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# NATIONAL GEOGRAPHIC

THE TEMPLES OF

## Angkor

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NATURE'S greatest marvels, I've come to realize, are its simplest, the ones we take most for granted. But there's nothing simple about bringing them to you.

Here at the GEOGRAPHIC we have a loose category for article ideas that we call, for want of a better term, "commodity stories." They usually germinate from a single-word suggestion, itself often less than compelling: Water. Coal. Salt. Aluminum. Bamboo. Oil. And even those lacking the innate glamour of our stories on gold, diamonds, and silver, for example, usually rank near the top in our annual reader-interest surveys.

In between lie a lot of fascinating exploration and discovery, more travel and expense than we like to think about, and, frequently, years of gestation. As with all our articles, the creative talents of many are brought to bear—writers, artists, cartographers, illustrations experts, researchers, editors.

To tell the story of coffee, for instance, senior staff writer Ethel A. Starbird and photographer Sam Abell circled the globe. The author trod nervously in troubled El Salvador, where workers carried arms and guard dogs patrolled guerrilla-infested mountainside plantations. In economically depressed Istanbul, she found no Turkish coffee—except on the black market at \$36 a pound. Thirty months after our Planning Council approved the subject of coffee, we published the story of the world's most popular beverage (March 1981).

This month we take a look at the humble potato. The subject, undertaken more than two years ago, required 145,000 miles of travel around the world by author Robert E. Rhoades, an anthropologist and potato researcher, and photographer Martin Rogers.

Among the things we learn about the simple spud is that Thomas Jefferson introduced French fries to the U. S., serving them in the White House; that there are some 5,000 varieties discovered so far; that they're cousins of tomatoes and tobacco.

And, they hold promise for a 21st-century solution to the world food crisis.

Watch for forthcoming issues in which we explore other such "simple" but surprising subjects: A bright account of platinum. The bittersweet story of chocolate. And yes, even the earthy tale of topsoil.

*Wilbur E. Garrett*  
EDITOR

# NATIONAL GEOGRAPHIC

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May 1982

## THE TEMPLES OF ANGKOR

### Will They Survive? 548

*A GEOGRAPHIC team visits Kampuchea's fabulous ruins, rarely seen by Westerners in years. Wilbur E. Garrett introduces a closeup look at Angkor's...*

### Ancient Glory in Stone 552

*War and neglect have again swept across some of humanity's most magnificent expressions of faith, yet the temples of the Khmer endure, reports Peter T. White. Photographs by Wilbur E. Garrett.*

## Kampuchea Wakens

### From a Nightmare 590

*The nation once known as Cambodia reels from war and genocide that claimed perhaps a third of the population. Peter T. White finds a country, occupied now by Vietnamese troops, striving to regain a semblance of normalcy. With photographs by David Alan Harvey.*

## Birds That Walk on Water 624

*Western grebes perform elaborate courtship rituals and communicate in ways just now being understood. Dr. Gary L. Nuechterlein tells of his seven-year study of these intriguing marsh dwellers.*

## Perth—Fair Winds and Full Sails 638

*Isolated from the rest of the continent, the capital of Western Australia has burgeoned and prospered through a can-do spirit of independence. By Thomas J. Abercrombie, with photographs by Cary Wolinsky.*

## The Incredible Potato 668

*Throughout history the noble but humble spud has often been misunderstood, occasionally maligned. Robert E. Rhoades comes to the defense of this versatile vegetable. Photographs by Martin Rogers.*

**COVER:** *Leaves like tears trail across the face of a monumental deity at Angkor's vast complex of crumbling temples, once heart of the Khmer Empire. Photograph by David Alan Harvey.*



WILBUR C. BARKETT

# THE TEMPLES OF Angkor:

**F**OR EIGHT CENTURIES this serene and seductive celestial dancer has graced the entrance to the temple of Angkor Wat, holding promise of the imagined delights of heaven. Aged yet ageless, she represents, in the Khmer lore of the 12th century, "the one who goes through the water of the clouds." Throughout the great religious complex at Angkor, thousands of these delicately carved apsaras bear witness to the glories of the Khmer Empire that ruled Indochina for six centuries. Time mellowed her lines but left her beauty undiminished.

Then—in a shattering burst of gunfire—she became another victim of the senseless brutality and destruction that has plagued Cambodia, now Kampuchea, since 1970. This victim was of stone—most were not.

After the victory of the radical Khmer Rouge in April 1975, the victors, vengeful and full of hatred for fellow Khmer who had not shared their wartime jungle hardships—and driven by a Hitlerian fervor to purify their nation of foreign influences—launched a systematic slaughter and enslavement of their own people perhaps unmatched in history. In four years as many as

# Will They Survive?

*three million died of starvation, disease, forced labor, or execution.*

*Even before this carnage, United States saturation bombing of suspected Viet Cong sanctuaries had killed thousands of Khmer.*

*Then in 1979 their historic enemy, the Vietnamese, swept through the battered nation and drove the oppressive government of Pol Pot's Khmer Rouge into the mountains along the Thai border. More suffering, more death. Through all those years a tight veil of secrecy kept most of the suffering from the eyes of the world. But the invasion sent hundreds of thousands of Kampuchean refugees pouring into Thailand. Pictures of their emaciated bodies shocked the world, evoking the horror of Nazi death camps.*

*Millions of people, wrenched by this continuing tragedy, contributed millions of dollars to help.*

*Many Khmer were saved and have returned home to a less oppressive government. But violence still stalks the country as Pol Pot guerrillas and the non-Communist forces of Son Sann's Khmer People's National Liberation Front attack a common enemy—the present government and the 180,000-man Vietnamese occupation force.*

*Recently the veil of secrecy has lifted slightly. Last fall three of us from NATIONAL GEOGRAPHIC were permitted an extensive look at Vietnamese-controlled areas of Kampuchea—including the fabulous temple complex of Angkor, which has been virtually closed to the outside world for a decade. It was my first visit since 1968, when Prince Sihanouk's government still maintained a tenuous neutrality in war-ravaged Southeast Asia. That year a surplus of rice was harvested. At Angkor Wat a ballet company danced with the delicacy and grace of living apsaras, to the enjoyment of thousands of tourists. The countryside was green with life.*

*What I now saw were mass graves, barren fields, and a people trying to return from hell on earth. Only children—and only a few—were dancing.*

*At Angkor, Peter White, photographer Dave Harvey, and I made—as tourist brochures used to say—the grand circuit, visiting most of the 72 major stone and brick temples and monuments of Angkor. Despite rumors and exaggerated reports that the temples were demolished or severely damaged, we can report that, amazingly, they are*



*Sentry to the soul of Kampuchea, a militiaman stands guard at the 12th-*

*nearly unscathed by the years of war. Of all the apsaras at Angkor Wat itself, only this one is so extensively damaged. She had survived intact the 12th-century sacking by the Cham and the 15th-century Siamese conquest, but not the recent chaos.*

*Thiounn Prasith, Pol Pot's Democratic Kampuchean ambassador to the United Nations, recently told me that the mutilation*

*was almost certainly the work of a Vietnamese soldier. Perhaps. Most likely it was just senseless vandalism.*

*Whoever did it, and for whatever reason, the very defacing by the bullets of war make it for me a memorial in stone to the horrors of the past decade.*

*After a thousand-year cycle of destruction, decay, and rebirth, the ancient complex of temples now desperately needs a renewal of the*



WILBUR L. GIBBETT

*century temple of Angkor Wat—a national symbol for all Cambodian regimes.*

*loving and expert preservation and reconstruction once lavished on it by Cambodia and France. That work has been halted for a decade. War, vandalism, and theft have scarred the temples superficially, but it is the implacable jungle that threatens their very existence.*

*Under UNESCO sponsorship, the National Geographic Society has mounted an exhibition in the lobby of*

*the United Nations building in New York during the month of April. It shows the glories of Angkor as it was—and as it appears today.*

*It is our plea to the forces that contend for control in Kampuchea to demilitarize Angkor and permit the work of saving and restoring this remarkable site to resume. If that comes to pass, we can be sure that the glories of Angkor will survive. \* \* \**

**I**N THE LANGUAGE of the ancient Khmer, and of the Khmer people of contemporary Kampuchea, Angkor means "the city" or "the capital." Geographically it denotes some 75 square miles of fertile plain between the Kulen Hills and the lake of Tonle Sap, where between the 9th and 13th centuries A.D. a dozen Khmer kings constructed successive capitals. These encompassed a sophisticated irrigation system that mastered the vagaries of monsoon rains and drought to grow rice enough, eventually, for a million inhabitants; and a multitude of major building complexes in laterite, brick, and sandstone, of

which the gigantic temple that later became known as Angkor Wat is the largest and artistically most accomplished.

Altogether, these creations of great conquerors and artisans embodied an integrated concept of the universe rooted in myth and deep religious belief, and hence a combination of physical and spiritual grandeur found elsewhere only in ancient Greece and Egypt, among the Maya and Aztecs, and in the medieval Europe of the Gothic cathedrals. That is what Angkor was. Its brilliance began to fade in the 13th century.

In the 20th century, Angkor became a model of restoration. Modern archaeology and physical science retrieved from the earth and the jungle some of the world's most impressive monuments and preserved them in a setting of tropical greenery: a juxtaposition of disciplined works of man and wildly exuberant nature, dramatic yet harmonious, on a scale uniquely memorable. That is what Angkor was until a decade ago.

But what of Angkor now?

Warfare and political upheaval forced the last archaeologists and maintenance crews to leave in 1972. Since then art historians and museum directors around the globe have wondered—what's really been happening at Angkor? Reports from occasional visitors, allowed limited access for a day or two, spread conflicting impressions. Some said they saw no major damage. Others spoke of unattended temples eroded by the elements, smashed by artillery fire, despoiled by thieves. There were tales of decapitated statuary, of great sandstone heads bartered on the border of Thailand for their weight in salt, going secretly to rich collectors on other continents. *(Continued on page 566)*

*The tumbled head of a divinity stares heavenward as a woman goes about her immemorial chores at the western entrance to Angkor Thom, last great capital of the Khmer Empire. In the past decade the statuary and temples of Angkor have been scarred by incessant war and a consuming jungle.* NATIONAL GEOGRAPHIC PHOTOGRAPHER DAVID ALAN HARVEY

## THE TEMPLES OF ANGKOR

# Ancient Glory in Stone

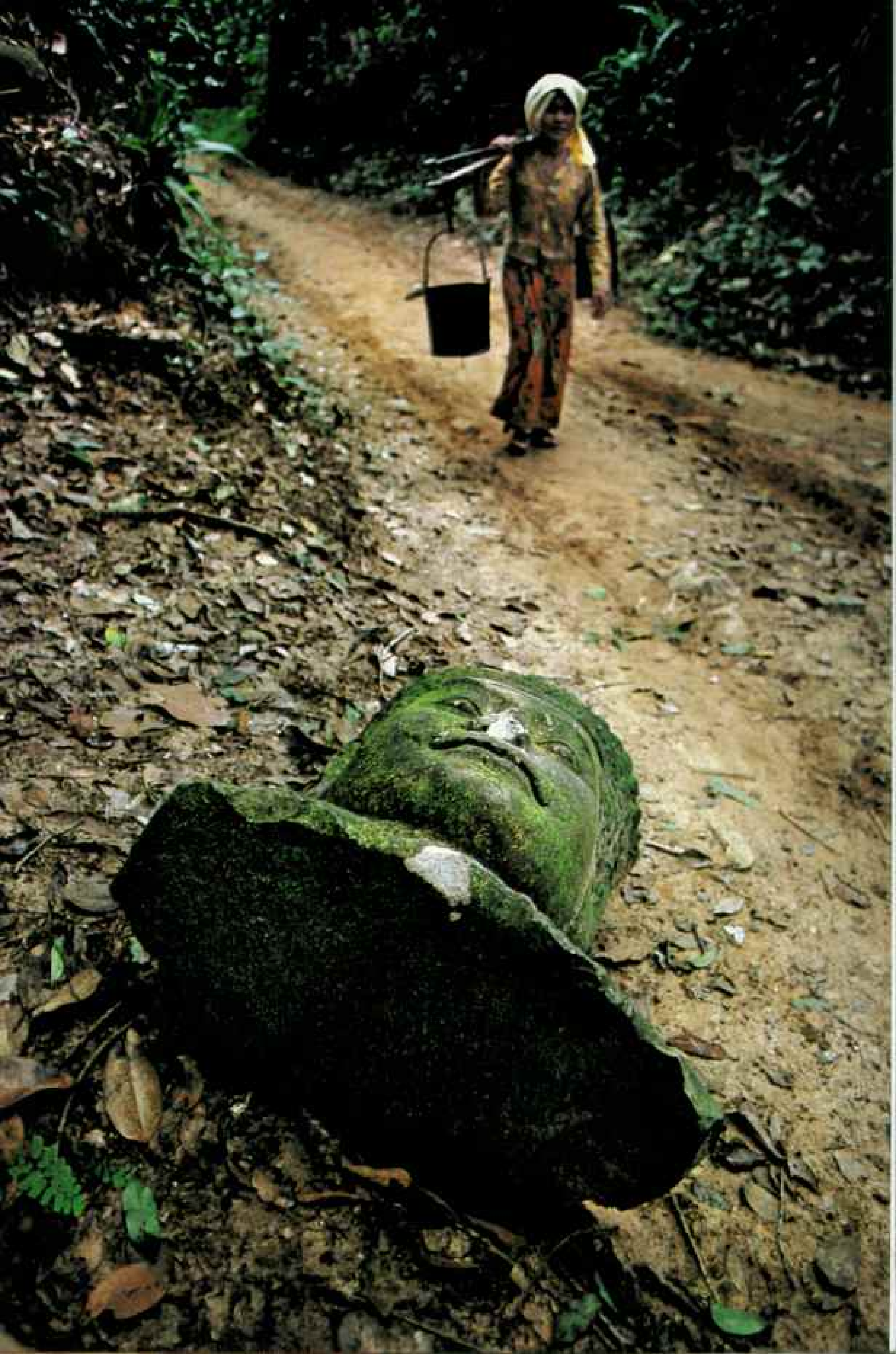
By PETER T. WHITE

NATIONAL GEOGRAPHIC SENIOR WRITER

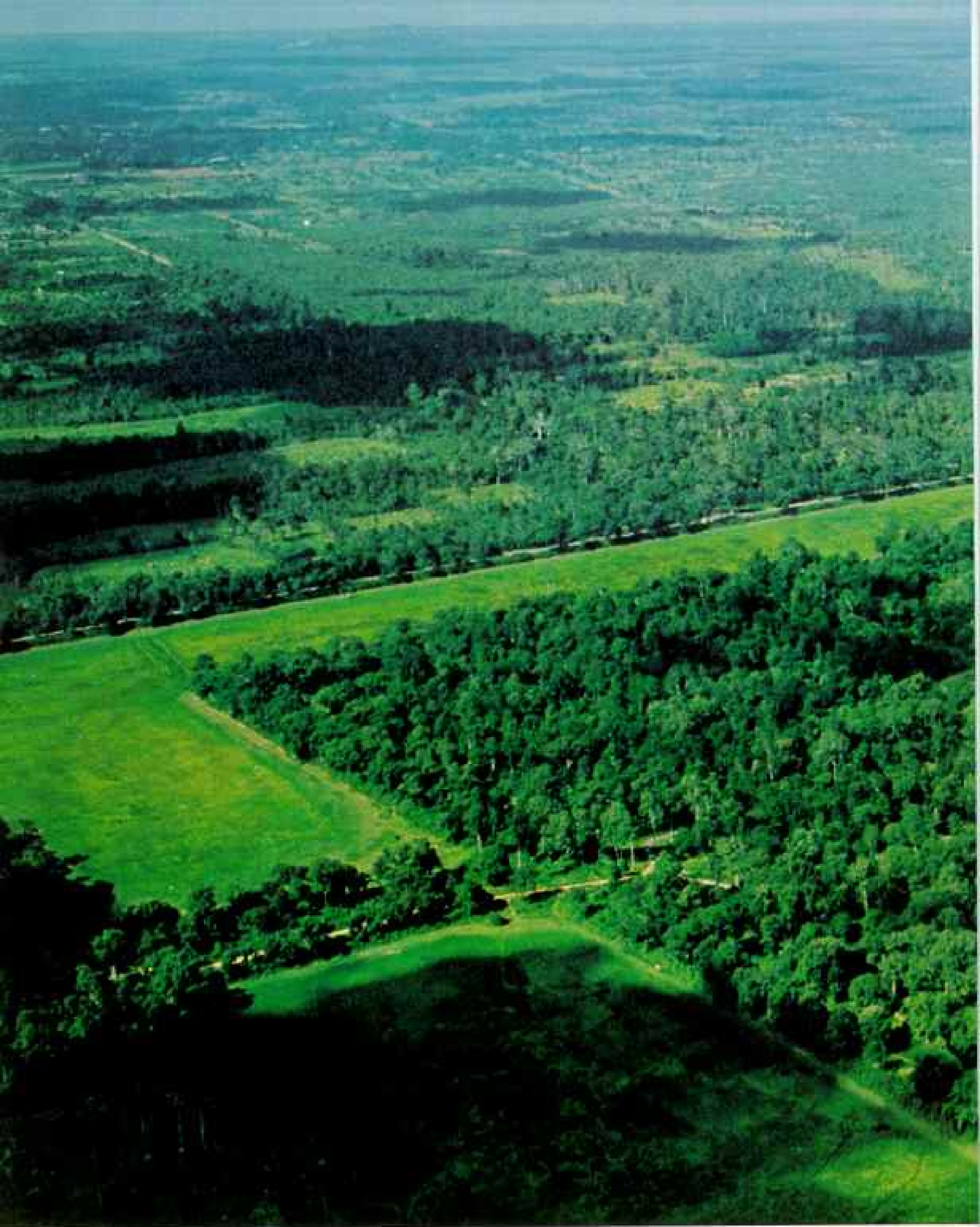
Photographs by

WILBUR E. GARRETT

EDITOR







*Stone likeness of the Hindu universe, Angkor Wat dominates the plain where the Khmer Empire—heir to the kingdoms of Funan and Chenla—flourished from the ninth century A.D.*

*Financed by the spoils of war, the temple was designed by the king's architect and built from a wax model by artisans, workers, and slaves who transported stones in 3,000 ox carts, completing it*



ARMON CORP. NEWS, LTD.

*within 37 years. The temple was dedicated to the Hindu god Vishnu; by the fall of the empire in the 15th century, the site had become a Buddhist shrine. Angkor Wat is partly protected*

*from its most lethal destroyer, water, by a network of hidden drains emplaced in the 1960s by the French scholar and former conservator Bernard Philippe Groslier and his staff of 1,000.*



*The epic symmetries of Angkor Wat begin with the outer gallery that runs in a circumference of half a mile. Within the gallery, sculptures in bas-relief unfold*

*narratives from the myths of Vishnu, Krishna, and Rama; a vision of manifold heavens and hells (pages 568-9); and scenes of the Khmer army in full panoply.*



*One section of the gallery, top left, that sheltered the depiction of a Hindu creation myth was removed for restoration. The stones were cataloged and neatly laid*

*out in the grassy area beyond.*

*Nearly every surface is richly decorated. For example, some 1,700 figures of celestial maidens, or apsaras (page 548), are woven*

*into the stone tapestry. Although the plan, form, and symbols differ, Angkor Wat is cathedral-like in its harmonious mix of small details and massive architecture.*

*Why the main gateway, flanked by libraries at right, faces west is unclear. The other temples face east, away from the direction of the dead.*

NIKON DENPA NEWS, LTD.

# Angkor's vast splendors

AS IMPRESSIVE as are the temples of Angkor, it was the whole complex of 72 major monuments and the irrigation system that made it one of the architectural wonders of the world. Yet not until Bernard Groslier made aerial surveys after World War II was its full extent rediscovered.

The painting at right shows the breadth and majesty of Angkor. As it expanded from about A.D. 900, kings built temples to glorify their lives and assure their apotheoses. As temples were added, so too were canals with dikes, moats, and reservoirs called baray. The hydraulic system was used for transportation and, most important, for rice cultivation to support a surrounding population of about one million.

Only temples are shown. They alone were made of brick or stone, materials reserved for the gods. Even the kings' palaces were wooden, and none survive. The countryside was planted in rice and other grains, and trees were cultivated for fruit.

Groslier notes that the Khmer had an integrated conception of the universe. "In Angkor this was reflected by a harmonious combination of a powerful political organization, a strong, centralized, and uniform society, and fabulous technical organization for rice cultivation. And over these elements was an artistic genius and deep religious belief."

PAINTINGS OF RECONSTRUCTED FACADES OF PHIMEANAKAS, PRASAT KHAN, AND TA KEO ARE BASED ON DRAWINGS BY LOUIS DELAPORTE; PHNOM BAKHENG AND THE BAYON BY JACQUES DUMARCAZ; ANGKOR WAT BY GUY RATILYAN. THE PARTIAL RECONSTRUCTION OF PRASAT KRABANH IS BASED ON THE WORK OF BERNARD GROSLIER.

PAINTING BY NED N. BEIDLER, COMPILED BY HAROLD A. HANSON, NATIONAL GEOGRAPHIC ART DIVISION



PHIMEANAKAS

*Phimeanakas (ca. A.D. 910-1000)*  
A single pyramid of laterite (the tower's shape is conjectural) was legendary as the site where, to protect the empire, the Khmer king had nightly union with the serpent goddess in the form of a beautiful woman.



BAYON

*Bayon (ca. A.D. 1200)*  
With bas-reliefs of commoners as well as gods, it is disintegrating because of crude construction. Of other shrines Groslier says: "An Angkor temple is like a French Camembert: it flows down, and the crust of stone bursts open."

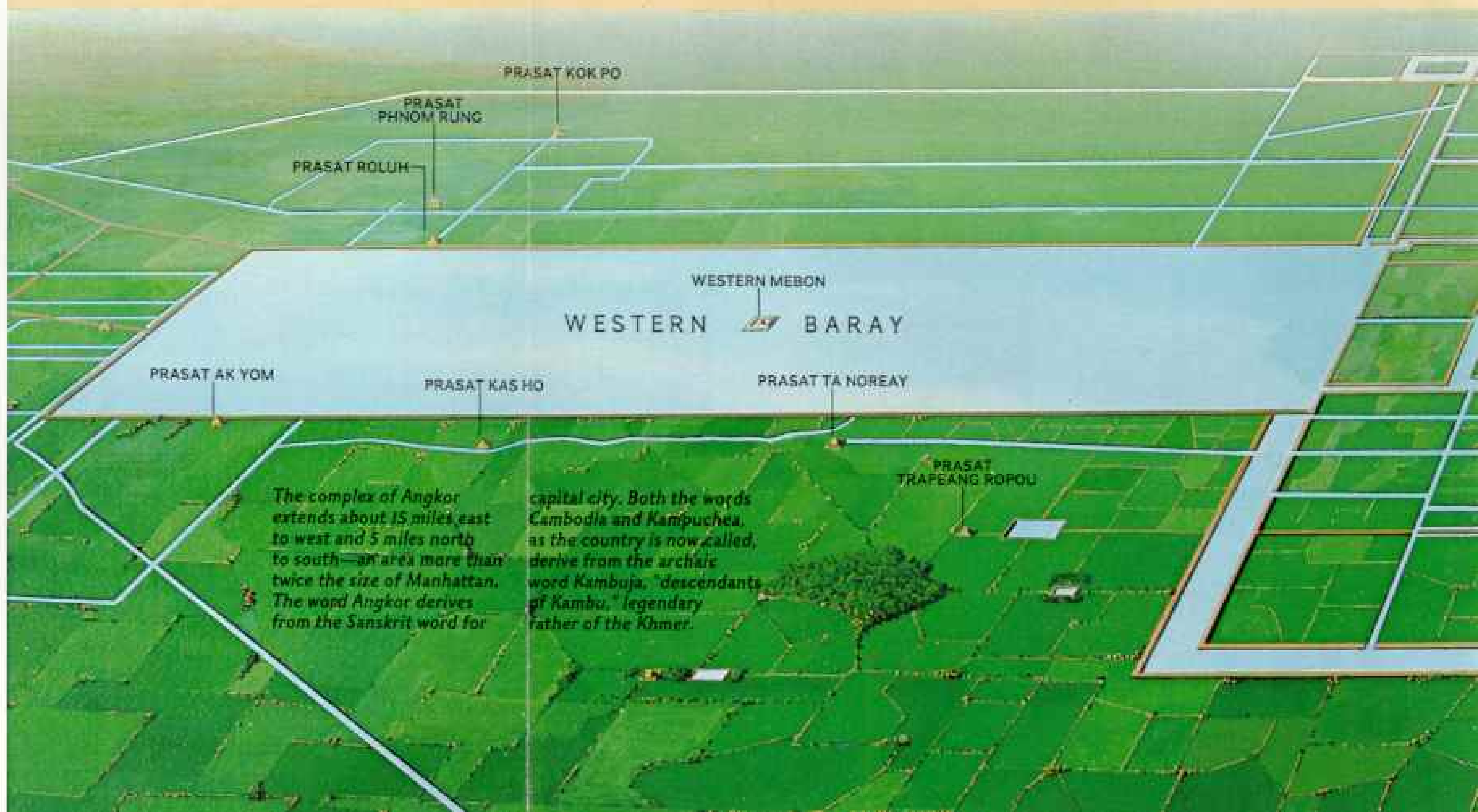


PHNOM BAKHENG

*Phnom Bakheng (ca. A.D. 900)*  
Constructed on a natural hill, it was the first temple at Angkor. Its builder, Yasovarman I, also diverted the Siem Reap River to fill the Eastern Baray, the first irrigation project.



ALL TEMPLES DRAWN TO SAME SCALE, ABOUT 40 FEET PER INCH



The complex of Angkor extends about 15 miles east to west and 5 miles north to south—an area more than twice the size of Manhattan. The word Angkor derives from the Sanskrit word for

capital city. Both the words Cambodia and Kampuchea, as the country is now called, derive from the archaic word Kambuja, "descendants of Kambu," legendary father of the Khmer.



PREAH KHAN

*Preah Khan (A.D. 1191)*  
A labyrinth of pavilions, halls, and chapels, it was built by the Buddhist Jayavarman VII in memory of his father.



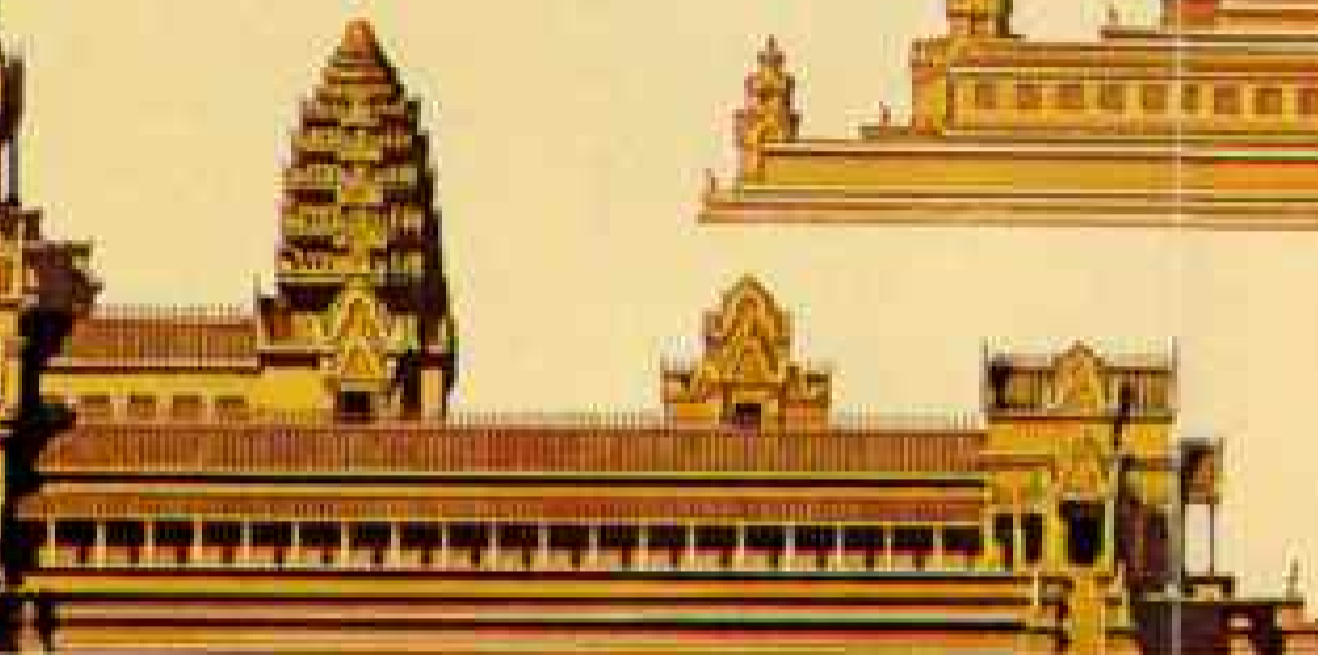
ANGKOR WAT

*Angkor Wat (A.D. 1113-1150)*  
Largest, finest, and best preserved of the temples, it is a physical representation of Hindu cosmology. The five central towers (two are obscured in this view) represent the peaks of Mount Meru, the Olympus of the Hindu gods and center of the universe. The outer wall represents the mountains at the edge of the world, and the moat, the oceans beyond. Building the temple probably required 5,000 workers with 50,000 more supporting them.



TA KEO

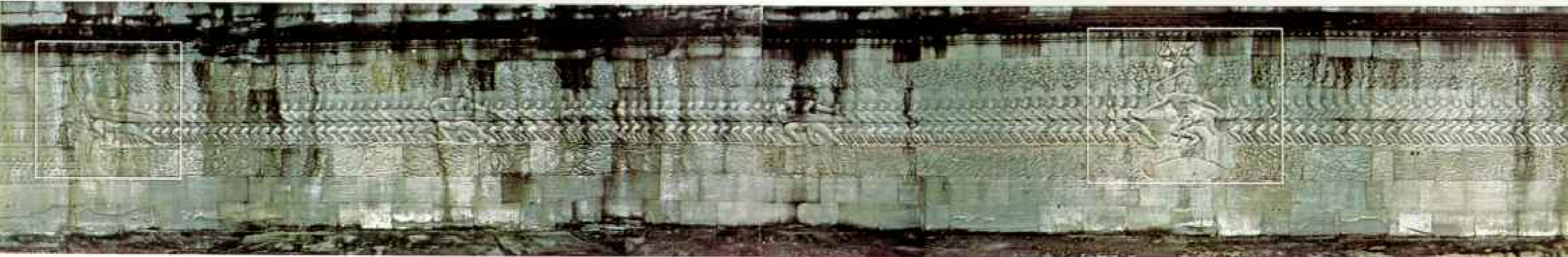
*Ta Keo (ca. A.D. 1000)*  
It was the first major temple made of sandstone, with each of its five towers laid out in a cruciform pattern. Dedicated to the Hindu god Shiva, it was the most massive temple of its period.



PRASAT KRAVANH

*Prasat Kravanh (A.D. 921)*  
Constructed by high court officials, it is unusual for its row of five brick towers and brick bas-reliefs within.





The Khmer were able to adapt aspects of Hinduism introduced to Southeast Asia by Indian traders as early as the first century A.D. and to mold them into artistic, religious, and political expressions that became uniquely theirs.

One of the greatest of such expressions is the 160-foot-long bas-relief along a wall at Angkor Wat (above) that depicts a Hindu creation myth known as the "Churning of the Sea of Milk." The central

figure is Vishnu (outlined at center above and below center), who is closely associated with Angkor Wat's builder, King Suryavarman II.

To the left are the asuras, or demons, of the underworld led by Ravana (below left), whose 21 heads give a sense of motion comparable to multiple exposures or cinema. At right are the celestial gods led by the monkey god, Hanuman (below right). Between them stretches the serpent

Vasuki, reminiscent of snake worship by ancient, aboriginal Khmer.

In a cooperative effort of the gods and the demons, the serpent is used to churn a seminal fluid from which springs the ambrosia of immortality and, by extension, the king's beneficence. This is symbolized by a flight of celestial apsaras born of the churning foam.

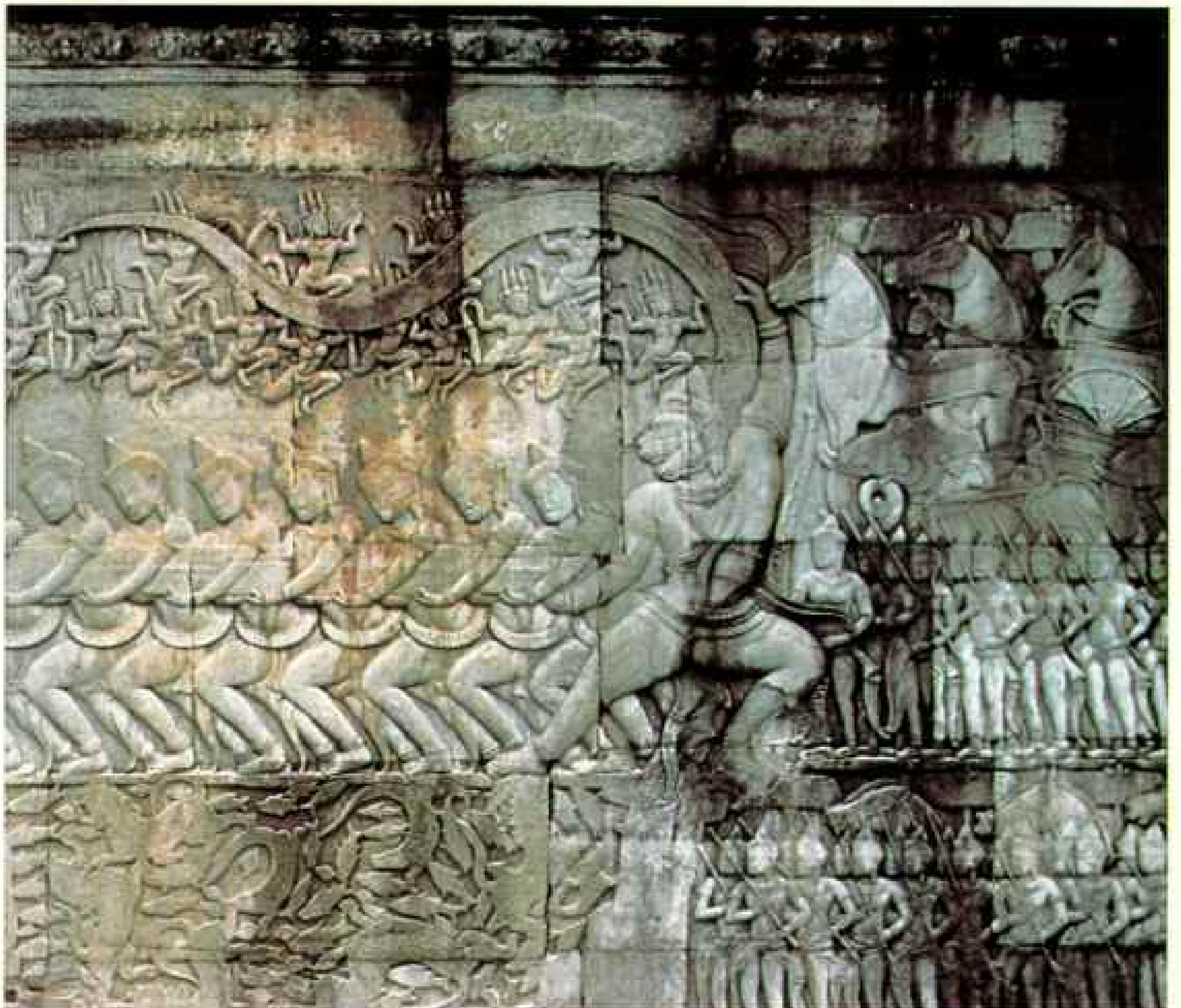
Originally protected by a corbeled vault that was removed for restoration, the bas-

relief is now open to the elements (far right). Dark areas on the relief show that when water penetrates fissures between the unmortared sandstone blocks, it can become trapped and escape only by leaching directly through the stone. In doing so, it evaporates on the surface, leaving destructive residues. Bernard Groslier estimates that the damage will not become irreversible for several decades.





*The bas-reliefs are among the finest artistic creations of the civilization that dominated Indochina for more than six centuries before falling to the Siamese for the last time in 1431. Other pieces of great artistic merit, especially statuary, have been removed to the National Museum at Phnom Penh, where they are safe, at least from the elements.*





(Continued from page 552)

I had not been to Angkor since 1968. When I arrived recently for an extended visit, it was with considerable foreboding.

**O**N MY FIRST DAY I stand in the half-mile-long outer gallery of Angkor Wat, which houses a succession of bas-reliefs unparalleled in extent: eight panels, carved in sandstone, each more than six feet high and 150 to 300 feet long. They are among the highlights of Angkor. The panel before me depicts an allegory of creation: gods and demons churning a mythical Sea of Milk to produce ambrosia, the elixir of life (preceding foldout). It's a theme from the sacred literature of the Hindus, for the brilliant civilization of the ancient Khmer has its antecedents in India.

In the time of the Roman Empire, when trade between India and the Mediterranean reached a peak, Indian merchants seeking more gold and gems, sandalwood, spices, and drugs sent ships to Southeast Asia and established themselves in trading settlements. Over the centuries these peaceful traders were assimilated by the Khmer, who thus acquired Sanskrit writing and the astronomy, mathematics, technology, and religions of India, blending these with elements of their earlier culture.

