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NATIONAL GEOGRAPHIC

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May 1981

IT SEEMS CLOSER to yesterday than to 17 years ago that Helge Ingstad's memorable article on the Viking settlement at L'Anse aux Meadows in Newfoundland appeared in our magazine. Helge and his wife, Anne Stine Ingstad, had made this once-in-a-lifetime discovery in the simplest way imaginable. He was convinced that the Vinland of the sagas, as well as Markland and Helluland and the other regions recorded in Nordic folk history, centered on Newfoundland and along the Labrador front. So he traveled there and stopped at each remote hamlet and inquired about ruins until he found the site at "bay of the meadows," which the Ingstads began excavating in 1961 with Society help.

I remember well the excitement in the editorial offices when the Viking spindle whorl showed up, and we were able to make a late change and lead the article with a picture of this positive proof of Vikings in North America five centuries before Columbus.

How would we have reacted to bits of chain mail, and cloth, and ship rivets, and pieces of carpentry? The old excitement came back when archaeologist Peter Schledermann first displayed the wonders he had so carefully exhumed from the frozen ground of Ellesmere Island. The site is extraordinary for the Eskimo remains that go back 4,300 years and represent all major culture groups of this arctic area. It is extraordinary for being so far north—a crossroads near the top of the world. And it is extraordinary for its Viking materials, whether delivered in person by long-ago adventurers or traded there.

The first European to see the New World may well have been a man named Bjarni Herjulfsson, whose *knarr* was blown off course between Iceland and Greenland and, the sagas relate, sailed for five days along unknown lands, which Leif Ericson soon went in search of and found again. For a decade and more, Vikings made a serious try at settlement; a child named Snorri was born on those wild shores. But then the sagas close on history. Only now is the ground yielding tantalizing clues to what must have been a remarkable period of adventure and exploration—and we are all delighted that the GEOGRAPHIC once again can publish a memorable "first" in its field.

Silvestro M. Brovarone
PRESIDENT

Eskimo and Viking Finds in the High Arctic 575

On Ellesmere Island, far north in Canada, archaeologist Peter Schledermann finds dramatic evidence of early inhabitants and visitors—among them, possibly, Norsemen. Photographs by Sisse Brimberg.

Iowa, America's Middle Earth 603

The deep-soil heartland of the nation's farming empire has far more to offer than tall corn. Harvey Arden and Craig Aurness discover.

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Australia's "gift to the world," a huge ocean preserve newly created on the Great Barrier Reef is described by marine biologist Soames Summerhays and photographed by Ron and Valerie Taylor.

Paradise Beneath the Sea 636

Veterans of more than 20 years of diving on the Barrier Reef, the Taylors capture in words and glowing color this coral kingdom of the Pacific.

Jawbreaker for Sharks 664

Valerie Taylor dares to test an experimental chain-mail diving suit against shark attack.

Pakistan Under Pressure 668

Wedged between Iran, Soviet-occupied Afghanistan, China, and India, a military-ruled nation of diverse peoples and harsh Islamic law tries to walk a middle road and emerge an Asiatic power on its own. By William S. Ellis and James L. Stanfield.

America's Forgotten Crops 702

Little-known plants long used by Indians hold new promise for food and industry, reports chemist Noel D. Vietmeyer. Photographs by Burgess Blevins, paintings by Paul M. Breeden.

COVER: *A blue shark tries—in vain—to bite off diver Jeremiah Sullivan's steel-clad arm. Photograph by Ron Taylor.*



ELLESMERE ISLAND

Eskimo and Viking Finds in the High Arctic

By PETER SCHLEDERMANN

DIRECTOR, THE ARCTIC INSTITUTE OF NORTH AMERICA, CALGARY, CANADA

Photographs by SISSE BRIMBERG

THROUGH THE FROZEN CRUST of soil I caught a faint metallic sound and carefully withdrew the blade of my trowel. Beneath it lay a lump of dark material fashioned of interlocking rings.

The rings appeared to be iron, for they were slightly rusted as well as caked with dirt. Brushing them clean, I lifted the material for a closer look and suddenly realized what I held in my hand.

In more than 15 years of archaeological exploration I can recall no greater prize than that shapeless lump of iron. The rings obviously had come from a suit of chain mail, the typical armor of medieval Europe. Yet here they lay, in an area of the world supposedly unknown to medieval Europeans—a site that is less than 800 miles from the North Pole, in Canada's high Arctic.

Did the chain mail belong to some Norse explorer whose unrecorded voyage ended in shipwreck on that remote coast? Or had the armor made its way through Eskimo hands from southern Greenland, where Eric the Red founded a Viking colony in A.D. 986?* Still more bizarre but possible, the armor might have traveled eastward from Europe across Asia to the Bering Strait, and from there in stages via Eskimo migration to Canada's eastern Arctic.

Whatever its route, the chain mail had found its way to one of the most interesting archaeological sites in North America: the Bache Peninsula region of Canada's Ellesmere Island (map, pages 580-81). Thanks to a unique combination of geography and climatic conditions, eastern Ellesmere Island has been frequented by peoples of the Arctic over a period of more than 4,000 years. *(Continued on page 580)*

*Norwegian archaeologist Helge Ingstad described Viking voyages to the New World in the November 1964 NATIONAL GEOGRAPHIC.

Survivors of time, toy dolls more than 500 years old (left)—one in a bearskin skirt—recall an Eskimo people whose predecessors reached Canada's Arctic some 4,300 years ago. Searching the ruins of a 14th-century winter house near Ellesmere Island, the author discovered links of medieval chain mail (below) and other Norse artifacts suggesting that early Viking voyages ranged 500 miles farther north than previously thought.



JIM FLECKO, SHUTTER 2 INC.



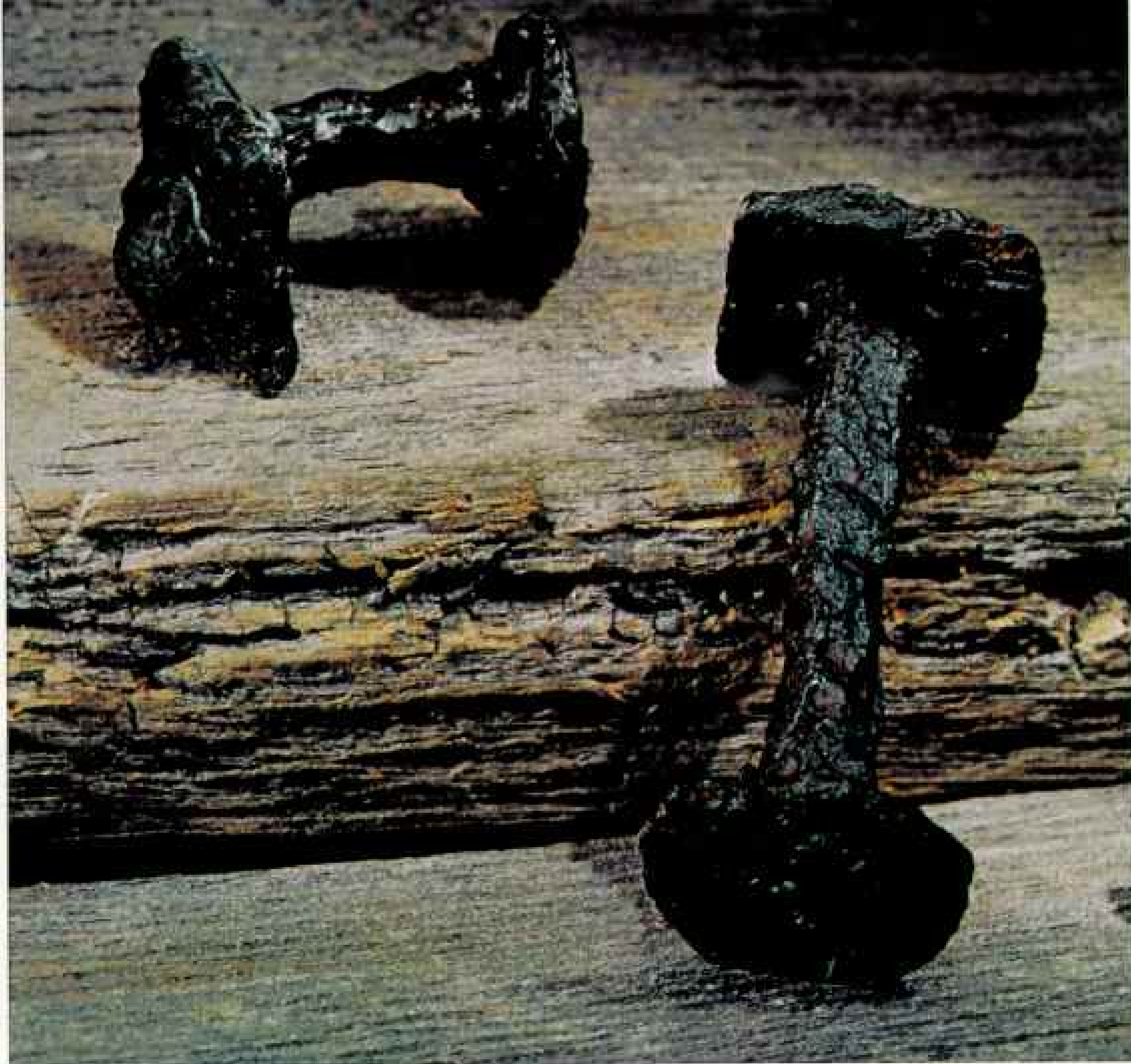
At the height of summer, pack ice surrounds the author's boat on Alexandra Fjord, less than 800 miles from the North Pole, as he and assistant Ian Robertson leave Skraeling Island, where they found one of the northernmost prehistoric settlements

National Geographic, May 1981



MARTHA COOPER

ever discovered. Temperatures plunge as low as minus 40°F by November, turning the fjord into the southernmost part of the ice bridge between Canada and Greenland that proved an irresistible attraction to migrating peoples.



The Norse

UNEXPECTED PRIZE: Boat rivets from a Viking ship (above) were struck by the author's trowel as he excavated the floor of an old Eskimo house. Further searches turned up box sections made of oak—a common Scandinavian wood not native to arctic Canada—parts of barrel bottoms, European-style knife blades and spear points, and medieval chain mail. In addition, a piece of woolen cloth (right) found on Skraeling Island reveals a weave pattern typical of Norse farming settlements in southern Greenland, founded in 986 by Eric the Red. An unlikely trade item for Eskimos, who wore tailored skins and furs exclusively, the cloth may well have reached the island on the back of a Viking.

He may not have been the first Norseman to arrive, however. An enigmatic two-inch carving (above right) from an early 12th-century house

may be a rough portrait of an earlier Viking visitor. Clearly native in style, the carving exhibits features the author believes are distinctly Norse: straight eyes, a straight mouth, a pointed chin, and what looks like a cap. A copper blade taken from the floor of the same house may confirm his hunch. If tests show the metal did not originate in North America, they may indicate that Norsemen encountered Eskimo settlements in the Smith Sound region even before the two peoples came in contact farther south in Greenland.

Viking trading and exploration parties had reached Labrador by 1000. But clues of voyages farther north at this time were not discovered until three years ago, when the author began uncovering Norse artifacts in arctic Canada.

In addition to directing the Arctic Institute of North America, Dr. Schledermann teaches archaeology at the University of Calgary in Alberta. His expeditions have been funded in part by the NATIONAL GEOGRAPHIC.



2 IN LONG



1 7/8 IN TALL; 27 IN LONG (YELLOW)



Despite its significance, the chain mail we found represents one brief chapter in that immense sweep of prehistory of the Arctic.

I FIRST CAME to Ellesmere Island in 1977 on a research project for the University of Calgary in Alberta, where I serve as a professor of archaeology. With Tore Bjørge, a Norwegian friend and graduate student in archaeology, I set out in search of prehistoric living sites in Canada's high Arctic, above 74 degrees north latitude. Here vegetation is sparse, farming is nonexistent, and from time immemorial man has been a hunter.

A glance at the map explains my choice of Ellesmere Island. Separated from Greenland in summer by 25 miles of open water and usually connected to it in winter by solid sea ice, Ellesmere offers a natural crossing point between two great landmasses, Greenland and North America. For millennia migrants and hunters alike shuttled back and forth across Ellesmere Island's mountainous terrain through the great notch known today as Sverdrup Pass.

Many of these groups established settlements along the island's rugged east coast in the hunt for walrus, seal, and whale. Inland from the coast Ellesmere offered another vital resource: herds of musk-oxen whose descendants roam the island to this day.

Tore's and my search was successful beyond our hopes, thanks in part to two Canadian government organizations. The Polar Continental Shelf Project, an arctic research unit, flew us to the small airstrip of a former Royal Canadian Mounted Police post at Alexandra Fjord south of the Bache Peninsula. There a team from the Geological Survey of Canada welcomed us aboard their helicopter as it left for an aerial reconnaissance of the area.

In eight days Tore and I located the remains of more than 150 prehistoric dwellings, proof that the Bache Peninsula area is enormously rich in archaeological deposits. It also represents the northernmost major prehistoric settlements so far discovered.

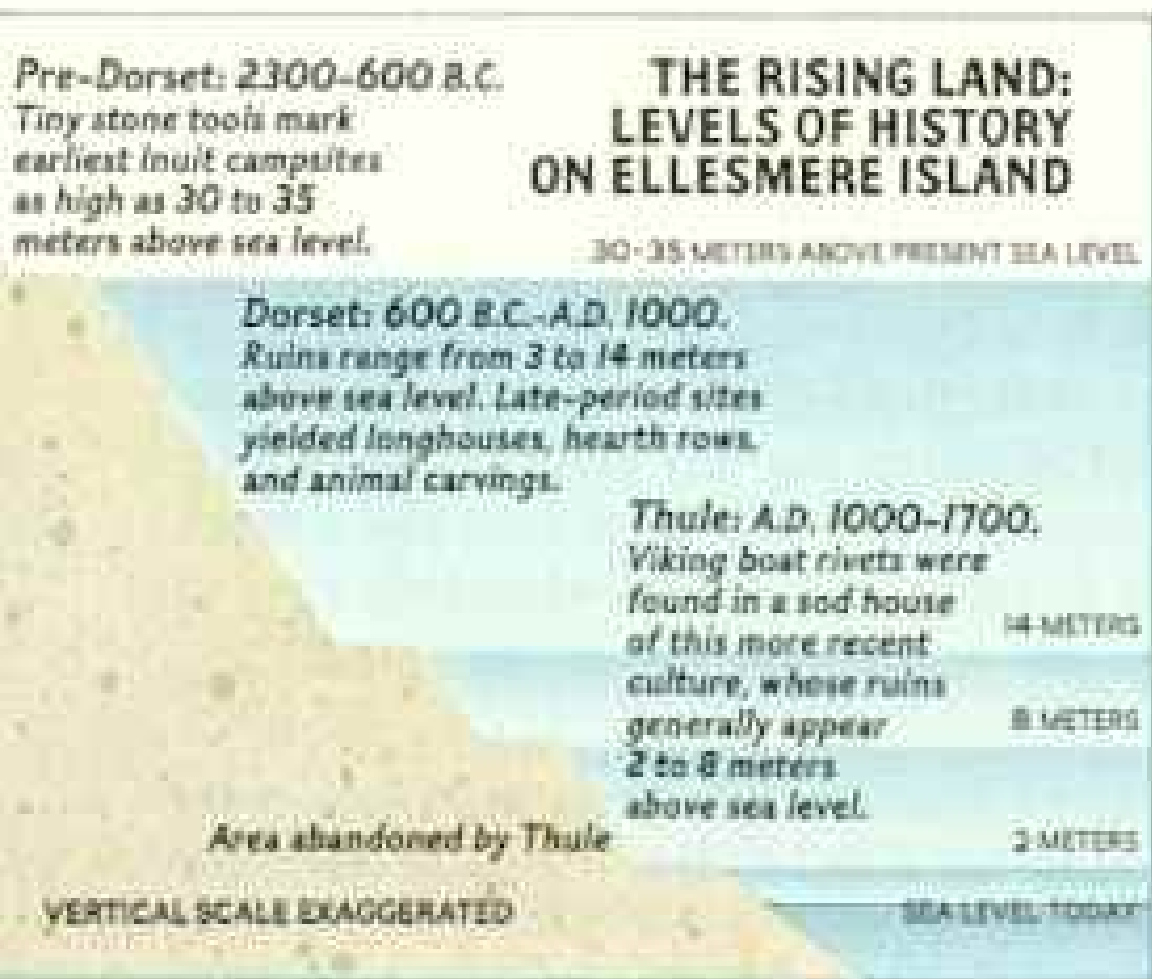
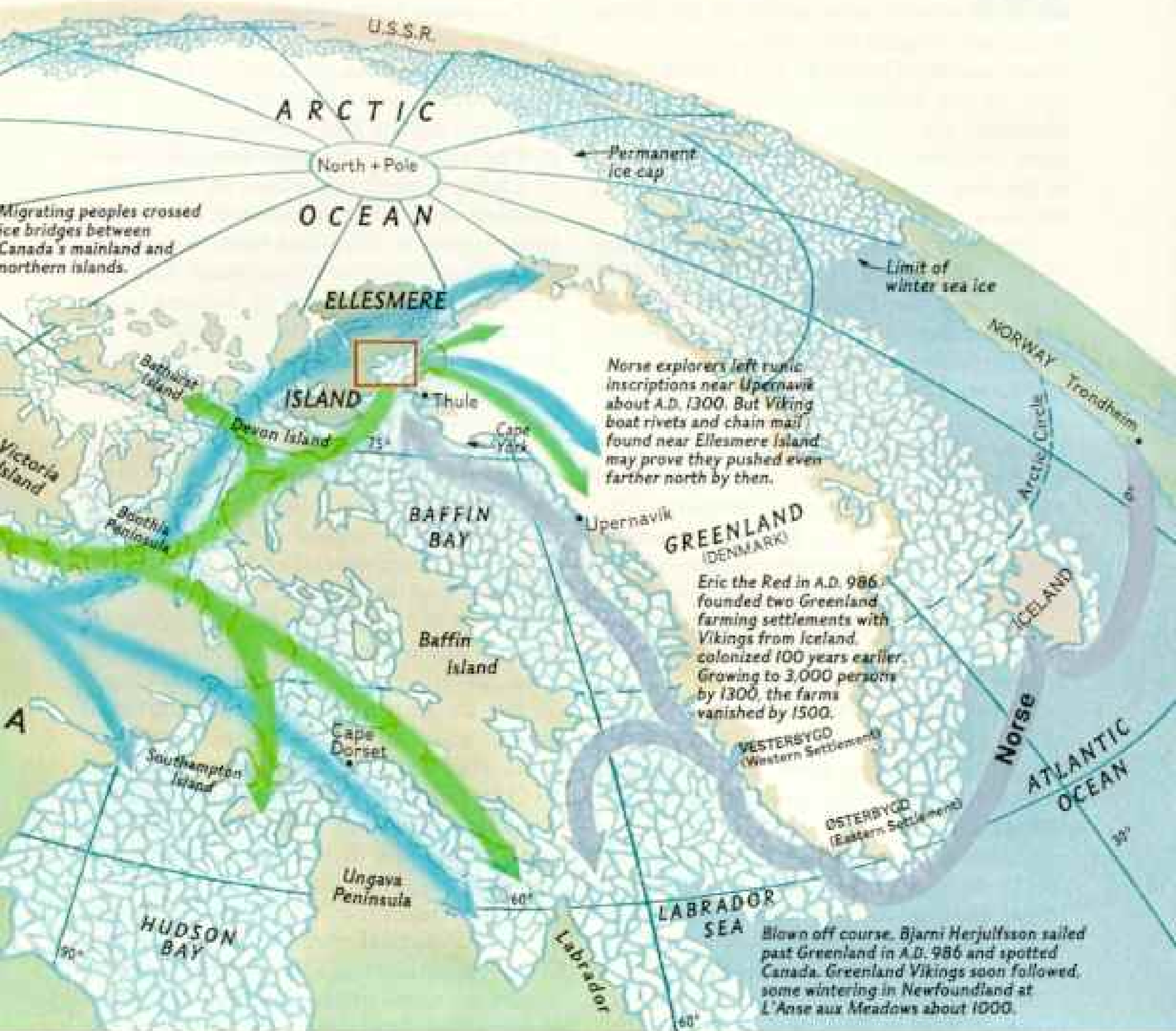
Freezing temperatures of mid-August put an end to our survey, and we flew home, our thoughts already turned to a full-scale expedition the following year, 1978. It was to become known as the year of the chain mail.

Ellesmere Island:



RISING like punched bread dough, land pushed down centuries ago by massive glaciers bounces back to former heights, carrying ancient living sites farther above sea level (*diagram, right*). Once located on gravelly beaches close to sea-mammal hunting areas, old campsites that have risen as much as 115 feet in 4,300 years now stand nearly a quarter of a mile from the receding shoreline. In the Bache Peninsula region of eastern Ellesmere Island (*map, far right*), the author identified 180 prehistoric Eskimo sites. Most peoples of the Arctic today prefer the name Inuit—"the people"—to Eskimo, an old Indian word meaning "eaters of raw flesh."

Crossroads for three northern cultures



PAINTED BY SUSAN SANFORD, COMPILED BY DAVID B. MILLER NATIONAL GEOGRAPHIC ART DIVISION

MY DISCOVERY of the armor occurred on tiny Skraeling Island, several miles south of the Bache Peninsula. During our brief survey the previous summer Tore and I had visited the island in our inflatable outboard boat and identified the ruins of some 40 prehistoric stone dwellings. It was while digging alone in the floor of one of these that I uncovered the piece of chain mail.

Somehow I restrained my excitement until lunchtime back at camp. For the 1978 season Tore and I had been joined by four new team members: Edson Way, a professor of anthropology at Beloit College in Wisconsin; Karen McCullough, a graduate student of archaeology at the University of Toronto; and two assistants, Jimmy Nowra and Jarloo Kigutak, both Inuit—"the people," as dwellers of Canada's Arctic call themselves. The term Eskimo was actually coined by American Indians for their neighbors to the north, and means "eaters of raw flesh."

As the six of us gathered around the makeshift table of packing crates, I did my best to appear casual. I fooled no one.

"Let's have it, Peter," Edson remarked. "You've been working that living floor like it was the last site on earth, and now you're hiding something in your hand. What is it? What have you got?"

Carefully I spread the piece of iron mesh on the table, and there was a moment's silence, then a rush of comment. "Chain mail!" from Karen. "Beautiful!" from Tore. And from Edson, "How on earth. . . ?"

"Exactly," I agreed. "How on earth did it get here? Your guess is as good as mine, but one thing's certain—it isn't Inuit. It had to have come from Europe, and the question is not only how, but when?"

In the next few days the same living floor produced an iron boat rivet, obviously not of Inuit origin. From that point on our work on Ellesmere Island assumed a new dimension: the possibility of an early European presence in the Canadian high Arctic. That dimension, however, was still secondary to

our major goal, the study and analysis of Inuit prehistory.

Two major Inuit cultures are represented by the ruins on Ellesmere Island: the Arctic Small Tool tradition, so called for the miniature scale of the artifacts it produced, and the Thule culture that ultimately succeeded it. The latter takes its name from the region of Thule, Greenland, where its distinctive artifacts were first discovered. Both cultures appear to have had their roots in the Bering Sea region or in northeast Asia and to have spread eastward by degrees to the Canadian high Arctic. Discoveries by the Danish archaeologist Egil Knuth have shown that the Arctic Small Tool tradition also spread to northern Greenland.

Of the two cultures the Arctic Small Tool tradition is by far the older and more long-lived. It developed roughly around 2500 B.C. and lasted until about A.D. 1000, when it abruptly disappeared and the Thule culture rose to prominence.

For simplicity many archaeologists divide the Arctic Small Tool tradition into two principal stages. The more recent is known as the Dorset stage, named after artifacts from Cape Dorset on Baffin Island that were classified by Dr. Diamond Jenness of Ottawa's National Museum of Man. The preceding period is referred to simply as pre-Dorset. The dividing line between the two stages is generally drawn at 600 B.C.

No such line exists in the actual digging of an archaeological site. Prehistoric peoples did not lead their lives for the convenience of future archaeologists, and there are exceptions to the rule of thumb that the deeper an object lies buried the older it is.

In this respect Ellesmere Island offers both advantages and drawbacks, for its soil is frozen ten months out of the year and is therefore less subject to disturbance than sites in warmer regions. Excavation, however, is far more difficult and must be measured in inches per day rather than in feet. We soon learned to expose as broad a work area as possible to round-the-clock rays of

Miniature blades struck from a core of chert helped give the culture of its makers the name Arctic Small Tool tradition. Inset or lashed into handles of bone or ivory, the one- to three-inch-long micro-blades were used for cutting or scraping skins. Little changed over millennia, the blades link early Inuit to distant ancestors in Siberia.

ILLUSTRATION BY J. W. H. H.



the midnight sun, thus achieving the maximum thawing effect.

The same conditions forced us to shorten our summer work season. Although we arrived in Ellesmere's Bache Peninsula area in late June, we found the coastal waters still clogged with floe ice and many of our prospective work sites buried under several feet of snow.

IN 1978, prior to our work on Skraeling Island, we had begun to excavate one of the most exciting ruins. Tore and I had located in our original survey. It was the stone foundation and part of the walls of a late-period Dorset longhouse situated near the shore of Knud Peninsula just south of Bache Peninsula.

The house was an immense structure even by present standards, measuring 5 meters in width by 45 meters in length (16 by 148 feet). It was not a house in the sense of an enclosed building but a framework of waist-high walls built of boulders. I believe it served as a foundation for a row of skin tents such as the Dorset people doubtless used.

One of the most striking features of the site was a long row of outdoor stone hearths located some distance from the house and extending 32 meters from end to end. The row contained 18 individual hearths, each one separated from its neighbor by a stone platform undoubtedly used for temporary storage of food. This multiple arrangement of outdoor hearths is unique; nothing like it has ever been identified among prehistoric living sites in North America (pages 592-3).

Near the main longhouse we found the ruins of three similar but smaller structures, also in conjunction with hearth rows. Together the ruins indicate a sizable population that must have gathered near the coast each spring for the hunting season. Judging from the number and size of the hearth rows, I estimate that the community probably consisted of 15 to 20 tents with a total occupancy of some 100 people.

Those long-ago dwellers along the Knud Peninsula had eaten well, judging by our excavations among the hearths and on the longhouse floors, where the families obviously retired to eat. Here we unearthed an

Living clues to a lost culture, patches of mosses and lichens lead Peter Schledermann, left, Karen McCullough, and Diane Lyons to a prehistoric camp. Drawing upon nutrients from bones dumped perhaps 4,000 years ago by people of the Arctic Small Tool tradition, the plants stand out vividly against the polar desert, where less precipitation falls than in many parts of the Sahara.

CHIP CLARK



assortment of bones of birds and animals: geese, ducks, foxes, arctic hares, seals, walruses, belugas, and even narwhals.

The discovery left no doubt that the longhouses were designed for summer use. Among the bones of foxes and arctic hares, we found the remains of immature animals, some less than four weeks old. Since both species give birth between late May and early July, the bones indicated a strictly summer menu.

In time the hearths furnished even more vital information. With the cooperation of Dr. Weston Blake, Jr., of the Geological Survey of Canada, radiocarbon dates were obtained on charred fragments of willow used as fuel in the hearth rows. The results ranged between A.D. 800 and 900, very close to the time when the Dorset people mysteriously vanished.

The longhouses provided ample evidence that the Arctic Small Tool tradition was well named. We found scattered among the bones countless miniature cutting instruments that are called micro-blades, meticulously fashioned from chert (page 583). Even more impressive were the uses to which these tools were put. In and among the longhouses we unearthed exquisitely carved figurines of ivory and bone representing game birds and animals ranging from ducks and geese to caribou and polar bears.

At least one form of life was beyond the ability even of Dorset carvers to portray—the infamous arctic mosquito. During all my years in the far north I have never encountered such a plague of mosquitoes as we suffered on Knud Peninsula. Most of us resorted to nets and repellent, but Tore put his trust in the electronic age. As we unpacked our gear at the base camp, he produced a device about the size of a pack of cigarettes, equipped with a cord to be worn around the neck.

"It's a battery-powered sonic mosquito guard," he announced. "It gives off a signal so high you can barely hear it, and mosquitoes hate it."

Poor Tore. Whoever designed the device must have chosen the wrong frequency. The mosquitoes loved it, and they flocked to Tore in such droves it almost seemed that the best spot to be was roughly ten feet away from him so that he acted as a lure. Within a

week the sonic guard quietly disappeared, and Ellesmere Island's brief electronic age came to an end.

During the summer of 1978 we witnessed a phenomenon that helps to explain Bache Peninsula's attraction for prehistoric hunters. Just south of the peninsula a large patch of winter sea ice begins to melt in early summer, well ahead of the surrounding ice. The phenomenon, called a polynya, is caused by a combination of factors including shallowness of the seafloor, tidal currents, and configuration of the shoreline. The combination may exist for thousands of years, producing the same polynya every season.

Polynyas are irresistible magnets to arctic wildlife, for they provide early access to nutrients in the sea. These attract predators in ascending order up the feeding chain to the top level, occupied by man.

On our arrival at Bache Peninsula in late June the polynya was literally in full cry. Our camp resounded to interminably squabbling flocks of snow geese and eider ducks, the staccato bark of seals, and the bellowing of walruses.

The latter, some 300 of them, were lords of the polynya, and were comfortably ensconced on a dozen or more ice floes that floated regularly in and out with the changing tide. Often when we were absorbed in our work, excavating or some other task, a member of the team would glance up and announce, "Here they come again."

Like so many Colonel Blimps the herd of walruses would sail majestically past, har-rumphing as they went.

OUR DAYS RAN TOGETHER, not only in the sense of continuous sunlight but also in the long hours it enabled us to work. Sleep was never a problem despite the absence of night; fatigue took care of that. Yet there was never enough time, and it became increasingly clear that we needed at least another season, probably several. In mid-August we flew out of Ellesmere Island by courtesy of our old friend the Polar Continental Shelf Project and headed home. In fact, we were to return to Ellesmere Island two more summers.

During the 1978 season, supported by the Social Sciences and Humanities Research Council of *(Continued on page 592)*





PETER SCHLEDERMANN (ABOVE); MARTINE ECKERT

Well of life in a frozen world, a patch of Flagler Bay (above) near the Knud Peninsula melts earlier than surrounding waters, thanks to a combination of strong tidal movements, a shallow bottom, and the narrowness of the bay. A natural magnet to arctic wildlife, the open water, called a polynya, rings with the cry of migrating waterfowl and the barking of seals by mid-June. In mid-July walruses arrive by the hundreds from the Greenland coast, taking command of the polynya and driving the seals away. A whiskered visitor

(left) may then be seen comfortably gliding in and out with the tide on an ice floe. By mid-August a frigid silence returns to the land as the summer pageant of wildlife draws to a close.

Arctic hunters found the game-rich polynya thousands of years ago, after crossing east through a notch in Ellesmere Island's mountainous interior called the Sverdrup Pass. As he searched for traces of their presence on Knud Peninsula, the author found ruins unlike any others yet found in the far north.



1.5 IN TALL (ABOVE); WARTHAN COOPER (RIGHT), 2 IN LONG

The Dorset

M*MAGIC SUPPORTED SKILL* among the Dorset people, whose ancestors were the first Inuit on the scene. Dorset hunters carved masterful figures of the animals they killed, and shamans fashioned ritual images of the evil spirits they opposed. One such image (above) was discovered at the longhouse site on the Knud Peninsula. Pierced through the chest, the tiny figure was probably gouged by a shaman in a ritual wounding of an enemy.

The most important rituals, however, the Dorset reserved for the hunt, upon which the life of the community depended. At the longhouse site the author and his team found artful replicas the Dorset may have offered to animal spirits to preserve good relations between hunter and hunted. To neglect the spirits of animals that allowed men to catch them would have meant denying the continuity of life.

Among the most powerful creatures of the





1.75 IN LONG

spiritual world stood the polar bear and the loon. A walrus-tusk carving found at a late Dorset site shows the long-necked flight of a loon (left), complete with an outline of the animal's skeleton. The same motif also appears on an arctic hare (above) and may emphasize the spirit's bodily aspect. A striking polar bear head (right) follows conventional Inuit portrayals of the crafty nanook. Small caribou hooves (below right) may have been worn by hunters as good-luck pendants.

Because of the Dorset people's concern for maintaining harmony between man and nature, hunt leaders may have played priestly roles, conducting rituals in the longhouses before a hunting party set out. For other matters a tribal shaman, or medicine man, might have been called upon. Shamans cultivated helper spirits through secret formulas, charms, and songs to increase their healing powers or to see more clearly into the future.

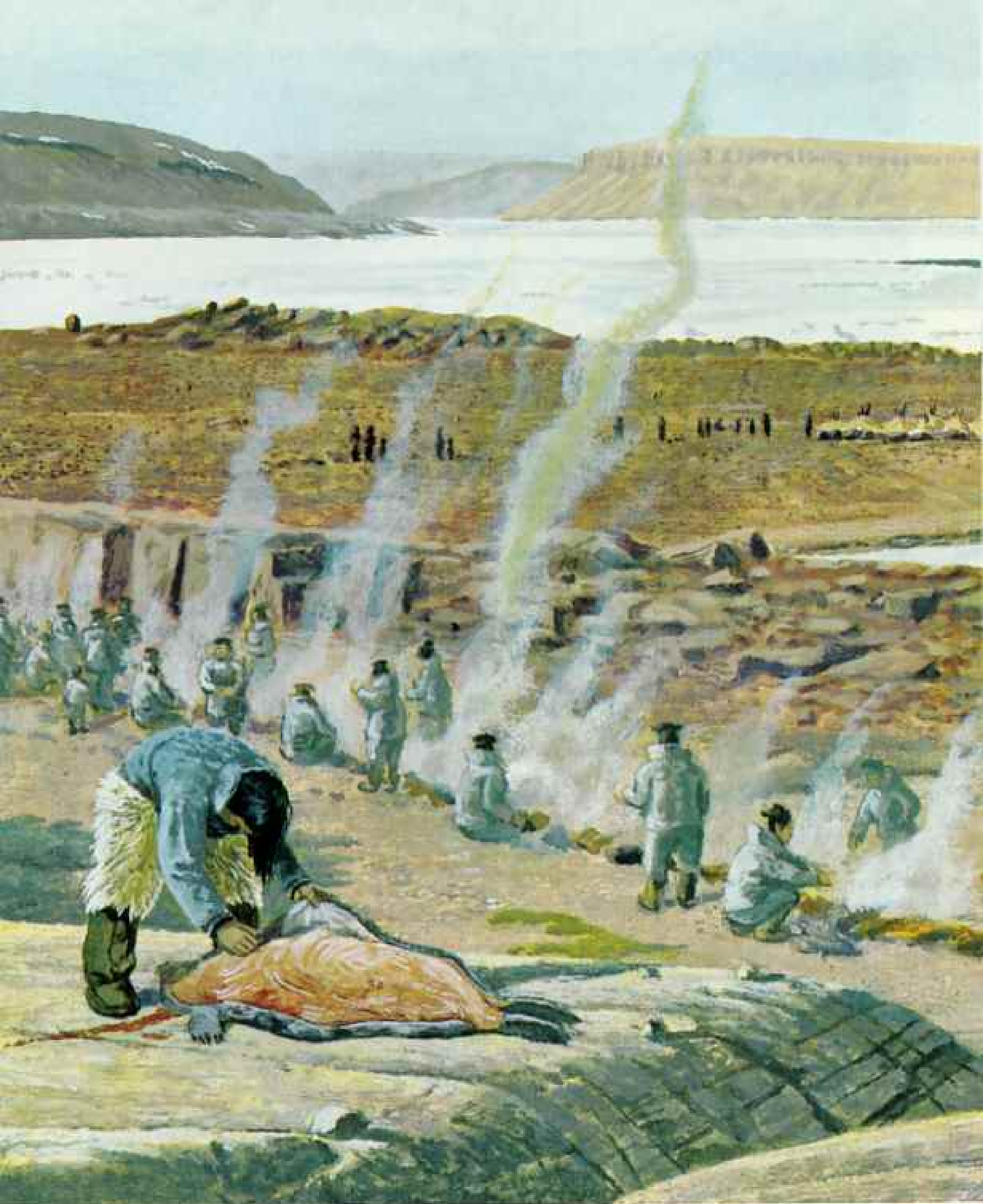
No one knows, of course, if any Dorset shaman foresaw the mysterious disappearance of his culture around A.D. 1000 as a more vigorous and inventive people began arriving from the west. The Thule Inuit probably coexisted with the Dorset before absorbing them or driving them away. Carvings of Thule women show them wearing their hair in buns in a fashion they may have picked up from Dorset women. Dorset artifacts are frequently found in Thule houses.

