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NATIONAL GEOGRAPHIC

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August 1979

IT IS BY EATING the light of a star that we exist, in the final analysis, just as it is by perceiving the light of stars that we define the world around us. Life as we know it relies on food chains based on the synthesis of chemical compounds in plant cells with the aid of sunlight. That same radiant energy signals our senses as to the shape and heat of all creation, but how differently it is perceived by a frog in a pond or by a bird in flight.

Man has always regarded himself as the epitome of earthly beings—the one able to step outside of and control nature. The ingenuity to invent the microscope, the telescope, the electronic eye, to plunge into the depths of the sea, to soar through space, seems to have freed him from the limitations that finite senses impose.

Yet a close look at nature reminds us not to be so cocky. There are incredibly sensitive mechanisms at work in other life forms that make man's most sophisticated machines seem puny. An owl hits its target in pitch darkness, guided by an audio system of astonishing complexity. A scallop relies on chemical sensors to help it elude predators. A snake uses heat sensors in grooves of its lips to detect prey.

Of the vast spectrum of radiation that fills the cosmos, human eyes capture only a narrow band—what we call visible light. Some creatures, among them the honeybee and other insects, do not see the color images familiar to our gaze but look upon a world alive with the play of ultraviolet. We may be blind to vivid patterns and textures that help guide tiny nectar sippers and pollinators.

We stand in awe before the massive dramas of nature—the run of salmon to their native rivers, sweeping migrations of wildebeests across the Serengeti, the tidelike drift of caribou to the shore of arctic spring.

And certainly the most dazzling of all life's dramas is the annual migration of uncounted millions of birds. As the lead article in this issue reports, scientific experiments suggest that birds navigate by a number of astoundingly sophisticated cues, including the pull of earth's magnetic field and the celestial tracks of stars. As those few ounces of feathered power sail overhead on an autumn evening, spanning continents or oceans with energy and sureness that boggle the mind, consider that you are witness to one of life's miracles—and one that remains, despite our increase in knowledge, an ultimate mystery.

Silvestro M. Brovarone

Mysteries of Bird Migration 154

How do birds find their way across thousands of miles of land and trackless ocean? Research indicates that they may use sensory powers beyond our present understanding. Allan C. Fisher, Jr., and photographer Jonathan Blair report. A double map supplement traces New World migration routes from Arctic to Antarctic.

Walk Across America: Part II 194

The trek from upstate New York to New Orleans behind him, Peter Jenkins takes a wife, Barbara. Together they complete his coast-to-coast odyssey, meeting and photographing an American people of strength and generosity.

The Yellow Sea Yields a Shipwreck Trove 231

In the murk and mud off South Korea, a 14th-century hulk provides new insights into early Oriental ships—and a vast, virtually intact cargo of Chinese ceramics. Photographed by H. Edward Kim; introduction by Donald H. Keith.

North Yemen: Middle East Flash Point 244

Noel Grove and photographer Steve Raymer find this ancient, once fertile land plagued by fractious neighbors, splintered loyalties, and full-tilt inflation as it seeks a secure future amid the power politics of the Middle East.

The Hard Life of the Prairie Dog 270

Resilient ground squirrels of the American West survive decades of extermination campaigns, though a Utah species is endangered. By Tim W. Clark, with photographs by Patricia Caulfield.

Inadan: Artisans of the Sahara 282

Niger's master craftsmen live side by side with their Tuareg overlords in a mutually beneficial caste system. Article and photographs by Michael and Aubine Kirtley.

COVER: *On the road again, Peter Jenkins—joined by his wife, Barbara—braves a blistering Texas day during a 4,751-mile transcontinental trek (page 194). Photograph by Skeeter Hagler.*

MYSTERIES OF

Bird Migration

By ALLAN C. FISHER, JR.
ASSISTANT EDITOR

Photographs by
JONATHAN BLAIR

IN MY HAND I held the most remarkable of all living things, a creature of astounding abilities that elude our understanding, of extraordinary, even bizarre senses, of stamina and endurance far surpassing anything else in the animal world. Yet my captive measured a mere five inches in length and weighed less than half an ounce, about the weight of a fifty-cent piece. I held that truly awesome enigma, a bird.

Many years ago ornithologist Frank M. Chapman said, "Everyone is born with a bird in his heart." He meant that each of us holds something inherent in our very being that reacts with pleasure and interest at the sight and sound of a bird. Indeed, for those who are serious bird-watchers, an experience with one particular species may become forever memorable. In my case the bird in my heart is the first one I ever held that had been netted for banding.

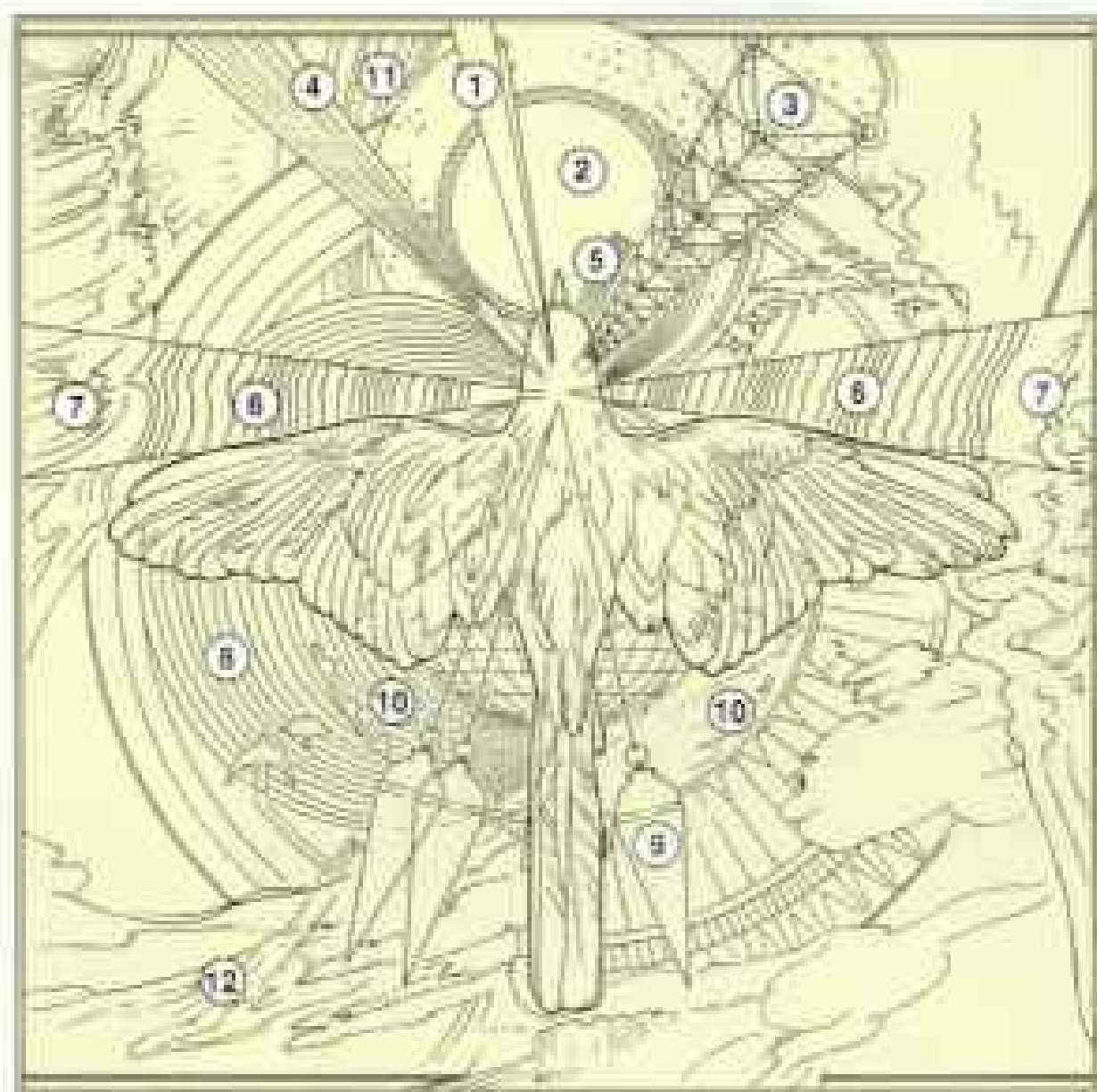
The Tennessee warbler seemed to regard me with more curiosity than fear. It had been caught by volunteer banders in the first wan

Cues beyond man's ken may guide the migrating birds on their incredible odysseys—details on page 156.

PAINTING BY SANDOR STORCI







Have compasses— will travel

All the world's a compass for birds that migrate, so it seems. Aloft over a symbolic earth, a yellow-billed cuckoo (above) illustrates a remarkable repertoire of sensory abilities. Daytime migrants use their vision (1) to steer by the sun (2), aided by a precise sense of time. Night fliers take compass cues from star patterns (3).

Homing pigeons and perhaps migrants see ultraviolet (4) and polarized light (5), and hear low-frequency sounds (6) that can emanate from distant surf (7). Though scientists do not know whether such information is used to navigate, many believe that migrants tune in on earth's magnetic field (8), probably in combination with gravity (9), to get direction.

Excellent weather sensors, birds usually wait until the passage of fronts (10) that bring favorable winds (11). While in flight birds sometimes use landmarks (12) as steering aids.

How a bird determines its position remains a mystery to man, but not to three tiny warblers (facing page) ready to resume their travels after being carefully banded in West Virginia.

light of a gray dawn near Cape Charles, Virginia, where the Chesapeake Bay's diurnal ebb and flood mingle with the mother Atlantic. The warbler wore its drab autumn plumage, greenish on the back, a pale, rather dingy yellow underneath. A commonplace bird—but it exerted a powerful hold on my imagination.

Each autumn the Tennessee warbler migrates some 3,000 miles from nesting sites in Canada and the northern United States to wintering places in Central and South America. Like many migratory species it seeks out the same locale where it wintered the year before, and in spring, again typically, it wings back to the same spot, often the same tree, where it raised its previous brood. En route it may perch on the same branch of the same tree visited before, drink at the same stream, forage in the same patch of woodland or field.

I opened my hand, the warbler hesitated a long moment, then flew away. It wore on one leg a feather-light aluminum band bearing its own identifying number, 1420-77887, and the request: Advise Bird Band. Write Washington, D. C., U. S. A. Perhaps any subsequent recovery would be reported. Yet never again did I hear of my captive, although large-scale banding has enabled ornithologists to plot the migratory paths of many kinds of birds (map, pages 172-3).

In another gray dawn, at a banding station high atop West Virginia's Allegheny Front, a mountain on the crest of the eastern divide, I held yet another special bird, also an affair of the heart. Behind my rocky pinnacle all waters drained east, and in front of me, far below, all waters flowed west toward the Mississippi through barrier undulations of misty mountains. But I had no time for the superb view. Members of the Brooks Bird Club of Wheeling, West Virginia, had been bringing me netted captives to admire and release: ruby-crowned kinglet, black-throated blue warbler, magnolia warbler. And finally I held that lion-hearted mighty mite, a blackpoll warbler.

The blackpoll breeds in northern forests and in fall migrates to the Atlantic Coast. Some may follow the coast to South America, but most are more venturesome. In great numbers they join the more than 100 million birds that (Continued on page 164)





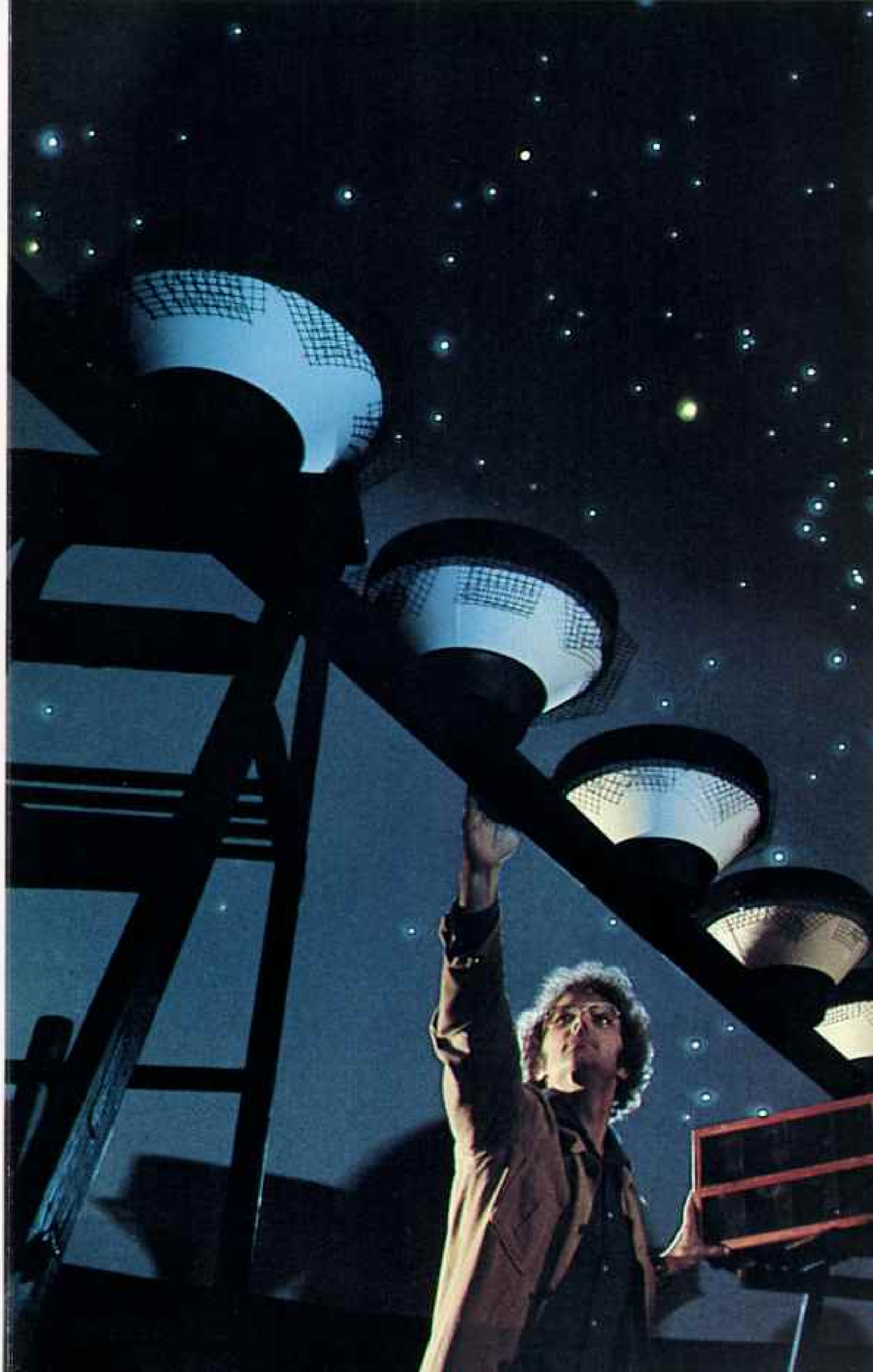
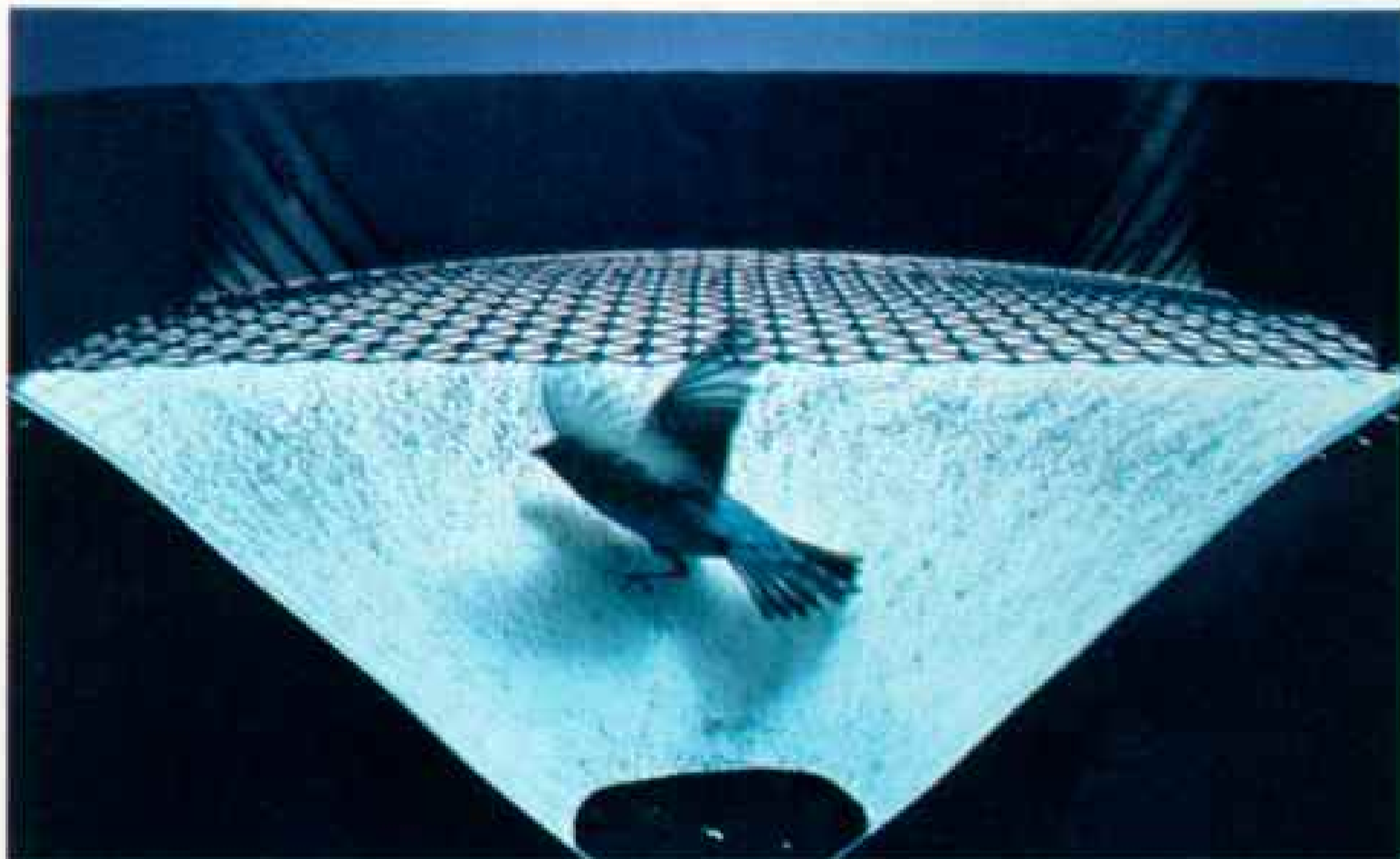


◀ A spring tide of surfbirds surges from the mud flats of Alaska's Copper River delta (overleaf). The strong-flying migrants winter as far south as the Strait of Magellan.

Most birds travel for food, good weather, and breeding sites. Some seem to follow patterns set during earth's glacial periods.

With only stars to steer by, indigo buntings in conical cages (following pages) orient successfully under a planetarium sky in an experiment by Dr. Stephen T. Emlen of Cornell University. From an ink-pad perch, a bird makes tracks to the northeast, its spring course (bottom).

With the stars turned off to simulate a cloudy night, another bird flutters aimlessly (below). Dr. Emlen found that buntings take bearings from star patterns in the vicinity of the North Star—even when they fly south.







Bird in a box, carried aloft by a balloon, is released and radar-tracked by Dr. Kenneth P. Able (left) of the State University of New York at Albany. A TV picture at release (above) shows, from left, a radar reflector used to track the balloon, a white-throated sparrow, wings opening, and the cardboard box, triggered open and still tethered to the balloon at top. The technique was invented by Dr. Emlen with his wife, Natalie Demong.

Birds oriented correctly if stars were visible or if they had seen the late afternoon sun that day. Without these cues, they merely flew with the wind.

(Continued from page 156) take off from the coast of North America and fly over the Atlantic and Caribbean to South America. Dr. William H. Drury and Dr. Ian C. T. Nisbet of the Massachusetts Audubon Society proved the existence of that flyway by radar studies along the New England coast.

Incredibly, the blackpoll and other small land birds make a nonstop, overwater flight of more than 2,300 miles lasting an average 86 hours. During one part, to find favorable winds, some fly at the cold, oxygen-starved altitude of 21,000 feet. This is the longest, both in distance and time, and the highest nonstop flight of small birds yet observed.

We know these heights and times largely because of six years of research by Dr. Timothy C. Williams of Swarthmore College in

Pennsylvania. He and his colleagues, including his wife, Janet, tracked migrants with nine radars, ashore and on ships.

In a year's time the blackpoll warbler may journey 10,000 miles. But larger birds undertake even more remarkable migrations. The champ seems to be the arctic tern. Some breed as far north as any bird, 450 miles from the North Pole, and nearly all fly to Antarctica (pages 184-5).

GREATER SHEARWATERS range northern Atlantic areas, and by some miracle of navigation fly across 8,000 miles of featureless ocean to the minuscule Tristan da Cunha islands in the South Atlantic. Many American golden plovers quit the coast of Labrador and Newfoundland

and cross 2,800 miles of open sea to Suriname and Brazil. Others leave Alaska and fly 2,500 miles to Hawaii, wings beating a quarter of a million times en route; many, after resting, continue another 2,100 miles to the Marquesas Islands and beyond.

In their own way little land birds are just as remarkable. One not many of us have seen, an arctic warbler, weighing a third of an ounce, breeds in Alaska but winters in the far-off Philippines. Some bobolinks wing from the prairies of Canada to the pampas of Argentina, more than 6,000 miles. The little ruby-throated hummingbird, weighing an eighth of an ounce, flies 500 miles across the Gulf of Mexico, wings beating fifty times a second—a prodigious 25-hour marathon feat for so small a bird.

Why do such tiny creatures undertake such epic migrations? How do they endure these grueling journeys? What marvelous alchemy powers them? Above all, how do they find their way? By what strange means do they pilot and navigate so unerringly?

Men have been asking these questions for untold centuries. The mass migration of birds is a great show for all to see, and it takes place twice a year on a worldwide stage. But only in the last 25 to 30 years have scientists obtained the first glimmerings of understanding. In quite recent years one exciting find has followed fast on another, though they often pose new puzzles.

Many species of birds can set courses not only by the sun but also by the stars, and they possess a remarkable awareness of time. For humans solar and stellar navigation are complex, requiring sextant, chronometer, compass, charts, and mathematical tables. How birds use their "instruments," in fact what they are and where they are in those small bodies, remains unknown. Moreover, evidence indicates that in some baffling way birds also rely at times upon the magnetic field of the earth in orientation and possibly the gravitational field as well.

As one might expect, they employ favorable winds with masterful skill. Indeed, they are excellent weather forecasters, some of them detecting the minute difference in barometric pressure between the floor and ceiling of a room. They often react to weather changes before any visible sign of them.

Obviously they have acute vision, but

researchers have discovered that pigeons, at least, also see polarized and ultraviolet light. They may use both in navigation.

Adding to the enigma, recent experiments reveal that pigeons hear infrasound, noise in ultralow frequencies of long wavelength; such sound carries vast distances through the atmosphere. Human ears will not pick up sound waves under ten to twenty cycles per second, but birds may detect much lower levels. Thus a migrant flying high above the Mississippi Valley might hear a thunderstorm above the Rockies, an aroused surf lashing Cape Hatteras, even the rhythmic pulse of the ionosphere. Conceivably these cues too may be used to find the way.

"Birds are not living in the same sensory world that we live in," says Dr. Stephen T. Emlen, a professor at Cornell University and one of the leaders in avian research. "They are hearing, seeing, and sensing a world expanded from ours."

QUESTIONS MAY MOUNT, but so do discoveries. Today, research into birds, their strange powers, and mysteries of migration comprise one of the most active fields of scientific investigation. It has produced ingenious experiments, and papers as absorbing as detective stories.

Educated guesstimates have been made about the number of birds in the world, and one authority came up with the figure 100 billion. In the United States during the breeding season we have six to seven billion. Scientists can be surer about the number of species. Worldwide there are about 9,000. Some 660 nest in North America, and more than two-thirds of these migrate.

They do so in enormous numbers. Dr. Sidney A. Gauthreaux, Jr., a professor at Clemson University, will never forget September 28, 1977. That night he surveyed migrating birds with radar and telescope at South Carolina's Greenville-Spartanburg Airport. Dr. Gauthreaux scanned a front, or line, across the path of migration and computed the number of birds that passed through it in a six-hour period. He got a peak count of 218,700 in one hour and more than a million in the six hours. He thinks it possible that fifty million birds were flying through the area over a front extending fifty miles—and that's just (Continued on page 169)





Pigeon in a picnic cooler at a Cornell laboratory (left) shows it can see ultraviolet light. Randomly beamed through the chest's circular lens, the light was followed by a mild shock that increased the bird's heartbeat. Soon its heart beat faster before the shock, indicating the bird had seen the light, invisible to man.

Another pigeon (above) responds to a tone 11 octaves below middle C, the lowest sound ever heard by a laboratory animal. Such infrasound from surf and storms and wind can travel thousands of miles. Other Cornell pigeons have responded to polarized light and minute atmospheric-pressure changes.



Caught but unhurt—injury is rare—a blackpoll warbler waits in a net of fine nylon at a birdbanding station at Dolly Sods, West Virginia.



Bands "fingerprint" birds. Recovery elsewhere helps reveal their migration routes.

one small part of an autumnal migration.

"I refer to that night as a landslide migration," says Dr. Gauthreaux. "At one point an airline pilot told me, 'There are so many birds out there they look like insect swarms.' A cold front had gone through so that the migrants had the wind at their backs from the northeast. Skies were clear, the air stable, ideal for flying. Every plane landing at the airport that night hit birds."

Why birds migrate remains open to question. You say, oh, surely they do it to escape cold and find food. That may be only part of the answer. Most birds journey much farther than would be necessary to find food and good weather. Those compulsive mass journeys evolved over aeons and many global fluctuations of weather. Whatever conditioned the movements may have occurred when the world was much younger. Moreover, numerous species, particularly some shorebirds, head south before cold weather or shortages of food. And stay-at-homes feel no urge to migrate. The bobwhite and cardinal, for example, rarely go farther than ten miles from their birthplaces.

In the north temperate zone, which includes the United States, advances and retreats of Pleistocene ice sheets that ended some 11,000 years ago certainly would have affected the distribution and movements of birds. Some scientists believe many species evolved their migratory instincts during that period. Other experts point out that Pleistocene glaciation comprised only a hundredth of the time span of birds on our planet, perhaps not long enough to condition them so remarkably and indelibly. Also, many birds migrate to and from areas glaciation never affected.

The Southern Hemisphere may be the original home of numerous species that now, aeons later, breed in northern climes. Perhaps these birds merely return each year to their ancestral sites. That's another theory. Certainly some familiar northern species, notably vireos, orioles, and tanagers, originated in the tropics. But others did not.

However, one truism of migration has long been evident. The outline of North American coasts, direction of large rivers, trend of mountain chains, all aid northward and southward migration. Moreover, the temperate landmass of North America,

which most birds leave in autumn, bulks much larger than the temperate area of South America. So in Canada and the United States a larger proportion of birds migrate than in Latin America. Though paths are rather widely diffused, migrants generally use established routes, or flyways. (See the supplement map, **Bird Migration in the Americas**, distributed with this issue.)

The southern bent of birds in autumn aroused written comment very long ago. Job in the Old Testament (39:26) asked: "Doth the hawk fly by thy wisdom, and stretch her wings toward the south?" And Jeremiah (8:7) said to Judah, "Yea, the stork in the heaven knoweth her appointed times; and the turtle and the crane and the swallow observe the time of their coming. . . ."

Aristotle thought the swallow and several other birds hibernated in holes during winter, and he believed the European robin changed into the redstart in summer. But he wrote that many kinds of birds flew to other lands. Untroubled by concerns of geologic time, he believed only an urge for fuller bellies and happier climes motivated migrants. Aristotle even remarked upon altitudinal migration, the descent of some birds to lowlands in autumn and back to the hills in spring. We see this in the mountain quail of the western U. S. They nest on mountainsides up to 9,500 feet, but when fall comes, they walk single file, in little groups of ten to thirty, down to elevations below 5,000 feet. Come spring, they file back up again.

The belief that some birds hibernate persisted until the 19th century. Only one species, the poorwill, is known to hibernate. It sleeps the winter away in rock niches of canyons in western North America.

BIRDS ARE NOT the only creatures that migrate dramatically. I shall never forget a moonless but star-filled night many years ago on a beach at Ascension Island, a barren volcanic speck on the vast expanse of the South Atlantic. Dimly all about me I could see mound-shaped shadows, large hulks that moved haltingly while making slithering sounds in the sand. With a flashlight I examined them: green turtles, each big enough for a man to ride.

They had crawled from the sea to lay their eggs in the warm sand. In the darkness,

companionably, I remained more than an hour, walking beside one as it moved slowly back to the water with the ponderous, slack-muscled deliberation of an elephant.

Ascension Island is so far from anywhere that even human navigators can have trouble finding it. Airplane pilots seeking it out as a refueling stop in World War II used to say, "If you miss Ascension, your wife gets a pension." Yet sea turtles, migrating 1,400 miles from Brazilian waters, find the seven-mile-long island with pinpoint accuracy. They may do it by smell, but no one knows.

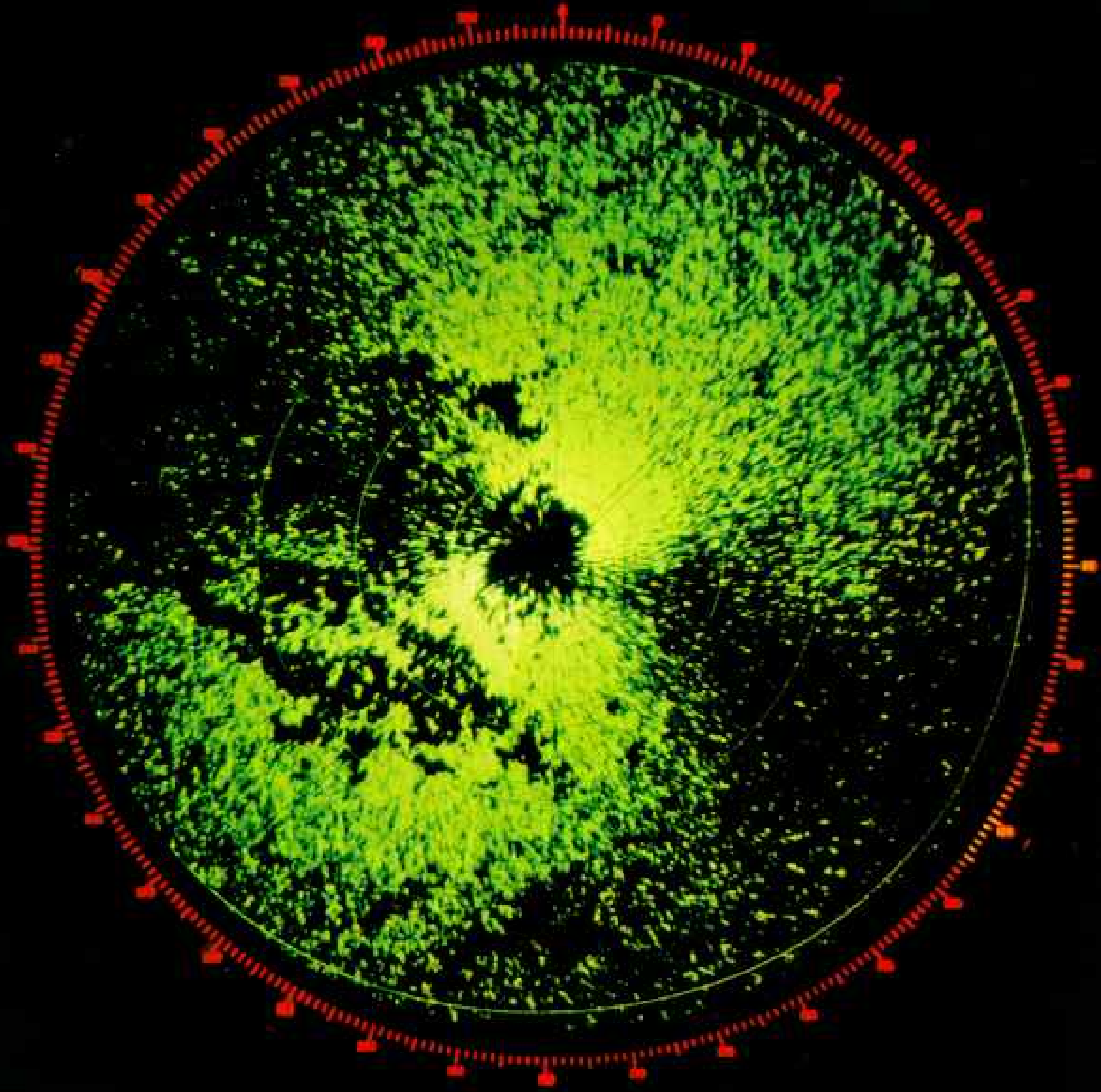
Eels, salmon, whales, zebras, monarch butterflies—many creatures migrate. But birds, migrants on a far grander scale than any of the others, are the most wondrous.

Apparently photoperiodism, the effect of length of day, triggers bird migration, both in autumn and spring. The days shorten or lengthen, affecting such glands as the pituitary and pineal, and birds become increasingly restless. Finally, they know it's time to go. Not all species migrate at the same time, and some vary their departure because of weather. But others, such as the swallows of San Juan Capistrano, are remarkably punctual, departing and arriving within the same few days each year.

Before migration most species build up layers of fat to sustain them. The little blackpoll warbler, for example, may nearly double its weight and set off as a real fatty. Sometimes you can feel balls of fat, like tumors, in birds netted for banding. Banders refer to these deposits as "fuel tanks."

Blackpolls departing New England for their over-ocean leg to South America carry fuel reserves for nonstop flights of 105 to 115 hours. They metabolize the fat with marvelous efficiency. Dr. Williams, the Swarthmore scientist who plotted the Atlantic migration with radar, says the metabolic equivalent for a man of that nonstop flight would be to run four-minute miles continuously for eighty hours.

In relation to overall size, a bird's pectoral muscles powering the wings are much larger and better developed than any similar muscle in a mammal. They anchor in part to a projecting ridge on the breastbone called the keel, more pronounced in the hummingbird than in any other. Its keel helps the hummingbird to hover, wings beating 3,000



Night exodus of approximately two million migrating songbirds appears like green continents on the radar at a South Carolina airport. A Clemson University study seeks to determine the weather variables that trigger such multitudes.

times a minute. While hovering, it expends energy per unit of weight at a rate ten times that of a man running nine miles an hour.

A bird's respiratory system, like its metabolism and muscular development, shows distinctive evolution. A countercurrent flow of blood and air in the lungs enables it to extract oxygen from the atmosphere with efficiency far exceeding any other vertebrate. Thus the blackpoll and some other small birds can fly at 21,000 feet, a height unsuspected for songbirds until Dr. Williams's

findings. But in the Himalayas geese have been seen at 29,500 feet and godwits and curlews near 20,000. In the Rockies sandpipers fly at 13,000 feet, geese even higher.

However, radar studies by Clemson's Dr. Gauthreaux and others reveal that most birds migrate at less than 7,400 feet above the ground. Most small migrants flying at night stay between 800 feet and 1,600 feet; day migrants fly still lower. They travel at about 25 to 30 miles an hour, hummingbirds at about 20; larger birds, geese and

sandpipers, for example, at times fly a mile a minute or more.

A majority of birds migrate at night. Usually these are the smaller ones; they rest and forage during the day. Waterfowl and shorebirds fly day or night. Migration is more leisurely and concentrated in fall, quicker though more scattered in spring.

INEVITABLY, migration takes an enormous toll. Dr. Williams, talking with me one summer evening on the waterfront at Woods Hole, Massachusetts, gestured toward the Atlantic and said, "Only half the songbirds that leave this coast will ever see it again. You lose half every year." Many, believed to be mostly immature birds and overland migrants that strayed or were blown offshore, perish at sea. It's not unusual for ocean fish to be caught with bird remains in their stomachs.

Off the New Jersey coast and in mid-Chesapeake Bay, I've had a few exhausted warblers perch in the rigging of my sailboat. That is not unusual. Vessels at sea occasionally experience an absolute deluge of hitchhikers, many exhausted and even dying.

Attrition ashore also is severe. Flying at night in fog and overcast, birds often dash themselves to death against tall structures. Lighthouses and skyscrapers long have taken a toll, and television towers have become notorious killers. For example, seven towers in central Illinois felled some 3,200 birds during just one night in late 1972.