And so it is that the Khmer, in a sense, owe their existence as a nation to India, as the French do to the Roman occupation, and that the builders of Angkor, steeped in Hindu cosmology, dedicated their temples to Siva, Brahma, and Vishnu.

In the Kulen Hills they carved a riverbed with thousands of lingas, phallic symbols of Siva's creative power, to sanctify the waters that irrigate the Angkor plain. The temples—Phnom Bakheng, Baphuon, Angkor Wat—model the universe: An enclosing quadrangle delineates the earth bounded by mountain chains with limitless oceans beyond. In the center rises Mount Meru, the celestial abode of the gods, who like all else are subject to interminable cycles of destruction and creation.

The very dimensions of Angkor Wat are allegories. The American art historian Eleanor Mannikka calculated that the 617-foot length of the bridge over the moat, when measured in Khmer *hat*, corresponds to the

432,000 years of an age of decadence; that the 2,469 feet between the first step of the bridge and the threshold of the temple's center represent the 1,728,000 years of a golden age. A Khmer Brahman of the early 12th century, passing those bas-reliefs and successive terraces, she writes, would have stepped off many more such meaningful measures before entering at last the central tower's dim sanctuary, as Suryavarman II may have done for the first time in 1131, to face the great image of Vishnu. There, "Time stops, divinity and space merge and a long numerical journey ends in infinity."

That Vishnu image vanished long ago. Now, in the central tower, I see five Buddhas. They reflect a chain of profound changes begun in the late 12th century.

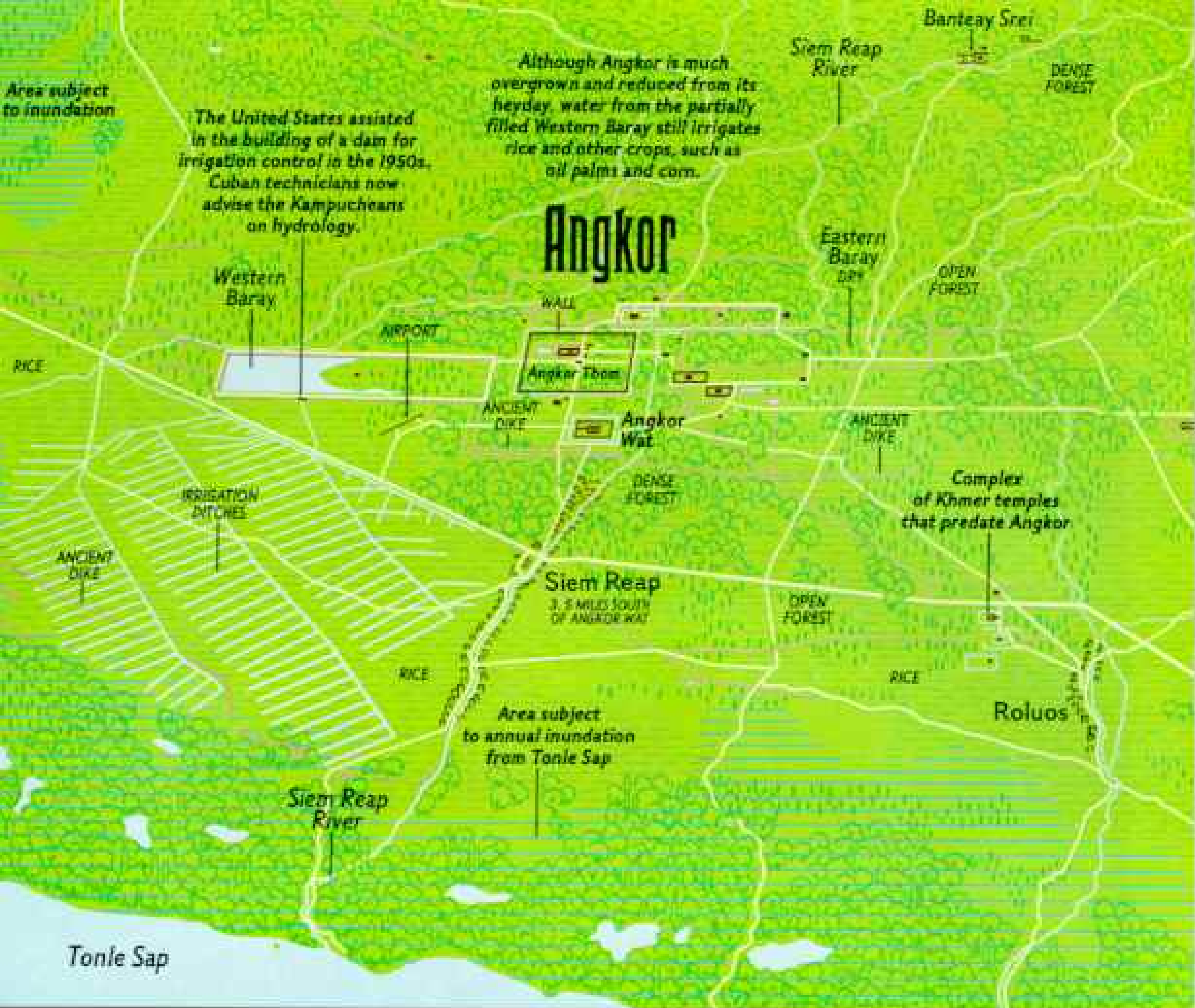
The Cham, sometime vassals of the Khmer, came from the east and sacked Angkor in 1177. It was a fateful shock. Eventually King Jayavarman VII took his revenge, and then turned to rebuilding Angkor. The Hindu gods had failed as protectors. Jayavarman did not abolish their worship, but he dedicated his new capital—Angkor Thom, "the great city," surrounded by an eight-mile moat 300 feet wide—to a new protector, also derived from India: the Buddha.

The largest monument of Jayavarman VII, the Bayon, in the center of Angkor Thom, bears 216 faces of an omnipresent deity. It is another highlight of Khmer artistry (pages 582-3).

The last Sanskrit inscription from Angkor dates from 1327; the first in Pali, the Indian dialect of Buddhist scripture, from 1309. And by the 16th century the city with the Sanskrit name Yasodharapura had acquired the Khmer appellation Angkor. That glorious temple became known as Angkor Wat—a wat being a Buddhist monastery.

**I** SWEAT in the humidity and the searing sun. Why is the Sea of Milk gallery's roof missing? It was dismantled by the Angkor Conservancy in 1969. Hundreds of sandstone blocks lie nearby, neatly numbered. The bas-relief on the wall shows dark splotches. I have come face to face with some of Angkor's fundamental problems.

The first is structural. For their monuments' foundations, the Khmer made trenches filled with fine sand that allowed



OBLIQUE VIEW BY SHELJINKA STEFANOFF, COMPILED BY HAROLD B. HANSON NATIONAL GEOGRAPHIC ART DIVISION

their mortarless walls to be perfectly level, resting on laterite slabs put over the sand. After centuries of rain seeping down, the sand shifts, the temple settles and cracks.

Those perfectly fitted sandstone blocks also are prone to trouble. Sandstone consists of hard mineral particles in a relatively soft alluvial paste, mostly clay. Centuries of rainwater passing through will dissolve this paste. The block disintegrates. What had been supported will cave in.

The second problem is biochemical, a kind of skin disease. Water dripping down from the vaults and seeping up from the soil by capillary action contains organic compounds, often including sulfur. When water enters a stone and passes out again, by evaporation, sulfur is deposited on the stone's face. Bacteria come and oxidize that sulfur, altering the carving.

To shore up the temples and to stop the damaging transmigration of water through the sandstone, the Angkor Conservancy chose a drastic two-step remedy. First, dismantling. Then complete reconstruction, of the painstaking sort first called anastylosis by the 19th-century restorers of the Acropolis; it means reconstruction of a monument with its original materials, adding new materials only as absolutely necessary.

At Angkor this has meant new foundations of concrete, so the walls will be stable and no water can seep up. New interior walls of concrete, behind brick or sandstone facing. And drains, to catch the rainwater and carry it outside.

Much of this work has been completed—at the Baphuon, at Prasat Kravanh, in parts of Angkor Wat. The Sea of Milk gallery has its new foundation and drains. But before



**I**N SEEKING to assess the past glories and present problems of Angkor, one must consult French sources. It was the École Française d'Extrême-Orient, the French government's research institution specializing in Southeast Asia, that took charge of Angkor in 1908. A distinguished

member of the institution has been Bernard Philippe Groslier, a student of Khmer culture and the chief rebuild-er of Angkor. His insights—gleaned from his publications and from conversations with him at Angkor in the 1960s and recently in Paris—contributed much to this report. —THE EDITOR



*Preview of a modern hell: A section of bas-relief at Angkor Wat depicts the good awaiting better lives on the top tiers, while those at the bottom can expect reincarnation in the likes of dogs, vermin, or despots. Their agonies of being starved, bludgeoned, led away in chains, and more were common under the Khmer Rouge regime of the 1970s.*

*As a guide told the author: "Before, hell was a place we could not see. It was a belief. But Pol Pot made it a reality."*

*Kept lustrous by the touching hands of current Kampuchean visitors to Angkor Wat, the bas-relief may have become a kind of talisman to protect them from a reincarnation of their own recent history.*

the roof could be reconstructed, the time of the Angkor Conservancy was over.

Sponsored by the French government, the Conservancy had taken charge of Angkor in 1908. From 1953, when Cambodia became independent, it had been financed equally by the Royal Cambodian government of Prince Sihanouk and by France; it was a technological powerhouse, an archaeologist's delight. A hundred vehicles—trucks, bulldozers, jeeps, and 19 cranes, the tallest 200 feet high—a sandstone saw so big



*Magical vandalism: By painting tattoos and a wristwatch on a Buddha, defacers hoped to gain protection and a current status symbol—a fine watch. Pich Keo, a former Groslier assistant and current conservator, lacks resources to prevent such acts, as Angkor lies within a zone contested by government troops and Khmer Rouge guerrillas.*

it was fed by its own small railway; power plants, weather stations, air-conditioned laboratories; engineers, architects, photographers, draftsmen, mechanics, a thousand laborers.

The Angkor Wat towers were checked regularly by a topographer with a theodolite; a millimeter's variation from the vertical, and there'd be a check for trouble. I remember the archaeologist in charge, Bernard Philippe Groslier, telling me in 1968 that he had nearly everything he needed.

Soon after, civil war engulfed Cambodia. What followed, from 1975 to 1979, was the fanatically destructive regime of the so-called Khmer Rouge, or Red Khmer, led by Pol Pot. Its reign of terror, of purposeful starvation and murder, summons up the vision of hell carved in one of the Angkor Wat bas-reliefs. (A detailed report of Khmer life then and now begins on page 590.)

A few months ago when I met the new conservator of Angkor, a former Groslier assistant named Pich Keo, he had one small truck, a bicycle, and a hundred unskilled men, not even enough to keep all the greenery cut that sprouts among the stones. . . .

**P**ICH KEO is my guide for monument touring in a government jeep that brought me in a two-day drive from the capital, Phnom Penh. We begin one day with Prasat Kravanh (page 581), a five-towered brick sanctuary completed under Harshavarman I in 921; disentangled from the jungle by Henri Marchal and Georges Trouvé in the 1930s; and reconstructed, with new foundation, interior walls, and drains by Groslier in the 1960s.

When the bricks were put back, a few broken ones were replaced with carefully made reproductions. They are discreetly marked with the letters CA, the Conservancy initials. That's the way of anastylosis.

The central tower, originally closed, was left open at the top so the carvings inside can be seen by natural light. The opening was covered with special glass, to filter out radiation that might harm the sculptures. It has been shot out. A steel door—lockable, to discourage vandalism—is gone. Pich Keo says the grasses outside were cut a month ago. They're nearly three feet high.

Sras Srang, the royal bath of Jayavarman

VII—2,500 by 1,300 feet, once full of water—is full of grass. And Banteay Kdei, called the citadel of cells because of its many gallery-connected small chambers—for Buddhas, for monks—is a mess.

Blocks of stone lie jumbled where a gallery has fallen in. The sun shines through where more pieces of the corbeled vault will follow before long (page 575). In the center of a littered chamber, where once a statue stood, I see a charred palm stalk. "Somebody burned it to make smoke," says Pich Keo, "so the bats will fall." So they can be eaten, in bat soup.

I see a column made of two vertical pieces, originally held together by bronze clamps. Those clamps were taken long ago, presumably for their magic properties; a dagger of Angkor bronze has special powers. In the early 1920s, the Conservancy encircled the two-piece column with a steel hoop. That was removed recently, presumably to make a rim for an oxcart wheel.

In another chamber sits a Buddha image disfigured with black paint (facing page). Isn't that awful? Yes and no. The wavy pattern on the Buddha's chest is the same that many Khmer carry tattooed on theirs, for protection against illness or injury. By daubing the image, the dauber apparently hoped to gain protection for himself.

But what's that, painted on the Buddha's arm, a wristwatch? I got an authoritative explanation, later, as follows:

In the time of Khmer Rouge rule, when all religion was officially despised, some underlying defaced this image with the approval of his Khmer Rouge superiors; but deep inside he hoped that by presenting the Buddha with a symbolic wristwatch he might somehow acquire a real one himself—preferably a Swiss Omega, then the mark of high functionaries. He hoped to become a powerful man himself, by magic. . . .

I remember some Angkor magic myself. In a dark recess of the Bayon was a well. Chinese businesswomen from Phnom Penh were said to buy its water, to bathe in so as to do well financially and be more attractive to men. Soldiers went away with full bottles. It was clear, and cold, and gloriously refreshing. An old gentleman assured me it would give me long life.

That was in 1968, when some 70,000

tourists came, many of them Americans on round-the-world trips, and stayed at a luxurious inn near the main causeway to Angkor Wat. A hundred thousand were expected in 1970; Air France built another hotel.

It was just finished when Vietnamese Communist guerrillas attacked government troops nearby. From then on they and the Khmer Rouge, then their allies, held sway at Angkor; tourism was finished. Groslier was allowed to continue his work on a limited scale, but in 1972 he was ordered out.

The few visitors to Angkor nowadays—official delegations from Communist countries, international-aid functionaries from Phnom Penh, the odd journalist—are put up three miles away in the little provincial capital of Siem Reap, at the old Grand Hotel. Of those two luxury hotels right at Angkor, nothing remains.

The Grand Hotel has running water, and electricity in the evening. In the morning, before the sun becomes too intense, the benches in front are occupied by goats. Visiting the monuments requires an armed escort of provincial militia; there might be troublesome Pol Pot guerrillas about. This morning the militiamen carry extra percussion grenades. We're off to see some of Angkor's formidable hydraulic works.

**K**HMER PROSPERITY depended on water—on its favorable distribution throughout the growing seasons, with the rice fields softened for tilling and then flooded at the right times. But the monsoon rains might come too early or too late. And so, when building a major monument, the Khmer would construct what has been termed a hydraulic city. With canals, wide moats, and *baray*—huge rectangular reservoirs.

These baray were not dug into the earth. They were formed by the raising of dikes. When such a reservoir is filled by rain and a diked river, the water level will be above the level of the plain; when water is needed, open the sluices and gravity will distribute it via irrigation canals and ditches. Thus dry-season farming is possible too.

By these means the Khmer obtained two and even three harvests a year, sustaining an enormous population on which rested the kingdom's economic, demographic, and



DAVID BLAN HARVEY (RIGHT)

*A tide of vegetation now flows through and around a building at restored Preah Khan (above) since it was photographed in 1968 (top). The edifice—with its rare round columns—evokes Western architecture, but it is probably a replica of a wooden structure.*

*A similar monument at Ta Prohm (right) was deliberately not restored by Groslier. It was to be the “before” to Preah Khan’s “after.” About 12 feet of humus was removed, enough to expose the gnarled roots of an enormous silk-cotton tree. “We created a kind of false, romantic view of nature,” says Groslier.*









Structural weaknesses inherent in Khmer building techniques and the assaults of water and trees have conspired against the monuments. In the 1920s and '30s, concrete shoring pillars (top) and other temporary conservation measures were employed. When, however, deterioration is as advanced as in a gallery of Banteay Kdei (facing page), dismantling and reconstruction on hidden, waterproof concrete footings are necessary.

Years would be required to assemble the proper equipment and staff before the stones themselves could be moved, even if unhampered by Kampuchean politics, which can be as lethal as a snake (above) the people call Hanuman. The tree-dwelling serpent drops down on its victims from above.

consequently political strength. At the beginning of the dry season the king would lead the army to make war in the north or east or west, for glory, for slaves. Especially powerful kings ordered new hydraulic cities, new monuments, new baray.

Branching from the brownish Siem Reap River, a 15-foot-wide canal slowly flows westward, lined with shrubbery so tall that the branches over it form an intermittent tunnel. The canal skirts the square of Angkor Thom, turning south and then west again—and there's the Western Baray, built 900 years ago, the biggest of all.

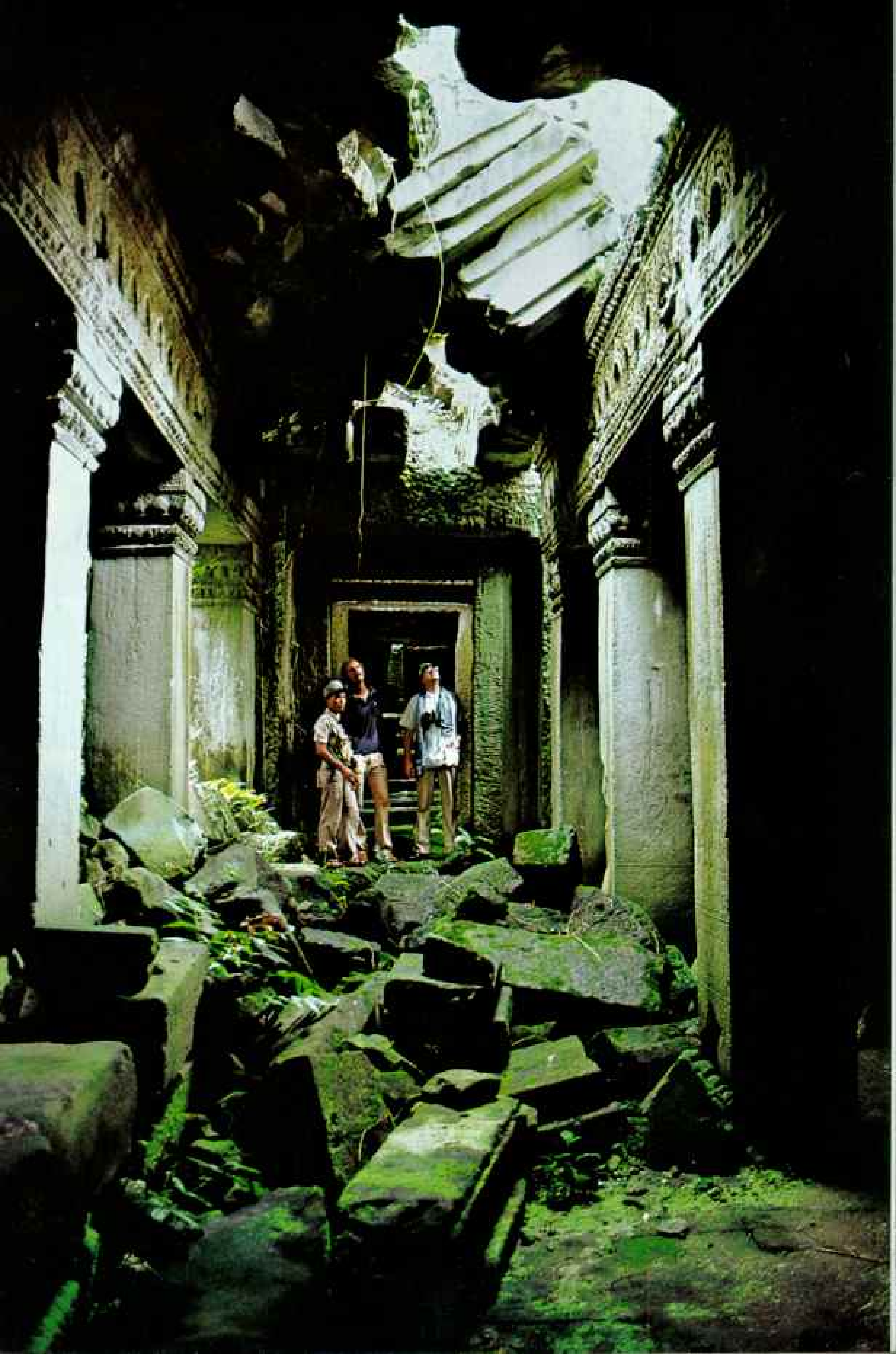
Its dimensions amaze me all over again—one and a quarter by five miles. A little more than half of it is silted up: Oxen graze in it; in the distance two boys fly a kite. But the far-western portion, fed by that slow-moving canal, is an inland sea.

There's a sluice gate there, built in the 1950s, partly with foreign-aid funds from the United States. I remember being told that it dispensed irrigation water to 32,500 acres, through 140 miles of arterial canals. The farmers had radios, motor scooters, and houses with tile roofs. It was a landscape of prosperity.

That was 14 years ago. The civil war and the Pol Pot terror brought a dramatic decline. The population has shrunk. Most of the land lies uncultivated. The houses are thatch. A village official tells me that people have trouble getting enough salt.

**A**ND WHAT BROUGHT the decline of Angkor? Groslier believes this complex process may have begun as early as the mid-11th century. So much was built that eventually all available space was taken, all the water captured. After Angkor Thom nothing of importance was built. Waterworks gradually deteriorated, population declined, a once assertive faith gradually made way for a fatalistic Buddhism. The Siamese increasingly attacked from the west and at last gave Angkor a final blow, killing all the men they could capture and carrying off multitudes of women. Around 1430 nearly all Angkor was abandoned, though not Angkor Wat; that remained a Buddhist pilgrimage shrine.

Subsequent Khmer monarchs held court far to the south, but in the mid-16th century



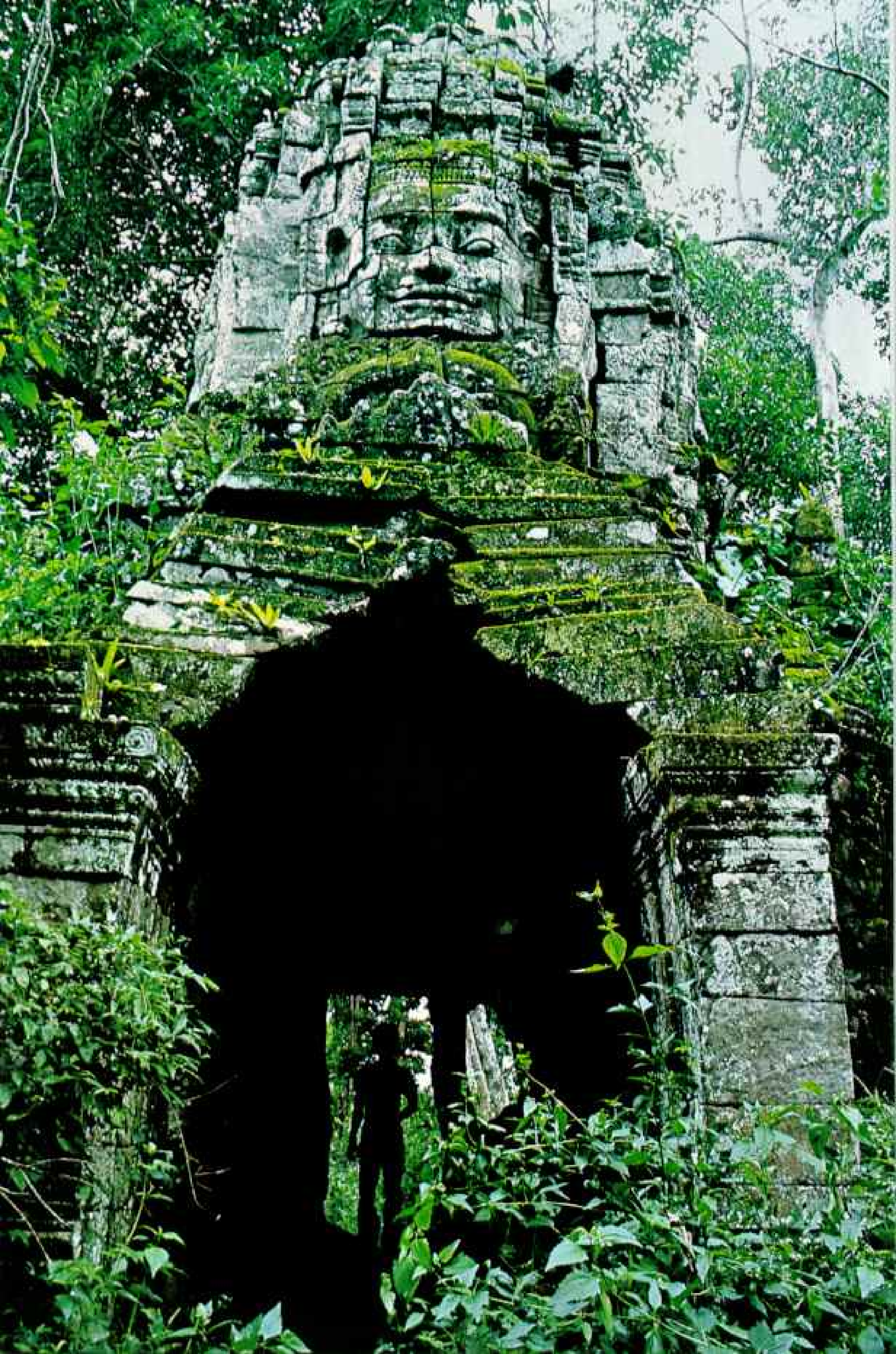




*Beheaded by war? Stolen for the illicit art market and sold, as rumor has it, for their weight in salt? Or hidden nearby? If any heads missing from the north entrance to Preah Khan (top) are simply buried, they are in no greater danger than they were in 1968 (left). As Groslier points out, "One agent of destruction at Angkor was the beginning of conservation in 1908 that exposed stone to new cycles of erosion."*

*Angkor has suffered worse, having been sacked by the Siamese in the 14th and 15th centuries and later abandoned. In recent years the suffering of the monuments has been, says Groslier, "practically nothing compared to the suffering of the Khmer people. The most important thing is to save the people. For the time being, the monuments can wait."*

*Yet as time drags on with little prospect of peace in Kampuchea, possibilities are being explored to mount an international effort for the purposes of preserving Angkor and resuming its restoration.*



a king hunting elephant and rhino stumbled upon Angkor Thom, by then a dead, overgrown city. He had it cleared and restored; for 50 years, as kings came from time to time, Angkor again saw pomp and ceremony. Spanish and Portuguese missionaries and traders came too. Their accounts, published in the early 1600s, were the first word of Angkor to reach Europe. These marvels, they said, must have been created by Alexander the Great, or ancient Romans, or Jews from China. And then all but Angkor Wat once more was left to the birds and the trees.

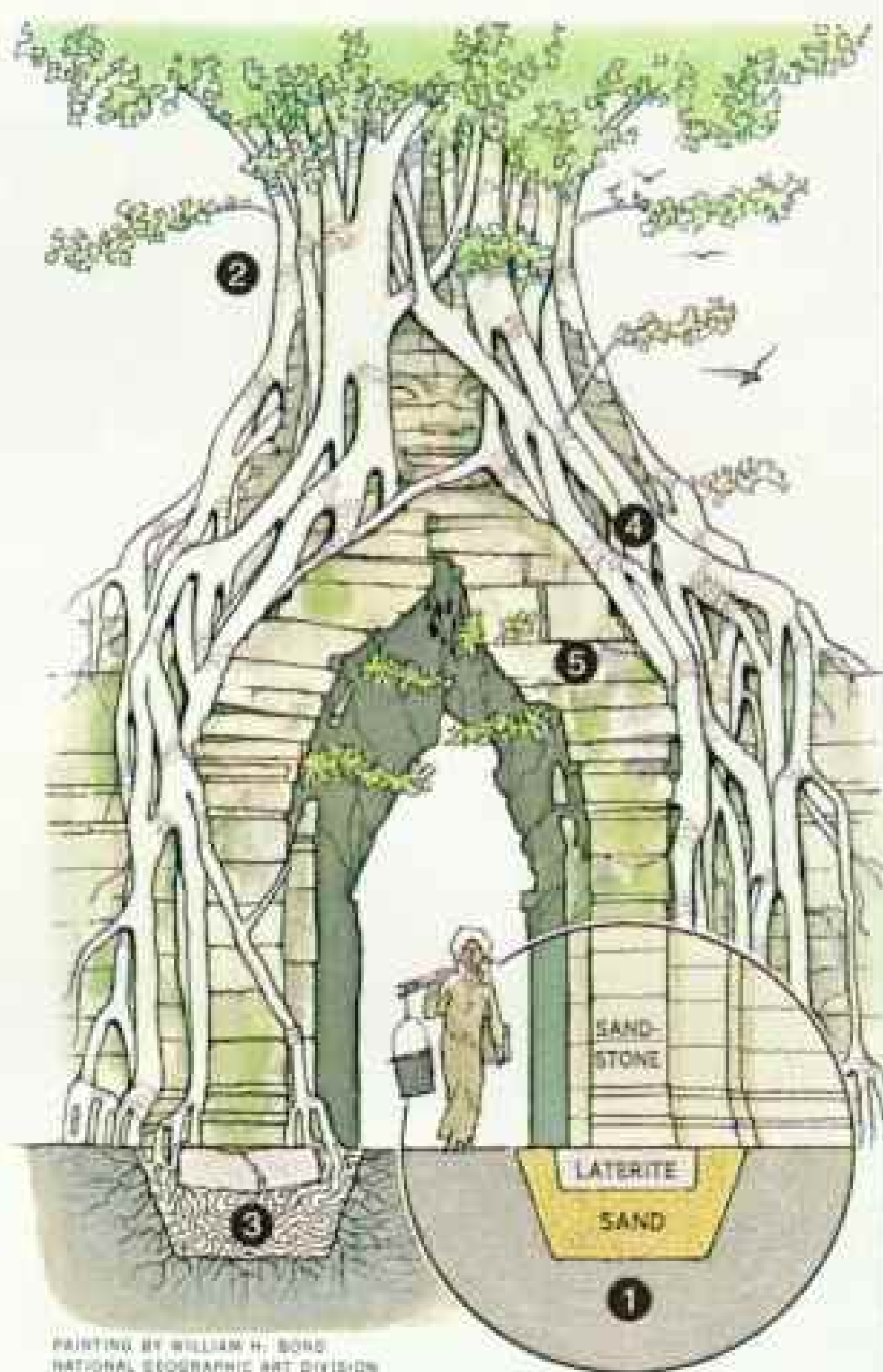
**WHEN MAINTENANCE** is neglected, and birds excrete seeds of the fig tree on the tops of monuments, the seeds may germinate and send down roots. Small roots also enter between stones, and as they grow larger they pry the stones apart. But while the tree lives, its roots often hold the parted stones together, as would a net. After the tree has died, its roots rot and the stones spill apart. Humus forms.

This process has been common at Angkor; I see it most clearly at Ta Prohm, where the Conservancy let the roots have their way (pages 572-3). As we climb over mossy, slippery piles of spilled laterite blocks, Pich Keo quietly says watch out. A Hanuman snake. Named for the fearless, super-agile leader of the benevolent army of monkeys—"It jumps, it flies, it is skillful like Hanuman in battle." It's only a foot long, beautifully emerald green, and poisonous (page 574).

Given earth enough and time, the spilled stones or even a building still standing will eventually be covered over by a mound. Numerous Angkor monuments were first encountered in this condition—Preah Khan, Ta Keo, just mounds. Uncovered, the stones were invariably found to be well preserved; the covering earth had suppressed moss and fungus.

Groslier made many photographic reconnaissance flights over Angkor and reported many more mounds still. And so it's likely that sizable monuments are yet to be uncovered, and presumably thousands of fine Khmer bronzes. Compared with archaeological sites in Greece or Egypt, he says, Angkor remains practically virgin.

In Angkor and vicinity—as elsewhere in Cambodia, officially called Kampuchea



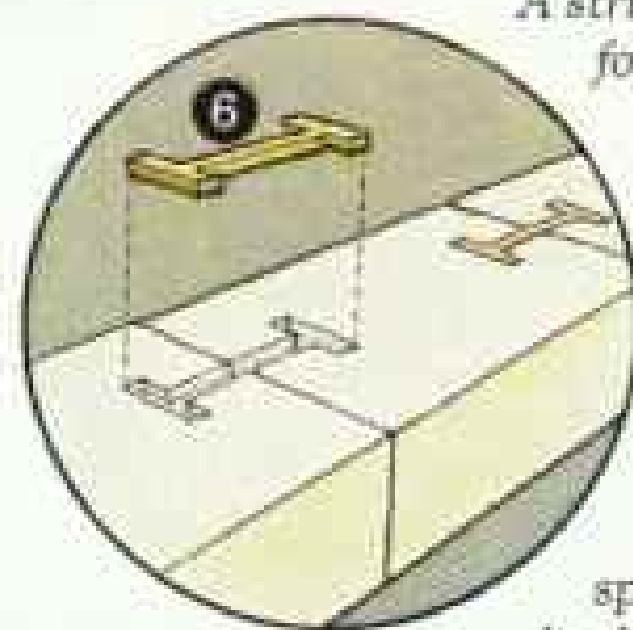
PAINTING BY WILLIAM H. BOND  
NATIONAL GEOGRAPHIC WWT DIVISION

## Nature and neglect

Structures such as a gate at Ta Som (facing page) may suffer multiple natural attacks.

A structurally unsound foundation of sand and laterite (1) promotes cracks by settling and water penetration. Seeds of banyanlike fig trees from bird droppings sprout atop structures (2) and send roots down to the spongelike foundation (3).

As the tree matures, its enlarging roots (4) penetrate interstices between stones. When the tree dies, the dislodged, unsupported stones fall (5). Some stones were held together by bronze clamps (6), many of which were looted long ago probably for their magical powers.





now—one sees soldiers of the Socialist Republic of Vietnam. They were instrumental in ejecting the regime of Pol Pot and still occupy most of the country, guarding against his return. Climbing around on the Bayon one morning, I encountered a cheerful bunch of them, unarmed. One took my picture. I snapped him and his buddies.

But this morning Angkor swarms with tense Vietnamese carrying rocket launchers, field radios, mine detectors. Some sweep around the Bayon. Who's the VIP with a jet all to himself?

It's Gen. Vo Nguyen Giap, who prevailed in Indochina against the expeditionary forces of France in the 1950s—and, later, against the United States. Three hours inside Angkor Wat, and he's gone. He never did get to the Bayon, where bas-reliefs depict the land and naval battles of the Khmer and the Cham. Among the sandstone soldiery are Vietnamese fighting for the Cham king. The Khmer called the Cham and their mercenaries by the Sanskrit word *yavana*, denoting evil foreign barbarians; whence comes *youn*, the disparaging term some Khmer employ for the Vietnamese today.

As our tours take us farther along the periphery of the monuments, Pich Keo seems increasingly nervous. To me, the panorama of the stones and the greenery appears peaceful enough: occasional oxcarts or bicycles on the paths; a few people cutting timber or drawing lamp oil from *chhoeu teal* trees. Over it all, a great calm.

Not long after I left, a respected Swiss daily, the *Neue Zürcher Zeitung*, reported from Phnom Penh that Pol Pot guerrillas were said to have attacked the Siem Reap airport, which stretches to within 400 yards of the Western Baray. Supposedly there were at least ten dead. I wondered. Such reports must be treated with caution. But as of mid-December 1981 the government severely restricted foreigners' visits to Angkor, at least for the time being. . . .

**A**LL ALONG I had been bracing myself for unpleasant surprises, for some major damage or loss.

I saw carvings and statuary chipped and bullet pocked.