The key to the Dorset's disappearance may well lie in the weather. The author speculates that the Dorset, who flourished in the high Arctic during a long period of falling temperatures, may have lost their competitive edge during a gradual warming period that began about this time.



CHIP-CLARK (ABOVE), 1.75 IN LONG; 2 IN LONG (BELOW)





To reunite the clan after the brutal arctic winter, when family groups scattered offshore to hunt separately on the ice, Dorset Inuit returned each spring to rebuild the longhouses and hearth rows on the Knud Peninsula. A sociable people, they hunted together at the Flagler Bay polynya for goose, duck, and other plentiful game. They prepared food along the communal cooking rows, worked and ate together in the



PAINTING BY BRENDA CARTER

longhouses, and probably gathered in them to watch tribal shamans work their magic. Well adapted to survival on the coastal tundra, the Dorset also hunted seal, walrus, beluga, and narwhal as well as caribou, musk-ox, arctic hare, fox, and even polar bear. Sealskin like that being removed above, at left, was made into clothing, tents, and boat coverings or, if thick enough, was used for boot soles and thongs.

(Continued from page 585) Canada, we had made an excellent start with the excavation of more than 15 separate ruins and had recovered enough material to keep us busy all winter long, cleaning and analyzing. But both literally and figuratively we had merely scratched the surface. Another season in the field might provide clues to the mysterious disappearance of the Dorset culture and in addition would give us an opportunity to excavate many more of the rich Thule culture sites.

Finally, in the back of everyone's mind lay the rusted fragment of chain mail and the iron boat rivet. Were there other items like them beneath Ellesmere Island's frozen surface, items that could establish an early European presence in the high Arctic?

Over the winter of 1978-79 such questions intrigued others as well. The following June we returned to the Bache Peninsula area

with support from an additional source: the NATIONAL GEOGRAPHIC.

ESTABLISHING our main camp again on Knud Peninsula, we concentrated first on the late Dorset ruins. These represent the final stage of a great migratory movement that began 4,500 years ago, most likely in northeast Asia. Crossing over the Bering Strait, these prehistoric hunters had gradually spread eastward, probably driven by the endless search for new game. At length some of them reached eastern Ellesmere Island.

Here they had doubtless discovered the polynya, and here they settled, laying the stone foundations for their tents in preparation for the summer hunting season.

But where did the Dorset people go in winter? To me that question is almost as intriguing as the final disappearance of the



Dorset culture altogether. The only Dorset ruins we have found in the Bache Peninsula region relate strictly to summer life: the longhouses and other stone foundations for tents. Neither would have provided much shelter from Ellesmere Island's murderous winters, so where did the occupants go?

I can think of only one answer—out on the ice. As the Inuit have done until recent times, the Dorset people must have moved offshore in winter just as soon as the surface of the sea froze solid. There they undoubtedly built snug winter quarters out of blocks of snow and hunted seals through their breathing holes in the ice.

Occasionally they were hunted in turn, judging by our own experience. Polar bears are an ever present threat to travelers and scientists in the Arctic, and Ellesmere Island is no exception. One day I was standing with Karen atop a rise just behind the beach,

looking through binoculars at the flat sea ice with some small bergs frozen into it. Karen suddenly took my arm.

"One of the bergs is moving," she said quietly, pointing to a spot near shore. I swung the glasses and, sure enough, there was a big old *nanook*, as the Inuit call a polar bear, shuffling in our direction. Without further discussion Karen and I did some rapid shuffling of our own.

One of the major differences between the pre-Dorset and Dorset ruins on Ellesmere Island is the development of the longhouse during the latter stage. Whether this was basically a social phenomenon or one related to changing climatic conditions is not yet clear. In any case we know that at some point in the transition between pre-Dorset and Dorset stages, temperatures in the high Arctic gradually declined.

Either despite or because of that cooling

BOTH BY MARTHA COOPER

Longest dwelling of its kind in North America, communal living quarters being excavated on the Knud Peninsula by the author and assistants (left) measure 148 feet by 16 feet. The waist-high framework of walls probably supported a string of family tents, last occupied about A.D. 900 by the Dorset Inuit, named after Cape Dorset on Baffin Island, where their artifacts were first found. The final phase of the Arctic Small Tool tradition, whose people had inhabited the region for 33 centuries, the Dorset built this unusual longhouse and three others near the polynya to shelter a seasonal community of some 100 people. They also created a row of outdoor stone hearths nearby unlike anything seen before among the Arctic's prehistoric ruins; Karen McCullough (right) probes for charred wood or bone. Though hearths are usually found inside Dorset houses or in separate units outside, these 18 hearths and meat platforms, probably ceremonial in design, stretch 105 feet in one row.



trend the Dorset culture—which is generally thought to have emerged around 600 B.C.—developed and flourished across a wide area of the Canadian Arctic, including the far northern islands. It lasted nearly 16 centuries, until its sudden decline toward the end of the first millennium A.D. At roughly the same time the Thule culture began its rise.

In the case of Knud Peninsula's Dorset settlement we have a range of dates for the decline. Radiocarbon tests on fragments from the longhouse hearths indicate that the occupants gathered for the last time between A.D. 800 and 900, although similar groups may have continued occupying other sites in the region beyond that time.

Did they know their cherished way of life was passing, or that a new and more aggressive culture was literally on the doorstep? Had the Thule people already taken up residence on Ellesmere Island, and were they threatening the Dorsets, or did they merely absorb the older culture? We cannot say. So far we have only a series of dates, and the fact that a great culture vanished.

One thing strikes me as ironic. Around the time of the Dorset culture's decline, temperatures in the high Arctic gradually began to rise again. Did the Dorset people, who had originally developed and flourished during a cooling trend, simply fail to adapt to a warmer age? And were the same rising temperatures responsible for the emergence of a new and rival culture? In the hope of answers we turned once more to the Thule culture sites. They were to occupy us during much of the next two years.

ONE OF THE most promising Thule settlements was on Skraeling Island, where I had unearthed the chain mail and the boat rivet. Although the Thule Inuit lived in summer tents as the Dorset people did, their winter homes were far more substantial. The latter were dug into the ground and equipped with tunnel entrances designed to trap warm air inside the houses. The builders then added walls and roofs of stone, sod, or occasionally the baleen and bones of bowhead whales.

The latter material has led some archaeologists to theorize that the Thule peoples were highly successful whale hunters.

Although some of our later discoveries on Skraeling Island confirm the practice of whaling, I believe that its importance has been exaggerated.

Baleen and whalebone are durable items, and they were obviously reused in Thule house construction. I estimate that all the whalebone in the Bache Peninsula area represents a total of no more than 30 or 40 whales. Since the Thule culture flourished on Ellesmere Island on and off for about seven centuries, whaling hardly seems to have been a mainstay of the economy.

The solid construction of Thule winter dwellings makes them far more difficult to excavate than Dorset sites. In most cases the walls and roof have collapsed, not only covering the living area beneath but also insulating it from thawing action by the brief arctic summer. Once cleared, the site is that much harder to penetrate.

The problem is bad enough with a single dwelling, but it becomes far worse in the case of a house reconstructed on a previous foundation. Several houses on Skraeling Island proved to have been rebuilt as many as three times, requiring many weeks to reach the bottom levels.

When an arctic ruin begins to thaw, the effect is unforgettable. Whale blubber that has been deep-frozen and buried for seven centuries, then finally warmed up, has an aroma all its own. So does a sun-ripened parka made of walrus gut, not to mention essence of sealskin boots, rotting sinew, and partially gnawed bone. Inevitably the scent pervades one's hair and clothes.

Thule culture sites differ from those of the Dorset people in another major respect, pottery. The only pots or bowls found in Dorset culture sites are those carved out of soapstone. By contrast many Thule ruins on Skraeling Island contain fragments of pottery, some resembling Alaskan pottery of the same period and other pieces obviously of inferior quality.

It seems likely that the Thule Inuit brought some earthenware vessels eastward on their migration to Ellesmere Island. Once there, however, they found only meager supplies of driftwood with which to fire their pots, and the quality of the vessels gradually declined. Apparently the Thule people finally abandoned the use of pottery altogether

and reverted to the method of carving vessels out of soapstone.

When it came to hunting, the Thule Inuit had few equals. Among the houses on Skraeling Island and Bache Peninsula we have recovered a number of bone or ivory harpoon heads of different shapes and sizes, testifying to the variety of animals the Thule Inuit hunted. Among the artifacts are comparatively thin heads designed for seal, and the somewhat larger and stubbier points that are obviously intended for walrus, beluga, and narwhal. Finally there are even larger heads patterned on the walrus type that could only have been meant for the bowhead whale.

Harpoon heads have been in use among these peoples for more than 4,000 years, and their development in design is well documented. As a result, harpoon heads provide a reliable time scale against which comparable cultures can be matched.

The early Thule-culture harpoon heads from Ellesmere Island bear a striking resemblance to those of the Bering Sea area, suggesting a direct connection between the two. The suggestion contradicts earlier theories that the Thule culture originated on the northern coast of Alaska, rather than in the Bering Sea area, and then spread to eastern Canada's high Arctic.

Radiocarbon tests on some of our material have altered the Thule people's arrival date as well. It now appears likely that their culture reached the eastern high Arctic somewhat later than the generally accepted date of A.D. 900.

THERE SEEMS NO DOUBT that the Thule people of Ellesmere Island are the direct ancestors of today's Polar Eskimos who inhabit Greenland's northwest coast. Some of our Thule finds are almost identical to those made by the Danish archaeologist Erik Holtved in northwest Greenland during the late 1930s.

The Thule people, of course, are known to have colonized Greenland's west coast not long after they arrived on Ellesmere Island. That migration ultimately brought them into contact with colonists of a far different sort from themselves—a people who used iron boat rivets and were familiar with chain mail.

(Continued on page 600)



Most complex weapon in a Thule hunter's collection, the toggle harpoon head employed a variety of materials. After penetrating a seal with a point of chipped stone or beaten iron, the carved ivory head would swivel and detach itself from the loosely fitted foreshaft. Secured by a long sealskin thong, the embedded head ensured a hunter's hold on his prey. A unique copper point (below) may be European in origin. The harpoon head from Skraeling Island, both sides shown (bottom), strongly resembles those used by Bering Sea Inuit.



MARTHA COOPER (ABOVE); 1.8 IN. LONG; 4.75 IN. LONG (BELOW)





Even better adapted to the Arctic than Dorset Inuit, the Thule lived year round on Shraeling Island, constructing sunken whale-rib-and-sod houses when the weather grew too bitter for tents. The Thule culture, named for an expedition from Thule, Greenland, that first discovered its artifacts, grew from the Arctic Whale Hunting



PAINTING BY BRENDA CARTER

tradition of the Bering Sea area. Hunting with dogsleds, large skin-covered boats called umiaks, and swift kayaks, the Thule pursued whales as well as smaller mammals, taking enough food and blubber from an occasional bowhead whale to last several families all winter. Polar bear skins, stretched to dry as at left, made warm pants and mittens.



The Thule

SYMBOL OF PLENTY for seagoing hunters, the whale gave Thule Inuit more than meat and blubber. Fibrous baleen from its mouth became part of the beaters used to knock snow from clothing, drying racks for skins, and hunting bows. Its bones held up roofs and filled walls of winter houses. And even its massive skull was occasionally used to support a dwelling's entrance tunnel. In a baleen cutout (above) a Thule artist may have memorialized the rare catch of a sperm whale.

As a vital resource, however, the small ringed seal, which remained in the Arctic all year, and the seasonally numerous walrus were probably more valuable. From them the Thule took a steady supply of skins for their boats and clothes, meat for themselves and their dogs, and ivory for their implements and carved figures and pendants. An ivory clasp of three women hanging upside down on a cylinder (left) probably drew together the cords of a parka or dress.

In a surprising find, a fragment of pottery (right) shows designs characteristic of Alaskan earthenware from the same period. Archaeologists believe the Thule stopped making pottery shortly after they began arriving about 1,000 years ago in northeastern Canada, where clay and firewood are scarce. Instead, they carved

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8.7 IN LONG

vessels of soapstone for seal-blubber lamps, over which they boiled meat or fish. Migrating Inuit probably carried this Alaskan-style pottery with them as they made their long journey eastward. Perfectly preserved utensils of wood, baleen, ivory, and bone have also been found safely frozen since the day they were abandoned.



2.9 IN LONG

Besides being useful, needle cases also express traditions. Carved to hold bodkins for working sealskin, an ivory case (above) illustrates the "winged" design of the late Thule period. An earlier case (below) carries human figures, following styles of the Bering Sea area.



3 IN WIDE (LEFT); 2.8 IN LONG (ABOVE)

IT HAS BEEN three years now since that piece of rusted armor came to light. Two members of our 1980 team, Peter Francis and Carol Hanchette, located additional Norse artifacts including boat rivets and knife blades. The Thule houses have also yielded an oak box section, parts of bottoms of wooden barrels, and numerous iron and copper pieces. One of the most revealing finds was a piece of woolen cloth whose date was established by radiocarbon tests at about A.D. 1250. Hoping for identification of the cloth, I took it to Else Østergaard of the National Museum staff at Brede in Denmark, my native country. After careful analysis, she pronounced the cloth definitely Norse in origin and of the type of weave common to the Viking colony in southwestern Greenland.

Although the information doesn't tell us how or even exactly when the cloth had reached Ellesmere Island, at least we now know who made it, as well as the earliest possible date it could have arrived.

Radiocarbon tests on the bulk of material from our other Norse finds produced dates ranging between A.D. 1190 and A.D. 1390. The latest date, 1680, pertains to an ivory figurine, possibly representing a Norseman, found on Haa Island west of Skraeling.

The Thule Inuit were hardly strangers to iron. We know that they fashioned implements out of iron obtained from the meteorite deposits at Cape York in northwest Greenland. We have found numbers of these iron implements among the Thule ruins on Ellesmere Island. They are easily identifiable by laboratory analysis, for they have an unusually high nickel content.

But other iron artifacts tested for us in laboratories at the University of Calgary have a low nickel content, indicating that the iron came from elsewhere, possibly far beyond Greenland. Erik Holtved found a number of such artifacts in his excavations on Greenland, and it is hardly surprising that others should turn up on Ellesmere Island, so near at hand. But how did they get there?

One of our fascinating discoveries to date is a small carved wooden head unearthed in a Thule ruin on Skraeling Island by one of our 1979 team members, Diane Lyons. The head dates from around A.D. 1100. Although plainly Inuit in style, the face to me seems strongly Nordic (page 579). It is as if the carver had seen a Norseman with his own eyes and sought to capture that startling vision forever in wood.

AND STILL the question remains: How did objects of Norse and European origin reach the high Arctic at a time when there is no record of their owners' actual presence there? Certainly the pioneering Norse settlers in southwest Greenland could have sailed as far north as Ellesmere Island during the five centuries that their colony survived.

Nearly 200 years ago a small stone engraved with Norse runic symbols was discovered near Upernavik on Greenland's northwest coast. The stone proves a Norse presence of some kind as high as 72 degrees north latitude, though not as high as Bache Peninsula's 79 degrees.

Did the Norsemen or their European contemporaries reach Ellesmere Island during the 11th or 12th centuries? Or were some of their belongings carried there in trade or as souvenirs by Inuit hands? I believe that both events took place and that further analysis of our discoveries in the Bache Peninsula regions may provide the proof.

Two legendary voyages to the high Arctic intrigue me. According to the *Annals of Greenland*, an expedition in 1266 led by Norse priests from the southwest colony sailed farther north than anyone ever had. How far north was that?

A book now lost entitled *Inventio Fortunatae* refers to a voyage in 1360 led by an English monk, Nicholas of Lynne, whose goal was to reach the area of northwest Greenland. Did Brother Nicholas make it, and did he or his crewmen wear chain mail?

One day we may have the answers. □

The Norse disappeared from Greenland by 1500, about 180 years before this Thule carving resembling a hooded Norseman reached Haa Island through Greenland Inuit traders. By 1700 the Thule had abandoned Ellesmere Island during the little ice age to join relatives in Greenland; their descendants today populate the island.



1 IN. TALL



Iowa, America's Middle Earth

By HARVEY ARDEN

NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by CRAIG AURNES

IOWA HAS A RIGHT to feel insulted. Outsiders tend to confuse it with Idaho or Ohio—states with all those I's and O's in their names. "Where are you from?" goes a typical conversation. "Iowa." "Oh, really? I have a sister in Columbus!"

Such urban provincials usually picture Iowa as a featureless flatland of corn with a hayseed farmer standing in the middle. They crack jokes about "the little old lady from Dubuque"—for whom, said the *New Yorker's* late editor Harold Ross, his magazine was *not* intended. Then they toss out that other cliché Iowans detest, "But will they get it in Des Moines?"

Well, if Iowa secedes from the Union, we asked for it. We've literally been biting the hand that feeds us. Last year Iowa led the states in production of corn, soybeans, and livestock. If Iowa were to secede with its similarly maligned neighbor, Illinois ("But will it play in Peoria?"), the rest of us would have to import grain, like the Russians.

But Iowa, of course, isn't seceding. It asks only that we cast aside our stereotypes and take a long clear look at this fertile Middle Earth in our midst.

I did just that this past year, and I want to report that Iowa is not flat, is not featureless,

and that they'll not only "get it" in Des Moines—they probably heard it long ago.

And if you think they grow only corn in Iowa, consider a few of the American originals to spring out of this rich earth: from Buffalo Bill to Lillian Russell to John Wayne, from Bix Beiderbecke and Glenn Miller to Bob Feller and Johnny Carson (sorry about that, Nebraska), from John L. Lewis and Grant Wood to Herbert Hoover and Mamie Doud Eisenhower.

This is top-choice America, America cut thick and prime.

I arrived in deep winter—a presidential winter, you might call it, following a papal autumn. It was January 1980. Pope John Paul II's visit to Iowa just three months before had come during the biggest corn harvest in history. There was a sense of providence about it all.

And now the voice of the politician was heard in the land. It was that quadrennial commotion, the Iowa precinct caucuses—kicking off Campaign '80 a month before the New Hampshire primaries. Here, in 1976, Jimmy Carter won his first big victory on his way to the White House. It was little noted at the time that he actually ran second—to "uncommitted."

Now 1980's (Continued on page 608)

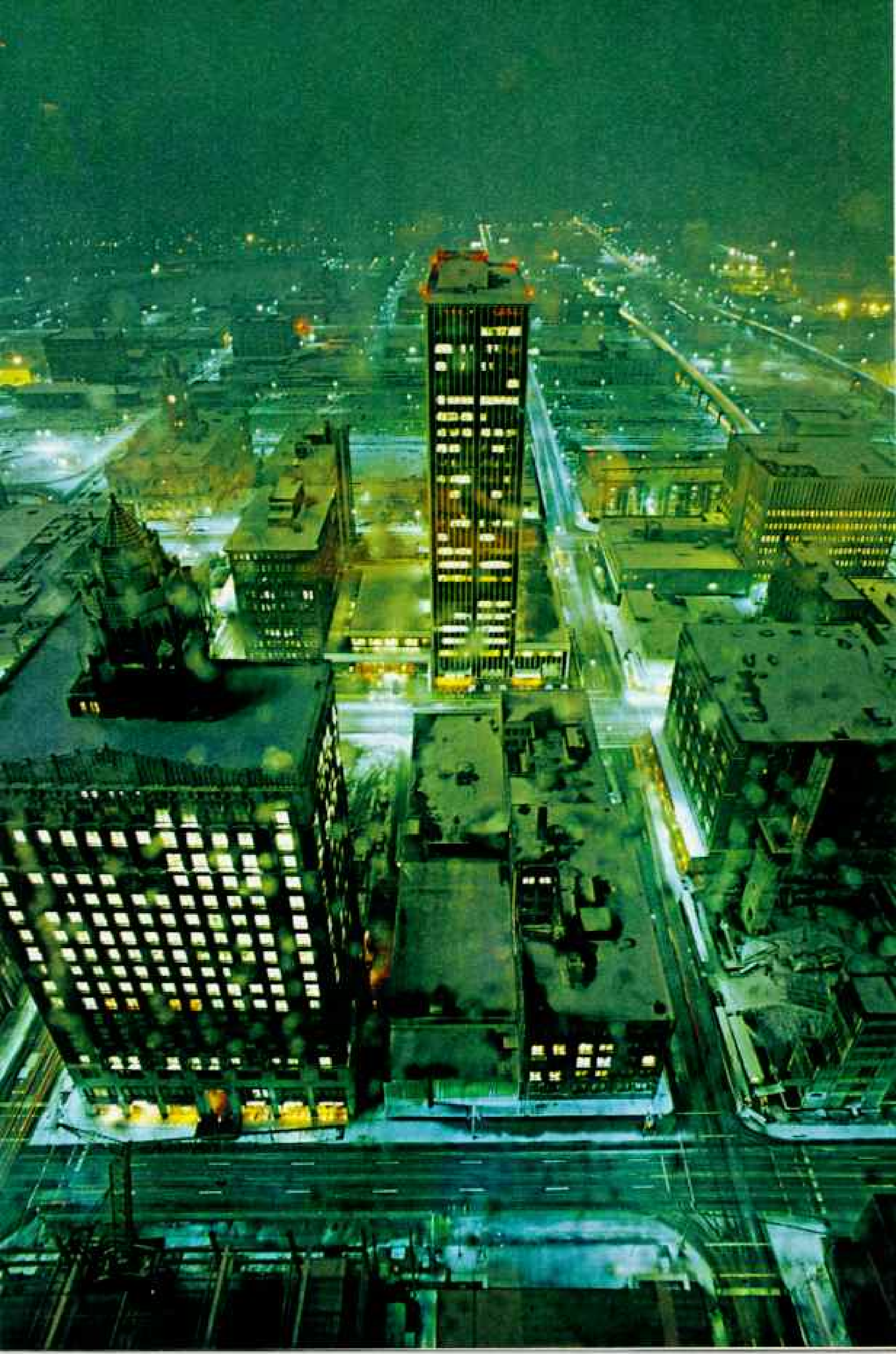
Tough hands and warm hearts pledge allegiance to America at a fair in Mount Pleasant, Iowa. Backing that pledge with sweat, grit, and know-how, Iowans help provide the good life for the rest of us as they lead it to the full themselves. While cherishing the back-home image of native son Grant Wood's "American Gothic," the state invites visitors to discover the surprising variety, sophistication, and modernity behind the stereotype.



Smoothed by ancient glaciers, enriched with deep topsoil by millennia of tallgrass prairie, north-central Iowa's black-earth country ranks among the best farmland on earth. On prime lands like these around Garden City, near Ames, an acre sells for



\$3,500 or more—making a typical 300-acre farm with improvements a million-dollar-plus investment. Yet yearly profits seldom exceed a hundred dollars an acre—prompting the perennial lament that Iowa farmers are “land rich, cash poor.”





Corn and culture mix in Iowa's capital and largest city, whose name derives from the French "des moines," meaning "of the monks"—referring to monks who lived along the Des Moines River.

Shivering in an unusual late October snowstorm (left), Des Moines aggressively builds to meet a growing potential as the unofficial capital of America's grain empire. Marketing hub for much of Iowa's huge grain output, the city with a population of just under 200,000 is the likely site of the world's largest plant for making ethyl alcohol from corn for use in gasohol.

Culture rides the crest of Des Moines' economic promise. Outside the gleaming new Civic Center (above), sculptor Claes Oldenburg's striking "Crusoe Umbrella" graces spacious Nollen Plaza. Within the center (right) theatergoers attend lavish traveling productions as well as performances by the city's own orchestra and ballet.



Iowa

Twenty-fifth in size and 27th in population among the 50 states, Iowa prides itself in being the golden buckle of the corn belt. But there's more than corn and soybeans in this land of the golden mean. In 1979 Iowa was second to Texas in cash receipts from livestock, third in total value of agricultural products (after California and Texas), and may soon surpass number one Illinois in value of exports.

What's more, the Hawkeye State has enormous energy potential—both as a producer of ethyl alcohol to make gasohol and as a coal producer. Sixty years ago, coal—chiefly from the south-central area of the state—was Iowa's leading nonfarm industry. After decades of quiescence, the industry is promising further wealth from the state's rich earth.



AREA: 56,290 square miles.
POPULATION: 2,913,000.
ECONOMY: Corn and soybeans, hogs and cattle, dairying, manufacturing, food processing, insurance. **CAPITAL:** Des Moines (pop. 191,000).



candidates were stalking each other through the snow-custed corn stubble. Carter, who'd just jolted Iowa farmers with the Soviet grain embargo, was unable to campaign personally, he said, because of the Iran and Afghanistan crises. Among the Republican candidates was a certain former Davenport and Des Moines sportscaster fondly remembered hereabouts as "Dutch" Reagan. The media swarmed. Even Walter Cronkite was here.

Well, of course, the results are long in. Carter drubbed Kennedy. Bush edged Reagan. A white-haired dark horse named John

Anderson emerged from the Republican pack. The lineaments of Campaign '80 were being sketched out here in Iowa.

But the quickest flowing comment came from the good citizens of Emmetsburg (population 4,600). The level in the town's water tower, it seems, drops measurably when water usage is heavy. A local radio station asked supporters of candidates to flush their toilets on signal. When President Carter's name was announced, the level dropped a tenth of a foot—about 300 flushes. When Senator Kennedy's name was called, it barely dropped at all. Characteristically,

In democracy's showcase, visiting Chinese officials and Governor Robert Ray of Iowa (below) discuss the possible opening of a market of nearly a billion new customers for Iowa corn and soybeans—a prospect as dazzling as the golden dome of the State Capitol (right).

At a fire station (bottom) in Farragut (population 600) grass-roots democracy has its day as citizens cast their votes at a state Republican Party precinct caucus in January 1980. Held a month before New Hampshire's primaries, Iowa's caucuses kick off the presidential election year.



DANA DONNIE (BELOW)





land—nothing like the vast ruler-straight horizons in parts of Kansas or Nebraska or North and South Dakota.

Most of Iowa, in fact, is emphatically hilly. The landscape curves almost sensuously, the horizons undulate, the hills roll in and out of each other like ocean swells.

When a movie company last year combed the state for location shots of an uninterrupted flatland of corn, they couldn't find any and went over to Illinois.

Had they been looking for blue-water

lakes, however, they might have tried northwest Iowa's Great Lakes resort area, centered around beautiful Lake Okoboji and Spirit Lake. If they were after limestone bluffs and stream-laced forests, they might have explored northeast Iowa's Little Switzerland. Along the Mississippi River they could have roamed a coastline about as long as Oregon's seacoast, studded with towns and cities mingling Victorian elegance with an almost maritime flavor—Keokuk and Muscatine, Burlington and Davenport,



Clinton and Dubuque, and picturesque little McGregor.

Iowa has a second great coast—along the Missouri River Valley, where, between Council Bluffs and the Missouri state line, hills tumble in lovely disarray. Created millennia ago by winds sweeping across the glacial-age Missouri River floodplain, these highly erosive hills and bluffs of loess—windblown silt—have few counterparts.

If it's human geography you seek, the state is dotted with ethnically flavored

While the tall corn grows, old-timers in Mapleton mull over such imponderables as the Soviet grain embargo, fluctuating grain prices, crippling interest rates, grain-elevator bankruptcies, and the financial collapse of the Rock Island Railroad, a major grain carrier. Despite droughts, tornadoes, and hailstorms adding to man-made woes, Iowa last year still led the states in production of corn, soybeans, and hogs.





Land of the annual festival, Iowa crams its calendar with celebrations, especially in summer when fair hopping from county to county becomes a favorite pastime. Arm wrestlers (top) compete at the mammoth Iowa State Fair held each August in Des Moines. At the Mount Pleasant Threshers Reunion in early September (above right), spectators at an oat-threshing exhibition savor the past.

Who can resist a stop at that American institution, the midway refreshment stand? This one (above) flaunts diet-busting snacks at the Clay County Fair.

communities—Dutch Pella and Orange City, Danish Elk Horn and Kimballton, Swedish Stanton, Norwegian Decorah, Czech Spillville, the Amana Colonies,* Amish Kalona, the Mesquakie Indian settlement near Tama, to name but a few.

And then there's Carter Lake (population 3,400)—a bit of Iowa in Omaha, Nebraska! Back in 1877, a shift in the Missouri's course put Carter Lake on the Nebraska side of the river. The Supreme Court in 1892 ruled it still belonged to Iowa.

*Laura Longley Babb described the life of today's Amanaites in the December 1975 *GEOGRAPHIC*.



"We've resisted every effort to include us in Omaha or Nebraska," Mrs. Dee Harrison told me. "We're Iowans, pure and simple. We even lobbied and got an Iowa area code [712] and our own Iowa zip code [51510]."

A Stone Against a Storm

Farmer Bob Barr keeps a rock propped up next to his house in Iowa's black-earth country near Fort Dodge. It's a curious rock—dark, and bigger than a watermelon. On its face, as if chiseled there, a pink cross stares out in rough relief.

"Hit it with my plow out in my bean field

about five years back," Bob told me. "Pulled it out, wiped off the dirt, and there it was—a cross, the Lord's sign.

"Something made me haul it up here and set it by the door. Then, one day last August I looked out, and there, like doom itself, coming straight for the house, was a twister, the biggest thing I've ever seen. . . .

"Me and my wife, Bun, we hid under the cellar steps. For four minutes that twister shook the house like a demon. Bun and I prayed for the Lord to take us quick.

"Finally the noise stopped. I went out to look. Well, that twister had ripped apart

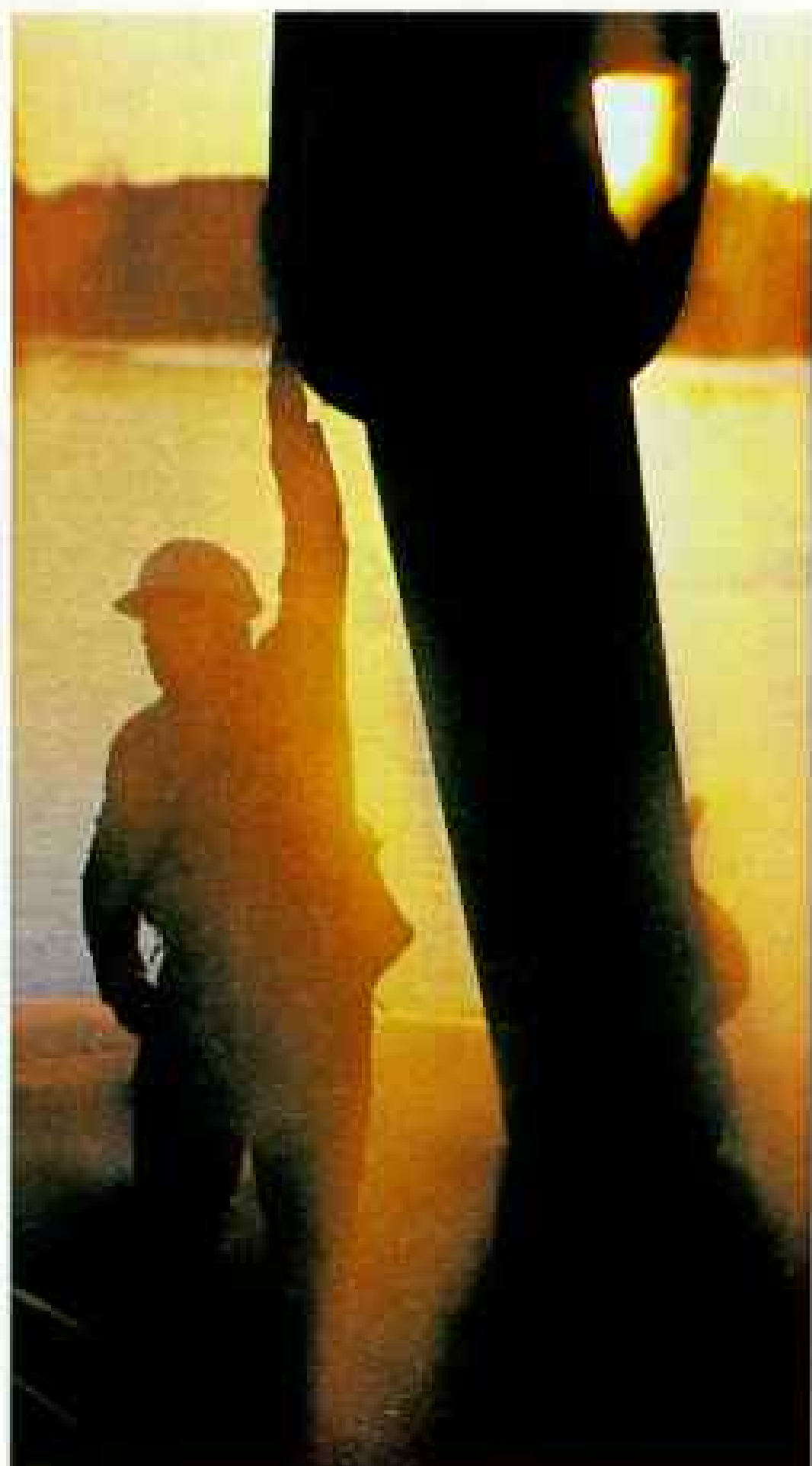


both the barn and garage. Not once but twice it came up to the house and stopped—by God—right in front of that rock, then backed off.

“Now, I know my Bible. You remember in Luke, the line about the stones crying out to the Lord? Well sir, surely this rock here cried out to the Lord on our behalf.”

Faith. You need plenty of it out here in Iowa. And, by God, you find it.

There’s geology as well as theology in Bob Barr’s “rock of the cross.” Some rocks, it



Cornucopia: Ranks of hybrid seed corn (left) march toward the horizon near Des Moines. Pioneered in Iowa by Henry A. Wallace and others, hybrid corn has helped double and redouble yields over the past half century. Mountains of Iowa grain unload (above) in October at McGregor, on the Mississippi River, bound for the Gulf of Mexico and world markets.

happens, tend to weather in crosslike patterns. Some 14,000 years ago a glacier gouged this boulder from somewhere to the north and dropped it down here onto the patch of ground that would one day become Bob Barr’s soybean field. In the process the ice modified the topography left by earlier glaciers in north-central Iowa and laid the groundwork for as prime a piece of agricultural real estate as exists on the planet.

