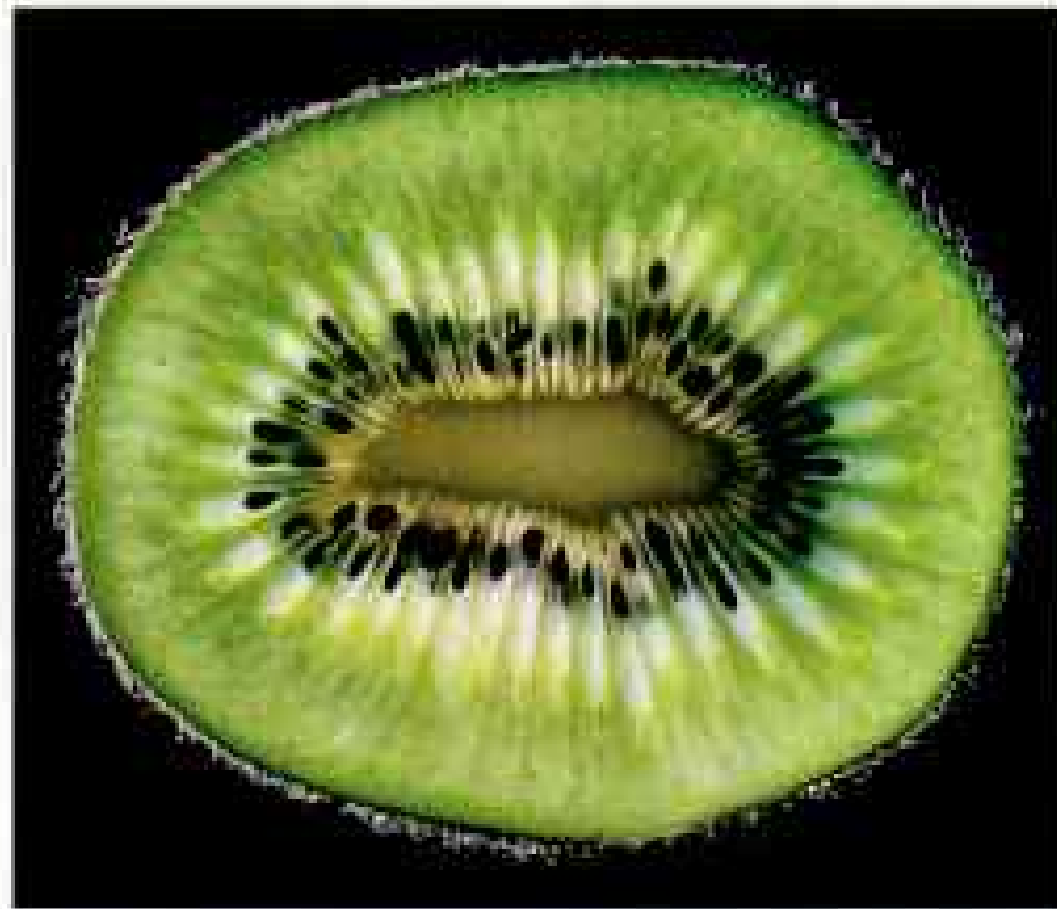
Cape Reinga is sacred to the Maori. From a gnarled pohutukawa tree, rockbound beside the ocean, the spirits of Maori who have found death begin the underworld journey to Hawaiki, their lost ancestral homeland.

I thought back on what New Zealand had openly and fairly told me of herself. Something a Maori leader had said about his country came to mind: "I'm an optimist. I have the pessimism of the intellect and the optimism of the heart."

The New Zealanders are greathearted people. □



The Captivating KIWIFRUIT



By NOEL D. VIETMEYER

Photographs by JIM BRANDENBURG

THIRTY YEARS AGO, growing up in New Zealand, I often sliced into a brown berry that looked like a duck's egg in a bristly hair shirt. Repulsive? Not really, for I knew a secret: The berry's odd appearance disguised an equally exotic interior, a sunburst of neat white streaks radiating from a cream-colored core, past tiny black seeds and into shimmering green flesh (above). Sweet-tart in taste, it seemed a succulent blend of strawberry, banana, melon, and pineapple flavors. Delicious! I loved the kiwifruit.

I still do, and today this peculiar product of a woody vine is captivating palates outside New Zealand at an extraordinary pace. In 1986 more than a billion kiwifruit, once called Chinese gooseberries, were tucked into trays and shipped to at least 30 nations. Thousands of acres are newly planted each

year in a dozen or more countries, including the United States, France, Japan, and Italy, the leading producers after New Zealand.

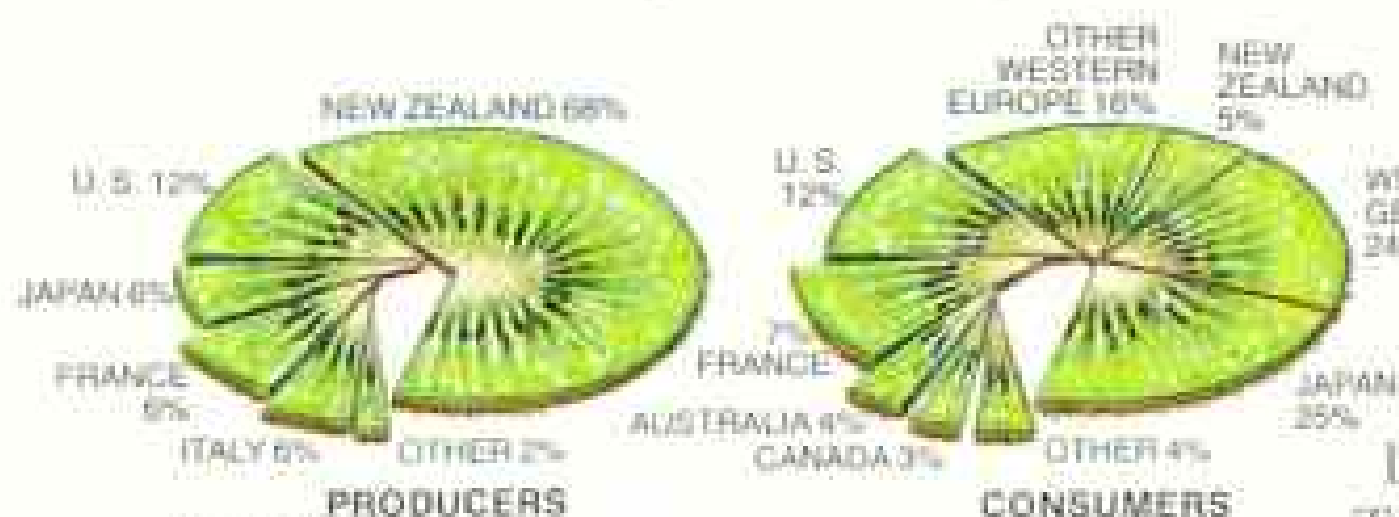
This universal success has uniquely New Zealand roots. The kiwifruit's conversion to a commercial crop occurred in New Zealand, and its name—coined in the 1950s as a marketing tactic—conjures up both that likable country and its whimsical, flightless native bird, renowned for oversize eggs and hairlike brown feathers. Moreover, exports of the fuzzy, four-ounce berry are increasingly important to New Zealand's economy and the creator of more millionaires than anything else in my homeland's history.

The only fruit with such bright green flesh, the kiwifruit is one of just a handful of food plants domesticated within the past thousand years. Originating in the Yangtze Valley, it has long been a favorite of the

Sweet emerald treasure, the kiwifruit has built manors for once struggling New Zealand farmers. Checkerboard windbreaks of trees shelter the profitable berry vines on the North Island, where most of the world's crop is grown.



Honored as the father of the kiwifruit, the late James MacLoughlin (facing page) stands by a vine he planted in 1937 in one of New Zealand's first commercial orchards. Seeds of a small berry known in China as mihoutao, or monkey peach, were brought to New Zealand early in this century. By



1985 FIGURES

the 1930s experiments had yielded a larger, more flavorful fruit called the Chinese gooseberry.

Exported to Europe in the 1950s, it was strongly promoted in the U. S. for the first time in 1962 by Los Angeles produce marketer Frieda Caplan (top). She endorsed the commercial name kiwifruit, suggested by the fuzzy skin that makes it resemble New Zealand's flightless kiwi bird. The payoff began about 1980 as the nutritious fruit moved from restaurant novelty item to supermarket staple. Production in California alone has since risen more than 500 percent.

Chinese, glorified in poetry as early as the eighth century. Chinese peasants still gather the wild fruit for sale in rural markets.

THE TRANSFORMATION of a small, hard, and wild Chinese berry into fleshier, tastier kiwifruit began about 1904, when a traveler returned from a China visit with seeds for Alexander Allison, a nurseryman on New Zealand's North Island. In the following three decades he and other gardeners developed superior kiwifruit vines through careful selection, pruning, and grafting. Most of these early fanciers were as much interested in the vine's showy white blossoms and attractive fan-shaped leaves as in its berries.

Kiwifruit farming got its commercial start in the 1930s, most successfully at Te Puke on the North Island's east coast. The late James MacLoughlin became the father of the modern kiwifruit—and ultimately a millionaire—by chance.

