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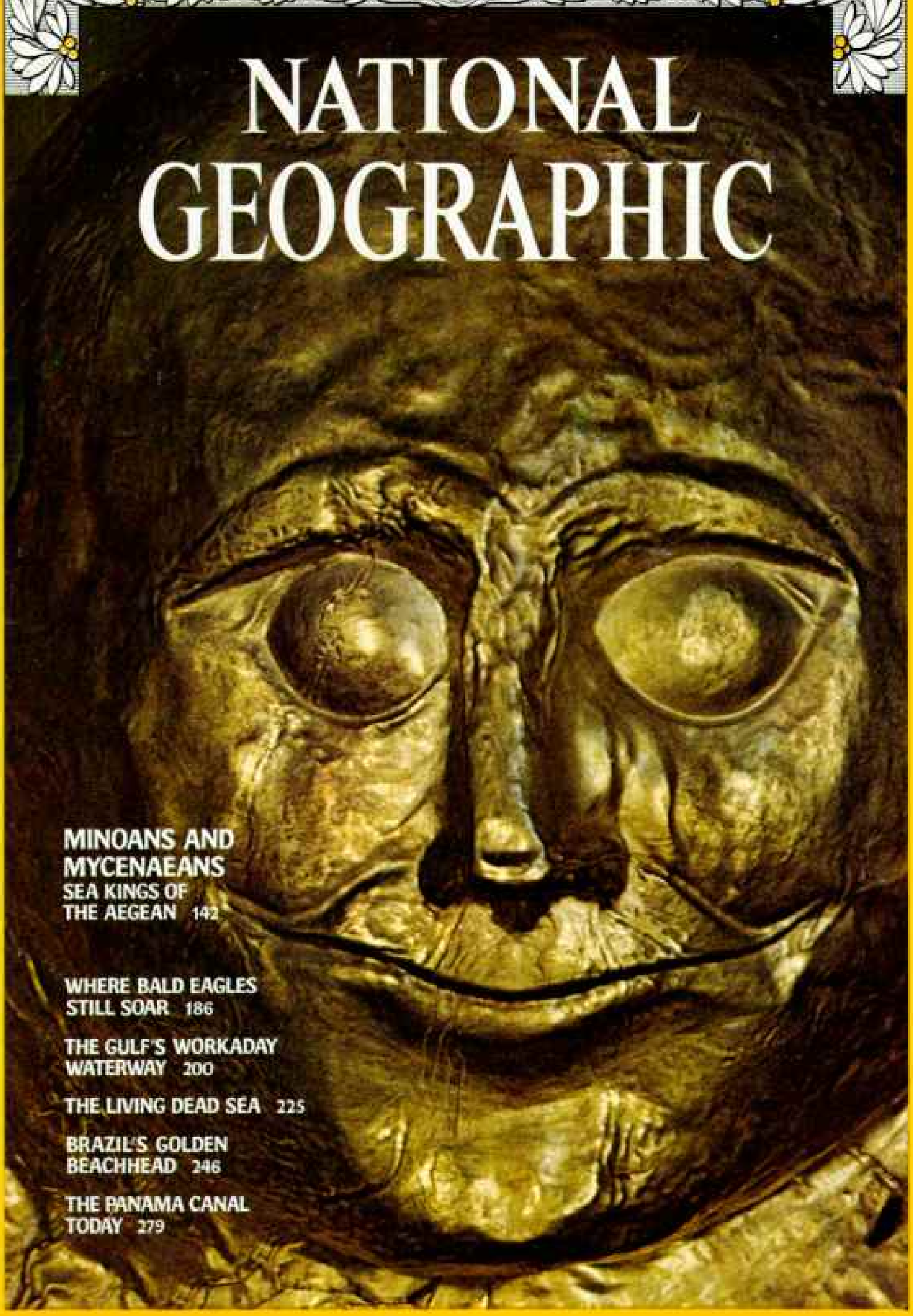
NATIONAL GEOGRAPHIC



LAST SUMMER I had the pleasure of traversing the Panama Canal aboard the good ship U.S.S. *Point Loma*, support vessel of the research bathyscaphe *Trieste II* en route to explore the deep Cayman Trough in the floor of the Caribbean Sea.

For years I had looked forward to sailing the canal, and I was not disappointed. As we threaded a narrow gap through the Continental Divide, I could scarcely leave the bridge. I scanned endless terraces of rock scalloped from the steep slopes. The tall green grass, encouraged by a rainy climate, failed to hide the scars of the awesome engineering project, completed 63 years before, that had claimed so many lives.

While the landscape was new and exciting to me, it was also familiar. Your journal has published no fewer than 55 reports on Panama and the canal, beginning in 1889. In 1896 we covered in some detail the national debate over the siting of the canal at Panama, rather than Nicaragua, and in 1911 published a description of the work by its chief engineer, Col. George Washington Goethals, U.S. Army. Later, on March 3, 1914, President Woodrow Wilson bestowed the Society's Special Gold Medal upon Colonel Goethals for his great achievement.

"The United States," said the President that night, "has made the world very uncomfortable, but it has at least done so by the exercise of extraordinary dynamic qualities."

Indeed, a world ruled largely by Europe's old monarchies and bound to colonial commerce had been startled by the achievements of a free people who had spanned a continent with rails, spilled forth airplanes and automobiles, raised skyscrapers, and now created a masterwork in Panama. But only five months later the world was aflame with war, and the guns of August were blowing away the old order.

Now, it seems, it is the turn of the United States and other developed nations to be uncomfortable, faced with a Third World showing great political vigor, with the steady ideological contest with Communism, and with keeping economies running as the cost of energy rises.

In the case of Panama, the relations of the United States with its Latin-American neighbors and the delicate questions of national defense and sovereignty combine in a charged national debate over the canal. In this issue, the GEOGRAPHIC once again returns to the canal at Panama for a look at the people and places behind the headlines.

Gilbert M. Grosvenor

NATIONAL GEOGRAPHIC

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February 1978

COVER: *An enigmatic smile from the past lights a golden death mask found in a 16th-century B.C. royal grave at Mycenae (following pages). Photograph by Gordon W. Gahan.*

MINOANS AND MYCENAEANS

GREECE'S BRILLIANT BRONZE AGE

THERE IS A LAND called Crete in the midst of the wine-dark sea, a fair land and a rich, begirt with water, and therein are many men innumerable, and ninety cities. . . . And among these cities is the mighty city Cnosus, wherein Minos when he was nine years old began to rule, he who held converse with great Zeus. . . .

THE "ODYSSEY" OF HOMER, BOOK XIX

Sometime in the blue dark before dawn, the dawn of a Greek Easter Sunday, the first faint image of Mount Juktas, washed in pale rose, appeared beyond the harbor of Herakleion, modern Crete's largest city. I stood at the rail of a passenger ship and was amazed at how perfectly the mountain resembled a sleeping man, his head to the north, profile to the morning star, shoulders lost in shadow.

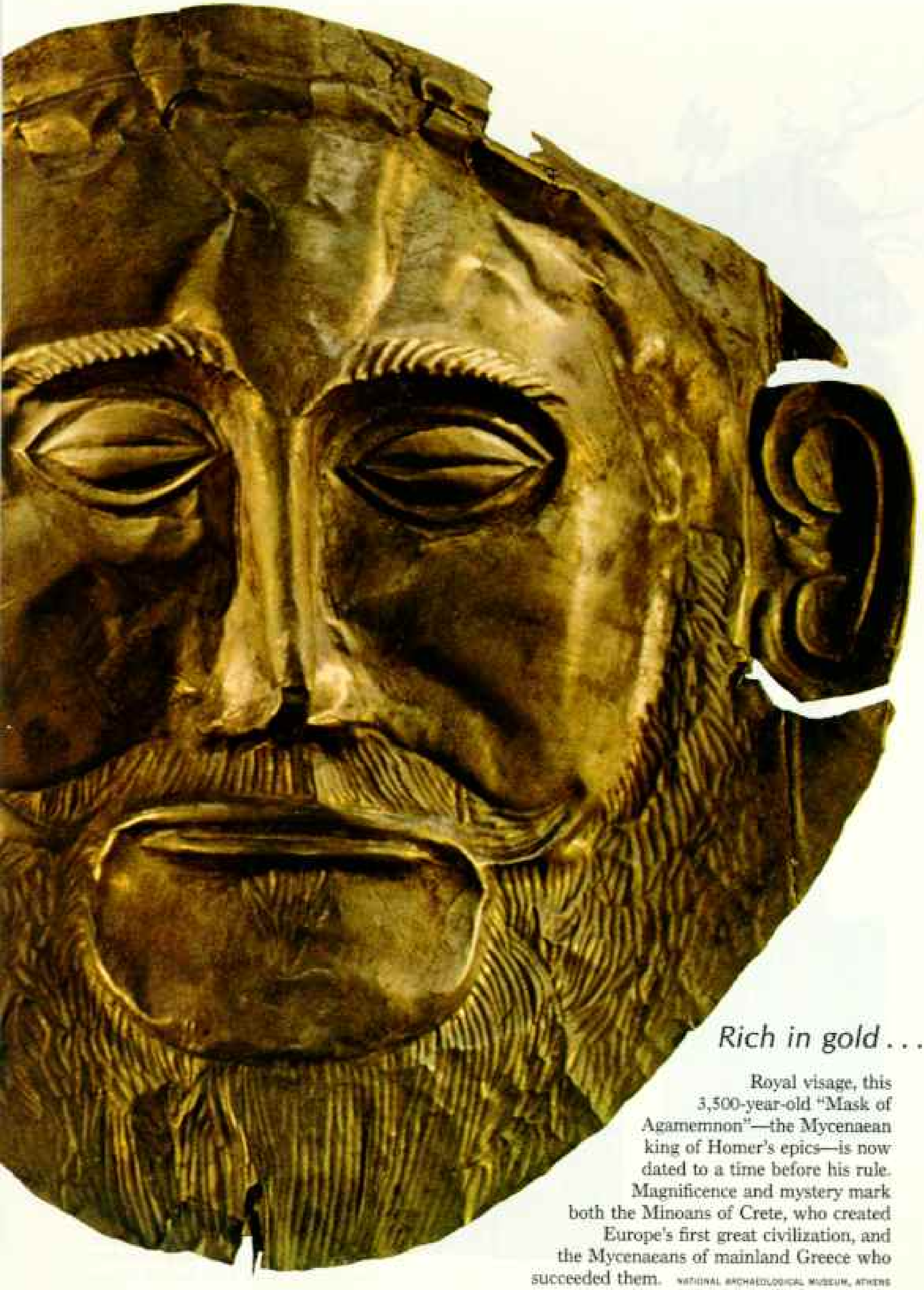
"No," said a fellow passenger, an early riser like myself, "not a sleeping man but a dead god, Zeus himself. On Crete he rises again, or so the ancient Minoans believed. For that the Greeks called them liars. I think the Minoans had a different Zeus in mind, but they would never tell."

With the island of Dia looming eastward, the breeze, from *(Continued on page 146)*

Article by
JOSEPH JUDGE

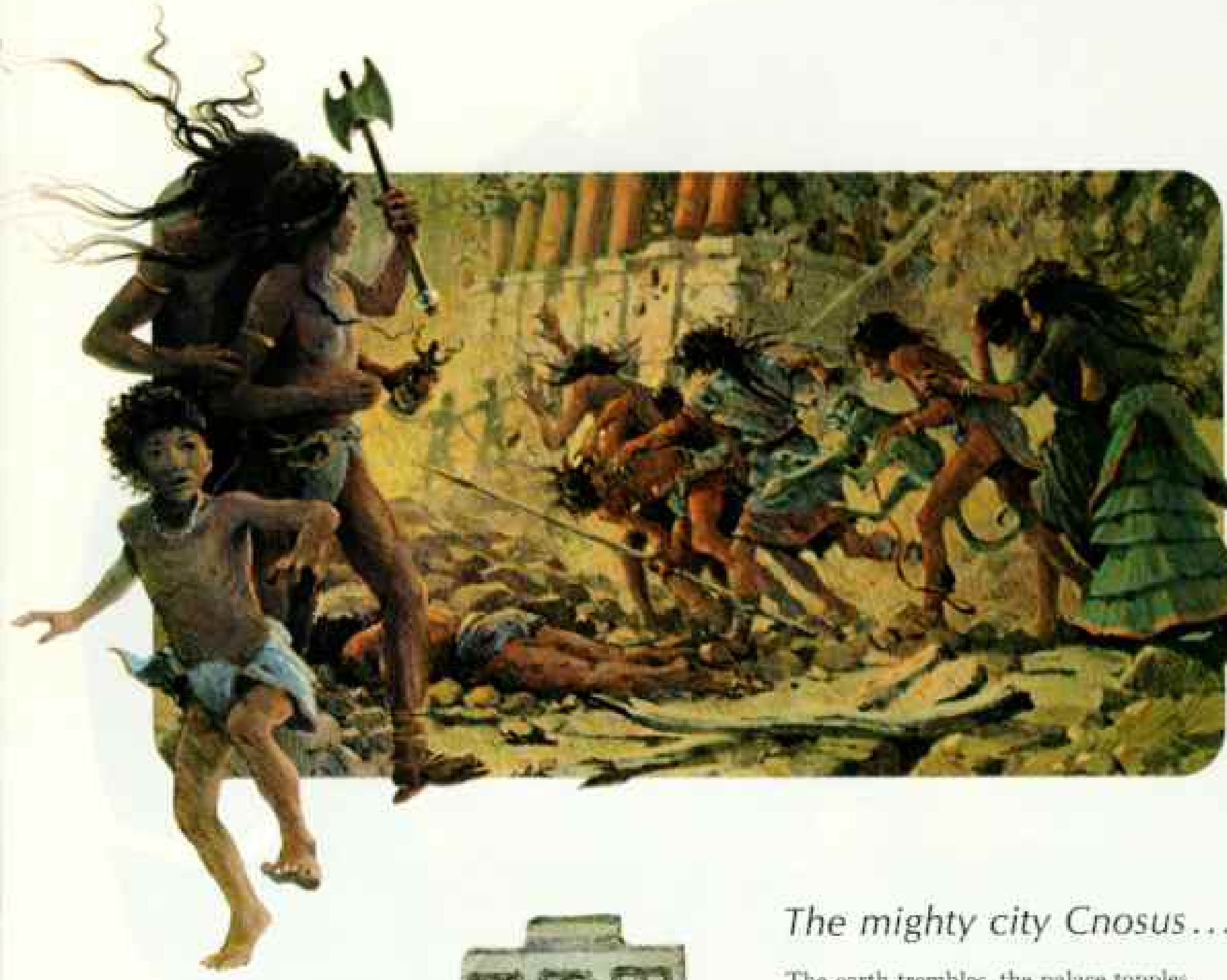
Photographs by
GORDON W. GAHAN

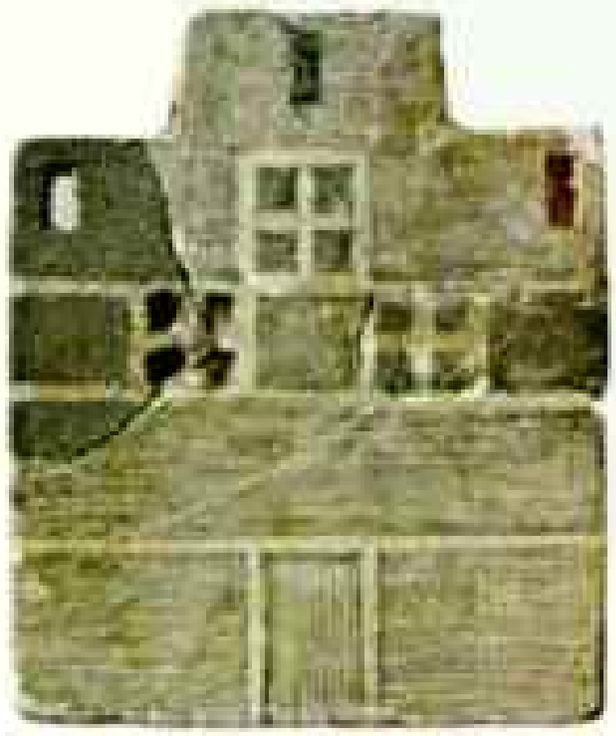
Paintings by
LLOYD K. TOWNSEND
ALL NATIONAL GEOGRAPHIC STAFF



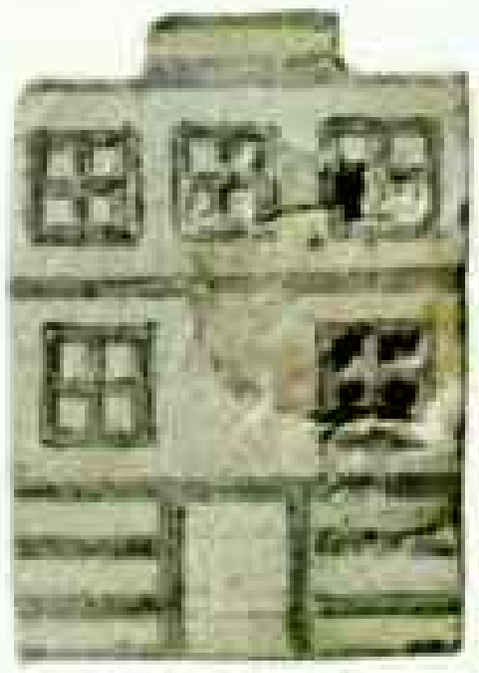
Rich in gold . . .

Royal visage, this 3,500-year-old "Mask of Agamemnon"—the Mycenaean king of Homer's epics—is now dated to a time before his rule. Magnificence and mystery mark both the Minoans of Crete, who created Europe's first great civilization, and the Mycenaeans of mainland Greece who succeeded them. NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS





EKDOTIKE ATHENON S.A., ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE



*The mighty city Cnosus . . .**

The earth trembles, the palace topples, and citizens of Knossos flee (**above**). Despite recurrent earthquakes, the Minoans flourished on Crete from 3000 to 1450 B.C., enriching their culture with major advances in art and architecture, commerce, and urban living.

Unearthed at the turn of the century, the palace complex at Knossos (**right**) appears to have been the center of Minoan power and centerpiece for Europe's first metropolis, which had a population of perhaps 80,000.

Though little is known of everyday Minoan life, miniature faience plaques (**left**) found at Knossos show what may have been the homes of minor officials —structures of stone, plaster, and timber with windowless first floors.

*Quotations from Homer in this article are from the Lang-Leaf-Myers-Butcher translations of the *Iliad* and the *Odyssey*.

that wide valley where ancient Knossos lay unseen, warmed with a thousand scents.

"Nowhere," my companion said, "nowhere on earth does a land smell so sweet as Crete, with its herbs and wild flowers." Then, mingled with the rusty cry of gulls, the first bells of Easter tolled from somewhere in the sleeping city on this lucid dawn of resurrection for both man and nature.

I HAVE TREASURED that moment among many as I explored the caves and mountaintops, the sun-struck bays and palace ruins that provide the unforgettable setting for the vanished world of the Minoans.

What an alluring world it was, with its shining palaces, its magnificent fleets at sea, its comfortable country houses, its bull-leaping spectacles, its lithesome men and handsome, bare-breasted women, its great goddess with her snakes and doves and dances in sacred groves, its vivid eggshell-thin pottery and its massive jars, its stunning frescoes, its exquisitely carved precious stones and jewels. And its essential peace; we know of not a single fortified Minoan site.

For perhaps 1,500 years following 3000 B.C. the Minoans flourished on the island of Crete, where they created Europe's earliest high civilization. Ships of this first maritime empire dominated the commerce of the eastern Mediterranean and the Aegean Sea. Centuries later we find Minoan achievements and beliefs reflected in the culture of the

ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE

There were youths dancing . . .

Across a gulf of countless generations, the Minoan love of dance still finds expression in Crete, where villagers at Lasithi (**right**) need little excuse to take to their feet. Numerous depictions in Minoan art—such as a seven-inch-high clay model (**above**) of a round dance—resemble folk dances popular throughout present-day Greece. A sense of spontaneity pervades Minoan art, unlike the stylized works of older cultures in Egypt and the Middle East.

classical Greeks, our intellectual forebears.

As I wandered the splendid Minoan collection of the Herakleion Museum—one of the world's premier troves of art—I felt I was leafing through the first family album of Western man.

Yet this splendid display of pottery and paintings, sculpture and jewelry, is, in effect, uncaptioned. No ancient civilization is more enigmatic. A brooding mystery seems to hang over the grand staircase at Phaistos, the central court at Mallia, the Gorge of the Dead at Zakros, the throne room of Knossos.

Unlike their Babylonian and Egyptian contemporaries, the Minoans left little written history—and the writing they left is largely undecipherable. We cannot determine exactly when any of the events attested in the archeological record occurred.

The most profound of all Minoan mysteries is the final one, for at the zenith of its power and brilliance about 1450 B.C., the civilization collapsed in a flaming destruction. The end was so sudden and emphatic that some scholars have attributed it to one of the most violent natural catastrophes known to man, the explosion of the volcanic island of Thera (Santorin), some 70 miles north of Crete. Others cite the all too familiar pattern of aggression and plunder by invaders bent on conquest.

EACH DECADE seems to produce its own startling new finds. Few would have believed, after more than half a

DISCOVERIES THAT STARTLED THE WORLD

Prime movers in early archeology, two brilliant, eccentric, and rich men almost single-handedly revealed the Bronze Age origins of European civilization to a stunned world. Spurred by his trust in the Greek poet Homer, German-born Heinrich Schliemann followed his 1873 discovery of Troy in Asia Minor with the excavation of spectacular gold artifacts at Mycenae in Greece—thus giving first substance to the writings of Homer. Thought to be the strongest of a coalition of city-states that flourished from about 1650 to 1200 B.C., the supposed home of Agamemnon has lent its name to the entire Mycenaean age. In 1900 discoveries in Crete by Englishman Sir Arthur Evans pushed back the frontiers of European civilization more than 1,000 years. The ruins of Knossos he uncovered and partly reconstructed gave first light to the Minoans—a remarkably sophisticated society for so distant a time.

DR. HEINRICH SCHLIEMANN
1822-1890

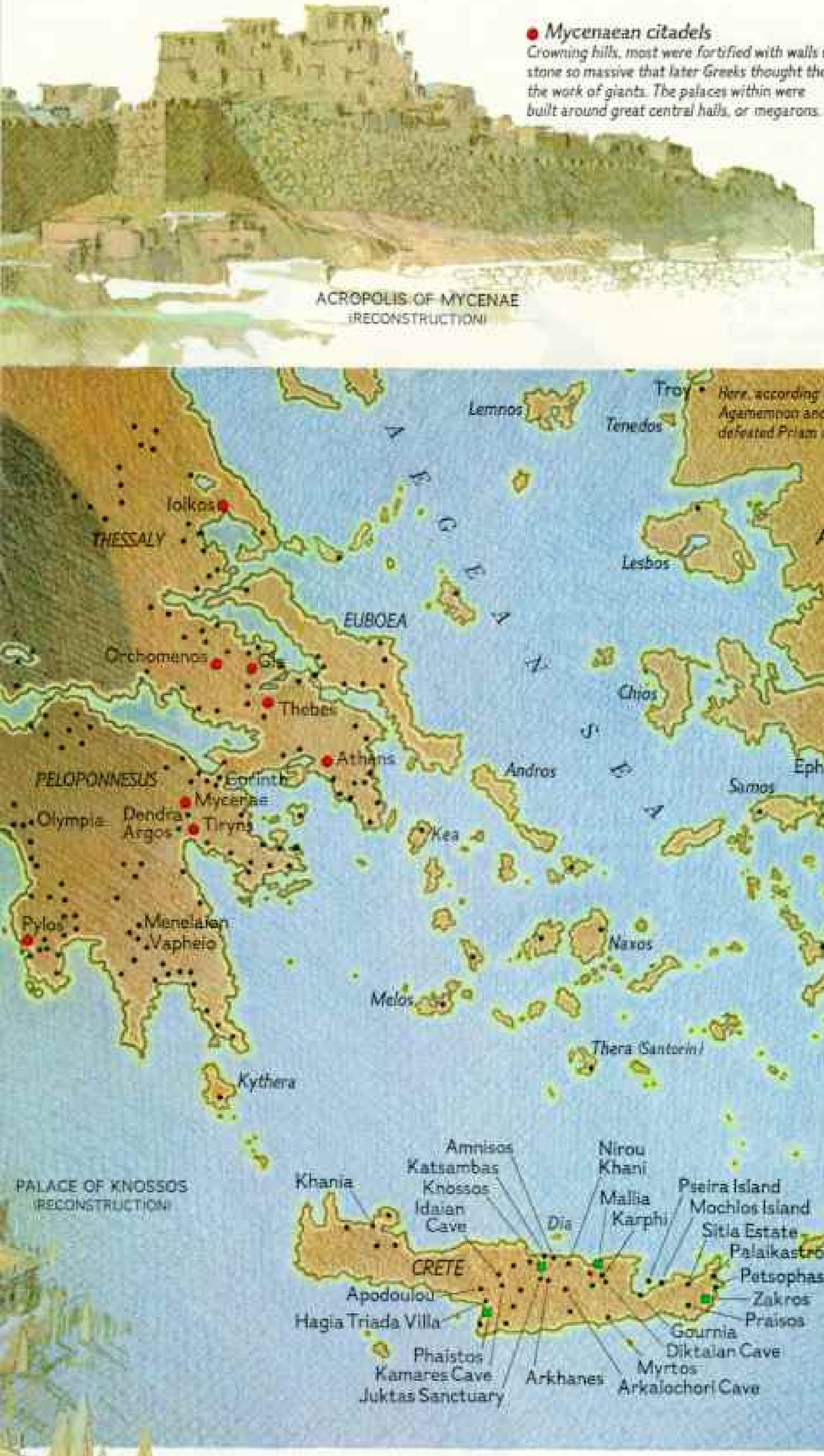
SIR ARTHUR JOHN EVANS
1851-1941

Cephalonia

Ithaca

• *Bronze Age sites*
Of the major villages, sanctuaries, and graves shown here, many have yet to be excavated.

■ *Minoan palaces*
Sprawling, multistoried complexes of as many as 1,500 rooms, they were remarkably lacking in fortification. At Knossos royal apartments were located in the balconied east wing, below. Top floors of the west wing, across the courtyard, were used for religious ceremonies. Plumbing and drainage systems were highly advanced.


Mycenaean citadels
Crowning hills, most were fortified with walls of stone so massive that later Greeks thought them the work of giants. The palaces within were built around great central halls, or megarons.
ACROPOLIS OF MYCENAE
(RECONSTRUCTION)
Here, according to Homer, Agamemnon and the Mycenaeans defeated Priam and the Trojans
Troy
Lemnos
Tenedos
Iolkos
THESSALY
ASIA MINOR
Lesbos
EUBOEA
Orchomenos
Chios
Thebes
Athens
Andros
Ephesus
Samos
PELOPONNESUS
Corinth
Mycenae
Olympia
Dendra
Argos
Tiryns
Kea
Miletos
Pylos
Menelaion
Vapheio
Naxos
Melos
Thera (Santorini)
Kythera
RHODES
PALACE OF KNOSSOS
(RECONSTRUCTION)
Amnisos
Katsambas
Knossos
Idaian Cave
Nirou Khani
Khania
Dia
Malia
Karphi
Pseira Island
Mochlos Island
Sitia Estate
Palaikastro
Petsophas Sanctuary
Zakros
Praisos
Gournia
Diktaian Cave
Carpathos
CRETE
Apodoulou
Hagia Triada Villa
Phaistos
Kamares Cave
Juktas Sanctuary
Arkhanes
Myrtos
Arkalochori Cave

century of fine-tooth combing of Crete by archeologists, that an unknown, undiscovered, unplundered Minoan palace could be found—but Nicolaos Platon found one at Zakros in 1962. Few would believe that an entire Bronze Age settlement, preserved like Pompeii for the ages, could be found—but Spyridon Marinatos found one in the volcanic ash of Thera in 1967. And who would have guessed that the intact burial of a queen, or priestess, could be found—but John and Effie Sakellarakis found not one but two at Arkhanes, the latest in 1975.

This constant excitement of discovery keeps the Minoan scholars in lively ferment, and in a field where the written record is mostly a puzzle, speculation simply abounds.

Speculation has always abounded in regard to the Minoans. But ancient authors took the myths and fables to be authentic remembrances of a real past. Though presenting varying, sometimes contradictory accounts, most agree on the basic Minoan myth:

The god of the sea, Poseidon, sent to King Minos a brilliant white bull, which stepped from the waves, intended as a sacrifice. But the avaricious Minos kept it. In revenge, the god inflicted Queen Pasiphae with an unnatural passion for the bull. The cunning craftsman Daedalus, an exile from Athens, arranged the tryst by fashioning a wooden cow in which the queen hid herself. Thus was born that monstrous Minotaur, which

The fair goddess made answer . . .

Both fierce and seductive, the snake goddess, found in a shrine repository at Knossos, stands arrayed in the Minoan fashion of bared breasts and flounced skirt. Since the Minoans left no holy writ to explain their beliefs, the symbolic intent of this 11.6-inch faience figurine remains obscure. She is seen by many as the Minoan equivalent of the Great Mother Goddess of most ancient religions, who promises the renewal of life. Though their piety is attested by a wealth of sacral art, the Minoans built no large temples.

EKDOTIKE ATHENON S.A., ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE

Daedalus imprisoned in a maze of his making called the Labyrinth. . . .

The son of Minos, Androgeos, entered games at Athens, and so victorious was he that in envy he was treacherously slain. Minos besieged the city and, aided by famine and drought, secured a tribute of seven youths and seven maidens shipped to Knossos every year, to be devoured by the Minotaur. At the time of the third tribute, Theseus, son of King Aegeus of Athens, offered himself as a sacrifice, and so arrived on Crete. There Ariadne, the daughter of Minos, was smitten with love for Theseus and, on the advice of Daedalus, provided him with a ball of thread. By this means he found his way out of the Labyrinth after slaying the Minotaur with his sword. . . .

Theseus and Ariadne fled Crete, but he abandoned her.

AFTER THE PASSING of the ancient world, more cynical generations relegated the story of Minos, Theseus, and the Minotaur to the status of fairy tale. The same was true of Homer. His great poems had described a civilization of palaces and fleets and warriors and chariots that once flourished on the Greek mainland and included the island of Crete. The story of the expedition to Troy, on the coast of modern Turkey, is the West's first noble literature. Yet, like Dante and Virgil and Milton, Homer was thought to have invented it all, a colossal and compelling fiction.

Then, beginning in 1870, the inspired amateur archeologist Heinrich Schliemann, with a burning faith in the historical veracity of Homer, unearthed an impressive Bronze Age city about where the poet had located Troy (pages 148-9).

Four years later he went on to the ruins of the great fortress at Mycenae on the Greek mainland—called by Homer "rich in gold"—and traditional home of the Trojan War leader Agamemnon and his unfaithful wife, Clytemnestra. There he opened the now famous Shaft Graves, revealing an incredible treasure of gold objects, some 44 pounds. There were death masks of unforgettable visage, moving Schliemann instantly to cable King George I of the Hellenes: "I have gazed on the face of Agamemnon!"

It was one of the most dramatic, though incorrect, conclusions in the history of archeology. Later work on the site dated the masks to about 1550 B.C., three centuries before the fleet set out for Troy.

THE TRAIL OF DISCOVERY led southward across the Aegean to the island of Crete. Clues that something was to be found there—unmistakable clues in the form of huge pithoi, or storage jars for grain or olive oil or wine—had come to light on a hill called Kephala, just south of Herakleion. Schliemann attempted to buy the site as others had before him, but the price was exorbitant, and Crete was governed by a Turkish administration not disposed to approve the excavation.

After Schliemann withdrew, a Briton named Arthur Evans, wealthy, well educated, and filled with a lively curiosity about the unknown script he had seen on some sealstones in Athens, bought Kephala. In 1900, after Crete gained political autonomy, Evans started to open the totally unsuspected splendors of the Palace of Minos at Knossos.

An entire previously unknown civilization of vast material accomplishment and artistic achievement, Europe's first, was now revealed. Myth became reality as the vast complex of the palace came to light, a labyrinth indeed. Few would have been surprised had Evans announced that in the midst of the maze he had found the bones of the Minotaur.

These discoveries presented students of the prehistoric Aegean with a jigsaw puzzle of sites and artifacts that has yet to be worked out to everyone's satisfaction.

Were the Minoans of Crete and the Mycenaeans of the mainland the same people? At first, and for a long time, it was believed so—the rulers of the mainland palaces at Mycenae and Pylos and Thebes being thought of as either Minoan colonists or as vassals of the king of Knossos. Certainly their culture, their religion, their art, and their writing—on tablets inscribed with characters representing two languages, called Linear A and Linear B—were so similar as to appear to be the same.

One thing seemed certain. Whatever they were, these Minoan-Mycenaean peoples were

not Greek. Were not generations of schoolboys taught that the forefathers of the classical Greeks arrived much later in history, around 1200 B.C., as warriors of the Dorian tribe? It was well known that Greek history formally began with the first Olympiad in 776 B.C.

EVANS'S VAST LABORS at Knossos extended over 25 years. Not content with unearthing the palace, he reconstructed it in parts, a procedure later scorned by the more meticulous archeologists. The reconstruction has made Knossos an international tourist attraction, like Stonehenge or Chartres or the Sistine Chapel.

It deserves the billing. I have visited the palace many times and in many seasons, and I have never failed to be moved and mystified by the structure that covers some five acres.

The visitor today approaches from the west, past a bust of Evans, and crosses the western court, with its raised walkways for ceremonies, toward a small porch and entrance set at a corner of the west facade—an extensive gypsum wall still blackened by the fires of the final conflagration. Knossos survived the Minoan holocaust of 1450 B.C. and continued to be occupied until its end came some seventy years later.

In the time of greatest Minoan power—the two and a half centuries following 1700 B.C.—the palace dominated a city of perhaps 80,000 people who lived along the valley and in the harbor towns. To the south, beyond a high range of mountain, lay the island's most extensive and fertile plain, the Messara.

