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NATIONAL GEOGRAPHIC

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October 1981

FOR 20 YEARS our family's water needs have been generously and graciously supplied by a loyal, chlorine-free well; its water is so satisfying that a son long gone from home returns regularly to fill jugs for drinking. Recently the press of more neighbors and heaven knows what other new demands have so lowered the water table that we must now ration our precious nectar. So far the only thing to suffer is our lawn.

We are not alone. Most Americans have always taken for granted plentiful, pure, inexpensive water. Just as we no longer enjoy cheap gasoline, a day is coming when we will pay dearly for water. Not that there is less of it—we simply use more than ever, and it isn't always where we want it.

This month the GEOGRAPHIC looks at one of the most controversial water battles in the United States today—the tug-of-war over California's Mono Lake. More than 150 parties are involved in legal action over how much of the waters that feed this lovely saline Sierra lake, a hatchery for 95 percent of the state's California gulls and a feeding station for millions of other birds, should be diverted to the faucets of Los Angeles.

The city's Department of Water and Power says the withdrawals will not destroy the lake. Environmentalists charge they will.

Two-thirds of southern California's water must be brought from the north or across the desert and over the mountains from the Colorado River. When the Central Arizona Project goes on line in 1985, Arizona will take each year 660,000 acre-feet of Colorado River water now used by California. This must be replaced, and a lot more provided to fill a growing need. An ambitious plan for a new canal to divert more water from the north has stirred opposition from northerners who, remembering the drought of 1977, don't want their water piped south. California voters will be asked to decide the canal's fate next June.

The problem is certainly not limited to California or my well. Across the nation the water table drops. Each of us now uses 2,000 gallons a day for domestic, agricultural, and industrial purposes, twice the 1940 rate.

We will not send our son away without water, and Californians will not go thirsty, but there will be many more Mono Lake-type battles ahead as our most precious resource grows ever scarcer.

Wilbur E. Garrett
EDITOR

Crosscurrents Sweep the Indian Ocean 422

Big-power politics swirl around little-known, idyllic, hardscrabble island nations lying along some of the world's most strategic sea-lanes. Bart McDowell and Steve Raymer assess what is happening from the Maldives to Madagascar.

People of Fire and Fervor 458

High in Pakistan's Hindu Kush, the Kalash—numbering only 3,000—preserve a unique culture. Debra Denker describes her adoption into the tribe, photographed by Steve McCurry.

Columbia Closes a Circle 474

Our Phenomenal First Flight 478

Author Tom Wolfe traces the space shuttle back to experimental rocket planes of a generation ago. Astronauts John W. Young and Robert L. Crippen recount their near-perfect April launch and landing, which opened a new era of man in space. With paintings by Ken Dallison.

Mono Lake's Troubled Waters 504 and Far-flying Phalaropes 520

A High Sierra salt lake dwindles away as freshwater streams that once fed it flow instead to the taps of Los Angeles. Gordon Young and photographer Craig Aurness document a mounting California war of water and words. Ornithologist Joseph R. Jehl, Jr., studies the clouds of sandpiper-like Wilson's phalaropes that feed at Mono Lake on their way to South America.

New Finds at Aphrodisias 527

Dedicated to the goddess of love and fertility, this ancient city in Turkey yields more stunning works of art. Excavation director Kenan T. Erim and photographer David Brill reveal the glories.

I Climbed Everest Alone 552

Reinhold Messner breaks physical and mental barriers to reach the summit of the world. With photographs by the author and Nena Holguin.

COVER: Riding twin columns of fire, Columbia rockets into history on its maiden flight. Photo by Jon Schneeberger, National Geographic staff.

Crosscurrents Sweep a



Militant posture came ashore with the 1977 leftist revolution in the Seychelles, where island youths now march in close-order drill. Regardless of their size and sympathies, Indian Ocean nations watch apprehensively as the Soviet Union and

Strategic Sea

By BART McDOWELL

ASSISTANT EDITOR

Photographs by STEVE RAYMER

NATIONAL GEOGRAPHIC PHOTOGRAPHER



the United States maneuver for influence in waters through which much of the world's strategic raw materials must pass.

ALONE among the great seas of the world, the Indian Ocean spawns currents that reverse themselves as seasons change. In its southwestern reaches, where the Agulhas Current collides with South Atlantic rollers, waves may build 70 feet high. Even in the usually tranquil doldrums, a U. S. Navy officer recently reported what looked like smoke off his bow; under closer examination it appeared to be the boiling of an undersea volcano.

It has always been a restless giant, this Indian Ocean; beautiful, violent, often mystifying. But today, symbolically at least, it simmers as never before.

Many supertankers have outgrown the Suez Canal, and some 80 percent of the strategic minerals consumed by the United States, Europe, and Japan cross these waters, in cargo ships "nose to tail," as one skipper put it. Scanning these sea-lanes with nervous radar eyes, a beefed-up Soviet presence (some 30 vessels including the likes of the 38,000-ton carrier *Minsk*) faces a U. S. fleet of—sometimes—30 ships: two carrier groups and one amphibious group.

South Yemen's Aden and the island of Socotra, Ethiopia's Dahlak, and, ironically, the U. S.-built Vietnamese base at Cam Ranh Bay supply Soviet men-of-war. Facilities on the British atoll of Diego Garcia support the U. S. fleet. Warships of France, India, and Australia also patrol these vital waters. A fisherman on the Madagascar coast told me of "suddenly looking into the face of a periscope—whose submarine I do not know."

Little wonder, then, that whatever their size, the varied island groups scattered between India and Africa loom larger each day in any assessment of prospects for world stability and peace. Some of them hold prime natural sites for air or naval bases; others offer immensely strategic locations on little more than exposed coral reefs.

In these seas (Continued on page 431)

Moves and countermoves on a board of blue



MALDIVES

This archipelago nation, whose average island is less than a square mile, has resisted being drawn into any big-power orbit.

GOVERNMENT: Republic. **AREA:** 115 sq mi. **POPULATION:** 136,000. **RELIGION:** Sunni Muslim. **ECONOMY:** Fishing, tourism.



MAURITIUS

Most Indian of the islands in the western Indian Ocean, the country depends on its sugar crop.

GOVERNMENT: Parliamentary democracy. **AREA:** 790 sq mi. **POPULATION:** 957,000. **RELIGION:** Hindu, Christian, Muslim. **ECONOMY:** Sugar, tea, knitwear, light manufacturing, tourism.



DIEGO GARCIA

Part of the Chagos Archipelago, this small British island is used by the U. S. as its major military facility in the ocean. Extensive work is being done to increase its capacity to support both air and naval operations.

GOVERNMENT: British possession. **AREA:** 10.5 sq mi. **POPULATION:** None permanent. **ECONOMY:** None.



SEYCHELLES

Marxist rhetoric of its president has not scared sun worshipers away from one of the most beautiful and still friendly vacation retreats in the world.

GOVERNMENT: Socialist republic. **AREA:** 171 sq mi; 92 islands. **POPULATION:** 65,000. **RELIGION:** Roman Catholic. **ECONOMY:** Tourism, fishing.



MADAGASCAR

Despite aid and training from both Eastern- and Western-bloc nations, island economy is faltering badly. The port of Antsiranana (Diégo Suarez) is the best natural harbor in the region, attracting the interest of the Soviet Union.

GOVERNMENT: Marxist republic. **AREA:** 226,658 sq mi. **POPULATION:** 9,375,000. **RELIGION:** Animist, Christian, Muslim. **ECONOMY:** Coffee, cloves, vanilla, rice, perfume essences, subsistence farming.



COMOROS

Though the group has been independent since 1975, Mayotte island remains under French control. Islanders are poor and, for the most part, illiterate.

GOVERNMENT: Republic. **AREA:** 719 sq mi. **POPULATION:** 369,000. **RELIGION:** Muslim. **ECONOMY:** Vanilla, perfume essences.



REUNION

An overseas department of France and French military headquarters for the region, the volcanic island is subsidized by the mother country.

GOVERNMENT: Integral part of the French Republic. **AREA:** 969 sq mi. **POPULATION:** 510,000. **RELIGION:** Roman Catholic. **ECONOMY:** Sugar, perfume essences.



Mediterranean Sea

Cairo ★
Suez Canal

ISRAEL

JORDAN

IRAQ

KUWAIT

EGYPT

SAUDI ARABIA

Riyadh ★

Berenice

Jiddah

Mecca

Port Sudan

SUDAN

Mits'iwa

Asmera

Dahlak

Aseb

DJIBOUTI

Djibouti

Addis Ababa ★

ETHIOPIA

Hargeisa

Berbera

YEMEN

Al Hudaydah

Aden

KENYA

Mombasa

Zanzibar I.

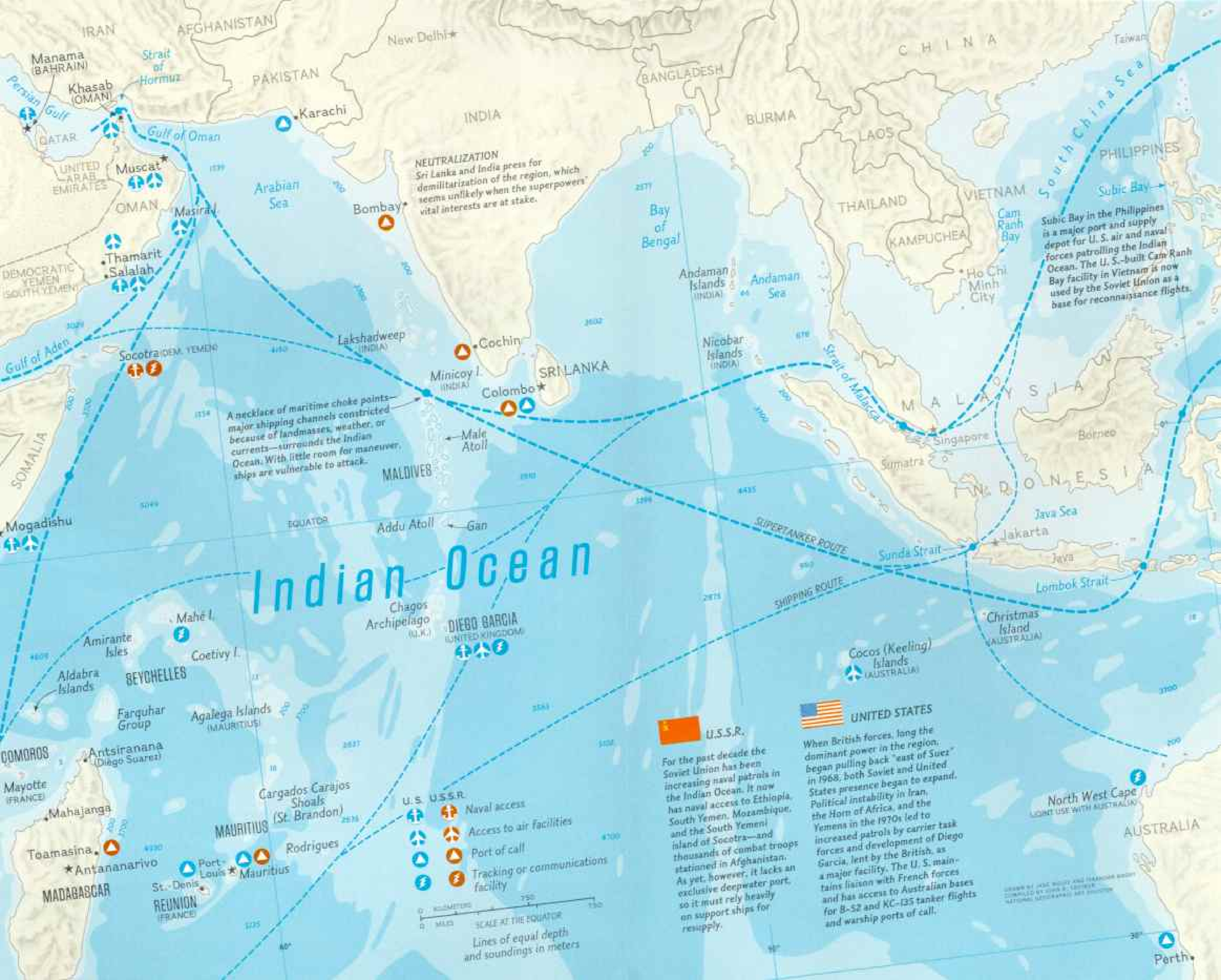
TANZANIA

MOZAMBIQUE

Nacala

Beira

Mozambique Channel



NEUTRALIZATION
Sri Lanka and India press for demilitarization of the region, which seems unlikely when the superpowers' vital interests are at stake.

A necklace of maritime choke points—major shipping channels constricted because of landmasses, weather, or currents—surrounds the Indian Ocean. With little room for maneuver, ships are vulnerable to attack.

Subic Bay in the Philippines is a major port and supply depot for U.S. air and naval forces patrolling the Indian Ocean. The U.S.-built Cam Ranh Bay facility in Vietnam is now used by the Soviet Union as a base for reconnaissance flights.

Indian Ocean

 **U.S.S.R.**

For the past decade the Soviet Union has been increasing naval patrols in the Indian Ocean. It now has naval access to Ethiopia, South Yemen, Mozambique, and the South Yemeni island of Socotra—and thousands of combat troops stationed in Afghanistan. As yet, however, it lacks an exclusive deepwater port, so it must rely heavily on support ships for resupply.

 **UNITED STATES**

When British forces, long the dominant power in the region, began pulling back "east of Suez" in 1968, both Soviet and United States presence began to expand. Political instability in Iran, the Horn of Africa, and the Yemens in the 1970s led to increased patrols by carrier task forces and development of Diego Garcia, lent by the British, as a major facility. The U.S. maintains liaison with French forces and has access to Australian bases for B-52 and KC-135 tanker flights and warship ports of call.

-   **U.S. U.S.S.R.**
-   Naval access
-   Access to air facilities
-   Port of call
-   Tracking or communications facility

0 100 200 300
0 60 120 180
Kilometers Miles
SCALE AT THE EQUATOR
Lines of equal depth and soundings in meters

DRAWN BY JANE BERRY AND FRANKIE BERRY
COMPILED BY JOHN R. COOPER
NATIONAL GEOGRAPHIC MAGAZINE



ROGUE WAVE rising above an enormous trough breaks over the supertanker *Esso Nederland*, loaded with Persian Gulf crude oil off the Cape of Good Hope, as it makes its way with the powerful Agulhas Current. LEONARD WILLACOTER

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(Continued from page 423) new reefs themselves are occasionally discovered, some of them hazardous to deep-draft tankers. It is doubtful that all such findings are reported promptly to Western navigators, for more than half the world's 400 hydrographic ships belong to the Soviet Navy.

The Indian Ocean has moved on its tides Arab merchants and Portuguese conquerors; missionaries, warriors, slavers, pirates, and smugglers. But history seems to have slighted even some of the ocean's major islands. Probably not one American in a thousand knows where to find Male, Victoria, Port-Louis, Antananarivo, and Moroni in the Indian Ocean. They are the capitals of the independent Maldives, Seychelles, Mauritius, Madagascar, and Comoros.

Photographer Steve Raymer and I visited them all in a tour some months ago that took us from Cape Town to Perth, Sri Lanka, and the Persian Gulf. Along the way we encountered vacationing "beautiful people"; sunburned agents from the U.S.S.R., North Korea, East Germany, and Cuba; gung ho U. S. marines and sailors; and abject islanders uprooted in the game of strategic chess.

We found disparate cultures, some of the world's most spectacular scenery—and a paradoxical paradise. These islands produce sugar and spice and everything nice from precious gems to perfume essence. Yet some feel the grip of overpopulation, crippled economies, and socialist governments.

LET US START this personalized primer with the Maldives, a scant 400 miles southwest of Sri Lanka—hot, flat, palm garnished, populated with 154,000 dark and wiry people who resemble folk on the mainland of south India. At the international airport on Hulule Island, I watched some jet-lagging German tourists go through exhaustive customs inspection. A sign lists

Coral necklaces on a velvet blue sea, the thousand Maldivian Islands, due south from India, span 540 miles. The southernmost atoll, Gan, a British air base until abandoned in 1976, is now coveted by the superpowers and private developers.

ADAM WOOLFIT



forbidden imports: alcoholic beverages, pigs, dogs, and graven images. Islam is the only religion here. Republican government dates from 1968, when an 815-year-old sultanate was peacefully abolished.

Houses and two-story buildings crowd Male. Along streets of white coral sand, the houses bear no numbers—only names like Honeysuckle, Everest, or Passion Flower. A man in a sarong carries a fresh-caught tuna by its tail. Youngsters grin and hail foreign sailors in English, "Hello!" Midday pedestrians make only a small equatorial puddle of shade.

At the docks, sailors and fishermen tie up their marvelously untidy boats, cook their meals, hang bananas in the rigging, and

gossip with fellow mariners. Theirs are the lateen-rigged *dhonis*, a Maldivian variant of the Arab dhow that brought coastal traders and Muslim culture to these isles. In 1153, according to legend, a saintly Moroccan in this same harbor dispelled a mischievous genie and converted the king to Islam.

Ahmed Shareef of the government office of religious affairs guessed that some 500 people from Male alone—population 40,000—had made the pilgrimage to Mecca. Here, Islam is gentle, reflecting Sunni Shafii teachings. Women go unveiled and aggression seems alien to the Maldivian character. Though I asked, I never found anyone who had ever seen two Maldivians in a fight. "No, we just don't like fighting," said one.



ADAM WOOLLITZ

Women haul and men heave to bring their shallow-draft fishing boats ashore. The influence of Arab traders is still evident in the lines of their vessels, called "dhonis." Maldivians are Muslims, having been converted eight centuries ago.

our history," remarked Rashida Didi, the headmistress of a girls' high school and U. S. consular agent in Male. "We never had the experience of being a colony." Although Portuguese occupied Male for 15 years in the 16th century, they were slain to the last man by Maldivian patriots. The British established only a protectorate here, leaving all domestic matters to the Maldivians.

THROUGH THE CENTURIES, island life has changed little. The great 14th-century Arab traveler Ibn Batuta observed that "coconuts . . . along with fish" composed the local diet. This is still largely true for some 27,000 fishermen and their families, people who depend on their dhonis, fishing poles, and schools of skipjack and yellowfin tuna. Rising fuel costs are a hardship for 875 owners of motorized dhonis, but wind still powers 14,000 craft.

Malaria is endemic to some Maldivian islands, as in much of the Indian Ocean. "But, being isolated, we have a better chance than most in the region of eradicating malaria," notes Dr. Abdul Samad Abdullah of the health ministry. The republic has only nine doctors, so selected islanders have been trained to make blood tests. But a Maldivian baby's life expectancy is still only 47 years.

Tourism now brings some prosperity; 30 of the once uninhabited Maldivian Islands have become playgrounds for European divers—strictly segregated from the workaday isles inhabited by Muslims. Luxury resorts offer strong drink in their bars and pork in their restaurants, both banned on other isles. Last year 42,000 tourists left their share of marks, francs, and lire here.

Yet I was surprised to find so many resort employees able to speak English.

"I worked at the British base on Gan," explained Hassan Mohammed. "I learned."

In several ways Gan was a learning experience. In 1941 a British Royal Marine battalion established a base on Gan. After

Crime is rare, and the severest sentence invoked in decades has been banishment to one of the thousand-plus Maldivian Islands (only 200 are inhabited).

"Because I was once considered politically dangerous, I was banished for 18 months to an island called Dunidu, only 500 yards long," said Ahmed Zaki. "I had four guards, who were not permitted to talk with me. I was not allowed to read or to write, so I exercised morning and evening, and prayed five times a day."

When the government changed to a more democratic regime, Mr. Zaki was released; he now serves the Maldives as ambassador to the United Nations.

"Our religion is a great influence, but so is



World War II it was expanded. Then, in 1976, as part of their withdrawal "east of Suez," the British closed up shop. The decision not only disrupted the world power balance, but also some human lives.

"I was a waiter at the Gan base," said Moosa Raha, "as I am here on Male. The British paid better wages." He now makes \$30 a month at the Alia Hotel. "My wife and five children live on the south atoll, Addu. I must send money. My father was a farmer on Gan before the base was built, the best farmland in the Maldives. He raised yams." And when the rich soil was paved? "Father had to work as a beggar. . . . His children worked at the base; nine girls and three boys. Only I am working now. . . ."

In 1977 the Russians tried to lease the Gan base for a million dollars a year, but the Maldives refused. "We want no bases for any country," explains H. A. Maniku, director of information and broadcasting. "Perhaps the airfield can be used for tourist planes. We still hope to make use of Gan." Caretakers now tend empty barracks and cut back verdure encroaching on the runways. The best air facility in the Indian Ocean remains essentially a ghost base.

But the Russians aren't idle. The U.S.S.R. has provided scholarships to Maldivian students at Patrice Lumumba University in Moscow. "But I won't go back!" insisted pretty Shahida Zubair, just returned from a year of premedical courses there. "Too cold! And boring—all about the October Revolution and Lenin."

FLY WEST from the Maldives 1,400 miles to the Seychelles: A traveler feels the distance from India and nearness of Africa, still 1,100 miles away. People look Negroid, speak the languages of onetime colonial masters, and express a former colony's anger, sophistication, and taste for creature comforts. In the Maldives fresh vegetables come from Sri Lanka and Coca-Cola from Singapore; in the Seychelles they come from Kenya and South Africa.

"But we have no diplomatic relations with South Africa," insists an official.

Politically, the Seychelles have a leftist government with a defense force reliant on Eastern-bloc weaponry. President France Albert René calls Fidel Castro "comrade"

and uses Marxist rhetoric: "Down with capitalism! The Revolution marches on!"

"But we are not a Communist country," emphasizes the minister of education and information, James Michel. He can point to the U. S. Air Force satellite tracking station that perches like a giant medicine ball on a hill above the capital, Victoria. Only tourism and the Seychelle government employ more local people than the tracking station.

And how do resident Americans regard the Seychelles? "Paradise," said one. Politics aside, why not? Granite cliffs rise like



BOTH BY ADAM WOOLFIT

Ignoring geopolitics, Maldivian islanders gather coral (facing page) or stroll past a satellite antenna whose messages are peaceful (above). Armadas of tourists now stream into the Maldives, far more welcome here and elsewhere in the Indian Ocean than squadrons of gray warships.

castle towers above languorous coves. Sunbirds and flycatchers flit through air scented by wild cinnamon. And shapely jet-setters, glossy with lotions, bask on great beaches.

Everything has been imported here—including people—for these were desert isles known to the Portuguese and Arabs but unsettled until the French came with slaves in the mid-1700s. After the fall of Napoleon, the Seychelles went to the British. "But in ceding their islands here," observes Roman Catholic Bishop Felix Paul, "the French urged that the British not interfere with religious customs and laws."

Though the British administered these 92 islands until independence in 1976, most Seychellois today remain Catholic and speak French-based Creole.

For years the British used the Seychelles as a refuge for exiles—kings from Uganda and the Gold Coast, a Malaysian sultan, even Archbishop Makarios from Cyprus.

SINCE THE COUP that brought the René government to power, the Seychelles have felt other influences. A sign hails the construction of "19 flats for the Embassy of the U.S.S.R. in the Seychelles." Soviet soccer instructors coach Seychelle youngsters, who are encouraged to join the Young Pioneers, as in the Soviet Union.

A two-year National Youth Service (NYS) program at first brought protests and demonstrations by high-school students and parents. Now the program is under way with a camp on Mahé, where youngsters 15 to 18 are separated from their families in "a disciplined organization," where they are taught "vigilance" and "the history of imperialism." Without two years of NYS, few students can take entrance exams for foreign universities or get government jobs.

Granite is a solid and special fact of geology here. Nowhere else do geographers find mid-ocean islands of granite. According to tectonic theories, the Seychelles are a remnant of an ancient landmass dating from 600 million years ago. "You can think of the Seychelles as the world's smallest continent," Amoco geologist Jeff Pinch says with a laugh. "We even have a continental shelf." Amoco has been drilling for oil on this

shallow shelf, 100 miles west of Mahé.

I flew out one day aboard the company-chartered helicopter to the drill ship *Diamond M. Dragon*, working in 90 feet of water, using a collection of wise machines: satellite navigational devices that fix the well's position within two yards of latitude and longitude . . . diamond drills . . . a 146-foot derrick . . . closed-circuit television to watch the coral-crust bottom.

"Also very good food," a locally hired Seychellois volunteered with a grin. "But no *sousouri* here." *Sousouri* is a fruit bat, usually served in murky curry sauce.

Expenses mount up: The drilling operation costs more than \$65,000 a day.

"I hope they find no oil," a Victoria businessman told me quite seriously. "If the petroleum companies find oil, the government will not need money from your tracking station or from tourists. Then they could afford to be *real* Communists."

Another entrepreneur reassured me somewhat about local customs. "We have no secrets here. Too small," he said. "Only 65,000 people. Yes, I have a family: six children by three girl friends. Not married. All my girl friends work, and I send them money for the children.

"My girl friends can go out with other men—but someone would surely tell me. We gossip. We haven't great troubles here. No hunger. No one breaks into cars. Girls are friendly and sexy. People are easygoing. A happy, happy life."

On the other hand, one Victoria professional woman describes the Seychelles as "a country of strong women—matriarchal. We keep our men for display," she says.

Not exactly revolutionary dialectic. Yet the official press attacks U. S. naval exercises in the Indian Ocean as "cause for more concern." Soviet exercises are not mentioned. And Western intelligence notes that Soviet ships use an anchorage near the Seychelle island of Coetivy.

MAURITIUS, like the other Mascarene Islands a thousand miles to the south of the Seychelles, is a serene landscape created in violence; volcanoes hurled it up from the ocean floor some seven million

years ago. Igneous soil, chocolate rich, stretches wide, and stones cleared from the fields are stacked in pyramidal heaps like ruins of ancient temples. Everywhere, everywhere grows sugarcane.

The population—just short of a million—presents a special problem: “Too much people,” as one worker summed it up. Mauritius has one of the greatest population densities in the world.

Four centuries ago Mauritius was uninhabited by man; the dodo waddled about, free of enemies and any means of defense, and perished when hunters arrived.

The French came, bringing African slaves with them, and at last came the British, bringing not slaves but indentured labor from their Indian subcontinent.

Independence for Mauritius and its several dependent islands came in 1968 with an abundant human inheritance: two-thirds Indo-Mauritians (both Hindu and Muslim); 28 percent Creoles, generally a mix of white colonists and African slaves; and the rest mostly French and Chinese Mauritians. The Mauritians’ official language is English, though Creole, Hindi, and French are more widely spoken.

I repeatedly sampled Hindu hospitality—a wedding with farm families, a Tamil fire-walking ritual, and a temple tour during the festival of lights, Divali.

Hindus here are more affluent and less strict than those in mother India. None of the templegoers asked me, as they might have in India, to remove my leather belt, and I was invited to take part in the chanting of mantras, with a ceremonial dot of white paint, a *tika*, dabbed upon my brow.

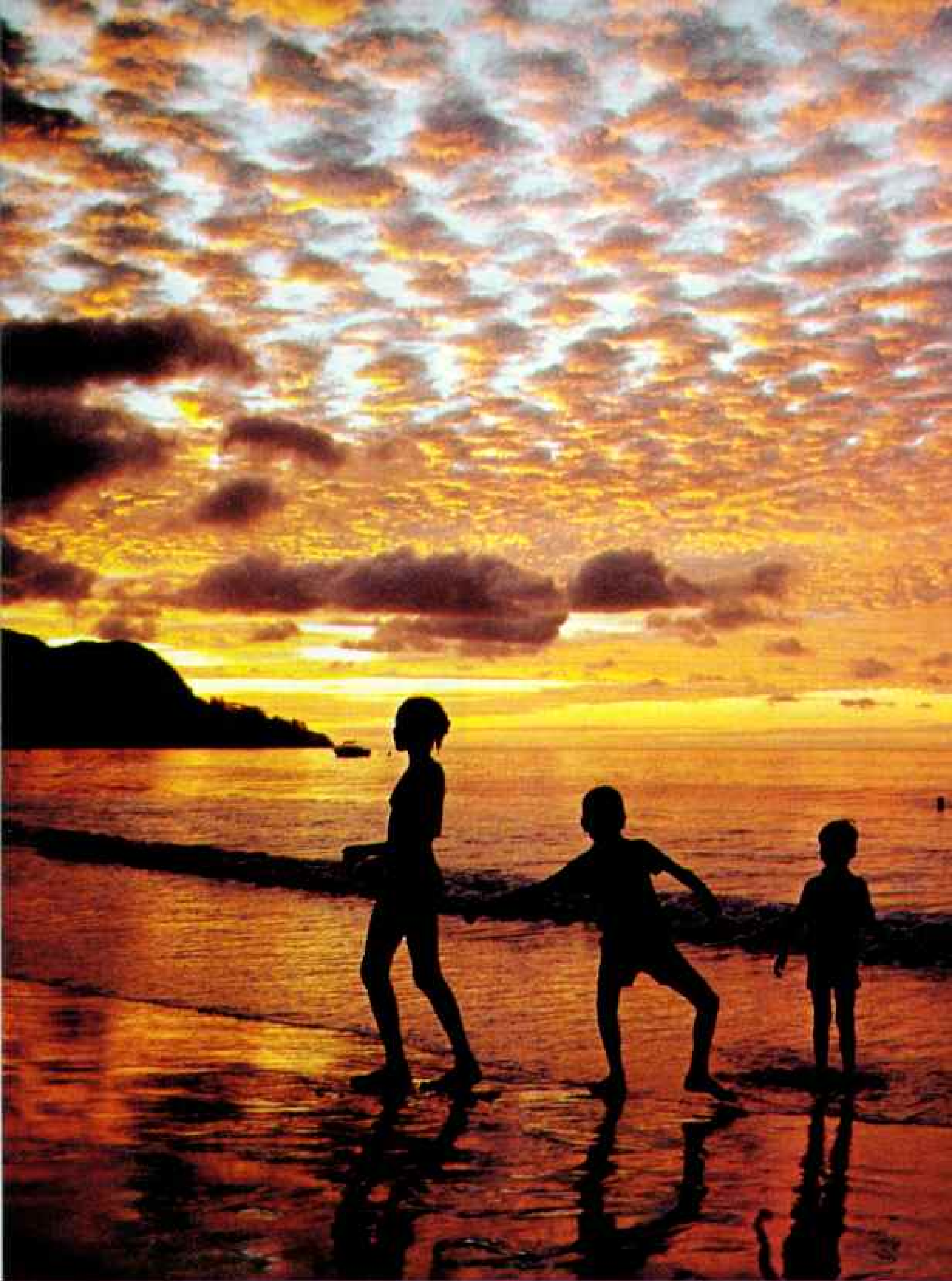
Indo-Mauritians control the government. The founding father of independent Mauritius and the only prime minister so far, Sir Seewoosagar Ramgoolam (page 442), was the son of rural Hindus. At age 81, with platinum hair, bronzed face, and solid Churchillian shape, Sir Seewoosagar seems already to be the statue in a park.

“The future will take care of itself,” he said, as we visited in his office. His observations ranged the gamut of his young nation’s problems and progress: “I have large unemployment. And last year we had three



Off their pedestals and behind bars in a storage shed, busts of British monarchs George V, Edward VII, and Victoria will someday occupy a museum in the Seychelles, their former colony whose capital city is yet named Victoria.

The island republic attracts jet-setting tourists. They bash on strips of beaches that fringe a country being socialized with Marxist-sounding exhortations—but still in the Commonwealth.



Red banners of sunset fly over a beach on Mahé, most populous of the



Seychelles. Beyond, Silhouette Island stands true to its name.

cyclones between December and April. . . ."

The winds, in fact, ruined a third of the Mauritian sugar harvest at the moment the world market hit its highest price in years.

"Our new Sugar Terminal will help us in the future," said the prime minister. He is proud of the mechanized facilities in Port-Louis harbor—larger than any such terminal in the Western Hemisphere. Sugar from 21 island factories can be loaded into a ship's hold at 1,500 tons an hour.

A foreign economist studying Mauritius told me, "I don't know of any country that is trying harder to improve its economy." He referred to wage restraints, the devaluation of the Mauritian rupee, and cuts in government spending. With access to the European Common Market and cheap labor, Mauritian factories attract foreign investors. Australian wool comes to Mauritius to be transformed into sweaters for European department stores. In such a way, small, tropical Mauritius has become one of the world's major exporters of knitwear. The economy is still shaky, though, and prosperity is by no means universal.

Take a group of slum dwellers known as the Ilois, or islanders. These are the some 400 families evacuated by British administrators from the Chagos Archipelago from 1965 through 1973. The purpose of this evacuation was to make way for the U. S. Navy facility on the atoll of Diego Garcia.

In assigning the atoll rent free to U. S. use, the British agreed with their new tenants that no population meant no problem. It didn't quite work that way. The displaced Ilois—nearly 1,300 of them—are black, largely unskilled laborers, and illiterate in a country where literacy is high. They also speak a French patois different from the local Creole. Yet the Ilois have been very popular among politicians of the far left who want the U. S. Navy out of Diego Garcia.

I talked with dozens of Ilois, visited the

shacks they lived in, and watched them cook over outdoor campfires. Many were unemployed or had only part-time work; several were beggars. The Ilois themselves seemed to have no politics at all.

In the early 1970s Great Britain gave £650,000 (\$1,400,000) to the Mauritian government to compensate the Ilois. But no money reached them until 1978, by which time land prices had risen drastically. So the islanders still lacked homes.

Two years ago the British tried to end the problem with a £1,250,000 payment direct to the families, in exchange for their waiving future claims to return to the Chagos. But the Mauritian government and its opposition party, the Mauritian Militant Movement, both want improved compensation for the Ilois as well as the return of Diego Garcia. So the Ilois continue to live in squalor and to take part in demonstrations and hunger strikes.

Typical is a 40-year-old mother of eight named Issel Elysee. "My husband is away, working as a fisherman on St. Brandon. He visits us twice a year, and I must feed the children on his 300 rupees a month [about \$38]. If we eat in the morning, we have no dinner. At least I now go to school, for we had no school on my island. I want to learn how to write."

I watched the U.S.S. *Virginia* pull into Port-Louis one day and hundreds of sailors swarm ashore on leave—all in friendly, un-intimidating civilian clothes. One young sailor from Tennessee was wearing an experimental mustache and a red T-shirt with palms and the words Diego Garcia. "Yeah, we were there four days," he told me. "Not really a port, although I got ashore. This is our first real liberty port since the Philippines. We're here five days."

Later U. S. Navy visitors were told not to wear Diego Garcia T-shirts, and to stay clear of Ilois hunger strikers. Though the

Mind over pain is put to the test by a man of the Tamil people in Mauritius, who has been pierced with pins and skewers for the religious observances of Cavadee. Indians were brought to Mauritius by the British in the 19th century as indentured laborers and are now the largest group on an overpopulated, cyclone-wracked island dependent on sugar as its main crop.





Big-stick diplomacy while treading softly is practiced by both the U. S. and U.S.S.R., particularly in Port-Louis, Mauritius, where ships of all nations are welcome. While the relatively low-paid Soviet sailors (top) often barter for goods, free-spending American sailors may pump a million dollars into the local economy on a single liberty call. Observing the social amenities, Vice Adm.



Carlisle Trost of the U. S. Seventh Fleet (left, below) greets Prime Minister Sir Seewoosagur Ramgoolam at Mauritian Independence Day ceremonies. Steaming into Port-Louis, the all-purpose carrier U.S.S. Independence (above), part of the United States' 30-ship force in the Indian Ocean, is dogged by a Soviet intelligence-gathering ship off her port bow.

Mauritians are naturally friendly toward Americans, Port-Louis is also open to the merchantmen and navies of other countries—Australia, France, India, the Soviet Union. I asked several taxi drivers whose navy had the best behaved sailors.

Several said the U.S.A.; some said India.

"And what about the Russians?" I asked.

"They have no money for taxicabs," replied a driver. Merchants concurred: Soviet sailors, short of hard currency, try to barter for souvenirs.

Despite Marxist efforts, the government of Mauritius remains friendly to the West—the friendliest of any island nation in the area. Mauritians would prefer a neutral Indian Ocean. "But we are realists," the prime minister told me. Regarding Diego Garcia, "We would prefer that the U.S.A. dealt with Mauritius instead of with Great Britain."

A visitor feels sure that as long as Sir Seewoosagur holds office, the U. S. can deal with a wise and reasonable man. Yet, playing back my tape of our conversation, I was conscious of a symbolic, disturbing sound: the ticking of a clock on the desk of the 81-year-old prime minister.

For reports on Diego Garcia itself, one must rely on congressional hearings, photographs, old maps, and hearsay. British landlords have allowed no journalists ashore since 1977. The atoll, shaped like a 15-mile-long footprint, is meager: Nowhere is the land more than 1.4 miles across, and its highest point rises to only 23 feet.

"Isolated," says one naval officer who was there this year. "U. S. sailors and Seabees and a couple of dozen British. There were exactly four women when I was there—officers attached to a submarine tender."

Others mention Korean laborers dredging coral from the harbor. A modern pier has been completed this year, but so far no carrier has entered the lagoon. "Diego is well out of the cyclone area, but our channel is narrow and makes a sharp turn," an officer

explained. The narrow runway takes C-5s and P-3 Orion antisubmarine patrol planes. Half a dozen merchant ships stand in the lagoon, ready with matériel for any needs of the Rapid Deployment Force.

"We were there for several weeks," said Comdr. James W. Davis, Jr., skipper of the nuclear submarine *Memphis*. "I thought boredom would set in—maybe the men would drink too much beer. Instead, they made good use of the ball fields and the swimming pool. We could scuba dive inside the bay, but you have to watch out for sharks. There's one named Hector, a giant hammerhead. Somebody photographed it alongside a whaleboat—it seemed to be more than 20 feet long."

Others talk about the old coconut plantation at the far end of the island, wild donkeys running among the palms, and pigs and chickens, presumably first put there to provision anybody who needed them.

FRIENDLY mainland nations on the Indian Ocean do not want their cooperation with the U. S. Navy to be publicized, and the navy was not engaging in military exercises in the Chagos. So to join U. S. naval contingents, Steve and I flew to Perth, Western Australia, and boarded the U.S.S. *Tarawa*, a general-purpose amphibious assault ship with three dozen H-53 helicopters and nine rocket-carrying Harrier jets.

The men had been away from home for months. Amphibious Squadron Seven had just finished a week's delicious liberty in Perth. With landing exercises scheduled in Australia, some of the 1,800 marines felt less than fine. When they applied green camouflage paint to their faces, some hangover victims barely changed color. Even so, I found morale and efficiency good.

Sit around a ship's wardroom and you hear young officers ask tough questions about national priorities. Is an American presence needed full time 10,000 miles from

Dispossessed for strategy's sake, natives of Diego Garcia stage a hunger strike on Mauritius, where some 1,300 were relocated when Britain lent their island home to the U. S. for a base. Britain has offered to increase compensation to the Diego Garcians, but not by enough to satisfy the Diego Garcians or the Mauritians.

GIVE US BACK
OUR NATIVE LAND
DIEGO GARCIA

— / —
WE NEED ADEQUATE
COMPENSATION
TO SURVIVE IN
MAURITIUS





home? And how much presence? ("Our carriers are bigger than some islands here.") They discuss fleet mobility now that carriers can traverse a wider, deeper Suez Canal. They talk expense ("think of the oil we burn and the overhaul in dry dock") and the new ships such money would buy. Strategy is always up for review with changing events and the policies of other countries.

I was surprised, for example, to find the French presence so strong in the western Indian Ocean. "We exchange information about ship locations with the American Navy every 12 hours," a high-ranking French officer told us. "We even do it in English," he smiled. The French Navy keeps some 15 ships in those waters. In fact, on a yearly basis, only the United States and the Soviet Union log more naval ship-days there than does France.

Yet, the Tricolor flies over diminished real estate: France has withdrawn from its former colony of Madagascar and has recognized the independence of the Comoros. Réunion, a volcanic island of the Mascarene group, remains an overseas department of the French Republic.

IN SEVERAL WAYS Réunion seems the high point of the western Indian Ocean. In elevation, the Piton des Neiges looms 3,069 meters above the sea, the record altitude. The smart airport, the abundantly stocked shops of St.-Denis, the cleanliness and sheer efficiency make Réunion exceptional. The French obviously mean to stay.

Réunion is larger than Mauritius, but has only half the people—some 500,000, including 120,000 in St.-Denis. The population is relatively prosperous, young (half under 20), and varied: Indian, Creole, Chinese, European, and any number of mixtures. But French culture predominates.

In a helicopter I flew around the island from the east coast, green with sugarcane, to the brown west, over the lunar terrain of an active volcano, tamarind forests, ferny gorges, and waterfalls that conjured rainbows. Réunion has a terrifying beauty.

And a comfortable security. French military units remain here. Public-housing projects are numerous and well maintained. "Only Communists want independence," said Charles Henri Robert, a 22-year-old

student. "Not an important group. We will remain French."

Madagascar, the world's fourth largest island, did not remain French, and the loss was harsh. With 9.4 million people—the Malagasy—it ranks second only to Sri Lanka as the most populous nation moated by the Indian Ocean. I found it a land of emerald foliage, and red earth steep as the hills of Italy. To me Madagascar seemed the



Applying the war paint, U. S. marines aboard the assault ship U.S.S. Tarawa camouflage each other (facing page) in preparation for a practice helicopter-borne mission near Perth, Australia. Vanguard of the much larger Rapid Deployment Force, the 1,800 marines are on station, ready to move quickly as needed.

Servicemen don't slow up ashore, and showing off T-shirts (above) is one way to break the ice and start liberty in Perth.

MADAGASCAR

most beautiful, and perhaps the most baffling, land in the area.

I arrived on an Air Madagascar 747. Just a year earlier this same great plane had been welcomed to local use with a blood sacrifice: A zebu bull, its hooves tied, was ceremoniously killed at Ivato airport to ensure successful voyages.

The capital, Antananarivo—city of a thousand warriors—is a cubist arrangement of stairs and streets. This was the highland capital of the Merina people whose monarchs ruled Madagascar from a hilltop palace until the 1890s. French elegance dressed later facades, and through the years many a French colonial retired here. Today, though France still provides considerable foreign aid, there are changes: For example, there's the empty, scorched Hotel de Ville, the city hall wrecked in uprisings of 1972. Tree-rimmed Lake Anosy reflects a French monument to the dead of World War I, but across the street, grounds of the Presidential Palace look besieged: girt by barbed wire, guard towers, and armed soldiers wearing jungle camouflage with red berets.

