"CLOSE-UP: U.S.A." — WISCONSIN, MICHIGAN, AND THE GREAT LAKES

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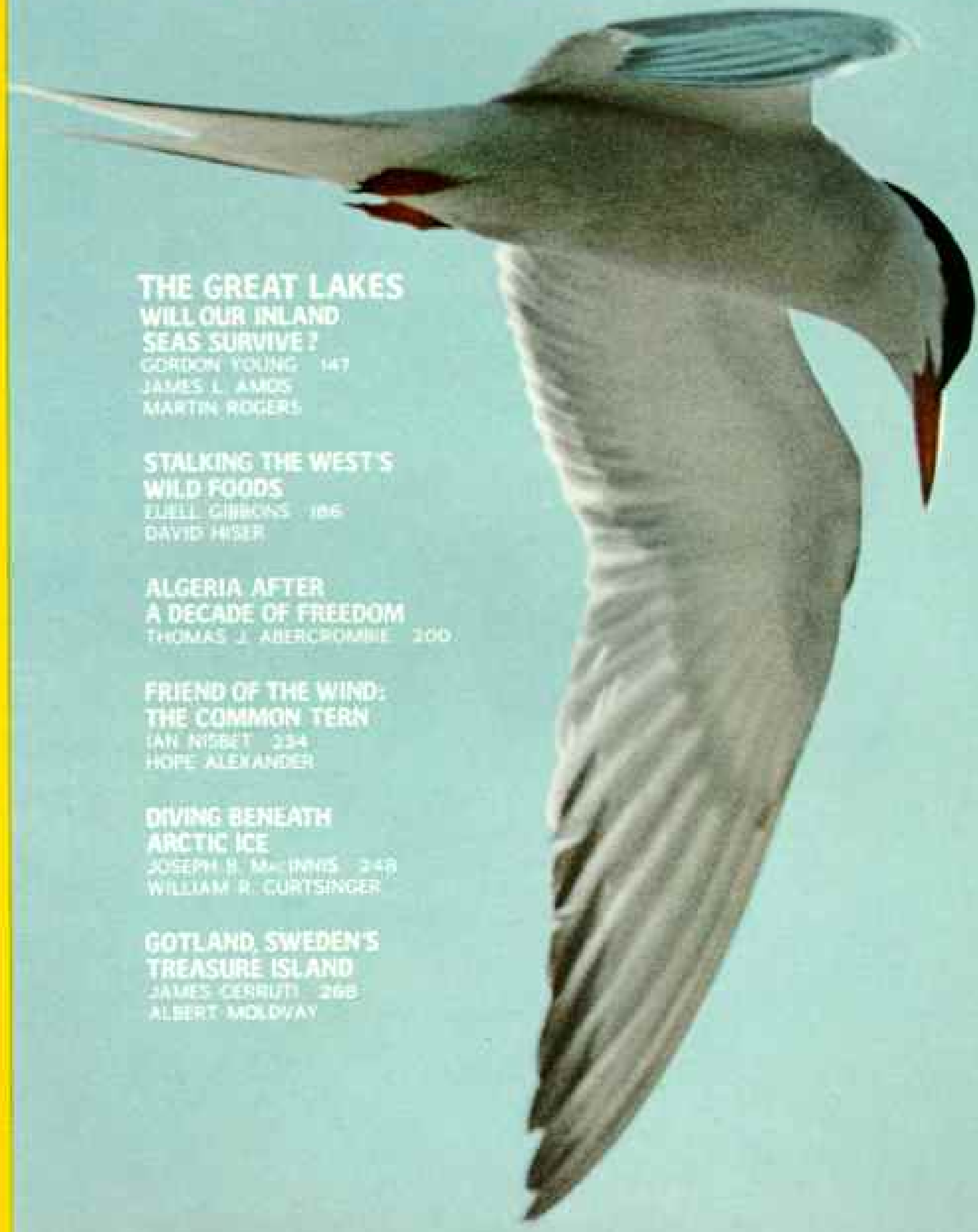

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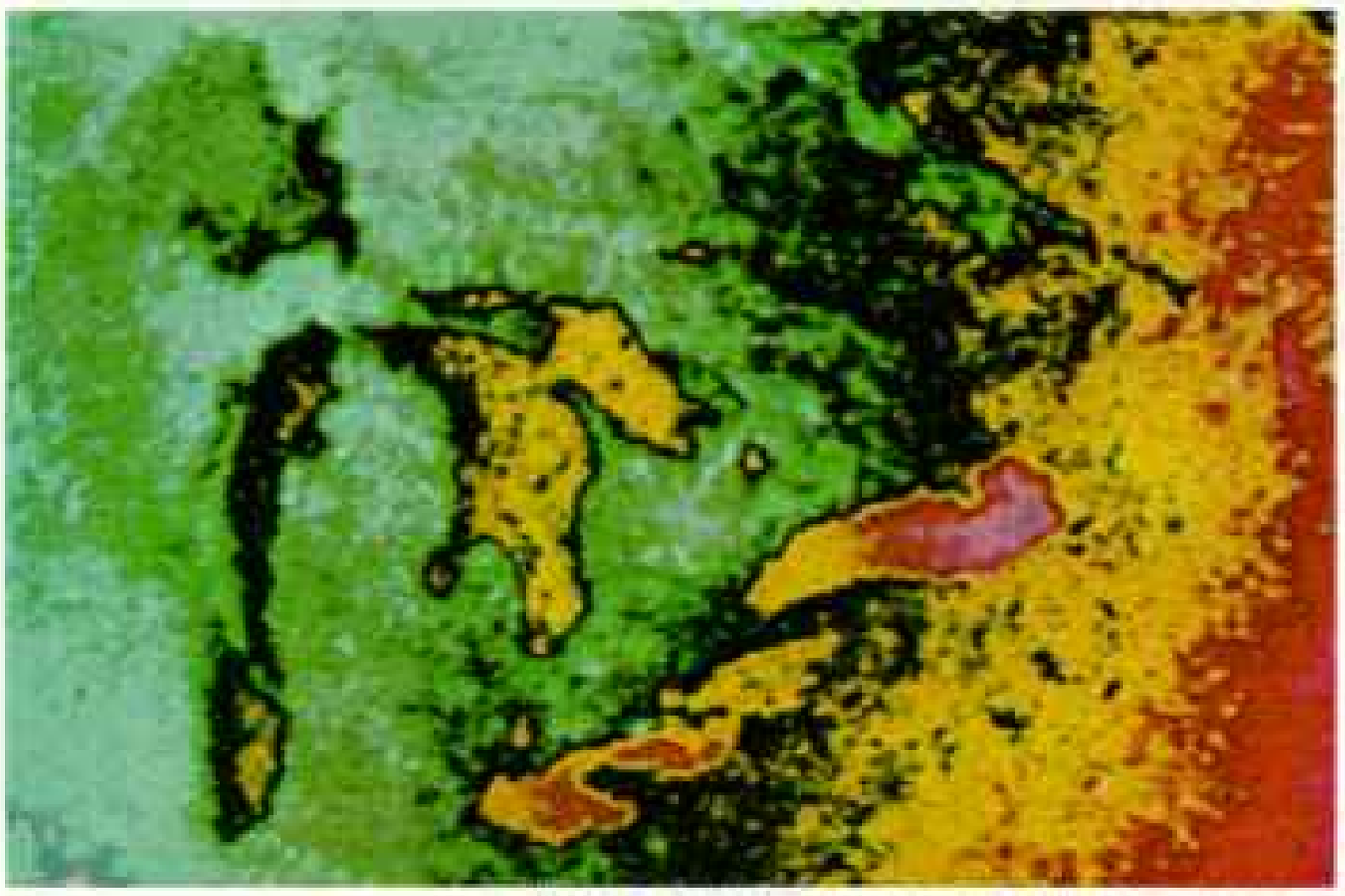


INFRARED PHOTOGRAPH BY NATIONAL ENVIRONMENT SATELLITE SERVICE

"Heat picture" from space color codes the ailing Great Lakes on an October day. The cold greens of Superior and Michigan loom darkly against the Midwest's still chillier blues. Warmer waters of Huron and the lower lakes shade from yellow to red, as does the Atlantic seaboard.

SUPERIOR-MICHIGAN-HURON-ERIE-ONTARIO

Is It Too Late?

By GORDON YOUNG

SENIOR EDITORIAL STAFF

Photographs by JAMES L. AMOS

NATIONAL GEOGRAPHIC PHOTOGRAPHER

and MARTIN ROGERS

THEIR SHINING SURFACES are the playgrounds of millions of people; their dim bottoms are the resting-places of thousands of wrecks. Benignly they serve two nations in many ways—cooling cities, quenching thirsts, carrying away sewage, generating electricity, fending off tornadoes, providing ocean ports a thousand miles inland.

Sometimes, in a less benign mood, they remind us that they were not placed on earth to be man's servants. With eroding waves, they devour beaches and summer cottages. In the winter they batter with fists of ice at the works that man has built to control them.

Not idly are they called the Great Lakes. After touring them from Minnesota wilderness to New York shores, I am astonished at how well man has managed to tame these watery giants. But I am sobered by the injury he has inflicted and by the urgent task that he now faces in keeping the lakes alive.

The Great Lakes cover nearly 95,000 square

Iced to the gunnels, a huge laker loaded with iron ore for South Chicago steelworks squeaks through the Soo Locks in late January. Shipping normally freezes to a halt from mid-December to April. To help the region's wintertime economy, an experimental

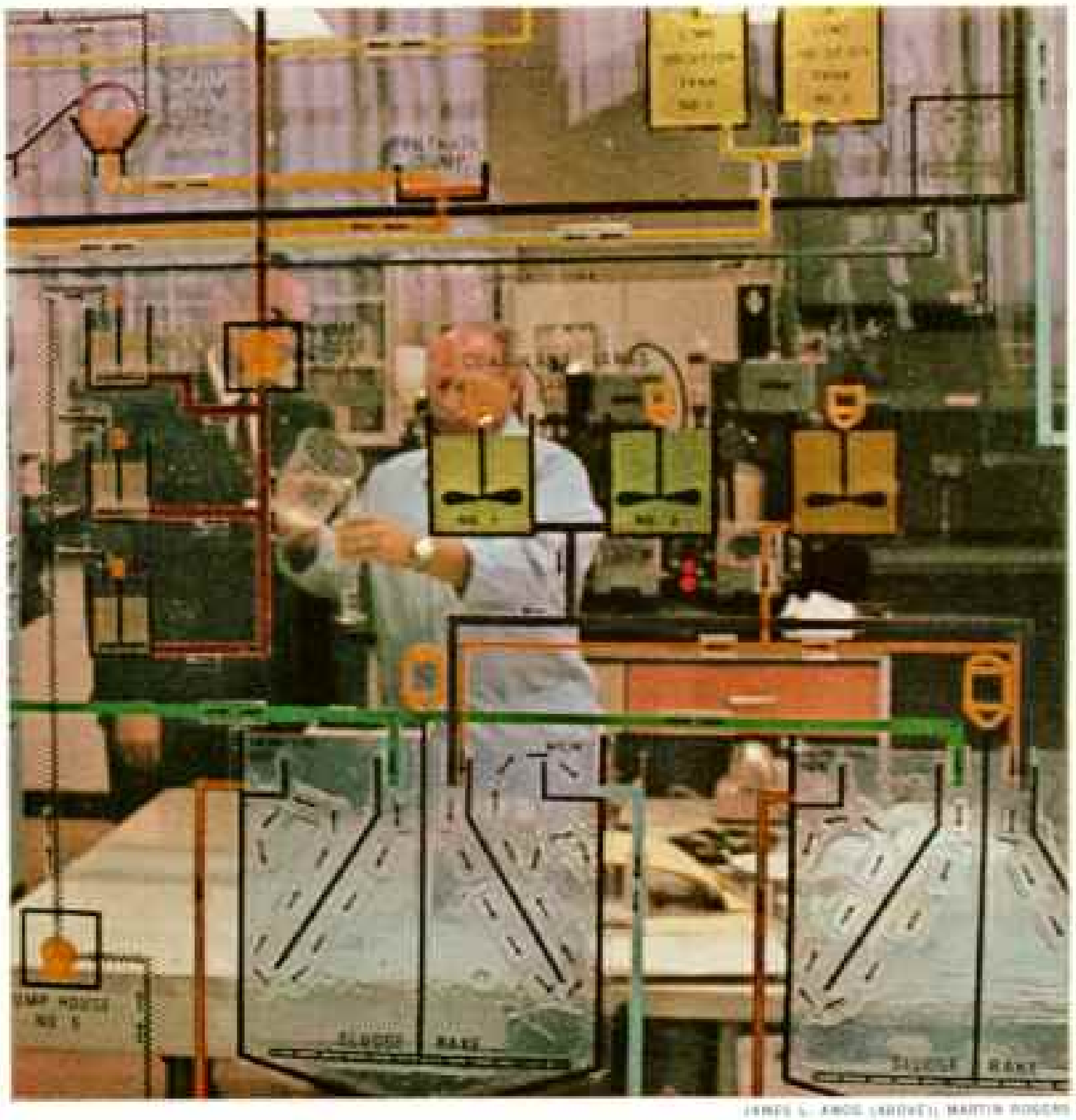
U. S. Government program pits a small armada of ice-breakers against the Great Lakes' winter armor. This year's efforts, aided by mild weather, extended the season into early February. Ultimately, the program may lead to year-round shipping.

miles of North America, making them the greatest expanse of freshwater on this planet. Even the smallest of them, Lake Ontario, ranks a respectable fourteenth among the world's largest lakes. Erie, Michigan, and Huron rank twelfth, sixth, and fifth. Lake Superior? Its area is second only to the salty Caspian Sea, which is also a lake by definition—being completely surrounded by land.

Slow to react to winter's chill and summer's heat, the Great Lakes play an important role as weather makers. When spring comes—tornado season in the Midwest—the lakes appear to exert a calming influence on the air that passes over them. The lakeside city of Grand Haven, Michigan, for example, seldom has known a tornado, but Grand Rapids, 25 miles inland, has alerts almost every spring.

After the Great Lakes have stored up summer's heat, their role reverses. In fall and early winter they pump their heat back into the cold atmosphere. Low-pressure systems moving from the west sometimes slow down as they cross the Great Lakes, absorbing energy from the released heat. Intensified, they move on to plague the lands to the east with storms and gusty winds.

For 150 years the Great Lakes have drawn people like magnets. Today, a seventh of all United States citizens and a fourth of all



Modern alchemy changes dirty water to clean at the General Motors Harrison Radiator Division in Lockport, New York. A see-through flow chart diagrams the firm's new $14,000,000 water-treatment plant—one of many springing up throughout the Great Lakes region as government, industry, and an aroused citizenry gear for a pitched battle against lake-killing pollution.

Pleasure-boating on troubled waters, yachtsmen on Lake Michigan furl their sails before motoring into a Chicago marina. Beneath their hull flows water that does double duty as drinking fountain and cesspool for many lakeside cities. By 1977, if new federal standards are met, all U. S. municipalities will have stopped flushing inadequately treated sewage into the lakes.