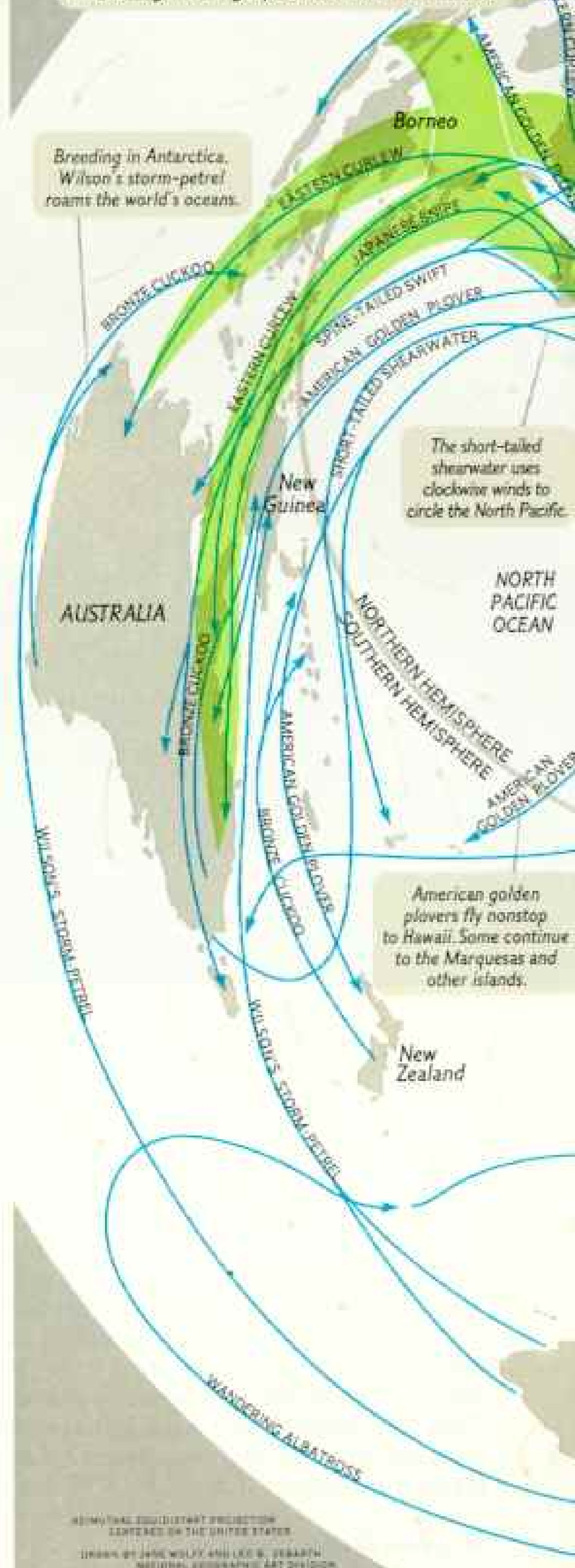
Reflective glass, a modern innovation in construction, can be deadly. Birds see reflected trees and sky and attempt to fly into them. Even clear glass may confuse them.

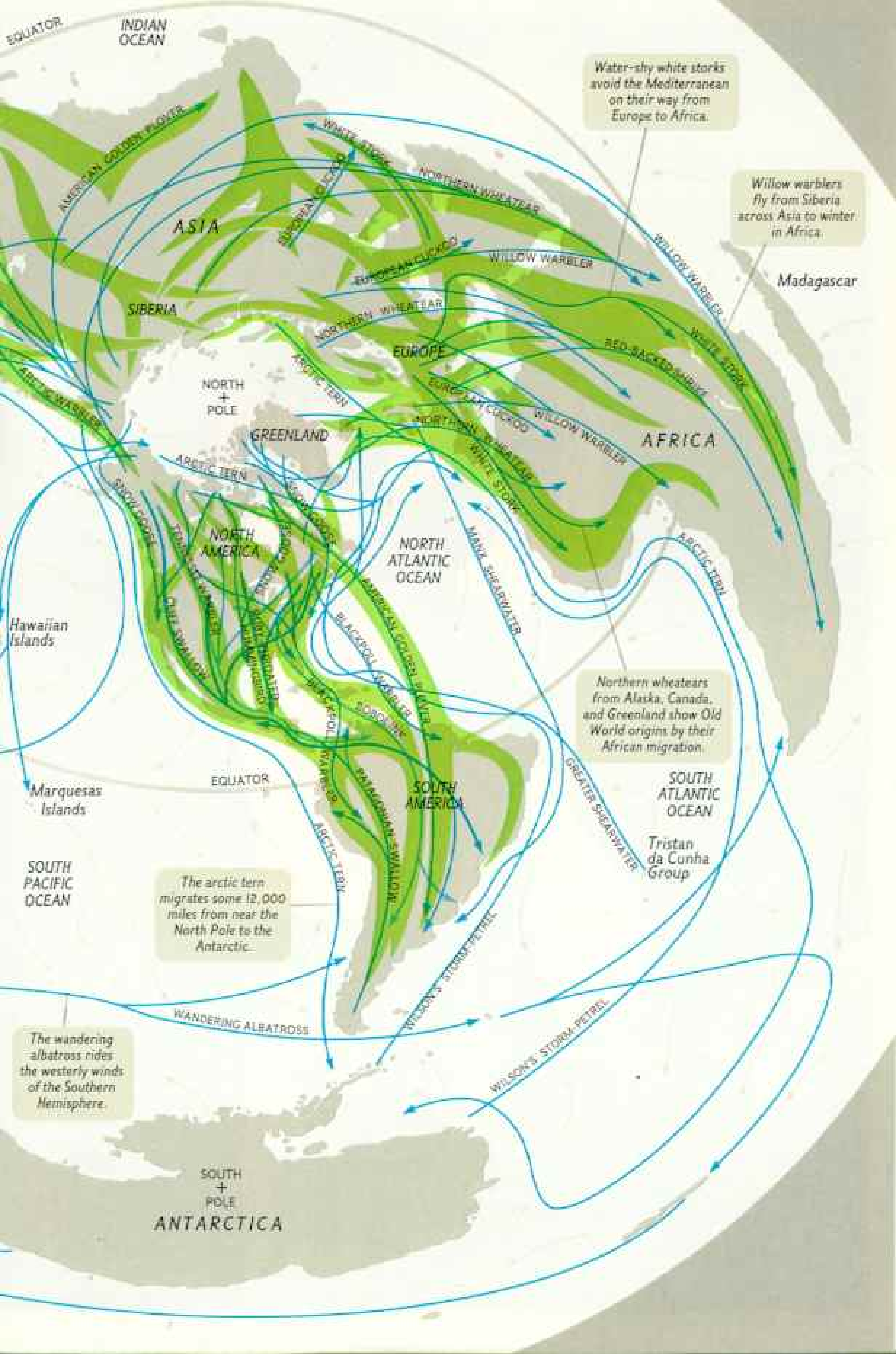
Spring storms and cold often kill birds that have ventured too far north too soon. Cold weather and lack of insects caused a huge die-off of warblers in Manitoba in 1974. In one area an observer found a dead warbler an average of every eight inches.

To set hunting bag limits, wildlife experts study waterfowl populations intensively, so we have a good idea how many survive each year. In North America a hundred million waterfowl migrate south each fall, but only forty million return to breeding grounds. Hunters kill twenty million; predation, accidents, environmental dangers, and disease claim the other (Continued on page 180)

HIGHWAYS IN THE SKY

Major paths of land and coastal birds (green); general routes of selected migrants from breeding grounds to wintering areas (blue). Prevailing winds (gray arrows) aid the travelers.





Water-shy white storks avoid the Mediterranean on their way from Europe to Africa.

Willow warblers fly from Siberia across Asia to winter in Africa.

Northern wheatears from Alaska, Canada, and Greenland show Old World origins by their African migration.

The arctic tern migrates some 12,000 miles from near the North Pole to the Antarctic.

The wandering albatross rides the westerly winds of the Southern Hemisphere.

Hawaiian Islands

Marquesas Islands

SOUTH PACIFIC OCEAN

SOUTH + POLE
ANTARCTICA

Madagascar

SOUTH ATLANTIC OCEAN

Tristan da Cunha Group

NORTH + POLE

NORTH ATLANTIC OCEAN

NORTH + POLE

EQUATOR

EQUATOR

INDIAN OCEAN

ASIA

SIBERIA

EUROPE

AFRICA

NORTH AMERICA

SOUTH AMERICA

GREENLAND

ARCTIC TERN

ARCTIC TERN

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FROM CANADA
TO SURINAME

Tracking the shore dwellers

ANCHORED in muck, Dr. R. I. G. Morrison gently removes a semipalmated sandpiper from a net near North Point on Canada's James Bay. Three other sandpipers, previously snared, wear a dye he applies to mark them for possible sighting during migration.

Each July and August the Canadian Wildlife Service scientist and his associates endure windswept isolation and mosquitoes—"about five million per acre," he says—to dye and band sandpipers, red knots, and others bound for South America.

When the birds depart the bay, Dr. Morrison usually returns to Ottawa. Last year, at the invitation of the National Geographic Society, he went to Suriname for a possible rendezvous with his birds.

But first, learn how a red knot becomes orange . . .



ORDINARILY a red knot sports a proper red breast in summer. Daubed with picric acid, it becomes orange (*left*). The yellow wing also turns orange when the harmless acid weathers.

A parade of sandpipers, many bearing Dr. Morrison's mark, files by the James Bay shoreline (*below*) to roost after feeding.

"Some birds nearly double their weight in three



weeks," he says. "They're gassing up for the next leg."

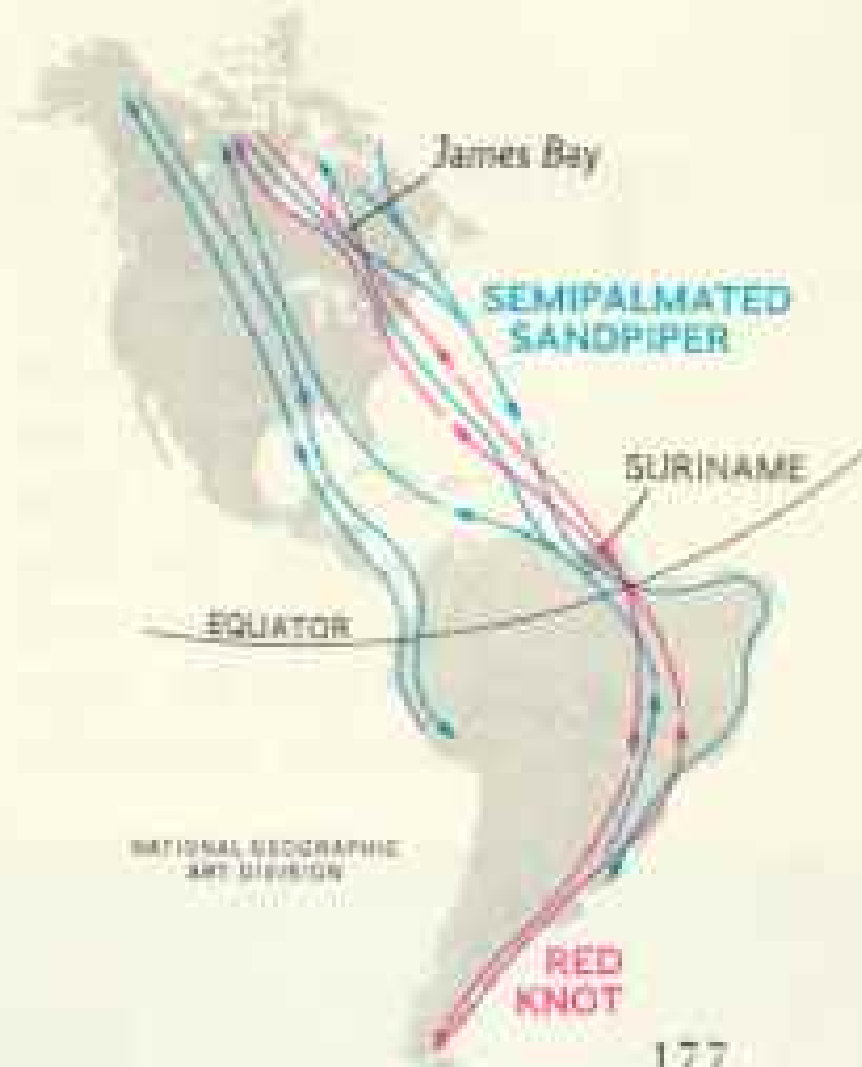
Most of the birds fly southeast for another gas-and-go sojourn on the Eastern Seaboard (map, *right*). Then they embark on a remarkable flight over water to the coast of South America—a nonstop journey of around 2,700 miles.

Fueled again, many sandpipers head for Brazil to winter. Some of the indomitable knots continue

all the way to Tierra del Fuego at the continent's tip. Returning in spring, some sandpipers swerve over the Gulf of Mexico.

The map also records the routes of sandpipers that breed in Alaska and eastern Canada. "We know the shorebird routes in outline," says Dr. Morrison, "but there are blank spaces for individual birds."

In Suriname he filled in some of those spaces . . .



THE SIGHTING in Suriname of three "orange" knots, one feeding on a creek bank (*below*), documented the species' movement from James Bay for the first time. "We marked only thirty-two," says Dr. Morrison. "Spotting three after

a 3,500-mile journey is a spectacular record."

With Dr. Arie L. Spaans, a Dutch ornithologist (*bottom, right*), Dr. Morrison looked for more birds. The pair had exchanged bird data but never met. At night they measured captured birds (*right*).

Other sightings included a semipalmated plover, the first banded in Canada and recovered in South America, and a dozen semipalmated sandpipers.

A banding scheme (*bottom*) recorded the date the birds had been marked at James Bay. * * *



DIAGRAM BY WILLIAM H. BONE
NATIONAL GEOGRAPHIC ART DIVISION



(Continued from page 172) forty million.

Man's alteration of the environment ranks as a major killer. Consider the plight of wild ducks. In North America many species nest among thousands of rain-filled potholes in Canada's Prairie Provinces. But farmers now bulldoze and plow potholes for grain crops. Since ducks feed on these crops, they get little sympathy from farmers. Some species are dwindling at an alarming rate.

EVEN CAPISTRANO'S cliff swallows may be in trouble. Traditionally they return from Argentina to the California town on St. Joseph's Day, March 19, but actually they arrive over a period of several days. On St. John's Day, October 23, they leave—or begin to. In the meantime the swallows build mud nests or repair old ones on the walls of the San Juan Capistrano mission. At least that's what they used to do. Now only a few nest there.

I visited the town on a recent St. Joseph's Day and saw nary a swallow. But perhaps they couldn't find room. Capistrano celebrated its annual Festival of the Swallows that weekend, and the California State Highway Patrol counted 125,000 cars entering the town. As for the guests of honor, a festival publicity man assured everyone excitedly that swallows had been sighted overhead. On a quiet Monday morning, the hoopla finally over, I strolled through the mission, seeing none of the birds and only a few old nests.

Walking about the town's outskirts, I could see what bothered its celebrated residents. Swallows eat insects caught on the wing, and fields and meadows around Capistrano had succumbed to real estate development. In less than a decade the community's population had grown from 2,500 to 16,500. So nearly all the birds went elsewhere, some to nearby Mission Viejo.

Yet the publicity man had an expedient solution. He said a cast had been made of one of the mud nests, and plastic nests would be made from it. He thought that if the plastic substitutes were put on the mission's walls, the swallows might move in.

But the scheme hasn't been tried and probably won't be. Cliff swallows, unlike martins, sparrows, and other birds, do not nest in man-made houses. "A nest-building

rite may be part of their integral behavior," says Dr. Kenneth P. Able of the State University of New York at Albany.

Dr. Able is one of an impressive number of dedicated scientists, all known to one another like congenial members of a club, who are trying to wrest from birds their secrets of navigation (page 164). As Dr. Able puts it, "It's such an extraordinary phenomenon—so dramatic. When I go out on a fall night and hear those birds calling, it nearly drives me crazy to know how they do it."

For a long time many observers believed that birds relied mainly, if not entirely, on familiar landmarks to find their way, often flying random search patterns until they came upon something they recognized. The contemporary approach to ornithological research, marked by questioning, imagination, and ingenuity, began with releases of trapped birds just before and after World War II. Researchers reasoned that if birds relied solely on landmarks, they should become confused and lost if taken far from their nests and freed in unfamiliar areas.

In 1937 two British scientists, R. M. Lockley and David Lack, collected Manx shearwaters, birds known for homing ability, from their burrows on Skokholm Island, off Wales, and released them from distant points on land and sea. Many returned, including one from Venice. Normally these seabirds do not fly over land, but the one released at Venice was seen to set a direct course for home, presumably flying over the Alps and across France to return.

In 1951 and 1952 another British expert, Geoffrey Matthews, also released banded Manx shearwaters from many points. Again shearwaters showed an uncanny ability to return. One released at Boston got back to Britain in 12½ days, beating by ten hours a letter announcing its release.

Other experiments soon showed that adult Laysan albatrosses shanghaied from their nests could home successfully. Some land birds, such as cliff swallows and purple martins, also could home accurately.

It seems unlikely that these released birds relied solely upon landmarks for orientation. Yet birds do use landmarks when it suits them. Daytime migrants often follow coasts, rivers, or mountain ranges—"leading lines," as scientists refer to them—and

may rely upon landmarks in home areas.

Kittatinny ridge in the eastern Appalachians is a good example of a leading line (pages 188-9). It stretches from southeastern New York into Alabama. Hawks and eagles, soaring birds that utilize air currents, follow the Kittatinny during fall migration to catch updrafts off its slopes. You can enjoy a superb view of these predators, often surprisingly close, from a rocky vantage point atop Hawk Mountain, a spur of the ridge in Pennsylvania. In 1934 it became the world's first sanctuary for birds of prey after years of use by hunters.

On the day before I visited Hawk Mountain, a cold front had gone through, and winds blew thirty miles an hour from the northwest, gusting to fifty. That's great weather for an aerial ballet along the Kittatinny. In one day observers had counted 5,000 hawks, five bald eagles, and a golden eagle. But when I arrived, winds had died, and the sun shone from a benign, cloudless blue that had the scoured look October brings. Few birds passed—ah, but one that did was yet another bird of my heart, the peregrine falcon.

No longer do peregrines nest atop cliffs along eastern rivers. Except for young ones released experimentally, they are extinct in the eastern U. S. as a nesting bird. But I never see that splendid predator, a master aerialist clocked at 180 miles an hour diving after prey, without feeling my soul has been washed a bit cleaner by the experience. The peregrine: bold marauder, preeminent hunting falcon of ancient kings, symbol of aery freedom and of our own obligation to wild creatures.

WITH DEPENDENCE upon landmarks a continuing question, scientists tried another kind of release: displacement during autumnal migration. In a ten-year study ending in 1957, 11,000 starlings were banded in the Netherlands and released in Switzerland—with surprising results. Some 354 recoveries showed that most adult birds corrected for the displacement and headed toward wintering grounds in the British Isles and northwest France. But juveniles held their ancestral direction for migration, southwest by west. Later recoveries showed that these birds established

a new winter range in southern France and the Iberian Peninsula. The importance of this experiment seemed clear: Young birds followed some inborn sense of direction, and adults possessed a remarkable compass and an ability to change course when displaced.

In the early 1950's a brilliant German, Gustav Kramer, showed what that compass might be. Instead of experimenting with birds in the field, he put European starlings in round cages and observed them through the transparent bottoms. Grippled by spring restlessness, the birds faced the proper direction of migration, northeast. In fall they faced southwest, again the right direction. He then found that with everything blocked from their view but sunlight, the birds still oriented as they should. Using mirrors, Dr. Kramer changed by 90 degrees the direction of light from the sky, and the birds changed position 90 degrees. They took bearings from the sun, an exciting find.

Then Dr. Kramer devised another ingenious experiment. He built a featureless round cage with feeders at the four points of the compass. At the same hour each morning, he hid grain only in the east feeder and trained a starling always to seek food to the east. Then one day he moved the cage miles away and put food in the east feeder late in the afternoon. So for the first time the sun entered the cage behind the west feeder, not the east one. Would the hungry bird go toward the now setting sun? It did not. With its magnificent sense of time and direction, after a brief period of indecision, it selected east. Again, bearings taken from the sun.

In other imaginative experiments using caged birds and an artificial light as the sun, Dr. Kramer showed that his starlings had an amazingly accurate sense of time. If the artificial sun did not move, the birds nonetheless would shift direction; their inner clocks made them compensate for expected but nonexistent sun movement. Scientists could gradually "clock shift," or reset, this biological clock over several days by manipulating the apparent time with the light source. A bird used to a false time according to the position of its sun would fly in the wrong direction when released on a sunny day. The error would be 15 degrees for every hour its internal clock had been shifted.

Unbelievable as it seemed, birds could

determine compass direction by the sun and could compensate for solar movement. In short, they had a sun compass and a biological clock of amazing precision. Ornithology would never be the same after these discoveries. Scientists became enterprising detectives, devising exciting investigations that continue to this day.

IF BIRDS possessed a sun compass, could they also steer by the stars? A German husband-and-wife team, Drs. Franz and Eleonore Sauer, put European warblers in a cage with a glass top so they could see part of the night sky but nothing else. The birds oriented in the right migratory direction as long as they could see some of the stars. With the sky overcast, they fluttered aimlessly for a while, then went to sleep.

Next the Sauers took birds into a planetarium where star positions could be varied to simulate any time of year. Under spring skies the birds pointed northeast, under autumn skies southwest, just as they should for migration. The Sauers also tested a lesser

whitethroat warbler that had been raised from an egg and had never been outside a cage, though it was permitted to view the sky. Birds of that species migrating from Germany to headwaters of the Nile first fly southeast, then south. When the Sauers shifted the stars as they would appear along the entire journey, the bird shifted its orientation accordingly. A bird never in the wild seemed to know its migratory route and could follow it by the stars. The experiment, however, has not been repeated.

So, amazing as it seemed, migratory birds also use stellar positions to determine compass direction, a fact soon confirmed by other investigators, notably Cornell's Dr. Emlen. He placed indigo buntings, night migrants, in funnel-shaped cages, their walls made of blotting paper, their base an ink pad (page 161). Since the birds would hop and flutter repeatedly in their preferred direction, they left ink tracks on the side of the cage, marks easily counted. Dr. Kramer and others had observed and recorded each movement, but Dr. Emlen's technique



Puffin transplant project by the National Audubon Society seems to be reviving a former habitat. Removed from a Newfoundland nest in the morning (left), a chick is snuggled into a new one 1,000 miles away on Eastern Egg Rock, Maine, by late afternoon (above). After migration some are returning to Maine. A puffin fledged in 1975, indicated by a white leg band (right), strode among decoys last year.

greatly simplified the task of noting the birds' directional preference.

Dr. Emlen showed that his birds depended on stars in the northern part of the sky and that they need not see all of them to orient successfully. Their ability was acquired, not inborn. At first young buntings determined the north-south axis by the rotation of stars but soon learned to determine direction by star patterns. The Sauers believed their birds used a time-compensating technique with these patterns, just as birds use their clocks with the sun, but Dr. Emlen found no evidence of clock reliance. His buntings presumably could determine north-south directions by star patterns alone. This is now a widely accepted theory.

Dr. Emlen also experimented with his birds in a planetarium. If he allowed them to mature while seeing a reproduction of a normal sky, they oriented well when tested in autumn. But if the birds grew up under an artificial sky that made stars rotate around Betelgeuse instead of Polaris, the North Star, the birds learned the wrong axis,

and they oriented in the wrong direction.

However, these discoveries did not solve the navigation mystery; they compounded it. Mounting evidence confirmed that birds used sun and stars merely to obtain compass directions. True navigation requires more, a knowledge of position. A sailor, for example, must know where he is before he can set course for where he wants to go. Assume it's daytime. He can work out his latitude and longitude with a sextant to read sun angles, plus a chart, celestial tables, and a precise knowledge of his own time compared to the time at Greenwich, England. That's called bi-coordinate navigation, and there is no proof a bird does anything approaching bi-coordinate complexity.

The bird does use the sun's azimuth, or direction from it, and consults its internal clock to compensate for the sun's changing position. This gives a compass reading. It can also recognize and steer by star groupings, just as we might use the Big Dipper, Orion, and other star groups for orientation. That, too, is merely compass direction.

STEPHEN KRSEZ, CORNELL UNIVERSITY







Dr. Sidney Gauthreaux summed up the problem. "We know a lot about compasses of birds," he said, "but that's a different question from knowing how they can be displaced hundreds of miles from where they want to go, yet end up at the right place."

Scientists recognize three kinds of orientation behavior, a helpful breakdown first suggested by Dr. Donald Griffin, a senior American biologist. Type I he defined as a bird's reliance on landmarks; Type II, the ability to choose a flight direction and hold to it over unfamiliar territory; and Type III, an ability to choose the right direction for its destination and to find it, even when released at a distant place it has never seen.

"Most long-distance migrants must have a Type III capability," said Cornell's Stephen Emlen, "but they do not appear to use it until near the end of their journey. The bird may have a built-in program to migrate, for example, to fly a northeast compass direction in spring, and to do so for a predetermined length of time. Thus much of the journey may involve Type II capabilities. This makes experimentation difficult, since the birds only rarely show us their potential for precise homing."

Swarthmore's Timothy Williams told me, "I would guess that some very simple program gets them very, very far. The way by which they get to their final home also may be incredibly simple."

Most scientists, however, feel Type III homing, when understood, will prove complex. Kenneth Able, for example, thinks birds may be "doing something relatively unsophisticated in migration and something more sophisticated toward the end."

What might that "something more sophisticated" be, that baffling ability to home so precisely? A growing number of experts suspect it may have something to do with the magnetic field of the earth.

On this subject too German investigators

The ultimate migrant: A native of the most northern points of land, the arctic tern winters on the South Polar ice pack. Its round trip is as long as 25,000 miles. In a courtship ritual on Machias Seal Island off the coast of Maine, a tern brings food to a prospective mate.

made an interesting find. Dr. Wolfgang and Roswitha Wiltschko, another husband-wife team, put European robins in a featureless circular cage and blocked out the sky. The birds, all in a state of migratory restlessness, faced the proper seasonal direction even though they could not get cues from sun and stars. The Wiltschkos then surrounded the cage with Helmholtz coils, which produce a magnetic field when an electric current

passes through them. When these coils altered the direction of the normal magnetic field surrounding the cage, for example by changing magnetic north to coincide with geographic east, the birds changed their direction. Apparently they responded to a magnetic field and read direction from it.

HOW THEY OBTAINED direction proved puzzling. One would think they would use the direction of the field of magnetism, just as a sailor uses his north-seeking compass needle. However, experiments show that the birds may measure the angle between magnetic lines, which enfold the earth, and the vertical direction of gravity. In the Northern Hemisphere the smallest angle between these forces corresponds to magnetic north, and that may cue the birds.

Dr. Emlen and others verified these findings, and Dr. William T. Keeton of the Cornell group went a step further, using pigeons. Homing pigeons do not migrate but are extensively used in experiments because of their extraordinary abilities and because they can be followed and retrieved. Dr. Keeton, an expert on these birds, put little bar magnets on the backs of some to disturb their magnetic fields and outfitted others with nonmagnetic brass bars. Released in sunny weather, both groups homed equally well. But released under overcast skies, only the "brass" birds flew normally. Those with magnets, not able to use their sun compasses and getting false information about the magnetic field, became confused.

Dr. Charles Walcott of the State University of New York at Stony Brook refined this experiment. He placed tiny Helmholtz coils on his pigeons, one atop the head, another round the neck. His birds were tracked by radio. Using the coils to change the direction of north, Dr. Walcott could alter the direction of flight under cloudy skies (page 191).

Several experimenters released birds near magnetic anomalies, areas where mineral deposits alter the normal magnetic field, and the birds showed confusion. Other investigators found that radar and sunspot activity, both of which affect the magnetic field, also affected orientation.

Dr. Keeton and Timothy Larkin, an assistant, made other baffling finds. Pigeons



Doing a favor for the birds—as well as himself—a bander has placed migrating hawks snared at Cape May Point, New Jersey, heads down in open-ended cans. The technique soothes the birds of prey and also spares him from a painful grasp by their sharp talons. Banded, weighed, and measured, the hawks are usually en route again within ten minutes.

often show what researchers call a site bias; when released at certain points, they adopt an initial heading at variance with the most direct homeward route, and this may be an effect of the magnetic field. But the Cornell experts also discovered that initial bearings shifted from day to day with changes in the lunar month. Since earth's gravity alters with position of the moon, the pigeons may be detecting these minute variations as well.

Both Dr. Keeton and Dr. Walcott conducted several fascinating experiments using pigeons wearing lenses over their eyes (page 190). On cloudy days pigeons with such translucent coverings, through which they could see very little, homed just as well as pigeons with clear lenses.

Did they get their bearings from the magnetic field? It would seem so, but we don't know how.

Using pigeons, Dr. Melvin L. Kreithen, an associate of Keeton and Emlen at that protean place Cornell, played the leading role in researches into other strange sensory abilities. He and his colleagues conditioned birds to react to ultraviolet and polarized light, barometric-pressure changes, and infrasound (pages 166-7).

Scientists will be sorting out for years the implications of these newly discovered senses. All may be used in navigation.

Before we can know how birds use these extraordinary senses, we must find out how the senses work. We're not near such knowledge now. "If you ask what the receptors are for these sensory abilities, and where they are in the bird, we have scarcely a clue," said Dr. Emlen.

Scientists recently have found that some bacteria synthesize magnetite, a compound of iron and oxygen, and use it to orient themselves in the earth's magnetic field. The substance also has been found in the heads of pigeons and the abdomens of bees. Some investigators believe bees do rely upon magnetite in orientation, but no one knows what use, if any, pigeons make of it.

Other persons have suggested birds employ a kind of inertial-navigation system. Polaris submarines do. With a gyrocompass and other instruments, crewmen know where they are by keeping a minute record of how they got there and where they have been. But pigeons have been carried to

release sites while completely anesthetized; in no way could they sense the turns, the zigs and zags, the ups and downs, of how they got there, which is essential for inertial navigation. Once awake again and chipper, test birds homed normally.

Italian scientists working under Dr. Floriano Papi think pigeons may follow their noses home. Releases of pigeons with plugged nostrils or severed olfactory nerves



Talons restrained, a bright-eyed hawk, just captured, gets its crop checked for the presence of food. The open beak poses little danger to the bander's finger—the bird seldom bites.

Solitary in their habitats, hawks migrating down the Eastern Seaboard congregate at Cape May Point when winds delay their passage across Delaware Bay.





Hawk-eyed bird lovers migrate each fall to eastern Pennsylvania's Hawk Mountain (below), part of a ridge that extends from New York to Alabama. Above them hundreds of hawks spiral effortlessly upward—a rising bubble of warm air called a thermal does the work.

For these migrants, a straight line is not the shortest distance between two points. Over a mountain ridge (left), a hawk rides the upwelling wind, then glides to a thermal over a plowed field. After gaining altitude, the bird seeks another updraft.

How do hawks find thermals? People who fly sailplanes would like to know.

PAINTING BY NATIONAL GEOGRAPHIC ARTIST NEIL W. SEIDLER



did show poor homing, whereas normal birds seemed able to guide themselves by distinct odors, such as olive groves. In America, however, tests of homing by smell did not support the Italian conclusions.

Birds, you might say, have given us a real bag of worms to sort out. Summing up, just what do we know for sure? We know that most birds are remarkable pathfinders. They possess a sun compass, a star compass, and an internal clock. They sense weather and often utilize winds with great skill. They have been shown to detect minute changes of barometric pressure. Apparently they employ the magnetic field of the earth, and possibly the gravitational field, in navigation and may also use their sense of smell. Pigeons, at least, detect polarized and ultraviolet light, and hear infrasound. Birds use some or all of these abilities in complex, interrelated ways that vary with species, age, experience, location, weather, and season.

Dr. Wolfgang Wiltschko suggests birds actually may carry in their little heads—or somewhere—a sort of mosaic map of familiar landmarks plus a grid of gradients directionally oriented by compass information, in effect a kind of map overlay. Thus equipped, true bi-coordinate navigation would be possible. But such assumptions have yet to be proved.

“We simply cannot explain what birds do on the basis of what we know about them; particularly we cannot explain the homing phase of migration,” comments Dr. Able. “We know so little about what tells them where they are in relation to where they



STEVE JOHNSON



DAN J. DRY (ABOVE AND BELOW)



Even with frosted glasses, pigeons make passes at their home loft—on an overcast day to boot (facing page). The experiment by Dr. Charles Walcott of the State University of New York at Stony Brook indicated the birds didn't require the sun or landmarks to navigate. "We think they're getting compass information from the earth's magnetic field," says Walcott, who handles the driving (above) while an assistant releases pigeons to hone their homing skills.

The birds were later fitted with a portable magnetic field, induced by current in wires on the head and neck (below). Tracking (left) showed that the pigeons homed when the portable fields were roughly tuned to the earth's. With fields reversed, they tended to fly away from home under an overcast sky.

But birds don't seem to be mere airborne Boy Scouts following a compass. Trials with European robins suggest they combine magnetic cues with a sense of gravity.



WILES CHERRY

want to go. That is virtually unknown."

"We need to know more about what migrant birds do en route," says Dr. Williams. "For example, do birds, particularly young ones, go straight to their destination? They may wander all over the place. We do not know the whole migration route, without gaps, of any bird."

WHAT SCIENTISTS do know about bird movements, and what they will learn in the future, depends in part upon those unsung, selfless volunteers—the worldwide fraternity of birdbanders. In the United States we have more than 2,000 licensed banders. The U. S. Fish and Wildlife Service requires, as do most states, an operating permit. To get one, a bander must convince three experts that he can recognize

common birds that live in or visit his area—a tough quiz. Thousands of volunteers trained to trap, net, and handle birds under supervision assist licensees.

Nylon "mist nets" take most of the captives. The nets stretch, yield, and form enmeshing pockets when birds fly into them. I've seen hundreds of birds small and large netted (pages 168-9). Never have I seen one injured; it does happen, but rarely. After capture, birds are identified, examined for age, sex, and physical condition, get their leg bands, then resume their journeys.

The Bird Banding Laboratory at Laurel, Maryland, keeps more than thirty million banding records on file and adds a million new ones annually. The laboratory receives reports of some 60,000 recovered birds each year, a surprising number considering the

Basking in the fall sun, Canada geese will remain at Bombay Hook



long odds against being taken a second time.

All this herculean effort has taught us much that we presently know about migratory routes. For instance, bands returned from such distant places as France, Nigeria, Natal, and Cape Province, South Africa, helped trace the flight of the arctic tern. Recoveries also can reveal when birds migrate, where they winter, whether they return to old homes, how long they live, and much other information useful to science.

For me being near birds, watching them, marveling at them, is like sailing: Somehow it has the power not only to refresh but to heal. For a time at least my spirit is clean and free, and it soars. As I write these words, it is still winter in the water labyrinth of the Chesapeake Bay, and Canada geese in swift skeins pass over my dock and my house,

sending down to me their raucous *ronk-aronk-ronk*. My heart goes up to them, and my thoughts will follow them, this year as every year, when the soft call of spring bids them north. Yet I will be equally moved and wondering when ospreys and martins return on the breath of the south wind.

Science will never isolate or explain the special hold birds have on the hearts of men and women. But perhaps in trying to understand birds, we somehow feel closer to grasping the mystery of our own creation and evolution. Perhaps there is a bit of the migrant in each of us, and birds symbolize the freedom we envy but rarely find. Of one thing I am sure: In our awe at the mystery and wonder of birds, at those powers so far beyond our ken, we feel a humility that all too seldom graces the human spirit. □

National Wildlife Refuge, Delaware, until the migrating mood returns.

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PART II

A Walk Across

Only rabid coyotes and cross-country walkers go out in the west Texas sun. Even the rattlesnakes must have taken cover this 100°F afternoon. It's taken Barbara and me most of a day to walk

I WAS WALKING along the solitary, fog-haunted Mississippi Gulf Coast, heading for New Orleans. The Gulf broke inches from my soggy feet. Weighed down by my backpack, I left a deep trail of footprints in the sand for the waves to erase.

I'd walked almost 1,900 landlocked miles now. It was sheer pleasure to drink in the mind-clearing salt breezes and feel the cool salt water gushing up through the worn-out soles of my track shoes. They were the 13th pair of shoes I'd gone through since setting out on this walk across America 18 months before.*

I walked fast but my thinking was slow. The waves seemed to pat me endlessly on the back for having come this far, but still I had 2,000, maybe 3,000, miles more to go before reaching the really big water, the Pacific.

A single pair of footsteps marked my trail. Lonely steps. Once, not long before, the prints of my dog, Cooper, would have braided in and out of mine. But Coops, my forever friend, was gone now, killed by a truck, buried in the soft red earth of Tennessee.

(Continued on page 199)

*See part one of Peter Jenkins's "Walk Across America" in the April 1977 NATIONAL GEOGRAPHIC.



America

TEXT AND PHOTOGRAPHS BY
PETER AND
BARBARA JENKINS

*the 15 or so miles of rugged road you see here. By now we've
walked 800 miles together since getting married in New Orleans.
We've still got more than 2,000 miles to go to the Pacific.*

SHEETER HASLER



TRAIL'S END—JANUARY 18, 1979

The Pacific! We waded right into it, hugging each other. The walk's over. But this isn't the end—only a new beginning.



I'd arrived in New Orleans alone in 1975, after walking and working my way from upper New York State in 18 months. I left New Orleans with a wife, Barbara—who'd never camped out in her life. As Barb's feet show all too painfully (below), our walk was no honeymoon.

