

VOL. 164, NO. 5



NOVEMBER 1983

NATIONAL GEOGRAPHIC



THE LAST SUPPER
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LEONARDO'S MASTERPIECE 664

**KAMEHAMEHA—
HAWAII'S WARRIOR KING 558**

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NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 194, NO. 6
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November 1983

EARLIER this year the Alaska Statehood Commission, authorized by referendum in 1980 to study the state's relationship to the United States, issued its final report. One of the alternatives explored in the million-dollar study was secession from the Union.

Happily, Alaska is willing to remain the 49th state. The commission reported, "We considered the benefits and liabilities of commonwealth, of free association, of territoryhood, and of partition. We studied independence by legal means. None is preferable to statehood."

Over the years many other regions have agreed with this conclusion, but until this year none has asked to join the Union since Alaska and Hawaii entered in 1959.

Last September 9 a formal petition and constitution for a state of New Columbia, approved by voters of the District of Columbia in 1982, went to Congress.

In 1847 the governor of the rebellious Mexican state of Yucatán, troubled by a Maya uprising, sent his son-in-law to Secretary of State James Buchanan to seek protection or admission as a U. S. state.

In 1861 five Indian tribes were promised by the Confederacy that if the South won the Civil War, the land that is now Oklahoma would be given to them for their own state.

A decade ago a few unrealistic people suggested statehood for South Vietnam. Puerto Rico constantly debates the merits of becoming a state. A presidential candidate in the last Philippine election stood for statehood.

Old Glory's design seems safe for now, but I wouldn't bet that we won't have to find a place for a new star or stars someday.

This coming year Alaska and Hawaii both celebrate a quarter century of statehood. In observance of these birthdays, this month we publish a look at the first king of all Hawaii, Kamehameha. In January we'll follow with a story on southeast Alaska. Both will be accompanied by supplement maps. We're also pleased to have had a small part in two commemorative stamps to be issued next year (see On Assignment page). Hawaii's was designed by free-lance artist Herb Kane, whose paintings grace this issue, and Alaska's by staff artist Bill Bond, whose illustrations help explain problems of preserving the "Last Supper."

Wilbur E. Garrett

EDITOR

Kamehameha— Hawaii's Warrior King 558

Conqueror, statesman, and founder of a dynasty, the first ruler of all the Hawaiian Islands balanced foreign influences with ancient ways, leaving a heritage that now lights a modern renaissance. By Louise E. Levathes, with photographs by Steve Raymer, paintings by Herb Kawainui Kane, and a double map supplement.

Sun Car Crosses Australia 600

Running on captured solar power, adventurers Hans Tholstrup and Larry Perkins drive their lightweight vehicle 2,500 miles from Perth to Sydney. Photographs by David Austen.

Honduras: Eye of the Storm 608

Surrounded by neighbors in turmoil, Honduras struggles for greater security and a more diversified economy. Mike Edwards and David Alan Harvey report.

Decoys: Artifice and Art 639

Decoys made for the plain purpose of bringing meat to table have become highly valued collectors' items and emblems of America in a simpler age. By George Reiger, photographs by Kenneth Garrett.

Restoring the "Last Supper" 664

After five centuries of abuse by man and nature, Leonardo da Vinci's masterwork is being reborn—paint fleck by painstaking fleck. Art historian Carlo Bertelli views the progress, photographed by Victor R. Boswell, Jr.

The Miracle Metal—Platinum 686

Much more than a setting for gems, this precious metal cleans automobile exhaust, helps make fiberglass and fertilizers, prevents ships' hulls from corroding, and combats cancer. Gordon Young and James L. Amos detail its myriad uses.

COVER: Christ and the Apostles glow behind a filmmaker documenting the restoration of Leonardo da Vinci's "Last Supper" in Milan, Italy. Photograph by O. Louis Mazzatenta.

KAMEHAMEHA

BY LOUISE E. LEVATHES



A WATERCOLOR FROM LIFE BY
LOUIS CHORIS, [1818]
HONOLULU ACADEMY OF ARTS

Hawaii's Warrior King

PHOTOGRAPHS BY STEVE RAYMER BOTH NATIONAL GEOGRAPHIC STAFF

PAINTINGS BY HERB KAWAINUI KANE

WHEN KAMEHAMEHA'S mother, Kekuiapoiwa, was pregnant with him, she had a craving for the eyeball of a chief. She was given instead the eye of a man-eating shark. The *kahuna* (priests) prophesied that this desire meant her child would be a rebel, a killer of chiefs. Alapainui, the old ruler of the island of Hawaii, secretly made plans to have the newborn infant killed.

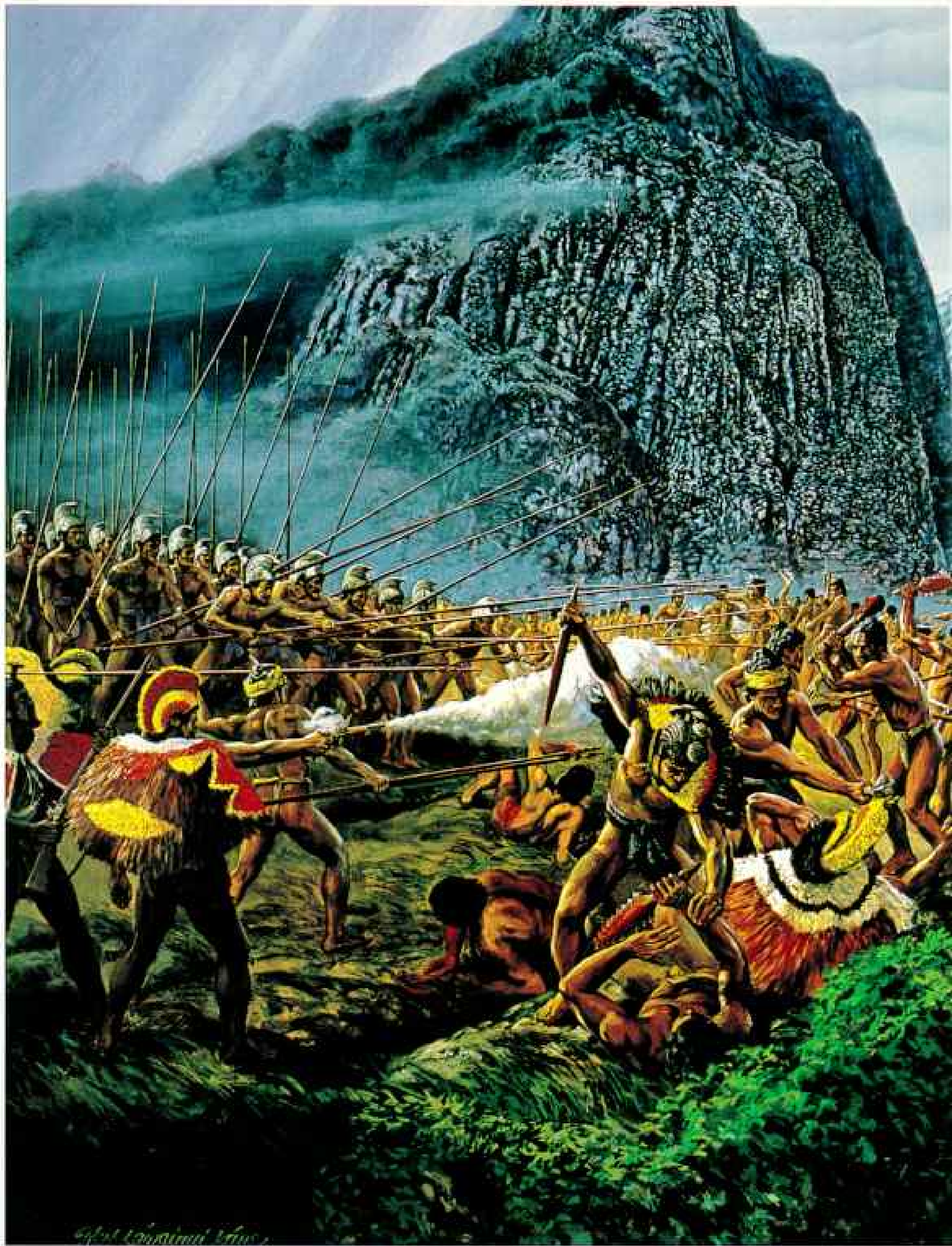
Kekuiapoiwa's time came on a stormy night in the Kohala district, when a strange star with a tail of white fire appeared in the western sky. According to one legend, the baby was passed through a hole in the side of Kekuiapoiwa's thatched hut to a local chief named Naeole, who carried the child to safety at Awini on Hawaii's north coast. There was a search for the child similar to King Herod's search for the Christ child. And, like Moses, the infant was hidden in a basket and covered with *olona* fibers used for making fishnets.

Where history ends and myth begins in this tale, no one will probably ever know. Even the date of Kamehameha's birth is

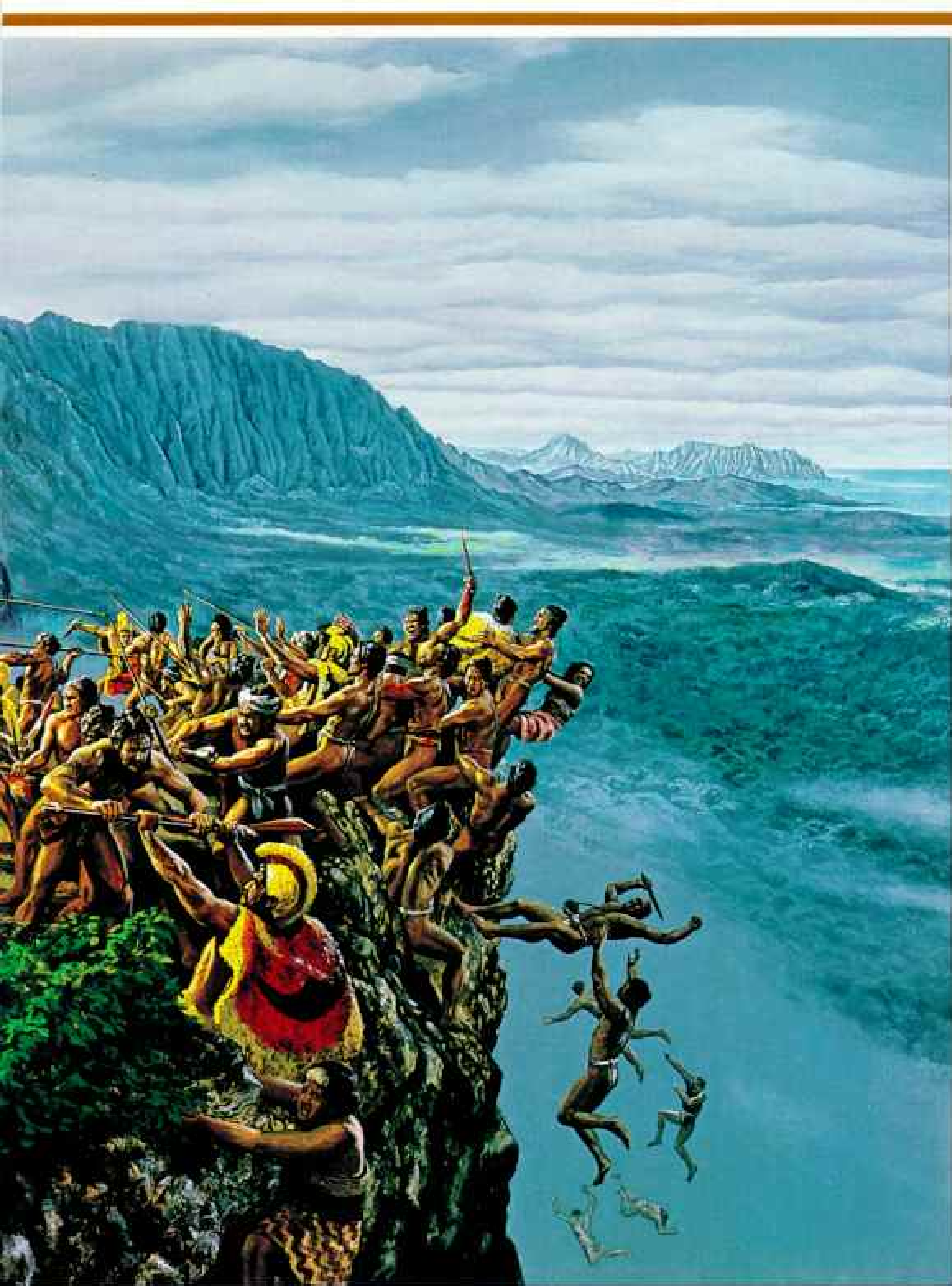
"A harsh and rugged face . . . strongly marked with lines indicative of self-reliance and changeless purpose"—thus a successor described Kamehameha the Great, the war chief who unified the Hawaiian Islands, welcomed foreign trade while thwarting foreign rule, and left a legacy of pride, expressed today in an exciting cultural resurgence as the 50th state prepares for its 25th anniversary next August.

In yellow-feather leis, once reserved for royalty, women of a benevolent society named for Kaahumanu, Kamehameha's favorite wife, attend the inauguration last December of George R. Ariyoshi, Hawaii's first governor of Japanese descent, and John D. Waihee III, the third lieutenant governor of Hawaiian descent.





DEATH LEAP at Nuuanu Pali, a 1,200-foot cliff behind present-day Honolulu, gave victory to Kamehameha, whose invasion of Oahu climaxed a bloody 13-year conquest of every Hawaiian island except Kauai and Niihau. In 1795 the powerful chief



COLLECTION OF NICK S. MAGGOS

from Hawaii landed at Waikiki with perhaps 12,000 men. The invaders, including chiefs, or ali'i, in feathered apparel, crowded the defenders to the head of Nuuanu Valley, where hundreds of trapped Oahu warriors, some with wives, met defeat.



Where native footpaths wound, the new Pali Highway sweeps up the ever verdant Koolau Range, tunnels through the Pali, and shoots down the Nuuanu Valley to Honolulu. Once Kamehameha had ended inter-island warfare, China-



bound traders from Europe and the United States dropped anchor in growing numbers in Honolulu's harbor, attracted by Oahu's fertile valleys, its abundant water, and the Hawaiian willingness to trade for the fruits of Western technology.



Playground of Hawaiian kings, Waikiki has seen its taro fields disappear under high rises that block the whispering trade winds. It has watched tourists



blanket the reef-protected beach and surfing become as popular as with Kamehameha and his entourage, whose houses dotted the shore to Diamond Head, upper right.

(Continued from page 559) uncertain. Many believe it was 1758—a year in which Halley's comet was visible in Hawaii.

For some Hawaiians, the extraordinary happenings in this hero's life are very real indeed. Walking along a beach on the island of Maui, Charles Keau spotted a jawbone, unmistakably human, in the sand. Kneeling beside it, he gently pulled away the wild *naupaka* taking root in the flawless teeth.

"If you could talk," he said, "what would you tell me?"

His voice quivered with sadness, though he has had many such disturbing encounters with Hawaii's past. As a boy, he walked these deserted dunes near Wailuku, discovering whole skeletons and skulls. He reburied them where they lay, but there was little he could do then or now, as the custodian of nearby Kepaniwai County Park, for the hundreds of bone fragments that appear and disappear in the shifting sands after a storm.

Whose bones are they?

"We don't know," said Keau. "The dunes have never been excavated."

The name Wailuku means "water of destruction," suggesting that the area was the site of some fierce battle. In fact, nearly 200 years ago, when the Pacific island chain was divided into separate warring kingdoms, the ambitious chiefs of the neighbor island of Hawaii landed their canoes near Wailuku and clashed with the powerful Maui ruler. So many were slain that the stream flowing through the Iao Valley was supposed to have turned red with blood. The Hawaii warriors were victorious, and their leader, Kamehameha (Kah-MEH-ha-MEH-ha), was on his way to consolidating the archipelago under one rule. Could these be the bones of the fallen warriors?

"Whoever they are—they are my *ohana* [family]," said Charlie Keau, whose ancestors have farmed the Iao Valley for generations. "I wish I could bury them all so they would never be disturbed. Why should they suffer more from the harshness of nature?"

Throughout the islands, native Hawaiians have a deep emotional relationship to their past. (See *Hawaii*, a historical map supplement with this issue.) To them, it is as tangible—and in many ways as unsettling—as the bones in the Wailuku dunes. Since the arrival of British explorer Capt. James Cook

in 1778 and the gradual domination by Western culture (culminating with statehood in 1959), they have rarely expressed these feelings openly.

Decimated by the white man's diseases, Hawaiians became a minority in their own land. Their cultural pride suffered under the influence of 19th-century missionaries who vilified them for polygamy, public nakedness, and "lewd" and "wicked" dancing.

"Even when I was growing up, Hawaiians were considered second-class citizens," said Phil Kwiatkowski, 35, a security guard who is part Hawaiian. "Some would hide it, if they could. To be Hawaiian carried a certain stigma—it meant you were ignorant, lazy, primitive, pagan."

The winds of the civil rights movement of the sixties reached Hawaii a decade ago, bringing a cultural awareness and a political activism to the islands. Hawaiians and part Hawaiians, now 19 percent of the state's 994,000 people, began excitedly exploring their rich cultural heritage. They re-created a 3,000-mile canoe voyage of their Polynesian ancestors,* stepped up the restoration

*See "Hokule'a Follows the Stars to Tahiti," by David Lewis, and "A Canoe Helps Hawaii Recapture Her Past," by Herb Kawainui Kane, NATIONAL GEOGRAPHIC, October 1976 and April 1976.



of historic sites, and revived ancient hula, chanting, religion, and traditional crafts and sports in an ongoing lovefest that has been called the Hawaiian Renaissance.

THE GREAT WARRIOR who audaciously invaded Maui in 1790 and finally, 20 years later, subdued all the Hawaiian Islands occupies a special place in their history and this cultural revival. Conqueror, king, statesman, lawgiver, Kamehameha (circa 1758-1819) has been called the Napoleon of the Pacific.

He bravely steered Hawaii out of the Stone Age without abandoning faith in the ways of his ancestors. While he impressed Cook, and later Capt. George Vancouver, with his shrewdness, he was remembered by his people as "a father to the orphan, a savior to the old and weak, a helper to the destitute, a farmer, fisherman, and cloth maker for the needy."

"In any land and in any age he would have been a leader," wrote King Kalakaua, sixth Hawaiian monarch to succeed Kamehameha. "He was so strong of limb that ordinary men were but children in his grasp, and in council the wisest yielded to his judgement."

He deserves a monument, observed Russian explorer Otto von Kotzebue after meet-

ing him in 1816. Today Kamehameha has many, though he is one of the most inaccurately documented men of destiny. He is the only king to be honored along with George Washington and Robert E. Lee in the National Statuary Hall collection of the U. S. Capitol, and a Polaris nuclear submarine bears the name of this son of seafarers.

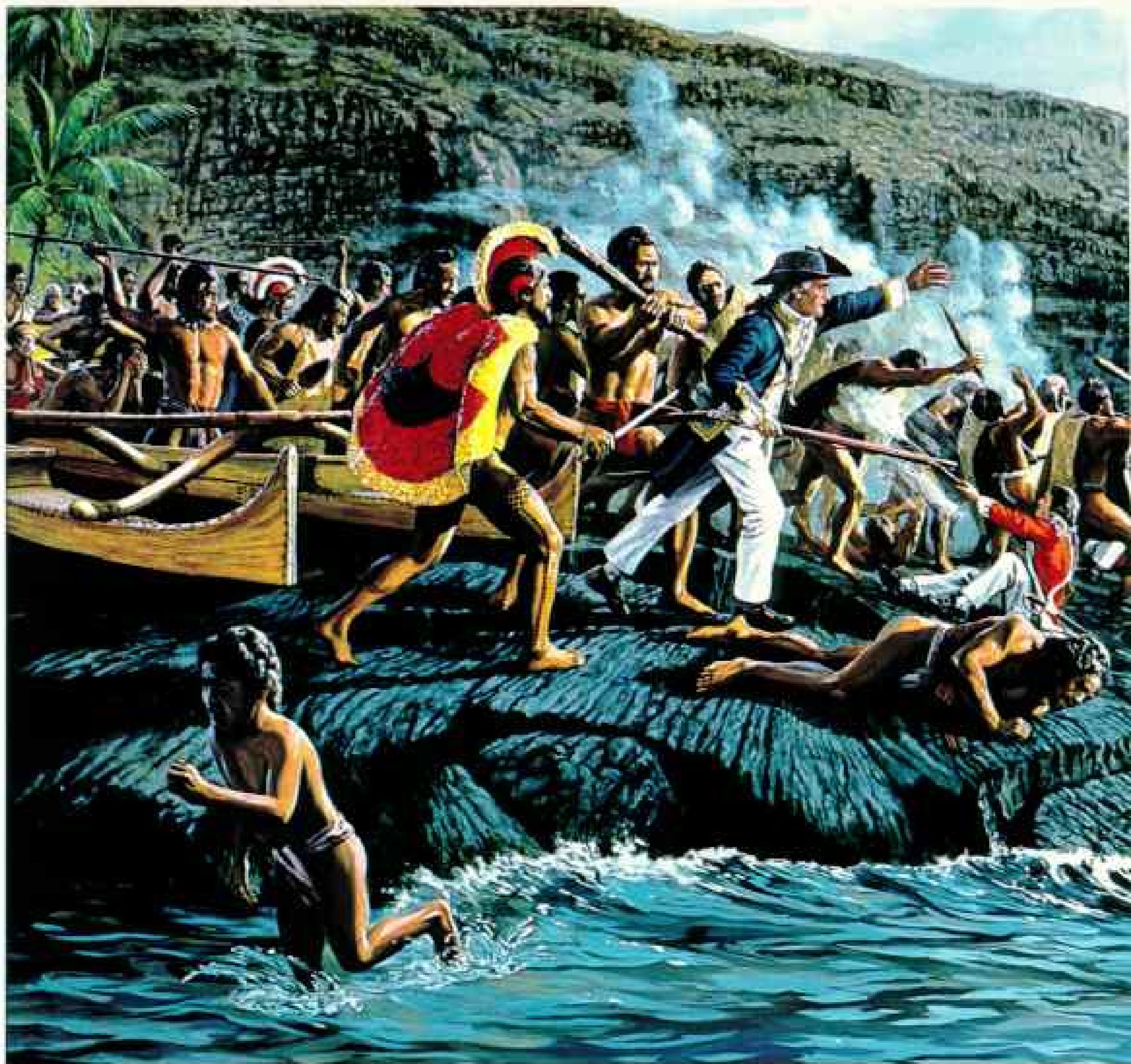
For Hawaiians today, struggling to resurrect their cultural values, Kamehameha is viewed both as founding father and unwitting antihero, whose reign marked the beginning of the end of the Hawaiian way of life. Still, if a Hawaiian can claim to be descended from Kamehameha, it is a little like a mainland American tracing his family back to the Pilgrims. Kamehameha's memory is marked every June in a lavish state holiday with parades and luaus.

The setting sun cast an orange glow on the statue of Kamehameha and the large crowd that gathered in downtown Honolulu for the official beginning of the King Kamehameha Celebration. Although plastic leis are sold at newsstands in Honolulu's airport, the custom of giving leis with genuine *aloha* (love) was evident here. Eighteen-foot garlands of yellow and orange marigolds, ti leaves, delicate *ohai ali'i* and *ilima* blossoms, and leis of orchids were gently draped on the statue's



Ambition to rule led Kamehameha into skirmishes with rival chiefs, who ruled a feudal society often compared to medieval Europe's. Born on Hawaii about 1758, he distinguished himself first as a warrior serving his uncle, ruler of the island. In 1790 Kamehameha launched his conquest of islands to the west, invading Maui with a new weapon, a cannon from a captured ship, the Fair American. So many Maui troops fell near Wailuku that, legend says, their corpses choked a stream. A wind-eroded jaw (left) symbolizes that carnage to local people.

Battle site
 0 KILOMETERS 25
 0 STATUTE MILES 25
 DRAWN BY DEBBIE DRAMURA-JOHNSON
 (ILLUSTRATED BY BRADLEY J. TRUCCO)
 NATIONAL GEOGRAPHIC CARTOGRAPHIC DIVISION



“**A** MOST MISERABLE SCENE of confusion,” as one observer wrote, marked the death of navigator Capt. James Cook, first European known to have reached the Hawaiian chain. In 1779 he landed at Kealahakua Bay, on Hawaii, where he accepted the effusive hospitality of the island’s high chief, Kamehameha’s uncle, whose priests mistook the Englishman for the god Lono. Kamehameha joined in the welcome. Cook sailed away only to return when a storm damaged one of his two ships. After Hawaiians stole or

impounded a cutter, Cook and his marines audaciously tried to take the chief hostage, but were met by several thousand armed villagers. By various accounts Cook was hit with a club and stabbed with daggers of iron and a swordfish bill (**below**).

For this painting, artist Herb Kane researched the weapons, uniforms, ships and eyewitness accounts in Hawaii and England. His daughter, Lehua (**right**), swims underwater to read a 55-year-old commemorative plaque on a shore that has sunk 32 inches since Cook’s day.



PHOTOGRAPHED AT BISHOP MUSEUM



COLLECTION OF NICK G. MAGGOS (ABOVE)



neck and raised arms with the help of Honolulu firemen. Nervously, a little girl approached the statue with a lei made from the young red buds of the *ohi'a lehua* tree from the island of Hawaii, where Kamehameha was born. She said softly in Hawaiian:

"From us, your children, accept these tokens of love and labor this day. Help us, teach us unity. . . ."

Darkness was falling when the dancers of Frank Hewett's hula studio, black hair flying, burst into the park in front of the statue.

*The rain in Hamakua
Falls to the sea at Opaeha.
First it rises up,
Then it falls down.
It easily pierces the surface.
Where? Here!
Where? Right here.
This one doesn't play deaf.
He acts—Kamehameha.*

Bare feet stamped cool grass, and ti-leaf skirts whirled feverishly in the shadows, as a chanter recited the *mele* and pounded the rhythm of the dance on a gourd drum. The hands of the dancers in the forceful language of the ancients described rain as the life-giving force in nature and made it clear that the dance celebrated the sexual prowess of Kamehameha, whose duty it was, like all great chiefs, to pass his *mana* (spiritual power) on to successive generations.

The earthy themes of ancient hula horrified New England missionaries, who convinced the chiefs to ban it. Even a decade ago a public performance might have embarrassed some Hawaiians. Today, however, there are more than a hundred hula schools, and tickets to the annual Merrie Monarch competition are harder to get than box seats at the World Series. The early Hawaiians had no written language, so hula and chanting became their literature and history as well as part of their religious ceremonies.

"There is a hula for life and a hula for death, hulas for kings and common people, and hulas for joy and sadness," said hula master Robert Cazimero. "It is the heartbeat of the people."

Cazimero has been instrumental in reviving hula for men in recent years. One of the theories of the origin is that it is related to

lua, Hawaii's ancient martial art, and that the first hula dancers were men.

Interest in hula is one of the most conspicuous aspects of the Hawaiian Renaissance, but there is, under the gaiety of song and dance, a serious concern for the poor and disadvantaged native Hawaiians. Like most minorities in America, they are underemployed and undereducated and overrepresented on the welfare and prison rolls. The problems are far from being solved, but at least, as the *Honolulu Advertiser* noted in a recent editorial, they are finally being addressed by such organizations as the new state Office of Hawaiian Affairs and the Native Hawaiians Study Commission, whose report on the needs of the Hawaiian people was presented to Congress last June. The editorial concluded:

"There remains a sense of impending change not yet fulfilled in the Hawaiian community on this Kamehameha Day, even as there might have been during the early years of the great king's life when important events were in the offing."

BY THE TIME the infant in Naeole's care was five, Alapainui had forgotten his fears and accepted the boy into his household. It was said that he was a child without laughter, and so he was named Kamehameha (The Lonely One).

At the royal court he was introduced to the complexities of the *kapu* system, the network of taboos that reinforced Hawaiian society and pervaded every aspect of life. Canoes were not built, nor fields cultivated, without the proper prayers and ceremonies. It was forbidden under penalty of death for men and women to eat together, or for the shadow of a commoner to fall on a chief.

Kamehameha was placed in the hands of Kekuhaupio, the most famous warrior of the day, who instructed him in sports—diving, wrestling, spear throwing, surfing—which the Hawaiians thought would develop a warrior's strength and courage. The young *ali'i* (chief) grew so strong of limb that it was reported he overturned the huge Naha stone in Hilo, weighing 4,500 pounds. People shuddered at this portentous feat, for it was believed that whoever moved the great stone would one day rule the island.

In the ways of being a man Kamehameha

was taught by the beautiful young wife of his uncle Kalaniopuu, who later succeeded Alapainui. The experience produced his first son. Eventually, by some accounts, Kamehameha would have 21 wives and father 24 children by nine of them.

The memory of the young Kamehameha lives among the people of Kohala, still a sparsely populated agricultural district with weather-beaten towns reminiscent of the mainland's Old West. Paved roads stop at the edge of the jade green mountain valleys where Kamehameha first lived. Winding mule trails surrender to precipitous footpaths local people say were cleared by ancient warriors. At Awini is an old lodge that boar hunters still use and the remains of a rusty still, where Japanese farmers in the 1920s made a fiery bootleg liquor from the root of the ti plant. Nearby, adventurous young families are exploring the life-style of their ancestors, cultivating taro, a root crop and Polynesian staple. Bananas, guavas, avocados, papayas, and edible ferns grow wild in this remote Eden.

A strong wind blows off the valleys, and clouds move quickly overhead. At night the *kukui* trees move and sway restlessly. "Night marchers"—spirits of the dead—seen as a procession of lights or shadows along ancient trails, are reported. Some people say the towering image of Kamehameha is sometimes among them. Kahuna are often consulted in Kohala before a new house is built, to be sure it is not in the path of these wandering shades.

STOUT, MUSCULAR, well over six feet tall, Kamehameha had already proved himself an able warrior when Captain Cook landed at Kealahou Bay in January of 1779. Hawaiians thought the British explorer, probably the first white man they had ever seen, was Lono, the god of peace and agriculture, and presented him with offerings of the finest taro, the fattest pigs, and the freshest fruits and vegetables. Journals from the voyage make note of an arresting young chief, who was apparently a favorite of the king:

"We soon discovered among his attendants . . . Maiha-Maiha [Kamehameha], whom at first we had some difficulty in recollecting, his hair being plastered over with

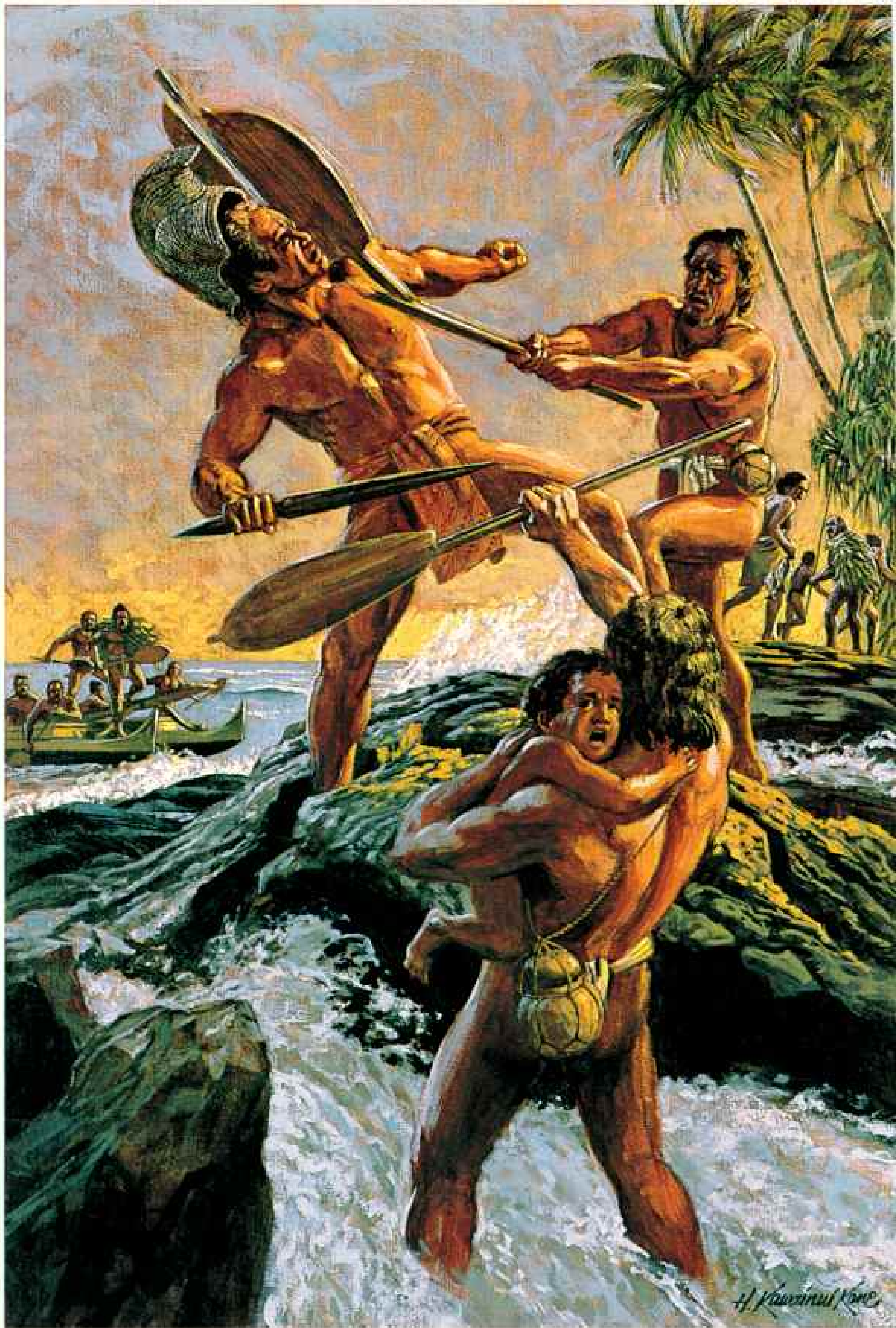
a dirty brown paste and powder, which was no mean heightening to the most savage face I ever beheld . . . it however by no means seemed an emblem of his disposition which was good natured & humorous; Although his manners shew'd somewhat of an overbearing spirit & he seem'd to be the Principal director in this interview. . . ."

Captain Cook was soon discovered to be very mortal indeed and was killed by the Hawaiians during a dispute over a missing cutter. British seamen thought they saw Kamehameha at the scene. It was also reported that Kamehameha added to his prestige by keeping the hair of Captain Cook.

IN 1782 KALANIOPUU died, naming his son Kiwalao heir but giving his nephew Kamehameha custody of the powerful war god, Kukailimoku. The cousins did not get along well. Kamehameha had preempted Kiwalao in an important human sacrifice at a new *heiau* (temple) in the district of Kau. Kiwalao insulted his cousin at the interment of Kalaniopuu's bones in the sacred sanctuary at Honaunau. Before long there was open warfare between Kamehameha and his rivals, and Kiwalao was struck down by a slingstone and his throat cut with a weapon edged with shark's teeth.

On an unprovoked raid on the Puna coast, Kamehameha's foot was caught in the crevice of a rock and, while trapped, he was bashed on the head with a paddle by a fisherman (painting, next page). Years later he enacted one of his most stringent laws, called *Kanawai Mamalahoe*, Law of the Splintered Paddle, to protect the defenseless and ensure the safe passage of women, children, and the elderly on roadways.

The Law of the Splintered Paddle was incorporated into the new 1978 state constitution to underscore Hawaii's concern for personal safety. The state also committed itself, in a broader fashion, to respect the traditional way of life of native Hawaiians, to "conserve and protect" Hawaii's beauty, and to hold "in trust" for the people all natural resources on public land. The full impact of these extraordinary provisions has yet to be realized, but recently Hawaiians in north Kohala used them to help maintain their access rights to the traditional hunting and fishing grounds of Kamehameha.



H. Kaurinus Kone



ARTIFACTS PHOTOGRAPHED AT BISHOP MUSEUM



A SKULL-BATTERING lesson, taught to Kamehameha in 1783, became law. Spotting fishing families loyal to a rival, the brash Kamehameha leaped ashore to attack, catching his foot in a lava crevice. One fisherman smashed a paddle over his head before rescue arrived. Years later Kamehameha decreed that persons should be secure from wanton attacks by chiefs—his *Law of the Splintered Paddle*.

More than by laws, however, Hawaiians were ruled by religion. Kamehameha was appointed guardian of the war god,

Kukailimoku, seen here as a six-foot wooden image (above left), to whom chiefs sacrificed animals, criminals, and conquered warriors. Kamehameha, wearing his cloak of yellow feathers, carried into battle the god's bird-feather visage set with dog teeth (top right).

Any object of a chief took on his power, or *mana*. This driftwood refuse bowl, set with 289 human teeth (above), would be emptied in secret, so "enemies cannot afflict them [the chiefs] with any disease by enchantment," a Russian navigator noted.



Stage for sacrifices, this temple to the war god rose at Hawaii's Puukohola in 1790 after a soothsayer predicted that it would ensure Kamehameha total victory. To build it, his followers came in relays, bearing stones and camping on nearby hills.

A lava path to Kamehameha's headquarters on Hawaii (right) winds through ancient petroglyphs. To preserve them, today's Hawaiians insisted that a golf course be diverted.

When falling sugar prices forced the Kohala Sugar Company to close its mill in 1975, much of the land was leased to ranchers for cattle grazing. Fences went up to keep the cattle in and the poachers out, and, for the first time, local people were denied access to favorite fishing coves and upland forests where their families had hunted for generations.

"Yes, I can live without being able to use these lands, but it would be a hardship for



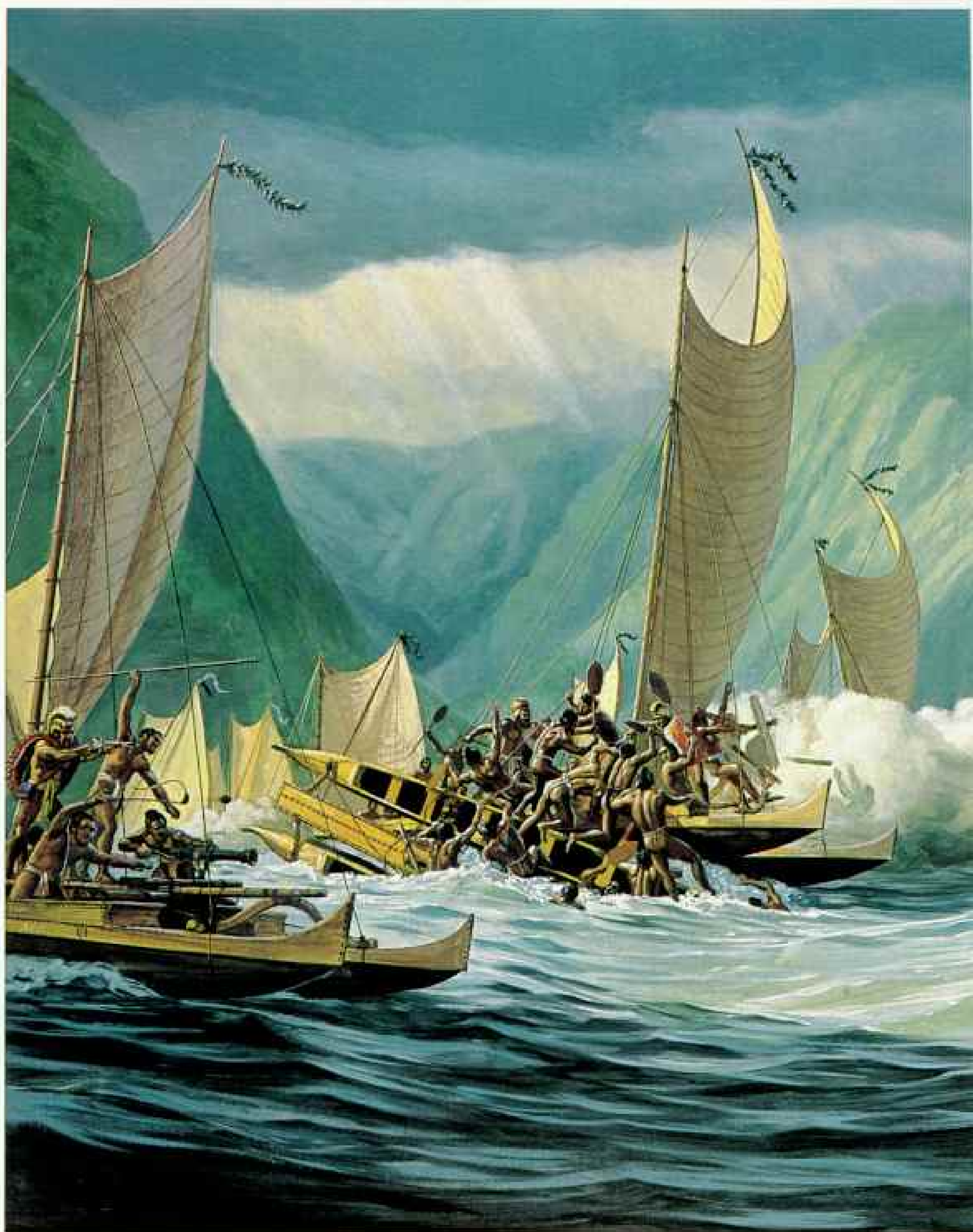
me and my family," said Tommy Solomon, a retired ambulance driver.

Banding together with his Hawi neighbors, Solomon formed an organization named for the Law of the Splintered Paddle and succeeded, after lengthy legal battles, in obtaining keys to some of the ranchers' locked gates.

