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NATIONAL GEOGRAPHIC

ELEPHANTS

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SEE "THE SOUL OF SPAIN" WEDNESDAY, MAY 15, ON PBS TV

NATIONAL GEOGRAPHIC

MAY 1991

COVER: An African dawn bathes a bull elephant and a herd of antelope at a water hole in Botswana's Chobe National Park. Photograph by Frans Lanting.

Out of time,
out of space
ELEPHA

By DOUGLAS H. CHADWICK

NTS

With a plunge into the currents of Macpherson's Strait in the Andaman Islands off India, an elephant swims a short distance to a logging camp. Unlike African herds (overleaf), Asian elephants were widely tamed more than 4,000 years ago. Yet those still wild share the plight of their African kin—overwhelming loss of habitat. Unless that can be halted, the largest of land animals have no future as free beings.

Confiscated and closely guarded, these 2,500 tusks would have brought three million dollars on the international ivory

LOUISE GUNN, IN PICTURES

market in 1989, but Kenya's President Daniel arap Moi burned them instead. His smoke signal to the world: Stop buying ivory.

Heavy traffic in Kenya's Amboseli National Park finds a tusker in the driver's seat—for a change. With camera-toting

DIANNE BLELL

tourists spending some 50 million dollars each year to see its elephants, Kenya now realizes the profits of herd preservation.

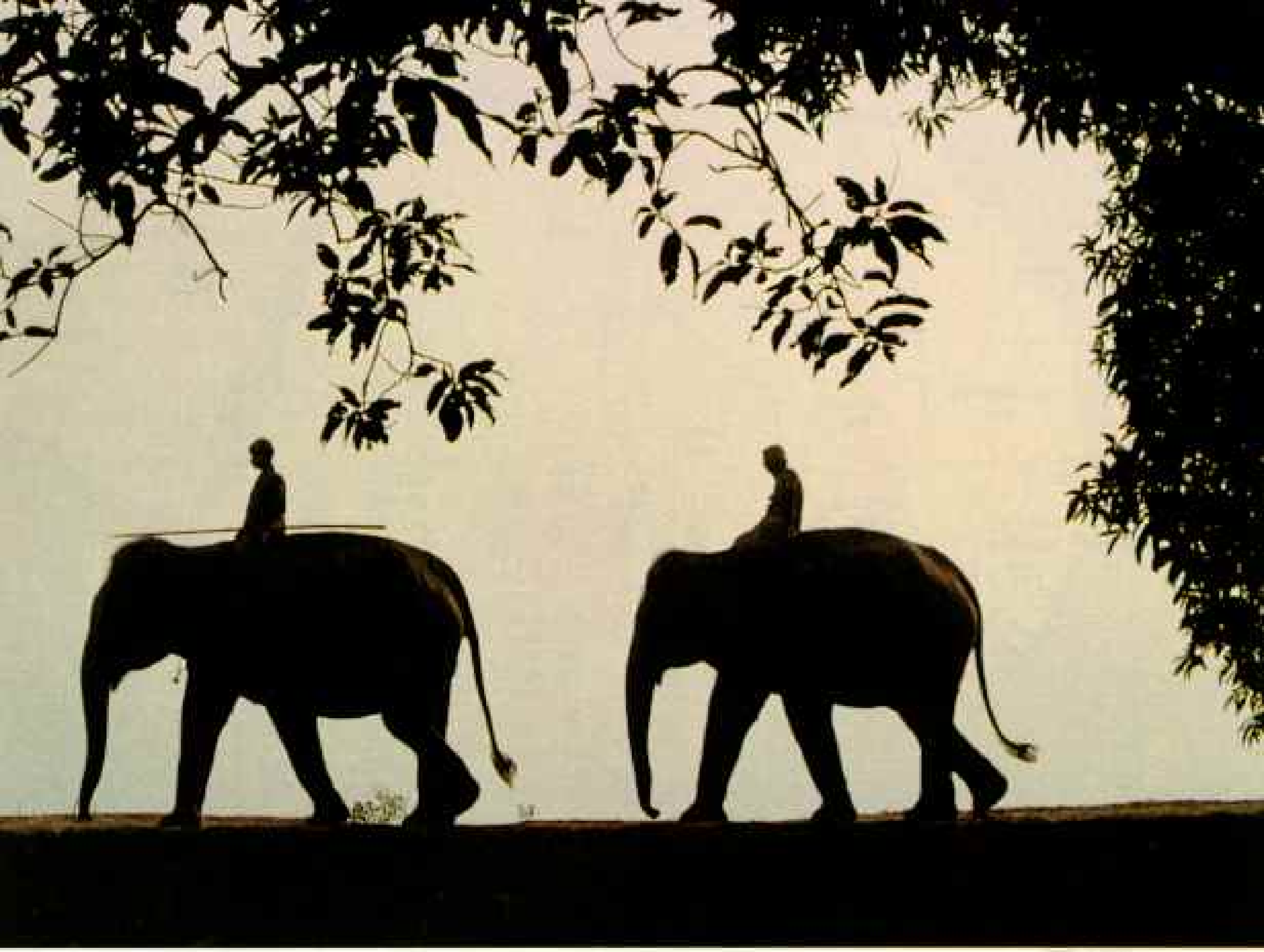
Mango trees frame the morning at Sonpur in India's Bihar state, as mahouts guide their elephants to a nearby river for a bath. Later in the day owners and

THEY LOOMED over the plains on pillar legs, trailing a haze of insects and dust. Swallows wove around them. Egrets perched on their backs. The giants' heads alone were the size of the zebras and wildebeests making way before them. I approached these wild elephants in Kenya's Amboseli National Park with three researchers. Norah Njiraini, a member of the Kikuyu tribe, pointed to a 60-year-old female resting her trunk across one of her long tusks and said, "That's Jezebel, the group's matriarch." "Next to her is the ten-year-old male we call Joshua," added Soila Sayialel, a Masai. The leader of the team, Joyce Poole, just said, "Watch this," and threw a dried chip of buffalo dung partway to Joshua. He walked toward our car, picked up the chip, and chucked it straight back to Joyce.

Joyce laughed and turned away to talk. In short order she was bonked on the head with a tossed wildebeest bone; ten-year-old male elephants don't drop a game that easily. So Joyce took off one of her rubber sandals and threw it to Joshua. Instead of hurling it back, though, he flipped it away over his shoulder, then kinked his tail and shook his head with a hint of challenge. As that failed to draw a reaction from Joyce, he walked back, picked up the shoe, chewed on it a bit, then finally threw it toward her. And there we stayed on the shimmering plains below the snows of Kilimanjaro, two species playing catch.

I once followed a much larger bull, as males are called, into a clump of bushes, trying to get a closer view of a wicked-looking scar on his side. Just as he was stretching to take a bite, the big creature froze. All at once he was coming back my way, fully alert.

DOUGLAS H. CHADWICK, a writer trained as a wildlife biologist, wrote about sagebrush country for the January 1989 GEOGRAPHIC. He is a frequent contributor to the magazine.



PETER JACKSON

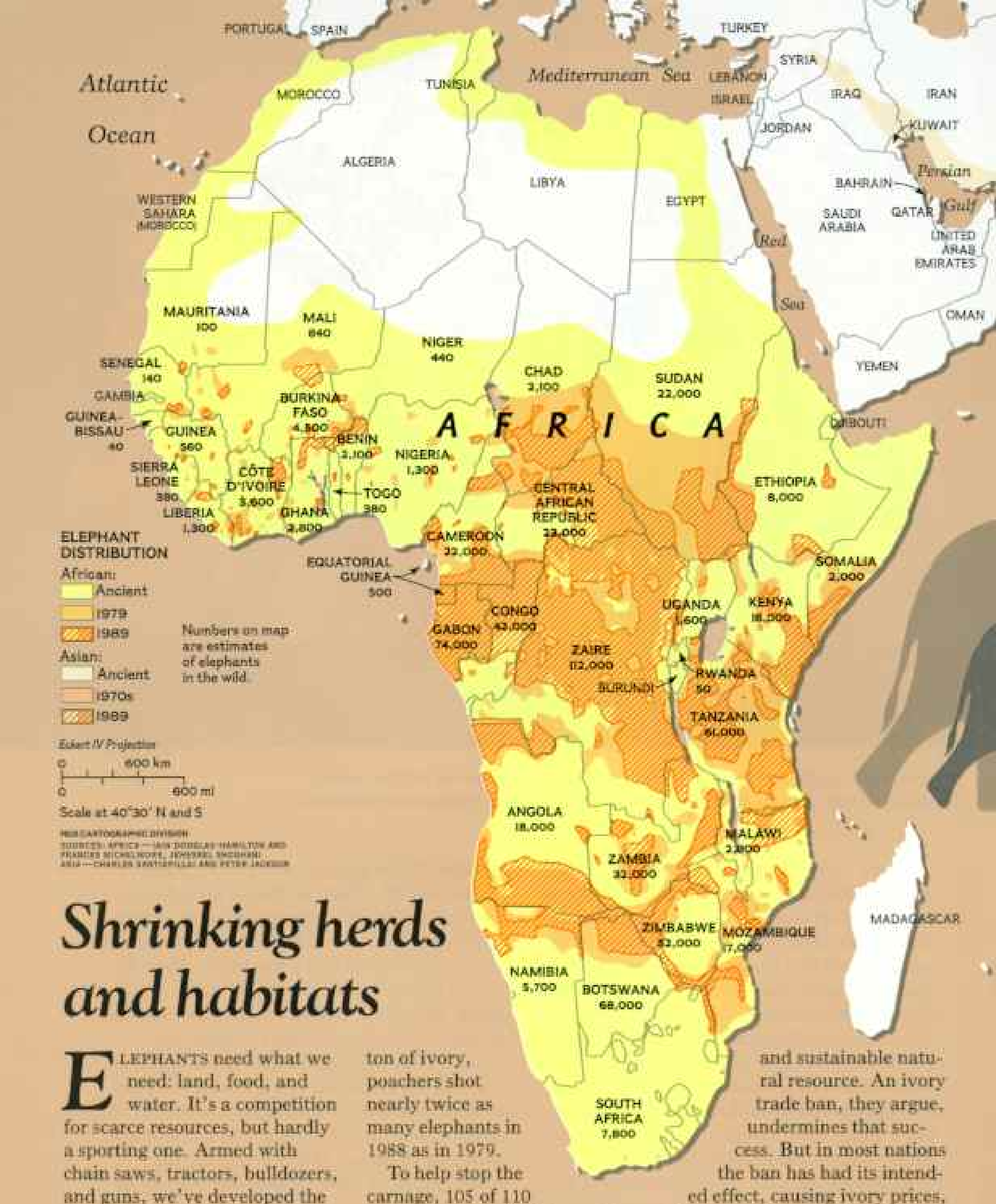
brokers will haggle at a local fair where the majestic animals will be rented, traded, and sold for use in logging camps, festivals, and religious ceremonies.

How? . . . The wind was still in my favor, and I'd been dead quiet. Then I understood: He hadn't sensed me—not yet—but another bull nearby was sending out an alarm in frequencies too low for the human ear to detect. Since biologists Katharine Payne and William Langbauer's recent discovery that elephants communicate through infrasound,* Joyce Poole has cataloged 15 different types of rumble sounds that are partly "silent" and that can transmit information over many miles. No wonder earlier elephant-watchers sometimes thought the animals had ESP.

In Kerala state, at the southern tip of India, Venkatadri Ganapathy dresses elephants in gold for religious festivals and marriage processions. He told me about an elephant handler, or mahout, who worked most of his life hauling timber with a very stout bull. Come payday, this mahout, who was also quite stout, would ride his elephant to the tavern in a nearby village and buy the beast a bottle of rice liquor—and several more to drink himself. When he finally keeled over, the bull would pick him up like a log, wrapping his trunk around the mahout's body and resting him on his two great tusks. Then he would bear his drunken friend home. Once there, he laid the mahout on the doorstep and waited until someone came to drag him inside. They might have grown old together, for, like us, elephants reach sexual maturity around age 13 or 14 and enjoy a potential life span of more than 60 years. But the bull died suddenly of rabies. One week later, the mahout died of causes unknown. Maybe he went to look for his elephant.

Exactly what kind of creatures are these, besides the biggest and strongest of all on land? Their closest kin are furry, tusked rock

*In the August 1989 NATIONAL GEOGRAPHIC Katharine Payne, supported by an NGS research grant, reported that elephants use infrasound to communicate across distances of several miles.



Shrinking herds and habitats

ELEPHANTS need what we need: land, food, and water. It's a competition for scarce resources, but hardly a sporting one. Armed with chain saws, tractors, bulldozers, and guns, we've developed the land, forcing earth's largest terrestrial mammal onto smaller tracts of savanna and forest, right to the brink of extinction.

It's been bloody at the brink. After shooting many of Africa's largest tuskers, poachers have turned their guns on younger elephants with smaller tusks, speeding the slaughter. For each ton of ivory, poachers shot nearly twice as many elephants in 1988 as in 1979.

To help stop the carnage, 105 of 110 nations party to the Convention on International Trade in Endangered Species have agreed to ban the raw ivory trade. Malawi and Zambia refuse to honor the ban, as do three nations with healthy herds—South Africa, Zimbabwe, and Botswana. Tough conservation programs there have protected a valuable and sustainable natural resource. An ivory trade ban, they argue, undermines that success. But in most nations the ban has had its intended effect, causing ivory prices, hence poaching, to plummet.

Ultimately, though, people, not poachers, and growth, not guns, pose the most serious long-term threat to the elephant's survival. With Africa's human population projected to double in 24 years and Asia's in perhaps 50, elephants cling to a habitat under siege.

ASIA

AFGHANISTAN

PAKISTAN

NEPAL
50–90

BHUTAN
60–100

CHINA
150–300

SOUTH KOREA

JAPAN

BANGLADESH
200–350

INDIA
17,300–
22,100

MYANMAR
3,000–
10,000

LAOS
2,000–
3,000

MACAU (PORTUGAL)

HONG KONG (U.K.)

Taiwan

Pacific Ocean

Arabian Sea

THAILAND
1,300–
3,000

VIETNAM
1,300–
2,300

PHILIPPINES

Andaman Islands

CAMBODIA
2,000

SRI LANKA
2,700–3,200

BRUNEI

MALAYSIA
1,300–3,000

Singapore

Sumatra

Borneo

INDONESIA
2,900–5,500

AFRICAN ELEPHANT

The forest elephant, Loxodonta africana cyclotis, lives in central and western Africa; the bush elephant, Loxodonta africana africana, is larger and has thicker tusks than its cousin.

Population Estimate
1979
1,300,000

1989
600,000

ASIAN ELEPHANT

Sacred to both Hindus and Buddhists, Elephas maximus remains endangered by loss of habitat. Poaching poses a secondary threat because only males have tusks.

Population Estimate
1979
no data available

1989
34,500–53,700

and tree climbers you could carry in your coat pocket—hyraxes—and the submarine grazers that spawned legends of mermaids—manatees and dugongs. Early in the age of mammals some common ancestor gave rise to the trunked beasts, the Proboscidea, which grew to include 150 more or less elephant-like species spread across every continent except Antarctica and Australia. Woolly mammoths, a mainstay of human hunting bands through the later glacial epochs, may have led the first Paleo-Indians across the Bering land bridge to colonize North America. Many thousands of years later, American Indians would claim that their great-great-grandfathers had stalked creatures as tall as trees.

Now let me list the proboscideans of today. The Asian elephant, *Elephas maximus*, once spanned Asia from Syria to northern China. Now it inhabits only India, Sri Lanka, and Southeast Asia. It has an arched back, an enormous domed head with relatively small ears, and a single protuberance, or "finger," at the tip of its trunk. Only the males carry tusks, the specialized upper incisors whose lustrous white dentin, or ivory, has spurred trade since the earliest empires arose.

The African elephant, *Loxodonta africana*, once ranged throughout most of Africa, even to the shores of the Mediterranean. Today it is found only south of the Sahara. It has a swayed back, a tapering head with large ears, and two trunk "fingers." Both sexes carry the ivory that changed millions of human lives as the practice of using forced labor to transport countless tusks to the coast spurred the slave trade. Larger than the Asian giants, bulls can reach seven to eight tons and females about three. The greatest among them stand 13 feet tall at the shoulder, bearing tusks that can each weigh as much as a man and measure twice as long. But now such titans are rare.

Becoming independent of female groups as they mature, males periodically enter an aggressive, rut-like condition called musth. Long known in Asian elephants, it was not documented in African bulls until just a few years ago. Yet it explains generations of tales about enraged rogue elephants.

BOTH BY WILLIAM THOMPSON

Training and teamwork enable Sarasu the elephant to work without a harness at a logging depot in India's Kerala state. Responding to a wide range of verbal commands—and periodic prodding by the mahout—Sarasu hauls timber, serving as an agent in the destruction of her species' natural habitat. Although "pachyderm" means thick-skinned, elephant skin is sensitive. Daily baths remove ticks and lice and strengthen the bond between man and beast.

That's it. Of all the truly colossal beasts that once walked the planet, only these two remain. And they are disappearing even as we are just beginning to learn about their lives. I spent two years traveling the globe to understand why.

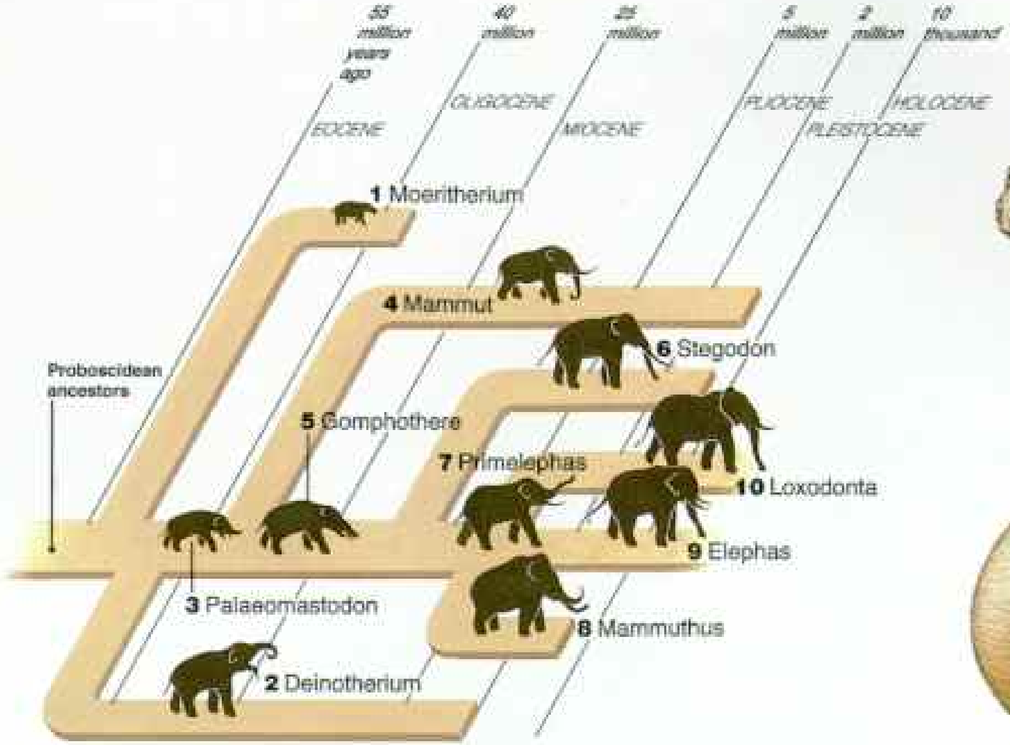
AT THE TURN OF THE CENTURY Asian elephants numbered perhaps 200,000. Today there may be no more than 35,000 to 54,000 left in the wild. Many, if not most, are in isolated pockets of habitat too small to sustain them over the long run.

In 1930, the year the matriarch Jezebel was born in Amboseli, Africa held five million elephants, maybe ten. No one really knows, and we are only now coming up with sound numbers. By the time of the first real census, in 1979, there were 1.3 million elephants. By 1989 Jezebel was one of the last 600,000 or so on the continent. Late in 1989 African elephants joined Asian elephants on the endangered species list.

The fundamental problem is that elephants need a lot of room to live, and humans have become their direct competitors for it. The tropical and subtropical realms where the giants dwell are precisely where the human population has been exploding the fastest, quadrupling in number since the turn of the century, claiming more and more elephant range for cropland, pastureland, and timber.

As economic and political instability became more the rule than the exception in many developing countries, illegal killing of elephants grew. They had always been killed for meat or to *(Continued on page 24)*

They charge in silence. But for the clank of ivory resonating across the Kenyan savanna, no other sound is heard. In the frenzy of musth, a period of heightened aggressiveness in males, both bulls struggle for the right to mate with a female in estrus. This contest was over in a minute when the younger bull, at left, retreated. JOEL SARTORE



PAINTING BY KAREL HAVLICEK; DIAGRAM BY MARK SEIDLER; CONSULTANT: JEHESKEL SHOHAMI

Evolution of elephants

The lineage of elephants traces back some 55 million years. Ancestors gave rise to various branches as well as to the direct line leading to living elephants. Early proboscideans originated in Africa and southwest Asia and migrated via land bridges to every continent except Antarctica and Australia.

Remains of *Moeritherium* (1), dated from 50 million years BP, were found in North Africa. This hog-size creature had two small tusks in each jaw.

Deinotherium (2) apparently originated in Africa during the late Eocene. Lacking upper tusks, its lower jawbone curved backward to reveal tusk-like front teeth used for digging.

Four tusks appeared again in *Palaeomastodon* (3) from North Africa at the end of the Eocene. It began the main line to today's elephants.

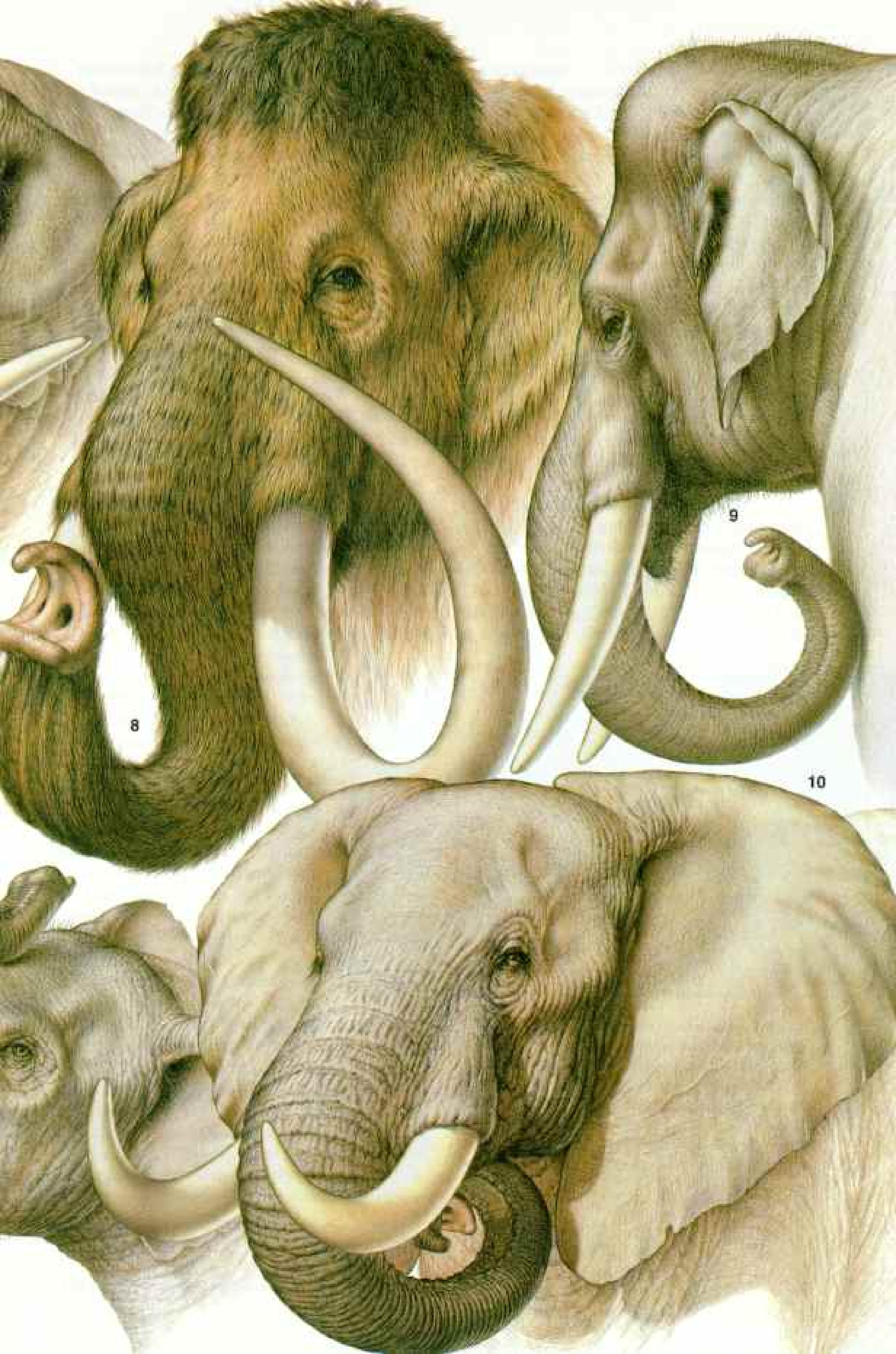
By the time *Mammut* (4) developed in Africa during the early Oligocene, proboscideans had prominent tusks and trunks that allowed them to eat leaves from treetops.

Gomphotherium (5) roamed Eurasia and Africa during the late Oligocene.

Stegodon (6), once deemed the progenitor of modern elephants, lived near African and Asian lakes and rivers during the mid-Miocene.

The last four-tusker, *Primelephas* (7) was the immediate ancestor of the extinct *Mammuthus* (8), which lived in Africa, Eurasia, and North America during the Pliocene and Pleistocene, and today's *Elephas* (Asian elephant) (9) and *Loxodonta* (African elephant) (10).

Changes in climate and food supply—and perhaps overhunting in the Pleistocene—caused widespread extinctions, leaving modern elephants as the only survivors.


8
9
10

(Continued from page 17) eliminate problem animals. But, increasingly, it was for hard cash from ivory. Tusks became a sort of underground currency, like drugs, spreading webs of corruption from remote villages to urban centers throughout the world.

The seventies saw the price of ivory skyrocket. Suddenly, to a herder or subsistence farmer, this was no longer an animal but a walking fortune, worth more than a dozen years of honest toil. To currency-strapped governments and revolutionaries alike, it was a way to pay for more firearms and supplies. In the eighties Africa had nearly ten times the weapons present a decade earlier, which encouraged more poaching than ever. Ivory was running above a hundred dollars a pound, and officials from poorly paid park rangers to high-ranking wildlife ministers had joined the poaching network.

Over the past two decades Tanzania's elephants have dropped from nearly 250,000 to 61,000, Uganda's from around 20,000 to barely 1,600. Kenya was home to 140,000 elephants in 1970. When I visited in 1989, it held maybe 16,000. The largest single population, numbering 5,000, was in Tsavo National Park. I went there in a light plane piloted by Iain Douglas-Hamilton, seated beside his wife, Oria. Working in Tanzania's Lake Manyara National Park, Iain and Oria carried out the first in-depth studies of wild elephant society. They concluded that, in many ways, elephant society is a culture held together by enduring bonds of affection and guided by the memories, experience, and knowledge of its elders, the matriarchs. Early on the Douglas-Hamiltons warned that Africa's elephants are vanishing.*

Some of their colleagues called them alarmists. The census data is incomplete, said the critics. Relax; ivory poaching can be controlled. "What did the elephants do while we argued? They died and died and bloody well died," Iain told me while we flew over freshly killed elephant carcasses in the parklands below. "As the big tuskers disappeared, poachers turned to the females. Bang! there went the reproducing part of the population—and its learned traditions involving migratory routes, dry-season water sources, and so on. The whole society began to collapse. Now you see leaderless bands of subadults and orphans. The gathering of these last groups into big terrified herds of refugees. Always on the move. Poachers close behind."

Fifteen minutes after we landed in Tsavo, a ranger ran up with the news that two safari vans at the edge of the park had been shot up and robbed. A week later I helped a blood-stained German visitor hobble to a waiting rescue plane; he had been shot a mile from where I was watching giraffes. Poaching gangs—including tough, bush-wise bandits called *shifta* from neighboring Somalia, armed with AK-47 assault rifles—were increasingly turning their guns on tourists. Such incidents have all but shut down Meru National Park in the north. In Mount Elgon National Park at the Uganda border I was required to take armed rangers with me to the backcountry. Instead of elephants, we ran into a wildfire set by poachers as a distraction and listened to rifles boom on the slopes while we fought the blaze.

*The Douglas-Hamiltons' African elephant census survey was reported in the November 1980 issue.

No Loch Ness monster, the snorkel trunk of an African elephant crosses the Chobe River in Botswana. Young forest elephants (right) frolic in a salty pool of Dzanga-Sangha reserve in the Central African Republic. The creatures find a rare refuge here—one of the few protected forest areas in that country.

WHENEVER I came upon elephants in Tsavo, they fled as soon as they sensed me. One afternoon I worked my way close to the only herd for many and many a mile. Brick red as the termite mounds that rise from Tsavo's iron-rich soil, they were feeding at the edge of a river. A couple of calves, still so young they hadn't quite figured out how to operate the more than 50,000 muscles of their trunks, tried to spray themselves, missing as often as they hit. Small juveniles sparred with bigger ones, who dropped to their knees to make the contests more even. In one mock battle each flourished a broken branch high overhead in its trunk like a flag.

Around them, ground hornbills, banded mongooses, vervet monkeys, and baboons picked seeds and insects from the elephant droppings. Dung beetles rolled balls of the stuff to where they would bury them as a food supply for their larvae. Honey badgers would later dig the balls up and feast on the plump grubs inside. Meanwhile, by pushing over trees, girdling others by stripping the nutrient-rich bark for food, and generally stomping around being elephants, the herd was transforming woodland into open savanna, creating grazing habitat for dozens of grassland species. When they moved on, the savanna would grow up into scrub for a host of browsing animals and then, once more, become woodland. I was witnessing a pattern of change that has helped mold the very look and feel of Africa over the eons. Then the wind turned, and all 600 elephants—nearly three million pounds of beast—tore apart the water with plunging feet and went screaming away into the distance, all because of one 180-pound man.

One ashamed and angry man. I left to go back to my doomsday safari among vultures massed in acacia trees, to the stench of rotting flesh, elephants with their faces hacked off to allow the killers to get at the root of the tusks. Near the heads, like the carcasses of some unfathomable beasts, lay the severed trunks —the miraculous organs that had served as arm and hand, periscope of smell, taster, trumpet, snorkel, and shower head.

Elephants support sick and wounded herd members with their trunks and shoulders, then stay with them when they can no longer move, sometimes even bringing food. They

FRANS LANTING (FACING PAGE); WILLIAM THOMPSON

Deft strokes of padded feet yield clumps of grassy sod for a family of elephants feeding at the base of Mount Kilimanjaro in Amboseli National Park. Headed

will linger by dead members of their family and may cover them with branches and dirt. (For more on how elephants treat their dead, see pages 39–41.) Now and then the giants "bury" other fallen creatures such as antelope—and humans. I watched herds that came upon old elephant carcasses carry the bones and tusks around for more than an hour. A tame elephant named Eleanor that I met in Tsavo has been known to grab ivory bracelets from tourists holding them out of view. Elephants occasionally shed tears when stressed, and several researchers told me they think these giants can die outright of grief.

Anthropologist Richard Leakey was a frequent critic of the Kenya Wildlife Service's failure to stem the elephant slaughter. In April 1989 he abruptly found himself appointed the service's new director. Within weeks he was weeding out corrupt officials, giving demoralized park rangers decent wages and equipment—I'd seen patrols carrying bolt-action rifles made before World War I—and beginning to put poachers hard on the run. Tanzania followed suit, rounding up 1,800 ivory poachers and middlemen in the space of a few months. The situation in those two countries has been improving ever since. But while they contain many of the African wildlife areas best known to foreigners, they tell only a small part of the elephants' ongoing saga.

HIDDEN among the tangled forests and dark rivers of Cameroon, Zaire, Equatorial Guinea, Gabon, the Central African Republic (C.A.R.), and the People's Republic of the Congo is the subspecies *Loxodonta africana cyclotis*, known as the forest elephant. Distinctly smaller than the typical savanna, or bush, elephant, it has smaller, rounded ears and tusks that grow straight or even

BERNARD KORBEL

by a matriarch, families of related females raise the young. At adolescence young bulls leave the group to join other males or range alone.

downward rather than curving up. Other than that, remarkably little is yet known about these beasts, though they make up about a third of the elephants left on the continent. Precious few have been counted directly; instead researchers make estimates based on droppings and other signs.

At the southern tip of the C.A.R., where the Congo Basin begins, I made my way to the new Dzanga-Sangha reserve, a joint project of the World Wildlife Fund and C.A.R.'s department of water and forests. Dozens of forest elephants were drinking from a series of salty springs in a clearing. With them were giant forest hogs and the long-hoofed, swamp-dwelling antelope called sitatunga. At one end stood a crowd of one of the most rarely seen of all Africa's antelope—bongo, white stripes running down their orange-brown fur like sunlight slanting through palm leaves. I became a sort of salt lick for butterflies; so many hovered around my face to sip sweat that they fanned it cool with blue and yellow wings. Toward evening the chest-thumping of lowland gorillas mingled with the drumbeat of rain.

Other life-forms appeared while we traversed the forest over the days that followed. In front of me, his soft, infectious laugh keeping the jungle gloom at bay, Mbutu Clement, an Aka Pygmy, said, "Don't worry, the worms crawling through the skin of your feet never burrow too deep." He swung his machete awhile, then spoke again: "Wait. The leaves on the ground are not right . . . something was fighting here. . . . It was a squirrel. And . . . there! On that side of you! A rhinoceros viper. Ah. It is slow because the squirrel is now in its stomach."

Using concealed pits, spears, and poison arrows, Mbutu used to hunt elephants for meat. Then a trader from the village gave him a gun and put him to work poaching ivory. Later, Mbutu was arrested, beaten on the

soles of his feet so badly that he couldn't walk for weeks, and jailed. Not for poaching but because the influential trader suspected him of keeping a pair of tusks for himself. Beside us now, with a tiny biting tick in his eye and a mild case of malaria, was Mbutu's new employer and friend, Mike Fay, a botanist with the Missouri Botanical Garden. Together the scientist and the Pygmy showed me how elephants were the architects of the jungle.

Elephant trails wound like a maze of tunnels through the green walls, creating thoroughfares for the Aka people. Many other ground dwellers take to these broad avenues for travel, and leopards like to wait on overhanging branches. Where the elephants tug on certain tasty lianas, whole treetops enwrapped by the vines often snap and fall, bringing sunlight crashing down to the damp forest floor. "The openings are invaded by monocots, a major group of plants that includes palms and bamboo," Mike explained. "Monocots tend to be high in starch and protein, with relatively low concentrations of the toxic chemicals plants use for defense. They are the preferred food of forest elephants. And of gorillas, the most direct beneficiaries of the elephants' bulldozing. Chimpanzees benefit as well. So do crested mangabey monkeys and a variety of hoofed species. Before they became more dependent on trade with local villagers, the Aka too may have found most of their starch in the clearings made by forest elephants."

Elephants also disperse the seeds of as many as one-third of the tree species in lowland tropical forests. Naturally. Co-evolving with large mammals over thousands of years, the trees developed succulent fruits with smooth lozenge-shaped seeds designed to slip down a large gullet and emerge ready for germination in a nice fertile pile of manure.

"Look at this *Treculia* fruit in the fig family," Mike said. "The size of a basketball. No hope of moving beyond the shade of the parent tree unless it gets broken up and transported by some big animal. Here's *Balanites*, with a pit the size of an avocado. Only elephants are going to swallow this one and spread it around." Mbutu pointed out trees that produce flowers and fruit directly from their trunks a few feet off the ground,

Just short of tiptoeing, an African bull tears branches from a protein-rich acacia. *When leaves are too high, he simply pushes over an entire tree. The beanlike pods that rain down provide a feast for nearby warthogs, kudu, and baboons.*

MICHEL GENTS HOIST, NGA-DVI

an arrangement called cauliflory. "Looks like another adaptation to dispersal by big animals," Mike noted. "Once you take elephants and gorillas out of a community like this, the whole ecosystem begins to make less and less sense."

It also becomes less and less rich. What happens to the countless smaller creatures, from duiker antelope that scavenge seeds in elephant dung to the insects that rely on vegetation in sunlit openings? What of the elephant-dispersed trees in the family Irvingiaceae whose seeds, laden with oil, are used by Pygmies? The relationship of elephants with gorillas, chimps, and Pygmies here led me to other questions. Given the elephant's key role in promoting biological diversity within the tropical forest, plus its equally major role in the dynamic savanna-woodland balance, what influence might its kind have had on the long sequence of primate evolution that led to *Homo sapiens?* Who planted the tree where our ancestors were born?

Much of Africa's tropical forest realm is destined to be cut. Only 3 percent is protected, and most of that is already plagued with illegal logging and widespread poaching. Who will replenish the wild fruits of the earth if the elephant is gone? Much of the C.A.R. consists of savanna. There the elephants are largely gone, taken out by poaching caravans from Sudan and Chad, and most of the parks now hold more illegal cattle than protected wildlife.

IN MALAYSIA'S northern state of Perak, the jungle air lay against my face like a hot compress while I rested with a crew from the Department of Wildlife and National Parks, picking off leeches and waiting for elephants. We already had one in front of us—a young adult female. Captured with tranquilizer darts earlier, she stood chained to a tree, hurling branches at anyone who ventured close.

We knew from a trampled swath through the swamp below that our captive had been visited by her family during the night. But the elephants we were waiting for were two tame ones to help us move the female out of this rain forest where she grew up. It was becoming a patchwork of farm plots and vast new rubber and oil palm plantations. When the tame female arrived, she soothed the wild one with caresses of her trunk. Then Bahadur, the mighty bull brought from Assam in India for this kind of work, placed himself on the opposite side. The mahouts chained the captive between the two, and they began to drag her up the hill toward a distant truck. But she kept falling to her knees.

One front leg was a swollen mass of infection with a snare wire embedded in it—the work of poachers after deer and wild boar; often it is the trunk that gets caught and mutilated. Two bullet holes festered in her side—the work of angry farmers with trampled crops; some put battery acid or arsenic in ripe fruit along elephant trails. "One of every five elephants we handle has serious wounds," sighed Mohammed Shariff Daim, whose translocation teams have already had to move one-fourth of the estimated thousand elephants left in peninsular Malaysia.

Finally, using her trunk as a crutch, the injured female reached the top. We took her in the truck 120 miles north to Lake Temenggor, doctored her as best we could, loaded her on a raft, continued north for half a day, and left her on the shores of one of the last wide tracts of jungle on the Malaysian mainland. Seamless, lush, beckoning wilderness tracked by tigers. "Let me hike here a while," I pleaded. "No, the paths have land mines planted by communist rebels," Shariff told me. "This has been a no-man's-land for years. That is one reason it is still undeveloped and available for the elephants." The communists had declared a truce though, and selective logging was about to begin.