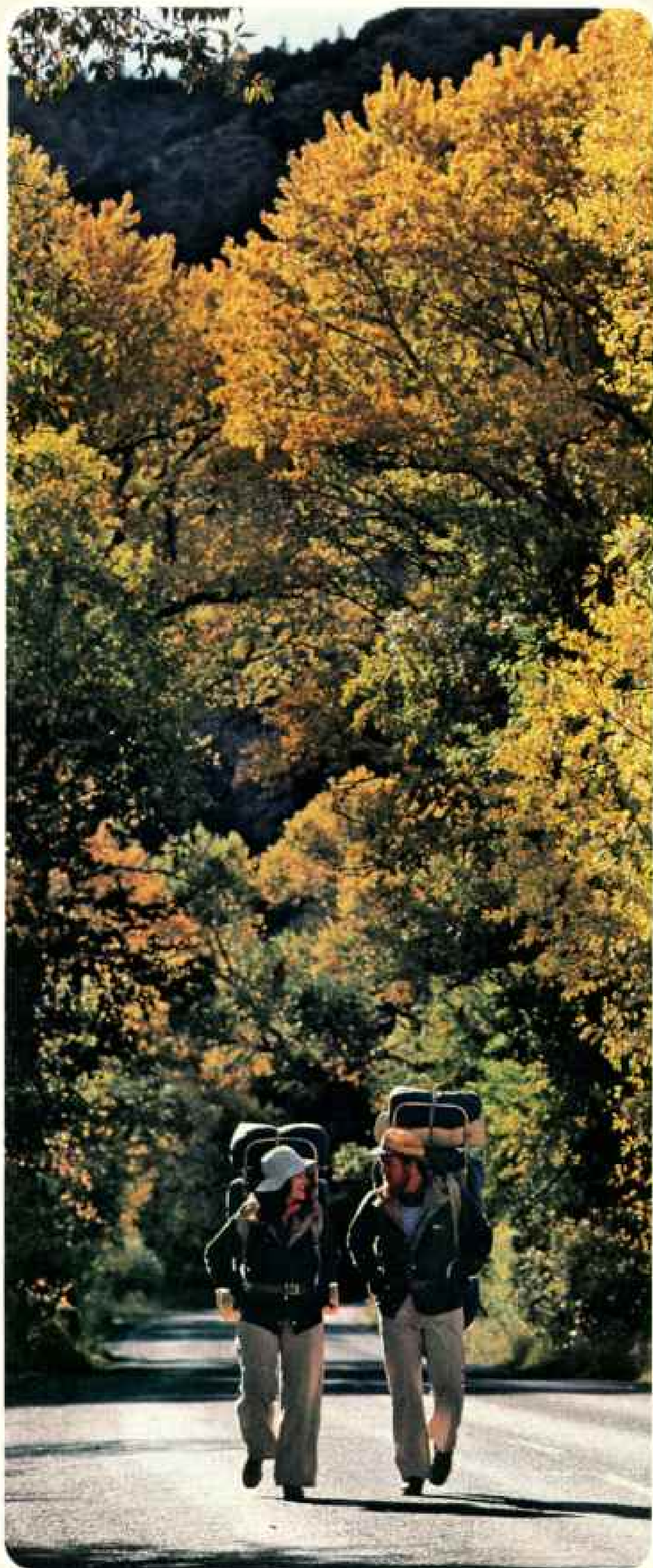
By the time we reached the New Mexico Rockies a year and a half later (right), we were keeping step smoothly. Throughout our journey we found an America we loved.

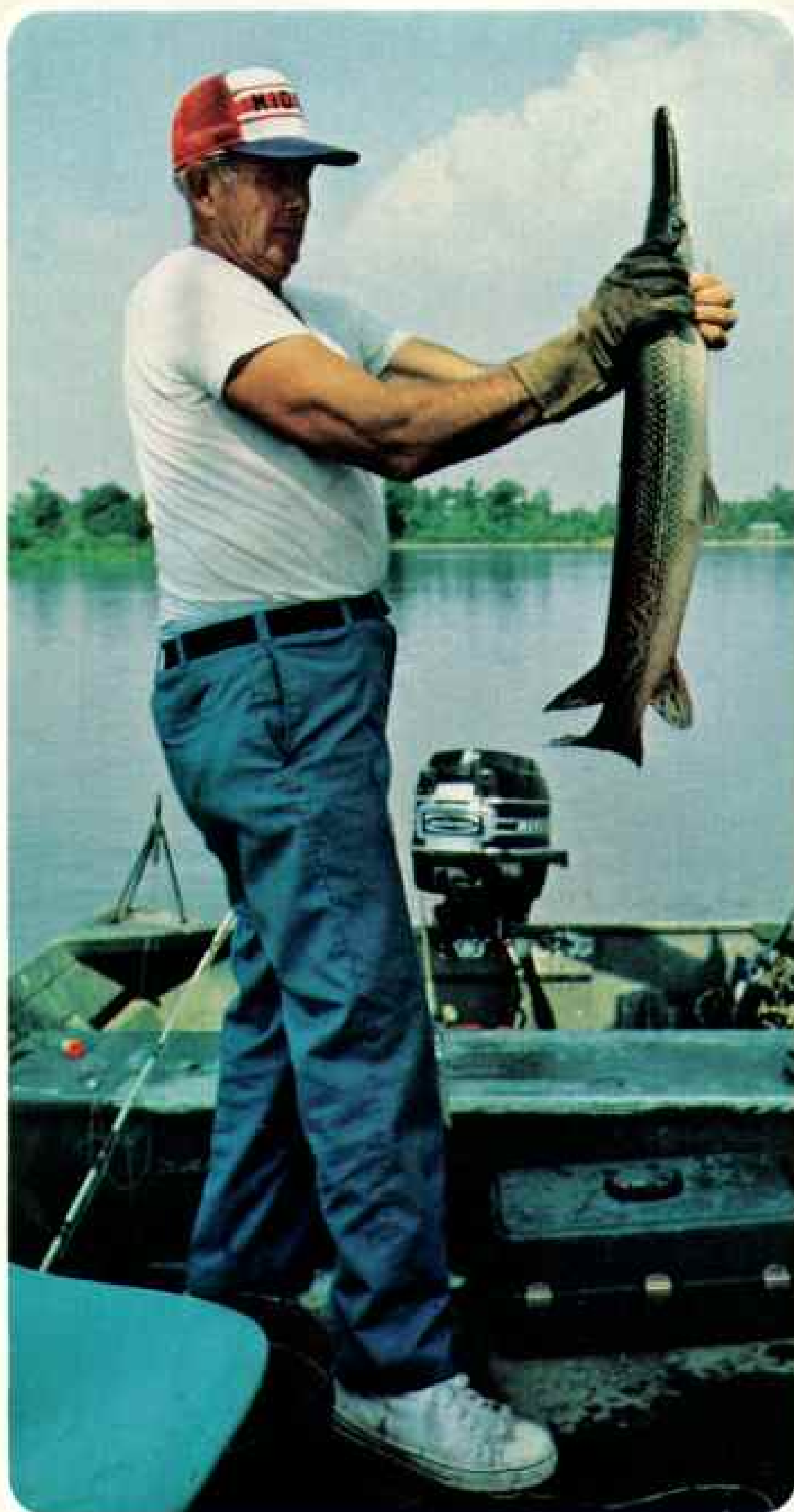


LEAVE JULY 5, 1976

My stopover in New Orleans changes the walk — and my life. Here I meet and marry Barbara. After I earn walking money on an offshore oil rig, we set off together for the Pacific.

CAJUN COUNTRY
Louisiana's swamplands give us some of our toughest walking. What hurts the most is watching Barbara suffer. We work a while in a gator-trapping camp.





In the swamp country of southwest Louisiana most folks were bayou-poor back when Wally "Preacher" Hebert was growing up. The Heberts all learned early how to live off what they could catch, trap, net, and shoot. Fishing and breathing are about equal hereabouts. Preacher (above) measures a medium-size alligator gar for a Cajun-style barbecue. Barbara and I lived and worked with him in a gator-trapping camp (it's legal here) near Westlake.

Everybody's got a story to tell. Preacher Hebert's hands tell his. The same hands that can devein a shrimp in the flick of an eye (bottom) once struck out Babe Ruth and Lou Gehrig in the same game—June 20, 1932. That's Preacher (below, left, with Ted Lyons of the White Sox) when he pitched for the old St. Louis Browns.



(Continued from page 194)

Looking to my left, I saw shimmering small fish leaping in the Gulf. Farther out, a fog was coming. By the time I passed hurricane-battered Waveland, it closed off my view. I looked at my feet. Memories of this walk of mine swirled like the fog itself.

It had all begun back in the college town of Alfred, New York, on October 15, 1973. I was so totally turned off by my own bleak image of America—Viet Nam, Watergate, racial hatred, drugs, immorality, the whole national agony—that I came close to leaving the United States altogether after graduating from college. Instead, I decided to give America *and* myself another chance. I decided I would walk clear across this country of ours to see America with my own eyes before accepting or rejecting it.

Extreme? Possibly. Over-simplified? Sure. But that decision set my feet walking and pushed my life in directions I hadn't even dreamed of.

Now, nearing the walk's midpoint, I had been turned *on* by America in a thousand ways. I had met a gallery of American heroes—a wild mountain man in Virginia, a loving black family in North Carolina, a gutsy governor named George in Alabama, and countless others. I had started out searching for my country and myself, and found both. What's more, without expecting or deserving it, I had come face to face with God and accepted Him as my own. And more—much more—

was still to come.

When the fog cleared, I had crossed into Louisiana.

TWO THINGS I knew I had to do in New Orleans. One, write the story of the walk so far. Two, make enough money to start walking again—maybe taking a job on one of those big oil rigs out there in the misty blue Gulf.

As I neared the enchanted city, I tried to figure out where to live. The French Quarter? A cabin in a bayou? Then I remembered Bill Hanks, a guy I'd met at the revival back in Mobile—the same revival that had spun my weather-vane soul around. A graduate student at a New Orleans seminary, Bill had invited me to visit him.

Soon I found myself walking—backpack, sweaty duds, leaky shoes, and all—onto the elegant, green, palm-sheltered campus of the New Orleans Baptist Theological Seminary. A seminary? My old friends would pass out.

Bill had an idea. Why not stay at the seminary to write my story? It was an almost monastic place, with a thousand seminarians, nearly all male, studying the Bible day and night. No stereos beat from dorm windows. No wild parties. The perfect place, in short, to shut myself off from this loose and luring city. I moved into the dorm and got down to work.

Then *she* came along.

One night, out strolling, I heard laughter explode from a plantationlike mansion that housed the few female students on campus. The doors crashed open and a

guy soaked with water ran out laughing. I was drawn inside. She stood there poised, a tall girl with a jug of water in her hands. She wore jeans and her hair was thick and curly black. Smiling angelically, she cut toward me with deerlike strides and dumped the water over me.

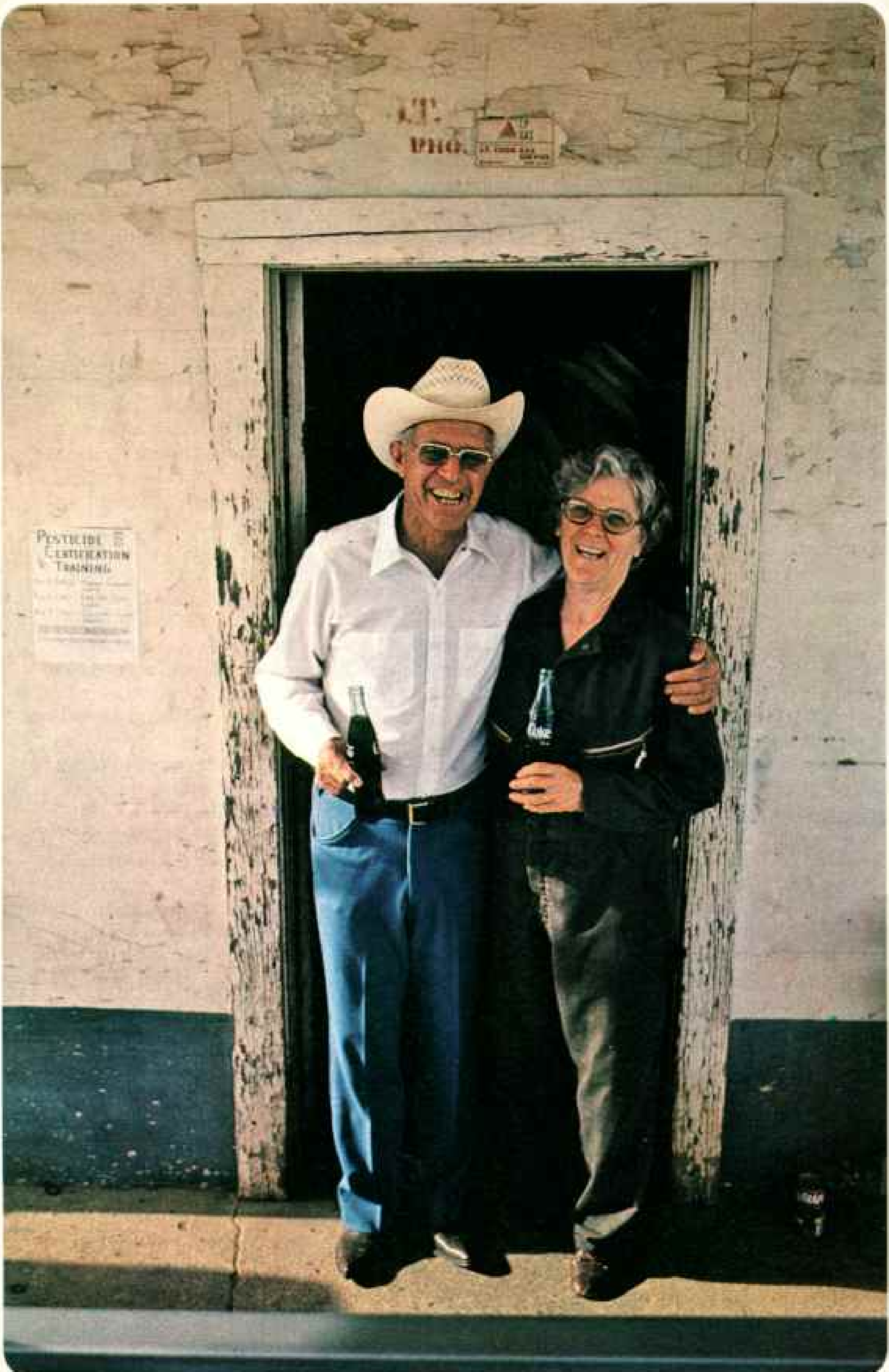
I ran after her as she darted into the kitchen. Water was flying in there like a Louisiana thunderstorm. I'd barged right into a water war! Getting into the flow of things, I dashed up to my tormenting angel, swung her over my shoulder, grabbed a jug of water, and poured it all over her head.

We laughed and mopped up water as I explained to everyone about my walk. And when I asked—looking her in the eye—if someone could show me around New Orleans, she volunteered. In Barbara Pennell, I knew I had met my match.

We were happy as children that first date as we drove around the French Quarter. Out of the car, I took her hand. We walked and talked for hours. Everything was perfect, as it was in the days after, and soon we were thinking marriage.

THE practical side of it all hit us only gradually. Me, in the middle of a 5,000-mile walk, marry a gentle belle who had never camped out in her life? Would this scholarly seminarian be willing and able to walk along with me for 3,000 miles under full pack and through who knew what hardships and dangers? It seemed impossible.

(Continued on page 203)



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It's unsung people who make this country tick. They've got plenty to be proud of. Like Idahoans Wyatt, Tommy, and Rex Williams (left), who show off trophies won by the W. T. Williams ranch for its prize cattle. And Jason Ramsey (below left), grandson of the Williamses' banker, who doesn't mind showing off his blue-ribbon case of chicken pax. Then there's Lake City, Colorado, school principal Larry Stukey (below), who's button-bustin' proud of his 1978 8th-grade graduating class of one—Shawn McConnell.



Friends like Homer and Ruby Martin (left) made the path easier. Homer drove by us in his dust-painted pickup one blistering hot west Texas day. He offered us a drink of warm water from his cooler. We drained every drop. He and his wife, Ruby, sort of adopted us after that, bringing us food and drinks on the road.

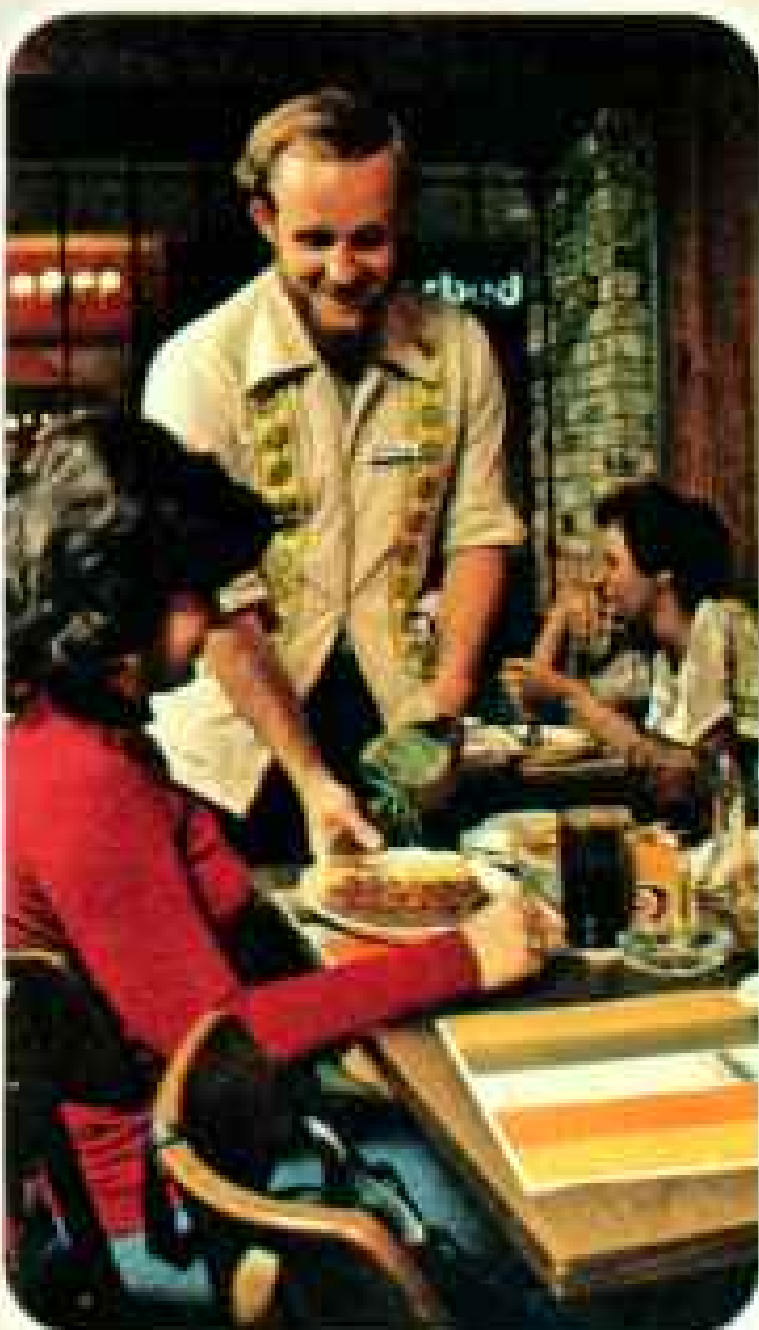






I'd almost always tented out when I walked alone, but when Barbara came along, we occasionally got a room in places like this old-timey hotel (left) in Athens, Texas—\$8.50 a night. To pay for such luxury, I waited tables in a Mexican restaurant in Dallas (below). Robert, a fellow waiter (above), counts tips after an 11-hour day of tamales, tacos, and hot sauce.

WIDE WINGERS



Realizing she would have to pull up her entire life by the roots to go with me, Barbara became torn, confused. She decided we had to break up. For weeks we didn't see each other. Then one day I heard footsteps behind me. Barbara had come with a message. We would give it one more chance—in church that Sunday.

"If we don't get a sign from God," she said, "everything between us is over."

Pastor Charles Green at the Word of Faith Temple introduced a guest speaker, an elderly preacher from Detroit named Mom Beall. She had fluffed red hair and sat in a wheelchair.

"Turn to Genesis 24," Mom began, her clear voice calm as a falling leaf.

It was the story of Abraham sending his servant to Mesopotamia to find a wife for Isaac. Stopping at a well, the servant prays: "O Lord . . . Let the maiden . . . who shall say, 'Drink, and I will water your camels' . . . be the one whom thou hast appointed for thy servant Isaac."

Rebekah appears and waters the camels. The servant reveals his mission and she is asked the question.

Mom Beall paused. She pounded the wheelchair.

"Will you go with this man?"

Again Mom shouted, banging the wheelchair with each word.

"Will you go with this man?"

Barbara was thrown back in her seat. The sign! Blinking through her tears, she whispered to me:

"Peter . . . I'll go with you."

WE HAD no honeymoon. My job on the oil rig came through, and for four months I worked as a galley hand and roustabout on the *J Storm I*, 70 feet above the Gulf.

I washed dishes until my hands wrinkled. During breaks I often stood at the swaying rail. I would hear a high-pitched chirping and see a school of porpoises romping past, leaping and twisting. The place was an oceanic Eden! Life was everywhere, attracted by the rig. Often I watched the passing parade—blue-backed barracuda, slow-swimming hammerhead sharks, limitless schools of bluefish, dreamily flapping rays. Game fish called ling prowled the waves like wolves. I caught a 68-pounder—a *J Storm I* record!

When not galley-slaving, I loaded man-crushing pipe, painted ceilings, mopped the floors till they shined.

On my last day, rig boss Grady Cockerham called me into his office. The whole crew was there, some of the toughest guys I'd ever known. For once there were no wisecracks. Every face was dead-serious. Behind closed doors, out in the stormy Gulf, I was initiated into a secret brotherhood of offshore riggers. I was never prouder.

With enough money now to start walking and my manuscript sent off to NATIONAL GEOGRAPHIC, we concentrated on training, hardening our bodies for the tough miles ahead.

Compared to this, training with my dog, Cooper, had been easy. For one

thing, Cooper couldn't talk back. With Barbara I had to explain over and over why all these aches were necessary. I drove her until she could jog and walk for six continuous miles.

By June we were running eight blocks and walking just one. It was taxing for Barb, but I knew she had the inner toughness of pioneer ancestors who had trekked cross-country to Missouri in covered wagons. We were ready for the walk.

WE BOTH felt tight and trembly inside when we rose at 5 a.m., July 5, 1976, the day after the Bicentennial anniversary. We had spent the Fourth packing our creaking-new gear and felt a little guilty that we hadn't celebrated the Bicentennial like everyone else. But, then, this walk across America was our celebration.

By first light we ferried across the swirling brown Mississippi and headed out on the road at last. The real walk was here—and soon so was the pain, the physical and mental torment that we would know often.

The temperature in southern Louisiana was nearly 100; likewise the humidity. We walked 12 miles the first day, then 15, then 16. Barbara's feet turned into masses of blisters. I told her to keep walking, that she would get past the pain. I didn't realize she would *never* get past it. She wept but kept going.

One evening we pitched our tent in a swampside sugarcane field. In the morning we woke to a loud,

dull, vibrating sound; the outside of the tent was black with swamp mosquitoes! We couldn't stay there all day, so we finally lurched out, slapping wildly. The black cloud enveloped us. Jumping in torture, we yanked down the tent, grabbed our gear, and stumbled out on the road. Our faces were swollen; every inch of bare skin was livid with bites.

Another time we found ourselves swarming with tiny baby ticks—thousands of them. It took hours before we got them out of our skin and hair and stopped shuddering.

Barbara's blisters began growing calluses. We discovered that she was better off in solid hiking boots than in track shoes like me.

We kept walking. We started to *see* the world around us—a world of blackwater swamps and bearded cypresses with crawling roots. Alligator country. Cajun country.

NOW LET me tell you about a pair of hands we discovered.

Incredible hands. The hands of a man named Preacher Hebert.

Folks around Westlake in Louisiana's swamp country will tell you that Wally "Preacher" Hebert's the best gator skinner around. Watching his big fingers flicking a razor-edged knife while skinning a soft, delicate gator hide is like seeing a five-fingered ballet.

For a month we apprenticed our hands to his—trapping and skinning bayou gators, deveining thousands of huge Gulf





JEFF DICAMAN

The hardest part of walking across America—saying good-bye. Barb shares tears with Sarah Stevens, a Dallas friend, as we hit the road for the Rockies.

shrimp, filleting endless red snappers, lunker bass, and speckled trout. Best of all, we feasted on everything Cajun style, even gator.

Preacher, who's past 70, went back to his beloved bayous after working 29 years in a Firestone tire plant in Lake Charles. Filled with country quiet, he doesn't talk much. That must have been how he got his nickname, but Preacher doesn't remember for sure. "Anything's better than Wallace," he says. The nickname stuck through the early '30's when he pitched pro ball for the old St. Louis Browns. On June 20, 1932, he struck out Babe Ruth twice and Lou Gehrig once in the same game. Then,

as now, Preacher let his fingers do the talking.

When his strong, gentle hands shook ours good-bye, we knew we'd found another American hero. This country could never have been built without wise and working hands like Preacher Hebert's.

WE CROSSED a creaky, rusted bridge over the mellow green Sabine River into Texas. I'd half expected to see deserts, sagebrush, and dust-twirling ranches right at the border, but east Texas turned out to be pretty much like the gator-gar-and-gumbo country in Louisiana. The Cajun influence and French place-names stayed

behind in the bayou country.

Then we entered the wide wide world of Texas, with red cattle as big as Chevy pickups and red steaks the size of chrome hubcaps. September sizzled as we walked along Highway 69 between Lufkin and Jacksonville. I learned to slow down to about 13 to 17 miles a day, which made me feel guilty at first but made life bearable for Barbara. We even stayed overnight at a motel every week or two, something I'd never done during the walk before. Barb just had to have a once-in-a-while reminder of civilized comforts.

But slower walking and higher expenses drained our



Walking through Olney, Texas, we met master leatherworker Asa Pease. "Maybe my legs don't work too well," he said, "but I've got as good a pair of hands as you'll find in Texas." Asa's no bragger. He was stating a fact.

He had polio as an infant. But to Asa obstacles are just things you step on to go higher. He'd become a horsebreaker, motel manager, trader, and owner of the

Silver Spur Leather Shop. He also became a father—the best, says his daughter Melanie (right).

Asa makes belts for cowboys and country-music stars—and for me too (left). He also resoles cowboy boots (above). "The longer they wear 'em," he says, "the better they get. Ya know, some o' these cowboys treat their boots better than they do their women."



meager finances. We'd begun in New Orleans with fifty twenty-dollar traveler's checks. By the time we followed Highway 175 to the outskirts of Dallas, 600 miles later, we were down to \$1.87. I'd have to find work there.

We didn't know a soul. We didn't have enough money to buy one of us dinner. Ahead, the steel-and-glass skyline grew like a geometric cactus out of the flat, bare plains. The winds whirled around us; we felt lonely and scared.

We joined hands and prayed, and then kept going. Less than an hour later, just beyond Seagoville, Ron Hall came riding along on a bicycle.

"You folks hungry?" he asked. Turned out he was the minister of a small church. He took us to his home, got his car, and drove us into Dallas, where we ate our fill at a restaurant called El Chico. It was my first real Mexican meal—burritos, tacos, enchiladas, guacamole, and honey-drowned sopapillas.

My stomach told me this was the place to get a job. The founders, a family named Cuellar, put this gringo to work as a busboy. We wintered over in Dallas. I worked my way up to waiter, balancing countless plates of hissing Tex-Mex food, including Mama Cuellar's famous corn tamales—made from a secret recipe she had introduced at a county fair back in 1926. Now Mama's gone, but her sons—once poor sharecroppers—have parlayed her tamale stand into a string of more than a hundred El Chico restaurants throughout the Southwest

and Southeast. We wrote the Cuellars into our book of unheralded heroes.

When time came to leave next spring, I had fattened more than my wallet, but I boiled off all those tamales in a month of conditioning. The Rockies lay ahead.

“**Y**'ALL gotta be kiddin!” folks told us when we said that we were crossing west Texas on foot.

One old-timer warned: “You either boil or freeze. Past Fort Worth the only thing 'tween you and the North Pole is a few strands of barbed wire.”

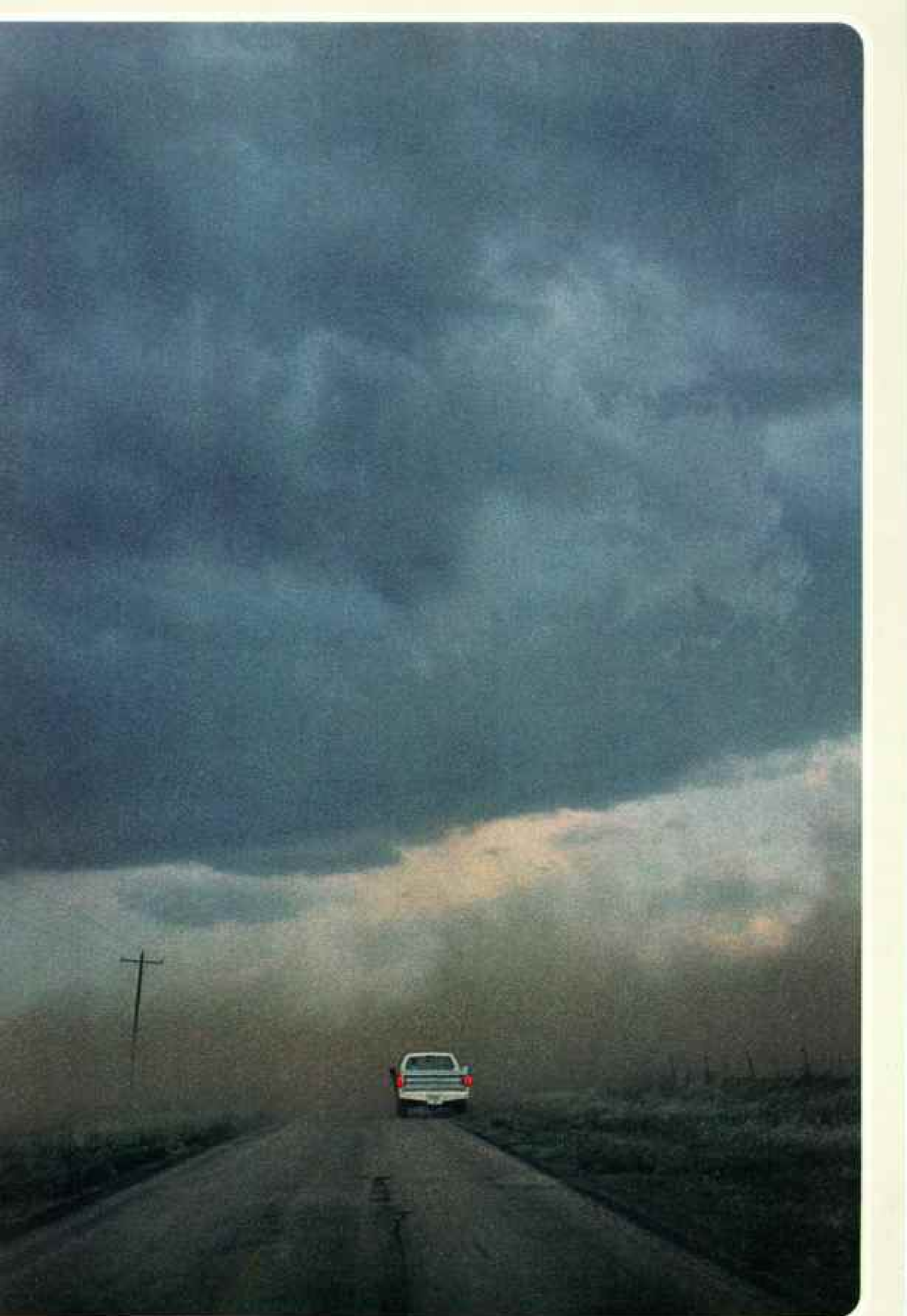
With two large golfing umbrellas attached to our backpacks to keep off the August sun, we moved into that world of dust storms, tornadoes, cactus, melting roads, rattlesnakes, fire ants, barbed wire, and hundred-mile gaps between water holes.

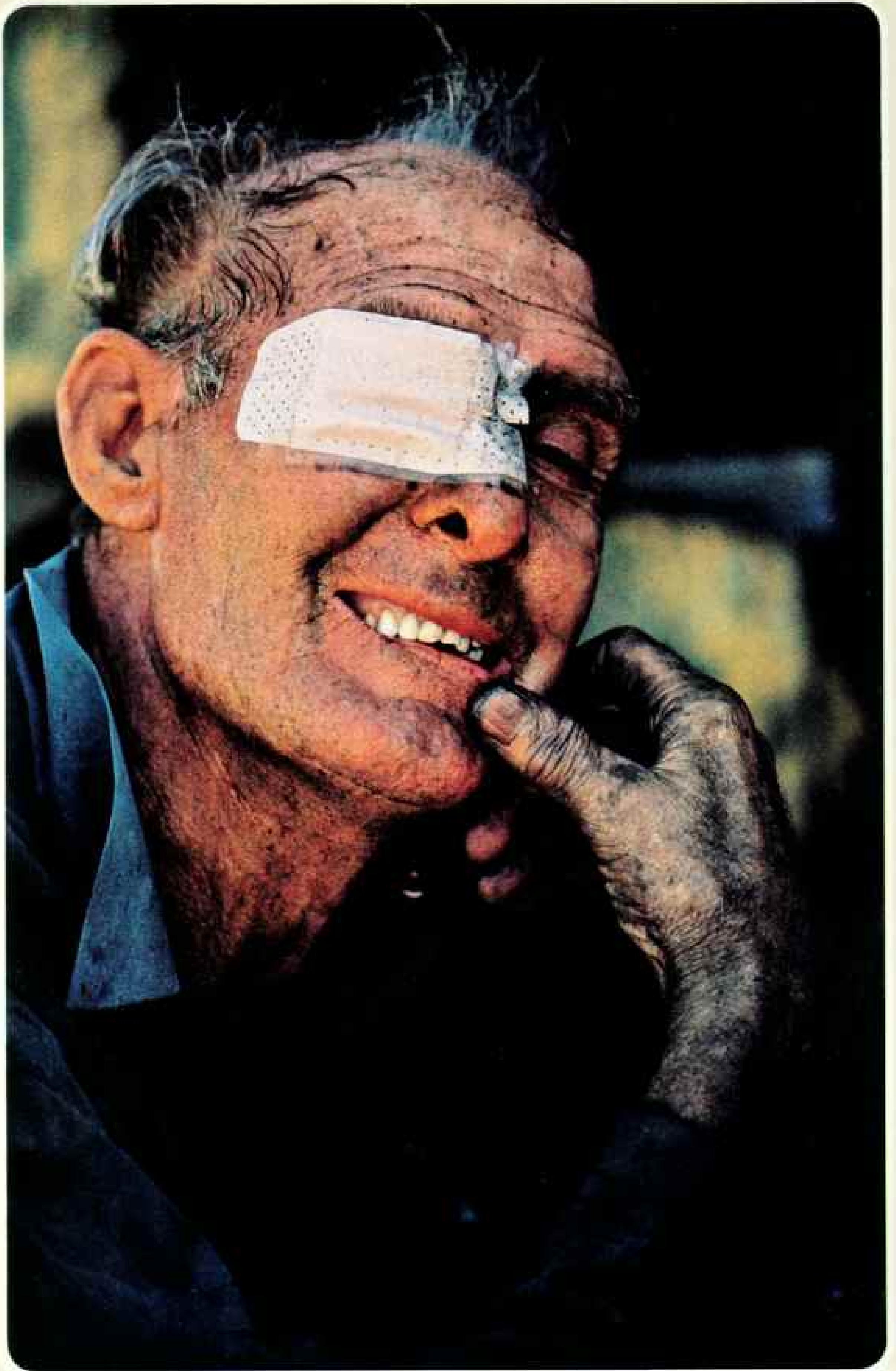
One 105-degree day, out in the parched emptiness between Seymour and Benjamin, Texas, a silvery camper loomed up at us through the heat waves.

“Get out of the way!” I shouted. “They’re coming right at us!”

“My folks!” Barb yelled.
(Continued on page 213)

We tumbled into a ditch, tossing off packs, rings, and everything metallic as this black-bellied storm charged us in a fit of Texas temper near Gilliland. The wind turned red with dust. Bolts of lightning lit the dark sky like giant flash-bulbs. One shattered a telephone pole a few feet away. We were shaking scared.







BARBARA JENKINS (LEFT AND BOTH ABOVE)

Working the gas and oil fields of the Southwest is a job where you're always one spark away from kingdom come. C. B. "Joe" Davidson (left) has been at it for 45 dangerous years. The adhesive patch keeps carbon grime out of Joe's eye socket. He lost the eye years ago in an accident, and recently lost the plastic replacement as well. At a natural-gas field near Borger, Texas, where we cleaned wells, Joe was my boss. When I didn't learn to do a job right

instantly, like wrenching pipe together (above), Joe stepped in and did it for me, disgusted but gentle. On the Johnson ranch (above) each oil company that leases land has its own lock and key.

Our wallets fattened by oil-field wages, Barb and I walked on across the Texas Panhandle. It's a world of surprises—often dangerous ones. A baby rattler (below) reminded me it's wise to shake your boots out before putting them on in the morning.