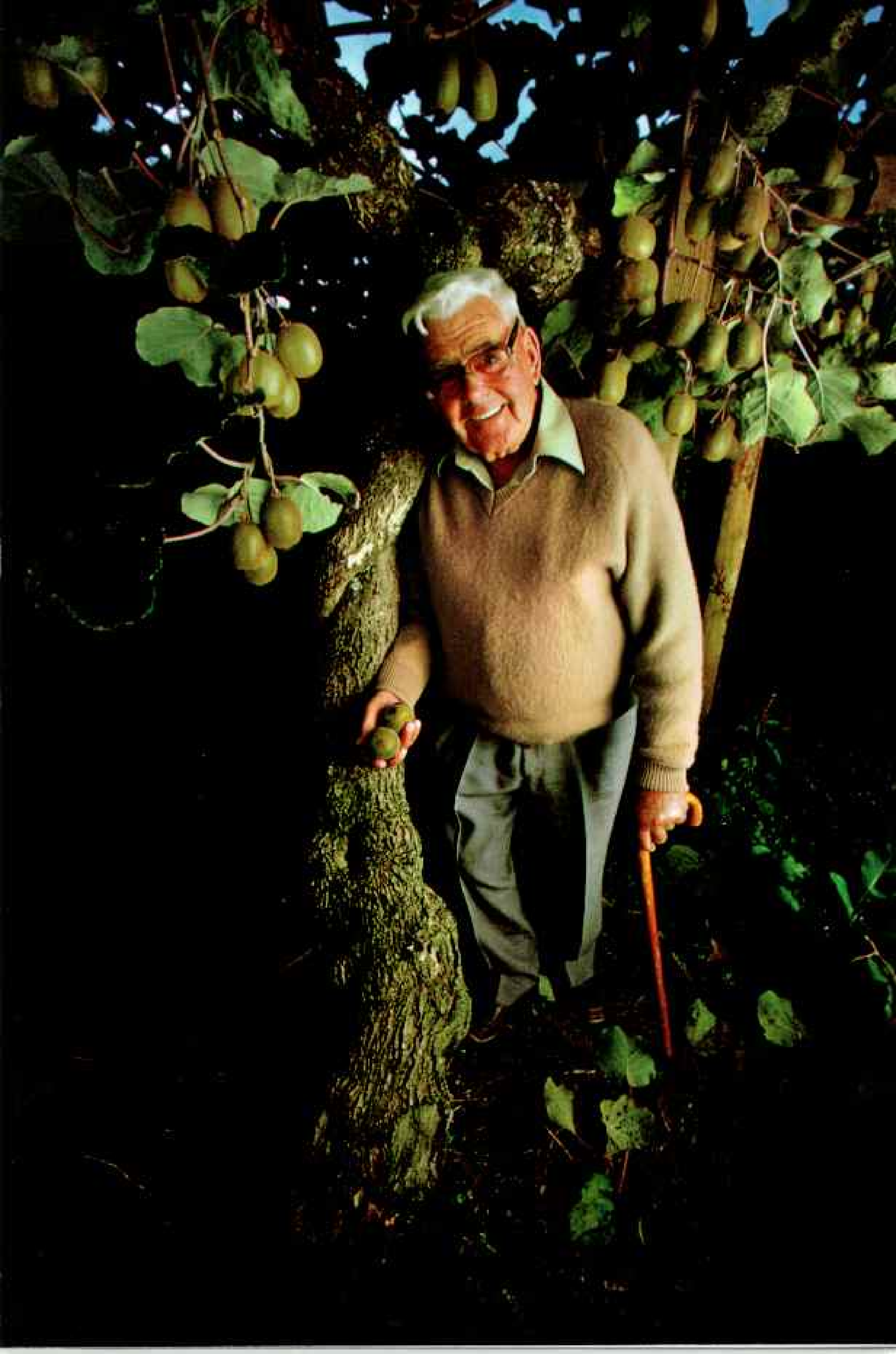
After he lost his job as a shipping clerk during the Great Depression, Jim's wife's aunt invited them to stay on her lemon orchard at Te Puke. "Later the bottom fell out of the lemon market," he told me, "but a neighbor sold the kiwifruit from a single plant for five pounds [then worth about \$20 U. S.]. To me that was a lot of money, so I risked putting in half an acre of them."

Luckily for MacLoughlin, the warm, wet climate and volcanic soil at Te Puke favored his vines.

Neighbors soon launched their own commercial orchards, which further expanded during World War II when GIs stationed in New Zealand developed a taste for kiwifruit.

Then chance intervened again. In 1952 an English fruit importer ordered a shipment of New Zealand lemons. "To fill spare space in the ship, we included ten cases of kiwifruit," Jim MacLoughlin explained. "A dock strike delayed the ship five weeks and the lemons arrived rotten, but the kiwifruit were in perfect shape." They sold well, and New Zealanders suddenly realized that they'd opened a world market.

Not all first reactions to kiwifruit were so favorable, pioneer exporter Mack Nicol told me one day in Auckland. "In 1976 our agents in England delivered a case of kiwifruit to





Gentle harvesting by hand begins in May in New Zealand (right) and in October in California. Kiwifruit vines grow as rapidly as eight inches a day and must be heavily pruned. Fertilized by pollen from male vines, carried by bees or the wind, female vines bear the fruit. High acidity allows it to retain color once sliced. Inspectors check for canning quality (left) in Mount Maunganui, New Zealand.

Lloyds of London and left it in the foyer. It was a time of Irish Republican Army bombings; someone was suspicious, looked in the box, and decided it held grenades. The building was emptied, the bomb-disposal squad was called, and those harmless fruits were blown up!"

By then Jim MacLoughlin's experiment had set off a horticultural boom as well, making tiny Te Puke the kiwifruit capital of the world. Today the local population of some 6,000 swells to almost 10,000 from May to July, the picking season, and a Te Puke kiwifruit-packing and refrigeration house is the largest in the world.

Dairy farms that once surrounded Te Puke are fast disappearing: An average hundred-acre farm earns the equivalent of \$30,000 U. S. yearly, but can bring in a million dollars if planted with kiwifruit. Male vines produce pollen to fertilize fruit-bearing females, and both sexes grow so vigorously—as much as eight inches in 24 hours—that unless constantly pruned they throttle themselves in unresolvable tangles.

Harvesting kiwifruit—by hand and before they are fully ripe—has become a frenzied national event in New Zealand. Daily for 12 weeks, thousands of laborers cradle their pickings in apron-like canvas slings, and in packinghouses graders hover over the fruit as it rolls down chutes and jounces along belts. Sorted, wrapped, and cushioned in trays like eggs, the berries are chilled in cool sheds at an unvarying zero degrees Celsius. At that temperature the kiwifruit remains in perfect condition for six

Noel D. Vietmeyer studies the economic potential of neglected plants and animals for the National Research Council of the U. S. National Academy of Sciences. National Geographic contract photographer Jim Brandenburg was Magazine Photographer of the Year in 1980 and 1982.



months or more; it keeps for weeks even in a home refrigerator.

In 1985, 90,000 tons of fresh kiwifruit—and an estimated 12,000 tons of canned, frozen, dried, or juiced fruit—left New Zealand for overseas markets. By 1990 New Zealand may export a total of 300,000 tons annually.

RECENTLY a "cheeky little wine" has also begun flowing out of New Zealand's kiwifruit orchards. "Our wine is often mistaken for a Riesling," David Manton said as we quaffed his product at his modern winery near Tauranga on the North Island. Hard to believe that it wasn't made from grapes: It was dry and smooth and the color of a normal white wine. It was also lower in alcohol.

A gold-medal winner in European competitions, Manton's kiwifruit wine has been adopted by Japanese businesswomen



An "intense kiwifruit bouquet . . . that has elegance and style," judged tasters who gave four stars to a kiwifruit vintage from New Zealand's Durham Light Winery.

as an alternative to sake and whiskey, traditionally men's drinks. "We're among New Zealand's largest export wineries," Manton told me, "and we've only been in business four years. The grape is the wrong fruit for wine making!"

In the 1930s U. S. Department of Agriculture researchers planted New Zealand kiwifruit vines in Chico, California, establishing a crop now worth 40 million dollars annually. Most is exported to Europe, Japan, and Canada, but a substantial share appears in U. S. supermarkets. Because the California crop matures in October and the New Zealand harvest begins in May, kiwifruit is available all year.

LIKE AN AVOCADO, a kiwifruit is ready to eat when slightly soft to the touch. Cut in half, it can be scooped out with a spoon. Kiwifruit seeds are edible, and the sliced green flesh is slow to turn brown, a boon for fix-ahead salads, garnishes, desserts, and main courses. Enzymes in the fruit even make it a good meat tenderizer.

According to a study by the Produce

Marketing Association of Newark, Delaware, kiwifruit may be as good for us as it is good tasting, and the more traditional apple, pear, peach, or orange cannot compare to it nutritionally. Gram for gram, the kiwifruit provides more iron, magnesium, phosphorus, potassium, vitamin C, and riboflavin than any of them. A kiwifruit is also high in fiber, low in calories (about 45), and has no cholesterol or sodium.

Up from nowhere, the kiwifruit seems destined for a place in the world's diet forever. As orchards multiply, so will desirable mutations—genetic variations that could be propagated to create berries with less fuzz or vines that are self-pollinating or bear more heavily. Recently it was reported that the Chinese were experimenting with a variant whose fruit is red inside. Might this be the lucky chance that triggers another kiwifruit boom?

With a plant this astonishing, who would discount it? The secret I knew as a youngster is well and truly out, and I suspect that the kiwifruit has a few more pleasant surprises under its hairy skin. □

NATIONAL GEOGRAPHIC SOCIETY

"For the increase and diffusion of geographic knowledge"



THE NATIONAL GEOGRAPHIC SOCIETY is chartered in Washington, D. C., as a nonprofit scientific and educational organization. Since 1890 the Society has supported more than 3,100 explorations and research projects, adding immeasurably to man's knowledge of earth, sea, and sky.

GILBERT M. GROSVENOR, President
OWEN R. ANDERSON, Executive Vice President
ALFRED J. HAYRE, Vice President and Treasurer
FREDERICK C. GALE, **LEONARD J. GRANT**, **JOSEPH B. HOGAN**,
JAMES P. KELLY, **ADRIAN L. LOFTIN, JR.**, **LEWIS P. LOWE**,
RAYMOND T. McELLIOTT, JR., **CLETIS PRIDE**, Vice Presidents
EDWIN W. SNIDER, Secretary **SUZANNE DUPRÉ**, Corporate Counsel

BOARD OF TRUSTEES

GILBERT M. GROSVENOR, Chairman
OWEN R. ANDERSON, Vice Chairman
LLOYD H. ELLIOTT, Vice Chairman
 President, George Washington University
MELVIN M. PAYNE, **THOMAS W. McKNEW**, Chairmen Emeritus
JOE L. ALBRITTON, Chairman, Riggs National Bank
THOMAS E. BOLLIER, Chairman of the Board, Bell Atlantic
FRANK BORMAN, Vice Chairman, Texas Air Corporation
LEWIS M. BRANSCOMB, Kennedy School of Government, Harvard University
ROBERT L. BREEDEN
J. CARTER BROWN, Director, National Gallery of Art
WARREN E. BURGER, Chief Justice of the United States (Ret.)
MICHAEL COLLINS, President, Michael Collins Associates
GEORGE M. ELSEY, President Emeritus, American Red Cross
WILBUR E. GARRETT

Trustees Emeritus

CRAWFORD H. GREENEWALT, **CARYL P. HASKINS**, **CURTISE L. MAY**,
WM. McCHESNEY MARTIN, JR., **LAURANCE S. ROCKEFELLER**,
FREDERICK G. VOSBURGH, **JAMES H. WAKELIN, JR.**,
JAMES E. WEBB, **CONRAD L. WIRTH**

COMMITTEE FOR RESEARCH AND EXPLORATION

MELVIN M. PAYNE, Chairman
T. DALE STEWART, **BARRY C. BISHOP**, Vice Chairmen
HARM J. DE BLIJ, Editor, *National Geographic Research*
EDWIN W. SNIDER, Secretary
WILBUR E. GARRETT, **GILBERT M. GROSVENOR**, **CARYL P. HASKINS**,
 Former President, Carnegie Institution of Washington, **THOMAS W. McKNEW**,
BETTY J. MEGGERS, Research Associate-Anthropology, Smithsonian Institution,
PETER H. RAVEN, Director, Missouri Botanical Garden, **CHARLES H. SOUTHWICK**,
 Professor of Biology, University of Colorado, **JOHN H. STEELE**, Director,
 Woods Hole Oceanographic Institution, **GEORGE E. STUART**, **JAMES H. WAKELIN, JR.**,
GEORGE E. WATSON, Former Curator of Birds, Smithsonian Institution,
FRANK C. WHITMORE, JR., Research Geologist, U. S. Geological Survey,
 and **HENRY T. WRIGHT**, Professor of Anthropology, University of Michigan

