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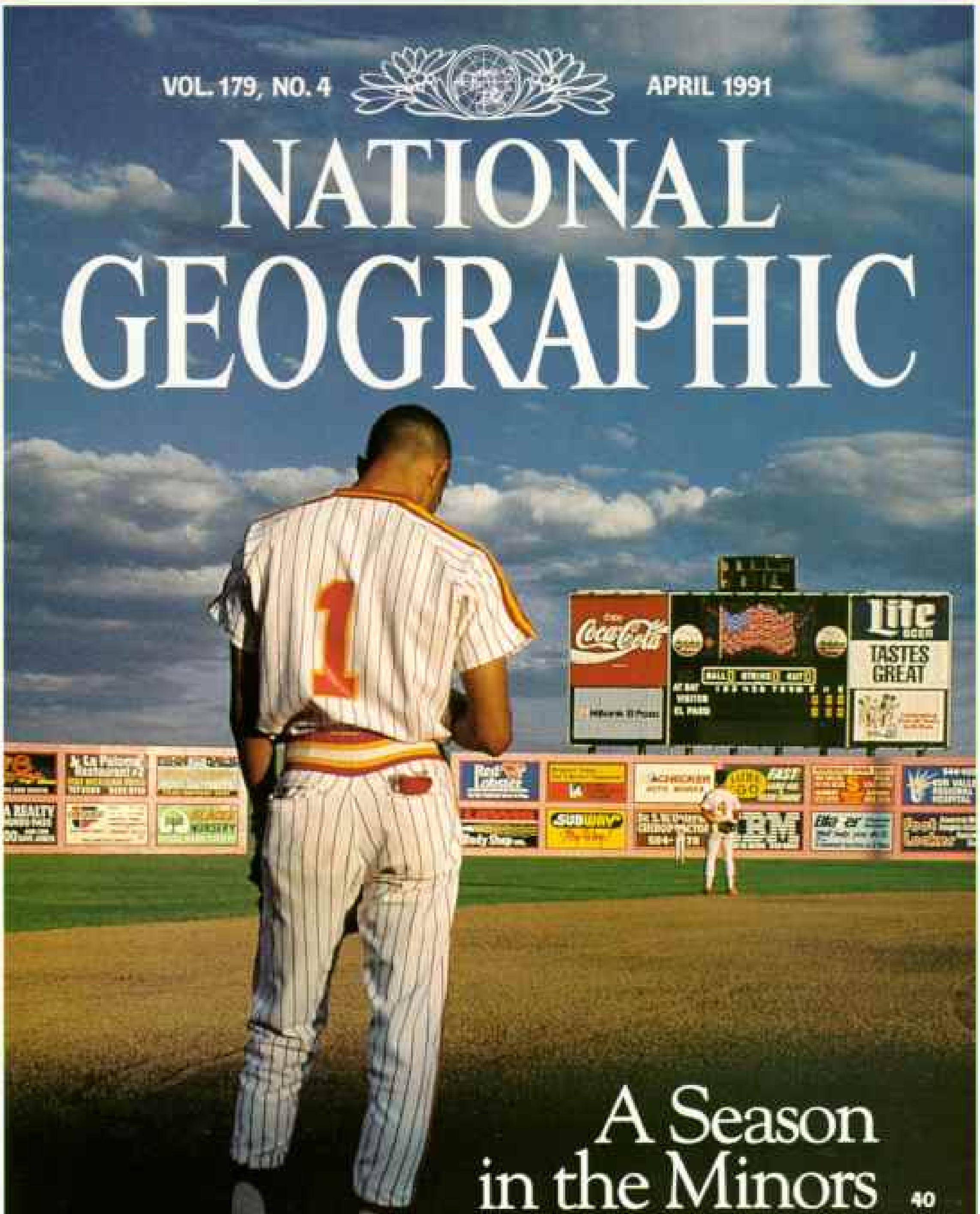
NATIONAL GEOGRAPHIC



A Season in the Minors 40

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NATIONAL GEOGRAPHIC

APRIL 1991

COVER: A moment of reflection during the national anthem, and then it's "Play ball!" for the El Paso Diablos minor-league baseball team. Photograph by William Albert Allard.

Larger than life as a pharaoh, builder, and sire, Ramses II spread his likeness across Egypt during an epic reign.

RAMSES

By RICK GORE ASSISTANT EDITOR

THE GREAT

Photographs by O. LOUIS MAZZATENTA SENIOR ASSISTANT EDITOR

LIMESTONE COLOSSUS PHOTOGRAPHED AT THE MEMPHIS MUSEUM

IN THE YEAR 1279 B.C. the Sphinx, that great man-animal monument that stands near the ancient Egyptian capital of Memphis, was already more than a thousand years old. A young warrior strides between its paws. He is dressed in regal garb, a ceremonial wig concealing his close-cropped hair. His father, Pharaoh Seti I, has died. The warrior is not only the new pharaoh but also a god—descendant of the lion-bodied Sphinx itself.

From his private shrine between the paws the pharaoh surveys the great stone face. The wind-driven sands of time have taken their toll, eroding its once sharp features. The base of the limestone statue is eroding even more rapidly. The pharaoh is disturbed at the damage. The Sphinx, which he knows as Hor-em-akhet, embodies the primal sun god Re as well as Horus, the god of kingship. It is from Hor-em-akhet that kings receive their authority to rule. And this king is not about to let that authority erode with the monument.

He will order laborers to buttress the base with stones. Freshly cut stones, he will specify, not those scavenged, as was the custom, from some earlier pharaoh's monument.

Fit for a pharaoh, a gold and lapis lazuli bracelet found at Bubastis was worn by Ramses II or one of his favorites. The ducks represent offerings to the gods so that they would keep order in the world.

ARTIFACT FROM THE EGYPTIAN MUSEUM, CAIRO; PHOTOGRAPHED AT AN EXHIBITION PRESENTED BY THE DALLAS MUSEUM OF NATURAL HISTORY ASSOCIATION

On a colossal statue that scholars now suspect stood between the paws, he orders workers to chisel in his throne name, User-maat-re—Strong-in-truth-is-Re. And beside that inscription he commands them to carve his personal name, Ramesse—or, to us, Ramses the Great.

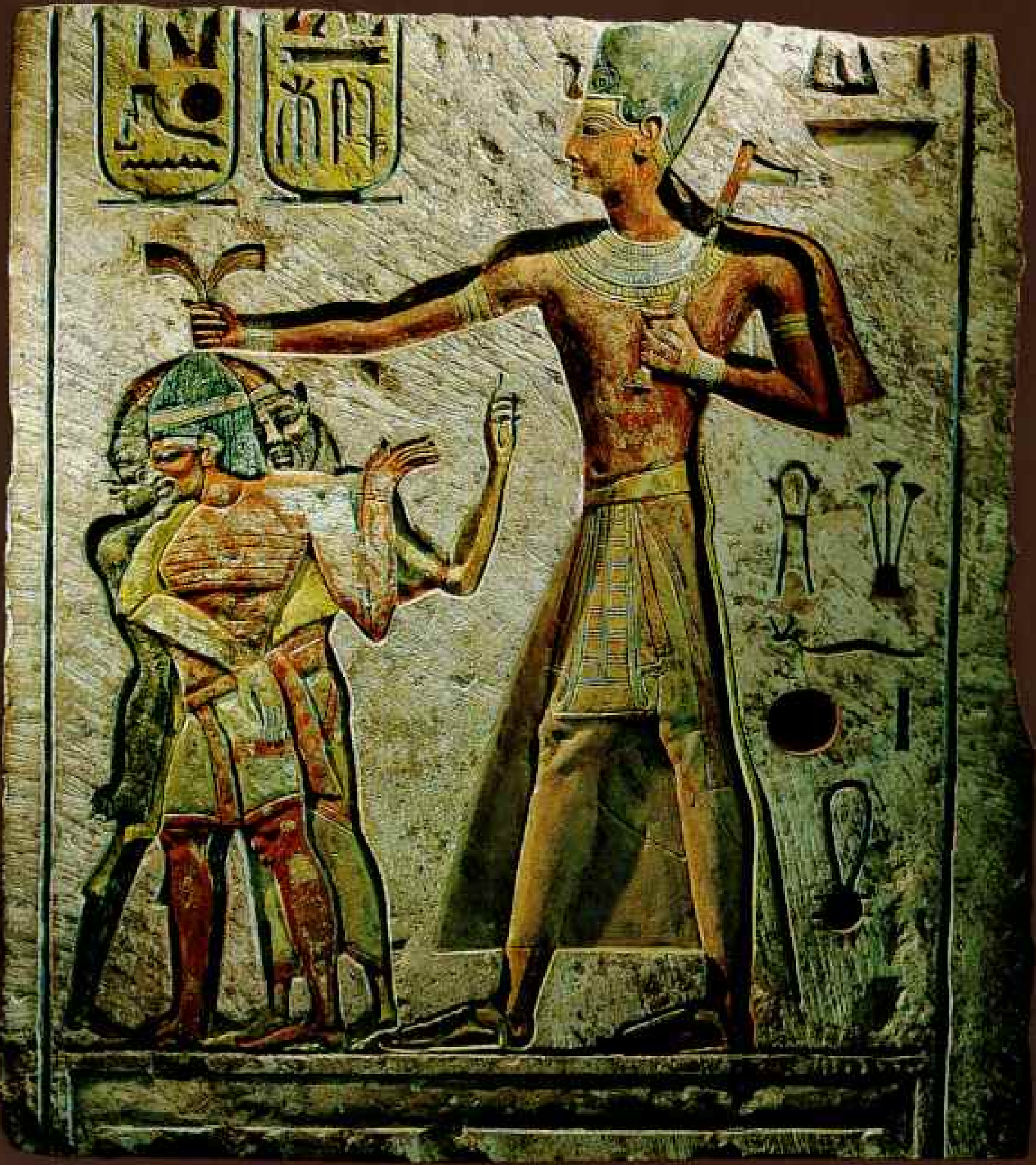
He will reign more than 60 years, sire at least 90 children, bring his empire prosperity and peace, build more colossal structures and have his name carved on more stone surfaces than any other pharaoh. He will be linked also with the Exodus of the Hebrews.

More than 32 centuries later I stand on scaffolding that encases the face of the Sphinx. I reach out and touch the crumbling face. No sparks leap from the rock. But then I am no god. I have no *ka*, or divine spirit, to be recharged. I am what Ramses would have called a scribe—one trying to understand this man whose name symbolizes the grandeur and the great monuments of ancient Egypt.

Our perception of Ramses has long been colored by the English poet Percy Bysshe Shelley. He wrote his famous sonnet "Ozymandias" after a magnificent bust of Ramses, found near a shattered colossus at the pharaoh's funerary temple in Thebes, was shipped with great fanfare to the British Museum in 1817. The name Ozymandias came from a Greek corruption of User-maat-re by the historian Diodorus, who described the fallen statue in antiquity. Shelley imagined Ramses as a symbol of tyranny and unbridled egotism:

Half sunk a shattered visage lies, whose frown,
And wrinkled lip, and sneer of cold command,
Tell that its sculptor well these passions read . . .
And on the pedestal, these words appear:
My name is Ozymandias, King of Kings,
Look on my Works, ye Mighty, and despair!

Clutching Nubian, Libyan, and Syrian prisoners by their hair, Ramses wields an ax to dispatch them. Egyptian reliefs, like this limestone fragment from the ancient capital of Memphis, proclaim only victories, never defeats. Such painted propaganda had undeviating purpose: to ensure loyalty and inspire fear.



PHOTOGRAPHED AT THE EGYPTIAN MUSEUM

Welcoming Ramses to eternity, relief at the entrance to his tomb at Thebes praises the sun god in his seventy-some forms.

No time being too early to prepare, this passage and the chambers below were decorated early in Ramses' reign.

PHOTOGRAPHED AT THE EGYPTIAN MUSEUM

Ramses evaded death for nearly 90 years, and his mummy has evaded destruction for 3,000. Embalmers spent 70 days preparing the corpse; it survived looting of the royal tomb and removal by priests to a secret site near the Valley of the Kings. Recent medical tests show that Ramses suffered from arthritis, dental abscesses, and poor circulation.

But there must have been another side. At the British Museum, I had visited the Ramses bust with Egyptologist Kenneth Kitchen of the University of Liverpool. Kitchen has spent the past 22 years translating and studying 2,000 pages of hieroglyphs that relate to Ramses. He is the world's leading authority on the man.*

We looked up at the bust.

"See, Shelley got it wrong," said Kitchen. "Our man never sneers. Look at his lips. He smiles. Gently. It's a lovely poem, but I'm afraid it's pure Shelley."

Kitchen's work and new archaeological interpretations are indeed helping us see beyond the cruel and romantic vision of Ramses. As this scholarship enriches our knowledge of ancient Egypt, it is rounding out a more human portrait of this towering figure. Who was the man behind the great stone mask? That is the question that pulled me to Egypt.

ARTIFACT FROM THE EGYPTIAN MUSEUM

The coffin that contained Ramses' mummy bears the crook and flail of Osiris, god of the afterlife.

MY SEARCH for Ramses begins in Cairo, the capital of modern Egypt. This swollen city is growing now by a million people a year. Urban sprawl envelops it; its streets are gridlocked with fuming buses and bleating automobiles.

I make my way through this raucous congestion to the Egyptian Museum. I want to see Ramses' mummy. It sits in a display case on the second floor, draped in dark velvet and tended by a drowsing guard. Thousands of tourists pass by each day, oblivious that the "King of Kings" lies at rest inside that unmarked case.

Until 1980 anyone could look at Ramses, as well as 26 other royal mummies in the museum's collection. Then the late President Anwar Sadat declared that it was undignified to display the bodies of kings, and the mummies were covered up or removed from view. Actually, they were decaying; their cases did not adequately protect them from the environment. New airtight cases are being developed, and museum officials plan to display some of the mummies again in the next few years.

For now, a museum official tells me I will need special permission to see Ramses, and that will take time. But I already know a few things about the body beneath the velvet. James Harris of the University of Michigan led a team that X-rayed and examined the mummy before it was removed from view. He described the physical Ramses:

"He was about five feet eight inches in height—one of the taller pharaohs. He had a strong jaw; a beaked nose, a long thin face. That was not typical of earlier pharaohs. He probably looked more like the people of the eastern Mediterranean. Which is not surprising, because he came from the Nile Delta, which had been invaded in the past by peoples from the east."

If I couldn't see Ramses' mummy that day, I could see in the museum images of the earlier pharaohs who had shaped his world. There was a robust statue of Thutmose III, who, two centuries before Ramses, had built an empire reaching east across Palestine and Syria and south as far as the Fourth Cataract of the Nile (map, page 11). And the enigmatic Akhenaten, oddly portrayed with a big belly, the "great heretic" pharaoh whose reign left Egypt in disarray.

Akhenaten and his elegant wife Nefertiti struggled to overthrow Amun, the state god, and his powerful priesthood. They replaced Amun with the worship of a mystical force embodied in the light from the sun. The royal couple transformed Egyptian art, introducing a fresh and loving depiction of nature and familial bliss. They moved Egypt's religious capital from Thebes to a new city in the desert, known today as Amarna.

They also neglected the empire. The Hittites, Egypt's archenemies to the northeast, began to encroach. The reign of Akhenaten

*The dates in this article are based on recent scholarship by Professor Kitchen.

Bound in winding sheets of traffic, this Ramses of hard granite from Aswan is being gnawed by a new threat to immortality—Cairo's dense air pollution. The colossus was moved to the capital from Memphis in 1955.

and Nefertiti ended abruptly. Their names were chiseled off the monuments and out of the memory of Egypt. Worship of the god Amun and orthodoxy returned, but the empire remained shaken.

A succession of pharaohs tried to restore Egypt's confidence. They included the young king Tutankhamun, believed by some to be Akhenaten's son. King Tut would gain fame for the treasures discovered in his tomb.

In 1295 B.C. the crown passed to a commoner who had risen through the bureaucracy to become vizier, the second most important post in the realm. This was Pramesse, Ramses' grandfather, who inaugurated Dynasty XIX as Ramses I. He ruled for a brief 16 months before his son Seti, a vigorous warrior, assumed the crown.

Ramses II was about eight when his father became pharaoh. Seti must have filled his son with romantic tales of war. I can imagine him personally showing the boy how to charge a chariot into a fray. Seti also infused his son with his own two great dreams: to reclaim the lands lost to the Hittites and to build colossal monuments to his own godliness in the style of the great kings of earlier dynasties.

Seti began making annual incursions into Syria to reclaim lost lands. He probably did not permit his son to go into battle for a few years. However, he did name Ramses commander in chief of the army at age ten. At about 14 the fiery youth was allowed to join his father in fighting in Libya.

Together they swore to recapture from the Hittites the city of Kadesh, today in Syria. It guarded the trade routes to the east. Seti and Ramses took the city briefly, but it fell back to Hittite rule as soon as they returned to Egypt.

Meanwhile, Seti had other plans for Ramses; he had selected a harem for him. The message was clear: start procreating. Ramses wasted no time. His principal wife, the lovely Nefertari, quickly produced a son. His second favorite wife, the clever Istnofret, soon delivered another. Within ten years each wife had borne at least five sons and several daughters. His other wives may have accounted for another five to ten sons and as many daughters.

"Ramses' house must have resounded with the gurgles, yelps, and whimpers of each year's crop of bouncing royal babies," notes Kitchen.

During this period Ramses spent much time overseeing his father's building projects. An age of colossal construction had begun a century before. Egypt had built an empire. Its vast holdings required a huge bureaucracy and a large army. The leaders of each had accumulated power. Many scholars now believe that the pharaohs of this era, to guard their own power, began to reemphasize the ancient belief that they were gods and to build statues and temples on a grand scale to reaffirm that message to their subjects. If so, Seti and Ramses may not have been merely expressing their egos with their constructions—but meeting a requirement of their job.

TO BE A GOD. Nowhere was that role emphasized more awesomely than in Thebes, the country's religious capital. I fly south from Cairo and confront the towering temples of Karnak and Luxor, sacred complexes where pharaohs competed to overshadow their predecessor's monuments. I feel so tiny, so inescapably mortal. I wonder

WORLD OF RAMSES II

Ramses was born in the eastern Nile Delta about 1303 B.C., during Egypt's golden age, known as the New Kingdom. Egypt had been unified 2,000 years earlier; by Ramses' time its borders reached the Fourth Cataract of the Nile, and its sphere of influence extended to northern Syria.

The Ramesside dynasty was born when Pharaoh Horemheb died with no heir, and his powerful vizier was proclaimed Ramses I, first pharaoh of Dynasty XIX. He was succeeded by his son Seti I and then his grandson Ramses II.

In 1279 B.C. Ramses II assumed the crowns of Upper and Lower Egypt. To keep neighbors at bay, he built forts in the Western Desert and invaded Syria with a highly trained army of charioteers, archers, and foot soldiers. Ramses left more monuments to himself throughout Egypt than any other pharaoh.

Ramses the Great

how Seti felt when he disembarked at Karnak from the royal barge for the first time as pharaoh. Once a commoner, he was now divine—entitled to enter the temple's inner sanctum, the "holy of holies," where Amun lived.

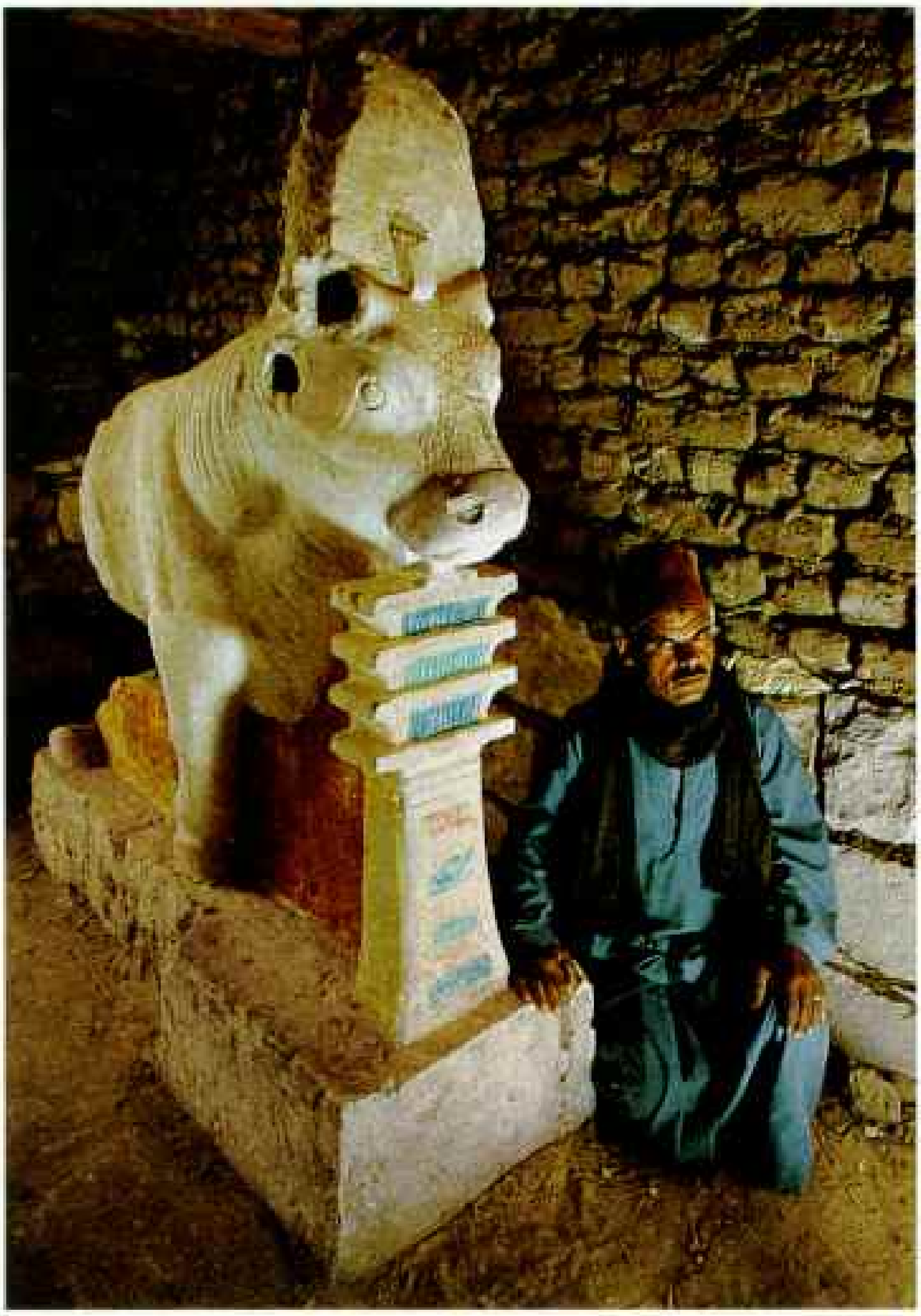
And young Ramses. How he must have looked up at the colossal pylons and statues, knowing he too would be a god. He too would be the intermediary between the world of the gods and human society. His breath would keep the heavens and earth separate. His rituals would make the sun rise and the Nile flood.

On their first official visit both father and son could still see how the temple had been defaced during the Akhenaten years. The name and figure of Amun had been chiseled off its monumental walls. That must be corrected. Seti sat down with the priests to plan enormous new works—new walls and a hall of columns that today still dwarf us mortals.

I walk through the 56,000-square-foot hall they built. In the central nave 12 papyrus-shaped columns soar nearly 70 feet. It is said that 50 people could dance on the top of each column. On both sides stand forests of 61 smaller columns—only 42 feet high.

But the bases of many columns are stained brown. Water is wicking up the stone from the soil. The columns are slowly eroding. I touch the corner of one base. It crumbles like sand.

I look at the surrounding high walls, which



Buried bureaucracy: The tombs of high officials at Ramses' court were excavated at Saqqara by the late Sayed Tawfik, chairman of the Egyptian Antiquities Organization. Beside the Djoser pyramid, Egypt's oldest, he unearthed burials of officials in charge of medicine, records, canals, and granaries. A worker kneels beside a statue of a sacred bull resting on the symbol for "stability."

Seti and Ramses covered with gloriously painted reliefs, detailing great moments in their lives. The walls too are stained by moisture, as well as marred by white blisters of salt deposited when the moisture evaporates.

"In 30 years many of these reliefs may be gone," one local scholar tells me.

Until the last century much of this temple lay safely beneath the sands. Then it was excavated and exposed to destructive agents in the atmosphere. Next, a 20th-century monument, the Aswan High Dam, was built, raising the level of groundwater throughout much of the country. Farmers compound the groundwater problem by irrigating much more frequently to feed Egypt's multiplying population.

For the time being, however, the walls of Karnak still provide some of the most revealing glimpses of how a pharaoh was supposed to feel. "His Majesty," reads one inscription, "exults at beginning the battle, he delights to enter into it; his heart is gratified at the sight of blood. He lops off the heads of the dissidents. . . . His majesty slays them at one stroke—he leaves them no heirs, and whoever escapes his hand is brought prisoner to Egypt."

WHEN SETI DIED at about age 50, Ramses, still in his 20s, became king. Among his first duties was to sail again to Thebes that September, to participate in the festival of Opet. Thanks largely to the work of Lanny Bell of the University of Chicago, we are learning how important this festival was to ancient Egypt. It was there that the pharaoh performed perhaps his most important religious function.

The Opet festival came at the time of the year when the god Amun was dying, and the world was threatened with chaos. Actually, Amun had a double personality. The Amun who lived at Karnak was a sky god. His alter

Empty sarcophagus at a newly excavated tomb at Saqqara bears the owner's idealized image and hieroglyphs identifying him as overseer

of the royal household in Memphis. The mummy was probably looted along with burial goods that rested on the stone shelf.

ego—Amun-Min, a phallic god of fertility—lived two miles away at the Luxor temple.

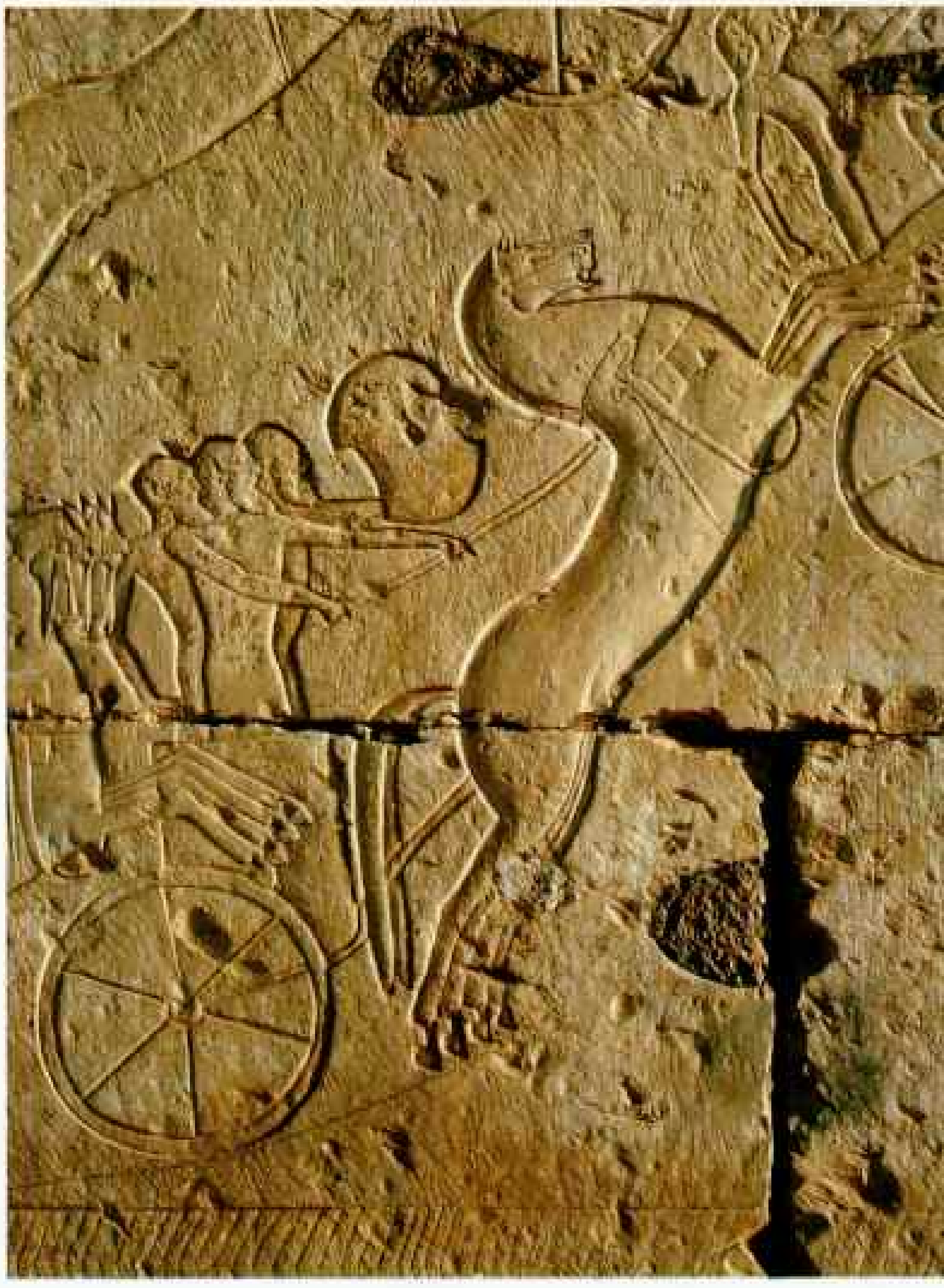
Each year, amid singing, dancing, and celebration, the pharaoh and priests of Amun led a procession that bore a golden statue of the dying sky god from Karnak's inner sanctum to a waiting barge. This boat was then towed behind the royal barge to the temple at Luxor. While the high officials of the realm ceremonially rowed the royal barge upriver, soldiers and peasants on the shore with tow lines did most of the work.

At Luxor the statue was escorted into the temple, where it stayed for about two weeks while undergoing secret ceremonies of renewal (painting, page 23). The pharaoh led those rituals, which simultaneously renewed his own *ka*. The rites also reaffirmed the pharaoh's legitimacy as ruler and mediator between the gods and humanity. So in year one of his reign, with rituals mastered, Ramses saved the world from chaos for the first of many, many times.

Ramses next sailed north on his golden barge to the sacred city of Abydos, home of Osiris, god of the afterlife. His father had been building a spectacular temple there. Ramses was appalled to find it unfinished.

"A son should be concerned to care about his father," he declared. He ordered an intensified building program, "such that it will be said forever after, 'It is his son who perpetuated his name.'" Ramses then proceeded to put his own name and image many places in his father's temple.

The new pharaoh began a great orgy of construction. He completed his own temple at Abydos. He built a great city in the Nile Delta at his old family home, calling it Pi-Ramses, House of Ramses. He finished the columned hall at Karnak, commissioned the mighty rock



Behind a rearing horse a chariot warrior raises a Hittite shield (right), as Hittite and Egyptian empires clash at Kadesh, a caravan city in Syria. The 1274 B.C. battle was a draw. Yet in wall art throughout Egypt, such as this relief at Abydos, Ramses II had the contest portrayed as his personal victory.

After 16 years a peace treaty was signed. The Hittite king later offered the pharaoh his eldest daughter as a bride. Bearing a magnificent dowry and retinue, Maat-Hor-Neferure came to Pi-Ramses, the city Ramses had built in the eastern Nile Delta. Of its grandeur little remains except artifacts such as this giant Ramses hand (opposite, far right).

German Egyptologist Edgar B. Pusch has found shield molds (opposite, near right), chariot workshops, and weapons that suggest joint Hittite-Egyptian military training.

temples at Abu Simbel, and raised other temples in nearly every important Egyptian city. He also took credit for many structures built by his predecessors, chiseling out their names and substituting his.

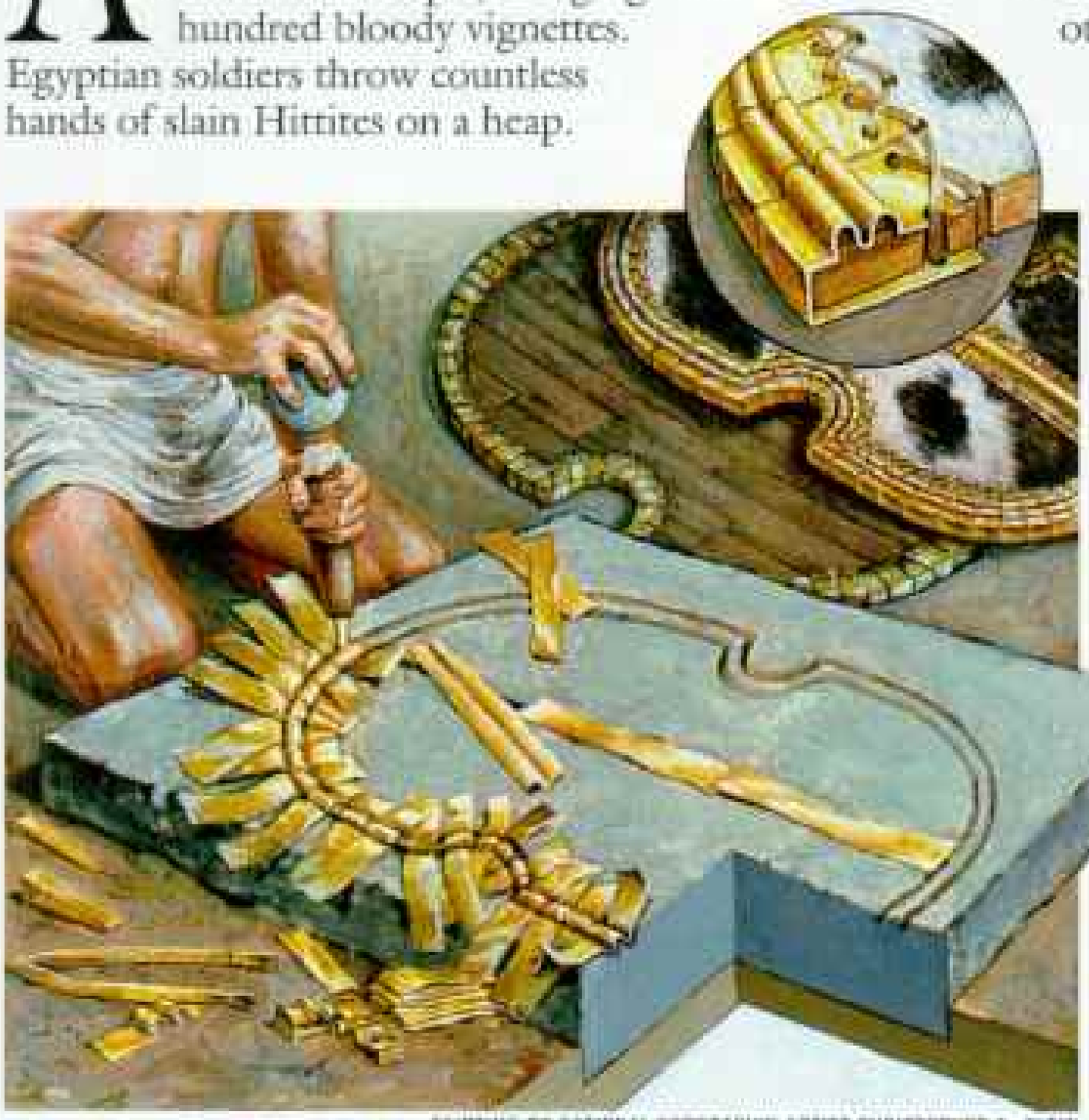
"He commissioned so much art," says Rita Freed of Boston's Museum of Fine Arts, "that it became mass production. He seemed more interested in quantity, not quality. There probably weren't enough good artists. Whereas his predecessors chiseled a lot of raised relief, he chose sunken relief. It's easier to do—and harder for your successors to chisel away."

AT ABYDOS the late afternoon sun hits the sunken reliefs on the outer walls of the Ramses temple, bringing to life a hundred bloody vignettes. Egyptian soldiers throw countless hands of slain Hittites on a heap. Horses rear, chariots race. Terrified Hittites run into a river. This wall chronicles Ramses the Great's most glorious hour—the Battle of Kadesh.

In the fifth year of his reign Ramses decided to take the strategic city of Kadesh once again. With a huge army of 20,000 men, he marched northeast into Syria, provoking a superpower showdown with Muwatallis, the king of the Hittites.

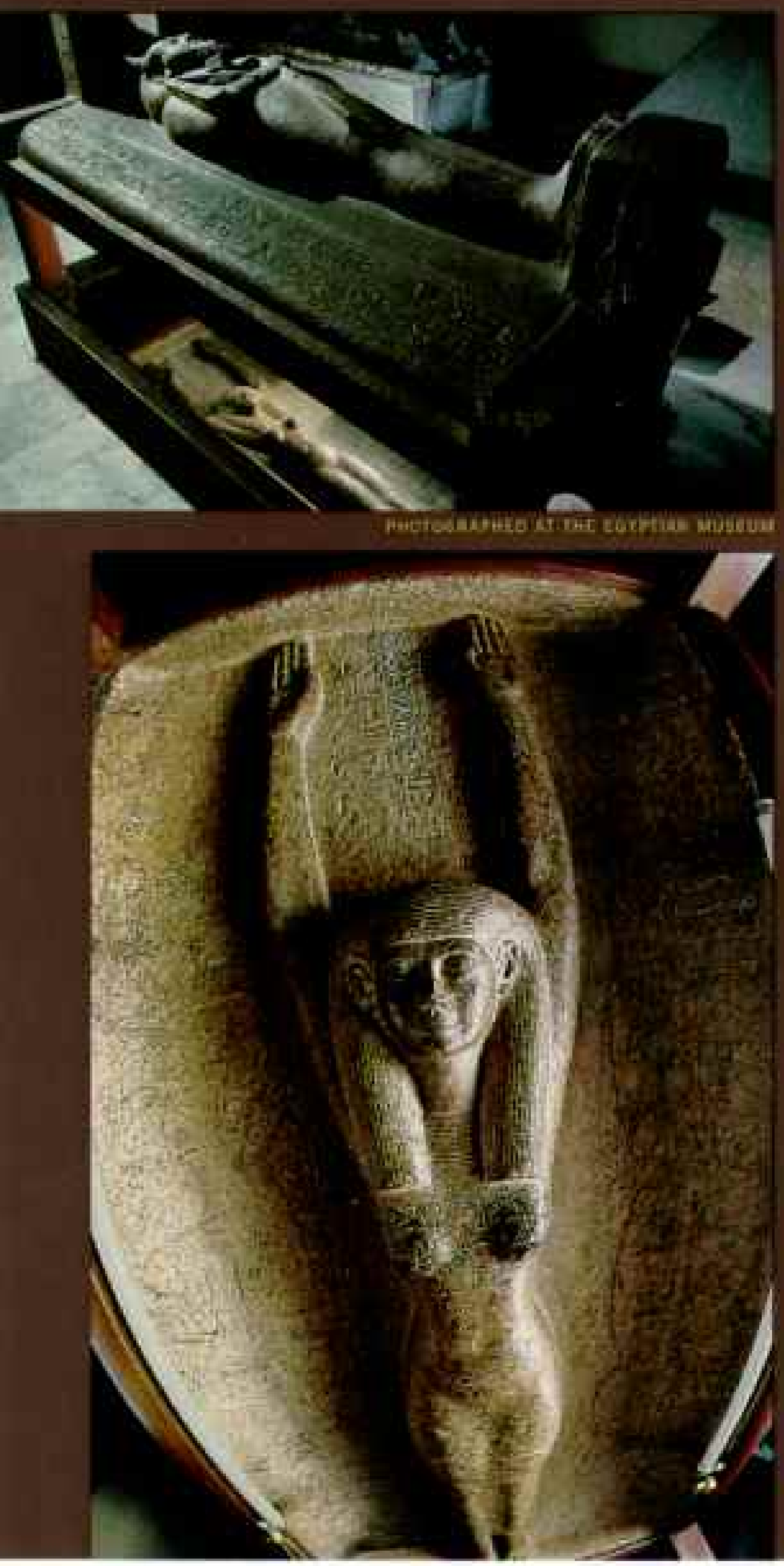
"If Ramses had lost the Battle of Kadesh, you would never have heard of him," Kenneth Kitchen told me. "He would have been an obscure king who ruled four and a half years."