Canadians cluster near their shores. (See **Close-up: U.S.A.—Wisconsin, Michigan, and the Great Lakes**, distributed as a supplement with this issue.) Demographers predict that, by the turn of the century, a complex of cities—a megalopolis—will ring Lakes Erie and Ontario, and extend to Milwaukee and beyond on Lake Michigan's western rim.

Too Many People, Too Much Waste

But already the lower Great Lakes and southern Lake Michigan are being sorely stressed by the cities, farms, and industries lining their shores, and by the polluted rivers flowing into them. With the lakes already in trouble, visualize the problems we'll have to face three decades from now, if predictions of a megalopolis come true!

Actually, we know little about what goes on in the nearly 5,500 cubic miles of Great Lakes water. Until the mid-1950's most efforts focused on navigational problems, water-level control, and fisheries. It seemed that there was just too much water to analyze—and too much to be tainted by man.

But some scientists weren't that complacent. Analyzing water samples taken over the years, they saw an increase in dissolved solids, including the nutrients phosphorus and nitrogen. Only Lake Superior showed no

Chicago's Oak Street beach attracts sunbathers to a segment of the Great Lakes' 9,000-mile

JAMES L. AMOS

shoreline on a calm summer day—prior to last spring's tumultuous high waters (next pages).

detectable increase over a 60-year period. Lake Huron had experienced a 10-percent increase. The other lakes were in even worse shape. Lake Michigan's increase was 20 percent; both Erie and Ontario had increases of more than 30 percent.

Dr. David C. Chandler, who has headed the University of Michigan's Great Lakes Research Division since 1953, was one of those concerned scientists. "We have company now," he told me in his office at Ann Arbor. "It's clear to almost everyone that the Great Lakes are deteriorating. We realize that we must learn a great deal about them as quickly as possible.

"We need to know the materials balance in each lake—what is coming in, how it's being dispersed, what biochemical reactions are going on, and what's being sent downstream." Dr. Chandler paused. "In other words, what is the present state of each lake? Knowing that, we'll have something to judge against in the future. And of course we'll have a better idea of what corrective measures are needed."

There Are No Push-button Remedies

Like most scientists, Dr. Chandler is a realist. "Yes, I'd like to see all five lakes as clean as Superior," he mused, "but nobody can press a button and shut off the pollution. The Great Lakes will continue to be pollution receptors for some time to come."

Dr. Chandler's division operates the 114-foot research vessel *Inland Seas*. Other research ships, including Canada's well-equipped *Limnos*, launched in 1968, sail the lakes, too, probing for facts.

How can we clean up the Great Lakes? The answer is immensely complex, for many sources of pollution and many jurisdictional units are involved. Canada and the United States share four of the lakes. Eight states border the U. S. shoreline. On the federal level the Environmental Protection Agency now has prime responsibility for the Great Lakes cleanup, but several departments of the U. S. Government—including Agriculture, Commerce, Defense, Interior, and Transportation—have some area of control.

Complicating matters further, even the water that flows through the lakes moves at a different rate in each, and there are enough other differences—natural and man-made—to give each its own character.

Lake Superior is cold, deep, and rugged. Huron is a bit more civilized. Lake Michigan, with no Canadian boundary, penetrates the great prairies of the U. S. Midwest. Erie is an industrial worker. Lake Ontario patiently carries out Erie's garbage and struggles to remain hospitable to vacationists.

My explorations began with the greatest of

High-rise breakwaters: Luxury apartments on Chicago's lakeshore trembled under the assault of thunderous, ten-foot waves in April, as Lake Michigan's waters rose. Prodigious rains last spring followed a year of heavy precipitation. Over many lake areas, cloud cover for the same period was prolonged, slowing evaporation. Result: the most disastrous water levels in two decades, causing millions of dollars in damage.

the Great Lakes, Superior. It's the deepest, the cleanest, the largest. Its volume equals that of all the others combined—with three extra Lake Eries thrown in. It deserves the title of "inland sea," for its fog and its storms have an oceanic feel to them.

Small Boats Travel Piggyback

I tried to fly out over Superior to reach Isle Royale National Park. My chartered floatplane was ready at Grand Marais, Minnesota. But day after day a wall of thick, gray fog barred the way.

"Superior is a real fog generator," said Warren (Luigi) La Panta, a bush pilot for 25 years. "The lake is big, and it's cold. When warm land breezes blow over it, the lake chills them, and we get this." He gestured at the opaque blanket.

A more dependable way of reaching the island is aboard the National Park Service's 165-foot motor vessel *Ranger III*, which makes the 70-mile trip from Houghton, Michigan, three times a week in the summer. Frequently the ship carries an assortment of small boats as deck cargo; because of Superior's sudden storms, yachtsmen are advised not to venture across the open lake in boats less than 20 feet long.

What waits at the end of the six-hour voyage? You may hear the distant howl of a wolf or see a moose nibbling in the shallows of a creek mouth, but you'll see or hear no automobiles. And perhaps that as much as anything draws vacationists to Isle Royale.

Each end of the 45-mile-long island offers a comfortable lodge where tourists can sleep in innerspring comfort. Primarily, though, Isle Royale appeals to campers, hikers, and wilderness seekers.

FROM FILM, CHICAGO DAILY NEWS

"By the shore of Gitche Gumee . . ." Lake Superior, the "shining Big-Sea-Water" of *The Song of Hiawatha*, retains today the elemental wildness that inspired Longfellow. The severe winters on North America's largest body of freshwater echo the Ice Age,

when glaciers helped gouge the Great Lakes. At times their waters drained into the Gulf of Mexico via the Mississippi River system, or reached the Atlantic through the Susquehanna or Hudson. Now the lakes empty through the St. Lawrence River.

Much of Lake Superior's shoreline has a wilderness feeling. On a bright July day I drove along Trans-Canada Highway 17, where it hugs the lake's northern shore, constantly conscious that beyond the pavement lay vast stretches of wild and roadless forest. On the other side of the highway lay mighty, restless Lake Superior. A city boy, I hugged the highway between those two disturbing immensities.

And then, a few miles past Nipigon, I made friends with young Milton Carlson, hitchhiking from Peace River, Alberta, to Toronto.

Milt's zest for life and sense of wonder at this land were contagious. I found myself stopping often at scenic overlooks to gaze into mist-filled valleys, or to listen to the clatter of beach stones under endless attack by lake waves.

A maverick stream trickled down one dusty roadside cliff, painting the pale rock with color. Milt climbed halfway up, to sample the water.

"You can taste the minerals," he announced with a grin.

On an impulse I turned off the highway into the tiny lakeside village of Rossport. There thirty years of my maturity peeled away as, once again, I hunched over the candy counter of a little general store, deliberating, while the proprietor waited with folded arms. Those big yellow candy peanuts, I ordered at last, and jawbreakers for my friend. Of such small adventures are memories made.

Wilderness—"A Very Special Thing"

There is such an incredible amount of wild beauty on Lake Superior's shores! Fortunately, both the U. S. and Canadian Governments have recognized the need to safeguard that beauty.

Along the southern shore, Wisconsin's Apostle Islands and Michigan's Pictured Rocks have been designated national lakeshore areas. On the west, Grand Portage, Minnesota—a major stop on the canoe route of the voyageurs—has been declared a national monument. Canada has established Sibley Provincial Park on the western shore and Lake Superior Provincial Park on the east. More parks are in the planning stage.

As I roamed the campgrounds in Lake Superior Provincial Park, I checked car license plates and found that more than half the campers were countrymen of mine.

Ian Seddon, the park's youthful district

MARTIN BRIGDEN (KEYSTONE PHOTOGRAPHIC)

Mid-American port of call: The great shipping complex at Duluth-Superior attracts European commerce via the St. Lawrence Seaway to Lake Superior's westernmost tip, more than 2,300 watery miles from the Atlantic Ocean.

Here, amid a babel of languages, huge oceangoing "salties" and the European seamen who tend them (**above**) exchange cargoes—Belgian farm machines for American gantry cranes, and British steel for pipe-fed loads of midwestern wheat (**right**), the stuff of many a European's loaf of crusty bread.

naturalist, explained: "This part of Ontario is only a day's drive from some of your biggest cities. It is a very special thing for people from Chicago or Detroit to come up here where they can still see lynx, moose, and timber wolf."

I, too, found it a very special thing. I shed my shoes to wade in and scoop up some of Lake Superior's unprocessed drinking water. I turned inland to watch the morning mist rise over little Rabbit Blanket Lake; yes, the mist did seem to form a blanket of rabbit fur. And I strolled Superior's cobble beach, searching (fruitlessly) for one of the great nestlike pits excavated centuries ago by Ojibwa Indians, perhaps for some long-forgotten rite.

The wilderness vanishes at the lake's far western corner, where Duluth, Minnesota, and Superior, Wisconsin, have teeming port facilities. About 40 million tons of cargo pass through this harbor each year.

Oceangoing freighters—"salties"—tie up at the general cargo docks. Their foreign flags and the names of far-off ports lettered on their sterns give the port a romantic air.

But most of the ships here are lakers, whose long, black hulls will never glisten white with ocean spray. They tie up at the nation's largest ore-loading dock, then carry off their cargo to steel mills along the lakes. Almost as long as three football fields, the newest lakers can swallow 50,000 tons or more. When the iron-rich ore has been unloaded at a distant mill, the ships speed back empty for a new cargo. Older, slower vessels may undergo a quick cleaning and return riding low in the water with a load of coal.

Should a Lake Be Used as a Dump?

Federal and state governments, increasingly aware of environmental problems, are strengthening pollution-control laws. Freighters can no longer flush oily wastes. Since municipal sewage is a major problem, treatment plants are being upgraded along the shores.

Industry is under pressure, too, and much of it focuses on one plant 60 miles northeast of Duluth. There the Reserve Mining Company, owned by Republic Steel and Armco, processes taconite, an iron-bearing rock, and dumps tons of pulverized waste into the lake.

Company officials feel they are caught in a vise of changing values that casts them in an unfavorable role. "When we began operations 18 years ago, we satisfied every government requirement," said Edward Schmid,

Angling for answers to ecological problems, fisheries expert Howard Tanner lands a coho salmon (**left**). In the 1960's he led in introducing the fish into the lakes. Cohos eat alewives, whose soaring numbers crowded out other species after their enemies were killed by sea lampreys (pages 170-71).

Banded but undaunted, a fledgling herring gull nips a biologist who seeks the cause of a sharp decrease in the species' numbers in northwest Lake Michigan.

MARTIN RUSSO (LEFT); JAMES L. AMOS (ABOVE AND FOLLOWING PAGES)

After a cornfield snack, Canada geese take wing near Horicon National Wildlife Refuge, northwest of Milwaukee (**next pages**). In decades past, many of the wetlands that attract the migrating birds were drained for farms. Fortunately for the geese, the peaty topsoil discouraged cultivation, and much of the marsh area has been restored.

assistant to the president. "And the material we discharge into the lake is harmless."

But not everyone agrees. One of the most militant opponents is Mrs. Verna Mize of Potomac, Maryland, whose love affair with Lake Superior began during her childhood in Houghton County, Michigan.

"Superior is the last clean Great Lake," she told me. "Yet Reserve uses it as a free private dump for as much as 67,000 tons of waste a day. It's not just sand. Much is as fine as flour, and remains in suspension. Other taconite plants deposit their tailings on land, which can be revegetated. Superior feeds the other lakes and is vital to the entire lakes system. We can't afford to take such risks with it."

All over the lakes—wherever an industrial sewer pours waste into public waters—such debates go on between industrialists and environmentalists. Yes, cleaning up the Great Lakes will be a complex job indeed.

Profits Rise and Fall With Water Level

When Lake Superior's water funnels into the St. Marys River at the twin cities of Sault Ste. Marie in Michigan and Ontario, it is put to work. The famed Soo Canals, among the world's busiest, are there—with four locks on the U. S. side and one on the Canadian.

Most of the fast-moving water channels into the power canals to generate electricity, and about a fourth passes through regulating gates to control the level of Superior. Only a small portion is needed to fill the locks.

I looked up the man in charge of the locks for the U. S., Clifford Aune of the Army Corps of Engineers.

"This is a high-water year on the other lakes," he told me. "So we're holding water back in Lake Superior. That's why you see very little pouring through the regulating gates. That means less water for the power-generating plants."

High water can mean money in the bank, though, to shippers, Mr. Aune said. "If the lake rises an inch, some vessels can be loaded to ride an inch deeper in the water. On a big ship, that can mean an extra 100 tons of cargo."

The locks look deceptively small from the banks, but Mr. Aune assured me that they can take any vessel able to pass through that ocean doorway, the St. Lawrence Seaway.

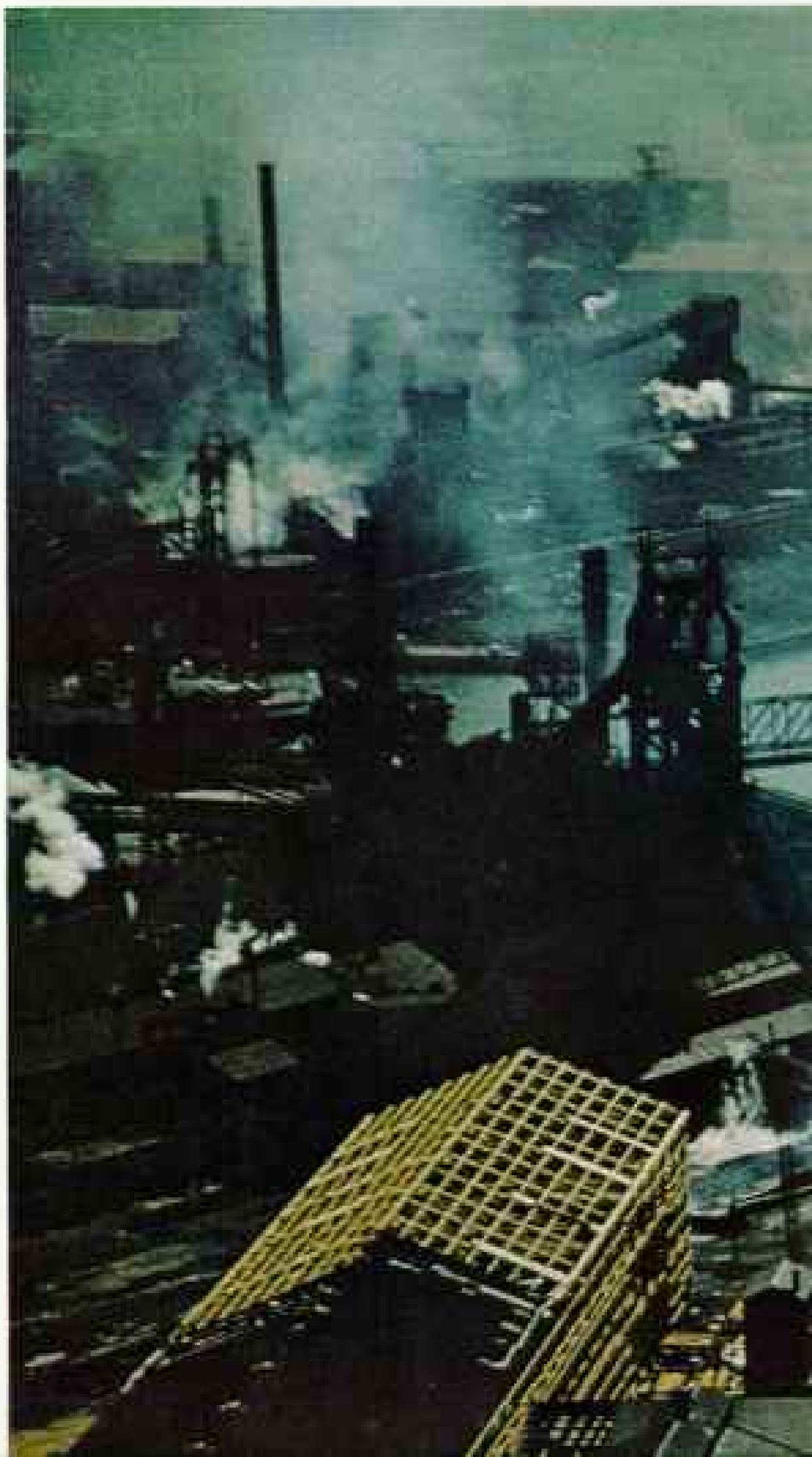
"Seaway locks are 860 feet long and 80 feet wide," he said. "Our largest lock is 1,200 feet by 110 feet. But the lakers are getting larger. Some of the newest ore carriers will pretty well fill up that 1,200-foot lock" (pages 148-9).