ADMINISTRATION

ASSISTANT VICE PRESIDENTS: Joyce W. Graves (Asst. to the Pres.), Howard R. Hallison, Thomas E. Kulikowsky, Ross L. Mufford, Ward S. Phelps, H. Gregory Platts, Carl M. Shrader, Paul B. Tyler, **ASST. TREASURER**: Dorothy M. Wagner,
GEOGRAPHIC LIAISON: Barry C. Bishop, **ASST. TO THE PRESIDENT**: Diplomatic and Civic Affairs: Richard E. Pearson, *Special Projects*: Robert E. Dull
Accounting: Dorothy J. Edwards, Douglas E. Hill, Laura L. Leight, George E. Newstedt, *Admin.*: D. Evelyn Carnahan, Robert V. Koenig, Zbigniew Jan Lutyk, Marita M. Marschallko, Myra A. McLaughlin, Jennifer Moseley, Shirley Neff, Janet C. Newell, Jimmie D. Pridemore, Joyce S. Sanford, Frank M. Twigan, *Computer*: Scott Bolden, Warren Burger, William L. Chewing, George F. Habbs, Ronald C. Kline, Richard A. Mochler, James G. Schmelzer, Harold E. Smith, *Exec. Services*: Wendy G. Rogers, Dean R. Gage, Carl W. Harmon, Jr., Albert Meyer, *Membership Services*: Margaret L. Bassford, Robert C. Dove, William T. McDonnell, Marguerite M. Wise, Peter F. Woods, *Personnel*: Robert E. Howell, Glenn G. Pepperman, Shirley N. Wilson, *Promotions*: Joseph S. Fowler, Joan Anderson, Eileen W. Bowering, James R. Dimond, Jr., Robert L. Feigt, Thomas M. Kent, Charles T. Kneeland, F. William Rath, *Purchasing*: Robert G. Corey, Margaret Cole, Thomas L. Fletcher

PRODUCTION SERVICES

Quality: Joe M. Barlett, Frank S. Oliverio, *Pre-Press*: Geoffrey T. McConnell, Billy B. Barnett, Richard A. Bredeck, Elwood M. Kuhler, Jr., Phillip E. Plude, Bernard G. Quattrick, *Photographic Lab*: William S. Petrine, David H. Chisman, James H. Trout, Alfred M. Yee, *Printing*: Hans H. Wegner, Joseph M. Anderson, Sherrie S. Harrison, *Admin.*: Lawrence F. Ludwig (Director); Joan S. Simms

ADVERTISING

Vice President: George E. Moffat, *Sales Mgr.-West*: Philip G. Reynolds, *Sales Mgr.-East*: Jack Lynch, *Office Mgr.-Detroit*: O. W. Jones, Jr., *Los Angeles*: Robert D. Johnson, *San Francisco*: James D. Shepherd, *International Adm. Dir.*: Michel A. Bourin, 90, Champs Elysees, 75008 Paris, Washington—*Promotion*: Pandora Browne, *Operations*: G. Bartha Lapham, *Marketing/Sales Development*: Alex MacRae, *Research*: Ronet A. Schewn, *Production*: Gail M. Jackson

COPYRIGHT © 1987 National Geographic Society, 17th and M Sts., N.W., Washington, D. C. 20006. Second-class postage paid at Washington, D. C., and elsewhere. **NATIONAL GEOGRAPHIC** and **Yellow Border**: Registered Trademarks of Marine Registrations. \$18.00 a year, \$2.25 a copy. **POSTMASTER**: Send address changes to National Geographic (ISSN 0027-9578), P. O. Box 2374, Washington, D. C. 20013.

NATIONAL GEOGRAPHIC MAGAZINE

GILBERT M. GROSVENOR President and Chairman

WILBUR E. GARRETT Editor

JOSEPH JUDGE Senior Associate Editor

THOMAS R. SMITH Associate Editor

SENIOR ASSISTANT EDITORS

Thomas Y. Canby, Science; John B. Curver, Jr., Cartography; William Graves, Expeditions; Thomas R. Kennedy, Photography; Robert W. Madden, Layout; Samuel W. Matthews, Production; O. Luis Mazzalana, Control Center; Charles McCurry, Contract Writers; Bart McDowell, Special Projects; Elizabeth A. Moize, Legends; Howard E. Paine, Art; John J. Putman, Manuscripts; W. Allan Royce, Illustrations; Mary G. Smith, Research Grant Projects; Ann K. Wood, Research

TEXT

ASSISTANT EDITORS: Kent Brim, Rowe Findley, Rick Gore, Alice J. H. Marie Severy, Peter T. White
SENIOR WRITERS: Thomas J. Abercrombie, Harvey Arden, David S. Boyer, Mike Edwards, William S. Ellis, Noel Grove, Bryan Hodgson, Phil J. Vedlund
SENIOR EDITORIAL STAFF: Robert Booth, Allen A. Borisko, John L. Egan, Boyd Gibbons, David Jeffery, Larry Kohl, Douglas Lee, Michael E. Long, Production: John L. McIntosh
EDITORIAL STAFF: Judith Brown, Charles E. Cobb, Jr., Louise E. Levathes, Peter Miller, Cathy Newman, Cliff Tarpy, Jane Vessels
RESEARCH: Lesley B. Rogers (Assoc. Dir.), Madeline A. Sweeney (Asst. Dir.), *Research-Editors*: Carolyn H. Anderson, Susan L. Anderson, Ann B. Henry, Jeanne E. Peters, *Research-Asst.*: Catherine C. Clarke, Jan Holderness, Anne A. Jamison, Kathy B. Maher, Barbara W. McConnell, Jean B. McConville, Miriam R. Miller, Abigail A. Tipton, Margaret N. Walsh, *Legends*: Victoria C. Dochowicz, *Planning Council*: Mary McPeak

ILLUSTRATIONS

PHOTOGRAPHERS: Dean Cinger (Assistant Director), James L. Aitken, Joseph H. Bailey, James P. Blair, Victor K. Boswell, Jr., Judi Cobb, Bruce Dale, Emily Kristof, Joseph D. Lavenburg, George F. Mobley, Steve Raymer, Robert F. Sisson, James L. Stanfield, *Admin.*: Susan A. Smith, Alvin M. Chandler, Claude E. Petrone, Maria Senzel
ILLUSTRATION EDITORS: Robert W. Hernandez (Assistant Director), William L. Allen, David L. Arnold, William T. Douthitt, Taylor Gregg, Kent J. Kobersman, Bruce A. McIlfresh, Charlene Murphy, Robert S. Patton, Elie S. Rogers, Jon Schneberger, Susan Welchman
LAYOUT: Gerard A. Valerio (Designer); Constance H. Phelps, *Design*: Betty Clayman DeAtley, Timothy J. Conroy, Douglas M. McKenney
ART: Jan Adkins, J. Robert Terango, Charles C. Uhl (Associate Directors); Allen Carroll (Asst. Dir.); *Artist*: William H. Bond, *Research*: Karen E. Gibbs
ENGRAVING AND PRINTING: William W. Smith (Director); James R. Whitney (Associate Director); Bill M. Aldridge, Judy L. Garvey, John W. Gergel, Ronald E. Williamson

CARTOGRAPHY

Harold E. Aber, Jr., John F. Shape (Associate Directors); Alice T. M. Rechin (Sr. Asst. Dir.); David P. Beddoe, John F. Dom, Harold A. Hanson, Harry D. Kaftane, Richard K. Ringers, Elie Sabban, Leo B. Zebarth (Asst. Dirs.); *Archaeologist*: George E. Stuart, *Geographer*: Ted Dachtler, *Map Editor*: Thomas A. Walsh (Supvr.); John T. Blazis, Charles W. Gotthardt, Jr., Thomas L. Gray, Etelka K. Horvath, Gus Platts, Thomas A. Wall, *Designers*: Lisa Ingham, John A. Bunker, John W. Linters, Nancy Schwaickart, Sally Suominen-Summerall, *Researchers*: Dorothy A. Nicholson (Supvr.); John L. Benson, Timothy J. Carter, Ross M. Emerson, Marguerite B. Hanaker, Linda R. Krieger, Günther G. Kybos, Mary C. Latham, David B. Miller, Douglas A. Strobel, Juan J. Valdes, Andrew J. Wahl, Susan Young, *Jour.*: Oliver G. A. M. Payne, *Map Artists*: Roland K. Nichols (Supvr.); Iskandar Baday, James E. McClelland, Jr., Alfred L. Zebarth, *Computer Cartography*: Charles E. Cassi, Martin J. Golden, *Specialists*: Charles L. Miller, Henri A. Delanghe, Edward J. Holland

EDITORIAL SERVICES

ADMINISTRATION: M. Jean Vile, Benita M. Swash (Assts. to the Editor); Elaine Rice Ames, Marie L. Barnes, Mary L. Blanton, Marisa Domezko, Neva L. Folk, Lilian Davidson, Virginia H. Finnegan, Eleanor W. Habbe, Ellen E. Kohlberg, Lisa Maurer, Katherine F. McGown, Carol D. Rhoads, Emily Seammahren, Susan E. Scott, Charlene S. Vidari, *Picture Requests*: Barbara A. Shattuck, *Correspondence*: Carolyn F. Cresswell, Gwendolyn C. Blackman, Joseph M. Blanton, Jr., *Indexes*: JoJene M. Blatts, Anne K. McCain, *Travel*: Virginia A. Hachant, Ann C. Judge
LIBRARIES: *Publications*: Susan Fifer Canby (Director); Patricia Murphy Smith, Margery K. Beckhill, Arlene T. Drewes, Carolyn Locke, Mirra Strada, *Reprints & Illustrations*: Lois Northrop (Director); L. Fern Damm, Mary Anne McMillen, Carolyn J. Harrison, Maury A. Mulvihill, Mennett M. Smith
NEWS SERVICE: Paul Sampson (Director); Joy Aschenbach, Mercer Cruz, Kenneth C. Danforth, Donald J. Frederick, Barbara S. Moffet, Boris Weintraub, *Radio*: Robert C. Radcliffe
AUDIOVISUAL: Joanne M. Hess (Director); Jon H. Larmon (Tech. Director); Betty G. Katcher (Librarian); Ronald S. Ahomas, Robert G. Fleegal, Paul Goski, Boris Littlehales, Gerald L. Wiley