(Continued from page 208)

The circling buzzards must have been amazed as we all hugged each other on the pizza-soft asphalt. Barb's folks—Ernie and Betty Jo Pennell, retired truck-stop owners from the Missouri Ozarks—had driven more than 900 miles trying to track us down and surprise us. After getting lost for a day, they spotted our bright umbrellas on Highway 82.

I was half afraid they'd try to take Barb back to their everyday world when they saw her bandaged feet and blistered sunburn. But they'd only come to give us a parental blessing. Next day the Pennells drove off into the heat-rippled horizon.

AFTER I'D WORKED more than a month in the Panhandle cleaning out gas wells near Borger, we finally made it across that world of long distances called Texas. Crossing into Clayton, New Mexico, we headed northwest. For six days we didn't see a town of any size. Only a few pickups passed us. We got water from windmills set out for cattle.

With a westward wind at our backs, we moved along with the tumbleweed. Prairie falcons wheeled on heat currents high overhead—mere specks in the vastness. We felt no bigger.

We hadn't seen a single mountain yet, and it was

three years since I'd left the gentle Appalachians. Then one day at sunset, we topped a ridge and there they were—the New Mexico Rockies—crashing up into the distant fiery sky. I'm sure we felt every emotion the pioneers felt when they followed this same route west a century before.

GRADUALLY, desert lifted up into mountain. The weather cooled. Our spirits soared with the landscape. We finally crossed Colorado's Continental Divide in late October. Elk and mule deer watched us from pine-forested slopes tilting gigantically in every direction. Eagles swooped down to greet us.

Heading through 11,361-foot Slumgullion Pass, we approached tiny Lake City, Colorado—ringed by 14,000-foot peaks jagged as sharks' teeth. I knew we were just one step below Heaven. That winter of '77-'78 we holed up above Lake City in a snug log cabin on the uplands ranch of the Vickers clan.

For seven months I fed cattle by day and worked nights writing the book-length version of part one of the walk.* On the peaks the powdery snows fell thirty feet deep. Many a blue black mountain night we huddled

**A Walk Across America*, by Peter Jenkins, William Morrow & Company, Inc., New York (1979)

A bald eagle soars above Colorado's Gunnison River as if to examine a jet's contrails—which remind me of a mule deer's trail in deep snow. Eagle, elk, bear, bobcat, ermine, and other natives shared their Rockies with us.

in front of the glowing fireplace and listened to Perk Vickers's stories.

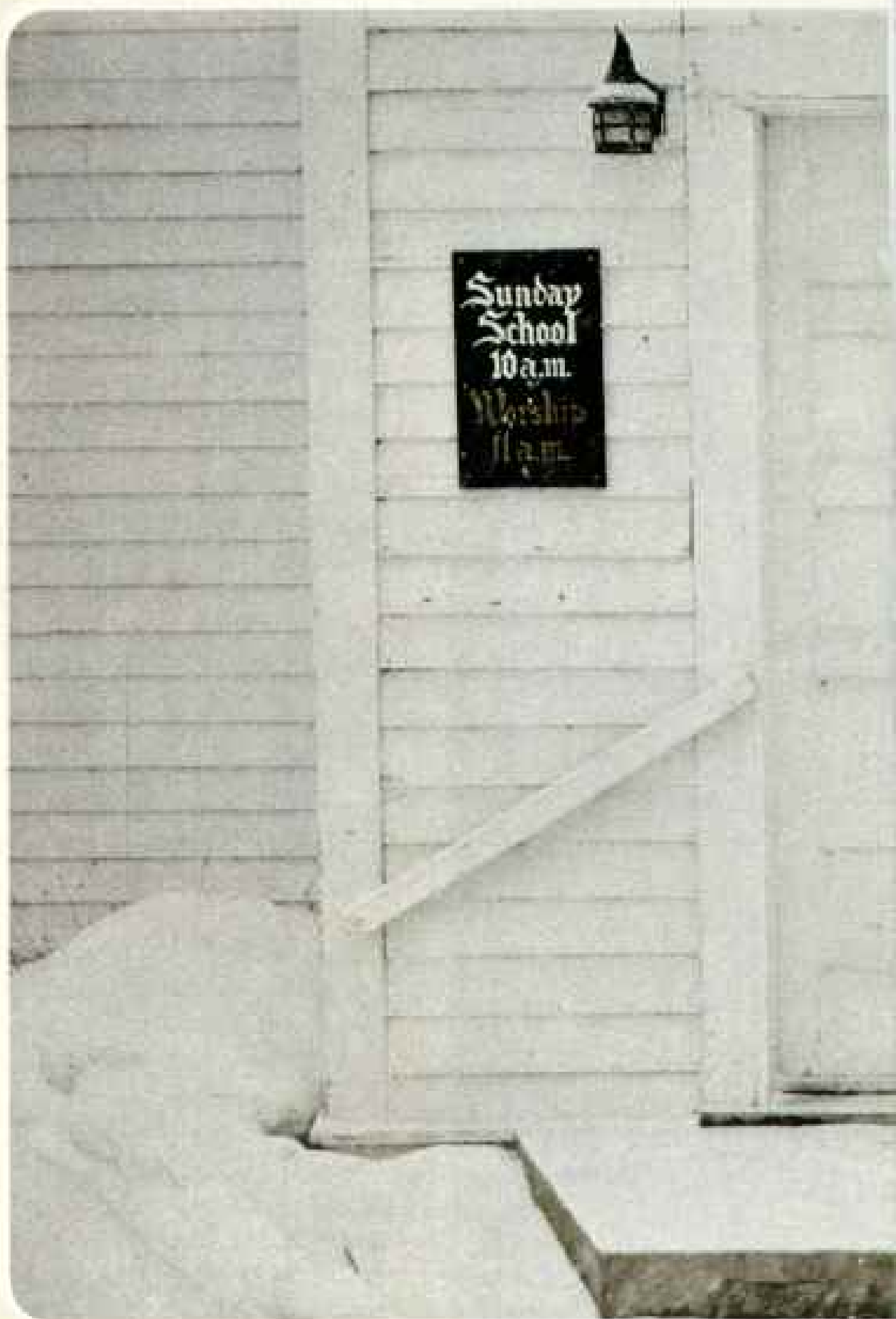
He told us how his dad had come out here from the coal mines of the East during the gold-and-silver boom of the late 1800's. How back then there'd been 3,000 ripsnortin' miners in Lake City. Other towns like Cathedral and Hermit and White Cross sprang up and roared. Perk's dad, riding the boom, opened the Silver Street Saloon—a model for Western movies with its shoot-outs and bar-clearing brawls.

Then came the bust. The price of silver plummeted in 1893. The miners—those who weren't killed by the cold or each other—took off. Lake City's population dipped below a hundred. Every other town in huge Hinsdale County turned into a ghost.

But Perk and all the Vickerses loved these mountains; nothing would move them. They eked out a living raising draft horses and cattle on their ranch. Today it covers more than 3,000 acres—downright prosperous.

Perk's passed his love of these mountains on to his son, Larry, who got himself a master's degree and went searching for today's gold in the big city before coming back to "God's country," as Perk calls it.

BY MAY we had cabin fever. Heavy snows still fell every few days, but the sub-zero cold let up. Our bodies had been fattened by regular feasts of elk steaks, Perk's sourdough

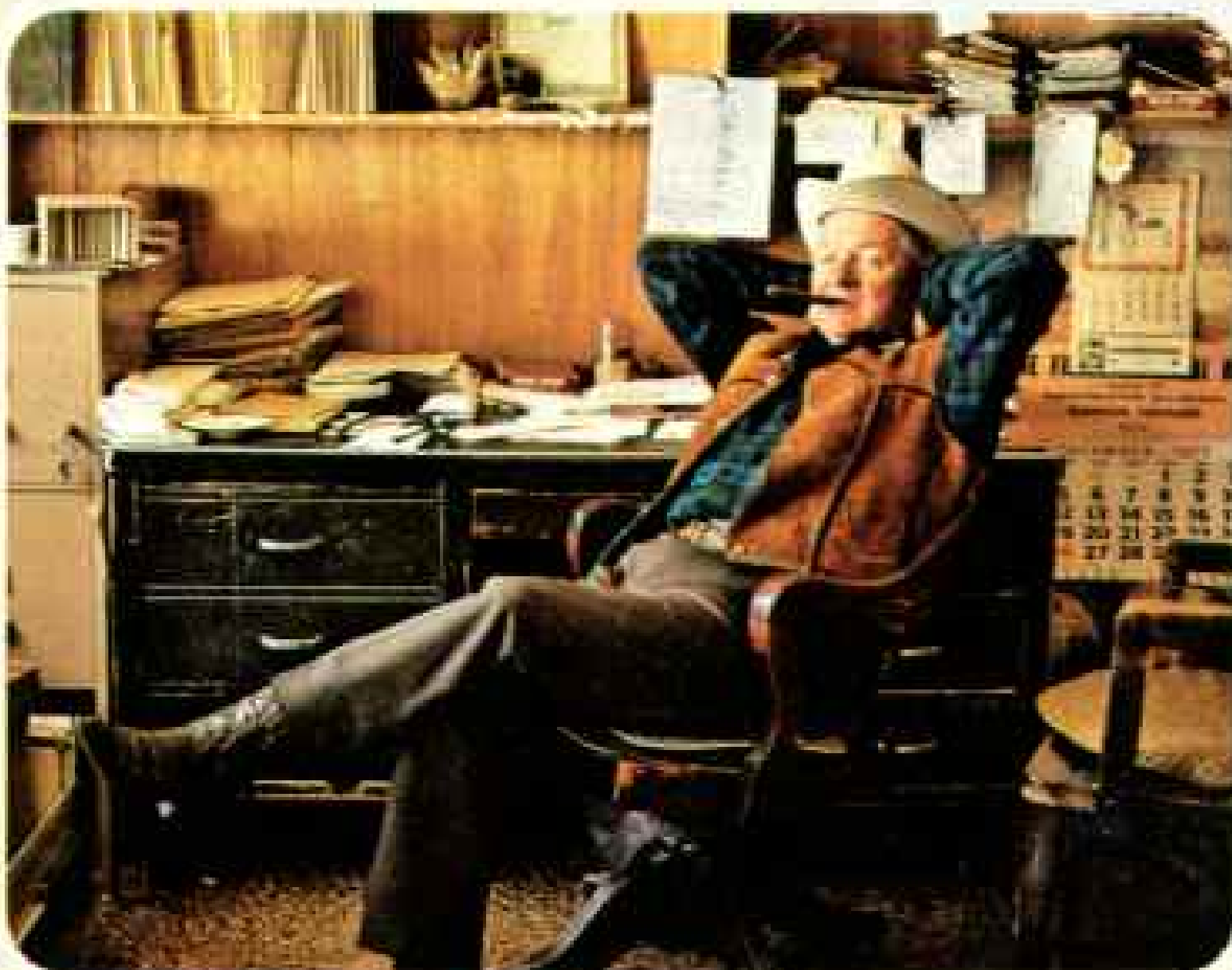




*F*alling snow's about the only noise in winter around Lake City, Colorado, 8,658 feet up in the Rockies. A Saint Bernard (above) snoozes at the only church that's open year round. We holed up in a cabin on the Vickers ranch. Perk Vickers (right) chased away our cabin-fever blues with captivating tales of old Colorado.

Barbara spent lots of time painting the blizzard-wrapped mountains that surrounded our cabin (left).

A Walk Across America: Part II



BARBARA JENKINS

We crossed the Colorado Rockies by way of Engineer Pass—at 12,800 feet, the highest point of the walk. It was June 25, 1978.

pancakes, rainbow trout, and Barb's fine country cookin', Ozark style. We started training again. When I looked up at the chain of 14,000-foot peaks we'd soon be crossing, I stretched the sore muscles in my neck. All winter I'd been bent over a typewriter; now the book was finished. One day Barbara

came into the cabin. "Peter," she sang, "it's the first barefoot day of the year!"

It was hard to leave this mountain paradise. "You folks may as well just stay here forever," Perk suggested. It was another one of those difficult good-byes—the roughest part of walking across America.



THE SNOW was still thirty feet deep in places when we set out across Engineer Pass. Somewhere beneath us was a road. We walked across ice-crusting drifts. It was so warm in the June sun that I wore my shorts. Our winter-white skin soon reddened.

Two days of bright sun and

white snow half-blinded us. Sheer mountain walls blocked off our view and sense of direction. We got lost. We climbed one slick, collapsing wall of crusty snow after another. Our lungs grabbed for each breath of oxygen.

Finally, almost at 13,000 feet, we came to a notch in the wall of mountains. There

was a deep wailing in the air. The wind, funneling through the notch, was pouring in from the great western deserts and the Pacific.

There, at the highest altitude of our walk, in the thin air, we paused hand in hand. Looking down at the
(Continued on page 221)

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In eastern Utah a sign said No Services on I-70 Next 107 Miles. And that was for cars. Umbrellas (right) give scant relief when the temperature reaches 122° F. We were almost done in when we reached Green River (above). Barbara's face shows the strain (below).







A photograph, taken in 1903 by Mormon photographer George Edward Anderson, shows three little girls (above left) praying at their mother's knee for their missionary father, away in England. White-haired Estella Manwaring Brockbank (above) remembers it all—she's the girl on the right, then age 9. This and thousands of other Anderson plates, dating from 1880 to 1928, were stored in a dusty basement in Springville, Utah, and acquired by Rell G. Francis (left) in 1972. Long before tracing roots became a national fad, the Mormons encouraged members to document their ancestry back four or more generations.

quivering blue brown flatlands stretching away to the west, I saw this walk of ours with a new understanding.

I had started out alone, feeling an outsider, seeking other outsiders—Homer the mountain man, Mary Elizabeth of Smokey Hollow, the far-out disciples at a commune. Now, with Barbara and me things were completely different. We weren't being drawn to America's fringes but to its center. The people who mingled their lives with ours were just ordinary Americans—the ones whose working hands and loving hearts *make* this country—literally.

WALKING DOWN off the Rockies toward the desert, our steps were light, buoyant. The Pacific still lay far distant, but its call was getting louder.

No sooner did we reach Ouray, Colorado, our first town after Lake City, than we began our withdrawal blues from the heady skies of the Rockies. The land soon flattened and flattened into eastern Utah.

Heat again. Desert. I'd read somewhere that the Mormons had stopped in Utah because it was a green paradise, but all we saw was a hundred miles of emptiness, hell without the flames but with all the heat.

Saliva dried in our throats. The only thing that mattered was WATER. We could never carry enough; we would go without for as long as a full day. Coming to an irrigation ditch, we

would scoop up the muddy water—pieces of sticks, leaves, bugs, and all. Eating hardly mattered; we could barely swallow anyway. Occasionally, air-conditioned cars with tinted windows sped by, the people inside waving at us and smiling. The distance they drove in an hour would take us four agonizing days.

One heat-delirious noon we staggered into Bob's Family Restaurant in Helper, Utah. After downing a dozen glasses of ice water, we dived into a hot lunch. I ate lots of thick grilled burgers, mountains of fries. Was I the same guy who'd started this walk a vegetarian? Thank God for hamburgers!

On the clean-scrubbed walls of Bob's, I noticed some old-fashioned brown-tone photographs. I looked closely. These were obviously historic works of the photographer's art. I was told the prints were recently made by a fellow up in Springville, Utah—Rell G. Francis, 50, the "keeper of the plates."

Rell, we learned, had been given 10,000 or so photographic glass plates that had been gathering dust in a friend's basement. The plates had been made between 1880 and 1928 by a forgotten Mormon photographer named George Edward Anderson. They document a past generation of Mormon life. Genealogy is an integral doctrine within the Church of Jesus Christ of Latter-day Saints. The church urges members to trace their family ancestry back at least four generations in search of relatives who

were never baptized into the Mormon faith. These can then be saved, Mormons believe, by performing a baptism for the dead.

When Rell received these old plates, he felt a calling to quit his teaching job and dedicate himself to G. E. Anderson's photographs. By preserving these images of the Mormon past, he's preserving the American past as well.

HEADING into Salt Lake City, we were joined by my red-headed, freckle-faced sister, Winky, who wanted to experience the romantic life of a cross-country walker. After three days of brain-frying heat, she was yearning for cool green Pennsylvania, where she teaches school.

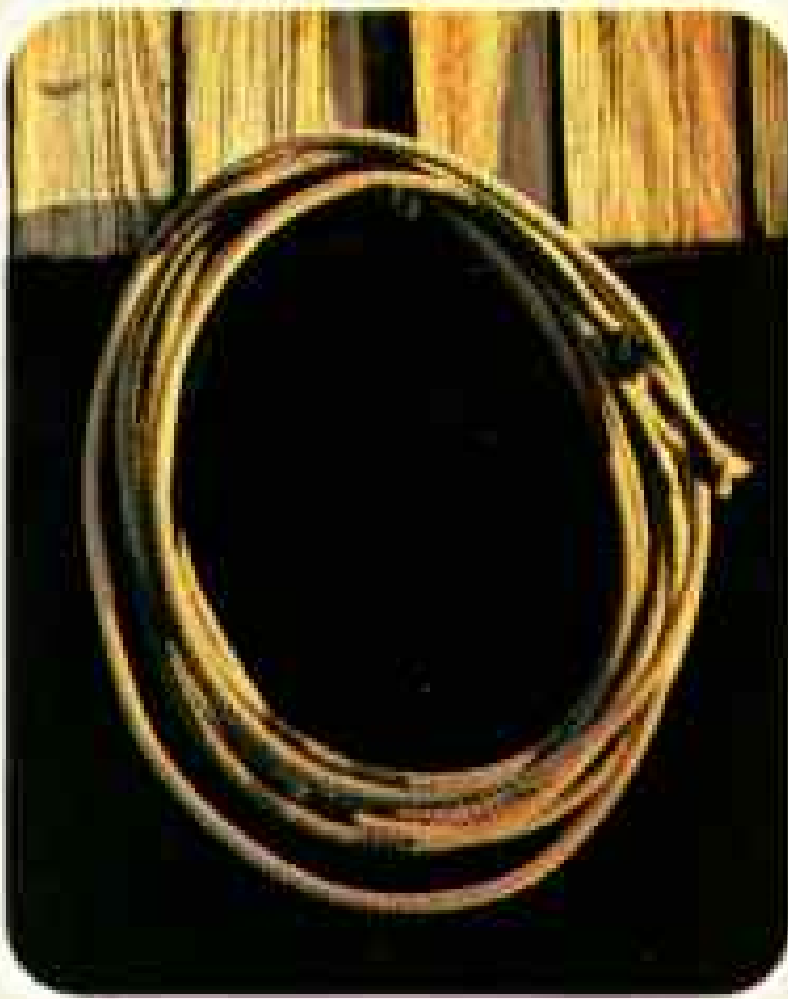
Almost always we walk facing traffic, but this day we decided to walk *with* traffic to take advantage of some shade across the road. Barb and Winky hiked side by side, chatting. I was 15 feet ahead. As we passed the sunburned lawn of the Deseret Mortuary in Sandy, Utah, I heard a terrifying squeal of tires behind us. I whirled around. The next few seconds froze before my eyes frame by frame.

The first frame was of a dark blue car bearing down on us. The second was of the shiny car veering and skidding sideways. The third, etched forever on my mind, was of runaway tons of steel and chrome fishtailing wildly and slamming sideways into Barbara and Winky. Limbs askew like rag
(Continued on page 226)

VOTE NO ON
CITY
SALES TAX



Here's a love story, western style. Two love stories in fact. This bumper sticker (below) could be the title of the first—about Carol and Rodney Hopwood (bottom right), who ride the Idaho range from spring to fall each year herding cattle. "Carol's as good a hand as any man," Rodney says. "We

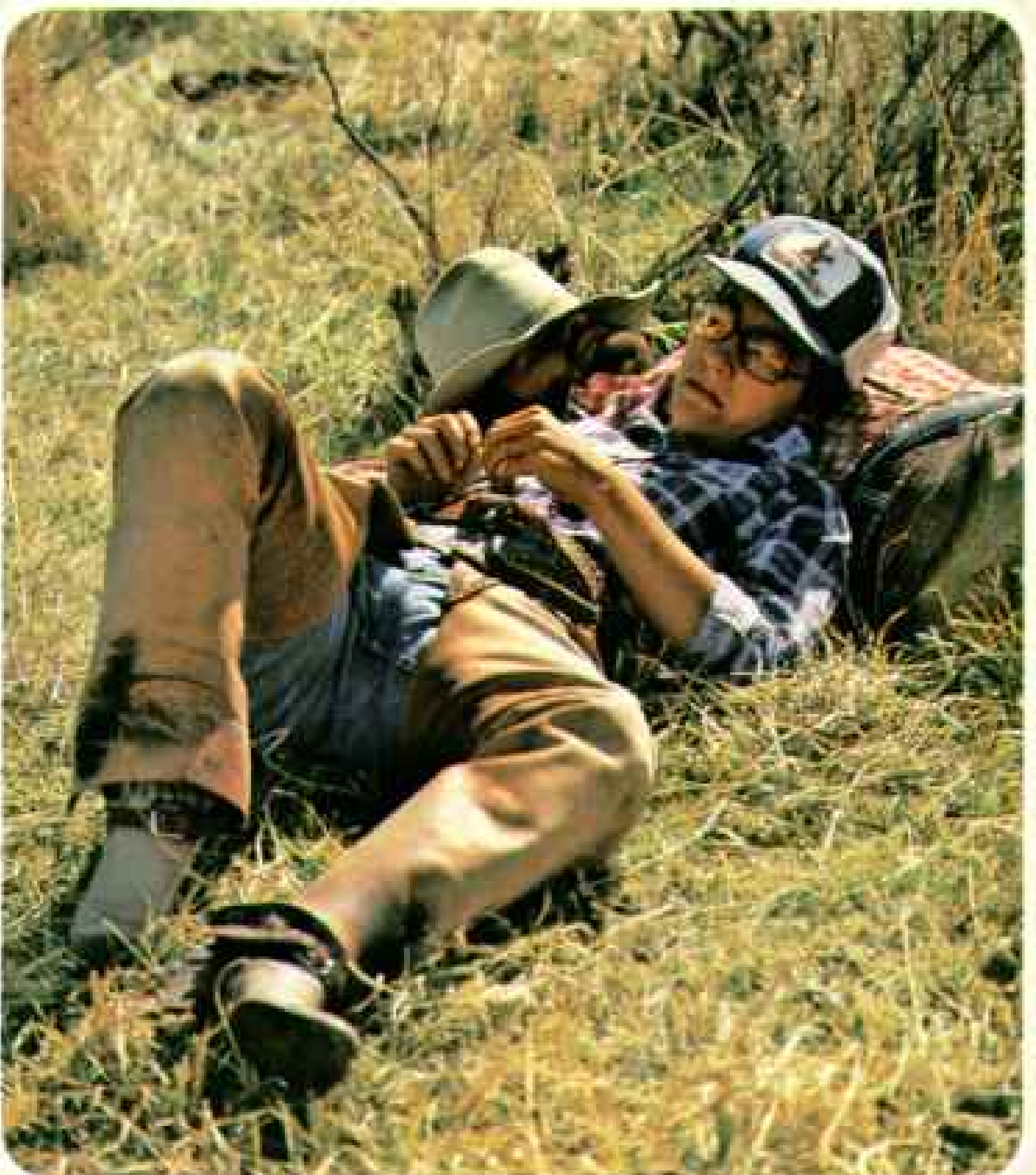


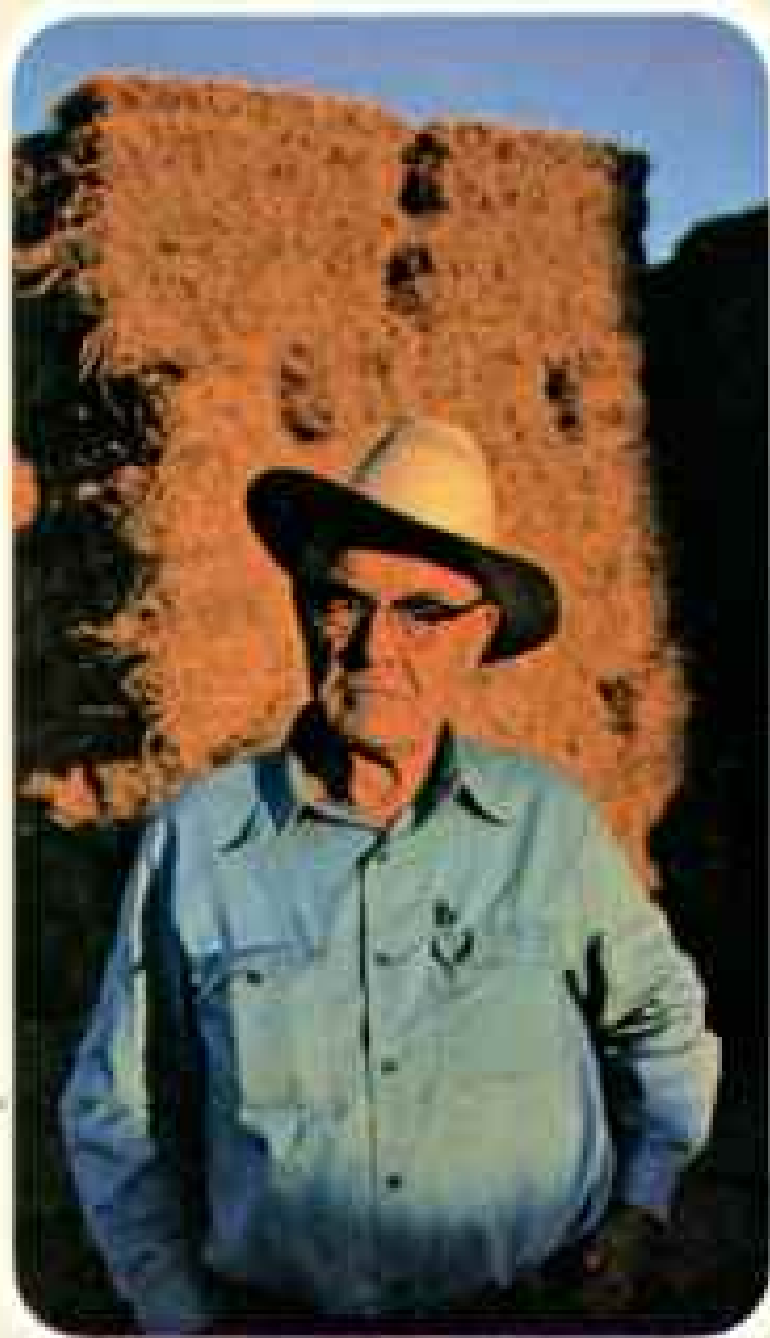
**ONLY COWGIRLS ARE
BRAVE ENOUGH TO MARRY
COWBOYS**

chose cowboyin' 'cause out here we can be together all day, alone, on horseback. No better way t' live."

Which brings me to the second story—Barb's and mine. We rode with them for a week and understood. Beyond all the body-breaking work, there's the soul-stretching bigness of the sagebrush valleys. There's listening to coyote concerts and splashing yourself awake with icy springwater. There's the feeling of your knees about to fall apart after an all-day ride and watching your sweat-stained horse rolling jubilantly in the day's end dust. We know why Carol and Rodney chose cowboyin'.

A store window in Delta, Colorado (left), reflects a lot about today's new-old West.





When W. T. Williams (above) was 21, he homesteaded 160 Idaho acres that could barely grow tumbleweed. Now his ranch pushes the horizons. It takes more than hard work. You need bankers like Jack Ramsey (right, center), who talks over a loan with W. T. and his son Billy. W. T.'s wife, Viola (below), has fueled the ranch's success, cooking three meals a day for fifty years.



BARBARA JENKINS (LEOVE AND RIGHT)





(Continued from page 221)

dolls, they hurtled, screaming, thirty feet through the air and landed in a heap of dust and groans.

The car halted about fifty feet away, and its driver, a 16-year-old boy, emerged crying uncontrollably. I was screaming. In minutes sirens and red lights cut through the August dust and heat. Dozens of cars stopped along with police and an ambulance. Stretchers carried Barbara and Winky into the ambulance and it departed.

I walked over to the boy and managed to calm him. He hadn't been at fault; a pickup truck had veered into him, forcing him off the road.

When I got to the emergency room, a nurse came up to me.

"I know the word is overused," she said. "But it's a *miracle*. They're both OK. No major injuries. Those backpacks cushioned the blow."

Winky soon returned home. Barely a week after the accident, Barb and I were on the road again—*facing* the traffic this time.

WE WALKED northwest, passing through calm, self-assured Mormon towns like Bountiful, Brigham City, and Honeyville. Beyond snowless Snowville we crossed into Idaho and kept going for 65 empty miles past Curlew National Grassland and Black Pine Peak. The first Idaho community we reached was a cluster of grain elevators called

Burley, on the Oregon Trail.

When I think about Idaho, I think about the W. T. Williams ranch. It stretches from south of Twin Falls toward the Nevada border—some of America's harshest landscape.

"It all started with a horse and a dog," W. T. Williams explained one day, pointing with a huge leathery index finger toward the south border of his spread. He talked as if it were only a few hundred feet off. Actually, it was 17 miles. You can ride a good saddle horse all day on the Williams ranch and not see another human being—just sagebrush, howling coyotes, fence posts, a few golden eagles, and scattered herds of cows, calves, and muscle-packed bulls.

W. T. told me he had started with 160 acres back when he was 21. I didn't ask how many acres or cattle he had now. Asking a rancher things like that is like asking city folks how much they've got in their checkbooks or savings accounts.

I hired on. For two months I wrestled 375-pound calves and helped harvest corn, wheat, hay, and pinto beans. We hunted pheasant and wolfed down everyday lunches of T-bone steaks big as western saddles.

We learned fast the ranchers' reality. Their world was bitter yet beautiful. The Williamses never said a word about the difficulties. They kept silent and usually smiled through it all.

It takes big people to beat this big land. The Williamses—W. T., his wife, Viola, their sons, Billy and

Tommy, and their grandchildren—are all big people, big in body, big in soul.

Barb and I had started off calling W. T. and Viola "Mr. and Mrs.," but they insisted that made them feel old. After all, they were only 77 and 72.

I'll never forget the day, out in the dusty corrals, when Bill grabbed my hand and pressed my open palm on his chest. "Feel that," he said. "That's a pacemaker. I 'bout died a while back. The nurses beat my chest till my heart started tickin' again. Now this pacemaker keeps me goin', strong as ever."

AS WE PACKED, we felt that same old mingled feeling of sadness and soaring elation. Our beloved Jansport packs, once vivid blue, now faded like old jeans, had become like parts of our bodies. Putting them on to begin the last leg of our walk gave us a sense not of weight but of lightness. The road was calling to us as strong as a bird's migratory song.

We decided to walk right on through the winter. Always before we had wintered over. But now—so near the end—we were impatient. Barbara had been living on visions of our post-walk domestic life.

We headed for Oregon, our last state border crossing and my 17th since leaving Alfred, New York, five years earlier. Five years! I remembered once thinking I would make it across the country in eight months. . . .

Flights of long-necked cranes glided over us. We felt

as if we could flow as easily as they all the way to the Pacific. On the dull gray day we crossed the Snake River into Nyssa, Oregon, we shouted and lifted our arms in exultation.

I'd expected Oregon to be filled with trees, bearded loggers with friendly smiles, joggers, and hip college types. We found, instead, hundreds of miles of desolate ranchland, will-cracking blizzards, hundred-mile spaces between towns of a thousand people, and frozen slush spraying us from passing logging trucks.

Barbara took it hard. I'd given her the impression that most of the pain was behind us. Now she grew depressed. She seemed a different person. Before, she would always tighten up and tough out whatever faced us. Now the slightest puff of snow made her think of quitting. She started talking about letting me go on without her, about how she could meet me at the Pacific. . . .

If we hadn't met a new set of heroes named Mike and Mary Lou Koto and Milo and Evelyn Franke, I don't think we'd have made it. We met them in a little town named John Day. Mike works for the U. S. Forest Service.

Milo is a retired rancher. They made it *their* responsibility to get us to the Cascades. Each day as we slogged farther west from John Day, either Mike or Milo would drive out to see us on Route 26 and bring food, hot and home cooked.

Still, the Ochoco Mountains awaited. After leaving speck-size Mitchell, we began a 107-mile stretch



As we walked through the winter of '78-'79 in eastern Oregon, logging trucks splashed slush on us. Numb, sick, and dead-tired, Barbara cried.

over ice-slick roads. Blizzards raged, as if to keep us from the Pacific. The Pacific? Out here in the numbing mountain wilds of Oregon, the Pacific didn't seem to exist. We were walking through the coldest winter here since 1919.

Barbara grew weaker, too tired to complain, or even to move out of the way of the spray from the trucks.

Milo, coming out to us one day, made a suggestion. He could see our determination waning.

"I've got this doctor friend in Prineville," he said. "Why don't we drive over and have him take a look at Barbara." Barb agreed, barely able to nod her head.

Milo and I sat in the waiting room, fidgeting nervously. Finally the bald, tanned

doctor came out. His lips were tight.

"Son," he said, "you're going to be a father."

He had to say it again. I'd been expecting bad news. I grabbed Milo. We both started jumping and hollering. The nurse had to quiet us down. When Barbara came out, she was radiant.

Now, understanding what her symptoms meant, Barbara found the strength and will to go on. After a week more of sub-zero temperatures and howling snows, we reached the spine of the Cascades. A body-pushing wind tried to blow us back. But nothing was going to stop the *three* of us. We coasted down to the Oregon lowlands, right on through sophisticated Eugene. We could smell the Pacific!

WE WALKED our final mile on January 18, 1979. We'd stopped in Florence, Oregon, so our families and some of the friends we'd met over the past five years and 4,751 miles could join us for the final steps. About 150 people came, including Barbara's 83-year-old grandmother from Phoenix, Viola Pennell, who led us at her own good pace over the grassy dunes. Before the final dune she stopped for a moment, pulled a small brown bottle from her purse, jiggled out a tiny white nitroglycerine pill, and popped it under her tongue. As we approached the ocean's foaming surf, Barbara and I moved away from the crowd. The vast Pacific rolled right up to greet us—a blue and sparkling



welcome mat just the right size to fit our feelings. When we got to the edge of the water, we couldn't stop. We kept on walking, right up to our waists. Everyone was yelling, laughing, crying, and hugging each other. Especially Barbara and me.

We'd done what we set out to do—and much more. Our own personal odyssey had somehow come to have a special significance for all these wonderful, laughing people around us.

I knew the God who had

guided this walk was guiding us still.

I'd started off disillusioned and without hope, and now I had an unshakable love for my country.

Although I'd lost my forever friend, Cooper, I'd found the one, eternal love of my life, Barbara . . . and now we were being blessed with a child to share the America we'd found.

The waves were really cold. Our legs were turning numb. We slogged back out onto the shore to begin the rest of our lives. □



CLYTON COLLISON (ABOVE) AND JAY DICKMAN



Our LAST MILE took place January 18, 1979. It felt more like all the July Fourths we've ever known. Family and friends—150 of them—walk with us. That's Barb's 83-year-old grandmother between us and, on my right, Mary Elizabeth Lloyd, who welcomed me into her family in North Carolina. Giving each other the last hug of the walk, Barb and I mingle our tears with the waters of our long-dreamed-of goal—the Pacific—near Florence, Oregon. We'd made it.



YELLOW SEA YIELDS SHIPWRECK TROVE

A 14th-Century Cargo Makes Port at Last

Photographs by H. EDWARD KIM

NATIONAL GEOGRAPHIC STAFF

Introduction by DONALD H. KEITH

INSTITUTE OF NAUTICAL ARCHAEOLOGY, COLLEGE STATION, TEXAS

FIGHTING A TREACHEROUS current and numbed by the icy water, I descended a buoy line anchored to the shipwreck seventy feet below. For the first fifteen feet, sunlight filtering through the sediment-filled water made some visibility possible. Beyond that I entered a world of total darkness. Only my sense of touch remained.

At the end of the line my diving partner, In Seong-jin, took my hand and guided it over a section of the wreck. I tried to visualize the features I felt, an intact bulkhead supported on one side by two vertical timbers. The construction was massive. I reached in and felt hard, round objects—with the glassy touch of ceramics.

I was exploring what was probably a 14th-century Chinese seagoing vessel—if so, the first ever investigated underwater. The wreck had been discovered three years earlier, in 1975, off Sinan, a district on the southwestern coast of the Republic of Korea (South Korea).

As a doctoral candidate at Texas A & M University, specializing in Oriental maritime history, I was principally interested in the ship's wooden hull, more than ninety-five feet long and about twenty-five feet wide. Study of it could elaborate on the scanty historical references to the appearance and construction of Chinese ships before the 16th century, when sustained trade began between

Restoring age-old luster, South Korean technicians use acid to remove marine growth from earthenware and glazed jars (left), part of the largest undersea lode of Chinese ceramics ever recovered. A rare statue of Kuan-yin, a Buddhist deity (right), was salvaged with its head cleanly broken.



STATUE: 26 CM (10 IN.)

the Far East and Europe. From those early documents it appears that Far Eastern shipwrights had built vessels with squared-off ends, flat, keelless bottoms, and bulkheads that divided the interior into compartments. Western ships had pointed ends, rounded hulls with keels, no bulkheads, and also different sails and rigging.