A farmer coming from that way for a harvest festival or other ceremony would cross a high pass and descend toward Knossos, where a stone *(Continued on page 160)*

Libation . . . of gleaming wine . . .

Resurrected from the rubble, a vessel (**right**) from the palace at Zakros was probably used for ritual libations. Its marine motif of starfish and whorled shells represents the high point of Minoan pottery art. Man-high storage jars, or pithoi (**facing page**), filled the basement at Knossos, repository for hoards of oil, grain, and wine. Modern Cretans still store olive oil and water in large containers thrown on the potter's wheel (**below**). In the Aegean, Minoans were the first to use a hand-turned wheel, probably around 2500 B.C.

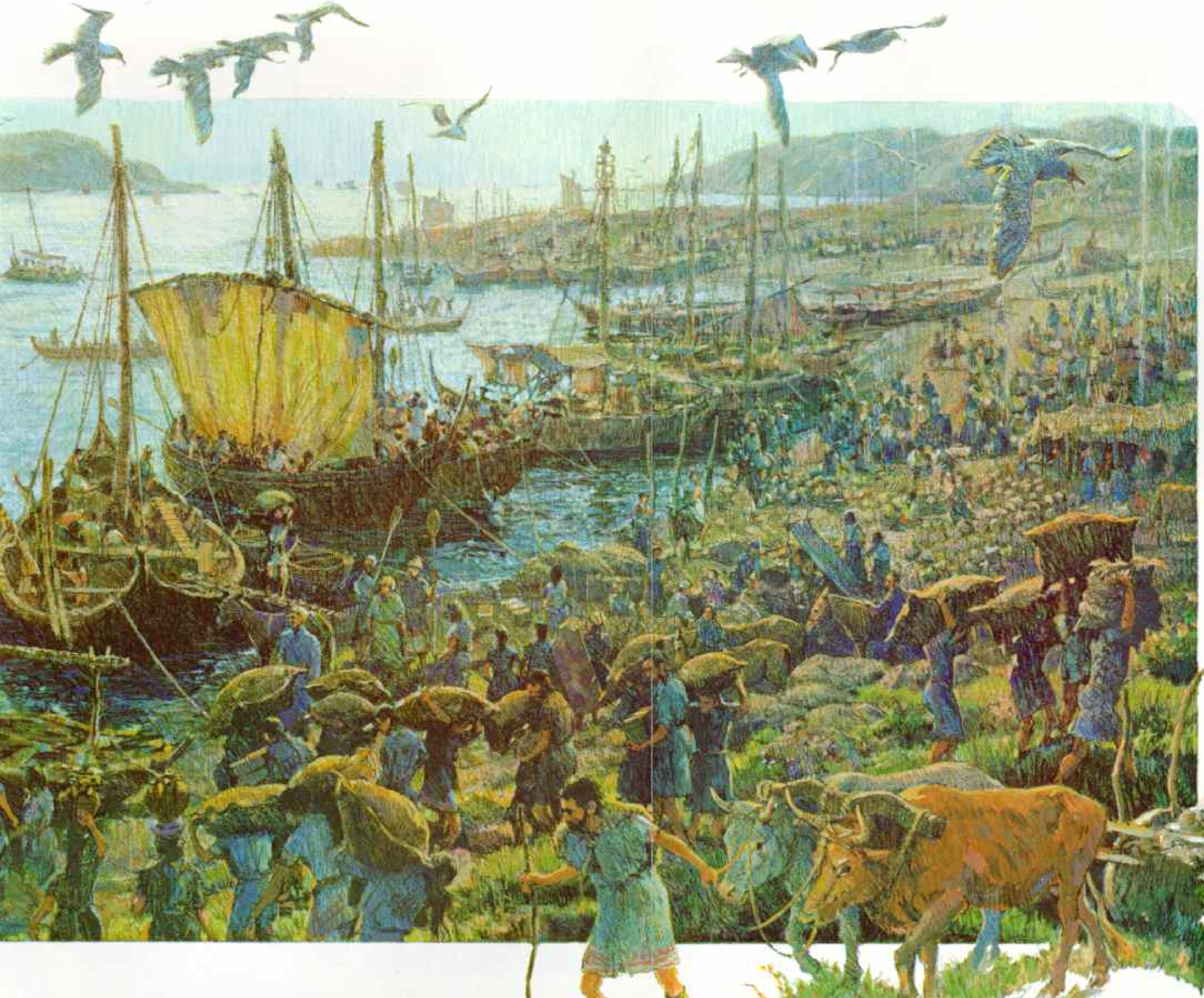
CREDITS: KTIMATIKI ATHÊNON S.A., ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE (RIGHT)

BRONZE AGE MAN MASTERS THE SEA

Heavy with cargo from the far corners of the ancient world, Mycenaean galleys crowd a mainland port of Greece (**right**) near the end of the 16th century B.C. The early people of the Aegean had long braved the open seas and wrathful gods. The impetus for their daring was bronze—a durable alloy of copper and tin that had transformed their ancestors from hunters and gatherers into farmers, craftsmen, and warriors. But short on copper and virtually bereft of tin, they were soon forced to improve their crude boats and put to sea in search of both. Using sail and oar, and probably inventing the keel, they fashioned stalwart vessels capable of crossing the hazardous reaches of the Mediterranean. Though this nautical revolution was occurring simultaneously throughout the Aegean, the Minoans—with their advanced economy—were to become the world's first maritime power. For at least a century they subdued pirates and kept the Aegean a safe highway for commerce in goods and ideas. After Crete's power crumbled around 1450 B.C., the warlike Mycenaeans ruled the seas, trading with the strong, plundering the weak.

Sea routes *Prevailing northerly winds dictated a circular trade route that brought tin from Asia Minor, copper from Cyprus, and luxury goods from Egypt.*

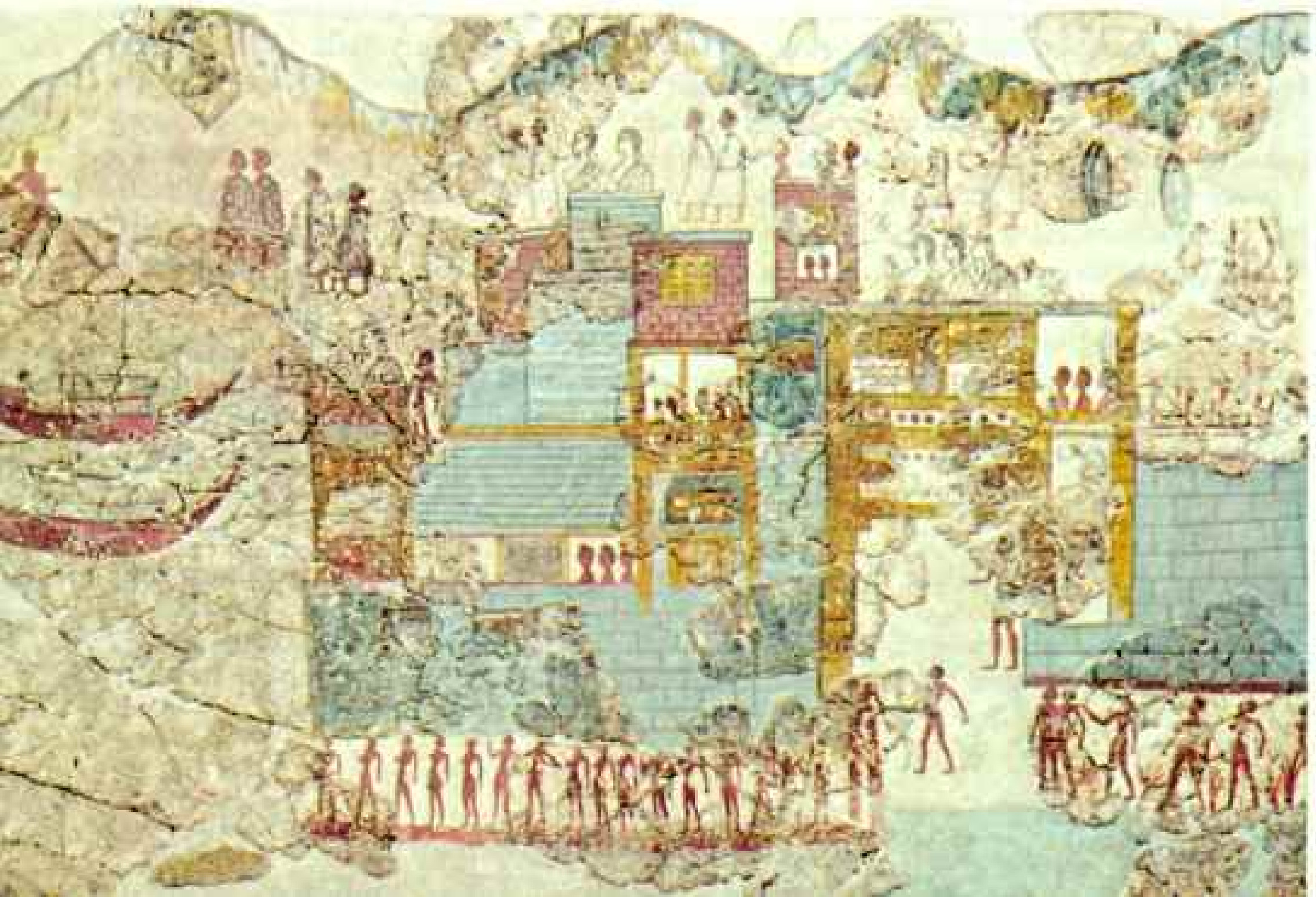
OPPOSITE PAGE FOLDS OUT



Over the wine-dark sea . . . A unique masterpiece portraying the glory of Minoan sea power, this fresco from Akrotiri—a settlement recently unearthed on the island of Thera (pages 162-3)—is the only such rendering ever discovered. It offers a gold mine of information on ancient nautical design. Only 16 inches high, it once spanned more than 20 feet along three walls of a house thought to have belonged to a wealthy sea captain. Scenes of battle and subtropical landscape fill the first two sections, not shown here. According to one interpretation, warships attended by sporting dolphins (**above**) sail in triumph past what is thought to be the Libyan coast of Africa. Passing one city—framed by a river above which a lion pursues a herd of deer (**above,** left)—the fleet approaches a

second (**below,** right), where the populace turns out to welcome their arrival. Near each stern a helmsman mans a steering oar. All ships except one have their sails furled, and five have their masts lowered. Dense ranks of red-hued paddlers form an almost solid line along the gunwales. The use of paddles instead of oars indicates a reliance on sails for long voyages.

EXDOTIKE ATHENON S.A., NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS



(Continued from page 152) causeway carried him over the Vlychia stream to a wide, stepped portico. Ascending by easy stages, he would enter the palace and pass down a long corridor, the walls of which displayed a procession of hundreds of figures—musicians and graceful young men bearing rhytons, ritual vessels for offerings to a god. Toward the end, he would behold a painted image of great power and beauty—a young priest or king leading a griffin or sphinx, with butterflies, symbols of eternal life, hovering nearby.

A passage then led the visitor to the warmth and dazzling light of the vast central court. Here, perhaps, a ceremony was in progress at the tripartite shrine. Lovely priestesses of the goddess, visions of color in their whirling, flounced skirts, bared breasts held upright by tight bodices, poured libations of wine and honey—mixed perhaps with the blood of a slaughtered bull—from rhytons of precious alabaster or marble.

To the east opened the entrance to the residential quarters, or so these magnificent rooms have been interpreted. There one of the masterpieces of ancient architecture, a grand staircase built around a large light well (fully restored by Evans), led down two stories to apartments of singular grace, airy and amply lighted, decorated with frescoes of sporting dolphins, where the rulers may have lived.

RELIGION pervades the west wing. Beside the triple shrine—each of its three small rooms fronted by pillars and each crowned with symbolic bull's horns—stairs divided by a large column led up to a second story. Here the great hall and sanctuary hall, used in one interpretation for communion feasts, were painted with scenes of obvious religious significance. At the time of the destruction, a fragment of a fresco fell from these halls to the ground floor: the small but winning portrait of a lady with a nose so pert and coiffure so modern she was named La Parisienne (page 171).

Beneath and to the west of the upper halls lay 18 enormous magazines containing more than 400 giant pithoi (150 survive) capable of holding 17,000 gallons of wine.

To the north of the divided stairway and down a few steps, the most famous of the palace's hundreds of rooms was illuminated by soft light from a well. Against a wall stood —and was still standing when Evans discovered it—a gypsum chair with a regal back, flanked by painted wingless griffins—mythical creatures with the body of a lion and head of an eagle. It may be Europe's oldest throne (page 170).

Still scattered on the floor from the palace's last hour lay small vessels used in religious rites and an overturned jar once containing precious ointment. A last desperate attempt to appease an angry god?

On this day of bright ceremony, however, the balconies overlooking the court would be filling with the residents of the palace, and visitors would be milling about the sides.

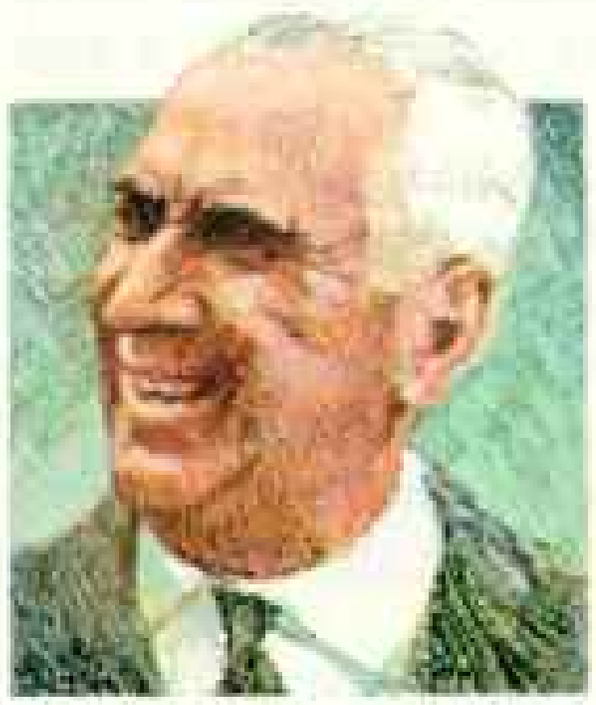
What had they come to see? At least one scholar, J. W. Graham, an authority on the Minoan palaces, believes it would have been a spectacle of heart-stopping excitement, danger, and glamour, the leaping of bulls by highly trained athletes.

That such a sport, or ceremony, took place seems beyond speculation. It is pictured in a famous fresco from Knossos showing the athlete in full somersault over the back of a huge piebald beast (pages 168-9).

Professor Graham believes the spectacle was staged not in a field outside the palaces but in the central court itself. He noted odd holes cut into the side of the court at the palace of Mallia that could have served as sockets for barricades to protect the viewers. A famous carved stone, used to seal documents by impressing it on clay, shows a bull on its hind feet and the leaper launching himself over its back from the vantage of a high block of stone. A series of joined X's forming a strung diamond pattern decorates the block. Professor Graham notes that this X motif is found at only (Continued on page 164)

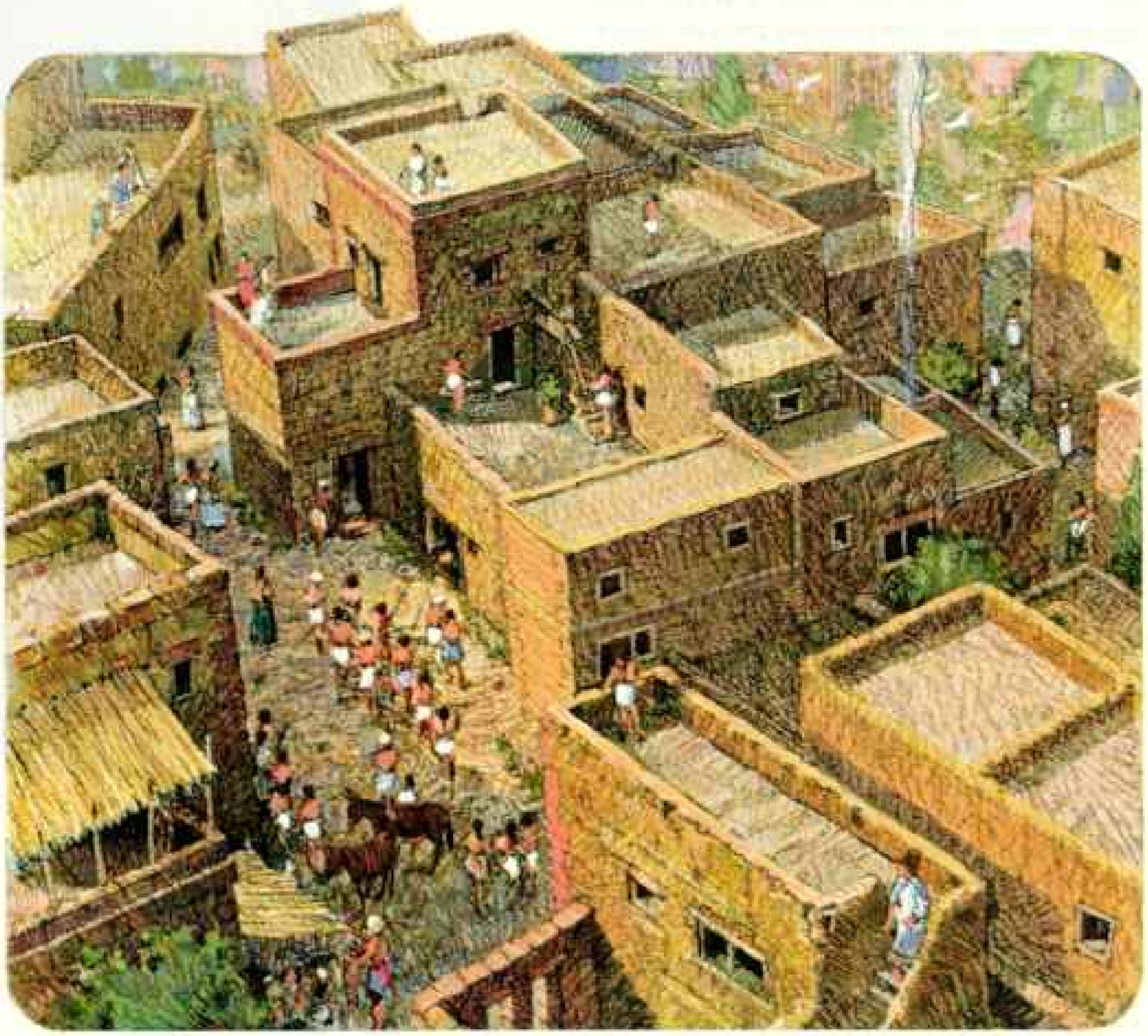
The sea gives store of fish . . . Spirit of youthful innocence marks a fisherman bearing a bountiful catch. Also discovered on Thera, miraculously intact beneath volcanic debris, this fresco reveals the great naturalism and freshness of Theran art. Painted on a three-foot-high stucco panel, it is perhaps the first "portable" artwork. NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS

Shaker of the earth . . .



Cradle of a sleeping giant, the island of Thera—also known as Santorin—curves around a colossal submarine crater formed 35 centuries ago when a volcano erupted and collapsed into the sea. Beneath the gleaming town of Thera (**left**), the caldera plunges from 200 feet at quayside to 1,300-foot depths.

Here in 1967 Greece's Inspector General of Antiquities, Spyridon Marinatos (**right**), made a startling discovery—the tephra-preserved town of Akrotiri. Still being excavated, this Bronze Age Pompeii boasted such Minoan refinements as terra-cotta plumbing and town-house architecture. Its fresco-rich West House appears in the upper left of this artist's depiction (**below**). Before a fatal fall at Akrotiri in 1974, Marinatos eloquently expounded the theory that the Minoan empire was snuffed out by the Theran volcanic upheaval. Other studies suggest it only weakened the Minoans by damaging their farmlands and great fleets with falling ash and tidal waves—thus enabling a takeover by the Mycenaeans.



one other place, in recesses beside the central court at the palace of Phaistos, beside which stands, in the court's corner, a high block of stone.

If true, what a spectacle it must have been —the massive bulls with flaring nostrils charging into the court, the thin young men and women grasping the horns and somersaulting as the mighty head came up, the crowds screaming with excitement.

Is not something similar still done today?

LIKE SO MANY THINGS MINOAN, the cult of the bull—symbol of strength and fertility—probably came from the East, and, as with so many other things Minoan, a myth embodies the event:

As Europa, daughter of the king of Sidon, a famous city on the coast of Phoenicia, walked by the seashore gathering wild flowers, the god Zeus watched and felt a profound love. He appeared to her in the form of a most beautiful chestnut bull, with a silver circle on his brow and horns like the crescent moon. Attracted to him, Europa mounted his back, and he raced off with her across the winds of the sea to Crete. She bore him famous sons —Minos and Rhadamanthus and Sarpedon— and gave her name to a continent.

Scholars of comparative religion, such as Sir James Frazer, have puzzled over the symbols and associated myths of the Minoans for many years. The grounds for speculation were recently improved by the startling discoveries made by Professors John and Effie Sakellarakis near the town of Arkhanes, a few miles south of Knossos.

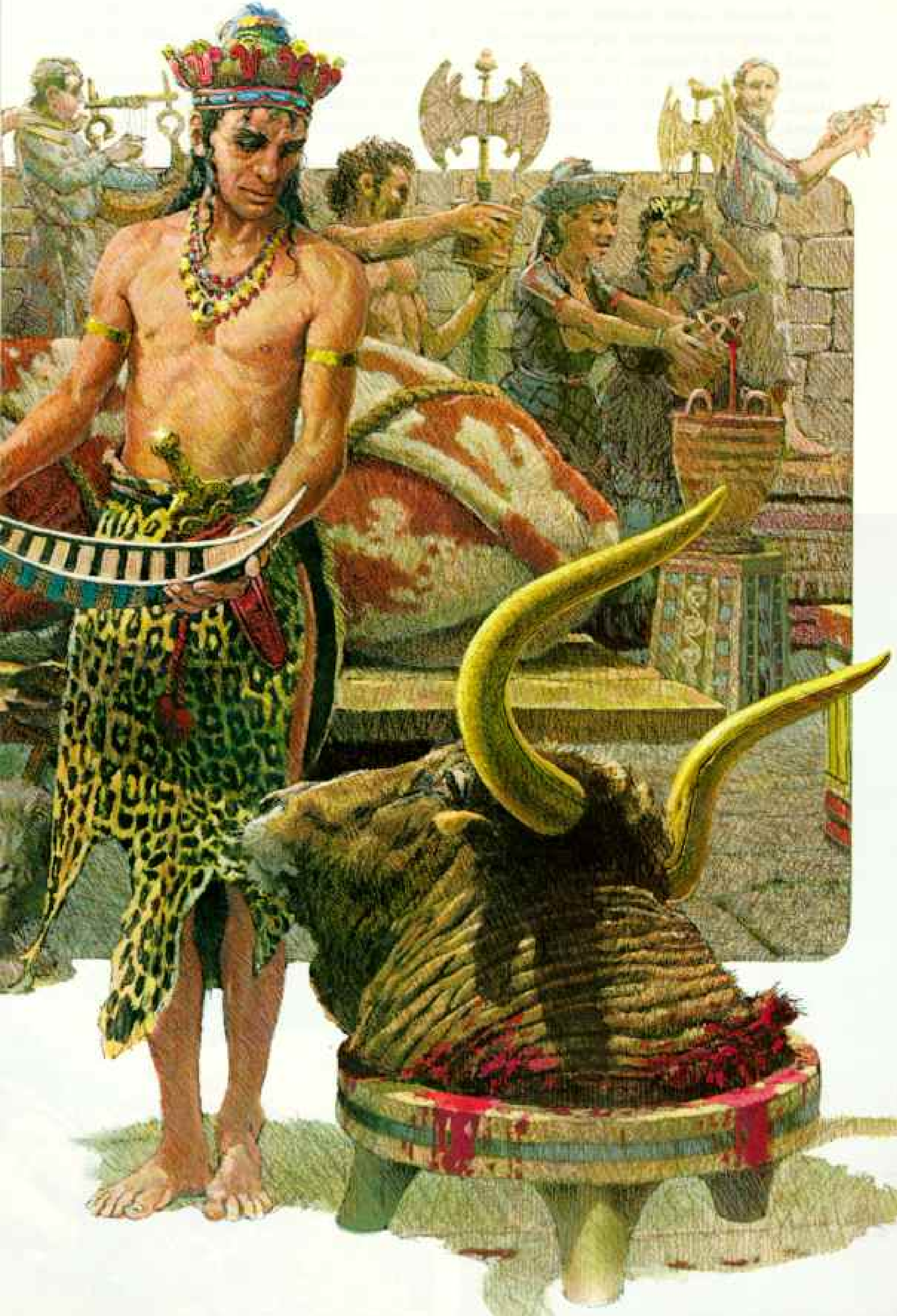
The way there is marked by a small sign, and a narrow paved road soon ends, but it is a pleasant walk up the dirt path, with a wide view over a gorge to the west, birds circling, and the welcome shade of olive trees as one walks. At the top one finds the tombs.

The Sakellarakises began digging there in 1964. They first uncovered a graveyard for collective burials, containing 200 human skulls and built in early Minoan times. This was replaced, around 1800 B.C., by a remarkable tomb—remarkable in that there was associated with it something almost unknown on Crete, a temple for the dead.

In 1965 they found a second tomb, the main chamber of which had been robbed. There

Many sleek oxen were stretched out . . .

In homage to the gods, the head of a bull with gilded horns is readied for a royal entombment at Knossos around 1400 B.C. Leopard-skin loincloth and model boat reflect Egyptian influence.



was, however, a side chamber, and there the spade came upon the first unplundered noble burial, that of a woman, to be found on the island. The skeleton of a horse lay scattered about, and in the debris blocking the door rested—the legend of Europa sprung to life! —the skull of a bull.

The woman's remains rested in a sealed larnax, a clay basin used both for baths and for burials. She had been adorned with more than 140 pieces of gold jewelry, including a signet ring bearing a cult scene that was to prove of great importance.

In July 1975 the excavators found a second notable lady, buried in a small tomb. She wore a necklace of astonishing beauty, each of its gold parts shaped like a paper-nautilus shell. She lay on her left side, facing Mount Juktas, and held in her hands a copper mirror, a stunning image of death.

Was she a queen, or perhaps a priestess serving the goddess? "No one knows for sure," John Sakellarakis told me. "But she had green eyes."

"How could you possibly know that?"

"One of my colleagues working on the dig dreamed it. The goddess appeared to this young man, wearing that fantastic necklace, and gazing upon him with green eyes. The image is rather haunting."

Equally haunting is the scene on the gold ring worn by the first lady. A female figure in the familiar long skirt and bared bosom stands between two men. One is tearing a tree by

Olives in their bloom . . .

Aglow with sunshine, olive gatherers in central Crete enjoy a playful break (**right**). After beating the fruit from trees with sticks, islanders traditionally extract the oil with presses and separators similar to

its roots out of a small shrine, and the other kneels and laments.

"The ring cleared up some doubts about Minoan religion," John told me, "about the ancient belief in the dying and resurrected god."

THE THEME is an old one in the Middle East—the soul of the harvest represented by a Divine Infant or Young God, consort of the Earth Goddess, or Great Mother, or Mother Goddess. We know their names as other peoples used them—Isis and Osiris in Egypt, Ishtar and Tammuz in Babylonia, Aphrodite and Adonis in Greece.

Each year, as the autumn winds arrived and vines withered, the people would mourn the death of the god, and each spring, as life renewed itself, they would hail his resurrection.

In the ancient Middle East, the Young God was often represented by the king, and the Great Mother Goddess, his companion, by the queen. An actual Sacred Marriage took place as part of the ritual; the fertility of men and crops was thought to depend upon such a union, and there is some indication that in the dim past, an aging king was put to death to ensure the fertility of the realm.

Other cultural indications also point eastward for Minoan origins. Scholars of language have long noted an odd fact; some of the most famous Greek places like Corinth, Olympus, and Knossos bear names that are not Greek. No one is certain what language they represent, but the indications are that a people

those found in Minoan ruins. Though sheep and goats provide the milk for the island's tasty cheeses (**left**), overgrazing through the centuries has damaged much of the land. Yet the sturdy olive tree still thrives here, producing some of the highest yields in the Mediterranean.

Worship him with bulls . . .

Defying death and credulity, athletes somersault over a charging bull—a favorite Minoan spectacle. Such feats may have inspired the myth of the half-man, half-bull Minotaur that dwelt in the Labyrinth of King Minos, legendary founder of the Minoan empire. This embossed gold cup from the mainland, thought to have been a Cretan export, depicts the capture of a bull.

BOTH PHOTOS BY HIRMER S.A., ARCHAEOLOGICAL MUSEUM OF HERAKLION, CRETE (ABOVE); NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS

speaking it spread over the eastern Mediterranean long before our historical knowledge begins, perhaps as early as 6000 B.C.

Linguist Leonard Palmer detects a Middle Eastern flavor to the words left behind—specifically Anatolian, and more particularly, Luvian, a people who once inhabited the hills of what is now Turkey.

The very first settlers of Crete found a safe and bountiful land, heavily forested, with vast stands of cypress trees, and oak, chestnut, and pine, unlike modern denuded Crete.

When archeologist John Evans began work at Knossos in the late 1950's, he uncovered below the courtyard the deepest Neolithic layer, 23 feet down, ever found in Europe. Experts count ten building levels, covering more than 3,000 years. The oldest houses, in level nine, were made, surprisingly, of mud bricks hardened in fire—a Middle Eastern technique used then and never again in ancient Crete.

One suspects from all this that the first settlers in Crete brought a Middle Eastern Neolithic civilization already well developed. On a day of scudding gray clouds and glinting pewter waves, I climbed a hill overlooking the Libyan Sea, near the town of Myrtos on the island's southeastern coast, to reach one of the finest of early Minoan sites.

Here, in 1967 and 1968, British archeologist Peter Warren excavated a remarkable community occupied between 2600 B.C. and 2200 B.C. The people lived in a single stone and mud-brick building of more than 90 small living and working cells, tiny open spaces, and passages—a veritable hive for humans. At its largest extent, the settlement covered 1,500 square yards of the summit.

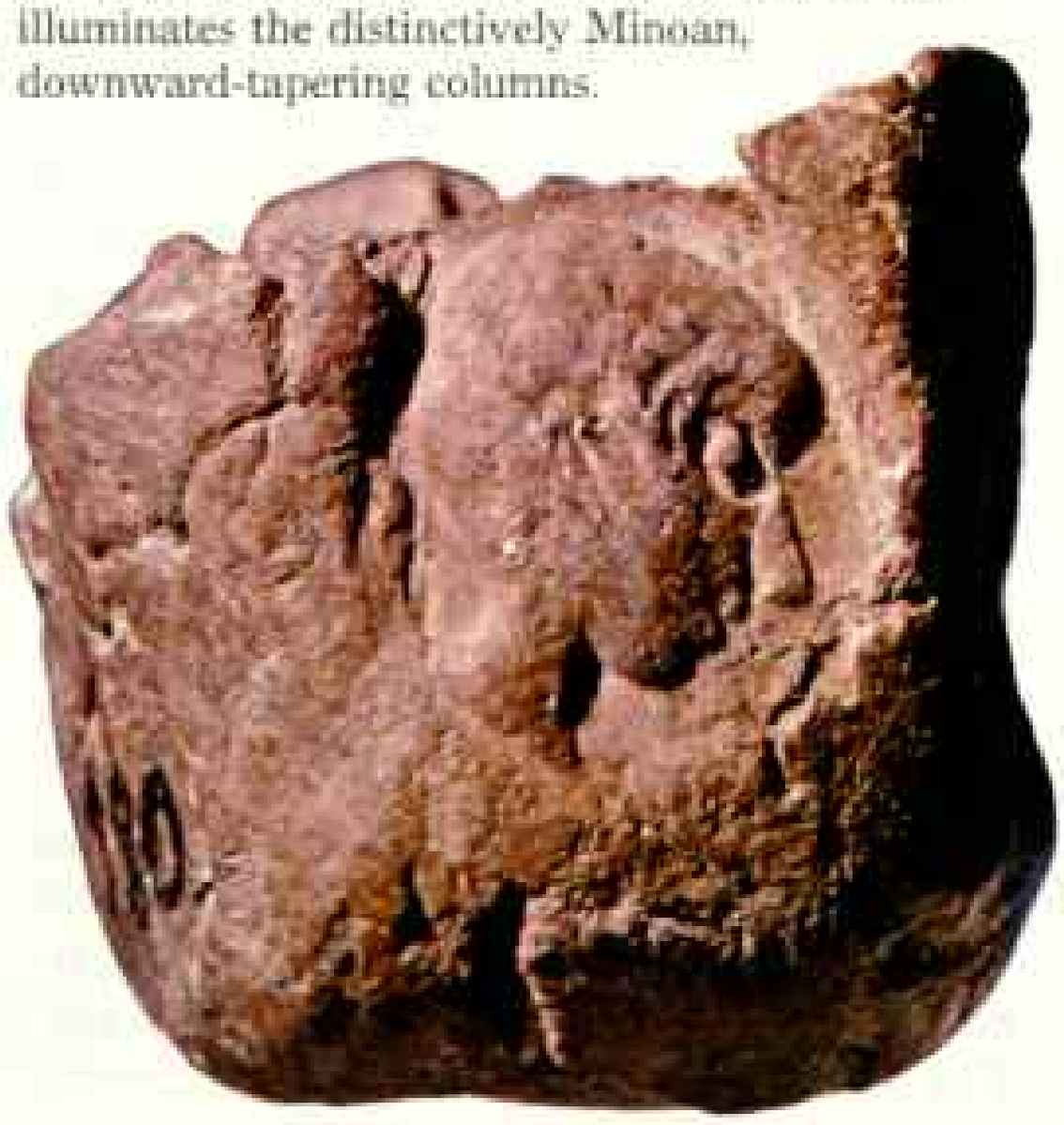
KKOSTAS ATHENON S.A. (BELOW AND RIGHT); ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE (ALL)

Ariadne of the lovely tresses . . .

