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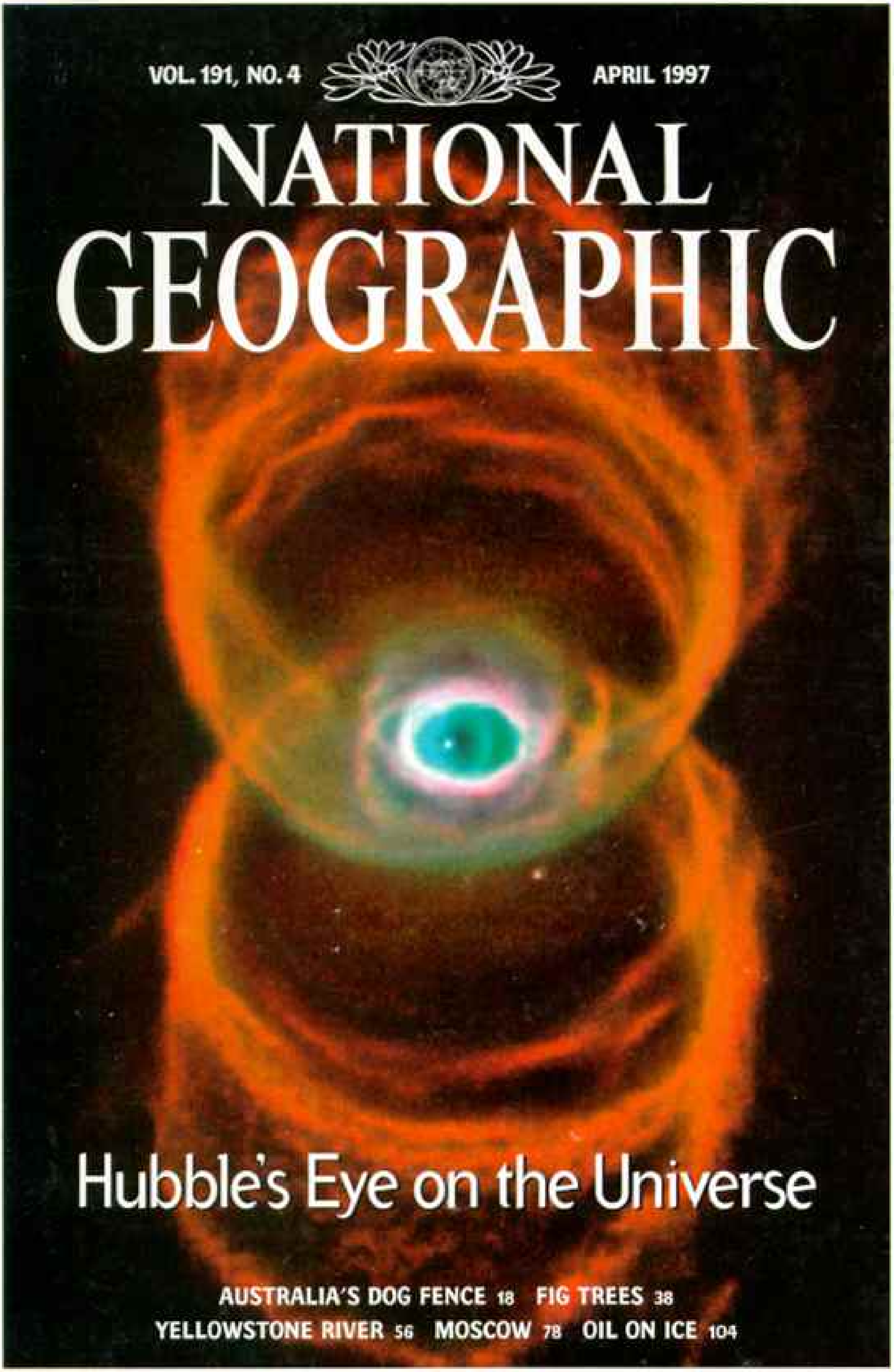

Hubble's Eye on the Universe

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NATIONAL GEOGRAPHIC

From the Editor

THIS YEAR MARKS the 125th anniversary of a very special place—Yellowstone National Park—a fitting subject, it seems to me, to inaugurate this column, where I hope you will join me each month. Yellowstone became a model for the world—the first of our great parks, which have been celebrated as "the best idea America ever had."

I had to agree with that assessment after a recent visit to Yellowstone with an old friend, Dan Sholly, now chief ranger there. We paddled across Yellowstone Lake toward a small island, our canoe battling high wind and waves. While Dan spent his supposed day off repairing an old cabin, I took my fly rod to the lee shore and, sheltered by towering pines, proceeded to catch and release some of the park's most beautiful residents, wild cutthroat trout. I saw no other fishermen that summer afternoon, unless you count the bald eagle that glided above, keeping an eye on the water below.

RAYMOND GEHMAN

Such moments remind us all of the restorative value of parks like Yellowstone, where flows the river of the same name, explored elsewhere in this issue.

We should not let Yellowstone's birthday pass without mentioning some of the challenges to its future health: the increasing crush of visitors and the pressures on bison and other wildlife, and the development of mining and geothermal power on its borders.

These are troubling, but Yellowstone has prevailed in the past—rebounding from the great fires of 1988, providing a new haven for the gray wolf, nourishing its grizzly bears. Indeed the record shows that the guiding vision that inspired Yellowstone is alive and well. With care, and a touch of luck, that should sustain America's oldest national park for another 125 years.

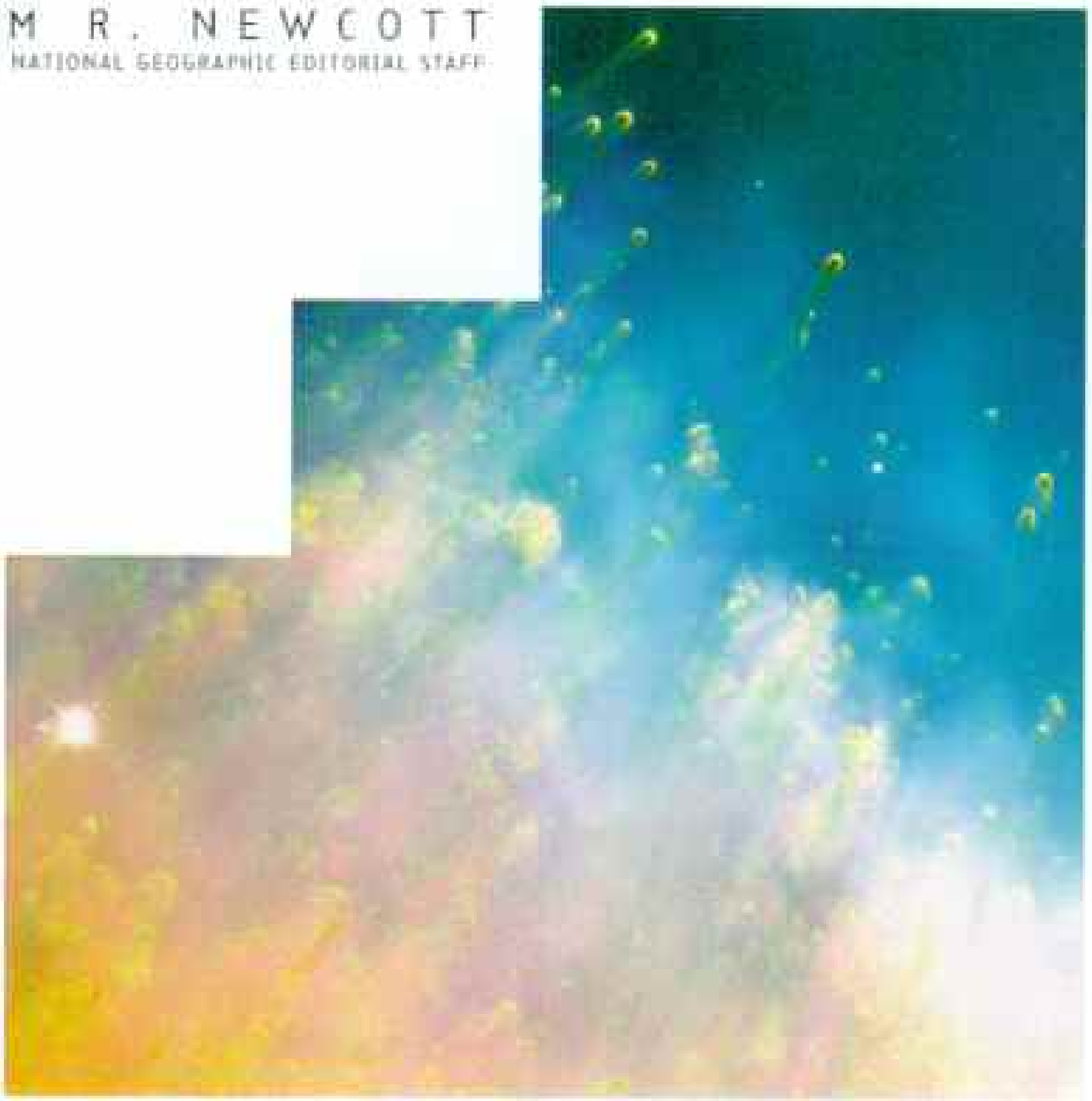
Bill Allen

THE HUBBLE TELESCOPE VIEWS THE UNIVERSE FROM SPACE

Time Exposures

By WILLIAM R. NEWCOTT
NATIONAL GEOGRAPHIC EDITORIAL STAFF

Astronomers looked 8,000 light-years into the cosmos with the Hubble Space Telescope, and it seemed that the eye of God was staring back. The Etched Hourglass Nebula is actually a shell of gas expanding from a dying star. In the Helix Nebula (below) a dying star creates knots of gas and dust twice the diameter of our solar system. Once a rare sight, thousands of such knots—and myriad other cosmic surprises—are now seen through Hubble's unmatched eye.



RAGHVENDRA SAHAI, JOHN TRAUGER, AND NASA (LEFT); ROBERT O'DELL, KERRY HANDOUR, AND NASA

Stellar blowout

Billowing outward at 1.5 million miles an hour, clouds of gas and dust pour from the poles of the exploding star Eta Carinae. A gossamer disk of ejecta encircles its equator, earning the star the nickname "Ant in a Tutu."

Long a curious blob in terrestrial telescopes, Eta Carinae to Hubble's eye is a spectacle of stellar violence. The star, still burning five million times brighter than our sun, illuminates the clouds from the inside, like frosted Christmas bulbs.

Despite Hubble's unprecedented view, astronomers still aren't sure how Eta Carinae survived the cataclysm that for a time made it one of the brightest stars in the southern sky.

JON MORSE, KRIS DAVIDSON, AND NASA

ONE NIGHT in the early 1600s Galileo got tired of using his newfangled telescope to spot ships and pointed it to the heavens instead. Suddenly the moon had mountains. A fleet of moons encircled Jupiter. And people would never again gaze at the night sky in the same way.

I expected Bob Williams to hedge when I asked him if the Hubble Space Telescope is the most significant single device to scan the skies since Galileo's discoveries. Even the director of the Space Telescope Science Institute, I figured, would hesitate at that threshold.

"Well," he answered, "let's face it. It probably is." He smiled faintly. He knew he'd said a mouthful.

Remember that at 2.4 meters in diameter, Hubble's mirror is dwarfed by the ten-meter twins in Hawaii's Keck I and II telescopes. While you could play football in the dish of the radio telescope at Arecibo, Puerto Rico, Hubble has no radio detectors at all. And a companion in orbit, the COBE satellite, has infrared and microwave detectors that have mapped the ancient universe.

And yet it is hard to argue with the proposition.

Orbiting 370 miles up, above city lights and the rippling atmosphere, Hubble has confirmed the existence of black holes, revealed a rogue's gallery of bizarre galaxies, ushered us to a ringside seat for a comet collision with Jupiter, and chronicled the catastrophic explosions of dying stars.

Not bad for a satellite that in the beginning had something of a catastrophic reputation itself. Hubble was lifted into orbit with great pomp and expectation by the space shuttle *Discovery* in April 1990. Almost immediately it was clear that the primary mirror was misshapen—not to any funhouse extreme but enough to pull some sheer lace curtains across Hubble's ballyhooed "window on the universe." The telescope's true golden age began in December 1993, when the crew of the shuttle *Endeavour* rode to the rescue.

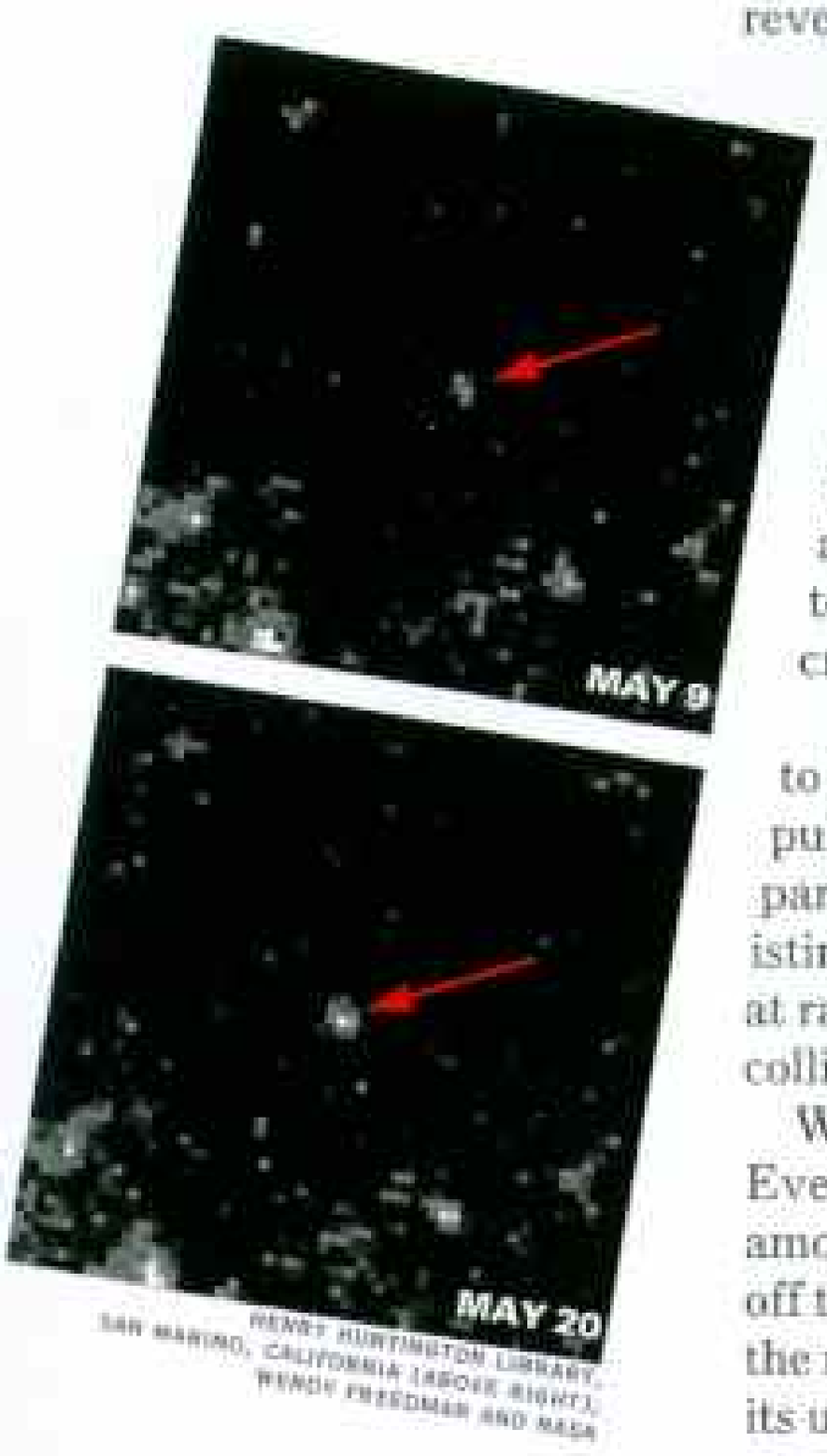
With hinged doors and modular parts, Hubble was designed to be serviced in space. Like roadside mechanics, the astronauts pulled up to Hubble, opened the hood, and installed replacement parts. They included corrective mirrors that canceled out the existing mirror flaw. In the following months astronomers marveled at razor-sharp views of a universe dizzy with exploding stars and colliding galaxies, stretching off from here to the edge of eternity.

When you look into space, you are looking back through time. Even at 186,000 miles a second, light requires a measurable amount of time to get from one place to another. Sunlight bounced off the moon requires a second to reach earth, so when you look at the moon, you are actually looking at the moon a second ago. With its unobstructed view, Hubble can look back some 11 billion years—just two billion years or so after the creation of the universe—to see galaxies already forming.

These galaxies are speeding away from us. The farther they are,

Hide and seek

Astronomers use stars called Cepheid variables, which periodically dim and brighten, to measure distances in space. To find one, Hubble repeatedly viewed part of the spiral galaxy M100. Experts then studied the series of images and found a star (arrow) that changed in each exposure.



HENRY HUNTINGTON LIBRARY, SAN MARINO, CALIFORNIA (ABOVE RIGHT); WENDY FREEDMAN AND NASA

LAURA FERRARESE, HOLLAND FORD, WALTER JAFFE, AND NASA

the faster they're going—the most distant approach the speed of light. In the 1920s astronomer Edwin Hubble (above left) came up with a formula that expresses the proportional relationship of distances between clusters of galaxies and the speeds at which they're moving. But there is an unknown factor: the precise rate at which objects are rushing away from each other, the so-called Hubble constant. Among Hubble Space Telescope's chief assignments is its mission to settle on a standard Hubble constant.

Bob Williams is the first to admit that in the search for the Hubble constant, earth-based observatories are vital. "Keck can gather light from a galaxy enormously better than Hubble," he said. "That's essential for telling how far away the galaxy is. But without Hubble, which sees things much more clearly, Keck wouldn't know what it was looking at. So the ground's gotta have Hubble, and Hubble's gotta have the ground."

For the rest of us Hubble is simply the greatest tour guide ever. The Eagle Nebula's towering pillars evoke the same primal awe as Grand Teton. The violence of Eta Carinae's explosion is as heart stopping as the maw of a roiling volcano. And thanks to Hubble we can begin to register the notion that while earth is our local address, we have an entire universe that we can call home.

Learn more about the Hubble telescope online at www.nationalgeographic.com.

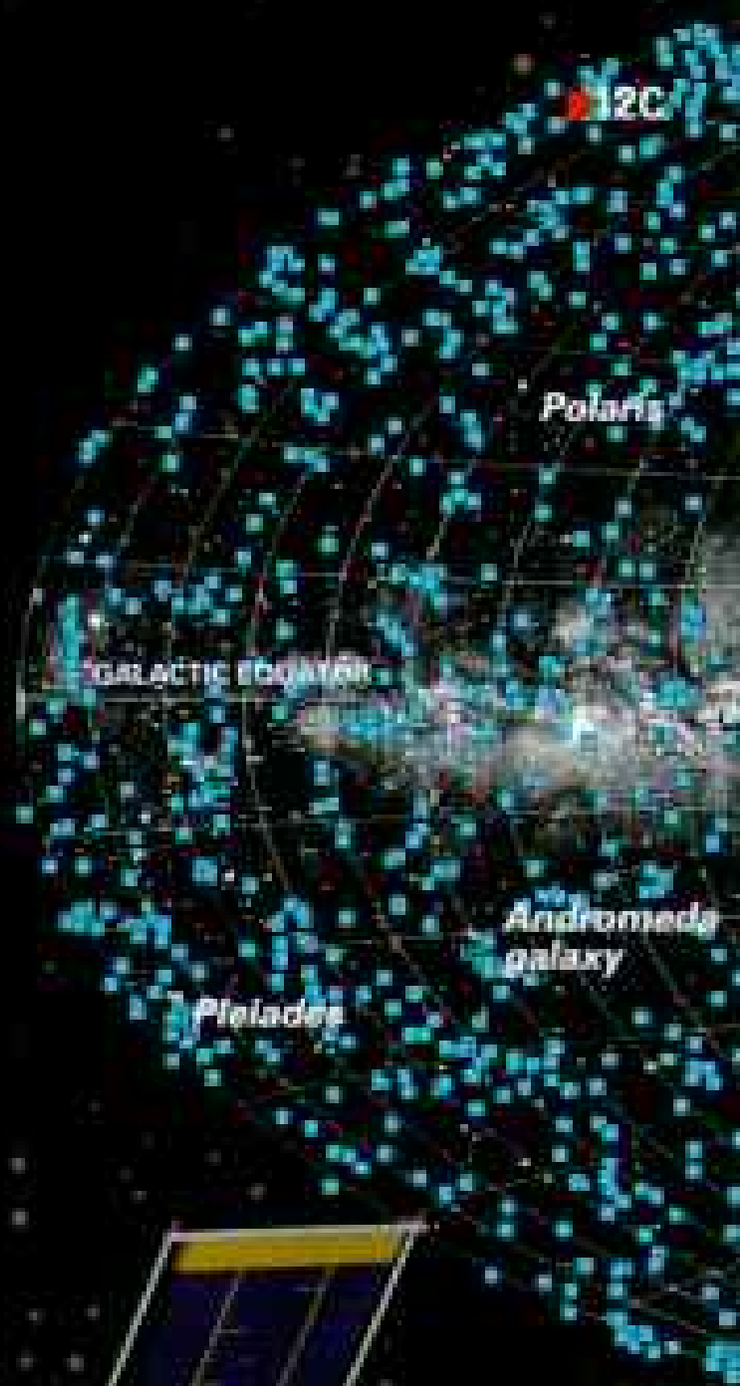
Close look at a black hole

At the center of galaxy NGC 4261 a disk of dust and gas swirls into the deepest of cosmic drains: a black hole with 500 million times the mass of our sun. Not even light can escape its intense gravity; the bright point at center is the final flare of heated matter.

An eye in space

In 1923 German scientist Hermann Oberth proposed an orbiting telescope above earth's distorting atmosphere. Hubble was launched in 1990—four months after Oberth's death. Rebounding from early problems, Hubble is unrivaled for clarity of view.

1997
Several new devices are scheduled to be installed this year. An imaging spectrograph (STIS) will give vital information about galaxy composition and dynamics; a near-infrared camera (NICMOS) will enable Hubble to see inside dust clouds.

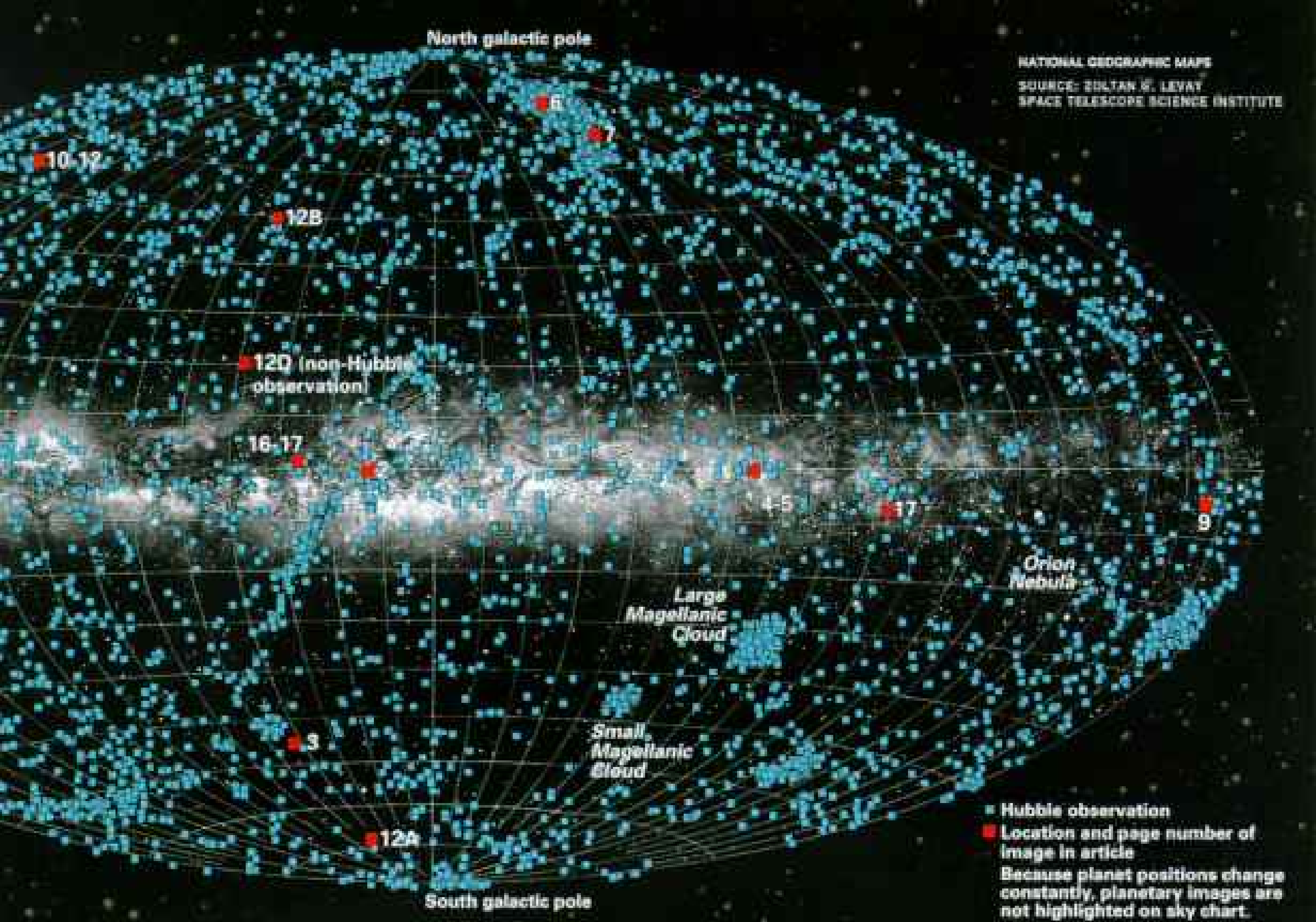


1999
The Advanced Camera for Surveys will increase Hubble's light sensitivity by a factor of ten. NASA plans to replace Hubble's solar panels with smaller, more efficient units.

2002
On the final servicing mission instruments will be added that may enable Hubble to function past its planned 15-year life span.

Aperture door
Light enters front aperture
Secondary mirror
High-gain antenna
Primary mirror
Fine Guidance Sensor
STIS (Space Telescope Imaging Spectrograph)
Solar array
NICMOS (Near-Infrared Camera and Multi-Object Spectrometer)

ART BY DON FOLEY

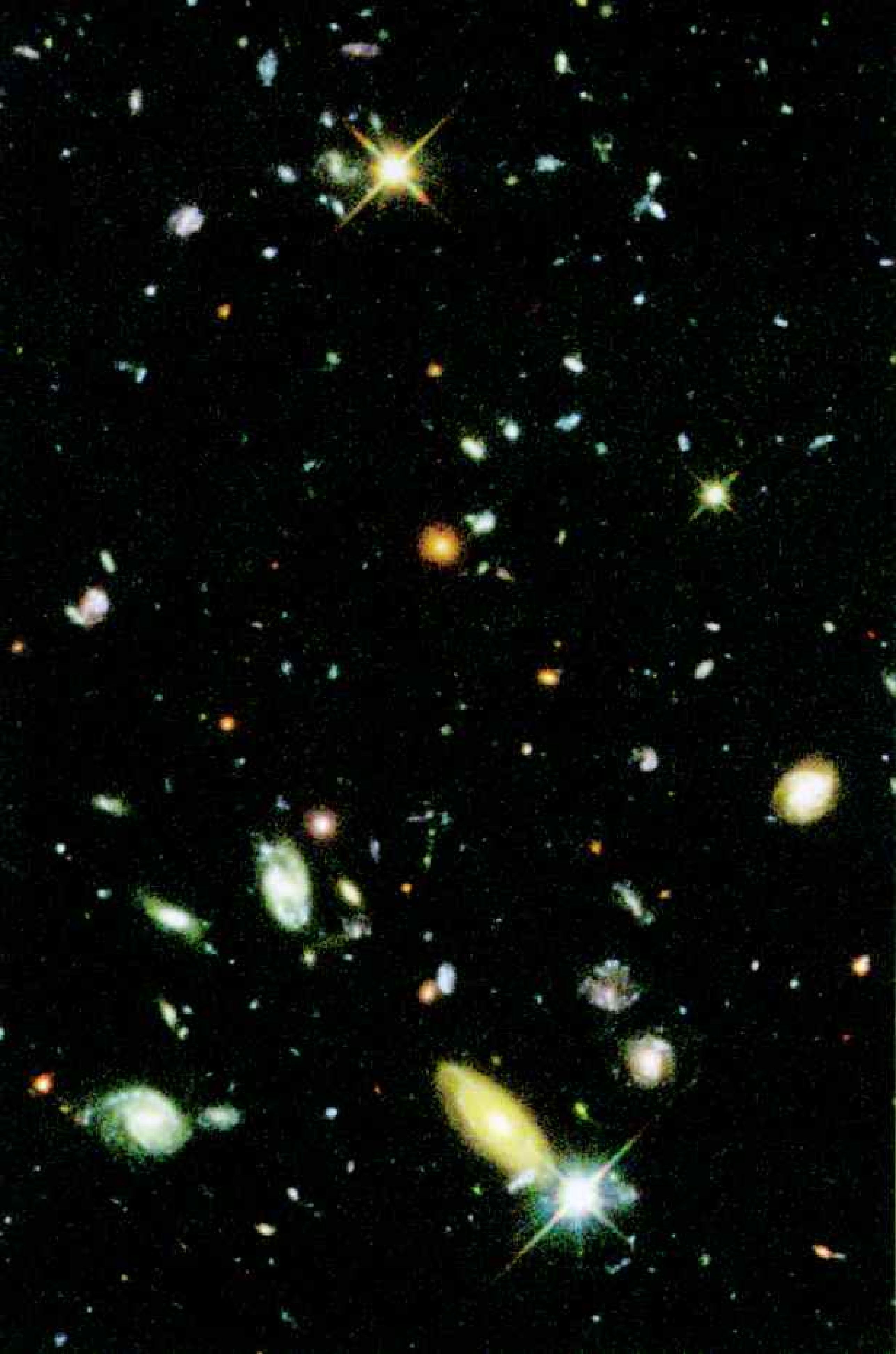


Where Hubble has looked

Oriented by internal gyroscopes powered by solar cells, Hubble's eye can sweep across virtually the entire sky. Only an area within 50 degrees of the sun and 8 degrees of the moon—where Hubble's delicate instruments run the risk of being damaged—is off-limits. Against an illustration of the entire night sky, with the Milky Way stretching across the galactic equator, symbols indicate everywhere Hubble has looked since its launch in 1990. Some areas have been closely scrutinized, such as the two Magellanic Clouds at lower right. Another Hubble study, the "serendipitous survey," randomly imaged various parts of the sky. Pictures from that study revealed a surprising abundance of irregular galaxies.

NIGHT SKY DRAWING BY LUND OBSERVATORY, SWEDEN (TOP); JEFF HESTER, PAUL SCOWEN, AND NASA

INSIDE THE CRAB NEBULA: The star at left in the above series is a pulsar—only 12 miles wide, more massive than the sun, and spinning 30 times a second at the heart of the Crab Nebula. Images taken months apart reveal an ever changing "halo" beneath the pulsar, caused when high-energy electrons are trapped in its magnetic field.



MASSO GIAVALISCO, DUCCIO MACCHETTO, AND NASA

MARK DICKINSON AND NASA

ALAN DRESSLER AND NASA

ALAN SANDAGE

It was a surprise to scientists that galaxies had formed within two billion years of the big bang. Hubble images reveal evolving galaxies.

Worlds without end

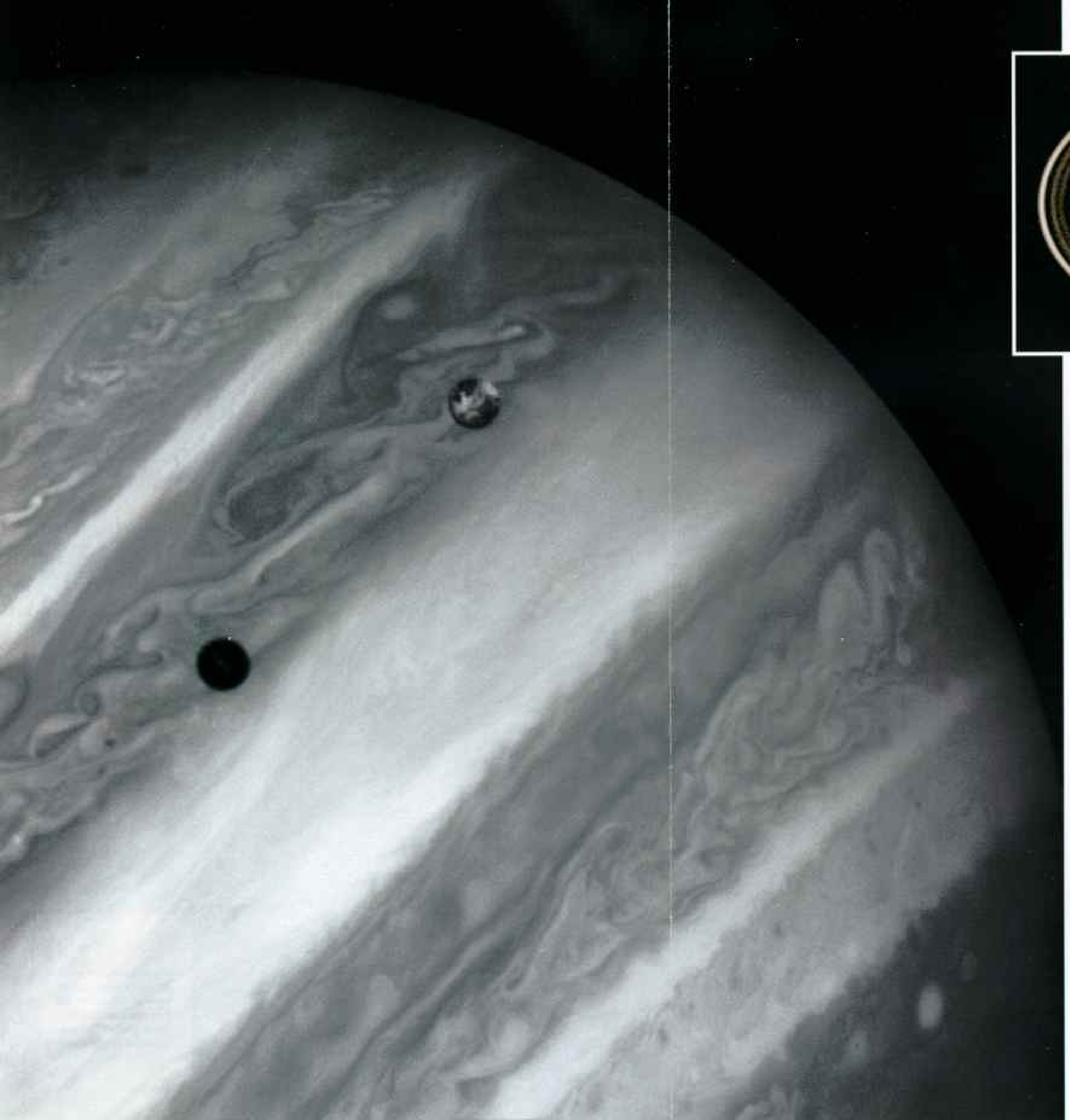
Hubble pointed at one of the emptiest parts of the sky, focused on a region the size of a grain of sand held at arm's length, and found layer upon layer of galaxies as far as its eye could see.

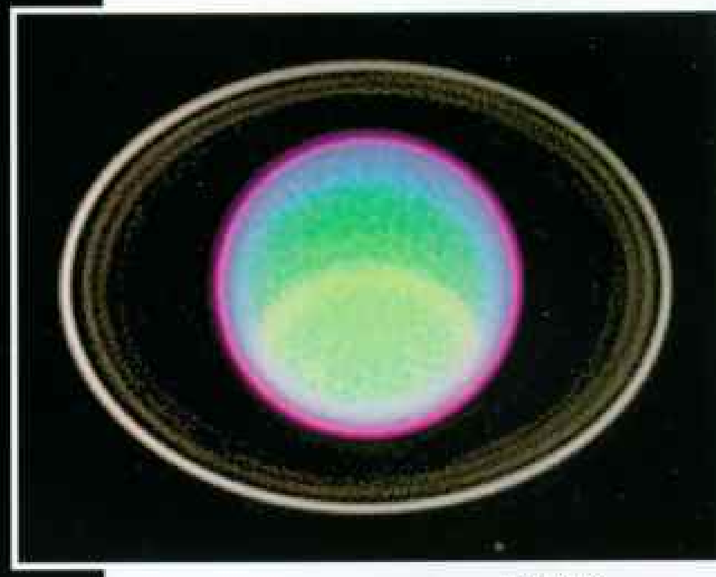
The Hubble Deep Field image required 276 exposures taken over ten consecutive days to gather as much distant light as possible.