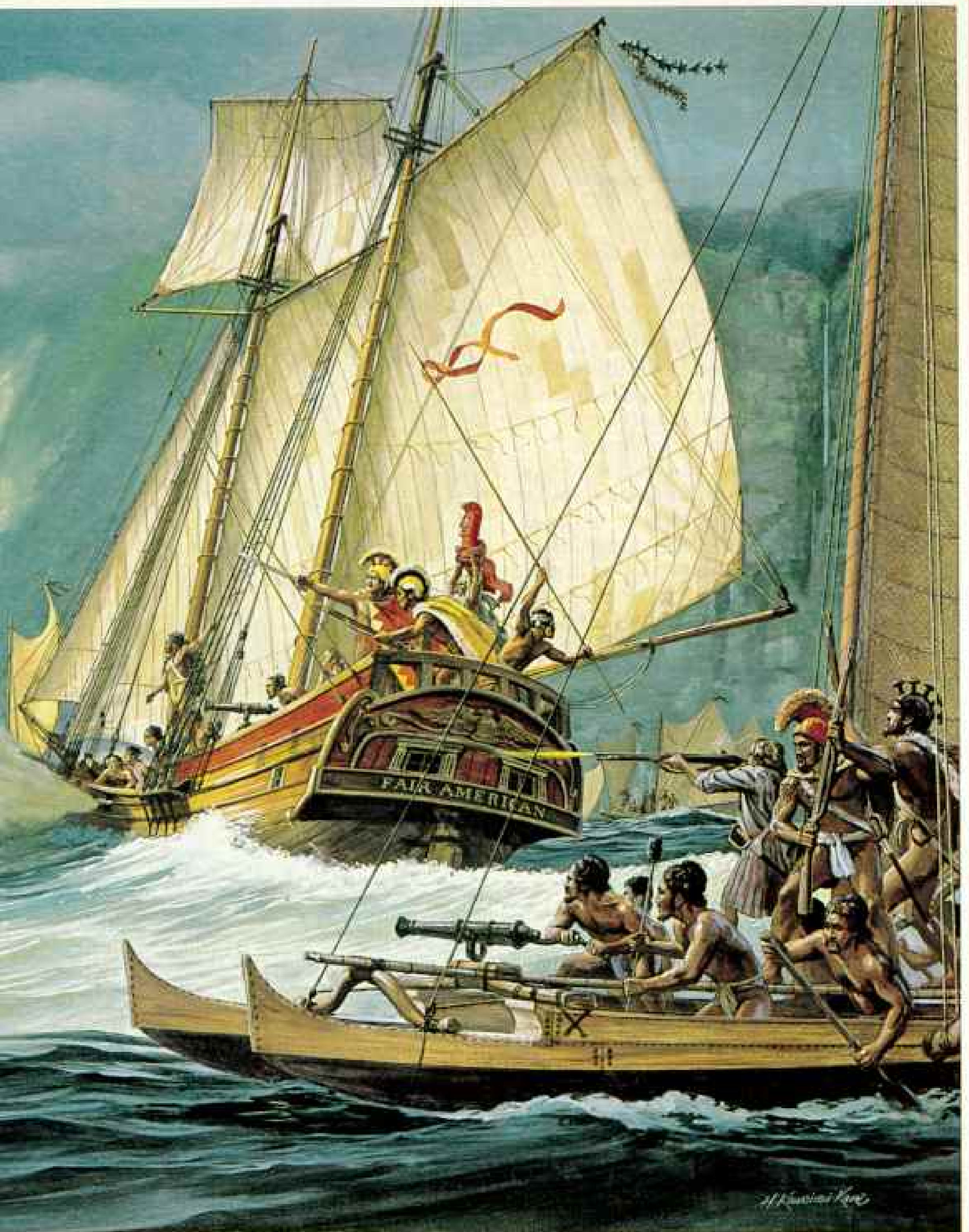
On a summer afternoon Solomon drove me through cow pastures near Halawa to two enchanted coves, Kapana Beach and

Hapuu Bay. These were, he said, Kamehameha's favorite surfing and fishing places in his youth, and they are still popular with local surfers and fishermen. A tropical storm to the south churned the sea that day. We watched as several teenage surfers rode the perilous waves, abandoning them moments before the angry water shattered against the rocky coast.

"On a good day, I bring home 75 or 80 pounds of fish—mullet, aholehole,



BATTLING AT SEA, Kamehameha took on the combined fleets of enemy chiefs from Oahu and Kauai who in 1791 reclaimed Maui and then raided his home island of Hawaii. Here off Waimanu, from the deck of the 54-foot schooner *Fair American*, Kamehameha directs with his sword beneath the raised



feathered war god. A signalman waves pennants to relay orders. Recently captured Englishmen fire a cannon from midship. By day's end the shattered invasion fleet returned to Maui to prepare for retaliation. Hawaiians named this bloody encounter the battle of the red-mouthed gun.

bonefish, or threadfish," said Solomon, whose quiet disposition seemed in tune with the temperate climate. "I save some and share the rest with my neighbors."

*These are our gods, whom I worship;
Whether I do right or wrong,
I do not know;
But I follow my faith, which cannot
be wicked, as it commands me
never to do wrong.*

—KAMEHAMEHA

FOR NINE YEARS, between 1782 and 1791, Kamehameha had little time to enjoy his surfing coves as he battled rival chiefs on the island of Hawaii and embarked on his conquest of Maui. There were many bloody encounters but no clear victor. As contact with foreign traders increased, the chiefs hurried to equip themselves with muskets and cannon. In addition, Kamehameha pressed two English seamen into his service, Isaac Davis and John Young, who would play a large part in his future victories.

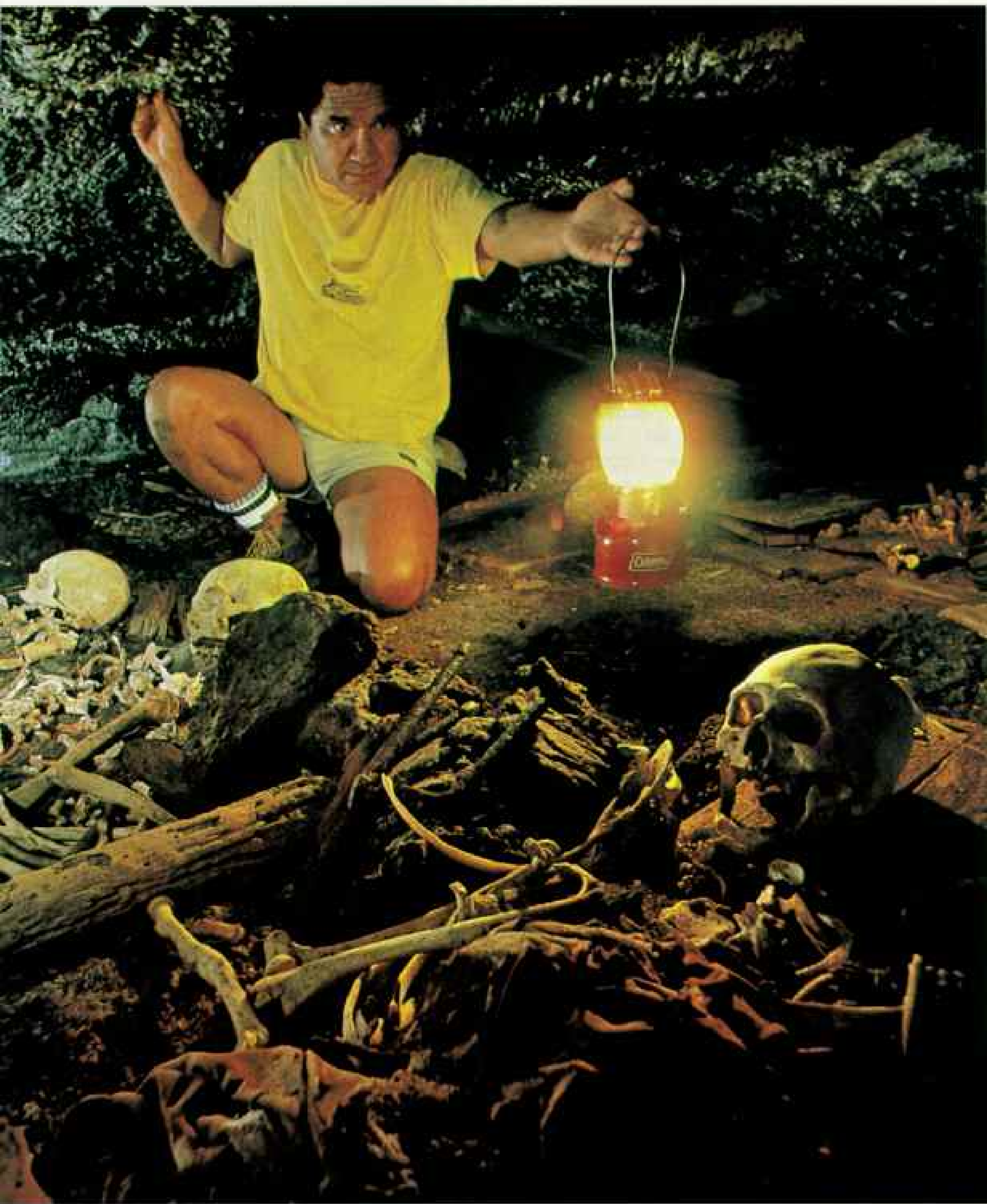
During this time Kamehameha took two wives. One was Kaahumanu, a six-foot, 300-pound woman who would become Kamehameha's great counselor and the "wife of his heart." The other bride was the delicate 11-year-old Keopuolani, with whom he would have a formal, politically expedient union. She belonged to the highest ali'i class, and the right of succession of their two sons (Kamehameha II and III) was never questioned.

In 1790, frustrated by the stalemate with his rival chiefs, Kamehameha sought the advice of a famous soothsayer on the island of Kauai, who said that he must build a new temple for his war god on Puukohola (Hill of the Whale) near Kawaihae if he was to be ruler of Hawaii. Work on the structure began just before Kamehameha successfully repelled an attack by his cousin Keoua.

On Keoua's retreat south to his home in Kau, he tragically lost a third of his warriors in a violent eruption of the Kilauea volcano on the slopes of Mauna Loa. Suddenly engulfed in a dense cloud of smoke, ash, and suffocating fumes, hundreds perished. Rain turned the fine ash to clay, which hardened, preserving what is believed to be the footprints of the trapped warriors. They can still



Pursuing a legend, Tyrone Young visits a burial cave in a lava tube on Hawaii where four skeletons lie on moldering wooden planks as if at



attention. "My family and neighbors believe the remains to be crewmen of the *Fair American* captured right off this shore," he reports. The ship's lone survivor, Isaac Davis, and fellow Englishman John Young—detained from another ship—served Kamehameha as interpreters and advisers for the rest of their lives.

be faintly seen today, in Hawaii Volcanoes National Park.

More than the loss of men, the incident was psychologically damaging to Keoua. It appeared that the volcano goddess, Pele, had shown her favor to Kamehameha. Were the gods now on Kamehameha's side?

IN 1791 the Puukohola heiau was completed. Rows of wooden images and thatched houses for priests and the ruling chief were erected on a huge 224-by-100-foot platform of lava rocks with a commanding view down the coast. Two of Kamehameha's counselors traveled to Keoua and persuaded him to come to Kawaihae, saying Kamehameha wanted peace. Against the pleadings of his advisers, Keoua went. Along the way, however, he stopped to select his *moepuu*, companions in death, who then rode in his canoe. Clearly, Keoua suspected he was about to die.

"Here I am," Keoua said, when his canoe reached Kawaihae.

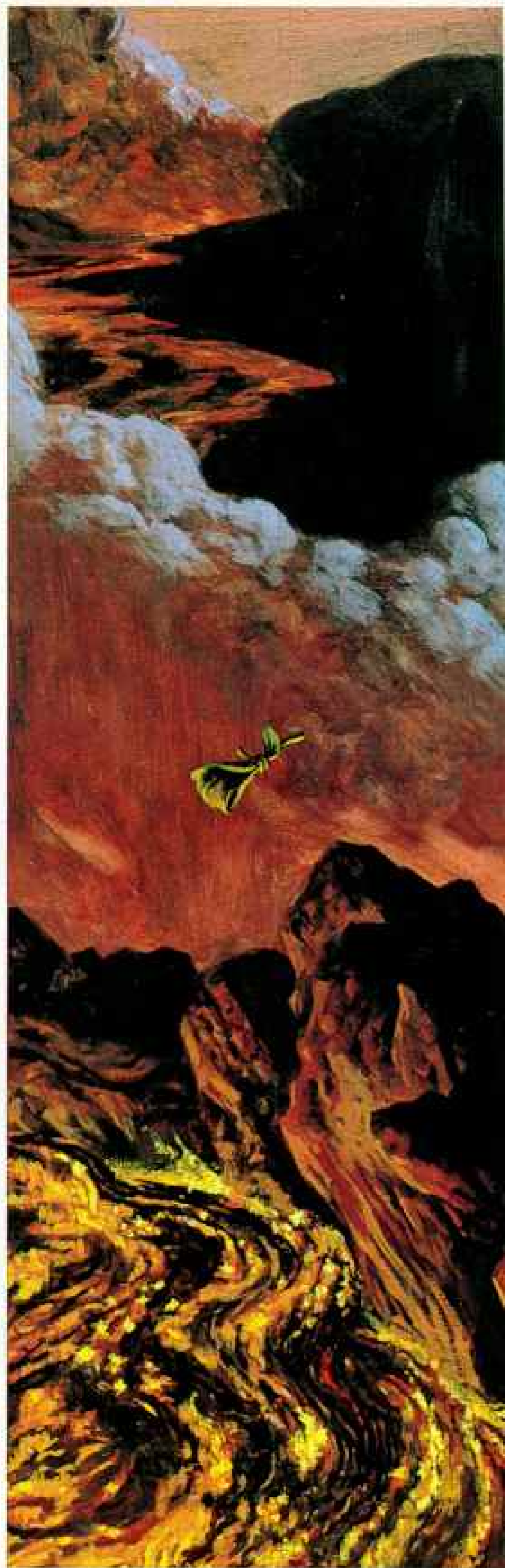
"Stand up and come forward that we may greet each other," Kamehameha called.

As Keoua rose, one of Kamehameha's chiefs threw a spear at him, which he dodged. Muskets were then fired from the shore, and Keoua was killed. Some accounts of the story say that Kamehameha genuinely sought to end the fighting with his cousin but was thwarted by his ambitious chiefs.

As was the custom, Keoua's body was baked in an underground oven until the flesh came loose from the bones. The bones, which Hawaiians believed contained the mana of the chief, were offered to the war god Kukailimoku in a solemn night of prayer. If anyone made a sound—if a baby cried or a dog barked—the night the prayers were offered, they would themselves have been put to death.

"The bones of chiefs were sought for making fishhooks, because their mana would

TO INVOKE the goddess Pele, Kamehameha in 1801 casts a gift—a lock of his hair wrapped in a ti leaf—into a lava flow from Hualalai, after an eruption had covered fishponds and endangered villagers. Shortly, the volcano quieted—and has not erupted since.





H. Krumpholtz Kano

have been good for fishing," said Ed Ladd, a National Park Service archaeologist and an expert on Big Island sites. "Out of respect for Keoua, however, his bones may have been secretly buried or returned to Kau."

Late one afternoon Ed Ladd and I visited the Puukohola heiau, now a national historic site. Only the round, black stones of the temple base remain, resting on a barren hilltop like some primordial creature. The sun set orange against a purple expanse of ocean, and the only sound was the wind through the dry grass. Mountain, sea, and sky seemed to come close together here as if they were in a giant kaleidoscope.

We lingered. A total eclipse of the moon was expected that night. Not long after the full moon peaked above Mauna Kea, it began to turn a tomato red. The color deepened as the moon moved deeper into the earth's shadow. Science could explain the event but not dispel the uneasiness I felt sitting under a red moon.

"Are religious ceremonies still held here?"

"The Waimea Hawaiian Civic Club was primarily responsible for putting a kapu on the temple, prohibiting visitors," said Ladd. "Local people use it—for what, I don't know."

Vestige of a belief in the ancient gods is not something most Hawaiians acknowledge. Yet, to inspire their steps before an important hula festival, dancers will toss flowers and bottles of gin into the Kilauea volcano for the high-spirited goddess Pele, and make offerings of fresh fruits wrapped in ti leaves to Laka, the goddess of dance. Many Hawaiians know who their *aumakua* (family gods) are and tell stories of how these spirits, in the shape of lizards, owls, sharks, or other creatures, intervened in their lives. And an occasional fugitive still seeks safety, as the ancient Hawaiian lawbreakers did, in the Pu'uhonua o Honaunau (Place of Refuge).

"Our religion went underground—it didn't die," said Edward Iopa Kealanahale, a lay Congregational minister and kahuna, who is descended from the kahuna who worshiped at the Puukohola heiau in Kamehameha's time.

Kealanahale, a soft-spoken man in his 50s, visits Puukohola at least once a month. He said that he enters the heiau after midnight and sits for hours on the cold stone

foundation of the *hale mana* (house of spiritual power) communing with the spirits of his ancestors by tapping stones.

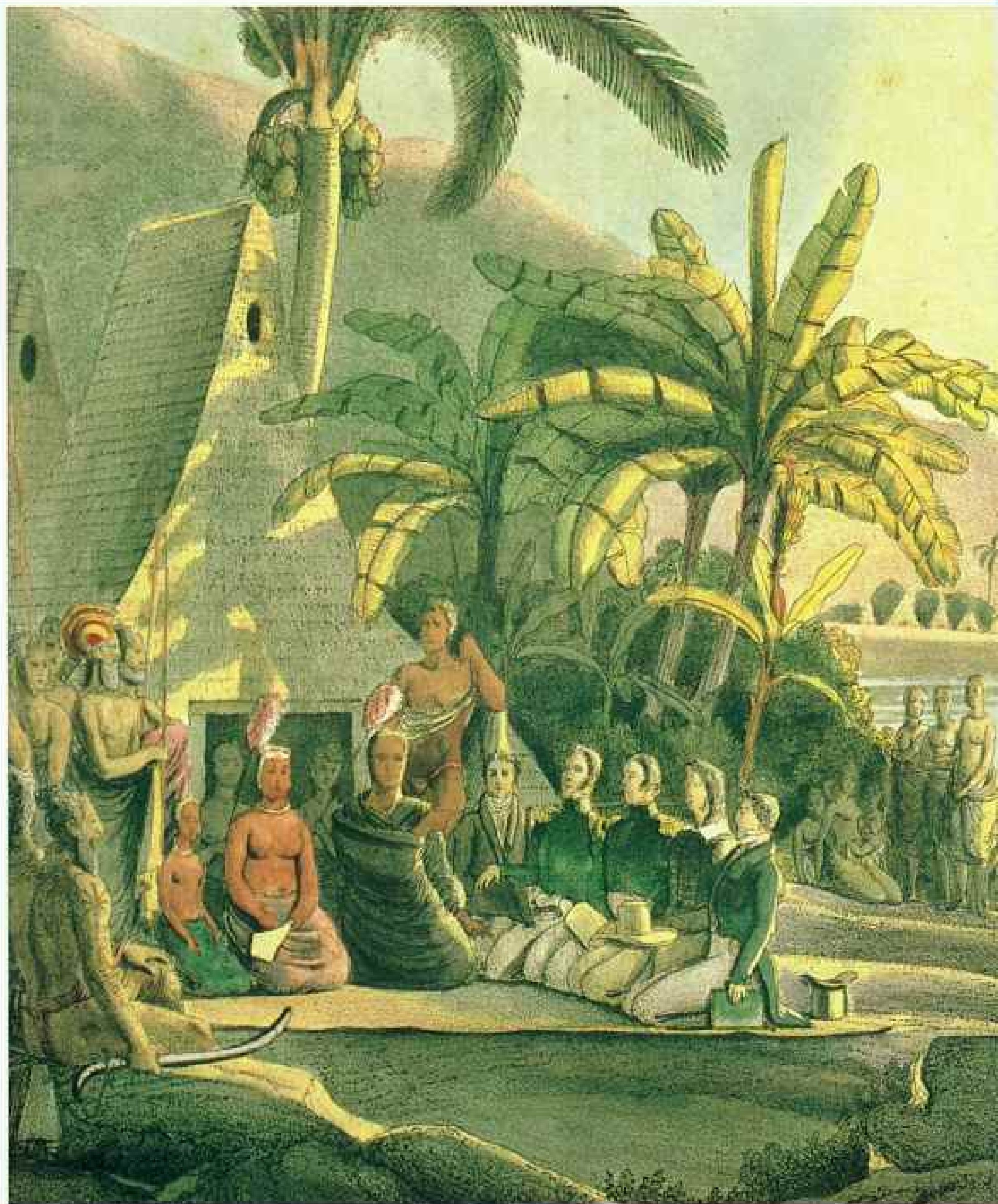
WITH THE DEDICATION of the Puukohola heiau and the death of Keoua, Kamehameha in his 30s became ruler of the island of Hawaii. Four years later, in 1795, he launched an invasion fleet of some 1,200 canoes and more than 10,000 warriors and finally took Maui, Molokai, Lanai, and Oahu. Kamehameha's superior strength in European weapons was credited with routing the strong Oahu army



RICHARD A. COOKE (IN BRIGHT)

Fountains of fire, 800 feet high, erupted last spring from Kilauea—one of the world's most active volcanoes. Slow-moving lava engulfed some homes. A 1790 explosion flung clouds of cinders and stones, raining destruction for miles and trapping warriors of one of Kamehameha's rivals. Footprints, perhaps from that era—pitiful reminders of terror—are visible in Hawaii Volcanoes National Park (above).





THE FINAL GOLDEN YEARS of peace and plenty found an aging but loquacious Kamehameha receiving all Honolulu-bound traders and explorers at his compound in Kailua, Hawaii. There in November 1816 Russian naval officer Otto von Kotzebue was impressed by the English-speaking king's "unrestrained friendly behavior," his ability to adopt Western ways that he deemed useful, and his astuteness in keeping his chiefs with him, depriving them of "any opportunity they might otherwise have of conspiring against him." The Russian



LITHOGRAPH BY LOUISE CHORIS, BISHOP MUSEUM

party marveled at the well-built thatched houses and the temple, right, devoted to the Hawaiian religion that the king espoused, since "it commands me never to do wrong." Statuesque women, draped in kapa (tapa) and in silk scarfs, ate separately from men, as required by strict taboo.

up the Nuuanu Valley. Trapped, many of the fleeing warriors were pushed or jumped in hopelessness to their deaths off the 1,200-foot Nuuanu Pali (painting, pages 560-61).

Kamehameha immediately set his sights on Kauai and Niihau—70 miles away and the only islands outside his control. Halfway across the treacherous channel between Oahu and Kauai, however, Kamehameha's men encountered a storm, or *ino*, that capsized many canoes. The crippled fleet returned to Oahu.

Kamehameha's next strategy was to build a navy of very large, stable canoes, rigged with sails of Western design for speed, which could hold 50 to 100 warriors. Some 800 of these *peleleu* canoes were eventually assembled on Hawaii, but this fleet met with no more success than the last. During a stop-over in Oahu on the way to Kauai in 1804, an epidemic, probably cholera or plague, killed many of his warriors, and the magnificent *peleleu* canoes were left to rot on the shores of Waikiki. Kamehameha himself became ill, but recovered. In just 26 years after first contact with Europeans, the Hawaiian population had shrunk from an estimated 300,000 to 195,000, primarily because of imported diseases, such as pneumonia, smallpox, measles, syphilis, and gonorrhea.

Elusive Kauai and Niihau were finally incorporated into Kamehameha's kingdom in 1810 by diplomatic means. At the urging of American and European merchants, who feared warfare would disrupt the lucrative sandalwood trade, Kauai ruler Kaumualii acknowledged Kamehameha as sovereign and agreed to pay him tribute. Kamehameha, in turn, permitted Kaumualii to govern the island until his death. The conquest of the islands was complete. It had taken Kamehameha 28 years.

According to Kauai islanders, Kamehameha did, in fact, once land on the island near Koloa on the southern coast and was badly defeated. Tales speak of the crafty Kauai warriors who attacked Kamehameha's men at night and loaded their canoes with heavy rocks so they would capsize in a hasty retreat. The Hawaiian word "ino" can mean either a "storm" or "to harm." Perhaps bad weather was not responsible for the failure of Kamehameha's attack on Kauai in 1796.



Westernization of Hawaii, increasing in the 19th century, found expression in ornate Iolani Palace in Honolulu. Overthrowing Queen Liliuokalani in 1893, American businessmen

turned the royal home into Hawaii's capitol, a role it served until 1969. An exacting restoration, led by Princess Abigail Kekaulike Kawanunakoa (above), has returned the palace to its

original sparkle.

Westernization also spelled loss of power. Kamehameha III (upper right, center) allowed foreigners to own land and join in government. He is



pictured about 1852 with wife Kalama, at right, niece Victoria, and nephews who became Kamehameha IV and V. Their half sister, Princess Ruth (right), was governor of the island of Hawaii.



BISHOP MUSEUM (ABOVE AND BELOW)



It is ironic that Kauai, the first place Captain Cook set foot in the Hawaiian Islands in 1778, is one of the few places where Hawaiian is the everyday language, spoken by people who come from Niihau. Kauai is also the last home of the nearly extinct 'o'o, a forest bird, whose yellow feathers were used to make the cloaks of the Hawaiian chiefs.

For more than a hundred years the 200 Hawaiians on the small, barren island of Niihau, 17 miles from Kauai, lived pretty much to themselves. The Robinson family, descended from New Zealand sheep ranchers who bought Niihau from Kamehameha V more than a century ago, seldom permitted visitors. Until recently, when shortwave radio was installed, the only contacts with the outside world were via carrier pigeon, signal fires, or the weekly visits of a whaleboat. The island was the only Hawaiian precinct to vote solidly against statehood.

In the past decade, however, the Robinsons' ranching operation on Niihau has not been self-supporting, and many of the Niihau people have been brought over to Kauai to live and work on the Robinsons' large sugar plantation. In the summer the population of the Robinsons' plantation village of Pakala, near the spot where Kamehameha was supposed to have landed, swells with Niihauans. There is no renaissance here. People of Niihau live their culture.

"Hu-u-i, alo-o-oha!—Hey, hello!"

I was bumping along the dirt roads of Pakala with teacher Paul Williams and a truckload of Niihau children he was tutoring in English. People smiled and waved at us. It was the warmest greeting I received on the islands. Outside the weathered, metal-roofed homes, women sat at picnic tables weaving strands of tiny shells into necklace leis. There is little water on Niihau and few flowers. Women use the island's delicately colored *momi* and *kahelalani* shells to make leis that bring \$85 to \$2,000 each in a good market. When the last child was dropped off, we stopped to talk to Mrs. Alina Kanahele, who, we discovered, was related to Benehakaka Kanahele, perhaps Niihau's most famous citizen.

Benehakaka jumped a Japanese pilot who crash-landed on Niihau after the bombing of Pearl Harbor in 1941. Benehakaka took three gunshot wounds before finally

picking up the pilot and knocking him unconscious against a wall. His wife then crushed the pilot's skull with a rock.

As Mrs. Kanahele worked on her leis, she listened to a large stereo radio the Niihauans call *pahu ho'olele leo* (literally, "box that makes the voice fly").

"I want my children to learn English so they can help us," she said. She spoke very rapidly in Hawaiian to Paul Williams. "But I am worried about my son John. His Hawaiian was getting so rough I sent him back to Niihau for the summer. No, I don't want him to forget his Hawaiian. . . ."

For the people of Niihau, English opens the door of opportunity. It can take them off the plantation. But it also pulls them away from their island and their culture, and they are understandably torn. How long the Niihauans can retain Hawaiian as their native language with a growing number of stereophonic *pahu ho'olele leo* and *kiwi* (TVs) also remains to be seen.

AS RUTHLESS as Kamehameha was in war, he was generous and forgiving in peace. In addition to the Law of the Splintered Paddle, he created laws against murder, theft, and plundering. He encouraged his people to increase food production and, as an example, set up several farms and worked the land himself. Shrewdly, Kamehameha divided the conquered lands among his high chiefs in detached parcels to diffuse the possibility of rebellion and to create a lasting kingdom.

Once, when a British sailor told Kamehameha that he had never seen King George III, Kamehameha was astonished.

"But, does not George go about amongst his people to learn their wants as I do?" he asked.

"No," said the sailor, "he has men who do it for him."

Kamehameha shook his head and said, "Other people can never do it so well as I can myself."

In 1812 Kamehameha returned to the island of his birth, Hawaii, and spent the remainder of his days in Kailua on the Kona coast, now a bustling resort town and center for deep-sea sportfishing. Kamehameha himself was an avid fisherman and scheduled affairs of state in his later years

around the running of his favorite fish.

Of all Kamehameha's abilities, it was his resourcefulness in dealing with foreigners that inspires the most admiration from young Hawaiians today. He obtained from the British and Americans arms to conquer the islands and Western luxuries to enhance his people's life-style. His masterful diplomacy is reflected in the Hawaiian flag, which was inspired by the Union Jack and the Stars and Stripes. And, yet, he managed to keep both countries at bay. Although Kamehameha's ties to Capt. George Vancouver and the British were close, a cession agreement was never accepted or ratified by the British government. No foreigners were permitted to own land.

The island of Kauai might well be Soviet territory today had not Kamehameha insisted that Kaumualii expel an ambitious German doctor, Georg Schäffer, who was in the employ of the Russian-American Company. The tsar of Russia desired only friendly trade relations with Hawaiians, but Dr. Schäffer built a fort for the Russians on Kauai and even planted the Russian flag on leeward Oahu.

One of Kamehameha's most perplexing foreign problems at the end of his reign was—cattle. Captain Vancouver, under instructions from King George III to conduct surveys of the northwest coast of America and Hawaii, brought the first cattle and sheep to the islands as gifts to Kamehameha in 1793 and 1794.

At the second landing of the animals in Kealahou Bay, one of the expedition members reported:

"The cattle greatly delighted [Kamehameha], though it took some time to quiet his fears lest they should bite him. He called them large hogs and after much persuasion we prevailed on him to go close up to them; at the same instant one of the poor animals turned its head round quickly [and] so alarmed his Majesty that he made a speedy retreat and [ran] over half of his retinue."

Vancouver, a midshipman on Captain Cook's earlier expeditions, found that Kamehameha "had softened that stern ferocity which his younger days had exhibited," and the two developed a warm relationship. Once, Vancouver engineered a reconciliation between Kamehameha and his beloved

Kaahumanu after a stormy lovers' quarrel.

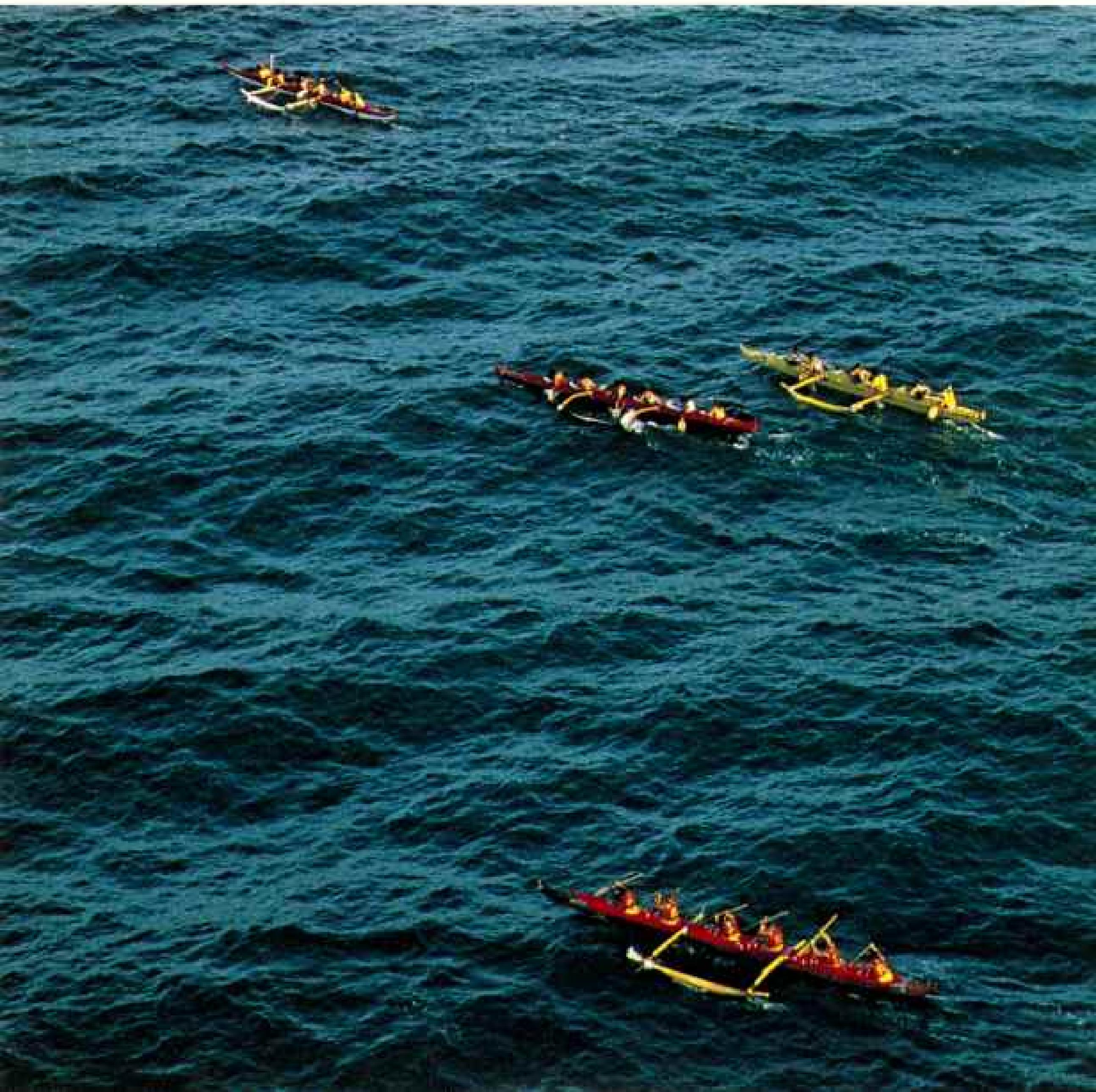
At Vancouver's suggestion, Kamehameha placed a kapu on killing cattle so the herds would multiply. Horses, transported there by an American trader, Richard Cleveland, in 1803, were also permitted to run wild. By 1815 thousands of wild cattle roamed the hills of northern Hawaii, trampling crops and terrorizing farmers. Finally, Kamehameha permitted a young Massachusetts sailor, John Palmer Parker, to shoot the cattle and supply salted beef to foreign vessels and local people. Parker married into a prominent Hawaiian family and established what is now one of the largest privately owned cattle ranches in the U. S.

The sprawling 224,000-acre Parker Ranch at the base of Mauna Kea and its 45,000 head of cattle are now owned by Richard Palmer Kaleioku Smart, sixth generation of the family. The ranch is so big its climate varies from desert to tropical rain forest. Rotating cattle to the best grazing areas is particularly challenging to the 90 ranch hands, called *paniolo*, a corruption of *Españoles*, or "Spaniards." Mexican and Spanish cowhands from California, brought to the islands by Kamehameha III, first taught Hawaiians how to handle cattle.

HAWAIIANS' difficulties with *haole* (foreigners) did not end with the ambitious German doctor or obstreperous cattle. A steady influx of immigrant workers in the 19th century churned the melting pot, creating a highly diverse population, which today includes 26 percent Caucasian, 23 percent Japanese, 11 percent Filipino, and 5 percent Chinese. In addition, with 42 percent of the islands now under state and federal control and most of the private lands in the hands of fewer than 50 individuals or corporations, many young Hawaiians feel dispossessed of their land and no longer in control of their own destiny.

"We were never annexed properly. We were occupied—we still are," said Hayden Burgess, an attorney who refuses to salute the American flag and heads the Sovereignty for Hawaii Committee.

Hawaiians lost their land and their sovereignty under Kamehameha's less capable successors. Persuaded to help the large plantation owners protect their vested interests,



Sleek heart of Hawaiian culture, the handcrafted canoe carried the first Polynesians to Hawaii more than 1,200 years ago and still lifts the spirits of their descendants. A 58-foot ceremonial canoe (left), carved from a single koa log, is purified with seawater by chanter Keli'i Tau'a at Waikiki on Kamehameha Day, a statewide June holiday. Its name, Makani Hou O Keauhou—New Wind of the Changing Times—alludes to the wind that blew down this protected koa tree. The Kamehameha Schools sponsored the construction to help youngsters appreciate their

ancestors' ingenuity.

Always looking to the sea for spiritual and physical rejuvenation, Hawaiians have made canoe racing the state's favorite sport. Driving through ten-foot swells (below left), women paddle the 40 miles between Molokai and Oahu in less than seven hours during one of the state's toughest meets, Na Wahine O Ke Kai.

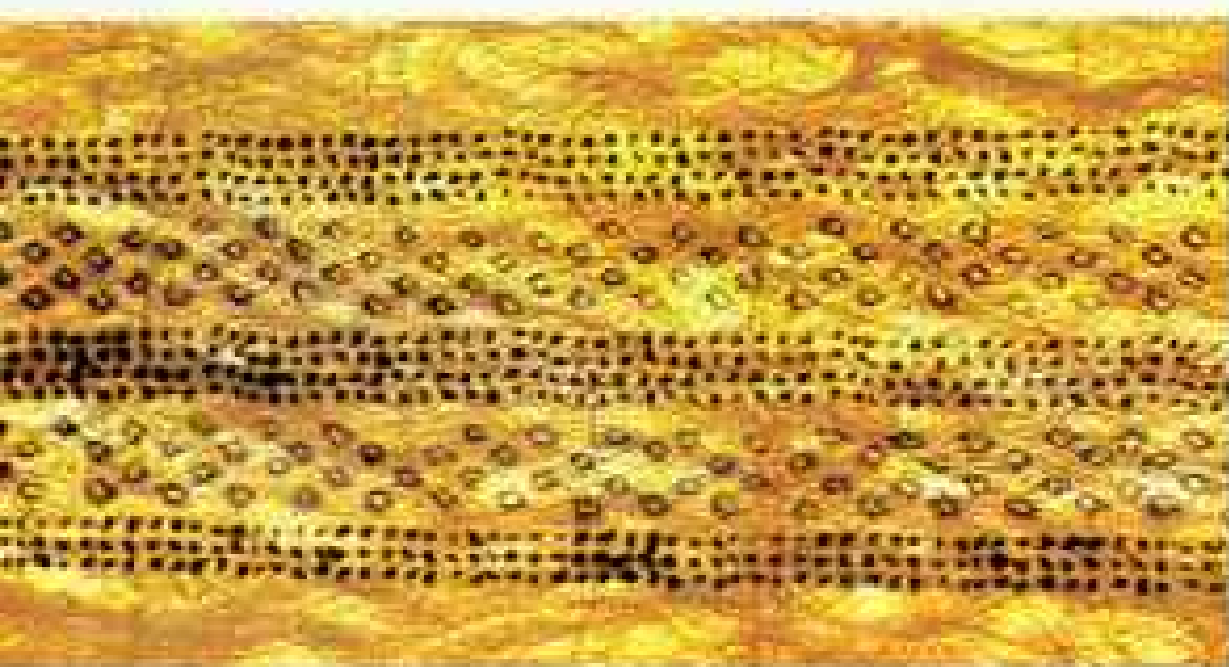
Though his club didn't place in the Queen Liliuokalani race, Edward Akiona Tinao (below) is glad to be among the finishers of the Kona coast classic that draws paddlers from as far as Tahiti.





"There were no recipes," Puanani Van Dorpe discovered when she became interested in kapa, the bark cloth made by her ancestors for clothing, bedcovers, and shrouds. Women in the South Pacific have perpetuated the craft, but in Hawaii only fragmentary records existed along with kapa samples, from

corduroy-like loincloth to fine gauze. Puanani experimented with copies of early tools, softening paper mulberry bark in seawater, scraping, pounding, felting, sun bleaching, fermenting, and pounding again. She printed designs with vegetable dyes (right). Making the finest kapa took 500 hours.



Kamehameha III gave up his title to all Hawaiian lands, except certain large estates that became known as crown lands. He then allowed the chiefs, commoners, and foreigners, in a series of laws from 1845 to 1850, to file fee simple titles or purchase the rest. Because the concept of landownership was unknown to most Hawaiians—land, like the sky, belonged to the gods—common Hawaiian people acquired less than one percent of the land. The Great Māhele, as this land division was called, became the great eviction.

“Without a land base,” said Emmett Aluli, a Molokai physician and activist, “Hawaiians lost their identity, their sense of pride and place. They could no longer be self-sufficient.”

Power slipped slowly from the hands of Hawaiian monarchs. On January 14, 1893, Queen Liliuokalani tried to rectify this with a new constitution. A handful of mostly American businessmen, eager for more favorable trade agreements, seized the opportunity to promote annexation with the United States. They were aided by resident U. S. diplomat John Stevens, who called in a contingent of marines and sailors, ostensibly to protect U. S. lives and property. On January 17 the queen yielded “to the superior force of the United States,” and a provisional government, headed by Judge Sanford Dole, the son of a missionary, was established. President Grover Cleveland was appalled by the conspiracy and withdrew the hastily presented annexation treaty from consideration by Congress.

Five years later, however, Congress did pass an annexation resolution. Crown lands comprised most of the two million acres appropriated by the interim government and ceded to the United States. They were eventually turned over to the state when Hawaii joined the union in 1959. It is these “ceded lands” that Hawaiian activists claim should be returned to the Hawaiian people.

The legal issues are complex and probably will never be resolved. No treaties of cession, in which the U. S. government recognized native Hawaiians’ rights to certain lands, were ever signed, as they were with American Indians and native Alaskans. Recent talk of reparations in Hawaii was undoubtedly fueled by the Alaska Native Claims Settlement Act of 1971, which gave



Abode of gods, cloudy Waialeale feeds streams on the island of Kauai. An average 460 inches of rain a year makes this the wettest spot on earth. Kamehameha,



who eventually won Kauai by diplomacy after offshore gales aborted his invasion, is remembered by islanders for his ability to meld tradition and progress.

Eskimos, Aleuts, and Indians nearly a billion dollars and extensive landholdings. There is also the problem of who, with so much intermarriage, is really Hawaiian.

In its June report to Congress, the Native Hawaiians Study Commission itself was split over the question of whether or not the U. S. government was responsible for the 1893 overthrow of Queen Liliuokalani. The majority of commissioners—subcabinet appointees of President Reagan—maintained that, despite the involvement of U. S. officials and the military, the coup d'état took place without the permission of the government. The three Hawaiian members of the commission, in a dissenting study, asked

Congress to consider "a just and equitable resolution of compensable claims by native Hawaiians for losses of domain and dominion." Congressional hearings on both reports are scheduled for early next year.

"A practical solution that I think Congress would buy in these austere times is to turn over all unused ceded government lands to the state Office of Hawaiian Affairs," said Hawaii Senator Daniel Inouye.