So beguiling and chic was the lady in this fresco fragment from Knossos (**left**) that her discoverers dubbed her La Parisienne; the sacred knot behind her neck may identify her as a priestess. The salute on a bronze statuette from Tylissos (**below**) is thought to be a Minoan gesture of worship. A profile impressed in clay by a sealstone (**lower left**) may be that of a young prince.

Wherein Minos . . . began to rule . . .

Deep within the Labyrinth of the palace at Knossos stands what may be Europe's oldest throne. Found intact, the gypsum seat commands the reconstructed throne room in the west wing (**left**), where sunlight from the central peristyle illuminates the distinctively Minoan, downward-tapering columns.



A fair land and a rich . . .

A time of joy and laughter. In rural Crete workers (**below**) still reap their crops with sickles similar to those depicted on Minoan artifacts. The cut-stone Harvester Vase from Hagia Triada (**bottom**) may depict a harvest celebration. Grain is still threshed underfoot by cattle in the Lasithi Valley (**facing page**), where a farmer's wealth is measured in windmills. This somewhat modern method carries on the Minoan practice of irrigation thought to have been used at Lasithi.

Olive trees, vineyards, and fields of barley spread over the nearby slopes, where goats, sheep, cattle, and pigs were kept. Professor Warren found, among other things, six sealstones, perhaps made locally, of a kind common in Middle Eastern civilizations.

In the southwest corner of the settlement was a small shrine, the earliest known in all Crete. Against the east wall, a strange little terra-cotta goddess—only eight inches tall—once sat atop a stone bench. She has a squat body, a very elongated neck topped by a tiny head, and two thin arms that clasp against her rotund body a small jug. She may represent the Great Mother Goddess of Neolithic man, whose figure was to dominate Minoan religion.

Bit by bit, as quantities of potter's wheels and loom weights began to accumulate, it became apparent that the Myrtos settlement was a going concern, a community of cottage industries. Pottery was thrown on the slow, hand-turned wheels, and cloth was woven, dyed, and fulled, which implies trade, the gathering of surplus wealth, and the rude beginnings of the magnificent civilization that was to come.

AT SOME TIME around 2000 B.C., and for reasons not yet clear (some think a new people arrived, others think that only new ideas arrived), the Minoans began to build what they are most famous for—the grand palaces at Knossos, Phaistos, Mallia, and Zakros. For all their basic similarity, each of the palaces has its own distinct beauty.

Around 1700 B.C., after the first palaces had been standing for perhaps 300 years, something, presumably earthquakes, knocked all of them down. The Minoans went about rebuilding them on a vaster scale than before, and Crete entered upon its maturity of power and culture. Minos ruled the waves. Minoan colonies spread out to nearby islands, like Kythera and Rhodes, and trading posts were maintained on distant Cyprus and at old Ugarit on the coast of Syria. The sacred symbols of the bull and the double ax reigned in the Aegean.

Mallia on the northern coast reposes by the sun-burnished sea and leads one to think of the golden age of Crete, of a life lived in harmony with the creatures of land and ocean. The palace spreads itself like a grand country

KYRIAKOS ATHERON S.A., ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE

All have not the same speech . . .

Inscrutable relic from ancient Cretan archives, the Phaistos Disk (**above**) has baffled scholars since its discovery around 1900. Some think it an import, since it differs from recognizable early Minoan hieroglyphics and was found alongside a tablet written in Linear A—the yet undeciphered system of Cretan writing. Others think the Minoans devised more than one set of symbols, and later used them as sacred script concurrent with Linear A.

Impressed with 241 pictogram seals, this 3,600-year-old clay disk holds the earliest known example of printing. Covering both sides, 61 "words"—separated by lines and arranged in spiral form—perhaps express a hymn to a divinity.

Deciphering Linear B, a milestone accomplishment in 1952, revealed so much, yet so little. For years the script (**facing page**) had been seen as a Minoan evolvement of their older Linear A. Its presence on both Crete and the mainland suggested a strong Minoan influence over the Mycenaeans. But when a young English scholar, Michael Ventris, found it to be a primitive form of classical Greek, just the opposite became clear: Mycenaeans had taken over Knossos around 1450 B.C. and imposed their language on the Minoans. But that revelation was somewhat clouded when the translations revealed no records of events—only long and monotonous inventories and statistics.

house within the sound of the surf, reminding us that the culture of the Minoans was markedly maritime.

Apart from its vast silos for grain or other stores, my impression of Mallia is one of religion. Most major areas in the palace seem to contain a pillar crypt, or an altar, or a shrine.

Phaistos on the opposite side of the island was obviously built for the view—north to snow-capped Mount Ida, east toward the wide Messara Plain, west to the sea. It is the most elegant of the known palaces and the most beautiful in the dignity of its wide entrance stairway, even though the entire southeast side has fallen away into the valley (following pages).

IN FAR easternmost Crete, a lonely and desiccated region, a dirt road descends to the sea and the oasis village of Kato Zakro, with its bananas and olive grove. Halfway down the long shoulder of hills, a gorge seems to open almost beneath the tires of the car. It is a sudden canyon of crumbling red cliffs, the distant calling of birds, and Minoan burial caves, giving it the name Gorge of the Dead. At its mouth a small settlement in the shade of trees surrounds a gentle half-moon beach that looks toward the Levant.

This unusual place long attracted the attention of archeologists, but it was not until 1962 that Nicolaos Platon found what every archeologist dreams of—an unknown Minoan palace, intact, unplundered, untouched from that day 3,400 years ago when, at the moment of greatest splendor, its life came to an end in fire and smoke and quaking earth.

Today, its two-acre complex of some four hundred rooms lies open to the sun, a blueprint of stones. In the central shrine area were found a number of things that indicate wide prosperity and distant trade—elephant tusks from Syria, copper ingots from Cyprus, diorite from the Nile Valley. The shrine area has yielded 55 ritual vessels and artifacts that are unsurpassed for beauty and workmanship. There were two bronze double axes, one of them the most exquisitely decorated ever discovered. Tablets in the unknown Minoan language, Linear A, indicate at least official literacy. But they remain mute on the nature of the tragedy that stilled the life of Zakros.

So definitely palatial, royal, and luxurious

TABLET FROM PYLOS, C. 1400 B.C., NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS

is the Minoan ambience that one soon begins to ask: Where are the farmers, weavers, fishermen, smiths, and potters? Across the broad geographic range of Minoan culture, we have only a few places that portray the life of the multitude—none of them more revealing than the little town known as Gournia.

Gournia scatters along a gentle slope above the blue Gulf of Mirabello on Crete's northern coast. Even its name associates it with the daily life of the people—after *gourni*, a small trough from which barnyard animals drink. We owe the discovery of this simple but provocative place to a young American of aristocratic and intellectual means, Harriet Boyd. Led there by a "peasant antiquarian,"

In broad Crete . . .

Grand in aspect, elegant in style, Phaistos—second in size of four great Minoan palaces—commands a hilltop in southern Crete. Who ruled here before its destruction in 1450 B.C., and with what degree of sovereignty, remains a mystery.

Miss Boyd began digging in 1901 and had uncovered the entire town by 1904.

This earth-colored maze spreads over 18,000 square yards of the hill, its remaining walls, streets, steps, and courts resembling a spiderweb of stones. The 70-odd houses seem to us cramped and small, though they surround a grander house that is almost a miniature of ancient Crete's great palaces.

Yet here, as nowhere else, one touches the life of the average Minoan through the implements of daily life left behind—awls, nails, razors, tweezers, knives, carpentry tools—and in places such as metalworkers' shops and a factory for processing olive oil or wine.

GOURNIA, along with so many other Cretan places, met its flaming doom around 1450 B.C.

This sudden destruction of so many Minoan sites at the same time led scholars to seek the cause in a stupendous natural catastrophe. Just such a catastrophe did occur, at about the right time and place, when a volcanic

island 70 miles north of Crete known as Thera exploded in one of the most violent events in historic times on this planet.

The idea first occurred to Professor Spyridon Marinatos during excavations at the Cretan port of Amnisos. He found great blocks of building stone displaced by a massive force, and volcanic pumice among the ancient ruins. In 1934 he pointed to the Thera explosion as a possible cause of the destruction of Minoan Crete.

An early reconstruction has an initial explosion burying the Thera settlement in ash and pumice around 1500 B.C., followed by a 50-year lull, and then a single blast of such violence that clouds hurled into the stratosphere darkened Crete for several days. Once the center had blown out, the mountain collapsed in on itself, and huge tidal waves swept outward, smashing the settlements of the Cretan coast and turning the Minoan fleet to a shambles of broken timbers. Add to that earthquakes and clouds of falling ash, with resulting fires and the general destruction of

EXCITING ATHENON S.A., C. 1500 B.C. ARCHAEOLOGICAL MUSEUM OF HERAKLEION, CRETE

The goddess heard my speech . . .

Ecstatic Minoan women with strangely stylized heads behold a goddess on an exquisite gold ring found near Knossos (**left**). Like the final blaze of a dying star, Minoan art reached its peak just before the demise of the empire. But its splendor would linger for three centuries in the hands of the Mycenaeans, who may have commissioned Cretans to make the rings shown here—or produced them themselves. Demons (**above and below,** left) and women (**below,** middle) bear gifts to a goddess, while a stag hunt decorates another (**below,** right).

NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS (TOP AND ABOVE)

crops, springs, and rivers. What a picture of grand and utter destruction! The very drama of it riveted men's imaginations.

In the years following World War II, evidence began to accumulate. Two U. S. marine geologists, D. Ninkovich and B. C. Heezen, studied cores from the bottom of the Aegean that traced the ashfall in a wide arc southeastward of Thera, across the eastern end of Crete. Professors Marinatos and J. V. Luce, among others, made comparative studies between the Thera explosion and another cataclysmic eruption, that of Krakatoa near Java in 1883, which took 36,000 lives and spread a cloud of ash around the earth. By their estimate, the Thera explosion was four times greater!

Could this have been Atlantis? Professor Luce thinks so—a distorted memory preserved by the Egyptians of a great land sinking almost overnight and an empire of great culture and delight vanished forever.

In 1967 Marinatos set out to prove his theory. For several years his team carefully dug out Akrotiri, a town steeped in Minoan culture. It flourished when Thera was a verdant paradise, with forested slopes rising above the sea to the crowning summit of the great volcano. The ruins were buried under a load of ash and pumice that showered down on the remains of the once great island.

Today Marinatos's marvelous dig at Akrotiri lies under the protective canopy of a huge corrugated roof. (It was here he met a tragic death in 1974 when he toppled into an excavation and struck his head.) Concrete doorframes—re-created by pouring concrete into the spaces evacuated by decayed timbers—invite the visitor into rooms and streets that echo in the imagination to the shouts and voices of a people dead these 3,500 years.

Thus far, only a few acres of the town have been dug out. Though there are almost no treasures or personal valuables at Akrotiri—the inhabitants obviously had time to flee—what has been uncovered is beyond price: frescoes that provide a breathtaking view of the Minoan attitudes toward nature and life.

One of the streets opens into a small square, overlooked by a structure called the West House, which proved to be a veritable art gallery of painted walls.

In one room was found a portrait called the "Young Priestess" and frescoes of ships' sterns. In another, brilliant portraits of two young men holding their catch, large masses of fish. But the masterpiece from the West House is the so-called miniature fresco. Here, at last, past a landscape of palms, river, and a flying griffin, a Minoan fleet sails forth in all its glory (pages 157-9).

THE ARCHEOLOGISTS found pottery in quantity, some of it unmistakably Minoan, and the pottery cast the first shadow of doubt on the destruction theory. The precisely dated sequence of middle and late Minoan styles on Thera is complete, and stops at the time of the eruption. But on Crete, in the following fifty years, a new style emerged, the most distinctive of all, easily identified by the writhing octopuses, seashells, dolphins, and other creatures of the sea that give it the name marine style (page 152).

If the Thera eruption had destroyed Crete, who was making all those beautiful pots for another generation and more?

Also, it seems that Knossos was spared the absolute destruction visited upon other Minoan centers, while Phaistos, on the south coast and the other side of an 8,000-foot mountain, was destroyed—but presumably by no wave or ashfall.

Proponents of the destruction theory have not given up. Professor Luce points out that a few artifacts from Thera, notably a table and a pot, have distinctive marine-style motifs. He also proposes telescoping the date of the explosion to 1470 B.C. and making a similar change in the ceramic dates from Crete so it all comes out even—one bang, one big finale to all things Minoan.

Last year the German scholars Hans Pichler and Wolfgang Schiering presented their assessment of the data: "There is no connection between the decline of Minoan civilization and the Thera outburst." Their claim is regarded as assertive and unfounded by noted Greek scholar Sir Denys Page. One suspects that the truth may still lie buried in the ash of tragic Santorin.

WELL, if not a thunderous bolt from heaven, what did cause the Minoan catastrophe? Several scholars are convinced it was the hand of man.

Sometime around 1450 B.C., whether in the wake of a disaster or merely following their

own instincts for plunder, the Mycenaeans of the mainland came ashore on Crete, occupied the palace of Knossos, and took command of both island and empire.

You will recall that for a long time the world thought as Evans did—that they were a colony of the Minoans, or a mainland people related to them.

While their culture was heavily influenced by the Minoans, these mainland people had a distinctive warlike cast. The great fortress at Mycenae, commanding the Argolid Plain at the head of the Gulf of Argos, expressed well their personality. The famous Lion Gate overlooks walls of rock so huge and well fitted that later men believed them to be supernaturally made, by the Cyclopes.

Myth knows well who was king here—Agamemnon, who led the Greek forces to Troy. That expedition may reflect genuine history, for the rulers of Mycenae and other fortresses did in fact assume power in the eastern Mediterranean upon the demise of the Minoans. Their trading posts spread wide and far, and some think they were involved in raids and wars commemorated in Hittite and Egyptian chronicles.

The ruins of Pylos yielded a large batch of "Minoan" tablets, some 1,200. Working with the 600 then available, as well as 1,400 of the 3,000 Knossos tablets that were finally found, a young architect and amateur philologist named Michael Ventris pushed toward a decipherment. In a British Broadcasting Corporation program of 1952, he calmly claimed that the unknown language was—Greek!

If the Mycenaeans were a Greek-speaking people, that meant the ancestors of the classical Greeks had entered Greece a full 500 years before history gave them credit for it. It meant that the Homeric heroes who fought at Troy were Greeks. It meant that the Mycenaeans were a distinct and separate people from the Minoans, and their presence at Knossos in the last centuries of the palace's existence was due either to force of arms or to a political marriage. Either way, the Mycenaean seal was now firmly affixed to the former Minoan civilization, and it would remain that way for another three centuries.

It was clear that Schliemann and Evans had discovered these civilizations in reverse order, so to speak. From Middle Eastern immigrants, Minoan civilization had risen on Crete and been exported, through trade or example or piratical raid, to the early Greeks of the mainland. They in turn now ruled an empire that can only be called Mycenaean.

To this day, 25 years later, there are still some archeologists who hold that the language is not Greek, simply because it cannot be Greek. But the vast majority have accepted the Ventris decoding; an associate, John Chadwick, has written a book based on his reading of the Pylos tablets.

The decipherment that revolutionized our interpretation of Minoan-Mycenaean prehistory is, when viewed in the cold morning light, rather disappointing. Chadwick has called the entire corpus of Linear B tablets from the Aegean world "the contents of a few wastebaskets at five state capitals."

The tablets were written by clerks and were used almost exclusively to keep track of stores and production—flocks of sheep, disbursements of military equipment, harvests of wheat and olives.

But there is one tablet from Pylos that rivets the attention. It seems hastily scratched out and calls upon all of Mycenaean heaven for some kind of help—no less than 13 gods and goddesses, some of whose names, such as Zeus, Hera, Hermes, and Poseidon, ring familiar. Promised to the heavenly host are 13 gold vessels, and to each of the two chief gods a man, and to each of the eight chief goddesses a woman. Professor Chadwick believes they were intended as human sacrifices. Some final catastrophe was obviously at hand as the Mycenaean world of Homer's heroes was, in its turn, to pass from history.

THE AIRY COURTYARDS and palaces declined to weeds, to fire, to the reckless violence of interlopers and of nature. Sons of dead and talented fathers lost the power of writing, the desire for art, the wisdom of administration as wars flared, and the descendants of the old heroes fled to the welcome coasts of Asia Minor to begin a new life.

Thus Greece passed into its dark ages. But even in this difficult time men remembered. As shepherds huddled over fires and kings gathered near their hearths, the old tales were told of that former age of glory in which their race was forged—of great palaces and vast fleets and mighty monarchs, when gods seemed to walk among men.

Mightiest they were, and with the mightiest fought . . .

The fearless Mycenaeans immortalized by Homer battle a lion in a scene on a bronze dagger found in a royal grave (**above**). Inlaid with gold and silver, the weapon illustrates the basic difference between the Minoans and Mycenaeans. While the former left little evidence of violence in their art, the latter took it as a major theme. Add to that an oral history of death and devastation passed down through Homer, and a people emerge forever girded for battle. A loose amalgam of mainland fiefdoms ruled by warrior kings, the early Mycenaeans lacked the kind of central authority indicated on Crete. Evidence of migrations and invasions suggests a landscape of human chaos that would make Crete seem a Utopia.

EXCAVATIONS ATHENS S.A., NAUPLION MUSEUM

NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS (ABOVE)

Harking forward to Europe's age of medieval knights, bronze armor (**left**) from around 1400 B.C. was probably still being used some 200 years later in the Trojan War. According to Homer, the Trojans' Hector fought "in dread armor of bronze."

Though skilled metallurgists from early in the Bronze Age, the mainland Greeks did not emerge as a power until about 1650 B.C., when feudal rivalries were perhaps quelled by the area's then strongest overlord—the king of Mycenae. For the next two centuries, while gathering strength and extending their domain over much of the Aegean world, they lived in apparent harmony with the Minoans, drawing heavily upon the Cretans' skills to forge their own civilization. But when natural disasters beset Crete in the 15th century B.C., the opportunity for complete Aegean control was open, and they moved swiftly into Knossos. Within a century Crete had become a full-fledged Mycenaean colony, and the cultures had merged. This knife maker in modern Crete (**right**) might just as easily be descended from sons of Agamemnon as from daughters of Minos.

At some time around 800 B.C.—many centuries after the events they recorded—this oral tradition was set down in the winged words of Homer. He remembered that the ingenious Daedalus had built "a dancing place" in Knossos for the beautiful Ariadne, that the port of Amnisos was "hard to win," that nearby the goddess of childbirth was worshiped in a cave. In time what had been history became myth—a half-man, half-bull who lived in a labyrinth; a great king whose power extended on the wings of his fleet across all seas; a young god named Zeus, born in a cave.

The poet was describing nothing he had ever seen, but we know now there was truth in his descriptions of the palaces, with their gold and bronze riches, spacious halls, central hearths, echoing porticoes—because we have seen their remains.

NATIONAL ARCHAEOLOGICAL MUSEUM, ATHENS

The stablished fortress . . .

Rich and great were the kings who peopled Homer's tales. Named for Agamemnon's wise counselor in the *Iliad*, Nestor's Cup (**above**) was found buried in one of the royal Shaft Graves within the Cyclopean walls and Lion Gate of Mycenae (**facing page**). After the Trojan War, the Mycenaean empire crumbled, and three centuries of dark ages would bury Greece's heroic age in myth.

There is a place deep in the high eastern mountains of Crete, named Praisos. Here we are told by the historian Staphylos that a people called Eteocretans, "real Cretans," were to be found around the fourth century B.C. Inscriptions they left behind are written in the Greek alphabet, and in the Greek fashion called boustrophedon: left to right, right to left, the way an ox *(bous)* plows a field. But they are not in the Greek language. One suspects it was the language of the palaces.

THE MOUNTAINS of central Crete form a dramatic backdrop for the end of the tale, and no place is more spectacular than the vale of Lasithi—that all but hidden hanging valley cupped in the highest peaks.

The fertile plain, about 2,800 feet above sea level, is dominated by peaks up to 7,000 feet, but it is not so much the scenery that has made it famous but the decoration applied by man—10,000 white-sailed windmills that power water pumps for irrigation (page 173).

Each spring, at runoff, the vale fills like a huge chalice, the water brimming and flowing out as a river descending to the north.

In the Cretan season of the dying god, on a morning dark with cloud and spattered by rain, I ascended to Lasithi and a dizzying pass on what seemed the roof of the world. Above the pass, above the plain, above most of the island of Crete, stands a natural pillar of stone called Karphi, the Nail. It seems to pierce the scudding clouds, more fortress than mountain. On its peak may be read at least one ending to the Minoans.

Here, onto this towering pinnacle of rock in the heartland of the island, people moved in late Minoan times, obvious refugees. Here, around 1100 B.C., they established a settlement of 150 rooms, driven at last to the peaks on which they had so often worshiped. They had with them images of their beloved goddess. They lived on Karphi for perhaps a century; almost nothing of that remains now.

I made a slow and careful ascent to where an extraordinary view opened back down toward Crete to the north. Through the immense gulf of air, there was the single sound of a bell, and then nothing. The wind left no whisper of its passage—in all the world a profound quiet. It seemed fitting, for at the end, after all we know, the Minoans leave only beauty and silence. □

Fierceness glinting in golden eyes, our national bird rides the wind. Still plentiful

Our Bald Eagle: Freedom's Symbol Survives

By THOMAS C. DUNSTAN, Ph.D.

Photographs by JEFF FOOTT

GLENN W. EUSER, PHOTOGRAPHED AT ADAK ISLAND, ALASKA

in Alaska, the long-imperiled raptor may yet escape extinction in the lower 48 states.

THIS COLD OCTOBER MORNING the pair of bald eagles has failed to reappear. I saw them last evening snatching pike from the lake shallows, carrying the fish to the tall pine where they had nested, and eating them.

Today the shoreside aspens, oaks, and maples still blaze with the chromatic fires of fall, but today also a skim of ice glazes the northern Minnesota lake. A warm spell would melt it, and the eagles might fish again. Just as likely, they have flown south, nudged by the first sharp cold.

In October I worry. I say to myself, "I've got to hope and believe that those old birds will make it back next spring."

These are the great eagles I have watched building their nests, feeding their young, fussing at the nestlings' first flights, drifting on broad wings through summer skies. Can I expect that these white-headed emblems of our nation, these symbols of all that's wild and free, will survive for yet another year the multiple hazards that already have decimated their numbers?

As an associate professor of biology at

Features proud and stern mark both the adult (**below**) and adolescent bald eagle (**bottom**), but only the mature bird wears completely white head and tail feathers after the fourth or fifth annual molt. The brownish juveniles can be mistaken for golden eagles, the only other eagle species found in the United States and Canada.

In Oregon, a subadult feints at another in a display of aggression (**right**). Eagles rarely fight; this behavior may have been triggered by hungry frustration at the presence nearby of a feeding adult.

GARY MARTIN

Western Illinois University, I've studied bald eagles from Minnesota to Florida, from the Mississippi to the Pacific. In all, I have spent much of the past ten years close to these noble birds, my research supported in part by the National Geographic Society.

Large predatory birds such as hawks and eagles—birds that through size and food requirements need an extensive home range—probably never have been numerous. A century ago, perhaps a quarter of a million bald eagles were thinly spread throughout North America. Then, as now, they were abundant in restricted feeding habitats and certainly plentiful in their breeding ranges.

Today this majestic raptor—2½ feet tall as he grips a perch, 6½ to 7 feet from wing tip to wing tip in soaring flight—is counted only in the thousands. Fewer than 4,000 survive in the contiguous United States; a recent survey recorded only 708 breeding pairs. Perhaps 35,000 to 80,000 bald eagles remain in Canada and Alaska.

Two races live in the United States—the northern bald eagle *(Haliaeetus leucocephalus alascanus)* and the smaller southern race *(Haliaeetus leucocephalus leucocephalus)*. The southern one is officially endangered; both literally are fighting for their lives.

The southern bald eagle, less migratory than the northern subspecies, nests sparsely across the southern states from California to South Carolina, and in Florida. Some birds drift up the East Coast.

Predators Pressured by Man

More than with most creatures, the bald eagle's survival hinges on man, whose reshaping of the landscape and intrusion on wild places put unrelenting pressure on the bird, for it requires both water and land environments. The bald eagle feeds primarily on fish and most often nests in tall trees beside lakes and rivers, or near the sea.

The eagle's decline can't be pinned on any single element of environmental degradation:

It results from loss of feeding and nesting sites due to human activities, from chemical contamination of food supply, from poaching and accidental shooting, and from electrocution on power lines used as perches.

I've done most of my bald eagle research in the Chippewa National Forest in northern Minnesota, a land of lakes and forests where spring comes late. I recall shivering beside Trout Lake one March day as I swept treetops and scanned lake shallows with my binoculars. Would the bald eagles be back? My heart drummed with anticipation—or was it apprehension?

A muskrat swam toward its house of cattails and aquatic grasses. Then the flash of a white head and tail caught my eye! An eagle had alighted on an old nest 85 feet above ground in a white pine. I saw the large yellow beak deftly move left and right, up and down, as the female eagle intertwined twigs and reeds. She was renovating a nest that she and her mate had used the previous three years.

In June 1974, after finishing my spring teaching at Western Illinois University, I moved, with my wife, Maria, and our daughter, Kristin, into an unoccupied U. S. Forest Service building on Little Cut Foot Sioux Lake in the Chippewa. A former graduate student, Jim Harper, would help me with radio tracking of juvenile eagles.

A permanent radiotelemetry station allowed us to monitor young eagles within a ten-mile radius. We also used portable radio receivers while walking or moving around by boat, automobile, or airplane.

Long winter hours had gone into building the miniature backpack transmitters for attachment to the eagles. We would climb to the nest and place them on 4-to-8-week-old eaglets, before they could fly. Then when the birds left the nest, we could follow them.

To locate nests with young eaglets, we watched eagles carry fish from lakes to known nests. But some headed in new directions to nests as far as six miles from the lake.

Tender abductions from towering nests are routine for the author (**left**). Here in Minnesota's Chippewa National Forest, one of the bird's last strongholds south of Alaska and Canada, a nearly fledged female was carried to the ground in a zippered bag, banded, outfitted with a radio transmitter and marker (**above**), and returned to her nest. Dr. Dunstan and assistant Erik Toivonen, who weighs the youngster at eight pounds, will then be able to track her.

ALL BY THOMAS C. DUNSTAN

So I painted some of our radio transmitters bright colors and sewed them to three or four colored corks. The whole rig was then placed inside a dead fish, and this decoy was floated on Middle Pigeon Lake. As the instrumented fish drifted past a perching tree, its white belly would attract an eagle.

I watched from a boat as the bugged fish was picked up, and by radio I called my young helper Erik Toivonen, two and a half miles away in a forest watchtower. From the tower the radio signal could be directionally tracked as the eagle was seen carrying the fish. Erik noted the flight path. After the fish reached the nest, it was simply a matter of homing in on the pulsing radio signal of the decoy fish and finding the nest.

Young eagles, by this time 8 weeks of age or older, tore the fish apart and, while playing with the colored corks, usually threw them and the transmitters out of the nest. We could reuse recovered transmitters.

Back in the early 1960's I had helped John Mathisen and Dr. Alfred Grewe, Jr., begin leg banding of nestlings. To date, about 330 eagles have been banded in the Chippewa. Eagles are long-lived birds, and the migration and survival data are just starting to accumulate. Returns, unfortunately, are meager: Only a dozen or so bands have been recovered, and all but one have been from dead birds. Someone shooting an eagle, and finding it banded, probably will not report the event. Band-return data are sorely needed to trace movements and longevity.

Since our Chippewa study began, we have watched the physical and behavioral development of 111 eaglets. The eagle population in the forest is just about maintaining itself. U.S. Fish and Wildlife biologists have estimated that such a population will stabilize with an average yearly production of close to one bird per active nest. During the past ten years, the Chippewa nests have produced an average of .84 birds a year. In 1976 the average number of young produced —1.17 per active nest—was the highest since 1963, when we initiated the censuses.

Short on grace, long on appetite, a downy eaglet (**above**) dines on fish brought by its parents from Kachemak Bay, Alaska. Attached by safety belt, cinematographer Jeff Foott (**left**) works from the platform of the baby's nest—an ideal flight-training deck. An assistant photographed him from an adjacent tree. If a young eagle's maiden flight ends in a crash on the forest floor, its survival will depend on whether the parents can reach it to deliver food.

Fledgling Flights Can Go Awry

Nine weeks after hatching, young eagles romp and stomp about the nest and vigorously flap their powerful wings. A few more weeks and they're airborne. First flights are often target-oriented to perches the fledglings have seen their parents use, and initial landings of the 9-to-12-pound young are rarely graceful. A few, struggling for balance, tumble to the ground.

One youngster, number 14, made a crash landing on the 13th of July 1974, and we observed this bird daily to see if and how it would find its way back up above the forest canopy. For more than a week number 14 struggled through alder thickets and swamps and climbed over fallen trees, trying to follow the calls of the adults. After nine days number 14 clawed and flapped its way up to a high

Prodigious home builders, bald eagles often return to the same site each spring, repadding nests with fresh grass and twigs. Their aeries can reach

incredible dimensions; one in Ohio weighed an estimated two tons. Here, set against the misty slope of an Alaskan valley, an adult fortifies its nest with a twig.

perch, where its parents resumed feeding it.

The day number 14 got back to the treetops, I declared a camp celebration. That evening Maria garnished our table with fresh snapping turtle and wild mushrooms. Dessert was a wild raspberry pie. The best bit was the sequel: Number 14 survived to take its normal departure from the forest.

Observations of other fledglings grounded in the forest taught us that birds younger than 7 to 8 weeks tumbling into dense woods probably won't survive.

Young eagles leaving the family ranges have to learn food gathering the hard way—on their own. Fortunately this phase of development coincides with the southward duck migration: Ringnecks, scaup, mallards, and goldeneyes begin massing on the lakes. Young eagles feed on dead and crippled ducks left by hunters and supplement their diets as well with fish. A road-killed rabbit or a winter-killed deer also provide food during periods of scarcity.

I have seen eagles in South Dakota feeding on hunter-killed coyotes, and also on dead cows and sheep in the desert of southwest Idaho. Such episodes spawn misleading stories about bald eagle predation on livestock, still a matter of controversy in the western U. S.

Pursuing Eagles by VW Bus

As our radio-tagged eagles from Minnesota moved south for the winter, so did I, returning to my teaching. Jim Harper stayed to monitor the eagle dispersal and migration.

On September 17, 1974, my phone rang. "Number 23 is on the move," Jim said, "and I am following it near Park Rapids, 80 miles

WC BANAS (ABOVE); GARY MARTIN

Winter spectacle, bald eagles convene in cottonwoods by Alaska's Chilkat River (**above**). As many as 3,000 gather yearly to feed on salmon that have spawned. Eagles leave their home ranges when snow and ice force them elsewhere for fish, their diet mainstay, and other food.

Once thought to prey on livestock and compete with salmon fishermen, eagles are now known to eat mostly carrion, such as road-killed deer (**right**), and dying or dead salmon. More than 100,000 eagles were killed in Alaska before bounty hunting ended there in 1952. The state now harbors perhaps 40,000.

southwest of the nest." Jim had detected the instrumented bird moving out of its normal range. In his Volkswagen bus, equipped for radio tracking, he had followed the young eagle during six and a half hours of flight. I encouraged Jim to continue the chase. After all, this had never been done before.

Next morning the pursuit continued for four and a half hours and another 45 miles to Fergus Falls, Minnesota. The day after, the young migrant ended a six-hour flight at Sisseton, South Dakota. On the fourth day the eagle flew over Sand Lake National Wildlife Refuge and put in for the night near Aberdeen, South Dakota.

Jim called in regularly. Late in the chase, Jim said he had good news and bad news. "The good news is that I am still with the eagle; the bad news is that I am still in the same socks and underwear."

Journey Covers More Than 400 Miles

On the fifth evening, after crossing the Missouri River and spending nine grueling hours covering 170 miles, Jim and the eagle both took up roosts for the night.

We decided to abandon the chase at that point so that Jim could get back to the Chippewa and increase our sample size by picking up another migrating bird. Number 23 had averaged 95 miles a day, apart from time spent circling, and had covered a distance of 410 miles from the nest at flight speeds of 14 to 26 miles an hour.

Number 23 may have eventually stayed near the Missouri River's Fort Randall Dam in South Dakota, which is about as far north as bald eagles winter in the Midwest. Most of the bald eagles coming from central Canada and the northern plains states tend to fan out farther south. The young birds seem to wander almost aimlessly, heading for areas of open water that promise fish. Some of our banded eagles from the Chippewa have turned up as far afield as Alabama and Texas.

In winter in the Midwest from 900 to 2,900 young and adult bald eagles assemble along rivers and streams and in waterfowl refuges. In cohorts of from 3 to 200, they congregate below the 26 Mississippi River dams from Hastings, Minnesota, to St. Louis, Missouri. There they feed on dead fish killed passing through hydropower turbines and canal locks.

From 70 to 180 eagles spend the winter

near the Alice L. Kibbe Life Science Station, across the Mississippi from Keokuk, Iowa. The birds fish below lock and dam No. 19 during the day, mostly for gizzard shad, and roost at night in a four-acre, tree-sheltered hollow in the adjacent hills. It proved an ideal place for my student-assisted studies.

In 1970, through the efforts of the Illinois Chapter of the Nature Conservancy and Dr. John Warnock of Western Illinois University, Cedar Glen Eagle Roost became the first protected winter roost area. Since then four similar areas have been preserved along the Mississippi and Missouri Rivers.

All too little is being done to clean up our major rivers, from which the overwintering eagles take their food, yet conditions for eagles in some portions of North America remain

Earthbound eagle, in the U. S. Fish and Wildlife Service's captive breeding program, exercises at Patuxent Wildlife Research Center in Maryland (**below**). Her eggs or young will be placed in nests in the Northeast where human encroachment and stream pollutants have caused a decline in the birds' reproductive rate. Other projects include a computer data bank at the National Wildlife Federation in Washington, D. C., that compiles bald eagle information. The eggs of wild birds are again hatching at near-normal rates in Maine and the Chesapeake Bay area, an improvement that researchers ascribe in part to the 1972 ban against DDT, though they note that proof is lacking. Much remains to be learned in the effort to safeguard our national bird.