Neighboring Thailand not only fought epic battles with elephants, the prototype of tanks, it once fought a war because of them. When word reached a Burmese king that seven white elephants had been found and sent to the Thai monarch, he was overcome with jealousy and mounted an invasion.

In the beginning, you see, all elephants were white and flew through the air, keeping company with the clouds and rain. Millennia later a white elephant entered the side of Queen Sirimahamaya as she lay dreaming. Later she gave birth to Prince Siddhartha, the future Guatama Buddha.

Among the predominantly Buddhist kingdoms of Southeast Asia, the finding of a white elephant during the reign of a monarch was the most auspicious event imaginable. Stories speak of such beasts lumbering across

Fighting fire with fire, an anti-poaching unit in Kenya met rare success in this 1986 raid. Typically these units were outmanned and outgunned, their efforts thwarted by corrupt government officials and inadequate equipment. Poachers swarmed unchallenged into parks like Tsavo, where herds of the 1970s (below)

PETER BEARD, VISIONS

BERNHARD GRZIMEK, OKAPIA/PHOTO RESEARCHERS

had been ravaged by 1989 (below). But when Richard Leakey took command of Kenya's Wildlife Service in 1989, he gave his anti-poaching units automatic rifles and helicopter gunships to execute their shoot-to-kill orders. Since then more than a hundred poachers have been killed, giving Kenya's elephants a fighting chance.

DOUGLAS H. CHADWICK

the palace grounds, shaded by attendants with silk umbrellas and offered platters of delicacies while musicians played soothing music. The youngest were said to be suckled by human wet nurses.

AT THE ROYAL PALACE in Bangkok, Sanet Thanapradit, in his mid-80s and still an overseer of ceremonies, spoke while white elephants bathed in a courtyard pool beside us: "To an inexperienced man they may look like other elephants. But I have studied all my life to be able to tell their special qualities: a certain shape to their ankles and tails. A whiteness of the eyes, the hair tips, the skin between the folds, and the nails. The greatest of all the elephants here has two extra toenails. Most rare. He is of the same rank as a prince."

This royal giant's name is four lines long, proclaiming him to be a lotus-colored gift from heaven who will add his matchless power to that of His Majesty the King. The title was carved onto a sugarcane stalk and fed to him as a young elephant by King Rama IX. Yet no trainer worked with the great beast to keep him manageable once he grew larger.

I found him where he has been for decades now, in the darkness of his gilded pavilion, surging endlessly back and forth at the end of a chain, his strange pale eyes blue one moment and green the next, alone, colossal, and very likely insane. Thrice this great mad elephant has trumpeted wildly in alarm, I was told. Each time, the king was threatened by danger, including an attempted coup.

Although Asian elephants were first tamed more than 4,000 years ago, they have rarely been bred in captivity. It was long believed that elephants raised among people from birth had no fear of their handlers and could become dangerous once grown. More important, breeding a female meant losing her from the work force for 22 months of gestation followed by at least two years of nursing.

Indians drove wild herds into stockades called *kheddas* or caught the giants singly in pits. In Vietnam they were run into lakes and forced to keep swimming until they tired, then harpooned in each ear and dragged out by tame elephants. The Khmer-speaking Suay people of eastern Thailand, who traditionally supplied the nation with much of its elephant work force, rode the wild ones down with the tame ones and lassoed their feet.

Shooting then stabbing an elephant to death, this Pygmy was just following orders. Deep in the Congo, Pygmies are hired and exploited by ivory traders, many of whom come from foreign countries. Issued a gun and a few bullets, the Pygmy must return with an elephant to receive his payment: meat rations, manioc, perhaps liquor and cigarettes.

In Hong Kong, ivory carver Lee Chi perfected his craft for 44 years, specializing in miniature elephant trains. But the international ban on ivory has put him out of business. "Many carvers have changed jobs," he says. "But I don't know what else I can do at my age."

BOTH BY WILLIAM THOMPSON

In a friendly test of strength and status, an older African bull spars with a younger one. Females entwine trunks too in

WILLIAM THOMPSON

family greeting rituals. They rumble, trumpet, flap ears, click tusks, urinate and defecate, saying hello—with a twist.

"I went with 30 other men, and each of us had two elephants. On some trips we would be gone three months into Cambodia," 56-year-old Bhan Kanin remembered as we sat beneath his thatched roof in the old Suay elephant-training village called Tha Klang. "Dangers awaited us always, especially from fighting between wild elephant families and our mounts. Before we started from the village, we brought the catching rope from its resting-place and made offerings. The wives could not cut their hair or speak to strangers when the men were away. We spoke only a ghost language to bring us luck and not let the elephants know who was coming." The expeditions ended 25 years ago when soldiers in war-torn Cambodia began sowing the hillsides with mines and shooting at the Suay.

Thailand's elephant work force in 1850 was estimated in the tens of thousands, most trained to haul teak and other hardwoods from forests to market. Currently all the tame elephants in Asia add up to perhaps 13,000, and the 4,000 to 5,000 in Thailand are mostly unemployed, because few forests remain there. Elephants weren't the only ones affected. As naked hillsides replaced the thick woodlands that normally absorb and store rainfall, Thailand suffered lethal floods and mud slides during the monsoons and serious water shortages during the dry season.

Some of the giants now work part-time as what could be called doctor elephants. Traveling the countryside, they allow people to walk under their bellies for luck and fertility while the mahout collects fees and sells ivory trinkets and charms made of elephant hair. Others carry billboards for resorts or greet guests at massage parlors.

While elephants at a tourist camp finished the morning show by giving rides to visitors, I spoke with a former logging mahout who gave his name only as Dang. "The pay is good, and the work is much easier, for me and for my elephant," he said, pointing to a small female well past her prime. Thailand's logging crews have moved on with some of the stronger elephants to two neighboring countries. One is Myanmar (Burma), believed still to harbor several thousand wild elephants. The other is Lan Xang, Land of a Million Elephants; now known as Laos, it may hold 2,000 to 3,000.

"Wherever you build a logging road, you build a pathway for colonization by migrating farmers, who clear the land for their

Dust douser and water hose, the trunk is a multipurpose tool. More than 50,000 trunk muscles allow an African elephant (left) to puff sunburn protection that cools its sensitive skin.

A white Asian elephant (right) showers itself on the palace grounds of Thailand's King Rama IX. One of 11 such elephants belonging to the king, it exhibits special traits that include scant pigment in the eyes and whiteness between the skin folds. White elephants were once automatically the property of the king. No longer sought as prized possessions, today they are merely a vestige of a royal tradition.

plots," said Choowit Mahamontri of Thailand's Forest Industry Organization as we surveyed some beaten-looking northern countryside between Chiang Mai and Lampang. "They start fires that sweep through the hills each year. Poachers set them too, trying to drive game and make better visibility for hunting later. The first time we catch squatters, we just warn. How can you throw them away in jail? These are families with children. Many are refugees. They are very poor. We have a new program to try to keep them in one place by offering housing and schools. Also a job. The job is replanting the forests." But they don't plant forests, really. They plant orderly rows of teak, exotic eucalyptus, and fast-growing pines, a world apart from native jungles.

Most of Thailand's wild elephants are isolated in small preserves that are being invaded by squatters and poachers. Even tame bulls risk being poached or else stunned with high-voltage cattle prods and having their incisors sawed off. Thieves often cut the tusks so close to the base that the tooth nerve is damaged, and the elephant dies from infection. Owners often remove the ivory themselves and sell it. I saw only a handful of bulls with tusks in the entire country. But then who can stand guard every minute over an animal that needs to forage as much as 18 hours of every 24 to obtain the 300 to 500 pounds of vegetation it requires daily, along with 25 to 50 gallons of water?

With 17,000 to 22,000 wild elephants and 2,000 captive ones, India contains at least 35 percent of Asia's elephants. That any should coexist here among nearly 900 million people shows the Hindu reverence for all life—a concept known as ahimsa—and for elephants in particular. The deity most often called upon, after all, is not omnipotent Siva but his elephant-headed son, Ganesh. For it is Ganesh who deals with everyday needs and worries, transported on his errands by a tiny rat. (Westerners cling to a different belief: that elephants are naturally terrified of such small creatures. Nonsense. An elephant keeper I met tells of seeing a captive elephant regularly set aside grain for a resident mouse.)

The other factor in this nation's success has been a solid system of protected wild areas. In south-central India, where the states of Karnataka, Kerala, and Tamil Nadu meet in

BOTH BY WILLIAM THOMPSON

a swell of mountains, several parks and wildlife sanctuaries were recently combined with adjoining forest reserves to fashion the 2,150-square-mile Nilgiri Biosphere Reserve. After many a mile on the elephants' trail, I found real hope for the future there.

Not that the resident giants had escaped the ivory crunch. Led by the notorious outlaw Veerappan, a poaching band shot down several rangers and nearly all the big tuskers before moving on to precious sandalwood trees. Still, since Asian females lack tusks, they were spared. If anything, the Nilgiri elephants have increased slightly over the years and are now approaching 4,000, I learned from R. Sukumar, who has devoted much of his career to studying them.

As it turns out, elephants poach 150 to 200 people a year in India. Dr. Sukumar has documented 160 deaths from elephants in the biosphere reserve area alone over the past 15 years. The majority of them were caused by bulls in areas where cultivated fields have pushed up against protected acreage. "Female elephants and their young tend to linger close to the forest edge when they raid crops, and they are fairly easily frightened away," he noted. "A big bull will come out into the center of the fields at dusk and stay right there feeding until dawn."

Which is exactly where we were as the September dusk gathered—in the middle of millet fields near the reserve's eastern border. With us was Boran Gowda, the owner of several plots. Like most of his neighbors, he spends more than a hundred nights each year guarding his fields. Spotted deer, elk-like sambar, and langur monkeys can be a problem. "But it was elephants that ate the whole field next to mine last year," Boran said. "One year, they took three-quarters of my crop just days before the harvest."

From watch huts on the ground, from platforms in scattered trees, from campfires gleaming in the distances, the farmers sent a growing chorus of hoots and clangs out against the dark. Two days earlier, at just this time, I had blundered into an elephant while returning from a hike. It blasted out fair warning, and all I remember after that is running in blackness and feeling, more than hearing, the thunder of feet somewhere behind me. I kept racing and swerving between trees until I realized that the only pounding sound left was inside me.

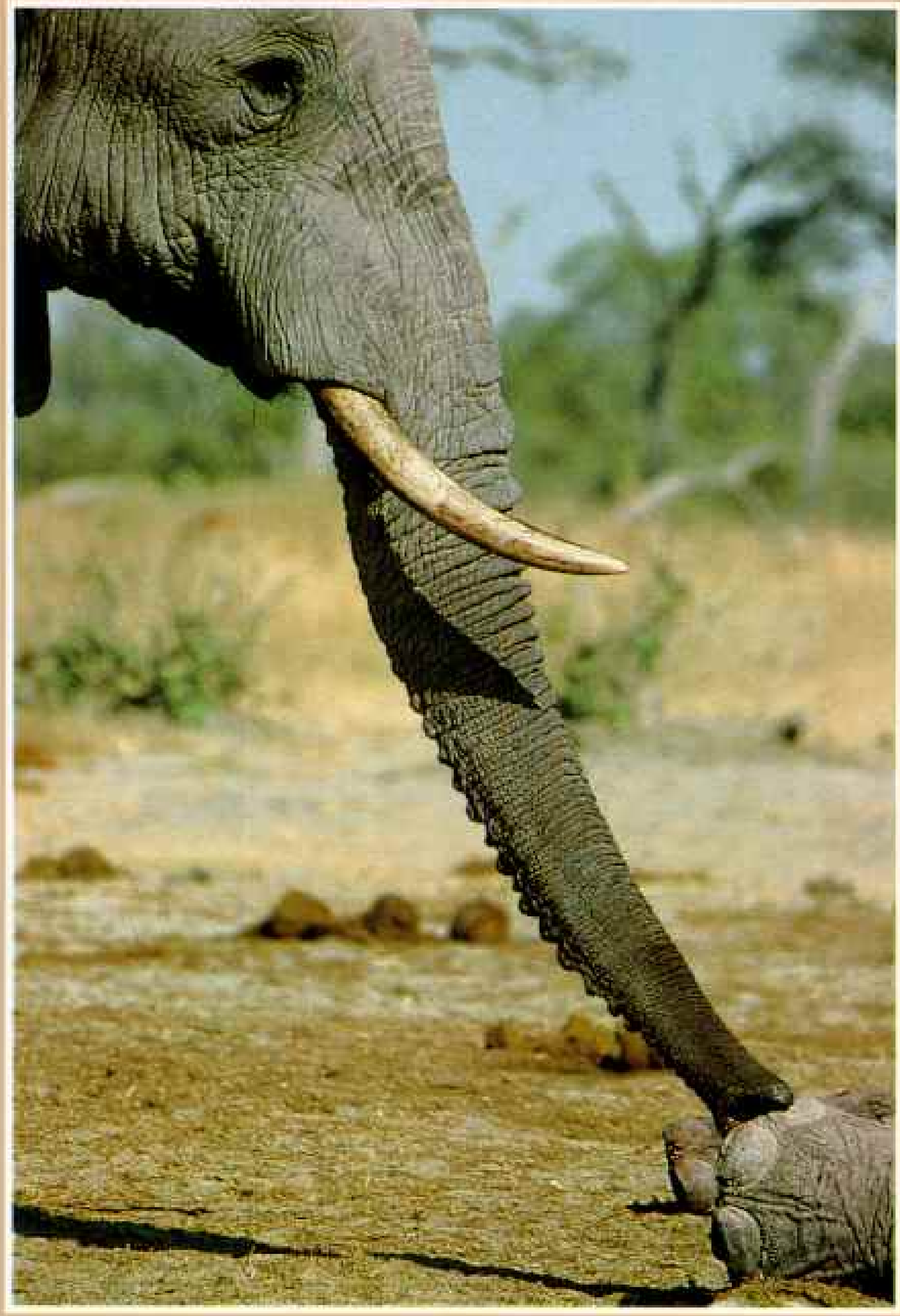
Now, in the fields, I drifted away from the racket around me and into fractured dreams. Sometime near midnight I was awakened by yells and led stumbling through pools of moonlight toward a great roaming boulder of darkness. We were expecting the smaller bull that had come the night before. This one was enormous and trumpeting like doom. Once enough men had gathered with torches and flashlights, and screamed and hurled stones, he finally gave way. But he returned from the forest at a different point 15 minutes later, was driven off again, returned. . . . Back at his hut, Boran rubbed his eyes and said, "I believe the elephant is a god. If I lose my crops, I never blame the elephant. I blame myself. I wonder what I have done wrong. I pray to Ganesh not to destroy my food."

IN THE HIGH, QUIET HEART of the reserve, head-tall grass grew everywhere for the taking, but no elephant would visit until the sprouting season at the start of the monsoon. The herds were far downhill, closer to cultivated lands, feeding in the thornscrub.

Researcher N. Sivaganesan and I scrambled from one tree perch to another close to one family group, trying to see what they were eating. "Mostly grasses in the early, more nutritious stages of growth plus a few berries," he whispered. "These animals do not just bash along eating everything as they go. Their system is unable to digest rough forage that efficiently. To keep in good condition, they must constantly seek out the highest quality foods. For creatures so huge, they are actually fairly picky eaters."

This appears to be true of most Asian and African elephants, and it means that to ensure their long-term survival, it won't be enough merely to set aside a certain minimum amount of sheer acreage. Ideally, the acreage should include varied ranges with good migration corridors between them. Only then can the elephants freely follow the rains and turning seasons to wherever the plants sprout best or the fruits are ripest or the bark is flushed with minerals. Only then—perhaps with the help of electric fencing, which has proved fairly effective—can the growing conflict with agriculture be reversed.

Sri Lanka developed a model system of refuges linked by corridors to allow both seasonal movement and vital genetic exchange.



EYEWITNESS TO AN

Elephant Wake

By DERECK JOUBERT

Photographs by BEVERLY JOUBERT

A fallen bull's companions tend his carcass for seven days, but their reasons remain a mystery.

WE HAD BEEN watching the old elephant for several months, checking up on him every few days. He was about 50, maybe older. He had no name—we called him M40 for our records. He had distinctive tusks that were very evenly matched and a series of small holes near the rim of his left ear. He seldom ventured far from the water hole.

It was the dry season in northern Botswana, and M40 was failing. His skin sagged over his huge, protruding bones, and his head hung low. His trunk, when extended, drooped in the dust between his legs.

My wife, Beverly, and I, working in Chobe National Park, wondered how long the old fellow would last. One morning a friend called us with the news that M40 was finally down, lying in the gray sands of the Kalahari. We drove over to see the great beast. He was alive but lying very still.

The other elephants approached him with great deliberation and gentleness, smelling every inch of his body, trunks lingering over his neck. There appeared to be a tusk wound. Perhaps in his desperate condition he had disobeyed the strict drinking hierarchy; perhaps another bull had inadvertently gored him in the jostling for precious water. Whatever the cause, his injury, combined with exhaustion, finished him. Some four hours after he went down, the great bull was dead.

Still the other elephants continued sniffing and prodding the fallen bull. They were quite orderly, moving away to make space for others. They came in twos and threes. Younger bulls approached his body, sweeping their trunks slowly over him, not touching him for the most part but maintaining an inch of distance between his skin and the moist tips of their trunks. The ritual was more impressive for its silence. Not a rumble was uttered, and no scraping of skin or sand broke the afternoon stillness.

Earlier, within an hour of M40's collapse, a strange thing had happened. Younger bulls mounted him one by one, while he was still clinging to life. First they just stood on him, but later they looked as if they were attempting to mate with him, even in death. At least three individuals did the same thing throughout the first day and night. When daylight came, the young bulls seemed to lose interest.

The explanation is uncertain, but we thought it was significant that they attempted to mate only while M40 was still warm. Perhaps it was a dominance display related to elephant hierarchy. The younger bulls, presumably from lower ranks, could have been trying to dominate their companion in the hope of acquiring his status.

Others tried to raise M40—but only while the body was warm—by slipping their own trunks and tusks under him and lifting as hard as they could. Some broke their own ivory in the effort of lifting. We had witnessed this behavior on several occasions when elephants gathered around a fallen one. When lifting failed, we had seen them prod the body gently, just as an elephant mother nudges her sleeping calf to wake it up. They tried this with M40 as well.

The death of M40 reminded us of another time we had seen elephants investigate a dead bull. He had been shot in the forehead. All were intent on sniffing every part of the carcass until they reached the bullet hole, a black spot about the size of a quarter. There their trunks lingered for a minute or two, and then the elephants left the carcass. Perhaps they hoped to

discover the cause of death, which would have obvious survival advantages.

We have noticed that elephants spend a great deal of time touching and holding chunks of ivory from their dead. (The ivory in Botswana tends to be brittle because of mineral deficiencies in the soil, and one often finds pieces of it around the water holes.) We have even seen elephants pass a piece of ivory or bone from a dead elephant around the herd, each one giving it to the next. Why . . . no one knows.

Most of the herd abandoned

our old friend M40 a week after he fell. Scavenging hyenas and lions had left little of him, only a few gnawed bones scattered among a soft carpet of elephant droppings.

Whether the gathering around M40 had been a tribute to a companion, a survival tool, or simply curiosity, it is difficult to say or prove.

DEREEK and BEVERLY JOUBERT are currently at work in Africa filming a story on elephant behavior for National Geographic EXPLORER. The television program will be broadcast in 1992 on TBS SuperStation.

But strife between Tamil separatists and Sinhalese nationalists has lately resulted in dead rangers, poisoned water sources, and uncontrolled poaching where elephants once thrived. Northeastern India, where some hill tribes still hunt elephants for meat, probably sustains Asia's largest wild populations. Lately, however, a nationalist rebellion by the Bodo people has led to the closure of parks and another uncertain future for the resident large mammals.

ONCE AGAIN I was in Africa, backtracking an elephant from squatters' fields within a forest reserve. I found droppings full of millet and melon seeds. A familiar scene by now. Yet the manure also contained seeds of a wild tree from hills formed by ancient Kalahari sands. Joining the ranks of species that forage in the wake of elephants, I cracked the shells open and began to eat the walnut-like centers. I'd been camping and traveling on bush rations for weeks, trying to learn why the herds in Zimbabwe and Botswana had continued to grow until the challenge became how best to keep their numbers in check.

Botswana may contain 68,000 elephants. Lightly populated by people, it simply has room for the animals to live much as they always have, migrating over circuits as long as 300 miles with little but wildness in their path. Smaller and more crowded Zimbabwe, with at least 50,000 elephants, has had to work harder. Mark Butcher of the Forestry Commission was arresting more than 350 poachers a year when he realized that conservation enforced through the barrel of a gun was at best a holding action.

"Most people in this country are communal farmers and herders who see elephants as dangerous pests and a hindrance to development," he told me. "If they don't want elephants around, we won't have them in the future. If they do, we will. It's that simple. The question is how to help them understand the value of wildlife." The answer, for now, is to make it more profitable than anything else, including poaching.

Private ranch owners have already discovered that they can make far more money raising game for hunting safaris than raising cattle, which tend to graze arid pastures to dust anyway. As a result, livestock fences have come down around key parks and reserves, and—rare news these days—the total range available to wildlife has expanded.

In the late 1980s the Zimbabwe government gave communal people the same authority over wildlife on their lands that private ranchers have, provided they first set up a management plan. Through a program called CAMPFIRE, money from safaris now goes into constructing schools and hospitals, compensating for wildlife damage to crops and livestock, and improving the water supply.

Not long ago CAMPFIRE netted each household in one northern district a check for $200, an amount roughly equal to the average annual income there. If enough such communal lands join existing game ranches as good wildlife habitat, elephants could regain their old dry-season migration route north from Hwange toward the Zambezi River on the border with Zambia. With 5,500-square-mile Hwange already connected to elephant range in Botswana, this could reawaken an immense regional ecosystem.

I listened while Alan Sparrow of the Zimbabwe Trust, a rural-assistance organization, introduced the CAMPFIRE program to representatives from an area crucial to the linkage. He displayed cable snares in which he had found a Cape buffalo, kudu, zebra, and a young male elephant—all dead. "That buffalo could have been taken by a hunter who would pay several thousand dollars," he said. Eyes grew wide. "The kudu and zebra, thousands more for each one. And you can even have the meat. These hunters come all the way from across the seas and usually want just the head." Jaws dropped. "And this elephant bull, when he grew bigger, some hunters would pay $25,000 U. S. to go after one. . . ."

A tall, straight-backed man with silver hair looked on, saying little, measuring much. This was Chief Hwange; the park was created from part of his father's tribal land. Tapping a traditional carved staff of authority against his palm, he gave me his thoughts: "For a long time the government told us that wildlife was their resource. But I see how live animals can be *our* resource. *Our* wealth. *Our* way to improve the standard of living without waiting for the government to decide things. A poacher is only stealing from us. If our forefathers guide me, my task now is to bring this message to the people."

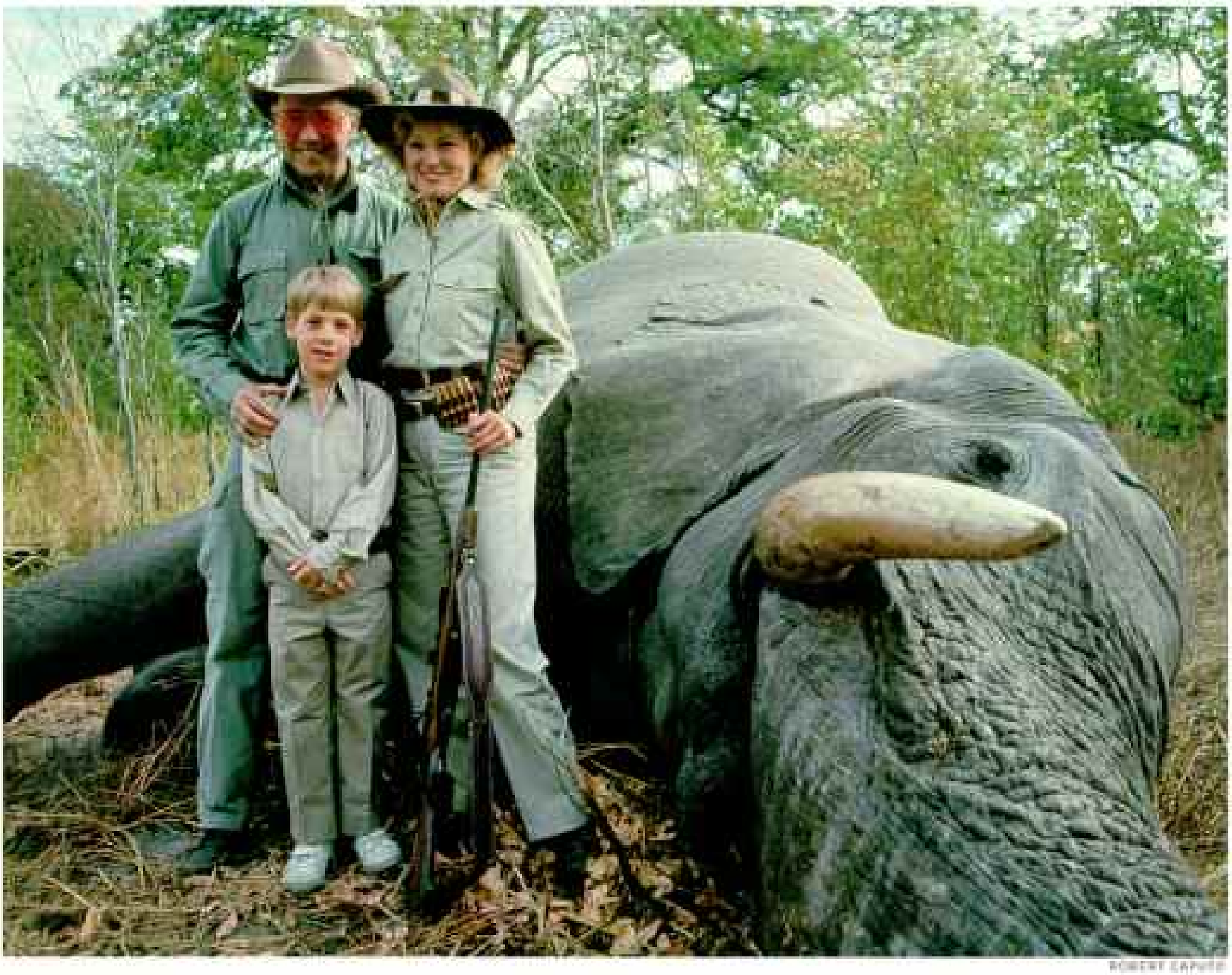
To minimize changes to the social structure and the genetic makeup of elephant groups from trophy hunting, biologists limit the take of bulls to half of one percent of the population. In the meantime some game ranchers are moving on to photography and natural-history safaris—and doing better than ever financially.

A MESSIER MANAGEMENT ISSUE is the culling of elephant populations in reserves where they have become concentrated. Zimbabwe practices it. South Africa, with nearly all its 7,800 elephants fenced inside Kruger National Park, does too. Botswana is about to begin. The idea is to keep the elephants in balance with native vegetation, though no one is exactly sure what the right balance is. In any case, culling teams try to shoot entire families, leaving no survivors to spread fear among the rest of the herd.

Deep in Hwange the shallow pans of rainwater were drying out one by one under the June sun. Some shrank visibly overnight when elephants came in to drink. Under a waxing moon, young herd members chased off impala in play and tried to bluff buffalo. The day before, I'd watched a huge bull back away from a plover defending its nest. He pranced a bit as he left, as if laughing to himself. Elephants often give that impression. It would be slightly less anthropomorphic to say they have an immense capacity for amusement, and, I think, joy, not surprising in a life-form supreme in its realm.

Related families often spend time together, forming what are called bond groups. Separated from one another for as little as 20 minutes, the families may reunite in a greeting ceremony that amounts to a minor detonation. Waving trunks and squalling, they race toward one another, caked dust flying from their outfanned ears, clear liquid flowing from the temporal glands on their temples, to place their trunks in one another's mouths

"I don't want the animal to suffer," says Jan Duncan, who bagged this bull while on safari in Zimbabwe with her husband, Dan, and son, Scott. "But Zimbabwe has too many elephants, and being shot is less painful than starving to death."



ROBERT CAPUTO

and rumble out messages of contentment. Their range of emotions and the intensity—the freedom—with which they express them seem to spill over to the observer. How else to explain why the sight of elephants together gives such a burst of pleasure?

I began to wonder why I rarely saw females and young come in to water holes before dusk in Hwange. Several people told me this wasn't the case before culling began. Wildlife biologists often capture animals by shooting them with guns that fire darts filled with tranquilizing drugs. The same technique can be used to inject free-roaming animals with contraceptive drugs. "But look," Mark Butcher explained, "the money we receive for the ivory from the culled elephants is absolutely vital to wildlife management."

IN OSAKA, JAPAN, I found an elephant graveyard. Ghostly white ivory dust filled the air and settled onto heaps of tusks at a local ivory company. Saws buzzed, lathes turned. And crates on every side filled with little ivory cylinders. Here was what elephant after elephant had crashed to the ground for: finger-size personal signature seals—*hanko*, the "chop" required on official documents in Japan. Livestock horn, wood, stone, or ceramic can all be used. But the popularity of ivory seals as a status symbol grew along with Japan's affluence until they became the single largest use of tusks anywhere.

Most of the tusks taken in the past 20 years passed through Hong Kong or through outposts scattered from Singapore to Dubayy by Hong Kong dealers one step ahead of international trade regulations. However, Japan was the world's largest importer of tropical timber and the ultimate destination for 40 percent of all ivory, thus consuming elephants and their habitat. And what of the Western world, so fond of wild creatures? The European Community accounted for 20 of every 100 dead elephants, while the U. S. took 15.

Yet it was while I was exploring the ivory industries of the Far East that the public at last cried, "Enough!" First the U. S., then Europe, and finally Japan banned further

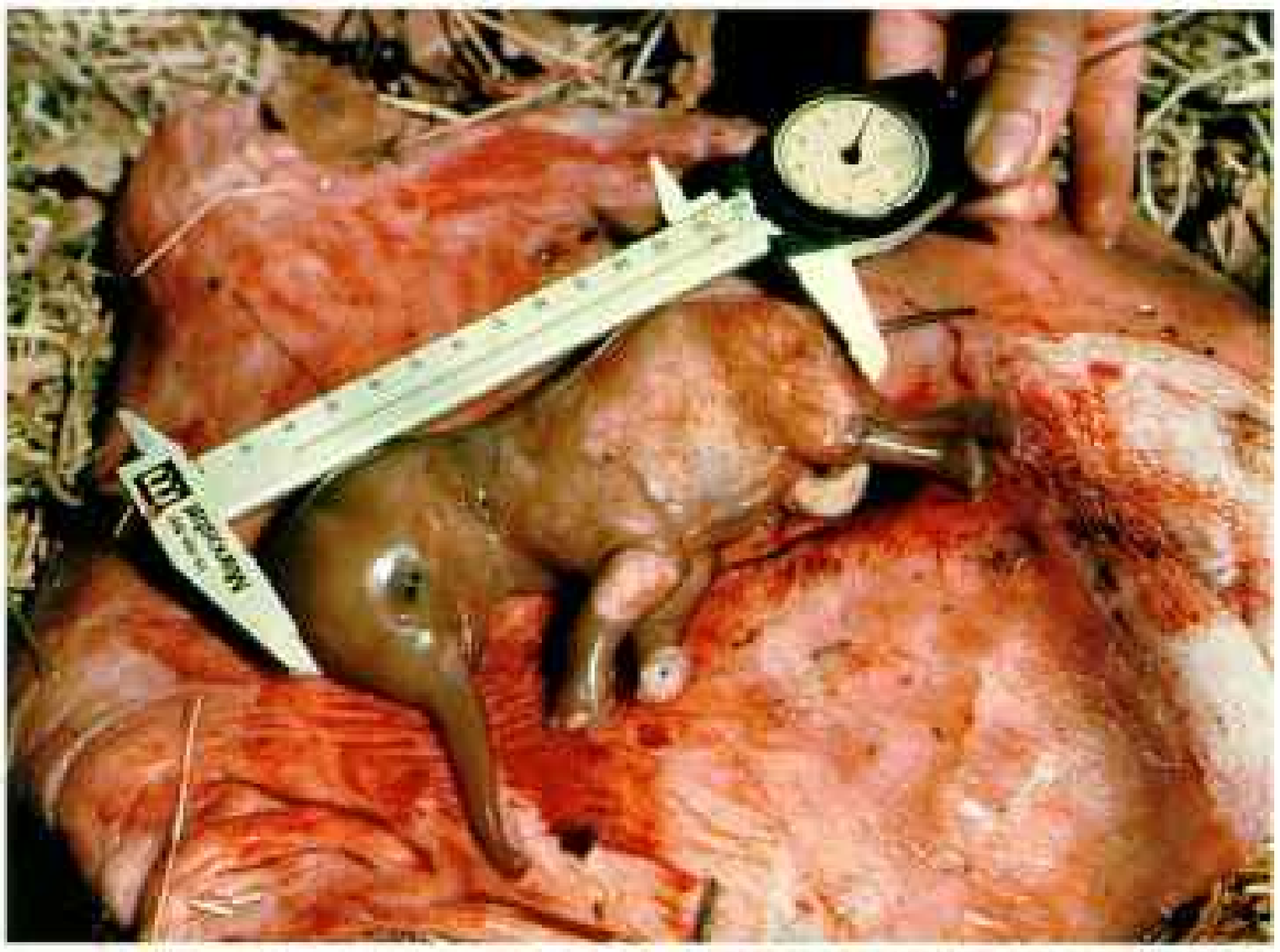
Killing of the few prevents starvation of the many in Zimbabwe and South Africa, where elephant herds compete for limited food.

To that end, government-sponsored culling teams try to bring elephant and environment into equilibrium. In Zimbabwe's Mana Pools National Park (above), a team of riflemen destroy an isolated elephant family. The marksmen try to shoot the matriarch first because without their leader family members mill about making easy targets.

One casualty was a cow carrying a four-month-old fetus (left), examined by scientists studying the elephant's 22-month gestation period. Most culling teams spare elephants old enough to survive without their mothers yet small enough to be moved to less populated areas or to be sold to game ranches, safari parks, and zoos.

When the shooting stops, the elephants are butchered. Hides, meat, and ivory are sold to help support game management.

Culling, unlike poaching and trophy hunting, attempts to maintain the herd's natural age and gender balance. Still, critics emphasize the inevitable loss of genetic diversity and the horror of slaughtering great and intelligent beings.



BOTH BY MAR LAWRENCE, KATZ EYEGLOB PICTURES

ivory imports. Carvers began looking for new jobs. Stores selling mass-produced statues and trinkets hung "50% Off!" signs in the window. When the African elephant took its place on the international endangered species list soon afterward, managed sport hunting was allowed to continue. Commercial export of ivory was not. At once the wholesale price of tusks began to plummet. Elephants had won a chance to live.

A CHANCE. Ivory has sunk to pre-1970s prices on the international market. Poaching is falling off in a number of countries. However, it appears to be holding steady in others and increasing in a few—the rumor is that people are stockpiling tusks until they can establish new trading networks. Iain Douglas-Hamilton put it this way: "Even if we solve the ivory crisis, we're back to the crisis we've had all along—the booming human population."

Kenya's population could more than double within the next two decades. Malaysia expects to increase its populace of 18 million to 27 million by the year 2020. Tropical forests continue to fall across Africa and Asia alike at a clip so furious that authorities say they will be all but gone within a century. Just where in the world are elephants supposed to fit in?

How about Borneo? Its very name suggests the ultimate in remote wilderness. On this vast island, 50 acres can contain as many different tree species as all of North America. And it has perhaps a thousand elephants, whose ancestors may have come from the mainland via an Ice Age land bridge. What about the similar island of Sumatra, thought to contain 3,000 or more elephants? The rain forests of both areas are being cut down as quickly as are portions of the Amazon and converted to agricultural use, stranding the elephants in little enclaves.

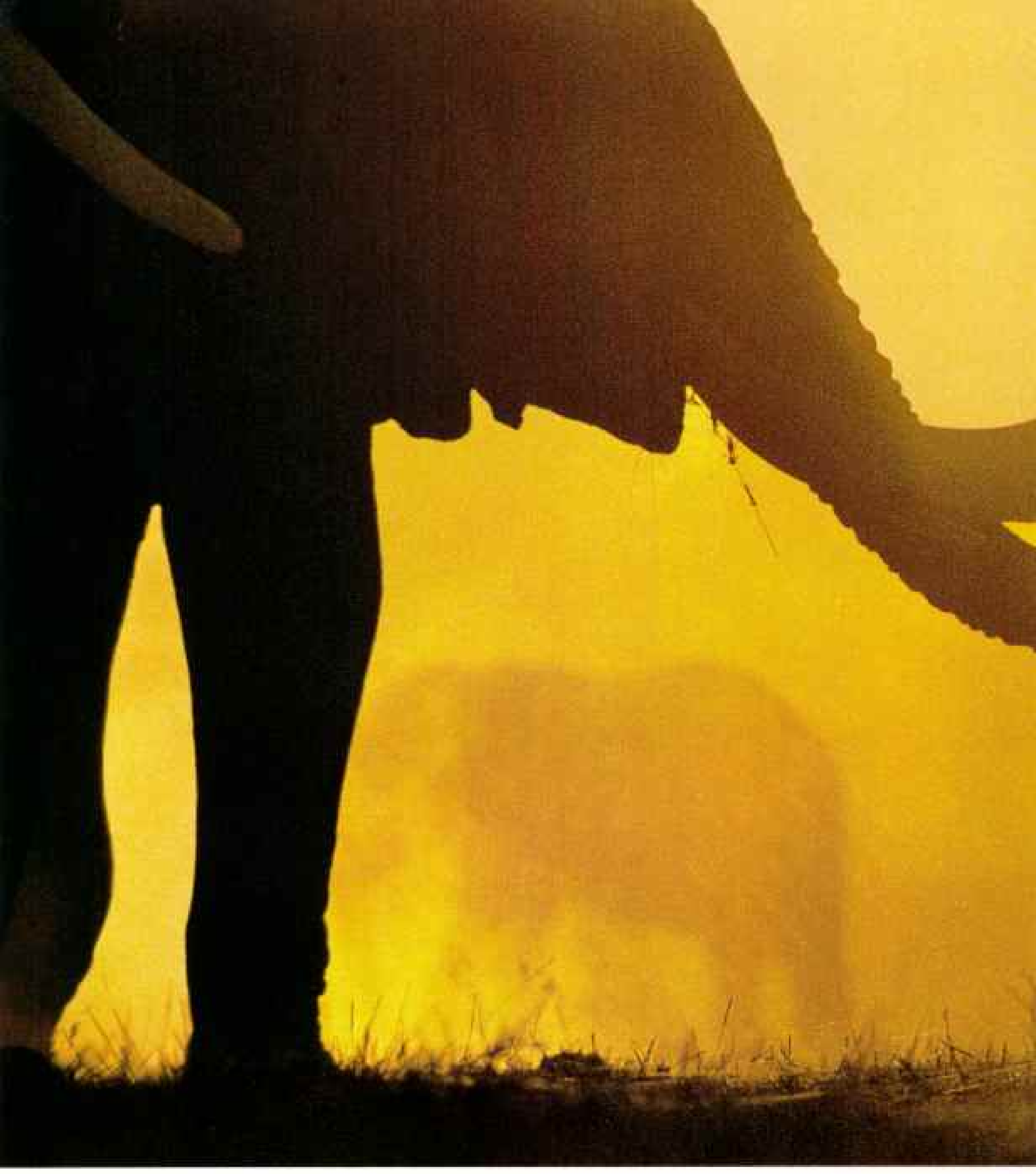
Saving elephants is clearly not going to be as simple as throwing bad guys in jail and deciding not to wear ivory. As the human population increases from its current 5.4 billion toward a projected seven to nine billion just three decades from now, the fate of these giants will tell us about the dimensions of the natural world we can save. How large and varied? How strong and interconnected? More than a collection of individual species, nature is a superstructure of communities and processes. From it issues a flow of wonder and possibilities. That flow, the very nature of nature, cannot continue as we have known it without big, diverse stretches of wildlands and linkages between them, the very things elephants need.