And lose it he almost did. King Muwatallis had amassed an army of 40,000 men. Poor reconnaissance let the Hittite chariots catch Ramses' main force off guard. The Egyptian troops scattered in panic. Ramses



PAINTING BY NATIONAL GEOGRAPHIC ARTIST CHRISTOPHER A. KLEIN

To assemble Hittite shields, workers joined wooden planks and covered them with cowhide at a workshop in Pi-Ramses (painting). To add decoration—and strength—they edged shields with embossed bronze. Edgar Pusch believes that the bronze strips were shaped by stamping them in grooves cut into stone molds. The strips were then laced to the covers.



PHOTOGRAPHED AT THE EGYPTIAN MUSEUM

At the head of a charge on Nubian rebels, a young Ramses initiates his chariot-borne sons into warfare.

Ramses II lived so long that his oldest surviving son was at least 60 upon succession. Merneptah ruled the empire until his death a decade later. Under the lid of the coffin bearing his image (top), the goddess Nut (above) personifies the star-filled night sky that carries the sun god to rebirth each dawn.

found himself abandoned. Nevertheless he leaped into his chariot, telling his trembling shield bearer: "I shall go for them like the pounce of a falcon, killing, slaughtering, and felling them to the ground."

Propaganda? We have only his version. He says he literally went it alone, charging six times back into the fray. Then suddenly the luck of Amun blessed him. Egyptian reinforcements arrived; the Hittites were thrown into confusion. King Muwatallis was suddenly watching his soldiers fleeing before the wild

PAINTING BY H. TOM HALL

young pharaoh, leaping into the river and swimming for safety behind their own lines.

The next day brought reality to both sides. Neither army was likely to displace the other, so Ramses declared a great victory and went home.

Ramses kept his battered army home for a year to rebuild. Then he renewed his forays into Asia to nip here and there at Hittite forces or to subdue stubborn vassals.

Ramses may also have had to deal with a troublesome people at home—the Hebrews. They had most likely migrated centuries earlier into the Nile Delta, the biblical land of Goshen, to escape famine. When Ramses began to build Pi-Ramses, they were forced into labor. The Old Testament is our only version of how Moses persuaded the pharaoh to let his people go.

Concerning the parting of the Red Sea, modern scholars suggest that Moses may have led his people through a swampy region of lakes east of Pi-Ramses. Perhaps strong winds blew aside shifting waters on one of these

lakes. Then, when the pharaoh's charioteers were in hot pursuit, the winds could have turned, swamping the Egyptians.

Beyond the Scriptures, evidence of the Exodus is slight. It was not an event—the destruction of one of his prized chariot brigades—that Ramses would have documented for posterity.

Even a great pharaoh cannot rule an empire alone; there must be an army of functionaries. At Saqqara, the necropolis of Memphis, I visit Sayed Tawfik, chairman of the Egyptian Antiquities Organization.* He is excavating tombs of some of Ramses' highest officials. His dig sits on a baking, windswept desert plain. Around us rise the Old Kingdom pyramids at Dahshur and the Step Pyramid of

*On December 20, 1990, Dr. Tawfik died of a heart attack.

Djoser, built 1,400 years before Ramses.

"This was the cream of Ramses' society," says Tawfik. "Remember, Memphis was the administrative capital, where the day-to-day business of empire was carried on." We walk amid crumbling wall foundations and pits 30 feet deep. Over one pit rises a scaffold with a winch needed to pull heavy stone sarcophagi from the burial chambers below.

We visit the temple-like tomb of Neferronpet, Ramses' chief administrator. At the rear is the base of a small pyramid.

"These people were rich; they wanted pyramids like the king's," says Tawfik.

I wander amid the tombs. Ghosts abound: the overseer of the army and the overseer of the royal household, the royal physician, the keeper of the house of gold and silver, the

In a forest of columns, tourists marvel at the temple of Karnak, birthplace of Amun, greatest of Egyptian gods. Ramses II and his father, Seti, raised this hall, one of the largest built until modern times. Originally plastered, painted, and roofed, the temple filled during the festival of Opet, a month-long ritual of renewal. The exterior of the north wall (left) displays incised reliefs commemorating the victories of Seti.

During the festival, a statue of Amun was carried from Karnak to the temple of Luxor (map and following pages).

An obelisk dedicated to Amun and a statue of Ramses witnessed the yearly arrival of Opet festival processions at the temple of Luxor.

Followed by priests, the pharaoh enters wearing the solar crown with solar disks, ram's horns, and cobras—symbols of divine rule. Ramses offers flowers and incense (right), dropping an aromatic pellet into a burner and wafting smoke to the god. Amun returns the fumes, thereby renewing Ramses' own divinity.

chantress of the goddess Wadjit. What were the lives of the privileged like? Inscriptions of the day hold their voices.

A bureaucrat boasts: "I was appointed as Viceroy of Nubia . . . I directed serfs in thousands and ten-thousands, and Nubians in hundred-thousands, without limit. I brought all the dues of the land of Kush in double measure. . . ."

A teacher advises his students: "Be a scribe! It saves you from toil and protects you from all kinds of work. It spares you from using hoe and mattock, that you need not carry a basket. It keeps you from wielding the oar and spares you torment, so that you are not subject to many masters and endless bosses. . . . Now the scribe, he directs all the work in this land."

Another teacher scolds, "I am told that you have abandoned your studies and whirl around in pleasures, that you go from street to street and the place stinks of beer every time you leave."

And, of course, there is romance. A girl describes her sweetheart: "He is like a date-cake dipped in beer." A boy confides of his love: "I wish I were her signet-ring upon her finger, seeing her love every day."

PRINTING BY H. TOM HALL

BY THE TIME Ramses reached his mid-40s, he had given up his annual campaigns against the Hittites—but not his mania for building. Shortly after returning from Kadesh, he had begun planning his grandest monument—Abu Simbel.

He chose a remote site far to the south in Nubia, where bluffs of pink sandstone towered above the Nile. He had four 67-foot seated statues of himself carved into the rock. Then, behind the statues, his workers cut a temple 160 feet deep into the hillside. They adorned the walls with the glories of Kadesh. On an adjacent bluff he built a second monument, one that honored his favorite wife, Nefertari.

Why did Ramses build his most colossal temples so far from the Egyptian heartland? I ask Rita Freed of the Museum of Fine Arts as we speed south toward Sudan on a new road through utterly desolate sands.

"It was a political statement to the Nubians," Rita answers. "Nubia was a critical source of gold, labor, and exotic materials. Those statues said: 'I am Ramses the Great. You will continue to pay tribute to me.'"

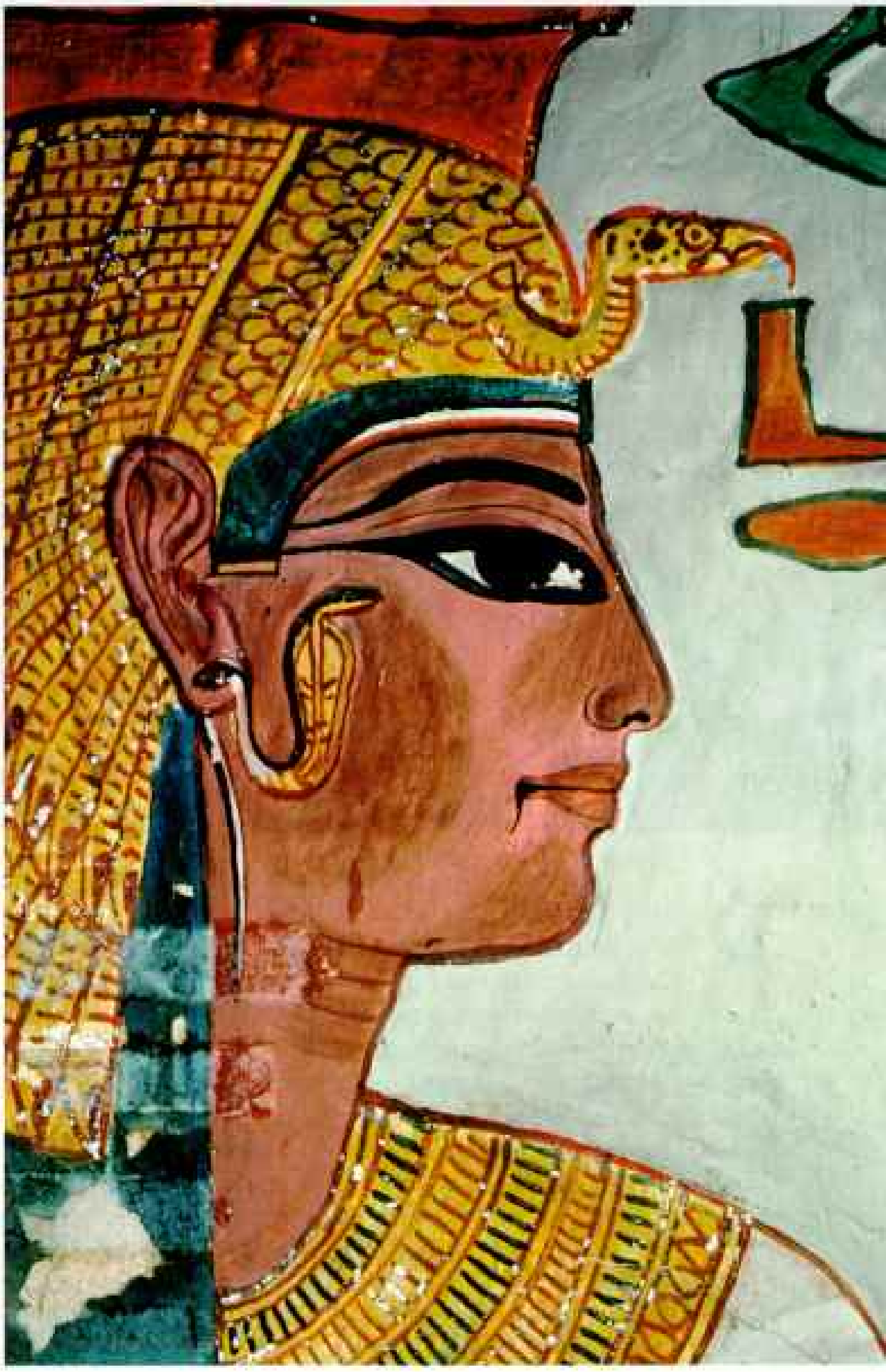
Rita says the great statues are best seen at sunrise. So we wind around the hillside in the cold predawn. I try to put myself in the

His first and favorite queen, Nefertari accompanied Ramses on official occasions. She bore the pharaoh six or seven children before her death about 1255 B.C. Her graceful profile (right) adorns her tomb in the Valley of the Queens at Thebes.

GUILLERMO ALDANA E., GETTY CONSERVATION INSTITUTE

The walls of the central chamber (top) are decorated with the guardians of the underworld. Looters emptied the tomb, leaving little behind but this fragment of a gold bracelet (above), found in 1987.

To arrest deterioration by salt crystals dislodging the paint from the bedrock (facing page), the Egyptian Antiquities Organization and the Getty Conservation Institute work to stabilize the walls. On one surface Ramses paid his queen the warmest tribute: "Possessor of charm, sweetness, and love."



mind of an ancient Egyptian, who didn't view the cosmos from our scientific perspective, who didn't know the sun was a nuclear fireball. To the Egyptians the sun was a god who returned each morning after another night's uncertain battle with the serpent of chaos.

The horizon reddens and lightens. Then the disk rises above the eastern mountains, glowing with a brilliance unmatched by anything earthly. A rush of warmth. The face of Ramses receives the sun's energy and glows in its recharging power.

At this moment Ramses starts to transform in my eyes as well. His mask begins to crack. However briefly, he is no longer the supreme egotist. He is humanity challenging the gods, striving desperately for eternal life by using its hands and its tools and its unique brains to steal the fire, to claim the magic of the sky, to trumpet the universal need to say that a particular someone was here.

Ramses' humanity also resonates in the beautiful companion statues of Nefertari. He had elevated her to the same eternal heights he sought for himself. For Nefertari, Ramses found words of uncharacteristic tenderness: "Possessor of charm, sweetness, and love," he had inscribed in her tomb.

It is tempting to compare Nefertari with Ramses' other chief wife, Istnofret. Little is known of her, but Kitchen speculates:

"Nefertari had the looks. He was obviously proud of her, showing her off all the time. But I think Istnofret had the brains. It's *her* offspring that wielded the most power as Ramses aged."

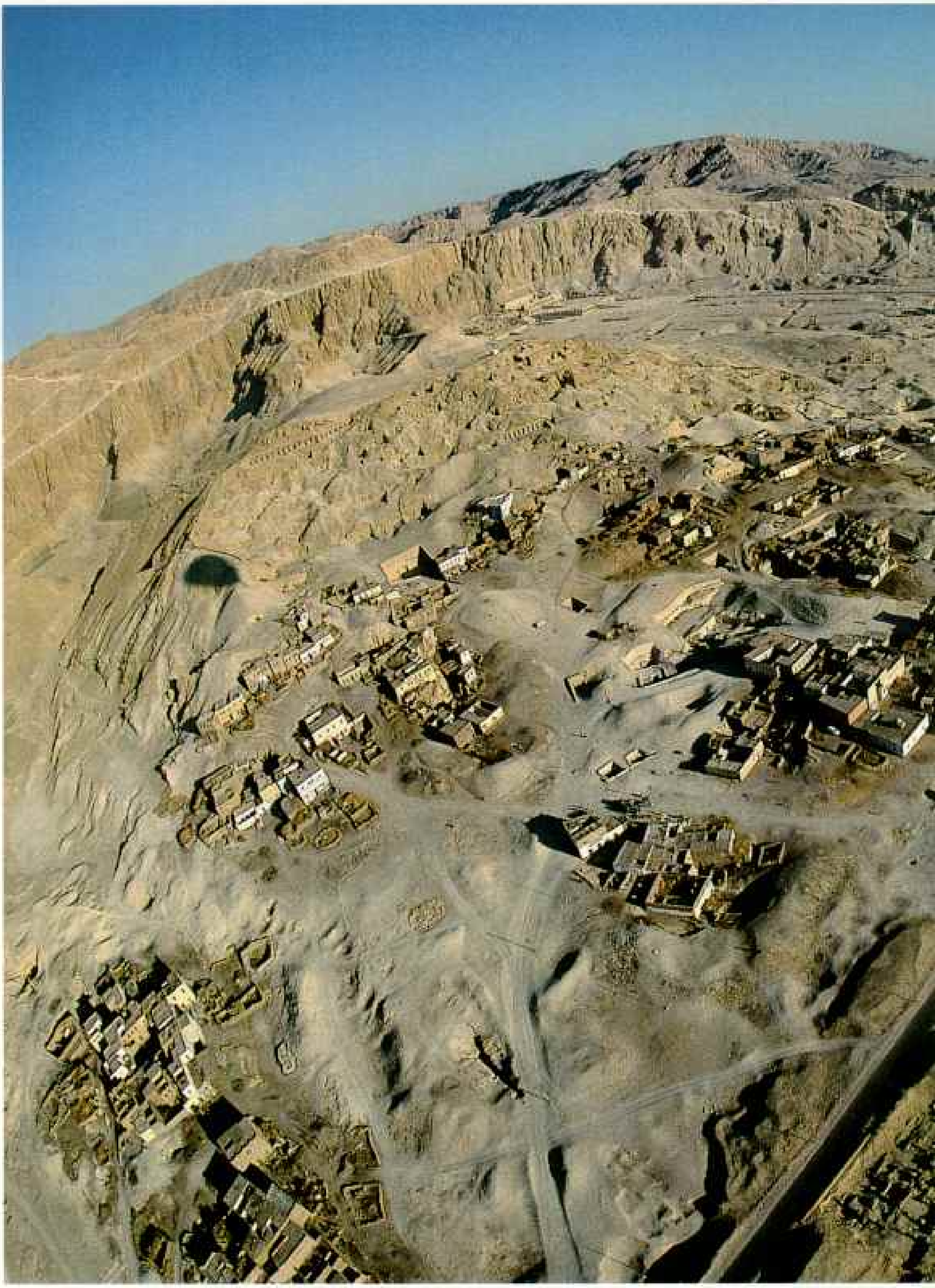
Istnofret also outlived Nefertari, who disappears from official correspondence after Ramses' 21st year in power. At that time the Egyptians and the Hittites had finally come to terms. A long-lasting peace treaty was signed between them, and Nefertari wrote a cordial state letter to the Hittite queen.

Nefertari was probably still alive at the dedication of her great monument at Abu Simbel, in about year 24. But she may have been ill, suggests Kitchen. It would have been a difficult journey—1,500 miles round-trip. Her daughter Meryetamun is the one depicted

at the ceremonies on the commemorative stela; Kitchen proposes that Nefertari rested on the royal barge, too fatigued to play her role.

THERE WERE, of course, other queens in Ramses' life. The peace with the Hittites was so successful that in year 34 of Ramses' reign the Hittite king Hattusil III sent his eldest daughter to wed the pharaoh and seal the new friendship. She was accompanied by soldiers, dignitaries, and a dowry of "gold, silver, much bronze, slaves, spans of horses without limit. . . ."

German scholar Edgar Pusch has uncovered evidence that the peace between the two long-feuding empires may have been more trusting than previously *(Continued on page 30)*



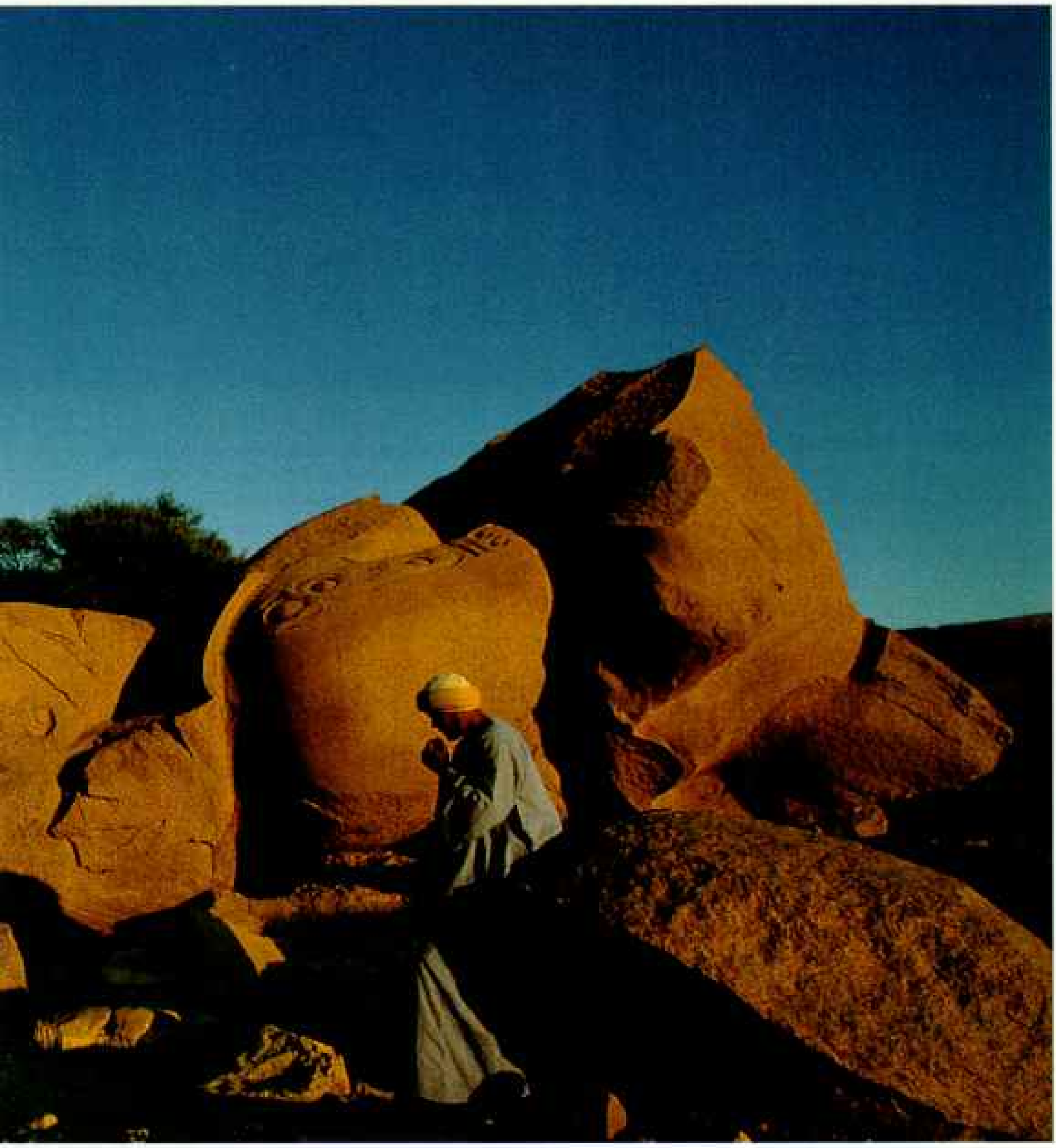
A godlike view sweeps across Thebes' city of the dead, where the modern village of Qurna has sprung up amid the ancient tombs of officials and priests. A road cuts

past storehouses—their granaries filled from rooftop holes—that once supplied priests making daily offerings in the Ramesseum, the mortuary temple of Ramses II.

The "shattered visage" of Ramses (above), his cartouche on his right shoulder, still lies in the Ramesseum; columns portray the pharaoh in the guise of Osiris. Travelers' accounts of the site and the arrival of another statue in London inspired Percy Bysshe Shelley to write the melancholy "Ozymandias." European enthusiasm

ARTIFACT FROM THE BRITISH MUSEUM

for Egyptian art had fired adventurer Giovanni Belzoni to move the bust (left) from the Ramesseum in 1817. Belzoni hired scores of Egyptians to pull the seven-ton statue on rollers to the Nile for shipment to London. The bust and other Belzoni "conquests" formed the core of the British Museum's Egyptian collection.



FROM "SIX NEW PLATES . . ." BY G. B. BELZONI, NEW YORK PUBLIC LIBRARY

Colossal Ramses, times four, proclaims his might in Nubia at Abu Simbel. Twice yearly—in late February and again in October—the rising sun reaches 160 feet into the inner sanctum to bless Ramses (below, at center) beside the god Amun.

believed. At Pi-Ramses, Pusch takes us to the site where he has found a large metalworking complex. He shows us a shield mold shaped like the figure eight.

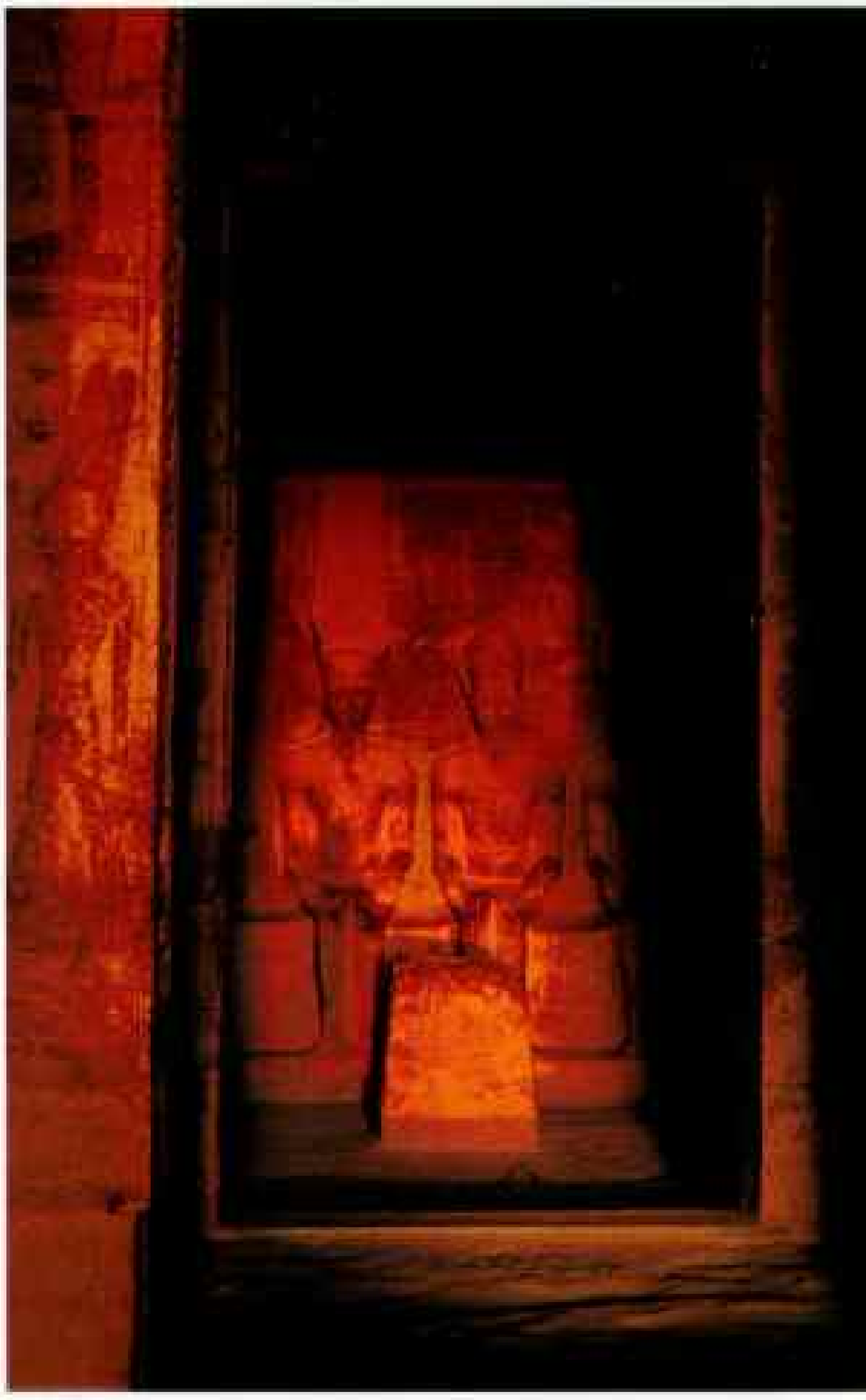
"This is not an Egyptian design," says Pusch. "It looks just like those the Hittites carried in the Battle of Kadesh. We found bronze chisels and hammers next to it. I can draw only one conclusion. Hittite craftsmen were producing Hittite weapons in the capital of Egypt. They were probably working side by side with Egyptians. Ramses may have pioneered a way for superpowers to get along."

Ramses' great works at Pi-Ramses have eroded back into the rich soil of the delta. But inscriptions still evoke the pageantry that must have attended his frequent returns to the palace there:

"Get on with having everything ready for Pharaoh's arrival. . . . Have made ready 100 ring stands for bouquets of flowers, 500 food baskets. . . . Foodstuff . . . to be prepared: 1,000 loaves of fine flour . . . cakes, 100 baskets . . . dried meat, 100 baskets at 300 cuts . . . milk, 60 measures; cream, 90 measures; carob beans, 30 bowls; grapes, 50 sacks; pomegranates, 60 sacks."

The scribes of Pi-Ramses also recorded the king's great jubilees. The first jubilee of a pharaoh was traditionally held when he had been 30 years on the throne; then one was held every three years. They symbolically reinvigorated an aging king as the annual flood of the Nile renews the land. The tradition dated back to the earliest kings. Its rituals, feasting, and holiday spirit could last more than two months. Huge crowds watched a reenactment of his coronation. Finally, to demonstrate his fitness, the king ran around a special track.

For his jubilees Ramses built a huge hall at



Pi-Ramses, purloining columns from nearby temples. In all, he had at least 13 jubilees.

I look out across the fields where the proud pharaoh once ran. I can see only goats, camels, alfalfa. And a phantom image that makes me smile: the old pharaoh doggedly huffing and puffing around a track. Eventually, he must have been carried or driven in a chariot.

In his later years he probably lived "in a golden sunset," says Kitchen. "Decorating acres of walls, and traveling a circuit up and down the Nile, rather like a Methodist minister, making sure everyone was doing his job."

As Ramses grew older, he turned the reins of government over to the two oldest sons of Istnofret—Prince Ramses and Khaemwaset. Both died before their father, as did at least ten other sons. A younger son of Istnofret, Merneptah, inherited the throne.

How did Ramses die? Probably of old age.

"I suspect that right up to the end," says Kitchen with a chuckle, "he sat around telling everyone how good he was at the Battle of Kadesh—but perhaps that's a bit uncharitable."

ON MY LAST DAY in Egypt I finally receive permission from the Egyptian Antiquities Organization to see Ramses' mummy. My colleague, Lou Mazzatenta, is also permitted to photograph the pharaoh. At the Egyptian Museum in Cairo, conservation director Nasry Iskander lifts the dark velvet off the mummy case. I behold the face. Browned and chisel sharp. Arms crossed regally across his chest. A long neck, a proud aquiline nose, and wisps of reddish hair, probably colored by his embalmers.

Ramses' mummification and burial rites likely took the traditional 70 days. Embalmers removed internal organs, placing the liver, lungs, stomach, and intestines in sacred jars. His heart was sealed in his body. Egyptians believed that it was the source of intellect as well as feeling and would be required for the final judgment. Only if a heart was as light as the feather of truth would the god Osiris receive its owner into the afterlife.

Egyptians did not appreciate the brain. The embalmers drew it out through the nose and threw it away.

After they dried the corpse with natron salt, the embalmers washed the body and coated it with preserving resins. Finally they wrapped it in hundreds of yards of linen.

Within 150 years of Ramses' burial his tomb was robbed by thieves and his mummy desecrated. Twice reburied by priests, the body retained some of its secrets. X-ray examinations of the body indicated that Ramses suffered badly from arthritis in the hip, which would have forced him to stoop. His teeth were severely worn, and he had dental abscesses and gum disease.

The photography finished, the velvet is replaced over Ramses' mummy—but the face stays with me. Not the face of Shelley's Ozymandias, not that of a god, but the face of a man. Was Ramses bombastic, cruel, ego driven? By our standards, certainly. He left no evidence of the human complexity or the bitterly learned insights that redeem such proudful mythic kings as Oedipus or Shakespeare's King Lear, but he did love deeply and lose. And all those children who died before him—Ramses knew human suffering. Did he really believe he was a god? Who can say? But clearly, he strove to be the king his country expected—providing wealth and security—and succeeded. He also wanted to live forever. More than most, this man got what he wanted. □

COMPUTER REBUILDS THE ANCIENT SPHINX

G. LOUIS MAZZATENTA, NGS STAFF

For 4,500 years wind has scoured, sand has engulfed, and man has defaced the stone lion with the head of a pharaoh. The numbered limestone blocks, set in its paws in a 1980s restoration, are being replaced. And computer-generated models are now helping us visualize how the Great Sphinx at Giza appeared in the time of Ramses II.

By MARK LEHNER
ORIENTAL INSTITUTE, UNIVERSITY OF CHICAGO

Restoration work on the Great Sphinx began long before present efforts—by several thousand years.

Carved from limestone bedrock to stand guard before the Giza Pyramids, the 66-foot-high colossus had been extensively reworked by 1279 B.C., when Ramses II ascended Egypt's throne.

The Sphinx was created in about 2500 B.C. for Pharaoh Khafre (Chephren), who raised the second Giza Pyramid. When his workmen quarried a U-shaped pit to obtain blocks for that pyramid and nearby temples, they left a core to sculpture into a sphinx—"the living image of the sun god."

Khafre never finished his scheme, and later Giza was largely abandoned. About 1400 B.C., Thutmose IV, son of Pharaoh Amenhotep II, stopped his hunting party by the enormous head rising from the sand. While he napped under its chin, the Sphinx appeared in a dream, speaking as both the sun god and the god of kingship, Hor-em-akhet. The Sphinx prophesied that Thutmose would be made king and free the god from the sand.

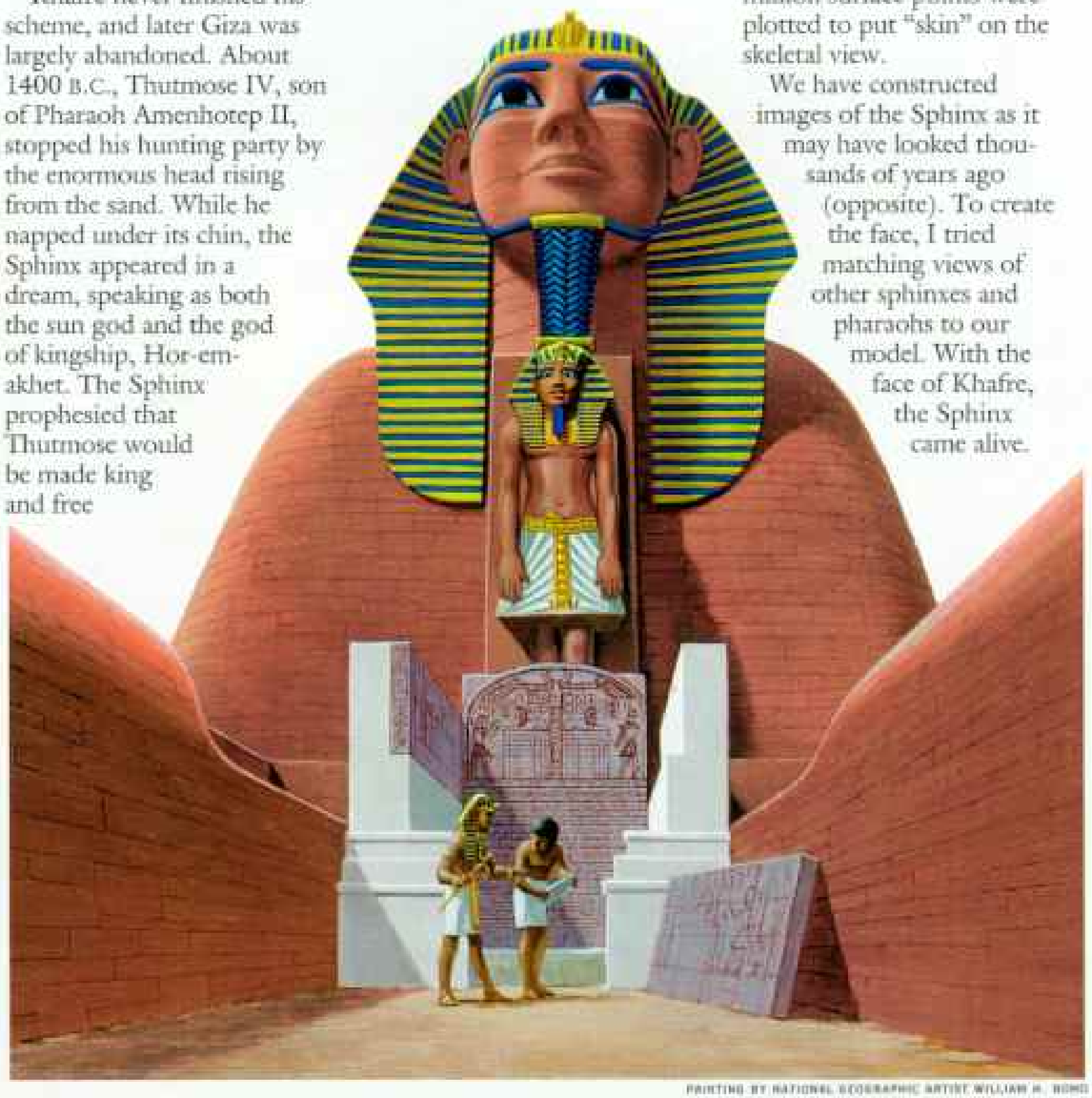
Thutmose uncovered the statue, encased its weathered body with limestone blocks, and painted it blue, yellow, and red. And he erected, I believe, a statue of his father in front of the Sphinx's chest, symbolizing the king's emergence from—and protection by—Hor-em-akhet.

When Thutmose became pharaoh, he inscribed his dream on a tall granite stela. It became the centerpiece of an open-air shrine below the statue. More than a hundred years later Ramses II placed two of his own stelae on the sidewalls of the shrine and may have added his name to the statue of Amenhotep II (painting below).

How did the Sphinx appear in Ramses' day? I had pondered that question since Zahi Hawass, director general of the Giza Pyramids, invited me to join his excavation in 1978. During the next four years I led a project to map the Sphinx in detail for the first time. We produced front and side views with photogrammetry, a technique using stereoscopic photography. For an overhead view I mapped by hand with drawing board and measuring tape, crawling over the colossus like a Lilliputian on Gulliver.

Computers have taken the record further. Maps were digitized to make a 3-D wireframe model; some 2.6 million surface points were plotted to put "skin" on the skeletal view.

We have constructed images of the Sphinx as it may have looked thousands of years ago (opposite). To create the face, I tried matching views of other sphinxes and pharaohs to our model. With the face of Khafre, the Sphinx came alive.



PAINTING BY NATIONAL GEOGRAPHIC ARTIST WILLIAM H. BOND

Builder of the Sphinx, Pharaoh Khafre was portrayed in this life-size diorite statue. The author used this face for the computer reconstruction of the Sphinx.