Rare sight in the lower 48 states, bald eagles stage an impressive fall gathering along a salmon-spawning stretch of Lower McDonald Creek in Glacier National Park (**left**). Selected groups of visitors may view them, but only from a blind (**above**) to minimize disturbance. From here, the eagles will probably disperse southwest for the winter.

good. For example, along a 2.4-mile stretch of Lower McDonald Creek in Glacier National Park in Montana, more than 300 bald eagles gather each November to feed on dead and dying kokanee salmon.

Thousands of Eagles Still Congregate

Perhaps the most impressive of all eagle gatherings takes place each fall along the Chilkat River in southeastern Alaska. Here several thousand birds convene from October to December to feed on several species of salmon that die after spawning (preceding pages). Most of these are eagles that probably nest along the isolated, tree-lined coast. Salmon are attracted by the warmer waters of the Chilkat, which remain open after many other streams have frozen.

Seeing such gatherings can lull a watcher into complacency. Actually, the future survival of the bald eagle hangs in the balance. This wonderful bird occupies a precarious position in the environment, because of its close ties to both land and water.

To help conserve the species, we have to learn much more about its movements. More winter tagging of adults is needed, to give us clues to migration routes to the nesting grounds. We simply don't yet know the seasonal travel routes that most eagles follow.

Illegal shooting, chemical poisoning, logging and other habitat destruction—these threats to eagles all stem essentially from people. Man holds the key that can lock the bald eagle into extinction, or keep it free to thrive and multiply. □

The Gulf's Workaday Waterway

By GORDON YOUNG
SENIOR EDITORIAL STAFF

Photographs by
CHARLES O'REAR

"YOU KNOW, this waterway is like a mule," Captain Jimmy said. "Slow, sort of unbeautiful, and it can give you unpleasant surprises now and then. But it's—well, useful."

True. And Captain Jimmy should know. He started towboating on the Gulf Intracoastal Waterway at age 12, keeping an eye peeled for the truant officer when he went ashore. He once owned nine towboats plus seven helicopters and a passel of waterway-connected businesses in Sabine Pass, Texas.

He's inclined to sniff at that other waterway—the almost glamorous one—which carries yachts back and forth along the Eastern Seaboard. His waterway is more a work route, stretching almost 1,200 miles between Florida's panhandle and the Mexican border (map, pages 206-207). When it was conceived in 1905, backers hoped to see traffic grow to five million tons of commerce a year. Today, its yearly load approaches *one hundred* million tons, and both the waterway and its traffic are still growing.

Some call it a canal; actually, it is a varied blend of man-made ditches and winding bayous, quiet rivers and windswept bays. Now and then, the waterway "goes to sea," becoming a buoy-marked path offshore in the Gulf. But even there, islands a few miles

Feathered wake of hungry gulls clamors after a shrimper's pickings in the rich seafood nursery of Galveston Bay. From the

Florida panhandle to the Mexican border a string of bays, natural channels, and man-made canals offers barge tows (background) and small craft a protected passage. Booming waterway traffic has quickened the pace of growth and alarmed environmentalists.

farther out help shield marine traffic from the threat of Gulf storms.

Residents along the Gulf have learned to live with that threat. Last fall, when hurricanes flirted with the Texas and Louisiana coasts, people boarded up their homes and fled inland, to wait in safety. Many still vividly remember Hurricane Audrey which, two decades earlier, had blasted ashore in southwest Louisiana. It hit near Cameron, a coastal town along the waterway, with sustained winds of 130 miles an hour and towering tides that all but destroyed the town. More than five hundred died.

Dr. Cecil Clark of Cameron and his wife, Sybil, who lost three children to the storm, told me of its fury. For two days Sybil had clung to floating wreckage until rescued by a passing boat, while her husband—working to keep storm survivors alive in the ruined town—wondered about her fate (page 212).

"Only two large buildings were relatively undamaged," Dr. Clark said. "The courthouse, which became our hospital, and the icehouse, which became our morgue. The waters rose over the tops of telephone poles."

In spite of such killer storms, people have been drawn to these Gulf shores because they offer not only a rich source of food but also access to world trade routes.

One day in Carrabelle, Florida, not far from the waterway's eastern end, I wandered along the dock talking with old-timers. They told of the big sailing ships that used to anchor offshore, when this was a major lumber port and vessels from Africa and the Mediterranean sailed in for Florida pine. They talked of townsfolk going to sleep at night to the sound of creaking winches, as ships' crews hauled ballast rocks out of the holds and dumped them in the bay to make room for cargo.

The ships stopped coming when the sawmills failed. But the old piles of ballast rocks are still out there. They're underwater reefs

Mixing pleasure and business, the Gulf Waterway hosts small boats as well as tugs (**above**) that push and pull nearly one hundred million tons of cargo a year. A fourth of that is crude oil pumped from huge fields on the Louisiana and Texas coasts and from offshore wells—making the passage from New Orleans to Port Arthur the busiest section of the waterway. Pleasure boaters and fishermen also benefit from the combination of sheltered waters and easy access to the open sea. Charter fishing boats line the pier at Panama City, Florida, where a crewman takes time out for a haircut (**above, left**).

now, loaded with fish. Carrabelle's tourist industry wouldn't be worth nearly as much without them.

During World War II precious fuel oil moved by barge from Texas refineries to Carrabelle, where it was piped north. Those barges would have been easy pickings for German submarines lurking in the Gulf, but in the sheltered waterway the tows were safe.

Sailors Become Skimmers on SES-100B

When you sail farther west along Florida's panhandle, you find the towns becoming larger and more polished. Near Panama City I cruised through St. Andrew Bay, a part of the waterway, aboard the SES-100B. The hundred-ton experimental vessel can reach speeds of more than 90 knots as it skims on a bubble of air trapped between its catamaran-type hulls and the flexible "skirts" at each end. We moved out into the Gulf to practice tight turns at 65 knots. It was an eerie sensation, for the 75-foot craft rode smoothly over a two-foot chop.

The SES-100B is just one of the strange new machines being tested at the Naval Coastal Systems Laboratory. The lab sprawls on 650 acres of land near the waterway.

"Naval personnel, civilian and military, work as a team here," commanding officer Capt. James V. Jolliff told me. The lab is staffed largely by civilian scientists, but the Navy has also assigned various military tenants. The lab played a significant role in clearing the Suez Canal and Viet Nam's Haiphong harbor of mines. Also, the three Navy Sealabs—underwater habitats—were developed here, and Sealab crews trained here.

Captain Jolliff's mission includes not only diving and salvage development, amphibious landing technology, and improvement of mine countermeasures, but also other, less warlike, pursuits. I watched as scientists experimented with sonic bursts that tear bacteria apart—useful perhaps, someday, to treat effluent from Navy ships.

I cast off from Panama City aboard a big, luxurious sportfisherman, *Scorpio II*, headed west. Bob Zales, *Scorpio*'s owner, is a transplanted Midwesterner who once served aboard cargo ships on the Great Lakes. Here on salt water he wears two captain's hats. When he's not skippering *Scorpio* on charter trips, he captains a supply ship that services offshore oil rigs.

Either way, his wife usually is a crew member, though she, too, holds a captain's certificate. "Just call me able-bodied seaperson Clara Zales," she told me with a grin. "I got that captain's license mostly to prove to Bob that I could do it."

While we cruised through little more than ripples, I tuned *Scorpio*'s marine radio to conversations between shrimp boats struggling with ten-to-twelve-foot seas out in the Gulf and counted my blessings.

Captains Talk in Toots

Each time an eastbound tow approached ahead, Bob reached not for the boat's horn button but for the radio microphone. "One whistle, Cap'n?" he asked cheerily. Always the reply was affirmative.

"It's a holdover from preradio days," he explained. "One toot means pass to starboard; two toots means pass to port."

"And three toots?" I asked.

"That means everybody back engines and sort things out before going ahead."

Frequently Bob queried passing boats about the traffic around the next bend. The waterway is only 125 feet wide.

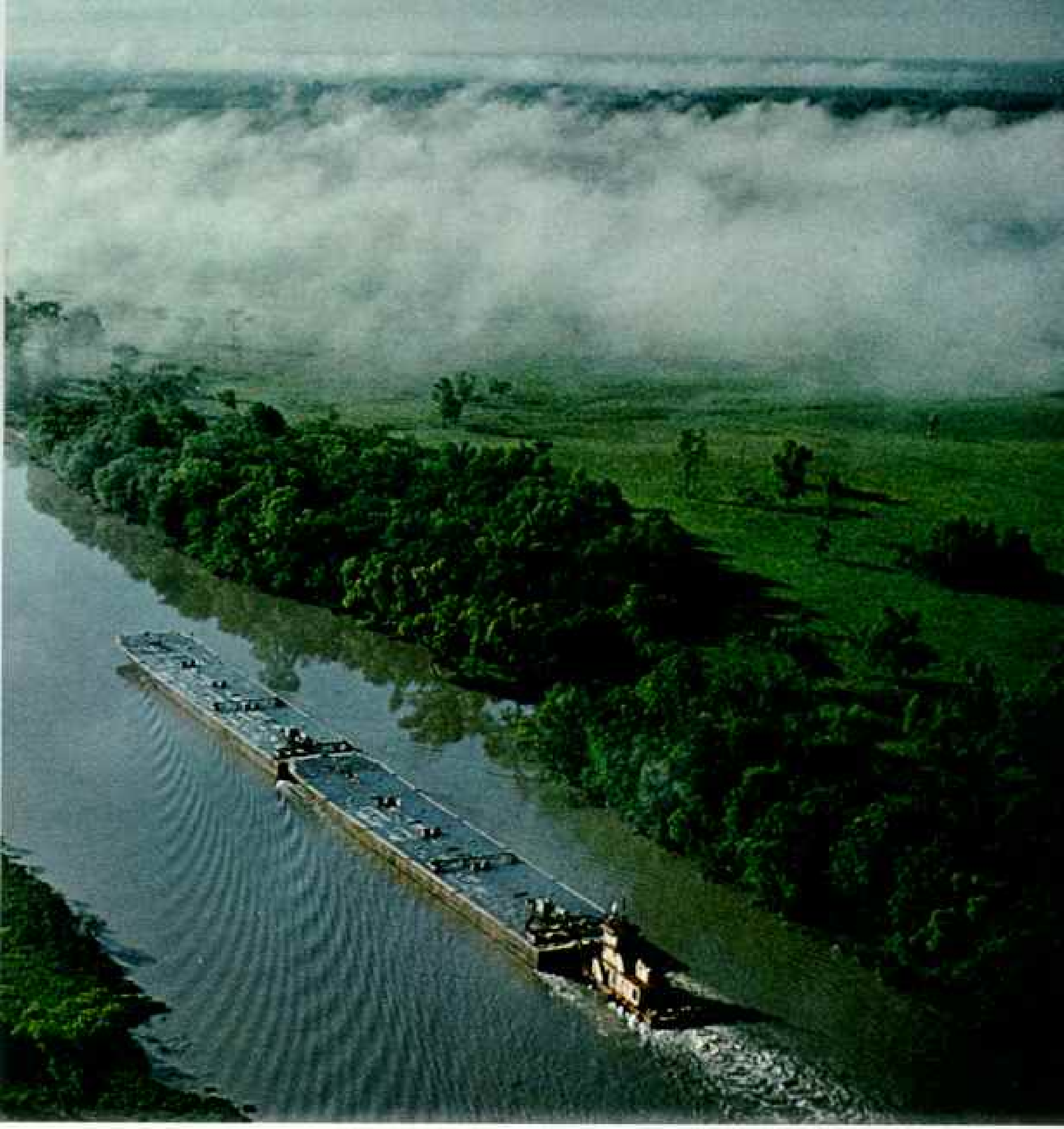
"The bottom is dish-shaped," he pointed out, "so we can't get too close to the banks. I like to know what's coming."

The banks climbed steeply on either side of us; here they served as dikes to keep silt from washing into the channel from surrounding lowlands. Then, abruptly, the waterway changed character. The earthen banks retreated, and we entered broad Santa Rosa Sound, picking our way from channel marker to channel marker toward Pensacola.

Few U. S. cities *(Continued on page 208)*

Ready for takeoff, a contestant at the 1976 National High School Championship Rodeo in Sulphur, Louisiana, settles astride 1,500 pounds of outraged bull. Fairs and festivals reveal the polyglot origins of Gulf Coast residents. A Greek Orthodox priest blesses shrimp boats in Galveston. New Orleans' Mardi Gras takes Gallic *joie de vivre* to the limit. And Brownsville jumps with the beat of fiesta beside the Rio Grande.

Safe from capricious waters of the open Gulf, a tug pushes its tow through Louisiana bayou country (**above**). Throughout the 1,200-mile-long Gulf Intracoastal Waterway, shown in blue, boat captains are assured of a channel never less than 12 feet deep and 125 feet wide. The waterway was completed in 1949 with final dredging of the section behind Padre Island.



IANA
Mississippi River
Baton Rouge
MISSISSIPPI
Tombigbee
Montgomery
ALABAMA
Atchafalaya
Franklin
Morgan City
New Orleans
Pass Christian
Biloxi
Mobile
Mobile Bay
Bon Secour
Pensacola
Santa Rosa Sound
Harvey Lock
Pensacola Naval Air Station
Pensacola Bay
Naval Coastal Systems Laboratory
Panama City
Tallahassee
St. Andrew Bay
FLORIDA
Apalachicola
Carrabelle
GEORGIA
0 KILOMETERS 100
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have seen more battles, or had more owners. Since the first attempt at settlement more than four centuries ago, five different flags have flown from Pensacola flagstaffs: Spanish, French, British, Confederate, and the Stars and Stripes.

The wars are over now. In fact, as we docked, angels were winging overhead: The Blue Angels, members of the Navy's crack aerobatic team, were going through peaceful and precise maneuvers as if glued together. Finally, they slanted downward toward the Pensacola Naval Air Station, their home base.

Still, echoes of war linger on the Gulf Intracoastal Waterway. We cruised next day up Mobile Bay, where in 1864 Adm. David Farragut dared—and damned—Confederate "torpedoes"—which actually were anchored mines. One of them claimed the Union ironclad *Tecumseh*, whose hulk still rests on the muddy bottom.

Our own damns were aimed at the vicious Gulf chop that intruded into the bay. I braced myself on *Scorpio*'s gyrating flying bridge and stared up in envy at the big freighters gliding serenely by.

Mobile Vies for New Orleans' Trade

As we motored up the Mobile River, I noted the well-maintained look of the 300-million-dollar Alabama State Docks, with berths for 34 freighters. Mobile, Alabama, can well afford to keep its warehouses painted. The port handles more than 32 million tons of seagoing cargo annually and services heavy traffic from a river system that stretches almost to the state's northern border.

"When the Tennessee-Tombigbee Waterway is finished," a Mobile civic booster commented, "it will hook us into the network of mid-America's rivers, too. That will be a great day for Mobile—but not for New Orleans. We'll start getting some of its cargoes; steel from Pittsburgh, wheat from Ohio, corn from Kentucky."

Mobile's boosters suffered a rude surprise last year when President Carter, citing the waterway's mounting construction costs, recommended that the "Tenn-Tom" project be halted. He later changed his mind.

A midget among giants, *Scorpio II* motored past the huge freighters as we sought a berth for the night. Our timing couldn't have been better, for *Jamelle III*, Alabama's state yacht,

was just leaving her pier, heading into dry dock. At the invitation of the harbor master, we tied up in her place. A Greek freighter was on one side, a Yugoslav ship on the other.

I went ashore to pay a call on the United States Army Corps of Engineers, whose Mobile office administers the eastern end of the waterway. Affable public affairs officer John Jones greeted me with a flood of facts and figures about the waterway.

"Each year, transportation savings on the Gulf Intracoastal Waterway exceed the *total* cost of building and maintaining it," he said. "If a shipper had to use a more expensive form of transportation, he'd have to charge consumers more for his product. That's what I mean by transportation savings."

Railroad executives have long been frustrated by the low rates of waterborne commerce. Unfair competition, they say, leading a fight to impose "user fees" on waterway traffic. More and more Congressmen seem inclined to agree.

"No other controversy will get a waterman's blood pressure up as fast," John said. "Traditionally, use of the nation's waterways has always been free."

I suggested to him that the Corps of Engineers might be having their own blood-pressure problems these days, in view of widespread environmental concerns.

John gave a noncommittal shrug. "This waterway probably could never be *started* today, considering the environmental pressures that exist. But the waterway *is* built, and its cost-benefit ratio is outstanding. Still, we find it harder—and much more expensive—to make changes nowadays."

Sleek Lady Seems Out of Place

A few days later *Scorpio II* was under way again. From here to Galveston, marine traffic would be about five times as heavy.

Scorpio's shining varnish and brightwork had brought no curious stares thus far, for we had been just one yacht among many on the eastern end of the waterway. But as we approached New Orleans, her gleaming topsides seemed as out of place as a mink-clad tourist in a factory district. The Gulf Intracoastal Waterway had become a working canal, lined with industrial plants. Workboats and barges were our neighbors here.

At New Orleans I said my good-byes to

Elegant turnstiles, streetlamps in Franklin, Louisiana (**facing page**), are turned sideways each fall to accommodate wide loads of sugarcane, the area's main crop. Cane country is Cajun country, where descendants of French farmers banished from Nova Scotia by the British in 1755 still speak a distinctive dialect of the mother tongue. Early French colonizers of the coast left a legacy of names like Bon Secour, Alabama, where a bridesmaid (**below**) pauses under Spanish moss.

Some like it hot—and few foods are hotter than the peppers of Avery Island. Steeped in oak kegs for three years at the McIlhenny factory on the isle, they are then mixed with vinegar (**right**) to become the most active ingredient of Tabasco pepper sauce—frequent companion to boiled crayfish (**above**) and other Cajun delicacies.

The ocean rose in fury when Hurricane Camille struck the Mississippi coast in August 1969. Gusts of 200 miles an hour and a storm tide 25 feet above normal reduced a proud mansion in Pass Christian (**above**) to muddy rubble (**above, right**).

Dr. and Mrs. Cecil Clark (**below**) lost three children to Audrey in 1957. Mrs. Clark spent two days in the waves that demolished their home in Cameron, Louisiana, while Dr. Clark, uncertain whether she had survived, continued treating storm victims.

Captain Zales and Clara and moved ashore to wait for a passing towboat.

"Houston and Mobile can argue about who ranks number two—but there's no doubt at all that New Orleans is the number one tonnage mover on the Gulf." So said Col. Herbert R. Haar, Jr., associate director of the Port of New Orleans. "We get barges from as far away as Minneapolis and Montreal. And more than 3,800 foreign ships tied up at our public docks last year. The 'Total Port,' we like to call it."

The claim doesn't seem extravagant when viewed from his office window, 23 stories above the Mississippi. Together we looked down at Old Man River twisting his way among endless piers and bulkheads, numberless ships and barges. The Mississippi and its tributaries—including the Gulf Waterway—encompass 12,500 miles of commerce-bearing waterways, and this port is the hub.

"LASH and the somewhat similar Seabee system are revolutionizing cargo handling," Colonel Haar told me. "With less than half the work force, we can load twelve times as much per hour, using those two new systems."

LASH (standing for "lighter aboard ship") and Seabee each utilize special barges

DENNIS HOLSTON (LEFT AND ABOVE)

that are designed to be carried aboard a ship. The first system uses a shipboard crane to lift its barges aboard. Seabee barges are floated onto a submersible elevator at the stern of the mother ship and then rolled onto the deck. Faster loading is not the only advantage. With sealed barges cargo damage is reduced, as is the risk of pilferage.

Consider this transportation problem: You have 20,000 tons of Texas soybeans that must be moved to Cologne, West Germany. The soybeans are loaded into LASH barges at Corpus Christi. A towboat moves the barges along the waterway to New Orleans. There they are lifted aboard the mother ship, which steams directly to Rotterdam. There the LASH barges are off-loaded. A towboat moves them up the Rhine River—and the soybeans poured in at Corpus Christi, Texas, are scooped out at Cologne.

"By the end of this century," Colonel Haar predicted, "our port activity here should be one-third LASH and Seabee, one-third conventional containerized shipping, and the rest the traditional 'break bulk' type of cargo."

Later, as I traveled farther west on the Gulf Intracoastal Waterway, I saw many tows made up of the boxy LASH and Seabee barges. Their wakes, I reflected, could well be the wave of the future for America's inland and coastal waterways.

Residents Fight Expansion Plan

Because the central section of the Gulf Intracoastal Waterway is so heavily traveled, there is continued pressure to improve it. In fact, Congress authorized an enlargement between New Orleans and Houston back in 1962. Part of the waterway was to be widened to 200 feet, and most of it to be deepened to 16 feet. But the expansion never happened.

A Louisiana homeowner whose house fronts on the waterway expressed the prevailing lack of enthusiasm for the project. "They'd want part of my yard to widen the canal—plus local tax money to move the pipelines under the thing. There'd be no benefits at all to this community—just more barges coming by."

Now talks are under way for the Federal Government to pay much of the cost. That should get the expansion project moving.

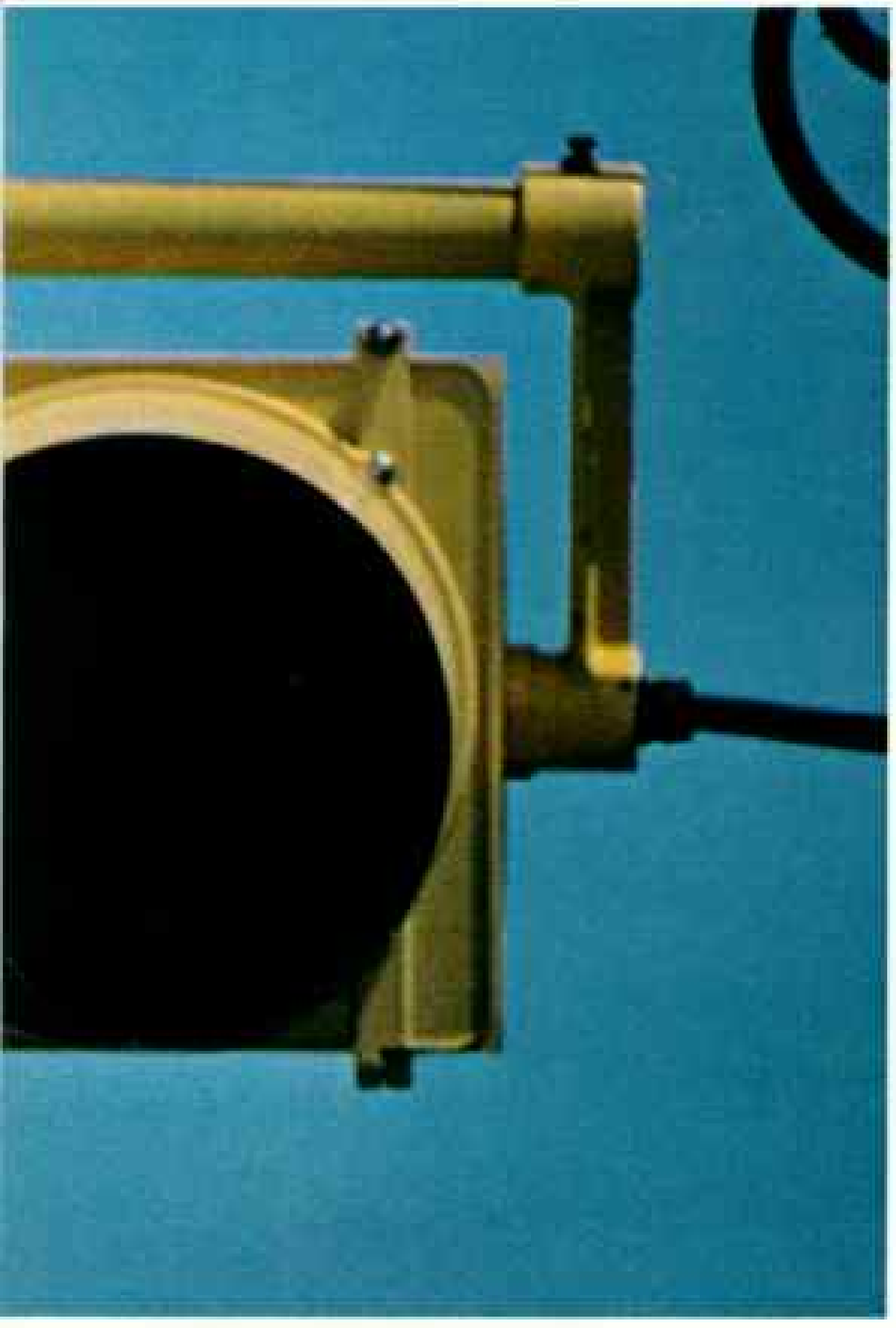
Still, even if the money were available, progress would be slow, for there are many groups to be satisfied—municipalities, counties (in Louisiana *(Continued on page 217)*

Vintage notes of traditional New Orleans jazz slide from the trombone of Preston Jackson (**right**). He plays with a loose-knit family of veteran musicians known as the Preservation Hall Jazz Band, who gather nightly in the city's French Quarter to perform—and preserve—the freewheeling style of music that was born there.

Another kind of Jazz, New Orleans' professional basketball team, as well as the football Saints, plays in the Superdome (**above**), the world's largest multipurpose indoor arena. Entertainment is just one of the city's assets. Its docks, receiving goods via the waterway, Mississippi River, and Gulf of Mexico, handled 150 million tons last year, making the port second in the United States only to New York.

NATHAN BENN

Eye-stopping silhouette of an opportunistic nest builder (**above**) greets motorists near Port Arthur, Texas. Songbirds, ducks, and geese in huge numbers winter around the Gulf. Warm waters take the sting out of winter winds, and shirt-sleeve weather comes to Galveston long before its Oleander Festival in May (**below**). The flower was introduced in Galveston in 1841. Today it lines the streets of the island city that each year draws some four million visitors.



they are called parishes), hunting and fishing clubs, environmentalists, and others.

Environmentalists are generally opposed to expansion of the Gulf Intracoastal Waterway. But J. Ross Vincent, president of the Ecology Center of Louisiana, takes a pragmatic view: "I'm not opposed, per se, to expansion—but I'm very skeptical about what is being planned. I'm against any project that would harm the wetlands. They are Louisiana's most important asset, and waterway dredging is their most destructive element."

With us that day was James D. McGovern, Jr., then director of the Louisiana Wildlife Federation. "Take the problem of saltwater incursion," he said. "Any time you cut across a stream, you increase the salinity from the Gulf. Salt water kills freshwater plants along the banks, and erosion starts before saltwater plants have a chance to get going. Deepening the channel also causes increased salinity; and, in the bargain, it may stir up harmful pollutants down there."

Environmentalists are represented at corps hearings, but Mr. Vincent feels this is not early enough. "By the time public hearings are held, it seems to us that the engineers, local officials, and key members of Congress are largely committed, and most of the decisions have already been made."

Mr. McGovern—known to most of his friends as "Muskrat Jim"—recalled a battle won. "Ten years or so ago, shipping interests were pushing hard. They wanted the waterway wide and deep enough to let ocean freighters use it. Imagine what *that* would have done to the wetlands."

Where Push Comes to Shove

Patches of cottony fog sailed slowly down the Mississippi next day as I waited for my ship to come in. She was the *Rebel Spirit,* 45 feet of stubby pushing power, designed with one purpose in mind: to move barges.

There was no mistaking her when she appeared out of the rain and fog: A Confederate flag was emblazoned on her blue-and-white pilothouse. I jumped aboard, leaving the bustle of a big-city port to enter the slow-motion world of towboating.

It is a self-contained life. Two shifts work the *Rebel Spirit;* while one is on duty, the other sleeps in the small cabins below deck.

Judge Harrell, relief captain, was at the wheel. As we pushed our big barge loaded with Kansas wheat down the river, I asked him how long he'd been towboating.

"I started decking back in 1968," Judge said. "Worked my way up to front-end man, and finally made captain."

At dusk we reached Harvey Lock, one of two entrances to the western end of the waterway. Nonchalantly, Judge shoehorned towboat and barge into the lock and waited with engines idling until the gates ahead opened. Then the long, monotonous trip proceeded again. At three and a half knots, we chugged past New Orleans' industrial outskirts until we were cruising between wooded banks.

"What kind of wildlife do you see on these trips?" I asked.

"Oh, lots of gators, deer, muskrats, nutrias, otters, and snakes," Judge replied. "Sometimes water moccasins come aboard, so watch where you walk. Last week a big one somehow got on deck through the scuppers. Scared hell out of the engineer. He killed it and threw it overboard."

Fog patches continued to plague us that night, but shortly before dawn a chilly "blue norther" whistled in, causing an abrupt drop in temperature. We were among the few Gulf Coasters who welcomed it, for it blew the fog away at last.

Petroleum and petroleum products account for most of the traffic on the Gulf Waterway. We passed barges bristling with pipes and valve wheels. "Some of the barges cost more to build than this towboat," Judge remarked.

In most of Louisiana the waterway weaves inland, following bayous connected by man-made canals. Here alligators and other wildlife far outnumber people. Each time we passed another tow, I was reminded anew of what a tight, self-sufficient world a towboat is. Eating, sleeping, working—leading lives that seldom touch the land moving past.

At Morgan City, Louisiana, the waterway

Delicate residents, roseate spoonbills, great snowy egrets, and other water birds find sanctuary in the marshes of Sydney Island, built with soil dredged from the

loses its tranquillity. Barge tows chug southward from Baton Rouge along a spur canal to join the main channel. Oil workboats shuttle down the Atchafalaya River, carrying supplies and crews for Gulf offshore rigs.

But the Atchafalaya brings problems as well as business. "Upstream, it's been widened for drainage," Morgan City's mayor, Russell "Doc" Brownell, told me. "When spring comes, we can get a flood of water coming down. We're at the small end of the funnel here—nobody's worked on the channel downstream to let all that water and silt go by. All we can do is organize sandbag parties and try to keep from being flooded again."

He gave an explosive sigh. "We'll keep butting heads with the corps and the environmentalists about it until something gets done."

Leave Louisiana's last arrow-straight canal, swing southwest into the Sabine River, and

waterway. But environmentalists fear that further dredging will harm the wetlands.
Citizens' groups have successfully opposed plans to extend the channel in Florida.

you approach the world of man again. Port Arthur: Its skyline of refinery towers and tall silver chimneys spouting blue smoke introduces you to the Texas stretch of the waterway. Stare out into the Gulf, and you find another skyline out there—offshore oil rigs.

In Port Arthur I paid a call on one of Texas' truly good ol' boys, Capt. Jimmy Lee. This was home port to the *Rebel Spirit*, and Captain Jimmy was her owner. In addition to his towboats and helicopters (each bearing that Confederate flag on its side), he owned an ice plant, fuel dock, offshore communications station, grocery store, liquor store, and assorted other enterprises. In his spare time he headed the Sabine Pass Port Authority.

"Back when I started towboating almost 35 years ago," Captain Jimmy said, "we towed our barges at the end of a hawser. Then some push boats turned up from the Mississippi River, and we saw that pushing beats pulling."

Captain Jimmy wants no man to doubt that his heart belongs to Dixie. He took me on a brief tour of Sabine Pass Battleground State Historical Park, where in years past he has led a cannonading, rebel-yelling reenactment of the Civil War battle. The park commemorates the Confederate forces under the command of Lt. Dick Dowling, who repulsed a Union landing attempt.

Jimmy's grandfather was the park's first caretaker, and Jimmy does his bit to maintain the battle's proper place in the annals of the South by restaging it.

"I love history and proud men," said Captain Jimmy.

Rare Cranes Unruffled by Boats

From Galveston the Gulf Intracoastal Waterway meanders southwest toward the Mexican border, sometimes at sea, where it is protected by sheltering islands.

It dips inland to cut through the marshes of Aransas National Wildlife Refuge, winter home of the whooping crane.

"The channel used to run outside the refuge," E. Frank Johnson, refuge manager, told me. "Today, there is talk of widening and deepening our stretch of the waterway. I'd like to see that old channel reactivated and this one abandoned. There's no place along the banks for the dredging spoil, anyway."

The magnificent white cranes are accustomed to boat traffic, I learned. They feed in

Sailors ride the high side of a catamaran on Pensacola Bay (**above**), which carries a brisk traffic in pleasure craft. America's quest for the sun has brought a construction boom along the Gulf. New hotels and condominiums like the Bahia Mar complex (**right**) spike the southern end of Texas' Padre Island. Northward along the narrow barrier island lie eighty miles of dunes and unbroken beach barred to developers. The Padre Island National Seashore was set aside in 1962 to remain in its natural state. More than shells are found along the beach —three Spanish treasure ships foundered on this "graveyard of the Gulf" in 1554. All have been partially salvaged.


18155

the shallows along parts of the waterway. "But a bad spill from an oil or chemical barge could kill the crustaceans on which they feed," Mr. Johnson said.

Are the cranes coming back from near extinction? Mr. Johnson had bright news. "A few years ago the crane count was down to 49. But last winter's count was the highest on record—69, including 12 young ones."

In mid-October—before the cranes are due to arrive from their Canadian summering grounds—the offshore oil rigs nearby are required to close down for half a year. And the Army Engineers cease any dredging operations under way in the refuge area. To me, it is heartening, this sudden silence of giants. All that quietude, so that 69 birds can occupy their winter home in peace.

Sea Turtles Find a Haven

Beyond Corpus Christi, last major port on the Texas coast, the Gulf Intracoastal Waterway hides behind Padre Island. There are nature lovers at work here, too.

While some islanders work to attract tourists, others strive just as hard to lure turtles. A number of eggs have been transported from a Mexican beach—the only known hatchery of Atlantic ridley sea turtles—and buried on a remote Padre Island shore. Eventually, some hatchlings may return there to lay their own eggs.