When I began this assignment, I thought the world was much larger. I thought there would be untamed places between the snow-bound latitudes to explore for generations to come. I am not sure of that any longer. I cannot guess the future of the elephant because I cannot guess ours.

RUTH BY LOUISE GUBB, JR PICTURES

One chained up, one chopped up—two elephants are the last of 262 killed during the 1990 cull in South Africa's Kruger National Park. In the park's abattoir the meat is cut, cooked, and canned.

"Heating provides a delicious and quickly prepared meal," says the can's label. "Avoid excessive stirring."



Earnest as a handshake and gentle as a caress, two African bulls touch and explore each other's mouths in greeting—a gesture extended frequently when elephants meet. As time and space run out, such meetings in the wild, such displays of ponderous affection, cannot long endure.

CAPTIVE ELEPHANTS have been known to unscrew the bolts on their cages, and I've seen an Asian elephant named Ruby at the Phoenix Zoo paint canvases with deft twists of her trunk. If you even say the word "paint" around Ruby, her eyes open wide and her ears begin to flap with excitement. Elephants were long said to be color blind. Ruby doesn't know that. If someone in, say, a bright

REINHARD KÜNKEL

orange dress is standing nearby, she is likely to choose orange from her palette. A red truck parks within sight of her yard; red is her next choice. Handler Anita Schanberger told me, "I think the two African elephants in the yard may be jealous of all the attention Ruby gets. Lately, they've begun scratching patterns on the retaining wall with sticks."

Most mammals' brains at birth are around 90 percent of their adult weight. In a human infant the brain is only 27 percent of its adult weight. For elephants the figure is of the same order—35 percent. Their brain is highly convoluted—another measure of intelligence, which they share with humans, the great apes, and dolphins. And elephants have the largest brain of any land mammal. Trying to conserve such a being is not a burden. It is an opportunity to continue living in a world with great things. □

CHICAGO

Welcome to the Neighborhood

By RICHARD CONNIFF

Photographs by BRUCE DAVIDSON MAGNUM

ONE MORNING at a place called the Busy Bee, I was having coffee with a Chicago social reformer, an athletic-looking man with curly hair winging out from under the sides of his baseball cap and a persistent glow of youth about the eyes. He was telling me about a current campaign to revoke the franchise of the city's electric utility, and I ventured that it was never going to happen.

His eyes flashed momentarily. Then he leaned closer, rising up slightly out of his seat. "Do you know why people come to Chicago?" he asked, as if I had just beamed in from Mars. "It's not the *weather*. It's not the *mountains*. It's *hustle*. Don't tell me I can't ever do something."

It was enough to make a utility executive fret for his paycheck. It was also pure Chicago: Enthusiastically combative, a little rough at the edges, with maybe an added hint of image consciousness now that many children of the two-fisted blue-collar work force have clambered up into more genteel occupations. It was above all full of Chicago's deep conviction, shared even by social reformers, that here in the breeding ground of such noisy ideas as the skyscraper, the blues, and the atom bomb, anything is still possible.

No city in America has a stronger notion of itself, a fiercer sense of its own identity, or a better literature to keep it alive. As an Easterner (not quite a Martian, but close), I knew Chicago as the city of Studs Terkel and Studs Lonigan, of Saul Bellow and Nelson Algren, of Upton Sinclair's *Jungle*. I knew it enough from previous visits to wonder if the tough image was not a bit dated now, a vestige of the city's past manufacturing strength and more particularly its reputation as a workingman's city. "Brawling" was the word Carl Sandburg applied to Chicago in his famous poem about the city. Outside of its fractious political life and the occasional conversation at the Busy Bee, I wondered how well it applied to Chicago today, almost 80 years later.

"No city in America has a stronger notion of itself, a fiercer sense of its own identity..."

Chicago is, of course, no longer the "Hog

The streets belong to the people on summer weekends when block parties break out across Chicago. On Lowe Avenue in Bridgeport, neighbors get even closer during the dancing hour.

Another workday dawns as a pre-rush-hour L—elevated train—crosses the Chicago River into the Loop, the heart of the city's vibrant downtown. Long a destination for newcomers seeking

employment, Chicago has lost half its manufacturing jobs since 1960. Today a healthy service economy offers work to many of the 60,000 people, one-sixth of them immigrants, who arrive yearly.

Butcher for the World." The slaughterhouses long ago moved out to farm country in search of a cheaper work force, and no one much laments either the pervasive stench or the carpal tunnel syndrome that afflicted the laborers. The site of the Union Stock Yard now houses companies with names like Wines Unlimited and Brodie Advertising Service. What remains of the old industrial base are mostly printing companies, metalworking plants, and food processors (Chicago is still "the nation's candy capital"; the prevailing smell in some neighborhoods is chocolate). Where manufacturing provided 36 percent of all employment as recently as 1960, it accounts for only one job in five now. Instead, jobs in banking, insurance, and other aspects of finance have opened for the middle class; those whose lack of education would once have restricted them to factory work must now resort to jobs in less lucrative service industries. The Chicago that Sandburg called "Tool Maker, Stacker of Wheat" is increasingly the city of the broker and the data processor on the one hand and the hotel maid on the other.

CHICAGO'S DOWNTOWN is more prosperous looking and economically more diversified than in its industrial past. It is cleaner and more sophisticated. If the shoulders are big now, it is often because they are padded. North of the Loop, in a new art district named Su-Hu (pronounced SOO-HOO) for Superior and Huron Streets, more than 75 art galleries occupy converted manufacturing lofts—Soviet and East European art chockablock with southwestern and American Indian. In the Loop itself there is actually a parking garage where customers are urged to remember their floor according to the famous painting reproduced there. (One can hear a laid-off autoworker musing: "Did I leave the kid's BMW on 'Brushstroke With Spatter' by Lichtenstein? Or was it on Gauguin's 'Ancestors of Tehamana'?")

Whether Chicago is also stronger now is subject to argument. The population has stabilized, after a long period of decline, at about three million. But in the City That Works,

17 percent of the people depend on welfare, and one adult in three is functionally illiterate. The theory of a ghetto underclass abandoned by both whites and the black middle class was developed here, but solutions have not followed. The public schools are not measurably better than in 1987, when then Secretary of Education William Bennett called them "the worst in the nation." A new reform effort, giving parents and teachers more control through local school councils, holds promise. But a youth culture of gangs, guns, and drugs remains in real control of many schools. With a systemwide high school dropout rate of over 40

RICHARD CONNIFF, a writer based in Connecticut, chronicles American life for *Time* and other national publications. BRUCE DAVIDSON, who was born in the Chicago area and now lives in New York City, photographed "New York Harbor" for the July 1986 NATIONAL GEOGRAPHIC.

percent, most young people enter the job market unprepared for any kind of productive life.

But the city's powerful mythology about itself persists and appears to give Chicago an enduring strength. You can hear the cardinal principle of this creed from any coffee-shop regular in a snap-brim cap and a flannel shirt buttoned to the neck: "It's the best city in the world for work. If you can't get a job in Chicago, you can't get a job no place."

This international reputation for jobs is one reason Chicago has always been a city of immigrants and ethnic neighborhoods. Even now, when good jobs are harder to come by, one

"What would you like to hear?" is the greeting of Steve Kowalczyk, who plays accordion for the joy of it on Milwaukee Avenue in a Polish neighborhood. "My favorites are tangos and waltzes," he says, "but if I'm in the mood, I can do polkas all day long." Today a music teacher and insurance agent, he left Poland in 1974 with five dollars and his instrument.

resident in seven is foreign-born, and newcomers continue to arrive from places as disparate as Lithuania and Vietnam. The schoolchildren speak some 110 languages and can find bilingual education teachers in 20,

including Assyrian, Urdu, and Tagalog. Jobs are also the reason the city is now 41 percent African American and 18 percent Hispanic, with a Mexican flavor in neighborhoods formerly regarded as satellites of Warsaw. (Polish-Mexican weddings are commonplace, often blessed on both sides with the muttered benison, "At least they're Catholic.")

But beyond mere jobs, the mythology of workplace Chicago has to do with opportunity, with the main chance being out there on the street for anybody smart enough to find it. Hyman Golant, now 80 years old ("Seventy-nine, make it"), came to Chicago from Poland and got his start selling meat from the back of a station wagon. He sells 200,000 pounds of ribs a week now from a Fulton Market warehouse.

"I was a hard worker. I was a wheeler-dealer," he says, giving the classic formula for success in a city sometimes known as Hustletown. Like a lot of people in Chicago, Golant still believes that anyone with those two traits will prosper. Whereas the myth of New York City is about the near impossibility of getting to the top—"If I can make it there, I'll make it anywhere"—Chicago's approach to success is precisely the opposite: "If you can't make it here," says Golant, "you're not gonna make it anyplace."

FROM 4,000 FEET UP, on the glide slope into O'Hare International from the east, I saw Chicago by night as a flat, amber-lit grid, a vast network of rectangles proceeding in orderly fashion to the horizon. Between this sea of light and the darkness of Lake Michigan, the downtown skyscrapers rise up like a spectacular crystalline outcrop of an aqueous green color. In the past decade alone ten billion dollars' worth of construction has changed this face of the city. A 1990 downtown architectural guide lists 78 major new buildings (up from 55 in its 1988 edition) undertaken just since the Sears Tower was built in 1974.

It is a much different downtown now. The commercial district has broken out of the traditional boundaries of the Loop, defined by the circuit of the elevated trains. It has pushed north of the Chicago River along the section of Michigan Avenue known as the Magnificent Mile, and more tentatively, with large new apartment houses, to the south and west. The Loop no longer feels like a small town, as it did 20 years ago; you can no longer walk to every downtown shop or business place.

The architecture has changed too, in ways that sometimes make the cityscape less distinctively Chicagoan. Since the Great Fire of 1871,

For sunbathers in Lincoln Park the most visible hunks are the muscular skyscrapers of downtown. Displaced by Los Angeles as the second largest city in the U. S., Chicago, with three million residents, claims the most eye-catching skyline, with three of the nation's five tallest buildings.

Chicago's ethnic mosaic

First settled in the 1770s by Jean Baptiste Point du Sable, a trader of African and French-Canadian ancestry, Chicago is home to some 80 ethnic groups. Settlement waves have included mass migrations of Europeans in the 19th century, of southern blacks beginning with World War I, and, recently, of Hispanics and Asians. The map, based on the 1980 census, shows ethnic communities.

The Italian presence peaked in 1920, with 23 communities.

The Philippines and India have supplied the majority of Asian immigrants. Vietnamese have lately had the fastest rate of increase of any ethnic group.

The fast-growing Hispanic community, at 550,000, or 18 percent of the population, has more than doubled since 1970. Mexico is the leading place of origin—61 percent—followed by Puerto Rico and Cuba.

Germans rank third, after Poles and the Irish, among non-Hispanic white ethnic groups, which account for 37 percent of the population.

Poles, with a population of 300,000, constitute one of every four non-Hispanic white residents.

African Americans, many with roots in the Mississippi Delta region, are 41 percent of the population. Their numbers multiplied 24-fold between 1915 and 1980.

MAJOR ETHNIC CONCENTRATIONS

- German
- Irish
- Italian
- Other West Europeans
- Polish
- Other East Europeans
- Nonresidential
- African American
- Asian
- Mexican
- Other Hispanic
- Mixed ancestry
- No dominant ethnic group
- No data

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NGS CARTOGRAPHIC DIVISION

The Irish, fleeing famine in the 1840s, were the first major immigrant group to arrive.

Chicago: Welcome to the Neighborhood

Winter builds character, insist Chicagoans. And on the Wabash Avenue bridge, frigid winds put the test to pained pedestrians. The nickname Windy City, popularized by New York newspapers in the 1890s, referred not to climate but to the boastfulness of the locals.

the city has repeatedly shaped and reshaped itself with often brilliant architecture characterized by simplicity and honesty of form, a product of the plain prairie landscape and the city's industrial orientation to function—to the mechanical underpinnings that make things work. It remains spiritually the city of Louis Sullivan, Frank Lloyd Wright, and Mies van der Rohe, architects whose names have powerful meaning, as in few other cities, for ordinary people.

The city has shaped itself with ingenious structural innovation, such as the development of the steel frame to lift skyscrapers beyond the limits of load-bearing stone walls or, more recently, Fazlur Khan's use of nine elongated boxes bundled together to make the Sears Tower the tallest building in the world. The urge to bigness is powerful in Chicago, and critics now worry that towering office blocks overwhelm the street in places. There

is, moreover, something foreign to Chicago about the principally decorative appeal of the current crop of postmodern buildings, which make powerful statements only about what color their marble is or how prettily they can ornament their art deco corner turrets. Form has triumphed temporarily over function.

And yet when the L train bursts unexpectedly from behind the Merchandise Mart and a nighttime rider finds himself out above the middle of the Chicago River, where buildings on either side are bathed in pure white light and sparkle in the darkness beyond, Chicago remains capable of taking the breath away. It has partly to do with the flatness and openness of the city. Invidious comparisons with Manhattan are a major local pastime, but there is a ring of truth to it when a Chicagoan says: "There may be beautiful buildings in New York, but nobody knows it. You can see the buildings here. That's really the difference."

FROM THE TOPS of these buildings, you can see out across the amber grid, which Chicagoans will tell you is where the real life of the city occurs, in neighborhoods marked by churches, temples, and mosques, by thin Protestant spires and blocky East European domes. On a Sunday afternoon in October, as the last Mass lets out at St. Francis of Assisi on West Roosevelt, children on the sidewalk raise their voices in the musical cries peculiar to street vendors. Some sell fried dough by the bag (*"¡Churros! ¡Dólar la bolcita!"*), and a flower man cries *"¡Un dólar la rosa!"* People stop to buy spears of cucumber and mango, or corn on the cob rolled in mayonnaise and sprinkled with chili pepper and Parmesan cheese.

Inside the church a father straightens the white tuxedo on his eight-month-old son, adjusting the cummerbund, which has wriggled up under the armpits. The boy is one of eight Mexican American infants being baptized today. "It's the slow season," a priest explains. "In summer we get 15 or 20." Afterward, the families cluster all across the altar for photographs, in a show of reproductive exuberance and familial attachment reminiscent of the Irish a generation or two back, who are represented in the parish now only by names in the memorial stained-glass windows.

Chicago is 25 miles long and 10 miles wide, and its spaciousness gives every ethnic group its own streets and corners, where it is possible to speak the native language, buy familiar foods, know everyone, and live, if you wish, in isolation from outsiders, at least until the next ethnic group, or the next wave of one's own group, takes over in the natural succession of the neighborhood. For Mexicans the Pilsen neighborhood around 18th Street is the usual point of entry; 26th Street is the suburbs, or at least a step in that direction. Bridgeport, now ethnically mixed, was long the stronghold of the Irish and the Democratic political machine. Irish in the suburbs still return to meet with friends at their old gathering places.

If Chicago is a "grid on the prairie," as

Making a buck means working the street for members of the fringe economy. A youth exploits a police barricade to shine shoes; a blind keyboardist plays for the hat on Michigan Avenue. Chicago's homegrown black music, the electric blues, often deals with money woes. Sings a bluesman: "If trouble was money, I'd be a millionaire/If worry was dollar bills, I'd buy the world and have money to spare."

sculptor Richard Hunt describes it, it is thus also a grid on the minds of its residents. Their knowledge of the city is strikingly numerical; addresses are the stuff of casual conversation, partly because the grid system is so logical. An address tells exactly how far west of State Street you live, or how far north or south of Madison. But it can also reveal where your grandparents came from, how much money you have, and what color your skin is. One white businessman narrows his world down to "an area smaller than a suburb." Then he gets specific. His acquaintances almost all live in a narrow corridor stretching from 600 north to 3200 north, and if they are at all prominent, it is in the easternmost three blocks of that corridor, along Lake Shore Drive. "You don't go south or west," he adds. In the city's highly segregated social geography, those are mainly black areas.

THE NEIGHBORHOODS are the city's strength and its weakness. For new immigrants, who often arrive unfamiliar with industrial society, much less its Chicago variations, they are a kind of halfway house. One Vietnamese woman arrived carrying a jar of seed rice for sowing the first season's crop. Chicago weather was apparently news to her. But so was Argyle Street, a busy strip of Vietnamese stores selling sea cucumber, fresh durian, dehydrated squid—and 25-pound bags of rice in 17 varieties, from Royal Elephant to Long Grain #103 Dynasty.

Such communities are almost always temporary. The customary immigrant impulse is to get one's feet on the ground amid friends, then move on to better things and sentimentalize the old neighborhood afterward. In their prime, the immigrant neighborhoods aren't so much about colorful customs and three-star ethnic restaurants as about a bittersweet blend of ambition and heartsickness—a feeling for which black Chicagoans up from the South created a perfect music, the urban blues. The neighborhoods serve as a consolation to people torn by painfully contradictory yearnings. "If you are Vietnamese at heart," says one man, "you want to do something for your country. But you can't do anything for your country until you do something here." Meanwhile your children grow up and become, at heart, American.

"The city very beautiful, and make money easy," says a woman named Thuy Huynh, who has recently opened her own restaurant. But by this she means that she used to waitress 13 or 14 hours a day, six days a week, and that she lives in a one-bedroom apartment with her husband and four children. Folded within the comforting limits of the neighborhood, the immigrants themselves become infused with Chicago's ideas about itself. The Argyle Street Vietnamese say they are harder working and more serious than their California counterparts, more levelheaded, less interested in the display of material wealth. "We are Midwesterners," says one.

The strength of the neighborhoods is that

It's a man-eat-dog world at Fat Johnnie's on Western Avenue, one of countless hot-dog stands on city streets. "Where else can you get a two-dollar lunch?" brags owner John Pawlikowski. "When it's 20 below, I've got people standing in line."

A feast for her customers' eyes, a model shows off lingerie for sale at the Golden Shell restaurant in southeast Chicago. Business has boomed with the lunchtime "fashion shows," a hot trend in the city's blue-collar bars. Says one model, "Fortunately the lunch crowd is pretty harmless."

Midwest ethnic—an ear of buttered corn—receives serious attention at the Taste of Chicago food festival at Grant Park. More than two million people attend the city's biggest summertime bash, lured by everything from deep-dish pizza to gyros and Peking duck.

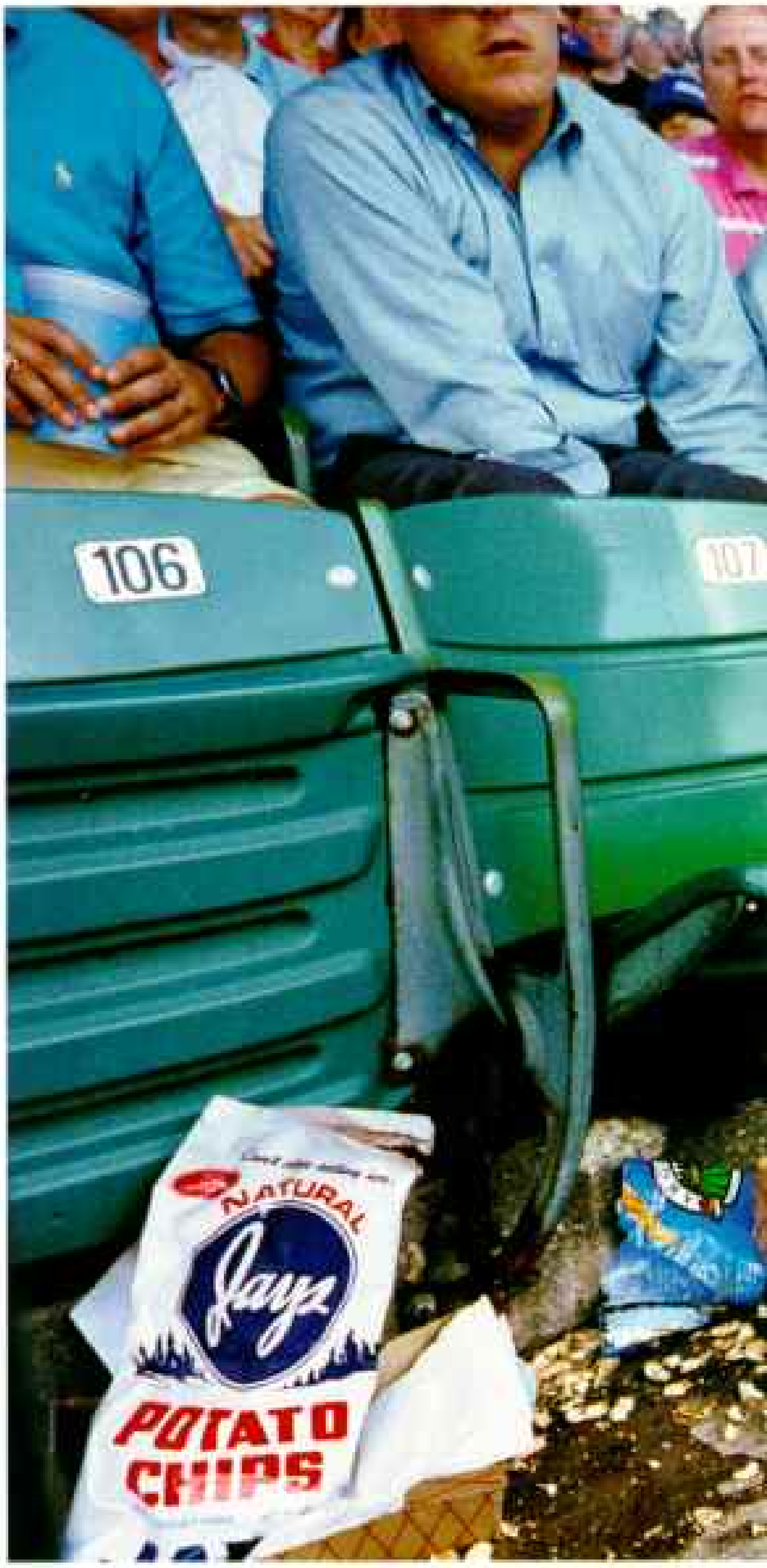
Na Zdorovia! *Alexandra and Vasyl Mudry, who fled Ukraine during World War II, toast their guests' health at a nostalgia-tinged Easter breakfast. The fare includes the special Easter bread,* **paska.** *"I am an American now," says Alexandra, "but I cannot forget Ukraine."*

they give Chicago the intimacy of a small town amid the clamor of a metropolis. To pass by a restaurant like the Busy Bee, one of those unofficial centers for the life of a neighborhood, and to peer through the window is like eavesdropping on a family together for Thanksgiving. To the left on Tuesday and Thursday afternoons, "millionaire's row," a group of Polish retirees, trades news on a change in the Social Security index. The owner's grandson refers to one of them as "big *dziadzia*," big grandfather, and another as "little dziadzia." Big dziadzia usually drops off the restaurant's outgoing mail on his way home.

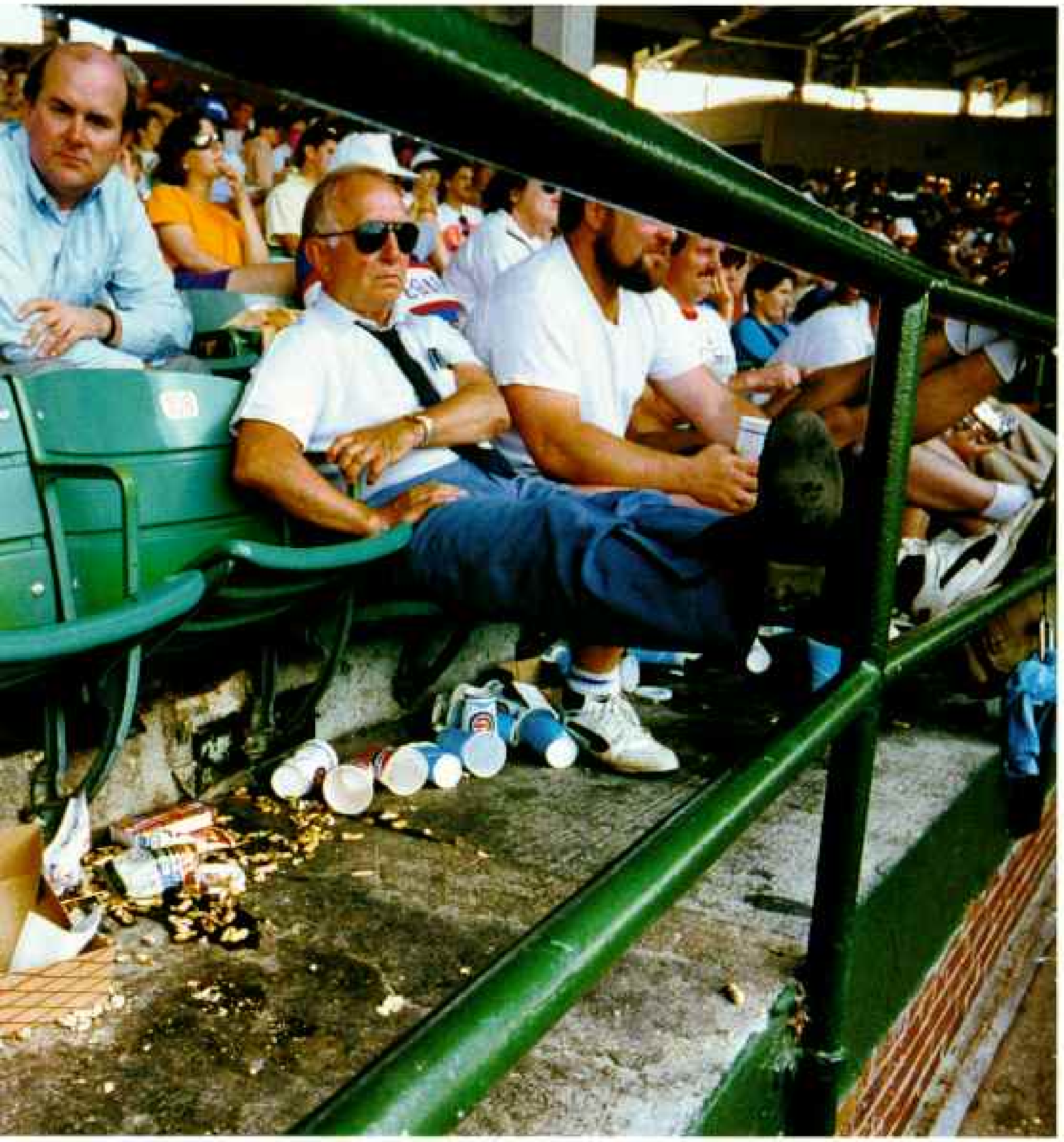
To the right, hunched over her coffee, is an afternoon regular in a fur coat and a stocking cap who is rumored to have sung in the opera (or maybe it was a church choir). Behind the counter the Polish waitress refills her cup and calls in orders for *pierogi*, hamburger and *fritki*, and *szynka* on rye.

AFTER A LONG PERIOD of decline this near northwest neighborhood, called Wicker Park, has lately become trendy among young artists and writers, the real estate developer's avant-garde. A Latino group up the street has converted a firehouse into an experimental theater. An art gallery has opened around the corner. A nearby tavern, which formerly catered to derelicts and prostitutes, now has a neo-proletarian storefront and a yuppie fern inside. But all these elements, old and new, mix at the Busy Bee, which has a healthy leveling influence. The Polish owner, Sophie Madej, came to Chicago in 1951. For a time, after the race riots of 1968, she lived in the suburbs, but it didn't take. "I am a plain, simple woman," she says. "I don't like this business 'I'm better than you.'" In the suburbs, she says, "Nobody knew nobody, and everybody knew everything."

Chicago's neighborhoods are the source of the opposite idea—the city's highly likable lunchpail-populist attitude that one person at the counter is as good as the next and no better. This attitude permeates every element of city life. For example, Chicago artist Ed Paschke lately achieved an international reputation for his paintings. But an art critic chooses to praise him this way: "He's Mr. Ordinary Guy. He could live down the street and be a very successful washing machine repairman." (It is true that Paschke's paintings feature



hermaphrodites and other non-lunchpail types, but, hey, the man works at it, and in Chicago this counts.) Of Bernard Sahlins, a founder of the Second City theater company and one of the most important producers in the city's theatrical community, a friend affectionately remarks: "He might be your dentist. He doesn't flash into a room in an Armani suit and expect you to applaud his entrance." Even when Chicago people display their wealth, it often has an almost mandatory edge of self-deprecation to it. Hyman and Maryane Golant use the fold-down rosewood trays in the back of their 1951 Bentley mainly when



they take the grandchildren to McDonald's. The license plate on their yellow Rolls-Royce says "SNOB," to show that they aren't.

There is, of course, a flip side to the appeal of neighborhood intimacy. Every neighborhood enforces its own brand of conformity, and the old mold doesn't necessarily fit new arrivals. Perhaps 50,000 Poles came to Chicago in the 1980s because of martial law at home—and also because the excellent Polish educational system had produced people too capable to endure the stale Polish economy.

In Chicago older Poles, generally less educated, sometimes resent the newcomers because many of them have not had to work their way up cleaning houses or working in factories. The newcomers are often secure enough in their schooling to learn a new language and find work as accountants, architects, or real estate agents. With an illogic born of frustration and envy, old immigrants

Take me out of the ballpark, say somber faces at Wrigley Field, the North Side home of the long-suffering Cubs. Last of the major-league teams still to play most of its home games in daylight, the Cubs have not won a World Series since 1908 or a pennant since 1945.

Priestly duties take Father Roman Kozak into the streets of Ukrainian Village, a close-knit neighborhood centered around three Catholic churches. New to Sts. Volodymyr and Olha Orthodox Church, Father Kozak introduces himself to an elderly parishioner. "I mostly meet people at baptisms and funerals," says Father Kozak, "and these days there are a lot of both."

denounce the new ones not as yuppies but as communists. The newcomers meanwhile resent their predecessors as the stuff of Polish jokes. "Who cares about them?" says one. "They dance the polka. We never even knew the polka was a Polish dance."

THE SMALL-TOWN MENTALITY has also contributed to Chicago's well-known "second-city complex" (which was not much alleviated by news that the city in fact ranks third in population, behind New York and Los Angeles). Neighborhood populism—particularly the idea that anybody can make it in Chicago, and that those who do are mere mortals sharing the same coffee-shop counter with those who don't—leads with no great leap of the imagination to the suspicion that making it in Chicago is somehow second-rate. Other factors, including the weather and the Midwest's uninspiring image, have contributed to the generally acknowledged sense of insecurity, even inferiority, beneath the city's bluster.

Despite the success of the Bears in football, the city also resonates to the persistent failings of both the Cubs and the White Sox, who have not made it to the World Series since 1945 and 1959, respectively. (The visceral identification with these teams surely developed in part because, until the opening of Comiskey Park this spring, both teams played in small neighborhood ballparks.) "Cubness" is deemed such a "debilitating virus" that *Chicago Tribune* columnist Mike Royko predicted the Oakland A's would lose last year's World Series simply because they had three ex-Cubs on their roster.

The city's misguided sense of insecurity surfaces even on the subject of architecture, where Chicago often leads the world. When Chicagoans deservedly vilified the new State of Illinois Center as a "hulking, candy-striped" pop palace, James R. Thompson, the governor who built it, claimed the critics were harsh simply because the architect was a Chicagoan.

"Chicago is famous for panning its own," said Thompson. "We are such cannibals. We've always got to dump on ourselves and admire New York and Los Angeles." He described the building as world-class, a bid for global status that one hears over and over in a city where Chicago-class ought to be sufficient. Only here would people tout "the world's tallest concrete building" or "the world's tallest freestanding apartment building." Only here would a bowling newspaper (posted over the urinals in the men's room at Ed Debevic's diner) boast that it is the "World's Greatest Bowling Weekly."

The real weakness of the neighborhoods is that they allow Chicago to be ethnically balkanized and racially segregated, producing rivalries Chicago politicians adeptly exploit. "In this town," a Chicagoan says, "you say the word neighborhood and people get a warm glow. Then they start talking about 'them.'" When Harold Washington was running a rainbow-coalition candidacy in 1983 to become the city's first black mayor, his white rival's blunt slogan was "Epton—Before It's Too Late." More recently a black congressman, Gus Savage, won reelection with the cynical but effective tactic of reading the names of Jews who had contributed to his black rival's campaign.

Negative campaigning is one noisy idea that did not originate in Chicago, but in its racial and ethnic divisiveness the local variety has encouraged police, government functionaries, taxi drivers, and almost everyone else to think of whole neighborhoods as "our people" or "theirs," and to treat half-abandoned areas around the city as if they belong to nobody.

A MORE APPEALING COROLLARY to the idea that anybody can make it in Chicago is the conviction that he *will* make it—and big. Locals recall with something akin to admiration that in 1942, under the football stands at the University of Chicago, Enrico Fermi achieved the first release of atomic energy, with no guarantee that the city would be standing when it was over. In Chicago they like to say that they are a city for risk takers. "What the mind can conceive," a taxi driver assured me, "you can achieve." This pervasive attitude gives a lot of people the impression that the city motto is "I Will."

I was contemplating this world-beating spirit as I drove out to Garfield Park, one of

On a banner day for Chicago's Polish Americans, police carry the motherland's flag in the annual Polish Day parade. Held in early May, the parade honors the Polish

constitution of 1791, Europe's first. To serve the large ethnic community, a local Polish-language radio station and newspaper were on hand to cover the patriotic event.

those gray areas where nothing good is ever supposed to happen. Abandoned by whites in the '60s, it has all the familiar problems of joblessness, drugs, gangs, and crime. On the boulevards, designed long ago to bring carriage traffic from the Loop to outlying parks, the Victorian houses with their rusticated stone arches stand vacant. In the corner turrets, tattered bits of plastic flap at the empty windows.

But around the corner at Providence-St. Mel (Mel—there's a saint for Chicago!), the school day begins as if there is valuable work to be done. The 530 high school students are black, and many have been born into the supposedly unbreakable "cycle of poverty." When President Reagan visited, the Secret Service brought along extra boxes for confiscated weapons. It came up empty. While waiting for the first bell, the students do not talk in some gang code language. What they say is, " 'Au' is gold. What's 'Sr'?" " 'Sr' is strontium," and so on through the periodic table. That such an ordinary scene should seem worthy of note would be laughable, if the more typical alternative weren't so dismal. At a nearby public school, there have been two shootings in the past week. In high schools citywide, 70 percent of the students read below the national average for their class level.

Asked why his school is different, Paul Adams, the principal at Providence-St. Mel, polishes his tortoiseshell bifocals and says, "Expectation." Adams has never assumed, as many public schools do, that he is dealing with a permanent underclass. His students generally start out in about the 45th percentile on standardized tests. But the school asserts that all of them without exception will win college admission, and it pushes them and their parents (who may not believe it at first) firmly in that direction. By graduation they average in the 72nd percentile and test at 12th-grade level or better in all subjects.

Adams is one of those Chicago "I Will" sorts, a 50-year-old black man in a goatee and a rumpled gray business suit. He was sent to jail when he led a protest the first time the Catholic archdiocese tried to shut down the school. The second time, he set up a nonprofit corporation and bought the place, winning an agreement from the Sisters of Providence to let the nuns continue teaching there. He has persuaded lay teachers to work for half what they could earn in public schools, and he has gotten various businesses, who see that their future is not coming out of the public schools, to pick up much of the 2.1-million-dollar annual budget; the rest comes from tuition.

Adams runs his school in the familiar tones of the best school principal from one's youth, somewhere between a loving father and a drill sergeant. He knows his students' names, congratulates them in the hallways when they make the honor roll, and will meet with them or their parents at seven in the evening, if need be, or at nine on Saturday morning. He also makes it clear that if they cannot work hard all day and handle three hours of homework at night, they should hit the door, and he conveys

to them a matter-of-fact intolerance for the disorderly world they will find outside.

"A guy from a public school asked me how I handle drug problems," Adams says. "I terminate anybody who deals with drugs. 'Oh!' he said, 'that's not the right way.' 'Well,' I said, 'you asked how I deal with it.' People want to overcomplicate it."

The danger with a school like Providence-St. Mel is that it can serve mainly as a reassuring story useful for producing a warm feeling in one's audience, rather than as a model to the public schools. There the teachers union has struck nine times in the past 20 years, and

Sweet summer kiss bonds Lester Gates and daughter Chiffon on a day when friends and neighbors fill the stoops on the 7200 block of Rhodes Avenue for a South Side party. So far the family-oriented block has fought off an area-wide invasion of gangs and drugs. "We're just holding on," says a nervous resident.

when one teacher, who sends her own children to private schools, says she worries about falling behind during a strike, she is referring not to her students but to the payments on her car.

Despite the promise of reform, the board of education's bureaucracy remains bloated,

Fashion plates and license plates attract attention on the Magnificent Mile, a posh shopping district on North Michigan Avenue. Dressed in de rigueur black, a no-nonsense shopper, right, takes home treasures from a newly opened boutique. Outside the Drake Hotel, socialite Maryane Golant stands with doorman Howard Cherry in front of her Rolls-Royce with its cheeky vanity tag. "It's not enough to be rich to live around here," says Cherry, who's seen it all in his 25 years with the hotel. "You have to be a millionaire."

with 2,000 employees (versus a central staff of 42 for the city's Catholic school system, which has one-third as many students). The jobholders are often black now, and critics charge that many regard the paycheck, rather than improved school performance, as the measure of racial empowerment. Asked why they cannot do better with their 2.3-billion-dollar budget, black and white educators alike typically point a finger at the hopelessness of the neighborhoods where the schoolchildren live. Lack of expectation remains a problem.

AT 8:30 OR 9 most weekday mornings, Keith D. Banks and a handful of other developers meet for coffee at a McDonald's on the South Side. Hopelessness doesn't figure in their vocabulary. Banks is an affable 68-year-old in a heavy flannel shirt who has lived down the memory that whites once tried to run him off his job at the electric company because of his skin color, and that for most of his life financial institutions refused to make loans on his apartment buildings even when they were helping white landlords in the same neighborhoods.

He owns seven rehabbed apartment buildings in the South Shore area now, has made himself a wealthy man, and doesn't mind pointing out that he buys a 50-cent biscuit every morning and gives it away because it comes with a free cup of coffee, which would cost him 70 cents by itself. He says he also picks up pennies. These traits begin to suggest how Banks and perhaps three dozen other mom-and-pop developers have managed to make a profit over the past 15 years while turning a declining neighborhood into a livable community for ordinary black working people.