RELATED EDUCATIONAL SERVICES OF THE SOCIETY

ROBERT L. BREEDEN Senior Vice President

Danforth P. Fales (Vice President); William B. Gray (Exec. Asst.); Suzanne J. Jacobson (Asst. to the Sr. Vice Pres.); **BOOK SERVICE**: Charles O. Hyman (Director and Sr. Asst. Ed.); Ross Bennett (Assoc. Dir.); David M. Seager (Art. Dir.); Greti Arnold, Melanie Corner, Mary Dickinson, John T. Dunn, Susan C. Eckert, Karen F. Edwards, Anne D. Kober, J. Edward Lanouette, Carol B. Lutyk, Linda B. Meyerwecks, Elizabeth Newhouse, R. M. Poole, Suzanne K. Poole, David F. Robinson, Lisa Sajewski, Margaret Sedeen, Penelope Timbers, Jonathan Tourtellot, Richard Wan, **SPECIAL PUBLICATIONS**: Donald J. Cramp (Director and Sr. Asst. Ed.); Philip B. Silcott (Assoc. Dir.); Bonnie S. Lawrence (Asst. Dir.); Jody Bolt (Art. Dir.); John G. Agnone, Jane H. Buxton, Margery G. Dunn, S. L. Fishbein, Ron Fisher, Patricia F. Frakes, Sallie M. Greenwood, Mary Ann Harrell, Charles E. Herron, Stephen J. Hubbard, Alice Jablonsky, Paul Martin, Jane R. McCuskey, Tom Melham, Robert Messer, H. Robert Morrison, Thomas O'Neill, Barbara A. Payne, Thomas B. Powell III, Cynthia Ramsay, David V. Showers, Gene S. Stuart, Jennifer C. Urquhart, **WORLD-PAT ROBBINS** (Editor); Margaret McKelvey (Assoc. Ed.); Ursula Woseler (Art. Dir.); Jacqueline Geschickter, Pat Holland, Joan Hurst, Venetia Morrison, Judith Rigard, Eleanor Shannahan, **EDUCATIONAL MEDIA**: George Peterson (Director); Jimmie Abercrombie, David F. Beacom, James B. Caffrey, Tom Eagan, Sandra L. Matthews, **TRAVELER**: Joan Tippet (Editor); David R. Bridge (Ilus. Dir.); Suz B. Kehl (Art. Dir.); **PUBLICATIONS ART**: John D. Gaunt, Jr. (Director); Virginia L. Baza (Asst. Dir.); Isaac Ortiz, Peter J. Balch, **EDUCATIONAL FILMS**: Sidney Platt (Director); Donald M. Cooper (Assoc. Dir.); Louise C. Millikan, Carl E. Ziebe, **TELEVISION**: Dennis B. Kase (Vice President and Director); Tim T. Kelly (Assoc. Dir.) and Tim F. Cowling, **EXPLORER**: Yeorgos N. Lampothakis, Karen S. Marsh, Marjorie M. Mooney, Nola L. Shewsherry, Kathleen F. Teter

HOW TO FIND THE RIGHT HOUSE WHEN IT'S 3,000 MILES FROM HOME.

With the exclusive ERA[®] Moving Machine,[®] you can preview homes all over the country in about six minutes.

It happens all the time.

You get transferred and you have to uproot your family.

First and foremost, you need the right home.

There was a time when that meant getting on an airplane, exploring neighborhoods and making a snap decision.

Thank goodness, there's a better way today.

The magic of the ERA Moving Machine

The ERA Moving Machine, quite simply, sends photographs and descriptions of homes to ERA offices across the nation.

It's an amazing tool. And it's something only ERA has.

This way, if you're in, say Boston, an ERA Real Estate Specialist[™] can help you "see" homes in San Diego in about six minutes.



The ERA Moving Machine electronically links over 2,000 ERA offices by sending digital data over the telephone lines.

Most likely, you'll save money on unnecessary travel.

And find something a lot closer to what you had in mind.

Of course, if you're selling a home, the ERA Moving Machine



Before the ERA Moving Machine, relocating to a faraway city meant making trip after trip, combing through unfamiliar neighborhoods — often settling for something less than what you'd hoped for.

can help you reach potential buyers relocating to your city.

That's important, since an amazing 40% of all home buyers come from out-of-town.

And it's a big reason to choose ERA over real estate companies that only operate locally.

The right services

Our ERA Real Estate Specialists all strive for one simple goal: to make buying or selling your home faster, easier and with less hassle.

Take, for instance, the ERA Buyer Protection Plan^{*}

Think of it as protection for both buyers and sellers alike while a home is on the market.

It covers many surprises that homeowner's insurance doesn't always cover for your interior plumbing, central air conditioning, the furnace, and more.

And there's the ERA Sellers Security[®] Plan. In short, if we don't sell your house, we'll buy it.**

We can even show you ways to

save money on things like your new appliances, furnishings, decorating — even moving***

But we're just scratching the surface. And there's an easy way to find out more.

We're here to help

Stop in your neighborhood ERA Real Estate office.

Sit down. Have a cup of coffee. We'd be happy to explain any and all of our services.

In fact, we'd be glad to help in any way we can.

That's the spirit of the new ERA. And we think that's the very best way to help make your American Dream come true.

To find out more information or the ERA Real Estate office near you, call our toll-free number **1(800)ERA-SOLD**



*An ERA Home Protection Company, Inc. product. Some conditions and limitations apply. **Credits apply, including a program participation fee. Home must meet specific qualifications, a second home must be purchased through ERA, and purchase price will be determined solely by ERA. *** Available in interstate moves only. Call your participating ERA Real Estate Specialist to review details. © 1987 Electronic Realty Associates, Inc. Each office independently owned and operated.

**FIRST WE GAVE OUR
FRONT-WHEEL DRIVE
PLYMOUTH VOYAGER
A BIGGER ENGINE.
(A V-6 ENGINE.)**



PLYMOUTH. THE

**THEN WE GAVE
THE ENGINE
A BIGGER VOYAGER.**

**INTRODUCING
PLYMOUTH GRAND VOYAGER.**



**PLYMOUTH GRAND VOYAGER
WITH MORE ROOM FOR COMFORT,
CARRYING SPACE
AND MORE POWER: V-6 POWER.
ONLY THE PLYMOUTH VOYAGER SERIES
OFFERS YOU A CHOICE.**

**NEW GRAND VOYAGER
NOW PASSENGERS HAVE MORE
COMFORT AND LUGGAGE ROOM.**



The Plymouth Voyager Series proves the Pride is Back. Only Voyager gives you a choice of sizes: the spacious Plymouth Voyager or the new Grand Voyager with twice the knee room and carrying space in back.



Voyager



Grand Voyager

**MORE POWER
FOR BOTH VOYAGERS-V-6 POWER.**



Plymouth Voyager offers you the option of a powerful new fuel-injected V-6 engine. It gives you more power to pass, to climb, to carry and tow.

**THE ONLY MINI-VANS
WITH FRONT-WHEEL DRIVE
FOR EASE OF HANDLING.**

Plymouth Voyager was the first mini-van of its kind. And it's still the only one with front-wheel drive for car-like handling and sure, steady traction on slippery wet roads.

BOTH EASY TO GARAGE.



Height has never been a problem for the original Plymouth Voyager. And for the new longer Grand Voyager garaging is just as simple.

**THE ONLY MINI-VAN
WITH A 7-YEAR OR
70,000-MILE PROTECTION PLAN.***

The Voyager Series is protected by the best warranty of any mini-van: 7 years or 70,000 miles on the powertrain and 7 years or 100,000 miles against outer body rust-through.* It's your proof of the commitment to long-term quality by Plymouth. The Pride is Back. **770**

*See limited warranty at dealer. Restrictions apply. †Based on a survey of owner problems with '86 cars and light trucks (combined) sold Oct.-Nov. '86 (5 month avg. usage) and a warranty comparison of competitively priced models. For vehicles designed and built in N. America. Buckle up for safety.

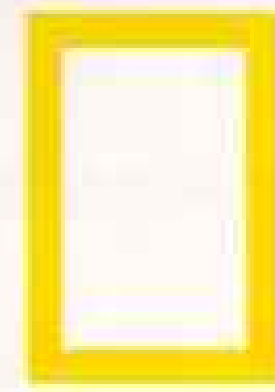
PRIDE IS BACK 

Chrysler Motors: Best-built, Best-backed American Cars and Trucks.†



PRIDE IS BACK 

Chrysler Motors: Best-built, Best-backed American Cars and Trucks. † Division of Chrysler Motors



New missions for old magazines

WILL NORTH AMERICA soon—as geologists measure soon—sink into the oceans? The *Journal of Irreproducible Results* once predicted just that—not as the result of some geologic catastrophe, but from the combined weight of back issues of NATIONAL GEOGRAPHIC, stored as they are in attics, basements, garages, and summer cottages across the continent.

I think North America will bear up a while longer. Still, the question I'm often asked by Society members, "What can I do with my old GEOGRAPHICS?" is a good one.

Many have found that their collections have grown to the point that storing issues is a problem. Yet most also feel that the magazines are too valuable to just throw away.

Out in Hawaii a Rotary club has come up with one answer. Its solution exactly squares with the educational aims of the Society.

Looking ahead to the 1988 Summer Olympic Games to be held in Seoul, South Korea, and knowing the importance of the English language in international gatherings, North Hawaii Rotary Club member Bob Henrickson thought: Why not send back issues of NATIONAL GEOGRAPHIC to help Koreans with their English skills?

That was in 1983. Since then 30,000 copies have made their way across the Pacific Ocean and into enthusiastic Korean hands.

The North Hawaii club, assisted by other service and religious organizations, continues

to collect the magazines. The U. S. Army, Navy, and Air Force have helped by carrying bundles of them on ship and airplane runs to Korea when space is available.

On the Korean end, two Rotary clubs in the city of Taegu manage the distribution. Kyu Byong Huh, former secretary-

dous interest to anyone who doesn't ordinarily see them. Getting them to those people makes a great service project with little or no out-of-pocket cost. I would certainly encourage other service organizations, churches, and synagogues to start their own programs."

It's a fine idea. Our presses



SUK TAE, HEE JONG, AND HIL JA KANG PORE OVER BACK ISSUES OF NATIONAL GEOGRAPHIC IN KOREA. PHOTOGRAPH BY ROBERT L. HENRICKSON

general of the Rotary district, told Bob Henrickson, "English has become the language of international commerce and trade, so learning English may be the best way for a family in a developing nation to prepare to join the middle class."

Henrickson sees a message in the success of the project, one that goes beyond Rotary, Hawaii, Korea, and the 1988 Olympics.

"Those magazines from whatever year are of tremen-

print more than ten and a half million copies of the magazine each month. We plan them and publish them to serve the cause of geographic knowledge—not to keep company with the Christmas tree ornaments, not to hunker down near the workbench, and not to sit out with the lawn mower, shovel, and rake.

Those old GEOGRAPHICS can have a new life. And who knows—we may save a continent in the bargain.

Silbert Browner
PRESIDENT, NATIONAL GEOGRAPHIC SOCIETY



At Whirlpool, we put some of our best ideas on the shelf.