Ila Loetscher—South Padre's "Turtle Lady"—is known island-wide as a soft touch for a shellback. Any ailing turtle that finds its way to local shores probably will end up as one of her houseguests.

She had ten patients in her home when I visited her. Nine were splashing happily in plastic wading pools; the tenth, recovering from a near drowning while trapped in a shrimp net, lay on a pile of Ila's cushions. When the Turtle Lady passed, it seemed to give her a heavy-lidded stare of gratitude.

"All I can give them is tender loving care," Ila explained. "Dr. Porter of the zoo comes here to treat them."

It takes at least seven years for a female turtle to reach egg-laying stage, and the South Padre hatchery is only 14 years old. Still, a few females have come back to nest, so the prognosis is promising.

A Coast-to-Coast Waterway?

Optimistic adherents of the waterway would like to see it extended into Mexico, perhaps as far as Veracruz. And they wouldn't mind if the *other* end of this water road was lengthened until it connected with the waterway that runs up our Atlantic coast. But those dreams may never come true.

At Harlingen, Texas, not far from the Mexican border, I roamed through a kind of outdoor museum of World War II aircraft, all in flying condition, belonging to an organization dubbed the Confederate Air Force. Fighters and bombers, American and German—the planes took me back to the 1940's, when I was a young naval air cadet.

And from the cockpit of one of them—a silver-winged time machine known as an AT-6—I took my last look at the Gulf Intracoastal Waterway.

It was an olive-colored ribbon in the blueness of Laguna Madre. Just to seaward stretched Padre Island, built by the waves and crowned by wind-formed dunes. From my high vantage point, I watched a barge tow inching along the channel. Not far from it, a flight of ducks settled into the marshes to feed.

A comforting sight, those feeding ducks. But a cause for concern, as well. Towboats are getting more powerful engines, to push larger tows. Plans to widen and deepen channels are already well advanced. Because the Gulf Intracoastal Waterway is already such an economic success, industry strives to make it even more successful.

If the waterway is to grow in a rational way, with minimum impact on an already altered coast, I hope that industry and engineers will notice the quack of ducks over the growl of tugs, and hear the harmony. □

As if to fire the sun, heat from stacks of a massive petrochemical complex at Texas City shimmers into evening. Growing industry, spurred by the favorable cost of barge transport, has brought new prosperity to many towns along the reach of the waterway. But the question remains: Can more and more barges ply the Gulf's wetlands and leave them unspoiled in their passing?

The Living Dead Sea

By HARVEY ARDEN
NATIONAL GEOGRAPHIC STAFF

Photographs by
NATHAN BENN

GETTING TO THE BOTTOM of it all is not so difficult. If you happen to be in Jerusalem, as I was one rainy November, you need only hail a taxi and ask to be taken to the Dead Sea —the lowest spot on the surface of the earth.

It's only a half-hour drive from Jerusalem's 760-meter spiritual height to the Dead Sea's netherworldish shore—399 meters (1,309 feet) *below* sea level. Snaking through sere Judaean hills where Abraham and Jesus once walked, you pass a sign that says "SEA LEVEL" in Hebrew, Arabic, and English. It may vaguely occur to you that there aren't too many places in the world where you can dip below sea level in a taxicab and keep going, but such thoughts are now shunted out of mind by the fact that your ears have begun to pop, your head is ringing slightly, and the wool sweater you'd snuggled into back in Jerusalem's 10°C (50°F) chill has become uncomfortably warm.

Your Israeli driver, Shlomo, informs you that this new-looking road was modernized by Jordan's King Hussein just before the six-day war of 1967 brought the West Bank under Israeli military control.

"Nice of the king," Shlomo remarks wryly, and you slouch back in your seat just a bit uncomfortably at the thought that this is occupied territory. Before 1967 only the

Pendulum of moods swings over the Dead Sea, a pit of brine between Jordan and Israel. Laughter echoes (**facing page**) at Suwaymah, a Jordanian resort. Bleakness more often prevails along the world's lowest shoreline.

Beyond Judaean hills sloping to the northwestern shore of the Dead

Sea, rising vapors veil the mountains of Biblical Moab in Jordan.

southwest quadrant of the Dead Sea belonged to Israel (map, page 231). An Israeli in West Jerusalem, unable to cross into Jordanian territory, had to take an hours-long roundabout drive through Beersheba to get to the Dead Sea. Nowadays, using "King Hussein's road" across the West Bank, it's just a short trip.

"There—there it is!" Shlomo announces. "'Yam Hamelach—Sea of Salt' we call it in Hebrew."

He pulls over, and you get a glimpse of the most unusual body of water on the planet—a wedge of metallic blue green hemmed by rust-colored hills, with the purple mountains of Moab in Jordan for a backdrop.

Off to the left a splash of green brightens the ocher landscape. "That's Jericho," Shlomo says. "Oldest known town in the world. Been there 10,000 years. And that's the River Jordan just beyond, where Jesus was baptized by John. Over there"—he points to some cave-riddled cliffs to the right—"is Qumran, where most of the Dead Sea Scrolls were found. And see those mountains? One of them is Mount Nebo, where Moses died. Joshua then led the Israelites into the Promised Land right down there, across the Jordan above the Dead Sea."

He smiles. "It's easy to believe in the Bible when you come to a place like this."

Ten minutes later you reach the Dead Sea shore at a former Jordanian spa called the Lido. Like most first-time visitors, you cross the salt-encrusted beach to the water's edge, crouch down, poke one finger through the oily-looking surface, then gingerly put it to your tongue.

Arghhh-h! The taste is as strong and stinging as lye. "Worst-tasting stuff in the world!" Shlomo laughs, and you don't argue.

LET A CONTAINER of Dead Sea water evaporate in the sun, and it will still be a quarter to a third full of a whitish residue of salt and other minerals. That's more mineral content than in water from Utah's Great Salt Lake, and seven to eight times as much as in seawater.

This residue has enormous commercial potential. Israel runs a large saltworks at Sedom on the southwest shore (right), extracting immense quantities of potash, magnesium, bromine, and other Dead Sea treasures. Jordan is now constructing a similar plant.

Harvest of chemicals from the saltiest body of water on earth buoys the Israeli economy. At the Dead Sea Works at Sedom, an exhaust pipe (**right**) spews noxious gas during the production of bromine, used in dyes, pharmaceuticals, and gasoline. The plant lies in the supposed vicinity of Biblical Sodom and Gomorrah. Plastic sheets (**below**) cover a shipment of potash, a life-nourishing fertilizer. Convicts were once offered parole to work in this oppressive environment, where summer temperatures often exceed 40°C (104°F). Most employees today commute from cities in the nearby Judaean hills.

The water's density enables you to float on your back without effort, as if on a giant water bed. Since the surface water often reaches body temperature, it's a bit like floating in some primordial amniotic fluid. You feel weightless, almost sensationless. But one drop in your eyes and your senses return with a vengeance. A thin white crust forms on the skin after you swim, and it's wise to shower quickly. Even then, the skin tingles for hours.

Fish can't survive in these hypersaline waters. Those washed in from feeder streams during floods soon float belly up in putrefying masses along the shore. Without fish, of course, there are no fishing boats. In fact you see few craft on the sea. Pleasure boating is simply not much of a pleasure here: The air is too hot, the sun is too bright, and the water enervates more than it refreshes if you break the monotony by taking a dip.

DESPITE ITS NAME, the Dead Sea is not a sea at all. It's actually a lake with a deep northern basin 331 meters (1,086 feet) deep, and a smaller southern basin averaging only about two meters deep. The two, totaling 75 kilometers (45 miles) long by 15 kilometers (9 miles) wide, are joined across a now submerged neck of land that could be crossed on foot in Biblical times, when the water was lower.

The deep northern section—almost as deep again as its surface lies below sea level—is cupped in the bottommost cranny of that colossal fracture in earth's crust called the Great Rift. Since it has no outlet, you'd think the Dead Sea would eventually fill up with the inflow from the Jordan and other streams. But, in fact, evaporation caused by dryness and heat—routinely topping 40°C (104°F) in summer—roughly balances inflow.

In recent years, after rising earlier in this century, the water has been slowly dropping again due to climatic changes and diversion of the Jordan's headwaters for farming. Israel now has a rather amazing plan to create a channel and tunnel more than a hundred kilometers long that would pour Mediterranean water into the Dead Sea. This could help control the Dead Sea's level while providing a major source of hydroelectric power.

Nor is the Dead Sea "dead." While it's true that fish can't live in it, scientists have discovered in its waters a number of halophilic —salt-loving—microorganisms. One of them, *Halobacterium halobium*, has recently been found by U. S. scientist Dr. Walther Stoeckenius to yield a purple pigment that is the only known biological substance other than chlorophyll capable of photosynthesis—the conversion of sunlight directly into energy.

It works less efficiently than chlorophyll,

"Fresh from the holy stream!" A Jordanian fisherman displays the day's catch of carp from the River Jordan, chief tributary of the Dead Sea. Fish die almost instantly when washed into the Dead Sea's supersaline waters, where only microorganisms survive.

Dead Sea

Not a sea at all, but a landlocked salt lake 75 kilometers long by 15 kilometers wide, the Dead Sea lies 399 meters below the surface of the Mediterranean, which brims only 75 kilometers away. The basin is a northeastern extension of the East African Rift, or Great Rift, a system that includes the Red Sea and reaches as far south as Mozambique.

Elevations in meters (black) feet (red)

∴ Ruin or archeological site

0 KILOMETERS 20

0 STATUTE MILES 20

BATHYMETRIC DATA DERIVED FROM "THE DEAD SEA GEOPHYSICAL SURVEY, 1974," BY DAVID NEEV AND JOHN K. HALL, JERUSALEM: GEOLOGICAL SURVEY OF ISRAEL, 1974

DRAWN BY ELIE SABBAH, COMPILED BY OLIVER G.A.N. PAYNE
NATIONAL GEOGRAPHIC ART DIVISION

Cross section below

Deep northern segment of the Dead Sea plummets almost as far below the surface as the surface is below sea level. Periodic fluctuations are credited to climatic and geologic factors as well as to diversion of the Jordan's waters for agricultural purposes.

Shallow southern segment averages only two meters deep. In Biblical times it was probably dry; traffic across a ridge extending from Al Lisan Peninsula to what is now the western shore could be watched from Herod's fortress atop Masada.

BELOW SEA LEVEL

KING HUSSEIN BRIDGE (ALLENBY BRIDGE)

Mount of Temptation 301 +489

Jericho

Traditional place where Jesus was baptized

Mount Nebo

Suwaymah 803 +2,631

Bayt Haarabah

Jordan

The Lido

Madaba

Khirbat Qumran ∴

Wadi Qumran

Jerusalem

Bethlehem

Dead Sea's greatest depth below sea level −730 −2,395

Callirhoe Hot Springs

Zarqa Main Waterfall

∴ Machaerus (Mukawir)

Mizpe Shalem

WEST BANK

Dead Sea

JORDAN

Mizpe Qedem

David's Waterfall

En Gedi

Hot springs

987 +3,238

Hebron

LEVEL IN BIBLICAL TIMES −436 METERS

981 +3,219

Al Mazraah

Masada ∴

Al Lisan Peninsula

Dhira

1977 SUMMER LEVEL −399 METERS

ISRAEL

Arad

En Boqeq Hot Springs

Gomorrah?

Hotels

Sodom?

Dikes under construction

Newe Zohar

Arab Potash Company proposed refinery

Lot's Pillar ∴

Beersheba

Sedom

Safi

Dead Sea Works

1930 LEVEL −390 METERS

Evaporation pans

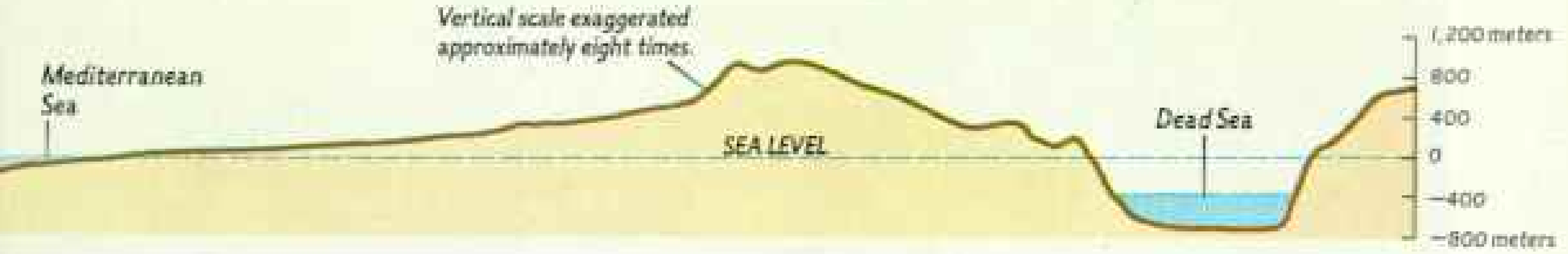
559 +1,834

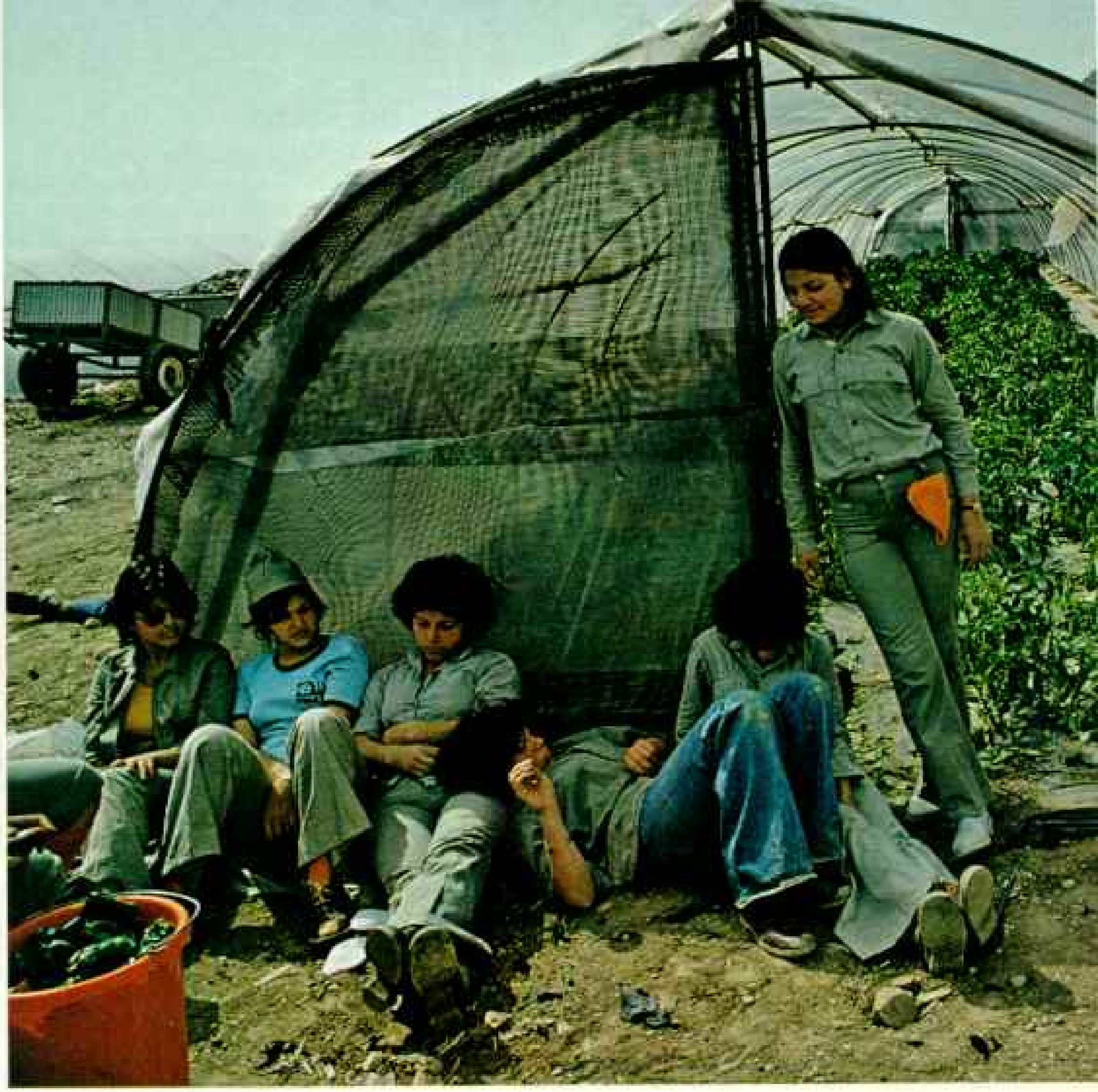
BELOW SEA LEVEL

Neot HaKikar

Mediterranean Sea

Mediterranean Sea





Greening the shore of the Dead Sea, the Israeli kibbutz of En Gedi wrests crops from soil painstakingly leached of its salt content. Bushed by hard work in the enervating heat, volunteers (**above**) take a break while harvesting peppers from moisture-conserving plastic greenhouses. Children outnumber adults (**left**) in the flourishing communal settlement, founded in 1956 just south of Israel's border with the West Bank. The kibbutz runs a guest hostel along with a spa where visitors take a "cure," combining dips in the Dead Sea with prolonged immersion in the mineral-rich waters of local hot sulfur springs.

but its ability to convert sunlight into electrochemical energy could prove useful in the field of solar power. Since the pigment helps the microorganisms expel salt, it may be applied in desalination projects. Its similarity to certain pigments of the eye may help medical researchers explain the intricacies of human vision.

Israeli scientists have also recently discovered that the halophilic alga *Dunaliella*, found in the Dead Sea and its salt flats, can be converted into petroleum. They envision huge "oil farms" in the low-lying Arabah, south of the Dead Sea, channeling its waters into saltwater ponds for growing enormous crops of *Dunaliella*.

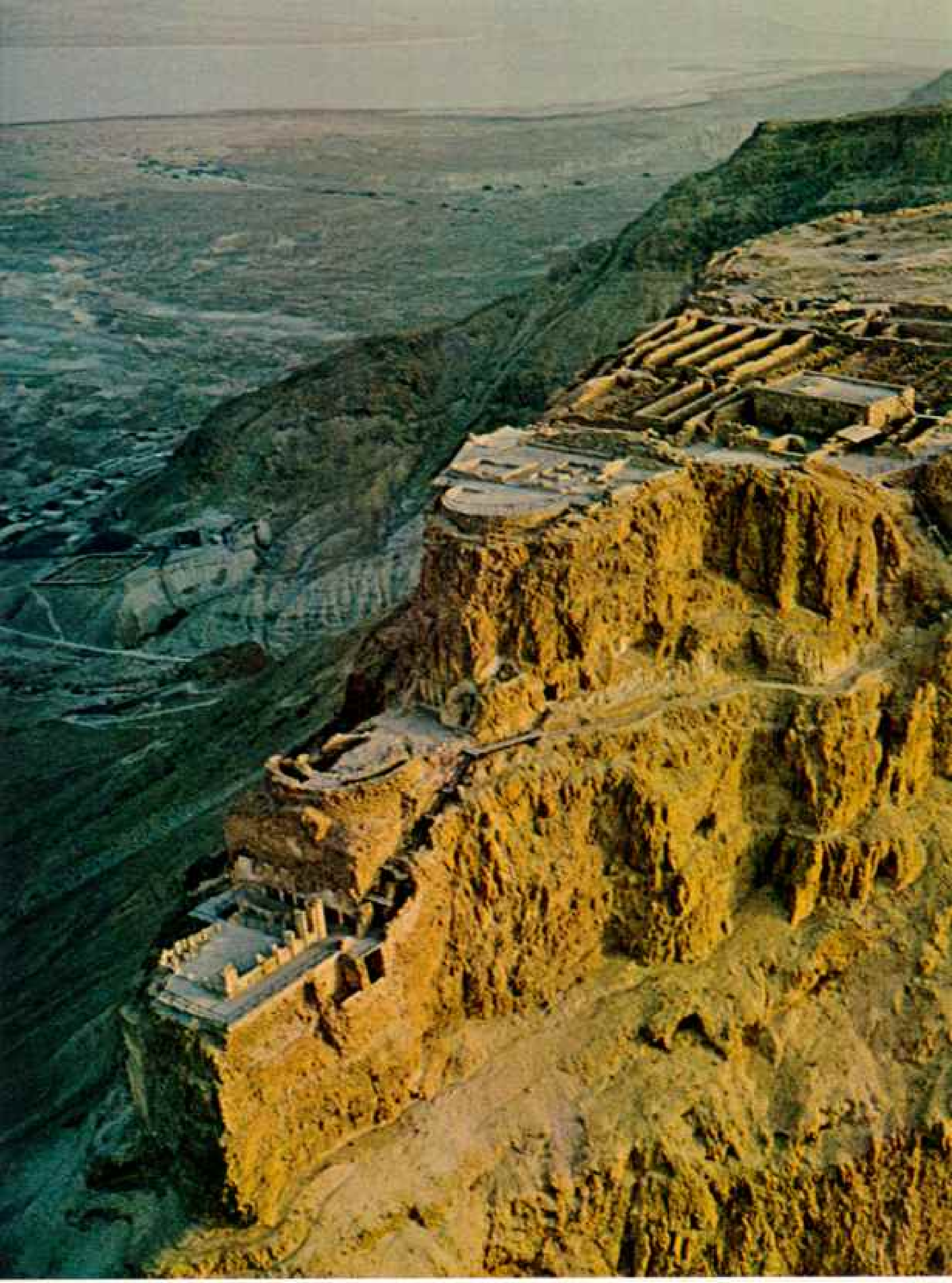
Despite drillings down to 3,660 meters (about 12,000 feet), the sea itself has proved dry as far as oil is concerned. Though globs of asphalt occasionally bob to the surface (hence the Roman name, Lacus Asphaltites), it would seem that any petroleum here was long ago destroyed in the geologic paroxysms that created the Great Rift.

IF PLANS for producing energy from bacteria or digging a channel to connect the Mediterranean and Dead Sea seem just a touch visionary, consider that the Dead Sea has always been a place of visions.

The prophet Ezekiel, after the destruction of Solomon's Temple in Jerusalem in 587 B.C., envisioned a rebuilt heavenly temple from whose eastern gate would issue forth a magical stream of pure water that would flow all the way down to the Dead Sea, nourishing its shores and freshening its waters.

Though the Dead Sea has yet to turn fresh, Ezekiel's vision finds expression in the modern Israeli kibbutz of En Gedi, founded in 1956 just south of the border with the West Bank. Here, indeed, the Dead Sea's shores have come to life (facing page).

"When our founders came here, this place was almost a wasteland," explains En Gedi's economic manager, Danny Shachaf. The Dead Sea sun has bleached his hair a blondish brown and bronzed his handsome face. "The soil was saturated with salt and filled with stones beyond counting. Only some year-round freshwater springs made development possible. For years we washed the salt out of the soil. For years we picked stones out of the ground—and *(Continued on page 238)*



Shiplike fortress of Masada rides at eternal anchor above the Dead Sea. Here,

in A.D. 73, *Jewish Zealots committed mass suicide rather than submit to Rome.*

"Masada shall not fall again!" Paying grim-lipped tribute to the defiant Zealot ancestors who died here 19 centuries ago, Israeli recruits (**right**) climax training at a dramatic nighttime ceremony atop Masada; torches (**above**) light their way down. At home with a rifle or a tractor, a young Israeli woman (**below**) shares military and agricultural duties at Mizpe Shalem, a settlement overlooking the northern Dead Sea.

(Continued from page 233) still do. But now look what we have."

His hand waved across the miragelike miracle that is En Gedi—tree-lined sidewalks curving through a green-lawned community of modern buildings, children laughing and playing, sprinklers tossing out rainbowed mists, farm workers lovingly tending fields of vegetables, melons, and mangoes.

"Over there," he enthused, "we will someday have gardens and orchards, and over there splashing fountains." His voice took on an almost prophetic tone.

Old Ezekiel, I thought, must be smiling somewhere in his heavenly temple.

I SPENT A HOT, DUSTY AFTERNOON touring the nearby ruins of Masada, the storied Herodian fortress perched on a butte high above the Dead Sea (pages 234-5). Here, in A.D. 73, a group of 960 Jews of the Zealot sect—men, women, and children—committed mass suicide rather than surrender their lives and honor to the besieging legions of Rome. Their heroic defiance has inspired the modern Israeli motto "Masada shall not fall again!"

Using either a cable car or a snaking path up the mountainside, tourists breach these heights with much greater ease than the Romans, who spent more than a year building an earthen assault ramp up the western side. At the top an almost overwhelming silence reigns. The suggestion of a breeze stirs the heat-rippled air. Guides show visitors the ruins of Herod's "pleasure palace," replete with luxurious hot and cold baths. The whole perches like some architect's fantasy on the north rim.

After the tour I stopped at the refreshment stand at the base of Masada and found myself sitting across from a rather elegant-looking white-haired woman. "Excuse me," she asked, "would you happen to know where I can find some mud?"

Mud?

She leaned forward. "You see, I have this friend back in Pennsylvania. Three years ago he came here to the Dead Sea and found some black mud that relieved the arthritis in his thumb. He asked me to bring him some more mud, because the old mud doesn't work anymore. He gave me this to put it in."

She held up a small cosmetic jar.

"Just big enough to put your thumb in," she said, holding it out as if I might care to try. "But now where's the mud? It's dry as a bone down here. I was going to walk down to the beach, but it looks so far."

I explained that she was unlikely to find anything but salt, stones, and sand down at the beach; the black mud she was looking for is found only in the area of sulfur springs.

"You can buy some from the hotels down at Newe Zohar," I told her.

"Buy it!" She looked incredulous. Then she whispered almost conspiratorially: "It *is* just a lot of nonsense, isn't it?"

If it's nonsense that the Dead Sea has curative powers, then it's very ancient and persistent nonsense indeed. Herod the Great, builder of Masada, came often to these shores to soak his ailing body in the salt-laden waters and hot mineral springs. Very likely he daubed himself with the same sulfurous black mud—containing radioactive barium among other allegedly curative ingredients—that now attracts thousands of sufferers annually from Europe and the United States.

These visitors hope to cure anything from simple aches and pains to arthritis, rheumatism, asthma, eczema, psoriasis, and even infertility. (Legend has it that the prophet Abraham's aged wife Sarah bathed in the Dead Sea before conceiving Isaac.)

"I've been here three times now," one elderly gentleman from Belgium told me, his body smeared with black mud from toes to scalp as he lay on the beach at a luxurious hotel at Newe Zohar.

"Each time I come here my psoriasis gets better. Much better. But always, after a few months, it gets worse again. Still, it costs no more to come here from Antwerp than it does to have expensive hospital treatments. So why not combine therapy with a vacation?"

PERHAPS it was the Dead Sea's reputation for curing bodies that first suggested it might also be a good place for curing souls. More than a century before Jesus and John the Baptist walked these shores, a religious community established itself on a cave-pocked terrace above the northwest shore (pages 240-41). Founded by a man called the "Teacher of Righteousness"—an outcast Jewish priest from Jerusalem—this communal settlement of a few hundred souls, known as

Essenes, practiced ascetic ways and waited for what its members actively and militantly hoped was the end of the world order.

They envisioned a time when the "sons of light"—meaning themselves—would wage a victorious war against the "sons of darkness," their enemies. At war's end, they would establish a new age.

For the better part of two centuries they fasted, prayed, studied Scripture for hints to the future, and awaited that apocalyptic finale. When it came, however, as it did in the year A.D. 68, it was not the sons of light but the sons of darkness—in the person of attacking Romans—who prevailed. The community at what we now call Khirbat Qumran (Ruins of Qumran) was razed by Rome's legions on their way to even greater destruction at Jerusalem and Masada. The little community's existence was recalled only in a few references in the works of ancient historians.

ALMOST 19 CENTURIES LATER, in 1947, a Bedouin lad—trying to flush out a stray goat—tossed a stone into a small opening on the same Dead Sea terrace. To his amazement, he heard the distinct shattering of pottery.

Within, of course, was the first batch of what soon came to be known as the Dead Sea Scrolls—among the most electrifying archeological discoveries of modern times. Hidden in clay jars, the manuscripts had been preserved for nearly two millennia by the Dead Sea region's extreme aridity.

In all, 11 caves in and around Qumran yielded the remains of hundreds of rolled manuscripts. Among them were parts of every book of the Hebrew Bible except the Book of Esther (the only book to omit any mention of God). Some of these dated from the second century B.C. or earlier, predating by a thousand years the oldest previously known copies of Biblical books in Hebrew. Since most of these manuscripts show only minor variations from today's Old Testament, the Dead Sea Scrolls confirmed the scrupulous accuracy of Biblical scribes over the centuries.

In addition to Biblical manuscripts, the caves also yielded numerous works relating to the Teacher of Righteousness and the religious community at Qumran.

No serious scholar suggests today—as a few did when the scrolls were first made public—that the Teacher of Righteousness can be equated in any way with Jesus of Nazareth. One of the sharpest of the many differences between them was that the Teacher of Righteousness reserved the promise of salvation for only a small number of disciples, while Jesus preached to the multitudes and offered salvation to all.

But Jesus likely knew of this sect, which shared many of the apocalyptic expectations of the early Christians—even if it lacked their sense of universal brotherhood.

So, too, John the Baptist must have known of it. In fact, a case can be made that John had once been a member of the Qumran sect, which put great emphasis on baptism.

Could he have been a member who rebelled against the notion that only a spiritual elite could be saved? Might he have quit and gone out into the wilderness preaching to all who had ears to hear?

His diet of honey and locusts—among the few available foods permitted by the community's dietary laws—would seem to fit the theory. And what more likely place for him to preach than the banks of the Jordan, only a three-hour walk from Qumran? There he baptized, in addition to the multitude, none other than Jesus of Nazareth, thus beginning the latter's public ministry and launching, in effect, the Christian era.

Though wholly speculative, the theory is attractive—particularly to one exploring the Dead Sea's shores. There you find right at hand not only Qumran and the traditional site of the baptism of Jesus, but also—on the eastern side of the Dead Sea—the Masada-like peak of Machaerus, another of King Herod's fortresses, where, the historian Josephus tells us, John the Baptist was imprisoned and beheaded.

TO GET TO MACHAERUS and the eastern side of the Dead Sea, I crossed the King Hussein Bridge, also called the Allenby Bridge, which spans the Jordan a few miles above the point where it empties into the Dead Sea. With my Jordanian visa stamped in my passport, I boarded a bus that takes the traveler from the Israeli-held West Bank to Jordan proper.

The Jordan itself seemed unimpressive, a sluggish green stream that I could easily have lobbed a stone across. At the customs depot,

Caves that hid the Dead Sea Scrolls pock the walls of Wadi Qumran. Flash floods periodically turn the watercourse into a raging torrent emptying into the Dead Sea.

Atop the terrace at upper left, an ascetic community founded by a mysterious "Teacher of Righteousness" flourished for most of two

centuries until destroyed by Roman legions in A.D. 68. Scrolls of Biblical books and other writings were hidden away in caves at the Romans' approach—not to be found until 1947. A restorer at the Israel Museum works on a fragment (**left**), removing tape applied by an earlier restorer.

an official glanced at my American passport.

"You come from where?" he asked.

"From . . . Israel," I said, hesitating.

His forehead wrinkled. "No," he said sternly, "not Israel. From the West Bank. You've been in Jordan all the time."

The Jordanians are only beginning to exploit the Dead Sea's touristic and commercial potential. Whereas the Israelis have built an excellent road along the entire western shore, the eastern shore is accessible by car only in the north and south. The middle third of the coast can be reached, if at all, only down a few precipitous canyons.

FROM AMMAN it's less than an hour's drive down to the spa of Suwaymah on the northeast shore. I was surprised to find there a busy public beach, guesthouses, a pleasant café, and, of all things, a carnival complete with Ferris wheel, penny-ante gambling tables, and a magic show.

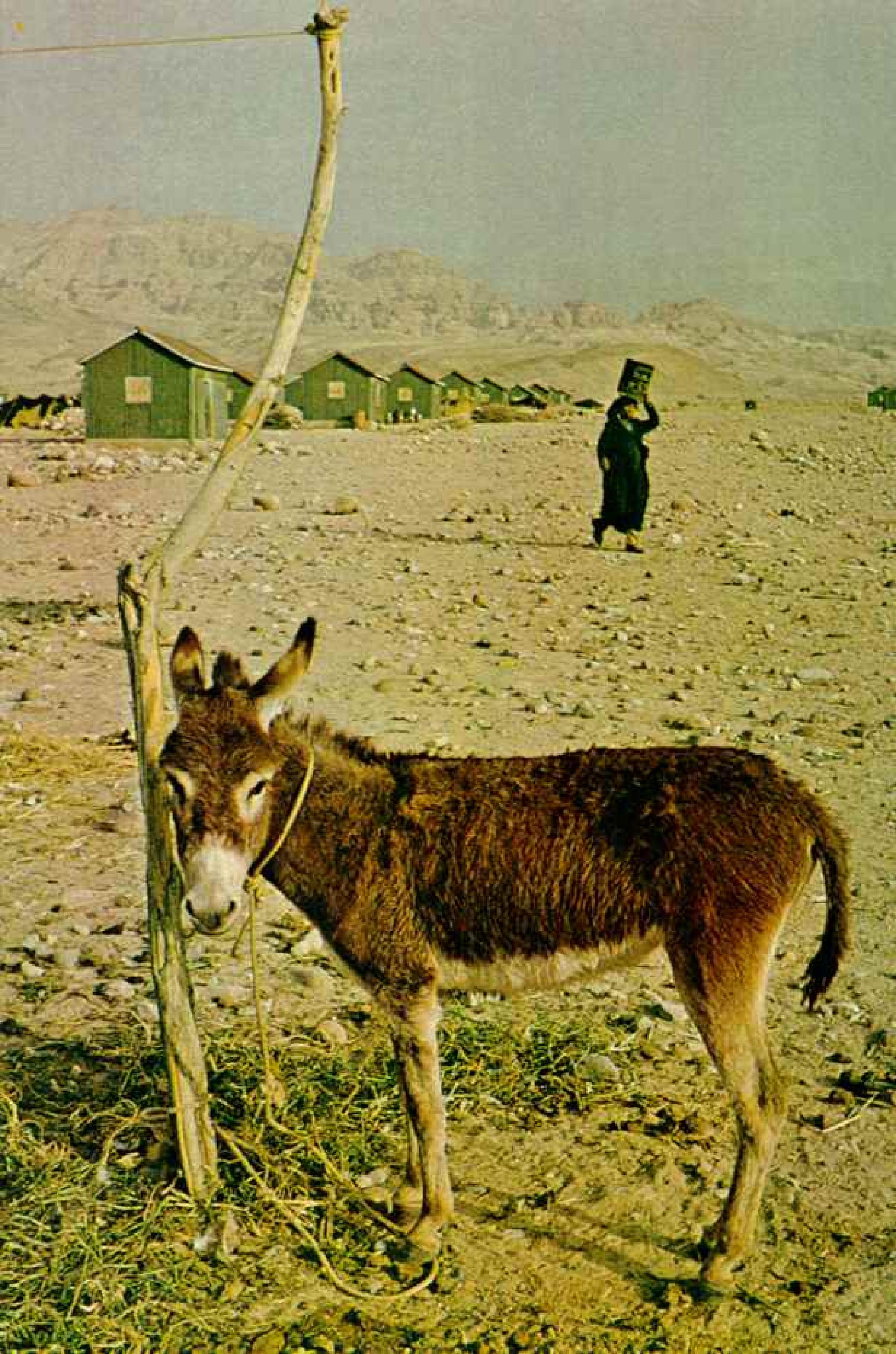
"People in Amman used to go to the Lido," I was told by Jordanian official Shehab Madi. "But, of course, it was lost in 1967, when Israel seized the West Bank. Now we're building up Suwaymah to replace it. We have great plans—a road connecting the north to the south, hotels, health spas. . . . But, frankly, we worry that, if another war comes, these would be the first places to be hit. It makes it hard to build with enthusiasm.