PHOTOGRAPHED BY O. LOUIS MAZZATENTA AT THE EGYPTIAN MUSEUM, CAIRO

With computer modeling the Sphinx can be shown from any angle. This view illustrates how the statue of Pharaoh Amenhotep II, now missing, could have been attached to the leonine chest. Modeling can also test ideas for repairing the Sphinx.

The NATIONAL GEOGRAPHIC sponsored this modeling of the Sphinx. Architect Jon Jerde contributed computer facilities at Jerde Partnership, Inc., of Venice, California. Tom Jaggers, his director of computer-aided design, digitized maps drawn by the author and by Ulrich Kupp of the German Archaeological Institute to create the model.

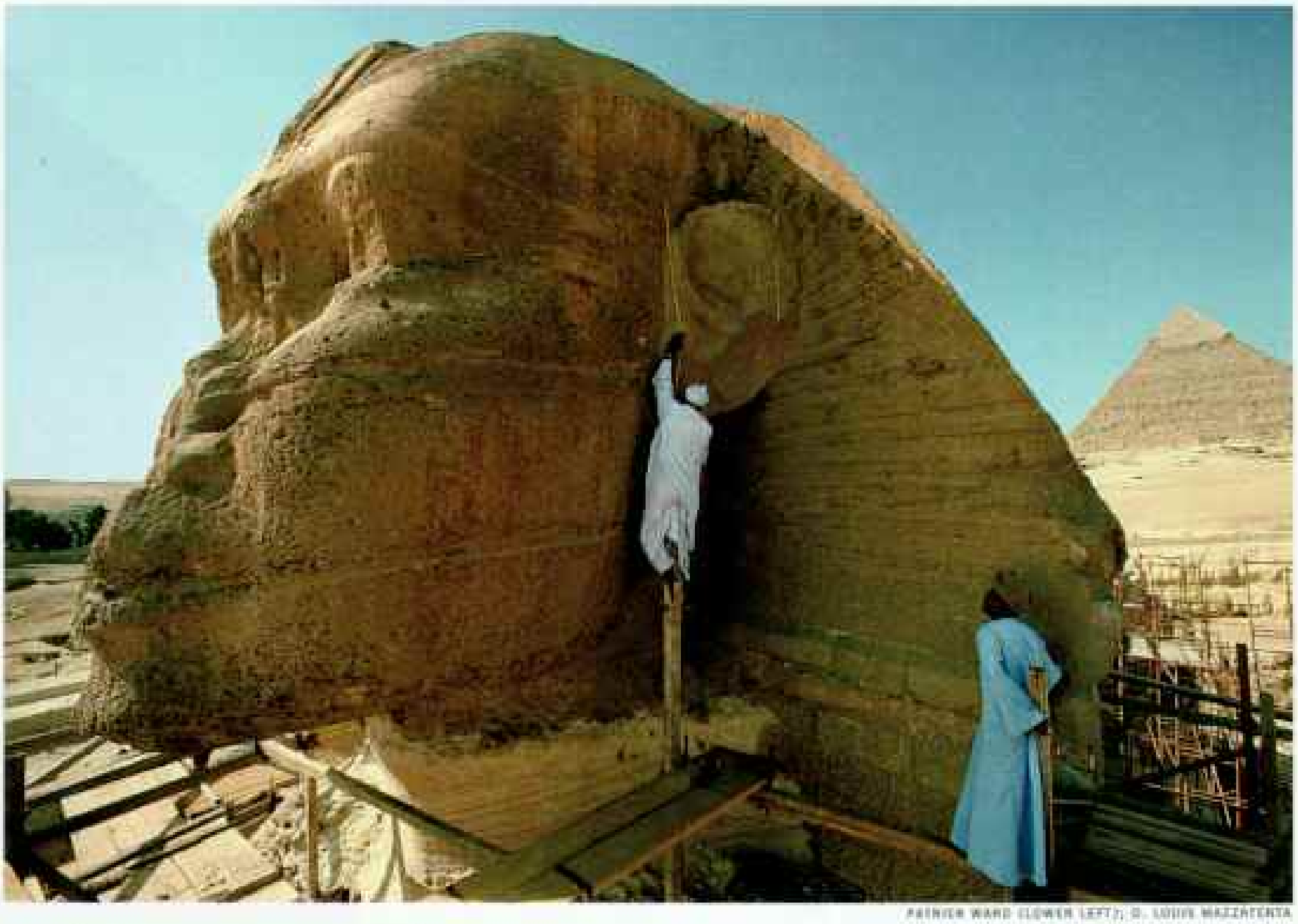
The Sphinx mapping project was sponsored in part by the American Research Center in Egypt and supervised by the Egyptian Antiquities Organization.

I sought clues from history and archaeology for the computer reconstruction. An early 15th-century Arab historian reported that the face had been disfigured in his time. Yet to this day the damage is wrongly attributed to Napoleon's troops. Scholars accompanying the French invasion of 1798 recorded the monolith and other antiquities, opening Egypt to European scholarship.

In 1818 Giovanni Caviglia, a Genoese sea captain who was looking for an entrance into the Sphinx, cleared the chest (engraving, lower right), uncovering the chapel before it. He removed the two Ramses stelae, now in the Louvre, and discovered pieces of the Sphinx's stone beard.

From a fragment now in the British Museum (lower left) and other pieces in the Egyptian Museum, we reconstructed the length and look of the braided beard for our model. Behind the chapel, Caviglia discovered a pedestal of large limestone blocks and a column of stones against the chest. This I take to be the attachment for the missing statue of Amenhotep II.

In 1925-26 the Sphinx was cleared down to its rock base by French engineer Émile Baraize. He shored up the weathered flaps of the headdress with stone blocks and mortar, still visible (below). In 1936-37 Egyptian archaeologist Selim Hassan excavated a mud-brick wall around the colossus, apparently



PATRICK WARD (LOWER LEFT); D. LOUIS MAZZATENTA

built to hold back drifting sand. He found bricks stamped "Thutmose IV" and scores of small stelae with inscriptions invoking Hor-em-akhet. Six of those show a statue of a striding king before the Sphinx (upper right), further evidence of a statue once placed there.

Although damaged, the great face has weathered less than the body, since the limestone strata from which the face was carved are harder than lower layers. The powdery residue on the neck is typical of flaking from the softer strata.

Traces of red paint from antiquity are still barely visible on the cheeks. In fact, if you probe any seam in the masonry covering the lower part of the body, a red powder appears, as if the Sphinx were bleeding.

National Geographic, April 1991

PHOTOGRAPHED BY BARRY HICKSON AT THE EGYPTIAN MUSEUM

FROM HOWARD VYSE'S "OPERATIONS CARRIED ON AT THE PYRAMIDS OF GIZEH," MUSEUM OF FINE ARTS, BOSTON

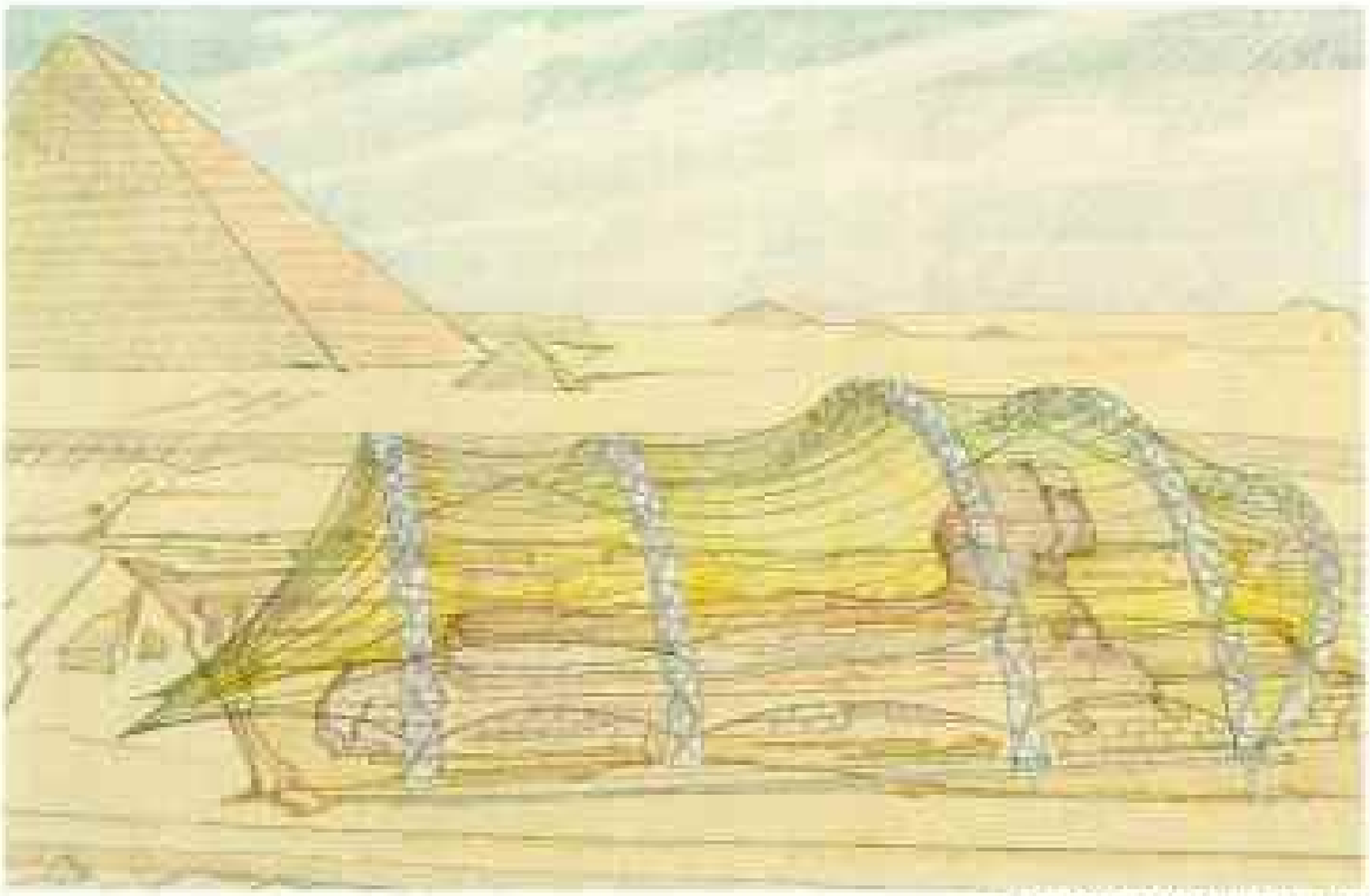
Recent deterioration, while real, has in my opinion been overblown by the press. Yes, part of the right shoulder fell off in 1988. No, the Sphinx will not turn to dust in 20 years.

Its limestone is laden with salts that migrate with moisture to the surface. Drying, the salt crystalizes, pushing off flakes of stone that blow away like giant potato chips. Rising groundwater, tourist traffic, and even vibrations from explosions in a distant quarry may compound the Sphinx's misfortunes.

For the past decade the Egyptian Antiquities Organization has been trying to resolve these problems. Our scale maps are helping to guide its efforts to restore the base (above). Large slabs from repairs in the 1980s are being replaced. Workmen fill cavities before setting new, smaller blocks (right).

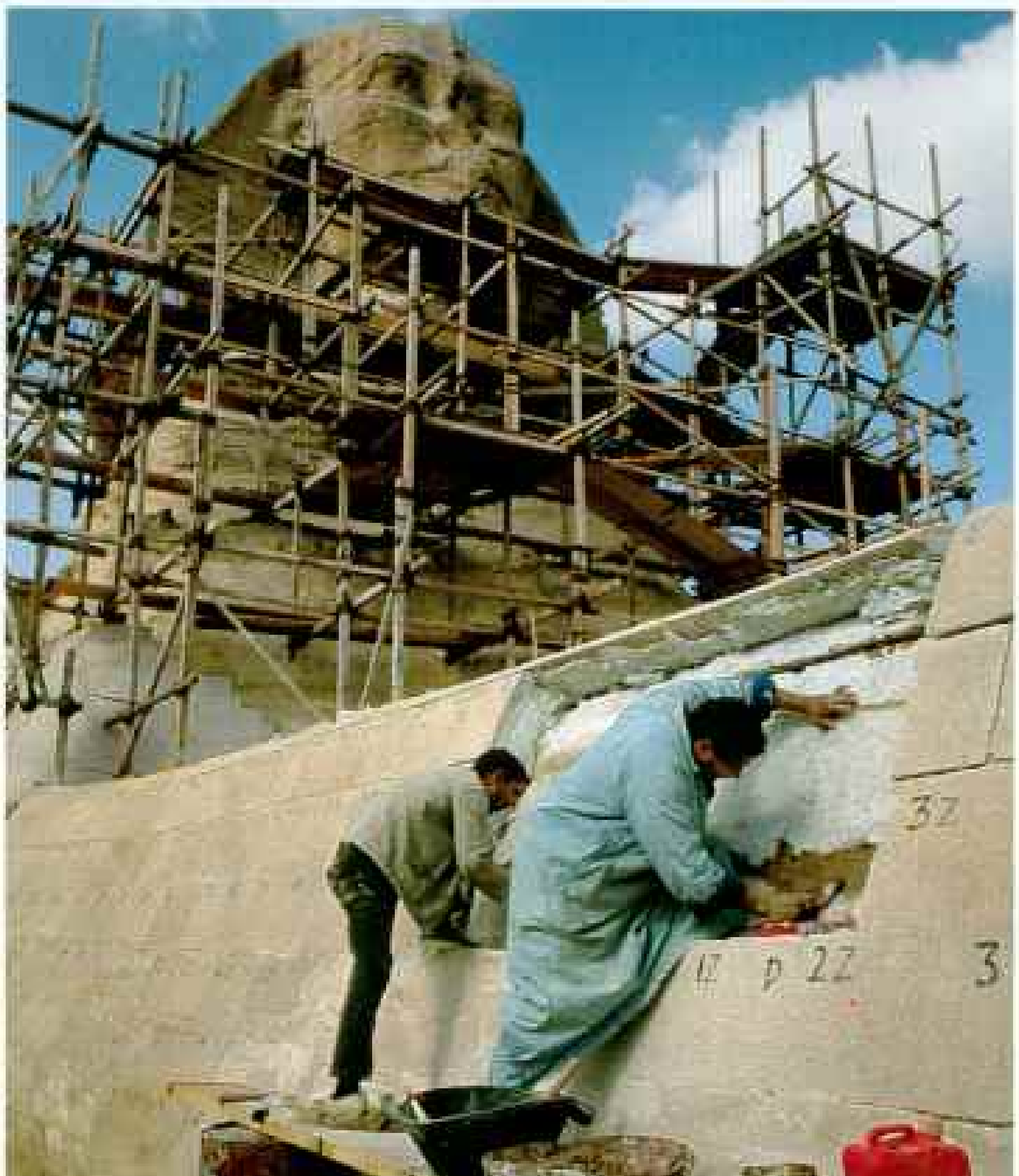
Meanwhile, proposals for conserving the natural rock of the monument range from covering the colossus with a glass pyramid to reburying it in the sand, although these ideas have not been taken seriously. Another plan, formulated by the Getty Conservation Institute, envisions a retractable shelter on rails (drawing, left).

At the moment, controversy



GETTY CONSERVATION INSTITUTE

© LOUIS MAZZATENTA (BELOW); NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES L. STANFIELD



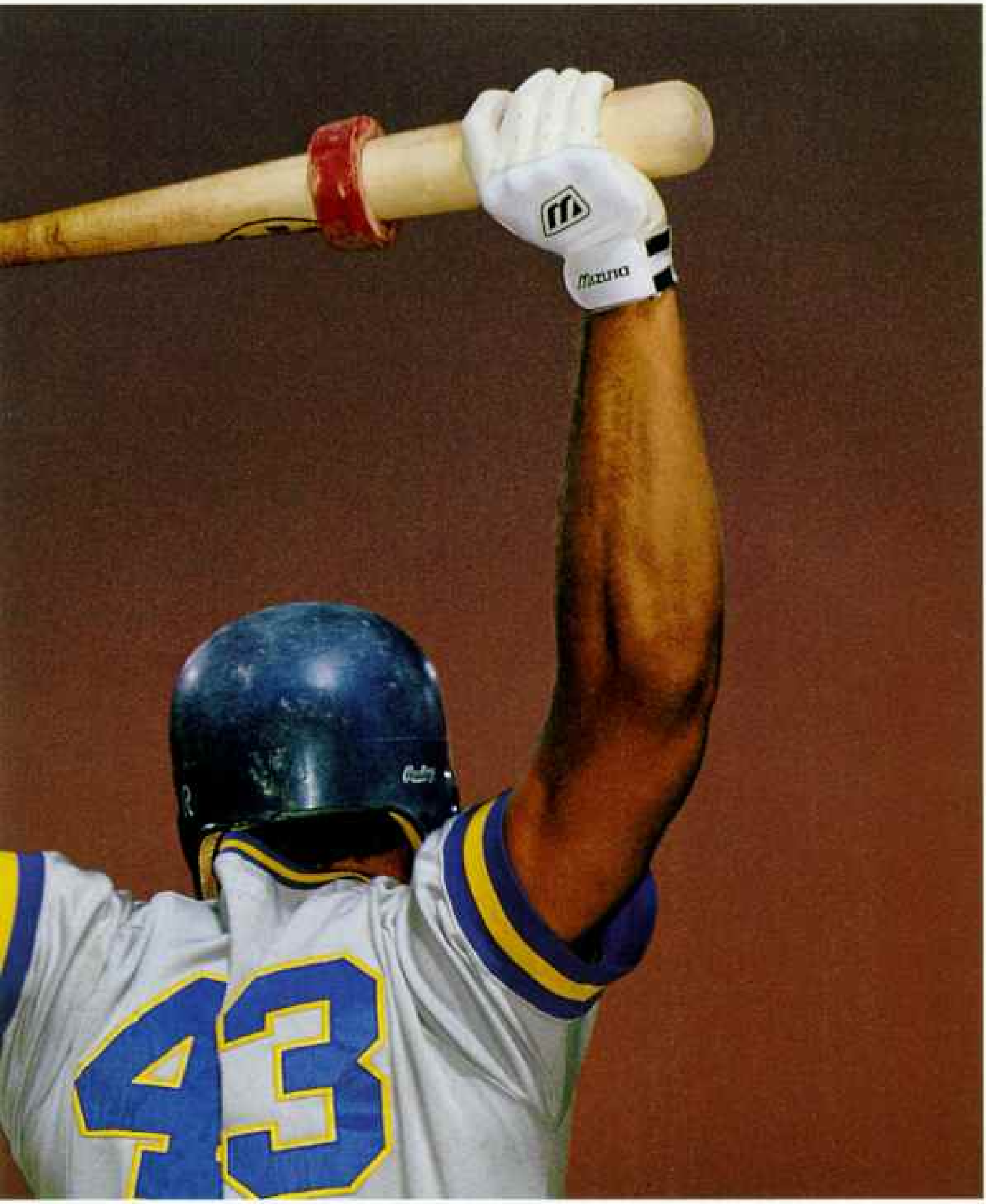
in Egypt swirls about the proposal of building a great wall to shield the Sphinx from an encroaching town. The plan would include an amphitheater for a sound-and-light show.

It would be rash, I think, to adopt any proposal without knowing more about ambient conditions. To that end, instruments have been set on the Sphinx's rump to monitor wind speed and direction, air pollution, and moisture.

Since Khafre had it hewed, the Great Sphinx has represented protection for the pharaohs and people of Egypt. Even the powerful Ramses II thought of himself as being enfolded by the colossus. After thousands of years as symbolic protector, the Sphinx needs protection by—and from—the modern world. □

A Season in the

Power hitter John Jaha of the Stockton Ports limbers up before batting against

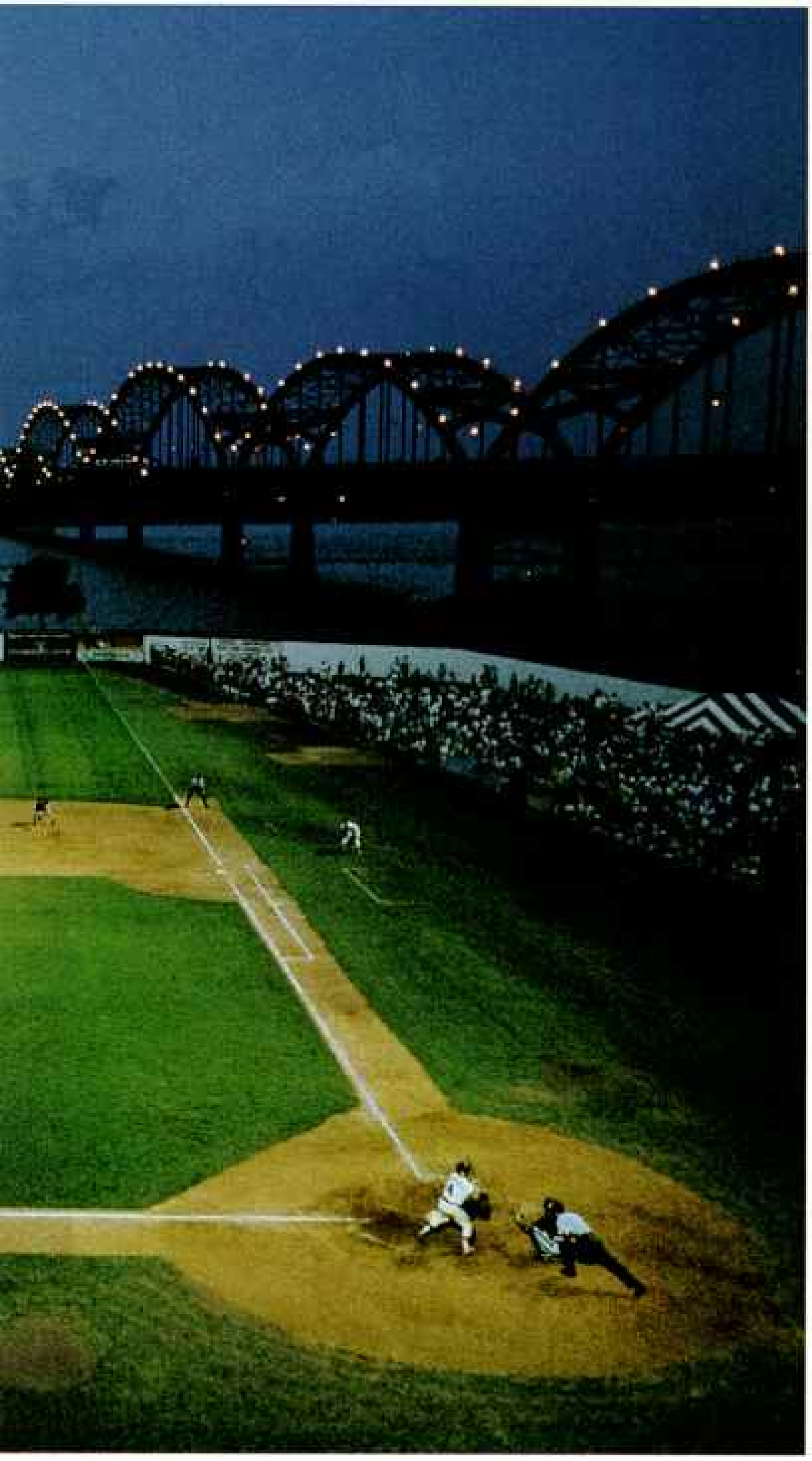


Minors

By DAVID LAMB

Photographs by
WILLIAM ALBERT ALLARD

Bakersfield. After a long slump, minor-league baseball is on the upswing.



A field of dreams for players hoping to make it big, John O'Donnell Stadium in Davenport, Iowa, sits only a long home run away from the Mississippi River. This night, in a Midwest League contest, the home team Quad City Angels blanked the Waterloo Diamonds, 2-0. The teams compete at the Single-A level, one of four classifications in the minor-league hierarchy.

Every minor-leaguer aspires to make it to "the show"—slang for the major leagues. While bringing live professional baseball to smaller cities, the minor leagues provide the majors with a farm system for cultivating future stars.

With hopes as big as his glove, a youngster eager to snag a foul ball stakes out a spot early at Dudley Field for a game between the hometown El Paso Diablos and the San Antonio Missions.

The Diablos moved to a new stadium in 1990 to accommodate their growing attendance. Fans numbered 228,000 in 1989, helping El Paso win the award for the best run Double-A club of the 1980s. Total minor-league attendance in 1990 topped 25 million, the highest turnout in four decades.

IT WAS AN HOUR to game time. Evening shadows crept over the wooded hollow and bathed the infield in twilight. George Fanning, the Bluefield Orioles' 81-year-old general manager, ambled out of his tiny office, fiddling with a key that would open the padlock on Bowen Field's sole gate. Fanning had completed his trip to the bakery to buy its supply of surplus buns—three dozen for a dollar, which enabled him to sell hot dogs for 75 cents each—and now, with the first fans already in line at his wife's ticket booth, he settled onto a bench by the gate, his baseball cap pulled low over his brow, palms on his spread knees.

Down the dirt road, the lights of a few houses shone through the trees, and Fanning could see kids riding their bicycles toward the ballpark. Bowen Field feels as timeless as a summer memory from our youth, and somehow that's how it should be. For here in the low-rent district of professional baseball, in these hamlets of the Appalachian League and in other minor-league towns across the nation, is the face of Norman Rockwell's vanishing America—a place where, for hundreds of young men, the journey to the major leagues begins and, more often than not, ends.

Fanning exchanged evening greetings with the fans passing his bench and seemed to know most of them by their first names. "People tell me I'm crazy not to do promotions," said Fanning, a retired high school chemistry teacher who has run the team for nearly four decades, "but I know I'm not. If I promote, the damn federal government's just going to take that much more money anyway. I get people to keep coming back because I don't rob 'em. I don't promise anything but a good evening of baseball. And I don't charge but two bucks for admission. If someone doesn't have any money, heck, I let 'em in for free."

The 3,000-seat park filled quickly. Entire families came, sometimes three generations in a group. There were old men in suspenders who chewed tobacco and miners' widows who brought padded cushions to soften the bite of concrete bleachers. Teenage boys with slicked-back hair and freshly ironed shirts came too, leading girlfriends by the hand

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DAVID LAMB, a national correspondent for the *Los Angeles Times*, is the author of *Stolen Season: A Journey Through America and Baseball's Minor Leagues* (Random House, 1991). Free-lance photographer WILLIAM ALBERT ALLARD has contributed to 20 NATIONAL GEOGRAPHIC articles.

to the semiprivacy of the uppermost row.

From the steps of the first-base dugout, Bluefield's rookie pitching coach, Chet Nichols, watched the fans stream in. He had white hair and a paunch and, just shy of 60, was old enough to be the starting pitcher's grandfather. Back in the early fifties, when I was growing up in Boston, I had seen Nichols pitch in Braves Field, and, not having heard of him in all those years, I asked what he had been doing since he left the majors.

"Banking, for 29 years," he said. "I ended up as the bank's vice president. But you know, I got tired of the pressure. Then a couple of months ago an old friend calls and asks if I'd be interested in going back to the minors. 'Damn right!' I said."

So now Nichols was living at a cheap motel and loving every precious moment of his second childhood. Like so many people I met on my journey across America and through the minor leagues, Nichols had found that life without baseball was not a complete existence. He was a victim of the magical grip baseball exercises on America as surely as were the young athletes whose dreams of reaching the majors took on desperate proportions. Their dreams, though, ignored the basic truth of the underpaid, overworked life they lived: Only one in fourteen would ever make it to the major leagues.

Stormy skies fail to keep fans of the Great Falls, Montana, Dodgers from Legion Park, where Andy Dunkin, 83 (left), has taken tickets for 46 years.

Rainstorms rarely splatter El Paso's Dudley Field. Fans started calling it the "Dudley Dome" after rain repeatedly soaked nearby neighborhoods while the Diablos' ball field stayed dry as a rosin bag.

"You want to know why players can't let go of the game, why you don't worry about odds like that?" said rookie infielder Dan Snover. "I'll tell you why. There's no ecstasy like winning. Nothing feels that good."

Bluefield gave the visiting Pulaski Braves a pasting that night. Pulaski's 18-year-old Tab Brown, making his first professional appearance, gave up seven runs in three innings and left the mound looking as though he were about to burst into tears. The catcher kept rising out of his crouch, thwarting a succession of pitchers. Manager Fred Koenig, a veteran of 37 years in baseball, including ten as a major-league coach, jotted himself a note. "Shoot the catcher," it said.

I had started my journey nearly three months earlier, on the opening day of baseball season, with the Stockton, California,

His Rookie-class game rained out, a Billings Mustang kisses his wife good-bye before boarding the team bus in Great Falls,

Montana. Biggest adjustments for rookies: the pressure of playing a game almost daily and lonesome days and nights on the road.

Ports, self-proclaimed descendants of the Mudville Nine, starring Mighty Casey, immortalized by Ernest Lawrence Thayer in his poem of 1888. The Ports had won more games in the 1980s than any other team in minor-league baseball.

For their first home game the team hired a band—"Mudville's Finest: Available for Intimate Bashes, Wakes, and Fancy Balls"—and three female sky divers, who made a perfect landing on the infield just before the first pitch. In the press box the public-address announcer, Buddy Meacham, sang "The Star-Spangled Banner," unaccompanied, and the crowd applauded generously as his final words swept over the field.

Ahead of me on that April evening lay a sport I had loved as a child and a country I had lost touch with during eight years as a foreign correspondent for the *Los Angeles Times* in Africa and the Middle East. I feared that perhaps professional baseball had changed more than the nation had. Salary disputes—the average major-league salary was now about $600,000, with .250 hitters routinely earning a million dollars or more—and labor strikes and lockouts had disillusioned me. In the minors I hoped I would find the people and values that had not yet been corrupted by fame or fortune.

ELEVEN YEARS after Lee surrendered to Grant at Appomattox Court House in Virginia, major-league baseball was born with the formation of the National League. In little more than a decade, independent minor leagues were flourishing. Pennsylvania, Ohio, Kansas, and Montana all had their own. Others were scattered from New England to the Pacific Northwest. For most towns, particularly those in the still isolated West, having a team was tantamount to being part of the nation's growth and progressive spirit.

"Salt Lake City has for a number of years fostered the game of baseball," said the *Salt Lake Daily Tribune* in 1887. "In fact, our city would not be up to modern ideas did she not do so. In these times baseball clubs are almost an imperative necessity."

For a long time the minor leagues were sovereign entities, competing for fans with the National and American Leagues. Some players spent their entire career of 20 years or more in the minors. Then, in 1919, Branch Rickey became manager of the St. Louis Cardinals, a team so poor they wore shoddy mended uniforms for spring training and held it that year in St. Louis instead of Florida. Rickey decided that since the Cardinals couldn't afford to buy players, they would

Baseball's second cities

Minor-league baseball was born with an alliance of seven teams as the International Association in 1877. By the late 1940s the minors counted more than 450 teams. That number has dwindled to 171, grouped in four classes.

With their gear stowed on the bus, the Single-A Beloit, Wisconsin, Brewers prepare for a road trip (left). Triple-A teams enjoy the luxury of travel by airplane.

have to raise their own. Over the next 20 years he got control of 32 minor-league teams, and the minors became what they are today—a farm system, subsidized by major-league teams needing a pool of young talent to compete in an industry that has room at the top for only 650 men.

If a minor-leaguer's career goes as planned, he ascends through the four levels of the farm system—Rookie, Single-A, Double-A, and Triple-A—and in a few years reaches the majors, "the show." Figuring in the players who fail to complete the journey, the cost of developing a major-leaguer is upwards of two million dollars. No longer can the minors afford to provide a last hurrah for former major-leaguers whose skills have deserted them. What is wanted today are young men who, like championship racehorses, become stronger and faster and more skillful with each new season.

The Ports' starting pitcher, Steve Monson, was built like a concrete block on which someone had painted a blond flattop. He glowered and mumbled wisecracks through clenched teeth, cultivating the image of a tough guy and trying to camouflage a heart that was as soft as a teddy bear's. Like his peers, Monson earned less than $1,000 a month, plus $11-a-day meal money on road trips, and pursued his baseball dream with missionary zeal. He worked the graveyard shift at a convenience store in the off-season so he could train during the day, and to keep his legs in condition, he ran before games until sweat poured off him.

This was Monson's fifth season in pro ball and his second at Stockton with the Ports, a team he remained with after his pitching arm became sore during spring training. Talking to him in the dugout, I was struck that the pressure of the minor leagues—the pressure to succeed and advance or be gone, laid off with no compensation other than a plane ticket home—had robbed part of his youth from him. He spoke of "turning my life around for baseball," of the need for a pension plan in the minors, of the fear of debilitating injuries, and of a book he'd like to

The pressure to excel is intense during an intrasquad game at the Milwaukee Brewers' minor-league training facility near Phoenix. With the season's first cut only days away, every player competes for the label "prospect"—a player thought to be talented enough to one day wear the Milwaukee uniform. While players worry about their chances, managers ponder the bottom line: It costs at least two million dollars to develop a player from the minors to the majors.

write titled *Highs and Lows: My Life in Baseball*. Those were things one might expect to hear from an older man. Monson was 22.

"You watch me pitch," Monson said. "I'm aggressive. I like to intimidate, like I'm coming after you, so what are you going to do? You won't see me smile. I do that for atmosphere. I want batters to think, 'This guy doesn't fool around. He doesn't take bull from anyone.' "

I LEFT STOCKTON after two weeks, in the recreational vehicle that served as my hotel and office, crossed the snow-covered Sierra and followed the back-roads through the Arizona desert, poking along toward Texas. Whenever I found a minor-league team, I stopped and lingered in that town until my feet again grew restless. In those little ballparks, I found moments of shared summer leisure and time to dream—of the days when I was young and all great feats seemed possible. The world around me had changed, yet everything about baseball was exactly as I had remembered it—the game's rules, the language of the fans, the rituals on the field, even the soft glow of June nights.

Texas is full of baseball tradition. At least a hundred Texas towns have had minor-league teams since the Texas League started playing in 1888—five years before historian Frederick Jackson Turner declared the American frontier settled. Galveston gave baseball a ladies' day that year, building a new grandstand and admitting women free on Wednesdays. "Don't fear to compromise your sex by attending the baseball game," encouraged the *Austin Daily Statesman*.

I parked my RV outside El Paso's Dudley Field, home of the Diablos. I walked into the grandstands (made of adobe brick) just as the PA announcer, Paul Strelzin, a junior high school principal, was testing his mike. On the top of the visiting team's dugout was painted in red the word ENEMY. Strelzin's voice boomed across the field:

"Well, the umpires have arrived, fans. Finally. Behind the plate tonight is Jeff Henrichs, just back from helping clean up the oil spill in Alaska. At first is his illegitimate brother-in-law, Cris Jones. Fearless Dick Fossa is at third. He sells panty hose in the off season. . . ."

By the second inning El Paso's cheerleaders, the Diamond Girls, were dancing on the roof of the Diablos' dugout. Strelzin was playing "Charge!" on his kazoo and waving a green flag out the window of his booth. Shon "the Avenger" Ashley obliged with a three-run triple, and moments later 2,000

fans were on their feet, waving white tissues they had been given at the gate as the Arkansas Travelers' starting pitcher plodded off the mound.

Sitting next to me in Section CC was Mitch Malott, nearly 80, a gentlemanly fellow who from time to time would surprise me by emitting a terrible bellow—"Aw, come on, ump! That was a strike when I played." Malott wore white suspenders, blue sneakers, and a baseball cap. He sat with his feet draped over the seat in front of him, his hands folded between his knees like a boy. Every year he took a road trip with the Diablos, and one year, when he didn't have the money to follow the team from San Antonio to Wichita, the players offered to cover his expenses. He said no, he couldn't accept, because they had less money than he did.

"All winter long," he said, "I keep waiting for baseball to return. Dudley's my summer home. I can remember when we just had wooden benches up here, and down there was an organ. My wife used to come out here with me then, before she passed away."

Talking to Malott, I lost track of the game and hardly saw the ball Sandy Guerrero banged over the right-field fence and into the El Paso Zoo. Suddenly Malott was on his feet, hurrying down the aisle while reaching

An agonizing moment arrives for both players and managers when the crop of hopefuls must be culled. Huddled in a Phoenix motel room (left), the Brewers' farm staff decides whom to cut. The next morning pitcher Chris Diemer slumps in the clubhouse (above) after getting the bad news from farm director Bruce Manno. "I've been doing this for 12 years," says Manno. "It never gets any easier."

for his wallet. Guerrero circled the bases, then slowly made his way along the infield wall, where Malott and 70 or so other fans waited, each holding out a dollar bill. Guerrero cheerfully piled the crumpled bills into his helmet, one by one, chatting, shaking hands, signing autographs. The ritual, dating back to barnstorming days when underpaid players counted on contributions to survive, is celebrated after every Diablos home run and is part of the bonding between fan and player that is unique to baseball.

Back in Stockton, Steve Monson, his right arm healthy again, had gotten off to a fine start and gained a promotion to the Double-A Diablos. He caught a flight to El Paso, dumped his four suitcases at the airport hotel, and took a cab with his last ten-dollar bill to Dudley Field. "I've won everywhere I've

been, and I'll win here too," he said when I spotted him in the clubhouse, changing into his new uniform. "I can carry this club." His escape from the Single-A level was one that many minor-leaguers never make, and Monson now had legitimacy in an elite fraternity: He was a "prospect."

MINOR-LEAGUE BASEBALL—like the El Paso franchise itself—seemed moribund in 1974 when a Vietnam veteran, Jim Paul, bought into the Diablos with a thousand dollars he had borrowed. The popularity of the minors had peaked in 1949 with 40 million Americans turning out to watch more than 450 teams in 59 leagues. But soon Americans had an alternative to a night at the minor-league park: They could stay in their newly air-conditioned homes and watch major-league games on television. Minor-league attendance tumbled below ten million, financially pressed teams folded in mid-season, and a litany of wonderful names faded into history: the Sooner State League, the Sunset League, the Tobacco State League.

I found Jim Paul in his cramped little office, wearing a new pair of cowboy boots. He was sizing up the crowd through a book-size window cut in his wall. Anything less than a full house he took as a personal insult.

"I may have bombed on this one," he muttered. Paul, sole owner since 1975, had transformed the Diablos into one of baseball's most successful franchises by being among the first to take advantage of one of minor-league baseball's peculiarities: It may be the only business in the country in which the stockholders have no control. The product—team performance—is controlled by the major-league teams that supply the players and own their contracts. The majors' concern is their own welfare, not building minor-league champions. If they need to move a player in the heat of a minor-league pennant race, they will, so Paul and his peers can't promote a single player, or even a team. They sell entertainment first, baseball second.