This is Class I farmland—a geologic treasure. Glaciers provided its underlying rough till, scooping much of it out of Minnesota’s lakes region. Ancient winds whipped in rich silt and fine sand. During dry seasons huge fire storms raged across the prairie, halting encroaching forests by destroying tree seedlings but leaving the tallgrass roots unharmed. Millennia of deep-rooted prairie plants helped knead into the surface the organic matter that would transform the primordial mix into that ultimate end stuff—Iowa topsoil.

Timely Invention Conquers Prairie

Pioneers in the 1830s found topsoil nearly two feet deep. They didn’t even try to farm the prairie, however, preferring to clear the wooded river bottoms. Their wood-and-iron plows simply couldn’t break the root-tangled prairie sod. Only after John Deere invented a sharp-bladed steel plow in 1837 was the prairie’s conquest assured.

“People don’t realize that much of north-central Iowa was once marshland,” Bob Barr recalls, harking back to his grandfather’s days. “Early farmers tilled the knolls. Draining the land became crucial. You see all those ditches around here? Without them this would still be marsh.”

I walked one afternoon through a 160-acre patch of wild-flower-paisley preserve called Cayler Prairie. With me was Dr. John Downey from nearby Lakeside Laboratories on West Okobojo Lake. Waist-high grass swayed in the prairie wind like strokes of a Japanese painter’s brush.

“People driving past don’t comprehend what they’re seeing here,” Dr. Downey said. “They think this is a bunch of weeds. But it takes centuries for tallgrass prairie to reach full development.”*

*See “The Tallgrass Prairie: Can It Be Saved?” by Dennis Farney, in the January 1980 issue.

Today barely a tenth of one percent of Iowa's prairie remains. The state's topsoil has dwindled to an average depth of eight inches. Each decade another inch or so erodes away. Productivity has its price.

A Bumper Crop of Industry

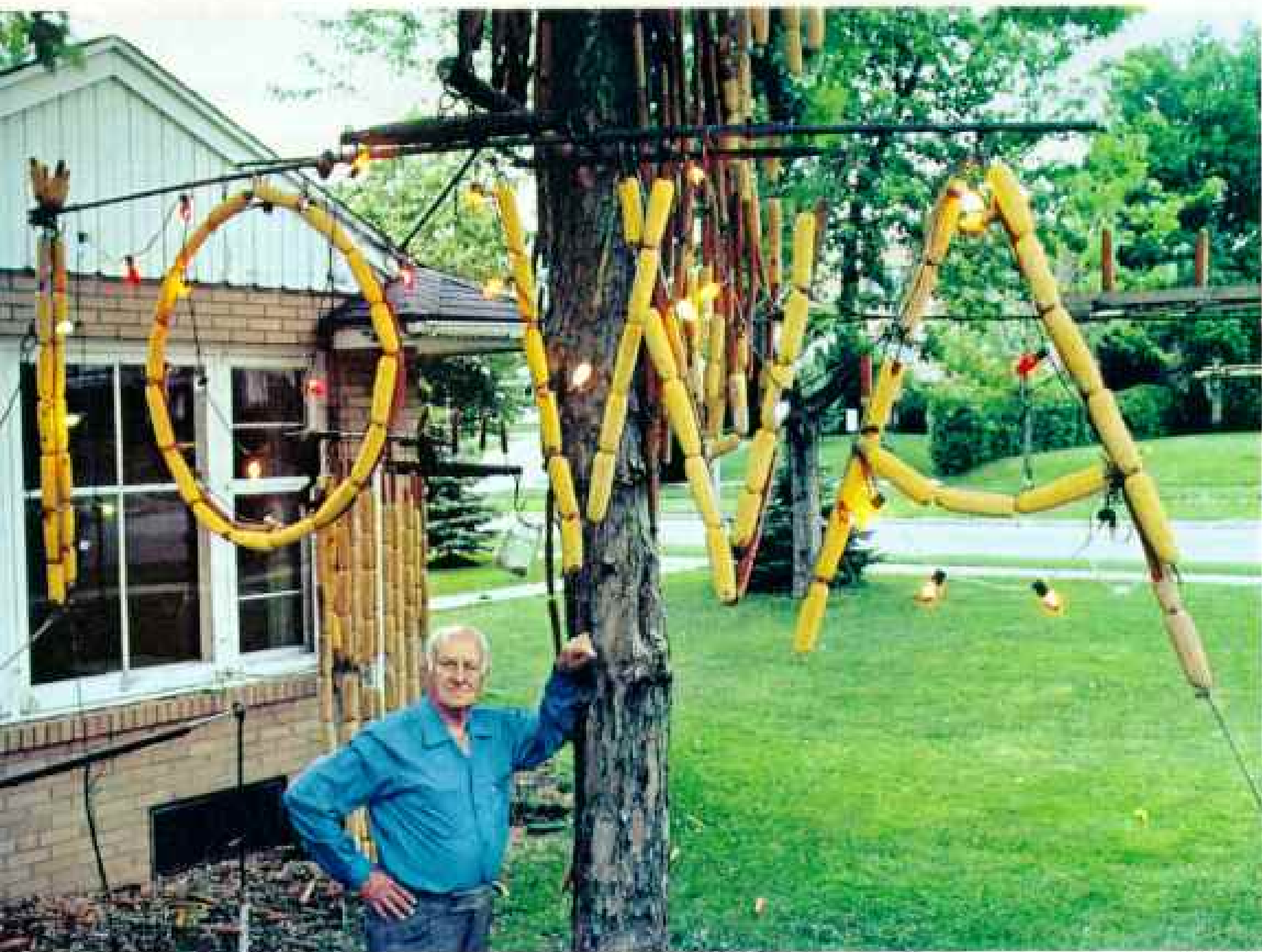
It's not only the soil that's productive in Iowa. The state's often unsung industries actually produce three times the dollar volume of its farms. Of the nation's top 500 corporations, 135 maintain plants in Iowa. Many of these, of course, are farm-related—big-name implement dealers like John Deere, food processors like Quaker Oats, and the remarkable Iowa Beef Processors, which over the past decade eclipsed Swift, Armour, and others to become the world's biggest meat-packer.

But Iowa also produces nonagricultural

staples, such as Maytag washers and dryers (in Newton), Amana microwave ovens (in Middle Amana), Sheaffer pens (Fort Madison), and Winnebago motor homes (Forest City). Rockwell International, in Cedar Rapids, makes printing presses and avionics equipment.

Some 100 insurance firms are headquartered here—from Des Moines-based majors like the Bankers Life of Iowa, American Republic, and Equitable of Iowa Companies to Farmers Mutual Hail Insurance Company of Iowa.

Again, you expect Iowa to produce agricultural giants like Henry A. Wallace, who pioneered hybrid corn and edited *Wallaces Farmer* before becoming secretary of agriculture and vice president, or Dr. Norman Borlaug, the Nobel Prize-winning geneticist whose new wheat strains spurred the Green



DANA DORRILL

"Birdman of Kingman Boulevard," Des Moines' Vernon Schall keeps this corn-ear bird feeder on his lawn—to the delight of local pigeons but the consternation of neighbors. "Back in the Depression I often ate pigeons," Schall says. "Now I'm returning the favor."

Revolution that has saved millions around the world from hunger.

But Iowa's genius extends to the skies as well as the earth below. Native son Dr. James Van Allen, discoverer of the Van Allen radiation belts, helps keep the University of Iowa at Iowa City in the vanguard of astrophysical research, just as the much respected Iowa State University at Ames helps keep the state at the cutting edge of the agricultural revolution.

Reading, Writing, and Rhythm

"Hayseed" Iowans?

Then why do eight million subscribers from New York to San Francisco and abroad take monthly cues for daily living from Iowa-based *Better Homes and Gardens*, published in Des Moines by the Meredith Corporation—which also publishes *Metropolitan Home* (formerly *Apartment Life*) and *Successful Farming*?

Why has the Des Moines Register and Tribune Company, publishing two dailies in a city of under 200,000, garnered no fewer than 13 Pulitzer Prizes?

Why does the Writers' Workshop at the University of Iowa continue to turn out major American authors—from novelists Flannery O'Connor (*Wise Blood*) and John Irving (*The World According to Garp*) to Pulitzer Prize-winning poets W. D. Snodgrass and, just last year, Donald Justice?

The unexpected, you come to find, is routine in amazing Iowa.

Tap. Tap. Tap. Maestro Yuri Krasnapolsky of the Des Moines Symphony lifts his baton, and Beethoven's Ninth fills the magnificent new Civic Center—centerpiece of the Iowa capital's downtown renovation (page 607).

Outside, sculptor Claes Oldenburg's whimsically monumental "Crusoe Umbrella" mimics the nearby red neon umbrella of the Travelers Insurance Company. Pile drivers beat a deep tattoo as spidery cranes toy with the city's modest but muscular skyline—topped out by the 36-story Ruan Center. On a hilltop across the Des Moines River, the gold-domed State Capitol presides in dowager elegance.

Des Moines is rebuilding, revitalizing itself after a three-decade inner-city downslide that saw its once flourishing downtown

turn dowdy as business and industry, customers and residents flowed out to prospering new suburbs. It's what happened in Detroit and Chicago and Cleveland, but on a smaller scale here in Iowa—in cities in the 50,000 to 200,000 range such as Des Moines, Council Bluffs, Cedar Rapids, Davenport, Sioux City, Waterloo-Cedar Falls.

Yet Iowa's urban areas are now regearing for the future. People-luring complexes such as Cedar Rapids' Five Seasons Center and Council Bluffs' Midlands Mall are models of inner-city rejuvenation.

If money is the dough of this statewide effort, culture is the yeast. Des Moines' Civic Center, with its 2,735-seat theater, has its cultural counterparts at Iowa's three state universities—the C. Y. Stephens Auditorium at Iowa State in Ames, Hancher Auditorium at the University of Iowa in Iowa City, and the UNI-Dome at the University of Northern Iowa in Cedar Falls.

Iowans care about the arts—deeply, and sometimes furiously. When the Des Moines Symphony's board of directors last year decided not to renew the contract of brilliant but fiery conductor Yuri Krasnapolsky, citizen uproar was tremendous. Krasnapolsky was triumphantly rehired.

Out in little Garrison (population 400), a professional acting troupe headed by artistic director Tom Johnson runs the Old Creamery Theater Company—attracting 25,000 theatergoers in 1980 and reaching out via touring companies to 75,000 more.

Over at the Iowa State Arts Council in Des Moines, director Sam Grabarski and his associate Nan Stillians weigh thousands of requests for the precious few funds available to subsidize projects in the arts.

Says Stillians: "Who's to say the next Shakespeare or Rembrandt won't come from right here in Iowa? We reach out to every corner of the state, searching for new talent, funding theaters and orchestras and museums. We also send out Touring Arts Teams—actors and artists and musicians who perform and teach in small Iowa towns.

"Even if no Iowa Shakespeare emerges, we have our rewards—like the look in the eyes of a farm kid when he watches professional actors turn a gymnasium into a stage and first realizes the magic of the theater."

Effervescent talk-show hostess Mary



The family farmstead abides although it has gotten farther away from the next family farmstead as Iowa's average farm size jumped from 160 acres in 1920 to nearly 300 today. Farms for sale are usually bought up by local farmers adding to their acreage, not by big corporations, which are prohibited from doing so by state law. The Auderer farmstead near Balltown (above right) glows with down-home warmth and good cheer.

Making self-sufficiency a way of life, farmer Ed Dettman and his wife, Lois (above), keep the family budget in trim at their home near Farmersburg.

Brubaker whirls into the offices of station KCCI-TV, Des Moines' answer to Johnny Carson (who, by the way, was born in Corning, Iowa, though raised in Nebraska), Mary hosts the weekday-morning "Mary Brubaker Show," a bubbly potpourri of celebrity interviews, social controversy, homemaking, and local announcements.

"I remember one day back in February 1975," she recalls. "One of the politicians in town for early presidential campaigning wanted an interview. I'd never heard of him, but I agreed if we could get him on and off as quickly as possible. Well," she laughs, "it was Jimmy Carter, of course."



In 1977 Mary found herself up against the network “Donahue” show, shown in Des Moines in the same time slot as her own.

“Can you imagine a tougher competitor?” she asks. “In only three months our locally produced show lost 5,000 of our regular 20,000 listening households.

“I like ‘Donahue’ myself. But we’re going on. We’re committed to local programming here. We’re committed to Iowa!”

Drought and Deluge – A Vicious Cycle

I’m out walking the beans. As any local teenager will tell you, that means going up and down the endless soybean rows hacking

out the weeds. There’s no better way to get a sense of just how big an acre is than walking the beans.

It’s late July. Hot. Texas has moved up to Iowa. Each time I poke my hoe at a weed, a cloud of dust swirls up. We’re six weeks into the second drought of the year. The first came during the April and May planting season, scotching hopes that 1980’s harvest would reach 1979’s record levels.

Rains finally came in June, but as gully washers, which dissolved newly sprayed herbicide too quickly, leaving weedy fields in their wake. Then came the hailstorms—some of the worst in memory. And now a

second drought—this one not only dry but also searingly hot, scorching the corn tassels just as they're pollinating. No pollination, no kernels. No kernels, no corn crop.

I scan the sky. Not a cloud to be seen. I'm learning, as you never do in the city, about the menace of an empty sky.

At times I seemed to be writing a disaster story. You'd think that Iowa farmers, coming off 1979's record harvest, would have plenty of money to plant the next spring's crop. But not so. Last year's bin buster became this year's glut. Even before the Soviet grain embargo in January, corn and beans were selling at 10 to 25 cents a bushel *below* what they cost to produce.

Farmers who could afford to were holding their old grain, waiting for prices to rise. Meanwhile, they needed cash loans to put in the new crop. But interest rates were astronomical. So were costs for seed, fertilizer, pesticides, fuel, and machinery. A few farmers were robbing the kitchen till to buy seed, then lining up for food stamps.

Think of it—food stamps for farmers!

Despite it all, the 1980 crops went in—and they went in fencerow to fencerow, the most acres planted in Iowa history.

Why corn? Why beans?

"Heck," says my father-in-law, Crawford County farmer E. Paul "Jake" Jacobson, "we could plant the state clear across with wheat. But there's no reason to waste good Iowa land and rainfall on wheat, which can grow fine in drier areas. Our soils and climate are perfect for corn and soybeans. We raise primarily corn because it's the most profitable form of food energy we can grow. Corn'll give you two to four times more bushels per acre than wheat."

Then why soybeans?

"Because, by rotating with soybeans, you control corn pests and diversify your crops so you don't get wiped out by, say, a corn blight. Beans also return nitrogen to the soil. And, next to corn, they're the best source of food energy. Once the oil has been extracted, the meal becomes a high-protein food



supplement for livestock—hogs and cattle.

“Iowa’s big in pork and beef, of course, because this is where the corn is. Nothing matches corn-fed meat for quality, and you may as well feed the animals Iowa corn right here in Iowa as pay the costs of shipping it out to fatten ‘em elsewhere.

“So, you see, it all comes back to corn.”

Free Lodging for Butterflies

These are Jake’s beans I’m walking. He cautions me not to kill the occasional milkweeds among the rows. “I like to keep the milkweed—that’s where the monarch butterflies lay their eggs. Not that you need ‘em to grow corn or beans, but who wants a world without monarch butterflies?”

Jake’s farm is an example of erosion control. Co-author of McGraw-Hill’s *Agricultural Engineers’ Handbook*, he worked 31 years for the U. S. Soil Conservation Service (SCS). In 1961 he bought the nucleus of this 347 acres near Dow City.

“It was poor land,” he recalls, “rough and

hilly, scarred by deep gullies and ravines, with hardly any topsoil. This is loess soil. Unlike most soils, you can bulldoze it around without hurting anything. The loess goes down 60 feet or more and, when fertilized, what’s down below can be as productive as the top foot. I bought this place to test some theories I had.

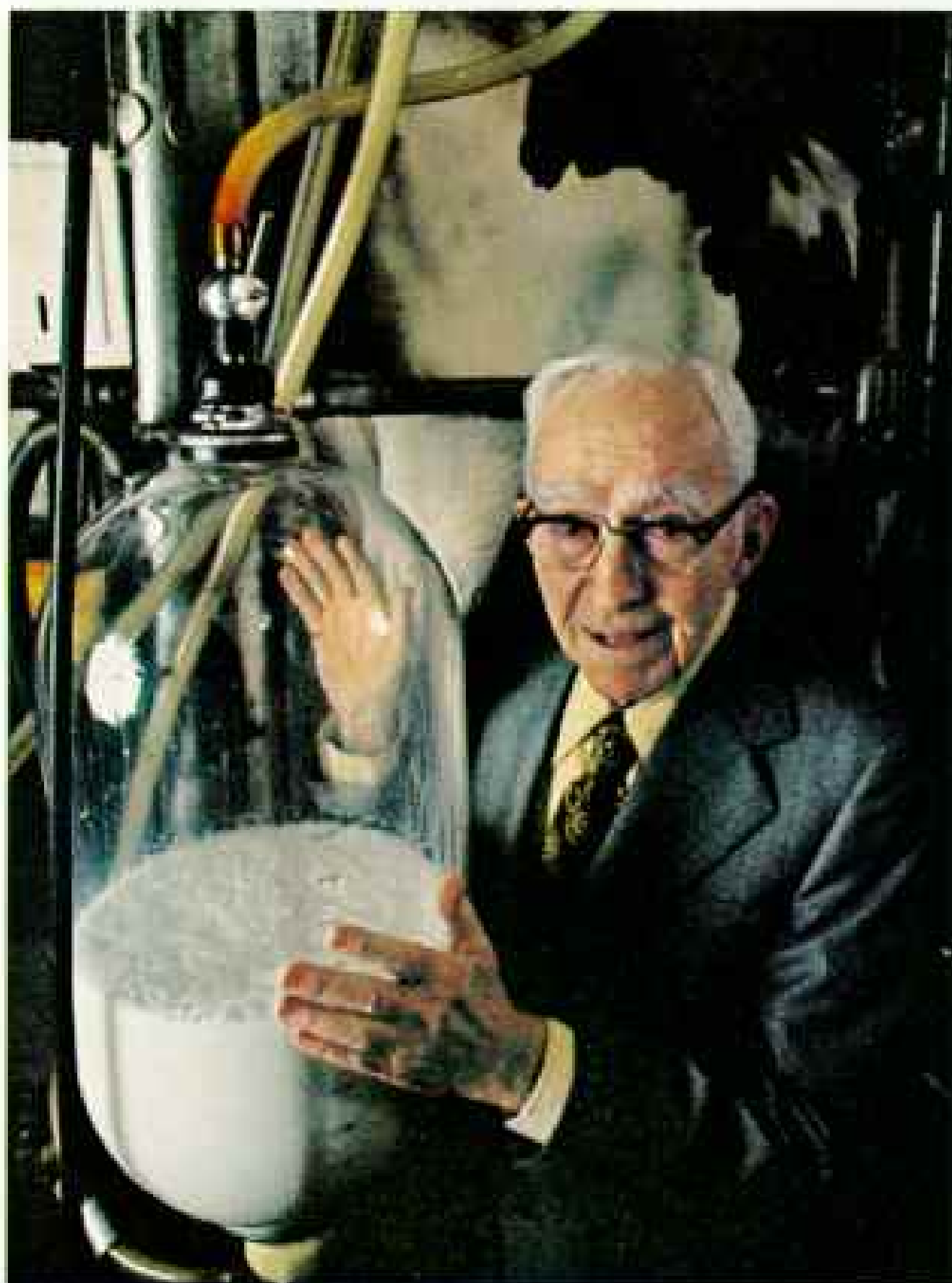
“I designed hundreds of conventional contour terraces for the SCS here in Iowa. They kept the soil on the steep slopes, but they were crooked and uneven—hard to farm with big equipment.

“Any farmer knows that, for efficient farming, level land with long straight rows is the ideal. Well, I won’t load you down with technical details, but my theories involve restructuring the hills themselves by using what are called pushup terraces—which don’t necessarily follow the contours at all.

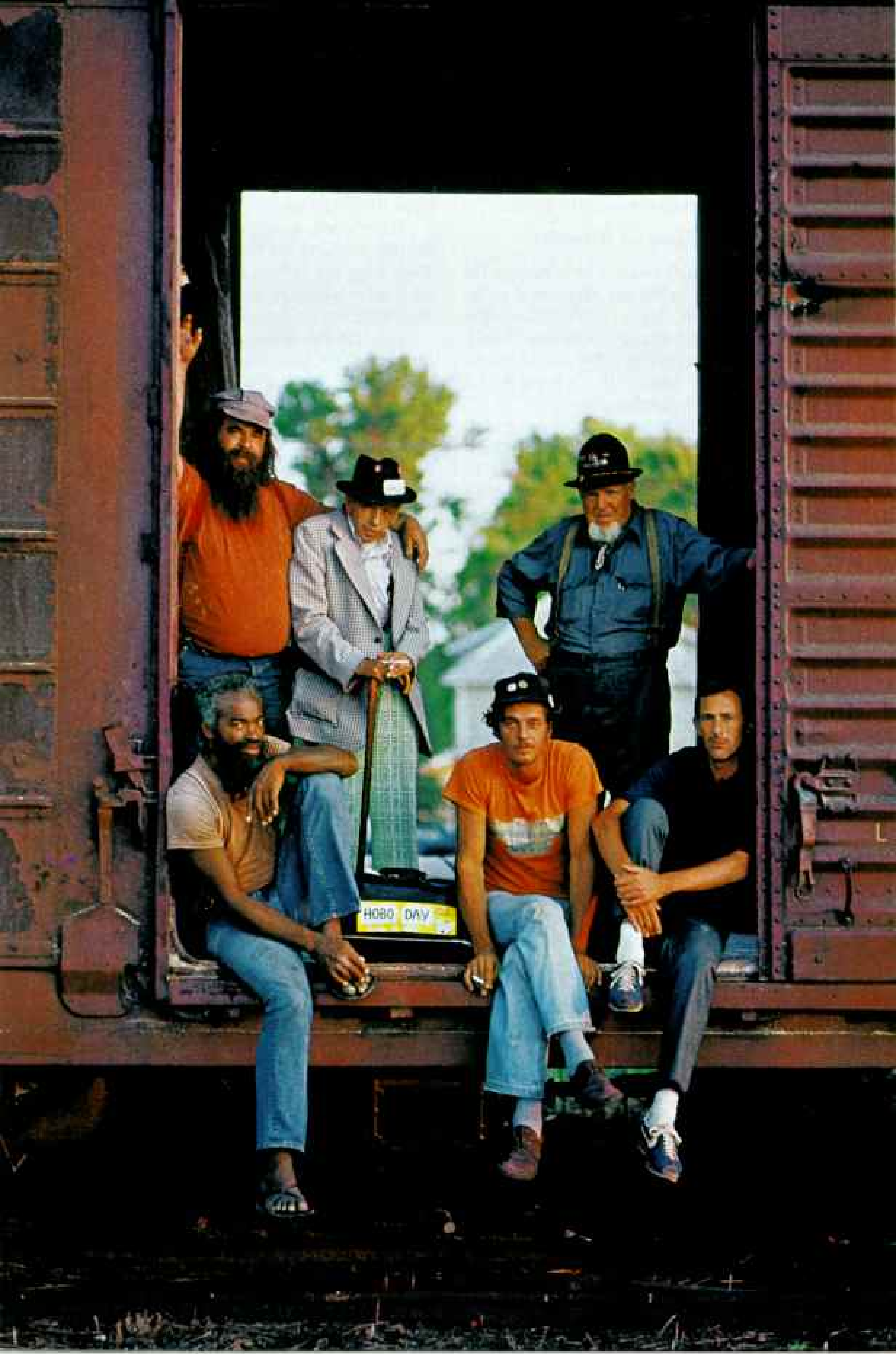
“After some bulldozing, the natural power of erosion goes to work filling in gullies and flattening out steep slopes into wide,

Frontiers of veterinary science are pushed back at the National Animal Disease Laboratory near Ames (left), where a germ-free piglet, removed from its mother by cesarean section, is kept in a sterile plastic isolator. Bred for experimentation, such germless piglets can be inoculated with specific disease-causing organisms to determine precise effects.

At the nearby College of Agriculture at Iowa State University, 85-year-old geneticist Dr. J. L. Lush (right) grasps a container of freshly drawn milk that will be weighed and minutely analyzed for desirable and undesirable traits, part of a decades-long effort to improve livestock through genetic research.



BOTH BY DANK DOBRIE



straight bench terraces—perfect for modern equipment. By using underground tile outlets to control water flow, hardly a grain of soil is washed downstream. It gets moved around a lot but remains right on the farm—where it belongs.

“Really, the basic principles are nothing new. I’ve seen 2,000-year-old similar bench terraces in the Philippines that are virtually erosion free. I’ve just adapted the method to the needs of big farm machinery.

“You can see the results. These beans you’re walking grow right over what used to be a 30-foot-deep gully. That cornfield up there used to be so steep you couldn’t use a tractor on it without risk of tipping over.

“And this system of benching will work wherever you have the right soil and slope conditions. It could turn millions of unused acres around the world into productive cropland. It’s already being used in Israel and Kenya as well as Iowa—wherever they have deep, erosive soils.”

We walk up to Jake’s cornfield, and he picks an ear off the nearest stalk. “Look at this,” he says. Despite six weeks with only a trace of moisture—just enough to pollinate most of the kernels—it’s fully formed.

“But the kernels are all dented,” I say. Jake sighs. “Of course! This isn’t the sweet corn you buy at the store. It’s field corn, and it’s supposed to be dented. You can feed it to livestock or do a thousand things with it, but you don’t eat it on the cob.”

Yet how can it be so big after six weeks of drought on land without topsoil?

Jake plops the ear into my hand. “Take that to Bill Brown at Pioneer Hi-Bred in Des Moines,” he says. “He’s the one to tell you about hybrid corn.”

Bill Brown holds an ear of corn with a special reverence. “Not bad,” he says, looking at the ear Jake gave me, which was produced from hybrid seed developed by Bill’s Des Moines-based firm, Pioneer Hi-Bred International, Inc.

“Back before hybrid corn became available in the 1920s,” Bill explained, “a farmer

like Jake, out in the loess hills in a dry year, would have been lucky to have any corn at all. Even the best land in a good season yielded only 40 or fewer bushels per acre.

“In those days, farmers simply used kernels from the prettiest ears of last year’s crop to plant next year’s. Then along came hybrid corn—the result of genetic experiments in inbreeding and crossbreeding. Pioneer’s founder, Henry A. Wallace, was one of its earliest promoters. Today we can create strains specially adapted to virtually any soil and climate conditions—including Jake’s.

“Here at Pioneer we produce about a third of the seed corn grown in the U. S.—more than 300 million dollars’ worth last year.

“Farmers using hybrid corn on prime land can get 150 or more bushels per acre. Of course, they have to buy new seed corn every year. If they just use seed from last year’s crop, the yield goes way down. Only seed newly crossed each growing season has the vigor for top yields.”

Bill held up Jake’s ear of corn, scepter-like. “You might call that a miracle,” he said. “And it’s a miracle that wouldn’t exist but for hybridization.”

Administrator in a Class by Himself

Council Bluffs, Iowa, has a national treasure. His name is Raj Chopra, superintendent of schools. But don’t go looking for Raj in his downtown office; he’s probably not there. Nor are most of his colleagues. Unlikely though it may seem, these high-ranking city school administrators are out in the schools, dealing with teachers and kids on a personal basis.

A few years back TV’s “60 Minutes” blew into this town of 56,000, just across the Missouri River from Omaha, and did a story on Council Bluffs’ school system—rife with factionalism, low morale, and low student test scores.

The show on national TV left Council Bluffs feeling put down, dispirited. Weren’t school systems elsewhere also in trouble? Why single out Council Bluffs?

Hard-travelin’ gents of the road—some of whom are also fully employed—make a way-stop each August at the annual National Hobo Convention in Britt. Capping the celebration, townsfolk elect a king and queen of the hoboes. This boxcarful of also-rans lost out to 1980’s winners: Sparky Smith and Cinderbox Cindy.



Oldest of Iowa's cities—first settled by lead miner Julien Dubuque in 1788—the Mississippi River town of Dubuque combines industrial muscle with patrician

Then along came Raj Chopra. Hired in 1978 to rebuild the school system, this energetic native of Pakistan did more than that. In less than three years he has helped boost Council Bluffs' civic morale to heights undreamed of a while back.

Raj is a positivist. Brightly colored slogans decorate his office walls:

"Positive attitude begins here."

"Together we can help our children grow."

"Learn the 3 p's: pride, progress, & positive thinking."

I caught the busy superintendent in his office between the classroom visits that take up more than half of his time.

"When I was a boy in what became Pakistan," he told me, "the country was in a civil war. Our home was destroyed, and I had to live in a truck. People were starving. Bodies were stacked in the streets. I would have lost



elegance. With a population three-fourths Roman Catholic, the city of 62,000 has been called Iowa's Little Rome. Carolyn Farrell, a nun, became mayor in 1980.

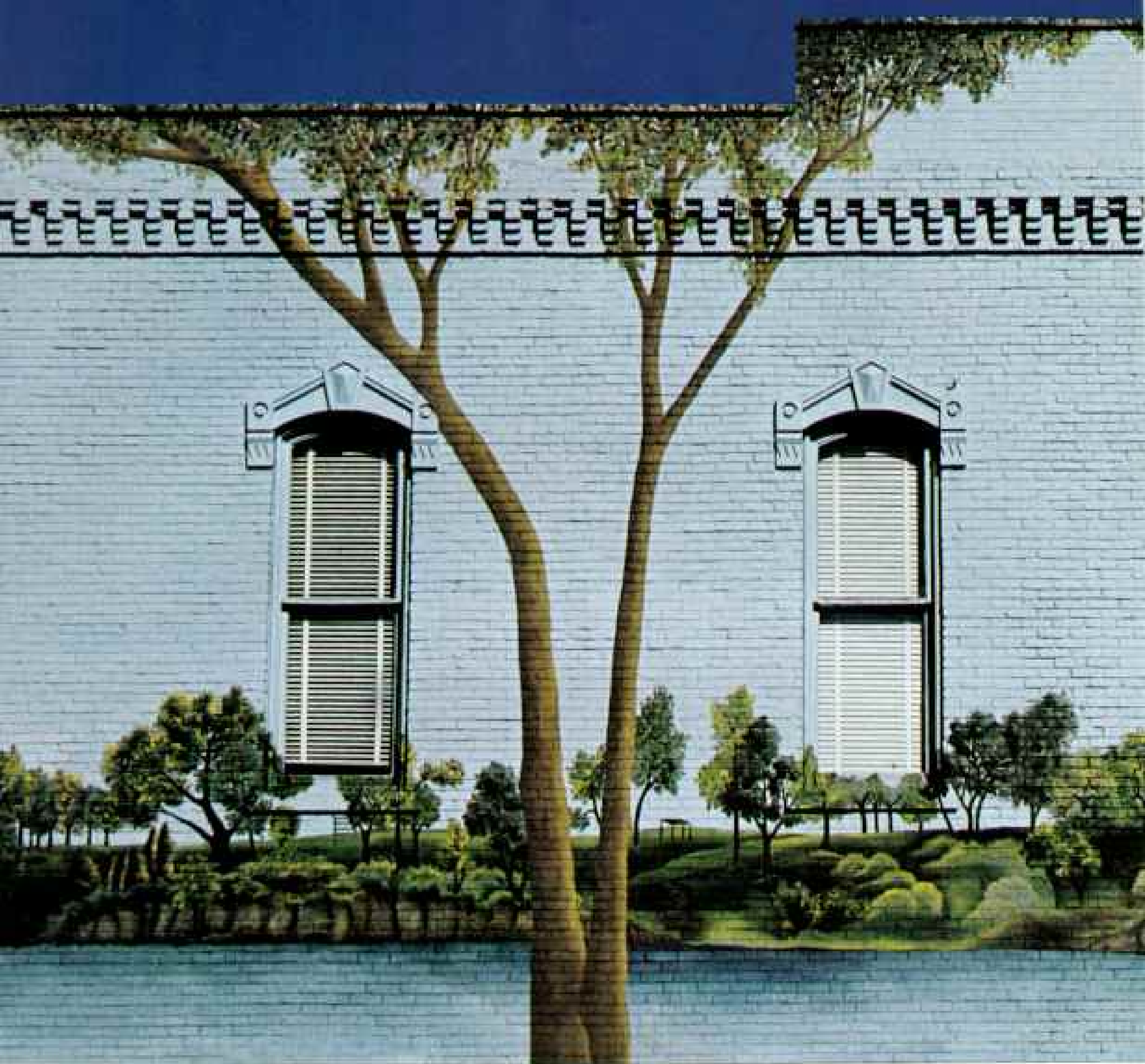
all hope, all faith except for my old grandmother. She always told me: 'Don't lose faith. Believe in God and the future. Whatever you must do to succeed, *it can be done!*'

"I've lived my life by that philosophy. When I came to the U. S., I learned even more about positive thinking. I learned that a poor man from a far country can make a success of himself by hard work.

"Well, I want to repay America, and what

better way of doing that than teaching its children my grandmother's message?

"So I start right here, in our schools, and in Council Bluffs itself. People see what we're doing, and it catches on. What's more, it works! Morale is way up, and so are student test scores. We instituted a Pride Week—it started with the schools, but now it's a citywide celebration. Suddenly everybody's proud to be from Council Bluffs!



"When people are proud—and this is the whole secret—that's when they get things done. And in a country with so very much to be proud of, there's no more important message to get out. Pride—that's my most important product!"