"Still," he smiled, "if you want to experience the Dead Sea as it was in the days of Jesus and John the Baptist, then welcome to Jordan!"

For ten surprise-packed days I journeyed along Jordan's wild side of the Dead Sea. I visited Mount Nebo, from whose height Moses looked across the northern end of the Dead Sea to the Promised Land he was never to enter.* I marveled at the hot waterfall at Zarqa Main (page 244), where a series of thermal pools allows you to pick the bath temperature of your choice. These pools are fresh water, not sulfuric—and hence are easier on the nose than the Dead Sea's normally foul-smelling hot springs. For sheer lushness Zarqa Main is rivaled on the Dead Sea only by David's Waterfall near En Gedi on the Israeli coast—and David's Waterfall is lukewarm, not bone-soothing hot.

Herod the Great, when he stayed at the

*The author traveled "In Search of Moses," in the January 1976 NATIONAL GEOGRAPHIC.



nearby fortress of Machaerus, often had himself carried by litter to Zarqa Main's steaming pools. It was his son, Herod Antipas, the Herod of the Gospels, who imprisoned John the Baptist. The Jordanians don't publicize the spot. Only a small tilted sign saying "MUKAWIR" directs you along a rocky dirt road to a small hilltop village across from which rises the conelike eminence on which the fortress of Machaerus once stood.

John had been taken here because he denounced Herod Antipas's marriage to his half-brother's wife, Herodias—a union forbidden by Mosaic law. Herodias, furious, had her daughter, Salome, dance for the king, who was so pleased that he promised Salome anything she wished. At her mother's inducement, she asked for the head of John the Baptist on a platter.

And so history was played out on this forlorn height overlooking the Dead Sea.

DRIVING SOUTH to Al Karak, site of an imposing Crusaders' castle, I turned right and headed downward toward what must be the most different part of the Dead Sea—Al Lisan Peninsula.

Lisan is Arabic for "tongue," and indeed this low-lying peninsula seems like a tongue of land licking out from the eastern shore. It has an almost tropical atmosphere, with tall palm trees, white sand beaches, eroded salt formations, and a sleepy village called Al Mazraah. Some Jordanian soldiers sat around an open, palm-frond-roofed café, drinking beer and looking at me with mild suspicion.

There was a time when the peninsula extended all the way across to what is now Israel—only a mile or so away across the narrowest part of the Dead Sea. I could see, just to the southwest, a green expanse of reeds on the Israeli shore—so near, as they say, and yet so far. . . .

South of Al Lisan Peninsula sprawls the shallow southern part of the Dead Sea, rimmed by muddy, almost impassable salt

Wilderness outpost, the village of Safi, Jordan, at the south end of the Dead Sea, was destroyed during fighting between Jordanian troops and Palestinian guerrillas in 1971. One-room prefabricated cabins now house resettled families.

flats. Some say that beneath this segment lie the Biblical cities of Sodom and Gomorrah —destroyed by God for their iniquities.

Abraham's nephew, Lot, lived somewhere in this region. Before Sodom and Gomorrah were destroyed, God allowed Lot and his family to escape—but Lot's wife, taking history's most famous backward glance, was turned into a pillar of salt. Near Israel's Sedom saltworks stands a jutting rock that tradition calls "Lot's Pillar." Lot's name also persists in one of the Arabic names for the Dead Sea—Bahr Lut, or Sea of Lot.

BEFORE LEAVING the Dead Sea, I climbed to the monastery that sits halfway up the Mount of Temptation, on the West Bank near Jericho. Within, Greek Orthodox monks show visitors a rock with two indentations in it—said to be the marks from Jesus' knees when he prayed for forty days and nights during his battle with Satan.

From here Jesus would have looked out on a panorama of the Dead Sea, with the towers of Jerusalem barely visible atop the heights of Judaea.

I was told a hermit lived in a small cave just outside the monastery. On my way out I knocked on the large black iron door that seals the cave off from our world of temptations. The door reverberated like a metal drumskin, but no one answered. "Oh, he's there, all right," I was told, and so I knocked again, and again. Still no answer. I thought I heard a rustle within. But then, only silence. I decided not to knock again.

After all, this unseen hermit had come to this mountain overlooking the Dead Sea precisely to be away from such worldly interruptions. He obviously had no desire to see me. Without words he had communicated that message most effectively.

I accepted his answer and walked back down the mountain. □

Bathing in a hot waterfall, a visitor to Jordan's Zarqa Main revels in a freshwater cascade from natural springs whose temperatures reach more than 60°C (140°F).

Workers giving nature a hand near Safi (**above**) dig a drainage ditch through salt-mud flats once covered by the Dead Sea. The Jordanian project turns almost lifeless soil to life-giving agricultural land.

Brazil's Golden Beachhead

By BART McDOWELL ASSISTANT EDITOR

Photographs by
NICHOLAS DEVORE III

CARNIVAL IN RIO brought me two moments of worry: one, when I first tried on my skimpy costume . . . and later, when I made plans to ride a special Carnival train.

"Dangerous," a journalist called that journey. A government functionary warned, "You'll be mugged." A reluctant travel guide said, "I'll take you to the train, but I must have $150 in advance—tomorrow you'll be dead or in a hospital."

My problem was simple. I had joined a Rio de Janeiro *escola de samba* so I could observe Carnival inside out. "Don't think of it as a school," my friend Carlos Alberto Machado said. "It's really a club—one of many that compete in the famous annual parade here. It's the only way to know the people of Rio. Carnival is anthropology."

So, searching for Carmen Miranda, I found Margaret Mead: I met musician, physician, physicist, laundress, laborer, and prince—along with pickpocket and racketeer.

As a precaution against robbery, I taped hundred-cruzeiro notes to my feet, left my valuables at the hotel, and caught the train anyway. But that's ahead of my story.

I was concerned with the 20 million urban Brazilians living in the three historic coffee states on the Atlantic coast—Rio de Janeiro, São Paulo, and Paraná (map, page 257). The people of this Brazilian beachhead provide the money, crops, ideas, taste, credit, and manufactured goods that are generating the extraordinary development of Brazil—an annual growth rate ranging from 5.7 to 9 percent in recent years.

They are also learning to live with a staggering rate of inflation: 40 percent annually. And from this region come many of those who are colonizing that starkly different Brazil, the Amazonian jungle.*

*In last November's GEOGRAPHIC, photojournalist Loren McIntyre portrayed "Brazil's Wild Frontier"—the Western Hemisphere's largest remaining wilderness.

Inflamed by Carnival, a young Brazilian flickers to a samba at one of Rio de Janeiro's expensive balls, as the lights of the city (**right**) dance about Sugar Loaf. From romantic Rio to industrious São Paulo and beyond, coastal Brazil knows no pause.

Since Brazil's 113 million people represent almost half of all South Americans, this golden beachhead ranks as one of the most important regions in the Western and Southern Hemispheres. Its people, I found, are open and friendly. Yet an outsider may find them difficult to understand, for Brazilians are intricately divided by race, class, geography, and custom.

A regal case in point is the imperial family, headed by Dom Pedro Gastão de Orleans e Bragança, princely heir to the throne Brazil abolished in 1889. Other rebellious nations have sent their rulers to the headsman or firing squad; Brazil asked only abdication of its last emperor, the current prince's great-grandfather. Today the country is governed by an oligarchy of generals, headed by President Ernesto Geisel.

Dom Pedro, distinguishedly gray at 64, drives a Volkswagen, owns a real-estate firm and a newspaper, and raises bees in the mountain town of Petrópolis near Rio. He is no pretender since he has relinquished all claim to the throne, but still he serves as a kind of elder statesman and leader of society. "But we are also informal," he insists, with a wave of his pipe. "Only yesterday, for example, we were dressing to go to a family funeral, and my 21-year-old son said, 'Dad, please tie my necktie—I don't know how!' "

Busy São Paulo Versus Relaxed Rio

Like Petrópolis, Rio is that informal. São Paulo is not. Brazil's two greatest cities could hardly provide greater contrast.

Eight million people live in that cursive, undulating, feminine city of Rio de Janeiro. With its rounded, exfoliated mountains diving down into Guanabara Bay, Rio de Janeiro looks as if it had been served up by a gigantic ice-cream scoop.

São Paulo seems hacked out on a chopping block. Some ten and a half million Paulistas live and work amid an astonishing jumble of skyscrapers perched on the 2,500-foot-high plateau 270 miles southwest and inland from Rio (pages 276-7). From the air, notes the Brazilian magazine *Manchete*, "São Paulo looks like a child had thrown all his bricks on the floor in a rage."

The cities have an altogether different pace. "Walking in Rio, I'm the fastest one on the sidewalk," says an American diplomat who has worked in both cities, "and in São Paulo I'm the slowest."

Or consider coffee drinking. With a sweep-second hand, I timed Rio's deliberate folk—Brazilians call the pleasure-loving Rio natives Cariocas—as they chatted over a demitasse, or *cafèzinho*. They averaged 90 seconds, twice as long as Paulistas.

Dr. Josef Kijen, a medical doctor and psychologist, says of his fellow Paulistas: "They are always searching for material prosperity. Want to arrive fast, cut corners. The Carioca wouldn't sell his pleasures so easily. But when the Carioca calls us *cold*—well, we are simply *busy!*"

Growth Patterns Ebb and Flow

For years I have watched the rivalry between these cities; they easily outdo the competition between Los Angeles and San Francisco. A few years ago Paulistas boasted that theirs was the world's fastest growing city. Cariocas grieved: Brasília had just replaced Rio as the national capital. But after some 10,000 government workers moved to Brasília, Rio began to grow again.

A bay bridge now connects Rio with its neighbor, Niterói. The world-famous Brazilian architect Oscar Niemeyer has designed a new conical cathedral. Tunnels stitch through mountains on the west side of Rio, and a whole new seaside city scrapes the sky on Tijuca Beach. Now Rio adds nearly a million residents every three years.

São Paulo, meanwhile, has faltered. Though it remains the largest city in both the Americas (eighth largest in the world), São Paulo has fallen behind Mexico City in the world growth rate—"only about 5 percent a year," says Mayor Olavo Egydio Setubal. "But that's *good*. Our only hope is to grow slowly enough so our services can catch up."

A surge of Cariocas—residents of Rio—crests of a Sunday on world-renowned Copacabana Beach. From all over Brazil people come to live or vacation in this neighborhood, the country's most densely populated. Even some of the sand is immigrant, having been pumped over an adjoining mountain to create an urban shore.

A businessman confirms His Honor's view: "I paid $4,000 for my new telephone. Otherwise I might have waited a year or two for installation. To get a dial tone, I still sometimes wait half an hour."

"Electricity is now a bigger problem than phones," a woman in São Paulo complained. "Once a week the power fails in my apartment house. The elevator stops. I walk up ten floors."

I've done the same in Rio, and shaved by flashlight. The acute power problem touches everyone in urban Brazil, and thus even casual visitors can appreciate Brazil's concern for energy.

The urban thirst for electricity now has 20,000 men at work along the Paraná River on the Paraguayan border near the scenic Iguaçu Falls. "Foz do Iguaçu used to be a bootleggers' town," said an engineer when I visited the project. "It was a very tough place. Fifteen years ago men here ate lunch with a pistol on the table. In only two years they had 11 mayors."

Project Dwarfs All Predecessors

A bi-national corporation today is building Itaipu, planned as the world's largest power-generating project, at a cost of some six billion dollars. The diversion canal for the Paraná River already yawns wide. I watched the night shift digging under strong lights. Brazilians and Paraguayans jointly staff the project, working toward completion in 1989 when Itaipu will generate some seventy billion kilowatt-hours of electricity annually. (Grand Coulee produces twenty billion, and Aswân ten billion.)

"And then we'll *still* have a shortage," laments a Paulista businessman. "By 1990 we'll run out of hydroelectric sites here in southeastern Brazil. We're site poor."

This explains the Brazilian quest for nuclear power. Below green coastal hills near Rio I drove a new, winding, bayside highway, where succulent trees comb water from clouds, to Angra dos Reis, where nine thousand hard hats were building a domed tank that resembles both a refinery and a capitol (page 260). This is the Adm. Álvaro Alberto Nuclear Center, equipped by Westinghouse —with United States approval—for uranium-powered generation of electricity. Commercial production starts this year.

That's phase one. Phases two and three of the huge complex will be installed by West Germany—over the objection of U. S. diplomats, since the process involves plutonium and its possibly explosive by-products. The quarrel between the Carter Administration and the military regime that governs Brazil itself seemed explosive. "But our energy crisis gives us no choice," a student insists,

Sporting mania: The national passion for *futebol*, or soccer, draws standing-room-only crowds to Rio's 180,000-seat Maracanã stadium (**above**). To protect players and referees from zealots in the stands, the playing field is encircled by a deep moat.

Fans (**left**) in all shades of excitement and color cheer and ponder the action. Though Brazil was the last nation in the Western Hemisphere to abolish slavery, class lines have usually been drawn according to economic status rather than race.

Where luncheon is an institution, the Confeitaria Colombo obliges Rio businessmen with elegant food and turn-of-the-century setting as they meal and deal

in a din of clattering tableware and conversation. Although wrought iron, plasterwork, and stained glass are passing from modern Rio, the devotion to luxury is not.

pointing out that Brazil produces less than a fifth of the petroleum it needs. Gasoline costs $1.55 a gallon—no small consideration for commuters expensively stalled in São Paulo traffic jams.

Traffic jams notwithstanding, I like São Paulo—or I did when I left recently. The city changes fast. "You wake up in the morning, it's a different town," one businessman told me.

City on the Move—With Problems

That's the exciting quality of São Paulo: change. Everything happens at once, though not without price. The sprawling city had no freeway at all until 1969, no zoning law until 1972. Its polluted air is unbelievably foul, the worst I've breathed anywhere in the world. Many houses in the city remain unconnected to sewer lines; the tap water is barely fit to drink. The infant mortality rate has risen an incredible 25 percent during the past decade—largely because of infectious diseases.

A resident sociologist calls it "a hard, inhuman city." "São Paulo is a cultural desert," laments a local banker. The leading local paper, *O Estado de São Paulo*, has diagnosed it a "sick city."

Still, I recall the Paulista cabdriver who boasted of the city's "opportunity—if you work." When I tipped him, he wished me, "Good business!"

I also recall the old woman of 74 who had just moved out of a *favela*—an urban shantytown—into a new, unpainted, one-room house with her eight children and her grandchildren. "It's heaven!" she told me, grinning exultantly. "We used to have garbage in front of the door. They'll never take me out of here. Look!" She spread her hands toward her bare but decent quarters. The state housing company had built this project as part of its slum-clearance work. Change.

Or ask my enthusiastic, theoretically retired friend Fernando. He shouts: "God is a Brazilian, and He was born in São Paulo! Ah, I have this city in my heart." Fernando Edward Lee was born in the young 20th century to the beautiful Brazilian wife of the U.S. consular agent. Reared in the relative security of a prominent industrial family, Fernando watched from his window in the family's grand 48-room house as São Paulo grew. In

A hundred holidays, a thousand futebol matches, or even a few odd revolutions could hardly match the yearly excitement of Rio's four-day Carnival. Rival samba schools, really neighborhood clubs, whirl through the streets (**above**), as the man in the dark clothes, half drill sergeant and half maestro, keeps order.

For months before, the schools cut and stitch costumes, hammer their extravagant floats, and practice over and over. Many members cannot afford the enormous costs of preparation, but of course they must try. So important is Carnival that for safety the sale of alcohol is restricted.

With dawn comes exhaustion (**right**), total, happy, but not final—the pre-Lenten celebration will not end until Ash Wednesday.

his boyhood it was only a middling city of 400,000 people.

"People asked Father, 'Why live so far out in the country?' We boys hunted foxes right here—and fished in the Saracura River right *there*." I saw no river at all. "It's there, though. In a culvert under the street, the Avenida 9 de Julho." Farther downtown that one avenue carries exactly 18 lanes of traffic.

Failure Brought Renewed Energy

The old Lee mansion, once the largest house in town, now awaits demolition for a skyscraper. The elder Lee died during the worldwide depression of the 1930's. Many a Brazilian fortune vanished then. Young Fernando paid his father's debts and started afresh. Today he lives in a 23d-floor apartment with a sweeping view of São Paulo, and owns an offshore island where he experiments with wind power and solar power.

Mayor Olavo Egydio Setubal, an engineer and banker, puts São Paulo's development into orderly perspective: "Two geographical conditions determined the history of this city. First, there is the altiplano itself—fertile and flat. Suitable for coffee. And second, the altiplano abruptly drops half a mile to the port of Santos on the sea, so São Paulo has access to cheap hydroelectric power."

My friend Norberto Nicola—one of Brazil's leading artists—took me on a drive around Rua Augusta's cornucopia of shops and restaurants, then along Rua Helvétia (this street runs straight along the Tropic of Capricorn), and finally south toward the coffee port of Santos. Our 45-mile route paralleled the shining steel flumes that conduct waters from the Tietê River. Its flow has been diverted to generate electrical power.

"The name of this highway," Norberto said, "is Imigrantes. To honor our great 19th-century influx of Europeans, among them all four of my grandparents from Italy."

Other successful Italian-Brazilians have raised conspicuous monuments, like the 47-story Itália Building, tallest of all São Paulo's skyscrapers. Then there was Italian-born Francisco Matarazzo, who in 1881 opened a small processing plant to make lard. It grew eventually into one of Latin America's largest private companies, with 23,000 employees and 133 factories.

Some 60 nationalities are now represented in this city, which has been called the largest racial melting pot in the world.

Twice a week an Arabic-language newspaper circulates to readers here. "And we have two Russian Orthodox churches," the grandson of a tsarist general told me. Liberdade, a city within a city, represents the greatest population of Japanese outside their home islands. It boasts three Japanese-language daily newspapers, uncounted restaurants, and half a dozen theaters showing samurai blood-and-thunder movies.

North Americans, too, have felt the pull of Brazil's magnet. Before slavery was abolished here in 1888, a wave of immigrants came from the defeated Confederate States to begin their lives anew.

"After the war my great-grandfather Norris came down here with his son," explains Dr. Charles Jones, a dentist. "They found good farmland north of here, so they brought a whole colony of people to a community now called Americana." Dr. Jones speaks English with a Portuguese accent softened by a vestigial Alabama drawl. On one office wall hangs the Confederate flag, on another a portrait of Abraham Lincoln.

Hope Lures Brazil's Northeasterners

Today the greatest group of immigrants to São Paulo are native Brazilians coming from their impoverished northeast. "Our one biggest social problem," Mayor Setubal calls them. Near the Roosevelt Railroad Station, I scouted several crowded blocks where interurban bus lines stop.

"Maybe 70 percent of our arriving passengers are from the northeast," said bus-line executive José Adailton Ribeiro. "After the harvest—especially in dry years—they come to escape hunger. Whole families charter a 32-seat bus. They come with cousins and grandmothers and uncles and aunts—and 32 babies on their laps."

The bus-station neighborhood teems with the northeasterners. Ethnic grocers sell strange sausages, pork gut, *arribação* (salted wild birds), jungle tapioca root, and the wine of the *jurubeba* plant. A newsstand peddles comic books, *novelas*, and *literatura de cordel*, so-called string literature, named for the way it is hung on display. The regional migrants bring with them their whole lives—food, drink, and daydreams.

And their ambitions, too. At the construction site for a new $200,000 residence in the Alto de Pinheiros section, I talked with some workers from Bahia. They were cooking spicy food over an open fire; Brazilians don't like to eat from lunch pails if they can have a hot meal.

"We worked on farms before coming here," said one named Joaquim. What does the crew do when they're off work? "Two of us are going to school at night," he said, "learning to read."

Those men were typical. I've never seen people so obsessed with education. Everyone seems to be taking his *cursinho*, or little course. Correspondence instruction flourishes. Newsstands throughout the city weigh heavy with manuals and learning aids. Night schools do a booming business.

Brazilians Master Germanic Skills

Out from the center of town, in the industrial suburb of São Bernardo do Campo, some 10,000 trainees are enrolled in a special school run by Volkswagen of Brazil.

"When I came here 21 years ago," said Alwin Dierkers, "we were beginning at zero. No one knew what to do with tools. Training courses fixed that. Today, even though I come from Germany, I can say that Brazilian workers are as good as Germans. More enthusiasm—and more productivity. They adapt and improvise. Brazilians have a saying, 'If you don't have a dog, then hunt with a cat.' Now we have only 61 Germans at the Volkswagen plant."

At latest count, 38,000 Brazilian employees turn out 1,980 cars a day, or about a fourth of Volkswagen's worldwide production. Neighbor factories—owned by Mercedes-Benz, Ford, Chrysler, and Saab-Scania—make industrious São Bernardo do Campo the Detroit of Brazil.

"But that's our very problem—so many private cars," insists the young architect and city planner Candido Malta Campos. "As recently as 1968 some of our municipal planners actually chose your city of Los Angeles as our model to copy!"

"We had fewer than 200,000 automotive vehicles in the 1950's," notes Mayor Setubal, "and more than a million today. That's the reason we need our subway system. We have finished one line—about 11 miles of underground—that carries 600,000 people a day. But that's not many, especially when you realize that we carry eight million passengers on the rest of our mass-transportation system.

"We have difficulty with all our growth predictions here. *(Continued on page 261)*

Restless and relentless, southeastern Brazil animates a huge nation. Despite national policy favoring development of the interior, most of the people, industry, and agriculture remain here, where opportunity still makes house calls.

Brassy morning stirs Costa Verde hills with a reveille of light. Precipitous shores, like these west of Rio, confined Portuguese settlers of the 1500's to isolated enclaves along the Atlantic rim. The early Portuguese, annealed with Indian and African strains, produced a

distinctly Brazilian culture based on a plantation society. Only the *bandeirantes*, part explorers, part land pirates, penetrated far into the interior. A coast road between Rio and São Paulo has only recently been completed; the older main highway runs inland.

Atomic boom comes to the small port of Angra dos Reis (**left**), as Brazil's first nuclear plant nears completion. Housing for construction workers (**below**) takes to a nearby beach.

By the year 1990, Brazil plans to have completed installation of eight nuclear reactors, which will produce ten million kilowatts annually to power an industrial economy already mushrooming. Since capacity to produce weapons-grade nuclear material will be a by-product, the United States has protested the plan. That and U. S. statements on alleged human-rights violations have angered many Brazilians.

Whether left, right, or center, Brazilians are nationalists first and expect their country to become a major world power.

Even with recent zoning restrictions, São Paulo could grow to 20 million people by the year 2000." The mayor shakes his head. Still he loves this city; he would live nowhere else. Why? "The chances it offers! In every field. It's an open society."

I agreed with the mayor even when I explored São Paulo favelas. Fortunately, only a small portion of the São Paulo population lives in these ramshackle enclaves—an estimated 150,000 people. A national housing project is steadily building new communities to resettle entire neighborhoods—for example, the Olimpia favela, which is now being displaced by a new freeway.

Patriarch of Olimpia when I went there was Augusto Procopio Pinto, age 79, a self-employed junk dealer (page 268). Procopio lived with his 40-year-old wife, Dona Teresa, and their 4-year-old daughter, Cidinha, in a makeshift one-room shack.

"Come inside." He laughed. "Careful—don't get lost in our house!"

The tiny place was tidy, but Dona Teresa was full of apology: "These boxes! We will be moving next week to the new Olimpia."

Even so, she and Procopio invited me to a traditional dinner of *feijoada*—a sort of black-bean stew—that Procopio cooked himself and served with wine in goblets. Rain began to fall and the roof to leak. "Don't worry," my host assured me, "I can get your car out of the mud."

Then he strummed a waltz on his *cavaquinho*, a small, banjolike guitar; Dona Teresa beat a rhythm on a triangle. Rain grew heavy, and we rattled about, fetching pans for the leaks. Procopio removed his pipe from his mouth to sing, while we beat time by clanking our spoons. And in full cacophony the child Cidinha went happily to sleep.

Suburbs Reach Older Cultures

As São Paulo's opportunity lures more residents from rural areas, the city itself spreads out. Already São Paulo can count its first commuters and weekend residents as far afield as Cantareira, where the city has recently built a chain of reservoirs for the municipal water supply. On the bank of the new Lake Juqueri I met Dona Teresa Caetano de Salles, who works as caretaker for a family with a weekend house. She was wearing a nondescript skirt made from a fertilizer bag, she

wore no shoes, and she guessed her age as "perhaps 44 or 45." Yet Dona Teresa has a poise any woman could envy. "Yes, I have forever lived here," she said, and she spoke movingly of her 12 living children and of the one whose grave was flooded by the new lake. She had never visited São Paulo, 15 miles away. Hadn't she wanted to go, after seeing the city on television? "But, sir," she said, "I have never seen television."

In the highlands of the State of Paraná, far to the west of Lake Juqueri, a calamitous event in July 1975 uprooted many Brazilian countryfolk. Its repercussions soon were felt at millions of American breakfast tables.

"Nobody expected such a cold night," said a black farm laborer named João Batista Norberto. "My whole family carried all their bedclothes next to the fire for sleeping." João shivered in demonstration.

On his plantation near Londrina, Dr. Alceu Serpa Ferraz, a prosperous coffeegrower, spoke in a voice of awe. "With the first cold wind of morning we could smell the coffee trees—like burned leaves. By noon we knew it was the freeze of the century. Green leaves had turned black. The land was in mourning!

"Some 30,000 families—perhaps 150,000 people—left Paraná farms in 1975, some for the Mato Grosso frontier. Now our coffee lands have a labor shortage. Once our State of Paraná produced eleven million bags of coffee a year—more than Colombia. But half our trees were killed."

The day after the freeze Dr. Ferraz bought more coffee seed. His family started their

Master of the bossa-nova beat, Antonio Carlos Jobim (**above**) composed the mesmerizing score for the classic Brazilian film *Black Orpheus*. Using his talents to serve conservation—"I just wrote a song about the turkey buzzard"—Jobim works for the day when respect for the environment will equal the rush to exploit it.

Bearing the torch of modern sculpture, teenager Marise Prosdocimo (**right**) aspires to create the kind of whimsical works that surround her at the Center for Creativity in Curitiba. The fine and folk arts share a vigorous tradition in Brazil, and zest for self-improvement flourishes.

nursery and still sets out more coffee seedlings. "But my neighbor—he only plants soybeans," says Dr. Ferraz. "He has invested in heavy machinery, so he cannot afford to return to coffee."

The black laborer João Batista fared differently. "I stayed for a while to cut coffee trees and turn plantations into pasture. But then I moved."

Few Leave Lovely Curitiba

I met João Batista in Curitiba, capital of the State of Paraná, where he works as a night watchman for a thousand cruzeiros—$66.50—a month. His wife and son also found work, and the family lives in a new house, built by the municipality in a slum-clearance pilot project. "No, I will never return to the coffee farms," says João Batista. Both his son and his wife are now going to school. They like Curitiba.

No wonder. In this city of more than a million people (following pages), the tall buildings are clean, the parks plentiful and profuse with flowers, and the climate delicious (just south of the tropics at 3,000 feet in altitude).

"Ours is known as the University City," said Ted Orla, a son of Curitiba and second-generation Pole. "We have, per capita, the most students of any Brazilian city."

I watched some of the students stroll. Freshman boys self-consciously rubbed their heads, newly shaved for initiation ceremonies. Youngsters admired and polished motorcycles owned by affluent upperclassmen. Girls walked by, heads turned, laughs and

Cutting the Gordian knot of a city that had become ensnarled in its own traffic, Jaime Lerner (**above**), then mayor of Curitiba (**left**), did not hesitate. "We were tired of diagnoses," he says. "We needed action."

By closing some streets and rerouting traffic on others, he created in malls and pedestrian ways a series of "meeting points" for the city's million residents. "There are two important places to talk," Lerner says, "bed and table. One I couldn't do anything about, but tables—points of contact in the city—I had to provide. It was my job."

Lerner's success has put him in demand as a consultant to other cities in Brazil and beyond. And Curitiba, capital of coffee-rich Paraná State, now enjoys a reputation not only as a humane city, but also as one attractive to commerce and industry.

comments flew. That's the ambulating way on Curitiba's cobbled walkway, the myrtle-brightened Rua das Flores.

This Flower Street was once a driver's dread, with strangled traffic in the aging center of the city. Then a young architect, Jaime Lerner (preceding page), became mayor in 1971, and his team of youthful planners turned Rua das Flores into the symbol of a citywide renaissance. Today Rua das Flores incites crowds to loiter. Pausing at a newsstand, licking an ice-cream cone, flirting over a demitasse, people watch people.

Like the city's strollers, new industries have also been attracted here—more than a hundred since 1973. Factories have sprouted in a new 17-square-mile industrial city to the west, downwind from the prevailing easterlies to avoid future smog problems.

"Curitiba has all the advantages," says Dr. Lotario Weigert, chief of the industrial city's expansion department. "Location, labor skills, high education level, a good transportation system. Imagine: a city without major traffic problems! Soon we should be getting 8,000 new jobs here each year. All kinds of businesses: manufacturing trucks and refrigerators, packing horsemeat for export to Japan, making textiles, hypodermics, and electronic equipment. Everything!"

Curitiba's main exports go downhill—as I did by train one afternoon—through the scenic

Pregame warm-up of gesturing conversation betrays the Latin origins of Portuguese and Italian workers taking a domino break at São Paulo's Municipal Market. Most immigrant groups have been assimilated into Brazilian society, including the die-hard

Serra do Mar mountain range to the port of Paranaguá, population 80,000. If the São Paulo port of Santos remains the nation's largest, the 32-foot-deep port of Paranaguá proudly claims to be "on the economic frontier with soybeans," as one executive insisted. After the freeze in coffee areas, many of the planters switched to soybeans; in three years Brazil became the world's second largest soybean exporter, after the United States.

The soybean harvest of 1976 caused a massive traffic jam on the Paranaguá highway: a nine-mile-long line of trucks waiting to unload. Many drivers parked in line a full week. Now eight Paraná farm cooperatives have built their own new port facilities. "Last year we handled more than 400,000 tons," said port engineer Alfredo Jorge Budant, "and this year we'll have one million."

Cheaper Coffee in 1980?

But inevitably talk still turns to coffee. Says Joscy Antonio Silva, president of the Paranaguá Coffee Center: "Our quantity of coffee is down, but with higher prices our revenue is up. If we are lucky, Brazil can still pay for oil with coffee. That's four billion dollars. With good weather and crops—and with new coffee planting in Minas Gerais—you North Americans should have cheaper coffee again in 1980."

After workaday trips to the south, I would

Confederates who arrived after the U. S. Civil War. The leather-crafting Kobashi family (**below, right**) is part of the largest Japanese population outside Japan. One proud Brazilian told the author: "Only my face is Japanese."

DICK SUBRANCE II (BELOW)

sometimes return to Rio de Janeiro to spend the weekend. I had a solid excuse: Carnival was approaching and my samba group had Saturday rehearsals.

The pre-Lenten festival of Carnival does to Rio what Mardi Gras does to New Orleans —plus what Vesuvius did to Pompeii: The four-day celebration involves perhaps five million people at costumed receptions, block parties, and grand balls, and culminates in three simultaneous 18-hour parades of competing escolas de samba.

Each escola boasts thousands of dancers and musicians who spend most of the year preparing for the Carnival season. Mine was a poor man's group named Mocidade Independente de Padre Miguel, with members from a working-class neighborhood called Bangú. What our group lacked in wealth, we made up for in our 2,500 members, our enthusiasm, and our 160-man *bateria*, or percussion section, which had won us a second-place honor the previous year.

I say *us;* the pronoun came with loyal ease after my first sweaty summertime rehearsal. It was held in a roofless compound an hour's drive from the Rio waterfront. Over cacophonous sambas, fellow members fed me tidbits of Carnival gossip.

Racketeers Support Samba Schools

"You know our 'Game of Beasts'? It's the Brazilian numbers game—illegal. Every number corresponds to a beast; one is the eagle, two an ostrich, and so on. Well, the owners of these beast games—the beast men, or *bicheiros* —are rich. They are patrons of samba schools —they pay the bills. Not ours, of course! But you should see some of the other schools' rehearsals. I've seen people shot—*killed,* by rival gangsters!"