In the Angkor Wat bas-relief of the great military parade of Suryavarman II—with its



BERNARD PHILIPPE GROSSELER (TOP); DAVID ALAN HARVEY (ABOVE)

*One of the earliest temples in Angkor was privately financed and built of brick in 921. It became known as Prasat Kravanh, or cardamom sanctuary, for the overgrowth that hid it long after the fall of Angkor. Restoration began in 1960 (top). Despite some later damage, it stands as a fine but unusual example of Khmer architecture (above).*

*Inside, bas-reliefs depict scenes from the myths of Vishnu and his consort, Lakshmi (facing page).*





*A map and model of the kingdom, the Bayon was the last great temple built at Angkor. Each of its 54 small towers was a ritual compass conveying blessings*

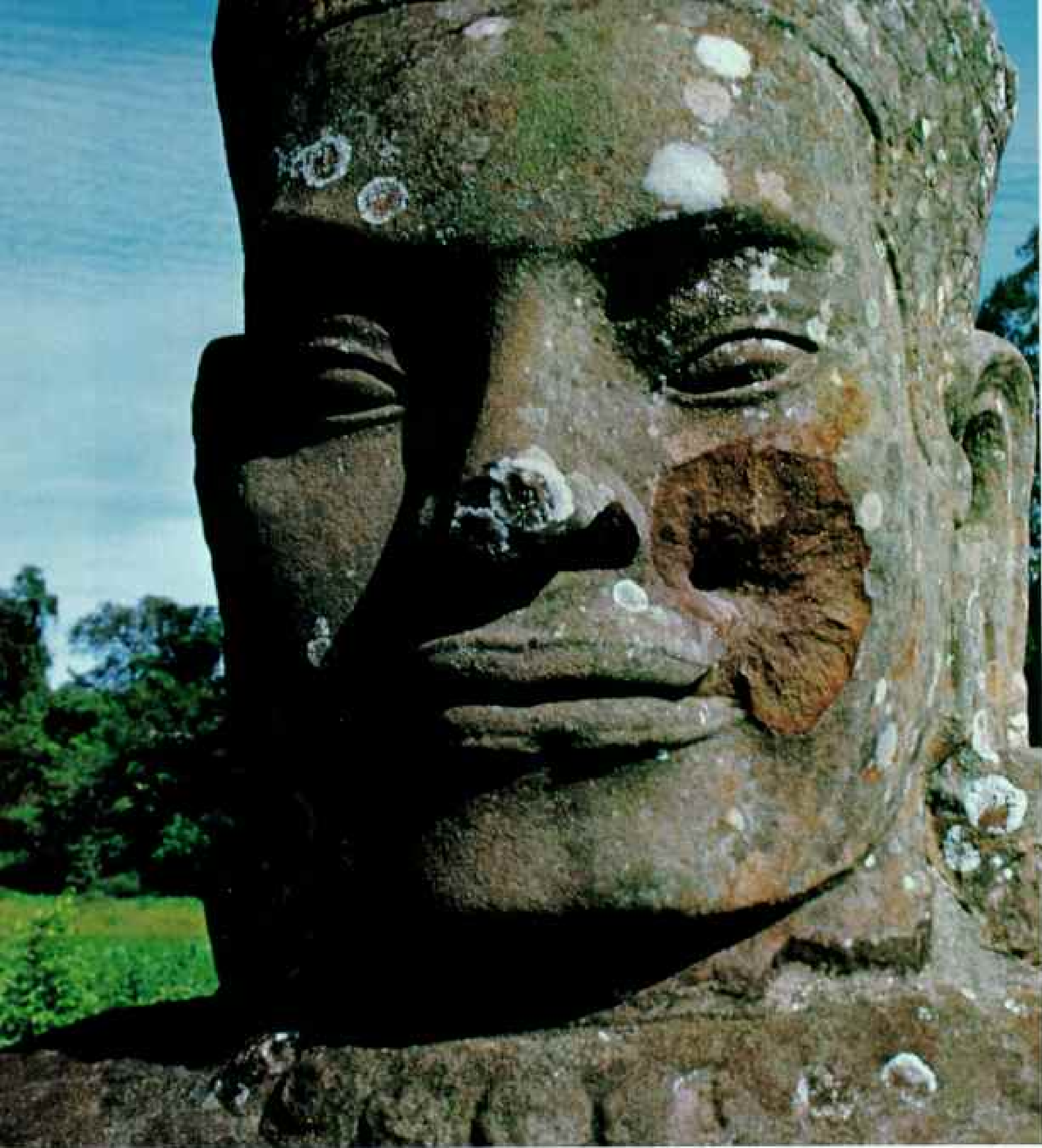
*on temples and hospitals across the country. The marking atop the front central tower was placed by Groslier as a sign to deter bombing.*



SHON DAKE NEWS, LTD.

*After the Buddhist Jayavarman VII became king in 1181, he conquered Champa, a state in what is now Vietnam, whose legions had sacked Angkor in 1177. He began*

*a frenzy of slapdash building, and because the old Hindu gods had failed in 1177, Jayavarman dedicated his largest temple, the Bayon, to Buddha.*



chariots and war elephants, with the sacred fire carried ahead of the troops—there are holes, made by shrapnel. An artilleryman of the government army, aiming for Khmer Rouge, sighted his howitzer improperly.

Near the Bayon lies half of the head of a colossal Buddha, dynamited by Khmer Rouge zealots. When I later reported this to Groslier—now a senior government scientist in Paris—he said it was a 16th-century

piece and artistically not important.

Historically, of course, everything is important. But one must remember that a number of Angkor's artistically most important works went to some of the world's great museums long ago. And that those left in place were removed by the Conservancy in the later 1950s, when thievery was rising and guarding such vast expanses became clearly impossible.



DAVID BLAN HARVEY

Groslier had noticed that the famous statue of the so-called Leper King, at Angkor Thom, had saw marks on the neck. Someone was after that head. He sent the statue to the museum in Phnom Penh and put out a reproduction. A naive thief stole that.

Today the world's outstanding collection of Khmer statuary by far is on view in the National Museum in Phnom Penh—the great bronze Vishnu, two heads purportedly

*Wound in stone flesh of a god has been made by rifle fire since 1972, but whether by a Vietnamese, Khmer Rouge, soldier of the current regime, or drunken militiaman is unknown. Random violence has marred Angkor, but all factions seem to have agreed that the temple complex should be immune from major battles.*

of Jayavarman VII. In short, I have learned that the major problem at Angkor of late has been neither war damage nor thievery, but simply neglect.

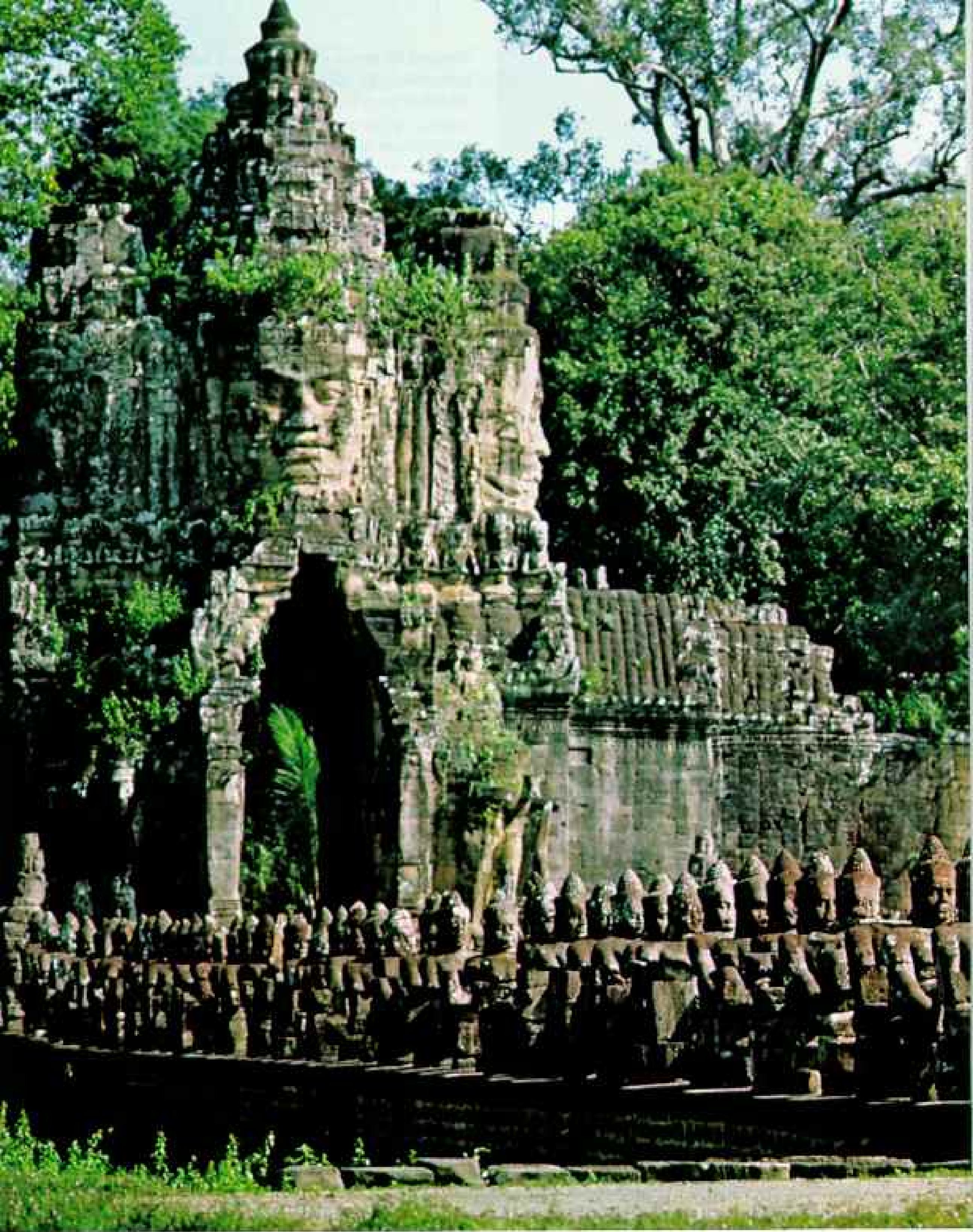
Just the same, Preah Khan was a shock. In 1968, Wilbur E. Garrett, now Editor of NATIONAL GEOGRAPHIC, photographed the long line of stone divinities along the northern gate causeway. At that time, one head was missing. Now it's two, three, four, five, six, seven, eight, nine. . . .

Lost en route to the Thai border, or to Vietnam? Smuggled out by some diplomat, and sold in Geneva or Düsseldorf? Or still in a dealer's storage in Bangkok? Perhaps strewn somewhere hereabouts?

**W**HAT'S BEEN HAPPENING lately to promote conservation at Angkor? There's been visiting by representatives of international organizations. Much talk about help, not much action.

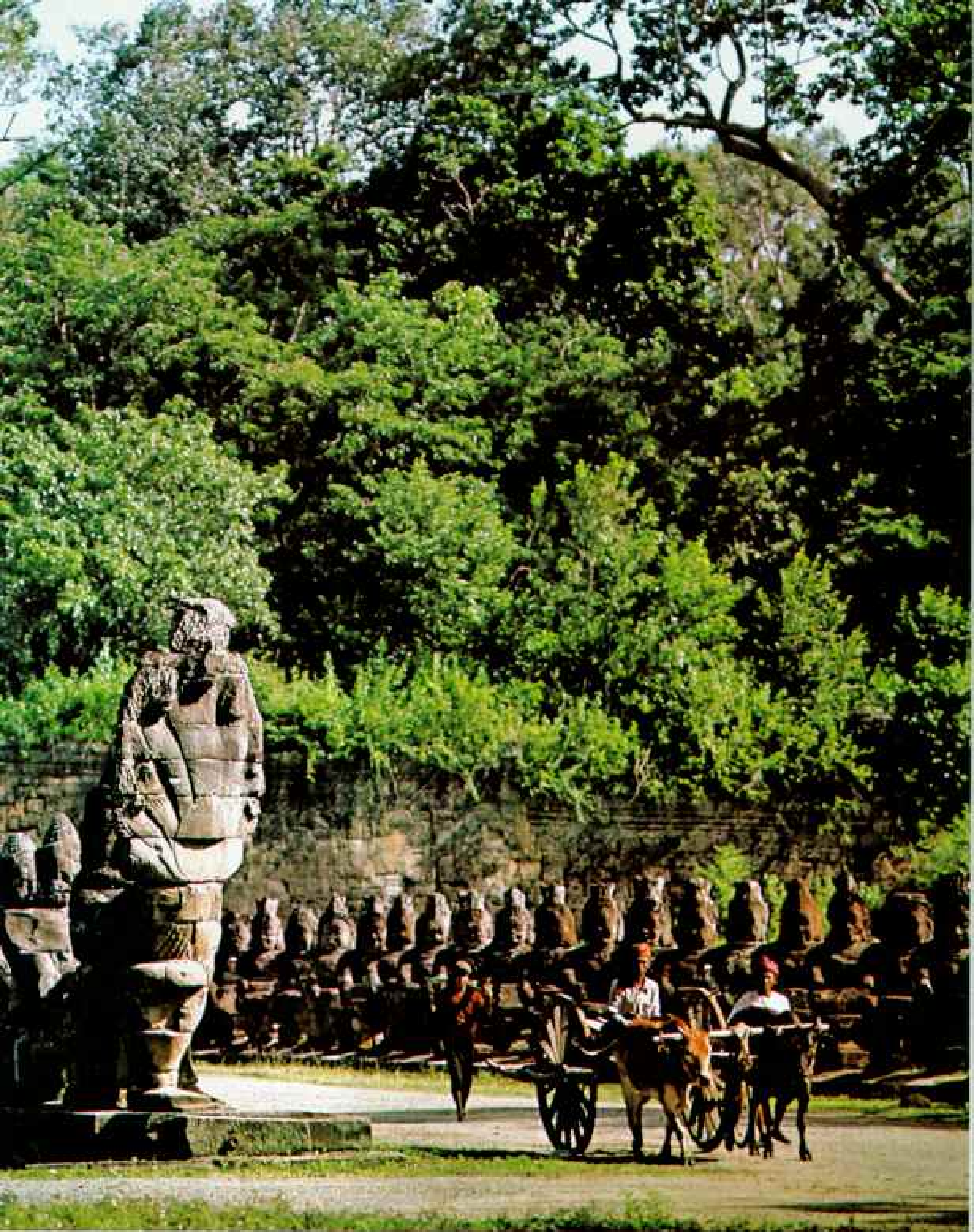
The government of India gave several Khmer a three-month archaeological course in Delhi, and sent equipment for a photographic laboratory. It was still in Phnom Penh. The U.S.S.R. invited Pich Keo and several colleagues to Moscow, to survey restoration techniques. An international Roman Catholic group headquartered in Paris sent drafting equipment and paper, ten bicycles, a Toyota truck. All in all, a few drops in a very large bucket.

Back in Phnom Penh, the head of the Directorate for the Preservation of Monuments told me of a law in preparation to prohibit the stealing of sculptures and damaging of stonework. "It will have 104 articles, and heavy penalties." He showed me a workshop where souvenirs are carved for sale, to aid the restoration. And on behalf of the Ministry of Culture of the People's Republic of Kampuchea he thanked Editor



*Symbols of two related faiths, Buddhist heads above the archway and the Hindu "Churning of the Sea of Milk" in parallel rows of statuary*

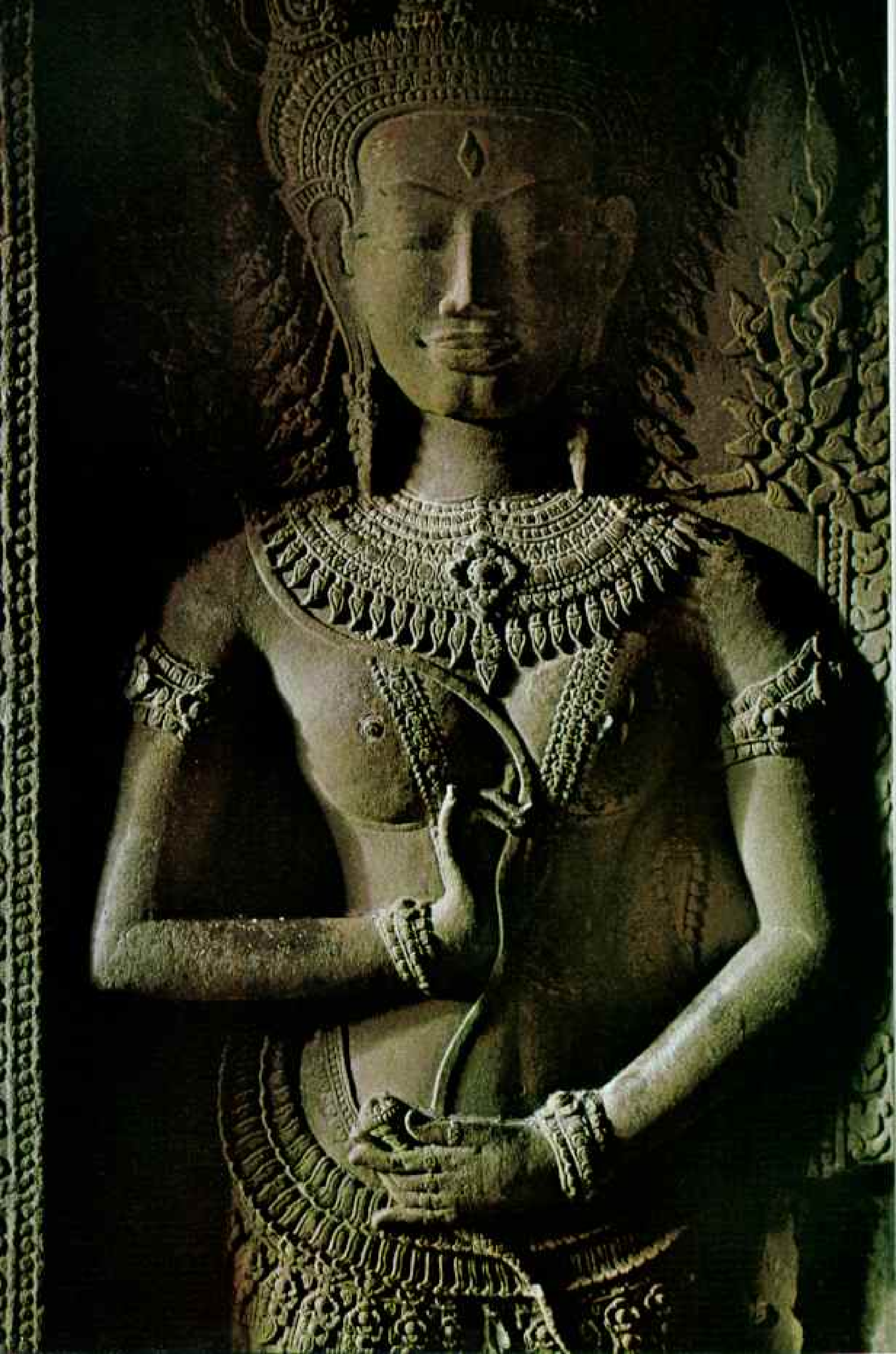
*coexist at the southern entrance to Angkor Thom. This "great city" was built by King Jayavarman VII. Just as his faith, Buddhism, had been tolerated*



DAVID ALAN HARVEY

*for centuries when Hinduism was the state religion, so was the reverse true. As the kings no longer worshiped Hindu gods, Buddhism, long popular with the*

*masses, became the sole faith. In time, the Khmer people came to view much of Angkor as both pagan and alien though still magical.*



Garrett for bringing valuable books and documents: "They will be very helpful." He added: "Through your presence here we would like to ask international opinion to help us restore the Angkor temples. They are our national patrimony, but they also belong to the patrimony of the whole world."

**P**ICH KEO just told me the same thing. And what says Ith Khlok, chief monk of Wat Angkor? That's the Buddhist monastery situated between Angkor Wat's outermost wall and the moat. It was founded by Siamese monks a century and a half ago. The chief monk, now 80, has seen a sizable slice of history.



DAVID ALAN HARVEY (LEFT)

*They are waiting, the celestial apsaras who will dance and sing for the Khmer elect. One in Angkor Wat (left) survives in glory, but a depiction in the Bayon (above)—along with many others—suffers damage to her stone breasts, targets of modern vandals. Though battered, the apsaras do not age. They promise a joyful existence after the last reincarnation. Angkor itself awaits that time, having known cycles of decay and rebirth for a thousand years.*

When Ith Khlok was born, Siem Reap Province was under the Siamese. Then came French colonial rule, Japanese occupation, once more the French; then Sihanouk's regime, Lon Nol's regime, the Khmer Rouge. In all but one of these periods there was rebellion, the monk says—only in the time of Sihanouk did people have peace and prosperity.

He hopes such a time will come again. He adds he also hopes that foreigners, Americans, will help the Khmer people—especially with the conservation of Angkor. "It is our patrimony, but yours also."

I'd heard this now so often. It sounded like a rehearsed line from political school; monks, too, must attend nowadays. But it also sounded sincere.

**L**OOK FOR THE LAST TIME at a most beguiling aspect of Angkor, the celestial dancers called *apsaras*.

Fleshly counterparts of those sensuous entertainers of Khmer royalty were carried off by the Siamese despoilers of 1394. But their intricate dancing survived, and was admired at the 19th-century court of Bangkok by the British governess Anna Leonowens, the real-life protagonist of *Anna and the King of Siam*. I envy her for what she saw.

She wrote of a swaying like withes of willow, of arms and fingers curving in seemingly impossible flexures, of all the muscles of the body agitating like the fluttering of leaves in a soft breeze. "Their eyes," she said, "glow as with an inner light. . . ."

She called it a miracle of art. A latter-day reflection can be seen by today's tourists as "Thai classical dancing" in Bangkok hotels.

From the walls of Angkor still smile ideal apsaras, sculpted in sandstone as permanent entertainment for the gods. They have suffered the damage of time and war and mindless vandalism. But aren't there about 1,700 apsaras at Angkor Wat alone, and thousands more elsewhere at Angkor? Surely they will not disappear in the foreseeable future.

And yet, shouldn't effective ways be found now to safeguard their beauty—and the wonder of the world that is Angkor—regardless of the turmoil of the day?

I say the sooner the better. □



# Kampuchea Wakens

By PETER T. WHITE NATIONAL GEOGRAPHIC SENIOR WRITER

“**T**HAT CHECKERED cotton cloth we put on our heads is called *krama*,” the young man said—the Khmer people are familiar with it from birth and make it serve in many ways.

“To keep off the sun when working in the rice fields. To carry home food—corn, vegetables. To cover the body when washing in a stream, for the sake of modesty.” A man will wrap it around his middle, for comfort in the evening breeze. A girl may put a pretty edge on one and give it to a young man, as a token of love. He’ll kiss it and think of her.

“And then came the time when people used the *krama* to hang themselves.” To escape the hell on earth created by the previous regime. They knew it only as *angkar*, the organization. Survivors have come to know it by the name of its leader, Pol Pot.

Wherever I went in the land of the Khmer—formerly Cambodia, now Kampuchea—and whatever the subject of conversation, I was to find all too poignant reminders of that recent time of horrors. How could it be otherwise, when from 1975 to 1979 multitudes were systematically done to death? Through overwork and starvation, torture, execution. “Only my mother and I are left now,” another young man told me. “My father, three brothers, and two sisters were murdered.”

World opinion was shocked by estimates of a million victims. The new government speaks of three million, out of a total of approximately seven and a half million Khmer

*Life resurges in the land long known as Cambodia, where peasants gather rice seedlings. They can hope for a better harvest than the yields of death reaped under a Khmer Rouge regime that cost the lives of perhaps three million of their countrymen from 1975 until Vietnam invaded in December 1978. Continuing conflict clouds the future.*



# From a Nightmare

Photographs by DAVID ALAN HARVEY NATIONAL GEOGRAPHIC PHOTOGRAPHER



in the mid-1970s. Were similar proportions projected for the population of the United States, the dead would be 30 to 90 million.

What explanations will I find for self-inflicted genocide on such a scale—for this well-nigh incredible phenomenon that may stand unique in history?

**S**TAYING ON week after week, I am struck by another aspect of today's Kampuchea: the many signs of revival. Among the liveliest is the morning scene at the railroad station in Phnom Penh.

Thousands scramble aboard the train to Battambang—traders, off to buy goods smuggled in from Thailand, to bring back for sale in Phnom Penh. Soap, cigarettes, medicines, watches. A man says he'll be back in four days with pieces of cloth for sarongs: "Good color!" He means bright enough to knock your eyes out. In the Pol Pot years everyone wore only black.

Two railway cars in front of the engine are weighted with steel rails and spare wheels, to set off mines along the track. Interspersed among the other cars are three with armor plate and heavy machine guns, served by soldiers of the Vietnamese Army—to counter ambushers.

These are reminders of still another set of compelling factors in the daily life of Kampuchea. The Vietnamese, having driven Pol Pot from power, are here in force. But his guerrillas remain a menace. Clouds of uncertainty hang over the land.

I too am off toward the Thai border—northwest on Route 5, through the provincial capitals of Kompong Chhnang and Pursat—through shimmeringly hot and humid countryside stretching flat and emerald green with rice (map, page 598). Typically Khmer, those squeaky oxcarts with four-and-a-half-foot wheels. So are the ubiquitous, bristly sugar palms: Boil the sap from the flower stalks and you get sugar.

*Like swarming bees, traders in Phnom Penh appropriate every square inch on, in, and alongside a train bound for Battambang through guerrilla-menaced territory. Many will return to the capital with contraband from Thailand, main source of consumer items in a shattered economy.*





I see boys herd cattle and water buffalo, catch crabs in watery fields, splash in turbid canals. Women and men rhythmically pull up bunches of rice seedlings, slap them against upraised ankles to knock away the mud, and bundle them for transplanting. At midday there's shade under the carts for a meal and a snooze.

If only the potholes weren't so typical. They're wide, deep, and unavoidable, so constant shifting of gears is necessary as one wheel plops in and then another. Most of the time you're lucky to make 15 or 20 miles an hour, but you get used to that, and to all those automatic rifles. Mostly Chinese-made AK-47s. Beyond the provincial capital of Battambang you see some every few hundred yards—carried by Vietnamese troops at bridges that look as if they've been blown up and repaired several times; lying near Khmer militiamen at checkpoints; dangling from bicycling civilians. Guns everywhere, handled as casually as hoes.

In the market town of Sisophon, a hotbed of resurgent commerce, a village entrepreneur can sell a fat pig for enough money to stock up on sandals, flashlight batteries, cooking pots, and aspirin—enough to keep a little crossroads stall back home going for months. Big stalls cluster by the score, supplied from Thailand 30 miles to the west by people who know their way through the forests and back roads.

For big items, stereos or motorcycles, payment commonly is in gold. How much for this Honda Super 700? Ten *chi*—that's 37.5 grams, worth 520 dollars at the world price *today*. Sisophon keeps on its toes.

Some 20 kilograms of gold may be flowing through to Thailand daily, a provincial official surmises—about seven metric tons a year, more than a hundred million dollars' worth. What flows in keeps the economy going, keeps people happy.

But where does this gold come from? The answer is rooted in the sequence of events that led to the nightmare of Pol Pot.

In 1970, while the United States was fighting Communist-led insurgents in neighboring Vietnam, a coup d'état replaced the chief of state, Prince Sihanouk, with Gen. Lon Nol. The general allied himself with the United States. The Vietnamese

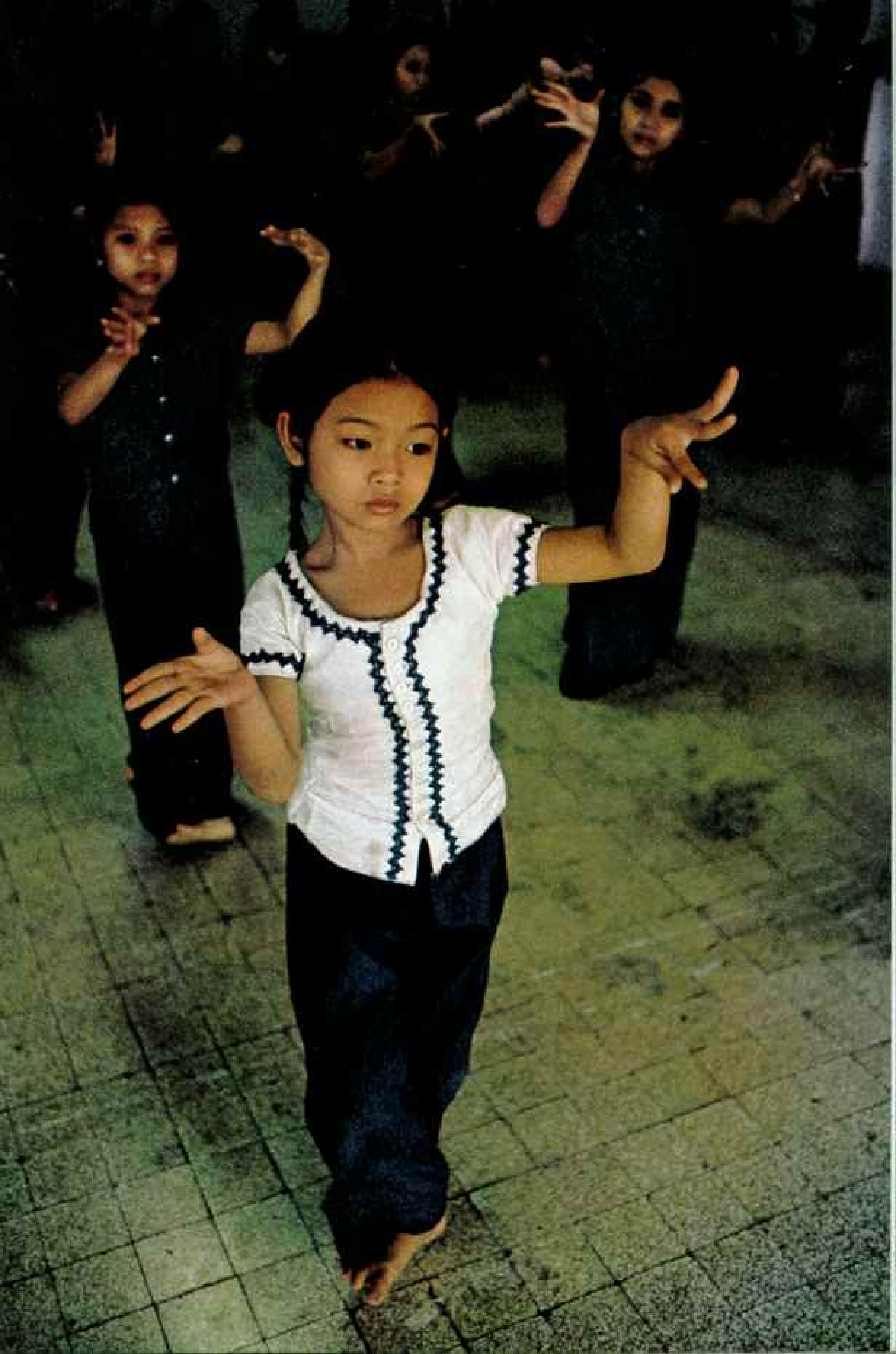
Communists, in turn, supported anti-Lon Nol insurgents: the Communists that Prince Sihanouk had dubbed the Khmer Rouge, or Red Khmer.

U. S. aid to Lon Nol brought in floods of goods and money, fostering unprecedented corruption. This produced vast new wealth; added to old wealth, it accumulated in the government-held towns, chiefly in Phnom Penh; much of it was hidden away in gold.

Meanwhile the countryside, increasingly subject to the Khmer Rouge, languished. And the U. S. Air Force dropped three times



*Hands speak a language of 2,000 gestures in classic Khmer ballet, rehearsed by the first class (right) to enroll at Phnom Penh's reopened School of Fine Arts. Students train to join the national troupe. Banned under the Khmer Rouge, art, education, and religion conjoin in a brass statue of a deity (above), cast at the school from spent artillery shells.*







*Fresh from combat, a soldier in the fledgling army of the Vietnamese-backed People's Republic of Kampuchea (RPK) returns home on leave to Siem Reap (left). Decorations on his U. S.-made M-16 rifle belie the deadliness of nearby fighting. His cap, he said, came from a Khmer Rouge he had killed the day before. The badge bears the RPK symbol. "Guns are as commonplace as hoes,"*



*says Editor Wilbur E. Garrett. For a Phnom Penh boy, a car jack becomes a toy burp gun (above).*

*The 180,000-man Vietnamese occupation force provides the main strength pitted against about 35,000 Khmer Rouge guerrillas. Smaller independent guerrilla forces also harry RPK and Vietnamese troops.*



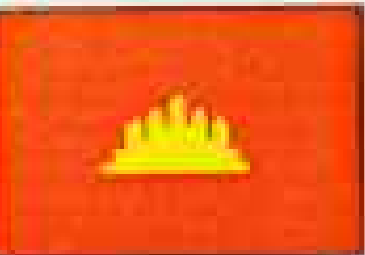


*By 1979, 700,000 refugees were gathered along the Thai border. Most have since returned home. Figures show those remaining in November 1981.*

*Tonle Sap swells in size during the rainy season from 1,000 to some 4,000 square miles. The nutrient-rich lake supports huge stocks of aquatic life.*

*The majority of the country's 6.6 million inhabitants concentrates in the central rice-growing region, leaving large outlying areas only sparsely inhabited.*

- 6,000 REFUGEES ▲
- 12,000 REFUGEES ▲
- 18,500 REFUGEES ▲
- 41,500 REFUGEES ▲
- 43,000 REFUGEES ▲
- 36,000 REFUGEES ▲
- 8,000 REFUGEES ▲
- 15,000 REFUGEES ▲
- 2,000 REFUGEES ▲



**F**ERTILE and star-crossed Kampuchea sits in a cockpit of Indochina's historic rivalries. Several ethnic groups share the modern nation's 70,000 square miles with the majority Khmer, whose civilization emerged in the ninth century to peak in empire about 400 years later. A wealth of rice fueled the empire, and even under later subjugation by Siam (Thailand), Vietnam, and France, Kampuchea grew surpluses in rich central lowlands. That ended when civil war and American saturation bombing disrupted rural life in the early 1970s.

The Khmer Rouge, led by Pol Pot, defeated the U. S.-backed Lon Nol government in 1975. Pursuing Pol Pot's vision of a peasant nation modeled on the Khmer Empire, the victors forcibly emptied cities and towns and methodically executed the educated class, deemed tainted by non-Khmer influences. Brutal migrations and deadly work-camp conditions killed untold thousands from every stratum of life. Vietnam's invasion drove Pol Pot forces to border areas, and life has regained some normalcy for much of the population.



DRAWN BY JOHN G. WEBER, COMPILED BY GRAHAM J. TRUSCOTT, NATIONAL GEOGRAPHIC ART DIVISION

as many tons of conventional explosives as fell on Japan during World War II.

One day in April 1975 the victorious Khmer Rouge entered Phnom Penh. Right away all inhabitants—by then about two million, most of them seeking refuge from the bombing—were marched into the countryside. The same happened in Kompong Thom and Kompong Cham, in Takeo, in all the other towns. The gold was left behind. Thus began *peal chur chat*—the sour and bitter time.

**N**OBODY LIKES to hear an enumeration of gruesome experiences, but in Kampuchea this can hardly be avoided—nor should it be; without it, how could one appreciate how greatly things have changed for the better? Driving east along Route 6 toward the provincial capital of Siem Reap and the temples of Angkor—those magnificent remains of a Khmer empire that bestrode Southeast Asia eight centuries ago—I seek to summarize what I've heard from numerous survivors about life under that ultranationalist Communist who envisioned a period "even more prodigious than the age of Angkor Wat."

This vision of Pol Pot, like the greatness of Angkor, was to be based on the growing of great quantities of rice. And so, in his view, that was all the masses would need to know. Cities were useless—empty them! Trade was evil, abolish all markets. Abolish money. Destroy contaminating foreign vestiges—television sets, air conditioners. Destroy contaminated people: former enemy soldiers, teachers, physicians. . . .

*In the countryside there was a basic division. The Old People, who had been there all along, and we New People, expelled from the towns. We could own nothing, not even a cooking pot. Families were separated—men and women had to live apart, collectively. Imagine sleeping in a 45-foot collective bed. We were expendable, treated worse than prisoners. We were used as machinery.*

For 18 hours a day of plowing, hoeing, or building irrigation works, on pitiful rations of rice gruel, driven by a pitiless "cadre"—a supervisor with power of life and death.

*If one felt too weak in the morning to work and asked to be excused, the cadres would say, "Ah, while we suffered in the forests to*

*liberate the country, you were lazy and comfortable in Phnom Penh. Now you must work." They were full of revenge.*

*Every night the New People had to meet and criticize each other in front of the cadres. What had they done wrong that day? Picking up anything to eat—a piece of fruit, a root, a worm—was wrong. If you were criticised two or three times, you'd be killed.*

Taken away at night, arms tied behind the back. . . . I'd been shown the steel bars for breaking necks, the pits the corpses fell into one by one, the skulls by the thousands. There's many a killing ground amid the sugar palms. . . . (Continued on page 604)



*Doing peaceful duty in a Phnom Penh foundry, a U. S. Army helmet serves as a dipper for aluminum—from melted U. S. Air Force wing tanks—poured into molds to make cooking pots, which are in short supply. Under Pol Pot, the populace had to turn in their pots and pans and eat in communal kitchens.*

## THE SECURITY REGULATIONS

1. YOU MUST ANSWER ACCORDINGLY TO MY QUESTIONS. DON'T TURN THEM AWAY.
2. DON'T TRY TO HIDE THE FACTS BY MAKING PRETEXTS THIS AND THAT. YOU ARE STRICTLY PROHIBITED TO CONTEST ME.
3. DON'T BE A FOOL FOR YOU ARE A GUNP WHO DARE TO THWART THE REVOLUTION.
4. YOU MUST IMMEDIATELY ANSWER MY QUESTIONS WITHOUT WASTING TIME TO REFLECT.
5. DON'T TELL ME EITHER ABOUT YOUR IMMORALITIES OR THE ESSENCE OF THE REVOLUTION.
6. WHILE GETTING LASHES OR ELECTRIFICATION YOU MUST NOT CRY AT ALL.
7. DO NOTHING, SIT STILL AND WAIT FOR MY ORDERS. IF THERE IS NO ORDER, KEEP QUIET. WHEN I ASK YOU TO DO SOMETHING, YOU MUST DO IT RIGHT AWAY WITHOUT PROTESTING.
8. DON'T MAKE PRETEXTS ABOUT KAMPUCHEA KROM IN ORDER TO HIDE YOUR JOB OF TRAITOR.
9. IF YOU DON'T FOLLOW ALL THE ABOVE RULES, YOU WILL GET MANY MANY LASHES OF ELECTRIC WIRE.
10. IF YOU DISOBEY ANY POINT OF MY REGULATIONS YOU WILL GET EITHER TEN LASHES OR FIVE SHOCKS OF ELECTRIC DISCHARGE.