Whether or not the land battle is ever resolved in Congress, small victories have been won on the local level. The Hawaiian *aloha aina* (love of the land)—perhaps the essence of the renaissance—has been embraced by Hawaiian citizens of every ethnic



Passing on tradition, Gerri Sasabe teaches hula pa ipu—a gourd dance—during a summer session at the private Kamehameha Schools. Students, who must be part Hawaiian, cleaned, decorated, and oiled their gourds. The state constitution requires public schools to offer Hawaiian language, culture, and history programs.

background. A statewide group called Protect Kahoolawe Ohana has succeeded in placing uninhabited Kahoolawe, the smallest of the major Hawaiian islands, on the National Register of Historic Places and restricting the U. S. Navy's use of it as a target and training area.

"We are the land. The land is us," said Walter Ritte, trustee of the Office of Hawaiian Affairs. "How you treat the land is as important as how you treat people."

Public pressure has also brought about much-needed reform in the Hawaiian Homes Commission, established by an act of Congress in 1921 to lease 200,000 acres to Hawaiians. The commission, however, was given almost no money to run itself, and after 60 years only one-fifth of the land has been delivered to the Hawaiian people. Now, most of the commission's nine-million-dollar budget is provided by the state, and more than 200 Hawaiian families are placed on new homesites each year.

*Let him go and play . . .
Let him be accepted where
he is laid to rest,
Let him go in peace,
Let him go in silence.*

—FUNERAL PRAYER FOR KAMEHAMEHA

IN THE SPRING of 1819 Kamehameha became very ill, and, when it was clear that he was beyond the help of men skilled in the medical arts, the leading kahuna said a human sacrifice should be made to save the king. Kamehameha, however, would not permit it.

"Men are sacred to the chief," he said.

As he grew weaker, those gathered around him asked for some word.

"For what purpose?" he asked.

"As a saying for us."

"Endless is the good that I have given you to enjoy," he replied.

Early on the morning of May 8, Kamehameha drew his last breath. A pig was cooked and offered to the gods so that his spirit would be received into the realm of the *au-makua*. The heir, Liholiho, was sent to Kohala to escape defilement of the land caused by his father's death, and Kamehameha's flesh was removed from his bones and laid to rest in the sea. A sennit basket was then

woven around the bones and taken to Kalo-loko in north Kona. There has been much speculation about where Kamehameha's bones are really buried, and it is probably true, as the legends say, that only the stars know where they are.

Six months after Kamehameha's death, Liholiho (Kamehameha II) and Kaahumanu, who became *kukina nui*, or co-ruler, broke the kapu that forbade men and women to eat together. The two then ordered the destruction of the heiaus and abolished most religious and social taboos. It is one of the most abrupt and puzzling ends of a society in history. Certainly, Hawaiians may have lost faith in their gods when nothing bad befell Westerners who broke their strict laws. They were thus receptive to the teachings of a new god when Christian missionaries from New England arrived on their shores in 1820.

In the midst of political forces that swirled around them, and which ultimately they could not control, Kamehameha's successors tried to provide for their people. Princess Bernice Pauahi Bishop, the last direct descendant of Kamehameha the Great, founded the Kamehameha Schools for children of Hawaiian ancestry, which are supported by her vast landholdings, currently valued at 1.5 billion dollars. To honor her memory, her husband created the Bishop Museum, now an important center for the study of Hawaiian and Pacific cultures.

Although the monarchs converted to Christianity, they from time to time ignored the sober preachings of the church and made efforts to keep their culture alive. Much of what survives today of ancient hula is due to King Kalakaua, who delighted in performances of hula and ancient chanting at his festive court.

"There have been other cultural revivals, but only now are we beginning to regain our self-respect," said Abigail Kawananakoa, the great-grandniece of Queen Kapiolani, wife of King Kalakaua. "We are not just the happy ukulele player or the pretty girl with a flower behind her ear. We are a people."

Miss Kawananakoa and her cousins are considered by many to have the strongest claim to the Hawaiian throne, if the monarchy still existed. A trim, handsome woman in her 50s, she plays, as she said, the

"Princess Margaret role" in Hawaii and is spearheading a ten-million-dollar restoration of Honolulu's Iolani Palace, the only royal palace on American soil.

The current renaissance perhaps also differs from past revivals in its intensity and commitment. A number of Hawaiian families have abandoned comfortable city life to live off the land in remote mountain valleys. *Kupuna*, or elders, have been brought into the public schools to teach Hawaiian language and culture; and slowly Hawaiians are building a political base that could have far-reaching consequences for the islands.

"Hawaiian issues now play an important part in any election," said Kina'u Boyd Kamali'i, chairman of the Native Hawaiians Study Commission. "Hawaiians are the swing vote, and will become increasingly important because a third of our population is still under 18."

The key to the survival of the children of Kamehameha may not be in the political arena or even in a new economic base in the land. The answer may be more basic.

Dr. William H. Wilson and Kauano'e Kamana of the Hawaiian Studies Program at the University of Hawaii in Hilo are concerned that their children be Hawaiian. To them, it is not just how much Hawaiian blood runs in their veins, but how much their children will know about the language, history, and value of the islands' first people that is important.

"Where do we really learn about our culture? It's at home," said Kauano'e.

When their son, Hulilauakea Kepo'i'ula Kamana Wilson, was born in 1981, the couple spoke only Hawaiian to him.

His first word was *i'a* (fish).

There is an old Hawaiian saying: *I ka olelo no ke ola; I ka olelo no ka make.*

"In the language is life and death." □

Evoking the uplands and chanting in Hawaiian, Sherrie Hamamura tells of a prince and princess who live on the slopes of Waialeale. Kauai-born of Japanese descent, she earned her Hawaiian name Wailana, or Peaceful Water, by mastering classical hula in a revival of Hawaiian traditions that embraces all who live on the islands.





Across Australia by Sunpower

By HANS THOLSTRUP
and LARRY PERKINS

Photographs by
DAVID AUSTEN

SHADELESS, HOT, and perfect—this was perfect weather (*right*) for 720 solar cells collecting fuel from the sun to power our vehicle across the 4,130 kilometers (2,566 miles) from Perth to Sydney.

The 1981 flight by the *Solar Challenger* over the English Channel inspired us to attempt the first solar-powered transcontinental land journey. A \$45,000 grant from British Petroleum of Australia put the project in high gear last year.

The 125-kilogram (276-pound) vehicle, named *The Quiet Achiever* after BP Australia's corporate motto, was simplicity itself: tubular steel frame, fiberglass body, bicycle racing tires and brakes, solar panels, batteries, electric motor, and chain drive.

Since our vehicle made such good progress, cruising at 25 km/h (15 mph), we thought early on that we had a fair chance to better the 28-day time Francis Birtles made in 1912 on the first motor-vehicle trip across Australia.







ELDERS among
Aboriginals who turned
out near Nullarbor
station (**below**) reacted with
great interest, looking first at

the car and then to the sun.
Their children watched for a
while and went back to
playing electronic games.

By then we were starting
to relax a bit. Greenmount,
our first obstacle outside
Perth, was far behind us. The
locals said we'd never make
it, but we scalded up that hill
in low gear.

In the desert, temperatures
inside the car approached 50°C
(122°F). With the high-
pitched whine of the motor
and the chatter of the double-

chain drive, *The Quiet
Achiever* was anything but.
We wore earplugs or listened
to Bob Dylan and Don
McLean on a stereo headset.

We drove about 11 hours a
day, changing drivers only
once. As we went on, the
race against Birtles's crossing
time intensified. On New
Year's Eve, however, we
pulled into the Railway Hotel
at Manahill (**right**) and took
time for a dance with the
local kangaroo shooter's wife.
A very nice evening.

602





HIGH CLOUDS. Squalls. Dust storms. Across the Nullarbor Plain, head winds were against us. Evenings when we took the car off the road (*right*, Larry inside, Hans alongside), we tilted the solar-paneled roof to catch the last of the sun to top off the batteries.

Poor visibility and gusty winds delayed us, but the car kept on performing well. The solar cells bore the weather, but Larry's brother and our mechanic, Gary (*below*), covered the seven-by-ten foot lid as a precaution against hailstorms.

The vehicle's only real limitation was lack of springs, which was hard on its chassis—and ours. Even though the roads were rougher than we had figured, the vehicle performed better. Of all things, we had *underestimated* solar power.

We couldn't use our radio gear, because it was just too noisy inside to hear, so we had to write notes and throw them out for the support

vehicles to pick up.

We often had to replace tires and broken spokes. Since we could easily lift the chassis out of the fiberglass body (*below right*), we made repairs quickly and had the whole thing reassembled in five minutes. Our warehouse for spares and supplies, our home on the road, and our nanny was the mother truck.

Overall, the design of *The Quiet Achiever* did what we wanted. The driver's low seating position added stability to the rig, and the body's shape gave us minimal wind resistance for low drag. Of course, the great flap lid is a very bad aerodynamic shape, but we had to live with that.

There's room for improvement, and next year we may find out how much. We've said we'll race anybody's solar vehicle. We don't care whose it is. Some Americans have challenged us to race from California to Florida in 1984, and we may just take them on.









THE SUN shone steadily after Port Augusta, and we skimmed across New South Wales (*lower left*, Larry driving). We felt the sun's power pushing us along, the way you feel daylight's warmth on a frosty morning. It was quite magic. January 3, our best day, we covered 307 km (191 miles).

The greatest challenge was to come, climbing Victoria Pass over the Great Dividing Range, one of the continent's steepest highway grades.

The car moved slowly up the hill, but *The Quiet Achiever* didn't disappoint us. We topped the crest and raced downhill to Sydney (*left*) at our top speed of 65 km/h.

At the Opera House 2,000 people cheered our arrival on January 7, just 20 days after departure—eight days better than Birtles's time in 1912.

Senator Sir John Carrick, then Minister for National Development and Energy, welcomed us (*left*). He took a flask of Indian Ocean water we had carried with us and poured it into the Pacific—two oceans linked by solar power. We proved it was possible to travel great distances on the sun's energy. Now it's up to other people to prove it's practical. □



Hans Tholstrup, in yellow cap, who conceived the idea of the solar car, has circumnavigated Australia in an open powerboat and soloed a small airplane around the world. Larry Perkins, at left, is a racing-car driver and engineering consultant, who, with brother, Gary, designed and built *The Quiet Achiever*.



Afternoon clouds roil above Tegucigalpa, capital of a small impoverished

By MIKE EDWARDS
NATIONAL GEOGRAPHIC SENIOR WRITER

Photographs by
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NATIONAL GEOGRAPHIC PHOTOGRAPHER

Honduras:



nation that finds itself center stage in Central America's turmoil.

Eye of the Storm



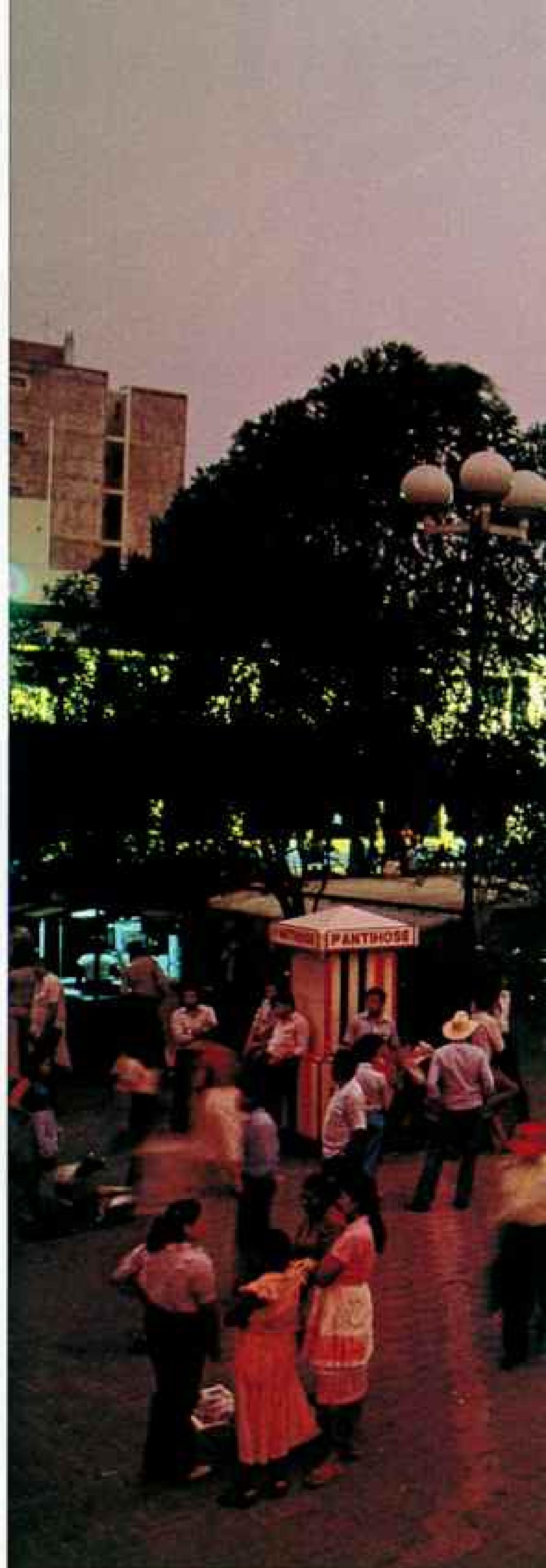
FRESH FROM A SWIM, a Miskito Indian girl from Nicaragua contemplates a new life in a refugee settlement on Honduras's Mococon River.



Throughout the virtually roadless eastern region, the dispossessed come, fleeing Nicaragua's leftist Sandinista regime and the fighting between government and rebel forces.



FINGERS SNAP to a disco beat at the Hippopotamus (above), one of several lively night spots in San Pedro Sula, Honduras's second city. A major commercial center, it outstrips the capital in manufacturing while serving as a conduit for food grown in the fertile Sula Valley. For the less affluent, nighttime amusements must be found on the street. Beneath the glow of San Miguel Cathedral (right), strollers in Tegucigalpa's central park snack on fast food, buy trinkets for the kids, or just enjoy the cool spring night.







BUOYED BY DREAMS of the stadium, a youngster watched by a fan practices his soccer style in the old section of Tegucigalpa. But future practice may be



with a rifle instead. Young men face induction into an army that has been known to summarily conscript virtually the entire eligible population of a village.



PROGENY of a rich and volatile chapter of Caribbean history, a Black Carib youngster rests against a dory in the Mosquito Coast village of Tocamacho (right). Descendants of Carib Indians and African slaves, the nation's Black Caribs were banished from St. Vincent to the Bay Islands after a revolt in the 1790s. They spread to the mainland, where many of their villages remain isolated save for supply boats. Despite Christian missionary efforts, shamans continue to invoke their magic to cure the sick. And at night, doors lock against evil spirits.





IN THE HOLIDAY WEEK before Easter the beach at Tela, on the Caribbean coast of Honduras, displays a crowd divided by neither wealth nor race.

All the colors of Honduras are here: Indian rust, African black, European white. Families arrive hanging onto groaning yellow buses, castoffs from United States school systems, and in expensive cars.

Willowy girls in swimsuits from Miami boutiques draw admiration. Campesino women wade the surf in their underwear; no one criticizes them. Millionaire and cane cutter, both know equality on Tela's beach.

There are T-shirts that say "M*A*S*H" and "100 Percent Fat Free" (this on a buxom lady). Everyone consumes: skewers of charcoaled beef, ices drenched in pink and purple, the water and flesh of coconuts.

Palms wave, the surf is cool. Only the passage of an army patrol—four men in camouflage with pistols and carbines—suggests that Hondurans have anything to worry about save the pursuit of tropical pleasures.

Geography locks Honduras into the turmoil of Central America. To the south, the Sandinista government that came to power in Nicaragua in 1979 seems increasingly Marxist. Honduran and Nicaraguan soldiers have skirmished. To the southwest, in El Salvador, vicious warfare continues between U. S.-backed government troops and guerrillas. Nicaragua has been accused of slipping arms across Honduras to the Salvadoran guerrillas; those guerrillas have been accused of terrorist acts within Honduras. To the northwest, Guatemala has known years of strife (map, pages 620-21).

Alarmed by the increased presence among its neighbors of leftists/Communists (take your pick), the Honduran government snuggled up closer to the United States, becoming in effect a U. S. bastion. Honduras looked the other way as the CIA sent counterrevolutionaries into Nicaragua from its soil. Last summer Honduras allowed Green Berets to set up a base for training Salvadoran troops while preparing to welcome thousands of other U. S. soldiers on extended maneuvers. Meanwhile, U. S. warships steamed off the coasts. Honduras is receiving from its ally 37 million dollars in military aid and 97 in economic aid this year.

Yet, as I watch the happy crowd on Tela's

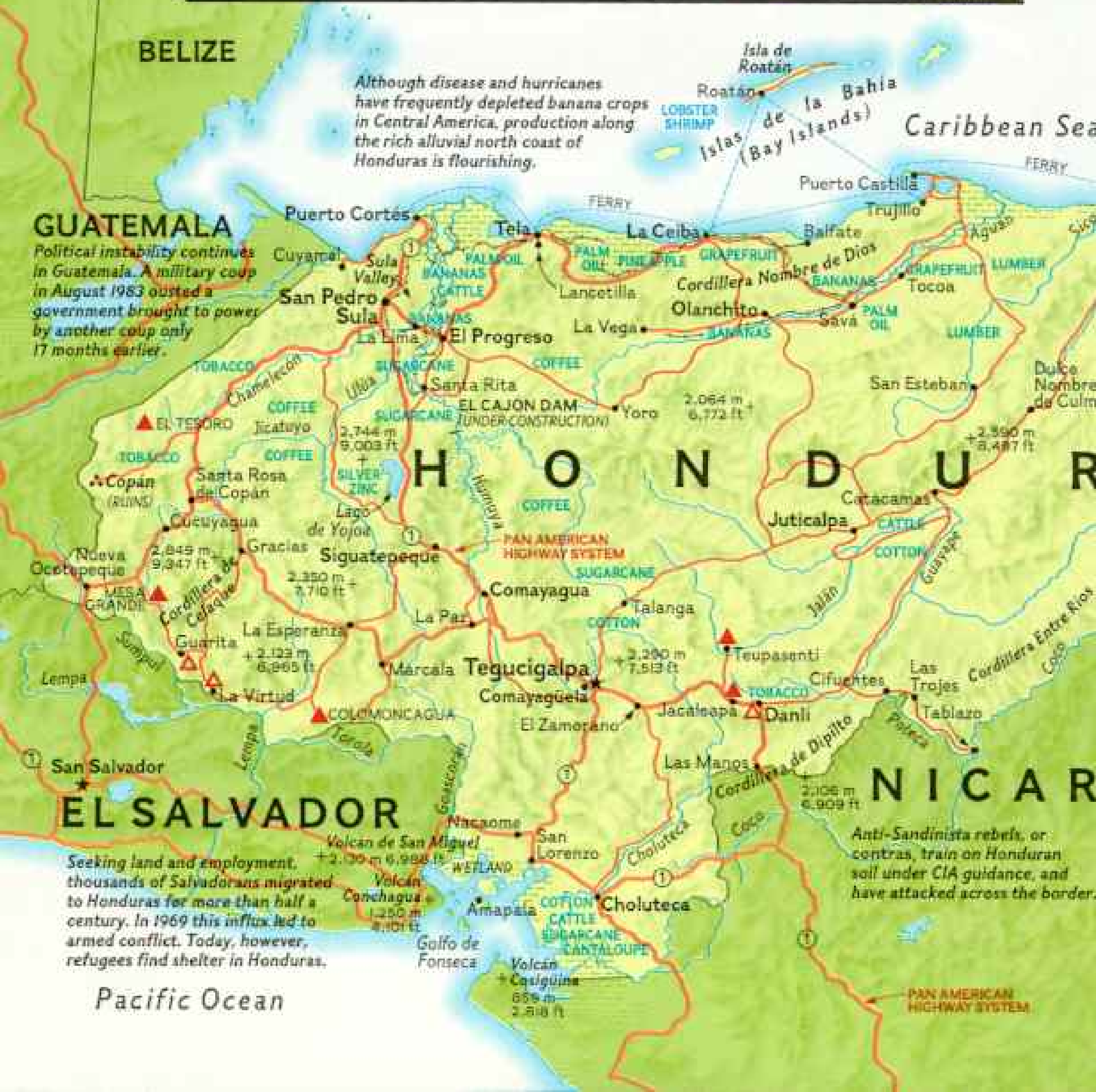


Journey out of fear brings a Honduran campesino family to the treacherous road from Las Trojes to the abandoned village of Cifuentes, less than a mile from

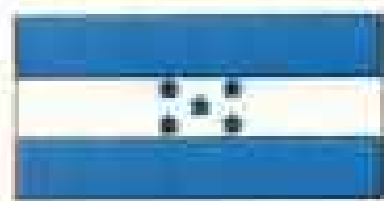


the Nicaraguan border. Honduran troops stand by to assure their safe passage to sanctuary with relatives in Danlí. Ten days later two American journalists were killed on the same road when their car struck a land mine that Honduran officials claim was planted by Sandinista forces.

NICARAGUAN AND SALVADORAN REFUGEES, 1983



UNFULFILLED DREAM of Central American harmony finds expression in the Honduran flag. Each star represents a constituent of the United Provinces of Central America—Honduras, Guatemala, El Salvador, Costa Rica, and Nicaragua—established in 1824 after declaring independence from Spain, but dissolved in 1838.



The region's poorest country, Honduras now finds its own problems compounded by those of old confederates (chart).

AREA: 112,088 sq km (43,277 sq mi). **POPULATION:** 4,200,000. **CAPITAL:** Tegucigalpa. **RELIGION:** Roman Catholic. **LANGUAGE:** Spanish. **LITERACY:** 60 percent. **ECONOMY:** Export crops: bananas, coffee, lumber, beef, sugar. **INDUSTRIES:** food processing, textiles, mining. **LIFE EXPECTANCY:** 58 years. **PCI:** \$600.

With Central America's strongest air force, Honduras has accepted a U. S. offer to enlarge airstrips and build a training center near Puerto Castilla. The U. S. charges that Salvadoran guerrillas are supplied by Nicaragua through Honduras.



beach, Honduras seems better prepared for peace than for war.

During the centuries that Spain ruled Central America, from the 1500s until 1821, Honduras was a backwater, sparsely populated. Conquistadors sought quick wealth in gold and silver, but never found a bonanza lode. Only a handful of Spaniards settled and farmed. Revolutions bloodied the country—the government has changed hands a hundred times—but the typical Central American alliance of rich landowners and army never became so oppressive here.

In recent years land reform has proceeded, albeit in fits and starts. The press freely reports. Labor enjoys guaranteed rights. In 1981 more than 80 percent of the eligible voters cast ballots for a president, ending 18 years of almost continuous military rule.

But enormous problems still dog Honduras. Nearly half of the four million people cannot read. Development lags; Central America looks risky to investors. Tourism has shrunk to a trickle of divers lured to reefs around the Bay Islands, off the Caribbean coast. Most visitors pursue other affairs. At my hotel in Tegucigalpa, the capital, were arrayed one day a table of missionaries, one of arms merchants, and one of journalists looking for a war.

HONDURAS REACHES OVER from its long Caribbean shore to poke a toe into the Pacific, on a littoral squeezed between Nicaragua and El Salvador. Between oceans, it is a nation of parts. The savannas and rain forest inland from the Mosquito Coast are the back, back of beyond. To the west, pine-clad peaks spill over from Guatemala and El Salvador.

Highway 1, the nation's main stem, wriggles northwest from Tegucigalpa, descending to great tropical trees, the soaring *ceiba* and the wide-reaching *castaño*. "The north coast," Hondurans call the region around the cities of San Pedro Sula and La Ceiba. Millions in the U. S. slice and sprinkle a bit of the north coast's production over their cornflakes; bananas and sugar, along with coffee, beef, and lumber, are important exports. Especially bananas.

Toward the fruit on a big, drooping stem, Roberto Hernandez thrust calipers set at the right diameter for harvest, a fraction less

than an inch and a half. The fit was snug. Two easy swings of his machete and he had fulfilled his job title, which is *cortador*—cutter. The stem fell on the shoulder of Angel Castro, a *cablero* or cableman. Angel trotted off to hang his hundred-pound load on a heavy wire; a tractor would draw this stem and dozens more to a packing shed.

I watched them work a few miles from La Lima, headquarters of the Tela Railroad Company. You know its product as Chiquita Banana. The Boston traders who created the United Fruit Company (now United Brands) at the turn of the century also built railroads; Honduras rewarded them with land grants. The tracks never went farther than the plantations and ports.

Bananas locked the United States and Honduras into a relationship almost familial. Honduras's 20-centavo coin, worth ten U. S. cents and the size of a dime, is called a "die-meh." Teenagers at Puerto Cortés attend "El Franklin"—El Colegio Franklin D. Roosevelt. Rarely in two months in Honduras did I hear anti-U. S. sentiment.

It is curious, this good feeling, for when Chiquita and her friends were riding high,

earlier in this century, they were no ladies.

Samuel Zemurray, a U. S. planter, may have financed the overthrow of a Honduran president in 1911, to gain concessions from a friendlier regime. At least, many Hondurans believe he did. Fruit companies got possession of a million acres; by 1915 Honduras was the quintessential banana republic. As recently as 1975 United Brands was accused of paying a Honduran official one and a quarter million dollars for a tax break.

"We have made mistakes in the past," acknowledged Fred Koch, Tela Railroad's general manager. "But we live here and we try to act responsibly."

This much is certain: In its relations with its employees, the company has improved enormously. Cortador Hernandez and cablero Castro will each earn in a fair day about \$15, more than some agricultural laborers earn in a week.

I met Señor Isabel Canales, whose muscles bulge from hefting stems, over a beer. We walked to his home, a three-bedroom house, painted blue, fringed with red hibiscus. It cost \$9,400. "I pay half," he said. "The company pays the other half."



Diplomas on the living-room wall testified to the completed schooling of Oswaldo, Fernando, and Maria Canales. The company paid for their education through the sixth grade. "I didn't learn to read and write myself until five years ago," Isabel said. The company paid for that too.

Rafael Valle, president of the 10,000-member Tela Railroad union, recalled the year 1954, when he earned \$1.15 a day. "We were being exploited. The government had no laws with which to rule the banana companies." Twenty-five thousand United Fruit employees struck for 67 days that year.

The workers won; the benefits accrued to the entire country: legal recognition of workers' rights, guaranteed minimum wages. "Companies learned they could not exploit," Señor Valle said. "Workers learned how to settle problems." Many Hondurans believe the lesson of 1954—that disputes can be settled peacefully—has helped the nation enjoy greater internal peace than its neighbors.

Tela Railroad shrank its payroll by 60 percent. But worker productivity soared. The company returned much land to the government. Planting a more compact

banana variety, the company harvests more fruit on less land—in a good year, 800 million pounds of bananas on 17,000 acres.

SOME of Tela Railroad's redundant workers got jobs in San Pedro Sula, a 20-minute drive from La Lima. Sticky after a rain, San Pedro seems too tropical to be the energetic city that billboards advertise. Five miles outside the city signs proclaim manufacturers of jeans, swimwear, and chemicals. The main enterprise seems to be none of these, but billboards.

Edgardo Canahuati, 26, Georgia Tech graduate, explained the energy: "Arab people are aggressive. They like to work, they like to make money, they like to live good."

Edgardo's father migrated from Bethlehem when it was still part of Palestine. In a small building he began to produce brassieres for the Lovable Company, a major supplier to U. S. stores. The venture has been successful, not to say uplifting. Before the recession the company was shipping as many as 10,000 dozen brassieres to the United States in a week. Another 5,000 dozen were produced for Central American

Taking aim with M-16 rifles, Honduran security forces get target practice under guidance of United States Green Berets at a regional military training center (left). Opened in June near Puerto Castilla, the U. S.-financed center trains Honduran and Salvadoran troops.

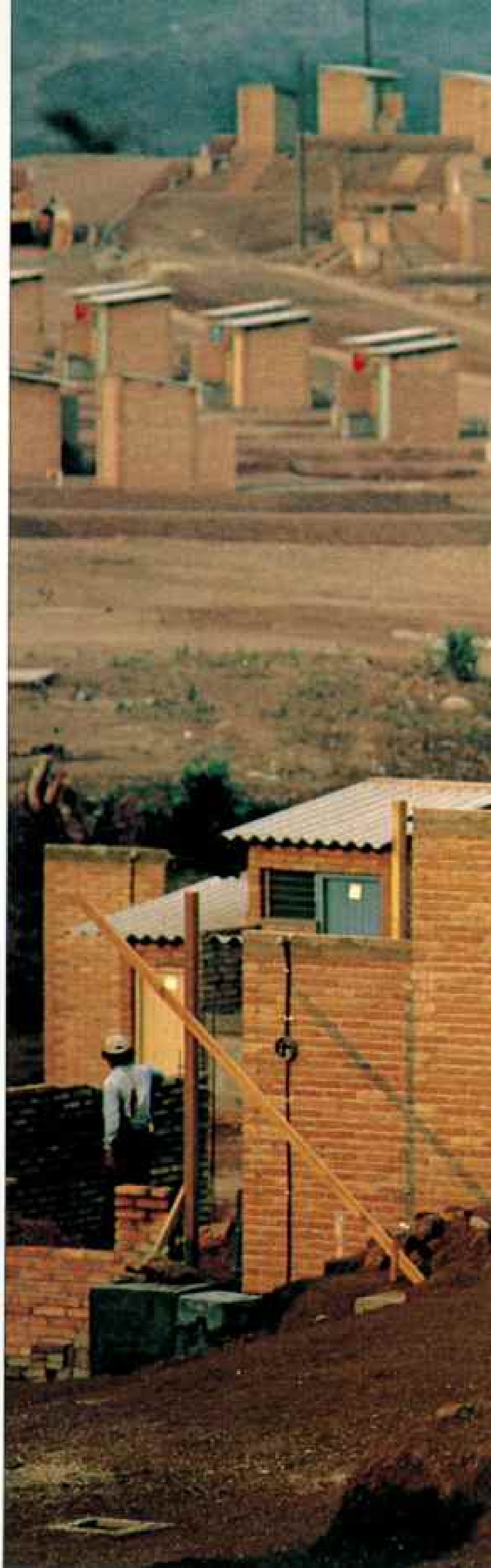
Near the Salvadoran border, Gen. Gustavo Alvarez Martínez (right, at right), head of the Honduran armed forces, briefs a battalion commander on plans to enlarge the airstrip at Cucuyagua. By dispatching its own troops for maneuvers in Honduras and stationing aircraft carriers offshore, the U. S. hopes to "establish its presence" in Central America.

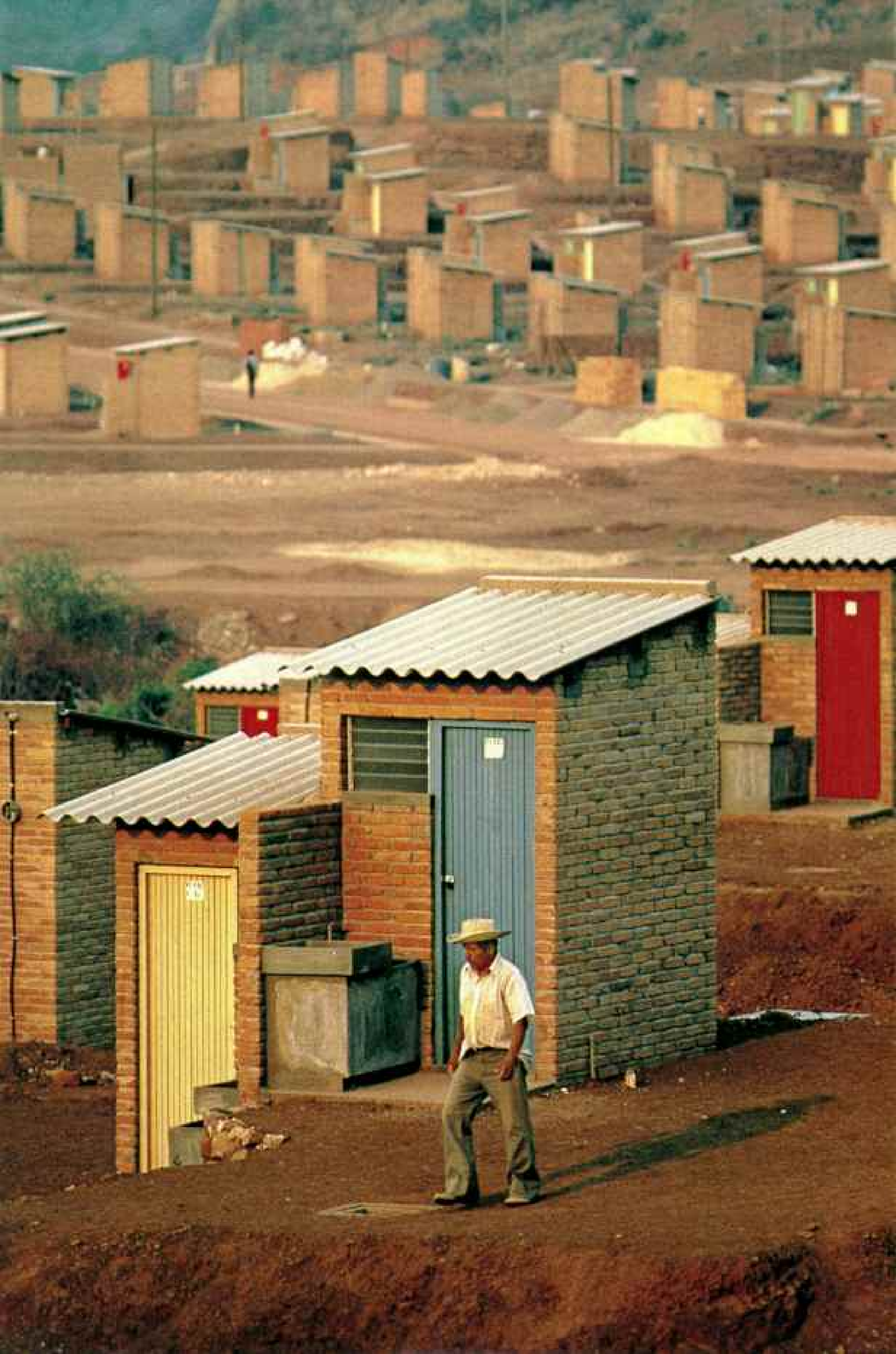




Cries of "El Doctor" greet President Roberto Suazo Córdova on a Good Friday visit to his hometown of La Paz (above), where he practiced medicine for many years. Suazo sometimes carries his black bag to treat children on the spot while campaigning. His election on the Liberal Party ticket in 1981 ended 18 years of predominantly military rule, though some believe General Alvarez enjoys equal if not greater authority. Friend and foe alike watch to see whether El Doctor, whose trademark is a brown cowboy hat, can cure Honduras's ills.

Not least among them is housing. In the past decade Tegucigalpa's explosive growth has brought more and more barrios of rude shacks to the surrounding hillsides. In a self-help program, the U. S. Agency for International Development guarantees loans for construction of core units (right)—small buildings equipped with toilets, running water, and electricity. Buyers add rooms as their finances and building skills permit.







Teeming crossroads in Comayagüela, Tegucigalpa's sister city, San Isidro market sprawls over six blocks of stores and open-air stalls. Like taxis, Honduran buses are privately owned and compete for passengers. The country's railroads



are limited to the north coast. Main arteries are paved, but dirt roads predominate.

markets—markets now constricted on account of the region's troubles.

I went to a factory that produces shirts, underwear, and pajamas to meet Gabriel Kattan. He spoke machine-gun English, honed on buying trips to the United States. "My father came from Palestine at the time of World War I on a Turkish passport," he said. "That's why we're called Turcos here. [Many consider the nickname degrading.] People were fleeing the Ottoman Empire, which wanted to conscript them as soldiers. They were Christians—they wouldn't fight for the Turks. My father was 18. My grandmother got him a bride, got him married, and 'Out you go.'"

Few Hondurans had deigned to enter commerce; there was little manufacturing. Long tradition in trade well prepared the Arabs to fill the vacuum. They now number some 12,000, mostly Palestinians.

Sewing does not pay well, but it *is* work. Women in towns near San Pedro sew covers on a fifth of all the softballs pitched in the world. I watched Mirtala Carranza pull threads with a needle in each hand, stretching her arms in a politician's victory gesture. An affiliate of Tennessee-based Worth Sports Company pays her \$5.50 if she sews 48 softballs in a day, and a bonus for any over that. Her record: 72.

The trouble with such work, as manufacturers see it, is that there isn't enough of it. "So many of the garments your people wear come from Asia," Señor Kattan reminded me. "Why can't we make them here? We're in your backyard. Your country would not have such problems in Central America if we could keep the people busy."

NEAR QUIET Comayagua, once Honduras's capital, I turned off Highway 1 and headed for La Paz. Attention has been lavished on this town: new water mains, paved streets, a renovated bridge on the new highway. Such are the rewards of being a president's birthplace.

Dr. Roberto Suazo Córdova, country doctor turned politician, led the Liberal Party to victory in the 1981 election. His La Paz retreat is a plain house built around a small courtyard.

To Hondurans, President Suazo's simple tastes are refreshing. The government he

took over from the military smelled of corruption. But many people, long used to army rule, wonder if their government now has two heads, one the president's, the other a general's. "There is only one head, President Roberto Suazo Córdova's," the president told me firmly.

He talked briefly of plans for a campaign against illiteracy. But mostly this day he wanted to talk about threats from without. "We are in a half-moon of convulsion," he said, citing El Salvador's civil war and neighboring Nicaragua, "definitely Marxist, receiving support from Cuba."

As to the future? "If the guerrilla is successful in El Salvador, both Honduras and Guatemala are finished." It is the domino theory. "If Central America falls, Mexico falls too, and then the problem will be at the border of the United States."

Honduras, he added, intends to maintain "the tightest relationship with the United States"; so tight, in fact, that 125 U. S. soldiers now train Salvadoran troops on Honduran soil (page 622). The base was built last summer—a favor to the Reagan Administration, which preferred not to invite congressional ire by sending more military advisers to El Salvador.

"La Base" worries some Hondurans, who fear that it will bring terrorist retaliation by Salvadoran rebels.

"I don't think we should be a training ground for El Salvador or a post office for counterrevolutionaries in Nicaragua," a young man told me. "If we've got to fight somebody, I'll do my part, but first I think we ought to try to settle things peacefully."

Declared Efraín Díaz Arrivillaga, U. S.-educated member of the Honduran Congress and outspoken critic of government policy: "I don't think the Sandinistas are a real threat to Honduras, nor are the guerrillas in El Salvador, if they win." He believes the U. S. government has used Honduras to further its own aims—to bolster El Salvador while trying to cripple Nicaragua.

"We should be more worried about strengthening our democratic institutions," Señor Díaz said. "The government should work harder on social problems—health, malnutrition, housing, land reform, illiteracy. If we do not attack our social problems, we will have fertile ground for revolution."

AT THE END of April, Tegucigalpa is praying for winter—that is, for the rainy season, which usually arrives with May. Water is rationed in the new neighborhoods that climb the mountainsides, and some days the airport is closed on account of smoke.

Slash-and-burn agriculture is still the norm in Honduras, at a cost both to the forests and to comfort in the capital, which appears some days almost as smoggy as Los Angeles. Once the rains begin, however, the fires are quenched and the mountainsides turn brilliant green.

On a hazy Sunday evening I could detect no gloom in the central park, clutched in tangled thoroughfares. Strolling families met around the equestrian statue honoring Francisco Morazán, hero of a brief Central American federation in the 1820s and '30s. Young men made the acquaintance of young women, buying them cotton candy or pizza.

There is the look of the country about many of these strollers; half, in fact, probably grew up in some small town. A city of only 150,000 in the early 1960s, Tegucigalpa—possibly "silver hill" in an Indian tongue—has almost quadrupled.

One Sunday I walked in Colonia Kennedy, one of the first subdivisions built to cope with spurting growth. Funds from President John F. Kennedy's Latin American program, the Alliance for Progress, built the first 750 houses. Expanded with soft loans from the Inter-American Development Bank, Colonia Kennedy now holds 48,000 people. Roses and geraniums show the pride that residents take in their modest homes.

Among Hondurans, Kennedy is beloved as no recent U. S. President—although President Reagan is gaining because of his strong anti-Communist stand.

I heard praise for Mr. Reagan inside the turreted armed-forces headquarters in Tegucigalpa's sister city, Comayagüela.

As commander of Honduras's 17,000-man military force, including police, Gustavo Alvarez Martínez wears the four stars of a general. His status is unique in the world, he believes: He cannot be fired by the president. "I was elected by Congress. To replace me, the president would have to get Congress to pass a petition." That was not defiance. He added emphatically: "The

president gives me orders. The military accepts the role of being governed."

At one point he spoke of the "human responsibility for protecting the environment"—the restoration of United Fruit's botanical garden at Lancetilla is one of his special interests. A few minutes later he was declaring that as a last resort "direct military intervention" might be necessary to curb Nicaragua. I pass on his emphasis: This would be a last-resort step. "It could not be done if the United States did not go in."

Nicaragua, the general contends, is the chosen base for "an aggressive invasion" of Central America, "originated by the Soviet Union through Cuba." He cites the arms buildup there and the thousands of Cuban advisers and workers. "Nicaragua just got two new helicopters and four more are on

the way. They have four Ilyushin transports and will receive more."

Not with optimism, I think, General Alvarez reckons the future of Honduras dependent upon public opinion in the United States. "How can we defend ourselves alone? The United States can say 'That's your problem,' but I think there is a moral commitment. Latin America was inspired by the American example of 1776 and the French Revolution. How can it be that you would abandon us and allow those principles to be lost in this hemisphere?"

Some Hondurans contend that the army and police have not always paid diligent attention to democratic principles. Dr. Ramón Custodio López, a physician who chairs the private Committee for Defense of Human Rights, told me the committee



Floating market comes to the customers on Roatán, largest of Honduras's Bay Islands. Small craft bring bananas, plantains, and cassavas from the mainland to island harbors, where the boatmen peddle the produce. Bananas are the country's chief product, accounting for one-third of all exports.



Tallest power plant in Central America, a 745-foot-high dam under construction at El Cajón (above) will generate a third of the country's electricity. Damming the Humuya River will flood 36 square miles of land rich in unearthened ancient Indian artifacts, possibly Maya. While archaeologists bemoan that loss, ecologists decry the destruction of forest by slash-and-burn agriculture. Fire set by this farmer (right) to clear land for an orchard burned out of control, scorching 40 acres of pine.



counts 31 murdered Hondurans and 33 disappearances this year and last. Many—not all—were leftists; in most instances the committee suspects the security forces.

This record pales beside those of neighboring nations where political victims are counted in the hundreds or thousands. Still, Dr. Custodio asks: "Why is this possible in a democracy?"