Only a few objects in this image are individual stars, which appear as spiked points of light. Everything else is a galaxy, each containing billions of stars. The large white galaxy at top center is one of the closest—a mere four billion light-years away.

Hubble has also seen ancient galaxies from perhaps 90 percent of the way back to the big bang. Curiously, at such vast distances objects don't necessarily appear smaller due to distance, only dimmer. Light from the faintest, most distant galaxies in the Deep Field image has taken some 11 billion years to reach earth. This "core sample" of the universe is helping astronomers learn more about the early formation of galaxies.

ROBERT WILLIAMS AND THE HUBBLE DEEP FIELD TEAM AND NASA





URANUS

Closer to home, Hubble can make frequent return "trips" to nearby planets for weather updates.

A look at Jupiter (left) reveals intricate cloud patterns on the giant planet, as well as bright patches of sulfur dioxide frost on its moon Io. Io's shadow races across Jupiter's cloud tops at 10.5 miles a second.

Uranus (above) points its poles at the sun more directly than any other known planet. Its charcoal black rings have been highlighted for study of their structure.

No one had clearly seen the face of Pluto before Hubble's historic images. Maps derived from Hubble data (right, top left) show that Pluto has the highest contrast between light and dark regions of any planet except earth. Morning clouds appear on the western edge of Mars (top right) in the clearest telescope image ever taken of the red planet.

A huge storm on Saturn is seen as a white arrowhead-shaped feature near the equator (center). Neptune—currently the most distant planet from the sun—had not been seen in detail since Voyager flew by in 1989. Hubble has tracked clouds on both hemispheres of the gaseous planet (bottom), including high-level clouds (yellow) that reflect sunlight at the top of the image.

JOHN SPENCER AND NASA (LEFT); ERICH KARKOSCHKA AND NASA

Planetary weather

PLUTO

ALAN STERN, MARC BUIE, ESA, AND NASA

MARS

PHILIP JAMES, STEVEN LEE, AND NASA

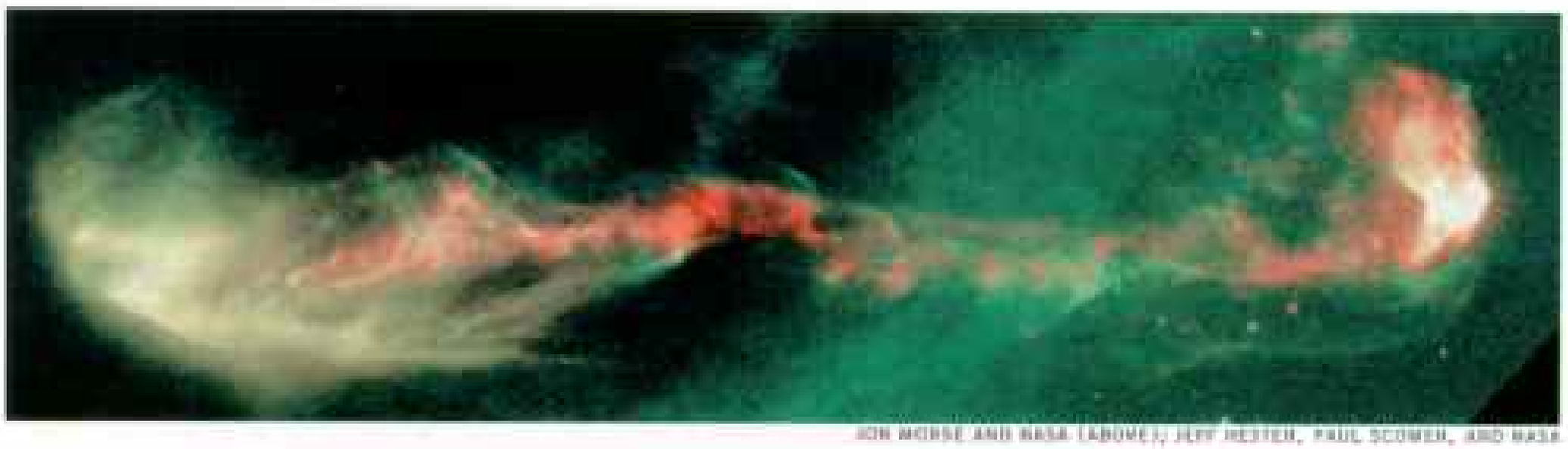
SATURN

RETA BEEBE, DIANE GILMORE, LOUIS BERGERON, AND NASA

NEPTUNE

NEPTUNE

LAWRENCE SROMOVSKY AND NASA (ABOVE AND ABOVE LEFT)



JON MORSE AND NASA (ABOVE); JEFF HESTER, PAUL SCOWEN, AND NASA

Pillars of creation

The miracle of star birth unfolds in the Eagle Nebula. Deep inside the pillars of dense, cool gas and dust—the tallest one here measures three light-years in height—molecular hydrogen and dust condense into lumps that contract and ignite under their own gravity to become stars. Ultraviolet light from other stars is evaporating the pillars, leaving the embryonic stars enveloped in their own thick clouds of gas.

Young stars often emit huge jets of gas. Hubble has shown these jets in unprecedented detail, including a curious twisting pattern in a three-trillion-mile-long specimen in the Gum Nebula (top). The star itself is hidden in a dust cloud to the left. With a new infrared sensor, Hubble scientists hope to see inside such clouds—and ever deeper into the universe. □

Traveling the Australian

By THOMAS O'NEILL
NATIONAL GEOGRAPHIC SENIOR STAFF

Under a dust-red sky the author travels the front line of Australia's long war between sheep graziers and the dingo, the wild dog of down under. This wire fence stretches unbroken for 3,307 miles across the interior, barring marauding dingoes from southeastern sheep lands. Yet, in a land of flash floods and hard-charging kangaroos, holes happen.

DOG FENCE

Photographs by MEDFORD TAYLOR

"ISN'T IT BEAUTIFUL?" Jerry Stanley demanded to know. A rough-edged Aussie bushman, Stanley stepped out of his souped-up four-wheel-drive vehicle and stood in the middle of the dirt track, staring fiercely into the distance. The outback sky looked awesome as usual, a hot blue ocean with schools of clouds floating across it. At ground level a flock of galahs, Australian cockatoos, blew by in a gust of pink.

But Stanley wasn't glorying in nature's handiwork. He had his eye on the man-made, on a horizon of wire and wood.

"OK, the fence looks great," I said. "It's the greatest fence ever built."

That would be the dog fence. And if it isn't the greatest, the most beautiful fence in the world, it's surely the longest—3,307 miles of continuous wire mesh, snaking across the outback from the cold surf of the Great Australian Bight off South Australia all the way to the cotton fields of eastern Queensland, just shy of the Pacific Ocean. This epic fence exists for only one purpose: to stop dingoes, Australia's wild dogs, from killing sheep.

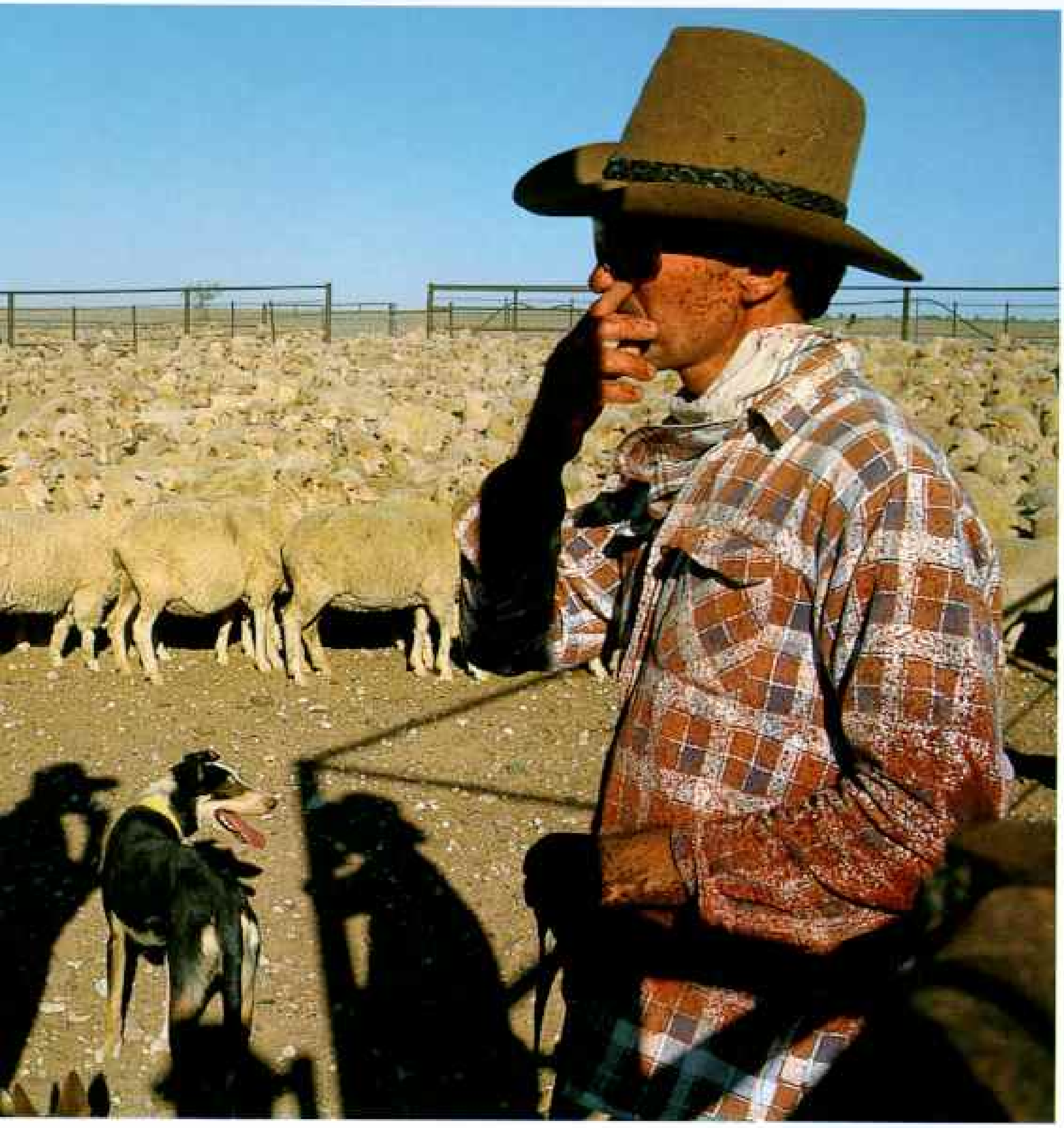
The fence here is six feet tall, with small wire mesh on the bottom, wide diamond-shaped steel mesh above it, and on top a flashy strand of barbed wire. For the past few days, here on the Argyll sheep station in central Queensland, Stanley, the state's chief of fence maintenance, had been helping a work crew put an aging section of fence through a makeover. Steel posts replaced sagging wooden ones, new mesh panels were strung over creek beds periodically scoured by flash floods. Holes got patched, foot netting laid.

That night around the campfire, as the tired crew swallowed beer and listened to heartsick Patsy Cline tunes, Stanley expressed satisfaction. "This section won't be fixed again in my time," the 39-year-old manager said. When he didn't see the proper awe in my face, he sat up from his swag, his bedroll, and said, "You don't understand. Without that fence the sheep industry wouldn't survive."

I would come to understand. The dog fence is Australia's version of the Great Wall of China (but longer), erected to keep out hostile invaders, in this case hordes of yellow dogs.

The empire it preserves is that of the woolgrowers, sovereigns of the world's second largest sheep flock, after China's—some 123 million head—and keepers of a wool export business worth four billion dollars (five billion U.S. dollars). Never mind that more and more people—conservationists, politicians, taxpayers, and animal lovers—say that such a barrier would never be allowed today. With sections of it almost a hundred years old, built by bushmen traveling with camels, the dog fence has become, as conservationist Lindsay Fairweather ruefully admits, "an icon of Australian frontier ingenuity." There

Photographer MEDFORD TAYLOR's work for NATIONAL GEOGRAPHIC includes coverage of Australia's "Simpson Outback" in the April 1992 issue. He lives in Richmond, Virginia.



is a saying that Australia was built on the sheep's back. Maybe one should add "and on the inside of a fence."

To appreciate this unusual outback monument and to meet the people whose livelihoods depend on it, I spent part of an Australian autumn traveling the wire. It's called different names in different states: the Dog Fence in South Australia, the Border Fence in New South Wales, and the Barrier Fence in Queensland. I would call it simply the Fence.

For most of its prodigious length, the Fence winds like a river across a landscape that, unless a big rain has fallen, scarcely has

Cutting the tails off 4,000 merino sheep to prevent blowfly infestation leaves manager Stuart Thomson, at right, bloody and beat at Mount Stuart Station near Tibooburra in New South Wales. The dog fence guards the world's second largest sheep flock, after China's. "Without the barrier," says a fence administrator, "the sheep industry would be ravaged."

Unharried by shooters and trappers, a dingo outside the fence licks its mouth after visiting a water hole. Probably introduced by Asian seafarers more than 3,500 years ago, Australia's largest land predator hunts roos, rabbits, and, for the past 200 years, sheep.

rivers. The eccentric route, prescribed mostly by property lines, provides a sampler of outback topography: The Fence goes over sand dunes, past salt lakes, up and down rock-strewn hills, through dense scrub, across barren plains, and down sand-choked gullies.

The Fence stays away from towns. Where it passes near Coober Pedy, an opal-mining site in South Australia, it's actually a tourist attraction, visited on bus tours. "People go up and touch it," says a tour guide. "Little ones try to climb it like a dog. The smart alecks go up and lift their legs."

The Fence marks the traditional dividing line between cattle (outside) and sheep (inside). Outside is wilder, drier, emptier. Inside, far inside, is where the "high rainfall people" live with their cities, farms, paved roads, and grass lawns. Inside is where dingoes, legally classified as vermin, are shot, poisoned, and trapped. Sheep and dingoes do not mix. The Fence unscrolls that message mile after mile after mile.

The world's longest fence—nearly a thousand miles longer than China's Great Wall—marches over sand hills on the South Australia-New South Wales border. Tracks mark where patrollers passed by. Cattle coexist with dingoes on the outside, though dogs will prey on calves.

What is this creature, this dingo, this rapacious killer of sheep that by itself threatens an entire industry, inflicting several millions of dollars of damage a year despite the presence of the world's most obsessive fence? Cousin to the coyote and the jackal, descended from the Asian wolf, *Canis lupus dingo* is the Australian wild dog, an introduced species. Skeletal remains indicate that the dingo came to Australia more than 3,500 years ago, probably with Asian seafarers who landed on the north coast to trade. The adaptable dingo spread rapidly and in a short time became the top predator. Eventually its marsupial competitors, the now extinct Tasmanian wolf and the raccoon-size Tasmanian devil, disappeared from mainland Australia.

The dingo looks like a small wolf. It is a leggy dog, with a long muzzle, short pointed ears, and a bushy tail. The most common color is ginger, a kind of ruddy yellow. Dingoes rarely bark; they yelp and howl. Standing about 22 inches at the shoulder—slightly taller than a coyote—the dingo is Australia's largest land carnivore.

As ceaseless hunters, dingoes chase down anything from red kangaroos and badger-size wombats to rabbits and lizards. Easiest pickings by far are sheep: They are slow, panicky, and have nowhere to hide. The dogs pull them down by their necks or hindquarters and with powerful jaws tear the sheep apart. Adult cattle usually prove too large to handle. Unless provoked, a wild dingo has never been known to attack a human.

The woolgrowers' war against dingoes—similar to the sheep ranchers' rage against coyotes in the western United States—started not long after the first Australian settlers disembarked in 1788, bringing with them a cargo of merino sheep. Dingoes officially became outlaws in 1830, when authorities placed a two-shilling bounty on their heads. (Today bounties for problem dogs that are killing sheep inside the Fence can reach $500.)

As pioneers penetrated the interior with their flocks, fences replaced shepherds until, by the end of the 19th century, thousands of miles of barrier fencing crisscrossed the vast grazing lands. Sometimes the wild dogs simply overwhelmed graziers, particularly in areas prone to flood or drought, events that can set dingoes moving.

Stations that once sheared 100,000 sheep suffered so many kills that their owners

switched to cattle. Others fought back with massive poisoning campaigns and shooting drives. Stations reported annual kills of hundreds of dogs.

"The dingo started out as a quiet observer," writes Roland Breckwoldt in *A Very Elegant Animal: The Dingo*, "but soon came to represent everything that was dark and dangerous on the continent." Worse, there seemed no end to the threat, despite the mounting body counts. Laurie Corbett, a noted dingo researcher, estimates that since sheep arrived on the continent, dingo numbers may have increased a hundredfold. Though dingoes have been eradicated from parts of Australia, an educated guess puts the population at more than a million.

Eventually government officials and graziers agreed that one well-maintained fence, placed on the outer rim of sheep country and paid for by rates levied on woolgrowers, should supplant the maze of private netting. By 1960 three states joined their barriers to form a single dog fence. Queensland has the longest fence, with 1,591 miles, followed by South Australia, with 1,353 miles. The New South Wales fence covers 363 miles, all of it along state boundary lines.

"Such a fence is unknown in most parts of the world," says Tom McKnight, a geography professor recently retired from the University of California at Los Angeles. "In southern Africa there is some exclusion fencing to stop antelopes from entering grazing lands, but otherwise the long-distance barrier fence is an Australian institution."

THE SERIOUSNESS of the Fence is immediately clear at its western starting point. "Just head toward the water" were our instructions as photographer Medford Taylor (providentially known as "Dog") and I set off from the remote Aboriginal village of Yalata, 430 miles northwest of

No "woollyback" is totally safe inside the fence, particularly lambs, no matter how Gordon Litchfield cuddles them on Wilpoorinna Station in South Australia. Earlier a dingo tore up two lambs before Litchfield and his son, Adam, chased it down and shot it (above). A dingo will maul up to 50 sheep a night, killing far more than it needs for food.

the South Australian capital of Adelaide. We found the Fence where it arrowed off from the Eyre Highway and proceeded to drive alongside it until it stopped on the sheer edge of a limestone cliff.

Below boomed the cold, wave-tossed expanse of the Great Australian Bight. Only a dingo with fins or wings could outflank this section. A sign a few miles back, emblazoned with skull and crossbones, warned of poison baits and traps. The only missing elements to complete the menacing scene were dead dingoes strung like war trophies from the mesh, something we would see in other locations.

That the western end of the Fence runs through Aboriginal land struck us as ironic. Australia's indigenous peoples have long coexisted with the dingo. Early on Aborigines adopted the dingo as a camp companion. The dingo figures in many native myths. In the winter sky the Pleiades, or Seven Sisters, were seen as a flock of kangaroos being chased by the dogs of Orion.

MEDFORD AND I could drive for hours, days even, and never see a soul along the Fence—just a stray mix of kangaroos, emus, and foxes darting in and out of our way. And yet, somewhere out ahead of us, or behind, some 50 people, singly or in pairs, were traveling just as we were, devoting their days to patrolling the wire. Fence riders from the three states were filling in tunnels, patching rips, setting traps, replacing posts, closing gates, and shooting dingoes.

Natural forces conspire against the Fence. Floods wash it away, rust eats it up, blowing sand buries it, falling trees crush it. Then there are the animals. Wombats, foxes, spiny anteaters, and pigs all dig holes under it. Hot-blooded bulls and wild camels knock it down. Kangaroos pry away the foot netting. Emus for some reason run full speed into it and split the mesh. Dingoes usually don't make holes. They just wait to step through one.

One day I joined fence rider Dean Jaensch as he made his rounds of Mulgathing, a 2,000-square-mile sheep station in South Australia edged by 95 miles of dog fence. Jaensch crept along in his weathered pickup, staring at the five-foot-high fence as intently as if he were decoding a hidden image amid endless X's of wire mesh.

"My eyes ache after a while, and I have to stop," admitted the bespectacled 50-year-old patroller.

"You should have been here last year," Jaensch said at one point, breaking a long fence-watching trance. "We had so many dingoes, I got sick of setting traps. I must have caught 200 of them. It was a dry year, and most of the dogs were skin and bones. But there was nothing here for them—nothing except the traps and me."

We stopped frequently in the scruffy brush country, but Jaensch did mostly touch-up work—shoveling dirt into holes begun by some animal, replacing rusted wire foot netting with new plastic-coated mesh. "Bloody fox," he swore, finding one dead in a leg trap meant for a dingo. Meticulously he reset and buried the trap, doctoring the steel jaws with

Caught trespassing, a dingo is hung as a trophy on the South Australian fence. A scalp brings the Phillips twins $20 ($16 U.S.) in Queensland, where Barry, left, and Ron collected 16 in five weeks on their fence-divided lands. Problem dogs can bring up to $500.

strychnine, enough to kill any creature trying to chew its way free.

No dogs had been seen for weeks along the Mulgathing barrier. But that afternoon Jaensch spotted tracks in the orange sand. "Look, the dingo stopped to mark its territory," he said. Then, up ahead, we saw the dingo. It was standing in a trap, its eyes glazing from the poison. The dog, a yellow female, silently hung her head. Dean shot her and reset the trap. No sympathy. No remorse. Fence patrolling is all business.

From its salt-sprayed start at the Great Australian Bight, the fence doesn't stop until it has threaded half a continent, stopping where the bush ends and farmland begins near the Pacific Ocean. Some sections go back a hundred years, when patrollers rode on camelback. Now government subsidies and taxes buy graders, four-wheel-drive vehicles, and overnight huts.

THE MASTER of Mulgathing Station and one of the largest landholders in Australia is a square-jawed, sandy-haired, tweedy patrician named Hugh MacLachlan. When I met him at his office in Adelaide, he was examining a swatch of Chinese-made netting. He kept turning it over in his hands, as fastidious as an archaeologist with an intriguing bone. He pulled out a ruler to measure the thinness of the wire. Finally he looked up. "This is good only for repairs," he sniffed. "It's cheap."

MacLachlan has reason to value quality netting. Besides Mulgathing, he leases from the government two other properties on the Fence. Altogether his holdings encompass 7,500 square miles—the size of New Jersey—on which he runs 120,000 sheep and maintains 233 miles of dog fence.

MacLachlan spoke about the prolonged slump in wool prices and about promising new markets in Asia. But he kept returning to the Fence and the people who tend it. He prefers middle-aged fence riders like Dean Jaensch. "You need a bit of mental strength and patience to do the job," he said. "Young people get bored. 'It's just a fence,' they say." MacLachlan leaned forward, color rising in his face. "Well, that fence is keeping the whole country viable. Without it there's no business, no jobs."

The most critical job on Mulgathing belongs to manager Richard Armour. I joined him as he sped around the property to eyeball the levels of its 60 water tanks to make sure the wind-driven pumps were drawing enough groundwater to keep thirsty sheep alive. At the troughs, skinny, long-legged lambs wandered around—lost, bleating, abandoned by heat-stressed mothers. Armour reckoned that drought, disease, and dingoes eliminate 6,000 of MacLachlan's sheep a year.

The strongest argument for the Fence, graziers insist, is to watch what happens when part of it fails. Michael Sheehan's experience on Moolawatana Station in South Australia, across the state from Mulgathing, provides one such cautionary tale. Let the Fence go, and your sheep-raising days are history.

I met Sheehan, a sturdy, graying man with a sea captain's trim beard, at his homestead, one of only a few residences in a hundred-mile radius. "It's rough country," he said, nodding toward the low gray hills of the northern Flinders Ranges. "Full of big creeks when it rains. That's when the fence gets washed away."

Unlike landholders who lived along the Fence in New South Wales and Queensland, Sheehan, as a leaseholder in South Australia, was solely responsible for maintaining his 71

miles of netting. In the other two states—and since 1996 in South Australia—private contractors and state employees do the fence work, absolving the landowner of any direct involvement other than paying a special tax.

The South Australian government subsidized Sheehan's labors at a fixed rate, paying him $185 a year per mile of fence. Unfortunately this amount could not cover repairs, much less pay for regular patrol. Each time it rained hard in the Flinders, creeks filled and swept away his barriers. Sheehan, who took over the property from his father in 1963, put up a tireless effort for years because he could count on five or six hired hands to help him. But wool prices plunged in the early 1990s, and Sheehan had to cut back until only he and his wife, Audrey, were left to run the 730-square-mile station.

Sheehan took his story to the kitchen table, where Audrey set a simple lunch of homemade bread and pumpkin soup. A power generator crooned from somewhere in the dusty yard. "After a while I couldn't pretend I was looking after the fence anymore, and the dogs were coming in at will," Sheehan said. "A drought had made rabbit numbers crash, and the dingoes were on the move looking for food."

That year, 1992, "we destroyed 992 dingoes, 98 of them inside the fence," Sheehan continued, "and still we lost 3,000 grown sheep. Fewer than half our lambs survived. Every day I saw maimed or dead sheep, guts hanging out."

So the Sheehans mailed back their subsidy check (the first ever to do so), sold their remaining sheep to the slaughterhouse, and

Feathered but earthbound, emus make a habit of racing up and down the dog fence until they tire and try to crash through. Fence saboteurs also include burrowing wombats, headstrong camels, and, worst of all, mobs of wire-tearing kangaroos.

Repair work is relentless on a fence pressured by weather and wildlife. In Queensland a full-time maintenance crew reconstructs a section worn down by rust and seasonal flooding. The work is hard and hot: unloading post logs (above, right), carrying timber (top), stringing new mesh across a creek bed (above). To build a mile of six-foot-high netting costs as much as $12,000. Lower and cheaper, solar-powered electric fencing is going up in South Australia.

converted to cattle. Dingo anxiety faded. In fact, before long the Sheehans were growing philosophical about dingoes. "The dog was only doing what comes naturally," Michael said, pushing away from the table. "Now I don't mind seeing them. They're a magnificent creature, you know."

THE INTENSE private battles between woolgrowers and dingoes have usually served to define the Fence only in economic terms. It marks the difference between profit and loss. Yet the Fence casts a much broader ecological shadow. What the Fence has become is a terrestrial dam, deflecting the flow of animals inside and out.

The ecological side effects appear most vividly at Sturt National Park, a 1,200-square-mile collection of onetime sheep

stations abutting the barrier on the New South Wales-Queensland border. In 1845 explorer Charles Sturt led an expedition through these parts on a futile search for an inland sea. For Sturt and other early explorers, a kangaroo sighting marked a noteworthy event. Now try *not* to see one.

As I drove through the nearly deserted park, the rumble of my vehicle sent dozens of large red kangaroos bounding across the grasslands. Ostrich-like emus, their feathers shaking like grass skirts, joined the stampede. On every side, animals raced across open country. This was Australia's Serengeti. But something was missing, something to chase the roos, to bring them down as a lion would a gazelle. There were no dingoes.

Without a native predator the kangaroo population has exploded inside the Fence. Some of the increase is due to pastoralists bringing permanent water to the outback in the form of wells and tanks. But more important, once the dingo was banned from sheep country, large marsupials—red and gray kangaroos and wallabies—lost a crucial check on their populations.

Kangaroos are now cursed more than dingoes. They have become the rivals of sheep, competing for water and grass. In response state governments cull more than three million kangaroos a year to keep Australia's national symbol from overrunning the pastoral lands. On Mulgathing alone, professional shooters annually kill 7,000 kangaroos and then market the meat and hides.

Park officials respond to the surfeit of roos with a stiff upper lip. "The fence is there, and we have to live with it," John Eveleigh,

a veteran administrator with the New South Wales park service in Broken Hill, told me. In return local woolgrowers must live with the fact that the few dingoes that get inside Sturt Park are protected. This may explain why, since it opened in 1972, the park has struck most locals as an invasive stranger. It could have been a 19th-century buffalo hunter from America's Great Plains speaking when a fence rider in New South Wales remarked to me, "With progress, something is always in the way. Here it's animals. We don't want to demolish them, but they're in the way."

Conservation groups have rarely taken direct aim at the Fence and questioned the ecological sense of both it and the sheep industry. Instead, activists have targeted animal cruelty issues. Their efforts have led to some restrictions on the poison 1080 (sodium fluoroacetate), widely used in dingo control since the 1960s. A move is also afoot to ban steel-jawed traps throughout Australia.

When conservationists do attack the dog barrier, they allege that the Fence impairs seasonal migrations of wildlife beyond the normal movements of local populations. Yet geographer Tom McKnight of UCLA and Gordon Grigg, a University of Queensland zoologist, disagree. In their opinion large Australian mammals like the red kangaroo do not undertake cyclical migrations.

Grigg sees the Fence as an appendage to the larger issue of restoring the health of an overgrazed landscape. To achieve this, he has publicly floated a provocative idea: Replace the sheep industry with the commercial harvest of kangaroos. "There's a large potential market for kangaroo meat," contends Grigg, who envisions graziers reducing their flocks and making up the loss with the export of kangaroo products. The culling quota would stay the same.

"Sheep have done so much harm to the land," Grigg says. "But does that mean one could take down the fence and let the dingoes in with the kangaroos?" No one, including Grigg, seems to have an answer for that.

On a night so still you can hear the lonely howl of a dingo from a mile away, patroller John Norwood and his daughter Jade find company in a campfire along the South Australian fence. During his 17 years on the wire Norwood has killed hundreds of dingoes, filled thousands of wombat holes, and gone cross-eyed when looking for rips. Why do it? "I love the bush," he says.

SHEEP COUNTRY baked under a fierce blue sky as I left New South Wales and followed the Fence into Queensland. Rain hadn't fallen here since Christmas, six months earlier. Woolgrowers asked the heavens why they had gotten into such a bloody business in the first place.

Still, the seasons had turned, and now it was shearing time. I stopped to watch at a hangar-size shed at Norley Station, north of Thargomindah. Clouds of fleece piled up in the sorting bins.

Outside, in the fly-buzzing heat, a big yellow dingo hung upside down in a mulga tree. John McNamara, the station manager, had shot the dog at sunrise a few days earlier and carted the carcass to the shearing paddock. The dingo would stay in the tree until the shearing ended—a rotting good-luck charm.

For weeks I had been traveling inside the Fence, and the only dingoes I had seen were either dead or in their last moments in a trap. If I was to see a dingo running free, I figured I'd better go outside.

I crossed the Fence near the town of

Tambo and struck off on a dirt track. I had slowed to pick my way through loitering Brahman cattle when a dingo loped out of the straw-colored high grass. I stopped. The dog stopped. It was a nice-looking beast, rusty brown on the sides, a strip of black on top, the familiar white tip on its tail.

The curious dingo circled my vehicle several times. I figured it was a young male that had left the family group to seek its own territory. Obviously it had never been shot at or chased. After a few minutes the dog broke away and trotted down the track, back toward the Fence.

The Fence stops in a Queensland cattle paddock overgrown with prickly pear. No sign announces the end of the world's longest fence. A tractor rattles in the distance. Here's where farmland begins—oats, cotton, wheat. Dingoes steer clear of cultivated country.

At the edge of the paddock I stood beside the final gray wooden post, five miles from the farm town of Jandowae, 115 miles from Brisbane and the Pacific Ocean. Few people—friend or foe, sheepman or cattleman, outbacker or city dweller—can in the end fail to marvel at this dogproof fence, this single wire barrier underpinning the world's most lucrative wool-export industry.

Rain began to fall. As the ground darkened and birds fell silent, I found myself anticipating the reactions of the principal players along the Fence. The graziers would love the rain—if it didn't come in torrents. The patrollers would curse it because it might foul their roads. And the dingoes? A good rain would likely set the dogs moving. But the Fence would be waiting for them. □

Rappelling 120 feet from the sun-washed canopy into the dark of the rain forest floor, orangutan researcher Cheryl Knott—my wife—slides past the girdling roots of *Ficus stupenda* after taking a break from her own work to help me with mine.

Borneo's Strangler Fig Trees

Article and photographs by
TIM LAMAN

Tossing back breakfast, a young rhinoceros hornbill is one of many animals in Borneo's lowland rain forests that find nourishment in the fruit of strangler figs. Time and again I have journeyed to Borneo to study these wondrous trees, whose seeds germinate high in the canopy and whose roots descend to form a menacing vise around the very trees that support them.

The sky-high world of the rain forest canopy is a biological frontier where there is much to discover. No less so is Indonesia's Gunung Palung National Park, an uninhabited area spanning more than 220,000 acres now threatened by illegal logging on the island of Borneo. Several times over the past few years Cheryl and I have called this still lush ecosystem home. Within and beneath the dense green ceiling of the canopy, I have gone about my work studying strangler fig trees and the creatures that depend on them.

"Stranglers" is something of a misnomer. They don't actually squeeze the trees on which they piggyback. Rather, their roots form rigid rings around the host's trunk, restricting further growth. Over time the supporting tree may begin to die. Some figs, such as *Ficus caulocarpa* (left), put down roots so thick that they completely surround the host. Eventually all that's left is a moss-covered scaffold of fig roots.

Early one morning I climbed a tree to survey the forest limits. A white fog breathed slowly around fruiting dipterocarps (above). As I sat statue still, Borneo's wildlife set the day in motion.

Three feet of hunger on the wing, an adult rhinoceros hornbill soars toward a meal of fresh figs. This hornbill ranks among the largest of some 50 fruit-eating bird species in Borneo. Birds are a major disperser of strangler fig seeds, which pass through their digestive tracts and are scattered throughout the rain forest.

Surviving at the top

Somewhere along their evolutionary path certain ground-sprouting fig trees adapted to life in the canopy, taking a shortcut to essential sunlight. Today there are hundreds of species of treetop-sprouting stranglers, at least 25 of them within my study area.

A Research Project Supported In Part By Your Society

Most of the fig seeds that are dropped by birds in the rain forest fall onto the densely shadowed ground and fail to flourish. A few land in the moist mulch of decayed leaves and mosses that collect in the clefts of branches. For a tiny strangler seed (top left, dwarfed by a seed of the Bornean ironwood tree) such small plots provide an ideal locale and medium for germination.

Vulnerable to insects, seedlings of *Ficus stupenda* (above left) begin their slow growth in the canopy. Paradoxically, in a forest that receives some 170 inches of rain a year, drying by the tropical sun is one of their biggest threats. Their waxy leaves help them retain moisture.

Strapped in a harness high above the rain forest floor (top right), I measure the leaves of a three-year-old *Ficus stupenda* that has sprung from one of more than 6,000 strangler fig seeds I planted in the crowns of 45 trees to observe their growth.

This one has a pretty good toehold, aided by clinging roots that are already seeking a pathway toward the forest floor and the groundwater below. Traversing the trunk, root tips creep down and around the host tree (above). Though never sapping it of nutrients, the fig will stifle the host's growth as the roots meet and fuse together.

Within several decades this host tree (right), having been caught in an unyielding embrace by a *Ficus sumatrana*, most likely will have rotted away.

Harvard University biologist Tim Laman has explored the Borneo rain forest canopy for seven years, aided by Society grants.