*Rules to die by, translated on a sign (top) for the benefit of foreign visitors, governed the last sufferings of more than 16,000 political prisoners executed at Tuol Sleng prison, now a museum exhibiting Pol Pot atrocities. One of seven surviving inmates, museum director Ing Pech (above right) was spared because he possessed mechanical skills useful to his captors. Behind him are a few of thousands of photographs of prisoners taken by prison authorities as part of a meticulous record-keeping system. The arms of most are bound behind them. Many underwent*

*prolonged torture before they died.*

*Four out of five prisoners brought to Tuol Sleng were Khmer Rouge supporters purged by their leader, Pol Pot.*

*Documents also show that four American yachtsmen captured off the coast were among the Tuol Sleng dead. Not all Khmer Rouge victims were so duly recorded—at a shrine in Phnom Penh bereaved women still pray for the return of missing husbands (above left).*

*Another exhibit displays a defaced—and rare—portrait of Pol Pot and photographs of Tuol Sleng's executioners*





*(left). Some guards probably escaped west and now fight as Khmer Rouge guerrillas. Others may have died in the prison where they worked: Escalating terror swallowed the Khmer Rouge along with their erstwhile victims as the regime turned on its own ranks with increasing ferocity.*

*Nearly all prisoners signed confessions that they worked as agents for the United States, the Soviet Union, or Vietnam. Without a signed confession, wrote an interrogation officer, "We won't let you die easily."*

*Testimony of the dead surrounds exhumed mass graves (right) near Phnom Penh. Some skulls still wear blindfolds tied on before execution (below) at the "killing fields," located in virtually every district in Kampuchea. Visitors are told that the 129 pits found here held New People, the name given to city dwellers and others not under Khmer Rouge control in early 1975. Damned by Pol Pot's hatred, New People received especially harsh treatment. The Vietnam-sponsored government disdains Khmer Rouge counterclaims that such skeletal remains represent Kampuchean victims of Vietnamese violence, and is collecting skulls for a museum designed to show foreigners evidence of Pol Pot's massacres. Kampucheans need no reminders; as a Soviet diplomat remarked to the author, "You can still see the fear in their eyes."*



WILBUR K. GARRETT (AROVE)





(Continued from page 599) *In the early years the Old People had enough to eat, they were the cooks. They could work as they wanted, play cards, enjoy cockfights. They were the most ignorant peasants, but now they could lord it over us. If they didn't like you, they could have you killed.*

How did New People survive? Several whose previous status had left them especially vulnerable—a professor, a business manager, a lady of the traditional theater, a journalist, a student—told me essentially the same. The thing to do was to conceal your background if you could, work hard, try to be deaf and mute, trust nobody. . . .

*We made our way back to my father's village, thinking my uncles would receive us well. They didn't; they denounced my father. Once there was no place as nice as our village, but I'll never go back. I remember the cries at night. Of more than a hundred New families there, only twenty widows and orphans survived. They've all fled back to Phnom Penh.*

So, many of the villages I've been passing are full of Old People. Do some in secret still sympathize with Pol Pot?

*Yes. But our government doesn't want to tell about that.*

Not far from the provincial capital of Siem Reap, my government-assigned driver abruptly speeds up. He won't say why, but I can guess. "We take care of our mouth," I've been told. "When we're afraid of poisonous snakes, we don't talk about snakes." You don't talk about Pol Pot guerrillas when you're afraid they may be near.

**A**FTER A REWARDING STAY in Siem Reap, visiting the Angkor monuments day after day (pages 552-589), I return to Phnom Penh. The representative of UNICEF, the United Nations Children's Fund—then the senior UN official in Kampuchea—recounts how international efforts have been bringing succor since 1979, when the country faced famine. Agriculture had been totally mismanaged. The economic infrastructure lay in complete ruins.

"First we had to get the ports working, fix jetties, bring cranes and forklifts." Then UNICEF brought in a thousand Japanese, East German, and British trucks and dozens of river barges, so food could be distributed to the people: tens of thousands of tons of rice provided by the UN's World Food Program, paid for by the United States; rice and wheat flour from the Soviet Union.



"Schools had been abolished. UNICEF brought in blackboards, notebooks, ball-point pens, tools to repair furniture." Now one and a half million children are said to get elementary instruction.

In the port of Phnom Penh, 200 miles up an arm of the Mekong River from the South China Sea, officials of assorted international relief organizations watch the unloading of more ball-point pens from UNICEF, bags of rice seed from Oxfam, a tractor, a machine for forming chalk.

Chalk? A lady from CIDSE, a Catholic group based in France, explains that Khmer schoolchildren carry little blackboards, they need lots of chalk. "There's gypsum to be mined in Battambang Province—this machine will make thousands of pieces of chalk every day."

The ship captain says he'll sail back to Singapore empty. Except for a little rubber going to the Soviet Union, and some of the world's finest rubies—also mined in Battambang Province, around Pailin, and smuggled to Thailand—Kampuchea produces nothing for export.

Famine has been averted, but Kampuchea remains plagued by malaria. The Vietnamese doctor in the provincial hospital

at Kompong Speu says half his patients suffer from malaria—80 percent of the falciparum variety; if not treated, many would quickly die.

And, alas, food problems seem far from over. A mission from FAO, the UN Food and Agriculture Organization, is preparing a bleak report: Fifteen years ago twice as much land was planted in rice. Uncultivated fields can now be seen in every district because not enough men are left to do the plowing; two-thirds of the adult population are women. Nor are there enough oxen and buffalo. And while the 1980-81 growing season was relatively good, yielding twice as much as the year before, 1981-82 will be bad, because of flood and drought.

I've had a glimpse of that too. Flying over Prey Veng Province, southeast of Phnom Penh, I saw square mile after dismal square mile of watery expanse—some milky white, some brownish and scummy. The Mekong hadn't surged so high in August in a hundred recorded years.

Only 20 miles away, due south of Phnom Penh in Kandal Province, a subdistrict chief told me the seasonal rainfalls were too little and too late. At seeding time the ground was too dry, too hard to plow. "We finished

*A healing time begins in a land bereft of healers. Of 600 Kampuchean doctors practicing before Pol Pot's era, fewer than 60 were known to be alive and in the country in 1979. One of 25 physicians trained since then, Dr. Channeary Ry tends a young patient at a World Vision pediatric hospital (left). Malaria and other ills—mental disorders not least among them—have run rampant. Vietnamese administrators and professionals supervise the rebuilding society, but keep a low profile wherever possible: Unarmed, a Vietnamese soldier mingles with Phnom Penh market crowds (right).*





planting a month and a half late, so there would not be time for the rice to mature before too much sun would kill it. We will have to harvest prematurely."

FAO predicts a deficit of 278,000 tons. The minister of agriculture says it will be 450,000 tons, that even now a third of the people are hungry—only 2 percent in Battambang but 62 percent in Kompong Cham, 72 percent in Pursat. . . . "We will intensify the planting of dry-season rice, but we don't have enough irrigation."

**O**NE LATE OCTOBER DAY the wind changes. It has been coming from the south. Today it's strongly and refreshingly from the north, making ripples on the clear Tonle Sap river before it merges with the brown Mekong. Now it's the Khmer winter, when rice yields its seed. Until a dozen years ago there used to be celebrations on this night—a hundred lighted boats racing, crowds on the shore.

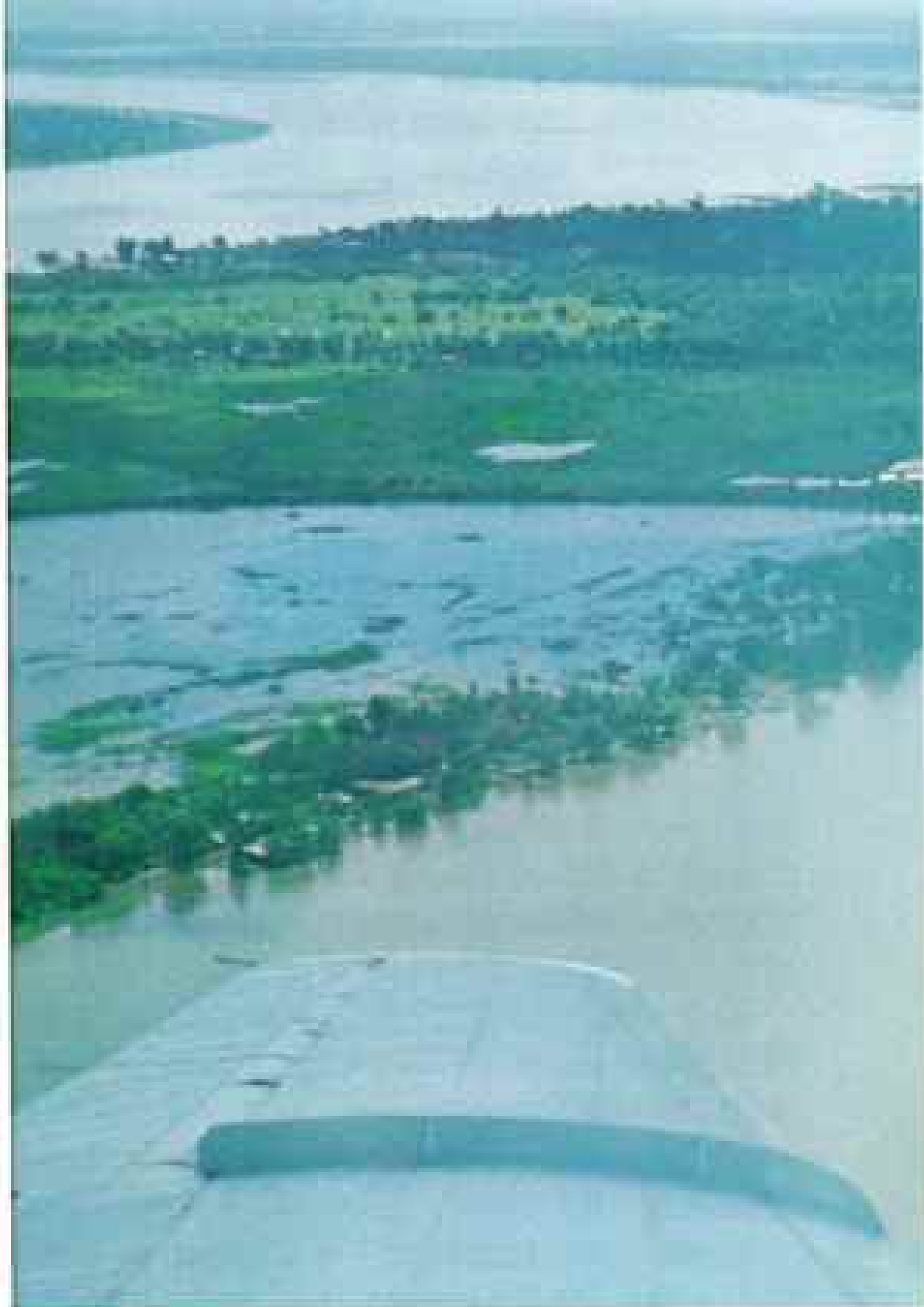
I'm on a motor launch going up the wide Mekong, past rusting remnants of Lon Nol's navy, a brickkiln, people sawing logs. A UNICEF barge carries rice upstream to Kompong Cham. A small boat brings down big round bales of tobacco. A crowded ferry crosses, with a multicolored flag and music: This is the season of *kathen*—for collecting money for gifts to the Buddhist monks, to be presented at a *bon*, or festival. Under Pol Pot all religious observances were suppressed.

This village *bon* is fun.

Everyone feasts. Players of the traditional band—drum, flute, cymbals—prance, hop, and jump. A cheerful procession passes three times around the *wat*, or monastery, carrying flowers in silver bowls, multicolored parasols, and the gifts for the two monks—new robes, a kerosene lamp, an umbrella, a new bed.

Inside, after much ceremony, men hold up a big cloth behind which the monks change into their new robes. Two old ladies urge me to sneak behind the cloth and take photographs: "Then you can send us pictures, and we can see what these two really look like."

Outside, young people dance to highly amplified electric guitars. I ask a singer what he sang about. "About a grasshopper. He's clever, he has political consciousness."



*Turned inside out by evacuation, Phnom Penh reenters life wearing scars from the past. A Tonle Sap river bridge demolished in 1972 remains unrepaired*



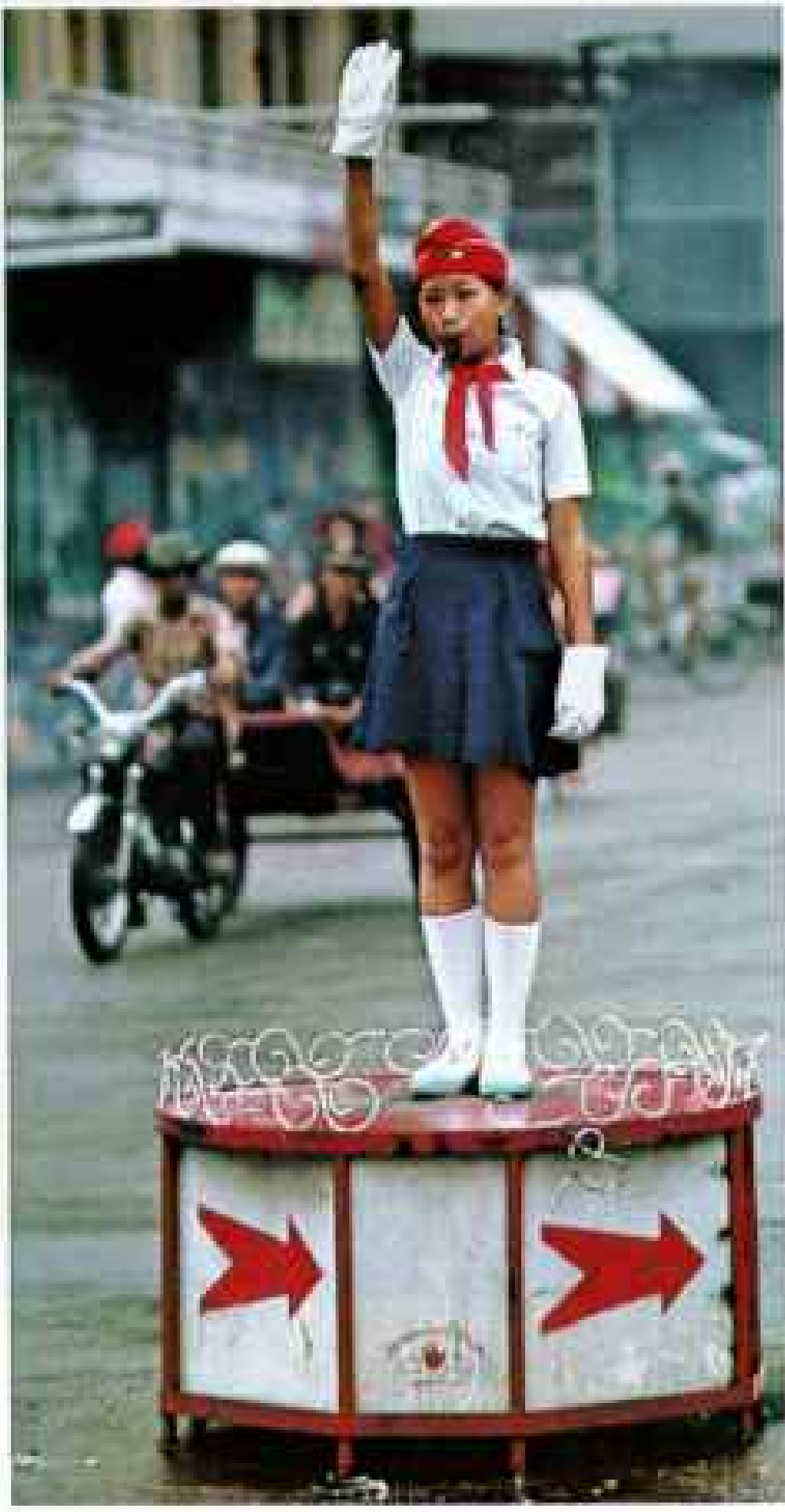


BOTH BY WILBUR E. BARRETT

*(above). Abandoned cars, now stacked for removal (below), littered streets when only Khmer Rouge functionaries and a handful of essential workers*

*lived in the nearly deserted city. Floodwaters, above left, have further hurt a rice crop already damaged by drought, threatening more shortages.*





*Two-wheeled traffic dominates morning rush hour in Phnom Penh (right). Velo-cabs—bicycles rigged to carry passengers or baggage—and motorcycle carts (below) serve as taxis. In Revolutionary Youth uniform, a girl from an orphanage directs traffic (left), a service designed to involve orphaned children in civic functions.*

*Before American bombings began, Phnom Penh held 600,000 residents, a figure that swelled to more than two million until evacuation in 1975. In late 1981 the city counted 400,000 Kampucheans. Legally, only RPK officials, their families, and needed workers may live here, but the government, mindful of the past, lets squatters stay.*

*Few buildings receive electricity. Fewer have running water. Sanitation is nonexistent for most. Yet many feel more secure here.*





Really? "Well, it's a funny song—he *thinks* he has political consciousness."

Fun aside, political messages are everywhere. In posters, broadcasts, traveling-theater performances; in the village meetings and political schools that reach nearly everyone. "To make our people understand the dirty tactics of the enemy," says a provincial information chief. "The enemy makes propaganda that our government is serving only Vietnam, not Kampuchea," he continued. "They want to break up the relationship

between Kampucheans and Vietnamese."

What is this Vietnamese connection?

It's complicated. Pol Pot's Communists feared traditionally expansionist Vietnam, now allied with the Soviet Union. They launched a vicious campaign against Vietnamese nationals in Kampuchea, killing thousands, and beginning in 1976, increasingly ferocious attacks across their eastern border into Vietnam itself. At the same time, Pol Pot ordered tortured to death thousands of his own people—those that he labeled



"Khmer bodies with Vietnamese minds."

The outraged Vietnamese Communists—concerned about Pol Pot's alliance with their main enemy, the People's Republic of China—struck back with a lightning invasion in December 1978. They captured Phnom Penh in January 1979, pushed Pol Pot's forces to the Thai border, and installed the present regime.

"It is true, we have Vietnamese advisers at every administrative level," a Khmer official told me in Phnom Penh. "But as we

become better organized, they will leave."

For the moment, some 180,000 Vietnamese are said to be in Kampuchea, most of them soldiers. They will not leave unless they can be sure of a secure and friendly government on their southwestern flank; not with China threatening from the north.

Pol Pot's remaining fighters—about 35,000—are supplied with arms by the Chinese, via Thailand. The Vietnamese forces are sustained by the Soviet Union. Soviet advisers are in Kampuchea too.

And so it is that this tortured, impoverished country no bigger than Oklahoma finds itself a cockpit of confrontation between world powers.

**U**NARMED VIETNAMESE soldiers blend into the population in Phnom Penh. In the countryside I've seen them hauling cannon and guarding off-the-road headquarters with armored cars, but usually I see them unarmed: fishing, bicycling, gardening, buying vegetables, giving each other haircuts, playing the guitar, carrying a dog. Roast dog is a favorite Vietnamese dish.

Khmer don't eat dog and tend to dislike the Vietnamese as traditional enemies, especially those from the south, from the Mekong Delta, which 300 years ago was Khmer territory. . . . By 1840 the expansionist Vietnamese controlled a Khmer puppet monarch through a Vietnamese resident, and had advisers supervising every provincial governor. But then France colonized Vietnam and made Cambodia a protectorate. That lasted into the mid-1950s. . . .

No wonder, then, that many Khmer have mixed feelings about their Vietnamese liberators. In an unguarded moment a Khmer



*Baby boom sounds in Phnom Penh's streets, where market-bound mothers gather to board a motorcycle cart. Under Pol Pot, families were torn apart: Children were raised by the state, men and women slept in separate barracks, and conjugal visits required permission. Authorities separated couples and dictated marriages. Unsanctioned liaisons were punished by death. Now birthrates have soared as couples embrace more normal lives.*



*Along a shifting shoreline, lake fishermen dwell in stilt huts that can be moved to keep pace with Tonle Sap's rising and sinking waters. One of the world's richest*

official tells me, "They are imbeciles."

Those I met were not. I watched them fix a road damaged by guerrillas, using logs held in ponds along the right-of-way, cutting them to fit into the newly blown potholes swiftly and efficiently. A Vietnamese soldier told me he dislikes Kampuchea, the Khmer, the Russians, and the war. "But my country was attacked, so I suppose I've got to be here." He sounded like many a young American I met in Vietnam in the 1960s.

In Phnom Penh I fiddle with my radio.

"Resistance to Vietnamese forces . . . is increasing," says the Voice of America. "[They] are plagued by malaria . . . and desertions." The U. S., labeling Vietnam's occupation of Kampuchea blatant aggression and the government in Phnom Penh a Vietnamese puppet, just voted to let Pol Pot's Khmer Rouge continue to represent the country in the UN. . . . The Khmer Rouge call their regime Democratic Kampuchea.

A Pol Pot broadcast, from China, claims 25 Soviet advisers killed in ambush on



*aquatic nurseries, the strategic lake also provides access for commercial and military cargoes bound from Phnom Penh to Siem Reap in the north.*

Route 4 between Phnom Penh and Kompong Som, the port on the Gulf of Thailand where Soviet military equipment is unloaded. "Probably means they got three," says a resident foreigner. And perhaps explains why I was refused permission to visit Kompong Som just now. . . .

Officially, the government in Phnom Penh exudes confidence.

The President of the People's Republic of Kampuchea—Comrade Heng Samrin, a former Pol Pot division commander who

rebelled in 1978 and defected to Vietnam—declares that despite the sabotaging maneuverings of the American imperialists and the Chinese expansionists, the people struggle successfully for stability and prosperity. "Under the enlightened direction of the People's Revolutionary Party of Kampuchea," he says. That's the Communist Party; Heng Samrin is the first secretary.

The party still has only a few hundred members, so its political line trickles down through the United Front for National



Reconstruction and its youth movement, women's association, labor organization: Increase production! Unmask "double-faced elements" hiding themselves among the people. . . .

**T**HE MOST DRAMATIC symbol of reconstruction and revival is Phnom Penh itself. A journalist from East Berlin remembers March 1979, two months after the departure of Pol Pot: the wind whistling through a ghost town like a decaying Hollywood set, corpses lying around, helicopters spraying disinfectants.

A Soviet diplomat says a year later he still couldn't walk in many side streets, the smell was so awful. There were nearly 100,000 inhabitants by then; most still wore black. "But now, look around, people look normal, the place is changed completely."

By official estimate, the residents number 400,000. Early morning traffic moves steadily with the stately rhythm of bicycles. Many—called *kong dup*, "double bicycles," or velo-taxis—have the luggage carrier padded for a paying passenger. Motorcycles have trailers for several passengers. Occasionally there's some powerful comrade's white Mercedes.

Not that the city looks prosperous. There's still an inescapable air of decrepitude and neglect: broken streets, unrepaired buildings, the odd fetid smell. I saw many a truck-squashed rat. But what impressed me was the purposeful stirrings of life.

Waiters from the Monorom Hotel clean away weeds at the nearby railway station, officials sweep around the Foreign Ministry. From one day to the next, familiar heaps of garbage are gone.

Sooner or later everybody seems to get in on this act. One Sunday I see trucks and horsecarts full of people with hoes, shovels, brooms. The Phnom, the city's grassy central hill, is atwitter with thousands of schoolchildren cutting grass. "Last week we did the school grounds," says the principal of Sala Padevat, the Revolutionary School;

she has 3,412 pupils from 6 to 14. "All this is production, socialist labor. . . ."

And evidently enjoyable. There's horseplay, flirting. A boy has caught a foot-long frog, and proudly gives it to the principal. She beams. She'll take it home and cook it.

In theory, only state employees may reside in Phnom Penh. They live rent free. Electricity also is free, when available; usually water has to be carried into the house. But a lot of people without state jobs have been sneaking in—they stay with relatives or pay for quarters. Phnom Penh is a good place "to make little commerce." Like selling egg rolls and other curb-fried goodies.

Little markets do sizable business. Ox-carts squeak in from Kompong Cham—75 miles and three days away—piled high with ceramic pots. Near a waterside stand a boatman lands his lemons, just brought upriver from An Giang Province in Vietnam. Good lemons? Not so good, he says, but they sell anyway because none are grown here now. Good money? "Not so good, but enough to get rice." To make a living.

The ramshackle Tuol Tumpoung market bustles all day; the hall of the old central market has been refurbished so wives of state employees can earn extra money.

Is this compatible with Marxist-Leninist principles? For the time being, yes. "The state has no interest to show itself too austere in regard to the free markets," declares a government guidance document: They do a better job of encouraging consumption and giving the necessary initiatives for the stimulation of production. . . .

Which brings up this tale of two Phnom Penh restaurants. The state-run Peace did poorly, the privately owned Pailin thrived. The state closed Pailin. Peace still did poorly. So the state closed Peace and reopened it under the management of the successful Pailin restaurateur. He is supposed to divide the proceeds with the state. "Business is great," he says. "Each day it gets better." Outside waits a white Mercedes.

Now what's this coming down the street?

*Top-heavy with humanity, a truck lists along a road northwest of Tonle Sap. Transport is scarce, so cargo drivers cram passengers aboard to boost their incomes. The numerals 7 and 1 appear first on all Kampuchean license plates, signifying the January 7 liberation of Phnom Penh by Vietnamese forces in 1979.* WILLIAM D. GARRETT



Thirty drummers, rows of white-shirted boys and girls with red scarves—Revolutionary Youth from Orphanage No. 1. What does it say on the big sign they carry—this spidery Khmer writing? Oh, I see. "Condemn neutron-bomb production by Reagan Administration."

Well, that's another thing you get used to in Phnom Penh. Ever fresh posters show

Uncle Sam in unflattering positions as the pal of China and Pol Pot. Several times a day I am asked why my country upholds the Pol Pot presence in the United Nations.

Nothing personal, though. Buying a basketball and a soccer ball for the orphanage, I tell the man at the Tuol Tumpoung sporting-goods stand that I suppose foreigners have to pay more. "Yes," he replies,



"especially imperialists." But he's grinning.

At first I am usually taken for a Russian. That's why on the road, sometimes, Vietnamese soldiers salute me. I always salute back. But to the buxom Tuol Tumpoung fish lady I am just a cheapskate: "Why you just look, you don't buy!"

OK, OK, I buy some of her giant shrimp to have them cooked back at the hotel. I also

buy a bunch of freshly boiled *pong tea kon*, literally "egg duck baby": Let ducks sit on their eggs for 18 days—then the best eggs will have big babies in them. Eat with pepper, salt, lemon, and a sprig of mint—it's a Khmertreat. "They'll give you strength, fortify the blood."

How did they taste? Sorry, at the last minute I chickened (Continued on page 622)



*A son's agony, a father's pain: While herding water buffalo, 15-year-old Mith Yon lost a leg to a live rocket he found in the fields. One companion died. Two others recovered from injuries. The Vietnamese doctor who amputated the boy's leg told the GEOGRAPHIC team that he did not expect him to live. Following Kampuchean custom, the father, Chan Mith, or another family member will be with the boy at all times until he dies or recovers.*

*Mines and booby traps pose added dangers in areas contested by guerrillas. Where Vietnamese troops rule by day and Khmer Rouge roam by night, villagers face the dilemma of living between implacable enemies. "While they're planting rice in the fields," says photographer Dave Harvey, "the war comes to them."*



*A black-market capital, Sisophon thrives on goods smuggled from Thailand, just 30 miles away. The government winks at smuggling and free trade*

*that provide basics such as cloth (bottom right) as well as luxury items. Standard equipment at stalls in Sisophon, scales for weighing gold*



WILBUR E. BARRETT (ABOVE AND LEFT)

(above) denote the surest medium of exchange, but new Kampuchean riels have also gained acceptance. Notes issued under Lon Nol, banned along

with all currency by Pol Pot, are worth exactly as much as the paper they are printed on—handy for making shopping bags in the market (top right).



*Off to visit relatives, a family travels by oxcart past water buffalo on Route 5, main road link between Phnom Penh and Tonle Sap's populous western shore.*



WILBUR E. GARRETT

*A national vaccination program is drastically reducing a variety of diseases among the 35 percent of draft animals that survived the worst war years.*



out; I gave them all to a grateful hotel waiter.

**RUMOR** startles Phnom Penh. Food is being poisoned! It's the oranges from Battambang. Yes, and bananas and cucumbers—they use syringes to inject the poison. No, fingernails. Even money may be contaminated. Four have died. No, fifty. "They do this to make people afraid, to shake confidence in the government," says a man from the Justice Ministry.

Militiamen circulate to calm people, saying that some of the enemy made a demonstration of eating, collapsing, and looking ill. "Some went to a hospital pretending to be sick, but before the doctor could look at them, they ran away."

Operatives of Pol Pot? Or of KPNLF, the non-Communist Khmer People's National Liberation Front, led by Son Sann? Or of Prince Sihanouk's new FUNCINPEC (National Union Front for an Independent, Neutral, Peaceful, and Cooperative Cambodia)? These also lurk along the Thai border. . . . In 1979 about 700,000 hungry Khmer huddled there, in refugee camps—many had been forced to accompany Pol Pot's retreat. By now, says the Office of the UN High Commissioner for Refugees, half are back in the interior; the rest are still fed by international organizations. Half of those Khmer are controlled by Pol Pot. . . .

I remember a soccer match, Phnom Penh vs. Vietnamese. The guests were outclassed, but when they scored a goal, at last, the crowd applauded politely. I thought, if terrorists should strike, which way shall I head to avoid being trampled? Or have I become overly cautious?

Now there's a trial.

A former Pol Pot brigade commander—sent to Phnom Penh to organize a resistance network—was caught at the stadium, with grenades. He had been working as a velo-taxi man. One of his accomplices, another Pol Pot officer, had been a driver for the Telecommunications Ministry. They are sent to prison. A woman who hid their

grenades and mines is sent home. After all, she has small children.

I am surprised at such leniency. "We don't execute people," I am told. "Have not enough Khmer died already?"

And who is this Pol Pot—leader of the *khmau*, those black-clad men who did black deeds and still cast such a shadow?

He has hardly ever been seen in public, but most accounts tend to agree. . . . *Born Saloth Sar, 1928, in Kompong Thom; Chinese mother, Khmer father—not unusual in Kampuchea. Educated in Buddhist monastery and French-Catholic school in Phnom Penh. In Paris, studied radio mechanics, planned radically new society with fellow Khmer students Khieu Samphan, Ieng Sary. Taught secondary school in Phnom Penh, took new name—not unusual for a revolutionary; became head of Khmer Communist Party, visited China, met Mao. . . . The rest is bloody history.*

At this writing, Khieu Samphan is the nominal head of the Khmer Rouge, of Democratic Kampuchea; but Pol Pot, supposedly at the Thai border or in China, is reported to be still in command. Ieng Sary often speaks for him at the UN in New York.

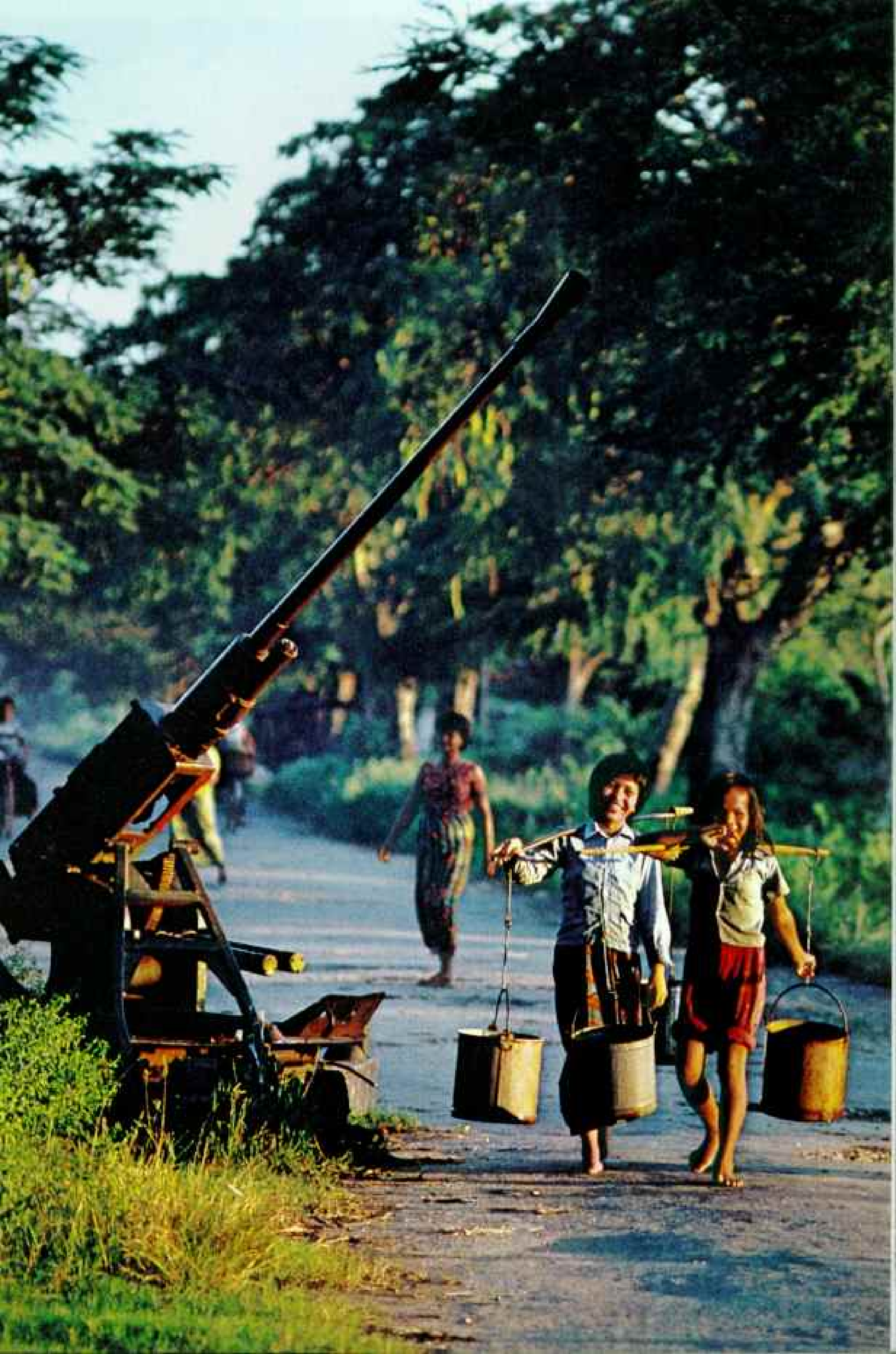
Meanwhile, inside Kampuchea, Pol Pot's guerrillas continue their black doings. A report from Stung Treng Province in the northeast: A subdistrict head of the Women's Association was tied to a pole to be eaten by mosquitoes and sexually mistreated for weeks. Now free, she is confused, cannot pronounce words, only wants to sleep. . . .

**AT THE AIRPORT** a group of young Khmer waits nervously. They're off to East Germany, to study industrial chemistry. The boys smoke, the girls cry. If all goes as planned, they will be home again in five years.

As our plane lifts off, I remember an old man telling me: "May you meet only good and overcome all your enemies." It's a way the Khmer say good-bye.

May their enemies not overcome them. □

*Familiar with war's ghosts, girls fetch water home past a rusting antiaircraft gun left from days when all the land was a battlefield. Weary with suffering, Kampuchean hope against hope that the nightmare is over. But demons from the past, still very much alive, haunt the nights of a people who have walked through the "valley of the shadow."*



## WESTERN GREBES

# The Birds That Walk on Water

ARTICLE AND PHOTOGRAPHS BY  
GARY L. NUECHTERLEIN

**H**EARING the cricketlike call, I pushed my floating blind through the cattails and searched the open channel of the marsh. Expanding rings of ripples revealed where the bird had dived. Then a flash of silver, and the western grebe surfaced again. He craned his neck, spread his crest, and christened the break of day with his clear, two-note calls: "cree-creeet" . . . "cree-creeet" . . . "cree-creeet."

Startlingly, from just behind my blind, came a loud, abrupt reply. Or challenge? Immediately the more distant bird turned to meet his adversary, fiery red eyes seeking the intruder. As the nearer bird, another male, swam into the open, their stares met and locked. Cautiously they closed, crest feathers bristling.

Less than a yard apart, the two birds came to a taut standstill, face to face. Inching forward, both birds opened rapierlike bills

*Propelled by whirring feet, a male western grebe, left, skitters over the water with a female in a ritual known as "rushing." A stylized repertoire of courtship maneuvers characterizes these little-known birds, subject of a seven-year study by the author.*





threateningly and cut the stillness with raucous cries. Then each repeatedly bobbed his head to fling a splash of water to the side.

Suddenly the two whirled, lunged upright out of the water, and noisily ran across the surface side by side, each long neck bent stiffly serpentine. Lobed feet blurred in splashing motion; the birds seemed driven by churning propellers. Finally, as if by cue, they dived simultaneously, leaving the morning to silence once again.

The skittering water run, or "rushing" ceremony, of the western grebe surely is among the most spectacular performances in the avian world. Two males can execute it, a male and a female, or several males and a single female.

That May morning in the Delta Marsh in Manitoba, Canada, I hardly had settled back to tranquil observation when I heard more calls blending into a faint but prolonged double trill. Far out in the bay two more of the mallard-size birds were duetting, with heads held high. The action, this time, was in a different key. As they approached, the male and then the female dived silently. When they surfaced, both held weeds—materials normally used in nest building—dangling from their bills.