THE U. S. M-16 confronts the Soviet AK-47 at the ragged town of Las Manos, on the Nicaraguan border, less than a three-hour drive from Tegucigalpa. The weird nonwar confrontation I glimpsed there

offered no indication that skirmishes had erupted in the vicinity. Some miles distant, two U. S. journalists were killed last June; Honduran officers said their car hit a Sandinista mine on a Honduran road.

On their side of Las Manos, a group of Honduran soldiers played soccer. Others lounged about in combat gear. Beyond a 50-yard strip of highway respected as a no-man's-land, a Nicaraguan soldier watched the game.

"Sometimes we hear them shouting slogans like 'Live Free or Die,'" said a Honduran lieutenant. "I think they try to encourage themselves." An extra clip was



taped to his M-16. A gold parachute emblem signified that he had made a hundred jumps; like many Hondurans, he was trained at a U. S. installation in Panama.

Nearer to Tegucigalpa on the route from Las Manos, I met other men uniformly dressed—students in denim. They planted bananas, sacked seed corn, and sprayed insecticide. The Pan-American Agricultural School at El Zamorano believes in getting dirt under the fingernails.

"The trouble with most agricultural schools in Latin America is that they produce *agrónomos* who don't know what to do when they hit reality," said Dr. Simon E.

Malo, the school's director. "You don't learn farming just by reading books."

At the urging of Samuel Zemurray, he of the 1911 revolution tale, the United Fruit Company founded this school in 1942; it is independent of the government.

No agricultural school in Latin America enjoys a better reputation. Students work hundreds of hours on its 12,000-acre farm, besides going to classes. This labor helps the school earn half a million dollars a year from vegetables and seed. Some 15 nations, including Nicaragua, are represented among this year's 425 students. Many graduates take advanced degrees in the U. S.

Food production lags in Honduras and other Latin American nations, which import much of what they eat. "There aren't nearly enough trained men to take information to the farmer," Dr. Malo said. He hopes the school can find funds to quadruple enrollment. It could do a lot with the price of a couple of Huey helicopters—or a couple of Ilyushin transports.

ONE DAY at San Pedro Sula I got into a Huey lent by the Honduran Air Force. Second Lt. Rafael Rivera Suazo rose to 2,000 feet and clattered south. After half an hour we spied a blade of a ridge through which the Humuya River had forced a notch. San Juan trees bloomed on the flanks, flashing yellow through the haze. Closer, we hovered over hairpinning roads and a temporary town.

With 360 millions in borrowed dollars, Honduras is building Central America's tallest dam here in order to trim the nation's oil bill. The 745-foot-high El Cajón dam will hold back a lake of 36 square miles.

Beyond the construction site, Lieutenant Rivera plunged into the river canyon. Suddenly we were looking up at trees—flashing past at 90 knots. Only 23, and only six months out of flight training, my pilot was cool as ice; while skimming the water, he was listening to rock music on his headset.

The air force, pride of Honduras, has about 70 pilots and 50 combat aircraft, including French Super-Mystères and updated Sabre-jets of Korean War vintage. Hardly modern, this air force is nevertheless rated as Central America's best.

Copán, near the Guatemalan border, is hardly modern either. I drove to this site, one of the great Maya centers of Middle America, with Ricardo Agurcia, the young director of the Honduran Institute of Anthropology and History. "I love this place," Ricardo said. The feeling is infectious.

In the afternoon came a gentle shower, and we took cover beneath a corbeled arch. I looked across the main plaza, at the temples, the stairway with more than 1,250 glyphs, the ball court, and the elaborately carved statues of rulers whom archaeologists know as Squirrel and 18 Rabbit. There is, to me, no edifice here so awesome as to overpower. The plaza is like a garden of sculpture.

"What do you think of this place?" asked Bill Fash, Harvard-trained U. S. archaeologist and a colleague of Ricardo's.

"Peaceful," I said.

"You got it," Bill said, laughing. "That's one reason I've worked here five years."

Three deer ambled out of the woods, making our tranquillity complete.

Do not think Copán is static. Less than a mile from the main plaza I stood atop the house of a man of influence in the eighth century and watched 35 archaeologists, workmen, and students from Pennsylvania State University. Probing the remains of numerous stone buildings, they used wheelbarrows, buckets, shovels, trowels, dental picks, brushes, and transits. Honduras borrowed three million dollars to finance an ambitious study of Copán and the restoration of temples and residential buildings.

Bill Fash turned to the long bench behind me. Perhaps it had been the sleeping area of



Silent beauty beneath the waves lured Leah Riley (above) from a desk job of selling insurance in Oregon to the Bay

the dignitary who dwelt here. It bore a row of 16 glyphs. "Nobody beat the artisans of Copán at carving," he said. "They had the best stone in the Maya realm, this volcanic tuff." Soft when quarried, it could be worked easily. Exposed to air, it hardened.

"Their writing was very stylized," Bill continued. "There was a lot of competition, and the way to distinguish yourself was to put your message in an innovative way." He regarded the figure in the glyph at the left end of the row. "This little curl under the fellow's eye is the numeral eleven. This little torch that the next figure carries stands for three." He read more, then calculated that the building was dedicated in A.D. 786, late in the Maya's Classic period.

A figure holding a "sun glyph" suggests that the occupant watched the heavens; perhaps he was an astronomer.

Copán's population may have climbed to 15,000. But soon after the dedication that

Bill deciphered, Copán was in decline. Most archaeologists believe it could no longer feed itself. Preliminary analysis of bones from burials at the end of Copán's greatness suggests that the people were malnourished and diseased. Many died young.

For modern Honduras, these indications are sobering. At the present growth rate, it will have 20 million people in half a century.

I TOOK the good highway that climbs to Santa Rosa de Copán, an antique town with cobbled streets, two hours from the ruins. In this vicinity the mountains get serious about being mountains, sending two peaks beyond 9,000 feet; in the valleys the isolation is intense:

The road on to Gracias was a jarring challenge, all ruts, rocks, and fords. Briefly in the 1540s Gracias was the seat of the Spanish *audiencia* that governed Central America. But the government moved to Guatemala in



Islands, where she co-manages a resort, teaches scuba diving, and leads tours. Off Roatán (right) she explores coral formations that, diving enthusiasts say, compare in splendor to Australia's Great Barrier Reef.

1549, and Gracias is today merely the capital of the Department of Lempira, boasting neither industry nor asphalt.

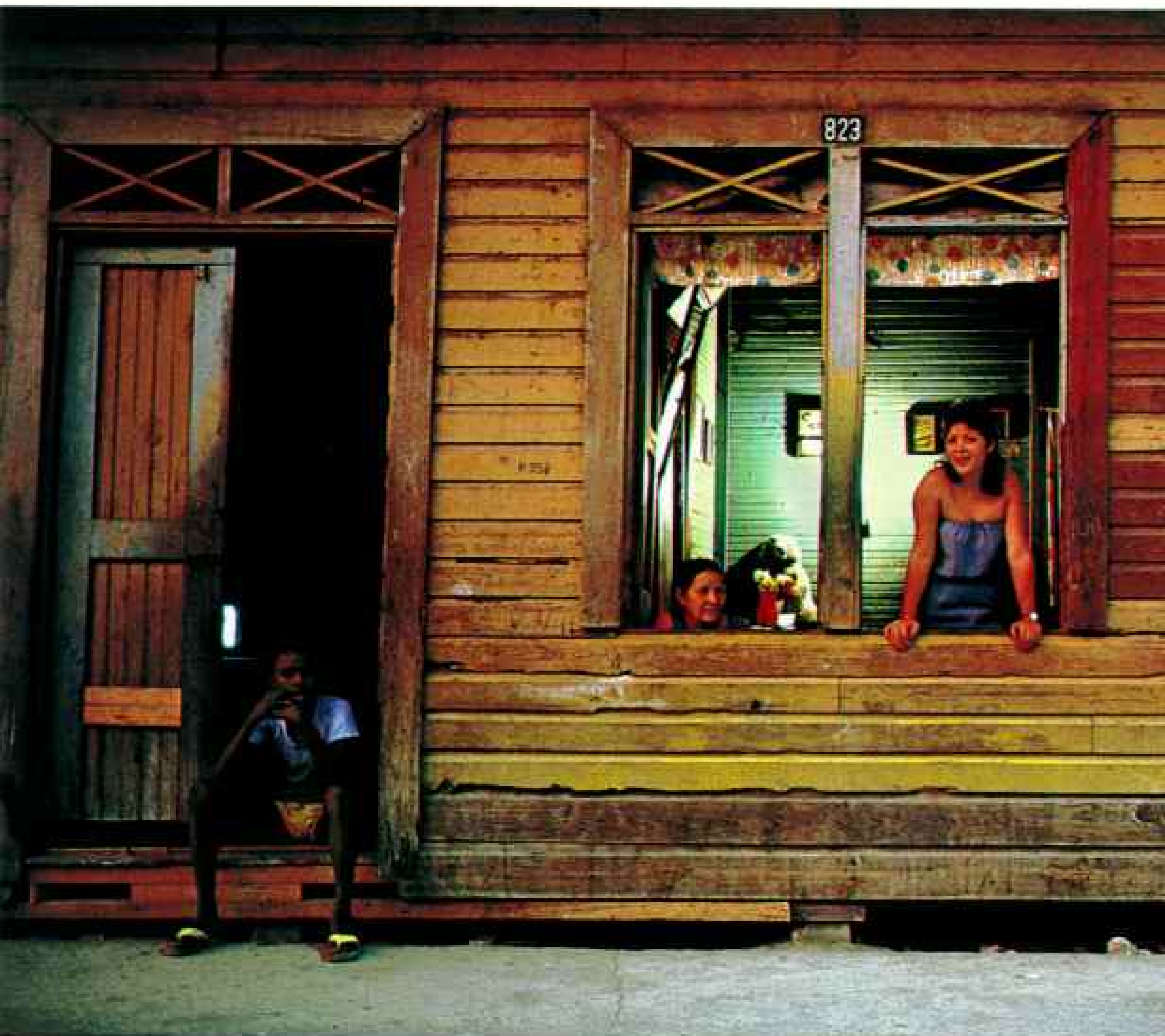
Men travel miles to earn a dollar or two in Gracias, bending under loads of heavy red pottery. Sometimes a trudging man is accompanied by a boy. Not really a boy, it seems, but a miniature adult, with his own load of pots roped to his forehead.

Indian blood courses the veins of the people who claw the hillsides and sell a bit of pottery. They revere the Indian leader that the Spaniards called Lempira—Lord of the Mountain. He fought valiantly against the conquest for two years beginning in 1537; the Spaniards killed him during a truce.

Soldiers told me that the nation's best troops are recruited in this area. "They're hardheaded, but when they learn to fight, nothing stops them," a sergeant said.

Recruited? Not precisely. Compulsory military service is enforced by the press-gang, an old Central American custom. "The soldiers take anyone who is healthy," a woman in the Gracias market told me.

A villager said: "A *comandante* tells the mayor to produce 25 young men. He cannot refuse. A truck comes. The boys cry because they do not want to leave their mothers. The mothers cry because they want their sons at home." Once in the army, however, many Lempirans make it a career.



UNTIL A FEW YEARS AGO frequent air service relieved the isolation of such towns as Gracias. But air service shrank as it grew more costly, and Honduras's road network is far from complete. So I chartered a Cessna when I started along the Mosquito Coast. Charlie Wettstein, son of German immigrants, set me down first at Trujillo.

My host was a voluble Italian, manager of a little jerry-built hotel sheltered by sea grapes and almond trees. In this pleasant but plain setting Angelo Rubboli strove to maintain a patrician aura, dressing in white shirt and white pants with a blue scarf at his neck. Angelo, wanderer of the world, is not

the first Italian to reach this place. That was Christopher Columbus, in 1502.

Trujillo, an early Spanish stronghold, is guarded by a massive brick fortress whose rusting cannon still point seaward. Behind, the town is small and drowsy. There being no taxi, I engaged Arturo René Ramos and his old pickup. "To the cemetery," I said.

Among the leaning stones we found one that said "Wuliam-Walker 1860." Contemporaries called *William Walker* a "filibuster," a military adventurer. Nashville-born, he made himself dictator of Nicaragua for one year in 1856. On another expedition he captured Trujillo but was pried out by a British man-of-war. Pursued by Hondurans, he surrendered to the vessel's captain, who gave him to the locals. They shot him.

Arturo regarded the stone. "He doesn't deserve anything this good," he said. "He was a mafioso, and he didn't like blacks." Arturo, who is black, knew that Walker had planned to introduce slavery in Nicaragua.

Trujillo has forgotten another William who, like Walker, arrived in difficulty. William Sydney Porter was on the lam in 1896, avoiding trial for bank embezzlement (for which he eventually served time). This was before he became famous as short-story writer O. Henry. In the book of stories called *Cabbages and Kings*, in which Trujillo is "Coralio," Porter described paradise: "The fetterless, idyllic round of enchanted days . . . a life full of music, flowers, and low laughter . . . and the many shapes of love and magic and beauty that bloomed in the white tropic nights. . . ."

In a beachside cottage at Angelo's hotel, lulled by the surf and the drum of rain on the thatched roof, I rejoiced that Trujillo seemed unchanged.

It will change. At nearby Puerto Castilla, Honduras is spending 45 million dollars to develop a port for lumber, bananas, and palm oil. A new paved road reaches back into the Aguán River Valley, a promising



An open-door—and open-window—policy prevails in Tela, where residents visit with passersby. Life geared down to a slower pace in Tela when the United Fruit Company, now United Brands, moved offices inland to La Lima.

agricultural area. And, close by, Green Berets train Salvadoran soldiers.

EGLISH SEA DOGS who preyed on Spanish galleons spread the name Mosquito Coast, possibly commemorating its premier pest, or taking the name of a prominent group of Indians in this region.

Charlie's Cessna followed the coast, over savannas green and flat as a billiard table. Turning, we trailed the Patuca River inland. Above the dense treetops of rain forest, I had the sensation of flying over broccoli in a supermarket. We pancaked down on the grass strip at Wampusirpi.

I looked there at people standing in a line, expecting to see in their rust-hued faces confusion and fear. But the eyes revealed nothing. Each person, each silent, withdrawn person, seemed simply stunned. All had walked days to get to Wampusirpi.

Name, age. Names and ages of children, grandmothers, uncles. At the line's end the information was recorded. Then each family could draw a ration of food: corn, beans, rice, powdered milk, enough coffee for one cup per person per day.

Miskito Indians from Nicaragua, some of these people fled heavy-handed changes imposed by the Sandinista government. Some fled fighting between the Sandinistas and counterrevolutionaries. Nearly four thousand Miskitos have been settled along the Patuca by World Relief, an evangelical church organization headquartered in Wheaton, Illinois.

Everything is boomtown raw in Wampusirpi. Smoke rises from cooking fires by tents. A *private* bath in the creek? Maybe after ten at night. Lacking dormitory space, World Relief's staff lays pallets on office floors and strings hammocks for a second tier of bodies. It is makeshift, crude, urgent ministrations to the burdened. It is beautiful.

At the present time Honduras is sheltering 23,000 refugees from Nicaragua, 20,000 from embattled El Salvador, and 500 from Guatemala.

— Many who reached Wampusirpi tell of violence. Sidney Kittle Goslen, minister of the Moravian faith, the dominant faith among Miskitos, said Sandinista soldiers burned his village. Son of a Texan who mined in Nicaragua, he spoke fair English. "They burned my house first and killed my little cattle. They burned another house. They went to the church and burned it down."

His village was beside the Coco River, also called the Segovia, which forms part of the border between Nicaragua and Honduras. The Sandinistas apparently burned riverside villages to clear the border of inhabitants. Miskitos who did not flee were compelled to resettle elsewhere.

"It's my faith that the people will be able to go back," said Señor Kittle, who is 69. "I'm getting old, and I'm not very healthy. Maybe I ain't going." He looked away, but not before I saw that his eyes were wet.

The little clapboard Moravian church in Wampusirpi filled with people after dark, and presently there floated in the velvety night yearning voices. A good Baptist would recognize the old hymn as "What a Friend We Have in Jesus." As the Miskitos know it, the words, in rough translation from their language, say that in time of trouble,

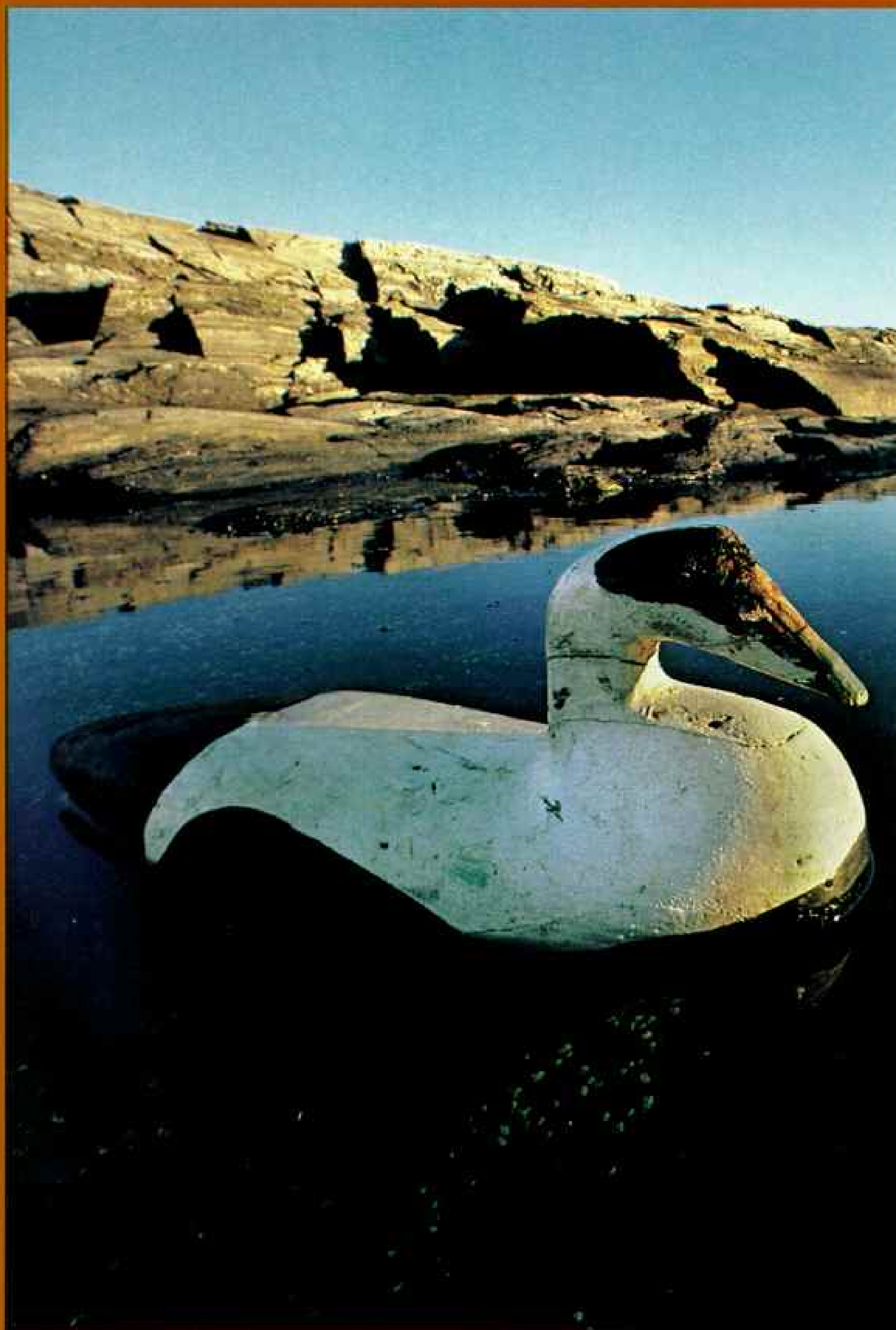
*I run fast to God,
And tell him in his ear.
He knows everything about me,
He understands my suffering.*

WENT BACK to Tegucigalpa and took the highway that twists to the hot Pacific coast. A dugout bore me to Amapala, on an island in the little Gulf of Fonseca. Three Honduran patrol boats painted with menacing shark's teeth rode at anchor there.

From the island it is possible on a clear day to see the volcano named Cosigüina in Nicaragua and two volcanoes, Conchagua and 7,000-foot San Miguel, in El Salvador. "Where the hell is Honduras?" asked a T-shirt I had seen on a boy in Tegucigalpa. (Yes, they have those there, too.) I can answer: It is between volcanoes. □

Facing an uncertain future, a 13-year-old Miskito Indian clears land at Wampusirpi resettlement area after she and her family walked for more than a week from Nicaragua. Supplied with basic farming tools, they and countless other refugee families throughout Central America struggle to carve out new lives free from the ravages of war.





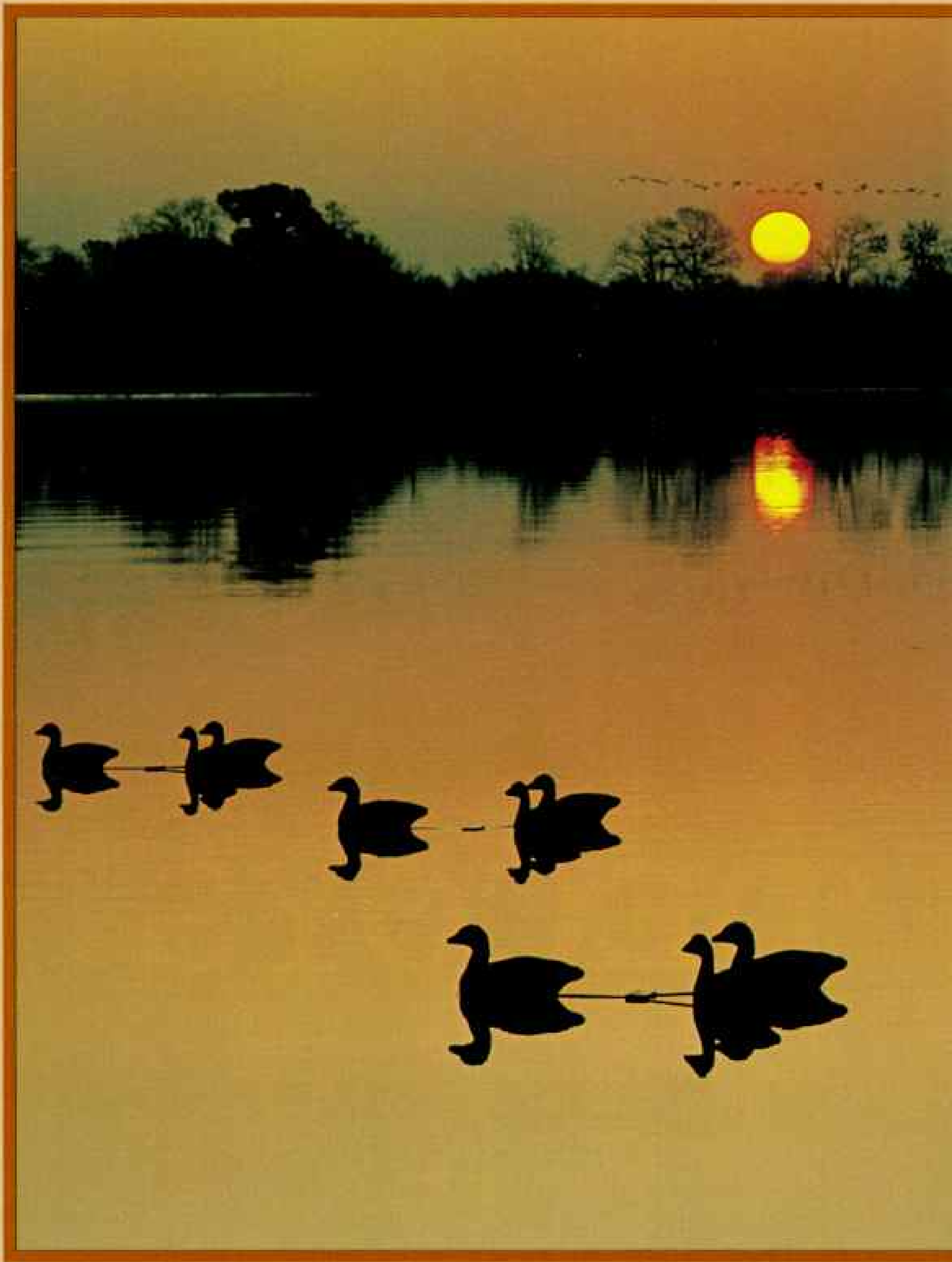


Humble Masterpieces:
DECOYS

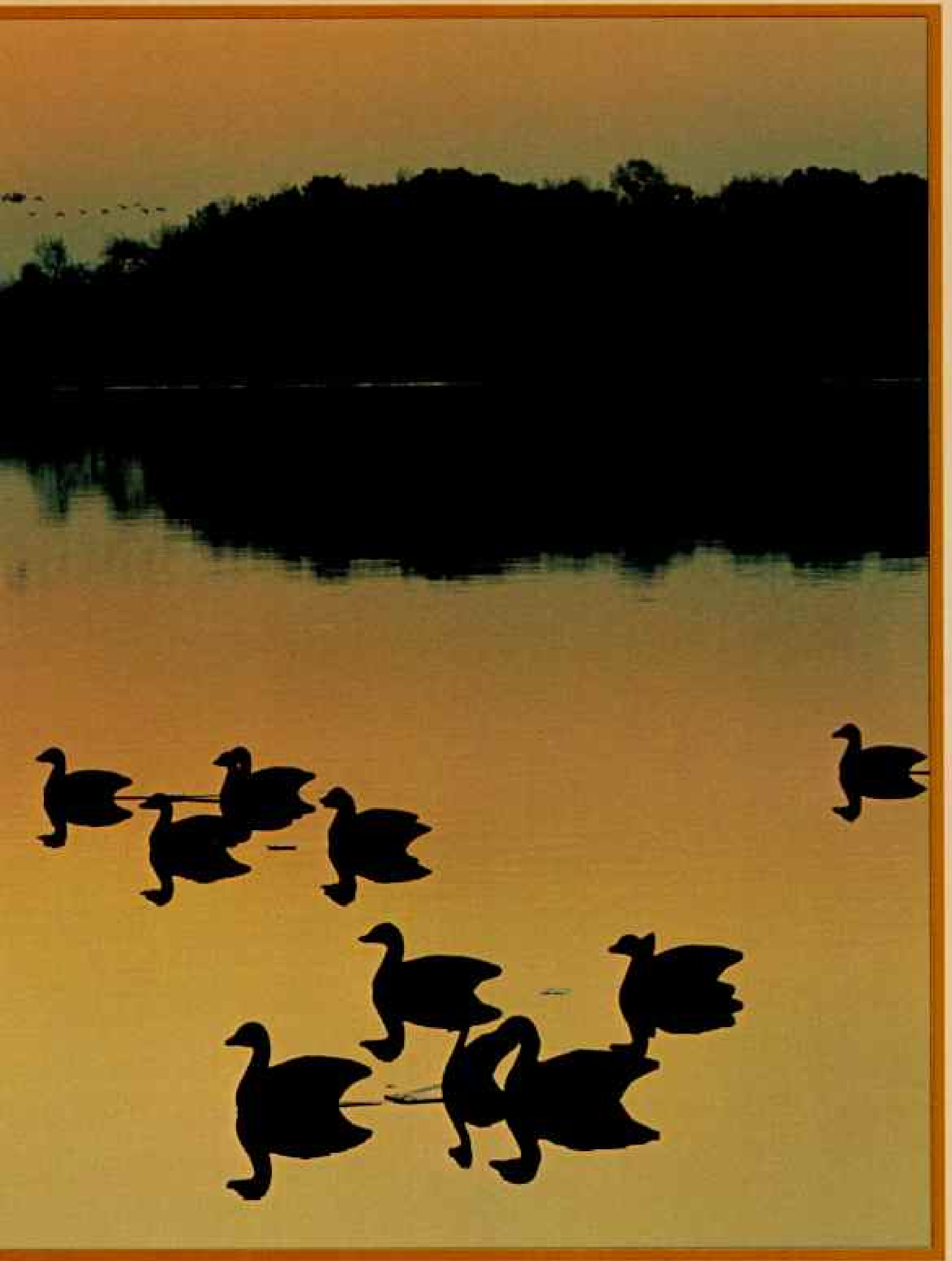
FLOATING SCULPTURE to admiring collectors, this common eider drake served as a rugged lure for the Maine hunter who carved it from cedar about 1910. Rough-cut in its beauty, it captures a nostalgia for earlier times that haunts this popular folk art.

By GEORGE REIGER

Photographs by KENNETH GARRETT



REFLECTIONS OF NATURE, silhouette decoys atop V-boards rest peacefully on Maryland's Chester River as a line of Canada geese wings across the horizon. Sets of these lightweight decoys, three to a board, can



be rapidly deployed in relatively large numbers. Since the days of Egypt's King Tutankhamun, hunters have tricked wildfowl with all kinds of lures, from tethered live birds to skins stuffed with hay to full-size models of wood.



WOODEN ARTISTRY: Joel D. Barber, dean of American decoy collectors, made this ring-necked duck (left) about 1920, bringing out the elegance of that rarely carved species through a distinctly marked bill.



PHOTOGRAPHED COURTESY OF SHELBURNE MUSEUM, SHELBURNE, VERMONT

The canvasback drake (above) was carved from swamp cedar about 1890 by Lee Dudley of Knotts Island, North Carolina. A blend of beauty and utility, the best decoys capture the essential qualities of the birds even as they meet the practical demands of the hunter. Besides being handsome and a close imitation of life, they must also be reasonably lightweight and durable, ride well in the water, and, most important, show a knack for attracting wildfowl.

A DOZEN ITEMS were put on the auction block and quickly absorbed by a crowd that seemed embarrassed by the paltry prices being paid: \$40 here; \$70 there.

A gentleman in a blue blazer leaned across an empty seat and told me that this was merely the warm-up—"to get the junk out of the way." When auctioneer Richard A. Bourne finally held up the first of two items to be sold as one, the gentleman's hand shot up with a \$1,000 offer.

"Fifteen hundred!" sounded elsewhere, and in swift \$500 increments the bidding climbed until the man in the blazer bowed out at \$5,000.

The crowd buzzed with pleasure. This was more like it! This is what they had come to see and hear at Hyannis, Massachusetts, after traveling from as far away as Houston, Los Angeles, and Seattle. All of us had come out of reverence for a mystical American folk artifact, the waterfowl decoy—and clearly anything less than a thousand dollars represented insufficient reverence.

Thousands of dollars for facsimiles of ducks and geese at rest? Thousands of dollars for items that were once everyday tools for countless rural American families? Why this demand for old decoys, many of them assembly-line factory products turned out in untold numbers?

It is more than their age, more than their (sometimes limited) artistry. It is, as well, a reflection of the America of yesteryear, when the United States was still a young nation confident that no problem was without its solution, when capitalism was the highest form of patriotism and conservation an unknown philosophy. Art, history, geography—decoys embody them all.

As a boy, 30 years ago, crouched silently in the finger-numbing cold of a brisk November dawn with my father and older brother, waiting for that heart-stopping moment when a squall of ducks would come

winging within shotgun range, I thought of decoys only as our partners in duplicity, lures that would help put redolent, succulent wildfowl on our holiday table.

Oh, I traded the wooden birds out of my bicycle basket, but this was no precocious regard for history or art; I merely wanted to find better birds to hunt over.

My older brother once made an outstanding trade of some new papier-mâché mallards for seven red-cedar brant decoys from the old Bellport (Long Island) Gun Club. We considered the trade a success, not because the brants were so much more valuable as antiques, but because we needed them to hunt Long Island's Great

South Bay, where mallards were then a relatively rare species.

However, I didn't think my brother's trade was such a shrewd bargain after our first mile hike across the marshes with the seven decoys in burlap sacks over our shoulders. Each brant weighed more than six pounds, and by the time we reached Reynolds Channel, each felt like 60.

We used the brants for several seasons, and when my older brother and I moved from home, younger brother John fell heir to them. Several days after one hunting season, John lugged the birds into New York to see whether anyone would buy them at Abercrombie & Fitch, the sporting-goods firm. Indeed, they would! Pleased but suspicious at the salesman's eagerness to pay roughly four dollars each for the birds, John went back the next day and found that all but a couple of the more battered specimens had gone home with A & F employees. And those two birds sported \$75 price tags!

Still, our orientation toward decoys was functional: If you couldn't use them, why keep them? That changed, however, in the fall of 1962, while I was in graduate school at Columbia University.



Marks of distinction, pellet holes (above) add to the sentimental value of a 1910 canvasback once used by professional hunters. Out for the sport, a Cape Cod hunter (right) prepares to deploy decoys on a snowy day perfect for hunting.



Hunting by myself on the Great South Bay, my punt was swamped by gale-roiled waves. Swept over the side were several dozen decoys, including the last of the lot my grandfather had carved.

I spent the next several hours in waist-deep and white-capped water, trudging in circles to keep warm and singing hymns and popular songs to keep up my spirits. I was finally rescued by a Coast Guard Auxiliary crew led by a gentleman who had spotted me in the middle of the bay from an observation platform on the roof of his house.

Although I went out again the next day and searched the windward shore for the decoys, I found only a few, none of them those my grandfather had carved. It was weeks before I could even bear to think about the loss. From that point I began looking for and preserving old decoys.

DECOYS, animate or inanimate, are nothing new. A 3,300-year-old illustration on a golden shrine from the

tomb of Egypt's King Tutankhamun depicts the young monarch clutching what appear to be live decoys by their legs. Over the centuries such simple devices as mounds of soil turned up on mud flats or a small rock set forward on a larger rock (representing a bird's head and body) or unadorned coconuts set afloat to bob in the waves have all been used to attract wildfowl.

Still, if decoys were discovered and rediscovered by different societies, why have only North Americans refined their use and appreciation into what practically amounts to a cultural phenomenon?

Of all the northern landmasses and all the northern river systems, probably none surpassed those in North America for sun-darkening clouds of waterfowl. Inuit and Indians harvested the molting, flightless birds of August and the restless, wandering birds of autumn. Even after the ducks and geese reached wintering grounds along the Atlantic and Pacific coasts or on the lower reaches of such gulf-bound rivers as the



Massive killing was pursued by professional "market gunners" from the 1840s to 1918, when Congress outlawed the industry. Some hunters used a cannon-like punt gun (left) that could shoot dozens of birds at once.

On Chesapeake Bay about 1920 a sportsman set

Mississippi and Colorado, ancient Indians took a toll. Yet, as long as the birds' breeding grounds were safe, wildfowl numbers seemed unaffected.

Unlike the satraps of Asia and aristocrats of Europe who rigidly controlled all hunting rights throughout their domains, North American waterfowlers have traditionally been opportunists of every social stripe. Because the earliest tribes of Americans were trekkers, moving from place to place as their whim and the seasons dictated, they felt no need to domesticate any of the game they hunted. Only people with permanent base camps are interested in raising tame waterfowl. For that reason, only the urban-oriented Indians of Mexico raised flocks of ducks (Muscovies). Other native Americans killed wildfowl where they found them. The first dead birds were themselves turned into decoys by thrusting sticks into their chins and down into the mud in order to hold their heads up. Canvasback decoys made from dried skins, feathers, and tule bulrush—and

at least a thousand years old—have been found in Nevada's Lovelock Cave.

By the time the British colonization of the New World began in the 17th century, the taking of waterfowl in England was dictated by strict procedures of rank and hierarchy reflecting England's own highly structured society. Swans and cranes were owned by the crown, and the right to harvest them was leased to various guilds and aristocrats. Ducks were taken on private ponds in enormous traps called *eende-kooi* by the Dutch, who developed them. The British adopted the Dutch system, and to this day refer to such traps as decoys. The only practical way for a commoner to participate in waterfowling was to work for one of the lords who owned land where it occurred.

However, in America, then as today, the birds belonged to whoever made the effort to capture them. In a 1621 letter home, Edward Winslow of the Massachusetts colony advised prospective Pilgrim immigrants to bring shotguns and to "let your piece be long



CHESAPEAKE BAY HERITAGE MUSEUM, HARRY WALSH COLLECTION

out nearly 500 decoys (above) in hopes of attracting canvasbacks from nearby flocks of thousands.

A field kit from about 1900 (right) held powder and lead shot for hand-loaded shells, along with decoys and a whistle to draw shorebirds within shooting range.





RELAXED POSES by a family of impostors are meant to convince passing Canada geese that all is well and they may safely approach. In North America it is considered unsporting to shoot birds not on the wing. Made

in the barrel, and fear not the weight of it, for most of our shooting is from stands." Such stand shooting was a privilege in England, reserved for the gentry; it was a functional form of recreation in New England, reserved for everyman.

ONE CAN ARGUE that waterfowl hunting played a role in underwriting self-reliance and democracy in the New World. On the dark side, however, was the greed unleashed by commercial gunning in the 19th century, when entrepreneurs found it possible to pick up quick

fortunes by exploiting the men who exploited the resource.

By the turn of the century, the development of assembly-line, rapid-fire shotguns meant that almost anyone could afford to buy a highly effective fowling piece.

The expansion of the railroads into remote corners of the country from mushrooming urban centers along the Atlantic coast and in the Midwest coincided with a growing demand for red-blooded protein in the diet of our swelling middle class.

And with the railroads came development of refrigerator and freezer cars that made



PHOTOGRAPHS COURTESY OF SHELBURNE MUSEUM

about 1849 with hollow bodies and detachable heads, these five graceful birds are the only known geese carved by Capt. Charles Osgood of Salem, Massachusetts. Together they are perhaps the most valuable set in any collection.

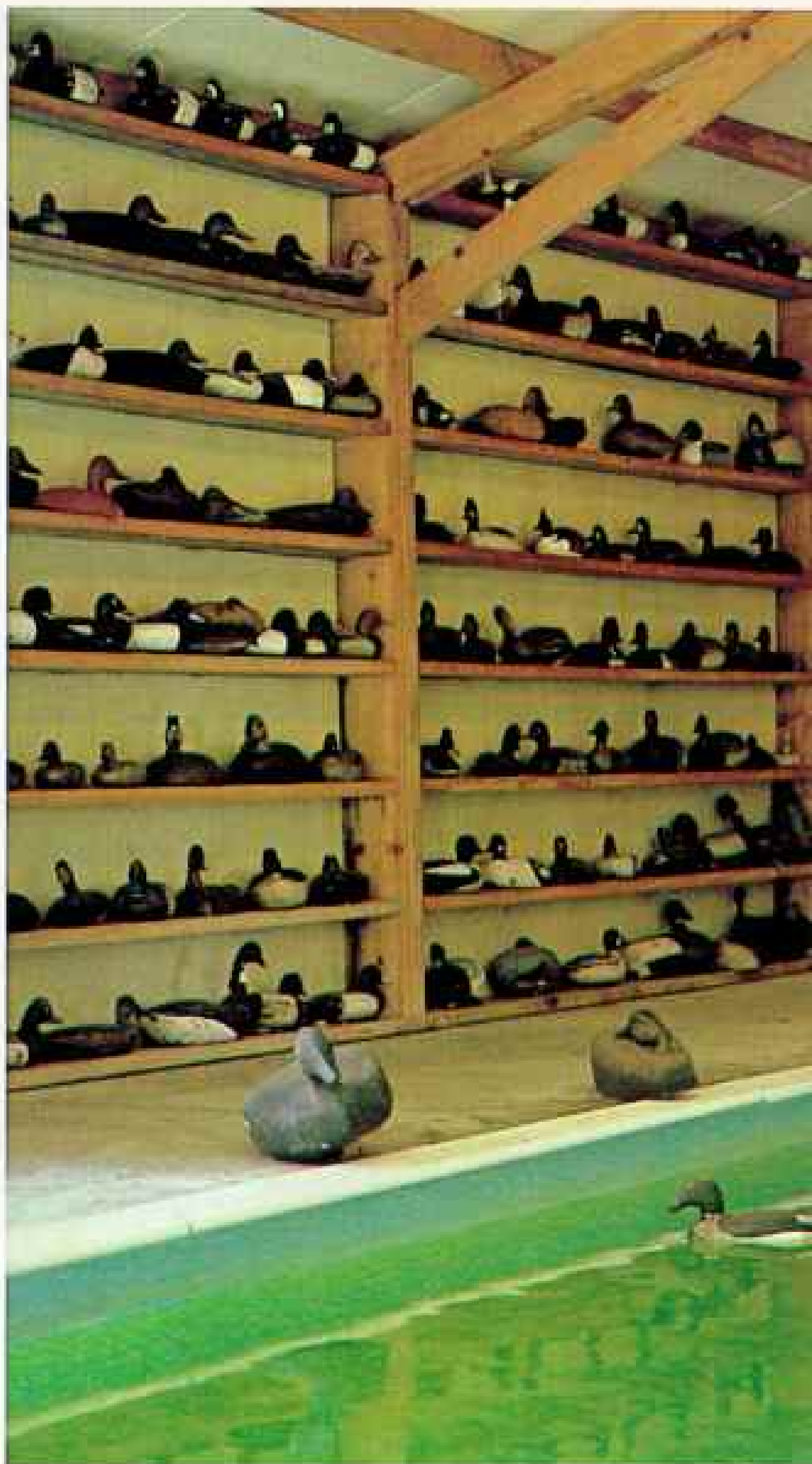
spring-killed mallards from the Midwest as much of a treat for Bostonians as winter-killed canvasbacks from the Chesapeake Bay. H. Clay Merritt, who began shooting for the market in the 1850s and claimed to have the first freezer in Illinois in 1870, stressed that “no first class hotel or restaurant was considered worthy of the name that didn’t furnish frequent game dinners.”

The demand for ducks, geese, and swans became so great that even after night shooting was outlawed on the upper Chesapeake in the last half of the 19th century, poachers were happy to pay a percentage of their kill

to local magistrates who somehow then became unable to find sufficient evidence to convict the night shooters.