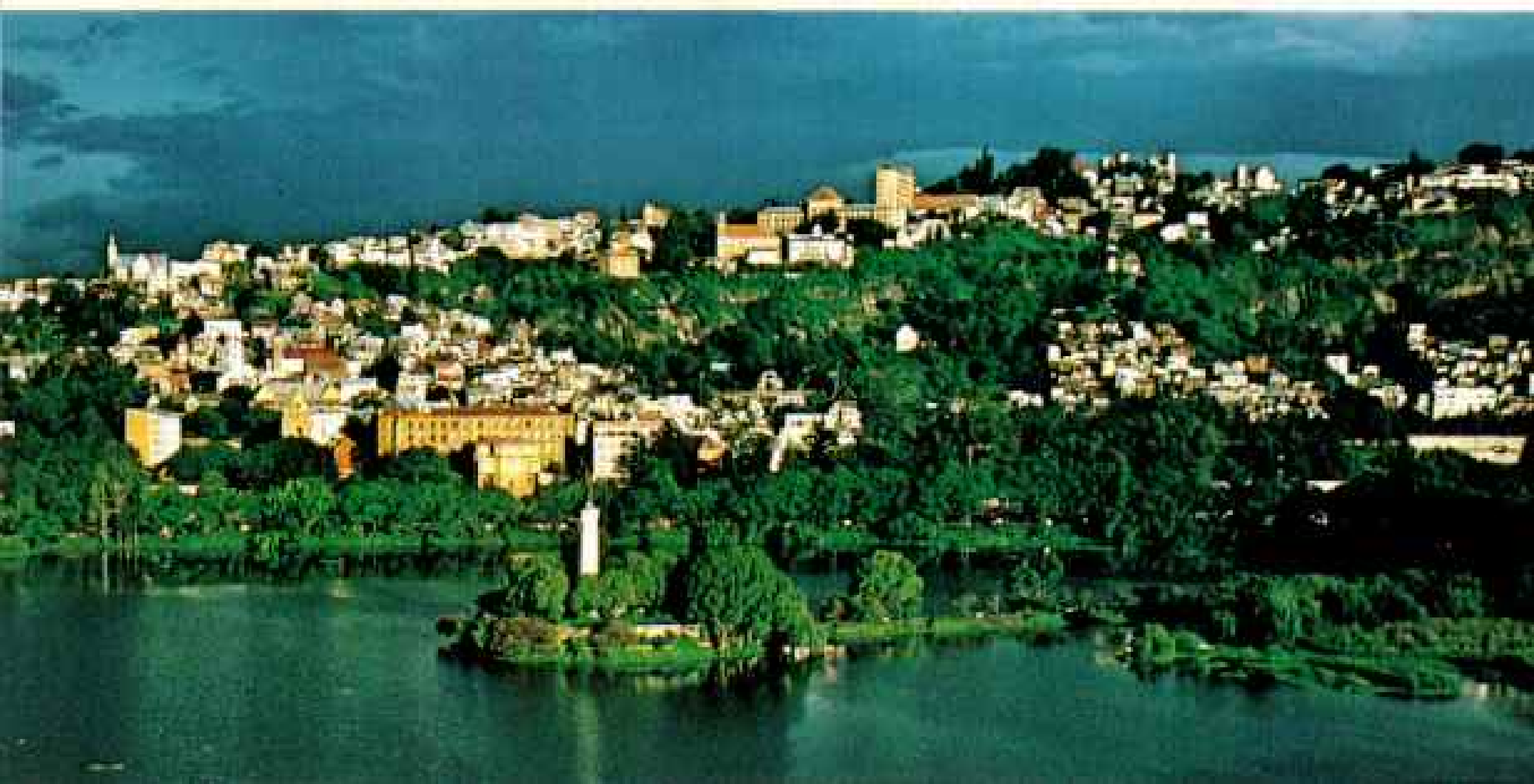
Madagascar is now ruled by President Didier Ratsiraka, who characterizes his regime as "Christian Marxist." The president, however, does not have time to attend Mass; he has been busy building socialism with the abundant help of Eastern-bloc nations.

In the public rooms of the Hotel Hilton International Madagascar, I met Cubans (they assisted the local television station), North Koreans (engaged in rice-farming education and excavations for government buildings), and Russians (doing everything). "Those Russians take their vodka into the sauna to drink," a hotel worker confided. "They don't lose much weight."

On Antananarivo's streets people are curious and smile easily. The Malagasy remind me of Thais. Actually, the highland Merinas are kin to Malaysians and Polynesians.

Slow as the economy, horses clop through the streets (above) of Antananarivo (below), capital of Madagascar, a country that, despite infusions of foreign aid, has nearly come to a standstill.





whose voyages somehow brought settlers here, 3,600 miles west of the Strait of Malacca, during the first millennium A.D. On the coast, people look more African. French scholars used to classify the Malagasy into 18 tribes; but whatever the variety, everyone considers himself Malagasy. "All who live under the sun," goes a proverb, "are plaited together like one big mat." The nation has always looked inward.

Ancestors—*razana*—are revered in special ways. Family tombs, where the *razana* are united, are a focus of family life, and a Malagasy would regard it a calamity to be buried away from his ancestors. The bones of long-dead ancestors are periodically exhumed, washed, and bundled into fresh shrouds. A village diviner, or *ombiasy*, can ask the dead for advice; their spirits are thought to remain active in the community.

"At a village gathering," notes one scholar of Madagascar anthropology, "people ask ancestors' permission to have the meeting. This conception is common to the whole country: Nobody dies.

"Madagascar is like a puzzle. When a Malagasy says *yes*, he means that he understands you—not that he agrees with you."

Folkways can inhibit social change. A man may have a taboo—*fady*—against working in the rice fields on a Tuesday. Or a worker may resist migrating to a new job away from the family tomb. Diviners and astrologers influence villagers.

"Malagasy are very individualistic, but they have always organized to help each other," said the anthropologist. "Together they build houses, help with the harvest, and so on. It looks like Marxism, but isn't. They like to have their own things at evening—their homes, meals, beds. Socialism is possible here, but it must be a very Malagasy form of socialism."

So far, the system seems neither Malagasy nor socialist. Until 1973 the country exported rice. Today Madagascar imports and subsidizes some 200,000 tons a year. Even so, a sort of rice rationing and black market exist. Once I watched townsfolk stand in long lines for their subsidized share. "One man sold rice here with a false measuring can," a local resident complained.

And so it goes with other shortages—cooking oil, petroleum. Some town dwellers

hire people to stand in line for them. Inflation is 14 percent. But at least three-fourths of the population engages in subsistence farming, unaffected by the new order.

The Madagascar government has nationalized the oil business, utilities, and most major industries like textile factories and bottling plants. One economist guessed that the government now controls 75 percent of the gross national product—up from 13 percent five years earlier.

Yet only land owned by absentee foreigners has been nationalized; some resident Frenchmen still own their land. No one has suggested expropriating Malagasy farms.

THE MARKET—called the Zoma—still seemed opulent: a crowded jumble of hawkers and customers on the lower streets of the capital. Here we were offered dried fish, fruit, buttons, caged birds, used shoes, zebu-horn spoons, bridal veils, curative herbs, and magic amulets so expensive they *must* have been potent. Women gracefully carried shopping bundles on their heads. Hucksters cried their sales pitches; beggars keened their woes; and invisible, omniscient pickpockets watched us all.

That is the eternal Zoma. But one day earlier this year, things abruptly changed.

"I was in the Zoma when the trouble started," a grim foreign businessman told me. "Everyone seemed good-natured at first. The soldiers and students were joking with each other. Then the line of soldiers began to advance, and I saw kiosk keepers folding up their wares and leaving. Those fellows know! So I left too. And a minute later I saw a student pick up some stones. . . ."

Soldiers fired their guns that day. Rumors ricocheted like bullets: 80 wounded, eight dead? The government issued official figures later: five dead, 44 wounded.

The military were out in force as Steve and I moved through streets of the capital moments after the violence. Markets remained closed, crowds dispersed—and photographs were discouraged. But some students were willing to talk about their grievances: Their dissents came from both far left and far right. Some wanted more autonomy and better classrooms; some, political changes.

Yet, curiously, the friendly atmosphere

quickly returned: Both students and soldiers responded cheerfully to our questions.

During the troubles in Antananarivo, Steve and I flew north to Antsiranana (formerly Diégo Suarez), until 1973 a French naval base for 3,500 people. We half expected a ghost town, like Gan.

"There's not an empty house or apartment in town," a local entrepreneur assured me at a sidewalk café. "Oh, our population fell off for a while, but now it must be 50,000—and twice that for the region. We have . . . visitors, from abroad." His eyes wandered to a far table. There sat a group of burly Slavs. "Of course, Russians," said my companion. "Engineers installing radar across the bay, or that's the rumor."

The bay, one of the finest natural harbors in the Indian Ocean, is often compared in beauty to Rio de Janeiro's. President Ratsiraka has insisted that the Russians will not be given access to the old French facilities. And, indeed, until the raising of some sunken ships from World War II, the great harbor could not serve a large navy adequately.

President Ratsiraka has said, "I am ideologically closer to the Soviet Union than to the Americans." But he also insists that Madagascar "is probably the only really nonaligned country." He defends Red Army action in Afghanistan as "a strategy of 'encirclement.'" Yet he has also warmly welcomed the first U.S. ambassador in Antananarivo for five years. Madagascar's



With arms stacked and lorries ready to roll, Madagascar troops control the streets early in 1981 after bloody clashes between soldiers and students of both the political left and right. With nine million people to feed and rice having become a net import rather than export crop, the country's economic fabric is frayed.



Staging a light-and-sound show for tourists and scientists, the volcano



Piton de la Fournaise fumes, rumbles, and flares on French Réunion.

government accords foreign newsmen greater freedom to move around than any of the half dozen Communist countries I have covered—and the Malagasy are open in their comments. Despite its avowed Christian Marxist regime, Madagascar is not really a Communist country.

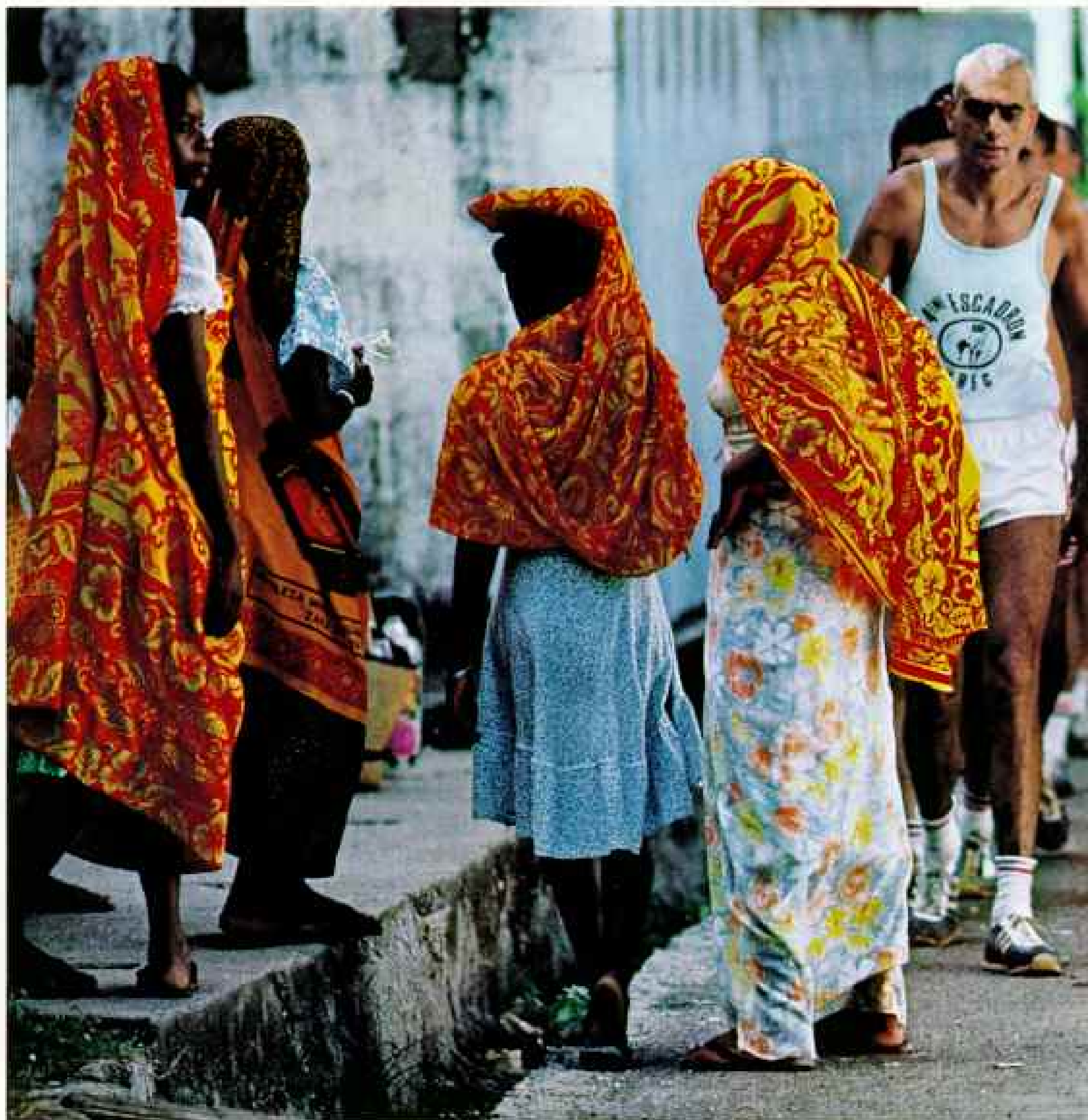
Nor need it drift leftward. Officials court U. S. oil explorers and talk of a policy open to “all points” politically. Still, some 2,950 Malagasy study in Eastern-bloc countries. The U.S.A. gives two scholarships.

Rumors—true, false, lurid, and surreal—waft through the picturesque land. In future

village meetings we can wonder what advice dead students and dead soldiers may give. Will they continue to say yes to Marxism? And what would they mean by yes?

IF MADAGASCAR is Third World, then the Federal and Islamic Republic of the Comoros is Fourth. Its 400,000 folk are grindingly poor and 80 percent illiterate.

I got there by Air Comores; its only plane, a crowded Fokker F-28 turboprop, was later seized by creditors. In better times it bobs its informal way between the capital, Moroni, on Grande Comore, and the other isles,



Mohéli, Anjouan, and Mayotte. (Mayotte, claimed by the Comoros, stays in the confident care of 300 of the toughest men wearing French uniforms.) At each stop, passengers and relatives sought the shade of the plane's wing. The women, wearing brilliant cotton togas called *chirromani*, animatedly spoke their Swahili dialect.

There's a look of Africa in the color and hair of Comorans, but their isles also lie in sailing range of Arab dhows, a fact still visible in the faces of people, in the arabesque alleys and white minarets of Moroni, and in the swarms of lateen-rigged lighters serving



freighters offshore. (Not one of the four islands has a proper harbor.) The seaways here still give the islands strategic urgency: As many as 5,000 oil tankers annually navigate these waters.

Local products are arcane: the Comoros lead the world in producing ilang-ilang, a flower essence used as a component of perfume. Next to Madagascar, the Comoros also lead in vanilla production. But both products could be undercut by synthetics. Soil here is rocky and depleted, so that the nation imports 40 percent of its foodstuffs.

Natural calamities seem casual—like the eruption of Kartala volcano in 1977. ("It was red and glowing—a river of fire—just as sunset," an eyewitness told me.)

Tides of refugees have brought problems. In 1976 and early 1977 some 16,000 refugees arrived after hundreds of other immigrant Comorans were killed in ethnic rioting in Mahajanga, Madagascar. "We did not lock our houses before those people came," a Moroni resident said sadly. "Now—because they are so poor, we have thieves."

Perhaps the greatest recent calamity was the rule of a Marxist recluse, one Ali Soilih, who took power in 1975, overthrowing the first president of the independent Comoros, Ahmed Abdallah. Soilih's coup was engineered by the famous French mercenary Robert Denard, whose exploits figured in the novel *The Dogs of War*. Soilih restructured the nation, seized lands, burned all public records, and turned the government over to teenagers.

"One of my pupils was a boy of 13," a teacher told me. "He dropped out of class and explained, 'I'm going to be a judge.' Two weeks later he jailed five people."

Near the thatched village of Iconi, troops fired capriciously into a crowd on presidential orders, killing several people. The act was typical.

In 1978 the manic rule ended when mercenaries, again led by Robert Denard, came

Rock-hard elite troopers of the French military keep battle-ready by jogging on the island of Mayotte in the Comoros. The chain of four islands rides like a flotilla in the Mozambique Channel, main super-tanker route to the West.





ashore one night from a waiting ship. They took the presidential palace, and—in a switch—restored Ahmed Abdallah to power. The coup was nearly bloodless: Soilih, however, was shot—trying to escape, a communiqué said.

Rumors of plots and countercoups persist, though things seemed serene when I met President Abdallah in the backyard of his palace. He was receiving village elders beneath a mango tree; nearby, his personal guards, in bivouac around the palace, were hanging out their wet wash. The elders left, and the president, dapperly dressed in a navy blue suit, greeted me with the warmth of a natural politician.

He talked about his country: "A young nation, very poor, but full of personality." His face, especially about the eyes, was animated. "We have no quarrel with our neighbors. We don't want others to be enemies because they favor France or Russia. Each man must choose his own wife! We're unknown in the U.S.A., but still we consider Americans our friends.

"But the United States does not even buy our ilang-ilang directly from us. Products go to Europe and are then transhipped. How can we buy U.S. cars if we do not sell our products?"

Then President Abdallah offered me some refreshment, Coca-Cola bottled in the Comoros.

In 1938 the scientific world was astonished by a fish caught in these waters, the coelacanth. Before that time, the species was thought to be long extinct.

"We ate the coelacanth all the time before we knew its story," said Saidali Youssouf, a deputy in the Comoran Parliament. "It's fat and delicious. But now it has become too expensive. One caught a year or so ago brought \$250 from a museum."

Like the defenseless dodo, the coelacanth offers an Aesop moral: The cost of living in the Indian Ocean is high for survivors. □

Chains of new housing interlink in St.-Denis, Réunion, which has by far the highest standard of living in the Indian Ocean. Réunion is a department of France, as fully integrated into that nation as Hawaii is into the United States.

PAKISTAN'S KALASH

People of Fire and Fervor

By DEBRA DENKER

Photographs by STEVE McCURRY



Elegance is routine among Kalash women, but for a festival, 15-year-old Taigun Bibi adds a cowrie-shell headdress and a design to her makeup of burned millet paste.

The author became a blood sister to another woman of the Kalash, a people of Pakistan numbering only 3,000. Unlike neighboring tribes, they have never been converted to Islam. With strong Caucasian features and probably of Indo-Aryan stock, the Kalash baffle scholars, who discount a persistent legend that they descend from warriors of Alexander the Great.

BASHARA KHAN'S prominent black mustache looms across the crackling fire. "When Chaomos festival is finished, you must take a Kalash husband." This I had not bargained for when I accepted a Kalash friend's invitation to become blood sister to this remote tribe.

"Husbands are much trouble," I respond.

Bashara Khan is undaunted. "One night!" he grins.

I suddenly pretend not to understand a word of Kalasha, and literally dance out of the situation. Slipping away from the smoky warmth of the small wood-and-stone house into the frosty night, I am immediately swept up in a dancing crowd of young girls.

Tonight is the climax of Chaomos, winter festival of the Kalash, an isolated mountain tribe that preserves its own ancient religion. About 3,000 Kalash remain in three high, narrow valleys of the eastern Hindu Kush range. These three valleys, Rumbur, Brumboret, and Birir, are a 20-mile journey from the town of Chitral in the North-West Frontier Province of Pakistan, and lie adjacent to the Nuristan region of Afghanistan.

The strategic location of this tiny ethnic minority, in a sensitive border region on the fringes of the Soviet-Afghan war, complicates Kalash life and makes Kalash culture seem fragile. Yet most Kalash remain strong in their culture and beliefs. Few in recent years have been lost by conversion to Islam, and the population is in fact on the increase.

In the center of Balanguru, largest village of the Rumbur Valley, a wild circle of dancers whirls round the ten-foot-tall bonfire, which spurts sparks and embers, dragonlike, into the moonlit mountain night. Girls and boys, and occasionally older men and women, suddenly spin off the main circle into lines or small circles, creating a joyous chaos.

One old woman with a deeply lined nut brown face and an Eiffel Tower earring (given her by a French anthropologist)



Good-natured insults fly between Kalash men and women during the course of their midwinter festival, Chaomos. The celebration chiefly honors Balomain, a legendary demigod whose spirit counts the Kalash and collects their prayers.

delights in croaking out the most sexually explicit lyrics, while small girls listen admiringly. Fifteen-year-old Taigun Bibi, her face aglow with excitement, shouts the words into my ear as we are furiously clapping and jumping.

My friend Saifullah Jan, 24, the only English-speaking Kalash, catches me from behind, unsettling my heavy cowrie-shell headdress. "I couldn't recognize you!" he exclaims. "You look Kalash." Saifullah had been right when he told me on my initial visit five months earlier: "If you want to learn about our religion, you must see Chaomos."

Annual Festival Upholds Culture

Chaomos, roughly coinciding with the winter solstice, is the year's most important festival, a time of great celebration both reverent and ribald. It is the distillation of the cultural and religious elements that make the Kalash unique, as the only tribe in the region never converted to Islam. Chaomos is part of the pure tradition to which the Kalash have clung despite threats, force, and even slavery to the rulers of nearby Chitral.

The Kalash religion is the last remnant of the pre-Muslim culture of Kafiristan, which Muslims called "land of the unbelievers." Its borders once extended through the Hindu Kush far into present-day Afghanistan. This land, though never a single political entity, culturally embraced not only the Kalash, but also several tribes inhabiting the neighboring valleys of what is now Afghan Nuristan. Though every tribe had its own pantheon and dialect, all shared a predilection for ornate carvings on temples, houses, and furniture, and a preference for low chairs rather than sitting on the ground. They also erected elaborately carved effigies of ancestors in graveyards, had a great fondness for wine, and attached a ritual importance to livestock, especially goats.

Neighboring Muslims, who abhorred graven images and alcohol, were offended.



From 1895 to 1898, Abdur Rahman, Emir of Afghanistan, campaigned to subdue the "infidels" of Kafiristan, and converted them at sword point. He changed the name of the country to Nuristan, "land of light," and annexed it. The Kalash escaped conversion because of their (unwilling) attachment to the princely state of Chitral, within the British sphere of influence.

Only vague traces of ancient practices remain in Nuristan, but among the Kalash the religion of Kafiristan persists. The Kalash pantheon includes Dezao, the omnipotent creator god; Sajigor, god of flocks and shepherds; Mahandeo, god of honeybees; and Jestak, goddess of home and family.

The Chaomos festival honors Balomain, the legendary demigod who once lived



among the Kalash and did heroic deeds. Once every year, during Chaomos, Balomain's spirit passes through the valleys, counts the Kalash, and collects their prayers on behalf of Dezao. He then "carries" them back to Tsiam, mythical land of origin of the Kalash. This year, Balomain will count one extra person, as I will join the tribe as a blood sister.

Photographer Steve McCurry and I reach the Rumbur Valley a few days before the festival. Saifullah meets us and escorts us to the "Rumbur Palace Hotel," a modest structure owned by his father-in-law, Kata Sing. Kata Sing lives with his family in another village, but this extra house, an informal community hall by day, will be our sleeping quarters at night.

The handsome Kata Sing and his two sons remember me from the past summer. "*Ish-patch, baba! Prusht taza?*—Hello, sister! Are you well?" The Kalash hail each other as *baba* (sister), or *baya* (brother), unless there is a more specific relationship of blood or marriage. I introduce Steve as my cousin, so no one mistakes him for my husband.

We proceed to Saifullah's village, Balanguru, by way of the mill, where women are grinding flour for the festival. The houses of Balanguru climb the steep hillsides like stairs. Saifullah leads us up a tricky, rough-hewn log ladder and across a flat mud roof into his home:

Washlim Gul, his vivacious young wife, welcomes us affectionately, offering walnuts and dried mulberries. She suckles their



As if shingled into a sheer cliff, Gri village (right) climbs above Birir Valley. Amid the rarefied isolation of the Hindu Kush, the Kalash venerate numerous deities and a shadowed history. Their lore gives a land called Tsiam as their origin; where it is or was, no one knows.

Muslims abhor the Kalash custom of carving graveyard effigies (above), which are rarely made today because of the expensive feasting that accompanies their installation. Many older statues have been stolen, destroyed by Muslims, or sold to art collectors and museums.

During the Ceremony of the Bean Feast (following pages) villagers gather on a porch where they will offer prayers to be fruitful and multiply—a petition seemingly fulfilled by their rising population.

eight-month-old son, Wazir Ali, while their two-year-old son, blond, blue-eyed Yasir, eyes us intently. Like these children, many Kalash males have names of Muslim derivation. When asked why, the Kalash simply shrug and call it custom.

Dressing for the Occasion

Batan Gul, Saifullah's neighbor and clan sister, calls me to her house. As promised, she has finished making my thick cotton *cheo*, the voluminous black dress worn by Kalash women. I try it on with a long woven magenta sash that binds it tightly at the waist, allowing objects to be carried safely in the pouch formed in the folds of the dress above the sash.

On her terrace we sit in the wintry sun as Batan Gul braids my hair into *chui*, the five braids worn by all Kalash women. She nods approvingly. "Your braids are very long." Saifullah appears with several strands of fashionable red and white beads, obtained from his mother and clan sisters. Compared to Washlim Gul, whose hundreds of necklaces hang down nearly to her waist, I look like a pauper.

Ceremoniously, Saifullah places my *kupasi*, the heavy Kalash headdress, on my head. I am weighted down by its several pounds of cowrie shells, buttons, beads, bells, and assorted ornaments, all sewn into rows and patterns on a thick piece of wool.

"Now you are Kalash, and I am your uncle," he teases, green eyes crinkling into a smile. "It is the uncle who gives the girls their first headdress."

I am pleased to be in Kalash dress for Mandaik, the day offerings are made to the ancestors. As the sun hovers on the high wall of the valley, the clans gather in their Jestakhans, temples of the goddess of home and family. We go with Saifullah's family to the large, one-story building that serves as temple to Balanguru's two largest clans, perhaps 20 families altogether.

People come to their respective Jestakhans laden with baskets of berries, nuts, and dried fruits, the rich earth tones of the harvest glowing in the afternoon light. Inside, a warm fire beckons. Each family puts a portion of the food into a large communal basket, which will be placed outside for ancestors' spirits. (Continued on page 467)









In front of the Jestak-han, men construct a pyramid of pine chips. This is the *kotik*, the light for the ancestors. Everyone is given a small torch of three sticks. Upon entering, we light these hurriedly before we are shut inside, so no one will fear the spirits of the ancestors as they "suck the taste" from the food offerings outside the door.

The *kotik* is lighted. Two men hold a thick cloth over the open doorway, closing us in. A hundred torches light the rough geometric carvings of the four wooden pillars. I am in a hushed sea of ornate cowrie-shell headdresses adorned with feathers. We listen intently for the rumblings of visiting ancestors. It is a moment of magic, a moment when belief brings the once silent temple to life.

As the *kotik* smolders out, the cloth is dropped from the door, and conversation begins anew as we throw our torches joyously on the fire. Since the offered food has been touched by the ancestors, it is now considered impure for consumption by men and is permitted only to women past childbearing age, who quarrel cheerfully over its division. Once it has been divided, people drift home to finish preparations for Chaomos. The temple is again cold and silent.

Rites Begin With Purification

Enough flour has been ground to last the length of the festival, and the elders declare that Chaomos may begin. The first day is *Shishaou* *Suchek*, the purification of women and girls, beginning the week during which no one may make love. This ensures that everyone will be pure when Balomain comes to the valley.

Because I am staying in one of Kata Sing's houses, his clan must purify me. So Saifullah leads me to Kalashagram, the village high above the river where Kata Sing's family lives. Billowing clouds of blue smoke in the morning sunlight mark the places where men bake *shishaou* over open fires. The special pure bread, used in today's ceremony, must be baked either in a field away from the

village, or in the cattle house, which is forbidden to women.

Kata Sing's pretty daughter-in-law, Sunugur, guides me down the steep, icy path to the river's edge, where I must join the women of the village in a ritual bath. Icicles cling to boulders above the river, and I am thankful that bathwater is being heated over a small wood fire among the rocks.

In the afternoon the men arrive with the special bread. The women, wrapped in fine, newly woven dark green-and-blue-striped blankets, their bulky headdresses crowned with lavender and purple feathers, begin slowly chanting the hymns to Balomain. They smile encouragingly as I join them, though I know only the last words of each chorus: "He came down."

Solemnly, we file up the hill to an open place near the cattle house. A few at a time, the women and girls come forward. Water is poured over their hands, and they are given five loaves of bread to hold. A male member of the clan waves a branch of pungent burning juniper three times over each woman's head, murmuring, "*Sooch*—Be pure." My turn comes, and I feel strangely reverent, like a small girl at her first Communion.

That night I help Washlim Gul and Miza Dana, Saifullah's mother, bake *jaou*, the thick Chaomos bread filled with goat cheese and crushed walnuts. Washlim Gul patiently demonstrates over and over how to form the dough into a cuplike hollow for the cheese and walnut mixture. My awkward hands invariably produce clumsy, misshapen forms.

"Don't you bake bread in America?" asks Washlim Gul. I explain that in America nearly everyone buys bread from large stores. This they find very funny.

When we are finished baking, Washlim Gul removes the heavy griddle and puts two loaves in the embers to warm. "One of mine, one of yours," she says, laughing at my easily recognizable undersized creation.

"Is it good?" I ask doubtfully as she tastes my loaf.

A winter's fire stokes old tales among the menfolk. Their low chairs with seats of woven rawhide distinguish Kalash from neighboring Muslims, who prefer sitting on the ground. A grandson dozes in a shaft of sunlight from the doorway of this sole room of a house that as many as a dozen Kalash call home.

"Very good," she says, and I am relieved that appearances deceive.

We chat in my limited Kalasha. The fact that I am 26 and unmarried is first a source of mystification, then amusement. "Maybe in two or three years," I tell them.

"In two or three years you will be old," answers Washlim Gul with a mischievous grin. "I am 23 and have two children."

The next day men and boys are purified.



Sap of renewal rises during Chaomos at the altar of Sajigor, god of flocks and shepherds (facing page), when male Kalash offer branches and bread filled with goat cheese and walnuts; women are barred from the site. Before carved horse heads adorning a shrine of Mahandeo (above), god of honeybees, a boy offers a sprig against illness. The multitude of Kalash gods are all subordinate to Dezao, creator and supreme deity.

Like the women, they must bathe, but are forbidden to sit on chairs or beds until the evening, when the blood of a goat sacrifice is sprinkled on their faces in the cattle house. Before their morning bath the men sacrifice 30 goats at the altar of Sajigor, patron of flocks and shepherds.

Under the bare, spreading branches of the giant walnut tree overlooking the flat ground below Balanguru, women await the men after the sacrifice. They keep up a constant quavering of Balomain songs.

From Solemn to Salacious

In the distance the men file down the path from the Sajigor altar in solemn procession, led by elders in bright coats of silver or gold brocade. Their rolled woolen caps are decked with sprigs of holly oak and juniper, with feathers and beads. Baraman, a venerable old man with a strong-featured face, is in the lead, his green-and-gold coat glittering in the sun. His dignity and bearing remind me unaccountably of the ghost of Christmas present.

As the men approach, the women, still singing, sink to the ground. The men, chanting in low bass voices, slowly circle the women three times. It is an awesome moment in this faraway valley, at once alien and frightening, yet somehow familiar. Suddenly the men's songs change to aggressive sexual chants, and the young boys jump on each other's backs, crying boisterously, "Oh, ho, ho!"

Groups of young men and women hurl insults, and an occasional clod of earth, at each other. They cite each other's inadequacies and transgressions, and the girls gloat over the frustrations of the boys during the seven days of sexual purity.

In the midst of this, someone places a string of apricot kernels around my neck, and I suddenly remember the summer, when I helped Kalash women shell hard apricot pits against a stone. Some of the edible kernels were strung into these long necklaces, to be given as gifts during Chaomos. I feel a sense of time flow, the peaceful closing of a circle.

The following night is Chanjah-rat, the dramatic torchlight procession that takes its name from the long torches made of pine bound with willow. Before the procession I





Summoning the dignity of a village elder, Baraman dons for Chaomos a brocade coat and a hat bedecked with feathers and a juniper twig (above). A member of Rumbur Valley's council of elders, he helps settle disputes. Neighborly spirit keeps the animals together in Guru village, where everyone's goats take advantage of the earthen roof of their stable to browse on grass shoots (right).



am invited to Kata Sing's house for a festive meal of tasty but chewy goat tripe and Chaomos bread. Well after darkness, the village of Kalashagram gathers on a high place. All light their torches in the bonfire, and the long, slow progress down the mountain begins. It is exhilarating but also frightening. A fire storm of embers hails about me, onto my clothes and my headdress, and whole chunks of burning pine fall at my feet.

Across the valley a small constellation of torches snakes down the dark mountainside from the high village of Grom. At the very same moment, both processions reach the bridge that leads across the narrow gorge to Balanguru. At the best of times the supple plank bridge is treacherous, but it is positively terrifying in this traffic jam of bodies and fire.

Festivities Move to Nearby Village

On this night all Rumbur Valley heads for Balanguru, which has the largest dancing space. The village is ablaze with a giant bonfire. I throw myself into the melee of people madly circling the fire, singing, leaping, dancing, glad to be rid of my torch as I hurl it into the fire with the others. The moon is high and bright, the stars like chips of ice in the thin black sky. The ragged snowy mountains rise close by, shutting out most of the sky, and seeming incalculably wild. And yet I feel at home.

The next day Saifullah informs me that the dancing is finished here, and suggests that Steve and I follow the festival to Brumboret Valley, which lags two days behind.

Brumboret, largest and most accessible of the three Kalash valleys, also has the largest Muslim population. Some are converted Kalash, others are outsiders come to build hotels or shops. As we arrive, the Muslim call to prayer echoes up the snow-dusted mountains, carried to the Kalash villages by a powerful loudspeaker.

In Brun, a picturesque stair-step village, an unpleasant surprise awaits us. We are informed by the inhabitants that, having shared a jeep with Muslims, we are now impure. Vainly, Saifullah argues that we did not eat in the impure jeep. But we will not be allowed in the houses until we undergo purification, Brumboret style. The price: one goat sacrificed in the cattle house. Steve and

Saifullah return spattered with the blood of the sacrifice.

Afterward, we celebrate with several bottles of strong local wine, corked with corn-cobs. The sweet, heady wine soothes my nerves, and we joke, dance, and sing. Then Saifullah becomes pensive. It was not easy for him to become the only educated member of his tribe. The few other Kalash boys who made the ten-mile journey to school in the Muslim town of Ayun either quit or succumbed to pressure to convert to Islam. One even became a Christian. Saifullah describes how one of his Muslim teachers used to call on him: "Stand up and read the lesson, dirty Kalash."

He tells us of the past oppression of his people, surrounded by a different religion and culture. Until Pakistan's independence in 1947, the Kalash were virtual slaves to the rulers of the semiautonomous Muslim state of Chitral, and were subject to forced labor. Laws required Kalash who visited the town of Chitral to wear hats with beads or feathers, to differentiate them from Muslims. There were cases of forced conversion.

Today the official policy of the Islamic government of Pakistan is one of respect for the rights of religious and ethnic minorities. In practice, many land disputes between Kalash and Muslims remain unresolved, and the best business properties are in Muslim hands. In Brumboret all the hotels are owned by Muslims from outside the valley.

Saifullah feels the courtroom is the best place to defend the rights of his people. His goal is to become a legal adviser, and later a full advocate. He hopes somehow to raise money to continue his education.

We return home to Rumbur on Christmas Day, and invite some of our friends for dinner. In my halting Kalasha, I try to explain the "foreigners' Chaomos." Jesus is a little like Balomain, but he is the son of Dezao, the Kalash creator god. Some confusion is evident in the faces of my listeners. Over wine, I sing Christmas carols, then Kalash songs.

The time is nearing when I must leave the valley. We visit Sumali Khan, a *tum puchawao*, "bow shaker," who tells the future with a small bow made from a twig and a string of goat-hair yarn. Saifullah insists that I ask when I will return to Kalash, and I suddenly become afraid. "What if he says

Will the future bring author Debra Denker back to the people who have adopted her? She awaits an answer from Sumali Khan, a "bow shaker" who consults the gods. When the bow began to swing, he predicted her return within six to eighteen months.

She takes seriously her blood sisterhood with Washlim Gul, the wife of her interpreter. "In spirit," she says, "half of all I have is hers, and vice versa, for the rest of our lives."



five years, or ten, or never?" I wonder.

Saifullah reminds me that I told him the future is made by our own minds. I sit tensely on the rooftop next to Sumali Khan, shivering in the snow-laden air. Will the bow never move? It begins to sway, and at last Sumali Khan speaks. I understand the words "six months" and "one year, six months." Saifullah explains that I might return within six months, but definitely within a year and a half. I am so happy I am ready to embrace them both.

Finding a New Family

The day before I leave, I become blood sister, or *dari*, to Washlim Gul, and thus am formally adopted into the tribe. Washlim Gul is happy, but worried. It is good to have an American sister, she says, but why must we be so far away?

I arrange for a sheep to be killed and roasted, and the simple ceremony takes place on the front porch of Saifullah's house. Akbar Hayat, Washlim Gul's brother, officiates.

I am nervous, aware that I am undertaking a responsibility that the Kalash take very seriously. I watch intently as Akbar Hayat cuts one roasted kidney. He feeds half to Washlim Gul on the point of the knife, then half to me. When he has repeated the process with the other kidney, we are officially blood sisters. I feel elated. Something very

important has taken place. Whatever else I may become, I am always Kalash, and an only child has found a sister.

We send portions of meat and rice to all my newfound relatives, then invite close relations and elders to a feast. I feel sad as I look from face to face in the soft lantern light. I have found a family, only to lose them to distance, borders, and visas.

Washlim Gul's father, Kata Sing, gives an emotional speech, which Saifullah translates. "You are our guest in Kalash, and yet you have made us your guests twice, and now have become as my daughter. We have had foreigners here, but never before have they shared their Christmas with us. In the past we have been made many times to feel low. But because you have made us your guests, we feel we are something high."

"But Saifullah, why should such good people ever feel low?" I ask in disbelief.

"We have been told so many times that we are low," he replies, "that it is carved on our brains, like the carpenter carves on wood."

Another tragically human story, this—a story of the oppression of one group by another, a story of pride won slowly and painfully. It is with love and respect for my blood sister, Washlim Gul, and my adopted brother-in-law, Saifullah Jan, their families, and their tribe, that I write their story, in hope of a future of pride and freedom. □

Columbia's Landing



KERRY SMITH

TO ME there was a touch of Rip Van Winkle about it all. After 54½ hours in earth orbit an airplane—not a capsule or a command module but an airplane, a ship with wings—descends above the high desert of California. It glides toward a landing at Edwards Air Force Base. As in the old days, the mirages of Rogers Dry Lake envelop it like a hallucination. The ship makes a perfect touchdown and rolls to a stop. At last the commander emerges. He is 50 years old. He has grown old and farsighted waiting for this flight. He had to wear glasses to read the instrument panel. He opens his mouth and out comes a drawl that takes me back 25 years, at least, to the cowboy days of Chuck Yeager.

Not to press John Young into the role of Rip Van Winkle, but his flight with his 43-year-old copilot, Robert Crippen, in the space shuttle *Columbia* resumes a story that was broken off a quarter of a century ago. It returns the American space program to where it started—which was not Cape

Canaveral but the throwback landscape of Edwards Air Force Base, a terrain that evolution left behind, a desert decorated with the arthritic limbs of Joshua trees and memories of Chuck Yeager, Scott Crossfield, Joe Walker, Iven Kincheloe, and other pioneers of manned rocket flight.

Yeager began the American advance toward space at Edwards—or Muroc as it was then called—on October 14, 1947, when he broke the sound barrier in the X-1. The X-1 was the first in a series of experimental aircraft built solely to test the effects of supersonic speeds and very high altitudes on aerodynamics and structural integrity. The X-1 consisted of a four-chamber rocket with wings (just six inches thick), tail assembly, cockpit, and a set of controls. There were scarcely 30 people on hand who knew what it meant when Yeager's sonic boom hit the desert floor. The Air Force had a security lid on the X-1 project, and no announcement was made of Yeager's triumph. The only celebration was a free steak dinner and

Closes a Circle

By TOM WOLFE

all he could drink at Pancho's Fly Inn, a ramshackle dude ranch, saloon, and pilots hangout, just outside the base, run by a female stunt pilot named Pancho Barnes.

Three days before the flight Yeager had taken a terrific fall during a midnight ride through the Joshua trees on one of Pancho's dude-ranch horses. He wound up with two broken ribs, making it impossible for him to use his right arm. But in this, the cowboy phase of manned rocket flight, there were no preflight physicals. Yeager told only one person about his little problem, the flight engineer, a good old boy from Oklahoma named Jack Ridley. So Ridley smuggled a length of broom handle onto the X-1 to give Yeager's one good arm more leverage, and that was the way he went up: with one arm and a piece of a broom handle.

By October of 1957, when the Soviet Union launched Sputnik 1, the first artificial earth satellite, Yeager, Crossfield, Kincheloe, and other pilots at Edwards had gone more than twice the speed of sound in the X-1A, the X-2, and the D-558-2. Crossfield, the prime pilot for the project, was awaiting delivery of the X-15, an airplane North American Aviation had built to fly into the lower reaches of space, 50 miles above earth, although not in earth orbit, and then return through the atmosphere for a landing at Edwards. (This it eventually did, many times, and Joe Engle, scheduled to command the second flight of the space shuttle, was one of the pilots who took it up.)

Assuming that the problem of the heat of reentry could be solved, it was but a short step, in terms of technique, from the X-15 to a ship such as the X-20, which the Air Force started work on within days after the launching of Sputnik 1. Boeing had the contract to build it. The X-20 would be a 35-foot-long black metal version of a paper airplane. It would be launched by a Titan III rocket, which would disengage after lift-off. The ship would orbit the earth and land at Edwards. To pilots like Yeager, this was

such familiar and inevitable stuff that they were astounded to see the Soviet Union's little Sputnik, a 184-pound ball with nothing but a little radio transmitter in it, throw the government and the press into such a panic.

The problem with the X-20 program—the political problem—was the Titan III rocket. The Titan III was to consist of a Titan II ballistic missile, ten stories high and 150 tons in weight, capable of 430,000 pounds of thrust at lift-off and boosted by two large solid-propellant rockets, each ten feet in diameter, attached to either side of the Titan II. Atop the Titan II would be the X-20. But this great brute of a rocket assembly was at least two and perhaps three years away from development. The space race, as it was now called, seemed like such an urgent national priority that the government decided upon a "quick and dirty" approach. Even though the X-20 program would go forward, the emphasis of the space effort would be in a different direction. NASA would use smaller, already fully developed military attack rockets, such as the Redstone. The Redstone had a lift-off thrust of 78,000 pounds, less than one-fifth that of the Titan II, but it was ready to go. The test subject would be placed inside a small shell—a capsule barely six feet across—and the shell would be placed on top of the Redstone. It was the human cannonball approach. All that was required was a test subject who could sit still and stand the strain.

A *test subject*; such a creature could scarcely be called a pilot. He would be a passenger with biosensors attached to his body. He would *splash down* in the ocean at the end of his ride—he wouldn't even land like a man. Because the poor devil couldn't control his own flight, entire fleets of ships and aircraft, plus a worldwide network of radio

The author: In his best-selling book *The Right Stuff*, Tom Wolfe traced the story of early manned rocket flights—and the daring pioneers who broke the barriers of the unknown.

tracking stations, had to be mobilized in order to be sure of finding him when he hit the water. Afterward neither the capsule nor its rocket could be used again. It was like buying a new Buick Electra 225 every time you drove over to the Seven-Eleven.

At Edwards the rocket pilots looked with derision upon the astronauts, as the test sub-

jects were called. They spoke of NASA's Project Mercury as "Spam in a can," and added: "A monkey's gonna make the first flight." It was true. Chimpanzees took the first sub-orbital flight (before Alan Shepard's) and the first orbital flight (before John Glenn's). An ape filled the bill as handily as a human test subject.

What self-respecting pilot would volunteer to become a human chimp? Every hot pilot wanted to do it like Yeager. One of

that breed in 1957, when Sputnik went up, was a 27-year-old Navy test pilot named John Young. He was soon to set two world time-to-climb records in a supersonic Navy interceptor, the F4H-1, for the fastest climb from takeoff to 3,000 meters and the fastest climb from takeoff to 25,000 meters. It went without saying that he had a fully developed Yeager drawl.

But soon an aura of national mission and blazing glamour, complete with *Life* magazine covers, was upon Project Mercury. Not only that, the performance of the Mercury astronauts, whether one regarded them as pilots or guinea pigs, was exemplary. By 1962 the objections and taunts of Edwards' great rocket pilots scarcely even registered any longer. Ambitious pilots like John Young were determined to make it not to the old Olympus, Edwards Air Force Base, but to the new one, NASA's Manned Spacecraft Center in Houston. Even the Air Force attached paramount importance to producing astronauts for NASA.

Young was selected for the second group of astronauts, which included Neil Armstrong, Jim Lovell, Pete Conrad, and Frank Borman. The entire emphasis of American

manned spaceflight was now upon the goal of reaching the moon. In 1963 the Air Force's X-20 program was canceled, even though Boeing had begun manufacture of the first ship. As something of a sop, the Air Force was given the Manned Orbiting Laboratory program, which would involve astronauts going back and forth to space stations in two-man capsules of the sort used in Gemini. That scheme was canceled in 1969—the year Young, on his third spaceflight, the Apollo 10 mission, orbited the moon. NASA now somewhat reluctantly absorbed the Manned Orbiting Laboratory trainees as the seventh group of astronauts. One was Robert Crippen, who had come into the program from the Navy.