In a swimming ballet the two birds touched breasts—and slowly began to rise out of the water. Bills pointing to the sky,

they united their weeds and held them above their outstretched heads, almost as if presenting an offering to the gods.

During many seasons of studying western grebes at this famed marsh of Lake Manitoba, I never tired of watching these contrasting courting rituals: the rushing ceremony, with its raucous calls, loud splashing, and mad dash across the water; the "weed dance"—quiet, deliberate, infused with an almost poetic grace (page 632).

My introduction to these dramatic performances came in 1972 while I was a research assistant at the Delta Waterfowl Research Station at Delta Beach, Manitoba. In the station's library I was surprised to find how little had been published on the western grebe. So the following year, with support from the American Museum of Natural History's Frank M. Chapman Memorial Fund and the Manitoba government, I undertook the task of filling the gap in our knowledge of the behavior of this fascinating bird.

Western grebes are fish-eating divers highly adapted for an aquatic life. Their entire natural history seems rife with strange, poorly understood behavior that relates to this narrow specialization. Yet technically grebes are not waterfowl at all—they form the distinct order Podicipediformes, an entirely separate group of diving birds.

From the start, it was my goal to become a



*Partners in parenting, males take their turn in incubating eggs and caring for and feeding the young. Awkward out of water, a male grebe (left) stands to turn eggs. Another male works his incubating shift (right), tending three to four eggs that begin to hatch in about 24 days. Nests, built from vegetation salvaged from the marsh bottom, are anchored to reeds near open water.*







The world of the western grebe extends across the marsh- and lake-flecked portions of the northwestern United States (above), north into Canada's Prairie Provinces, and south into Mexico. Migrating at night, water-dwelling grebes of Manitoba move to their coastal wintering grounds in October, and return to breeding grounds in May. Dr. Nuechterlein's studies, funded by various organizations including the National Geographic Society and the Delta Waterfowl Research Station, centered around Delta

Marsh (left, above), along the southern shore of Lake Manitoba.

Taking up temporary residence in a grebe colony, the author constructed a blind resembling a muskrat house from an inner tube, chicken wire, and cattails. The blind—so realistic it deceived a pair of Forster's terns (left, below) that courted on top—allowed close study of nesting grebes.

Though not an endangered species, western grebes, once hunted for their plumage, have been protected by United States law since 1918.





part of the world of this mysterious species—to hear what a grebe hears and see what it sees, to live through its trials and feel its excitements . . . in short, to *think* like a grebe. To accomplish this, I would have to learn the meaning of the western grebe's vocal signals, then somehow establish communication with the shy birds.

In 1975 I obtained grants from the National Geographic Society, and the Bell Museum of Natural History at the University of Minnesota, in association with the Delta Waterfowl Research Station. These enabled me to continue the project four more years and to complete my doctorate at the university.

In the Delta Marsh the largest grebe colonies all included nesting Forster's terns. The nesting grebes, having very limited perspective from the water surface, appeared to use the jittery terns as aerial sentinels. When terns sounded their alarm call at my approach, grebes hidden within the reedbeds would leave their nests and make for safer open water. To reach the wary grebes, I would have to fool the ever watchful terns.

Muskrats abounded in both tern and grebe colonies; the terns often used their houses for nest sites. Somewhere I had heard of hiding in a blind that simulated a muskrat house. Within a week I had fabricated a portable, floating muskrat-house blind

from a truck inner tube and cattail-thatched chicken wire. Sitting in the rude contraption, I wore chest waders to protect me from the cold water and marsh muck.

On my first venture into a grebe colony a pair of terns landed atop my blind, inches from my head (pages 628-9). As I slowly walked the blind about in the shallow water, the pair vigorously defended their newly gained turf from all intruders. While the terns helped to allay the grebes' wariness, they also prompted me to modify my blind: Above my head I added a plastic shield; one tires of ending the day covered with guano like a park statue!

#### Camouflage Allows Closeup Study

Over the years my reed blinds took many shapes—from small, collapsible compacts to more spacious models. From these cozy mobile lookouts, with room for tape recorder, notebook, and camera, I began studying western grebes almost within arm's length.

I found that with a tree sprayer and hair dyes I could mark birds on their nests without interrupting their incubation routine. Preening the dye into its feathers, each bird acquired a distinctive pattern that allowed me to log its activities as an individual.

During live-capture operations I found that I could simply place grown grebes in the



*Beak to beak, a small-billed female, at left, and nasal-tagged male square off in a preliminary courtship move called "ratchet pointing" (above). With the help of voiceprints Dr. Nuechterlein unscrambled some of the mysteries of grebe language and can tell a bird's sex, mating status, and individual identity by its advertising*

bottom of a boat, unfettered. On such solid footing these diving birds could hardly walk, much less fly. Instead, they pushed along on their bellies, "swimming" across the wooden floor. Small wonder that one almost never sees a western grebe on land!

But in water the grebe is as much at home as the muskrat or the beaver. Although no one, so far as I know, has reported seeing it do so, the bird, while swimming submerged, may spear fish with its bill, like anhingas and some herons. The western grebe's scientific name, *Aechmophorus occidentalis*, means "western spear-bearer."

Grebes build their nests on the water. In early June hundreds of mated pairs group at traditional colony sites in large bulrush beds. The nest consists of rushes and rotting vegetation pulled up from the bottom and often topped with fresh green algae. On this the female lays three or four pale blue eggs, which within hours turn a chalky white.

A grebe pair is a close-knit team: Both members share in nest building, incubation, and caring for the young. About three weeks after the eggs are laid, the first bizarre infant emerges. Still wet, the "grebeling" crawls to the rear of the incubating adult and, almost like a marsupial, climbs into a pocket formed by the wing and back feathers (pages 634-5). Naturalist Aldo Leopold spoke of the

young riding "neatly enclosed in a corral of humped-up wings."

When the eggs have hatched, the parents abandon the nest and carry the brood on their backs out to the open bays. While one serves as a floating nest, the other dives for small fish to feed the young.

### Breaking the Grebe's Secret Code

As my study progressed, I shifted field operations to Marshy Point, 25 miles northeast of Delta Beach. The new area, privately owned by the Curry and Vincent families, counts a breeding population of nearly 8,000 western grebes, one of the largest known. Taking over an abandoned muskrat trapper's shack perched on an island of marshy vegetation surrounded by nesting grebes, I set out to break the birds' secret communication codes—to translate and understand their calls.

For three months I recorded colony sounds from a tower atop the shack, and my tapes soon held calls from hundreds of individual birds. Back at my university sound lab, I made Sonagrams, or voiceprints, of each call, and looked for variations that might represent different messages.

First I learned that a bird's so-called advertising call was its individual signature: Calls given by a particular grebe at different



JONATHAN E. SCOTT

call, a signature cry unique to each grebe. As part of these pioneering vocalization studies, the author covered a female's head with a sock to quiet her, then played recorded calls to chicks nestled on her feathered back (above). When food calls were played, the young popped out "like jack-in-the-boxes."



*The choreography of courtship features elaborate maneuvers, including rushing (above), here with a female, far right, and competing males. Male and female later join in a "weed dance" (left). Atypically, a second male tries to interfere.*

*A rare photograph of a flying grebe was made in early May (right). After the birds arrive at breeding grounds, breast muscles atrophy; the author suspects that nesting birds may be incapable of flight.*







times could be easily matched, for each bird has its own unique call-frequency pattern. Calls from females were slightly higher pitched and less drawn out than those of males. Each call, therefore, potentially revealed not only the bird's species, but also its sex and individual identity.

I was sure the advertising call must be used to attract potential mates—very much like the songs of other birds and the mating calls of frogs, crickets, and other animals. The following spring, walking my muskrat house through the shallows among rushes, I broadcast, from the previous spring's tapes, recordings of a female's advertising call. Males quickly responded. Playing the call over and over, I became the Pied Piper of Lake Manitoba: My blind was soon surrounded by unmated males. They began challenging one another, then faced off and raced noisily across the water in rushing displays. The males were courting me, sight unseen. I stopped the tape recorder—the males dispersed. I resumed the female calls, and again males converged.

Females, recognizing the calls as from another female, paid no heed. When I played recordings of male calls, the males ignored them. So striking were these reactions that I felt chided: "Of course we grebes can tell males from females. Can't you?"

The grebes, I found, would respond only to recordings that were clear and free of wind noise—audio quality good enough to fool a human. As I continued my experiments, it became evident that the birds' advertising, far from simply attracting a mate, is a flexible signal with different functions in different contexts.

Approaching a nest in my blind, I played to an incubating female a medley of advertising calls recorded from ten different males, her mate among them. Faithfully, she ignored other suitors and three separate times advertised in response to her true mate's call. Here was proof that after pairing the uses of

*A patch of red on a "grebeling's" head may signal alarm or hunger. The patch ordinarily stays pale yellow. Its male parent offers a feather, thought to help prevent fishbones from entering the intestines. Grebes may use their beaks to spear fish, their primary food.*

the advertising call changed so that each bird of a couple could identify its own mate's call even among the welter of vocalizations from other colony members.

I wondered how a courting male seeking a partner could sort out calls by unpaired females, rather than wasting his attention on those communicating with their mates. The answer evolved from my tapes and notes.

Many birdcalls fall into sequences that ornithologists call "bouts." A bout is a linked series of calls. I found, significantly, that the tapes I had recorded during May contained advertising bouts mostly comprising three to five calls in sequence. Yet those recorded in July (after most pairing had occurred) showed only one or two calls per bout.

The next June, in the middle of the breeding season, I recorded calls both from unpaired birds and from those already mated. As I suspected, courting grebes called mostly in bouts of three or four; mated birds in bouts of one or two. When I tested courting males with recorded female calls, they readily answered and approached a three-call bout, but ignored the same call when played singly. Here was confirmation that the number of calls per bout distinguished unpaired birds from mated ones.

#### Different Calls for Different Species?

To round out my research, I recorded western grebes toward the western limit of their range, in Oregon and California. Manitoba grebes are nearly all dark phase, having dark feathers around the eyes. Farther west I also found the locally common light-phase birds, sporting white feathers above the eyes. Previous observers had noted that the light-phase birds almost invariably mated with their own color type.

I discovered that the light-phase males utter a strange, one-note advertising call—"creeet"—quite distinct from the two-note call of the dark-phase birds. I also found that courting males ignored playback calls from females of contrasting feathering. Why, they were behaving almost like separate

species! Yet their vocalizing differed only in the presence or absence of a mid-call gap. Indeed, by producing artificial gaps in my recordings of light-phase females, I could attract dark-phase males.

#### Chicks Respond to Parental Recordings

Back in Manitoba, I experimented with a captured grebe pair and their newly hatched young. As long as I kept the adults' heads covered with dark socks, they sat motionless while I played recordings of parental calls to the chicks snuggled safely on their backs.

The chicks were charming and quite tame. When I played a low clucking call, normally uttered by the parents when bringing food, the chicks emerged from the back feathers and vigorously contested for the tidbits I offered. On the other hand, recordings of the ticking call used by parents when alarmed caused the chicks to duck their heads beneath the feathers and lie quietly.

A curious triangular patch of bare skin adorns the crown of a newly hatched grebe. I noticed that the patch changed color from pale yellow when the chick was contented to a brilliant red when it was excited or begging for food. Possibly a red bare spot signals to the parents that a chick is hungry or in need of attention.

Much of western grebe behavior remains a mystery. Why, for example, do western grebes engage in such complex courtship compared to other species? Are light- and dark-phase birds possibly distinct species? And what is the purpose of the grebe's habit of eating small feathers?

A rare sense of accomplishment came as I learned to read, from its vocalizations, an individual grebe's species, sex, color phase, pairing status, and particular identity. Yet among the western grebe's varied acts of life, none stands forth in memory more dramatically than the breathtaking ritual of rushing, as a courting pair hold their bodies in sculpturesque immobility above thrashing feet that propel the matched performers across a watery stage. □

*Riding in a feathered rumble seat, a young grebe snuggles on its mother's back, where it climbed minutes after hatching. Here chicks spend their first weeks. "There is some barrier between this bird and all mankind," wrote naturalist Aldo Leopold, who confessed himself "helpless to translate" the "secret message" of the grebe. Research has lowered, but not fully breached, that barrier.*





# Fair Winds and Full Sails

# PERTH

By THOMAS J. ABERCROMBIE

NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by CARY WOLINSKY

STOCK, BOSTON

**W**HAT'S A NICE TOWN like Perth doing in a place like this?

That was the question I asked myself on that first stroll down elegant St. Georges Terrace, main street of this opulent oasis. Thriving big-city architecture loomed all around me, 20 and 30 stories and more—the Allendale Square complex, the Australian Mutual Provident building, City Centre—in stone, glass, and burnished metal, recalling vaguely a Dallas or a San Diego. And the humming of a dozen tall building cranes told me that this skyline was far from final. Perth the city was striving toward Perth the metropolis.

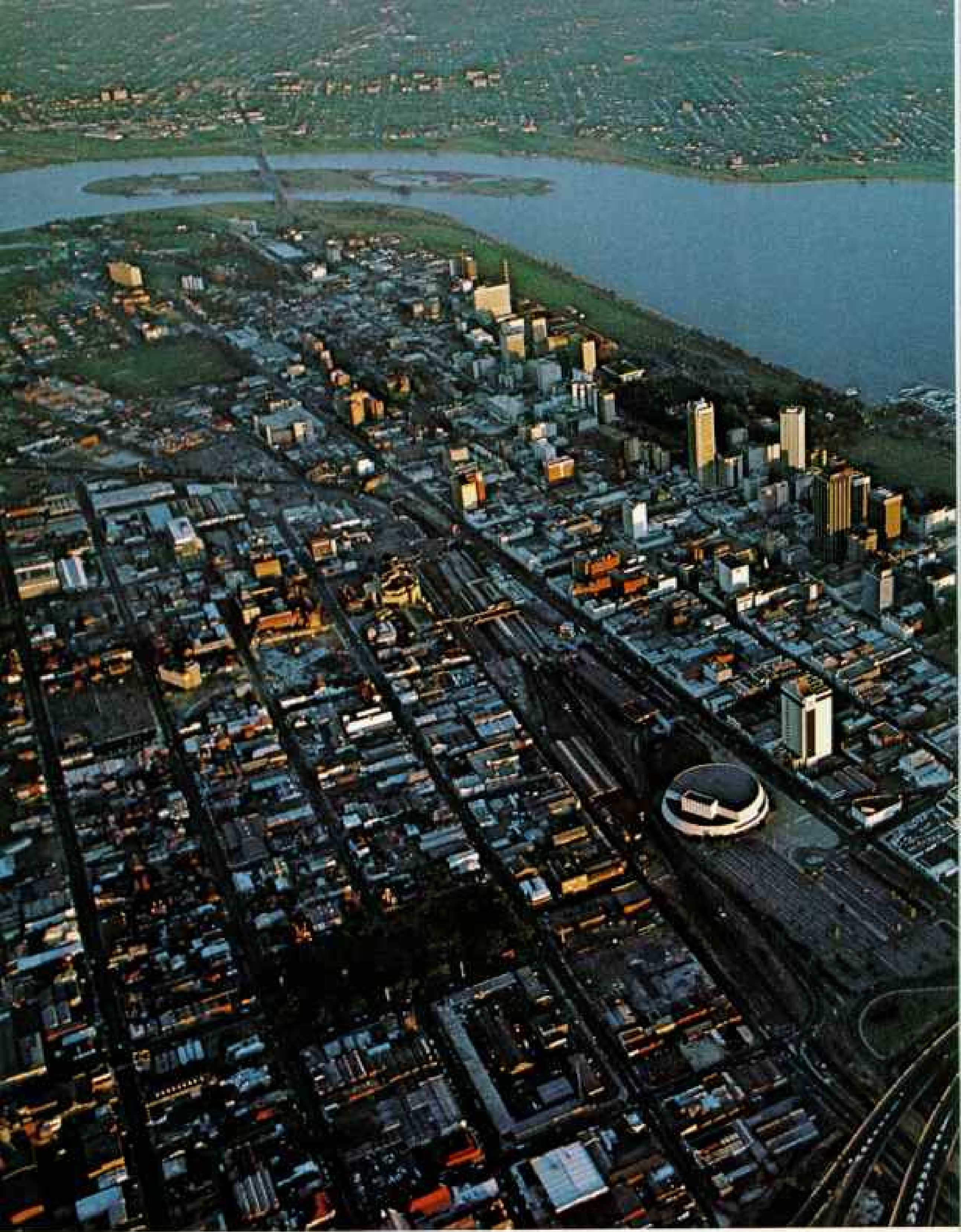
All this despite the fact that the capital of Western Australia, a city of 925,000, stands, globally speaking, plunk in the middle of nowhere. "Sand Gropers," Western Australians call themselves. Adelaide, Perth's nearest urban sister, lies 2,700 kilometers (1,700 miles) east, beyond the barren Nullarbor Plain; the road between them was first paved only in 1976. Jakarta, Indonesia's capital across the Indian Ocean, stands closer than Canberra. Mother England is 12,000 sea miles away.

Isolation stunted Perth's growth for decades, but it fostered a frontier mentality, independent and self-sufficient, that vitalizes the city to this day. And distance proved a cultural quarantine, guarding in Perth a distinctly British flavor.

*Australia's booming southwest centers on Perth—young, prosperous, and free spirited, yet tradition minded. Harnessed to trapeze outrigger, three sailors reflect Perth's mania for sport as they beat upwind on a racing skiff capable of 35 knots.*







*Sweeping curves of the Swan River bracket downtown Perth where, deep in the Southern Hemisphere, an April sun warms an autumn day along a coast blessed with a Mediterranean climate. A city of suburbs, Western Australia's*

*National Geographic, May 1982*



*capital sprawls north and south of the river. A corridor of new high-rise buildings along St. Georges Terrace stands free of factories, thanks to the creation of an industrial park at Kwinana 32 kilometers (20 miles) south on the Indian Ocean.*



On the edge of down under, Perth is one of the world's most isolated cities. Yet the metropolitan area's 925,000 residents include sizable numbers of Greeks, Italians, and Vietnamese.

Protecting the area's extensive beaches, crack lifesaving teams admitted women for the first time last year. This unit (right) practices by carrying an instructor.

Dwarfed by office giants, mementos of Perth's first century still stand their ground: the 1863 Government House, tile roofed and Tudoresque, the Gothic brick St. George's Cathedral, the old Town Hall and its clock tower, His Majesty's Theatre, the Barracks Arch—all lend the texture of history to a promenade through the city.

People you pass further the feeling of an English country town: a tanned and tweedy farmer in for the day, suburban ladies in hats and white gloves ready for a spot of tea after a shopping rendezvous, preppies from Guildford in straw boaters and blazers.

"Piper! Piper!" I follow the cockney shout to the red-covered man hawking the *Daily News*. Today's headline proclaims MURDER. But no fear, that story comes out of sinister Sydney, a continent away. Here in Perth crime seems unfashionable.

As a bearded young troubadour reminds me, strumming his guitar and toe-tapping a tambourine, "it's a jingle-jangle mornin'."

In Perth, most every morning is. Gracing the banks of the wide Swan estuary where river meets ocean, the city sparkles in the

stark blue of a sea and sky still unsullied by smog and pollution. With an average of ten hours of sunshine daily in summer, and winters rarely worse than cool, Perth is twice blessed with setting and clime.

I continue downhill toward the Barrack Street Jetty through a perfect Australian spring, October at its finest. A soft sea breeze tempers the sun, but women of the city have already changed to fetching summer gossamer attire. The watery horizon is flecked with sails, and along the Esplanade the bottlebrush is in bloom.

**N**EAR THIS SPOT in 1829 Perth's first settlers, led by Capt. James Stirling, felled a tree and whispered a prayer, celebrating the founding of the city. Other British had settled Sydney four decades earlier, but only now was England beginning to worry about French intentions in the new continent.

"Unlike the founders of Sydney, Perth's first settlers were not prisoners and soldiers installed by the crown. They were mostly landed gentry, homesteaders who were



paying their own way," said Mary Durack-Miller, a Perth author and historian. "Few were prepared for the hardships they would face here."

We sipped coffee in her white brick house in Perth's fashionable suburb, Dalkeith. Properly speaking it was "Dame Mary Durack-Miller, DBE," but in egalitarian Perth titles can burden as well as honor (politicians have been known to respectfully decline knighthoods). "Mary, it is," Dame Mary said, and quickly put me at ease.

"Cut off from distant England, living in brushwood huts, harassed by Aborigines, the settlers battled flies, sandstorms, unfamiliar climate and soil. Food supplies often ran short," she said.

"They learned how to work, to improvise and make do, to cooperate in good times and bad—even while guarding precious English values," Mary said. "To a great extent Perth today reflects this early heritage."

The new colony expanded slowly. By mid-century all Western Australia still counted barely 5,000 souls. But, beginning in 1885, gold rushes in the Kimberley and

Kalgoorlie brought tidal waves of immigrants westward, and after the boom thousands stayed on, to settle in Perth itself or the expanding wheat and grazing lands around it. With the development of the railroad and new agricultural methods, the government worked to bring idle men and idle land together. On 1,000-acre homesteads they plowed the scrubland, greening an 800-kilometer-long wheat belt that supplied first Perth, then the world.

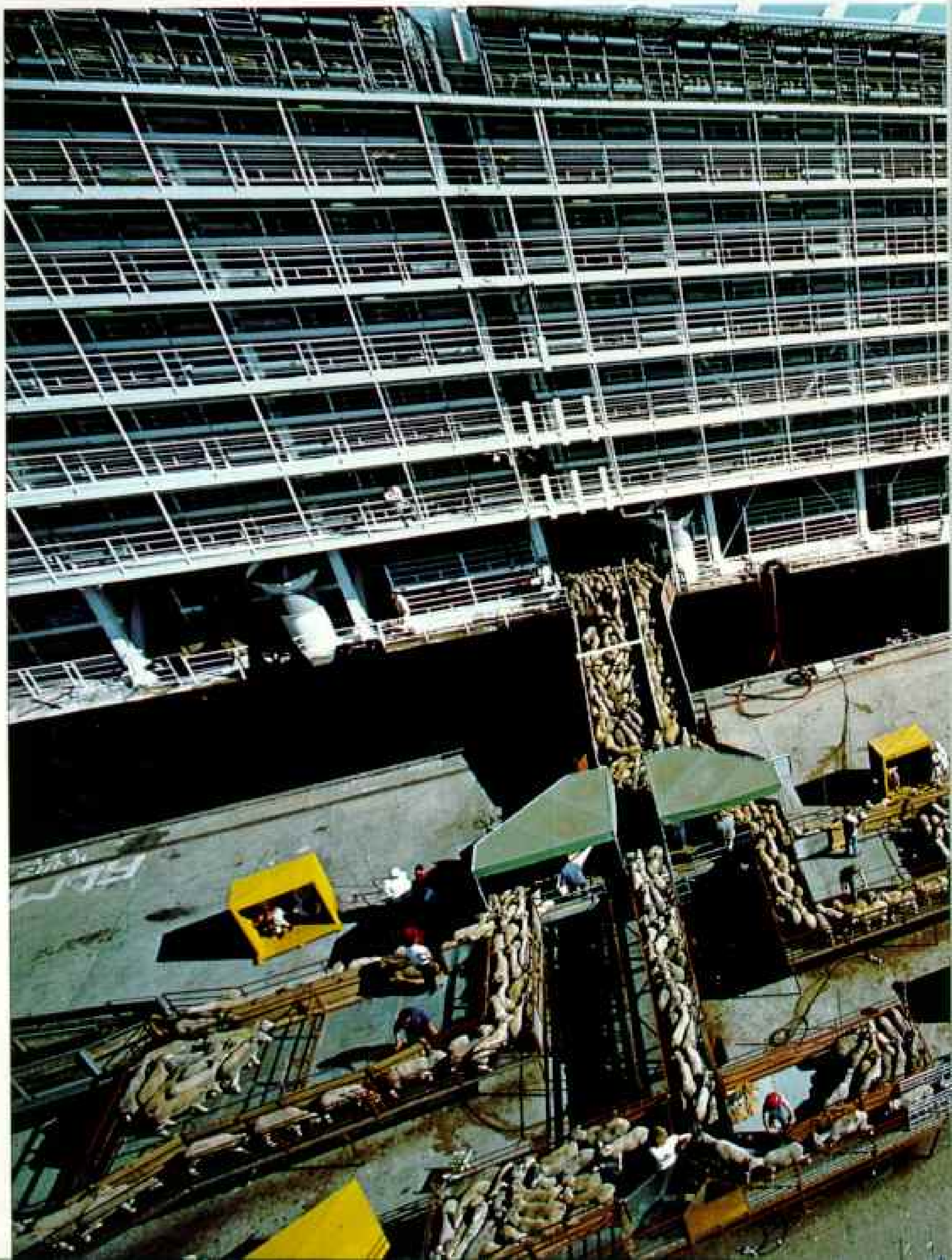
Perth still plays the farm town. Over a net of railways and sidings the winter wheat rolls in special hopper cars to the farmer-owned Cooperative Bulk Handling Limited facility in Kwinana, Perth's industrial zone (page 658). The million-ton terminal, largest in the world, can pour 180,000 bushels an hour into waiting bulk carriers from China, Indonesia, the Soviet Union, and the Middle East.

**S**CATTERED THROUGH the wheat belt and on lonely sheep stations for hundreds of miles beyond, Western Australia's pastoralists, too, focus

*Floating stockyards haul sheep from Perth's Port of Fremantle. With a capacity of 115,000 head, the Danny F. (right), a converted oil tanker, is one of the largest sheep ships that call here. Loading (below) takes two days. The ships trade with Muslim countries, where religious tradition dictates*

*specific methods of slaughter.*

*The trade is a boon to Australia's sheep industry, which ships 5.8 million live animals annually, half of them departing from Fremantle. It also helps make the port the busiest in Western Australia, with more than 1,000 ships calling each year.*







on Perth. Out of the state's flocks, 30 million strong, only the best of some 17 breeds make it to the week-long Royal Show at the Claremont fairgrounds.

With a crowd of farmers at the sheep pavilion I watched veteran judge Stan Dorman pinch flanks, spread wool, then award the blue ribbon to a prize Corriedale.

"The fleece of the winner isn't quite as heavy as on the runner-up," Mr. Dorman

explained. "But the Corriedale is a dual-purpose animal, and this one has the greater 'stretch.' That means more meat. Given the growing Middle East market for live wethers today, meat is becoming the more important criterion."

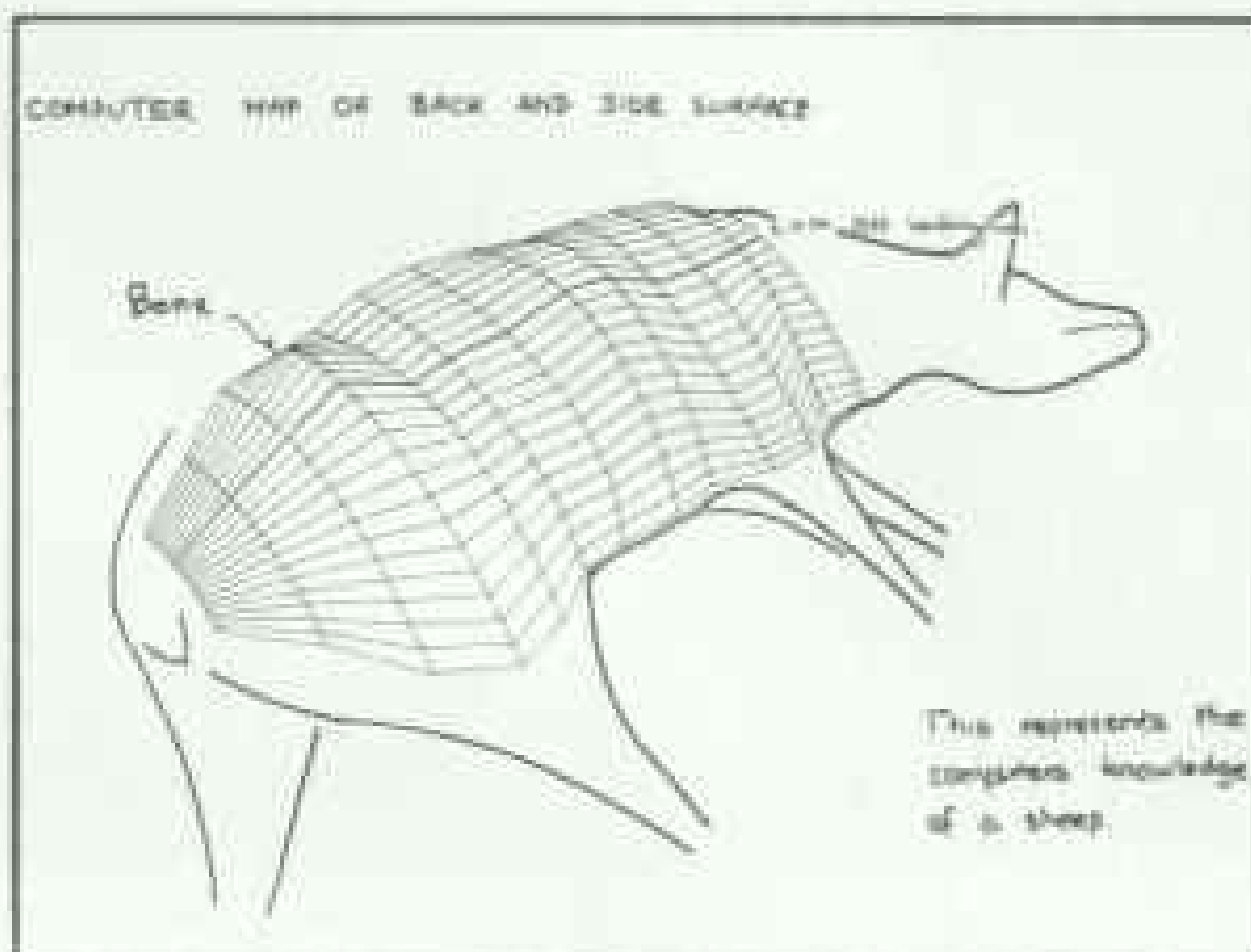
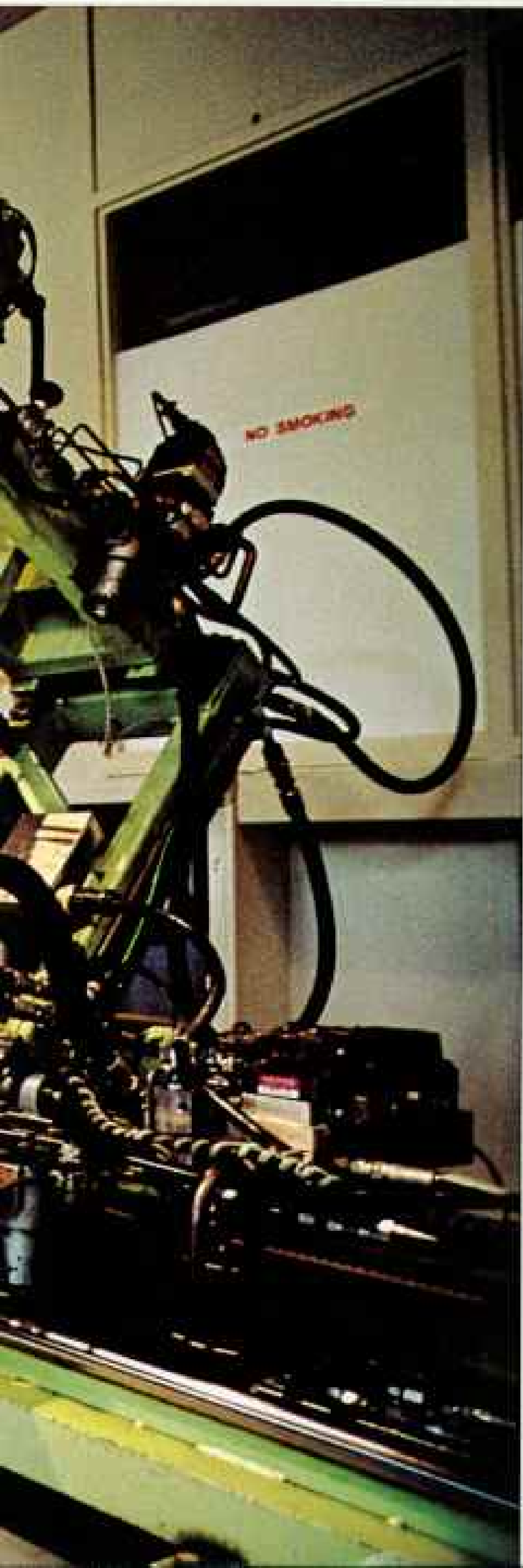
Half the sheep exported from Australia today leave from Perth's nearby port, Fremantle, a harbor for shrimpers and lobstermen as well as Western Australia's busiest



seaport. To land sheep on the hoof in Egypt, Iran, and Saudi Arabia, a Perth firm has launched a fleet of unusual ships. The one I watched loading at Victoria Quay was two blocks long and 12 stories high, looking every bit like a Holiday Inn someone had set adrift (pages 644-5). Rumbling trailer rigs backed up to the chutes, six at a time, each disgorging some 300 bleating sheep; longshoremen brandishing shepherd's crooks

kept the woolly stream flowing. One told me, "To put the 115,000 animals aboard takes two days." Barking dogs quickly corral occasional strays.

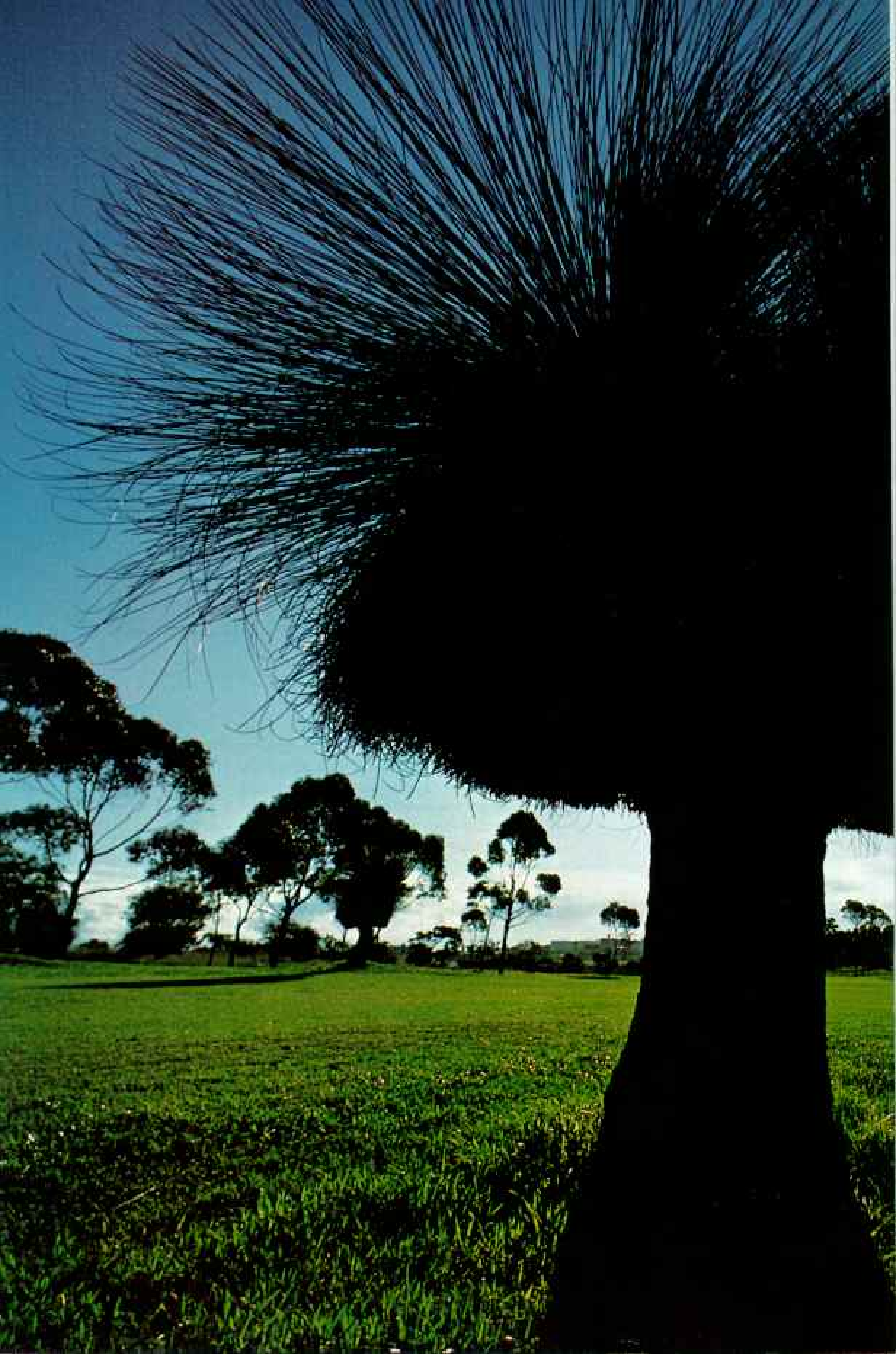
Capt. Rodolfo Mata, director of Fares Rural Company, helped pioneer this shipping technique. "It's been an international effort, you might say. Our largest vessel, the *Danny F.*, is a former British tanker converted by Mitsubishi in Kobe. It's crewed by



*Mechanical hand guided by a computer may someday end the skilled manual task of sheepshearing. An experimental version at the University of Western Australia (left) can now shear a sheep in three minutes, about the same as a human. It may ultimately beat a man's time.*

*Financed by the Australian Wool Corporation at a cost of a million dollars, the machine creates a contour drawing (above) that guides the mechanical shearer over the animal's body. To avoid nicking the flesh, the shearer head can retract in  $\frac{3}{1000}$  of a second when the body moves even slightly, as when breathing.*

*The computer constantly improves the machine's efficiency by sensing the subtleties of a sheep's anatomy and committing the information to memory.*





*Porcupine foliage on a blackboy tree makes for a bizarre hazard on a Fremantle golf course (left). Though stout and woody, the plant is a member of the lily family. It grows less than an inch a year, but may reach heights of 12 feet or more.*

*The Perth area is a variegated garden of such curious plants; 2,400 species of flora are native only to southwest Australia. Many are displayed in the botanical garden at 1,000-acre Kings Park downtown, including the delicately hued banksia (top) and kangaroo paw (above), Western Australia's state flower.*





*A medley of styles develops on the courts of a tennis club in Nedlands (above), a wealthy riverfront community. Early training pays off handsomely for sports-minded Australia. With a population of only 14.6 million, the country produces more than its share of world-class athletes in tennis, swimming, long-distance running, and team sports.*

*Perched on the edge of an arid plateau, Perth luckily sits atop enormous underground water reserves, making swimming pools more the rule than the exception in many affluent suburbs—even those located adjacent to the sea.*

English officers and Pakistani stockmen and flies the Lebanese flag," said Captain Mata—himself an Argentinian.