Where the St. Marys River ends, Lake Huron begins. In size and purity it ranks second to Lake Superior, but it's first in the hearts of millions of U. S. and Canadian vacationists.

One reason is accessibility. It takes only an hour or two to drive from Detroit or Toronto. It's warm enough to be swimmable and has some magnificent scenery.

Much of Lake Huron's tourist traffic flows along Ontario's Bruce Peninsula to the town of Tobermory, terminus of car ferries that serve Manitoulin Island farther north.

Tobermory, in the past decade, has become



Into a maw of industry: A freighter noses up Chicago's smokestack-lined Calumet River. From here southeastward beyond Gary, Indiana, the lakeshore throbs with one of the world's greatest concentrations of steel mills, fed by lake-borne ore. JAMES L. AMOS

another type of "jumping-off place," for scuba divers have discovered that the surrounding waters cover shipwrecks by the dozens.

The most famous Great Lakes wreck is the *Griffon*, built for the explorer Robert Cavelier, Sieur de La Salle; it vanished mysteriously in 1679. In 1955 a Tobermory fisherman, O. C. (Orrie) Vail, recovered pieces of what could be the *Griffon* in a cove on a nearby island. He carried what was left of the timbers back to his cluttered shop, where he makes knives and sells fishing tackle. There I examined the relics.

"There are those who don't agree," he told me, "but I'm sure in my own mind that this is the *Griffon*. Some of the wood has been identified as white oak that could be as much as 300 years old. And the remains I found bear a striking resemblance to a sketch of the ship made by La Salle's chaplain."

He hefted two spikes from the wreck. "Here's another type of evidence. All the metalwork is crudely hammered, forged in the field, as described in the chaplain's journal."

Has Orrie Vail really found the *Griffon?* The matter is open to argument, but support has come from an unusual quarter. The conservative Wedgwood company, British pottery manufacturer, has issued a special Wedgwood plate ascribing the discovery of the *Griffon* to Orrie Vail.

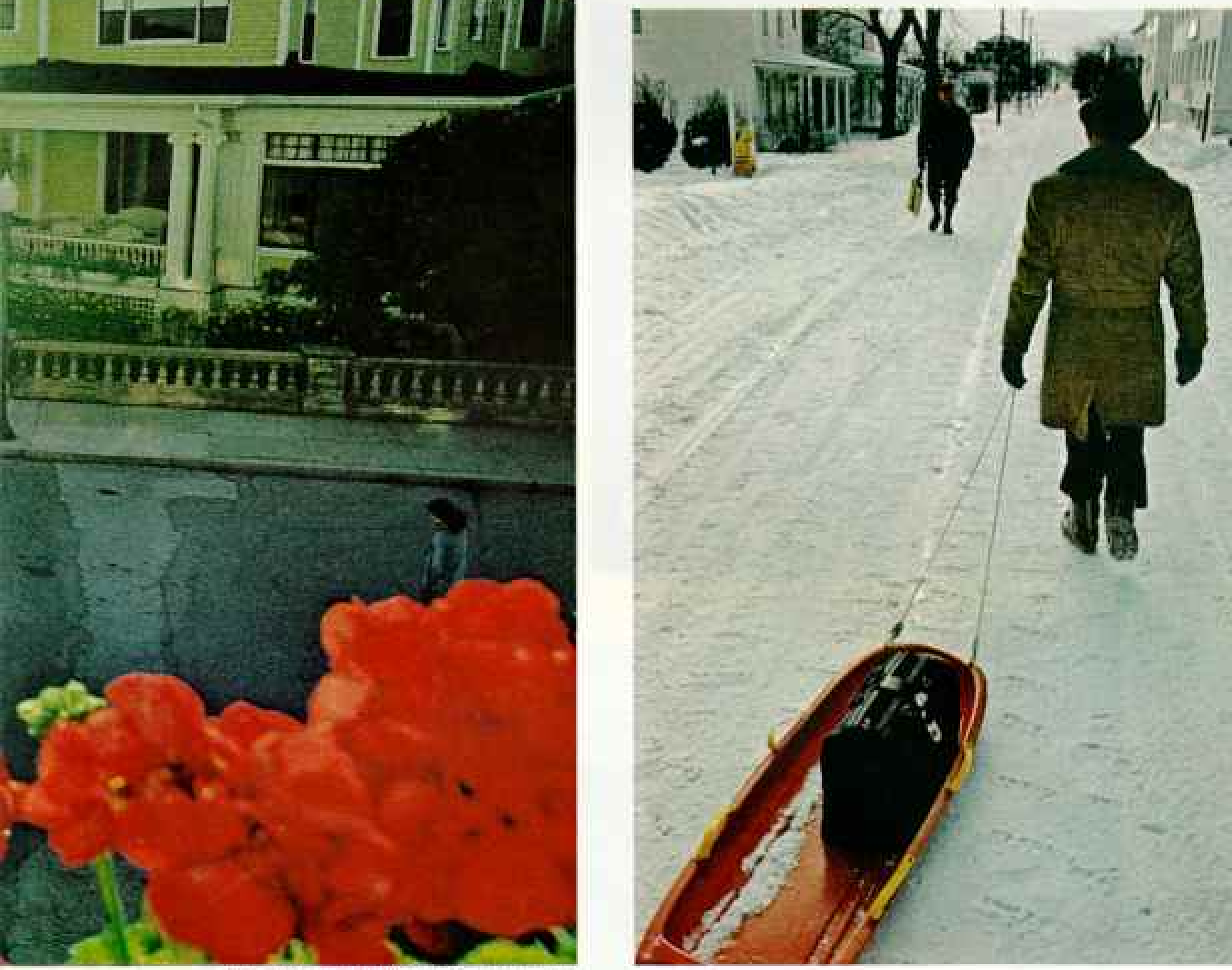
Where Hideaway Islands Beckon

Twenty-six miles from Tobermory, across stormy Main Channel, I came to Manitoulin —the world's largest island in a freshwater lake. In the Ojibwa tongue it's "holy place."

In truth, 80-mile-long Manitoulin is a delightfully tranquil land of picture-postcard scenes, quiet villages, and a hundred lakes. I paused in the town of Gore Bay on the island's north shore to chat with Jack McQuarrie, editor of the weekly *Recorder*.

"Farming is still our main industry," Mr. McQuarrie told me, "but tourism is growing

(Continued on page 170)



MARTIN RIGGERS (LEFT AND ABOVE); JAMES L. AMOS (RIGHT)

A place out of time, Mackinac Island in northwestern Lake Huron keeps to the clip-clop pace of the horse and buggy. Here automobile-company executives from Detroit come each summer to unjangle their nerves and find respite from urban traffic jams. Visitors savor the 19th-century atmosphere (**above left**) during an early-morning horseback ride. Taking part in a whimsical end-of-the-season ritual, waitresses at a local resort hotel jump off a pier—serving trays and all (**left**). In winter the population shrinks from summer's thousands to 500 year-round residents. Dr. James Fraser (**above right**) transports his medical bag in a sleigh along a street that has been cleared by a snowplow—one of the few motor vehicles allowed on the island.

On the job in Motor City, assembly-line workers at Detroit's Cadillac plant (**left**) put finishing touches on 1973 models. Second in size only to Chicago among Great Lakes cities, Detroit taps the flow of raw materials between Lakes Erie and Huron.

Foot-power promenaders by the thousands join in the annual just-for-fun Mackinac Bridge Walk (**right**). Participants in the popular Labor Day excursion usually take one to two hours to cross the five-mile span, which links Michigan's Upper and Lower Peninsulas at the junction of Lakes Michigan and Huron.

Enjoying a day off, Detroit auto worker Melvin Simpson (**below**) plays a few backyard innings with a son. Once dominated by auto plants, Detroit has diversified its industry. Now only one worker in eight builds cars.

MARTIN ROGERS (ABOVE AND BELOW), ANTHONY ROBERTS

Deadly hitchhikers, sea lampreys cling to a brown trout. Suction-cup mouth (**right**) bristles with horny teeth that clutch the host. The tongue rasps a hole through which vital fluids are sucked. Invading the lakes via man's canals, sea

fast. Things aren't as quiet around here as they used to be."

Turning to a wall map, he pointed to a speck in Georgian Bay. "When things get too hectic, I like to escape to that little island. Life moves slowly there."

I'll not betray Mr. McQuarrie's trust by naming his island. Someday, though, I'd like to visit it and talk to the residents. Do they yearn to escape to an even more peaceful haven somewhere?

Leaking Derelict Teaches a Lesson

Across Huron from Manitoulin a few days later, I circled in a light plane near Alpena, Michigan, over the wreck of the *Nordmeer*.

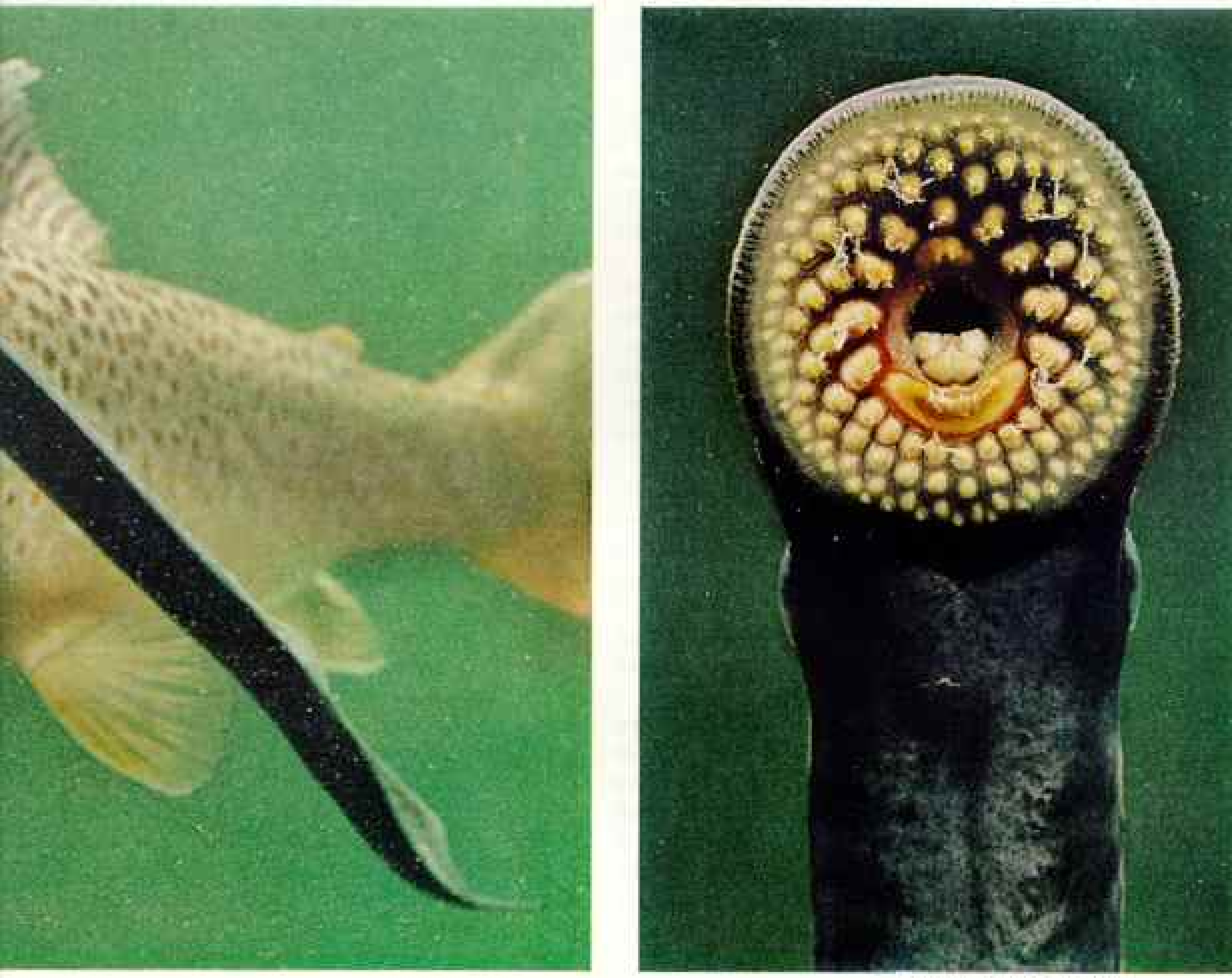
The West German motor vessel grounded near Thunder Bay Island in 1966. Salvage operations, hindered by storms, were abandoned when the ship began breaking up.

The *Nordmeer* lay on a shoal for three years, little more than a local curiosity. But in 1969 oil began to leak out of the ruptured hull.

Who bore the responsibility for removing the oil? There wasn't time for long legal battles. The ship's 47,000 gallons of oil could form a mammoth slick. So the U.S. Government moved fast to pump the oil from the ship's bunkers.

There will be other wrecks and oil spills on these inland seas. But with the example of the *Nordmeer* in mind, contingency plans have been worked out to get clean-up operations under way promptly.

Lake Superior is barely tainted. Huron's problems are largely local ones. But the other



JAMES L. AMOS (BOTH PHOTOGRAPHS)

lampreys during the 1950's had virtually wiped out the lake trout population and sharply reduced other commercial and game fish. Happily, discovery of a chemical especially toxic to lamprey larvae has brought the menace largely under control.

three Great Lakes are in more serious trouble.

In many places they are overfertilized—oversupplied with nitrogen and phosphorus. Plants, mostly algae, thrive on that diet.