Three-liter bottles. Short, squat six-packs. Fat turkeys. Or small garlic cloves. At Whirlpool, we believe that virtually every kind of food should fit in your refrigerator easily and be easy to reach. So we put our minds to work refining the art of refrigerated storage.

Our shelves adjust, even on the doors. All groceries are not created equal. So shelves on most Whirlpool® refrigerators adjust quickly and easily to let you store just about anything. On our new DesignerStyle™ models, even door-mounted shelves adjust to handle hard-to-fit three-liter bottles and six-packs. And their drip-catching edges help hold spills to a single shelf. It's even easy to adjust the temperature because our controls are right up front.

Clean-up has never been easier. Wiping up spills is no fun. So Whirlpool refrigerators have

easy-to-clean interiors. Smooth glass shelves let you wipe up spills in short order. Vegetable crispers and meat keepers remove quickly for easy cleaning. And, of course, our textured steel doors help hide fingerprints and wipe clean quickly.

A promise of quality we stand behind. Every Whirlpool refrigerator is backed by our promise of good, honest quality. And we stand behind that promise with helpful programs like our toll-free, 24-hour Cool-Line® telephone service to help you with problems or questions. Just call 800-253-1301. It's one more way we can make your world a little easier.

**Whirlpool**
Home Appliances
Making your world
a little easier.



WHEN YOU TRY TO CASH A CHECK OUT OF TOWN, DO THEY SEE YOU LIKE THIS?

Cashing a personal check is usually a routine matter. As long as you're in the congenial confines of your neighborhood bank.

But venture forth into the world beyond, and a weird transformation takes place. Some banks treat you as if you were a stranger from another planet. They scrutinize, question and dare you

to prove you're just an earthling after all.

Why not save face and open up a checking account with a member of the 1st Nationwide Network? You'll find the welcome mat out at over 600 locations in more than 30 states across the country. Simply present a valid check from any Network affiliated institution, and you can get up to \$500 in cash,

no questions asked. Now that ought to get your antennae up.

To locate the Network member nearest you, call our toll-free number 800-245-0111.

Pain-free checking. One of the great advantages of networking with 1st Nationwide Network. The bankers who finally put an end to the identity crisis.

**1ST NATIONWIDE
NETWORK** 

The bankers that changed banking.

California: Deauville Savings & Loan Association, 1st Nationwide Bank Colorado: 1st Nationwide Bank Delaware: Delaware Savings Florida: First Federal of Perry, 1st Nationwide Bank Georgia: First Federal of Columbus Hawaii: 1st Nationwide Bank Idaho: American Savings Illinois: Peoria Savings & Loan, Security Federal of Springfield, Southbun Federal Savings & Loan Association Indiana: American Savings & Loan Iowa: Hawkeye Federal Savings Bank Kansas: Franklin Savings, Railroad Savings & Loan Kentucky: 1st Nationwide Bank Louisiana: Capital-Union Savings Maryland: First Shore Federal Massachusetts: Bay State Savings Bank, Mutual Bank, Warren Five Cents Savings Bank Michigan: D & N Savings Bank Minnesota: Metropolitan Federal Bank Missouri: 1st Nationwide Bank Montana: First Federal Savings Bank of Montana Nevada: Frontier Savings Association New Hampshire: First Northern Bank, Fortune Community Savings Bank New Jersey: Fellowship Savings, The Provident Savings Bank New Mexico: New Mexico Federal New York: 1st Nationwide Bank North Dakota: Metropolitan Federal Bank Ohio: 1st Nationwide Bank, The First Savings & Loan Company Oklahoma: American Home Savings Pennsylvania: East Stroudsburg Savings Association, Elmwood Federal Savings Bank, Citizens Savings Association, First American Savings South Carolina: First Bank of Rock Hill, Newberry Federal South Dakota: Metropolitan Federal Bank Tennessee: Athens Federal, Morristown Federal Texas: Continental Savings Utah: United Savings & Loan Virginia: Newport News Savings & Loan Association Washington: American Savings Bank, Mt Baker Bank

A SEDAN TO EXPRESS YOUR DRIVING AMBITION. FORD TEMPO.

If your ambition is to drive, you can share this rather pleasurable pursuit in the sedan that was designed to be driven. Ford Tempo.

Its aerodynamic outward form reduces front and rear lift for enhanced directional stability and cornering agility.

A fully independent 4-wheel suspension makes for a smooth, balanced ride. Tempo's inner design also makes driving a pleasure. With features like comfortable seating, easy-to-use controls, and quick-read instruments.

Available with air bag restraint system.
And for 1987, Ford Tempo is also available with



Buckle up—Together
we can save lives.

a supplemental driver side air bag restraint system. Ford is the only American car manufacturer to offer this option. Ford Tempo. Designed for people with driving ambition.

New 6-Year/60,000-Mile Powertrain Warranty.

Ford now covers all new 1987 cars with a 6-year/60,000-mile warranty on major powertrain components. Certain restrictions and deductible apply. New, longer corrosion warranty coverage for body panel rust-through is 6 years/100,000 miles. Also, participating Ford Dealers stand behind their customer paid work with a free Lifetime Service Guarantee.

It's good for as long as you own your Ford car. Ask to see the limited warranty and the service guarantee when you visit your Ford Dealer.

Ford. Best-Built American cars... six years running.

"Quality is Job 1." In fact, for the past six consecutive years, Ford quality has led all other American car companies. This is based on an average of owner-reported problems in the first three months of service on '86 models, and in a six-month period on '81-'85 models designed and built in



Have you driven a Ford... lately?





Putting the wonders of science at a child's fingertips.

If we want great scientists and engineers tomorrow, we must encourage their love for discovery today.

That's why Dow created the Touch Tech Chemistry Lab at Impression 5, a hands-on science museum in Lansing, Michigan. It's the kind of place where kids and science can really get together with specially designed experiments and exhibits that educate, entertain, inspire...

And who knows what that could lead to?

Dow invites you to contact the people at the Impression 5 Science Museum, 200 Museum Drive, Lansing, MI 48933, (517) 485-8116 if you would like more information.

Dow lets you do great things.

Corporate Sponsor of National Science & Technology Week 1987.

© 1987 The Dow Chemical Company

*Trademark of The Dow Chemical Company.

DOW



WHY YOU GET MORE HORSES FROM A DEERE.

You're looking at one of the overhead valve engines we're putting in many of our lawn tractors and riding mowers.

It's made to deliver more power under tough conditions than other engines of the same horsepower rating.



Part of the credit goes to the engine's large displacement, which helps it churn out a lot of power in the first place.

But the major difference lies in its valves. Our valves open in line with the piston instead of to the side.

This simplifies air flow, so the engine can breathe easier and get more power from every piston stroke.

You also get improved cutting performance, thanks to the engine's ability to keep the blade running at a constant speed.

In fact, you might call it the first mower engine made specifically to climb hills and to cut and bag thick grass.

But then, our machines have always been made for the worst conditions. That's why you can always expect the best performance.

For more reasons why nothing runs, or keeps running, like a Deere, or the name of



your nearest dealer, call us toll-free at 800-447-9126 (in Illinois call 800-322-6796)

Or write to John Deere, Dept. 59/83, Moline, IL 61265.



NOTHING RUNS LIKE A DEERE®

What is a Best Western?

"Dependable lodging
on a retirement budget."



Ask about our Senior Citizen Discount.
More than 1,300 Best Westerns offer
discounts to guests over 55 years of age.
Check It Out Before You Check In...
Call toll-free:

1-800-528-1234

The Right Place
at the Right Price.



Best Western is the world's largest chain of
independently owned and operated hotels, motels and resorts!

Think Think
Think Think
Think Think
Think Think
Think Think
Think Think



Think Think
Think Think
Think Think
Think Think
Think Thanks

A Public Service of This Magazine
& The Advertising Council

**The Invisible Fence
dog containment system.
It works like nothing
you've ever seen.**

You can't see it. But it's always at work, protecting your dog without disturbing the beauty of your property. Invisible Fencing safely teaches your dog to stay where you want him. University tested, vet approved. It even costs less than traditional fencing! Try Invisible Fencing for 30 days. If you're not completely satisfied, we'll refund your purchase. Guaranteed.

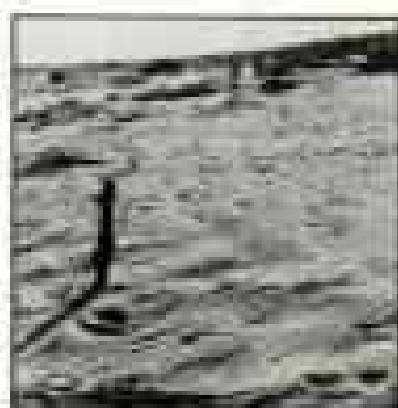
To find out how you can get a free brochure call toll free
800-331-1000 ext. 104

INVISIBLE FENCING.

© 1987 Invisible Fence Company, Inc.



COOL THE SUN



A cool shaded home and a searing landscape may seem worlds apart, but the only difference between the two are trees... Conservation Trees that can turn a

desert into a cooling oasis.

Thanks to trees, we can cool the rays of the sun. When trees shade our homes, the temperature drops substantially. That means our air conditioners won't have to work so hard in the summer. We save energy, and money as well.

Conservation Trees do a whole lot more. Planted on steep hills, the trees' roots keep the land from washing away when it rains. And in the country, trees can be planted as shelterbelts keeping the soil from blowing away.

Find out how Conservation Trees can help you. For your free brochure, write: Conservation Trees, The National Arbor Day Foundation, 100 Arbor Avenue, Nebraska City, NE 68410.



Members Forum

California Desert

Barry Lopez has captured the expansive spirit of the California Desert (January 1987), as well as the magnitude of development pressures that threaten its fragile beauty. The only way to avert gradual diminishment of this resource is with a clear congressional mandate, such as the California Desert Protection Act proposed by Senator Alan Cranston and Representative Mel Levine. This legislation acknowledges that the desert cannot be all things to all people. The act sets aside the best of the wilderness for permanent protection but with boundaries drawn to exclude areas needed for mining and off-road vehicle recreation.

LAWRENCE D. DOWNING
President, Sierra Club
San Francisco, California

Barry Lopez is not alone in his disdain for the military's disregard of natural areas. As a national park ranger, I have been "strafed" by a Navy jet in a rain forest and surrounded by attack helicopters while enjoying lunch atop a sea stack. More serious, 20 uniformed soldiers marched through Olympic National Park last fall, leaving campfire scars in subalpine meadows and all their garbage behind. Military flyovers, damaging to people and wildlife, should have been long ago met with strict fines and reprimands.