"For weeks before loading, the sheep are fed hay pellets laced with vitamins," Captain Mata said. Aboard ship, conveyors and piping systems feed and water the animals automatically.

Wool harvesters, too, are exploring new technology, developing an amazing robot that will safely barber a sheep in three minutes flat (pages 646-7). Electronic sensors on the shearing head of the computer-controlled device even correct for the animal's breathing. It is designed to cope with rising labor costs and a shortage of young Australians willing to take up the dirty, hard work of manual shearing.

**I**N THE 1950s Perth hit pay dirt again; this time it was iron, mountains upon mountains of it, 1,100 kilometers to the north in the semidesert of the Pilbara region. A flamboyant symbol of this latest boom is prospector Lang George Hancock (page 653), the burly, outspoken "king of the Pilbara."

Hancock's controversial proposals to mine ore with nuclear explosions and to use sterilization as birth control for mixed-blood Aboriginals (and his pleas for Western Australia to secede from the rest of the country) keep him in headlines and hot water. But his luck, his passion for minerals, and his battles with parliaments and prime ministers have made him a living legend—and the richest man in Australia.

Sitting in his modest office in suburban Claremont, he told me how it all started back in 1952. He was flying his small plane back to Perth from a remote asbestos mine when lowering weather forced him off his course.

"I was weaving down the narrow Turner River Valley at treetop height when I noticed the walls of the gorge," he recalled. "They looked like solid iron! Later I flew back, landed in the scrub, and collected some samples.

"They proved out top-grade hematite ore, 63 percent iron," he said. "I traced the ore body for 70 miles. Prospecting farther, I found more deposits, whole mountain ranges of iron.



"But what to do? Back in '38 the government, having determined that Australia was critically short of iron, had slapped a ban on ore export. So for years I kept the exact location of the place to myself and didn't 'peg' me a claim."

It took Hancock 18 years to get the embargo lifted, to persuade Britain's Rio Tinto Ltd. and America's Kaiser Steel Company to build the mine, and to sign up the Japanese Mitsubishi-Marabini Consortium to buy the ore. It soon amounted to approximately half of Japan's iron ore imports. Hancock never got a mine or a lease, not even a share of stock in the venture. But he was awarded a royalty of 2.5 percent. Today, even though demand for steel has slackened, Australia remains the world's largest iron ore exporter. Hancock's dividend: about \$40,000 a day.

"Heft these," he said, handing me two heavy gray ore samples from his desk. "Sweet as anything that ever went into a blast furnace. If you need more convincing, I'll have the boys weld these rocks together for you. Altogether there's 125 billion tons of it in the Pilbara, enough to supply the world for the next hundred years."

**B**ESIDES IRON, uranium, and exciting new diamond deposits, Western Australia mines significant lodes of bauxite and nickel that feed its refineries at Kwinana. Offshore exploration has brought in oil and gas. Deposits of strategic metals—cobalt, chrome, molybdenum, tantalum, vanadium—are among the largest in the world.

Until the recent iron boom, gold led Western Australia's mining industry. It still pays handsomely. Clicking open the polished brass locks, a uniformed guard let me into the courtyard of the small Perth Mint on Hay Street. A quaint study in 19th-century stone and wrought iron, the mint does an impressive business refining and selling gold and silver bars, as well as stamping out millions of Australian pennies.

Mint director G. W. Robinson led me past vaults and giant balance scales to the small refinery, a smoking, stygian scene of roaring furnaces and flaming crucibles, where foundrymen wearing grotesque asbestos gauntlets melted the Monday morning pour.

But despite its medieval atmosphere, the mint's world reputation is second to none.

"We purge and repurge the molten gold, bubbling chlorine gas through to remove the last impurities, mostly silver," Mr. Robinson said. "Before we pour, samples from each crucible are checked in our X-ray fluorescent spectrometer. Fine gold bullion must assay at least 99.5 percent."

Gleaming finished ingots worth \$600,000 at current market value, each about the size of a common brick, awaited one more assay before the figure of a swan was hammered into the gleaming gold, the prestigious Perth Mint seal.



*Flavors of the old country mellow in the curing room of John and Tom D'Orsonga (left), Italian immigrants who produce 70 varieties of sausage.*

*Lang George Hancock (above), Australia's wealthiest man, discovered a vast deposit of high-grade iron ore in 1952. He arranged for the mining of the reserves and receives 2.5 percent of the proceeds.*



Perth's newfound wealth has not turned her head; Australia's fastest growing major city is one of its friendliest. I met a "T'other-sider" from Queensland who years back had come west for a visit and stayed on. He told me why: "In Sydney the first question they ask is 'What's your net worth?' In Melbourne it's 'What about your family?' Adelaide inquires 'Which religion?' In Perth the first question is 'How 'bout a beer, mate?'"

Back in 1962 hospitable Perthians got a bright idea and switched on every light bulb in town to greet America's first orbiting astronaut, John Glenn, as he sped through the night overhead. United States sailors by the thousands still find a roaring, roisterous welcome when they tie up here after an Indian Ocean patrol.

Days before a U. S. Navy ship arrives, local newspapers begin printing the "dial-a-sailor" telephone number. As the vessel docks, the phone is plugged in and offers start ringing in. Even when an aircraft carrier calls with a crew of 5,000, there are more invitations than the sailors can accept.

"Two for a family barbecue."

"Room for five on our sailboat."

"I'm 23, 5 foot 5, and like dancing and swimming. . . ."

"Perth," one young ensign said, "has gotta be the best liberty on the seven seas!"

**P**ERTH'S PACE is as pleasant as its people. At his St. Georges Terrace office hung with multicolored maps of freeways, population densities, and land use, town planning commissioner David Carr presides over the shape of Perth's future. At day's end from the veranda of his lovely bluffside home near Kings Park, he can gaze down on the city's center to see firsthand how it's going. Late one afternoon Dr. Carr shared his skyline with me, and some secrets of Perth's success.

"First, our seaport, Fremantle, and the industrial area, Kwinana, are outside the city. This keeps heavy traffic out of downtown," he said. "Another positive factor in Perth's quality of life is the favorable ratio of developed to recreational land. Out of our land-use taxes we have committed 54 million dollars to purchase more parks for the future. We estimate Perth will reach one and a half million people in twenty years."

From the very beginning Perth's city fathers valued open spaces. The colony's first surveyor general, John Septimus Roe, forbade cutting trees on Mount Eliza and recommended land there be set aside for the public. Thousand-acre Kings Park was officially dedicated in 1872.

"That park today, to a developer, would be extremely valuable," Dr. Carr said. "But as a public asset it is priceless."

Several times I tramped through this quiet retreat. The local equivalent of New York City's Central Park, it is filled with childhood memories for even Perth's oldest citizens. They come for the sweeping views of the river from the ANZAC bluff—where an obelisk stands in honor of Western Australians who fell in foreign wars—and to stroll the boulevards lined with lemon-scented gum trees, to explore natural bushland, or to follow scenic grass paths to playgrounds, ponds, and gardens.

As precious to Perth as its sense of space is its sense of history.

"I think we all realize that not everything new is beautiful. Perth is growing so fast that if we're not careful there won't be anything left of our heritage," said Alan Bond, who as an energetic financier and America's Cup racing sailor is well known on both sides of the Equator. We talked at the penthouse office of Bond Corporation Holdings Ltd., soon to be dwarfed by a new complex that by 1985 will top Perth's skyline.

"We want to preserve the old Palace Hotel, even though the land under it is probably the most valuable piece of real estate in the city. Economic reality precluded anything but a tall, modern building on the site," Mr. Bond said. "So we've designed our 50-story office tower around the old landmark."

Despite a sagging world economy, Perth still incubates many millionaires. Bond, 44, began his career modestly enough as a sign painter, soon after migrating from England in 1951. Then he began remodeling old houses. Before long he was subdividing and building houses of his own, then investing. Today the Bond Corporation has grown into a major Australian conglomerate of brick-kilns, apartment complexes, seaside developments, gold mines, oil and gas ventures, a quarry, and—its latest acquisition—a brewery.

**T**HE SOPHISTICATION of Perth has greatly diluted its down-under dialect. Immigrants from continental Europe and Asia now join the traditional inflow from Britain; radio, television, and films have their leveling effect. But one place you can still hear fair dinkum Aussie spoken is the football match.

I wedged into Subiaco Oval with 50,517 feverish fans for the Grand Final, the annual Australian Rules football championship, played this year between the Claremont Tigers and the defending South Fremantle Bulldogs. I had come as a neutral observer, of course, but swayed by the presence of blue-and-gold pennants around me, I decided to "barrack" for the Tigers. (I had learned that one never "roots" in Australia—at least not in polite conversation.)

"Claremont, yer beauty. C'mon, rubbish 'em!" shouted a fan behind me. "C'mon, bash the bawrstards!"

And the game hadn't even started yet. A

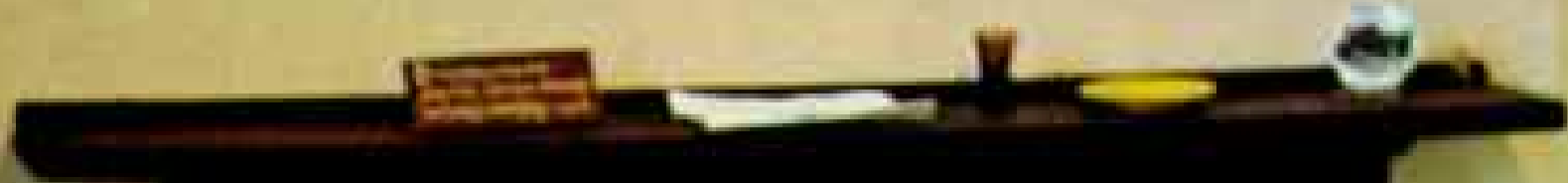
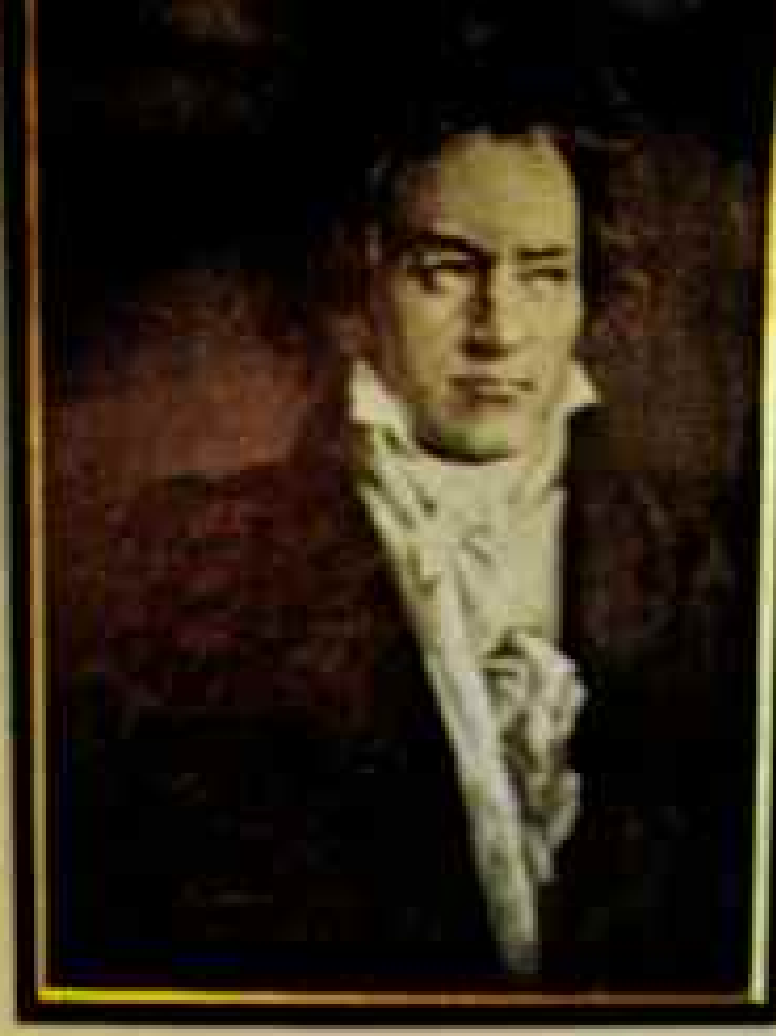
sky-diving team was still floating down into center field, cheerleaders pomponned to the bleachers, and 10,000 balloons were loosed. When the band struck up the national anthem, "Advance Australia Fair," I found myself the only one standing. But the next number, "Waltzing Matilda," had everyone up and singing full chorus.

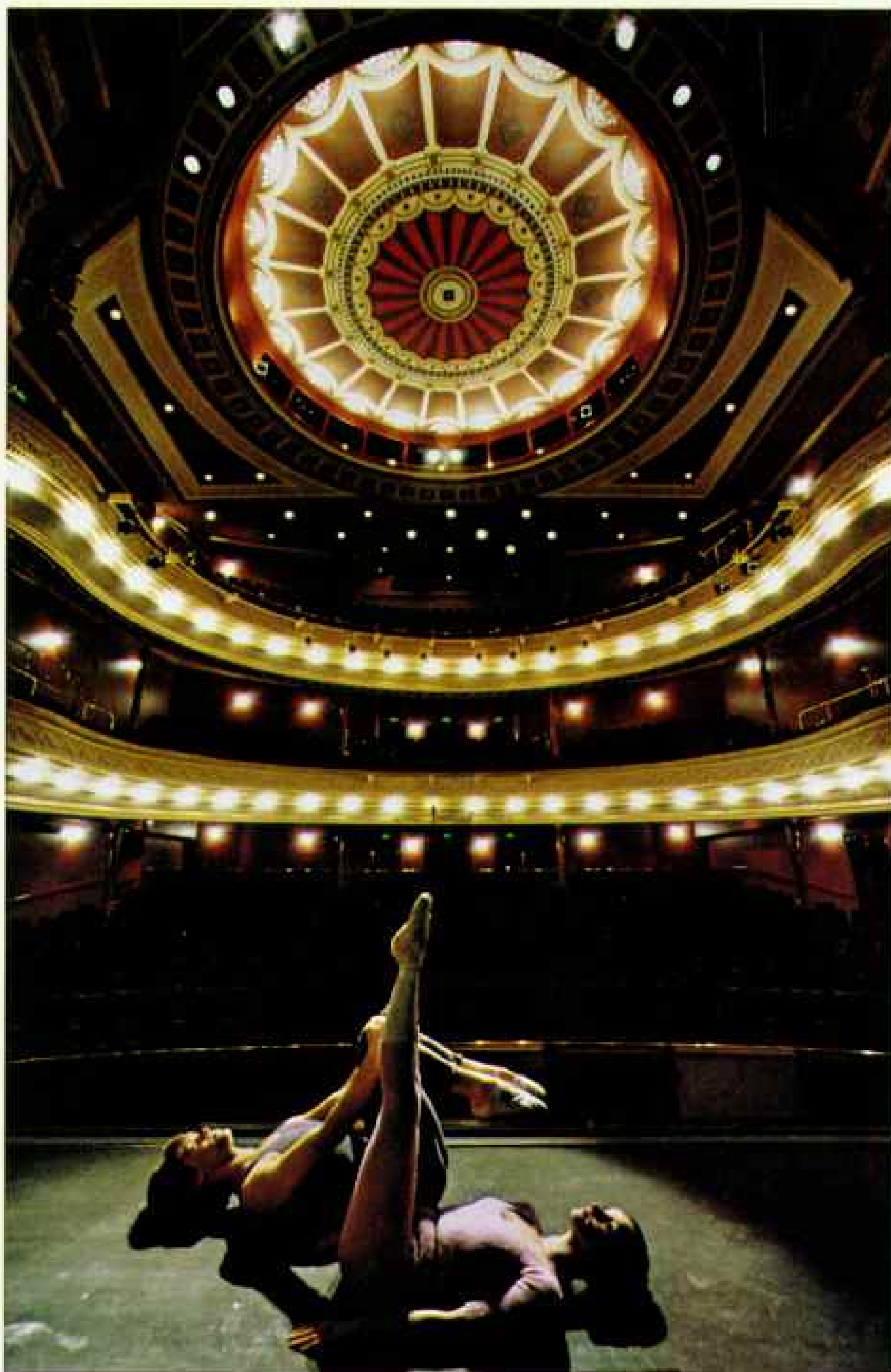
A blend of rugby, old Gaelic football, and soccer—with a mayhem all its own—Aussie Rules, or "footy," is played by eight semipro teams in the Perth league. A team fields 18 players, with two in reserve, on a gigantic field 180 meters long, 120 wide. Points are scored by kicking the red leather ball between goalposts, four at each end.

At the starting kick, Claremont receives, but within seconds a donnybrook on the field has the crowd on its feet. A burly South Fremantle half-forward has flattened the Tigers' key ruckman, Barry Beecroft, who is hauled away with a concussion. More brawls follow, as many as 20 men in a knot

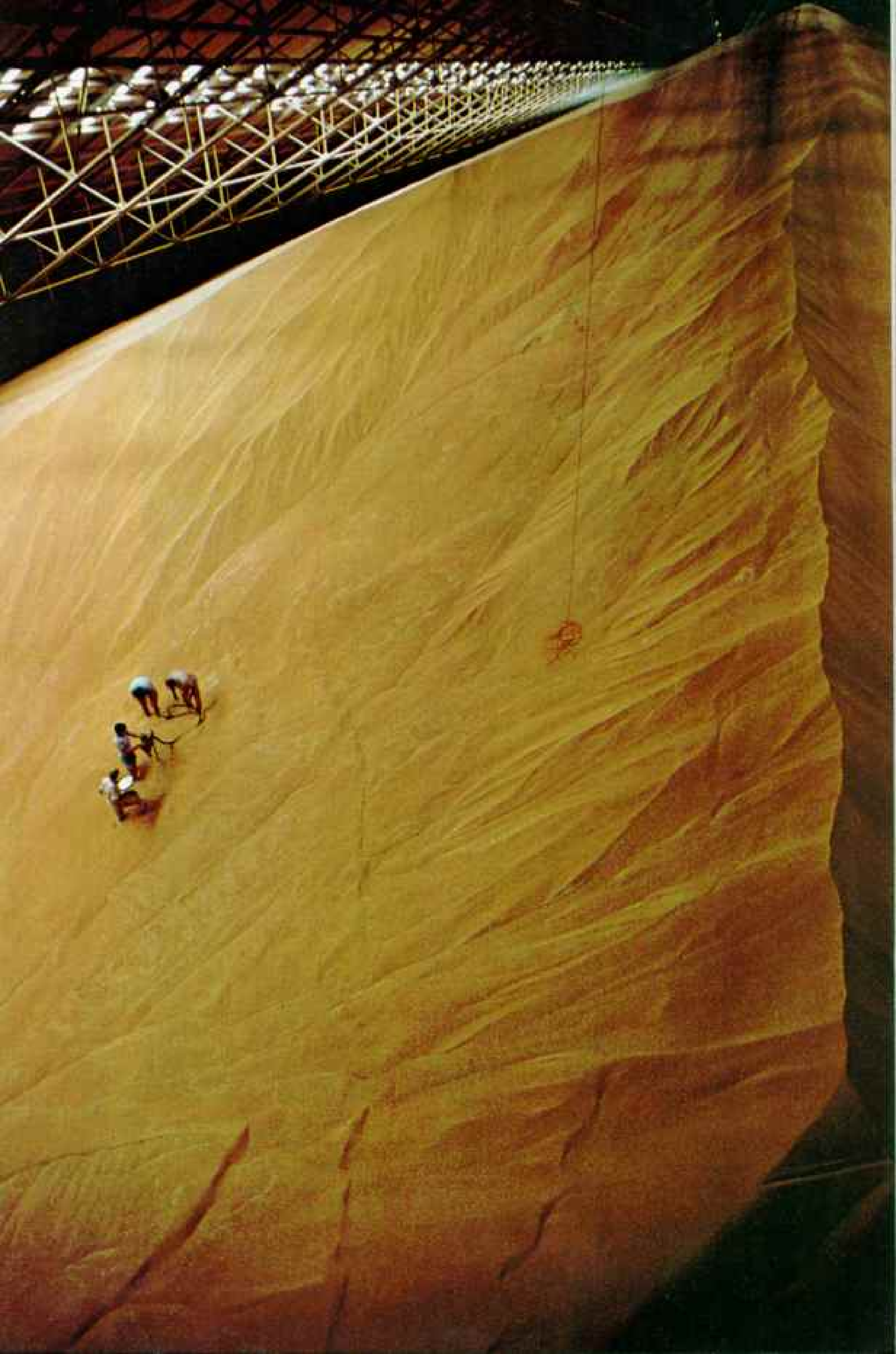


*Distant cousins of the kangaroo, quokkas get fond attention on a family outing on Rottnest Island, 18 kilometers west of Perth. The animals played an important role in the search for a cure for muscular dystrophy. Studying these marsupials, scientists first discovered that muscle tissue has the ability to regenerate with massive doses of vitamin E.*





*A bit of body English helps Katherine Troy, seven, through her violin lesson (left) as Beethoven stands watch above the fireplace. Limbering up before practice, two members of the West Australian Ballet gaze at the ceiling of His Majesty's Theatre (above). By the late 1980s Perth hopes to complete construction of the Perth Cultural Centre. An art gallery, drama theaters, and a state library will take their places near the already existing Western Australian Museum.*



of flying boots, knees, and elbows, and even a haymaker or two. The umpire nearly runs out of whistle, and I'm jostled by the partisan crowd. "They're just wrapped, these blokes," yells the fan behind me. "They bloody went mad!"

Maintaining the lead first quarter, Claremont soon lags. It's neck and neck to the end, when Claremont's Krakouer brothers spark a last-minute spurt and the Tigers win 111 to 96.

"Whata dye! Whata pair o' pliers!" the fan shouts. "I told ya she'll be right. Freo went crook. They were bloody knackered, they ran outa legs!"

**P**ERTH'S SPORTS FANS are never far from a cricket pitch, tennis court, or bowling green. Most would rather play than watch.

Surrounded by tempting water, the city has bred its share of sailors. According to one wag, all Perth can be divided into two kinds of people: those heading for their sailboats and those already on board. Thousands of sails fleck the horizon each weekend. Most boats, you soon notice, whether toddlers' six-foot Mudlarks or millionaires' oceangoing thoroughbreds, sail in determined fleets, locked in combat, racing their hearts out.

I was invited on board *Siska*, the flagship of Perth's ocean-racing fleet. From behind her teak wheel, Capt. Rolly Tasker drove the tall racing sloop up the windward leg with the confidence of a man accustomed to winning. No shouts or gymnastics here; the 12-man crew was as one with the boat.

A nod from sail master Rob Lynn, and the pair manning the big coffee-grinder winch tightened the jib ever so slightly. Tasker's eyes made their rounds from compass to wind gauge, to the masthead ten stories above, then back to the speedometer: "That gives us an extra tenth of a knot." The sun-scored skipper smiled, and we bore down on the finish line off Fremantle half an hour ahead of the fleet.

For Tasker all this was serious business even though for *Siska* the morning race, a qualifier around the buoys, was child's play. The sleek scarlet 77-footer finds its stride in deep water, circumnavigating the island continent, or setting the speed record for the 12,000-mile England-to-Australia run.

**T**HE SAME TALL SAILS on Perth's horizon that heralded the first European settlers spelled doom for a flourishing culture of native Australians. Today government provides Aboriginals with increased welfare, schooling, and housing. Yet problems remain for many of these people, whose ancestors lived here for millennia before the colonists landed. Displaced and dazed by the trauma of white occupation, a few survive only as second-class citizens in squalid camps around the city.

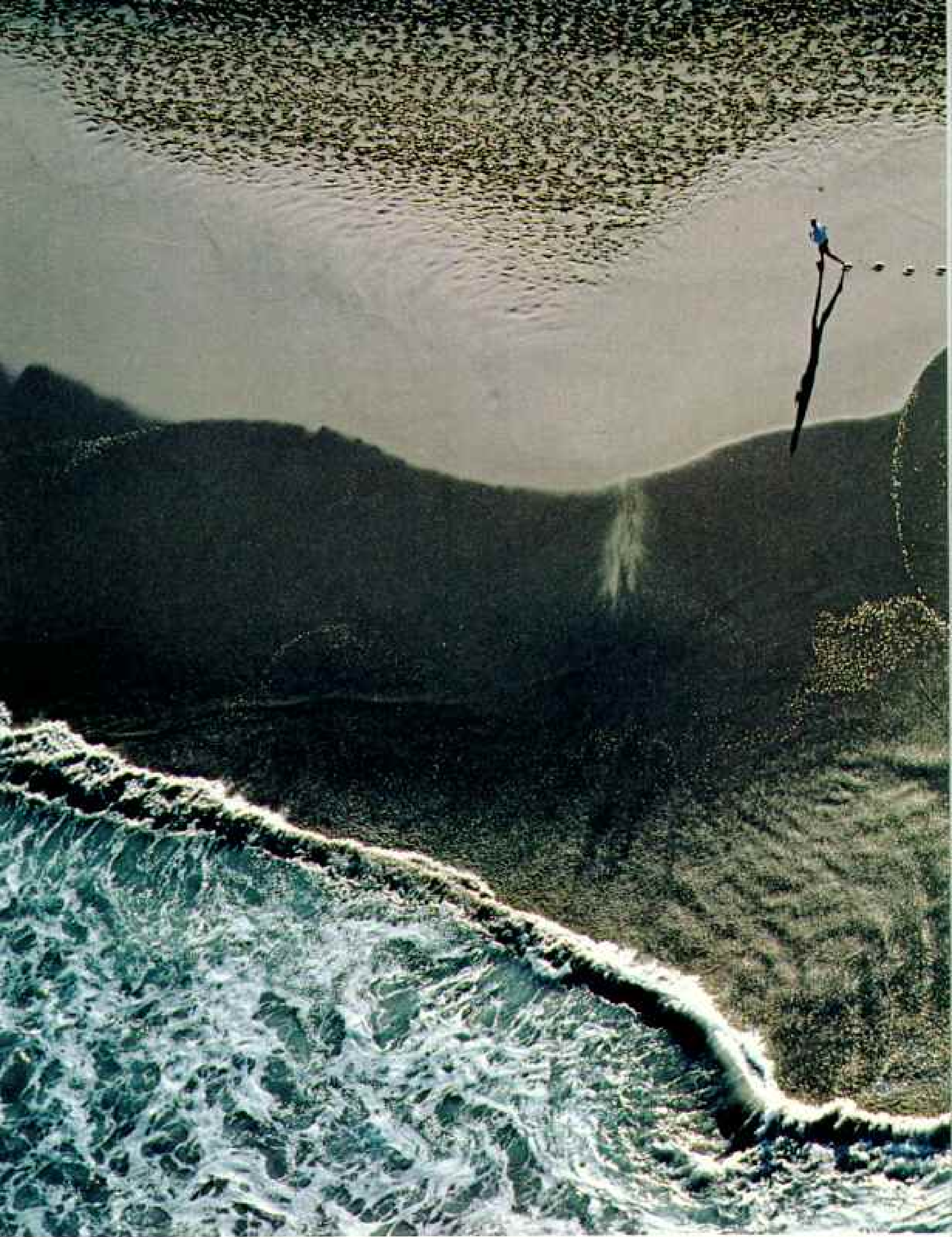
At Lockridge, in a "fringe dwellers' " tin-and-canvas campsite amid riverbank vineyards and cheerful new subdivisions near Guildford, I introduced myself to Robert Bropho, an angry spokesman for the land rights of Aboriginals.

"Yes, I know NATIONAL GEOGRAPHIC. I used to read it in jail," Bropho said. "For years I was a jailbird, an alcoholic, but I kicked the grog." Now, he told me, he spends time helping others overcome the plague of alcoholism. Bropho and I talked under the shade of an ancient gum tree while his 93-year-old mother stared into a small campfire nearby, never looking up. From a makeshift pole, a black-red-and-yellow flag fluttered defiantly. The colors signified the black man, his blood, and the sun.

"How are we supposed to respect the white man's law?" Bropho asked. "He killed our people, stole our land, defiled our religious sites, seduced our women, brainwashed our children in his schools. He broke all his Ten Commandments on us.

"For 40,000 years we lived in peace and in harmony with this land," he continued. "Then, in a few short years the white man robbed us of a whole continent.

*Halfway up a mountain of wheat, inspectors check for insects in the cavernous terminal of Cooperative Bulk Handling Limited at Kwinana. Capable of loading ships at 180,000 bushels an hour, the facility helps keep Australia the world's third largest wheat exporter, after the United States and Canada.*



*Dashed line left by a jogger joins the work of wind and tide in an ever changing sand sculpture at Cottesloe Beach—a popular surfing spot. Perth abounds with*



*such getaway places: superb beaches, the Swan River, spacious gardens, numerous parklands, nearby Rottnest Island, and the Indian Ocean.*



"All we ask for is our rights, for ourselves and our children: land!"

The local public-assistance office had bored a well for the Aboriginal campsite at Lockridge and set up five house trailers for its 50 inhabitants.

Through lack of understanding more often than malice, Australia's Aboriginals suffered under their new rulers. Primitively armed, greatly outnumbered, they put up little resistance. Now, generations later, many Aboriginals live a schizophrenic life somewhere between their culture and ours.

Ken Colbung, leader of the Nyoongah Cultural Complex at Gnangara Lake, 20 kilometers north of Perth, believes the black man's only hope is integration (pages 664-5). As a young man Ken worked as a stockman on a cattle station, living a semi-wild life in the bush. During 15 years as a sergeant in the Royal Australian Engineers, he finished school and learned boxing and how to handle explosives. But he never forgot how to throw a boomerang. He insists he is just as happy lurching on kangaroo meat, emu eggs, and witchetty grubs ("they taste a bit like almonds") as on steak-and-kidney pie and chips.

"We must learn to adapt," Ken said. "Let's face it, we are a microscopic minority here, maybe one percent."

Colbung says his name derives from *kalbin*, a kind of Aboriginal high priest. In his job at the center he lives up to his name, serving as a sort of mayor, medicine man, justice of the peace, and Mr. Fixit. Several times the phone interrupted our chat: A man needed help starting his truck; a woman, advice on filling out forms for a housing loan. A scholar sought more details on the legend of Waugal, the "great rainbow snake" who, Colbung said, made the mountains and the freshwater springs back in Dreamtime, the Aboriginals' mythical time of creation.

Later a young woman came in to enroll two freshly scrubbed youngsters at the community's innovative school.

"So far we have 35 boys and girls at our Nyoongah Aboriginal Community College, ranging in age from 4 to 13, bused in from the urban fringe camps," Ken explained. "The teacher, who worked with Indians in the United States and Canada, keeps the classes unstructured. No grades are given;

the only competition is outdoor sports. All books, desks, crayons are community property. Along with reading, writing, and arithmetic the youngsters learn spear throwing, tracking, and Aboriginal art.

"For the sake of our souls we must never forget our heritage," Ken concluded. "Meanwhile, to survive this life, we better learn to live with the rest of Australia."

**B**ASKING in one of the sunniest spots on earth, Perth—small wonder—has become a leading marketer of solar energy; its factories supplied the estimated 80,000 solar water-heating units in service throughout Western Australia. A lion's share of the 25-million-dollar-a-year business goes to Perth's Solahart firm. Plumbers and galvanizers since 1901, the firm of S. W. Hart & Company Ltd. first started making solar water heaters 30 years ago, and today deals worldwide, equipping a whole subdivision in California, a copper-mining town on New Guinea.

Said managing director Wayne Reed: "We consider ourselves pacesetters in this rapidly growing industry. Last year we spent nearly \$400,000 on research and development, while turning out 40,000 units, mostly 300-liter domestic heaters."

To absorb some solar energy of my own, I rode city bus 762, the "Surfie Special," to North Cottesloe, then trudged the half mile up the shore to Swanbourne, Perth's largest nude beach.

An unguarded stretch of seashore between the more strictly regulated city beaches, Swanbourne attracts a growing crowd of followers who prefer their sunlight straight up. On my way I passed a grim-faced crusader bearing a cumbersome sign on a staff: ETERNITY WHERE?

I remember the gilt-framed painting of a bare, milk-white damsel in the Palace Hotel downtown. It was flanked by velvet drapes. "Sometimes we draw them if the clientele objects," the waiter had explained. Swanbourne no doubt offends some, but when it comes to sun worship, Perthians, while always proper, are rarely prudes.

Clad only in a heavy layer of Sea & Ski, I ventured across a sort of no-man's-land toward the colony of flesh. If I had expected to encounter mostly the young and trendy

here, I was surprised to see a fairly broad cross section of Perthkind, from the pail-and-shovel set to animated centerfolds to basking gray pensioners. Between make-shift driftwood wickets and washed by waves, a team of small boys played cricket; farther inland, across a net staked in the sand, leaping teenage girls were locked in a fascinating game of volleyball. Somewhere, nippers had launched a kite that cast the only shadow on the endless shoreline.

"We've been coming out most every Sunday," said the husky red-bearded man taking the rays with his bronzed wife and small son. He was a clerk, he told me, in a Perth plumbing-supply house.

"For a while the park rangers used to drive down and give us all the boot. But that's done with. Now, on a good day like today, 4,000 turn out for a bake," he said.

"The only bother now is the occasional gaper walking by with his clothes on."

**E**ACH YEAR a quarter of a million people head for an "overseas" vacation on tiny Rottnest Island lying just 18 kilometers off the coast. It was so named by a 17th-century Dutch sea captain who mistook the island's small marsupials, called *quokkas*, for rats.

Some tourists pass an idyllic week or two on "Rotto," fishing, skin diving, or exploring the rocky coves and secluded beaches. I made a day trip on the fast ferry from Perth.

I rented a rusty bicycle to tour the island's quiet country roads, all off limits to cars and motorbikes. In a grove of tea trees and oleander not far from Bathurst Point lighthouse, I shared my picnic lunch with a friendly pair of quokkas. These knee-high marsupials, distant cousins of the kangaroo, have survived the fur industry, hungry Aboriginals, and the governor's hunts as well as droughts and famines. Today they are a protected species (page 655). They also play an interesting role in medical research.

"Studying the Rottnest Island quokka, we proved for the first time that damaged muscle tissue can completely repair itself," said neuropathologist Dr. Byron Kakulas, medical director of the Muscular Dystrophy Research Association of Western Australia. "During droughts on the island these animals, lacking sufficient greens, come down

with a serious vitamin deficiency that ravages muscle tissue and can even cause paralysis.

"Once I sat up all night nursing a paralyzed quokka with doses of vitamin E," Dr. Kakulas said. "By morning the little fellow was walking around again. Ultimately all its damaged muscle regenerated itself. It was a breakthrough."

The quokka's disease and muscular dystrophy in humans may involve essentially



*Mythological images surround Professor R. M. Berndt of the University of Western Australia's Anthropology Museum. The center, dedicated to the preservation of the Aboriginals' heritage, was opened in 1979 and houses hundreds of art pieces, many collected by Berndt himself.*



*Playing his didgeridoo, a traditional instrument, Ken Colbung, an Aboriginal (above right), keeps young hands clapping at the Nyoongah Cultural Complex, which he directs. Long a resident of the outback, Colbung, 51, was a stockman and served a stint in the army before deciding to devote his life to helping Perth's 9,500 Aboriginals. Many live in trailers (facing page) on the outskirts of the city where, Colbung says, the unemployment rate is persistently high.*

*Colbung also founded the Nyoongah Aboriginal Community College, supported by state and federal funds. Its*



*35 students range in age from 4 to 13. Colbung hopes eventually to enroll 500 persons of all ages and provide "cradle to the grave" education.*

*In a temporary classroom (above left) a barefoot youngster listens as an instructor teaches basic reading, writing, and math skills.*

*"We're teaching people how to live off the land, as well as by the computer," Colbung says. "Some want to keep their traditional ways of living and, in a democratic country, that should be available. We're like a religious order, filling spiritual needs as well as physical ones."*



the same type of muscle-membrane damage, he said. And a cure for one, it is hoped, might lead to an eventual cure for the other.

