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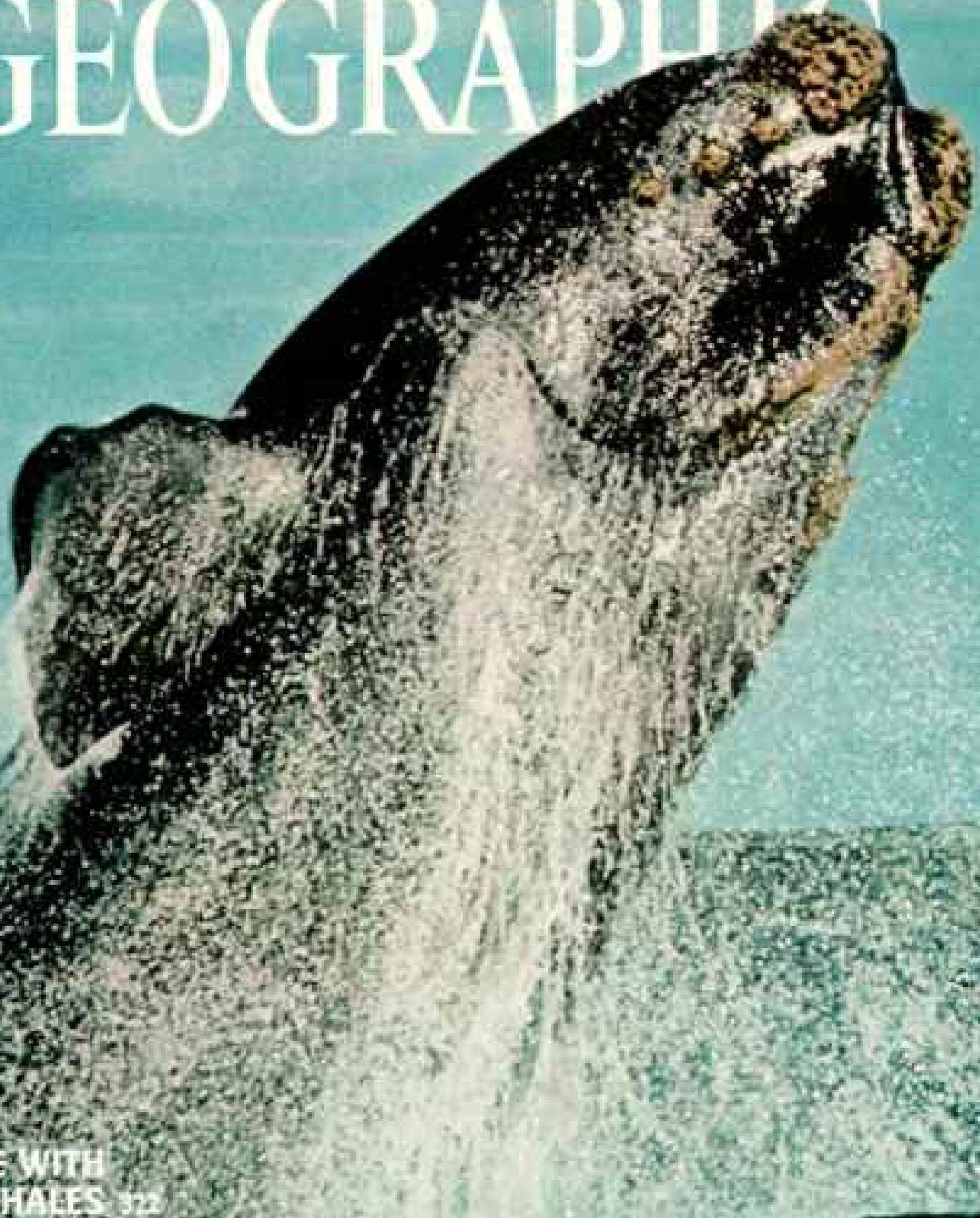

OFFICIAL JOURNAL OF THE NATIONAL GEOGRAPHIC SOCIETY WASHINGTON, D. C.

IN THIS THE NATION'S 200th WINTER, with costly fuel combusting in furnaces and engines at an alarming pace, it may seem odd to suggest that the United States is not confronted with an energy shortage. Yet, viewed in longer perspective, it is true. The shortage is one of time.

Since our political revolution of 1776, we have undergone two transformations in the field of energy: from wood to coal, and from coal to oil and gas. Dr. Robert C. Seamans, Jr., Administrator of the Energy Research and Development Administration (ERDA), points out that each transition took about 60 years.

Now, with the end of the petroleum era in sight, we face another energy revolution. This time we can contemplate fuel supplies as limitless as the sun and the sea. Inexhaustible solar energy, for example, waits to be converted into power; author John L. Wilhelm explores the prospects on page 381 of this issue. The breeder reactor defies layman's logic by promising to produce more fuel than it consumes. And in time nuclear fusion may utilize isotopes freely available in seawater.

Such processes promise ample energy. What we do *not* have is 60 years to make them work.

It is the task of ERDA to buy time, while weaning us from dangerous dependence on petroleum.

Recently Dr. Seamans—a member of the National Geographic Society's Board of Trustees—reviewed ERDA's priorities for me. He stressed conservation of energy in its end use: in automobiles, homes, and industries. Also, more efficient production of energy, including its extraction from waste heat and waste materials. Gradually our energy-supply patterns will alter. . . .

- From now until 1985: renewed emphasis on coal (especially conversion to gas and liquid fuels); expansion of safer, more efficient nuclear power; search for new oil and gas sources.

- From 1985 to 2000: accelerated development of synthetic fuels from coal and shale. More use of geothermal energy and solar heating and cooling.

- Beyond 2000: vigorous pursuit of "inexhaustible" energy sources such as the breeder reactor, fusion, and solar electricity.

No doubt our ingenuity can devise means of holding down energy consumption and tapping new sources. But can it do so before petroleum becomes too precious to burn? That depends on how wisely we use our scarcest commodity: time.

More power to ERDA—and to us.

Gilbert M. Grosvenor

NATIONAL GEOGRAPHIC

THE NATIONAL GEOGRAPHIC MAGAZINE VOL. 149, NO. 3

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COVER: *A right whale at play breaches off Patagonia's bleak and timeless desert coast. Photograph by Des and Jen Bartlett.*

Argentina Protects Its Wildlife Treasures

In an ecological wonderland a gambol of guanacos—cousins to camels—lope along Argentina's Patagonian shore. Here, where parched desert confronts life-teeming ocean, live armadillos and sea lions, dolphins and penguins, sand-dwelling rodents and shore-hugging whales. Invaded in the 1800's by fur-and-oil hunters who all but annihilated some species, the isolated coastal strand lately has richly repopulated itself. Now, its animal treasures rediscovered, Patagonia is striving to preserve them for future generations.

By WILLIAM G. CONWAY

GENERAL DIRECTOR, NEW YORK ZOOLOGICAL SOCIETY

Photographs by DES and JEN BARTLETT

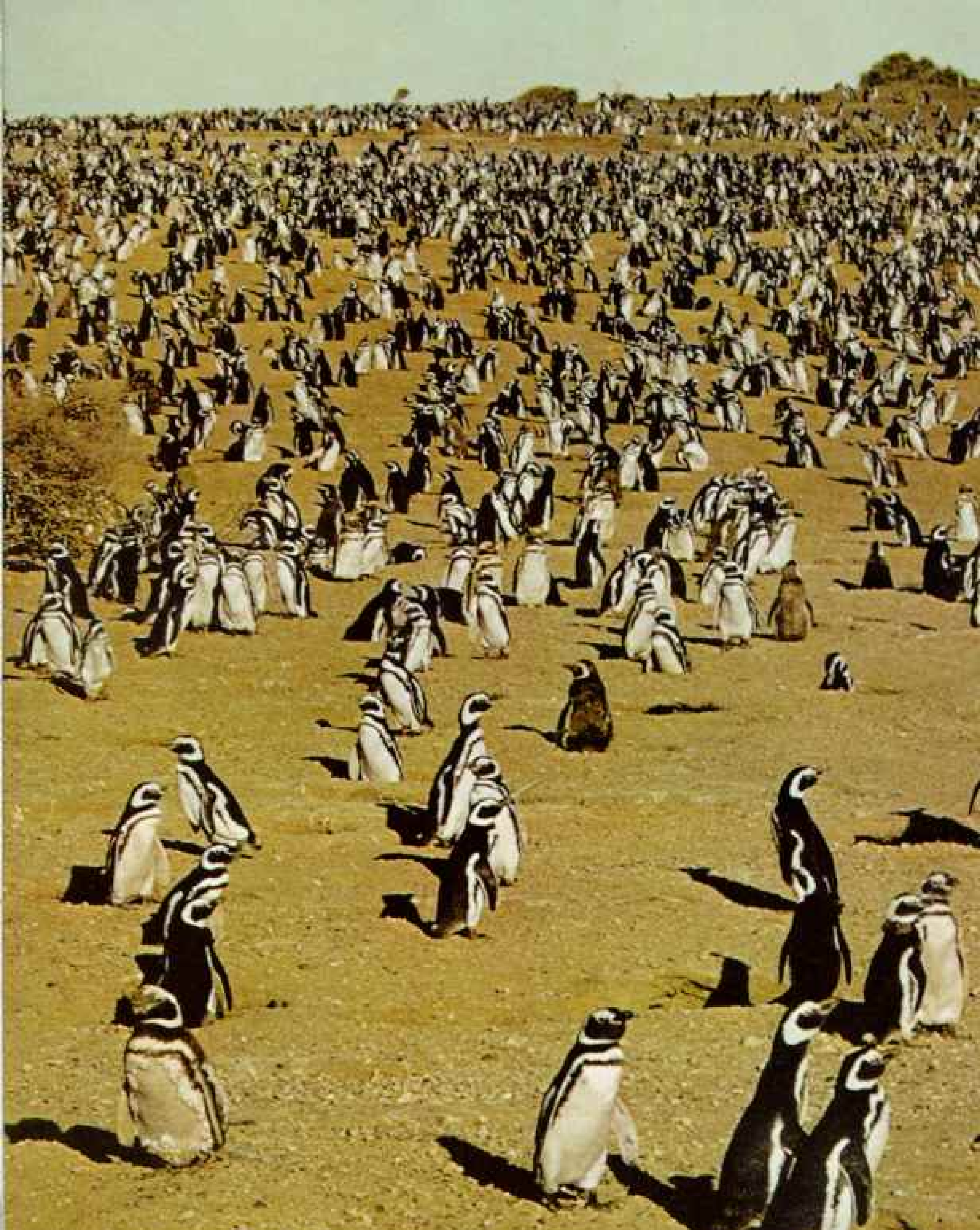
NOSE TO THE GROUND, snuffling along among the penguins, the normally wary armadillo seemed dangerously oblivious of its shadower—me. Evidently I was perceived only as one more among a colony of nearly a million Magellanic penguins.

For all its seeming unawareness, an animal of a kind that has survived almost unchanged in Patagonia for nearly forty-five million years merits a biologist's sincerest respect. Yet today that respect is tempered with concern, for man is again an increasing and potentially dangerous presence among Patagonia's unique, sometimes bizarre, and now abundant wildlife.

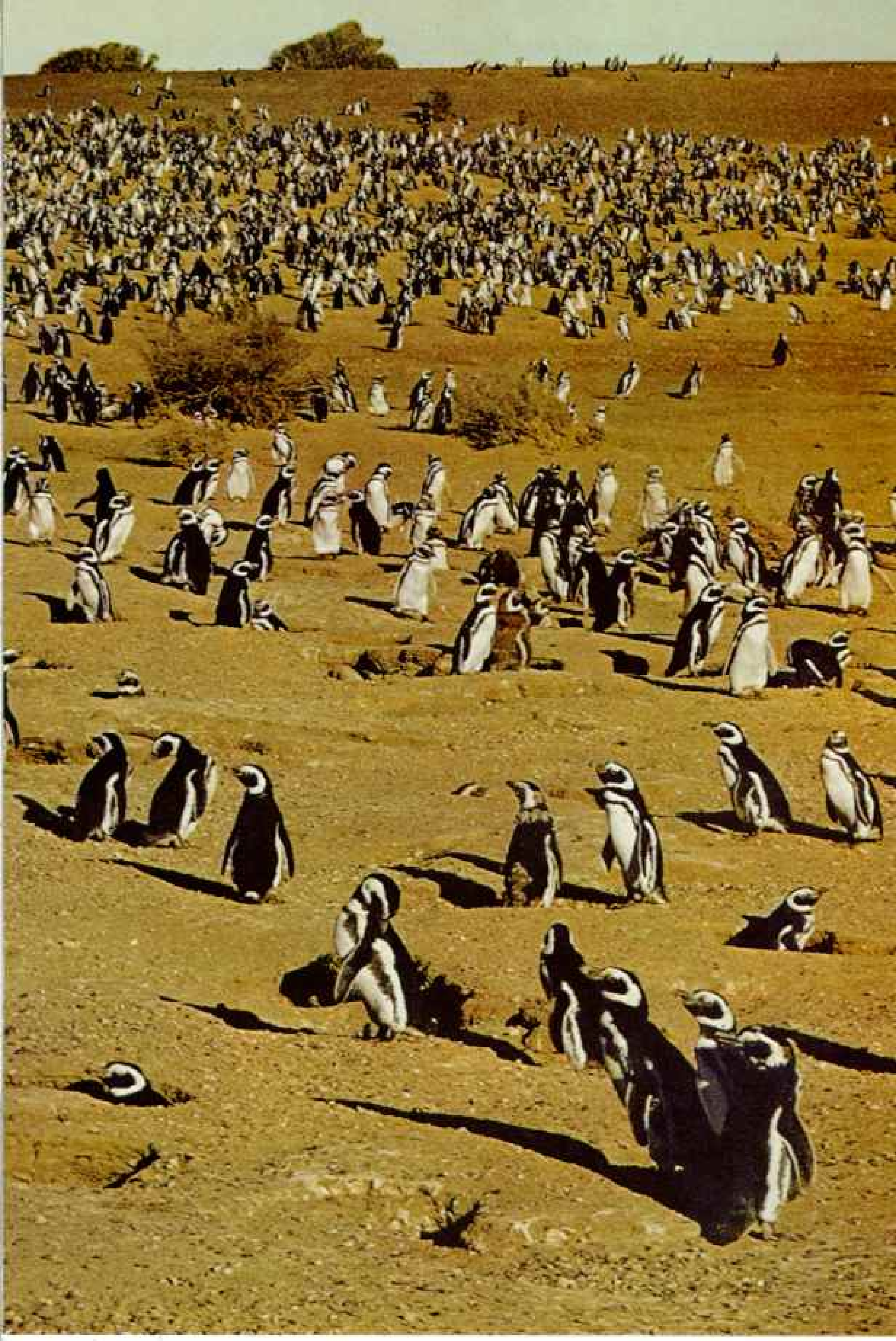
As it happened, the armadillo ambled safely away among the penguins with a freedom ensured, in part, by the remoteness of Argentina's far southern region.

Once nearly destroyed by overhunting, this vast natural refuge was slowly restored by a combination of changing markets and isolation. Today Patagonia's wild treasures are newly accessible, fascinating but little studied —and highly vulnerable to disturbance and exploitation. In many ways the coastal creatures have been rediscovered, and this time there is some reason to hope that they may better survive man's renewed interest.

More than once a polite listener to my tales of Patagonia's wild animals has interrupted to inquire, "But—just exactly where *is* Patagonia?" The well-publicized visits of Magellan, Drake, and Darwin notwithstanding, Patagonia is not a household word. Besides, its arbitrary boundaries have varied both with the years and with geographers. Today most people speaking of Patagonia refer to that great arid pampa in Argentina that



HAVE TUXES, WILL TRAVEL. *Their seagoing season ahead of them, Magellanic penguins gather on a Patagonian shore in multitudes unknown here for more than a century. Once slaughtered for food and oil, the birds are now protected by provincial law.*



stretches from the Rio Negro in the north to Tierra del Fuego in the south, and from the Andes to the Atlantic Ocean (map, page 297).

From the standpoint of wildlife, the coast of Chubut Province is Patagonia's heartland. Except for the Andean region of its far west, Chubut is mainly a desert. Until very recently it has been largely uninhabited. It appears overwhelmingly bleak—wind, sky, dust, and monotonous miles of broken plateaus thinly covered with hostile thorny shrubs. Life clings to a yellow flaky soil that is dominated by round, timeworn pebbles.

Food-rich Current Sweeps Barren Shore

At the coast Chubut meets a sea of huge tides with sterile yellowish cliffs, wind-eroded red rocks, or wide, steep shingle beaches. The province's frontier with the South Atlantic is one of the world's most starkly forbidding coastlines. Here the desert's bizarre, depauperate animal community mingles with great colonies of marine birds and mammals attracted by the rich food supply of the cold Falkland Current as it brushes the shore on its way north from Antarctica.

Among the land creatures that dwell where the desert meets the sea, it is as if all extravagance had been muted by the energy required to survive the extremes of climate. Ancient, conservative life forms are the rule, clothed in the brown, gray, and tan colors familiar to all who study desert fauna. Coastal seals, whales, and seabirds add little but black and white.

It is the strangeness of these creatures, and their large numbers, and, especially, the fact that they exist in this harsh environment at all, that give Patagonia's wildlife unique interest. The vast penguin rookeries, groups of somnolent elephant seals and noisy *"lobos,"* or sea lions, on the shingle beach, the slowly swimming whales—all convey a feeling of timelessness, primeval and undisturbed. One of the penguin rookeries ranks among the world's largest. The region's southern elephant seal breeding ground is the only continental colony of its kind on earth. And Patagonia's southern right whales are the remnant of an endangered species in its largest known nursery (see article beginning on page 322).

In five visits to this harsh and beautiful coast, I have yet to see the Atlantic horizon smudged by a passing steamer. There can be few places left where man's hand is so little in evidence, his existence seemingly of so little consequence.

The bleak shoreline with its dangerous weather has provided a mainland refuge for animals that elsewhere live only on islands. But the history of the coastal creatures has been complex and violent.

Early Patagonian Indians ate giant ground sloths, prehistoric horses, and glyptodonts—large extinct relatives of the armadillo. All three had vanished long before the first European, Ferdinand Magellan, arrived in Patagonia in 1520. Later tribes of Indians must regularly have killed as many nesting penguins and cormorants, along with seals and sea lions, as they wished. Beginning in the 1800's and continuing into the 1950's, Europeans took up the hunt—relentlessly.

Since Patagonia was devoid of roads and inhabited by hostile Tehuelche Indians, European sealers approached from the sea. They systematically exterminated many of the sea lion and elephant seal rookeries. Even the penguins were killed and boiled down for their oil, while the southern right whale was so reduced in the waters nearby that it verged on extinction. Finally, with the most accessible animals eliminated, the slaughter let up. Renewed isolation began its slow, restorative work.

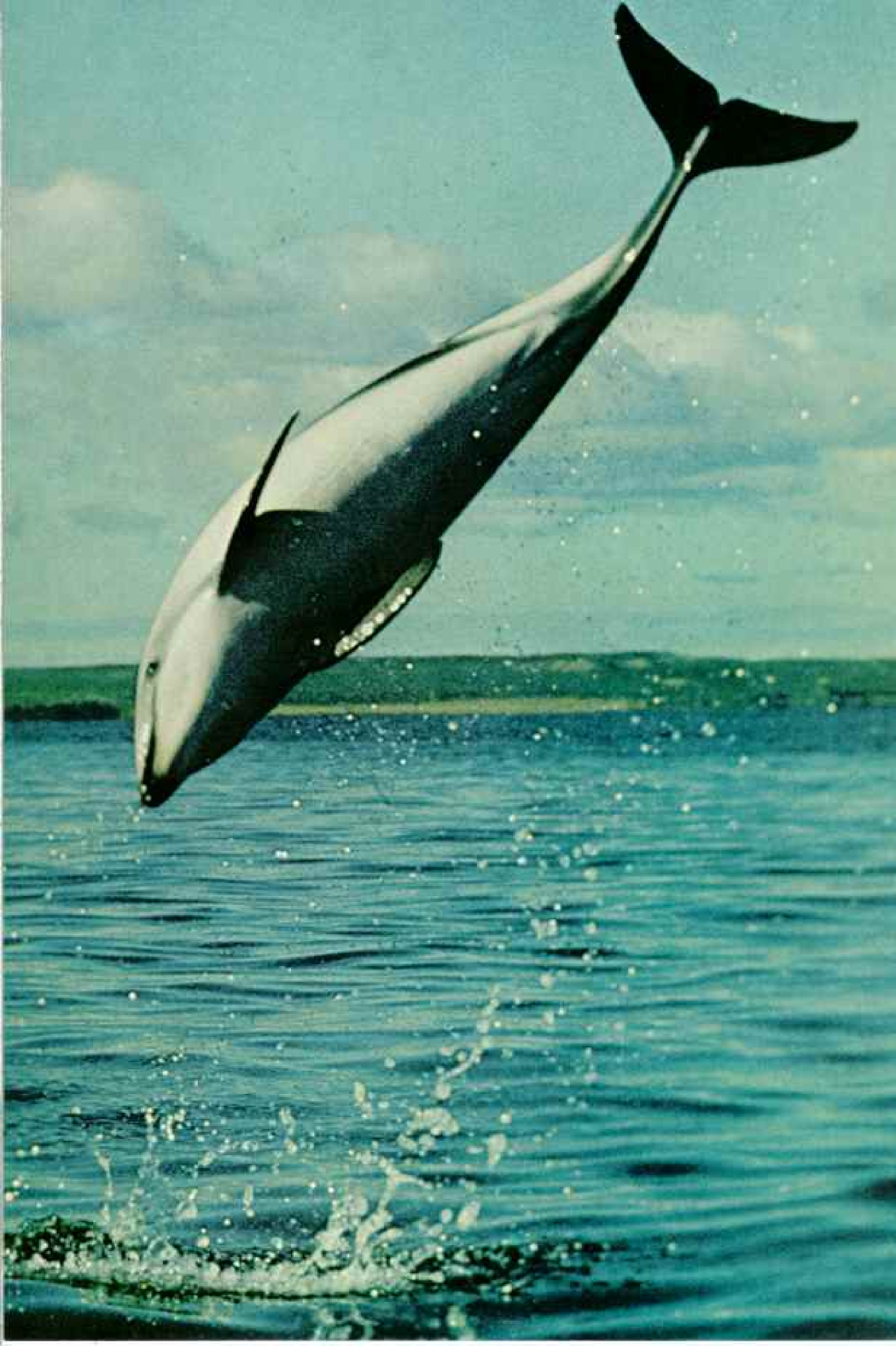
Penguins Return to Site of Slaughter

Along the Patagonian coast today there may actually be more bird colonies than there were a century ago. When British ornithologist Henry Durnford wrote of his visit to Chubut's Punta Tombo in 1878, he made no mention of Magellanic penguins, although subsequent excavations suggest that they had been there earlier. Now nearly a million Magellanic penguins raise their chicks here (preceding pages).

Almost every form of life that Magellan might have seen during his visit in 1520—except for the Indian—is still extant in Patagonia and, in some instances, increasing. But there is one crucial difference: The protective isolation has been shattered forever.

A campaign to open up the Patagonian "frontier" has resulted in newly improved roads, new industries, and growing towns. Even a casual visitor can now see almost

"Like rabbits wearing miniskirts," as one observer described the breed, Patagonian cavies, or maras, run with a bouncing, stiff-legged gait. Like many isolated Patagonian species, maras have developed unusual habits. They are rarely known to drink but somehow derive the moisture they need from munching the region's parched vegetation. The 30-inch-long adults apparently never enter burrows in which the young reside in large communal litters. A mother simply approaches the mouth of the burrow and cautiously calls her own youngsters out with soft maternal squeaks. The mother mara here is leading her four youngsters from their nest to a nursing site.



all of Patagonia's fascinating wildlife within yards of his car. There are no dense jungles, no dangerous diseases, no unpleasant insects.

Once again the stage is set for an extraordinary wildlife slaughter, though of a different sort from the past. The threat today is one of gradual destruction through thoughtless disturbance and careless development. Yet, conversely, the stage is also set for a breakthrough in the history of man's relationships with colonial animals.

Which way will Patagonia's rediscovered coast go? Will its creatures be wiped out, this time with the permanence made possible by modern efficiency? Will the development of the coast be planned with the preservation of wildlife and scenic values in mind? In most places the answers to these questions would be depressing. But something strange appears to be happening in Chubut.

Government Attuned to Wildlife Needs

Far from initiating a new round of killing and exploitation, Chubut's growing accessibility seems to have ushered in an equally new interest in tourism. In a remarkably short time the provincial Department of Tourism and Wildlife, led by a dynamic director, Antonio Torrejón, has set up a system of wildlife reserves and parks.

These reserves are small but effective, providing not only protection by wardens but also interpretive centers, school programs, and housing for visiting scientists. Indeed, Chubut's mix of wildlife research, tourism, and park development may be the best possible alternative to destructive exploitation.

Today in Patagonia scientists from the New York Zoological Society, with support from the National Geographic Society, rub elbows with Argentine biologists. Their presence and their studies may help forestall the fate usually suffered by large concentrations of wildlife in developing areas.

There is a chance, albeit a modest one. What happens on Argentina's last frontier could have great influence on the future of Latin-American wildlife.

One can only hope that significant numbers of Patagonia's braying penguins, magnificent whales, sea lions and elephant seals, curious rheas and primitive guanacos will continue to provide perspective and delight to future generations of man. □

Between two worlds, the Patagonian coast of Argentina affords its rich array of animal life a feast-and-famine environment. While land-oriented mammals eke out the barest subsistence, marine mammals loll just offshore in relative ease —like the dusky dolphin somersaulting out of the water (**left**). Two reasons for the unusually fertile offshore waters: relative isolation from human exploiters, and the cold but plankton-rich Falkland Current sweeping along the Patagonian littoral. The nearly landlocked bay of Golfo San José on wind-pummeled Peninsula Valdés has been set aside as a marine sanctuary by Argentina's Chubut Province.

In the morning calm, ostrichlike

PATAGONIA'S WILD SHORE

Where Two Worlds Meet

A PHOTOGRAPHIC PORTFOLIO BY
DES and JEN BARTLETT

Darwin's rheas share a freshwater rendezvous with a Patagonian crested duck.

"IN NEARLY 25 YEARS of making films around the world," report Des and Jen Bartlett, a gifted husband-and-wife photographic team, "we have not often encountered such an amazing variety of wildlife, both above and within the sea. Coastal Patagonia, because of its isolation, is a natural treasury of countless species either endangered or unknown elsewhere in the world."

For two years the Bartletts explored a 200-mile segment of the Patagonian coast to capture on film what had intrigued the great British naturalist, Charles Darwin. Survival Anglia Ltd., producers of natural history motion pictures, sponsored their expedition.

So unusual was the region that Darwin devoted several pages of his 1839 journal to observations on its flora and fauna.* So unusual does it remain that Argentina has taken steps to preserve it intact. Nature helps keep the idly curious away by adding fierce, unpredictable winds to the desolate terrain. "There is a saying," remarks Jen Bartlett, "that if you want to see Patagonia, just sit still long enough and it will all blow past you."

*That journey was retraced by Alan Villiers, "In the Wake of Darwin's *Beagle*," for the October 1969 NATIONAL GEOGRAPHIC.

GYMNASTS OF THE SEA, dusky dolphins cavort above the surface of Patagonia's Golfo San José. Traveling in groups of from six to as many as 200, these smaller relatives of the bottle-nose dolphin excel at aerial acrobatics.

"A single dolphin may excite the whole school," reports Des Bartlett. "If one begins to breach, others will follow suit, executing series of graceful leaps and somersaults as beautiful as any we have seen among whales and dolphins."

Beneath the surface the "duskies" proved equally frolicsome. "They played their own version of 'chicken' with us," Jen Bartlett adds, "speeding straight at us like homing torpedoes and veering off only at the last moment. Not once did they misjudge and even graze us."

As though to demonstrate their effortless skill, the dolphins from time to time would poise beside the photographers, then streak out of sight into the depths.

The foursome at left glides past Jen's camera at a range of less than six feet, nearly the maximum for clear photographs in Golfo San José. On hunting forays the dolphins work in teams, driving schools of fish to the surface, where alert gulls share in the feast. While feeding, the dolphins seem to ignore the occasional presence of a shark.

TIMELESS FRONTIER between desert and sea yields fossils of dolphins and whales that have inhabited Patagonian waters for millions of years. Arrowheads and other artifacts identify a prime hunting ground of the Tehuelche, Indians who once occupied the now largely deserted coast.

An outraged male calandria gris, or Patagonian mockingbird, berates Jen Bartlett for her intrusion (**far left**) while she photographs the female (**center**) warming her eggs.

"When it came to invading *our* territory," Jen says, "all rules were off. The calandrias made free with everything, especially food, snatching it right off our camp table even as our daughter, Julie, sat there (**left**)."

Despite a constant defense of their nest, these calandrias raised only one chick to flying age in two seasons. The rest fell victim to predators such as foxes.

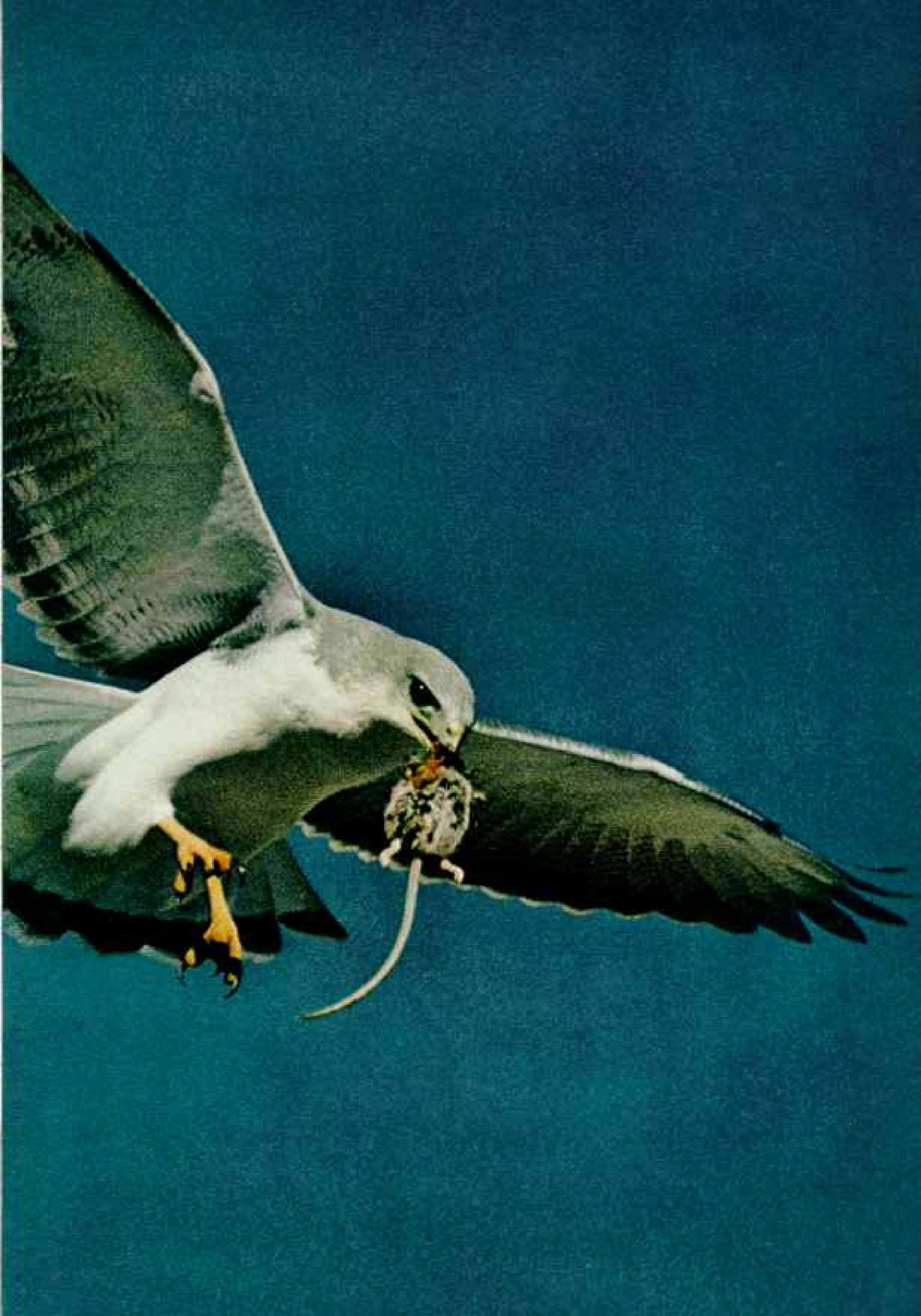
SMILE OF CUNNING seems to light the face of a Patagonian gray fox (**left**) beside a piquillin bush. Normally a hunter of small rodents, lizards, and birds, the fox in autumn also feeds on the red piquillin berries.

Sharing the feast, a cuis (**right**) nibbles a ripe berry. Rumble-seat litter of week-old rodents (**lower right**) crowd close to their mother for early-morning warmth.

The mouse-size murine opossum (**below**) frequented the Bartletts' camp at night, foraging for insects, lizards, and young birds. During periods of plentiful food the opossum stores fat in its prehensile tail to carry it over leaner times.

SCARLET BEAKS seem painted on these mating dolphin gulls (**above**). At Punta Tombo more than 50 pairs of the scavenging birds nest in an area 15 by 30 feet. Despite their lesser size, the aggressive dolphin gulls raid neighboring kelp gull nests to dine on the eggs.

Airlifting a choice morsel, a red-backed hawk (**right**) clutches a dead rat in its powerful beak. To entice the hawk within camera range, the photographers' nephew, Les Bartlett, placed a daily offering on a bush near camp. "On gusty days," Les recalls, "the hawk made as many as half a dozen unsuccessful passes at the bush before gripping the rat in its talons."



NOW YOU DON'T see it; now you do: The tawny-throated dotterel (**above**) blends with the desert. When it is away, nest and eggs lie wholly exposed but almost invisible against the litter of pebbles.

For a more obvious but no less effective defense, the Patagonian canastero, or basket-maker (**right**), constructs a bristling nest of thorny twigs.

FIERCE IN STARE and also name, the tufted tit-tyrant (**below**) ranks as a heavyweight only when compared to the tiniest hummingbirds. In trees and scrub the minute flycatcher is less often seen than heard, whirring its wings and trilling.

Like its North American cousin, the peludo, or hairy armadillo (**bottom**), relies on a portable shield for protection. A keen nose and powerful claws compensate for poor eyesight as it forages for insects, bird eggs, lizards, and carrion.

Spiny symmetry of a Patagonian cactus (**bottom center**) adorns the sand. It traps moisture in a fleshy base a few inches underground.

SPIKY PLUME crowns the splendid camouflage of the elegant crested-tinamou (**right**). Crouched in the undergrowth, the tinamou remains motionless at an intruder's approach, exploding into flight only at the last moment. "The experience," says Des Bartlett, "can be heart-stopping for an unsuspecting human whose thoughts are miles away."

A distant relative of the rhea (pages 298-9), the 16-inch-long tinamou rarely takes wing except to escape predators. Only its shrill morning and evening whistling indicates its whereabouts in the brush.

In a rare reversal of roles, the male tinamou alone incubates the eggs, after one or more females deposit them in his nest (**below**). Jade-green with a bright enamel-like finish, the eggs lie well concealed under a shrub.

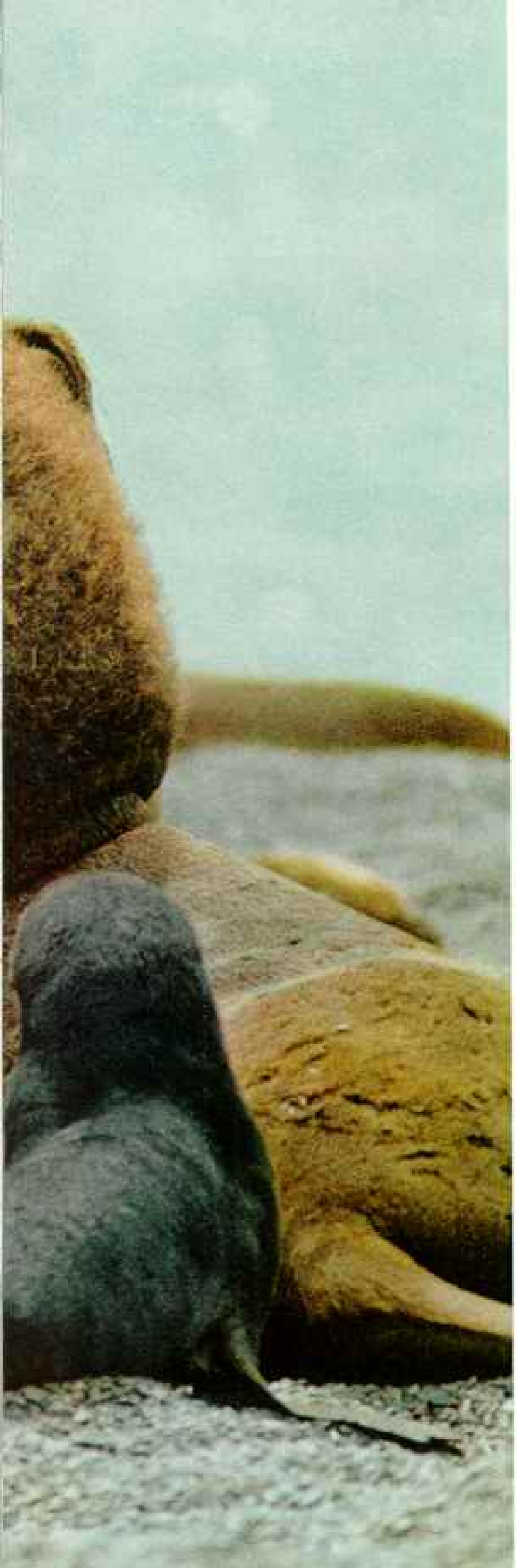
MASKED AND MENACING, a male southern lapwing (**above**) defies the Bartletts to approach his nest. When a series of aerial sweeps and piercing cries failed to deter the photographers, the foot-long lapwing landed and stood his ground. Wing spurs are used as weapons in duels with other birds.

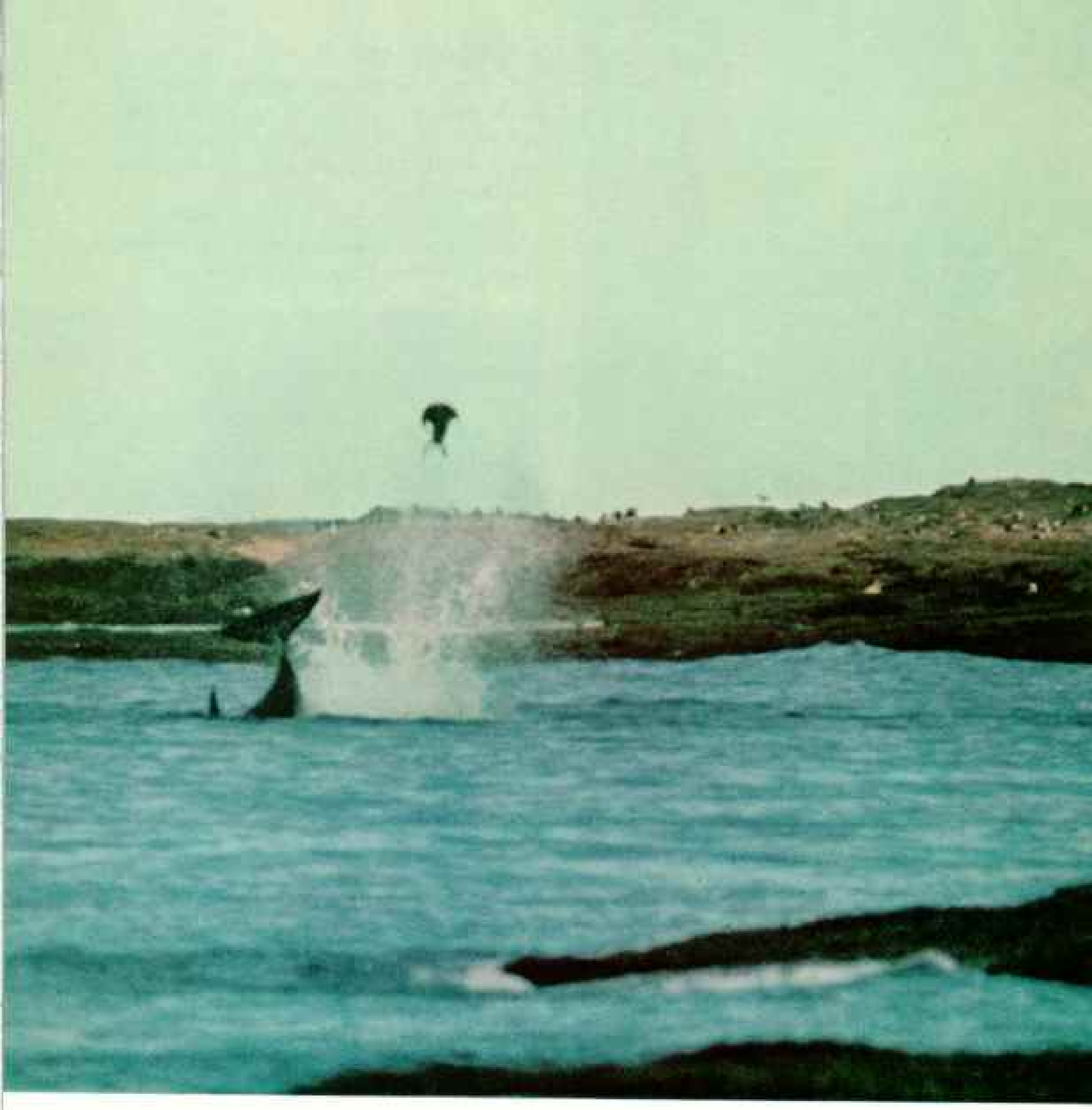
The lapwing relies on camouflage rather than cover to conceal its home. "It took us a long time to locate the nest," Des Bartlett explains. "Only by watching both male and female from a distance with binoculars could we pinpoint the site."

REGAL MANE of a three-quarter-ton South American sea lion bull rivals that of its African namesake. This patriarch guards his harem of females and their small dark pups at a Punta Norte breeding colony.

A pup perched atop a dozing neighbor—a light-colored female elephant seal (**below**)—gets a firm but gentle brush-off.

LISA LELAND (LEFT)

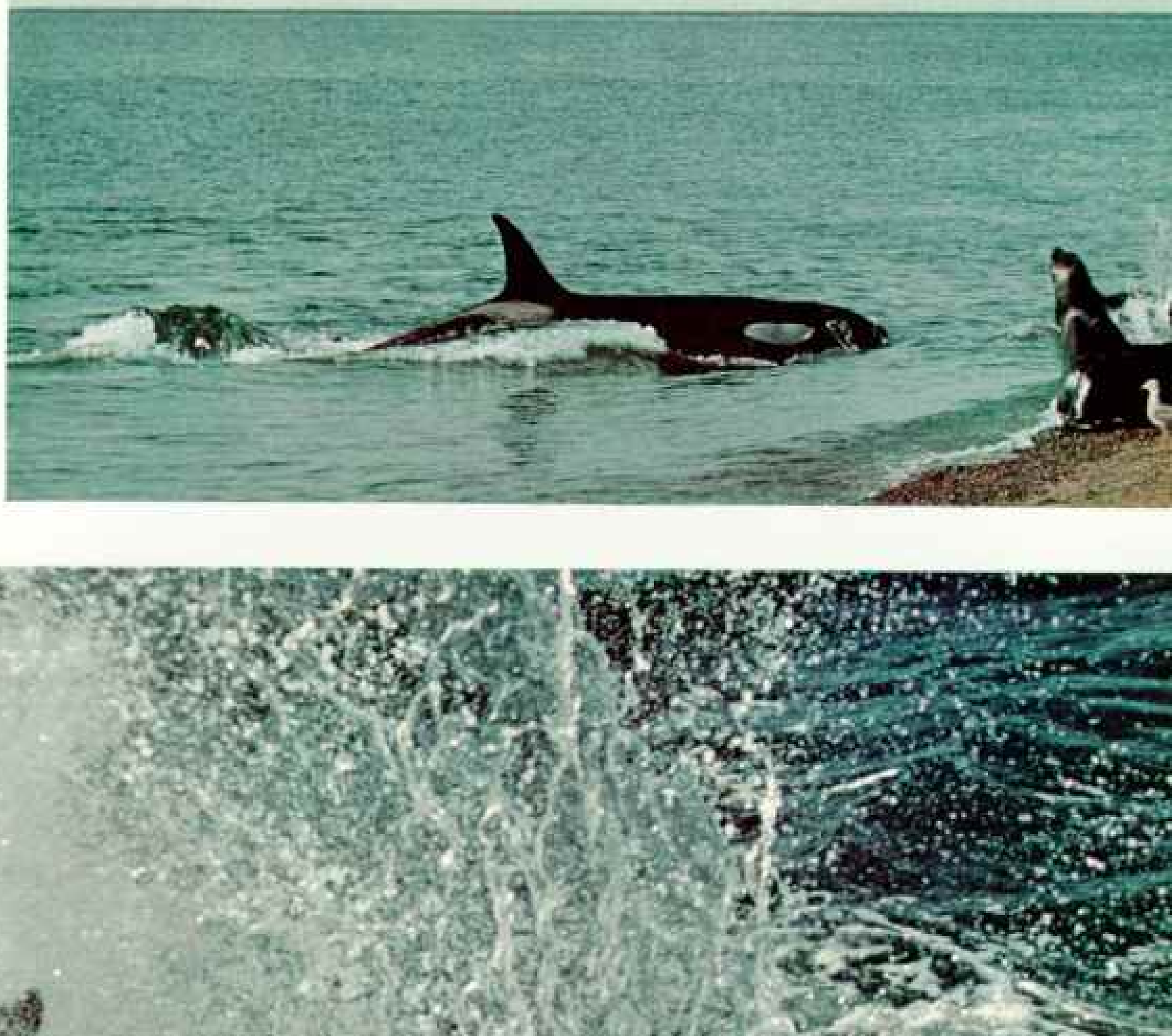




CATAPULT OF DEATH: The powerful flukes of a killer whale loft a full-grown sea lion (**above**) 20 to 30 feet into the air. "The force of the blow is tremendous," observes Des Bartlett, "considering that the sea lion may weigh several hundred pounds." The Bartletts believe the technique may serve to stun the sea lion, making it easier to kill. Local observers tell of seeing killer whales repeat the performance several times with the same sea lion, in the manner of a cat toying with a mouse.