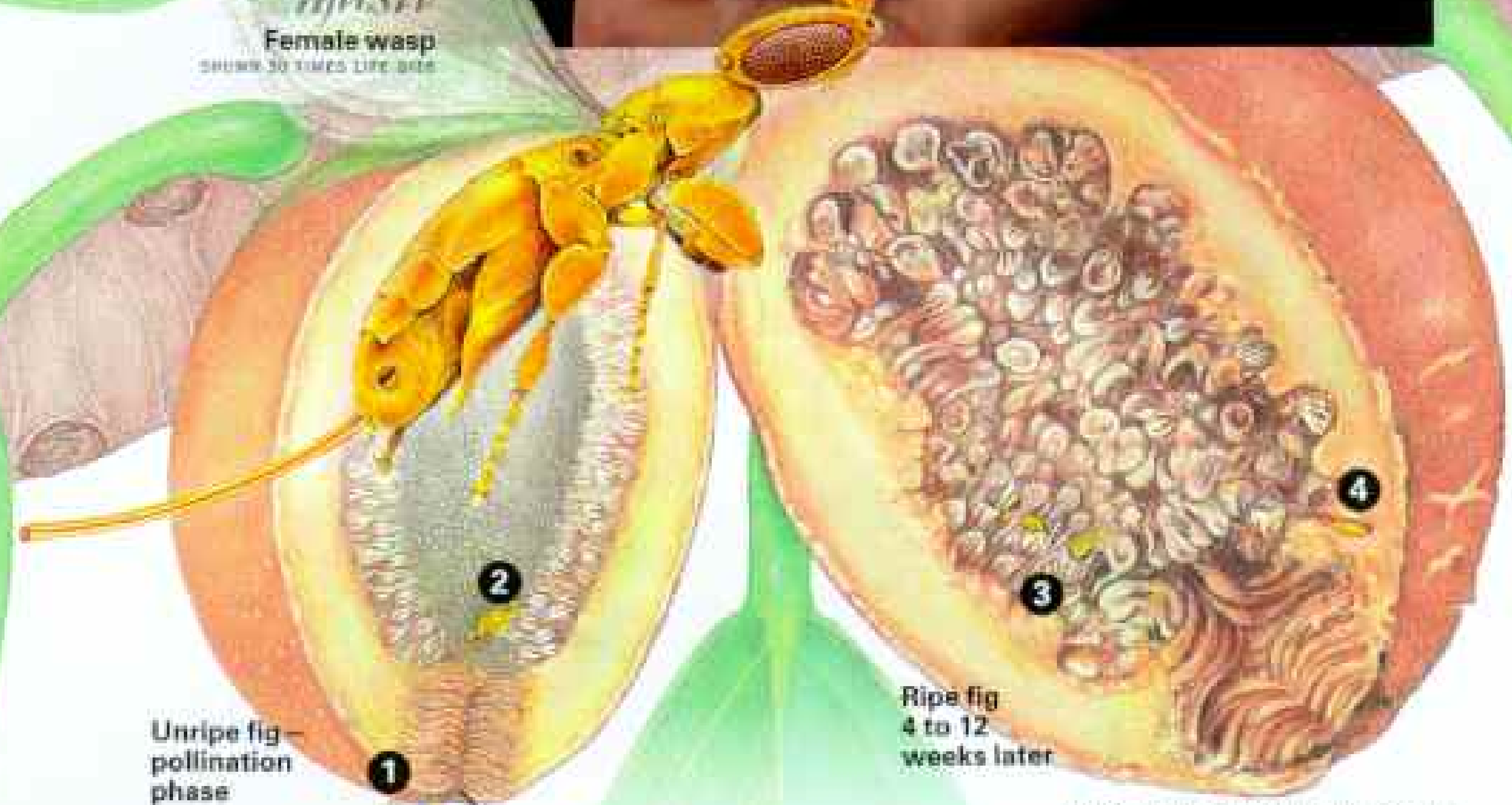
A close partnership

Bound in a cycle of reproduction, fig trees and fig wasps maintain a symbiotic existence. Most fig species depend on a specific wasp species for pollination. The fig (right) provides the wasps a safe place to lay their eggs.

Waterstoniella silvestri

Female wasp

SHOWN 50 TIMES LIFE SIZE

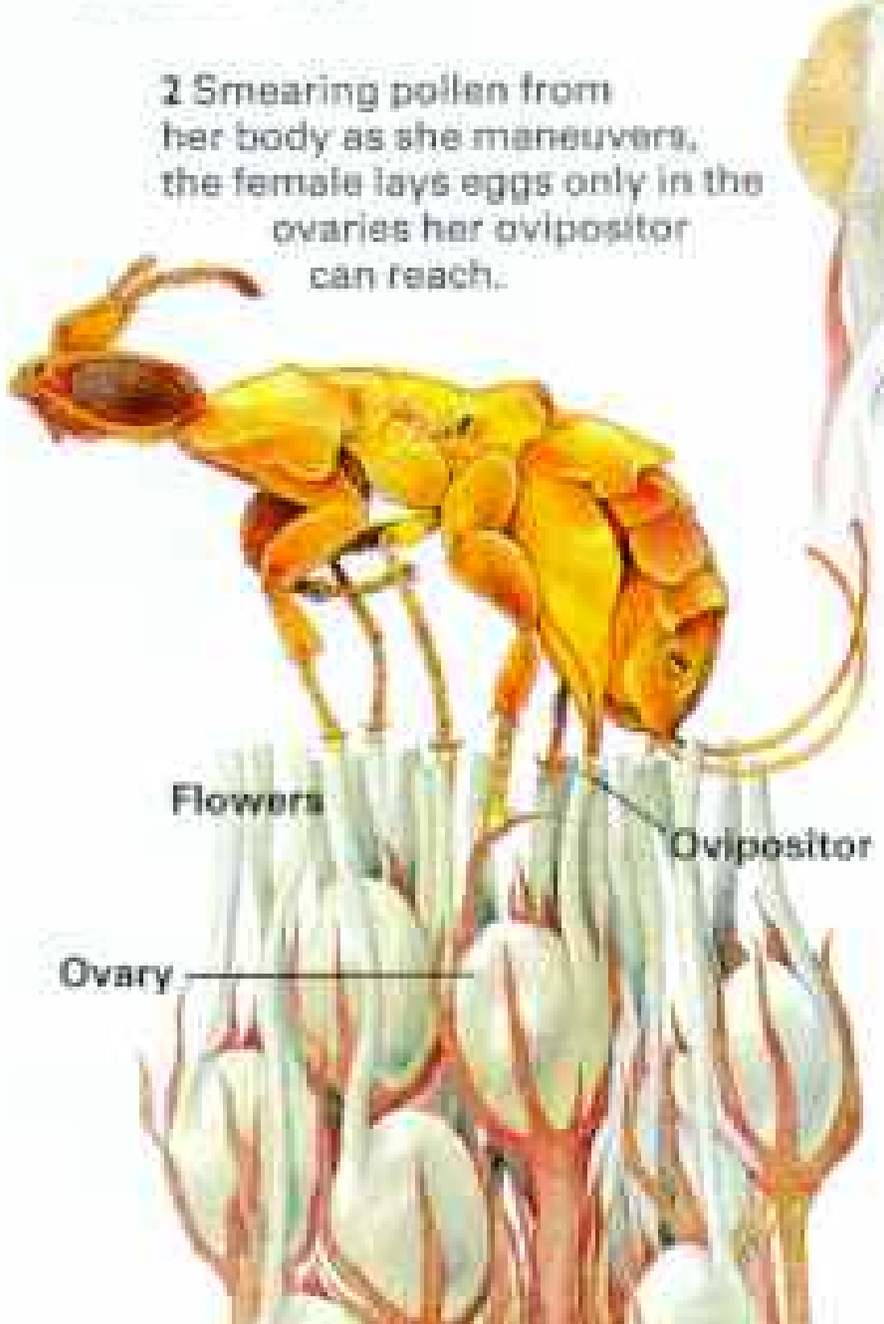


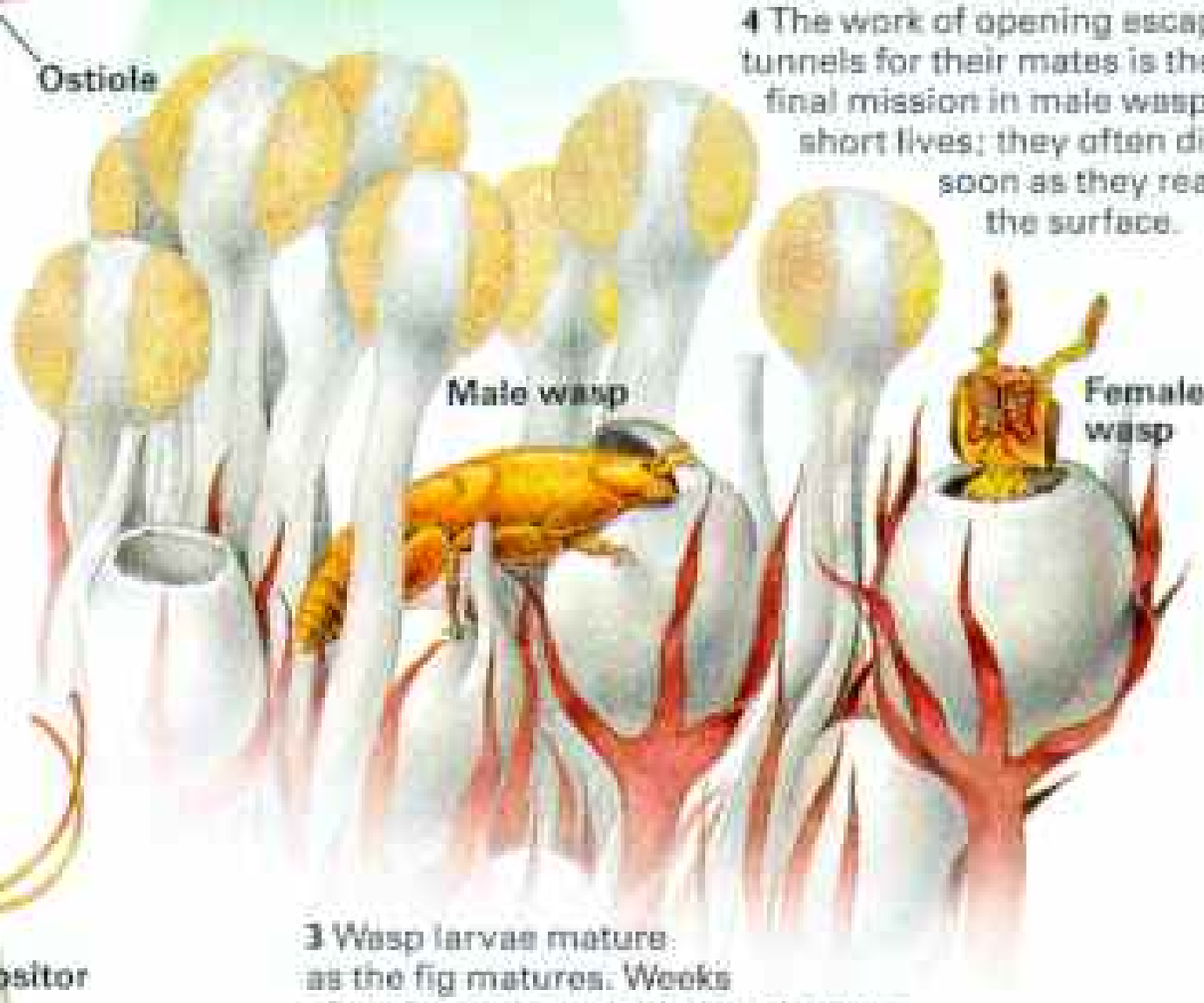
1 The ostiole at the bottom of an unripe fig provides an entryway for a female wasp.

2 Smearing pollen from her body as she maneuvers, the female lays eggs only in the ovaries her ovipositor can reach.

3 Wasp larvae mature as the fig matures. Weeks after the eggs are laid, the wingless, sightless males are first to emerge. With their strong mandibles they rip open the walls of the flower ovaries and mate with the female wasps within.

4 The work of opening escape tunnels for their mates is the final mission in male wasps' short lives; they often die as soon as they reach the surface.





ART BY ANATOLY

The hidden world of the fig

Life, death, and battles for dominance take center stage in the confines of a fig.

A gravid female wasp begins the cycle by transporting pollen from male flowers growing inside the fig where she hatched. Flying to another tree, she enters the ostiole at the end of an unripened fig.

Losing her wings as she squirms through the fig's skin, the wasp navigates the labyrinth within. She moves from one flower to the next, laying a single egg when her ovipositor can reach the flower's ovary and depositing pollen everywhere. Fertilized ovaries without eggs will produce seeds. When the female wasp completes her task, she dies.

One of her offspring, a female (A) covered with pollen, wriggles through a tunnel opened by a male that has hatched before her. Guided by chemical attractants, she flicks her wings (B) and darts off to start the cycle again in another fig.

Competition for space is fierce in this small world. Opportunistic wasp species also lay eggs in the unripe figs. This female (C) will use her long ovipositor to lay her eggs without ever entering—or pollinating—the fig.

A male fighting wasp (D), also an opportunist, emerges from a fig. His enlarged mandibles may have served him inside in a battle over mates, but—winner or loser—he will take only a step or two before he dies.

Inchworming through a tangle of roots, Cheryl does a little canopy exploring of her own. Working mostly on the ground, she researches how the rain forest food supply affects reproduction in orangutans.

Bounty from the trees

Many rain forest animals, such as the red-crowned barbet (above), rely on figs as an important part of their diet.

Even the tiniest creatures find nourishment in the stranglers. One day, while collecting botanical samples high in a fruiting fig crown, I noticed that *Polyrhachis* ants were carrying fig seeds away from fresh animal droppings on the branches. As I followed the trail of the ants to their tree-crotch nest site, I realized with growing excitement that I had discovered a new player in the stranglers' seed dispersal.

Discarding a morsel of fig pulp (facing page, top), an ant has already picked out and stored seeds to eat later. Those it consumes will be destroyed, but any leftovers stand a chance of germinating and maturing into full-grown strangler fig trees.

Polyrhachis goes about its business undisturbed for the most part. The spines on its

back (middle) are a painful deterrent for both predators and camera-toting humans like me.

Unfazed by my intrusion, a *Lexias* butterfly flits across sodden ground to sip juice from a fallen fig (bottom). Since the seeds cannot survive on the ground, rotting figs are nearing the end of their usefulness. Yet they provide one final benefit: They fill the bellies of wild pigs, civets, and deer.

Borneo's Strangler Fig Trees

Braced for a bumpy ride, a young gibbon straddles and clutches its mother as she swings through the canopy (left). She is searching for branches laden with ripe figs, like those framing a long-tailed macaque (above). Primates are among the many species of animals that turn to figs when other fruit is scarce.

Fortunately, the overall supply of figs rarely runs out. Unlike fruit trees such as mangoes that bear all at once within a season, at least one strangler fig tree of each species can usually be found fruiting in the rain forest. For their central role in many species' survival, strangler fig trees are considered keystone species.

So far the stranglers are at risk only from their association with hardwood hosts such as dipterocarps, which fall to chain saws and end up as plywood.

If we are to preserve this natural laboratory, this intricate web of life in which strangler fig trees play such a vital part, large pristine areas like Gunung Palung National Park must be protected. It's the only way. □

TWO OCEAN PLATEAU, WYOMING

THE YELLOWSTONE

TWO OCEAN PLATEAU, WYOMING

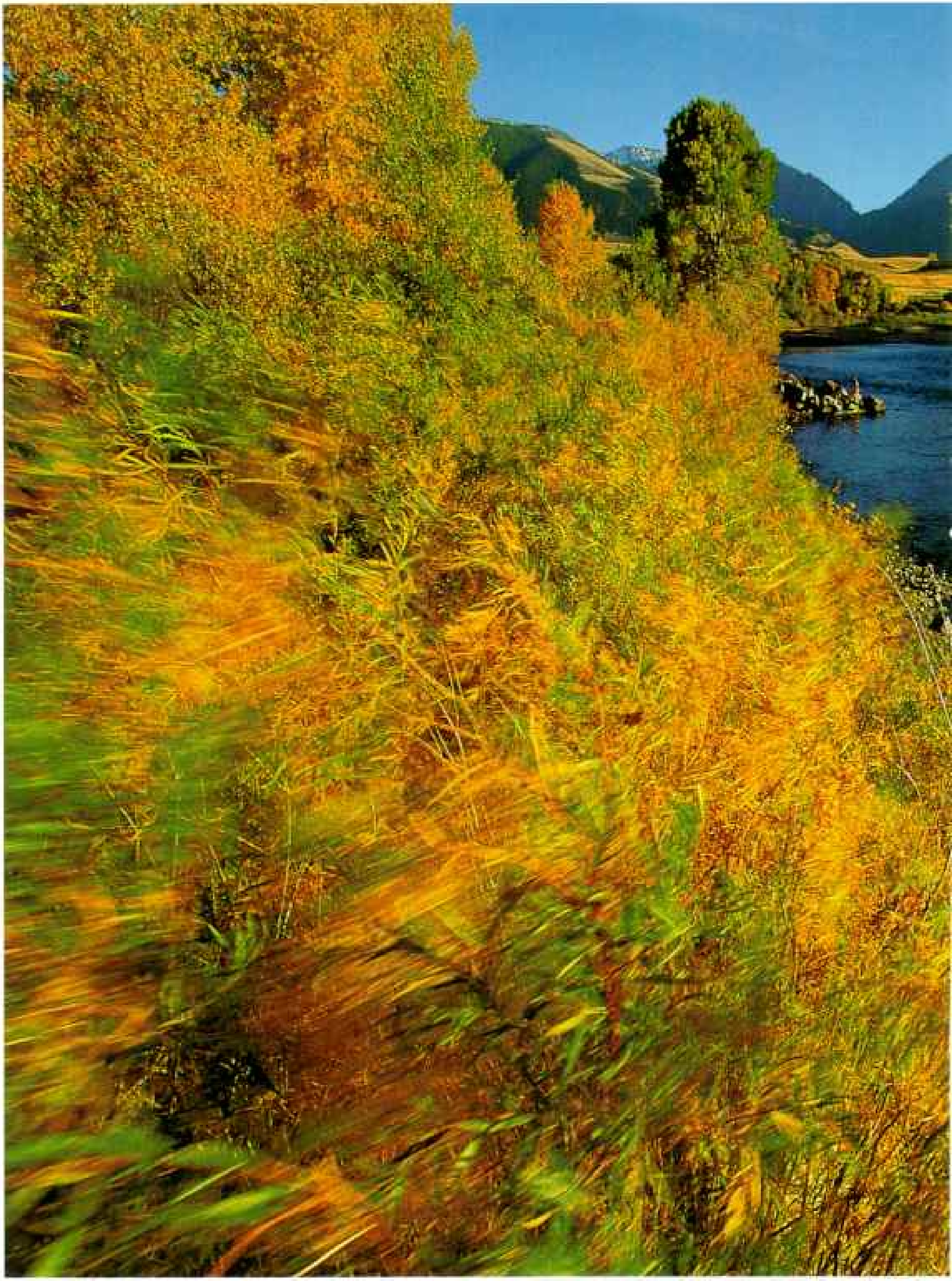
The Last Best River

Fluid emblem of vast western spaces, the Yellowstone runs free, undammed despite potent demands for irrigation, flood control, and electric power. Making for the river's headwaters on the Continental Divide, outfitter H. A. Moore (above, and previous pages) finds moments of respite in the wilderness. In the Yellowstone's namesake national park (following pages) the earth's cauldrons turn lodgepole pines into lifeless needles that measure the sun's passage across a steam-filled sky.

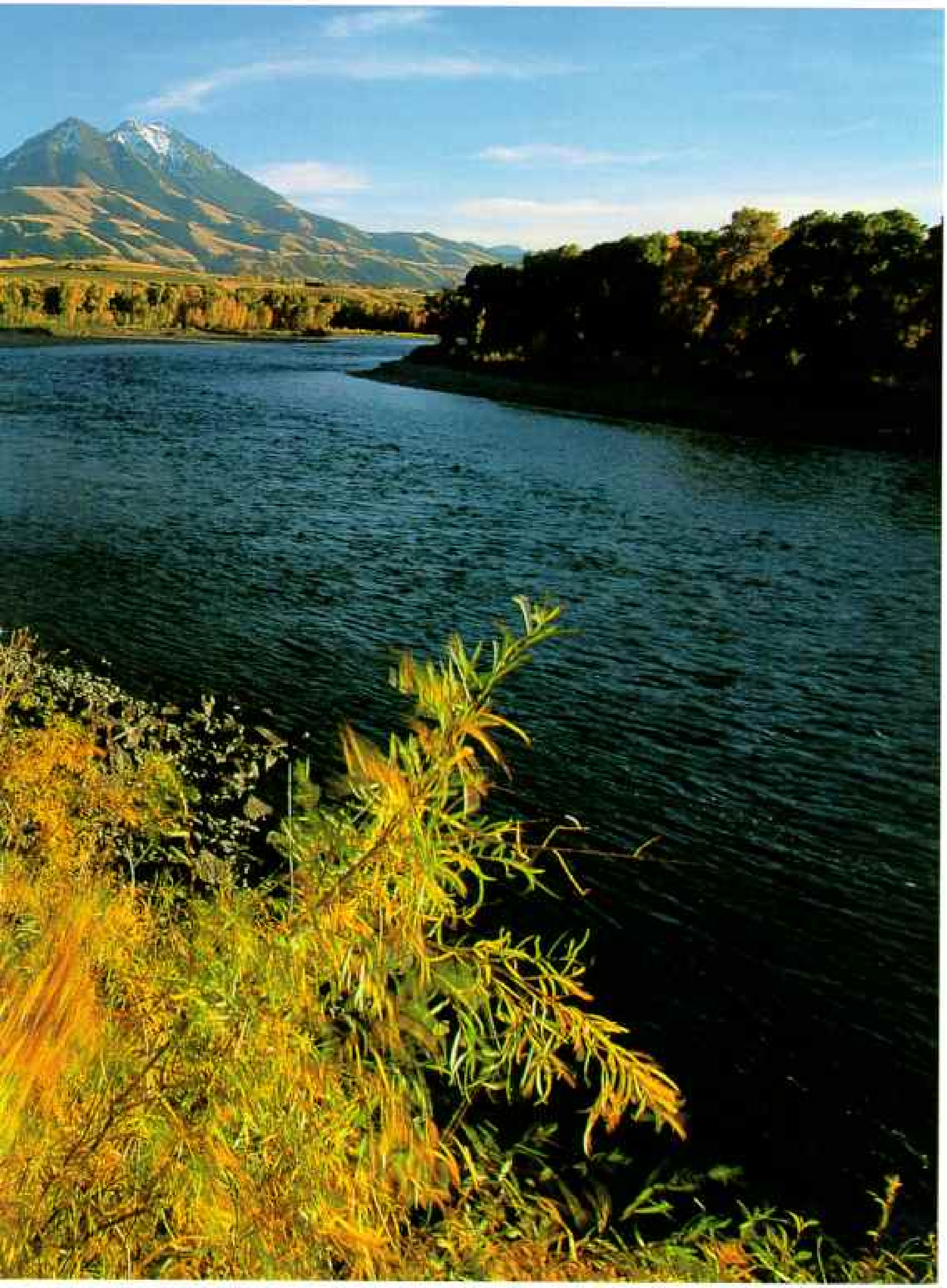
By STEVE CHAPPLE

Photographs by ANNIE GRIFFITHS BELT

LOWER GEYSER BASIN, YELLOWSTONE NATIONAL PARK, WYOMING



In 1864 a wagon train of prospectors found their heart's desire here in Paradise Valley. Their claims on Emigrant Peak, at center, played out long ago, but the mountain still stands guard while fall-bright willows and cottonwoods heap the riverbanks with gold.



PARADISE VALLEY, NEAR EMIGRANT, MONTANA

AT SUNSET, below a cut bank inside the northern boundary of Yellowstone Park, a female grizzly enters the swollen Yellowstone. She thrashes through the spinning plates of current like an angry dog. The muddy river catches her, swings her downstream, toward the Lamar River. But she reaches the far side soon enough, her massive head already focused upward on the trellis of game trails that rises before her. She is chasing an elk and her calf. The calf, eyes screwy with panic, stumbles.

Six hundred miles downstream, in Sidney, Montana, Gordy Rambur, a sugar beet farmer, tramps a shorter bank. It is December, and dawn. "The orb of day rose as red as blood," John James Audubon wrote of an earlier prairie sunrise. This winter morning the river is a white arabesque of cracked ice. The rays ricochet off the ice in a kaleidoscope of crimson. The temperature is ten degrees, coolish by Montana standards. Rambur is hunting pheasants in a field of stubble wheat bordered by wild rosebushes. His yellow Labrador retriever, Buck, stops in point. Four bright birds rise over the river with the arc of the farmer's shotgun.

YELLOWSTONE LAKE, WYOMING

From top to bottom the Yellowstone, all 670 miles of it, is the longest undammed river left in the lower 48. While haze from southern California confuses the vista of the Colorado, the Columbia no longer sustains many salmon, and the Sacramento has been corseted, the Yellowstone still rumbles and sings through canyon and badland pretty much as heard by Lewis and Clark, the Sioux and the Crow.

To me the Yellowstone has always been personal—a place to float, imagine, and learn. It's a sweep of seasons and moods, as cantankerous sometimes as the people who live along its banks. For a time I abandoned the Yellowstone in favor of urban dreams, but now I live by its banks again, a prodigal son who counts himself lucky to be home. To Montanans the Yellowstone is the soul of the last best place, joining mountain to prairie. To the rest of the country its very name signifies freedom and adventure and untrammeled beauty. (French explorers called the river La Roche Jaune, Yellow Stone, perhaps for the pale brown sandstone bluffs of the middle river.)

The river's unfettered flow creates seasonal ecologies, flooding young cottonwoods, allowing the mature trees to drop their seeds onto dampened silt when the waters recede. Fish spawn and waterfowl still nest on the Yellowstone, which

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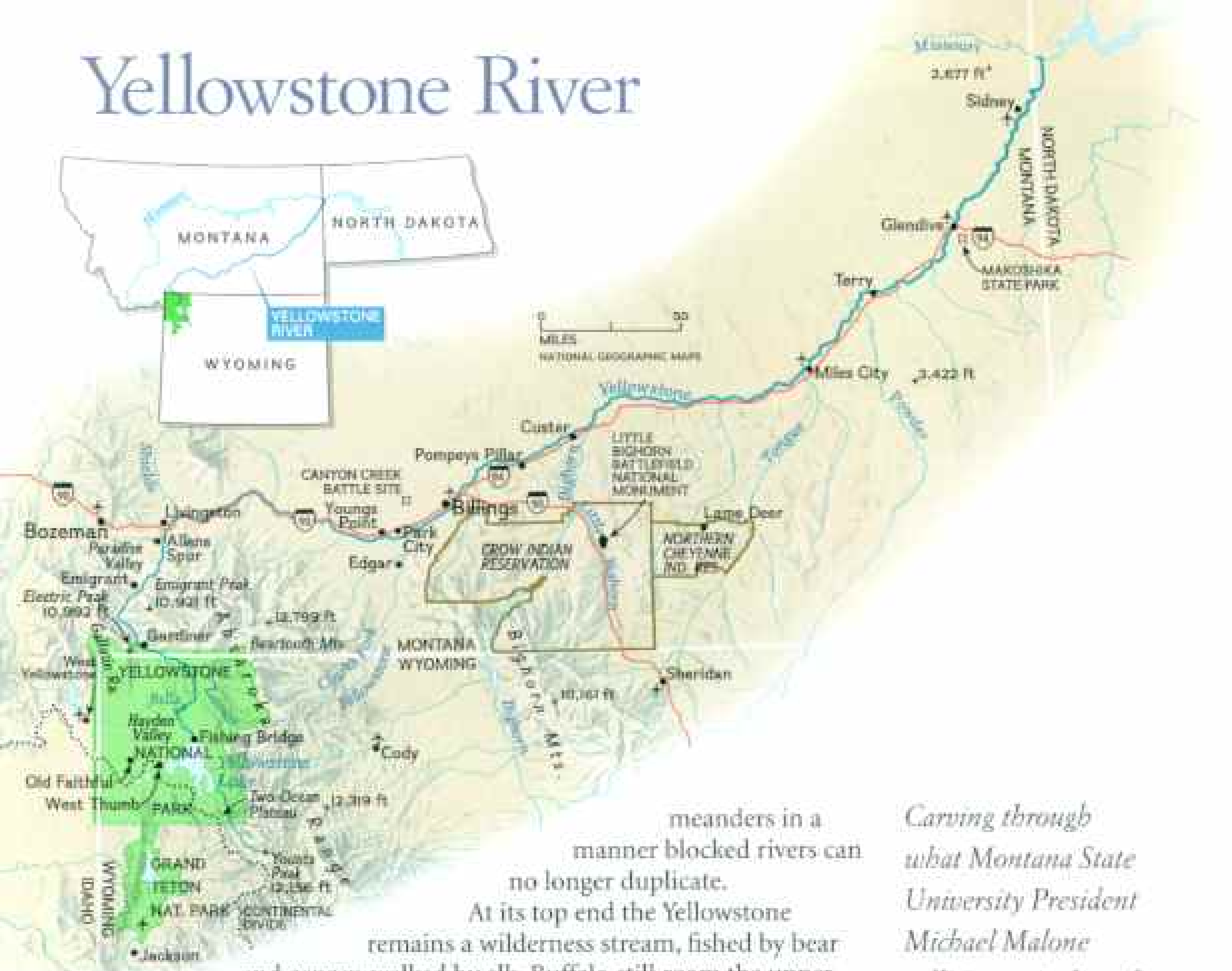
STEVE CHAPPLE, a native Montanan, wrote of his journey down the Yellowstone in *Kayaking the Full Moon* (HarperPerennial, 1994). ANNIE GRIFFITHS BELT, who was born and raised in Minneapolis, has photographed more than two dozen NATIONAL GEOGRAPHIC articles.

Cast in sharp relief by the setting sun, a driftwood gallery (above) conjures visions of the grandly antlered elk that roam the shore of Yellowstone Lake. Moment by moment, dawn reveals the riverbanks (right), endlessly shaped and shifted by the water's sculpting power.

JUST WEST OF BILLINGS, MONTANA

Yellowstone River



meanders in a manner blocked rivers can no longer duplicate.

At its top end the Yellowstone remains a wilderness stream, fished by bear and osprey, walked by elk. Buffalo still roam the upper river. And wolves eat them—full-grown and healthy buffalo—not a pretty sight but the way it is. The middle Yellowstone, from Livingston to Custer, is a working stream, tapped to water cows and irrigate alfalfa. In the homestretch, for hundreds of miles, the Yellowstone seems primeval, a lost river of the most ancient history, with layers of coal along its banks and prehistoric-looking paddlefish in its pools. In truth, rural American civilization is always only a ridgeline or two away.

Carving through what Montana State University President Michael Malone calls "an epic slice of western America," the Yellowstone runs unshackled by dams through 670 miles of crashing mountain rapids and silt-laden prairie curves. Its destination: the Missouri.

THEY SAY THE YELLOWSTONE begins as a trickle off Younts Peak, in the mountains of Wyoming, south of this nation's first national park. But because the stream labeled Yellowstone, which flows into the southeastern arm of Yellowstone Lake, leaves no discernible channel in the lake's bottom, I like to think the river really begins as a hot spring, a rip in the earth's skin located a little way off the lake's West Thumb Geyser Basin, underwater. This is more in keeping with the beginnings of Yellowstone Lake itself, as the filled puddle of the caldera from a huge volcanic eruption—in fact, one of the biggest explosions of any kind on earth, ever.

The Yellowstone soon escapes its caldera and flows under Fishing Bridge, where, as kids, we used to tangle lines and snag passing cars with worms and red daredevil lures. Now only the bears are allowed to take swipes at spawning cutthroat here. Through the Hayden Valley the river coils in a series of switchbacks, like a snake, until it strikes.

straight and falling, first 109 feet, at Upper Falls, then immediately again at Lower Falls, 308 feet, almost twice the drop of Niagara.

This is the Yellowstone's Grand Canyon, a rainbow of rhyolite where John Muir wrote, "All the earth hereabouts seems to be paint," and Rudyard Kipling exclaimed, "The sides of that gulf were one wild welter of colour—crimson, emerald, cobalt, ochre, amber, honey splashed with port-wine, snow-white, vermilion, lemon, and silver-grey, in wide washes."

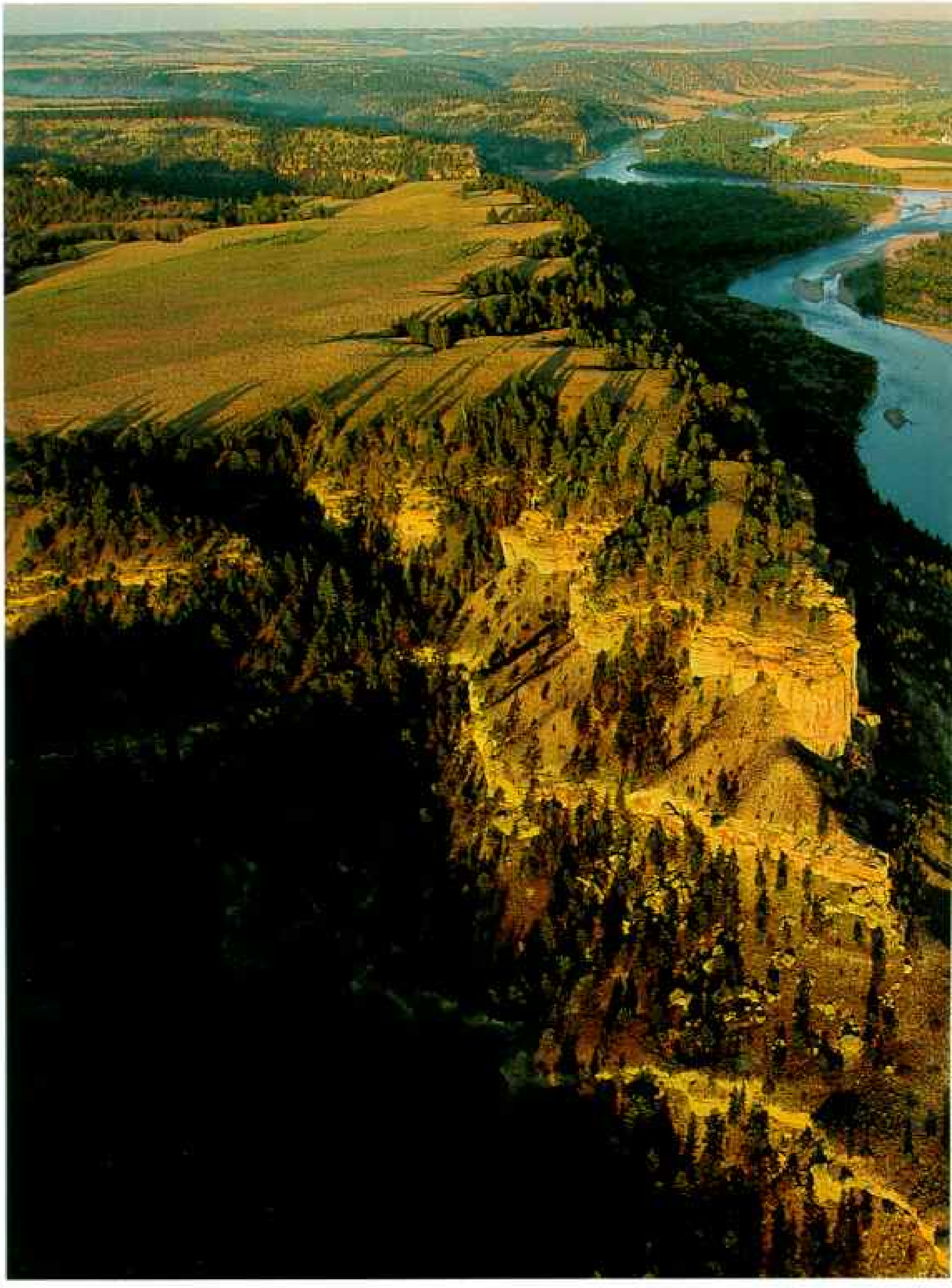
The Yellowstone then fairly screams through Black Canyon, a crescendo of white water, and crashes out of the park at Gardiner, Montana, all smiley, like a bobcat with its mouth full of feathers, to amble on down the length of the state, until, gathering strength from the Shields, the Clarks Fork, the Bighorn, the Tongue, and the Powder, infusions of mud, silt, and history, it bashes into the Missouri like a drunken pugilist.

When an overflowing thermal spring beats the river but the air is minus 20°F, some oddities in bathing attire become necessities. Local high school friends enjoy a ritual weekend soak in their "Boiling River."