It was not until 1969, after the success of the Apollo moon project, that NASA returned to the task of developing a rational and affordable system for flight in earth orbit. Which is to say, the X-20 project, reborn as the space shuttle. The shuttle would be launched by a more powerful and sophisticated version of Titan III. Like the X-20 it would have two solid-fuel boosters. The ship itself would be larger than the X-20 and look more like a conventional aircraft. But, in effect, the shuttle would be the X-20 project resumed, updated, and loaded with the technical bijoux developed in Mercury, Gemini, Apollo, and Skylab.

Young was the reigning astronaut assigned to the program. He had flown in space four times and, as commander of Apollo 16, had been the ninth man to set foot on the moon. So Young was named commander of the first space shuttle mission, which would presumably take place by 1979. Crippen was named pilot. He would be the first of the Manned Orbiting Laboratory leftovers to get any spaceflight at all.

Politically the times were very different. At NASA it was with a sense of old-oaken-bucket sentimentality that they now talked about the glorious days of "budgetless financing." That had been during the Apollo program, prior to the landing of Apollo 11, when NASA simply spent whatever it needed and Congress was only too happy to take care of the overdrafts.

Those days were gone. Now they could barely pay the light bills down in Houston. Shuttle development dragged on. The ship

JOY OF ACHIEVEMENT LIGHTS ASTRONAUTS' FACES AT COMPLETION OF FLIGHT



John W. Young

was referred to as a lemon. In fact, all that was lacking was the money and the sort of national commitment that had made almost anything possible, overnight, for Mercury, Gemini, and Apollo. Years went by, and Young and Crippen grew older, until Young, like many men his age, had presbyopia, literally "old eyes," better known as farsightedness, and had to wear spectacles for close work.

Time had taken its toll on the old notion of pilot's control of the craft too. Ironically, the high speeds that Yeager himself introduced had made automatic guidance systems increasingly important. A computerized inertial guidance platform had been developed to help X-15 pilots bring the ship back through the earth's atmosphere at the proper angle. Neil Armstrong, NASA's backup for Joe Walker in the X-15 project, gave the system its first lower-altitude tests. To the great satisfaction of the rocket aces, the platform had its problems. It was still the brain, the reflexes, and the body of the pilot that controlled the X-15. As the talk of computer-controlled flight grew louder, Scott Crossfield put in a word for the test pilot: "Where else would you get a non-linear computer weighing only 160 pounds, having a billion binary decision elements, that can be mass-produced by unskilled labor?"

But by 1980 things like inertial guidance systems were routine in high-performance aircraft. The Navy even had an automated system for landing fighter planes on carriers. The pilot took his hands off the controls and just sat there as his aircraft nosed toward the deck, lurching and shuddering as the computers corrected its course in sync with the motions of the carrier's flight deck.

The space shuttle had five computers in control of most phases of flight. Originally there had been four. During one simulation the computers had arrived at a Mexican standoff, two against two, with no decisions being made. In an actual flight the results would have been disastrous. A fifth computer, an arbiter, a Solomon with a heart of transistors, was added later. In most situations in shuttle flight, the pilot's decisions are not relayed directly to the various movable parts and fuel supplies. They enter the loop of the Computer Solomon along with the other machines' binary decision

elements. Technically, none of these computers, not even the Solomon, actually makes a decision. Only the pilot can do that.

One component of classic flight test, Edwards style, had not changed by the time the space shuttle *Columbia* was launched last April with John Young and Robert Crippen in the cockpit. Namely, the danger inherent in the first flight of a completely new aircraft. NASA's other space systems, Mercury, Gemini, and Apollo, involved shells guided by computer from lift-off to recovery, and each was tested first by sending the shells into space without pilots. The space shuttle was like the X-1 or the X-15 in that it would be manned for its first all-out test. The shuttle had never before gone into orbit.

The shuttle, like the X-1 and the X-15, had to come into Edwards without power and make a so-called dead-stick landing at high speed. The ship could make one approach and that was it. Even in an age of computers, to attempt a dead-stick landing without a pilot aboard would mean risking a billion-dollar hole in the ground.

It is this, the unspeakable danger—and the term "danger" is itself taboo among the pilots—that has always given the phrase *the first flight* such a righteous aura among test pilots. And what great first flights remain? It has been 18 years since Milt Thompson, for NASA, and Yeager, for the Air Force, made the first flights of a wingless aircraft (lifting body) at Edwards. It has been 13 years since the X-15 made its final flight. The flight of *Columbia* in April may prove to be the last historic first flight in this century.

So even though it took Young and Crippen almost a decade to reach that moment, and even though they grew very old, in the life span of a pilot, there was no reason to doubt Crippen when he said: "It was worth that wait." Everyone in the flying fraternity, and especially the veterans of those skies above the arthritic Joshua trees, knew exactly what he meant. □

NASA TELEVISION



Robert L. Crippen

Columbia's Astronauts' Own Story: **Our Phenomenal First Flight**

WE WERE 60 MILES above Midway and coming home, Crip and I, when we saw the reddish pink glow. The space shuttle *Columbia* was dropping through deep black night during the last half hour of our phenomenal first flight. Our nose was pointed 40 degrees up so that the heat-shielding silica tiles on *Columbia's* underbelly would bear the brunt of the scorching temperatures as it broke into the upper reaches of earth's atmosphere.

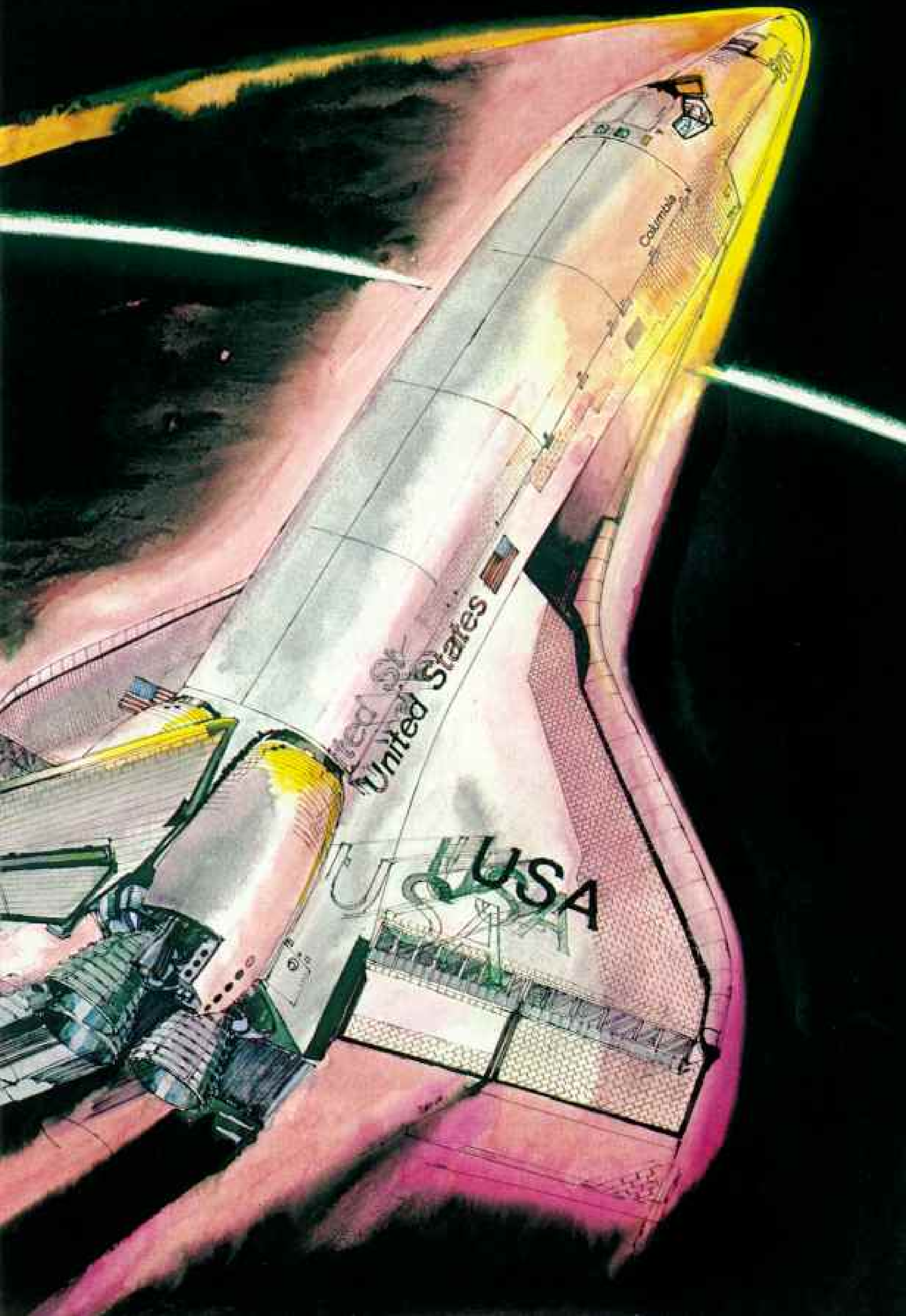
People had worried a lot about this reentry heat. Even our own engineers had told us that at least one of the critical tiles on the underside would probably come off. If enough did, they said, the hot plasma outside could burn right through *Columbia*.

But we had faith in those tiles, and that tenuous glow proved they were out there doing what they were made to do. They were taking 2300°F and lighting up the sky around us. Outside our windows that glow was light red, but it turned reddish orange near the superhot nose (right). I felt as if we were flying through a neon tube.

I grabbed my camera, but the film was too slow to record the glow. Then the sun lit up the far horizon. For a moment that bright band of dawn streaked through, then the full burst of sunrise washed the glow away. It was so beautiful, I hated to see it go. *(Continued on page 485)*

By JOHN W. YOUNG and
ROBERT L. CRIPPEN
Paintings by KEN DALLISON





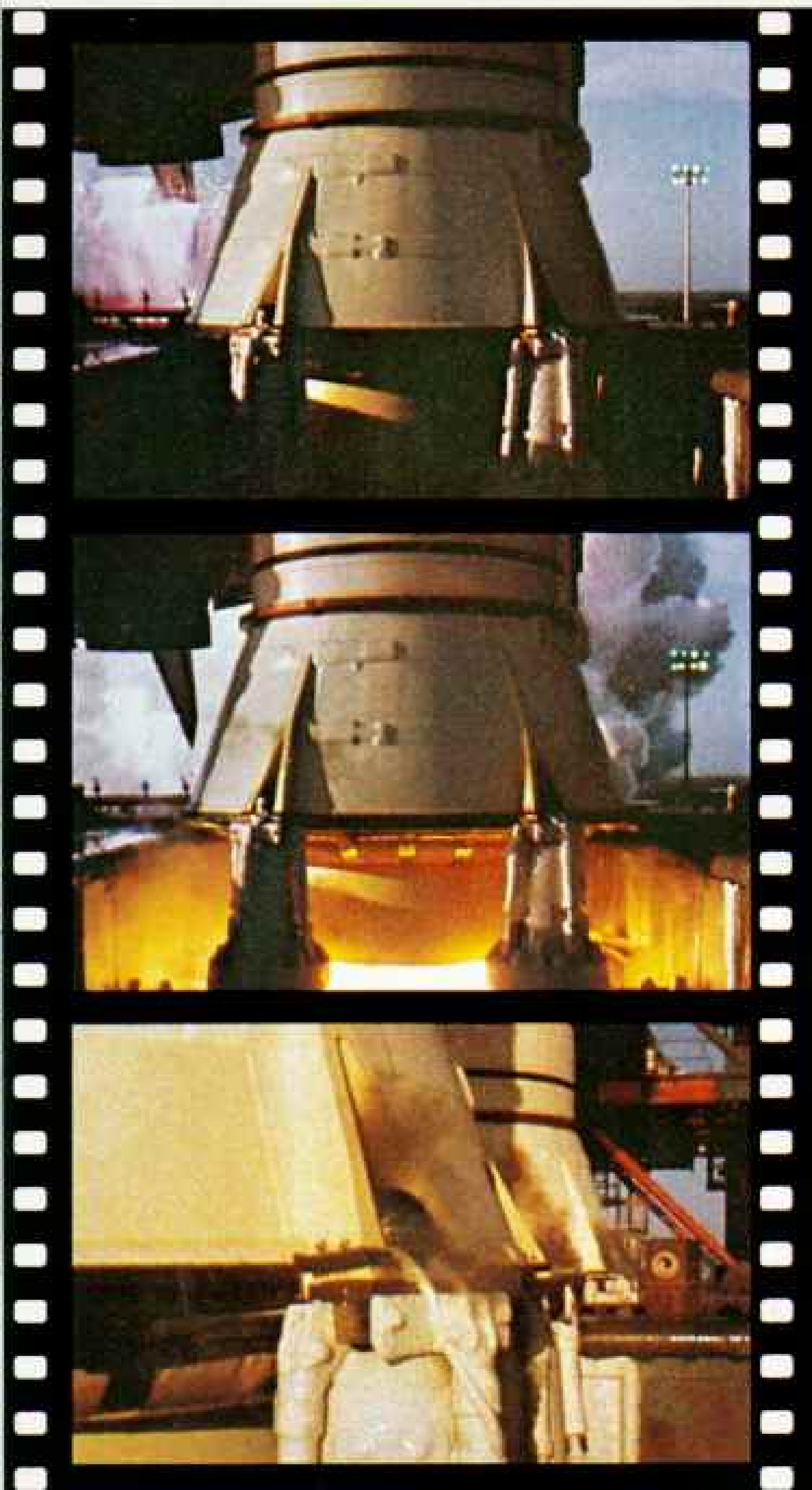


Dawn of a new space age breaks over Cape Canaveral just after 7 a.m. on April 12 as a fireball brighter than the Florida sun rises into a clear sky carrying the United States' first reusable spacecraft. The blast-off knocks down several hundred feet of wire fence, blows apart a camera near the launchpad, hurls away public-address speakers, and sears grass within a mile. Its rumble shakes buildings three miles



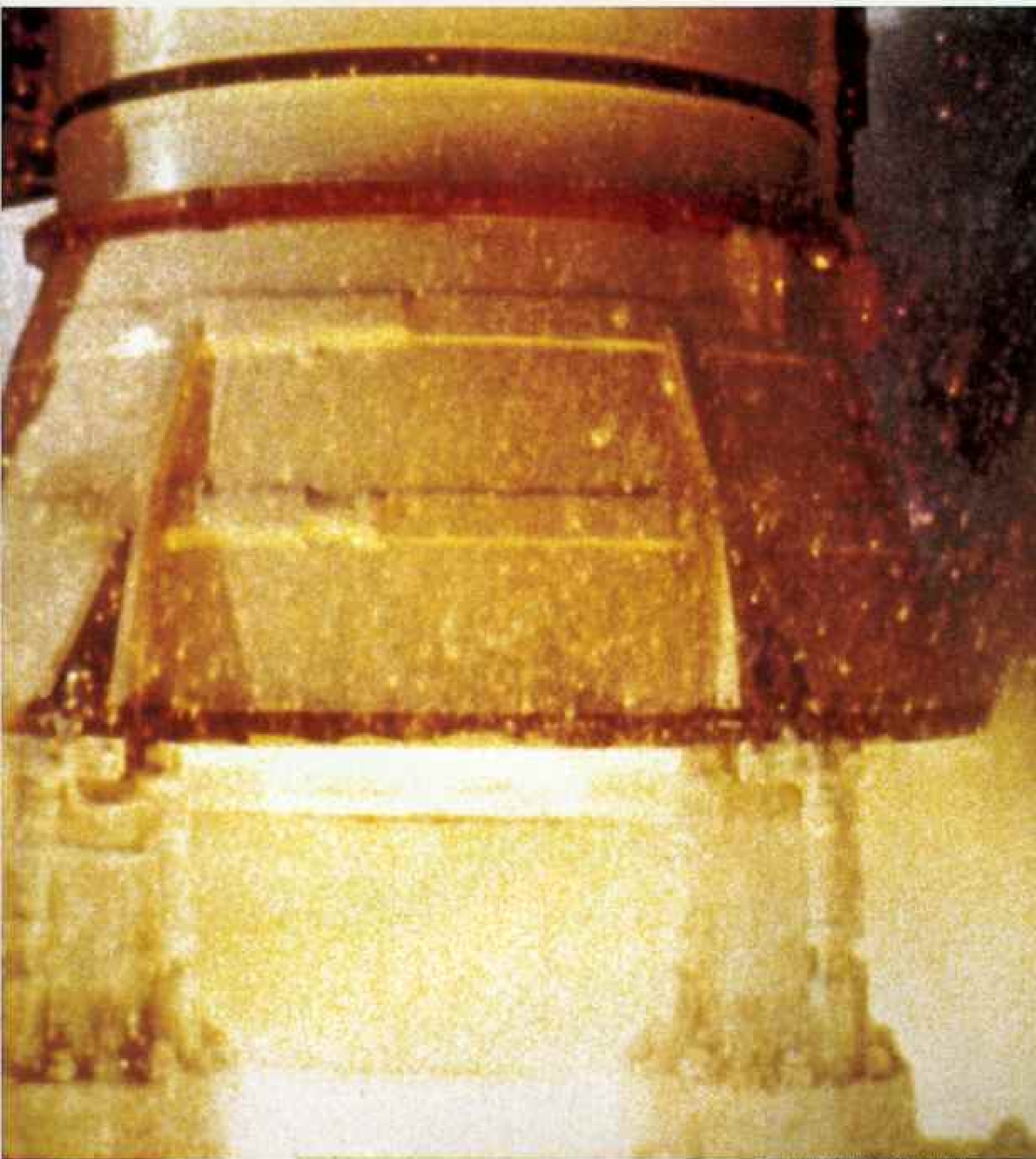
JOHN SCHNEEBERGER, TED JOHNSON, JR., AND ANTHONY FERITDER, ALL NATIONAL GEOGRAPHIC STAFF

away. Yet to space shuttle commander John W. Young and pilot Robert L. Crippen, the lift-off feels "as smooth as glass," like "riding a fast elevator." Columbia returns Americans to space after a six-year absence, exactly 20 years to the day after Soviet cosmonaut Yuri Gagarin made man's first orbital flight. Now the shuttle program intends to put some 200 Americans in orbit by the end of 1987.



Booster ignition: a solid performance

SPLIT-SECOND TIMING records a picture-perfect lift-off, as seen in film from protected high-speed cameras near one of the shuttle's two solid-fuel rocket boosters. Just 2.6 seconds after the orbiter's blue-flame main engines (top, at left) reach 90 percent of their 1.12 million pounds of thrust, the two booster motors burst to life



ALL FROM NASA KENNEDY SPACE CENTER

(middle) within one millisecond of each other. At the same time, the four huge bolts that anchor the aft skirts of each rocket explode (bottom), freeing the 4.5-million-pound craft for flight (above). The explosive force of ignition unexpectedly jolted elevons and a flap on Columbia's wings and tail, requiring modification of the launchpad for the next

flight. Burning more than four tons of fuel a second, each booster throws out 2.65 million pounds of thrust, 34 times that of the early Redstone rockets. By refurbishing the 149-foot-long boosters and flying them as many as 20 times each, NASA hopes to reduce their per-flight costs from about 25 to 7 million dollars apiece, a 70 percent savings.



THAT WAS THE 36TH SUNRISE John and I had seen since we had climbed into Columbia's cockpit well before dawn two days before, on April 12, at Cape Canaveral. Thirty-six sunsets too. Each of them different.

I remember that first sunrise especially. We were out on the launchpad, lying on our backs in the cockpit, with not really that much to do, looking at the stars through Columbia's wraparound windows. As dawn lit up the Florida coast, we could watch pelicans flying up and down the beach. It was nice and peaceful.

We'd gone through the countdown so many times in simulations, it seemed routine. We'd been through it just two days earlier and had had to scrub the launch because we couldn't get our five flight control computers synchronized. Even before they announced the scrub that day, we both knew we weren't going. John and I had looked at each other and in effect said, "Well, this is the first scrub." I was expecting we might not launch on that second try either.

I was very doubtful we'd launch. Crip and I knew and understood that vehicle so well. We thought the concepts were all valid and that it would eventually fly. But you don't realize how many thousands of things have to work together to launch, and human beings have to put all those things together.*

NASA doesn't pay you to express anxieties and fears, but I was probably less confident of total success than most of our people. If we did get off, I thought we might well have to abort. I thought we'd have failures in orbit. We were prepared, however, to deal with anything short of Armageddon.

Actually, we almost ran into a serious problem that second morning as well. Up in the cockpit, when we locked the faceplates onto our helmets, we couldn't breathe. We threw open the plates, grabbed a breath, and started looking for the trouble so we wouldn't have to scrub again. Eventually Loren Shriver, an astronaut in the close-out crew, found a loose connector and tightened it. The countdown continued. The crew closed the hatch, and we sat there watching the dawn and the weather and reviewing all

*See "When the Space Shuttle Finally Flies," by Rick Gore, in the March 1981 GEOGRAPHIC.



JON SCHNEIDER



NASA (FACING PAGE, 300-INCH TRACKING CAMERA, AND ABOVE)

At maximum stress during the ascent, the main engines throttle back to 65 percent of their power to lessen air pressure on Columbia (top). Spent boosters (facing page) part company with the craft 33 miles above the Atlantic at 2,795 miles an hour. Falling on target within 2.5 miles of each other, the boosters are towed back (above) to Cape Canaveral, 160 miles away. The external tank, as planned, later breaks up during reentry over the Indian Ocean about 1,700 miles west of Australia.

the cue cards we have for dealing with possible problems during ascent.

By T minus five minutes we were really busy. I was making sure all the switches were in the right position. Crip was over there like a one-armed paperhanger, starting up the three auxiliary power units.

I *WASN'T* until we hit T minus 27 seconds and nothing had gone wrong that I made up my mind we were really going to do it. That's when my heart rate went up to 130. I'm surprised it wasn't higher. John, I guess, was calmer. He had been into space four times and walked on the moon. Maybe that's why his heart rate was only about 85.

I was excited too. I just couldn't get my heart to beat any faster. I was pretty impressed anyway, when at T minus five seconds I heard the three main engines start up with bangs. Then the two solid-rocket boosters, which were strapped onto our big white external tank, exploded to life. Within three-tenths of a second we were off the ground. I saw pictures later of the conflagration all those engines and boosters made. I'm sure glad we didn't have rearview mirrors.

Looking out the side windows, I watched the vehicle go by the tower. There was a little vibration right at first, and much less noise than I expected. Basically it was smooth, like riding a fast elevator. I was sitting there thinking, "Boy, they've done it. They got it all together, and here we are!"

We launched with *Columbia's* tail pointed south. Immediately after clearing the tower, we did this roll, pitch, and yaw maneuver to get ourselves headed east-northeast toward Gibraltar.

We were getting more thrust from those solid rockets than we expected. When we jettisoned the solids, for instance, we were supposed to be at 164,000 feet, but were already at 174,000. Performance had been better than anticipated in this first stage, which means on later flights we'll be able to take up more payload.

Those solids were putting out a tail of flame that was more than 600 feet long and 200 feet wide. Photographs from the chase planes show the flames were so hot that the back of the external tank was glowing bright white. We were about to lose the solids,

however. We could feel a slight deceleration; their fuel was just about spent. Then, two minutes and 11 seconds after lift-off when we were 29 nautical miles high, there was bright yellow-orange flame all across our windows. Six-tenths of a second later it was gone, and so were the solid rockets. Eight booster separator motors had flared up and fired the solids off into the Atlantic. That was some flash. We weren't expecting it to be so breathtaking, but for six-tenths of a second you don't have time to get nervous.

About two minutes later we were feeling good. All our testing data had indicated that if the engines were going to fail, they'd have done it already. Then we got the call from Mission Control in Houston we'd been waiting for: "Press to MECO." MECO, or main engine cutoff, occurs just before we reach orbital velocity. If we were cleared to go that far, we knew we weren't going to have to turn around and come back.

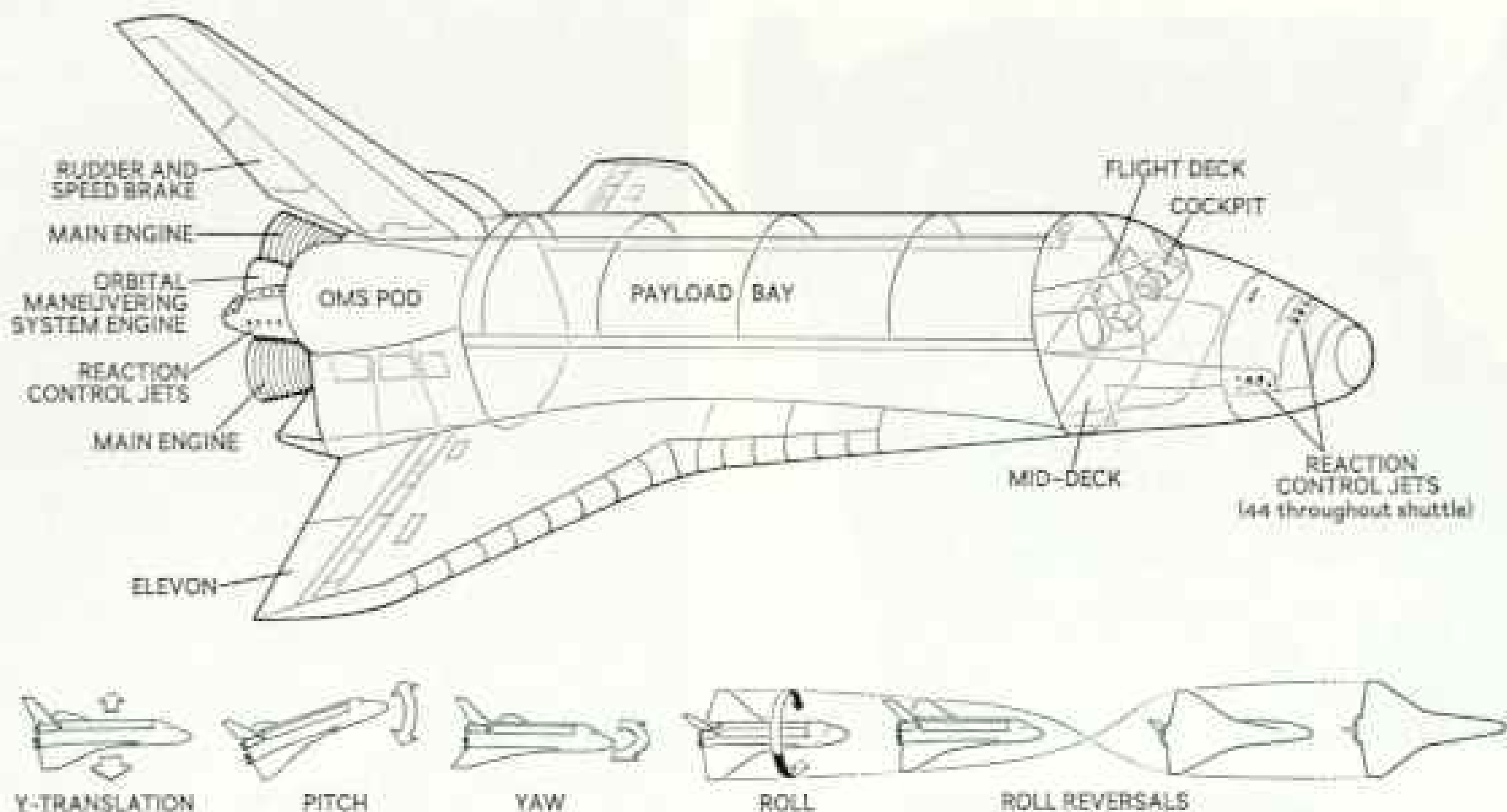
At this point, right on schedule, Columbia suddenly pitched over to level off our trajectory. As it did, I saw earth from space for the first time. "What a view! What a view!" was all I could get out. Seeing that curvature of the earth against the black of space, the multihued ocean, and the vivid blue shimmer at the top of the atmosphere grabbed my breath.

"It hasn't changed any," said John.

Neither of us could sightsee, however. In less than four minutes we had to jettison the external tank. Pieces of white insulation from the tank drifted by our windows. They looked spectacular, like chunks of ice.

We were flying upside down underneath the tank, to make getting away from it easier. The main engines cut off, and the computers activated a 16-second separation sequence. Our umbilical propellant lines were pulled out of the tank back into the orbiter. Then explosives blew the bolts fastening us to the tank, and Columbia was flying free. We couldn't see the tank, but knew it was up above us and would soon begin to drift down on a trajectory that would take whatever pieces survived the heat of entering the atmosphere into the Indian Ocean.

Up in the cockpit the only way we knew we had separated from the tank was that three red lights on the panel in front of Bob



DRAWING BY JOHN W. LITHEBEL, NATIONAL GEOGRAPHIC ART DIVISION

Basic maneuvers of Columbia are all performed through computers. Either at the command of shuttle pilots or by following automatic programs, computers can fire 44 reaction control jets to change pitch, yaw, or roll in space. As the craft reenters the atmosphere, computers balance use of the jets with aerodynamic controls. As commander, Young took control of the system at 115,000 feet and Mach 5 to fly the last two of five roll reversals, or high-speed S turns, to slow the craft. Near the runway he took the stick again, landing the craft with aerodynamic controls only.

Crippen went out. There was no motion, no sense of the explosives firing. I took the stick and began manually flying off to the side to guarantee that we wouldn't run into the tank as it fell.

ACTUALLY, it felt like we were walking away from the external tank. The orbiter has 44 reaction control engines. These thrusters, which you can fire one at a time or in tandem, let us control the direction and attitude of Columbia most of the time we were in space. They were very physical and really shook the vehicle. They sounded like muffled howitzers right outside our door. Later, when we fired them at night, we could see 30-foot-long tongues of fire leaping out from them. It was a little uncomfortable initially, and we never entirely got used to it. When one of the bigger ones fired, it was like something had hit the vehicle.

To get away from the tank, John flew the vehicle off to the side, and the computers fired one reaction control jet on the nose and

one aft. The one on the nose cut off intermittently to hold attitude. That kept Columbia positioned properly, but it also made us feel as if we were sidestepping across the sky. We didn't anticipate that.

Now rid of the tank, we were busy getting ready for our next maneuver. John took the rotational hand controller and pulled up Columbia's nose. He pushed a button. The two large orbital maneuvering system (OMS) engines, which sit above the main engines at the rear of the spacecraft, fired. They gave us a smooth and silent push into orbit. That orbit would have been very elliptical—130 nautical miles at its highest point, 60 at its lowest. So about 20 minutes later, at the high point, we fired the OMS engines again to make our orbit circular, about 130 nautical miles above the earth.

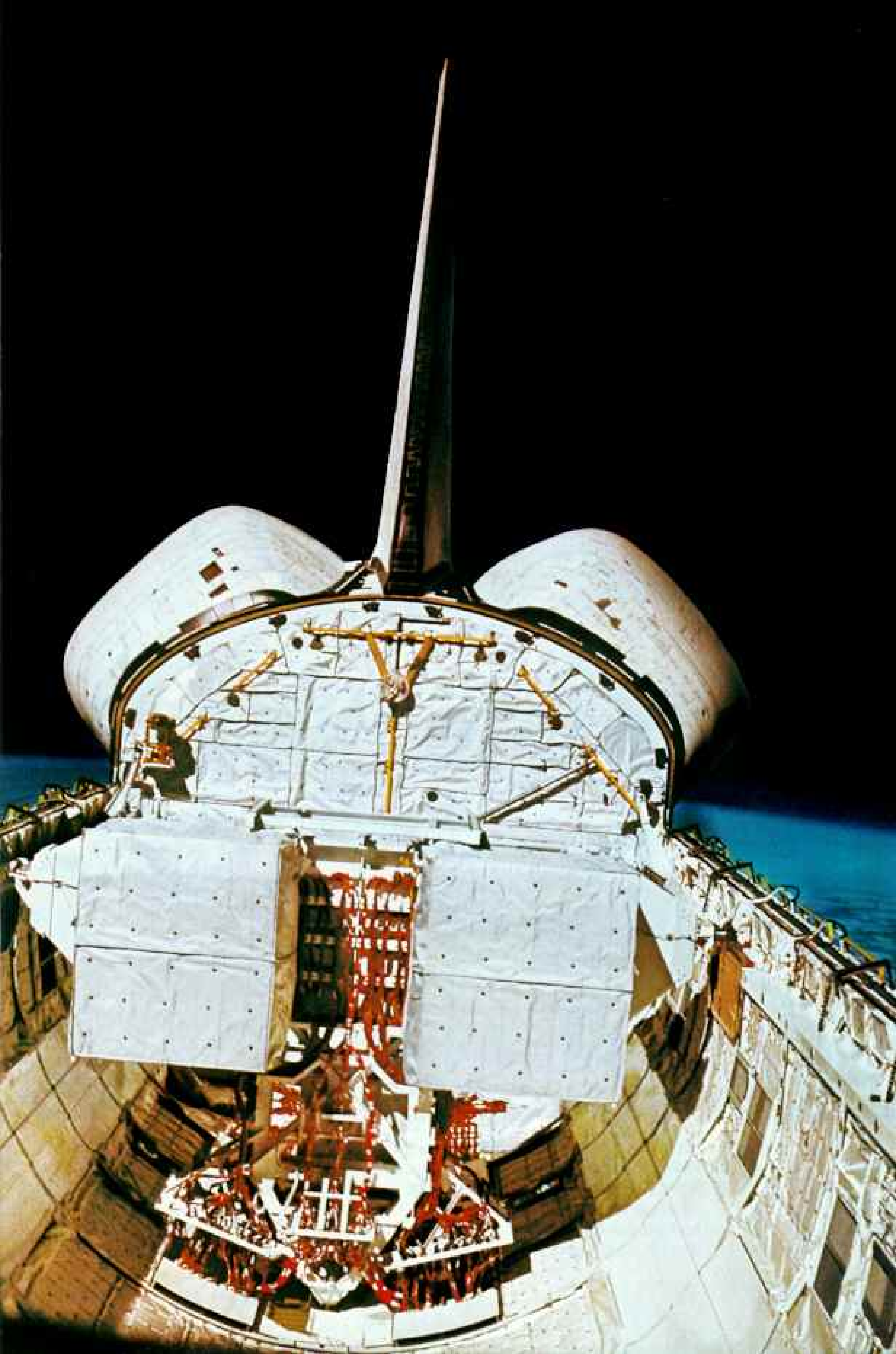
Once we hit orbit, we unbuckled our seat belts and went to work. We loaded the computers with the on-orbit programs they needed to control and monitor just about every aspect of our (Continued on page 492)



ROBERT L. CRIPPEN (TOP); JOHN W. YOUNG (ABOVE AND RIGHT)

Good news and bad news greet the astronauts as they open the doors of the 60-foot-long payload bay (right), where future flights will stow up to 32.5 tons of cargo. The huge doors open right on cue, but they also reveal the loss of one complete thermal tile and pieces of 15 others that were insufficiently bonded to the orbiter's engine pods. Fears that critical tiles on the shuttle's bottom may also have come loose later prove unfounded. Yet the astronauts show no concern as they follow tight schedules: Young going over a checklist (top) and Crippen trying out a vacuum in the crew quarters (above).







With only one chance to land the 99-ton glider safely, Young eases the billion-dollar Columbia toward a 215-mile-an-hour rendezvous with the Mojave Desert floor. Swooping under the shuttle in a T-38 chase plane, fellow astronauts Jon McBride and George Nelson inspect its tiled bottom for damage. In fact, Columbia had slipped through the atmosphere so smoothly half an hour earlier—as it dived into the first molecules of air 76 miles above the Pacific—that in places it was 600°F



JON SCHNEIDERBERGER

cooler than the worst predicted for its fiery reentry. Despite 303 nicks and dents, mostly caused by pieces of ice and insulation flying off the external tank, only about 100 (out of 31,000) tiles had to be replaced after the flight. "You can't believe what a flying machine that is!" said Young, shortly after touching down on runway 23 at Edwards Air Force Base—54 hours, 20 minutes, and 52 seconds after leaving the launchpad in Florida. "What a way to come to California!" said Crippen.

flight and environment. As I got up to go into the aft flight deck behind the cockpit, I really noticed my weightlessness.

Right after the main engines had cut off, we had seen a little debris—washers and screws—floating through the cockpit. But not until I unstrapped my seat belt did I realize how spectacular weightlessness is. I felt like a bird learning to fly from its nest.

I had taken a motion-sickness pill because some astronauts have found themselves too spacesick from zero gravity to work for a couple days. I didn't have time for that. In the beginning I was also careful to keep myself upright. Rather than jerk my head around, I moved my whole body.

I floated to the aft flight deck to open the large doors that cover the payload bay. This is where in the future cargo will be stowed. The payload bay doors must stay open most of the time in orbit. They have reflectors that radiate into space the heat that builds up from all the electronic equipment.

"Here I am," I thought, "opening these doors again, which I have done a hundred-odd times in our simulator—except this time my feet aren't on the floor."

John was back there too, feet up in the air, and getting ready to take pictures with three remotely controlled TV cameras located in the cargo bay.

As soon as we got the doors open, I noticed some dark patches on the pod that houses the starboard OMS engine. "Hey John," I said, "we've got some tiles missing."

We didn't know it, but those missing tiles caused quite a commotion back on earth. We weren't worried. The pods weren't supposed to get that hot during reentry, and NASA was being conservative by tiling the area.

Also, we could see that the red compound called RTV, which helps bond the tiles, was still there. That itself will insulate against heat up to 900 degrees. The wings and tail were OK, and they were the most critical parts of the orbiter that we could see from the windows that look out on the cargo bay.

We did not know what had happened during ascent to the really important tiles on the underbelly. But it looked to us as if the tiles we had lost had not been hit by anything. There is a complex curvature on the OMS pod, and it appeared that mechanical flexing during ascent had popped those tiles off. It



"Welcome home, Columbia," Mission Control proclaims from Houston, as the shuttle rolls toward a runway intersection on Rogers Dry Lake at Edwards. Close-out



ORB HOUSE, USAP FROM NASA

procedures keep the astronauts in the cabin for an hour as ground crews position a wind machine, right, to blow away toxic fumes discovered near the orbiter's nose.

Two tractor-trailers, center, bring up umbilical equipment to purge the craft of residual gases and cool off its elaborate electrical systems.

seemed unlikely that that would have happened on the gentler curves on the bottom of the spacecraft.

We spent most of that first day making sure *Columbia* was working properly. We went around checking out systems and doing routine first-flight things like surveying noise levels in the cockpit or checking the hand controller. One of us always stayed on the flight deck, since that is where the alarms and controls are. Because of zero g it was more fun to zoom down below into the mid-deck to do a checkout. Bob Crippen thought so too. He was learning how to swim in space pretty quickly.

After I assured myself I wasn't going to get spacesick, I spent a lot of time enjoying zero g. You don't have to do fancy aerobatics. Just moving around is enough. At first I did things that surprised me, like shoving off from one side of the mid-deck a bit too hard and finding myself sprawled on the opposite wall. But I mastered it pretty quickly. Soon I felt graceful and could fully control my body and motion.

WE HAD a complex flight plan, detailing what we were to do almost minute by minute. After we finished the first day's chores, Crip fixed us dinner. Mission Control told us it was bedtime and signed off for the next eight hours. Neither one of us slept well that first night. For one thing it was light out much of the time and far too beautiful looking down at earth.

I had taken along a 70-mm Hasselblad camera. Before launching, some geologists, oceanographers, and meteorologists I know had told me things they would like to see from space. Things like dune patterns, evidence of internal waves moving below the ocean surface, sediments off mouths of rivers, and clouds forming near coastlines and islands. Most of the time we were too busy to take pictures on this mission, but it was so easy to do after working hours.

Sixteen years ago on Gemini 3 we didn't have any windows to speak of. There was one porthole in front of me and one in front of Gus Grissom. The only way we could take pictures was to point a camera straight at something or open the hatch. (We didn't do

that much.) On Apollo we were on our way to the moon. We didn't have much chance to look back and take pictures. We were moving too fast anyway.

The shuttle has those wraparound windows up front. But the best views are from the flight deck windows, looking out through the payload bay when you are flying upside down with the doors open, which we were doing most of the time. You see the whole earth going by beneath you.

I remember one time glancing out and there were the Himalayas, rugged, snow covered, and stark. They are usually obscured by clouds, but this day was clear and the atmosphere so thin around them that we could see incredible detail and vivid color contrast. The human eye gives you a 3-D effect no camera can. Sights like the Himalayas and thunderstorms, which we later saw billowing high above the Amazon, are especially dramatic.

John and I have spent a lot of time with the Navy in the Mediterranean. It often has a haze over it. When you are flying over the Med at night and you see ships out on the sea below and stars up above, you can lose all sense of what is up and what is down. Luckily the Med was fairly clear for us now. We had gorgeous views of Gibraltar, the Sahara, and the Bay of Naples. We could see Mount Etna smoking. Whenever the sun was setting, the sun glint on the water let us see ships on the surface hundreds of miles away. Perhaps the most stunning sight, however, was Dasht-e Kavir, a salt desert in Iran. It looked more like Jupiter with the great swirls of reds and browns and whites, the brilliant residues of generation after generation of evaporated salt lakes.

I really liked the Bahamas. They glowed like emeralds. Unfortunately the pictures could not capture their shimmering beauty. The human eye is so much better for seeing colors and contrasts. The human being, with the detail he can pick out, will prove to be very useful in space.

I would like to get together with our photographic guys and touch up the colors in our pictures. That would probably not be cricket, but it is disappointing to look at Eleuthera and not see that emerald glowing.

I wasn't ready to go to bed that first night at quitting time even though we had been up for 18 hours. I slept only three or four hours. Crip did a bit better. When we did turn in, we just fastened our lap belts and folded our arms. We could have gone down to the mid-deck and just floated around, but I like some support. Anyway you do it, sleeping in zero g is delightful. It is like being on a water bed in three dimensions.

WE WERE BUSY most of our second day, April 13, doing burns with the reaction control jets, going into different attitudes and performing maneuvers. We needed to understand how well the computer autopilot can control the vehicle. Could we make fine maneuvers? Houston wanted to see how well the crew could coordinate with the ground in positioning the orbiter.

I just kept feeling better and better about that vehicle. After we launched and got it into orbit, I had said to myself, "Well, that went pretty good." Then the vehicle worked so well the first day I had said, "We'd better take it back before it breaks." The second day it worked even better and so I thought, "Man, this thing is really good. We'd better stay up here some more to get more data." But Mission Control made us come back the next day.

We both slept soundly that second night. I was really sawing the z's when an alarm started going off in my ears. I didn't know where I was, who I was, or what I was doing for the longest time. I could hear John saying, "Crip, what's that?" It was a minor problem, fortunately. A heater control in one of our auxiliary power units quit working. We just switched on an alternate heater and went back to sleep.

It was about 2:30 a.m. Houston time when flight control greeted us with a bugle call and some rousing music. John fixed breakfast that morning, although usually I took care of the chow. Then we checked out the flight control system one last time and stowed everything away for reentry. We strapped on biomedical sensors to keep the doctors happy, and got back into our pressure suits. We programmed the computers for reentry and closed the payload bay doors.

The first step toward getting home was to de-orbit. We had tested all our engines and were very confident they were working. We were really looking forward to flying reentry. Bringing a winged vehicle down from almost 25 times the speed of sound would be a thrill for any pilot.

We were orbiting tail first and upside down. We fired the OMS engines enough to feel a nice little push that slowed us down by a little less than 300 feet per second. That is not dramatic, but it did change our orbit back to an ellipse whose low point would be close to the surface of the earth.

When we finished the OMS burn, John pitched the vehicle over so it was in the 40-degree nose-up angle that would let our insulated underbelly meet the reentry heat of the atmosphere.