Where do the chemicals come from? Virtually every sewage-treatment plant on the Great Lakes adds its share. Even after sewage has been treated, much of the "purified" water that flows back into the lake is high in nitrogen and phosphorus. Industrial effluent often contains those chemicals too. Another source is farmland. Rain washes chemical fertilizers—which almost invariably include the two nutrients—off fields into streams that feed the lakes. Drainage from farm feedlots adds animal wastes.

In overfertilized waters, algae can multiply with frightening speed. When the thick mass dies, it decomposes and soaks up precious oxygen from the water.

At the University of Michigan in Ann Arbor, research oceanographer Dr. John C. Ayers talked about algae.

"The algae bloom rhythm is getting faster and faster," he told me, "like a quickening beat on a kettledrum. It may become continuous. We've seen it in Lake Erie and Lake Ontario. Now we're beginning to see the same pattern in parts of Lake Michigan."

Dr. Ayers pointed out that solutions to the problem would not be easy. "First we'd have to limit the nutrients coming in," he said. "Then we'd have to remove quantities of the nutrients already present. There's been discussion of removing the algae for use as fertilizer or food, but that would take a great

deal of money and research. The most intriguing idea is to somehow favor natural removal through the food chain."

When man develops a practical use for algae, the knowledge may well come from a college research program begun by Congress in 1966. A marine equivalent of the century-old agricultural land-grant colleges, it's called the sea-grant program.

Our inland seas fall under the program, too. The University of Michigan, with its team of researchers, receives federal, state, and industry funding for sea-grant projects. Dr. John Armstrong, director of the university's program, outlined some of the things his group was working on.

"We're not large enough to take on all five lakes at once, of course," he told me. "Studying even one of them intensively would be an immense job. So we started by focusing on one area that is a model of one of the lakes."

He unrolled a map of Lake Michigan and indicated Grand Traverse Bay, notched into its northeastern shore.

"There's our model. Notice that it is shaped and oriented like Lake Michigan itself. It even has a miniature 'Chicago'—Traverse City—in the right location. The bay is small enough for us to study intensively. And as we understand Grand Traverse Bay, we'll be better able to understand Lake Michigan and the other Great Lakes."

Lake Study Helped by Make-Believe

At lunch Dr. Armstrong went into another aspect of sea-grant aims. "We're interested not only in the biological and chemical aspects, but also in the relationship between man and the lake."

How does one study a relationship like that? One way, Dr. Armstrong pointed out, is by playing games.

"We gather some of Traverse City's decision makers together—the mayor, the city councilmen, real-estate people, conservationists—the people whose decisions affect Grand Traverse Bay. We give them a hypothetical situation—let's say the possibility of a new lakeside park in Traverse City—and they hash the thing over, as they would do in a real situation. By feeding their reactions and decisions into a computer programmed with the bay's characteristics, we can get an idea of what effect the group's decision would have on the bay twenty years from now."

Scuba Dive Reveals Bay's Plight

As a teen-ager back in the late 1930's, I liked to prowl the lake bottom off Evanston, Illinois, in a homemade diving helmet. Underwater visibility was excellent, I remember, even though Chicago's city limits were less than two miles away.

On a June morning I donned wet suit, flippers, and scuba gear and plunged into Grand Traverse Bay. My companion was Dr. Lee H. Somers, University of Michigan oceanographer and sea-grant diving officer.

Our first dive was 30 miles from Traverse City, near the mouth of the bay. The water seemed clear as we descended, but on the sandy bottom I saw pockets of wispy brown material. Dead algae.

Our vessel moved close to the city, and we dived again. Here I saw more dead algae on the bottom, and the water was filled with flecks of suspended material. Visibility was poor indeed.

The plight of the lakes was more real to me as I climbed back aboard. Yet, looking down from the boat, I saw what seemed to be clear water.

"I wish everyone could get down there to see the changes close up," Lee Somers said. "It takes a scuba dive to make you really aware of how the lakes are going downhill."

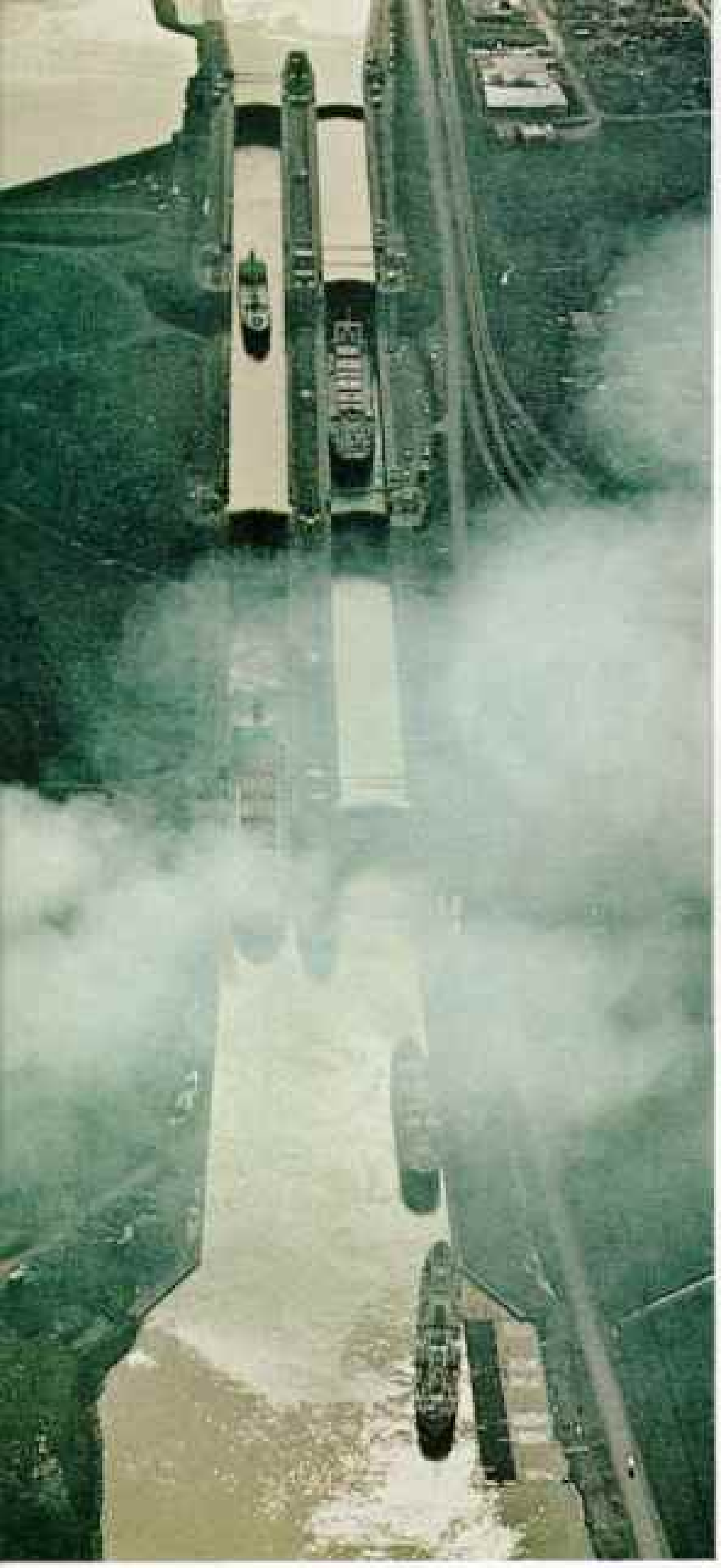
We moved back to clear water for our final dive of the day. As Lee and I ghosted along the bottom 55 feet down, I suddenly forgot about Lake Michigan's troubles. Sticking out of the sand beneath me were unmistakable pieces of a wreck.

Lee hovered patiently a few feet away as I struggled to pry a spike out of one of the rotting timbers. Then, triumphantly, I flippered toward the surface clutching my souvenir.

"You've just committed a crime," Lee told me with a grin as we climbed aboard the launch. "The State of Michigan prohibits divers from stripping wrecks without a permit.

Booming city on a sickly lake. Roar of a football crowd at Cleveland's Municipal Stadium sounds over pollution-plagued Lake Erie. Predictions in the mid-1960's that Erie would soon be dead—devoid of living organisms—sparked a desperate clean-up campaign. The effort seems to have at least checked the advancing blight.

MARTIN ROGERS



Bypassing the impassable, ships plying between Lakes Erie and Ontario use the Welland Canal (**above**) to sidestep Niagara Falls, here seen at night from the Canadian side (**right**). The Niagara River carries the furious overflow from the four higher lakes into the fifth, Lake Ontario. End-running the great cataracts, ships on the Welland Canal are lifted or lowered by eight locks.

Too many historically important shipwrecks have been torn apart for souvenirs."

I treasured that rusty spike for a moment, then let it splash back down to the lake floor.

Part of Lake Michigan's floor has recently been coveted as "real estate"—an index to the increasing population pressures around huge lakeside cities. Officials in Chicago, where landfill has already extended shorelines, talked of a plan to use part of the lake bottom far from shore.

They envisioned a major airport out there. A giant dike would enclose a polder of drained

JAMES L. AMOS (BOTH PHOTOGRAPHS)

lake bed—11,000 acres, five miles across. Chicago badly needs a third major airport, they said. The noise problem, always a big factor in siting an airport, would be minimized. The new airport, connected by a bridge or tunnel to the city, would be only 12 miles from the Loop.

But environmentalists talked of problems. They worried that the huge dike could disrupt lake currents that now help to disperse pollutants. Jet-fuel spills from the pipeline or tankers could play havoc with aquatic life. Rock for the giant rampart might be mined from the lake bed, and that, too, could have major environmental consequences.

Resistance to the plan has been heavy; it seems unlikely, now, that the airport will be built. Still, the controversy points up a battle that will be fought in coming years. Land seekers will continue to cast speculative looks offshore at all that potential "real estate." Increasingly, though, they will find environmentalists barring their way.

In the past few years there has been a ground swell of public resistance to needless contamination of our lakes and rivers. Save

MARTIN ROGERS (BOTH PHOTOGRAPHS)

the Great Lakes! Some groups rely on court suits to stop polluters. Others picket or rally public opinion through newspaper advertisements. At least one man prefers direct action in the battle to stop pollution.

He signs himself "the Fox." With a small group of conspirators, he wages anonymous war against water polluters near Chicago—plugging pipes that pour chemicals into streams, depositing dead skunks at the homes of offenders. He has become a folk hero, and the bane of local police.

In Chicago I let it be known as widely as possible that I wanted to interview the Fox. Weeks later, at my home near Washington, D. C., I received a long-distance phone call from a mild-voiced man. "People call me the Fox. I hear you'd like to talk to me."

The next week I met the Fox and his two chief confederates. I still have no clue to the identity of the three men.

What does the Fox look like? I can tell you this: He does not resemble the flashing-eyed crusader I'd expected. His eyes twinkled when I asked why he'd begun his life of crime.

But his answer was serious. "I've never stopped being a law-abiding citizen. It's those companies I visit that are breaking the law—the moral law. They're taking our public water, using it, contaminating it with their wastes, and dumping it back into our public lakes and rivers."

He doodled a fox head absentmindedly on the back of the business card I'd given him. "Oh, maybe I trespass a little, and cost those people a bit of time and effort to unplug their pipes when I stuff them up—but they're the ones who're breaking the law. They're committing ecological murder!"

And then his eyes were twinkling again. "When you bring home to a plant owner just what he's doing—when you dump some of his own plant's effluent on his office carpet, or toss a dead skunk on the roof of his home—you start getting through to him."

Citizens Take Up the Fox's Battles

The deeds of the Fox have become legend. Once, dressed as a workman, he climbed an industrial chimney that spouted noxious fumes. He measured it, and went home to make a chimney cap. The next night he returned to cap the stack.

Five times he plugged a pipe that poured chemicals into a stream. When the company welded a metal screen over the end, he wriggled in through a manhole and crawled a quarter of a mile to plug the pipe from the inside.

The local police and the guards at plants he's visited would like to catch him. At this writing, he's still at liberty. Have his midnight attacks brought results?

One Aurora plant, after seven raids, has installed an efficient treatment system for its effluent. Citizens groups in the area have been spurred to begin legal battles against other companies. Aurora residents drop their litter into barrels marked with the Fox's insignia.

Though it was those midnight raids that made the news, most of his ecological projects today are lawful ones, carried out with the help of trusted lieutenants by schools and Scout troops. Corporate officials wince at bad publicity,

Devouring its own shores, a swollen, wind-lashed Lake Michigan last winter clawed with unwonted savagery at scores of beach-side communities. After several violent storms, residents of Beverly Shores, Indiana, shuddered to find homes perched on the edge of oblivion (**left**). Frantic bolstering of retaining walls with sandbags (**below**) generally proved futile. Another big blow in March brought further damage to both shore and houses.

regardless of its source, and more and more concerned citizens are generating headlines.

I got a dramatic picture of another lake's troubles as my jetliner settled toward the airport at Cleveland, Ohio. At first Erie's waters were cobalt blue beneath me; then I spotted a gray fan-shaped stain spreading out from the mouth of the Cuyahoga River.

The lake's western basin is shallow, with depths of 30 feet or less. Many of the pollutants settle there. The bottom stairsteps down then, into the 80-foot-deep central basin, and finally into the eastern basin, whose deepest point is 210 feet.

No other Great Lake is as heavily polluted. Eighty percent of its water flows from Lake Huron, past heavily industrialized Detroit. Much of the rest comes in from industrial streams like Cleveland's Cuyahoga. Erie's bottom is coated with a sediment layer that ranges from 30 to 125 feet thick.

At a Great Lakes conference in Toronto, Ontario, Dr. Noel M. Burns of the Canada Centre for Inland Waters talked with me about that sediment.

"Normally, sediment serves the beneficial role of trapping excess phosphate," he said. "Soluble iron, released from the sediment, is

turned into nonsoluble iron hydroxide by the oxygen in the water—and it traps the phosphate. But when the water's oxygen is depleted by dying algae, the iron compound breaks down again, releasing phosphate to stimulate further algal growth."

And so the battle of Lake Erie should begin with algae, experts say. If the plants don't grow, they won't deplete the lake's oxygen by dying. How can they be stopped? By not feeding them with nutrients from sewage plants, industry, and agricultural runoff.

Most scientists believe phosphorus control is the best approach. It's one of the major nutrients (nitrogen is another) upon which algae feed. And phosphorus can most easily be removed from incoming wastes.

If the torrent of contaminants is slowed, perhaps Lake Erie—which has a faster natural flushing rate than any of the others—can gradually sweep the problem downstream, and ultimately into the Atlantic Ocean.

Ironically, two of the Great Lakes' biggest problems came *up* from the Atlantic. One was the alewife, a mild-mannered member of the herring family. The other was the nightmarish sea lamprey, an eel-like parasite as much as two feet long, with a front end

ROBERT W. MADDEN (BOTH PHOTOGRAPHS)

Visitor gets a charge from harmless static electricity at the Ontario Science Centre in Toronto. Ontario—only Canadian province on the Great Lakes—joins U. S. agencies in searching for solutions to lake problems.