Nevertheless, as I tried to reconstruct the configuration of the vessel, I couldn't hide my excitement at its cargo. Here, side by side, lay a pair of vases; there, a cluster of broken dishes. Farther along, bowls, pots, and unfamiliar shapes projected, half-buried, from the muck.

By the end of 1978, South Korean Navy scuba divers had raised more than 200,000 Chinese coins, plus an additional 12,000 artifacts—including the largest collection of Chinese ceramics ever excavated outside China. The treasures include fine stoneware called celadon as well as porcelain, lacquer ware, bronze and iron cooking utensils, and silver and iron ingots.

Some artifacts give tantalizing clues to the vessel's itinerary and age. A bronze counterbalance for a scale was inscribed Ch'ingyüanlu, a reference to the modern Chinese port of Ningpo (Ningbo). Was that the last port of call?

The most recent coins found aboard, minted about 1310, prove that the ship could not have sunk before then. A lacquer-ware bowl bearing four Chinese characters—possibly designating the year 1331—indicates that it may have foundered very close to that date.

It seems most likely that the ship was a Chinese merchant vessel bound for Japan with trade goods. Attempting to cross the Yellow Sea, she may have been driven eastward by a storm and sought shelter in the Sinan area.

It is ironic that the murky waters that helped preserve the ship and her cargo for more than 600 years now thwart precise scientific investigation. The rare hull demands careful recording and reporting. Can it be raised? Working conditions are among the most difficult ever encountered in the history of marine archaeology. But South Korea plans to try. One thing is certain: It will take years to excavate. * * *

Crewmen row for their lives in sampans as a howling storm claims their ship off the tip of South Korea. Thus the vessel, probably a Chinese merchantman bound for Japan, may have met her doom. Based on available evidence, the artist has depicted her as a 14th-century three-masted junk.

PAINTING BY LLOYD R. TOWSEND







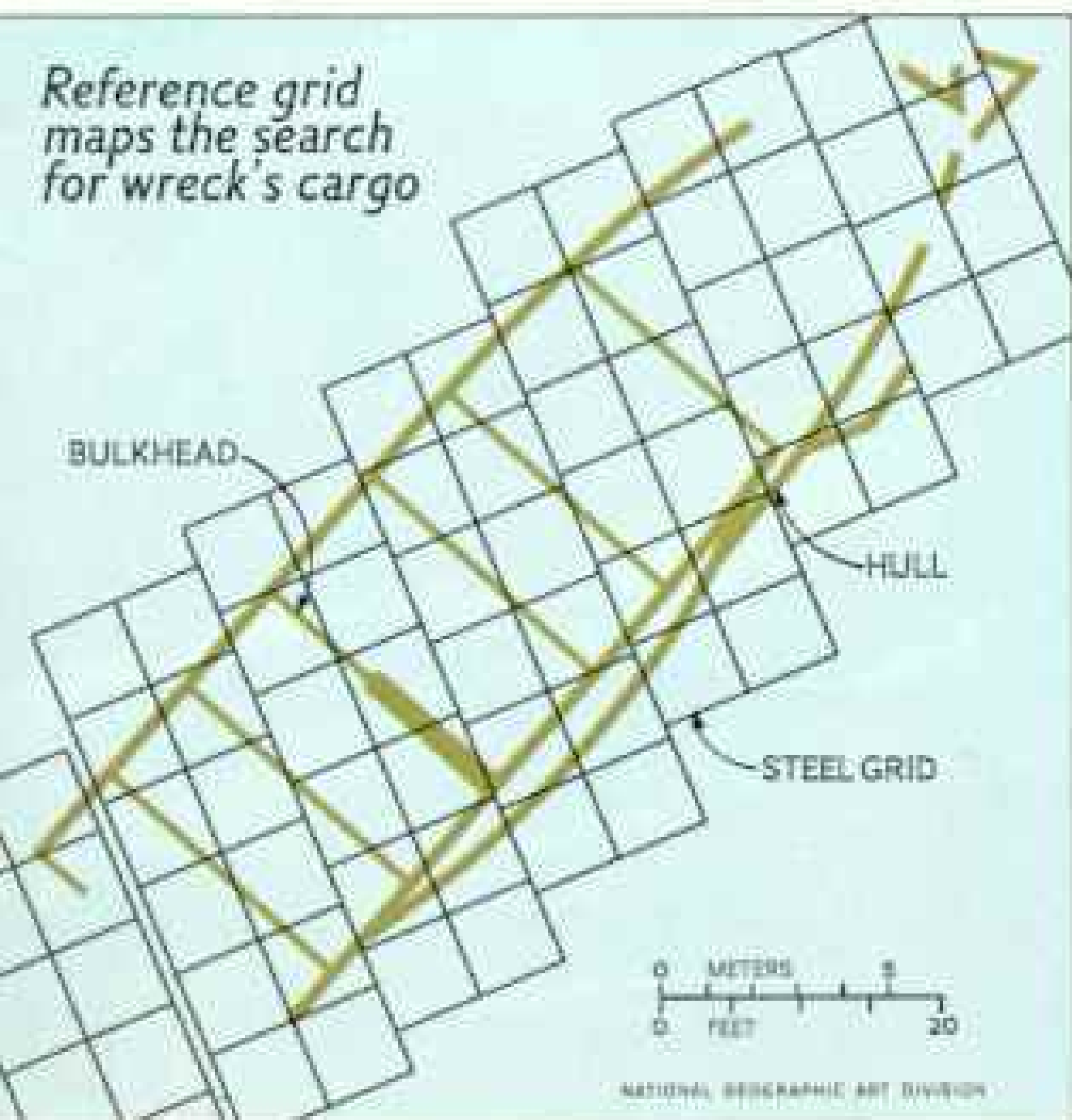
KOREAN OVERSEAS INFORMATION SERVICE (FACING PAGE)

THE TREASURE HUNT began in May 1975, when Ch'oe Hyong-gun (*left*, in shirt sleeves) snagged several heavily encrusted ceramic vessels in his net while trawling for croaker in Sinan waters (map, *below*). His brother, schoolteacher Ch'oe Pyong-ho, standing beside him, later examined the finds and suspected their importance. He first showed the pieces to local authorities, who dismissed them as imitations. Finally, pottery experts in Seoul, the nation's capital, confirmed them as genuine antiques.

The word was out. Other fishermen began looting the wreck and selling the wares to antique dealers. Police made arrests, the government confiscated the treasures, and the South Korean Cultural Property Preservation Office, aided by the navy, began systematically excavating the site in October 1976.

Despite the nightmarish working conditions, divers located what remained of the ship itself—the hull, almost completely buried in mud. Across it they built a steel reference grid (*lower left*) to aid in recording the position of each artifact. Of some 12,000 art objects retrieved, the vast majority were ceramics, preserved by the sediment and in most cases intact. A portion of the haul floods the deck of a support ship (*right*), as members of the recovery team pack the pottery for transfer to the National Museum of Korea in Seoul.

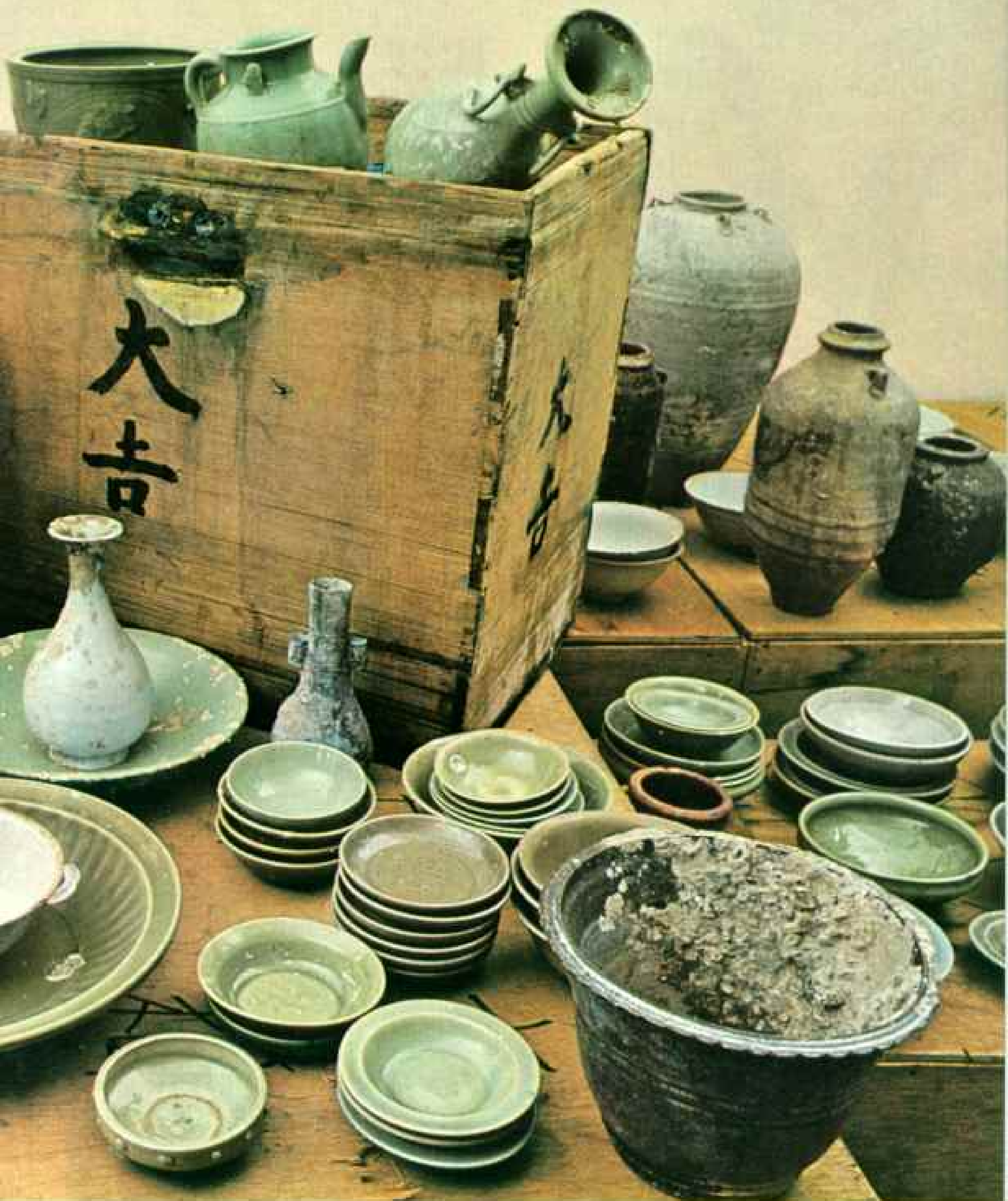
Reference grid maps the search for wreck's cargo







AS IF SHIPPED yesterday, crates held neatly packed ceramics with the wrapping string still intact. The original Chinese characters on the right box mean "great luck." Many of these dishes, as well as the vase and pitcher in



the open crate, are celadons—stoneware colored in varying shades of green by iron-oxide-tinted glaze. Celadons were prized for their beauty, for their resemblance to jade, and for a belief that if poisoned food was served in a celadon dish,

the vessel would break or change color. First made in China, celadons were soon in wide demand; they were exported to Egypt and Persia as early as the ninth century, and to most of Southeast Asia shortly thereafter.



DROPPER: 7 CM (2 1/2 IN.)

HALLMARK OF EXCELLENCE: Celadons from kilns in and around the Lungch'üan (Longquan) district of southeastern China were produced in enormous quantities, including the fine examples shown here. A water dropper (*left*) in the form of an immortal, or legendary figure, was used with dried ink at a scholar's writing table. A scroll of peonies, the traditional spring flower, is incised on a covered jar, similar to others adorned with crisp vertical ribbing (*below*). Peonies also decorate widemouthed vases with ring handles supported by elephantlike masks (*right*).

All these pieces were crafted during the Yüan Dynasty (1279-1368), the era of Mongol rule after Kublai Khan completed the conquest of China. Yüan pottery in general was more obviously ornamented to satisfy Mongol and export-trade tastes, in contrast to the subtler styles of the preceding Sung Dynasty (960-1279).



LARGE COVERED JAR: 31 CM (12 1/4 IN.); SMALL JAR: 8 CM (3 1/8 IN.); VASES: 38 CM (14 1/2 IN.) AND 28 CM (11 IN.)





JAR GROUP: 19.11 CM (7.4 IN.)

VARIETY SPICED the inventory. Stoneware vessels (*above*) include a black-glazed jar and vase with loop handles and two jars with decorative bosses, one black glazed, the other with a biscuit, or unglazed, body. A jar with an iron-oxide floral design (*left*) may be T'zuchou (Cizhou) ware, named for a pottery center in northeastern China.

A red lacquer-ware jar bears a peony pattern painstakingly carved into layers of lacquer (*upper right*). A bronze incense burner shaped like a lion features a detachable head through which smoke filtered (*right*). The back of a bronze disk, possibly a pendant (*far right*), depicts an old Chinese fable of a hare pounding the elixir of life beneath a spreading cassia tree—in the Orient, still a symbol of the moon.



PEONY JAR: 25 CM (9.8 IN.)



LACQUERWARE JAR, TONKIN



BRONZE BURNER
10 CM (4 IN)



DIRT
8 CM (3 1/8 IN) DIAMETER



BOTTLES: ABOUT 14 CM (5 IN.), INCENSE BURNER: 10 CM (4 IN.), PITCHER: 12 CM (5 IN.)

COOL and more comfortable than it might appear, a pillow supported by the figure of a reclining woman (**below**) may have been destined for a bedroom or to serve the dead in a tomb. The porcelain piece, termed *ch'ing-pai* (bluish white), was probably fired in Kiangsi (Jiangxi) Province in one of the famous kilns of Chingtechen (Jingdezhen), a city that by the 1700's had become a metropolis of more than a million people primarily engaged in making and selling pottery.

Ch'ing-pai porcelains were exported from Chingtechen by the ton and have been excavated throughout Southeast Asia. Well represented in the wreck's cargo, they include a small incense burner and four bottles (**above**), made during the Yüan Dynasty and likely used in religious ceremonies as altar sets. A Yüan Dynasty ch'ing-pai pitcher was decorated with spots caused by iron oxide daubed on the piece before firing (**right**).

A new museum in Kwangju, east of the wreck site, will

house the Sinan finds, which have already added immeasurable depth to the study of Chinese ceramics. Suzanne G. Valenstein, associate curator of Far Eastern Art at the Metropolitan Museum in New York City, was part of a team of experts that examined the collection. "There was a type of flowerpot [page 236, top] with a piccrust edge," she recalls. "None of us had seen anything like it. And it wasn't just one piece—they had dozens of them sitting right there. How do you appraise a collection like that?" □



PILLOW: 10 CM (4 IN.) HIGH



Once a crossroads for the frankincense trade, now a flash point in global politics

NORTH YEMEN

By NOEL GROVE

Photographs by STEVE RAYMER

BOTH NATIONAL GEOGRAPHIC STAFF

Green mountain valleys and grazing slopes (facing page) stand above the Arabian Peninsula's scorching emptiness. But North Yemen—the Yemen Arab Republic—is no longer an oasis secluded from Middle East conflict. Earlier this year it was briefly invaded by Marxist South Yemen—the People's Democratic Republic of Yemen. Then more than rifle



cartridges and traditional daggers (above) were needed to match modern rockets and artillery.

In the early 1960's, when the south was British controlled, Egypt dominated North Yemen, and Soviet arms and influence were imported.

Now North Yemen receives U. S. weapons and aid from Saudi Arabia, as big-power politics comes with a vengeance to a land of fragmented loyalties.

DUST SWIRLED from our churning wheels and rose in an angry cloud above the pickup truck. I rolled up my window and wondered how the man with the gun, riding in back, could breathe. We had left Marib behind, a cluster of mud-walled houses perched on a small rise in the middle of a baking plain. Somewhere ahead lay our destination: the remnants of a massive dam that once made this ground, now parched and troubled, bloom with grain and fruit trees.

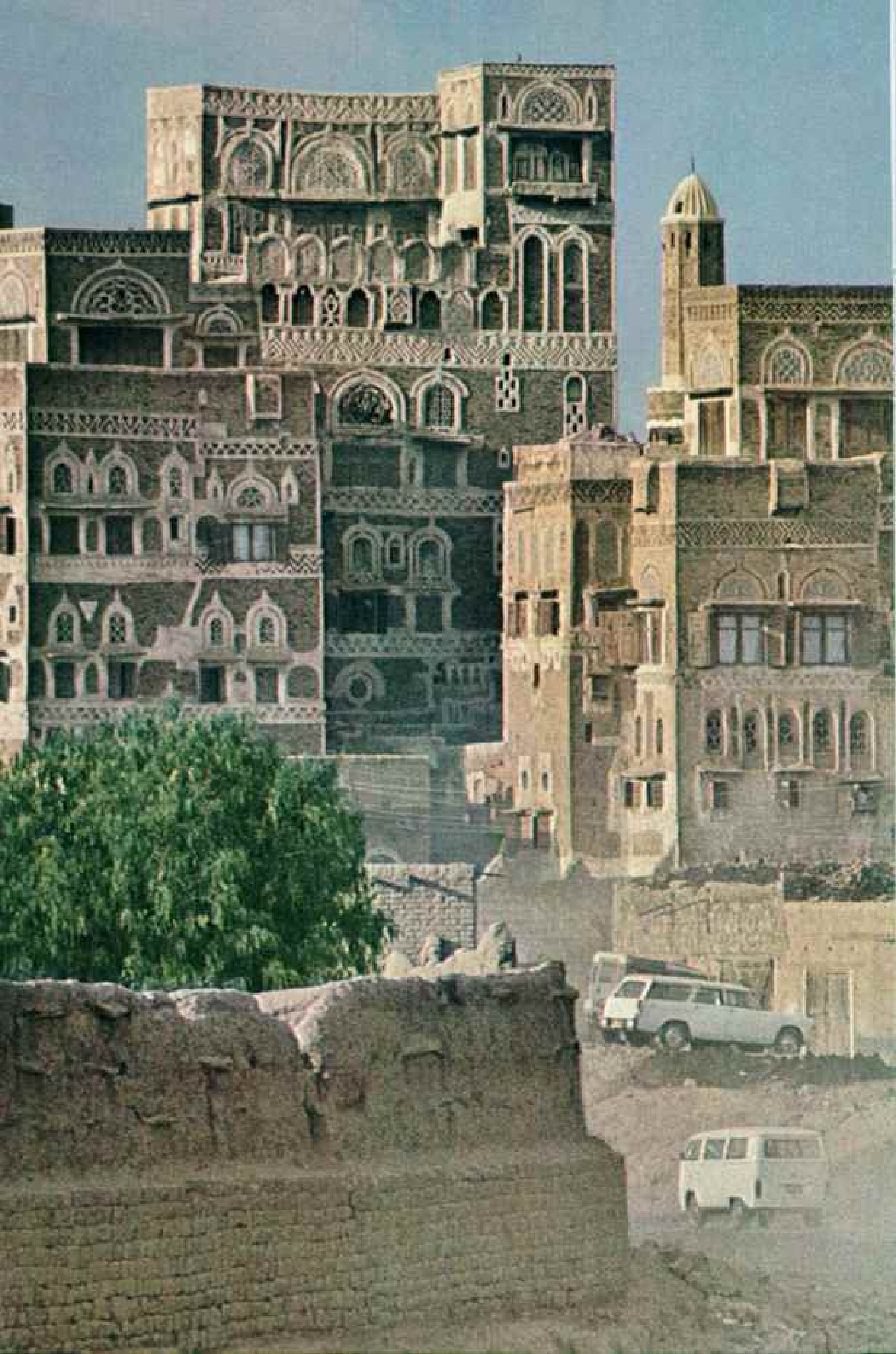
To the Romans this elbow of land along the Red Sea and the Gulf of Aden was Arabia Felix—Happy Arabia—perhaps because the abundance of frankincense, silks, spices, and pearls that came north by camel caravan made it seem a bountiful place. Muslims called it Yemen, meaning “the right side,” the position it occupied when one faced east from Mecca.

Most of those precious goods originated elsewhere and were merely passed along by early Yemeni middlemen. Yemen lay at the crossroads of trade from the Orient and Africa to the Mediterranean coast.

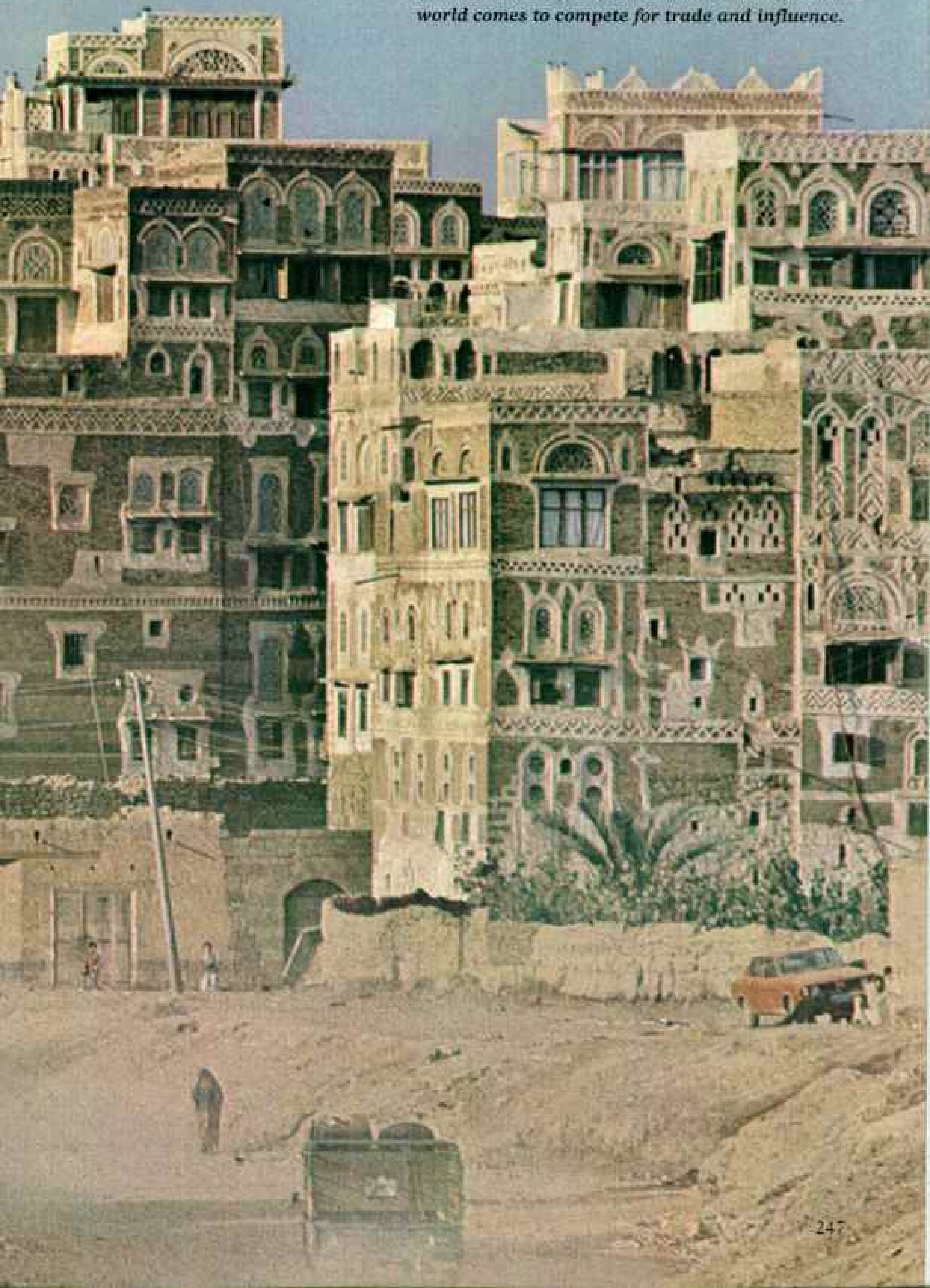
For centuries Yemeni city-states like Marib waxed fat off the traffic of Arabia Felix, acquiring wealth and power that allowed them to raise imposing structures such as the irrigation dam, perhaps built as early as the eighth century B.C. It lasted more than a thousand years. Islam's Koran says it burst as Allah's punishment of the Sabaean people at Marib for turning from him.

The truth of the dam's destruction is lost in the sands that now cover Marib's fields. “The old men used to tell us that cats had been tied along the dam to keep rats from burrowing holes in it, and that one cat got away,” said the caretaker, a local villager named al-Sharif Saud Hassan Mohtam, as he guided the pickup along the rutted and dusty track.





DISTINCTIVE TRACERY still curtains windows of Sana, the nation's capital. Outwardly little changed for centuries, the city now hums with traffic as the world comes to compete for trade and influence.





Top draw at the market in Sadaah is the Soviet-designed AK-47 rifle (above), priced at about \$2,000. Yemeni men carry these guns as casually as Westerners carry credit cards. And bandits employ them—as the author found out. Peaceable imports include motorcycles (facing page). But peace has never lasted long. President Ali Abdullah Saleh (below) took office in 1978, after his predecessor was killed by a bomb concealed in a South Yemeni envoy's briefcase.



In this ancient land kingdoms flourished, formed confederations, and fought each other for power. Though Yemenis have long shared cultural bonds, they have rarely formed a unified country. As the dust boiled around our pickup, the man with the gun riding in the back served as a reminder that in 1979 Yemen remains a divided land.

British and Turks each held parts of it into the 20th century. After both left, two opposing Yemeni governments took their places. At Sana in the central plateau, capital of the Yemen Arab Republic, northerners have attempted a representative government, one nevertheless controlled largely by a succession of military leaders. Aden, capital of the People's Democratic Republic of Yemen in the south, has become dominated by Marxist ideologists (maps, pages 250-51).

South Yemen's restrictions on travel made GEOGRAPHIC coverage of that country impossible. Two days before I arrived for a second month-long visit to North Yemen, the differences between the two governments erupted into a brief but bloody war along the border. Fighting raged south of Marib, one of three principal targets of the advancing southern forces. The man in the back of the truck was our protection against hostilities.

Other pickups, loaded with armed, turbaned tribesmen supplementing North Yemen's regular army, growled past us, heading for the front. I prepared to photograph them, but Saud shook his head. "These are northern tribesmen from remote villages," he said. "I'm not sure what they will do when they see a camera."

Unlike most of its peninsular neighbors, Yemen has yet to produce a drop of oil. But the nearness of this populous country to oil-rich Saudi Arabia causes it to be coveted as an ally by major powers. World attention focused on the fighting last February and March because of aid given the southern forces by the Soviet Union and arms supplied to North Yemen by the United States.

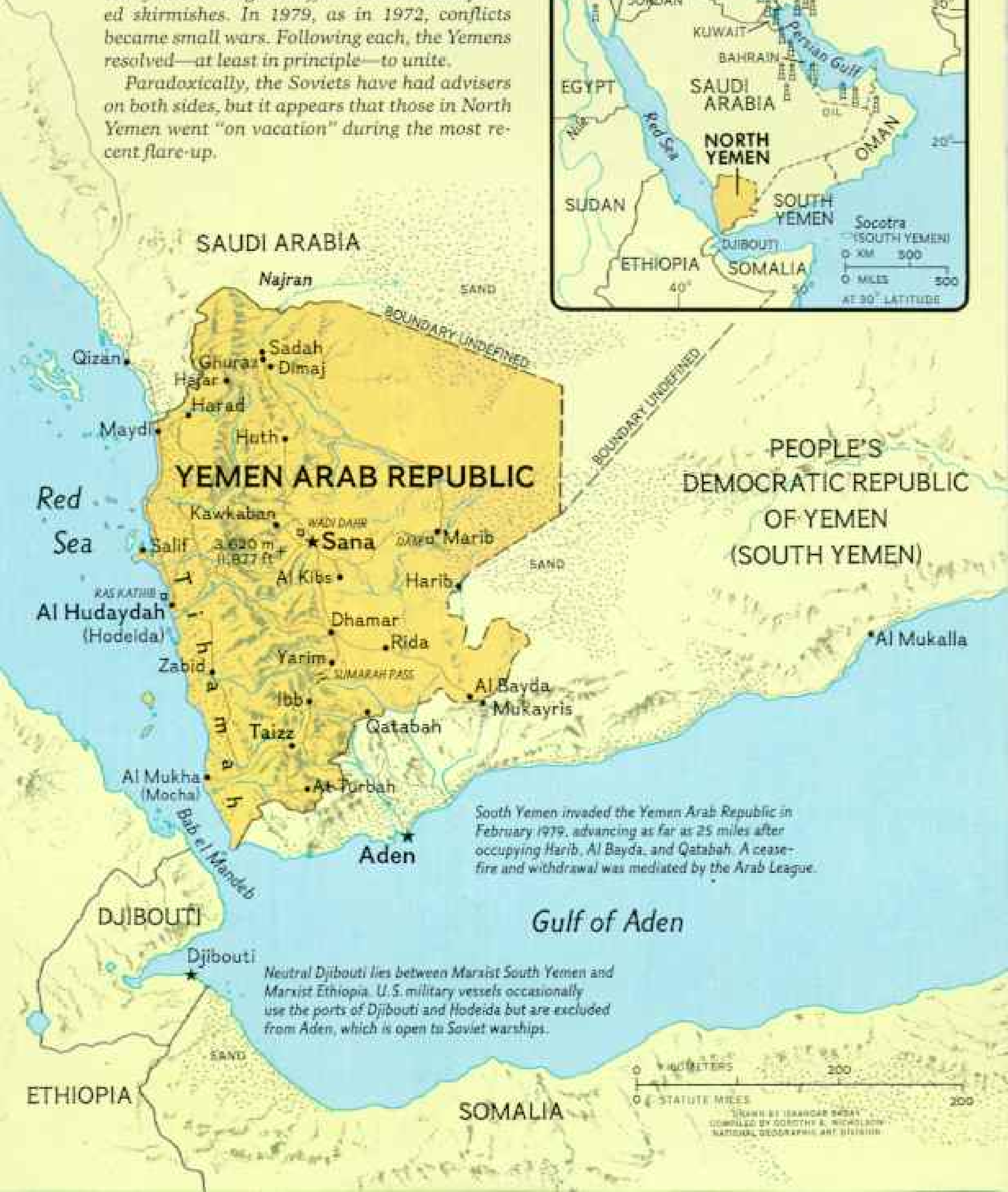
Several times during the three-week conflict I was to see C-130 turboprops swoop into the airport at Sana to unload arms and ammunition. More sophisticated weapons—tanks and jet fighters—followed later in the U. S. effort to maintain a balance of power in the Middle East. Yemen in the



An Arabian state without oil seems an unlikely battleground for international influence. But the Yemen Arab Republic, positioned at the mouth of the Red Sea, is strategically important. If this populous nation on the peninsula were to become hostile to Saudi Arabia, the balance of power in the region would shift drastically. As it is, North Yemen serves as a buffer state between Saudi Arabia and radical South Yemen.

Historically, clans more than nation-states have claimed the allegiance of Yemenis. In recent years ideological differences caused repeated skirmishes. In 1979, as in 1972, conflicts became small wars. Following each, the Yemenis resolved—at least in principle—to unite.

Paradoxically, the Soviets have had advisers on both sides, but it appears that those in North Yemen went “on vacation” during the most recent flare-up.





In antiquity, Saba—the Sheba of Biblical accounts—controlled the trade routes for frankincense, myrrh, gold, ivory, and spices.



Shedding the yoke of Persian control, Yemen became an early convert to Islam in the last years of the Prophet Muhammad.



Today's north-south boundary was demarcated in 1904 not by the Yemeni peoples but by the British, who controlled Aden, and the Turks, who held sway over Yemen.

20th century, I reflected, still finds itself at a crossroads for wealth originating elsewhere.

WELL OFF THE BEATEN TRACK of frontline reinforcements, we stopped the pickup at a skeletal monument to Yemen's past glories. Rains gushing down the wadi long ago washed away most of the earthen dam; once it had stretched 2,000 feet across the Wadi Dhana, its sluice gates diverting floodwaters to 4,000 acres of farmland (page 259).

How many backs had strained to lift the gates' five-hundred-pound stone blocks into place? In the script of the Himyarites—a pre-Islamic people—a toppled stela told of a partial rebuilding in the fifth century A.D. Repairs were undertaken, it said, by “twenty thousand men, 14,600 camels, and 12,000 pairs of donkeys.”

Marib was the capital of the land of Saba, the Biblical Sheba. Its queen, the Koran says, ruled from “a magnificent throne.” The Old Testament says she visited King Solomon in Jerusalem (about 950 B.C., before the dam was built) “with a very great train, with camels that bare spices, and very much gold, and precious stones.”

Both descriptions fit the wealth of ancient Marib, as do the ruins of its huge temple. Eight thick columns remain of a huge portico that led to an elliptic enclosure. I stepped off 100 paces from one side of the arena to the remnants of wall on the other side—a sizable and costly house of worship.

A decline in the incense trade and sixth-century invasions by Abyssinians and Persians led to a crumbling of those early Yemeni kingdoms. But today North Yemen remains a country where the nearly unchanged past lies only a hillock or ravine away from the present. A short distance from the temple we stopped again at a Bedouin tent surrounded by bleating goats and dour camels. “The home of my cousin,” explained Saud.

The camels were for producing milk, not for transport, he pointed out. Inside the tent the cousin motioned us to recline on rugs and lean against thick cushions. Young women in long black dresses, veiled to their dark and luminous eyes, served us tea spiced with clove and cardamom. From one of the tent poles our host hung his Soviet-made

Kalashnikov AK-47 assault rifle, a popular weapon in many Third World countries. At his waist was the ornate horn handle of a *jambiyya*, the traditional dagger with a boomerang-shaped blade (page 254).

From the top of his loosely wound turban to the hem of his skirtlike *fiuta*, the host looked every inch the hawk-faced desert nomad—living on dates and yogurt, one would think, leading his family from oasis to green-fringed oasis. In fact, he was a trucker, hauling goods from Saudi Arabia to Yemen. Like about one in three Yemeni men, he has

worked at intervals in that oil-rich neighboring country, earning money to send home—and to buy his cherished pickup.

“Life is better now than before we worked in Saudi Arabia,” he said. “Today we have money to buy more food, tea, and *kat*.” That plant, ubiquitous in Yemen, is chewed for the stimulant alkaloids in its leaves.

Remittances from expatriate workers are the cornerstone of North Yemen’s economy. The country’s import bill was 834 million dollars in 1978, and exports, principally cotton, coffee, and hides and skins, offset less



than one percent of that. The difference is made up by the more than one billion dollars sent into the country by Yemenis working abroad, most of them in Saudi Arabia. More Yemenis may live in Jidda than in Sana.

Saudi Arabia's boom has triggered a secondary explosion of activity in North Yemen. Construction activity doubled shortly after the oil price increases of 1973, and continues to climb. So does inflation, at the rate of 40 percent annually, by some accounts. Land prices in Sana soared from \$36,000 an acre in 1972 to roughly \$500,000 in 1979.

The money flow brings new comforts to the lives of the North Yemeni people, still among the world's poorest. "We buy mills for grinding grain now, instead of using a stone," said a woman living near the southern border.

Jon Mandaville, resident director of the American Institute for Yemeni Studies and a frequent companion in my travels around the country, finds the country's progress impressive. "It seems to have all happened in the last five years—and without the oil which makes it easy for other countries in



National obsession with kat, a mild stimulant, may consume as much as four hours a day and a third of a family's income. Bought at market (above), the fresh green leaves are chewed in company (left) with water pipes and conversation.

Since a day's supply of kat may cost \$25, Yemeni farmers cultivate it rather than such crops as coffee, once widely grown and of excellent quality.

the peninsula," he told me. "The side roads may be bad but they were built by the people themselves with remittance money."

Before the recent fighting, this country ranked as one of the least known corners of the world, a South Dakota-size secret hidden behind jagged mountains and deep-cut ravines. Unlike the blast-furnace heat sweeping over sandy wastes in much of the peninsula, temperatures in the lofty interior remain moderate year round. To the west, the mountains drop abruptly to a flat plain called the Tihamah, and the sweltering humidity of the Red Sea coastline.

Behind these bastions of height and heat dwell perhaps six million people. On the



Walk-up banking with service in Yemeni and Saudi riyals and U. S. dollars—even traveler's checks—occupies money changers in Sana (above). Like most Yemeni men, each comes armed with a jambiya, a curved dagger, cinched by a waistband.

At Hodeida, whose port was built by the Soviet Union, fishermen (facing page) string the day's catch, mainly barracuda, for local sale. Fish from the Red Sea offer some potential for reducing North Yemen's need to import food.

Arabian Peninsula only Saudi Arabia rivals North Yemen in population. Short of stature, long on independence, the Yemenis have been dominated but never subjugated. The Ottoman Turks, who occupied North Yemen off and on from the 16th century until 1918, settled for mere containment of the many tribes and nominal sovereignty.

In a town in the Tihamah named Zabid—once a center of Turkish military operations—an old man approached as I was having tea at a streetside table. His face was broader, his frame larger than those of the fine-featured Yemenis. He admitted that he once had been a Turkish soldier, but would talk of it no further.

Was it true, I asked, that Yemen was known as the "graveyard of Turks," because over the centuries thousands of Ottoman occupiers lost their lives here?