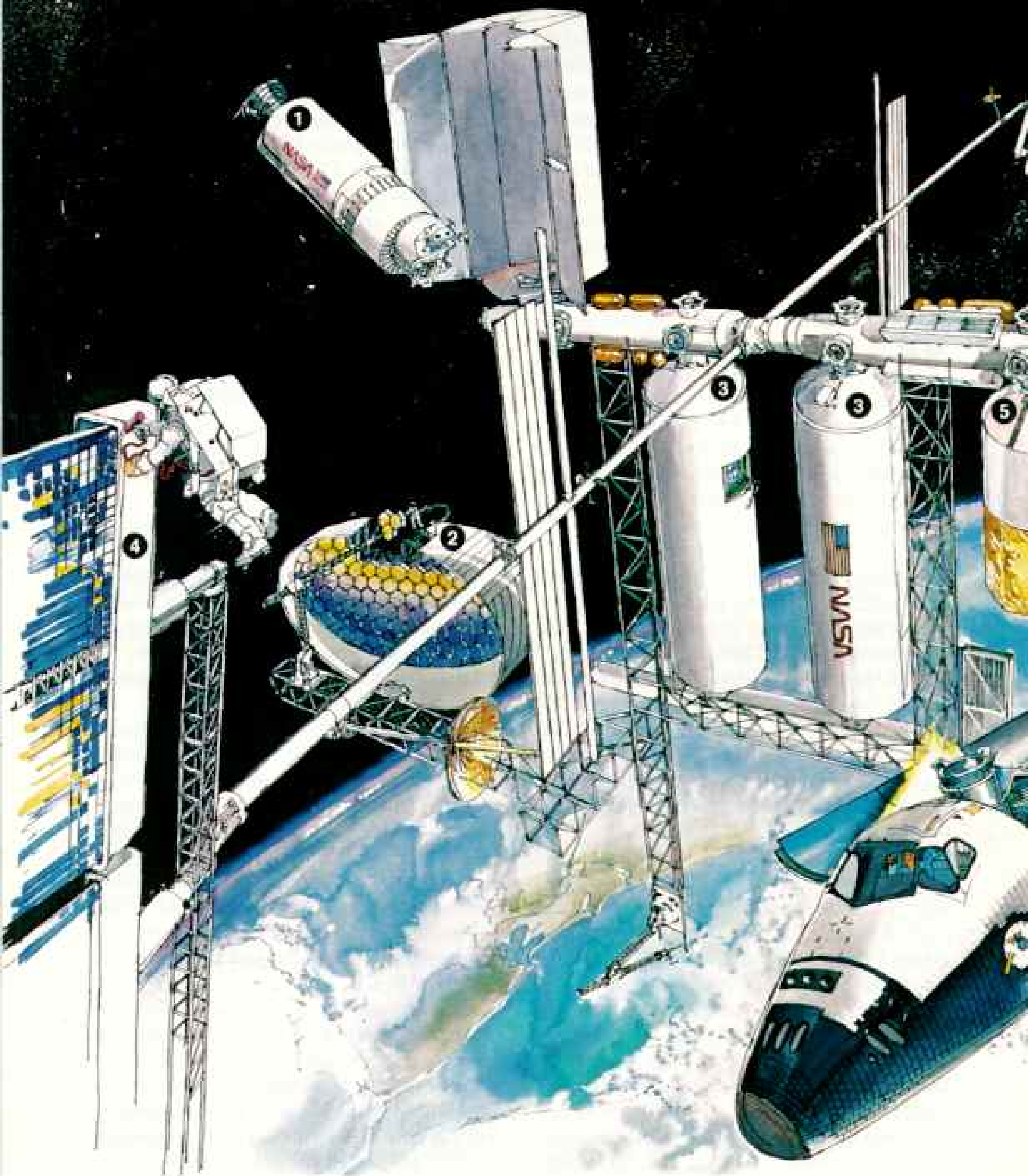
We hit the atmosphere at the equivalent of about Mach 24.5 after passing Guam. About the same time we lost radio contact with Houston. There were no tracking stations in that part of the Pacific. Also, the heat of reentry would block radio communications for the next 16 minutes.

Just before losing contact, we noticed a slight crackling on the radio. Then, out of the sides of our eyes, we saw little blips of orange. We knew we had met the atmosphere. Those blips were the reaction control jets firing. In space we never noticed those rear jets because there were no molecules to reflect their light forward. Those blips told us that *Columbia* was coming through air—and hence plenty of molecules to reflect the thrusters' fire.

That air was also creating friction and heating *Columbia's* exterior. About five minutes after we lost contact with Houston, at the beginning of reentry heating, when we were still flying at Mach 24.5, we noticed the reddish pink glow. Bob and I put our visors down. That sealed our pressure suits so that they would automatically inflate if somehow reentry heating burned through the cabin and let the air out. Other than the pink glow, however, we had no sense of going through a hot phase.

Columbia was flying smoother than any airliner. Not a ripple!

As we approached the coast of northern



Outpost on a new frontier

ORBITING BEEHIVE of activity, a space station on NASA's drawing board serves as a staging point between shuttle flights 200 to 300 miles above the earth and satellites at higher altitudes. A manned orbital transfer vehicle (1) returns from servicing communications platforms in a 22,300-mile-high geostationary

orbit. Later it will boost a deep-space relay satellite under construction (2) to a similar orbit. A crew of eight is quartered in two living modules (3) powered by two 50-kilowatt solar arrays (4). Supplies for 180 days are stored in a logistics module (5). Preparing to dock, a shuttle readies its manipulator arm (6) to unload a



California, we were doing Mach 7 and I could pick out Monterey Bay. We were about to enter the most uncertain part of our flight. Up to this point, Columbia's course was controlled largely by firings of its reaction control thrusters. But as the atmosphere grew denser, the thrusters became less effective. Columbia's aerodynamic controls, such as its elevons and rudder, began to take over.

We had more and more air building up on the vehicle, and we were going far faster than a winged vehicle had ever flown. Moreover, the thrusters were still firing. It was an approach with a lot of unknowns. Wind tunnels just cannot test such complex aerodynamics well. That was the main reason John took control of the flight from the automated system at a little under Mach 5. We had been doing rolls, using them a little like a skier uses turns to slow and control descent down a mountain. The flight plan called for John to fly the last two rolls manually. He would fly them more smoothly than the automatic system, helping to avoid excessive sideslipping and ensuring that we would not lose control as we came down the middle of our approach corridor.

IT TURNED OUT to be totally unnecessary for me to manually fly those last two roll reversals. *Columbia* had been flying like a champ. It has all those sensors: platforms for attitude control, gyroscopes, and accelerometers. Its computers take all the data, assimilate it instantly, and use it to fire thrusters, drive elevons, or do anything needed to fly the vehicle. They are much faster at this than any man. The orbiter is a joy to fly. It does what you tell it to, even in very unstable regions. All I had to do was say, "I want to roll right," or "Put my nose here," and it did it. The vehicle went where I wanted it, and it stayed there until I moved the control stick to put it somewhere else.

Flying down the San Joaquin Valley exhilarated me. What a way to come to California! Visibility was perfect. Given some airspeed and altitude information, we could have landed visually.

John did his last roll reversal at Mach 2.6. The thrusters had stopped firing by then, and we shifted into an all-aerodynamic

replacement logistics module. It would take only six shuttle trips to build the space station, beginning at the earliest in 1989. Meanwhile, the shuttle will carry, among other projects, a flying laboratory in 1983, a powerful remote-controlled telescope in 1985, and a number of military payloads.

mode. We found out later that we had made a double sonic boom as we slowed below the speed of sound. We made a gliding circle over our landing site, runway 23 on Rogers Dry Lake at Edwards Air Force Base.

On final approach I was reading out the airspeeds to John so he wouldn't have to scan the instruments as closely. Columbia almost floated in. John only had to make minor adjustments in pitch. We were targeted to touch down at 185 knots, and the very moment I called out 185, I felt us touch down. I have never been in any flying vehicle that landed more smoothly. If you can imagine the smoothest landing you've ever had in an airliner, ours was at least that good. John really greased it in.

"Welcome home, Columbia," said Houston. "Beautiful, beautiful."

"Do you want us to take it up to the hangar?" John asked.

Our work wasn't done. We still had a lot of switches to throw and systems to shut down. A convoy of 21 safety and service vehicles had raced out to the orbiter to check for noxious gases and provide external power and cooling. It took them about an hour to make sure we could get out safely.

I've never seen John so enthusiastic. He bounded out almost as soon as the hatch was opened. I stayed behind until a relief crew came in to officially switch Mission Control communications back to Cape Canaveral, whose staff would supervise Columbia's return to Florida atop a 747 aircraft two weeks later.

WE HAD DONE IT! The whole package. And done it just far better than anyone—including me—imagined. I headed right for the underbelly of the orbiter. There was not one tile missing. Not one! Considering how many human beings worked on that rascal, the complexity of putting those tiles on, and the beating they took, that's a wonder. It's the finest brick-laying job that's ever been done. American workers can do a heck of a job, and the bottom of that vehicle proved it to the world.

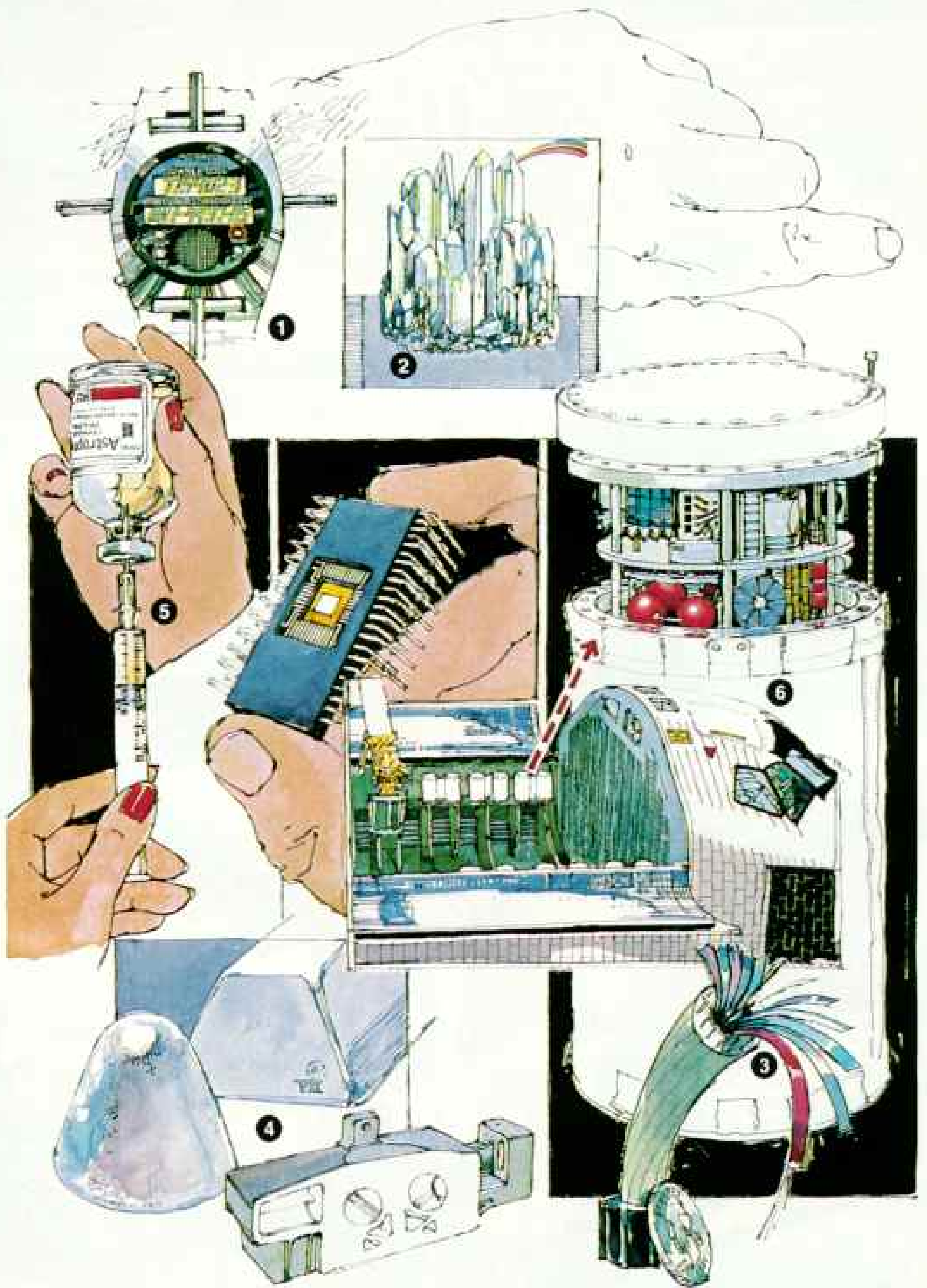
People ask me what the space shuttle means. Before I can answer that, we'll have to make the shuttle operational. A new crew, Joe Engle and Dick Truly, is scheduled to take *Columbia* up for five days this

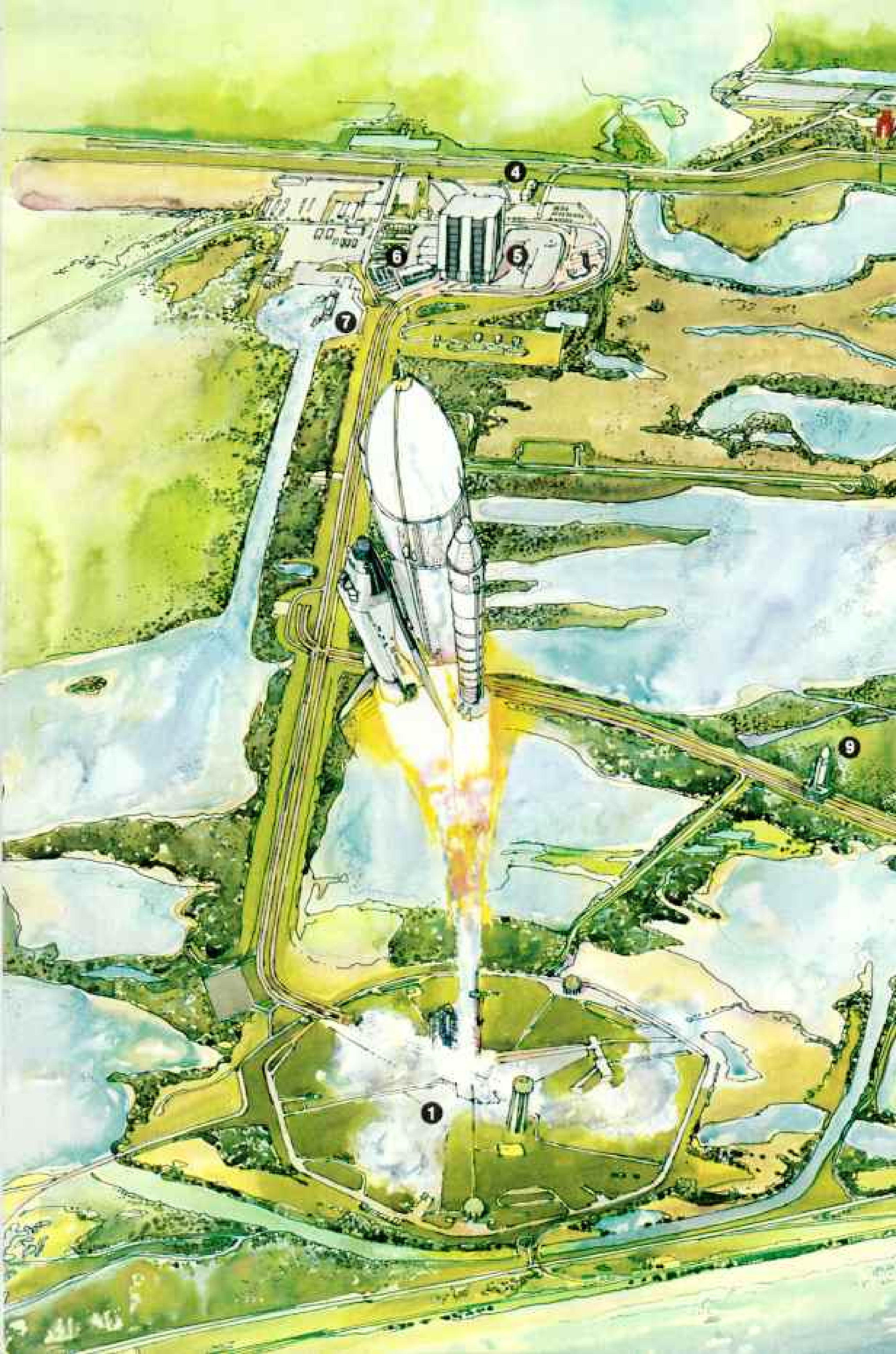


Industry in orbit: science goes weightless

THE BIGGER THEY GET, the more amazing satellites may become. With an antenna 300 feet across, a communications satellite assembled by a shuttle crew in space (above) could handle 250,000 calls at once from wrist radios (right, 1), relay hundreds of television channels, deliver mail electronically, or do dozens of other Flash Gordon-age jobs.

Some industries want to use the zero gravity of space to make purer crystals for microelectronics (2), clearer glass for fiber optics (3), and stronger alloys (4) from metals that refuse to mix down on earth. McDonnell Douglas will conduct pharmaceutical experiments on the shuttle in 1982 and by 1986 plans to make drugs (5) in orbit. About 200 other businesses, governments, and individuals have reserved space for their own experiments in "getaway special" canisters (6).





America's first spaceport

MORE ROCKETS and fewer alligators are predicted for NASA's 83,000-acre Kennedy Space Center as Launch Complex 39 (left) evolves into the space shuttle's main cargo terminal. Rocketing skyward as many as 40 times a year from Pad A or Pad B (1 and 2), shuttles will return to land at the spaceport's 2.8-mile-long runway (3). Columbia may touch down here as early as its fourth flight. After being refurbished at the Orbiter Processing Facility (4) and refilled with space cargo from payload check-out facilities, each orbiter will be taken to the cavernous Vehicle Assembly Building (5) beside the Launch Control Center (6). There it will join an external tank, delivered by barge (7) from the factory in Louisiana, and a pair of reusable boosters, reassembled with refurbished segments arriving by rail (8) from Utah. Then they will inch back to the pad on a crawler transporter (9 and below) to begin the cycle again.



NASA



CIRANKA/MICHAEL LERTON (ABOVE), BOBBI WALLEY

No strangers to the space plane, the crew for Columbia's second flight, commander Joe H. Engle, 49, right, and pilot Richard H. Truly, 43, flew the test orbiter *Enterprise* in 1977 when it was released from a 747 over the California desert. Columbia (right), resting near the jumbo jet that returned it to Florida, will next carry into space a 50-foot-long mechanical arm and a package of experiments that may help prove its bright promise as an orbiting research platform.

fall. They will test its handling under less conservative conditions than we did, and their flight will have a pallet of earth-viewing sensors. After two more test flights, the shuttle will be in business. By 1984 there could be 12 shuttle flights a year. As many as 40 a year by 1990. Three new orbiters, *Challenger*, *Discovery*, and *Atlantis* are being built or are on order. The shuttle is completely booked up through 1986, carrying up such things as communications satellites, military surveillance hardware, scientific laboratories, and a giant space telescope. Customers are waiting in the wings.

If shuttle flights do become routine, then we'll start seeing a lot of people going up into space who never dreamed they would. I think we should get to work right away planning a permanent habitable space station. The Russians are working on one.

NASA is proposing one such structure, called the Space Operations Center (SOC). It would be assembled from modules taken up by the space shuttle and would be a space service station. One day pieces of large communications platforms could be constructed at the SOC. Space tugs could dock there and

take those pieces on to the higher orbits they require. We might eventually want to use it as a base for building solar-power satellites that will beam the sun's free energy down to earth in microwaves.

Much sooner than that, I think, such a station would prove worth building if only because it would force us to develop advanced technology. Zero g will be a remarkable new laboratory for basic science. People already predict we'll learn how to build purer glasses for lasers and telescopes and stronger metals in space. But there will also be a serendipity effect: We'll discover things we never imagined. Things that will pay for ten space stations.

I HOPE to have a few more flights on the shuttle myself. Then I'd like to play a major role in putting that space station in orbit, maybe by taking up some of the modules. Or maybe they'll let me stay up there and run it for a while. We could build that structure in another decade; it's not that complicated.

You know, right after the landing, John said it all: "We're really not that far, the human race isn't, from going to the stars." □



The Troubled Waters of Mono Lake

By GORDON YOUNG

NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by CRAIG AURNES

FROM A ROADSIDE OVERLOOK, my first view of distant Mono Lake was 61 square miles of cobalt blue mirror. White puffs of cumulus clouds crept along its surface, framed by inverted peaks of California's Sierra Nevada.

Absolutely gorgeous. Yet a century ago Mark Twain, in *Roughing It*, had written: "This solemn, silent, sailless sea—this lonely tenant of the loneliest spot on earth—is little graced with the picturesque."

The lake is ten miles from the Nevada line and just east of popular Yosemite National Park, so countless skiers and summer tourists can testify that Mark Twain was wrong about its picturesqueness. And though it may be silent, its advocates are not. Mono Lake, for several years now, has been the focus of a war of words and writs. On one side, environmentalists; on the other, a power often known simply as the "Department."

As I drove closer, the lake's beauty took on the look of fantasy. Misshapen giants stood in groups in its green shallows and on the pastel beach—sight-seeing trolls fixed by an enchantment.

They were columns of tufa, a porous form of calcium carbonate. Each was born under the surface of the lake, as fresh springwater brought up calcium to interact with Mono's chemicals, coalescing into the towers. Some of them are home to rock wrens, swallows, and great horned owls.

Mono basin, formed some three million years ago at the western edge of the Sierra, has held a lake for perhaps a million years. The lake has no outlet other than evaporation and has not overflowed its basin in tens of thousands of years. Over time, minerals have concentrated in the lake, until today its water is two and a half times as salty as the ocean. Ironically the undrinkable lake is dwindling further to feed the faucets of Los Angeles, 275 miles to the south.

Five streams used to enter it. Four are diverted into aqueducts now; the fifth is too small to be worth diverting.

"In recent years the lake level has dropped about 18 inches annually," botanist and researcher Dean Taylor explained. He had come to give me a tour along the lake's perimeter in his venerable microbus. "Not only is a scenic asset shrinking, but an expanding rim of alkaline shoreline is exposed. Winds kick it up into very unpleasant dust storms in the Mono basin."

Concerned about those dust storms, Dr. Taylor is pursuing a research project to determine what effect, if any, the alkali has on area vegetation.

Residents in the lakeside village of Lee Vining, too, are unhappy at the sight of the shrinking lake. "Their favorite intellectual exercise," Dr. Taylor remarked, "seems to be the designing of bombs that could blow up the tunnels and aqueducts."

Ghostly islands of tufa in California's Mono Lake stand as bleak monuments to a bitter dispute over the lake's future. Built by upwelling springs, the deposits of calcium carbonate testify to a 44-foot drop in the water level since 1941, when Los Angeles began tapping all but one of the lake's five main tributaries.





Slaking the thirst of a distant city, Mono Lake's receding waters leave a ring of powdery alkali flats as much as a mile wide (above). Born with the Sierra Nevada that surrounds it and fed by springs and runoff from snow and glaciers, the lake has no natural outlet. Evaporation and diversions of its freshwater



WALLIS MOPHERSON



inflow make it two and a half times as salty as the ocean. At its former level, seen in a hand-tinted 1925 photograph (below left), water surrounded Negit Island at top center. In 1979 exposed lake bottom connected the island to the shore (below), spurring a drive to cut Los Angeles' diversions by 85 percent.



© 1978, MORGAN ENCLAVE



Diminishing lake could diminish life, affecting both a nesting place and food supply of the California gull (above). Conservationists say that its primary food, brine shrimp (right), would be reduced if the lake gets too salty, but the Los Angeles Department of Water and Power counters that there is no evidence to support such a claim. The fact, however, that the harvesting of brine shrimp for fish food (left) has become more difficult and expensive suggests that the upwelling springs where the shrimp congregate are diminishing.



PAUL A. ZAHN

It is not a furtive activity. In a Lee Vining café a teenage resident enthusiastically sketched his infernal device. He drew a chain of minisubs, each packed with dynamite, to be detonated by remote control as they floated through a diversion tunnel.

Well, fear not, officials of the Department in Los Angeles. The exploding subs have surfaced only on a paper napkin. Lee Vining's weapons exist only in fertile imaginations. Or, so I have been told.

Nesting Gulls Meet Disaster

The big losers at Mono Lake, though, are not people but birds. David Gaines, head of the Mono Lake Committee that spearheads the environmental fight, told me that as many as 50,000 California gulls—95 percent of those in the state and one in five of all in the world—habitually flocked to the lake to nest, 30,000 of them on Negit Island.

The gulls nested safely in 1978. Later that summer the falling water level opened a land bridge to the island, which the National Guard tried to sever with explosives to protect the gulls from coyotes.

Three tons of explosives were used the following spring, but coyotes easily crossed to Negit. In panic the gulls attacked each other's nests. "There was disaster on Negit," Mr. Gaines said. "Not a chick survived."

In 1980 the state erected a high barbed-wire-topped fence across the causeway, but the gulls nested on other islets that year.

Though bitter Mono Lake contains no fish, it teems with feathery brine shrimp, food for the hungry gulls. And for millions of other birds too—phalarope, grebe, teal, sandpiper, plover—more than 100 species in all. (See the article beginning on page 520.) An incredible 800,000 feeding birds have been counted there in one day. Many of them are on migratory flights, using shrimp-rich Mono Lake as a filling station between breeding and wintering grounds.

Are those migratory birds endangered too? Yes, said David Gaines and Dean Taylor. Both men posed the same melancholy questions during our conversation:

- How long can birds cope with the increasingly bitter waters of Mono Lake?
- Will a day come when increasing salinity makes the shrimp population collapse, turning the lake into a sterile sump?



Taproot for a metropolis and thorn in the side for Mono Lake, the Los Angeles Aqueduct dwarfs workers during a periodic resurfacing (right). The 340-mile-long aqueduct annually delivers 32 billion gallons of Mono basin water to Los Angeles (map), supplying 17 percent of the city's water and 2 percent of its electricity. Replacement sources would be uncertain and costly, the city argues.

• If the shrimp *do* go, will the migratory birds go too? The nearest known protein-rich lake is the Salton Sea, 350 miles south.

"At present diversion rates, Mono Lake's salinity is bound to continue to increase," David Gaines said. "The results could be disastrous to the entire ecosystem. That's why we are asking the DWP to share water during years of average and above-average precipitation. Gradually the lake level would rise, reflooding the land bridge and reducing salinity to lower levels. With much of the shoreline dust under water, the air-pollution problem would be eased too."

Who could argue with those eminently attractive goals? Primarily, the Department—full name: the Los Angeles Department of Water and Power.

Alas, Los Angeles is in the wrong place. It sprawls in the arid south, whereas two-thirds of California's water supply is in the northern third of the state. Supported by state law and acts of the U. S. Congress, Los Angeles can tap streams in the Mono basin.

Just south of the Mono basin lies a sere reminder of Los Angeles' thirst. It is the Owens Valley, once dotted with farms and ranches, now the arid property of Los Angeles. In the first quarter of this century a violent water war raged there. Repeatedly, sections of the aqueducts were blown up by

desperate local people, trying to keep their valley from going dry.*

The Mono Lake fight, though, has been a civil one, in spite of those paper-napkin bombs. "We can save Mono Lake without anyone in Los Angeles going thirsty," David Gaines argued. "All it requires is modest water conservation in the city, and the effective recycling of waste water by the DWP."

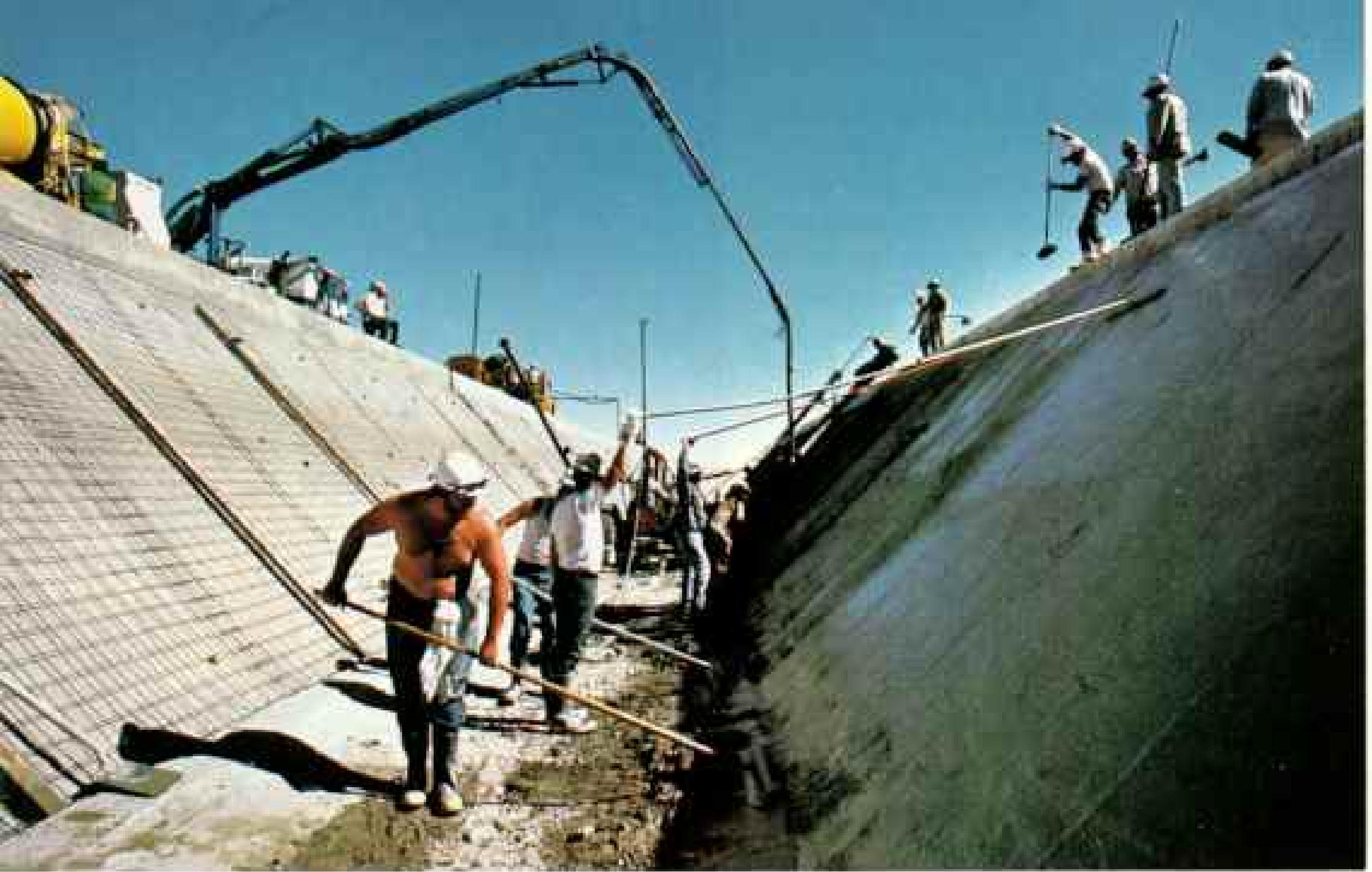
Lake Changes Before Residents' Eyes

According to local residents, some species of birds have already begun to leave. I chatted with building contractor Jeff Hansen in the living room of his lakefront home. "The lake was thick with ducks and geese 25 years ago," he told me. "It's hard to find even one out there now." Unlike ocean shorebirds, ducks and geese are ill equipped to stomach the increasingly salty diet.

Mr. Hansen's front yard lengthens each year as the lake recedes. He pointed out a landlocked tufa tower 30 feet from the water's edge. "As a boy I used to swim out to that tower. Its top was a few feet below the surface, and I'd rest there from the long swim before heading back."

I stared at him quizzically. "You used to

*Judith and Neil Morgan described the plight of this valley in the January 1976 *GEOGRAPHIC*.



swim in Mono Lake?" I thought of Mark Twain's account of a dog with "raw places" that had unsuspectingly jumped into the water, only to thrash ashore yelping. "He finally struck out over the mountains, at a gait which we estimated at about two hundred and fifty miles an hour, and he is going yet."

Mr. Hansen grinned. "Sure we swam in Mono Lake. And boated on it, and water-skied on it." He pointed along the shore to the site of an old marina, now thoroughly landlocked. "People still do. But it's hard work, getting to the water through the salty muck along the shore. As long as you follow your swim with a freshwater shower, though, you feel great."

Some of the present-day boaters on Mono Lake are scientists. Zoologist David Winkler of the University of California at Berkeley is one of them. He focuses on the California gulls that continue to feed and nest there on smaller islands still isolated in the shrinking lake. His bird counts show their number has decreased.

An ingenious fellow is David Winkler. During his frequent visits to the lake, he sets up housekeeping in a hollow plaster volcano built 30 years ago, during production of a Hollywood epic, *Fair Wind to Java*.

While he trains his binoculars over Mono Lake, other University of California

researchers look beneath its surface. Limnologist John Melack and his crew, funded in part by the National Geographic Society, study the aquatic ecology.

The lake they probe is ever changing. In winter, shrimp are dormant but algae are plentiful. Spring comes; shrimp hatch, and begin feeding on the algae—while newly arrived birds dine on shrimp.

In summer, the lake stratifies. Its warm upper regions are thick with shrimp, while the algae supply decreases. Below, in the cool depths, the situation is reversed.

Fall brings cool days that weaken the lake's stratification. Once again, algae are plentiful, while the shrimp go dormant.

The flurry of scientific interest in Mono Lake is recent—extensive research began only in 1976. "Few of our biological studies have a good baseline," Dr. Melack complained. "We can tell the condition of the lake now, but without something to judge against, it's hard to tell how fast the ecosystem is changing."

Only scattered small tracts of private property remain near the lake's perimeter. Largest landowner is the federal government, represented by the Bureau of Land Management and the Inyo National Forest.

Next comes the city of Los Angeles—for back in the 1930s the city acted to ensure its

future water supply by buying up land around the lake.

There is a strong difference of opinion regarding the state government's decision giving Los Angeles the right to tap streams in the Mono basin. The National and Los Angeles Audubon Societies, Friends of the Earth, the Mono Lake Committee, and four individuals have filed suit against the DWP, claiming that the diversions damage a unique asset held in public trust by the state. The DWP, in turn, has cross-claimed against 153 interested parties, including the state and federal governments, seeking a judicial determination that its diversion of water from the Mono basin is lawful.

In another suit, the Sierra Club and the Natural Resources Defense Council have demanded that the federal government assert its rights to protect the lake's ecosystem. Neither suit has yet been decided.

Los Angeles Stakes Strong Claim

A great deal is at stake, for 17 percent of Los Angeles' water comes from Mono basin. High-quality water, it needs little processing, and it flows through tunnels and aqueducts that have largely been paid for.

Paid for by the water itself and by electric power it generates. Gravity pulls it to the distant city—and along the way, it races through hydroelectric turbines that produce 2 percent of the city's power.

To get the city's side, I visited the Los Angeles DWP headquarters. That building rises from a pond spanned by a pedestrian causeway. In the mind's eye one might see the pond as a moat, and the causeway as a drawbridge to be raised at the first sign of approaching environmentalist armies.

Duane L. Georgeson, engineer in charge of the aqueduct division, is a pleasant and rational man, convinced of the rightness of his cause. One by one he responded to the environmentalists' claims.

He was not convinced that gulls will disappear from the lake's nesting grounds. He was not convinced that increased salinity would destroy the brine shrimp. The lake will stabilize, he assured me, at about half its present size—a third of what it was in the 1930s. Surface evaporation will then be offset by underground springs.

"We'd like to see a five-year study of the



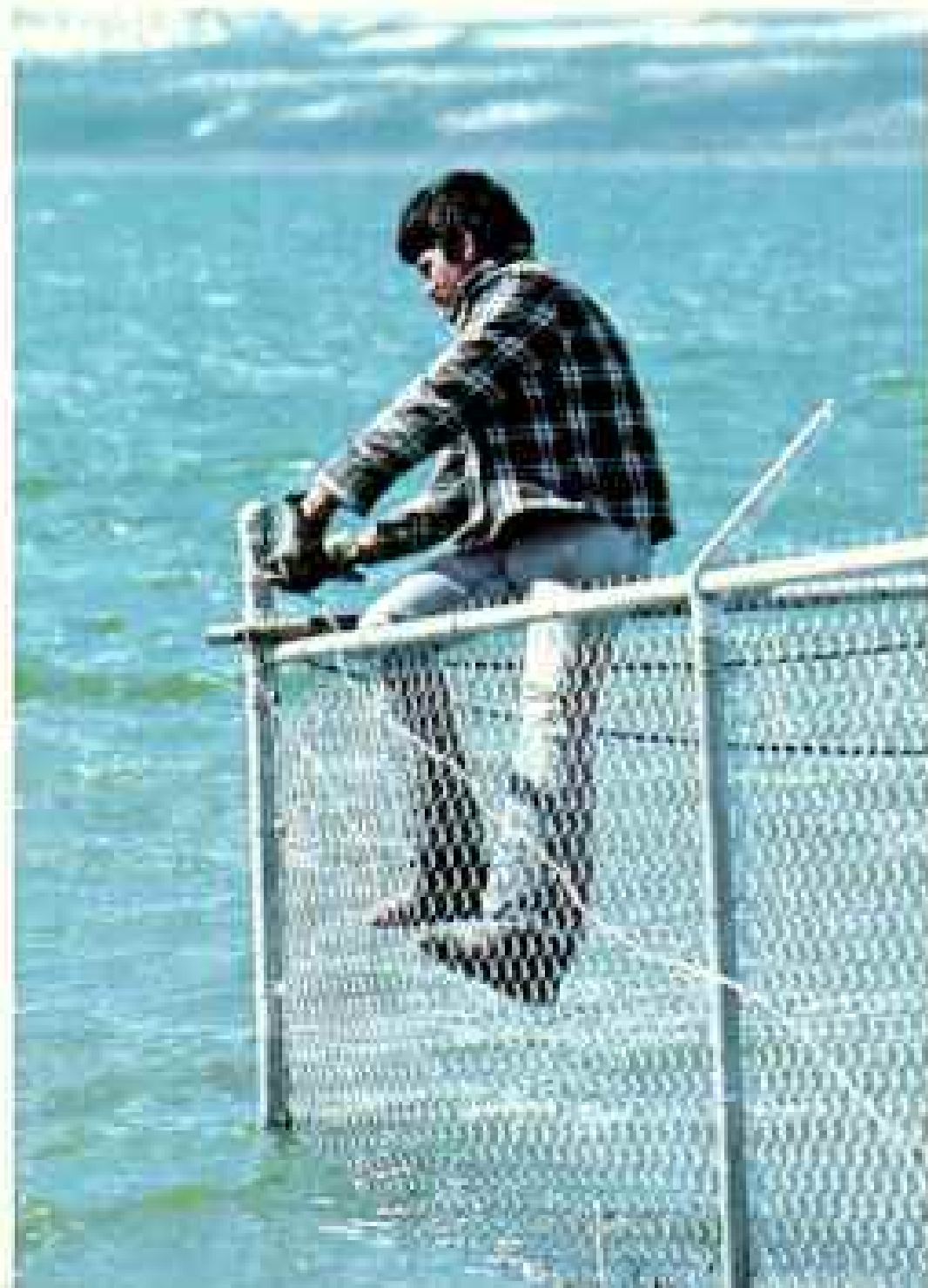
NICHOLAS DEYORE III





Massive surgery failed to correct a balance of nature thrown awry by the lake's sinking level. The land bridge to Negit Island remains (above) despite two attempts to sever it with explosives. Coyotes and gulls crossing paths (left) brought disaster to the 1979 nesting season. The next year a chain link fence was built to thwart the coyotes, but proved of no use since the birds chose other nesting grounds. With the lake too salty to support fish, the birds have no natural rivals to compete for brine shrimp and brine flies. More than 100 bird species frequent the lake, one of the major inland breeding grounds for California gulls and an important resting and feeding station along western flyways.

The Troubled Waters of Mono Lake





lake's ecology," Mr. Georgeson said. "It would tell us a lot more about the situation."

The overriding argument, though, was not environment. To Duane Georgeson, it came down to a matter of simple justice.

"Back in 1967," he said, "the California Department of Water Resources reported that one of the benefits of increased diversion from the Mono basin would be a reduction of the amount of water wasted by letting it flow into saline Mono Lake. Well, if California has decided that public values have changed—that water flowing into Mono Lake isn't a waste—why should Los Angeles be penalized?"

He leaned forward. "Los Angeles built and paid for the whole aqueduct system. Not a nickel of federal money went directly into its actual construction. Is it fair to take the system away and ask us to find our water somewhere else?"

Then he moved on to the energy question. "Each acre-foot [325,000 gallons] of water that flows through the diversion generates electricity equivalent to five barrels of oil. If we lost the system, it would cost five barrels of oil per acre-foot to pump replacement water over the mountains. That is a pretty poor trade-off these days. I believe the security of an affordable, high-quality water supply to the people of Los Angeles should be as important as the fact that a picturesque saline lake in the high desert is declining."

More controversy may be afoot when in 1985 the Central Arizona Project begins taking 660,000 acre-feet of Colorado River water now going to southern California. When Phoenix and Tucson turn on their taps, farms and towns in California will have to find replacement water. While Los Angeles now uses only a small portion of Colorado water, it owns the rights to considerably



MICHAEL DRESSLER

Friends of the lake conduct their own diversions (left), symbolically stocking Mono with water brought from local streams and back from Los Angeles, including a bottle filled at the water department's reflecting pool. The Mono Lake Committee claims that 15 percent conservation by Los Angeles in good rainfall years would stabilize the lake at an acceptable level. Committee chairman David Gaines (below) extols Mono's mineral-rich water as invigorating, though its alkali stings cuts in the skin.



more being used elsewhere. In Georgeson's view, shutting off Mono Lake water would vastly intensify the water-rights game.

But were the three million Angelenos solidly arrayed behind their Department? I wandered around the town next day, taking a public opinion poll.

Conclusion: If my unscientific sampling of 11 people holds true in the rest of the city, then environmentalists and the Department are talking only to each other. No one else seems to be listening.

Only two people in my survey were even aware that Mono basin was part of the city's water supply—and one believed the lake itself was the source of drinking water. "We need that water," he said firmly. "People are more important than a few birds."

Clearly, problems that tower in the minds of naturalists and aqueduct engineers may hold little relevance on crowded city streets.

In a suburb of Sacramento I talked with William L. Kahrl, editor of an impressive volume, *The California Water Atlas*, and perhaps California's most objective expert on Mono Lake.

"Remember," he said, "you have two environmental viewpoints matched against each other. Preservationists are trying to save a lake and the birds. But the Department considers itself conservationist—fighting to keep a water system that generates rather than expends electrical energy."

Then he switched to economics. "Have you ever heard of the 'theory of the long purse'? It means that, to develop water rights anywhere, you also need money to fight the legal battles involved. You need a long purse—and the Los Angeles Department of Water and Power certainly has one. It's a powerful adversary."