Since visibility is limited even on moonlit nights, the weapon of choice was a huge single-barrel gun weighing as much as 160 pounds and firing up to two pounds of shot over a broad area. George Bird Grinnell, editor of *Forest and Stream* until 1911, recalled that the “gun was mounted on a pivot in the bow of a small skiff, to be paddled through the water. . . . The stock of the gun was braced against a block in the boat, and the recoil of (Continued on page 654)

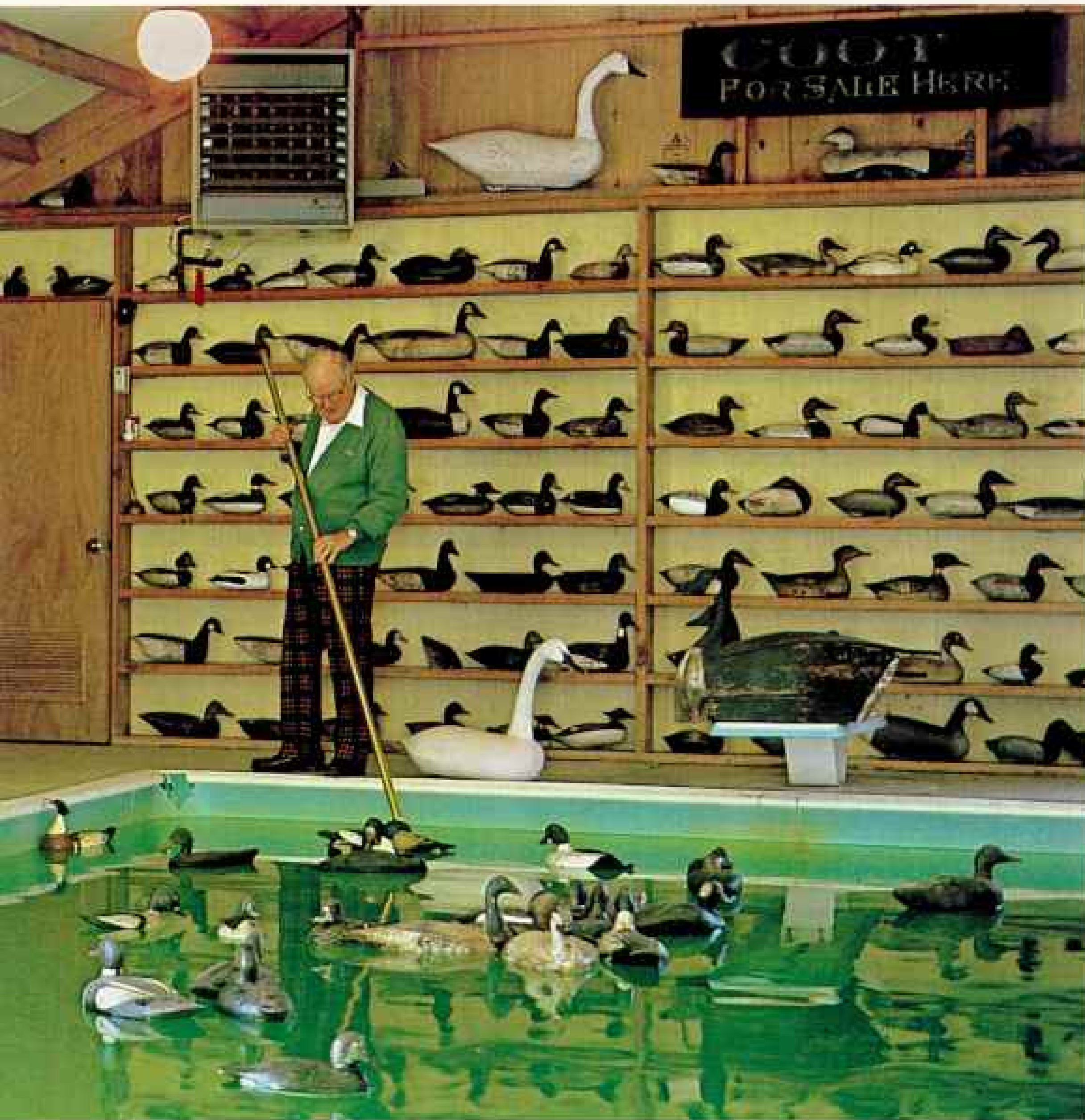
Stolen property, six decoys taken from a home on Virginia's Eastern Shore were recovered in 1981 by Deputy Sheriffs Ronnie Toth (below, right) and Mike Sterling of Accomack County. The two most valuable birds, foreground, were spotted at a decoy show in Ocean City, Maryland. The thief badly burned the other four to destroy the evidence just before he was arrested. The danger of theft has increased



dramatically as the value of carvings has risen. With decoy collecting more popular than ever, sportsmen, art lovers, hobbyists, and investors compete to outbid one another at well-attended auctions.

In Manhattan's William Doyle Galleries, Michael Fayer and his son Steven (right), both New York physicians, examine pieces to be auctioned. The mallard drake held by Michael, left, was later sold for \$11,000. Balanced on an iron foot, this rare standing ice duck was carved about 1900 by Charles Schoenheider, Sr., of Peoria, Illinois.





PHOTOGRAPHED COURTESY OF SHELBURNE MUSEUM

Tending his flock of birds, Dr. George R. Starr, Jr. (above), of Duxbury, Massachusetts, a leading authority, has built a private collection of 1,000 decoys, one of the largest in the United States. When first sold by their makers, most of Dr. Starr's birds went for less than a dollar apiece.

By contrast, decoys by Bill Bowman, a skilled Maine woodworker and carver of shorebirds, have recently sold at public auction for as much as \$25,000. This tiny Bowman dowitcher (left), made about 1900, is displayed at the Shelburne Museum in Vermont.

REGION TO REGION, the shapes of decoys reflected local hunting conditions. The breast of a canvasback carved in Wisconsin about 1930 (left) was made narrow like the prow of a boat to cut through river ice, with a high neck that kept the bill from



dipping into the water and icing up. Materials also varied according to price and suitability. On Long Island, carvers obtained natural cork from life rafts and vests that washed ashore, and the lightweight material served for the bodies of such decoys as this black duck (below, left) made by Charles E. "Shang" Wheeler of Stratford, Connecticut. Another black duck, right, by Harold Haertel, of East Dundee, Illinois, was carved from compressed cork used for insulation. Papier-mâché, canvas, barrel slats, and even cast iron have been used to fashion decoys.

653



(Continued from page 649) the discharge often sent the boat back a long way through the water. . . . The gunner paddled up quietly to the raft of sleeping canvas-backs, adjusted his gun to suit himself and discharged it, sometimes gathering from 75 to 100 ducks as the result."

But even when everything went smoothly—when the weather was calm and the gun caught the resting birds with their heads up (instead of tucked under protective wings)—night shooting was never as deadly as day shooting from a sinkbox, or battery, using shotguns almost identical to those used by millions of recreational hunters today.

A sinkbox was a kind of floating coffin set in the midst of hundreds of decoys in the

middle of prime diving-duck feeding grounds. Birds poured in and were slain by the thousands. According to Grinnell, ". . . in Chesapeake Bay, it is recorded, a gunner, shooting from a battery, with two guns, killed, in one day, over 500 ducks; and there is a more recent record of one man who killed 300 birds in a day."

The crime was neither in the time of day nor the technology. The crime was in refusing to establish any management guidelines. When the state of New York, in 1910, prohibited the sale of wild game, a crucial eastern market was eliminated. Even this was not enough. In 1918 the federal government assumed overall responsibility for migratory birds.



BUSINESSES that had sprung up in the late 1800s to meet demand for market-hunting paraphernalia tried to reorient their products for sportsmen after the turn of the century. Many didn't make it, for a scarcity of birds also meant a scarcity of recreational hunters.

Among the casualties were three decoy factories: two in Detroit, Michigan, and one in Weedsport, New York. Before 1900 these factories had shipped thousands of wooden birds to every part of the country. By 1924 the last of them, Mason's in Detroit, was forced to close its doors, and its machine-tool operators and painters sought more lucrative employment in the burgeoning automotive industry.

A romantic association with bygone days of abundance is the principal reason most any old factory bird has an intrinsic value not found in the "future family heirlooms" turned out by modern decoy factories. And like the Packards and Fords made by many of the same skilled artisans who had made the decoys, these antiques were built to work well and last.

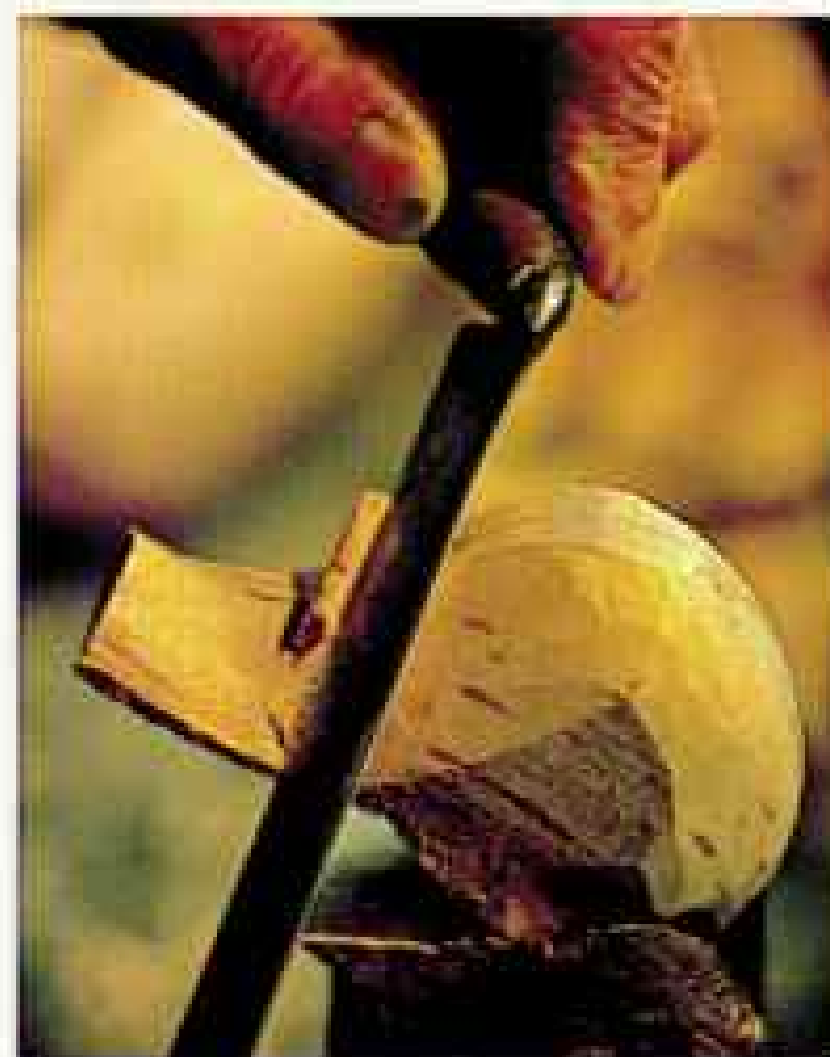
Of course, factories were not the only places decoys were produced before the turn of the century. Regional craftsmen have long turned out birds uniquely suited to meet local conditions.

For example, Barnegat Bay decoys were hollow and generally smaller than Great South Bay birds because waterfowlers in



Decoys by the dozen come from a wood-carving machine (left) at Wildfowler Decoys, Inc., in Babylon, New York. Following the shape of a master decoy, Joe Felten makes 12 new bodies for birds that will be sold mainly as decorative gifts.

In Havre de Grace, Maryland, carver R. Madison Mitchell (above) shows the traditional method of shaping a body. To sculpt the decoy's head (right), he uses a razor-sharp drawknife.



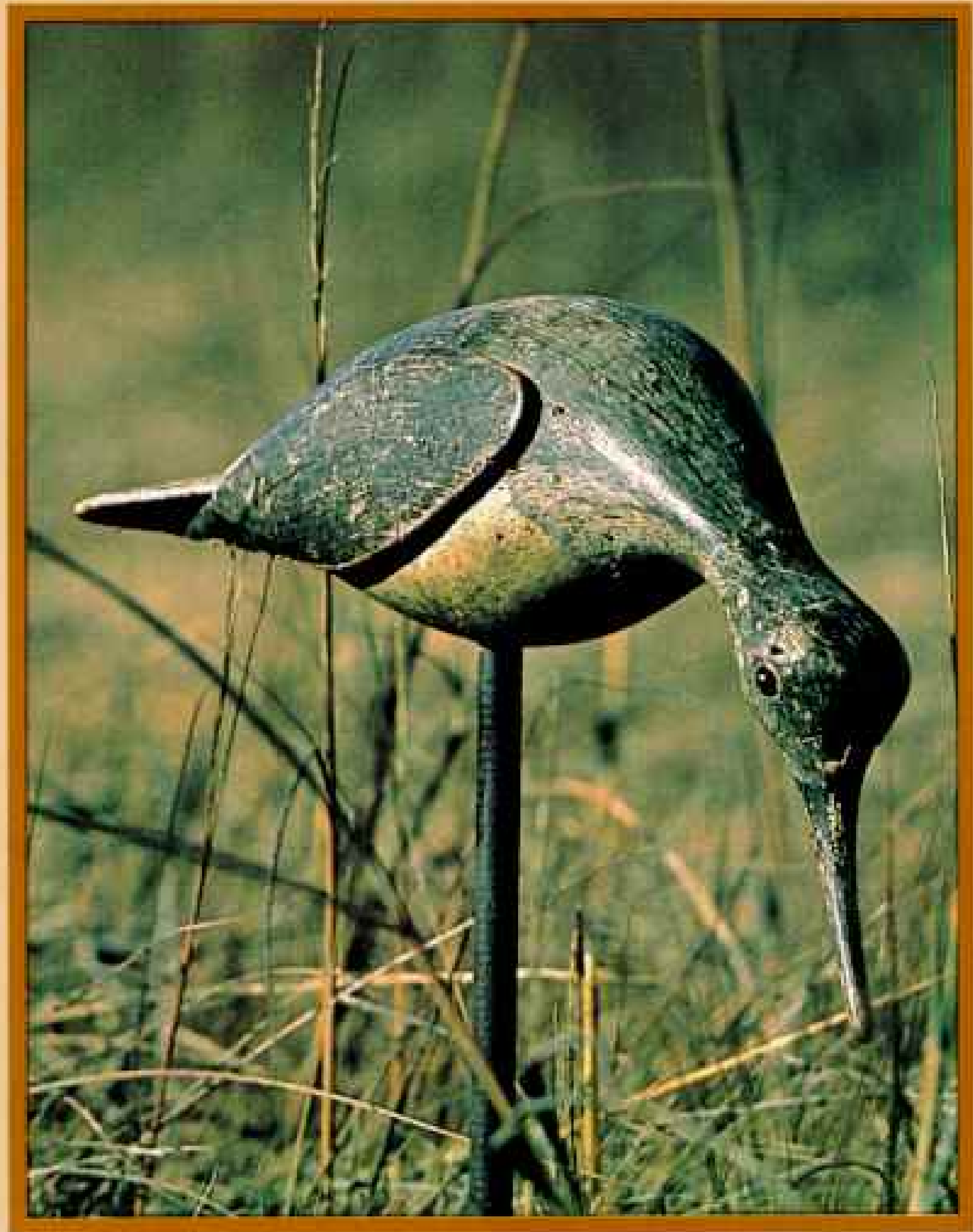
EASIER TO SHOOT than ducks or geese, shorebirds took disastrous losses during the years of uncontrolled hunting before 1918. Driven to feed, they were attracted to all kinds of lures, from golden plover silhouettes (below) in a Maine marsh to full-bodied stickups (right, bottom) on Virginia's Eastern Shore. Even after hunters opened fire on a group of birds like these dowitchers (right, top), survivors often kept returning until all had been killed.

Market gunners took so many that they counted the birds by the bushel, with the smallest ending up in "peep pies." In 1821 John James Audubon reported having seen 48,000 plover killed in one day along the Mississippi near New Orleans. And on Nantucket

in 1863, golden plover and Eskimo curlews arrived in clouds that darkened the skies. In two days of shooting, hunters would use up all the powder and shot on the island. Such slaughter along the East Coast helped drive the Eskimo curlew to near extinction, from which it never recovered.

Because all working shorebird decoys were carved before 1918, they are relatively scarce today and thus more valuable. Yet the best of them exhibit the same lively qualities of other decoys. In this yellowlegs (below right), carved about 1900 by Fred Nichols of Lynn, Massachusetts, a small cut in the body creates a subtle illusion of movement, as if the wing had just been folded for feeding. An intuitive touch, it evokes the bird's nervous demeanor.





New Jersey hunted in pairs or by themselves in small sailing boats, called sneak boxes, while Long Island hunters often went out in parties of eight or ten, riding in a "ferry" and towing their individualized "punties" behind. The ferries were designed to accommodate hundreds of large decoys, while the sneak boxes could only take a few dozen smaller and lighter-weight birds.

Over on the Delaware River near Bordentown, birds were carved and painted with particular attention to heads, wings, and tails because local wildfowlers hid some distance from their decoy spreads until the counterfeits had attracted several passing birds. Then the hunters would drift or scull down on the birds and shoot them when they

jumped into the air. Delaware River gunners felt that the more realistic they could make their decoys, the longer the wild and wary birds would stay among the decoys.

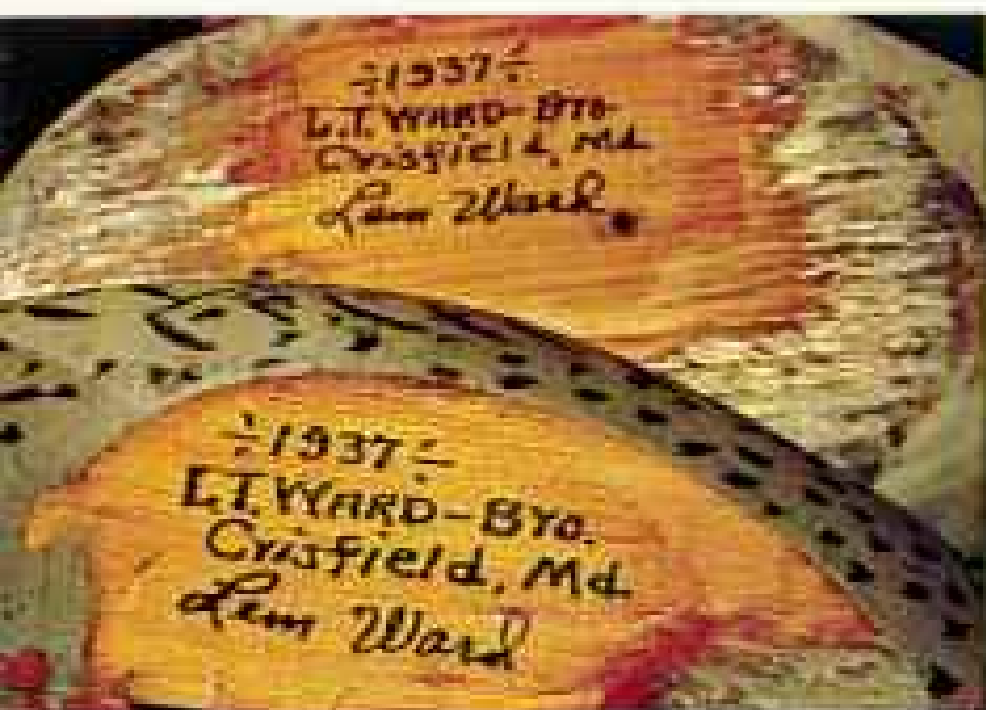
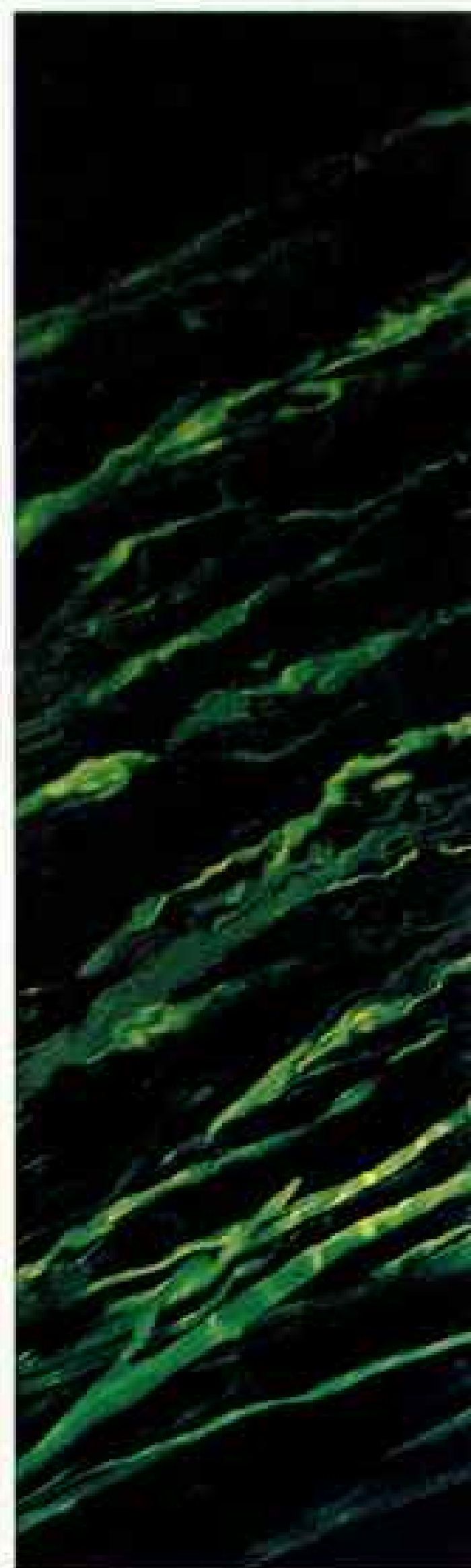
Farther west and through the upper Mississippi flyway, some river hunters carved birds with narrow breasts to cut through drifting skim ice and high heads that not only increased visibility but also kept the decoys' bills from dipping in the water, icing up, and sinking the birds under coatings of frozen water.

On the Eastern Shore of Virginia, two neighbors in Chincoteague carved distinctly different birds because of their distinctly different orientation to coastal waters. Ira Hudson built boats for open-water work,



Modest master of the craft, Lem Ward (above) carved decoys with his late brother, Steve, for more than 50 years at their workshop in Crisfield, Maryland. Experimenting with

new styles, they helped lead the art away from the simple lines of this 1930s goldeneye drake (right) to the more intricate realism of a 1965 Canada goose (above). Beginning as fulltime barbers and part-time carvers, the Ward brothers made their signature a valuable addition to any decoy collection. They also gave their name to the Ward Foundation of Salisbury, Maryland, repository of artifacts from market-gunner days and sponsor of an annual carving competition and art exhibit.



and his early decoys had deep, keel-shaped bottoms to ride through rough water like a sloop. Miles Hancock, on the other hand, carved birds with broad flat bottoms, like the sheltered-water workboat called the scow—decoys that would ride over all but the roughest chop.

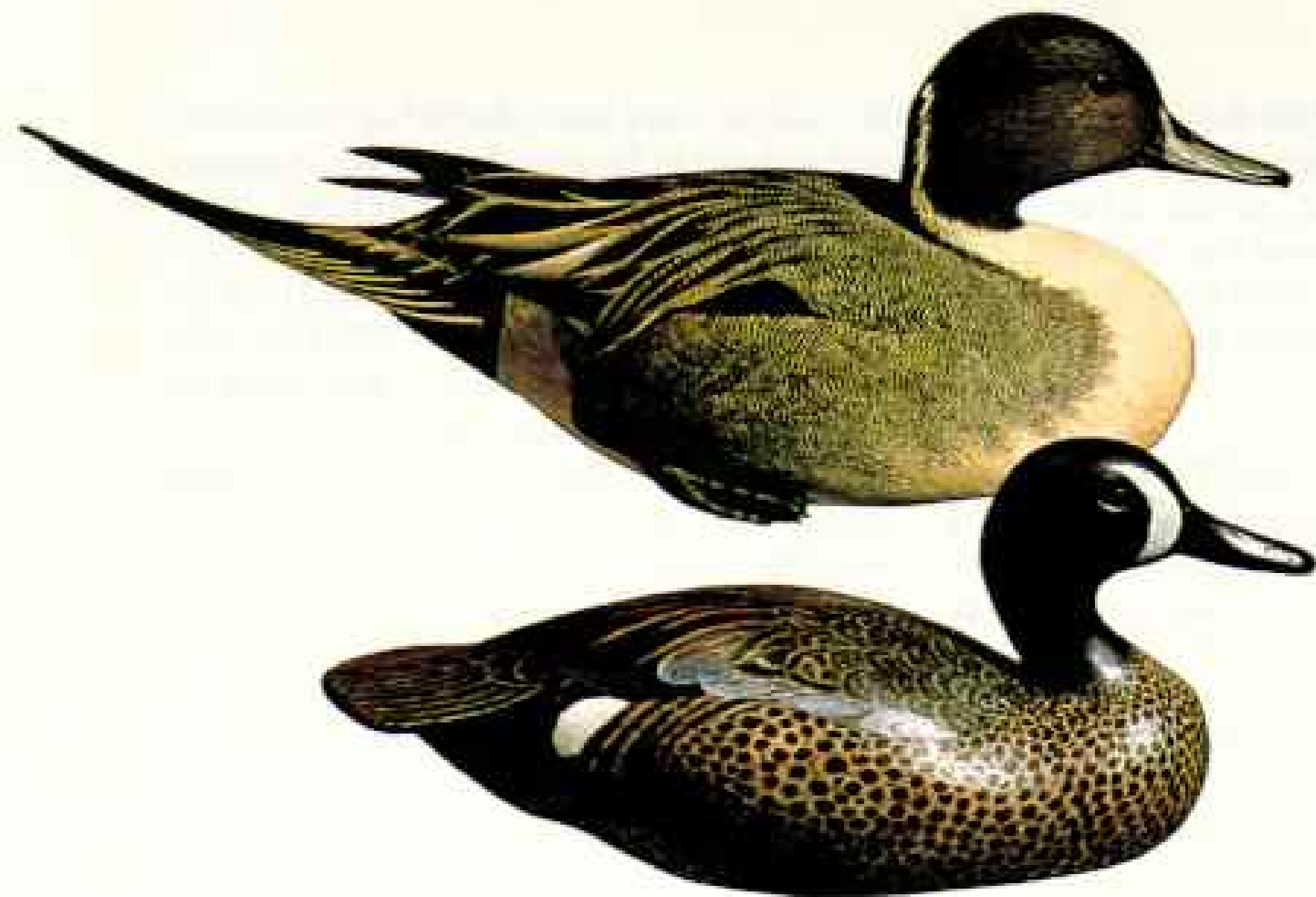
WITH THE FACTORIES gone, some regional carvers began using lathes to help fill orders that were large enough to keep them busy but not large enough to support many full-time employees. Upper Chesapeake bayman R. Madison Mitchell has made many hundreds of birds with only a hatchet, a spokeshave, and a drawknife. But many hundreds more of

his designs have been shaped by machinery and painted in his style by an ever changing guard of apprentices who eventually leave to try their own hands at carving.

“The market had stopped before I took up hunting and carving,” recalls Mitchell, who was born in Havre de Grace, Maryland, in 1901 and still lives there. “But we had a good many men—my father, for example—who shot ducks for the market. He farmed on Spesutie Island below the Susquehanna Flats, and if he hadn’t gunned for the market, we’d have been hard pressed to make ends meet.”

In the spring, great logs of white pine would flood down the still undammed Susquehanna, and the off-season wildfowlers





World's oldest decoys made by man were found in Nevada's Lovelock Cave in 1924. A replica (right) represents one of a dozen left by ancestors of the Paiutes at least a thousand years ago. Today's artists use varied painting and woodburning techniques to make extremely lifelike carvings such as a 1977 pintail (top) by Tan Brunet of Galliano, Louisiana, and a 1971 blue-winged teal (above) by John B. Garton of Jasper, Ontario. Plastic makes a practical lure (below) for hunting Canada geese.



would go out in boats to tow the drifting timber to shore near their workshops.

"Almost all the quality pine is gone now," observes Mitchell. "I still get some by listening around for word of an old building being torn down or one partially ruined by fire. I and some of the youngsters who like to help in the shop drive over to see whether we can salvage any suitable timbers."

Madison Mitchell went to work for carver Samuel T. Barnes in 1924, the same year Mason's Decoy Factory closed. Barnes died of pneumonia two years later, and Mitchell

was left with a growing decoy trade as well as his own funeral business.

"I should have chosen one profession or the other," reflects Mitchell. "If I could have concentrated on decoys, I suppose I could have made some profit. But as it was, I could never finish enough decoys to pay for my material and labor as I went along. I figure decoys cost my funeral business money every year I made the birds."

How much does a Madison Mitchell decoy cost?

"Back in the 1920s I had to charge \$1.50



for a canvasback. Gradually costs have gone up, and by the end of the sixties, I had to charge \$4.50. Today, I'm ashamed to say, I charge \$25 a bird. Frankly, I hate to make out a bill for a funeral, let alone a decoy!"

JUST AS MANY DEALERS made the best livings from the market-hunting labors of men like Mitchell's father, comparable middlemen make the most money from Mitchell's decoys. Don't bother thinking you can get a \$25 canvasback directly from Mitchell; he's so busy with

back orders, he figures he has at least another lifetime of work to complete. The only certain way to acquire a Mitchell decoy is through a dealer, and the markup is generally 200 percent above the carver's price. For birds he made before 1950, you may have to pay \$250 or more.

Still, such prices are small when compared with what is being paid for some of the rarer decoys. "Undisputed pedigree in original paint" is how carver and collector Grayson Chesser, Jr., characterizes the most expensive birds. A 19th-century brant



POISED TO FLY into life and soar away above the foam, a snipe by Dan Brown of Hebron, Maryland, tricks the eye with its realism. Never meant to be a working bird, this 1968 decorative carving reflects a modern trend in wildfowl art toward finely detailed replicas. Yet just like the decoys of generations



past that sprang from waterfront sheds, it pays tribute to the feathered creature it imitates by such masterful renditions in art.

carved by one of the Cobb brothers on the Virginia barrier island bearing their name sold at a recent public auction for \$28,000.

Naturally such money has attracted a growing number of confidence men, counterfeiters, and just plain thieves. Twice my Virginia home has been broken into and old decoys stolen. Although the sheriff apprehended the thieves both times, most of the birds had already been fenced to dealers in Maryland and New York and eventually sold to innocent buyers yearning for something old and handmade in their modern and mostly machine-made lives.

Since most antique decoys are so individual as to represent a kind of wooden equivalent of fingerprints, thieves are easily caught when they attempt to sell their loot to honest and knowledgeable dealers. Maryland dealer Henry Fleckenstein, Jr., spotted a Ward brothers' Canada goose valued at \$2,000 and a pintail by Ira Hudson valued at \$1,500 that had been stolen from another carver and collector five months earlier. Unfortunately, the thief tried to burn four other comparably valuable decoys, though arresting officers managed to prevent their complete destruction.

WHO ARE THE BEST JUDGES of value in a working bird?

Collectors would say they are, because they appreciate better than anyone else a decoy's aesthetics.

Carvers would say they are, because they understand not just what appeals to birds but what appeals to the buying public.

Yet the only meaningful judges are the wild birds themselves, which one day cup their wings and glide trustingly into preposterous rigs of painted bleach bottles and the next day won't approach within 100 yards of anything not actually wearing feathers.

Their choice may seem fickle, but it is frequently final, and the very existence of wild-fowl depends on their ability to distinguish friend from fraud.

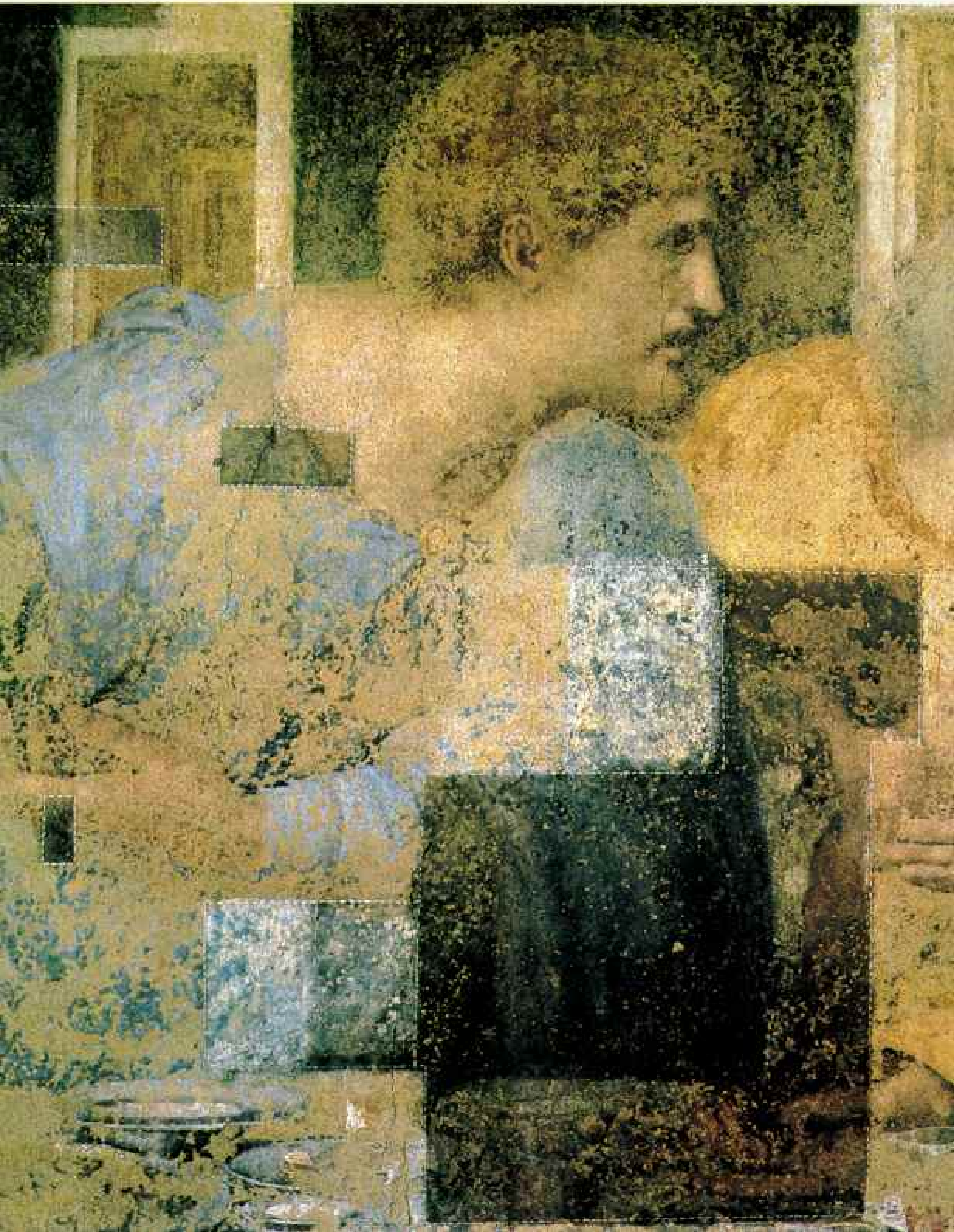
Thus there is only one proper setting in which to evaluate and perceive the meaning of a working decoy, and that is in a marsh at dawn, when wild wings overhead whisper softly of eons of time, describing the ancient saga of men and waterfowl. □

*Restoration
reveals*

THE LAST

664

By CARLO BERTELLI Photographs by



SUPPER

VICTOR R. BOSWELL, JR.
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Masterpiece reborn, Leonardo da Vinci's "Last Supper" comes to light—patch by patch—after five centuries of abuses by man and nature. This restored section shows Apostles Matthew, Thaddeus, and Simon.



I SEE A MAN, an artist of some 40 years, arguing with lawyers in a piazza of Renaissance Milan. The duke's patience wears thin, says one lawyer. There are contracts, says another, and deadlines that have passed. Perhaps, suggests a third, the famous Leonardo da Vinci has taken on too many projects. Casting of the great bronze horse, a monument to Duke Ludovico Sforza's father, has not yet begun. Plans for new weaponry are due. Can not Leonardo speed up his work in the dining hall of the Dominicans? Why does that painting of the "Last Supper," the duke's gift to the friars, take so long? Why, Leonardo, do you dabble with oils and resins when the faster fresco techniques are so well proven?

Abruptly, I see Leonardo break away. He is distracted by a passing face. The stranger's nose and chin line have a classic grace. The eyes bear a sadness and pathos he has struggled for weeks to sketch.

Leonardo pursues the stranger through the winding streets of Milan. Summoning his powers of concentration, the artist memorizes details of the man's face and carriage. At last he has solved the crisis of visualizing the Apostle James the Younger. Leonardo will not rest now until he can reproduce those details on the wall of the Dominican refectory, or dining hall.

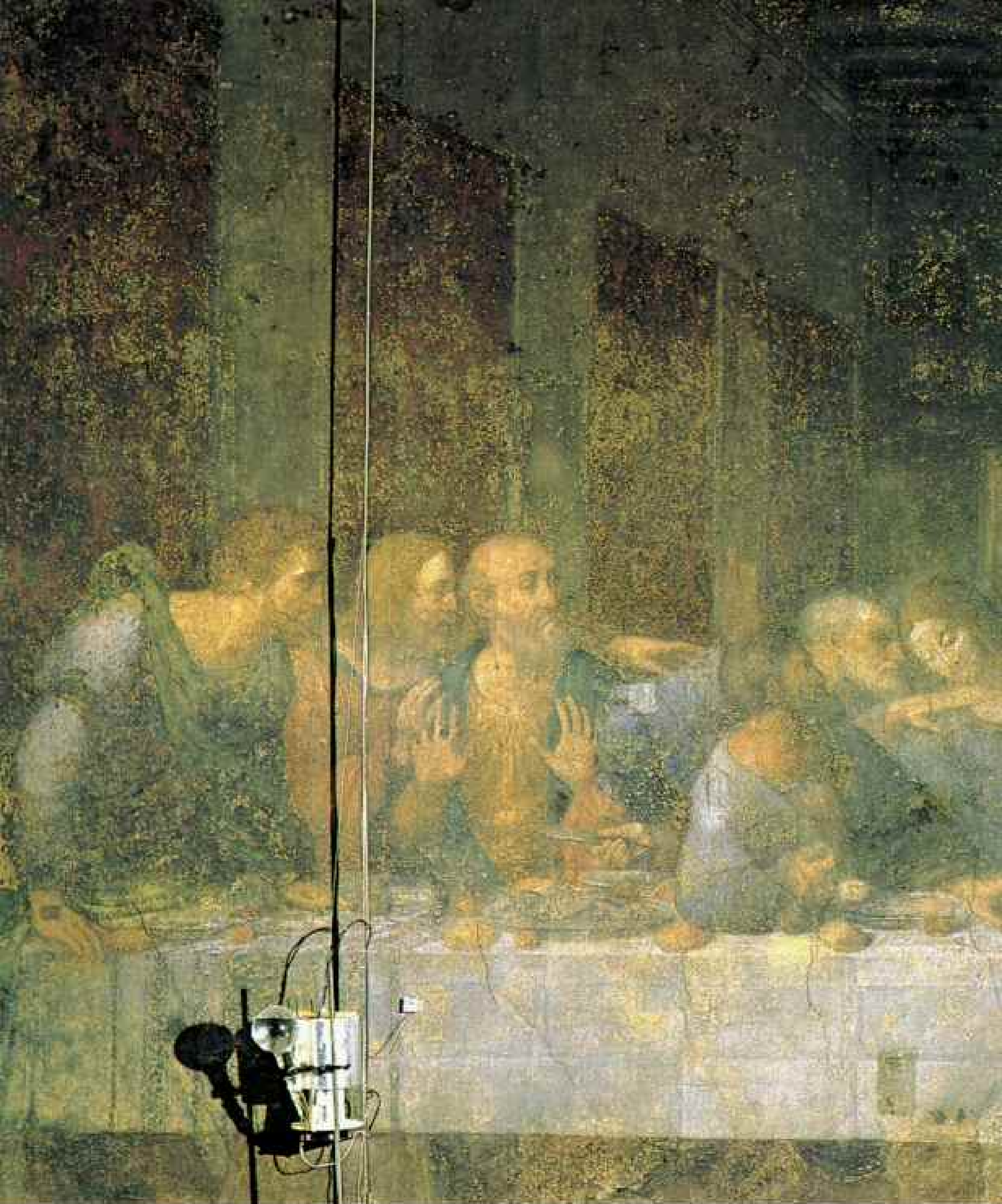
Five centuries have passed. Once again scaffolding obscures that monastery wall. This time the scaffolds are there to salvage perhaps the world's most abused masterpiece. For the past six years it has been my job, as superintendent of fine arts in Milan, to help coordinate this rescue operation.

Now, when I visit the monastery of Santa Maria delle Grazie, I see a woman. Her concentration must at times rival Leonardo's. The woman, Dr. Pinin Brambilla Barcilon, works at a microscope about the size of a dental X-ray machine. As Dr. Brambilla moves it up and down, it magnifies by as much as 40 times (Continued on page 676)

As in Leonardo's day, visitors flock to admire his wall painting in this former refectory of a monastery in Milan, Italy. Lunettes display crests of the Sforza family who commissioned the mural, under repair since 1977.