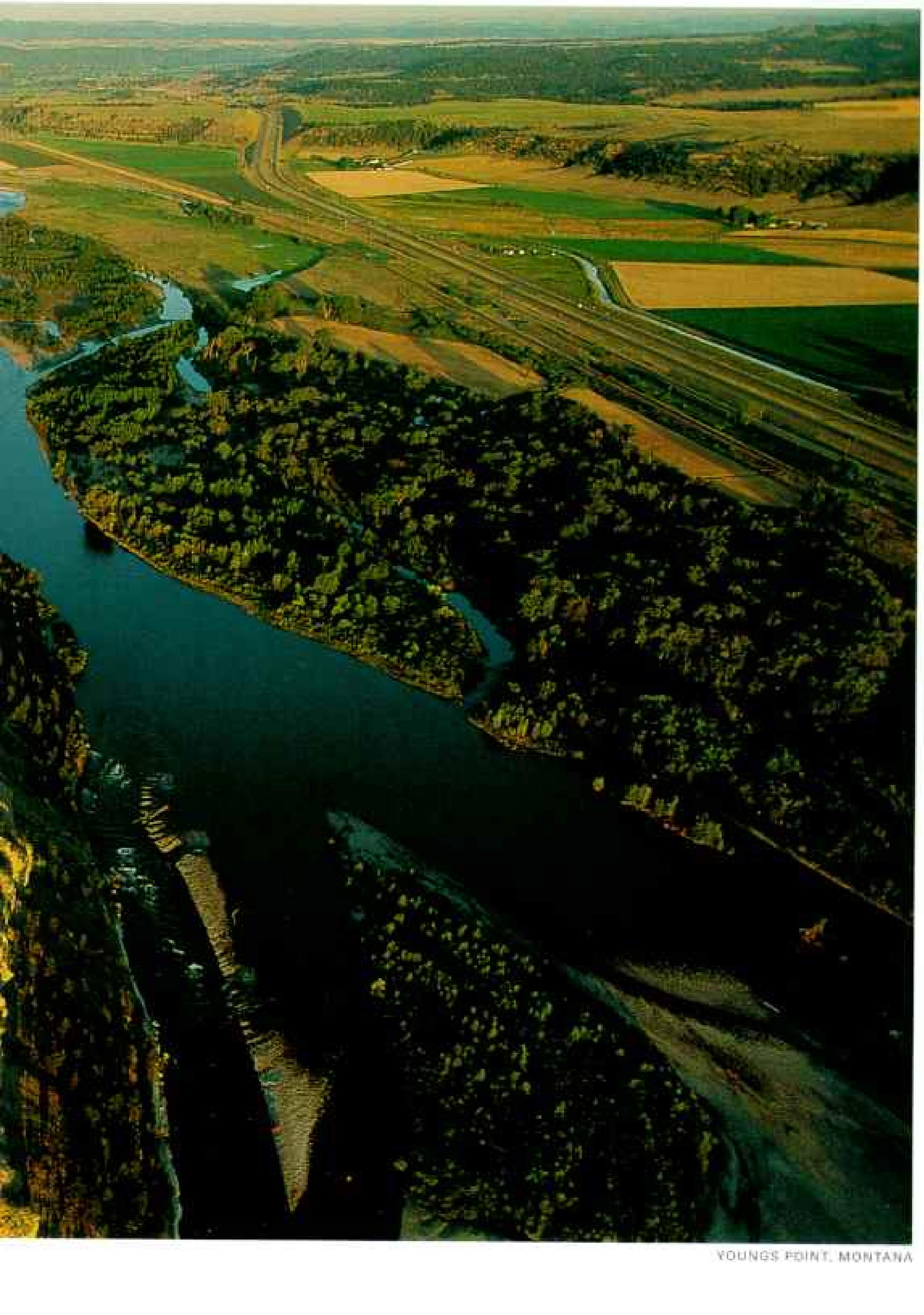
I GREW UP overlooking the Yellowstone, in Montana's biggest little city, Billings, where my grandfather, a frontier doctor, founded what would become the state's largest hospital. My great-uncles Will and Ed rode as Cossacks in Buffalo Bill Cody's Wild West show. In those days the real Jeremiah Johnson was a deputy sheriff in Billings, and Calamity Jane lived in a cabin close to where Chief Joseph of the Nez Perce crossed the Yellowstone on his epic retreat, humbling Colonel Sturgis at Canyon Creek.

A hundred years later the Yellowstone and the people who live along it have come to symbolize the new American West. Robert Redford shot a good part of *A River Runs Through It* along the Yellowstone, while country singer Merle Haggard simply rasps: "Turn me loose, set

NEAR GARDINER, MONTANA



Dropping from the story elevations of the Absaroka Range, the Yellowstone Valley widens, embracing broad fields of winter wheat. Massive sandstone bluffs shadow the river as it bears eastward to meet the Clarks Fork, the Bighorn, and the prairies beyond.



YOUNGS POINT, MONTANA

me free / Somewhere in the middle of Montana."

Yet the Yellowstone suffers a curious duality. Within Yellowstone Park the blue cascade has been subsumed in the competing grandeur of Old Faithful, paint pots, and petrified trees, while the river outside the park has become mixed with that modern myth of Montana and the West.

They are the same river. Pull out a smoky map of the state, spread it on your lap before a pine fire at Carbella camp on a moonlit night when the coyotes are yipping in protest against the return of the wolf and the silver roils of Yankee Jim Canyon swirl below the reflected shock of Electric Peak. Then you can understand what a wondrous run the full length of the Yellowstone really is.

Of course, I'm prejudiced. A few years back, following a dream of personal homecoming, we—myself, my wife, and two toddlers—pulled up strings in San Francisco and went the distance, floating and kayaking the river from the park boundary to the Missouri confluence. It was a watery rodeo. In Yankee Jim Canyon granite walls flashed by all too quickly, and equilibrium was maintained through front-of-the-boat shouting. In Paradise Valley, a 40-mile chute of Himalayan grandeur, we lazed along gawking up at the peaks of the Absarokas and the Gallatins, which fly off both sides of the river like a dragon's wings.

At Livingston the Yellowstone doglegs due east just north of the Beartooths. First a railroad town, now a trouting mecca for artists, writers, and cowboys with clean boots, Livingston has enjoyed a reputation as the best party town on the river for more than a century.

Flowing into the big open of the Montana prairies, the Yellowstone moves through landscapes littered with the driftwood of abandoned dreams. For many homesteaders in the

THINGS QUIETED DOWN after Livingston for us, though not for Sgt. Nathaniel Pryor of the Lewis and Clark expedition. Pryor, who accompanied the 1804–06 reconnaissance of the West, woke up one morning to find the horses gone on what is now the Crow Indian Reservation but was then simply Crow territory. Clark recorded in his journal: "The night after the horses had been stolen a Wolf bit Sergeant Pryor through his hand when asleep, and this animal was so vicious as to make an attempt to seize Windsor, when Shannon fortunately Shot him."

Pryor and crew skinned buffalo, stretched the hides on a frame of sticks, and soon were skittering downriver after Clark in odoriferous "bull boats." Their point of departure was Pompeys Pillar, the only historical landmark, so far as I know, named for a child: Sacagawea's son Pomp, which means "little chief" in Shoshone. Clark's broad signature is still carved on the monolith, protected by bulletproof glass.

When you float a river like the Yellowstone, you may pick your companions from the century of your choosing: Paleolithic hunters,

NEAR EDGAR, MONTANA

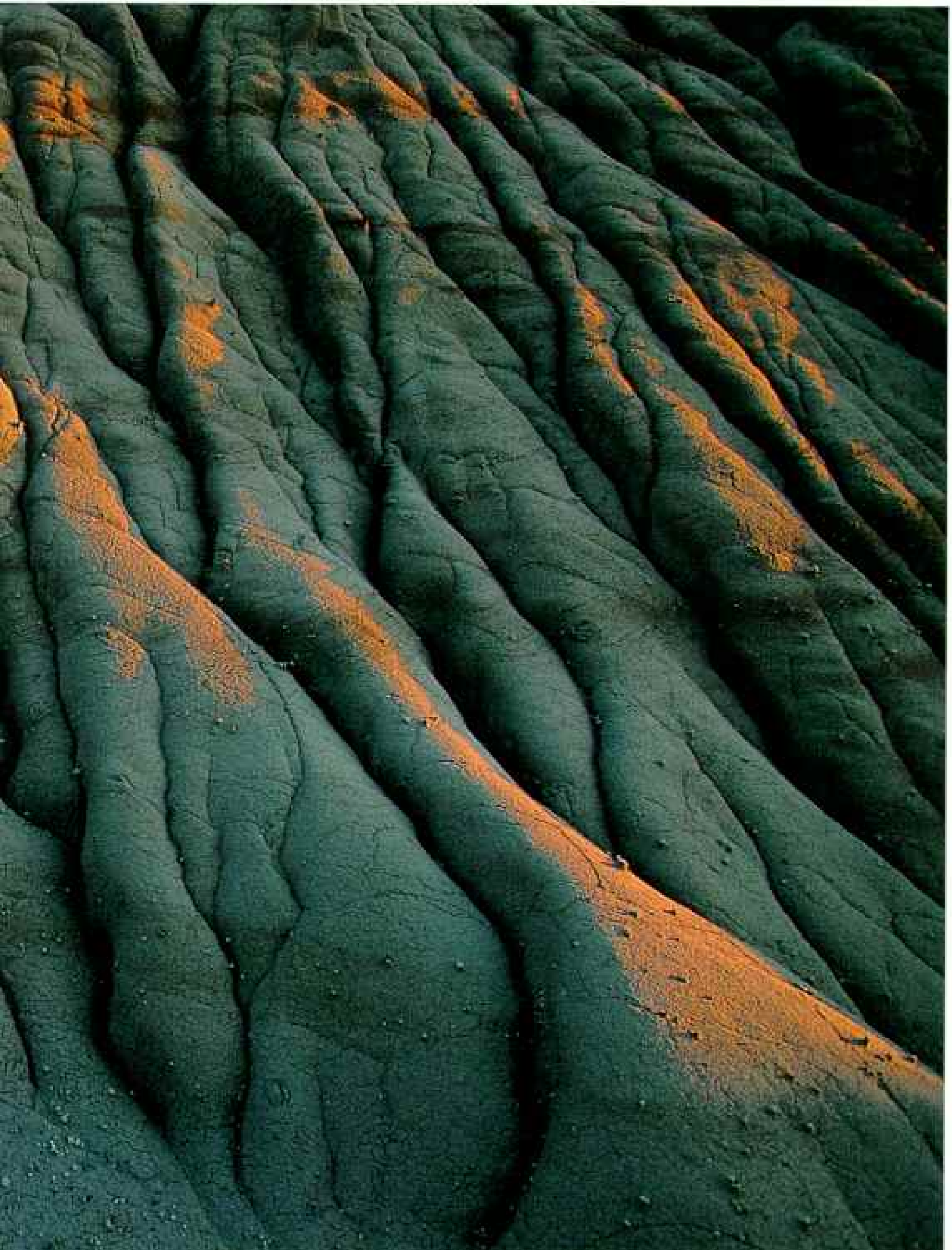
first decades of this century, visions of pioneer prosperity faded rapidly as pest-ridden drought exhausted fragile soil while debt and isolation seeded clouds of despair.

Crow, Cheyenne, Sioux, Jefferson's explorers, mountain men, gold miners poling back to the "U. States" in flatboats, Texas drovers, America's first congresswoman, Jeannette Rankin, or homesteaders speaking every language heard at Ellis Island, long forgotten now in the flattening rituals of Fourth of July rodeos.

Near Terry, a place as rangy as Montana gets, the Powder tributary marches into the Yellowstone like a ghost cavalry. This is a good place to linger in camp, and we did. Sitting Bull and his people wintered here in 1868. Supplies for the intrepid George Armstrong Custer were brought in by steamship and off-loaded in the grassy little delta, and the dead bodies of Custer and his officers, taken out by steamship, passed by a little while later, after the Battle of the Little Bighorn.

You stretch out on the lower river. This side of Montana used to be the floor of a huge inland sea. Since the late Cretaceous, triceratops and T-rexes have languished in the layers of dried mud like pressed flowers.

Last light gleams on the sand and clay of a 20-foot-tall ridge in eastern Montana's Hell Creek formation. Makoshika *is the Lakota word for badlands, where scouring erosion lays bare the sinew and substance of the earth.*



MAKOSHIKA STATE PARK, MONTANA

In the blue upstream Yellowstone we caught black-spotted cutthroat trout. Downstream it was channel cats and goldeye. All along, we smiled at the bassoon cackle of the herons and wondered what made those hoarse, screaming cat-barks late at night. Turned out to be red foxes calling to their kits. In the mountains we admired the aspens, but on the prairie we fell in love with the gnarly cottonwoods.

Toward the end of the journey the changing weather mirrored the moods of the Yellowstone, hail falling in one corner of a dark salmon sky, sun shining brightly in another, as clouds chased each other about like bear cubs on a hill. We listened to Cheyenne drummers at a "give-away" ceremony outside Lame Deer, where a family flushed with some success showed their humbleness by showering friends with gifts. We also chatted with environmentalists and developers, crotchety paleontologists and the occasional movie star, all following their own wilderness odysseys.

"About day three in Montana, I was kind of gone," says Michael Keaton, who now lives up one of those tributaries and considers the Yellowstone to be the classic American river. "You either feel comfortable with that slightly lonely, lonesome sense of place or you don't." Mel Gibson, Glenn Close—the Yellowstone has always attracted a better cast for *Hamlet* than Malibu Creek. Montana, after all, is where Gary Cooper and Myrna Loy once made up the local talent.

YELLOWSTONE NATIONAL PARK

Early winter's translucent frost glazes the brittle cones and bristling needles of a fallen pine. Come spring, the trunk may well be tossed downriver, a tumbling matchstick in the snowmelt flood.

ON A RECENT RIVER FORAY I stopped in Paradise Valley to talk with Pete Story, whose great-grandfather drove the first cattle up from Texas. (Story felt *Lonesome Dove* was accurate except on two counts. "We drove the cattle up ten years before Custer, and we didn't steal 'em from the Mexicans," he growled.)

I had heard that not long ago Story, 63, had attacked a stud bull with a garden rake. It seems that three bulls Story keeps in a pasture near his ranch house had gotten into a terrible fight. He grabbed the first implement at hand—a garden rake—and began whapping one bull about the head. But then one of the other bulls charged. "The bull took a notion to take me," says Story, "and he might have mashed me against the fence." But right then his Great Dane, Jabba, leaped up and latched onto the bull's ear. The raging bull circled once, twice, with 150-pound Jabba swinging clean off the ground. "That bull forgot all about me."

"Not too much of a cowboy, is he?" says Mrs. Eileen Story, taking the last word.

Story owns four miles of Yellowstone frontage. He represented the voters on this part of the river for 18 years as a Republican state senator. Many environmentalists believe setbacks or a 300-foot, no-growth corridor might protect the Yellowstone from chemicals,

sediment, and the price great beauty inevitably extracts from itself.

"That would be an unlawful taking of property," says Story, who believes the river is probably best protected by conservation easements and pride of ownership.

Twice, Story's political opponent has been Democrat Richard Parks. Parks is not the descendant of Texas ranchers, nor the owner of major river property, but in these parts he is probably an equally legendary "nonindigenous life-form," as Parks refers to his fellow Yellowstone humans. Parks has been a guide, fishing and talking the stretch from Gardiner and on through Story's 11,000-acre ranch for 35 years.

"The whole Paradise Valley is an aquatic system," says Parks. "It's all alluvial gravel. What you pump into a drain field is likely to come up in 10 or 15 years. Sewage, animal waste, nitrate from some fertilizers, these things can trigger frantic plant growth in a river like the Yellowstone. Worst-case scenario is an algal bloom, which uses up available oxygen. Fish are not into salad bars. They choke. We need to get over our paranoia about planning and decide it's not a communist plot, or if it is, that it's the kind of communist plot we can live with."

A few days after talking with Story, I went floating with Parks. At the head of Preacher Rapids, my young son, Cody, wanted to know why he couldn't keep the 16-inch cutthroat he had just caught on a Trude dry fly. "Because, Cody," said Parks, releasing the winded fish, "these trout are my business partners, and people who get in the habit of eating their business partners soon go out of business."

I have written that along the Yellowstone we must not trade trout for gold. Environmentalists and politicians now share that view, at least in the case of a controversial mine at the headwaters of the Clarks Fork, under a prime swath of bear habitat just outside the northeast entrance to Yellowstone Park. Worth 600 million to 800 million dollars in gold

Keen enough to detect the squeaks and scrabbles of mice tunneling under the snow, the coyote's ears direct its eager pounce. A snout full of snow is a small price for a meal in February's exhausting cold.

YELLOWSTONE NATIONAL PARK

and silver, the mine site is to be traded for federal lands in less sensitive areas.

Potential big-time gold mines, expansive rural subdivisions, perhaps farm pesticides and excess fertilizers draining into the lower river, these are the environmental threats of the moment. In the 1970s public outcry and the state legislature beat down a scheme to dam the river at the Allens Spur narrows, just south of Livingston. The plan then was to store water for coal-burning power plants downstream, as well as to slurry away some of the enormous coal deposits in eastern Montana.

The Yellowstone may be getting too much attention these days, but popularity brings affection as well as problems. If the river is cared for by those who love it, the Yellowstone may last till the next big volcanic outburst.

The Hayden Valley, named for a geologist who mapped and measured this wilderness more than a hundred years ago, yields the chill of an autumn night to dawn's slow

AT SIDNEY, Gordy Rambur, the pheasant hunter, fires three times. Three birds drop. Rambur rubs his gloved hands together as he walks to meet his dog, Buck. It's cold. Buck already has the first pheasant. Rambur's hunting partner, Judge Gregory Mohr, ambles over. The judge likes to tell any pheasant-hunting beet farmers willing to listen, and that's most of them, how to build settling ponds cheaply at the edge of feedlots. The ponds neutralize runoff, which could be harmful to the river. Rambur and Mohr are sentimental men, and tough. The flow of the Yellowstone is as vital to them as blood to the body.

Up in Yellowstone Park, at the same place where the grizzly plunged into the Yellowstone at spring tide, I stop to catch my breath. I'd prefer to be off the cut bank and on the white water, but it's illegal to kayak the Yellowstone inside the park. Also, it would be difficult for a paddler of my abilities to navigate the surge below the narrow bluff. Above the sound of crashing water I can hear the whack of pine logs thudding against granite boulders. This June the Yellowstone is two feet above flood stage.

A hundred yards in front of me, and a little to the left, is the carcass of a large herbivore. The twisted rib cage flattens a patch of new blue grama grass. The stripes of the backbone are smeared pinkish with dried blood. I wonder how fresh the kill is. Not-so-fresh means I can keep strolling the short distance down to the confluence of the Lamar, close to where, two weeks before, I saw a dark wolf bedeviling a grizzly over another carcass. But *fresh* leads to several questions, the most pressing of which is: How likely is it that predator or predators are guarding this carcass from behind one of several boulders inconveniently located just downwind?

I dawdle. Though the river rages below, it's a perfect day. The scorch

HAYDEN VALLEY, YELLOWSTONE NATIONAL PARK

promise of warmth. However precise, surveyors' instruments have never captured the soul of the Yellowstone: It dwells in freedom, immeasurable as the morning mist.

of the mountain sun passes through my shirt, and my attention wanders to the gaudy locusts that seem to be dive-bombing elegant black mourning cloak butterflies. Examining the kill through binoculars, I see that it's a buffalo and, concluding that discretion is the better part of many things and that Yellowstone remains a wild river, I retreat. I can't forget the earlier scene here, when the grizzly pursued the elk calf. The bear had risen up out of the water, bounded up the sage bank, and snapped the calf's neck. Then the feasting began.

I recall that William Clark also had trouble with grizzlies, in the summer of 1806, as he was searching for trees big enough to make dugouts for his journey to rejoin Lewis at the confluence of the Missouri. He found his trees—cottonwoods—near a side stream the Indians called "the lodge where all dance."

That's a good name for the Yellowstone itself, Montana's—America's—river, a place where the spirit dances. □

Light and shadow cut across Red Square in newly capitalist Moscow. The rule of the dollar has brought the city riches and hunger, freedom and anxiety, commerce and crime.

MOSCOW

THE NEW REVOLUTION

By DAVID REMNICK
Photographs by GERD LUDWIG

Cash and carry: Millions of dollars in imported TVs, VCRs, and stereos move every weekend in this open-air market. Like most city businesses, sellers pay protection money to "the roof"—slang for mafia gangs. Police look the other way.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IT WAS THE SUMMER OF 1991. THE SOVIET REGIME WAS CRUMBLING LIKE WEEK-OLD BREAD, AND MY WIFE AND I WERE SCHEDULED to fly home to New York for the last time, ending a nearly four-year stint in Moscow—mine for the *Washington Post*, hers for the *New York Times*. The flight was scheduled for August 18, a Sunday. A few days before, I had interviewed Aleksandr Yakovlev, who had been Mikhail Gorbachev's closest aide throughout the *perestroika* years. The "forces of revenge" within the party and the KGB, he said, were preparing a putsch.

I didn't know what to make of his comment except to put it in the paper. The next day, at a party with some Russian friends on the Moscow River, we talked about Yakovlev's prediction. My friends and I agreed—a coup seemed far-fetched. The Soviet Union, after all, was no banana republic.

"But I will tell you one thing," I said, in the plummy tone of one rehearsing his valedictory. "Check out Moscow in a few years, and there will be shopping malls everywhere."

"You've gone nuts," said my friend Sergei. "Oh, you're right!" Sergei's wife, Masha, said mockingly. "Downtown will look just like Fifth Avenue. Be sure to visit!"

So that was the consensus: no coup, no shopping malls. The world would change, to be sure, but Moscow could forget about Sears, much less Saks Fifth Avenue. A couple of days later the first prediction went sour. There were tanks parked not a hundred yards from my front door on Kutuzovsky Prospekt. The coup was on. (It was over three days later.)

Less earth-shattering to historians, perhaps, is the fact that the second prediction—"the shopping malls vision," as my friends dubbed it on the spot—came true far more quickly than I had imagined. Capitalism may be creeping only slowly and erratically into provincial cities like Tambov, Stavropol, and Vologda, but in Moscow the signs of money are now everywhere: advertisements, billboards, finishing schools, neon, Nikes, and, by God, shopping malls.

To visit Moscow in the five years since the collapse of communism and the Soviet state is to be thunderstruck on a daily basis. Street names change overnight, erasing honors given decades ago to Bolshevik warriors; youth gangs form, recapitulating, in their way, the history of young people in the West—Hippies, Punks, Grungers, Skinheads, Metal Heads, Tolkienites; a gay bar opens down the street and features "transvestite night"; the Lubavitcher Hasidim set up a synagogue and are lobbying the government for possession of a trove of manuscripts stored away for decades in the damp corners of the Russian State Library; the Hare Krishnas come jangling across Red Square trailing clouds of incense; a 19th-century downtown apartment building is cleaned out by mafiosi who have decided "to privatize" the place. The involuntarily gentrified are told, not asked, to accept an apartment so far from the center of town that it is nearly in the center of Minsk. The changes reach to the most basic stuff of everyday life. Lines are rare now, but there are more homeless living in underpasses, train stations, city parks. The body politic has eroded so quickly that the Russian body has followed suit: The life expectancy of an average Moscow male is

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DAVID REMNICK is the author of two books about Russia: *Lenin's Tomb*, which won a Pulitzer Prize in 1994, and *Resurrection*, just published by Random House. He is a staff writer for *The New Yorker*. Freelance photographer GERD LUDWIG, a frequent contributor to the magazine, lives in Los Angeles. He documented life in the former Soviet Union in "A Broken Empire" (March 1993).

Dressed to sell, models strut the latest styles in nightclubs, stepping into the void left by state-controlled fashion. Last year Russian designer Elena Souproun presented her first collection, including this gown priced at $5,000—two years' average wage in Moscow.

57 at last count—a dramatic drop from the mid-60s just five years earlier. At the same time the number of car owners—and the level of traffic—has doubled. In Moscow only the weather is more or less the same as it was.

NOT LONG AGO, on one of many trips to Moscow since the Soviet collapse, I met a woman named Larissa Pavlova. She was a teacher who now sold old clothes evenings and weekends to supplement her family's income. Countless thousands of Muscovites work second and third jobs to get by in a world of higher prices, greater appetites, and disappearing social guarantees. "Moscow is filled with what our good Comrade Lenin called contradictions," she said. "The rich get richer and the rest of us tread water or drown. I work much harder than I did in the old days, and sometimes that makes it hard to remember what we've gained. Freedom is sweet, but it's also a heavy, heavy load."

The rules of class and privilege in Moscow are approaching the draconian code of the industrialized West. Money talks and nobody walks. If you have cash (or a credit card) in Moscow, you can taste it all: lobsters flown in from Maine, salmon from Scotland, caviar from Azerbaijan, lamb from Auckland, pineapple from Hawaii. Visitors to Moscow in the seventies remember well the dreary ritual of eating at restaurants offering shoelike "cutlets" and bonelike "chicken *tabaca*." Now there is every cuisine imaginable—even Russian, if you look hard enough. One night at a Chinese place not far from my old apartment, I asked for hot-and-sour soup but was informed by the waiter that this was a *northern* Sichuan restaurant, not southern, and would I consider one of a dozen other soups?

There are other cities in Russia that have, each in its own way, joined this process of transformation—Nizhniy Novgorod, Yekaterinburg, Khabarovsk, Vladivostok—but the center of it all is still Moscow. There really is no second place. Even St. Petersburg, with its historical role as the window on the West, cannot compare. More than 60 percent of foreign investment in Russia is in Moscow. The banks, the businesses, the political actors, the cultural and intellectual institutions, the information and communications nexus, the trends in fashion, language, and popular culture—all of it is centered in the capital. In some provincial

cities a single natural resource can transform the lives of the top layer of the population—oil in north-central Russia, nickel in Norilsk, diamonds in Yakutia—but the deepest transformations are in Moscow, which, with nearly nine million people, is among the world's biggest cities.

"You cannot understand Russia just by understanding Moscow," the reform politician Grigory Yavlinsky told me, "but without understanding Moscow you can't understand the future."

"I suppose I'm a patriot," Masha Lipman, a journalist friend of mine, told me, "but to tell you the truth, there are times when I feel as if Moscow is an entirely separate country, and I don't mind a bit."

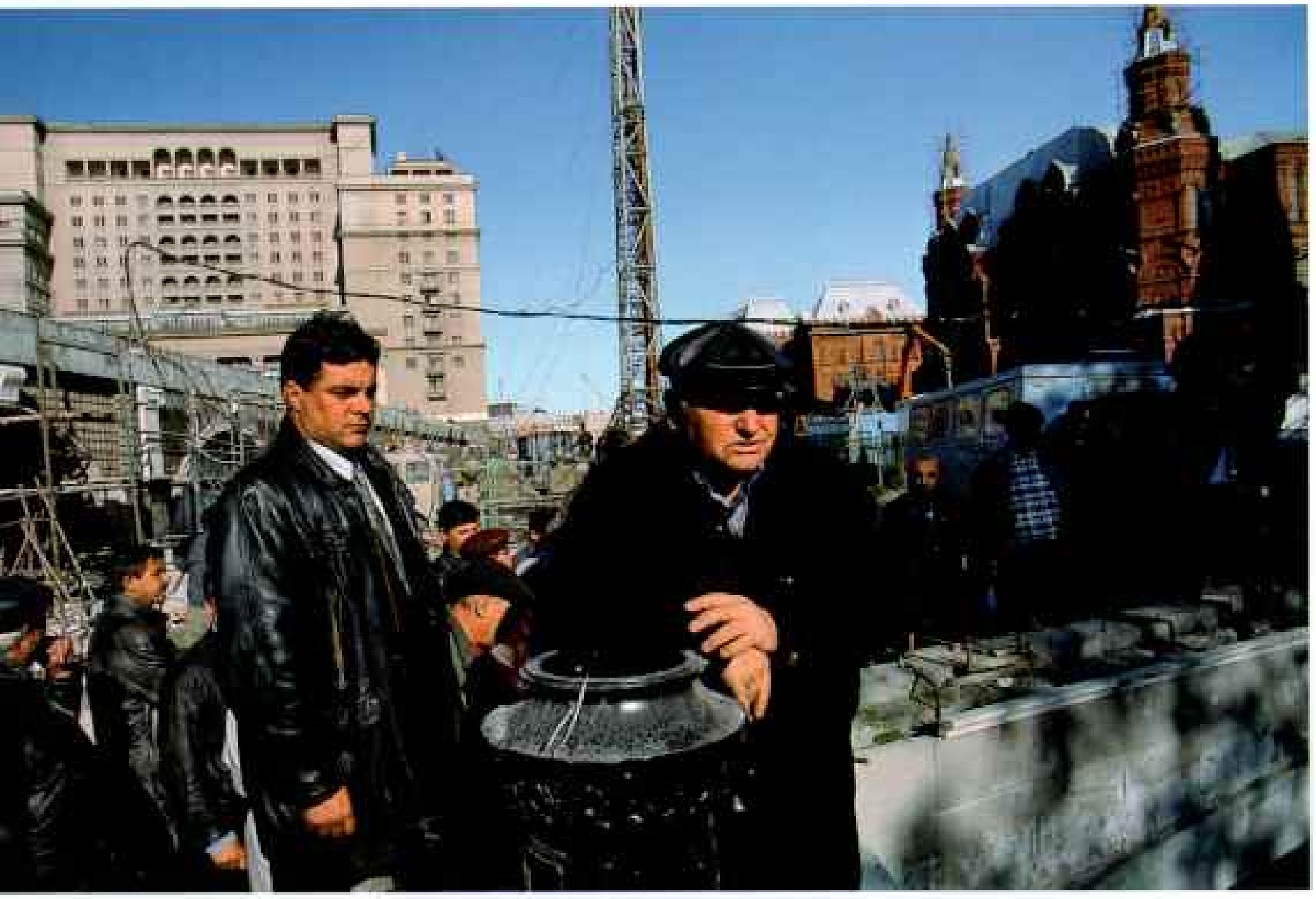
If you have money in Moscow, you might live in a gated mansion outside town and send your kids to boarding school in the Alps; you

Freely versing. Konstantin Kedrov recites one of the poems that cost him his teaching job in 1986 because it dealt with God. Now he speaks through newspaper, radio, and TV. Says Kedrov, "Today I tell my words to a hundred million people."

also might meet your end in a contract hit, blown to smithereens by a car bomb ignited by state-of-the-art remote control. If you have money in Moscow, you might be invited to a party at a Mexican restaurant (as I was) and meet a young television executive who will tell you, deadpan, "When I was a diplomat in Rangoon, I was bringing socialism to Burma. Now I'm the guy who brought *Santa Barbara* to Russia!" If you have money in Moscow, you might slap down several thousand dollars to join a private club; the highlight of the evening at one now defunct establishment was a rat race, featuring real rats sprinting through a neon-lit maze. (The race did not begin until a dwarf dressed as an 18th-century page rang the bell.) The owner of a nightclub called the Silver Century is planning to open a new club near Lubyanka Square within firing distance of the old KGB headquarters. He has announced a fervent desire to have party games. He said he would hold mock arrests and serve dishes like "Brains of the enemy of the people." Outside one club I talked to a guard named Vasya, a wiry and ancient man, who told me, "When I was a boy, we used to hunt down rich people and jail them. Now we guard them. For money."

Everyone is looking for a taste of "the sweet life." Hundreds of women in Moscow have quit their low-paying jobs as teachers, doctors, and engineers and have taken to selling

Resurrected in 1995, six decades after the Soviets removed all traces of the original, the Cathedral of Christ the Savior adds a cross-topped dome to a skyline of high-rises. Stalin erected skyscrapers to promote Moscow as the model socialist city. Today his successors celebrate religion and nationalism. "This church shows Russia is alive," says President Boris Yeltsin.



Wearing a worker's cap, Mayor Yuri Luzhkov, an engineer turned city boss, inspects round-the-clock construction on a 340-million-dollar underground shopping mall near the Kremlin. "I'm a manager, not a politician," says Luzhkov, reelected last year with nearly 90 percent of the vote, despite charges of corruption.

cosmetics for Avon, for Mary Kay. (A pink Cadillac in modern Moscow would not be out of place; there are now dealers for Porsche, Mercedes-Benz, Saab, and BMW.) The Communist Party newspaper, *Pravda*, is dying, but a newer version called *Pravda Pyat (Pravda Five)* has started publication in search of the more "left leaning" souls of Generation X. Venerable literary monthlies like *Novy Mir (New World)* hang on, mostly thanks to the largesse of American financier George Soros, but a former Maoist from the Netherlands, Derk Sauer, is making a fortune with Russian editions of *Cosmopolitan* and *Playboy*. Exams in scientific socialism are, of course, no longer required in universities, and business schools are filling up as soon as they can be opened. On Marshal Rybalko Street a producer named Aleksei Karakulov runs a school for children who want to become supermodels. There is a market for all this. Propaganda has shifted from the ideological to the corporate. In today's Moscow the pouty mug of Claudia Schiffer is nearly as ubiquitous as Lenin's once was.

THE LEADERS of the Soviet Union were determined that the capital of their revolution exist in a realm devoid of imperialist history. The mythology and ideology of Bolshevism required the destruction of all previous myths and ideologies. Nineteen seventeen was meant to be year zero. In 1918 Lenin decreed that all tsarist monuments had to be replaced by monuments dedicated to "the liberation of labor." Those churches that were not leveled by an order of the Kremlin and the wrecking ball were either left to decay or were transformed into stores, warehouses. One was replaced with a public toilet. Renaming streets has always been a part of revolutions—the French

RUSSIA'S HEART Radiating outward, Moscow grew as its defenders built walls farther and farther from the Kremlin. The multilane Sadovoye Koltso circles the modern center. Beyond lie 94 percent of the city's area and most of its nearly nine million people.

found this even easier than toppling heads into baskets—and under the Bolsheviks street names resonant of monarchy or commerce were renamed. Meat Traders Street, for instance, became Kirov Street.

But since the collapse of the old regime and the rise of Yuri Luzhkov, Moscow's popular and all-powerful mayor, there has been an attempt through the manipulation of symbols in Moscow to prove to Russians and the world that the country has reentered the flow of history. Moscow City Hall has a special office in charge of renaming streets or, better to say, *re*-renaming. Kirov Street is Meat Traders Street again. The process of re-renaming is so widespread that no one knows where anyone is going anymore—a fairly apt metaphor for just about anything in post-Soviet Russia.

One of the more modest institutions in town that has marked well the speed of historical change in Moscow has been the Museum of the Revolution on Tver Street. In the lobby, where it had once been possible to buy volumes of Marx, Engels, and Lenin, there is now a shop offering a stuffed Mickey Mouse, Solzhenitsyn's *How to Reform Russia*, baseball trading cards, and Lego sets. Another shop acts as a trading post for Communist-era desiderata: propaganda posters, Komsomol pins, party banners, Lenin busts, Stalin busts, medals, a complete set of Brezhnev's ghostwritten memoirs. Sacred objects are now sold as kitsch. The young man named Aleksandr Fomin who runs the shop told me that sometimes he can unload the "high-end" material from the twenties for thousands of dollars.

"I don't collect any of this stuff myself," he said. "Who could stand to look at it? After all, I practically grew up in the new times. To me, this is just business."

Upstairs, the museum's exhibits on Soviet history have about them a sense of rueful

Hungry for space, Western companies financed the gutting of the century-old Belinsky Building to create offices (right) in the city center, where rents are among the highest in the world. Over 60 percent of foreign investment in Russia goes to Moscow. Foreign capital restored the Petrovsky Passaj indoor mall (left) and stocked it with luxury goods.

irony. A propaganda picture of the happy masses ("Thanks to the Party for Our Happy Childhood!") hangs next to a picture of slum children in an industrial city. History is recaptured with nothing censored or missing: the labor camps, the stampedes at Stalin's funeral, the repression of artists and writers, the brutalities of industrialization and collectivization, the extraordinary triumph of the war. Perhaps only one figure is consciously slighted. Gorbachev, still so hated in Moscow for dismantling the old system, merits only one small display case.

In his otherwise thin and unrevealing book, *Moscow, We Are Your Children*, Mayor Luzhkov tries to paint an alternative vision of the city's past. Using photographs, paintings, drawings, and old maps, Luzhkov describes a Moscow as glorious as Rome, a city rich with commerce, character, and architecture. Just as Stalin was determined to create a new Moscow by destroying remnants of the pre-Soviet past, Luzhkov is determined to create a new Moscow by rebuilding many of those same places. Russian workers and workers hired from abroad have in just a few years rebuilt or restored the National Hotel, Resurrection Gate at the entrance to Red Square, the Tretyakov Gallery, the Moscow Zoo, Gorky Park, and dozens of other sites. The outer Ring Road, once known as "the road of death," is now decently lighted and as smooth as any ordinary highway in the West. A grandiose war memorial has opened on Marshal Grechko Prospekt. The complex includes a church—a mosque and a synagogue are planned—and a fountain, lit red at night, the better to evoke the bloodshed of the war. Outside the Kremlin gates the vast Manezh Square became a vast pit during the construction of an underground mall that will include several levels of offices, stores, banks, parking, and who knows what else. Luzhkov has also announced plans to build a financial center modeled on the City of London.

WHILE THE STORY of President Boris Yeltsin in the mid-nineties has been one of political and physical decline, Luzhkov is ascendant. In the 1996 elections, while Yeltsin struggled his way to the finish line, Luzhkov barely had to campaign to win nearly 90 percent of the vote. Luzhkov's reputation in Moscow is like that of Richard Daley at his peak in Chicago. Everyone assumes he uses less than ethical means to achieve constructive ends and almost everyone excuses him everything. When he was first appointed to a top municipal job in 1990, members of the Moscow City Council asked him whether he was a democrat, a communist, or, perhaps, an independent.