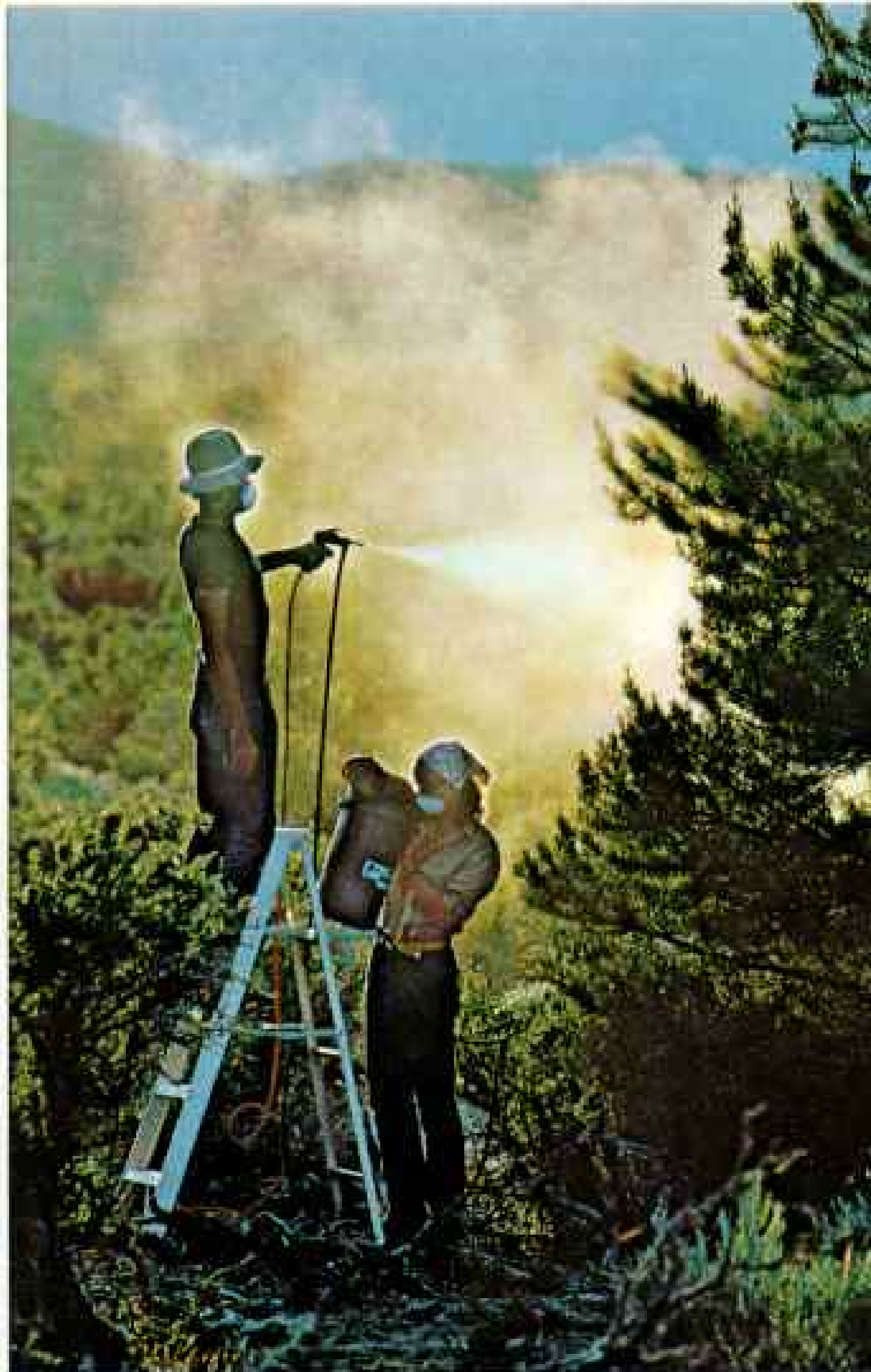
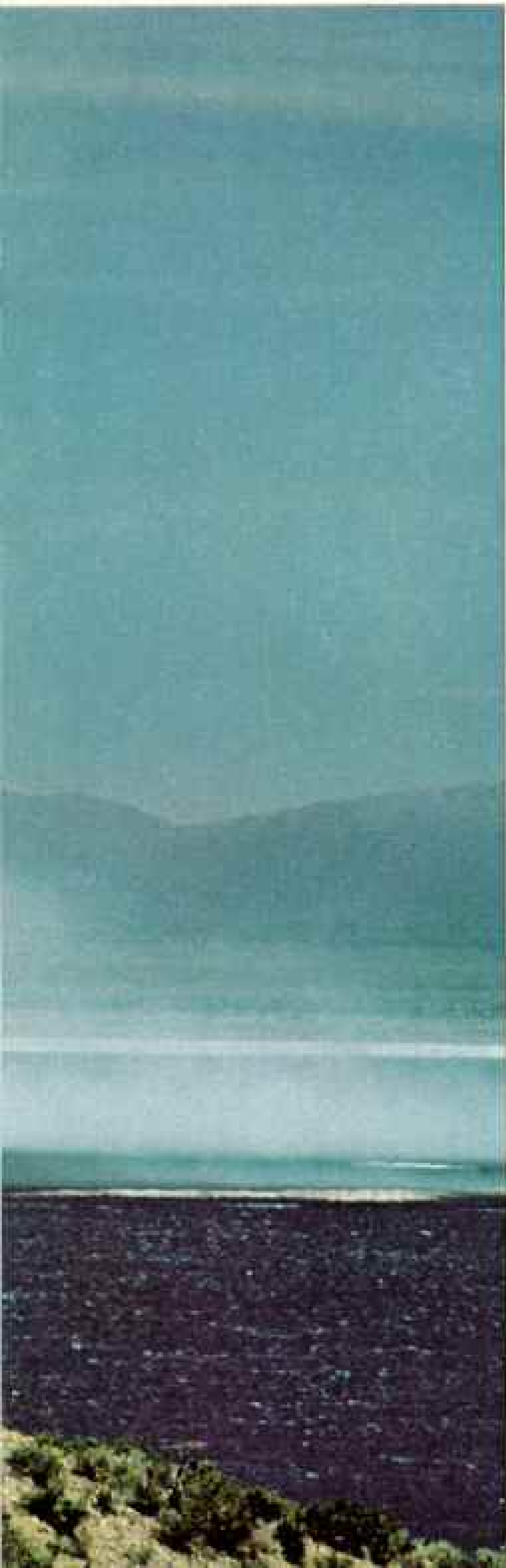
As we talked, one house of the California

An ill wind blows from the basin, carrying a caustic cloud of sulfates toward the mountains (below). Visibility can drop to less than 40 feet, and dust may have reached as high as 20,000 feet. Air quality on the east shore often falls below state and federal minimum standards. As part of his research Dr. Dean Taylor, a botanist, vacuums dust from the shore (bottom right), then sprays it on piñon



pinus to study the long-term effects (right). Results are not yet known. Since diversions began, Mono's surface has shrunk from 86 to 61 square miles, exposing 16,000 acres of lake bottom, reviving the old nickname, California's Dead Sea. A bill to curtail the diversions failed to gain approval of the State Assembly last year and never reached the State Senate.

PAUL A. ZIM



Legislature was considering a bill calling for a drastic reduction in the diversions. The bill resulted from a plan proposed by a local, state, and federal task force formed to deal with the problem. Many lawmakers did vote in favor of the plan, but it failed to pass. Even so, Mono Lake boosters could view the defeat as a partial victory—at least it demonstrated that support for their cause was growing.

Academic interest in the lake continues. In addition to studies sponsored by the DWP, six different research teams from various universities are now at work there. Though each focuses on a separate link in the environmental chain—brine shrimp, algae, water salinity, shorebirds, nesting birds, alkali dust—their combined efforts are bringing a clearer picture of Mono Lake's biosphere.

Unearthly sculpture gardens of fragile, windswept tufa on the shore



In the spring of 1980 only about 40,000 California gulls returned to Mono Lake. By a July 1981 count, conducted by David Winkler and the DWP, the number of chicks had dropped to less than half the 1980 hatch. This drastic decline puzzles scientists.

The gulls' nesting choice will be even harder in the future. "Winter was dry here in the Sierra," David Gaines of the Mono Lake Committee told me recently: "If the lake

drops at its usual rate this year, the islets where 40 percent of the remaining gulls nest will be connected to the mainland."

While courts struggle to balance a city's rights against those of nature, Mono Lake's plight worsens. The problem comes down to this: Americans view water as a public asset that must be put to the highest and best use. Is that use for the city of Los Angeles or for the preservation of Mono Lake? □

would be protected under a proposed Mono Lake Tufa State Reserve.

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Mono Lake: A Vital Way Station for the Wilson's Phalarope

ARTICLE AND PHOTOGRAPHS BY
JOSEPH R. JEHL, JR.

IT IS LATE JULY and the birds are restless. Suddenly a few, then several hundred, begin to lift off. Within moments the stillness of the lake is broken by the whir of thousands of wings.

Slowly the birds gain altitude. Then, passing the snow-whitened peaks of the Sierra



Salts from Mono Lake cake the face of the author, Dr. Joseph R. Jehl, Jr., during observation of the Wilson's phalarope, a study financed in part by the National Geographic Society and the Los Angeles Department of Water and Power. He is assistant director of Hubbs-Sea World Research Institute, of San Diego, California.

Nevada, they turn south to continue a migration that will take some as far as Tierra del Fuego, at the tip of South America. The Wilson's phalaropes are leaving Mono Lake.

What is it about this desolate inland sea in California that attracts the Wilson's phalaropes in such immense flocks each summer? With research support from the National Geographic Society, I hoped to find out.

Like all sandpipers, these phalaropes have long legs and beaks for walking and picking through shallow water in the hunt for food (*facing page*). Although not seabirds, they are highly specialized for aquatic life. While others of their family—sandpipers, for example—stay along the shore, phalaropes swim well and are at home on land and water.

The life cycle of the bird, named after the eminent 19th-century naturalist Alexander Wilson, begins in May on its major breeding grounds in the prairie pothole country of the northern Great Plains of the United States and southern Canada. But the bird winters mainly on the high-altitude lakes of the central Andes (*map, page 522*).

After the female phalaropes lay the eggs, the males take all responsibility for incubating them and raising the chicks. Thus free of parental duties, the females start their southward

migration early; by mid-June they are assembled in small flocks in preparation for the first leg of their journey. Taking wing, many head for Mono Lake, where they will prepare for their long nonstop flight to South America.

The start of our fieldwork at Mono Lake was inauspicious. To band a representative group of birds, we set up traps and nets in likely spots. But each night when we returned to camp, our question was the same: "Where are all the birds?" We had been able to discover only a hundred or so scattered along the western shore. And all were males!

To find the females, my field associate Bart Cord set off on an 18-mile trek over marsh and sandbar. He returned jubilant, announcing that an immense flock had just arrived on the eastern shore.

The next day he led us to the most inaccessible spot on the lake. Thousands of female phalaropes were crammed into a knot that stretched along a mere quarter mile of beach. They were not feeding, but standing quietly in shallow lagoons or sleeping on sandbars.

We were soon able to predict the pattern of daily activity of these birds. By early morning they would leave their shoreline-roosts and fly to the lake to feed on brine shrimp. By late morning they would head shoreward to spend the afternoon preening





their incoming winter feathers.

Molting is a gradual process, which usually requires several months. But we discovered that the Wilson's phalarope can replace its body plumage in only 35 to 40 days. Birds caught in our traps were molting from all parts of their bodies, lining the shore with feathers.

By mid-July the number of females had increased considerably, and the bedraggled males, newly rid of their chicks, arrived in numbers. Instead of

congregating in huge molting flocks as did the females, however, the males spread out more widely along the lakeshore, mostly near freshwater springs and tufa towers, and spent most of their time on the beach, loafing or feeding on swarms of brine flies (*below*).

In late July the young birds, still clad in their brown juvenal plumage, began to arrive. By this time, the adults were in peak abundance, and most females had molted into the gray



coat they would keep until spring. Then the multitudes flocked to the western half of the lake, and for the first time females joined the males. Many gathered at a small freshwater marsh near my camp to wash the lake salts from their feathers and drink the sweet water. Characteristically, the female (right, at left) is larger than her male companion.

Later in the day I launched my boat to study the birds "at sea" and was astonished to see

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STELANORUS TRICOLOR





that most of the females were so fat they had great difficulty in taking flight.

By the end of July, when migration began, the skies were thick with birds (*above*). The first females departed, to be followed by the fattened-up males by mid-August. Before leaving

Mono Lake, the adults may double their weight, storing enough fat to power their non-stop flight to the northern coastline of South America. The most adventurous phalaropes will fly more than 15,000 miles before returning to Mono Lake the following summer.

Although our studies at Mono Lake have just begun, we are starting to understand the lake's importance to the phalaropes' life cycle. Their activities there—molting and laying on fat for their migration—require large amounts of food. The virtually unlimited supply of brine

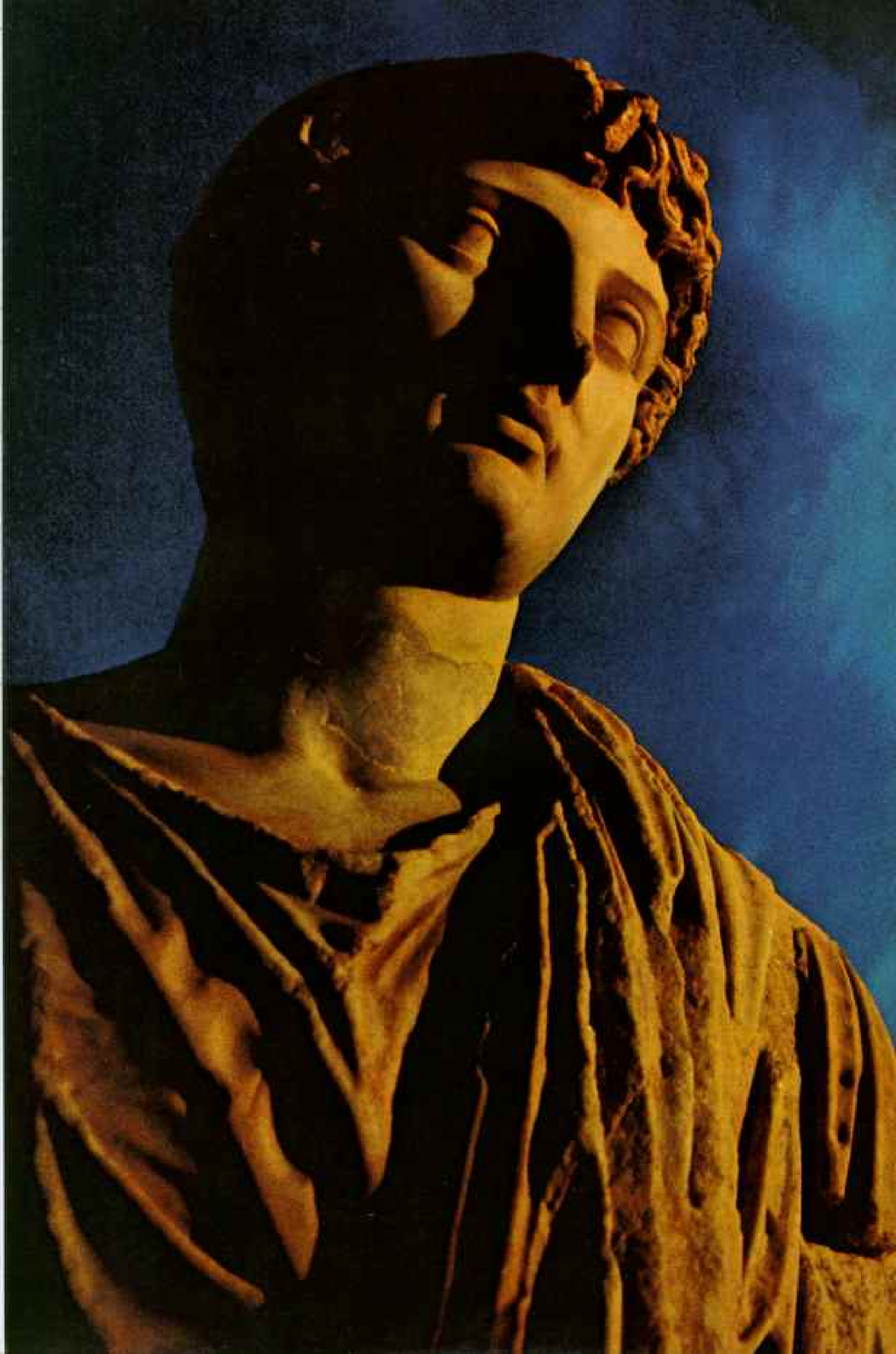


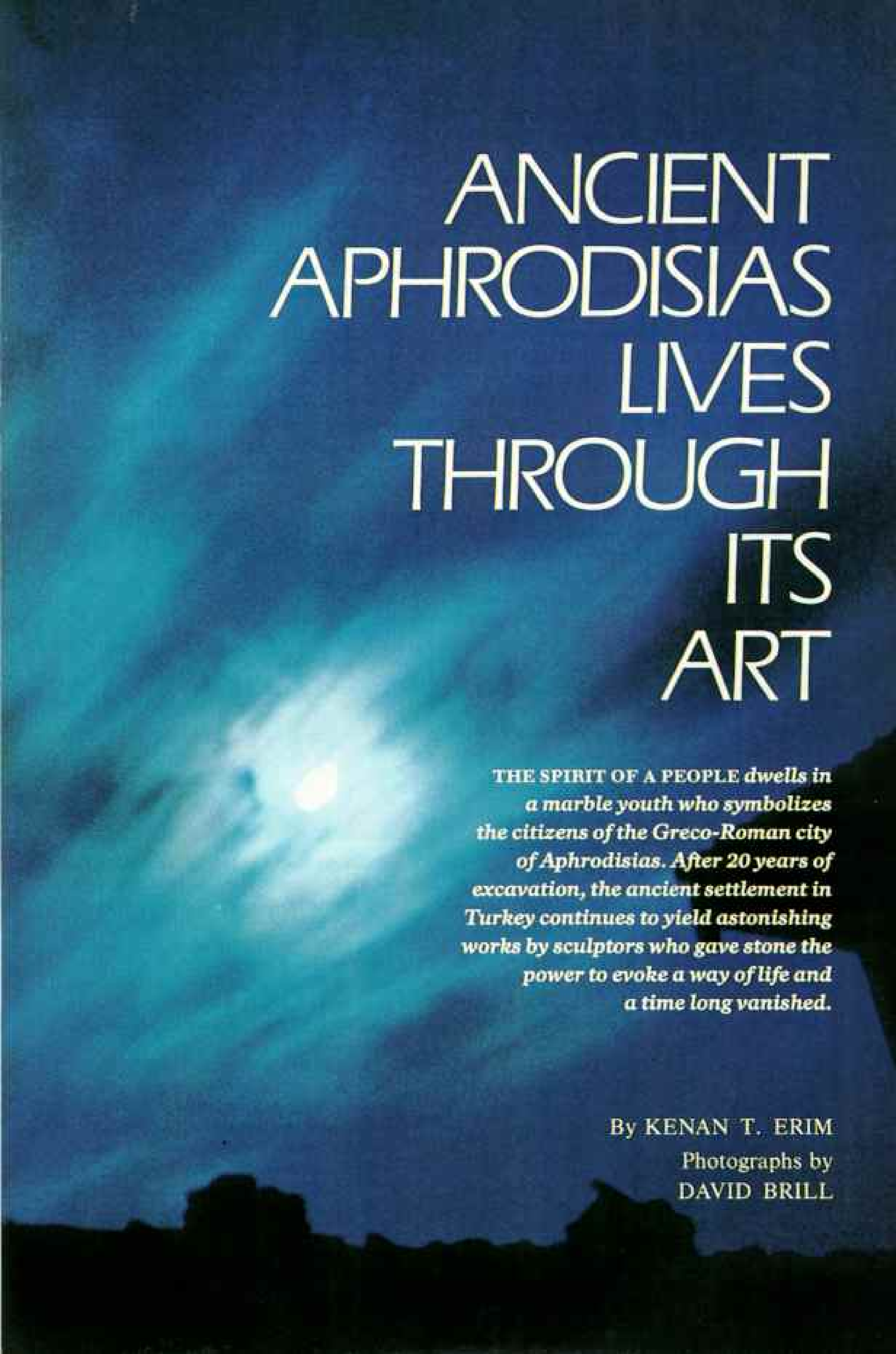
flies and brine shrimp in the lake permits the birds to molt and fatten in a remarkably short period. There are no nearby lakes with food sufficient to accommodate the host of migrants. For those phalaropes that take this western route to South America, Mono Lake is

the major refueling station.

By September, summer's heat has given way to frosty mornings and the phalaropes have gone. Streams that gave the lake its meager annual ration of fresh water have dried as the snowmelt of the Sierra has been diverted to provide water

for Los Angeles. If conditions go on as they are, and as time passes, Mono Lake will continue to shrink, and its already high salinity will climb. A key question for our research remains: Will Mono Lake still be able to support vast numbers of Wilson's phalaropes? □





ANCIENT APHRODISIAS LIVES THROUGH ITS ART

THE SPIRIT OF A PEOPLE dwells in a marble youth who symbolizes the citizens of the Greco-Roman city of Aphrodisias. After 20 years of excavation, the ancient settlement in Turkey continues to yield astonishing works by sculptors who gave stone the power to evoke a way of life and a time long vanished.

By KENAN T. ERIM
Photographs by
DAVID BRILL

OCTOBER'S BREATH cools me as I mount the acropolis of Aphrodisias and look out over the Greco-Roman city whose life for 20 years I have made mine.

The Anatolian sun, riding low in the circle of day, explodes in a riot of color on the western rim. Across the broad fertile valley, sun-rays wash with gold the scars of hillside quarries. Marble from them, transmuted into the living countenance through the art of its sculptors, brought the city fame from Julius Caesar's day to the age of Justinian, from the first century B.C. to the sixth century A.D. Shafts of sun strike autumnal fire in poplars that line the clear, cold stream watering the city and echo twin ranks of columns in its Temple of Aphrodite. This ardent patron deity drew pilgrims and wealth to her namesake city.

The scents of fig, thyme, and pomegranate caress my nostrils. Birdsong fills the air, and from nooks amid the smooth white stones comes the cooing of doves, sacred to Aphrodite. A donkey's bray splits the air. I hear the distant wail of the muezzin's call to prayer and look beyond the ancient city, beyond the yellow stubble of harvest, the copper vineyards, the returning amber flocks of sheep, to the relocated village of Geyre with its orderly rows of cinder-block houses.

Twenty years earlier I stood on this same mound in summer's heat, full of anticipation—and apprehension. This western region of my native Turkey was, I knew, rich in the husks of vanished cities—Ephesus, Pergamum, Smyrna, Sardis, Priene. Aphrodisias's highland valley drains into the Menderes—the ancient Maeander. That river meanders to the Aegean at Miletus, whose urban planner Hippodamus devised the grid street pattern that influenced ancient cities and New York City alike. A hundred miles west of Aphrodisias lies Bodrum; its crusader castle looms over Halicarnassus, birthplace of Herodotus, where the Mausoleum of King Mausolus rose, one of the ancient Seven Wonders of the World.

What would I find here within these unmanned ramparts and columned edifices,

The author, Dr. Erim, Professor of Classics at New York University, first reported on Aphrodisias in the August 1967 *GEOGRAPHIC* and again in the June 1972 issue.

long untenanted and tumbled down? What lay under this raucous arena of chickens, dogs, and children? Under this jumble of peasant houses with marble inscriptions and chunks of statuary peeking from their walls, and sarcophagi garlanded with grapes serving as winepresses?

Each season, with generous support from the National Geographic Society, our restless spades have revealed more of Aphrodisias's artistic and architectural treasures. The theater, its marble seats for 8,000 spectators now spread before me, emerged from the overburden of centuries. Its "archive wall" yielded an unprecedented series of imperial letters. Aphrodisias also has given us one of the most complete inscriptions extant of Emperor Diocletian's maximum-prices edict of A.D. 301. In it he froze the cost of



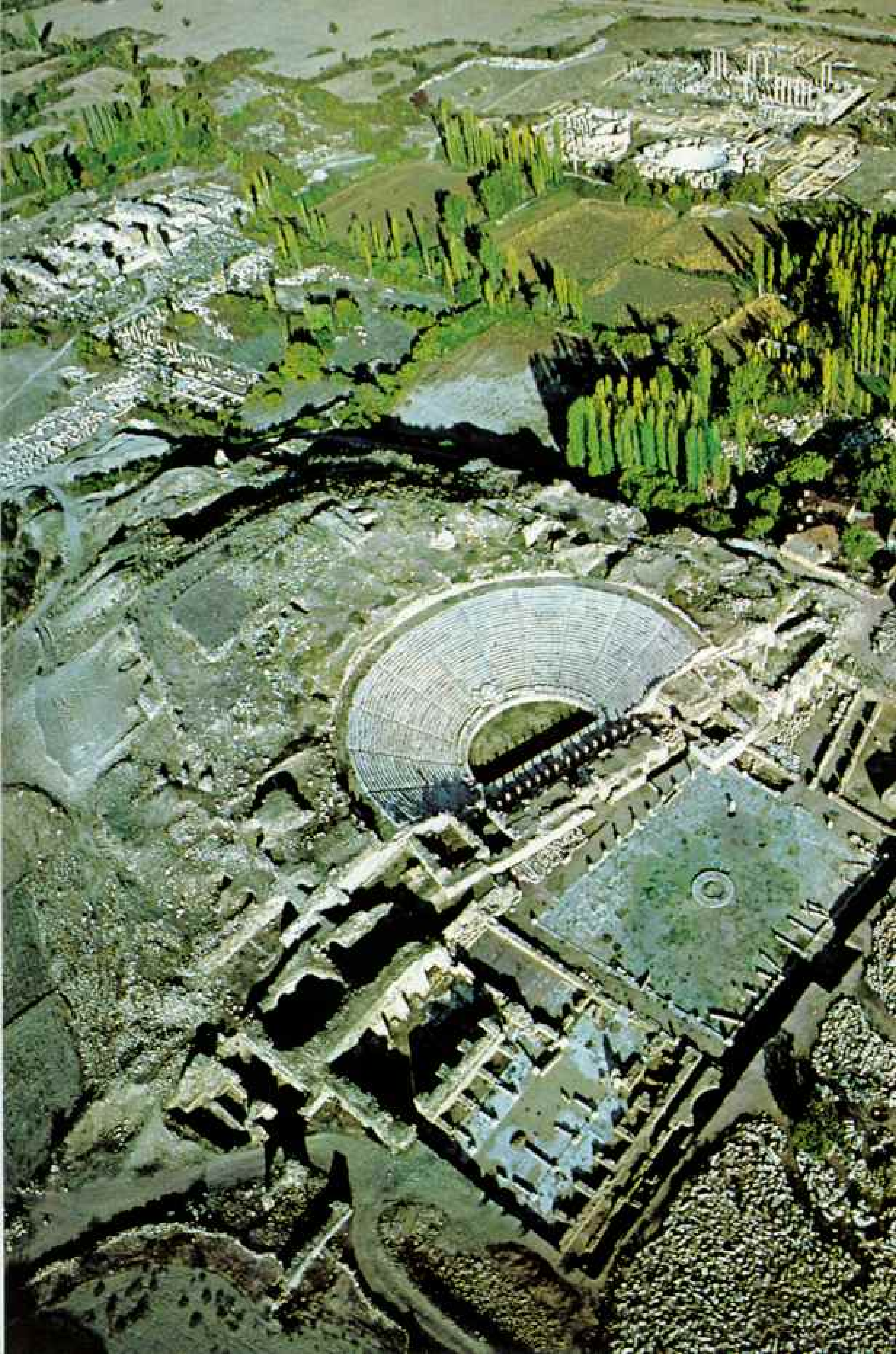
Faces from the realm of myth came to earth in glorious form at Aphrodisias, a city devoted to and named after Aphrodite, goddess of fertility, love, and beauty.

A gentle nativity (right) may depict Aphrodite in a rare pose cradling her son, the winged god of love, Eros. An unknown face looks on from behind a figure that could be Hermes, one of the goddess's many lovers.

A necklace of snakes identifies a life-size head of Medusa (above), whose countenance turned men into stone.

These marble relief panels decorated the recently uncovered Sebasteion, a grand complex honoring the early Roman emperors, who claimed descent from Aphrodite and favored her chosen city with local autonomy and tax relief.







JOHNSON S. BLAIR

Encore for a city of grandeur: Laborious excavation displays the jewel on the crown of Aphrodisias—a semicircular theater seating 8,000—and a piazza flanked by the remains of opulent Roman baths. In 1966 the village of Geyre (above) topped the mound, known as the acropolis, which had grown over millennia to more than 75 feet high as settlements rose and fell in this fertile region.

The advent of Roman rule in the second century B.C. brought Aphrodisias a prosperity that lingered into the sixth century A.D. and supported a population, large for the time, of 50,000. Greek remained the common tongue, probably dating from the late fourth-century B.C. conquests of Alexander the Great, when the cult of Aphrodite began to evolve from centuries-old worship of a local fertility goddess.

Pilgrims flocked to the Temple of Aphrodite (left, at top). Vigorous trade pulsed in the heart of the city, the agora, a large rectangular area between the theater and the temple. At one end of the agora lay the Baths of Hadrian, upper left, which beckoned as the workday ended. Everywhere the eye met the dazzling sculpture that brought the city fame.

Its star falling, Aphrodisias continued as a Byzantine center until violent earthquakes and Seljuk Turk invasions finally lowered the curtain in the 12th and 13th centuries.

Even so, the atmosphere of the city survives, says Director of Excavation Kenan T. Erim. "Remember, we are uncovering the remains of where people lived and loved, were happy and unhappy, and died."



Sheltered in a remote valley of Anatolia, Aphrodisias eluded modern excavators while ancient troves at Ephesus and Troy made 19th-century headlines and monuments of Byzantium's Constantinople, now Istanbul, had been admired for centuries. Aphrodisias remained relatively unexplored until the expeditions of the author, sponsored by the National Geographic Society since 1966. The quantity and quality of the finds unearthed have exceeded all expectations. Yet excavation has touched little more than 15 percent of the city's 100 hectares (250 acres).

commodities ranging from peas and beans to wagon wheels in an attempt to stem a disastrous inflation that had pushed prices to 200 times the second-century level.

Trenching the acropolis and a second conical mound, we cut down through layers of superimposed settlements—past the day when Alexander the Great marched by here to the Indus, when coinage was invented in the neighboring Lydia of Croesus; past invasions of the Persians, the fall of Homer's Troy, and the rise of the Hittites, of Egypt's Pyramids, and of writing in Sumer—back to Stone Age habitations of 8,000 years ago.

Above all, sculpture sifted from the rubble—and now restored and preserved in our new museum—has disclosed the extraordinary range and enduring quality of Aphrodisian art during the city's prime.

GAZING UPON the parade of public edifices, honey-hued in the sun's wane, I let imagination quicken the porticoes and plazas with the shades of people who lived, loved, laughed, and sorrowed here 15 to 20 centuries ago. Life here, more than a thousand miles east of Rome, reflects much of life in the capital. Their names I know from inscriptions. Their familiar faces, softened by shadows from marble into flesh, glow with personality and emotion. I endow them with phrases from Horace, Petronius, Pliny, and other authors of their day. For that, poetic license is not far to seek. "My dear man," a character in Lucian

objects when a long-departed philosopher prescribes silent meditation, "I like to talk; I don't want to be a statue."

In the revived city I envision a feast day of Aphrodite. Smoke curls from the blazing altar standing before her temple, the focus of processions.

*Darling of Gods and Men . . .
For every living thing achieves its life
through you. . . .
Love caresses all hearts and kindles
all creatures
In overmastering lust and ordained
renewals.*

So sang Lucretius, and frenzied music, orgiastic dancing, and flagellation might accompany the rites. Frequent custom in Anatolia obliges women before marriage to prostitute themselves in the sanctuary, dedicating their earnings to the goddess—or to sacrifice their hair. Through the Anatolian mother goddess, Cybele, honored as the giver of all life, Aphrodite is metamorphosed from the fertility goddess, Ishtar of Babylonia, and her Phoenician counterpart, Astarte. Romans identify her with Venus, from whom the "divine Julius" (Caesar) and his successors, emperors of the Julio-Claudian line, claim descent through her Trojan son, Aeneas, and his descendants Romulus and Remus, founders of Rome. Hence Romans' affection for Aphrodisias.

A shout rises from the stadium beyond the temple. Cheering swells in a crescendo from

30,000 people packing the stone stands for games in Aphrodite's honor. Like Roman provincials everywhere, Aphrodisians thrill to foot races, javelin throwing, to the clang of swords and the snarl of wild animals. They dedicate stelae and statues to gladiators, wrestlers, boxers, and other professional athletes they admire. Partisanship and passion for gambling run high. Competing factions—the Reds, Whites, Blues, and Greens, who bribe contestants in the arena, boost rival matinee idols in the theater, and back opponents for city office—carry on as if their team's victory were a military triumph and its defeat a public disaster, as Mediterranean soccer fans do today. (The historian Tacitus reports violence in Pompeii's amphitheater between locals and visitors from neighboring Nuceria. Zealots first hurled abuses, then picked up stones and finally weapons, escalating the brawl into carnage so frightful that Emperor Nero punished Pompeii by forbidding such gatherings for ten years.)

Though Aphrodisians have no weekly Sabbath day of rest and religious observance to interrupt their daily affairs, the imperial Roman calendar marks a holiday for nearly every day worked. Sports, pageants, plays fill many of these.

In the odeum, or concert hall (pages 546-47), beside the agora, imagination brings us a soothing harmony of pipes and flutes, the plucking of lyres and zithers, the martial music of trumpets, hydraulic organ, drums, and cymbals. Or perhaps the philosophers Alexander or Asclepiodotus are declaiming. "When cool evening collects a larger crowd to hear you," as Horace observed, a local author might "publish" a new work. If this public reading stimulates demand, teams of slave scribes will make copies, writing the work on rolls of papyrus in ink made from resin, soot, wine dregs, and cuttlefish.

But this afternoon Aphrodisians seated in the tiered semicircle of the torchlit hall feel their pulses race to the vision of Virgil:

"Remember, Roman, these shall be your arts: To govern nations, to impose the custom of peace, to spare the humbled and war down the proud."

In the theater at my feet, mobbed with boisterous Aphrodisians shaded by a great awning, I summon on stage a comedy by

Menander or Plautus. Howls of laughter and catcalls greet stock characters properly masked and robed: white for the bearded old miser; multicolored for the scapegrace young lover; yellow for the courtesan; red wig, short tunic, and grotesque, big-mouthed mask for the cunning slave. In the plots, sons disobey fathers, wives deceive husbands, slaves outwit masters.

"Kick out your cares, forget your debts," prescribes Plautus. "It's a holiday for everyone—even bankers." Reveling in the rollicking overturn of sacred Roman virtues, letting off steam in a bawdy farce or pantomime, Roman and provincial alike take a holiday from *virtus*, *gravitas*, and *pietas*.

AT THIS HOUR on a workday, the chink of the sculptor's chisel, the clanging of the smith's anvil fades; carpenter, tanner, rope maker, butcher, mason lay down their tools. The hurly-burly of the agora, the central marketplace or forum, slackens as stalls close and the cloth merchant, fish-sauce vendor, goldsmith, cobbler, potter, perfumer, ironmonger, money changer, and sausage maker cease their singsong cries. Peasants shoulder their produce and head toward home outside the gates of the city.

"Give me a copper, and I'll tell you a golden story," calls the storyteller. He collects a knot of listeners while other strollers pause before a fortune-teller's urn. From it she draws inscribed lots that foretell their fates.

In the arcade of the adjacent basilica a well-fed lawyer, "blessed with a sharp, litigious tongue," consoles a legacy-hunting colleague. "What's one defeat? Don't abandon hope or quit the game. Be cunning and be thorough. I guarantee it: You won't lose." They nod in deferential greeting to a magistrate, who emerges full of dignity, his toga edged with purple.

"No matter what you say, nothing talks like money. Money makes the man. No money and you're nobody," comments one merchant to another as they enter the elegant Baths of Hadrian from the agora. They disrobe and bathe in pools of differing temperature—the bracing *frigidarium*, the lukewarm *tepidarium*, and the steaming *caldarium*, heated by underfloor hot air ducts from furnaces stoked by sweating slaves.

Some bathers go out to the adjoining palaestra, or sports ground, surrounded by its columned portico, for a workout—handball, jogging, wrestling, or lifting weights. Then, scraped clean with a strigil, oiled, and perfumed, they relax to the slap of the masseur's hand. Others browse in the library or lounge as a poet resounds his epic verses off the mosaic vaults and stuccoed walls. His rich verbiage contrasts with his seedy clothing, for alas, "Genius has always had Poverty as his sister."

Baths were the Aphrodisian's club, epitomizing Juvenal's prayer, "a sound mind in a sound body."

"BUY WELL, SELL WELL." Our merchants, still rapt in conversation, emerge from the baths to find the narrow streets thronged with people. As in Mediterranean towns today, Aphrodisians spill out of their living quarters behind or above their shops as the hot sun retreats, to take the air and to meet friends. Life is public. Though the city in the six centuries of its prime numbers some 50,000 residents, including those who dwell in villages, estates, and farms in the surrounding countryside, people know one another, greet one another by name.

"Hail, Zoilos!" Tradesmen salute the benefactor who won tax exemptions and self-government for Aphrodisias from the future emperor Augustus. A slave freed by the "son of the divine Julius," C. Julius Zoilos also served as a priest of Aphrodite and ten terms as a magistrate, and contributed to building the theater. Grateful Aphrodisians honor him in a frieze, crowned by a woman symbolizing Polis, the city, and greeted by a man symbolizing Demos, the people. Puffed up with his own importance, Zoilos, in belted tunic and medium-length coat, tosses a coin to a beggar in a tattered cloak and acknowledges the greetings in stride.

There's Flavius Palmatus, governor of the region, Caria, thronged by a phalanx of

clients who shoulder out a path for him through the crowd. I recognize him from his statue (page 546). And I make out Tiberius Claudius Diogenes, granted Roman citizenship by the emperor. When he achieved eminence, he showed his gratitude by contributing a wing of the sculpture-adorned Sebasteion honoring the Julio-Claudian emperors. This edifice flanks a processional way that I have only begun to excavate.

Here too come Antonius Tatianus and Aristocles Molossus; both contributed to beautifying the theater precincts. And Theodorus, who dedicated a relief of Aphrodite. Also the market overseer—I know his face but not his name (page 546); and Alexandros Dikaios, of whom the reverse is true, for I have yet to find the head to his statue.

Adrastus, son of Apollonius, pauses to chat in the local Greek with his nephew, another Apollonius, son of Hypsicles. If they had been granted Roman citizenship (which only became general throughout the empire with Emperor Caracalla's decree of A.D. 212), they would have adopted the *tria nomina* (Gaius Julius Caesar, for example) of a Roman citizen. Whence our custom of three names today.

The trio of slaves, Syrus, Dama, and Dionysius, clad in the same tunic as the artisans and shopkeepers they rub shoulders with in the street, will—if they follow custom—add their master's family name to theirs when he frees them in his will.

Boys in tunics play with knucklebones under the colonnades. From dawn until noon they have chanted the alphabet and drilled in the three R's with slate, wax tablet, and abacus under the rod of an irritable pedant. The street teacher sets his low stool on a corner, in front of a shop, or in a square—a rent-free spot in the public eye. This draws patrons, who pay him a few coppers each month to beat a little learning into their sons.

A wedding party reels past, waving torches and singing bawdy songs. The boys dive for nuts scattered as a symbol of fertility.

Veiled to uncover her beauty, the head of a second-century A.D. Aphrodite soaks in water to loosen encrustations and to leach damaging impurities that have penetrated the marble. The cloth holds moisture on features above the water's surface. Sculptures small enough to fit in tubs may soak as long as a month; large works must be repeatedly washed by hand.



The bride wears a ring on the third finger of her left hand; a nerve, Romans believe, leads from that finger directly to the heart. Arriving before their new home, the groom grasps a torch and lights a symbolic fire on the hearth. Then, lest she stumble and bring bad luck, or make a *sinister* entry, left foot first, his bride is lifted by attendants and carried across the threshold.

Knots of workers, seeking a panacea for what Juvenal calls a "life of competitive squalor," gather at the corner wineshops. Their talk grows louder and more vulgar when heated with syrupy wine, poured from amphorae and diluted with water in a large crater, or mixing bowl.

They are joined by a henpecked husband, pursued by a fishwife spouse straight out of Plautus: "Enough is enough, woman," he groans. "Save your voice. You'll need it to nag at me tomorrow." Drinking buddies console him for the burden of a wife, "a legalized hardship," Petronius puts it.

IN MY MIND'S EYE, I see the shades of all classes mingle in the narrow streets, the enforced intimacies of city life softening the hard edge of social division. Magistrate, merchant, metalworker, muleteer.

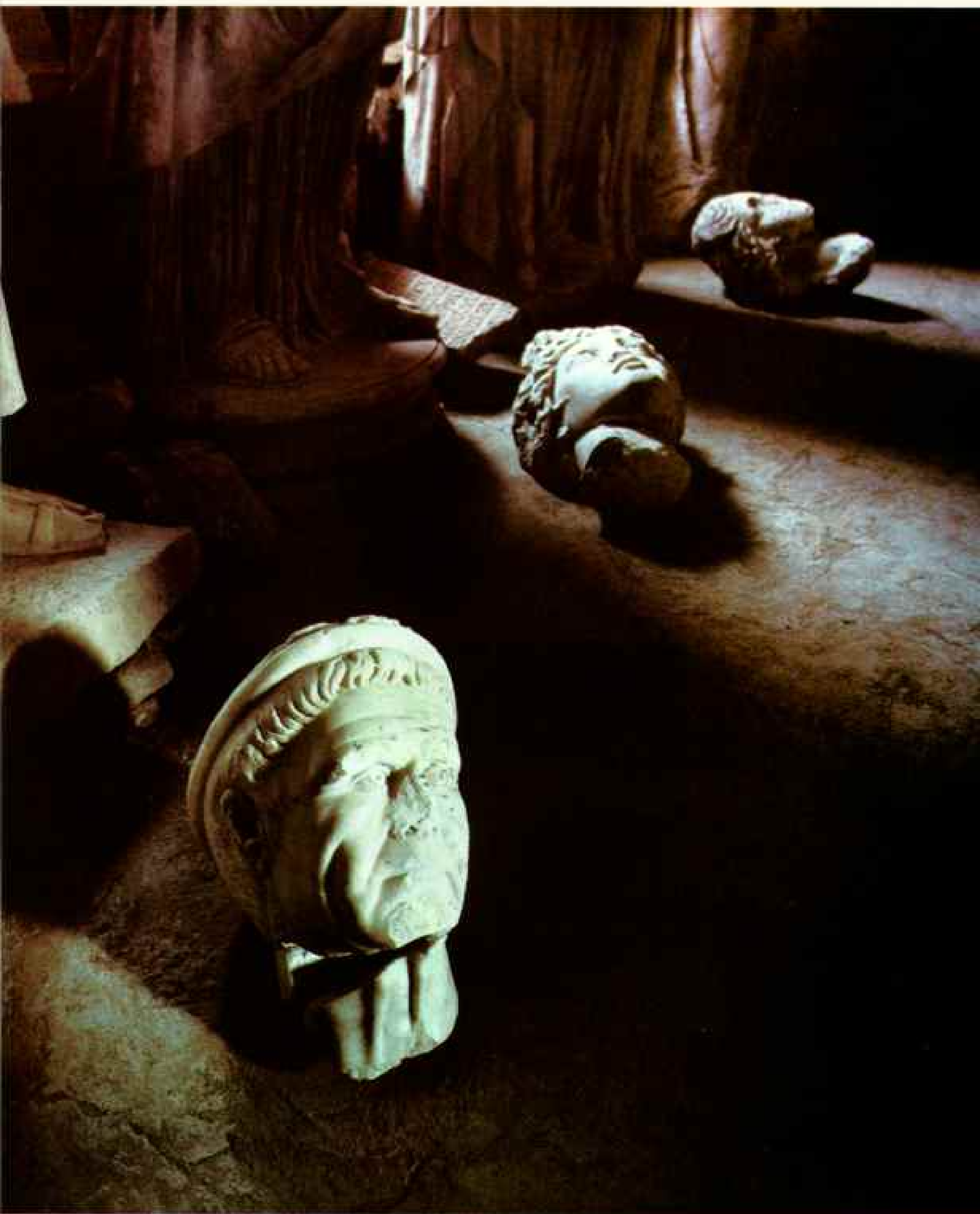
But few soldiers. The legions are on distant frontiers, guarding against Parthians in the east, Picts in Britain, Germanic tribes across the Danube, nomads in Africa. Within the empire the Pax Romana reigns. Civil life and trade flourish with "no wars any longer . . . no piracy, but at any hour we may travel by land, or sail from the rising of the sun to its setting," so Epictetus tells us.

In Aphrodisias only the local watchmen might bear arms. They patrol the streets at night, arrest thieves, and with axes and buckets rush up the stairs of two-story tenements to fight fires—a constant hazard in the days of flaming torches and oil lamps, charcoal braziers and wood fires kindled on chimneyless hearths.

Four sturdy slaves shouldering a litter elbow their way through the sea of white clothes. It's Claudia Antonia Tatiana. Her aristocratic family has estates outside the city. Sumptuously robed and diademed, she's on her way to dine with her cousin, Lucius Antonius Claudius Dometinus Diogenes, as weighed down by honors as by



Heads meet their bodies centuries after parting—and now await reunion. A fourth-century A.D. citizen proudly wears



the headband of a priest of Aphrodite. The god Apollo and one of the nine Muses, both from the turn of the third century A.D., lie beyond. Clues such as marble texture and workmanship guide restoration of often scattered pieces of a sculpture.

names, a local magistrate with a proud beard and flowing mustache.