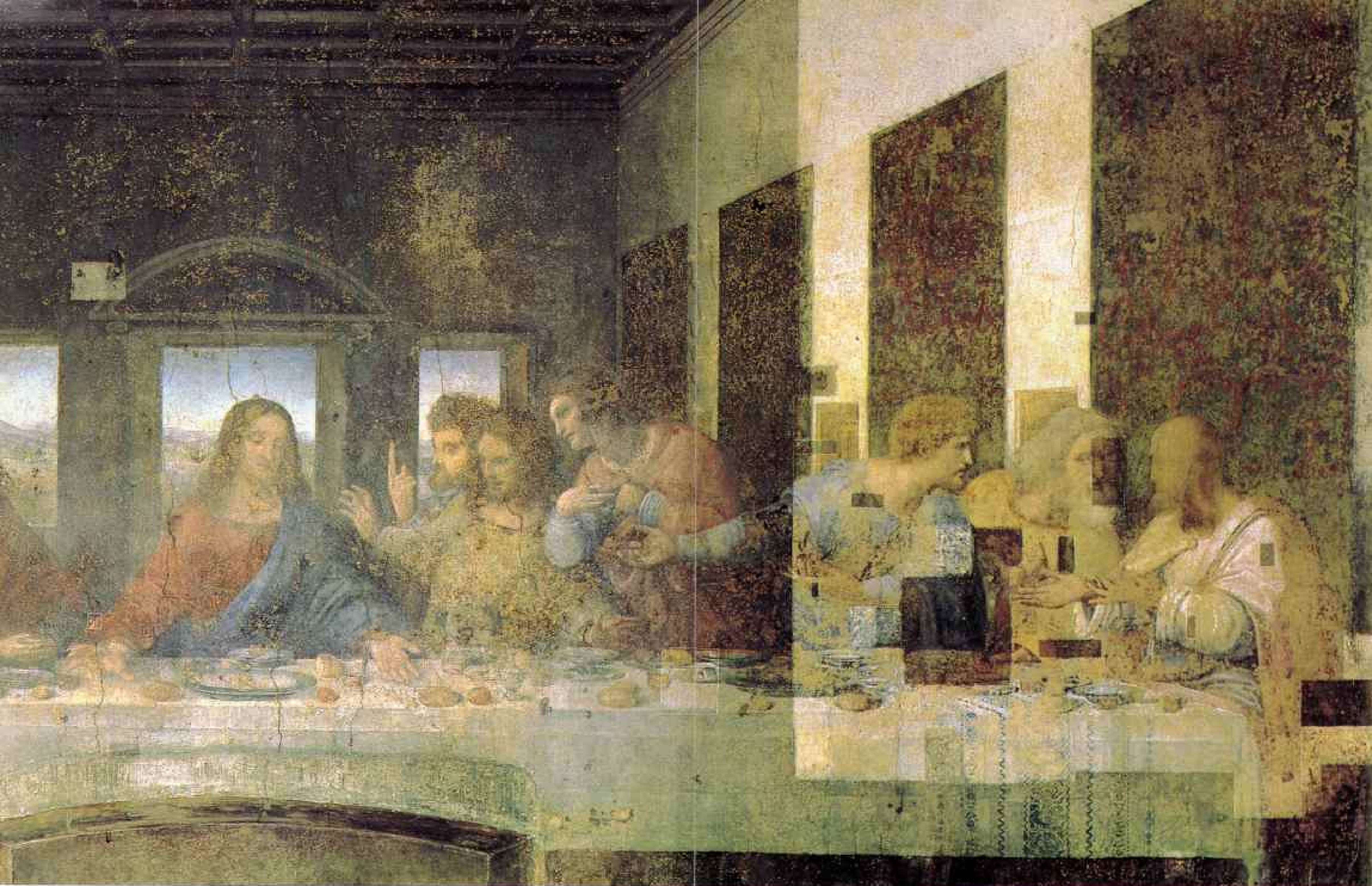




"One of you shall betray me." Turmoil disrupts the Passover table as the twelve disciples react to Christ's forewarning. In capturing this moment before the traitor is revealed, Leonardo plumbed a psychological depth unknown in previous

paintings of the Last Supper and heightened the drama by grouping the Apostles in threes.

From the left, behind a humidity monitor, are Bartholomew, James the Younger, and Andrew. Judas, shadowed



in guilt, clutches his betrayal fee, while Peter whispers to John, "Tell us who it is of whom he speaks." Thomas, his finger raised; James, brother of John; and Philip ask, "Is it I, Lord?" The now luminous Matthew, Thaddeus, and

Simon confer below tapestries hanging on newly revealed hooks and nails.

Scientist as well as artist, Leonardo devised an extraordinary accelerated perspective, converging all lines in the painted room on Jesus and riveting

attention on the figure isolated in a halo of window light.

Historians date the Italian High Renaissance to this monumental work, painted about 1495-97. It began to decay within a decade. By 1652 it was

presumed lost, and the friars enlarged a door through Christ's feet. His face (overleaf), shown here in the size it appears on the mural, bears heavy repainting from past restorers. Its cleaning will culminate this restoration.





Bringing Leonardo back to life

“YOU HAVE TO THINK like the artist,” says restorer Dr. Pinin Brambilla Barcilon (**right**) as she searches for the heart of the “Last Supper.” “What you see of the painting is largely the invention of past restorers,” she explains. “What we are bringing to light will be truly by Leonardo’s hand.”

Leonardo’s experimental painting technique quickly proved unstable, and much of his original pigment is now lost. Six major restorations since 1726 usually did more harm than good, repainting the mural in somber tones, darkening it with oil, anchoring pigment with dirt-collecting glue and wax, and destroying Leonardo’s paint with harsh solvents. One restorer even signed his name. But the last restorer carefully anchored the paint after World War II; without his effort even less would remain today.

Dr. Brambilla’s artistic surgery proceeds with excruciating slowness and care. After three years of testing, the restorer has spent three years cleaning the lunettes and the right quarter of the mural, thought to be the least damaged. She first examines a small area through a microscope, enlarging the paint fragments as much as 40 times. She then applies specially developed solvents, and blots quickly before the chemicals reach Leonardo’s colors (**far right**).

Delicate details return: A once obscured object becomes a lemon slice reflected on a pewter plate (**right**). “If Leonardo gave this attention to the table setting, you can imagine what his figures once looked like,” says one Leonardo scholar.

The transformation of Matthew (**left, top to bottom**) brings us closer to the artist’s concept. The black-and-white photograph records his condition after a turn-of-the-century restoration. With cleaning, his countenance re-emerges. Dr. Brambilla works in chalk-marked patches to compare different areas. Completed, Matthew regains his classic profile, and his mouth is once again open in speech. Where none of Leonardo’s pigment remains, Brambilla paints a neutral, easily removed watercolor, seen in Matthew’s hair.



SOPRINTENDENZA PER I BENI ARTISTICI E STORICI (TOP); POLAROID CORPORATION (BOTTOM)



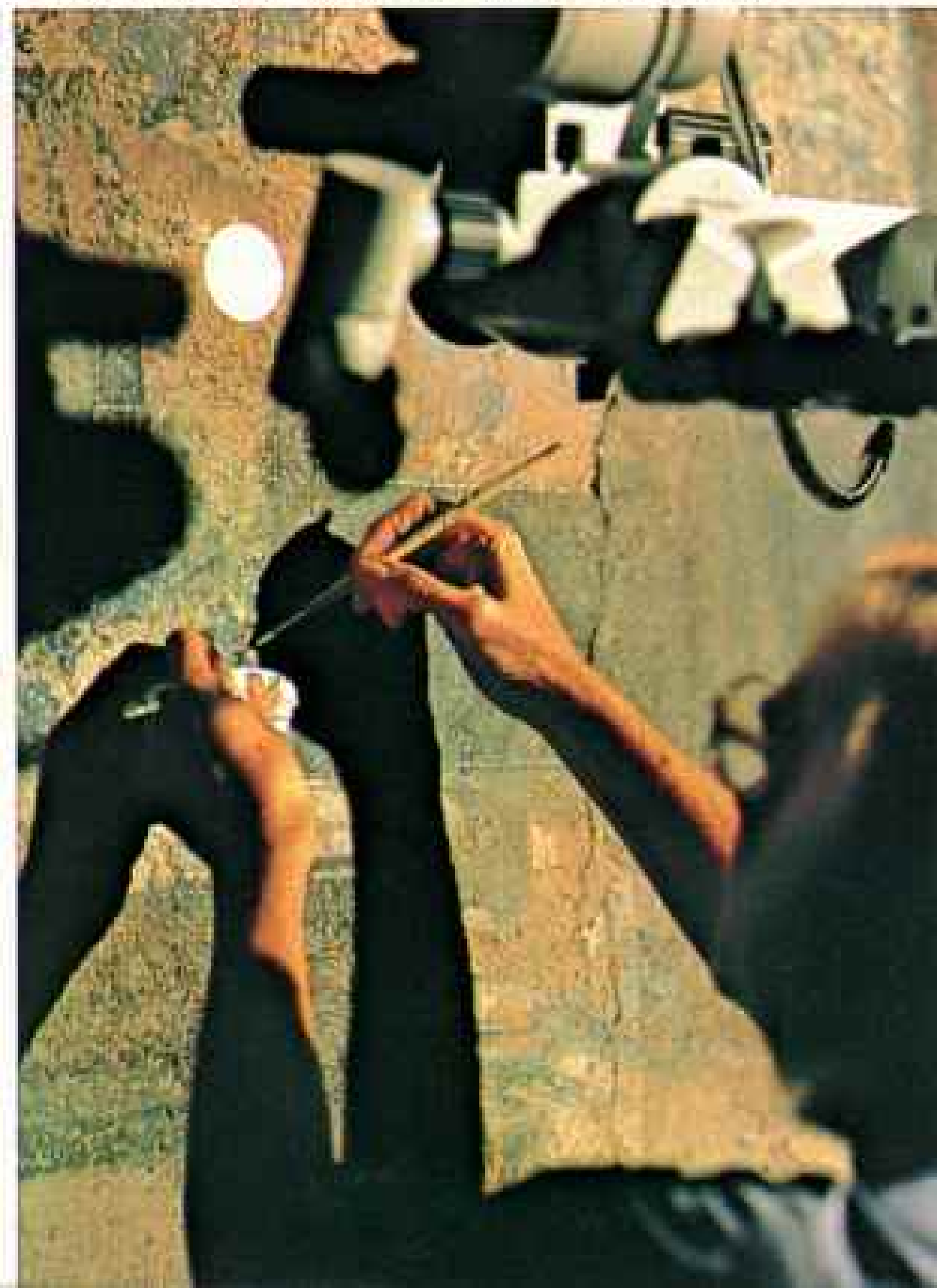


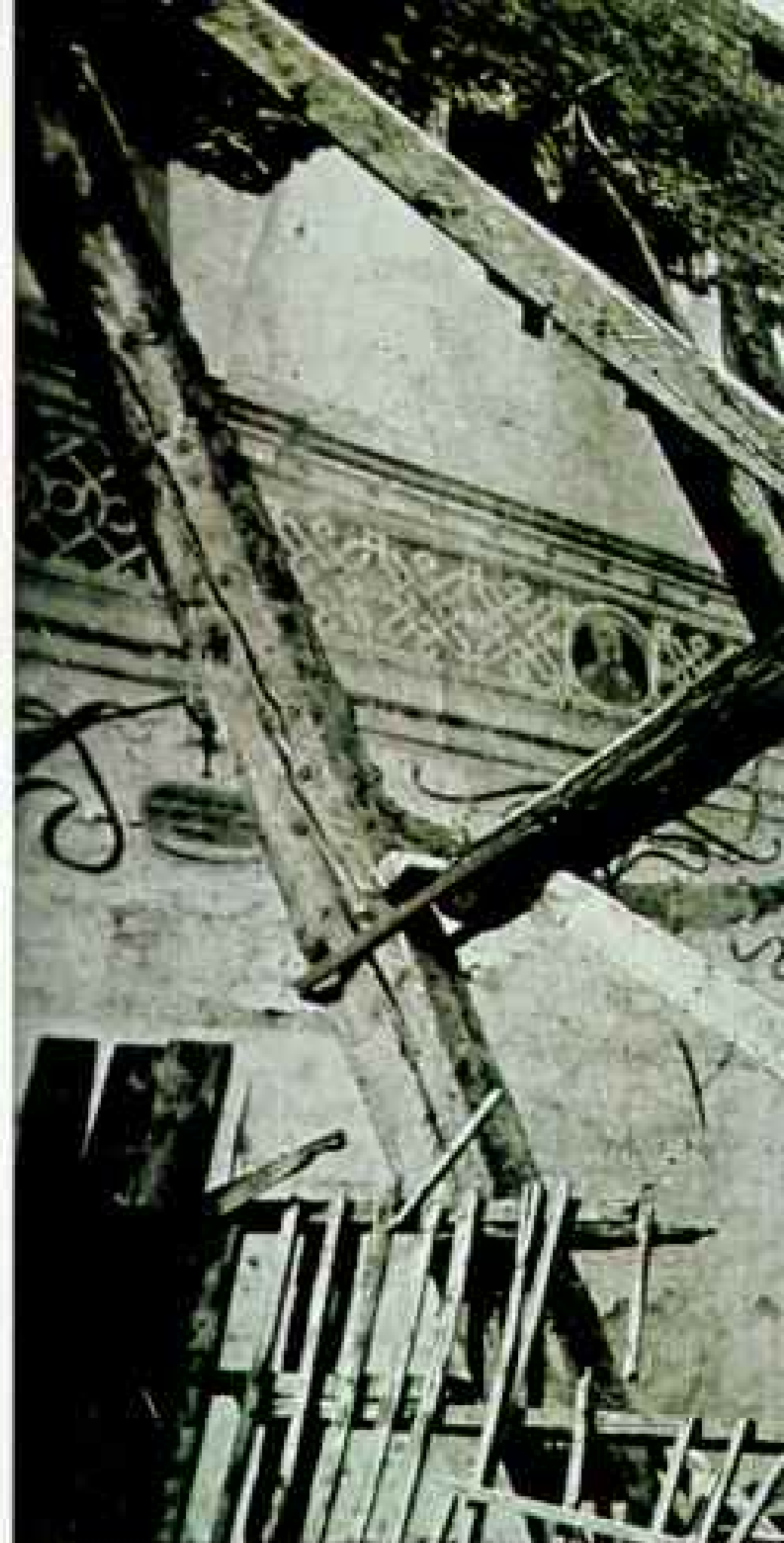
© LOUIS MAZZATENTA, NATIONAL GEOGRAPHIC STAFF (BELOW RIGHT AND ABOVE)



Researchers are still attempting to discover the composition of Leonardo's paints. Italy's Olivetti Corporation provides funds and equipment for that work as well as for the restoration. The Polaroid Corporation provides photographic documentation. Time estimates for completing the project range from three to five years.

Restoring the "Last Supper"





"Even in disaster there was good luck," reflects Father Angelo Caccin (left), speaking with a visitor at the Dominican monastery of the Church of Santa Maria delle Grazie. A World War II bombing ravaged the complex in 1943, but spared

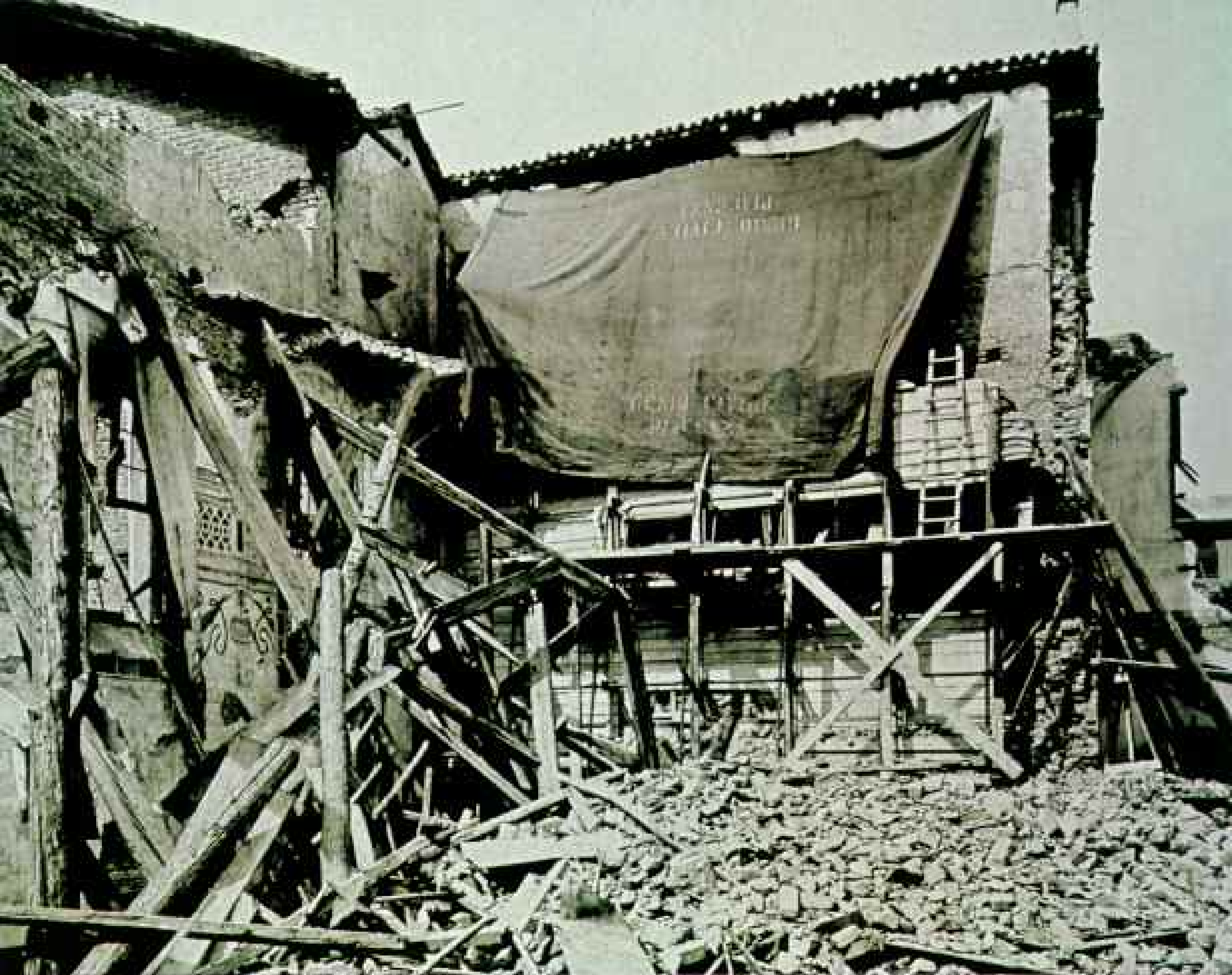
(Continued from page 666) particles of the paint Leonardo applied in the 1490s.

Like Leonardo, Dr. Brambilla works with a paintbrush, along with a scalpel and a surgeon's skill. She is cleaning and scraping away 500 years of dirt, glues, and mold, as well as many layers of overpainting by zealous previous restorers.

Those restorers added their own idiosyncratic embellishments to Leonardo's masterpiece. They have darkened the painting, destroying the bold and brilliant colors. They have changed the lines of the Apostles' faces and obliterated much detail. The face of Christ, the magnetic central focus of the painting, is a mere mask. No one knows for sure what features Leonardo conceived for Jesus. We suspect also that Judas has been given more devilish features. This current

restoration is, in a sense, an excavation. The true "Last Supper" lies buried beneath centuries of overpaintings.

THE "LAST SUPPER" has been assaulted by more than restorers. Its problems began almost with its inception. Some experts maintain that Leonardo betrayed himself by using the wrong technique. Murals such as the "Last Supper" were traditionally done in fresco. In that method, paint is applied directly to wet plaster, so that color and plaster become one. A fresco painter must work very quickly, but working quickly was exactly the opposite of what Leonardo wanted to do. Further, the fresco technique would have limited the types of paints Leonardo could have used. We know he experimented with



SOPRINTENDENZA PER I BENI ARTISTICI E STORICI

the church dome by Renaissance architect Donato Bramante and—amazingly—the “Last Supper” (above). The wall had been braced with steel and the painting covered with the boards and sandbags seen below the tarpaulin.

a rich but still poorly understood variety of paints to achieve the innovative colors of the “Last Supper.”

To free himself from fresco’s limitations, Leonardo had the freshly plastered wall of the dining hall painted with lead-white primer. When this priming dried, he proceeded to paint at his own pace and with the paints he preferred.

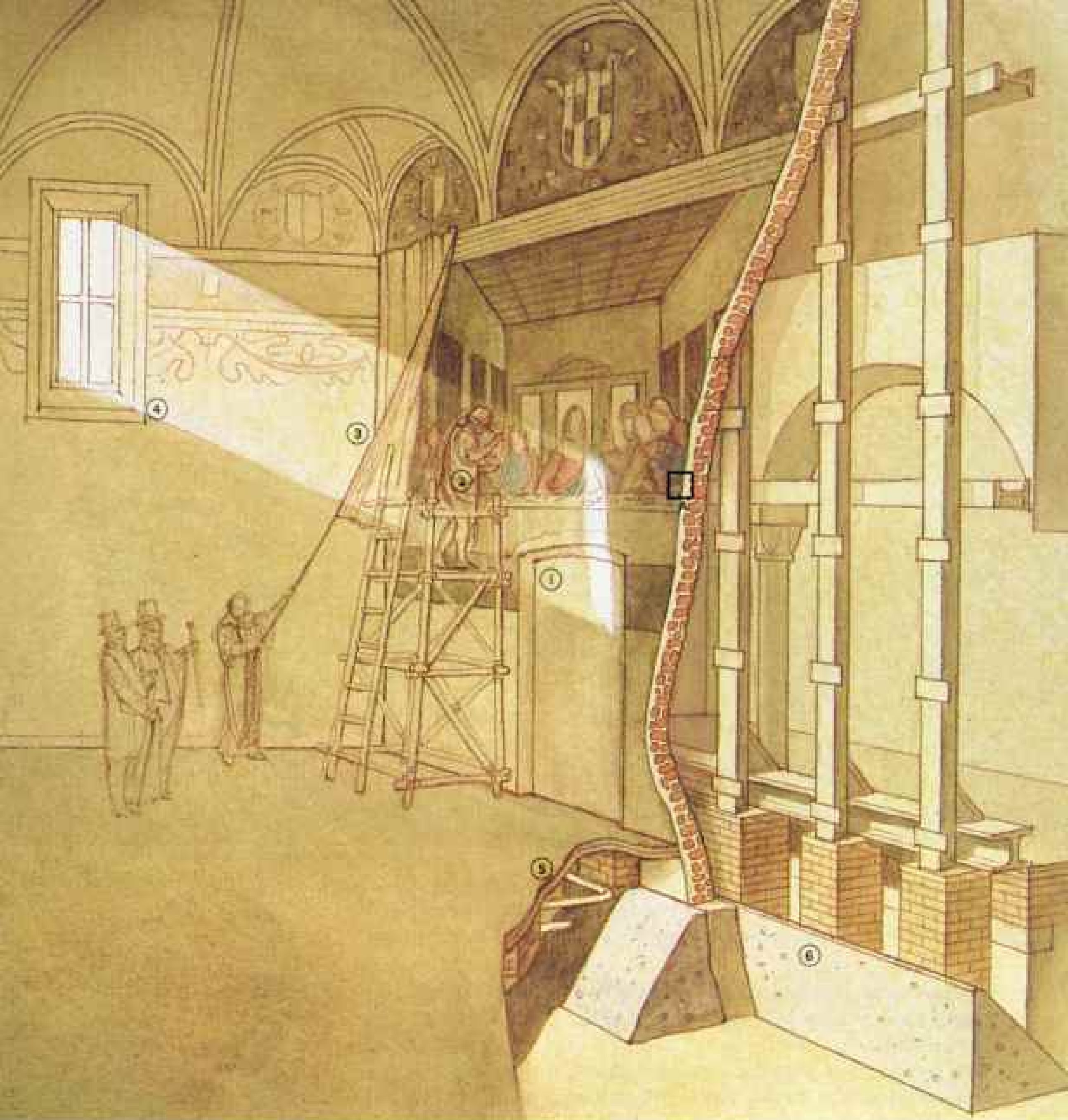
The Renaissance writer Matteo Bandello, who in his teens observed Leonardo, gives us some idea of how the artist worked on the “Last Supper”: “Many a time I have seen Leonardo go early in the morning to work on the platform before the ‘Last Supper’; and there he would stay from sunrise till darkness, never laying down the brush, but continuing to paint without eating or drinking. Then three or four days would

pass without his touching the work, yet each day he would spend several hours examining it and criticizing the figures to himself.

“I have also seen him, when the fancy took him, leave the Corte Vecchia when he was at work on the stupendous horse of clay [that is, the model for the gigantic bronze equestrian monument to Ludovico’s father that was never cast] and go straight to the Grazie. There, climbing on the platform, he would take a brush and give a few touches to one of the figures: and then suddenly he would leave and go elsewhere.”

The priming technique that gave Leonardo the luxury to deliberate, some contend, was too experimental. Indeed, the priming cracked, and even in Leonardo’s lifetime the paint began to flake.

The technique Leonardo used was not



PAINTINGS BY NATIONAL GEOGRAPHIC ARTIST WILLIAM H. BOND; ADAPTED FROM ARTE LOMBARDA NUOVA SERIE (1988 RIGHT)

Portrait of destruction, this drawing (above) condenses misfortunes the "Last Supper" has suffered and reveals modern corrections. (1) A door was enlarged in 1652. (2) Half a dozen well-meaning restorers seem to have been its worst enemies. (3) A protective curtain hung by friars in 1768 trapped humidity and abraded the mural when opened for visitors. (4) To ward against sunlight, nearby windows are now boarded. Post-World War II rebuilding added (5) central heating to stabilize winter temperature and humidity and (6)

strengthened foundations.

The downfall of the "Last Supper" began with its creation. Most murals were painted quickly and directly on wet plaster. But Leonardo had plaster covered with lead-white primer on which he could paint slowly. A wall diagram (near right above) shows the layers of paint, primer, plaster, mortar, and brick. Why his method failed is still unclear. Perhaps humidity affected the plaster so that primer and paint could not adhere.

A cradle of steel behind the mural

unknown, and he was simply too careful a man to experiment recklessly. I suspect that nature was also a culprit behind the decay of the "Last Supper." Consider that the years during which Leonardo was painting had exceptionally dry winters. We know, for instance, that the nearby Alps were free of snow. So the plaster may have dried faster than usual, causing the priming to crack easily, and the paint along with it.

Although the "Last Supper" was immediately acclaimed upon its completion in the late 1490s, by 1517 it was known to be flaking. Several large-scale copies were completed during Leonardo's lifetime, including at least two by his students. King Francis I of France ordered a copy, as well as a tapestry version, as a gift to the pope.

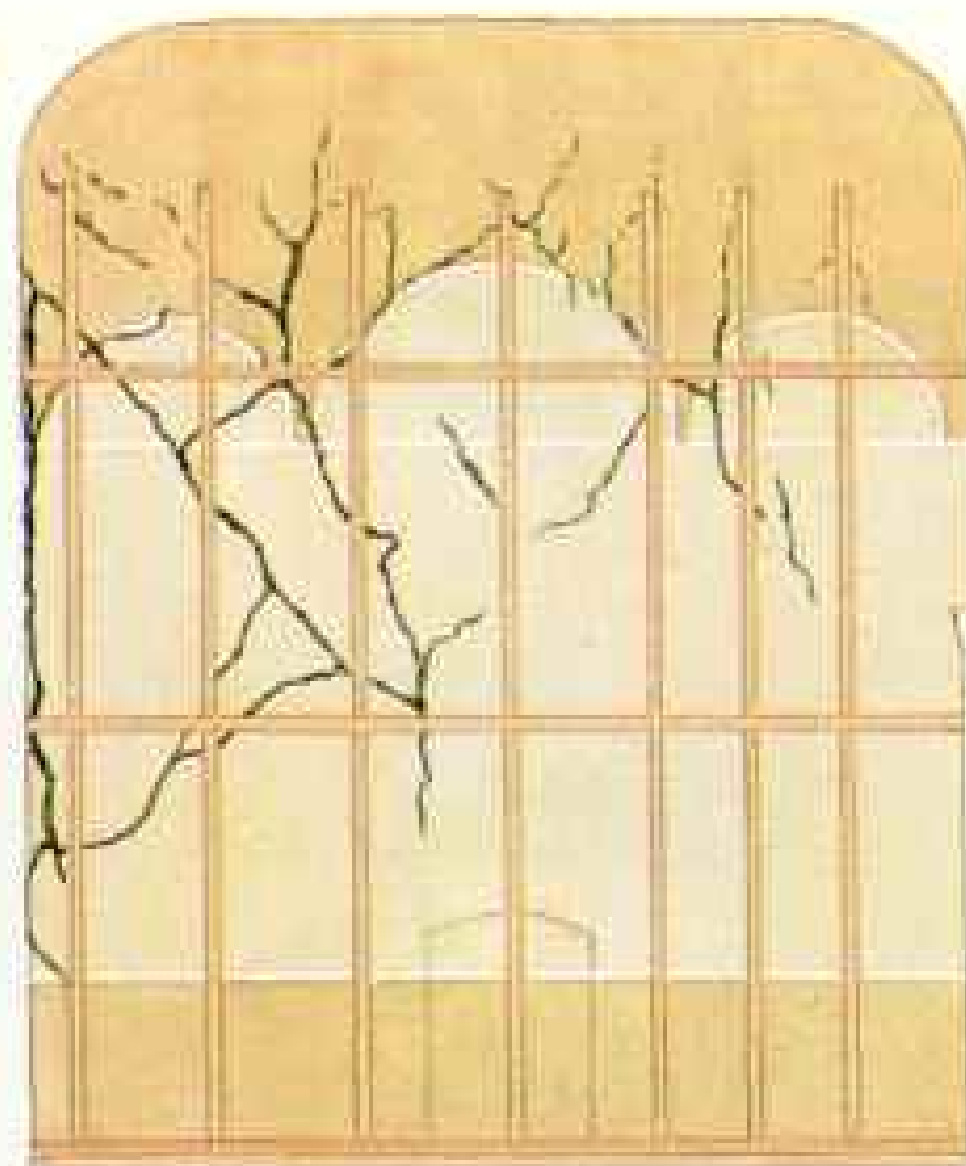
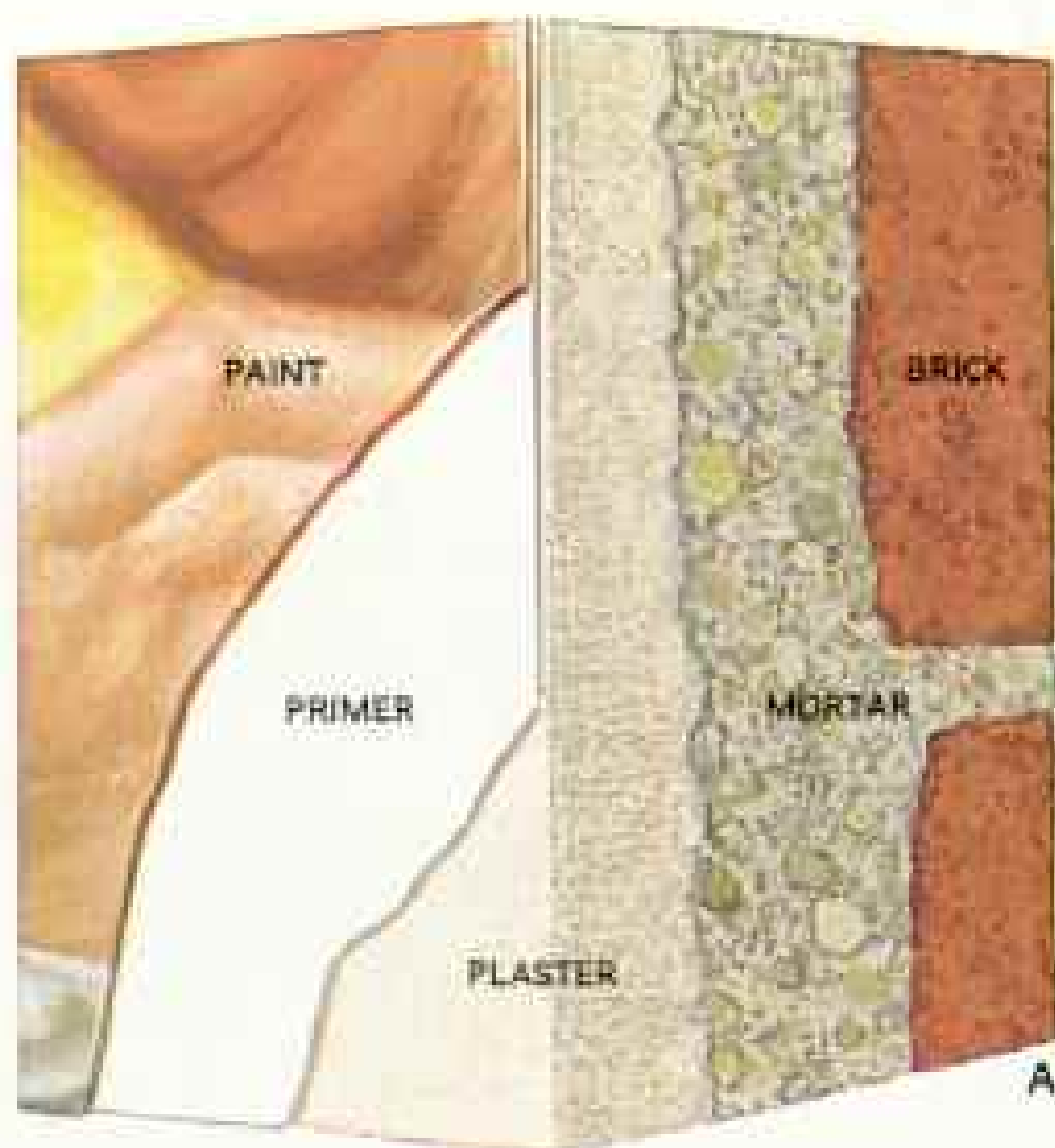
By 1587 the painting was described as "half-ruined." In 1652, perhaps because the

friars thought the "Last Supper" was lost, they enlarged a small door beneath the mural. In doing so, they cut off Christ's feet.

Still the painting remained one of the most celebrated works in Europe. In the 18th century the friars put a curtain over it, which they would pull open for visiting dignitaries. The curtain, of course, scratched the flaking mural. It also trapped humidity. In fact, 18th-century reports allege that "rivulets of water" ran down behind the curtain.

About the same time, the friars initiated the first so-called restoration. In 1726 they engaged a painter, Michelangelo Bellotti, who was almost unknown, to repaint the original entirely. His work proved so incompetent that another painter, Giuseppe Mazza, was asked in 1770 to remove Bellotti's overpainting with a scalpel.

A visiting Irish artist, James Barry, saw



wall (right) supports sensors that record vibrations set off by changes in temperature and humidity. Air conditioning is needed to control such shifts as well as pollution and mold. At the level of the lunettes, architect Roberto Cecchi, left, consults with Lionello Costanza Fattori, director of the agency in charge of the wall. The author heads the department responsible for the painting, while another group monitors the building. Wall cracks detailed here (above right) have been largely contained.

Restoring the "Last Supper"



the damage Mazza's scratching was doing and protested vehemently. His protests were probably what convinced the Dominican prior to halt Mazza.

Perhaps the painting's low point occurred in 1796, when Napoleon's troops occupied Milan. They used the refectory as an armory and a stable. French soldiers threw stones at the Apostles and even climbed ladders to scratch out some of their eyes.

That desecration was an excuse for more overpaintings and restorations, which continued into this century. Then, in 1943, an Allied bomb landed next to the dining hall. Miraculously the wall, which had been sandbagged as a precaution, survived. But had the bomb landed one meter closer, the painting probably would have been lost. "The bomb," says the Dominican's current prior, Father Angelo Caccin, "was more intelligent than humans."

Although the dining hall has been rebuilt, one cannot enter the hall today without a sense of dismay. Modern life continues to assault the "Last Supper." Milan's dirty air

corrodes and besmudges the painting. Fluctuations in humidity afflict the wall. Mold grows on remaining flakes of paint. As Father Caccin says, "The 'Last Supper' is the most important dying thing in the world."

But like physicians unwilling to let a patient die, we are making a last stand. Funded largely by the Olivetti Corporation, we are attempting a true restoration of the "Last Supper." We must accept that much of Leonardo's masterwork is irretrievably lost. We want to salvage what is left of the original by removing the overpaintings and the dirt, even though that means that part of what we now see will be lost.

"We no longer have the 'Last Supper' of Leonardo," one expert has said. "It's better to have a little bit of Leonardo than all of this 'Last Supper.'"

EVEN THOUGH MUCH of the painting is altered, the greatness of Leonardo's concept still emanates from that special wall at Santa Maria delle Grazie. Leonardo was a master of perspective.



He designed the ceiling of the room in his "Last Supper," the tabletop, and the height of the figures all to give anyone in the dining hall the feeling of dining with Christ and the Apostles.

"Last Suppers" were common Renaissance paintings. Practically every monastery dining hall had one. What drew such an innovative man as Leonardo to this subject? For one, it offered a vehicle for themes that interested him.

Consider that, for the first time in a rendering of the Last Supper, Christ is completely isolated. Usually John, commonly identified as the Apostle especially beloved, has his head on Christ's shoulder or lap. Leonardo's Christ has an aura of loneliness surrounding him, perhaps akin to the isolation of the creative genius.

Also, Leonardo clearly was fascinated by the potential to explore the concept of betrayal. The scene takes place just as Christ has announced that someone in the room shall betray him. Leonardo wanted to show the reactions of 12 men to that statement.

Because each is asking if he is the betrayer.

The painting is psychologically sophisticated. It is not theatrical. The drama all lies within the characters. Our restoration is beginning to reveal more of that inner drama.

We are fortunate. We now have numerous new technologies, and, like doctors with a dying patient, we can use them to give the "Last Supper" a thorough examination.

This physical was begun in the early 1970s by my predecessor, Franco Russoli, who died suddenly of a heart attack in 1977. When I arrived from my previous position in Rome, the wall was still so dark and dirty that large parts of the painting were almost invisible. Dr. Brambilla had accomplished only a small part of her cleaning.

I was, and still am, shocked at the simple way the painting is kept—with no protection from humidity or pollution. Moreover, the central heating at that time worked only during the day. This provoked daily temperature shock treatments when the heat went on and off.

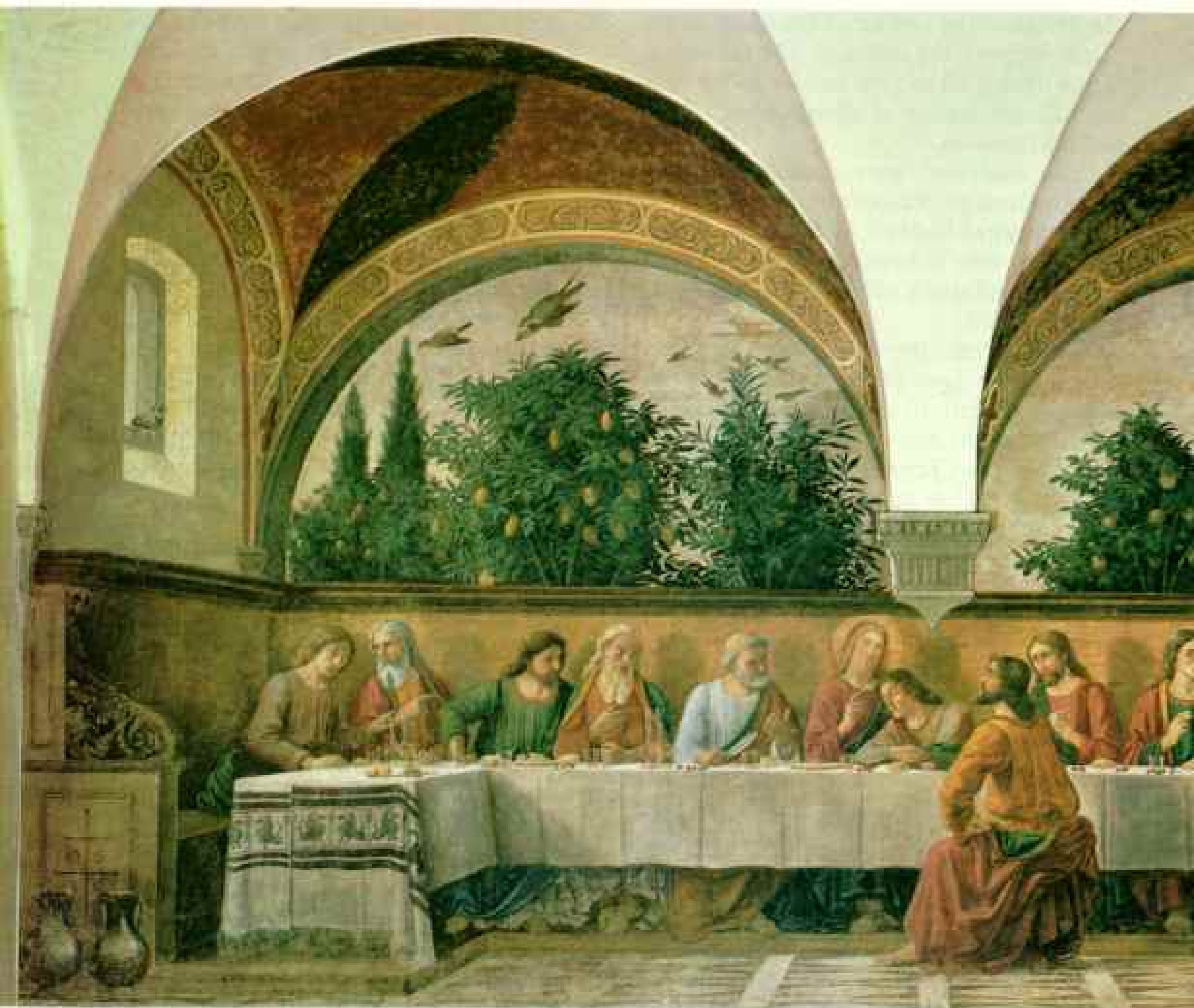
In Italy, however, we have bureaucratic

BY PERMISSION OF QUEEN ELIZABETH II (LEFT AND BELOW)



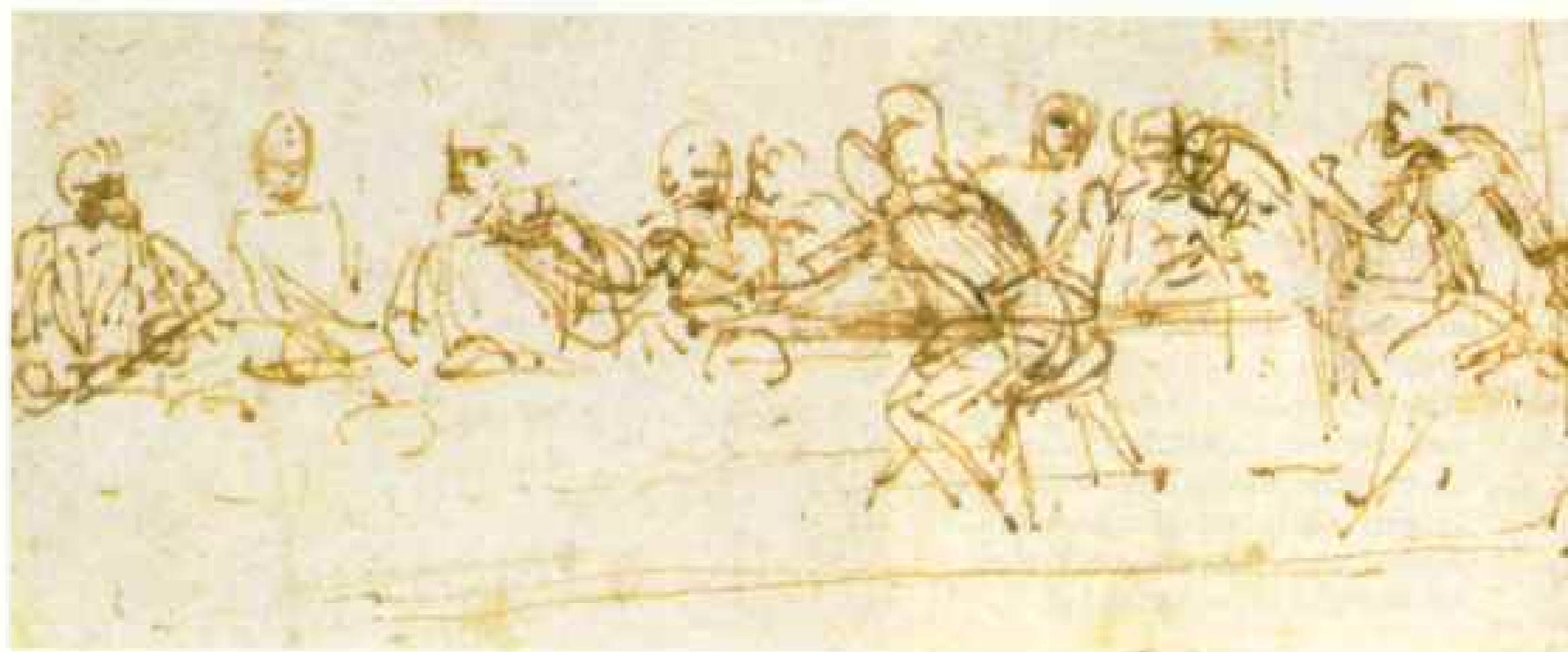
Scholar of anatomy, Leonardo drew meticulous studies for the "Last Supper." The few still in existence help guide today's restoration. Peter's arm and hand remain similar in sketch (above) and painting (left). But Judas varies from his chalk portrait (right). Early restorers probably altered his features and added to his beard to cover lost paint.