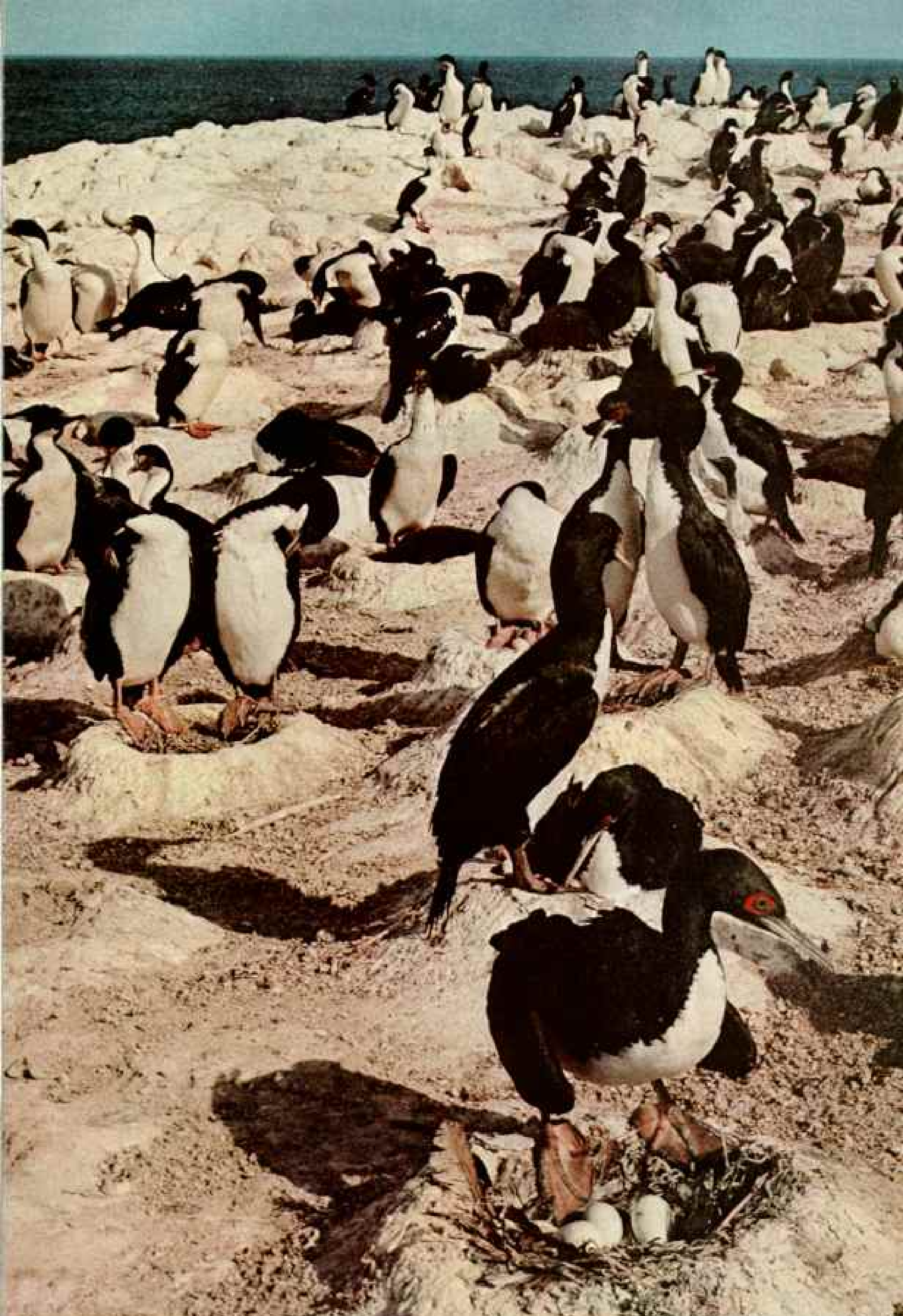
Jen Bartlett caught this dramatic scene near the shoreline of Punta Tombo peninsula. "I noticed a pod of half a dozen killer whales patrolling slowly back and forth. After an hour the whales shifted to an area just off the tip of the peninsula. Moments later the ocean erupted and the sea lion came hurtling out of the water. The other whales moved in, and it was all over in a matter of minutes, with nothing left but scraps of meat on the surface for the kelp gulls to scavenge."

A luckier sea lion (**left**) seems to soar through the water with flippers swept back like a jet plane. Although it can exceed 15 miles an hour underwater, even that speed does not ensure escape.



STALKING to the limit of its territory, a killer whale (**left**) momentarily strands itself in pursuit of a sea lion. "Adult sea lions actually appear to tease the killer whales," says Des Bartlett. "When the herd knows the whales' location, the adults seem to delight in maintaining just enough distance for safety."

Grief comes in a churn of spray (**below**), as a killer whale breaches with the hind flippers of its underwater catch—a sea lion pup—tightly clamped in its jaws. Another killer whale cruises by, dorsal fin out—waiting.



RAUCOUS CONCLAVE of 10,000 nesting cormorants crowds the tip of a slender peninsula believed to be the only joint nesting site in the world for three cormorant species—the king, rock, and guanay.

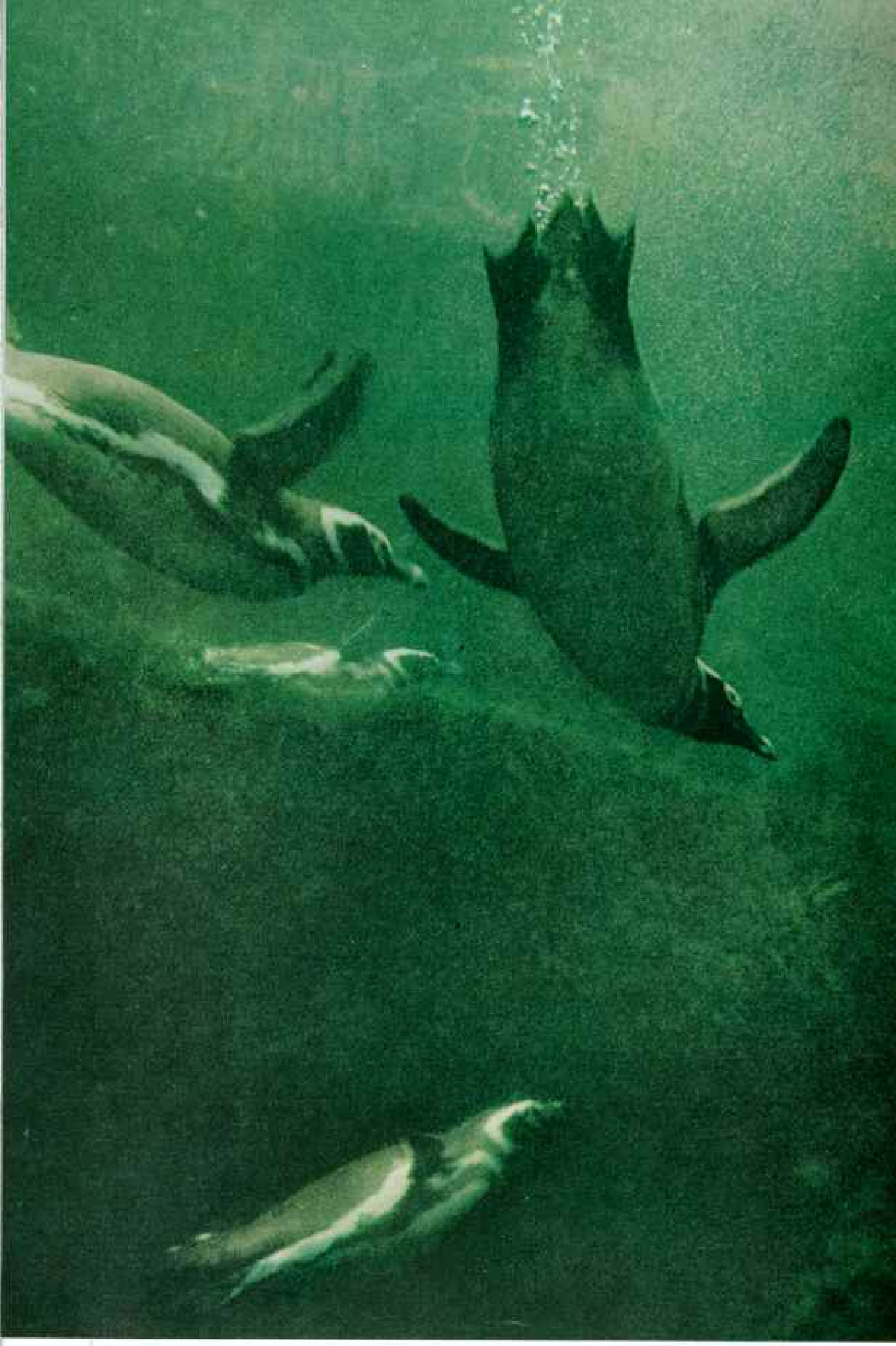
White-throated king cormorants, with a blue eye ring and gold caruncle above the beak, far outnumber the other two. Guanays, with black throats and red eye rings, were once thought to nest only on the Pacific coast of South America. A more extensive red mask marks the smaller, more timid rock cormorant (**below**).

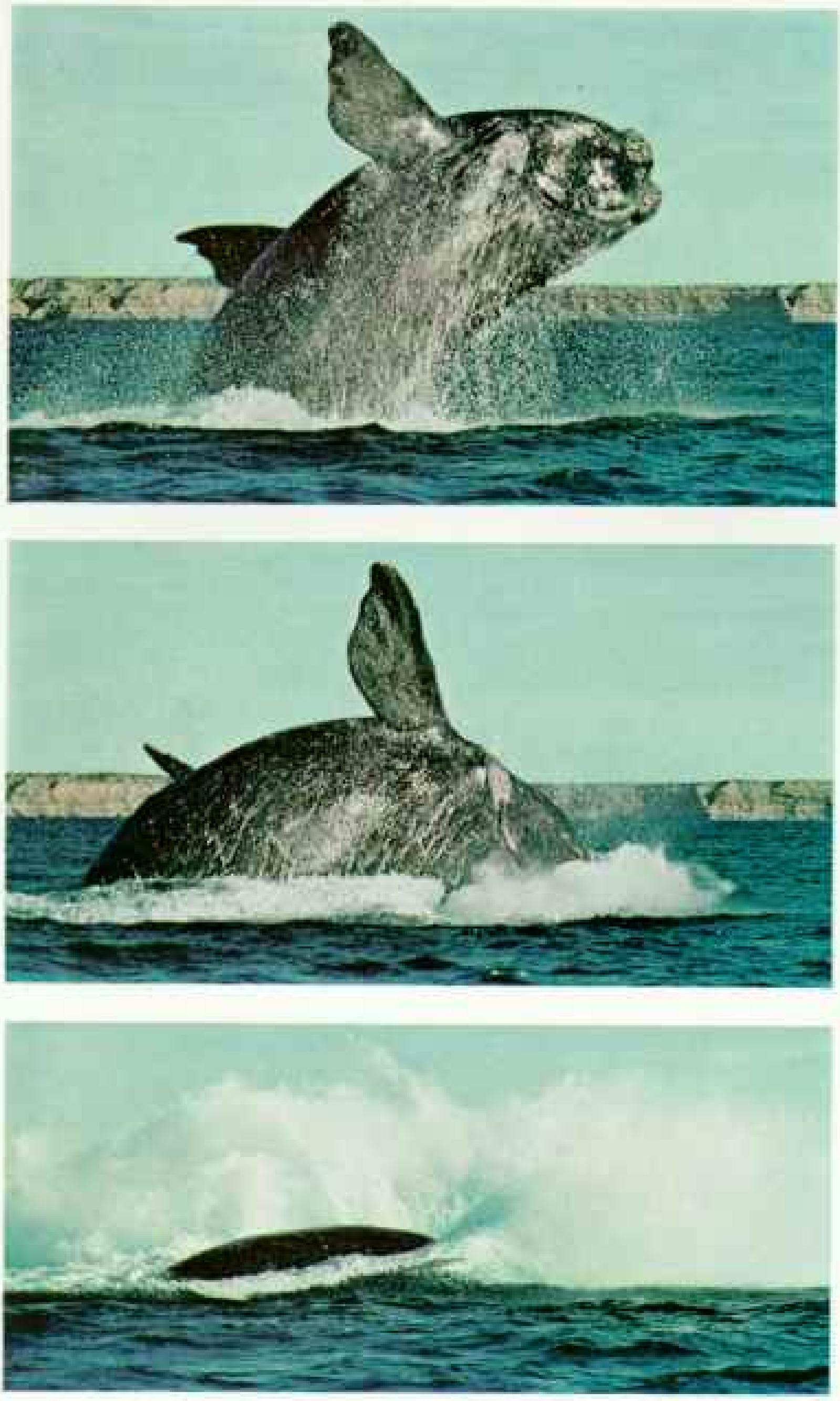
For all their grace and skill, cormorants occasionally fall victim to Patagonia's winds. "One stormy day," reports Jen Bartlett, "the birds returned from the ocean with seaweed for nest building. The wind was coming in powerful gusts and veering all around the compass. Suddenly, from overhead we heard a tremendous thud, and a king cormorant fell dead nearby. Another cormorant fluttered down a second later, flopped once or twice, and died.

"Obviously the birds had collided in midair, either because of the quick-shifting winds or from being blinded momentarily by the clumps of seaweed in their beaks."

ALTHOUGH BORN TO SWIM, young Magellanic penguins can drown while still in their downy state. An adult (**top**) tries to shepherd a bedraggled chick from the dangers of a flash flood caused by a rare desert downpour. After mating and the hatching of eggs, adults wait out the molting season before returning to sea. A scrubby awning of a tree (**above**) gives scant shelter.

Ill-designed for land, the penguins become the epitome of grace and competence in their adopted element, the sea. Wings useless for flight become powerful flippers for swimming (**right**); feet are used for steering. For five months Magellanic penguins course the South Atlantic without touching land. Only the imperative of another generation calls the birds back to shore. □





"And God created great whales...."

GENESIS 1:21

FORTY TONS of ponderous grace erupt as a southern right whale breaches amid a self-made storm of spray off Patagonia. These frames, taken in just over one second, show a whale near the peak of its leap (**right**), then on its downward course (**top and middle**), and, finally, in a thunderous reunion with the sea (**bottom**). Author Payne believes the maneuver may be a way of saying, "Here I am!" to other whales.

At Home With Right Whales

By ROGER PAYNE, Ph.D.
Photographs by
DES and JEN BARTLETT

In Patagonia a noted zoologist and his family continue research into the life of these giants of the sea

THIS PAGE FOLDS OUT

BY LATE AFTERNOON intermittent squalls had developed into a violent storm. In our research station overlooking Argentina's remote Patagonian coast we watched the wind whip the ocean before us into a maelstrom.

All seemed secure behind our concrete-block walls until I glanced out the window at the porch roof. With ominous sounds it began to part company from the house, threatening to fly off across the Patagonian desert. Shouting for help to my two colleagues, Christopher Clark and Bernd Wuersig, I dashed outside and grabbed a loosened rafter. Chris and Bernd joined me and for 20 minutes we hung on for dear life, alternately being lifted off our feet and set back on the ground as we struggled to lash the roof fast.

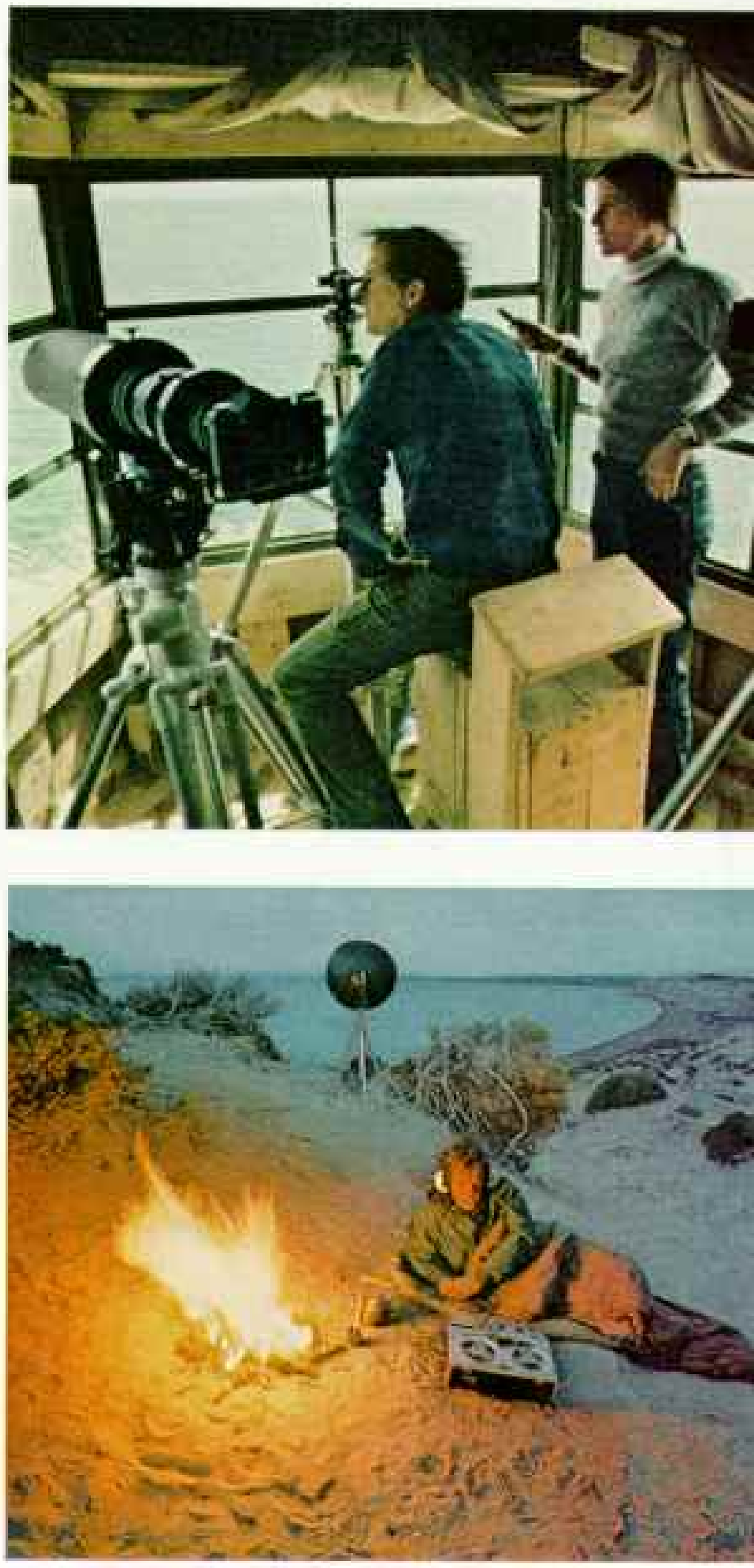
Finally we managed to run a rope from the roof to our truck and secure it. The storm abated, and we all trooped back inside.

Such are the winds of Patagonia. For five years my wife, Katy, and I have survived them. We make no claim to be winning—merely surviving. Other creatures along the coast fare considerably better. Often at the height of such blows we have seen what first appeared to be series of explosions offshore, sending up geysers of water that were bundled and hustled away by the wind.

Whales Revel in Stormy Seas

These monumental clouds of spray and foam are made by right whales breaching—leaping into the air to crash back into the sea (foldout, pages 322-324). The creatures that perform these acrobatics are so large, so aloof from the normal torment and buffetings of this world that they are, quite literally, playing with the storm. The same wind that threatens man and his works with destruction is apparently a jovial playmate, a source of boisterous entertainment, to a whale.

This spectacular combination of wild storms and wild whales occurs at Peninsula Valdés, an enormous cape enclosing two large, almost landlocked bays in Patagonia—a tableland wilderness near the southern tip of Argentina (map, page 297). In this isolated area everything—plants, animals, and landscape alike—is shaped by the fierce and unpredictable wind. To the question, "What shall we do today?" there is always the same answer: "It depends on the wind."



Shadowing a leviathan, the author's wife and an assistant skim alongside a piebald right whale calf (**foldout, left**). A one-meter-wide disk on the bow of the boat is used as a gauge in aerial photographs to measure the whale's length—in this case about 26 feet. With his wife, Katy (**top**), the author monitors whale activity from a clifftop hut above Golfo San José. Through a long night (**above**) he uses a dish antenna and battery-powered recorder to investigate whale noises and their correlation with behavior.

ROGER PAYNE (FACING PAGE)

Veteran whale-watchers, the four Payne children and their mother (**below**) have a ringside seat on the Golfo San José, where Dr. Payne (**above**) kayaks near two lolling right whales. His study, sponsored by the New York Zoological Society and the National Geographic Society, has made Patagonia a home away from home several months a year for his suburban New England family. To children on vacation from the civilized world, the rugged environment presents exciting alternatives. They have the wilds of Patagonia for their playground; whales, penguins, and flightless rheas for their playmates. "What school could offer more?" asks Dr. Payne.

ROGER PAYNE

For five years I have come to this wonderful peopleless world to observe the rare southern right whales that appear off the coast. Each winter they arrive to mate, calve, and raise their young. My interest in studying right whales stemmed from five years of research on humpback whales—particularly on their "songs," those complex and lovely chains of sounds that are repeated for hours on end in the spring.*

In the search for an ideal site to explore whales' behavior, we followed up a lead from the U.S. Antarctic Research Vessel *Hero*, and hit upon Peninsula Valdés.

It was a stroke of extraordinary luck, an event that has profoundly changed my life and that of my family. I have always taken Katy and our four children with me on major expeditions. During our first full-scale study at the peninsula in 1971, John was 9, Holly, 8, Laura, 7, and Sam, 6.

At first we all lived in tents, but later we built a primitive concrete-block building—without such luxuries as heat, lighting, or plumbing—in which to work and live. In all we have made four expeditions, generously supported by the New York Zoological Society and the National Geographic Society.

Our research has focused on southern right whale anatomy, acoustics, and population changes, as well as behavior.

Leviathans Have Colossal Birthmarks

One of the things that convinced me right whales were ideal for study is that, alone among all whales, they are adorned with series of peculiar growths called callosities (following pages and 334-5). On every right whale the number, size, shape, and placement of callosities are unique, making it possible for us—and presumably the whales too—to tell individuals apart on sight.

Callosities consist of thickened white skin, sometimes many inches deep, with a rough outer surface. The rough surface offers excellent anchorage for creatures such as whale lice, barnacles, and smaller organisms, which hitch a ride on the whale and perhaps feed on what spills from its mouth or on bits of dead skin flaking off.

The largest callosity appears as if perched on the whale's head. The old whalers called

*The author described his early research on right whales in the October 1972 NATIONAL GEOGRAPHIC. His recording, "Songs of the Humpback Whale," has delighted listeners the world over.

it the "bonnet," and indeed from some angles it does look somewhat like a 19th-century lady's headgear (above). To the old-timers this was the "right" whale to hunt because it swims slowly, has an unusually rich store of baleen, or whalebone, and floats when dead.

In our studies of callosities we discovered an interesting parallel with human beings. Callosities have scattered hairs growing from them. Curiously, right whales' facial hair grows in the same places that a human's does, and only in those places. The whales appear to have what we call mustaches, as well as eyebrows, beards, and even sideburns!

Callosities seem to serve several functions. One of them is to act as a sort of splash deflector, preventing water from entering the whale's blowhole. Other species of whales also have splash-deflecting structures, but these are usually fairings, or ridges, around the blowhole, quite different in character from the callosities of right whales.

In aggressive situations callosities may have another use. Right whales sometimes

Wraparound grin and tucked-back eyes make even more bizarre a face mottled with calluslike growths called callosities. Uniquely patterned on each right whale, the patches make visual identification easier. Central callosity on upper jaw was called the "bonnet" by whalers reminded of ladies' hats. Whale's left eye is positioned below "eyebrow" callosity, far right.

Bonnet raised, a whale surfaces with eyes just beneath the waterline (**below**), presumably enabling it to see directly ahead. In normal horizontal position, the creature may be able to see only downward and to the sides.

KATE PAYNE

rub their heads across a competitor's flank or back. Since a whale's skin is very soft, even the slightest brush from a crusty callosity could be painful.

Several of our right whales have white spots on their backs that, in addition to callosities, help us keep track of individuals. Y-Spot—or Adele, as we later called her—had a calf in 1971 and then vanished for two years. I thought she had died, but she returned in 1974 with a new calf. To us it was a wonderful reunion. It also taught us that the adult's callosity patterns are constant over long periods and that some females may breed only once every three years.

Such a low birthrate would help to explain the very slow recovery of one of the rarest whale species from two centuries or more of intensive hunting. From a population running to tens of thousands in the past, the southern right whale today numbers perhaps fewer than 1,500 individuals.

When you first see a whale, it is often the spout that attracts your attention. The spout

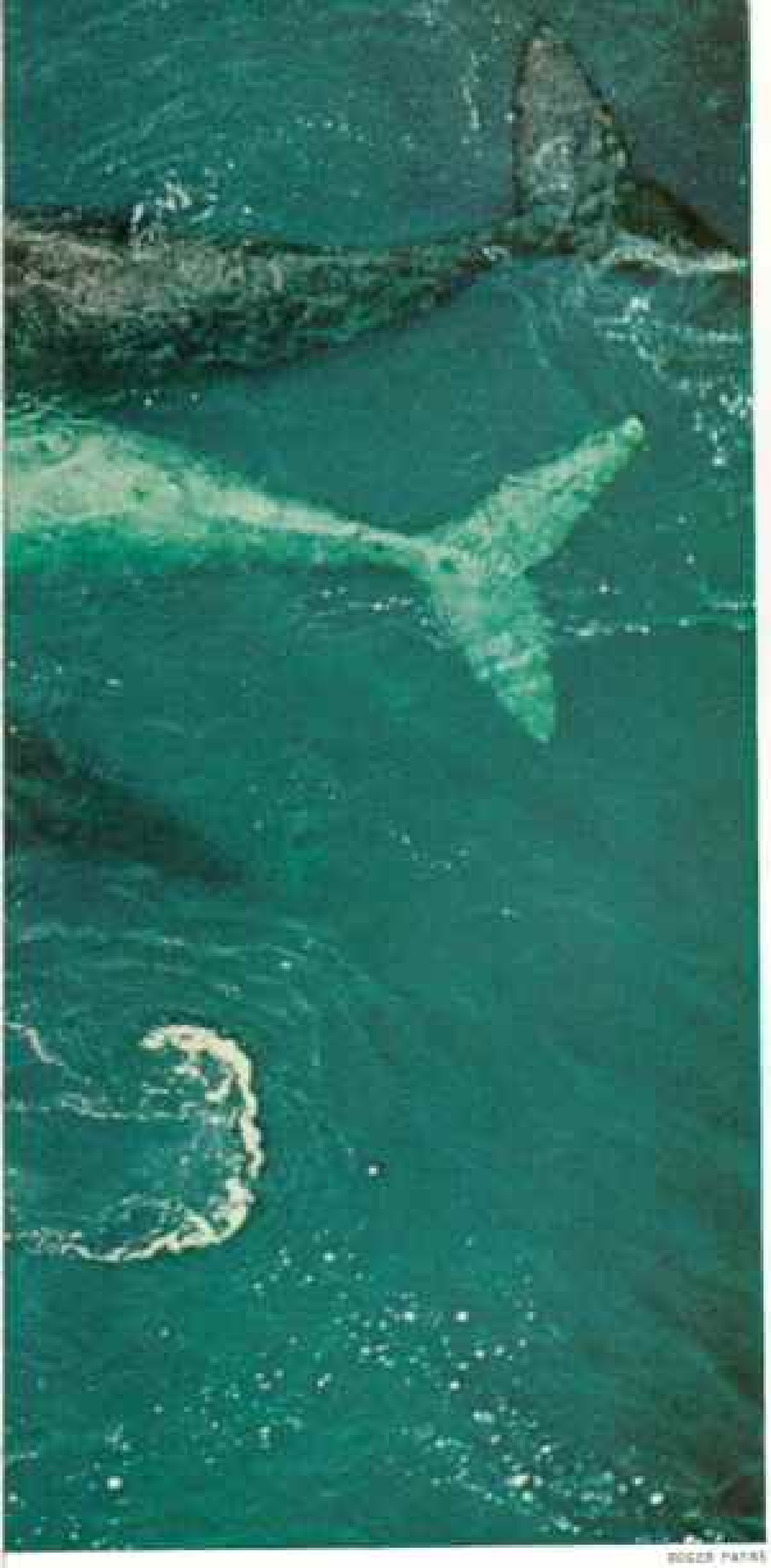
is, of course, the creature's breath. Like all mammals, whales must breathe air to survive. In the case of the right whale the spout appears as a V-shaped cloud of mist. The creature, like most other great whales, has not one but two blowholes.

Just why the whale's spout is so visible has been the subject of much speculation. Wildlife photographer Des Bartlett's remarkable slow-motion film, along with observations of our own, has helped clarify the question.

Those observations suggest that a visible spout results principally from the atomization of water surrounding the nostrils when the animal exhales sharply. We learned further that invisible spouts often alternate with visible ones in the same whale, and that many more spouts are seen on windy days than on calm ones. The reason, naturally, is that in rougher weather more waves wash over the whale's blowhole.

Breath Brings Life—and Danger

When right whales are being pursued, they often exhale underwater, thus reducing the time they must be at the surface. The advantage is twofold, since it exposes the whale for the shortest possible time and also makes for greater speed. Whales can swim much faster submerged than on the surface.



ROGER PAYNE

Flurry of suitors roils around a female right whale that floats belly up, left center, to elude their collective advances, including those of a white adolescent, at right. In this nonmonogamous society, many or all are likely to win the female's favor. Gestation period among most whales is about one year. The author believes the slow-breeding southern right whale today numbers no more than 1,500 worldwide—down from the tens of thousands that roamed as lords of the sea before man and harpoon entered the picture.

Some observers maintain that whales have halitosis. I have had many whales breathe on me at close range, but only once have I smelled fetid breath.

A whale's breath may give it life, but, alas, it also betrays the animal, often fatally. In many cases it is the spout that announces the presence of the whale to the whaler. Whenever we saw a spout at Peninsula Valdés, we too took note, but instead of trying to close in for a kill, we sat back and watched carefully, often for hours or even days at a time. Slowly, over the years, we began to learn something about the fascinating social lives of these magnificent animals.

Perhaps the most surprising yet persistent feature of life in a herd of right whales is peacefulness. Although six or more males are frequently in direct competition for the same female (left), I have never seen any squaring-off between individuals. In fact, the only behavior among right whales that can possibly be called aggressive consists of occasional mild pushing, shoving, or rubbing against one another.

Likewise, one sees little punishment of young, as with so many animals that nip, kick, or slap their obstreperous offspring. The mother whale simply endures the high jinks of an infant as if her peaceful good nature were an endless resource from which she—and the calf—can draw. I have watched many a calf boisterously playing about its resting mother for hours at a time, sliding off her flukes, wriggling up onto her back, covering her blowhole with its tail, breaching against her repeatedly, butting into her flank—all without perceptible reaction from the mother. When finally she does respond to the torment, it may be only to roll onto her back and embrace the infant in her armlike flippers, holding it until it calms down. It is hard to think of comparable equanimity among any other mammals, including man.

Children Learn in Nature's School

One of the most rewarding aspects of our work at Peninsula Valdés is the rare opportunity it has afforded our children.

The isolated life we led raised some questions among our friends and fellow parents about whether the children longed for their playmates, school, baseball, and television. Of course they occasionally missed such things, but not nearly as much as all of us

miss life at Peninsula Valdés when we are back in Massachusetts.

When our children would go out to play in the desert behind our house or on the enormous tidal flats that stretched before us, I would watch them walk until they vanished into the vast Patagonian sky. And I would not fear for their safety. They would encounter no thugs, drunk drivers, or drug pushers. They would be surrounded by the infinite variety of a million acres of virtually unpeopled coast and desert wilderness—all of it safe, all of it to be explored by them alone.

At supper the four would come home exhausted, full of stories about hunting lizards, stalking Darwin's rheas, watching eagles, or, once, about witnessing—from beginning to end—the birth of a sea lion. Their pockets would be loaded with sand dollars, fossils, bones, dead birds—we learned to greet the children on the porch—flowers, or arrowheads. Deprived? I truly believe they are the luckiest children on earth.

As a result of their experiences, they seem more impressed with what nature can do without man than by what man can do without nature. And as the depth of my children's feeling toward those who would threaten their beloved wilderness and its whales has unfolded, I am struck by the hopeful thought that maybe they and their generation will be able to achieve something that we in our generation only dream about. We relegate to dreamers thoughts of going back to nature. But the children's approach seems fresh and positive—they think in terms of going *ahead* to nature. And unless our generation has room for its children's goals, then we have no future at all.

Wily Females Avoid Suitors

I have mentioned that many male right whales compete, albeit gently, to mate with the same female. At Peninsula Valdés we found that females use several techniques to get rid of unwanted suitors. The commonest

Crusty cetacean: Found only on right whales, callosities are raised patches of rough skin, often several inches thick. The hairs on a whale's face (**left**) appear in much the same places as those on the face of a human male.

Close-up of a callosity (**right**) reveals a seemingly mountainous landscape. "Peaks" are barnacles whose sharp edges may serve to scrape the sensitive skin of a rival whale during courtship scuffles.

Photographer Des Bartlett (**middle right**) carefully plucks a whale louse (**inset**) from a right whale's lower lip. Such tiny hitchhikers may feed off flaked bits of whale skin and also off snippets of food that the whale loses in its food-straining process.

"The right whale is a very sloppy eater," says Dr. Payne. One reason may be sheer size of the vast strainer (**below**) with which the whale feeds on diminutive sea organisms. Made of parallel plates of baleen, or whalebone, that is fringed on the inside with dense hairlike fibers, the strainer mechanism catches small shrimplike krill, or brit. The whale probably scrapes the matting with its tongue to ingest the captured morsels.

To old-time whalers, this once-abundant but now-rare species known as *Eubalaena australis* was the "right" one to catch because it swims slowly, does not sink when it dies, and has a particularly rich store of baleen. The tough, flexible whalebone plates were used for such things as corset stays, umbrella ribs, clock springs, and riding crops.

is to lie belly-up at the surface, in which position the normal posture of mating—the female on an even keel at the surface with the male beneath her holding his breath—is impossible. When a female is in the belly-up posture, the males can be seen swimming around her, breathing quietly, as they wait for her to run out of air. Eventually she must roll over to breathe, and when she does so, the males quickly dive, pushing and shoving to be the first to get into proper alignment for mating.

Often one of the males will try a different strategy, holding his breath for prodigious lengths of time while lying patiently underneath the female and waiting for her to roll her belly toward him to breathe. The longest-held breath I ever timed, 25 minutes, was registered by a male doing just this.

Another trick a female employs is to go into water too shallow for males to get beneath her. Still another ploy occurs when the female hangs vertically, head down in the water, with her tail thrust high in the air. In order to align with her for mating, the male must put *his* tail in the air too. When he does that, his propeller—namely his tail—is out of water and he can't maneuver. All the female needs to do then is revolve slowly, presenting her back to the hapless suitor.

Playful Whales Use Tails for Sails

Only certain females employ this tail-in-the-air strategy. Troff, a mother we grew to know well, was extremely adept at this and did it by the hour. For a period of a couple of weeks whenever we saw a tail held aloft in the bay, we could tell by its unique outline that it was Troff.

One form of behavior among right whales looks similar to mating maneuvers but is actually a fascinating form of play. Of all the things we have so far learned, this one delights me most: Right whales appear to sail! As far as we know, they are the only marine creatures, other than some jellyfish, that use the wind for propulsion. Right whales, however, do it as a game.

When a whale sails, it usually does so alone. The tail is "set" straight up above the surface, and at right angles to the wind. Sailing is usually associated with other, more-obvious forms of play. When a whale is carried by the wind into shallow water so that its head is

Casting an eye, a whale peers inquisitively into the camera—only two feet away. A segment of the lip arches down around eye and "eyebrow" callosity. Approximately the size of an orange, a right whale's eye swivels inside its socket in much the same manner as a human eye.

Keeping tabs on her 18-foot youngster, a mother right whale gives her offspring a reassuring touch with her tail fluke—not unlike a human mother reaching back her hand to make sure junior is close behind.

WILLIAM R. CURTEMANCHE (BELOW)

bumping along the bottom, it will return upwind, circling around for another sail, like an otter going back up the bank for another slide. As the whale does this, it rollicks and galumphs along in a variety of games we have frequently observed. Sailing is done in winds of from five to thirty knots, and can go on for three or four hours.

Noisy Antics Keep Herd Together

When it comes to this sport, young whales frequently have a lot of trouble attaining the proper set of their tails. What starts as an apparent effort to sail can degenerate into a wild lobtailing session—that is, with the calf throwing its tail into the air and bringing it back down with a thunderous slap.

At other times lobtailing seems to have a definite function. As with flipper-slapping and breaching, it makes a resounding noise. Though we had looked on such behavior as playfulness, we arrived at a second explanation for the noisy surface displays after systematically recording their occurrence in the bay.

Lobtailing, we found, begets lobtailing. When one whale starts lobtailing, or flippering, or breaching, another nearby will follow suit. Thus, in the most elementary sense, the actions are a form of communication.

There is a curious correlation between an increase in wind and an increase in breaching, lobtailing, and flippering. When the wind blows really hard, there are so many right whales splashing spray and foam that it's hard to keep track of who is who.

Increased wind also brings increased wave noise underwater. In shallow bays it particularly increases low-frequency noise—the very frequencies at which whales "speak"—and thus probably drowns out their voices. It may well be that lobtailing, flippering, and

breaching permit the whales to communicate with one another and keep together as a herd, even over the noise of an all-out storm.

The whales are at Península Valdés for only a few months, roughly from July to November. As November approaches, the blooms of plankton begin to increase, and all the whales except females with newborn calves depart for the right whales' unknown feeding grounds, where the shrimplike crustaceans known as krill and other minute forms of marine life are plentiful.

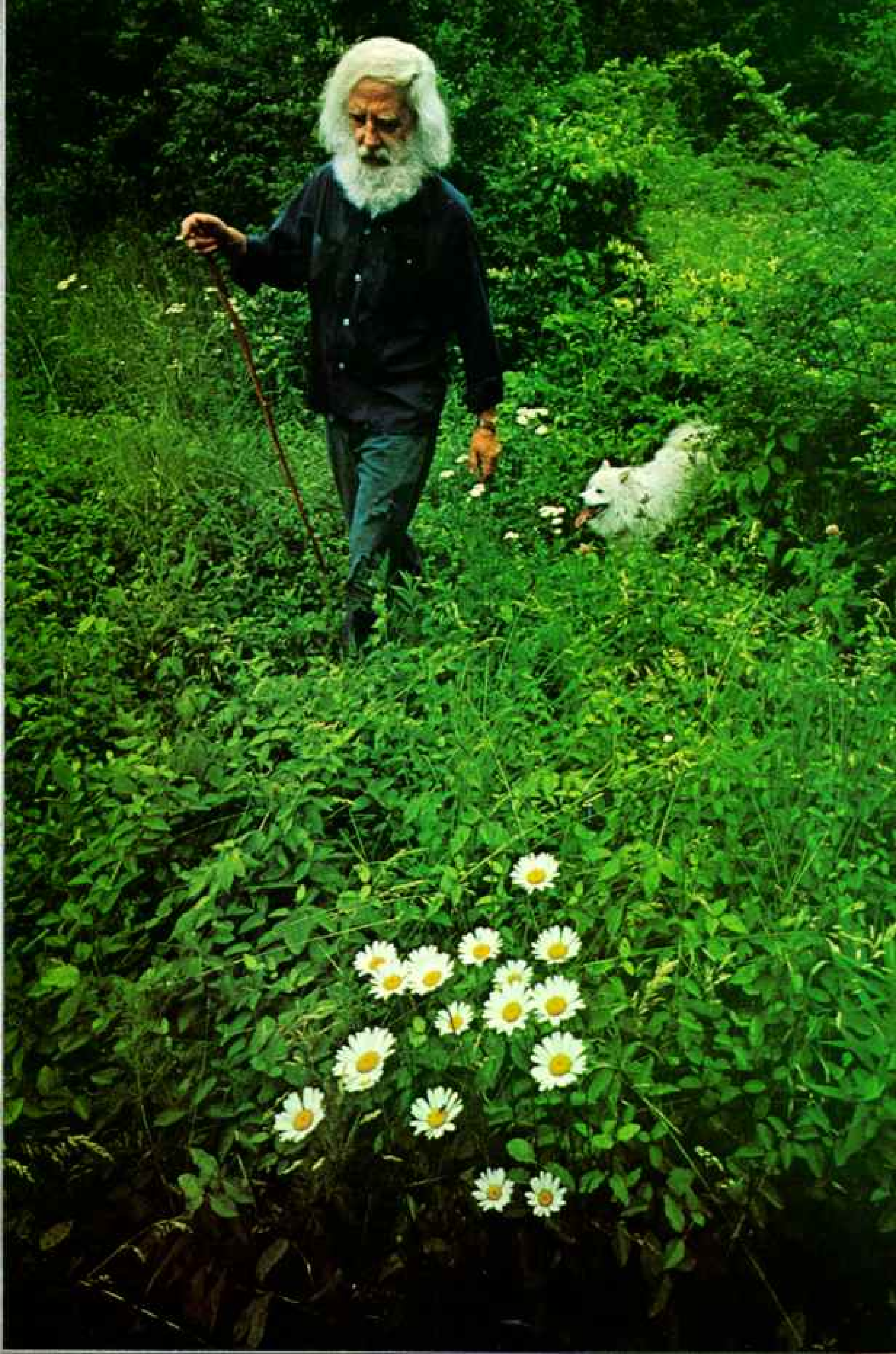
We called the following brief interlude the "time of the mothers and babies." In our five years at Valdés it was always Katy's and my favorite time, for the bond between mother and calf is one of the subtlest and most moving ties on earth.

The whaling industry viewed this bond in a different light. It was a convenience, for the mother whale will not abandon her calf, and since the calf swims slower than its mother, harpooners would aim for it first, using its agony as a way to draw the frantic mother within range.

Such vicious tactics, coupled with relentless hunting, all but eradicated southern right whales, which now are being actively protected by a growing number of nations. The band at Península Valdés may be the single largest population left on earth. This fact alone makes the area a priceless treasure for mankind. In December 1974 the provincial legislature of the Province of Chubut, where Peninsula Valdés is located, enacted a historic law for which the whole world can be grateful. It set aside forever all of Golfo San José, the northernmost of the two bays enclosed by the peninsula, as a permanent sanctuary for right whales.

May other nations be equally wise in preserving their irreplaceable resources. □

Flukes and flippers: Tail flukes some 20 feet across lift skyward (**left**) as a whale dives. Flipper (**above**) has five rows of bones, supporting scientists' belief that the whale's distant ancestor was a five-toed land animal.



Indiana's Self-reliant Uplanders

By JAMES ALEXANDER THOM

Photographs by
J. BRUCE BAUMANN
NATIONAL GEOGRAPHIC STAFF

ONE WINTER EVENING I stood on a wooded ridge in southern Indiana and watched the last orange tint of sunset dissolve into lilac-gray twilight. Not an electric light, a car, a plane anywhere. In the darkening valleys I could hear an ax biting into wood, the ring of a hammer on an anvil. It was one of those hushed moments that make a man wonder about his relation to time and place.

Most of my adult life I have lived in cities, writing about the complexities and anxieties of modern society. Now and then I need to return to these old uplands where I was born and raised, because here time seems to pause and let me think.

When I was a boy, Etta Macy, then in her eighties, used to live with other elderly Quakers in a sagging, vine-covered pioneer house on this ridge. They had almost no income, but ate well, laughed much, and needed little beyond what they grew themselves. Etta was famed for her recitations of poems; when townsfolk stopped at the farm to hear her, she would advise them:

"If thee needs anything and cannot find it, just come to me and I'll tell thee how to get along without it."