GALEN HUNT
Woodland, Washington

As a Navy pilot, I am stationed at China Lake, California. The A-7 Corsair pilot who disturbed the author (page 71) was out of bounds. Over that portion of the military restricted area, he should have been 3,000 feet above the ground. The military takes such violations very seriously. As for being "buzzed" while in the Saline Valley, Mr. Lopez was squarely in the middle of a large military flying area that extends from the surface to 29,000 feet and higher. Military pilots have better things to do during low-level training than fly into the ground while looking for people who might be disturbed. The military is already in the desert to avoid disturbing the general populace. When people come out into desert military operating areas, they are just going to have to put up

with some noise. And for all the noise of the A-7s, not a grain of sand was disturbed.

LCDR. R. G. THOMSON III
Ridgecrest, California

The Bureau of Land Management should be commended for its efforts in accommodating so many diverse interest groups requesting access.

ERROL J. BORSKY
Burnaby, British Columbia

You were much too gentle in your criticism of the off-roader. You forgot to mention the popular sport of chasing jackrabbits and coyotes until they drop. Immortality is achieved by carving

one's initials on the shells of desert tortoises. Then there are the animal lovers who take the tortoises home, thereby preventing breeding of the protected species.

MARILYN K. VORHIES
Linden, Tennessee

I was greatly disturbed by the cold facts of vandalism and the total lack of respect by the few for the national and archaeological marvels of this region. As a scuba diver, I have seen so many instances of irreparable damage done to the sensitive coral reefs of southern Florida. The same disrespectful minority is gradually stealing the most valuable treasures of our land. Thank

Full-sized ability. The mid-sized

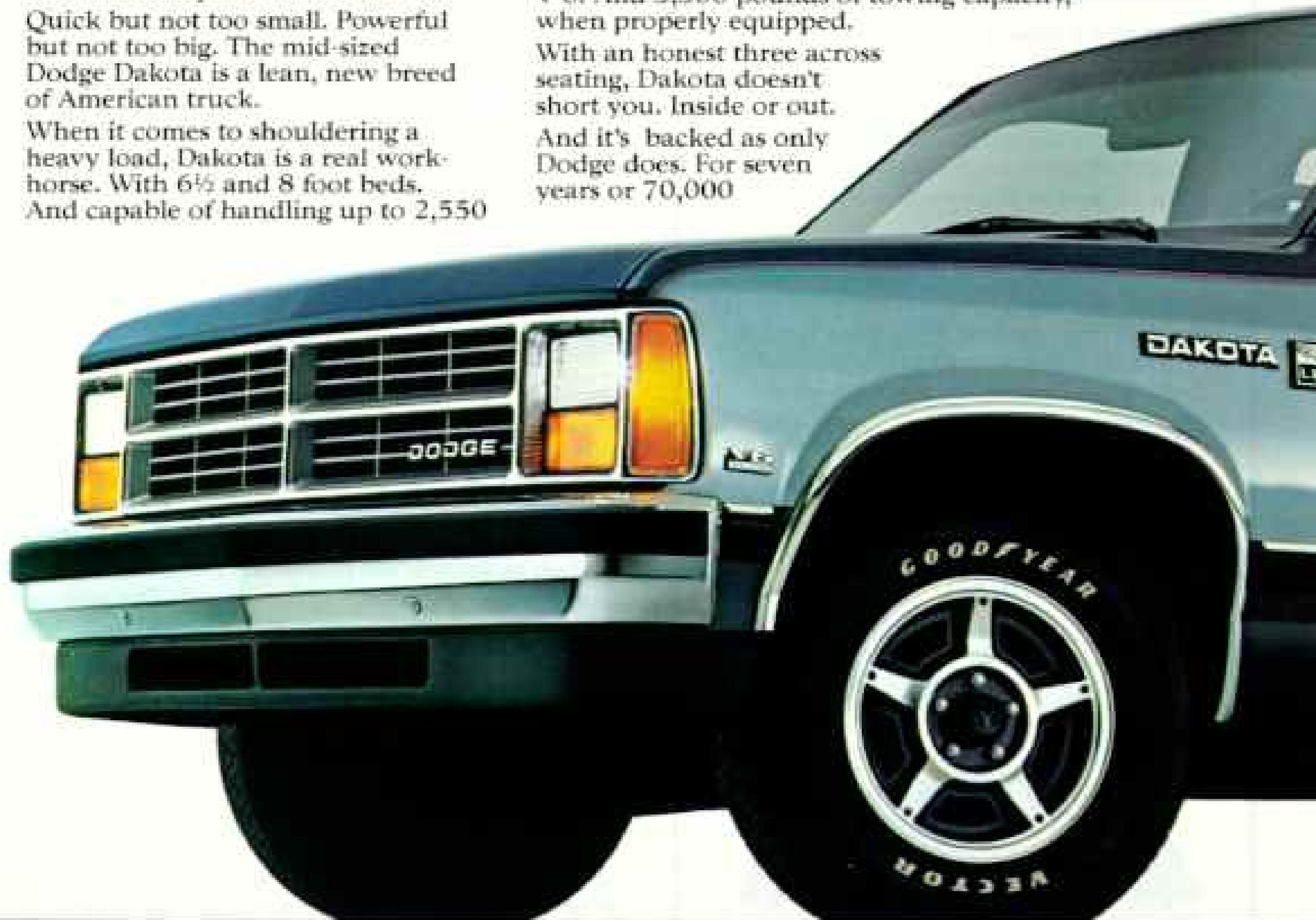
There's never been a truck quite like this before. Because there's never been a truck quite this size before. Quick but not too small. Powerful but not too big. The mid-sized Dodge Dakota is a lean, new breed of American truck.

When it comes to shouldering a heavy load, Dakota is a real work-horse. With 6½ and 8 foot beds. And capable of handling up to 2,550

pounds maximum available payload without missing a step. Under the hood, Dakota really hauls. With an available 3.9L V-6. And 5,500 pounds of towing capacity, when properly equipped.

With an honest three across seating, Dakota doesn't short you. Inside or out.

And it's backed as only Dodge does. For seven years or 70,000



you for your continuing efforts to build public awareness.

JAY D. CARTER
Pembroke Pines, Florida

Medicine's New Vision

Your article on medical imaging in January was excellent. People need to be made aware of how far medical technology has come. I am grateful because, when I fell victim to a brain tumor five years ago, this technology saved my life.

PATTI HOLLENBECK
Highlands Ranch, Colorado

The contributions of cardiologists and neurosurgeons were noted, as well they should have been.

Unfortunately, the article omitted the fact that it is a radiologist who is responsible for the equipment discussed and the procedures described. The radiologist also contributes to the diagnosis of the disease.

RAYMOND DEL FAVA, M.D.
American College of Radiology
Reston, Virginia

Not only should patients shop wisely for the right doctor, they should also insist on having the procedures outlined in your article analyzed by qualified radiologists. Many doctors in other fields feel themselves competent to read films when they are not specifically trained to do so.

RANDAL J. ZABROWSKI, M.D.
Des Plaines, Illinois

Compact agility. Dodge Dakota.

miles.* Dakota, quite simply, has no competition.

The mid-sized Dodge Dakota is America's new thoroughbred. The heart of a full-sized pickup. And the spirit of a compact.

A breed unlike any other. A truck unlike any other.



7/70

DIVISION OF CHRYSLER MOTORS

**THE BEST BUILT, BEST BACKED AMERICAN TRUCKS
ARE RAM TOUGH***

*"Best Built" based on survey of owner problems with '86 light trucks designed & built in No. America & sold Oct.-Nov. '85 (9 mos. avg. usage). See 7/70 powertrain & 7/100 outer body run-through limited warranty at dealer. Restrictions apply.

BUCKLE UP FOR SAFETY.



As a registered sonographer and nuclear medicine technologist, I was disappointed in the images. Adding color may be more pleasing to the untrained eye, but there was an extreme loss of detail as well as inherent beauty. Next time, please leave the images in their natural state.

GALE KENNEDY
Bangor, Maine

These devices are a direct dividend from basic research funded in the United States by the Department of Energy and the National Science Foundation. They originated with the measurement of nuclear magnetism in the 1940s. The dramatically improved imaging capability must now be matched by improved radiation treatment techniques. Protons and heavy ions can localize radiation effects to tumors with comparable precision in three dimensions. Pioneering treatment at Harvard University Cyclotron Laboratory and Lawrence Berkeley Laboratory, as well as work in Europe, Japan, and the Soviet Union, has shown the efficacy of this treatment. The investment in basic research has paid off, since the accelerators being used were originally built for basic particle physics research.

PHILIP V. LIVDAHL
Fermi National
Accelerator Laboratory
Batavia, Illinois

Your medical and scientific articles are lowering the value of my NATIONAL GEOGRAPHIC collection. These are very well written, but as technology continues to advance, they become redundant and obsolete in a few years. Would not the space be better used for timeless geography articles about disappearing cultures and habitats that can never again be seen or described?

WILLIAM B. TRECOTT
Detroit, Michigan

Slovakia

Yours is one of those rare publications with the sensitivity and insight to do an article about Slovakia and not merely lump this determined nation in with the larger entity, Czechoslovakia. Those of us of Slovak heritage in America—perhaps two million strong—were able to join hands with our countrymen and women through your pages in the January 1987 issue.

PAUL WILKES
Gilbertville, Massachusetts

Page 126 states that World War II was followed by the partition of Czechoslovakia and "liberation by the Soviet Army." The U. S. 16th Armored Division entered Pilsen on May 1, 1945, and took 30,000 German prisoners. After taking Pilsen, we were stopped by a message from

General Eisenhower and told not to proceed to Prague, despite the pleas of hundreds of Czechs who had bicycled and ridden horseback from Prague to beg us to help. The Soviets have destroyed all evidence, including a monument in Pilsen honoring the American liberation of Czechoslovakia. Children are taught that the Russians freed them.

STEVE J. CHYLINSKI
Broadview Heights, Ohio

Ice

Thank you for the article on ice (January 1987). It was beautifully illustrated, interesting to read, and provocative. Numerous glaciologists and climatologists disagree on major details of the Ice Age. There has been no general unanimity as to its duration, number of glaciations, or its contributing causes. In view of long-standing disagreement and lack of indisputable evidence, I appreciated your use of "it is thought" or "some believe."

WILLIAM A. SPRINGSTEAD
Maupin, Oregon

May I join the legions of those who will identify the Porsche on page 90 as a 928, not a 944. Note the sunken retractable headlights. Still a bargain though at \$4,000.

GARY R. DIAMOND
Wayne, Pennsylvania

It's quite a hailstorm that turns a Porsche 944 into a 928.

MIKE GILLILAND
St. Louis, Missouri

We heard from more than 50 Porsche lovers. The car was originally misidentified by the dealer, and we caught the error too late. A sign on the car indeed priced it at 8,500 German marks (\$4,000).

"The tong-wielding iceman" may have "melted away in the 1930s" where Samuel Matthews came from, but he was still rock-solid in Iowa Falls, Iowa, in 1949. I remember because when we ran out of ice before the iceman "cameth," I had to trundle down River Street to the icehouse and haul a 50-pound chunk back uphill in my brother's little red wagon, past Tommy Kelly's house, which was humiliating to a smitten 12-year-old. We didn't have a refrigerator until 1950. I never did find out if the Kellys had one.