South Shore, 15 minutes south of the Loop on Lake Michigan, was a comfortable community until the 1960s, when whites fled and banks shut off the capital necessary to keep the housing stock in shape. In 1972 South Shore Bank made just two mortgage loans in its namesake community. But the following year new owners came in with the novel idea that enlightened capitalism was the route to social reform, and they recommitted the bank to the neighborhood. While savvier institutions put their money into more lucrative ventures, such as junk-bond-financed business takeovers and

Importing custom and costume from Mexico, Raul Muñoz rides his horse down West 26th Street for the Mexican Independence Day parade in September. Local organizer of charreadas—riding and roping competitions—he wears the elaborate outfit of the charro, the Mexican horseman.

Sidewalk history lesson unfolds at the Polish Day parade as Jozef Sikora displays medals given him by Polish civic groups for combating communist rule in his homeland. His pupil wears a costume of the Kraków region. The medals, Sikora says, "show that I never gave up the fight."

Free haircuts draw neighbors to Irena Luszowska's back porch. Like many immigrants before her, she is leaving the old neighborhood, having saved enough money from nursing and cleaning jobs to have bought a house in the suburbs. "This was my dream," says the native of Poland.

"Many a Ukrainian church was built on varenyky," goes the saying. Starting before sunrise in the basement of Sts. Volodymyr and Olha Church, parish women from the old country expertly prepare the small stuffed pastries, whose sale will help finance church operations.

loans to Brazil, the plodding types at South Shore lent money to people like Keith Banks.

Banks paid $55,000 for his first building in the neighborhood, a 44-unit apartment house ruined by drug dealing, prostitution, and general neglect.

"I don't think you'll understand this, you're not from Chicago," says Banks. "I had a dog, of course. I had a gun, of course. But you've heard of the Black Muslims? They had a reputation then. I was going down to introduce myself to the tenants, and I was so worried. Then I saw this guy on the corner selling the Muslim newspaper. I said, 'Give me 30 of them.' I didn't tell them I was a Muslim. I just gave out the newspapers and said, 'Come to the mosque,' and I put up a picture of Elijah Muhammad in my workroom. They said, 'Leave that man alone.' " Banks set to work pushing out the troublemakers, repairing the apartments, screening the new tenants. He sold the building nine years later for $450,000.

Banks has become the father figure to the area's platoon of shoestring developers. He stops by to advise an insurance man who has just bought a run-down storefront for his business. The new owner has his hands jammed in the pockets of his trench coat and wears the bleak look of a homeowner who has just learned the definition of rotten sills. A contractor has told him that to repair the brick front he must remove a steel I beam rusting behind it, at a cost of $9,000. Banks looks it over and advises keeping the beam and welding on a support shelf for the bricks instead.

"You go tell him you had a structural engineer out here from the City of Chicago, and he said put an angle iron in there. That'll impress him. Don't tell him Banks said so."

WITH THE SHREWDNESS and energy of people like Banks, and with money from South Shore, almost every building in a 40-block area is now tuck-pointed against the weather and acid-washed to bring out the color of the brick; banners along the streets announce the neighborhood's revival. Other small rehabbers have had to push beyond the neighborhood limits to find something sufficiently run-down to be worth fixing up. The South Shore Bank itself has turned its attention to the Austin neighborhood on Chicago's West Side to attempt another revival. At a time when the misconceived real estate loans of other financial institutions make daily headlines, South Shore's 1990 loan losses totaled about one-half of one percent.

"If the primary reason for decay was the systematic withdrawal of capital," says Joan Shapiro, an officer at the bank, "then if you carefully put money back into the community—gradually, prudently—you should be able to get the market to function again. Government failed to do that. Nonprofits failed to do that. So our thought was 'Let's apply a business approach.' " Curiously, few other banks have chosen to follow this example. And in South Shore the public schools continue to

underachieve, even now that the neighborhood is certifiably not hopeless.

That may change. It will have to change if Chicago aims for the whole city, and not just its downtown, to become world-class.

"This is what happens in Chicago," says Marc Smith, a poet. "People have the opportunity to do new things, and they have the guts to do them. It always starts from the bottom. The big shots are always looking somewhere else to bring something in, because they don't think their own people are credible enough. But the little people know they're good enough. So they just do it on their own."

City life still tweaks a smile from a seasoned gent at a bus stop. With its proud, gutsy neighborhoods, where affection for the past and hopes for the future thrive together, Chicago commands a loyalty that goes heart deep.

Keith Banks takes the same line: "It's a pioneer town. You build and you rebuild. That's what happened after the fire. There's a lot of people here with energy."

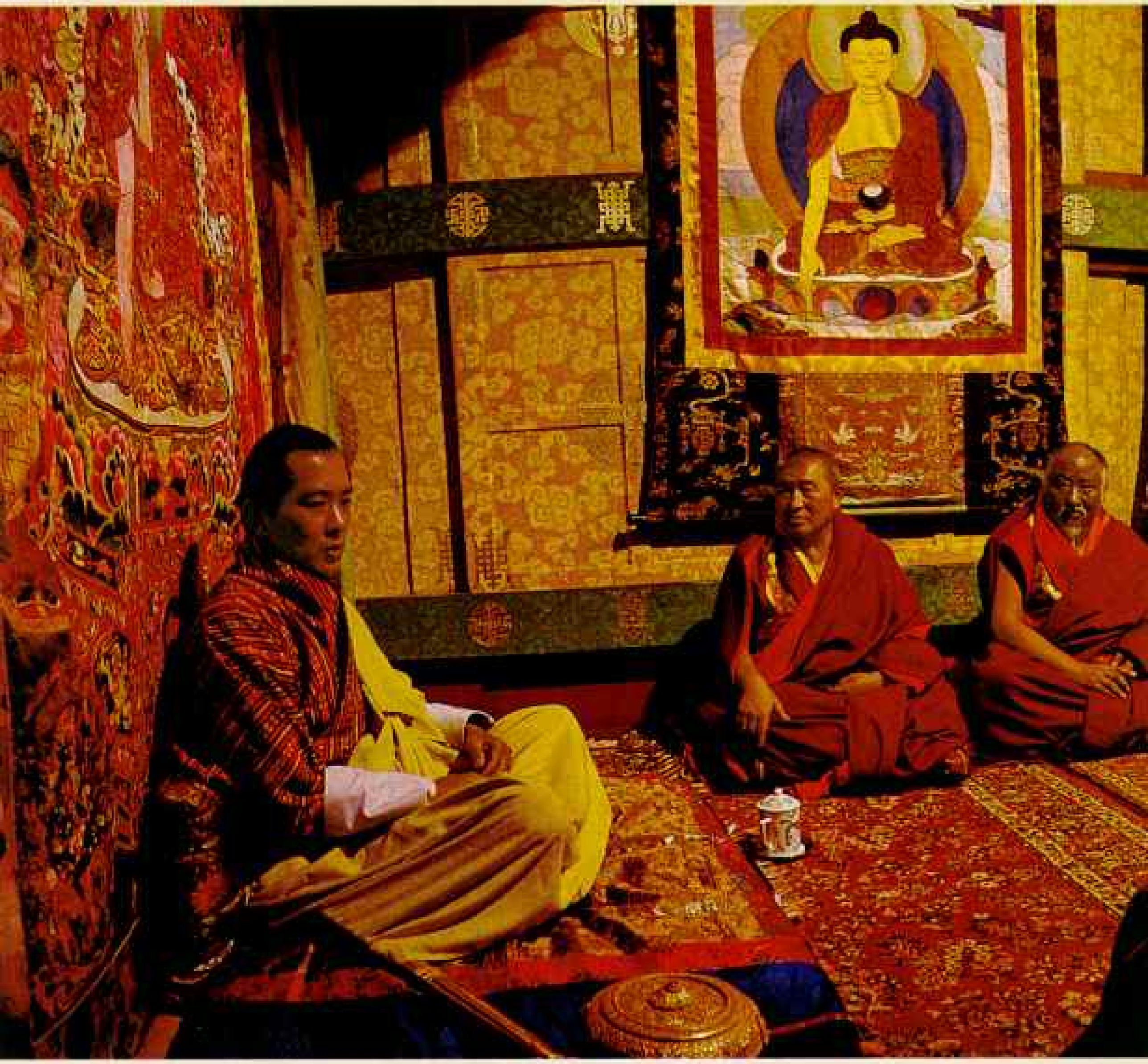
Around Chicagoans like this, who believe they can do anything and will not be told otherwise, you get the feeling that maybe someday the Cubs will even make it to the Series. □

BHUTAN

Kingdom In The Clouds

In serene isolation, a dzong, or monastic fortress, in central Bhutan reflects the spirit of this Himalayan kingdom, thrust into the glare of modern times after centuries of solitude.

By BRUCE W. BUNTING
Photographs by JAMES L. STANFIELD
NATIONAL GEOGRAPHIC PHOTOGRAPHER



Church and state entwine in Bhutan, where King Jigme Singye Wangchuck (above, at left) wears a yellow scarf, symbol of his authority, as he consults with Buddhist leaders on matters of public policy.

His audience this day: the four lopons, or masters, of the central monastic body in Bhutan.

"Only through a blend of tradition and modernity can we enhance the quality of life of our people," declares the 35-year-old monarch, a hands-on ruler who speaks flawless English and used to play a decidedly un-Bhutanese sport—basketball—in his spare time.

To unify his nation, an ethnically diverse people scattered in remote villages, the King often leaves his Thimphu palace and travels to districts like Paro (right) to meet elected representatives.

He also works to bolster cultural identity, vulnerable now that Bhutan has ended its historic isolation. The National Assembly recently approved a plan to restore driglam namzha, an ancient code of conduct, and to punish offenders with fines or jail. The code dictates the wearing of traditional dress, such as the kimono-like gho, which the King tied around his waist when playing basketball.

IT WAS BITTER COLD in the long shadows of Jhomolhari, one of Bhutan's tallest mountains, and a village *gomchen*, a lay priest, whose claret-colored robes billowed in the wind, was hoping for snow.

"I always pray to the local deities for snow when you outsiders come to our valley, so you will go away," he said, looking me in the eye and leaning on a stave. "You use all our firewood and show little respect for our traditions."

As an environmentalist concerned with keeping this naturalist's Shangri-la as it is—a land of pure air, fragrant pine forests, and diverse wildlife—my sympathies were with the priest.

Dogs run free in Thimphu, the capital of Bhutan, where Buddhist reverence for life makes the killing of strays intolerable.

How, I wondered, could Bhutan, a Himalayan kingdom emerging from its medieval past, join the modern world without sacrificing its rich natural heritage, not to mention its cultural traditions?

I had no time to consider the question further, for the gomchen's prayers were soon answered. The skies clouded, and the snows came. My party of six—which had been surveying the rugged border near Tibet for the World Wildlife Fund—just managed to escape through the mountain pass the next day. Then the weather sealed off the upper Paro Valley, leaving it in seclusion once more.

Just as snows guarded the Paro Valley, so have the Himalaya long shielded Bhutan from the outside world. Wedged between China and India, Bhutan covers only 18,000 square miles, about the size of Switzerland. Like Switzerland, most of Bhutan is wrapped in mountains, but this sparsely settled country of about 700,000 people is scarcely touched by the modern age. Blue sheep, wild poppies, and the elusive snow leopard thrive in this isolation, and some Bhutanese will tell you that several varieties of yeti, the legendary Abominable Snowman, live here as well. It is also a land of orchids and tigers. During a recent visit I walked through a lush oak and rhododendron forest at an elevation of more than 10,000 feet. The night before, a large tiger had walked the same path, leaving its footprints. Tigers are well known in the lower elevations of southern Asia—but in Bhutan there are confirmed sightings as high as 12,000 feet.

In Bhutan's capital of Thimphu (population 30,000), you may find black bears or wild boars in the backyard. "Last year," a friend told me, "my wife was startled by a black panther when she went out to see why our dog was barking." Dogs far outnumber cars on Thimphu's sleepy streets, which have no need of traffic lights. The city has only two gas stations. Although traders, traveling on foot or by yak, have plodded the country's network of trails for a thousand years, Bhutan had little use for gasoline until 1962, when its first highway was finished, linking Thimphu with Phuntsholing on the Indian border.

Since opening to the outside world, this nation, which Bhutanese know as Druk Yul (Land of the Thunder Dragon), has moved toward modernization while holding to the traditional cultural values of Mahayana Buddhism, which Bhutan shares with some of its Himalayan neighbors.

To reach Taktshang (Tiger's Den) Monastery, one of Bhutan's most revered Buddhist sites, I obtained the necessary permits and, accompanied by a monk named Gempo Dorji, began the long, slow climb from 7,000 to 10,000 feet. We passed in and out of sunlight, up worn, slippery steps carved into the cliff face, trudging

BRUCE W. BUNTING, a vice president of the World Wildlife Fund, has been a regular visitor to Bhutan since 1986, the year he helped upgrade Royal Manas National Park.

toward the stone monastery at the top. From the distance Tiger's Den appeared to be an integral part of the mountain itself, teetering high above the valley. Below I saw a land carpeted with thick green pine and spruce, interspersed with rice fields and houses where red chilies dried on the rooftops.

According to ancient scripture, a saint known as Guru Rimpoche (Precious Teacher) landed on this mountain from Tibet in the eighth century, astride a flying tiger. The guru, who had come to fight spirits then plaguing the Bhutanese kingdom, later became one of the country's most important religious figures.

Gempo guided me through the shadows of 40-foot cypresses, Bhutan's national tree, and past conifers draped with moss. We reached a waterfall cascading down the cliffside at the entrance to Taktshang and quietly crossed stepping-stones set in a pool, which spilled out into a ravine some 250 feet below.

"The waterfall helps focus one's meditation," said Gempo, making his way easily to the other side.

I followed, and he explained how some monks have mastered a form of meditation called *lunggom*—literally "walking on air"—which allows them to bound across the landscape with great strides. "Unfortunately, it takes much time to learn the theoretical *(Continued on page 88)*

NGS CARTOGRAPHIC DIVISION
RELIEF ART BY JOHN A. BONNER

Timeless, modern Bhutan

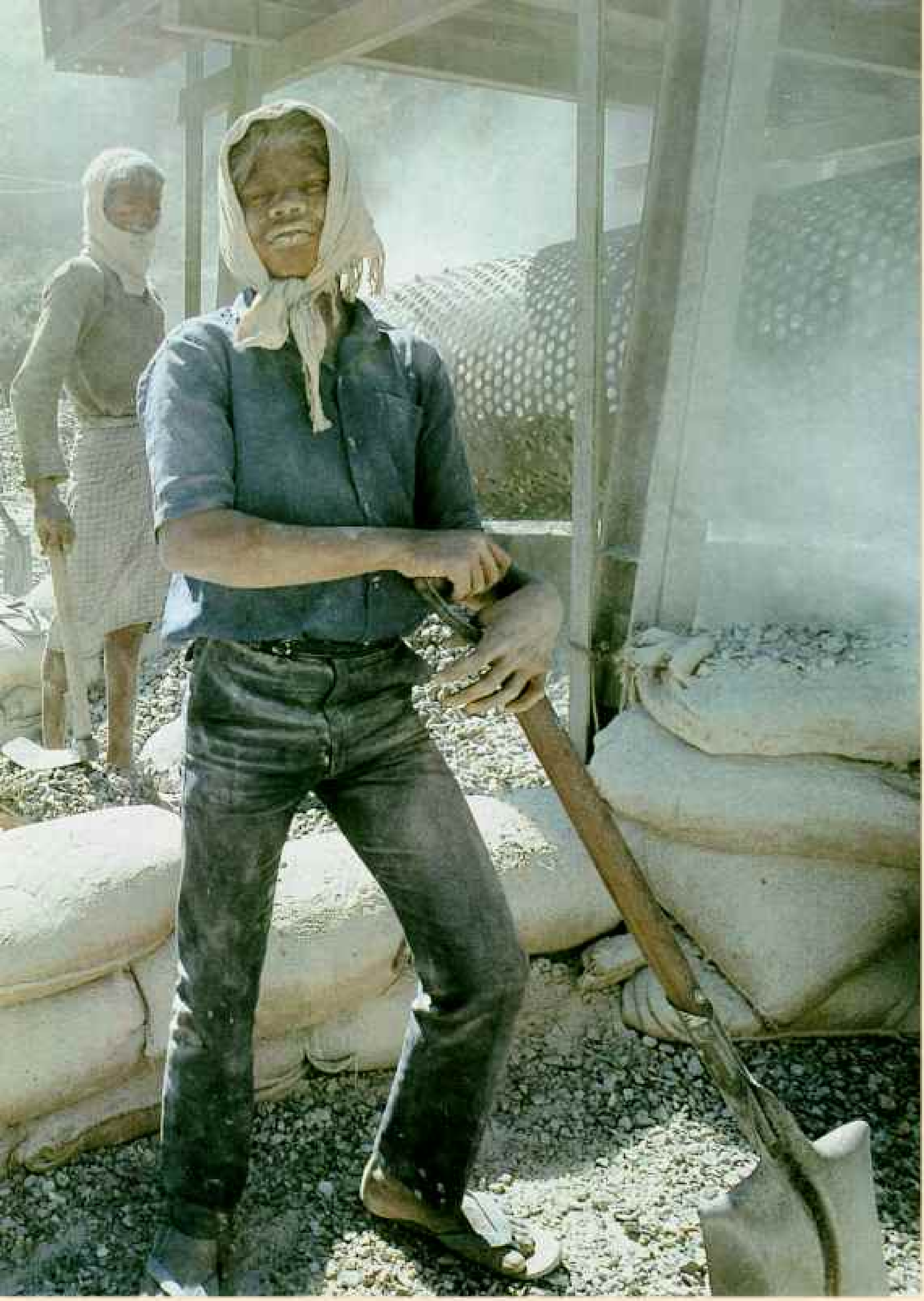
AREA: 18,147 square miles. **POPULATION:** Approximately 700,000. **CAPITAL:** Thimphu. **RELIGION:** Mahayana Buddhism, Hinduism. **LANGUAGE:** Dzongkha, Tibetan and Nepali dialects. **LITERACY:** 30%. **LIFE EXPECTANCY:** 48 years. **ECONOMY:** Food processing, distilling, handicrafts. Export crops: fruit, vegetables, cardamom.

Wedged between giants, Bhutan is linked historically and culturally with its northern neighbor, Tibet. Yet politically today's kingdom has drawn much closer to India.

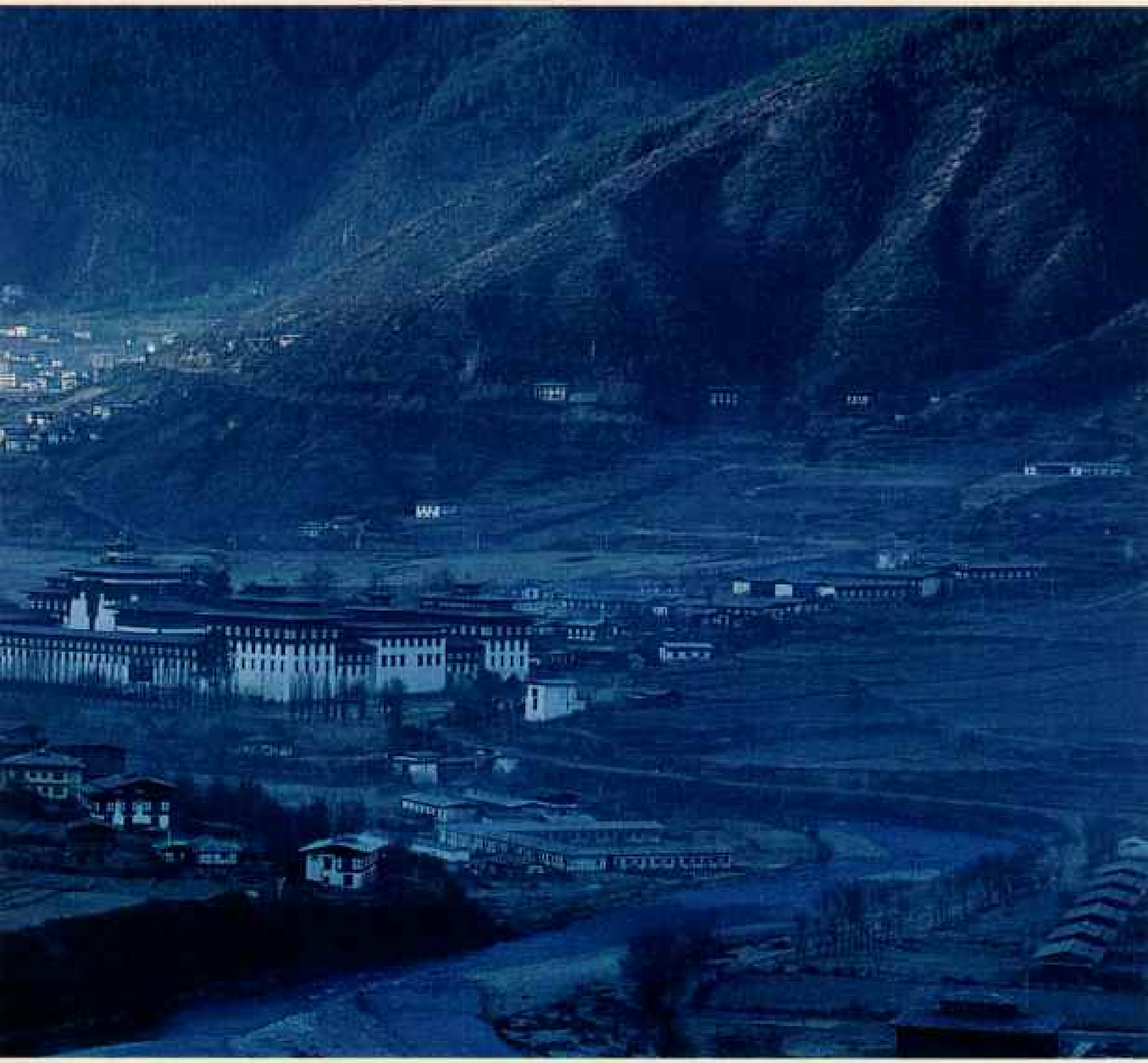
Known as Druk Yul, Land of the Thunder Dragon, Bhutan was a loose confederation of fiefdoms until 1907, when it elected its first hereditary king. In the 1950s Bhutan began moving toward modern systems of health care and education. Development proceeds cautiously; Bhutan severely limits tourism and the logging of forests, which cover half its territory.

Indian imports, a stone-crushing crew from West Bengal gathers roadside debris to extend the runway at Paro's airport.

With its own work force busy on farms, Bhutan depends on Indian workers to fill many kinds of jobs. In 1910 a similar



project—the building of a railroad nearby in India—brought an influx of settlers from Nepal. Today one in four Bhutanese is an ethnic Nepalese, and trouble is brewing. Demonstrations have recently turned violent, as the Hindu residents protest Bhutan's "national identity" campaign, including driglam namzha and new restrictions on Nepalese immigrants.



The father of Bhutan was a Tibetan lama named Shabdrung Ngawang Namgyal, who unified the country under his rule in the 17th century. To fend off invaders, Shabdrung built fortified dzongs in nearly every valley. The Tashichho Dzong in Thimphu (above, foreground) has been besieged numerous times—mostly by Tibetan warlords. Today it serves as combination monastery and capitol, housing everything from King Wangchuck's ornate throne room to the national archives.

It was the young monarch's father, King Jigme Dorji Wangchuck, who opened Bhutan to the outside world. Alarmed by China's invasion of Tibet in 1950, he forged strong ties with India, which today gives about 25 million dollars a year in aid. The King brought the first highway to Bhutan in 1962. And he abolished serfdom, widely practiced when he took the throne.

At the market in Paro (left), villagers haggle over the price of yak meat. No devout Buddhist would kill an animal, so most butchering is done by a northern people called the Makheps, who were the designated butchers in Tibetan society before they fled the Chinese invasion.

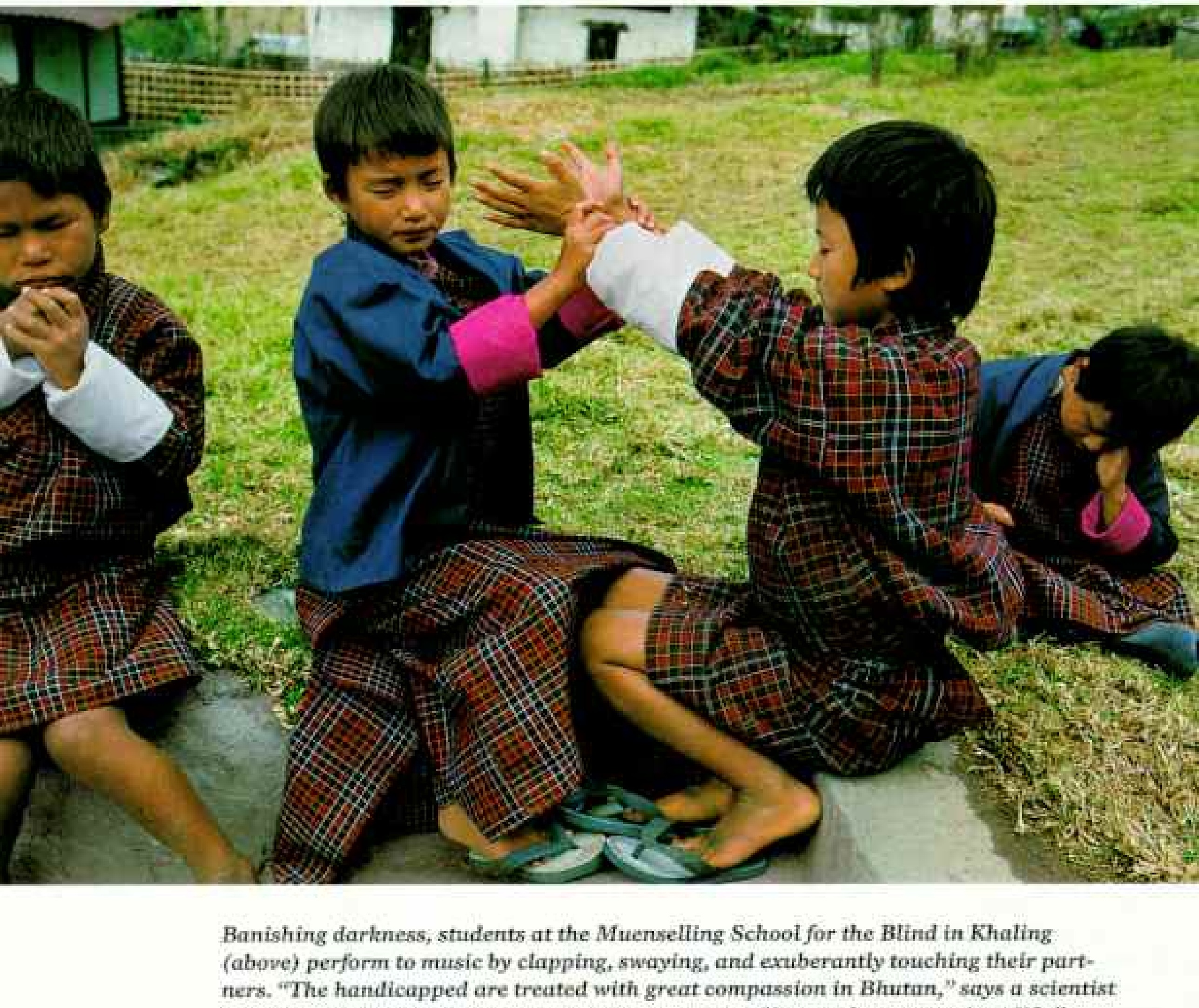
aspects of lunggom before one can put it into practice," he said, sighing as he turned to climb again, "so I am afraid that we will just have to walk normally."

We explored a succession of caves and meditation chambers that smelled of incense, the walls lit by flickering yak-butter lamps. Now and then I heard the faint tinkling of bells in the wind and the chanting of monks.

Finally at the top, I stood before a statue of Guru Rimpoche, who often changed his form to combat spirits. Here he had changed into the guise of the fearsome Dorji Droloe—eyes wide, teeth flashing, his fabled tiger mount flying beneath him.

At that moment it was as if I had been plunged into a world where time ceased to exist. The old ways still matter here, even as the country seeks a place in the modern world. This often makes for certain incongruities.

Taking a path through the forest, you stop to watch a farmer chipping wood . . . and he pauses to converse with you in nearly flawless English. Or you find, among Bhutanese postage stamps depicting monasteries and weavers, a stamp with Donald Duck's image printed on it. Or a government minister interrupts an interview, produces a shortwave radio from his desk, and proceeds to tune in the closing minutes of a Los Angeles Lakers basketball game.



Banishing darkness, students at the Muenselling School for the Blind in Khaling (above) perform to music by clapping, swaying, and exuberantly touching their partners. "The handicapped are treated with great compassion in Bhutan," says a scientist from Thimphu. "They're thought to have an excess of karma from a previous life."

At a painting school in Thimphu, budding artists practice with stylus and chalk (facing page). Art in Bhutan—even the work of a master—is anonymous, an act of piety.

WALKING through Thimphu on my first visit in 1986, I was drawn by a crowd gathered around an outdoor basketball court.

I heard the thump of a basketball and the scuffle of sneakers, and then saw Bhutan's young King, Jigme Singye Wangchuck, for the first time. Dark-haired and straight-backed, he was dressed in the traditional robe, or *gho*, all Bhutanese men wear. The King worked his way down court with regal assurance, dribbling past defenders who gave him a wide berth. He sank the basket.

The 35-year-old King faces the daunting task of building a modern nation, an effort complicated by the politics of southern Bhutan, where activists are demanding reform. During clashes last fall between government security forces and demonstrators, at least three people were killed and several others injured.

The Bhutan People's Party, an outlawed political organization composed of ethnic Nepalese, initially claimed that hundreds of protesters were killed, a casualty figure denied by the royal government. Accounts in Bhutan's national newspaper, *Kuensel*, said that the demonstrators rioted, set off bombs, ransacked state offices, killed one policeman, and injured 15 citizens.

At the bottom of the affair is a battle of cultures, between the Drukpas of the north and the ethnic Nepalese of the south. Most of the country's government, including the King, is composed of Drukpas, Buddhists who have inhabited the mountains for centuries.

Many of the southerners, most of whom are Hindus, came to Bhutan to work as farmers early in this century. They are coming still, seeking jobs and fertile land. In recent years thousands of Nepalese have resettled as illegal immigrants in southern Bhutan—one reason the royal government recently imposed restrictions on all residents.

King Jigme Singye Wangchuck is clearly concerned about the instability. He worries that the nation's cultural traditions might someday be swamped by the Nepalese living in Nepal, who outnumber Bhutanese almost 25 to 1.

In an attempt to integrate the Nepalese culture in Bhutan, the royal government has used financial incentives to encourage marriage between ethnic Nepalese and northerners. To establish Bhutan's distinct identity, a national dress code has been imposed, requiring that all citizens wear traditional clothing. Bhutanese who do not comply face possible fines or jail. The government has also stopped teaching the Nepali language in schools.

"We want to unify the country as a single entity," the King said recently. "It is too small to maintain diversity. We want the people living in the south to stop regarding Nepal as their motherland. We are all Bhutanese."

In an interview, he also told me that he wants to see political change. "We are

definitely not opposed to democracy and are confident that we will resolve our ethnic problems. We would like to develop rapidly, but we would also like to ensure that there is a certain amount of harmony between rapid development and our culture and environment."

This country relies heavily on foreign assistance from India and other nations, which contribute about 65 million dollars of Bhutan's annual budget of a hundred million dollars. Now, according to government officials, Bhutan will begin relying more on private enterprise for its economic development.

"Our international friends have been most helpful in facilitating Bhutan's economic development," said Dasho Leki Dorji, secretary of the Ministry of Agriculture. "But it *(Continued on page 94)*

The true colors of Bhutan are woven in soil: Nine out of ten Bhutanese are farmers like Sonam Yudron, who lives near Lumitsawa, and most harvests are bright with chilies drying on rooftops. Sonam stores her rice in the shed and guards it

round the clock; nearly 30 percent of Bhutan's crops are ruined by wild boars, deer, or monkeys.

Only a tenth of Bhutan is arable land. Still, says the author, "you can grow almost anything" in its diverse climate, which ranges from subtropical to alpine. Some growers are turning to cash crops—oranges, apples, apricots, and cardamom—for export to Asian markets.

Working hand in hand with Thimphu's modern hospital, the indigenous hospital nearby practices gsoba rigpa, *the traditional Bhutanese medicine, which has roots in Himalayan folk cures and Buddhist theology.*

Once admitted, patients are diagnosed using a long, careful reading of the pulse (above). "The pulse is made up of three elements," explains Dungtsho Dorji, a staff physician, "loosely translated as air, bile, and phlegm. By measuring these, we can tell how the body is out of balance and determine the cause."

Treatment may take many forms. The doctor might simply counsel a patient to change his diet or behavior. If all else fails, a migraine headache may be relieved with gtar, *or bloodletting, into a metal pan (right). Arthritis of the elbow is treated with medicinal herbs, by applying a compound that is then ignited (above).*

"These techniques may look primitive, but they're not," says Paolo Morisco, an Italian physician in Bhutan. "These doctors have been treating the common cold with herbs for a thousand years."

There are limits, however, to what traditional medicine can do. Bhutan's life expectancy, 48 years,

is the second lowest in Asia; its infant-mortality rate is 128 per thousand, compared with 95 in India and 22.5 in Sri Lanka. With UNICEF support, the kingdom recently built a network of free health clinics and began vaccinations. Another breakthrough came when the King persuaded rural monks to emphasize hygiene in their teachings—and to refer all sick infants to the local clinic.

is now essential that Bhutan encourage the private sector to take over. When you have your own money invested, you are in for the long haul. That is the type of friend Bhutan needs now."

BHUTAN HAS BEEN SLOW to take advantage of its natural resources, leaving its extensive forests virtually untouched and most of its rivers running free. Only a few dams have been built to date; the largest, part of the Chukha Hydel Project, produces about 25 million dollars in government revenues each year, from electricity sold to India.

Similar projects will be undertaken only after the King and his advisers are satisfied that they can be built with minimal damage to the environment.

"Our forests are a unique reservoir of genetic material," Dasho C. Dorji, deputy minister of Bhutan's planning commission, told me. "They can never be replaced once they are gone, so we will not rob from our children's future to pay the cost of development today."

To preserve the best of its wild landscape, Bhutan has set aside more than 20 percent of its land in a system of ten reserves. One of the most outstanding of these is Royal Manas National Park, a 165-square-mile sanctuary for many of the endangered species of southern Asia. Here you find elephants, golden langur monkeys, tigers, wild buffalo, and gaur, a species of wild ox. More than 500 bird species thrive here as well.

While Bhutan's natural environment remains strong, the country lags behind its neighbors in many measures of material well-being. It is one of the least developed nations in the world; its infant-mortality rate, one of the worst. Its literacy rate is, at best, about 30 percent. However, Bhutan is making progress. Its gross national product grew rapidly in the 1980s, and its health care and educational systems are improving.

"You have to understand," said Father William Mackey, a Canadian Jesuit who came to Bhutan in 1962 to teach school, "that this country has one foot in the Middle Ages and the other in the 21st century. It's made remarkable progress." Now Father Mackey, who helped establish Bhutan's first college, watches over an educational system that has grown to include 180 elementary and secondary schools.

Despite such signs of change, much of Bhutan remains as it has always been, an unspoiled land of farmers and herders of yaks and cattle. Some 90 percent of Bhutanese live in the cold, clear heights as their forefathers did, following livestock through the high summer meadows, planting plots of rice and chilies in the valleys. People like Tshering Dem, a woman I met in the northern village of Soe near the base of Jhomolhari, still follow the ancient rhythms.

With a warm smile Tshering invited me and my friends to sit by her hearth

on a cold spring afternoon. Together we watched pine smoke curl from her kitchen fire, sipped warm bowls of yak-butter tea, and talked about the sorts of things that concern farmers everywhere—the price of meat, the cost of clothing, the health of the herd.

Tshering joined her father in the brisk air outside to call in the family's yak herd. The stout, shaggy animals came readily home, assembling at the entrance of their pen beneath Tshering's house. Each yak, exhaling steam, tossed its head, from which hung the brightly colored tassels that identify ownership. The great beasts provide milk, hides, and meat for Tshering's whole family, which also trades yak meat and cheese for other staples—salt, tea, wheat, rice, and cookware.

"Our life is hard but very peaceful," Tshering said, summing up the timeless Bhutan that endures despite the country's growing tensions.

And what of tomorrow's Bhutan?

The nation had already made a long journey in a short while, emerging into modern times in just three decades. As Bhutan finds its way toward the future, I hoped that it would prosper while remaining the place I had come to admire—a country of gentle, proud people, immense forests, clear mountain streams, and venerable monasteries, wreathed in Himalayan fog and mystery.

Anything goes when villages face off in archery, Bhutan's national sport. Archers are allowed to jeer an opponent, jump in front of the target as he shoots, or undo him between shots with homemade wine and groups of "seven, nine, or eleven women dancers." The pressure has driven most players from wooden bows to state-of-the-art imports.

At a restaurant in Tashigang (above), a woman rolls cigarettes for her husband, who wears a hat made from yak hair. Its "horns" carry rainwater away.