"Let them lie," he said softly.

Not even the Yemeni Islamic leaders, called Imams, could win the total support of northern tribes, whose first allegiance lay with the local sheikh. From 1904 until 1962, Imam Yahya and later his son Ahmad held a tenuous rulership over North Yemen by military might, by holding as hostages the sons of sheikhs, and by isolating the country from the outside world.

THAT HALF-CENTURY stutter-step in time left North Yemen with a dual legacy of charm and misery. Modern architecture has not yet replaced the multi-storied, stone and mud-brick buildings, decorated with stained-glass windows and whitewashed plaster. But neither has modern plumbing replaced the primitive toilets that simply drain outside most Yemeni houses. "Cholera broke out in Taizz in September of 1978, and we found raw sewage seeping into several drinking wells," I was told by a Peace Corps nurse.

The capital city of Sana is a labyrinth of twisted narrow streets, now choked with dust raised by automobiles. In even narrower alleys of the old suq I bartered for sandalwood and ambergris amid such other exotic scents as fenugreek and cumin, stepping around a beggar with a monstrous foot—a victim of mosquito-borne elephantiasis.

Poor health services are a partial carry-over from the days of the Imams. In the



With men absent—more than half a million work in Saudi Arabia—women are beginning to fill positions in government and industry. At a textile plant built and modernized by foreign interests, women hold some 85 percent of the jobs (below). Modern office skills are at a premium, and typists (right) apply themselves at a government training institute.



villages flies feast on the corners of children's eyes, often resulting in trachoma and blindness. Nearly half of North Yemen's infants don't reach the age of 15. In 1962 there were only 15 doctors and 600 hospital beds in the country. That year the fall of the Imamate by military coup and the creation of the Yemen Arab Republic launched a civil war.

The Imam escaped the shelling of his palace and rallied support. His royalists, supported by Saudi Arabia, battled republicans and, for a time, Egyptian troops. The republicans took control in 1970.

Leadership has since been marked by one coup, several coup attempts, and two assassinations. Lt. Col. Ali Abdullah Saleh (page 248), a military man with no government or diplomatic experience, became head of state in 1978 after his predecessor was blown up by a bomb in a briefcase.

Despite this combative environment and tradition, an atmosphere of friendliness and Arab hospitality prevails. At the same time, North Yemenis—never colonized and ever aware of their land's ancient glories—deal with foreigners without apology.



Progress, however small, is emphasized. Problems, however large, seem to be taken in stride. I motored to a village one day on a track so agitating that I felt I was inside a washing machine. A Yemeni companion turned to me and said, "This trip used to take all day by donkey instead of one and a half hours by car. Believe me, this is better."

Main roads are slowly spider-webbing across North Yemen; side roads to remote villages remain rock-strewn torture strips.

Lack of public services results from the lack of public money. There is no obligatory

income tax, except for government employees. "Our income tax is like a tithe, as stated in the Koran," I was told in Sana by Minister of Economics Mohammed Hizam al-Shohaty. The donation often goes to a local sheikh, because local allegiances still outweigh those to the central government.

"Much of the workers' remittance money is going for imported goods, so the government obtains most of its revenues from substantial import duties," he explained. "We have a 67 percent duty on cars, for example, because they are luxury items. We also



receive grants and assistance from our Arab brothers and other foreign sources."

The Russians have provided military equipment, and the Saudis have funded the construction of schools, hospitals, and water systems, often faster than the facilities can be staffed.

Chinese in conical hats were repairing the road to the Red Sea port of Hodeida when I made the 4½-hour drive from Sana. The four-berth port is being expanded by two berths, with help from the World Bank.

Photographer Steve Raymer and I climbed on a giant crane for a better view of the port. An army officer spied Steve aiming his camera and began heaving planks at him in anger. Such are the tensions of the Middle East, where it is feared that a photograph may guide enemy bombers.

Three-fourths of North Yemen's vast imports come into Hodeida and its neighbor, Ras Kathib. Not surprisingly, most imports

are foodstuffs such as cereals and sugar. "Everyone comes back from Saudi Arabia as an owner of a truck or as a businessman," said Capt. Abdulla Ragab, director of Ras Kathib. "Nobody comes back a farmer."

Some people who work in cities, however, go home to their villages on weekends. One Friday, the Muslim holy day, I drove to the village of Al Kibs with one of its native sons, Deputy Foreign Minister Ibrahim Alkibsi. No women were visible, in keeping with Muslim tradition, but I shall always remember their unseen presence by the feast laid out on a table only inches high.

Before us were bowls of rice, potatoes, boiled lamb, and *nashuuf*—stew of lentils, buttermilk, onion, garlic, and barley. We tore strips from flat bread and dipped them into a frothy gruel called *mediid*, made of yogurt, butter, fat, and green onions. Also an unforgettable crepelike delicacy soaked with honey. Yemenis call it *bint sahn*—girl



Not Solomon's wisdom nor the riches he shared with the Queen of Sheba could save her kingdom from eventual ruin. Pillars of a Sabaean moon-god temple near Marib loom beyond a broken slab (left). In the inscription, fathers petition for divine protection of their sons, contemporaries of Jesus. Remnants of the great dam nearby include a huge sluice gate (above). For more than a thousand years until the sixth century A.D., the dam stretched some 2,000 feet to divert floodwaters to irrigate 4,000 acres.

on a plate—for its extreme sweetness.

Nationwide, malnutrition remains a problem, although there are few empty stomachs. The poor live on a diet heavy in bread, and much of the vitamin content in their few vegetables is lost by overboiling.

After the meal at Al Kibs several men retired to a long *mafraj*—a room for relaxation, lined with cushions—for a *kat* chew (pages 252-3). The room gradually filled with some two dozen men. Quiet conversation mingled with the rustle of branches. The tenderest *kat* leaves were pinched off and popped into mouths, to be chewed and sucked for hours. "Many foreigners come to Yemen and say *kat* is a great evil," said a Yemeni seated next to me. "But if done with restraint, it is a harmless social activity."

Drug specialists have described the plant as a mild stimulant, comparable to several cups of coffee. Users claim that it induces a pleasant euphoria, with no more serious side effects than insomnia and temporary loss of appetite. But a day's supply can cost \$25; top *kat* brings \$50 to \$75 a bunch. The contradiction of a poor country spending a high proportion of family income on a drug makes *kat* a national issue.

"I would like to see it disappear from North Yemen," said the deputy foreign minister, who did not participate in the Al Kibs chew. "It is a waste of time and money. But before we remove it, we must first come up with alternative forms of recreation, and an alternative cash crop for farmers."

The plant can grow in poor soil, requires little water, and can be harvested frequently. Near Kawkaban northwest of Sana one day a smiling farmer pulled from his pocket a roll of bills that could choke a bullock. "I sold 20 bunches today and made 2,000 riyals [about \$445]," he told me proudly.

CONTRASTING with the quiet munching in the *mafraj* was a raucous wedding celebration I attended. Like American frontiersmen, villagers occasionally fired their AK-47's in excitement. I took a

turn firing at a tree on an opposite hill, little knowing that before long I would meet up with the other end of the gun.

I had heard that banditry was not uncommon on the road to the northern city of Sadah, but I had driven it twice before without mishap. With Jon Mandaville I headed north again. Two hundred kilometers from Sana on an open stretch of highway, a gray pickup ahead of us suddenly turned sideways and stopped. Two of the three young men inside jumped out and leveled the familiar AK-47's at us.

Kat bulged out their cheeks and formed a green slime around their lips. They wanted our car, a rugged new four-wheel-drive vehicle, but we refused to get out. We had passed a village three kilometers back, and the loud report of a Kalashnikov can be heard from a great distance. Clearly confused by our stubbornness, they grabbed for a cooler of food from the rear seat, but Jon held onto it, while protesting in Arabic: "Who are you? These things belong to us."

The driver of their pickup, older and more experienced, reached in, pocketed our keys, and silenced Jon's protests with a jab from the butt of his gun. Still in our car, we watched helplessly as they took luggage, camera bags, and food, and drove away.

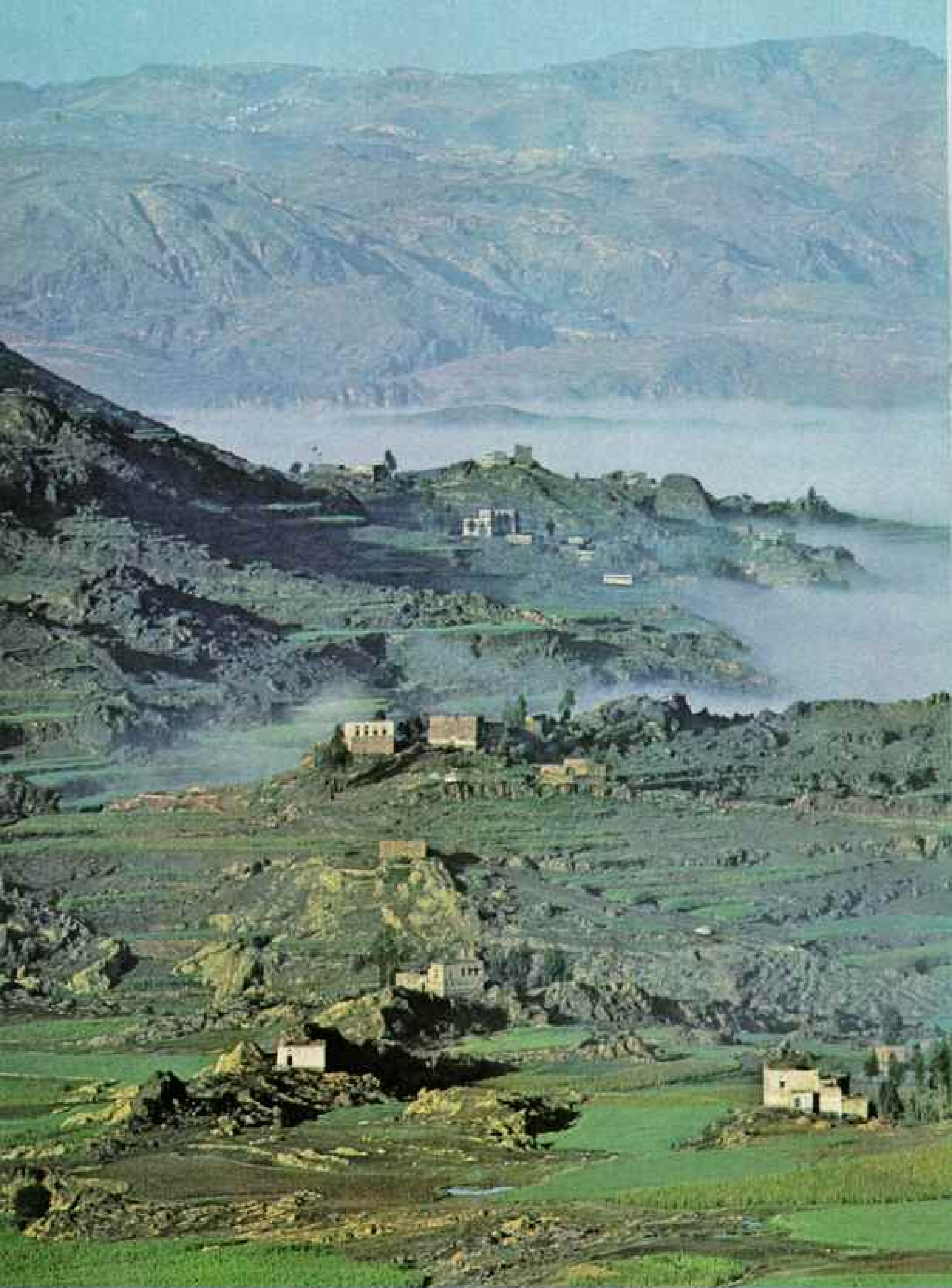
The next Yemeni motorist stopped and wired the ignition, and we drove to the nearest settlement. Outraged villagers grabbed weapons, and we set off in pursuit of the bandits in a pickup posse. Law enforcement in the far north is in the hands of sheikhs and their men. The chase ended with the predictability of a Wild West scenario—at the border between Ammar and Sufyan tribes.

The loss of one item taken with my baggage caused me to cancel my next visit. At the emotional request of Jews living in Ghuraz, near Sadah, I had promised during my first tour of Yemen to bring them a Torah—the Jewish scripture. I had not the heart to tell the villagers that their holy book, after a journey halfway around the world, had

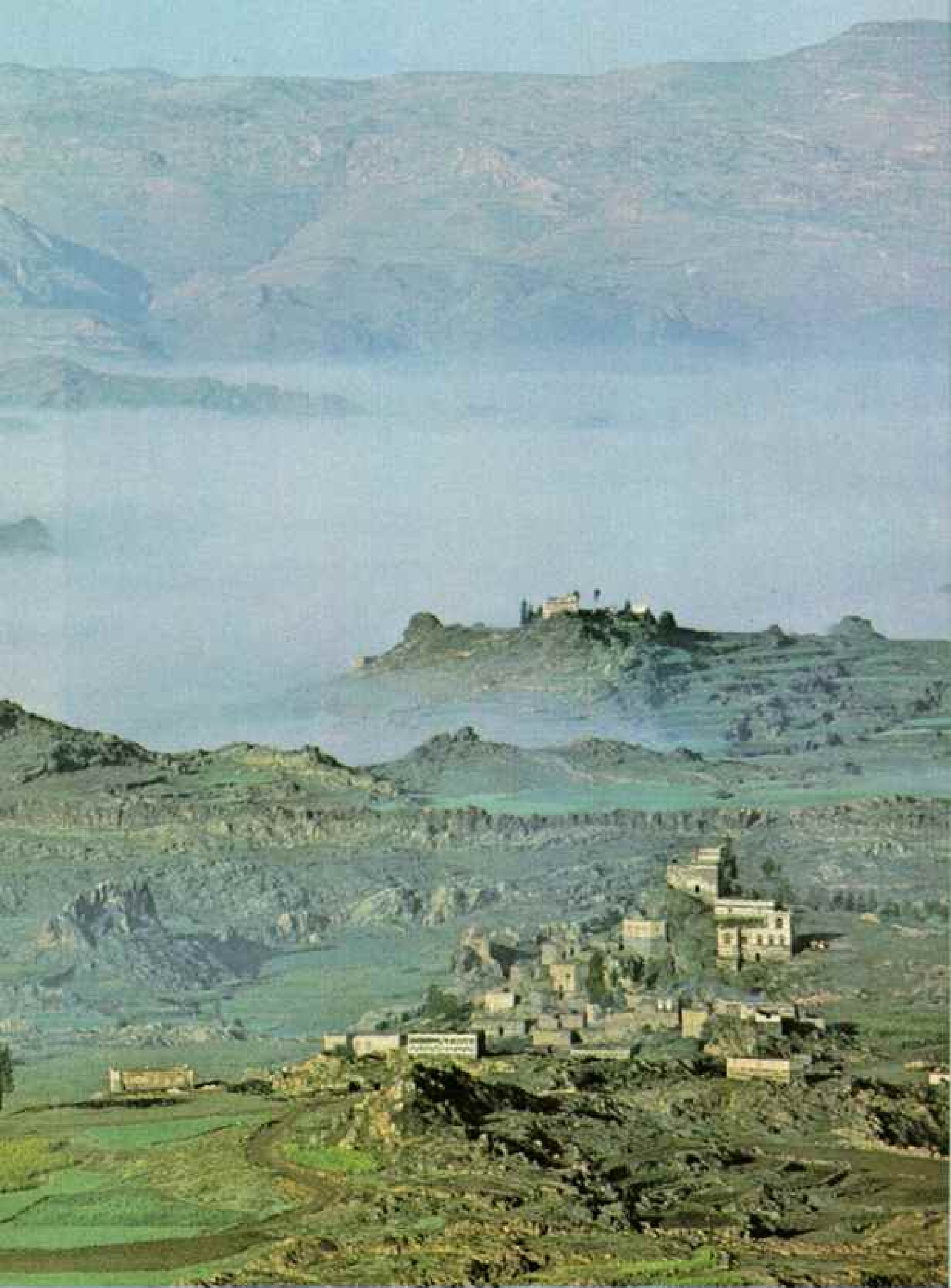
(Continued on page 264)

Immemorial chores, such as gathering firewood, occupy children at Marib. Built atop the ruins of an earlier Marib—the capital of the Sabaean kingdom—today's nearly deserted town lies at the end of an unpaved road. One salient of the 1979 South Yemeni attack dissipated only about 40 kilometers away.



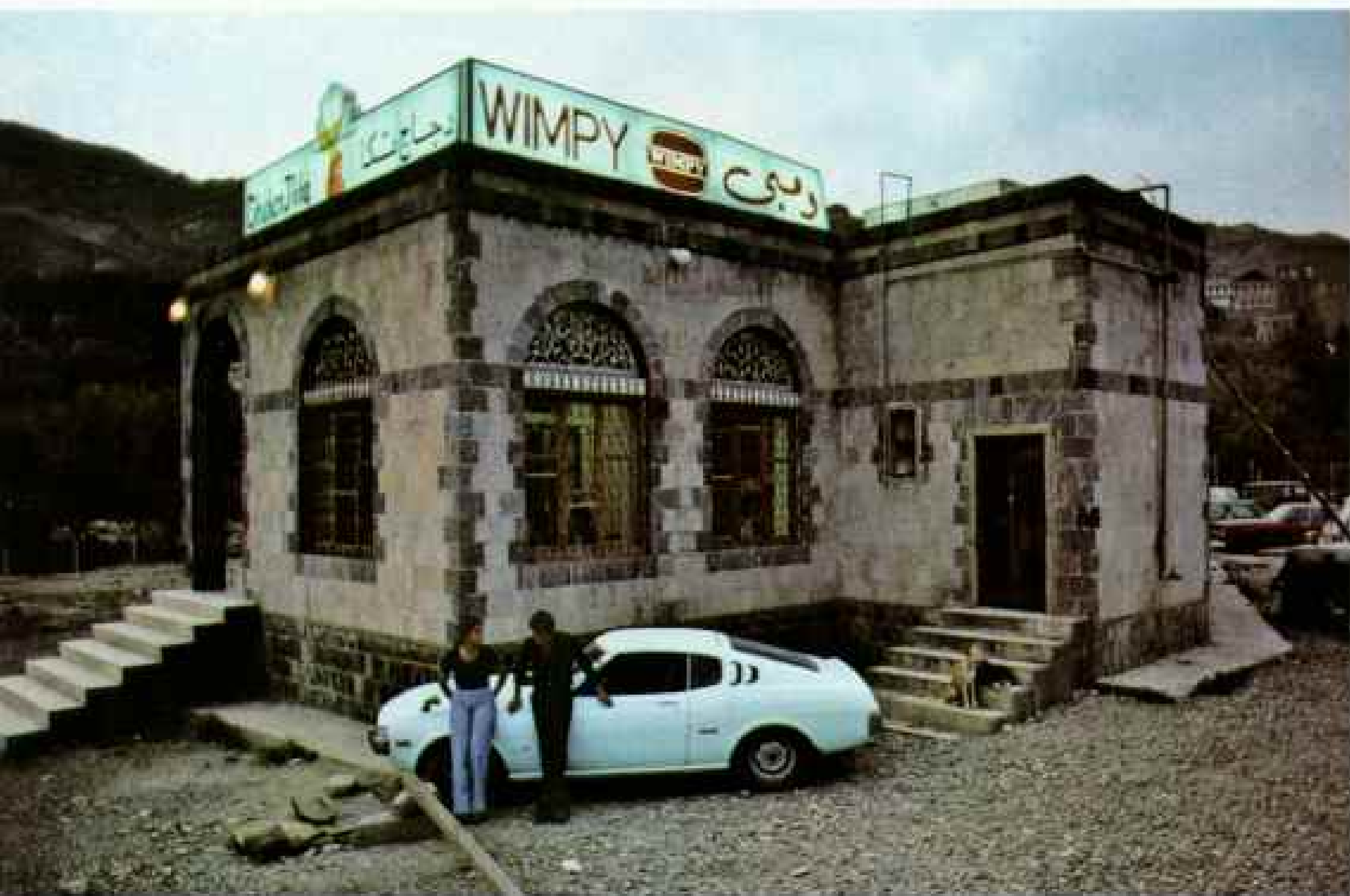


Fog nuzzles into a farming valley south of Dhamar. Volcanic soil, terracing



of slopes, and irrigation help produce cereal crops such as corn and sorghum.

Burger outpost of Sana serves a mainly Western clientele, but a modern chicken operation (right) outside the capital adds protein to the diet of Yemenis. Development of both agriculture and industry must be accelerated for long-term economic health. Were it not for the remittances sent home by workers in Saudi Arabia, North Yemen's imbalance of payments would be catastrophic.



been lost only 25 miles from their home.

No one seems to know how many Jews still live in North Yemen, one of the founding countries of the Arab League. Those in Ghuraz numbered fewer than fifty, I estimated, but they spoke of larger groups. "At Hajar, some five hours from here," said a silversmith, "are many more."

Government policy toward Yemeni Jews appears to be liberal. Former leader Ibrahim al-Hamdi appealed to those who migrated to Israel to return with their skills. The present government has given approval for American Jews to ship religious books where they are needed in North Yemen.

The only unofficial reference to Israel that I heard was a lighthearted one. While walking through Dimaj, also near Sadah, one late afternoon, I chanced upon a village council meeting. "*As-salaamu alaykum*—Peace be with you," I said in the traditional greeting. "*Wa-alaykumu s-salaam*—

And unto you, peace," several responded.

I asked what matters the council was considering. "We need more water wells," said a spokesman. "But drilling is expensive."

Testing the waters of national allegiance, I asked if they would accept money for the wells from the government in Sana. Several nodded, then the village jokester spoke up: "We would accept money from Israel if they would offer it." The council roared.

WATER is not the major problem standing in the way of higher Yemeni food production. Ordinarily North Yemen enjoys more rainfall than the rest of the peninsula. More than 7 percent of the land is under cultivation, compared with less than one percent in South Yemen and Saudi Arabia. "Twenty years ago the country was self-sufficient," Dr. Nasser Aulaqi, a University of Sana agricultural economist, told me. "By 1990 we will be importing





Tower on a rock at Wadi Dahr was a palace of the Imams, temporal and spiritual leaders until a revolution in 1962. With rival tribal leaders to pacify, the Imams kept the country isolated from foreigners. Imams trace their lineage to Muhammad through the Shia branch of Islam, which most northern tribesmen follow;



Yemenis farther south adhere to the Sunni branch. The push and shove of modern geopolitics atomizes even more the loyalties of a people who are strangers to unity.

800,000 tons of wheat. Many of our farmers leave for Saudi Arabia; for those who remain, inflation makes labor here so expensive that most farming is unprofitable."

Coffee, once Yemen's major export, made the Red Sea port of Al Mukha so prosperous that the drink became known as mocha. But both the port and the production of "Arabian wine" have fallen into decline.

"Coffee trees must be pruned and replanted to keep up production," an Egyptian United Nations horticulturist told me. "It is easier to make money growing kat."

NEAR SANA I visited a training program in poultry production, started by the United States Agency for International Development (AID). A few miles away I saw 22,000 broilers packed feather to feather in a long shed at the Omeri Poultry Farm, most modern in North Yemen (page 265). "They're going to market in three days," said Mohamed Omeri, one of six brothers in the 3.3-million-dollar operation.

Some time later I found myself in a jeep with fifty pullets bound for a much smaller operation in Taizz—the hen houses of a leprosarium called the City of Light.

South Yemen forces were pushing toward the Sana-Taizz road in the border war as the jeep tip-tired around the hairpin curves. The better-trained, better-equipped southern forces might have taken the mountain-nestled city of Taizz, but that would have left them too far south of strategically important Sumarah Pass. Instead they struck farther north, traveling flat wadis toward the towns of Ibb and Dhamar, but reached neither before the cease-fire took effect.

Outside Ibb we picked up a hitchhiker and asked if there was fighting nearby. "Yes, back there," he said, and disconcertingly pointed in the direction from which we had just come.

"Does it worry the people here?" I asked.

"No." He shrugged. "They are just fighting."

His resignation, bred in centuries of conflict, was borne out in Ibb. No streams of refugees flowed northward. Smiling shoppers jammed the suq, parting at one point as truckloads of armed and singing *qabii-liyyiin*—tribesmen—headed for the front.

With far less nonchalance I approached

the City of Light leprosarium operated by the Missionaries of Charity. Peace Corps volunteer Pamela Pine, in charge of egg production at the colony, reassured me that the widely feared affliction now known as Hansen's disease is not easily transmitted, usually requiring prolonged personal contact.

Despite its damage to bone and tissue, the disease can be arrested, as it has been with most of the four hundred patients here.

I was greeted by ravaged but smiling faces, and salutes from nubbed fingers. Hadj Hamud, once a merchant seaman, patted the bed beside him in invitation to sit and chat, but I remained standing.

How did he feel about living here?

"*Tamaam, tamaam*—good, good," he responded enthusiastically. "The food is good, and I teach in the colony school."

"It is better to be among others with the disease," he added, looking at me without reproach. "When you ask someone to sit on the bed with you, they will do so."

Whole families move to the City of Light. Some families develop there, as residents meet and marry.

In Yemen the family is the single strongest unit, a close-knit galaxy usually revolving around the eldest male.

Slightly more than 97 percent of Yemeni women are illiterate, compared to 74 percent of the men. Girls marry young, 5 percent between the ages of 10 and 14, and more than half by 19.

A few break the mold. Sumaya Raja's parents sent her to the U. S. for education, and she returned with an independence as unveiled as her face. "I would marry the right Yemeni man, but my career is more important," said the 25-year-old teacher and sometime television announcer, one hand patting down black curls. "I want to be able to show Yemeni women that there are possibilities other than getting married and bearing a number of children."

"We do not hear as much opposition to women working these days as we once did," I was told by Prime Minister Abdul Aziz

Abdul Ghani. Armed guards lounged just outside his office during the interview. The mild-mannered executive has remained at his official post through two changes of government by assassinations.

"Yemen is looking more into the future now," he said. "Some fifty years ago the government objected to Gramophones, saying such frivolity conflicted with religion. Now most Yemenis want television."

I remembered a night spent in a village near Marib, at the house of al-Sharif Saud Hassan Mohtam. As darkness fell, we retired to the *mafraj*, where Saud lighted a gas lantern and leaned against the cushions. His two young children clambered contentedly around his knees. His wife, Johara, brought wheels of bread and bowls of *foul*—beans and chilis—to dip it in. With the comforts that money from Saudi Arabia now brought, I asked, what more did he wish?

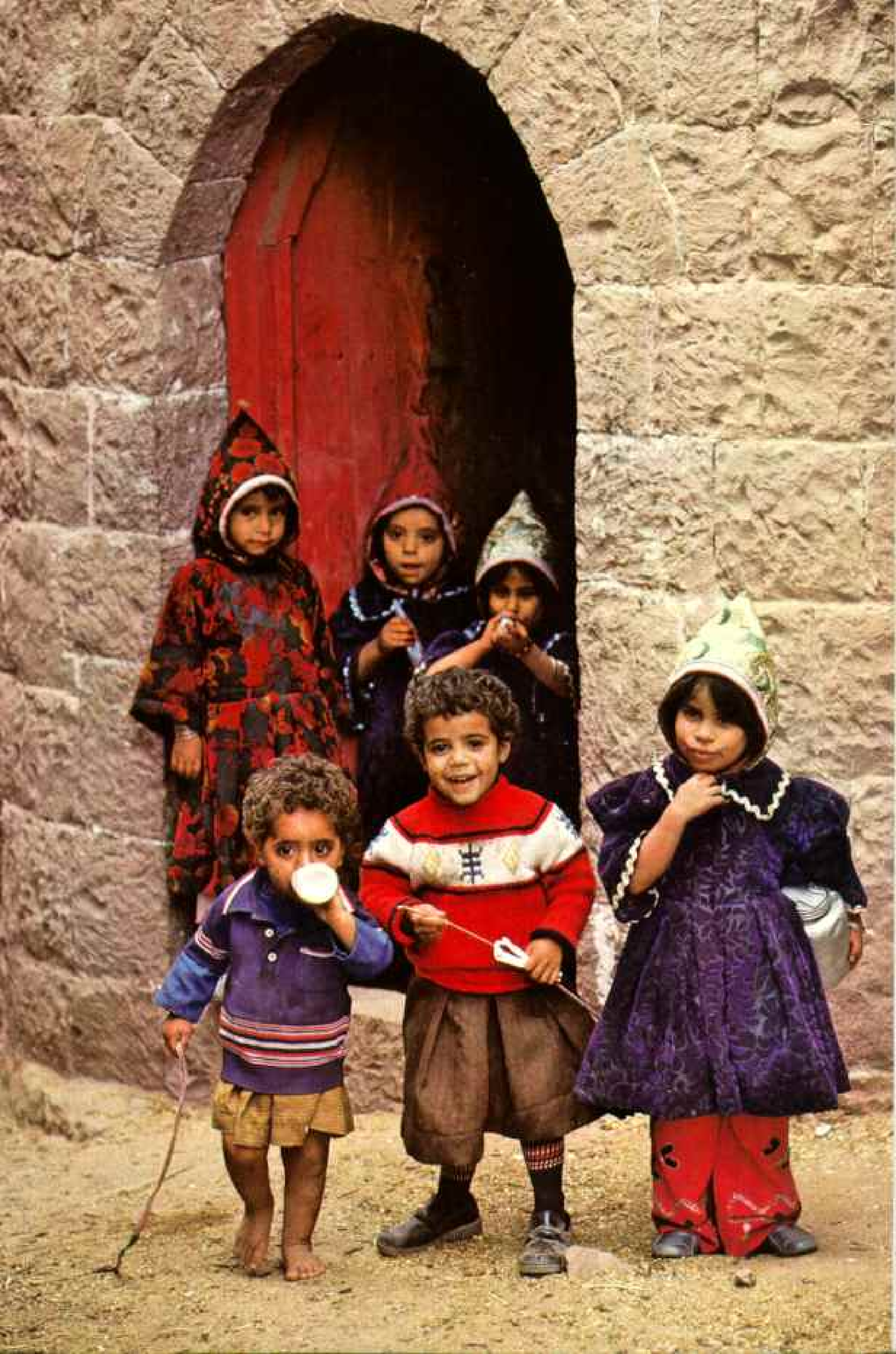
He reflected. "Electricity," he said. "Schools, hospitals, and larger houses."

His rifle leaned against the wall. I noticed that he did not add "peace" to his list. With conflict so common among generations of Yemenis, perhaps it has become an accepted part of life. Peace pacts and agreements to unify have now been signed by both Yemens, but their permanence would be contrary to the area's recent history.

I SLEPT THAT NIGHT on the roof of the mud house, under bright stars and a three-quarter moon. About midnight, a Kalashnikov AK-47 boomed several times outside the village, jarring me awake. Before too long I drifted back to sleep, then awoke to a dawn of crowing roosters. Rising to my knees, I looked down from the tooth-edged parapet on a timeless, tranquil scene of scurrying goats and of women carrying water from a village well.

That rooftop night and the morning that followed came to symbolize for me the history of this forgotten land. Yemen has lived for centuries in the darkness of conflict. It is long overdue for a dawn of peace. □

The next generation of Yemenis will need the virtues of their forefathers: pride, toughness, self-reliance, and good humor. The strains of modernization and trying to settle differences with South Yemen will be great. For all its history, beauty, and tradition, the ultimate resource of Yemen is its children.



The Hard Life of the Prairie Dog

By TIM W. CLARK

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Photographs by PATRICIA CAULFIELD

SNAPPING TO ATTENTION, the prairie dog froze and scanned the horizon. A small dot in the sky grew rapidly larger. Other prairie dogs rose in alertness to the oncoming intruder.

Watching through binoculars, I saw a golden eagle, flying about ten feet off the ground. It bore down swiftly on the burrow-pocked earth of the dog town. The first animal barked a warning. As if orchestrated by some unseen maestro, hundreds of prairie dogs vanished amid a chattering chorus of barks, diving to safety in their network of burrows. Failing to snatch a fat prairie dog for breakfast, the eagle flew on, perhaps to find an easier meal.

That spring morning in the Thunder Basin of eastern Wyoming, I saw at work the complex social behavior of the black-tailed prairie dog—behavior that culminates aeons of accommodation to an open-prairie environment.

Two centuries earlier my glance might have encompassed thousands of prairie dog burrows with their teeming populations. Of the bison, elk, and pronghorn that shared the golden grasslands, instead of today's relic herds, I could have counted myriads.

Now let us go back only one hundred years. The cattleman and wheat farmer

were arriving. In their view the earth-turning prairie dog in its untold millions threatened crops and livestock. The doughty little rodent was a pest to be destroyed.

The record of the extermination efforts that ensued is appalling. Poisoning, drowning, shooting, and other methods of eradication pushed the prairie dog to the edge of oblivion. As this century draws to a close, only diminished populations remain; two of the five species are on the U. S. Department of the Interior endangered list.

For 13 years I have been studying prairie dogs, my travels taking me to all 12 states where they occur (map, page 273). With support from the National Geographic Society, I have worked extensively in Wyoming on the two most numerous species, the blacktails and whitetails.

Scientists coined the Greek word *Cynomys*, meaning "mouse dog"—no doubt inspired by the barking noise these squirrels made. A "wild dog of the prairie" (as the bill of lading called it) was sent to Thomas Jefferson in 1805 by Lewis and Clark from the newly acquired Louisiana Purchase.

Lewis and Clark's "Prairy Dog," now known as the black-tailed prairie dog (*Cynomys ludovicianus*), occurs over most of the Great Plains. Like the closely related

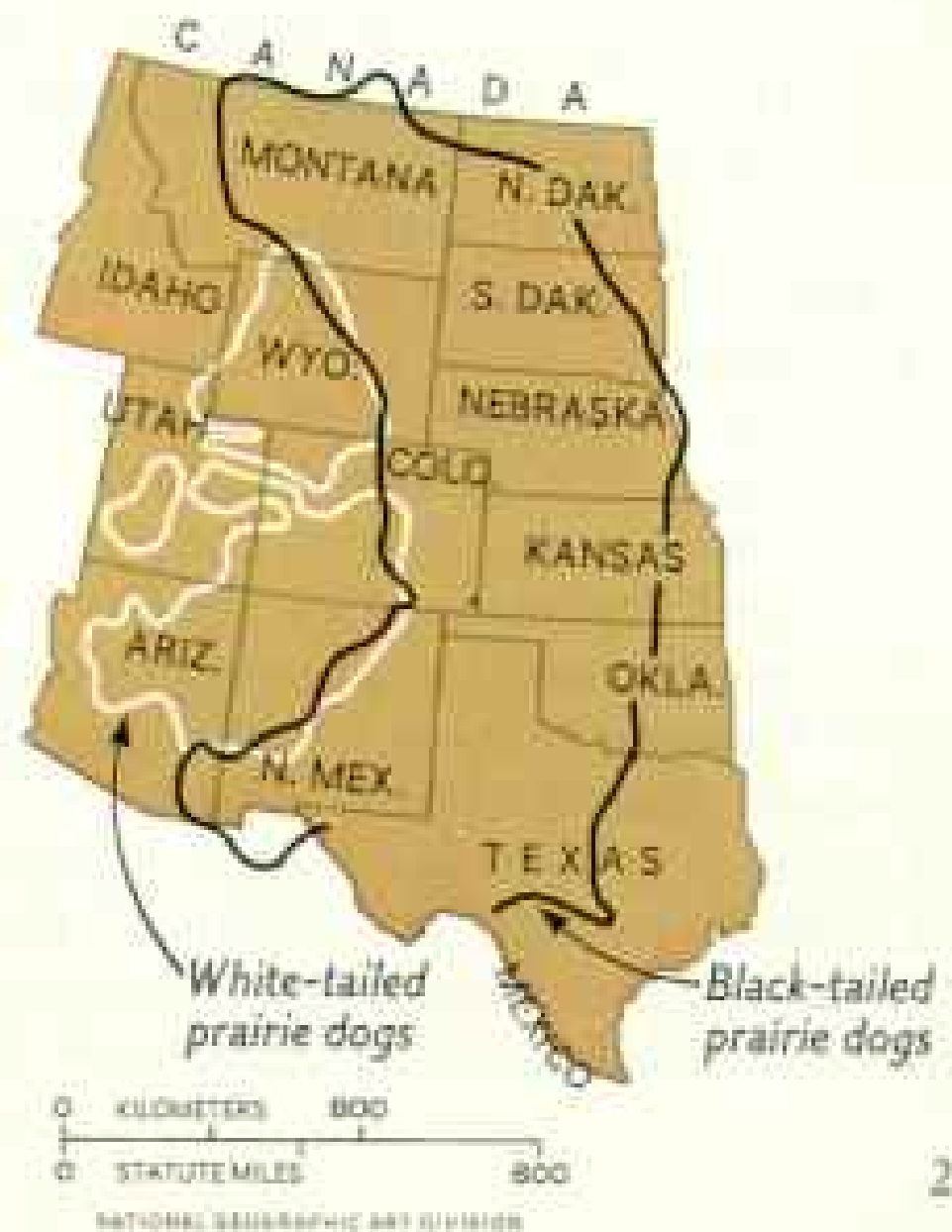
Flying mud erupts over a juvenile prairie dog, as an adult repairs a burrow damaged by rain. Highly gregarious, prairie dogs have evolved a complex social order and dwell in large communities. Though targets of massive extermination drives by farmers and ranchers, they survive in reduced numbers over much of their original range.