Urban idyll: With Toronto's skyline for a backdrop, a girl feeds geese on an island in Lake Ontario. Smallest in area and farthest downstream of the Great Lakes, Ontario inevitably brims with problems washed down from its upstream neighbors.

that terminates in a suction-cup mouth studded with rasping teeth (pages 170-71).

At the Bureau of Sport Fisheries and Wildlife Laboratory in Ann Arbor, Michigan, biologist Stanford Smith gave me the background.

"The lamprey got up through the Welland Canal into Lake Erie by the 1920's. But, of course, it took the alewife longer."

Of course? Dr. Smith grinned at my puzzlement. "Remember that the locks on the Welland Canal are filled from upstream. And when the valves are opened to lower a ship, the locks empty with the force of a cataract. Free-swimming fish like alewives almost always get swept downstream. Really, that canal isn't the open door to the other lakes that some people think it is.

"But the sea lamprey usually waits for a free ride," Dr. Smith continued. "It gets around by hanging onto a fish—or the hull of a ship."

"Once through the canal, the lamprey moved clear up to Lake Superior, all but wiping out the lake trout as it went. In 1958 the U. S. and Canada began to control it up there, since Superior still had trout to save."

Dr. Smith told me that sea lampreys travel up streams to spawn, and the control program focused there. Electrically charged wires were installed to block the streams, but the lampreys managed to bypass them in times of unusually high water. Finally a lampricide was developed that—if very carefully used—would kill the lamprey larvae without harming desirable fish.

"The initial result of the program was a fast drop of about 80 percent in Lake Superior's lamprey population," Dr. Smith continued. "Since then, the lamprey count has wavered between 10 and 20 percent of the original peak."

The meek little alewife, I learned, posed a different problem. After it finally managed to breast its way through the Welland Canal in the 1930's, it simply ate all its competitors out of house and existence.

Normally surrounded by water—but rarely by so much—one of the St. Lawrence's

The parasitic lampreys helped by killing off lake trout and burbot, which would have preyed on the alewives. Eating up the zooplankton upon which other small fish had lived, the alewife multiplied at an almost unbelievable rate. Soon alewives came to comprise about half the fish bulk in the Great Lakes. Until recently they were regarded as formidable pests.

For a while a commercial alewife fishery was in operation, but it wasn't always a financial success.

Lakeside residents came to detest the alewife. Periodically, massive die-offs paved beaches with dead fish.

When I asked Dr. Smith what caused the die-offs, he shook his head. "We're not sure. Sharp temperature changes in the water, perhaps, or winter temperatures colder than their native ocean environment. Some people suspect that they're caused by the poisonous properties of algae."

But the alewife population appears to be on its way down, because large numbers of coho and chinook salmon have been introduced successfully into the Great Lakes. "We hope they and lake trout will be able to eat up the alewife problem," Dr. Smith said.

New Peril Plagues Shore Residents

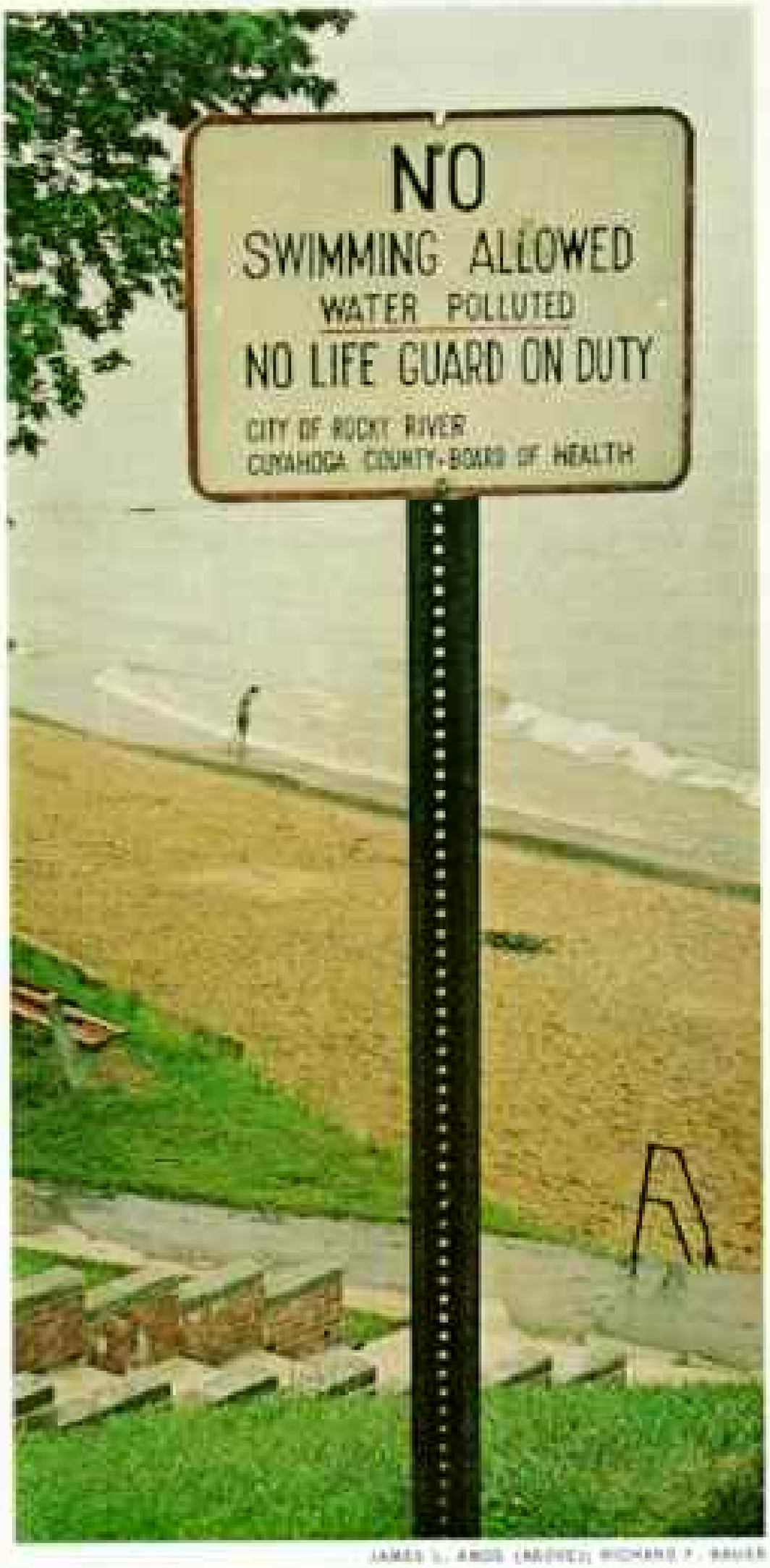
Lakeside cottage owners have been known to growl in disgust when dead alewives littered their beaches. But recently they have faced a much more serious problem: high water, bringing wave damage and shore erosion. All of the lakes except Superior have suffered heavily.

Last March I visited Port Clinton, Ohio, on Erie's southwestern shore. The lake was quiet on that windless day, but still the lakeshore end of the town's main street was awash.

B. Jerry Campbell, managing editor of the Port Clinton *News-Herald*, voiced the townspeople's fear. "Winds out of the northeast can mean trouble," he said. "If there is an extended storm—sometimes they last for days

Thousand Islands lies all but submerged by high waters pouring from the Great Lakes. 181

MARTIN ROGERS



JAMES L. AMOS (ABOVE); RICHARD P. BAUER

Clean water is worth working for. Sad signs of the times, like that on a once-busy Lake Erie beach (**above**), have turned many a disappointed swimmer into an ardent anti-pollutionist. Hoping to save Lake Michigan's shores from the fate of Erie's, supporters of the Milwaukee Coalition for Clean Water (**right**) give up a weekend in April to remove noisome debris from the Milwaukee River. In the two-day spring cleanup, some 3,000 volunteers collected more than 180 truckloads of muck and junk.

—incoming waves can be ten feet high. And then this town gets very, very wet!"

In a chartered plane I surveyed the lakeshore and the Bass Islands offshore. There had been a storm last November that raged more than 24 hours, and I could still look down at collapsed porches and boarded-up windows. I winced at the vulnerability of those who build too close to an inland sea.

Why are the lakes high? Blame mother nature. Rainfall last year was 14 percent above normal. Heavy rains again in the spring sent water levels to record highs, especially on Erie and little Lake St. Clair.

Much of Niagara Flows Unseen

Nowhere is the immensity of the Great Lakes more evident than at Niagara Falls, where their vastness is translated into thunder.

Honeymooners and other assorted tourists really see only about half the story. More than 100,000 cubic feet of water a second roars unseen through tunnels to generate electricity for two nations, and a smaller portion flows through the 27-mile-long Welland Canal.

What is left? Merely another 100,000 cubic feet a second, thundering 193 feet down the face of a cliff.

It's quite a sight. I've looked down at it from a helicopter and up at it from the pitching deck of the *Maid of the Mist*. From the mouth of a rock-hewn tunnel far below ground level I've seen the falls from behind. Unforgettable views, all three of them.

More than 90 percent of the water plummets over Canada's giant Horseshoe Falls (pages 174-5), raising a cloud of spray far higher than the falls. Of the many people swept over the precipice by accident, only one 7-year-old boy in a lifejacket is known to have survived. At least seven people have deliberately ridden over the edge in barrels or other contrivances of their own design. Records list four who lived to boast about it.

The first, incredibly, was a buxom, middle-aged teacher named Anna Edson Taylor. In 1901 she was launched in her steel-bound wooden barrel, and hauled out later below the falls, battered but alive.

And Niagara's tightrope walkers have been legion. The original—a Frenchman billed as "Blondin"—first cavorted across the river gorge in 1859. During the next year he performed a number of daring variations: blindfolded, on a bicycle, pushing a wheelbarrow, carrying a man on his back,

Racing fleet booms downwind during a regatta on Lake St. Clair, between Huron and Erie. Millions who live far from the sea find fun and livelihood on the Great Lakes.

stopping halfway across to cook an omelet.

The parade continued, each aerialist trying for new sensationalism. The gorge became a magnet for daredevils, and accounts of their stunts became legend. I like the story, unconfirmed, of an aerialist who crossed on a wire while hanging by his teeth from a wheeled mouthpiece, waving the British and United States flags. Halfway across, the slack in the cable brought him to an ignominious stop, the story goes, and there he hung until rescue —desperate but wisely silent.

Two Nations Join to Seek Answers

Below the falls the Niagara River runs fast and deep for seven miles. Then it quiets and broadens into Lake Ontario, smallest of the Great Lakes. Ontario's pollution problems are second only to Erie's. Cities such as Hamilton and Toronto on the Canadian side, and Rochester and Oswego, New York, on the U. S. shore contribute their chemicals and algae-spawning discharge from sewage plants.

But also located on Lake Ontario's shore is the Canada Centre for Inland Waters, at Burlington, Ontario. Scores of scientists there probe the physical, chemical, geological, and biological processes occurring in the lakes.

Canada has two advantages in her war on Great Lakes pollution. First, only one province is involved; the giant Province of Ontario spans Canada's entire Great Lakes shoreline. Second, virtually all the nation's water-pollution research is focused in the Canada Centre for Inland Waters.

Canada and the United States are working through their International Joint Commission to save these lakes, so precious to both nations. The teamwork has been little short of spectacular lately. Extra dividends of data are expected from the International Field Year for the Great Lakes, which just ended.

The field year, part of a UNESCO program, concentrated on Lake Ontario, dotting it with a network of recording buoys and monitoring towers, surrounding it with shore-based radar and weather stations. Research ships and aircraft crisscrossed the lake, probing for answers to the myriad questions of scientists.

Never has one of the Great Lakes been

SANDY EDWARDS

North America's greatest freshwater reservoirs. Whether future generations can use and enjoy them hinges on the present battle to save the lakes from complex pollution woes.

studied as intensively. For years scientists will be poring over the field-year findings. From their analyses will come a clear portrait of a Great Lake, the most thorough ever painted.

The lakes will grow dirtier while that portrait takes shape. As Dr. Chandler said, there is no pollution-stopping button to push. But we'll be much closer to the answer when the returns from Lake Ontario are in.

Meanwhile, both nations are beginning to take essential steps: upgrading sewage treatment and enforcing pollution regulations.

Experts generally agree that the lower lakes are sick. Are they doomed? There's now a fighting chance they are not. Their complex illnesses are being diagnosed, and the two nations have signed a pledge to undertake the remedy. But will they inject the massive doses of money needed? Only time will tell.

Nature Provides a Note of Hope

My Great Lakes travels ended on the St. Lawrence River, that beautiful waterway where yachts, tourist boats, and foreign freighters mix. The poor, tired Great Lakes water swirls its way among the Thousand Islands, past modest cottages and island mansions. It still has more than a thousand miles to go before it will reach the sea.

But nature has a way of trying to perpetuate its works. As the water moves downstream, a remarkable improvement in its quality begins to take place.

More than anything else, that gives me hope. Think of a drop of water that leaves Lake Superior, pure and loaded with oxygen. Consider the abuse it takes as it moves through Lake Huron, industrialized Lake Erie, the Niagara River, and the length of Lake Ontario.

But then, as the drop jostles its way down the St. Lawrence, a purging process begins. Impurities begin to settle out. The hustling drop absorbs new oxygen.

Nature is ready to help if we can only make our cities, farms, and factories spew less harmful waste. It is an immense, expensive task, but surely worth tremendous effort. For what more precious legacy could we leave our children than five shining inland seas? □

Stalking the West's Wild Foods

By EUELL GIBBONS

Photographs by DAVID HISER

YUCCA STANDLEY

Gathering groceries on the desert floor, the author and grandchildren Colleen and Mike cut pulpy stalks from yucca near Rough Rock, Arizona. The outdoor gourmet and his family tackled rugged, often hostile terrain of the West to prove they could survive on its scanty fare. Always they followed a basic rule: *Never use any wild plant or creature for food until you have identified it and know it to be edible.*

WE DROVE OUT of Shiprock, New Mexico, early one April morning—my wife, two grandchildren, and I—determined to live off the land.

Mike, our 13-year-old grandson, sat beside me as our camper-bus rolled past miles of drab, brown, unpromising landscape. Suddenly he pointed to a spot of color—a few green plants with bright purple blossoms.

"They're pretty," he said. "What are they?"

"Locoweed," I replied. Eating enough of it, I told him, will drive a horse mad; there's no record of what it'll do to people.

But that didn't keep Mike from suggesting, "Let's try some. Then maybe we'll be crazy enough to go ahead with this trip."

In the days that followed, the local people did consider us a bit daft when we told them we were trying to find enough wild foods to live on in this high, arid Four Corners area of the West, where New Mexico, Arizona, Colorado, and Utah meet (map, page 193).

I am accustomed to raised eyebrows, though, for my lifelong passion has been to seek out nature's bounty and subsist on it.

As a teen-ager, I had roamed widely through the Four Corners region, and had found food to stave off starvation for a week at a time. But perhaps young Mike was right. As we drove northward through the Navajo Indian Reservation, I found spots where, 45 years ago, I had staked my horse to a 30-foot lariat and he had eaten his fill. Now these places were bare, overgrazed by sheep.