Life revolves around yaks in the western highlands, where seminomadic herders like the Gakhis use the shaggy beast to supply most of their material needs. Their vat contains yak milk, boiled over a fire (fueled by yak dung and wood) to make butter

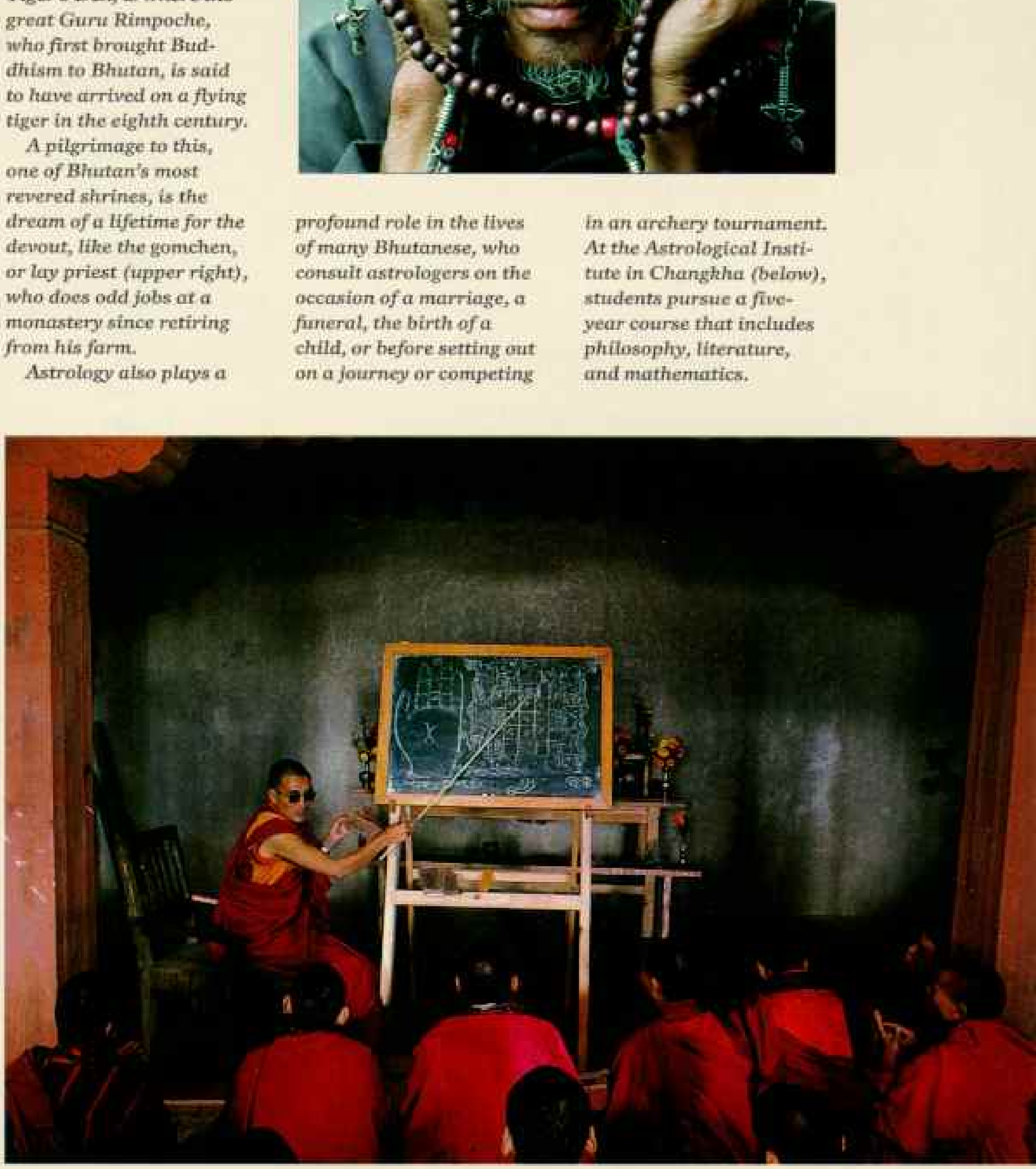
and cheese, which the family eats, sells, or trades. Yak meat feeds them, and yak hair provides the fabric for their clothes and tents. And, yes, even yak tails are put to use: They are sold as fans or dusters.

Wealth, says King Wangchuck, must be measured in scenes like this; no one starves in Bhutan, despite its rank among the least developed nations.

The path of enlightenment is lonely and narrow for monks at Taktshang Monastery, who take turns meditating alone in a cliffside retreat (left) for three years, three months, three weeks, and three days. Taktshang, the Tiger's Den, is where the great Guru Rimpoche, who first brought Buddhism to Bhutan, is said to have arrived on a flying tiger in the eighth century.

A pilgrimage to this, one of Bhutan's most revered shrines, is the dream of a lifetime for the devout, like the gomchen, or lay priest (upper right), who does odd jobs at a monastery since retiring from his farm.

Astrology also plays a profound role in the lives of many Bhutanese, who consult astrologers on the occasion of a marriage, a funeral, the birth of a child, or before setting out on a journey or competing in an archery tournament. At the Astrological Institute in Changkha (below), students pursue a five-year course that includes philosophy, literature, and mathematics.



Once forbidden to outsiders, a glimpse of the Himalaya in Bhutan is as tantalizing as the sighting of a rare and beautiful bird. This mountain is Jhomolhari, at 23,996 feet Bhutan's second highest peak. In the foreground a fortress built to repel Tibetan invaders crumbles to the ground.

After a thousand years of solitude, the hermit kingdom is trekking over steep ground to reach the modern world. Its gentle pace, for better or worse, is a choice made long ago.

"You have to understand," says a Jesuit priest who has lived in Bhutan for decades. "By and large, most of this country still exists in the time of King Arthur." □

LYNN ABERCROMBIE, PHOTOGRAPHED AT IRAQ MUSEUM, BAGHDAD (LEFT); FREER GALLERY OF ART, SMITHSONIAN INSTITUTION

IRAQ

CRUCIBLE OF CIVILIZATION

From the gilded bulls of pre-Babylonian Sumer to the sinuously figured lusterware of Islam's golden age, an epic parade of peoples and empires has left its mark on ancient Mesopotamia. Birthplace of the written word, Iraq today endures the bitter fruits of another of its traditions: war.

By MERLE SEVERY
ASSISTANT EDITOR

The great storm howls above. . . .
In front of the storm fires burn;
the people groan. . . .
In its boulevards, where the feasts
were celebrated,
scattered they lay. . . . the people
lay in heaps. . . .
"Alas for my city . . . alas for my house. . . ."

COULD THIS BE 20th-century Baghdad, historic capital of Iraq? No. It is a lamentation over the destruction of Ur, traditional birthplace of Abraham, in the delta of the Tigris and Euphrates Rivers, at the northern end of what is today the Persian Gulf. The time is about 4,000 years ago, in the fiery morn of civilization.

Mesopotamia—the "land between the rivers" that forms the heart of modern Iraq—gave to the world writing, the wheel, the 60-minute-hour, the 360-degree circle, and codes of law. In ancient—and modern—times the region also fomented tyranny, terror, and brutal aggression. Like Cain and Abel, war and civilization grew up together here, where legend places the Garden of Eden.

Let us for a moment examine this land whose legacy to the world is a singular blend of the creative and the destructive.

Archaeology reveals that around 3500 B.C. the world's first cluster of cities arose in ancient Sumer, or lower Mesopotamia (map, pages 106-107). They were cities with names such as Ur, Eridu, Uruk, Lagash, and Nippur. As they jostled for precedence, a council of elders might choose a *lugal*, or "big man," for temporary leadership in time of crisis. As more independent cities arose and encroached on one another, the crises became continual. So the lugal stayed on and consolidated his hold. In time kingship was "lowered from heaven"; kings began to rule by divine right, some eventually becoming gods themselves.

City-states coalesced into kingdoms under the most powerful. Territorial aggression expanded them into the first empire—that of Sargon of Akkad, whose armies around 2300 B.C. pushed to the cedars of Lebanon, the silver-rich Taurus Mountains of Anatolia, and eastward to Elam, source of stone.

Technology played its role. The long-range composite bow enabled Sargon and his grandson Naram-Sin to usher in the first missile age. Metallurgy that produced the plowshare that greened the fields with grain also forged weapons that reddened those fields with blood. Writing tallied crops—and conscripted men.

The potter's wheel was tipped on its side to create the wheel. Hitched to the now domesticated horse, the light, two-wheeled chariot became the spearhead of the Assyrians, at their height in the ninth to seventh centuries B.C. A regular standing army, swords and spears of iron as well as bronze, siege craft, calculated atrocities as psychological warfare—with these the Assyrians made war their business

and thrived on the dividends of conquest.

In extending their iron hand around the Fertile Crescent, from the Persian Gulf to Egypt, the Assyrian warrior-kings overreached. In 612 B.C. a coalition of Medes, Scythians, and Chaldeans besieged and destroyed Nineveh, wiping the mighty Assyrian empire and its capital from the face of the earth.

In the eighth century A.D., under Harun al-Rashid of *Arabian Nights* fame, Islam entered a golden age. Artists and scholars flocked to Baghdad, the new capital on the Tigris. But in time the caliphs' power ebbed, no longer matching their pretensions. The Mongols struck, destroying irrigation works, sacking Baghdad, building pyramids of skulls.

Süleyman the Magnificent, and then Shah Abbas, conquered Baghdad, and Mesopotamia became a battleground between the Ottomans and the Persians.* In the mid-19th century, this region of decayed towns, arid countryside roamed by nomads, and mounds of crumbled, serpent-infested brick caught the eye of European archaeologists. Colossal winged bulls and startling bas-reliefs of Assyrian lion hunts and sieges were excavated and shipped home. They drew awestruck crowds to the British

*See "The World of Süleyman the Magnificent," by the author, in the November 1987 GEOGRAPHIC.

A gift without equal, writing appeared in Mesopotamia about 3200 B.C. From simple depictions of commodities, such as those on a tablet in the Iraq Museum (below), the system evolved to include the abstract symbols of cuneiform. This in turn opened the door to written history and other scholarship, such as a world map and its accompanying text (left). Assyrian archers, a battering ram, and impaled captives (bottom), represent the dark side of Mesopotamia's legacy.

NATIONAL GEOGRAPHIC PHOTOGRAPHER VICTOR R. BOSWELL, JR., BRITISH MUSEUM, LONDON (TOP); LYNN ABERCROMBIE, IRAQ MUSEUM

VICTOR R. BOSWELL, JR., BRITISH MUSEUM

CALENDAR OF EVENTS

6000 B.C. As early herdsmen and farmers from the north filter into the Tigris and Euphrates River basins, villages and towns appear. Stockbreeding, grain cultivation, and irrigation evolve to form the agricultural basis of the prehistoric Ubaid culture.

3500 B.C. Irrigation systems create the food surpluses needed to nurture the world's first cities. Their inhabitants, the Sumerians, invent writing, a cornerstone of civilization. A powerful priesthood emerges to serve local deities, whose temples dominate each city.

3000 B.C. Ruled by newly powerful leaders, the first kings, cities become city-states. With lance and shield, they clash for power. Trade blossoms with cultures in Anatolia, Syria, Persia, and the Indus Valley.

2300 B.C. Armed with spears and arrows, the Akkadians, under their king Sargon, subdue the Sumerians, creating the first Mesopotamian empire. After a Sumerian revival the region splinters into small kingdoms, absorbing incursions from both east and west.

1792-1595 B.C. Under Hammurapi, whose legal code commands an eye for an eye, Babylon gains ascendancy. Commerce, astrology, and the arts flourish before Babylon is sacked by the Hittites.

1595-1157 B.C. The Kassites—a tribe from the Zagros Mountains—control southern Mesopotamia; in the north Assyria gains strength.

883-612 B.C. Following a 300-year Mideastern dark age, a resurgent Assyria, with chariots and iron weapons, forges an empire that controls the entire Fertile Crescent, from the Persian Gulf to Egypt.

612-539 B.C. Medes, Scythians, and Chaldeans oust the Assyrians. A Neo-Babylonian empire emerges. Nebuchadnezzar raises Babylon to new glory and takes the Israelites captive.

539 B.C.-A.D. 637 Eleven centuries of foreign domination begin with the conquest of Babylonia by the Persians in 539 B.C. Following Hellenistic rule starting with Alexander the Great (who dies at Babylon in 323 B.C.), Mesopotamia is controlled for 350 years by the Parthians, then by the Sassanids.

A.D. 637 Five years after Muhammad's death at Medina, Arabs seize the Sassanid stronghold of Ctesiphon, gaining control of Mesopotamia.

A.D. 750-1258 The Abbasid Caliphate establishes its capital at Baghdad, which becomes the beacon of an Islamic golden age in the arts and sciences.

A.D. 1258 The Mongols destroy Baghdad, a city of 800,000 people, ending Abbasid rule. They become assimilated into Islamic culture.

A.D. 1534-1932 Süleyman the Magnificent enters Baghdad. Some 400 years of Ottoman dominance end with the British occupation in 1917. In 1932 Iraq is admitted to the League of Nations as an independent state.

IVORY PANEL, SYRIAN, CA 750 B.C.; LYNN ABERCROMBIE, IRAQ MUSEUM

ANATOLIA

RIVERS

TURKEY

SYRIA

Tell Halaf

Aleppo

Ebla

Zenobia

Archaeological gold mine, a 260-room palace here has yielded more than 20,000 cuneiform tablets. A Mesopotamian trading hub, Mari was ruled by Semitic-speaking kings.

Dura Europos

Mari

Palmyra

For a thousand years or more, the desert metropolis of Palmyra—a cultural synthesis of East and West—was an entrepôt for caravans between the Mediterranean and the Euphrates.

ASHTAR, BABYLONIAN GODDESS OF LOVE, CA 2ND B.C.; VICTOR B. SCHRELL, JR., THE LOUVRE, PARIS

SYRIA IRAQ

IRAQ JORDAN

Syrian Desert

Black Sea

U. S. S. R.

Caspian Sea

TURKEY

SYRIA

Mediterranean Sea

LEBANON

Baghdad

IRAN

ISRAEL

West Bank

IRAQ

JORDAN

Gaza Strip

KUWAIT

Persian Gulf

SAUDI ARABIA

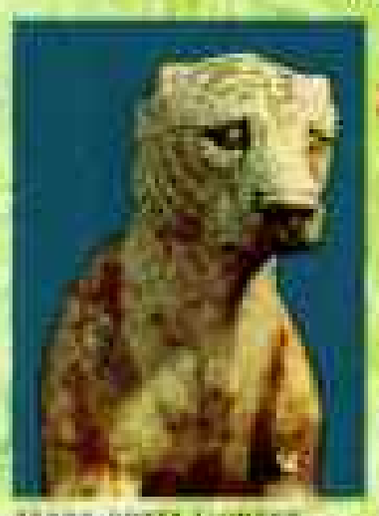
EGYPT

Red Sea

Fertile Crescent. Richer in human potential than in soil, the cradle of Western civilization—an arc reaching from Mesopotamia to Egypt—arose by the third millennium B.C. To the east a similar florescence occurred in the Indus and Yellow River Valleys.

IRAQ'S ANCIENT HERITAGE

An awesome record of human achievement defines the history of Mesopotamia, the "land between the rivers." Traditional birthplace of man for Jews, Christians, and Muslims, it provided seed and soil for nearly all that is good and evil in modern life: literature, medicine, and science; despotism and warfare. Unprotected by natural barriers, at the mercy of unpredictable rivers, the region endured and profited from legions of invaders and migrants, whose blood mingles with that of today's Iraqis.



TERRA-COTTA LIONESS, MARI?, CA 1900 B.C.; LYNN ABERCROMBIE, IRAQ MUSEUM

Tepe Gawra

Dur Sharrukin

Nineveh

Mosul

Balawat

Nimrud (Calah)

Arbela

Hasanlu

Jarmo

Enriched by plunder from the Assyrian capital of Nimrud under Ashurnasirpal II (883-859 B.C.) trumpeted his might through monumental sculpture, discovered during early British excavations.

Ashur

Nuzi

Tepe Gawra

Samarra

Euphrates

Dur Kurigalzu

Baghdad

Nippur

Chogha Mish

Ctesiphon

Tigris

Though young by Mesopotamian standards, Babylon had been the capital of Babylonia for more than a thousand years when it was sacked by the Assyrians in 689 B.C. Under Nebuchadnezzar, it rose phoenix-like to become the greatest city in the world.

Babylon

Karbala

Kish

Borsippa

An Najaf

Shuruppak

Nippur

An immense archive of cuneiform records, sacred Nippur served as the spiritual font of power claimed by Sumerian and Akkadian kings. Like Nippur, Uruk dates from the Ubaid culture. Its walls, according to legend, were built by Gilgamesh, epic figure of Mesopotamian literature.

Uruk

Lagash

Ubaid

Ur

Eridu

Traditional birthplace of Abraham, the royal city of Ur was abandoned in the fourth century B.C., possibly after the Euphrates changed course, leaving Ur enclosed by desert. Artifacts excavated at Eridu date from before 5000 B.C., fixing it as Mesopotamia's oldest city.

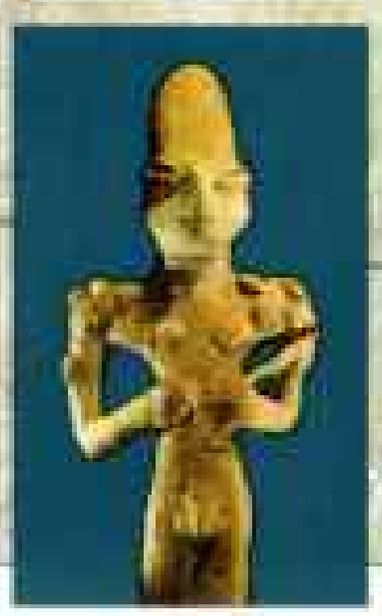
Tepe Mussian

Susa

Basra

Shatt al Arab

STONE FIGURE, SUMERIAN, CA 3000 B.C.; LYNN ABERCROMBIE, IRAQ MUSEUM



TERRA-COTTA FIGURE, UBAID, CA 3500 B.C.; LYNN ABERCROMBIE, IRAQ MUSEUM

IRAN
IRAQ

IRAQ
SAUDI ARABIA

IRAQ
KUWAIT

KUWAIT
SAUDI ARABIA

Al Jahrah

Kuwait

Al Khafji

Persian Gulf

Ancient shoreline (about 5000 B.C.)

Archaeological site

Modern city

0 50 km

0 50 mi

NGS CARTOGRAPHIC DIVISION

Museum in London and the Louvre in Paris.

Adventurer and archaeologist Austen Henry Layard wrote *Nineveh and Its Remains*, which became a sensation.

Henry Rawlinson, another British scholar, scaled a Persian cliff to record a trilingual inscription that gave him the key to cuneiform. Now the clay tablets brought from Nineveh to the British Museum by Layard could be read.

IN THE DAYS before Iraq became a bristling armed camp, I climbed the ziggurat at Ur, a stepped mountain of brick, the best preserved model of the biblical Tower of Babel. I gazed over the sand-drifted site of the Sumerian city excavated by the great archaeologist Leonard Woolley.

Where were the fields that had fed the city? The canals? Where was the Euphrates, which bore ships from as far away as India to Ur's two ports and whose waters moated its ramparts? I saw only sere and sterile wasteland rolling away on all sides. The river flows through a channel several miles north.

Scrupulous excavations, painstaking decipherment of the world's oldest writings by Samuel Noah Kramer and other Sumerologists, monumental mapping by land and air of the intricate irrigation systems by Robert McCormick Adams continued to illumine the

The lion of Babylon provided great snapshots for British troops following their occupation of Baghdad in 1917. In the next decade British archaeologist Leonard Woolley probed deeper into Iraq's past at Ur (bottom). In the mid-1960s an American team excavated a Parthian fortress above the even deeper secrets of Nippur. Of Iraq's 25,000 identified sites, fewer than 10 percent have been worked.

NATIONAL GEOGRAPHIC ARCHIVES

BRITISH MUSEUM

origins of civilization—even as the skies darkened over modern Iraq.

The Western world paid little heed when Iraq emerged from the wreckage of the Ottoman Empire, first as a British mandate in 1920, then as an independent monarchy in 1932. Or when a 1958 military coup set the stage for Saddam Hussein's climb to dictatorial power in an oil-rich, purposefully arming, increasingly jingoistic state. Even when he plunged Iraq and Iran into an eight-year-long bloodbath, three out of four Americans could not locate the Persian Gulf on a map.

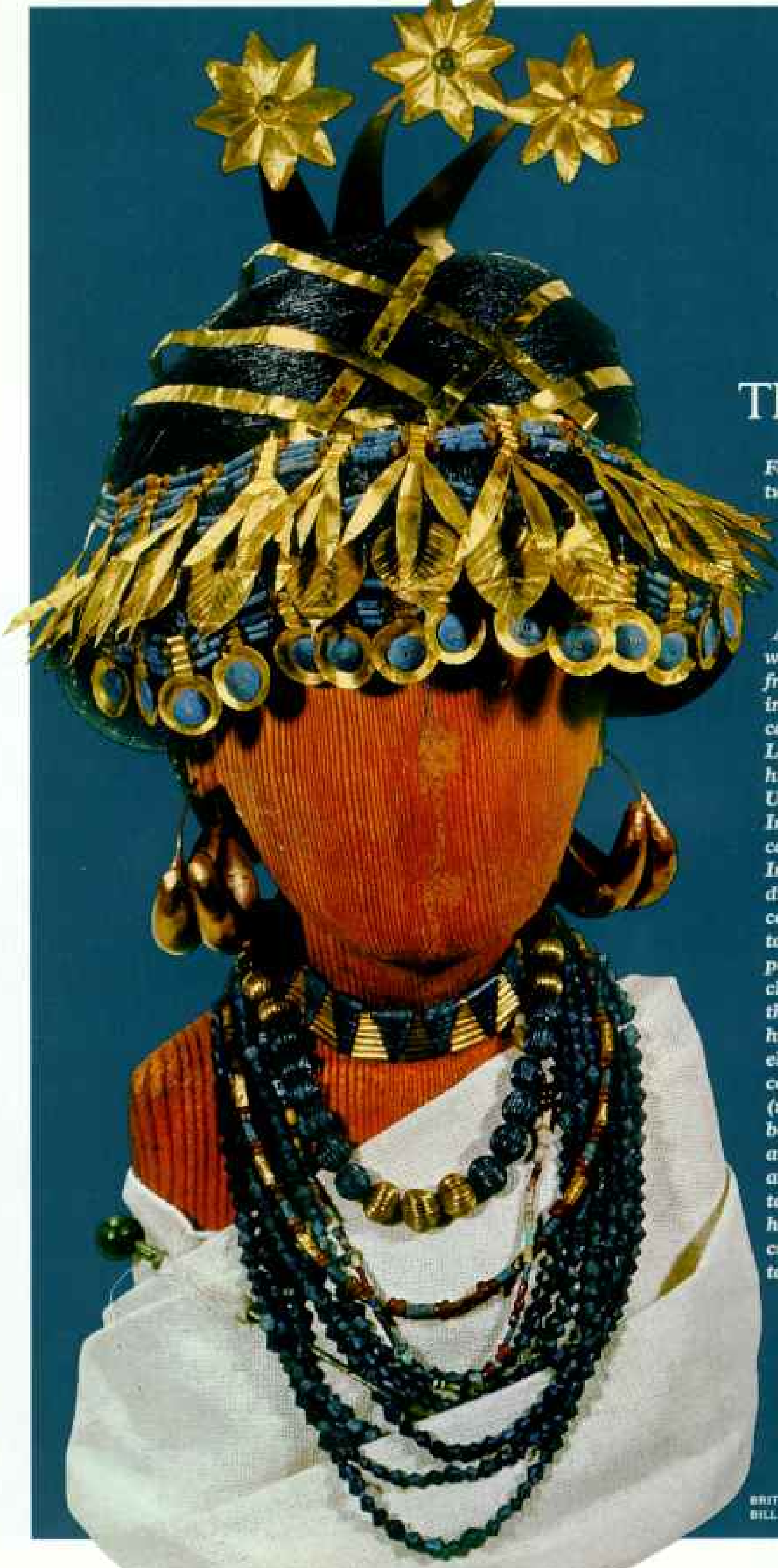
Abruptly, following the brutal invasion of tiny Kuwait in August 1990 and the United Nations' resolute response, Iraq burst into the world's homes with high-tech war on TV.

I recall strolling the ruins of Nebuchadnezzar's Babylon and trying to picture in those endless mounds the greatest city of antiquity, to imagine the Hanging Gardens, one of the Seven Wonders of the World—peopling the rubble with processions to the god Marduk streaming through the dragon-guarded Ishtar Gate and thronging the great ceremonial way.

I stumbled, stubbing my toe on a brick in the dust. I picked it up. It was inscribed with cuneiform characters. But I could no more make out its message than revelers at Belshazzar's feast could decipher the biblical warning, MENE, MENE, TEKEL, UPHARSIN, in which Daniel read the overthrow of Belshazzar and his kingdom. Indeed, Babylon fell to Cyrus the Persian, who was merciful in releasing the Jews from their Babylonian captivity.

That was in 539 B.C. Today those who, like Saddam Hussein, seek to command the Arab world beyond their own borders again overreach. What does the handwriting on the wall say now?

GEORGE GERSTER



GOLDEN ROYAL TREASURES

Fabulous ornaments from two hoards of grave gold reveal the remarkable wealth and craftsmanship of two Mesopotamian civilizations—the Sumerian and the Assyrian. An elaborately wrought headdress (left) from about 2600 B.C. was included among the burial caches discovered by Leonard Woolley during his historic excavations of Ur in the 1920s and '30s. In a find of equal significance just two years ago, Iraqi archaeologists discovered two eighth-century B.C. Assyrian tombs under the royal palace at Nimrud. In one chamber—the tomb of three Assyrian queens—hundreds of pieces of jewelry were found in pristine condition. They include (right): a gold crown embellished with rosettes; an armband with cloisonné and turquoise; and two tassled ornaments, a headdress and a palm-crested plaque of uncertain function.

BRITISH MUSEUM (LEFT); ALL BY BILL LYONS (FACING PAGE)

HEADDRESS, IRAQ MUSEUM

ARMBAND, IRAQ MUSEUM

CROWN WITH ROSETTES,
IRAQ MUSEUM

PLAQUE, IRAQ MUSEUM

EMPIRE BUILDERS OF BABYLONIA

Beginning in the 24th century B.C., the kings of Akkad forged Mesopotamia's first empire. Once thought to depict Sargon, founder of the dynasty, a bronze mask (right) is now believed to represent his grandson Naram-Sin, first ruler to claim divinity. During the first Babylonian dynasty under Hammurapi in the 18th century B.C., the land of Sumer and Akkad found greater political cohesion. Though heir to the tradition of the sword, the reform-minded ruler is known chiefly for his legal code. Atop a black stela inscribed with 282 of his laws (far right), he is seen standing before the god Shamash, patron of justice.

Warriors without rival, the Assyrians terrorized the ancient world. In a frieze from Nineveh (above) their last great ruler, Assurbanipal, dispatches a lion in this sport of kings. In the seventh century B.C. the Assyrian empire was obliterated by a vengeful coalition of subject nations. A Chaldean dynasty returned the empire's seat to Babylon. A glazed relief from the Ishtar Gate (right) recalls Nebuchadnezzar's boast: "On the threshold of her gates I set huge bulls. . . ."

VICTOR R. BOSWELL, JR., BRITISH MUSEUM

AND ASSYRIA

STEVE McCURRY, MAGNUM, IRAQ MUSEUM (LEFT); LYNN ABERCROMBIE, IRAQ MUSEUM (ABOVE); VICTOR R. BOSWELL, JR., THE LOUVRE

THE ADVENT OF ISLAM

Time seems frozen as Iraqi women approach the 1,100-year-old minaret at Samarra. When Islam came to Mesopotamia, it brought both unity and conflict. In A.D. 680 the Prophet Muhammad's grandson Husain was killed at Karbala while rebelling against the Umayyads, whom his Shiite followers considered usurpers. So the mosque at Karbala (below) is holy for today's Shiite majorities in both Iraq and Iran.

Distant kin of the Prophet, and thus acceptable to Shiites, the Abbasid caliphs made Baghdad the world's foremost center of learning. As illustrated by an Arabic version of a Greek medical text on rabies (left), Islamic scholars were custodians of Europe's ancient heritage while the Continent languished through its Dark Ages. □

FREER GALLERY OF ART

GEORG GERSTER (ABOVE); LYNN ABERCROMBIE (FACING PAGE)

Once and Future Landfills

How will we dispose of our trash when dumps like this one in New York City are full? Discoveries by garbage archaeologists clarify our options.

By WILLIAM L. RATHJE
Photographs by LOUIE PSIHOYOS

GARBAGE OUGHT TO BE simple to understand—it's the tangible result of our most familiar activities. But it's really a lost realm we're just beginning to explore.

I'm an archaeologist, with one small difference. All archaeologists study garbage; my refuse is just fresher than most.

I started examining modern garbage because I felt that if archaeologists can learn about ancient societies by exhuming old refuse, maybe sorting through fresh trash would produce new insights into our own society. So in 1973 my undergraduate students and I founded the Garbage Project at the University of Arizona. Over the past 17 years the insights have been astounding.*

We began by studying the contents of garbage cans and in 1987 moved on to landfills. From the beginning we knew there were plenty of popular myths about landfills. Perhaps the major one relates to what is being

*See "The Fascinating World of Trash," by Peter T. White, NATIONAL GEOGRAPHIC, April 1983.

buried in them every day. Most people, we found, believe that landfills are 20 to 30 percent fast-food packaging. They believe that another 30 to 40 percent consists of polystyrene foam and that 25 to 45 percent is disposable diapers. These items would seem to make up at least 75 percent of all landfills.

In fact, such estimates are pure illusion. The Garbage Project's excavations have dug out the facts, and they are startling. Fast-food packaging, for example, makes up only a quarter of one percent of the average landfill. Some of that packaging is polystyrene, although polystyrene products in general make up just 0.9 percent, and disposable diapers only 0.8 percent.

Garbage sorting can reveal other unsuspected truths. For example, there was the "great beef discovery." Poring over refuse straight from Tucson's garbage cans in the spring of 1973, we found that people were discarding inordinate amounts of edible beef—even entire steaks untouched. This phenomenon coincided with a national beef shortage. We attributed the waste to crisis buying—people rushing out to purchase cheap cuts they didn't know how to prepare and large quantities they weren't used to storing. The result was beef waste three times higher than normal. Our critics said this was merely a local aberration.

Up to their elbows in trash, the author's students and colleagues collect samples at New York City's Fresh Kills Landfill. The bucket auger behind them works like a giant cookie cutter, lifting cores intact from buried layers. By cataloging and analyzing such samples, archaeologists, microbiologists, and environmental engineers better understand the composition and long-term fate of the tons of similar debris buried in the nation's landfills.

Fifteen years later we were digging in the Mallard North Landfill in Hanover Park, Illinois. Suddenly a sorter straightened up with an entire steak in hand—bone, fat, meat, everything. My mind flashed back to that spring 1973 shortage. There had to be a connection. Soon the student came up with an old but legible newspaper: April 23, 1973. Bull's-eye!

I DIG IN LANDFILLS because America is in a widely proclaimed "garbage crisis." More than 70 percent of our trash is now being buried in 5,500 active landfills across the country; these landfills are reaching capacity, and few new ones have been approved. I'm afraid that we are wasting precious time, money, and emotion because we don't know much about what is really in our landfills or what is happening to it.

For direction we rely on perceptions. They tell us, for example, that we can trust in trash decomposing rapidly in landfills. But our perceptions can be wrong, as our digs at 11 landfills have shown us. And mistakes can be costly, because the nation's annual trash bill is about 15 billion dollars and climbing.

BILL RATHJE, professor of anthropology at the University of Arizona in Tucson, earned the 1990 American Association for the Advancement of Science/Westinghouse award for popularizing science. This is LOUIE PSIHOYOS's sixth assignment for the GEOGRAPHIC. He lives in Antigua.

Trash technology digs deep

The long reach of an excavator gives researchers access to refuse as deep as 25 feet. The bucket auger—developed to dig vents for methane gas that organic decomposition produces in landfills—bores to at least a hundred feet.

This gear penetrates cells of trash, the daily deposits that bulldozers have compacted against the slanting landfill face, then encapsulated with several inches of soil—shown as dark diagonal bands in this cross section. Once a layer of deposits covers the available surface of a landfill—which may take years—dumping continues on top, creating a new layer.

Since such burial admits no light or air and scant moisture, organic matter in the trash decomposes slowly. The author commonly uncovers nearly whole foods such as those pictured below, excavated in 1988-89. He has found that 20 to 50 percent of food and yard waste biodegrades in the first 15 years.

Lettuce buried 1964

Corn buried 1971

Roll buried 1964

Hot dog buried 1974

ILLUSTRATION BY PIERRE MION

BEVERLY J. COPAS

In our 17 years we have found much to record in household trash—the vast quantity of wasted food, the differences between what people said they ate and drank and the telltale packaging, the newspapers and aluminum cans not recycled, the hazardous wastes such as pesticides or used motor oil.

To compare our castoffs with those of our ancestors is sobering: In no other civilization has garbage ever been more grand—or grandiose—or had more to say about its creators.

One of the largest human-made monuments in the world is Fresh Kills Landfill on Staten Island (map, page 126), which receives 17,000 tons of refuse from New York City daily, six days a week. It covers 3,000 acres and consumes 2.4 billion cubic feet of space, 25 times the volume of the Great Pyramid at Giza.

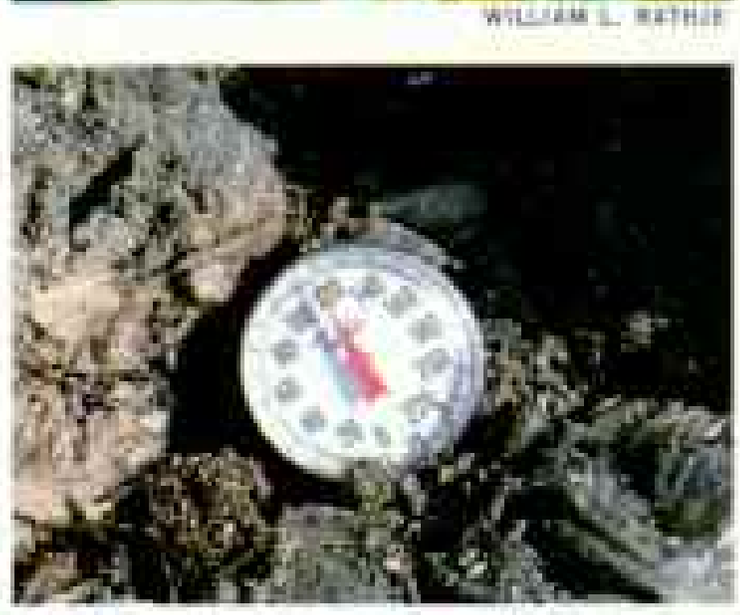
If we are making such a large contribution to future generations, we should know exactly what we are bequeathing them. The only way to unlock these entombed secrets is to excavate—with hands-on digging, sorting, analyzing, and even smelling.

But what on earth could dig down a hundred feet? One sunny day in 1987 fate took my hand. As I drove into Durham Road Landfill near San Francisco Bay, my eyes grew wide at the sight of a truly wondrous machine. It was a bucket auger—a truck-mounted drilling rig that could burrow with a bucket at least a hundred feet down! Its owner, Charles "Buddy" Kellet, Jr., drills holes in landfills to vent or capture methane gas generated by decomposing trash. More than a hundred of America's landfills have been tapped for methane. They produce 73 billion cubic feet of fuel a year—a minor but helpful fraction of the nation's total gas production.

Along with the lease of Buddy's auger we acquired face masks to filter particulates and veil the pungent-sweet stench of exhumed refuse. But the odor stuck with us. One day when I took the crew to lunch at a Pizza Hut, it was crowded, and I worried about a long wait. I needn't have. After ten minutes we were the only customers remaining.

When we left, the manager called after us, "Thanks for stopping by, but for you guys we'd be really glad to deliver."

WILLIAM L. RATHJE



WHEN WE DIG, established procedures of garbage archaeology come into play.

After each ten-foot depth the auger operator swings the bucket so it unloads its cargo onto a plywood board. At once a student plunges a thermometer into the pile of steaming refuse; temperature usually runs from 90° to 130°F. This is the heat of biodegradation, reflecting the metabolism of microorganisms as they break down organic matter.

Next, microbiologists take samples, seeking to understand how moisture content, nutrients in soils and refuse, pH, and other factors affect biodegradation. Meanwhile my students shovel at least a hundred pounds of refuse into heavy-duty garbage bags for later analysis of content, weight, and volume.

Although landfills are full of the unexpected, many government policy planners imagine that such sites contain huge quantities of materials—such as polystyrene—that really aren't major components. That perception diverts government from the real disposal problems. When polystyrene cups are banned, for

JAMES A. SUGAR, BLACK STAR (ABOVE AND BOTTOM LEFT)

Buried 12 years and still readable, a newspaper suggests a discard date for items around it. Graduate student Masakazu Tani, masked against stench and dust, checks a Coke bottle for its year of manufacture.

Excavated in Illinois in 1988, a steak (far left, top) retains its fat after 15 years of burial. Such finds support the author's thesis about the 1973 national beef shortage: Shoppers bought more than they could use or store. Thermometer reading indicates that bacteria are decomposing a load of newly exhumed garbage.

DENIS FINLEY (BOTH)

A seemingly innocent bottle of nail polish (above) put xylene, dibutyl phthalate, toluene, and other potential pollutants into a landfill. Household hazardous waste, a special category that the author's Garbage Project teams sometimes study, includes everyday items that contain toxic chemicals.

Excavations at a municipal dump in California turned up medical items (top), which the teams find frequently and sort carefully because of the risk of infection.

example, they usually are replaced by plastic-coated-paper cups that take up just as much landfill space. These cups don't biodegrade in the short run and aren't recyclable. Jan Beyea, staff scientist of the National Audubon Society, adds, "Don't forget the chlorine bleach and the sulfur emissions in the paper production process." So one undesirable item is replaced by another.

What actually fills our landfills?

The largest "invisible man" lurking inside landfills is paper. It also is the fastest growing component. From 35 percent of volume in 1970 refuse, paper has burgeoned to 50 percent. The most common variety is newspapers; despite our recycling efforts they occupy 12 to 15 percent or more of landfill volume in the East and Midwest and 10 to 12 percent on the West Coast, where export to Asia promotes recycling.

In landfills, tires work their way to the surface, like noodles in a boiling pot of soup, as a result of compression and expansion as traffic passes over the landfill. One day the tires are collected from the surface; the next week more pop into view.

PLASTIC, everyone's favorite villain, isn't really so bad. Clearly an unnatural substance, lacking the heritage of glass or metal, plastics embody our immense guilt over superconsumption and the plight of the environment. We will believe anything bad about plastics—for example, that plastics are 30 percent by volume of the solid-waste stream.

That sounds about right, doesn't it? For years I have seen this 30 percent figure in stories on the environment, invariably with no source given.

Our Garbage Project data—based on measurements of 200-plus samples from 11 landfills—reveals a very different figure, consistent from New York to California: about 10 percent, a third of the standard quote. The 30 percent figure may represent the plastics in your kitchen refuse, where two-liter plastic soda containers and other rigid plastics retain their original form and plastic bags are puffed with air. But plastic is highly crushable, and landfills are, by definition, compact. Stand on a landfill as a truck rumbles by and you'll feel the refuse jiggle like a thousand tons of Jell-O. This motion applies pressure on buried objects from every side—the ultimate crushing machine.

Another landfill myth is that the volume of plastics is growing. I looked for proof at the Mallard North Landfill in Illinois, where the newspapers in our test samples dated from 1970 to 1974, a good period for measuring earlier plastic volume.

Our lunch talk one day centered on the large volumes of plastics the students thought they were finding. "Don't jump to conclusions," I advised with the seriousness that only a professor can conjure up over a chorizo burrito. "Wait for the final statistics. You know there were fewer plastics in the early '70s."

When garbage volumes were calculated for Mallard North, I had to eat my words. In early 1970s refuse, plastics occupied the same percentage of landfill space as the plastics in 1986 refuse. Later digs at other sites have confirmed this paradox.

How could this be? After adding a few more clumps of gray to my hair, I believe I know the answer—"light weighting."

In their ceaseless search for profits, businesses seek to

Miscellaneous
20 percent by volume
Includes construction and demolition debris, tires, textiles, rubber, and disposable diapers.

Paper
50 percent
Includes packaging, newspapers, telephone books, glossy magazines, and mail-order catalogs.

Plastic
10 percent
Includes milk jugs, soda bottles, food packaging, garbage bags, and polystyrene foam.

Metal
6 percent
Includes iron as well as aluminum and steel cans for food and beverages.