Etta found contentment in knowing that she could get by with little and take care of herself. I think this trait runs strong in many Indiana uplanders because of the kind of country this is.

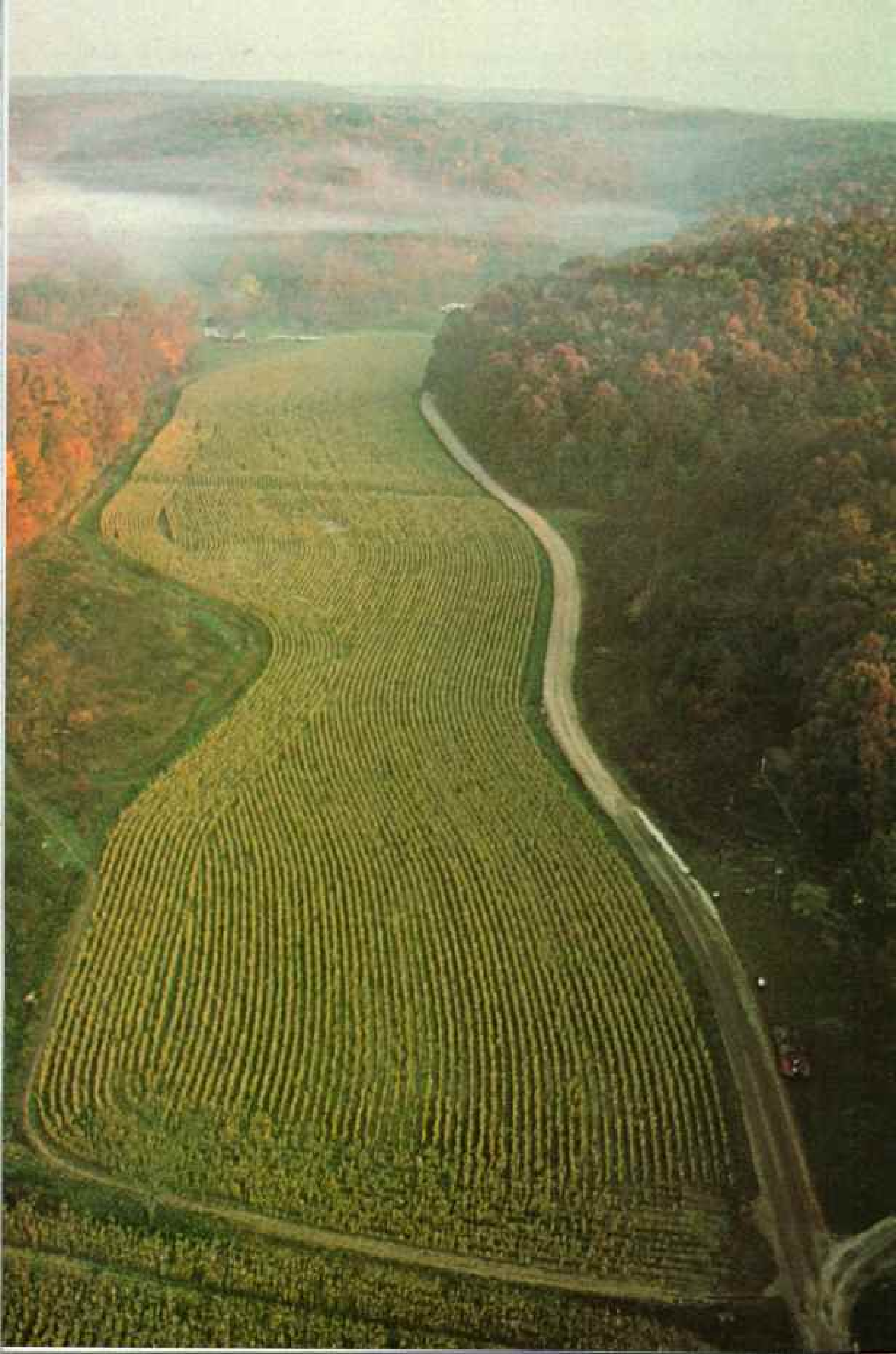
I turned up my overcoat collar and looked around. Every horizon was another long, level, deep-blue ridge. Most of Indiana, flattened and filled by Ice Age glaciers, is rich farmland. But the glaciers bypassed the uplands, leaving a spine of forested sandstone and shale hills flanking a limestone plain honeycombed with caves and sinkholes. The uplands (map, page 345) are not adapted to large-scale farming; the gun, ax, and anvil, as much as the plow, were the survival tools of settlers.

The people who began settling in the uplands about 1820 were of English, German, Scotch, and Irish blood. Many were sons or grandsons of pioneers who had first pushed westward through Cumberland Gap.* They were true frontiersmen who had learned to live by their hands and wits. They could hack

*See "The People of Cumberland Gap," by John Fetterman, NATIONAL GEOGRAPHIC, November 1971.

Knee-deep in June, Leo Coleman ranges the hilly fields near his Owen County home, searching for ginseng and other herbs that can bring more than $60 a pound. Coleman shows the spirit that brought settlers into this area in the 1800's, many of them by way of the Cumberland Gap. "I was raised on blackberries and gooseberries," he says. "I don't want a million bucks. There's absolutely no reason for a man to have more than he's going to need."

With the same attitude toward the soil, uplanders carefully husband their small plots (**overleaf**). On a misty morning, a cornfield set between hardwood hills swerves around a pocket of marsh.



out a living in deep woods and on hillsides. We know the sort of people that kind of life can forge: Abraham Lincoln lived and worked in the southern Indiana woodlands from his eighth to his twenty-second year.

THE INDIANA HILLS are part of modern America now, of course, and all of civilization's trappings are here. But many people in this region still would rather meet their basic needs as their forebears did. They don't rely much on producers and middlemen; they would rather not pay good money for work they can perform themselves. They like knowing that they could survive if our technological society failed.

When my mother, Dr. Julia Thom, retired from a career as a psychiatrist, she moved to the old Macy land. One of my brothers designed a house for her; it stands on the site of the Macy home, utilizing the old sandstone fireplace. I stay there on my visits.

About a mile below the ridge lives Estel Freeman, a descendant of early Owen County settlers. When I hailed him from the road on a spring afternoon, Mr. Freeman was riding in one of his fields, breaking clods of freshly plowed earth with a wooden frame-like contraption pulled by a pair of big draft horses (below). Fists full of reins, his slight, 78-year-old body balanced lightly on the drag, he looked like a water-skier being towed slowly across the field, absorbing the jolts with flexing knees. Since he was 12 years old, he has been working his land just this way.

"Never had any want of a tractor," he said, taking off his cap and wiping his forehead. "Folks who get started buying tractors and all, their trouble is they get too involved with money. They get to depending on it."

We talked for a long time while the horses waited, dark with sweat. I learned just how Estel Freeman feels about his horses and his tools, about crooks and honest men, about his

"I'd loan you anything but my team," says Estel Freeman of his matched Belgians, Mike

obligations to God and his fellow man, and about his two main accomplishments in life: "I've always given at least a dollar's worth of work for a dollar of pay." And, "I'll leave my land better than I found it."

Standing in the sun-drenched field with this tireless plowman, I perceived a sense of time measured not by clocks but by the rolling of the seasons.

Mr. Freeman said that he's slacking off work as he approaches 80. "Got a friend. He brags to me, 'Estel, I can still work as hard as I did fifty years ago.' I told him, 'So can I. But I don't get near as much done.'"

Chuckling, he gathered up the reins to get his horses under way. "Man stopped me one day, asked how I get such straight furrows. I said I followed Jesus' advice: Put your hand to the plow and don't look back. Gee-yup!"

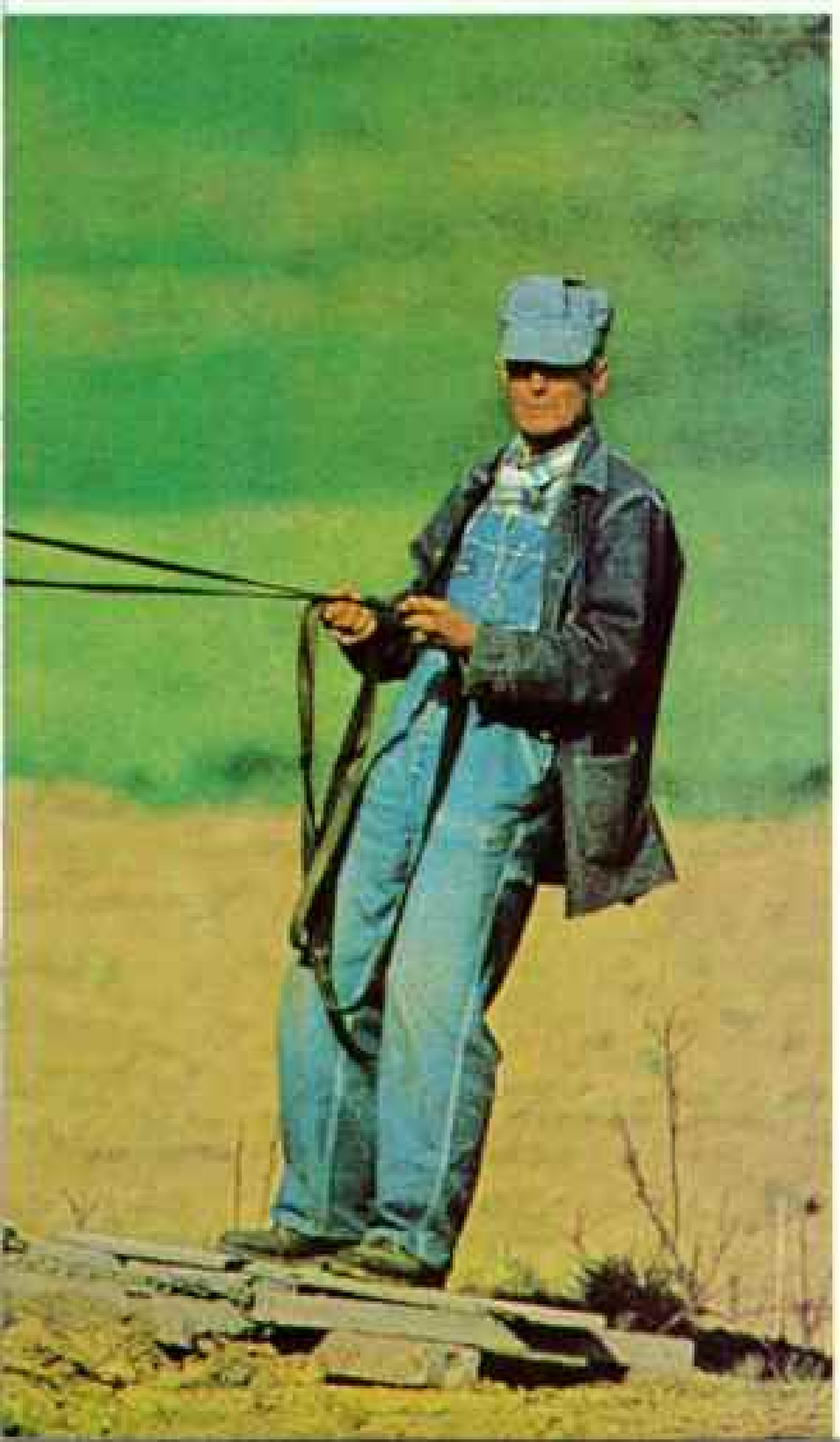
Thousands are lured to Monroe County by Indiana University, at Bloomington, and by Monroe Lake, a 10,750-acre recreational reservoir that twists through the valley of dammed-up Salt Creek (pages 348-9). But down the unpaved back roads, in the hills and hollows, native uplanders live out their long, uncomplicated lives, seldom seeing or being seen by students or vacationists.

Cora Stafford, whose great-grandparents came to southern Indiana from Kentucky early in the 1800's, is admired by people in the Little Salt Creek area for her independence. Never married, now 75, she lives in a weathered house (pages 356-7) on about 60 acres of land a few miles from the reservoir.

Cora lights her home with kerosene lamps, heats it with iron stoves, and draws water by bucket from a well. A few chickens and one guinea hen chase and fuss about. Several white-faced cows amble among the log outbuildings and graze the sloping lawn.

When I first saw her she was mending fence to keep those cows in. She came along the barbed wire, a stake in one hand, an ax in the

and John. They run on feed and affection.



other. I offered to carry the ax as we toiled uphill to the house.

"Nope. I'm usin' it for a cane."

Cora believes people would get by on less money if they mended things instead of throwing them away. "Some used to say my people were stingy. Well, they weren't stingy. But they wouldn't go buy a thing just t'be a-buyin'. Only if they'd need it."

She receives no money from the government and wants none. "Shame how folks scheme t'get money out of th' government. One feller, I told him, 'You, y'd rather have 50 cents y'd schemed for than a dollar y'd earned.' "

AMERICANS COULD ALSO LEARN from Hebert Deckard, a 65-year-old bachelor who lives near the end of a long, unpaved valley road. Heb has found that the best way to get along without worrying about money is to do for himself. He gets by on a farm of about 40 acres. He was squatting on the floor of his garage, repairing the starter of a mower, on the rainy spring day when I met him. He spoke pure southern Hoosier dialect: twangy, lively, and emphatic.

"I try t'get out a good garden. That's 'bout half of a livin', is a good garden. Fruit's about half my livin', too. I like dried apples and canned peaches." As for meat, "A man can get it all from th' woods, if he likes t'hunt." But Heb is particular about game meat. He doesn't care much for squirrel. As for venison: "Them

It took a heap of houses to make this home. Paul and Janet Elliott of Pumpkin Center trucked in a one-story log cabin and a two-story barn, then joined and shored up and finished them with parts of 11 other buildings. Snug outside and in, it is their dream realized. "We built this place for two other reasons," Paul says. "One was cost. The second: When someone walks through that door they'll feel at home." Homey details include spinning wheel and wood stove. A jukebox adds an offbeat touch.

dag-gone deers . . . they hain't no count. A feller cut me up a mess of venison last fall; I didn't like it a'tall. I told him, said, 'By gum, I wouldn't give a half-grown rabbit f'r th' whole deer.' Now, y'take rabbits, why, yes, I like 'em pretty well."

Heb saves money by heating his home with firewood. He also repairs his old tractor and car. "Now, y'take anything into a garage, they really charge ye. Do it y'self, y'save that. If y'got th' time. I got th' time."

MANY Indiana University students find these hills a living laboratory for the natural ways of doing things. In a Bloomington restaurant or coffee shop you're likely to find a dozen students gathered around William Addison, the local Pied Piper of organic farming. Fiftyish, with long hair, grizzled beard, and a dazzling white grin, Addison is a nonstop teller of outrageously funny tales and a zealous back-to-earth advocate.

About three years ago Addison started talking to a few ecology-conscious adults who believed that organic matter should be returned to the soil. They became stockholders of Scarab Compost Company, a small firm that under his management began converting large portions of Bloomington's biodegradable waste into compost.

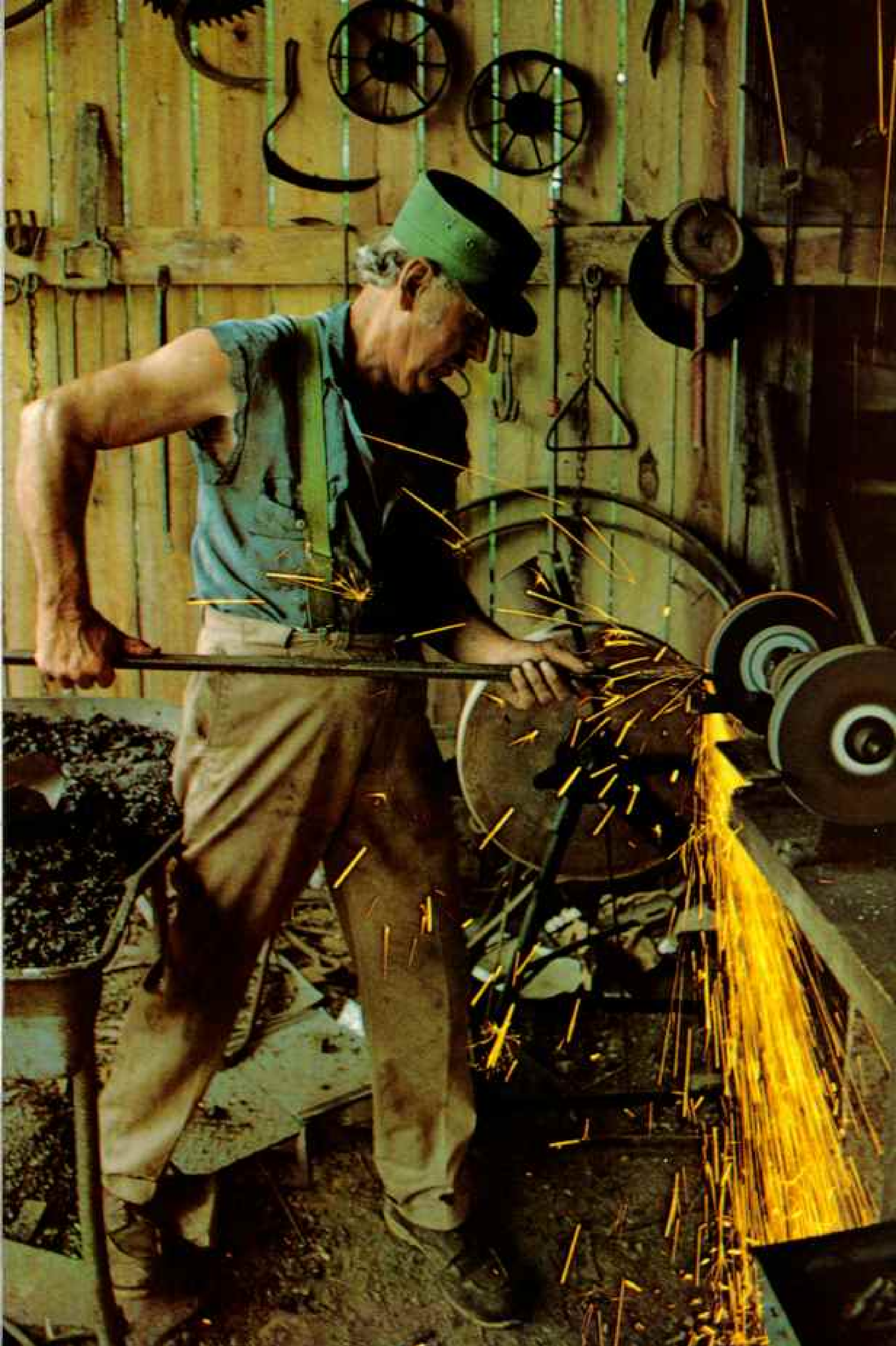
Addison maintains that compost is the world's best fertilizer. Using the city's annual accumulation of autumn leaves and virtually any other organic waste, he and a few part-time employees—sometimes including the stockholders themselves—create rich, black compost in 14 days (page 354). Mechanized piling and turning is scientifically timed. Thus, the Scarab company solves some municipal waste-disposal problems while manufacturing compost in large quantities. Other Indiana communities have sought Addison's counsel for development of similar plants.

So far only the soil is getting rich. Scarab's stockholders say that's their main concern anyway. *(Continued on page 352)*

"**And the sunshine and shadder** fell over it all." Hoosier poet James Whitcomb Riley's old swimmin' hole has been revived on a grand scale at Monroe Lake, largest in the state. Recreational facilities help expand tourism and feed the uplands' economy.

With eyes for calipers, upland craftsmen still fashion art from need. In Indiana limestone, Jake Peterson (**top**) chisels freehand pieces such as a model of A. J. Foyt's winning car in the 1967 Indianapolis 500. One of the area's last few master stone carvers, Peterson turns out stonework for buildings across the country.

Sparks splay from the grinding wheel of John Foglesong (**right**), blacksmith and collector of antique tools and engines. Come autumn, Foglesong assembles like-minded artisans for a day of talking and doing. Whisking a drawknife across split hickory, Frank Fancher shapes one of his specialties—an ax handle smooth as a baby, balanced as a fly rod, tougher than store-bought.



Indiana University and the surrounding uplands enjoy a sort of symbiotic relationship. The university, keenly interested in the region's culture, arranges for local craftsmen —weavers, toolmakers, stone carvers, and others—to teach their skills to students. And the hill country has become home to many educated young people who have decided there's no place they'd rather live. Some natives look askance at their bearded free-thinking new neighbors. But one old-timer chuckled and told me, "Now, I'll admit we could stand to have our minds opened up a bit. And them kids'll do it."

RON AND SARA NEHRIG have made their life here an adventure in self-reliance. They live in a large, snug log house they built with their own hands on three and a half acres of land. Ron, a muscular 27-year-old with an engaging grin, studied economics and political science in college. "I feel that being self-sufficient brings us closer to our basic needs," he said.

The Nehrigs grow and preserve their own vegetables, milk a cow named Blossom, and make almost everything they need, even the complicated looms upon which Sara weaves. She has mastered intricate patterns, such as a design of squares and wavy lines known as "snail trail and cat track."

Their house is not rough or primitive. Its polished floorboards gleam. Through the picture window Blossom gazes curiously into the living room. The structure is so tightly built that the Nehrigs heat the two floors with a small stove, which Ron often fuels with chunks, shavings, and sawdust out of his woodworking shop.

Ron earns most of the little money they require with his custom-built lamps and fine hardwood furniture. They tan hides, from which Sara makes shoes for herself and Ron and their 3-year-old blond daughter, Rachel (opposite). Sara's cobbling also contributes to their income.

"We've been able to get our expenses down to just about nothing," Ron said. "The largest expenditure we have is our property tax."

Brown County, bordering on Monroe County, gives most outsiders quaint impressions of Indiana's uplands. Attracted by the stunningly beautiful springs and autumns and the rustic county seat at Nashville, tourists learn of places with such names as Gnaw Bone, Beanblossom, Needmore, and Possum Trot Road.

They may find a little village called Pikes Peak, and they wonder whether their leg is being pulled when they hear how it got its name. Old-timers say a covered wagon was headed for Colorado with a sign that said "Pikes Peak or Bust." Unable to make it farther than Brown County, the pioneers just named the place Pikes Peak, and that took care of that.

Brown County lies in a picturesque section of a stream-dissected plateau called the Norman Upland. It has narrow ridges, steep slopes, and deep, forested, V-shaped valleys. In spring the profuse redbud and dogwood blossoms look like plumes of pink and white smoke among the oak and hickory trees. In autumn the foliage blazes with colors.

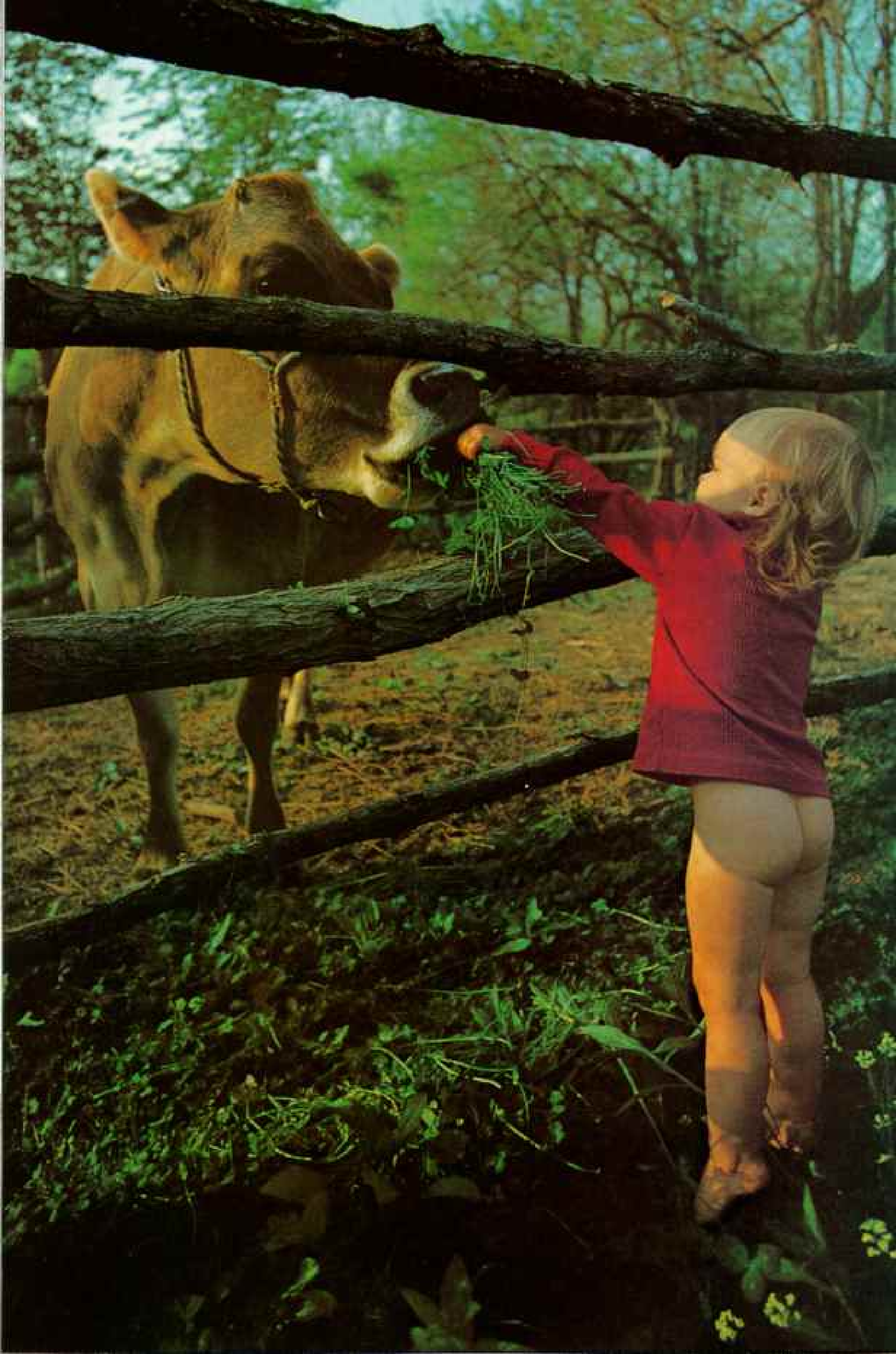
But Brown County is just one small section of the uplands. The hills extend south to the Ohio River, the southern edge of the state, and each county claims that its vistas are best.

Between the Norman Upland and a parallel formation, the Crawford Upland, is the Mitchell Plain, an area of thick limestone deposits riddled with caves, sinkholes, dry valleys, and sinking streams. In a single square mile near Orleans in Orange County, 1,022 sinkholes have been counted. About 1,400 caves have been explored in southern Indiana, the most famous being the Wyandotte, Marengo, Squire Boone, and Blue Spring caves with their miles of winding passageways and cathedral-like rooms.

Quarries in the Bloomington-Bedford area produce the famous Indiana limestone, a choice building material since the early 1800's. Many of the older men in this vicinity were quarrymen or stone-mill workers sometime in their lives.

But the advancement of concrete building techniques stole much of the market

A bouquet for Blossom repays the gifts of milk and butter to a child of nature, Rachel Nehrig. Part of a quiet trend, her college-educated parents have gone back to the basics of a self-reliant life. Says her mother, "I plant a seed and nourish myself."



from the limestone industry, and the quarries and mills gradually declined.

Twenty-five years ago my high-school friends and I used to look down into the great quarry at Romona in Owen County when it was full of shouting men and clangorous machinery, and hazy with white dust. Now it is as quiet as a canyon. The mammoth junk that was its heavy equipment is ruddy with rust. The only recent signs of man are a few spent shotgun shells and the waffelike tire tracks of cross-country motorcycles.

Jake Peterson of Spencer, a 37-year-old stone carver (page 350), believes that the secret of being independent rests in having a skill people will pay you reasonably for, and not wanting more than your earnings will buy.

Jake's limestone balusters decorate state capitols and other buildings as far away as California and the Carolinas. On big lathes in his shop he turns out balusters for the limestone companies for which he, like his father, used to work as a stonecutter.

"I do a lot, but I do it at my pace," Jake said. "What I like best is to carve me some freehand pieces." These are limestone gateposts, flower boxes, birdbaths, and other ornamental objects, many of which imitate stumps and tree trunks. Jake gets much of his inspiration from the woods.

Mechanical beetle controlled by Bill Addison overturns refuse steaming with the heat of its own decomposition. President of the Scarab Compost Company in Bloomington, Addison produces garden compost in commercial quantities at record speeds. Frequent, meticulously timed turning accelerates organic breakdown. Home-grown produce nourished on Scarab compost and canned by Bill's wife, Terry (**right**), stocks their root cellar. They store two years' food supply as a hedge against crop failure.

Bloomington, largest city in the uplands and home of Indiana University, provides a climate where intellect and practicality serve each other. Addison's composting provides good, cheap fertilizer for city residents and alleviates a municipal headache—unwanted leaves.

"It's kinda nice," he mused, "to know that work I did will still be around after I'm gone, still a-lookin' good."

Often Jake's shop is closed on nice days. Like many of the men in these parts, he goes out and fishes or hunts to put food on the dinner table.

ONE DAY before the leaves were on the trees, Rich Brault, a young hunter, fisherman, and mechanic from Hobbieville, came by to visit. His brother, a Marine on leave, was with him. Rich found that I hadn't had supper yet and asked if I liked rabbit. Very much, I replied. "I'll get you one," he said. The brothers went to their van. I thought they were going to get a rabbit out; instead, they let out a dog. With guns they disappeared into the woods.

I'd always thought rabbit hunting had to be part luck, so I began wondering what else I might fix for supper. But in minutes they returned to the house with a kitchen-ready rabbit. They had bagged and skinned it as routinely as one goes to the supermarket for a chicken.

Every Saturday morning from November through February, pickups, vans, and cars line Court House Square at Spencer, laden with pelts—muskrat, squirrel, fox, mink, raccoon.

Buyers come, stroll around, bid, and buy. No one sponsors or runs this Owen County fur market; nobody knows how it started. But it has been going on every winter Saturday morning for well over a century.

Hunting, fishing, and trapping are just a few of the many things these people do well. The jack-of-all-trades is alive and well in the hills of southern Indiana.

John Foglesong of Gypsy Hollow near Owensburg is an example. John drives a school bus. "'Course, you can't make a good living at that." But the schedule permits him to spend the best hours of his days operating his lucrative milling, timbering, and blacksmithing businesses (page 351).

He admitted that he can make or repair just about anything. "Growing up during the

Depression, I learned to make things 'cause we were poor. You just couldn't find a dollar. So we made everything we used." John designed and built a modern sawmill he can operate single-handed. At his forge he hammers out knives, cleavers, and tools of tempered steel, welds ornamental items, and restores such archaic tools as hay saws, adzes, and cradle scythes.

No newcomer, no electricity, no bills, and no nonsense. All describe Cora Stafford who, with more than 70 years on the same farm, looks to her own needs from chopping firewood to mending fences.

His most useful restorations are the half-century-old single-cylinder gasoline engines that power his grist mills, blacksmith shop, and sorghum press. Their rhythmic popping and chuffing is familiar music at Gypsy Hollow. Stone-ground cornmeal and wheat flour, sold in cotton bags, are the main supplements to his income.

John is dedicated to keeping as many farm and home crafts alive as he can. With the help of his brother, Carson, and his friend Ray Baker of Springville, John organizes informal fairs at Gypsy Hollow. These gatherings bring together the region's many weavers, gunsmiths, beekeepers, woodworkers, home canners, and various collectors, who come to show, tell, and sell.

I remember their first fair, on a clear day in 1974. John entertained on the anvil, demonstrating his skill. Old engines jiggled and banged, cornmeal sifted out of the mill, and scores of visitors prowled among the exhibits.

Ray explained why the fairs have become a labor of love: "We want people to come see how things used to be done, so they won't be forgotten. As for me personally, well, I work in computers over at Crane Naval Weapons Support Center all day. So when I get done there, well, gosh, I just need to get my hands onto something real."

ONE OF THE CRAFTSMEN John admires most is Frank Fancher of Grantsburg, who is considered to be probably the last of the old-time master handle makers. A friend and I drove down to see Frank, a lean 63-year-old. We needed to replace ax handles we had broken while cutting hardwoods for fuel.

Using a sledgehammer, steel wedges, a mallet, and a froe, Frank split a hickory log. Despite a severe limp he manhandled the heavy wood without interrupting his monologue. "When I was in the eighth grade, I would've had to walk three and a half miles to school, so I gave that up and started doing this. That was 47 years ago."

Frank roughed out the handles with an old broad-bladed hand ax. He measured only by eye and touch. Then he locked one of the pieces of hickory in a sturdy homemade rig called a shaving horse and pulled his razor-sharp drawknife toward him along the length of the piece, pausing only to study the grain of the wood. The knife hissed; long, white shavings curled and piled up at his feet. Not a motion was wasted (page 350).

"I used to shave one of these out in eight minutes," he said, "but I don't work that hard anymore."

In Frank's opinion there are three things wrong with the mass-produced ax handles normally sold in hardware stores: "They're sawed out. They're kiln-dried, and that makes them brittle so they break easy. And they cost too much."

Frank sells his handles directly to customers who come to him, eliminating the middleman's share. He has all the orders he can keep up with, and demonstrates his skill at fairs and expositions.

"I shaved handles at an arts and crafts festival down in Madison," he said. "They had a trophy. They gave it to me when we were done. An artist alongside me said, 'I sure was after that trophy, Frank.' I told him, 'Well, I didn't even know there was a trophy.' That's the way it goes, I guess. If you're working for trophies, you likely won't get 'em. If you're working for the work, maybe you will."

Our handles were finished. His knife had shaved them so smooth that no sanding was necessary. I held them together; they were within an eighth of an inch of being identical. This master craftsman charged us less than half what we would have paid for store-bought handles.

Frank rewarded his labors by hand-rolling a cigarette. I asked if he had come by his limp through a woodcutting accident. No, he said, his leg and back were bent by infantile paralysis when he was young. Suddenly I understood why he hadn't been able to walk to school 47 years ago. "A doctor looked at me not long ago," he said with a grin. "Told me he didn't see how I'd ever been able to do a day's work in my life."

LIKE GENERATIONS of southern Indiana natives, Frank has survived on his knowledge of wood. Hardwood is one of the major resources of this region, where trees cover about half of the land.

In Martin County wood proved to be the salvation a few years ago of an unusual community called Padanaram. I drove into a

His chickens his claque, David Ort fiddles in the mellow light of after-chore hours (**left**). "You have to be away from machinery to find a peaceful existence," he says, and so the Orts chose a life of no conveniences. By mid-May their organic garden has already produced a healthy crop for Cindy to harvest (**right**). A dam now being built will back a new lake to within a mile. "That's too close," says Ort, thinking of yet another spot for seclusion.

secluded valley to visit this communal village, whose buildings of logs and rough-sawn lumber, dirt streets, bearded men, sheltered women, and active children suggest those of an American pioneer town (facing page). There are no television sets.

Yet Padanaram roars with modern technology. Large diesel-powered forklifts charge around the log yard, grabbing up hardwood logs. From the tin-roofed sawmill come rumblings, rattles and thumps, the metallic whine of high-speed saws, the yells and whistles of busy men, a yellow plume of sawdust, and stacks of graded lumber.

An independent logger, waiting while his trailer rig was unloaded, shook his head in admiration and said, "It's about the cuttin'est mill I know of."

THE MILLION-DOLLAR-A-YEAR sawmill and the village it supports are the inspirations of 57-year-old Daniel Wright, who had been an itinerant preacher (below). The ideal of a self-sufficient utopian society is the motivation of Padanaram's 140 citizens, and the closest thing to a common religion. They speak fervently of their unique brotherhood and their freedom from the "inequalities" of the outside world.

"I can't imagine myself ever leaving here," said Larry Hopkins, a young carpenter, gazing over the green valley. "It's like it's God's plan."

Daniel Wright is certain that Padanaram is God's plan. In 1966, after interpreting a series of mystical visions, Daniel tried to sustain an agrarian commune here on 86 acres with 11 followers. Months of bad weather and crop failures ensued.

"Then," Daniel said, "for the first time we really *saw* the timber we had here, and we decided to build a sawmill." The mill made $4,000 in its first year. Padanaram now owns about a thousand acres of mortgage-free timberlands and fields, in which all adult males have equal shares.

The people of Padanaram have faced the hostility and suspicion of neighbors, politicians, and some newspapers critical of communal living. Some voiced alarm because the commune was adjacent to the Crane Naval Weapons Support Center.

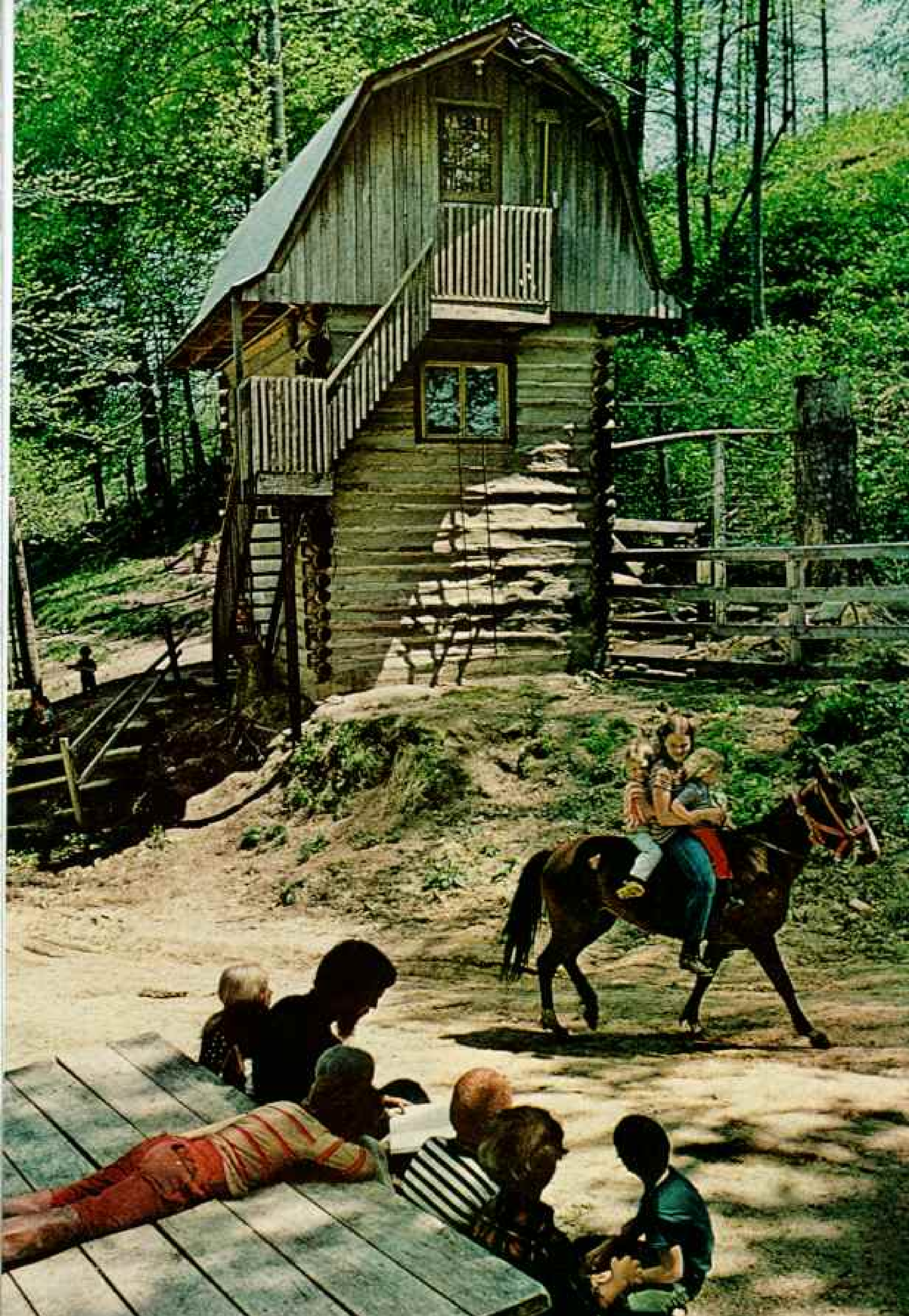
Little by little those attitudes have changed. The commune is open to visitors on Sundays and by special invitation, and the settlement is now tolerated by most and admired by many. Delinquent and homeless boys and girls sometimes are placed in the care of the commune by local authorities.

The settlement, named after a region mentioned in the Book of Genesis, is like an Old Testament patriarchy. "The men do the hard work and make the decisions here," said Daniel. "The wives serve their men, cook and wash, and bear and tend babies."

More than forty children have been born in Padanaram, usually by natural childbirth with midwives and husbands in attendance. Growing up close to nature and hard work, Padanaram youngsters might be seen quietly

Patriarch of Padanaram, a self-sufficient community he founded in 1966, Daniel Wright (**left**) nurtures the settlement of 140 people. Built on principles that blend Biblical strictures, socialism, and the utterly practical ("He that won't work won't eat"), the settlement thrives. So well, according to Wright, that "our biggest problem is getting people to stop working!"

Stacked three rooms high, the schoolhouse (**right**) looks like fun. Classes are often held outdoors, and students come and go as they wish. Says teacher Steven Fuson, "They're all active and bright because we don't try to subdue them."



Earth mother, once a suburbanite, Shirley Buehler manages a home, a hay-baling operation, and six sons, one still breast-feeding. Husband Bill farms and teaches engineering technology. Born to it or weaned to it, uplanders believe that by making do with less, they get more of what really counts.

fishing or herb-gathering, or running about with their arms extended forward, imitating a forklift.

I left Padanaram after a few days, my head full of unusual impressions, but one image, especially, sticks in my mind:

Black-bearded Tim Johnson, early in the morning of a two-shift workday, was using his few spare moments for a special project. Standing in the children's play yard, he was wielding a snarling, smoking chain saw to sculpt a hobbyhorse out of a log.

To me, this contrast of ruggedness and tenderness was the essence of Padanaram.

DWELLERS IN PADANARAM, I think, feel secure because they're part of a brotherhood of capable people. I sensed that kind of security one drizzly winter Wednesday in a valley below the country home of Ole Steffen Dahl, as I helped put fence posts and barbed wire around a livestock pond. It was strenuous work in cold, ankle-deep mud, but in good company, and our little group of fence builders finished the day with food and brandy in front of Ole's fireplace.

A Danish-born master violin maker who practices his art in a shop near Indiana University, Ole is one of a group of friends who get together on Wednesdays to pitch in on work projects that one person or another can't easily do alone. One week they might dig a root cellar, the next, harvest a field.

Besides saving money, they learn practical skills from each other, and their friendships grow. "It's a kind of insurance," said one member. "We just share the load."

The pioneers knew that the folks one can rely on are those who rely on themselves. I imagine it was reassuring, when a settler stood on a wooded ridge on a winter evening early in the last century, to hear the sounds of a gun, an ax, and an anvil, and know that such people were nearby in the wilderness—just in case they might be needed. □

"Surely the Lord is in this place" GENESIS 28:16

Canterbury Cathedral

By KENNETH MACLEISH
SENIOR ASSISTANT EDITOR

Photographs by THOMAS NEBBIA

THERE ARE ONLY A FEW of them left, sited in the old nerve centers of the Western World. Immense creations of superlative beauty and power, they combine in their form and function expressions of genius in every aspect of art. In the force of their impact upon the human mind and heart and soul, they are among the greatest of human achievements.