Glumly we turned for our meals to the standard camping fare we had brought with us. We grew more discouraged with every tin my wife, Freda, opened. But at last, along an intermittent stream that led us westward into Utah, things began to look up.

At a bend in the wash we spotted a patch of green and stopped. It resembled sea blite, a salty but palatable relative of spinach and chard that we had often eaten on the islands of Maine. Here it is called seepweed and grows in damp pockets of saline soil. Here, too, we found young tumbleweed only a few inches high. Mike and Colleen, my 11-year-old granddaughter, soon picked enough of these tender plants for a meal.

By now photographer David Hiser had joined our foraging party. We pitched our camp near the ruined stone buildings of an Indian village that had stood untenanted for 700 years, and began our scavenger hunt in earnest. We found abundant mature tumble mustard and tansy mustard, both blooming. These make good potherbs only when young and tender, but we gathered a supply anyway. Even the dry hills yielded some goodies. Yucca was just showing its asparaguslike bloom stalk above narrow-pointed leaves. Nearby was the strange joint fir, whose leaves resemble tiny scales. Westerners most often call it Mormon or Brigham Young tea. We made some

Forbidding thorns must be singed off or peeled away to reach succulent cactus flesh. Orange-red blossoms identify the tender red hedgehog cactus (**top**). Both the seeds and heart of the fishhook cactus (**middle**) are edible. Strips of prickly-pear cactus (**bottom**) sizzle in a frying pan.

SCHLUMBERGERA TRUNCATA

ECHINOCEREUS WHIPPLEI

DENIS BURNS

"MY GREATEST JOY is in opening young minds to nature's possibilities." This philosophy of Euell Gibbons, as expressed in his books—particularly *Stalking the Blue-Eyed Scallop* and *Stalking the Wild Asparagus*—led NATIONAL GEOGRAPHIC magazine to sponsor an expedition to a Maine coast island. The story of how Mr. Gibbons and his family and friends "feasted their way to survival" on the bounty of land and sea appeared in July 1972.

We then challenged Mr. Gibbons to try a less ample larder: the sere deserts and rugged mountains of the West. Calling on memories of childhood foraging in his native Texas, he knew what to look for—but encroachments of man and livestock, added to the sparseness of the land itself, made the provender less plentiful, the finding more difficult—THE EDITOR

Debris comes in handy at a Dolores River campsite in Utah. Here the author tries out an improvised fishing rig made from a Coca-Cola bottle. He winds line around the waist of the empty bottle (**bottom**), attaches sinker and hook, and uses a white grub for bait. Swinging part of the weighted line ever faster around his head, he suddenly points the base of the bottle outward and the line shoots out, as if unwinding from a spinning reel. Survival assured!

Carp and catfish mingle in a stew seasoned with saltbush, wild onion, peppergrass, and biscuit-root (**lower right**).

Gibbons also made a wet fly by tying strands of hair around a hook (**below**).

National Geographic, August 1973

that evening by boiling a handful of joint fir stems (upper right) for a few minutes and allowing the brew to steep. Everyone pronounced it a good everyday drink.

The boiled seepweed, though, proved to be naturally oversalted. We drained off the salty pot liquor and used it to cook the young tumbleweed. When Colleen remarked, "I could make a whole meal on food like this," Mike reminded her, "That's exactly what you'll have to do if you don't want to go to bed hungry."

We tried the mustards—tumble and tansy, boiled and salted, and found them bitter, aromatic, awful. The yucca was equally bitter. As Freda washed the dishes, a few soap flakes blew into the tansy mustard pot. Mike sampled the greens again and announced, "First flavor I ever tasted that could be improved by adding soap!"

In the morning we drove into the Utah desert between Blanding and Lake Powell. The wild flowers were beautiful; among those we gathered were the white four-petaled blooms of the spectacle pod (lower right). Its flat twin seedpods look like tiny sunglasses.

After pitching camp at misnamed Irish Green Spring, we had a tasting bee to decide how spectacle pod should be cooked. Behind its good flavors—hinting at garlic and horseradish—was a little astringency that I suspected was tannin. Since milk will tame down the tannin in a cup of tea, we added powdered milk when we boiled the plant—leaves, stems, flowers, seedpods, and all.

Prickly-pear cactus flourished all about our camp. It bore no fruit in April, but the flattened leaflike joints were juicy and tender inside their spiny skin. We found the flesh flavorless and gluey when raw. Boiled, it left a slimy, ropy juice. So I cut some filleted pads into strips, rolled them in flour, and fried them in cooking oil, thus supplying badly needed fats and carbohydrates. Mormon tea washed down our supper, after which we spread our sleeping bags under the stars, and were soon dreaming of hamburger drive-ins.

EPHEDRA TORREYANA
DRAWINGS BY STAFF ARTIST LISA BIGANZOLI

Joint fir stems steeped in hot water make a beverage variously known as Mormon, Brigham Young, Mexican, or squaw tea.

NEXT MORNING we indulged ourselves in pancakes and sugar syrup, for our energy was beginning to flag on the meager wild food we could find in this desert. We set off to explore, and shortly came on great numbers of thistles growing in the bottom of an arroyo. The crowns and flower stalks seemed good, and we gathered an ample supply.

Our map showed a cliff dweller's ruin to one side of the wash, and when we came to it, we were amazed. Many of the tiny rooms were intact, even to the juniper timbers in the ceilings. Broken pottery and tiny corn cobs, centuries old, lay scattered about.

"Take nothing but pictures," I warned the children, "and leave nothing but footprints."

We had now sampled most of the edible plants this arid region offered. The desert could indeed furnish food that would hold body and soul together at this time of year, but it produced very little that even a wild-food fanatic could call savory.

Our next project was really wild. We planned to pick an area from the map, walk into it, and live entirely off the land. After some discussion, we chose a roadless area of Utah's lower Dolores Canyon, where it meets the Colorado River.

It was touching, and a bit frightening, to see the faith the crew had in my ability to find enough wild food to feed us. They walked away from the locked camper in a holiday mood.

When the trail reached the flats near the Dolores River, I began to

STANLEYA PINNATIFIDA
DRAWINGS BY STAFF ARTIST LISA BIGANZOLI

Spectacle pod, a pungent wild flower of the desert, can be boiled in milk to remove its astringency, the author discovered.

Saltbush tells by its name that its leaves come self-seasoned; seeds can be ground for meal.

breathe easier. Saltbush (left), loaded with tender leaves, bordered the trail. This was a ready-salted plant so palatable that we enjoyed eating it raw. Under the bushes grew low, mealy lamb's-quarters, and two species of peppergrass dotted the ground. Our old friends, seepweed and tumbleweed, showed here and there.

Mike was quartering the range ahead of us like a good bird dog, and I heard him make a glad noise from up a little side canyon. When I arrived, he was digging wild onions (page 192) with his hands. Overjoyed, we filled a large bag. If one must live on vegetable stews, onions for flavor can be a great blessing.

As we gathered onions, I explained that biscuit-root should be found in exactly this kind of habitat. I described the low, inconspicuous plant in detail. Freda looked down and said, "I think you are standing on one." Sure enough, the white flower and lacy foliage were protruding from beneath my shoe sole.

Laden with food, we chose a campsite along the riverbank. We had lines and hooks—and a discarded Coke bottle we had picked up beside the road. I had learned Coke-bottle fishing in Mexico. I showed Mike how to wind his monofilament line around the waist of the bottle and swing the sinker and hook around his head to cast, pointing the base of the bottle outward at the same time. The line peels off the bottle as it would from a spinning reel (page 188). To retrieve it, one turns the bottle crosswise and winds in the line.

We found two white grubs for bait, and Mike landed a small

catfish. He cut it open, threaded part of its red entrails on his hook, and promptly pulled in a good-size carp. What more could one ask for than fish, mixed saltbush, onion, and peppergrass, a pot of biscuit-root—reminiscent of carrot and parsnip—and Mormon tea?

Next day Mike came running from his fishing hole shouting that he had caught a catfish three feet long. Deciding on a wilderness bouillabaisse, we boiled our wild vegetables, then added boneless catfish fillets. While it didn't taste much like a French bouillabaisse, it made a wonderful survivor's stew. We had found a small fishhook cactus, a barrel-shaped plant less than a foot high (page 187). I cleaned it as I would a pineapple and sliced it into rings for salad.

"It even tastes a little like pineapple," David said. Boiled biscuit-root and Mormon tea completed a fine meal.

"There's really not much left to prove here," I announced. "We can eat all summer in this canyon." The others agreed. We arrived back at the camper with full bellies, ready to seek some less arid part of the West and see what it could provide.

I HAD A YEARNING to gather Indian potatoes, and I especially wanted to find yampas, both delicious wild foods I had not tasted in a long time; so we headed for the Yampa River Valley in northwestern Colorado. We stopped along the way only to gather sheep sorrel, purslane, wild lettuce, and cattail hearts.

The Yampa River Valley is a garden of wild food. In the first riverside town we reached—Craig, Colorado—we found a vacant lot covered with dandelions just right for cooking, and all the spinachlike curled dock we could use. Then we found a great plenty of salsify, with roots like slender carrots. These sell in markets as oyster plants and make an excellent root vegetable.

We took a kitchenette suite in Steamboat Springs and cooked our

Yampa, its tubers sweet and nutty, gave its name to a valley, a river, and a town (map, page 193). It was even proposed as a name for the territory that became Colorado.

Finding edible plants proves difficult enough in the Arizona wasteland (**facing page**); the even greater challenge of drawing water from the sunstruck sands intrigues Mike and Colleen.

Experimenting with a solar still, they dug until they struck dampness. Placing a bucket at the bottom, they covered the hole with a plastic sheet. Moisture extracted by the heat condensed on the underside of the sheet. Here Mike depresses the center with a rock; only a few drops materialized to fall into the container.

ALLIUM ACUMINATUM

Wild onion accents any dish. The author cautions: Sniff the bulb to avoid its look-alike, the poisonous death camas.

SISYMBRIUM ALTISSIMUM

Bed of tumble mustard, dampened in a stream and laid atop hot stones, will soon begin to steam and season a meal of wild vegetables and game.

wild fare on an electric stove. Next morning we consulted biologist Bob Krear at Colorado Alpine College. He doubted that we would find the spring sprouts of yampas; it was still too early. However, he showed us how to find Indian potatoes.

This plant is seldom more than five inches high, and its slender leaves are almost perfectly camouflaged when growing in grass. After Bob pointed out several, Mike sat down and stared at them for about ten minutes. From then on he could see great patches of Indian potato where the rest of us could see nothing but grass. Each tiny plant bears but one tuber, usually less than half an inch in diameter (facing page). We found them tedious to gather, but worth it—crisp and palatable raw, utterly delicious when boiled.

Still we found no yampas. We even drove up the Yampa River to the town of Yampa. There we talked to Mr. Lee Jensen of the U. S. Forest Service, a man who is as devoted to yampas as I am. He showed us on a map where he gathers his supply. It proved to be 60 spine-jolting miles away over dirt roads.

While setting up our camp, we found an abundant supply of fresh meat to supplement our vegetarian diet. The stockmen in that area had killed off the coyotes. As a result, ground squirrels flourished unchecked. A plague of the animals was eating up the range. David and Mike shot several of them with their .22-caliber rifles.

Here, too, porcupines were plentiful and fair game in any season. Walking upstream from camp, I spied a large specimen grazing in a little meadow. Cautiously I crept up on the animal, and with one mercifully swift blow of a club dispatched the great hunk of meat.

That evening we had a large stew made of dandelion crowns, biscuit-root, squirrel meat, porcupine liver, some of our precious hoard of Indian potatoes, and wild onions.

But even such a feast did not dull my yearning for yampas, which by now had become an expedition joke. Mike and Colleen had even taken to calling me "Grampa Yampa."

AFTER A BREAKFAST of fried ground squirrel, we started for the yampa grounds, three miles away and several thousand feet higher. It was a strenuous hike, breathtaking in more ways than one, for it was superbly beautiful country. Elk tracks and droppings were everywhere, and beaver dams formed stairsteps up the stream. We puffed our way to the aspen groves where yampas were supposed to flourish.

In triumph I found a few old yampa stalks and dug them up. But the tubers that I had hoped would survive the winter were no more than hollow husks. Now I knew I would not eat yampas this trip.

My disappointment eased on the way back to camp when we came to a patch of western spring beauty (page 197), which has a tuber that rivals a potato in flavor. Then Mike found strings of western chickweed tubers. Beside a beaver dam we gathered a number of cattail rhizomes, or rootstocks. Then, too, there was that huge porcupine carcass soaking in salt water. Who needs yampas, anyway? Tonight we would eat red meat like proper savages!

Back in camp we prepared an underground oven, a rectangular pit lined with stones. Mike built a fire in it and put in more stones to heat. These we covered with water-sprinkled bunchgrass for a steaming agent; in drier areas we usually relied on tumble mustard (left). Finally we put in the porcupine, the spring beauty tubers, and the western chickweed tubers. *(Continued on page 197)*

HOOKERIA LUCIDA

"I searched for the Indian potato through the woods and valleys of my childhood," recalls the author, "dreaming of the Indians and pioneers who enjoyed it long ago." He found a patch of the elusive tubers (**above**) near Steamboat Springs, Colorado.

To sample the fare of four western states (**map, left**), the author and his family tramped the desert, backpacked to remote canyons, and jolted by jeep along mountain tracks. Crisscrossing a tangle of public and private lands, Mr. Gibbons sought out rangers, knocked on ranchers' doors, and checked with Indian tribal councils for permission to sample the wild plants and creatures his party found.

Working with fire, Euell Gibbons hardens an aspen sapling (**above**) he has shaped with a survival ax. Further sharpening with a stone gives the desired edge (**below**) for digging dandelions and tubers.

Plucking his way through a cloud-cooled meadow in Colorado's San Juan Mountains.

National Geographic, August 1973

COW PARSNIP- HERACLEUM LANATUM

the author makes a positive identification of the cow parsnip to avoid picking the similar but poisonous water hemlock. When peeled, young stalks of cow parsnip taste like celery.

To our hungry crew the oven-cooked porcupine was as succulent as roast goose. The tubers were done to a turn. Young nettles made a grand vegetable, along with a refreshing salad of spring beauty tops, wild mint, and wild onion. Topping it off with rose hip tea, we voted this our best meal yet. Afterward we roasted the cattail rootstocks. The starchy interior tasted as good as sweet potato.

We stayed another couple of days, and the western wilderness fed us well. But I wanted to explore even higher, to forage on the slopes above timberline, now blanketed with snow. By unanimous vote we decided to adjourn the expedition until warmer weather.

MID-JULY found us high above the old mining town of Ouray, deep in the San Juan Mountains of southwestern Colorado. This time Freda had stayed home. My daughter Pat, equally talented behind a skillet or a steering wheel, signed on as cook and driver of our rented jeep.

It took a nimble, sturdy vehicle to negotiate the old mine-supply roads to our goal: a tiny blue dot on the map representing a crystal lake nestled at nearly 13,000 feet. The ride furnished every thrill except speed—we made seven miles in the first hour and a half.