They will dine on three low couches, reclining three to a couch in the mosaic-floored *triclinium*, or dining room—she and her cousin, several other worthies, and a couple of “shadows,” hangers-on asked to round out the dining party to nine, the number of the Muses. Only rustics, laborers, slaves, and children dine sitting up, sometimes ballooning their cheeks with food so “you would think they were not so much eating as laying in supplies for the winter,” snorts Clement of Alexandria.

Our elegant diners savor delicacies and converse to the splash of fountains in the peristyle court. Song, dance, poetry, wizard’s tricks, and other entertainment punctuate the courses, while slaves fill and refill the generous cups of wine deep into the night.

This night will pass, and endless others through the following centuries. Imperial decay and the decline of pagan rite and revel will toll a slow death knell for Aphrodisias. Without its goddess and the arts of sculpture, the city will fade into oblivion. In Byzantine times it will be renamed Stavropolis, “city of the cross.” It will suffer religious strife, plague, invasion, flood, and earthquake. By the 13th century Seljuk raids will leave the site desolate.

Yet the richness of the well-watered plateau attracts settlers once again. They build their makeshift houses above the ruined porticoes and colonnades. The Turkish village of Geyre brings the turbulent history of Aphrodisias into our own times.

WHILE I have been standing on the acropolis hill, it has become the 12th hour of the Roman day (the Romans divided the time from dawn to dusk into 12 hours, each hour shorter in winter than in summer). Deepening shadows draw a purple curtain over the plazas. In the golden afterglow the ancient city falls silent.

As I slowly walk back down the mound, I think back on my two decades at Aphrodisias—seasons of toil, trial, frustration, despair, elation. I treasure the camaraderie of colleagues and students who have shared the joyous moments of discovery and the interminable labors and discomforts between, treasure the trust of the villagers who have

become my friends as well as skilled and loyal workers.

I recall light moments: the time when Martha Joukowsky burst out of the pottery shed shrieking, “A rat! A big rat!” She, her daughter, Nina, and a colleague would leaven their labor classifying thousands of sherds with peals of laughter and music from Martha’s cassette player. This time she was playing a Rachmaninoff concerto. And whether that, or her cries, scared it off, ever after we called the beast Ratmaninoff!

I recall hardships and dangers: the August night we were jolted out of bed by a quake. Floors and roofs creaked; our lamps



Tokens of everyday life help enlighten the eras frozen in layers at Aphrodisias. A bronze Byzantine coin picturing Christ (top) was probably dropped by a mid-11th-century shopper.

A bath patron in Roman times enjoyed

swayed. Following the villagers' example, we set our beds outside and spent long nights watching the magnificent spectacle of stars—apprehensively, until the upland coolness drove us back to our rooms.

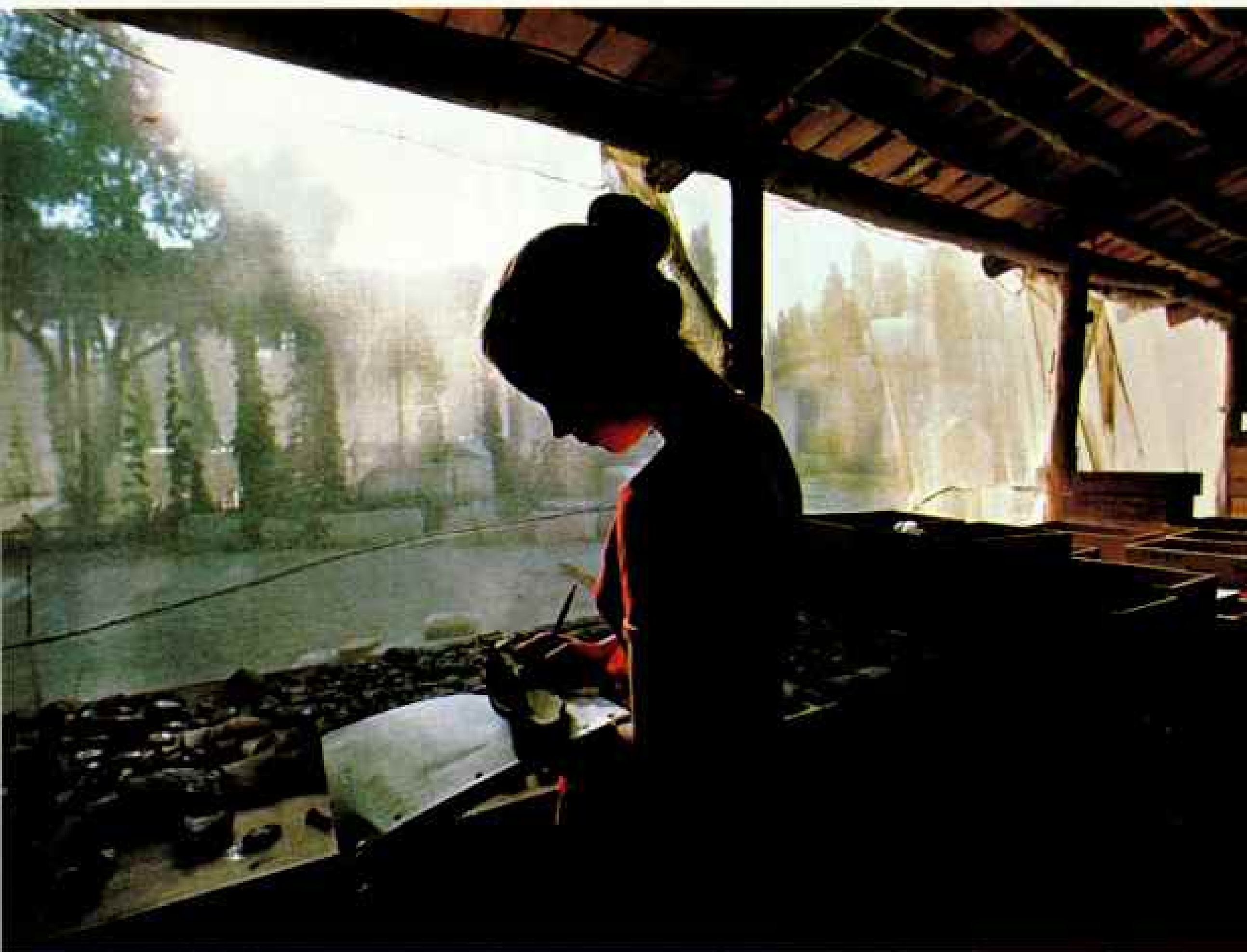
And yet, with the poet Martial, I find:

*. . . if we were to divide
The days by pebbles—on one side
Black, on the other white—the higher
Heap would be bright*

Why do I keep returning here? To bring a once great city back to the light of day is a privilege given but to few. We are excavating this city for science—yes, to increase

knowledge of its buildings, inscriptions, and its art. But also to share with people the human experience of Aphrodisias.

In a letter carved on the theater wall 20 centuries ago, the future emperor Augustus said: "I have selected this one city from all of Asia as my own. . . ." From the first marble sculpture I drew from the earth here 20 years ago—the head of a woman symbolizing the city—to the latest stunning find—the Sebastelion honoring emperors of Rome—our destinies, the city's and mine, have seemed strangely intertwined. In humble echo of those imperial words, I too have selected this city as my own. * * *



a refreshing splash of perfume or unguent poured from a glass vial (above left).

Cataloging human presence on the site to 5800 B.C., volunteer Nina Joukowsky (above) studies one of the hundreds of thousands of excavated potsherds. Most

of the prehistoric collection dates after 4500 B.C., the late Chalcolithic period, when continuous settlement appeared. Obsidian, shells, figurines, and carnelian beads give evidence of contact reaching into the Aegean.



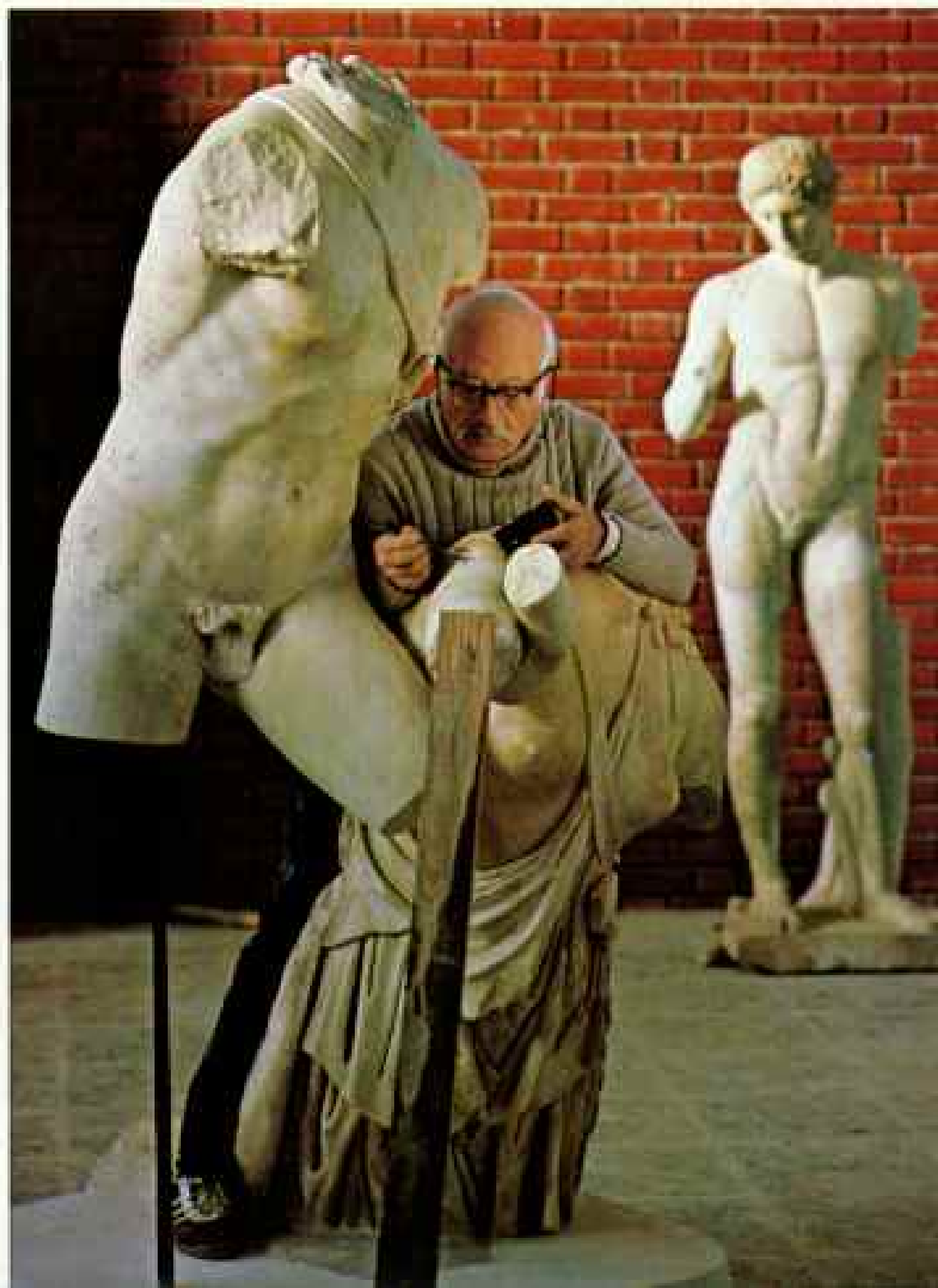
SKILLED HANDS RESTORE BODY AND SPIRIT

HEALING THE WOUNDS of the city's ancient marble survivors—beset by limb-wrenching quakes and assaults by zealous Christians—has demanded surgical improvisation in isolated Aphrodisias.

Bonds that might baffle Houdini suspend a fourth-century A.D. priest in an old storage depot (left) to allow a cement glue to fuse his body to his feet and pedestal. Earlier operations repaired his cracked neck and torso.

Workmen strain to delicately reposition the upper body of Nike, goddess of victory (right, top), carved for the theater in the late first century B.C. She grasps a fragment of a trophy, the armor of a defeated enemy hung on a tree.

Today restoration proceeds in the Aphrodisias Museum built by the Turkish government and the National Geographic Society. Preparing for the museum's 1979 opening, restorer Reha Arican (right) gives artistic first aid to the fallen Amazon queen Penthesilea, under the thrall of her now decapitated and legless slayer, Achilles. This moment of drama from the Trojan War, sculptured in the second century A.D., graced the Baths of Hadrian. A Greek athlete, modeled for the theater in the first or second century A.D., stands behind on mended thighs. These sculptures were commissioned as reproductions of earlier Greek works. But even as copyists, Aphrodisian sculptors set new standards, infusing tradition with the vitality of their day.







THE GENIUS that could bring marble to the threshold of life created a demand for Aphrodisian sculpture throughout the Roman world. Works have surfaced in Spain and North Africa, and a transplanted atelier thrived in the city of Rome. At a time when few artists signed their sculpture, many Aphrodisians proudly engraved theirs.

The flair for detail and subtle handling of marble texture emerges powerfully in a close-up of a figure from the late first or early second century A.D. (**facing page**). Seated and half-draped, he holds a pose traditionally used for poets and philosophers.

The highly polished surface of a left hand clasping an inkwell (**left, below**) reflects the style preferred in the mid-fourth century A.D. Unearthed in a sculptors' workshop, the hand belongs to an unfinished statue of an educated man—a status indicated by the inkwell and an accompanying sculptured box of papyrus. The right hand would have held a pen.

The translucent glow of a late fifth-century A.D. image of the sun-god, Helios (**left, above**), bespeaks quality of workmanship even toward the twilight of the sculptors' long reign.







GUARDIANS OF THE CULT, influential citizens of Aphrodisias were honored to serve as priests and priestesses of Aphrodite. A priest of the late first century A.D. (left) wears a diadem bearing the remains of a bust of the goddess. Traces of paint, perhaps once covering all sculpture, tint the hair of an early second-century A.D. priestess (above). A sculptor of a later time incised her pupils.



SPIRITED SUPPORTERS of the arts, Aphrodisians enjoyed mime, musical ensembles, readings, and lectures in a small marble concert hall called an odeum (above). Notables might have been seated beside an armrest carved as a dolphin, at right. The city council also met here. The wealthy eagerly donated buildings



and decorative sculpture. Portraits were commissioned to honor family, friends, and benefactors. *Flavius Palmatus* (left, bottom), a late fifth-century A.D. governor of the province of Caria, which included Aphrodisias, continued the patronage expected of his office. Sporting a five-o'clock shadow, he sat only for a head sculpture that was inserted

into a precarved body. Cement now rejoins his fractured neck.

Citizens below the aristocracy, like a market overseer of the early third century A.D. (left, top), also posed for posterity. Though unable to afford the talents of a master, the overseer has nevertheless achieved immortality in a sculpture on his tomb, damaged by fire.



THE OLD GODS SMILED on Aphrodisias in 1979, when a chance find led to the discovery of the imposing Sebasteion. A fragment of a marble relief panel pulled from an old Geyre house proved to match a panel section found in the area years earlier. Test trenching revealed more

panels, one depicting the emperor Claudius (41-54 A.D.) conquering Britannia, symbolized by a woman (*below*).

Ultimately, the base of a three-storied columned portico came to light (*above*). Clearing a 14-meter-wide stone walkway, excavators struck a facing north portico.





A WALK OF SPLENDOR

GLORIFYING the first imperial Roman dynasty and dedicated to Aphrodite, the south portico of the Sebasteion rose in the mid-first century A.D. This artist's rendition re-creates one section of the facade, known to stretch at least 60 meters. Evidence shows that relief panels between first-level columns hailed mythical characters, like the three Graces, companions of Aphrodite. The second story lauded the emperors and their domains: Here Gé, the earth, offers her power to a figure symbolizing Rome. Coffered panels with flowers topped the facade.

The south portico's colonnade faces the less excavated north portico; both probably lined the way to a main altar or temple. Rooms excavated in the south portico may have held individual shrines. Few such monuments, also called *Kaisareia*, are known. When earthquake and fire toppled the Sebasteion, its sculpture had already felt the wrath of Christian reformers.

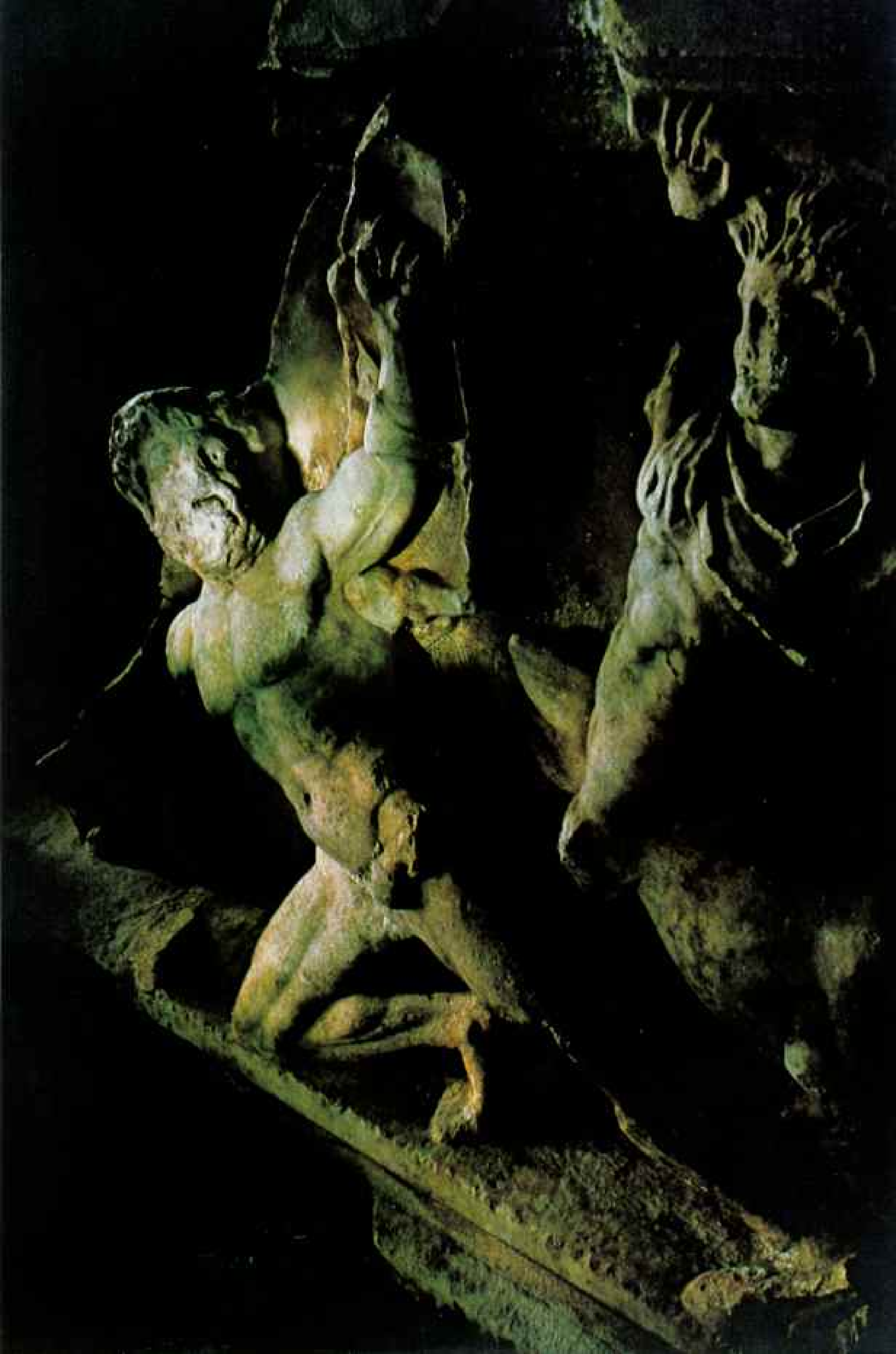
DRAWING BY RICHARD K. ANDERSON, JR., AND
NATIONAL GEOGRAPHIC ARTIST WILLIAM H. BONE

APPLAUDING VICTORIES of the empire, politically loyal Aphrodisias perpetuated its status. Commissioned for the second story of the Sebasteion, a woman weeping below a trophy (below) represents a people subdued by Rome.

Aphrodisians often resurrected decorative sculpture from damaged buildings to adorn the new. A marble relief panel of the late second century

A.D. (right) found use 300 years later on a fountain house at the agora gate. It portrays a member of the Lapithae held prone by the hoof of a now legless centaur. But, as the story goes, in the struggle with the savage race—half man, half horse—the Lapithae prevailed. The mythical conflict symbolizes the triumph of civilized man over barbarism—a battle that Aphrodisians fought with grace and valor. □

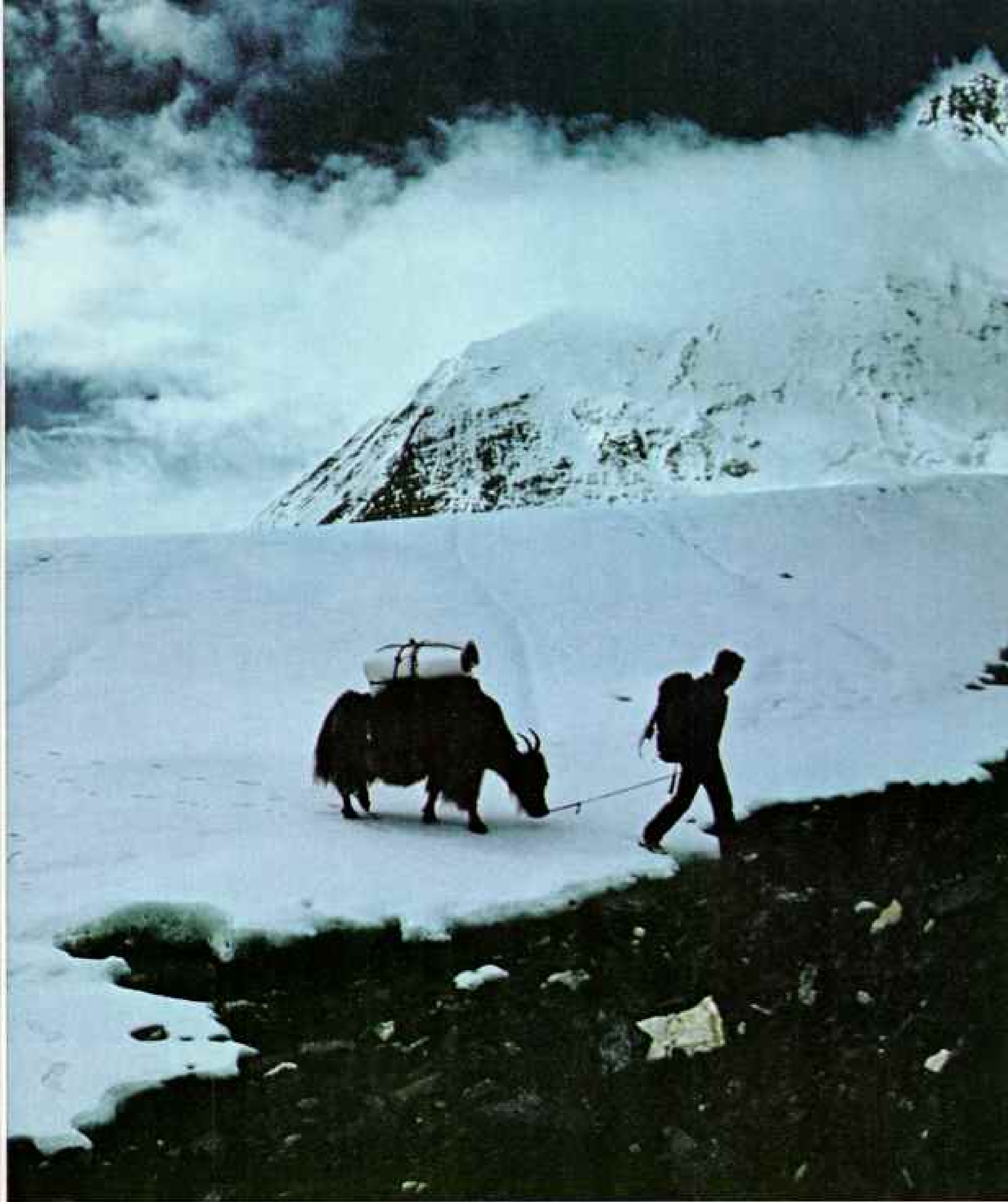






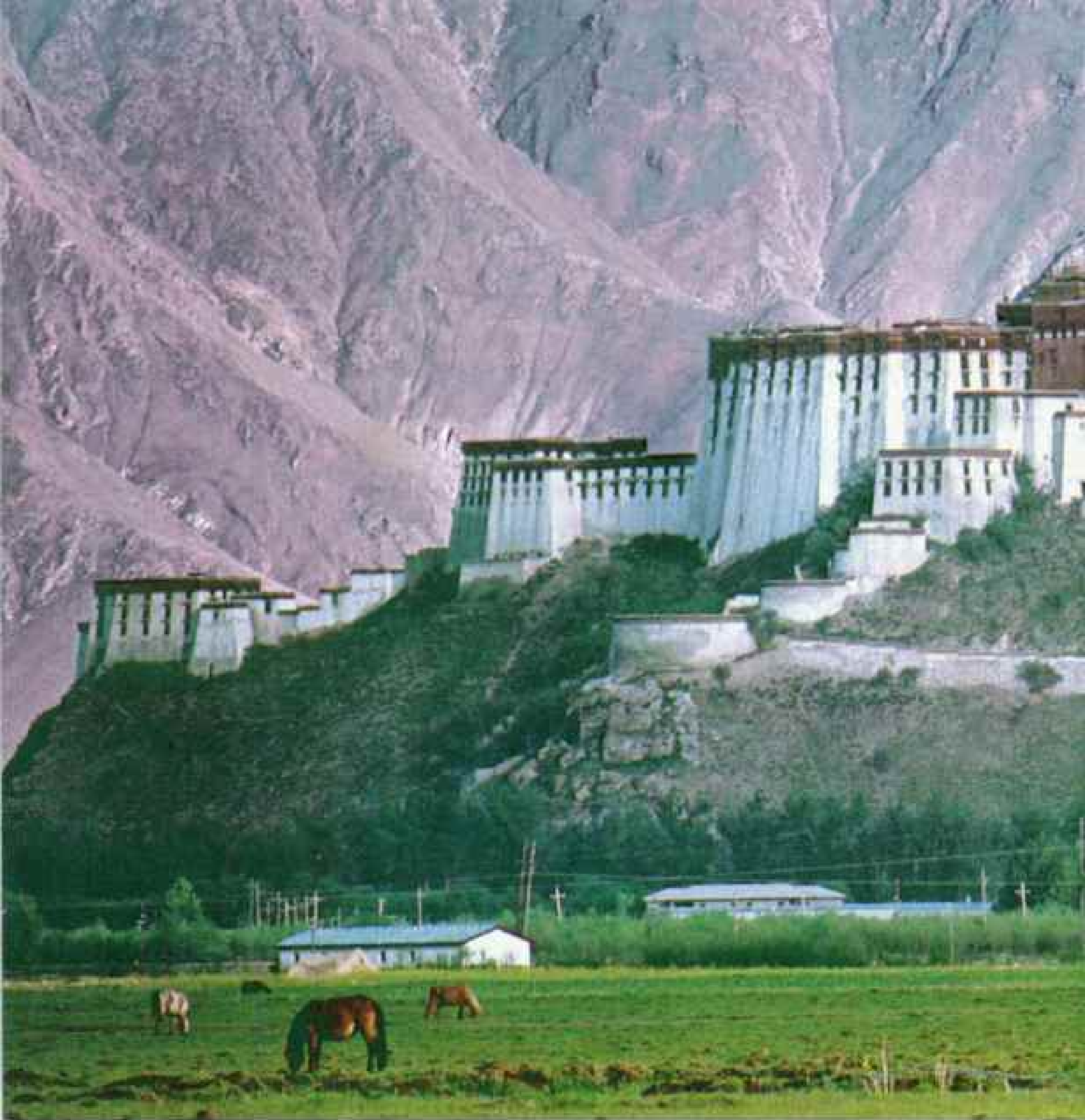
I CLIMBED EVEREST ALONE...

At My Limit



Yaks carry gear to the flank of the highest mountain for a unique achievement in the annals of mountaineering – a solo ascent without oxygen.

By REINHOLD MESSNER
Photographs by the author
and NENA HOLGUÍN



Barred gateway to Everest's northern slopes swung open in 1980, when for the first time since 1950 China allowed Westerners to tackle the mountain from Tibet, with its landmark Potala (above), former palace of the god-king, the Dalai Lama.

Early attempts took this route, including the ill-fated 1924 expedition on which George Mallory and Andrew Irvine died. Most were large-scale efforts—and all failed. Attempts after 1950 set out from Nepal, and in 1953 a British expedition placed Edmund Hillary and Tenzing Norgay on the top. The first U. S. success,

sponsored by the National Geographic Society, put six men on the summit in 1963.

Author Reinhold Messner, a native of the South Tirol, and Peter Habeler scaled the peak in 1978 without bottled oxygen. After the Tibetan route reopened, Messner (right, at right) and Canadian climber and journalist Nena Holguín arrived in the summer of 1980 on the heels of two successful Japanese teams. Messner and Holguín established High Base Camp at 6,500 meters (21,325 feet). She manned the camp while he set off for the summit without even radio contact.



MONA WOLFE/IN (BELOW)





AS MORNING lit up the mountain Tibetans call Qomolangma—"goddess mother of the world"—I was able to recognize every jagged formation along the Northeast Ridge. Here George Mallory and Andrew Irvine were last seen during their brave summit endeavor in 1924.

Now I was bound for that summit, following their route. But I climbed alone.

Two years earlier I had stood atop Mount Everest with Peter Habeler, on the 1978 Austrian Everest expedition. That was a typical large-scale effort, from Nepal on the south side of Everest. What had made it unique was that Peter and I climbed the 8,848-meter (29,028-foot) peak without the assistance of bottled oxygen. Even so, we had been aided by Sherpa porters up to the South Col at 8,000 meters.

This time there were no porters. No fellow climbers. No bottled oxygen. No radio. I was attempting the greatest challenge, to me, in mountaineering—to climb the highest mountain on earth completely on my own.

The British were the first to attempt Everest. Using rudimentary equipment, Mallory and his friends reached the 8,000-meter mark for the first time in mountaineering history in 1922. After Mallory and Irvine died on the mountain two years later, efforts continued from the Tibetan side, until the Chinese closed Tibet to Westerners in 1950. In time many climbers grew convinced of the necessity to carry oxygen. Finally in 1953 Edmund Hillary and the Sherpa Tenzing Norgay scaled Everest—from Nepal, with oxygen.

The Chinese reported they climbed the mountain by way of the North Ridge in 1960. And in 1975 they put nine people on the summit, planting a tripod there as proof. Then the Chinese opened the borders in the spring of 1980, and two Japanese teams reached the top from the Tibetan side.

Tibet, a land I had dreamed of. The endless space, the pastels of the mountain chains—I found these captivating as I jounced across the barren landscape by jeep with my friend Nena Holguín, a Canadian



WERNER HOLSINGER (ABOVE)

An icy trap almost ended Messner's solo push soon after a 5 a.m. start from High Base Camp, when a snowbridge leading to the North Col (above) collapsed, dropping him into a crevasse. A tiny ledge stopped his fall; painstakingly, Messner kicked

steps out of the abyss. As deadly as crevasses, exhaustion soon became the overriding challenge of a two-and-a-half-day ascent that required two bivouacs (below). The climber spent a third night at the upper site on his descent.





Walking dreams trudged beside Messner as altitude and fatigue took their toll. At times he shared food with an imaginary tentmate, conversed with his rucksack, and looked on his ice ax as a companion. Here, he pushes off on his second day,



to face deep snow and threatening fog. At 8,250 meters (27,065 feet) he will pitch his tent for another long night.

mountain climber and journalist who helped me write this record of events and impressions. Captivating, but tinged with melancholy: the Potala in Lhasa, former palace of the Dalai Lama, its 1,000 rooms drained of life; Rongbuk Monastery, where 400 monks once lived under the gaze of Everest, roofless, frescoes crumbling.

IN MID-JULY Nena and I moved up to 6,500 meters and established High Base Camp. From here, in 5 a.m. darkness on the 18th of August 1980, I set out on my greatest adventure.

Minutes later it almost ended in disaster. I was crossing a snowbridge over a crevasse. Suddenly it went, crumbling into powder and chunks of ice.

I was falling—falling into the deep. It felt like eternity in slow motion as I bounced back and forth off the crevasse walls. In the next moment I came to a sudden stop. Or had it been minutes? My sense of time had vanished. My headlamp, fastened to an elastic strap around my woolen cap, no longer functioned. Blackness surrounded me. “My God! Perhaps I will die down here!”

I peered up through a gap no wider than a tree trunk and caught a glimpse of stars twinkling overhead. If only I had brought the walkie-talkie! I could have called Nena, who was lying in the tent just 500 meters below. Nena could have climbed up with a rope to assist me.

I fumbled with my headlamp. As it flashed on, the walls of ice shimmered a dark blue-green. They were two meters apart where I stood, but nearly joined at the top. The snow platform that had halted my fall was no more than a meter square. I tried to illuminate the dark empty space below. There seemed no end to it. I became acutely aware that if the platform collapsed beneath my weight, I would hurtle into the abyss. No time to rummage in my rucksack for crampons to strap onto my boots.

Survival instincts surfaced. I quickly sought escape from the icy prison. A steep, narrow ramp angled up along the wall. With ice ax in one hand and ski pole in the other, I moved up the ramp, carefully balancing, kicking step after step in the ice, until I reached the lip of the crevasse, still on the downhill side.

As if in a trance, I walked back in the clear, crisp dawn to the hole through which I had tumbled ten minutes earlier. The bridge that had broken had carried me safely four weeks earlier on a reconnaissance trip up to the North Col, a saddle at 6,990 meters (22,930 feet). This had been the best place to cross the crevasse that diagonally splits the 300-meter-high ice wall under the col.

On this solo expedition I had neither aluminum ladder nor rope. My only climbing hardware were ski poles and an ice ax, plus an ice screw and a rock piton for holding my tent, or even my body, to the ground in case of a severe storm.

Beyond the crevasse the snow formed a steep wall. Driving my ski poles high into the wall as an anchor, I swung across.

THE FIRST RAYS of the sun were brushing the top of the North Col as I worked my way up the remaining 50 meters. Far to the east I could see massive Kanchenjunga protruding above a blanket of clouds, a majestic sight. I glanced at my watch. It was just 7 a.m. Only two hours after leaving Nena and our camp, I stood on the saddle. Despite my fall into the crevasse, I had managed to beat the record time of Mallory over the same ground.

Around 9 a.m. the altimeter indicated 7,360 meters. "Making good time," I thought, as I climbed over the rolls and bulges that form the lower part of the North Ridge. Now and then I would push through pockets of ankle-deep powdery snow collected by the wind. Snow swirled about my head. Gusts of wind began to sap my energy.

At 7,500 meters I could feel myself slowing considerably. I must not become exhausted, I told myself. The next two days would be far more strenuous.

As I followed the safest route up the ridge, I found a length of red rope. It emerged from the snow near a large rock and disappeared a meter farther up. Quite new, it undoubtedly was left by the Japanese on their 1980 ascent. In usual large-expedition fashion, they would have fixed a rope over steep passages between camps to assure safe, rapid ascent or descent. We had done the same during our 1978 expedition on the south side, for our party was also large—11 climbers and 25 Sherpa high-altitude porters.

My method this time differed immensely. The solo climber, alone against the elements on a Himalayan giant, is like a snail. He carries his home on his back, and moves slowly but steadily upward. No relays. No ferrying up of supplies. No setting up a series of camps higher and higher. No assault team kept well rested for the final push.

Everything I needed—tent, sleeping bag, stove, fuel, food, climbing equipment—had to go on my back. I would put up my tent for sleep, and then pack it and take it with me the next day. There was no one to carry a second tent, and I was not using oxygen, which could have given me more strength. The oxygen apparatus is too heavy for an Alpine-style ascent, a single push for the summit. Also my own theories rule out its use. I want to experience the mountain as it is, and truly understand how my own body and psyche relate to its natural forces. By using an artificial oxygen supply, I feel I would no longer be climbing the mountain towering above me. I would simply be bringing its summit down to me.

UNDER THE WEIGHT of my 15-kilo (33-pound) rucksack, I now found difficulty in breathing. Every dozen steps or so, I would stop and gasp for breath. My mind was drifting. The intervals between rest pauses became shorter and shorter. I would sit down, and then find it nearly impossible to rise again. Somehow I kept going. It seemed that there was somebody behind me giving me the needed courage. Step by step I pushed myself onward till I reached 7,800 meters.

I found a spot to my liking and trod down the snow until its surface was firm. This preparation for bivouac drained me. I didn't have the strength to pitch my tent. I sat to unpack my rucksack, looking down to the camp I had left at five that morning. I could see a small red dot. Nena must have draped the red sleeping bag over the roof of the tent to insulate herself from the intense heat down in that narrow glacial valley.

Even up here at this altitude, the heat caused more problems than the cold. In 1978 I had to bear temperatures as low as minus 40°C. Now, instead, the sun was drying me out. My throat felt parched, burned. Remembering that I carried a tiny plastic

tube of Japanese herbal plant oil, I placed two drops on my tongue. They gave instant but brief relief. This oil, and aspirin, and a couple of sleeping tablets were the only medications I carried.

Nena could surely see me with her telephoto lens. I hoped she wasn't too worried. I had explained to her that there shouldn't be any problem if I was able to climb 1,200 meters the first day. That I had managed and more, so my confidence was high in spite of my exhaustion.

My tent was made to withstand winds up to 100 kilometers (60 miles) per hour. I had difficulty pitching it. The wind, gusting to perhaps 80 kilometers, kept heaving it into the air. At last I secured it with the ski poles, the ice ax, and the rock piton, spread the finger-thick polyurethane mat on the floor, and crept inside.

THE TENT was barely large enough for me to curl up in. I lay listening to the wind, which blew ice crystals against the tent wall. It came from the northwest—a good sign. I should have begun cooking but couldn't bring myself to do it, although I had eaten nothing since morning.

My thoughts drifted to Maurice Wilson, a religious zealot who had dared a solo ascent of Everest in 1934, although he was not a mountain climber. Convinced that God would guide him safely to the top, he didn't give up even after terrible snowstorms and several plunges. When he crept back to camp after a four-day struggle to reach the North Col, his two Sherpa porters tried to persuade him to abandon his attempt. But as soon as he was able to stand, he tried again, like someone possessed. A year later his corpse was found below the North Col. The last legible words in his diary read: "Off again, gorgeous day."

Was I, possessed by an idea that not even many mountain climbers understood, just as crazy? I had already climbed Everest once. This time I was determined to make it alone, without oxygen, and attempting another route. To me, that made it a different mountain, a different challenge.

"*Fai la cucina*—do the cooking." It seemed somebody next to me was reminding me to light the stove. I was talking to myself, of course. But for several hours I had a

strong feeling that I had an invisible companion. I spoke only in Italian, although as a native of the South Tirol my mother tongue is German, and since the beginning of the journey two months before I had been speaking English with Nena.

I shoved dried meat, cheese, and bread into my mouth. Just those small movements were exhausting. "I must begin the cooking," I told myself. I needed to drink at least four liters of water a day; to dehydrate could be fatal. The tent was fluttering wildly in the wind. I opened the flap enough to scoop some snow with the lid of my pot. In that instant the flame of my gas stove blew out. "It will be a bad night," I thought as I relit it.

It is hard to imagine how much snow and time and effort it takes to produce a single liter of water at such altitude. I just lay there, holding the pot, forcing myself to fill it again and again with snow. Into the first potful of water I mixed dried tomato soup. The next two I used to brew the Tibetan salt tea that nomads had taught me to prepare with a handful of herbs and two pinches of salt.

The cooking done, I lay in the sleeping bag with my clothes on and dozed. When I

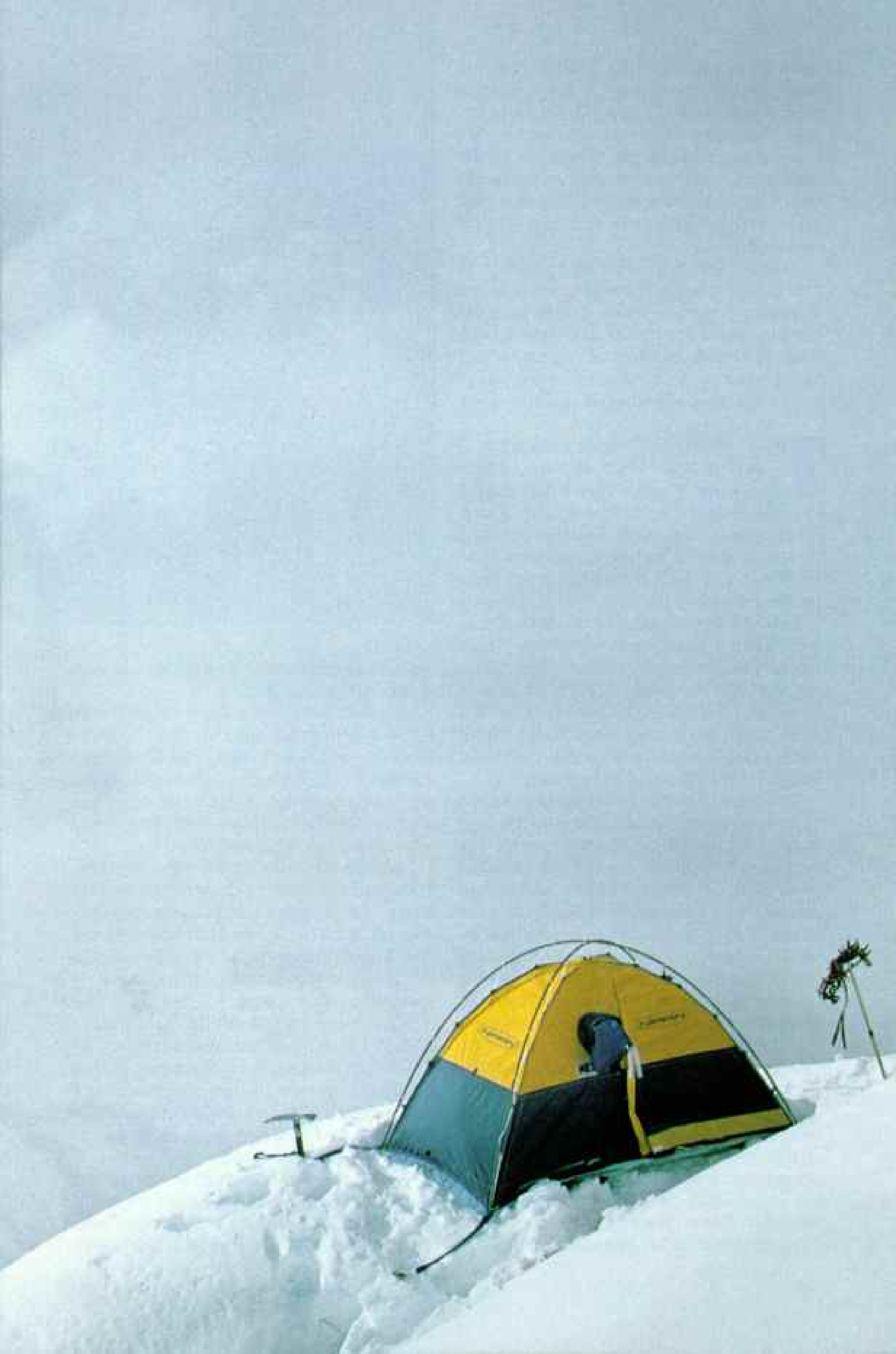


In a do-or-die chore, Messner struggles to melt a panful of snow for drinking water. At this high altitude, dry, thin air increases the peril of dehydration, and makes even this simple act difficult. Arranging the camera for a self-shot is a well-nigh-impossible feat.