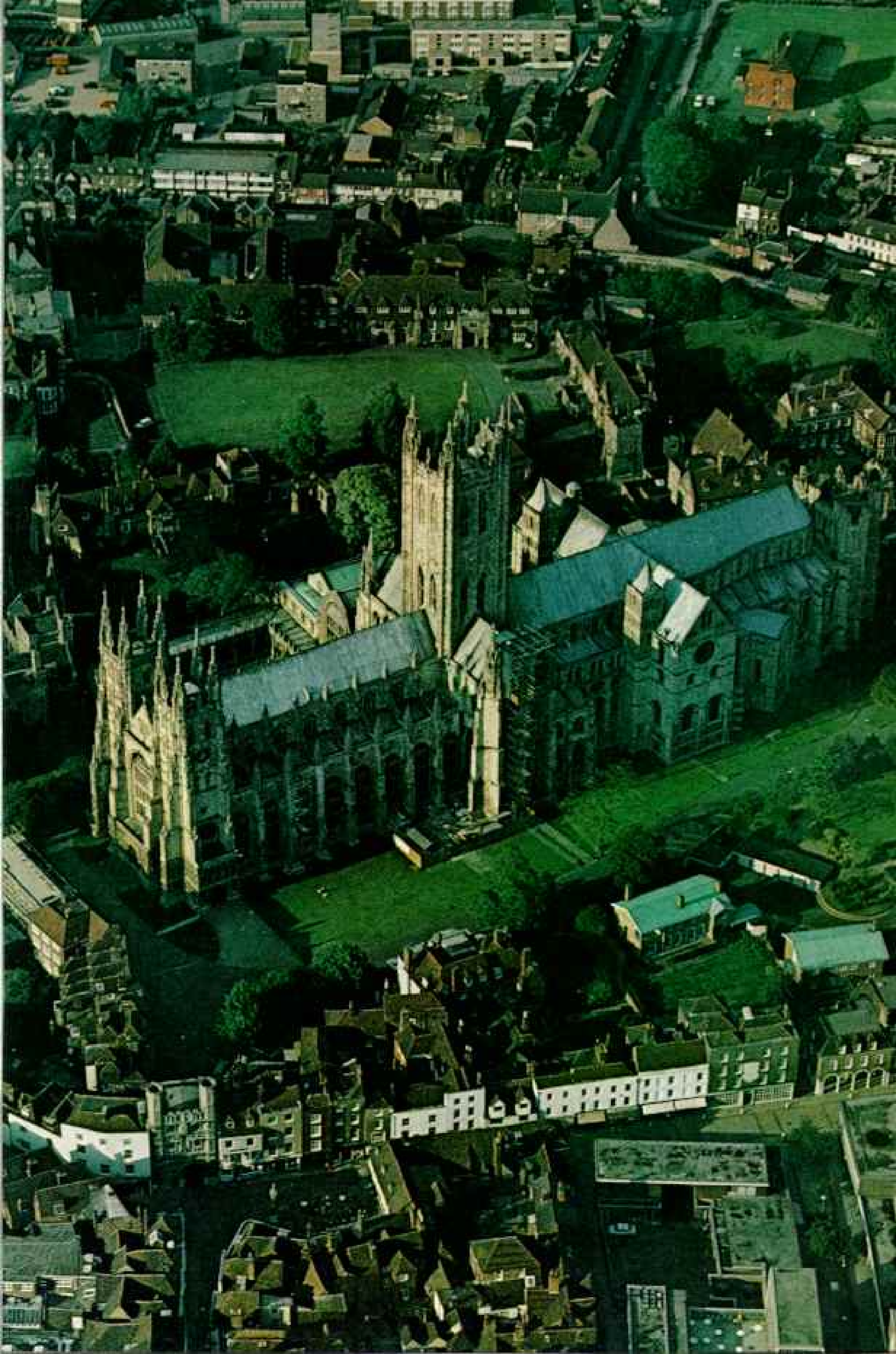
No palaces, these. A palace is made for man. Here are houses of God: cathedrals, those few renowned cathedrals that served as stages for history.

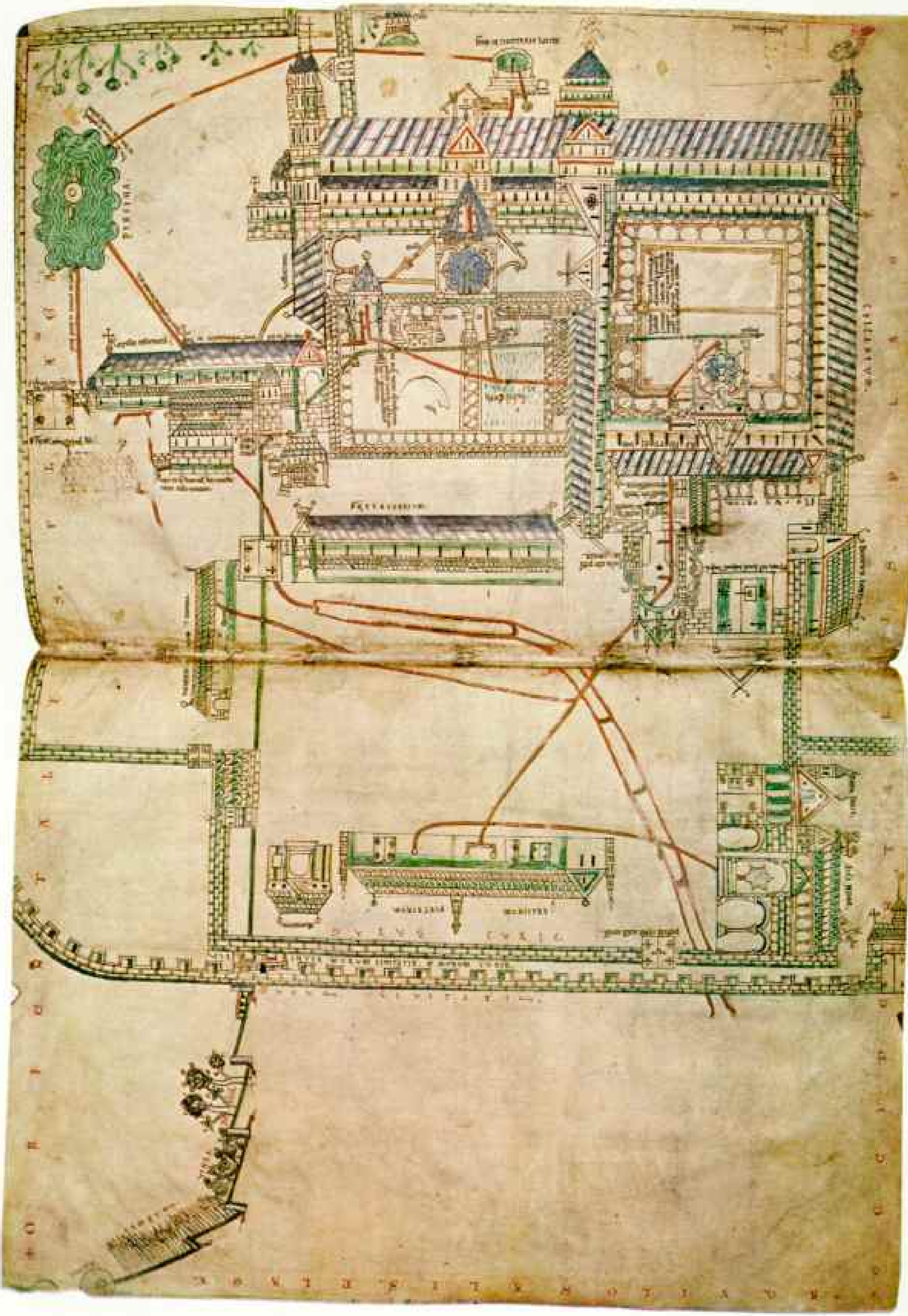
In our time some of the sacred structures have been allowed to stand derelict, quietly rotting in the face of indifference. Still, a few of these medieval miracles remain as symbols of all that is best in us.

High on this hallowed list is Canterbury Cathedral, heart of the English Church and a work of art on a staggering scale. It is there for the seeing. All we need do is look at it with a little understanding, so that we may appreciate what we are privileged to see.

I was privileged to see the Cathedral Church of

Lasting testament to the faith of its medieval builders, the Cathedral Church of Christ stands as the spired crown of Canterbury town. The cathedral remains the spiritual home of Anglican Christians all over the world.





Christ in Canterbury on many occasions and in its many moods. Massive masonry though it is, the cathedral responds to the world around it. The soft, silvery stone catches light and glows, it seems, according to its whim, joyously, majestically, awesomely. Once—just once—I saw it in its entirety from the only place to offer that entrancing view: the top of Bell Harry Tower, the "queenliest in Christendom," whose turrets rise 235 feet above the church's floor.

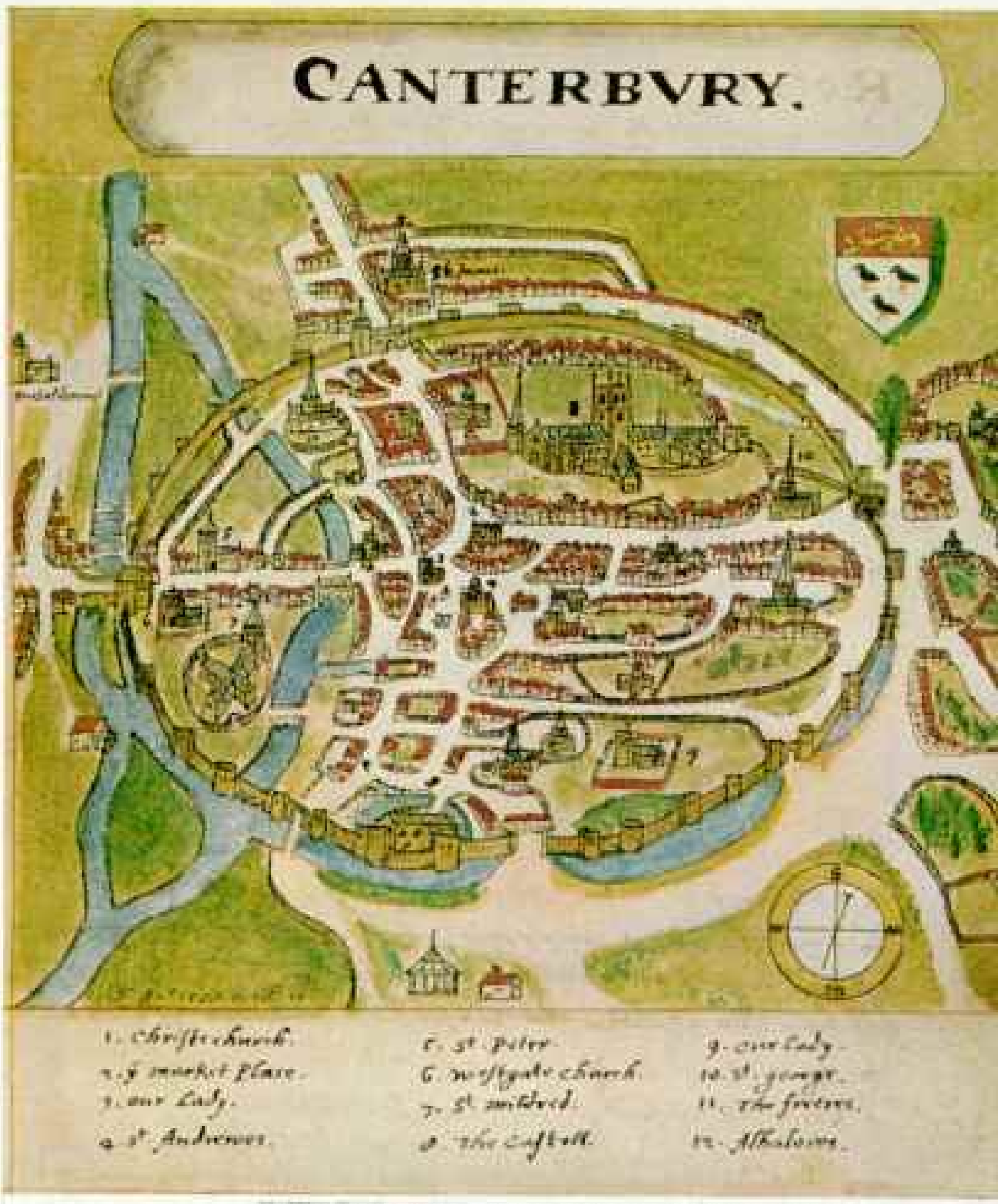
Why Bell Harry? Jim Brasier, the vesturer, explains: "On the tower's top there is a bell that rings rather a lot, and her name is Harry. That's right: *her* name. Bells are girls. No one is sure who the original Harry was."

The stone spiral by which we ascend winds within its circular shaft. Each step is a pie wedge; foot-worn, rough-faced. Before our eyes the pattern is unchanging: straight lines, curved lines, in identical array around the central column . . . a hypnotic sameness in which we wind without apparent progress through symmetrical surroundings.

Suddenly, a break. A door. We step out of our exercise in architectural efficiency into clear gray light and a wild wet wind. In the distance stretches green, gracious Kent, gently disarrayed. Below us huddle the red roofs and winding lanes of Canterbury, where the mystic soul of England took form.

Canterbury Predates Christianity

The town, part of it still walled, rests upon the ruins of a town spread upon another that overlies another still. Canterbury came into existence a few centuries before the birth of Christ for a good and simple reason—a reason we could see, if the driven clouds would let us. Here the bed of the River Stour



Christianity came to the "stronghold of the men of Kent," Cantwaraburh, in A.D. 597, when missionaries from Rome converted Ethelbert, the king of Kent. The ruler helped establish the first cathedral of Canterbury.

Ravaged twice by fire, and twice rebuilt, the cathedral and its Benedictine monastery assumed much of their present form in the 12th century, as shown in an engineer's sketch (**left**) that depicts the buildings' water system in red, brown, and green. Good sanitation due to the excellent water supply discouraged rats and thus helped the monks emerge relatively unscathed from the "Great Pestilence," or Black Death—scourge of 14th-century Europe.

In an Elizabethan drawing (**right**), the cathedral dominates a town girded by a fortified wall whose Roman foundations date from the third century.

COURTESY TRINITY COLLEGE, CAMBRIDGE (FACING PAGE) AND BRITISH LIBRARY BOARD

formed a shallow ford, the most convenient crossing whereby travelers in southern England could reach the Channel coast a few miles away. The Celtic Britons built a little fortified community beside it. Before long the Romans came, saw, and conquered it, along with the rest of England.

They stayed 400 years. They built a great road into central England from the ford of Durovernum Cantiacorum, as they called the place. And so, because of her geographical situation, Canterbury was to face every invader from across the Channel. She became an important outpost, then a king's capital, then the seat of the English Church.

And she acquired a cathedral. Not the splendid medieval edifice on whose tallest tower we now stand, but only the first of several built, destroyed, and rebuilt on this same spot. There was no such building in the neatly planned Roman town, with its straight, right-angled streets. There was none in the primitive hamlet built upon the Roman ruins by the Saxons, Jutes, and Angles who came swarming out of Germany after the legions were ordered home to shore up Rome's tottering empire.

Monks Take Over Pagan Castle

For a couple of centuries, in fact, nothing much happened to the village by the ford across the River Stour. Then, in A.D. 560, a Jutish king named Ethelbert made it his headquarters. The event was so modest that it could hardly have been heralded in the echoing halls of history by more than the toot of a flute. Yet within his reign, Durovernum Cantiacorum, rechristened in plain Anglo-Saxon Cantwaraburh—"stronghold of the men of Kent"—became the first city of English Christendom. And the badge of its primacy, the first cathedral in England, began to take form. Even Ethelbert's castle, newly built for his own use, became the residence of Roman monks.

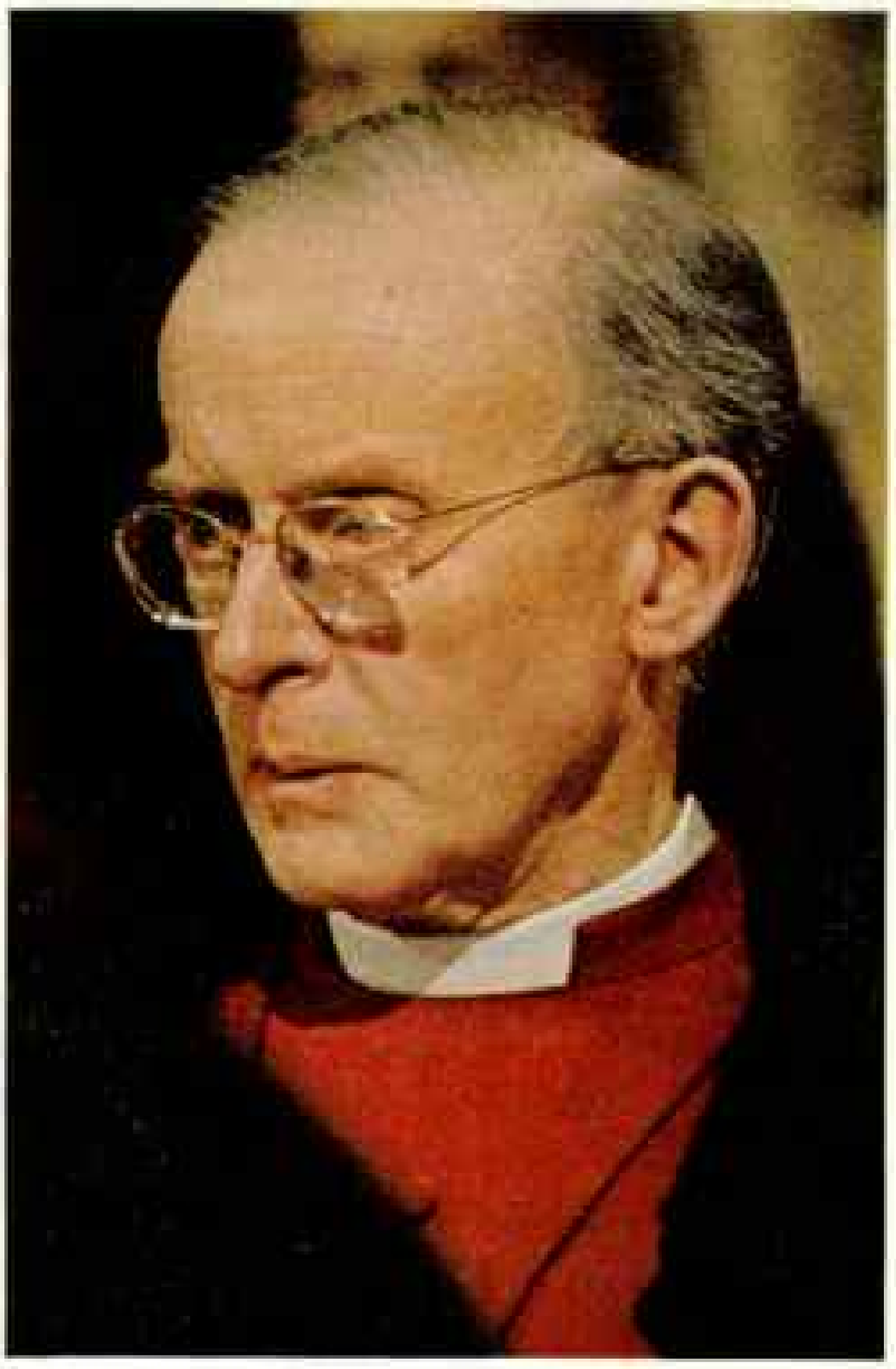
"How did monks get hold of his castle?" I asked Jim Brasier.

"Well, it was all because of a Pope's pun. Gregory, it was. Saw some beautiful, fair-haired boys up for sale at the Roman slave store. He said, 'What are those?' Someone said they were Angles. 'Not Angles, but angels,' quipped Gregory.

"He decided to send missionaries to the land of the Angles so that these angelic types would get into heaven, where they belonged. Augustine led the party. He made friends with Ethelbert, who not only got baptized, but gave Augustine land, his castle, and other buildings, and went to live elsewhere.

"Augustine and his people established their cathedral nearby. Probably right on the spot where our cathedral stands today."

Augustine did more than convert Ethelbert's gift into a church and monastery; he started an abbey outside the city walls. Christ



Solemn footfalls punctuate the close of ceremonies (**facing page**) enthroning Frederick Donald Coggan (**above**) as the one hundred and first Archbishop of Canterbury on January 24, 1975.

Among the Archbishop's predecessors, whose reigns date back nearly 1,400 years, were men who forged English history. Thomas Cranmer annulled King Henry VIII's marriage to Anne Boleyn. Stephen Langton helped win the Magna Carta from King John. Thomas Becket, who courted death by refusing to compromise with King Henry II, earned a martyr's crown.

Church was his administrative seat as Archbishop of Canterbury. The abbey was a sanctuary in which monks lived apart from the world, praying and contemplating. Within the slowly coagulating country of England, the cathedral knew no peer.

Things were looking up in Cantwaraburh. Its secular ruler, Ethelbert, had extended his control throughout the southern part of England, and its pair of ecclesiastical communities surrounded it with a double-distilled odor of sanctity. Wrote the Venerable Bede, "Happier times than these never were since the English came into Britain. . . ."

Italian Restored Church's Greatness

The hidden sun sank behind a curtain of roiling cloud. As we wound down to reenter the 20th century, it struck me that the somber scene we'd left evoked the dismal days that followed Bede's cheery declaration. Just so had troubled darkness swept over this pleasant land, bringing with it plague, corruption in Church and State, political chaos, Danish raiders and, 67 years after the millennium, the destruction by fire of Augustine's cathedral.

It was time for a new era. The new era came with William and his Norman conquerors, and with the new Archbishop of Canterbury he brought from Normandy, a brilliant Italian churchman named Lanfranc.

Lanfranc was a cleric and a lawyer. This duality of his nature brought about in England an awareness of the relationship between Church and State that has been basic to British and British-related societies to this day. Lanfranc felt that temporal affairs should be the concern of State, spiritual affairs that of the Church. Thanks to William's success at Hastings, the State was in good shape; but with the Cathedral Church of Christ in scorched ruins and the monks and brothers of abbey and cathedral at petulant odds with one another, the Church was in dismal straits.

With genuine piety, legal skill, and a certain number of well-forged documents, Lanfranc restored the first See of England to its proper level of authority and prosperity. He stitched back into the vast and varied cloak of the cathedral's real properties many segments ripped off by compulsive baronial thieves, both Saxon and Norman.

In accomplishing this he left, according to a contemporary report, nothing to chance; he renewed "all the liberties of his church and all its customs, Soca, Saca, Toll, Team, Flymenafyrmthe, Grithbrece, Foresteal, Haimfare, Infangentheof, with all other customs equal to these or inferior to these on land and water, in woods, ways, and meadows, and in all other things, within and without cities and burgs, and in all other places."

You get the picture, if not the precise meaning. The Archbishop's gale of verbiage led to the return of all church properties, and perhaps a few others besides.

Lanfranc obtained from William a precious bit of vellum, now known as the Accord of Winchester, that reaffirmed the primacy of Canterbury in the English Church—specifically over York, whose Archbishop, Thomas, signed with the grudging comment, *"Concedo"* (I concede), instead of the *"Subscripsi"* (I subscribed) of the other bishops.

And Lanfranc constructed another cathedral, the second house of God on this spot, to replace the charred and gutted ruins of Augustine's church. This the Archbishop did between 1070 and 1077.

But neither was it Lanfranc's church within whose massive walls we spiraled downward in dusty dusk. Less than seventy years after it was completed, that noble edifice stood transformed.

Its area had doubled. Its choir, particularly, had grown greatly in size and magnificence. Even the old Norman crypt was extended and heightened to give the church its most characteristic and special aspect: that of rising by broad flights of steps from nave to choir and choir to apse.

Choirboys Have Tarnished Halos

This immense renovation of the cathedral so soon after its completion says something fundamental about medieval man and his Church—something that is hard for us, living in a time when religion seems to mean so little to so many, to understand. The Church of the Middle Ages was a vital part of every person's life; the source of charity, education, and protection, and the way to an afterlife as real as life on earth. Nothing was too good—or good enough—for a monument raised to the glory of God.

Jim was rattling at another door. "Follow me," he said. "We're below the level of the

arches now. We'll go out on the walkways under the windows and see the interior from above."

He led the way out of the maelstrom of masonry and along narrow ledges from which we could see the nave, choir, and apse. Far below a white-and-purple caterpillar crept into the choir: choirboys assembling for Vespers. "Angelic little fellows, aren't they?" Jim asked, then answered himself. "Not always, they're not. Heaven knows what deviltry rests in their little hearts!"

He turned and motioned toward a low dark doorway, jingling a fistful of keys. "Almost everything that stands today is 13th century or later. But here . . ." he opened the door ". . . is one small segment of the church that remains exactly as Lanfranc built it before the end of the 11th century. A stairway he must often have used. Careful! The stone's badly worn. . . ."

Cathedral Ravaged by Blaze

We spiraled down to emerge upon the spot where, a few days after Christmas in the year 1170, murder defiled the cathedral: A murder that was to alter the balance of Church and State, and, incidentally, change the physical form of the cathedral.

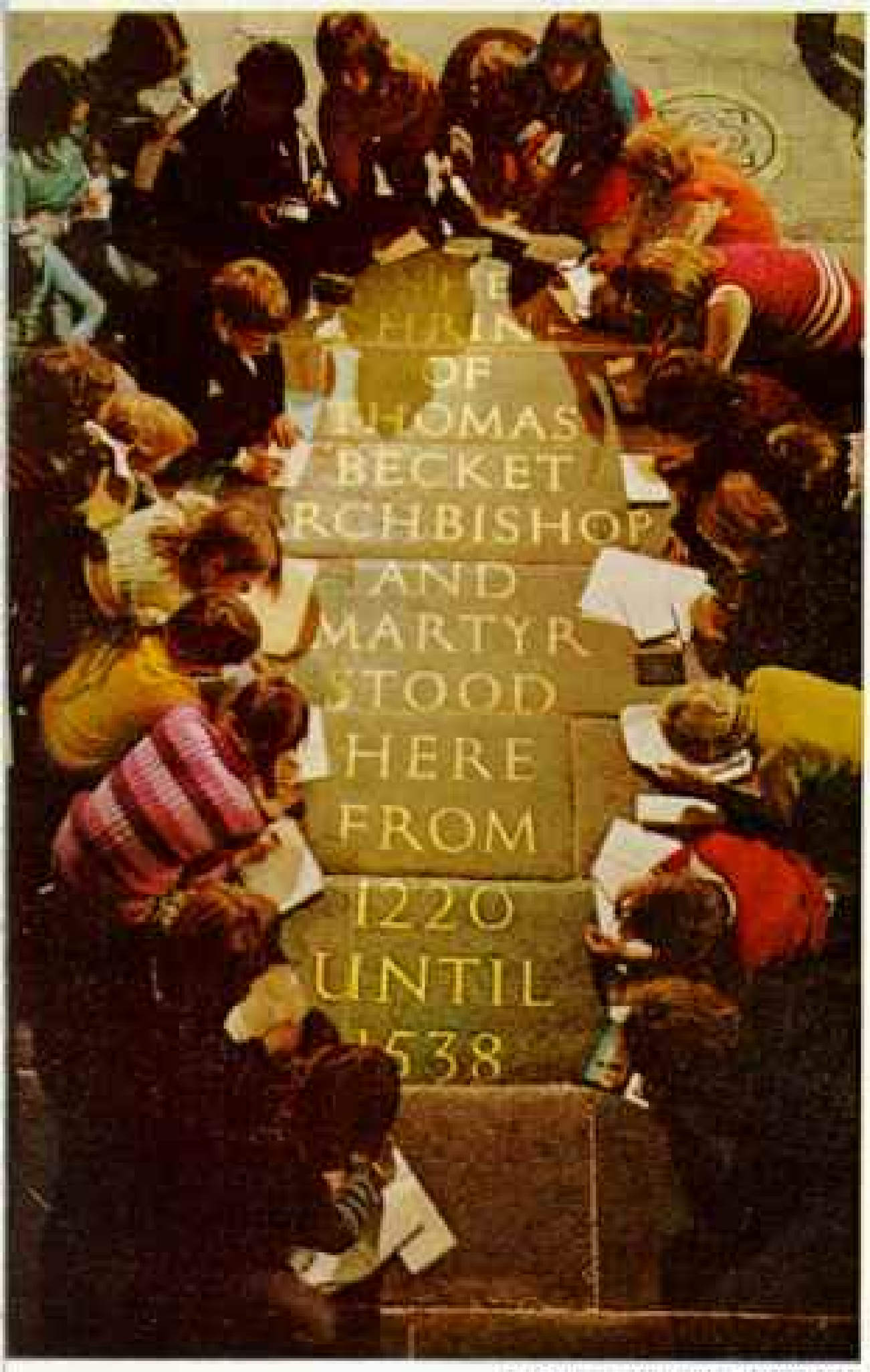
"Over there Archbishop Thomas Becket died," Jim said. "That is the very place where he fell and bled. These stairs and a few sections of wall are all that remain of the church that Thomas knew."

It's a marvel (a miracle?) that anything is left, considering the intensity of the great fire that broke out in 1174, four years after Becket's death, on just such a day of wild, autumnal winds.

The monk Gervase, an eyewitness, tells us that sparks from the burning thatches of nearby houses touched off the heavy beams beneath the cathedral's leaden roof. Within hours the "glorious choir" lay "contemptible in the ashes of the fire." The brothers held services in the unburnt nave, where they "howled rather than sang" their devotions.

The choir had to be rebuilt; a murdered Archbishop, whose soul was credited with performing miracles, had to be housed in a shrine worthy of its occupant. In a time of innocent and wholehearted belief in mysticism and even magic, relics—the best of which were the bodies or parts of the bodies

Mending time's rents, masons seal cracks in the ceiling of the Dean's Chapel (**above**). Restorers painstakingly cut clear glass (**below**) to reinforce panes in a 12th-century window. To finance the costly repairs, cathedral officials have appealed for donations of 3.5 million pounds—more than seven million dollars.



PIERPONT MORGAN LIBRARY (FACING PAGE)

And specially from every shires ende
Of Engeland to Canterbury they wende,
The hooly blisful martir for to seke. . . .

GEOFFREY CHAUCER, THE CANTERBURY TALES

Thus were pilgrims drawn in Chaucer's time, and so they are today (**above**), even though Henry VIII during the Reformation dismantled the shrine to St. Thomas Becket—the "holy blissful martyr"—and shipped it to London.

As Chancellor of England, Becket had been Henry II's loyal friend. Made Archbishop of Canterbury, he later found Henry's policies unacceptable. Becket had to choose, and he chose the Church. Four of Henry's knights murdered him in the cathedral (**facing page,** at top), December 29, 1170.

of saints—were properties that brought fame, the faithful, and, hence, money to the great religious houses.

The acquisition of Becket's body gave Canterbury, already superior in rank to other English churches, clear supremacy in sanctity as well, especially among those lusty optimists, the pilgrims of Chaucer's *Canterbury Tales.* Becket dead was worth more to his city and see than Becket alive and intemperate. A great golden shrine was planned for the mangled body, just east of the choir, and the whole form of the cathedral's eastern end was altered to make possible the most splendid presentation of this, the richest relic of them all.

Martyred Becket Loyal to God

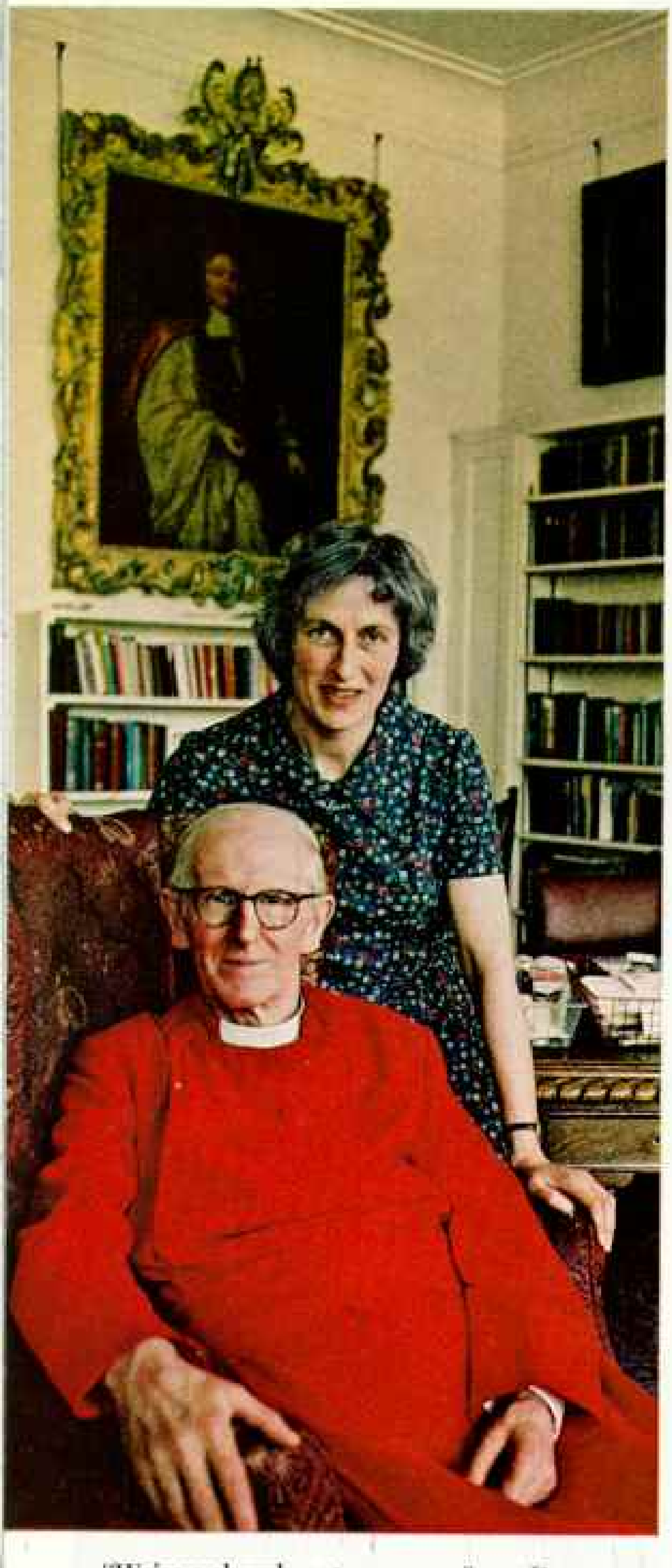
Who was Becket, before death brought him even greater honors than those he'd known in life? A London-born Norman of great wit and charm, he became the trusted friend of the temperamental Henry II, and Chancellor of England. Henry pushed Becket into the archbishopric against his will and over his stern warning. As the king's friend he was the king's man. As Archbishop he was, to a great extent, God's man—and, to some extent, his own. He dressed elegantly, but under his embroidered silk often wore coarse hair shirts or burlap tunics, dirty and louse-infested. Arrogance and humility shared Becket's soul. But he was always a fighter, and fought to defend the role and realm that had been forced on him.

Becket had to die. "Are there no caitiffs who eat at my table who will rid me of this low-born clerk?" roared Henry in a fit of Angevin pique. Four knights in his company decided that the word "caitiff" (coward) did not properly describe them, and set off to Canterbury to do the king's apparent bidding.

What happened then has made books and plays and films, and nothing of lesser scope can fully describe it. In brief:

The four killers came into Canterbury on a dank December day, picking up a few of Becket's local enemies on the way. After a tempestuous meeting with Becket in his palace they left, shouting "To arms!" A little later, Thomas and his attendants entered the cathedral for Vespers.

His companions tried to close the door, but Becket stopped them. "The Church of



"We're a church, not a museum," says Dean Ian White-Thomson, at home with his wife, Wendy. While the dean ministers to the faithful, the Archbishop, Primate of All England, lives in London and comes to Canterbury only on ceremonial occasions.

God is not to be made into a fortress," he said. The murderers came calling for Becket, "traitor to the king." And he answered his enemies, "Here am I; no traitor, but a priest of God."

The killers shuffled and clanked, for a moment subdued by the dimness of the great interior. Then, with raised swords, they crowded in upon their victim. Thomas stood firm, fearless, disdainful. "I am ready," he said. "I die for my Lord, that in my blood the Church may obtain liberty and peace."

The first stroke sliced through his scalp, but still he prayed. Three more blows, and he lay silent. One of his enemies reached down with a sword point and spilled his brains onto the stone floor, saying, "He will rise no more."

Nor did he. But Christendom did, in horror and fury. Only the lords of the Church stood between the people of Europe and the kings and barons who so often abused them. In their eyes one of the greatest of the Lord's servants had been cut down near God's altar, for protecting the Church that protected them.

Guilt Humbled Murderous King

Thomas became a martyr—in Chaucer's words the "holy blissful martyr." King Henry knelt in repentance and had himself beaten in atonement. He huddled alone by his friend's tomb in the echoing darkness of the cathedral's great crypt where powerful Norman columns stand like a forest of stone, holding the choir and apse above them higher toward heaven. Surely, in the still and haunted hours, he heard Thomas's sardonic words repeating: "A pretty saint you would give to that great bishopric," and, "You are indeed my Lord, but Almighty God is your Lord as well as mine."

No saint was Becket in his lifetime, but a saint he became, less than three years after his murder. And pilgrims, humble, noble, even royal, came to beg blessings of his bones. Hostels and almshouses sprang up in Canterbury, now become one of the most important towns in the Christian world.

Canterbury's period of greatest strength was probably that between Becket's death in 1170 (and, through his death, the acquisition of the relic of relics) and the Reformation in the 1530's, in which Henry VIII "purified" the Church by becoming its head, and drove all saints, with Thomas in the van, from the

English heavens. He had the martyr's remains burned and his images destroyed. The shrine's treasure was carried away to London in 26 wagons, and its greatest gem, the Régale de France, soon graced Henry's fat thumb.

The age of pilgrimages ended. The Abbey of Saint Augustine was dissolved, as were all others in England. The cathedral establishment, with its prior and monks, became and still is a chapter, consisting of canons to administer the see and a dean to take ultimate responsibility. The Archbishop, being Primate of All England, made a home in London (as he still does) and visited Canterbury as a guest of the dean. Having destroyed so much, Henry made one creative move: He founded the King's School, in honor of himself.

Church Stands the Test of Time

I sat enchanted through the vesper service, then joined the present dean for tea at the deanery, a warm and wonderful old mansion within the Precincts. The Very Reverend Ian White-Thomson is a tall, spare man, gentle but direct and keen.

"Our pastoral responsibility is great," he told me. "After all, we're not a museum. Our church was built for the glory of God, for His worship. It exists for that, not for the interest of tourists—who, nevertheless, we most warmly welcome. We'll go on with this living church regardless of what happens in the world, and pass it on to the next generation. Because it is God's house.

"We can't begin to take care of this vast place alone. So we've launched an appeal for three and a half million pounds [about seven million dollars]. Sounds a lot, doesn't it? But . . ." he ran long fingers through thinning gray hair ". . . well, I'm just thinking of hearing an American woman say: 'When I came into the cathedral, I felt as if I'd died and gone to heaven.' And, you know, if only a few can feel that way, then everything that has been done or ever will be done here is justified.

"Why did people build this cathedral, and the one before that? For God. Time was no object. Money was no object. It was 'Let's do the best we can.' And it's in the stone. The stone speaks."

That eloquent man! I didn't hear his charming wife, Wendy, come in with tea and cakes. She, unassuming, did not interrupt. The dean leaned back and spoke softly:

"In the sanctuary today, as I turned toward the congregation, I caught a glimpse of the lovely clock that hangs on the north side of the cathedral. You've seen it? I looked at it through the stone screen that encloses the choir. The pendulum was swinging, ticking, ticking away the seconds of my life—and indeed of everyone else's life. Time against the timelessness of the immutable stone. We move on. The church stands."

It stands, and will continue to stand, even though the stone and glass of its fabric are not literally immutable. They seem so to the human mind, and thus give great comfort. Cathedrals are built for the centuries, but centuries can melt the most massive masonry.

Said Peter Marsh, the cathedral architect and Surveyor to the Fabric: "A building like this can be made immortal by the constant replacement of its worn-out parts. Some might argue that if you replace everything, you have a new building. But that's false reasoning. This maintenance is a continuing process, as is the replacement of cells in the human body. A man's skin restores itself, but that doesn't make him a new man."

Craftsmen Preserve Ageless Structure

I went out of town to see Brian Le Mar at the Cathedral Restoration Centre, where replacement stones are shaped.

"We're working on the southwest transcept's gable end just now," he told us. "It's pretty far gone. If we let it alone, it would eventually collapse. You've seen the scaffolding covering its great windows? We go up and take measurements, from which we produce drawings, from which in turn we shape zinc templates to guide our stonecutters.

"It'll take a year to work the stones, one and a half to set them. Before we do that, all the glass must come out for safekeeping."

In the dust-whitened shop half a dozen apprentices, as long-haired as their medieval forerunners, cut up five-ton blocks of limestone with an electric saw, worked the pieces into shape with power tools, and finished the elaborate sections with mallet and chisel.

"When this gable end is in place," Brian said, "it *will* look different from the old one. It'll look the way the old one did when it was new. The way it was supposed to look."

Glass, too, needs special care, particularly when it's as old as Canterbury's. Many of the

Graceful Norman columns arch into the ceiling of the cathedral's crypt (**above**), where Dean White-Thomson, flanked by attending priests, celebrates the Eucharist. During the 16th century the crypt was reserved for worship by Huguenots who were fleeing religious persecution in France.

A bronze effigy (**right**) in Trinity Chapel covers the tomb of Edward, Prince of Wales. Because he is said to have worn black armor, he is known as the "Black Prince," but the name was not applied until nearly 200 years after his death in 1376.

This daring commander gained fame during the Hundred Years' War for his adroit use of longbowmen against mounted French knights at the Battles of Crécy and Poitiers. Yet he showed a grim side of chivalry at the conquest of Limoges. There the citizens knelt before him to beg for mercy, but Edward was "so enflamed with yre that he toke no hede to theym . . . mo than thre thousande men, women, and chyldren were slayne and beheeded that day. . . ."

windows are gone, victims of that ugliest of human emotions—fanatic zeal. But a treasury of great panels remains today, most of them dating from the 12th and 13th centuries. Frederick Cole has charge of these masterpieces and sees to their well-being in a studio in the Precincts.

"We got through the war without damage," he said. "The windows were stored in the crypt, and despite bomb damage to buildings very near the cathedral, the church never took a direct hit. Almost miraculous, isn't it?

"But time—time and weather—there's something else. Glass does corrode. The air is polluted by fumes from industries, and moisture, too, is a factor. The ironic thing is that stained glass is most beautiful while decomposing, while being destroyed. The corrosion roughens the surface and scatters the light so that each bit glows.

"People ask us why we can't make as good glass as was made in the Middle Ages. We can. But we can't make age."

Cathedral Doubles as School Chapel

He pointed out a priceless segment from the west window depicting Adam, driven from Eden, working the soil.

"This is almost worn through in places. We must strengthen and protect it. One way to do that is to make a mold of each segment and cast a matching piece of clear glass to reinforce it. We're experimenting with resins and plastics. We could even seal old glass into sandwiches of new glass to protect them against chemicals and sudden temperature changes. We could, if we could get enough money. Once, no price would have been too high. But now?"

The Precincts, the walled world of the cathedral, contains several domains other than those of master curators like Mr. Cole. The King's School, with its 50 King's Scholars and 650 Commoners, is the largest and liveliest of these. No petrified forest of academe, the place combines a physical mellowness of antiquity with the freshness of skeptical but searching young minds. I shared meals with the boys in their dining halls, where incredible amounts of conversation and consumption occurred simultaneously in lunch "hours" that lasted only minutes.

"People ask if we're a church school—if we prepare boys for ecclesiastical careers," said

Canon J. P. Newell, the headmaster. "We don't. Our boys needn't be Anglicans, or Christians for that matter. Still, we care about religion, and we use our chapel (a rather grand one—the cathedral) often."

A line from a new boy's first letter home gives an idea of the student's-eye view of the school-cathedral relationship: "There is a cathedral in the school grounds."

Bell Ringing Is Risky Business

Quiet is the rule in the cathedral and its grounds, but that rule is spectacularly broken at intervals by the church's own voice, the brassy clangor of bells calling out across the rich and gentle countryside. The bells may celebrate a wedding, a coming-of-age, a political event, or a wartime victory. But in general, they tell of churchly things.

I climbed in darkness up to the ringing chamber in the southwest tower one night when the band had gathered for practice. I recalled an ancient warning addressed to prospective bell ringers: "All you that do intend to ring, you undertake a dangerous thing." Why dangerous? A band member explained succinctly: "If you're not careful, instead of ringing a bell, the bell may ring you."

I could see why; the bell ropes come down in a circle from the sealed-off bell loft above, each through a reinforced hole. As the bells, which rest upside down, are swung into an almost complete circle around their axis, the rope lets down a bit, then rushes up. He who holds tight at that moment is slammed headfirst into the ceiling.

The ringers devoted a few preliminary cacophonous moments to getting all 12 bells

Showing its age, a doorway leans with the rest of a 17th-century timber building in Canterbury. Now a supply store for the King's School founded by Henry VIII, the building was erected in 1612 by Sir John Boys, a gentleman of Canterbury.

sounding in sequence, then began to practice that traditional English art, the ringing of changes. Nothing in campanology (bell ringing) is more complex. Grossly oversimplified, ringing changes means altering, according to fixed pattern, the order in which the bells are rung. This is done by "rope-sight," wherein each ringer watches the rope of the bell *his* bell is to follow, and pulls his rope accordingly. To give you an idea of the campanologist's problems, before fleeing from the mind-bending subject: Twelve bells can be rung 479,001,600 different ways.

But the results of these efforts are defined in wondrous words. One "double," played on five bells, is called "Superlative Surprise Major." Who could resist that? And consider the black humor of the miserably married man who ordered at his death "a grand Bob Major and merry mirthful peals" to celebrate his escape from marital strife!

Canterbury does not end at the Precincts wall. Nor does anyone in that enchanted world wish it did. As its civic officials rightly insist, Canterbury town would be there anyway. Its location on what is still a major route from Europe to central England would assure that.

Modern Pilgrims Flock to Canterbury

But Canterbury was and is a pilgrim town. Its two-and-a-half-million annual visitors are pilgrims of a sort. Like their predecessors of Chaucer's day they pray in the cathedral, buy souvenirs in the shops, and explore the winding ways. I followed this time-honored pattern with Frank Higenbottam, a gentle, warmhearted man, full of wit and wisdom, who had just retired from 35 years as chief of the city library.

We wandered around West Gate, a twin-towered entry through the western wall of the town where buses came in with millimeters to spare. Near there the River Stour splits in two to flow around and through the town, and peaceful old buildings of hand-knapped flint stand along its banks.