**A**T PARLIAMENT HOUSE back in Perth, I paid my respects to the Honourable Sir Charles Court, KCMG, OBE, MLA, Western Australia's premier until this January. A lifelong Perth resident, Sir Charles, at 70, remains one of its most energetic boosters.

"Perth is the most isolated capital in the world," Sir Charles said. "But we have proved isolation can be a blessing if you manage it properly.

"Cut off from the world, Western Australians were always obliged to think for themselves, to innovate," he continued. "To educate our outback youngsters, we developed Schools of the Air, classes linked together by a radio sparked by foot-pedal generators. For rural health care we organized the Royal Flying Doctor Service. Much of our soil was poor, so our scientists pioneered treatment with trace elements."

High above Sir Charles's office, alongside Australia's flag, the Union Jack often still waves; and once each year—for the formal opening of parliament—the governor arrives, accompanied by the usher of the black rod, the bearer of the mace, and bewigged justices of the supreme court, recalling the pomp of distant Westminster.

But as Geoffrey Blainey notes in his provocative history, *The Tyranny of Distance*, Australians are "rapidly turning away from England as the fountain of migrants, trade, capital, military security . . . culture, and technology."

Perth, facing the realities of modern politics and global economics, now must look to the United States and Asia as much as to the mother country. Busy as it is with its newfound role, the city still finds time to smile.

"We're not just growing," a longtime Perth architect told me. "We're growing better." □

*Past and present reflect from a pond at Kings Park as a woman and child wander by the Pioneer Women's Memorial, dedicated to the spirit that built Australia—and is building her still.*





# The Incredible Potato

By ROBERT E. RHOADES

Photographs by MARTIN ROGERS

**T**HIS IS THE VEGETABLE that conquered the world: the peasant's staff of life, the gourmet's delight, nutritious, delicious, lauded, and maligned—the paradoxical potato, the amazing spud.

Among the first Europeans to see the unimposing plant the Indians called *papa* were conquistador Francisco Pizarro and his rowdy band. When they overran Peru in the 1530s, they were unaware of the buried treasure beneath their feet. They rode roughshod over the *papa*, in hot pursuit of the Inca Atahualpa and his fabled gold.

Introduced into Europe over the next 50 years, the potato began four centuries of world conquest. The Inca Empire has vanished. Spain's glory is only a memory. King Potato keeps on reigning. Compared to the vast benefits this versatile plant has bestowed on humankind, all the gold of Peru becomes small potatoes.

Today the potato is produced in 130 of the world's 167 independent countries. One year's crop, at consumer prices, is worth 106 billion dollars, more than the value of all the gold and silver the Spanish ever carted out of the New World.

The average annual crop (291 million tons) could cover a four-lane superhighway circling the world six times.

The potato is so nutritious that a man in Scandinavia lived healthily for 300 days on only spuds dressed with a bit of margarine.

It takes seven pounds of potatoes, about 23, to total 2,500 calories, the approximate adult daily requirement; so eating a spud without rich toppings is no more fattening than eating a pear—the potato itself is 99.9 percent fat free.

An acre of potatoes yields almost as much food as two acres of grain, and when the water that composes about 80 percent of potatoes is squeezed out, they provide annually more edible dry matter than the combined worldwide consumption of fish and meat.

Without potatoes meat production would slump and meat prices skyrocket; nearly half the world's crop is fed to livestock.

Potatoes are for more than eating: distilled into vodka and aquavit, processed into starch, paste, and dye, convertible to fuel for our cars.

One never knows when a new and startling use will be found for the potato: Gangster John Dillinger reportedly found one when he carved a pistol from a potato, dyed it with iodine, and escaped from prison.

What has made the potato king among vegetables? Fruitfulness, hardiness, nutritiousness—and, above all, versatility, which is why in India a jack-of-all-trades is called *alu*, potato.

The potato yields more nutritious food more quickly on less land and in harsher climates than any such major crops as wheat, corn, or rice. On average it matures faster than any of these staples—in 90 to 120 days,

*Good earth of Ireland clings to potatoes bound from family garden to evening meal. Carried from Peru to Europe by 16th-century conquistadores, the potato long met suspicion and scorn. But now the South American native, praised for its nutrition and versatility, grows in more countries than any crop except corn.*





and edible tubers can be harvested after a mere 60 days.

Nutritionists rate the quality of potato protein higher than that of the soybean, and a single spud can supply half the daily vitamin C requirement of an adult, a fact sea captains early guessed at when they carried potatoes to prevent scurvy among their crews. If captain and crew had been cast away on an island with a bushel of potatoes, they could have grown a ton of food within a year and survived. With milk they could have held out indefinitely. A potato crop is

as well suited to backyard gardening as it is to large-scale commercial production.

The potato is so hardy and adaptable that it grows from below sea level behind Dutch dikes to almost 14,000 feet up in the chilly Andes and Himalayas, from the Arctic Circle to the Strait of Magellan, and in the scorching deserts of Australia and Africa. Only in the sultry jungles, where high humidity encourages wilt and other diseases, does the potato languish. If, however, the world's temperature should drop a few degrees, as some climatologists predict, the

*Round, long, straight, twisted: Potatoes grown in the Andes of Peru span such a range of hue and shape that the Quechua Indian language offers at least a*



cool-weather-loving spud will become an even more important food crop.

It may also become a useful source of energy in the decades to come. We may be burning potato gasohol in our cars. When Henry Ford first got into the automobile business, he predicted the world would soon run out of cheap petroleum. To make alcohol, he ordered potatoes from Europe that were grown for industrial purposes, but the project seemingly went down like an Edsel. The way things are going, it looks like Ford did have a better idea. Researchers have shown

that one acre of potatoes can yield 1,200 gallons of ethyl alcohol in a year.

If, like Ford, we choose to import our alcohol potatoes from Europe, there should be plenty. Europe and the Soviet Union grow 75 percent of the world crop. In a good year, the Russians, who call potatoes their "second bread," account for one-third of world production. Poland, with 15 percent, is second, followed by the United States in far third place with 5 percent.

The future of the Soviet potato crop was seriously threatened in an episode in World

*thousand words for them. The familiar brown oval spud is only one of eight cultivated species, and varieties within these number into the many thousands.*



War II, as shells from Nazi artillery burst into the potato plots of the Pavlovsk experiment station. The last to leave, Abraham Kameraz, senior Soviet scientist, scrambled to gather up pea-size tubers like precious gems. Slung his potato sack on his back, he struck out on foot toward Leningrad.

In a dark Leningrad basement he was joined by fellow scientists. They garnered every stick of wood, including furniture, for fuel to keep the potatoes from freezing. They stood watches to beat off the hordes of rats that gnawed at the sacks. Collapsing from hunger, the potato protectors would not touch a single tiny tuber. They were guarding a national treasure, defending the South American potatoes crucial to the genetic revitalization of their own varieties, which were no longer disease and weather resistant. They believed that without potatoes, a staple of Soviet life, German victory would be assured.

#### Study Center in Potato's Homeland

In the Paucartambo Valley, high in the Peruvian Andes, only village elders remembered that a Soviet expedition had collected wild and cultivated potatoes there almost 50 years before. Most villagers had no idea how important their potatoes had become in other lands. They wondered why foreigners like me came here to learn about potatoes.

I came as an American anthropologist, associated with the International Potato Center in Lima. From my base in the homeland of the potato I have traced its historic journey through five continents, but nowhere have I found more fascination in my studies than in Peru itself.

Before 6000 B.C. nomadic Indians collected wild potatoes on the central Andean plateau, 12,000 feet high, that stretches from the ancient city of Cuzco to Lake Titicaca. Over millennia they developed potato agriculture, and the potato became a staple of the great Inca civilization that, in the 16th

*Tools of harvest unchanged since before Inca times unearth a modern variety of potato grown for Peru's urban market but considered tasteless by Andean farmers. Potatoes were first cultivated in these highlands more than 3,000 years ago.*

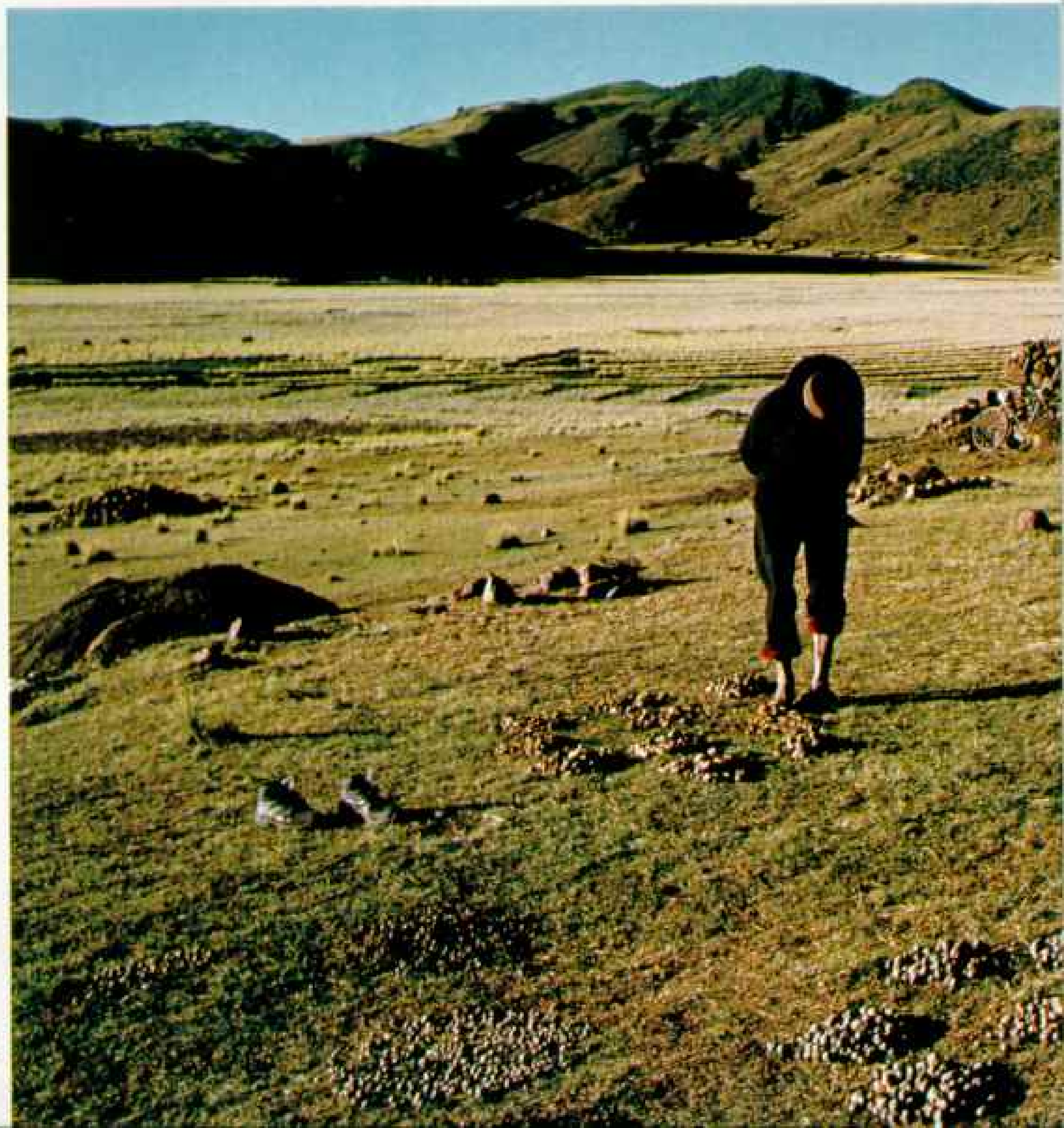






*Dancing a two-step, Peruvian Indians force water from potatoes (below and right) to make dehydrated chuño, an ancient Andean staple. About 80 percent water, the potatoes lose much of their moisture before the stomping by natural freeze-drying in frosty nights and warm days. Soaked in water to dissolve bitterness, then dried, chuño may keep as long as four years.*

*A 14th-century jug from coastal Peru (left) copies the shape and even the eyes of a food once worshiped as a spirit.*





century, extended 2,600 miles through western South America. The Indians worshiped potato spirits and fashioned pottery that blended human and potato forms.

Every chance I get I travel high into the Andes to visit old friends in their potato fields. Last year Don Maximo Zárate roped me into helping with his harvest. Like many small mountain farmers, he makes his living from a little llama herd and a few hillside fields of potatoes.

Half a mile across the valley I saw clusters of brightly clothed Peruvian Indians harvesting potatoes on postage-stamp-size fields stuck to a near-perpendicular mountain slope. Struggling along the rows of Don Maximo's equally perpendicular field, I couldn't believe I was unearthing potatoes. The colors of the rainbow and more, many looked like miniature pineapples, some like coral snakes, and others like bright red cherries or purple gumdrops.

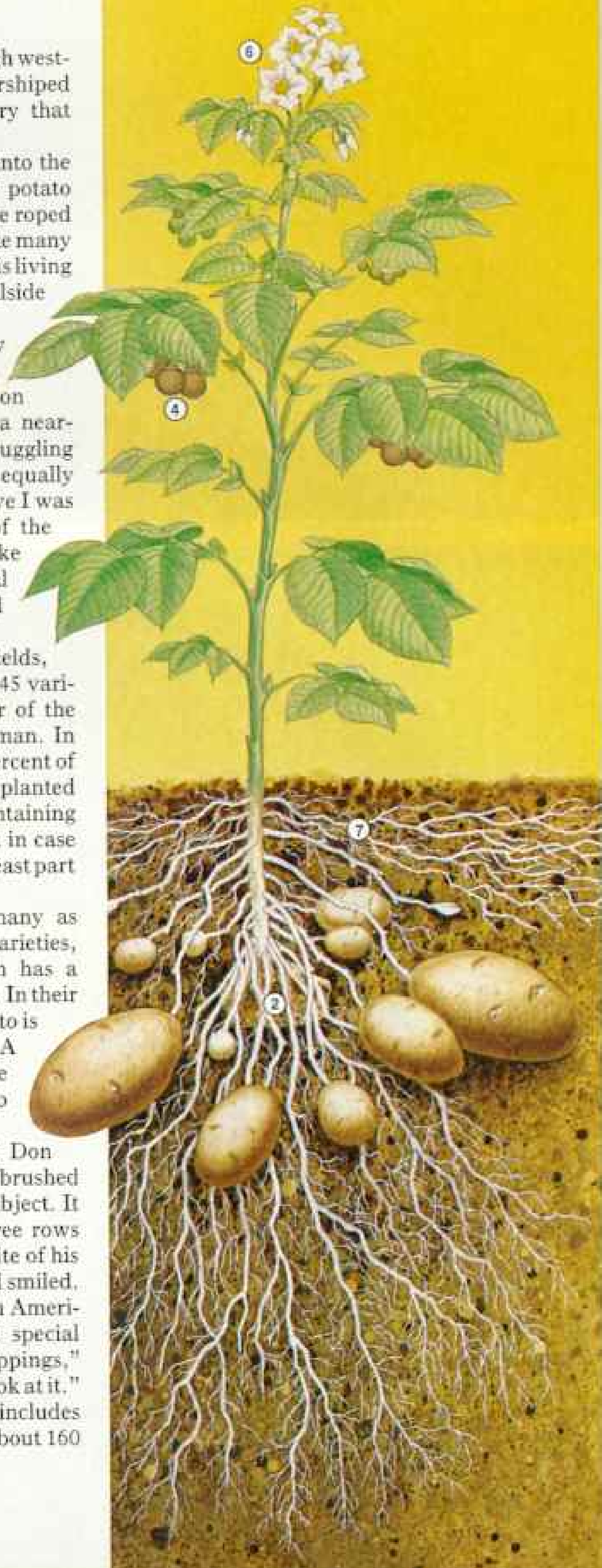
On his six acres of tiny scattered fields, Don Maximo cultivates as many as 45 varieties of potatoes, representing four of the eight potato species cultivated by man. In the United States and Canada, 80 percent of the 1.5 million acres of potatoes are planted to only six varieties. By maintaining diversity, Don Maximo knows that in case of disease, frost, drought, or hail at least part of his crop should pull through.

Andean farmers cultivate as many as 3,000 of the 5,000 or so potato varieties, embracing all eight species. Each has a name, often humorous and creative. In their language, Quechua, a long flat potato is called *mishipasinghan* (cat's nose). A knobby, obviously hard-to-prepare kind is *lumchipamundana* (potato makes young bride weep).

"Is this a potato too?" I asked Don Maximo, as I grounded my hoe, brushed away the soil, and held up an odd object. It was black, long, and curved. Three rows ahead of me and going strong in spite of his age, Don Maximo glanced back and smiled.

"What's wrong, amigo, don't you Americans know potatoes? We have a special name for that one. We call it pig droppings," he said with a hearty laugh. "Just look at it."

The potato's genus, *Solanum*, includes more than 2,000 species, of which about 160



- ① Eye or bud
- ② Sown potato piece
- ③ Eyebrow
- ④ Seedballs
- ⑤ Cortex
- ⑥ Blossoms
- ⑦ Roots



U. S. potato production ranks third, behind the Soviet Union and Poland, where nearly half of the world's annual 291-million-ton crop is grown. This diagram shows how the U. S. uses its 16-million-ton harvest.

- 12% Potato chips
- 27% Processed French fries and other frozen products
- 9% Dehydrated powders and flakes
- 8% Planted as seed
- 2% Canned potatoes and starch and flour
- 2% Livestock feed
- 32% Fresh
- 8% Storage loss

**R**OOTLIKE, and often mislabeled accordingly, the potato is actually a tuber, part of the underground stem. The plant sprouts from an eye, or bud, of a sown potato piece. A ridge, appropriately called an eyebrow, protects the bud. Flowering varieties produce seedballs. Since the hundreds of tiny seeds in a ball genetically vary from the parent plant, seed

remains too risky for commercial planting. But it is invaluable to research and is now available for trial in home gardens.

Potato blossoms resemble those of the related, and poisonous, nightshade plant, a fact that contributed to the tuber's initial poor reception in Europe. Tomatoes, tobacco, and eggplants are all related to the potato, but the sweet potato is not—even though

its Arawak Indian name, batata, became the English word potato.

About a third of a potato's nutrients lie beneath the skin in the cortex, a narrow band often visible as a ring on potato chips. The skin largely provides dietary fiber. Most of the world's crop, and all potatoes grown in the United States, belong to the species *Solanum tuberosum*.





are tuber bearing. *Solanum tuberosum* is the common potato known throughout the world. Although wild potatoes are found as far north as Nebraska, no species was cultivated outside South America at the time the Spanish arrived in the New World.

The potato was erroneously reported grown in Virginia in 1597 by John Gerard, the first man to mention the potato in English print. He called it *batata*, which actually meant sweet potato. This Arawak Indian name was misapplied to the spud, the name the potato later appropriated from the small spade used to dig it.

The potato has not only been misnamed but misunderstood down the centuries. Though there have been dedicated potato pushers in high places—Capt. James Cook, Sir Walter Raleigh, Sir Francis Drake, Catherine the Great—convincing the people to accept the potato wasn't easy.

When introduced to Europe, the potato was cursed as an evil food. The Scots refused to eat it because it wasn't mentioned in the Bible. Leprosy, consumption, rickets were attributed to potato eating. Lord Byron

wrote of the "sad result of passions and potatoes," reflecting a conviction of the early 19th century that potatoes had unwholesome aphrodisiac effects.

Much of this is guilt by association, for the potato does have villainous relatives. It belongs to the botanical family Solanaceae, which includes such hallucinogenic and narcotic cousins as mandrake and deadly nightshade. These contain alkaloid poisons such as scopolamine and atropine, used to prepare ointments "giving witches the power to fly." Law-abiding Europeans wanted no such truck with the devil, and so shunned the potato, as well as its cousin the tomato, another of the Solanaceae.

#### Underrated Spud Gains a Champion

Some suspicion still hangs over the potato. In my college economics class I was taught that the potato is a classic example of an inferior food, something to fill up on only when you can't afford better; as my income rises, I should desire to eat fewer potatoes.

Thomas Hughes, a 37-year-old American, is a modern crusader who resents the



*Prescription for health: Potatoes build up malnourished children at the Nutrition Research Institute in Lima, Peru, which seeks ways to maintain world child health on locally available protein. A three-month diet of potatoes, supplemented with vegetable oil, milk protein, vitamins, and minerals, dramatically increased the height and weight of this year-old girl (left). A year-old boy, almost half normal weight (far left), will test the same dosage.*

*Potatoes are fourth, after wheat, corn, and rice, in world production, but because of multiple harvests yield the most protein and food energy per acre. Few single foods have as much nutritional value. Potatoes brim with vitamin C, many of the B vitamins, and iron, but contain almost no fat. For the weight conscious: A medium-size spud provides only a hundred calories.*

potato's public bruising. As the founder and curator of the Potato Museum, situated in the Belgian village of Lasne-Maransart, he is doing something about it.

"Despite all its blessings, all it's given us, the potato is still the world's most misunderstood food," Hughes told me. "It has gotten a bum rap in the reporting of history. Historians write volumes on the minutiae of some military battle but forget the crop that made possible the industrial revolution." He explained that for 200 years the potato remained little more than a botanical curiosity in Europe, but by the 18th century, at last accepted by the masses, it provided the food surplus for the population expansion necessary to Europe's industrial growth.

After reading that the world had 25,000 museums but none devoted to the potato, Hughes decided to found his museum to give the potato its historical due. He has thousands of potato-related items and is looking for a new home for them.

The collection contains fascinating potato trivia, from potato peelers to stamps from Tristan da Cunha that cost four potatoes

each. It documents the *Kartoffelkrieg*, the potato war, fought between the Prussians and the Austrians in 1778-79. The war acquired its name after the contending armies ate up all the potatoes along the battle lines in Bohemia and then called off the fighting.

#### Dependence on Potato Led to Disaster

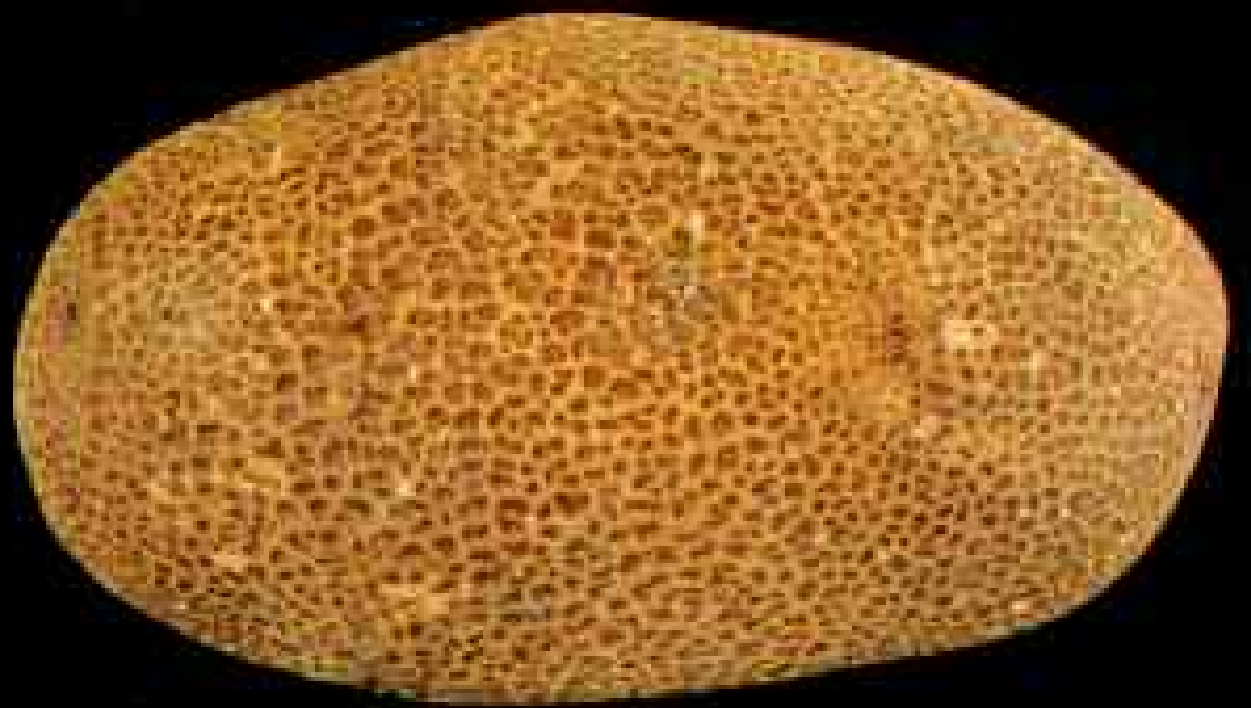
The *Kartoffelkrieg* is an all but forgotten historical oddity, but the potato famine of 1845-1851 is still grimly vivid in the minds of the Irish. In County Galway, 135 years after the potato blight had struck, I walked across a damp field toward a grass-covered knoll. It was a mass grave from the great potato famine, a reminder of one of Ireland's darkest hours. With me was Maurice Sheehan, a young Irish agricultural adviser.

"The younger farmers around here would like to farm over these old graves, but it goes against tradition," Maurice told me. "There are a lot of them around the county. The old folks never put up any grave markers, but no one's forgotten."

After the potato was introduced, the Irish population exploded, and by 1845 had



*Red LaSoda*



*Unnamed Russet*



*Norgold Russet*



*Monona*



*Norchip*



*Russet Burbank*



*BelRus*



*Norland*



**Kennebec**



**Red Pontiac**



**Superior**



**Katahdin**

## America's hottest potatoes

**S**CIENTIFICALLY BRED, these 12 varieties among 50 that are cultivated account for 85 percent of the U. S. harvest.

Most U. S. spuds are classified as round whites. The leader among these, Kennebec—developed in 1948—is processed into chips, French fries, and flakes. Katahdin, usually boiled or baked fresh, emerged in 1932 from the U. S. Agricultural Research Center in Beltsville, Maryland, and today heads Maine's harvest. Bred for chips, Norchip was released by North Dakota State University in 1968. Monona is also an outstanding chip variety. Superior, 20 years old, finds use in boiling, baking, and chipping.

Top draws among round red potatoes—Red LaSoda, Red Pontiac, and Norland—go for boiling, often as new potatoes, tubers picked before maturity.

But one spud—Russet Burbank—captures almost 40 percent of all sales. A top choice for baking, its shape is also perfect for French fries; half become frozen products and flakes. In a game of genetic roulette in 1872, horticulturist Luther Burbank planted seeds from the ball of a round white potato—and got a long white one. Further breeding developed the rough russet skin. Adapted to the Northwest, the Russet Burbank has allowed Idaho and Washington to surpass Maine's production lead. Norgold Russet, a 1964 variety, is largely eaten fresh. Beltsville created newcomer BelRus for the Northeast. A higher yielding successor to BelRus, soon to be named and released, hopes to recapture the eastern fresh market while appealing to the processing industry with thin, smooth skin.

VARIETIES PHOTOGRAPHED BY WENDY CORTESI



*The Americanized French fry might amuse Thomas Jefferson, once chided for serving this European novelty in the White House. The nation's appetite for processed fries—five billion pounds a year—boomed with fast food. Idaho-based J. R. Simplot Company produces most McDonald's French fries and audits them weekly (above). Sliced, blanched, and frozen, Simplot's Russet Burbanks (right) retain many nutrients, but almost quadruple in calories when fried.*

passed eight million. That was more than double the present population, and resulted in a density greater than modern-day China's. The potato was the staff of life for the Irish peasant. An average adult ate 9 to 14 pounds a day.

And then came an unknown malady, the deadly late blight, a disease caused by a fungus today recognized as *Phytophthora infestans*. After a rainy, cool period in the summer of 1845, plants slumped mysteriously as though struck down by a scorching drought. The harvested tubers as well as those still in the ground rotted, sending an unbearable stench across the countryside.

The Irish, though hardest hit, were not alone. The potato crops failed across Europe, and mass starvation was followed by pestilence. But in Ireland six ghastly

years of famine led to a million deaths.

I visited the William Joyce farm down the road. Elderly Mrs. Joyce shoved a bit more peat into her ancient stove and settled back in her chair to peel some praties, as the Irish call potatoes.

"Black 1847. A bitter, cold winter 'twas. People were a-dyin' by the thousands here in Galway," she said. "They hauled the bodies in wagons and laid them in pits. There was no money for coffins nor strength to dig separate graves.

"Anyway, that's how my great-auntie told it. She lived to be 92. Many of our family left for America. She never knew how many made it. They say 5,000 Irish died on the way, their bodies thrown into the sea."

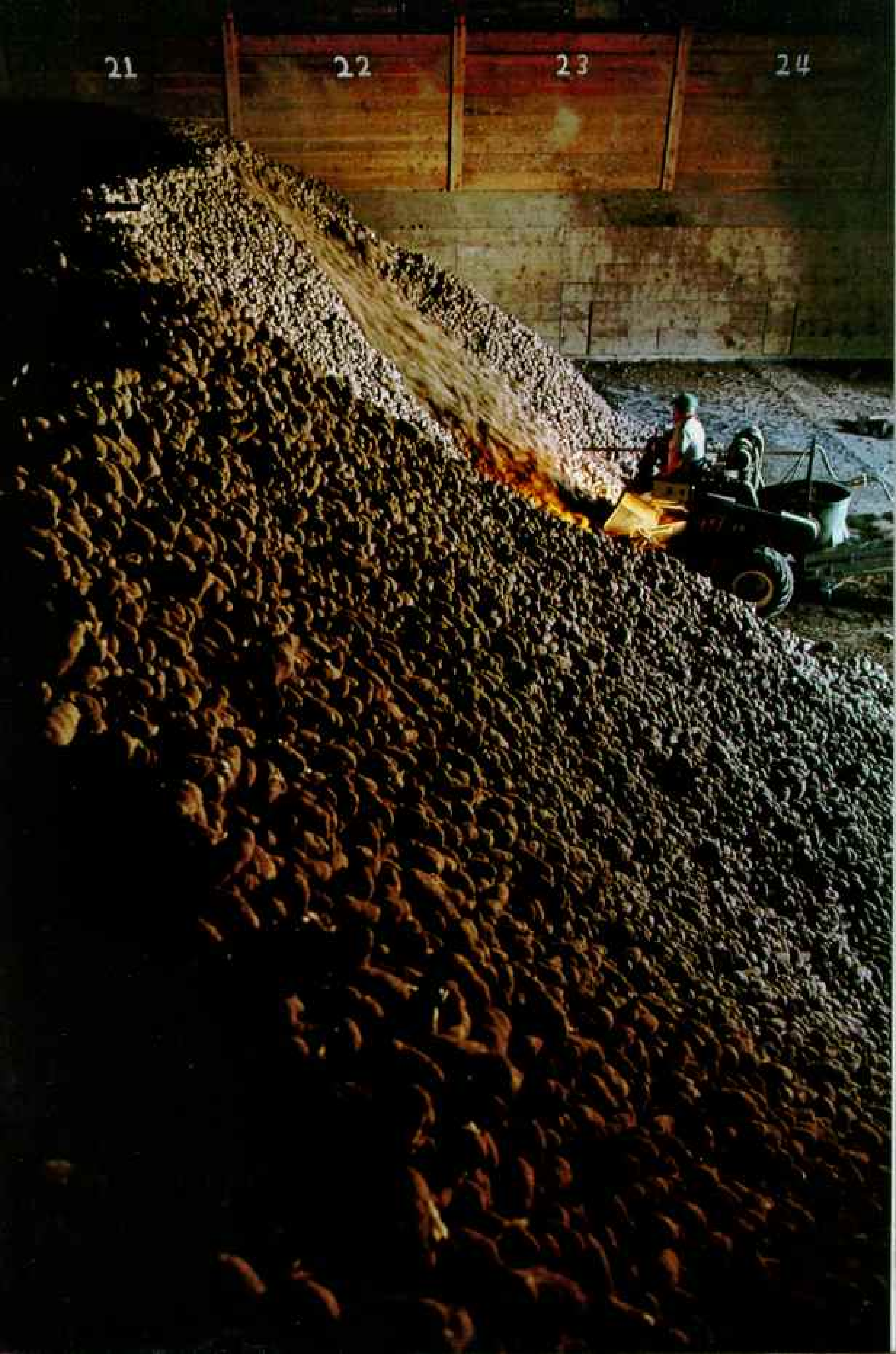
More than a million Irish sought refuge in North America because of the potato

21

22

23

24





*Giant steps in the race against hunger, potato fields climb 3,000-foot slopes in the Philippines north of Manila. Government efforts to supplement the country's largely rice diet with potatoes—still a luxury dish four centuries after Spanish introduction—find support from the International Potato Center, founded in 1971*



*in Lima, Peru. Brandishing the tuber as a weapon against world malnutrition, the internationally funded center helps adapt potato cultivation to regions as diverse as Turkey, Rwanda, and South Korea. Researchers worldwide draw upon the center's genetic bank of South American potatoes.*



famine. They found work as policemen patrolling Boston's streets, factory workers in Chicago, firemen in New York. And ultimately two of their descendants, named Kennedy and Reagan, rose to the Presidency of the United States.

"Your President's name was John Fitzgerald Kennedy; my name is John Fitzgerald," a country pub owner told me on the Dingle Peninsula. "When Kennedy was President, everyone here claimed kinship with him. Lots of Fitzgeralds on Dingle."

John proudly showed me his early potatoes. "Irish farmers today are ashamed to have the blight. The radio broadcasts blight warnings telling us when to spray."



*Hope takes root as seedlings in the Philippines meet the approval of Richard Sawyer, left, director general of the International Potato Center. If made genetically stable and disease free, a mere ounce of true seed could equal a thousand pounds of seed potatoes—expensive to transport and store in developing countries.*

He then recited for me the "Potato Digger's Song," repeating a favorite line: "The blessed fruit that grows at the root is the real gold of Ireland!"

On my worldwide potato pilgrimage, I found no people who pay more respect to the potato than the Irish. Only East Europeans eat more potatoes per capita. Potatoes and marriage, an Irish saying goes, are two things too serious to joke about.

Back on the European Continent, I headed south through the Netherlands, which devotes a surprising fourth of its arable land to potatoes. The pragmatic Dutch have made potatoes a lucrative export business, worth more than their tulip industry.

The ebullient French, by contrast, have made the potato high art and the key vegetable in their great cuisine. In Dardilly, Raymond Parot, headmaster of the cooking school *École Rabelais*, requires his students to prepare 60 potato dishes for graduation.

"In almost every French meal, the potato is a companion," Mr. Parot said. He added with a touch of poetry, "It enhances the taste and gives a softness to the meal."

In Limonest, France, I acquired membership in the *Académie Parmentier*, Grand Ordre du Noble Tubercule, an association of gourmets, restaurateurs, and chefs who honor and promote the *pomme de terre*, apple of the earth (pages 690-91). France has more than a hundred such *confréries* devoted to fine food and drink.

#### Potatoes Promoted as Forbidden Fruit

After my initiation we repaired to a five-hour feast of potato dishes. Between the potato entrée and the potato dessert, I was regaled with the legend of my academy's patron, Antoine-Auguste Parmentier.

When Parmentier was a prisoner of war in Hannover, Germany, in 1757, he reputedly survived only on potatoes. On returning to France, he found his countrymen facing famine but still suspicious of the vegetable that had saved his life.

Parmentier charmed King Louis XVI into granting him a notoriously sterile field near Paris called Les Sablons (the sandy plain), where he grew a dandy crop of potatoes. Knowing well the peasant mentality that "forbidden must be good," he asked the king to station royal guards around the field by

day and withdraw them at night. The trick worked, and the moonlight harvest by local farmers began. Potatoes soon bloomed all over the country.

Parmentier presented the king with a bouquet of potato blossoms. Queen Marie Antoinette wore one in her hair.

For Benjamin Franklin, then American Commissioner to France, Parmentier prepared a feast similar to the one I had just enjoyed: nothing but potato dishes. To cap the night, he served liqueurs made from the harvest of Les Sablons. France still remembers her great potato messiah in gourmet dishes prepared *à la Parmentier*.

### Maine Tries to Regain a Crown

Following the potato's historic migration from Europe to North America, I headed for New England. Potatoes were first introduced there in 1719 by Scotch-Irish immigrants settling in Londonderry (now Derry), New Hampshire.

My first stop was Aroostook County, Maine, which for 30 years, until 1957, produced more spuds than any state except its own. Now both Idaho and Washington out-produce not only Aroostook but all Maine.

"But in a good year we still grow spuds so big you could feed a crew of 12 with one at a sittin'," a burly farmer cracked as we watched the annual Potato Blossom Festival. Fittingly he wore a shiny "superspud" belt buckle.

After the parade I found myself bouncing along in Laurence Park's pickup. Slender as a French fry, this Yankee farmer cultivates 95 acres of seed potatoes near Presque Isle. Seed potatoes, tubers from which the next crop is produced, require special care to make sure they're disease free. Wherever you go at harvesttime, you hear, "Hey, did you dip your feet?" Everyone moving from farm to farm must disinfect his shoes to prevent the spread of potato diseases.

In his potato house, a building where potatoes are stored over the winter, Laurence told me of Aroostook's crisis. With Maine fallen to third in U. S. production, proud Aroostook farmers, many of their practices rooted in the last century, are trying to adapt to America's new food habits. The U. S. has become geared to fast-food outlets and supermarkets. While the rest of the world still

uses mainly fresh potatoes, more than half the potatoes Americans eat are processed as frozen French fries, potato chips, and frozen or dehydrated preparations.