Scanning the terrain around its sun-baked home, a Utah whitetail stands on a burrow (left). Of the four species occurring in the United States, only the Utah prairie dog is endangered, numbering perhaps 4,000. Protected by federal law, whitetails plague farmer Sheldon Olds (above). Precious irrigation water often drains into burrows, a problem throughout the prairie dog habitat (below).





Despite an air-raid-warning system, prairie dogs — like this victim — are

Mexican prairie dog (*C. mexicanus*), it has a black-tipped tail. Three other species have white-tipped tails: the whitetail (*C. leucurus*); Utah (*C. parvidens*), and Gunnison's (*C. gunnisoni*).

This rodent's life is tied to a series of burrow homes. It sleeps in them, finds refuge from predators, gives birth there to its young, and, in the case of the whitetail, hibernates there as much as half the year.

With the warming days of spring, the Great Plains explode into life. Prairie dogs start to breed; nearly all adults are preoccupied with mating between late February and mid-April, depending on location.

Especially at that time of year, a prairie dog town hums with "conversation." How often have I stood stock-still, sorting out high-pitched snarls and chuckles from the

tooth chattering and the barking that helped give the prairie dog its name!

In the 1960's Dr. George Waring transcribed prairie dog sounds to a visual picture, called a sound spectrogram. The blacktail, he concluded, has nine calls, the whitetail six, and Gunnison's eight. Noting the precise situation in which a call is made, scientists hypothesize about the function of each—a threat, a distress call, an alert.

In rugged terrain and moaning wind, warning noises may go undetected. I once walked over a hillcrest near Pawnee National Grassland, Colorado, and surprised a black-tailed prairie dog munching greenery. The animal, startled to find me between him and his burrow, froze and pressed as flat as possible against the ground, his brown fur blending with the terrain.



TIM W. CLARK

sometimes picked off by hawks.

I edged closer, slowly squatted beside the little guy, and reached out and stroked him lightly. That did it! Like a furry rocket, he took off in a cloud of dust and flying pebbles, circling me as he raced to shelter.

That was the only time I've ever touched a prairie dog in the wild.

Playing Follow-the-Leader

Last May, at Wind Cave National Park, South Dakota, I shared with a vacationing family the antics of blacktails.

"They're copycats!" the young daughter said delightedly. Each time a feeding prairie dog sat up and peered around, nearby prairie dogs were inclined to do likewise.

I explained that prairie dogs communicate with postures as well as sounds, that the sitting-up-and-looking-around

behavior probably signaled, "Pay attention, something may be up!"

Everybody laughed at one bit of behavior. It's called the "jump-yip" display and seems to signal an all clear from danger. One prairie dog leaped into the air, throwing his forelimbs up and his head way back. At the same time he emitted a call best described as a wheezing, whistling yip. Contagious as a yawn, this behavior swept through the town and dozens of the little animals began to leap and yip.

As we watched, two prairie dogs came together, touched noses, opened mouths, and turned heads sideways, touching their incisor teeth. Scientists interpret this "kissing," as it's called, as a gesture of recognition and identification, not of courtship.

Among whitetails, social contacts such as kissing are rarer, and these species have seldom been seen engaging in the mutual grooming or cooperative burrow construction characteristic of blacktails.

There are other differences. In a blacktail town, tunnels link about a tenth of the burrows (page 277). Whitetails interconnect only a small number of their holes.

Prairie dog towns are divided into distinct neighborhoods. Dr. John King, now at Michigan State University, found blacktails organized into coterie units of from two to a couple of dozen members, who may occupy an area from a few square yards to more than an acre. If members of one coterie move outside their own area, those of adjacent coterie challenge the intruders with a threat, a chase, or a fight. Recent studies indicate that whitetails share these characteristics.

Each spring, black-tailed prairie dogs produce a single litter of about five. The pups of both blacktails and whitetails stay in the burrow for four to five weeks before coming above ground. Usually by late May a blacktail town is bustling with activity as hordes of youngsters make their debut in the open air. In whitetails this emergence usually takes place a few weeks later. By the end of June the young of both species are up and playfully active, rolling off their mounds, shoving and sham biting each other.

By the time young prairie dogs can climb unaided out of the burrows, they are already programmed with many of the behavior patterns they *(Continued on page 280)*

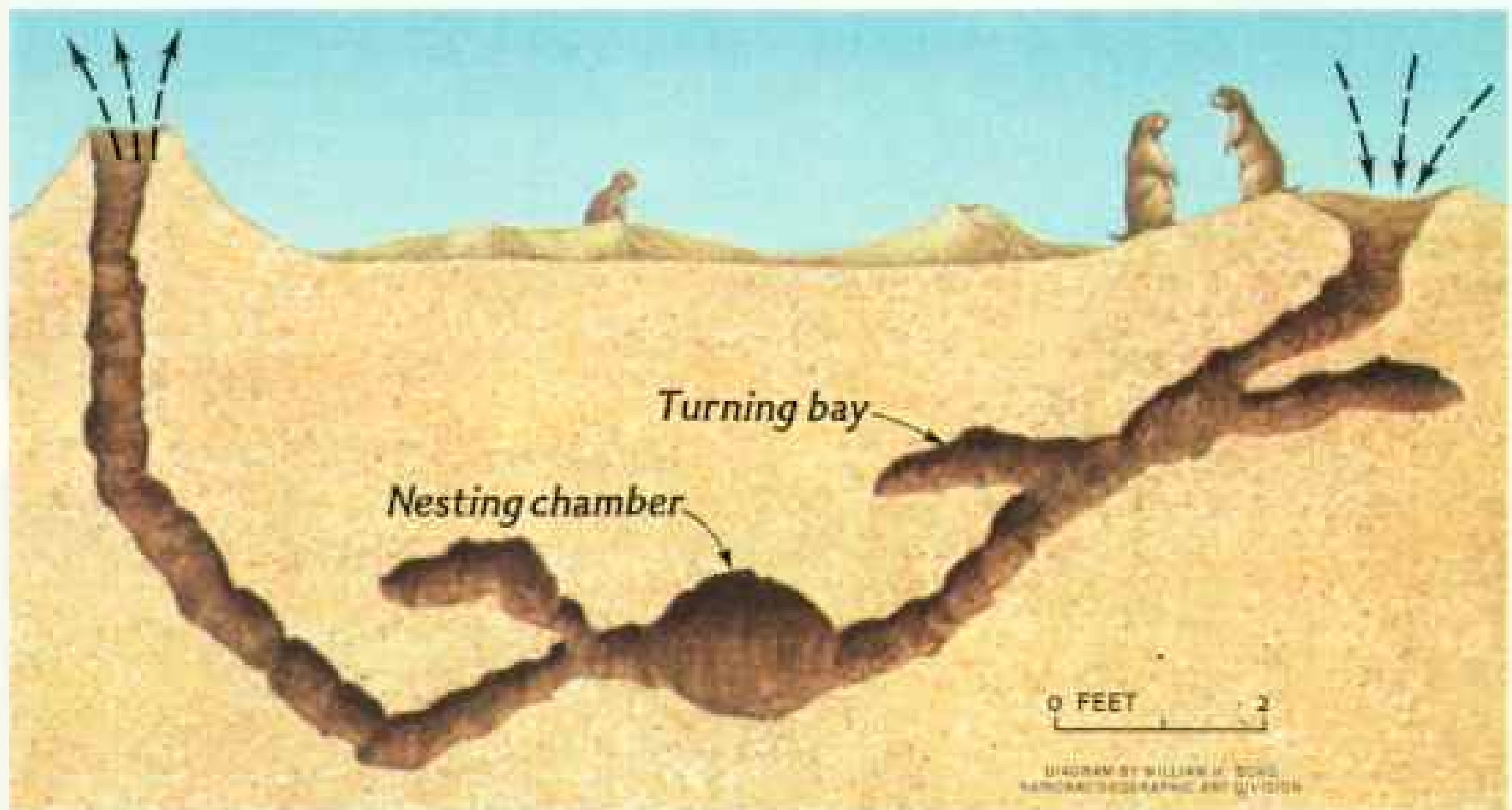


On the lookout, Utah whitetails stand alert by their doorstep. The reddish animal was dyed by researchers at Utah State University to study population density. Society among blacktails is well organized. Distinct neighborhoods, or wards, divide the town, and are subdivided into coterie. The coterie are defined by rough boundaries that the animals defend. Some researchers now credit whitetails with similar social patterns.

Communication is crucial to prairie dog survival. An animal spotting a predator gives a warning cry, which instantly sends all others scurrying to the burrows. An all-clear call later announces that danger has passed.

Seeking to escape water poured into its burrow, a Utah prairie dog is snared for relocation (right). Efforts to transplant the animals to public land have met with only limited success.





Excavated by master engineers, burrows of blacktails house an underground labyrinth (above). Turning bays provide refuge from predators, and nesting chambers serve as sleeping quarters and nurseries for the young. Entrance and exit mounds of different heights assure an air current that pipes in a steady oxygen supply.

In mock combat, two black-tailed pups square off for rough-and-tumble play (below). Pampered by town elders, the very young constantly pester adults for attention and grooming, and are seldom denied. Pups often wander into neighboring coterie, where they are usually warmly received. But as they grow older, they become increasingly unwelcome.

Deaf, blind, and weighing only half an ounce, a newborn (right) takes milk from an eyedropper at the Dakota Zoo in Bismarck, North Dakota. Nourished by grasses and herbs, the young grow rapidly and reach full size within six months.

Expressing recognition rather than love, Utah prairie dogs exchange a "kiss" (far right). By the touching of incisor teeth, kissing confirms the identity of group members.





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(Continued from page 275) will need to survive. Watching a new whitetail litter at the Hutton Lake National Wildlife Refuge near Laramie, Wyoming, I noticed that everything passing overhead—from harmless horned larks to preying hawks—sent the pups diving into their burrows. Little brown yo-yos, popping up and down, up and down, they apparently inherit sensitivity to things zooming overhead but soon learn what is harmful and what isn't.

By late summer, among blacktails and whitetails alike, you can hardly tell young of the year from adults. Among both age-groups the major activity seems to be eating; the animals must store fat to tide them over the winter. Their diet is mostly grasses and leafy weeds, and they must consume great quantities. Each animal, it is estimated, eats more than twice its own weight each month.

Come late October, all whitetails—residents chiefly of higher elevations with longer winters—are snugged down in their grass-lined underground nests for a long winter sleep. The plains-dwelling blacktails don't hibernate; they undergo a mild torpor for a few days at a time during periods

of harshest weather. Almost always, however, some individuals are active.

A dog town in summer presents a pageant of prairie life. One dawn two summers ago I was watching blacktails at Wind Cave National Park. Fresh piles of dirt told me that a marauding badger had been active overnight. A solitary coyote wandered by—the prairie dogs eyeing him closely. A couple of cottontails and a jackrabbit took cover in abandoned blacktail holes. The town was alive with birds—killdeers, prairie horned larks, meadowlarks, and plovers. Ferruginous hawks, red-tailed hawks, and sparrow hawks flew past. Now and then the sudden movements of bison and pronghorn startled nearby prairie dogs.

Here in protected terrain, I was savoring a scene reminiscent of two hundred years ago, when only Indians and a few mountain men could have witnessed it.

Early explorers of the West knew the prairie dog well. The expedition accounts of Coronado (1540-42), Louis-Joseph and François de la Vérendrye (1742), Zebulon Pike (1806-07), and others mention prairie dogs. Lewis and Clark in 1804 reported that

An outfoxed coyote noses around an escape burrow, while a lone



"this animal appears here in infinite numbers." Toward the end of the 19th century famed artist-naturalist Ernest Thompson Seton estimated a North American prairie dog population of five billion! Probably the largest town, in the Texas Panhandle, measured 250 miles long and 100 miles wide.

It is likely that the two most numerous grazers on the old-time Great Plains—prairie dogs and bison—benefited each other. Historian J. R. Mead noted that prairie dogs disappeared from parts of Kansas soon after the massive slaughter of the bison. Herds of the burly animals, he concluded, compacted soil and fostered growth of weedy forbs. Prairie dog burrowing, in turn, probably sped the recovery of areas overgrazed by bison. Feasting on the broad-leaved weeds, prairie dogs made way for the regrowth of range grasses.

With the bison gone, man's overuse of the prairies for agriculture and livestock grazing caused a prairie dog population explosion. The rodents came to be stigmatized as pests, competitors with cattle and crops. The magnitude of eradication efforts, still going on, was incredible. In some years

more than 125,000 men worked to poison as much as twenty million acres. The exterminators have resorted to poisoning, contagious diseases, dynamite, drowning, shooting, and gassing. As a result, since about 1900, prairie dog numbers have been reduced by more than 90 percent!

Plea for a Corner in the Sun

Though all prairie dog species have suffered cataclysmic declines, the list of endangered species carries only two, the Utah whitetail and the Mexican blacktail, and the latter does not occur naturally within the United States. A study by Dr. Don Collier, directed by Dr. J. Juan Spillett of Utah State University, produced alarming statistics: In six decades the Utah whitetail population shrunk from an estimated 95,000 to 4,000. By 1972 only 37 dog towns were left. But since then, species numbers have risen.

Studying to learn if Utah prairie dogs compete with livestock for good range forage, Coleman Crocker-Bedford, one of Dr. Spillett's students, concluded that on upland range sites competition is slight. In the lowlands, however, where prairie dog colonies have been plowed under and planted in alfalfa, what animals remain may eat large amounts of the crop.

Although our main concern has been for the Utah whitetail, the other species of prairie dogs are so sadly reduced in some areas that their future may be ensured only as small relic populations on federal lands.

It can't be denied that prairie dogs, especially blacktails, cause some short-term economic losses in certain rangelands and agricultural areas. Less clear is the other half of the balance sheet—the numerous beneficial influences that prairie dogs exert on the grassland community.

But the survival of a single species is not the only issue; more important is the overall health of the grasslands. I've watched burrowing owls hop in and out of nests in old prairie dog burrows. Some say these little owls couldn't survive without access to the mammals' abandoned homes.

More and more, people are speaking out for a new ecological ethic, recognizing the right of all plants and animals to share our planet. Let's save a corner for the much abused prairie dog. □

prairie dog views him askance.

CHARLES C. SUMMERS, JR.



THE INADAN Artisans of the Sahara

ARTICLE AND PHOTOGRAPHS BY
MICHAEL AND AUBINE KIRTLEY



ROUMER IBRAHIM, a Tuareg noble, is our host (below left). He has seated us on a palm-rib bed in the courtyard of his home in Talat, a village of the mountainous Air region in the south-central Sahara.

Under the star-blazing desert sky, Roumer—he is the headmaster of Talat's primary school—converses with my wife, Aubine, and me. A swinging kerosene lamp casts its amber glow on our faces. We are talking about the Inadan, blacksmiths and artisans in Tuareg society. Here in the Air region of the Republic of Niger, as throughout the Tuareg world, the Inadan live as a subordinate caste side by side with their nomadic overlords.

In the shadows a fourth person busies himself making tea. He lifts a metal teapot from the brazier (steel mesh from an old radial tire) and pours the syrupy liquid into glasses half-buried in the sand at our feet.

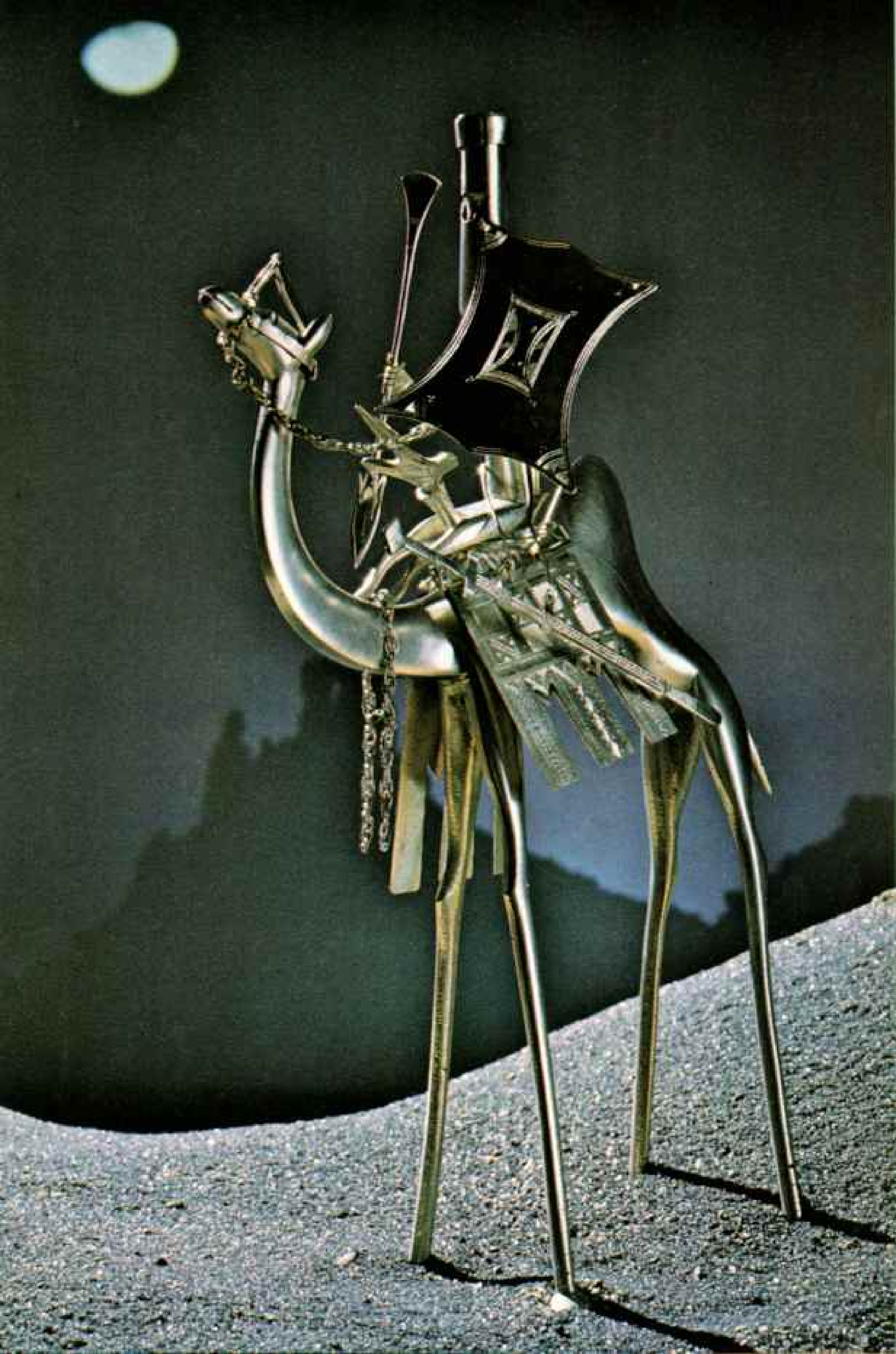
This is Choumba, himself a member of the Inadan. It is his people's prerogative to make jewelry, saddles, camel bags, tools, utensils, and talismans—all the tangible objects of beauty and utility that the princely Tuareg use.

While Choumba serves us, his expression remains stoic. Roumer Ibrahim, gingerly sipping his tea, smiles at the blacksmith and makes teasing remarks.

"Inadan are strange and ill-mannered, shabby and unkempt, never at ease, always out to get you. If one were standing here"—Roumer pretends that Choumba is not there—"especially if there was something to eat, or some possession he wanted, he'd reach for it without a gram of shame, shifty eyed, scratching himself. The look of the *Enad* [a male] is always shrewd, fiery with greed, never soft. . . ."

Listening, Choumba laughs and mutters, "It's true—all true."

Mirror image in silver, a 12-inch figurine cast from melted coins reflects the intense pride and panoply of Niger's veiled Tuareg nobles (left). Its creator, Saidi of Agadez, belongs to the Inadan—the artisan class within Tuareg society that crafts utensils and art to ease and embellish the sere Sahara existence.





Yet minutes earlier Roumer was calling the Inadan "my cousins. We are certainly dependent on them. We joke and laugh with them, haggle with them. Still, we remain apart, like goats and jackals."

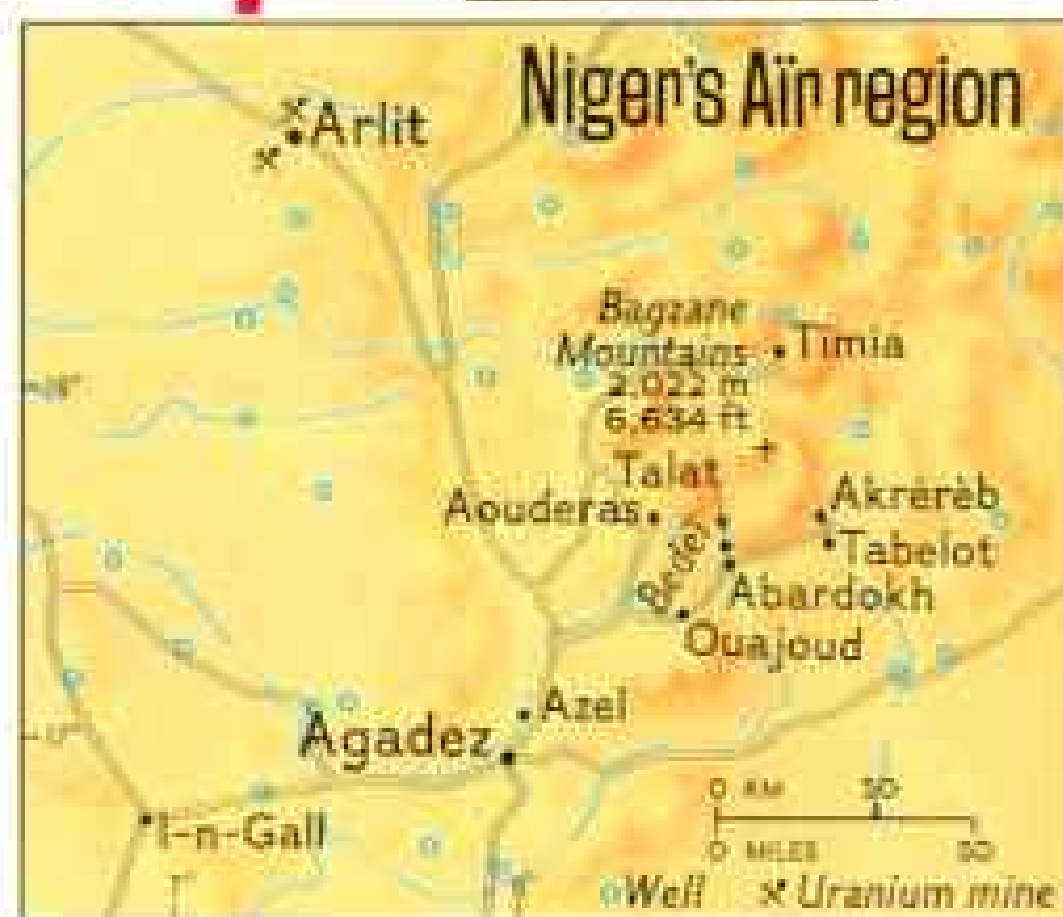
Though Tuareg and Inadan are mutually indispensable, the bond between them is rife with paradox. In this rare symbiotic relationship—a bizarre fabric of tensions and fealty—the Inadan, in return for services, expect and receive gifts and various indulgences from the Tuareg nobles. At times the Inadan also behave toward their

patrons in eccentric and outrageous ways.

An Enad generally asks no remuneration for the various day-to-day tasks he performs for the Tuareg, but costly or prolonged jobs are paid for. In this special working relationship, noble families give food and a share of their income (from caravan trade, harvests, and so forth) to their Inadan; the Inadan, in turn, furnish implements and utensils to the Tuareg, and through more demanding crafts like silversmithing and saddle making contribute beauty to an otherwise austere cultural environment.



Out of goats' reach, the necessities of desert life shade a Tuareg noble, selling goat cheese on a lonely track. From the Sahara's scrub and waste, Inadan men carve bowls, ladles, and beds; women sew water carriers from goatskins. Once artisan families were closely associated with wealthy nomadic patrons who lived by raiding and caravanning. Now modernization and drought have frayed Tuareg society, forcing some men to seek work in towns and uranium mines, or as truckers.



NATIONAL GEOGRAPHIC ART DIVISION

But artisans are not slaves: Should an Enad feel abused or undercompensated, he may shift allegiance to new patrons. Still, pride is no deterrent if groveling will exact extra gifts. Craftsmen of sure skill, the Inadan yet suffer the stigma of lowly caste, which the Tuareg attribute to the Inadan's obscure origins and reputed recourse to magic. While the children of nobles and those of craftsmen do not intermarry, Tuareg social protocol depends heavily on Inadan in their accustomed roles of negotiator, messenger, and go-between.

In daily give-and-take in the Air, nobles frequently find themselves uneasy with the Inadan. This breeds a degree of aloofness: Nobles normally keep their distance from a blacksmith encampment. Yet Tuareg nomadic excursions usually stay within reach of those Inadan who serve their needs. Only rarely do Inadan accompany the Tuareg on their wanderings.

Who are the Inadan? Legend describes them as "older than memory, proud as the crow, mischievous as the wind." Some scholars say they descend from Nubians, or

that their roots were among Middle Eastern blacksmiths. The Inadan themselves, though Muslim, claim to be sons of Our Lord David, possibly linking them to Jews of the central Sahara. Adding to the riddle is their darker complexion, which sets them apart from the often honey-skinned Tuareg nobles, who are descendants of the Caucasian Berbers of North Africa.

My wife, Aubine, who is French, and I first came upon the Inadan in 1974. Their intricate culture, little known outside the Sahara, challenged our curiosity. With training in graphics and the arts—I as a photographer, Aubine with a doctorate in art history—we felt an instant bond to these craftsmen and artisans.



Dainty as snowflakes—and almost as varied—two-inch ornaments, here made of stone instead of the usual silver, adorn necklaces throughout the Air region.

All Tuareg collect Inadan silverwork (facing page), hammered or cast in the lost-wax process. Selling jewelry helped some families to buy food during the recent drought in the Sahel.

On four annual visits to the Air, we have come to feel at home in that stark region. We have struggled along the dry riverbeds that stitch rolling dunes to black, sky-stabbing peaks. We have gossiped and drunk tea in the Inadan's domed huts. These frugal homes, walled by palm-leaf mats which can be lifted to admit the breeze, often cluster beside springs among scattered acacia trees.

Feudal System Withstands Drought

During the punishing Sahel drought of 1968-73, the people of the Air were hard hit, but they suffered less than the Tuareg in Mali.* Still, I saw Tuareg nobles laying brick in Agadez, chief city of the region, and found Inadan trying to set up businesses in faraway Niamey.

The drought wiped out much of the Tuareg wealth—herds of goats and camels. Many of the nomads are now poorer than their underlings, the sedentary Inadan and the slave-descended field hands. The Tuareg nobles have fallen into a seminomadic life-style more similar to these neighbors. Recently the government of Niger helped the stricken Tuareg by importing livestock—including hundreds of camels—for distribution among the nomads. This restored Tuareg pride and mobility—and also put Inadan shopkeepers back to work making saddles, camel bags, and other finery of caravanning.

We traveled, on one of our early Niger visits, to Abardokh, a village in the southern Air region. As we drove northeast from Agadez, a faint breeze raised a golden haze around the rusty hills. Finally, like an apparition, Abardokh appeared. Here we hoped to hire a renowned craftsman named Ahoudan to guide us on a trek into the rugged Bagzane Mountains.

"You'll be lucky to find him," a friend had told us. "He has two homes and two wives, in Abardokh and Tabelot."

As we drove up to Ahoudan's hut, children, chickens, and goats scurried away. From within came a loud burst of rock music. Hearing our vehicle, Ahoudan had turned up his portable cassette player nearly to the distortion level. His foreign

*Victor Englebert wrote of the Sahel disaster in "Drought Threatens the Tuareg World," NATIONAL GEOGRAPHIC, April 1974.



visitors must know that he was "with it."

Groping into the dark interior, we were able to make out two eyes and then the coffee-colored skin of a man with his black veil drawn away from the face. Like the Tuareg, Inadan men, not women, wear veils. The slim figure shook hands and offered Aubine and me a mat to sit on. In good French, Ahoudan introduced his local wife, who immediately left, but soon returned to sit in the doorway, much as a disturbed butterfly settles again on a bloom.

Origin of Ornaments a Mystery

Not displeased to have an audience, Ahoudan prepared for the day's work at the forge. Widely considered the best stone carver in the Air region, Ahoudan also is a respected silversmith. He would make an Agadez cross, he told us, most popular of the thirty ornaments resembling crosses that Inadan make (page 286). Why Tuareg favor this shape is obscure; it has been compared to the Egyptian ankh, a symbol of life.

The artisan used his handmade tools—"passed down from my father"—with reverential respect: skin bellows, pincers, hammer, charcoal burner, earthen melting cup, and a bronze mold that splits into halves to remove the cross cast in silver.

Furiously working the bellows, Ahoudan thrust the mold nearer to the embers and poured the molten silver from the cup he had been holding in the fire. Quenching the mold in a sizzle of steam, he knocked the two halves apart. The cross within had formed imperfectly.

"No mind," said Ahoudan cheerily. "This is a common occurrence. Silver doesn't always solidify evenly."

"Are you sure it's good silver?" I was trying to get him off the hook.

"Oh, yes, this silver comes from fine old European coins. Many blacksmiths buy new coins at Kano—very poor quality. But I only use good silver." He was a bit miffed.

Aubine and I watched him repeat the operation. The next cross was even more flawed. Ahoudan put the half molds down, looking at us gravely.

"I should have known better." He smiled as he spoke. "We have an old proverb that says 'A blacksmith being watched never produces.'"

Ahoudan agreed to be our guide, and the next morning we set out on foot for the Bagzane. Each morning Ahoudan would carve a little cross in soapstone and offer it to Aubine. But he steadily complained that the arduous travel would injure his pack camel. We were not stopping often enough to let the animal graze.

"Why are you so concerned about this camel?" I finally asked.

Ahoudan stolidly plodded on, and I felt that he was considering quitting on the spot.

Finally, he spoke: "Before the drought I always loaned out my camels—I had nine of them—to friends; back from a trip, they were fattened in green pastureland. With the dryness and browning of the grass, my camels died one by one. I could not find enough work in the mountains. The nobles had no silver and no money to give me any business, no goats to exchange. I went begging to the white man at Agadez. Now this one camel is all I have left."

From that moment our friendship ripened. Our trip to the Bagzane was a delight.

His reputation makes Ahoudan an exception, but most Inadan would be hard put to subsist from their handiwork alone. Their traditional roles in noble marriages and baptisms add to their incomes. It is they who announce the program of events to the invited guests. They serve the meals and provide most of the entertainment. At Tuareg marriages, only the Inadan may play the drum called the *tendi*; at baptisms, only they may bring the sacrificial sheep from the parents of the new father.

For such services the craftsmen are well compensated. And woe betide the nobleman tempted to usurp the Inadan's privileged position. Suppose a noble works at the forge himself, builds a saddle, or insults an elderly Enad. Inadan vengeance is swift through *al barussa*, a ritual of retaliation and harassment.

Aubine and I had been visiting an encampment along the Bedei, when Boucha, a Tuareg woman, provoked the craftsmen's wrath by allowing her son, Rissa, 14, to overstep the accepted spheres of responsibility. Taunted by Inadan youth for lacking a craftsman's prowess, Rissa went to a forge and set himself to the task of jewelry making. In a little while he was able to display

to his companions a creditable silver cross.

When Amud, an Inadan elder, heard of Rissa's presumption, he convened a council and belittled the noblemen: "Are we not worthy of respect? Let us show the nobles what could happen if we acted like rascals. This calls for al barussa."

The council of men let out a yell. A group of women hovering in the background rolled their tongues back and forth in their mouths, and let loose a high-pitched battle cry. As if the ground had opened, all the Inadan—council members, women, and bystanders—disappeared into their weather-beaten thatched huts. An ominous silence fell. Then, moments later, they swarmed out, eyes filled with wildness, mumbling strange words in *tenet*, the secret language of the blacksmiths.

Tuareg Camp "Attacked"

Men and women streaked their faces with ashes and put on old rags. Over their backs they placed worn mats and broken saddles. They ran howling, men with bellows in hand, women beating on tin cans. Flushing bleating goats and cackling chickens, they raced across the thorny scrubland that separated Inadan and Tuareg encampments.

No one had warned Boucha. When the Inadan arrived, she was cooling millet porridge inside her hut. The intruders seized her earthen cooking pot and smashed it; one blacksmith struck her with his scabbard. Boucha thought it was a sword and fainted—which so took the Inadan aback that they broke out laughing and left. The act was over.

More drastic results can sometimes attend an al barussa, until some adequate restitution is made to the belittled Inadan; but the outburst usually has no more punch than a pillow fight. Today, with changing life patterns, the more educated youths refrain from taking part, considering al barussa a childish regression.

Though fate has conferred on him inferior status, the Inadan is not a humbled man. What helps bolster his self-esteem is his reputation for casting spells. The Tuareg regard with awe what they believe to be the Inadan's occult powers, called *tesma* and *ettama*, which are thought to cause harm as a kind of retribution whenever



With mock attacks, the Inadan ward off any insult to their person or threat to their livelihood. When, for instance, a noble attempted to make jewelry—an Inadan prerogative—the insulted artisans dressed in rags and ran howling to the noble's house; this man arms himself with a bellows. To restore peace and goodwill, the noble gave gifts of sugar and tea.



a craftsman is refused any request.

In Tabelot we learned of a recent instance of reprisal by *tezma*—and how, in this case, it boomeranged.

A group of Tuareg camel riders had sailed proudly into the village. They showed their habitual haughty disdain for the townspeople. Moussa, an Enad from the blacksmith camp, stepped up to one of the lordly nomads and solicited a gift. "Please, lord! Some tobacco, or tea, or sugar."

The Tuareg rudely rebuffed the craftsman and turned his back.

That evening a shepherdess came into Tabelot, frantically seeking the camel rider.

"Your eldest daughter, Raisha, has been sick with a high fever since this afternoon. Tonight she is screaming in her dreams." The messenger broke into sobs.

The man, enraged, went looking for Moussa and, finding him, took him by the

neck and demanded that he instantly lift the evil spell that had afflicted Raisha. Moussa remained stoic until the Tuareg drew his sword and slashed one of the smith's fine camels and threatened to slit Moussa's throat as well.

With great emotion, Moussa whined that he had done nothing, but promised restored health to the nomad's daughter. Next day Raisha's fever disappeared.

Some Spells Are Automatic

The *ettama* spell is more cryptic: When an Enad sees an object he wants—or perhaps only suspects its existence—but is too shy to ask for it, the possessor of the coveted item falls sick. Black magic?

The impish Enad claims he has no control over such power—that it comes into action without his conscious willing. To avoid the effects of a spell, many Tuareg consider it



Sculptor of hair in the village of Talat, an Inadan woman, Bachi, braids a popular style for a noble's daughter. Such skilled beauticians first wash the hair in suds made from the leaves of a desert plant, then treat it with butter and shiny black sand. Fashionable in coiffure and jewelry, girls (below) await the feast ending Ramadan, the Muslim sacred month of fasting.



better to offer something to an Enad even before he makes a request!

Whatever the Inadan's mystic sway over their Tuareg overlords, the steadfast coexistence between them rides on day-to-day affairs. A nighttime wedding, for example, is taking place. . . .

We watch the old Enad, Hada, stand at the doorway of a big hut, the black, wrinkled turban coiled hastily around his head. Waiting for action, a crowd of men and women stir about, their eyes and teeth gleaming in the full moon's light. A voice booms from within the hut.

"Inadan, beware! Cover your eyes with your tattered veils; you are among wealthy men tonight. Be careful with what we give you! Our sharp blades will cut your hands. Their glint will hurt your eyes. Be grateful, Inadan!"

The hut conceals Tuareg nobles, who

have come to a river-bottom encampment to celebrate the marriage of a friend. Now they are offering ritualistic gifts to their attendant Inadan as a reward, on this special day, for their services as silversmiths, messengers, attendants—but especially, tonight, as drum players.

Through the hut door a hand offers a *takoba*, a Tuareg sword. Hada takes it, shakes it, unsheaths it—and screams.

"Aieeeeeeeeeeya-eeee! Is this dull thing a gift? I will ask the women, for the men do not accept it." Turning toward a group of Inadan women draped in indigo headcloths, Hada seeks their opinion.

"It could not slit the throat of a kid goat," the women cry in unison.

Hada hands back the sword, and receives another out of the shadows. This one, too, is contemptuously rejected. A third weapon is offered, this (Continued on page 296)





Challenged by scarcity, Inadan convert old silver, iron, and even stone into objects of beauty. Annually a small group of men treks into the blast-furnace desolation fifty miles east of the Bagzane Mountains to mine soapstone for men's arm rings, worn in battle to symbolically ward off blows and as a sign of virility (bottom). As an artisan shapes a rough doughnut (below), he listens for a change in tone, which reveals weakness, and discards such stone before it shatters. After each ring is filed and burnished with sand, master craftsman Ahoudan (left) heats it until it blackens. Payment is negotiable—money, millet, or even a favor.