The overhanging houses seem too picturesquely timbered and plastered to be real, but they are as real as they were when Charles Dickens saw and wrote of them, and they were old then. Some were homes of Walloons and Huguenots who brought weaving to the city in the 16th and 17th centuries, when they sought sanctuary from religious persecution in their own countries. Outside the walls modest little Saint Martin's broods away the centuries among gnarled yew trees; the least pretentious and, at some 1,400 years, probably the oldest church in all England.

Cathedral Casts a Special Spell

Frank drove to his snug home on the edge of town. Furniture bulked large and cushiony in the little rooms, but the place held a sense of serenity as dwellings of kind and happy folk often do. His wife, Phyll, made beautiful sandwiches and put me at ease with her selfless good nature. Frank proudly displayed his new study, built out back, full of books and windows and pleasant pipe smells.

"I'm well set up here," he said. "Quiet. No comings and goings. Down across the meadow there is the Stour, where we bathe in the summer and fish too. Oh my, yes. Big sea trout come up here. And if I'm lonely I've only got to go down to the corner. That's my pub there, and there'll be a few of the old boys for a pint or a game or a natter. Or all three. You know, really, a man can't ask for much more, can he?"

No, he can't. At a certain time in any human being's life, serenity becomes the most precious of conditions. And, just as Frank's cozy home gives him that priceless satisfaction of spirit, so does Christ Church bestow its special blessing on those who come to it in sadness or despair.

The cathedral is old and worn, some of its once-glorious windows now blind and gray. It is imperfect, for the mind of man, whose creative genius brought it into being, is imperfect. But it is all the more lovable for that. It is not soul-chilling in superhuman size and symmetry, but warm, attempting the best of beauty. It is forever a medieval cathedral. And the medieval cathedral is the greatest communal work of art that ever existed, because it is the most inspired.

Canterbury Cathedral was made and remade to the glory of God by inspired men. The old rain-melted walls still stand in their miraculous configuration, a heart-lifting song in stone for those who will listen—who try to hear. Those who do come swiftly and with an intensity that is overwhelming to the soul-stirring realization that God hears too—that "Surely the Lord is in this place." □

Solar Energy, the Ultimate Powerhouse

By JOHN L. WILHELM

Photographs by EMORY KRISTOF

NATIONAL GEOGRAPHIC PHOTOGRAPHER

The heat of the universe is produced by the sun.
—LEONARDO DA VINCI

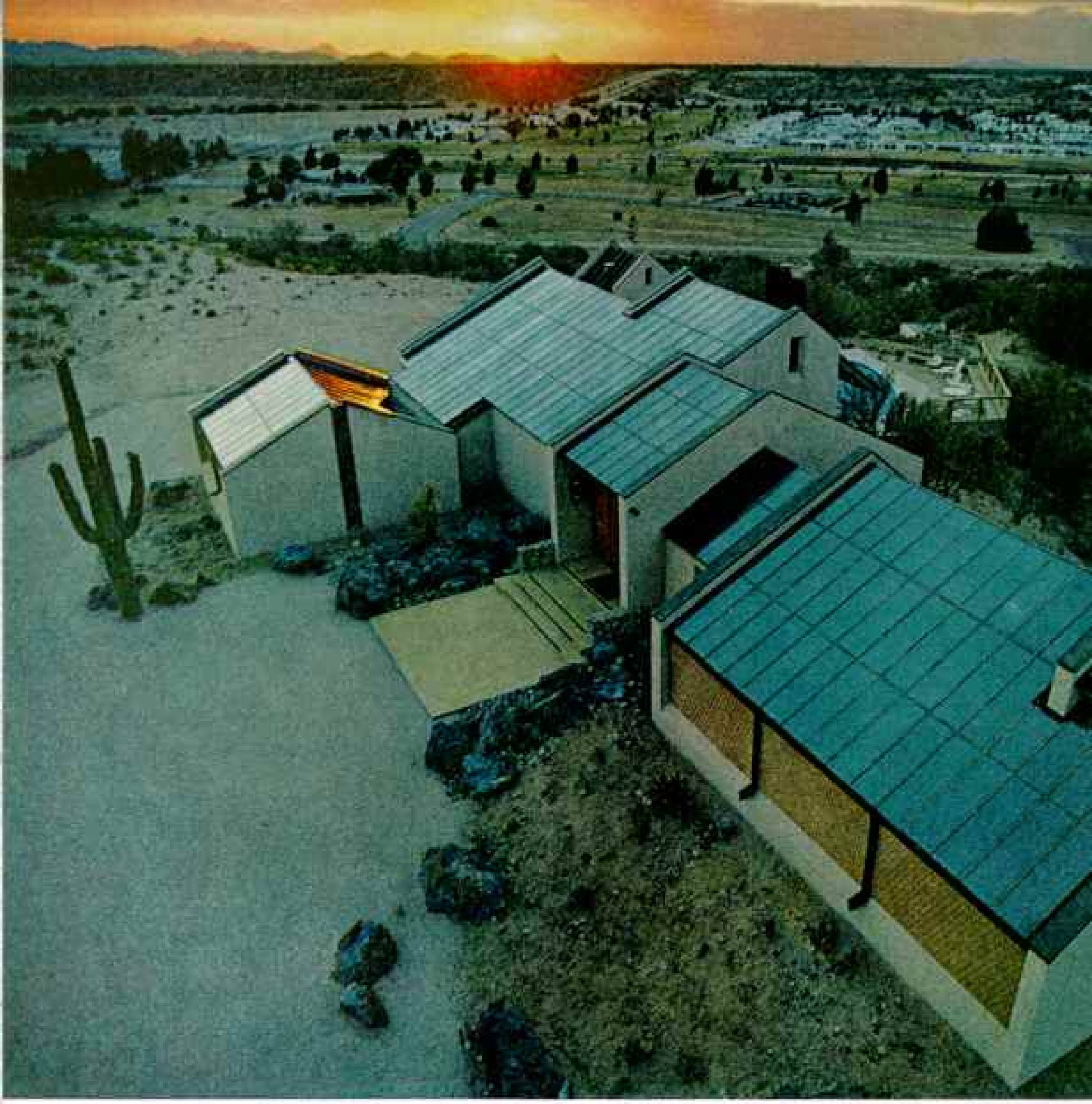
"DADDY, IT'S SO HOT," cries my 4-year-old son, snapping his hand back from the small magnifying glass. He has grown impatient with burning holes in dead leaves by focusing rays of the sun through the magnifier. Brushing warnings aside, he tries concentrating the miniature beam directly onto his hand. Immediately he learns the essence of Leonardo's dictum.

This experiment should be mandatory in every classroom in the country, insists Dr. A. I. Mlavsky, executive vice-president of the Mobil Tyco Solar Energy Corporation near Boston. Dr. Mlavsky urgently believes that people must become aware of the sun's enormous potential to help solve the threatened energy shortage.

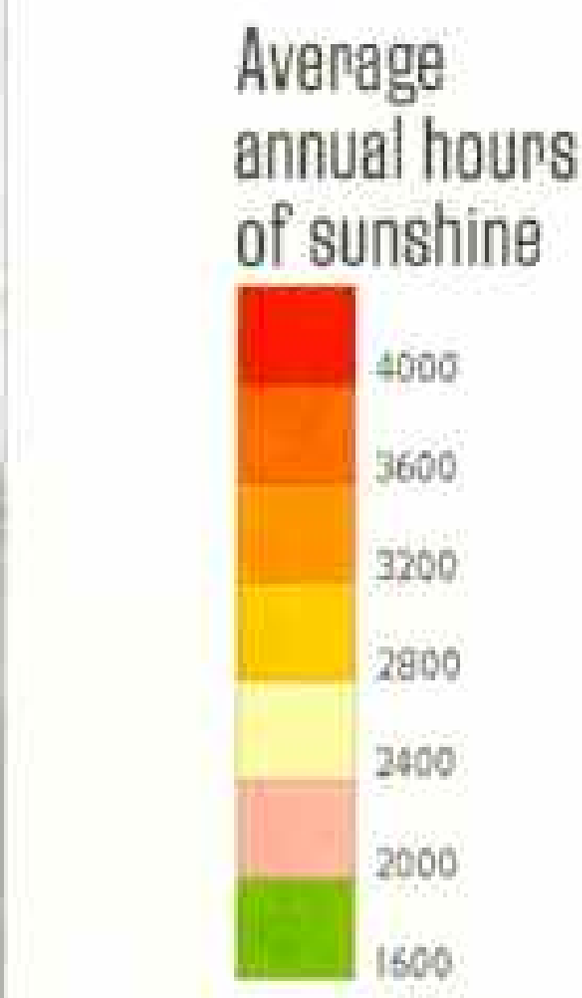
"If we want to have solar energy in our society by the year 2000, we've got to teach energy technology, energy economics, energy management—and we've got to begin today; otherwise we'll never have a solar revolution."

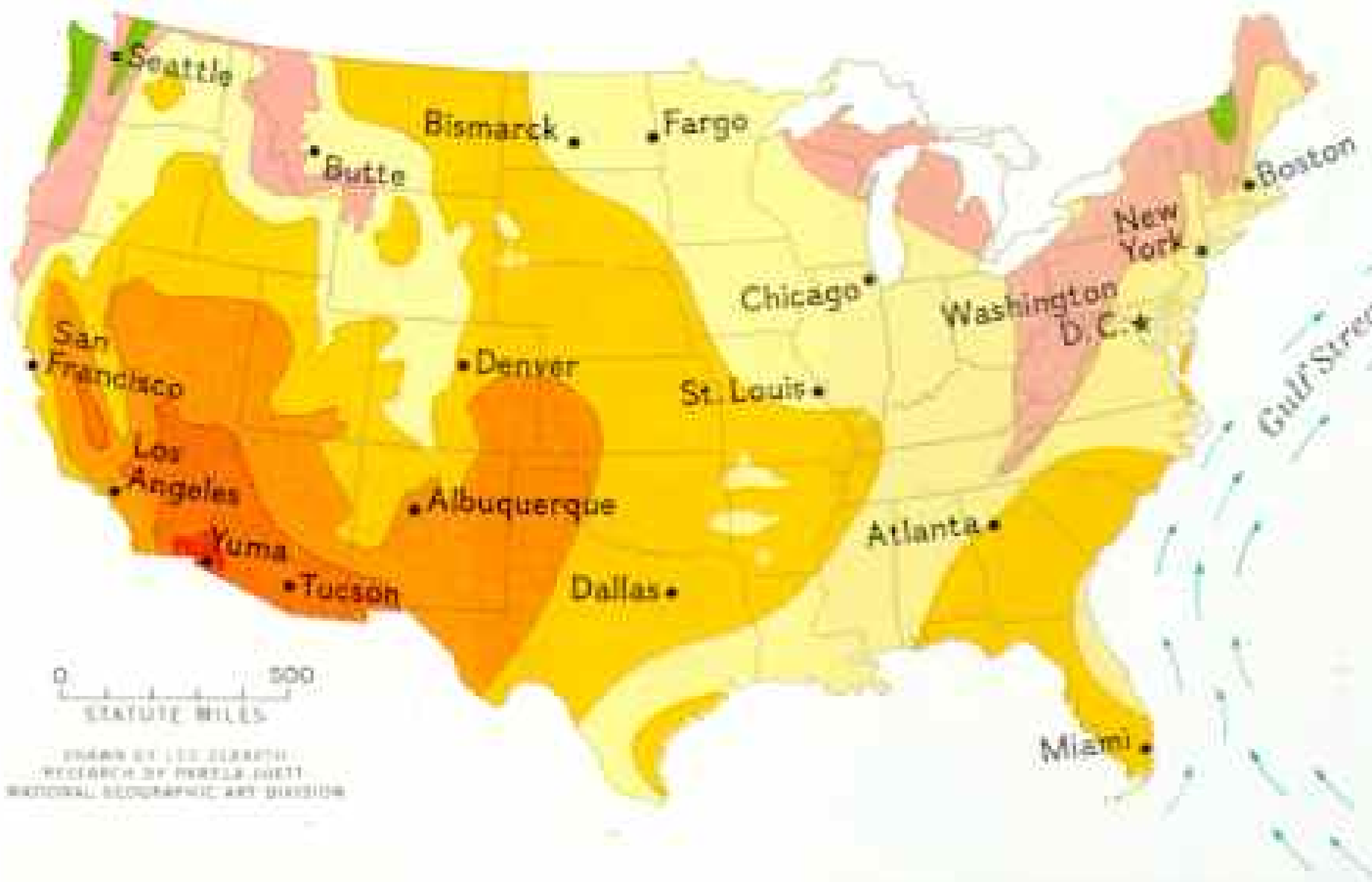
Since the legendary Prometheus first stole the fire of heaven, virtually all energy consumed by man has been fathered by the sun. Coal, oil, and gas are residues of plants and animals once fired to life by the warm rays of our nearest star. Solar heat also drives the earth's rain cycle, powering modern hydroelectric generators. Windmills that pump water or produce electricity *(Continued on page 385)*

Lighting a lamp against a dark tomorrow, a "power tower" taps the earth's first, last, and cleanest energy source: the sun. In this prototype near Genoa, Italy, mirrors focus sunlight into a receiver, glowing like a streetlight, where water is vaporized into 1,022° F. steam—powerful enough to drive a generator.



Average annual hours of sunshine

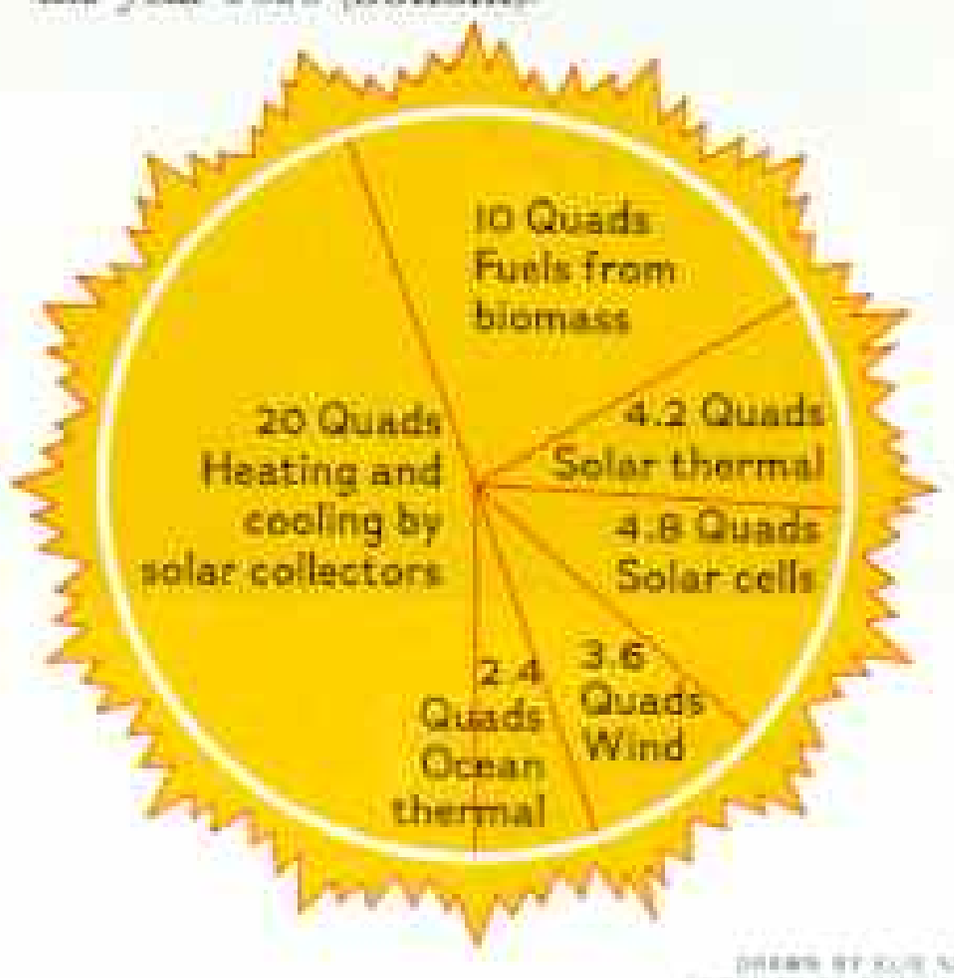




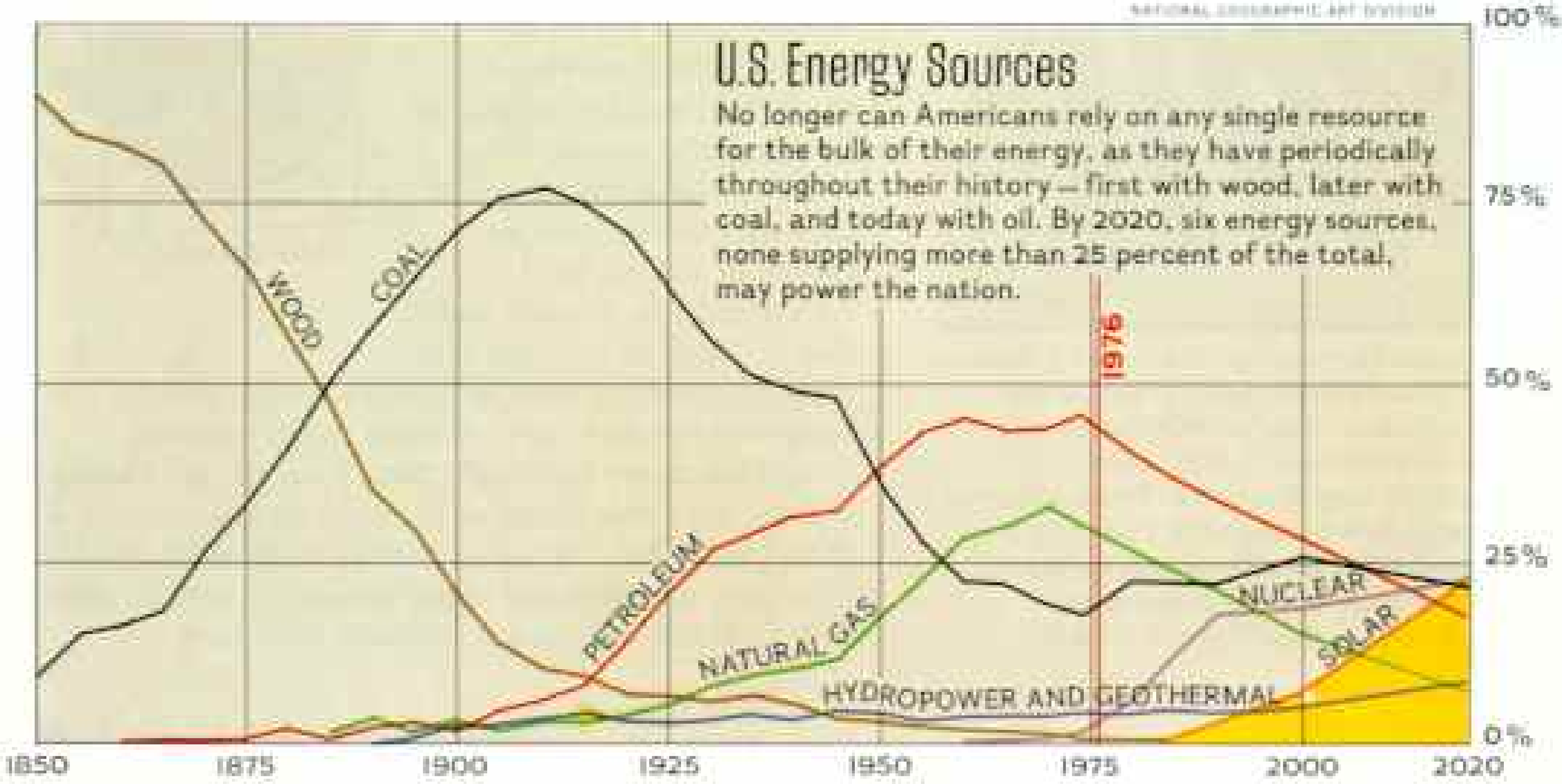
Sun power brightens future

ASCENDING STAR in a cast of fuels, the sun may soon partially heat and cool more than 200 buildings throughout the United States. Near Tucson, Arizona, in one of the nation's sunniest regions (**map**), the Decade 80 Solar House (**left**) uses water-filled solar collectors in its copper roof to provide all the test home's heat and hot water and 75 percent of its air conditioning.

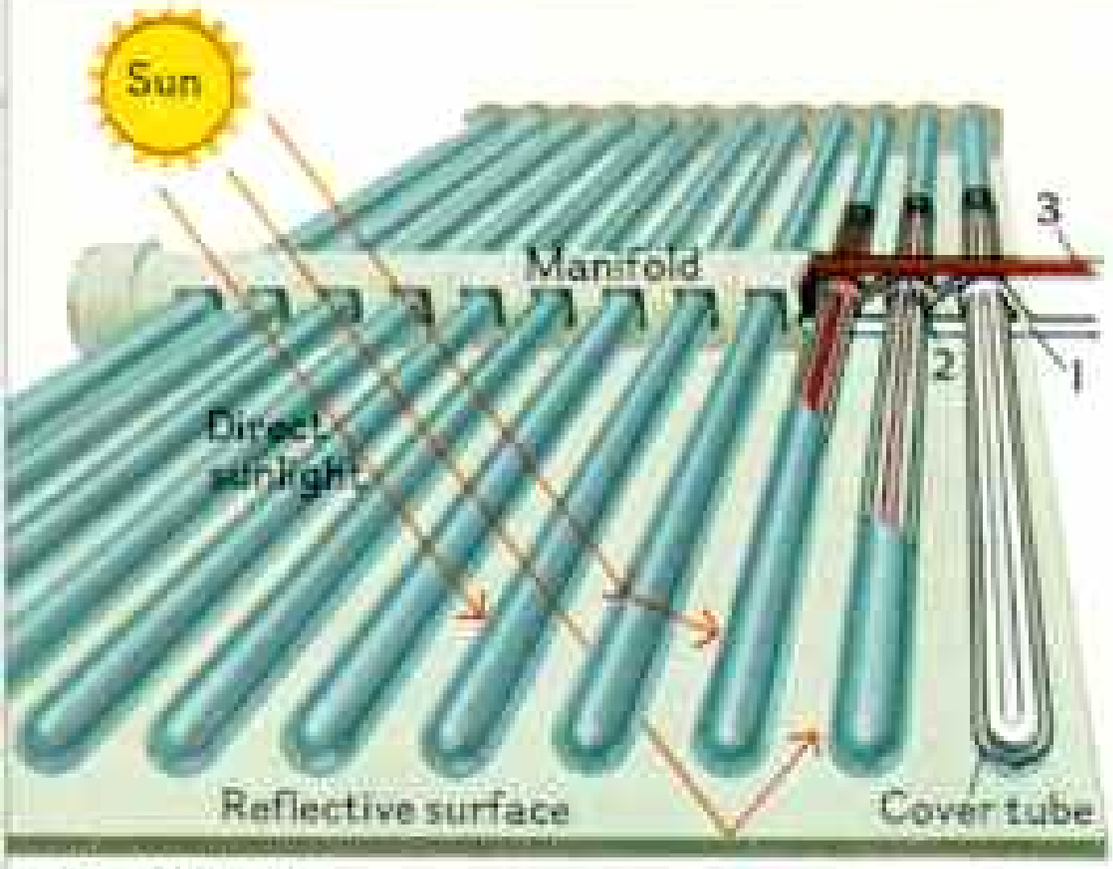
In the early 21st century, the annual U.S. appetite for power—expressed in measures of heat energy called British thermal units (BTU's)—may reach a staggering 200 quadrillion BTU's, or "quads." Six facets of solar technology (**below**) could help shoulder the demand: solar-heated buildings, "biomass" fuels from sun-nourished organic crops, steam power from solar-thermal machines, electricity from solar cells, power produced by sun-governed winds, and energy generated by ocean temperature differences caused by the sun. Together, estimates the Energy Research and Development Administration (ERDA), they could supply nearly a quarter of the nation's power by the year 2020 (**bottom**).



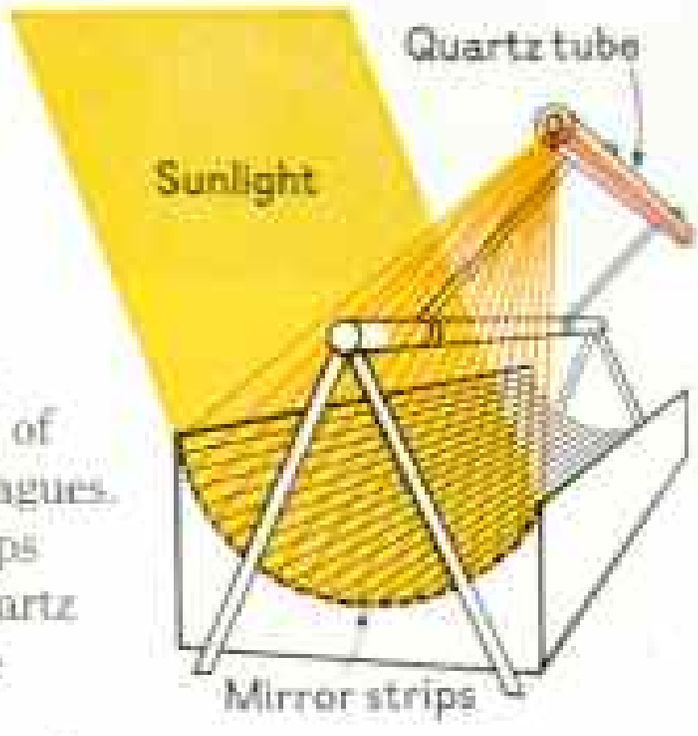
DRAWN BY ELLIS NASSOUR
COMPILED BY PAMELA JOYCE
NATIONAL GEOGRAPHIC ART DIVISION



ARTWORK BY NATIONAL GEOGRAPHIC STAFF ARTIST WILLIAM H. BOND



The SUNPAK traps more energy than most collectors by increasing exposure to sunlight. Water in the elevated glass cylinders absorbs reflected as well as direct rays and grows ever hotter as it travels a deceptively lengthy course. Water entering the system (1) must flow through the inner two of three nested glass tubes in each section before passing to the next assembly (2); it can reach 240° F. before being drawn off by exit tube (3).



To trap the sun, a "trough collector" does the trick with fixed mirrors, here reflecting Dr. Charles Backus of Arizona State University (**above,** left), a developer of the device, and two colleagues. In this model, mirror strips reflect sunlight onto a quartz tube that swings over the trough to stay in the converging rays (sketch, **right**). Gas or liquid in the tube could drive a generating plant in a future "energy farm" composed of many such collectors linked together.

Another new heat collector, designed by Owens-Illinois, Inc., uses an array of pipes, each composed of three glass tubes one inside another (**left**). Water slowly circulates, staying liquid under pressure as it heats up to 240° F., hotter than in conventional collectors.

turn because of solar-heated currents of air.*

Even the wood with which I stoke my fireplace is a form of solar energy. Like oil and coal, wood is merely solar power captured in convenient packaging.

But the earth is fast running out of these precious reserves of "stored sunshine." At our current pace, we will consume in the next 25 years alone an amount equal to *all* the energy used by man in recorded history. If such consumption continues, obviously alternative sources must be found. And the majority of experts with whom I have talked agree that mankind must look to the sun to help solve our energy needs.

Sun's Energy Is Boundless

"The solar energy that falls upon the Arabian Peninsula in one year is greater than twice the oil reserves of this entire globe," declares Dr. George C. Szego of InterTechnology Corporation in Warrenton, Virginia. Put another way, the sunshine falling onto Connecticut roughly equals the total energy used in all 50 states. Harvesting this diffuse energy is clearly possible, but doing it economically remains the major problem.

As Dr. Robert C. Seamans, Jr., head of the Energy Research and Development Administration (ERDA), says: "Solar energy is, in many ways, the 'white hat' of energy sources, clean and boundless. We're accelerating its development, in all its many forms. But to make solar energy economically competitive will require good, hard-nosed engineering."

This year a record 90 million dollars or more will be spent seeking ways to convert sunshine into economical energy. By the end of this century solar technology could fill about 10 percent of the United States' energy needs. If this seems a distant prospect, consider that it has been 30 years since the enthusiasts of nuclear energy promised utopian solutions through the power of the atom. Yet atomic energy today accounts for only about 2 percent of U. S. electrical consumption.

Already the sun's energy is being put to limited use in homes and buildings around the world. The most common examples are rooftop solar heaters that provide cheap hot water for washing and bathing. Estimates vary, but certainly more than a million of these simple heaters are now in use worldwide, in such countries as the Soviet Union, Israel, Japan, and Australia, and in such states as Florida and California.

In the United States alone, more than 200 houses and buildings are, or soon will be, partially heated (and some partially cooled) by solar energy. Solar-heated government buildings and schools are being built in half a dozen states; sun-heated condominiums are going up in Vermont and Colorado.

During the winter in Florida, I tested one of the several thousand solar-heated swimming pools in this country. Even though a chill norther was rattling the palms, the water was warm. Electric heating for the same pool would be prohibitive in cost.

Today the sun's roaring hydrogen-fueled furnace powers educational-television sets in Africa, offshore Coast Guard buoys, and navigation lights on Gulf of Mexico oil rigs. Even the crucial warning bell and lights of a Georgia railroad crossing rely on the sun to power them. So do emergency call boxes on the Washington, D. C., beltway. And nearly every spacecraft that has ever rocketed skyward has depended on purple-blue panels of solar cells.

By the year 2000 today's dawning solar technologies may have become a 25-billion-dollar-a-year industry (roughly equivalent to the size of today's electrical-machinery industry in the United States). This is the prediction of Walter Morrow, associate director of the Lincoln Laboratory of the Massachusetts Institute of Technology.

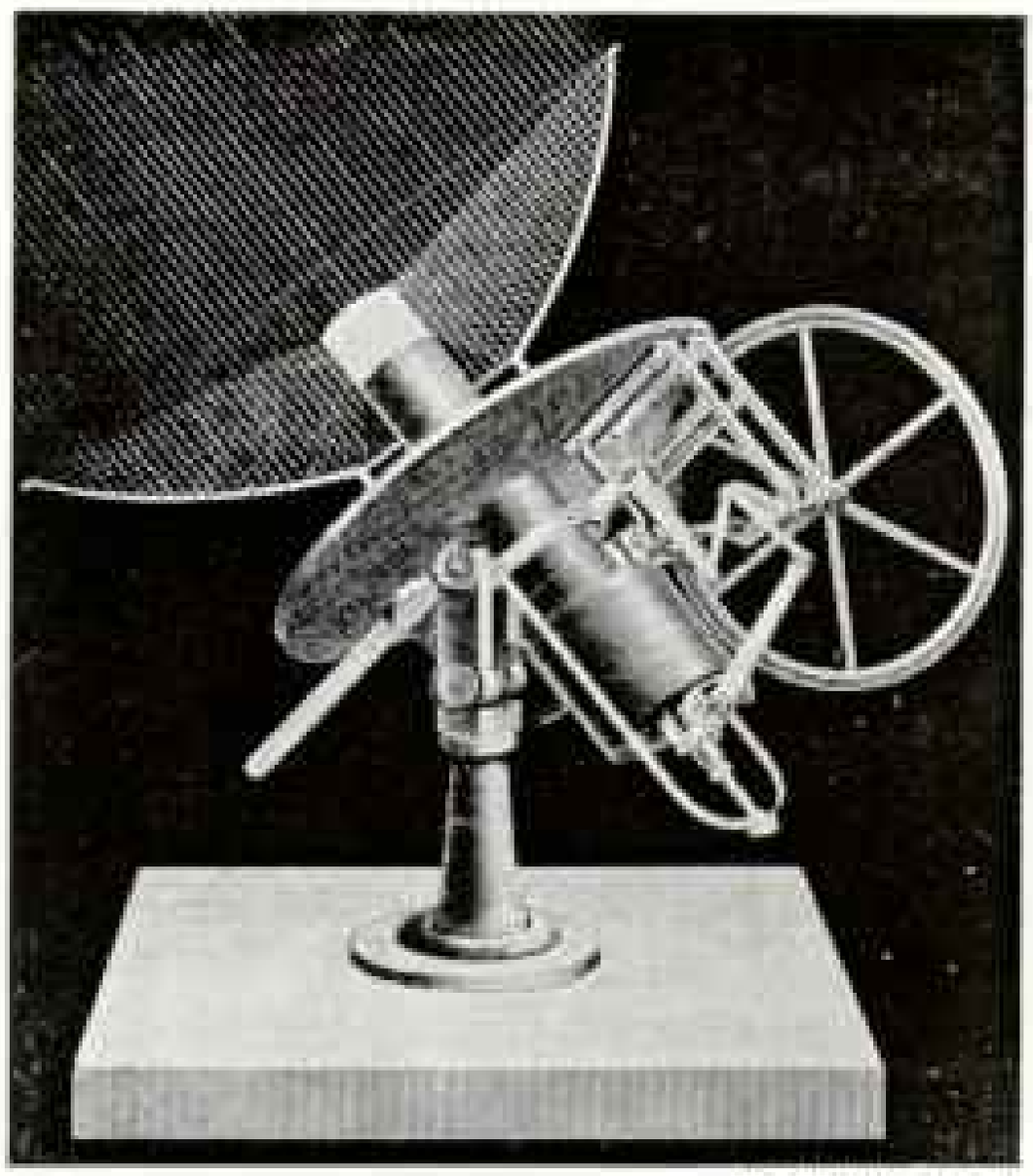
New Interest Fosters New Firms

No wonder that a solar conference I attended was jammed with scientists from as far away as Australia, Japan, India, and Israel. Basement tinkerers traded schemes with corporation executives, while a host of newly formed entrepreneurial firms with catchy names like Solaron and Solarex recruited eager ecologically minded engineers who, in previous years, would have signed on with major aerospace companies.

"Solar energy is where the action is," declared one bearded applicant.

Indeed. And here are some ways scientists hope to switch on to the solar powerhouse:

*See "Can We Harness the Wind?" by Roger Hamilton in the December 1973 NATIONAL GEOGRAPHIC, and Kenneth F. Weaver's "The Search for Tomorrow's Power" in the November 1972 issue.



THE BETTMANN ARCHIVE

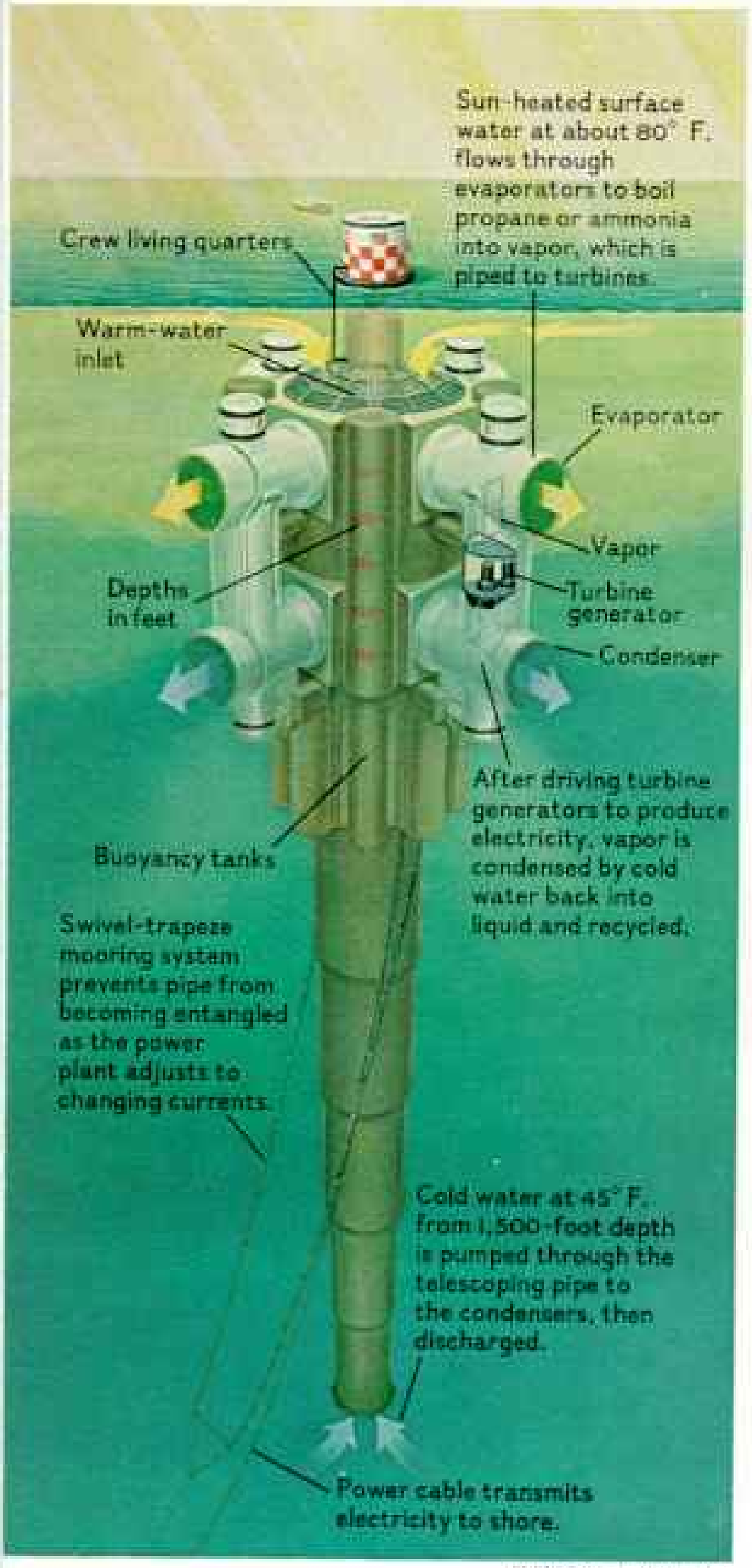
Clean machine of a century ago (**above**) was one of several solar engines built by Swedish-American inventor John Ericsson. This device used a reflector trained on the sun to heat the closed end of a cylinder. Expanding hot air drove a piston, powering a flywheel that turned 400 times a minute.

COURTESY THE AMERICAN SWEDISH HISTORICAL MUSEUM OF PHILADELPHIA

Sailors getting the hotfoot on the iron decks of the *Monitor*, famed Civil War "cheesebox on a raft" designed by Ericsson (**above**), may have influenced him to try to harness the sun. From the 1860's to the late 1880's, he established many of the principles used in capturing solar energy today. Painting behind him depicts the duel between the *Monitor* and the *Virginia*—the renamed *Merrimack*.

Sharpening the sun's eye, a special plastic lens concentrates sunbeams on a solar cell, inspected by a technician at Sandia Laboratories in New Mexico (**left**). The magnifier increases a hundredfold the electricity the silicon cell produces directly from sunlight.

Pioneer of the power tower (pages 380-81), Professor Giovanni Francia (**right**) stands behind another of his solar devices, a plastic grid designed to be mounted atop a flat-plate solar collector to boost its efficiency. The honeycomb retains more than the usual amount of heat from infrared rays by reflecting them among its cells.



PAINTING BY WILLIAM H. BOND

Hot sun, cold sea: Their difference could yield energy to drive ocean power plants of the future. In this design by Lockheed Ocean Systems of Sunnyvale, California, sun-heated Gulf Stream surface water would vaporize a volatile fluid, such as ammonia. The vapor (dashed arrow) would drive turbines to generate as much as 160,000 kilowatts, transmitted ashore by cable. Other designs would use electrolysis to capture seawater's hydrogen, which could be shipped or piped to land as fuel.

• **Heating and cooling.** Typical solar-heating systems collect the sun's energy with rooftop arrays of piping and flat metal sheets painted black to absorb as much radiation as possible. They are encased in glass or plastic and angled southward to catch maximum sunshine. The collectors act as miniature greenhouses, trapping heat under their glass plates. Because solar radiation is so diffuse, the collectors must cover a large area.

Air or water in the piping distributes the heat through standard ducts or radiators. Or it can be stored in an insulated water tank or a bin of rocks.

Solar cooling systems operate on much the same principle as gas refrigerators—the removal of heat by circulating a coolant.

Sun Power Cuts Fuel Bills

"I am utterly unaware of this being a solar house," says Mrs. George Löf, describing what it is like to live in a sun-heated home for 18 years. The five-bedroom Löf home in Denver has 600 square feet of rooftop solar collectors designed by her husband. "In winter they supply about a third of the heat requirements and some of the hot water," explains Dr. Löf, who heads solar research at Colorado State University. "In summer they supply all our hot-water needs."

Two 18-foot-high cylinders, filled with 12 tons of egg-size rocks, trap the heat as the air from the collectors is passed through them. The red-painted columns rise from basement to roof just inside the Löf entranceway—unique totems to today's solar technology.

This $10,000 prototype system cannot yet compete with Denver's cheap natural gas, says Dr. Löf. "But if the alternate source of heat in our house were electricity, we would have paid for the collectors long ago."

Solar energy of this type has a number of social as well as technical obstacles to overcome. For example: Even if an economical system were available for homes, who would install and maintain it? Sheet-metal workers? Roofers? Plumbers? Electricians? It is not clear which group would have jurisdiction.

Another concern is the fact that no single private builder in the U. S. puts up more than one percent of the new homes. Therefore, for serious impact, thousands of architects and contractors in this country would need to begin installing solar equipment. But the

building trades have been traditionally resistant to innovative changes.

Standards of equipment performance also have to be set. Building codes need adapting. The concept of "sun rights" has to be incorporated into city zoning laws (may a tall building shadow a lower one?). Tax legislation may be needed to allow homeowners credit for solar investments. So far, only a few states have voted such an incentive, even though today's price tag of $6,000 to $8,000 for a typical solar-heating system is far too steep for most homeowners.

However, the experts whom I have polled agree that costs should drop significantly within three to five years. And when homeowners average initial costs over the lifetime of a solar installation, solar energy can compete economically with other kinds of energy. In several sections of the country where fuel costs are high, such as Boston, solar already is cheaper than electric heating.

A Word of Warning for the Eager

Dr. Peter Glaser, a solar engineer at the Arthur D. Little research firm in Cambridge, Massachusetts, urges caution for those who would rush out to be the first on their block to install solar heating and cooling systems.

Glaser's advice: "Wait—unless you want to pay the extra money—or build it yourself. It will be at least three to five years before they are readily available."

After this brief waiting period, while efficient designs are refined and mass-production begins to lower costs, solar-heated and -cooled buildings should become widely accepted.

Farmers and manufacturers will also benefit from the sun's energy. "We feel that a major opportunity exists for industrial use," says William R. Cherry of ERDA's Solar Energy Division. "We can dry or dehydrate foods using solar energy, or heat water into steam for mineral processing or other industrial applications. All these will have a major impact on future energy requirements."

Most estimates agree that in 25 years solar systems could save more barrels of oil than will be flowing through the Alaskan pipeline —or about a third of all our current imports. That amounts to several billion dollars a year in balance-of-payments savings. And, as one lawmaker recently noted, "Sunshine cannot be embargoed."

• **Solar-thermal electric power.** Steam boilers used in generating electricity require temperatures of about 1,000° F. By comparison, a conventional flat-plate solar collector seldom gets above 200° F. To put sunshine to work producing electricity on a large scale, it is necessary to find new techniques.

The technical solution to this problem is centuries old: *Concentrate* the sun's rays, just as my son did with his magnifying glass.

In ancient times the sacred Greek temple fires at Delphi were lighted by concave mirrors. The Greek scientist Archimedes supposedly burned a Roman fleet at Syracuse with polished shields that concentrated the sun. In more modern times a steerable parabolic concentrator, aimed at the sun, powered a steam-driven printing press at the 1878 Paris Exposition.

Scientists Refine Old Methods

High-temperature solar-power plants of the future will require similar concentration techniques, such as plastic lenses imitating the eye of the horseshoe crab (an ideal concentrator of light), or special reflective coatings on curved mirrors.