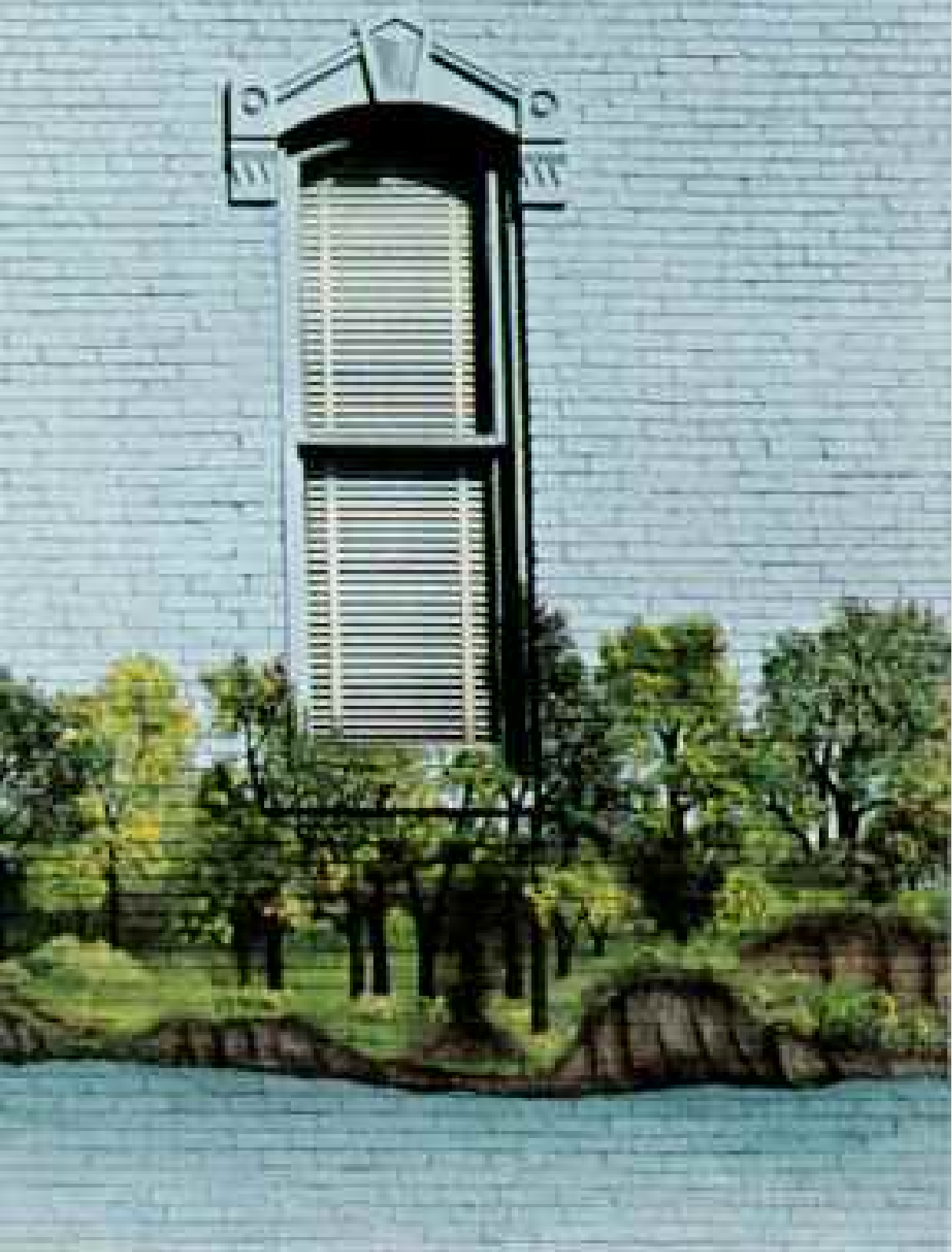
Through Adversity, Iowa Endures

Well, it's November, and the harvest is in. Amazing Iowa has done it again. Despite droughts and hail and tornadoes, despite every obstacle devised by fate and politicians to trip them up, Iowa's farmers have tied the record for the second biggest corn crop in the state's history—1.46 billion bushels.

The second drought finally ended in early

August. But the wheat, corn, and beans in many other areas—Missouri, the Dakotas, the South—were damaged or burned out altogether. In Illinois, traditionally number one in soybeans, the southern sector was struck hard by the record heat wave. For the first time in history, Iowa has surpassed Illinois to rank first in soybeans as well as corn. With both the U.S.S.R. and China also reporting poor crop production, grain prices have shot up to the point where most Iowa farmers should come out of this worst and best of years with a modest profit—enough, anyway, for seed next year.

"I don't remember a year when Iowans profited more from other people's misery,"



Visual double take: A mural by local artists Jeanne Griffin and Eric Abbott graces a building wall in Nevada, Iowa. Depicting Hickory Grove Park in Story County, the scene evokes both the beauty and whimsy of a state with plenty of both.

September, I had calls the next day from customers in Japan, Taiwan, and Belgium who wanted to know how damaging the frost was. This is big business. And Iowa is where the action is. If you're talking corn and beans, you're talking Iowa."

AGRI Industries runs the state's biggest grain terminal, on the Mississippi River at McGregor. I watched one October night as endless convoys of trucks and railroad cars unloaded Iowa's "yellow gold" to be borne downriver on huge barges to the Gulf and thence to the world. Pondering the miracle of such abundance, I mulled over some points my father-in-law, Jake, had pounded home to me during this incredible year.

I'd asked him: "What if we decided to use America's corn and soybeans and wheat as a 'grain weapon'—create a kind of 'OGEC' among, say, the United States, Canada, Argentina, Brazil, and Australia? Then we could double and redouble grain prices the way OPEC has done with oil. Wouldn't that benefit Iowa farmers?"

Jake nodded. "It might just work. But I doubt it'd help Iowa's farmers in the long run. Once big profits become a near certainty, the big corporations would move in and buy up the land. The family farm? It'd become obsolete, a fossil. Maybe it will anyway, but nowhere near so soon."

He squinted his eyes. "Let me make a different proposal for a different kind of future. Let's say, instead of having fewer and fewer people produce our food and live on farms, we adopted national policies that would make small-scale farming profitable.

"Then, instead of having out-of-work farmers migrating to the cities for jobs, you could have millions of cityfolk moving back out to the farms. Sure, food costs would have to go up, but so would the quality of life."

Visionary? An America where quality of life would have priority over profitability?

Ah, well, it's something to ponder. But will they get it in Washington, D. C.? □

agribusinessman Maurie Van Nostrand told me. "But if crops had failed here, too, meat prices might have doubled by next year. America can be thankful there's an Iowa."

Maurie is director of marketing research for AGRI Industries, a mammoth regional grain-marketing cooperative owned by 330 local farm co-ops—and, hence, indirectly by the farmers themselves. A growing phenomenon, AGRI Industries now rivals the big private grain companies.

"Right now we handle about 40 percent of the grain shipped out of Iowa, and hope to make that 65 percent. We've got the facilities to ship directly to overseas customers.

"When we had a freeze here in Iowa last

Australia's Great Barrier Reef

A Marine Park Is Born

BY

SOAMES SUMMERHAYS

PHOTOGRAPHS BY

RON AND VALERIE TAYLOR

In suspended fascination, a snorkeler cruises above coral formations of Heron Island reef in the heart of Australia's new Great Barrier Reef Marine Park.

The park is designed to satisfy a variety of interests. In most of the park, visitors may watch reef life from glass-bottom boats. The more adventurous may also snorkel, scuba dive, or, at low tide, walk across reefs. Other areas are reserved for scientific investigation, with access to some severely restricted to protect undersea wilderness.

A YEAR AGO LAST OCTOBER the Australian people presented the world with a priceless gift: 11,800 square kilometers of incomparable coral reefs, islands, and surrounding waters. The area—a small fraction of Australia's colossal Great Barrier Reef—was set aside by federal law as a marine park reserved for the people of the world to enjoy, protected from uncontrolled development and submarine mining and drilling.

As one involved in creation of that park, I share Australia's pride and hopes for the future. Sometime this year an additional 36,700 square kilometers may be included in the park, and more of the Great Barrier Reef may eventually be added.

None too soon. The world's largest structure fashioned by living creatures—in this case, astronomical numbers of coral polyps—the Great Barrier Reef extends 2,000 kilometers along Australia's northeast coast and encompasses an area of 207,000 square kilometers, roughly the size of England and Scotland combined. Yet this vast natural wonder has suffered from more than a century of exploitation and neglect.

In addition to its size and beauty the Great Barrier Reef supports an infinite variety of marine life—some 400 species of coral and an estimated 1,500 species of fishes. In effect, the reef is a vast genetic sanctuary of life forms of the sea.

My own interest in the Great Barrier Reef stretches back to a childhood fascination with marine conservation. I read voluminously on the subject of Australia's great offshore labyrinth of reefs and cays and later specialized in marine biology at the University of Southampton in England.

It was not until 1976, however, that I actually saw the Great Barrier Reef and explored a good deal of it with snorkel and scuba gear. I was hopelessly smitten and soon took a job with the Great Barrier Reef Marine Park Authority, the organization charged with recommending areas of the reef to be awarded park status. Among other things I developed fish-monitoring programs and educational materials.

In October 1979 a historic step was taken: an 11,800-square-kilometer area at the southern end of the reef was designated by the authority as the Capricornia section of



the Great Barrier Reef Marine Park, the world's largest (map, page 635).

TO ME Capricornia is an old and long-familiar friend. I have explored and dived on a good many of the area's countless reefs, shoals, cays, and coral heads, or "bommies," a term derived from the Australian Aboriginal word *bombora*, meaning "submerged rock."

My favorite time on the reef is late afternoon, as the undersea twilight wells slowly up from the seafloor. Around me the colorful reef fishes bob and dance aggressively, reaffirming the boundaries of their diminutive plots of real estate among the reef's crowded condominiums.

At a bend in the reef I encounter a large green turtle and exchange glances with it. Its huge black eyes peer blankly as I admire its almond-smooth carapace. I try vainly to span the gap of more than 200 million years of evolution, when our mutual ancestors parted company forever and went their separate ways.

Many of these inhabitants of the reef are personal friends of mine whose habits I know individually, whose private lives I have shared, and by whom I now have the distinction of being ignored.

The numbers of some species, however, have been slowly diminishing. There are not as many coral trout or other large predators as there once were in the Capricornia region, thanks to increased commercial and sport fishing. Some 30 kilometers off the Australian coastal town of Gladstone, Capricornia receives a fair share of the hundreds of thousands of annual visitors to the Great Barrier Reef. Many converge on Heron Island, site of a marine research station and one of the two resort hotels on the Barrier Reef itself. Here human pressure on the reef is evident, and here scientists study its ecology.

Protection of the reef, however, is up to the individual tourist.

"Most visitors know that the reef's protected now," Geoffrey Mercer, one of the park wardens, told me recently. "They know it's forbidden to collect live shells, but a lot of them just can't resist the temptation. They bring the shells all the way back to the hotel, and then their consciences get the better of them; they drop them in one of the



A light brigade of yellow-banded hussars marshals near a "bommie," or



LUTJANUS AMABILIS (NOUSARE)

coral head. In daytime, their eyes-front formation affords the safety of numbers near shelter. At night, they disperse to hunt for crustaceans and smaller fishes.

Conflicting energies of wind, waves, and currents shape cays such as the Fairfax Islands (below), built in shallow water by billions of coral polyps. Islets

within the reef boundary begin as sterile sandy mounds. Guano from nesting birds fertilizes the sand to support colonizing vegetation. The



nearby tidal pools." Geoffrey grins. "If you want to see the prettiest shells on Heron Island, check the area around the hotel."

Other parts of the park have been less fortunate. Such areas as Lady Musgrave Island, 70 kilometers south of Heron Island, are difficult to patrol. According to Geoffrey, the reefs there have been heavily exploited for live shells, and can recover from the loss only under continued protection.

BY NO MEANS ALL the Great Barrier Reef's attractions lie beneath the sea. The low-forested cays of Capricornia alone shelter an estimated three million seabirds, including shearwaters, boobies, and terns. During nesting season the cays fairly vibrate with the honkings, caterwaulings, and passionate chucklings of numberless flocks gathered to perpetuate the various species.

Other residents of the Great Barrier Reef divide their time both above and beneath the sea. The reef shelters perhaps the largest breeding populations of green turtles in the

world and the greatest number of loggerhead turtles in the Pacific.

During the summer nights hundreds of female green turtles, each weighing as much as 160 kilograms (350 pounds), grind their tortuous way over beach rock and coral sand to a point above the high-tide line.

I have often watched these great creatures, sighing and straining with the effort to dig an egg chamber, great salt tears streaking their sand-caked faces. Before returning to the sea, each female turtle deposits from 60 to 200 eggs—an exhausting night's investment in the future.

In the past it was man who reaped the return on that investment, and the green turtle appeared headed for oblivion. In the early 1900s a turtle-meat and soup cannery was established on North West Island, and the slaughter began in earnest. That operation's success led, in the 1920s, to the opening of a second cannery on Heron Island.

In 1932, when the green turtle stocks had been decimated, a sea captain by the name of Cristian Poulson converted the Heron

Bunker and Capricorn cays are major features within the park (map), but even at 11,800 square kilometers it is only a niche within the reef's vast expanse.



DRAWN BY LEO B. ZEBARTH, COMPILED BY DAVID C. CHENG. NATIONAL GEOGRAPHIC ART DIVISION

Island cannery into a resort, earning a modest living for himself and, at the same time, a reprieve for the green turtle.

Nearly half a century before, North West Island had suffered a different sort of invasion. In the late 1800s phosphate companies came for the rich guano deposits on North West, Lady Musgrave, Fairfax, and Lady Elliot Islands. With imported Chinese labor the companies set about strip-mining the islands, slashing vegetation and shearing away the topsoil. To this day Lady Elliot has not fully recovered from the ravages of that massive assault.

MODERN TECHNOLOGY and its occasional failings offer the specter of far greater injury to the reef. Seabed mining, oil drilling, and attendant spills are only a few of the dramatic threats. Other threats are more subtle, though equally harmful in the long run. Deforestation and high-intensity farming of mainland areas adjacent to the Great Barrier Reef have resulted in some runoff of fertilizer and other

pollutants, not to mention the soil itself.

"When I was a boy," Ron Isbel, a highly respected charter-boat captain in Gladstone, told me, "the Whitsunday islands to the north of here had some of Australia's finest fringing reefs. Today many of the inshore reefs are gone forever—smothered by silt from mainland rivers."

He shook his head. "You can maybe tell an oil company not to drill on this or that reef, but how do you tell a farmer 300 kilometers away not to clear his forests or fertilize his fields?"

How indeed? Yet a way must be found to preserve Australia's unique offshore treasure without cost to its resources on land. In the following pages my friends Ron and Valerie Taylor present a dramatic personal view of the Great Barrier Reef as it existed nearly a quarter of a century ago and as parts of it remain today.

No one, I think, can view these stunning pictures and read the accompanying words without sharing Australia's pride in its new gift to the world. ★ ★ ★

Paradise Beneath the Sea

TEXT AND PHOTOGRAPHS BY
RON AND VALERIE TAYLOR

*Beginning in the first sunlit fathom and down into darkness, the Great Barrier Reef is homeland to a fantastic citizenry. The tube worm (**below**) burrows in coral and feeds and breathes with its fountainlike appendages. Disturbed, it retracts them in a wink and battens down its own hatch. The "Spanish dancer," a mollusk without shell (**facing page**), does a slow fandango while grazing along the reef.*



SPIROBRANCHUS LAMARCKII AND HESPERBRANCHUS FLAMMULATUS

I DON'T RECALL her name, but even after 20 years I still see her clearly: an elderly woman neatly dressed in a plain white blouse and dark skirt, gray cotton stockings and serviceable walking shoes. With the majesty of a Spanish galleon she floated above a section of submerged reef, peering intently through a borrowed face mask and poling herself along with a stout walking stick.

The face mask belonged to me. I had pressed her to accept it, after considerable argument, the second day she had watched me from shore as I snorkeled off Heron Island in the Great Barrier Reef. At length she accepted the mask, and I remarked that what she needed next was a bathing suit. She surveyed my two-piece bathing suit with a gentle smile.

"Thank you, my dear, I'll just go as is," she replied, and with that she launched herself—blouse, skirt, stockings, shoes, and all—across the reef.

Over the next four days she snorkeled constantly, always in the same costume, poling herself happily among the reefs and shallows of Heron Island. By then I had learned her name and the fact that she was a retired schoolteacher from Sydney. When she left the island, she returned my spare face mask and snorkel with something very like tears in her eyes.

"Just think, my dear," she said, "if you hadn't encouraged me, I might have died without realizing there is another whole world under the sea. It frightens me to think how nearly I came to missing it."

Australia's Great Barrier Reef does that to people. Its spell is irresistible, whether to underwater newcomers or to veteran divers like my husband, Ron, and me. The reef has become a second home to us both, yet sometimes it frightens me to think how very close future generations came to missing it entirely.

Left unprotected for another decade or two, the Great Barrier Reef might well have become a wasteland, a giant undersea memorial to man's ignorance and neglect. The creation in 1979 of a vast park—Great Barrier Reef Marine Park—at the southern end of the reef has focused world attention not only on its incredible beauty but also on the fragile balance. (Continued on page 646)



DEFENDER of his territory during spawning, a male moon wrasse prowls in a tidal pool with feather stars, foreground,



and stinging hydroids. Some males are so born; others are born and breed as females but become males in later life.

THALASSEMA LUNARE (WRASS) - SCANDIS SUMMERHAYS



TEN radial arms feed a central mouth of the *bêche-de-mer* sea cucumber (top). Fernlike tentacles trap minute organisms. Arms swing over in turn, each inserting its tentacles entirely.

A reef shark (middle) may devour whatever might plausibly be food, here a floating piece of trash.

Startled by divers' lights, a small fish has blundered into the tentacles of a tube coral (facing page).

A triton conch feeds on a crown-of-thorns starfish (bottom). The starfish prey on coral; they reached plague numbers a decade ago and devastated parts of the reef. Evidence now suggests the plague was part of a natural cycle rather than being induced by man's activities.



BÊCHE-DE-MER, PNEUDOSOLECHARIUS AERULIUS



SHARK, GENUS CARCHARHINUS

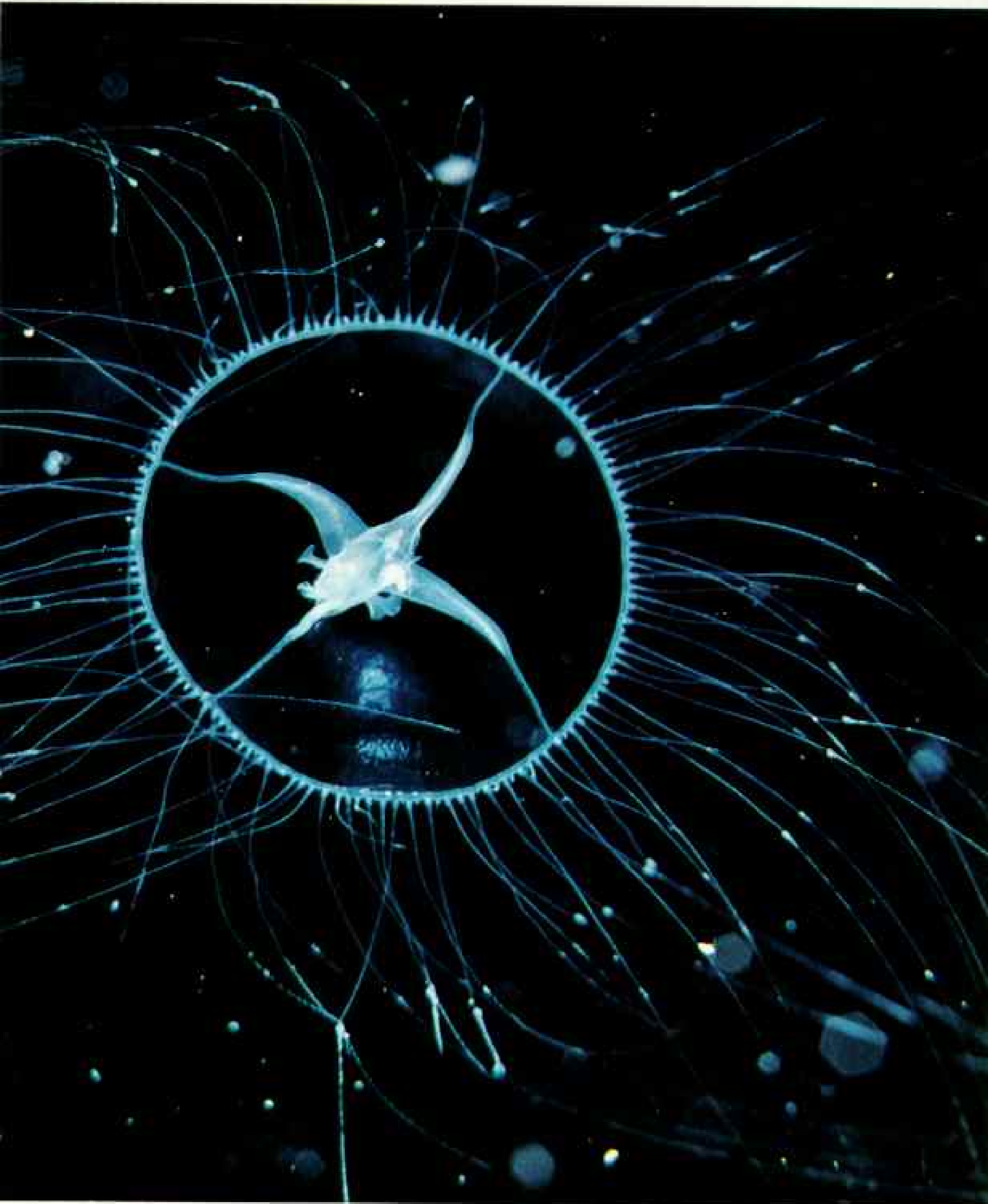


TRITON, CHARONIA TRITONAE; STARFISH, ACORONASTEA FLANDI; CORAL (RIGHT), SUDASTRAEA SOUCIERA





REEF DRIFTERS play significant roles in marine ecology. A two-inch-wide jellyfish (left) that might end as a juvenile turtle's meal is a large predator in the world of minute plankton.



Similar, but less than an inch across, is a medusa (above), the free-floating stage of a hydroid. These and other plankton are primary links in the undersea food chain, and only a few survive.



CARPICUS MACULATUS



CHROMIS FASCIATUS (ABOVE) AND ZANCLUS CORNUTUS (FACING PAGE)

FURTIVE in daytime, a spotted crab docilely permits handling at night, perhaps because its normal predators are not abroad. The harlequin tusk fish (left), a territorial loner, is fearsome appearing but makes the greatest use of its blue teeth by crushing bottom-dwelling crustaceans and mollusks. Once sacred to some Muslims, the Moorish idol (right) grazes on sponges.



A no-welcome mat is sprayed by a guitarfish surprised by divers (below). Cut off from going forward by photographer Valerie Taylor and sensing a threat approaching from behind, it burrows into the bottom (right). In the process it covers itself and dusts diver Sir Peter Scott, chairman of the World

Wildlife Fund—a better friend a fish never had.

Good eating when young, guitarfish were often taken simply by grabbing their tails and hauling them out of the water. Throughout much of the park, these along with all other fishes are now protected.



PLATYRHINA

(Continued from page 636) by which it survives. We can no longer take either one for granted.

Twenty years ago the Great Barrier Reef was not only Ron's and my second home but our filming studio as well. In those days few photographers earned a living shooting underwater film, so we paid our way aboard commercial fishing boats by spearing coral trout to supplement the catch. In our spare time we shot all the still and motion-picture film we could afford.

I'm ashamed to admit that we treated the reef the way everyone else did, as though its living treasures were inexhaustible. We speared more fish than we could possibly use or sell, hitched underwater rides aboard green turtles, collected live shells by the bushel basket, and generally abused the natural wonders around us.

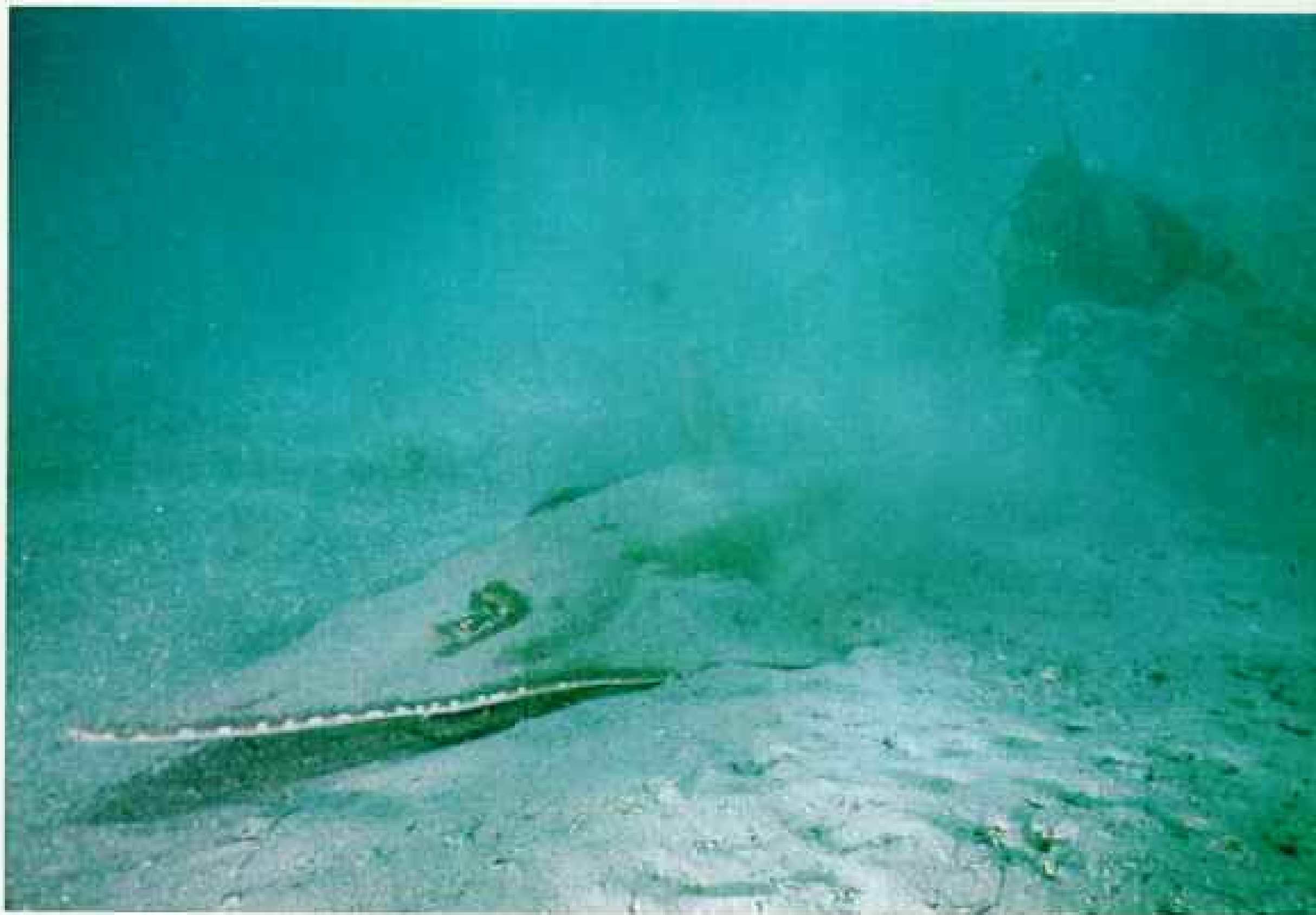
As practiced free divers, Ron and I entered occasional spearfishing contests and often won. The object was to land as many large fish of different species as possible. Queensland gropers were ideal targets—

huge, slow, and incurably friendly. Unfortunately, non-competition divers all but eradicated the species with such devices as explosive spearheads.

Then one day Ron and I had simply had enough. Surveying a score of trophies laid out on the hot deck of a diving tender, we were struck by a sense of total waste. Many of the fish were inedible species, and the others wouldn't be eaten anyway. As the brilliant colors faded to lifeless grays and the quivering slowly subsided, these living jewels from the Great Barrier Reef turned to garbage before our eyes. Never again did we kill underwater except for food.

ONE RESULT of our spearfishing was close contact with sharks. Nothing attracts those sleek marauders more quickly than speared and bleeding fish, and during our contest days Ron and I were often so beset by sharks that it was all we could do to boat a catch in one piece.

Gradually we learned how to deal with moving, feeding reef sharks and came to



know their habits. Over the years that knowledge has proved invaluable in our filming of many species of sharks as well as other potentially dangerous marine creatures. The short article beginning on page 664 of this issue describes one result of our experience with sharks: an experimental underwater diving suit made of stainless-steel mesh.

Some of our best footage of sharks has been obtained off Heron Island in the center of the new marine park. Although sharks have learned to avoid man and his deadly assortment of underwater guns and explosive devices, they are irresistibly attracted to his garbage. The Heron Island Resort refuse boat has so conditioned sharks in the area to a daily handout that they will surface at the sound of any outboard motor. They are all business, however, and if no garbage is forthcoming, they quickly disappear.

Ron and I often see big deepwater sharks, such as gray reefs and silvertips, sorting through the garbage as it drifts seaward with the tide. Although dangerous-looking

brutes, the sharks pose no threat to swimmers, for they are not only well fed but also rather wary, since several of their number were killed by sport divers.

Such senseless destruction is forbidden by park rules, though the preserve is not totally protected. Limited commercial and sport fishing are still allowed in certain areas of the Great Barrier Reef Marine Park.

"The idea is use, not abuse," one member of the park authority staff told me. "The park wasn't created to *deprive* anybody but to ensure its enjoyment by as many people as possible—and that means the future as well as the present. We want that reef to last another few thousand years."

So does Pam Land, and she thinks there's a chance, now that the park has been established. Pam's father, Cristian Poulson, was the farsighted captain who switched from canning turtles on Heron Island to building and running the island's resort hotel. Pam was a part owner of the hotel until last year, but her real love has always been the island and the

(Continued on page 652)



SAND FLIES as a green turtle digs a nest for her eggs (*left*), a labor she will likely repeat several times in one season but not again for two to four more years.

The mortality rate of hatchlings that make it to the sea is high. They are attacked by many predators from foot-long rock cods (*below*) to sharks. Yet the green turtles' worst predator has been man. For their meat, oil, shell, and skin, greens have been reduced to near extinction in areas of the world beyond Australia. Though hitching a ride (*right*) does no harm, the general rule in the park is: Hands Off!

SEANET SUMMERHAYS, BELOW



TURTLES: CHALONIA MYDAS; ROCK COD: EPYPTHWELUS FASCIATUS







OUTWARD BOUND, a recently hatched one-ounce green turtle, with its egg tooth still on its snout, swims beyond the reef into open sea. Having survived first predators, such as gulls and ghost crabs, it still faces an ocean of hungry mouths. If it eludes those, it can live for decades and reach a weight approaching 300 pounds.

abundance of life it supports both above and beneath the sea.

"We need to expand the marine park," Pam declares, "and tighten the rules a bit. Campers should be forbidden access during the summer nesting season in areas like North West Island, with its huge population of seabirds."

As in parks around the world, most damage is done out of ignorance rather than malice. In November 1979 Ron and I visited North West Island and found some 60 university students camped there. In many cases they had pitched their tents directly over the burrows of nesting shearwaters. We explained that each burrow contained a family of those marvelous birds and that the tents had condemned them to suffocation.

"Oh," replied one of the students, "they made such a terrible noise, but then they finally settled down. We thought they'd gone to sleep!"

DANGER of another sort once threatened the population of gannets and shearwaters on the Fairfax Islands at the southern end of the park. Long before the park was established, my diving friend Julie Vincent told me, the Royal Australian Navy used Fairfax as a bombing range. Julie, who studied green sea turtles on Fairfax for eight years, says she can still find craters—somewhat softened by new vegetation—pitting the islands, even though no bombs have fallen since 1953.

To Ron and me, turtles are among the most fascinating, lovable, and maddening creatures on the entire Great Barrier Reef. Now strictly protected, the green turtle populations have largely recovered from the depopulation caused by the canning industry.

Around Heron Island there are always turtles in the water, sometimes to the point where it seems there is little water around the turtles! During the summer mating season the big males hang off the edges of the reefs, waiting for the females to return from laying their eggs ashore and to mate again.

It takes two months for turtle eggs to hatch, and on Heron Island there is seldom any question about the event. Newly hatched turtles seek the brightest horizon, and since they almost always emerge in darkness, that often means the resort hotel.

It's not uncommon for guests to find their rooms full of baby turtles busily milling around in search of the ocean.

Even adult turtles get confused. Ron and I once returned to our cabin to find a large female green turtle burrowing under our bed. After considerable effort we managed to evict her, but she continued to hang around outside for hours.

The turtles of Heron Island have been tagged, sat on, fallen over, yelled at, measured, and harassed in dozens of ways. Yet still they come ashore, three or more times in a single year, then not again for several years thereafter. On land they are like prehistoric creatures in a modern world, awkward and slow. In the water they are all grace and speed, and their strength is incredible; they can easily tow a full-grown man. That is hardly surprising, however, since the female turtle swims with a 350-pound male on her back without effort during mating.

I remember one loggerhead turtle with great affection—he nearly drove Ron and me insane. We were shooting a television script that called for a large male loggerhead to perform, and after a considerable search we captured a 440-pound prospect.

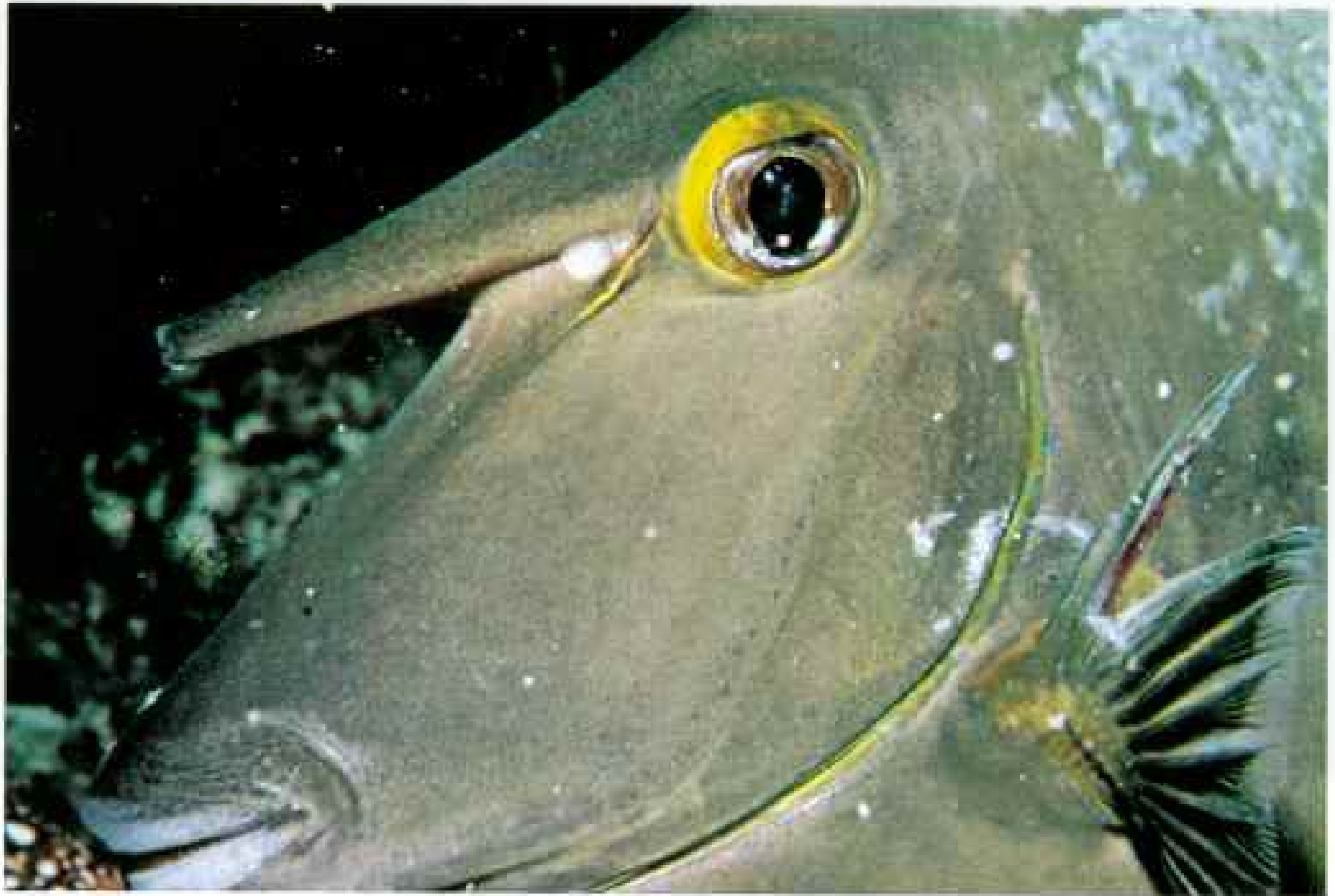
He was reluctant from the first. It took five strong men to wrestle him out of the water and get him bedded down for the night on his back in a hammock covered with a pile of diving wet suits.