Elaborate as a throne, a noble's camel saddle with fringed bags (left) is a specialty of the Inadan of Azel (above). Working with homemade tools beside their palm-leaf huts, kinsmen first carve the frames from branches at far left. Now Aboulaye cuts "silver" trim from a can and a scrap of car radiator, while Hamidan nails on cowhide and dyed goatskin. Wives decorate leather strips with bright yarn embroidery. A woman (right) punches holes with a primitive awl made from a nail and a brass cartridge casing.



(Continued from page 291) one obviously of excellent quality. At once the women roll their tongues and shriek with delight.

Other gifts are offered. At last there are enough. Hada goes to a drum standing in the sand. He sounds a loud roll on the taut skin, while around him the women sing. The wedding ceremony can continue.

A Village at Play

Seeking Inadan encampments, we poked into almost every corner of the Air. Frequently our coming provided an occasion for festivity, even frivolity.

At Aouderas, seemingly in response to our arrival, we were told that Inadan and field hands would convene from the country round about for an evening of merriment. Darkness fell, and the village emptied into the dry riverbed. The women, playing hand drums, were ranked along one bank, while the men milled about. High-pitched singing picked up a rhythm. The men drew near the women in twos and threes to dance, stamping their feet with hands on hips.

Inadan women—I found them unfailingly appealing—work as artisans, responsible for hairstyling, palm weaving, and almost all leathercraft. They were intrigued by Aubine's status as an equal to her husband. They teased her often about her uselessness as a housewife. One afternoon a woman of Abardokh jokingly suggested that I select an Inadan wife.

"What good is Aubine?" she asked. "She's too skinny. She's too weak to pound millet or carry a bucketful of water. She can't build a house and doesn't even know how to braid her hair."

Aubine became a good friend and confidante of many Inadan women. One, Bachi, persuaded Aubine to have her hair done Tuareg style. She spent hours shampooing Aubine's hair and preparing the gooey mixture of butter and sand that is smeared into the braided locks for added luster and body.

To Bachi's and bystanders' delight, Aubine squirmed as the braids were tightened

to the point of stretching every follicle, but in the end she looked every bit the true noble.

Strict Islamic traditions have been mellowed by local customs, making women in Tuareg society among the freest in the Muslim world. Aubine calls them the real power in the society, partly through circumstance. Many men are absent during the six-month caravanning season, when they head south to barter in Hausa country.

But men—and women—leave home for reasons other than trade. In Azel, known for its saddlemakers, we met young Aboulaye (preceding pages). A few years ago he took a job as an electrician in the uranium mines of Arlit, 135 miles to the north.

At first he found Western civilization to his taste—free room, commissary privileges, much more money than he could have earned back home. Some of his best friends were Europeans.

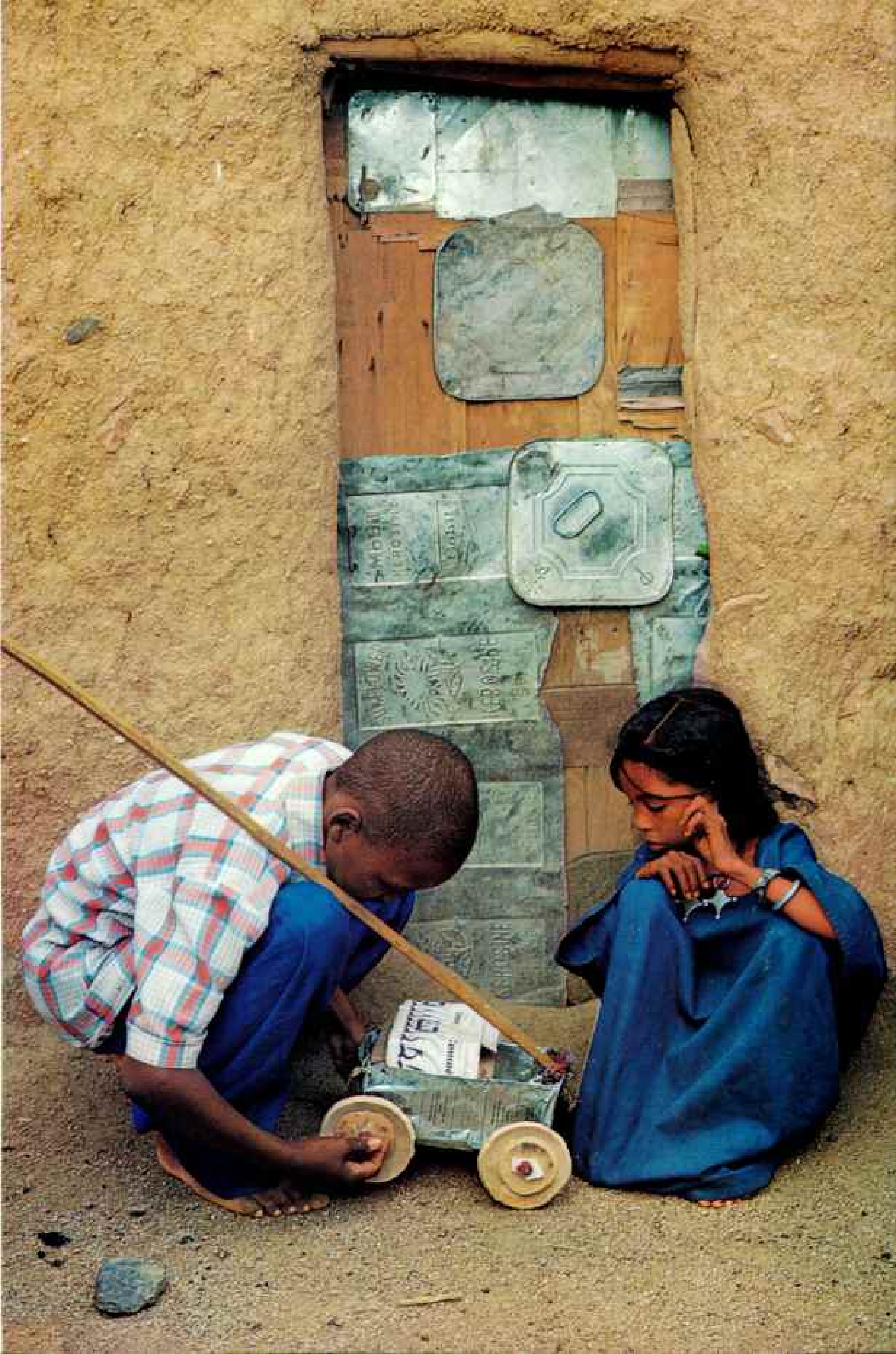
Yet today Aboulaye is back in his ancestral village, mastering his father's trade. What, I asked, made him leave Arlit?

"Oh, nothing, it was wonderful—very modern. For my wife also it was good—no millet to pound, new clothes. But for me, too many good things turned to bad things. I spent too much—at month's end nothing left to send home. For the first time I saw an Inadan woman sell her body.

"One day a telegram came saying my mother was ill. A trucker drove me home. But my mother had already died. I visited all my friends sitting around the forges. The noise of the hammers and the voices got to me. Now a year has gone by, and half my belongings are still in Arlit. My boss was mad, but the saddle business is good now. And I am master of my own time."

Aboulaye may one day become a famous saddlemaker, for in this village he is surrounded and stimulated by others skilled in the craft. Local specialization like Azel's has made Agadez the queen city of silver jewelry. Handsome camel bags come from Timia. Tabetot is famed for weaponry and Abardokh for stone carving, while the Inadan at

Resilient in the face of change, an Inadan family in Timia transforms urban castoffs—tin cans—into decorative door patches and a boy's toy wagon, intriguing a playmate. Even when settled in oasis towns, Inadan cling to the traditional language, religion, and social customs that mark their desert heritage.



I-n-Gall produce beautiful leather pouches.

Among all the craftsmen, competition is keen. Through a misadventure on the road, we witnessed this rivalry firsthand. Our Land Cruiser broke down near the desolate village of Ouajoud. While seeking help, I found the tiny shed where a boisterous old man named Sidi carves wooden dippers and spoons known from Akrérèb to Agadez. I bought some, but when I showed them to my friend Atahir, a teacher in Aouderas, he seemed unimpressed.

"Have you seen the work produced at the village right near here?"

"If you're speaking of Ali and Hamana, no, but no one seems to think they could do better." The fame of these woodworking brothers is widespread in the Aïr.

"Give me the keys to your Land Cruiser, and I'll drive you there. Let's make a bet," said Atahir. "If you agree that their work is better than Sidi's, then we go hunting tonight with your high beams to blind the rabbits. OK?"

I accepted, trusting in Sidi's reputation.

In the dusty Inadan camp, dilapidated huts leaned lopsided from the wind's incessant beating. Children played beside bleating goats. I sometimes wondered whether the Inadan cultivated this exterior image of poverty.

Artisan Rises to Challenger

The elder brother, Ali, was away, but Hamana was at work in a palm-mat work shed planted in loose sand. Atahir pulled one of Sidi's dippers from inside his cloak. Hamana, busy with the framework of a saddle, shrugged and murmured, "It is the work of

Sidi." The craftsman, legs on either side of the saddle, seemed to yearn for us to leave. Finally, as we lingered, he whispered something to a youngster squatting nearby, and the child ran out.

The boy returned with several chunks of wood. Hamana carefully selected one, picked up a small adz, and started to work. The form of a dipper quickly began to appear. With a wet rag the craftsman kept the wood damp.

The rough shaping finished, Hamana took a flat file and started smoothing the edges. In glowing charcoal he heated two wooden-handled steel blades, to burn geometric engravings into the bowl and handle of the dipper.

Hamana finally showed his teeth and chuckled as he offered me his handiwork. There was little sunlight left to see by, so I got a flashlight from my car, and Atahir clapped his hands when it shone on the dipper. The work was delicate, elegant.

"This is the first time I have seen Hamana at work," admitted Atahir. "Compare the ladles you bought to this one. I tell you, my friend, I am ordering five for my family."

I placed an order myself and spent most of the evening futilely chasing down rabbits with my high beams.

Upon our return early next morning to Atahir's house, we took tea. While savoring its sweet, hot aroma, I prayed with my heart that the traditional, carefree ways we had shared over the years with the Inadan—these people "older than memory, proud as the crow, mischievous as the wind"—would somehow survive the assault of progress in the Aïr. □

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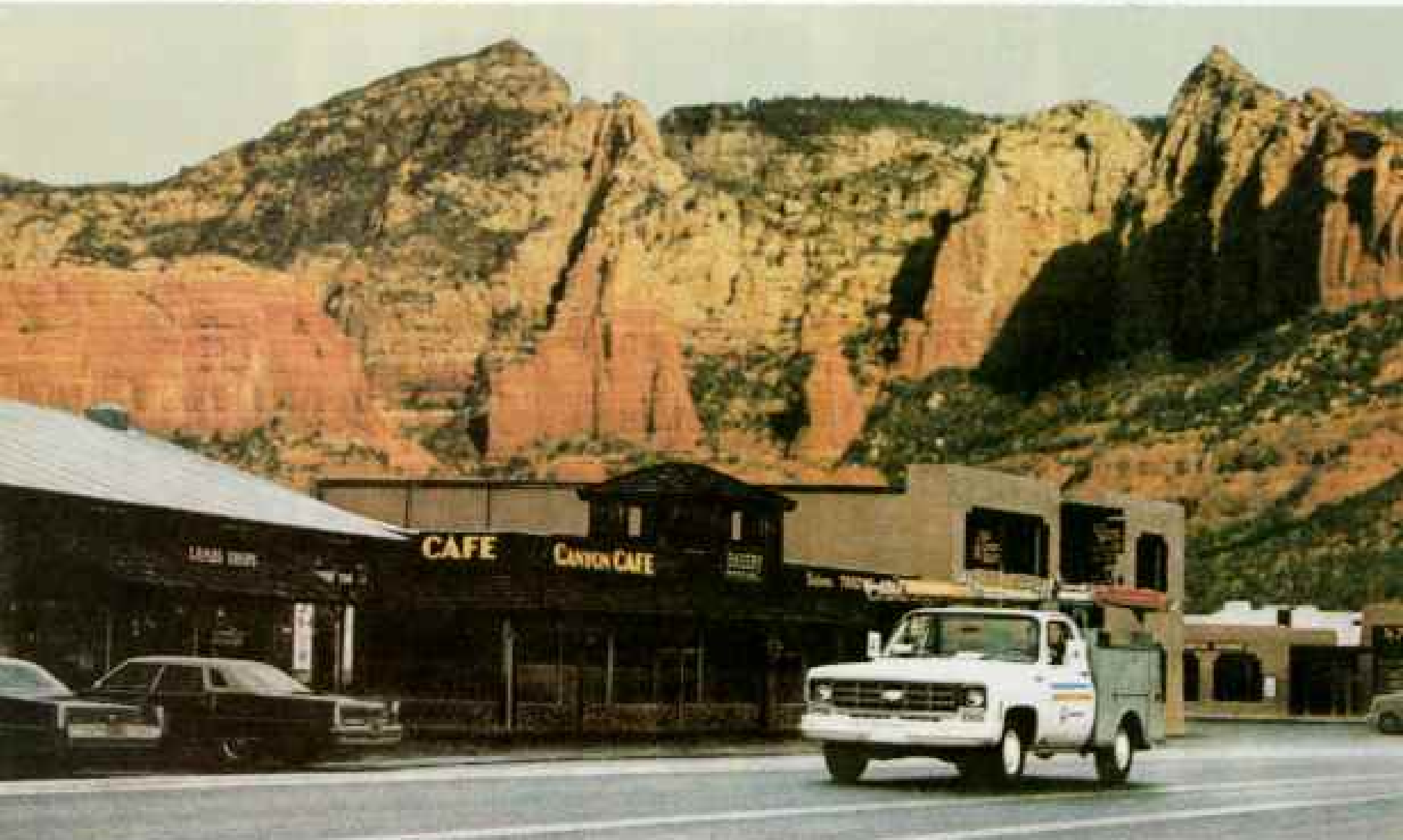
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NATIONAL GEOGRAPHIC PHOTOGRAPHER STEVE RAYMER

Assignment: North Yemen

ON THE ROAD to Taizz in the Yemeni Arab Republic (North Yemen), writer Noel Grove and photographer Steve Raymer came upon a large group of excited Yemenis. The men were carving the air with their *jambiyas* — curve-bladed daggers — in a dance of prowess. As Grove watched, they motioned him to join. So, brandishing camera and notebook (above), he did — and danced

a fair country imitation to shouts and grins.

Grins faded when forces from Marxist South Yemen briefly pushed into North Yemen last February. Grove, one of the few Western correspondents on hand, sought the story behind the headlines (see page 244).

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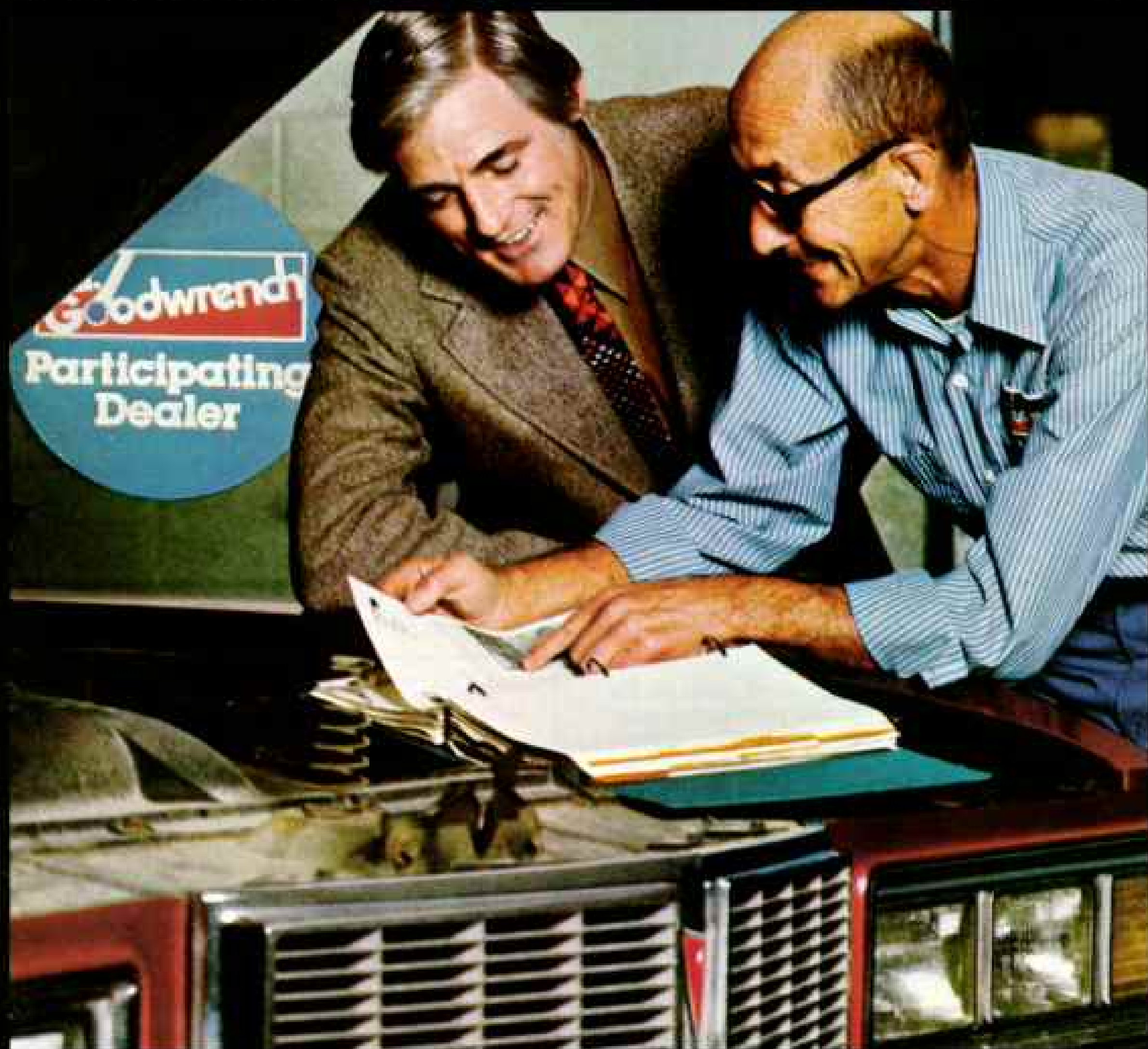
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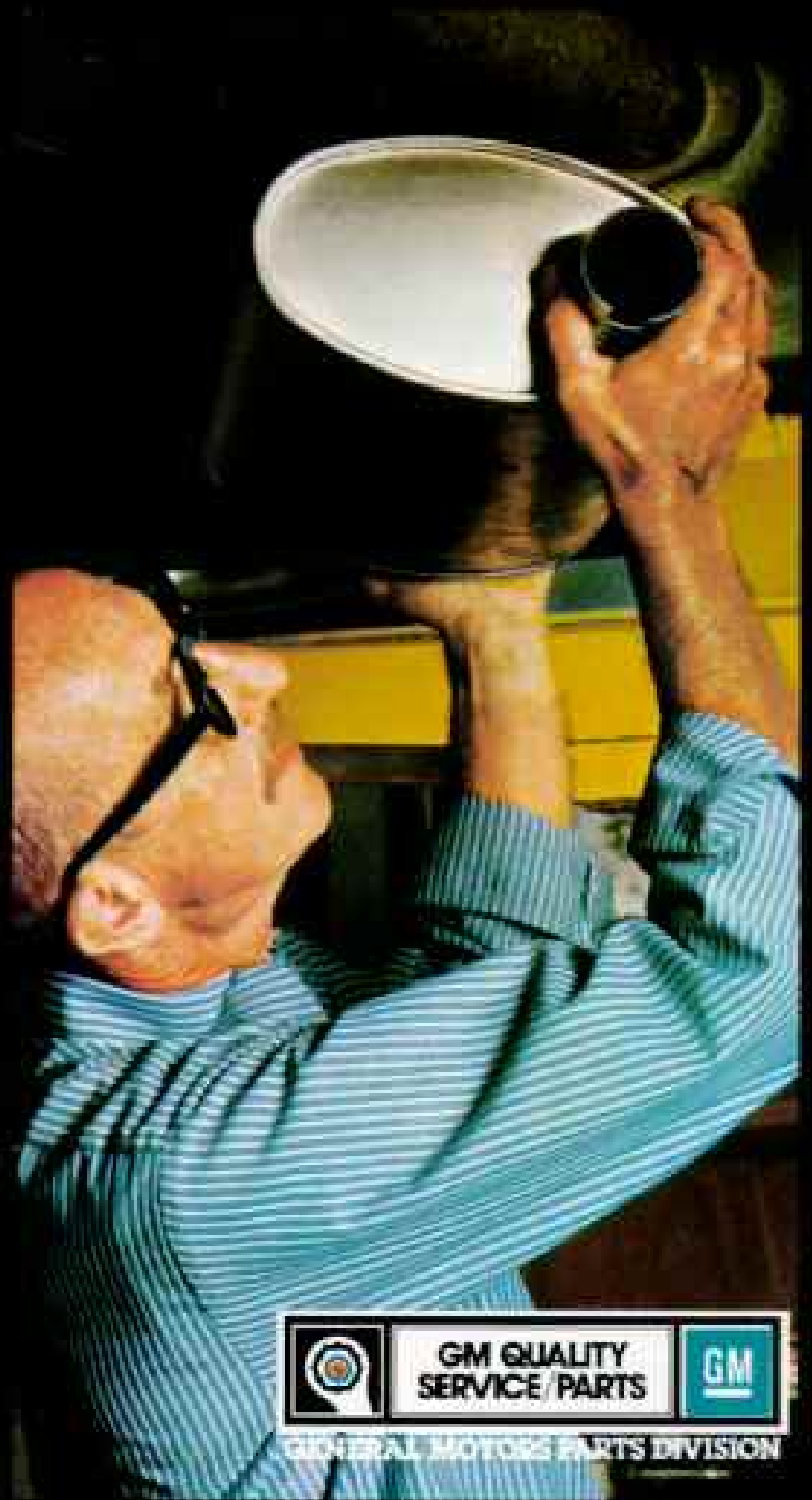
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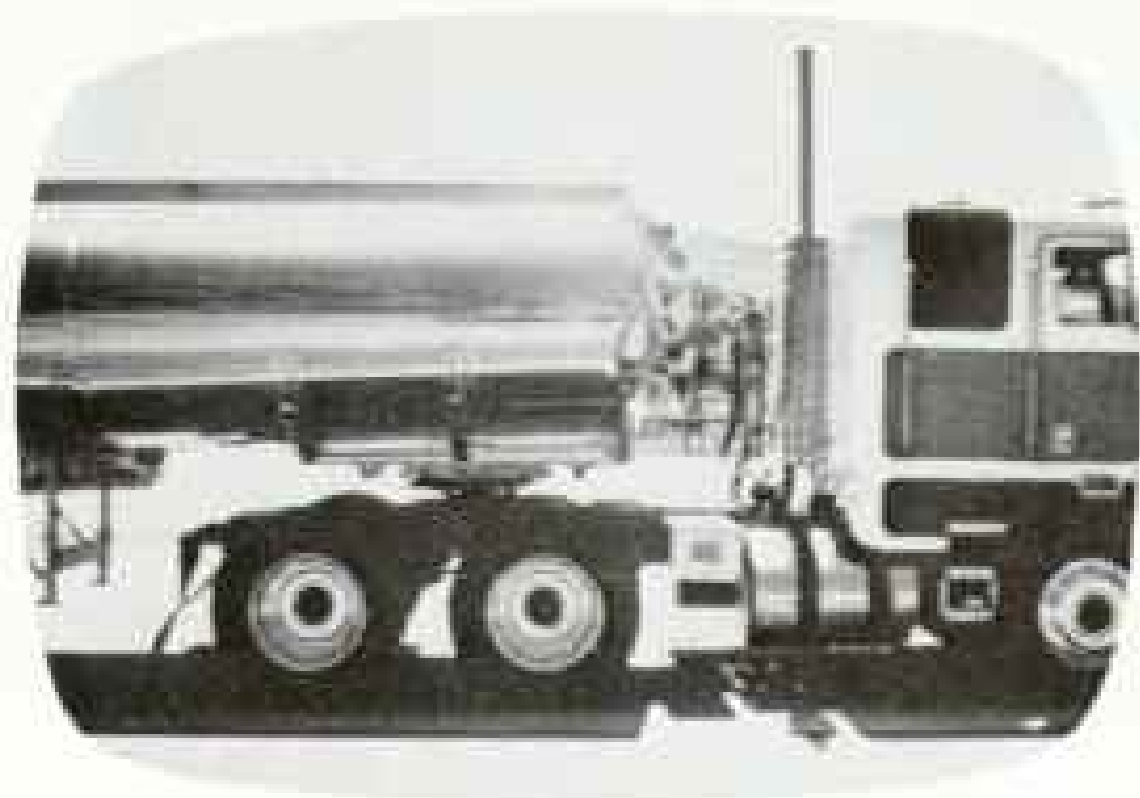
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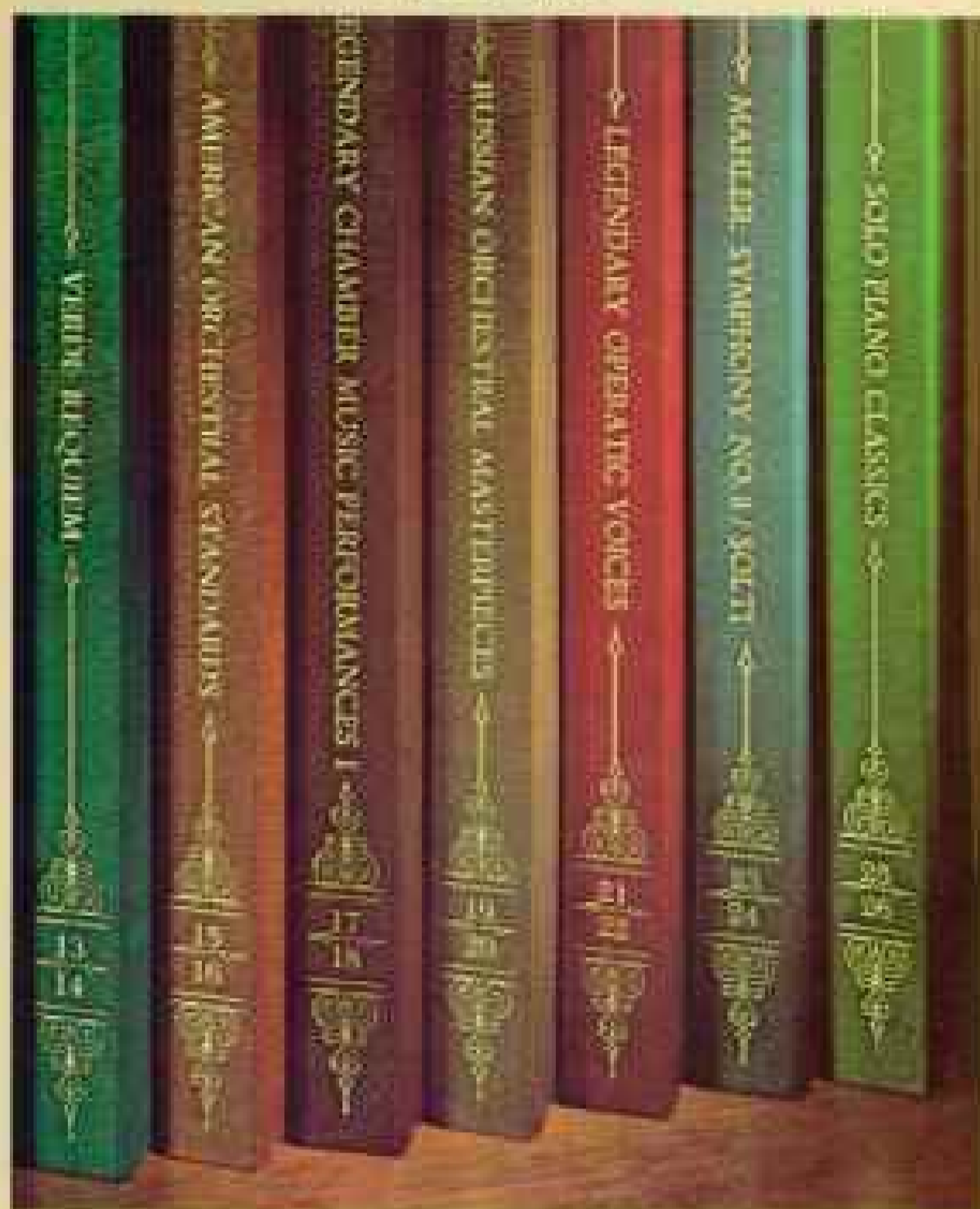
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The Story Of The Handsome Prints.



To make a long story short, we invite you to bring your next roll of 35mm film to a convenient Fotomat Store, drive up to the window and ask for: **Series 35 Custom Color Prints.** You'll get back a fistful of 35mm prints that are even handsomer than our good-looking regular-size prints. Bigger, too — 4 x 6 instead of 3½ x 5.

Only our most experienced photo-finishers, in a separate section of our

own Fotomat labs, do Series 35 work.

They take a bit longer with the negatives. And fuss a bit more over the detail. Then print your pictures 37% larger, with your choice of a borderless glossy or studio finish.

For this extra care and quality you pay a little more. And wait a few days longer. But we think you'll be happy.

Ever after.

FOTOMAT 

Introducing Kellogg's Most.

Wheat germ. Important high fiber. 10 vitamins and iron.
Woven into a combination no other cereal offers.

Kellogg's® Most™ cereal is what you should be having for breakfast tomorrow morning. Because Most has a combination of ingredients no other nutritious cereal gives you. The goodness of wheat germ. Bran for the high fiber you may need in your diet. And not just vitamins and iron, but a full day's allowance of 10 vitamins plus iron. All woven together into crunchy little biscuits with a delicious wheat taste.

With all that going for it,
why settle for less
than Most?



This view made practical with energy efficient PPG glass.

What could be more pleasant than a room like this? Open to the beauty of an inviting outdoor setting. Comfortably lighted by the daytime sun. Bright. Cheerful.

Most of all, it's practical. It helps this home conserve energy.

This glass wall exemplifies the success of a new concept in energy conservation called window management. It means that windows and glass, properly placed and designed, can use the sun's heat and light to improve the energy efficiency of your home.

PPG makes glass that can take full advantage of this idea in any climate.

In cold northern climates, for instance, PPG *Twindow*[®] *Xi*[®] welded-edge glass uses dry insulating gas between two sealed panes to reduce heat loss through a window by more than 40 percent, compared to single-pane clear glass.

And in the south, PPG *Solarcool*[®] Bronze glass reflects almost 50 percent more heat than clear glass. And that may help to reduce air-conditioning needs.

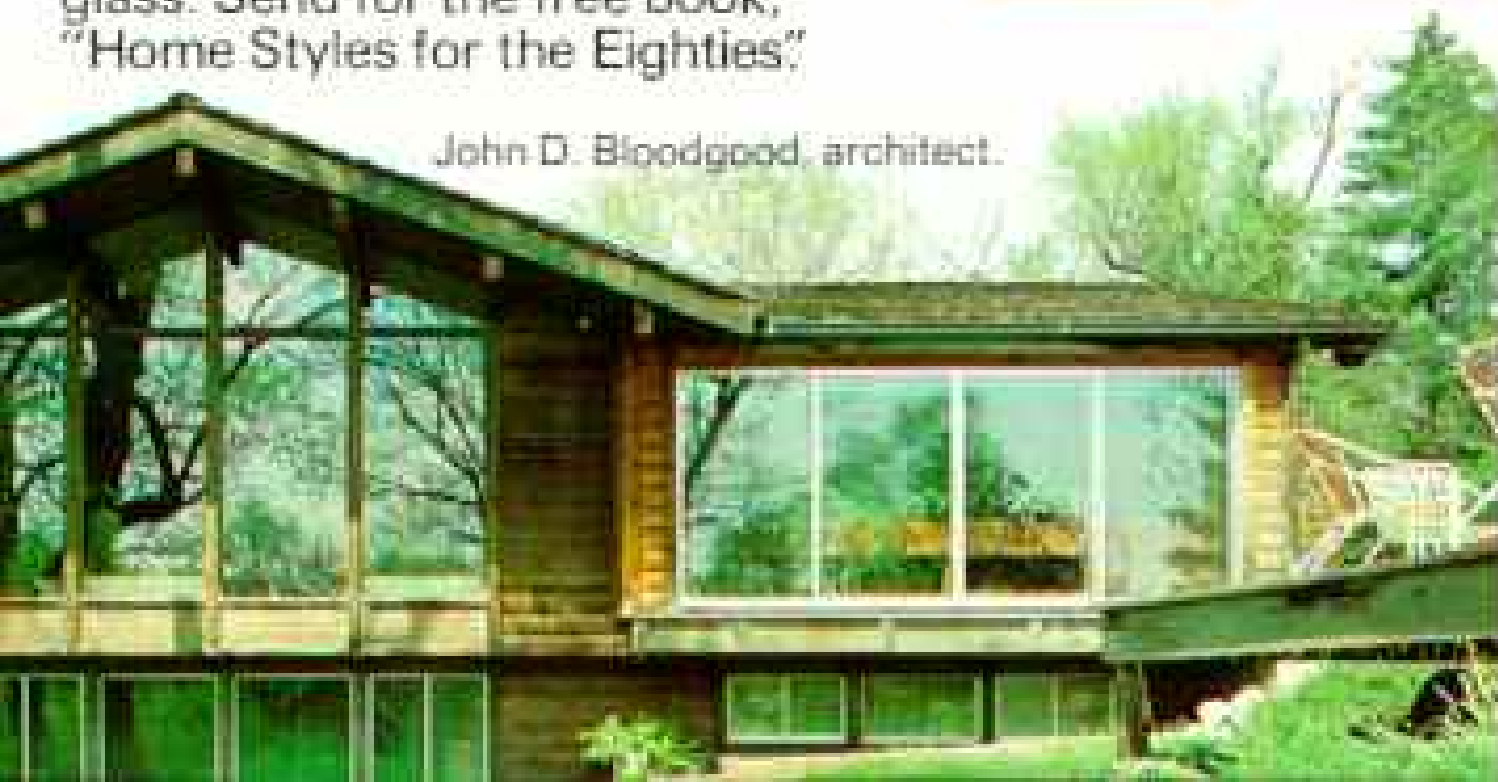
Both kinds of performance may add up to significant fuel savings.

PPG also makes tinted glasses which control the brightness and heat gain of a strong sun. They can be used in single, double or triple glazed construction designed to suit the needs of any home, north or south.

Work with your architect or contractor in making quality glass and the sun work together. For you.

There's much more to learn about window management. Find out how you can save energy with glass. Send for the free book, "Home Styles for the Eighties."

John D. Bloodgood, architect.



PPG Industries, Inc., Dept. NG-289,
One Gateway Center, Pittsburgh,
Pa. 15222.

PPG: a Concern for the Future

PPG
INDUSTRIES

HOW TO RING RITA IN RIO



DIAL DIRECT

If you have International Dialing, you can really do it yourself. In fact, you can dial all around the world and reach your party so fast, it might make your head spin! For Rio de Janeiro, just dial:

INTERNATIONAL ACCESS CODE COUNTRY CODE OFF. CODE

011 + 55 + 21 + LOCAL NUMBER

By all means, use International Dialing whenever you can. On a 3-minute call to Rio, it's \$1.30 less. That's a saving of more than 13%.

ALMOST DIRECT

Here's how to speed up your calls until your area gets International Dialing. Dial 0, and be ready to give the Operator the country, city and local telephone number you want. Specify Station or Person call. The quicker you give your information, the faster your call goes through, and the sooner you're in touch. And on Station calls not requiring special operator assistance, you can get the same low rates as International Dialing.

PS. Everyone can dial direct to Canada, the Caribbean, Alaska, Hawaii, and parts of Mexico—just as you dial direct to cities inside the continental U.S.

Buying bananas or breaking good news, make a record of the codes you use—and use them to call the world, fast.

CODES FOR PRINCIPAL CITIES IN BRAZIL (55)

Belém	51	Fortaleza	85	Rio de Janeiro	21
São Horizonte	31	Goiania	62	Salvador	71
Brasília	61	Niterói	23	Santos André	11
Compinha	192	Porto Alegre	512	Santos	132
Curitiba	412	Recife	81	São Paulo	11





How much energy can the nation afford to put off limits?

One third of all land in the United States, and most of the undersea continental shelf, is owned by the federal government.

Millions of acres of this land, including vast areas that have great potential for energy development, have been placed off limits by the government for environmental reasons.

It is ironic that, at a time when our country is dangerously dependent on foreign oil, there are

efforts to put even more federal land off limits.

It is ironic—and it's unwise. The record shows that energy development and environmental protection are compatible.

For example, more fish are being caught in the Gulf of Mexico today than before the Gulf became the most drilled body of water in the world. And at the Aransas National Wildlife Refuge in Texas, where Conoco has been producing

oil and natural gas for 35 years, there are more rare whooping cranes than when we started.

America's land can be put to a variety of compatible uses, including the development of energy the nation badly needs.



Doing more with energy.

Conoco, Stamford, CT 06904 © 1979