Suddenly, at 12,000 feet, a meadow of rose-colored blossoms brought a shout from me that stopped the jeep. Wild onions! We swarmed out and began to dig. Growing on this high, chilly, thin-soiled slope, they had the best flavor of any I have ever tasted. Mike, who is always hungry, decided to have a lunch of onions.

The plants, I explained, contain substantial amounts of sugar. "If a hiker broke a leg here, he could survive on these wild onions until a rescue party arrived."

Colleen, standing downwind of Mike, rolled her eyes toward the mountain peaks. "Yes," she said, "but the rescue party might refuse to carry him out!"

Just over a ridge at 13,000 feet, we glimpsed our lake below—an acre or two of blue water amid snowfields and flowery meadows. I carried a load of gear down to our campsite, following a tortuous trail that skirted the snow.

"Hey, Grampa!" Mike yelled from above. "Next time take the escalator!" He tobogganed past me down the snowfield, with bedrolls and cooking gear piled on a plastic sheet.

We pitched our tents in a wild vegetable garden, for our meadow was covered with marsh marigold and American bistort (next page). The marsh marigold is one of the finest of wild greens when gathered in earliest spring. Here at the edge of the snow it was spring in July.

I quickly discovered another treasure—mountain sorrel (right). Its little round leaves, as sour as lemons, would make a perfect substitute for vinegar to flavor the greens.

Pat built a campfire with the dry sticks we had hauled up to this treeless meadow, and filled her pressure saucepan with greens. At this altitude, water in an open pot boils at too low a temperature to do much cooking. The rest of us, meanwhile, went foraging.

At 13,000 feet, that is easier to say than to do. After a few dozen steps I had to stop and puff, and discovered at my feet the best wild dish on the mountain—alpine spring beauty. The rosy little flowers peep from dense clusters of fleshy dark green leaves, and the entire plant is edible; the tasty root grows as large as a carrot.

Suddenly Mike shouted from the other side of the hill, "Hey, there's a bird over here as big as a chicken!"

CLAYTONIA LANCEOLATA

Colorado bounty ranges from radish-size bulbs of the western spring beauty (**above**) to a breakfast array (**facing page**): clockwise from fork—wild rhubarb, nettle leaves, thistle root, dandelion root, dandelion crowns, and, at center, pigweed.

OXYRIA DIGYNA

Mountain sorrel leaves add a lemony tang to wild salads and spice to fish stock.

We arrived puffing, to see a white-tailed ptarmigan standing complacently in the path, only a few feet away. The plump brown-and-white-feathered bird was almost begging to be eaten, but we had agreed not to disturb the animal life in this delicate alpine environment. Later we encountered other ptarmigan we might easily have caught. Local people call them fool hens.

Leaving the ptarmigan to their foolish ways, we concentrated on wild plants. With our pressure cooker already in use, Colleen devised her own method of cooking spring beauty roots. She diced them, added wild onion, butter, and salt, folded them into aluminum foil packets, and roasted them in the campfire coals. When they were done, we sat down to a superb wild vegetarian dinner.

The marsh marigold, cooked with mountain sorrel and seasoned with butter and salt, tasted better than domestic spinach. A tossed salad of spring beauty leaves and vinegary mountain sorrel leaves was tartly perfect, dressed with a little salad oil and salt.

With well-filled stomachs, we sighed and feasted our eyes on the spectacle around us. Colleen said, "Grampa, this is the best camp we've ever had: running ice water in midsummer, a supermarket of wild food all around us, and flower beds in our front yard!"

The lower end of our meadow dropped out of sight, and across the clear, high void stood the peaks of the Red Mountains. The moment the sun settled below the horizon, stars popped out, almost near enough to touch. Cold, thin air drove us into our down sleeping bags before the last glow had vanished from the western sky.

WE STAYED on the mountain for two more days, feasting on wild plants high above tree line. Our foraging turned up two species of biscuit-root and moss campion in large quantities. We found only eight edible species, but all were growing in abundance. If a hiker carried in sugar, salt, cooking oil, and some source of protein, he could put together a wholesome wild-plant diet wherever the snow had melted on these slopes.

On the rugged, twisting, downhill road to civilization, we stopped frequently to collect wild foods at lower elevations—fireweed, king's crown and queen's crown, with succulent foliage; clumps of garlic mustard; and the delicately anise-flavored sweet cicely.

All these discoveries delighted me, but in one meadow, white with flowers resembling Queen Anne's lace, I examined the single linear-divided leaf that projects about halfway up each stem, and my heart started pounding.

I shoved a spade under a clump and lifted it. The base was crowded with small tubers.

Yampas! Great fields of yampas—yampas by the acre!

That evening, camped at a weathered, overgrown ranchstead, we feasted on yampas, dozens of them. Young and tender, they were delicious raw—better than the sweetest carrot ever grown. Boiled, they were superb.

As we crawled into our sleeping bags for the night, I contemplated with satisfaction our weeks afield in search of the wild foods of the West. True, in these southern Rocky Mountain States we had traversed thousands of acres that would yield not a single bite. But we had sampled fertile, fruitful areas where one can dine gloriously on nature's finest produce.

"Grampa Yampa feels fulfilled," I grunted quietly, but only an owl hooted in response. The others were already asleep. □

"**Foraging** wild picnics," maintains the author, "offers the thrill of a treasure hunt and the taste of something rare." He and Mike (**facing page**) examine the American bistort, one of the commonest subalpine wild flowers, near Ouray in southwestern Colorado. The roots taste best when roasted over coals.

Ever on the lookout, Mr. Gibbons garners dandelions on a vacant lot (**below**) in Craig, Colorado.

POLYGONUM BISTORTOIDES (FACING PAGE); TARAXACUM OFFICINALE

Algeria: Learning to Live With Independence

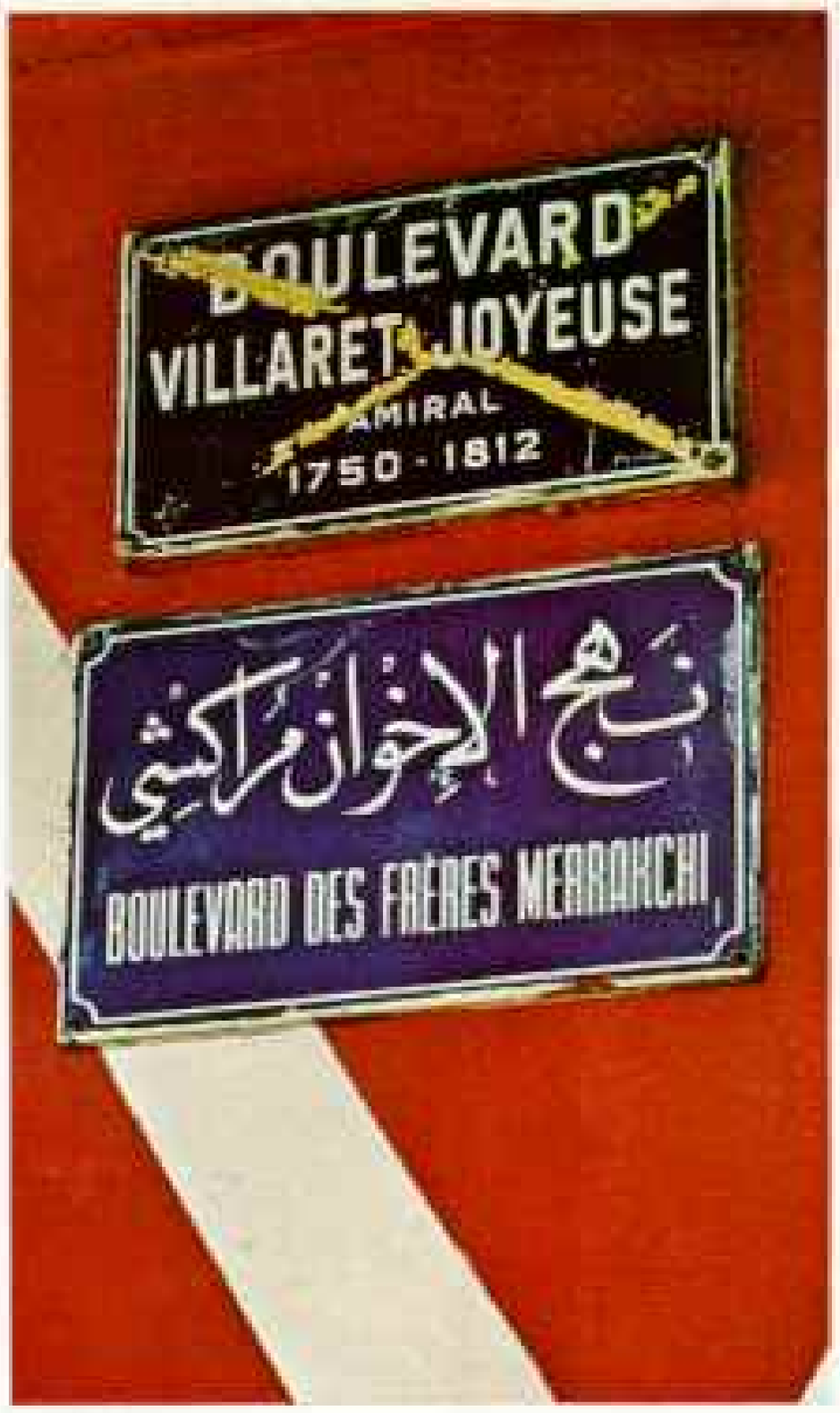
ARTICLE AND PHOTOGRAPHS BY THOMAS J. ABERCROMBIE
FOREIGN EDITORIAL STAFF

"**Algiers, the white,**" Algerians call their capital, here awakening under a pale winter sun. The city's arcaded quay was built by the French, whose 132-year rule of this North African land ended in 1962. Beyond Algiers, on opposite sides of a rugged mountain range, lie fertile coastal plains and the vast oil-rich desert.

FROM THE AMPHITHEATER of hills around us, the whitewashed city of Algiers smiled down upon its crowded harbor, waiting for the day's drama to begin.

With my official escort, Army Lt. Smain Dahmane, I walked along the jetty enjoying the early-morning stillness —that brief respite when yesterday's worries have faded and today's are not yet upon us. Poised between the azure Mediterranean and a deep African sky, the city glowed in the sun's first embrace, evoking a serenity that belied a torn and checkered past.

Phoenician biremes once anchored here. They were followed, in turn, by Roman merchantmen and the creaking



Its personality a paradox, Algiers cancels an honor to a French naval hero (**above**) and renames a boulevard for brothers who died fighting for independence—yet the city still translates the Arabic into French. At sidewalk cafés along Didouche-Mourad, Algiers' main street (**facing page**), students read local French-language newspapers and converse in both tongues.

Cosmopolitan areas particularly reflect the heritage of the French *colons*, or settlers, who shaped the administration, schools, and cultural life of modern Algeria. Following the bitter seven-year war that ended French rule, socialist regimes placed a priority on Arabic language and culture. Today more than half of all youngsters are enrolled in primary schools, where instruction is increasingly in Arabic. Yet French remains the predominant language in universities, shops, and even the government.

dhows of seventh-century Arab invaders. Through 300 years of Turkish rule Algiers harbored Barbary pirates.

Finally, after the port fell to France in 1830, it bustled with ships that funneled European colonists into the city and the surrounding plain, and eventually on to the green Atlas Mountains and the vast Sahara beyond.

"Yes, Algeria has suffered more than its share of history," the lieutenant said. "If we pay it less than its due, it is because we are consumed with the present. For us, the Algerian people, the real story began only 11 years ago."

Cultural Mix Flavors New Government

Always it had been outsiders who wrote Algeria's destiny. Then, in 1962, after a bloody seven-year war in which perhaps a million Algerians—and nearly 25,000 Frenchmen—died, the onetime colony wrested its freedom from France. The *Front de Libération Nationale* tailored a government unique and without precedent. They modeled it on the socialism of Eastern Europe, but tempered by Islamic law; they wove it through with modern French bureaucracy and ancient tribal traditions. The Democratic and Popular Republic of Algeria was born.

Recently I spent three months exploring this land, tasting its troubles and savoring its fervent hopes. Wherever I went—from the vineyards of the Mitidja Plain to the sweltering oases of the Sahara, from the snow-scoured passes of the Atlas to the teeming capital—I found the Algerians still fired by the spirit of their revolution, hard at work molding the personality of their new nation.

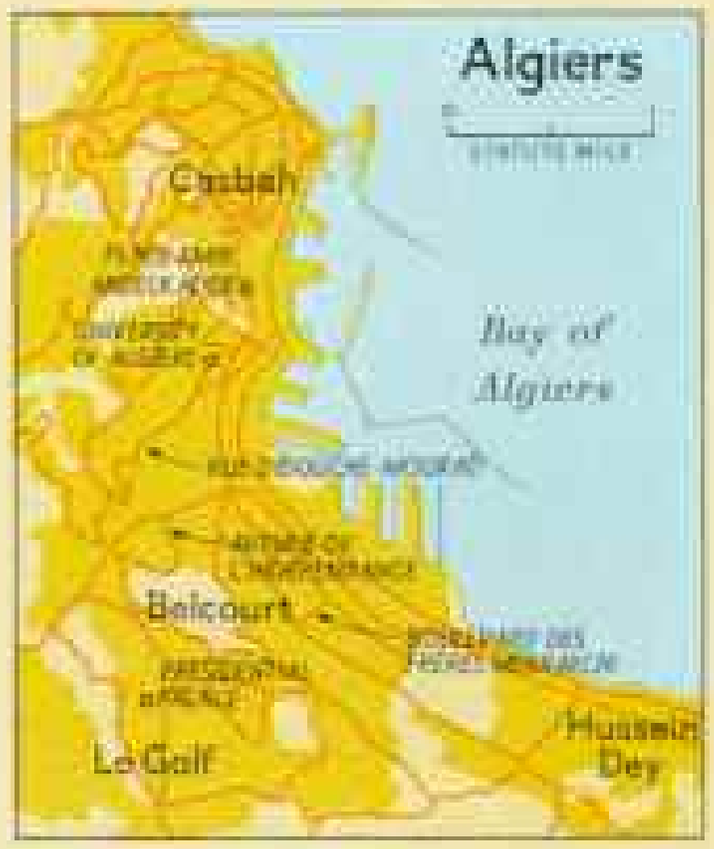
During the long *nuit coloniale*, the two worlds of Algiers, Moslem and European, lived apart. The labyrinthine Arab Casbah—with its narrow streets and noisy *suqs*, its minarets and Turkish baths—echoed the centuries past, ignored by the cathedrals, the factories of Belcourt, and the kiosks and chic Parisienne boutiques of Rue Michelet. Between these two worlds, at the Place d'Isly—since renamed—the imposing bronze statue of Bugeaud, Duke of Isly, conqueror of Algeria, guarded an uneasy peace.