He was even less cooperative the next morning. During the first underwater scene he bit Ron's air hose neatly in half and made a break for freedom. We hauled him back, and he bit everything else within reach, including diving flippers, hoses, and even the camera housing itself. No child star ever threw such tantrums.

By noon we were thoroughly exhausted and disheartened. It looked as if we would have to abandon the script. Then a curious thing happened; our matinee idol suddenly became stagestruck. He cooperated beautifully, swam where we pointed him, waited patiently and unattended between scenes, performed on cue, and generally acted like an old trouper. Once started, we finished the film in record time. By late afternoon we released our star and headed back toward the diving tender.

He would have none of it. He swam along

A reef bestiary would have to include the two-foot-long unicorn fish. But unlike its apocryphal namesake, whose horn was thought to have real powers, the fish has a real horn but of unknown powers. The fauna of the reef is so diverse that even cataloging it, much less studying it in detail, has yet to be completed.



NASO UNICORNIS

with us, and when we climbed aboard ship, he floated alongside with his head out of water, staring up at us almost pathetically. Ron remarked that he probably wanted to be put back in his hammock, but Vic Ley, one of our divers, disagreed. "No," he said, "he's an old pro now—he wants to edit the film."

FILMING TURTLES underwater, for all their gentle nature, can be extremely hazardous at night. They are both attracted and confused by our floodlights and occasionally blunder from the darkness, crashing into us, the camera, and the light fixtures, often throwing everything into total darkness.

Sharks and their relatives, on the other hand, are seldom a problem. Though some divers fear them more at night, we have been troubled only once, and even then it was more a warning than a real attack. The intruder was a large guitarfish, which Australians call a shovelnose shark, that took to butting Ron very hard in the side and arms. Ron could do little but hold his camera out of

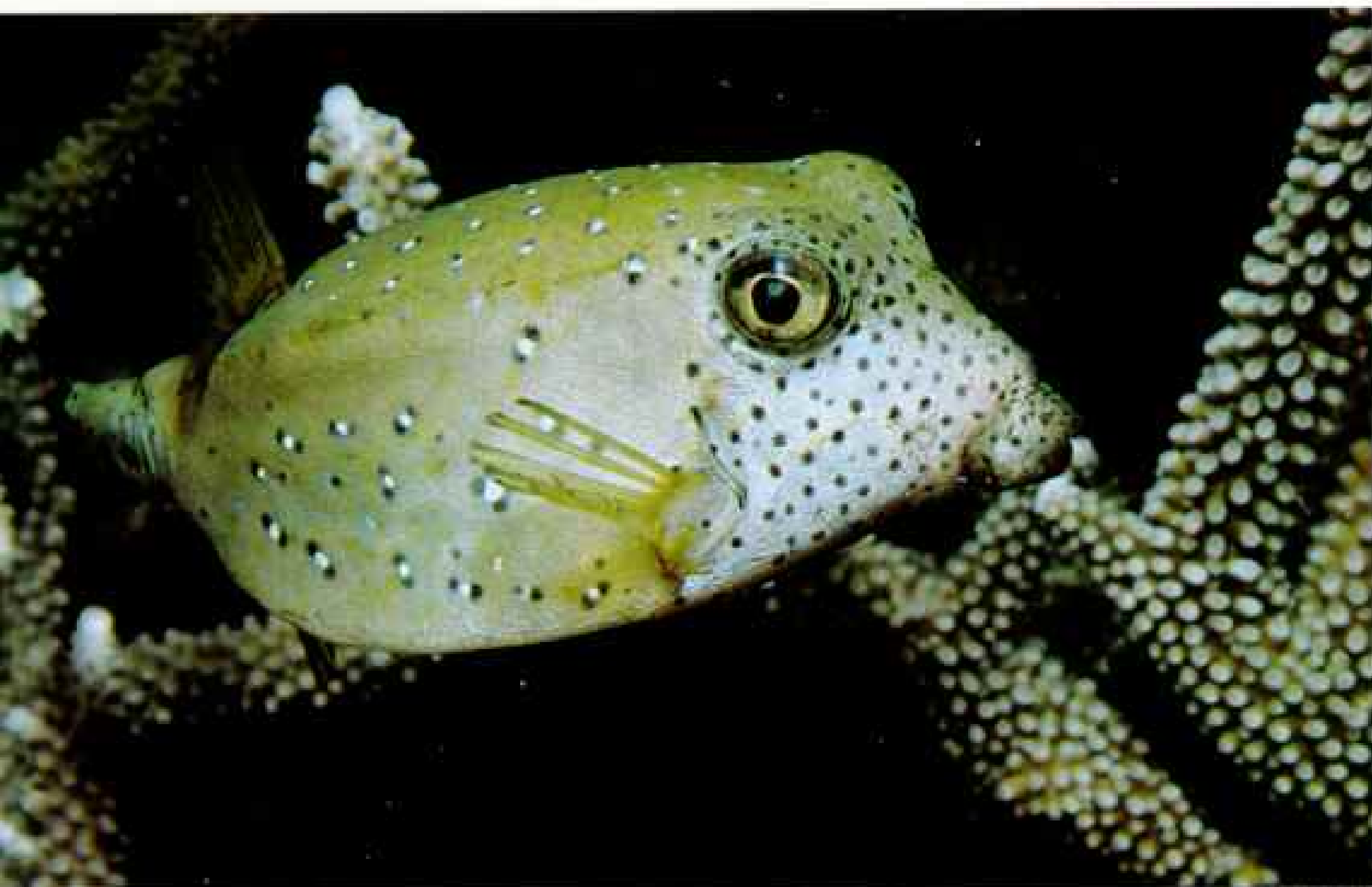
harm's way until the fish tired of the sport. At length it swam off, but Ron had a sore arm and ribs for nearly a week.

The reef at night is utterly different from the same scene in daylight. Once darkness falls, many of the fishes sleep, tucked into coral crevices for protection. It's amazing how little effect our floodlights have on them; they continue to sleep, eyes staring, never moving unless we actually touch or disturb them.

Into this black, silent world strange creatures creep forth—nudibranchs, worms, crabs, starfishes, and hundreds of other species that remain hidden during the day. Under cover of darkness they live, breed, and die, just as their diurnal counterparts do.

Many marine animals are attracted to our underwater lights. Tiny fishes and worms batter themselves to death against the glass lenses, striving as relentlessly as moths against a naked bulb. Why? I don't know. During the day these same creatures hide away, shunning the light. Yet at evening they come

(Continued on page 658)



CETRACION CURRIESI



CAESIO CHRYSOZONUS



TANK with fins, the boxfish (above) comes equipped with an array of bony plates fused into armor.

Another defense is used by the fusilier. When it sleeps at night (middle), its red coloration is broken by splotches. In natural illumination, even in moonlight, the red appears as murky gray, allowing the fish to blend with its surroundings. When startled awake, the fish reverts to coloration (left) that in daytime masks its presence from a potential predator looking down toward the reef or up toward the light.



BEAK of a parrot fish (left) is adapted for scraping coral to get at algae. In the process, just one fish (below) chews coral into 30 pounds of sand yearly. Together, the fish are major builders of beaches.

SCARUS SCHLESSELI



LIVING VENEER on the mass of the reef, corals may be the hard kind, whose skeletons build the reef (**below**), or wispy like a gorgonian (**right**), whose tentacles are open and feeding only on one side. After eggs of another coral are released (**bottom**), they emerge as larvae and float as part of the planktonic soup before attachment.





forth in their millions, their passion for light so great that they give their lives for a few seconds of cold white illumination.

Some nocturnal predators actually use our floodlights as a hunting aid, much as some human hunters jacklight their quarry. Venomous lionfish are particularly prone to snatching up small creatures that suddenly become highlighted by our floods. If I approach a lionfish too closely, I am instantly faced with a full array of its poisonous dorsal spines.

I have heard countless horror stories of swimmers attacked and killed by creatures such as lionfish, stonefish, and the deadly sea snakes of Australian waters. The fact is that these animals are all basically gentle and will attack only when threatened or provoked. The only death from venom that I know of on the Great Barrier Reef occurred years ago to a visitor on the Low Isles. He picked up a live venomous cone shell, perhaps *Conus geographus*, while exploring a tidal pool. Apparently the visitor slipped the shell into his pocket and was fatally stung through the cloth lining.

HAPPILY for visitors to the Barrier Reef, exploring tidal pools is a hundred times safer than crossing a city street anywhere in the world. I have often sat beside a pool for hours, just looking. Delicate as a blown-glass figurine, more beautiful than a casket of gems, an entire ecosystem unfolds beneath the crystal surface, completely unmindful of the huge land creature watching. Tidal pools come in many sizes, some even large enough for swimmers. All are unique in shape, color, and life—complete worlds to their inhabitants, magic living pictures.

Reef walking and tidal-pool exploration are among the most popular forms of recreation on Heron Island. The resort hotel regularly organizes boat trips to neighboring reefs at low tide, but the boat crew is always careful to count noses on the return voyage. Some years ago a guest was left on nearby Wistari Reef to make photographs while the boat explored other areas. He began to realize that he had been forgotten by his companions when the rising tide reached his knees and small sharks started moving in over the edge of the reef.

Fortunately Wistari is dotted with large coral heads thrown up there by long-ago cyclones. The marooned man climbed onto the highest of these and was finally rescued, though not before the water even there was lapping at his feet. Today that same coral head bears the name of the man it saved; Heron islanders call it Roughley's Rock.

Some marine animals in Great Barrier Reef waters are regarded as dangerous simply because of their appearance. One of these is the giant manta, that wonderfully graceful ray that seems to fly rather than swim through the water. Like whales, giant mantas have amazing weight and power, yet they are among the gentlest of large creatures in the sea.*

I recall a day long ago watching mantas off Wilson Island, within the northern sector of today's park. The mantas were leaping clear of the water, propelling their enormous bodies into the air and falling back with a thunderous slapping sound that echoed for more than a mile. No one knows why mantas leap that way, though some marine biologists believe the purpose is to dislodge remoras, or suckerfish, that cling to the manta's hide.

Underwater I have found mantas to be not only gentle but also extremely careful of divers. They appear to know always where you are, and if you come at them abruptly, they will fairly somersault aside to give you the right-of-way.

Ron and I grew very fond of a giant manta we encountered regularly near a coral head about 30 feet deep off Heron Island. We nicknamed her Mildred, and she seemed to accept us completely, hovering in the water with her great nine-foot wingspan while we filmed around the coral head.

One day when we had run out of film but still had air in our tanks, I drifted over to Mildred and idly began scratching her belly. The texture of her skin was about that of coarse sandpaper.

Mildred was ecstatic, and as I began to scratch harder, she slowly sank toward the bottom with me under her. At length I found myself pinned to the ocean floor with her nine-foot bulk draped over me.

*Peter Benchley described "A Strange Ride in the Deep" on the back of a manta ray in the February 1981 NATIONAL GEOGRAPHIC.

I finally extricated myself and found that in the process of scratching Mildred I had not only worn through my nylon gloves but filed down my fingernails as well. Unfortunately Ron was unable to record the scene, but now that I know one of the giant manta's weaknesses, I'm sure we'll eventually capture such a sequence on film.

AMONG ALL the marine animals I have come to know and cherish, none is more maligned than the moray eel. I don't just like moray eels, I *love* them. They have such wonderful personalities and, once they become accustomed to you, charming manners.

Morays can't help having long sharp teeth, and that ferocious-looking opening and closing of the mouth is simply their way of respiring. True, they will sometimes bite if severely provoked or frightened, but what creature, marine or terrestrial, won't do the same? In all our many years together Harry and Fang have been the gentlest of friends.

I met them both in 1971, when we were

filming a television series entitled "Barrier Reef." Much of the filming was done off Heron Island around the largest of its "bommies," as Australians call a submerged coral head. Among the bommie's permanent residents were two moray eels who frequently found themselves on center camera during the show. Over a period of several months they became quite blasé about underwater floodlights, whirring cameras, and countless diver-actors invading their home.

I don't recall how we began feeding and handling the morays, but that, too, was a gradual process. We called one of them Harry, after a friend, and Fang earned his name from a single tooth exposed by a deformed jaw—probably the result of an encounter with a fishhook.

In time the two morays and I became fast friends, so much so that I felt almost complete freedom with them. Once I even pulled Harry (below) from his lair, swam 40 feet to the surface with him, and held him out of the water to show three children in a dinghy how gentle a moray can be. Harry probably



MORAY, *LYCODONTIS FLAVIMARGINATUS*

The trouble with Harry is only his tough-guy looks. Valerie Taylor has known this same moray eel for ten years and asserts: "He is not dangerous. Harry will take my whole hand in his mouth and not leave a mark." As with many animals, however, morays become aggressive when provoked.



WILDLY variable in color, the reef clam (left) grows to about a foot in length. Its iridescent mantle is pigmented in part by symbiotic algae called zooxanthellae, which help provide it with oxygen and food.

Nudibranchs come in almost every conceivable color and pattern from orange and blue stripes (below) to cream with red fringes (right). To discourage predators, some nudibranchs that feed on sea anemones incorporate the stinging cells of those animals into their own skins.

TRIDACNA MAXIMA (ABOVE); *TAMBURA AFFINIS* (BELOW); *CASSELLA ATROMARGINATA* (OPPOSITE PAGE)





hated the experience, but he suffered it without a wriggle—something many divers find difficult to believe.

During the times when I carried him, Harry developed the habit of using my body as a private lair, tucking his head under one of my arms as I wrapped them around him. There is no mystery in all this, only the simple equation of patience, gentleness, and perhaps an occasional tidbit offered with affection. There are few creatures, including man, who don't respond to it.

I still see Harry and Fang occasionally when I visit their Heron Island bommie. They are celebrities now, but I'm glad to say they haven't forgotten their old friends. In fact Harry and I recently appeared in a wide-screen film special. He was a little rusty at first and took a bit of time getting used to the lights and camera, but after a while he settled down and performed beautifully.

NOT ALL CELEBRITIES on the reef are as docile as Harry and Fang. Ounce for ounce, John McGree's clown fish is probably the toughest character I know. John encountered him several years ago while diving on a reef near Heron Island, and he occasionally introduces the clown fish to special friends.

John is a tug captain and former charter-boat operator who has been diving off Heron and neighboring islands for nearly 30 years. Ron and I saw him again recently at a diving contest on Heron Island, and he offered to introduce me to the clown fish.

"I visit him every time I come to Heron," John said. "He lives in an anemone on one of the reefs, and he's hell on trespassers. As soon as he sees me coming, the little rotter rushes out of his anemone and bites me on the finger, just to let me know whose territory I'm in."

Sure enough, when at last we located the anemone, the fish was waiting. He darted out and bit John on the finger so quickly I couldn't even photograph the attack. John was obviously delighted, and it moved me to

think that a man with nearly 30 years' diving experience could be so proud of being recognized and bitten by a two-inch fish.

John is not alone, as I discovered a few weeks later. With his permission I introduced the clown fish to Ron's and my great friend, Sir Peter Scott, the distinguished naturalist and chairman of the World Wildlife Fund. Sir Peter and his wife, Lady Philippa, are strong supporters of the Great Barrier Reef Marine Park, and when I mentioned John McGree's clown fish, Sir Peter insisted on meeting him.

The clown fish did John proud. No respecter of titles, he streaked from his anemone and bit Sir Peter on the finger, not once but twice. It quite made that famous man's day, and on our return to shore he announced to his wife: "My finger was savagely attacked by a two-inch clown fish, but with Valerie's help I managed to escape."

Among the park's many visitors none is more devoted to preserving its natural treasures than Sir Peter. On countless dives I have seen him turn over live shells that have been capsized by other divers and replace clumps of coral that have been knocked loose. An artist as well as a naturalist and experienced diver, he becomes so absorbed sitting on the bottom and sketching fishes on his underwater pad that he is genuinely astonished when his air finally runs out!

I OFTEN THINK nowadays of my retired schoolteacher friend and her discovery of a new world under the sea. Like Sir Peter Scott, John McGree, Julie Vincent, and many others, she had found that world not only fascinating but worth a certain sacrifice—in her case a ruined outfit she could probably ill afford.

But for such enthusiasm and effort the Great Barrier Reef Marine Park would never have been born, nor could it be preserved against the dangers that still threaten it. With the world's help and with a few more like my schoolteacher friend, I have a feeling the reef will survive. □

Room service comes to a Heron Island bommie as a diver brings a sack of food to hungry customers. Such feeding is allowed at only a few park locations to limit disturbing the natural order of the community of creatures, all residents in the most colossal structure built by living things.



I am the bait in an experiment with an old idea—a chain-mail suit—put to a new use. Can it fend off the bite of a shark? In waters off the California coast, I coax a blue shark into cooperating. Despite 15 years of filming sharks with my husband, Ron, I cannot shake my apprehension as the razor-edged jaws close in for the strike.

A Jawbreaker for Sharks

By VALERIE TAYLOR







RON TAYLOR



MY GLEAMING ARMOR was Ron's idea, inspired by steel-mesh boning gloves worn by knife-wielding butchers. "That material might work against shark teeth as well," he declared. Codeveloper and friend Jeremiah Sullivan, a marine biologist, found a manufacturer in Massachusetts, Whiting and Davis, whose craftsmen welded 150,000 stainless-steel rings into a covering weighing some 15 pounds (*above*).

We tested the suit off San Diego, California. Lured by fish baits, several blue sharks

circled. Eyeing a mackerel in my hand, one closed in. I snatched back the fish and shoved my arm in the shark's gaping mouth (*above*). The jaws slammed shut as the shark tore at my elbow, whipping my arm from side to side. I waited for the blood and pain, but there was none. The mesh had defeated the destructive, sawing motion typical of the blue shark's bite.

The suit worked! But those sharks were six-foot blues, far from the sea's largest. We needed to experiment further to know how it would hold up against other species.



JEREMIAH S. SULLIVAN

We had our chance while diving in the Coral Sea off Australia. An assistant speared a cod to lure sharks into filming range. Half a dozen six-foot gray reef sharks moved in. With bait in hand I swam into a frenzy of snapping jaws and contorted bodies. The sharks were all around me—torpedo shapes, gray against blue—moving faster than my eye could follow.

Suddenly I felt a blow and heard a terrible grating noise. A shark had grabbed me by the face, ripping away my air hose. I turned toward Ron, unable to see because my mask

had flooded. Groping to find my mouthpiece, I surfaced, but was too weak. The weight of the suit dragged me down.

Blackness began to overtake me when Ron jammed the mouthpiece in my face. I gulped air and sank down, unable to move, shaken, bruised—but alive.

Back on the boat we examined four neat tooth punctures in my chin. The teeth had pierced the gap where the hood meets the suit. A tiny tip of tooth remains embedded in my jaw, where it will stay as a reminder of the day a shark bit my face. □

Pakistan

By WILLIAM S. ELLIS
NATIONAL GEOGRAPHIC SENIOR WRITER

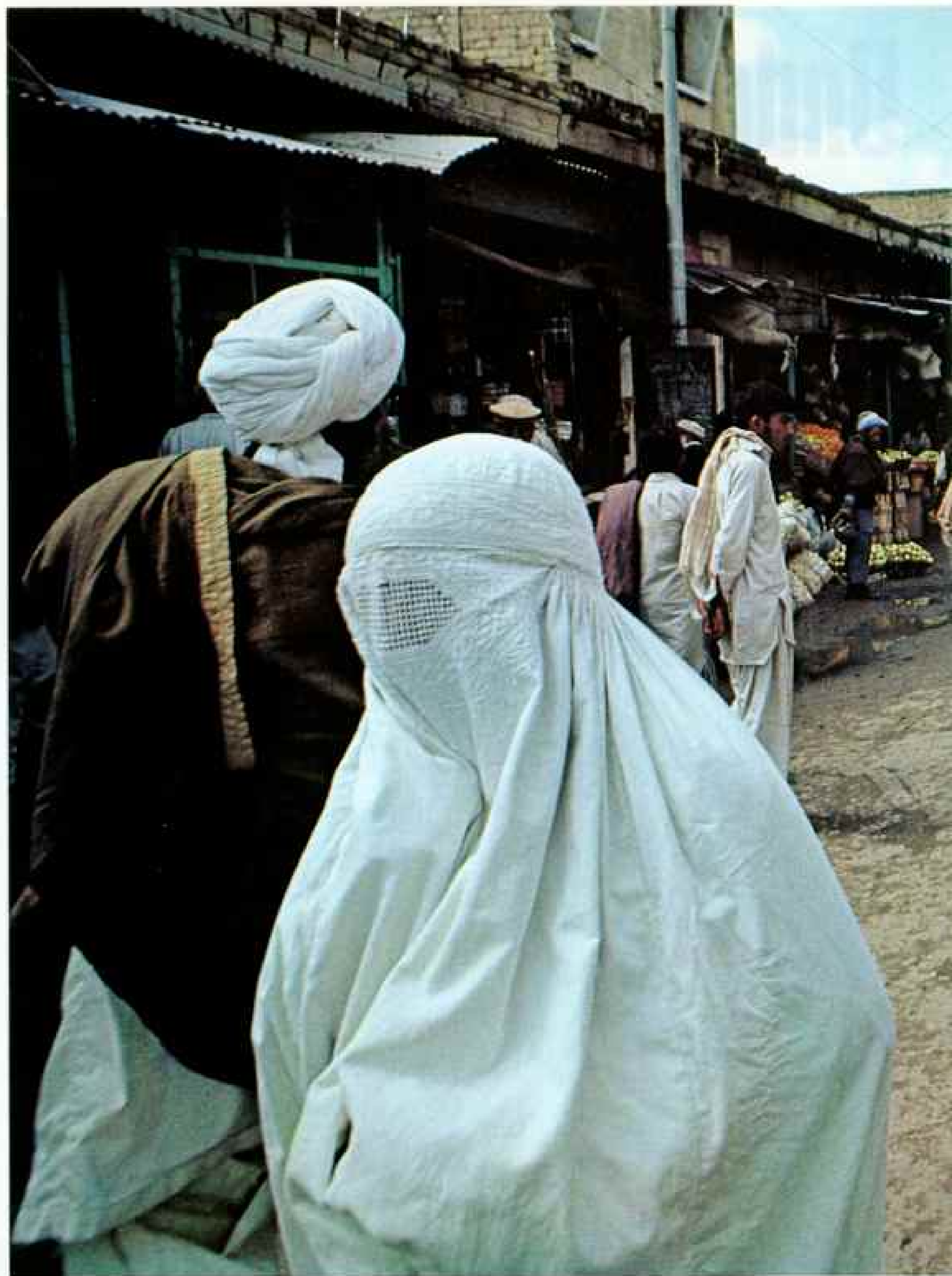
Photographs by
JAMES L. STANFIELD
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Bundled against the predawn chill, Pathan tribesmen of Pakistan guard the legendary Khyber Pass; its dual roads separate camels and cars. An avenue of conquest for Persians, Greeks, Turks, and Moguls, the pass now serves as an escape route for refugees fleeing Soviet invaders in neighboring Afghanistan. Close by the U.S.S.R., and sharing borders with Iran, China, and India, strategic Pakistan walks with measured tread.

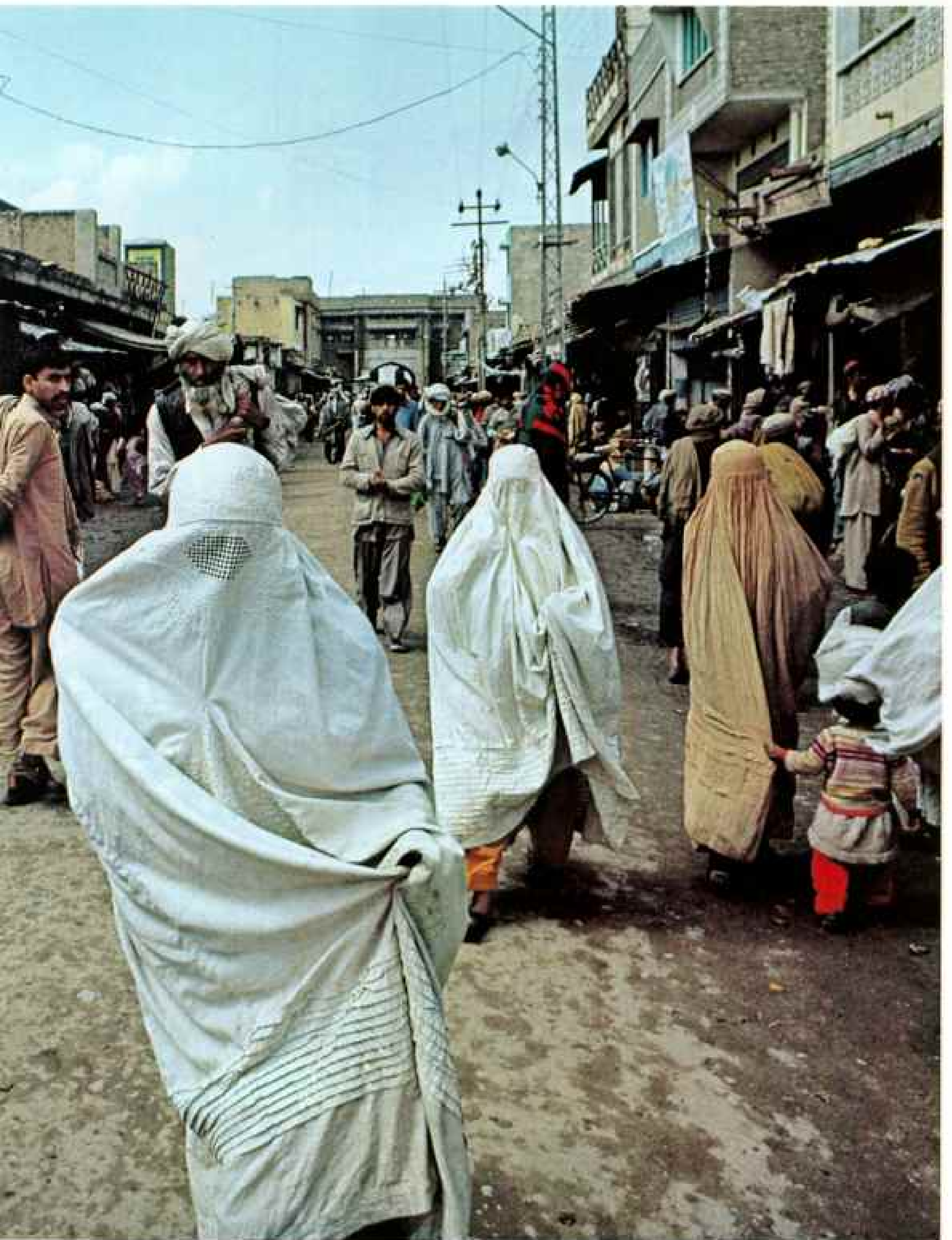


Under Pressure

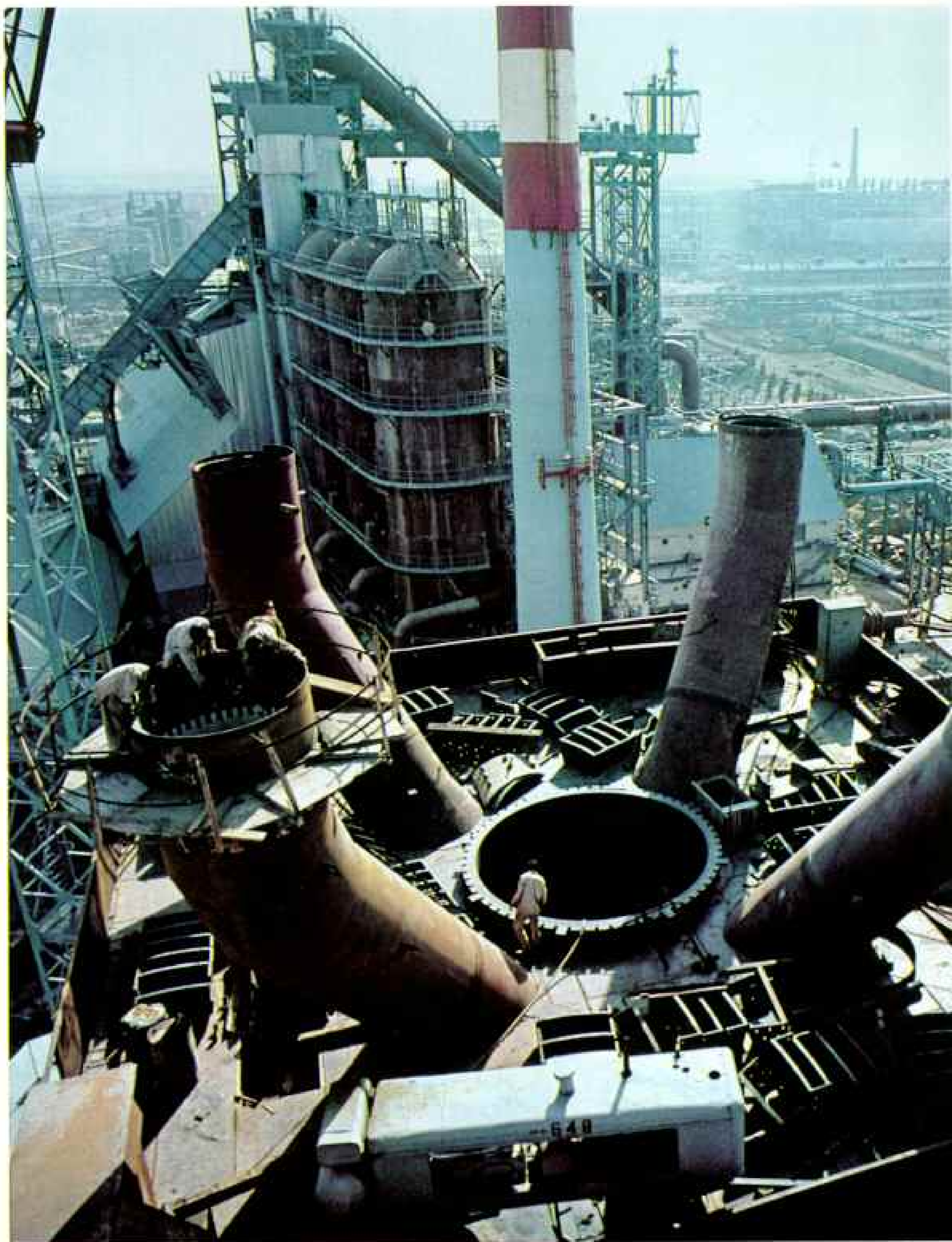




Veiled women shopping in Kohat represent the Muslim heritage of Pakistan, which sees itself as a leader of Islam.



In the cities, women enjoy greater freedom and opportunity, becoming teachers, journalists, doctors, and diplomats.



Looking both East and West, Pakistan turned to the Soviet Union for materials and know-how to build



its first iron-and-steel mill near Karachi. Supersonic Mirage fighters bought from France are refitted in Kamra.

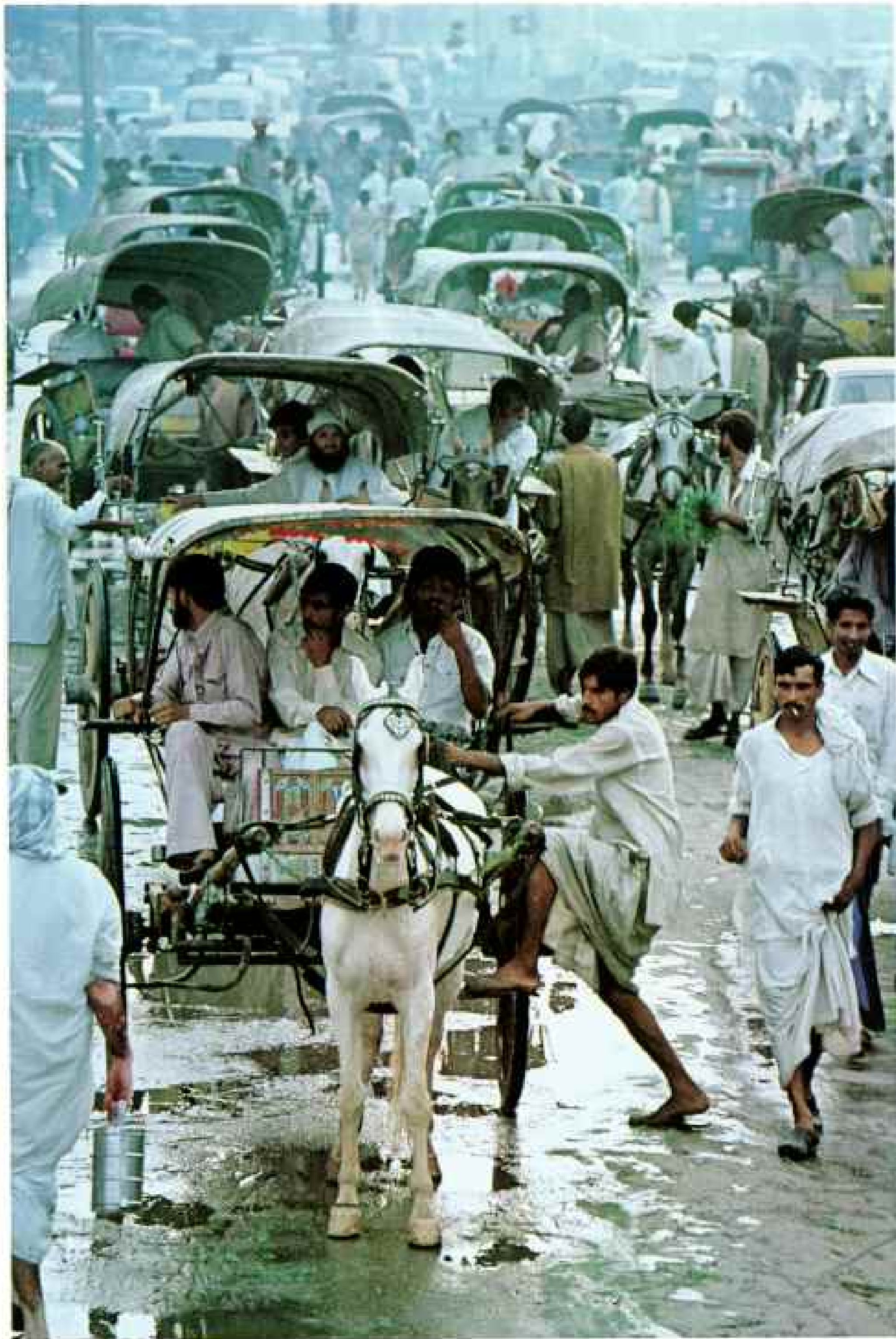


Nimble fingers tie knots—nearly 200 to the square inch—to fashion a carpet in Quetta. These girls

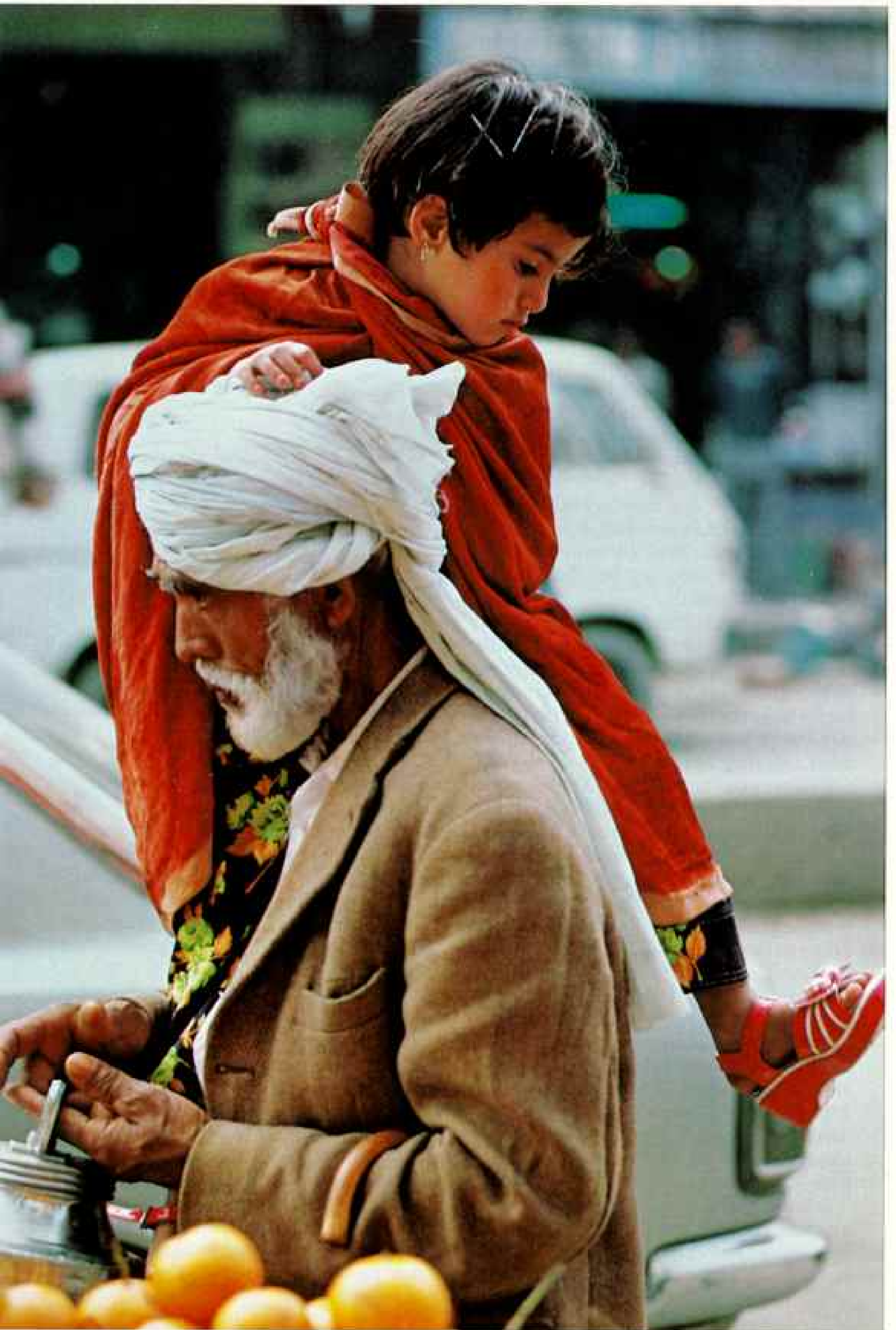
National Geographic, May 1981



train to teach others. With the decline in carpet exports from Iran, Pakistan labors to fill the breach.