"Our soil is worn out, our fields are small, full of stones, and the season is short. And we need a potato variety better suited to the French fry industry," Laurence said.

Help for Maine farmers may come from new varieties being developed especially for the East Coast by U. S. Department of Agriculture researchers at Beltsville, Maryland. BelRus and a newer unnamed variety, both excellent for processing, could help Maine become strong again.

The expansion of potato processing since World War II has been astonishingly rapid. In 1980 Americans consumed five billion pounds of French fries and one billion of potato chips.

The potato chip was allegedly invented in 1853. In Saratoga Springs, New York, short-order cook George Crum, an American Indian, got revenge on a customer complaining about Crum's thick fried potatoes. He defiantly prepared a batch of superthin slices and deep fried them. The rest is history. Today potato chips are an industry that yields about three billion dollars a year.

### Fries From France Found an Empire

French fries were introduced to the U. S. when Thomas Jefferson served them in the White House. But the man who pioneered our modern use of the frozen French fry is Idaho's potato king, J. R. "Jack" Simplot.

A crusty Idahoan of 73, Simplot has been in the potato business for 60 years, after dropping out of school in the eighth grade. His house-that-Jack-built, one of America's richest private empires, is all rooted in potatoes. The license plate on his Lincoln Continental proudly reads: MR SPUD.

Early one morning Mr. Simplot and I lifted off from Boise, Idaho, in his private plane, headed northwest. Somewhere over Oregon, which is fourth in U. S. potato production, the airplane dipped. As far as I could see were perfect 130-acre circular fields, designed to accommodate the massive pivoting irrigation systems.

"See that farm down there?" Mr. Simplot asked, pointing. "Gotta be the world's largest potato farm. (Continued on page 693)



*Blessing of plenty, replete with a pile of boiled potatoes (above), descends on the Joyce family of County Galway, Ireland, once the scene of starvation. Growing potatoes as the chief food—the only food for perhaps a third of the population—Ireland suffered catastrophe in the mid-19th century when healthy potato plants (top right) fell to late blight (middle right). Thriving in cool, wet weather, the fungus can destroy a plant within a week. Fungicides now battle late blight,*

*still a major world potato disease.*

*The potato crop failed throughout Europe when late blight crossed the Atlantic from North America, but Ireland's plight was most dire. A million Irish died, and a greater number emigrated during the great potato famine of 1845-1851. Grassy knolls mark mass graves of the victims.*

*Many of the thousands fleeing to the United States perished at sea on overcrowded, understocked vessels that became known as coffin ships. An*



WENDY CORTESI (TOP AND ABOVE)



THE GETTMANN ARCHIVE

American cartoon (right) pleads for aid and refuge for a devastated people. American charities raised large sums for Ireland, but the massive influx of impoverished immigrants soon put a strain on the welcome.

By the end of the century, steady emigration and a lowered birthrate had halved Ireland's population. South American potato stock revived the harvest, and today Ireland's per capita potato consumption is topped only by that of Eastern Europe.





*In fanfare for the noble tuber, members of the Académie Parmentier (left) march near Lyon to a meeting where they award their medal (top) to the photographer and author as "great potato explorers." The gastronomic society, whose officers include the "great peeler of distinction," lifts a toast (above) to Antoine-Auguste Parmentier, an 18th-century chemist who persuaded the French that potatoes were fit for food.*



MAINE POTATO QUEEN

POTATO

(Continued from page 687) Thirty thousand acres. So big you couldn't walk across it in a day."

Mr. Simplot attributes much of his success to the Snake River, which twists for a thousand miles from Wyoming, through southern Idaho, along the Oregon-Idaho border, and into Washington. The combination of soil, water, and climate along this river is perfect for the famous Russet Burbank variety grown there. A descendant of a variety developed in 1872 by Luther Burbank, this cylindrical potato is ideal for French fries, and has given the Northwest the edge in the U. S. potato industry.

At Mr. Simplot's Caldwell, Idaho, processing plant, I followed the complex assembly lines from the time fresh potatoes entered until they were loaded on trucks as boxes of frozen fries and hashbrowns. About 100,000 pounds of raw potatoes an hour feed the plant, which runs around the clock and employs 1,500 people.

Potato processing is an ancient technique. For at least 2,000 years Peruvian Indians have made a ready-to-serve dehydrated potato product called *chuño* that can be stored for three or four years. The process involves the same dehydration principles used today, alternate freezing and drying to reduce moisture content (pages 674-5).

When the heaviest frost falls in the Andes, small bitter potatoes are spread on the ground for exposure to the night's cold, and then left to dry in the sun. After several days, villagers gather them into small piles and do a rhythmic potato stomp with their bare feet. The trampling sloughs off the skins and squeezes out the remaining water.

The potatoes are soaked in water for one to three weeks to reduce bitterness, and then redried. The Indians use *chuño* in soups, stews, and a sweet dessert called *masamorra*. In prehistoric times *chuño* was placed in the tombs of the dead as food for their journey to the afterworld.

In our own day man is processing the potato for a better life in *this* world, and

in ways stranger and more intricate than freeze-drying. The success of these efforts could determine whether the human race will survive the population explosion.

In Tübingen, West Germany, at the Max-Planck Institute for Biology, genetic engineers have fused two botanical cousins, the potato and tomato, to produce pomatoes and topatoes. These hybrids, they hope, will someday produce food above and below ground, and share their best qualities.

"The potato is at an exciting point in its history," Dr. Georg Melchers, the scientist behind this new discovery, told me. "It's one of the most promising plants to which genetic engineering can be applied."

### Potential Solution to World Hunger

In Asia and South America I met scientists who are pioneering the commercial growing of potatoes by "true seed," the tiny seeds produced in the potato plant's berry. By this method potatoes can be grown much like grains. A hundred-pound sack of seed will sow more than a thousand acres. By contrast, the universal method used by farmers requires more than a thousand tons of potato tubers to seed the same amount of land. If perfected, the true-seed method could revolutionize potato growing. In China about 25,000 acres are sown to seed.

The most ambitious scientific effort to make the potato a 21st-century solution to the world food crisis is going on at the International Potato Center in Lima, where I work. The entrance to my organization is guarded by a towering representative of a Peruvian harvest god. In each hand he clutches a potato plant. One is healthy, the other drooping with disease. My colleagues face the same problems that confronted this deity more than a thousand years ago: disease, pests, rigors of climate.

Director General Richard Sawyer, my boss, is a native of Maine who organized our internationally funded center in 1971. "The potato is the forgotten crop in a world with a grain mentality," he told me. "It was never

*Queen of a flowering empire, Brittany Henderson reigns over Maine's July Potato Blossom Festival in Aroostook County, once the nation's chief producer. While holding proudly to traditional farming methods, Maine seeks to revitalize its tired soil and improve potato varieties to restore the bloom to its harvest.*



seriously considered as part of the solution to world hunger. Our goal is to make the potato available and inexpensive for everyone by the year 2000. You know, it is still a rich man's food in many poor nations."

I thought of my recent trip to the Dominican Republic, where I learned the expression *estar en las papas* (to be in the potatoes). That means a person has risen to afford more than a banana diet. In the Philippines, I was told, potatoes are so expensive a housewife will top off her shopping basket with a few spuds to demonstrate that hers is a family of means.

### Variety Essential to Crops of Future

Central to the work of the Potato Center is the World Potato Collection, located in our research station at Huancayo, high in the Peruvian Andes.

"One potato, two potato, three potato, four!" The jingle of my childhood echoed in my mind when I first saw the bewildering collection. But my count was way off. Stored in this germ-plasm bank are potatoes representing possibly 13,000 different native strains. Few resemble the potatoes known in Europe and America.

"Native and wild species of potatoes are a gold mine of heredity," Orville Page, the center's director of research, said. "They are the raw material plant breeders need to cross with modern high-yielding varieties to develop better varieties." Potentially, in terms of future food production, they are of inestimable value.

Besides safeguarding its potato treasury, the center is doing the main scientific work to improve true potato seed even as the Chinese experiment with it in practice.

The center's plant breeders, working with the wild and native varieties, are also attempting to manipulate the potato's built-in thermostat to stretch its natural adaptability to both cold highlands and steaming tropics.

Only a small fraction of the potato's genetic diversity is found outside South America. The rest is in native potatoes with such scientific names as *Solanum andigena*, *S. phureja*, and *S. stenotomum*. They contain genes resistant to diseases like late blight, wart, viruses X and Y, and others of the 265 diseases and pests known to plague the potato. There are even hairy-leafed species

that trap insects with a sticky secretion. The center breeds for this genetic material and distributes seed for worldwide testing, generally in developing countries.

Since this is a living collection, 8,000 specimens are planted every year in the center's Andean fields. And, as a safeguard against crop loss, 5,000 have been sent, in the form of seeds, to the National Seed Storage Laboratory at Fort Collins, Colorado.

My colleague in charge of tracking down wild and native potatoes to "bring them back alive" for the World Collection is Peruvian Carlos Ochoa. His expeditions range from Mexico to the southern tip of South America. His prizes are getting harder to find: Most Andean farmers are abandoning their traditional varieties for more modern, higher yielding kinds, and the wild potato's natural habitat is being destroyed by population growth, grazing, and logging.

"Like your American eagle, many potato species are on the verge of extinction," Mr. Ochoa lamented. "Others have disappeared forever, and no amount of money will bring them back."

But he is optimistic that genetic erosion among wild and native potatoes can be stopped if people care. "Just as the American eagle is being saved, so we can save the primitive potato. But if we destroy the genetic reserves of our major food crops like the potato, we could destroy ourselves."

The Incas, though they knew nothing about genes, were aware of how easily their basic food could be endangered. When their ancient kings called representatives from all parts of the empire to the sacred capital of Cuzco, they prayed for potatoes:

*O Creator! Thou who givest life to all things and hast made men that they may live, and multiply. Multiply also the fruits of the earth, the potatoes and other food that thou hast made, that men may not suffer from hunger and misery.*

Indeed, few foods can rival this versatile vegetable, so long misunderstood. In its great potential to feed our hungry planet, its fascination to science, and its legendary past, it offers much food for thought for all of us. I, for one, will never again take for granted the noble tuber, golden fruit of the earth, to which we owe so much. □

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KATHRYN KOSTER

## "Dip shaking" for science

**U**NDER ORDINARY CIRCUMSTANCES, the resemblance between bird and man seems remote. But to this western grebe, Dr. Gary L. Nuechterlein's behavior is pure grebe, through and through. In an eyeball-to-eyeball confrontation, Nuechterlein mimics a courtship ritual called "dip shaking." The grebe, raised by and imprinted on the biologist, follows suit, and responds with the same head-dipping-and-shaking maneuver.

"My goal was to learn to think like a grebe," Dr. Nuechterlein explains in an article this month on these sleek water birds. Funded by the National Geographic Society and other

organizations, including the Delta Waterfowl Research Station in Manitoba, Canada, Dr. Nuechterlein studied the elegant ballet of grebe courtship, including the spectacular water-walking display known as "rushing."

Days spent chest-deep in water and marsh muck in a special floating blind allowed the author to translate the intricacies of grebe language and to identify individual grebes by their calls. "It's one thing to sit by a marsh and use binoculars," he says. "But the real thrill comes in getting out in the thick of things."

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WWF/Nancy Nash

## The panda stands for WWF and for thousands of other animals and plants facing extinction

**T**HE WORLD WILDLIFE FUND (WWF) is dedicated to the conservation of all endangered forms of life. Sadly, the Giant Panda is one of the many species now in danger of extinction.

In a unique and historic example of international co-operation the People's Republic of China have invited WWF to work with them to save the world's most widely-admired animal.

The Chinese Government has been actively engaged in Panda Conservation for many years. Now a WWF team led by the distinguished ecologist

Dr. George Schaller is at work in Sichuan Province together with top Chinese scientists under the leadership of Professor Hu Jinchu to carry out an in-depth study of the Panda and its needs for survival in the wild.

A major problem: the Giant Panda's diet demands huge quantities of bamboo and the evidence suggests that the bamboo in Wolong Natural Reserve may be about to flower and die – a serious threat to the survival of Pandas in that area.

Other factors – the Panda's low reproduction rate, internal parasites,

dietary and territorial requirements – are also being studied.

Ultimately, to ensure that the Giant Panda has a future, we have to conserve the complex ecosystem in which it lives. This broad conservation philosophy is reflected in the hundreds of well-planned projects which are now being carried out by WWF in over 50 countries.

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Vase shown much smaller than actual size of 11¼" high. Hardwood stand included.

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## Members Forum

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### NAPOLEON

I have traveled the pages of Catton, Churchill, Parkman, Morison, Manchester, and others, but have seldom read as thrilling an account of a man and an epoch as that of your essay "Napoleon" (February 1982). I enjoyed every line. Somehow the military monster became a human being.

George Bleasby  
New Wilmington, Pennsylvania

In the article you stated that Napoleon, like Charlemagne, summoned the pope to preside at his coronation. Charlemagne did not summon the pope. Instead, he went to Rome and was crowned by Pope Leo III on Christmas Day, A.D. 800, in St. Peter's Basilica.

William E. Watson IV  
Narberth, Pennsylvania

*Charlemagne did summon the pope to crown him, but in Rome, not Paris. We regret any ambiguity from necessary condensing of the information.*

Your facts were a bit confused. In the caption of the picture of the Isle of Elba, you said that Napoleon was in exile at Elba for ten months. He was only there for three. These months are usually referred to as Napoleon's Hundred Days.

Joseph Silber  
Venice, California

*Napoleon arrived on Elba in early May 1814 and departed in late February 1815. The Hundred Days refers to the period between his return from exile and his defeat at Waterloo, although this period also exceeded 100 days.*

Napoleon has fascinated a great many people for a lifetime—including me. Your "Napoleon" is beautifully written and imaginatively illustrated. The caption people, however, made a boo-boo in the key to the coronation painting. Pauline and Elisa Bonaparte were the unidentified train-bearers for Joséphine.

John Maass  
Philadelphia, Pennsylvania

*Identifications for the David painting were provided by the Louvre. The museum gives the train-bearers as Mme de La Rochefoucauld and Mme de La Valette.*



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## TWO BERLINS

Congratulations! In your article (January 1982) you gave the impressions, the feelings, and the fears of all Germans, not only of East and West Berliners.

Hans-Jürgen Kutz  
Wiesbaden, West Germany

Your article "Two Berlins" was a very fair treatment of the situation. However, although Berlin is interesting enough from a historical and geopolitical viewpoint, it is no longer truly German. East Berlin is too much a pomp-and-concrete showcase of a government generally treated with indifference by its citizenry. West Berlin is typical of nothing at all.

Charles J. James  
Oak Park, Illinois

I must strongly object to the tendentious remark at the beginning of an otherwise commendable article on Berlin. You state that "Two World Wars marched across Europe from the proud capital of a unified Germany: . . ." No consensus exists among professional historians as to the cause of World War I, and none but the most ill-informed would assign responsibility for that disaster solely to Germany.

Kurt S. Schultz  
Oxford, Ohio

## GOLOGS

In "Nomads of China's West" (February 1982) author Galen Rowell refers to explorer Joseph F. Rock as "Dr. Rock." Rock never had ANY university degree. He spent 27 productive years in China and did explore and report to the National Geographic Society. He never published a single paper on Chinese flora. He produced what is known as the Rock manuscripts, now at Harvard in the Yenching Library. These relate to Nakhi history, ceremonies, and language.

Jean Anderson  
Swisshome, Oregon

*Highly respected as a scholar and botanist, Joseph Rock collected some 80,000 Chinese plant specimens, many of which were named for him, and his notes on Chinese rhododendrons were published. In addition, he was the recipient of three honorary doctoral degrees.*

I am appalled at the arrogance and total insensitivity of the mountaineering team climbing the sacred mountain of the Gologs. I wonder what would be the Western reaction if a Chinese (or Golog) mountaineering team would decide to climb the cathedral at Cologne, or perhaps St. Peter's Basilica at Rome.

Louis J. Mihalyi  
Chico, California

*National Geographic, May 1982*

## HUMMINGBIRDS

In "Hummingbirds: The Nectar Connection" (February 1982) you state: "Homing in on a stoplight-bright patch of California fuchsia blossoms. . . ." Neither the blossoms nor the foliage even remotely resembles any fuchsias I have seen here in California. The plant in the photo appears to be either a form of ice plant or moss rose. If it is a new form of fuchsia, let me know.

Mrs. Elaine Allen  
Hollister, California

*The California fuchsia (Zauschneria californica) is indeed different from the domestic fuchsia, although they belong to the same family, Onagraceae. Another common name is hummingbird's trumpet.*

## TAIWAN

The statement that Taiwan is but a province of China (January 1982) is merely a Chinese slogan. The Chinese use the slogan to disguise their territorial ambition over Taiwan, and the refugee Chinese Nationalists in Formosa use it as an excuse to reign over the Taiwanese. The second point to be made is that the post-World War II economic development and prosperity in Taiwan have been achieved entirely by the Formosan people, not by the Nationalist Chinese government on the island.

Name withheld by request

## PERU

I cannot forget the picture of the little Peruvian boy (March 1982) who had six of his sheep killed by a hit-and-run cab. Perhaps the author or photographer secured his name. We are enclosing our check for ten dollars, hoping that you can arrange to get it to him.

Mr. and Mrs. R. L. Torson  
Rhododendron, Oregon

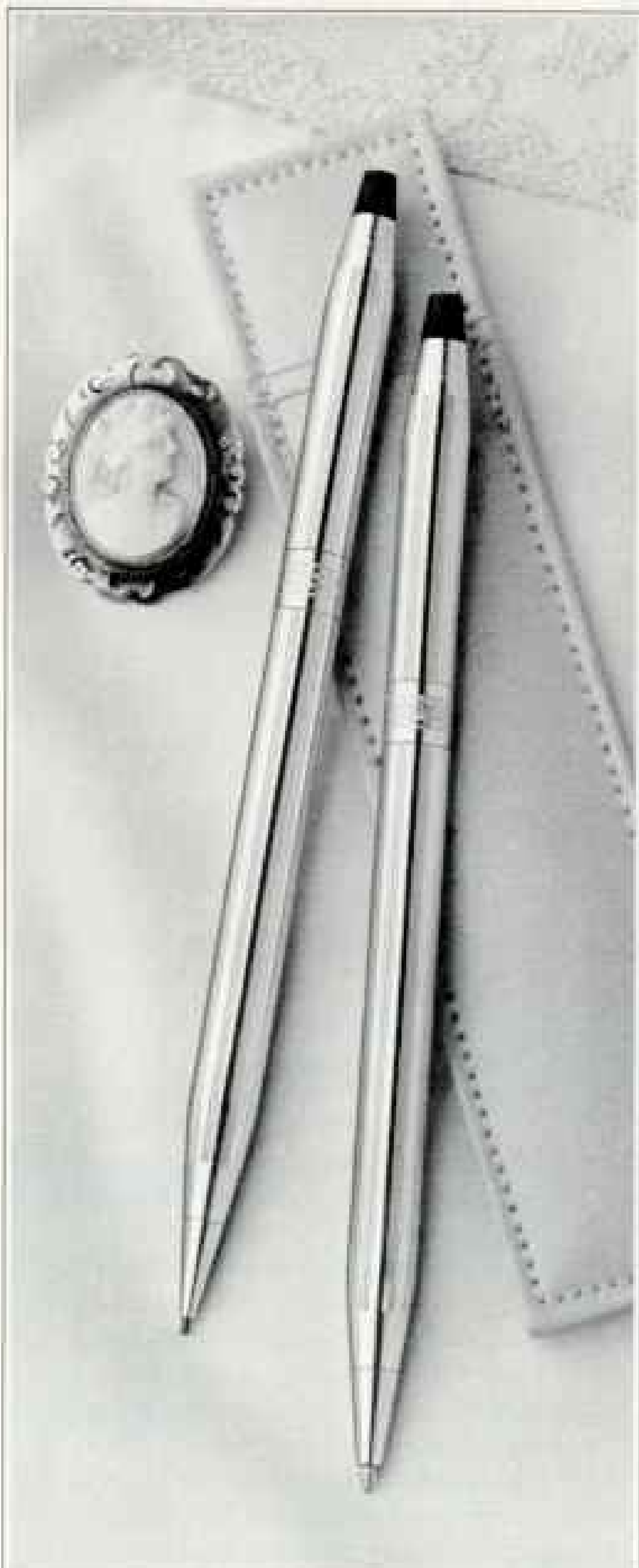
*We have received many letters and contributions in response to this photograph. CARE has agreed to try to locate the young shepherd and to accept contributions to replace his sheep. Any surplus will be used for a worthy project for Peruvian children. Checks should be sent to CARE, National Geographic Peruvian Children's Fund, 660 First Avenue, New York, New York 10016.*

## EGYPT'S DESERT OF PROMISE

This article (February 1982) mentioned plans to dig a canal so Mediterranean Sea water would create electricity as it fell into the Qattara Depression. May I suggest that solar energy would be a better solution for Egypt's electricity needs.

Arlene Wyatt  
Inverness, Florida

## Members Forum

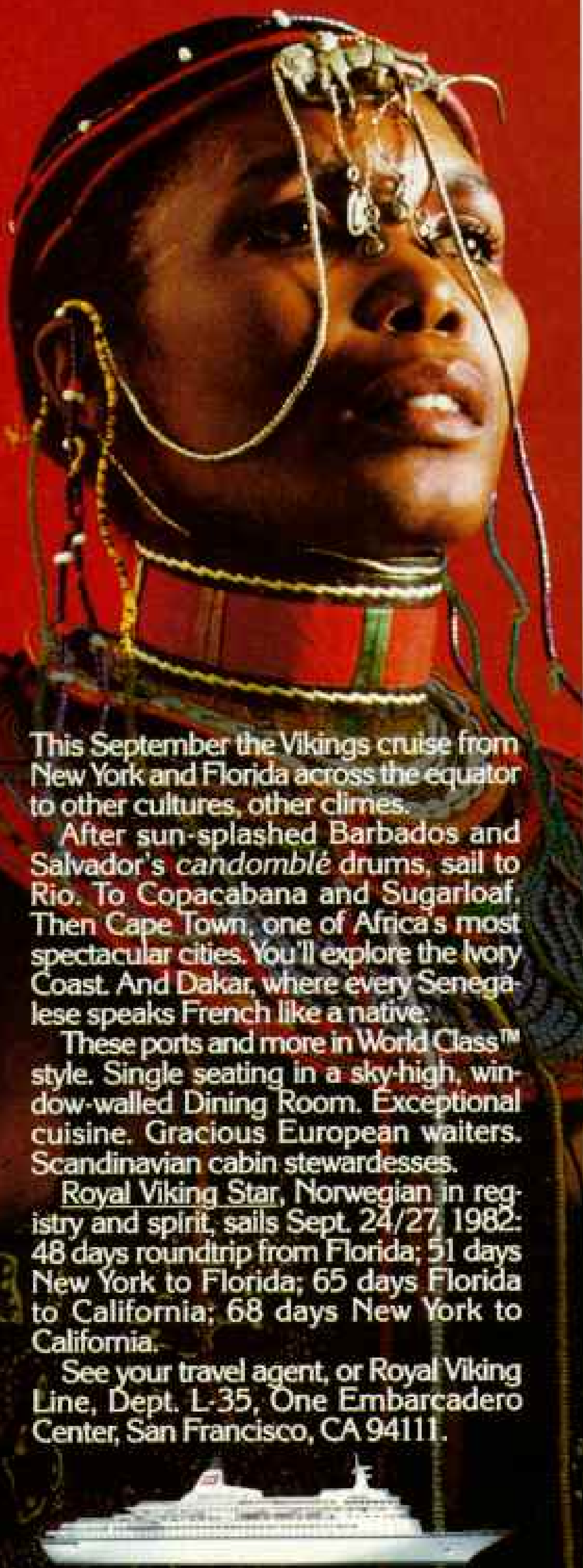


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## MOUNT ST. HELENS

In your excellent article on the Mount St. Helens eruption (December 1981), you say it was the "mightiest volcanic landslide ever recorded." Mount Meru (14,979 feet) in Tanzania erupted in similar fashion about 250,000 years ago. Geologists believe that before the summit and side of the mountain blew out it was higher than Kili-manjaro (19,340 feet). A vast landslide of debris and mud slid down over the surrounding countryside, largely obliterating it.

Geraldine Hobson  
Sturminster Newton, England

*We included "ever recorded" because of the many gigantic prehistoric volcanic explosions.*

In January 1981 you informed us that Mount St. Helens blew away one cubic kilometer of ejecta. In the December 1981 article you said it was almost a cubic mile. Which is correct?

Agam Napitupulu  
Jakarta, Indonesia

*The initial estimate of the ejecta by the U. S. Geological Survey was at least one cubic kilometer. Subsequent studies determined that 2.7 cubic kilometers (almost a cubic mile) of ejecta was thrown out by the blast.*

## NATIONAL RIFLE ASSOCIATION

It has recently come to my attention that the NATIONAL GEOGRAPHIC has refused to run ads from the National Rifle Association as part of its new "I'm the NRA" ad campaign because the GEOGRAPHIC considers them "too controversial."

Stephen M. Williams  
Kingman, Arizona

*It is unfortunate that the GEOGRAPHIC was listed with other magazines in the National Rifle Association journal as refusing to run the ad because of controversy. We did not accept it because it has long been the policy of the National Geographic Society not to publish advertisements relating to liquor, tobacco, patent medicine, politics, religion, firearms, or firearm-related material. We hold no grudge against the NRA or any reputable gun manufacturers. Just as some members of our staff belong to the NRA, staff members are also known to smoke, have a drink, attend church, even run for political office.*

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

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## On Assignment

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**H**IS FIRST STORY for the GEOGRAPHIC was an essay on tranquillity, Tangier Island in Chesapeake Bay. Nine years later photographer *David Alan Harvey* was riding in a cyclo taxi in Ho Chi Minh City, formerly Saigon. Next stop: Kampuchea, once known as Cambodia, a country mutilated by genocidal war, where the shooting hasn't yet stopped.

His colleagues, Editor *Wilbur E. Garrett* and senior writer *Peter T. White*, were old hands under fire. They first went to Southeast Asia together in 1961. They covered Laos, Vietnam (three times), and the Mekong River—and separately wrote other stories on the region.

When they began this trip, Harvey says, “I remember thinking those two must be a little crazy. I was the reluctant part of the trio. I think I had reason to be. They just forged ahead.”

When the three got to the great complex of temples at Angkor in Kampuchea, they were in territory partially controlled by government troops—at least in daylight.

“This may be the only picture of us that doesn't have armed soldiers in it,” says Garrett of them at the Bayon temple, he with tripod at shoulder arms, White in a jungle hat given him years before by the Tanzania People's Defense Forces.

White's assignments have taken him into situations he “would not face again for a million dollars—for any amount of money. Never.” He has found himself with U. S. troops sweeping through a tangle of swamp and Viet Cong, or inching his way across a sheer mountain face with an Austrian rescue team. “And I can't be up ten feet without getting dizzy,” he says. Why, then, do such things?

“You're there for your reader, for this final small product of all the sweat, work, money spent, time away from home.”

The once reluctant Harvey now says, “I learned those guys weren't crazy. They know how to operate in that part of the world and really have a passion for it. They want to go back to Angkor. So do I.”



WILBUR E. GARRETT (ARROW), DAVID ALAN HARVEY



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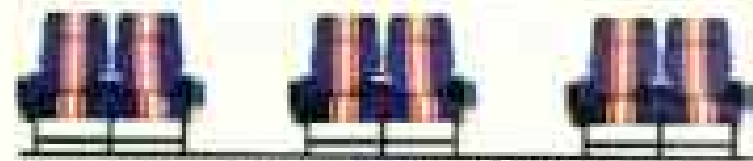
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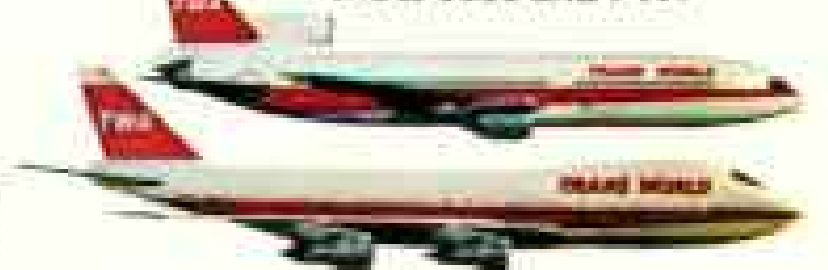
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**It's Better In The BAHAMAS**



Photographed by Loren McIntyre. *Giant Brazilian Otter: Genus: Pteronura Species: brasiliensis*  
Adult size: Average 1.5–1.8m Adult weight: Average 27kg Habitat: Small tropical rivers of northern and central South America Surviving number: Unknown; hunting it for its pelt has made this animal one of today's most endangered mammals

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Its sleek, luxurious pelt is one of the giant Brazilian otter's most attractive features. But ironically it has also been the greatest threat to its life. Because of it, it has been hunted to near-extinction.

There would be no way to bring it back if the giant Brazilian otter disappeared. And while photography can record it for posterity, more importantly it can help save it and the rest of wildlife.

Especially handy in the wild, photography is a versatile and reliable aid to scientific research, which is particularly essential for the giant Brazilian otter. A lot has yet to be learned about this animal, and in the past efforts to save it have been hampered by such a lack of knowledge.

Photography can also greatly influence the way people in general feel toward nature. Certainly, a photograph of a giant Brazilian otter showing those expressive eyes that mirror the animal's inquisitive, alert, playful and affectionate charac-

ter can lead to a deeper understanding of nature.

And understanding is perhaps the single most important factor in saving the giant Brazilian otter and all of wildlife.



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# A silver spoon won't do.



**When someone has a seizure never force anything hard between the teeth.**

It is physically impossible for a person to swallow his or her tongue during a seizure. Attempts to force the mouth open can often cause damage to the teeth and gums.

**Keep calm.** By keeping calm, you can reassure other observers. If possible, look for medical bracelet or neck chain.

**Clear the area.** Remove sharp, hard or other hazardous objects. Also remove glasses, loosen tight collars, neckties and/or belt, but do not interfere with movements.

**Turn the person on his/her side.** This keeps the airway clear so that breathing is not obstructed.

**Do not restrain or try to revive.** You can't stop a seizure once it has started. Place a pillow or a coat folded flat, under the head. Awakening should be voluntary. Don't panic if person seems to stop breathing.

**You may not have to call a doctor.** You need only to call an ambulance if the seizure lasts longer than ten minutes or if another seizure begins immediately after the first has ended.

**Be reassuring.** Some people are embarrassed when consciousness is regained after a seizure. It is very reassuring to see a friendly face.

Some people are very surprised to hear that you shouldn't place a spoon in the mouth of a person having a seizure. There are many myths and superstitions about epilepsy. Get the facts. Contact your local chapter of the Epilepsy Foundation of America.

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caster is shown here), and the modernization of several high-production finishing mills. Construction of the facilities is planned for completion over the next four years.

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# It takes a Honda years to do what some cars do in a day.



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These days you can appreciate that more than ever. But then Hondas have traditionally maintained a high resale value. In fact, the Accord, Civic and Prelude do better than most.

For example, the average retail value of a 1977 Accord Hatchback is an astonishing 109.4% of its original suggested retail price. On a 1977 4-speed Civic CVCC Hatchback, it's just under 95%. And a 1979 Prelude is 97%.

Naturally, your price depends on your car's condition, mileage, equipment and other factors.

But those figures are direct quotes from the January/February 1982 *Kelley Blue Book Used Car Values*.

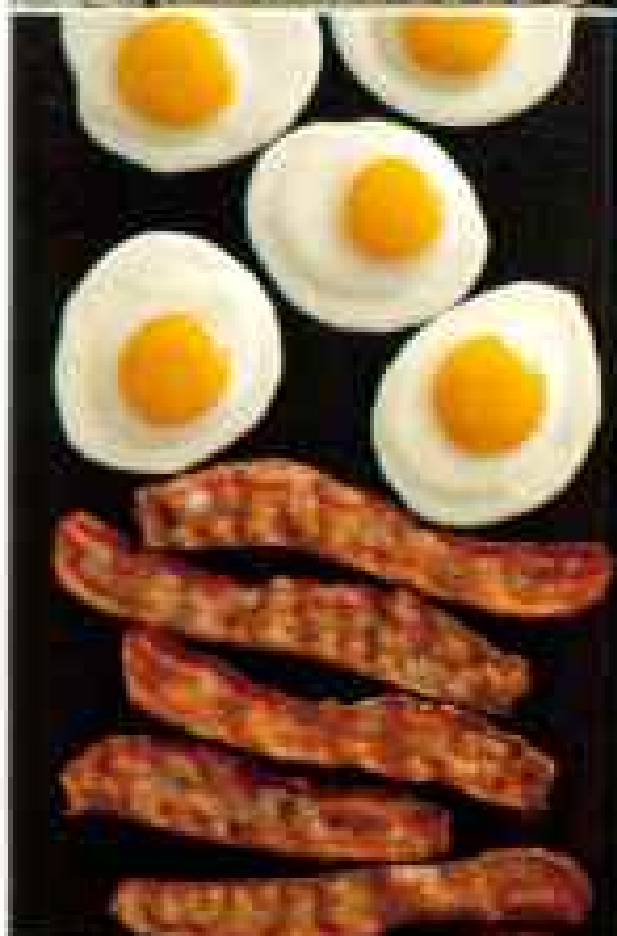
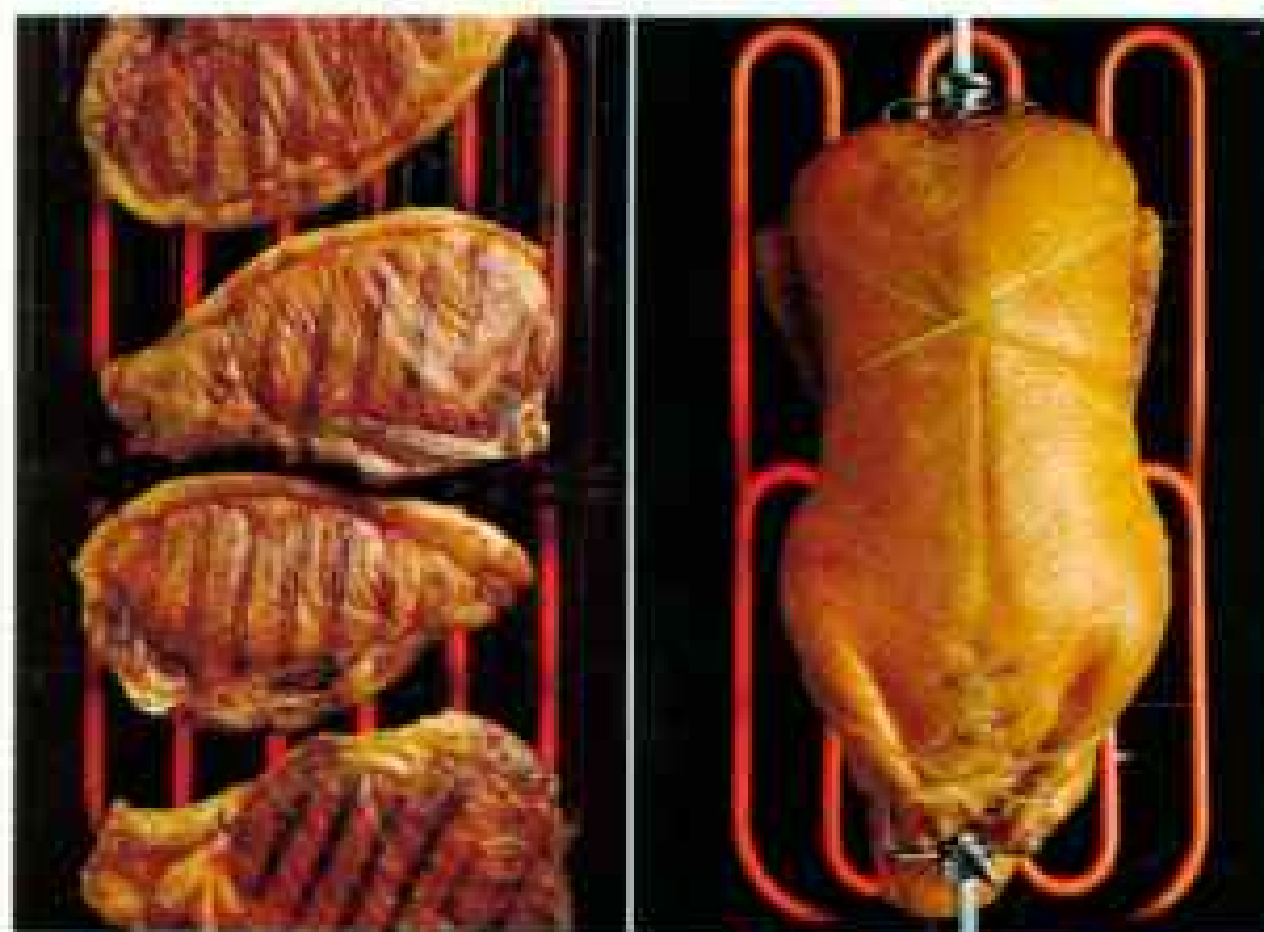
To quote another source might help explain Honda's high resale value. An editor in the February 1982 issue of *Car and Driver* said, "Honda builds the only cars I know of that act more expensive than they are. I always feel rich driving them."

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