Glass
1 percent
Includes beverage bottles, food containers, and cosmetics jars.

Organic
13 percent
Includes wood, yard waste, and food scraps.

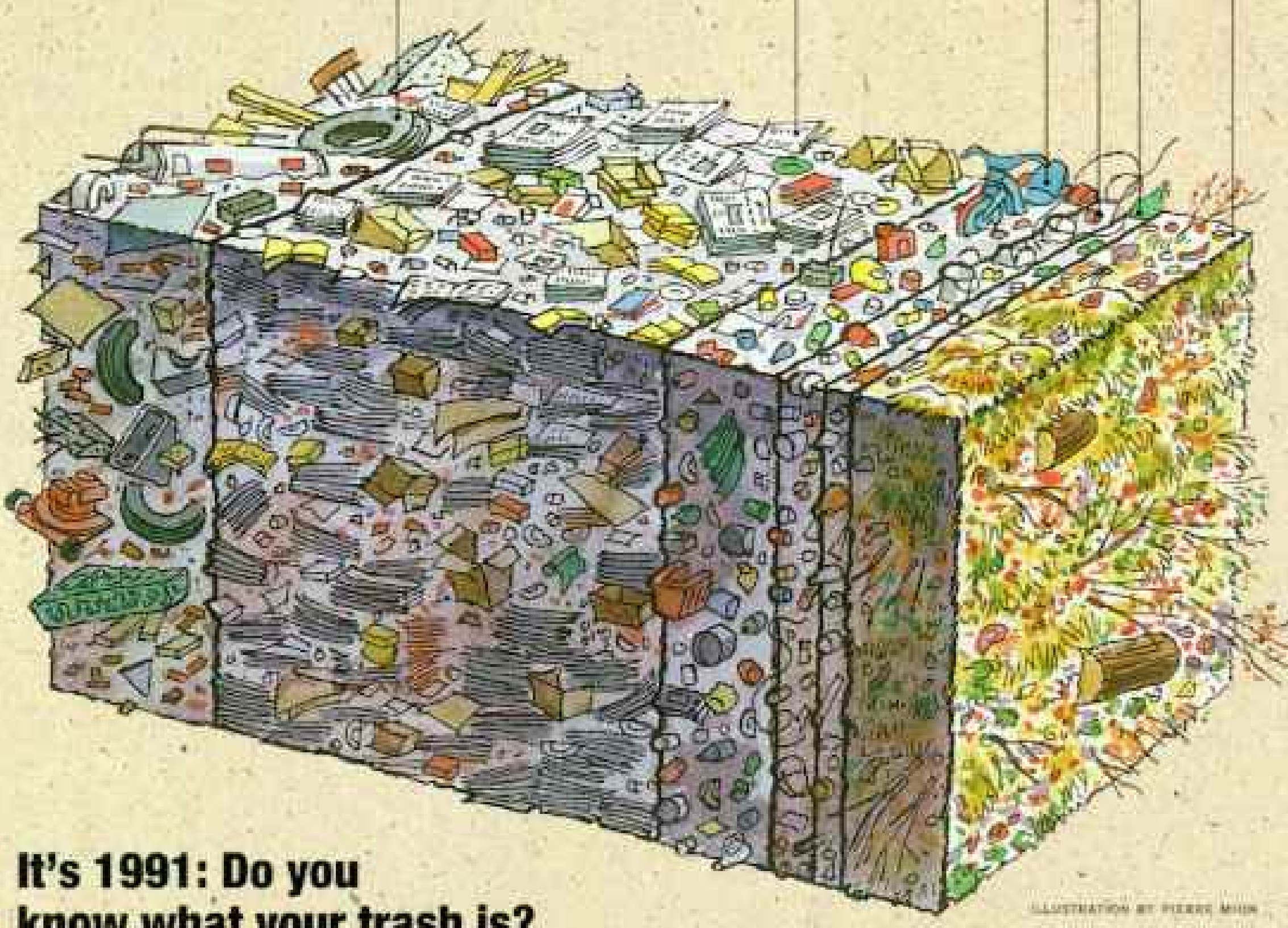


ILLUSTRATION BY PIERRE MION

It's 1991: Do you know what your trash is?

Every man, woman, and child in the United States generates four pounds of trash a day. Most of us have only vague ideas—and often misconceptions—about what that trash contains. But as landfill space shrinks and the cost of dumping trash rises, we need to know exactly what it is that we're throwing out so we can decide how best to manage it. With hands-on knowledge of our trash, the Garbage Project has calculated percentages of different materials in landfills, as represented by the schematic block above.

Perhaps the biggest surprise is the amount of paper we dispose of. Computers haven't saved us from a paper avalanche; they've added to it with mountains of printouts. In 1970 paper took up 35 percent of landfill space; today it takes up 50 percent.

Telephone directories, such as this one retrieved from Fresh Kills (below), are among the fastest growing paper components. Newspapers are the largest single item in landfills, taking up as much as 18 percent of the space. Contrary to popular opinion, they do not biodegrade significantly—the Garbage Project finds legible copies that have been buried for 40 years.

Used by about 85 percent of U. S. babies, disposable diapers are increasingly perceived as a serious trash concern. The nation's yearly load of more than 16 billion disposable diapers weighs some 1.5 million tons but takes up 0.8 percent of landfill space.

Polystyrene foam—thermal cups, for example—makes up nearly one percent. A bigger problem is construction and demolition debris, which accounts for 15 percent.

Recycling can reduce much of our trash load. The U. S. Environmental Protection Agency (EPA) estimates that we already recycle 13 percent. Aggressive recycling and creating markets for recycled materials could increase that figure to 45 percent, say some experts.

"Garbage isn't generic gunk; it's specific elements of our behavior all thrown together," says author Bill Rathje, here examining a wrapper from a steaming heap delivered by a bucket auger at Fresh Kills. "Garbage tells us almost anything

we want to know about ourselves. It tells us the major concerns of our society: Fast-food containers and disposable diapers point to convenience as a priority, for example." Since 1987 his Garbage Project has studied the contents of 11 landfills.

eliminate excess packaging with the same fervor as the most ardent environmentalists. The standard technique for edging out the competition is light weighting—making the same item with less material. The two-liter soda bottle that was 68 grams in 1977 is now 51 grams; plastic gallon milk jugs have gone from 98 to 60 grams. Lighter means not only thinner but also more crushable. There are indeed more plastic products, but they have not grown faster in volume than refuse overall. Glass too has been light weighted into thinner containers.

A third landfill myth relates to biodegradability—the decomposition of trash through the action of microorganisms. We cherish a faith that this process flourishes in every landfill.

In our trash analyses we began to notice that so-called perishables survived surprisingly long times: a mound of guacamole thrown out in 1967, leaves raked up in 1964, lumber from 1952. One of the most common foods preserved in landfills? Hot dogs—their preservatives really work!

Organics will biodegrade eventually, producing methane and other gases, but it can be a slow process. This is hard for us to accept, because we all know how food and yard wastes break down in compost piles. But landfills are not big compost piles. We chop up organic material for compost, add fluids, regularly turn the whole batch, and therefore harness the appetites of voracious aerobic microorganisms—the oxygen users.

In landfills, refuse is rarely shredded, large quantities of fluids are often prohibited, and circulation is usually nil. Little air circulates around the waste material in these closely compacted environments, so only the anaerobic microorganisms can flourish. As James Noble of Tufts University's Center for Environmental Management says, "It is not surprising that everything doesn't biodegrade rapidly; the miracle is that anything biodegrades at all!"

Where food is concerned, it's astonishing how much we can learn about a household's economic and ethnic characteristics. For instance, asparagus is a strong indicator of affluence: The more of the lower stalk you cut off, the richer you are. A scorched Mexican TV dinner must have come from an Anglo because few Hispanics would ever buy it. Mexican food is generally made fresh, and from a relatively small assortment of ingredients. So Hispanic households usually waste very little food.

Food waste also tells whether public-health education efforts have been successful. For instance, in 1982 the National Academy of Sciences published a report linking cancer and fats. All the communities we were studying—Marin County, California, a retirement community in Arizona, and Tucson—cut their purchases of steaks, roasts, and chops because of visible fat. What replaced them? More sausage and luncheon meat—products with substantially higher fat content. And fear of

New York's Great Pile

Half of what New York City throws out weekly—100,000 tons—ends up at Fresh Kills, 14 miles from Manhattan. Sprawling over 3,000 acres of Staten Island, this is the world's largest landfill. It holds 2.4 billion cubic feet of refuse—more than 25 times the volume of the Great Pyramid at Giza (right).

Sited on a salt marsh in 1948, the facility lacks modern comprehensive pollution controls. Before recent cleanup, more than a million gallons of its fluids, called leachate, seeped into nearby waters daily.

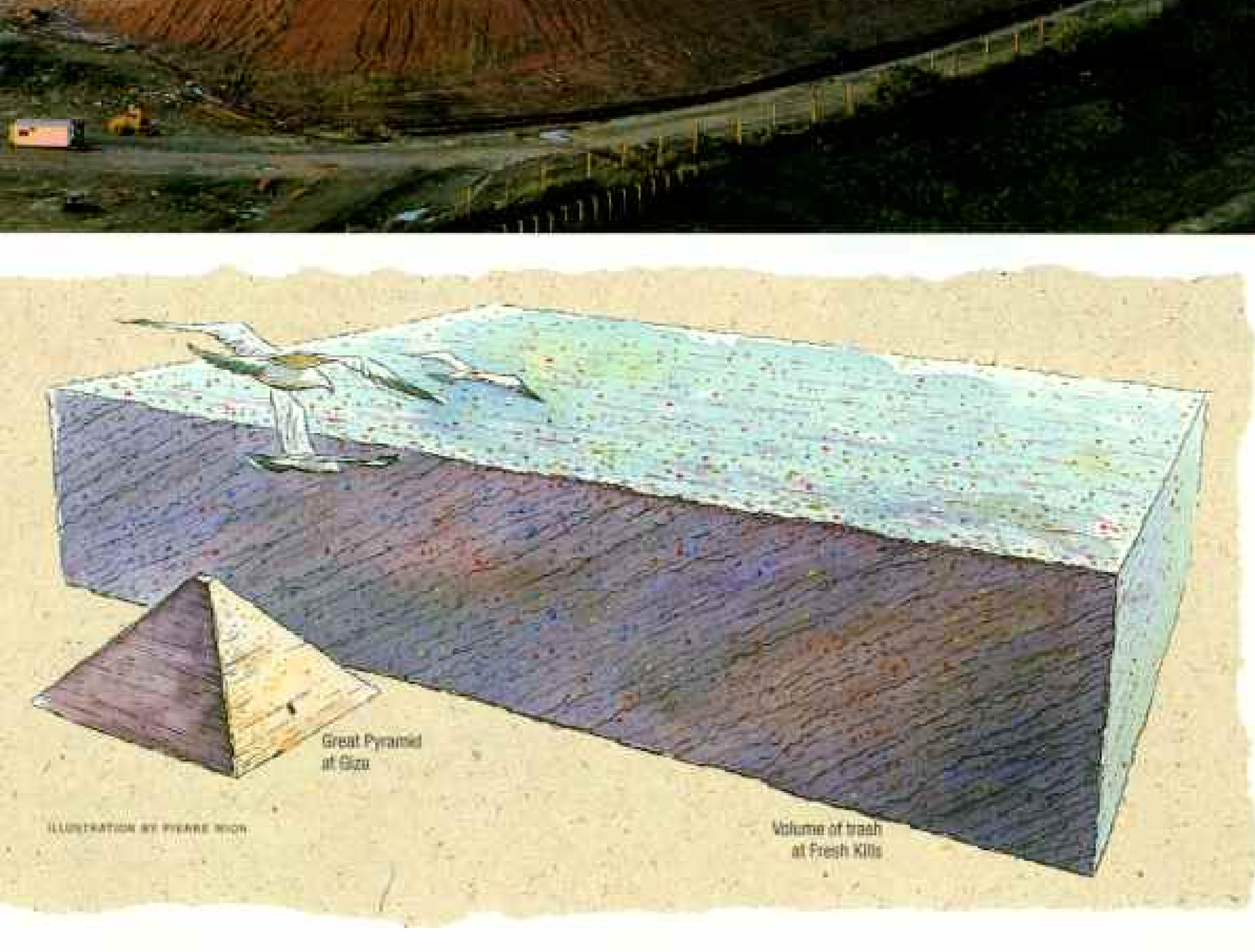


ILLUSTRATION BY PIERRE MION

botulism impels people to throw away even slightly dented cans, even though an expanded can is the real indication of botulism. Because we know so little about our own food, we waste it without much thought.

ONE EVENT WAS DESTINED from the start: Sooner or later the world's largest landfill was bound to be excavated by our world-class landfill diggers. In October 1989 the Garbage Project began to drill into Fresh Kills, the landfill opened by New York City in 1948 on Staten Island's tidal marshland bordering the narrow Fresh Kills (the Dutch word *kil* means "stream"). This landfill's insides were unlike anything we had seen.

The refuse near the top looked normal. But when we came within 25 to 40 feet of the level of the stream, which flows right between the landfill's tall mounds, things changed. At this level all the excavated debris was moist, and newspapers were damp. Another 15 feet farther and the refuse was dripping wet.

Toward the bottom of these layers, thick chunks of newspapers were blackened on the outside, as if by fire. "Newspaper bricks," our crew called them. Pried apart, the soggy pages, darkened but readable, emitted clouds of steam. A few more feet and there was only gray slime, studded with lumber remnants from demolished buildings.

Co-director Wilson Hughes and I didn't care much for the slime, but we said, "Is this science or what!" We picked up our shovels and went back to work, sloshing through our samples. Back in the lab we emptied the sample bags onto screens and hosed away the slime. Quickly, colors and reflections began to sparkle in familiar shapes—metal cans, bottle glass, plastic jugs and utensils and toys, and all the lumber. But no food debris or yard wastes, and practically no paper. The gray slime had to be the result of biodegradation.

Why do paper and other organics biodegrade in some parts of Fresh Kills, while they often don't at other landfills?

The site's tidal wetlands harbored the methanogenic bacteria that produce methane and that become degraders under anaerobic conditions. Fluids are very important to anaerobic microorganisms, which grow easily in them. Refuse soaks up water like a sponge (hence the wet materials two stories above the river's waterline).

Enhanced biodegradation made Fresh Kills an ideal test case for microbiologists at the dig. They are still culturing their samples through rigorous experimental protocols. In addition to normal tests, project environmental engineer Robert Ham of the University of Wisconsin at Madison and others are analyzing refuse samples and the gray goo for the cellulose and lignin components of paper, for various trace elements such as lead, cadmium, and arsenic, and for organic compounds. "The real problem with landfills," says Doug Wilson, who is completing a doctoral dissertation on household wastes, "is not what goes in, but what can leak out."

Hazardous wastes can enter landfills in innocent guises. Take fingernail polish, for instance, which often contains four or five chemicals the Environmental Protection Agency (EPA) calls

ACEY HARPER

"A landfill can be a digester rather than a disposal facility," says Robert Fahey, solid-waste director in Collier County, Florida. The machinery behind him screens trash mined from old dumping areas. Recovered soil and decomposed matter are then used to cover fresh layers.

At a conventional site like Fresh Kills, where Garbage Project volunteers store samples in a trailer (opposite), trash is buried and abandoned.

potentially harmful. If you bought your fingernail polish in a 55-gallon drum, you could not legally throw the empty drum into a landfill. You would be required to transport it to the nearest state-regulated commercial hazardous-waste disposal facility (from my home in Tucson, Arizona, the closest one is in California).

Yet Garbage Project records indicate that as many as 350,000 nail-polish bottles find their way into Tucson landfills every year. Along with these are other potent chemicals contained in such items as nail-polish remover, batteries, and oven cleaner. Household wastes are exempt from the Resource Conservation and Recovery Act, which forbids commercial interests to dispose of comparable hazardous wastes in landfills.

Show me a neighborhood's discarded hazardous wastes, and I can tell you its income range. Used motor oil, degreasers, fuel additives, and other evidence of home car care indicate a lower-income group. Middle-income families are addicted to home fix-up, which produces the substantial waste of paints, stains, and varnishes. Upper-income households cast off leftover pesticides, herbicides, fertilizers, and other yard-care items.

There is considerable debate over the most environmentally friendly landfill design.

One school of thought focuses on safety as promoted by current and proposed EPA regulations and on preventing leachate, potentially harmful landfill fluids, from forming. State-of-the-art landfills are positioned where they don't have the potential to leak into aquifers, rivers, lakes, or oceans. These landfills are lined by dense clays and often heavy plastics. In some, methane vents are set up like tall chimneys before the refuse is dumped around them. A lattice of pipes at the bottom collects potentially toxic liquids and pumps them to a treatment center.

Such landfills are often designed with a second career in mind when they are retired. Newark and John F. Kennedy International Airports are built on landfills, as is the VA Hospital in Cincinnati, and numerous golf courses from Mountain View, California, to Charlotte, North Carolina. No danger of our being buried by our garbage; like other civilizations we'll rise above it by living on top.

JOSEPH D. LAVENBURG, NGS

First crushed in a trash truck, these plastic soda bottles were further flattened in a landfill. Pressures of the marketplace have prompted container manufacturers to cut costs by using less plastic resin. Two-liter soda bottles weighed an average of 68 grams in 1977; thinner bottles now weigh just 51 grams. As a result, plastics take up about as much space in new landfill layers—10 percent—as they did in the 1970s, though production has boomed.

THE BEST WAY TO CHANGE our garbage treatment is to change our garbage; first, by reducing the amount that goes to the landfill. A popular target for reduction is excessive packaging, so we would have less to discard. But the Garbage Project shows that this theory lacks a material reality in our garbage cans.

The packaging from fast foods, prepared meals, and quick-cleaning home-care products are more—not less—common in residential refuse. It is probably no coincidence that the increase in convenience foods and cleaning aids closely parallels the rising number of households in which all of the adults work.

Diapers, which occupy less than one percent of landfills, exemplify our environmental schizophrenia. Virtually everyone is against disposable diapers; virtually everyone who buys them feels immensely guilty.

Yet 85 percent of parents use only disposable diapers. The diapers themselves, of course, resist biodegradation. Their contents—which do not belong in landfills, but usually end up in them—pose an additional problem. The conflict here is symbolic of most of what we buy: Convenience has its cost.

CAN WE PRESERVE both our environment and many of the opportunities afforded by our life-style? Yes, if we finally become committed to recycling.

It is now forgotten that the U. S. once was home to a highly efficient recycling-and-reuse system—the ragpickers of the early 18th and 19th centuries.

Ragpickers were the backbone of the U. S. paper industry. They turned in used paper and cloth rags to eastern paper mills; the rags, paper, and virgin wood pulp provided fibers for paper production. In 1989 dollars, a ton of rags would bring the ragpickers $350, compared with today's price for a ton of aluminum of perhaps $500.

Ragpickers recycled more than paper and cloth, however, and many of their descendants are still pumping scrap metal and used paper through the heart of the recycling industry. Their zeal in collecting and crushing cars and "white goods," such as refrigerators, stoves, and dryers, has made scrap metal a high-ranking export by weight for the past 30 years. Waste paper places among our top five exports by weight.

The United States has evolved its own 1990s recycling system. Yard sales now compete with swap meets. A new avocation, "dumpster diving," finds some people following a set schedule for rummaging through apartment, motel, and business garbage bins. Others take early morning routes through residential neighborhoods to hunt for aluminum cans, dry newspapers, and often food for dogs from garbage cans. Scavenging is back!

Major cities are beginning programs to remove recyclables from refuse headed for landfills. In more and more areas residents place newspapers, glass, metal, and plastic in separate bins for curbside collection. Other cities simply ask residents to separate recyclables and nonrecyclables. Recyclables are then hauled to an MRF (materials recovery facility), where the refuse is placed on a conveyor for mechanical or hand sorting.

My favorite MRF is Joe Garbarino's in San Rafael, California. Joe's father got his start as a "pearl diver," a garbageman and scavenger, in the 1920s in San Francisco, and Joe loves the family tradition. He even keeps a gang of pigs out back to recycle food scraps.

As Joe proudly says, "Nothin' goes to waste here. Nothin'."

Unlike the campaign against packaging, which involves a losing struggle with our life-style, recycling does not demand great change in our normal consumption habits. As it becomes an accepted part of life, I believe that consumers will begin to look for products and packaging that can be recycled. It will become a selling point.

Aluminum cans and some plastics are easily recycled; both are costly to produce and can be cheaper to recycle. And glass can be ground into cullet and used to make new glass of the same color. Newspapers have a long-established and widespread recycling

Once and Future Landfills

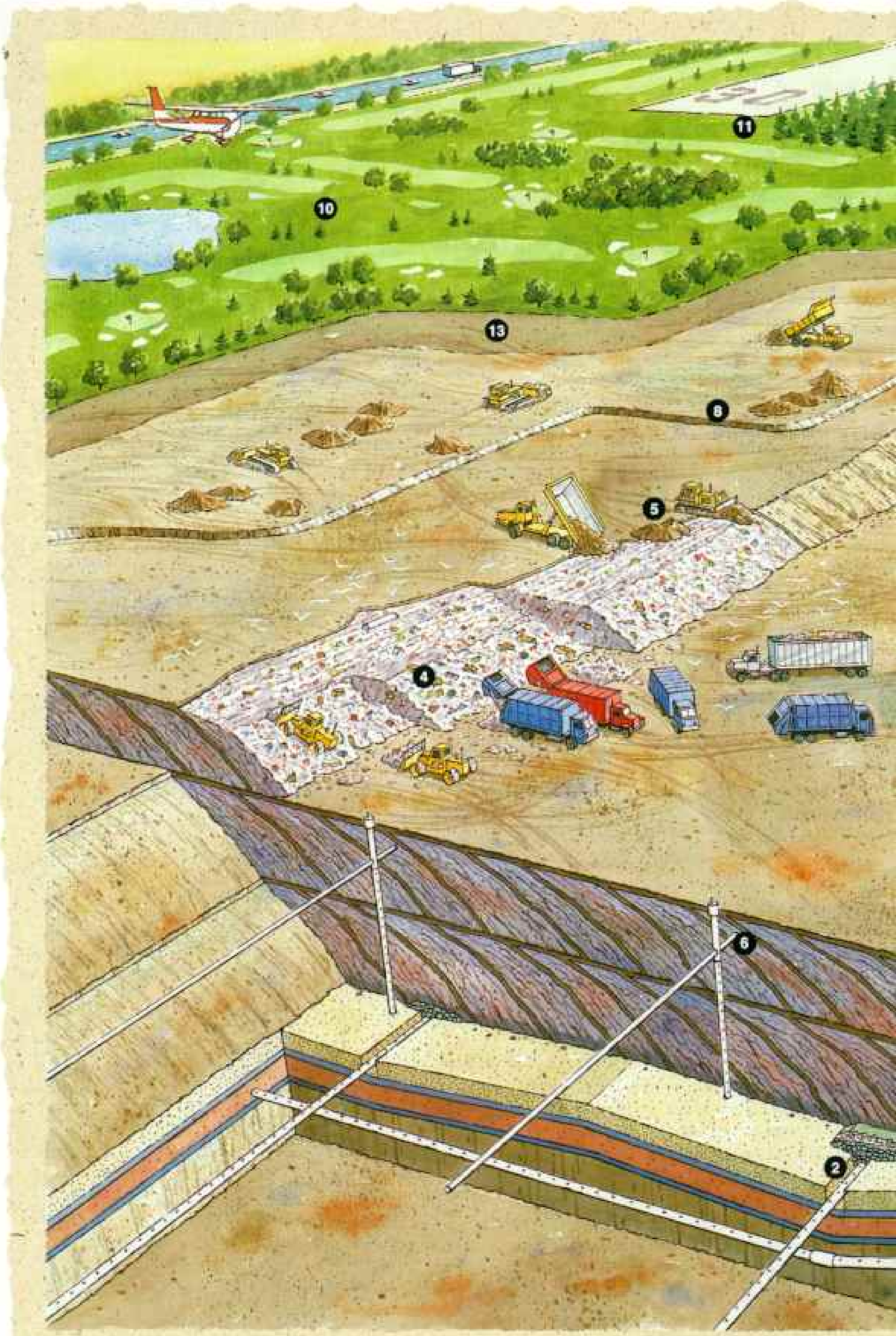
Pop-Top Field Guide

Like ancient arrowheads, these pull tabs from Arizona landfills convey information to archaeologists.

Distinctive designs identify which canned beverages the tabs opened. Tab quantities indicate the popularity of each beverage. And the brief time in which each tab design was manufactured helps date samples.

Used for just 40 months in the mid-1970s, Coors punch-top cans also supply an approximate date.

ILLUSTRATION BY PIERRE MION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Anatomy of a Landfill

More than 70 percent of the 180 million tons of things the U. S. disposes of each year winds up in landfills, says the EPA. (Incineration and recycling take care of the rest.) Once open pits, landfills now use a variety of controls to reduce impact on the environment and can cost as much as a million dollars an acre to construct.

In one design, layers of compacted clay and high-density plastic cover the bottom (1). Running between and above those liners, a system of perforated pipes (2) collects leachate that has percolated through the trash and channels it to a treatment center. Groundwater is monitored for contamination through wells that surround the site (3).

DENIS FINLEY

Unloaded and pushed into place (4), the day's trash is covered with soil (5) to eliminate odors and discourage scavengers such as gulls. Pipes sunk through the layers (6) collect methane gas. Many sites like Greene Valley in Illinois (above) burn off this gas, but a growing number convert it to electricity (7).

An impermeable clay cap seals the landfill after it has reached capacity (8), and a drainage ditch around the perimeter carries away rainwater (9). Facilities such as a golf course (10), an airport (11), and a wildlife refuge (12) can eventually be built on top of a final layer of soil (13).

ILLUSTRATION BY PIERRE MION

COURTESY GARBARINO FAMILY

MIGUEL LUIS FAIRBANKS

Finding a use for what others don't want has been good business for the Garbarinos. One of the old-time trashmen called "peart divers," John began salvaging reusable items in San Francisco in the 1920s (top). Recyclables surround members of his family who now own and operate a trash service in Marin County (above). "Recycling is the wave of the future," says his granddaughter Patty, at right. "Burying these resources is truly wasteful."

infrastructure—but nonetheless a major problem persists.

"There's never been a shortage of newspaper for recycling mills," fumed one frustrated scrap-paper dealer. "The shortage is in demand, in something profitable to do with the paper."

Hundreds of paper mills operating today in the United States process waste paper, and their product is used in a variety of consumer goods. Twenty to forty pounds may go into each new car—into the visors, door panels, and trunks. It goes into paperboard cereal boxes and other containers—if a box is gray (not white) on the inside, it is made from recycled newspapers. To recycle more, however, we have to demand more products made from recycled stock.

What can an individual or family do about the solid-waste dilemma?

Quite a bit. Garbage Project studies of fresh refuse show that 9 percent of residential garbage by weight is edible food (another 11 percent is inedible fruit and vegetable peels, skins, and bones). This represents a phenomenal waste of money: billions of dollars a year. If each household wasted less food, the resulting decrease in refuse could be felt instantly.

The problem, of course, is the modern dilemma. At the grocery store, you know what is good for you, and you buy salad fixings, fresh vegetables, fresh fruits for desserts, and fresh meats; with little time to cook, you also buy prepared packaged goods. At the end of a week or two, the boxes that held prepared meals are in the garbage and your lettuce, zucchini, and grapefruit are blue and gooey.

I wonder sometimes how future generations will see us when they look at our garbage. I interpret the Classic period of the ancient Maya civilization as one of profligate waste, followed by a period of decline. The Maya woke up and discovered resources were in short supply, and they became very efficient very fast—they recycled, they reused. But it was too late.

If we compare our garbage with theirs, I think we can see we're still in a classic phase; that is, we're still discarding tremendous amounts of valuable resources on a daily basis. We have an important opportunity today. We can go into a period of efficiency and pragmatism, and in that way sustain our society in the style to which we've become accustomed for a much longer time.

Every archaeologist has a favorite find. Mine was unearthed in Mallard North Landfill in Illinois in June 1988—two NATIONAL GEOGRAPHIC magazines (November and December 1972) discarded—doubtless by mistake—by some poor soul. I had them both framed. □

WILDLIFE AS CANON SEES IT

Black Stilt
Genus: *Himantopus*
Species: *novaezelandiae*
Adult size: Length, 38 cm
Adult weight: 200 g
Habitat: Rivers, swamps and lakes on South Island, New Zealand
Surviving number: Estimated at 60
Photographed by Rod Morris

Black stilt nests are particularly vulnerable to predators, such as ferrets, first brought to the islands by early settlers. To help ensure hatching, wildlife officials now gather the eggs and replace them with ceramic replicas. The real eggs are kept in incubators and returned to the nests just before hatching. Close management and continued protection are needed for the black stilt to survive.

To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Color images, with their ability to reach people, can help promote a greater awareness and understanding of the black stilt and our entire wildlife heritage.

NATURE

Watch "NATURE" on PBS, Sunday 8:00 p.m.
This program is funded, in part, by Canon U.S.A., Inc.

Report from the President

GILBERT M. GROSVENOR

A Few Thoughts on Penguins and Tourists

As our small group of tourists climbed the rocky slope of Half Moon Island, one of dozens of islands strung out along the west coast of the Antarctic Peninsula, I was struck by the air of absolute indifference assumed by the chinstrap penguins all around us. If I hadn't known better, I could have picked up one of the birds and taken it home with me—they showed that little fear.

That's precisely the problem, of course, posed by the tide of tourism now reaching remote places such as Antarctica. Unless visitors are carefully supervised, they are likely to disrupt the pristine worlds they come to enjoy.

Many nations are facing this issue. During the past 25 years the crowd of trekkers in Nepal has grown from 10,000 to 250,000 a year. Ecuador's Galápagos National Park handles more than 40,000 visitors annually. And tourism to Botswana, little heralded before the 1960s, now attracts more than 300,000 visitors a year, becoming a major source of foreign currency for that country.

Don't misunderstand me. I'm not against tourism in such places. On the contrary, I'm all for it. Because no one who witnesses the desolate beauty of Antarctica can fail to come back home as anything but an advocate for its preservation. No one who marvels at the sight of humpback whales playing in the shadow of icy cliffs, or Weddell seals snoozing on floes, or orcas slicing through the sea can tolerate the idea of beer cans in the snow. Or oil drills, for that matter, or mining equipment.

At the same time, we must be sure not to overwhelm Antarctica's seemingly unlimited space with even well-meaning disruption. While most of the approximately 3,000 casual visitors a year still arrive in ships run by responsible cruise lines, we must guard against future tour operations that might fail to comply with the accepted norms of Antarctic "ecotourism": Stay away from protected areas, never disturb wildlife, leave no trash, take no souvenirs.

When my grandfather Gilbert H. Grosvenor wrote about a proposed British expedition to the South Pole in the August 1899 issue of this magazine, the area was literally a blank on the accompanying map. Among the stated goals of the expedition was the "verification or disproof of the existence of a vast Antarctic continent."

We've learned an extraordinary amount about the place since then, including painful lessons on the long-lasting impact of thoughtless pollution by whalers, explorers, and even scientific stations. Wrecks of old whaling boats, heaps of ballast, rusted boilers, and other trash testify to what we now consider a disregard for the environment—an attitude that cannot be perpetuated by careless visitors today.

The purity of Antarctica, after all, could change as rapidly as its weather. Returning to the ship one afternoon, our party was caught by a sudden gale that tossed our rubber rafts about and filled them with six inches of frigid water. Considering the ease with which uncontrolled waves of tourists could similarly swamp this fragile, unspoiled land, we shouldn't let the challenge catch us by surprise.

Gilbert M. Grosvenor

National Geographic, May 1991

MINITRAN™
(nitroglycerin)
TRANSDERMAL DELIVERY SYSTEM

BRIEF SUMMARY

INDICATIONS AND USAGE

This drug product has been conditionally approved by the FDA for the prevention of angina pectoris due to coronary artery disease. Tolerance to the anti-anginal effects of nitrates (measured by exercise stress testing) has been shown to be a major factor limiting efficacy when transdermal nitrates are used continuously for longer than 12 hours each day. The development of tolerance can be altered (prevented or attenuated) by use of a noncontinuous (intermittent) dosing schedule with a nitrate-free interval of 10– 12 hours. Controlled clinical trial data suggest that the intermittent use of nitrates is associated with decreased exercise tolerance, in comparison to placebo, during the last part of the nitrate-free interval; the clinical relevance of this observation is unknown, but the possibility of increased frequency or severity of angina during the nitrate-free interval should be considered. Further investigations of the tolerance phenomenon and best regimen are ongoing. A final evaluation of the effectiveness of this product will be announced by the FDA.

CONTRAINDICATIONS: Allergic reactions to organic nitrates are extremely rare, but they do occur. Nitroglycerin is contraindicated in patients who are allergic to it. Allergy to the adhesives used in nitroglycerin patches has also been reported, and it similarly constitutes a contraindication to the use of this product. **WARNINGS:** The benefits of transdermal nitroglycerin in patients with acute myocardial infarction or congestive heart failure have not been established. If one elects to use nitroglycerin in these conditions, careful clinical or hemodynamic monitoring must be used to avoid the hazards of hypotension and tachycardia. A cardioverter defibrillator should not be discharged through a paddle electrode that overlies a MINITRAN patch. The arcing that may be seen in this situation is harmless in itself, but it may be associated with local current concentration that can cause damage to the paddles and burns to the patient. **PRECAUTIONS: General:** Severe hypotension, particularly with upright posture, may occur with even small doses of nitroglycerin. This drug should therefore be used with caution in patients who may be volume depleted or who, for whatever reason, are already hypotensive. Hypotension induced by nitroglycerin may be accompanied by paradoxical bradycardia and increased angina pectoris. Nitrate therapy may aggravate the angina caused by hypertrophic cardiomyopathy. As tolerance to other forms of nitroglycerin develops, the effect of sublingual nitroglycerin on exercise tolerance, although still observable, is somewhat blunted. In industrial workers who have had long-term exposure to unknown (presumably high) doses of organic nitrates, tolerance clearly occurs. Chest pain, acute myocardial infarction, and even sudden death have occurred during temporary withdrawal of nitrates from these workers, demonstrating the existence of true physical dependence. Several clinical trials in patients with angina pectoris have evaluated nitroglycerin regimens which incorporated a 10 – 12 hour nitrate-free interval. In some of these trials, an increase in the frequency of anginal attacks during the nitrate-free interval was observed in a small number of patients. In one trial, patients demonstrated decreased exercise tolerance at the end of the nitrate-free interval. Hemodynamic rebound has been observed only rarely; on the other hand, few studies were so designed that rebound, if it had occurred, would have been detected. The importance of these observations to the routine clinical use of transdermal nitroglycerin is unknown. **Information for Patients:** Daily headaches sometimes accompany treatment with nitroglycerin. In patients who get these headaches, the headache may be a marker of the activity of the drug. Patients should resist the temptation to avoid headaches by altering the schedule of their treatment with nitroglycerin, since loss of headache may be associated with simultaneous loss of anti-anginal efficacy. Treatment with nitroglycerin may be associated with lightheadedness on standing, especially just after rising from a recumbent or seated position. This effect may be more frequent in patients who have also consumed alcohol. After normal use, there is enough residual nitroglycerin in discarded patches that they are a potential hazard to children and pets. A patient leaflet is supplied with the systems. **Drug Interactions:** The vasodilating effects of nitroglycerin may be additive with those of other vasodilators. Alcohol, in particular, has been found to exhibit additive effects of this variety. **Carcinogenesis, Mutagenesis, and Impairment of Fertility:** No long-term animal studies have examined the carcinogenic or mutagenic potential of nitroglycerin. Nitroglycerin's effect upon reproductive capacity is similarly unknown. **Pregnancy Category C:** Animal reproduction studies have not been conducted on nitroglycerin. It is also not known whether nitroglycerin can cause fetal harm when administered to a pregnant woman or whether it can affect reproductive capacity. Nitroglycerin should be given to a pregnant woman only if clearly needed. **Nursing Mothers:** It is not known whether nitroglycerin is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when nitroglycerin is administered to a nursing woman. **Pediatric Use:** Safety and effectiveness in children have not been established. **ADVERSE REACTIONS:** Adverse reactions to nitroglycerin are generally dose related, and almost all of these reactions are the result of nitroglycerin's activity as a vasodilator. Headache, which may be severe, is the most commonly reported side effect. Headache may be recurrent with each daily dose, especially at higher doses. Transient episodes of lightheadedness, occasionally related to blood pressure changes, may also occur. Hypotension occurs infrequently, but in some patients it may be severe enough to warrant discontinuation of therapy. Syncope, crescendo angina, and rebound hypertension have been reported but are uncommon. Extremely rarely, ordinary doses of organic nitrates have caused methemoglobinemia in normal-seeming patients. Methemoglobinemia is so infrequent at these doses that further discussion of its diagnosis and treatment is deferred (see **Overdosage**). Application-site irritation may occur but is rarely severe. In two placebo-controlled trials of intermittent therapy with nitroglycerin patches at 0.2 to 0.8 mg/hr, the most frequent adverse reactions among 307 subjects were as follows:

	placebo	patch		placebo	patch
headache	18%	63%	hypotension and/or syncope	0%	4%
lightheadedness	4%	6%	increased angina	2%	2%

OVERDOSAGE: Hemodynamic Effects: The ill effects of nitroglycerin overdose are generally the results of nitroglycerin's capacity to induce vasodilatation, venous pooling, reduced cardiac output, and hypotension. These hemodynamic changes may have protean manifestations, including increased intracranial pressure, with any or all of persistent throbbing headache, confusion, and moderate fever; vertigo; palpitations; visual disturbances; nausea and vomiting (possibly with colic and even bloody diarrhea); syncope (especially in the upright posture); air hunger and dyspnea, later followed by reduced ventilatory effort; diaphoresis, with the skin either flushed or cold and clammy; heart block and bradycardia; paralysis; coma; seizures; and death. Laboratory determinations of serum levels of nitroglycerin and its metabolites are not widely available, and such determinations have, in any event, no established role in the management of nitroglycerin overdose. No data are available to suggest physiological maneuvers (e.g., maneuvers to change the pH of the urine) that might accelerate elimination of nitroglycerin and its active metabolites. Similarly, it is not known which — if any — of these substances can usefully be removed from the body by hemodialysis. No specific antagonist to the vasodilator effects of nitroglycerin is known, and no intervention has been subject to controlled study as a therapy of nitroglycerin overdose. Because the hypotension associated with nitroglycerin overdose is the result of vasodilatation and arterial hypovolemia, prudent therapy in this situation should be directed toward increase in central fluid volume. Passive elevation of the patient's legs may be sufficient, but intravenous infusion of normal saline or similar fluid may also be necessary. The use of epinephrine or other arterial vasoconstrictors in this setting is likely to do more harm than good. In patients with renal disease or congestive heart failure, therapy resulting in central volume expansion is not without hazard. Treatment of nitroglycerin overdose in these patients may be subtle and difficult, and invasive monitoring may be required. **Methemoglobinemia:** Nitrate ions liberated during metabolism of nitroglycerin can oxidize hemoglobin into methemoglobin. Even in patients totally without cytochrome b_5 reductase activity, however, and even assuming that nitrate moieties of nitroglycerin are quantitatively applied to oxidation of hemoglobin, about 1 mg/kg of nitroglycerin should be required before any of these patients manifests clinically significant (≥10%) methemoglobinemia. In patients with normal reductase function, significant production of methemoglobin should require even larger doses of nitroglycerin. In one study in which 38 patients received 2 – 4 weeks of continuous nitroglycerin therapy at 3.1 to 4.4 mg/hr, the average methemoglobin level measured was 0.2%, this was comparable to that observed in parallel patients who received placebo. Notwithstanding these observations, there are case reports of significant methemoglobinemia in association with moderate overdoses of organic nitrates. None of the affected patients had been thought to be unusually susceptible. Methemoglobin levels are available from most clinical laboratories. The diagnosis should be suspected in patients who exhibit signs of impaired oxygen delivery despite adequate cardiac output and adequate arterial pO_2. Classically, methemoglobinemic blood is described as chocolate brown, without color change on exposure to air. When methemoglobinemia is diagnosed, the treatment of choice is methylene blue, 1 – 2 mg/kg intravenously. **DOSAGE AND ADMINISTRATION:** The suggested starting dose is between 0.2 mg/hr* and 0.4 mg/hr*. Doses between 0.4 mg/hr* and 0.8 mg/hr* have shown continued effectiveness for 10– 12 hours daily for at least one month (the longest period studied) of intermittent administration. Although the minimum nitrate-free interval has not been defined, data show that a nitrate-free interval of 10 – 12 hours is sufficient. Thus, an appropriate dosing schedule for nitroglycerin patches would include a daily patch-on period of 12-14 hours and a daily patch-off period of 10– 12 hours. Although some well-controlled clinical trials using exercise tolerance testing have shown maintenance of effectiveness when patches are worn continuously, the large majority of such controlled trials have shown the development of tolerance (i.e., complete loss of effect) within the first 24 hours after therapy was initiated. Dose adjustment, even to levels much higher than generally used, did not restore efficacy.