In steaming Lahore, where summer temperatures can climb to 115°F, horse-drawn taxis called tongas afford a breath of comfort. Perched on her grandfather's shoulder in a Rawalpindi bazaar, a girl admires her bright new shoes.



SHE HAD LIVED behind the veil for most of her 25 years, and now, in death, she lay covered by a red-and-gold blanket.

Probably it was her grandest possession, that blanket, and when the services were over—when the words had been spoken and the body committed to final rest—it would be returned to her family and perhaps one day be passed along to the son born to her in the final minutes of her life.

She died in exile, in Pakistan. As one of the estimated 1.5 million persons who have

Pakistan Under Pressure

fled across the border since Soviet troops entered Afghanistan late in December 1979, she had taken up residence in a makeshift camp in the rugged North-West Frontier Province of Pakistan.

With her tribesman husband, a Pathan, she had trekked more than a hundred miles to the camp, and that cost her the strength needed for childbirth.

She had made the crossing in winter, when heavy snows in the high country thinned the ranks of refugees as they attempted to escape bombings and strafings of their villages by moving east until the mountains were behind them. But even on the other side they were dogged by bitter cold.

So it was on this morning. The four men carrying the body pushed against a chilling wind as they walked out of the camp, across the road, and along a dirt path to a hillside burial site more than a mile away. There were but few gentle words of remembrance in the graveside eulogy. Rather, the speaker exhorted those in attendance to vow to drive the Russians from Afghanistan. He cried for revenge. The hawk-faced Pathan tribesmen replied as one: Revenge would be theirs.

As the second anniversary of the invasion approaches, cries of outrage have softened, and the presence of 85,000 Soviet troops in Afghanistan has taken root. For those opposed to the spread of Soviet influence, one blessing may be counted in all of this: Neighboring Pakistan has survived.

Seldom in its short and troubled history as a nation has so much worldwide attention been visited on Pakistan as it was during the early phases of the turmoil in Afghanistan.



The Western world embraced Islamabad—Pakistan's gleaming modern capital—and whispered of delicious things forthcoming: aid and arms and nourishments enough to make the country a rock of strength. Or, failing that, to get the armed forces in a position where they could handle border skirmishes and put down any Soviet-inspired tribal uprisings within the country.

Then, as now, Pakistan was under martial law imposed by the military regime of President General Mohammad Zia ul-Haq. The press was censored, and the jails held hundreds of political prisoners. Waves of unrest and anger over the execution of former Prime Minister Zulfikar Ali Bhutto surged through the cities.

To some it was a question not so much of whether Zia and his government would fall, but rather when. The question went begging, for today the president has moved into a new position of strength. The economy,



Pall-covered body of an Afghan refugee woman is borne from the Aza Khel refugee camp to burial on a knoll more than a mile away. The woman died in childbirth, but her infant lived. Afterward the men of the camp engage in afternoon prayer (below). One and a half million Afghans have sought refuge in Pakistan since the Soviet Union sent troops into their homeland in late December 1979.



"Peanuts!" said President Mohammad Zia ul-Haq when he spurned a U. S. offer of 400 million dollars in aid after the Russians invaded Afghanistan. Standing beneath a portrait of Mohammad Ali Jinnah, founder of modern Pakistan, Zia speaks to a conference in Islamabad. The former general came to power after a coup in 1977.



gravely ailing three years ago, has improved to the point where the gross national product is among the fastest growing in southern Asia. Zia himself has gained prestige by acting as a mediator in the Iran-Iraq conflict. He has gained the confidence of China. He has won the admiration of conservative Muslims for his determination that Pakistanis shall adhere to the harshest of Islamic laws. And the Soviet presence in Afghanistan has helped to rally the nation's people behind him.

For all of that, Pakistan still seems an unlikely choice as a bulwark against Soviet expansion on the Indian subcontinent. Yet this is a role only Pakistan, geographically, can fill.

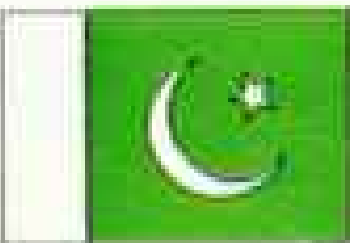
Pakistan was created in 1947 as a separate Muslim state carved away during the partition of India. The bond of Islam, however, was not strong enough; 24 years later the eastern portion of the country, separated by more than a thousand miles of Indian territory, broke away to become Bangladesh. The gap between the two cultures—predominantly Punjabi in the west, Bengali in the east—was too vast to be bridged by a shared faith.

What remains is a country with a landmass equal to that of Texas and Ohio combined. In the south the provinces of Baluchistan and Sind share 500 miles of Arabian Sea coastline. The North-West Frontier Province and the portion of Kashmir now under Pakistani control carry the country to the breathless heights of the Hindu Kush and the Karakoram mountains. A fourth province, the Punjab, abuts India north of Sind. And through much of the land runs a deep warrior tradition.

A Troubled Land Can Still Enchant

There was great bloodshed during the partitioning of India, and again when Bangladesh wrenched itself away. Indeed, has not Pakistan in all 34 years of its nationhood come to be synonymous with tragedy? War, hunger, poverty, and the shattered dream of uniting 120 million Muslims; all that, and yet there is a magic about this place.

It is a magic of landscape, for one thing, of mountains, including K2, that punch through the clouds to heights of more than 25,000 feet, and deserts where the highest



Pakistan

Since partition from India in 1947 as a Muslim state, the country has been intermittently wracked by turmoil: riots, coups, and wars. Yet, under the martial law of the current regime Pakistan experiences relative stability in politics and expansion in commerce.

GOVERNMENT: Republic. **AREA:** 803,943 sq km (310,404 sq mi). **POPULATION:** 87,381,000. **RELIGION:** 97 percent Muslim; Hindu and Christian minorities. **ECONOMY:** Exports textiles, rice, cotton, carpets, and leather goods. **CITIES:** Karachi, 7,000,000; Lahore, 3,500,000; capital Islamabad, 150,000. **CLIMATE:** Arid south, mountainous cool north.



AFGHANISTAN
Fighting helicopter gunships with rifles, Afghan guerrillas have put up a determined resistance against Soviet troops that invaded their homeland in December 1979.

Largest and least developed of Pakistan's provinces, Baluchistan lies between Soviet-occupied Afghanistan and the warmwater ports on the Arabian Sea.

Occasional incursions by Soviet aircraft into Pakistani airspace seem to be a test of nerves.

Pakistan and India have fought twice over Kashmir. India claims the region to its western boundary and into China—a red dotted line.

● Refugee settlement areas sheltered 1.4 million Afghans by January 1981.

DRAWN BY JANE WOLFE
BASED ON TERRAZZO DATA
COMPILED BY MARGUERITE S. HUNTER
NATIONAL GEOGRAPHIC MAP DIVISION



thing aboveground is the hump of a camel. There are lakes stained pink with flocks of stately flamingos, and valleys called Swat and Hunza where the play of breezes in flowering apricot trees is a grace note to the gurgle of sweet and glistening river waters.

There is a magic, too, of people and history. With a present population of 87 million, Pakistan not only fills but overflows the Asian mold of massed humanity. In the streets of the major cities of Karachi, Lahore, and Rawalpindi the throngs are like human slipknots as they manage barely to escape anatomical entanglements. And somehow, in those same streets, with horns butting and blaring, water buffalo dispute the right-of-way with '68 Chevys.

It is not unsavory chaos, however, for it all seems as a reflection of the times when this land was crowded with the legions of emperors, and with merchants who traded in the riches of the Orient. One walks here in

the footsteps of Alexander the Great, and in the paths of caravans that carried silk and gold, ivory and jewels to and from China.

Change has come slowly to Pakistan, and because of that, there is a lingering sense of the drama of the past—especially in Peshawar, sprawled upon a plain east of the Khyber Pass.*

Here is a city where the streets are paved with shards of history. Many believe that Herodotus referred to it in the fifth century B.C., calling it Kaspaturus, but it may well have been there even before that, as provocative and colorful a place as could be found in all of Asia. Great armies came to grief in and around Peshawar at the hands of tribesmen that Herodotus called "the most warlike of all." They were probably ancestors of the Pathans.

*Mike W. Edwards described this region in "An Eye for an Eye: Pakistan's Wild Frontier," in the January 1977 NATIONAL GEOGRAPHIC.



A warrior mentality stalks the highlands, where "just about everybody carries a gun," says author William S. Ellis. In Landi Kotal, bodyguards attend Pir Yaqub Shah (above), an administrator who helps settle disputes of Khyber Pass tribesmen. A storefront armory in Bara (above right) sells bullets, shotgun shells, and "fountain pen" guns that can fire a single slug. While a sole nuclear power plant (below) provides electricity for Karachi, the country's arms policy remains an international question mark. Is Pakistan building a nuclear bomb?





Fury's aftermath, charred vehicles and a diplomatic pouch are the debris from an attack on the United States Embassy in Islamabad on November 21, 1979. Inflamed by rumors that the U. S. had backed an assault on the Sacred Mosque in Mecca, a Pakistani mob smashed walls and broke down doors, torching everything. The embassy staff took refuge in a top-floor security vault. Pakistani troops arrived five hours later to rescue the staff, who had retreated to the embassy roof. Two Americans and two Pakistani clerks died in the attack.

Pathans of the Afridi tribe are the custodians of the Khyber Pass, and Peshawar its gateway city. So it has been all through the centuries, at times when Kushan, Turk, Mongol, Mogul, and others spilled through the passes with conquest in mind. The Afridis have never been truly conquered, not even by the British in the days of empire.

Pareshan Khattak, then chairman of the department of Pashtu studies at Peshawar University, said that the history of the Pathans passed down in writing amounts to little more than a quiltwork of fabrications, starting with the Moguls' account of how the first tribesmen were offspring of a hundred Chinese women impregnated by a giant.

"They were supposed to have been the most beautiful women of that time, and they were on their way to Persia for service in the

emperor's harem," Professor Khattak said. "Somewhere along the way they met the giant, and by the time they got to the emperor, they had to tell him they were no longer suitable for his harem. He ordered them out of the country. They went to Afghanistan, and there, according to the Moguls, the first Pathan was born."

Pathans Make Their Own History

Other fictions followed, in most cases concocted by the Pathans themselves.

An early chronicler made a case for their being related to the Jews, Professor Khattak told me. Another tradition holds that they are Aryans.

Professor Khattak believes that the original home of the Pathans was in the Sulaiman mountains in the west-central part of the

country. Outsiders, mostly invaders, who adopted the language and culture were accepted into the society, and the numbers increased until it became the largest tribal society in the world. With more than ten million members, it remains that today.

In the Khyber Pass on a day in January of last year, I walked with a group of Pathans along the main road toward the town of Landi Kotal. They talked of a shooting several weeks earlier, and when I asked if anyone had died, one man replied, "Forty." It was a matter of revenge, he told me, and therefore permissible under the Pathan code of justice. It is part of a life-style they call *pashtunwali*, or the way of the Pathans, and it is structured on dignity and pride.

The Pathans are concerned that Soviet forces might come through the Khyber Pass in quest of a warmwater port, perhaps at Gwadar or even Karachi.

The elders among them who bedeviled the British during the days of empire have also heard that it is not the same now. Her Majesty's rifles were one thing, but the Russians could come with rocket-armed helicopters and tanks that run at 50 miles an hour. It would be too much for tribesmen to handle, sitting atop a brown, craggy hill in the pass, squeezing off rounds from their homemade copies of a .303 Lee-Enfield.

Meanwhile, activity at the border crossing in the Khyber continues as usual. People in droves are moving back and forth between the two countries, while off in the distance trains of camels and donkeys freighted with refrigerators and television sets plod along the smugglers' route.

Money changers are seated in a line on the Pakistani side, fingering stacks of paper currency gone grimy and tissue thin with age. They sit facing the sun, and when the third one from the end smiles, the light dances on a tooth of gold. Generally he smiles at the conclusion of one of his transactions, as indeed he should.

There is a discernible pattern to the traffic across the border. They come from Afghanistan with empty sacks and satchels, and they return with bodies bent low under the weight of their purchases (rice costs twice as much in Afghanistan as it does in Pakistan). A boy of no more than five made three crossings in less than an hour, each time filling a

five-liter tin with cooking oil. He would deliver the oil to an Afghan merchant who would dump it into a large tank and then send him back across the frontier for more, and back again until the tank was filled.

On his last trip the boy was stopped by a border guard who cuffed him smartly across the cheek. He was a Pathan, but being only five or so, the spirit of *pashtunwali* had not yet taken hold of him. So he cried.

The border is often referred to as the Durand Line, after Sir Mortimer Durand, the foreign secretary of the Indian government who in 1893 signed the agreement with Emir Abdur Rahman for a line of demarcation between British India and Afghanistan. The boundary meant little to the Pathans then, and it means little to them now. They come and go as they please, for their loyalty is not so much to nation as it is to tribe. Many say they will have their own nation one day, and they will call it Pashtunistan. But even if the Russians encourage tribal nationalism, they are not likely to win favor with the Pathans—Communism stands too alien to their fiery devotion to Islam.

The same cannot be said of another tribal society in Pakistan.

Not All Tribes Fear Invasion

"If we heard that the Russians were going to invade Pakistan tomorrow, we would send them a cable saying please do not wait that long. Come today."

His name is Jamil Bugti, a tall, heavyset man with a beard the color of topsoil. He is 31 years old and the second-born son of Akbar Khan Bugti, chief of the 100,000-member Bugti tribe centered in Baluchistan Province. The Baluch, too, find fealty to tribe more important than nationhood.

"The younger Baluch, you have to understand, are much more radical than their parents," said Jamil. "They are saying, OK, the elders have tried for more than 30 years to win our rights, and it hasn't worked. So if the Russians come in, we will join them."

"We are Muslims, but we are not fanatic about it. I was born a Muslim, I will die a Muslim. That's OK. But Islam plays no role as far as Baluch politics is concerned."

"We ask ourselves what has Pakistan done for us, and the answer is they've killed 8,000 Baluch men, women, and children."



Splendid new capital, begun by a former president, rises at Islamabad. A presidential home at center dominates. While work continues (right) on

Bugti, of course, speaks for only a portion of the tribal population in the province. In northern Baluchistan, for example, most of the tribesmen are Pathans, and they tend to put themselves apart from Baluch unrest. Still, Bugti's sentiments are widespread.

For four years, from 1973 to 1977, there was a war in Pakistan that gained little notice in the world. On one side was the Pakistani Army of highly trained soldiers, on the other Baluch irregulars. They fought in the bleak hills of the sprawling province in the southwest corner of the country. Before the guns were silenced—not by a truce but a cease-fire only—close to 10,000 had died. The bitterness remains.

The Baluch population spills over into Iran, as well as into southern Afghanistan, and it became a source of irritation and concern to the late shah that the dominant political party in the adjacent Pakistani province was not only demanding greater autonomy but also was, in his view, pro-Soviet. He complained to the then Prime Minister Ali Bhutto, and because Iran was pumping money into Pakistan's debt-ridden economy, Bhutto acted by dismissing the elected provincial officials. The war, also aimed at breaking the power of the tribal leaders, began shortly after.

"Most of the Baluch boys who were fighting in the hills from bases in Afghanistan have not come back," Jamil Bugti told me.

"There are three or four thousand of them still out there. They will come back when the time is right. You see, it's not a peaceful situation in Baluchistan. It's just a cease-fire. The troubles could start up again any day."

In recent months President Zia has made frequent trips to Baluchistan, speaking to the tribesmen and promising them a greater share of the country's wealth. Indeed, the government late last year gave financial compensation to the heirs of those killed during the 1973-77 war. And a general amnesty was declared for the Baluch fighters who had remained in hiding.

Still, Western nations worry about possible Soviet intrusion into Pakistan. Baluchistan has almost 400 miles of southern coastline washed by the warm waters of the Arabian Sea. And the Arabian Sea leads to the Strait of Hormuz and the Persian Gulf.

It is not a hospitable route to the sea, however. Baluchistan for the most part is an arid plateau humped with reddish hills aswirl in dust. Temperatures range from below freezing in winter to above 100°F in summer. There are also extremes in the geology of the province: In May of 1935 an earthquake virtually destroyed the provincial capital of Quetta, killing more than 20,000 persons.

I arrived in Quetta in winter, on a morning when the smoke from a convention of coal fires cast a gauzy pall over the city. The cold of the night before had caused extensive



fountains and gardens to landscape the residence, head of state Zia lives in a simple house in nearby Rawalpindi and reportedly may decline to move.

damage. Many of the water pipes in the city had burst, cars stood abandoned with crippled blocks, and Lourdes Hotel, Quetta's finest, ran short of the kerosene needed to fuel the room heaters.

In Quetta, unlike Fort Lauderdale, people do not devote much of their conversation to the weather. They talk instead of camels gone lame, of pride and disappointments in firstborn sons, of tribal chieftains who travel to London for medical treatment. They talk of the Punjab and how they resent its privileged status among provinces.

Population and Power Centered in Punjab

Of Pakistan's four provinces, the Punjab holds the great bulk of population. The queen city, Lahore, is there, as is the national capital of Islamabad.

It is in the Punjab that the ghost of British rule does its heaviest haunting—from the tall, erect Punjabi soldier with Sandhurst bearing to the government functionary speaking in Oxford-accented English. In the cities the three-piece suit is as much a fashion as the baggy trousers and the turban.

The construction of Islamabad began in 1961, and by the end of that decade it had taken over the role of national capital from Karachi and from the interim seat at Rawalpindi, only ten miles away. They are called twin cities, Rawalpindi and Islamabad, but they hold scant resemblance to one another.

Rawalpindi is an old cantonment city. The new capital is a study in orderliness, of white office buildings set in striking vistas against the Margala Hills.

Islamabad is not without its scars, however. Enraged by rumors that Americans had backed the seizure of the Sacred Mosque in Mecca, thousands of Muslims marched on the U. S. Embassy in November of 1979. The 21-million-dollar complex remains a blackened shell, and staff members operate elsewhere in the city. Eight months before the burning, the U. S. suspended almost all aid to Pakistan because of evidence that the nation was secretly building a uranium-enrichment plant, possibly for the purpose of producing nuclear weapons.

Pakistan denies the charge, but evidence has mounted in recent months, pointing to a possible testing of a nuclear device within two years. Meanwhile, U. S. aid remains under suspension, except for an offer of 400 million dollars made at the time of the Soviet intervention in Afghanistan—an offer Zia dismissed as "peanuts," or in Urdu, the nation's official tongue, *mumphalli*.

Lahore, the nation's cultural center, was Pakistan's prized inheritance at the time of partition. Had the boundary with India not been drawn just 15 miles from the city, it likely would have been designated the Pakistani capital.

The grandest era in Lahore's 2,000 years



Solid opulence—a marble floor, fine carpets, and a tapestry from Bangkok—characterizes the living room of textile magnate Jehangir Azam Monnoo of Lahore. Educated in business administration at a Tokyo university, Monnoo runs a business begun by his father after partition, producing yarn for both domestic use and export to Hong Kong and Japan.

The Lohari Gate, straddling a thoroughfare in the old city of Lahore (right), is the remnant of a Mogul fortification that girded the entire city. Under the Moguls art and architecture flourished; magnificent gardens and mosques were created. The Badshahi Mosque, at top left, was built by the emperor Aurangzeb in 1674.





of history, when Mogul emperors held court in palaces of marble, lasted from the late 16th century into the 18th. The Moguls swept down out of central Asia to conquer India, and their legacy still survives. They left a finery of architecture. They left pavilions and halls of mirrors, waterfalls and gardens sweetened by the fragrance of a thousand exotic blooms. They left to Lahore an enduring aura of regal character.

The centerpiece of the Mogul period is Lahore Fort, a palace complex begun by the emperor Akbar. It was later added to by his son Jahangir and his grandson Shah Jahan, whose taste in architecture ran to creations that are made magical in moonlight, for it was he who built the Taj Mahal.

Shah Jahan was also responsible for the Shalimar Gardens, 40 acres of magnificent landscape where the emperor and his family took their ease in the shade of mango trees. It is a place where water cascades over marble spillways, and where 400 fountains raise cooling umbrellas over lakes and canals.

Both the palace fort and the gardens were neglected and abused by the Sikhs, who followed the Moguls as the rulers of the Punjab until their defeat by the British in 1849. For example, those warrior converts from Hinduism cut down the trees for firewood and carried off marble and decorations from the Shalimar Gardens for use in their own buildings. But restoration has gone well, and although elephants bearing ladies of the court in gilded howdahs are no longer a part of the scene, Lahore is still very much a showcase of Mogul genius.

Islamic Law Governs All

As in most countries with a history of riot and revolution, student activity is closely monitored in Pakistan—and more so in Lahore, home of the nation's oldest university, than in most cities. And what are the students saying, now that Pakistan is on the front line of the upheaval in Afghanistan?

This:

"It's good that the West wants to help us now, but they should have done that long ago. Anyway, it isn't so much the Russians that I worry about. Our problem, it seems to me, is on the other border. I don't think for a minute that India is going to let China, the United States, or any other country

make Pakistan a fearsome military power."

And this:

"Just yesterday I saw an officer in the Pakistani Air Force wearing one of the coats sent here for the Afghan refugees. It was shameful. But then you have to stop and consider how far we've come as a civilized nation. The answer is pretty clear when you realize that the government has resumed the practice of flogging prisoners in public. How do you Americans feel when you give money to a regime that promised free elections but gave us the stave instead?"

One of Ali Bhutto's last acts as prime minister was to institute severe Islamic laws in the country. General Zia has since moved to further tighten government control over the manners and morals of the people.

Consider:

- Any liquor found in a traveler's luggage is confiscated until he leaves the country.
- Public flogging is permitted; at times a microphone is placed before the criminal so that his moaning and cries of pain can be heard by the assembled crowd.
- Gory penalties for serious crimes are now lawful, although not a single doctor in the country seems willing to inflict the most gruesome: amputation. (Muslim Shia and Sunni sects also disagree on a thief's sentence: Shias maintain the fingers should be cut off only to the first knuckle, thereby allowing the punished to continue to help himself from the communal food bowl. Sunnis say the hand should come off at the wrist.)
- In July of last year the government announced it would collect a 2.5 percent tax on savings accounts over a certain amount. This tax, known as the *zakat*, would then be distributed among the poor, as the Koran prescribes. Many in Pakistan (mostly those who will be required to pay the tax) claim it should be voluntary.
- Judges of the Supreme Court, high courts, and the federal Shariat court are now to be addressed as "Sir" and "Janab Wala," instead of "My Lord," and they will wear traditional black sherwanis and Jinnah caps while attending court and official functions.

All of that has brought about a certain tension in Pakistan, and one must flee the crowded cities to escape it. The village of Bahrain in the Vale of Swat is a fine place to go. There, where mustard fields sit under

clouds of sassy bees, I met a merchant who offered me treasures of the world at prices I could afford: a star sapphire from Nepal, a stone carving from a first-century Buddhist stupa, an ancient coin from the realm of an obscure caliph of Baghdad.

I asked if they were genuine, and he rolled his eyes to heaven.

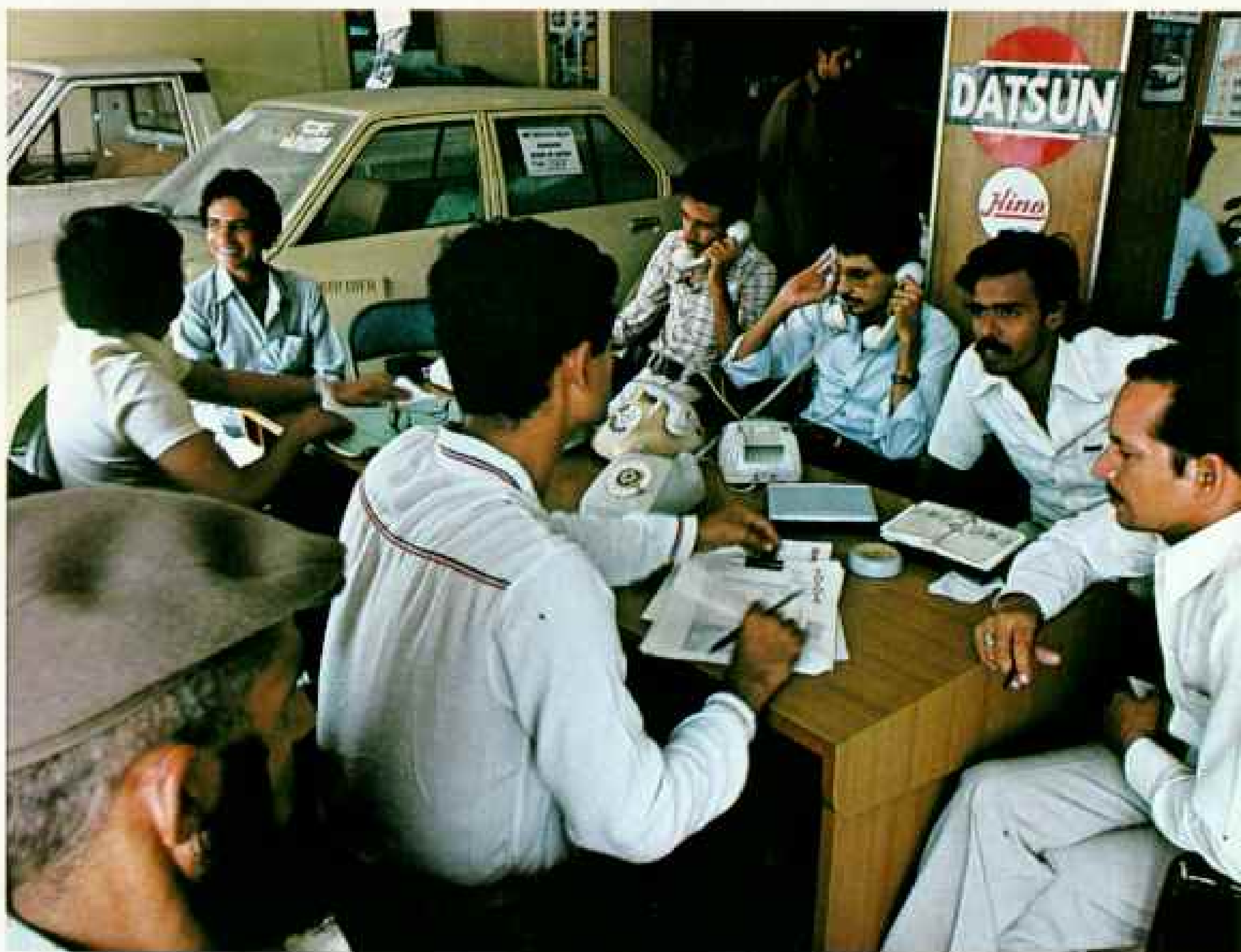
It would serve no purpose to reveal my choice, for the pain of the appraiser's report is still with me. A wise man, of course, would have gone for the stupa piece, considering that a great Buddhist civilization once flourished on this land. As long as 1,600 years ago the valley was described in the chronicles of Chinese pilgrims who trekked here in fulfillment of religious obligations.

There were more than a thousand stupas

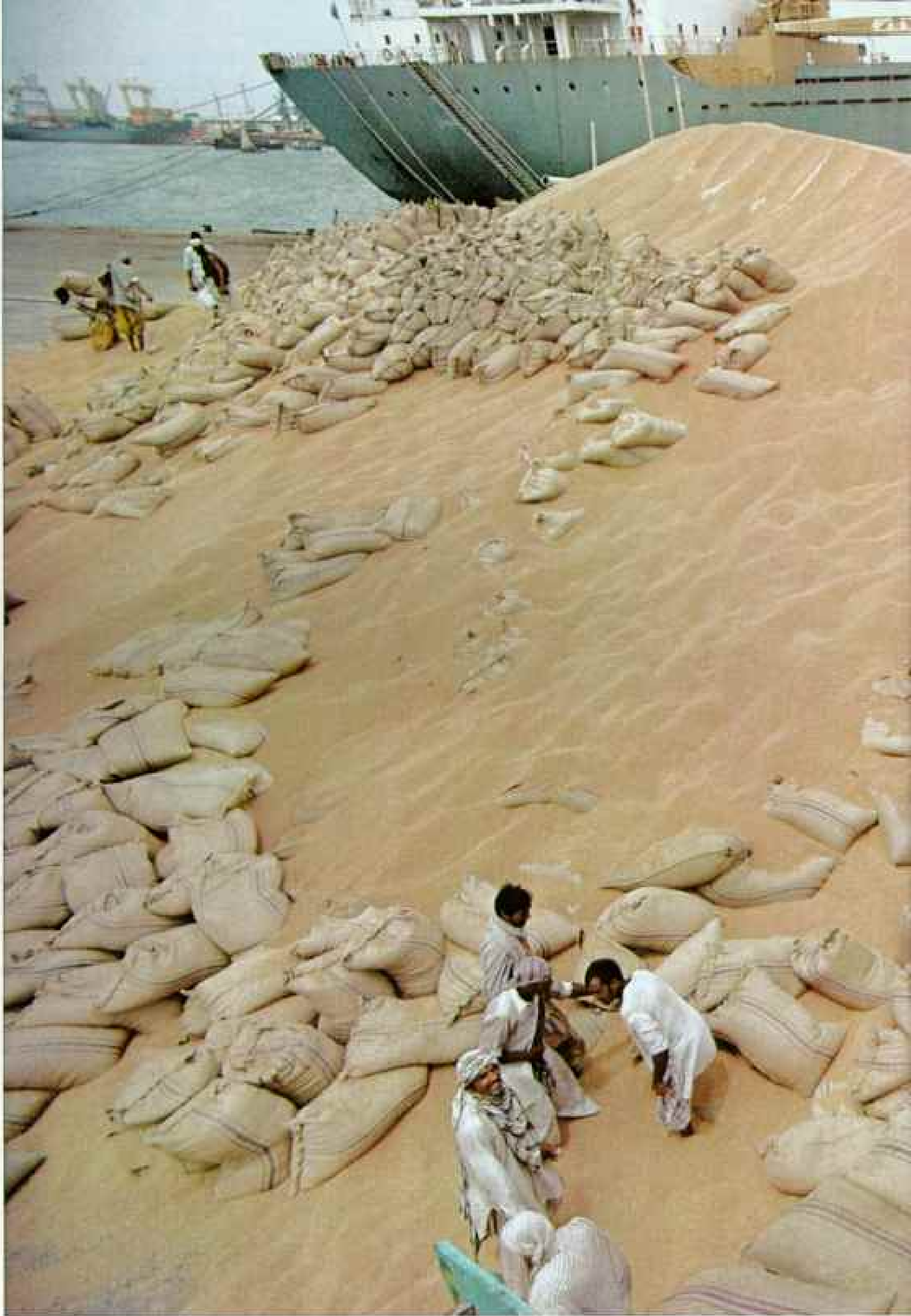
and monasteries in Swat when it served as a major center of Buddhist learning and worship. The fields are full of the ruins today.

The Chinese pilgrims would have a much easier time of it now. They could travel the Karakoram Highway linking Pakistan and China. This remarkable feat of engineering took 20 years to complete at a staggering cost in both money and lives. It follows a branch of the old Silk Road across the top of the world, threading through some of the most rugged terrain on earth.

Starting at Havelian, 62 miles north of Rawalpindi, the all-weather highway runs in the company of the Indus River for several hundred miles before pushing through Hunza and on up to the Khunjerab Pass for a crossing into China's Xinjiang region. At



Salesmen scramble to answer phones and take care of customers as another load of Japanese cars arrives at Bukhari Motors in Karachi. Japan has nearly cornered the market on imports. Yet in this country where the per capita income is less than \$300, only well-off businessmen and merchants can afford to buy.



Piled on a wharf in Karachi, Canadian wheat pumped ashore by huge air-driven hoses is laboriously bagged and carried to a truck. Nearing self-sufficiency in wheat



production, Pakistan still imports for reserve stocks. A government program stimulates agriculture through price supports, credit, and subsidized fertilizer and seeds.



the border the highway is at an altitude of 15,400 feet above sea level.

Travel on the Karakoram Highway is not for the weakhearted. Rocks loosened by the blasting at the time of construction frequently pummel the road. Just as frequently the fallen rocks restrict passage to the lips of drop-offs, from where wide and rushing rivers in the valleys below appear as scratches on the land. It can take an hour to travel just

one mile on the Karakoram, and only a second to depart it.

Pakistani and Chinese engineers worked together to build the highway. When it was formally inaugurated on June 18, 1978, it was hailed in Islamabad as "a symbol of Pakistani-Chinese friendship and cooperation." It was stressed that this costly penetration into the remote and isolated regions of northern Pakistan would bring the tribes



there into the mainstream of national life and would promote prospects of increased trade and tourism.