Cocoon of life, Messner's tent held the key to survival at highest bivouac (right). With superhuman effort, he pitched it in a gusting gale, then settled in for a night uneasy with fear and noisy with a tattoo of wind-hurled ice crystals. He slept with boots on to minimize the danger of frostbite, which had claimed most of his toes on Pakistan's Nanga Parbat in 1970, an expedition that took his brother's life.

At each bivouac Messner lightened his load (above). Extra food and gear stayed at the first site. For the final climb, even the rucksack was left behind, for Messner's strategy, relying on his 30 years of experience, called for an Alpine-style ascent, a dash to the summit and a quick return. On the final morning, approaching clouds posed a dilemma: Should he risk going up in a possible storm or go down in defeat? He pushed on.



opened my eyes, I didn't know whether it was evening or morning. I didn't want to look at my watch. Deep inside I was frightened. Not only of the present situation. My fear encompassed all my 30 years of climbing mountains: the exhaustion and desperation, and the thundering avalanches. These sensations spread over me and merged into a deepening fear.

I knew what could befall me up there, and how great the drudgery would be just below Everest's summit—when it was tantalizingly so near and yet so far. Had I not known what to expect and how to cope with it, I could not, hour by hour, step by step, have done what my body rebelled against.

THE MORNING SUN on August 19 hit my tent and began melting the frost on the inner walls. Slowly I packed. I decided to leave behind two cans of sardines, a gas cartridge, and half the soups and teas to lessen the torture of my load. The weather was good. I knew I had to reach the top the following day.

I moved very slowly for the first 50 meters. Then I swung into my rhythm once again. I felt fresh in the clear, crisp morning air. Not for long. Within an hour I was wading through knee-deep snow as I approached the steeper slope of the North Ridge. This reaches up to join the Northeast Ridge 455 meters below the summit.

Convinced I would be forced to abandon my attempt soon if I had to climb in the deep snow, I searched for an alternate route. The vast snow area of the North Face extended to my right. Several avalanches recently had poured down its flank. With the fresh snow swept away, perhaps the surface would be hard. It was my only chance. Climbing gradually with each step, I began the long crossing to the Great Couloir, first reached by British climber E. F. Norton in 1924.

Sometimes I broke through the crusty ice. Other times my boots barely gripped the surface. Concentrating on each step, I failed to notice the weather turning bad.

At three in the afternoon I was some 200 meters from the couloir, thinking of nothing beyond this world of white. The world below seemed a distant planet. I checked my altimeter. Damn! It read only 8,220 meters. I was frustrated at my progress. Worn out. I



wanted desperately to find a bivouac site. But I could see none.

One hour later, on a snow-covered rock ledge, I managed to pitch my tent. I wanted to photograph myself there. But I hadn't the strength to screw the camera onto the ice ax, put it on automatic, go back ten steps, and wait for the click. Far more important was to prepare something to drink.

I kept on my bulky double-layered plastic boots as I lay there in the tent. They were damp from perspiration. If I took them off, they could freeze. I dared not become careless. I measured my pulse while I was melting snow; it was racing—far more than a hundred beats a minute.

What if the fog did not lift by morning? Should I wait? No, that was senseless. At this height there is no recuperation. By the day after tomorrow I would be so weak that I could never advance toward the peak. Tomorrow I had either to go up or go down. There was no other choice.

The morning of August 20 was clear, but clouds were closing in. I strapped my crampons to my boots and took my camera over my shoulder and my ice ax in one hand.



Everything else I left in the tent. After a short time I missed my rucksack. It was my friend, my partner. I had conversed with it. It had edged me on when I was exhausted. Without it, however, the journey was easier—much easier. Besides, my second companion, the ice ax, was still with me.

Lack of oxygen in the blood circulating to my brain probably caused these hallucinations. I had encountered them in 1978 on my solo ascent of Nanga Parbat in Pakistan. Here, near the top of Everest in 1933, the Englishman Smythe had offered a snack to his imaginary partner.

The journey into and up the Great Couloir was physically taxing but technically not too difficult. Having studied reports of early British expeditions, I felt I had climbed here before. This helped me find the one feasible route: a snow gully leading to a steep step, interspersed with rock. After a while soft snow slowed my pace. I climbed on hands and knees, like a four-legged animal, sluggish and apathetic. A dark rock wall blocked the path. Something pulled me to the left. Making a small loop, I bypassed the obstacle.

I now stood just below the peak. The fog

Eclipsing all predecessors, Messner gains the summit on the third day, August 20, at 3:20 p.m., and plows toward a tripod left by Chinese climbers in 1975. Through heavy cloud cover, fleeting glimpses of the world below are his reward. Leaden and spent, he stays only 40 minutes.





REINHOLD MESSNER

Agony of victory overcomes Messner back at High Base Camp, where Holguin treated him for heat exhaustion and dehydration. First came tears, then the story of the ordeal, told in a flood of memory. Along with Messner's story came the realization that he had pushed himself as far as he could go, learning, as British poet C. Day Lewis wrote:

*"Those Himalayas of the mind
Are not so easily possessed:
There's more than precipice
and storm
Between you and your Everest."*

Reinhold Messner scaled the rock and ice, but also climbed the ranges of his inner self to succeed.

was thick, and I could hardly orient myself. The next three hours seemed to pass without notice. I climbed instinctively, not consciously. The clouds opened for brief moments, giving fleeting glimpses of the peak against the blue sky.

Suddenly I saw the aluminum tripod! There it was—the blessing of proof, the curse of desecration, on that supreme place of solitude—barely peeking out of the snow, a piece of cloth frozen around the top. The Chinese had anchored it at the highest point in 1975 to make exact measurements.

I sat there like a stone. I had spent every bit of strength to get there. I was empty of feeling. I needed to take several pictures. Each required monumental effort. Patches of blue sky graced me briefly, then clouds closed in once more and swirled about as if the whole earth were pulsating. For the second time I had reached the highest point on earth, and once again I couldn't see anything. This time it simply didn't matter.

I STILL DO NOT KNOW how I managed to achieve the summit. I only know that I couldn't have gone on any longer. Slowly I rose and began the descent.

In three and a half hours I was back at my bivouac site at 8,250 meters. I tried to prepare soup, but got only as far as pouring the melted snow into my water flask. I hadn't the strength to drink. I didn't sleep during

the night. Neither was I totally conscious. At the crack of dawn I heated the water and added some tea leaves. But as quickly as I swallowed the drink, it came back up. It was hopeless.

At 7:30 a.m. on August 21, packing only my camera, extra woolen mitts, and a second pair of sunglasses, and leaving everything else behind, I set out. My rucksack prodded me on, hardly allowing me to rest a moment. I moved downward and across the North Face, aiming for the North Col.

Choosing this direct route, I remained hidden from Nena's view until 10:30 a.m., when I reached the crest of the North Col. I no longer had my wits about me. Nena said I looked like a drunken man descending from the col. She knew I needed help. As I came across the glacier near High Base Camp, she was there to meet me.

Tears were the only possible release for me—tears of relief to be back to the safety of our camp. Within minutes I lay in the tent while Nena applied ice packs to my forehead for the heat exhaustion I had suffered and poured can after can of fruit juice into my dehydrated system.

After ten minutes I began to regain my senses. The story came pouring out of me. Nena asked about the possibility of my soloing another 8,000-meter mountain.

I could only answer, "I don't think I could handle it again. I was at my limit." □

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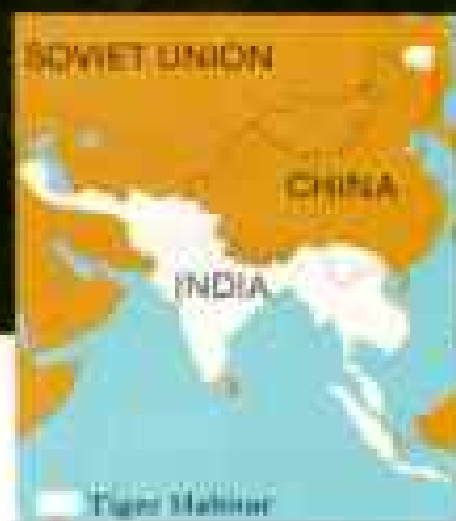
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AUDIOVISUAL: Joanne M. Hess (Chief); Jon H. Latimore (Technical Director); Ronald S. Altman, Robert G. Floegol, Mary W. McKinney, Gerald L. Wiley



Tiger Genus: *Panthera* Species: *tigris* Adult size: 5-6 ft. long with 2-3 ft. tail
Adult weight: Average male, 190kg; average female, 136kg Habitat: Once found throughout
practically the whole of Asia, ranging from the steamy jungles of the tropics to the snowy steppes of Siberia
Surviving number: Estimated fewer than 5,000 in the wild Photographed by Belinda Wright in India.



Wildlife as Canon sees it: A photographic heritage for all generations.

When a work of creation is gone, there is no way to bring it back. If the tiger disappears, we could never bring it back. What a loss it would be.

Its majesty. Its grace. Its eyes that are far more beautiful than the gemstones named after them. How could we let that vanish forever from the face of the earth?

That's where photography comes in.

It is an essential tool for wildlife conservationists in scientific research. So they can better accomplish their task of restoring the tiger to its once vigorous life.

Also, photography opens our eyes to the incredible beauty of wildlife. It helps us see what an amazing work of creation every bird and animal is. It helps us to truly understand. And understanding is perhaps the single most important factor in saving the tiger and all of wildlife.

With photography, the tiger can be recorded for posterity. It would be a precious photographic heritage for all generations.



New F-1

New FD 500mm f/4.5L

Canon
Images for all time.

Announcing...

The Ten Commandments Plate Collection

- Important and beautiful original works of art by the distinguished artist, Mary Mayo.
 - Lavishly hand-decorated with 240 square inches of pure 24kt gold.
 - More gold by far than on any previous Danbury Mint plate collection.
-

Never in Danbury Mint history has gold been lavished to such an extraordinary degree on collector plates! And never before have collector plates honored a subject of greater grandeur or with more artistic majesty!

Here is a collection unlike any you've ever seen — combining with breathtaking beauty *three* of the treasures of our Western civilization!

For here is *gold* — the king of precious metals, prized for its rarity and universal value.

Here, too, is magnificent *original art in the grand tradition of the "old masters"* — art reminiscent of the masterpieces which adorn the world's great cathedrals, museums and houses of worship.

Finally, here is a majestic tribute to the

foundation stone of our great religions and of our civilization itself — *The Ten Commandments*, plus two additional plates in honor of the two greatest teachers of those commandments, Moses and Jesus. (Please turn the page to see more of these plates.)

In all, the collection is a treasure that belongs in every home, *but only a fortunate few will have the opportunity to possess it!*

Hand-Decorated with a Lavish Border of 24kt Gold!

Each of these twelve collector plates will be richly hand-decorated with gleaming 24kt gold — more gold by far than any other plate collection in the history of the Danbury Mint!

From Biblical times to the present day, gold has been one of mankind's most treasured possessions and the ultimate standard of wealth.

(Continued)





Plate shown smaller than actual size of 9¼" in diameter.



Plates shown smaller than actual size of 9 1/4" in diameter.

(Continued)

It is so prized because it is extraordinarily *beautiful* and exceedingly *rare*. Indeed, it is so scarce that all the gold mined since the beginning of time could fit into a single large room!

What's more, gold is *permanent* — it doesn't tarnish, corrode or deteriorate. A gold coin minted in the days when Moses received The Commandments would gleam as brightly today as it did then. Thus gold is known as the *eternal* metal, the medium artists and craftsmen throughout the ages have used to portray and honor the foremost figures and timeless doctrines of the world's great religions.

And now you can bring such golden artistic splendor into *your* home, where you can admire and enjoy it as often as you wish!

Original Works of Art in the Tradition of the Old Masters

For this exclusive private edition, the Danbury Mint has commissioned the distinguished artist, Mary Mayo, to create twelve original paintings expressly and exclusively for this collection.

As few other artists of our day, Mary Mayo has mastered her craft after years of studying the styles and techniques of the "old masters" — giants of classical art such as Rembrandt, Michelangelo and Raphael. Her canvases inspire a profound respect and admiration for such classic, timeless beauty!

Old World Craftsmanship Involving an Intricate Process

Like the original works of art, the production process to make these plates will respect time-honored traditions, employing the most expensive materials, highest standards of excellence, and patient hand-craftsmanship at every stage.

The plates will undergo a painstaking process of *five separate firings*: one to bake the china... a second to glaze it... a third to bond the radiant colors of the original art... a fourth to apply the beautiful "Old English" lettering along the rim identifying each plate... and, finally, a fifth to seal the luxurious gold border, which a skilled artisan has lavishly hand-painted onto each plate using a brush dipped in *pure liquid gold*!

A five firing process is exceptionally *rare* in the production of fine collector plates, and is a measure of the unsurpassed importance of this collection!

A Limited Edition Available only by Advance Reservation

The Ten Commandments Plate Collection will be available exclusively from the Danbury Mint. No plates will be sold separately and none will be available in stores. The size of the U.S. edition will be forever limited to the exact number of collections reserved by the final deadline, December 31, 1981.

Convenient Acquisition Satisfaction Guaranteed

To reserve your *Ten Commandments Plate Collection*, simply complete the attached reservation application. There is no need to send payment now. Your twelve plates will be issued at the convenient rate of one every two months.



You will be billed for each plate in two equal monthly payments of only \$27.50 each.

If you receive any plate you are not completely satisfied with, you may return it upon receipt for replacement or refund. And you may discontinue your subscription at any time.

Act Promptly to Avoid Disappointment

This is truly a unique chance to assemble your own private gallery of classic art, richly embellished with an unprecedented *240 square inches of pure, 24kt gold*! To avoid disappointment, return the attached reservation application today!

RESERVATION APPLICATION H41

The Ten Commandments Plate Collection

The Danbury Mint
47 Richards Avenue
Norwalk, Conn. 06856

Must be
postmarked by
December 31, 1981.
Limit: One set per subscriber.

Please accept my reservation application to *The Ten Commandments Plate Collection*. I understand this is a limited edition of twelve original works by artist Mary Mayo lavishly hand-decorated with 24kt gold.

I need send no money now. The collection will be issued at the rate of one plate every two months. I will pay for each plate as billed in two convenient monthly installments of \$27.50 each. Any plate I am not completely satisfied with may be returned upon receipt for replacement or refund, and this subscription agreement may be cancelled by either party at any time.

Name _____

Address _____

City _____

State, Zip _____

Check here if you want each monthly installment charged to your:

Master Card

VISA

Credit Card No. _____

Expiration Date _____

Signature _____

Allow 8 to 12 weeks after payment for initial shipment.

Myth:

All freight carriers compete on an equal basis.

Fact:

Public subsidies for trucks and barges throw competition out of balance.

You, as an individual, pay part of the cost for everything shipped by truck or barge—whether you use it or not.

The public roads and highways—the rights-of-way for heavy trucks—are built and maintained primarily by money collected from drivers of passenger cars and light trucks. If a product travels by barge, it moves through locks and dams and over waterways built and maintained almost entirely with your tax dollars.

Nearly all of America's freight railroads build, maintain and pay taxes on their track and rights-of-way, and these costs are paid from dollars earned by the railroads. As a result, it costs the railroads 34¢ out of every dollar of revenue for track and rights-of-way, compared to the 5¢ paid by trucks and the .003¢ paid by barges, neither of which amounts to a fair share of costs.

All transportation has received government assistance at one time or another. The freight railroads, however, have reimbursed the government for most prior aid. Much of the current aid to some railroads is in the form of loans to be repaid with interest. On the other hand, trucks and barges have long received outright subsidies.

All forms of freight transportation should pay their full costs of doing business. When they do, the American people will receive the most economical transportation services—and a needless burden will be lifted from the motorist and taxpayer.

For more information, write: Competition, Dept. 5, Association of American Railroads, American Railroads Building, Washington, D.C. 20036.

Surprise:

Rights-of-way costs are heavy for America's freight railroads; motorists and taxpayers carry most of the burden for highways and waterways.



Members Forum

MOUNTAIN GORILLAS

As conservationists working in the Parc National des Volcans of Rwanda, we are disturbed by Dian Fossey's inclusion of "tourist presence" among the factors she lists as contributing to the demise of the mountain gorilla. No other single factor has done so much, in so short a time, to improve the chances of survival for the park—and hence gorillas—as the increase in park revenue, which is due solely to tourism.

J. P. von der Becke
C. Aveling

M. Condiotti
A. H. Harcourt
R. J. Aveling

Parc National des Volcans, Rwanda

SOLAR SYSTEM

The name of Earth's moon is Luna. Why has one of the most prominent celestial objects become unknown? Has Luna gone loonie?

Pat Dimmick
Cheshire, Connecticut

Our moon is an orphan; no official name has been approved by the International Astronomical Union—neither the Latin name for our satellite, Luna, nor the more common "moon," an ancient word related to month.

METRIC SYSTEM

The wonderful map "The Solar System" and article on Saturn were lost to me and, I'm sure, a lot of other people. I could do no more than look at the pictures, feeling a sense of bewilderment because I cannot understand kilometers.

Rev. George R. Ingham
Oswego, New York

This is the United States, and we are not giving it up for all the boneheads who believe they can push the metric system down our throats.

Raymond K. LeClair, Sr.
Old Tappan, New Jersey

The voyage to Saturn was measured entirely in metric by the scientists involved; our account therefore was generally in metric, but contained equivalents in the English system we are used to. Ever since the U. S. government decided to move toward metric in 1975 and join most of the rest of the world in the way things are measured, publishers have found themselves betwixt and between. We use metric when it is advisable and appropriate, as in science articles, but include enough equivalents to enable easy translation.



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You've saved and worked hard to buy your first house. Now you want to be around to enjoy it.

So if you have high blood pressure, don't take chances. Take your pills, control your weight, cut down on salt. Do whatever your doctor prescribes.

You can control your high blood pressure if you stay on your treatment every day, no matter how you feel.

High blood pressure. Treat it and live.

National High Blood Pressure Education Program.
National Heart, Lung, and Blood Institute.
U.S. Department of Health and Human Services.

INDEX AVAILABLE

I took advantage of your free magazine index offer for the July to December 1980 issues and was thrilled with it. Could you tell me when the next index will be ready?

Mrs. N. L. Kitteridge
Payson, Utah

The January-June 1981 index is now available. In addition, a 100-page supplement will be available next month. It covers the years 1977 through 1981 and costs \$1.00. A member may obtain it free with purchase of the 452-page NATIONAL GEOGRAPHIC INDEX, 1947-1976, at \$9.95.

APPIAN WAY

Pure joy. I laughed out loud. I was reading in bed. It was 3 a.m. I am 84.

Mrs. C. Walter Johnson
Torrington, Connecticut

The superficiality and lack of historical exactitude make this article worthy of Hollywood's view of ancient history.

G. Alessi
Hillegem, Belgium

Thank you for the beautiful photographs of the Via Appia Antica. So much of our history is to be found all around us, rather than only in museums, that it becomes part of our daily lives.

Dr. Emilio Tommasi
Italian Travel Commissioner
New York City

A slander of Italy and the Italian people.

Frank J. Costa
University of Akron, Ohio

A gem of wit, information, and style. I loved it. Bravo! Bravissimo!

Karolyn Curtis Carlton
San Diego, California

A magnificent article. Handled with superb skill and well researched historically.

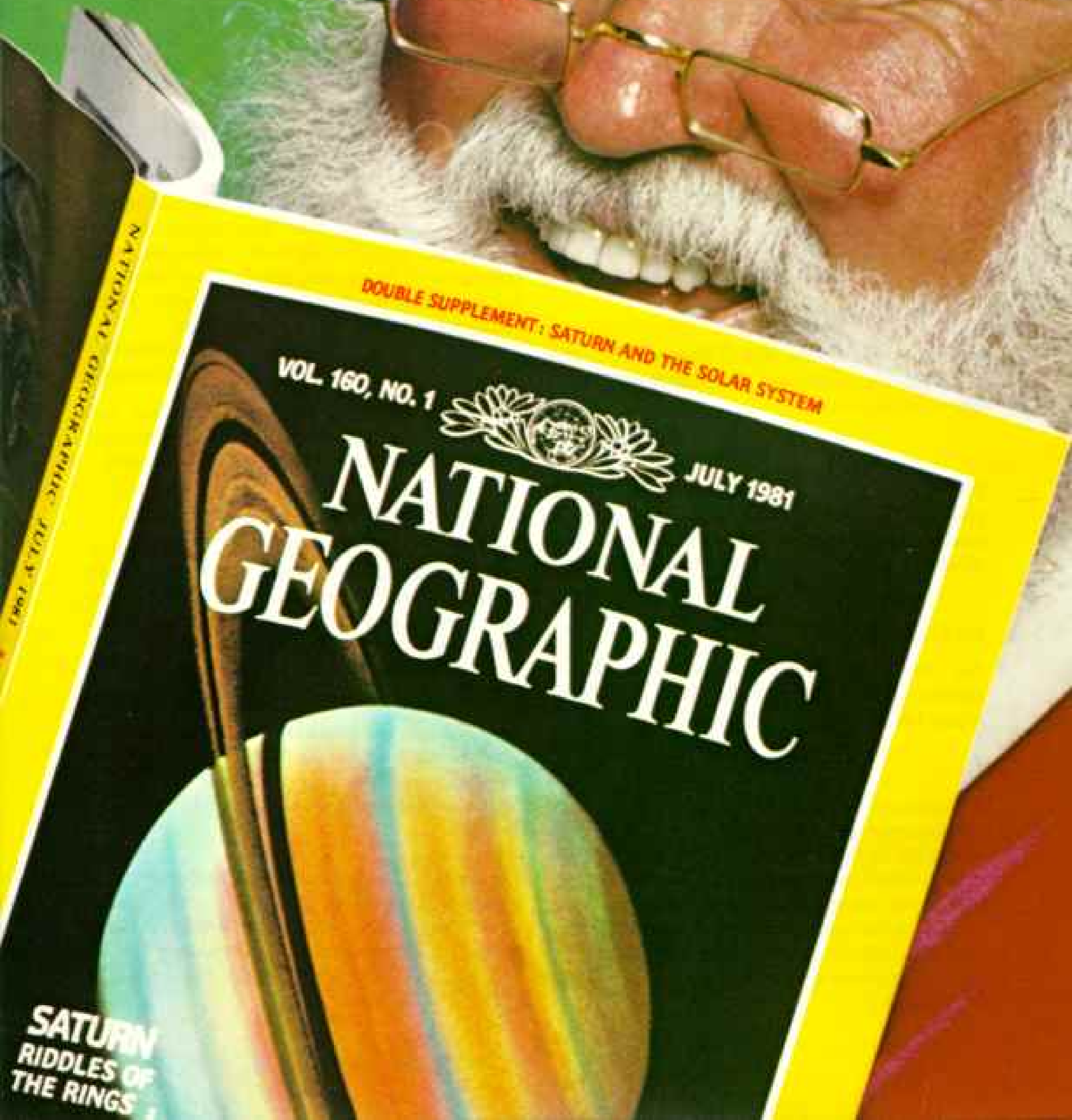
T. Steven Tegu
Rhode Island College
Providence, Rhode Island

WILD CARGO

As the largest retailer of scrimshaw in the state, I must take strong exception to the information that appeared in your article. The photograph of our artists' work, which accompanied the article, mentioned use of illegal materials. None of the ivory in that picture is fresh walrus. Lahaina Scrimshaw Factory neither buys nor uses fresh

The perfect Christmas gift.

Use the attached form to
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National Geographic Society
P.O. Box 2895
Washington, D. C. 20013



DOUBLE SUPPLEMENT: SATURN AND THE SOLAR SYSTEM

VOL. 160, NO. 1

JULY 1981

NATIONAL GEOGRAPHIC

SATURN
RIDDLES OF
THE RINGS

walrus. Ours completely complies with the U. S. directives regarding Alaskan walrus.

Howard Konrad
Maui, Hawaii

The GEOGRAPHIC did not and does not mean to imply that the Lahaina Scrimshaw Factory uses illegal materials. In fact, the firm was not mentioned in our article.

The walrus was making a good comeback, numbering 280,000 with an annual cull of about 3,000 by Alaskan natives. The rise in the price of elephant ivory and the native "exemption" under the Marine Mammal Protection Act has changed all that. Smuggling of bloody ivory (freshly killed and uncarved, i.e. illegal) out of Alaska has become a big business. A recent raid netted five tons, which represents 750 walruses. Should this go unchecked, it won't take many decades for walruses to follow the Steller's sea cow into oblivion.

Nicole Duplaix
TRAFFIC (U.S.A.)
Washington D. C.

TRAFFIC monitors trade in wildlife, plants, and their products; it is funded by the World Wildlife Fund—U. S.

SAN FRANCISCO BAY

Your map omitted the city of Pleasant Hill, one of the most beautiful and progressive communities in the bay area.

Patricia L. Sully
Pleasant Hill, California

The creation of a map is always a difficult compromise between what we would like to include, what we can show in terms of the map design, and what we need to show. No oversight intended.

EXPLORERS HALL

Are there any special considerations toward members when in Washington, D. C.? My family and I will be visiting this fall.

Larry J. Sampson
Chicago, Illinois

Members are urged to visit Explorers Hall in our headquarters at 17th and M Streets NW. The hall, with its famous 11-foot globe, offers permanent exhibits on "Early Man," the "Solar System," and many other topics, and there are always special exhibits such as the current "Treasure of the Quicksilver Galleons," a collection of Spanish treasure and artifacts from two Caribbean wrecks.

FOAM HOME CAUTION

Your special report, Energy, contained pictures of a free-form polyurethane foam house. The Society of the Plastics Industry recommends that all rigid polyurethane foam used in construction be covered by an approved 15-minute thermal barrier unless the use has been demonstrated to be acceptable by diversified fire testing.

Hugh Patrick Toner
Society of the Plastics Industry, Inc.
New York City

COSTA RICA

Hooray for Kent Britt and his well-written article. I can truly believe my friends from Costa Rica about that country's wonders.

Mrs. I. E. Bishop
Austin, Texas

TROUBLED TIMES FOR CENTRAL AMERICA

I was dismayed by your synopsis of the current situation in El Salvador and Nicaragua. You made it appear that the government in El Salvador has been conducting serious land reform and that leftist guerrillas have been responsible for much that is going wrong there. I also found your treatment of Nicaragua unfair. They certainly are having a tough time economically. What country wouldn't after such a civil war!

Sue Bradley
Portage, Wisconsin

Our report described the serious economic and social problems that underlie the turmoil; we neither endorsed nor condemned any government.

THE CONFUSING AMERICAN

I am disturbed by the misuse of the designation "America" when, specifically, the "United States of America" or "United States" is intended. Canada, Mexico, and all the countries of Central and South America qualify as "America."

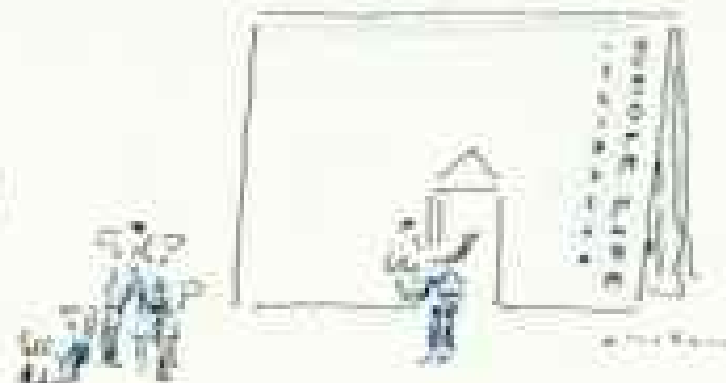
Lucien G. Mather
Auburn, California

True enough, but when it comes to nationality, professional linguists agree that "American" by general usage means a citizen of the United States, and is commonly understood thus.

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



Life Insurance...



Should you
'rent' it
or own it?

Deciding what type of life insurance you need can be compared to deciding whether to rent an apartment or own a home. This comparison can help you understand the different benefits the two basic types of insurance can provide and how Metropolitan's new **Whole Life *Plus*** policy may be the answer for you.

Term Insurance Is Like Renting

Both an apartment lease and a term policy last for a set period. Renting an apartment is often the only affordable choice for some. So too, term insurance can initially provide much more coverage per premium dollar than whole life. Like most rents, however, the premiums on term increase with each renewal. Also, as an apartment renter doesn't build up equity, a term policy doesn't build up cash value.

Whole Life Insurance Is Like Owning

Both a home you own and a whole life policy can protect you for your entire life if you want. And just as a home-owner makes equal payments with a conventional mortgage, the owner of a whole life policy pays the same premium each year. Further, the cash value builds up in a whole-life policy in much the same way as equity in the home does from making mortgage payments.

Which Type of Life Insurance Is For You?

The answer depends on your needs and preferences. If your needs are high, but your budget is limited, term insurance may be the answer. Or, you may prefer the permanence, fixed premiums and cash value of whole life, but feel you really can't afford this type of protection.

Now there's an answer to this dilemma—**Metropolitan's new Whole Life *Plus* Policy**. It's like putting an addition on your house at no extra cost.

Metropolitan's new Whole Life *Plus* Policy can give you the whole life benefits you need—at a surprisingly low premium.

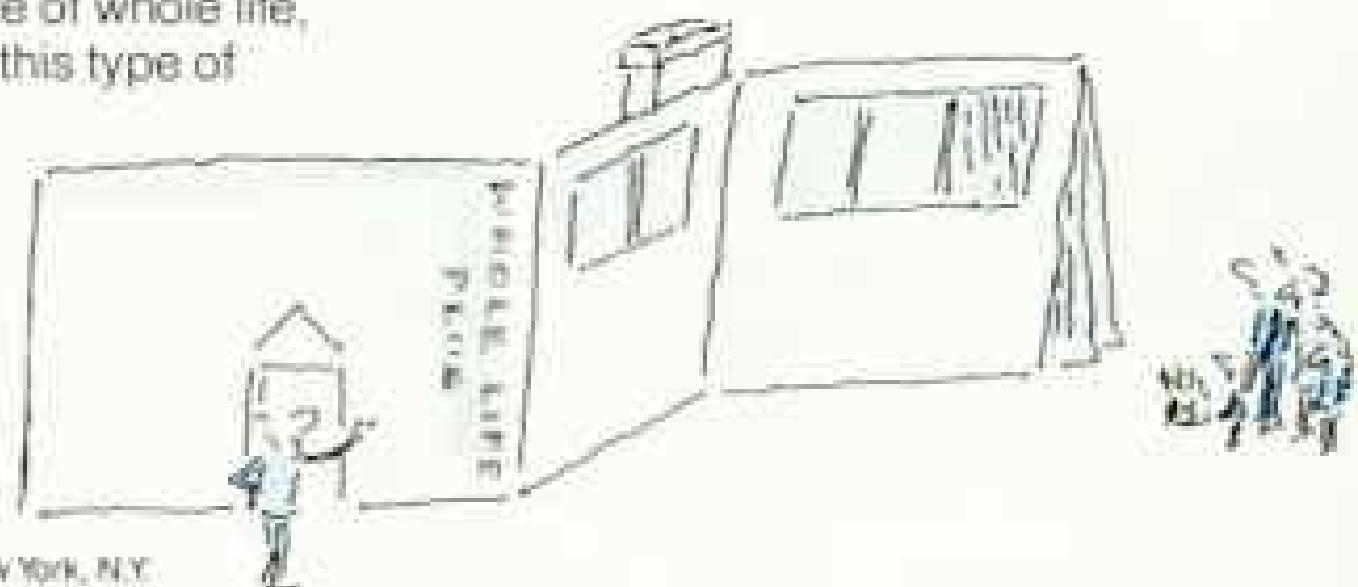
Depending on your age, Metropolitan's new Whole Life *Plus* Policy lets you buy **up to one-third more** whole life coverage than we offered before for the same premium payment. It's like building a sizeable addition on the cozy traditional whole life house—with no extra payment! Metropolitan is offering the Whole Life *Plus* Policy for coverage amounts of \$25,000 or more and you'll probably be surprised at how much coverage you can now afford.

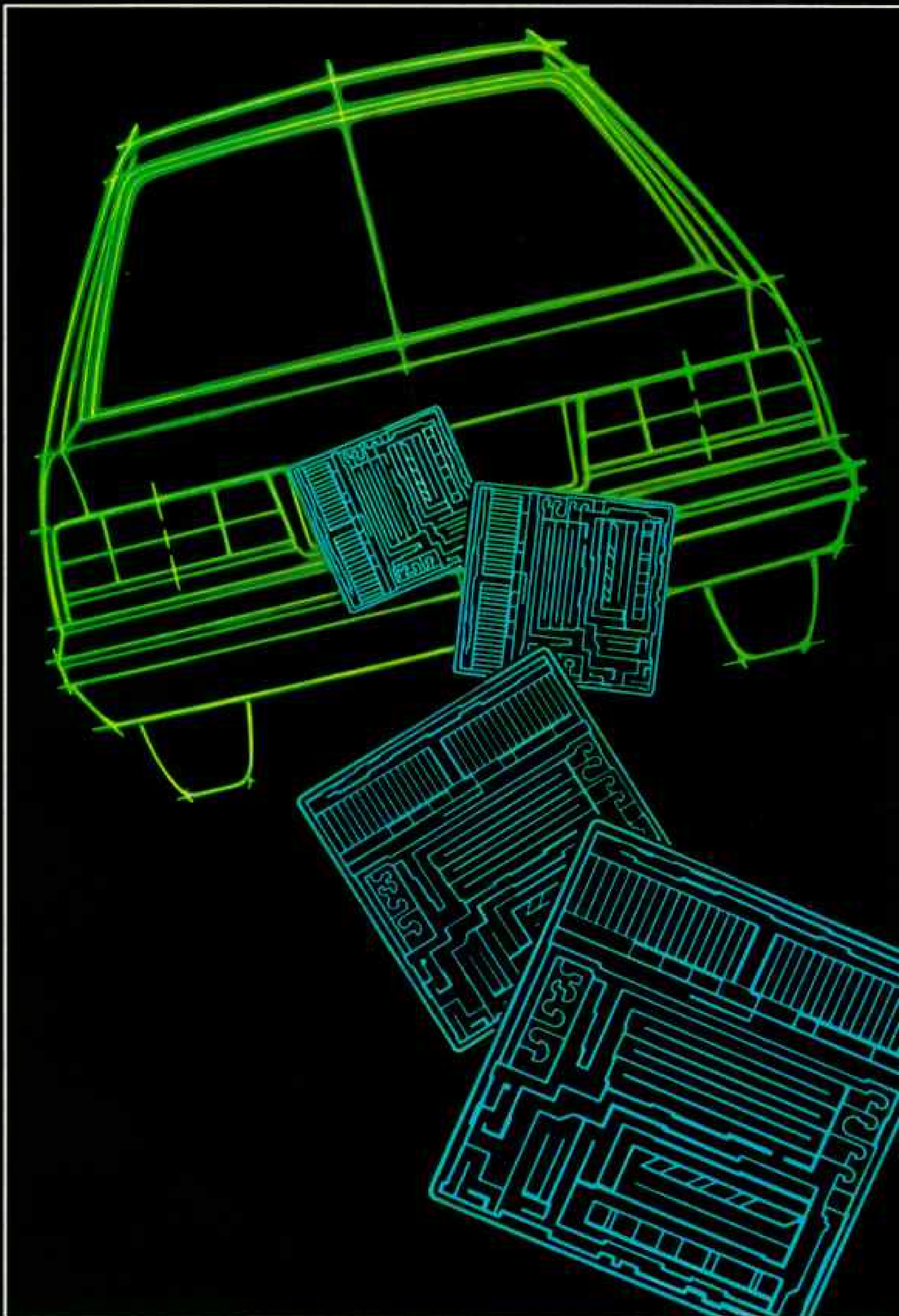
Is Whole Life *Plus* The Answer?

Your local Metropolitan representative is a trained professional, prepared to help you answer this question and meet all of your insurance needs—life, health, auto, home and retirement.

Metropolitan 

Metropolitan really stands by you.
LIFE HEALTH AUTO HOME RETIREMENT





To build a rugged car, inspect it under a microscope.

A car is only as rugged as its smallest parts. In new GM cars, those parts are integrated circuits. And they're only sixteen thousandths of an inch thick. They're the heart of the microcomputer that monitors and controls engine functions.

To be sure those integrated circuits are rugged, we submit them to numerous electrical and mechanical tests during various stages of manufacturing. We even examine a statistically valid sample under a high-power microscope. We also test the integrated circuits before they are assembled into the microcomputer.

Every computer is exposed to a range of temperatures from -40°C to 85°C .

We do a lot of testing, but it's worth it. You know that even the smallest part of a GM car is designed for durability.

That's our idea of how to use technology to build cars. Attention to details where you don't see them, as well as where you do. Appearance and comfort may sometimes sell a car, but today's customers demand real value.

Our goal, as the company that sells more cars than any other manufacturer in the world, is to maintain our lead by using new technology to build cars that run better and last longer, with lower maintenance costs, than those built by any competitor—American or foreign.

General Motors

The future of transportation is here.



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Right now at Sears you can see and hear any of the exciting video innovations pictured here.

Operating this new Sears Video Disc Player is as simple as mailing a letter. Just insert the disc (housed in a protective jacket) into the slot. Withdraw the jacket and the disc remains inside the player. Each disc rewards you with up to 2 hours of choice entertainment. *Rocky*, *The Godfather* and *2001: A Space Odyssey* are just a few of the award-winning films now on video-discs available at your Sears store.

This Sears Video Disc Player gives you two ways to locate a favorite scene: forward or reverse, in just seconds.

Visual Search lets you view the picture at high speed.

Rapid Access blanks out picture and sound as it zips you to a particular time segment.

As you close in on your favorite scene, revert to normal playing speed.

Other features include Pause Control and Play Time Indicator which is an easy-to-read digital display that signals the elapsed playing time of a single side up to 60 minutes.

Only \$449.95



Simulated TV reception
50" diagonally
measured picture

Sears Video Disc Player, Model 5474

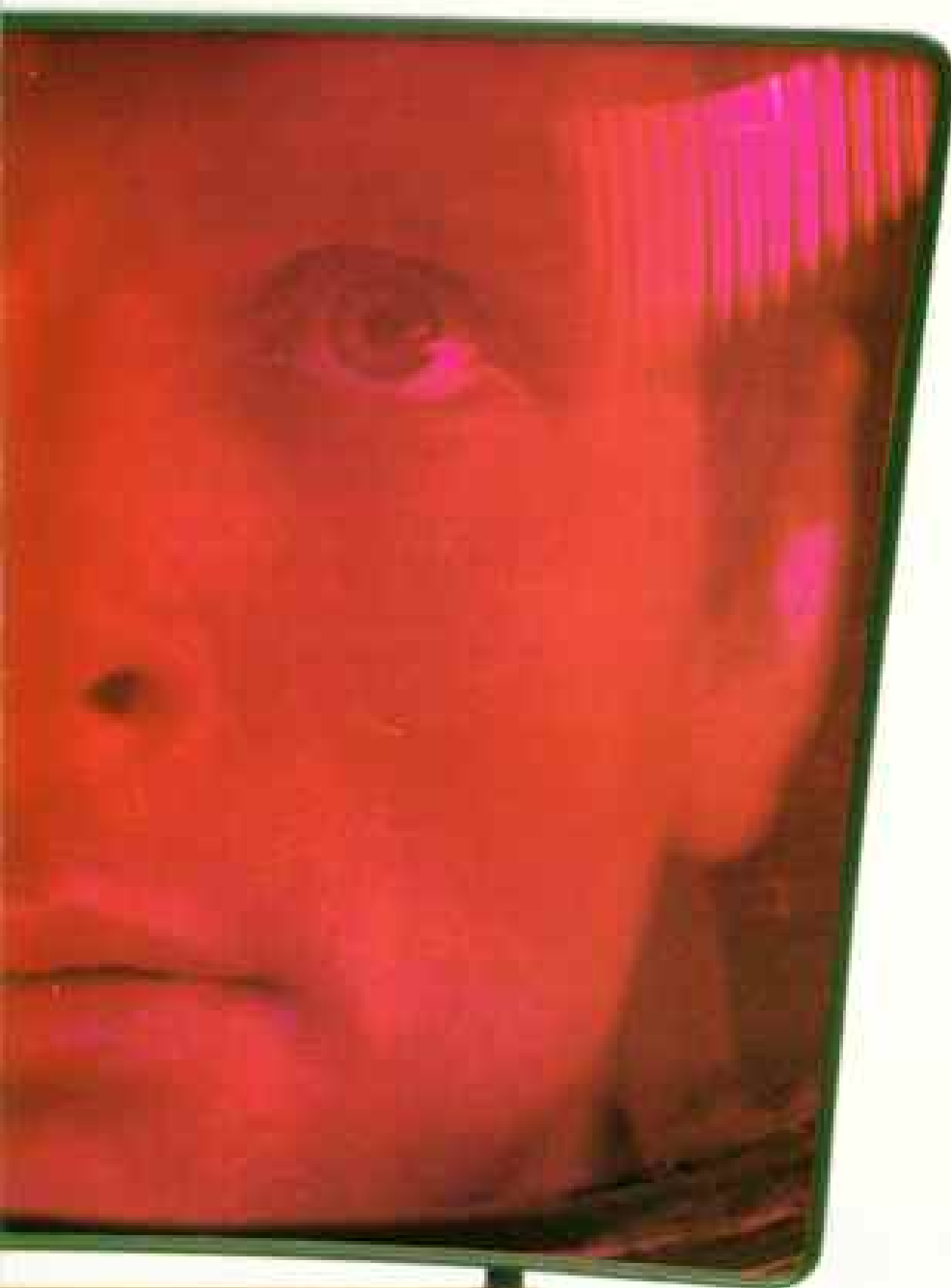


SEARS PROJECTION TV

Turn your living room into a theater with Sears Projection TV, both handsome cabinet and huge 50-inch screen in one compact unit. Regular price \$2,995.00.

Model 5450

NEW LOOK IN HOME VIDEO



SEARS BEST VIDEO RECORDER

No Sears videocassette recorder you can buy will work more electronic wonders or perform them more easily. The ease is assured by a remote control device that activates an astonishing variety of features.

2-Speed Beta Scan. Advances or reverses the tape at an average 15X or 30X normal speed while you view the picture.

Variable Slow Motion. Captures those special moments in sports, news or movies in the fluid beauty of normal slow motion. Gradually reduces speed all the way down to frame-by-frame viewing. Picture stays clear throughout.

Pause Control. Holds a clear picture allowing you to "freeze frame" during playback or edit out unwanted material when recording.

Fast Motion. Increases speed to two times normal while holding a clear viewable picture. Of course, you can watch one show while recording another. Or program the VCR to automatically record up to eight shows from your TV over a 14-day period. (By using Sears L-830 videocassette, you can enjoy up to five full hours of playing time.)

Get Sears Best BetaVision VCR on sale from Oct. 4 through Oct. 31. Save \$100*. Now only \$899.95.

Sears Best Video Recorder, Model 5322



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Roanoke, Roanoke and Co. 1981

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Prices and dates may vary in Alaska and Hawaii.

Available in most larger Sears retail stores.

Each of these advertised items is readily available for sale as advertised.