HOW SUPPLIED	MINITRAN System Rated Release In Vivo	System Size	Total Nitroglycerin in System	NDC Number
	0.1 mg/hr*	3.3 cm²	9 mg	NDC 0089-0301-03
	0.2 mg/hr*	6.7 cm²	18 mg	NDC 0089-0302-03
	0.4 mg/hr*	13.3 cm²	36 mg	NDC 0089-0303-03
	0.6 mg/hr*	20.0 cm²	54 mg	NDC 0089-0304-03

MINITRAN Transdermal Delivery System, 0.1 mg/hr, 0.2 mg/hr, 0.4 mg/hr, 0.6 mg/hr, is available in cartons of 30 patches. **CAUTION:** Federal law prohibits dispensing without prescription.

*Release rates were formerly described in terms of drug delivered per 24 hours. In these terms, the supplied MINITRAN systems would be rated at 2.5 mg/24 hours (0.1 mg/hr), 5 mg/24 hours (0.2 mg/hr), 10 mg/24 hours (0.4 mg/hr), and 15 mg/24 hours (0.6 mg/hr).

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*The current published average wholesale price for Minitran is less than that of Transderm-Nitro and Nitro-Dur. Retail pricing may vary from community to community and may affect cost savings to the patient. Transderm-Nitro is a registered trademark of Ciba Pharmaceutical Company; Nitro-Dur, of Key Pharmaceuticals, Inc.

†*Clinical Therapeutics*, Vol. 11, No. 1, 1988, pp 15-31.

Please see adjacent page for summary of prescribing information.

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Forum

Journey into Dreamland

I was born in Perth, Western Australia, and, having lived and worked in Broome, was disappointed that the historic pearl-lugging town was given only a passing mention in your article (January 1991). Readers should learn about the tenacious and fun-loving attitude of the 1,500 townspeople and their unique blend of Japanese, Malay, Aboriginal, American, and European cultures. The annual Shinju-Matsuri Japanese Festival includes a dragon parade, and many enjoyable hours can be spent visiting the wildlife park and crocodile farm, fishing for barramundi, or getting to know the locals, the oyster farmers, and the oil workers.

HELGA A. BREKTE
Willimantic, Connecticut

Instead of finding an educated description of northwest Australia, I found racy dialogue from Mike on the perils of crocodiles and from John on the hazard of running over bulls. Whilst this might make facts digestible for some readers, I am not in that market.

J. W. DAVEY
Godalming, Surrey, U. K.

I appreciated the inclusion of Aussie language, as I spent a year in Geraldton and Perth as part of a team building the modules for the Rankin A platform. I wish you had shown a daylight view of the platform; I did like seeing it on the map.

GREGORY OLSEN
Matteson, Illinois

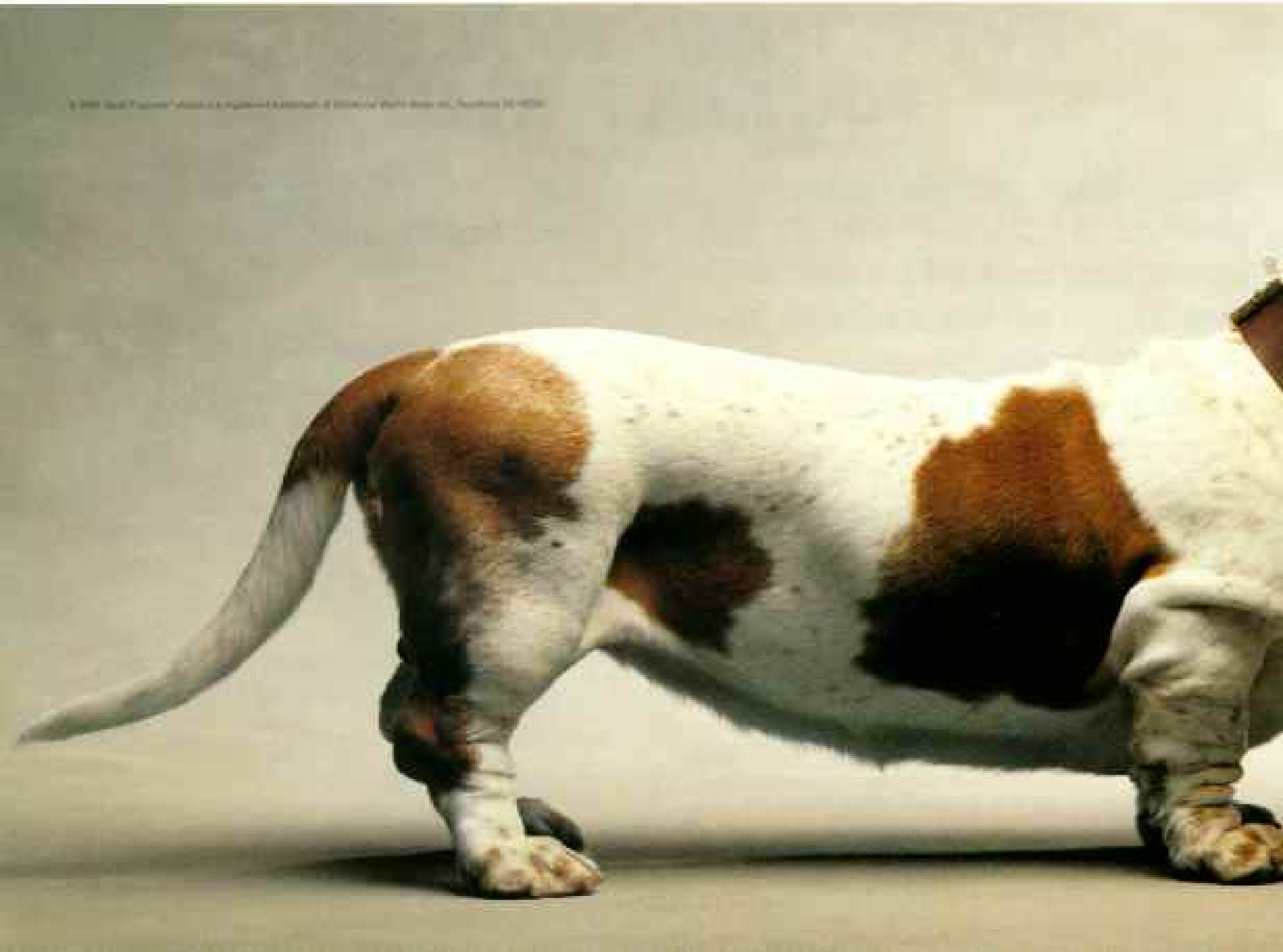
Your account of the ferocity of saltwater crocodiles reminds me of a visit to Kakadu National Park. As our group traveled along a river in a pontoon boat past sluggish-looking crocodiles, the park ranger warned us that these creatures can run as fast as a human. His tongue-in-cheek advice: Always take with you a mate who can't run as fast as you can.

JAMES MILLER
Hamilton, Ontario

The Sea Beyond the Outback

As a diver, I found this article enrapturing, the photographs fantastic. But a caption gave the impression that one can feed the dolphins at Monkey Mia.

The almost daily visits of dolphins are, of course, becoming more of a tourist attraction, but the



rangers work hard to keep the experience a scientific project and are very strict about feeding and petting.

An important part of their research is to find out whether and for how long the wild dolphins will visit the beach and its humans of their free will. The rangers go to great pains, therefore, to ensure that the dolphins do not get the idea there is a free feed on hand every day.

PAUL DOUGLAS
Svendborg, Denmark

The local shire of Shark Bay operates the Dolphin Information Centre and provides tourists with fish, but it closely supervises and regulates the daily dolphin feedings.

Your statement that "Australia remains a net energy importer" is not correct. Australia is a net energy exporter and has been for many years. The majority of the country's energy exports are in the form of coal, but Australia is also a net exporter of light crude oil. It is, however, necessary for Australia to import heavy crude oil for the production of lubricating oils and asphalt.

ROBERT RAWSON
Australian Institute of Energy
Wahroonga, New South Wales

Folk-Art Masters

A pervasive pressure in American culture is to homogenize. The school-age child learns quickly the social cost of being different. As adults we carry the mantle of sameness proudly. Bravo to the National Endowment for the Arts for supporting the courageous few whose identities are not defined by Madison Avenue and to NATIONAL GEOGRAPHIC for capturing in text and image these true champions of tradition.

CHUCK OLSEN
Fresno, California

If there was ever a conduit between my tax dollars and oblivion, your article showed it clearly. The quilts, masks, and storytelling were all interesting, but I could not figure out why those artists should receive federal grants for something they would be doing anyway. In these days of trimming excess fat, the National Endowment for the Arts should be the first to go.

STEPHEN M. STURM
Delaware, Ohio

Are any tapes available of the stories told by Ray Hicks, the songs of Dewey Williams and the Sacred Harp singers, and the fiddle playing of Dewey Balfa?

DAN AND ALISSA VAN KEUREN
Concord, New Hampshire

These artists have made recordings, which can be found in stores specializing in folk music and at many folk music festivals and concerts.

I know someone who surely deserves recognition under this program. Julius Pine learned to weave baskets as a boy in Lithuania. He continues to weave today, using willows grown at his Seattle home. I was fortunate to receive one of his baskets as a gift—it is truly a work of art!

GRETCHEN PFEFFER
Seattle, Washington

The nominating process for folk-art honorees is open to the public. Send names and information to the Folk Arts Program, National Endowment for the Arts, Washington, D. C. 20506.

Disease Detectives

I can't thank you enough for this article. I have suffered with Lyme disease since 1984. I was in pain and confused, could hardly walk or see, and literally wanted to die. This disease attacks every system in the body, clear down to skin that hurts to the touch. I saw 24 doctors and was diagnosed with everything from Epstein-Barr to amyotrophic lateral sclerosis, multiple sclerosis, and lupus. I finally found a doctor who helped me and have been on antibiotics for a year. I still have many symptoms, but they are less severe now.

CONNIE LAWRENCE
Terre Haute, Indiana

As a molecular biologist, I believe that success in fighting disease depends not only on our country's

epidemiologists but also on their joint efforts with health-care administrators, community health-care workers, and educators.

And I was dismayed that there was no mention of the community hardest hit by AIDS. Many of the successes in fighting the epidemic have come from the gay community, which has educated itself about health care, living, and dying. The AIDS memorial quilt (pages 138-9) is a powerful example of those efforts.

CYNTHIA M. BAUERLE
Eugene, Oregon

Page 134 shows an entomologist with the Centers for Disease Control (CDC) sucking mosquitoes into what you call a "hand-powered vacuum." In fact, this is a 1976-vintage Black and Decker cordless spot vac, powered by rechargeable batteries. It is the forerunner of the Dustbuster cordless vac, for which I hold the original design patent. This nontraditional use is equally effective around the house for flies, wasps, bees, and other unidentified flying objects.

CARROLL M. GANTZ
Carnegie Mellon University
Pittsburgh, Pennsylvania

While efforts to find a vaccine for humans continue, the prevention of Lyme disease has experienced a major breakthrough with the introduction of a vaccine for dogs. Since its introduction in July

1990 veterinarians have purchased nearly one million doses. Researchers estimate that the incidence of Lyme disease in domestic animals may be sixfold to tenfold that found in humans.

WILLIAM E. RYAN, D.V.M.
Fort Dodge, Iowa

The CDC officer drawing blood from a Guinea-Bissau native is not wearing gloves (page 121), though the CDC has repeatedly emphasized in its publications that all patients should be assumed to be infectious for blood-borne pathogens. Implementing this simple infection-control procedure is undoubtedly more difficult in the field. Nevertheless, a disposable syringe and butterfly needle were used to obtain the blood specimen. Wearing gloves would have been a good idea.

BISHARA J. FREID, M.D.
Royal Oak, Michigan

I was struck by your coverage of AIDS. I am a volunteer at a foster home for six children born with HIV antibodies. It is a common fallacy that children born with these antibodies inevitably come down with AIDS. In actuality, by the time they reach 24 months and their mothers' antibodies have worn off, 50 to 70 percent show no signs of infection. We are very fortunate that all our children are healthy and can lead full normal lives.

MICHELLE J. PARLO
Atlanta, Georgia

Pumas

Your map ignores the mounting evidence for the existence of the catamount, a native puma species, in Vermont. In the Northeast Kingdom and the Green Mountains, sightings and other evidence of a puma population continue to accumulate.

EDWARD L. QUEVEDO
Laguna Hills, California

Although random sightings have been reported in Vermont, none have been confirmed by photographs, tracks, or carcasses. Officials say there is no breeding population.

Satellite Mosaic

We are impressed by the new portrait of earth from space created by artist Tom Van Sant (November 1990, pages 127-9). Is it possible to order a copy suitable for framing? We want it on our wall.

CLINTON AND BERNICE KRAHN
Fairfield, Idaho

Posters measuring 24 by 36 inches are available for $18 each, check or money order, from: The GeoSphere Project, P.O. Box 1489, Pacific Palisades, California 90272.

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

Eruption of Kilauea volcano on Hawaii

"When you're working on a volcano, your equipment and wits can't fail you."

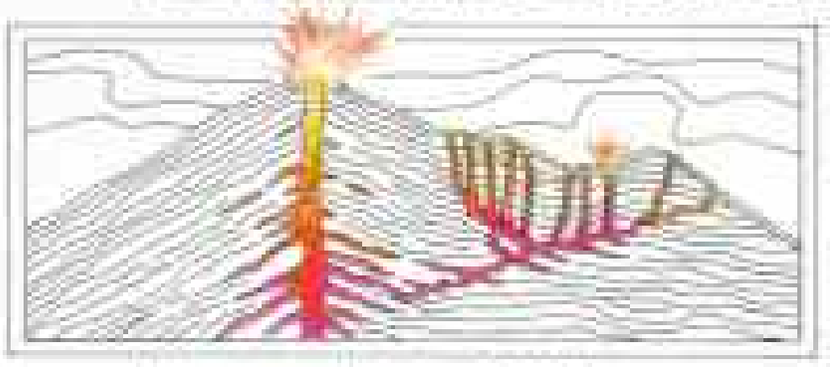
—Dr. Michael Garcia

Earthquakes rock the black, rippled terrain. Fire fountains explode from the mountain's side. Iridescent orange lava, as hot as 2100° F, sweeps down the volcano's flanks in thin sheets and swift rivers. The air is filled with the roar of molten rock slamming against a crater wall. It rains pumice.

Dr. Michael Garcia

This is Kilauea, which ascends majestically from the floor of the Pacific and disgorges a continuous stream of lava that can fill a large stadium in less than a day. Professor Michael Garcia has devoted his career to exploring the mysteries of volcanoes, particularly Kilauea, one of the most active in the world. "It's the premier place to study how volcanoes work," he said.

Dr. Garcia has been gathering data on Kilauea since 1978. When he is not in the lab conducting chemical analyses of lava, Garcia is in the field, measuring intervals between fire-fountain pulses and plucking samples from lava rivers. He believes that a keener understanding of the volcano and its internal



Magma conduits inside Kilauea

structure can help scientists better anticipate eruptions.

Working in such a hostile environment, Garcia must rely on his experience, instinct and equipment. "You have to respect Kilauea's might—especially when you feel it rumbling beneath your feet," he said. Demanding the highest standards from his instruments, Dr. Garcia insists that they be rugged and reliable.

It's little wonder that he has chosen a Rolex Oyster Perpetual as his timepiece.

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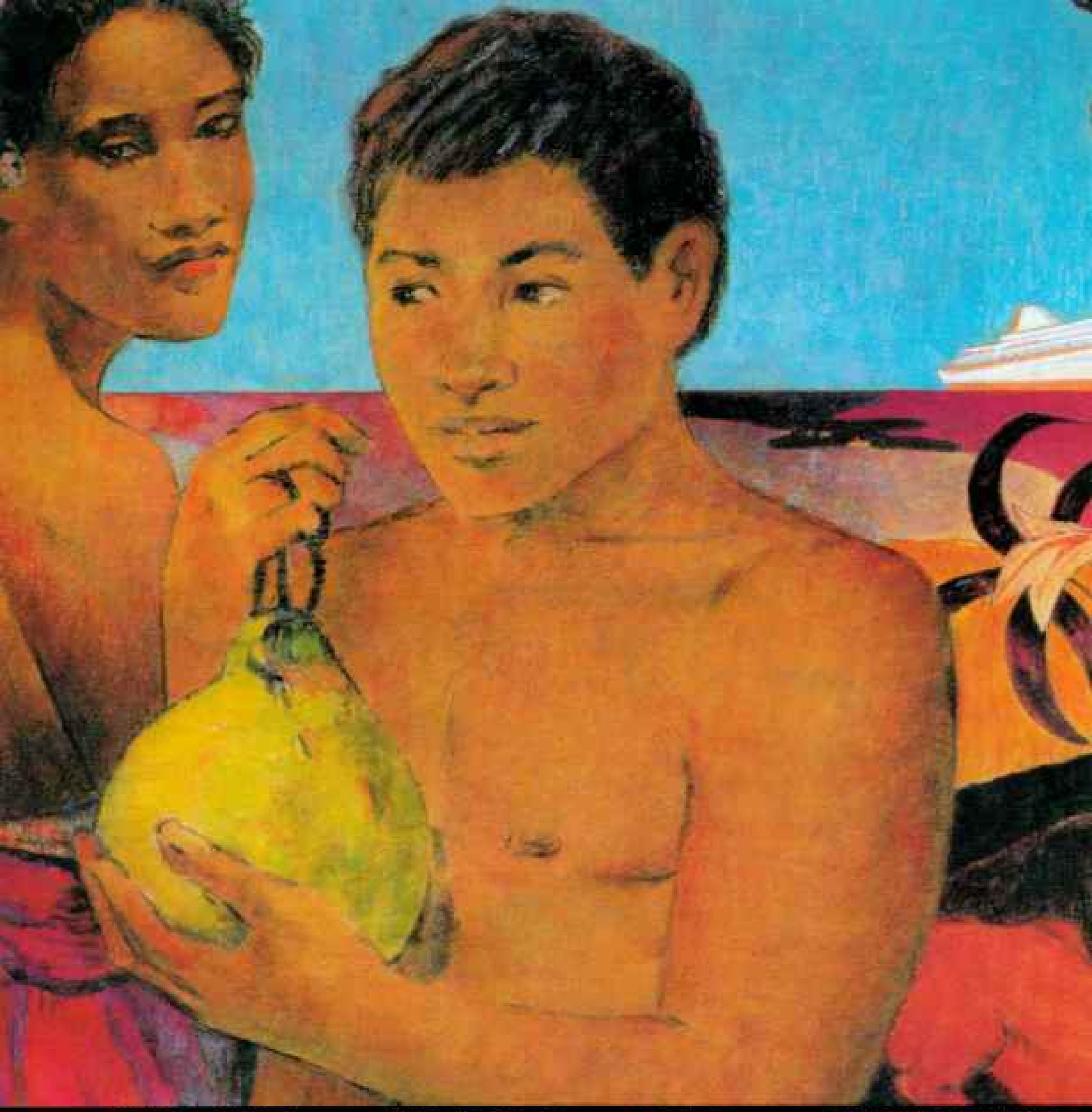

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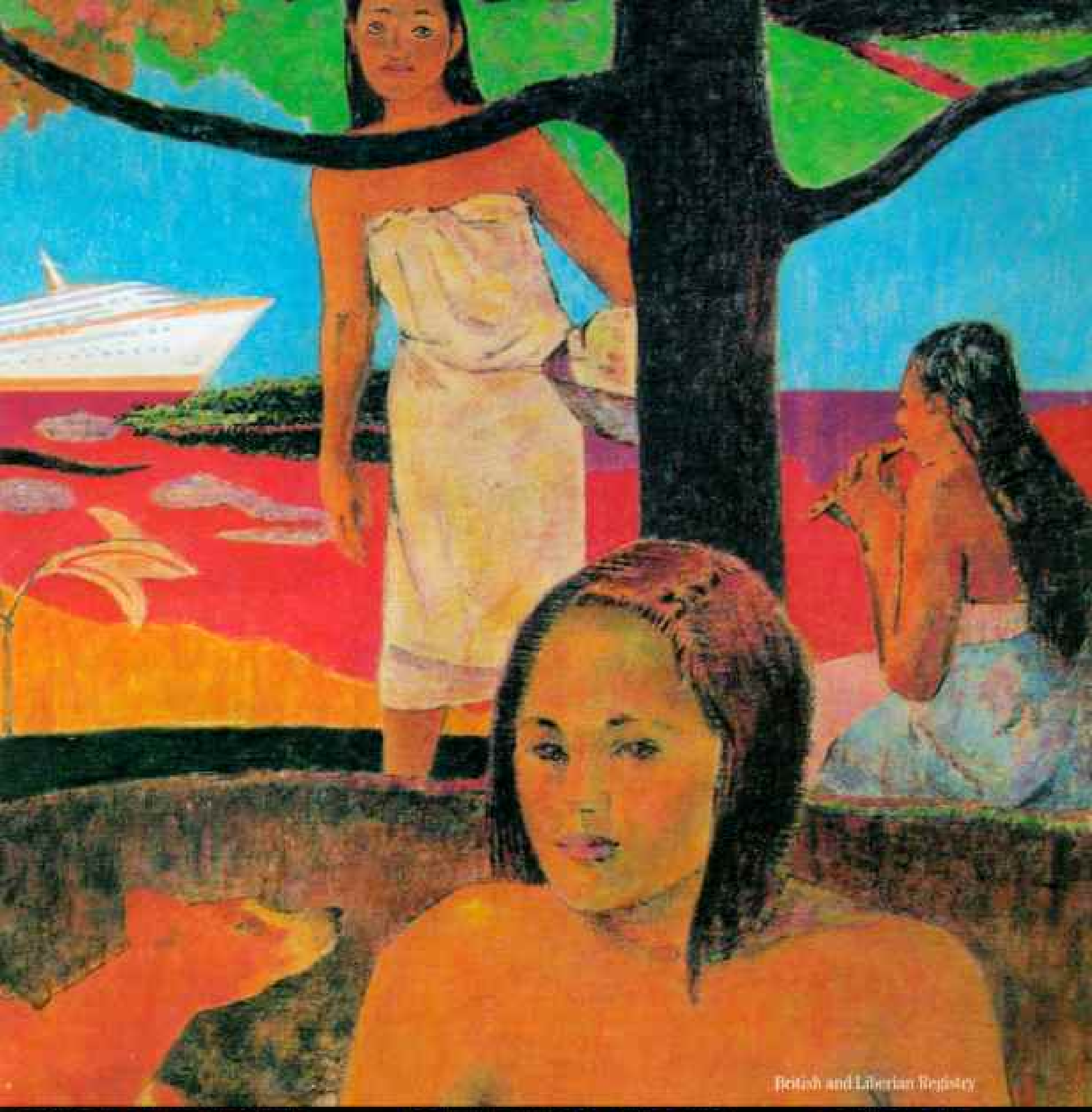

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Following age-old practice, fabric is washed in the *Asano* River to remove excess paste and dye. Tile-roofed huts on the riverbank are Yuzen workshops.

Goshiki (five colors) and old motifs from nature are combined in fresh new ways. Ultravision projection TV captures the classic and contemporary art of *Yuzen*.

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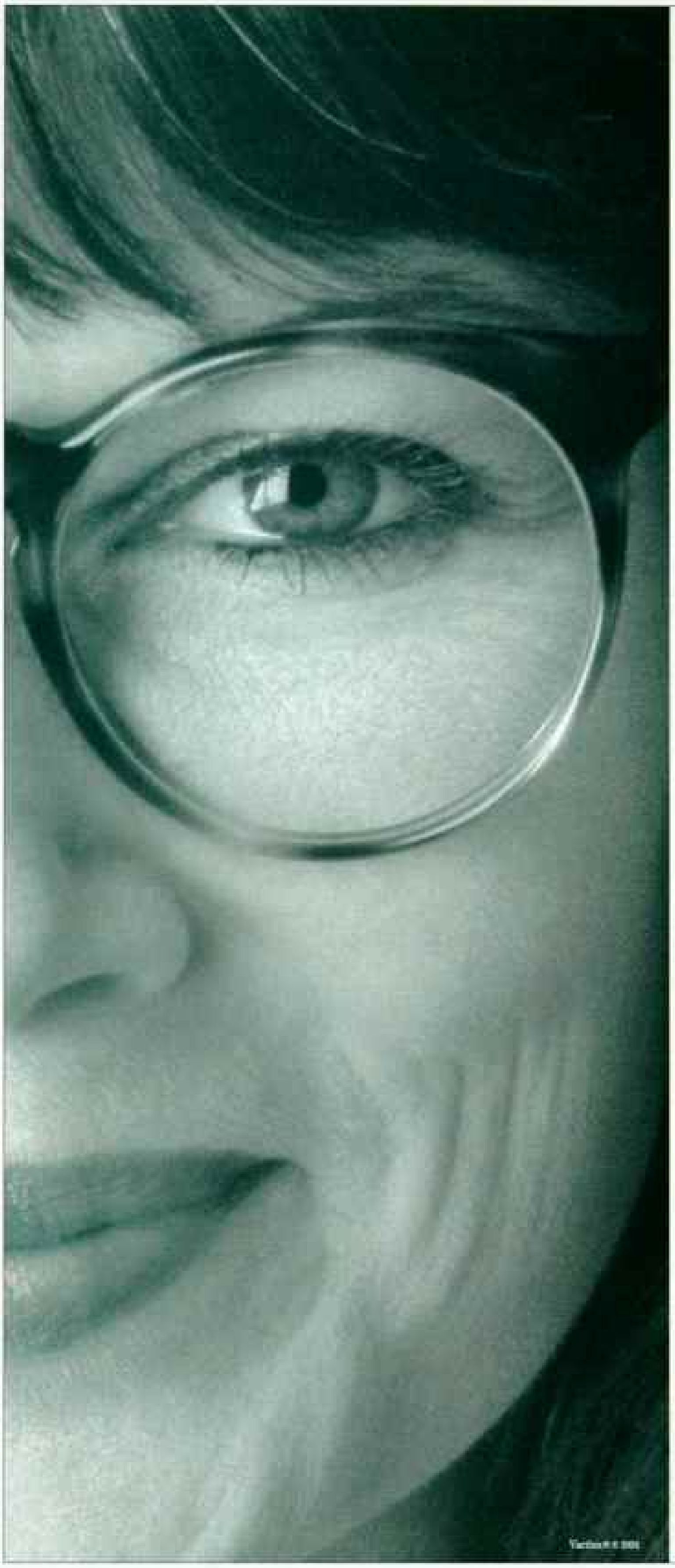

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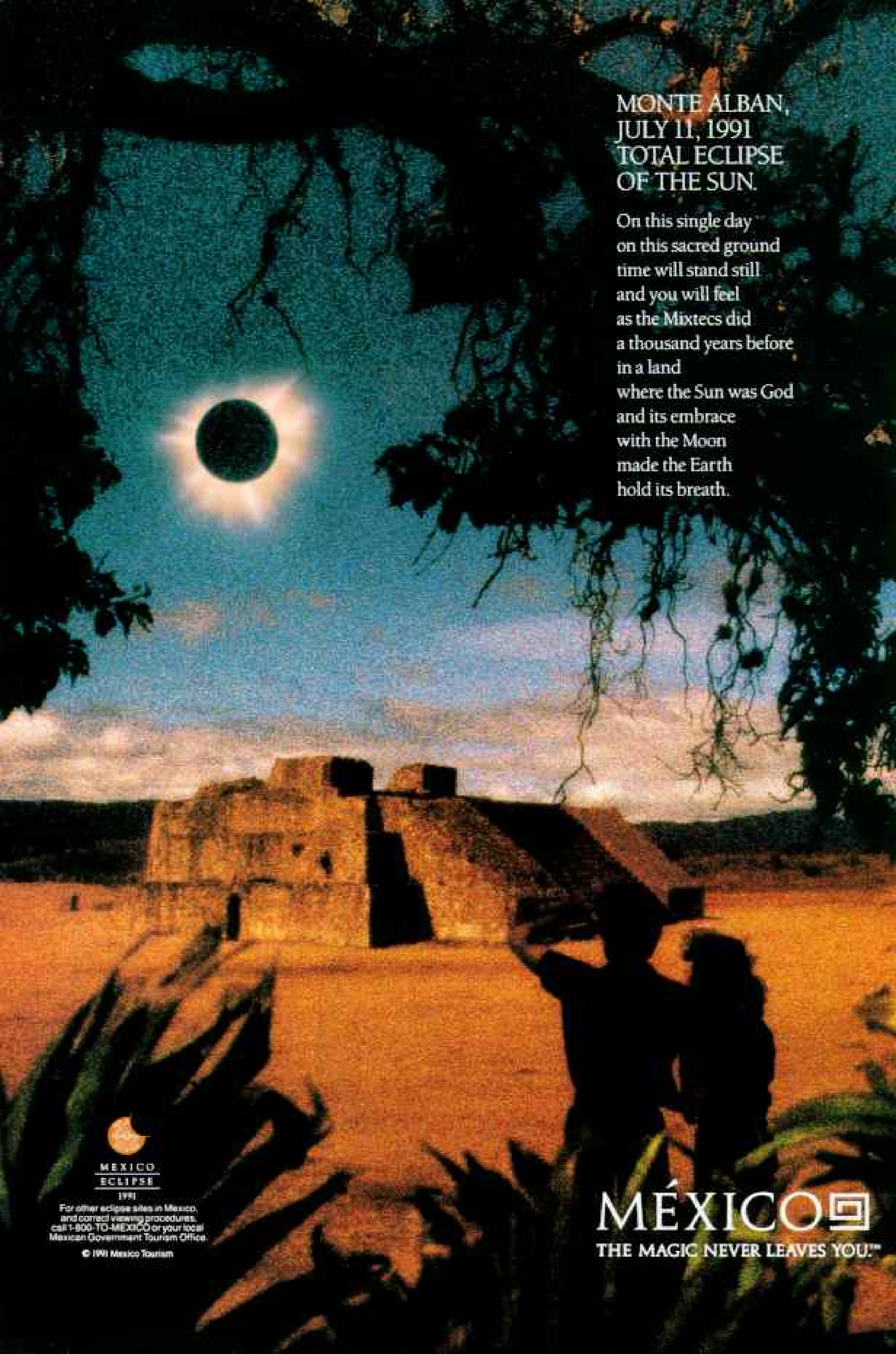
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Geographica

JOE KIM BUFF

Flying With Geese: Blending Science, Art

Bill Lishman saw a film of Canada geese flying behind a boat and wondered if a flock could learn to follow his ultralight aircraft.

The Blackstock, Ontario, artist obtained a Canadian wildlife avicultural permit, acquired a group of domestically hatched, day-old Canada goslings, and went to work. "C'mon, geese!" he'd call. It took three flocks and three years of teaching them to follow him wherever he went, but he got results.

On July 14, 1988, he took off, and for the first time his 12 geese took off too, falling into the familiar V-formation behind him.

"I became their parent," Lishman says by way of explaining why the geese followed his lead. "They had imprinted on me."

He and his Canada geese flew daily that summer when weather permitted, "maybe a hundred flights, 40 to 50 hours of flying. Sometimes one of them would take the lead, and I'd become part of the V."

A biologist's son, Lishman would like to use his techniques to help reestablish migratory birds in areas where they no longer fly, though this idea has led to trouble with Canadian wildlife officials because domestically raised migratory birds can't be released into the wild. He sees his flights as "a visual work of art." Flying with geese was, he says, an opportunity to "understand birds in their own medium."

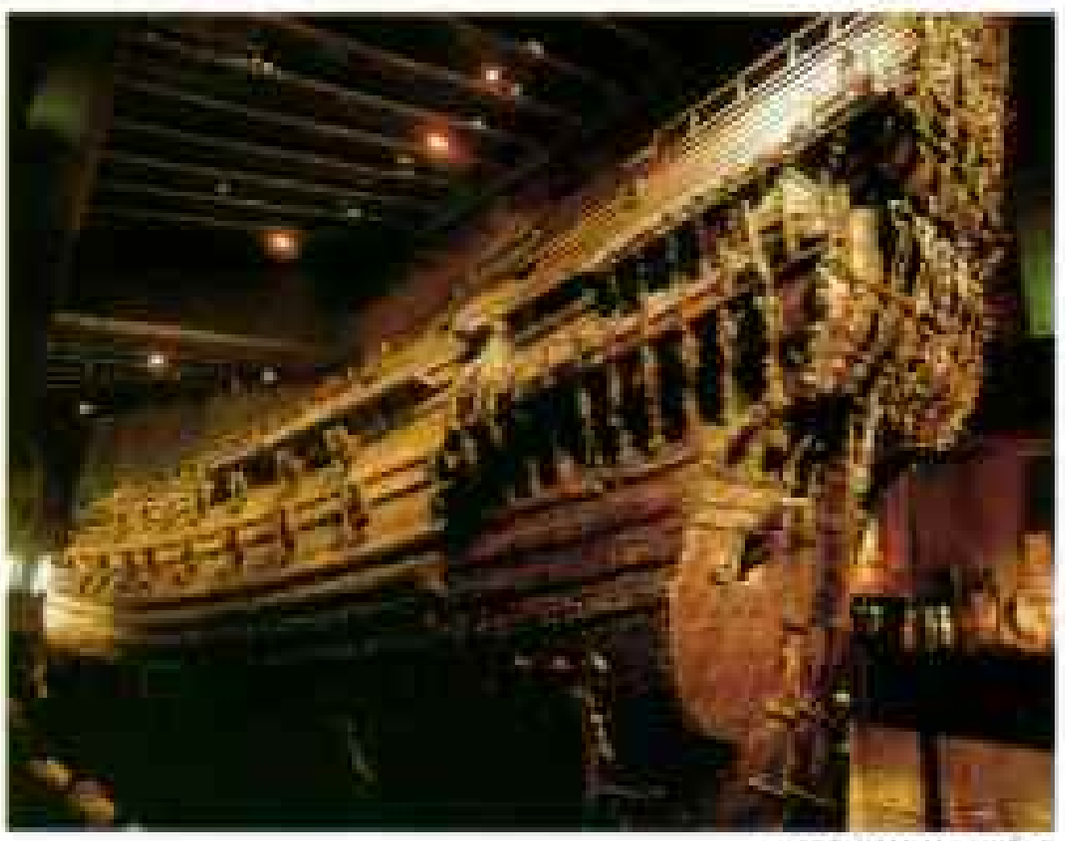
Safe Museum Harbor for a Preserved *Vasa*

Vasa has docked for the last time. The Swedish man-of-war capsized and sank on her maiden voyage in 1628. She was located and later raised (National Geographic, January 1962) and is now the centerpiece of a new museum on an island in Stockholm Harbor. It is only a few hundred yards from where she went down, claiming some 50 lives, on her way to battle in the Thirty Years' War.

Within decades of the disaster, many of *Vasa*'s guns were salvaged. Then the ship was forgotten until historian Anders Franzén found her in 1956 and led the effort to raise her. *Vasa* had been housed in a temporary museum while the new museum was planned and built. It opened last June.

"About 14,000 parts of this huge puzzle are in place," says Katarina Villner, the Vasa Museum's head of information. They include 95 percent of the hull and 98 percent of the 700 wooden sculptures carved on its exterior. The museum plans to use *Vasa*'s two remaining lower masts in the reconstruction of the ship's standing rigging.

Current exhibits include life on a warship, *Vasa*'s history, the exquisite artistry of the ship's three master carvers, and Sweden in 1628. To understand how the ship's instability led to disaster, a visitor can use a computer to design a ship, then add guns, wind, and sails. If the "new" ship is more stable than *Vasa*, the computer awards a passing grade. If not, says Villner, "the ship sinks right in front of you."



HANS HAMMARSKIÖLD

National Geographic, May 1991

Geographica

Tracking an Iceberg the Size of a State

It sounds like a work of science fiction: an iceberg nearly the size of Delaware drifts 1,200 miles at speeds as great as eight miles a day for almost two years—then splits into pieces.

But it's true. The iceberg (right), bearing the prosaic name B-9, was calved from the eastern Ross Ice Shelf of Antarctica in October 1987, reuniting what had been the Bay of Whales with the open ocean. B-9, 96 miles long and 22 miles wide, was tracked on its odyssey by scientists who used satellite data to plot its route, speed, and rotation.

B-9 was not the largest iceberg ever known—one measuring some 60 by 60 miles holds that record—nor was it tracked the longest; scientists followed one berg for 11 years.

But in the process of tracking B-9, says Stan Jacobs of Columbia University's Lamont-Doherty Geological Observatory, scientists gained insight into how icebergs interact with powerful Antarctic currents and the seafloor.

As for the Bay of Whales: Jacobs says the ice around it will advance at the rate of about 1,600 feet a year, so it should resemble its old self in a mere 70 years.

Fossils From China Rival Burgess Shale

For decades after its discovery in 1909 a small British Columbia site called the Burgess Shale was thought to be unique for its vast array of 530-million-year-old fossils of multicelled animals, the earliest site to yield such wide variety. But in the past half dozen years a trickle of papers from China has tantalized experts with word of an older site called Chengjiang that has some of the same sea-dwelling Cambrian-period creatures—and some previously unknown ones.