But no mention was made of the fact that the bridges on the highway were constructed to specifications allowing for passage of heavy military equipment, such as tanks. In today's course of events, with the Soviet Union and China at odds, with Pakistan and China in warm alliance, and with the three,

No clothespins are needed to fasten the wash at Dhobi Ghat—the washermen's place—in Karachi. Twisted clotheslines separate to hold the clothes. Some 2,000 washermen collect laundry, steam it in caldrons six feet wide, and beat it on slabs of stone—an unintended testament to the sturdiness of Pakistani textiles.

together with Afghanistan, tied in a knot of boundaries not many miles from where the highway goes through the pass, this 500-mile-long retrace of the old Silk Road is of immense strategic importance.

Roads in Pakistan are like that. Paved with intrigue. Roads chockablock with buses and trucks so lavishly decorated with sparkling gimcrackery that they look like circus calliopes. Desert roads that carry drug-laden cars in the night.

Pakistan has become a major artery in the

vast and sinister network of international narcotics traffic. "Until four years ago, the Golden Triangle of Southeast Asia was the leading producer of opium for export," Reza Husnain, former director of operations of the Pakistan Narcotics Control Board, said. "But that distinction now belongs to the Iran-Afghanistan-Pakistan area, and the disturbances in the first two mean that Pakistan's potential may be exploited further."

Until recently, Husnain explained, most of the opium was grown in Afghanistan and marketed through Pakistan. "Now it is the other way," he said. "Not too long ago we intercepted 250 kilograms of morphine being transported on a road from Quetta to Iran. Hauls of such size were unheard of before the troubles in Afghanistan and Iran."

In addition to that, he said, the closing of the opium shops has added to the problem. Under British rule, and continuing until February 1979, a Pakistani could purchase as much as 23 grams of opium a day from licensed vend shops. The closing of the vends, it is believed, has left from 100,000 to 150,000 addicts with little choice but to turn to a now flourishing illicit market.

"We have all those factors working against us," Husnain said. "In addition, our laws having to do with drugs are lenient compared to those of, say, Iran. If we are to keep this thing from getting out of hand, we have to come down hard now, as we are starting to do."

According to Husnain, his country's annual production of opium normally ranges from 200 to 300 metric tons.

"All around there are countries in turmoil, and so Pakistan is left to fill the gap as far as providing narcotics is concerned," Husnain said. "It is a very serious situation, and it has even started to result in the spread of addiction here. In northern Pakistan now you can find whole villages on hashish or opium."

The use of opium seems to be heavier in the villages than in the cities of Pakistan. In the largest city of them all, Karachi, the sweltering, swollen hub of the nation's industry and commerce, the apathetic stupor of an addict would go little noticed amid the bustle of millions of people in movement.

Seven million now live in Karachi, with another 500,000 added each year. By the end of the century this Arabian Sea port city



"My ribs like rafters. . . ." So the young Gautama Buddha, after a period of asceticism, described himself. A third-century sculpture of the "Fasting Buddha," one of Pakistan's most valued artistic treasures, reposes in the Lahore Museum.

Mud walls of family compounds in a village (right) near Quetta attest to the desire for privacy. Wheat and tobacco fields lie fallow till spring.





In topsy-turvy Hunza, a part of disputed Kashmir, the only level land seems to be fields terraced by farmers, who raise fruits and grains. Creasing the mountain at left and spanning the Hunza River on a single arch, the Karakoram Highway threads 25,000-foot mountains to link Pakistan with China. Bridges along the route are strong enough to support military traffic, including tanks.

may well overtake Calcutta as the most populous place on the subcontinent.

"We simply cannot keep pace with what is happening here," said Umar Yusuf Deda, deputy mayor of Karachi. "Our major problems are transportation, water supply, and housing. A third of the city's population lives in substandard housing."

A century ago Karachi was barely more than a settlement of fishermen. But, sitting on what is perhaps the finest natural harbor



on the southern coastline, it grew as only a port city could at a time when ships were the workhorses not only of the international trade but also of travel.

"I sailed to Karachi from Bombay 30 years ago," said an old man who was peddling oranges from a pushcart. "It took 36 hours and the fare was two dollars. My grandfather made the same trip in 1920 for 50 cents." We talked for several hours, and when he sold the last of the oranges to a

woman who kept her money knotted in the corner of a handkerchief, he invited me to his home for tea.

"As you can see," he said when we approached his house, "it is only a hut. I have lived here since I came to Karachi in 1950." It was a boxy structure of one story with a concrete floor, and frayed gray blankets hanging over the openings between the two rooms. On one wall was a picture of Clyde Beatty holding a raised chair in the face of a

snarling lion. A kerosene heater offered up a smelly breath of warmth.

"My five children are still home, so there are seven of us living here," he said. "Three of the five are sons, and they will take care of me when I can no longer work, *Inshallah*. Still, I suppose I will live in this hut until I die. Do you know the man in the picture, the one who looks in the mouth of the lion?"

In 30 years of working the streets, the old man had filled his mind and memory with snippets of data concerning Karachi. He presented them in the manner of an alderman speaking to members of the sixth-grade class on their visit to city hall:

- There are 1,000 camel carts and 7,000 motorized rickshas in Karachi.
- Ten percent of the city's population is "wealthy," 25 percent "medium," and the remainder "hand-to-mouth."
- A young camel sells today for about \$300 in Karachi.
- The lower caste Hindus who chose to remain in Karachi after partition now hold the lowliest of jobs.

Of the wealthy in Karachi, there is a small group called the Parsi. They are Persian-descended followers of Zoroastrianism, and over the years they have become highly successful in trade and commerce. Also represented in Karachi are some of the famous names of the textile industry.

Traditional Industry Still in Lead

On the outskirts of the city, at a place called Landhi, there is a sprawling complex of buildings where a work force of 3,700 produces textiles under the Adamjee label. Before Pakistan's textile industry fell on bad times because of growing import restrictions in Western countries and labor problems at home, the mill employed thousands more, and the ear-shattering drive of the shuttle looms was even louder.

Textile production remains Pakistan's leading industry, although money sent back by Pakistanis working in other countries

accounts for the largest source of foreign exchange. Most of the 155 mills in the country are still under private ownership, having survived the tide of nationalization started in the early 1970s.

Karachi's port operation is under control of the federal government, and so is the steel industry. The former is over a hundred years old, the latter now about to become operational. The firing of the first blast furnace of Pakistan's only integrated iron- and steelworks is scheduled for late this year.

The new plant, located on a coastal site 25 miles from Karachi, is part of a large industrial complex that includes a new port to handle imported iron ore and coal. The Soviet Union supplied the plans for the mill and the expertise to build it. Construction began in 1976 with hundreds of Russians in attendance as advisers and supervisors. Four years later, when I visited the site, there were still more than 500 of them there to oversee the work and the training of Pakistani steelworkers.

I was introduced to an engineer from Minsk, and as we were shaking hands, I thought of the irony in the encounter: Only two weeks earlier I had sat in a tent in a refugee camp near Peshawar and listened to five tribesmen from a village 35 miles across the border relate how they had killed two Soviet soldiers.

They would be leaving the camp in a few days, they had told me, to go back into Afghanistan and continue the fight. They had thoughts of digging a hole in a road near their village, camouflaging the opening, and then waiting with the hope that a Soviet tank would come along and fall in.

I remarked that the wait could be a long one, and I expected the reply to be rooted in the Asian strength of patience, something along the order of "Time is on our side." But no. They said I was right, that in terms of wasting valuable time, it was too risky.

They decided instead to cut some of the lines feeding electricity to Kabul. □

"I am 108 years old," says Wazirzadah Ali Murad of Hunza. Called "Joonu," he claims to remember the British invasion of 1891 when he served in the Hunza militia, though no supporting records exist. Joonu contentedly cradles his great-great-grandson and smokes a hookah—a world away from the cares that vex modern Pakistan.



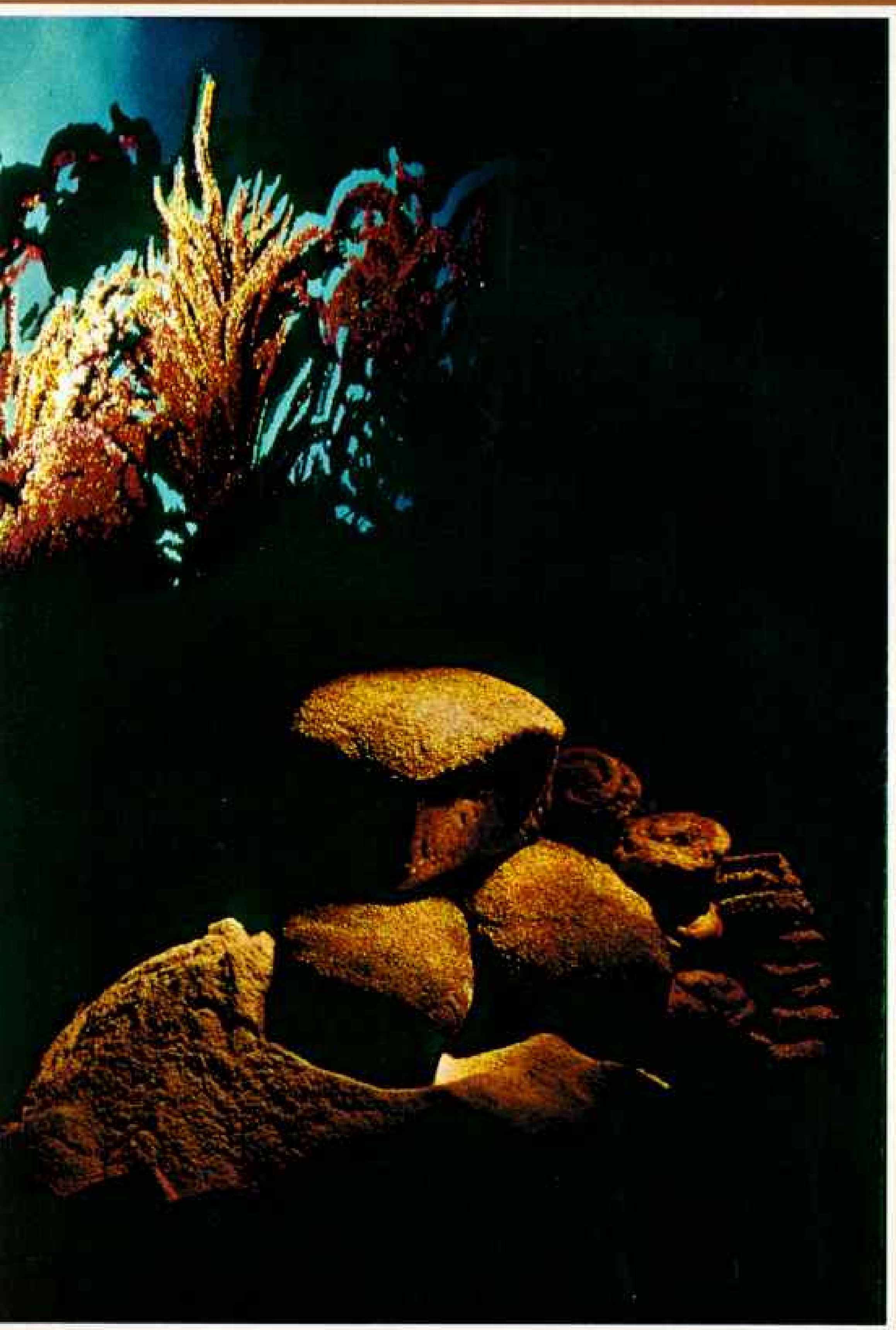


REDISCOVERING AMERICA'S
Forgotten Crops

Sacred food of the Aztecs, amaranth stalks hold as many as half a million seeds, source of a nutrition-laden flour that yields the bread and other bakery goods seen here. Many such plants, long known to native Americans, await rediscovery for food and industry.

By NOEL D. VIETMEYER

Photographs by BURGESS BLEVINS



"WE APACHES like to think of ourselves as fighters, not farmers. But from now on I think we'll be both." I was listening to Ned

Anderson at an International Jojoba Conference held at Riverside, California. He is chairman of the San Carlos Apache tribe, whose lands sprawl over almost two million acres of the Arizona high desert east of Phoenix and north of Tucson.

Ned has university degrees in both law and business, and although he wears a suit, he is clothed with Indian culture and character too. His conclusion about his tribe's future is formed by remarkable new discoveries regarding jojoba, a shrub that grows wild on Apache lands.

Until recently jojoba's virtues were known mostly to Indians. But products from jojoba (pronounced ho-HO-ba) could soon be lubricating motors, waxing floors,

softening leather, moisturizing skin, cooling transformers, feeding livestock, improving penicillin manufacture, and performing a lot of other jobs we ask of petroleum derivatives. It also could be a savior of farms that are faltering and failing in the Southwest as irrigation costs skyrocket, and even a way to prevent extinction of the sperm whale.

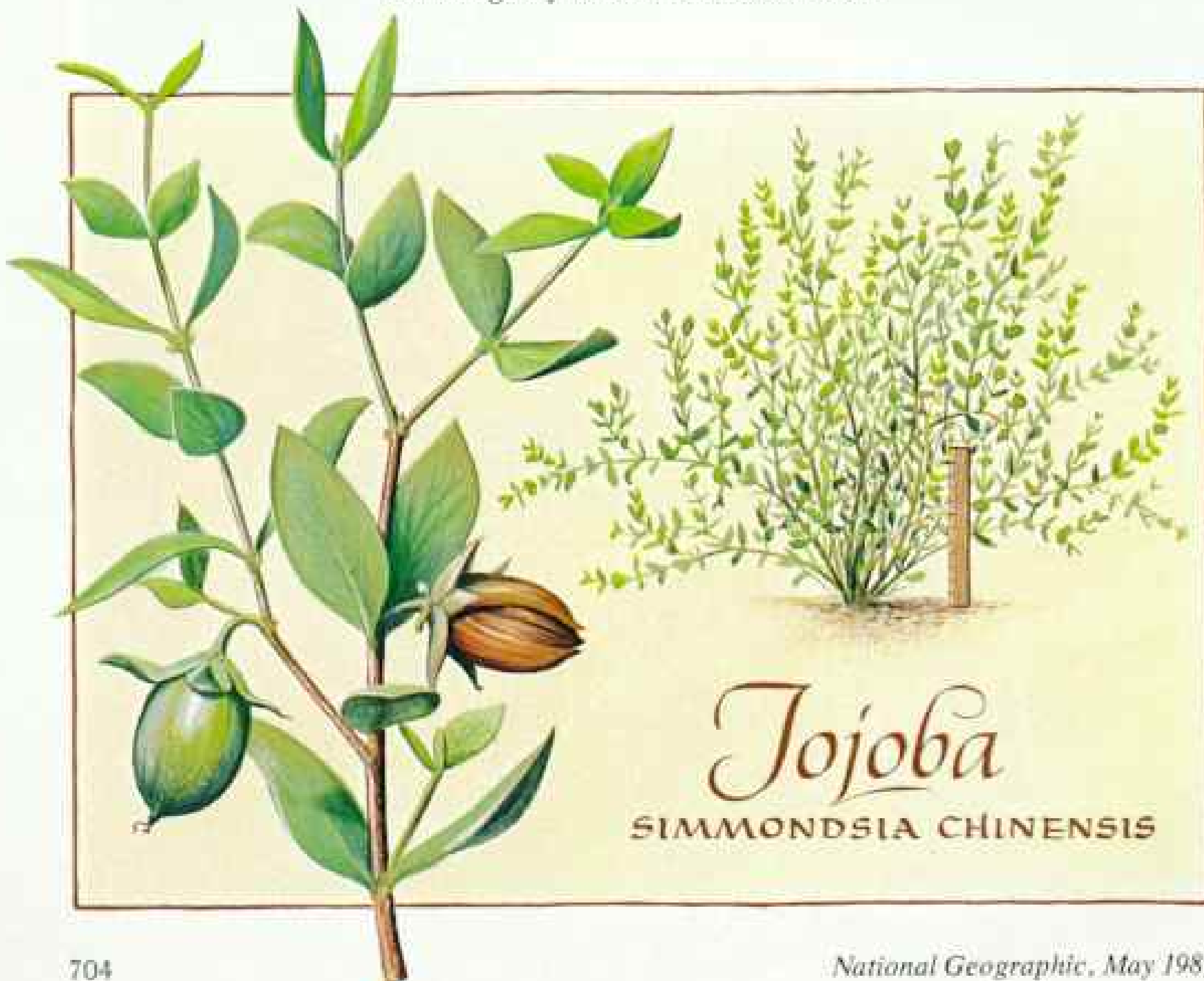
Jojoba (*Simmondsia chinensis*) is among dozens of former Indian crops that today lie unloved and untended within our borders. Some are so astonishingly useful that you can't help wondering why we non-Indians haven't discovered them before.

As a professional associate of the National Academy of Sciences, I study plants like these, which are little known but offer great potential. In addition to jojoba, the most promising include a rubber-rich shrub known as guayule, the drought-resistant tepary bean, and two other nutritious but neglected vegetables, the groundnut and the amaranth. Plants from Arizona, southern California, Pennsylvania, Maryland, and New Brunswick, Canada, were sent to an



Jojoba distribution

Paintings by PAUL M. BREEDEN



Jojoba
SIMMONDSIA CHINENSIS

Guayule

PARTHENIUM ARGENTATUM



artist for use as models in creating the paintings on these pages. A 12-inch ruler appears in each to show scale.

After Ned's speech I visited a five-acre jojoba field planted by Dr. Demetrios Vermanos of the University of California in dry bottomland near Palm Springs. The four-year-old shrubs were chest high, and many bore among their gray-green leaves the acorn-size seeds (left) whose oil is creating all the excitement.

Indians, who have long roasted jojoba beans for "coffee" and used the oil as hair-dressing, spearheaded the drive to bring the crop into modern agriculture. The leader has been William P. Miller of the Bureau of Indian Affairs, a handsome Cherokee who won a silver medal in the javelin throw at the 1952 Helsinki Olympics.

"Indian reservations in the Southwest harbor some of the worst pockets of poverty in the nation," he explained. "The land is useless for conventional crops; often two-thirds of the work force is unemployed. In five or ten years jojoba could bring self-sufficiency to reservations that have depended on federal services for a century."

For five years Ned Anderson and the San Carlos Apaches and other tribes in California scoured their sere slopes and handpicked enough seed to fill a tank car with jojoba oil. "By supplying samples to hundreds of industries," Ned told me, "we hoped to create a market."

It worked. So great is demand that in 1980 the San Carlos tribe received as much as \$3,300 for a barrel of jojoba oil—the yield of a single well-tended quarter acre.

Non-Indians from California to Texas have now planted more than 9,000 acres. The crop is not yet a commercial success; frost intolerance, unsuitable soils, the lack of advanced varieties, and the five years the plant requires to bear seed make it an uncertain investment. But scientists have sunk a taproot that could grow an industry in this decade.

When that happens, so will an amazing paradox: Plantations baking in the desert sun will protect sperm whales in the chilly ocean depths. Jojoba oil virtually duplicates







FOMELY SHRUBS able to thrive on a minimum of water could open large tracts of the Southwest to profitable use. Seeds of the jojoba (above) yield a liquid remarkably like sperm whale oil—used for everything from automobile transmissions to airplane engines. Cosmetics firms are among jojoba's best customers.

Raw bales of rubber and a tire made from guayule (left) are reminders that in 1910, before depletion of wild stands in Mexico, the guayule plant supplied half of U. S. rubber needs. As prices rise for petroleum-based synthetic rubber, the shrub's value is bouncing back.

the oil of the sperm whale; indeed it is far purer. With jojoba oil available in quantity, the whales should be able to live to old age unseared by explosive harpoons.

Nature's global garden contains hundreds of thousands of species, yet only about 150 are intensively cultivated. It seems inevitable that researchers will in time find many others of importance.

Rubber exemplifies what can happen. Until barely a century ago the rubber tree hid in the Amazon jungle, the secrets of its sticky sap known only to Indians. But today the United States imports almost a billion dollars' worth each year. Because synthetic substitutes made from petroleum are getting more costly and because the newly popular radial tires require increased amounts of natural rubber, demand is already overstretching supply, and prices have more than doubled over the past five years. A graceless, twiggy, knee-high shrub called guayule (*Parthenium argentatum*, page 705) could relieve the tension.

This desert relative of the sunflower grows wild only in the Chihuahuan desert of southwestern Texas and north-central Mexico. Indians have long chewed its stems to extract the rubber for making game balls. In 1910 guayule (pronounced gwy-oo-lee) factories on both sides of the border provided half the rubber used in the United States. Guayule rubber is essentially the same as that taken from rubber trees, but in recent decades few whispers of its promise have been heard.

That is, in the United States. In Mexico guayule is already well into a comeback. In the adobe town of Saltillo in the southern part of the arid state of Coahuila, Dr. Enrique Campos-Lopez leads an aggressive young team of guayule researchers.

"We have more than two and a half million acres of harvestable guayule in Mexico," Dr. Campos-Lopez told me. "It made this area relatively wealthy early in the century and during World War II."

Dr. Campos-Lopez guided me through a new half-million-dollar pilot factory. Baled shrubs arrived from the desert to be pulped like pines in a paper mill. From a yellow maze of pipes and tanks emerged the dark brown rubber, in bales so heavy I could barely lift them.



Groundnut

APIOS AMERICANA

Dozens of tires molded from these bales have been successfully tested in Mexico. The Goodyear Tire & Rubber Company in Akron has run a guayule radial through two Ohio winters, and it passed all endurance and speed tests.

While I was in Tucson, I set out to visit the Papago Indian Reservation to stalk one other desert plant still used by a handful of Indians. Named the tepary bean (*Phaseolus acutifolius*, right), it's got some university researchers jump-



ing, but this mild-tasting bean is otherwise unknown to agricultural science.

Gary Nabhan, a researcher in ethnobotany at the University of Arizona, joined me, along with Cynthia Anson, who works through Meals for Millions Foundation to encourage Indians to cultivate their highly nutritious traditional foods.

Seventy miles west of Tucson we towed a cloud of desert dust into the tiny village of

Big Fields. A mule eyed us moodily as we sought out Eloise Velasco and her brother Juan Lorenzo, who are among the last Papagos to retain their forebears' ways of farming. Eloise chuckled unbelievably when she learned I'd come to see her beans.

To the east, the Baboquivari Mountains lay across the desert like a protective iguana keeping out civilization. Sunlight spilled over the mountains onto Eloise's bean field in an ocher floodplain. The tepary plants shone healthy and green, though only one rain had fallen since Eloise, Juan, and their mule planted them.

"The bean is one of the most drought- and heat-adapted food crops known," Gary told me. "Also, the seeds contain more protein than most commercial beans, and they produce in quantity. After a downpour tepary plants literally kill themselves producing beans before the desert soil dries out."

Among other long-overlooked Indian crops my particular favorite is the native groundnut (above).

From the Gulf of Mexico to the Gulf of St. Lawrence, Indians esteemed the root of *Apios americana*. Wampanoags shared it with the Pilgrims, who knew it as the

groundnut (a confusing name now, since it is also used for the peanut). We owe a lot to this plant, for it helped save the Plymouth colonists during their first grim years.

Sir Walter Raleigh's colonists collected these tubers on North Carolina's Roanoke Island in the 1580s and sent some home to Queen Elizabeth, probably giving rise to the myth that Sir Walter introduced the potato to Europe.

Near the scene of Raleigh's ill-fated colony, I spied the distinctive flowers, which look like light brown wisteria blossoms. I scratched the damp sand and up came groundnuts strung on roots like beads on a string: five, six, even ten in a row, an inch or two apart. In an area the size of a breakfast table, I found 70 tubers. Nodules on the hair roots house bacteria that turn the air's nitrogen into ammonia, an excellent fertilizer.

I had to admit that the tubers didn't look appetizing. I boiled them in salty water, mashed them with butter, and found them smooth and delicious, every bit the potato's equal. But how nutritious are they? Groundnuts are legumes, related to soybeans and peanuts, two very nutritious

foods. I submitted some to the U. S. Department of Agriculture for analysis.

I once thought of root crops as exclusively starchy foods. But a call from the Department of Agriculture dispelled this notion: My groundnuts contained 13 percent protein by dry weight—almost three times the amount found in potatoes or in any other widely used root vegetable. No wonder the Indians appreciated the groundnut!

Another plant the Indians cultivated was amaranth (*Amaranthus hypochondriacus*). The seeds of this ancient crop were so revered that Moctezuma II, the great Aztec king, received 200,000 bushels in annual tribute. I was introduced to their delights by Robert Rodale.

Rodale, a farsighted, philosophic man, is narrowing the chasm between organic gardeners and agriculture-school graduates by publishing books and magazines on organic gardening. The amaranth fitted his interests. In 1974 he was able to get fresh seeds from Mexico for experimentation. They



UPHOLDING a near-vanished tradition, elders on the Papago Indian Reservation in Arizona still cultivate and eat the remarkable tepary bean (right). Richer in protein than most legumes, it thrives in the parched Southwest, often maturing after only one or two rains.

Equally shrouded in obscurity, *Apios americana* (below) helped sustain the Pilgrims and other colonists during their first years in America. The legume, whose lemon-size tubers were known as groundnuts or Indian potatoes, grows wild along rivers and lakes throughout much of eastern North America. Tasting like real potatoes, the tubers contain three times as much protein.







grew so well and showed so much potential that he decided to breed a better amaranth and get it into the American diet.

I visited the Organic Gardening and Farming Research Center near Maxatawny, Pennsylvania, where Rodale researchers guided me enthusiastically through experimental plots covering an area

larger than two football fields. "In two to three years we'll be on the threshold of a new crop," said Dr. Richard Harwood, the farm's research director.

Standing waist high and requiring little care, amaranth produces massive

seed heads (above) that may weigh six to eight pounds and contain as many as half a million seeds. In perhaps the largest horticulture experiment ever organized, 13,500 readers of a Rodale magazine successfully grew amaranth in all parts of the nation.

Will Americans accept amaranth on the dinner table? I got my answer during lunch at the company's cafeteria.

The meal began with an amaranth-leaf

dip and a platter of stir-fried greens. Rich in vitamins and minerals, the leaves had a delicate flavor similar to that of spinach. Then came the seeds, which when heated burst like—and taste like—popcorn. They also can be milled into flour rich in precisely the amino acids that wheat lacks. We had muffins made with amaranth flour, fruit cookies made with popped amaranth, and popped seeds with salt and butter. "These are snacks that are nutritious," said Bob Rodale. "Another big potential for amaranth."

The Indians began tapping such potential long ago, and they did it in the Indian way, keeping the land almost undisturbed. They knew how to live and leave little trace, like fish in water or birds in air. They learned to use many of North America's more than 20,000 native plants, because flower power was the energy source that provided them food, shelter, clothing, and raw materials.

Old Indian crops like jojoba, guayule, tepary bean, the groundnut, and amaranth today are whispering to us down the millennia of our continent's past. The researchers who hear the quavering echo are sowing the seeds of a greener future. □



Amaranth distribution

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Others like the fact that Skylark offers roomy accommodations for five—plus an accommodating trunk.



Lots of folks are taken with Skylark's good looks. And we modestly submit, who can blame them?

We couldn't get all the reasons people like Skylark on this page. But we sure got them into the car.



*Use "estimated mpg" for comparison. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Estimates lower in California. Buicks are equipped with GM-built engines supplied by various divisions. See your dealer for details.

Detective of prehistory

A WELL-EDUCATED GUESS led Dr. Peter Schledermann (below) to Eskimo settlements occupied as long as 43 centuries ago. Theorizing that prehistoric hunters must have crossed the southernmost part of the ice bridge between Canada and Greenland, he located by helicopter, boat, and afoot the ruins of living sites in the Bache Peninsula region, an uninhabited part of Ellesmere Island. Among his finds were ivory harpoon heads (right), one with a human face, and surprising clues of Norse contact at least 800 years ago. Support such explorations of the distant past; nominate a friend for Society membership.



CHARLES CLARK (LEFT); MARTHA COOPER

18-MONTH NATIONAL GEOGRAPHIC SOCIETY MEMBERSHIP

JULY 1981 THROUGH DECEMBER 1982

EIGHTEEN-MONTH DUES in the United States and throughout the world are \$17.25 U.S. funds or equivalent, which is 1½ times the annual fee. To compensate for additional postage and handling for mailing the magazine outside the U.S.A. and its outlying areas, please remit: for Canada \$26.79 Canadian or \$21.97 U.S. funds; for all other countries \$27.60 if paid in U.S. currency by U.S. bank draft or international money order. Upon expiration of the 18-month term, memberships are renewable annually on a calendar-year basis. Eighteen-month membership starts with the July 1981 issue. Eighty percent of dues is designated for subscription to the magazine.

Mail to: The Executive Vice President
National Geographic Society
Post Office Box 2895
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(FILL IN YOUR NAME AND ADDRESS BELOW.)

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00241

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It's the new low rate. \$4.95 for a 3-minute call to Germany. Just dial the call yourself during the lower rate periods, any night 5 p.m. to 5 a.m.

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Ireland	4.65	3.60 B
Italy	6.15	4.95 B
Luxembourg	6.15	4.95 B
Monaco	6.15	— A
Netherlands	6.15	4.95 B
Norway	6.15	4.95 B
Portugal	6.15	4.95 B
San Marino	6.15	4.95 B
Spain	6.15	4.95 B
Sweden	6.15	4.95 B
Switzerland	6.15	— A
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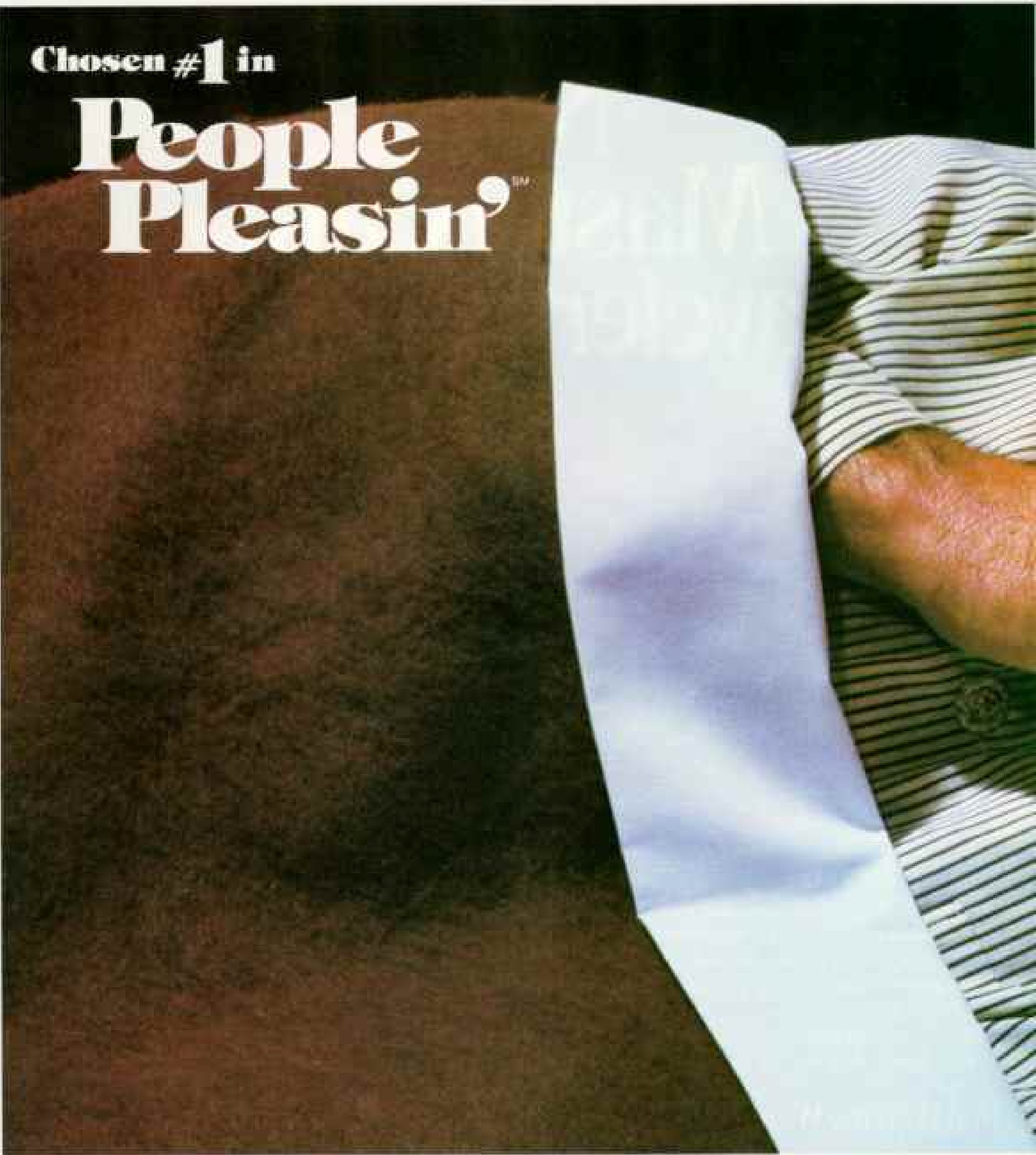
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You don't need elaborate equipment to use free solar energy to reduce your home's heating, cooling and lighting costs.

What you need is glass and windows, properly placed and designed.

For instance, a south-facing wall of PPG glass can collect the winter sun's heat and supplement a heating system.

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Of course, glass also provides a year-round source of free natural light, which not only brightens a room, but saves on electric lighting.

You can benefit even further by matching the right

PPG glass to your climate.

If yours is a new home in a cold area, PPG *Twilight*® *Xi*® or other insulating glass can help control heating costs very effectively. In fact, heat loss through the glass is cut almost in half compared to single-pane glass. And storm windows can get similar results in existing homes.

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To learn more about using glass to save energy, talk to your architect or builder. And write for our free idea book, "Home Styles for the Eighties!"

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PPG: a Concern
for the Future



You may be in a position to justify an airplane and not even know it.

To find out, take this simple test.

1. Do you or your people travel several times a month? Yes No
2. Do you travel to, or come home to, destinations not well served by airlines? Yes No
3. Have you ever been out of town two days and a night for a two hour meeting? Yes No
4. Have you ever lost business or money, or both, because your top management couldn't be there, when and where they were needed? Yes No
5. Do you often travel on a moment's notice? Yes No
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If you answered yes to any of the above questions, you'll have no trouble justifying a Beechcraft company airplane. To your accountants. Your board of directors. Or your stock holders. Because a Beechcraft means more efficient, more productive travel.

It means one of your most valuable resources, good people,

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can be there, when and where they're needed. And that's even more critical to small and medium sized companies, with fewer resources, than it is to large companies.



Our free Management Guide to Business Aviation shows that virtually any size company can, and has, used a

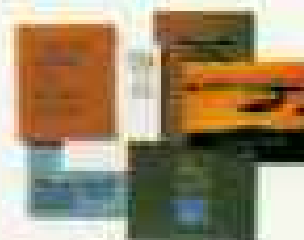
Beechcraft to increase profitability and/or productivity. The size of your company isn't nearly as important as the size of your ambition. The Guide lays it all out in black and white, net dollars and capital recovery. And the more you travel, the more sense it makes.

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Twelve exquisite miniature vases, re-creating the great porcelain artistry of the Chinese Imperial Dynasties.

A limited edition.