WE'RE EXXON

**We're Joan Williams,
bringing a dying
oil field back to life.**



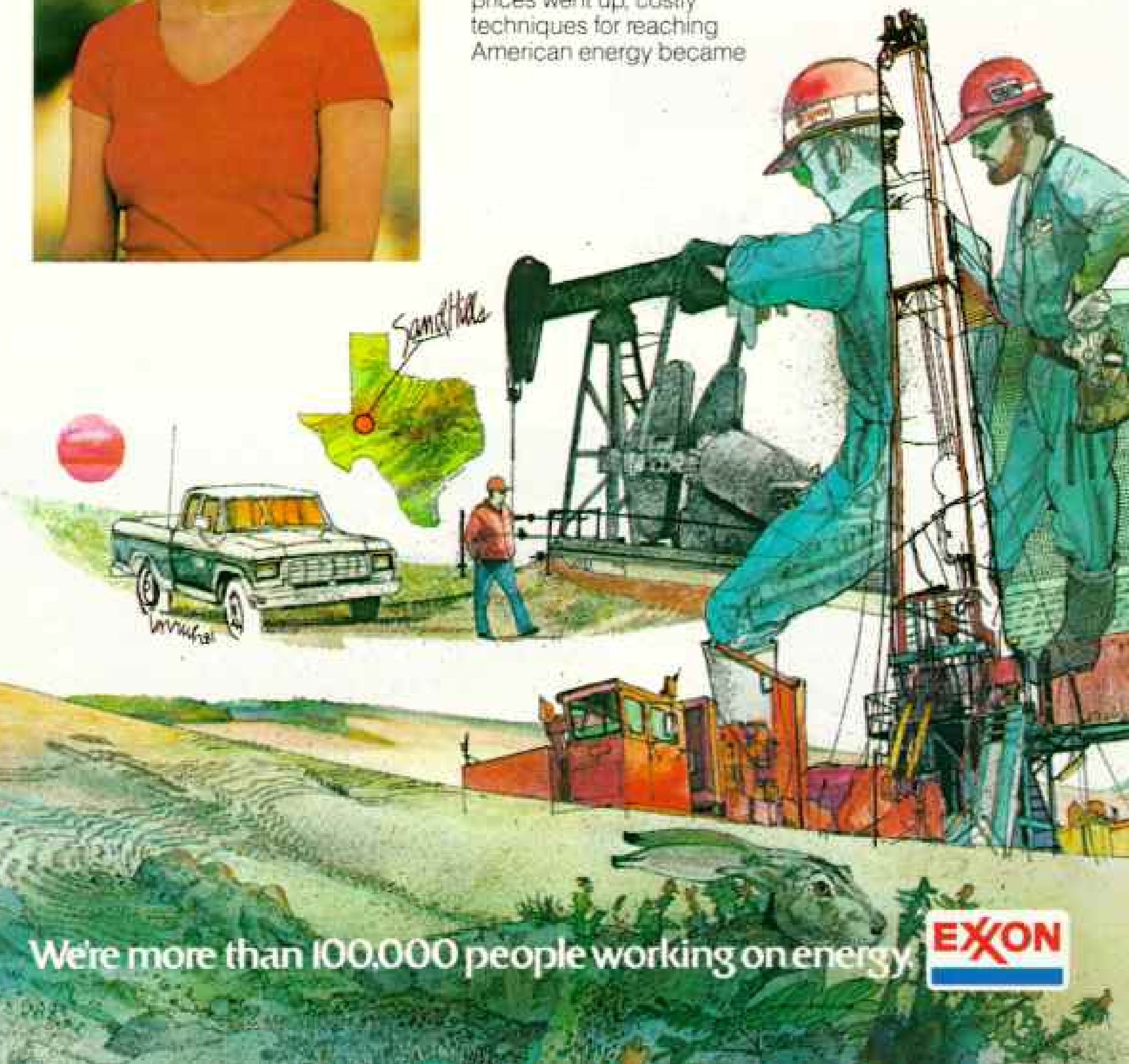
Joan Williams is helping to squeeze 2,400 barrels of oil each day out of a barren West Texas desert. As a Senior Project Engineer at Exxon's Sand Hills field, she's helped an old oil patch make a startling comeback.

Just a few years ago, this field was practically worthless. Much of the oil and natural gas that lay trapped in rock formations beneath Sand Hills was too expensive to reach.

But when world oil prices went up, costly techniques for reaching American energy became

more economic. Now, more than twice the original number of wells is being drilled. And the pockets of oil and gas that remain between the old wells are being tapped. This has made Sand Hills one of the most active fields in the Southwest today.

Williams helps pick the locations for new drilling. Along with hundreds of other Exxon people working in this part of Texas, she's supplying America with American energy.



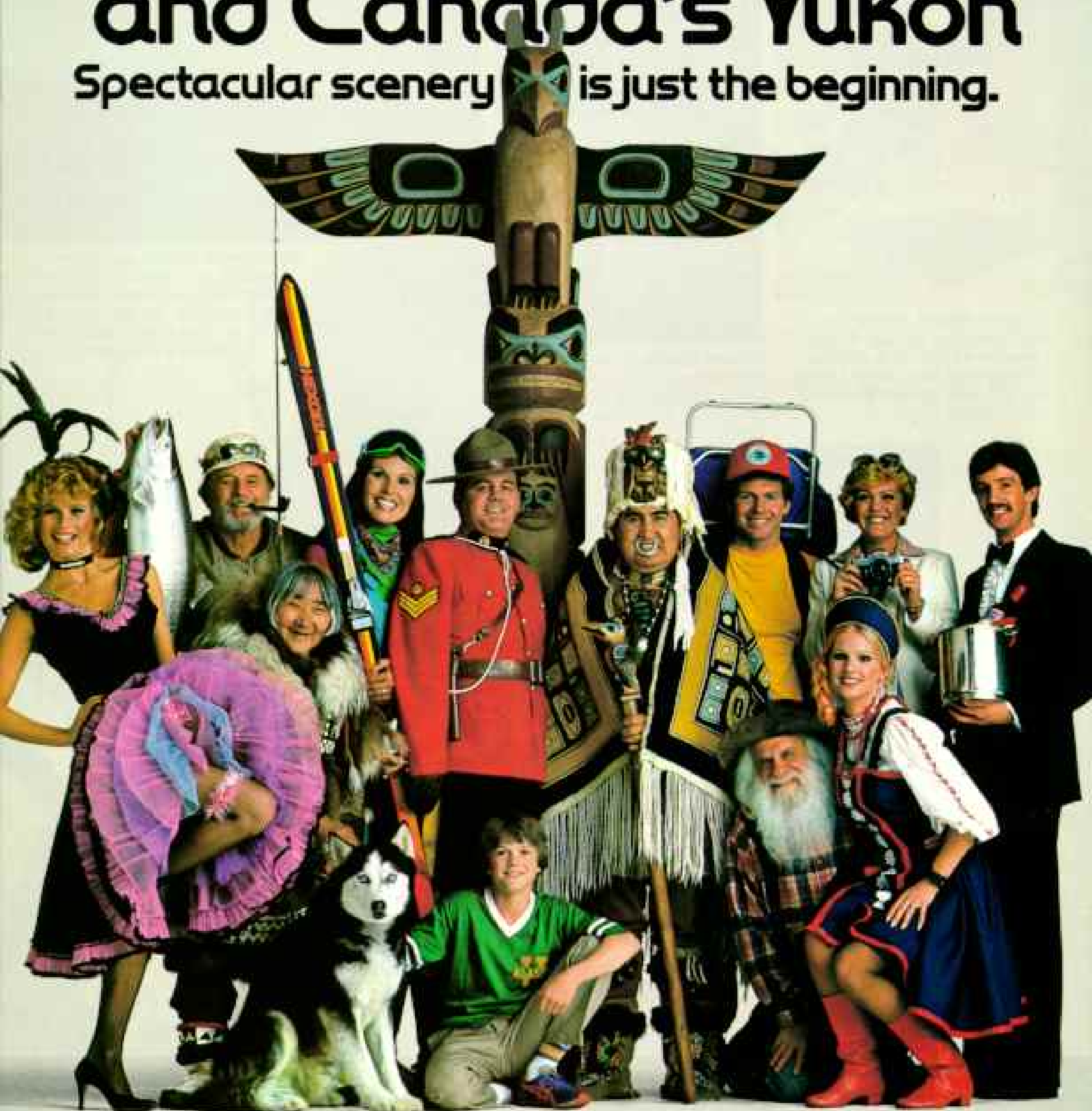
We're more than 100,000 people working on energy.

EXXON

Get this book FREE!
More information inside.

Worlds of **Alaska** and Canada's Yukon

Spectacular scenery is just the beginning.

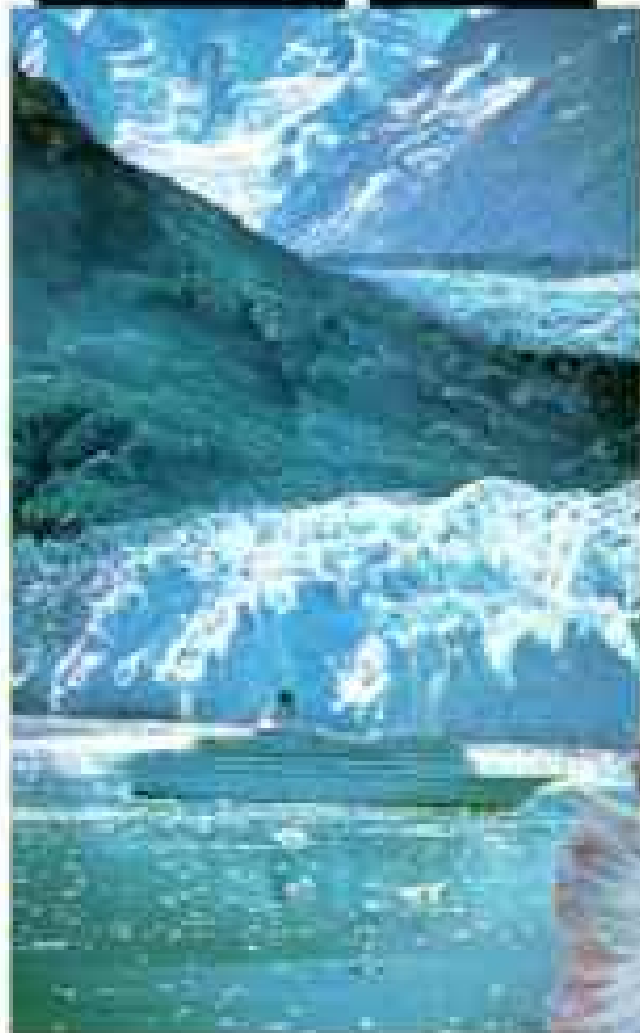


OFFICIAL VACATION PLANNING GUIDE

Alaska



Elegant Hotels. Skylighted atrium lobbies, rooftop dining, nightly entertainment, and luxuriously appointed guest rooms are typical amenities offered by many hotels.



Luxury Cruising. An astonishing contrast of luxury and the primal forces of nature—in shirtsleeve weather.



Anchorage. Anchorage offers residents and visitors alike the excitement and conveniences of a modern city surrounded by the beauty and adventure of Alaska's wilderness.



Red Fox Cubs. Katmai National Park and Preserve, a medium-sized park by Alaska standards, is twice the size of Delaware. Red fox flourish here, along with populations of moose, wolf, lynx, bald eagles, whistling swans, sea lions, and sea otters.



Arctic Alaska. Eskimo dances, the blanket toss, demonstrations of skin sewing, ivory carving, and other traditional activities of a six-thousand-year-old culture welcome visitors to far north Alaska.

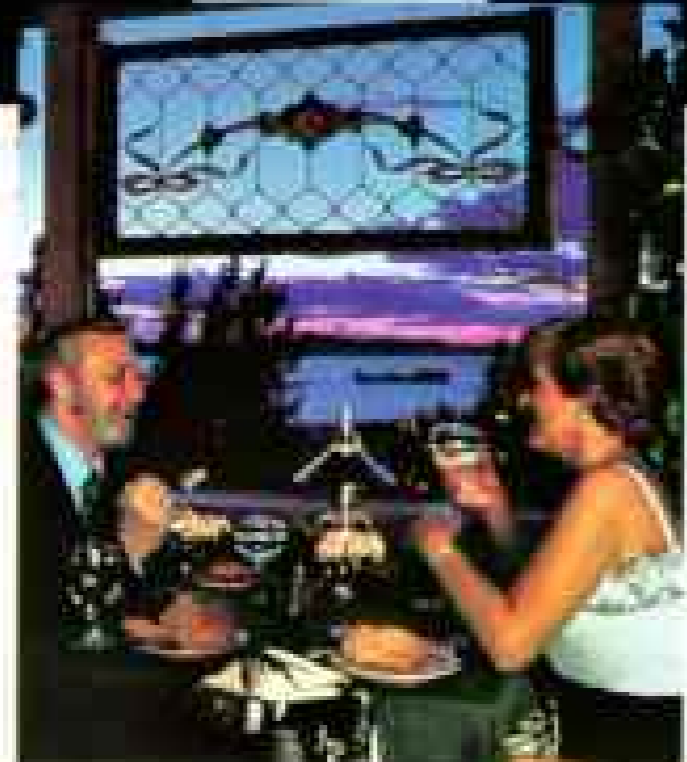
Worlds of
Alaska
and Canada's Yukon



ALASKA!



Totem Poles. In Sitka National Historical Park, scenic walking trails provide easy access to traditional totem poles set in a lofty forest of spruce and hemlock.



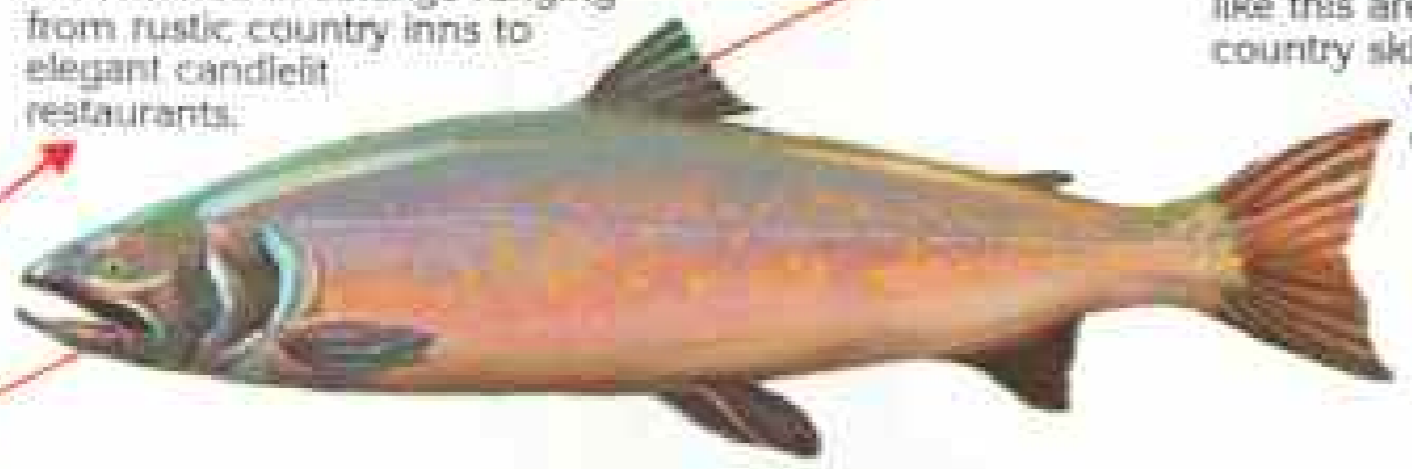
Dining. Fresh Alaska seafood, international cuisine, and a surprising variety of ethnic specialties are featured in settings ranging from rustic country inns to elegant candlelit restaurants.



Alaskan Artistry. Visitors discover value in a wide range of gifts produced by local artisans, including original art prints, scrimshaw, beadwork, furs, and carvings.



Matchless Winter Sports. Scenes like this are the backdrop for cross-country skiing, dog sledding, and winter hot-air ballooning over snowy peaks.



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Alaska is the vacation experience of a lifetime and this book will start you on your way. It's packed with useful information on how to plan your Alaska vacation. How to get there, what to see, what to do, where to stay, what to look for when you are shopping, and how to make it all fit your budget. You'll discover Alaska is warmer, closer, more comfortable, and more affordable than you ever imagined. **Worlds of Alaska and Canada's Yukon.** It's free. Send for it today.

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- Additionally, I am interested in more specific information on:
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20. What year are you likely to visit Alaska?
 1982 1983 1984 1985 & beyond
 I'm undecided about visiting Alaska.
21. Your age: _____
22. Level of education completed:
 Grade School High School College Graduate School
23. How many visitors will your party include? _____
 How many under age 10? _____
24. I plan to travel by Group Independently
25. In the past 3 years have you taken a vacation trip outside the North American continent? Yes No

Thank you!

(Offer expires December 31, 1982)

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Meeting Japan's Challenge
First in a Series

IS JAPAN'S CHALLENGE TO AMERICAN INDUSTRY GOING UNANSWERED?

"What are you doing about Japan?" It's a question we are asked almost daily.

It may be the single most important question American business faces. The challenge to the U.S. economic position that Japan poses is serious.

Starting now and for months to come, we're going to be answering that question—in public.

Obviously, this is a subject on which many companies can speak out, and should. We are doing so because we believe it will be good for our country, good for Japan, and good for Motorola.

It will be good for America to correct the impression many Americans have that Japanese businesses are in some way inherently superior. That impression is false.

It will be good for Japan because Japan relies on a strong confident America as a trading partner and ally.

It will be good for us because by learning how Motorola is meeting the challenge, you will have a more balanced, accurate view of our ability to serve our customers best anywhere in the world.

Now, don't get us wrong. We respect Japanese businesses. They are our customers and suppliers, as well as our competitors. And they are very good.

But we also know there are many things American companies like Motorola do extraordinarily well today. And we have an exciting commitment to do things even better in the weeks and months to come.

At Motorola, these things take the specific form of the development of new technology, employee participation in management, quality standards, accomplishments in productivity, effective cooperation with our government in foreign trade, and many other programs, products and plans of a company that is succeeding now and committed to perfection.

These will be the subjects of ads to come.

Motorola understands the challenge from Japan.

You can be sure we're not leaving it unanswered.



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You don't need elaborate equipment to use free solar energy to reduce your home's heating, cooling and lighting costs.

What you need is glass and windows, properly placed and designed.

For instance, a south-facing wall of PPG glass can collect the winter sun's heat and supplement a heating system.

And in the summer, when the sun is high in the sky, a roof overhang can shade south-facing glass and block out unwanted heat.

Of course, glass also provides a year-round source of free natural light, which not only brightens a room, but saves on electric lighting.

You can benefit even further by matching the right

PPG glass to your climate.

If yours is a new home in a cold area, PPG *Twilight*[®] *Xi*[®] or other insulating glass can help control heating costs very effectively. In fact, heat loss through the glass is cut almost in half compared to single-pane glass. And storm windows can get similar results in existing homes.

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WWF/Koji Teraoka/BCL

The Giant Panda needs your help to survive

ONCE every eighty to a hundred years the bamboo forests in China's Sichuan Province burst into flower and then die off. And that's bad news for the Giant Panda, which depends for its survival on huge amounts of bamboo.

But that's just one of the problems facing the Panda.

To ensure that it has a future it is vital to preserve the complex ecosystem in which it lives, to carry out research into its dietary needs and investigate possible alternatives, to discover the reasons for its low repro-

duction rate, to study the problem of internal parasites – all these factors and many more which threaten its survival.

Recognition of the urgent need to solve these and other problems has resulted in a unique and historic partnership between WWF and the People's Republic of China.

WWF has agreed to contribute US \$1,000,000 towards a total of about US \$3,000,000 needed by the Chinese Government to mount a major Panda Conservation Programme. This includes construction of a research and conservation centre in the largest of

the Panda reserves – Wolong Natural Reserve in Sichuan Province.

A team from WWF, led by the distinguished ecologist Dr. G. Schaller, is already at work in Wolong together with top Chinese scientists under the leadership of Professor Hu Jinchu.

The Giant Panda is an endangered animal. It is also the symbol of WWF's worldwide conservation efforts to save life on earth.

But WWF needs money – your money.

Please send contributions to the WWF National Organisation in your country or direct to:

WWF International, 1196 Gland, Switzerland.



WORLD WILDLIFE FUND

IF YOUR VIDEO INVESTMENT IS SHOWING DIMINISHING RETURNS,

It could be dropouts. White dots and dashes that spell trouble for your video investment. Before you blame your video deck, think about this. Tape passes over video heads that spin 30 times a second. With the wrong tape, friction can cause oxide particles to shed, leaving you with dropouts and other video headaches.



signal-to-noise ratio. They're densely packed and secured on the tape surface, which is polished mirror-smooth. The particles are there to stay. And so is your picture.

TDK's super precision mechanism keeps the tape running smoothly, with superb tape-to-head contact.

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Look. Once you know how your VCR works, you'll see that your video investment really depends on the tape. With TDK Super Avilyn, you'll see the dividends, again and again.

THE SOLUTION IS SUPER AVILYN.

Any quality video tape can look good at first. But wait until it's been played a few times. That's when one videotape really shows its worth. TDK Super Avilyn. It's made to prevail even under its severe working conditions.

Super Avilyn high energy tape particles are super refined. Their size and shape mean perfect alignment for high

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“...the compact 35mm SLR camera against which others are measured.”

-Modern Photography 'Top Cameras for 1981' Report

We didn't say it. Modern Photography magazine did. In the December 1980 issue.

What makes OM-2 the ideal by which all compacts are measured? For one thing, the way it measures light. Its revolutionary OTF™ meter system reads precisely *where* no ordinary meter can—off the film itself. *When* no ordinary meter can—during the actual exposure.

So if the light changes during exposure, OM-2 changes exposure. Automatically. Up to an incredible 120 seconds at f1.2 in near darkness. Or a blazing 5-fps with OM motor drive.

OM-2 even meters off the film with its dedicated Olympus T Series thyristor flash units. For automatic, camera-controlled bounce flash. Multiple flash (up to nine units!). Macro, motorized, filtered and zoom flash. Automatically, not just at

any f-stop—but at every f-stop. While a brilliant LED in the OM-2 finder shows when you can fire, then confirms exposure accuracy—another Olympus 'first.'

But for many, the real magic of the OM-2 is in its manual mode. Where your creativity commands every function for total control. At the flip of a switch.

More than a camera, OM-2 is the core of the most comprehensive compact system anywhere. With 300 matched components, including dozens of Olympus lenses. All as light, compact and virtually indestructible as the OM-2 itself.

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Model shown: The 112-channel, Model 150710. Oak veneer, wood and simulated wood products in antique oak finish. Limited TV picture. *With minimum continuous line power at 4 pins, from 100 Hz to 10,000 Hz with 2% or less total harmonic distortion.

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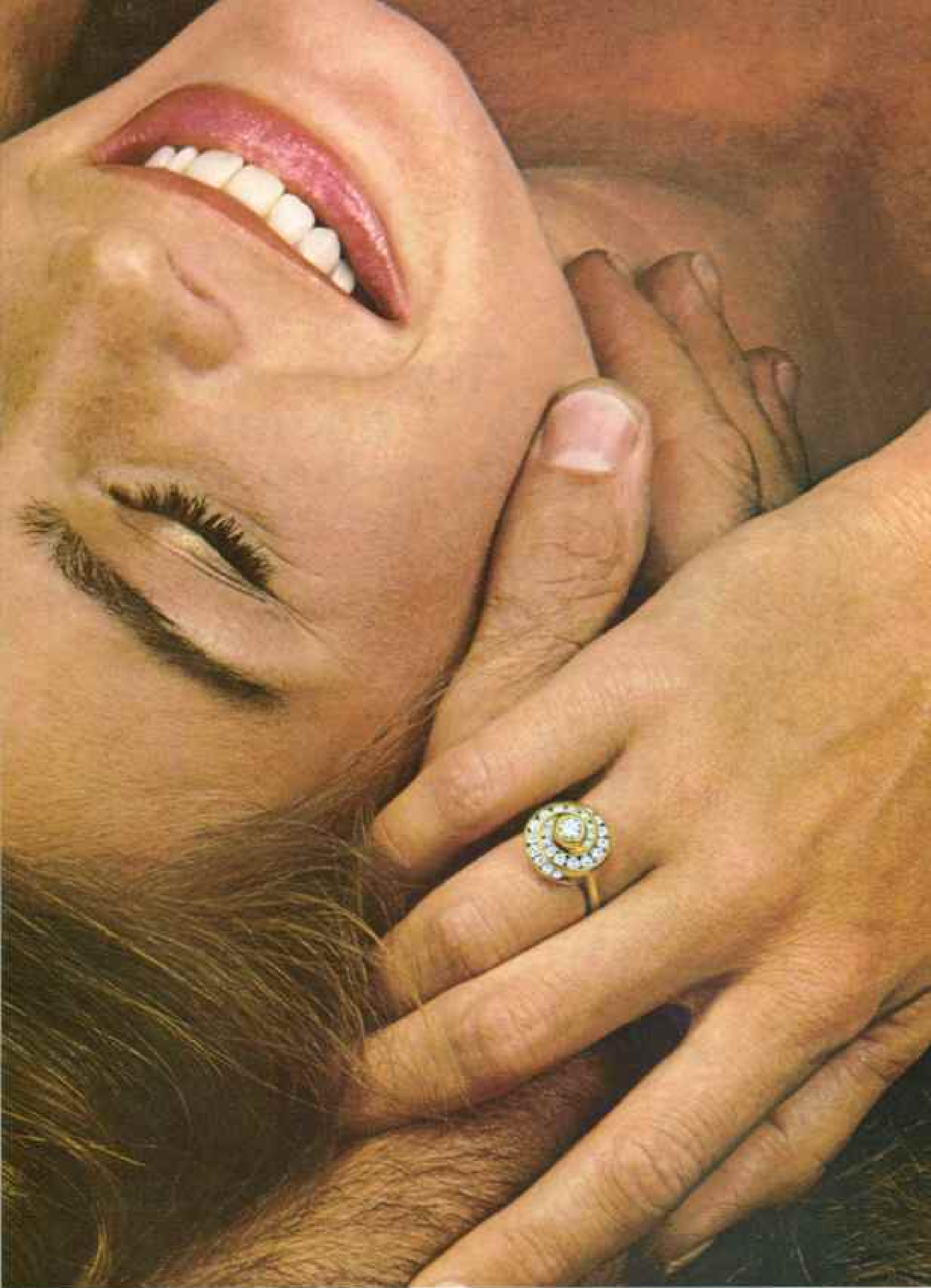
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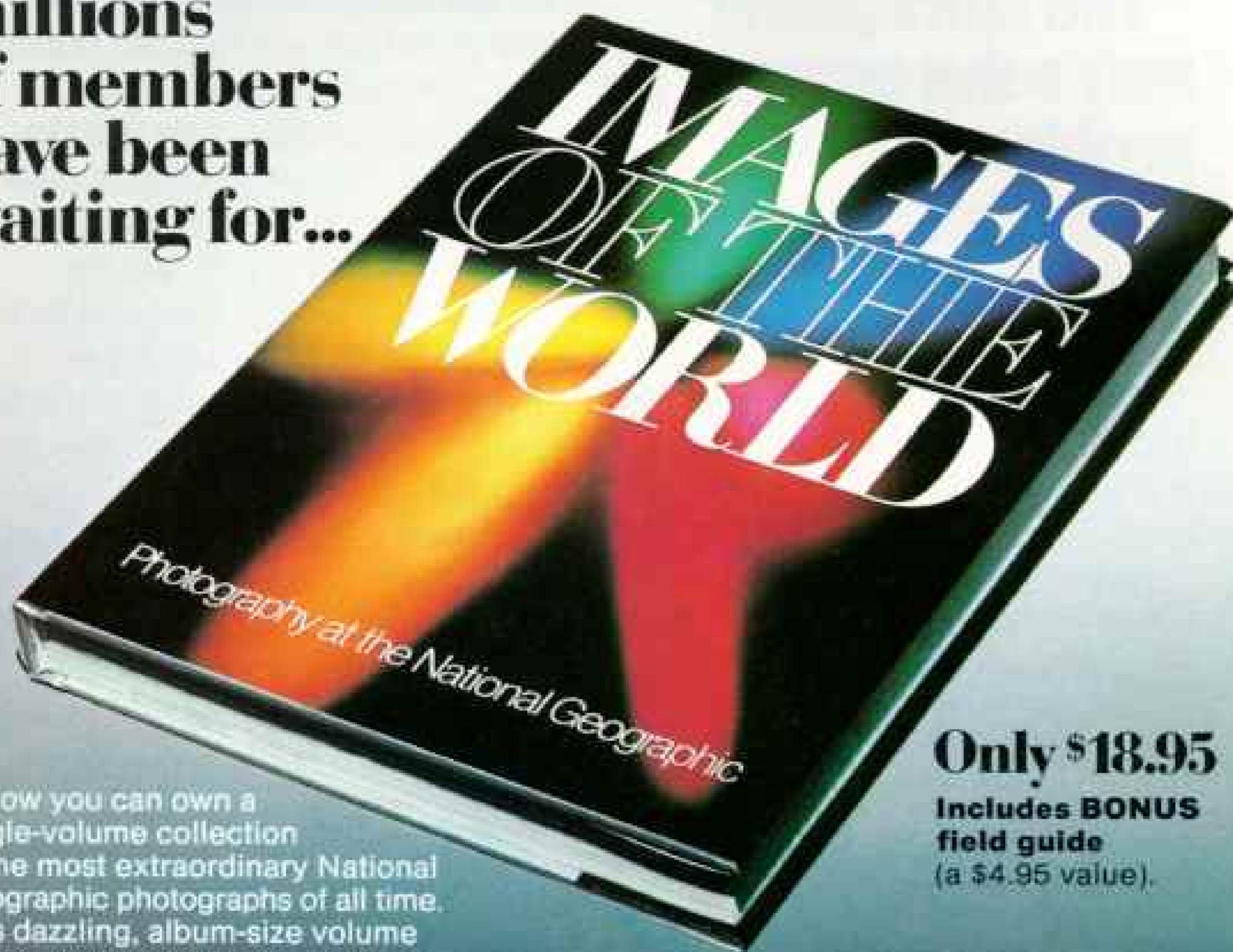
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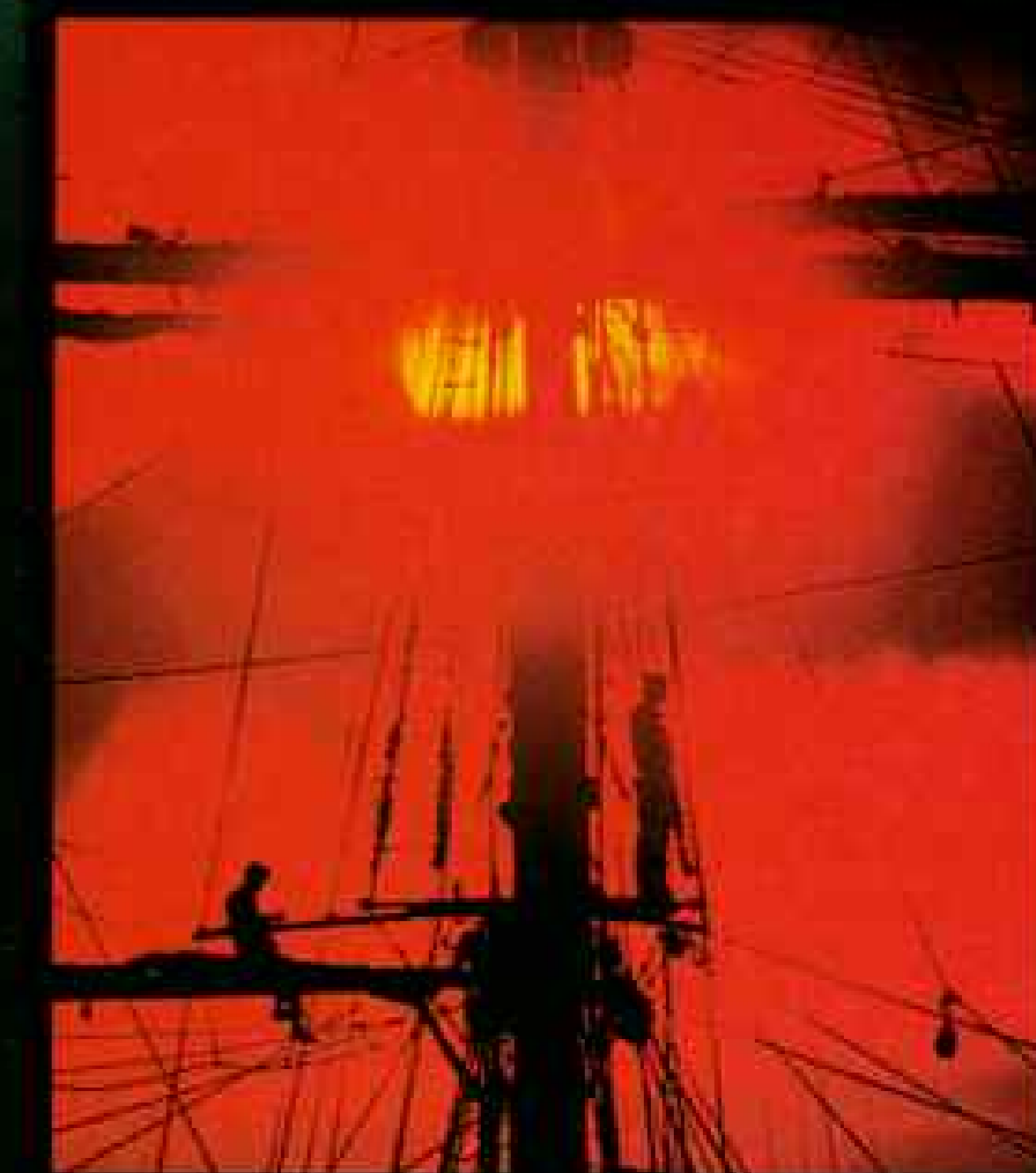
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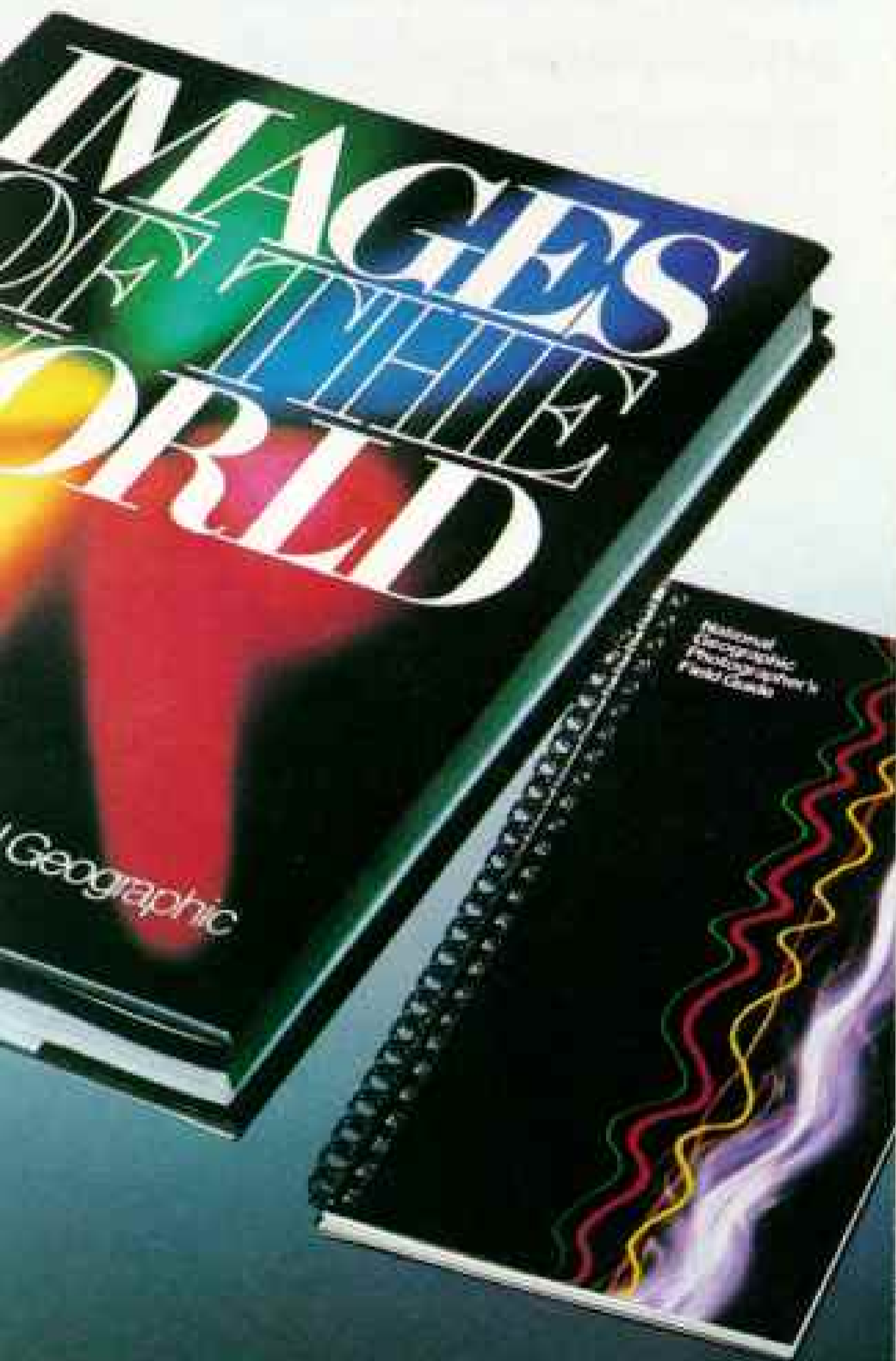
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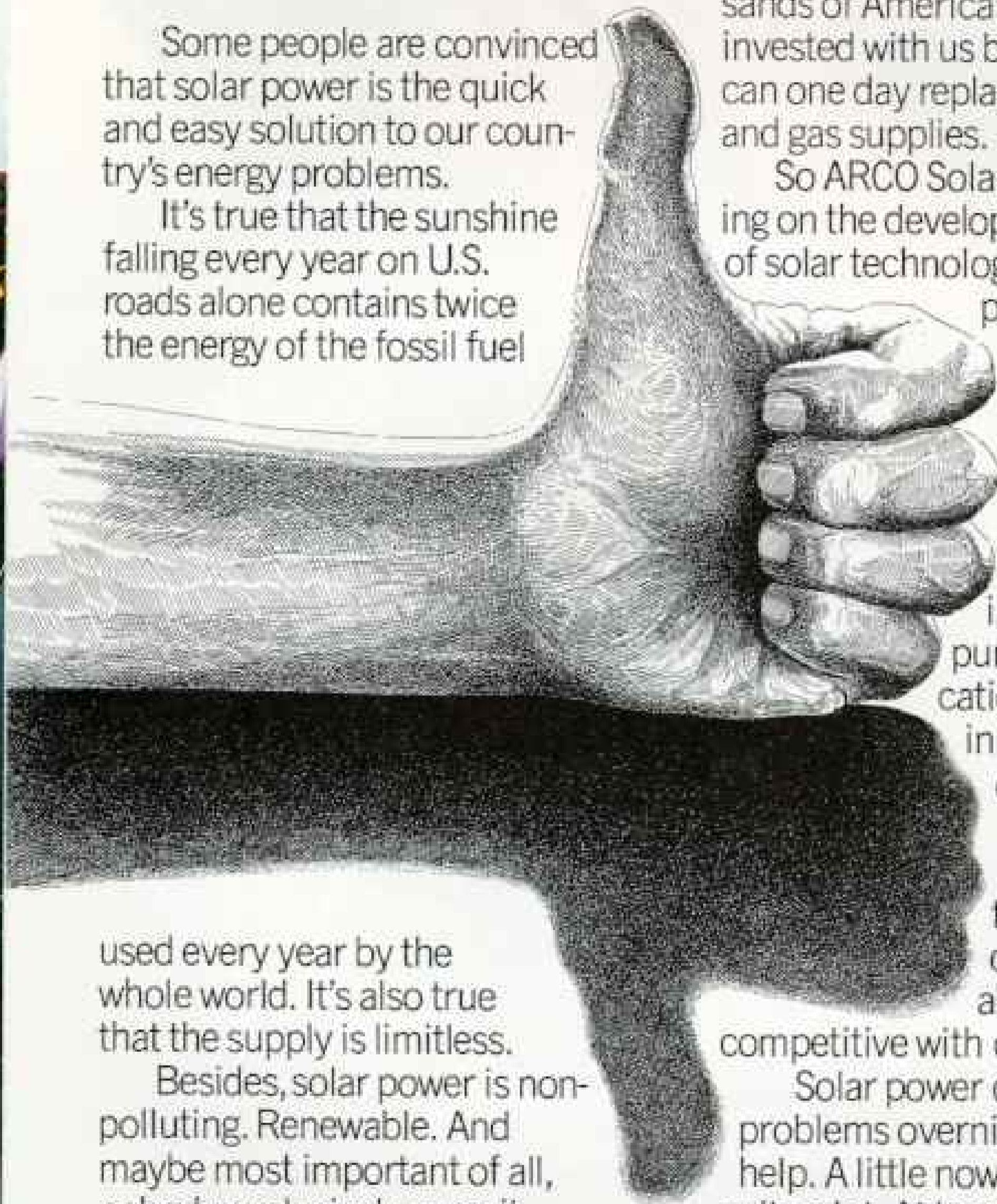
promising is photo-voltaic electricity, or power from solar "cells."

Today electricity generated from solar cells is powering homes, water pumps and communications repeater sites in remote areas all over the world.

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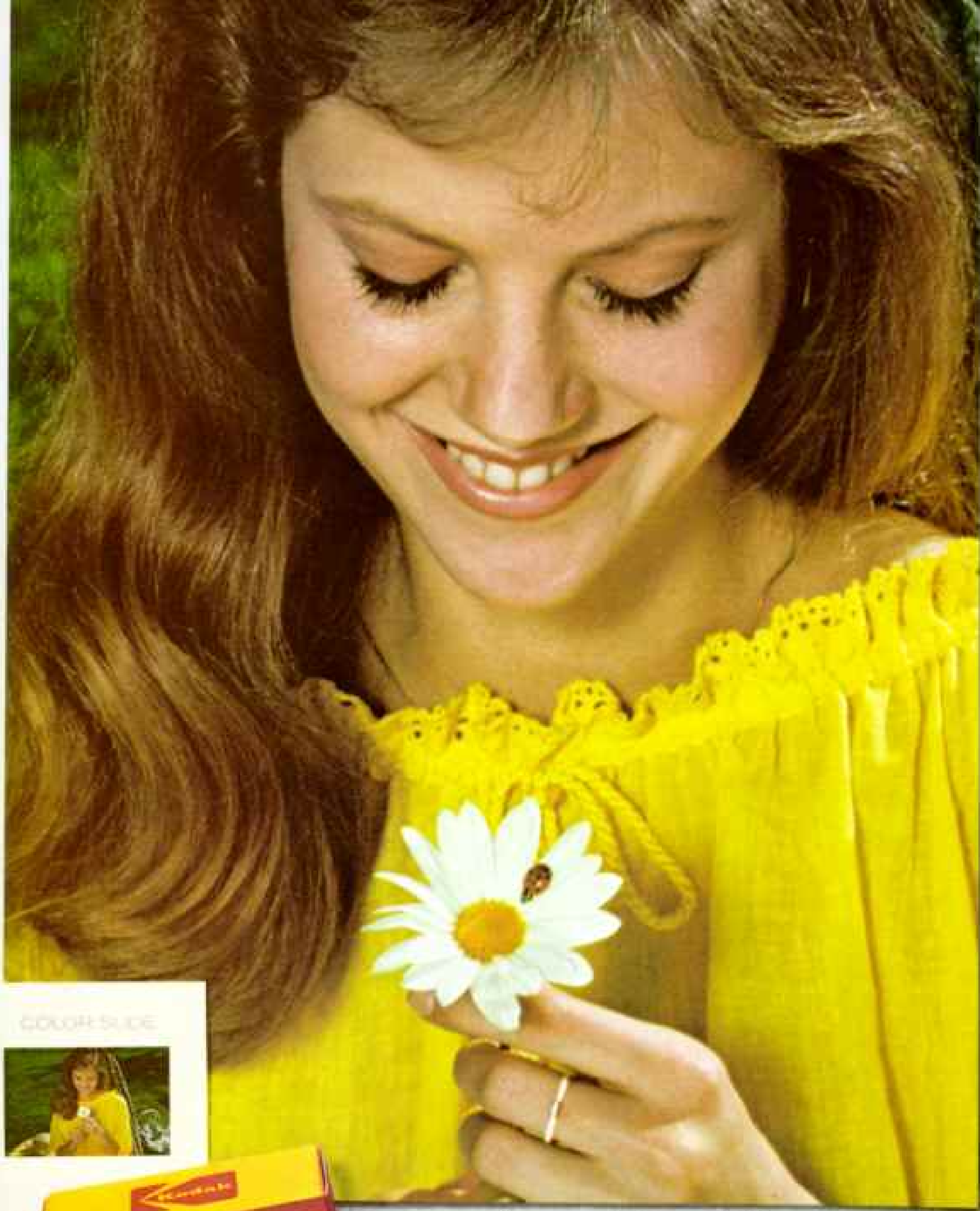
Solar power can't solve our problems overnight. But it can help. A little now. And in the future, quite a lot. At least that's what Atlantic Richfield believes.



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