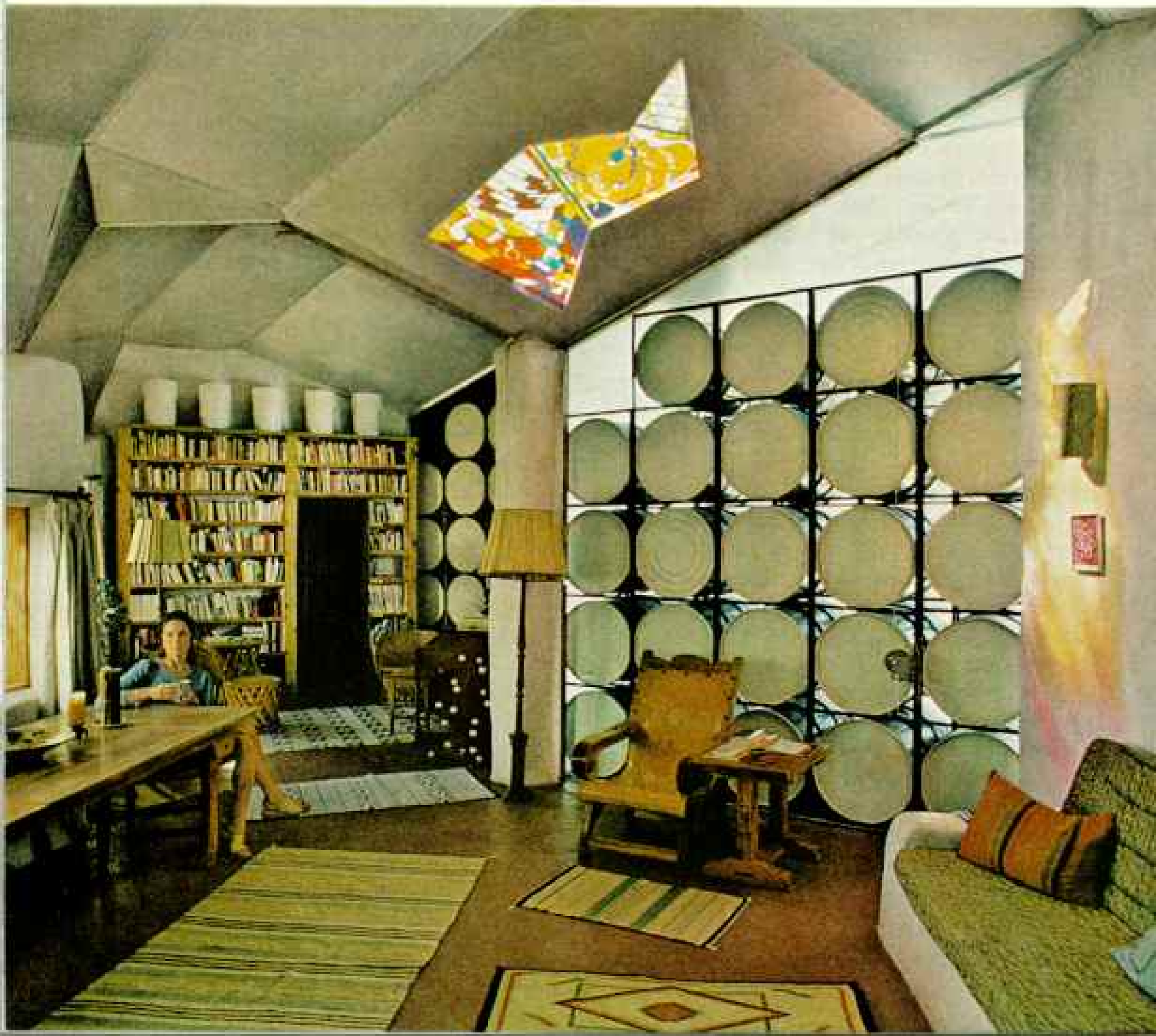
At the laboratories of Honeywell, Inc., in Minneapolis, I saw a heliostat that resembles silvered venetian blinds. Mounted on a turntable, it tilts and rotates to follow the sun, while focusing the reflected beam on a tall water tank about half a mile away.

Honeywell has a plan in which 74,000 such heliostats, each 10 by 20 feet in size, would reflect their searing beams onto a boiler at the top of a 1,500-foot-high concrete tower. The cluster of heliostats would cover more than a square mile, and could generate temperatures well above 1,000° F., sufficient to produce power for 40,000 homes.

• **Raising crops for fuel.** Imagine one of those ordinary tracts of pulp-mill forest—but growing cottonwood, poplar, or eucalyptus for energy instead of pine for paper. Place in the center a conventional steam-power plant, fed by a continuous conveyor belt of hardwood from the surrounding trees. Such "energy plantations" are considered by many to be a serious alternative to fossil-fuel power.

InterTechnology Corporation's Dr. Szego believes that certain fast-growing trees and grasses, called "BTU bushes," could be bred for high-energy output and grown in energy

Home sweet "zome": A special "zoned home" makes life in the desert an uncomplicated pleasure for Steve and Holly Baer near Albuquerque, New Mexico (**above**). Well water, pumped up by windmill, fills drums arranged inside a south-facing glass wall (**below**). On winter days movable outside panels are lowered to expose this unique solar collector to the sun. At night, with panels raised, the stored heat warms the house by radiation and convection. The panels are closed during the summer.



plantations. BTU stands for British thermal unit, a measure of heat energy.

Another strong contender for such "biomass" fuel is kelp, which can be fermented to produce methane or alcohol. This giant seaweed is the fastest growing plant known, sometimes spurting two feet in a single day.

Further in the future looms the possibility of generating power by actually using the mechanisms of photosynthesis, the process by which all plants live and grow. In Melvin Calvin's Laboratory of Chemical Biodynamics at the University of California at Berkeley, I was shown a crude experimental device that converts sunlight into minute electric currents.

• **Energy from the ocean.** French physicist Jacques d'Arsonval predicted as far back as 1881 that man someday would use heat from the sea. It soon may be true. The concept involves using small temperature differences between the sun-heated upper ocean layers and the colder, deeper water.

A typical ocean thermal-power plant (page 388) would be anchored off Florida. Heat from the constantly flowing warm Gulf Stream surface water, with a temperature of about 80° F., would vaporize a working fluid such as ammonia, and the vapor would drive a low-pressure turbine to generate electricity. The ammonia would then be recondensed to a liquid by cold water pumped from depths of 1,500 feet. The process would be continuous, since ocean temperature differences are constant, whether the sun shines or not.

The electricity produced by the offshore plant could also be used to break down seawater into hydrogen and oxygen by the process called electrolysis. The hydrogen could be stored in large container ships for transport, or piped ashore to be used for fuel or for synthesizing hydrocarbons.

This scheme seems like science fiction. Yet Carnegie-Mellon Professor Clarence Zener declares that "the probability of economic feasibility of ocean thermal power stations is so high that they will make obsolete today's advanced nuclear reactors before the reactors' development is completed."

• **Solar cells.** The unusual photovoltaic effect by which light can stimulate the flow of electricity in certain materials was discovered in the past century. The effect remained a largely undeveloped scientific curiosity until 1954,

COTTON GUILMON (TOP) AND THE NATIONAL BUREAU OF STANDARDS

Glaring energy waste in a well-insulated Maryland house (**top**) materializes as red and white zones (**above**) seen by a TV camera that records infrared rays, or heat. Color-coded scale at bottom indicates lowest temperatures at left, highest at right. Warmth leaking from hot spots concerns solar-home designers as well as conventional builders. The National Bureau of Standards, using this house as part of a study, estimates that the equivalent of 500,000 barrels of oil could be saved daily if all U. S. homes were properly insulated.

High roof vent allows escape of warm air drawn upward by a sun-heated chamber called a plenum, pulling cool air into house at ground level.

Tilted solar collector (diagram D) heats home and provides hot water.

Insulating glass cover for solar collecting chamber keeps heat from escaping.

Evergreens on northwest, north, and northeast exposures minimize winter winds.

Skylight with three sealed chambers transmits light but stops outward heat flow (diagram A).

Plenum's heat collectors face west and south.

Reflective roof surface bounces winter sun rays into collecting chambers and keeps unwanted heat from penetrating the roof in summer.

Flue for backup furnace

Enclosed south-facing sundeck avoids cold north winds in winter and the harsh glare of the late-afternoon sun in summer

Banked earth reduces home's northern exposure.

Interior greenhouse faces southward. Plants absorb carbon dioxide, yield oxygen, and humidify living spaces.

Fin wall protects greenhouse from winter wind and from excessive summer sun in late afternoon.

Recessed windows admit sun in winter but limit it in summer (diagram B).

West window uses reflective glass in the outer pane of a double-glazed unit to minimize summer heat.

Mirror above doorway reflects winter sun down to melt ice on stoop (diagram C).

Insulated and weather-stripped garage door

Low-level vents let cool air from shaded ground areas or cool night air enter the house in summer.

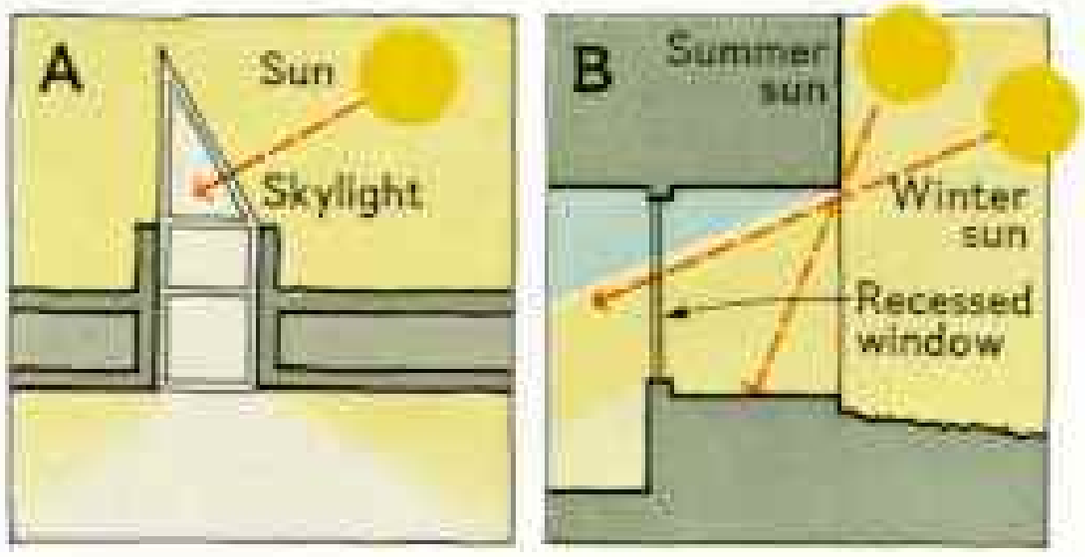
Leaf-bearing trees on southern exposure offer shade in summer, and in winter let sunlight through their bare branches for warmth.

PAINTING BY WILLIAM H. BOND
BASED ON DESIGN BY
RICHARD L. CROWTHER, AIA,
AND LAWRENCE C. ATKINSON
OF CROWTHER SOLAR GROUP

Energy-saving ideas for heating and cooling a house

The sun's rays penetrate into the porticoes in winter, but in summer the path of the sun is right over our heads . . . build the south side loftier to get the winter sun and the north side lower, to keep out the cold winds. XENOPHON, 4TH CENTURY B.C.

BUILDING on this 2,400-year-old concept, an architectural firm based in Denver, Colorado —Crowther Solar Group—tailors each of the



uniquely acclimatized structures it designs to the lay of the land and the cast of the sun (**left**).

The firm's founder, Richard L. Crowther, says, "The most sensible way to use solar energy is by first incorporating design features that would conserve energy from whatever source, and by using the local climate and topography to reduce the dependence on mechanical energy. My bedrock philosophy is very simple: I hate to waste anything."

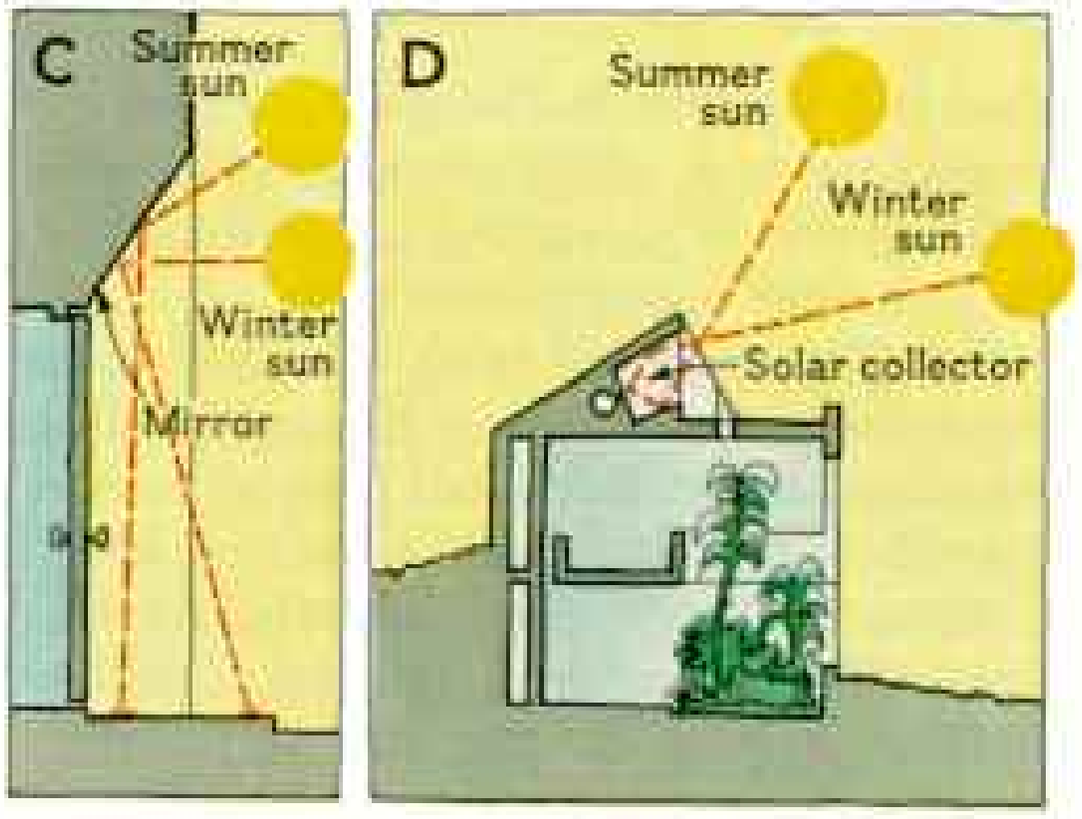
About a dozen homes or office buildings are already completed, under construction, or planned by Solar Group in Colorado, Wyoming, Alaska, and New York. Before the last shingle falls into place, as many as 150 individual energy-saving factors are considered.

Windows—notorious heat sieves—are kept to a minimum except on the south side, and recessed to a depth that allows the sun to enter in winter when its angle is low, but blocks it in summer when it is at its zenith (**B**). In windowless areas special chambered skylights (**A**) admit maximum sunlight but prevent escape of air.

Trees play important parts in the architectural staging. Deciduous varieties on the south side shade the house in summer when the sun climbs higher. When its path travels nearer the horizon in winter, sunlight penetrates the trees' barren branches to warm the house, while evergreens on the home's north face help baffle icy winds.

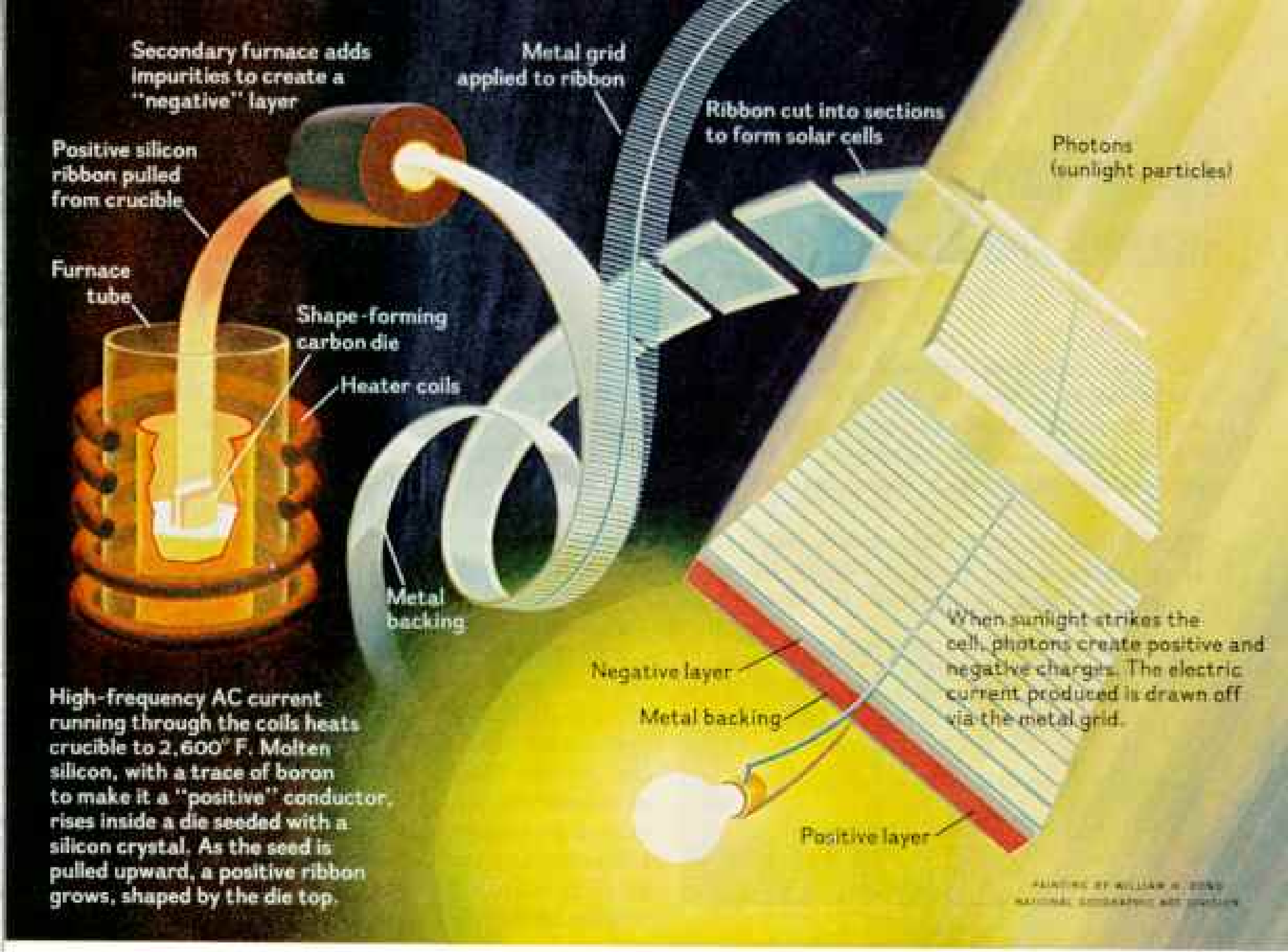
Another angle for winter sun: Mirrors mounted over the front door act as an automatic snow shovel, reflecting solar heat onto the stoop to melt ice (**C**). On the roof, solar-collecting chambers (**D**) use reflectors angled inside the top and bottom surfaces to provide the home's hot water; a pipe or duct at the rear of the compartment transfers the heat for storage in a water tank or rock bin.

Other components fine-tuned by the system include various layers and tints of glass to block or trap heat, a greenhouse to condition the home's air, and an ingenious summer cooling system—literally, air conditioning by mother nature. During the day the sun heats a chamber called a plenum on the roof. At night wall vents near the ground are opened to admit cool air. The heat retained by the plenum creates an updraft inside it, drawing warm air out of the house through the roof ventilator; cool air then replaces it.



"When the house is comfortable, you close it up to trap the cool air," says Crowther.

The construction price for the company's home designs ranges from $19,000 to $150,000, including the high initial cost of backup furnaces and, in most cases, air conditioners. "We can't do away with mechanical energy sources entirely in Denver's climate," says Crowther. "The idea is to use them as little as possible. Even without solar collectors, homes built to our designs can be heated and cooled for about 40 percent of what it would cost for a conventional home."



when Bell Laboratories scientists successfully created the first silicon semiconductor solar cells capable of producing a useful current. An entire new industry was born.

A typical solar cell is an ultrathin wafer about the diameter of an average political campaign button. It is sliced from an ingot of pure silicon crystal into which has been mixed a minuscule amount of impurity, such as boron. This impurity allows the crystal to conduct positive electric charges. Another impurity, such as phosphorus, is diffused into the top of the wafer, allowing that section to conduct negative charges. In essence the two sections behave like the oppositely charged poles of an ordinary car battery.

When photons of light strike the cell, they create positive and negative charges and start a current flowing. The negative charges, or electrons, are drawn off through a metallic grid at the top of the wafer, then returned through a metal film at the bottom after flowing through an electric light, a motor, or whatever else is being powered.

Many people have used solar cells without knowing it. For example, light meters in some cameras—those not requiring batteries for the meter—use a tiny solar cell to measure light levels and energize the indicator.

Solar Cells Essential for Spacecraft

The first totally solar-powered residence in the world—NASA's Skylab space station—ran on solar cells. Though crippled after losing one wing of cells at launch, Skylab sustained nine astronauts for 171 days in orbit. The output of the remaining 840-square-foot solar-cell array kept the mission going. When the array was in earth shadow, Skylab ran on batteries, which were recharged when the craft returned to sunlight.*

The total cost of this sunlit energy was more than $300,000 a kilowatt—1,000 watts, only enough to light ten 100-watt bulbs. Less sophisticated cells intended for earthbound use now cost about $20,000 a kilowatt, still prohibitive except in remote places like offshore oil rigs and isolated radio relay stations.

*A three-part Skylab presentation appeared in the October 1974 NATIONAL GEOGRAPHIC.

Breakthrough: The astronomical cost of electricity produced by solar cells for space vehicles—up to $300 a watt—may be brought down to earth by "growing" the cells in silicon ribbons. At Mobil Tyco laboratories, where the technique was pioneered, a scientist monitors a fiery furnace (**left**) that melts silicon into a strip emerging from a machine overhead. After processing (**far left**), cells cut from the ribbon yield current when stimulated by the sun. Panels of these one-by-four-inch cells could create the urban power plant of the future, if made cheap enough. Refinements already have cut the space-use cost to as low as $20 a watt on earth. The ribbon process aims for 50 cents a watt.

But many experts predict that solar-cell costs will spiral downward to a competitive $500 a kilowatt or less in the next ten years. And considering how fast the cost of electronic hand calculators (made from similar silicon circuitry) has dropped in just three years, such hopes do not seem unreasonable.

At the headquarters of Spectrolab, Inc., north of Los Angeles, I saw a solar array undergoing tests. From a distance the multifaceted panel of solar cells, mounted at the end of a 20-foot pole, looked like a gigantic sunflower waving on its stalk in the breeze.

Close up, I could hear the buzz of a small electric motor that kept the 12-by-20-foot array tilted toward the sun. Plastic lenses on top of each round cell concentrated the sunlight so that each disk "saw" the equivalent of ten suns. The array was capable of generating one kilowatt of electricity.

The Shah of Iran may soon become a big Spectrolab customer. He has announced plans to bring electricity by the end of this decade to the 70,000 remote villages scattered throughout his land. Each hamlet will be equipped with electric pumps for well water, medical refrigerators, even educational-TV sets receiving signals from a broadcast satellite Iran proposes to put in space.

And the answer to Iran's near-instantaneous rural electrification lies with solar-cell arrays such as the kilowatt prototype I saw—not, ironically, with petroleum. Thus may come a true socio-technological revolution.

New Process Promises Cheaper Cells

At the Mobil Tyco Solar Energy Corporation near Boston, Dr. A. I. Mlavsky showed me one of the most promising experiments for mass production of solar cells. So far solar cells have been made by hand in limited quantities. Tyco has developed a precision machine that pulls a thin silicon strip in a continuous ribbon (left, above). Already the process has produced ribbon more than 75 feet long; Dr. Mlavsky expects the automated machines will eventually wind out spools of solar-cell silicon several hundred feet long. "Within three years we should know if it is possible," he says.

The day may arrive when solar cells are delivered to a house like rolls of roofing paper, tacked on, and plugged into the wiring, making the home its own power station.

The imaginative brain of Arthur D. Little's energy expert, Peter Glaser, has conceived what he considers the ultimate solution to the world's energy needs—a solar power station orbiting in space.

Satellite Would Know No Night

At his Cambridge, Massachusetts, office, Dr. Glaser showed me a design for such futuristic satellites. They look like gigantic butterflies, with solar-panel wings 6 by 7½ miles in size. A single one of these power stations in synchronous orbit 22,300 miles above earth might provide as much as 5,000 megawatts, half the present capacity of New York City's generating plants.

The direct-current electricity produced by the satellite's cells would be converted at the space station into microwaves and beamed, much as by a standard radar transmitter, to a ground-based receiving antenna some five miles in diameter. There the microwave energy would be converted directly into alternating-current electricity and distributed for use.

The great advantage of having the solar cells in orbit is that they remain in total sunlight 99 percent of the time; only eclipses darken them. Consequently, they are far more efficient than earthbound systems. Glaser estimates that the cost of the energy delivered to transmission lines would be less than twice that of a nuclear power plant.

Transportation costs for the station, lifted from earth in stages, would be very high. But a Princeton physics professor, Gerard K. O'Neill, thinks he has figured a way around the price for getting the components into space. His idea is to have space colonists build the orbiting stations, using materials from the moon.

I spent a day with O'Neill recently, sitting in on discussions with aerospace scientists in Los Angeles. Referring frequently to a stack of intricate calculations that he has compiled over the past five years, O'Neill fended off every criticism, while defending his advocacy of immediate space colonization.

Using only present-day technology, O'Neill has worked out the basic design of a permanent space station that could hold 10,000 residents. He estimates it can be built for about four times the cost of NASA's Project Apollo moon program—or about 10 to 20 percent of what conventional power-plant costs would be in the U. S. during the next 25 years.

O'Neill is no wild-eyed dreamer. He is the respected inventor of the particle-storage ring upon which are based the latest atomic-particle accelerators. He told me that the space colonies would be able to construct 5,000-megawatt satellite stations—and their ground receivers—for less than ten billion dollars each, to produce electricity for slightly less than two cents a kilowatt-hour. Electric rates in New York City now cost the average consumer eight cents a kilowatt-hour.

"The U. S. market for satellite power stations should be in the 50-to-100-billion-dollar-a-year range by the year 2000," predicts O'Neill. "This may be one of the more powerful reasons for the early development of space colonies." Glaser adds: "That means we could become a different civilization."

Time to Switch on the Sun

This visionary concept has been well expressed by physicist Freeman Dyson: total utilization of the sun to power an advanced civilization.

"The only limits to the technological growth of a society are internal," argues Dyson, a resident of the Institute for Advanced Study in Princeton. "A society has always the option of limiting its growth, either by conscious decision or by stagnation or by disinterest. A society in which these internal limits are absent may continue its growth forever."

Farfetched? Perhaps not, if we learn to switch on more of the sunshine that warms us all, and make the sun a productive furnace for all mankind. □

Curing a crop—and a fuel shortage: In North Carolina State University's "solar barn," fiberglass walls and black heat-absorbing framework trap sun-heated air to dry tobacco. The innovative structure converts to a greenhouse during the off-season. The system can save a third of the propane needed to cure tobacco in conventional drying barns.

Frost, Nature's Icing

TEXT AND
PHOTOGRAPHS BY
ROBERT F. SISSON
NATIONAL GEOGRAPHIC
NATURAL SCIENCE PHOTOGRAPHER

LATE ONE NIGHT we had a happening in Harmony Hollow, my home in the Virginia mountains. Nature and science teamed up with Norse mythology. The local weatherman predicted frost by morning, and, in seeming confirmation, my friend the "hooty" owl began calling in his shrill voice as if to warn his neighbors of a change in the weather. Outside, the clear, cold, windless night held me tight in its silence, until I heard a snapping and crackling—small sounds, yet distinct. Was it frost in the making? Had I heard the sounds of Frosti, god of frost in Norse mythology, at work?

Signs of someone's work came into view as dawn's first light flooded the landscape. Fence posts, bushes, and grass were covered with a fragile icing that caught the sunlight and beckoned my camera. The laced edge of an ivy leaf spoke of Frosti's gentle craftsmanship (**right**). Just a few feet away, like a white spider in a green web, frost crystals stretched across the veins of a holly leaf (**left**). Why the lone formation? Perhaps because of varying air currents, differences in the texture of the leaf, or a lack of certain microscopic particles on which frost builds.

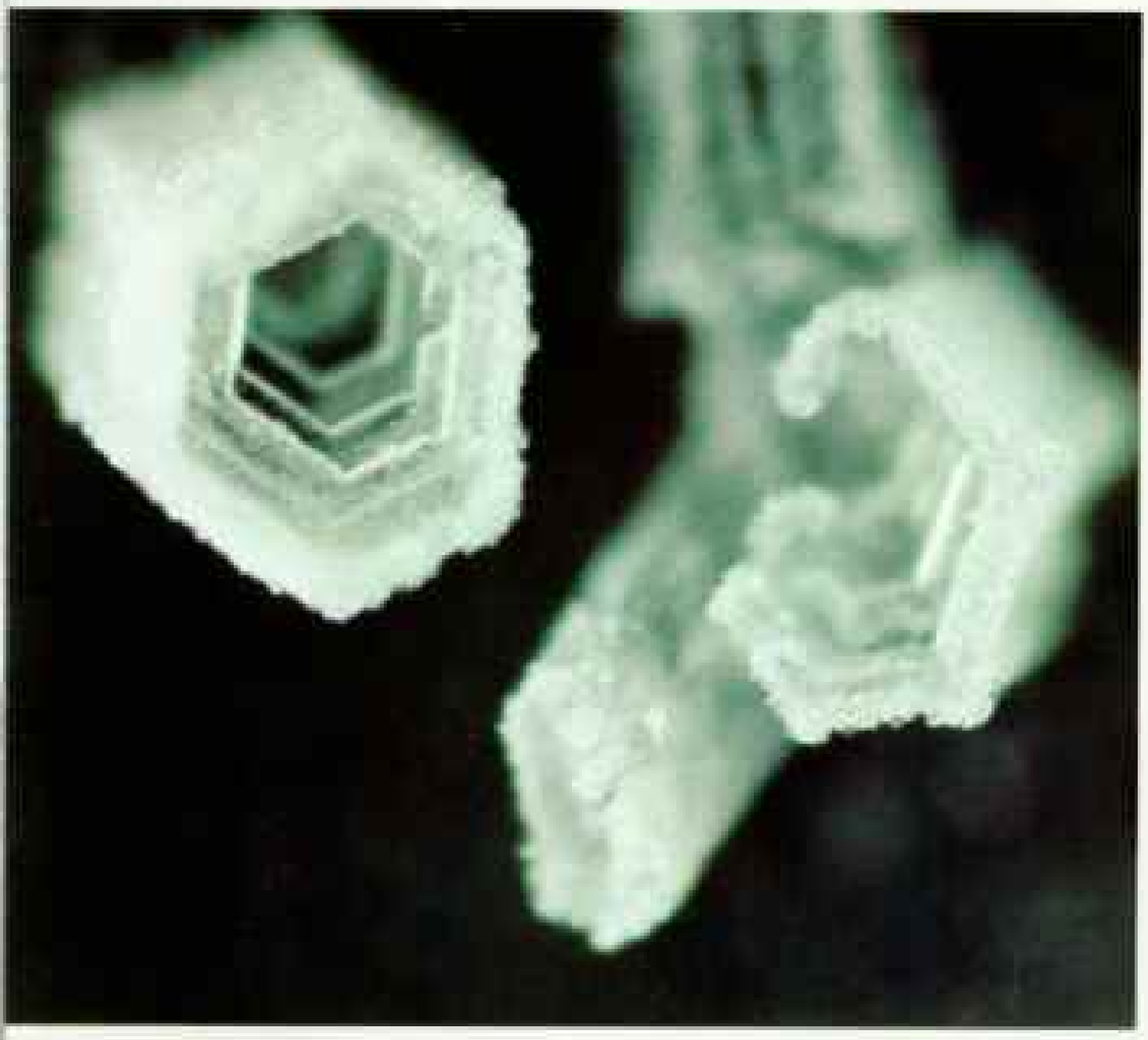
Back inside the house and warmed by cups of tea, I called my friend Lyle Denny at the National Weather Service to ask him how frost forms.

"Bob," he began, "frost is a crystalline form of water, created when water in its gaseous state changes directly into a solid without going through the liquid stage." He probably imagined my confused look. "Put more simply, air becomes saturated with water vapor, and if the temperature is cold enough, the vapor collects and forms frost crystals. We call it sublimation.

"It's important," Lyle reminded me, "to keep the difference between 'frosting' and 'freezing' in mind: some people blame frost for things it has absolutely nothing to do with. The 'frost' that gardeners hate—'black' or 'killing frost'—is not really frost at all but the moisture within a plant freezing. Under certain circumstances, the forming of real external frost can actually insulate the plants and help prevent damage from freezing."

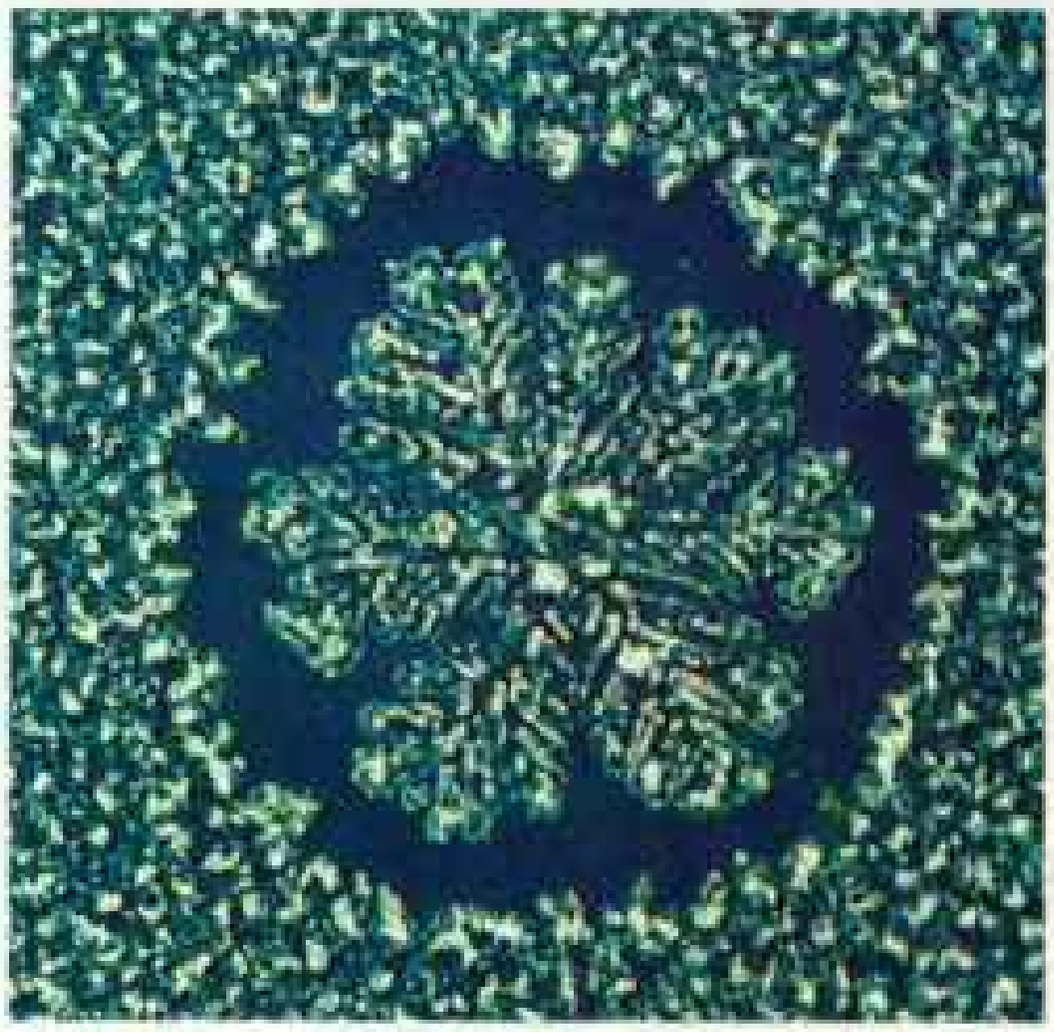
Dew differs from frost only because the water vapor is at too high a temperature to sublime; instead of changing from gas to solid, the vapor collects as tiny water droplets. One bonus of dew or—in colder climes—frost is that it becomes, in places of little rain and snowfall, a major source of water for plant and animal life.

FROST CAN BE WONDERFUL from a few feet, but getting nose to nose with crystals can be downright exciting. Learning there is no difference between man-made and natural frost, I scraped some particles from my freezer. The samples shone like diamonds (**above**). Tiny columns atop a frozen-fruit can looked like toppled pillars of glass (**right**). I looked closer at one crystal; it was hollow (**below**). I again called Lyle. "No, Bob, nothing new; just a type of cup crystal." Well, it was new—and beautiful—to me.



NOW that I knew what frost was, it was time to grow my own. I wanted to simulate the natural laying down of frost. As I walked the fields in search of a model, one found me—the taloned head of a burdock weed caught on my pants leg. Bearing the prize to the back porch, I dampened it with a fine spray of water to provide moisture, then gave it a short burst of Freon gas to lower the temperature. In about 12 minutes I had the delicate sculpture at left.

WORN-OUT shells of an old corncob helped me record the adolescence and adulthood of frost (**right**). Using the same technique as with the burdock weed, I photographed the cob just as the crystals began to form, then again ten minutes later when the coating was complete. On the long nights when I had waited in damp fields for Frosti to do his work, my lens had usually frosted along with the subject. No such problem here.



AS VARIED AS THE MIND will allow, frost assumes fantastic patterns: a railroad freight yard from 30,000 feet up (**left**), a lacy ice flower in its bordered garden (**above**), a running dinosaur (**below**). Crystals clinging to a windowpane (**right**) form mysteriously along surface scratches, like tendrils of icy vines. Science does not yet know precisely what causes the clear space around a frost pattern. I would like to think that it is there to set off the beauty. □

Sicily, Where All the Songs Are Sad

By HOWARD LA FAY
FOREIGN EDITORIAL STAFF

Photographs by
JONATHAN BLAIR

Mock pathos enlivens Palermo's outdoor market as balladeer Rosa Balistreri sings of a peasant whose donkey has died, leaving him no source of income.

In poverty-stricken Sicily, even the comic songs spring from sadness. Status as an autonomous region, granted by Italy in 1946, gave Sicilians more control of their affairs, but didn't cure the island's suffering economy. Massive financial aid is needed, Sicilians say.

SO FAIR AND VERDANT was this ancient land, according to a legend of the Greeks who colonized it, that the dogs of the hunters could not follow a scent because of the fragrance of flowers. Its trees were turned into masts for the ships of Carthage; its grain fed the far-flung legions of Rome. But centuries of pillage and abuse have left Sicily a gaunt, eroded island, and its people—courteous, inscrutable, wise—have learned to bear a heritage of poverty, rebellions, and dreams of emigration. Perhaps because they have endured so much, they are a sturdy and admirable folk, as though knowing in their hearts there is little more that history can do.

"We are old," wrote the island's great 20th-century novelist Giuseppe di Lampedusa, "... very old. For more than 25 centuries we've been bearing the weight of superb and heterogeneous civilizations, all from outside, none made by ourselves, none that we could call our own."

Phoenicians ruled here, as did Greeks, Carthaginians, and Romans. The Saracens seized Sicily from the Byzantines, and the Normans conquered the Saracens. Then came Germans, French, and Spaniards. When Garibaldi stormed ashore in 1860, bent on uniting Italy, most Sicilians saw him only as another conqueror.

A Sicilian friend told me: "Ours has always been an occupied country. And always exploited. Nowhere will you find a people more distrustful of authority. Until recently Sicily was always short of electricity. Some years ago the Italians stretched cables across the Strait of Messina to bring in electricity from their grid. But every Sicilian believed, in his heart, that the cables existed to drain away the little power we had."

Today's Sicily, with its abandoned farms, depopulated villages, and chronic unemployment, is consistent with its melancholy past—a place where, to paraphrase G. K. Chesterton's line about the Gaels, all the songs are sad.

As long ago as the 12th century, an observer described Sicily as a land that "devours its inhabitants"—a judgment that many still accept. To learn of the island's problems, I visited the Honorable Mario D'Acquisto, regional assessor for labor and cooperatives—equivalent to a cabinet minister—in the Sicilian Government.

The assessor proved to be young, astute, and marked by that healthy skepticism common to most Sicilians. "For as long as anybody can remember," he said, "Sicily has been underdeveloped. And the bitter truth we are learning

"**Seducer of the eye,**" a 12th-century Arab visitor described Palermo, Sicily's capital and largest city, with 700,000 residents. Set on a mountain-ringed plain beside the Gulf of Palermo, the site was colonized by Phoenicians, perhaps as early as the eighth century B.C.; in the Middle Ages it gained dazzling palaces and churches, many of which still stand.

Today Palermo is among Italy's busiest ports, but industrialization comes slowly —a blow to the hopes of the city's thousands who abandoned towns in rural areas looking for jobs. Taking a school break, two up-to-date Palermitans wear the universal uniform of the young, blue jeans.

now throughout the world is that underdevelopment causes underdevelopment. In short, where there is no capital, few skilled workers, and even fewer managers, a nation cannot cure its own ills.

"Let me be blunt: Sicily's cure is Sicily's historic curse, a massive intervention by outsiders. In the recent past Italy has expended huge sums to industrialize the island. But how? By building a few automated, staggeringly expensive oil refineries and electronics plants. Cathedrals in the desert! They employ only a few thousand technicians.

"Within the past twenty years, 600,000 Sicilians—people, we must assume, of initiative and drive—have left the island. We are experiencing a Biblical exodus."

One Sicilian preparing to join the exodus was Signorina Giusy Brucculeri, a teacher in a private school.

"I graduated from the University of Palermo in 1972 with a degree in foreign languages," she told me. "For a year I knocked on doors—travel agencies, airline offices, tourist bureaus, anywhere that my languages might be valuable. But there was no job, and also because I am a woman, no possibility ever of a job. Except, of course, as a very badly paid teacher.

"A normal Sicilian girl might accept this. But I have ambition, and this makes me a foreigner in my own country. To better myself, I must get out."

Farmer Loyal to His Land

A few days later I visited a Sicilian who had no intention of leaving—52-year-old Giovanni Guzzardo, who, with his family, farms 75 acres in the green tranquillity of the heights above Caccamo. As we strolled across his sloping fields, Signor Guzzardo—a strong man with a weathered, mobile face—told me: "The profit in farming is very little. It permits us to live, nothing more. But I was born here. I love this land. Besides, farming is a very proud profession. We feed the world. Without us there could be no art, no industry. Ours is the one indispensable occupation."

As shadows lengthened across the young wheat, we made our way to the farmhouse.

"**To have seen Italy** without having seen Sicily is not to have seen Italy at all," said the German writer Goethe. Lying in the Mediterranean's narrows between Europe and Africa, Sicily inevitably served as a stepping-stone for conquerors: Greeks, Carthaginians, Romans, Arabs, and Normans. All left notable relics, like the graceful temple at Segesta built by the mysterious Elymians (**facing page**). Erected 24 centuries ago, it still stands above a lonely valley.

The heavy, soothing smell of cattle permeated the barnyard. We washed at a basin and entered a small, immaculate room.

The other members of the family trooped in, and we took our places around an oilcloth-covered table. Everything served by Signor Guzzardo's buxom, pleasant wife, Rosa, was a product of the farm. We dined on olives cured with garlic, fresh tomatoes, boiled eggs, bread, sausage, cheese, and a tart red wine.

"Life here has a rhythm," said Giovanni. "We always know what we'll be doing on a given day. In late July we winnow the grain. In November we harvest the olives. In February we begin to weed the croplands."

Signora Guzzardo brought a bowl of walnuts for our dessert, and the youngest son, 10-year-old Giuseppe, gathered up his schoolbooks. His father watched affectionately as the boy departed to do his homework.

"Giuseppe is our hope," the farmer said quietly. "The rest of us have had no chance for an education, but I want him to study and better himself. A farm family *must* have at least one educated member. For instance, year after year the government votes millions to improve agriculture. But somewhere it melts away. I never see a penny of it, nor has any farmer I know. This is because I am ignorant. But if my son is educated, he will understand the laws. He will know how to take advantage of the grants.

"Above all, I want my children to stay on this land. Here life is better and cleaner than in any city. Here you have a rewarding family life. Here you breathe pure air and share the world with nature."

When I left Signor Guzzardo at his gate, beneath the clear, starry sky, amid the rich odors of ripening crops, I realized that I had spent a day with that rarest of God's creatures—a man who had found contentment.

Greek Monuments Grace Sicily

Sicily's long continuity manifests itself dramatically in its splendidly preserved Greek remains. Indeed, it is second only to Greece itself in Hellenic monuments.

In the eighth century B.C., Greek immigrants settled in this new world. Cities they

established—Syracuse, Agrigento, Taormina, Gela—rivaled the ancient capitals of Hellas. The greatest was Syracuse, as magnificent to me in ruin as it was in life. In 415 B.C., attacking Athenians, in a vainglorious mission, arrived with a mighty fleet. But the Sicilian city-state crushed the Athenian expeditionary force. Stripped of defenders, Athens, the greatest city of antiquity, fell to the Spartans a few years later.

The Athenians had attacked Syracuse at the behest of a little-known ally, a Hellenized people of northwestern Sicily called the Elymians. They ruled at Erice and Segesta until the Athenian invasion failed.

At Segesta 2,400 years ago, the Elymians left behind an unfinished temple that, in the words of one archeologist, rivals the "Parthenon in the subtlety of its refinements." The solitary roofless temple stands on a spur that dominates ridges and valleys (preceding page).

I visited Segesta on a day of early spring when a raw wind lashed the uplands and sullen clouds roiled through the sky like the smoke of sacked cities. I stood alone in the great temple, among the mighty Doric columns, with the hollow boom of the wind cuffing the eroded stone. An eerie and mournful sound; nature's dirge, perhaps, for fallen gods.

I waited while the sun sank behind the pagan sanctuary. Dusk—like a rumor of indigo—seeped across the timeless landscape.