"I have always been loyal to one platform and will remain loyal to one platform—the *administrative* platform," Luzhkov declared. He was a builder. He got things done. (Never

The rich flaunt their newfound fortune in the nightclub Titanik, named "to attract attention," says owner Oleg Tsodakov. Artists who can't afford the $30 cover charge get in free, "to add atmosphere." Cars, once difficult to obtain, crowd the Sadovoye Koltso (right). Registered autos have doubled since 1991 to 1.6 million, fouling city air.

mind exactly how.) Operating almost independently of the national government, he acts as the economic overlord of the center of Russian wealth. The Russian press rarely dares to criticize him, not least because his master-builder reputation and his blunt, even nationalist, rhetoric have made him so popular.

"Luzhkov is the most natural creature of this Russian transition," said Sergei Stankevich, who had been both deputy mayor and an adviser to Yeltsin before running off to the United States when he was accused of taking a $10,000 bribe. "Luzhkov is a fish very much in the water. This is a time when the market exists, but under the strictest supervision of the state. He is father, administrator, supervisor, boss. He encourages those private initiatives that are ready to cooperate with him. He is honest—in his understanding of honesty—and does not betray his own people. Of course, he created the necessary guarantees for himself, but this is one of the rules of the time. Still, he deserves respect."

The most central and mythic instance of historical reconstruction in Luzhkov's Moscow is the Cathedral of Christ the Savior, the largest church in Russia. No construction project embodies more of the earnestness and hypocrisy, more of the grandiosity of the resurrection of Russia than the rebuilding of a cathedral that had been looted and dynamited at Stalin's order in 1931.

The story of the Cathedral of Christ the Savior is magic realism, Russian style. After the defeat of Napoleon in 1812, Alexander I signed an edict ordering that there be a contest among architects to design a cathedral commemorating the great victory of the Russian people and the people's gratitude to God for the preservation of Russia. The cathedral took decades to build, but when it was finally consecrated in 1883, it was, if not the most beautiful of churches, certainly the most ambitious. There were five gold domes, the highest of which was as high as a 30-story building. There were 14 bells in four separate belfries—their combined weight was 65 tons.

"It might not have been the most exquisite of churches, but even nonbelievers like me used to go there, if only to be with our friends

and congregate in the park outside," Lev Razgon, a writer and camp survivor, told me.

ONE AFTERNOON I visited the construction site along the Moscow River—the precise location of the original church. Crews were working around the clock. There was a small exhibition hall on the grounds. The focus of this little museum was a television and videotape player that played, over and over, the history of the cathedral's rise and fall. Along with a fifth-grade class out for a field trip, I took a seat and watched. The narrator, in a grave March of Time voice, described how in the early twenties as Lenin's campaign against the church went into high gear, services at the cathedral were ordered stopped. Almost every church in the city was "smashed, liquidated." Priests were jailed, executed, or, at the very least, co-opted by the state. One priest, the narrator said, had his tongue cut out, his eyes scooped from the sockets. "Such was the state's struggle against the 'opium of the people.'" The children watched, still and absorbed. I couldn't help but think that, just a few years before, Soviet schoolchildren learned a history quite opposite to this one.

The decision to destroy the Cathedral of Christ the Savior was made in secret, and by July 1931 secret-police operatives and young Komsomol workers began the process through a gigantic looting operation. They wrenched huge slabs of marble off the walls, cut down the bells from the belfries, pried off the crosses, the icons. Finally, on December 5, 1931, demolition experts set off a series of high-explosive charges to finish the job.

Stalin's intention was to replace the Cathedral of Christ the Savior (a symbol, for him, of the archaic) with the Palace of Soviets, so enormous that it would tower over the greatest symbol of modernity at the time, the Empire State Building. For Moscow this building would embody the permanence and the genius of the regime. It would be its Pyramids of Giza, its cathedral at Chartres. Stalin approved a design that was, in fact, 115 feet higher than the Empire State Building, and the statue of Lenin he envisioned at the top would be so

huge that it would be twice the size of the Statue of Liberty—Lenin's index finger alone would measure 15 feet.

Stalin's design came to the most banal of ends. The foundation soon became an enormous and stagnant pool. What was delayed by water would soon be put off indefinitely by world war. For years the Palace of Soviets remained nothing more than a reeking sump surrounded by a wooden fence. After Stalin's death his successor, Nikita Khrushchev, decided to convert the construction site into what it had been for years. He ordered the construction of an outdoor heated swimming pool. "The biggest in the world."

The new post-Soviet masters of Moscow are, in their way, no less pretentious, no less interested in aggrandizement, than the old masters. Luzhkov & Co. make François Mitterrand, famous for his penchant for gigantism, seem like a putterer.

And yet, all cities are the result of the vanities and the haphazard tastes of their masters. Moscow could do worse than have a mayor who wants, at once, to rebuild the old and give free rein to the new. The cathedral project will cost 300 million dollars at the very lowest estimate and will result in a near-exact copy of the original. Building began on Orthodox Christmas, January 7, 1995, and the exterior should be completed this year, the 850th anniversary of the city.

After watching the film, I met with one of the Orthodox priests, Father Mikhail Ryazantsev, who runs the little museum and is preparing for the cathedral's opening. "The re-creation of the cathedral is a matter of historical justice," he said as the flock of children flowed by us. "After years of forgetting and the oblivion of our history since 1917, we are now coming back to our roots. We are recovering the memory of our ancestors."

The idea and the symbolism of rebuilding the Cathedral of Christ the Savior and so many other monuments ruined during the Soviet period has not escaped criticism. Since television and the printed press are controlled either by the state or bankers who depend on their friendly relations with the state, one does not frequently hear criticism of such projects. But

Miles from prosperity, most Muscovites live in housing projects, few as nice as these (below). Soup lines feed the new poor, including people who lost their homes to scams during privatization. One victim cried in gratitude when given a bar of soap, says Evelyn Labatte, in black Salvation Army uniform. "It's pitiful. It tears you apart."

modern, implicit censorship has nothing like the power of the old Soviet variety; contrary opinion is never entirely stifled.

The most prominent critical voice on the rapid transformation of Moscow is that of Aleksei Komech, the director of the Institute of Art Studies. "The annihilation of landmarks is rather rare nowadays, but we are still losing something because the construction interests are determining the character of the city," Komech told me one afternoon at his institute's plush downtown headquarters. "Charm is being lost. Historical Moscow is disappearing before our eyes. The mayor is very authoritarian and has uncultivated tastes. From 1989 to 1991 it was fashionable to take the public's advice. Now it is very different. Let them speak, but we will do what we want. There is an incredible search for the grandiose: the Cathedral of Christ the Savior, the war memorial, the Manezh underground mall. Pretentiousness prevails."

The Moscow intelligentsia—a skeptical lot—were fairly unanimous in their opposition to the cathedral project and the general transformation of the Moscow skyline. But most were less stern than Komech; they tended to irony more than anger.

Leonid Parfyonov, a popular television host and documentary filmmaker, smiled brightly when I asked him about the new cathedral towering over downtown Moscow.

"To some degree I agree with Komech," he said. "This is a junk copy of a Russian original that was never much good in the first place. It's also disgusting to watch former members of the Central Committee act pious and more religious than the patriarch himself. This is a cathedral being built by men raised in an era of Romanian furniture sets thinking they are Louis XIV. And yet there is vitality, real life in all this. This is an aesthetic built on illegal money and faux Orthodoxy and tawdriness. But what else is there? This is our life! To get angry at this is to be angry with life itself."

The transformation of Moscow is not only a matter of bricks and mortar. The rapid transition from communism, a system in which all were, as Joseph Brodsky, the Nobel Prize-winning poet, *(Continued on page 100)*

Left behind in the wake of free enterprise

Nina and Misha Petrakov read the only newspaper to which they still subscribe since quadruple-digit inflation slashed the value of their government pensions. Together the couple (she a retired accountant, he a retired scientist) receive $109 a month — half the average wage. They cannot afford new clothing or shoes, or special medical treatment.

Nor can they buy much food. "As for freedom, we do not feel it," says Misha, 66. "What kind of freedom is this when you are bound economically, when you are ill and cannot afford to take care of yourself?" By applying to the city in 1991, the Petrakovs took ownership of their Moscow apartment, but they still pay skyrocketing costs for gas, electricity, and water. Pensioners, a quarter of Moscow's population, are among those least able to adapt to the new Russia. Says Nina, 67, "It's better to be young."

Misha's parents worked the land as peasants in Safonikha, a village 60 miles northwest of Moscow. Now in order to feed themselves, Misha and Nina, who have no children, tend a third of an acre there from April to September, living in the one-room family home. Though both suffer from health problems, they toil long hours all summer (top), growing bushels of cucumbers, tomatoes, carrots, beets, onions, cabbages, and potatoes. In fall they harvest apples and gather mushrooms for soups and berries for jams. During the winter, which they spend in Moscow, their hard work pays off. Every month Nina and Misha visit Safonikha to collect food, traveling by train and bus, then breaking a trail to the log house (above right). Hoisting vegetables from the root cellar (above), they fill as many bags as they can carry—about 20 pounds each—on the half-day journey home.

Back in their Moscow apartment (right), Misha cuts onions for meatballs as Nina peels potatoes for boiling. Without their little farm, meals would be very spare, Nina says. The high cost of food drives less fortunate Moscow pensioners outdoors—to sell their belongings in the street.

put it, "equal in poverty" to one in which the world is almost oppressively filled with opportunity and unfairness, has been delicious for the lucky few and a shock to nearly everyone else. It takes cunning, flexibility, privilege, and youth to make one's way in the new world. Suddenly an outwardly classless society has fractured into classes of radically different experiences and levels of wealth, and the result has been a Moscow filled with resentment, confusion, and jealousy. These emotions are the fuel of modern Russian politics.

Tourists in Moscow understandably stick to its dense downtown, and that is where the wealth is. But most ordinary people live in the vast and dreary housing developments that go on for miles. And in neighborhoods like these there are no shopping malls, no luxury hotels. Change has radiated to the periphery almost as slowly as it has to cities hundreds of miles away. There are more soup kitchens and charity organizations around now, but the state has not caught up with demand. While many old people make up for pensions lost to inflation by receiving help from their more nimble and successful children and grandchildren, not everyone is so lucky. During the 1996 election campaign I met an older couple who told me they lived on a diet of oatmeal and bread and not much else. They were voting communist, they told me, because "this brave new world is so cruel."

Even the intellectuals who dreamed for decades of an open society now feel a sense of disillusion. "Before the fall there was a uniformity to life," my friend playwright Aleksandr Gelman told me. "Everyone was more or less equal. Everyone lived more or less OK, or equally badly, but no one was rich. Everyone dreamed about freedom, and this united them.

Victims of the bottom line, Moscow parks like Serebryany Bor are free but neglected. The city has cut maintenance and policing, turning the management of one park over to ultranationalists, who patrol in paramilitary uniforms.

People could recognize each other, who they were, with just a couple of words. This created a certain ambience, a quality of human relations. It wasn't always wonderful, but it was familiar. Suddenly lots of artists and composers and writers began to live quite badly. There was no government support. Their lifestyle changed. They didn't become opponents of democratic reform, exactly, but discontent grew. And so now freedom is associated not with joy entirely but with a depressed state."

IN MOSCOW ESPECIALLY, but in other big cities as well, political jokes have given way to jokes about the new rich—the New Russians. The gibes are what any American or Briton would recognize as nouveau riche jokes. One New Russian says to another, "I just bought the most fantastic tie in Paris. It cost $300!" "Oh really?" says the other proudly. "I just bought the same tie for $400!"

And so on. These jokes, so often told by people of superior education and declining incomes, portray the New Russian as loaded, lucky, and preposterously crude. The jokes are like those once told about oil sheikhs and their vulgar new mansions in Beverly Hills. There is also an air of perishability about the New Russian of legend and fact. I heard about the owner of a health club in Moscow who was desperate for new members; so many of the old members had been rubbed out in mob hits. It sounded like the beginning of a joke, a fable. But it was told to me as true.

The mob is a vivid presence in everyday life. Mobsters run protection rackets, car-heist rings, import-export scams; on a "higher" plane they bribe government officials for trade licenses, state contracts, and sweet deals on the privatization of one enormous industry or another. Mobsters are as present as the snows. There are certain hotels, certain restaurants and nightclubs, where one would have to be a blithe spirit indeed to go without a prayer and a bulletproof vest.

And yet, for most people, it is the pervasive ethic of mobsterism that is even more painful. While it's unlikely that an ordinary person or even a foreign tourist will find himself in the midst of a mafia *razborka*—a showdown—there is every chance that dishonesty will visit. With the fall of the old regime, law enforcement is weaker and suggestible. It seems that nearly every time I've gone to Moscow lately the police pull me over, or the friend I am driving with, and charge us with some bogus violation. Their goal is to extract a bribe: $20, $50, more. It seems the price goes up all the time. When I asked a city official about this, he looked at me with pity and said, "What do you expect from a fellow who earns a hundred dollars a month? Honesty? You try it."

Ironically, one of the most skeptical voices about the vibrant and chaotic culture of the new Moscow is that of the man who initiated the city's freedom in the first place. Mikhail

Gorbachev retains a priggish—call it Leninist-puritanical—view of consumer society, of wealth. In general he longs for the Moscow that he first saw as a young man come from the provinces to university.

"I think that a lot of what's happening is inappropriate," he told me one morning at his office. "It's the immorality I regret the most. Those who led this democratic process led a purge of everything that had been accumulated in this society for decades. They twisted everything in knots. Those who campaigned against privileges now build themselves gigantic palaces. They snatched up property. They have been like pigs at the trough. I am shocked by this. And for the Russians, this excess of American advertising—well, it's not all negative, but there is so much excess. In the first years after 1991, television was flooded with American and foreign movies."

Unlike most Muscovites, I admire Gorbachev, but it is easy to see that he is, in many ways, a man of his generation. He is missing the complexity of what is really out there on the streets and in the clubs. One memorable night not long ago I went with some friends to a nightclub called Pilot that was filled not with mobsters or obnoxious nouveaux riches, but rather with kids in their teens and twenties, students and young professionals, out for a good time. The rock bands on stage played a mix of American and British pop and new Russian songs; somehow the language of Pushkin extended a hand to Chuck Berry. Everyone danced. Everyone ate and drank. And no one got shot. The night, which lasted until breakfast, was at once normal, cosmopolitan, and Russian.

For younger people, like Leonid Parfyonov, the television commentator, it is natural that Moscow has become an international city and, at the same time, is distinctly Russian.

"That initial inferiority complex is gone, and now there is a kind of sense of wholeness," Parfyonov told me over lunch at a restaurant called Twin Pigs. "People now think, 'OK, so they live well in the West. And we can visit when we want. But we like it here in Moscow better. We're a tougher people, and life here is interesting now. We'll spend New Year's Eve watching a Grundig television and drinking Swedish vodka and eating American salmon and French cheeses. But we'll sing our songs. Russian songs. That is who we are now in Moscow. We are a city of *everywhere*.'" □

Christ the Savior looms above the Moscow River like a golden mirage of the future. But for some Muscovites prospects look less glorious. "I do not hope for a better life for myself," says one young woman. "Maybe for my grandchildren."

Oil on

Economic boon, environmental disruption— Alaska weighs the problem

BY **JOHN G. MITCHELL**
SENIOR ASSISTANT EDITOR

PHOTOGRAPHS BY **KAREN KASMAUSKI**

Ice

In the mind of the beholder

Some hear music in the drone of a drilling rig on Alaska's North Slope. Others hear fingernails scraping the silence of an Arctic dawn. Concerned that area wells will run dry within decades, oil industry advocates and Inupiat Eskimos, who will profit from the hunt for crude, support exploratory drilling in the Arctic National Wildlife Refuge. Environmentalists and Gwich'in Indians oppose the plan. As the search for oil intensifies, so do competing visions for the future of Alaska's wild lands.

A city that creeps but never sleeps

Mobile apartments (with sauna) house workers who probe for oil round-the-clock near the Colville River. Such work is done in winter on temporary ice roads to protect fragile tundra. Bob Coons, at right, a 20-year Alaska oil veteran, commutes from his Texas ranch. Says Coons: "I enjoy the work—and the money."

"You can feel the silence stretching all the way to Asia."

For writer Barry Lopez and wilderness preservationists the vast coastal plain that sweeps north from the Brooks Range to the Beaufort Sea in the Arctic Refuge is beyond price—one of the last undisturbed tundra ecosystems. Oil advocates see it differently—as a barren lid on the nation's best hope of a huge new oil reservoir.

Oil on ice

ON THE TOPSIDE OF ALASKA almost everything begins at Mile Zero, the fountainhead of Prudhoe Bay. Here begins the flow of oil by pipeline over mountains and rivers to another sea. Here surge the revenues and royalties that have lubricated Alaska livelihoods and lifestyles for 20 years. And here begins our tale, in a blue-nosed Cessna flying east to scout the coastal plain of the Arctic National Wildlife Refuge, where some Alaskans hope to strike a new petroleum bonanza before the older North Slope wellheads run dry.

For sightseeing, today could be chancy: low clouds pressing down and whiskers of fog twitching the lip of the Beaufort Sea. If it gets any worse, we won't see much of anything.

"Some people don't *want* to see anything." It's the pilot, on intercom. "A congressional staffer was up the other day. She kept looking and looking and finally said, 'What's all the fuss about? There's nothing down there.' "

If this is nothing, then it is beyond reckoning—a vast copper tapestry of tundra speckled with silver sloughs and braided with glacial rivers. There are signs of life and death everywhere: on the riverine gravel bars, animal tracks, caribou possibly; on the tundra sedge, the trailing scars of all-terrain vehicles; and strewn in windrows along the thin Beaufort beach, the bleached driftwood skeletons of spruce trees snatched up in flood on far Canadian rivers, then posted by current and tide to this treeless shore.

Our plan is to fly into the refuge along the coast, circle the Inupiat village of Kaktovik on Barter Island, and scoot up the Jago River to the foothills of the Brooks Range (map, page 114). I want to see if we can find the place where, ten years ago, I camped beside that stony river; where, if you time it right, you could catch cohorts of the Porcupine caribou herd coming down from the mountain passes to drop their calves. Or you could sit there with a map that depicts a plan for developing this part of the Arctic Refuge and try to imagine on those wild, seamless flats beyond the river a haul road, an airstrip, a pipeline to Prudhoe, and a string of drill pads padded with gravel.

Since 1984 KAREN KASMAUSKI has photographed numerous subjects for NATIONAL GEOGRAPHIC, ranging from Appalachia to Japanese women to the hazards of radiation.

And that is what the fuss is all about—to drill for oil on the coastal plain of the Arctic Refuge, as Governor Tony Knowles and the state's powerful congressional delegation would have it, or not to drill, as the Clinton Administration averred throughout the budget wars last year. The stakes are high.

Environmentalists and their Alaska native allies, the Gwich'in Indians, view the 1.5-million-acre coastal plain as a kind of American Serengeti, the most biologically productive part of the entire 19-million-acre Arctic Refuge. To protect this resource from oil exploration and development, they ask that the plain be designated as statutory wilderness—a protection almost half the refuge now enjoys.

For their part the proponents of development see the coastal plain as the last best place to bring in the Big Elephant—an oil field with

Measure of Alaska's pulse, the 800-mile pipeline that runs from Prudhoe Bay to Valdez pumps 1.45 million barrels of crude daily. A new strike could ensure that the 20-year-old line—and the cash it generates—will flow well into the next century.

reserves sufficient to push it right up to the top of the chart. Under the most optimistic long-shot scenario, that could amount to more than ten billion barrels of oil, almost as much as all the existing North Slope fields have yielded since the valves of the trans-Alaska pipeline were opened in June 1977. Some in Congress have argued that the nation needs another Arctic elephant to reduce its dependence on foreign oil. But that rationale apparently went down the drain last year when Congress voted to lift the 20-year-old moratorium on exporting Arctic oil to the far side of the Pacific Rim.

Though production has been declining in the older fields, such as Prudhoe, North Slope crude still represents a quarter of the nation's annual domestic oil output. Petroleum prices, however, are far below the top dollars of the early 1980s. And that's bad news for Alaska: Oil receipts have been putting about 80 cents into every dollar the state takes to its treasury.

Despite the revenue shortfall, Alaska continues to lavish on its citizens a per capita public-service expenditure that is twice the national average. There is no state income tax or sales tax to pick up the slack. The bottom line is awash in red ink: nearly 300 million dollars in excess of revenues last year alone. From appearances, you'd never guess it.

For the better part of a month I've been trying to take the pulse of this triumphantly troubled state as it awaits a resolution of the refuge question. Almost every place where I might measure change against the memory of an earlier visit, I measured it. Juneau: once a waterfront of seedy saloons, now gentrified with boutiques to catch the cruise-ship tourist. Anchorage: high-rise offices leapfrogging residential neighborhoods, Hollywood homes climbing the Chugach foothills. Fairbanks: strip malls and expressways bracketing a dour downtown. Despite lingering pockets of poverty, especially in some rural communities, the average household income in Alaska over the past 20 years has doubled to $48,000, the nation's highest.

"Alaska's been one boom after another," an old-timer in Juneau said to me, "and sooner or later each one goes bust. Fur, whales, gold, war. And now it's North Slope oil."

What next?

"Oh, I dunno," he said. "Up in Fairbanks they're talking gold again."

WE OF THE BLUE-NOSED CESSNA have Mikkelsen Bay off the port side. Huge chunks of broken sea ice nestle along the shore. They look as if someone had sprayed them with Windex. Big blue bergs, grown in Alaska.

"It's been an adventure," says Elvi Rebarchek (left, at left), who came to Alaska in 1935 to carve a small farm from the bush. Life eased for many Alaskans thanks to revenues from firms like ARCO Alaska—whose high-rise dominates Anchorage. Oil money provides 80 percent of the state budget and helps fund services like Elvi's retirement home.

The other day I drove from Anchorage to Palmer, in the Matanuska Valley, with hopes of seeing what "grown in Alaska" can really mean. The state fair was playing its last week there, and I'd been told that Alaska produce, much of it grown in the valley, was worth the price of admission alone. Among vegetables, it seems, the midnight sun works in mysterious ways. Blue-ribbon broccolis and turnips can top 30 pounds. A champion cabbage once hit the fairground scales at 98.

As it turned out, the trophy vegetables had been judged and carted away by the time I arrived. So instead of contemplating cabbages, I wandered through the fairgrounds randomly polling Alaskans as to what kind of mysterious ways the state might work to drive the deficit off its bottom line. For months there had been speculation that a personal income tax would be imposed or possibly a phasing out of dividends from the Permanent Fund. The 20-billion-dollar fund, primed entirely by oil, has lately been sending every Alaskan an annual dividend check of about a thousand dollars.

Of the dozen fairgoers with whom I spoke, only one believed the dividends should be phased out—"to end our addiction to oil," the young woman added. None believed the state should impose new taxes.

Optimism seems to run with the size of the vegetables, the territory, and the dreams. In the 20 years since Prudhoe opened the money store, many Alaskans have cheered as successive leaders or legislatures proposed new ways to spend the surpluses, as in former Governor Walter Hickel's aborted billion-dollar plan to pipe Alaska's surplus fresh water to the spigots of droughty California. Still, between the

Extremes are the only constant on Alaska's North Slope—a Minnesota-size plain abutting the Brooks Range. The region's only highway parallels the pipeline (top right). Men lay pipe (bottom right) at minus 40°F. And native peoples, oil firms, and caribou all lay claim to the land.

opening of the trans-Alaska pipeline in 1977 and a slump in oil revenues in the early 1990s, Alaska did manage to pump billions of dollars into infrastructure—everything from sorely needed drinking water systems in remote bush villages to those superfluous super roads bracketing Fairbanks.

FLAXMAN ISLAND off the port side, edge of the refuge. What a gray, lonely looking place it is. Ernest Leffingwell, an unsung expeditionary hero, bivouacked there alone in a hut for six winters shortly after the turn of the century. By sled, he mapped the coast from Demarcation Bay to Point Barrow, explored many of the North Slope rivers, and noted seeps of oil from a sandstone formation he called the Sadlerochit, probably for a nearby river. Leffingwell left Alaska convinced there might be a working oil field on its topside one day. He was right. The same formation runs under Prudhoe Bay.

Prudhoe. Just finished a tour there, courtesy of Atlantic Richfield Company (ARCO) and British Petroleum (BP), two of the principal North Slope producers. Last time up this way, some of Prudhoe's ancillary oil fields were getting ready to come on line. ARCO's Kuparuk facility was already running full-tilt boogie, but at BP's Endicott field a billion-dollar, state-of-the-art, colonial blue superstructure was still a few months short of commissioning.

Oil on Ice

Now Endicott is one of 13 North Slope fields putting oil into the trans-Alaska pipeline. But opinions differ as to how far these smaller operations can go offsetting a loss of vigor in the Prudhoe pool and how long their combined output might justify the costly maintenance of an 800-mile pipeline and a fleet of supertankers. Or, for that matter, whether anything less than a major new find—say, on the coastal plain of the Arctic Refuge—will save America from a 21st-century energy crisis and Alaska from economic ruin.

Saturated with conflicting statistics that purport to answer such questions but don't, I arrived at Prudhoe Bay and promptly remanded myself into the custody of Ronnie Chappell, an ARCO Alaska media specialist. We drove to Kuparuk, Chappell at the wheel. In the back of a company 4x4 sat Mike Joyce, an ARCO wildlife ecologist. Joyce seemed delighted that a few caribou could be seen now and then from the gravel road we followed. So could the pipeline linking Kuparuk to Mile Zero. "We learned a lesson here," Joyce said. "We learned that if you raise the pipeline five feet off the ground and give it some separation from the road, the caribou accept it."

In the fields I had expected to hear sanguine talk about the adaptability of caribou to roads and pipelines. But what I wasn't prepared for was an oilman saying that the outlook for long-term North Slope production was a whole lot rosier than some industry boosters had long been claiming.

"We expect to be producing oil here for decades," Chappell said. "In 1988 the state forecast figured total North Slope production this year would run about a million barrels a day. Well, we've been producing one and a half million." Not only are the new fields doing better than expected, he added, but so is Prudhoe, where the rate of decline has been slowed by new extraction technologies.

"The limiting factor on production at Prudhoe Bay isn't necessarily how much oil is left in the ground," Chappell said, "but the producer's capacity to handle increasing volumes of natural gas." In processing crude, production facilities must separate oil from the gas and water that reside with it in the geologic formation. At Prudhoe, after separation, a small portion of the gas is flared off. Some is used to generate electrical power for the oil fields. But most of the gas (as well as the water) is reinjected into the formation to help maintain pressure and enhance recovery of additional oil.

Lacking market access—a new pipeline that would carry the slope's natural gas to either an ice-free port or a grid of existing gas lines—the producers must flare off, burn as fuel, or reinject 7.5 billion cubic feet of the substance every day. I said to Chappell that sounded like a helluva lot of gas.

"It is," he said. "It's more than half of what residential consumers use throughout the United States in a single day."

AMONG ALASKA'S 600,000 people, natives can be hard to find. And I don't mean Native Americans; I mean individuals born and pedigreed under the seal of the Great Land.

Take young Pete Ahwesh here, this pilot in the seat beside me. Ahwesh, a native of Pennsylvania, is a tall, round-faced fellow whom I mistook at first, though more by name than

Silver braids of glacial silt, the Canning River traces the western boundary of the Arctic Refuge's coastal plain. Bereft of trees, the region is a wetland desert whose scant rainfall lingers on a surface underlain by permafrost. Yet ptarmigan preen, musk oxen graze, and grizzlies prowl on this naked sweep of earth.

looks, for an uppercase Native. A moment ago, as we crossed the mouth of the Canning River into the air space of the Arctic Refuge, I flashed the race card, and he said with a grin, "Nope. Ahwesh is Syrian."

Ahwesh has been in Alaska only five months, which qualifies him as a bona fide *cheechako*, a gold-mining sobriquet still applied to any tenderfoot newly arrived in the territory. After serving time as a cheechako, Ahwesh would graduate to the next level of apprenticeship—sourdough.

In my travels downstate I encountered a good number of both kinds, especially when I checked into the ranks of organized activists battling each other over the future of the coastal plain of the Arctic Refuge. The debate had been heating up in recent months to the point where it seemed that both camps—the environmentalists on one side, the oil boosters on the other—wouldn't be taking any prisoners.

In Fairbanks, at a restaurant beside the Chena River, I joined a group of sourdoughs from the Northern Alaska Environmental Center and listened to their reasons for opposing development of the refuge. You could kiss the tundra wilderness good-bye, they said, should Congress give the oilmen a green light. And good-bye to the calving grounds of the caribou too. "This is going to be a win-lose situation," one of them said, "because there isn't any room here for compromise."

For the other side of the argument I had checked in earlier at the Anchorage headquarters of Arctic Power, the citizens' and business advocacy group coordinating the effort to open the Arctic Refuge to development.

A staff person there supplied me with a handful of press releases. One release, quoting from a 1990 study, confidently predicted that development of the refuge would add 50 billion dollars to the gross national product and

Oil on Ice

Where caribou and conflict thrive

Tormented by mosquitoes, part of the 160,000-strong Porcupine caribou herd swarms an ice bank for relief. Cool breezes, rich forage, and low predation lure the migratory herd to the coastal plain each spring for calving. Oil exploration there could force cows to less optimal birthing sites, putting the herd's future at risk.

increase employment by more than 700,000 jobs nationwide by the year 2005. (I had already heard these figures cited by Governor Knowles in Juneau—and noted that the Congressional Research Service had proclaimed them to be overly optimistic.)

Then I dropped in on one of Arctic Power's key volunteer players: Cindy Schebler, president of an Anchorage employment agency called Personnel Plus. Schebler is a native of Indiana and has lived in Alaska for 15 years. She said, "Development isn't going to hurt the caribou migrations. It's like if I have a dog and put up a gate where the dog is used to going, then the dog will simply learn to go around the gate. That's my bottom-line feeling on it. Besides, there's already enough wilderness and wildlife right here around Anchorage."

AHWESH IS ON THE INTERCOM telling me that Kaktovik is dead ahead. The village hugs the seaward side of Barter Island a few miles west of the Jago River estuary. For many years the U.S. Air Force maintained two huge radar dishes here to sound an early warning should the Cold War heat up on the far side of the polar ice.

As Ahwesh banks the plane for a better view, I can see that the village has grown some since I was last there on the ground in 1987. There is some new housing. I understand a sewage system will soon replace the heave-ho honey buckets. And there on the beach as we circle beyond the village airstrip lies the carcass of a legally taken, fully butchered bowhead whale. The old ways and the new, side by side in this ambiguous age of Alaska oil.

Oil money has brought changes to rural Alaska that may be far more profound than the coming of high-rises and hot tubs to the outliers of Anchorage. In a growing number of rural communities, purchased convenience has taken some of the sting out of the old prickly frontier life. There are five or six flights a week to the city. The dark is light enough with the flip of a switch. The snowmobile has retired the sled dog. The mom-and-pop shop at the post office will sell you a pork chop when the freezer at home runs out of moose.

But it all costs money. Even with entitlements and subsidies, there is no such thing in rural Alaska as a free lunch.

On my way north I had stopped for a while at Fort Yukon, situated at the confluence of the Yukon and Porcupine Rivers. By some accounts this is the oldest English-speaking community in Alaska, going all the way back to fur-trading days, when it was an outpost for adventurers from the Hudson's Bay

Hunting caribou is a rite—and a necessity—for the Gwich'in Indians of Arctic Village at the Arctic Refuge's southern edge. Butchered meat (left) is a staple for the Gwich'in, who fear that oil drilling will shrink the herd and shift its migration away from the village. Says Faith Gemmill (above, at right), "The health of our people is the health of the herd."

Company. Now, among older residents, one is likelier to hear an Athapaskan language, even as that ancient tongue grows foreign to younger men caught up in the quest for paying jobs.

Consider the Carroll brothers, Richard and Tony, grandsons of an Irishman from Minnesota who answered the call of the wild, married an Indian, and started a clan. Tony has a job in the oil fields, two weeks on, two weeks off. The day I arrived, Tony was off, heading up Porcupine River to lay in some caribou meat for the winter. Richard is self-employed. For many years he was a trapper of marten and lynx till the fur market folded. Now he works a fish wheel on the Yukon, smokes salmon, and guides visitors around the gravel roads of Fort Yukon in an aging station wagon.

"The pipeline changed everything up here," Richard Carroll was saying the day we went out on the river to harvest the catch from his fish wheel. He was speaking, of course, of the pipe that comes out of the ground up at Mile Zero. "All of a sudden the state was spending money all over the place. We got water and sewer projects. We got vocational training, but we didn't get many jobs."

Richard's brother got a job with Doyon Drilling, the 34-million-dollar-a-year subsidiary of Doyon, Limited. (Doyon is one of 13 such corporations established pursuant to the Alaska Native Claims Settlement Act of 1971. The act extinguished all claims based on aboriginal title in exchange for the transfer to Alaska native groups of some 44 million acres of federal land and the payment of almost one billion dollars.)

I am told that Doyon Drilling goes out of its way to find room in its workforce for Alaska

Crude oil surmounts whale oil as the engine of Inupiat life.

The death of a bowhead still excites Barrow youth. Their community will feast on its flesh. The hunt remains a cultural mainstay for a people made rich by taxes on oil interests. Jonie Kaleak, who caught this 22-ton whale, favors drilling on Inupiat acreage in the Arctic Refuge: "We should be allowed to develop our own lands."


Orlando
Magic

natives. But affirmative action for bush Alaskans apparently is not widely pursued on the North Slope. While Alaska natives represent 17 percent of the state's population, they hold only about 5 percent of the oil industry jobs. In Anchorage I met a Gwich'in Indian who has worked nearly 20 years for one of the service companies operating at Prudhoe and along the pipeline.

"Every time I go north of the Brooks Range," he said, "I have to wear sunglasses."

"Because of the snow and ice?" I asked.

"No, because of the palefaces."

IT DOESN'T LOOK GOOD OUT THERE. We have been following the Jago River south from its mouth. Where there were scattered twitches of fog on the coast, now we are getting into a solid scrim of the stuff. Ahwesh says we are down about as low as we can safely fly. He wants to know how far it is to the place where I camped beside the river. The map shows ten, maybe fifteen miles. He shakes his head. No. Not today. We won't be going up the Jago any farther. Climbing, we turn west toward Prudhoe. Through a hole in the scrim, I watch the river slide away.

On a better day we might have flown on to a pass in the mountains, slipped past the glaciers of Mount Chamberlin on one side and the granite spires of Mount Michelson on the other, topped the great divide of the Brooks Range, and skimmed down the East Fork Chandalar River to Arctic Village. I've fresh memories from there.

I remember finding Arctic Village the way I figured bush Alaska used to be—lean log cabins, firewood for the barrel stoves, and precious few motor vehicles of any kind.