And: "Last year our enemies almost ruined Mocidade. Two weeks before Carnival, all our *fantasias*—our costumes—were burned . . . Well, our president simply wrote a large check, and seamstresses sewed new ones. This year our warehouse location is secret."

I talked to Hilda, the wardrobe mistress, and to designer Augusto, a green-eyed black man who confided the address of our secret warehouse, and to Ivonilda Peçanha da Silva, a handsome woman who for nine years had been the flag bearer, leading our school in the parade. Ivonilda worked as a laundress in a clinic, but she would wear a $3,000 costume, Cinderella style—the laundress crowned queen for a night.

But full-time royalty was also busy with Carnival plans. "My daughter is in the Portela School," Dom Pedro, princely patriarch of the imperial family, told me.

As our bateria chief, José Pereira da Silva, put it: "Each country has its rhythm, and the samba is ours. It penetrates all social levels in Brazil." So in the most festive sort of way, I began to penetrate the real Rio.

A City of Unwilling Workers

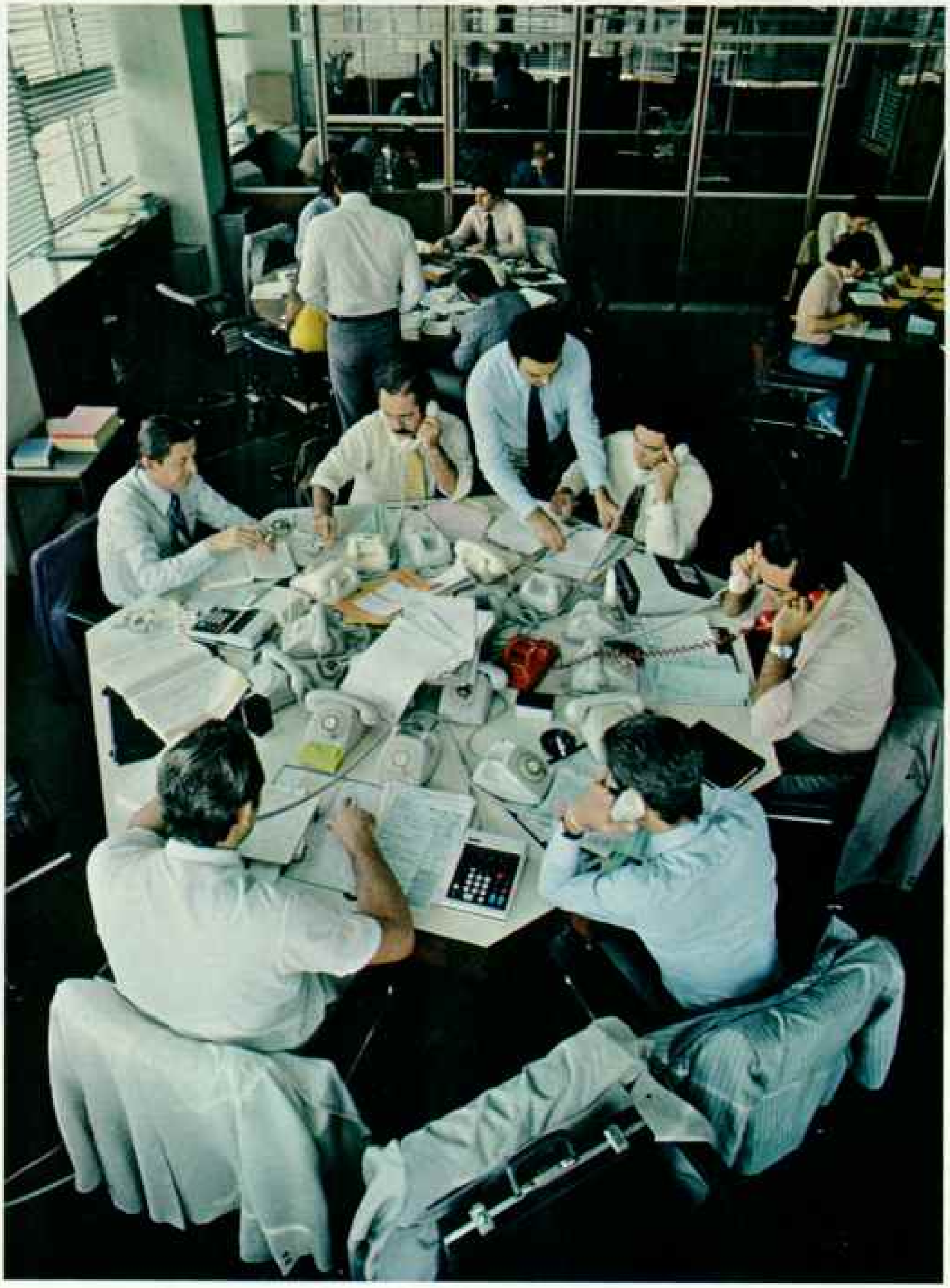
The Carioca artist Augusto Rodrigues notes: "It's not that we don't work. We *do.* But we don't *want* to. The Carioca's first concern is for a holiday. Our lives are shaped by the hills, the beaches, the swirling designs of our mosaic sidewalks. We are late because we can't walk a straight line."

This great beachside city enjoys the spontaneous charm of a sand castle. "So you get stuck in traffic," a cabdriver shrugged—"you can still watch a beautiful girl in a *tanga.*" The tanga is a Brazilian bikini so brief as to make nudity seem prudish.

Yet the seaside life has not always been so popular here. Architect Lucio Costa (page 277) pointed out that "in 1910 the houses on Leme Beach had their living rooms facing inland toward the tramway. Only the maids' rooms and kitchens faced the sea. People didn't believe it possible to live beside the ocean. They also said, 'Cariocas are too individualistic to live in common apartments.' You see the way things are today."

I saw the new apartment complexes as crowded, chaotic, marvelous—part of the world's most beautiful city. Lucio Costa

A little night music soothes the cat and young daughter of Augusto Procopio Pinto, who, at age 79, collects and sells junk in a São Paulo *favela*, or squatters' town. A collector as well of life's daily pleasures, he says, "I'd rather spend my money to live well than to have a fancy house." But since a freeway now runs through where his shack stood, progress has relocated the family far away in government-built housing. [illegible]



Freeze-dried disaster hit when the killing frosts of July 1975 ravaged 80 percent of Brazil's coffee plantations. Replanting continues (**left**), as a girl closes the pail that gave agricultural workers their nickname: *bôias frias*, or cold lunches. The ruined crop coincided with sharp rises in costs of imported petroleum, causing severe economic imbalance. Though the complex trading in coffee futures remains a staple of São Paulo commerce (**above**), dollar-a-pound coffee has gone the way of the five-cent cigar.

Superbean to the rescue. After the ruin of the coffee crop, many Brazilian farmers uprooted their withered trees and planted soybeans, shown here in combination

winced at my comment, waving away the high-rise wall of hotels on Copacabana (where people live 25,000 to the square mile), and said, "Before the Europeans came in the 16th century . . . when it was lonely here with Indians, mountains, and sky—*then* Rio was a beautiful place!"

Having missed Rio then, I prefer it as it is now, organic and disorderly. Old downtown Rio is doodled with the lace of wrought-iron balconies, enough of it to shame New Orleans.

The streets roar. Sambas blare from disc shops. Window air conditioners spit droplets onto sidewalks. Along the Rua da Alfândega, Carnival business quickens; this is the street for sequins, masks, and costume supplies—a walkway to fantasias.

Beyond the baroque churches at its center, Rio grows young. I preferred Sugar Loaf before its new, wartlike station for the cable trains, but I find the train ride itself as exciting as the view from the summit of Corcovado. Seen from such quasi-aerial points, Rio seems the whitest, most shining large city in

with rice fields in western Paraná. In short order good growing conditions and favorable world markets have made Brazil the world's second leading soybean exporter.

the world. Even most of the city's 270 favelas have a great view.

Visitors race for the beaches (Rio has dozens of them), nipping into tunnels to Ipanema. The composer-singer-musician Antonio Carlos Jobim (page 262) gave world fame to the girl from Ipanema. He himself lives near the beach next door, Leblon. "We will not have social justice in Brazil," he quipped during a recent TV special on the environment, "until everyone moves to Ipanema Beach." Though individual condominium apartments here can sell for a million dollars, crowds indicate that justice may not be far off.

Rio has spectacular parks and museums. A botanical garden nourishes 5,000 varieties of plants, including *pau-brasil*, the tree from which brazilwood comes, and which gave this nation its name in the 16th century. But varieties of human life provide Rio's most animated spectacle. At high noon or at midnight, sports enthusiasts play, on beach and court, games of volleyball, tennis, and—inevitably—soccer. Cariocas consistently fill

all 180,000 seats of the Marcanã, the largest soccer stadium in the world (page 251).

I still prefer the people-watching on Copacabana Beach just as sunset turns to dusk and the *maresia*, evening breeze, refreshes the shore. Swimmers in damp swimsuits and sandy T-shirts move slowly homeward. Then, as streetlights blink on, the tempo changes. Cariocas begin to plan their evening—the delicious drink called *batida*, a flirtation, a dinner of seafood, a samba school rehearsal, or a séance with a spiritist.

Religion Takes Various Forms

Below the surface old African religions thrive in the soil of Brazil. One of the spiritist groups is officially recognized, so that its marriage ceremonies can be legally performed. The higher clergy of another group, candomblé, are often trained in Africa.

But followers of these religions are not confined to Afro-Brazilians. At elegant Rio dinner parties I have heard bejeweled ladies talk about the exorcism of their houses as casually as of termite control. And on New Year's Eve, all Rio turns out to rim the beaches with votive candles, to honor Iemanjá, the water goddess. Rio has some 600 stores selling magic potions, amulets, and spiritist idols. In one store's showcase I counted the dried remains of three bats, two tarantulas, one toad, one small snake, and 15 scorpions.

But the strongest beliefs I found in Brazil had nothing to do with religion. Instead, they concerned the attitudes that some of the middle-class Brazilians have about the poor. Historian José Honório Rodrigues calls the Brazilian middle class that 15 percent of the population "marked by indignation rather than by influence." These were the folk who tried to warn me away from the working people of my samba school.

"When those toughs go into town for Carnival, they'll all be drunk and dangerous," they insisted. But it seemed illogical; passengers would all be in costume on our special

BOTH BY DICK DURRANCE II

From one Rembrandt and one Picasso in 1947, the São Paulo Art Museum has grown to become perhaps the best in South America. Another early asset was director Pietro Maria Bardi (**above**), author and critic, who built the collection that now ranges from 13th-century Italian paintings to those of contemporary Brazilian artists. At a party commemorating the 50th anniversary of Camargo Guarnieri as conductor of the São Paulo symphony, two Paulistas (**right**) epitomize the role of their city as a leader in Brazilian culture.

Carnival train, and each costume cost a month's wages. Besides, even cutthroats want a night off to play.

I visited the secret warehouse where our floats were stored, on the Rio waterfront. The parade was to begin in just 24 hours, yet all was chaos with the smell of sawdust and glue. Hilda, the wardrobe girl, was weeping about some sequin problem. And the dashing float designer, Augusto, was angrily pounding his right fist into his left palm. "No sleep for three nights," someone explained. "We have 12 floats, and we worry that the paint will not be dry."

Somehow it was. The afternoon of the parade we packed into cars at Bangú, standing room only, hanging onto straps, a trainful of costumed revelers. We sang our samba school song, banging rhythm on walls, turning the train itself into one big percussion instrument. Drunks? We had one or two amiable ones; we steadied them on the curves.

Disembarking at the Rio station, we sang our echoing way past kiosk keepers, who came out eagerly to point at us respectfully, and exclaim, "Ah, Mocidade!" I felt a truly personal pride.

Dancers Plagued by Bad Luck

In a way that moment was my happiest at Carnival. The parade itself was a disaster.

We danced our way past the bleachers and judges' box. Television lights blurred our view of 50,000 faces. I could hear applause —then suddenly, nothing at all. Our electronic sound system had failed. We could hear neither music nor the pulse of our famous bateria. We sang a cappella, every man for himself, off-key, and danced out of step.

Our school finished in eighth place.

"Next year will be better," said Ivonilda, dabbing at her tears. "Mocidade is getting a roof so we can rehearse even in the rain."

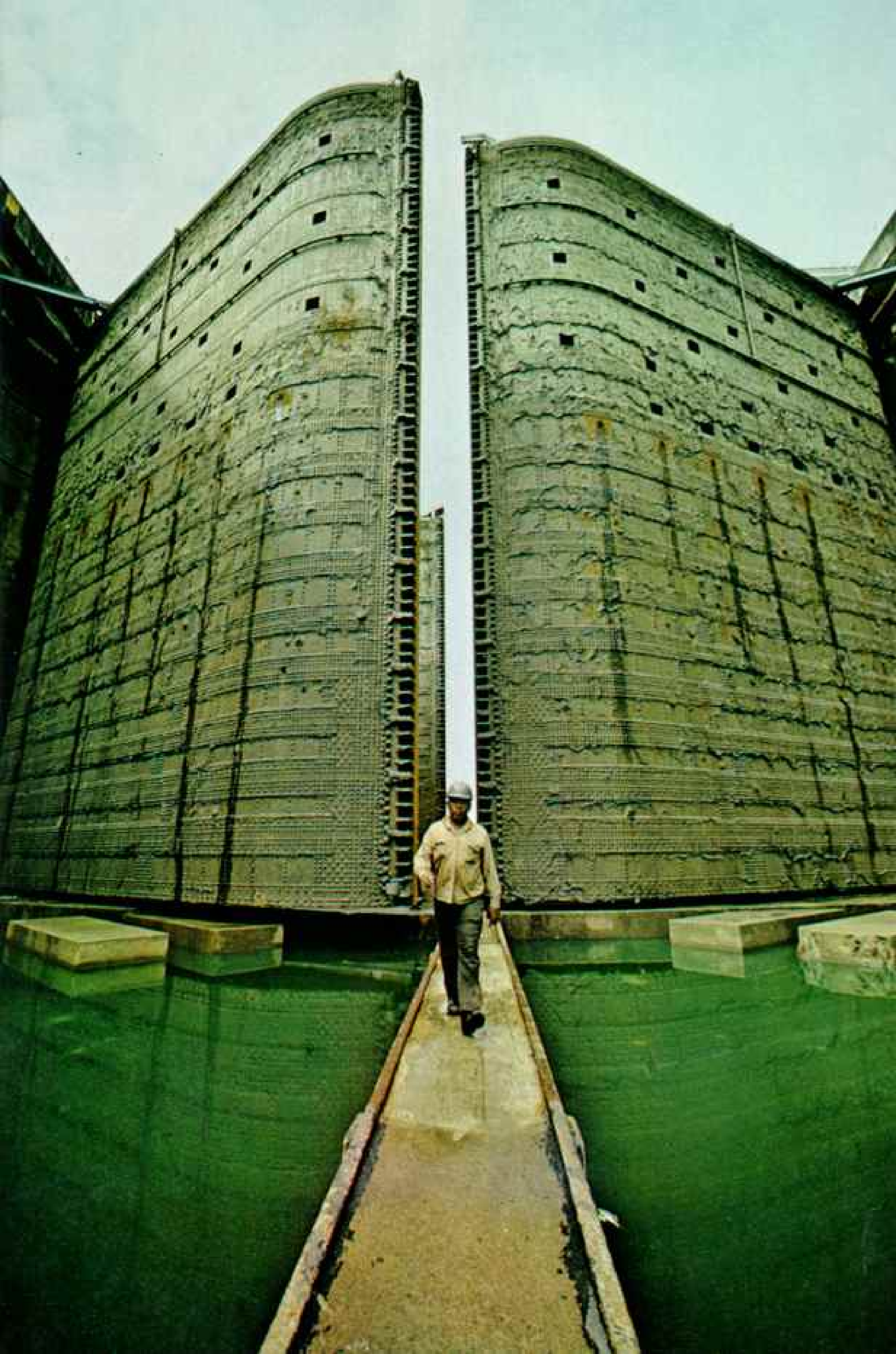
"Carnival takes our attention away from our troubles," a Brazilian friend remarked. "But someday, when the samba music stops, we need to think about poverty and inflation."

And also about the energy shortage, and about the world coffee market, and the environment, and the Amazonian frontier, and eventual free elections, and more. Of course, the Brazilians are forever great at improvisation. "And," added my friend, "the samba may just never stop." □

A world of its own, São Paulo spreads out uncontained even by an ultra-wide-angle lens (**above**). Now first in population, industry, traffic, and pollution, São Paulo has eclipsed Rio in size and economic importance, but not, Cariocas will argue, as a city in which to live the good life.

The look of today's urban Brazil owes an immense debt to Lucio Costa (**right**). Beginning in the 1930's, he and his innovative colleagues adapted the ideas of Europe's modernist architects into forms and plans truly Brazilian.

To blueprint the future, Brazil will try to guarantee economic growth without inflation and political stability without repression, then stamp the result: "Made in Brazil."



The Panama Canal Today

By BART McDOWELL

Photographs by GEORGE F. MOBLEY

BOTH NATIONAL GEOGRAPHIC STAFF

FRIDAY, 0936 HOURS, *port of Cristóbal. Preparing to transit Panama Canal, Atlantic to Pacific.*

A traveler could have logged similar words aboard any of some three dozen ships that daily make the 51-mile inland voyage between the seas. The entry comes from a log I kept aboard the *Andros Castle*, a Greek-manned freighter of Liberian flag carrying Texas sorghum to Japan. Ships, crews, cargoes are routinely international here, and these days the canal carries more than a hundred million tons of cargo a year. Little wonder that the complex new treaties for operation and control of this canal have sparked worldwide interest and headlined debate.

The headlines have brought me here to make this transit. I want to look behind them, to observe the everyday operation of this vital waterway, to meet some of the people—American "Zonians" and Panamanians—who make it work. I have personal memories here, for I celebrated V-J day aboard a transport in Gatun Lake. Not so strange. Just as this isthmus often intersects with history, so my logbook sometimes converses with the past.

Icons on bulkhead in chart house. We drink thick Greek coffee on the bridge. Our two pilots discuss work with captain; helmsman stands by. I scan the crowded harbor and city of Colón.

The Spanish name honors Columbus, whose frail fleet visited these shores in 1502, arriving upon "seas so high . . . a mass of foam . . . boiling like a cauldron on a great fire."

Balboa followed, and found the legendary "other

COLVER PICTURES

NOW WATCH THE DIRT FLY!
From the Globe (New York)

Opening the way just a crack for an inspecting workman (**facing page**), the massive gates at Gatun Locks swing wide for ships of many nations passing through the Panama Canal—the 51-mile-long shortcut that links the Atlantic and Pacific. Inspired by the roughriding leadership of Teddy Roosevelt (**above**), the United States in 1904 took over construction of the canal from a bankrupt French enterprise and ten years later finished the Big Ditch. Now, in response to Panama's demand for greater control over the canal and its revenues, treaties negotiated since 1964 have been signed by both countries. If ratified by the U.S. Senate, they would end U.S. jurisdiction by the year 2000.

ocean" he named the South Sea. Peruvian gold and silver crossed here by muleback. Later, forty-niners plodded the other way, bound for California's gold rush. In 1855 the first transcontinental railroad here charged $25 in gold to ride one way, or $5 to walk the ties. (Today it's $1.75—in an air-conditioned coach.) Colón stood on pilings above mud in 1879 when the builder of the Suez Canal, Ferdinand de Lesseps, came to inspect and inspire his new waterway project with a prophecy: "The canal will be made!"

It was. But first came the Republic of Panama itself—with full encouragement from the United States. During four swift days of November 1903, Panamanians declared independence from Colombia, the cruiser U.S.S. *Nashville* arrived off Colón, and the State Department recognized the new country. In less than two weeks a French citizen serving as minister plenipotentiary of Panama signed a canal treaty in Washington, D. C. For ten million dollars and a $250,000 annual fee, the U.S. took exclusive control of the ten-mile-wide Canal Zone.

Malaria and yellow fever had brought death and bankruptcy to de Lesseps' canal plan, but the dream of a waterway had survived. Theodore Roosevelt summed up succinctly: "I took the Isthmus, started the canal, and then left Congress—not to debate the canal, but to debate me. . . . But while the

Halfway between oceans, a cargo ship headed toward the Pacific furrows

debate goes on the canal does too." In 1914 the Big Ditch was completed. The total cost was 387 million dollars, including 40 million for French property rights and equipment, but the new waterway cut 9,000 miles off the voyage between New York and San Francisco.

In 1978 the debate goes on.

Delayed by lock repairs, Capt. N. Doryzas has been waiting his ship's turn for two days, among two dozen other vessels. Pilot Dick Andrews takes command. Captain Doryzas is nervous about possible collisions. Dick is not. It's his 1,127th canal transit.

Even the captains of warships must yield control of their vessels to pilots here—a procedure unique among all the world's waterways. The canal itself is unique. The *Pilots Handbook*, for example, charts currents at the Gatun sea entrance with split-level movement: Fresh water on the surface flows in one direction, while heavier salt water at the bottom moves the opposite way. The handbook discusses hazards of "bank suction," "vessel 'squat' and 'surge' in Gaillard Cut," shoaling, tides of 20 feet on the Pacific side and mere inches on the Caribbean.

Dick's orders to the engine room are gentle: "Half ahead, please." We pass a fruit ship named Jakov Alksnis *in Cyrillic lettering.*

"The second *(Continued on page 287)*

jungle-lined Gatun Lake. Some three dozen ships travel the canal every day.

CARIBBEAN SEA

Galeta Island

Fort Sherman

Coco Solo

Colón

Cristobal

Rainbow City

Margarita

Fort San Lorenzo (ruin)

Chagres

Fort Gulick

French canal

Fort Davis

Gatun Third Locks excavation

Gatun Locks raise and lower ships 85 feet.

Gatun

Gatun Dam

GATUN LAKE

PANAMA RAILROAD

A proposed path for a future sea-level canal is called Route 10. A price tag of 5.3 billion dollars and ecological problems cloud its prospects.

The railroad, opened in 1855, was relocated during the building of the canal.

BOHIO BEND

PANAMA

Barro Colorado Island

Escobal

The Smithsonian Tropical Research Institute is expected to remain custodian of Barro Colorado after the year 2000.

Darien

CAMBOA REACH

GATUN LAKE

Canal Zone boundary follows the 100-foot contour around Gatun Lake.

The first ship passed through the canal on August 15, 1914, only days after World War I exploded.

CANAL ZONE

0 KILOMETERS 5

0 STATUTE MILES 3

MAP AND DIAGRAM BY ROBERT C. MAHIS, SHELLMAN STEPHENS, AND LEO B. ZEBARTH
RESEARCH BY ANN RUNNA
NATIONAL GEOGRAPHIC ART DIVISION

Colón

Gatun Locks

CARIBBEAN SEA

ASIA

JAPAN

NORTH AMERICA

Europe receives 39% of Atlantic-bound cargo

52% of Atlantic cargo travels to North America

AFRICA

24% of Pacific-bound cargo reaches the west coast of North America

62% of Pacific-bound cargo goes to Asia

SOUTH AMERICA

1% of Atlantic cargo goes to Africa, 8% to South America

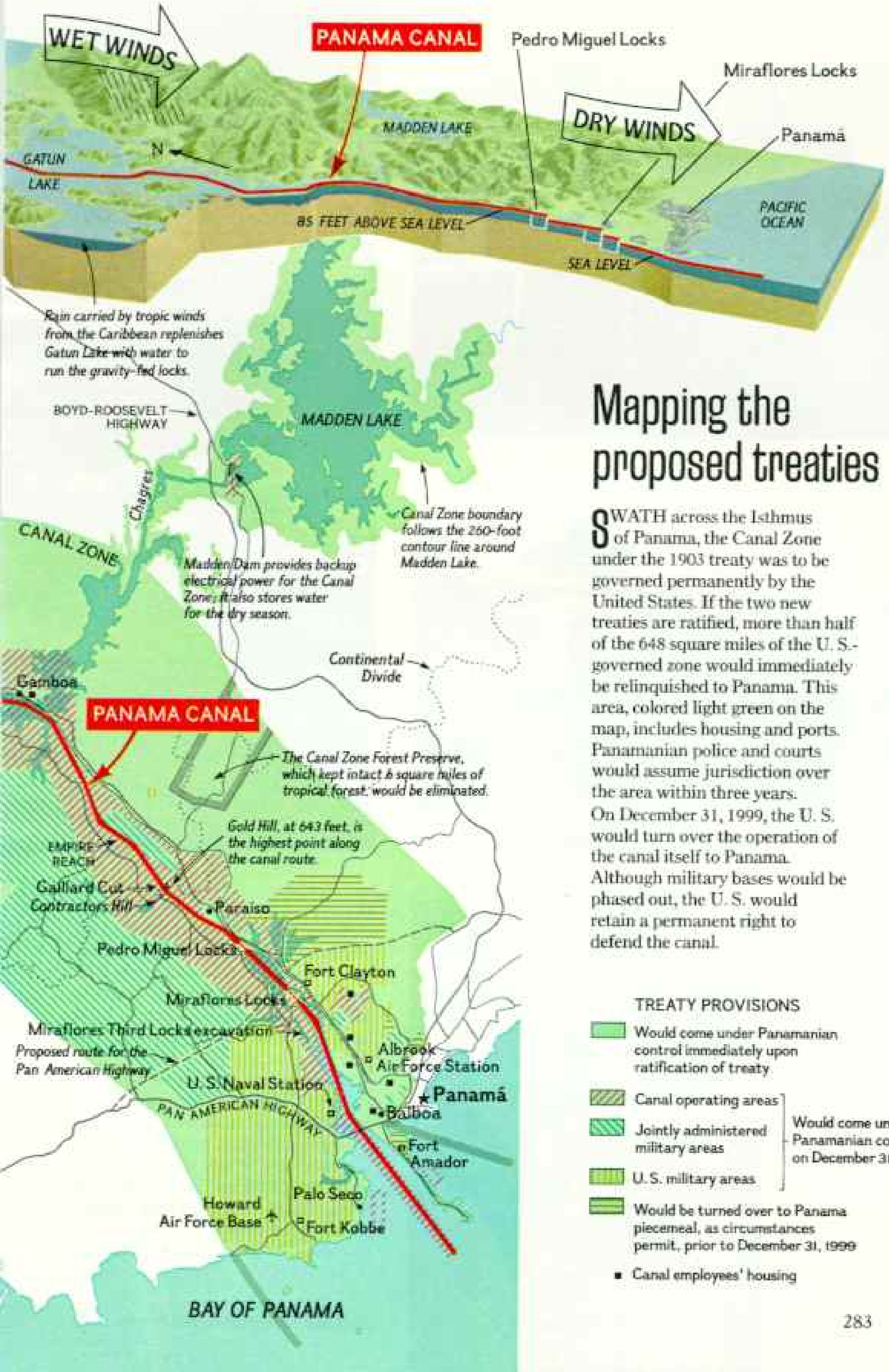
PANAMA CANAL

10% of Pacific-bound cargo travels to South America

AUSTRALIA

Oceania receives 4% of Pacific-bound cargo

Building a waterway through the Isthmus of Panama, first proposed by Spanish conquistadors in the 1520's, saved 9,000 miles for ships traveling from New York to San Francisco. Today some 5 percent of the world's total ocean cargo passes through the canal.



Mapping the proposed treaties

SWATH across the Isthmus of Panama, the Canal Zone under the 1903 treaty was to be governed permanently by the United States. If the two new treaties are ratified, more than half of the 648 square miles of the U. S.-governed zone would immediately be relinquished to Panama. This area, colored light green on the map, includes housing and ports. Panamanian police and courts would assume jurisdiction over the area within three years. On December 31, 1999, the U. S. would turn over the operation of the canal itself to Panama. Although military bases would be phased out, the U. S. would retain a permanent right to defend the canal.

TREATY PROVISIONS

- Would come under Panamanian control immediately upon ratification of treaty
- Would come under Panamanian control on December 31, 1999
  - Canal operating areas
  - Jointly administered military areas
  - U. S. military areas
- Would be turned over to Panama piecemeal, as circumstances permit, prior to December 31, 1999
- Canal employees' housing

"**Hard to starboard**. . . . Hold her steady. . . . Dead slow ahead." Calling commands by radio, canal pilot James Wallace (**above**) adroitly maneuvers a leviathan cargo ship into the locks at Miraflores. Veteran of more than 2,000 canal passages, Wallace belongs to an elite group of 200 pilots who guide all ships going through the waterway. The Panama Canal is the only place in the world where a military skipper gives over navigational control of his ship. Unpredictable winds and water currents, thick fogs, and narrow shipping lanes challenge these highly trained pilots. Since 1914 only one of every 400 ships has reported any damage

National Geographic, February 1978

during the eight-to-twelve-hour transit.

Any vessel traversing the canal must pass through six locks, half of them raising the ship 85 feet into the waterway at the start, and the other three dropping the ship back to sea level. Containership *Zim California* waits inside Miraflores Locks as the water slowly lowers it to the Pacific level (**top** and **middle left**). Control-house operator Richard Chaney (**left**) regulates the water flow in the chamber. For each transit of the canal some 52 million gallons of water—enough to supply a city of 250,000 population for a day—spills through systems of 18-foot culverts (**right**) and out of the locks.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PANAMA CANAL COMPANY

A day's silence did not come for seven years to Culebra Cut (**above**), where canal builders faced their most difficult challenge: How do you dig a nine-mile-long trough through the Continental Divide? Between 1907 and 1913 steam shovels groaned, dynamite exploded, and trains shrieked, as 96 million cubic yards of rock was excavated, 28 times as much as in Egypt's Great Pyramid. Massive slides often wiped out a month's labor. Today the ravage still shows as a Norwegian ship (**left**) glides through the 500-foot cut, renamed Gaillard for the engineer who supervised the work. A nearby drilling vessel digs still deeper.

(Continued from page 281) Soviet ship we've had today," notes Jim Wallace, pilot-training coordinator. Jim, making his 2,049th transit, will take the bridge during the southern half of the run (page 285). Ship size and type of cargo determine the number of pilots. We need two; ships that fill up the 110-by-1,000-foot chambers require at least four to watch the narrow clearances.

With the aid of the tugboat *Morrow* we approach Gatun Locks. Dick points. "There on the starboard hand you see the old French effort. Small ditch. But deep enough to drown in," he says. "Someone did recently." The French managed roughly one-third of the necessary excavation before giving up.

1040 HOURS. *Dick orders, "Stop engine—Morrow stop." Our whistle toots once. We ease alongside canal entrance and wait. Electric locomotives called mules will now tow us with lines fore and aft.*

Like about half of the canal's 200 pilots, Dick and Jim live on this north side of the zone. Earning between $29,000 and $45,000 a year, pilots are the aristocracy among the 10,500 civilian Canal Zone residents. (Military families bring the population to 38,000 —about 4,000 of them Panamanians.)

1115 HOURS. *Over his walkie-talkie Dick directs the locomotives: "Number Ones can go to towing positions. . . . Hold her steady!" We slide through massive gates into the lowest chamber of Gatun Locks.*

The three chambers here lift ships 85 feet to the level of Gatun Lake (pages 280-81). All the water flows by gravity from the lake itself through three culverts, each more than half the diameter of the Holland Tunnel. Our ship will use 26 million gallons of water to climb to Gatun Lake, a like amount to descend on the Pacific side. Nine months of heavy tropical rain each year keeps the canal working.

1142 HOURS. *"Full ahead, please." We enter the next chamber.*

Yesterday, when I visited Dick's house, I could see ships in the Gatun Locks from his windows. Now, from the freighter, I can see the three-bedroom house, a pleasant, old-fashioned place renting for $120 a month.

Pretty Irene Andrews, a schoolteacher until she married Dick, lives an outdoor life with

Man in charge: H. R. Parfitt (**left**), Governor of the Canal Zone, also heads the Panama Canal Company, the waterway operator. Some 34,000 U.S. civilians and military personnel live in the zone under U.S. laws. Since 1958 company commissaries (**below**) have been open to Panamanian employees of the canal who live in the zone.

Cuddly young margay frisks with Dr. Katharine Milton (**left**) at the Smithsonian Tropical Research Institute on Barro Colorado. The zone boasts one of the highest concentrations of Boy Scouts in any American community. A parade grabs the attention of one (**above**).

tennis and golf. Daughter Elizabeth is bused to school and enjoys horseback riding.

Irene had a maid until four years ago, when U.S. minimum-wage laws were applied to Panamanian domestics in the zone. "I wasn't used to maids anyway," says Irene. Nor to other things: Once, putting out the garbage, she encountered a boa constrictor. ("That was before the vampire bat got into the kitchen.")

Irene shops at the local commissary, where U.S. grocery prices are based on those in New Orleans. "I used to go into Colón twice a week. But now"—Irene pauses—"I just don't feel that comfortable about it. I haven't been outside the zone for some time."

The last significant anti-American riots flared in 1964, when Panama temporarily broke relations with the United States. Ever since then, the two governments have been negotiating new terms for the existing treaties. A 1967 treaty was rejected by Panama. In 1968 diplomacy was delayed by the overthrow of the government. The present treaties, signed late last summer and debated ever since, were in negotiation for four years.

I watched the Panamanian campaign during the plebiscite on the treaties last October. Graffiti penned on University of Panama buildings by leftists who want immediate control of the entire zone railed, "No bases!" Full-color wall cartoons pictured blue-eyed imperialist devils. Yet at one rally opposing the U.S.A. as well as the treaties, three young lawyers bought me a beer, saying "Nothing personal."

The treaties carried by a two-to-one vote in Panama, less than expected. And the charismatic strong man, Gen. Omar Torrijos Herrera, responded to some U.S. Senators' criticism that his regime disregards human rights by offering to resign if his presence should endanger ratification of the treaties by the U.S. Senate.

1210 HOURS. *"You can open the gate now, please." We move ahead.*

Jim Wallace's wife, Sue, was born here in the canal zone to U.S. parents, so like 18 percent of the Zonians she technically holds dual citizenship. "I go into Colón every day," she says. "I'm a member of the garden club there—lots of friends."