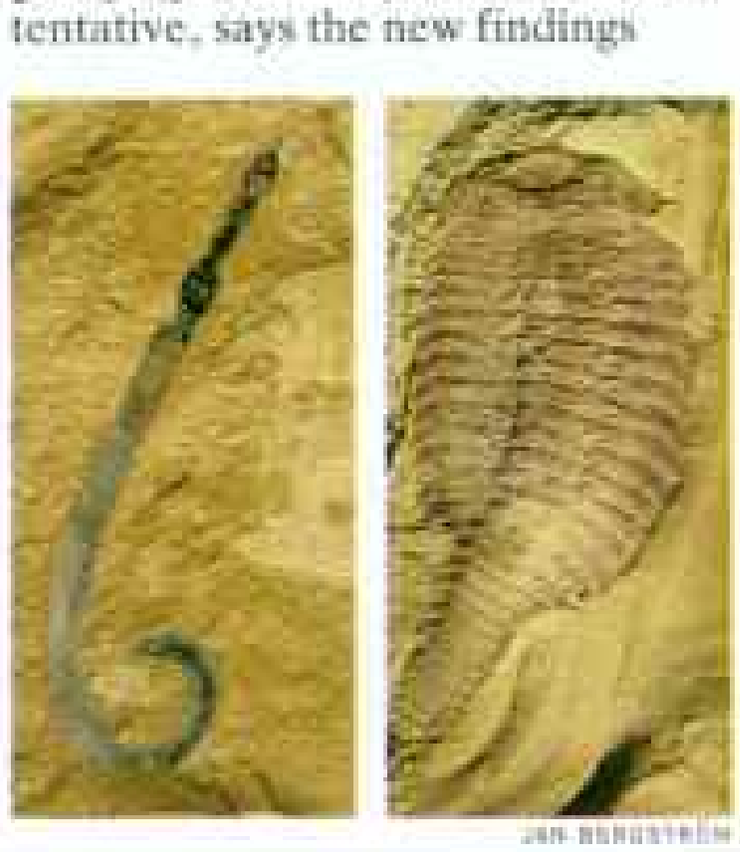
Many Western scientists now have had their first good look at the Chinese discoveries in an article published in the Winter 1991 issue of the National Geographic Society's scientific journal, RESEARCH & EXPLORATION. Written by two Chinese scientists, Chen Junyuan and Hou Xianguang, and two Swedish colleagues, Jan Bergström and Maurits Lindström, the report summarizes their view of the Chengjiang fauna and includes detailed photographs of many of the unusual fossils (below).

KOMO

Bergström, who admits that his group's preliminary conclusions are tentative, says the new findings bring scientists closer to understanding the origins of major animal groupings.

Harvard's Stephen Jay Gould, author of a recent book about new interpretations of the Burgess Shale creatures, says the site is important because it can be compared with the Canadian fossils.

"To have another site half a world away allows comparison," he says. "You can talk about the universal and not just the local."



JAN BERGSTRÖM

Drilling to the Heart of an Alaska Volcano

A colossal volcanic eruption, the century's largest, rocked Alaska's Katmai region in 1912. Over the next several years botanist Robert F. Griggs led a series of expeditions—sponsored by the National Geographic Society—into the isolated, largely unmapped area of the Aleutian Range and found a valley steaming with volcanic activity. He named it the Valley of Ten Thousand Smokes. The area was declared a national monument in 1918 and today is part of Katmai National Park.

For the past two summers, scientists have made a geophysical study of part of the region's vast volcanic system. Now they hope to drill 4,000 feet beneath the surface to study its "plumbing." If an environmental impact statement passes National Park Service muster, they plan to drill in 1993 and 1994. Core samples would reveal new evidence of how explosive eruptions occur and provide a record of the 1912 blast.

John Eichelberger of Sandia National Laboratories in Albuquerque, who heads the team, says drilling would be environmentally safe and "in the spirit of why the park was founded: as a place to study explosive volcanism."

The 15-million-dollar project involves 40 scientists from the U. S. Geological Survey, 12 universities, and four national laboratories. Funding comes from the U. S. Department of Energy, the National Science Foundation, and the Geological Survey.

National Geographic, May 1991

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Geographica

TERRENCE MOORE

A Felicitous Site for the Center of the World

Most people might look at 2,800 acres of land nine miles west of Yuma, Arizona, and see desert. Jacques-Andre Istel saw Felicity, California, the Official Center of the World. Now, in the geographic junction of imagination and whimsy, it has been so proclaimed.

Istel, a French-born parachutist and investment banker, created Felicity, named for his wife Felicia, after buying the parcel of land in the late 1950s. It was the center of the world to him, at least during the winter—"It's too hot in the summer," he admits.

On a spherical planet one place has as good a claim to such a designation as any other, so he wrote a children's book that gave Felicity that role. Then he had it legally declared the Official Center of the World by the board of supervisors of Imperial County, California.

As an incorporated town, Felicity will be on National Geographic Society maps where scale permits, though without further designation.

The exact location of the Official Center of the World rests inside a pyramid. "My wife said, 'This is a desert; build a pyramid,' " Istel says. Felicity consists of a restaurant, a store, and a few apartment buildings. Governed by a Council of Sages who each earn 18 cents a year, the town has a train station, though no trains stop there yet. Oh, did we mention its section of stairway from the Eiffel Tower?

Suggestions for GEOGRAPHICA may be submitted to Boris Weintraub, NATIONAL GEOGRAPHIC, Box 37357, Washington, D. C. 20036, and should include the sender's address and telephone number.

Solar Eclipse to Darken the Sky Above You

Mark your calendar! If you live anywhere from southern Canada to northern South America, the sky will darken July 11. The moon will pass between the earth and the sun, causing a solar eclipse; in some places the longest one for the remainder of the century.

A solar eclipse occurs somewhere every 18 months or so. The July 11 eclipse will be especially long, partly because the moon will be relatively close to the earth. In parts of the Mexican mainland and at the southern tip of Baja California—nearly 800 miles south of the U. S. border—the sun will be totally obscured for nearly seven minutes. The eclipse also will be total in parts of Hawaii, Central America, Colombia, and Brazil. It will be noticeable in all the contiguous U. S. except northern New England. How dark it will get depends on the distance from the path of totality (below left). Tucson will experience 72 percent of solar obscurity, Houston 60 percent, Denver 37 percent, Chicago 13 percent, Washington, D. C., 7 percent.

Jay Pasachoff, director of the Hopkins Observatory at Williams College in Massachusetts, who will study the eclipse in Hawaii for the National Geographic Society, notes that those who miss this one will have another chance, since eclipse patterns recur every 18 years, 11⅓ days. If you're making plans, that's July 22, 2009.

Liberty Book a Boon to Statue and Ellis Island

The renovation of the Statue of Liberty (GEOGRAPHIC, July 1986) and the restoration of Ellis Island (GEOGRAPHIC, September 1990) were carried out by the Statue of Liberty–Ellis Island Foundation with the aid of individual, school, foundation, and corporate contributions. A significant amount of money was raised through the sale of *Liberty: The Statue and the American Dream*, a book created for the foundation in 1985 as a public service by the National Geographic Society.

Foundation Vice President Gary Kelley says that more than 250,000 copies were sold, earning more than seven million dollars.

Tracing U. S. immigration history, *Liberty* was produced with a grant from the Kimberly-Clark Corporation and printed by QuadGraphics Inc. Delighted readers, says Kelley, include the foundation's head, Lee Iacocca. "It's one of his favorite books. He's read every word."

National Geographic, May 1991

It's amazing how much scrap metal you get from a few cans of beer.

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NATIONAL GEOGRAPHIC MAGAZINE

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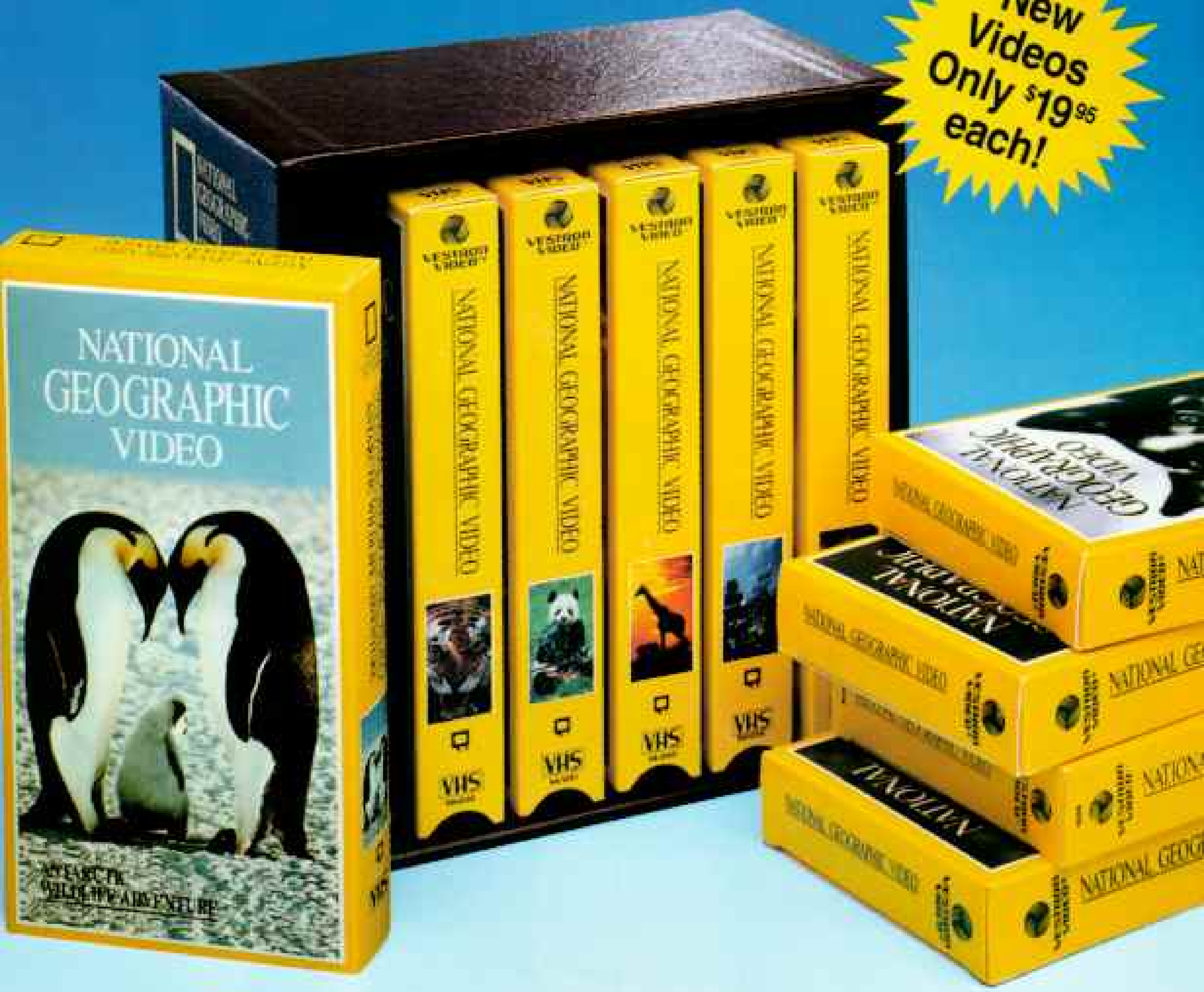

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HOW HUMAN

PEOPLE SMILE WHEN THEY'RE HAPPY, FROWN WHEN THEY'RE SAD. DO DOGS?

Yes. And no. A dog's expression and body language is largely determined by how important he feels around other dogs or his owner.

Dogs are very concerned about their 'social rank'. Like humans, they love being a big shot and hate being ignored or reprimanded.

So when a dog looks like he's smiling (left-hand picture), it means he's happy and excited to see you. From experience he knows you're about to give him a giant hug.

The half-smile (middle picture) is his way of saying, "Hey, I've been a good dog…pet me…pay attention to me…Pleeease?"

As for what we'd call a frown (right-hand picture), it usually just means he's sleepy or bored.

IS HE A MEMBER OF YOUR FAMILY OR ARE YOU A MEMBER OF HIS?

Ready for a colossal misunderstanding? You get so attached to your dog, you come to think of him as almost human.

Meanwhile he is thinking that you're a dog.

From his perspective you and your family are a prehistoric dog-pack which has taken him into their den (i.e. your house).

This is why he likes to sleep on your bed—apart from the fact that it's warm, soft and dry. Every dog instinctively wants to sleep close to the leader of the pack and in your house, that's you.

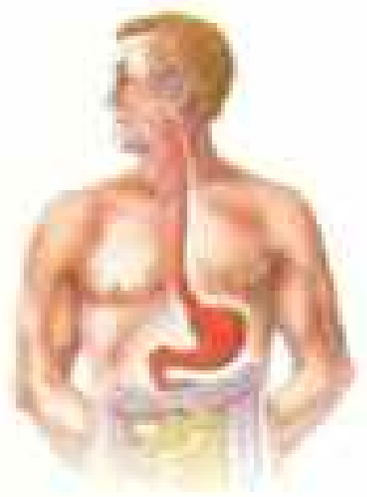
So, treat your dog like one of the family. But if you want to understand him better, it helps to think like a dog.

IS YOUR DOG?

YOU'RE CUTTING BACK ON MEAT. SHOULD YOUR DOG?

You've heard that people should eat less meat and more fruit, vegetables, fiber, and grains.

Maybe you think your dog should too. Judging by their labels, a lot of dog food manufacturers must think so.



Omnivores' (that's us) digestive system takes nutrients from various foods.

Carnivores' (that's your dog) digestive system specializes in meat.

But nothing could be further from the truth. Dogs are carnivores. They're supposed to eat meat. They thrive on meat.

Meat protein and fatty acids help your dog look and feel healthy. You can see what meat does for a dog by his thick and shiny coat.

(Dogs, by the way, never have problems with cholesterol. So they can eat more meat than we can.)

That's why dogs should eat Iams. It contains more meat protein than the leading supermarket dog food.

And since dogs naturally like meat, dogs will naturally like Iams.

So it's really very simple. If you're in the market for the best dog food, get out of the supermarket.

Your dog is different from you. But he does belong to your family. So you need to feed him right. And that means feeding him Iams.

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Thousands of bears are killed worldwide each year for their gall bladder, paws and other body parts. Equally as devastating for bears is continual loss of habitat.

Does this all sound sadly familiar? Could our own North American black bear be added to the growing list of endangered animals? The Dragonette Society is a non-profit organization dedicated to preserving all wildlife.

North American Black Bears

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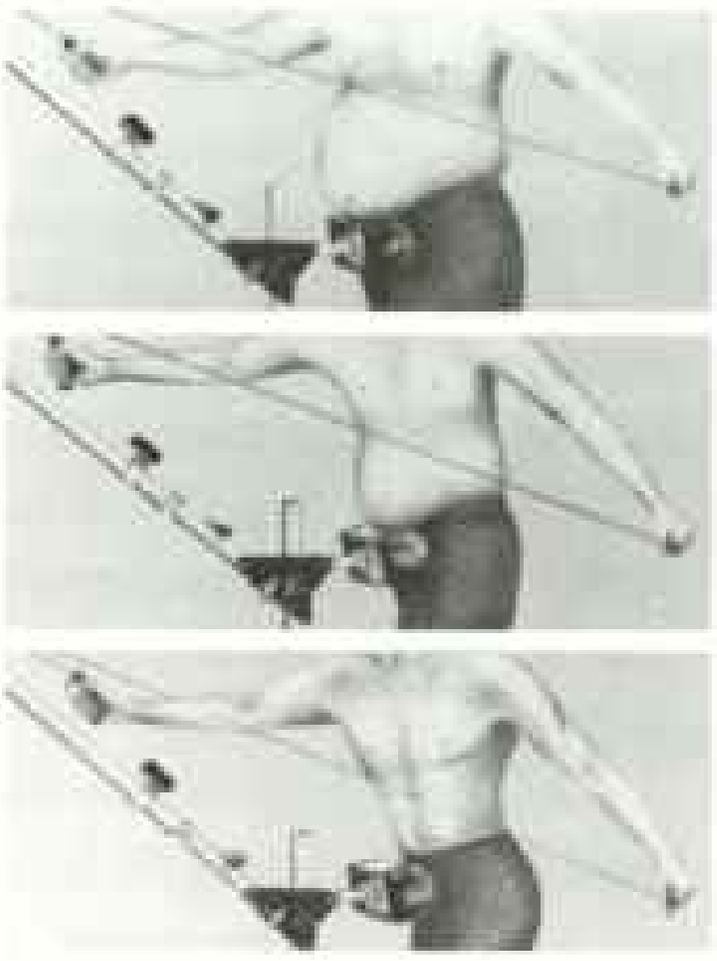

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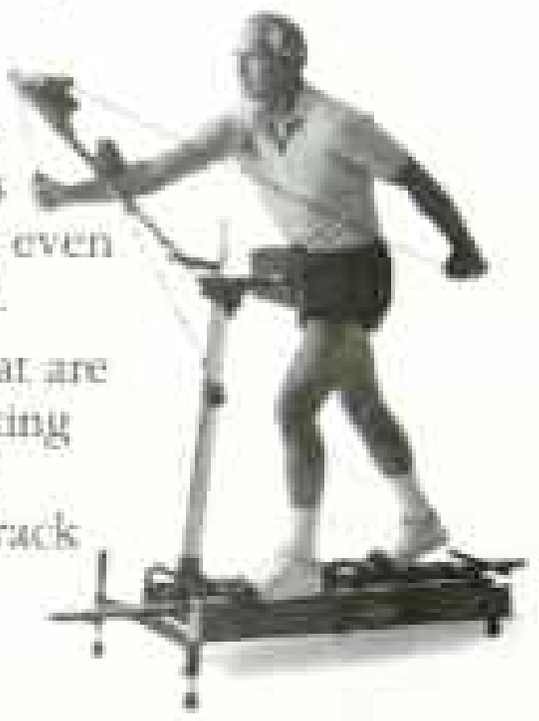

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Earth Almanac

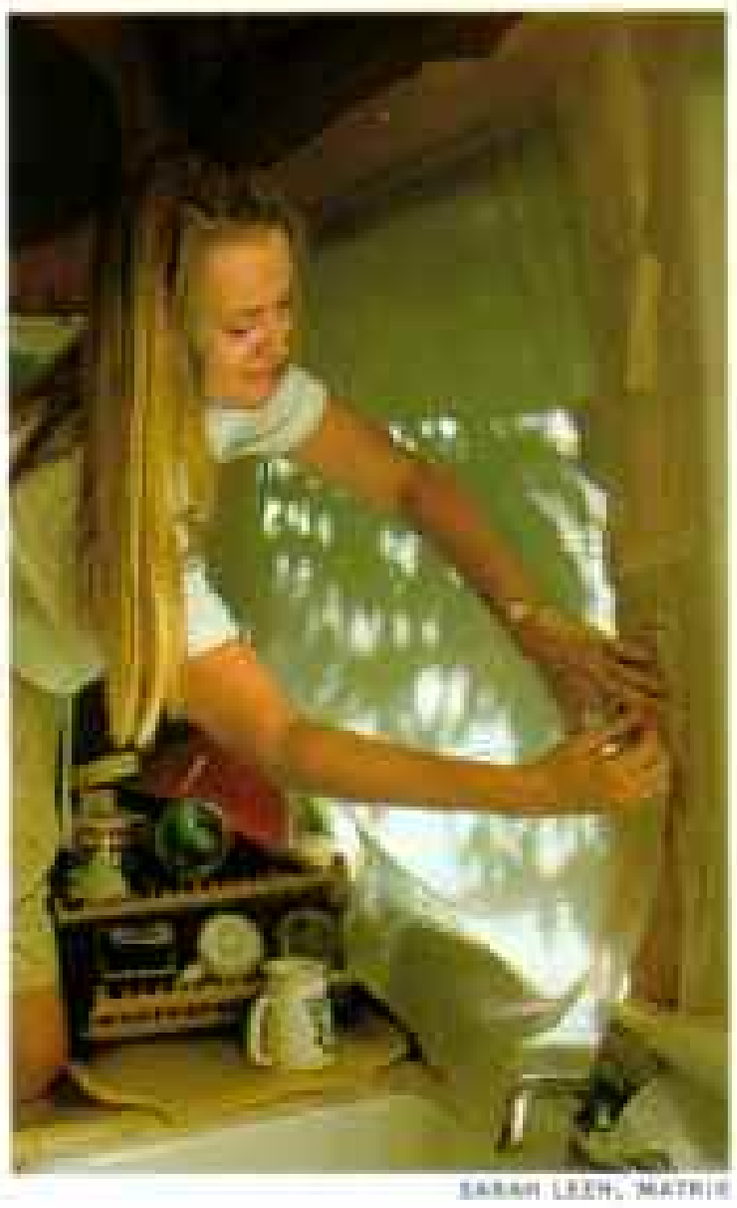
Is Fruit Fly Biding Its Time in California?

Victory was declared last fall by California officials in the state's latest battle against the Mediterranean fruit fly. But not everyone agrees that the war has been won; the pest may be back in force.

California's 15-month eradication campaign included aerial spraying of the pesticide malathion. The helicopter offensive forced some Los Angeles residents to seal their homes (right) and prompted protests and lawsuits. In addition, six billion sterile medflies were released to disrupt the flies' mating cycle.

The fly arrived in the 1970s—and continues to return, many authorities believe—in contraband fruit from the Pacific or Latin America, threatening California's 18-billion-dollar-a-year farming industry. Others believe the medfly has gained a foothold in southern California.

"The first medfly was detected in Los Angeles in 1975," says entomologist James R. Carey of the University of California at Davis. "It's since shown up repeatedly in the same neighborhoods. I think there are active population pockets now, simmering at a low level, which have taken years to build up."



SARAH LEEN, MATRIX

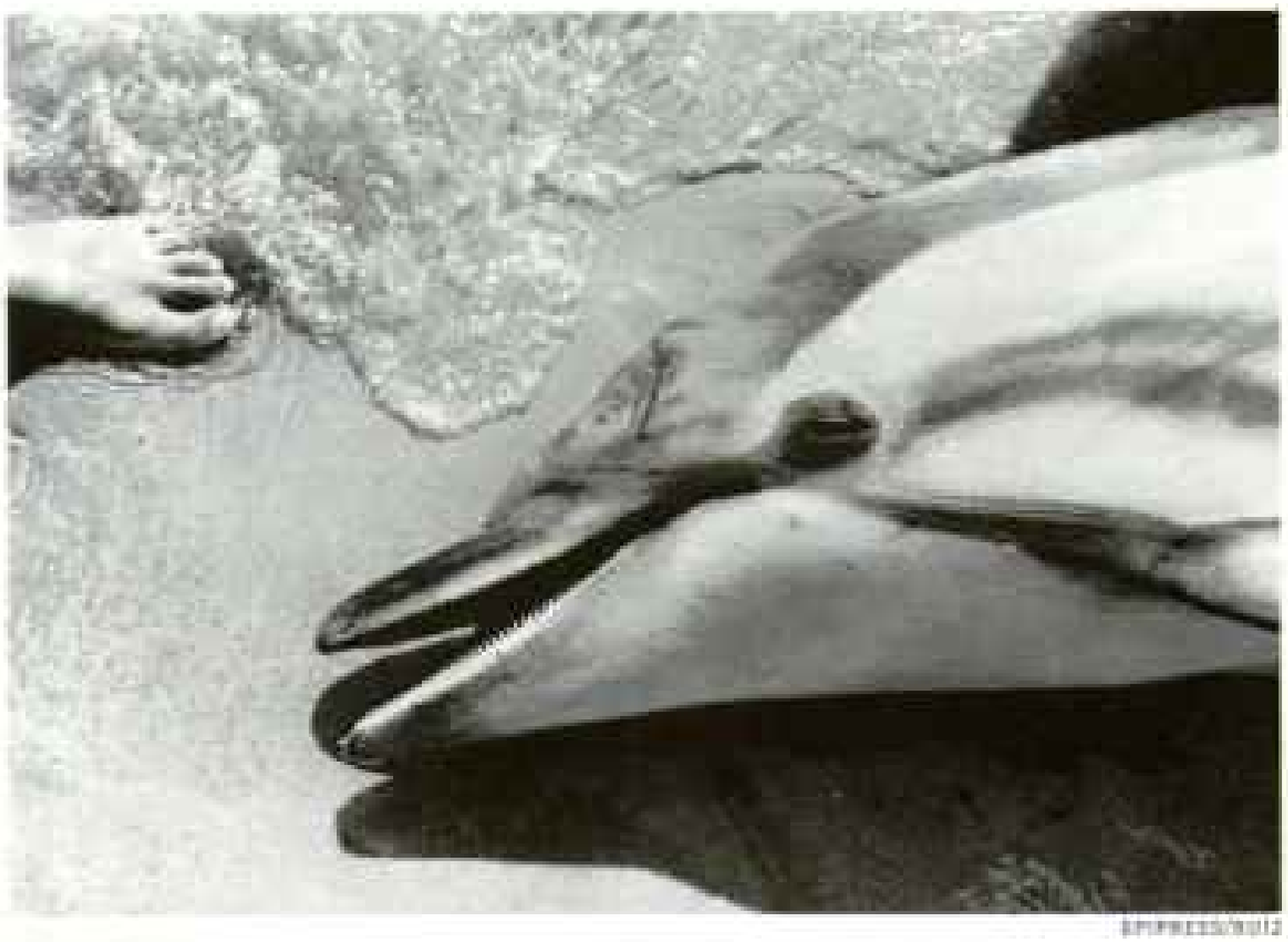
Spring's Glory, Dogwoods Threatened by Fungus

Cherished symbol of spring, dogwood trees in the wild are dying from a fungus that also menaces domestic dogwoods.

An invader of unknown origin, dogwood anthracnose appeared in the late 1970s. Now it infects flowering dogwood species in at least 18 states and British Columbia.

The disease begins as purple-rimmed leaf spots. The entire tree may succumb within a few years as the infection spreads. Forest dogwoods are more susceptible than trees in the open, which receive more sunlight and air circulation.

With mortality reaching 90 percent in some areas, will the dogwood disappear like the American chestnut? Some dogwoods may be naturally resistant. "For urban trees we have pruning, fertilizing, mulching, and watering methods that can help," says Robert Anderson of the U. S. Forest Service. Thus homeowners can care for the dogwoods most likely to survive—those in their own backyards.



EPIPRESS/KOZ

Deadly Virus Strikes Mediterranean Dolphins

"Swiftest of all animals . . . is the dolphin; it is swifter than a bird and darts faster than a javelin," wrote Roman naturalist Pliny the Elder, celebrating the marine mammals he saw coursing through the Mediterranean in the first century A.D. Today it is a troubled sea.

Recently hundreds of dead dolphins have washed onto beaches in Spain, France, and Italy, victims of a virus. The deaths may be linked to severe pollution in these waters. Some of the stricken dolphins were highly contaminated with toxic metals and polychlorinated biphenyls, or PCBs.

Plaguing striped dolphins (left), the epidemic is caused by a morbillivirus. Seamus Kennedy, of the Veterinary Research Laboratories in Belfast, Northern Ireland, identified the virus, which causes pneumonia and brain damage and apparently weakens the dolphins' immune systems.

The same virus may also threaten the endangered Mediterranean monk seal, of which only a few hundred remain. Three years ago a similar virus killed nearly 20,000 common seals in the North Sea.

National Geographic, May 1991

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EarthAlmanac

ANNE B. KEISER

As Australia Grows, Koala Habitat Shrinks

With a nationwide koala population of perhaps 400,000, Australia's most adored marsupials seem unlikely candidates for the endangered species list. Yet concern has arisen for koalas, which numbered several million at the turn of the century, as they continue to decline, largely from loss of habitat. Though legally protected, koalas have lost about 60 percent of their native forest on the east coast to burgeoning development.

The finicky koala's principal diet, eucalyptus leaves, makes it vulnerable. More than 500 eucalyptus species exist, but the animal prefers only three dozen or so.

As sections of eucalyptus forest are leveled, koalas become isolated, blocked from greener pastures by farms and housing developments. "When koalas cross roadways to seek forage, many are killed by motor vehicles," says Werner Heuschele, a veterinary microbiologist at the San Diego Zoo. He reports that Australian government officials and conservationists hope to connect fragmented areas with protected koala corridors.

Furthermore, in some koala populations as many as 80 percent of the adults appear to be infected with a bacterium called *Chlamydia psittaci*, which can cause infertility. It may explain why fewer than half the females give birth each year.

The koala and its problems have moved Australian and international conservation groups to encourage further study of the animal and preservation of its home territory.

In a Colorful Garden, Plants See the Light

For a bumper crop of Beefsteak or other juicy tomatoes, future gardeners should use red mulch. Agricultural scientists have shown that plants grown with that color produce more top-quality tomatoes than those grown with standard black plastic.

Michael J. Kasperbauer and Patrick G. Hunt of the U. S. Department of Agriculture in South Carolina use a rainbow of ground coverings (below) to test the response of various crops to a narrow band of light called far red. It falls between visible red and infrared in the light spectrum. The amount reflected varies with the color of the mulch.

"Mulch that reflects more of the far red from incoming sunlight enhances the growth of aboveground crops such as tomatoes, beans, and cotton," explains Kasperbauer. "A smaller amount of far red benefits below-ground crops like potatoes and turnips."

Stalking Wild Mushrooms With Knives and Guns

A new kind of outlaw is operating in the Oregon woods—the mushroom rustler. Commercial poachers bearing firearms and knives are harvesting the pine mushroom, *Armillaria ponderosa*, known as *matsutake* in Japan; there it can fetch more than $100 a pound. Armed rangers travel in pairs to root out the rustlers who invade Crater Lake National Park, where picking the mushrooms is a crime.

"They often work en masse, threatening the entire crop," says district ranger Mark Magnuson. "In places it looks as if they went through with a Rototiller."

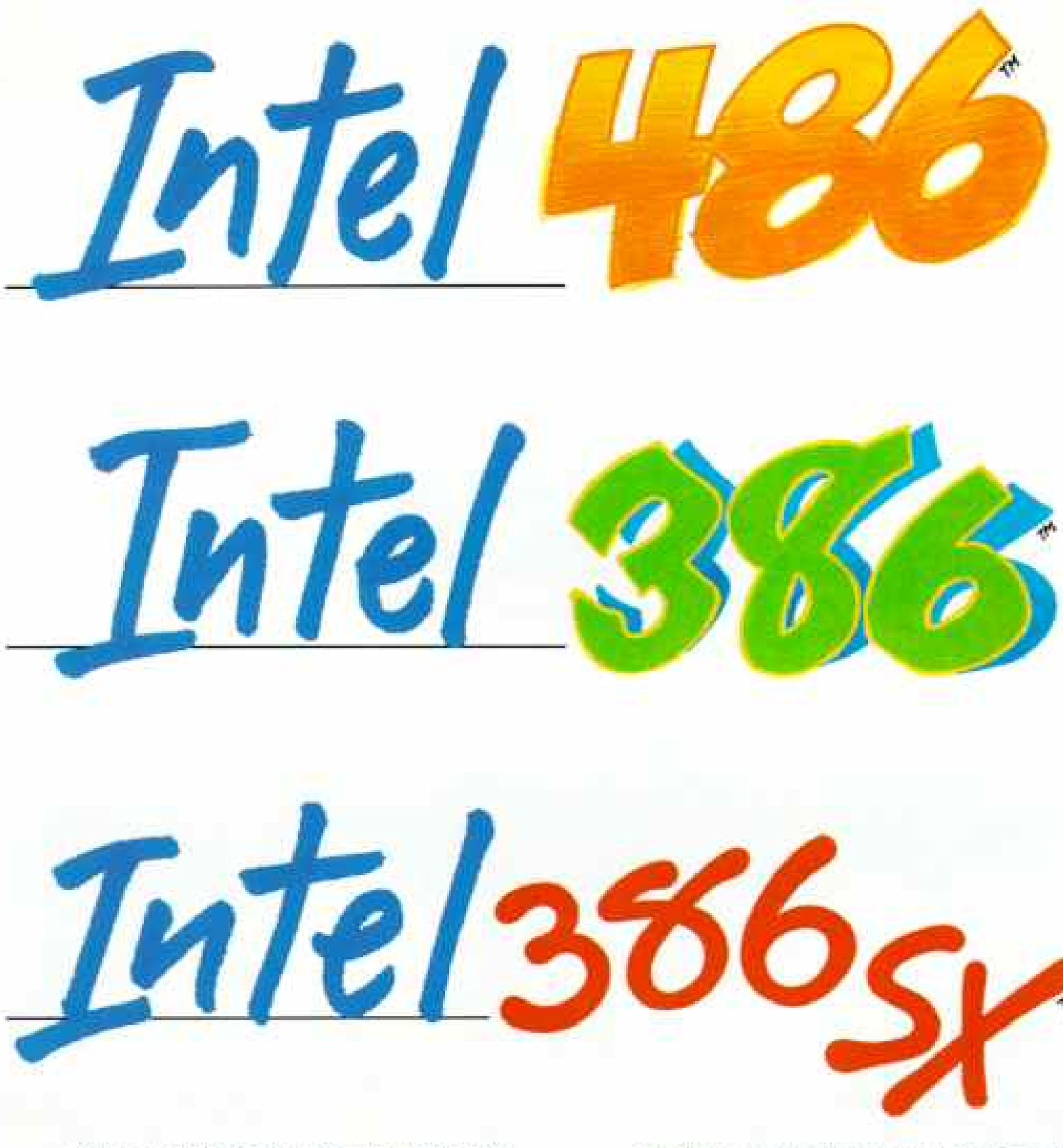
Near the park, poachers sometimes get $40 a pound at roadside stands. One buyer was found with $70,000 in his pocket.

Last fall park rangers seized 600 pounds of illegally harvested mushrooms and issued 28 citations, which carry fines of as much as $250. Poaching is also heavy in adjacent Winema National Forest, where picking pine mushrooms is legal with a permit.

WOODROW SANDERS, USDA

National Geographic, May 1991

Time's up.



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On Assignment

Trash is an eloquent, if unappealing, symbol of our throwaway society for University of Arizona anthropologist WILLIAM L. RATHJE, here accompanying a bargeload of municipal garbage to the Fresh Kills Landfill on Staten Island. A Maya specialist, Bill got involved with the artifacts of our own culture by accident. "In 1973 I asked students to pick an aspect of modern behavior and look for patterning in the artifacts related to it," he recalls. "One woman studied the relationship between how neatly people dress and the way they put ketchup on hamburgers. But several students got the idea to analyze garbage, and it struck me as a fun experiment."

Creating the Garbage Project, Rathje continued to study "fresh" garbage with students and colleagues, then four years ago turned to landfills. "We're using an unconventional approach to make people aware of what they're wasting."

A different kind of search consumes staff photographer JAMES L. STANFIELD (below, at left), whose work habits—punishing, 18-hour days—and extraordinary skills have earned him legendary status during a 24-year GEOGRAPHIC career. "The search for a memorable photograph means stretching each day to the limit," says Jim, who has twice been named Magazine Photographer of the Year. "I'm not satisfied unless I come back absolutely exhausted."

That was no problem in remote Bhutan, where Jim set out to photograph the nation's highest peaks, led by guide Wangdi Adap, at right, and a porter named Dole. The trio took a week to climb to 16,000 feet for a clear view of the Jhomolhari Range, behind them and on page 101, which includes some of Bhutan's grandest peaks. Jim calls this trek "one of the most strenuous experiences of my life"—a remark that astonishes anyone who's ever tried to keep up with Jim in the field.

PHOTOGRAPHS BY LOUIE PSIHOYOS (TOP); JAMES L. STANFIELD, NGS

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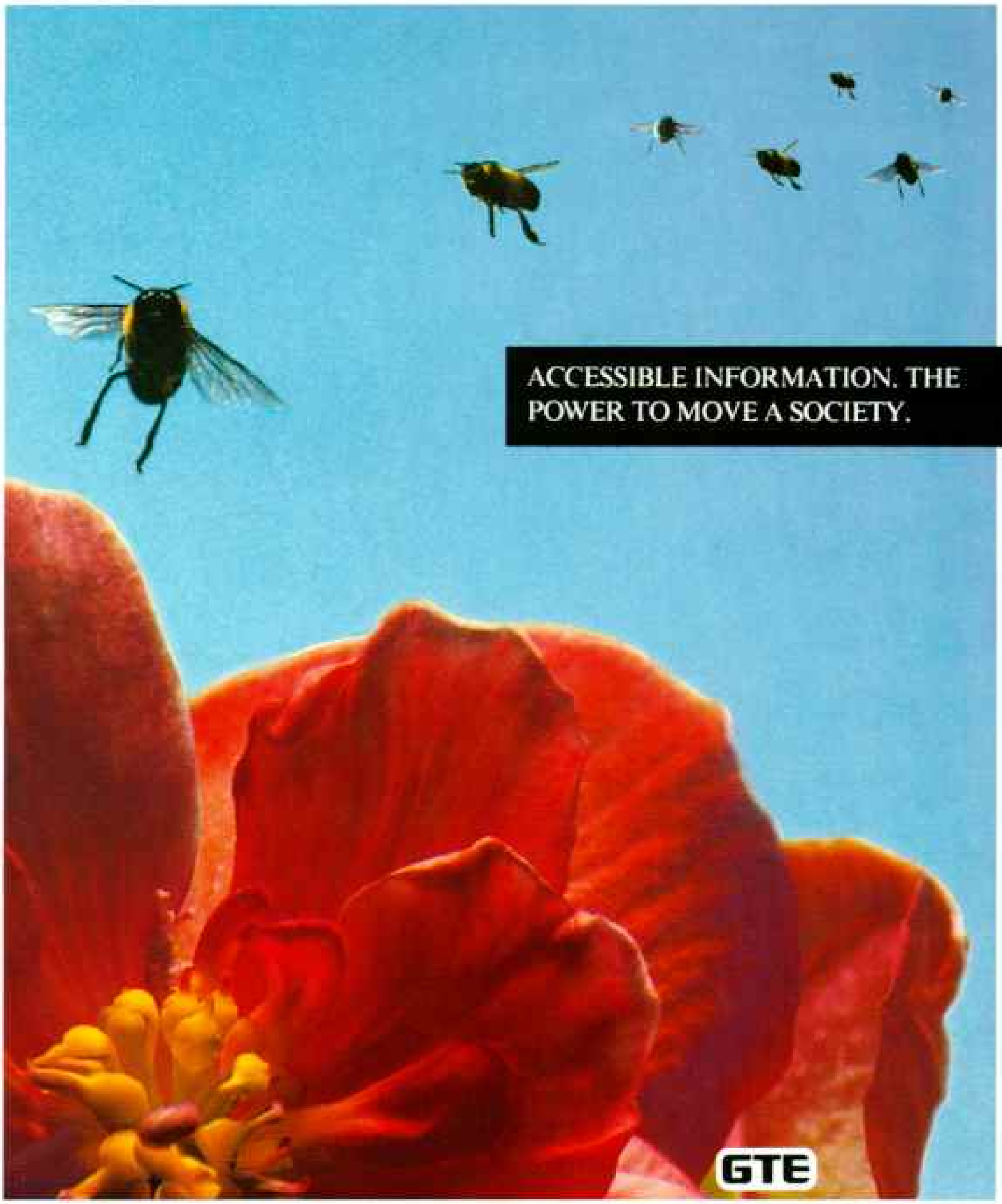

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