Paul's original investment is now worth several million dollars. Owning a minor-league club became the trendy business of the 1980s, and into its ranks came a host of celebrities: actors Bill Murray and Robert Wagner, athletes Don Drysdale and Roman Gabriel, singers Jimmy Buffett and Conway Twitty. It was a strange investment because they didn't own the stadiums (the municipalities did) and couldn't depreciate the players. Even the balls and bats were the property of the big-league teams. All the owners really

A pop fly distracts El Paso outfielder Shon Ashley from the business at hand—counting dollar bills donated by fans after he hit a home run, a long-standing tradition in El Paso. Every dollar is welcome; many players take home less than a thousand dollars a month.

Diablos infielder Charlie Montoyo exchanged vows with Dana Espinosa at home plate, then joined his teammates in drubbing the visiting Midland, Texas, Angels, 12-2.

owned, besides a few typewriters and maybe a Cub tractor to drag the infield, were the territorial rights to do business in the most American of industries.

"Ten years ago you didn't hear anything in ballparks but organs, and organs are for funerals," Paul said. "We play rock and roll. We dance in the aisles. We have a promotion every night. We give away trucks and pizzas. We have Bart Simpson look-alike contests and fireworks nights. We make it fun again to come out to the park."

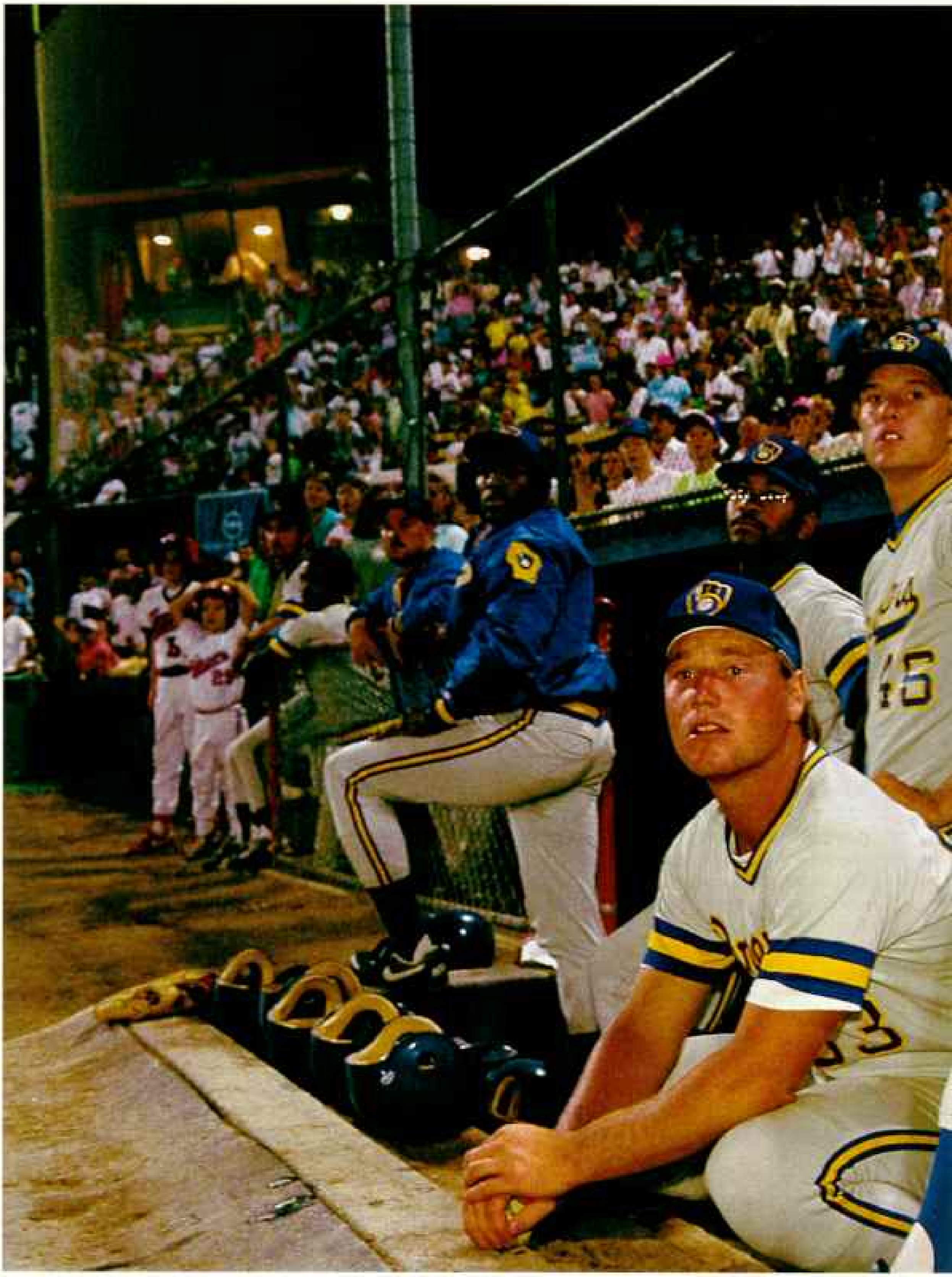
Paul peered out his window. On the infield below, just as the fifth inning ended, a Diablos employee dressed in a chicken costume took up position on second base. A little girl chosen from the stands was stationed nearby, midway between first and second. If the girl, running, could beat the chicken, walking, she would win ten dollars.

"Move the kid up," a fan yelled from the stands.

"Like hell," Paul shot back. "You ain't paying the ten bucks. She stays where she is." The crowd roared as the girl, her tiny legs churning like the blades of an eggbeater, rounded second, closed the gap at third, and flew down the stretch. Diablos catcher Tim Torricelli intercepted the chicken with a hip block inches from victory, and the girl crossed home plate to thunderous applause.

"Don't you love it?" Paul laughed, slapping his knee in delight. "Isn't this wonderful!"

The purists shuddered at first, complaining that Paul's circus-like antics were overshadowing the game. But Paul started filling up his park, night after night. Attendance nearly doubled his first year in El Paso and set a franchise record the next. Before long even the stodgiest owners had become P. T. Barnums with nightly promotions, discounted tickets, and distinctly nonbaseball food that ranged from smoked-turkey drumsticks at Sec Taylor Stadium in Des Moines to stuffed potatoes at Derks Field in Salt Lake City. By 1990 attendance had climbed above 25 million—a 39-year high—and one of the



Anxious eyes of the Helena Brewers turn toward the outfield as Salt Lake Trapper fans erupt after a hit by their team. Though

some players are rattled by hostile fans, most have been seasoned by the even more partisan crowds of college and youth leagues.

171 minor-league teams, the Buffalo Bisons, was outdrawing three major-league clubs.

By the time I got into the South, whiling away evenings in Chattanooga, Birmingham, Durham, and the towns of the Florida State League, I had begun seeing things on the field that earlier had slipped unnoticed by my eyes. Baseball was a different game from the one I had known at the beginning of the season, more complex and more demanding.

There was the secret language of the umpires as they spoke to one another on the field with a roll of the finger and a rub of the cap, acknowledging who would cover what base so that one of them would always be moving ahead of the play. There was the sign language flashed from the dugout to the third-base coach to the players that, even to some highly paid major-leaguers, remained no less bewildering than Chinese. "You know I'm not too good on these signs," the Milwaukee Brewers' Cecil Cooper used to tell his first-base coach, "so just give me a wink if I'm meant to run."

In one park I knocked on a green door that said "Unauthorized Visitors Not Allowed," and the young umpire who answered, Brian York, solved another great baseball mystery for me. York was rubbing a stack of baseballs with mud, a ritual umpires performed before every game. But I remembered how much I had prized a shiny white ball as a youngster, and for the life of me I could not understand why anyone would want to muddy up a new ball.

York said that good "working mud" takes the gloss off a ball so it doesn't slip from a pitcher's grip. The mud must have just a touch of grit, though not enough to scar or discolor, and should be sufficiently slimy to spread easily. Sometimes it is mixed with tobacco juice, spit, or other ingredients that umpires fuss over like chefs, each believing he has created the finest recipe, lightly garnished with Copenhagen or Bull Durham.

The mud used in the majors was discovered in 1938 by Lena Blackburne, a coach for the Philadelphia Athletics, and today comes from a New Jersey tributary of the Delaware River. Once a year a family enterprise packs Lena Blackburne baseball rubbing mud into one-pound, silver-painted coffee cans and ships it off (at $25 a can) to big-league stadiums. But in the minors umpires like York must find their own mud, and they spend a surprising amount of time checking out riverbanks and rain-soaked golf courses and roadside ditches.

"My teammates called me Frankenstein," joked Beloit pitcher Joe Andrzejewski (left), hit by a smoking line drive that left an imprint of the ball's stitches but no major injuries. The ball then bounced to the third baseman, who stepped on the bag for a force-out in a 6-1 win over Springfield. In Wichita, El Paso Diablos kill time with a card game.

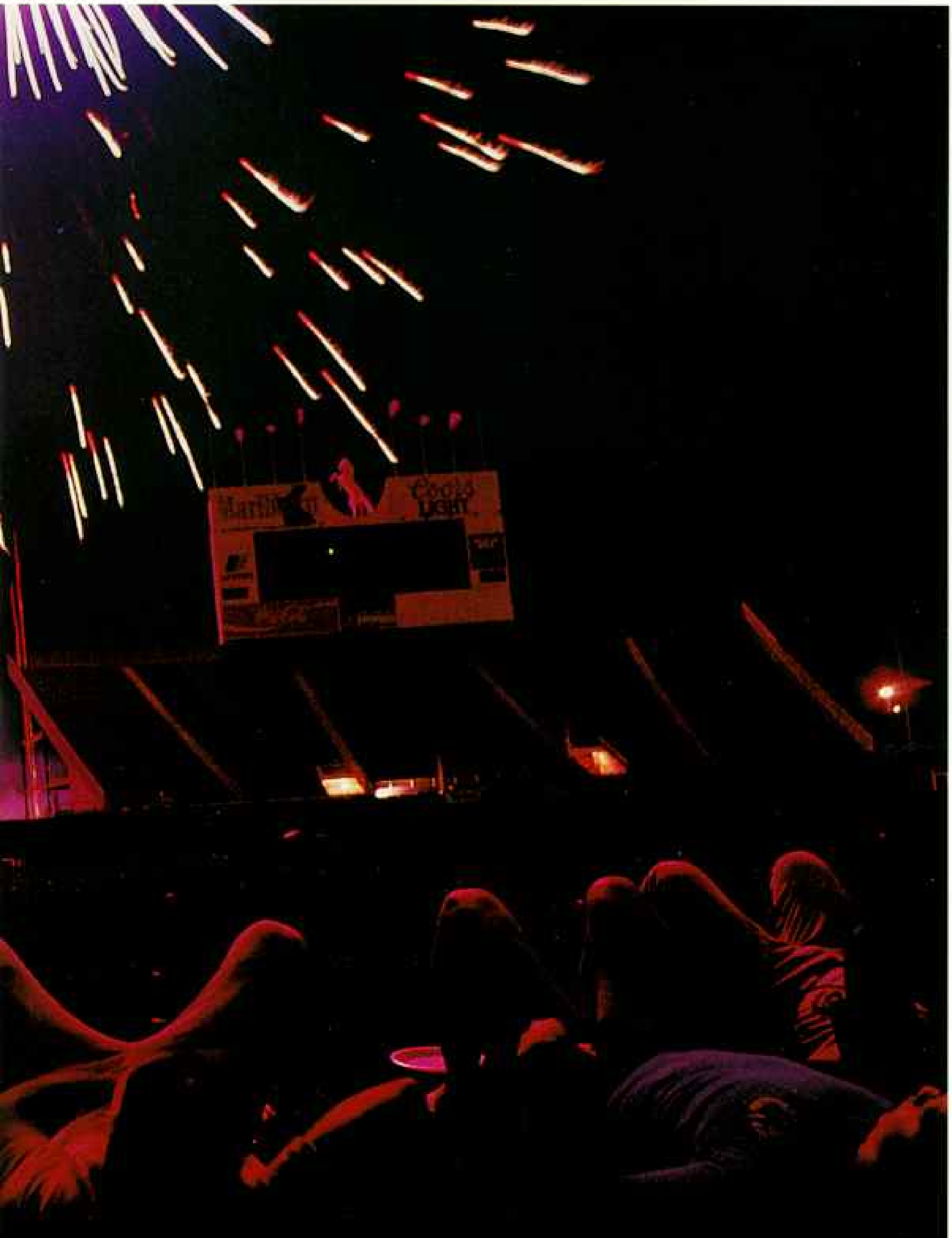
York and his partner, Bryan Wilber, were in the only profession where a man was expected to be perfect his first day on the job and get better as time went by. They, along with 200 other umpires in the minors, were competing for 60 major-league positions and, like the players, moved up through the levels of the bush leagues as their skills developed. York and Wilber, both recent college graduates, pursued their dream through the Midwest League in a battered '77 station wagon missing two hubcaps. They reminded me of desert nomads. They traveled at night to elude the heat, avoided bars and motels frequented by players whose performance they had to judge, and lived a Spartan existence, spending virtually every moment together from the first pitch of the season to the last. Each earned $1,900 a month, paid by the individual minor league; each man was expected to pay all his road expenses from that salary.

"Some nights I go back to my room, and I can still hear the yelling and booing. That bothers me," York said. "Then, when I think about it, I realize what's really bothering me is that I didn't have a very good game. So you replay the game in your head; you analyze your mistakes and try to learn from them. That's the only way you're going to get to the majors, a step at a time."

York and Wilber changed into their blue uniforms with padded shoulders and creased pants. They suddenly looked older and sterner. York stuffed the game balls into his pockets, and Wilber flicked some lint off his jacket. "It's seven of," he said. "Time to go." Shoulders straight and heads back, they moved together down the concourse and with deliberate strides walked onto the field to a chorus of boos.

I found in Brian York—indeed, in minor-league baseball itself—a refreshing honesty and innocence. Baseball felt like a game again, a ritual of summer. In the informality of small parks, where you could hear the umpire's voice and see the pitcher's furrowed brow, dwelt the hopes and humor of being good enough to dream. And when the Salt Lake Trappers board their bus for the numbing 17-hour trip to Medicine Hat, in Alberta,

Players loll on the grass during fireworks after a game between the Denver Zephyrs and the Nashville Sounds in Denver's Mile High



Stadium. From cheerleaders and sky divers to bingo games, owners use an endless variety of promotions to bring in the crowds.

Canada, wearing Walkman earphones and clutching the sports section of *USA Today*, they are convinced to a man that dedication and hard work will earn each a ticket to the majors.

"YOU KNOW, THE FIRST PITCH I threw in professional ball, I gave up a home run. *A home run!* Damn!" Bruce Throckmorton, a pitcher with the Pulaski, Virginia, Braves, said one day over a meat-loaf lunch with teammates.

"That's nothing," replied Dave Dickman. "My first pitch, I hit a guy in the head. I said, 'What am I doing here?' "

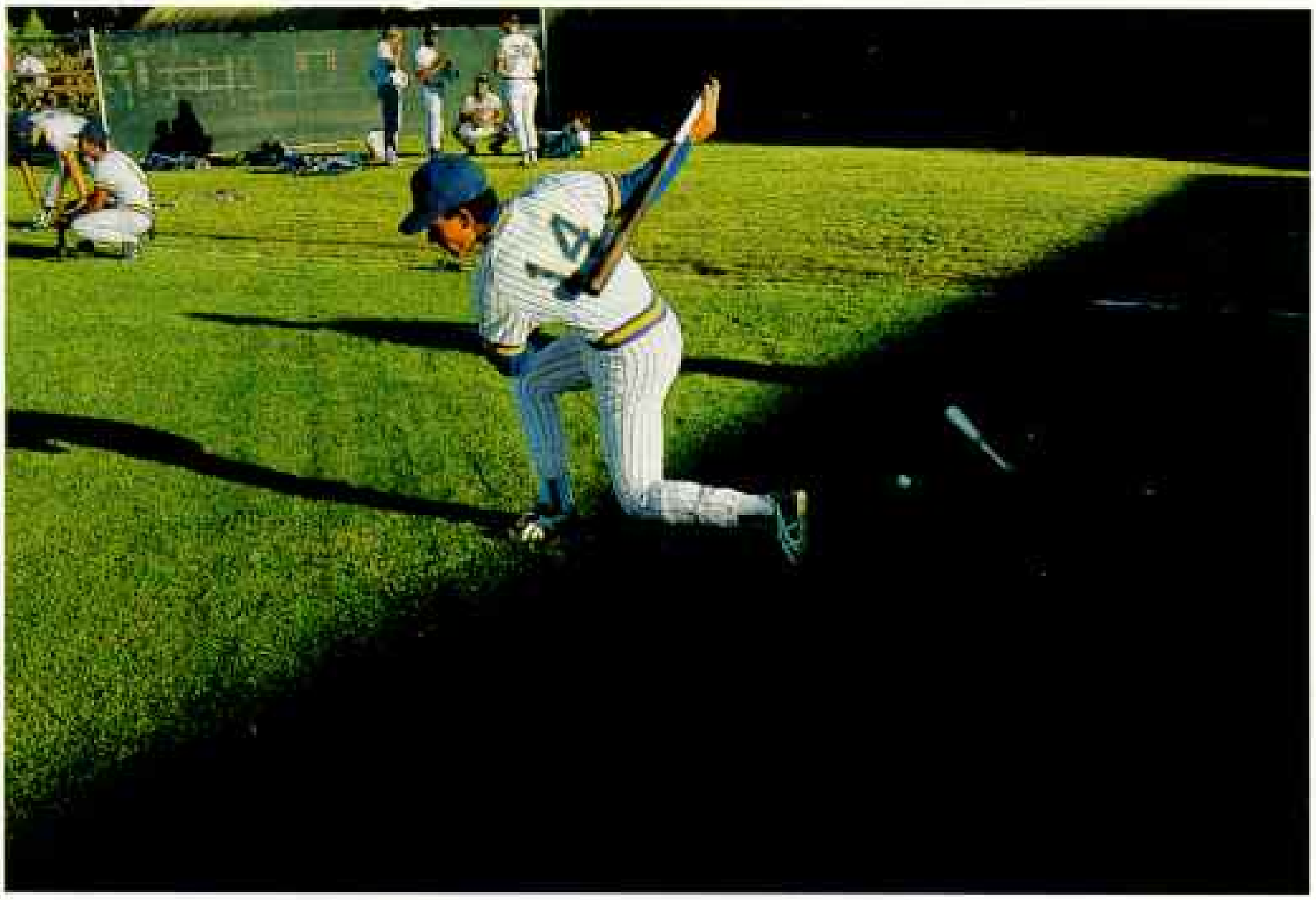
"The way my wife and I figure it," Throckmorton said, "at the end of the season we'll look at what kind of year I had. If we think this is as far as I can go, I'm not one to waste time. I don't think you should be living a dream if it's not going to come true."

"If I work my butt off, even if things don't pan out," Dickman said, "I know that one day my kid can say, 'Hey, my old man played a little ball, and he got paid for it.' Everyone at this table can say that, and we'll always be proud of it."

Some of the old parks where Dickman and the 4,000 other minor-leaguers play are joys to behold. They are full of nooks and crannies and odd angles, squeezed into downtown blocks, their size determined by existing buildings. In Durham, North Carolina, just behind the Bulls' right-field fence is the brick wall of an old tobacco warehouse. In Great Falls, Montana, Legion Park sits in the shadow of grain elevators, beneath a western sky that seems to stretch clear to the Pacific.

The first ballparks that took shape downtown in the 1800s symbolized America's transformation from 17th-century Puritanism, which considered popular recreation frivolous, to 19th-century industrialization, which wanted freedom from the factory and the pleasure of shared leisure. The old facilities were called parks or fields, not stadiums, and they were named for people instead of municipalities.

In Birmingham, Alabama, the Barons' new suburban home—12-million-dollar Hoover Metropolitan Stadium—offers sky boxes at $17,500 a season, and everything has the whiff of major-league quality. But it was the home the Barons abandoned after the 1987 season that I found compelling. "I wouldn't be leaving your van on the street if I was you," the man from the recreation department said as he unlocked the gate to Rickwood Field. "Better to park inside where it'll be safe. Then I'll lock up behind you."



Shadows grow long in Stockton before the Ports take on San Bernardino. In Beloit (left) a coach awaits game time. "It's a 24-hour job," says a veteran coach. "You teach playing skills, check on injuries, give players a sympathetic ear, file nightly reports—then hustle back to the park the next day to do it all over again."

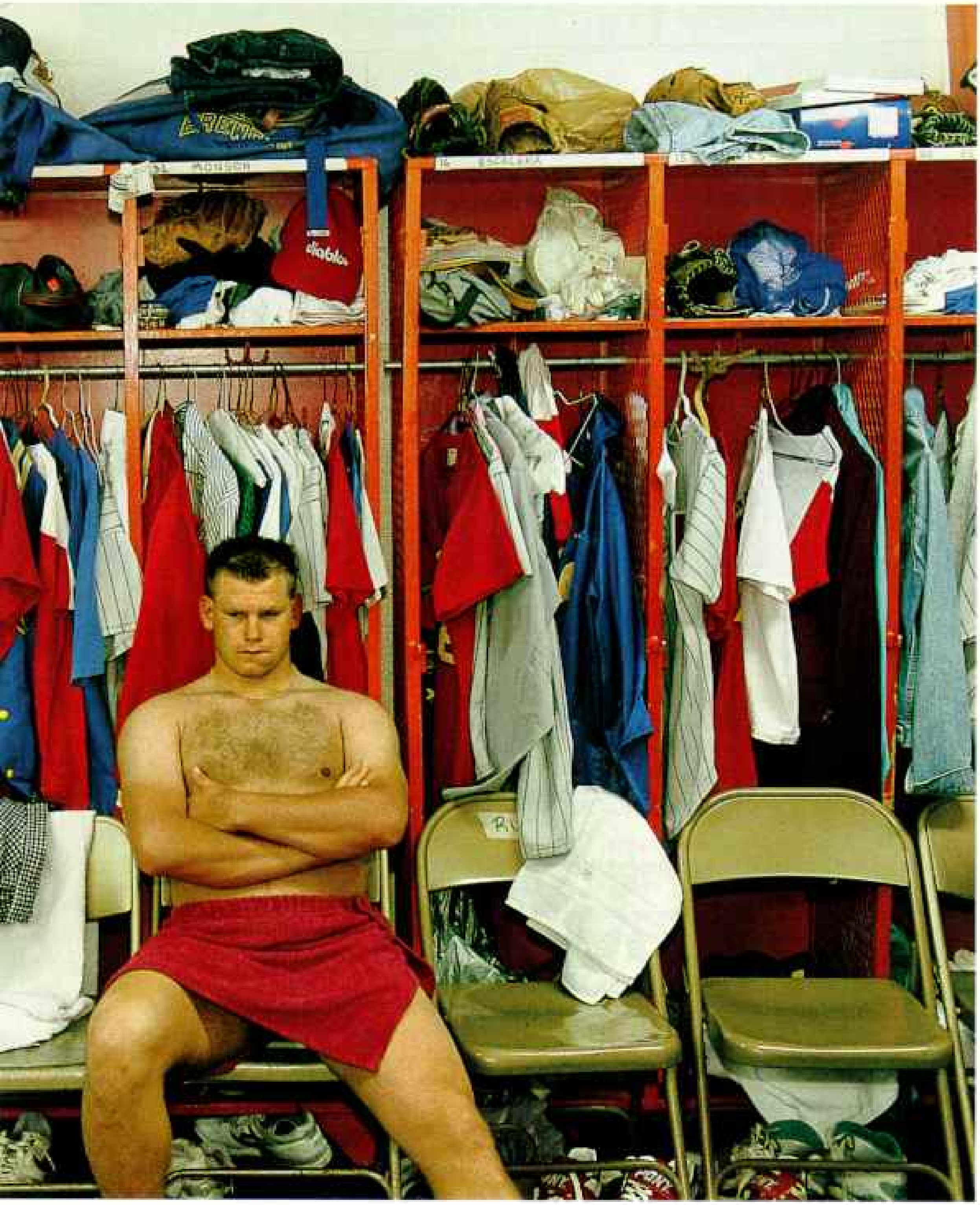
Rickwood Field was low and airy with a single deck and a wooden outfield fence. I parked in the shade of a dark concourse, next to a wall with nine painted flags, each marking one of the Barons' league championships. Outside, weeds crawled across the diamond, though the city still clipped the infield grass every two weeks, as if the Barons were only away on a road trip. I wandered into the home-team clubhouse and found a light that worked. Bare lockers lined the wall like skeletons. A cardboard box full of athletic tape and cans of shaving cream and a discarded baseball shoe sat on the trainer's table. By the light switch was a note from manager Rico Petrocelli, saying batting practice would be held at 5 p.m.

For a long time I sat alone in the bleachers, thunderclouds swirling overhead, and the ghosts came floating back. The stands filled, and I could see blurry faces in the crumbling press box across the field. Lumbering Walt Dropo stood between home and first, watching his soaring drive clear the clock deep in left field. . . . There was Babe Ruth, in an exhibition game of touring major-leaguers, rounding second with mincing steps, his ball settling on a moving freight train that did not stop until it got to Nashville, 200 miles away. It was said to be the longest home run ever hit. . . . And Norm Zauchin chasing down a foul ball. He crashed over the railing at first and landed in the lap of a fan named Janet Mooney, whom he would marry two years later.

Baseball ended its 78-year run at Rickwood Field on a rainy September night when, at 10:54 p.m., Rondal Rollin—the Barons' record home-run hitter—swung and missed on a third strike in his last at bat in the old park. Before that game and before every game for as long as anyone could remember, the Barons' starting lineup was written on a chalkboard for the fans to see as they went through the turnstiles. The board was still there, the names as distinct as if they had been chalked in yesterday: "Pino, 2b; Bertolani, ss; Thomas, rf; Rollin, lf. . . ."

The epitaph of the final game has been spared without so much as a mark to smudge the names of those last nine men. It was as

Portrait of dejection: Pitcher Steve Monson sulks in the El Paso Diablos' clubhouse. He took himself out of a game against the Midland Angels when his tendinitis flared up. "It was a demoralizing thing, especially for someone like me," said Monson, a converted catcher known for his bulldog tenacity. "But if I'd stayed in, I could have hurt myself." Monson's distress was eased somewhat when he got credit for a 10-5 victory.



if even vandals recognized the sanctity of baseball's past.

THE HUMIDITY was withering in the South, and I headed up the East Coast at a faster clip than I had intended, anxious to make the turn west that would point me toward the Pacific again. My RV—which I had named Forty-Niner in honor of both my adopted state, California, and my own age—behaved admirably, providing me with a comfortable bunk to sleep in, a reliable stove and refrigerator, and a little dinette table on which I could type. After four months on the road, I felt as though I had never known a home other than Forty-Niner.

The ballparks along the way offered a respite I never tired of. Each one had its own character, and each crowd was reflective of the town itself. In Durham the crowds were noisy and middle class; in Baseball City, Florida, elderly and reserved; in Salt Lake City, young and orderly.

Tinker Parnell has been coming out to the Durham Bulls games for so long—about 45 years, he reckons—that the section of the right-field grandstand where he sits is known as Tinker's Corner. "I've been to major-league parks in Atlanta, Baltimore, but they're nothing like the minors," he said. "It's just a different atmosphere here. The minors are like family. There's hardly a player who walks by who doesn't say, 'Hello, Tink. Glad you made it out tonight.' "

During my travels, only one thing never changed—the ballplayers. Knowing neither fame nor fortune, they were trusting and approachable and without pretense. They didn't wear earrings or have long hair or dress outlandishly. They were gracious with writers and fans. And they had passion for their work, a pride in excelling, a trait that seems all too rare in today's society.

What their lives were really about, I decided, was the acceptance of defeat, because in baseball failure is the norm. Even the best teams lose one of every three games, the finest hitters fail seven times in ten. When failure comes, a player's mind begins to focus on what has gone wrong. In a game his nervous and muscular systems go through the sequence of past failure, reinforcing the likelihood of more failure and less confidence.

"My first reaction was, this can't be happening to me," said Durham's slump-ridden second baseman, David Butts. "Then I started thinking I just wasn't much of a ballplayer." His batting average kept slipping, down to a minuscule .080, and every time he

Baseball tradition almost mandates a trip to the concession stand; during a doubleheader in Bakersfield, a fan makes quick work of a corndog. In Helena, Brewers second baseman Vince Castaldo, a crowd favorite, signs autographs for youngsters. Minor-league players are far more accessible to fans than their counterparts in the majors, where heads can be swelled by media hype and lavish salaries.

came to the plate, his eye would be distracted by the movement of an umpire or would focus on an outfield sign he had never even seen when his concentration was working. His mind had taken control of his body. He looked for reinforcement, but his teammates became distant, not wanting to say anything to hurt him and not knowing what they could do to help him. A deathly hush fell over the crowd every time he came to bat.

One week Butts would show up at Durham Athletic Park early for extra batting practice, the next he would stay away as much as possible. Nothing helped. Pitches blurred by him. "It was like I'd lost my vision," he said. Then one of Atlanta's batting instructors, Willie Stargell, came to Durham. Butts was alone in the park, working out, and Stargell walked up to him and said, "Here, let me help you." For a long time the overweight black Hall of Famer with 21 years as a major-league player stood in his street clothes in front of the mound, patiently throwing slow pitches to the young, white infielder with the furrowed brow. "Bat back, level swing, drive the bat right through the ball," Stargell would say. "Thataway. That's good contact."

Whether Stargell's encouragement was responsible for breaking the spell is hard to say, but by the time I got to Durham, Butts had started to hit again. But he knew that, at age 25, his career was almost over.

"The hardest part of David's being released or however it ends will be going home, because they won't understand," his wife said one night as we watched the game in seats behind home plate. "What they won't understand is how far he's come and what a long, hard endurance test this is."

IF I HAD GOTTEN to Helena, Montana, and the Pioneer League at the beginning of the season, rather than in August, at the tail end of my 16,000-mile journey, I might have stayed all summer. Kindrick Legion Field was small—its seats extend only 13 rows back from the field—and felt as cozy as a village green. The

stands look out toward Mount Helena, rising from a low chain of pine-clad mountains. Just beyond the outfield fence were a church, its steeple topped by a gold cross, and a row of small homes, on one of which was painted a huge yellow mitt as a target for hitters.

The crowd was sparse the night I got to Helena, only a few hundred, and the skies were heavy with the threat of rain. Many of the fans seemed to know one another, and I found the park an easy place not to be a stranger. Mary Gunstone was one of the first fans to arrive, a 40ish woman carrying 33 photograph albums—each a chronicle of the season—that she had put together. She had taken shots of players with their arms around one another's shoulders, of infielders scooping up grounders, of young men, bats cocked over their shoulders, their white uniforms pressed and spotless, each looking as proud as a newly commissioned Army officer. The albums were carefully wrapped in plastic, and each bore the name of one of the Brewers.

"Mary, why don't you just give them doughnuts?" the owner of the bakery where she worked had asked. "You could get them for free."

"No," she replied, "you can't take home doughnuts. I want them to have something they can keep, something to remember their season in Montana by."

She waited at the railing beyond the dugout, calling the Brewers aside one by one to make her presentations. The young men blushed, mumbled thanks, and seemed very pleased. "Come here, Emmett," she called. Emmett Reese, a retired California fire captain, was the clubhouse manager, and during the season he lived where he worked—in the clubhouse, on a rollaway bed stored by the washing machine. He walked over and quickly scanned the album she gave him.

"Oh, Mary," he said, giving her a hearty hug, "this is beautiful. Really beautiful."

Overhead thunder boomed, and, with one out in the fifth inning, the black skies opened and torrents of rain swept across the field. Fans dashed for cover.

Ron Romaneski, the owner, jumped out of his box seat and headed for the field. His 24-year-old general manager, Duane Morris, and a couple of fans followed. Emmett Reese ran in from his clubhouse in right field, and groundskeeper Randy Bruce sprinted across the concourse. The players poured out of the dugout. From the stands they appeared as formless shadows, splashing and soaked, nearly obscured by the swirling storm. In a moment they were all pulling and tugging at

With his fate in others' hands, El Paso outfielder Shon Ashley and his wife, Karen (left), listen to a radio for results of the Wichita-San Antonio game. Wichita lost, assuring El Paso—which had just won its game against Midland—a spot in the Texas League play-offs. After clinching the California League championship, the Stockton Ports celebrate with sparkling cider, observing the booze ban of their parent organization—the Milwaukee Brewers.

the tarp, hauling the huge black canvas across the infield. There is no executive privilege in the minors.

The rain delay lasted two hours, and it was midnight before the Medicine Hat Blue Jays secured the last out to beat Helena, 5-2. Only 40 shivering fans remained to the end, among them eight-year-old Heidi Goettel, who used her allowance each week to buy snacks for her favorite player, Kevin Tannihill.

After an hour or so the players had showered and drifted away. Randy Bruce stood alone under the lights, pounding, raking, and poking at the infield, a solitary performer on an abandoned stage. Emmett Reese scurried from locker to locker, scooping up jerseys, socks, and jockstraps, which he stuffed into the washing machine, the first of 14 loads he would do before rolling into bed at dawn. He knocked on the door of a closet-size office, where manager Dusty Rhodes and pitching coach Ray Burris, twice a 15-game winner in the majors, were filling in game reports to be phoned to the parent club, the Milwaukee Brewers.

"Would you fellows drink a pot of coffee if I made one?" Emmett asked. They nodded.

The nights were cold now, and I warmed my hands on the mug of coffee. The season had dwindled down to its last few days. I stayed in the clubhouse, talking to Rhodes. He spoke about the pressure on his players to succeed, about how baseball was like war, preparing every day for a new battle, every skirmish producing a winner and a loser. Only the best survived.

After a while I went out into the darkened parking lot and started up Forty-Niner. I had intended to stay one more night in Montana, but for reasons I cannot explain, a compulsion overtook me and I started driving. California lay over the mountains and down the coast. A chilled breeze gusted through the Prickly Pear Valley. I turned on the radio and heard a recap of exhibition football games.

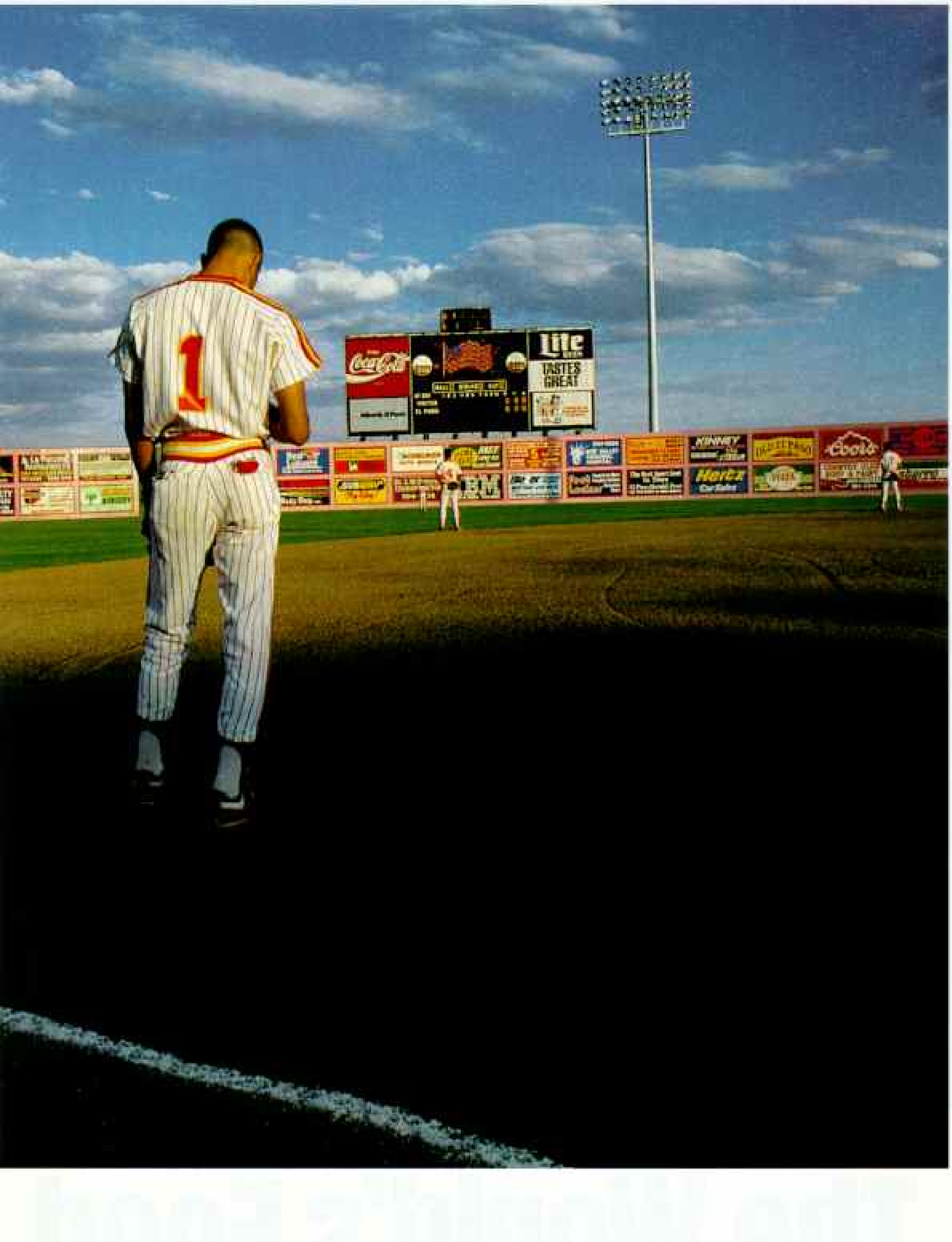
Summer was over, and it was time to go home.

Classic Americana: El Paso third baseman Greg Edge stands in silence for the playing of "The Star-Spangled Banner" before a game against Midland.

The minors offer young men monotonous travel, fast-food diets, and Spartan accommodations: All this for night work, in a seasonal job, with low wages and involuntary transfers.

Payoff? A one-in-fourteen chance of making it to "the show."

Play ball! □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Coca-Cola
Lite
TASTES
GREAT
Coors
Hertz

Spoiled by a freeze, a field of Florida tomatoes illustrates a global threat: Genetic uniformity

The World's Food

By ROBERT E. RHOADES

bred into crops increases yields but makes each plant identically vulnerable to disaster.

Supply at Risk

Photographs by LYNN JOHNSON BLACK STAR

The first cultivated plants

The grains, fruits, and vegetables we eat today had their origins in wild plants first domesticated thousands of years ago.

In high valleys of the Andes (left), hunter-gatherers may have unearthed and consumed one such plant, the potato, by 8000 B.C., but millennia passed before Andeans first cultivated that tuber.