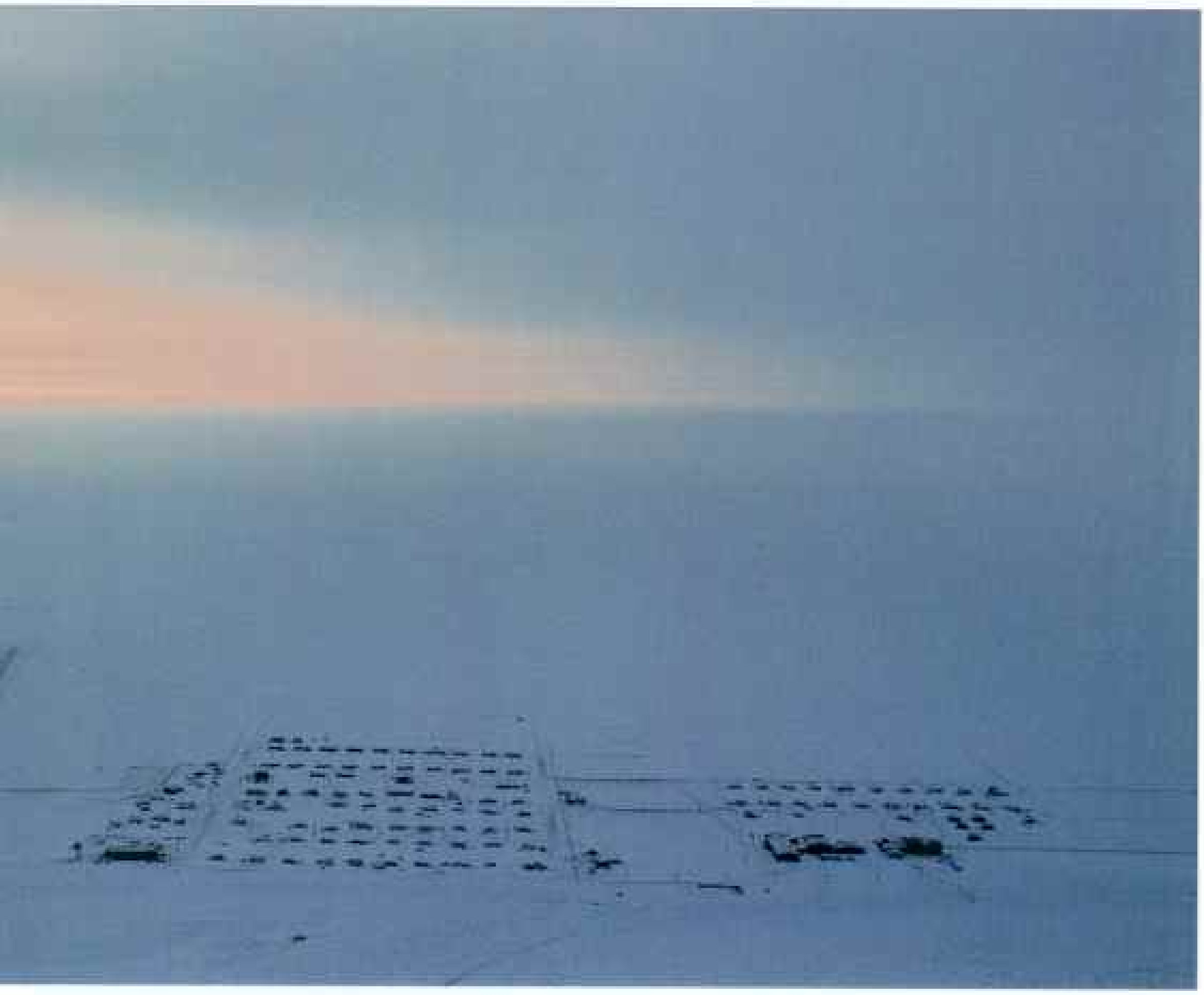
I remember catching Sarah James at her little cabin on the edge of town. James is a spokesperson for the Gwich'in Steering Committee, the Athapaskan organization most actively opposed to oil development in the Arctic Refuge. She had been packing for a lobbying sortie to the lower forty-eight, but now she paused to fling a barb or two at her enemies.

"People say that only Arctic Village doesn't want to see oil development," James said. "No, no, no. There are 17 Gwich'in villages that don't want to see oil development. Venetie, Birch Creek, Circle, Beaver, Stevens Village—all with one voice." (Arctic Village and Venetie, with an aggregate population of about 300, clearly spoke with one voice when they gave up their claim to oil money by opting out of the Alaska Native Claims Settlement Act in order to retain control over 1.8 million acres of wild country. Their land is known as the Venetie Indian Reservation and abuts the south side of the Arctic Refuge.)

Sarah James said, "Up in Kaktovik I see that even a single guy can get a three-bedroom house and in his garage a pickup and a four-wheeler and a snow machine. That's oil. And they want more."

After a while I left James to her packing and at the invitation of Steven Tritt, first chief of Arctic Village, joined two boatloads of Gwich'in hunters planning to scour the banks of the East Fork Chandalar for caribou sign. I sat amidships in a long aluminum punt propelled by a powerful outboard. A young man named Joel sat in front, scanning the shoreline with binoculars. He wore a camouflage jacket and a gray, short-visored 1860-ish military cap, the kind you might see on a redneck youngster in Dixie.

TV "helps us feel connected," says Doris Hugo (bottom, at center), co-anchor of a student news show beamed from Barrow to isolated Nuiqsut (right) and the seven other villages of the North Slope Borough. At 89,000 square miles it's the nation's largest municipality and one of the richest. Yet some changes come slowly. Though Nuiqsut has e-mail, its homes still wait for flush toilets.



The price of oil proved too high for some of Alaska's wildlife.

After 11 million gallons of crude spilled near Valdez in 1989, dying seabirds littered the Barren Islands. Unable to preen oiled feathers, tens of thousands of common murres—the species hardest hit—died of hypothermia. To learn why the colony hasn't recovered, biologists capture murres, amid white kittiwakes, for study.

"Hey," I said. "You look to me like the Confederate Army." Joel nodded enthusiastically. "Up here," he said, "we *are* the Confederate Army."

It is a full, wide, blue-water river, the East Fork Chandalar, uncoiling out of the high country past spruce-sprinkled hills and willow flats slumping to coarse sand beaches. From time to time the other boat would put two hunters ashore to check the freshness of caribou tracks in the sand. But in some 30 miles of river travel, going past the bend at snow-covered Under Cloud Mountain and back again, the hunters saw few tracks and no caribou.

The caribou looms large in the Arctic Refuge debate as well as in the culture and commissaries of the Gwich'in people. The number of these animals killed by subsistence hunters from all the region's villages, including more populous Canadian communities across the Yukon border, is said to fall into a range of 2,000 to 4,000 a year. The Porcupine herd as a whole fluctuates between 100,000 and 180,000, but there is heavy predation of calves by eagles, wolves, and grizzly bears, not to mention winter starvation. A healthy calf crop each spring is therefore important to sustain the herd.

The Gwich'in, the environmentalists, and the U.S. Fish and Wildlife Service, which manages the Arctic Refuge, argue that development of the coastal plain will surely disrupt the calving, lacing the plain with pipes and roads and drill pads. The proponents of development say not to worry and cite as evidence those pipeline caribou munching sedges at Prudhoe Bay.

The claims and counterclaims on this issue are almost as multitudinous as the arguable statistics on the future of North Slope oil. So, while I was in Fairbanks, I decided to pop the caribou question to Ken Whitten, a wildlife biologist who has been keeping an eye on the Porcupine herd for the Alaska Department of Fish and Game. I asked Whitten how he called it. Would development really have any negative impact on the Porcupine herd?

Whitten said, "We just don't know. We cannot confidently predict what the impact would be on the herd. But we do know this—there'd be some risk involved."

WHILE AHWESH is guiding our plane home, I am sitting up here in the sky with him thinking of Barrow. The Top of the World, they call it, 320 miles north of the Arctic Circle. Excepting the oil fields, no other place in Alaska has changed so dramatically in these past 20 years.

Kings, reds, humpies, dogs—each salmon has its season on Cook Inlet, where Aleut native Fedora Hedrick drys her catch. Inlet fishing suffered from the 1989 oil spill in Prince William Sound; crews there now conduct weekly clean-up drills (facing page). Fedora fears that if new offshore drilling begins in Cook Inlet, "our fishing will be lost."

I never got to see the old Barrow, before oil came in the 1970s. Then it was said to be the nation's dreariest rural slum. Today, thanks to oil, it just might be the richest little community in America. Some vital statistics: Population, 4,200. Two-thirds of the residents are Inupiat Eskimo. Average household income, $64,000 (33 percent higher than the state average, 88 percent above the national).

Barrow is part of the North Slope Borough, which embraces eight rural villages, including Kaktovik, and all the slope's onshore oil fields. The borough levies a property tax on the oil fields that yields about 220 million dollars a year. It maintains its own Permanent Fund of some 330 million dollars, the income from which feeds the borough's operating budget. The borough-based Arctic Slope Regional Corporation, which grossed 468.5 million dollars in 1995, is one of the wealthiest corporations in Alaska. Since coming into the money, the borough has constructed public buildings and utilities costing 1.3 billion dollars. The most remarkable building is the Barrow High School. It cost 89 million dollars. Enrollment has never exceeded 300 students.

Brenda Itta-Lee remembers the other Barrow. A handsome, soft-spoken Inupiat woman, Itta-Lee is a vice president of the Arctic Slope Regional Corporation. "I was born right here in Barrow in 1943," she told me when I called at her office on Agiak Street. "When I was growing up, we had no electricity, no telephone, no running water. We burned coal and whale blubber to keep warm in winter at 60 below. One of our chores was to hitch up the dog team and go inland to chop ice from the freshwater lake for drinking and

washing. Almost all our food was what my father caught. It was a very hard life until the oil economy entered our culture in the 1970s. Now we can begin to enjoy a life that other Americans have enjoyed for generations."

The borough government, the regional corporation, and most of the people of Barrow are much in favor of drilling for oil in the Arctic Refuge. It happens that the regional corporation, holding title to subsurface mineral rights out near Kaktovik, would reward the people hugely should a gusher prove up on the coastal plain. It also happens that there has been talk of drilling for oil on the outer continental shelf of the Beaufort and Chukchi Seas, where the borough and the corporation have no rights whatsoever and where development might adversely affect the habitat of marine mammals, which the people hunt. As the caribou is to the Gwich'in Indian, so the bowhead whale is to the Inupiat Eskimo.

George Ahmaogak, the mayor of the North Slope Borough, said, "Drill offshore? No! There's a danger of spills out there. It could be a disaster. The technology is not proved. Why have lease sales in the Chukchi and Beaufort Seas when oil reserves haven't been exhausted on the land, like in the Arctic Refuge? It doesn't make sense."

But what about the Gwich'in? What about Arctic Village?

"They wanted a reservation," the mayor said. "Not to be part of the native claims settlement. That's the way they wanted it to be so they could have their own little quarters and take care of their own little selves. Well, that doesn't mean they have any right to dictate what happens outside their boundaries now. This is our jurisdiction."

But what about the caribou?

"The caribou will always be there."

And so will the whales, I suppose.

There was a whale on the beach during my visit to Barrow. It was the third bowhead taken by whalers that season. Men were flensing the blubber and meat with long-handled cutting tools. It is a real social and cultural occasion in Barrow when the whalers come in. Families gather, food is shared, children run gaily back and forth.

For a long time I watched the people and the great red, white, and black lump of the whale as it slowly grew smaller on the beach. Then the people began to drift away, and I drifted with them, back to the place where they'd parked their late-model vans and suburbans and station wagons. There was even one taxi, waiting.

Frigid air boils with scorching exhaust from a North Slope oil-processing plant. If oil is discovered in the Arctic Refuge, development would cover less than one percent of its 19 million acres and would be done "in an ecologically responsible manner," declares Governor Tony Knowles. The question now: Is new oil a fair trade for a slice of virgin earth?

PRUDHOE, DEAD AHEAD. The ceiling is lifting. The fog's shredding out. Be on the ground soon. Mile Zero.

Somewhere down there the trans-Alaska pipeline is squirting Kuparuk and Endicott crude toward Valdez and the tankers in Prince William Sound. A couple of weeks ago I headed down to Valdez myself—and came away with two unforgettable memories. The first: How large the tankers seem, how close the mountain walls of the Valdez fjord, how alien to one's nose that lusty bouquet of low-tide salt water blended with eau de crude.

And second, I will not forget Ed Johnson, a charter-boat captain who runs a 27-foot sporter after halibut. Johnson used to be an oilman and told me he once worked on that rig that blew out off California in 1969, oiling the

beaches at Santa Barbara. Twenty years later he was working on the Kenai Peninsula when the *Exxon Valdez* went aground in Prince William Sound and oiled more than a thousand miles of Alaska shoreline. Johnson came over from Kenai, pitched in to help train the cleanup crews, and stayed.

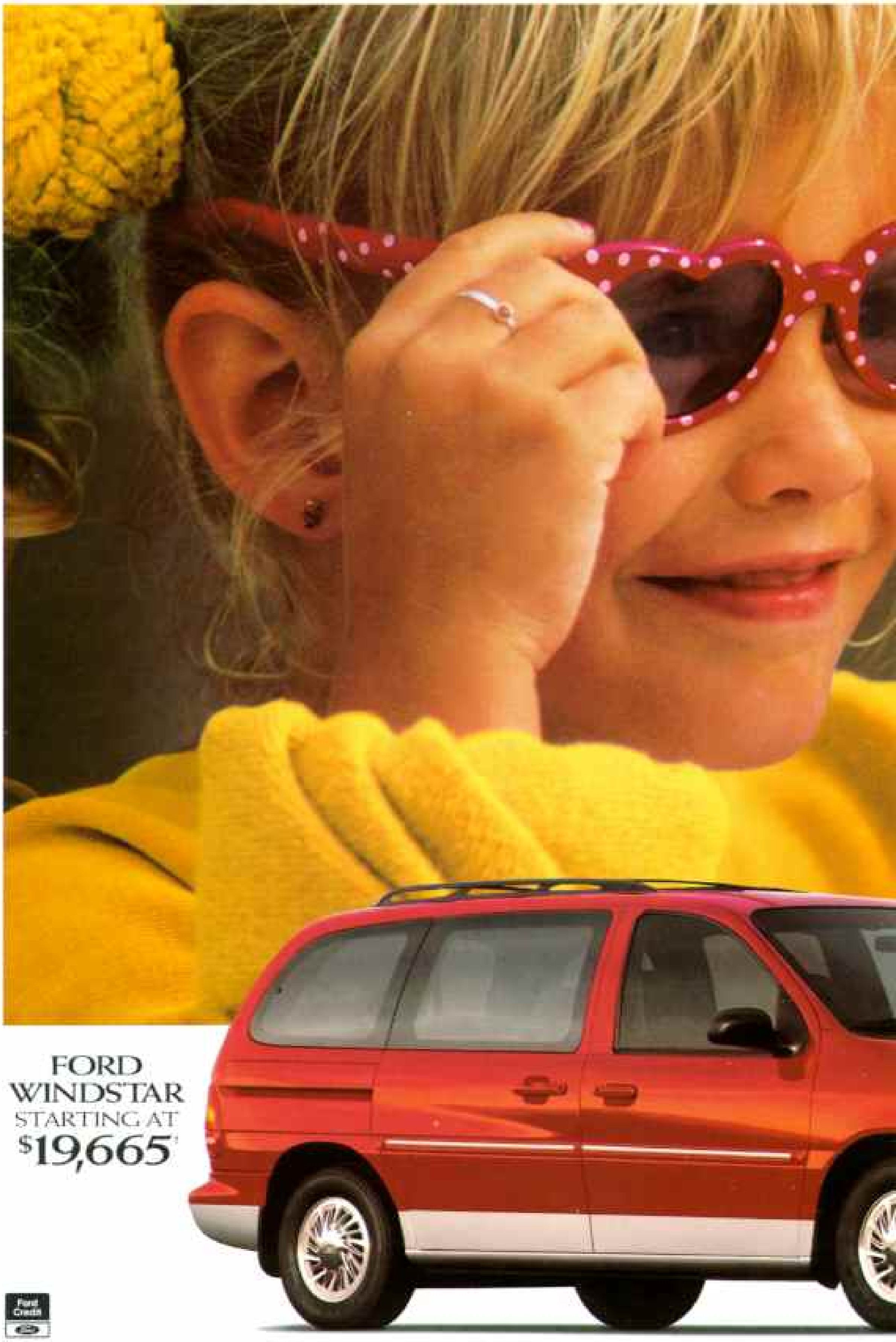
We talked about the Arctic Refuge and whether or not there was as much oil to be recovered over there as some optimists were hoping. Johnson said, "The truth about the oil industry is that you don't know a thing until you put the holes there. Years ago in Kern County, California, I remember there was a field where everything looked good. So they drilled a hole and all they found was salt with nothing under it. Sure, there's potential in the refuge, but I don't believe it can save the state."

And did that worry him? "No. I just worry about our being stuck on cheap oil, and everyone thinking it's going to last forever."

". . . You still buckled?" It's Ahwesh, on the plane's intercom. Runway ahead. We're going down.

Off starboard I can see the great blue superstructure at BP's Endicott field and imagine it—impossibly—plunked beside that refuge campsite long ago in the wild, aching solitude along the Jago River. Oil and wilderness. Wouldn't it solve everything if we could have it both ways? The Big Elephant and the Big Empty? But, of course, we can't. Not in the same place. You can raise the pipeline five feet off the ground to let the caribou pass by, but no pipe or road or runway can begin to accommodate the wilderness I knew on the Jago plain. The oil won't go away if we leave it untouched. But if we touch it, that wilderness will go away for a thousand years, and in only 30 the oil could be gone forever.

Suddenly I am distracted by a light. From a tall stack, gas is flaring. The dull orange wick of it trembles in the thinning fog. □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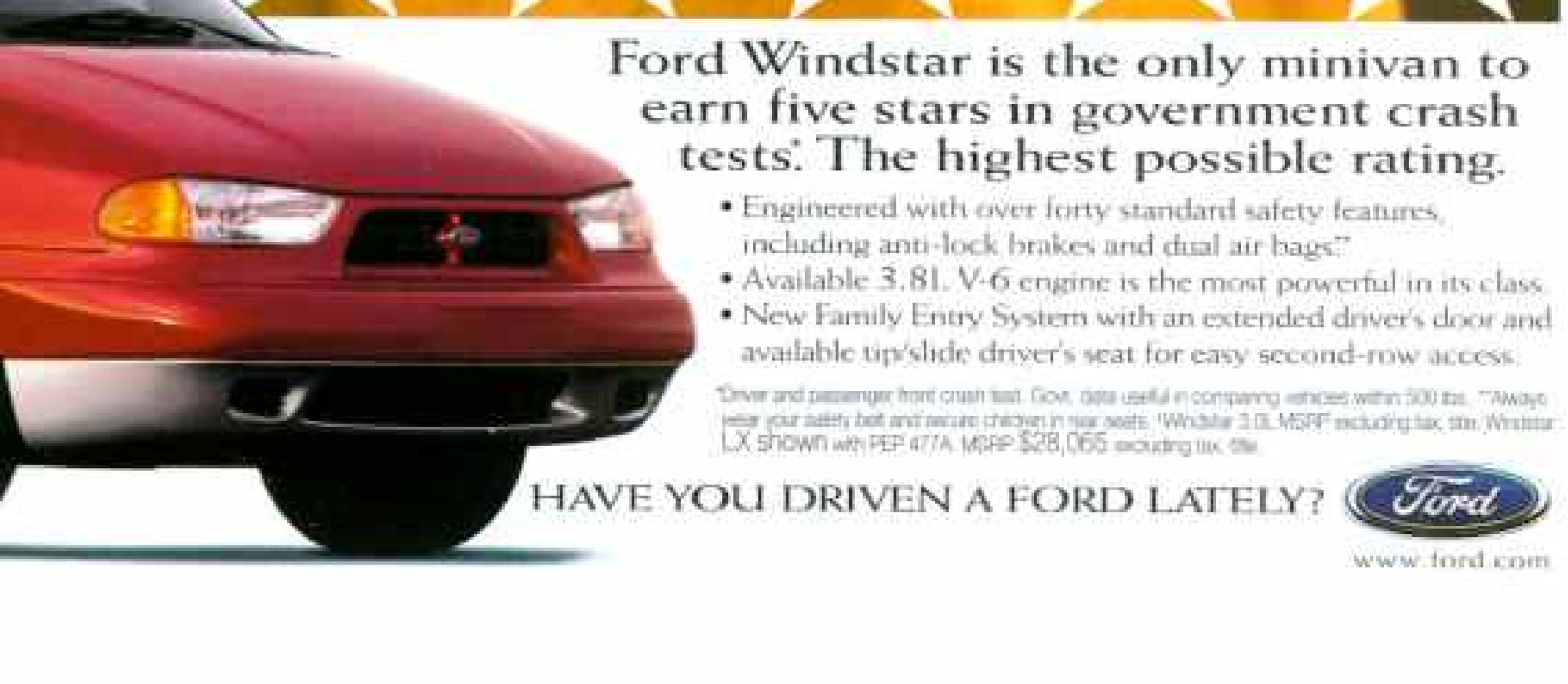

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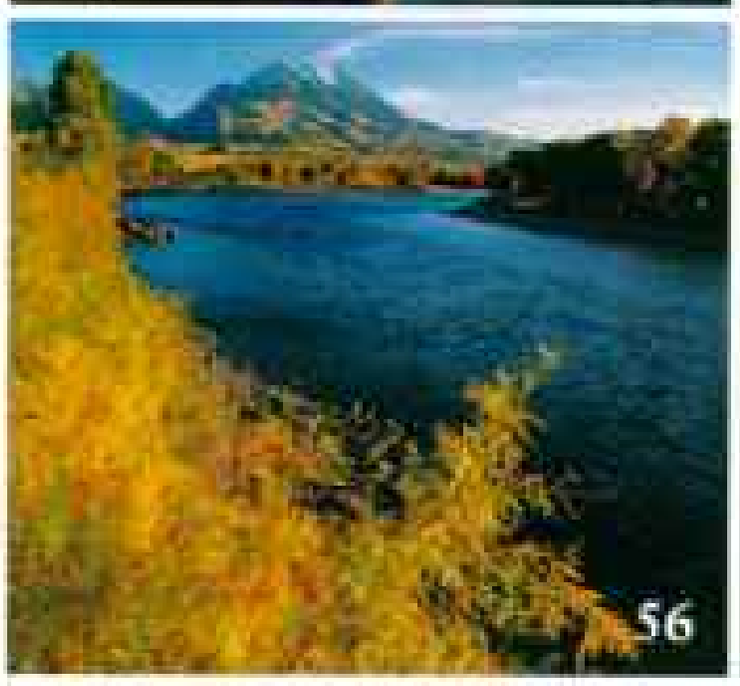

Departments

The Cover

The Hubble Telescope captured this dying star engulfed in gases 8,000 light-years away. Image by Raghvendra Sahai, John Trauger, NASA

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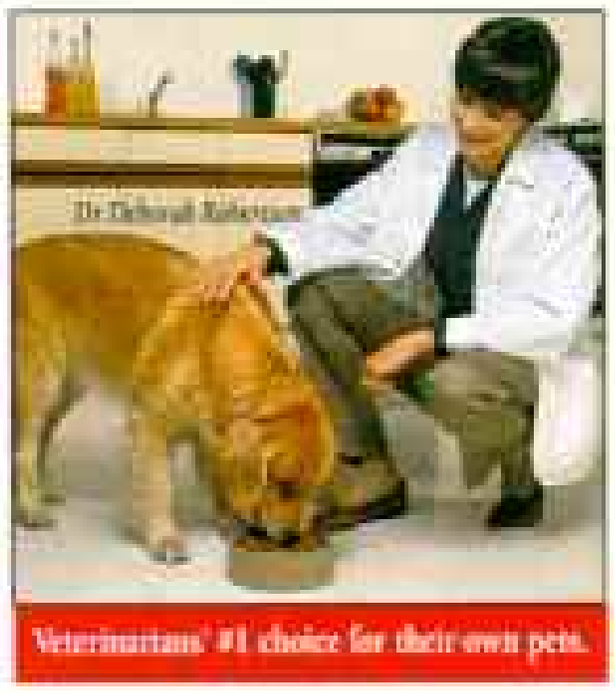

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NATIONAL GEOGRAPHIC

Behind the Scenes

Her Blooming Great Idea

Washington's most beautiful springtime tourist attraction originally came to flower because of one person: writer and photographer Eliza R. Scidmore, the first woman on the Society's Board of Managers. After returning to Washington from a trip to Japan in 1885, Eliza longed to see the cherry trees she'd admired there planted on the newly dredged land reclaimed along the Potomac River. "Since they had to hide those old dump heaps with something," she wrote, "they might as well plant that most beautiful thing in the world." But for years the city rebuffed her campaign. One official complained, "Boys would climb the trees and get the cherries and break all the branches!" When Eliza told him that the trees bore only blossoms, not cherries, he huffed, "No cherries! What good is that sort of cherry tree?"

Soon after William Howard Taft's inauguration in 1909, Eliza found an ally in Mrs. Taft, who had lived in Japan. Helen Herron Taft ordered 90 cherry saplings from a Pennsylvania nursery and had them planted along the Potomac. Hearing of the First Lady's interest, the city of Tokyo presented 3,000 more flowering cherries in 1912. Eliza wanted many placed around the Tidal Basin (right, in the 1920s), "where they might be reflected in the water," she wrote. "By chance, a whole 1,200 were put there, ranged as closely as currant bushes in a kitchen garden." Washington's cherry trees are expected to put on their annual flower show this month.

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HOW TO BECOME AN OVERNIGHT SUCCESS, IN ONLY FIVE SHORT YEARS.

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A new automotive architecture is born as Chrysler introduces cab-forward design in all-new Chrysler Concorde, Dodge Intrepid, and Eagle Vision.

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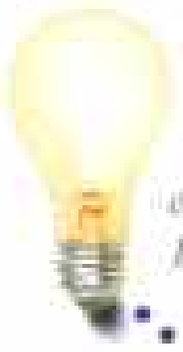
New Dodge Ram Pickup changes the rules with its aggressive styling and Magnum V10 engine. It's the most powerful engine ever in a pickup.



July 15, 1992:
Platform team reads letters from minivan owners asking, "Why not put a sliding door on the driver's side too?"

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The new 3.5 million square foot, $1 billion Chrysler Technology Center is now home to 7,000 employees, with state-of-the-art facilities to promote breakthroughs in design, engineering, safety, and manufacturing.

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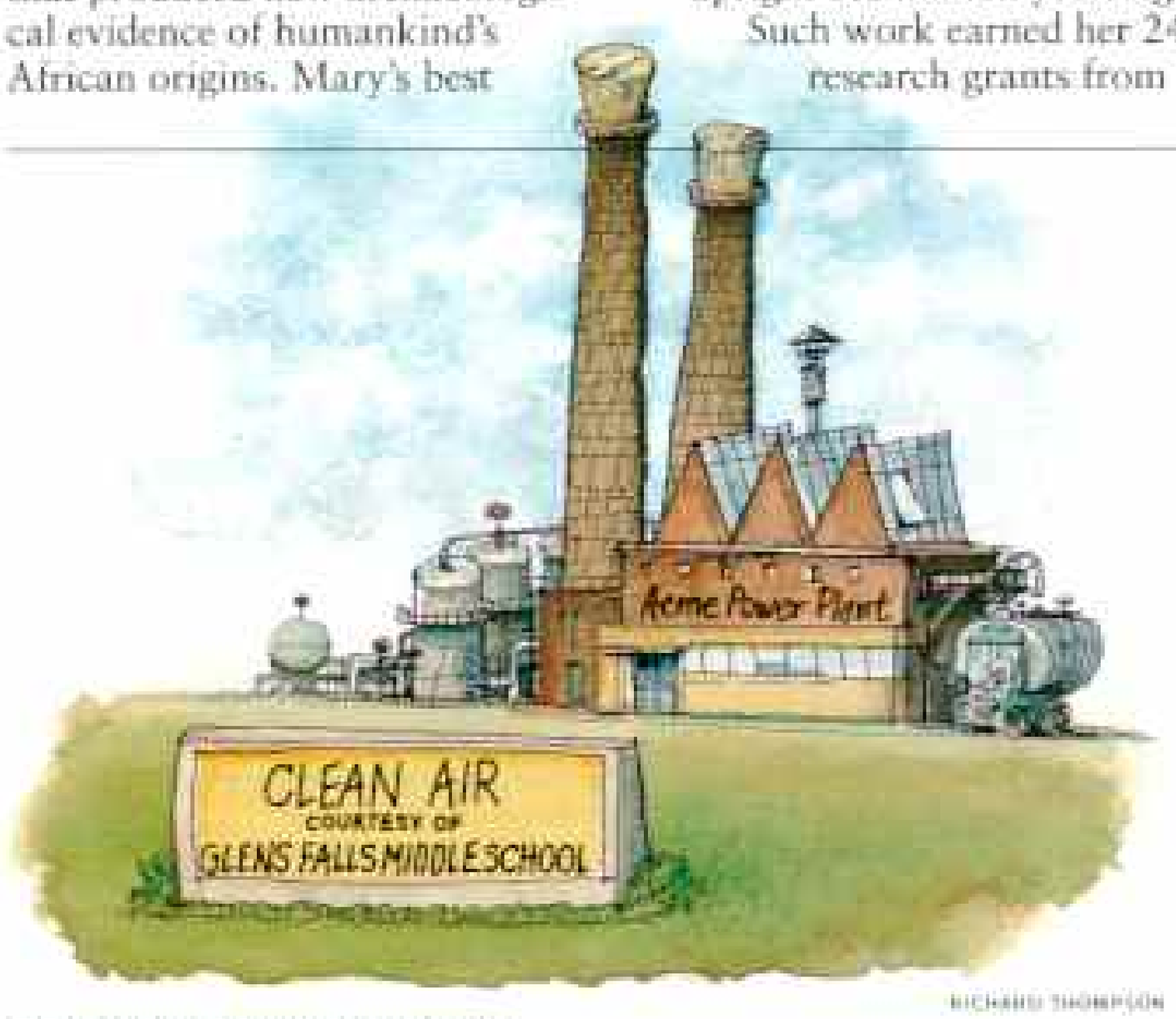
Mary Leakey Remembered

When paleontologist Mary Leakey died at 83 last December, she left a wider legacy than her status as matriarch of the famous family that included husband Louis, son Richard, and daughter-in-law Meave. "Mary Leakey, in her own right, made huge contributions to the science of human evolution," says retired Senior Assistant Editor Mary Smith, who fondly recalls the great lady's sense of humor—and love of cigars.

Art and archaeology were Mary Nicol's two passions in 1933 when she met paleontologist Louis Leakey, who asked her to illustrate his book. She soon added a third love: Louis himself. Married in 1936, they began a remarkable partnership that produced new archaeological evidence of humankind's African origins. Mary's best known find was the path of footprints in Tanzania (above) that showed hominids walked upright 3.6 million years ago.

Such work earned her 24 research grants from our Committee for Research and Exploration, along with our Hubbard Medal and Centennial Award. "I have been impelled," Mary wrote of her life—and life's work—"by curiosity."

BOB CAMPBELL



RICHARD THOMPSON

Cleaner Air Apparent

Near Schenectady, New York, kids are saving the earth—a ton of pollution at a time. Glens Falls Middle School went online with National Geographic Kids Network, our telecommunications curriculum, in 1994. Studying pollution, students learned that power plants receive "allowances" to permit emission of sulfur dioxide—a cause of acid rain. As economic incentive not to dirty the air, plants reducing pollutants can sell allowances to other plants. Or, it turns out, to anyone, who can then take the allowances off the market. So far Glens Falls classes have raised more than $24,000 to buy 313 allowances, which means 313 tons of sulfur dioxide will never be released. —MAGGIE ZACKOWITZ

Getting It to You

The National Geographic Society is using a new operation to fulfill magazine orders. The only noticeable changes will be a new return address on the statements and extended hours, listed below, for customer inquiries. Also, more international members will be billed in their own currency.

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Short-tailed Albatross *(Diomedea albatrus)* **Size:** Length, 1 m; wingspan, 2.4 m **Weight:** 6 - 7 kg **Habitat:** Pelagic and coastal waters of the north Pacific; breeds on Torishima and Minami-kojima Islands, Japan
Surviving number: Estimated at 900
Photographed by Hiroshi Hasegawa

WILDLIFE AS CANON SEES IT

Every October, short-tailed albatross begin their arduous journey from Alaskan waters back to their breeding islands. These large seabirds mate for life. Both parents incubate just one egg until it hatches in early January. By May the newly fledged chick departs for the sea. About four years later, it returns home and begins a new cycle of courtship dances to form its own monogamous pair-bond.

Short-tailed albatross once nested in large numbers, but feather exploitations reduced them to near extinction. Through conservation management, populations are now gradually increasing every year. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

Forum

Our photographs always draw comments but especially so in the December 1996 issue. Why, we were chided, put Genghis Khan on the cover at Christmas, "when we are supposed to be celebrating goodness, not evil." And of a Las Vegas casino: "I am tired of my children seeing nude and half-nude people." Still, Shenandoah River photographs were called "some of the most beautiful I've ever seen."

Believing Las Vegas

Your article was interesting on several counts. Having visited some of the well-known enterprises, I find the idea of gambling and pleasure to be antithetical. Viewing the faces of all those at the slots and tables, one thing curiously lacking was smiles. Facial expressions often exhibited a grim compulsion. I guess I have a different view of fun. Also, can people be so stupid as to believe they are going to win big? Those facilities aren't built because the odds are in the gamblers' favor.

JOHN PHILLIPS
Sandy, Oregon

The bulk of the casinos and population are in Clark County outside the city of Las Vegas, hence we have competing governmental agencies—the city council versus the county commissioners, with all the problems that dichotomy fosters. Only recently have the policing bodies joined to form the Metropolitan Police.

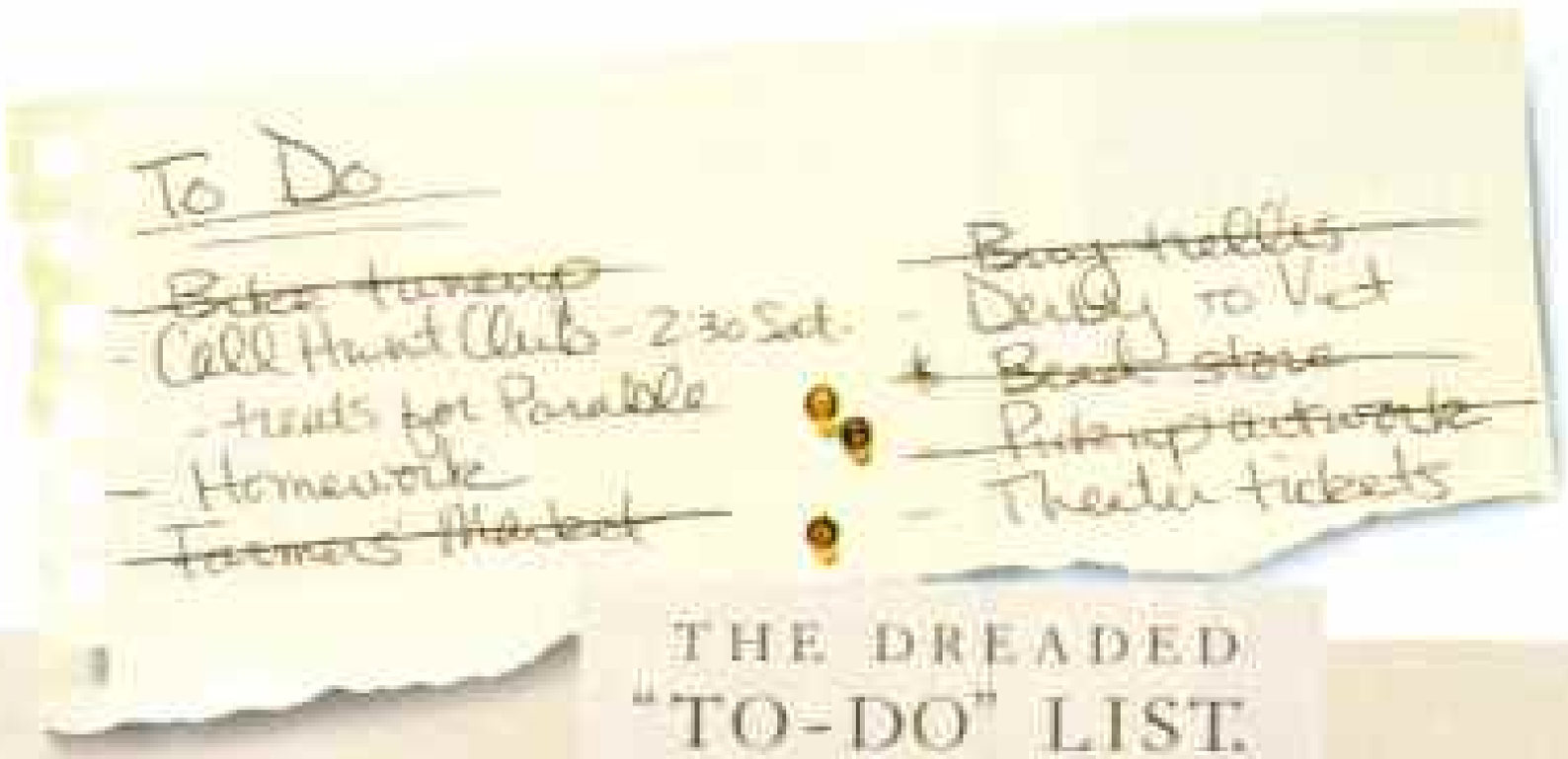
Your article states that the 1994 school-bond issue, requiring a $39-a-year tax increase, failed due to resistance from seniors. That statement is unfair to seniors. I blame poor marketing. On November 5, 1996, a county school-district bond issue was passed 61 to 39 percent. This measure authorizes 642.7 million dollars to build 16 new schools and to expand, improve, or purchase new equipment for 186 existing schools.

TOM CAMERON
Las Vegas, Nevada

I take issue with the outdated term "rust belters" on page 69. Sure, we can't match the sun of Las Vegas, but rust belt connotes decay. The facts are far from it. We're booming too. The 12 Midwest states make up the fourth largest industrial economy in the world, after the U.S. as a whole, Japan, and Germany.