Leonardo revolutionized portrayals of the Last Supper, which traditionally isolated Judas on the opposite side of the table, as in

this 1480 fresco (above), painted by Domenico Ghirlandaio for a convent in Florence. Even Leonardo's preliminary sketch (below) follows





SCALA LIBROVELLI BY PERMISSION OF QUEEN ELIZABETH II (LONDON)

this earlier practice. The group at right details John, leaning against Christ; Peter, and Judas, rising from his chair.



divisions that can slow progress. For instance, my office has only the responsibility for the painting itself. Other superintendents are responsible for the wall on which it is painted, and for the climatic conditions in the dining hall. It often takes a long time to get everyone to agree on any action.

Nevertheless, we have begun. The physical examination of the "Last Supper" is well under way. We are trying to learn all the possible causes of its deterioration.

OUR PRIMARY GOAL is to describe the painting and its environment in scientifically accurate terms, to create a data bank for future generations as well as today.

We have applied stereophotogrammetry, the technique cartographers use in making aerial topographical maps, to create in essence a relief map of the paint on the wall.

Using ultrasound, we have made a profile of the thickness of the wall at some 200,000 different points. We can resolve differences in thickness to a tenth of a millimeter. This lets us find little craters and pick out places where the priming is lacking and only bare wall remains.

With hygrometers, infrared cameras, and electronic sensors we have made detailed temperature and humidity profiles. We hope sophisticated new techniques that detect radioactive isotopes will reveal whether there is humidity between the layers of paint, the priming, and the mortar.

We have applied X-ray and ultraviolet techniques that can identify the minerals used in Leonardo's pigments. It is partly a way of discovering his craftsmanship. Did he use, say, violet or blue to achieve a particular shading effect? If blue, we can then ask what sort of blue. These techniques also help us determine which paints are Leonardo's. Some minerals, for instance, were not used in pigments in Leonardo's day.

So what have we learned?

For one thing, we have determined that the wall is not uniformly thick. It varies in thickness from 35 to 40 centimeters (14-16 inches). For its height it is a very thin wall.

We have learned that this wall is very sensitive to temperature differences. There is a small room behind it, and temperature differences between that room and the main

The spirit of Philip in Leonardo's sketch still speaks through a veil soon to be lifted. Though the painting was in ruins when the artist Rubens saw it in the early 1600s, he said of Leonardo: "By the fire of his imagination . . . he exalted divine things through human things and was able to lend men every degree of worth up to the heroic."



BY PERMISSION OF GISELE ELLIENBERG (L'ARBEVE), POLAROID CORPORATION (FACING PAGE)

dining hall can sometimes cause parts of the wall to oscillate a fraction of a millimeter. These microearthquakes can cause bits of paint to flake off.

Humidity differences between the two rooms are just as destructive. The porous wall allows humidity to pass back and forth between the rooms. Water can thus condense on the painting. These microscopic drops can leave deposits on the surface as they evaporate.

We have also seen large changes in temperature and humidity as big groups of tourists enter and leave the hall. Tourists also bring in microorganisms and dirt on their shoes. We know now we need a very advanced air-control system for the hall.

Dr. Brambilla already has made many exciting discoveries, even though less than

one-third of the "Last Supper" has been cleaned.

The dingy colors have given way to the daring and brilliant palette of Leonardo. Exquisite details are emerging in the still life on the table and in the wall decorations surrounding the painting. The most impressive changes, however, concern the Apostles.

Simon's nose turns out to be much smaller than we thought, and his beard is far less jutting than before. He now has a strong chin, and his neck is positioned so that he clearly is talking to Matthew and Thaddeus. Before cleaning, his garments were a dull brown. Now they are three colors: deep red, rose, and icy white.

"Matthew's mouth was closed," Dr. Brambilla tells me. "Now it's open, and he is breathing. He no longer has a beard. His nose has become straighter and more classical. His neck is as graceful as a bird's now. It reflects the true lines of Leonardo. Matthew's lips have become very sensual and beautiful. He is filled with emotion. Personality is emerging in the Apostles."

HOW LONG will it take for the entire new "Last Supper" to emerge? Dr. Brambilla just sighs at that question. It takes her a week to clean an area the size of a postage stamp.

"It's difficult," she says. "The work is hard and tiring. It creates much physical tension bending over the microscope. After a few hours my eyes grow blurry. I may come every day for months. Then I must take an extended break. There is also the psychological tension. All the eyes of the world that know Leonardo are watching what I do. Some nights I do not sleep."

Much of the wall, Dr. Brambilla has found, has totally lost any remnant of Leonardo's paint. There she applies beige or gray watercolor, a neutral background that enhances what remains of Leonardo.

Future generations may debate whether to repaint some of that neutral region, to try to recapture Leonardo's original vision. We certainly do not yet have the wisdom to make such an attempt. What we do in the coming years will provide at least some of the knowledge required. More important, it will give those future generations a "Last Supper" that still lives. □



The Miracle Metal

PLATINUM

By GORDON YOUNG

Photographs by JAMES L. AMOS

BOTH NATIONAL GEOGRAPHIC STAFF

Shining samples of platinum's allure, jewelry and other objects sold in London's posh Platinum Shop add up in value to the figure in pounds shown on the platinum-clad calculator—\$83,000.

Ultimately identified as the eighth metal known to man, platinum was found by gold-seeking conquistadores, who picked the mineral out of their pans and tossed it back into rivers, believing it would ripen into gold.

With its five kindred metals—palladium, osmium, ruthenium, iridium, and rhodium—which usually occur together in nature, platinum has assumed its place as the prince of metals and consort of industry.

ITS REPUTATION has long been overshadowed by gold—though, for a while in the early years of this century, it managed to gain a certain prominence in the jewelry trade. And that, to most of the world, is the long and the short of the platinum story.

But wait; there is so much more than that! Alone, or in combination with some of the five allied metals with which it is found in nature, it can work miracles.

Call it the philosophers' stone, that mythical substance that medieval alchemists believed would transmute lead into gold. Platinum is a master of transmutation.

What else can be used to create rubies? Screen the ozone from high-flying jetliners? Make wood stoves burn more efficiently? Without platinum, our food supply would dwindle and our air would darken. It is used in the manufacture of perhaps one out of five of today's products.

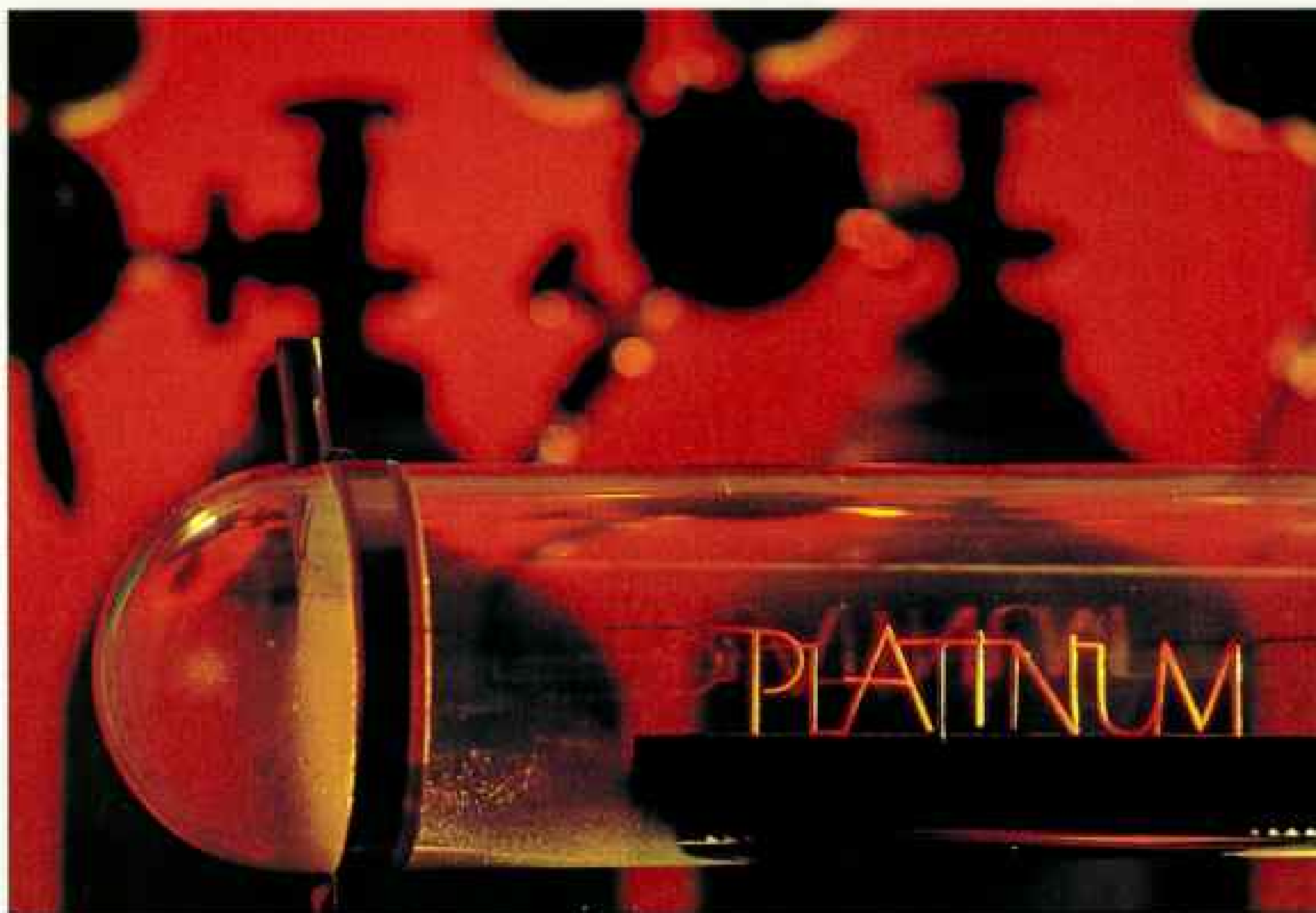
Fighter planes, missiles, and spacecraft need platinum. At least one assassin has used it to kill, and doctors are using it to cure. And *you* likely use mysterious platinum, too, each time you drive a car.

Economically as well as industrially, it is a precious metal, and its price has been far from constant—ranging, in the past few years, from under \$300 per troy ounce to more than \$1,000. It is our good fortune that it takes only a tiny bit of platinum to do a giant job.

Though traces of it have been found in ancient Egyptian inlays, Egyptian artisans probably thought it was a form of silver. Pre-Columbian Indians forged jewelry from platinum alloys, but it was the Spanish who reported its discovery in the 16th century. They found it mixed with gold placered out of the rivers of what is now the Chocó region of Colombia. Cursing the silvery grains in their gold pans, they painstakingly removed them one by one.

Platina—little silver—they called it. Some believed that it was gold not buried long enough to turn yellow and threw it back into the river to ripen.





In a feat of alchemy, platinum-lined catalytic converters transform toxic gas from automobile exhaust systems into harmless water vapor and carbon dioxide. One ounce of the metal can supply material for 64 auto catalysts (right). Each new car sold in the U. S. has about \$13 worth of platinum in its converter.

Glowing platinum wire in a glass tube (above) illustrates how the metal acts as a catalyst, starting a chemical reaction while remaining unchanged itself. A mixture of oxygen and hydrogen in the tube reacts on the surface of the platinum and burns.

In a junkyard near Moline, Illinois, Russel Mugge (left) torches off a converter from a muffler assembly. It will be sold to a Memphis, Tennessee, recycler, who will reclaim the platinum. About 10 percent of the U. S. platinum supply comes from such reclamation efforts.



Word of the strange new metal reached Europe in the mid-16th century. "There is a substance," wrote Italian scholar Julius Caesar Scaliger, "which it has not hitherto been possible to melt by fire or by any of the Spanish arts."

Two more centuries passed before sizable samples of platina reached the Old World, and even those were smuggled in, for the world had learned by then that "worthless" platina could be blended with gold and used to counterfeit bars and coins.

Recently in London I talked with Dr. Leslie B. Hunt, top authority on the history of platinum, and learned that Europe's fires did little better than Spanish colonial ones. Platina would blend with other metals, but it stubbornly resisted being refined into its pure state.

"The hottest furnace or the most powerful burning glass could melt only very small amounts," Dr. Hunt said. "Not enough to form even a small ingot." But craftsmen, eager to work the new platina, learned that adding arsenic made the platina melt at a lower temperature.

Marc Etienne Janety, a Paris goldsmith during the reign of Louis XVI of France, used that technique. One of his creations still exists, on display at the New York Metropolitan Museum of Art (pages 694-5). Amid elaborate creations of precious metals, Janety's sugar bowl glows with quiet beauty. It is adorned with intricately worked scenes in low relief. Janety had risked his life to make that bowl, for the melting process filled his workshop with poisonous clouds of vaporized arsenic.

Only in the 19th century did Europeans finally learn that platina was not one metal, but six separate elements.

"A London chemist, William Hyde Wollaston, was the first man to separate platinum from its allied metals," said Dr. Hunt. "He discovered palladium in 1802 and rhodium in 1804, and his partner, Smithson Tennant, found iridium and osmium. In 1844 Karl Karlovich Klaus, a Russian chemistry professor, extracted the final element of the platinum group, ruthenium."

Worldwide, daily production of the platinum family is measured in ounces, and of that tiny amount, platinum and palladium dominate; the others appear in much smaller

Platinum fever may grip southern Montana, when and if huge platinum and palladium deposits in the Stillwater Complex are tapped by such companies as Chevron, Marville, and Anaconda Minerals. Corings like these (right) have demonstrated that the finds could supply 10 percent of the U. S. demand for platinum metals by 1990. But environmental issues and mining difficulties could delay start-up.

For platinum, men move mountains; this South African miner in a 2,000-foot-deep tunnel drills an ore face (below). Each ton yields only enough metal to cover a man's fingernail.





quantities. All six have some common characteristics—high melting point and resistance to most acids—but there are subtle differences that are important to modern technicians. For example, adding small percentages of iridium to platinum creates an alloy with a higher melting point, increased electrical resistance, and increased ability to combat corrosion. Combining platinum with metals outside its family can be very effective too—platinum plus cobalt, for example, creates an alloy with extraordinarily high magnetic qualities.

TWO BILLION YEARS ago a giant meteorite crashed to earth in the Canadian province of Ontario, creating the Sudbury Basin. It fractured the earth's crust, letting mineral-rich magma well up to the surface. At the sprawling complex of mines, mills, smelters, and refineries owned by Inco Limited (once International Nickel) near Sudbury, I saw how very difficult it is to wrest platinum from the earth.

Each working day 34,000 tons of ore come from the mines. I followed the ore through

a multitude of complex processing steps. Along the way, tons of nickel, copper, cobalt, gold, and silver were taken out—and at the end I found a glob of unattractive mud known as slime. The day's production would fit nicely into a quart jar. It would be shipped off to England for many more processing steps, and from it would come the precious platinum family of metals.

Each year 10,000 tons of silver and 1,000 tons of gold reach free-world markets, but only 70 to 80 tons each of platinum and palladium. Canada produces 6 percent and Colombia much less. The lion's share comes from South Africa's Transvaal Province and homeland of Bophuthatswana and from the Soviet Arctic.

Of these four producing nations, only South Africa mines the platinum group as a primary product; output of the rest is geared to the demand for other major metals.

South Africa's Bushveld Complex, stretching 270 miles east to west and 180 miles north to south, holds an immense supply of platinum group metals, much of them concentrated in the Merensky Reef. "We



can't explain why the reef has as much platinum as it does," says David C. Kennedy, the chief geologist of one of the Rustenburg Company's mines. "It's an anomaly . . . there's just too much platinum to exist."

But as the mines deepen, the temperature and air pressure climb, making mining more and more difficult. "We won't run out of platinum for centuries," says Mr. Kennedy, "but there will come a time when it becomes uneconomic to mine."

As intrinsically valuable as platinum is, it possesses a mysterious property that is even more precious. For this philosophers' stone promotes chemical reactions through the magic of catalysis.

Just what is a catalyst? I asked Dr. Alex Mills, executive director of the catalysis center at the University of Delaware.

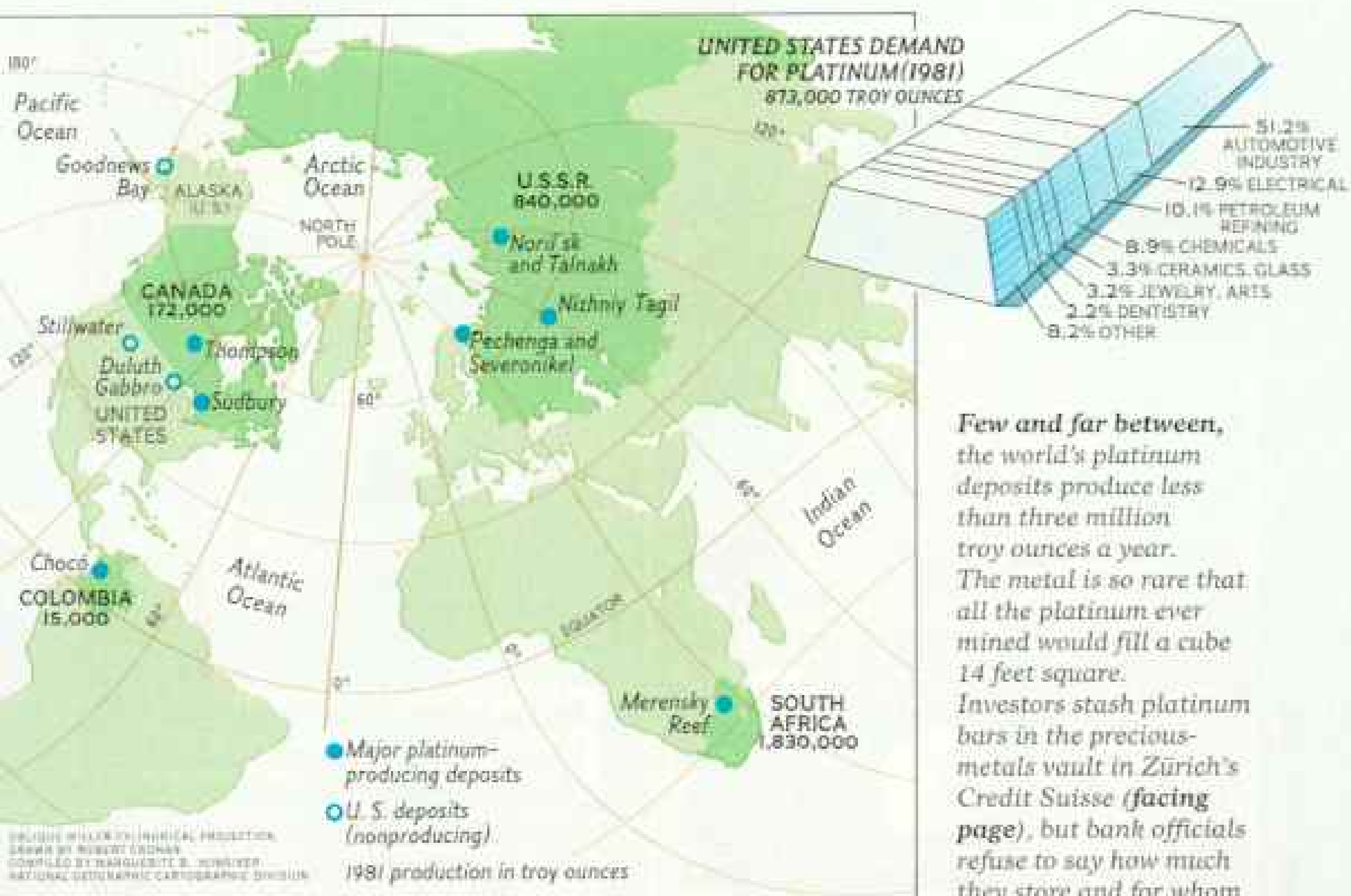
I braced myself for a highly technical answer, but Dr. Mills put it in simple terms. "Think of a catalyst as a mountain guide who takes parties over a pass to the next valley. He guides one party across, then—unchanged—returns to pick up another group."

He grinned. "Actually we don't know exactly how the guide makes that journey. We do know that it is fast. A catalyst directs a chemical conversion to form a new product, perhaps a millionfold faster than the conversion would take place on its own."

Platinum does its catalyzing job far better than any other metal, Dr. Mills told me, "though we're still not completely sure just why it works." What makes this all the more remarkable is the fact that platinum itself is so chemically inactive—inert enough to be used for pacemaker electrodes plugged into the human heart (page 702).

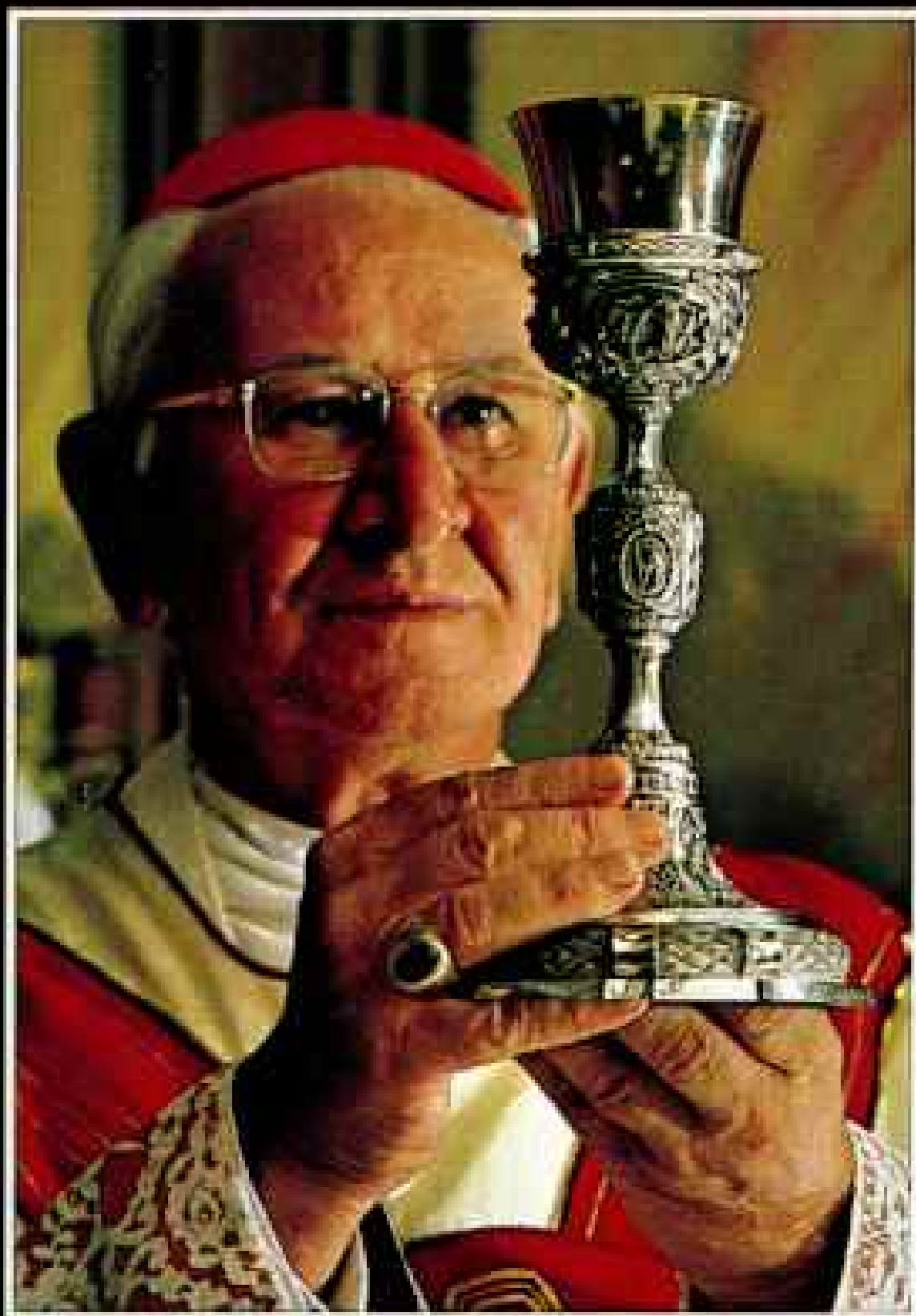
As a rule, chemical reactions involve complex diagrams that baffle the layman, but I found one at Engelhard Industries' plant in Union, New Jersey, that even I could understand. It had to do with an aircraft ozone converter, cousin to the automotive catalytic converter, used on many high-flying jet airliners today.

My guide was Martin Collins, Engelhard's assistant manager of systems. "Ozone can make airline crews and passengers sick," he explained. "Actually, ozone is



Few and far between, the world's platinum deposits produce less than three million troy ounces a year. The metal is so rare that all the platinum ever mined would fill a cube 14 feet square. Investors stash platinum bars in the precious-metals vault in Zürich's Credit Suisse (facing page), but bank officials refuse to say how much they store and for whom.

Splendors sacred and secular



FROM CHALICES to currency, platinum has added luster to art and commerce. Pre-Columbian Indians plucked grains from streams and, heating and hammering them with gold, produced platinum-alloy jewelry. Advanced artistry



PHOTOGRAPHED AT METROPOLITAN MUSEUM OF ART

awaited the 18th-century discovery that adding arsenic made it possible to melt platinum, rendering the metal malleable enough to be intricately worked.

John Cardinal Krol, Archbishop of Philadelphia (left), holds aloft the first platinum object created in Spain: a chalice made in 1788 and presented to Pope Pius VI. In 1976 Pope Paul VI gave it to the Philadelphia Archdiocese.

Coins of a secular realm – imperial Russia (above left) – were minted in St.

Petersburg in the 19th century to utilize the output of mines in the Urals.

A sugar bowl (above) reflects the brilliance of its creator, Marc Etienne Janety, goldsmith to Louis XVI of France. In crafting it, Janety braved the toxic fumes of arsenic.

just ordinary oxygen with an extra atom attached— O_3 . This platinum converter removes one atom, creating O_2 , which is ordinary oxygen. The converter holds onto that extra atom. When the next ozone molecule comes by, the converter releases the atom, turning the ozone into two regular molecules of O_2 .

While I was visiting another Engelhard plant, in Carteret, New Jersey, someone casually handed me a rod of solid ruby about an inch and a half across.

"Such rods are used for laser units," explained Sal Savarese, general manager of the plant. "They are grown in iridium containers and are purer than rubies found in nature." Iridium withstands the extremely high temperatures that the process requires, and there is no corrosion to contaminate the pristine mix.

"You might say we're a job shop for the platinum-group metals," said Mr. Savarese. "We turn out thousands of customized products. Some we just make to specifications, without even knowing what they are or what they're for."

Whether used in hush-hush military

hardware, spacecraft fuel cells, or simply in the manufacture of glass, platinum or platinum-coated devices are proving increasingly important.

"There is a continuing demand for higher temperatures in sophisticated manufacturing," pointed out Nelson Colton, Engelhard's president. "Only platinum or its alloys can fill that kind of need."

WHEN YOU RIDE in an automobile, platinum works for you. Think for a moment about that catalytic converter tucked down in your car's exhaust system. Its ceramic honeycomb is coated with a platinum catalyst. As noxious gases flow past, it turns them into harmless carbon dioxide and water vapor.

It is quite a task, for the exhaust contains carbon monoxide, nitrogen oxides, and a mixture of hydrocarbons. Sometimes the fuel mixture is rich; at other times, lean. Exhaust temperatures vary from summer to winter, from start-up to traffic jams. A demanding job indeed.

Automotive catalytic converters account for the largest single use of platinum in the



The upper crust of metals takes form in a one-of-a-kind status symbol: a scale model Phantom II Rolls-Royce (left), cast from 22 ounces of platinum. Michel Marks, chairman of the New York Mercantile Exchange, purchased the piece as "an investment and novelty." It is valued at more than \$30,000.

Elegance in a lower key, a platinum earring (right) is one of a pair that won third prize in a design competition in 1981. More difficult to work than gold, yet more durable, platinum has been wrought into objets d'art by such craftsmen as Peter Carl Fabergé, jeweler to the Russian imperial court.

Although jewelry accounts for only 2 percent of platinum consumption in the United States, the Japanese are highly appreciative of the metal as a personal adornment and use more than half of their supply—all imported—for making jewelry.

United States—and each year the U. S. buys nearly a half of the world's supply of the metal. The converters are designed to last at least 50,000 miles, a manufacturer told me: "That is, if they're not poisoned."

Oh, it's easy to poison the platinum under your car—just put leaded gasoline in the tank. Even though that practice is illegal, quite a few car owners do it, to save a few cents a gallon. And some—under the mistaken impression that they will get better mileage—remove the converter entirely.

Where do old catalytic converters go after a long and useful life? Many of them go to what has been called the "fourth largest platinum mine in the world": Gemini Industries, of Santa Ana, California.

I talked with Sebastian Musco, company president, curious to learn how he could operate on a national basis, since junkyards are scattered all over the country and their operators might balk at taking the time to remove a catalytic canister.

Mr. Musco explained: "By law, the wrecker has to remove the gas tank, which means raising the car. It takes 17 seconds more to remove the converter. He sends the

honeycomb or pellets to us, and we strip off the platinum and palladium, chemically."

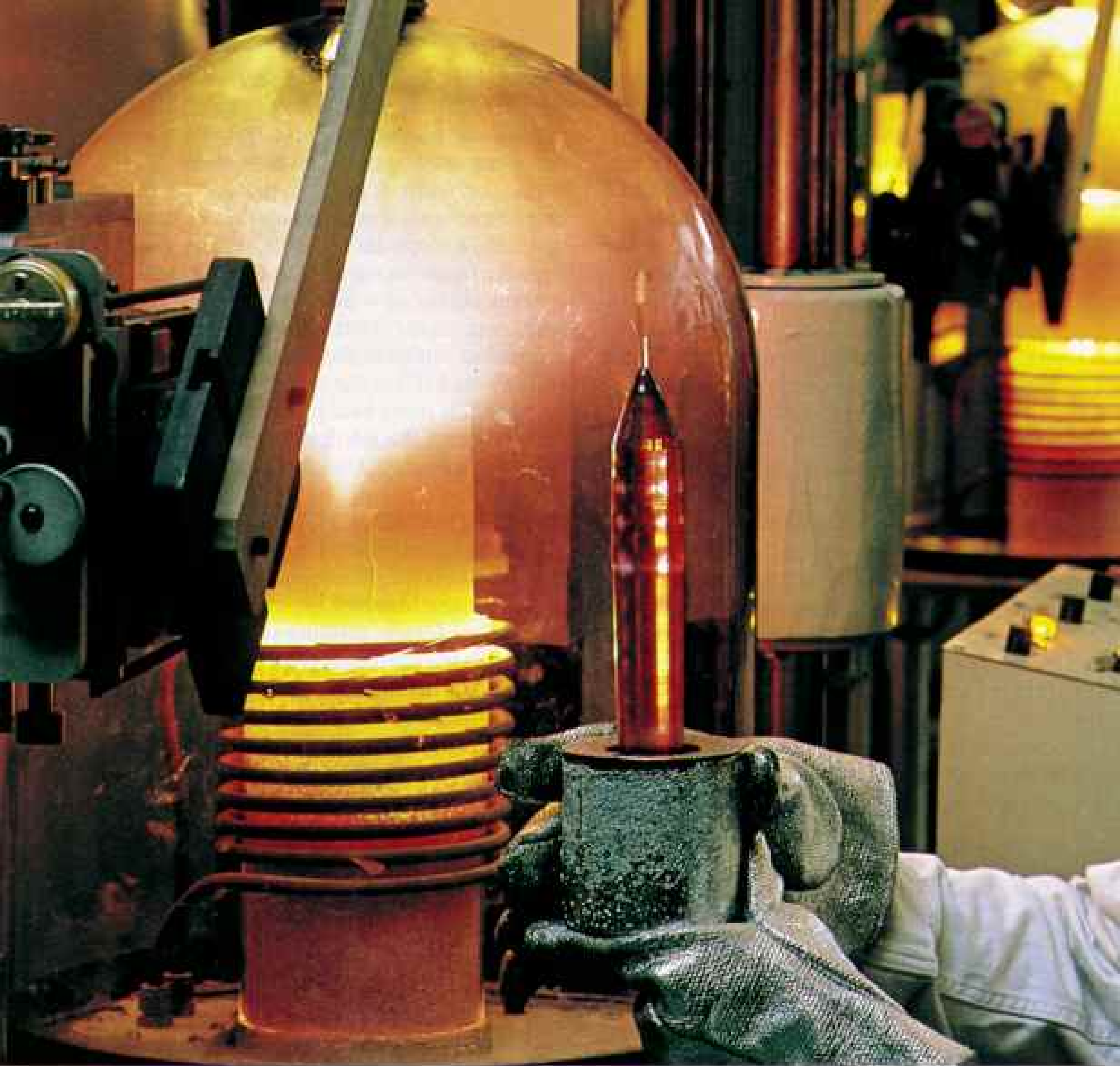
Like the automobile, the humble wood stove can use the philosophers' stone. Normally, between 5 and 30 percent of firewood's energy is wasted as smoke. As it goes upward, it deposits creosote on the chimney's surfaces—a significant fire hazard.

Some stoves now offer an option, a catalytic combustor containing platinum. It burns that smoke in the firebox. The device adds about \$150 to the cost of the stove, but the user gets more heat per load of firewood and can delay the job that few stove tenders love—cleaning out the chimney.

ANOTHER GIANT job shop for the platinum metals nestles in the woods on the outskirts of Malvern, Pennsylvania. Johnson Matthey Inc., like its competitor in New Jersey, produces a wide array of custom-made platinum products.

Here I watched wire mills with carbide and diamond dies squeezing quarter-inch platinum-rhodium rods down to a diameter of three thousandths of an inch, that of a human hair. The wire went onto looms





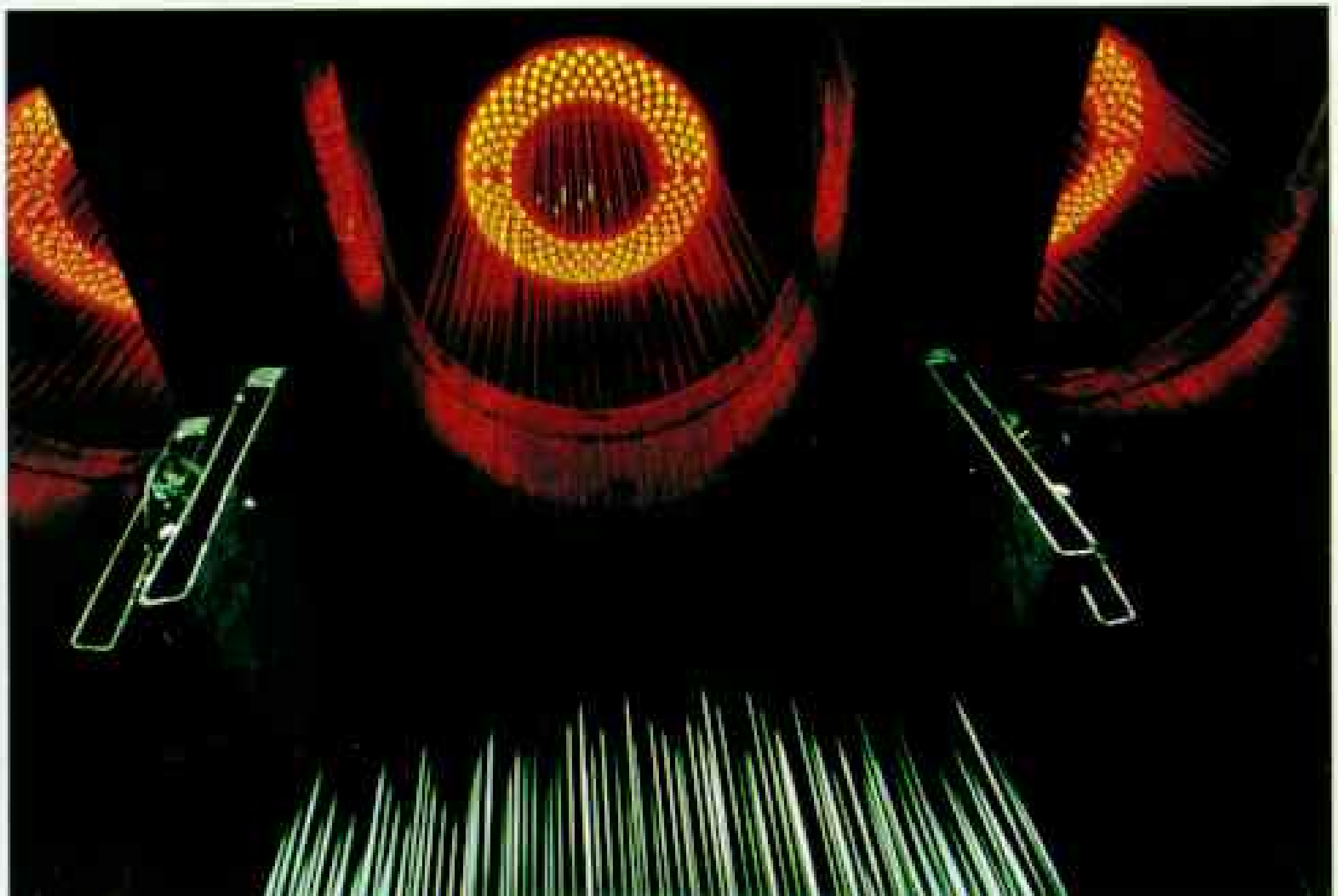
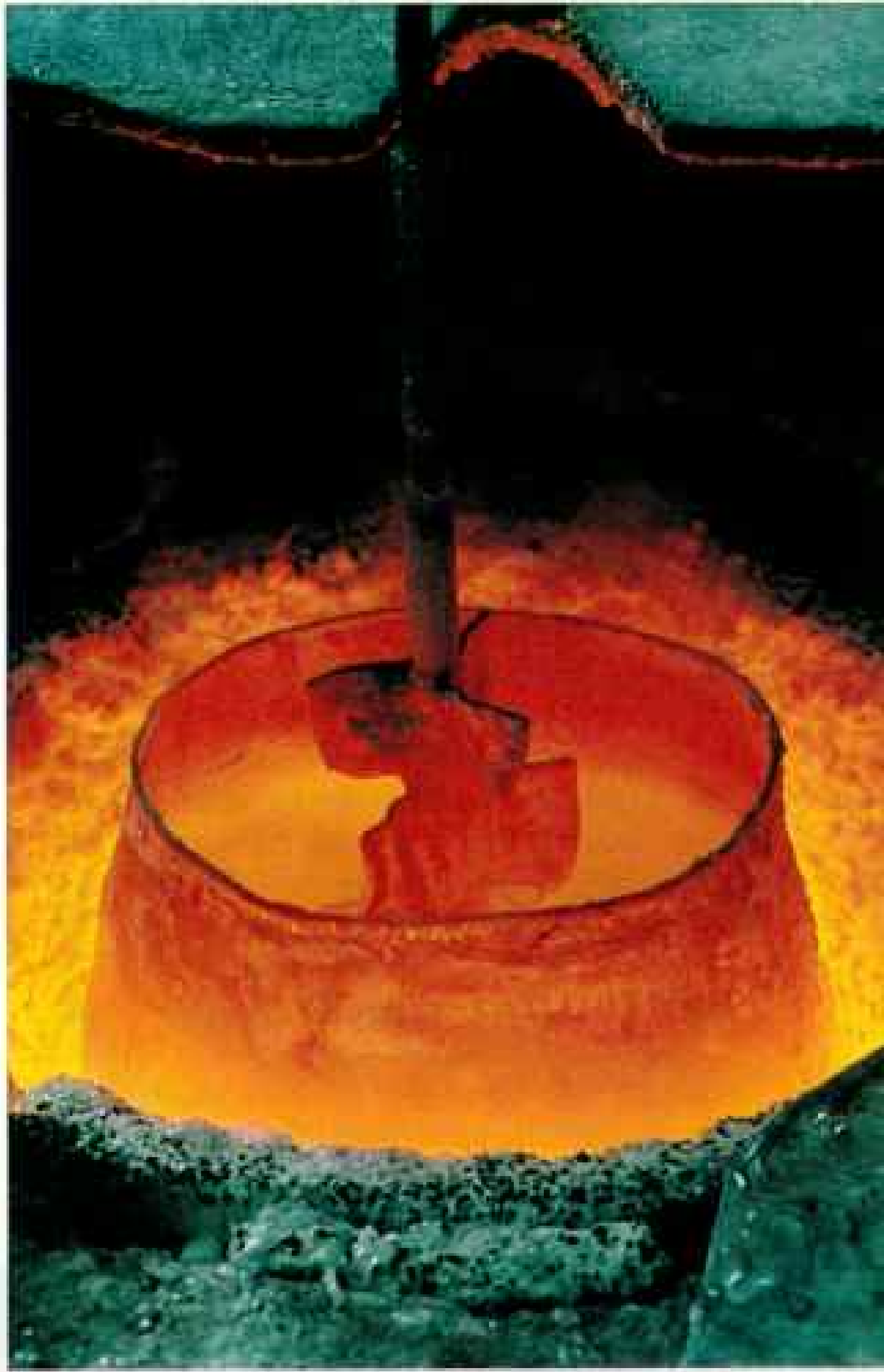
Because it can stand the heat, a crucible of iridium, a platinum relative, cooks an yttrium-aluminum-garnet crystal in the plant of Airtron Optical and Magnetic Components (above) at Morris Plains, New Jersey. This eight-inch-long crystal took 21 days to grow and will be formed into laser rods for medical, military, and industrial use.