Early farmers domesticated many other wild species around the world, selecting and sowing the seeds of plants with such desirable characteristics as high yield and resistance to pests, climate stress, and diseases.

Growers cultivated thousands of different strains, each with its own hereditary material, or germ plasm. These traditional varieties are today known as land races.

Some growers continue to raise many of the old varieties—such as potatoes being sold by a woman in Cuzco, Peru (above)—in the regions where they originated. These pockets of traditional agriculture thus serve as natural repositories for the diverse genes of land races and their wild forebears.

Since plant breeders now manipulate germ plasm to produce a relative few "improved" varieties, it has become essential to rediscover and protect the old strains. Their vigor and genetic diversity help provide insurance for the future of our food supply.

Traditional varieties bow to "progress"

Transforming the land, farmers in Sri Lanka (above) clear and terrace hillsides to plant new varieties of high-yield crops for market. When growers abandon old land races to plant modern varieties, often in single-variety monocultures, the potential for widespread disaster is greatly increased.

Clear-cutting across virgin lands destroys valuable natural vegetation, and in tropical rain forests—home to half earth's plant and animal species—some 60 acres a minute are denuded. A quarter of the total falls to the saw-toothed bite of commercial timber operations.

The resulting loss of naturally diverse germplasm—much of it not yet studied—is called genetic erosion. It is estimated that by the middle of the next century, one-quarter of the world's 250,000 plant species may vanish, victims of deforestation, the shift to monocultures, overgrazing, water-control projects, and urbanization.

A treasury under assault

Under armed guard, members of the International Potato Center (CIP) risk their lives to rescue an important collection raised at their agricultural research station in Huancayo, Peru. Eight months earlier a Maoist guerrilla group called Sendero Luminoso, or Shining Path, intercepted a busload of workers en route to the station and killed a guard. Continued threats forced this evacuation and, for safety, require the concealment of identities in this photograph.

CIP is one of 13 centers of the Consultative Group on International Agricultural Research (CGIAR), whose primary goal is to increase world food production while preserving natural resources. Another center, the International Board for Plant Genetic Resources, coordinates an effort to collect, evaluate, and preserve germ plasm around the world. In more than a hundred countries, gene banks maintained by CGIAR centers (map, pages 84-5), national governments, seed companies, and others form a network dedicated to preserving genetic diversity for world agriculture.


Beechcraft

THE RANGERS of Ruhunu National Park cannot fathom why we are risking our necks to collect a plant they call "pig's weed." Cursed by local farmers, disdained by cooks, and useful mainly to sorcerers, the weed grows in a part of Sri Lanka inhabited by crocodiles, wild elephants, and terrorists. My job is to watch for crocs and mollify our nervous escorts, whose guns have recently been stolen by rebels.

For all that, my colleague, Balendira Soma Sundaram, the country's chief plant explorer, seems unconcerned. Gripping a pencil in his teeth, he hitches up his rubber boots, adjusts the faded canvas bag on his shoulder, and wades into a lagoon. He scans the shore until he sees the object of our search, a tuft of scraggly weeds half-hidden in the shallows. Reaching out, he plucks a few golden panicles from the stalks, slips the grains into an envelope, and smiles.

"Each time I come here, I find some," he says, happy to have a few more specimens of pig's weed, the wild rice known to scientists as *Oryza nivara*, one of the world's most valuable resources. At least one strain of this endangered species contains an ancient gene that resists grassy stunt virus, a rice pathogen that, sweeping through the paddies of Asia, would be capable of destroying the mainstay of three billion people. Even a 15 percent drop in Asian rice harvests could bring mass starvation.

Balendira and I handle the seeds with due respect, noting the plant's location within the park and labeling a few specimens for shipment to the Philippines. There the rice will be stored in a gene bank in Los Baños, at the International Rice Research Institute. This bunker of concrete and steel is reportedly the strongest building between Tokyo and Frankfurt. Should a new rice virus strike, scientists could obtain *O. nivara* from the bank, attempt to extract a resistant gene, and insert it in other rice varieties to ward off disaster.

Scientists transfer genes between related plants by traditional cross-pollination techniques or, in recent experiments, through genetic engineering. Genetic engineers identify a section of the plant's DNA from which they wish to borrow material. Then, using chemicals, they extract the segment, isolate the gene in a solution, and splice it into the DNA of another plant. In its new home the gene goes to work, repelling insects or fighting diseases just as it had done before.

But biotechnologists cannot *invent* the gene.

That must come from wild sources or from one of the many varieties —which scientists call land races—traditionally bred by farmers. And therein lies the problem. The rice we recovered from Sri Lanka was still there only because it happens to grow in a wildlife reserve. That affords the grass a measure of protection. Outside the park *O. nivara* is disappearing faster than it can be saved. Around the world the same thing is happening to the wild relatives and land races of other major food crops—corn, wheat, and potatoes.

"What people call progress—hydroelectric dams, roads, logging, colonization, modern agriculture—is putting us on a food-security tightrope," said Te-Tzu Chang, head of the rice institute's gene bank, where 86,000 varieties of rice from all over the world are stored. "We are losing wild stands of rice and old domesticated crops everywhere."

Ironically the loss of genetic diversity accelerated with the green revolution of the 1960s. Back then, with the best intentions, scientists

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ROBERT E. RHOADES, former senior anthropologist at the International Potato Center outside Lima, Peru, wrote "The Incredible Potato" for the May 1982 NATIONAL GEOGRAPHIC. He recently joined the faculty of the University of Georgia in Athens. Photographer LYNN JOHNSON's byline appeared previously in the magazine on "Chicago's Hancock Center," in the February 1989 issue.

developed new "miracle" seeds by carefully crossbreeding plants to increase food production—mostly rice and wheat—in poor nations.

The results were dramatic. The new seeds, resistant to insects and diseases, yielded millions of additional tons of grain a year. Indonesia and India, formerly dependent on imports to feed themselves, soon were self-sufficient; India now produces a surplus for export to Sudan and other hungry countries.

The miracle seeds were not perfect, however. Opportunistic insects and viruses mutated and unlocked the genetic resistance of the new seeds. The pests sent scientists scurrying, searching for genes to withstand the threats. They have been successful so far. Meanwhile, the old varieties and wild plants are disappearing from many places, replaced by improved crops that are genetically uniform.

In Sri Lanka, where farmers grew some 2,000 traditional varieties of rice as recently as 1959, only five principal varieties are grown today. In India, which once had 30,000 varieties of rice, more than 75 percent of total production comes from fewer than ten varieties.

The trend toward single-variety monoculture, the planting of one strain instead of many varieties, leaves modern plant breeders little margin for error, says Garrison Wilkes, a professor of biology at the University of Massachusetts and a leading authority on genetic erosion. "The extinction of local land races by the introduction of improved varieties is analogous to removing stones from the foundation to repair the roof," Wilkes adds.

At present rates of extinction, as many as 60,000 plant species—one-fourth of the world's total—may be lost or endangered within the next 50 years. Meanwhile, there are more mouths than ever to feed.

A red tide of cranberries, one of North America's few original food crops, swirls around Jack McMahon and his sons in their Oregon bog. Keen to increase the nation's wealth of crops, Thomas Jefferson once wrote, "The greatest service which can be rendered any country is to add an useful plant to it's culture." Jefferson's garden book (left, with sesame seeds and corn) is preserved at the Massachusetts Historical Society in Boston.

WHEN FARMERS began harvesting the first domesticated plants about 8000 B.C., the earth's population was around four million. Today that many people are born every ten days. If the trend continues beyond the year 2000, we will have to grow as much food in the first two decades of the new century as was produced over the past 10,000 years.

The key for meeting that monumental demand for food may be wild plants. Inside each seed is the germ plasm containing the DNA, the genetic code evolved over millions of years in the wild that dictates each plant's development. This "stuff of life" determines a plant's resistance to pests, disease, drought, and similar natural catastrophes. The germ plasm controls the taste, appearance, and preserving qualities of food as well.

"The genes in wild species and old varieties have incalculable value to plant breeders looking for natural resistance to disease and pests," says Gene Saari, a staff scientist with

the International Maize and Wheat Improvement Center in El Batán, Mexico, who has introduced improved, high-yield seeds from India to Egypt. "Problem is," he adds, "the old varieties are disappearing as farmers take up modern ones."

Modern farmers prefer the modern varieties, the plants redesigned by genetic scientists who borrow the best attributes from various seeds and blend them into new ones to increase productivity, to meet the taste of consumers, and to provide maximum protein, among other reasons.

But there is a trade-off. By relying on a few crop strains instead of many, farmers open themselves to disaster. In the U. S., for instance, billions of rows of essentially identical corn are planted each year, making the entire crop vulnerable to a single pest or disease.

United States farmers learned that the hard way in 1970, when an unexpected epidemic of corn leaf blight wounded the pride of the world's most agriculturally advanced nation. A virulent new strain of fungus appeared in south Florida that winter and raced north like a killer flu. Since each ear of corn was a copy of every other, there was no margin of safety. The fungus destroyed half the crop from Florida to Texas. Nationwide losses amounted to 15 percent, at a cost of perhaps one billion dollars.

A SCIENTIST ON A U. S.-SOVIET PLANT EXPEDITION COLLECTS A SIBERIAN FORAGE GRASS, DESCHAMPSIA CAESPITOSA.

Such disasters are nothing new. Throughout history the sowing of uniform crops has led to a harvest of tragedy.

The collapse of Classic Maya civilization around A.D. 900, some anthropologists speculate, resulted from farmers' planting a mere handful of maize varieties, which were destroyed by a virus. Ireland's infamous potato famine of 1845 started with a fungus accidentally introduced from Mexico. That scourge, spreading through millions of genetically similar spuds, left the Irish without their main food source, and nearly a million people starved to death. A few decades later a fungus wiped out the homogeneous coffee plantations

The race against genetic erosion

"The diversity of our genetic resources stands between us and starvation on a scale we cannot imagine," warns leading plant geneticist Jack Harlan. Preventing such catastrophe requires tracking down the wild relatives of modern crops in habitats thought to favor their survival (green on map)—then preserving their germ plasm in a worldwide network of gene banks and protected natural settings. As population growth continues to degrade the environment, preserving the world's biological diversity is crucial to future food production.

EUROPE AND SOUTHWEST ASIA

Industrial pollution and deforestation threaten Europe, while overpopulation and overgrazing endanger genetic resources in Southwest Asia.

GRAPE
Rye
Olive
Cherry
Pea
Fig

WHEAT
OAT
BARLEY
Lentil

GRAPE
Alfalfa

Pear
Apple
Apricot

RICE

SOYBEAN

The Hague, Netherlands

Sugar beet

EUROPE

Sugar beet
Cabbage
Olive

Rome, Italy

Chickpea

ASIA

African rice
African yam
Pearl millet

Cowpea

SOUTHWEST ASIA

Common millet
Foxtail millet
Peach

Tea

TROPIC OF CANCER

SUGARCANE
Yam
Citrus

AFRICA

Hyderabad, India

Los Baños, Philippines

Bouaké, Côte d'Ivoire

Ibadan, Nigeria

Addis Ababa, Ethiopia

SOUTHEAST ASIA

SUGARCANE

EQUATOR

Nairobi, Kenya

SORGHUM
Watermelon

Eggplant
Pigeon pea

Banana
Coconut

Coffee
Finger millet

TROPIC OF CAPRICORN

AFRICA

Overpopulation drives the machine destroying Africa's plant and animal resources. Deforestation, overgrazing, and desertification devastate the land.

SOUTHEAST ASIA AND AUSTRALIA

Destruction of rain forests in Southeast Asia increases genetic erosion. Australia's germ-plasm base remains largely unstudied.

AUSTRALIA

SELECTED GENE BANKS

National centers

Consultative Group on International Agricultural Research (CGIAR) centers

- ● ▲ Long- and medium-term conservation collection
- ○ △ Medium-term conservation collection
- △ Research center

0 1500 km
0 1000 mi

Winkel's 'Tripel' Projection

NGS CARTOGRAPHIC DIVISION
SUPERVISOR: JACK R. HARLAN, PROFESSOR EMERITUS, PLANT GENETICS, UNIVERSITY OF ILLINOIS
JOHN BARTHOLOMEW & SON, LTD., EDINBURGH

Taming wild wheat

Humans domesticated wheat about 10,000 years ago from plants whose wild relatives (1) still survive. Today land races (2) and modern varieties number about 22,000 and belong to two major species: wheats used to make bread (3) and wheats used to make pasta (4).

PAINTING BY WILLIAM N. KORE, NATIONAL GEOGRAPHIC ARTIST

of Ceylon, transforming that island into one of the world's major tea producers. And as recently as 1984 a bacterial disease struck Florida, forcing 135 nurseries to destroy 18 million citrus trees and seedlings.

Luckily, America's bruising by that corn fungus reshaped attitudes toward genetic resources. The National Academy of Sciences set out to assess U. S. vulnerability to crop disaster. The findings were sobering: Half the U. S. wheat acreage is planted in a mere nine varieties, three-fourths of the potato crop in four varieties, half the cotton in three varieties, and more than half the soybeans in six.

Even before the corn blight, agricultural research organizations such as the International Potato Center had been established to broaden and improve the genetic foundation. The potato center, located in La Molina, near Lima, Peru, is one of 13 research groups in the Consultative Group on International Agricultural Research (CGIAR), a consortium conducting some 300 million dollars' worth of research annually. Individual research centers strive to identify, rescue, and preserve wild species and land races of plants. Plant explorers are searching the world over for fresh genetic material.

I ARRIVED in the Soviet Union with a team of scientists sponsored by the U. S. Department of Agriculture (USDA). Our mission was to hunt for seeds in Siberia, but first we stopped in Leningrad to pay homage to one of the giants of modern botanic exploration, Nikolay I. Vavilov.

Vavilov, working in the 1920s and '30s, identified eight specific geographic areas around the world where he believed farmers first domesticated plants. Those areas still have the greatest diversity of major food crops. Directing a staff of 20,000 in more than 400 research stations across the U.S.S.R., Vavilov urged his seed collectors to store plant materials for safekeeping. Long before others realized the value of such collections, Vavilov understood that a cache of diverse genetic material could determine whether a nation's larder was empty or full.

His associates knew it too. During the 900-day siege of Leningrad in World War II, Vavilov's staff faced starvation rather than eat the precious stocks they had painstakingly gathered from the far corners of the earth. In a gesture of stubborn optimism, curators straggled out into the besieged city and planted specimens from their collections. They had to regenerate stocks for the future. During the siege many curators died in the laboratories, their stomachs empty. Surrounding the corpses were the boxes of seeds and sacks of potatoes they had been saving.

Vavilov did not live to witness the suffering of his colleagues. Packed off to prison in Saratov after a scientific dispute with Stalin's pet agronomist, Vavilov died there, accused of spying and agricultural sabotage.

Yet his work continues at the Vavilov Institute of Plant Industry, on an old tsarist estate that is now a favorite location for filming Soviet Sherlock Holmes films.

"Vavilov is not yet as famous as Galileo, but his time will come," Vladimir Krivchenko, then director of the Vavilov Institute, told me. "He admonished us to preserve the plant diversity created over millions of years before it is too late," said Krivchenko, a robust Russian who motions with callused hands that speak of his own involvement with the soil.

A few days later, accompanied by a few of Krivchenko's colleagues, I ventured deep into Siberia, hunting for grass seed with Vasiliy Malofeev, an expert on Siberian plants. Kay Asay, a USDA grass breeder from Logan, Utah, led the American team.

We bounced along in canvas-covered trucks on the only road linking the remote industrial city of Novosibirsk with Mongolia. Each time we spied a promising plant, we stopped. We scoured mountain slopes, storage bins, haystacks—even overgrown graveyards where the dead of the Russian Revolution sleep. All in the search for forage grass.

"Most Americans think this stuff is hayseed," said Kay Asay, showing me a handful of crested wheatgrass. "It's the key to our successful western ranching operations."

Around the campfire one night I learned of our long-standing reliance on Soviet imports. Orchardgrass, bromegrass, wild rye, meadow fescue, clover—all came to us from the Soviet Union. Even the pride of the Great Plains, hard red winter wheat, descends from Ukrainian varieties that crossed the ocean with Mennonites in the late 19th century.

Guided through Siberia by Vasiliy and Kay, I stripped handfuls of ripened seed and put them into separate envelopes, carefully labeling each one: "Species: *Bromus* sp. Location: Ust Sema, Katun River, Siberia.

Rainbow harvest of corn dries in the yard of an Andean girl's home. Cultivating different land races not only assures a grower that no single pest or disease will destroy an entire crop, it also helps prevent the world's agricultural gene pool from drying up.

Elevation: 1,100 meters. Date: August 13, 1988. Collector: Robert Rhoades." This information would help scientists find the grass again, should it be needed in an emergency.

As the tiny seeds trickled from my palm into the envelope, a thought flashed across my mind: Could one of these grains contain a gene for a minor agricultural revolution? Like the wheat land race from Turkey with a disease resistance worth 50 million dollars annually to the U. S.? Or the Ethiopian barley that protects California's 160-million-dollar annual crop from a dreaded yellow dwarf virus?

Even the most obscure plant can work a minor miracle—on the farm or in the pharmacy. AIDS researchers have found a substance in Chinese cucumber roots that may work against the disease. An extract from the rosy periwinkle of Madagascar has proved effective in treating childhood leukemia. A Mexican yam contributed to the first oral contraceptive. Wild tomatoes, growing in the salty air of the Galápagos Islands, have been used to adapt California varieties to the state's heavily irrigated—and increasingly saline—farmlands. Nature has equipped plants with magical properties that science is only just beginning to discover.

CONSIDER THE MYSTERY of the Mexican bean weevil, an insect with a nasty reputation and cumbersome scientific name. *Zabrotes subfasciatus*, a brown bug about the size of a pencil eraser, destroys as much as 25 percent of the beans stored in Africa and 15 percent in South America. Spraying this major food crop with insecticides might kill the weevil, but it would also harm people. It is safer to repel the bean weevil naturally, by breeding a genetic resistance into its food. That brings scientists like César Cardona into the picture.

For five years Cardona and his colleagues at the International Center for Tropical

To separate grain from chaff, a Peruvian farmer and his family winnow their wheat by using the strong winds in the Urubamba Valley. First domesticated in the Near East, wheat crossed land and water carried in the packs of explorers, pioneers, and

immigrants. Likewise, many countries' "homegrown" crops originated elsewhere: Sixteenth-century conquistadores brought the potato from the Andes to Europe, and the Midwest's corn belt owes its girth to germ plasm that originated in Mexico.

Reaching toward the Peruvian rain forest canopy with a pruner, Percy Núñez Vargas (above) snips samples for the Missouri Botanical Garden. Passing the torch in Indonesia, 84-year-old master botanist Achmad Jahja Kostermans (below) continues his life's work on tropical Asian plants by dictating notes to an assistant at Bogor's botanical garden. His collection may take 50 scientists 50 years just to record and analyze. Such institutions play vital roles in collecting and identifying plants and helping scientists track related species for breeding programs.

Agriculture in Cali, Colombia, searched for a bean the weevil would find unpalatable. Ten thousand samples later, Cardona was ready to concede defeat. No cultivated bean, he concluded in a scientific paper, was immune.

"Those little scoundrels tormented me," Cardona recalls, underscoring the memory with a vivid stream of Spanish curses. "I came to hate them!"

A year later, a package of tiny, strange-looking beans appeared on Cardona's desk: They were ugly, blackish brown, trapezoidal, wild beans from Mexico.

"They didn't look like beans," Cardona remembers. "I was laughing at them." But, as a matter of routine, Cardona set them in front of the weevil and waited to see what happened. Nothing happened. The bean's secret armament proved to be a protein, detectable only under chemical analysis, that somehow repulsed the weevil. That protein could be transferred to its cultivated cousins—and was. Now the resistant beans are en route to Africa, a new weapon in the war against famine.

An American plant collector, Howard Scott Gentry, discovered the wild Mexican beans more than 20 years ago, during an expedition to the rugged hills of Guerrero. Exploring on muleback, Gentry spotted vines he had never seen before. He dismounted, gathered a few, labeled them, and forwarded the specimens to the USDA in Beltsville, Maryland. The beans were assigned a plant introduction number—P.I. 325690—and shipped to a plant introduction station in Pullman, Washington. There the beans sat on a shelf, unnoticed and unused, until—in a routine exchange of plant material—the USDA scientists in Pullman shipped a few specimens to their counterparts in Cali.

Gentry, meanwhile, went on with his life, oblivious to the wonders his discovery had wrought. On a visit to his laboratory at the Desert Botanical Garden in Phoenix, I had the immense pleasure of informing Gentry, 87, of the good deed his discovery had set in motion.

A smile spread across Gentry's face. "It makes me very happy that they are headed for Africa," he said, turning back to his plants.

Throughout history people have valued seeds, taking them as prized possessions when they left home. Rice made its way throughout Asia with traveling Buddhist monks. The Pilgrims carried sacks of peas, wheat, barley, and rye, among other seeds, on the *Mayflower*. African slaves often brought a handful of seeds with them to the New World, even if they had nothing else.

Like American music, language, or politics, American agriculture comes from all over. Consider a simple breakfast: Orange juice is squeezed from a fruit that originated in Southeast Asia; toast is made from a grain domesticated in the Near East; hash browns from an Andean tuber; coffee from a wild Ethiopian bush; peach preserves from China.

Trace the lineage far enough, and you learn that the turf at the golf course is Caribbean; the popcorn at the ballpark, Mexican; the Fourth of July watermelon, African; and the amber waves of grain in "America the Beautiful," probably Iraqi.

THE DANGER of importing plants, particularly from a center of diversity, is that they may carry diseases or pests that evolved with them over the centuries. It is for this reason that the borders of the U. S. and many other countries are protected by plant inspection stations. They are the first line of defense against silent invaders that could destroy the standing food supply.

"Are you carrying any plants?" queries an agricultural officer at Miami International Airport.

"No," I reply, handing over my documents. She considers my answer with suspicion, then directs me toward a sign that reads AGRICULTURE. There my luggage rolls through a scanning machine capable of detecting seeds, roots, and stems the way other machines reveal guns. I'm clean.

Deborah Baker, the inspection officer in charge, waves me through. "We deal with all kinds of people. Some try to smuggle endangered orchids. Others bring home a favorite house plant from abroad. Most don't realize how a few seeds in their pockets might introduce a disease."

I ponder how Thomas Jefferson, an incurable seed collector, would react to the fuss. Jefferson knew that America's future depended on new seeds for a viable and varied agriculture, and he encouraged his fellow citizens to import new plants.

"The greatest service which can be rendered any country is to add an useful plant to it's culture," he wrote. In fact, if the United States were forced to live off the plants originating on its own soil, the fare would be slim pickings indeed—sunflower seeds, pecans,

strawberries, cranberries, blueberries, and Jerusalem artichokes are among the most palatable items.

As if anticipating Jefferson's advice, Benjamin Franklin, who was serving a stint as Pennsylvania's emissary in England, sent new varieties of seeds to America. By 1827, U. S. consular officers had standing orders to ship home any promising plant they found abroad. In that era, of course, genes were unknown, and there was no concern over introduced diseases or, for that matter, today's baffling new threat to plants and genetic diversity—terrorism.

Maoist guerrillas who call themselves *Sendero Luminoso*, or Shining Path, have overrun a valley high in the Peruvian Andes where my fellow scientists maintain the World Potato Collection, a stockpile of more than 13,000 specimens gathered and cultivated in South America, where the potato originated. Our complacency that the terrorists would not harm their own national heritage was shattered when a busload of workers from the International Potato Center was intercepted by guerrillas in December 1988. One guard was killed. The workers were released, shaken but otherwise unharmed.

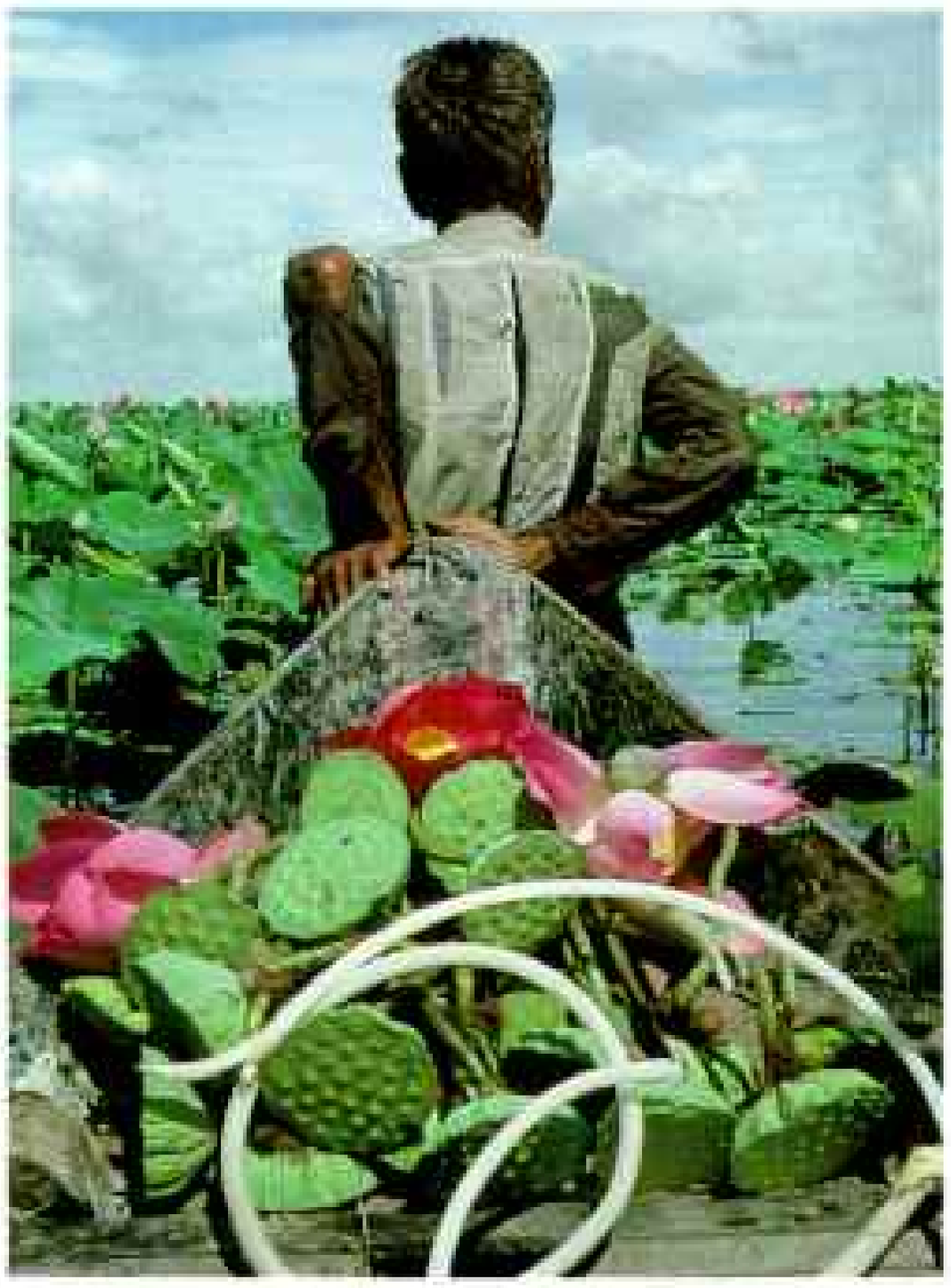
A year later three storage buildings at the experiment station were dynamited, forcing the evacuation of the scientific staff to Lima. Suddenly, after years of helping others, the potato center faces an adversary that takes aim upon humanity itself. How do scientists fight that threat?

"I've built this collection through revolutions and earthquakes," says Richard Sawyer, the pistol-packing director general of the potato center. "So I'm not about to kowtow to anybody."

Sawyer, a plain-spoken potato farmer who hails from Maine, has seen worse times. A prisoner of the Germans in World War II, he survived a death march by eating spuds. After that ordeal he became convinced that the plant that saved him could also save the world from hunger. To ensure a healthy potato supply for everyone, Sawyer founded the potato center more than 20 years ago.

Now Sawyer is preparing for what promises to be a protracted struggle. Saving seeds is no longer a matter of simple botanical technique, he tells us. To safeguard the potato collection, we pack samples in bags, stash seeds in airtight metal pouches, and insert plantlets in test tubes—all will be sent to safer regions of Peru and to other gene banks around the world.

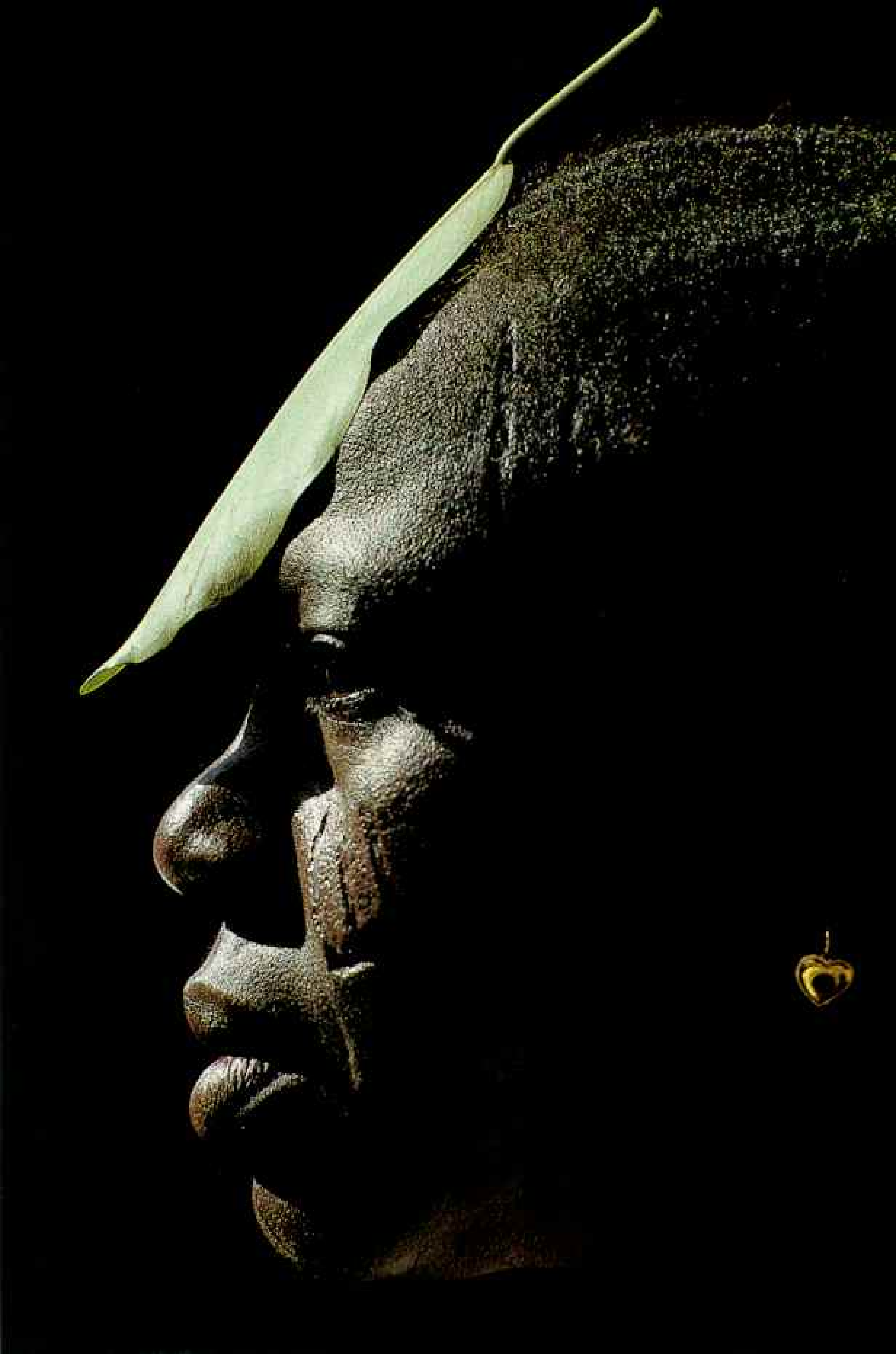
"Time is running out," says Carlos Ochoa, a Peruvian who has stalked wild spuds from North America to the tip of Tierra del Fuego. The specter of civil unrest weighs heavily on Ochoa, who sees his life's work imperiled by forces few understand.



By the boatful, Chen Nhim harvests lotus outside Phnom Penh. Cambodians brew lotus-seed tea to reduce fever. Boiled, its dried flowers help induce labor in pregnant women.

Nigerians stick leaves from a "headache plant" to their aching foreheads (right). Since only 2 percent of the world's plants have been scientifically analyzed, folk healing may help identify species useful in producing new drugs.

ASK ANY AMERICAN schoolchild where the country's most valuable national treasure is stored, and the answer will surely be Fort Knox. But the greatest wealth may be tucked away at a USDA facility on the campus of Colorado State University at Fort Collins, Colorado. Here, in an unassuming two-story building, 228,000 samples of seeds containing trillions of genes are cached in the National Seed Storage Laboratory, the central reserve bank of germ plasm in the U. S. The storage vaults



***Ultracold safety deposit:** A technician at the National Seed Storage Laboratory in Colorado closes a tank that stores seeds in the vapor of liquid nitrogen. While periodic planting of seeds helps maintain their viability, cryogenic storage may preserve some seeds for centuries.*

are protected by ultramodern security systems—microwave scanners and infrared sensing devices. Recently Congress authorized twelve million dollars to expand this national gene bank.

"No one knows when a pest will mutate and attack our crops," says Steve Eberhart, director of the laboratory. "Most Americans don't know how close we came to being a food importing nation during the 1970 southern corn blight. Now if we hear that a new corn blight has attacked China, our scientists can prepare to fight it by the time it gets here."

Dr. Eberhart leads me through rooms where his colleagues are testing seeds for viability and preparing them for storage. Some 3,000 seeds of each plant are kept on hand for eventual distribution to any plant breeder who needs them.

Some of these seeds can be kept viable for decades, preserved in stainless steel cryovats in the frigid vapor of liquid nitrogen kept at minus 196°C (above). From Washington, D. C., to Hawaii, scientists in 19 germ-plasm research stations have kept alive seeds and cuttings from thousands of plants, some of which arrived in the New World more than a hundred years ago.

"The world is different today from what it was in the age of the great plant hunters," says Dr. Eberhart. "Before, we could go to a plant's center of origin and find what we needed. Today many varieties in our collections are extinct in their natural habitats. And many governments have closed their borders to collecting."

WHO OWNS the genetic resources of a plant? Is germ plasm a natural resource—like oil or timber—to be exploited, controlled, or sold? Or is it the common property of all humankind? Like automobiles or toasters, some genetically engineered crops can be

"Nobody will continue this work," reflects 85-year-old Ben Talachy of Española, New Mexico, who stores seeds the old way—in airtight jars. Small-scale gardeners keep alive many land races, whose natural resistance to pests and disease can be bred into modern varieties.

patented. This means that genetic material taken from land races and wild species could make large profits for seed companies.

"The risk with plant patent laws," explains Canadian Pat Roy Mooney, a farmers-rights activist with the Rural Advancement Foundation International, "is that the seed companies obtain monopoly profits, whereas the farmers and countries that donated the genes receive nothing.

"For example, among tens of thousands of structural genes in a corn variety nurtured over the centuries by farmers, only a handful generally are altered by commercial breeders to produce a new hybrid. Does that give the breeder a right to patent it and reap the profits—profits sometimes earned by selling the hybrid back to the country where the genes originated?"

Mooney argues that commercial seed companies should be required to contribute a fraction of their profits to an international fund that would subsidize traditional farmers.

Back in the U. S., I got another view from Donald Duvick, then senior vice president for research at Pioneer Hi-Bred International, Inc., a company with annual sales of 870 million dollars.

"Over 90 percent of Pioneer's seed is sold in the U. S., Canada, and Europe," says Duvick. "Only a small fraction goes to poor farmers in developing countries." According to Duvick, it has taken a huge investment—more than ten years of time and tens of millions of dollars—to develop some of the successful new varieties.

"It's a bit like crossing a house cat with a wildcat," says Duvick. "You don't automatically get a big docile pussycat. What you get is a lot of wildness that you probably don't want lying on your sofa."

Attempts to control the flow of plant wealth are nothing new. During the spice wars of the 17th and 18th centuries the Dutch uprooted

Mashing potatoes with her feet, a woman in Peru's highlands follows an ancient Andean practice of forcing water from native tubers. She then leaves the potatoes in the field to dry. This staple, called chuño, is usually made using bitter, traditional

land-race varieties with low water content. Once dry, chuño can be stored for years. By continuing to cultivate thousands of old potato varieties, Peruvian farmers serve as natural guardians of plant diversity.

groves of nutmeg and clove trees—to keep prices high and to cut their competitors out of the market. And a sticky disagreement persists over rubber trees the British transplanted from Brazil in 1876, transforming millions of acres in their Asian colonies into lucrative rubber plantations.

DESPITE the verbal bombshells over seed sovereignty, I found an astonishing degree of cooperation among scientists and governments. In 1988 the USDA distributed 30,000 samples of seeds and cuttings to some 80 countries. If war or famine destroys native crops, international seed banks can replace them. Valuable potato varieties were lost to Bolivia after workers at the Belén seed bank rose up in protest over low wages and ate the national collection. The International Potato Center sent duplicates of the most important varieties to replenish the supply.

Many of Cambodia's indigenous food plants were lost in the Khmer Rouge reign of terror in the late 1970s. When that strife finally subsided, the International Rice Research Institute dipped into its reserves, returning more than 400 rice varieties to Cambodia, so the country could make a new start.

The spirit of reciprocity has been captured in a traditional Asian saying: "You cannot pick up a grain of rice with one finger alone."

Rice production in the Philippines has doubled since 1966 following the green revolution, in which careful crossbreeding produced high-yielding "miracle seeds." Though largely self-sufficient since 1977, the country had to import rice in 1990 (above) because of drought and typhoons. Despite advances, rapid population growth and rural poverty have forced many families, like this one in a Manila slum, from field to city in search of work.

MANY HANDS ARE AT WORK in the U. S., where local seed hunters search old fields, rocky hillsides, and abandoned farms to identify and save long-forgotten seeds. Often laymen, these enthusiastic collectors exchange information and germ plasm, hoping their efforts will provide a needed dose of variety to America's kitchen gardens and small-scale farms.

The largest North American seed-gathering network is Seed Savers Exchange, founded and run by Diane and Kent Whealy from their 140-acre farm in the Amish country near Decorah, Iowa. The inspiration came in 1975, when Diane's grandfather, Baptist John Ott, gave them seeds from Bavaria that her family had brought to this country four generations before.