The wind rose even higher as I picked my way down the hill. Behind me the temple seemed to glow with fitful gold, a trick of the light and the clouds. Yet it engendered a sense of ancient mystery, of ancient dread. I was not sorry to leave the old gods to night, to solitude, to memories.

Mafia Once Served Justice

Like every visitor to Sicily, I was curious about the Mafia. I consulted a knowledgeable journalist. "The Mafia plays a key role," he said, "but only in the west. In the east, for example in Messina, it has never been a factor. Long ago the Mafia served a purpose. It offered a poor man a means of justice outside the always unequal law."

Using Sicilian words, he said: "The present-day *mafiusi* maintain all the old forms. The junior members are expected to show their seniors *rispettu*, or respect. And there is *omertà*, the conspiracy of silence that every

Ten-ton showstopper, a float fashioned after a galleon bears a statue of St. Rosalia, Palermo's patroness, past the city's cathedral, consecrated in 1185. An annual three-day festival honors the reclusive daughter of a 12th-century count. She has been revered since 1624 when, says tradition, her bones were brought to plague-stricken Palermo, ending a deadly epidemic.

Musicians on the gilded oxcart wear festival costumes popular around 1700, toward the close of Spain's 300-year rule in Sicily. Allegorical captives on the cart's sides, their hands bound, represent heathen forces overcome by St. Rosalia.

mafiusu must observe under questioning. A Mafia assassination is still carried out with a *lupara*, or sawed-off shotgun. And a disappearance is a *lupara bianca*, or 'white murder.' But all this is stage dressing. The mafiusi of today are merely low-grade gangsters. Their specialties are extortion and protection."

Brave Few Fight Corruption

One man, at least, has dared to challenge the new Mafia. Danilo Dolci, an architect from Turin, came to Sicily 24 years ago. A baby died of starvation before his shocked eyes and, from that moment, he dedicated his life to bettering the lot of the poor in Sicily's western mountains. To reach his headquarters in the town of Partinico, I drove inland from the Gulf of Castellammare (map, page 410), past citrus groves and gnarled platinum-green olive trees. Above the sparse villages tower the mountains—craggy and hostile.

Signor Dolci, an author of international renown, has long been marked for doom by the Mafia; a combination of courage and caution has kept him alive. He has survived ambushes, shots from passing cars, even a rigged jail term.

"One of our greatest successes to date," he told me, "was getting the government to build a dam on the River Iato. It irrigates 27,500 acres that support 5,000 families. Formerly the Mafia controlled all water rights, and everybody had to pay for his share.

"Traditionally, individuals here have never related to each other, but always to some leader who could provide favors or protection. Naturally, many of these were of the Mafia. Sicilians are not violent people. Peasants and fishermen have always been resigned to poverty; each relied wholly upon himself; no one had faith in the strength of groups. But—as with the dam—whenever we have been able to offer the people sound alternatives, the Mafia's influence declines. And a little democracy is born."

Returning to Palermo, I passed through Montelepre, the birthplace of a 20th-century legend, Turiddu Giuliano—perhaps Sicily's most charismatic folk hero. Turiddu had ruled the mountains of western Sicily for six exultant years—from 1944 to 1950. "Every approach was guarded," a Sicilian friend had told me with admiration. "No one entered the

Men still hold the high cards in male-dominated Sicily. Consider rural Caccamo, where farmer Giovanni Guzzardo, center, whiles away an evening (**above**) playing *scopone*, a game similar to casino. A cordon of male kibitzers includes his son Giuseppe, at his left. A new Italian law gives wives the same rights in the home as husbands. Under the statute women may help plan their children's education as well as make financial decisions. Even so, as one official understated, "It will take a little time for customs to change." When younger Sicilians (**right**) reach adulthood, they may more readily accept women as equals.


FALCON

mountains without Giuliano's permission."

Peasant, bandit, patriot, he had stolen massively from the rich and given just as massively to the poor. His battalion-size band—sometimes allied with the Separatists who sought independence for Sicily in the mid-1940's—had humbled the forces of the Italian Republic. But this king, like his native land, could know no victory.

On July 5, 1950, the silver fingers of the dawn inched across a courtyard in Castelvetrano and found Turiddu. He lay crumpled in death. Shot by the Mafia? The police? The landowners? In the end, all had used Giuliano, distorting his struggle for the poor. In Sicilian tradition his death was steeped in treachery and violence. Although he was 27, his face, noted one observer, had the "calm beauty of an exhausted adolescent."

The end of that tragic legend, like the beginning, you can find in Montelepre. Desolate and poor, it huddles on a mountainside. Just beyond the town I came to its locked and somber cemetery. An inscription above the gate proclaimed: *Fummo come voi, sarete come noi*—We were as you, you will be as we.

Unable to find an attendant, I climbed the wall and located the cypress-bracketed mausoleum of Giuliano. Behind a wrought-iron gate he lies in a sarcophagus of white marble guarded by a statue of the Sacred Heart. In the grillwork of the door someone had entwined fresh wild flowers—all red and gold, the colors of the Separatists. Overhead, hawks patrolled the silent sky. On motionless wings they soared and careened on currents as secret and elusive as dreams.

Moslems Brought Glory to Palermo

Palermo, the capital of Sicily, is experiencing an unprecedented boom. While the population of the island has steadily declined, migration from the rural interior has swelled Palermo to 700,000 inhabitants; one of every seven Sicilians now dwells in the capital.

Although Phoenicians and Greeks exploited the city's fine harbor, it first came to greatness under the Saracen invaders who arrived in the ninth century A.D. Under the Moslems it eventually counted a hundred thousand inhabitants; it ranked among the most important cities of medieval Europe.

The Saracen influence lingers. Abutting the harbor is a section called the Kalsa—from the Arabic *al-Halisah*, loosely the Elite, because once the houses of Saracen dignitaries stood here. Above rises the quarter of Il Cássaro, from *al-Qasr*, the Redoubt, site of the emirs' fortress.

The twisting, narrow streets of this very old city have made modern traffic an unrelenting nightmare. Automotive anarchy reigns (below). Stop signs and red lights are ignored. A frustrated driver will not shrink from an end run along the sidewalk—if he can find the room. With little curb space, motorists preempt sidewalks for parking.

Against this abomination an arm of the police called the *Vigili Urbani*—Vigilant Ones of the City—wages ceaseless warfare. Day after day the Vigili range Palermo in flatbed trucks fitted with cranes, hoisting and carrying away illegally parked vehicles.

A vignette illustrates the futility of their campaign: Picking my way up the car-clogged sidewalk of Via Belmonte, I came upon a brace of Vigili whisking an Alfa Romeo onto their truck. Two drivers blocked traffic in the street, urging the Vigilant Ones to haste with impatient blasts of the horn. Each was eager to dart into the forbidden space being cleared by the police.

Palermo, with its international airport and busy harbor, belongs unquestionably to Europe. On the Via della Libertá and Via Ruggero Settimo, you find a cosmopolitan city of expensive boutiques, one caught up in the current Continental craze for English catchwords. In Palermo you can shop for infant togs—one hopes—at the Baby Market, for blue jeans at the Gulp Shop, or for a mink coat at the unfortunately named Squirrel Furrier. After a stick of Mash chewing gum, you can solace yourself at the Sympathy Bar with a Crazy Whisky (guaranteed five years old), and dine at the Charleston Restaurant. Or, if you prefer, you can wash your hands of the whole thing with a cake of Respond soap.

Marketplace Recalls the Past

Still, the past continues to thrive in the sprawling Vucciria, an outdoor market that recalls every Arab suq from Damascus to Algiers. Through narrow streets converging

Looking for a way out, a motorist resigns himself to the horn-honking horror of Palermo's narrow downtown streets. Morning, noon, and evening—seemingly always—traffic clogs the city. New highways fanning out from Palermo's crowded core, however, have shifted growth to the suburbs. Southeast of the city, in central Sicily, modern roads now replace horse and sheep trails. Rolling down a highway, a still-useful wagon (**above**) hauls away a more recently arrived vehicle, already reduced to junk.

on the Piazza Caracciolo, shoppers swirl and eddy in a polychrome wonderland. On all sides rise mounds of crimson apples, pale-green zucchini, scarlet tomatoes, purple eggplant, tawny oranges. The proprietor of a fruit stand entices clients with a traditional chant: "*Ma chi ciavuru i fravuli frischi!* What a delicious scent of fresh strawberries!"

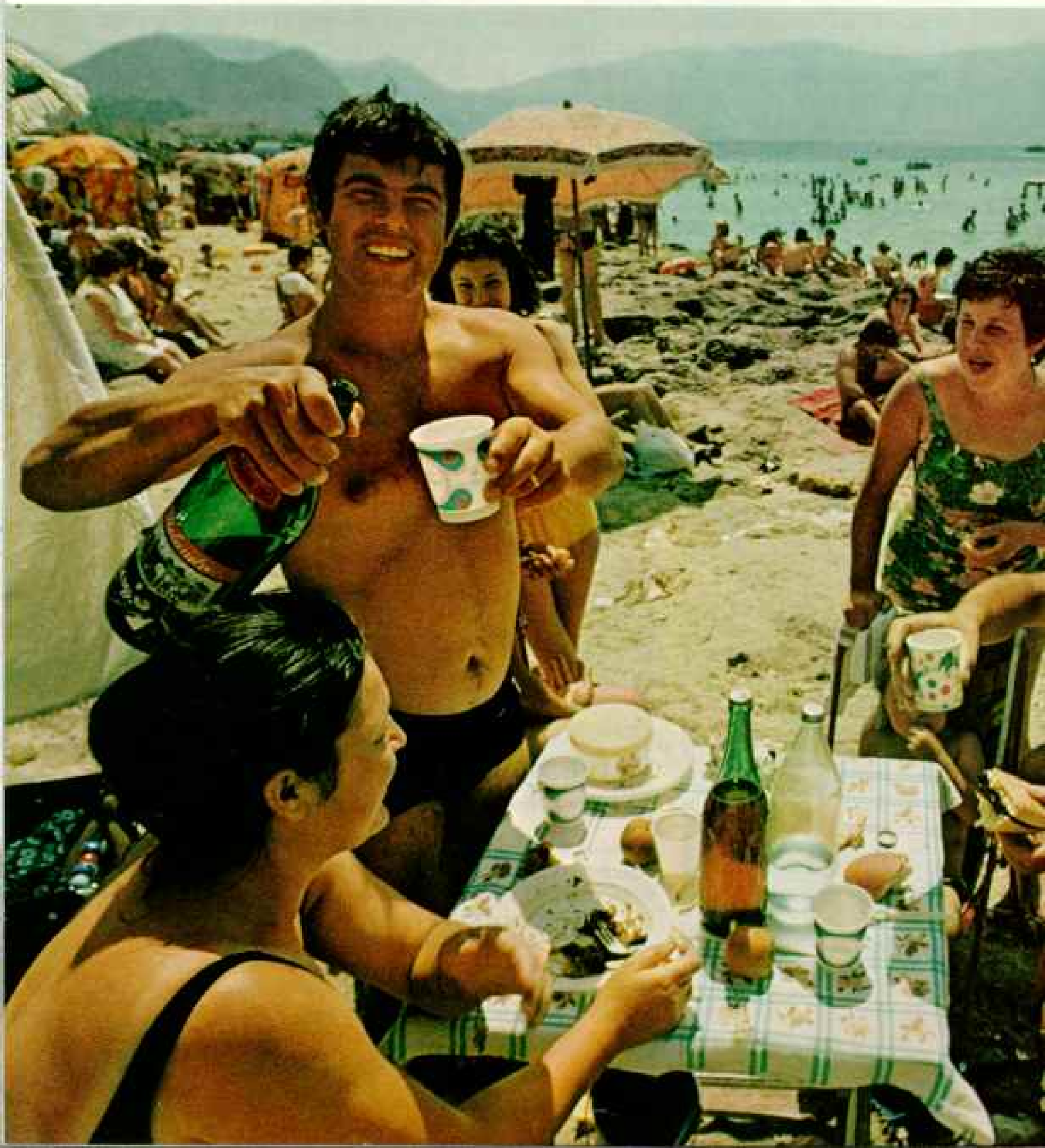
Another, presiding over a cart of sweaters in dazzling electric hues, calls: "*Robba mercata!* Oh, what cheap things I have!"

The smells! Fugitive scents of rose and carnation as you pass the florists. The aroma of artichokes, string beans, and new potatoes simmering in big pots. Roasting nuts and trays of baked onions. And the clean, piercing odor of lemons.

Streetside Cuisine Offers Variety

I buy a lemon—a huge chunk of gold the size of a linebacker's fist—and eat it, as Sicilians do, like an orange. While far from sweet, it is tangy and refreshing.

On all sides vendors offer the snacks so beloved of Sicilians. *Stigghioli*—goat intestines sprinkled with oregano—roast smokily over

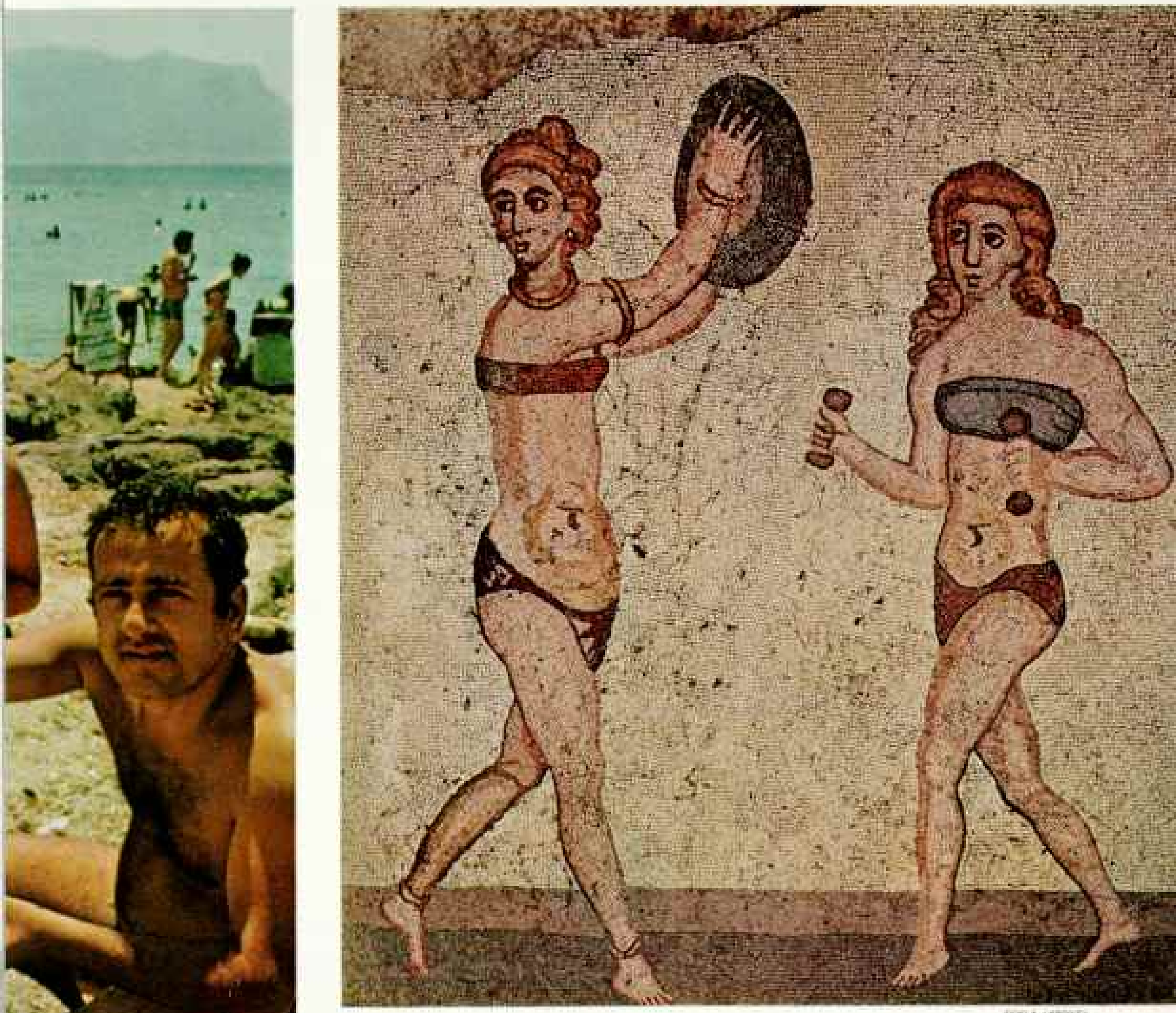


beds of charcoal. Men with sharp knives and swift fingers chop *purpu 'ugghiutu*, boiled octopus, into manageable morsels and heap them onto moist plates. But the supreme treat afforded by the Vucciria is *vastedda ca' meusa* —slivers of the spleen, liver, lungs, esophagus of veal fried in lard, sprinkled with salt, and served on a roll.

One day, as I left the Vucciria, I heard a new chant. It struck me as somewhat ambiguous: *"Cavuri, i domestici! Su' cchiu' duci d'un peri di porcu!* How savory, this kale! Sweeter than the foot of a pig!"

The high Sicilian regard for good food reaches its zenith in desserts. The island's pastries and ices have no rivals, and the entire populace seems to sample them endlessly. Once, as I drank a cup of espresso in a café, the dazzling display of pastry overwhelmed all scruples. I selected a cake filled with pistachio-flavored cream. For future reference I inquired the name of this confection.

"Il Trionfo di Gola, signor," the clerk replied. Licking my fingers, I reflected how devastatingly appropriate was that name—the Triumph of Gluttony.



SCALA (ABOVE)

Wearing fashionable bikinis, Roman gymnasts cavort across a 1,600-year-old mosaic from a villa unearthed near Piazza Armerina. They could easily make the scene at one of Sicily's sunny beaches (**left**), the major lure of a growing tourist industry. High rises recently have sprouted along the island's previously unexploited seashore, providing much-needed resort facilities.

Mantle of a mountain, the hill town of Gangi recalls feudal times, when powerful overlords housed serfs in towns built on heights for defense. Gangi gained notoriety in 1925 when about a hundred members of the Mafia, a loosely knit criminal society, were

arrested there during a widespread crackdown. Curtailment of the group's influence proved only temporary, however; violence and graft today enable the Mafia to control economic power and resources in wide areas of western Sicily, including Palermo.

The small pleasures of life, however, fade before the Sicilian cult of death. With a friend, Enzo Lo Dato, I visited one of the world's grisliest sites—the catacombs of Palermo's Capuchin Convent. From the entrance a stairway leads into quiet subterranean corridors. Along their walls are ranged some 8,000 Palermitans, most of whom died in the 19th century. All were embalmed by the monks of the convent; and all wear their funerary clothing, from top hat and tails to hoop skirts and bonnets—a clutch of doctors in dusty white coats, dead a hundred years; a series of mitered bishops (pages 424-5).

"These dead suffer from neglect," a monk told me with a note of accusation. "Years ago, to have a relative here in the catacombs conferred great prestige. Families would visit regularly to discuss important matters with the deceased and change the clothing. Now it is all left to us, and we are too few."

My last stop in the catacombs was before the tiny glass-topped coffin of Rosalia Lombardo, who died 55 years ago at the age of 2. The girl seemed to be sleeping, her face full and fresh. A satin ribbon secured her auburn hair, seemingly still moist on the forehead. Preserved in an infantile immortality, she was

the monks' masterpiece. She would be 2 years old forever.

"Death and Sicily," sighed Enzo, as we finally emerged from the morbid gloom of the catacombs. "We can't seem to get enough of each other. Look at our village doorways: always bearing printed signs bordered with black announcing the passing of some relative. For our children, November 2, the Day of the Dead, is more important than Christmas, which brings only minor gifts. On *Giorno dei Morti* they receive truly important presents, given in the names of the dead of the family."

Pickers reap a bumper harvest near Trapani, a major center of viticulture. If trends continue, wine may one day outrank citrus as Sicily's most valuable product.

Land reforms in the early 1940's and 1950's divided many of the island's large estates left fallow by absentee owners, a program aimed at improving the lot of the farmer. Today 90 percent of the island is used for crops or pasture.

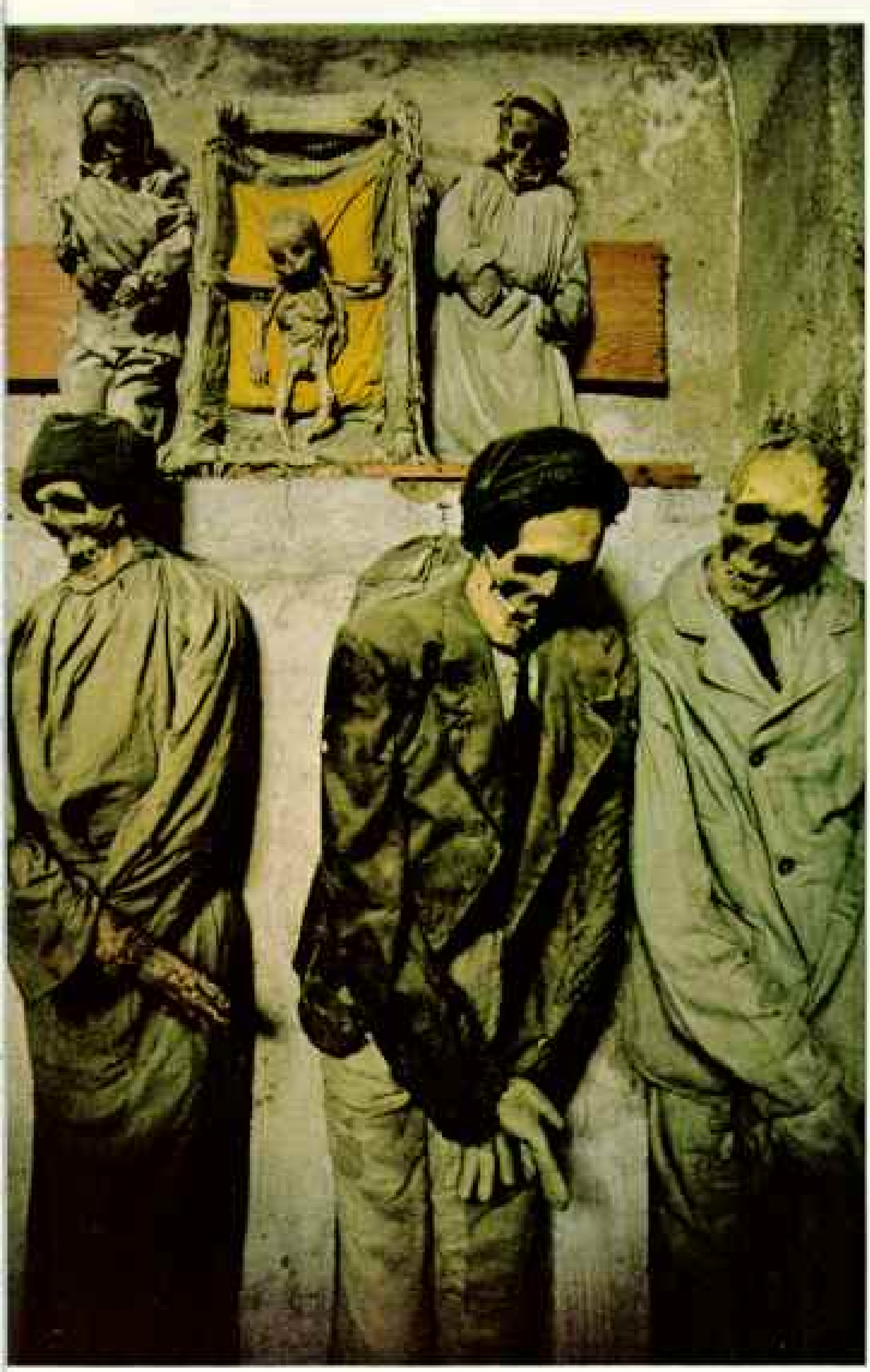
In Palermo and environs several magnificent structures memorialize the golden age that the Normans brought: the Church of the Martorana, the Palatine Chapel, the majestic Cathedral of Monreale, its walls aglow with 70,000 square feet of incomparable mosaics. All were built during the 12th century, when Norman kings ruled in Palermo and Sicily dominated much of the Mediterranean.

Normans Bring a Golden Age

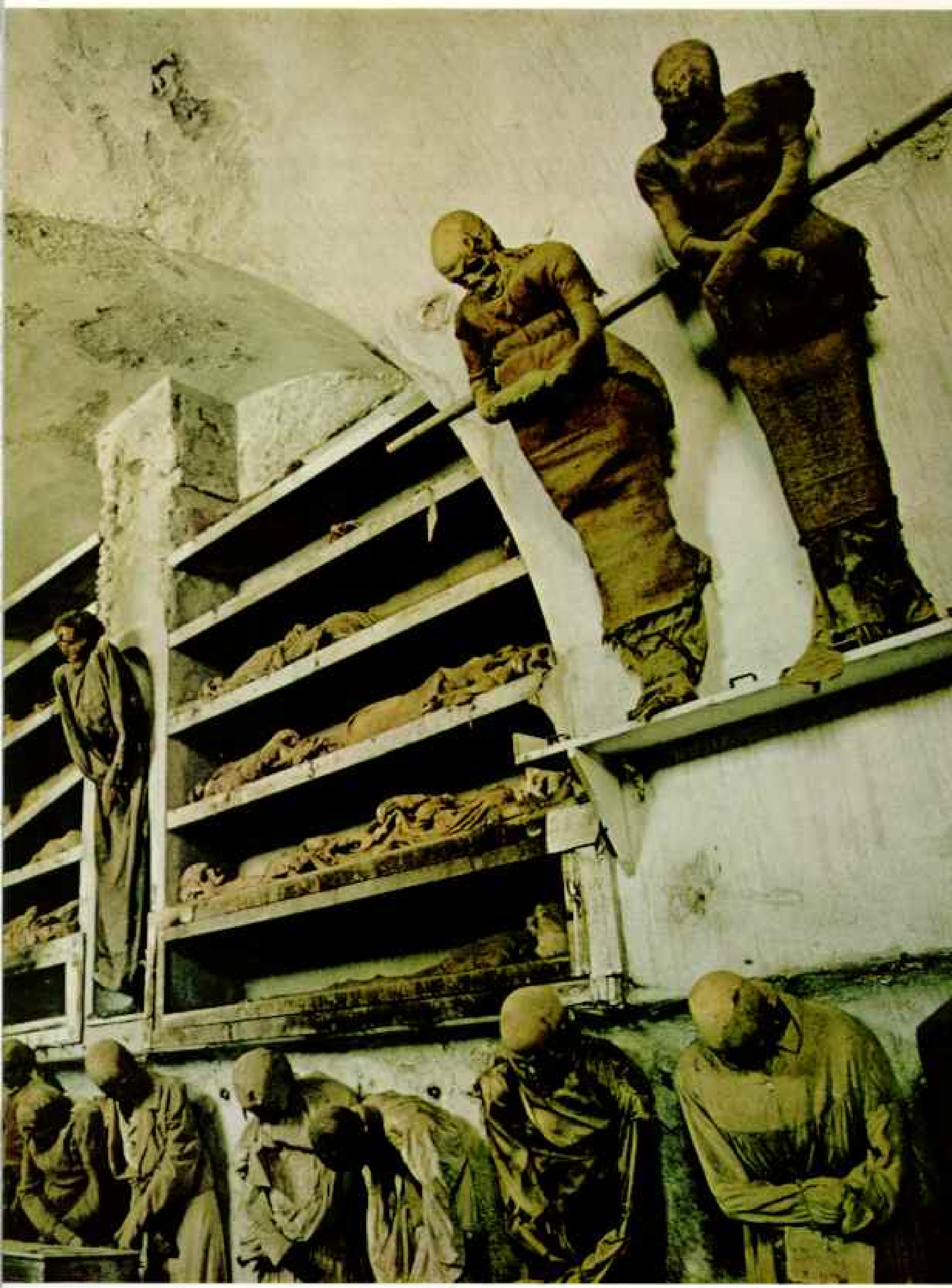
In the early 11th century several sons of a nearly impoverished Norman landowner, Tancred de Hauteville, rode into southern Italy to seek their fortunes. Incessant warfare racked the peninsula, and the tough, opportunistic Normans prospered as mercenaries and marauders. One Hauteville, a brilliant, rollicking brigand called Robert Guiscard, fought his way into the nobility. With perhaps a hundred horsemen, he and his youngest brother, Roger, invaded Saracen-ruled Sicily about 1060. Thirty years of warfare followed before all the island passed to the Normans. Guiscard's death in 1085 left Roger in control. From the beginning he imposed a policy of tolerance unique in 11th-century Europe. Charters guaranteed that "Latins, Greeks, Jews and Saracens shall be judged each according to their own law."

Arabic, Greek, Latin, and Norman French were all official languages in Roger's regime. He endowed Greek Orthodox monasteries and appointed Roman Catholic bishops. His army was built around Saracen brigades, and Moslems continued to provide the backbone of the Sicilian bureaucracy.

His son Roger II—one of the greatest men of the Middle Ages—became king of Sicily in 1130. Shaking off centuries of poverty, the island prospered under Norman rule. Farming and trade flourished. Every ship passing through the Strait of Messina paid a toll equal



Stark symbols of Sicily's preoccupation with death, bodies line the 350-year-old catacombs of Palermo's Capuchin Convent. Interment here was a mark of prestige; there were halls of judges, doctors, teachers, bankers. Some 8,000 Palermitans were mummified by monks before the practice was prohibited in 1881. A few bodies were added after that date, and regular visits by families—including children—continued well into this century. They came to change the clothing of deceased relatives or discuss family matters. Such visits are occasionally made even today.



Sicily, Where All the Songs Are Sad 425

to 10 percent of the value of its cargo into the treasury. Soon Sicilian gold and power dominated the Mediterranean. St. Bernard of Clairvaux, the most powerful spiritual voice of 12th-century Europe, hailed Roger: "Far and wide the renown of your magnificence has spread over the earth. For what lands are there to which the glory of your name has not reached?"

Roger's kingdom represented a miracle of synthesis. A Greek, George of Antioch—perhaps the greatest admiral of the age—commanded the Sicilian navy; his squadrons conquered North Africa, scourged Greece, and challenged mighty Byzantium. Robert of Selby, one of many Englishmen to serve the kings of Sicily, became Roger's trusted counselor; later, another Englishman, Walter of the Mill, became Archbishop of Palermo and built the great cathedral that still stands. Wondrously, Italian historians have transmuted him into Gualtiero Offamilio.

Coinage of the realm was dated according to the Moslem calendar; Roger's coronation

Rainbow on wheels gets a final flourish from a folk artist of Partinico (**right**). Painted carts, famed as distinctly Sicilian, are still seen daily in remote areas and elsewhere at *festa* time. The work of another artist adorns the car of Princess Vicki Alliata, a jet-setting member of one of Palermo's aristocratic families.

robe bore an embroidered inscription in Arabic; Greek mosaicists lent the glory of their art to Latin churches.

A historian has left us a portrait of this great Sicilian experiment in the brotherhood of man: "The bells of a new church, the chanting of the monks in a new abbey, would mingle with the cry of the *muezzin* from the minaret. . . . A marvelous variety of costume; the turbans of the orientals, the white robes of the Arabs, the iron mail of the Norman knights . . . infinite and continuous contrasts, which yet came together in harmony."

Roger's Greek and Arabic tutors had left him with a taste for scholarship. Men of letters found a ready welcome in his court. Many, of course, were Arabs, and Roger spent long days conversing with them in their own language. The famed Arab geographer, Al-Idrisi, passed many years in Palermo. Of the king, he wrote: "Nor is there any limit to his knowledge of the sciences, so deeply and wisely has he studied them. . . "

Under Roger's patronage, the geographer


FARMACIA
DOTT. A. LO BALBO

compiled one of the great books of the Middle Ages. A compendium of geographical knowledge, it pointed out that the world was round —thus anticipating Columbus by 300 years. Islamic scholars still know the work as *Kitab Rujar*, the "Book of Roger."

As did his successors on the Norman throne, Roger kept a harem, and eunuchs were no strangers to his retinue. Many of Roger's Christian subjects, reported one visitor to the island, "accused him of being . . . in his heart of hearts, a Muslim."

The king died in 1154. His son succeeded him, and then his grandson. But neither inherited Roger's gift for statecraft. Still, Norman Sicily survived the attacks and plots of jealous enemies. Even to the end, it stood as a brilliant prelude to the Renaissance. The passing of the 12th century, however, saw the end of the Hauteville dynasty. And with it, in the words of the premier historian of Norman Sicily, Lord Norwich, the end of "that sad, superb, half-forgotten Kingdom, whose glory shone ever more golden as the sun went down."

Precious Mosaic Survives Eight Centuries

On a Sunday morning I drove to Cefalù, 43 miles east of Palermo, to visit the most sublime of the Norman relics—the cathedral built by Roger II beside the Tyrrhenian Sea. Architecturally it is a synthesis of austere Norman masonry and graceful Saracen arches. Inside, covering the ceiling of the great apse, gleams a 12th-century mosaic of Christ Pantocrator. The face of the Ruler of All is stern, yet compassionate; nowhere in the nave can you escape the Saviour's grieving eyes. I am not alone in regarding this mosaic, by an unknown artist and all but lost in an obscure Sicilian town, as the greatest work of art the world has ever seen (page 431).

Between Cefalù and Messina, Sicily's north coast offers dramatic vistas. Green towering mountains plunge into the sea—sometimes gently, sometimes precipitously—and lonely beaches scallop the shore. Occasional resorts raise a brave sprinkling of cabanas and umbrellas, but these roughly pebbled beaches attract few vacationists.

Near Torre del Lauro I walked along a strand that stretched for empty miles. The waves of the Tyrrhenian Sea sighed against the beach like an uncertain lover. Everywhere lay the haunting impedimenta common to deserted seashores: driftwood caressed by patient currents into abstract sculptures, a strake and oarlock from some smashed boat, a single enigmatic shoe—plus a generous sampling of the garbage with which Sicilians so blithely strew their landscapes.

The Past Lives Under Sicilian Soil

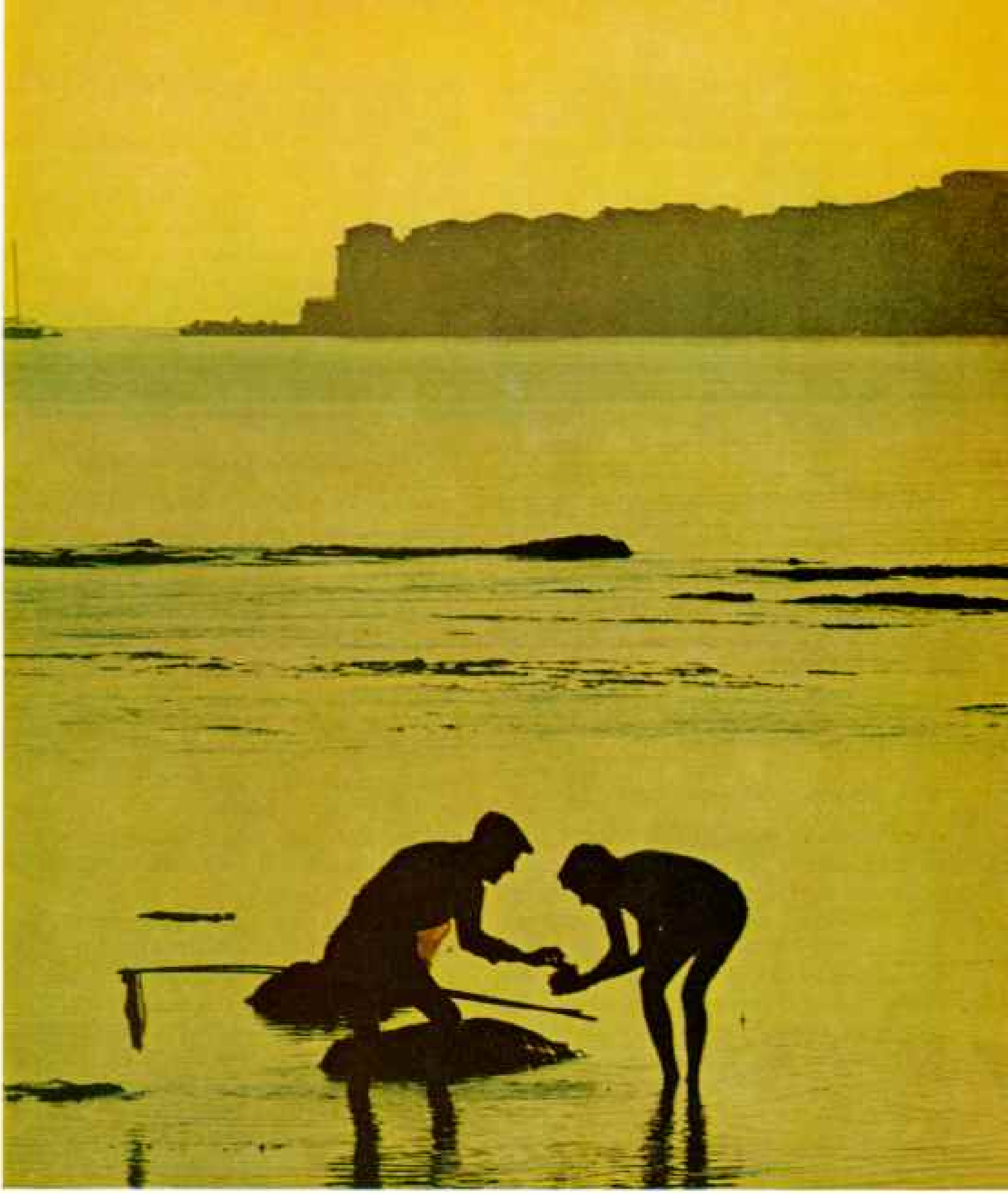
Among the pebbles I caught a glimpse of patina. I picked up a curious asymmetrical object, half stone and half corroded brass—three unfired .30-caliber rifle cartridges fused into a chunk of conglomerate rock.

In 1943 World War II had stalked this coast as invading Anglo-American forces advanced toward Messina. All the combatants—British, American, Italian, German—had used ammunition of roughly this caliber. An expert could certainly determine the nationality of these embalmed bullets. But did it really matter? Here, on this oft-conquered island, nature had fashioned a small monument to the futility of battles.

As every archeologist knows, Sicily is a time capsule. Sink a spade anywhere, and you will unearth the past. Does the fourth century A.D. interest you? Three miles southwest of the mountain town of Piazza Armerina, you can visit it—a world still Roman, still pagan, still splendid. In 1950 archeologists began to unearth a magnificent, rambling villa—built perhaps by an emperor, perhaps by a fancier of wild animals—with a phenomenally rich trove of Roman mosaics. The excavation continues and each year produces new discoveries.

As you drift from room to room in the vast pleasance, you see—portrayed on the floors in vivid reds and blues and flesh tones—the life of 1,600 years ago. Charioteers lash their teams around the Circus Maximus in Rome;

Hanging out at the corner store, San Fratello's war veterans bask in the morning sun. In World War I, Italians fought on the side of the Allies. During World War II a massive assault by British and American troops in 1943 wrested Sicily from the Germans and Italians after 38 days of fighting that left many cities and towns devastated.



Haven for a king: Fleeing a storm at sea, Sicily's first Norman king, Roger II, took shelter in this quiet cove at Cefalù more than 800 years ago, tradition says. Grateful for his survival, he began building a monument to Christ on a rocky headland overlooking the Tyrrhenian Sea. Thus the fishing village acquired its majestic twin-towered cathedral. A mosaic of Christ in the apse dominates the cathedral's interior (**facing page**).

Under Roger II, whose father had defeated the Saracens in Sicily in the 11th century, the Normans reached their greatest power in the Mediterranean—and Sicily its greatest prestige. Both father and son permitted the Saracen's sophisticated civilization to thrive beside Norman and Byzantine cultures. Art patron, author of Sicily's first written laws, and conqueror of parts of North Africa, Roger II created Europe's greatest court at Palermo. His intellectual curiosity spawned *The Avocation of a Man Desirous of a Full Knowledge of the Different Countries of the World*—known simply as the "Book of Roger." This 12th-century attempt at global knowledge, written by a court scholar, not only notes that the "earth is round," but also proclaims with equal assurance that some Norwegians are born without necks.

SCALA (BELOW)

straining men load camels, elephants, tigers, and rhinos aboard a ship, its rigging portrayed in meticulous detail. A pagan priest, in vestments that prefigure those of Christian prelates, sacrifices to Diana. A man leads two hounds whose collars and leashes can be found at your local pet shop. Women in bikinis exercise with dumbbells and a large ball (page 419).

To look at these, our distant ancestors, with their expressions of placidity and pain, smugness and astonishment, is to realize the profound truth of the French proverb, *Plus ça change, plus c'est la même chose*—The more it changes, the more it is the same.

Not far from Piazza Armerina lies a smallish steel-gray body of water called Lake Pergusa. Here, according to legend, the virgin goddess Persephone was picking flowers when Hades, ruler of hell, emerged from the lake and savagely abducted her.

The tale could serve, I thought, as an allegory for Sicily—a once-fair country ravished by invaders. From Pergusa I drove toward the east coast, through crumbling villages, past forsaken farmsteads and parched, untended fields. The land of Persephone.

Etna's Threats: Fissure and Fire

Virtually all eastern Sicily lives in the shadow of one of the world's most famous volcanoes—Mount Etna (facing page). The graceful cone-shaped peak rises to a height of some 10,900 feet. The altitude of Etna, however, pales beside its great bulk; the base of the mountain covers an area of 500 square miles, and 60 towns cling to its fertile, if sometimes heaving, slopes.

The ancient world regarded Etna as the forge of Vulcan. Pindar wrote of it in 475 B.C., and since his day chroniclers have described some 135 major eruptions—the last in 1971.

To learn something of Etna before ascending it, I called upon Professor Salvatore Cucuzza Silvestri in his volcanological laboratory at the University of Catania. The city of Catania, Sicily's second largest, is both a gift and a victim of Etna. Eons ago, the volcano began to build an offshore island that ultimately joined Sicily. Catania rests on a layer cake of lava on the seaward face of this relatively new land, and periodically—most recently in 1923—more lava boils down the mountain to menace the city.

A cordial, witty man, Professor Silvestri tended to deprecate his favorite volcano. "Etna isn't really deadly," he said. "This volcano is of a type that will never explode cataclysmically. Rather, small shocks continually rend the slopes, freeing gas and lava. In 1928 such a fissure destroyed the town of Mascali. Another similar split threatened Bronte in 1974.

"But the chief stigmata of Etna are the hundreds of little shrines you find on the slopes; each marks the spot where a saint stopped a flow of lava that threatened a village. Actually, the lava from Etna's fissures rarely flows for more than one or two miles. But people have great trust in their saints."

Sno-Cat Lumbers to the Summit

Reaching the summit of Etna combines a maximum of technology with a modicum of exertion. I followed a winding road up to Rifugio Sapienza, 6,230 feet high. From there, a *funivia*—an overhead cable car—swung me up to 8,200 feet. I came to Etna in April, a treacherous month of crumbling snow and sudden storms. So, for the final winding three-mile ascent, I rode in a tracked Sno-Cat piloted by Gaetano Mazzaglia, who lives on the mountain and works for the funivia. The prosaic vehicle, of American manufacture, becomes a poem in Italian—*Il Gatto della Neve*, the Cat of the Snow.

Ascending Etna is an inverted journey from Paradise to the Inferno. Vineyards and orchards and bright, neat villages dot the lower reaches; above 4,000 feet stand clumps of chestnut trees, then forests of oaks and beeches. At 6,000 feet you enter a sterile moonscape of reddish-black lava streaked with aging snow. Then comes the white glare of the snowfield that covers the upper slopes.