JOYCE RUDISILL HIGMAN
Ottawa, Kansas

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



***Grape-Nuts® Flakes.
The simple care and feeding
of your body.***

*Few things are better for your body than regular exercise.
And good, simple food.*

*That's where Post® Grape-Nuts® Flakes comes in. So good
for you because it's so simple.*

*You see, each flake is made from a single kernel of wheat,
to capture all the honest goodness of nature.*

*So you—and your body—can enjoy one of life's
simple pleasures: the light, crisp texture and extraordinary taste
of Grape-Nuts Flakes.*

*Low in fat. No artificial preservatives.
Just simple wholesomeness.*

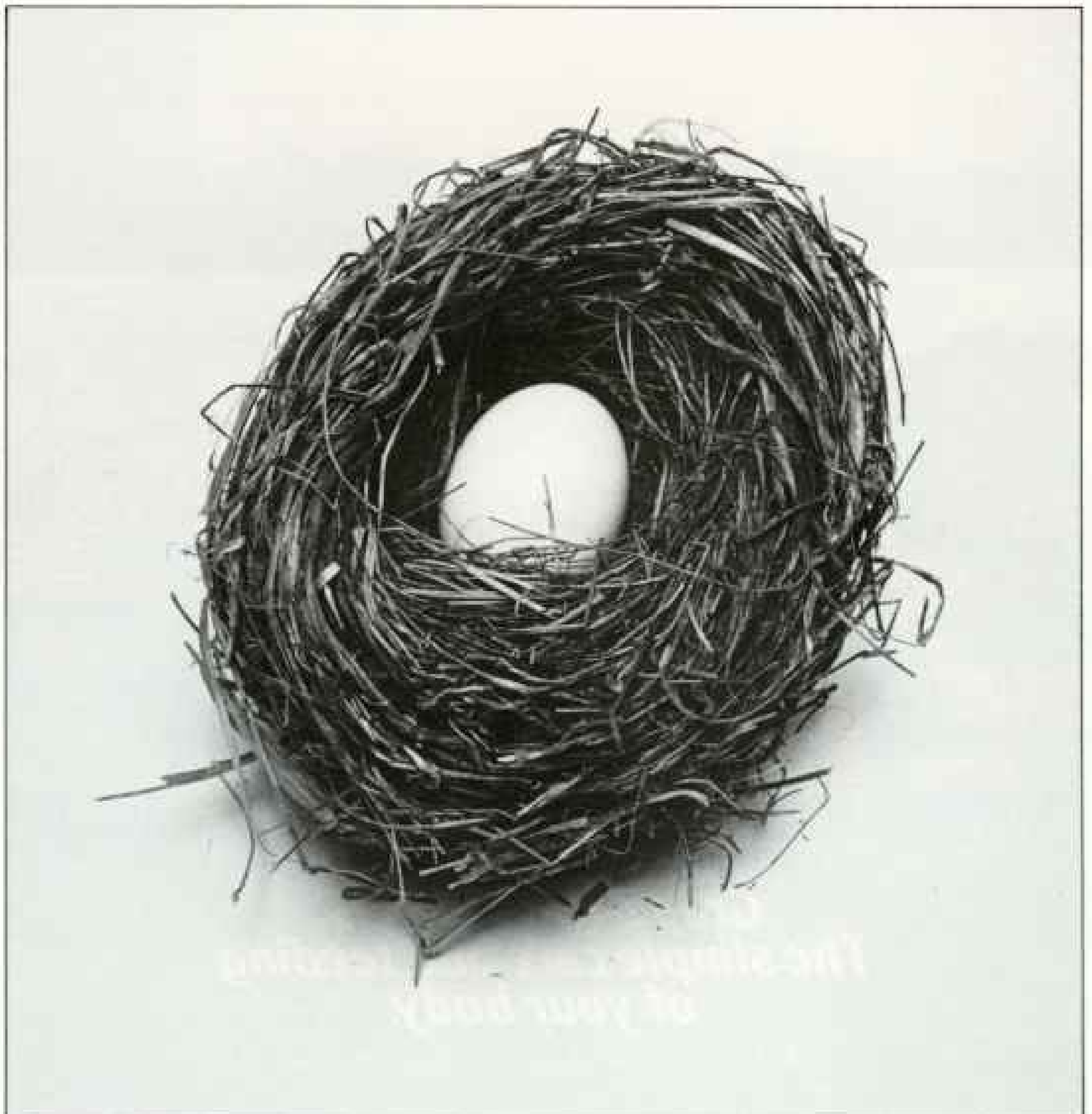
*Because for people who care
about their well-being, the
simpler, the better.*



© 1986 General Foods Corp.
Post and Grape-Nuts are registered
trademarks of General Foods Corp.



How safe are your deposits?



© 1987 The Foundation for Savings Institutions, Inc.

Forget about stuffing the mattress with cash.

Or hanging a picture over a wall safe in your bedroom.

For there's no safer place to put your money than in an interest bearing account at a member of The Foundation for Savings Institutions.

Because every member of The Foundation is a savings institution insured by an agency of the U.S. government.

Which is a foolproof guarantee that your money will be protected. Against

loss. Theft. Destruction. Or misuse. A guarantee that covers every penny in your account, up to \$100,000.

A guarantee that your money will earn more money for you.

A guarantee that your money will be returned to you—with every penny of interest earned.

A guarantee that comes with every account our members offer.

Our members are able to give you these guarantees because they, in turn, are protected by insurance that comes

from a corporation created by the United States Congress: the Federal Savings and Loan Insurance Corporation (FSLIC).

How confident can you feel about putting your money in an FSLIC-insured account?

Very.

Especially when you consider that the FSLIC is backed both by the entire system of FSLIC insured savings institutions, and by the U.S. government.

For example, savings institutions with FSLIC insurance are required to put aside a special reserve for the sole purpose of absorbing losses such as unrepaid loans. It's like your savings institution has a savings account of its own, in case of a rainy day.

The savings institutions also have to pay insurance premiums to the FSLIC, which has been accumulating these payments for more than 50 years.

But what if a really big institution failed?

The FSLIC has the right to draw directly from the U.S. Treasury, and to assess all the other banks it insures, if it ever needs more money to protect your money.

So your money is backed by your bank's money, which is backed by the FSLIC's money, which is backed by every FSLIC-insured bank's money, and by the money of the U.S. Treasury.

Nothing could be safer.

Which is why, if you want to be sure you get back every penny you invest, and all the interest it can earn, deposit your money in an FSLIC-insured, interest bearing account at any member of The Foundation for Savings Institutions.

It's the only kind of savings account our members offer.

The Foundation for Savings Institutions



This advertisement was brought to you by the members of The Foundation in your area:

Arverna Savings Bank, New Castle, IN
Arlington Federal FSL, Peru, IN
Arlington Heights FSL, Arlington Heights, IL
Barrington FSL, Barrington, IL
Bedford Federal FSL, Bedford, IN
Bell Federal FSL, Chicago, IL
Central FSL, West Dundee, IL
Citizens FSL, East Alton, IL
City Savings Bank, Hartford City, IN
Crown Land FSL, Elmhurst, IL
Columbus FSL, Milwaukee, WI
Community First FSL, New Albany, IN
Cragin Federal FSL, Chicago, IL
DeWitt Savings Assn., Lawrenceburg, IN
Dillon Riverside FSL, Dyer, IL
East Wisconsin FSL, Kaukaun, WI
Elmhurst Federal FSL, Elmhurst, IL
Farmers & Merchants FSL, Bloomfield, IN
Fidelity Federal FSL, Marion, IN
Fidelity Federal FSL, Reynolds, IN
First FSL of La Porte Co., Michigan City, IN
First Federal FSL, Huntington, IL
First Federal FSL, Corydon, IN
First Federal FSL, Dan Phelan, IL
First Federal FSL, East Alton, IL
First Federal FSL, Elgin, IL
First Federal FSL, Greensburg, IN
First Federal FSL, Jefferson, IN
First Federal FSL, Kendallville, IN
First Federal FSL, Lafayette, IN
First Federal FSL, Marion, IN
First Federal FSL, Moline, IL
First Federal FSL, Peru, IN
First Federal FSL, Richmond, IN
First Federal FSL, Ruston, IN
First Federal FSL, Sparta, IL
First Federal FSL, Waukegan, IN
First Federal FSL, Westfield, IN
First Federal FSL, Winchester, IN
First Federal FSL, Zionsville, IL
First United Fed. SB, Jasper, IN
Flora FSL, Ellettsville, IL
Fort Dearborn Federal FSL, Chicago, IL
Fountain Federal FSL, Bloomington, IN
Franklin Building & L.A., Frankton, IN
Greenacres Fed. SB, Greenacres, IN
Greensburg FSL, Greensburg, IN
Guaranty FSL, Milwaukee, WI
Hartford FSL, Hartford, WI
Heritage Federal FSL, Elwood, IN
Heritage Federal FSL, Jasper, IL
Heritage FSL, Jerseyville, IL
Hessdale Federal FSL, Hrosville, IL
Hobart Federal FSL, Hobart, IN
Home Building Assn., Martinsville, IN
Home Building FSL, Washington, IN
Home Federal FSL, Elgin, IL
Home Federal Savings Assn., IL
Home Loan Savings Bank, Ft. Wayne, IN
Home FSL, Madison, WI
Lake Federal FSL, Hammond, IN
Logansport FSL, Logansport, IN
Lyons Federal Trust & SB, Hinsdale, IL
Madison County Federal FSL, Gosport, IL
Madison First Federal FSL, Madison, IN
Marathon FSL, Wausau, WI
Marion County FSL, Salem, IL
Marshall FSL, Marshall, WI
Mid-America Federal FSL, Claydon Hills, IL
Mid-Southern Federal FSL, Salem, IN
Midwest Home FSL, Bedford, IL
Milwaukee Savings Assn., Maroon, IL
Milton FSL, Milton, WI
Moolgansery Savings Assn., Crawfordsville, IN
Mooresville Federal FSL, Mooresville, IN
Morris Federal FSL, Muncie, IN
Mutual Building & L.A. Franklin, IN
Mutual Fed. Savings Bank, Muncie, IN
Mutual Federal FSL, Terry Haute, IN
New Albany FSL, New Albany, IL
North Land FSL, Ashland, WI
Northwest Federal FSL, Arary, WI
Norwood Federal FSL, Chicago, IL
Peoria Federal FSL, Chicago, IL
Peoples FSL, Monticello, IN
Perpetual Federal FSL, Lawrenceburg, IN
Perpetual FSL, Princeton, IN
Pittsford's FSL, Indianapolis, IN
Regional Federal FSL, New Albany, IN
Savings of America, Elmhurst, IL
Security Savings Assn., Indianapolis, IN
South Milwaukee FSL, South Milwaukee, WI
St. Paul Fed. Savings Bank, Chicago, IL
Standard Federal Bank, Ft. Wayne, IN
Standard Federal FSL, Chicago, IL
Sterling Federal FSL, Sterling, IL
Superior FSL, Superior, WI
Tahara Home Federal FSL, Chicago, IL
Time Federal FSL, Medford, WI
Tipton FSL, Tipton, IL
United Savings Bank, Hillside, IL
Union Federal FSL, Crawfordsville, IN
Union Federal FSL, Kenosha, IL
Union Federal FSL, Lebanon, IN
Union Federal FSL, Shelbyville, IN
Union FSL, Cassville, IN
United Federal FSL, Vincennes, IN
United FSL, Springfield, IL
Viscous Federal FSL, Visconsin, WI
Washington FSL, Chicago, IL
West End Fed. SB, Richmond, IN
West River FSL, West River, IL
Washington Federal FSL, Bloomington, IN

If you'd like a free copy of "A Guide to Today's Financial Services World" write to The Foundation for Savings Institutions, 1522 "K" St. NW, Washington, DC 20005.