The Whealys—realizing that such "heirloom" seeds were being lost all over the United States—took up the challenge of developing a grass roots organization to save and swap such seeds. In the past 15 years the network has grown from a handful of people to some 5,000 backyard gardeners who maintain more than 12,000 heirloom fruit and vegetable varieties.

Today the heirloom gardening movement is spilling over to living history farms, where modern crops are being replaced by those of the appropriate era. These historical varieties

are becoming as much a part of the farms as heirloom reapers or grinding mills.

At Thomas Jefferson's Monticello outside Charlottesville, Virginia, I find John Fitzpatrick, director of the Center for Historic Plants. "We have over 500,000 visitors a year," he told me. "And we're finding that more and more they prefer to take home as a souvenir a plant Jefferson himself once tended instead of a dust-catching knickknack."

STORING SEEDS as heirlooms is better than letting them vanish, but many plants are best preserved in their original habitats.

"Most countries in Asia have centers for the conservation of art, music, and religion, but only a few have them for seeds," says Gerry Jayawardene, the proud head of Sri Lanka's new Plant Genetic Resources Centre. A few other places offer similar encouragement. In Mexico's Sierra de Manantlán Biosphere Reserve I found a small patch of *teosinte*, the closest wild relative of maize, growing in an area defended by park rangers fending off illegal herders.

But in Texas I discovered miles of pavement and screeching jets where valuable stands of wild grapes once flourished. Now the land is covered by the Dallas-Fort Worth International Airport. Perhaps the loss of a few grapes is a small price to pay for progress, until one thinks back to the 19th century, when an American louse, *Phylloxera*, brought the European wine industry to its knees.

Accidentally introduced into Europe in the 1860s, the louse ravaged thousands of vineyards before a solution was found. Since the American louse attacked European roots, someone finally hit upon the idea of grafting the European vines to American rootstock. Perhaps the New World roots had evolved a genetic resistance to the pest? The plan worked. The American roots kept the louse at bay, and the grateful Europeans were soon drinking wine again. But if a new breed of phylloxera should appear, to whom would the world turn today?

Rock stars and activists decry the loss of rain forests, and an admiring public leaps to the defense of pandas and snow leopards. But who speaks for a weedlike potato too bitter to eat or scraggly rice that spoils the pot?

These thoughts ran through my mind the last time I visited Luther Burbank's Gold Ridge Farm in Sebastopol, California, and saw the three remaining acres of the plant wizard's spread in a state of disrepair. Overgrown with weeds and brush, sandwiched between a housing project called Burbank Orchards and a cemetery, the old farm had been threatened by development. It seemed a fitting symbol of our society's indifference to genetic diversity. I was happy to learn later that the development had been abandoned after community organizations complained, and the farm was being revived.

From 1885 until his death in 1926, Burbank conducted his pioneering experiments with plants here. I saw his arbor of seedless grapes, his hardy Chinese-hybrid orange trees. Burbank bred hundreds of new plants, among them improved varieties of squash, plums, tomatoes, lilies, poppies, and roses. Yet he never obtained a patent. Not until four years after his death did Congress pass a plant patent act, which protects certain new varieties.

"You can almost see the old man working out there, pruning that old Royal walnut he planted in 1885," says Bob Hornback, a local horticultural historian who, working with the Western Sonoma County Historical Society, is among those helping to restore Gold Ridge to its former glory.

"THE SCIENTISTS BLAME the loggers. Loggers blame the settlers. Settlers blame the government. All of them are full of contradictions. Too many people who want too much."

The speaker, Achmad Jahja Kostermans, talks rapidly as he pads barefooted through the botanical garden in Bogor, Indonesia. Though he is 84, I have trouble keeping pace with Professor Kostermans, the greatest living botanist of the Asian tropical rain forest. The disappearance of food crops, he says, is part of a larger problem. The genetic diversity of the entire plant community is eroding, and nowhere is the rate of destruction greater than in parts of Southeast Asia.

"The chain saw sounds like an angry beast eating up the forest—*rrrrgh . . . rrrghhhh!!!*" Kostermans cries, mimicking the sound.

"Protected areas!" Kostermans laughs. "They exist only on paper in poor countries. Once I found a new tree species in a protected area in western Java. Only one of its kind, and loggers cut it down in a week."

This aged botanist appreciates the practical

Sowing seeds of peace, Tom Hargrove (below) returns to Vietnam's Mekong River Delta. When he served as a U. S. military adviser in 1969, Hargrove brought "miracle rice" to local farmers and thus was spared by the Viet Cong. Now he brings a new variety developed by the International Rice Research Institute in the Philippines. It was bred from a disease-resistant land race abandoned by Vietnamese farmers for the strains Hargrove and others introduced in the 1960s. Today half of Vietnam's fields, like this seedling bed (above), are planted in improved varieties.

Scratching a living in Nigeria's dry northern region, Abubakar Ladan plants seeds in soil turned to dust. The future of farming here may depend on finding drought-resistant land races of sorghum and millet—and improving their yields. But how long can the hungry wait? Throngs of schoolchildren in Oyo, Nigeria, give voice to the growing demand for food.

value of tropical forests. They saved his life when he was a prisoner of the Japanese in World War II. Kostermans, conscripted to help build the bridge over the River Kwai, survived on forest plants, using them for food and medicine. Of the 20,000 other prisoners, 18,000 died. When the war ended, a grateful Kostermans dedicated his life to the study and preservation of natural flora. He has also adopted students, so that others can continue his work.

He points to one of his protégés, a young Frenchman named Jean Marie Bompard, a researcher for the International Board for Plant Genetic Resources. "I am the past," says Kostermans, with an uncharacteristic softness in his voice. "He is the future."

Bompard's future will be busy. It is said that Kostermans has gathered enough plant material to keep another 50 scientists working for 50 years, just cataloging and testing it. Somewhere in Kostermans' collection may be the wonder seed of tomorrow or the raw material for a miracle drug that will cure AIDS—not so farfetched when you consider that about 25 percent of U. S. prescription drugs come from plants.

More than even life-saving drugs or food, plants and seeds carry a powerful symbolism in many cultures. From the Hopi of Arizona, for example, I learn that seeds represent a sacred link to their past, handed down through

ceremonies from generation to generation. To them, each seed represents hope for the future as well.

MY JOURNEY ENDED in southeastern Turkey, somewhere near the Garden of Eden. In this mystical land, bounded by the Tigris and Euphrates Rivers, Adam was doomed to work "accursed" soils that yielded the "brambles and thistles" of Genesis.

Here too, according to Sumerian epics, the legendary Utnapishtim landed his ark after a monstrous flood, finding a home for "the seed of all living things." This was one of several far-flung areas where prehistoric humans made their first bold experiments with wild plants, sowing seeds to grow their own food.

Even though the forests have vanished and the surrounding hills are denuded, the grain bursts forth with the spring, as in all the seasons before. I found scattered stands of wild wheat and barley.

But the cycle may end soon, when the valley is swallowed by another flood. If all goes as planned, Turkey will build 21 dams on the Tigris and Euphrates by the early 21st century. Perhaps that is a fitting symmetry. The land between the rivers will be green again, an irrigated area the size of the Netherlands and Belgium combined. But the Garden of Eden will be lost forever.

Cradled by her mother, a young girl near death from malnutrition receives syringefuls of soy milk at the Kersey Home for Children in Ogbomosho, Nigeria. Crossbreeding soybean varieties from Brazil and Indonesia produced this high-protein food,

which has saved many lives. Hunger already afflicts one-fifth of earth's five billion people. With population expected to double by 2070, food production must likewise increase. Now, as ever, the seed of humanity depends upon the fruits of the field. □

Text and photographs by GALEN ROWELL

FALCON RESCUE

Strafed by a parent, a biologist eases down a Big Sur cliff to collect peregrine eggs for incubation. Despite the raptor's comeback, California's coastal peregrines remain endangered by pesticides.

MISTY DAWN ARRIVED as we drove along the Big Sur coast of California, and Lee Aulman gestured out the window of his road-weary pickup truck. "Perfect peregrine habitat," he said, "lots of cliffs, lots of birds to eat, and lots of wild, open space."

Waves crashed against a succession of rugged headlands that faded into blue infinity as they merged with the ocean and the sky. I could see only one sign of human presence, etched like a goat path into the cliffs: the narrow road we were driving on.

"Don't let the pristine look fool you," added Aulman, a biologist from the Santa Cruz Predatory Bird Research Group. "This is the sixth year I've come here to collect peregrine eggs before they break. The shells are thin because of the pesticide DDT."

Miles later we pulled off the road at a small meadow, where we startled a group of picnickers by securing ropes to a tree and stepping off backward into space. All signs of humanity vanished as we entered a shadowy realm floored by the surf and roofed by the sky.

Rescuing weak eggs before they break, Lee Aulman of the Santa Cruz Predatory Bird Research Group packs them for the journey to the lab. He leaves two dummy eggs designed to maintain the parents' incubation behavior until he returns with captive-hatched chicks.

Our mission was to "augment" a nest. We would gather four wild eggs made thin and fragile by contamination and replace them with dummy eggs made of a special plastic, carefully crafted to have the same appearance, weight, and heat-exchange characteristics as the real eggs. We'd get the wild eggs quickly into Lee's handmade portable incubator, wired to the cigarette lighter of his truck, then on to an incubator at the University of California in Santa Cruz. We were buying time until Lee could return a few weeks later with foster chicks hatched in captivity, to place them in the nest. Adult peregrines will accept the chicks, as long as their incubation instincts have been maintained by dummy eggs.

When our ropes dangled in view of the nest ledge, the female peregrine shot out from the cliff and circled us in a wild aerobatic display of loops and rolls. As Lee neared the nest, I watched the bird target him, dive for his head like a heat-seeking missile, and pull out at the last moment, close enough to part his hair. The air was filled with the machine-gun-like *cack-cack-cack* of the bird.

The adult peregrine falcon *(Falco peregrinus)* is among the world's fastest and fiercest birds, a powerful crow-size raptor that catches dinner on the wing or kills prey by "stooping" in precise vertical dives clocked at more than 200 miles an hour.

Lee has devoted the past decade to saving California's peregrines, and on a shoestring budget. His voice cracks with emotion as he rattles off an alphabet soup of toxics—DDE, HCB,

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PCB, and, now, dioxin—found in high levels in Big Sur birds.

"When I started falcon work," he said, "we thought only about eggshell thinning caused by DDE—metabolized DDT. Now we're seeing a disturbing increase in embryo deaths that we can't explain. We've got a real witches' brew of chemicals with combined effects that have never been studied. Sixty percent of the eggs we collected in 1989 couldn't be hatched. It's sad to see these magnificent creatures aggressively defending a clutch of dead eggs."

Although augmenting is the most reliable way to introduce captive-hatched falcons into the wild, two other methods are used where no peregrine nests are active: Cross-fostering involves placing peregrine chicks into more common prairie falcon nests. Prairie falcons have not become endangered, because they eat mostly rodents, which have much lower toxic levels than birds. Prairie parents raise foster peregrine chicks as their own.

Secondly, "hacking" is a valuable tool for reintroducing peregrines into regions without nesting falcons, although it may have a lower success rate. Chicks are placed in a special box on a high cliff or tower a week before they are ready to fly. They receive round-the-clock management of food, water, and protection from predators by human attendants who act as surrogate parents while keeping out of sight.

Exhausted from pecking free of its shell, a 36-hour ordeal, a chick rests in the Santa Cruz lab (top). Until their eyes focus after one week, chicks can be fed with tweezers without imprinting on humans. Handlers mimic the adult peregrine's ee-chup call during feedings.

RIDING AS A PASSENGER on Big Sur's only highway brought back memories of my first visit during World War II. My mother and father saved gas-rationing stamps to take me to their favorite wild coast. At bedtime they read to me the disturbingly powerful verse of the Big Sur poet Robinson Jeffers, who in 1925 envisioned a "coast crying out for tragedy like all beautiful places."

For several decades Jeffers's dire predictions seemed to have been averted. A freeway plan was defeated in 1962, and a statewide coastal preservation initiative was passed in 1972. During the same period, however, Big Sur's peregrines quietly and inexplicably vanished. In 1970, when the bird was first listed as endangered, a statewide survey turned up just two nesting pairs, down from some 300 two decades earlier.

The peregrine's rapid, worldwide population crash was abrupt and unprecedented; as late as the 1960s, it was described as "the world's most successful flying bird" because of its stable, near-global population. After the peregrine's decline was linked to extremely high levels of toxic contamination, the bird became a different symbol. Tom J. Cade, who pioneered large-scale captive breeding of peregrines at Cornell University in the early 1970s, calls the bird "a unique biological monitor of the quality of the

Oblivious to the hand that feeds it, a two-week-old chick readily accepts meat from a puppet fashioned after an adult peregrine (above).

Returning to the Big Sur nest—a depression scraped into a ledge—Lee Aulman replaces dummy eggs with two chicks (upper right).

In nearly all such "augmented" nests, the adults accept the chicks, as does this parent in another nest (facing page).

world's environments." It is a veritable mine canary that is telling us, by dying before our eyes, that the planet is being poisoned.

Peregrines, like humans, live at the top of their food chain. Some of the birds they pluck from the sky have eaten other birds or fish that have eaten smaller organisms that have been exposed to toxics. These fat-soluble chemicals greatly increase in concentrations as they move up the chain. Dozens of man-made chemicals, many of them deadly to birds and mammals in parts per million, or even trillion, have been found in the fatty tissue and eggs of peregrines.

By the late sixties the pesticide DDT had been isolated as the major culprit in eggshell thinning, which was causing massive reproductive failures, not only in peregrine falcons but also in bald eagles, brown pelicans, and ospreys. The California coast was hit unusually hard because for more than a decade the Montrose Chemical Company dumped an average of 600 pounds of DDT a day into southern California's coastal waters. In 1972 the use of DDT was virtually banned in the United States.

By the end of the seventies, falcons were on the increase, and some scientists began to think the story was over. By the mid-1980s both scientists and politicians began to urge that the peregrine be among the first endangered species to become officially "saved" by removing it from the federal list.

In the late eighties, however, data on peregrines reintroduced near the California coast indicated much higher levels of toxic chemicals and lower levels of reproduction than predicted. At Big Sur, at Yosemite National Park, and at other wild and seemingly pristine areas, peregrines were still in trouble.

But why? At Yosemite, wildlife biologist Steve Thompson told me. "Our park peregrines prey on white-throated swifts and other birds that feed on insects contaminated with residual DDT. Moreover, many of these birds winter in Latin America. DDT is still used there indiscriminately. City peregrines, on the other hand, eat mainly pigeons that don't have much DDT."

The falcon's spotty recovery

The wide-ranging peregrine nearly died out in North America after the agricultural pesticide DDT was introduced in 1946. Stored as DDE in the fat tissue of animals that consume it, DDT becomes ever more concentrated along the food chain, and peregrines, like humans, sit atop their chain.

Peregrine reproduction rates plummeted; by 1969 extinction loomed. After the United States restricted DDT use in 1972, the falcon's chances improved. Though still listed as endangered continent-wide, the American peregrine has been reestablished in many areas, leading some biologists to recommend that the bird be listed selectively, by region. Spots outside the pre-1940 range mark areas where young falcons have been introduced.

IN LOS ANGELES peregrines nest on skyscraper ledges, the urban equivalents of sea cliffs. Some of these too are augmented. With Brian Walton, coordinator of the Santa Cruz Predatory Bird Research Group, I helped deliver a 14-day-old chick to its urban nest outside the 39th floor of the Union Bank building.

"Some people assume that we put adult falcons on these buildings," Walton told me. "That's not the case. We've introduced young birds into the area, but they've chosen their own nest sites."

But some roller pigeon breeders in the Los Angeles area have strong reason to be upset over the reintroduction of peregrines, their birds' deadliest enemy, complete with federal protection and upbeat media coverage. The chick placed in the Union Bank nest in 1989 was later found dead on the street with a bullet wound.

Said one outspoken man who raises prize roller pigeons, "I know for a fact that 14 peregrines have been shot in the area; I've seen their leg bands. A good pair of these pigeons is worth $1,500. We'll train 20 birds by having them circle at least a thousand feet

above the ground. They're bred to spontaneously somersault in a trancelike state and recover after a few revolutions. If a peregrine spots them, it's all over in a few seconds. We've tried everything to coexist with the falcon people, to no avail. What would Walton or the feds do if our pigeons were out there killing their peregrines?"

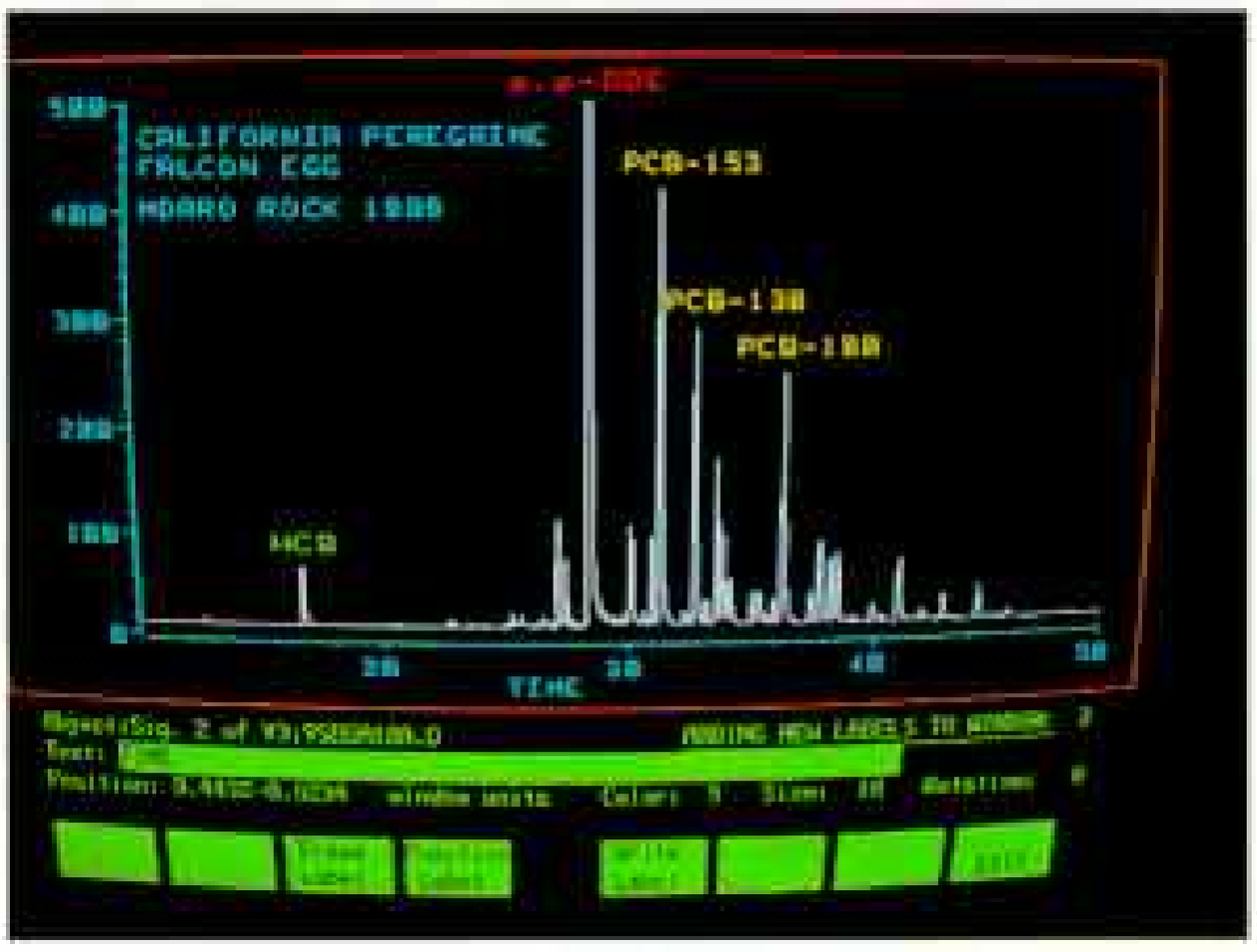
BIRDS from the northern interior normally carry fewer toxics than coastal birds, and at first biologists rejoiced at what appeared to be a healthy breeding population—59 of the state's 106 known pairs in 1990. But as birds age, their toxic levels often increase. Data from the interior indicate eggshells 17 percent thinner than average, precisely the threshold found by scientists for the long-term decline of an unmanaged population.

Even incubator hatching is on a downward trend. All four eggs Lee Aulman and I collected at Big Sur failed to hatch. Lee's colleagues sent them for analysis to the Joseph M. Long Marine Laboratory on the outskirts of Santa Cruz. The laboratory houses standard samples of highly toxic compounds to calibrate its machines, but, as toxicologist Wally Jarman told me when I went to visit, "The extracts we take from Big Sur peregrine eggs are among the most dangerous toxics we have here. We wear gloves and glasses to handle them.

"We're looking for contamination from all kinds of toxic organochlorine compounds, such as DDE or PCBs," he explained. "We can give you names and levels for most of them, but we know little about their effects on peregrines because toxic effects vary widely from species to species, and nobody has directly tested peregrines in a lab. Today's DDE levels in coastal peregrines remain extremely high, but since they haven't really increased since 1978, I'm looking elsewhere for the cause of increased embryo mortality."

In 1989 Jarman extended his search to dioxins, one of the deadliest of man-made poisons and a by-product of Agent Orange, the infamous Vietnam defoliant. Just five parts per trillion can cause a tumor in a rat. Jarman worked closely with scientist Bob Stephens of the California Department of Health Services Hazardous Materials Laboratory in Berkeley.

"The first results knocked my socks off," Stephens told me on the phone, "five to ten times the amount of dioxins that will kill a chicken embryo in peregrine eggs. But then the effects on species vary; a turkey embryo can survive 20 times the lethal level for chickens. The known ways in which dioxins affect other species are staggering: They're carcinogenic and mutagenic with major effects on hormonal and enzyme systems. And yet we can't make a firm statement about the effects of dioxins on peregrine falcons; tests



Fatal fingerprint, a chromatogram (above) reveals spikes of industrial chemicals as well as DDE that have led to lower reproductive rates in falcons. Eggshell measurements confirm severe thinning.

simply haven't been done. And evidence for their effect on human health is inconclusive and highly controversial."

WERE THERE BROADER IMPLICATIONS? I invited Stephens to join me on a trail run after learning that we had both finished the Big Sur International Marathon the same year in the same minute. We discovered that we shared emotions for peregrines and the coast far beyond our work.

In a drizzle at mile three, Stephens broadened the topic: "You're asking how dioxins directly affect peregrines, while my work relates to the human exposure issue. They're not entirely separate. We're both bioaccumulators at the top of our respective food chains. We know that human milk tested in several countries has 25 to 100 times as much dioxin as cow's milk. We know that birds in places like Big Sur have high levels. So we may have a dioxin problem at background levels far below what we thought were significant. Acceptable dioxin levels for public health may be a hundred times lower than levels the government has been considering."

Almost 700 peregrines have been released into the wild by the Santa Cruz group since 1977, and the state population is rapidly approaching 120 breeding pairs—the point at which the federal government can downlist the species to "threatened."

As Brian Walton says, "We've done our job, but the population is not stable. And now we're scheduled to stop augmenting birds after 1992." Many biologists feel that downlisting peregrines could doom the state's entire coastal population.

A new team of peregrine biologists, appointed by the U. S. Fish and Wildlife Service, is considering sweeping changes that may be enacted within two years. Says team leader James Enderson, "In much of the American West, the peregrine has increased rapidly, reproduces normally, and is no longer 'in danger of extinction'—the definition of endangered.

"We're suggesting that the bird be listed on a region-by-region basis, like the grizzly bear. We may conclude that the bird is still endangered along the Pacific coast and on the northern prairie, threatened in some interior regions, and has recovered in the Southwest."

After five months of research I am left with an intense feeling of the importance of the peregrine falcon as a monitor of global health—the mine canary for mother earth. □

Wary of nest attendant Mike Clark, a peregrine eyes the chick just placed in its nest on a ledge 39 floors up the Union Bank building in Los Angeles.

Talisman of ferocity, a peregrine climbs high into the city's skies ready to dive at more than 200 miles an hour. Yet its pinions cannot return it safely from the borderlands of extinction. Only its friend—and enemy—can do that.

Thundering past festival crowds in Arroyo de la Luz, horsemen ride with the

CRADLE OF EXTREM

By THOMAS J. ABERCROMBIE NATIONAL GEOGRAPHIC SENIOR WRITER

confidence of conquistadores who left this region to claim the New World for Spain.

CONQUERORS

ADURA

Photographs by BRUNO BARBEY MAGNUM

THE CRACKLE of the campfire coaxes me out of my bivouac, dark and damp as the grave. Under icy stars I shiver into boots and crunch through frosty thistles to the circle of dusty *vaqueros* passing a charred coffeepot around the flames.

"*Mal día*," mumbles Quico —foreman Juan Francisco Rollán—measuring the chill mists with reddened eyes. "Lousy day." He tips a splash of brandy into our cups to brace us for it. The devil's brew calms my rattling teeth. "Just after midnight a dozen cows broke out of the corral. We chased them, barefoot, all the way to the river.

"An hour ago the new calf died. All night I gave her vitamin injections. She died anyway," he says, slowly shaking his head.

El Pequeño, "the little one," arrives with a bloody knife and a large square of the calf's hide.

"A decoy," Quico explains, "to carry with us. The mother will follow the smell. Otherwise we'd never get her to move."

And move we must. As gravelly voiced El Pequeño rouses the animals, we begin another day in the ancient annual rhythm of transhumance—the herding of livestock with the seasons—across those harsh tablelands of western Spain known through the centuries as Extremadura.

On horseback for 45 of his 57 years, Quico and his four cowhands were driving nearly 400 head of valuable breeding stock from the approaching snows of the Sierra de Gredos to warmer pastures near Badajoz for the winter. In spring they would retrace the trail.

Spending raw, chilly weeks in the saddle with these vaqueros and roaming this grudging land alone in the blazing summer, I learned quickly that Extremadura lives up to its name—from the Latin "tough to the extreme." Or, as Quico put it, "Three months of winter, nine of hell!"

Shouldered against Portugal, comprising the provinces of Cáceres and Badajoz (one of the poorest in Spain), Extremadura in 1981 was declared an autonomous self-governing region with only loose ties to Madrid. And indeed it seems a far place from the bustling Spanish capital.

This stony, wind-scoured soil for centuries has bred hardy, independent men like Quico, and they wrought a rich history. During Christian Spain's nearly 800-year battle with the Moors, land-poor Extremadura sent its surplus sons to war. From here zealous soldier-monks joined Spanish knights to drive the last Muslim ruler from Spain in 1492; in that same year Christopher Columbus planted Spain's flag in the New World.

Extremadura was armed and ready for the new adventure. Its swords flashed through the early history of the Americas, wielded by men like Pizarro, Cortés, Balboa, de Soto, Orellana. They studded the new continent with namesakes of their homeland: Trujillo . . . Guadalupe . . . Mérida . . . Albuquerque . . . Medellín. Today Extremeños rightly call their land the Cradle of the Conquistadores.

"*¡Hay! ¡Hay! ¡Vaca! ¡Vaca!*" El Pequeño hoisted a red flag high on his staff to halt traffic along the busy Madrid-Lisbon highway as Quico and I worked back and forth, moving the herd down the asphalt. Modern Spain encroaches more and more on its *cañadas*, or old livestock trails. We detoured around new towns and shared bridges with cars and giant trucks—some carrying bleating sheep making the transhumance in style. At Almaraz the trail led past a nuclear power plant.

South of Miravete Pass we forded a stream beside crumbling Roman arches and moved into the warm, deserted plain. We paused to let the cattle graze, and under a leafy chestnut, to the scherzo of a lark, we lunched on slabs of air-dried ham, our thirst slaked with cool squirts from the wineskins.

In the last long shadows of afternoon we unsaddled the horses under the twin towers of Doña Catalina ranch. At the crossroads of two major cañadas, the palatial ranch house of the Count of Campos de Orellana for generations has offered passing herdsmen the hospitality of hot meals and a bunkhouse.

The present count, Miguel Granda Losada, invited me to spend a day.

"SOME OF MY FONDEST boyhood memories are of the wild tales spun by the vaqueros around our kitchen fire," Don Miguel told me. "Sadly, the days of the drovers are numbered. More and more animals now move by truck and train. As Spain draws closer to Europe, we have to modernize to compete."

"You can't do something like this alone," says one woman, stuffing morcilla de vientre, or blood sausage, with practiced hands. Once the weather turns chill, each family in Escurial invites neighbors to help turn an acorn-fattened pig into such traditional specialties.

Avenue of an empire's legions, a Roman road carries cattle departing summer fields in the Sierra de Gredos for lowland grass quickened by autumn rains. Livestock have been making this 250-mile migration since the 13th century. A traffic sign reminds highway drivers to yield.

A working aristocrat, Don Miguel holds a doctorate in agronomy from the University of Madrid. "It is the long, dry summers, the thin, rocky soil that keep Extremadura poor," he said as we bounded across his 10,000-acre spread in his dusty sedan. "To succeed here, you have to work at it, to plan for hard times. First we fenced the pastureland and then treated the soil with superphosphates. We built barns and silos and stocked them with hay and feed grains.

SAM ABELL

"Water is the critical factor," Don Miguel continued as we splashed through a brook. "During the drought in 1978 we had to haul in water by tank truck—at ten cents a gallon! Our herds—7,000 merino sheep and some 500 cattle—nearly drank us into the poorhouse.

"Since then we have dammed up our streams with 60 small reservoirs to see us through the long summers. We now run about two sheep to the acre, twice the local average."

Back at the rambling manor house, lunch clung deliciously to custom: sausage of wild boar, a *torta* of fresh La Serena cheese, and ruby red vintage Rioja. After cigars Don Miguel assigned me a quiet room in the west wing to pass the siesta.

Unlike Don Miguel's productive ranch, some of the region's vast ranches, or *fincas*, are the property of absentee landlords who visit only for a few weeks of hunting. Extremadura's socialist government continues to challenge these landowners with statutes calling for *expropiación* and land reform.

I reached Finca Valero, a 14-square-mile estate bordering Monfragüe Natural Park, by following a convoy of union farm workers and their families. They had come to "occupy" the ranch for a day to demonstrate solidarity with the government programs. Private guards brandishing carbines held them off at Valero's main gate.

"This ranch is as big as a

city," a demonstrator shouted. "How many earn a living off it? A half dozen *guardas* and gamekeepers!"

"We are *cabreados,*" another joined in—"fed up."

The owners have fought expropriation, arguing that the unspoiled acres complement the nearby park. Besides, say their lawyers, the rough ranchland, broken into small plots, would never produce good crops.

"At least we would have grass to eat," a leather-faced farmer shrugged. "That is more than we have now."

In centrally located Mérida, the capital of the Extremadura autonomous region, I met Juan Carlos Rodríguez Ibarra, president of the region's council, the Junta de Extremadura.

"Finca Valero is an important test case: landless peasants versus the outside landlords who have long held down Extremadura's economy," President Rodríguez told me. "Finca Valero's landlords are rich and well connected; Spanish kings have often hunted boar and partridge there.

"Almost one-third of the region's work force depends on agriculture—compared with less than 3 percent in, say, Britain or the United States," he continued. "Yet there is little land available to the small farmer. Some 850,000 people, nearly half of Extremadura's population, have left the region to find work," he said. "For us, land reform is critical.

"At the same time, we are helping finance small industry and co-ops to process and market our goods—meat, tobacco, cork," he said. "Extremadura should be exporting products, not people."

ALTHOUGH MÉRIDA has been the region's seat of government for only a decade, here on the Río Guadiana the Romans founded a show capital in about 25 B.C. to rule their lands in Spain and Portugal. They embellished it with temples and mansions that endure today, forming, many say, the best muster of Roman architecture in Spain.

The Roman theater, one of the finest surviving anywhere, is Mérida's pride. Each summer its 6,000 seats fill for a month-long drama festival.

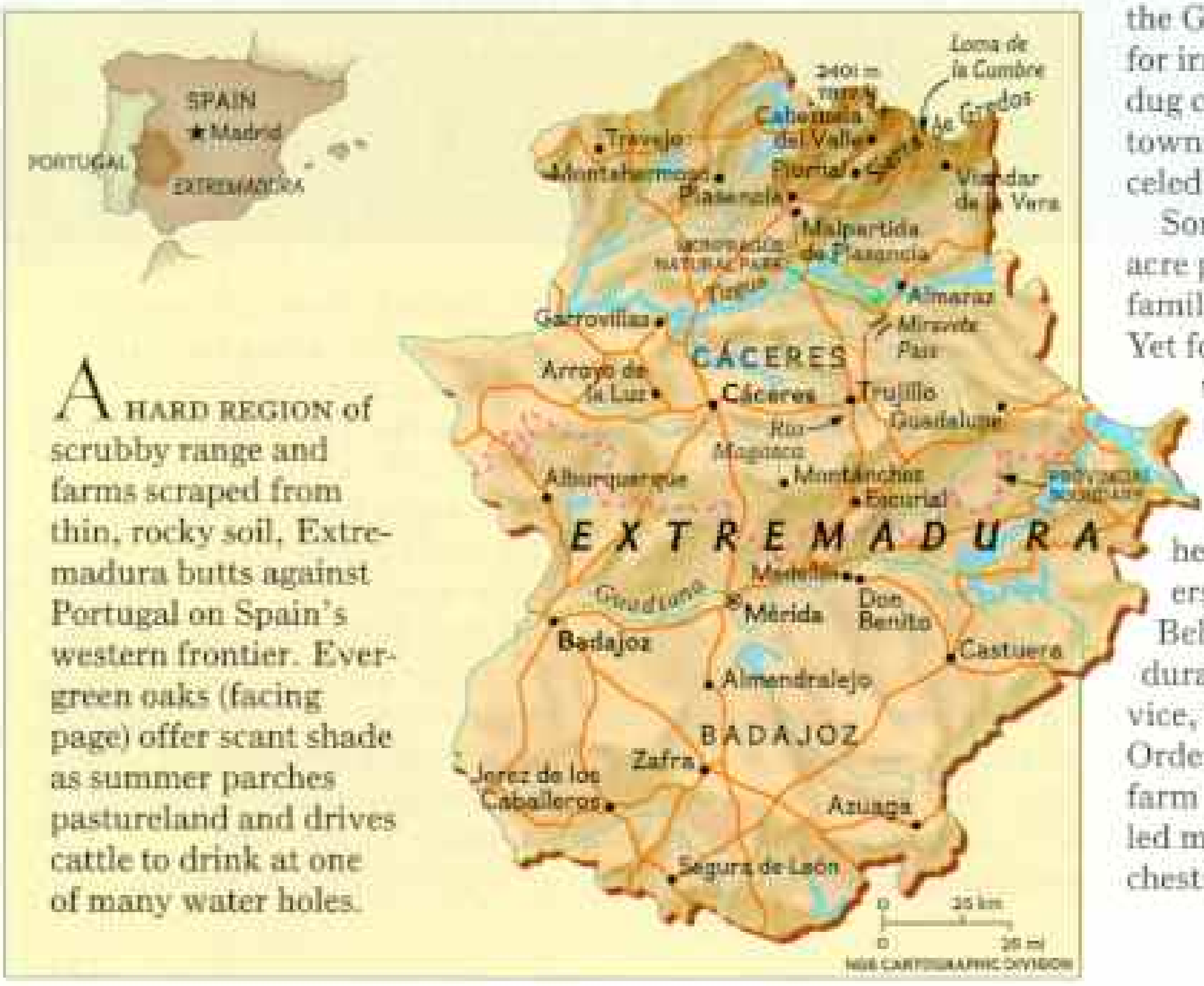
On a balmy July evening I rented a cushion and climbed to my granite seat high in the semicircle for a Spanish National Ballet performance of *Los Tarantos*, a flamenco melodrama sung and danced to soul-piercing Gypsy guitars. Its plot is as old as tragedy itself: two lovers sacrificed to family feuds—a tale of roses and sharp knives, a white horse on dark paths under hot moonlight. The row of statues along the stage, wrapped in their marble togas, observed this modern Greek tragedy in silence.

The wheat, olives, and vineyards that enriched the ancient Roman province around Mérida eventually slipped back into pastureland. After the Christian Reconquest, Extremadura languished even more.

In 1952 Generalissimo Francisco Franco approved a hundred-million-dollar development scheme, the Badajoz Plan, inspired in part by the United States' Tennessee Valley Authority. Engineers dammed the Guadiana and its tributaries for irrigation and electricity, dug canals, and built new towns. The government parceled land for settlers.

Some settlers found the 12-acre plots too small to support a family, and hundreds gave up. Yet four decades later, nearly all the plan's 300,000 acres have been planted.

"We are developing new varieties, trying to help Extremadura's farmers," said Manuel Martín Bellido, director of Extremadura's Agrarian Research Service, as we toured Finca La Orden, a 450-acre experimental farm near Badajoz. Dr. Martín led me past cherry, fig, and chestnut saplings, then down



A HARD REGION of scrubby range and farms scraped from thin, rocky soil, Extremadura butts against Portugal on Spain's western frontier. Evergreen oaks (facing page) offer scant shade as summer parches pastureland and drives cattle to drink at one of many water holes.

rows of asparagus, cauliflower, and green peppers.

On another ranch dotted with acorn-bearing oak trees, I visited a herd of 120 purebred Black Iberian sows helping revitalize Extremadura's pork production, an industry still reeling from disaster.

"During the 1960s and '70s African swine flu wiped out half a million pigs in Extremadura, 90 percent of our herds," said Isidro Lara, 27 years a *porquero*, now a livestock manager at the ranch. "With these *pata negra* we are rapidly restocking the herds."

Extremadura's long, lean porkers produce famous hams. *Oro vivo*, locals call them: "gold on the hoof." Salted, then hung to cure in the cool dry winds of hilly Montánchez and Piornal, the hams command as much as $50 a pound in Madrid.

"The secret is the acorns," Isidro said, passing me a handful. "All autumn the beasts gorge on them, fattening to more than 360 pounds.

"Two winters from now, buy your ham," he recommended. "For acorns, this has been a vintage year."

THE AUTUMN RAIN that had swelled the acorns plagued the cowboys' march southward. At the Río Magasca near Trujillo, Quico studied the current. "We can make it all right. Of course, in the end, it is the cows that decide."

El Pequeño dashed across, waving his red flag, his horse half-swimming, half-slipping over the rocky bottom. With whistles and shouts the other cowboys drove the lead cows into the muddy swirl, and the main herd followed, splashing and bellowing. The two dogs swam for their lives, landing 200 yards downstream. As the vaqueros, soaked and chilled, herded their charges up and out of the valley, a warming sun parted the clouds to silhouette a nearby hilltop fortress, the "noble and most loyal city" of Trujillo.