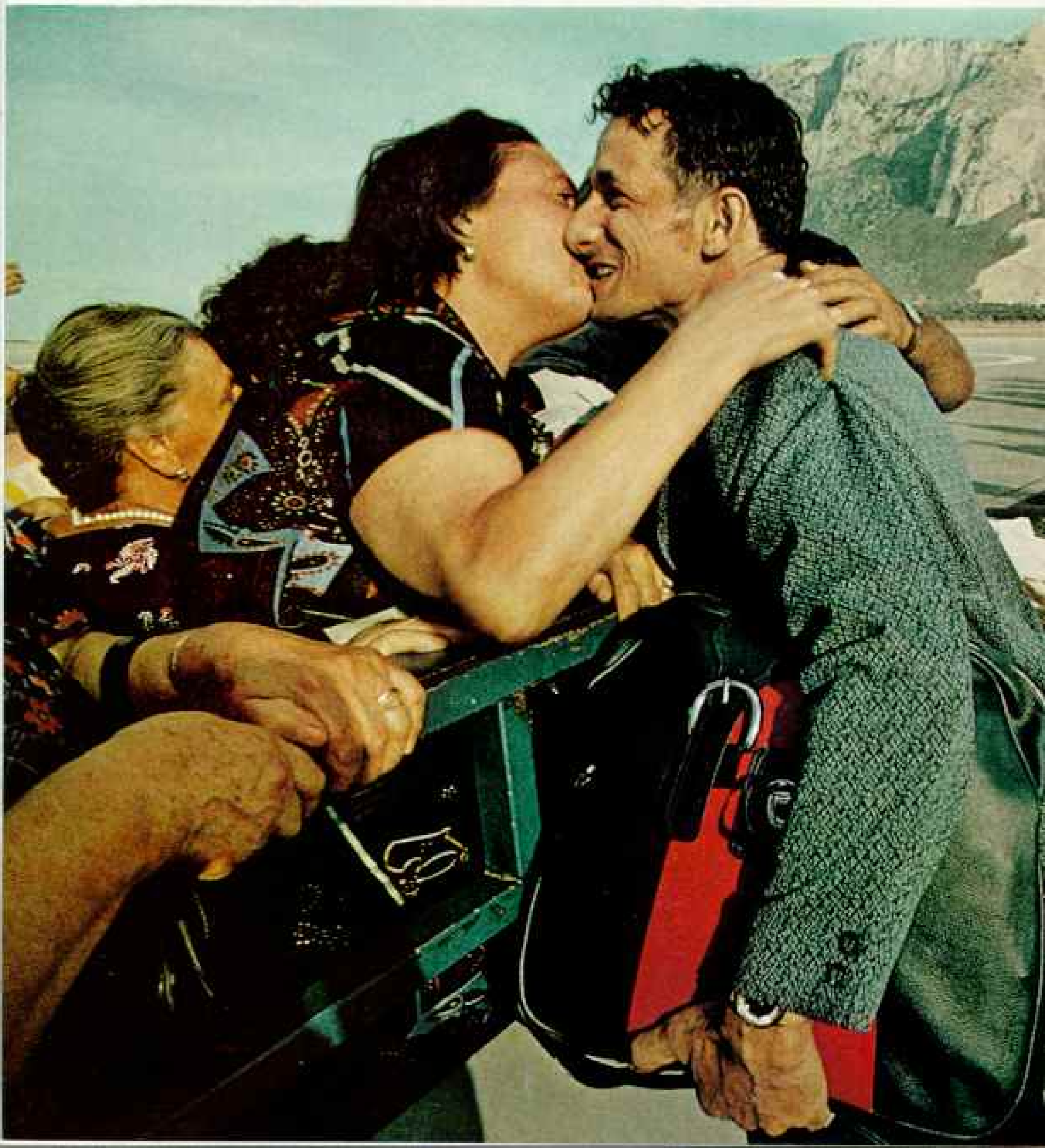
The Cat of the Snow lurched through the

Puffing a warning, Mount Etna spews steam and gas, constant reminders of her ability to belch "fountains of purest fire," as the Greek poet Pindar described an eruption in 475 B.C. Today tracked or four-wheel-drive vehicles carry visitors over a rugged trail almost to the main crater of Europe's loftiest volcano, 10,900 feet above the Ionian Sea.

drifts left by an early-morning storm as the driver provided a running commentary. "People tend to underestimate this mountain," he said. "Just last Monday a tourist insisted upon climbing to the summit in bad weather. When he didn't come back, we mounted a search. Luckily, we found him in a snowdrift, almost frozen but still breathing."

We stopped just below the crater. It was a "good" day. A piercing, icy wind had swept away the cloud that often veils the summit. From the crater great clouds of dirty gas belched into the clear sky amid surly rumbles. Chunks of lava—fiery red fading into maroon—erupted in bursts. Like mortar shells they arced high and lazy, plunging down to pepper the snowy summit in an endless barrage. Steam hissed from fumaroles, yet, thigh-deep in the snow, I shuddered in the near-zero cold. Etna: hell at high altitude.

Bouncing back down in the Cat of the Snow, I asked the driver if he had ever experienced a major eruption. "Yes," he said. "A few years ago a fissure blew open just above my town, Nicolosi. The lava rolled down like a burning tidal wave. At the last



minute priests came from Catania with a relic of St. Agatha. They held it up and the lava stopped."

He fixed me with his eyes. "Look, I don't necessarily believe that the relic made any difference. But the lava *did* stop."

Dark Politics at a Bright Resort

The next day I reached Taormina, perhaps the Mediterranean's loveliest resort. Luxury hotels rise above small hidden beaches, and the shop-lined streets wind up to a theater that is one of the glories of Western architecture. Built by Greeks in the third century B.C. and restored 300 years later, after the rise of the Roman Empire, it commands a view of the Ionian Sea and of Etna that mesmerizes the eye.

But I had come to visit the Honorable Attilio Castrogiovanni—ex-convict and ex-member of the Sicilian parliament. A cultured man of middle age with a narrow, ascetic face and impeccable manners, he lives quietly on a headland overlooking the exquisite turquoise arc of the bay of Taormina.

Dusk was lowering when I arrived, and no

Section by section, a tanker takes shape in Palermo's shipyard. Despite new industries, Sicily can't provide enough jobs, forcing thousands to work elsewhere. This Sicilian (**left**) returns from a foreign job to a reunion at Palermo's airport. Until Sicily's economy improves, its human resources will be wasted at home or lost to other markets.

lights were on in his apartment. In the living room Signor Castrogiovanni's sister poured drinks. Unaware that I understood Italian—although imperfectly—she said to her brother, "Attilio, please be discreet."

He smiled thinly. "To me bread will be bread and wine will be wine."

When an amnesty freed all Sicilian political prisoners in 1946, Castrogiovanni had served the better part of a year in jail and stood accused of 24 crimes, three of them meriting the death penalty. All stemmed from a small, savage war scarcely remarked by the rest of the world.

Unlikely Alliance Battles for Freedom

In 1943 he had helped to found a movement for an independent Sicily. Professors, students, landowners, artists, peasants joined it. But, with the end of World War II, Italian forces attacked and devastated the various headquarters of the movement. Separatists took up arms. The bandit Giuliano joined them. Following a flag of red and gold, the unlikely assemblage fought for a free Sicily.

The Separatists pled their case—in vain—when the United Nations was formed in 1945; Giuliano tried—in vain—to persuade the U.S.A. to annex Sicily as its 49th state.

In the end the little army of idealists disbanded. Many had died. Many more, such as Attilio Castrogiovanni, had been convicted of "attempting to subvert state institutions." But, while still in jail, he had been elected to the Italian Constituent Assembly—as an unreconstructed Separatist. Some Sicilians would disagree with his view of history, filtered as it is through his tragic experience.

In the apartment in Taormina the failing light glinted on his eyeglasses as he spoke. "I can assure you that Sicily would be different and better if we had separated from Italy in 1946. For a brief moment the opportunity was there, but we missed it.

"Italy had annexed Sicily in 1860. Eighty-three years of Italian rule had left our island depressed and disillusioned. So when we rose, most Sicilians supported our struggle; the British and Americans, who had captured the island in August 1943, regarded us sympathetically. For two years the movement expanded. Hope was everywhere."

Darkness deepened in the room, and his voice became faintly ironic. "In 1943 Italy switched sides in the war. Italian regiments invaded the mountains to root us out. The Communists fought us because an independent Sicily would have ruined their grand design for Italy. And the Mafia began to subvert us in every way. You see, mafiusi never create power; they join it wherever it appears. As soon as they saw that the Separatists were doomed, they allied themselves with the opposition and did everything in their considerable power to smash us.

"Despite that, we succeeded in forcing Italy to grant autonomy to Sicily. A statute—written by Sicilians—provided for virtually complete self-government. The great majority of Sicilians, including most Separatists, were satisfied with this new status. The movement for independence rapidly melted away."

"Did autonomy bring any benefits to Sicily?" I asked.

"None. Sicily was totally betrayed. The principles of our statute have never been fully applied, and the autonomy has been transformed into a mere farce. You must never forget," he smiled bleakly, "that Italy is the motherland of Machiavelli."

We walked across the dim room to the door. "One cannot deceive oneself," he said with his desolate smile. "The movement failed. Yet the Separatists planted a seed. Our statute—a constitutional law—is there. In ten years, or perhaps a hundred, it may bear fruit. This is the only optimism left to us."

History Weighs Heavily on Sicily

At the door we shook hands and I thanked him for his candor. Then I asked a final question: "Do you feel any bitterness?"

Again the bleak smile and a small inclination of the head. "*Infinita*. I have infinite bitterness." The last light, like the embers of a dream, was dying outside the windows.

Too long a history . . . too many conquerors. Now, exhausted by time and defeat, most Sicilians have made their peace with the present: They are Italian. Not, of course, Attilio Castrogiovanni brooding in the Taormina twilight; not the pilgrims who daily twine red and gold wild flowers on the mausoleum of Giuliano. But most of the rest.

O Singer of Persephone!
In the dim meadows desolate
Dost thou remember Sicily? □

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Datsun Saves

Polynesian voyager recalls Hawaii's past

ALL BY DAVID HISER

SIGHT UNSEEN FOR CENTURIES, a double-hulled voyaging canoe like those of the early Polynesians speeds wing and wing through Hawaiian waters (**above**). In a test of the performance of such craft, an 18-man crew will shortly attempt to sail *Hokule'a*, or "Star of Gladness," on a 6,000-mile round trip to Tahiti. Many Hawaiian hands have joined with the Polynesian Voyaging Society to build the vessel. Crew chief Kimo Hugho (**right, lower**) mends a steering sweep with a traditional adz. In next month's GEOGRAPHIC, training skipper Herb Kane (**right, top**) tells of the perilous testing of *Hokule'a*—an adventure you can share with your friends by nominating them for membership on the form below.

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We can explain how we did it in two words: brilliant engineering.

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The engine is mounted sideways up front by the drive wheels. So there's more weight where the traction is – to help keep a Honda Civic moving under difficult driving conditions.

Honda Civic Sedans and Hatchbacks have MacPherson strut independent suspension at all four wheels. There are also two independent braking systems with self-adjusting power-assisted front disc brakes.

There's brilliant engineering applied to the interior of the Civic, too. We designed the passenger compartment first, then built the rest of the car around it. So the Civic seats four adults, with room for luggage, too.

price. The 1976 Honda Civics.

And finally, there are those two very important things about cars these days: mileage and price. We have the highest and the lowest.

There are nearly 600 Honda Civic dealers who want to show you what brilliant engineering can do for you. Test own a Honda Civic soon. It's an unforgettable experience.

Civic 1237cc (Not avail. in Calif.)	Price††	EPA Mileage Estimates* Hwy.	City	Combined Hwy. & City
Sedan (4-Speed)	$2729	41	28	32
Hatchback (4-Speed)	$2939	41	28	32
(Hondamatic)	$3099	30	24	27
Civic CVCC 1488cc				
Sedan (4-Speed)	$2979	42	32	36
Hatchback (4-Speed)	$3189	42	32	36
(Hondamatic)	$3349	33	25	28
Wagon (4-Speed)	$3419	37	26	30
(Hondamatic)	$3579	32	24	27
5-Speed (Hatchback)	$3469	44	33	38
Avg. Sedan/Hatchback (4- & 5-Spd.)		43	32	36

CVCC, Civic and Hondamatic are Honda trademarks.

*Gas Mileage Guide 9/75. The actual mileage you get will vary depending on the type of driving you do, your driving habits, your car's condition and optional equipment. Combined mileage based on Federal Highway Administration estimates: 55% city driving, 45% highway driving conditions.

†Based on a comparison of manufacturers' suggested 1976 retail prices.**

**Manufacturer's suggested retail price plus tax, license, transportation charges, optional equipment not shown, and dealer's preparation charges.

HONDA CIVIC
What the world is coming to.

"My insurance company? New England Life, of course. Why?"

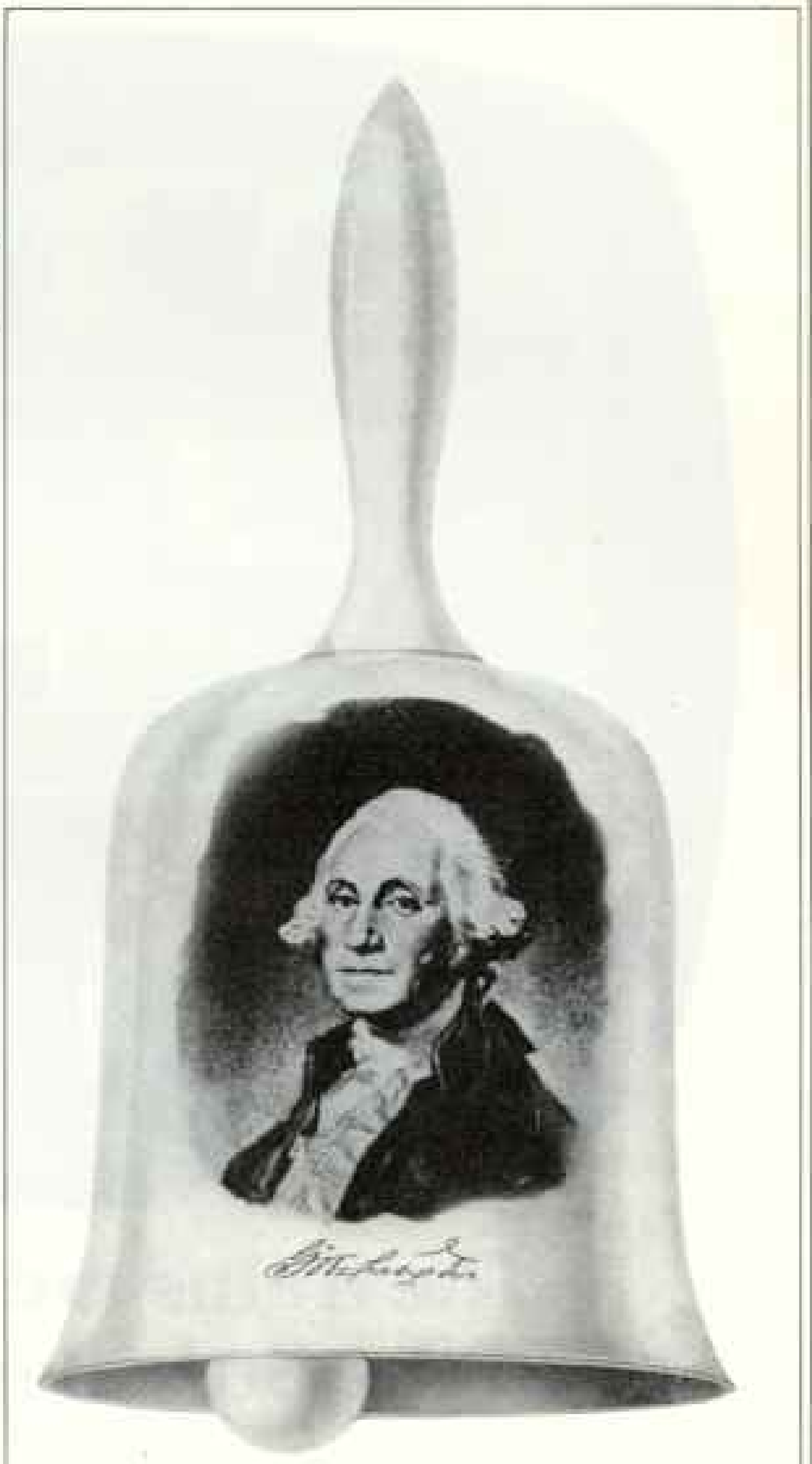
The class of 1976: our mutual funds, variable annuities and investment counseling.

George Washington

American Bicentennial Bell

A Limited Edition

- ★ One in a series of porcelain bells to commemorate, in vivid color, important people and historic events in the birth of America.
- ★ Beautiful porcelain heirlooms of our nation's proud Bicentennial celebration.
- ★ The George Washington Bell will be issued in a limited edition only for orders postmarked by March 31, 1976.
- ★ Each bell will be hallmarked and registered by the Danbury Mint.
- ★ Priced at only $25.00.



Height of Actual Bell — 6"

The achievements of "The Father of Our Country", George Washington, are legend. The greatest of all patriots, he guided a young and proud nation on a course of freedom.

From his courageous winter at Valley Forge, to his daring crossing of the Delaware, to his leadership as the first President, Washington truly was "First in war, first in peace and first in the hearts of his countrymen . . ."

Now, as the world celebrates 200 years of American freedom, we rededicate ourselves to this ideal by recalling the proud deeds of this great American patriot. To commemorate his everlasting contributions, the Danbury Mint will issue a limited edition Bicentennial Bell.

The front of this historic bell bears a full color portrait of George Washington. The reverse depicts his famous home, Mount Vernon. This beautiful porcelain heirloom will be available only briefly in a limited edition which closes forever on March 31, 1976. After that date, this Bicentennial Bell will be available only from original owners willing to part with it, and only at their asking price, whatever that might be.

Experience suggests that few of these bells will ever reach the open market. Most will be kept as prized reminders of our Nation's Bicentennial, and proudly passed on to future generations of Americans.

the Danbury Mint

The Danbury Mint
10 Glendinning Place
Westport, Conn. 06880

Must be postmarked by March 31, 1976

Please enter my order for _____ "George Washington" Bicentennial Bell(s). My check or money order is enclosed at the rate of $25.00, plus $1.25 shipping and handling) per bell.*
Please notify me as additional Bicentennial Bells are issued in the future, so that I may decide whether to purchase them.

Name _____

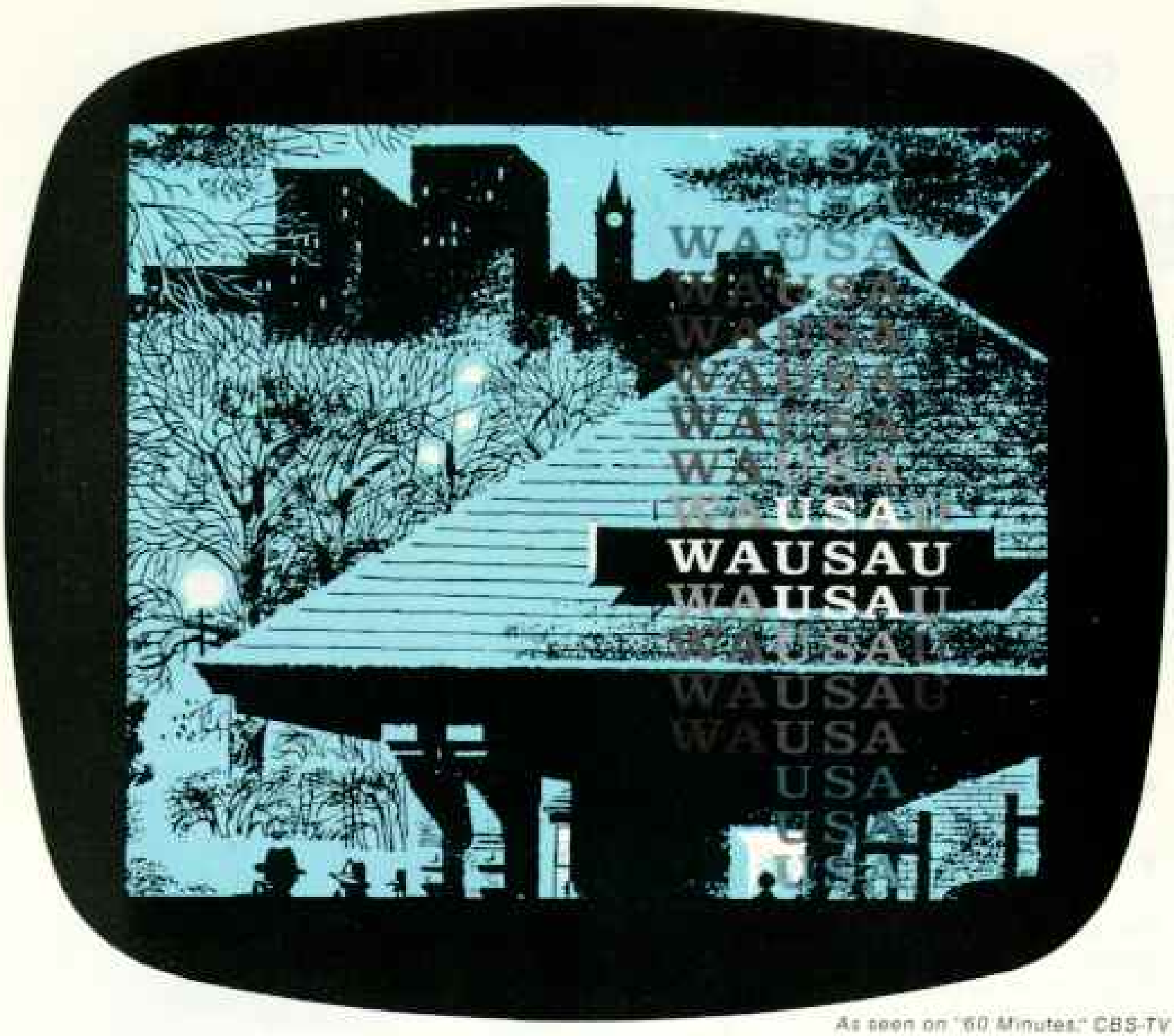
Address _____

City _____ State _____ Zip _____

*Connecticut residents add $1.84 per bell to cover sales tax.
Make check or money order payable to Danbury Mint.

ESTIMATED DELIVERY — 4 to 6 WEEKS.

D1



As seen on "60 Minutes," CBS-TV

The trains are gone, now. But the little depot works on.

This little railroad station has served as our trademark for 22 years—in magazine ads and as our signature on TV commercials—all across the U.S.A.

It symbolizes our way of working. Cooperative. Helpful. Honest work for honest pay. And it's also a reminder to us, as a major business insurer, to stay on that track.

Our story is as simple and straight-forward as our trademark. Business insurance is a *partnership*—with responsibilities on *both* sides. The partners we seek are a special breed. They are willing to roll up their sleeves and work with us to *earn* favorable rates.

Our guidance and know-how can help you control losses. But your commitment and effort are needed to get the job done right.

By working together, we become partners in saving life and health and property. And insurance *costs*.

We have the way. Do you have the will?

Come to the source

Employers Insurance of Wausau

Wausau, Wisconsin

The 1976 Thunderbird.
Could it be the best luxury car buy in the world?

The Private World of Thunderbird includes standard features like, automatic transmission, power front disc brakes, power side windows, solid-state ignition. Not to mention air conditioning, vinyl roof, steel-belted radials and split bench seats. In addition there is an impressive list of added comforts and conveniences available to choose from.

Enter the Private World of Thunderbird for 1976.

Shown: 1976 Thunderbird with optional Bordeaux Luxury Group, WSW tires, Moonroof and Convenience Group.

The closer you look, the better we look. See your local Ford Dealer.

THUNDERBIRD

FORD DIVISION Ford

A message to former members of the Peanut Gallery as they approach middle age.

The Peanut Gallery was the little grandstand on The Howdy Doody Show where all the children sat.

But it was also meant to include every child who sat in front of the TV enraptured by Buffalo Bob, Clarabelle, Phineas T. Bluster and friends. You were all buddies and contemporaries of Howdy Doody, and that's the way it would always be.

Of course, that isn't the way it stayed. You grew up and got married. And Howdy Doody, who would always be a child, is now thirty-three years old.

You can't postpone the future.

If all that time can fly by so fast, imagine how quickly the *next* several years will pass.

That's why we'd like to urge you to get ready for them

And that's where Metropolitan Life can help.

We don't just insure your life. We help insure your future.

You're probably hoping to send your children to college. We can provide insurance that can help make it possible.

Or maybe you'd like to build the vacation home you've always promised yourself. Your Metropolitan insurance can help.

Or maybe, instead of retiring, you'll decide to start a second career or your own business. We can help make that possible, too.

In fact, two out of every three dollars we pay out in benefits go to *living* policyholders—to help pay for their future.

He who hesitates pays higher premiums.

At Metropolitan Life, we insure over forty million people. We've been helping people prepare for the future for 107 years. But while much has changed over that time, one fact about personal life insurance is always the same:

The sooner you begin, the less it costs every year.

See your Metropolitan representative. Soon.

Because the future gets closer every minute.

Metropolitan

Where the future is now

"That would be a beautiful place for some new homes."

"It would be a shame not to use the sand and gravel."

How should we use aggregate-bearing lands? For houses or gravel? Parks? Farming? There's no pat answer. Optimum land use is a complex subject. People often have valid but differing opinions about what "optimum use" means.

Most people would rather see new homes across the street than a gravel pit. America needs more housing despite the building slump. Demand exceeds supply by hundreds of thousands of units. In 25 years, we'll need nearly 50 million additional dwellings.

But if we're to meet future building goals, we'll need sand and gravel. Lots of it. For fill, subbase. For concrete. Over 100 tons of concrete can go into an average bungalow with garage and drive.

We also need sand and gravel for schools, hospitals, factories, roads and bridges. And we need land to put those new structures on, and for farms, parks and forests. Which should have priority—land for buildings or land for building materials?

The answer may be both. Responsible planners see land use as a flexible thing, tuned to the needs of the day. Whatever its initial use, if deposits warrant and environmental impact permits, the land could be used for sand and gravel. After that, perhaps, for sanitary landfill or a park or housing development. Each sequential use should contribute to community needs, blending smoothly into the next, making best use of the land now while preparing for what's to come.

Sequential use should be a part of today's land planning.

Caterpillar builds machines used in agriculture, mining and construction. Those machines produce sand and gravel, develop home sites and reclaim land. We realize responsible land use is important to the quality of life.

There are no simple solutions. Only intelligent choices.

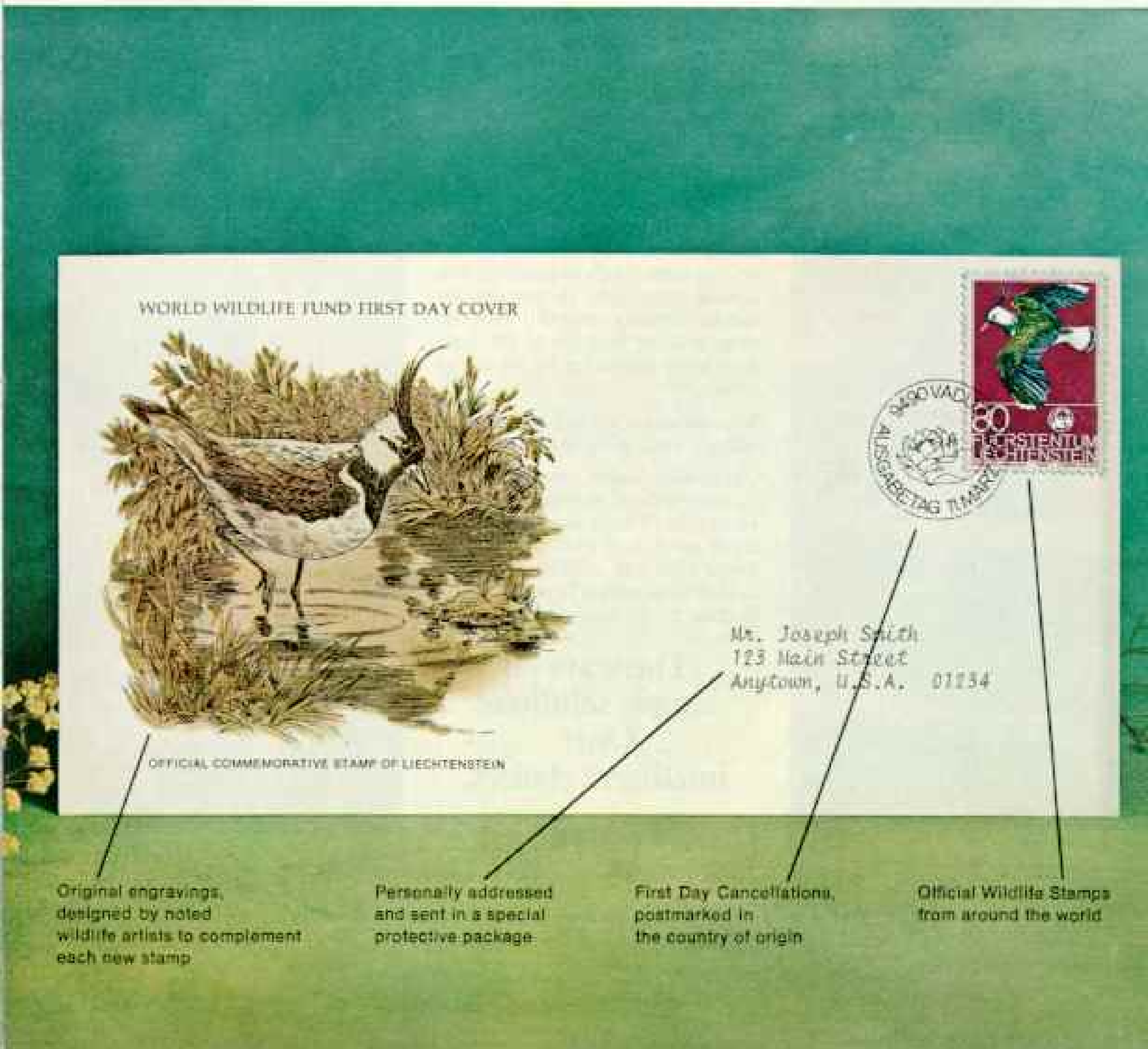
CATERPILLAR

Announcing the first

International Collection of World Wildlife First Day Covers

authorized by the World Wildlife Fund

H.R.H. THE PRINCE OF THE NETHERLANDS, PRESIDENT



Richly engraved First Day Covers bearing the world's most important new wildlife stamps, each postmarked with the first day cancellation in the country of origin.

Issued in strictly limited edition.
Charter Subscription rolls close: March 31.
Original issue price: $2.75 per cover.

IN MAY OF 1976, collectors in various parts of the world will receive the first issues in a most important new collection of international First Day Covers.

This will be the *first* collection of First Day Covers ever authorized by the internationally respected World Wildlife Fund of Morges, Switzerland—and the *first* collection of First Day Covers ever devoted exclusively to official wildlife stamps from nations around the world.

Charter Subscribers to this collection will be the *only* collectors in all the world eligible to acquire *every* issue in The International Collection of World Wildlife First Day Covers—from the very beginning.

To become a member of this select group, however, you must enter your Charter Subscription on or before March 31, 1976.

An official commemorative collection

As a subscriber to this historic collection, you will receive *every* outstanding new wildlife stamp, issued anywhere in the world, that is officially selected by the World Wildlife Fund.

Each of these important new wildlife stamps will be sent to you as part of an individual First Day Cover. And every cover will be a limited edition collector's item—combining an original work of art with the new wildlife stamp and the first day cancellation, *applied at the designated post office of first issue, in the issuing country.*

As astute collectors well know, this cancellation is extremely desirable, since it will permanently and officially certify the special First Day of Issue status of both stamp and cover.

Beautiful creatures of the wild

Historically, wildlife stamps have been treasured by collectors for their beauty and strength of design, as well as the spectacular subjects they portray. And *this* collection will present an exceptional array of these important and colorful stamps—from the far corners of the world.

In addition, each cover will bear an original engraving that presents a unique, artistic portrayal of the wildlife subject depicted on the stamp. These engravings will be designed exclusively for this series by noted wildlife artists of many nations. Their subjects will range from the great jungle animals to the world's most exotic birds and the strange and beautiful denizens of the deep—the beauty of nature in all its myriad forms.

Each cover will also be accompanied by an authoritative commentary about the wildlife depicted on the stamp and on the engraved cover. As a result, each cover will be a fascinating educational experience, as well as a significant collectible.

And *every* cover will be fully personalized with the name and address of the Charter Subscriber, if so desired.

A strictly limited edition

The International Collection of World Wildlife First Day Covers will be issued in strictly limited edition, exclusively for advance subscribers. There is an absolute limit of one subscription per person. *Back issues will not be available.* Thus, while the subscription rolls may be opened again in the future, Charter Subscribers will be *the only ones* eligible to receive every issue.

Furthermore, each Charter Subscription will be accompanied by a statement of dedication, bearing the signature of the President of the World Wildlife Fund, H.R.H. Prince Bernhard, The Prince of the Netherlands.

No advance payment necessary

Charter Subscribers will receive their First Day Covers at the rate of three per month for the three-year subscription period beginning in May 1976. Those who enroll as Charter Subscribers in the United States will be *guaranteed* the original issue price of $2.75 per cover throughout the full subscription period—a most unusual and significant price guarantee. Furthermore, the subscriber may cancel at any time upon 30 days' notice. However, once a Charter Subscription is canceled, the exclusive opportunity to build *the complete collection* of these important international covers will be lost forever.

World-wide deadline for Charter Subscriptions is March 31, 1976

This is *the only time* that a Charter Subscription for The International Collection of World Wildlife First Day Covers can be accepted. Only those applications postmarked by March 31, 1976, will be eligible for acceptance. The Franklin Philatelic Society, international stamp division of The Franklin Mint, will service all subscriptions. Your application should, therefore, be mailed directly to The Franklin Philatelic Society, Franklin Center, Pennsylvania 19091, *no later than March 31, 1976.*

A deluxe album, to protect and display the collection, will be provided to each Subscriber without additional charge.

Charter Subscription Application

THE INTERNATIONAL COLLECTION OF WORLD WILDLIFE FIRST DAY COVERS

Limit: One subscription per person.
Subscription deadline: March 31, 1976.

The Franklin Philatelic Society
Franklin Center, Pennsylvania 19091

Please enroll me as a Charter Subscriber for the International Collection of World Wildlife First Day Covers. I understand that I will receive 3 covers per month for 36 months, beginning in May 1976, and that the price of $2.75* per cover ($8.25* per month) will be guaranteed to me for the entire three-year period. A collector's album to hold all the covers will be sent to me at no additional charge, and I may cancel my subscription at any time upon 30 days' notice.

I need send no money now. I will be billed for my covers as they are issued.

**Plus my state sales tax*

Mr.
Mrs.
Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Signature _____
All orders are subject to acceptance.

Your covers will be personalized exactly as indicated above. If you wish a different personalization, print the name and address you wish in block letters on a separate piece of paper and enclose it with this form.

☐ Check here if you wish no personalization at all.

A statement from
H.R.H. The Prince of the Netherlands
President, World Wildlife Fund

It is a pleasure for me to recommend to you the collection of World Wildlife first day covers described in this announcement. The collection is the first of its type to be authorized by the World Wildlife Fund, and is both fascinating and educational.

But this is not all. It also serves as a constant reminder of the need for man to live in harmony with nature. The spectacular creatures portrayed on the covers are a part of the living world around us and they need our protection and conservation. This is what the World Wildlife Fund works for, and it is a task which concerns us all.

I am sure that you will obtain great satisfaction from this collection, and I look forward to it with warm anticipation myself.

H.R.H. Prince Bernhard
The Prince of the Netherlands

TV service technicians give their opinion about Zenith:

I. Best Picture.

In a recent nationwide survey of the opinions of independent TV service technicians, Zenith was selected, more than any other brand, as the color TV with the best picture.

Question: In general, of the color TV brands you are familiar with, which one would you say has the best overall picture?

Answers:

Zenith	36%
Brand A	20%
Brand B	10%
Brand C	7%
Brand D	6%
Brand E	3%
Brand F	2%
Brand G	2%
Brand H	2%
Brand I	1%
Other Brands	3%
About Equal	11%
Don't Know	4%

Note: Answers total over 100% due to multiple responses.

II. Fewest Repairs.

In the same opinion survey, the service technicians selected Zenith as the color TV needing the fewest repairs. By more than 2-to-1 (38% vs. 15%) over the next brand.

Question: In general, of the color TV brands you are familiar with, which one would you say requires the fewest repairs?

Answers:

Zenith	38%
Brand A	15%
Brand C	8%
Brand D	4%
Brand B	3%
Brand I	2%
Brand F	2%
Brand E	2%
Brand G	1%
Brand H	1%
Other Brands	4%
About Equal	14%
Don't Know	9%

For survey details, write to the Vice President, Consumer Affairs, Zenith Radio Corporation, 1900 N. Austin Avenue, Chicago, IL 60639.

The Panorama II. Sophisticated 25" diagonal console. A rich blend of soft Silver coloring and simulated Rosewood cabinetry. Model SG2564X. Simulated TV picture.

ZENITH®

100% SOLID-STATE CHROMACOLOR® II

The quality goes in before the name goes on.®

If you *started* with the fresh-perked flavor
of good ground roast coffee . . .

Then *froze* it.
To lock-in and preserve all that fresh-perked flavor . .

When you *removed the ice* you'd have
100% freeze-dried coffee that looks and smells
like ground roast. And tastes fresh-perked.

You'd have Taster's Choice®
Freeze-Dried Coffee. Regular.
And Decaffeinated, 97% caffein-free.

Tastes fresh-perked. Because it starts fresh-perked.

WORLD-
a super magazine for kids

WORLD—National Geographic's new, colorful, exciting magazine treats youngsters 8 through 12 to fun that teaches... learning that lasts. Young minds go to faraway places, meet unusual people, learn amazing facts, get craft and hobby instruction, experience true-to-life adventures—all in 36 big 8½-by-10⅞-inch pages. Twelve great issues are only $4.85 a year in the U.S., $5.50 in Canada and Mexico, $5.85 elsewhere. Three-year subscription (U.S. only) at $13.50 saves you even more. Invest in a child's future now.

MAIL THIS ORDER FORM TODAY!

NATIONAL GEOGRAPHIC SOCIETY
Dept. 2112, Washington, D. C. 20036

Please send a WORLD subscription to the person named below. Enclosed is $_____ for ☐ 1-year subscription ☐ 3-year subscription

Name _____ Year of birth _____

Address _____

City _____ State _____ Zip _____

South Carolina offers you the vacation with all the extras. At no extra cost.

We'd like to help you spend less money for your vacation this year. By getting more vacation for your money.

So we've put together the South Carolina Trip Kit. It's full of facts about all the things South Carolina has to offer. Like beaches, mountains, hunting, fishing, camping, golf, tennis, lakes, boating, gardens and historical cities. And you'll be surprised how many of our attractions are free.

Even the South Carolina Trip Kit is free. Just send us the coupon and find out how you can have all the South Carolina extras. At no extra cost.

Name _____ Address _____

City _____ State _____ Zip _____

Free South Carolina Trip Kit

Mail to South Carolina Division of Tourism, Room 217, Box 78, Columbia, South Carolina 29202

"Unbelievable."

The Aspen sedan has the look of a fine European road car.

The Aspen sedan was designed with as much attention to its outside appearance as to its inside engineering. The shape of its classic lines and the high sweep of its glass give a luxurious look to this finely engineered automobile.

The Aspen sedan has more total room than a Cadillac Seville.

There's plenty of room to seat six people quite comfortably. And that's more than enough to make an Aspen sedan the envy of some very expensive cars.

The Aspen sedan is priced lower than Ford Granada or Mercury Monarch.

Based on manufacturer's suggested retail price for Aspen sedan, excluding state and local taxes, destination charge, and optional equipment.

The Aspen sedan has a ride that rivals that of a full-sized car.

The unique Isolated Transverse Suspension is rubber isolated to reduce noise as well as vibration transmitted to the passenger compartment. This gives Aspen the comfortable ride you usually find in a much bigger car.

The Aspen sedan got up to 27 MPG on the highway according to EPA estimated mileage results.

According to EPA estimated mileage results, the Aspen sedan and coupe got 27 MPG on the highway and 18 city. The wagon got 30 MPG highway and 18 city. All were equipped with a 225 Six and manual transmission. (Your actual mileage depends on driving habits, condition of your car, and options. In California, see your Dealer for mileage results.)

The Aspen sedan offers the important convenience features of a luxury car.

A long list of options includes everything from power seats and windows to electric door locks and automatic speed control. So you can enjoy the same conveniences as you would in a big luxury car.

Here's "The Clincher."

"For the first 12 months of use, any Chrysler Corporation Dealer will fix, without charge for parts or labor, any part of our 1976 passenger cars we supply (except tires) which proves defective in normal use, regardless of mileage." The owner is responsible for maintenance service such as changing filters and wiper blades.

Dodge

ASPEN

The new Dodge Aspen. For a small car at a small price, it's unbelievable.

Home Study

CALVERT Kindergarten through 8th grade.

Educate your child at home with approved home study courses, or use as enrichment. Home is the classroom, you are the teacher with the help of step-by-step instructions. Start anytime, transfer to other schools. Used by over 425,000 students. Non-profit. Write for catalog. Admits students of any race, color, national or ethnic origin.

Calvert School

Established 1904 — 301-243-6039

Box N3-6, Tuscany Rd., Baltimore, Md. 21210

Parent's Name_____

Address_____

City_____ State_____ Zip_____

Child's Age_____ Grade_____

NEW from Calvert School! Individual subject courses.

Calvert introduces separate subject courses for 4th grade math, history, English (incl. grammar, vocabulary development, writing), science, reading (skill work, literature). Excellent for make-up, brush-up or enrichment. Start any time. Choose one subject or more. All texts, teacher's manual included. Also complete courses for Kindergarten—8th grade. Classroom tested. Since 1904. Non-profit. Phone 301-243-6039 or write for information. Admits students of any race, color, national origin or ethnic origin.

CALVERT SCHOOL

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AUGUSTA MILITARY ACADEMY
A FACULTY Advisor for each student. Individual attention develops the student's potential for academic self-reliance & leadership. Gr. 8–12 & P. G. Lower School Gr. 4–7. Write **Col. N. Harris Livick, P. O. Box 100, Fort Defiance, Va. 24437**

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Winter in Southeast Florida
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Accredited. Friendly individual attention. College prep, ROTC. All sports. Driver Ed. Good food. Admission throughout year. Episcopal—all faiths welcome. Write **Col. Keith G. Duckers, Box NG-756, St. John's, Salina, Ks. 67401**

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For boys 8-18. Boating, fishing trips. 85-foot fleet incl. 23 sailboats. All sports, 2 gyms, athletic fields, Pool. Approved summer school. Opens July 3. Catalog. **Farragut Naval Camps, Box LC, Toms River, N. J. 08753. (201) 349-1121**

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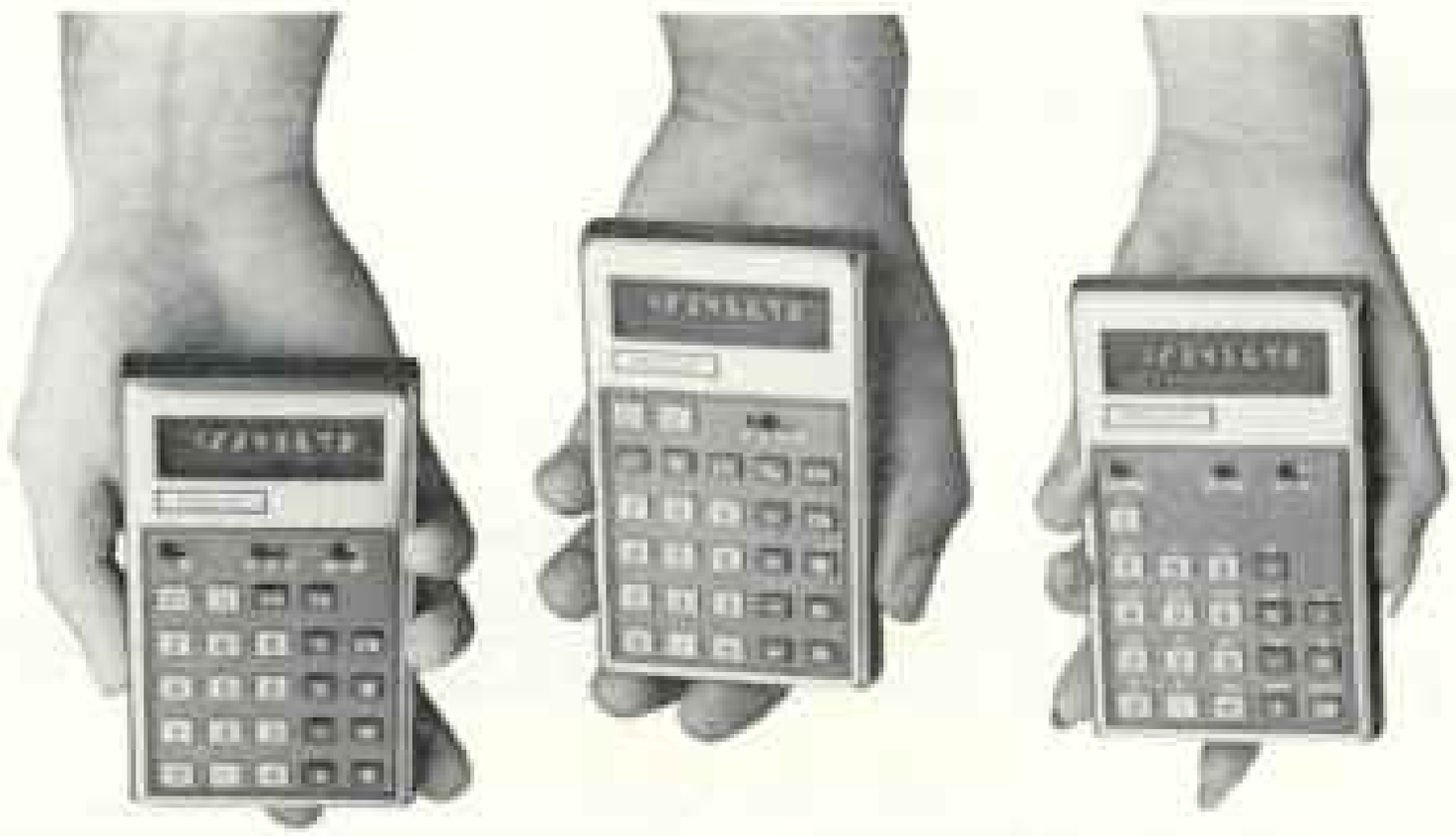

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