"She grew up speaking Spanish, of course," puts in Sue's mother, Mrs. Inga Prier. "So did

I." And no wonder: Mrs. Prier had come to Panama as a 4-year-old in 1902 with her engineer father. "When we got off the ship at Panama City, Dad handed us an umbrella and said, 'Don't ever go out without it.' Panama had no garbage or sewage system then—people threw everything out the windows."

Her memories of "this wonderful old canal" are as vivid as her oil paintings. "General Gorgas was grand, an Episcopalian like us. And Colonel Goethals—very tall and military." When President Theodore Roosevelt visited the construction site in 1906, young Inga presented the First Lady with a bouquet —"and Teddy picked me up and hugged me."

In Panamanian neighborhoods I heard other recollections. A black captain in the Panamanian Guardia Nacional told me he grew up in Colón and sometimes explored across the line into the zone. "Zone policemen then would arrest us for—is the word 'loitering'? I grew angry. So angry I learned to box so I could fight the Zonians. That is how I got to be a Golden Gloves champion."

And in Rainbow City, a community of Panamanians within the zone, an illiterate gardener raised his own ten children as well as four adopted ones in a small three-bedroom apartment so they could learn English in a zone school.

"Home was noisy," recalls the youngest of those children, Juan Luna (right, center). He graduated from high school with honors, joined the Panama Canal Company apprentice program, and became the first Panamanian to qualify as a control-house operator. Today at 27 he orchestrates the flow of water and ships in and out of the Gatun chambers, taking home $900 a month.

Another Zonian, Leverne Jackman, grew up in Paraíso, a community of folk descended from the black, English-speaking construction laborers brought from the West Indies. "My father worked for the dredging division," Jackman recalls. "The commissary at Gamboa had a wall down the middle. People who were paid on the Panamanian pay scale—mostly blacks—could shop only on their own side, but whites could shop in both places."

When Maj. Gen. William A. Carter was appointed Governor of the Canal Zone in 1960, he ended that practice promptly: "We issued everyone new identity cards—all the same color so everyone could shop on both sides of

The canal was a scar of colonialism in the eyes of Gen. Omar Torrijos Herrera (**right**) when he became Panama's leader in 1968. Torrijos urged the treaty that his countrymen approved last year two to one. His faith in a Panama-run canal rests on men like Juan Luna (**below**), first Panamanian control-house operator.

Counting on the future, Luis Wong (**above**) learns welding at an apprentice school. Panamanians, some 75 percent of the canal's employees, are currently winning better jobs. But under the new agreement a worker (**right**) would have even more opportunities.

the wall. Integration didn't even make the local papers."

Leverne Jackman grew up free of grudges, moved to New York City, and made the U. S. Army his career. Today he is back, using his bilingual gifts, a sergeant on liaison duty between U. S. military police and the Panamanian Guardia Nacional.

"No incidents last night in the entertainment district," Sergeant Jackman grinned. "In fact, it's usually quiet, even on paydays."

The provost marshal of the 193rd Brigade, Col. S. J. Lobodinski, concurs. "I've rarely seen any trouble between Americans and Panamanians. Relations are friendly."

I heard about one American woman who, in two years, had never left the zone for the adjoining Republic of Panama. But she was an exception. Conversely, I learned, the First Baptist Church at Balboa Heights transferred from the Southern Baptist Convention to an association of Panamanian churches. It holds services in both Spanish and English and seems unselfconsciously integrated.

"In the beginning the U. S. Government had to entice people here," explains Maj. Gen. Harold R. Parfitt, Governor of the Canal Zone (page 288). "People wanted a piece of America—a feeling of home. Today they feel it's *their* canal. That fierce pride makes it hard to accept change, but it's also what keeps the waterway functioning efficiently."

That piece of America includes one of the highest numbers of Boy Scouts per capita in America, good schools, a plethora of clubs—but almost no privately owned businesses and no local elections. "Our only American soviet," a diplomat wryly says.

Only a number identifies the grave of a Frenchman who died during the 1880's, when the French struggled to build a sea-level canal. Some 20,000 workers lost their lives, many from malaria and yellow fever. The U. S. work force fared better. Identifying carriers of diseases to be mosquitoes, not swamp gas, the U. S. doctors dramatically cut the death toll. A survivor of the American effort (**facing page**), Valentin Rivas, 93, still picks up a pension check, but now forgets what his medal was for.

1256 HOURS. *Bos'n gang casts off lines from electric mules. "Half ahead, please." Ship moves onto Gatun Lake.*

"If you want to take on fresh water for your boilers, it's good here," Dick advises the captain. A cool breeze, lush green shoreline, a sense of exhilaration. Deckhands with cameras record their personal encounter with history.

I feel it too. At this precise spot on August 14, 1945, my transport, the U.S.S. *Crosby*, picked up the radio dispatch that World War II was over. A proud moment—especially for the canal; without it victory could never have come so soon.

Off our port bow a ship waits at anchor. She's named the *European Highway*, Atlantic-bound with a cargo of automobiles; her flag is Japanese. Much water has flowed through Gatun since V-J day.

Today trade patterns have shifted; no longer is the canal chiefly a corridor between the U. S. coasts. More ships now ply the waters between Asia and the east coast of North America. Despite that, 45 percent of all canal cargo still originates in the U. S. and 26 percent is destined for U. S. ports.

The canal was always a money-maker until recessionary pressures in 1973 gave it its first recorded deficit. Losses through 1976, compounded by the reopening of the Suez Canal and an increase in the number of superships too large for the Panama locks,

totaled 29 million dollars. Today, however, bolstered by newly arriving tankers carrying North Slope oil from Alaska, the canal is again in the black. And changes have come to the canal itself.

New lighting now permits night transit for most ships. And Gaillard Cut has been widened from 300 to 500 feet. Excavations were once begun for a third lane of locks, but the work was abandoned at the outbreak of World War II and never resumed. Some of the steel sheathing that once protected gates against World War II bombs has been removed now. What could protect them against a nuclear missile?

Although the Pentagon no longer lists the Panama Canal among the strategic necessities of U. S. defense, the canal is not obsolete. Only 13 ships of the U. S. Navy, the biggest of the nation's aircraft carriers, are too large for these locks, and 95 percent of the world's ships over a hundred gross tons can still use the Big Ditch (right).

1343 HOURS. *At 12 knots we approach Bohio Bend, sharpest turn in the passage. On our starboard hand spreads Barro Colorado.*

That's the largest island in Gatun Lake, a hill until moated by the dammed-up Chagres River. Today it serves as a living laboratory for the Smithsonian Tropical Research Institute. Studies conducted here touch the fundamentals of tropical life.

Howler monkeys, for example. The howler has a special importance as a sentinel against yellow fever. Dr. Nathan Gale, veterinarian

with the Canal Zone Government, notes that in 1949 the island's population of howler monkeys dropped by 50 percent. (It now stands at 1,300.) "The cause was yellow fever," says Dr. Gale. "That was the only time in fifty years that yellow fever had crossed the canal. The deaths of the howler monkeys warned us."

1418 HOURS. *Alongside buoy 62. Passing clumps of water hyacinths. Dick advises skipper, "We'll soon be in Chagres River. Poor water there."*

We are approaching the cut known to excavators as Culebra and renamed to honor the engineer David Gaillard. Yet the greatest challenge in building the canal was not engineering, but medical. During the railroad-construction days, yellow fever and malaria provided the isthmus a ghastly export: cadavers preserved in barrels of alcohol for medical schools. During the de Lesseps era, the same diseases took some 20,000 French lives, dooming their project. Not until after Dr. Walter Reed's experiments with mosquitoes in Cuba following the Spanish-American War did Americans possess the medical skills to build the Panama Canal. Even then one man complained of "mosquitoes so thick I have seen them put out a lighted candle with their burnt bodies."

The job of mosquito control is never finished. Last September, for example, the 10-year-old son of a U. S. serviceman at Howard Air Force Base came down with the zone's first case of malaria in four years. "We beefed

Camouflaged by mud, a soldier of the U. S. Army's 101st Airborne Division slithers through the jungle-warfare course (**left**) at Fort Sherman. Treaty critics claim the canal will not be adequately defended. Advocates argue that it is indefensible against sabotage anyway. The military deems the canal important for transport of troops and supplies. More than 1,500 Government ships passed in 1968 at the peak of the Viet Nam conflict, compared with 85 in 1976. All U. S. Navy vessels can fit in the locks except 13 of the largest aircraft carriers, as shown by a superimposed outline (**above**). Modern supersize oil tankers likewise won't fit.

up our ditch crews and fogged more often," said Willard S. Sweeney, head of the sanitation department.

Today malaria control is complicated by waterweeds—hydrilla, water hyacinths, water lettuce. Some of the plants provide a mat that protects mosquito larvae from the oil sprays and from predatory fishes. The dread malaria vector *Anopheles albimanus* even uses these plants as breathing tubes, plugging into them for oxygen.

If neglected, clogging waterweeds could seriously hamper canal operations. Present measures—poisoning, cutting, and dredging—clearly are not preventing their spread. Ecologists are now considering the introduction of white Amur fish into Gatun Lake. This Siberian native is a carp that can eat its weight in hydrilla each day.

Meanwhile there are manatees. In the 1960's Dr. Gale, the veterinarian, began introducing those huge, sad-faced herbivores into the Canal Zone. It took some doing.

Dr. Gale knew that in remote Bocas del Toro, in western Panama, hunters sold manatee meat. He arranged to buy the animals alive for $300 apiece. Then he convinced the U. S. Air Force to fly training missions there—and haul them back. "With an 800-pound manatee flopping around, few pilots wanted to make the trip twice," he recalls.

Nonetheless, Dr. Gale brought back nine manatees to feast on the pernicious waterweeds. "And they've been breeding," he reports. "Just last week a man reported seeing 'two walruses' in the cut."

1434 HOURS. *Jim Wallace relieves Dick on the bridge. Rain clouds gather. "Dredging Division" proclaims the lettering on a gray building. A floating skyscraper stands nearby, the 250-ton crane* Hercules.

Each day a hydrographic survey boat electronically scans the bottom of the cut, for this region is subject to frequent quakes and landslides. More earth has been removed since the completion of the canal than during its initial construction.

Dredging may even have to be expanded. Gatun Lake's watershed—more than half of which lies outside the zone—is steadily losing its forest, with erosion and siltation the result. Maps of the watershed in 1952 show 90 percent of the forest intact; a 1976 map shows only 40 percent left. Some trees have been cut by timber poachers, others by squatters trying to wring a living from the jungle by clearing land and planting crops.

As the forest recedes, siltation grows and water storage capacity declines. Officials also worry about changing weather patterns. Water conservation measures have already been necessary for Zonians during the past two dry seasons. Without abundant rainwater the Panama Canal cannot work.

1518 HOURS. *Entering Empire Reach, we meet a northbound tanker; perhaps it carries Alaskan North Slope oil. . . . Below Contractors Hill, at the Continental Divide, we meet other ships. At Pedro Miguel Locks, begin descent. . . . Rainstorm catches us. Wearing oilskins, we enter Miraflores Locks. . . .*

These are our last steps down to sea level, and we now use another 26 million gallons of rainwater; precipitation at this wet moment seems to be keeping pace. Ours had been an easy transit, thanks to 1,754 cataloged job skills practiced along this waterway.

1715 HOURS. *In hard rain we climb down rope ladder to pilot's launch. We bob upon salty Pacific waters. Traffic on Teddy Roosevelt's canal goes on. Also the debate.* □

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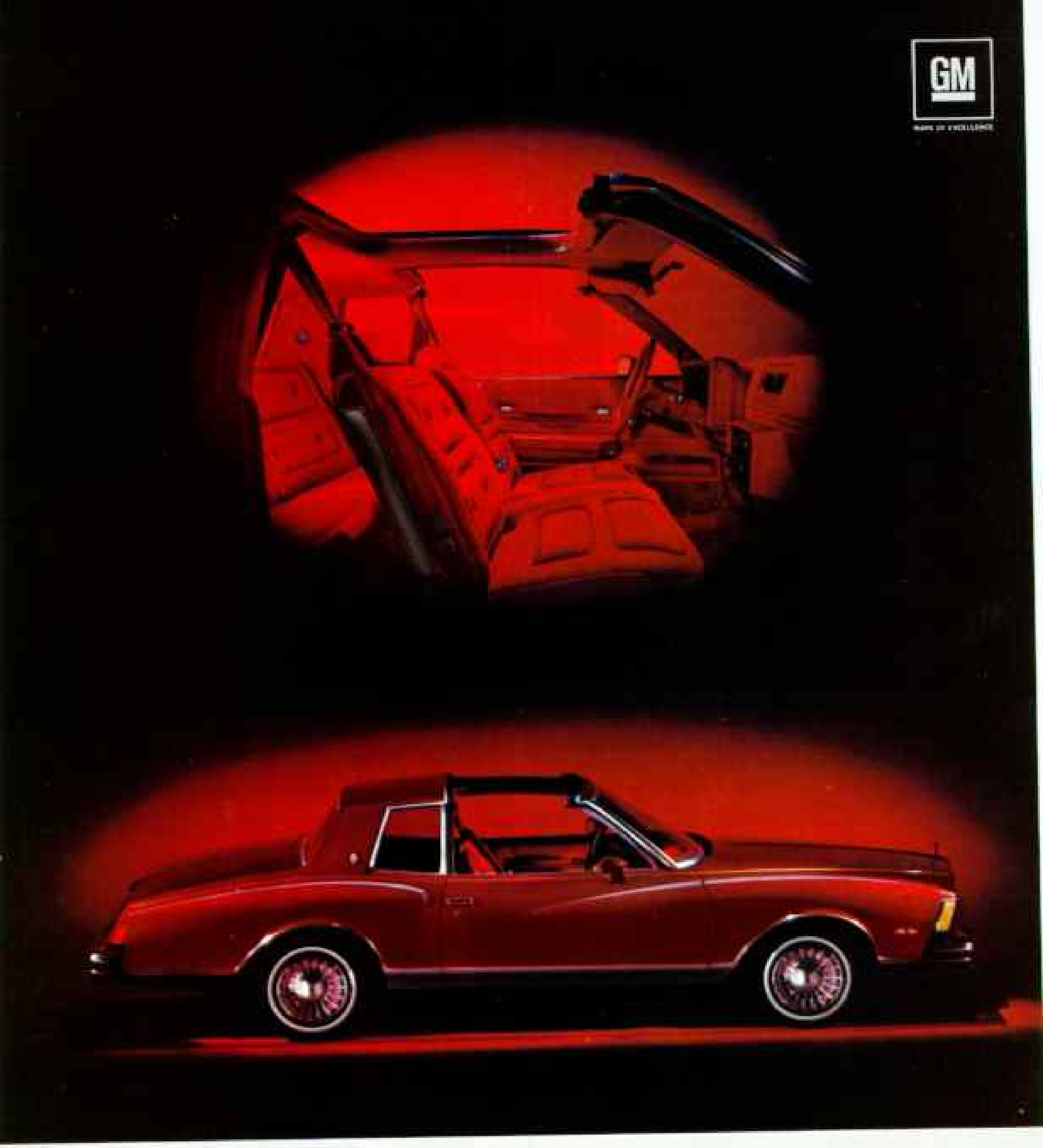

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ON THE TRAIL of a threatened species, Dr. Bernard Nietschmann examines a green sea turtle on an island in the Torres Strait between Australia and Papua New Guinea. Endangered elsewhere by human exploitation, the turtles thrive here, along with marine mammals called dugongs, or sea cows. The strait's seagrass beds offer pastures of plenty to both animals—the only large species that graze on earth's underwater grasslands. Aided by a National Geographic Society grant, the University of California geographer and his family have studied the animals, their ecosystem, and the islanders, who legally hunt them for subsistence.

With his wife, Judith, an anthropologist, and their son, Barney, Dr. Nietschmann endured hardships from storms to stinging jellyfish. After traveling 5,000 miles in a motorized dinghy, he joked, "My hands and feet got so waterlogged that I turned into an albino prune."

His arduous quest yielded a gold mine of knowledge. "Beneath the islanders' veneer of transistor radios and other modern trappings lies a very resilient culture," he reports. "They have maintained their legends, lore, and skills—their hunting repertoire—while adapting to the modern era. For them, hunting is more than a means of acquiring meat, it is a way of life."

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GIFTS

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First Day Covers are fascinating collectors' items. As you can well imagine, the combination of a historic stamp, cancelled on the first day of issue at an officially designated post office on a specially designed envelope, results in a collector's item of the first order. One that has been prized by collectors like Dwight D. Eisenhower, George C. Marshall and Franklin D. Roosevelt, plus others with the foresight to preserve yesterday and today for tomorrow.

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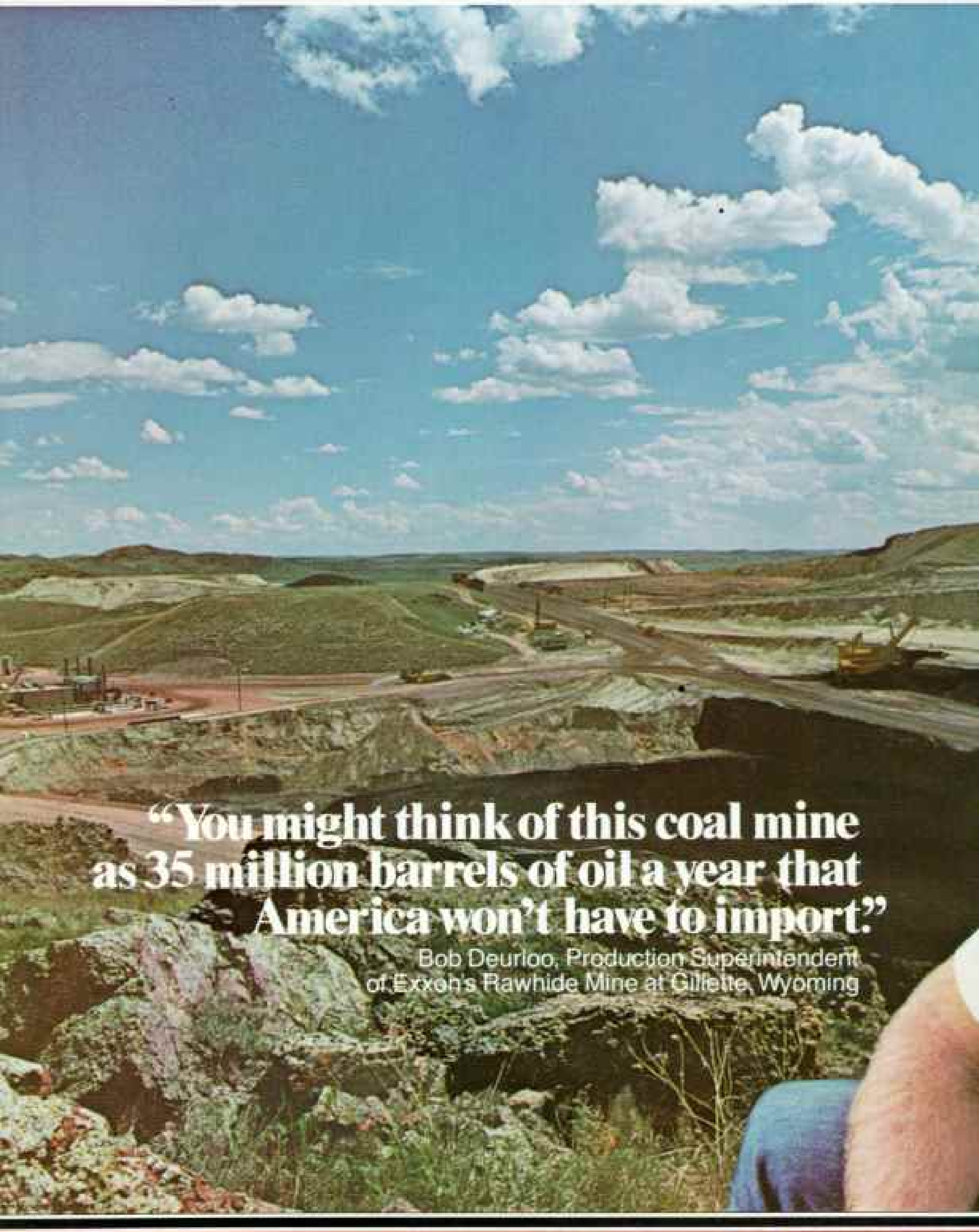

Energy for a st

America's vast coal reserves—an energy resource that is being developed now to help meet our country's growing energy needs.

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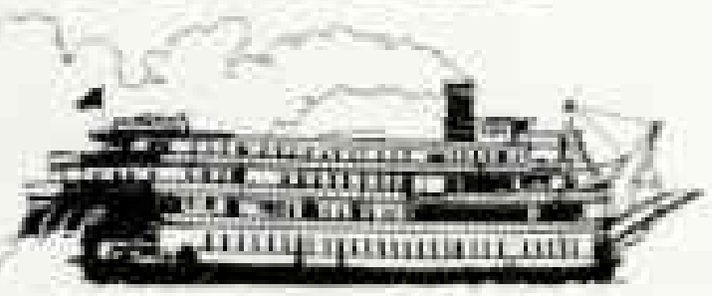

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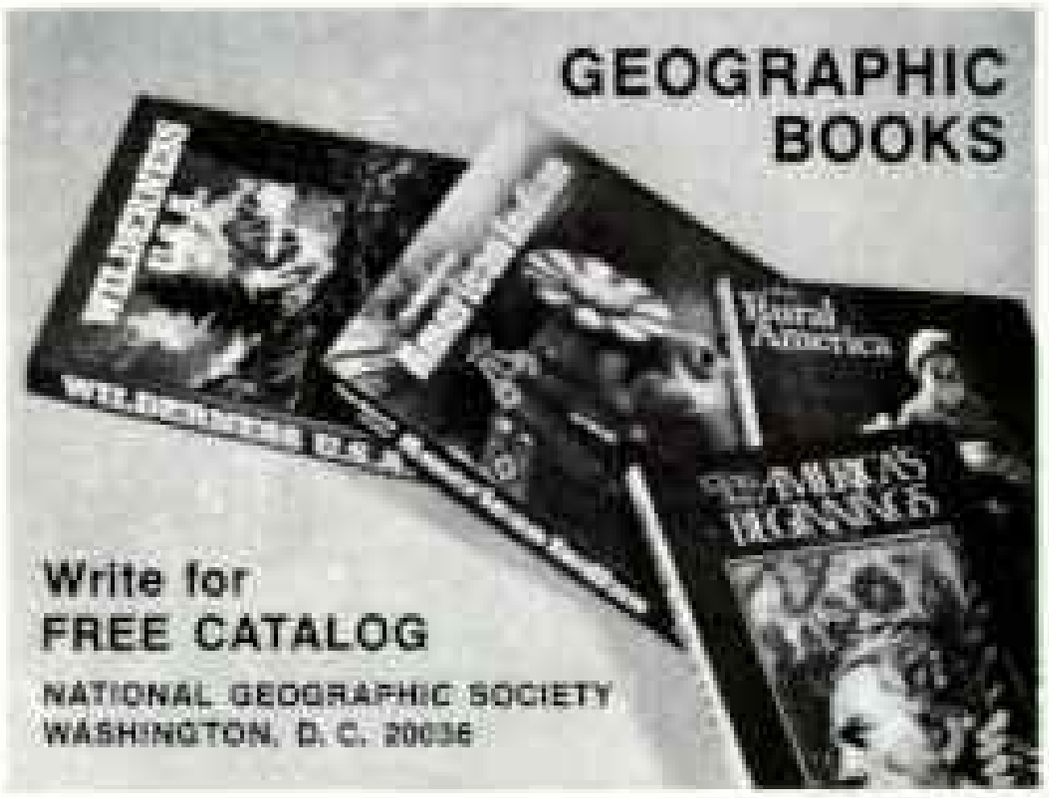

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One wants a bottleneck fixed. The other—cost conscious—thinks time may solve the problem.

Many places have outgrown their bridges. Traffic jams up at peak hours. Stalled cars, accidents, bridge repairs often cause catastrophic snarls. Service and delivery delayed. Emergency vehicles blocked. Idling motors wasting fuel. In the countryside heavy trucks must sometimes take roundabout detours. Because many rural bridges, too, are behind the times. Concerned people say, "Let's get after the bridge problem and repair or rebuild where necessary."

Others shudder at $23 billion to fix our 105,500 "problem" bridges according to the Department of Transportation! And bridge building can be disruptive. Tearing up the place. Taking property. Some people reason that energy conservation measures like car pooling, public transportation, and that smaller cars may cut tomorrow's bridge traffic drastically. They suggest low cost alternatives to building like better traffic control or staggered work hours.

Energy conservation will surely affect our travel habits. But, motor vehicles will continue to play a major role in our personal transportation. And improved fuel use demands attention to road systems. Moving traffic along on new and upgraded bridges and modern well maintained roads.. Yes, more miles per gallon of fuel, car pooling, better traffic flow are essential. But highway system maintenance and upgrade too must be a part of our national fuel management efforts.

Caterpillar machines build and maintain roads. We believe efficient transportation is essential to national well being.

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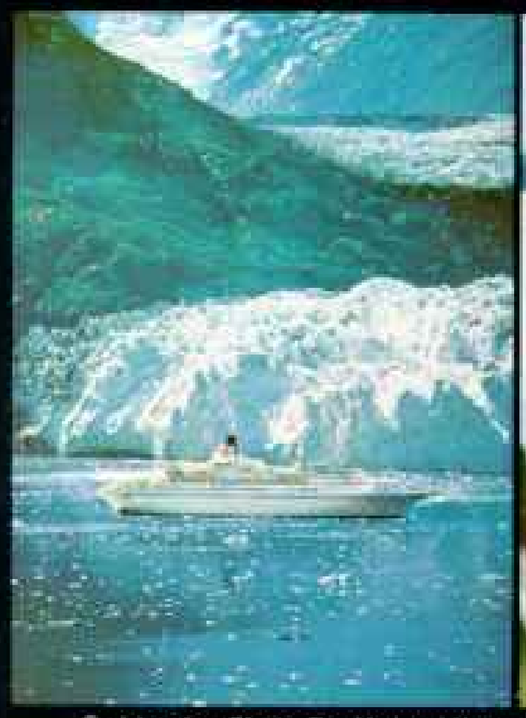

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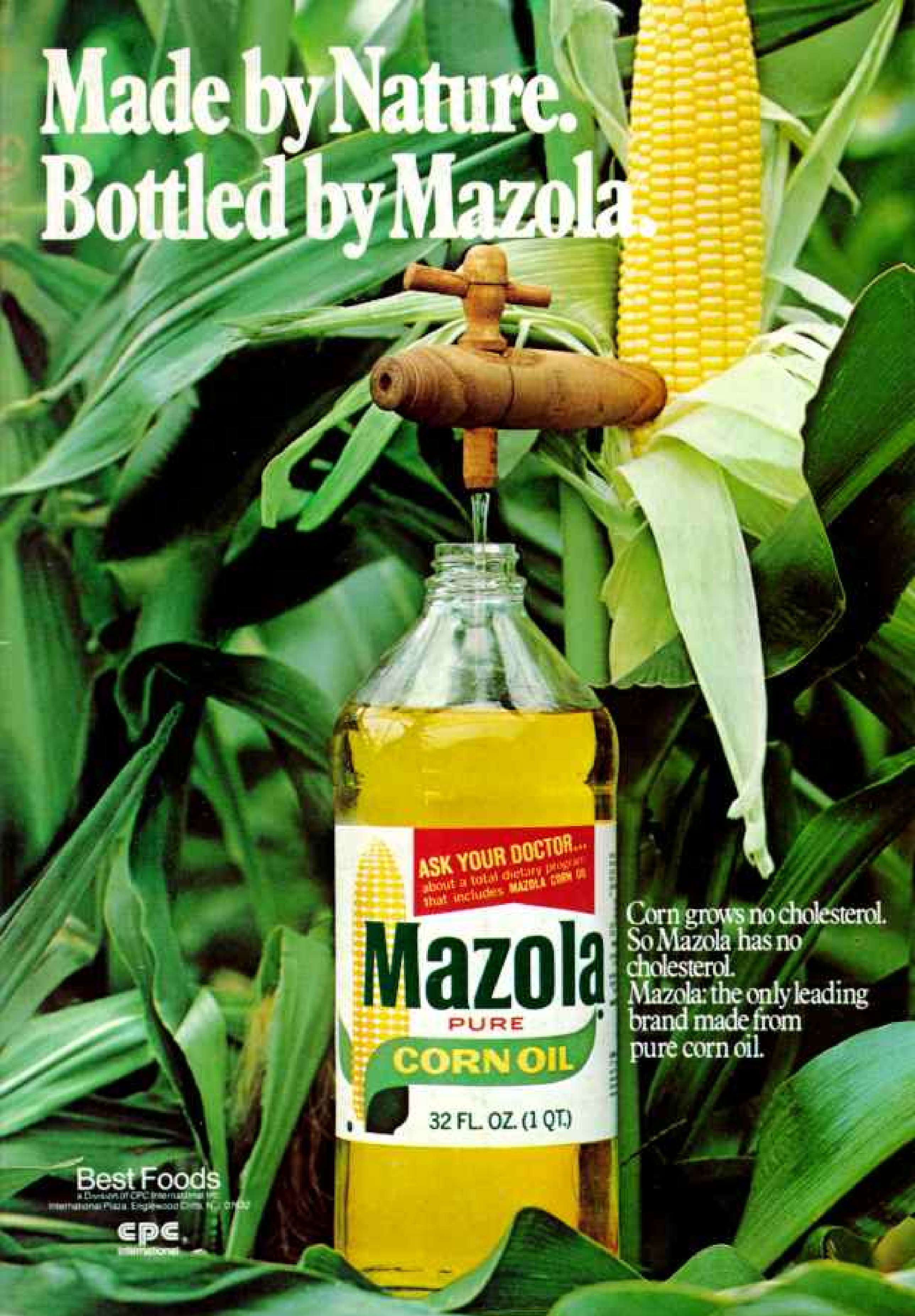

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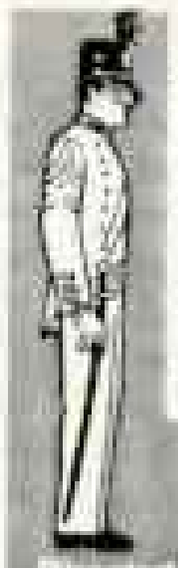

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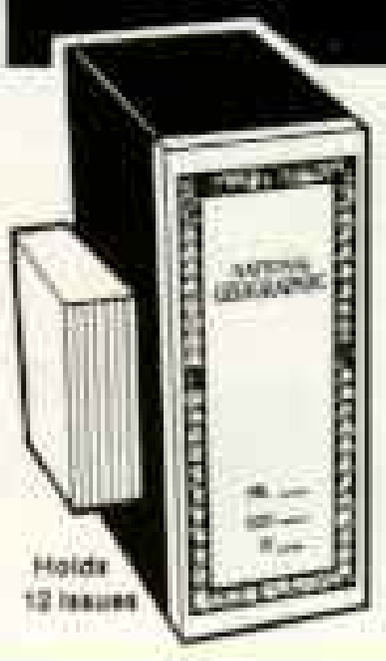

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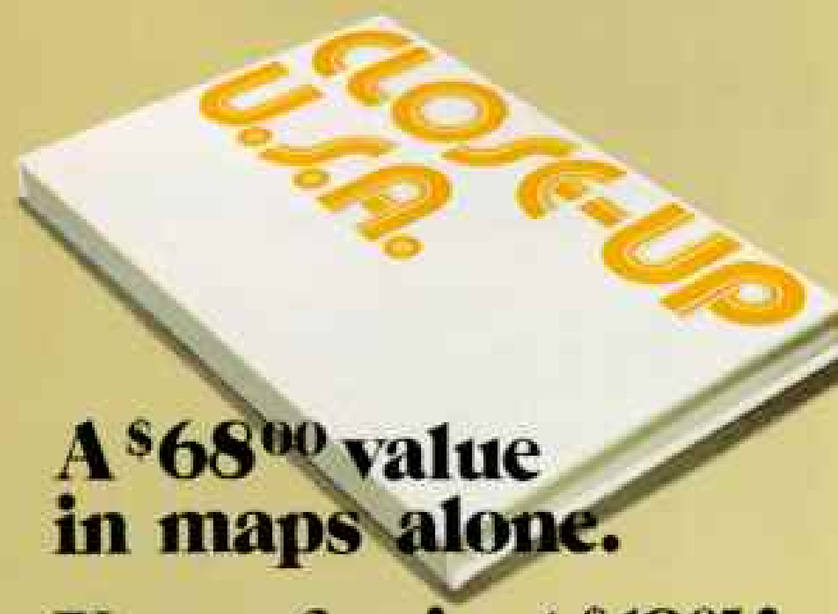

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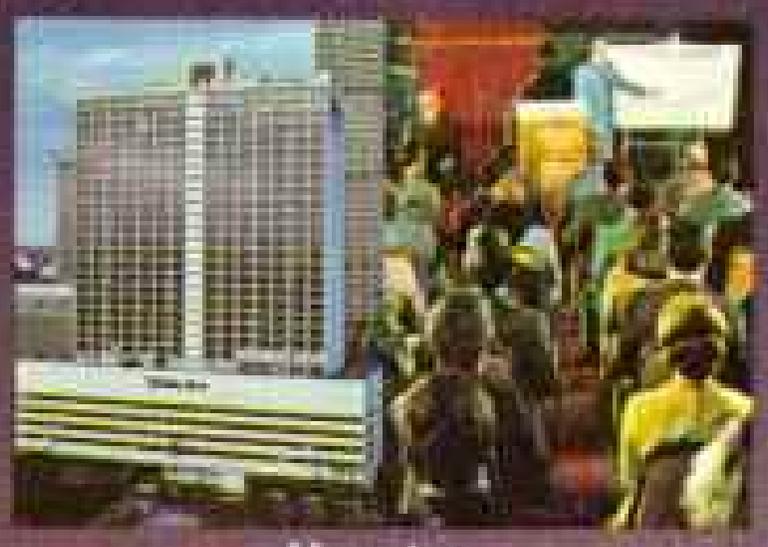

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