No town in Spain unleashed more local heroes on the New World than Trujillo. Fruits of their fortune frame the town's Plaza Mayor, stolid granite palaces embossed with escutcheons of native sons who returned cloaked in fame: the Orellanas,

Wary vaqueros ease a newborn calf away from its mother for a ride in a saddlebag. On its own the calf couldn't keep up with the migrating herd. Never far from their charges, the men eat a quick lunch. "It's a very hard life," says one rancher. "When these men are gone, no one will want to take their place."

Low profile along a mountain ridge, Trevejo appears as unpolished as surrounding boulders. Cars park outside town, leaving horses to carry loads down narrow streets of stone. Small-scale farmers who were born and will probably

be buried here tend nearby fields of olives and grapes. But urban professionals, attracted by the village's tranquility, are beginning to renovate houses as vacation retreats.

the Carvajals, the Pizarros. Francisco Pizarro, surveying the square from his bronze charger, rules these ghosts of Trujillo's past. A duplicate of his statue silently guards the cathedral in Lima in far-off Peru.

Born in the 1470s, bastard son of a local infantry captain, Francisco took early to soldiering, fighting in Italy for Castile before sailing to the Americas in 1502. He marched with Balboa across Panama on the historic discovery of the Pacific. After returning from Spain, where he had gone to enlist support, he sailed south from Panama, defeated the Incas at Cuzco in 1533, and founded his capital at Lima. He was assassinated there by fellow Spaniards in 1541. Today lifelike busts of the bearded conqueror and his Inca wife, Yupanqui, gaze upon Trujillo's plaza from niches high on the family palace wall.

I FIRST SAW Trujillo in the furnace of August, when it struggles to life twice each day, once to the morning rooster and again, in the late afternoon, to the barking of dogs.

I watched act two from my curbside table at Angel's café over a *cortado*, thick espresso "cut" with a drop of milk. About 5:30 the first small cars sputtered into the plaza and parked as shop blinds rattled open. Women in summer finery passed by, and noisy children sucking sticky frozen treats, a rough-hewn farmer with a lamb under his arm, a nun carrying a bundle of fresh loaves. At the next table a family of tourists from Barcelona worked on their postcards. Angel Guerra Iglesias, the café's proprietor, joined me, a young man with a finger on the pulse of the town.

"A new breed of tourist is discovering Trujillo now: the jet set," Angel said. "Fifteen years ago the Old Quarter under the castle housed the town's poorest. Now, wealthy Spaniards have formed a Friends of Trujillo society to acquire its old, rundown mansions and turn them over, at cost, to new owners willing to restore them. The first, a convent, went for only a few thousand dollars."

That evening I learned about the Pizarro palace from none other than Don José María Pérez de Herrastí y Narváez Orellana Pizarro y de Ulloa—a living Pizarro.

A tall businessman in his mid-50s, dressed in slacks and polo shirt, he was a contrast to the formal image of his famous forefather—in steel breastplate and plumed helmet—that I

remembered from my history books. His brothers are Madrid-based, but José María spends most of the summer on the ancestral ranch outside Trujillo.

"The palace still belongs to the family," he told me, nodding toward the five-story manor house glowing in the soft light across the plaza.

"Before he died, my father, the Marqués de la Conquista, talked with Spain's director of fine arts about using the palace," he said. "Would it not make a perfect museum of the conquistadores? An archive for scholars?

"Now the decision falls to his sons. We are eight altogether and still trying to agree on the building's future."

Staunch faith bolsters the anonymous volunteers who bear a statue of the entombed Christ toward Plasencia's cathedral in the final religious procession of Holy Week.

For the present, the grand manor of Peru's conqueror stands empty.

IT WAS FAITH that fired most of Extremadura's adventurers. That faith's icon was a small wooden Madonna. Buried in a stone sepulcher for six centuries to hide it from the Moors, it was found after a shepherd had a vision around 1300 in the green hills of Guadalupe. Soon after, King Alfonso XI prayed to the image before a crucial battle with the Moors. Although greatly outnumbered, his army won the day. Piously he raised a monastery to the Virgin at Guadalupe. Later monarchs expanded the shrine.

Christopher Columbus went there in 1493 to thank the Virgin for protection on his historic voyage, setting a precedent for conquistadores who followed in his wake. In 1496 Columbus returned again to Guadalupe to baptize two of the Indians he had brought back, among the first to set foot on European soil.

Today the monastery, a rich temple of baroque cupolas, arabesque courtyards, and Gothic towers, rises like a storybook castle above the whitewashed mountain village that hugs its walls. Just inside the bronze main door, one of the hooded guardians, Brother Tomás, offered to show me around.

In the large basilica my guide pointed out the famous Madonna, "Santa María Guadalupe, patron saint of Extremadura and queen of the Spanish world." She sat on a revolving throne, high in the massive gold altar, surrounded by the Apostles and other saints. Then Brother Tomás led me up the stairway of polished red jasper behind the altar.

"This is the holy of holies," he whispered, crossing himself, as we entered a lavish rotunda. The Virgin had turned half circle and now faced us, barely an arm's length away. Her face was plain, blackened by the centuries, but around it shone a halo of solid gold and a brocaded mantle set with jewels.

"Our Virgin has dozens of such vestments in her wardrobe, many the gifts of kings; others, from faraway Chile, Peru, and Mexico," Brother Tomás said. "One—perhaps the most costly garment here—is spangled with 150,000 pearls."

The passion that forged Spain's destiny has lost its grip on much of today's generation. While four out of five people list themselves as Catholics, barely one in five attends Mass on Sunday; monasteries are being boarded up.

REMOTE Extremadura, however, seems slower to abandon the comforts of its faith. Most villages still look to their priest.

"To share a problem is the first step in solving it," Padre Faustino Alonso said when I visited his parish, the town of Malpartida de Plasencia. A workers' priest, Padre Faustino wore a sport shirt when making his evening rounds. At the Café Palmeras men put away their card game to talk to him about renovations planned for the school. From the café the padre then made a phone call to try to speed up an

Blood-sport initiation done in jest celebrates Pilar Hernández Rincón's first big kill, a deer. For generations her family has hunted on the vast preserves that draw sportsmen from all over Europe.

Small bets on a card game entertain pensioners in a Garrovillas bar, an image mirrored in many towns where limited opportunities have moved younger people to find jobs elsewhere. Children in Segura de León will also likely face the region's age-old choice: work in agriculture or emigrate.

insurance payment due a parishioner. Another parishioner, ill at ease, led him away from the table briefly. With his hand on the young man's shoulder, Padre Faustino counseled him on matters not for our ears.

"Just to be available, to listen, is an important part of a priest's role," the padre said.

Next day, robed in green and gold before a glittering altar, Padre Faustino conducted a festive baptism, anointing a bawling, lace-clad four-month-old as prayers and laughter filled Malpartida's hilltop church.

I stood next to Padre Faustino's mother, Doña Rosa. A small shadow of a woman with a ready wit and smile, she has dressed in black since the death of her husband 47 years ago. It comforted her, she confided, that her son (she referred to him proudly as *el cura*, the priest) had pledged his life to "the One who never dies."

Months later I would see her again, to find that her faith and bright humor were being sorely tested by the rising tide of secularism. Padre Faustino had quit the church to marry in Madrid.

IN NORTHERNMOST Extremadura, along the foothills of the Sierra de Gredos, harsh rangeland gives way to fertile village plots. Their bounty flows into the Tuesday market fair at Plasencia, the region's cathedral town: luscious cherries from Cabezuela del Valle, melons from Montehermoso, peppers from Viandar de la Vera, and honey, cheese, garlic, olives, bee pollen.

Bee pollen?

"*Sí, señor.* Nature's energy, a tonic for the heart," insisted the man behind a rack of glass jars.

Most of the fairgoers settled for free cups of the local *pitarra*, homemade wine, tapped from great casks along the Calle Clavero. In front of the arcaded city hall *tamborileros*, folk musicians who calmly play a drum with one hand and a wooden flute with the other, competed for prize money.

Many at the market lived in surrounding hillside hamlets where poverty is kept at bay with money sent home by prosperous emigrant sons.

In Viandar de la Vera, the tiny, rough-cobbled square enclosed by narrow stone houses spoke of other centuries. But in side streets I saw shiny new sedans and motorbikes parked. On the edge of town, where the olive groves begin, new cottages were springing up.

Dionisio Castaño invited me in to show off his kitchen. It was small, but furbished with a new gas stove and an electric refrigerator.

"For 25 years now I have worked at a printing plant near Paris, but every summer I bring my family back to Viandar," he

said. "My daughter Rosa—she is 11—is growing into a French *mademoiselle*. I want her to know her cousins, to keep up her Spanish, not to forget her homeland."

Viandar de la Vera tobacco farmer Florencio Fernández, a spare, handsome man with large hands, told me, "When I worked in Switzerland, I earned three times what I make here. I saved enough to buy a small shop for my wife, Francisca, to pay for a new barn, a tractor. But seven years is long enough away from home."

Luis Javoloyes de Peralta, a young physician from the provincial health department, said: "The village has a normal air to it now in summer; the emigrant families are back for their vacations. The rest of the year the population drops to 400, mostly preschoolers and the very old.

"These are a tough people, self-sufficient. They can handle almost anything," he said. "But their world is quickly changing, becoming a more lonely one. The strain shows. Last year we had three suicides in the valley."

ONE MAN not bothered by solitude is goatherd Jesús Castaño. All summer he rules a mile-high kingdom a half day's climb above Viandar. We met on the weekly descent he makes to sell his fresh cheeses. He was a stocky, rawboned man with a quiet smile. He wore blue jeans, a straw hat, and a leather pouch over his shoulder, and he propelled himself along with a stout shepherd's crook.

At sunrise next morning Jesús and I loaded the mules—bread, coffee, sugar, feed supplement for the goats, oranges for the children, a packet of medicine, mail—and followed a charging brook through oak forests and meadows. On a rocky knoll we paused for a glance at the red tile roofs of Viandar, now a toy village 2,000 feet below. It was noon when we unloaded outside Jesús' stone and thatch *choso*, set among massive boulders below the Loma de la Cumbre, a knife-edge ridge that walls part of Extremadura's northern frontier.

The low-roofed chozo measured barely eight by ten feet, just room enough for his family of five to sleep. Jesús pointed out his 130 goats grazing in the steep brush. His red-cheeked wife, Bárbara, arrived from the small nearby cave where they make the cheeses, bearing a tin pitcher full of goat's milk and a surprised smile. I was their first visitor all year.

"In June, when the grass is rich, we can press about 30 two-pound wheels of cheese a day; by August, we press about half that," Jesús said. "We sell all we can make."

Near dusk Jesús set to milking while I helped the daughters feed the family's four pigs and a cackle of chickens. Bending over the small fire, Señora Castaño warmed potatoes and sausages for supper. We finished it under a rising moon.

Jesús said, "My eldest, María Victoria, is 17 now and cannot wait to get back down to school. This kind of life will not be hers. Little Gloria, six, loves it here; for her it is still a game.

"This is a hard life, I know that. Look at Ramiro; he is only 12, and it has made a man of him already. He plans to stay," Jesús said. "We have air to breathe, and we are as close to heaven as any cathedral. And for us, crime, strikes, traffic jams—these are just stories on the radio. It is far better than slaving away in some foreign country."

THE HARD LIFE on horseback along Extremadura's cañadas also offers its simple rewards. Our last night out was Christmas Eve. Tired and cold, we hobbled the horses and unloaded under a spreading encina tree. Quico and I eased a day-old calf out of one of the saddlebags and sent it wobbling toward its anxious mother. By dark we were warming ourselves, seated on bales of hay around the glowing fire. The neighing of horses and clinking of cowbells slowly faded as our beasts settled down for the night, a living manger scene under the chill December stars.

Quico hung an iron pot over the fire and, by flashlight, stirred onions, garlic, peppers, and laurel leaves into our bubbling mutton stew. El Pequeño roasted chestnuts in the coals. Bread crusts, dipped in sauce and tossed into the dark for the patient dogs, never touched the ground. No holiday dinner I could recall ever tasted better. And tomorrow the journey would end, with the vaqueros in their winter home near Badajoz. A bath, a clean shirt, a roof overhead.

"¡Feliz Navidad!" Quico saluted the feast—"Merry Christmas!"—and passed the wineskin around.

Before clouds canceled the moonlight, I looked far out across the plain—dim, tranquil, eternal—and was touched by the irony of Extremadura. Its hardy offspring—men of the soil like Quico, Don Miguel, Jesús—once sailed across a perilous ocean and changed a continent, forever. All the while their homeland lay anchored in time.

Only now, five centuries after Columbus and the conquistadores, is Extremadura discovering itself, finally girding for its most important battle: retaining the best of its past. □

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Report from the Editor

NATIONAL GALLERY DIRECTOR J. CARTER BROWN AND AN INTERN DISCUSS CONSERVATION OF A CHARLES WILLSON PEALE PAINTING. DENNIS BRACK, BLACK STAR

National Gallery of Art: Milestone on the Mall

Fifty years ago, on March 17, 1941, one of the world's great cultural institutions, the National Gallery of Art, opened its doors on the Mall in Washington, D. C. The gallery was a gift to the nation from Pittsburgh financier Andrew W. Mellon and housed his personal collection of 152 masterpieces in a 15-million-dollar marble building. Under terms of the gift, Mellon provided the collection, the building, and a generous endowment, while Congress paid only for maintenance.

In a letter to President Franklin D. Roosevelt, Mellon said of the gallery that "it is my hope that it may attract gifts from other citizens who may in the future desire to contribute works of art of the highest quality to form a great national collection."

The gallery exceeded even Mellon's vision. In the half century since its founding, the collection has grown to 80,000 priceless works, which attract more than five million visitors a year to the gallery's two magnificent buildings. It is one of the youngest and most widely visited art museums in the world today.

"The gallery represents a unique partnership between the government and the American people," says J. Carter Brown, the gallery's distinguished director since 1969. "Every single piece of art in this collection has come from private hands, not from government appropriation. In celebrating the gallery's 50th anniversary, we are celebrating the generosity and patriotism of thousands of Americans who have donated their cherished possessions to their fellow countrymen to enjoy forever."

The gallery and NATIONAL GEOGRAPHIC magazine have teamed up countless times to bring the best of the world's art to Society members. A joint project in November 1985 involved publication of an article and photographs titled "The Great Good Places: English Country Houses," together with a parallel exhibit at the National Gallery.

Such temporary exhibits play a vital role in the continuing operation of the gallery. To Carter Brown they are symbolic of its international character. "In a real sense," he says, "the gallery is a diplomat of the arts—a cultural attaché, if you will, that brings to America the art of foreign lands and people and sends abroad the best and most characteristic of our native artistic creations."

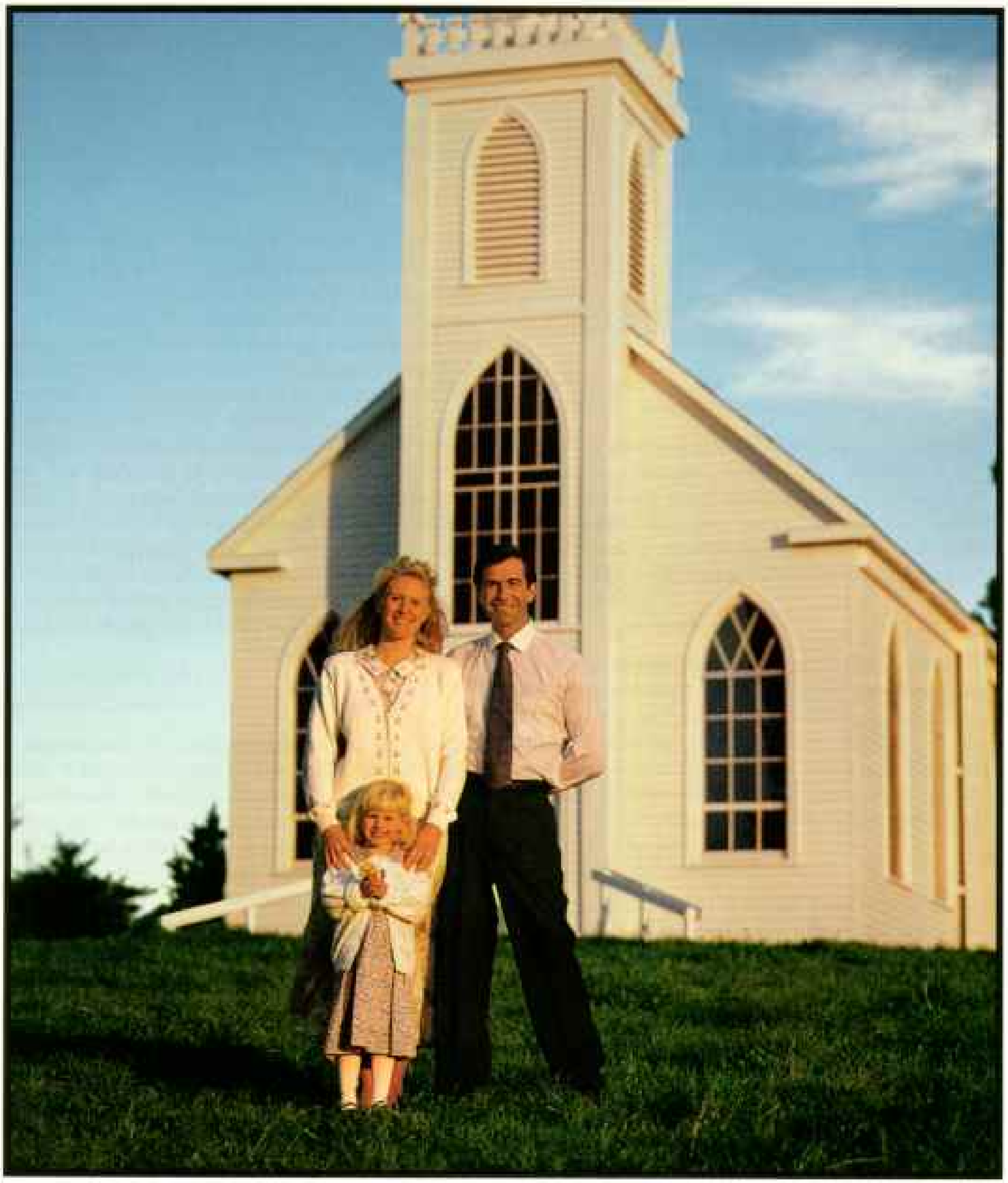
The Society and the National Gallery share another common goal—education. "We're as passionate about education as you are," Brown declares. Among its educational programs the gallery includes foreign and domestic internships, graduate lecturing fellowships, a summer institute for teachers, a nationwide lending program, and a center for advanced study in the visual arts.

The gallery and NATIONAL GEOGRAPHIC are currently cooperating on articles and exhibits featuring the 500th anniversary of Columbus's voyage to America.

On the occasion of the gallery's 50th birthday the GEOGRAPHIC offers warmest congratulations.

William Graves

National Geographic, April 1991



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Okavango Portfolio

Frans Lanting's images in the December 1990 issue took me on a trip through the Kalahari that I never thought possible.

RANDY LEARD
Greenwood, Nova Scotia

Having photographed the lake shown on pages 20-21, I would add that the long white stripes are formed when a strong wind raises the water at the lee side of the temporary lake and blows it over the shore, the former lake bottom. Eventually the water evaporates and leaves a white salt crust.

UWE MUUSS
Altenholz, Germany

I was bemused to read the poetic caption about the photographer drinking freely from the same waters as antelope and zebras. As a frequent traveler to developing areas, I'm alert to what I believe are rational guidelines regarding drinking untreated water, particularly from sources used by animals. Is this the unsafe practice it seems to be?

CAROL T. BAKER
Menlo Park, California

Many experienced travelers contend that water in the heart of the delta poses little risk to humans, but U. S. medical experts continue to advise visitors to use treated or bottled water.

I am a broadcast journalist deployed in Saudi Arabia as part of a ten-man airborne public affairs detachment out of Fort Bragg, North Carolina. We are producing for our corps an eight-page weekly newspaper, the first of its kind since Vietnam. We are glad that we can pick up your magazine and gain experience and knowledge every time we flip the pages, as in the photo essay by Frans Lanting.

PFC. BOB NELSON
APO New York

Okavango Delta

Even a small withdrawal of water from a closed system like the Okavango Delta will have a permanent negative effect. Witness the Aral Sea and to a lesser extent our own Pyramid Lake.

FRANK W. BROUSE
Norristown, Pennsylvania

As members of a World Health Organization team in Maun, Dr. David Scott and I investigated the outbreak of sleeping sickness in Ngamiland in 1966-68. I am sad that our work, followed by successful control of tsetse flies in wildlife areas and the subsequent takeover by cattle, was not in the interest of protecting the original habitat. In Africa these days conflicts between development and the preservation of the environment are common.

FRANK L. LAMBRECHT
Santa Barbara, California

You mentioned that foot-and-mouth disease may be endemic among the buffalo in the delta. Given this possibility, opening it to ranching would be unwise. In most animal populations periodic outbreaks occur in natural cycles. As immunity wanes in a population, a new epizootic may recur within a few years. I doubt that the eight years of freedom from major outbreaks is sufficient guarantee against future transmission to Botswana's cattle.

Many countries maintain an absolute ban on meat products from countries where cattle are not totally free of the disease. In Canada the virus was introduced via a sausage in the baggage of a European immigrant. In 1967 an outbreak in the United Kingdom was traced to frozen Argentine lamb fed to pigs. Opening up the delta is not simply a matter of taking down a fence.

PAT MURTAGH, D.V.M.
Winnipeg, Manitoba

Thank you for raising the issue of conservation through economic utilization of Africa's elephants. The professional managers of Botswana, Zambia, and Zimbabwe have made that concept a success. Their herds have increased in contrast to Kenya's policy of "total protection—no legal utilization of elephant products." Kenya is a center of the poaching industry. The ivory ban was a desperate emergency measure, not a long-term solution.

GLENN AND SUSAN SORG
Hampden, Maine

Showing the skinned body of a zebra and the reflection of the hunter in that same animal's eye was inexcusable. Although Douglas Lee treats the issue of trophy hunting objectively in the text, such offensive photographs elicit an unfavorable emotional response. I am a trophy hunter myself and have witnessed such sights as a necessary part of safari life. Such insensitive journalism clouds the issue and contributes to an emotional opposition to trophy hunting that ignores its positive contributions to the survival of wildlife around the world.

THOMAS EVAN MILLER
Versailles, Kentucky

I was pleased to find an article that brought trophy hunting to the public's attention. I find the concept hard to understand. It revolts me to see people who consider themselves civilized hunting these beautiful animals for only their hides, heads, and tusks.

B. DESMET
Spirit River, Alberta

How A Journey Into The Past Opened Up A New World For Mary Moe's Students.

"Montana is a state of big sky and open lands. Yet it's also a place where people — young ones, especially — can come to feel a sense of isolation from the rest of the world."

That's the perspective of Mary Sheehy Moe, a native Montanan who's been a teacher for seventeen years. Overcoming this problem in Columbia Falls, Montana became her special mission in the centennial year of Montana's statehood.

"My goal," she explains, "was to bring the world to Columbia Falls students and Columbia Falls students to the world."

She began by weaving drama, song, ballet and oratory into a tapestry of Montana's colorful history. Then she enlisted the talents of students and teachers throughout Columbia Falls High School.

The result was "Echoes from the Past," a centennial pageant that she and her students took on a statewide tour during the spring of 1989. The tour highlight was a performance for Montana's leaders in the rotunda of the state capitol.

"Not only did the pageant bring our talented students out of the isolation of their community," Mary explains, "but it also gave other Montanans the sense of togetherness and hope that is the special gift of art and youth."

For making that gift possible, we at State Farm are honored to present Mary with our Good Neighbor Award. The award includes a special gift of our own — a contribution of $5,000 to the educational organization of her choice. What's more, we also wish Mary the very best as she continues to bring her students' unique talents to the rest of the world.

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The Good Neighbor Award was developed in cooperation with the National Council of Teachers of English (NCTE).

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ADELIA G. RESNICKE
Bakersfield, California

Peale Family

We were pleased to find our friend Padihershef, the Egyptian mummy at Massachusetts General Hospital, in your article on the Peales. In 1981 my wife, Irene, and I began research on this mummy of a simple stonecutter who lived in Thebes during the seventh century B.C. It had arrived in Boston with its two decorated nested coffins in 1823. We found that this was the first burial ensemble of ancient Egypt to reach the Western Hemisphere.

CHARLES B. HAYWARD
Springfield, Massachusetts

The celebrations for Charles Willson Peale are most welcome. But one of his most distinctive aspects was slighted: his recognition of women painters. You mention one daughter named for Swiss painter Angelica Kauffmann but neglect three others. Sophonisba was named for Sofonisba Anguissola (1535-1625), the first distinguished woman

painter in the Renaissance, whose work attracted the attention of Michelangelo and Vasari. Sybilla Miriam was named for Maria Sibylla Merian (1647-1717), who did birds, insects, and nature studies in Dutch Guiana, undoubtedly inspiring the Peales, especially Titian II. Rosalba Carriera was named for the Venetian artist (1675-1757). In addition, Peale's niece, Sarah Peale (1800-1885), whose works include portraits of Lafayette and Daniel Webster, was the first American professional female artist.

EILEEN P. ARGUE
Conklin, New York

The item on page 112 appears to be a pantograph, not a polygraph. Your visual-aids section probably has a modern version of the pantograph, which can enlarge or reduce the size of a drawing or sketch.

JOHN C. RECKTENWALD
Bedford, Massachusetts

English-born inventor John Isaac Hawkins dubbed his device a polygraph—and considered it an improvement on the pantograph—because it could make two or more copies simultaneously.

You allude to the gunpowder experiments of Peale and David Rittenhouse for the Revolutionary War. Their relationship went much deeper. Rittenhouse was a dedicated member of the radical Whig Society headed by Peale, and they successfully wrested control of Pennsylvania from the

conservatives. Peale painted Rittenhouse's portrait on several occasions. Our organization is heading a project to restore David Rittenhouse's birthplace in Philadelphia and remnants of the colonial industrial village established by his great-grandfather in 1690 as America's first paper mill.

ANDREW A. ZELLERS-FREDERICK
Friends of Historic Rittenhouse Town
Philadelphia, Pennsylvania

Since your article appeared, one new Peale descendant has written, one known descendant received a subsidy to publish a family diary after the printer read the GEOGRAPHIC story, and we are moving ahead with plans for a Rembrandt Peale show in 1992.

LILLIAN B. MILLER
National Portrait Gallery
Washington, D. C.

Mexico's Bajío

I object to the statement, "Companies like Birds Eye and A P de México . . . offer Mexicans steady employment." It should be followed by saying, "and cost American citizens steady employment."

GENE MCNULTY
Ham Lake, Minnesota

What was said about our history and traditions was well explained and clear, but in describing the present a deeper analysis was needed. You mention some of the greatest problems of the region but fail to give the implications. For example, the extreme poverty, ignorance, and suffering of many of our people, the lack of democracy that explains why one party has governed for 60 years, and consequently the general corruption that has impeded Mexico's political and economic development.

MANUEL MEDINA PEGRAM
Torreón, Coahuila

Geographica

You report that the Lake Baykal hydrothermal spring is the first found to support such a diversity of deepwater life (December 1990). Other freshwater systems already described are Crater Lake in Oregon and Yellowstone Lake, where for the past six years we have been studying hydrothermal communities by scuba and ROV. Sponge communities, microbial mats, worms, and zooplankton similar to those in Baykal are described in NATIONAL GEOGRAPHIC RESEARCH (Autumn 1990).

CHARLES C. REMSEN
J. VAL KLUMP
University of Wisconsin-Milwaukee

The uniqueness of the Baykal vent is in its much greater depth.

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.

"Give fools their gold and knaves their power,
Let fortune's bubbles rise and fall,
Who sows a field or trains a flower or plants a tree,
is more than all."

...John Greenleaf Whittier

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First, there's the character who parks too close to your car in the lot. Then, there's the kid down the block with a great future as a pitcher. And of course, there are always shopping carts.

"If you think about all the unpleasant surprises your car faces in a day, making the bodyside panels dent-resistant starts to make a lot of sense."

Marcel Cannon's been thinking about all those surprises. He's a body engineer at Saturn who runs lots of tests, smashing cars into things and things into cars. Just like real life.

The shopping cart test is one of the more

unusual he's ever run, but there's a solid logic to it: to make sure our bodyside panels really do bounce back.

"The idea behind all this is actually pretty simple," says Marcel. "To make a car that looks good the day you bring it home, and looks good years later when you want to trade it in."

And, we might add, to park wherever you want. And not worry about shopping carts.

DENT-RESISTANT BODYSIDE PANELS are featured on every Saturn, reducing damage caused by corrosion, gravel and parking lot mishaps. Also, the paint flexes with the panels, so the car's finish should last for years. And one need only look at the world around

us to see the value of a durable finish.

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Geographica

J. MICHAEL KELLY

Mummified Reminders of Traditional Ways

On a limestone outcropping high above a remote village in Papua New Guinea (NATIONAL GEOGRAPHIC, August 1982) sit reminders of customs that once thrived in this tropical wilderness: smoked and mummified human bodies.

The bodies (above) were placed there years ago by their Anga relatives. Upon death, influential villagers were smoked, covered with clay to ward off burrowing insects, and placed on a scaffold to prevent damage by water and wild pigs.

Texas photographer J. Michael Kelly, who saw the bodies while working in Papua New Guinea, was told that the Anga collected the fluids that seeped out during the process to rub on their own bodies. The purpose, he says, was to collectively express grief over the loss of the dead person.

Largely abandoned before the nation became independent in 1975, the practices are discouraged by the government and missionaries as improper and unhealthy. But the mummies still dot the cliffs above some Anga villages, and village elders, given the task of guarding the sacred sites, still add a new coat of clay periodically.

Breaking the Ice in Eagle, Alaska

Eagle, Alaska, is the sort of place whose attitude is best summed up by postmaster John Borg: "In the dead of winter at 40° below zero, we're not snowed in; *you're* snowed *out!*" The town's 169 souls, most of them originally from the lower 48, do not live at the end of Taylor Highway, a snowball's throw from the Yukon River, because they want a lot of company. But they were in a sociable mood last summer as they gathered for a town portrait (below and following pages), taken by Myron Wright of Anchorage, who used a rotating camera made about 1915. Despite the look of the photograph, the residents actually formed a circle. Wright went from person to person, "coaxing the best expression out of each as the camera approached," says Mark Stouffer, who is filming a National Geographic Television Special on Alaska's interior.

The taking of the photograph afforded Stouffer a rare chance to see much of Eagle together at one time. "The water tower is the closest thing to a central meeting spot," he reports. "People go there when they need water. They haul it home and don't come back until they need water again the next week."

MYRON WRIGHT

National Geographic, April 1991

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Minitran is the smallest transdermal nitroglycerin patch ever made. It's thin, flexible, clear and hardly noticeable. It stays on until you take it off, even in the shower or when swimming. **And it should cost less than your current brand.***

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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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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 the 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 cool 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 36 patients received 2–4 weeks of continuous nitroglycerin therapy at 0.1 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	5 mg	NDC 0089-0301-03
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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 33 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).

NTR-4 BS APRIL 1990

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Geographica

Africanized Bees Reach U. S., Prepare to Settle

They're here. And though there is some debate about where Africanized bees are going, they're going to stick around.

The pests that some call "killer bees" (GEOGRAPHIC, April 1976) made their first appearance in the U. S. last October near Hidalgo, Texas. African bees were brought to the Western Hemisphere for a Brazilian breeding experiment. Since their introduction to Brazil in 1956, a wild population has been spreading north. The sting of an Africanized bee is no worse than that of a more tranquil European bee, but they are very defensive of their nests and attack in large numbers.

Experts say Africanized bees will spread through the southern states, halting only where long winters inhibit them. Some think colonies of hybrid African-European bees may go as far north as Pennsylvania, Iowa, and northern California. But Orley Taylor of the University of Kansas, an authority on the bees, says that evidence on hybrids is too skimpy to tell yet.

Wherever Africanized bees settle, they will be a headache. Taylor and Anita Collins of the U. S. Department of Agriculture's Honey Bee Research Laboratory in Weslaco, Texas, advise those who disturb Africanized bees—which are smaller than the European version—to run, as fast as possible. Heading downwind will prevent the bees from following any scents. "Getting into a vehicle or a building will at least reduce the number of stings," Collins says. "You may still get stung but probably not seriously."

RICHARD H. LEE

ROLAND H. GEBERT

Microscopic Beauty on a Grand Scale

Since the microscope was invented in about 1590 to help see what the naked eye could not, it has been used to prove theories, test for diseases, explain an organ's structure. But what a scientist sees using either the familiar light microscope or an electron microscope (GEOGRAPHIC, February 1977) may also be startlingly beautiful.

Photomicrographs—photographs taken through a microscope—were first made in 1833, and since then the technique of discovering art through a microscope has become widely practiced. Cross sections of beefwood leaves magnified 16 times (left) won microscopy professor Roland H. Gebert of Zurich, Switzerland, the grand prize in the 1990 Polaroid International Instant Photomicrography Competition. Richard H. Lee, a microscopist at Argonne National Laboratory in Illinois, took first prize in the 1990 Nikon International Small World Competition with a remarkable image of mixed chemical crystals magnified 50 times (above).

Cecil H. Fox, a researcher at the National Institute of Allergy and Infectious Diseases and an authority on photomicrography, fears scientists today may be tempted to create photomicrographic images that "improve on nature," using digitized data that have been altered by computer. The best images, Fox says, are both "scientifically correct and aesthetically beautiful."

Geographica

HARRY CARTY

New Views on Giants of the Southwest U. S.

They were, Gen. George C. Marshall wrote in the September 1952 GEOGRAPHIC, "simple in outline, childish in form, and yet so grandiose in scale as to take one's breath away."

Marshall, a Society trustee, was talking about works of art he had seen from a plane: human and animal figures etched in the desert near Blythe, California. Nearly imperceptible at ground level—this figure (above) spans 170 feet head to toe—they were created by prehistoric Indians who scraped away the dark brown surface layer to bare the tan-and-gray soil beneath. A 1952 NGS-Smithsonian Institution expedition made the first major study of the figures and concluded from historical evidence that they dated from the mid-1500s to the mid-1800s.

But last year Larry Loendorf of the University of North Dakota and Ron Dorn of Arizona State University used advanced radiocarbon techniques to date organic matter that grew on gravel in the Blythe figures. They found that the artworks were created about A.D. 890.

That date makes sense to Jay von Werlhof of California's Imperial Valley College, who has been surveying southwestern desert glyphs since the 1970s and has recorded 300 of them. The Blythe group has been thought to express creation myths (GEOGRAPHIC, January 1987); von Werlhof thinks they depict Kumastamho, the creator, and his mountain lion helper—figures still important to the Mohave and Quechan groups in the area.

Suggestions for GEOGRAPHICA may be submitted to Boris Weintraub, National Geographic Magazine, Box 37337, Washington, D. C. 20036, and should include the sender's address and telephone number.

New Craft Completes NASA's Shuttle Fleet

Late this month a new space shuttle vehicle is to be rolled out of the Rockwell International assembly plant in Palmdale, California, mounted on a jumbo jet, and flown to the Kennedy Space Center in Florida. At that moment NASA's shuttle fleet will have its full complement of four for the first time since *Challenger* exploded in 1986.

Endeavour, named for the flagship of 18th-century explorer James Cook, is scheduled for its first manned flight early next year. Like two of its sister orbiters, *Atlantis* and *Discovery*, it will weigh in at a trim 171,000 pounds. That's 7,000 pounds lighter than the first shuttle, *Columbia* (GEOGRAPHIC, October 1981).

Early Aztec Herbal Goes Home to Mexico

From the time of Cortés, Spanish conquerors were struck by the medical practices of the Aztec (GEOGRAPHIC, December 1980). Now the New World's earliest known medical book—compiled in 1552 by Aztec physician Martinus de la Cruz and translated into Latin by Juannes Badianus, another Aztec—has returned to Mexico after some four centuries in Europe.

The Aztec herbal, known as the Badianus Manuscript, was given to the Mexican government by Pope John Paul II to mark his May 1990 visit to Mexico. It had been in the Vatican's library since the early years of this century, but it originally crossed the ocean as a gift to the Spanish king, Charles V, in the 16th century. The book now resides in the National Museum of Anthropology in Mexico City.

MARK D. THOMAS, NGS STAFF

Carlos Viesca, a medical historian with Mexico's National Autonomous University, says that the herbal is a primary source on pre-Hispanic medicine, as well as a guide to plants still used in the Valley of Mexico. Its 184 illustrations accompany detailed instructions. A remedy for head boils (above) prescribes mixing roots, leaves of herbs, and egg yolks.

National Geographic, April 1991

CHICAGO

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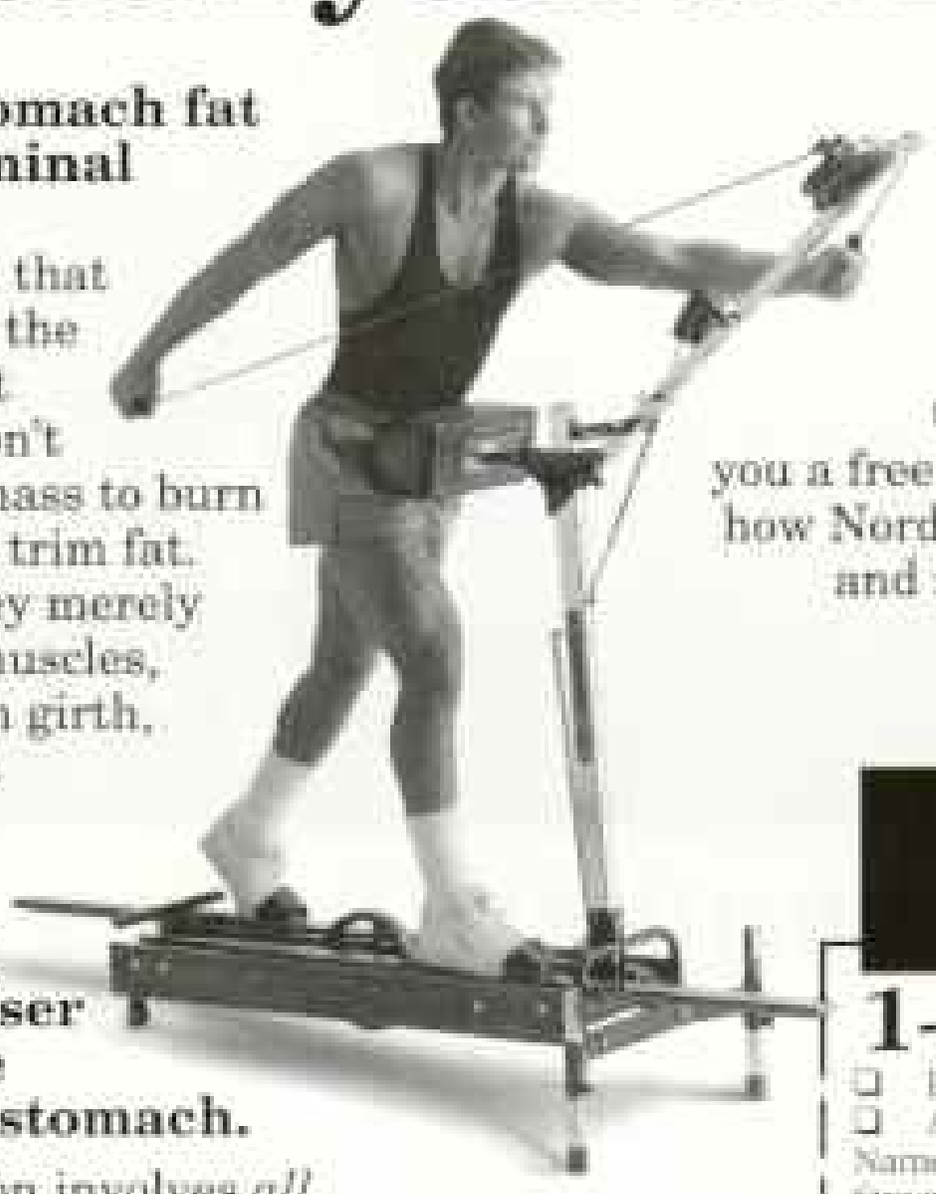
CHICAGO

THE AMERICAN RENAISSANCE.