PETE SHAWAKER
Toledo, Ohio

Adding to the surrealistic quality of the photograph on pages 38-9 is the fact that the two jet airliners are part of the fleet that ferries workers to the



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supersecret Area 51 in the Nevada desert. Still, as your article illustrates, nothing that goes on in that mysterious area could be stranger than what goes on in Las Vegas itself.

BRYAN JENNINGS
Boise, Idaho

As a geologist who has worked in the deserts near Las Vegas, I know caliche does not represent a dried-up lake bed. It is formed in part as a calcium carbonate-rich soil horizon and in part by evaporation of carbonate-rich groundwater. Also, with the exception of the enormous use of water, you did not mention the impact of the city on its surroundings. Vegas's light pollution is far worse than that of other cities with equivalent populations because of the uncountable megawatts burned by the casinos at night. Twelve years ago the lights were invisible 50 miles out; last year I spotted the glow when camped at Kelso Dunes, 100 miles away.

MARITH REHEIS
Golden, Colorado

If a successful society has to be built on a base of gambling and prostitution, I feel sorry for future generations.

LEE D. MACKEY
Rutledge, Missouri

Genghis Khan

To accomplish what the Mongols did in seizing most of Asia with limited manpower and resources rivals what the Romans and the British did in establishing their empires. Thanks to NATIONAL GEOGRAPHIC, more people will be able to understand an important time period and the history of the greatest light cavalry the world has ever known.

BRIAN BOSSON
Odessa, Texas

I found your article absolutely fascinating. During my times working and traveling in Iran, I was told that in Khorasan mothers still admonish their children, "Be good or the khan will get you!"

CHESTER J. HAIFLEY
Anaheim, California

Your feature was interesting and also very saddening. Genghis Khan and his followers had an enormous thirst for conquest and for destruction. I wonder how many beautiful monuments and temples were destroyed and burned down by these warriors. How does Genghis Khan differ from Hitler? I know history cannot be altered, but we can be better informed of the destructive path these warriors took to establish themselves.

MANI SHANKAR
Silver Spring, Maryland

To say that modern wars have been deadlier than the wars of the Mongols ignores the fact that the Mongols took few prisoners and ignored any distinction between combatants and noncombatants. When a city's defenses were overcome, the leader's cry "Feed the horses" was the signal for rape, murder, and plunder of the defenseless population. The

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—D.W., Kansas

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Before prescribing, please consult complete prescribing information of which the following is a brief summary

WARNING: Coadministration of terfenadine with itraconazole is contraindicated. Serious cardiovascular adverse events, including death, ventricular tachycardia, and torsades de pointes have occurred in patients taking itraconazole concomitantly with terfenadine. This is due to elevated terfenadine concentrations caused by itraconazole. See CONTRAINDICATIONS, WARNINGS, and PRECAUTIONS sections.

Another oral azole antifungal, ketoconazole, inhibits the metabolism of astemizole, resulting in elevated plasma concentrations of astemizole and its active metabolite desmethylastemizole, which may prolong QT intervals. Based on results of an in vitro study and the chemical resemblance of itraconazole and ketoconazole, coadministration of astemizole and itraconazole is contraindicated. See CONTRAINDICATIONS, WARNINGS, and PRECAUTIONS sections.

Coadministration of cisapride with itraconazole is contraindicated. Serious cardiovascular adverse events including death, ventricular tachycardia, and torsades de pointes have occurred in patients taking itraconazole concomitantly with cisapride. See CONTRAINDICATIONS, WARNINGS, and PRECAUTIONS sections.

INDICATIONS AND USAGE

SPORANOX (itraconazole) capsules, is indicated for the treatment of the following fungal infections in immunocompromised and non-immunocompromised patients:

1. Blastomycosis, pulmonary and extrapulmonary.
2. Histoplasmosis, including chronic cavitary pulmonary disease and disseminated, non-meningeal histoplasmosis.
3. Aspergillosis, pulmonary and extrapulmonary, in patients who are intolerant of or who are refractory to amphotericin B therapy; and
4. Onychomycosis due to dermatophytes (tinea unguium), of the toenail with or without fingernail involvement.

CONTRAINDICATIONS

Coadministration of terfenadine, astemizole or cisapride with SPORANOX (itraconazole capsules) is contraindicated. See BOX WARNING, WARNINGS, and PRECAUTIONS sections.)

Concomitant administration of SPORANOX with oral triazolam or with oral midazolam is contraindicated. (See PRECAUTIONS section.)

SPORANOX should not be administered for the treatment of onychomycosis in pregnant patients or in women contemplating pregnancy.

SPORANOX is contraindicated in patients who have shown hypersensitivity to the drug or its excipients. There is no information regarding cross-hypersensitivity between itraconazole and other azole antifungal agents. Caution should be used in prescribing SPORANOX in patients with hypersensitivity to other azoles.

WARNINGS

In U.S. clinical trials prior to marketing, there have been three cases of irreversible adverse events, hepatitis reported among more than 2000 patients taking SPORANOX (itraconazole capsules). One patient outside the U.S. developed fulminant hepatitis and died during SPORANOX administration. Since this patient was on multiple medications, the causal association with SPORANOX is uncertain. If clinical signs and symptoms consistent with liver disease develop that may be attributable to itraconazole, SPORANOX should be discontinued.

Prior to U.S. marketing, there have been three cases of life-threatening cardiac dysrhythmias and one death reported in patients receiving terfenadine and itraconazole. (See BOX WARNING, CONTRAINDICATIONS, and PRECAUTIONS sections.)

Coadministration of astemizole with SPORANOX is contraindicated. (See BOX WARNING, CONTRAINDICATIONS, and PRECAUTIONS sections.)

Concomitant administration of oral ketoconazole with cisapride has resulted in markedly elevated cisapride plasma concentrations, prolonged QT intervals, and has rarely been associated with ventricular arrhythmias and torsades de pointes. Due to points of cross inhibition of the hepatic enzyme system mainly responsible for the metabolism of cisapride (cytochrome P450, 3A4), itraconazole is also expected to markedly raise cisapride plasma concentrations; therefore, concomitant use of cisapride with SPORANOX is contraindicated. (See BOX WARNING, CONTRAINDICATIONS, and PRECAUTIONS sections.)

PRECAUTIONS

General: Hepatic enzyme test values should be monitored in patients with preexisting hepatic function abnormalities. Hepatic enzyme test values should be monitored periodically in all patients receiving continuous treatment for more than one month or at any time a patient develops signs or symptoms suggestive of liver dysfunction.

SPORANOX (itraconazole capsules) should be administered after a full meal.

Under fasted conditions, itraconazole absorption was decreased in the presence of decreased gastric acidity. The absorption of itraconazole may be decreased with the concomitant administration of antacids or gastric acid secretion suppressors. Studies conducted under fasted conditions demonstrated that administration with 8 ounces of a cola beverage resulted in increased absorption of itraconazole in AIDS patients with relative or absolute achlorhydria. Data are not available to this effect in a full meal is unknown.

Information for patients: Patients should be instructed to take SPORANOX with a full meal.

Patients should be instructed to report any signs and symptoms that may suggest liver dysfunction so that the appropriate laboratory testing can be done. Such signs and symptoms may include unusual fatigue, anorexia, nausea and/or vomiting, jaundice, dark urine or pale stool.

Drug interactions: Both itraconazole and its major metabolite, hydroxyitraconazole, are inhibitors of the cytochrome P450 3A4 enzyme system. Coadministration of SPORANOX and drugs primarily metabolized via the cytochrome P450 3A4 enzyme system may result in increased plasma concentrations of the drug that could increase or prolong both therapeutic and adverse effects. Therefore, unless otherwise specified, appropriate dosage adjustments may be necessary.

Coadministration of terfenadine with SPORANOX has led to increased plasma concentrations of terfenadine, resulting in rare instances in life-threatening cardiac dysrhythmias and one death. (See BOX WARNING, CONTRAINDICATIONS, and WARNINGS sections.)

Another oral azole antifungal, ketoconazole, inhibits the metabolism of astemizole, resulting in elevated plasma concentrations of astemizole and its active metabolite desmethylastemizole which may prolong QT intervals. In vitro data suggest that itraconazole, when compared to ketoconazole, has a less pronounced effect on the biotransformation system responsible for the metabolism of astemizole. Based on the chemical resemblance of itraconazole and ketoconazole, coadministration of astemizole with itraconazole is contraindicated. (See BOX WARNING, CONTRAINDICATIONS, and WARNINGS sections.)

Human pharmacokinetics data indicate that oral ketoconazole potently inhibits the metabolism of cisapride resulting in an eight-fold increase in the mean AUC of cisapride. Data suggest that coadministration of oral ketoconazole and cisapride can result in prolongation of the QT interval in the ECG. In vitro data suggest that itraconazole also markedly inhibits the biotransformation system mainly responsible for the metabolism of cisapride; therefore, concomitant administration of SPORANOX with cisapride is contraindicated. (See BOX WARNING, CONTRAINDICATIONS, and WARNINGS sections.)

Coadministration of SPORANOX with oral midazolam or triazolam has resulted in elevated plasma concentrations of the latter two drugs. This may potentiate and prolong hypnotic and sedative effects. These agents should not be used in patients treated with SPORANOX. If itraconazole is administered parenterally, special precautions are required since the sedative effect may be prolonged. (See CONTRAINDICATIONS section.)

Coadministration of SPORANOX and cyclosporine, tacrolimus or digoxin has led to increased plasma concentrations of the latter three drugs. Cyclosporine, tacrolimus and digoxin concentrations should be monitored at the initiation of SPORANOX therapy and frequently thereafter, and the dose of these three drug products adjusted appropriately.

There have been rare reports of rhabdomyolysis involving renal transplant patients receiving the combination of SPORANOX, cyclosporine and the HMG-CoA reductase inhibitors lovastatin or simvastatin. Rhabdomyolysis has been observed in patients receiving HMG-CoA reductase inhibitors administered alone or concomitantly with immunosuppressive drugs including cyclosporine.

When SPORANOX was coadministered with phenytoin, rifampin, or rifabutin, unexpected, reduced plasma concentrations of itraconazole were reported. The physician is advised to monitor the plasma concentrations of itraconazole when any of these drugs is taken concomitantly, and to increase the dose of SPORANOX if necessary. Although no studies have been conducted, concomitant administration of SPORANOX and phenytoin may alter the metabolism of phenytoin; therefore, plasma concentrations of phenytoin should also be monitored when it is given concomitantly with SPORANOX.

It has been reported that SPORANOX enhances the anticoagulant effect of coumarin-like drugs. Therefore, prothrombin time should be carefully monitored in patients receiving SPORANOX and coumarin-like drugs simultaneously.

Plasma concentrations of azole antifungal agents are reduced when given concurrently with isoniazid. Itraconazole plasma concentrations should be monitored when SPORANOX and isoniazid are coadministered.

Severe hypoglycemia has been reported in patients concomitantly receiving azole antifungal agents and oral hypoglycemic agents. Blood glucose concentrations should be carefully monitored when SPORANOX and oral hypoglycemic agents are coadministered.

Tinnitus and decreased hearing have been reported in patients concomitantly receiving SPORANOX and quinidine. Edema has been reported in patients concomitantly receiving SPORANOX and dihydropyridine calcium channel blockers. Appropriate dosage adjustments may be necessary.

The results from a study in which eight HIV-infected individuals were treated with zidovudine, 6 x 0.6 mg/kg/day, showed that the pharmacokinetics of zidovudine were not affected during concomitant administration of SPORANOX, 100 mg b.i.d.

Carcinogenesis, Mutagenesis and Impairment of Fertility: Itraconazole showed no evidence of carcinogenicity potential in mice treated orally for 21 months at dosage levels up to 40 mg/kg/day (low approximately 1/4 the maximum recommended human dose [MRHD] 200 mg/day). Male rats treated with 25 mg/kg/day (up to 1.5 x MRHD) had a slightly increased incidence of soft tissue sarcomas. These sarcomas may have been a consequence of hypercholesterolemia, which is a response of rats, but not dogs or humans, to chronic intermittent administration. Female rats treated with 40 mg/kg/day (2.5 x MRHD) had an increased incidence of squamous cell carcinoma of the lung (2/50 as compared to the untreated group). Although the occurrence of squamous cell carcinoma in the lung is extremely uncommon in untreated rats, the increase in this study was not statistically significant.

Itraconazole produced no mutagenic effects when assayed in appropriate bacterial, non-mammalian and mammalian test systems.

Itraconazole did not affect the fertility of male or female rats treated orally with dosage levels of up to 40 mg/kg/day (2x MRHD) even though parental toxicity was present at this dosage level. Male severe signs of parental toxicity, including death, were present in the next higher dosage level (160 mg/kg/day (8x MRHD).

Pregnancy: Teratogenic Effects: Pregnancy Category C: Itraconazole was found to cause a dose-related increase in maternal toxicity, embryotoxicity and teratogenicity in rats at dosage levels of approximately 40 (40 mg/kg/day (2x MRHD) and at doses of dosage levels of approximately 160 mg/kg/day (8x MRHD). In rats, the teratogenicity consisted of major skeletal deformity, an effect of unresolved encephalocele and cleft palate.

There are no studies in pregnant women. SPORANOX should be used for the treatment of systemic fungal infections in pregnancy only if the benefit outweighs the potential risk. SPORANOX should not be administered for the treatment of onychomycosis in pregnant patients or in women contemplating pregnancy. SPORANOX should not be administered to women of child-bearing potential for the treatment of onychomycosis unless they are taking effective measures to prevent pregnancy and the patient begins therapy on the second or third day of the next normal menstrual period. Effective contraception should be continued throughout SPORANOX therapy and for 2 months following treatment.

Nursing Mothers: Itraconazole is excreted in human milk; therefore, SPORANOX should not be administered to nursing women.

Pediatric Use: The efficacy and safety of SPORANOX have not been established in pediatric patients. No pharmacokinetic data are available in children. A small number of patients ages 3 to 16 years have been treated with 100 mg/day of itraconazole for systemic fungal infections and no serious unexpected adverse effects have been reported.

In three toxicology studies using rats, itraconazole induced bone defects at dosage levels as low as 20 mg/kg/day (1.5x MRHD). The reduced defects included reduced bone plate activity, thinning of the cross-connects of the lamp bones, and decreased bone marrow. At a dosage level of 80 mg/kg/day (10x MRHD) over one year or 160 mg/kg/day (20x MRHD) for six months, itraconazole induced small tooth pulp with hypercellular appearance in some rats.

While no such bone toxicity has been reported in adult patients, the long-term effect of itraconazole in pediatric patients is unknown.

CNS Infected Patients: Vacuolar hypoabsorption has been reported in CNS infected individuals, the absorption of itraconazole in these patients may be decreased.

The results from a study in which eight HIV-infected individuals were treated with zidovudine, 6 x 0.6 mg/kg/day, showed that the pharmacokinetics of zidovudine were not affected during concomitant administration of SPORANOX, 100 mg b.i.d.

ADVERSE REACTIONS

In U.S. clinical trials prior to marketing, there have been three cases of irreversible adverse events, hepatitis reported among more than 2000 patients. One patient outside the U.S. developed fulminant hepatitis and died during SPORANOX (itraconazole capsules) administration. Because the patient was on multiple medications, the causal association with SPORANOX is uncertain. (See WARNING section.)

ONYCHOMYCOSIS

Adverse events in the following table led to either temporary or permanent discontinuation of treatment:

Body System: Adverse Event	Incidence (%) (n=122)
Elevated Liver Enzymes (>3x normal range)	4%
Gastrointestinal Disorders	3%
Rash	2%
Hypertension	2%
Cardiovascular Hypertension	1%
Headache	1%
Malaise	1%
Allergic	1%
Dizziness	1%
Vertigo	1%

SYSTEMIC FUNGAL INFECTIONS

Adverse experience data in the following table are derived from 402 patients treated for systemic fungal disease in U.S. clinical trials, who were administered oral itraconazole monotherapy, multiple concomitant medications. Of these patients, treatment was discontinued in 10.7% of patients due to adverse events. The median duration before discontinuation of therapy was 81 days, with a range of 2-736 days. The table lists adverse events reported by at least 1% of patients:

Body System: Adverse Event Incidence (%)	Incidence (%)
Gastrointestinal Disorders	
Nausea	8%*
Vomiting	5%
Diarrhea	3%
Abdominal Pain	1.5%
Anorexia	1%
Body as a Whole	
Edema	3%
Fatigue	2%
Fever	2%
Malaise	1%
Skin and Appendages	
Rash	4%*
Pruritus	2%
Central and Peripheral Nervous System	
Headache	3%
Dizziness	1%
Psychiatric Disorders	
Libido decreased	1%
Somnolence	1%
Cardiovascular Disorders	
Hypertension	2%
Metabolic and Nutritional Disorders	
Hypokalemia	2%
Urinary System Disorders	
Albuminuria	1%
Liver and Biliary System Disorders	
Hepatic function abnormal	1%
Reproductive Disorders, Male	
Impotence	1%

*Rash tends to occur more frequently in immunocompromised patients receiving immunosuppressive medications.

Adverse events infrequently reported in all studies included: constipation, pruritus, depression, insomnia, dizziness, menstrual disorder, adrenal insufficiency, gynecomastia and male breast pain.

In worldwide postmarketing experience with SPORANOX, allergic reactions including rash, pruritus, urticaria, angioedema and in rare instances, anaphylaxis and Stevens-Johnson syndrome, have been reported. Marketing experience have also included reports of elevated liver enzymes and rare hepatitis. Although the causal association with SPORANOX is uncertain, rare hypertriglyceridemia and isolated cases of neuropathy have also been reported.

OVERDOSAGE

Itraconazole is not removed by dialysis. In the event of accidental overdosage, supportive measures, including gastric lavage with sodium bicarbonate, should be employed.

No significant lethality was observed when itraconazole was administered orally to mice and rats at dosage levels of 320 mg/kg and in dogs at 200 mg/kg.

Rev: April 1997, September 1997

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slaughter at Herat was the rule, not the exception. You did not show the true monuments of Mongol civilization: pyramids of the skulls of their victims.

LAWRENCE CRANBERG
Austin, Texas

Despite their abhorrent brutality, it is difficult to ignore one of the more appealing traits of the Mongols: their strong proclivity to empathize with the culture of people they subdued. I have a gold coin struck in Arabic by or in the name of Hulagu Khan, probably in Baghdad; the obverse invokes the names of Allah and Muhammad. This lends credence to the view that the conversion to Islam of Mongol conquerors of the Abbasid caliphate indeed started with Hulagu Khan himself. The phenomenon of immersion in local culture is even clearer with the later descendants of the Mongols who founded the Mogul Empire in India. Their reign is synonymous with the flowering of local arts and culture.

HAYAT MEHDI
Vienna, Austria

Crinoids

As a paleontologist who is used to his fossil crinoids being drab gray or white, I found Fred Ravendam's article on feather stars a welcome reminder that living members of my favorite group are as colorful as a fireworks display. However, contrary to the assertion that crinoids are seldom attacked, there is growing evidence that crinoids form part of the diet of many marine predators. Apart from observed attacks, crinoid remains have been found in stomachs of certain species of fish. Feather stars and sea lilies are often found regenerating arms, presumably in some instances following predation.

STEPHEN K. DONOVAN
Professor of Palaeozoology
University of the West Indies, Mona
Kingston, Jamaica

Reinventing Berlin

The text refers to "demolished Checkpoint Charlie, the Berlin Wall's most infamous crossing." I thought Checkpoint Charlie had been disassembled to be reassembled in a museum. As for its being an "infamous" place, I can only direct your attention to the nearest dictionary. Dachau was infamous. Checkpoint Charlie was a light in the darkness. I have been to both places.

SAMUEL B. SIMMONS
Wichita Falls, Texas

For people like me, born in West Germany more than 20 years after World War II, the fact that there was another country that called itself Germany was quite normal. Reunification has brought together almost total strangers who have different social, political, and cultural backgrounds. West Germans mostly didn't think there was anything worth saving from the East. This arrogance is a major problem in coming to grips with our past.

NORBERT W. ROLFES
Lohmar, Germany

The caption for the "Wrapped Reichstag" (pages 102–103) referred to the work of art as possibly "a monumental waste of money," implying that the government paid for this project. The artist Christo and his wife Jeanne-Claude funded the whole thing without recourse to foundations or sponsors.

HENRY SCOTT STOKES
Tokyo, Japan

Shenandoah River

Many in the eastern panhandle of West Virginia appreciate the writings of Angus Phillips. However, exception must be taken to his acceptance of the chuckles of locals who asserted that the Blue Ridge is not in West Virginia at all. Your cartographic department can confirm that the west slope of the Blue Ridge from the Potomac River Gap south for 14 miles is indeed in our state—enough to give credence to John Denver's popular (in West Virginia, very popular) song about country roads.

VINCENT PARMESANO
Mayor
Shepherdstown, West Virginia

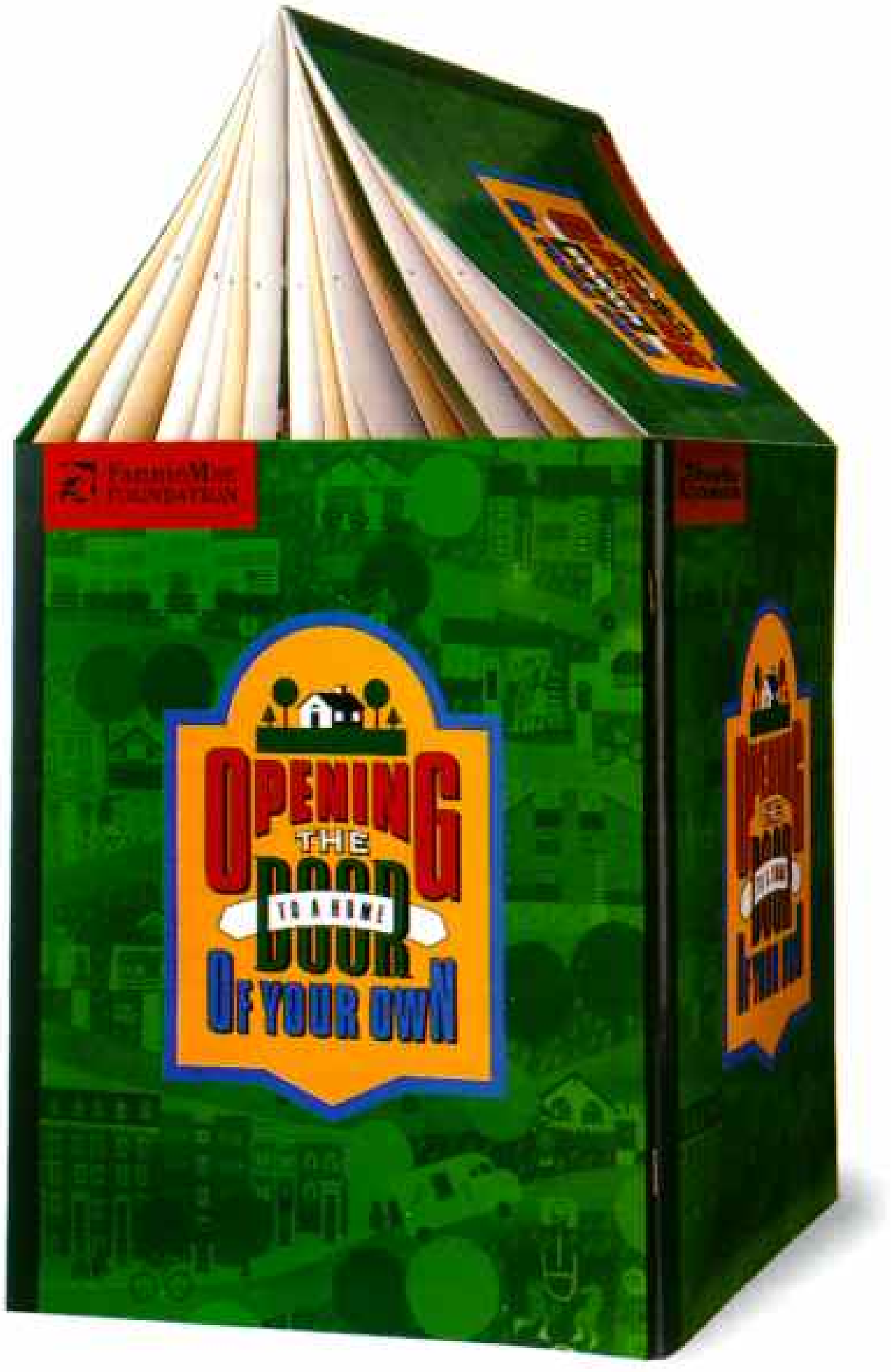
Being a lifelong resident of the Shenandoah Valley and now farming bottomland along the river, I appreciated the author's honesty about the hidden agenda of local environmental groups "to curtail what they see as the remaining serious threat to the river's health—agriculture." The quality of our waterways has been a priority of our farmers. In Shenandoah County water pollution levels attributed to agriculture are down 30 percent from 1985. The river is cleaner than it has been in many years, despite growth in animal agriculture, due to improved farming practices. The largest threat is the continued influx of people. What environmentalists fail to realize is that profitable farms will remain producing farms, and not subdivisions.

GARY M. MONROE
Shenandoah County Farm Bureau
Woodstock, Virginia

As a resident of Virginia and a frequent visitor to the Shenandoah Valley, I can say your article was wonderful. The beautiful mountains and river and the history of the area are something to behold.

BOBBY L. SETLIFF
Martinsville, Virginia

Letters for FORUM *should be sent to National Geographic Magazine, Box 98198, Washington, D.C. 20090-8198, or by fax to 202-828-5460, or via the Internet to ngsforum@nationalgeographic.com. Include name, address, and daytime telephone. Letters may be edited for clarity and space.*



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Coincidentally, the African baobab tree also seats seven.

THAT'S where the similarities end. AFTER all, a Land Rover Discovery offers far more than the appropriate seating arrangements. THERE'S permanent four-wheel drive, coil spring suspension, and a 4.0-liter V8 engine to help seven passengers evade the perils of any such environment. PROVIDED they haven't ventured outside the sheltering parameters of the Discovery's reinforced steel inner body cage. WHEN you consider all this and a price tag starting at just $32,900*, there's only one thing that can keep you from driving away in a Land Rover. AND he can't stay there forever. So why not visit our Web site at http://www.LandRover.com? OR simply call 1-800-FINE 4WD to experience a Discovery at your nearest Land Rover retailer. IT'S certainly preferable to going out on a limb.

DISCOVERY

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Peering at an Unseen World in Almost-living Color

That's not an imagined creature from outer space; it's an ordinary blackfly.

This scanning electron microscope (SEM) image, made by California-based micrographer David Scharf, demonstrates advances in the miniature world of scanning microscopy. Ordinarily an SEM passes a beam of electrons, rather than light, across a subject's surface to produce a 3-D image. When the GEOGRAPHIC featured Scharf's revolutionary work in the February 1977 issue, a note with the black-and-white images explained that "electrons cannot convey colors." They still can't. But Scharf, using an array of electron detectors set at different angles to register shadowing, has devised a means of producing micrographs in color. It's false color, but close to the real thing. "I get natural-looking color by assigning a color to each detector and then tinting the shadows in the right way," he says.

"Microscopy is fantastically exciting," Scharf says. "Many times you're looking at fellow earthlings, and they look like aliens."

DAVID SCHARF, PETER ARNOLD

Can He Fly a Sub to the Deep?

A winged submersible called *Deep Flight I* cruised in California's Monterey Bay last October, piloted by its inventor, engineer Graham Hawkes. The pressurized craft is so small that Hawkes calls it "a vehicle you can strap on and wear."

Hawkes designed the 15-foot-long fiberglass prototype as the first step toward manned exploration of the Mariana Trench, at 36,000 feet the deepest spot on earth. Unlike conventional submersibles, which rely on ballast to sink, *Deep Flight I* is powered by onboard thrusters that move it swiftly through the water. Highly maneuverable wings controlled by a joystick permit fast changes in direction. "Since water is very dense," Hawkes says, "you need a streamlined machine."

CHUCK DAVIS

Pleased by the test runs, he plans to build a superstrong ceramic version, *Deep Flight II*, to speed humans from the surface to the floor of the Mariana Trench in 90 minutes and allow two to three hours for research there. "We know the concept works," he says. "Now we've got to fine-tune it." It should take about 18 months once funds are secured. The first craft was funded in part by National Geographic Television.

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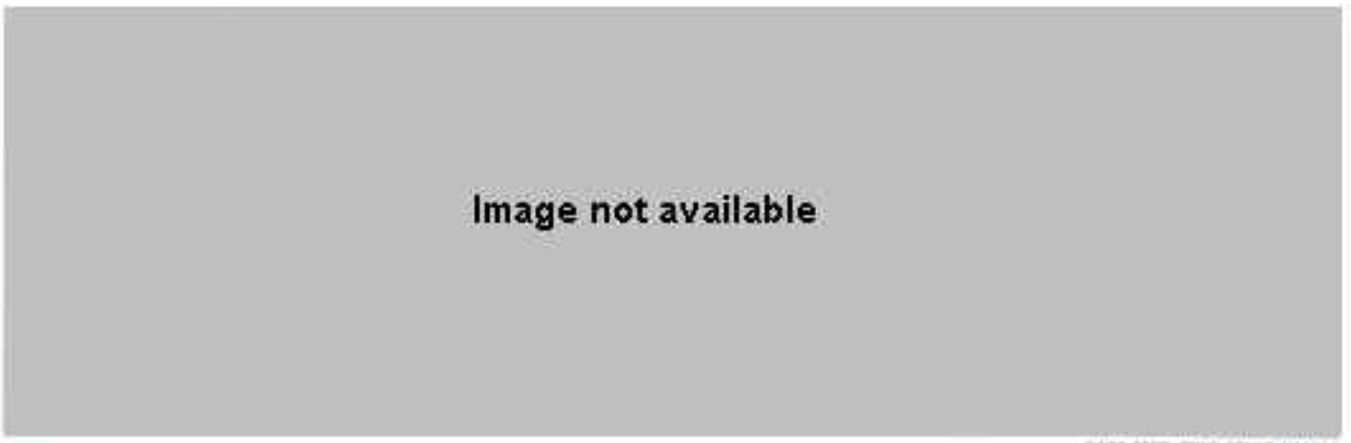


GARY FAYE, TONY STONE IMAGES

All-American Roads, Each Worth the Trip

High on California's wild, rugged coast north of Big Sur, a single-span concrete bridge (above) stretches 718 feet across Bixby Creek. It is part of a 72-mile stretch of the Pacific Coast Highway recently designated by the U.S. Department of Transportation as an All-American Road.

Created to honor the crème de la crème of U.S. scenic byways, All-American Roads hold scenic, cultural, recreational, or historic importance—"destinations unto themselves and an exciting adventure for all ages," according to former Secretary of Transportation Federico Peña.

Five other All-American Roads were named last year: the Selma-to-Montgomery, Alabama, civil rights march route; Rocky Mountain National Park's Trail Ridge/Beaver Meadow Road and the San Juan National Forest Skyway, both in Colorado; Natchez Trace Parkway through Mississippi, Tennessee, and Alabama; and North Carolina's Blue Ridge Parkway.

New Bird Is Found Atop a Peruvian Peak

John P. O'Neill and his team blazed a trail through the Peruvian jungle for 25 days and climbed more than 4,000 feet up a ridge east of the Andes. The effort was worth it: In the soggy cloud forest they found a spectacularly colored bird previously unknown to ornithologists.

O'Neill (below) brought home preserved specimens, the models for his painting that will serve as the bird's introduction to the scientific world. The Society-funded Louisiana State University ornithologist, who has discovered a dozen other new species in 35 years of study in Peru, identifies this unnamed bird as a barbet, related to the toucan. Its crown is scarlet, a red band lines its throat, and its breast and belly are gold and orange. Found so far on just one peak, it is an agile hopper that flies only about 50 feet at a time.

JACKSON HILL, SOUTHERN LIGHTS STUDIO

A Glimpse of Early Roman Gamesmanship

The game was under way, with blue and white glass pieces laid out and first moves made, when the hinged board was placed in a grave. They still lay in place when excavators unearthed the burial in a first-century A.D. cemetery at Colchester, Essex, England, last year.

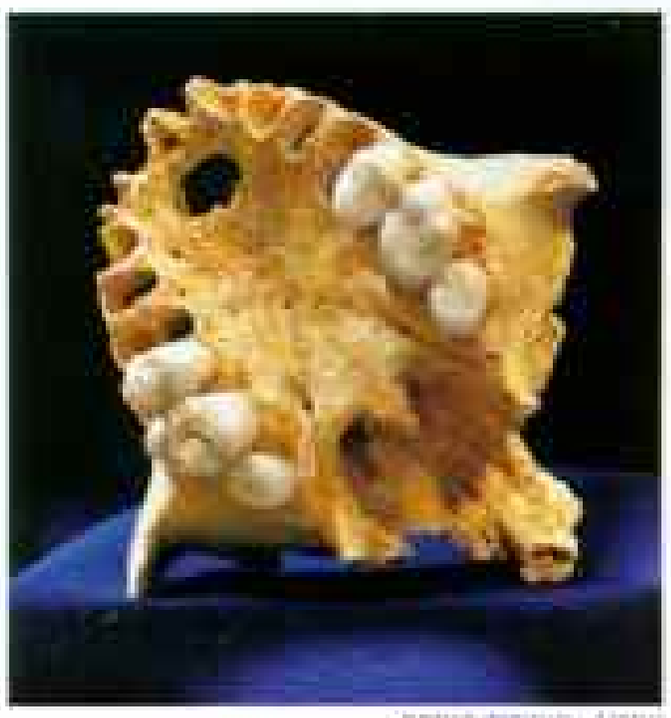
"This was a Roman game in a Briton's grave," says Philip Crummy, who led the archaeological team. Roman influence extended to Essex even before the Romans ruled there, he notes. The board had eroded, but metal hinges and supports survived, as did surgical tools hinting that the body was that of a physician. Game boards have been found before but never laid out for play.

COLCHESTER ARCHAEOLOGICAL TRUST

Long-lost Jaw of an Extinct Monkey

It's a grim discovery, but significant: the fossilized remains of a Jamaican monkey, the first and only primate known to have become extinct in the New World after European exploration began.

Ross MacPhee of the American Museum of Natural History and Donald McFarlane of Claremont McKenna College found this partial cranium along with limb bones of several monkeys deep in Jamaican caves last fall during a Society-funded expedition. Some of the bones lay atop the remains of rats, which were introduced to the New World by Europeans.



DENIS FINNIN, AMNH

The animal's teeth identify it as a New World monkey, the little-known *Xenothrix mcgregori*, and not a species of African origin. "It's possible we're finding the last of this species," says MacPhee. Scientists are uncertain as to why the monkeys became extinct.

Sea Turtles Swim "Home" to Texas

When two Kemp's ridley turtles came ashore at Padre Island National Seashore in Texas last May, they made news: They were the first to return out of 13,000 yearlings released there over the course of a decade in hopes of establishing a new nesting colony.

ELY HOGUE

Kemp's ridleys, the most endangered of all sea turtles (GEOGRAPHIC, February 1994), nest primarily near Rancho Nuevo, Mexico. Eggs collected there were incubated at Padre Island, and the hatchlings were reared for nine to eleven months, then tagged and released. The returnees were members of the 1983 and 1986 "classes," says Donna Shaver, the U.S. Geological Survey biologist who supervised the experiment at Padre Island. Both laid viable eggs; and 111 hatchlings like this one (above) swam off into the Texas surf.

WILLIAM COLLINS, MISSISSIPPI PRESS; ROBERT E. PEARY COLLECTION, NAS

With a Big Splash, a New Ship Honors an Arctic Explorer

A sideways launch, traditional at the Moss Point, Mississippi, shipyard where she was built, sends the U.S. Navy's newest oceanographic survey ship, the *Henson*, into service.

The vessel, fourth in a series of ships designed to gather data in both coastal and deep waters, is named for Matthew A. Henson, a pioneering black Arctic explorer. Henson accompanied Robert E. Peary on all the adventurous naval officer's voyages of discovery, including the 1909 thrust to the North Pole. Henson, a superb navigator, adept dogsled driver, and master of survival in the far north, was often overlooked by historians.