Subscription deadline:
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Imagine a collection of delicate and beautiful vases—authentic re-creations of historic Chinese porcelain designs. Imagine each one a fine miniature, approximately 3" high, and you have a collection to attract the admiration of all who see it.

Now you can own just such a collection. Twelve exquisite vases reflecting a thousand years of Chinese porcelain art. And, despite the careful craftsmanship involved, the price for each vase is just \$12.50.

A treasury of classic porcelain art

Displayed together on the black hardwood shelf provided, the 12 vases form a veritable treasury of porcelain art. A Mei-p'ing vase in the style of the early Sung Dynasty, when only the Chinese knew the

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A collection to grace any room in your home

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The total edition will be forever limited to the exact number of valid applications postmarked in this period. But remember the form at right is valid only if mailed by the subscription deadline: June 30, 1981.



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*Plus my state sales tax and \$1. shipping and handling per vase.

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Limit: One collection per person.

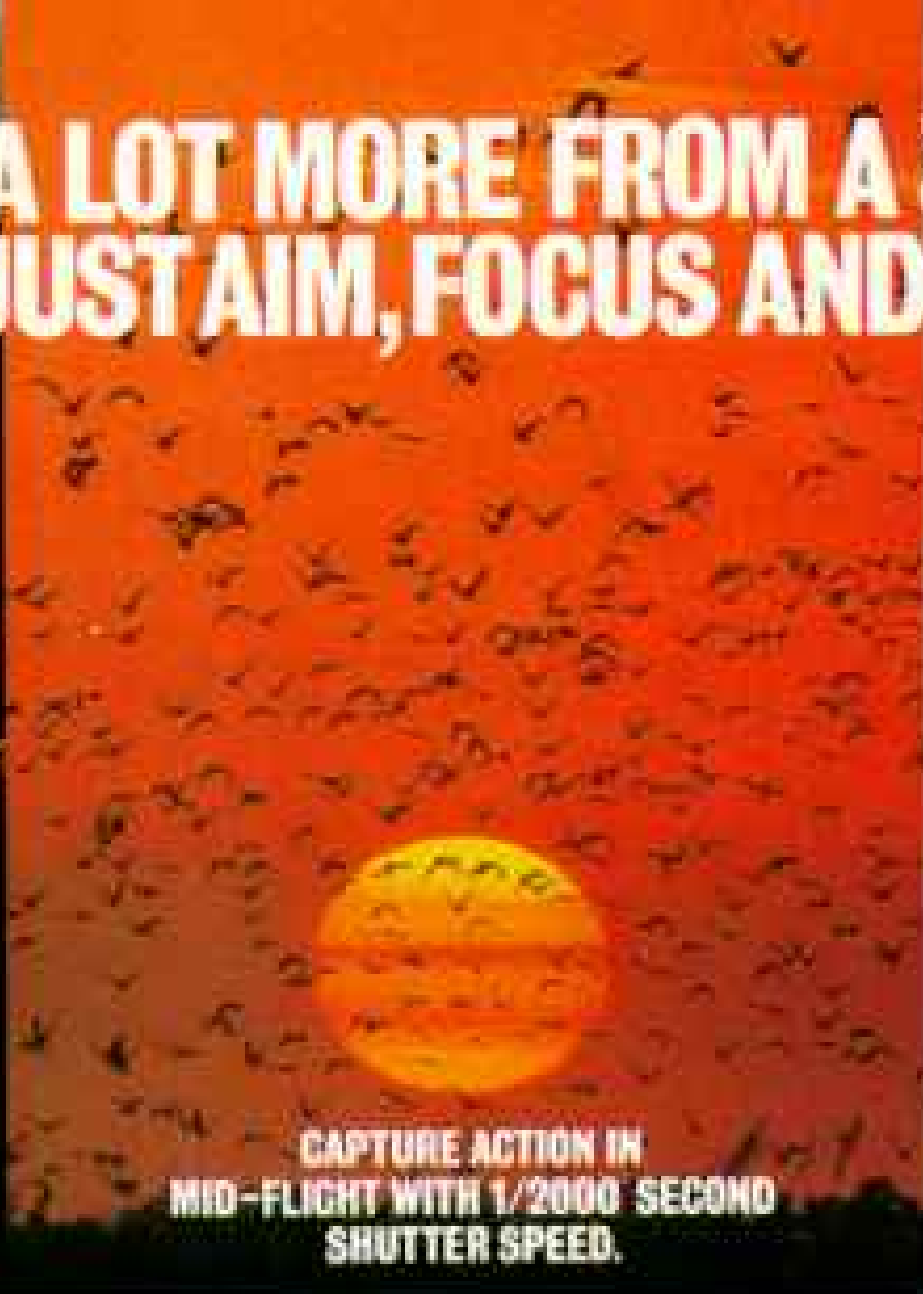
115

Vases shown slightly smaller than actual size

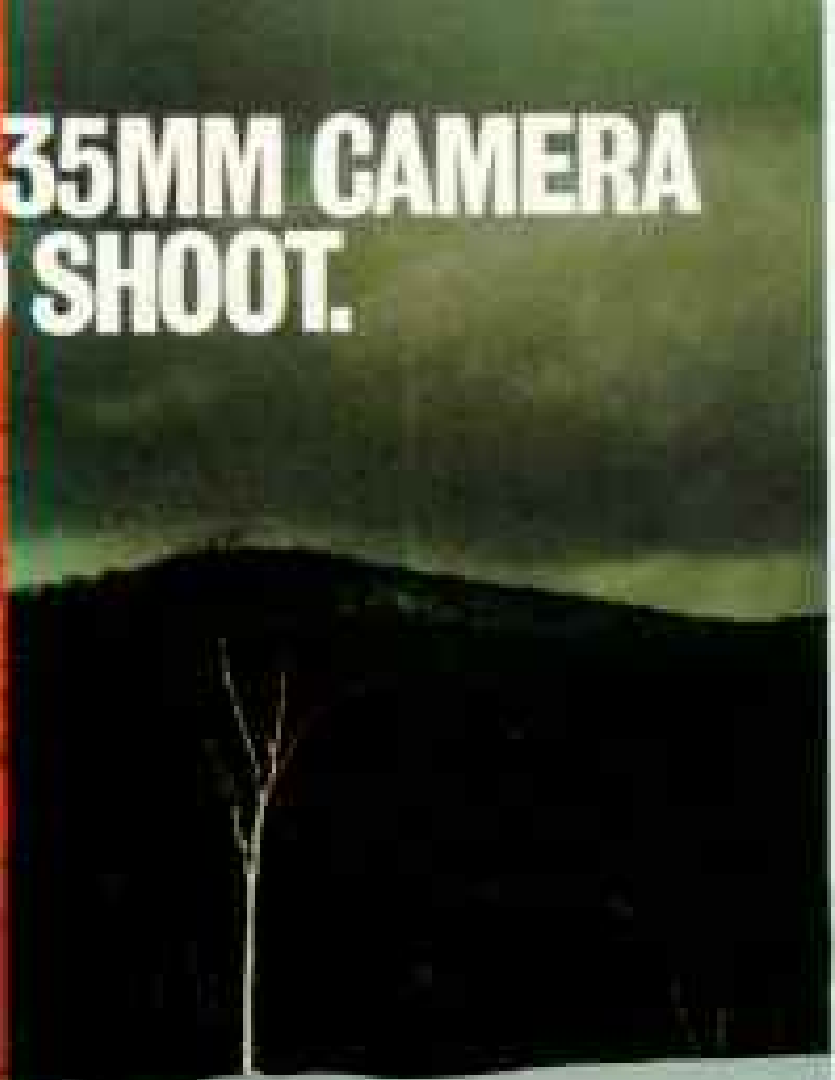
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Contrary to what the TV commercials tell you, a truly creative 35mm photograph, one that startles, exhilarates, inspires, is seldom the result of just a quick punch of a button.

It's a combination of skill and imagination and a camera's ability to respond to these qualities.

Which is why we created the ME Super.

EASY SNAPSHOTS OR BRILLIANT PHOTOGRAPHS.

On automatic, the Super Camera is just as easy to use as any aim-focus-shoot camera. So you can take good 35mm photographs of your kids, relatives and friends as simply and quickly as if you were using your old pocket camera.

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SPEED WITH CONTROL

With the ME Super, you have the ability to stop a 200 mph Formula One Racing Car dead in its tracks. How? With a shutter speed of 1/2000 second, a feature found on

only the most expensive professional cameras. And the ME Super.

And if you want to go out and be a great photographer you shouldn't have to worry about something as basic as loading your camera. That's why Pentax invented the Magic Needle loading system. It grabs the film and holds onto it, so you can keep your mind on taking great pictures—without wondering if your film is actually going through the camera.

A PHOTOGRAPH IS ONLY AS GOOD AS THE LENS IT GOES THROUGH.

Since we began as an optical company more than 60 years ago, we've incorporated numerous innovations and refinements into our lenses, most of which have found their way into every 35mm lens today.

The most revolutionary is Super-Multi-Coating, a seven-

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The fact is, the longer you own a Pentax Super Camera, the more you'll come to appreciate how its many innovations can help you to be the kind of 35mm photographer you want to be.

Which is, if you're interested in photography enough to read this far, a long way from aim, focus and shoot.

PENTAX

First where it means something to be first.



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HELP comes in a hard case that stores under a seat or in the trunk. It's easy to use. Simply put the magnetic antenna on the roof.



Then plug the adapter into the cigarette lighter and you're on the air. **HELP** is a full-power, full-performance 40-channel CB radio.



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We bring good things to life.

GENERAL  ELECTRIC



Super Avilyn. The face has changed, but the act is still the same.

It's the TDK Super Avilyn performance we never stop improving. And now you can catch the act in a super new package. Bright white with silver lettering, it really shines. You won't miss it on your dealer's shelves.

Best of all, under that flashy new exterior still beats the heart of the true performer — Super Avilyn. The videotape you've come to rely on for the picture that always comes through, brilliantly. Vibrant colors that don't bleed. Crisp, sharp images. A solid, steady picture, free of jitters. Even after six hours.

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TDK
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AMERICA'S BEST-SELLING WAGON.*



That's quite a claim, isn't it? Especially when you consider the sizes, shapes and numbers wagons come in these days. So if you're going to be the best seller in a market that's as competitive as the wagon market, you'd better have a lot going for you. Rest assured, Fairmont does.

Just look at these mileage figures. Pretty impressive for a wagon. These numbers are for **34** EPA EST. HWY. **23** EPA EST. MPG comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage and California ratings will be lower.

Of course, room is what a wagon's all about. And Fairmont offers 79.5 cubic feet of

*Based on 1980 calendar year retail deliveries.

it. In fact, according to the EPA Interior Volume Index and manufacturer's suggested retail price, Fairmont offers more room for the money than any other wagon in America.

And here's the bottom line. Fairmont handles all this great mileage and room for a base sticker price that'll make it easy for you to handle a Fairmont.

When you add it all up, it's little wonder Fairmont's the best-selling wagon in America ... and very likely to remain so.

FORD FAIRMONT

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New Coleman® Folding Trailers... Luxury Hideaway Hotels.



FREE! Write for our new 12-page
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AFFORDABLE FAMILY FUN



CAMPING TRAILERS

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Smile when you call it camping! Luxury features like queen-sized beds, thermostatically controlled heat, refrigerator, range and hot water (even a shower) make Coleman trailers true hideaway hotels.

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Check the Yellow Pages for your nearest Coleman dealer. You'll discover the lightest, most luxurious folding trailers on the market today. Camping fun for the entire family!



New Aerolite Design. Built to tow safely behind even the smallest new cars.

"In the past 15 years, I've had 7 sports cars, 14 sports car mechanics and one refrigerator. A Frigidaire."



FRIGIDAIRE
HERE TODAY, HERE TOMORROW.

Frigidaire One of the White Consolidated Industries. 

"You can feel it when you drive."

Lee Trevino

NEW BRIDGESTONE SUPERFILLER RADIALS.

The Bridgestone Tire Company announces new SuperFiller steel-belted radial tires.

Bridgestone's advancements in tire technology have resulted in a radial tire that gives you premium performance.

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The Bridgestone



SuperFiller radial tire is built with two steel belts behind the tread for strength,

a polyester cord body, and a special hard rubber insert in the bead area near the rim. This is SuperFiller, the key to our performance.

Think of the three areas of a tire (the bead, the sidewall, and the



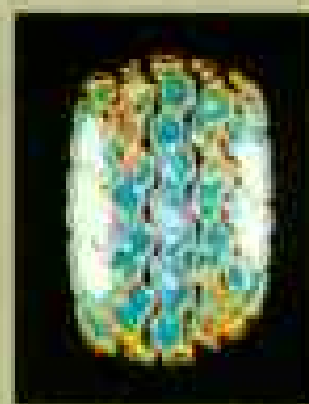
tread) as springs. Bridgestone SuperFiller construction allows these three areas to have different spring rates. There is



a very stiff SuperFiller bead area that allows a flexible sidewall for comfort and performance, and a hard tread area with an aggressive tread pattern designed for long wear.

"I'm certainly not the first to tell you that the grip is important when you drive."

Freeway or fairway,



on the roads or in the rough, grip is important. Bridgestone SuperFiller radials are

designed for a big footprint and an even pressured, sure footed grip on the road, with a minimum of heat generating "squirm" that ages tires.

"Put the advanced technology of Bridgestone SuperFiller radials between you and the road. You can feel it when you drive."

Check the Yellow Pages for the Bridgestone dealer near you.



Put Bridgestone between you and the road.

BRIDGESTONE

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Do you know what your body knows about vitamin C?

Cut your arm. Burn your hand. Break a leg.

None of these will heal properly without adequate vitamin C along with other essential nutrients. Nor will severe bruises or wounds heal properly.

Sore throat. Earache. High fever.

All can begin with an infection that overwhelms your body's natural defenses. Vitamin C, along with other essential nutrients, optimizes your body's natural capacity to resist illness and helps keep your tissues healthy.

Up tight or up in smoke.

With both acute stress and heavy cigarette smoking, the plasma levels of vitamin C in your blood may be lowered. So, you could be robbing your body of this essential vitamin without even knowing it.

Up your iron.

Vitamin C increases your body's ability to absorb iron from food when they are taken together. Iron is the most common deficiency in the diet, and may be related to a loss of energy.

There are many reasons why your body needs an adequate intake of vitamin C. Yet your body doesn't make it. Vitamin C must come from food or vitamin supplements. So, eat a balanced diet. You can also look for fortified foods when you shop or take a supplement containing vitamin C every day just to be sure.

Vitamin Communications, Hoffmann-La Roche Inc.,
Nutley, N.J. 07110

Vitamins. Something you can do for your health.

RCD 3276

THE FIRST OVEN WITH A SPLIT PERSONALITY.


The engineers at Jenn-Air have yet to discover anything they believe can't be improved upon. Even the concept of an oven.

So instead of designing an oven that cooks just one way (like most other ovens), they decided to design one that cooks two ways.



The result is the Jenn-Air Dual Use Convection Oven.

And it's unlike any oven you've ever seen before. On one hand, it's a normal radiant oven. So you can cook your favorite recipes the way you always have.

 But flip its switch and suddenly it transforms into something completely different: a professional style convection oven. An oven that employs hot, circulating air to cook the most tender, juicy meats and roasts you've ever tasted. And it cooks them up to 50% faster than your old oven.

The versatility this combined system affords you in preparing meals is unmatched by any other single oven in the world.

If you'd like more information on the Dual Use Oven, or any of the extraordinary cooking equipment from Jenn-Air, we suggest a visit to your local Jenn-Air dealer. You'll find him listed in the Yellow Pages. Or write to Jenn-Air, 3035 Shadeland Ave., Indianapolis, Ind. 46226.



 **JENN-AIR. THE FINEST COOKING SYSTEM EVER CREATED.**

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*If anything should tear our home apart,
we know it can be put back together again.*



When a house protects you and your family, you want to protect the house.

That's why, as homeowners, we just bought one of the best policies you can buy. It's from Metropolitan and it's called The Safekeeper Deluxe.* It gives us peace of mind in a lot of ways.

First of all, our policy provides us with inflation protection* on our home and also has an optional feature,* so any covered damage to our personal property will be replaced at today's costs rather than the original costs.

Secondly, Metropolitan has a 24-hour claims service. So you can report your problem anytime, day or night. This way your claim gets handled faster.

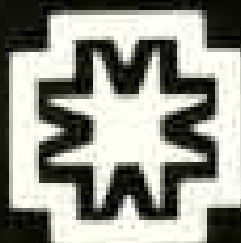
With all the benefits our homeowner policy offers us, we know that no matter what happens, we'll always have a roof over our heads.

Your Metropolitan representative is a trained professional who understands the needs of homeowners. So whatever your insurance needs, Metropolitan will really stand by you.



*Available in most states.
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Metropolitan



Metropolitan really stands by you.

LIFE/HEALTH/AUTO/HOME/RETIREMENT

Why are more full-size and luxury cars being traded for full-size Chevrolets than any other make?

The people who trade in full-size and luxury cars today, both foreign and domestic, can buy virtually any new car they choose, from the smallest economy car to the most expensive luxury model. So it's significant that more of them are choosing the full-size Chevrolet than any other single make.

Our 1981 Caprice Classic, for example. An automobile with a level of quietness and smoothness of ride very likely the equal of any full-size car you've ever owned.

A luxurious automobile. And now, with new available diesel power, one with higher fuel economy than some small foreign cars — 34 MPG highway estimate, [22] EPA estimated MPG.*

We invite you to spend 30 minutes with our uppermost Chevrolet today.

Sit in it. Test drive it. In your search for a quiet, comfortable, elegant automobile, you may have overlooked the most obvious choice of all.

The one at your Chevrolet dealer's.

The Chevrolet Caprice Classic.



You can spend more.

The question is, why?

Chevrolet

UP AHEAD

*Use estimated MPG for comparisons. Your mileage may differ depending on speed, distance, weather. Actual highway mileage lower. Estimates lower in Calif. Chevrolets are equipped with GM-built engines produced by various divisions. See your dealer for details.

Once every generation it seems, something comes along that changes the entire nature of home entertainment. That time has come again.

Pioneer introduces LaserDisc™ a whole new technology that makes your television and stereo do things they've never done before. Now you can watch a movie or hear and see a concert as easily as playing a record.

And when you hook up the LaserDisc player to your TV and hi-fi, for the first time, along with a television picture you get true stereo.

And a television picture that's actually a 40% sharper picture than home videotape.

And because the disc is read by a light beam rather than a needle or

video head,
nothing
touches the

disc. So, with normal use, it doesn't wear out from play. You can enjoy the disc forever.

But Pioneer LaserDisc offers you more than superb fidelity, it's truly the first form of personal entertainment. Your television viewing is no longer limited to what's on television. Because you can see what you want to see when you want to see it. A whole library of Pioneer Artists and MCA/Discovision discs with movies like *Jaws*, *Animal House*, *The Blues Brothers*, concerts like Paul Simon, Liza Minelli, Loretta Lynn, and Abba, sports like NFL football, and title fights.

You can study the standard-play discs in fast motion, slow motion, stop motion. Even create your own instant replay.

But there's something even more remarkable. A micro-computer built

into the Pioneer LaserDisc player lets you access any individual frame on the disc at the touch of a button. You can go right to your favorite scene in a movie, or a song in concert in seconds.

And because you can view the up to 108,000 frames on the disc one frame at a time, it just may be the future of education.

The cost of Pioneer LaserDisc is surprising as well. Just \$749* (with \$50* more for optional remote control). And a full-length movie on LaserDisc can cost less than taking your family out to the movies.

The only way to even begin to experience the magic of this remarkable LaserDisc system is to see it. And we've arranged for that. Just call at 800-621-5199** for the store nearest YOU. **On lines 800-872-6822.

*Suggested retail price. Actual price set by dealers.

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Simulated TV picture from Paul Simon.



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We bring it back alive.

Could you picture what
the world would look like
without Kodak film?



Most professional photographers agree: the more
you care about pictures, the more you need Kodak film.
Kodak. America's Storyteller.



BLUEPRINT
FOR
QUALITY

MORE MILES PER GALLON. MORE YEARS PER CAR.

Today most everyone wants a high-mileage car.

But sometimes the car that goes further on a gallon also goes faster to a trade-in.

Not the Datsun 210. It offers you the mileage you're counting on and the longevity you're dreaming of.

It guards against rattles with a body that's fused into one solid piece by thousands of welds, not held together by nuts and bolts. You know how fast rattles can shake you of that new car feeling.

It's protected against rust with panels of galvanized steel, coatings of zinc, yards of sealers and treatments of anti-chipping compound. You know how fast rust can dim your new-car glow.

36 **47** MPG
EPA EST. HWY EST.

* Extra life is built into the engine by a massive five-main-bearing crankshaft. It's an engine that has satisfied drivers for almost 400 billion miles. Inside there are rich, roomy seats. Big, readable instruments. Stalk controls. Electric rear-window defroster. And a level of workmanship you'd be proud to call your own. See for yourself at your Datsun dealer.

From the Nissan Motor Co., Ltd., world-wide leader in automotive excellence.



DATSUN 210 MPG

* Standard 5-speed with 1.4-liter engine, not available in California, where the best EPA estimate is 31 MPG, 44 estimated highway for a 210 5-speed. EPA estimates are for comparison. Actual mileage may differ depending on speed, distance and weather. Highway mileage will probably be less.

DATSUN WE ARE DRIVEN



hexa·photo·cybernetic

The Possibilities are Endless.



Programmed: 350 95

Six-mode exposure control.
System versatility.
Newer electronics for
wider applications.



The Canon A-1 is one of the world's most advanced automatic SLR cameras. Combining the finest in optical and mechanical engineering with the most sophisticated electronics, it's technology applied to give you the ultimate in creative control. At the touch of a button,

Depending on your subject, you can choose from six independent exposure modes to achieve the results you want:

1 Shutter-Priority: You select the shutter speed, to freeze the action and prevent camera shake or create an intentional blur. The A-1 automatically selects the appropriate lens opening.

2 Aperture-Priority: Control the area in focus by selecting the lens opening for the effect you want. The A-1 matches with the right speed.

3 Programmed: When you need to shoot fast, just focus. The A-1 will select both speed and aperture for great results.

4 Stopped-Down: For extreme close-up or specialized photography, a bellows, a microscope or almost anything can be attached to the A-1. It's still automatic.

5 Flash: Totally automatic flash photography, of course, with a wide variety of Canon Speedlites to choose from.

6 Manual: Yes. For those times when you absolutely want to do it all your-



self. To experiment. To explore the possibilities.

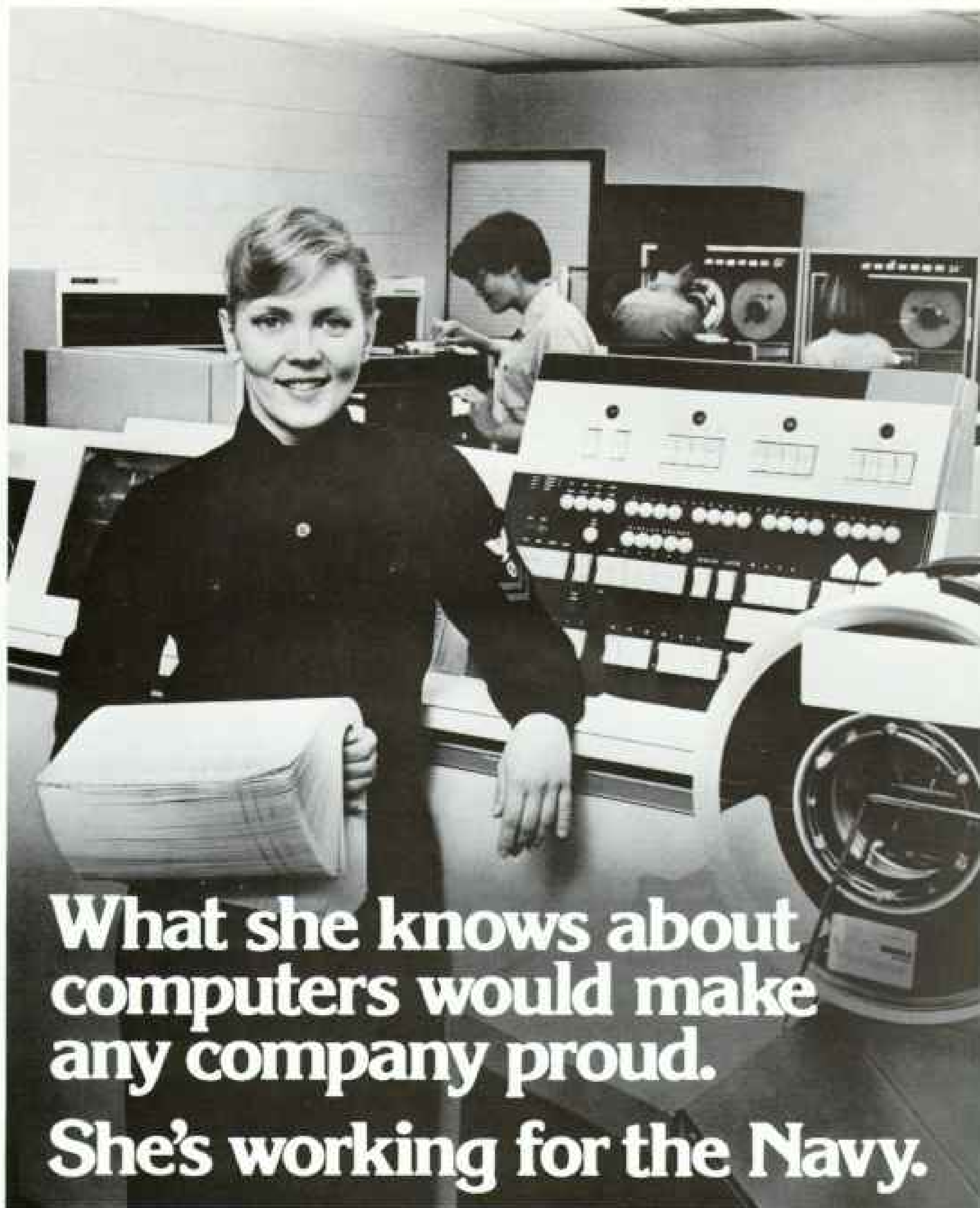
There are over forty fine Canon lenses ranging from Fish Eye to Super Telephoto, plus accessories to meet every need. If you can't photograph your subject with a Canon A-1, it probably can't be photographed.

From the sophistication of its LED viewfinder display, to a ruggedness that allows up to five-frame-per-second motor drive, the Canon A-1 represents an incredible technology. At a price that makes owning one a definite possibility.

Canon A-1

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What she knows about computers would make any company proud. She's working for the Navy.

Some of the best people in their fields are working for the Navy. And that makes us proud. Because they've taken advantage of top Navy technical training to get where they are.

Today over 75% of all Navy jobs are in highly technical areas with individual training offered in over 60 different career fields. The Navy's always been a great place to find a future. But we wouldn't be the best Navy in the world without the men and

women who have turned their highly trained skills into rewarding Navy careers.

A strong Navy depends on a workforce of men and women who not only believe in being the best at what they do, but also believe it means a little bit more when it's done for their country.

Navy know-how.
It's working for America.

A silver spoon won't do.



When someone has a seizure never force anything hard between the teeth.

It is physically impossible for a person to swallow his or her tongue during a seizure. Attempts to force the mouth open can often cause damage to the teeth and gums.

Keep calm. By keeping calm, you can reassure other observers. If possible, look for medical bracelet or neck chain.

Clear the area. Remove sharp, hard or other hazardous objects. Also remove glasses, loosen tight collars, neckties and/or belt, but do not interfere with movements.

Turn the person on his/her side. This keeps the airway clear so that breathing is not obstructed.

Do not restrain or try to revive. You can't stop a seizure once it has started. Place a pillow or a coat folded flat, under the head. Awakening should be voluntary. Don't panic if person seems to stop breathing.

You may not have to call a doctor. You need only to call an ambulance if the seizure lasts longer than ten minutes or if another seizure begins immediately after the first has ended.

Be reassuring. Some people are embarrassed when consciousness is regained after a seizure. It is very reassuring to see a friendly face.

Some people are very surprised to hear that you shouldn't place a spoon in the mouth of a person having a seizure. There are many myths and superstitions about epilepsy. Get the facts. Contact your local chapter of the Epilepsy Foundation of America.

Epilepsy.

It's not what you think.



With light the candle of understanding.
Epilepsy Foundation of America, 322 L Street, N.W., Washington, D.C. 20004
Discovering the Power Behind Epilepsy. 1-800-431-2273

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#1

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So call your Travel Agent. And say you want number one service to Hawaii.

We're American Airlines. Doing what we do best.

* 1979 independent mail survey of 37,495 APA members with 11,931 responding.

Why more Americans are choosing to own Seville than any single luxury import model...

The figures tell the story. In a time when nearly one out of every four new cars sold in America is an import, Seville outsells its nearest luxury foreign competitor by a wide margin—as you can readily see in the chart on the right.

Seville vs. Leading Luxury Import Models
Sales Per U.S. Park, Jan./Dec. 1989

Seville by Cadillac	25,541
Mercedes 240D	8,338
BMW 528i	8,189
Volkswagen (Swagens and Station Wagons)	6,216
Audi 100 (Complete "1000" series including Diesel and Turbo)	22,257
Porsche 911 (All models)	2,774
Saab 900 (Complete "900" series including Turbo)	8,578

What makes Seville the exception... its distinctive styling? Yes, to a degree. Ride and roominess are considerations, too. Or maybe the key factor in Seville's success is its advanced technology.

The benefits of front-wheel drive. The first time you sit inside a Seville, you'll notice what seems to be an inordinate amount of legroom. That's one of the benefits of front-wheel drive. Front-wheel drive also gives Seville impressive traction in a wide variety of road conditions. Note: Of the six luxury imports listed in the chart on the left, only Audi and Saab have front-wheel drive.

A unique choice in engines. Seville is available with any one of three power plants: the standard Diesel engine, a gas-powered V6 or the new V8-6-4 engine. No other carmaker offers a comparable selection—foreign or domestic.

Cadillacs are equipped with GM-built engines produced by various divisions. See your Cadillac dealer for details.

Seville is a generation ahead in electronics. Many foreign automakers are just beginning to experiment with their "black boxes." Microprocessors have been a part of Seville for years. The electronic climate control uses one. The electronically-tuned stereo radio does also. While the V8-6-4 Fuel Injection system uses a new on-board computer that can handle 300,000 decisions per second.

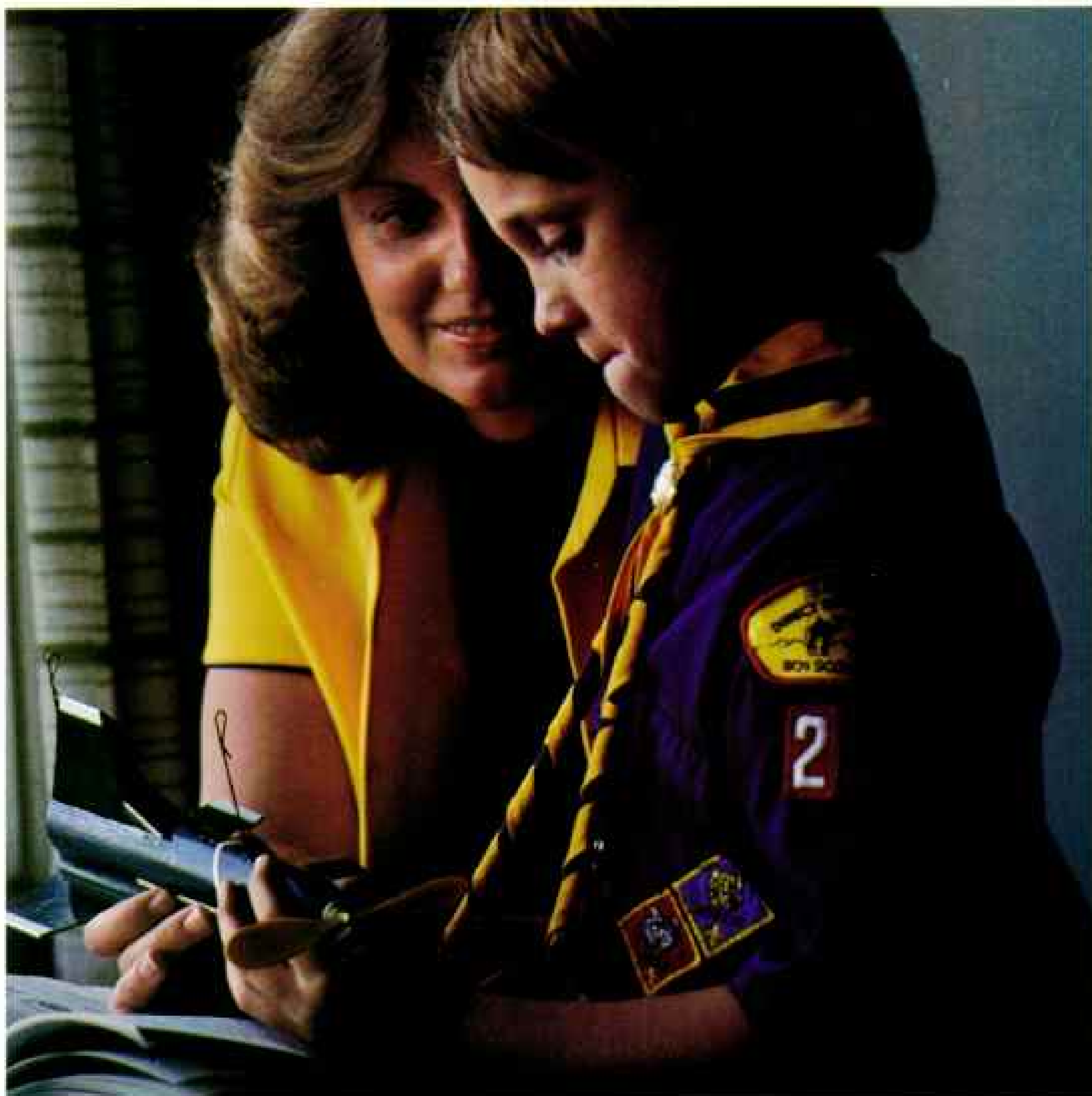
Advanced technology. Electronic sophistication. With standard features that often cost extra on luxury imports (if they're offered at all) plus distinctive styling, it's no wonder more Americans have chosen to own Seville than any single luxury import model. To buy or lease your Seville, see your Cadillac dealer soon.

Seville
BY CADILLAC

An American Standard for the World.



CADILLAC MOTORCAR DIVISION 1989



Important talks in the Middle East

Statesmen aren't the only people in the Middle East who have important talks.

In Saudi Arabia, where we live, Cub Scouts have important talks with Den Mothers. Car owners have important talks with mechanics. Batters have them with umpires. And schoolgirls have *lots* of them with other schoolgirls.

We're Aramco, the Arabian American Oil Company. There are 13,000 North Americans in Saudi Arabia with us. And even though you hear a lot of news about Saudi Arabia, there are things that might surprise you about our lives there.

1. We're doing something important. Aramco produces more oil than any other company. Badly needed oil. Including about 15 percent of the oil the U.S. imports.

2. Aramco is working on some *incredibly* large energy projects. And on huge communications networks, electric utilities, and more.

3. Our people are glad to be in Saudi Arabia with Aramco. They came for excellent pay and professional challenge.

4. After 46 years in Saudi Arabia, Aramco is still growing fast. So is the number of interesting and rewarding jobs we offer.

5. The model airplane took off on the first try.

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