Why it takes legwork to flatten your stomach



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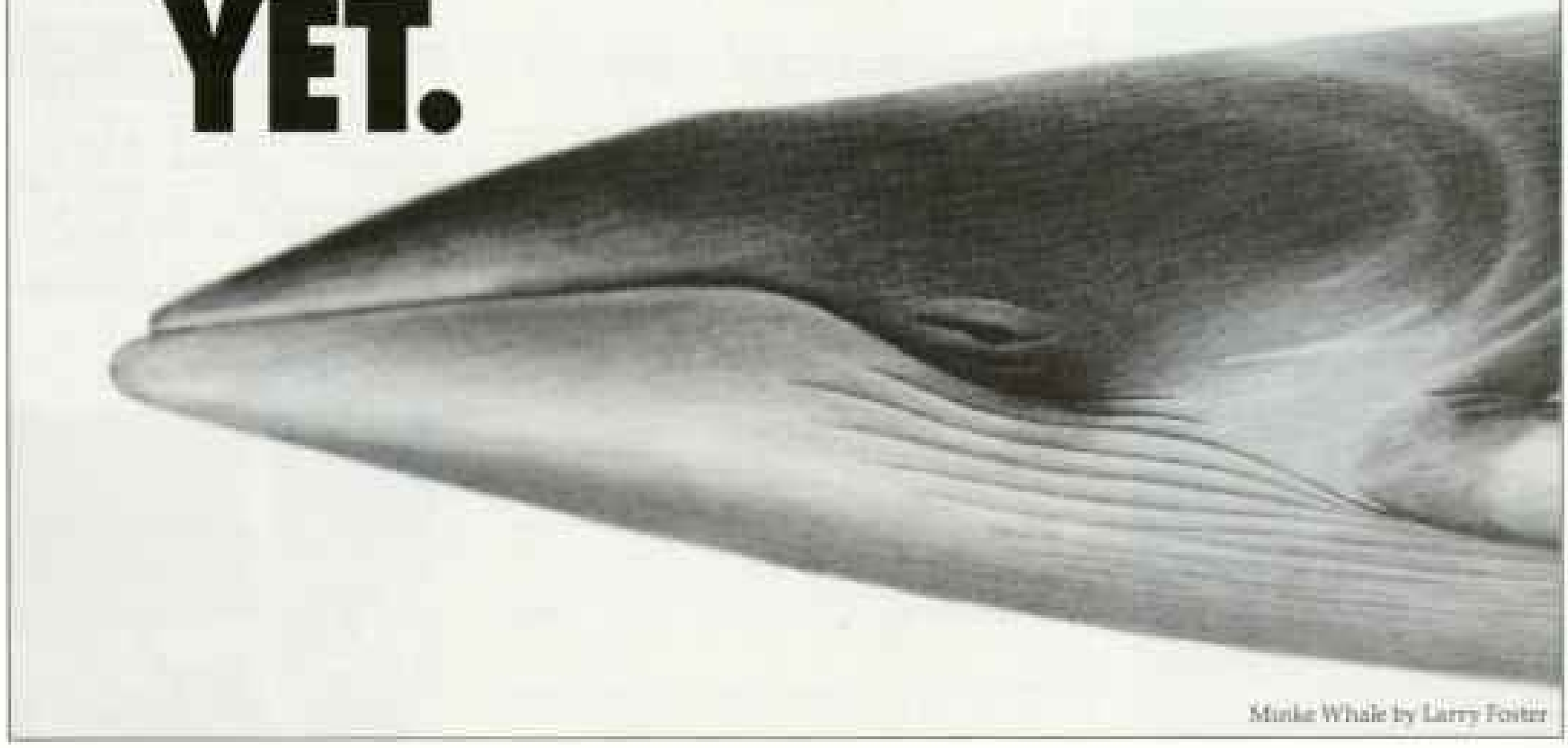

Minke Whale by Larry Foster

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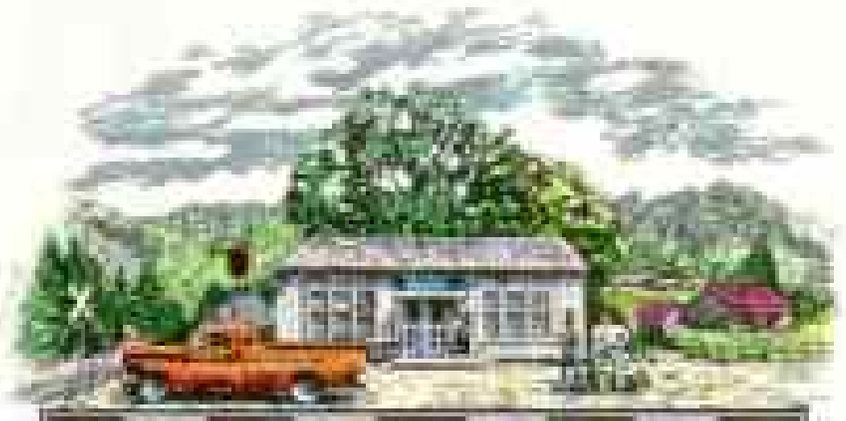

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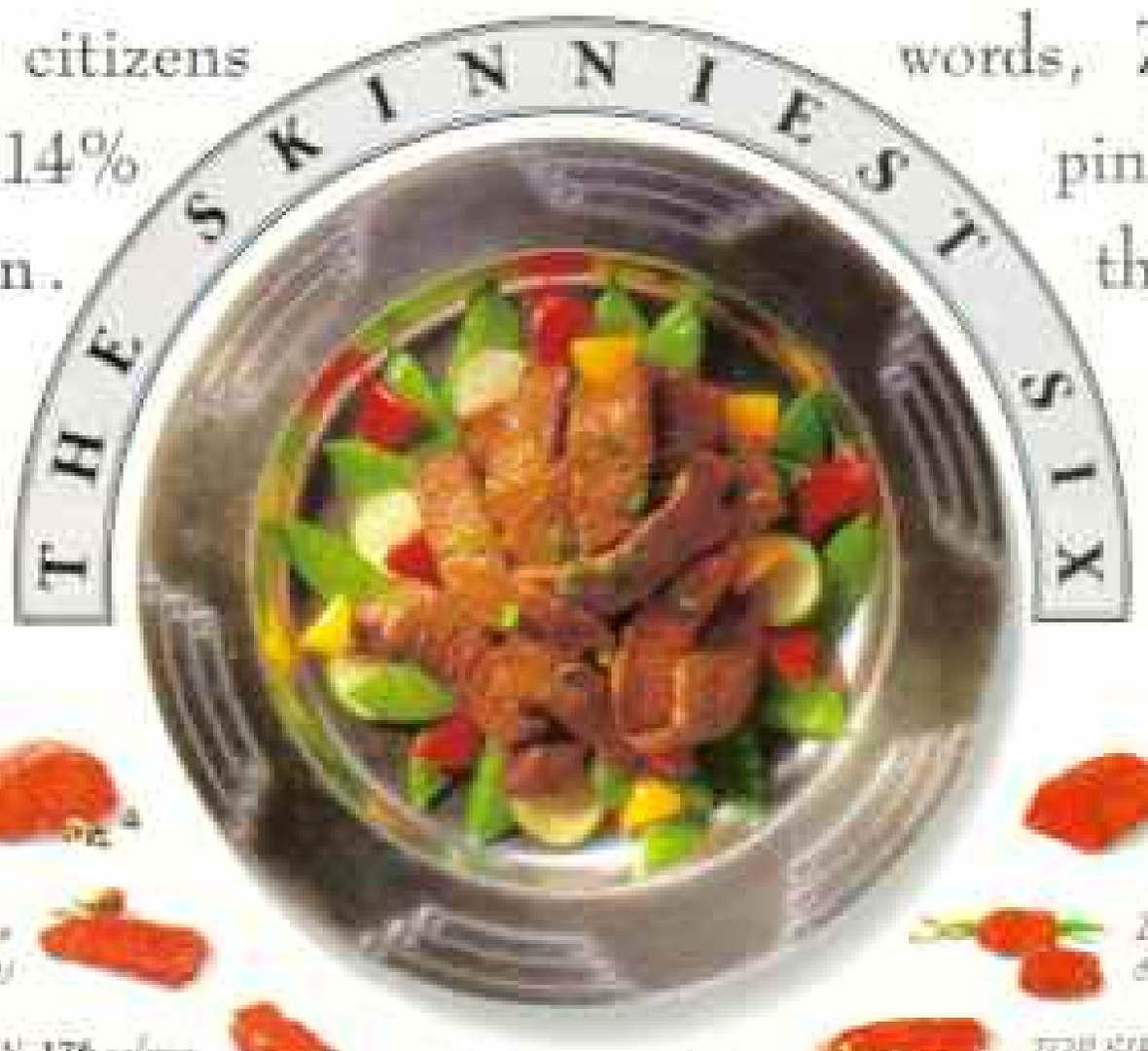
Around 56% of their protein. And a healthy 38% of their vitamin B-12. I'm quoting straight from U.S. RDA figures.* Zinc even gets its zinc from beef. Lean beef makes many valuable contributions to this town. After all, beef is a nutrient dense food. With a high ratio of nutrients to calories. In other words, Zinc is in the pink. See you in the next town.



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TOP LOIN 176 calories
8.2* grams total fat* (3.2 grams sat. fat)

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TENDERLOIN 179 calories
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8.1 grams total fat* (2.8 grams sat. fat)

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*Source: USDA Handbook #13 1992 Rev., U.S. RDA National Research Council 1989 10th Edition.
Figures are for a cooked and trimmed 3 oz. serving. 4 oz. uncooked yield 3 oz. cooked. ©1995 Beef Industry Council and Beef Board.

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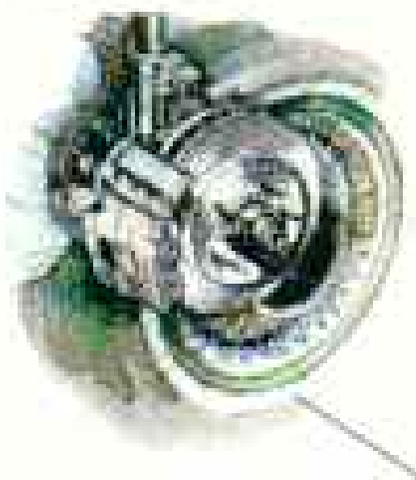

The First Minivan

Chrysler invented the minivan. We were first. Chrysler puts driver-side air bags in every car we build in the U.S.** Another first. The next step was a foregone conclusion...Chrysler is first with minivan air bags.

And when Ford, GM and the imports get around to putting drivers' air bags in their minivans, we'll be the first to offer them congratulations.

For the past seven years the competition has been trying to catch us. Match our success. Our innovations. And always ended up a poor second!

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**Excludes vehicles built for Chrysler Imports: Laser, Talon, Premier, Monaco, Summit. ††Based on total sales.

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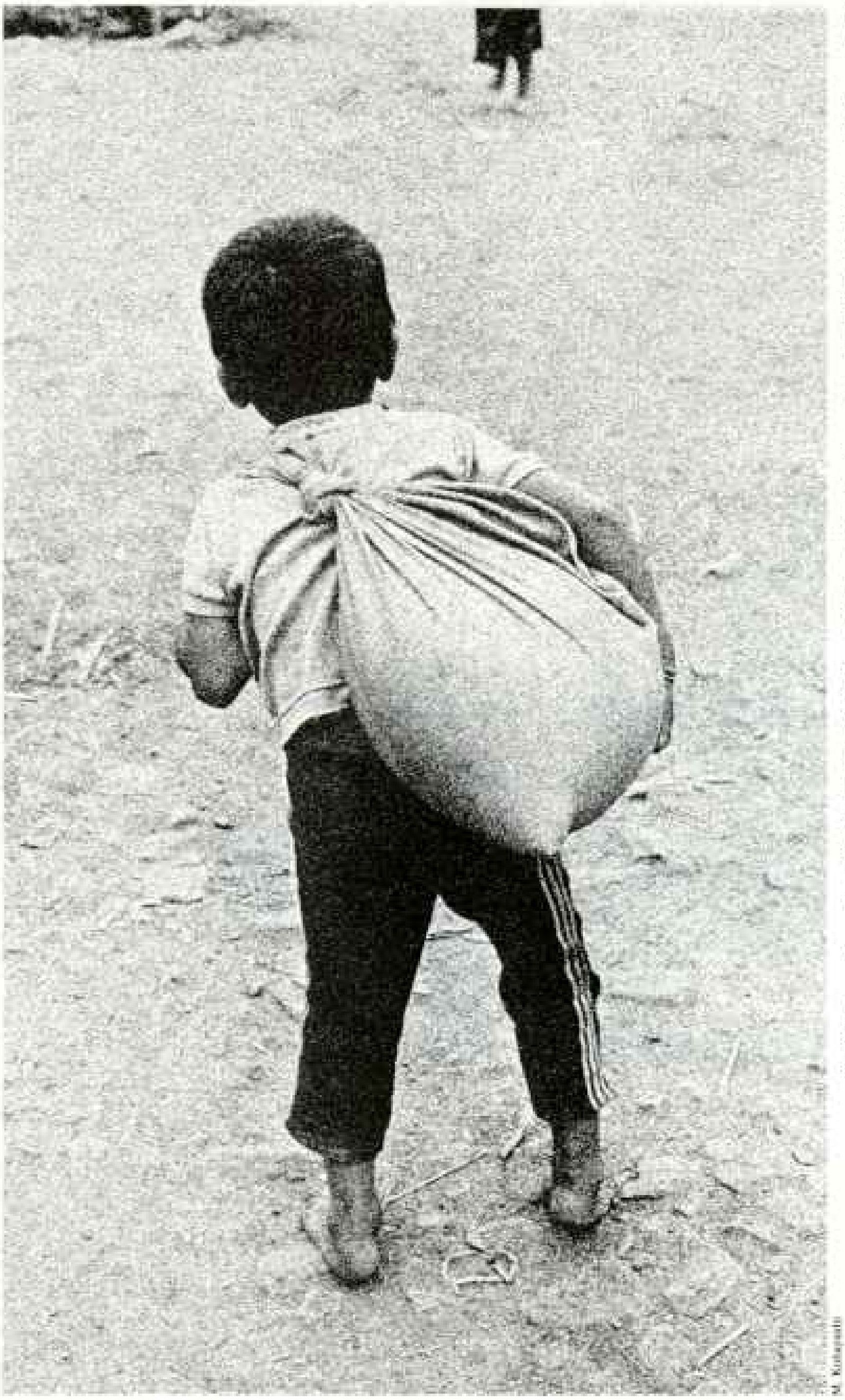
Dodge Caravan and Plymouth Voyager. The original. And still the leader. Beware of imitations.

Advantage: Dodge Advantage: Plymouth

He got in the way of somebody's war.



Nine out of ten casualties in modern warfare are civilians.

The vast majority of its victims never wore a uniform or carried a gun.

In the so-called "post-war" period since 1945, at least 20 million people have died in over 100 conflicts. A further 60 million have been wounded, imprisoned, separated from their families and forced to flee their homes or their countries.

In over 30 armed conflicts, this human misery is happening now.

Yet the Geneva Conventions – ratified by 164 states – lay down clear rules that all victims of war living under the darkness of conflict must be respected.

They have the right to protection from murder, torture, starvation and being taken hostage.

To focus attention on the plight of millions of civilians caught in the crossfire, the International Red Cross and Red Crescent Movement is launching a worldwide campaign to ensure that they get the protection and assistance to which they are entitled under international law.

No matter who. No matter where. No matter when.

We call on governments and combatants everywhere to respect the rights of all victims who get in the way of somebody's war.

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WILDLIFE AS CANON SEES IT

Akiapolaau
Genus: *Hemignathus*
Species: *munroi*
Adult size: Length, 14 cm
Adult weight: 29 g
Habitat: Koa and mamane-naio forests on the island of Hawaii, USA
Surviving number: Estimated at 1,500
Photographed by Jack Jeffrey

The akiapolaau searches the bark of forest trees for beetle larvae and insects. This Hawaiian honeycreeper uses its straight lower mandible to chisel into the bark and the curved upper bill to pick out the larvae. With most of the native forests already cleared, the establishment of sanctuaries in its remaining habitat will help ensure the akiapolaau's survival. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Photography, both as a scientific research tool and as a means of communication, can help promote a greater awareness and understanding of the akiapolaau and our entire wildlife heritage.

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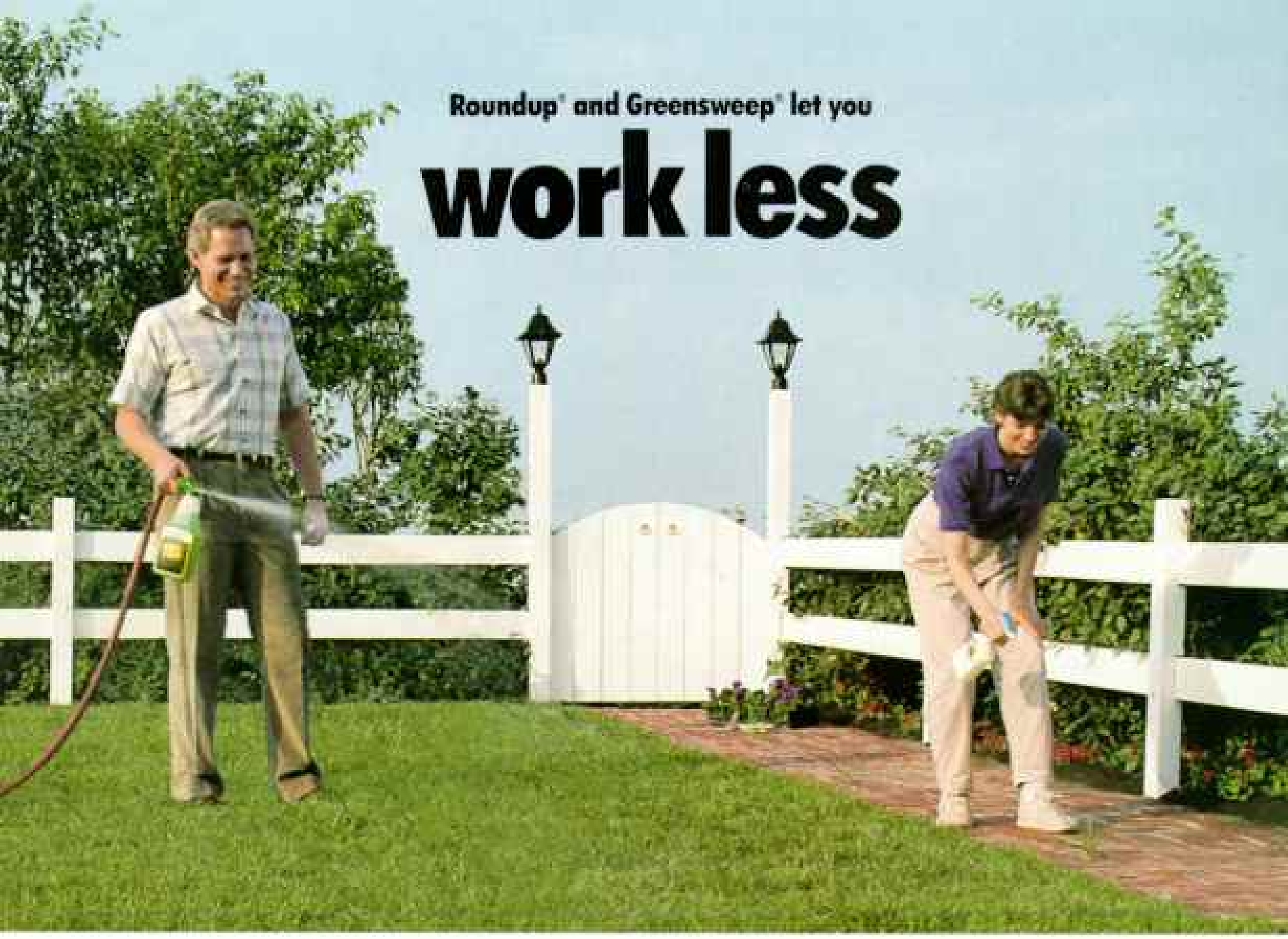

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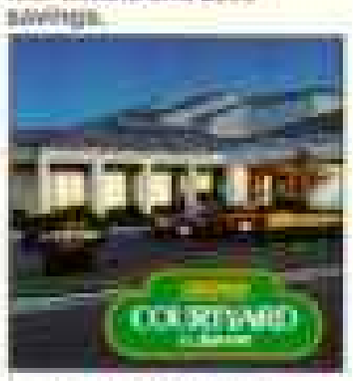

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The age-old question.

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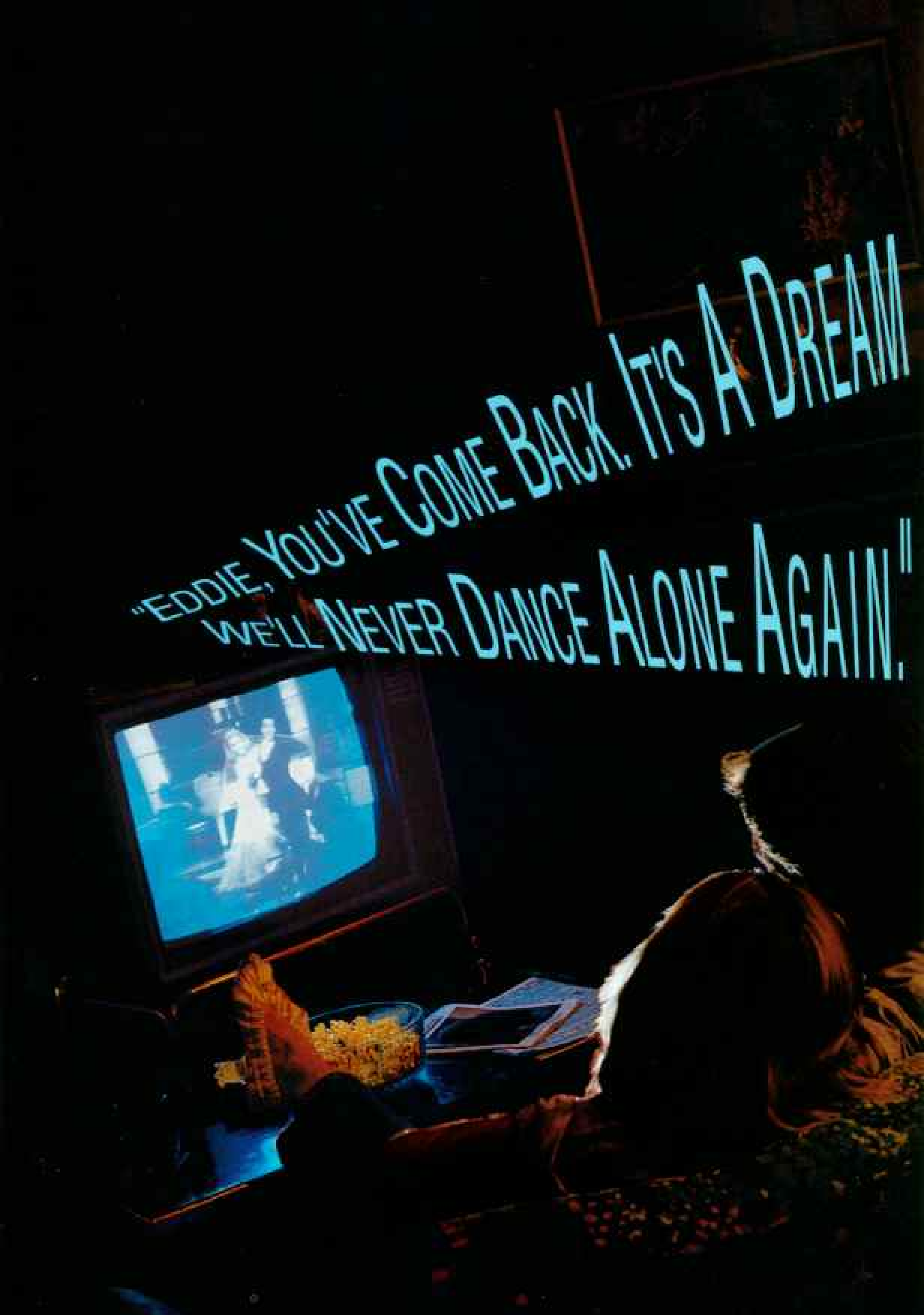

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Earth Almanac

Office Lunches Draw a New Ant Species

What law says that new plants and animals can only be discovered by eagle-eyed scientists searching the ends of the earth? True, a new and intense effort to study rain forests worldwide is under way by a team of naturalists. But Kathryn Fuller, president of the World Wildlife Fund, looked no farther than her Washington, D. C.,

MARK W. MOFFETT

office and found pale yellow ants that proved to be new to science.

Fuller noticed the visitors, persistently attracted to her desk by her brown-bag lunch crumbs, in the summer of 1989. She invited ant authority Edward O. Wilson to examine her guests, which were traced to a potted dracaena from a Florida nursery. Taking specimens to his Harvard University lab, Wilson found that the ants belong to a genus called *Pheidole*, "thrifty one," reminiscent of Aesop's fabled ant. Wilson says that Fuller's ant is a new species, and he plans to name it *Pheidole fullerae* in her honor.

Similar, previously unidentified specimens revealed that the ants' range includes Cuba, Haiti, and Puerto Rico.

"If you can find a new species in a Washington office," Fuller reflects, "the number of species out there in nature waiting to be discovered must be truly extraordinary."

Fast-moving scientists in a team organized by Conservation International are fanning out to inventory targeted rain forests from South America to Asia. They believe that the speed of deforestation compels a crash approach to identify every species they can find.

MARIA STENZEL

Massive Tumors Afflict Green Sea Turtles

Mysterious and deadly tumors are ravaging green sea turtles *(Chelonia mydas)* from the Florida Keys to the Pacific.

These turtles are already considered endangered or threatened globally due to beachfront development, poaching, fisheries conflicts, and other factors.

The malady, called fibropapillomatosis, manifests itself in grotesque masses of tumors, as many as 50 on some individuals, with some growths a foot in diameter. Not malignant per se, the tumors usually prove fatal when they grow over the eyes or mouth and hinder feeding or when they occur internally.

In Marathon, Florida, rescue efforts are coordinated by Tina Brown (below) and Richie Moretti, who have converted a hotel swimming pool to hold diseased turtles awaiting surgery at the island's veterinary clinic. Of 40 to 50 stricken turtles brought to Brown and Moretti over the past three years, 90 percent have died. Moretti reports: "We've had about 400 schoolchildren come to see the sick turtles. The one thing they all ask is, why?"

A possible connection came last December from Elliott Jacobson, a veterinarian at the University of Florida. After long study he discovered that the tumors are associated with a type of herpes virus.

Hawaii's green turtles have also been hit hard, and turtle tumors have been reported in the Caribbean, Central America, and Australia. Why such an explosion? "It may be related to pollution, which could suppress the immune system," Dr. Jacobson believes. "Nearly all the diseased turtles we've seen come from sites near shore, where most pollution occurs."

NICK HARPER

National Geographic, April 1991

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Earth Almanac

Bitter Pill: Rhino-horn Art Ground Into Potions

ESMOND BRADLEY MARTIN

Once they were fit for an emperor's eye. Now they are being turned to dust, swallowed up by a continuing demand from Chinese both in China and overseas for patent medicines.

Intricate cups, plates, bowls, and figurines were carved from rhinoceros horn by master Chinese craftsmen during the Ming (1368-1644) and Ching (1644-1912) dynasties. Most of these national treasures are kept not in China's museums but in drug factory storerooms (top). Factory owners have been buying such antiques for decades from collectors and businessmen.

As rhino-horn stocks dwindle—due to fewer rhinos in the wild and better protection of those that remain—drug factories are pulverizing these fabulous art objects into medicine believed to reduce fever and inflammation. Esmond Bradley Martin, who wrote of the rhino's plight in the March 1984 GEOGRAPHIC, recently became the first foreigner allowed to inspect stockrooms, where he found antique carvings. A top-quality cup—worth a pittance as a powdered potion—could garner more than $30,000 in hard currency from a collector, if the carvings were auctioned on the world market as Martin proposes.

On Tombs, Pollution's Toll Is Graven in Stone

Ten thousand tombstones bear disquieting epitaphs, says University of Delaware geographer Thomas C. Meierding. His study reveals a history of air pollution's destructive effects. Meierding and his students traveled 40,000 miles visiting urban and small-town U. S. cemeteries. They found the worst cases in the heavily polluted Ohio River Valley, shown by an eroded 1878 marble stone near Marietta, Ohio (right, at bottom). In contrast, a century-old headstone in Hawaii of the same Vermont marble remains smooth.

Meierding saw little damage in the Great Plains and Florida but severe effects in Illinois and western Pennsylvania. Deterioration increased between 1930 and 1960, then eased due to pollution controls and the decline of heavy industry.

He discovered that acid rain, his initial suspect, dissolved only a thin surface layer. The real damage came from sulfur dioxide gas—released by burning high-sulfur coal—which forms gypsum within the marble and forces the stone apart.

THOMAS C. MEIERDING

Vulnerable Yew Tree Yields Cancer Treatment

The northern spotted owl has become an environmental emblem for the cause of preserving old-growth forests in the Pacific Northwest. But those ancient woods also nurture another species, the Pacific yew tree, which may add its own argument for preservation—a treatment for cancer.

The yew tree's bark contains a substance called taxol. Dr. William McGuire and other researchers at Johns Hopkins University in Baltimore found that taxol reduced the size of malignant ovarian tumors by half or more in 30 percent of the 40 women they tested. Each year ovarian cancer strikes 20,000 women in the United States; about 12,000 die. Taxol may also aid treatment of melanoma and breast cancer, say scientists at the National Cancer Institute.

Frequently found with old-growth species, such as Douglas fir, the slow-growing yew trees have little commercial value as timber. They are often burned by loggers unless special arrangements are made allowing collectors to strip the bark from the trees.

The federal government has denied a petition to declare the yew a threatened species, so environmental groups are seeking other means of protection.

"The idea of asking people to care about species diversity in a distant rain forest may seem a little abstract," says Bruce Manheim of the Environmental Defense Fund. "Here we finally have a tangible example of a very valuable resource that is being destroyed."

National Geographic, April 1991

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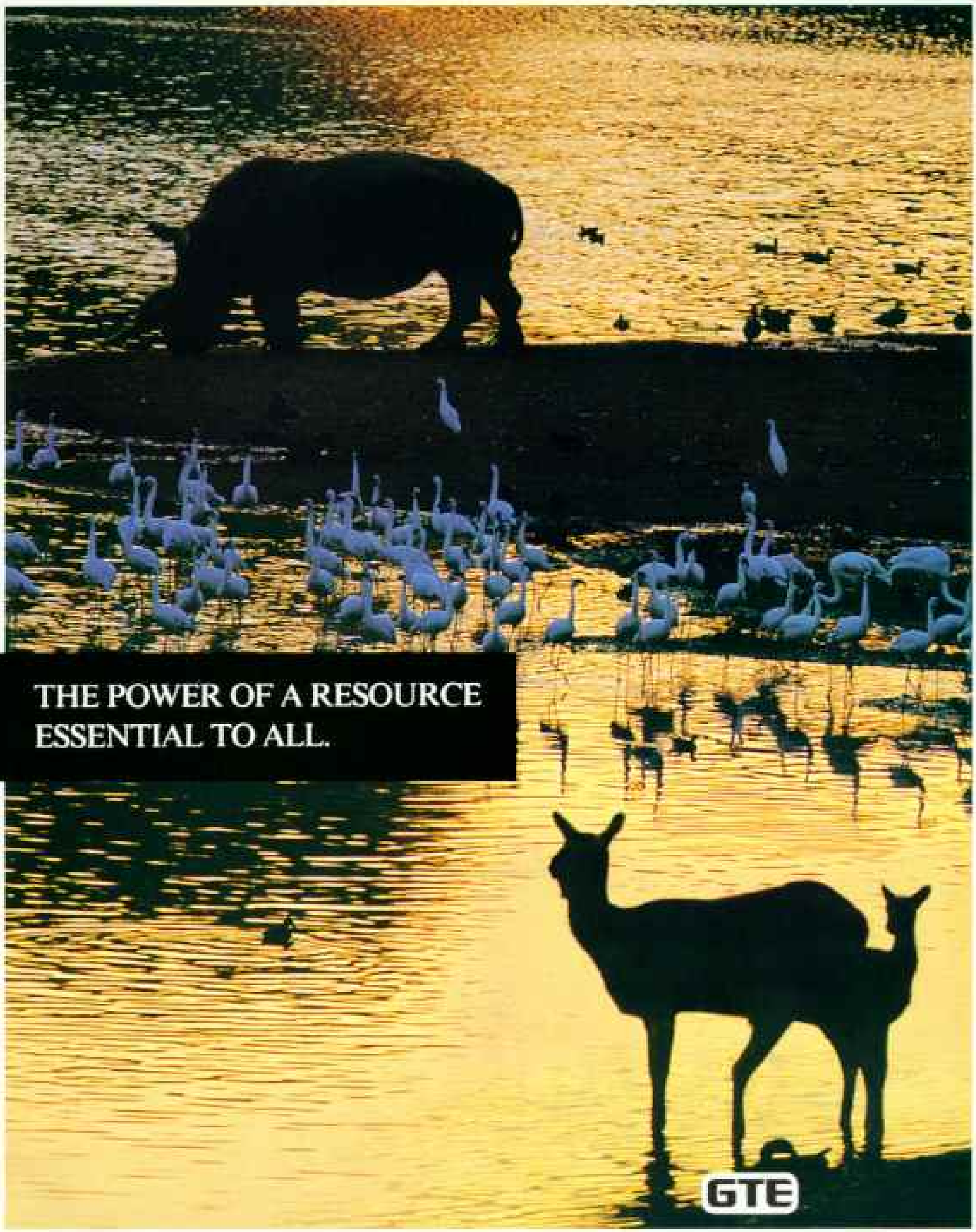

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On Assignment

A shared fascination with ancient peoples drew three veteran GEOGRAPHIC staffers into enthusiastic teamwork that has resulted in articles on the victims of Vesuvius at Herculaneum (May 1984), the Etruscans (June 1988), and now on pharaonic Egypt.

LOU MAZZATENTA (above) has photographed 13 articles during a 28-year career that has taken him from picture editing to directing the Control Center, the magazine's operations room. He found the Sphinx and the Ramses colossi mesmerizing. "I was familiar with Roman antiquities, but I wasn't prepared for the scale of these monuments; the corridor leading to Ramses' tomb is as long as a football field."

For illustrations editor ELIE ROGERS (center), 21 years on staff, this assignment meant going home; he was born in Alexandria and lived in Cairo before coming to the U. S. as a university student. Visiting a theme park called Pharaonic Village that demonstrates daily life in antiquity, colleagues talked Elie into assuming a king's garb in an open-air photo studio. Elie's command of Arabic and his friendship with officials helped smooth the team's way. Gaining background for the article was so intense, Elie says, "I learned more about Egyptian history than when I was growing up there."

The blank serenity of Ramses colossi, like this at Tanis, frustrated writer RICK GORE as he sought the personality behind the facade. "I came to see Ramses as a metaphor for a civilization whose remnants are eroding before we have time to understand them," he says. "There are so many missing pieces. Perhaps the most important is the ancient Egyptian mind-set, in which magic and unseen forces reigned supreme." Rick is accustomed to a more rational outlook. During his 17-year career at the magazine, most of his 31 articles have focused on science.

PHOTOGRAPHS BY O. LOUIS MAZZATENTA (CENTER) AND ELIE S. ROGERS

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"I'D BE AN expert ON THIS BY NOW if I didn't have to take SO MANY naps."

SARAH BAGWELL, AGE 4, *Cardome Center, Georgetown, Kentucky*

NO, SARAH'S NOT MASTERING a new video game. It's a computer.

What's a four year old doing in the same room as a computer, you ask?

"Why not? It's long overdue," replies Debbie Highsmith, director of the new early childhood development program at the Georgetown Cardome community center. "At first glance, we look like your everyday day care center. But what our kids do here between naps is quite remarkable."

Pre-schoolers here are taught a second language: Spanish. And when they're not playing

in the sandbox (still the most popular activity) they can be found in the computer room.

"By the time these children go to school they will be well prepared and ready to learn. They'll know their colors, numbers and the alphabet. It gives them a tremendous advantage," says Debbie.

Giving every youngster a running

start in life is the dream of Debbie Highsmith and her dedicated staff of 25.

And although it's still in its infancy, the program is already regarded by experts as a model for the nation.

Toyota is proud to have donated the $1.3 million

Georgetown needed to start this important community and childcare center.

Naturally, we're happy that the children of so many of our employees are benefitting from this superb day care.

But we are even more excited by the long-term value of Debbie's vision to the country as a whole.

How great will the impact of this project be? We're not sure.

Although we hope that some day Sarah and her trusty computer will be able to give us the answer.

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