Ten years ago Harvard professor S. Allen Counter located Henson's Greenland descendants and brought them to the U.S. to meet other family members, including a grandniece, Audrey Mebane, who represented the family at the ship's launch. Through Dr. Counter's efforts, Henson's body was moved from a New York grave to Arlington National Cemetery (GEOGRAPHIC, September 1988). —BORIS WEINTRAUB

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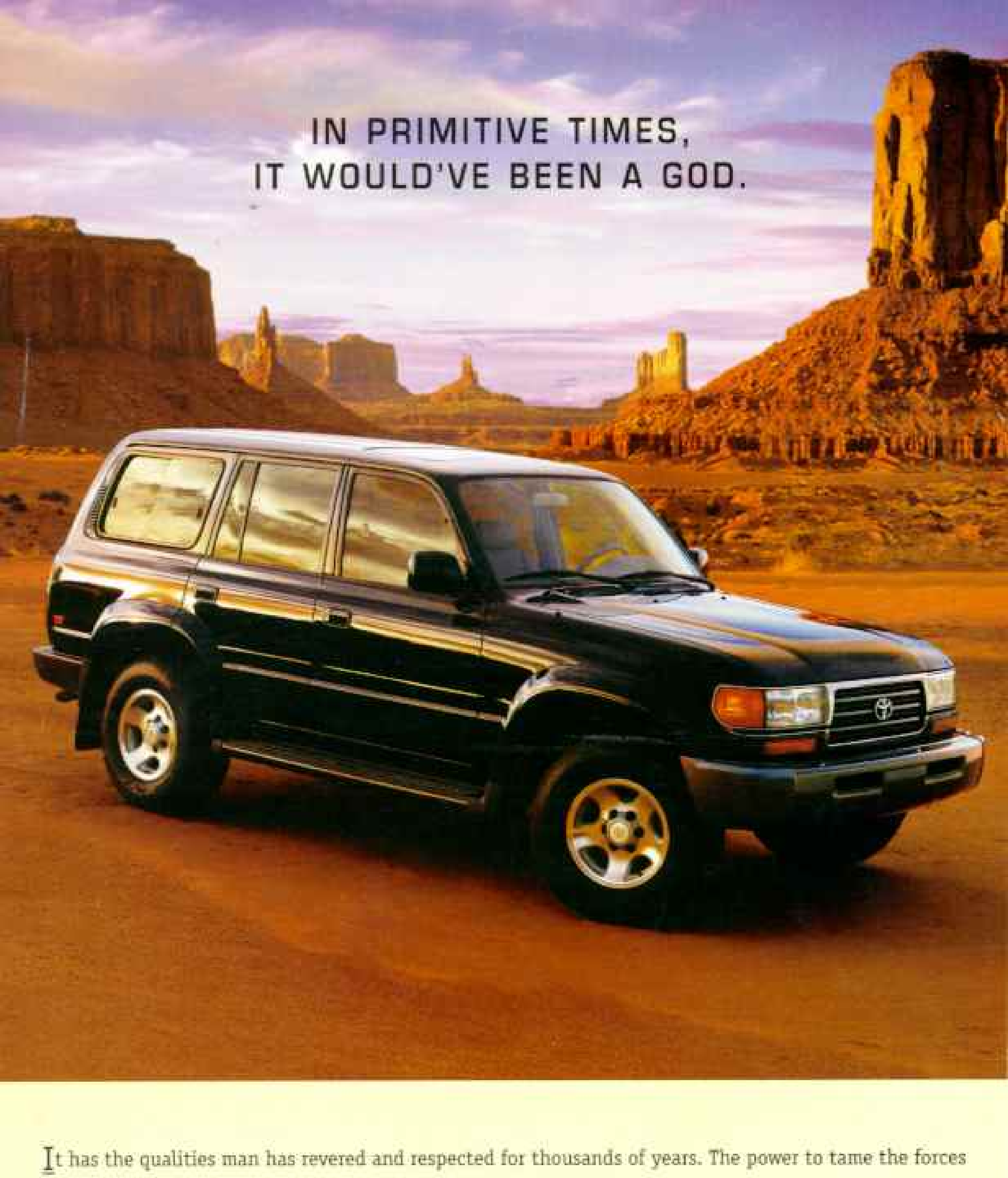

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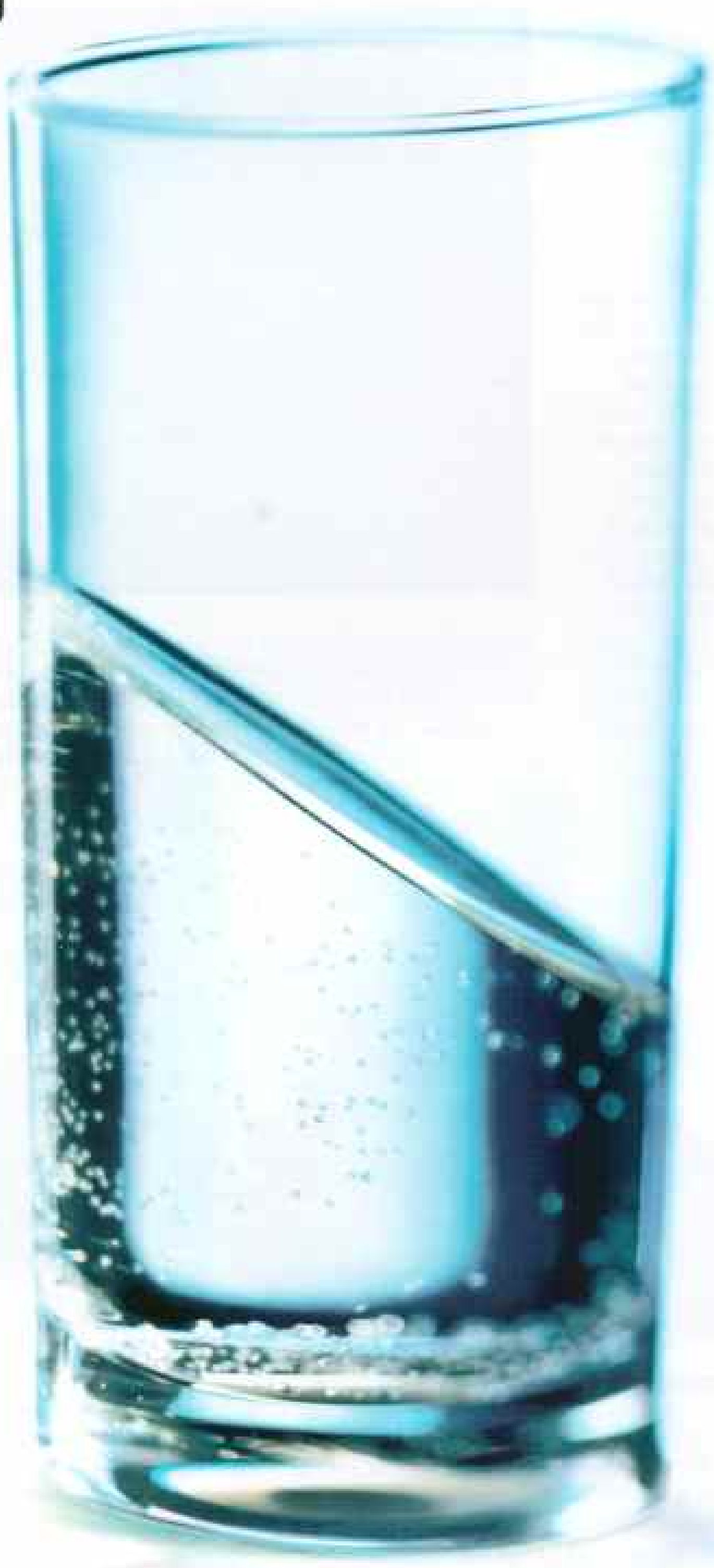

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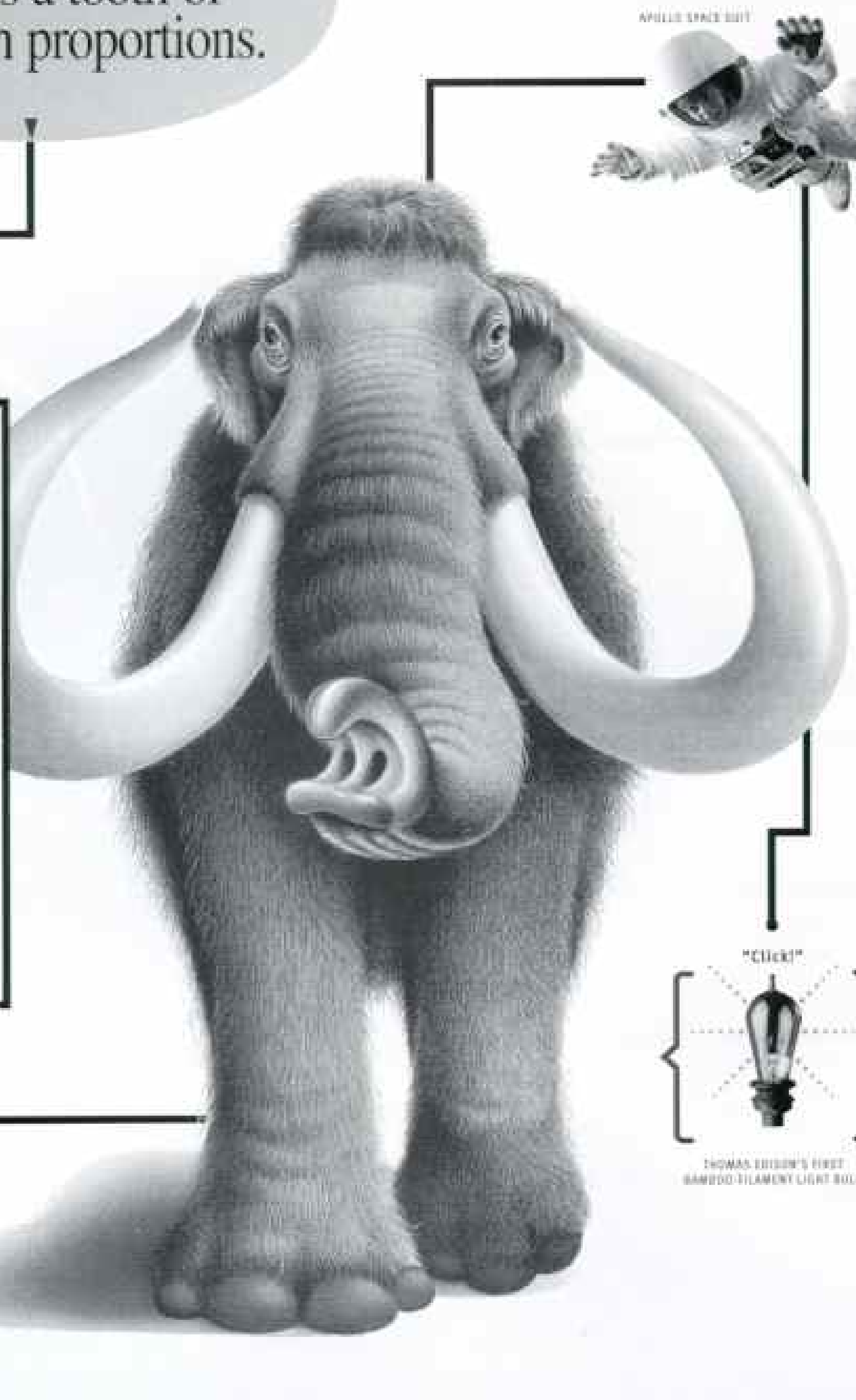

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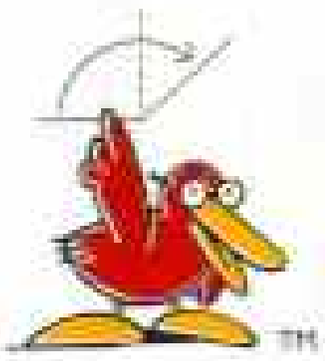
Catera is a personal luxury sedan fraught with Duck Logic. The result is the stuff of blue moons: a scrambling of preconceptions that turns out to be a whole new omelet. It's luxury that boogies. Refinement that giggles. The Caddy that zigs.

Ducks were designed in God's own wind tunnel. They eschew adornments that would make their dynamics any less aero. The resulting Duck Logic tells us that wind noise isn't the result of wind. It's a result of those that resist the wind; outside rearview mirrors, windshield wipers, hoods. So engineers tested and retested Catera at up to 125 mph over and over again.



Partially to optimize hood, wiper and mirror designs against wind noise. And partially, because it's fun to test things at 125 mph.

Duck Logic tells us that luxury is in more places than in the eye of the beholder, it's in the...other places too. So Catera's driver's seat is designed to be particularly comfortable because its "hip points" have been raised for the optimum driving position. And the available power memory seat adjusts for three different drivers. Partially because that helps each driver have optimal control. And partially, because it's fun.

No discussion of Duck Logic would be complete without music. It's a little-known fact that ducks fly in the midst of commercial radio waves, allowing them perfect, distortion-free sound, a boon to their migratory travels. (They plan flight lanes carefully, to circumvent the broadcast signals of shock jocks and talk radio.) Duck Logic knows the virtue of clear sound on long trips. It led to the design of an optional sound system with computer programs to create a three-dimensional picture of how sound would behave in a Catera. Partially because great sound would be fun. And partially, because it would be a lot of fun. (Duck Logic is no prisoner to logic.)

Duck Logic sneers at the mundane, scoffs at the expected, waddles and flies in the face of convention and then, way over its head. Duck Logic begets Catera: luxury that's fun, the Caddy that zigs. The ducks would be proud.

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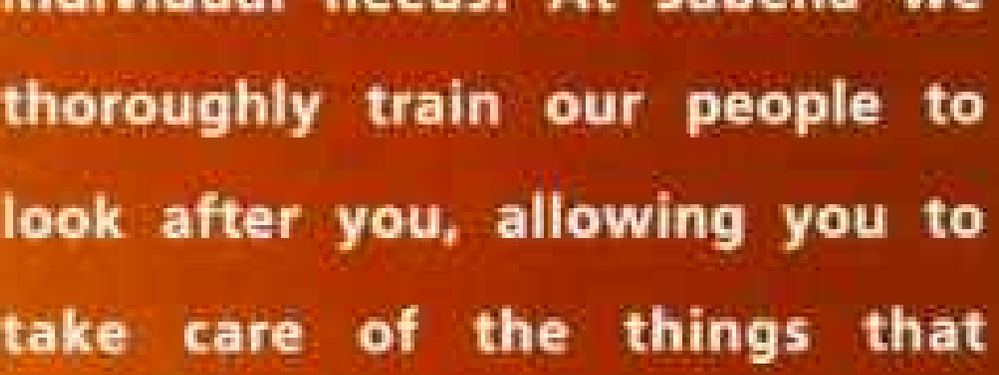

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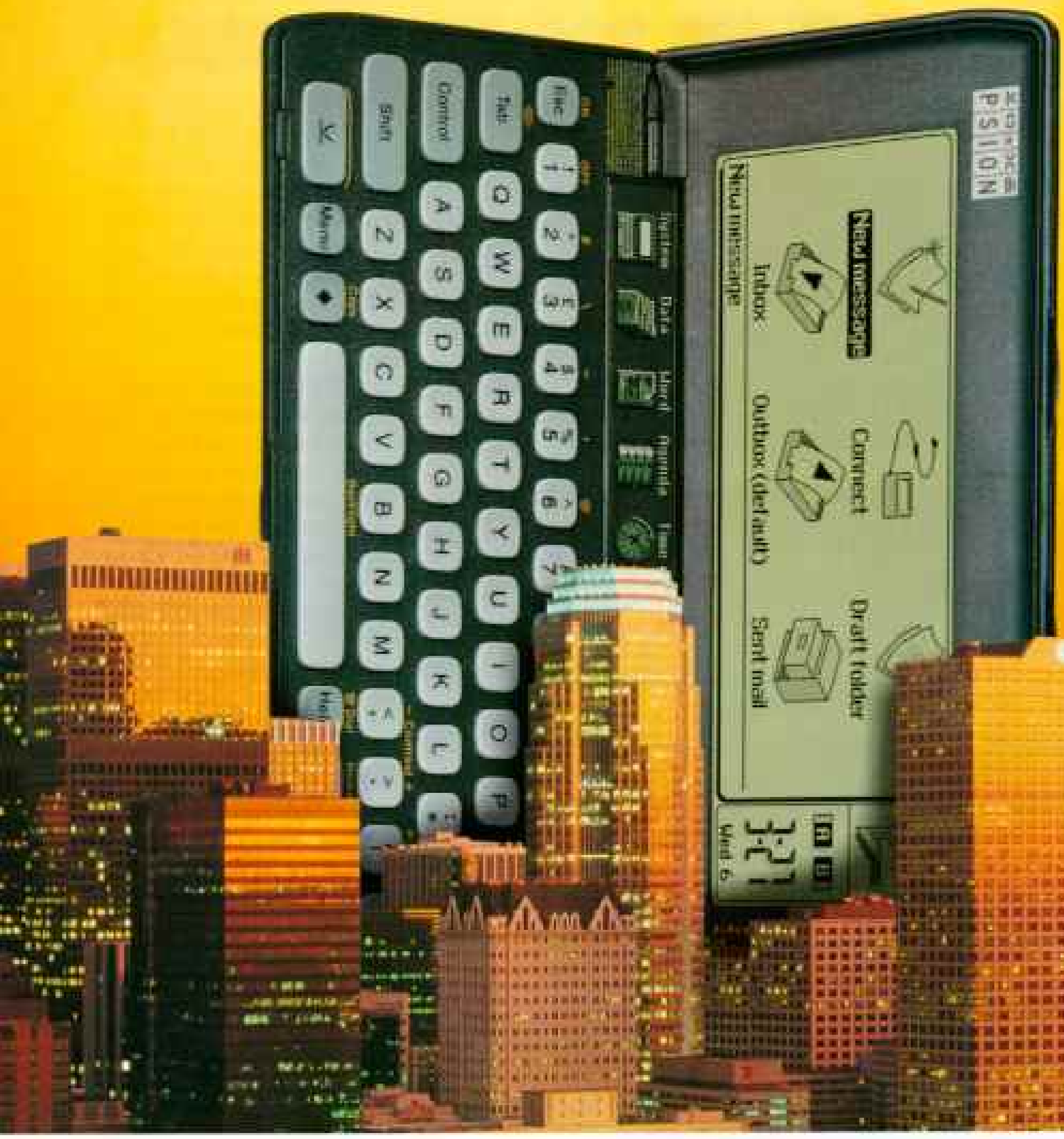

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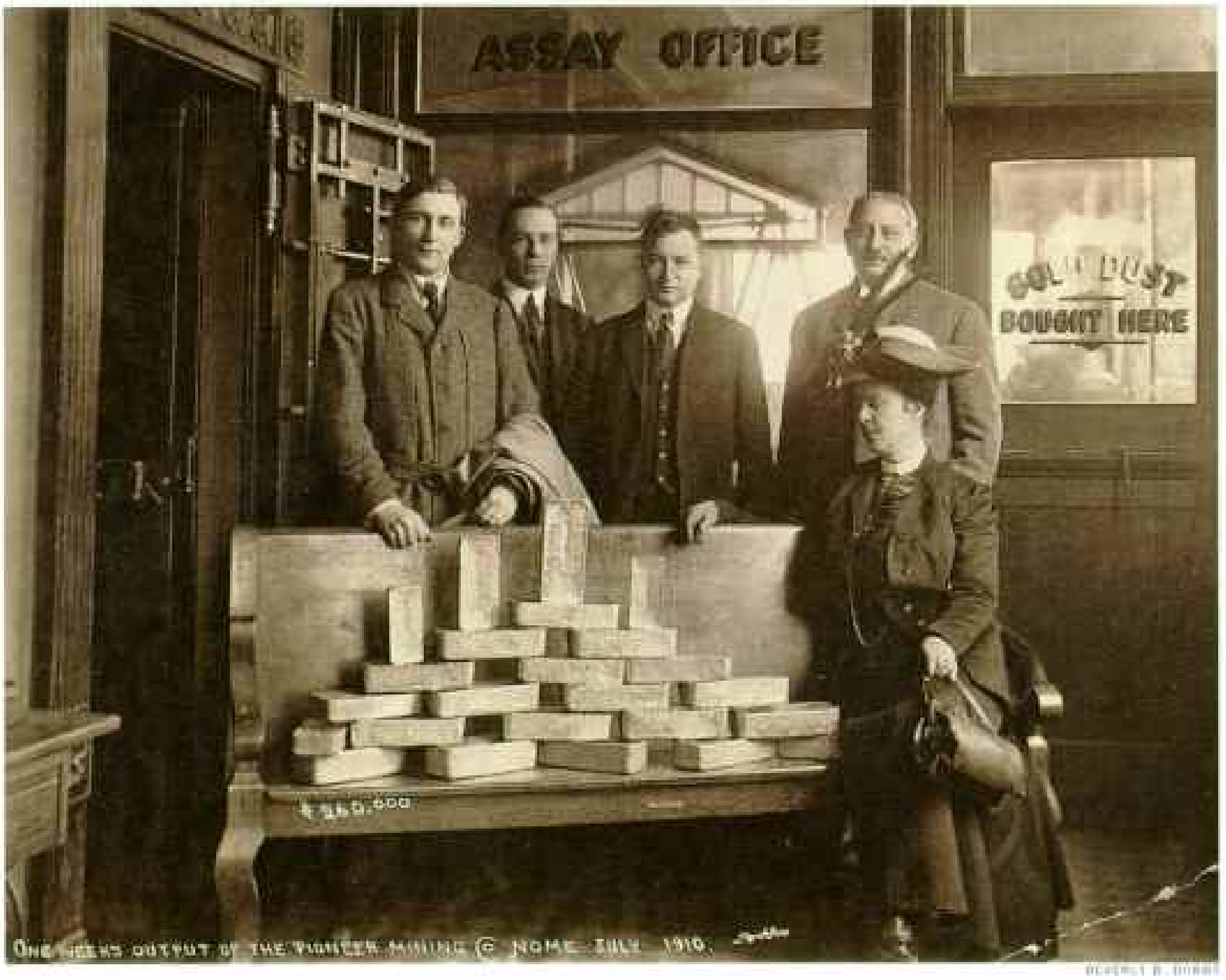

■ FROM THE GEOGRAPHIC ARCHIVES

Alaska's Golden Opportunity

The streets weren't paved with gold in Nome, Alaska, at the turn of the century, but the nearby seashore was peppered with it. Fortune seekers sifted two million dollars' worth from the town's beach. Success there, and in nearby mines, was weighed at the town's Assay Office. This benchload of bars, a one-week output of the Pioneer Mining Company, was worth $260,000—four million dollars today.

Alaska oil would bring greater riches yet. Secretary of the Interior Franklin K. Lane foresaw this in "The Nation's Undeveloped Resources," his report to President Woodrow Wilson, reprinted with this photograph in the February 1914 GEOGRAPHIC. Lane urged better management of the "unused and neglected" Alaska territory. "How rich its lands are in gold and copper, coal and oil, iron and zinc, no one knows. . . . no other section of our land today makes so rich a mineral promise."

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NATIONAL GEOGRAPHIC

On Television

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■ EXPLORER, APRIL 13, 7 P.M. ET

Primates Down Home in a Texas Melon Patch

Dilley, Texas, 65 miles from the Mexican border, is a little town with two big claims to fame: it calls itself the watermelon capital of the world, and on nearby scrubland of mesquite and prickly pear cactus lives a thriving band of unusual immigrants. With faces and bottoms the color of the inside of a ripe Dilley watermelon (above), snow monkeys from Japan have settled in this land of cattle and cowboys.

Crowded out of their native home on Mount Arashi near Kyoto, the snow monkeys, or macaques, came to the U.S. in 1972 when a Texas rancher offered them a home. EXPLORER's "Snow Monkey Roundup" tells their story.

Like any newcomers, the monkeys faced difficulties adjusting to their new home. Early on, for example, they had to invent an urgent vocalization for "Rattlesnake!"

Because of their success—they've increased from 150 to 500—the monkeys have had to move once again. The Texas Snow Monkey Sanctuary, directed by primatologist Lou Griffin, recently acquired larger quarters for the monkeys, which are now mostly born-and-bred Texans.

■ PROGRAM GUIDE

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NATIONAL GEOGRAPHIC

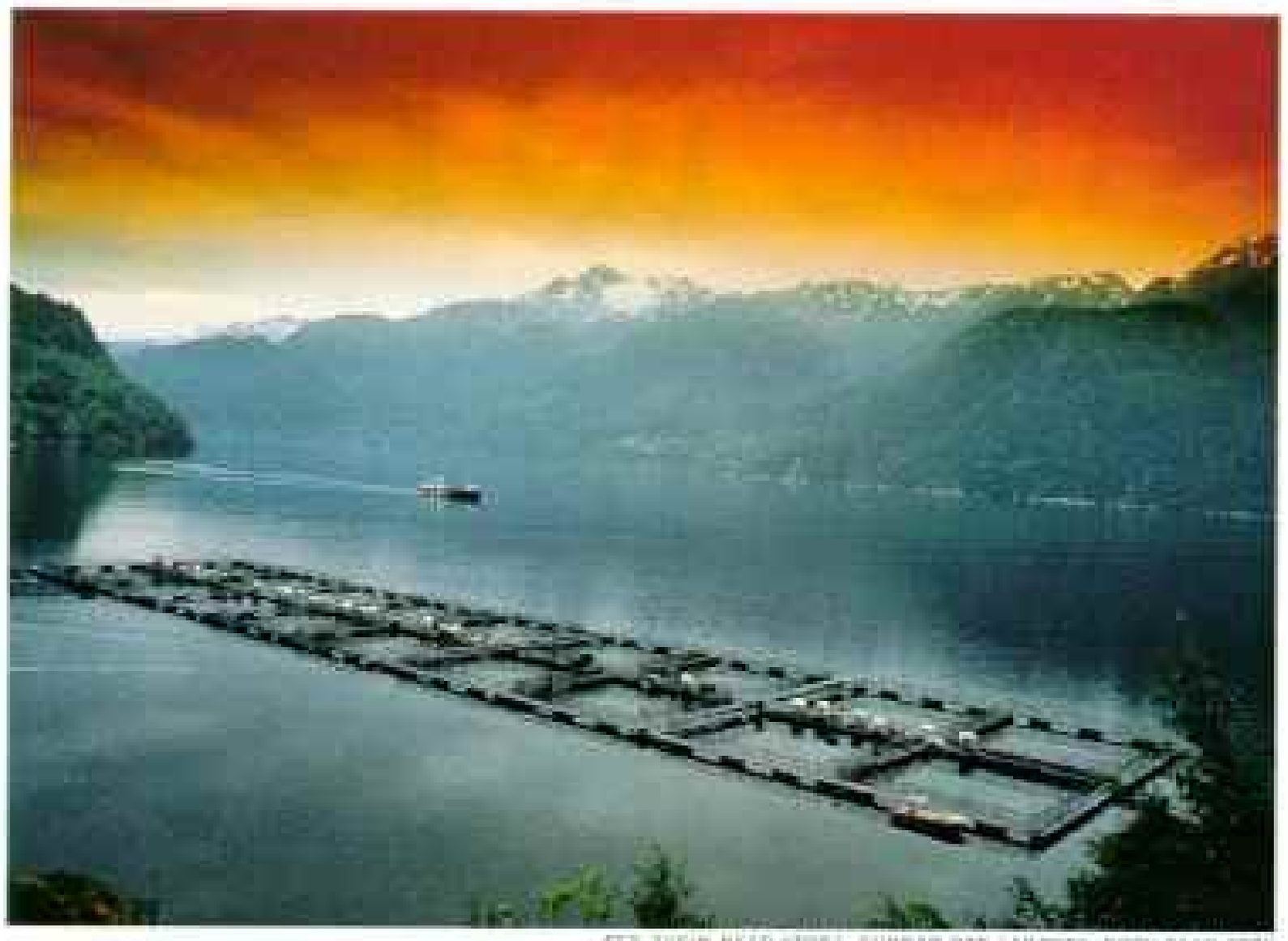
EarthAlmanac

Norway's Salmon Farms Leaking Like Sieves; Escapes Threaten Wild Fish

Salmon farming aids wild salmon by reducing fishing pressure on wild stocks. But in Norway that benefit is drowning under an onslaught of farmed salmon that are escaping sea pens, such as these in Åkra Fjord (below), and interbreeding with their wild cousins. When the latter return from the Atlantic to spawn in their native rivers, in some runs they are outnumbered four to one by the escapees, says Lars Petter Hansen of the Norwegian Institute for Nature Research.

Interbreeding may diminish the instincts of the wild fish, resulting in offspring less adapted to their ancestral rivers. Most farmed fish are freed when storms or hungry seals damage their pens or when pens are poorly maintained. The problem is huge. In 1995, an average year, between 200,000 and 650,000 farmed salmon escaped, but in 1990 storms loosed about four million. Depending on the season, farmed salmon will head for sea or invade the nearest stream after they escape.

While salmon farm inspections have been increased, some remedies come the hard way—by hand. Fisheries workers pull farmed escapees out of the Eids River (top) before the fish spawn.



PER JUSTIN REED (TOP); GUNNAR RYE (ABOVE); BOTH SEAN FOR

What's Deforming Our Frogs?

Minnesota schoolchildren on a field trip got a worrisome lesson in 1995 when half the frogs they caught were deformed. Frogs with extra legs or missing legs or eyes "have now been found everywhere frogs are common in our state," says Robert McKinnell of the University of Minnesota. Nearby states report the same phenomenon, but no one knows the cause. Researchers will make an intense systematic study of deformed juveniles this spring.

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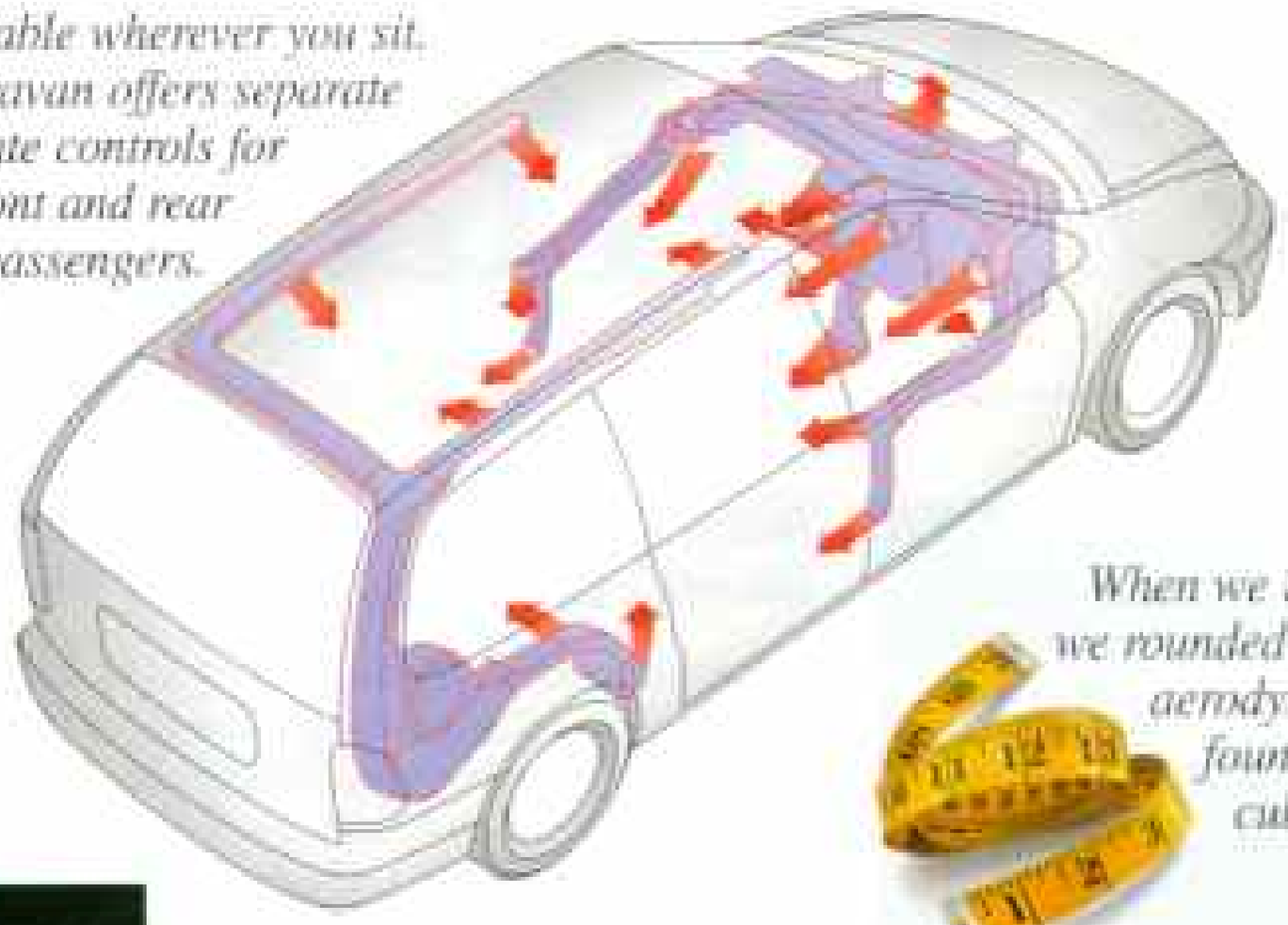

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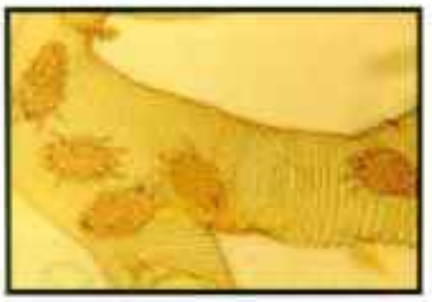
Bee-ware: Pollinators Are in Peril



More than a hundred U.S. crops depend on pollinators such as moths, butterflies, and especially bees. But these crucial helpers are suffering from loss of habitat. And among bee species, honeybees have been hit hard by pesticides, competition from Africanized bees, and two deadly species of mites. Tracheal mites lay their eggs in bees' breathing tubes (above), sucking their blood and eventually killing them. Varroa mites—the small reddish ovals on the bees below—also suck blood from bees, destroying entire colonies.

Mites have helped wipe out 90 percent of wild honeybees in the U.S. and seriously threaten commercial colonies, even as scientists work to develop ways to control them. Annual crop losses could reach 5.7 billion dollars, report Stephen L. Buchmann and Gary Paul Nabhan in their recent book, *The Forgotten Pollinators*.

USDA, AGRICULTURAL RESEARCH SERVICE (ABOVE AND TOP)

Image not available

Giving a Hoot for Plump Prey

Most predators pick off the old, the young, and the weak members of a population. But a little hunter in Scandinavia called Tengmalm's owl doesn't follow that familiar formula. These owls—called boreal owls in North America—kill voles and shrews that are a bit smaller than others of their kind but also fatter, says Vesa Koivunen of Finland's University of Turku. This may be because larger rodents take the best nesting sites and lose energy, and fat, defending them. Smaller ones wind up in meadows with plenty of food but no shelter from the owls' talons.

On the Trail of an Ice Age Fox

Ghostly gray denizens of Montana's Beartooth Plateau, elusive mountain foxes may prove to be a relic from the Ice Age: a distinct population within the subspecies *Vulpes vulpes macroura*. Amid brutal winters at 7,500 to 11,000 feet, the foxes may have been hunting snowshoe hares since the glaciers' final retreat some 12,000 years ago. "Compared with lowland foxes, their bodies are stockier and lose less heat," says Montana biologist Robert Crabtree, who livetraps Beartooth foxes to get samples for DNA analysis by Purdue University's Brad Swanson. —JOHN L. ELIOT

DAN HARTMAN

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NATIONAL GEOGRAPHIC

On Assignment

BOB REIT, #64

■ YELLOWSTONE RIVER

A Photographer Freezes the Moment

To find the wildest wildlife in Yellowstone, "we traveled 500 miles in four days by snowmobile," recalls photographer Annie Griffiths Belt, focusing on a herd of bison (above). "With the temperature at minus 20°F," Annie says, "the real challenge was keeping the cameras warm; I had to put them all inside my coat. I always look nine months pregnant when I work in cold weather."

Actually Annie did work when she was nine months pregnant. Two weeks before delivering daughter Lily, Annie made a portrait of a company basketball team and climbed a tall ladder to get all the players in the shot. But the players wouldn't keep still in her viewfinder.

"Those poor guys kept shifting around so they could catch me if I fell," Annie says. "I told them I'd spent my whole life up on ladders, but I don't think they were reassured."

MEDFORD TAYLOR

■ AUSTRALIAN DOG FENCE

A Writer Warms Up to Slowing Down

"I learned to take it easy in Australia," says writer Tom O'Neill. "It's too hot not to." Tom traveled the interior in autumn, tracing the 3,307-mile-long dog fence—the longest fence in the world—erected to keep dingoes out of sheep country. He stopped near Coober Pedy with patrolman Jeff Boland, at right, whose dog Missy never quite got the hang of relaxing. Soon after this photo was shot, Missy took off after an emu, scaring the big bird right into the dog fence. The emu looked fine, Tom says, "but that fence twanged like a guitar string."

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