Platinum's melting point, 1769°C (3216°F), exceeds that of iron by 230 degrees. Its ability to tolerate high temperatures without degradation makes the metal irreplaceable in the manufacture of high-grade optical glass, such as that being melted in a platinum crucible and mixed with a platinum

stirrer at the E. Leitz Optical Works in Wetzlar, West Germany (above right).

A platinum bushing—a sieve-like plate—resists the corrosive effects of the continuous extrusion of superhot strands of fiberglass at the Manville Corporation plant (right) at Penbryn, New Jersey. Rugged yet malleable, platinum can be rolled into a sheet a thousandth of an inch thick.

Industry shrouds its use of platinum in secrecy. "Few even like to admit they use the metal," says author Gordon Young. "And often they delay patenting a process, so they won't tip off a competitor. Everyone just relies on lots of security."



where it was woven into fine mesh gauze.

"That gauze is used to make nitric acid, a key ingredient of modern fertilizers," said Lyndel Hartshorne, a plant process engineer. "When ammonia and air are pumped through several layers of the gauze—a catalyst—they convert into nitrogen dioxide. That is dissolved in water, and you wind up with nitric acid."

Moving on, we saw other workmen welding heavy platinum-alloy sheets onto a perforated bottom plate of the same material. "For fiberglass makers," Mr. Hartshorne said. "Molten glass will be poured into this heated box. The liquid glass will then flow through the holes, forming strands. That's where fiberglass comes from. Optical fibers are made the same general way. Of course, the boxes are platinum because it can stand the high melting temperature without oxidizing and contaminating the glass."

A busy computer keeps careful track of the millions of dollars' worth of metals that flow through the Johnson Matthey plant. Some of it is reclaimed each night, by "mining" the wash water used to launder the workers' coveralls and by chemical treatment of the floor sweepings from the plant.

And I can attest that the security checks of visitors are awesomely efficient. I stood there, wearing paper sandals, while the polite security guard checked my shoes for

contraband platinum. Then he waved a metal detector over me—one so sensitive that it beeped in alarm as it passed over a supposedly empty pocket of my jacket. The detector had picked up the tiny staple in a book of matches.

David Lundy, a marketing manager at Johnson Matthey, gave me a gentle warning that some platinum facts might be hard to unearth.

"When companies develop a new technique in this business, they often don't tip their hand by patenting it," he said. "They just start using it, not letting the competition know. And you'll probably find companies that won't even admit that they *use* platinum. Partly from fear that it will be stolen, but they worry, too, about the safety of their employees during a robbery attempt."

He was right. Though I was hospitably received when I visited the Gillette Company, I was not shown the machine that puts a tough platinum-chromium edge on their razor blades. (On the other hand, most of their top executives had not seen it either.)

Inside the secret machine, I learned, argon gas bombards a platinum-chromium plate, knocking off atoms of those metals that drift onto the edges of the razor blades. The process is known as sputtering.

Pause, though, before you rush to the bathroom to collect a fortune in old razor



blades. You should know, first, that the coating on each blade is only about a hundred atoms in thickness. It might be worth a hundredth of a cent.

Today, platinum goes underwater to help solve a problem that has plagued mariners for more than a century.

In salt water a ship's hull acts as a discharging battery. Current flows from the more active metal (anode) through the seawater (electrolyte) to the less active metal (cathode), such as from an iron rudder to a steel hull. Corrosion takes place where the current leaves the anode. To combat the problem, plates of zinc are attached to the hull. Since it is more active than iron, the sacrificial zinc becomes the metal from which the current flows. But woe to the skipper who doesn't replace that zinc when it dwindles away.

In a system devised by Engelhard, anodes clad with platinum are installed on the hull. A carefully controlled current is sent from the ship's electrical system through the anodes, forcing all other underwater metal to become cathodes. Only the platinum-clad anodes are worn away by the weak electric current, and they can withstand the onslaught for years.

Industries and power companies that draw cooling water from the ocean face a different underwater problem: marine

organisms that clog their water inlet pipes.

The standard solution is dangerous—valving deadly chlorine gas into the water to kill the organisms. Another device using platinum-coated anodes converts the salt in seawater to sodium hypochlorite by electrolysis. It prevents the growth of marine organisms.

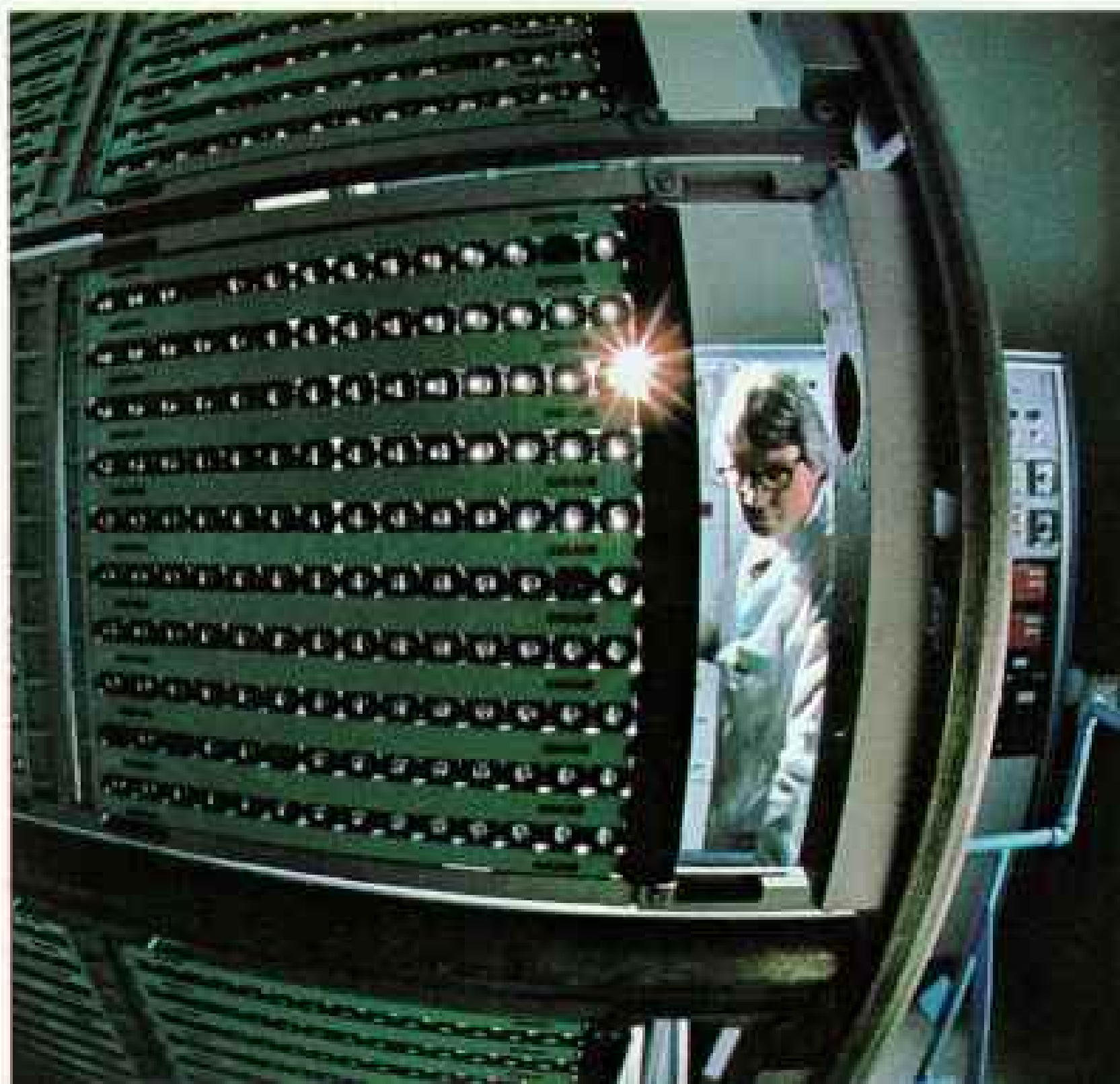
EVEN WHEN IT simply lies coddled in a vault, platinum can play a valuable role. In Gaithersburg, Maryland, near the nation's capital, the United States Bureau of Standards is the guardian of a platinum-iridium alloy cylinder weighing one kilogram. Now and then it leaves its special vault to journey to Paris, where it is checked against the equivalent international standard. The bureau also has a platinum-iridium meter stick—though it is only of historical interest in this electronic age, since electronic measurements are even more precise.

Like that kilogram weight, a great deal of the world's platinum lies around in vaults doing nothing exciting. Especially in Switzerland, where Zürich vaults hold a king's ransom of this precious metal. Platinum ingots, typically weighing from one to ten troy ounces, rest in safe-deposit boxes all around the world.

In one of the towering buildings of New

Delicate as tulle in appearance, a sheet of platinum-rhodium wire gauze is inserted in a converter at the Tampa, Florida, plant of Nitram, Inc. (left). Ammonia gas and air, pumped through 30 such catalytic sheets, eventually yield nitric acid, a major component of fertilizer. "If we still produced nitrates without platinum," one manufacturer says, "production would be so low, costs so high, that much of humanity might starve."

The focus is on purity when glass for lenses, such as these made by Eastman Kodak for their Disc Camera (right), is melted in nonoxidizing platinum crucibles.

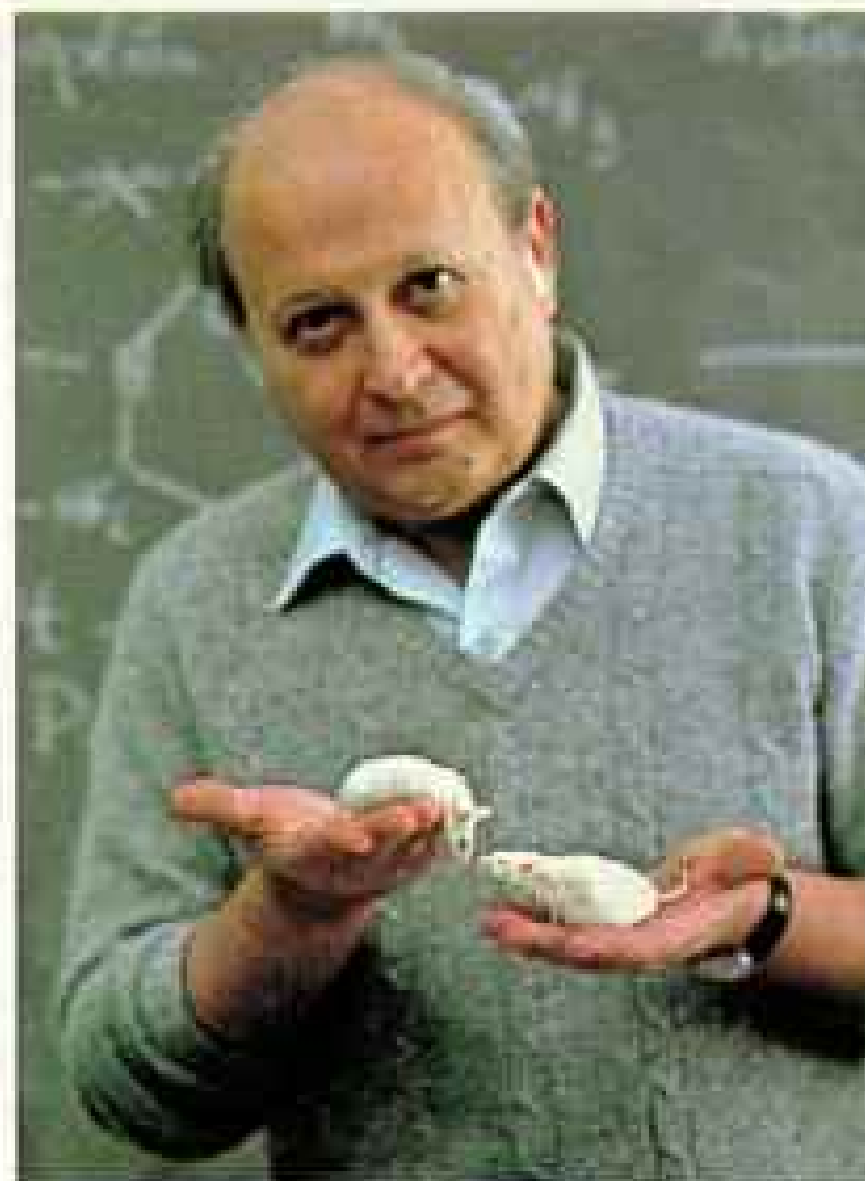




CALVERT MEMORIAL HOSPITAL, PRINCE FREDERICK, MARYLAND

A lifeline for patients with heartbeat irregularities, a pacemaker (left) discharges electrical impulses through platinum electrodes on the tips of leads, or wires. The leads, threaded into a large vein, terminate in the right ventricle of the heart. Platinum's inertness and conductivity make it the choice metal for such tasks.

Displaying one of the bright hopes in the war against cancer, a worker garbed in protective clothing cradles a dish of cisplatin at the Johnson Matthey plant in Malvern, Pennsylvania (below). The cancer-combating property of cisplatin, a platinum-based drug, was discovered in 1968 by Dr. Barnett Rosenberg, professor of biophysics at Michigan State University (right). The mouse he holds in his left hand will die of a tumor in several days; the other, also cancer-ridden but injected with cisplatin, should enjoy a normal life span.



York City's World Trade Center I watched businessmen buy and sell "paper platinum" on the futures market. "Both platinum and palladium are traded here," explained Michel Marks, chairman of the New York Mercantile Exchange.

Platinum's value usually is three to four times that of palladium, and both metals follow the ups and downs of gold. When inflation sweeps the land, platinum and palladium rise. Platinum's free-market price normally hovers just above that of gold, but now and then it climbs much higher. In 1980 it zoomed to \$1,047 per troy ounce. In recent months it has averaged \$425.

The United States government stockpiles platinum metals against the dire day when war might come and shut off the pipelines from South Africa or the U.S.S.R.

Germany learned during World War II how essential were platinum metals; they were desperately needed to keep electrical

systems of planes and vehicles operating effectively, and for the manufacture of explosives. Most of the platinum producers were at war with the Nazi regime; only Colombia was not, but after 1941 its entire production was committed to the United States.

In spite of the best efforts of U. S. and British intelligence operatives, the Germans managed to smuggle almost half a ton of platinum out of the remote Colombian jungle before the illicit flow was finally cut off.

The day may come, though, when the United States will join the ranks of major platinum producers. Eighty miles southwest of Billings, Montana, lies a geologic formation very similar to South Africa's Bushveld Complex. Since 1967, exploration of this Stillwater Complex has produced promising ore assays.

Manville Corporation, Anaconda Minerals, and Chevron Resources Company are partners in one project. "It would be the only



palladium mine in the world," said Michael Sharratt of Manville. "The ore is three and a half parts palladium to one part platinum."

But climate, mountainous terrain, and stiff environmental rules—the complex lies in national forestlands—hinder the project's development. Few roads traverse the area, and drilling equipment is often brought in by helicopter or skidded in over the snow in winter months. And there are lots of winter months—the work season extends only from late June through September.

When will the Stillwater Complex start producing? Mr. Sharratt refuses even to hazard a guess.

IN 1842 William Grove, a British electrochemist, created the first practical fuel cell—the device reinvented in the 1930s and now used in spacecraft.

Both Grove and NASA depended upon platinum to catalyze hydrogen and oxygen,

making them give up electrons, thus creating an electric current.

Think of the exciting possibilities of a device that can be fueled like an engine yet acts like a battery. Quiet, pollution free, and more efficient than old-style plants, fuel-cell pilot projects are under way now in such unlikely places as crowded Tokyo and busy downtown Manhattan.

Platinum played perhaps its most bizarre role on a busy London street one September day in 1978, when Georgi Markov, a Bulgarian defector, was wounded. His assassin used a minute platinum-iridium pellet impregnated with poison. Mr. Markov died four days later, under intensive care in St. James's Hospital.

If the pellet in his thigh had been made of a less inert metal, doctors might have discovered it during the four days that Mr. Markov survived. But there was no inflammation caused by biological rejection to alert them. The case has never been solved.

Yet platinum can be a lifesaver too. In 1962 a Michigan State University biophysicist, Dr. Barnett Rosenberg, set up an experiment to see if an electric current would inhibit reproduction of bacteria. Success: The bacteria stopped reproducing.

But, unaccountably, when his research team turned off the current, the bacteria still would not reproduce!

"We'd used platinum for the electrodes," he told me, "because it's a good conductor of electricity and it's relatively inert. But that first experiment gave us a clue that the effect had something to do with platinum itself, rather than with the electric current."

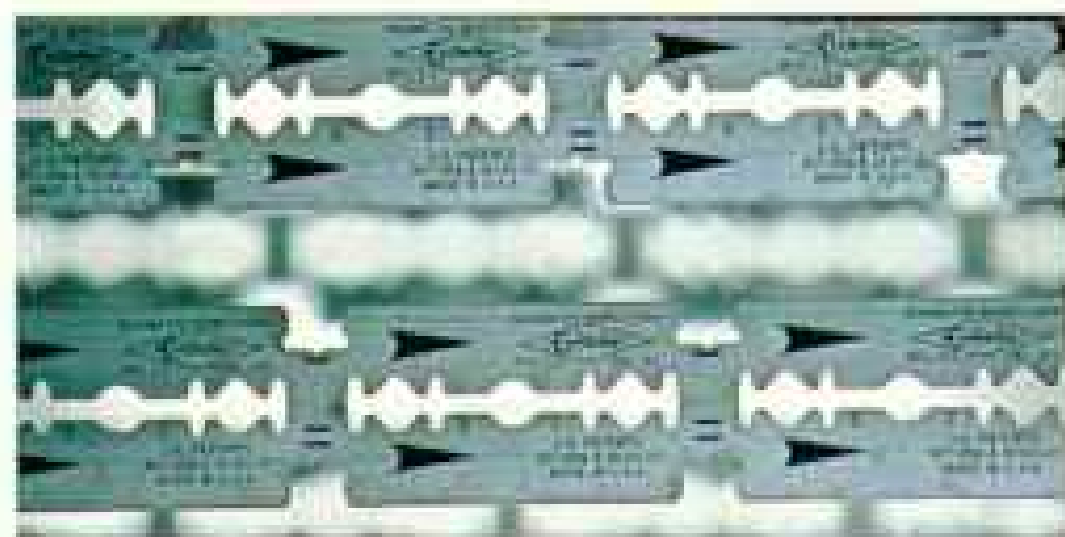
Many experiments followed, along with a dawning hope that something useful in the fight against cancer would result. Finally the drug cisplatin was synthesized—two atoms of chlorine and two molecules of ammonia, connected to a core atom of platinum.

"It's a chemical compound known since 1845," Dr. Rosenberg said, "though its biological activity had never been discovered."

The National Cancer Institute tried cisplatin. Their tests were successful, and so were those of the prestigious Institute of Cancer Research in London. Platinum companies and research laboratories supported the effort. Cisplatin's two most serious side effects (it was toxic to the kidneys, and it



Technology prefers platinum, given its durability and high tolerance for heat and corrosion, as shown by an array of wire, tweezers, crucibles, and a bushing (left). In a dental laboratory, platinum foil covers a base for a porcelain jacket to be fired at 930°C (1700°F) (above). A hundred-atom-thin layer of platinum and chromium keeps razor-blade edges sharp.





Notes and price tag in the upper registers distinguish a platinum flute played by Albert Tipton, chairman of Applied Music at Rice University. He also owns the wood, silver, and gold flutes arrayed on the table, but credits platinum with a "richer tone." Only 20 or so platinum flutes exist in the world, echoing the preciousness of the metal called "preferable even to gold itself" by the 18th-century French chemist Antoine Lavoisier.

caused extreme nausea) have been minimized. Now it is in use all over the world.

"We still aren't sure how it works," Dr. Rosenberg said to me, "though there is general agreement that, in some way, it attacks the DNA chain in a cancer cell. For testicular and ovarian cancer it has been remarkably effective."

Platinum—it can do so much more than gold. Yet it lies, almost unrecognized, beneath the golden shadow. Will it ever come forth? There are signs now that it will.

In London, on fashionable Bond Street, the Platinum Shop deals exclusively in platinum jewelry. In Pennsylvania, Johnson Matthey Inc. is creating a well-equipped workshop where jewelers can learn the platinum craft.

Platinum and palladium investment ingots are appearing in brokerage houses, and a futures market is being established in Japan that will deal only in platinum.

Industrial use is still on the rise too. British newspapers recently reported that

leaded gasoline would be banned in Great Britain and urged the rest of Europe to do likewise. Inevitably, the next step would be installation of catalytic converters—a huge new European platinum market.

Future uses for the platinum family of metals are still coming to light. One example: Photochemists hope to use sunlight to create hydrogen for fuel from water, and platinum-metal catalysts will be instrumental.

As industry becomes more complex and more sophisticated, efforts continue to make metals stronger—and more corrosion resistant, for corrosion costs the United States billions of dollars each year.

Platinum and its allied metals can help, wherever strength and durability offset the extra cost. Surfaces coated—or even sputtered a hundred atoms thick—with a platinum-group metal may be the answer.

And the catalytic uses? Who can envision what miracles the philosophers' stone will be performing by the end of the century? □

NEW VOLUMES OF RESEARCH REPORTS AVAILABLE

The 14th and 15th in the National Geographic Society's series of *Research Reports* summarize the results of 151 scientific projects supported by the Society in 1973 and 1974. These reports, compiled by John S. Lea and Nancy Link Powars, review investigations in many fields, including genetic studies of Darwin's finches in the Galapagos Islands, a survey of ancient shipwrecks in the Mediterranean, the ecology of lions in Kenya, and a resurvey of the heart of the Grand Canyon.

Copies of these latest volumes and the other 13, covering projects started in 1890 and the subsequent years through 1972, may be ordered at \$7.50 each, postage paid, by writing Dept. 61, National Geographic Society, Washington, D. C. 20036. Request later billing if desired.

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Photographed by Stanley A. Temple. *Mauritius Olive White-eye: Genus: Zosterops, Species: chloronotus. Adult size: 10cm. Adult weight: 12-14g. Habitat: Less than 100 hectares of native forest and scrubland on the upland plateau of the southwest corner of Mauritius. Surviving number: A few hundred pairs declining rapidly because of habitat loss.*



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

The Mauritius olive white-eye is one of 11 surviving bird species native to Mauritius, which was once the home of the dodo and some 25 other birds that are now extinct. Out of the 11 surviving species, seven, including the white-eye, are endangered.

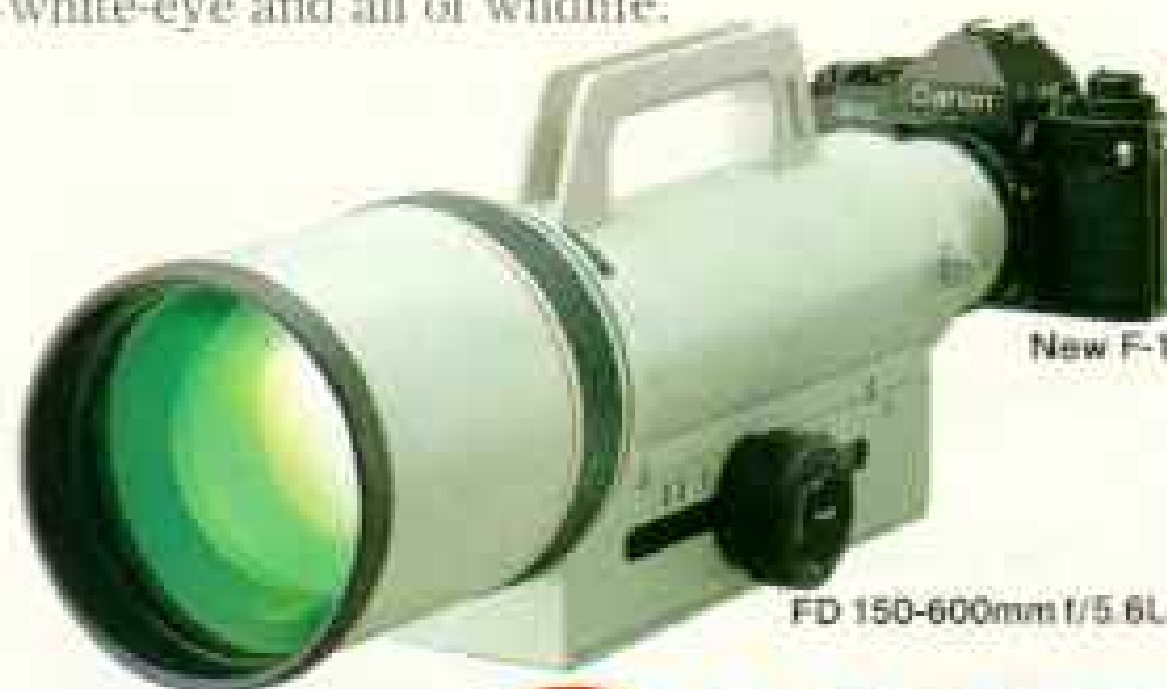
The Mauritius olive white-eye could never be brought back should it vanish completely. And while photography can record it for posterity, more importantly photography can help save it and the rest of wildlife.

The biggest threat to the white-eye is loss of habitat. It is restricted to a shrinking remnant patch of indigenous vegetation on which it depends for food, such as nectar from flowers. Many of these native plants are themselves threatened.

An invaluable research tool, photography can help save the white-eye as well as its life-sustaining habitat. In addition, photography can bring

us the beauty of this bird and its environment, moving us to a deeper understanding of nature.

And understanding is perhaps the single most important factor in saving the Mauritius olive white-eye and all of wildlife.



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Members Forum

AUTOMOBILE

I recently bought a new car from one of the Japanese automakers featured in your article (July 1983). I wanted to "buy American," but after reading product-comparison studies and test-driving a dozen or so cars, it was obvious that, for the money, the Japanese manufacturer had the better product. It is unfortunate that the U. S. auto industry is in such dire straits, but this is free enterprise, and if it takes a foreign country to show us a better way, so be it. Let's stop crying about our losses, pick up the ball, and get going!

Stephen Johnson
Gilroy, California

I was surprised and pleased to see my name in the automobile story, but it gives me undeserved credit. I was chief designer for the [Cord] company, and as such I was responsible only for styling. George Kublin was chief engineer, and the layout of chassis components was his responsibility. What was different in the 1936 Cord from the 1929 was placing the transmission ahead of the front axle. This resulted in almost perfect weight distribution for a front-drive vehicle.

The electric shift was a Bendix invention. With the transmission out in front of the radiator, it would have been difficult to rig a direct-shift linkage. With the electric device all that was necessary was to connect it with wiring.

I have been in this business since 1924. Congratulations on a very interesting story.

Gordon M. Buehrig
Grosse Pointe Woods, Michigan

As one of many "hooked on cars," I would like to point out that the car being destroyed on page 21 is not a 1962 Chevrolet but a 1968 Chevrolet. The two model years differ significantly in the position of the rear bumper.

Gary Daniel
Mount Royal, Quebec

Unless I am mistaken, the automobile being destroyed is a 1965 Chevrolet.

Michael Matthews
Sacramento, California

That is at least a 1967 Chevy the young lady is slugging away at.

Gloria D. Swalgin
Waterville, New York

The person who obtained the junker for the fair identified it as a 1962 model. Other readers cite years as late as 1970. General Motors says 1968.

The story on the automobile was delightful and most informative. In its historical and developmental aspects, however, it neglected any reference to the automatic transmission, which expanded the numbers of women drivers!

Jerome Apfel
Norristown, Pennsylvania

On page 29 of your July issue you quote Herr Rainer Paulsen, engineer with a West German transport research association, as saying, "A coal-gasification project now under construction could raise [the methanol production of West Germany] to eight million tons, enough to run only 3 percent of our 25 million vehicles." I ran through some quick calculations and came up with the astonishing result that German drivers, on the average, must drive their vehicles some 300,000 kilometers (188,000 miles) per year, enough to take them three-quarters of the way to the moon! That's very *fleißig*, indeed.

Laszlo Tetmajer
Butte, Montana

Herr Paulsen agrees his figures were high. He was calculating methanol use by high-mileage, fuel-inefficient vehicles such as buses and taxis.

UNDERSEA DESERT

I was gratified to read your July 1983 article on the denizens of the Red Sea. Your caption stating that the stargazer generates up to 50 volts, and speculating that the function of this electrical discharge is to "detect" prey, must seem a bit incongruous to scientists who study electric fish. This high voltage is on the order of a thousand times greater than that produced by those fish that are documented as using electric discharges for electrolocation. The stargazer uses its potent electric organs to stun its prey. A secondary function of the discharge is to shock would-be predators or careless scientists, as this researcher can attest.

Richard F. Martin, Ph.D.
University of Washington, Seattle

WALES

It is with deep regret that I criticize an otherwise perfect article on "Lyric Wales" (July 1983). However, as a member of the Richard III Society, I must take exception to the author's claim that Henry Tudor "had a legitimate claim to England's throne." Not a drop of English royal blood was inherited from his paternal ancestors. As for his maternal side, it is true that the Beaufort line was descended from Edward III's third son, John of Gaunt, but they were the children of Gaunt and his mistress, Catherine Swynford. Although Richard II may have legitimized the family, one hears rumors that Richard bestowed this miraculous legitimacy under the stipulation that

they never lay claim to the throne. But, even if they were legitimate, Tudor's psuedo-claim to England's crown was inferior to Richard III's.

Jim Woods
Hewitt, New Jersey

Though Henry Tudor's claim to the throne was indeed weaker than Richard's, that does not make it illegitimate, since he was the last male of the Lancastrian line. And John of Gaunt did eventually marry the "beautiful" Catherine, even though it was after their children were born.

Henry was not the only one to gain the throne questionably. Henry IV and Edward IV are other examples, as well as Richard himself, since his gain of it was surrounded by suspicious deaths.

I thoroughly enjoyed Bryan Hodgson's succinct yet comprehensive article. Wales is a hodge-podge of ideas, personalities, and backgrounds bound by a common fabric that is the Welsh spirit. Hodgson provided an excellent insight into this enchanted country, both for the uninitiated and for the familiar reader.

Kevin Cool
Petersburg, Indiana

It is particularly disturbing that your photographer saw nothing incongruous and offensive about the young couple on the Rhossili Bay coast and their portable stereo with speakers as large as their heads! Heavens, even the sheep appear to be distracted by it!

Mrs. James R. Kessling
Friendswood, Texas

UNIVERSE

Your article "The Once and Future Universe" (June 1983) was masterfully done but quite unconvincing. Do you really expect me to believe that Webster's Unabridged Dictionary came from an explosion [in space]?

Renton Maclachlan
Porirua, New Zealand

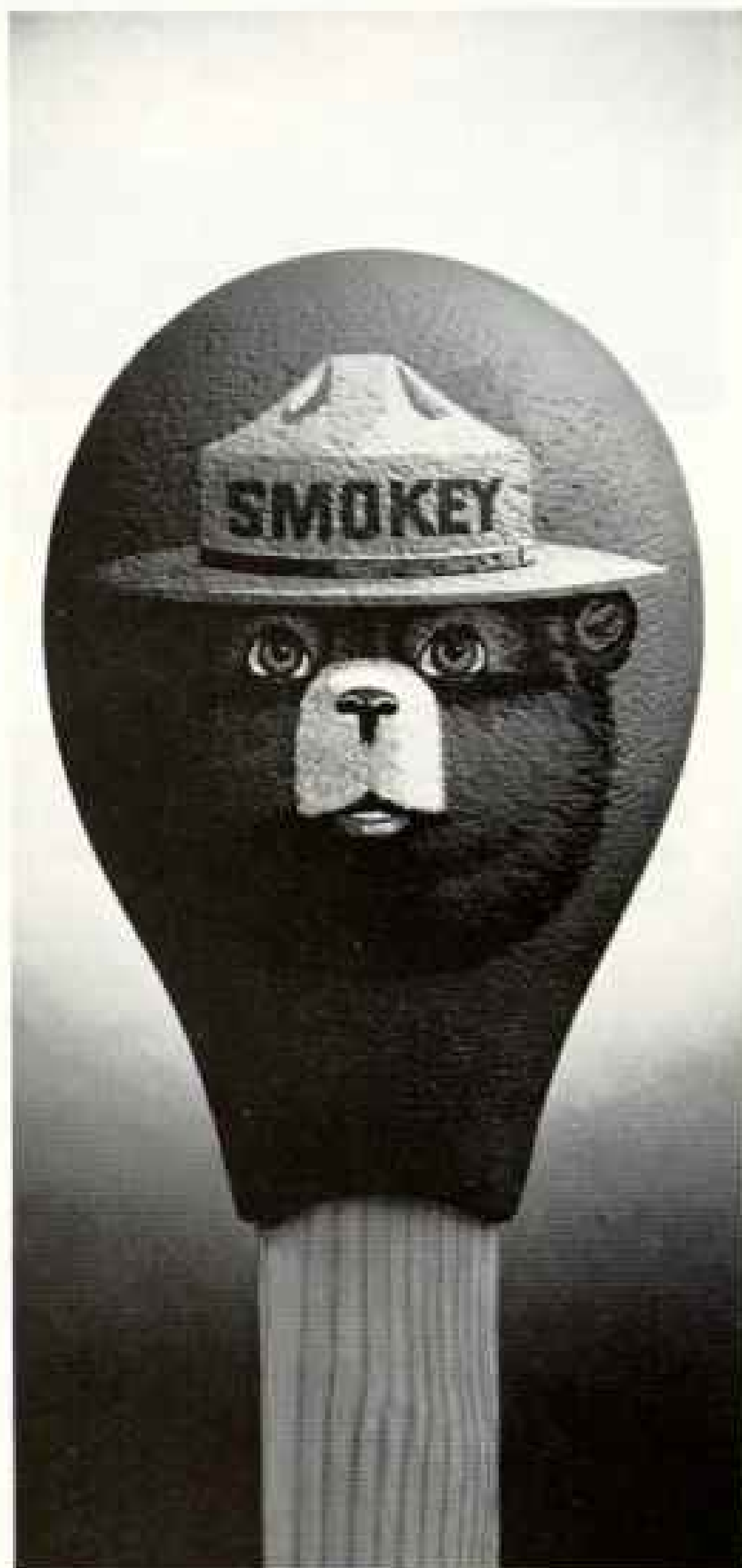
Nowhere do I find an explanation of the following: At the time of the big bang 15 to 20 billion years ago, there was a singularity that expanded with incredible speed. With our far-advanced technology we can now hear the radio signals from that big bang. But do we really? Since those signals were born, they have traveled steadily for all those billions of years, and now we hear them *here*? How did we and our galaxy get to this point in time and space *ahead* of those radio signals?

Irene E. McClenaghan
Piedmont, California

The background radiation that we read as radio signals fills the universe as air fills a balloon. We did not arrive at this point in space and time ahead of the signals; we are bathed in them, much as a fish in the ocean has water on all sides.

Members Forum

Think before you strike.



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RIACE BRONZES

In the article on the Riace warriors (June 1983), the author says there has been no trace of a ship found to this day. In 1981 skin divers out for fish spotted a wreck 100 meters from where the two bronzes had been found.

Yannis Apsouris
Athens, Greece

Further examination and carbon dating of the wreck determined that the ship was a galleon from a much later period.

TASMANIA

Please allow me to provide the happy ending to "A Walk and Ride on the Wild Side" (May 1983). A change of government, some legislation, and the High Court of Australia's decision on July 1 have ensured that Tasmania's southwest will remain a magnificent unspoiled wilderness to be enjoyed by future generations.

Geoff Owen
Sydney, Australia

ETHIOPIA

On page 635 of the Ethiopia article in May 1983: Those "wondrous castles unique on the African Continent" were designed by Portuguese survivors of 400 crusader-like young volunteers who answered the appeal of Ethiopia for help against

Muslim invaders in 1541. Dom Cristovao da Gama, 24 (son of the Great Admiral who found the way to India), was their leader. This gallant corps settled in the country, building those castles, two-storied mansions, and bridges.

J. Manuel C. Cerqueira
Lisbon, Portugal

ETC. . . .

I enjoy the GEOGRAPHIC as a well-researched, intellectually honest work and have been reading it from cover to cover for many years. I really don't care what other readers think and find some of their opinions offensive. May I respectfully suggest that Members Forum be discontinued.

J. J. Lenko, M.D.
Boonton, New Jersey

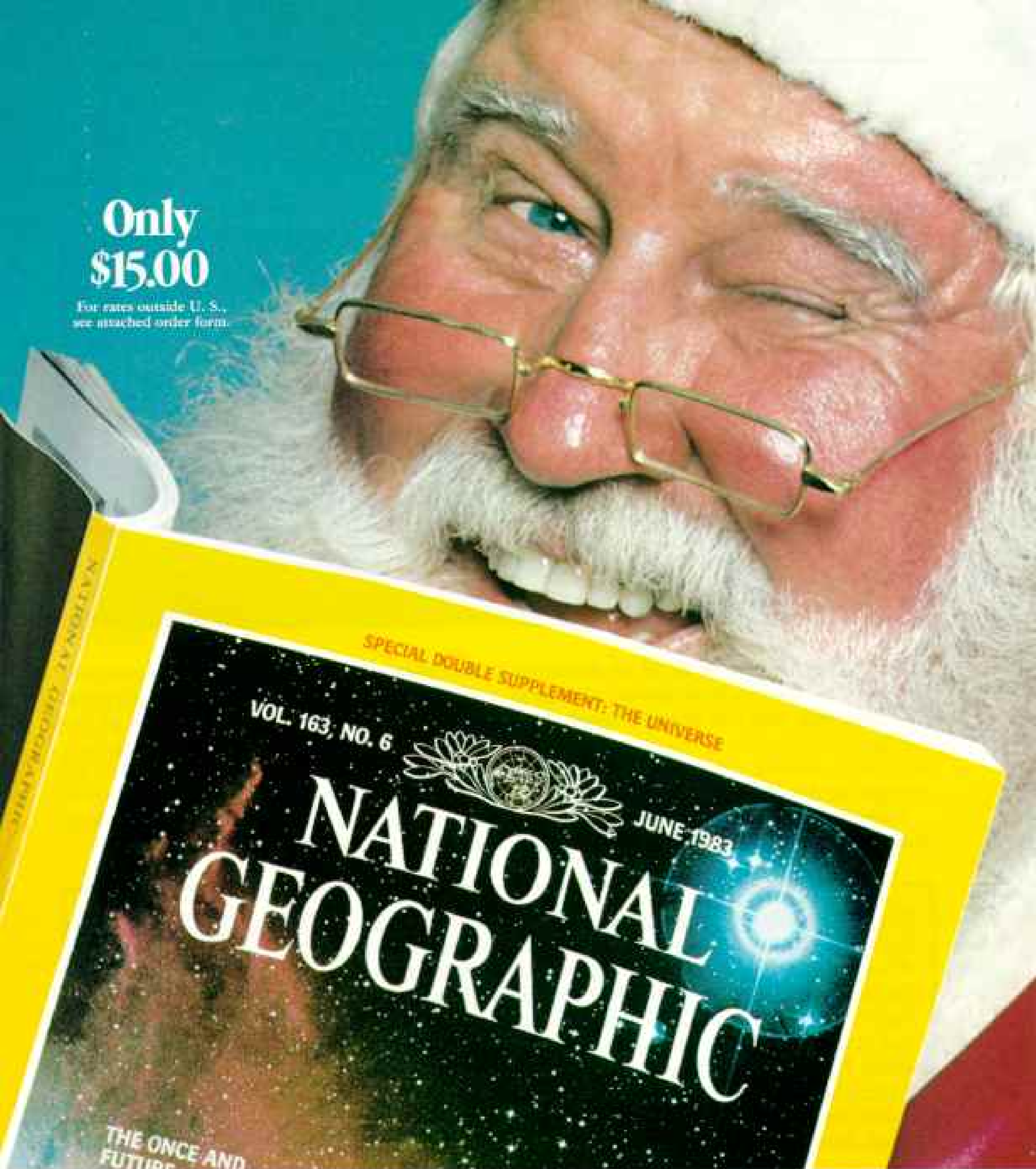
I have a new husband. When he asked me to marry him, the first thing I asked was did he take NATIONAL GEOGRAPHIC. He did—I did marry him.

Mrs. C. W. Ufford
Leesburg, Florida

.....
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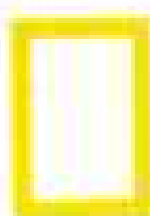


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On Assignment



GEORGE REIGER

TO CAPTURE the spirit of an American folk art, the wildfowl decoy, photographer **Kenneth Garrett** (above) spent three winters in frigid waters. "To show each decoy in the bird's natural habitat," he says, "I spent a lot of cold days living like a duck."

Garrett and author **George Reiger**, conservation editor for *Field & Stream* magazine

and a decoy expert, discovered a darker side to the art—thieves attracted by rising prices. "Some collectors wouldn't allow photographs," Garrett says, "afraid of losing their insurance if decoy pictures were published."

A University of Virginia graduate, Garrett has photographed subjects in Mexico, Colombia, South Africa, and Alaska.

One of the things we are proudest of is the quality of the art that illuminates our pages. This year two of our artists were chosen by the U. S. Postal Service to create commemorative stamps, to be issued in 1984 for the 25th statehood anniversaries of Alaska and Hawaii. The public's first look at the Hawaii stamp is on this page. It was painted by **Herb Kane**, a native Hawaiian, whose spectacular historical paintings are featured in this issue. Staff artist **Bill Bond**, who has contributed to almost every issue of the GEOGRAPHIC for the past 17 years, designed the Alaska stamp.



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Photography by Bruce Florkin

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