TOYOTA WONDERWAGON!

FAMILY ROOM

Wonderwagon has seating for seven with exciting options... dual sunroofs**

Captains Chair Package, dual air conditioning, even an ice maker/cooler.



THE WAGON FOR TODAY'S PIONEER FAMILY.

Discover the 1987 Toyota Wonderwagon, designed for active families on the go. More spacious than a station wagon, Wonderwagon drives like a car, turns on a dime. It can carry up to 149 cu. ft. of cargo* yet it parks in a normal-size garage.

4-WHEEL DRIVE

The new 4-wheel drive Wonderwagon takes on bad roads and bad weather at the flip of a switch.



WHO COULD ASK **TOYOTA**
FOR ANYTHING
MORE!

Get More From Life... Buckle Up!

*With rear seats removed.

**Sunroofs not available on 4WD vans.

© 1986 Toyota Motor Sales, U.S.A., Inc.

THE COLOR OF LIFE



UNSURPASSED COLOR IN PRINT FILM IS HERE.



A three quarter view of the future.



It's definitely not predictable. Yet it's everything you might expect. The luxurious Honda Accord LXi 4-Door Sedan. For once, the future is yours to see. **HONDA**

© 1992 Honda Motor Co., Ltd.

On Assignment

IN A DEEP FREEZE or a hot pot, GEOGRAPHIC authors immerse themselves in their subjects. **Dr. L. David Mech** spent the night in a vacant Inuit igloo (*right*) during weeks of travel that yielded his unprecedented report on an arctic wolf pack (page 562). A biologist for the U. S. Fish and Wildlife Service, he has studied wolves for 29 years, with two previous articles published in the magazine. He says, "Despite all that experience, I am still amazed at the care and attention that the arctic pack constantly showed for its pups."

Senior writer **Mike Edwards** had few solitary moments while covering Ukraine (page 595). As he steeped in a sulfurous mud bath at a Black Sea resort in



PHOTOS BY JIM BRANDENBURG (ABOVE) AND STEVE RAYMEN

Odessa (*below*), two nurses and a Soviet guide stood by. "The mud oozed out of a tube like black toothpaste," he recalls. Mudpacks for the hands were called gloves; for the legs, trousers. Though


skeptical about the mud's therapeutic value, Edwards did take something away from his half-hour soak: "Three days later I was still washing shiny little black specks from my skin."



The eagle has landed.

In Oklahoma and Mississippi. Georgia and Alabama. Where few bald eagle nests have produced young in the last 50 years. Using precious eggs and dedicated effort, the Sutton Avian Research Center is successfully raising eaglets from fuzzy to fierce. And releasing them into the habitats bald eagles

used to call home. Phillips Petroleum supports this unique program to re-establish our endangered national symbol.

After all, if Man can land an Eagle on the moon, he can surely keep them landing on the earth. 

For more information, contact the George Milsch Sutton Avian Research Center, Inc., P.O. Box 2007, Bartlesville, OK 74005, (918) 336-7778.

ENGLISH CARRIAGES, IRISH SHAWLS
AND MORAVIAN COOKIES, MADE IN



GERMAN VIOLINS NORTH CAROLINA.

A photograph of a violin and its bow resting on a colorful, knitted shawl. The violin is a warm, reddish-brown color, and the bow is dark wood with a yellow tip. The shawl has stripes of orange, grey, and white. In the background, a dark coat hangs on a wall, and a small sign with the word 'TRICE' is visible. The scene is lit with warm, low-key lighting, creating a cozy and historical atmosphere.

As dawn comes to the quaint, 18th-century village of Old Salem, the windows of a tiny bakeshop are already glowing with light.

In the cinnamon-scented warmth, Moravian ladies fill beehive ovens with paper-thin cookies and moist cakes, made from recipes that are over two centuries old.

In North Carolina, you'll find many people of European heritage whose art remains true to the values of the Old World.

You can buy a carriage built by a craftsman with a proper English name. Violins made by a German, that are applauded by musicians as far away as London and Rome.

And shawls, created by weavers of Irish descent, that are as warm as lowland peat fires.

You can come to a light-dappled city of trees, and stroll from gallery to gallery, shopping for contemporary art. Or, see something money can't buy:

A premier collection of the old masters, in our state museum.

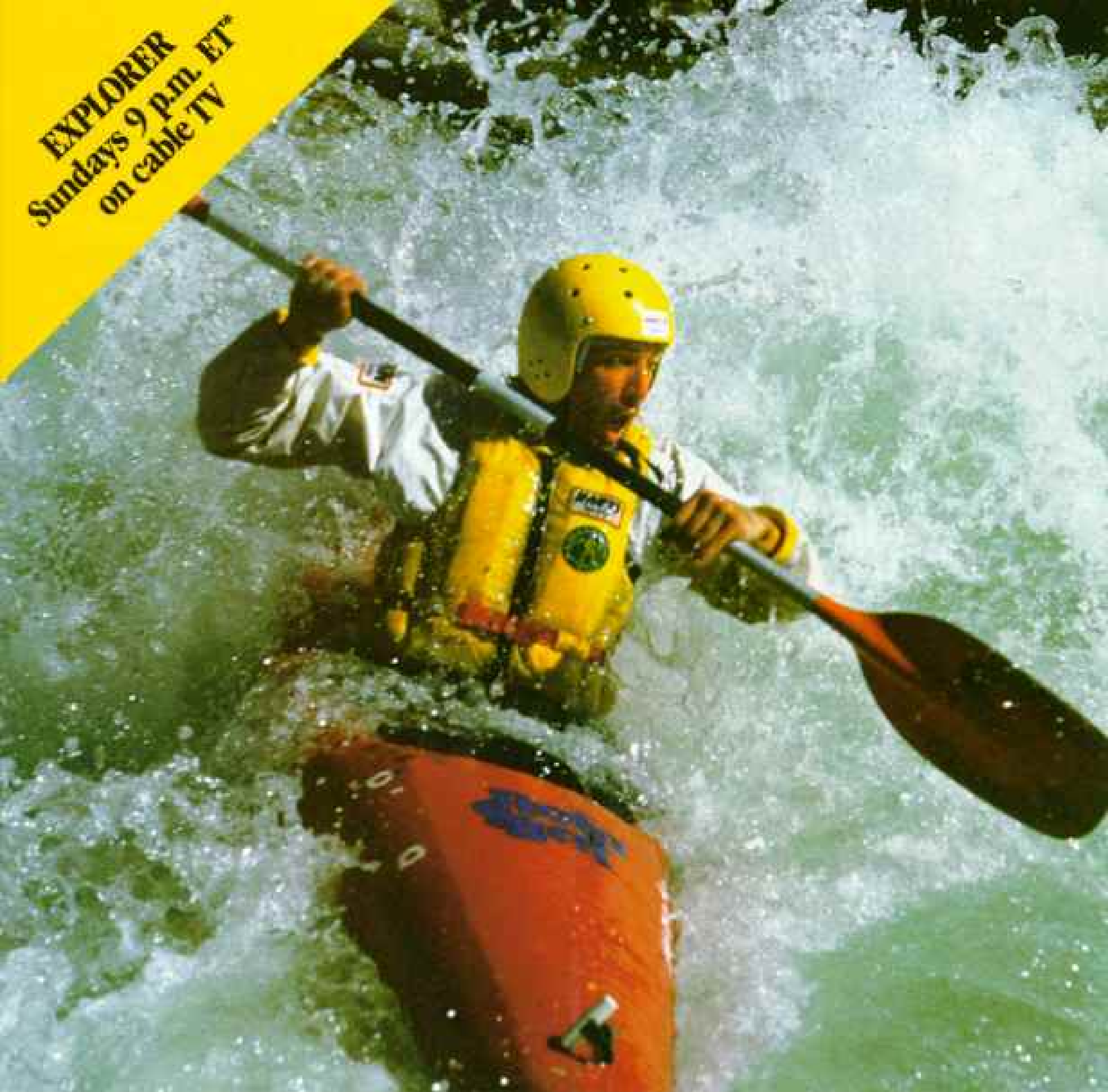
Of course, you can also shop for a memorable meal, from our mountains to our shore. In superb restaurants that even Craig Claiborne, himself, likes to visit.

North Carolina. Along with beautiful things to buy, there's also endless beauty to see. Free.

NORTH CAROLINA

For our new travel package, just write North Carolina Travel, Dept. 387, Raleigh, NC 27699. Or call 1-800-VISIT NC, Operative 587, 8 a.m. - 5 p.m. weekdays.

EXPLORER
Sundays 9 p.m. ET
on cable TV



Conquer the rapids...

IN NEPAL on one of the world's highest rivers! **Tune in May 10** as a team of adventurers fly ultralight aircraft to a perilous altitude of 17,000 feet—in sight of Mount Everest—where they begin their descent through the wild, frigid waters. *And, on other Sundays...*

MAY 3—Zip through the streets of London with a special class of cabbie.
MAY 17—Tour Thailand's waterways.
MAY 24—Wade through Australian swamps with deadly crocodiles.
MAY 31—See a GEOGRAPHIC photographer at work in Istanbul, Turkey.



Check your local cable listings.

**SuperStation
WTBS**

GREAT AMERICAN TELEVISION

*Also Mondays at midnight ET/9:00 p.m. PT and Saturdays at 9:00 a.m. ET

Lennox's Power Saver[®] Air Conditioner:



Most of the time it loafs to save you money.

Presenting the extraordinary Lennox Two-Speed air conditioner. In really hot weather, it switches to full power, then automatically cuts back to half speed for normal ongoing cooling, significantly reducing cooling bills and day-to-day wear and tear.

Deliberate, programmed laziness with significant built-in savings—another efficient idea for your home from the Efficiency Experts. Now, at your participating independent Lennox Dealer.



LENNOX

AIR CONDITIONING • HEATING

0% FINANCING*
for 12 Months
*Limited time offer
on selected
Lennox products