Now the duke is gone, replaced by his old adversary, Emir Abdelkader, the 19th-century poet-warrior immortalized by the recent revolution. Gone too is Rue Michelet, renamed Didouche-Mourad after a martyr of that revolution. The two faces of Algiers


AIR ALGERIE
AIR

REVENUES from enormous Saharan petroleum fields fuel industrial expansion in Africa's second largest nation; after 1976 Algeria expects to be providing much of the natural gas consumed on the East Coast of the United States. Yet agriculture remains the major occupation, and 95 percent of the people crowd along the narrow, fertile Mediterranean coast and the foothills of the Atlas Mountains. The 11-year-old Democratic and Popular Republic of Algeria blends Islamic tradition with 20th-century socialism.

AREA: 919,591 square miles. **POPULATION:** 15,000,000, mainly Arab with a large number of Berbers. **LANGUAGE:** Officially Arabic; French widely used. **RELIGION:** Islam. **ECONOMY:** Petroleum; wine, citrus; subsistence agriculture. **MAJOR CITIES:** Algiers, 1,000,000, capital; Oran, 330,000, port; Constantine, 255,000. **CLIMATE:** Hot summers, mild winters, adequate rainfall along the coast.



merge into a heady blend—a Christian church with minarets, Arab movies with French subtitles, Arabian Nights on the Champs Élysées.

Through morning rush-hour crowds I battled my way down the Rue Didouche-Mourad, the capital's serpentine main street, where packed commuter buses jockey through a bumper-to-bumper cascade of French-built Renaults and Peugeots. Along the narrow sidewalk I was swept up by the cosmopolitan current that overflowed the curbs, eddying into the street. Young bureaucrats in Western suits, anonymous women wrapped in crisp white veils, miniskirted co-eds from the nearby University of Algiers, tall, gaunt men from the countryside wearing flowing flannel jellabas with pointed hoods.

Arabs Learn to Read Arabic

Arabic and French mixed freely in the sidewalk café where I paused for a cup of rich espresso. Students from the university across the street filled the tables around me. Aptly, they embodied the young face of a country where 60 percent of the citizens are under 20.

"In 1963 a mere 2,800 students were at the university level; today there are 28,000," Dr. Djilali Sari, professor of geography at the University of Algiers, told me. "The government pays their tuition. A fourth of the national budget is allotted to education.

"The number of grade-schoolers has more than doubled since independence," Professor Sari said. "We have about 14,000 foreign teachers here—Frenchmen teaching at the upper levels, and Egyptians and Syrians instructing, in Arabic, at the primary level. Arabic is our official language," he added, "yet all too few Algerians read or write it well."

Next day I kept an appointment with Smail Hamdani, Deputy Secretary General of the President's Office. We talked amid Moorish splendor at his office in the Presidential Palace, set in the palm-shaded quarter of Le Golf. I found Mr. Hamdani a dedicated revolutionary, yet a deeply religious man.

"We are first of all Moslems. Islam was the one force that united us during our long struggle," Mr. Hamdani said as we sipped delicate glasses of *thé à la menthe*—tea with mint. "To its teachings we still look for guidance.

"Yet socialism is the logical answer to the dilemma we face. The war of liberation left Algeria a shambles, with two million people homeless," he said. "Our first job was to put together an economy from the pieces of an outdated system—one designed solely for foreign interests."

Still, I wondered, how could Algeria reconcile the teachings of such opposites as Mohammed and Marx?

"We are not Communists," Mr. Hamdani answered. "We could never abide its atheism. In orthodox Islam, the religion *is* the state, concerned with peoples' welfare in this world as well as in the next. In a modern industrial world, religion and state tend to emerge as separate strands, but our Algerian socialism will keep them closely entwined."

Although the state has taken over major enterprises—petroleum, mining, manufacturing, agriculture—the new socialism has only begun to color the complexion of the city.

Here and there banners in Arabic extol the new order: "SEEK THE TRUE ALGERIAN CHARACTER THROUGH THE CULTURAL REVOLUTION!" or "THE PEOPLE BELIEVE IN THE LEADERSHIP!" Glib acronyms on office buildings catalog a growing socialist bureaucracy: SONACOME, SONATRACH, OFALAC, SNED. A sign on Avenue de l'Indépendance made me do a double take: ENEMA. It marks the headquarters of the Établissement National d'Exploitation Météorologique et Aéronautique.

Strangers Still Inspire Caution

The foreign visitor can find this bilingual bureaucracy discouraging. A simple visit to a factory, a farm—even a fishing boat—requires written permission from Algiers. Sometimes, even with proper credentials, I was turned down by wary local officials. Twice I was arrested with my cameras.

"We are not really unfriendly," one Algerian friend explained, "just extremely reserved. We suffered long under foreigners. It is still hard to open up to them."

Armed with high-level introductions and my permit from the Ministry of Information, I drove out to the formerly French Berliet truck factory at Rouiba, ten miles east of Algiers. Run by SONACOME, the government motor-vehicle monopoly, the plant makes the rugged Berliet giants that have all but replaced the Sahara's camel caravans.

The plant director, Abdellah Daba, scrutinized my permit, made a photocopy for his file, then ushered me cordially into the quiet of his office.

"We produce 26 trucks and 2 buses a day now," Mr. Daba said. "We plan to double that

In a nation of abstaining Moslems, lush vineyards flourish—a legacy of French rule. Grapes destined for a winery at Mascara tumble onto a conveyor (**below**). Stripped of fruit, vines near El Bordj (**right**) serve as fodder for sheep.

Generations of French vintners converted Algeria's best land to grape cultivation and made their colony the world's major wine exporter. The heady vintage was usually mixed with a lighter French product to create the *vin ordinaire* that appeared on almost every family table in France.

At independence most colons fled the country, taking their skills and capital

Algerian farm laborers assumed management of the estates, later nationalized but still operated by the workers.

Now the U.S.S.R. and Poland buy much of the wine. But Algeria is converting half its vineyards back to pastures and fields. It seeks, without depending on imported grain and milk, to feed a population growing by half a million annually.

by next year. Our new technical school is already training the 6,000 skilled workers we will need."

Mr. Daba introduced me to a serious young man. "Surely you would like a tour. My deputy will show you around."

"Let's begin here with the main assembly line," the deputy said, opening a door at the huge clanging plant. Then pausing, "But before we go in, could I have a look at your permission from the ministry?"

Wealth of Few Divided Among Many

It is in the quiet countryside, not the noisy cities, that the revolution has wrought the deepest change. After the war the new government gradually nationalized the French estates that texture the rolling landscape with vineyards and orange groves, then helped former employees set up *domaines autogérés*, self-management farms.

I stopped at one of the largest, the former Domaine de la Trappe, a 2,600-acre spread west of Algiers in the Mitidja Plain. It was the peak of the vintage, and workers were picking and hauling grapes by the truckload. Much of this vineyard's 12-million-bottle-a-year production is still sold under the renowned Trappe label, but the sign at the gate reads "Domaine Autogéré Aomar Bouchaoui." It honors a former worker and revolutionary cut down in a fierce night clash with French soldiers. I spoke with the director of the farm, Aisa Razem.

"One family ruled all this land from here," Mr. Razem said, gesturing toward the four-story Victorian manor house. "One family!" Now 700 Algerian families share its bounty. The mansion has become a school for girls.

"Under our Self-management Program, the government itself owns the land. The workers elect a management council that supervises day-to-day operation," Mr. Razem continued. "We divide a third of the profits among the workers, the government takes another third for rent and taxes. The remainder goes into improvements."

We visited the *caves* and watched the day's press flowing into enormous glass-lined fermentation tanks. "Much Algerian wine is too full-bodied for the average palate," Mr. Razem said. "It is exported by special tanker ships for use in blending."

Driving through Algeria's countryside, I often witnessed a sight that would bring wine lovers to tears: workers uprooting rows of vines and hauling off the gnarled stumps for firewood.

"France imports only a fraction of the wine it once did from Algeria," Mr. Razem explained. "We have found new markets in Poland and Russia, but we are still left with an embarrassing surplus. There is no home market; most Algerians, being Moslems, do not drink at all."

Last year the government began distributing land, in plots averaging 30 acres, to hundreds of Algerian farmers. At a ceremony near Tlemcen, 280 miles southwest of Algiers, I watched the governor pass out deeds to 60 landless peasants (pages 210-11).

"For centuries we have tilled the soil for foreigners," he said to the cheering crowd. "Today this land is Arab."

No city in Algeria is more Arab, nor street by street more thoroughly charming, than the provincial capital of Tlemcen. While Europe slept through the Dark Ages, Tlemcen was evolving into an important center of Islamic art and learning. Today its citizens still try to keep it that way. Not that the city has been bypassed by Algeria's Four Year Plan. I saw workers busy on schools, a new water system, and a giant soccer stadium. But it is Tlemcen's 12th-century fort, its domes and minarets, its 2½ miles of crenellated ramparts that set the glowing scene. The crowded suqs around the Great Mosque, the coppersmiths, weavers, and sandal makers, the narrow stalls bursting with silks, brassware, and spices are scenes perfumed with the past.

Haggling Pays Off—in Any Language

In a small shop on Rue M'rabet Mohammed, I paused at a collection of fine wool jellabas—the hooded robes of the rural Arab. Bachir Bouaili, the smiling proprietor, rubbed the lapel of my battered Harris-tweed jacket between his thumb and forefinger.

"Ah, monsieur, you know fine wool," he said in French. Then, unfolding one of his wares, "This is sturdy material—and only 170 dinars."

"Jamila, wa-lakin ghali jiddan!" I replied in Arabic: "Handsome, but very expensive." The price dropped to 160.

"Mia ashara," I ventured. "One-ten."

"La, ya akhi, mia khamsin—No, my brother, one-fifty," he countered, switching to Arabic, perhaps the only sensible tongue for serious haggling. A quarter of an hour later we met at 140 dinars, about $32.50.

Carrying my new robe, I followed the quiet road up from the market toward the hillside village of El Eubbad. Along the way I passed many white-domed tombs, the kind that dot the landscape throughout Moslem Africa (pages 230-31). Each marks the resting-place of a marabout, a mystic or savant who, it is believed, possessed miraculous powers.

I climbed the stairs to a small white mosque roofed with bright green tile, the shrine of Sidi Bou Mediene, Tlemcen's patron saint. At my knock, the massive brass-bound door creaked open, revealing a fragile wisp of a man who answered my *"Salaam"* and gestured me inside. His beard was as white as his immaculate robes and turban. It could have been the ghost of the long-dead saint himself. In a voice no more than a whisper he introduced himself as Sheik Mohammed bin Mousa.

Faithful Find Sermon in a Birdcall

"Our Sidi Bou Mediene was born in Seville," he said, leading me down into the crypt. "But he lived and taught for most of his life here in Algeria. For 800 years now, we have revered the example of learning and devotion he set for us."

A Moslem myself, I lightly touched the green silk brocade that draped the bier, thereby assuring myself a share of the saint's *baraka*, or blessing. Outside in the courtyard doves cooed. Sheik bin Mousa hushed me. I listened and nodded. To the Arabs, doves don't merely *coo-coo*. Listen carefully, they say, and you can hear *"Uzkuru Rabbakum!"* which in Arabic means, "Remember your God!"

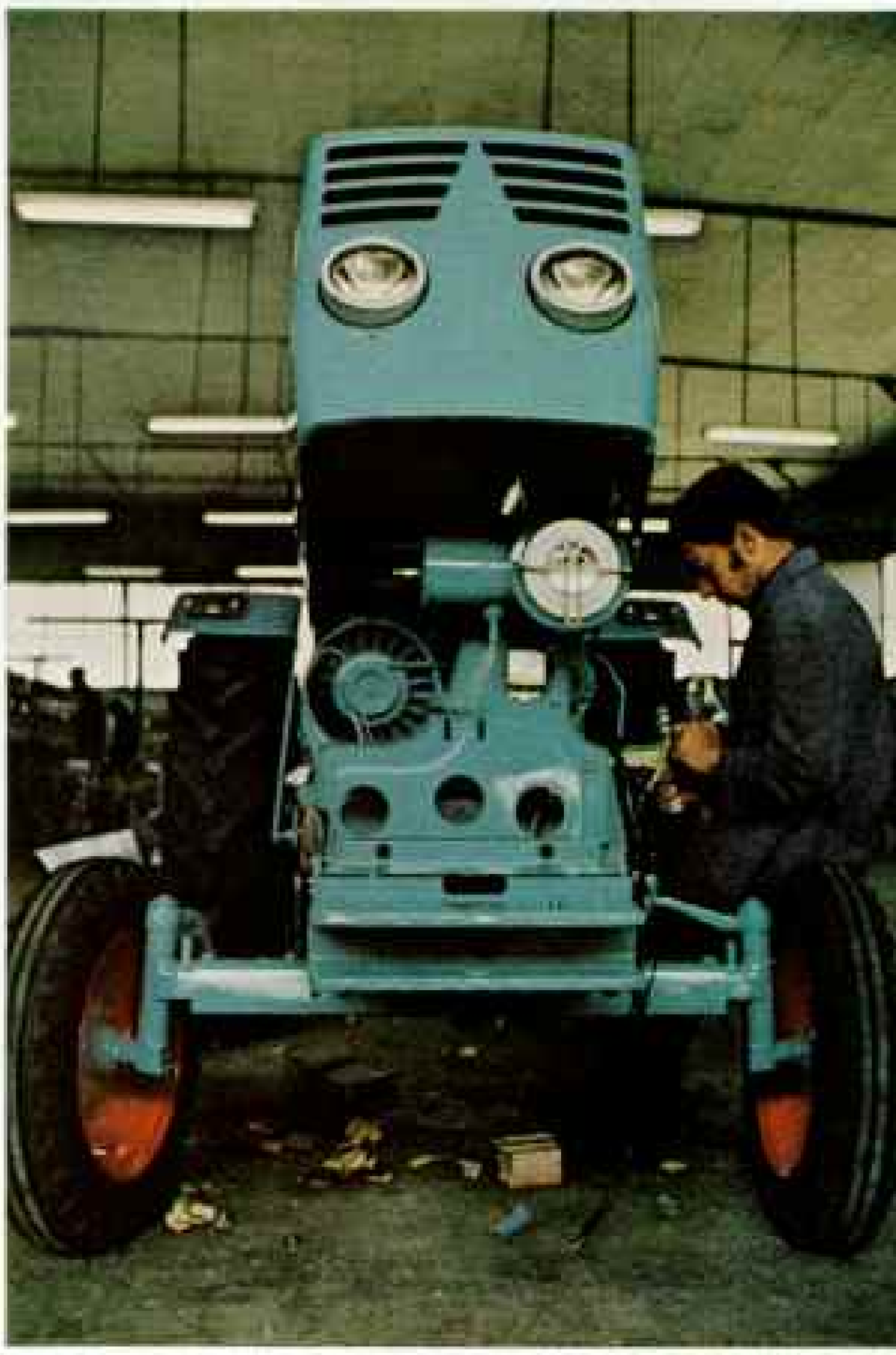
I walked back down through darkening deserted streets. It was Ramadan, the Moslem month of fasting, when the orthodox neither eat nor drink from dawn to dusk, and families were already gathering at home for the *iftar*, the evening "breakfast."

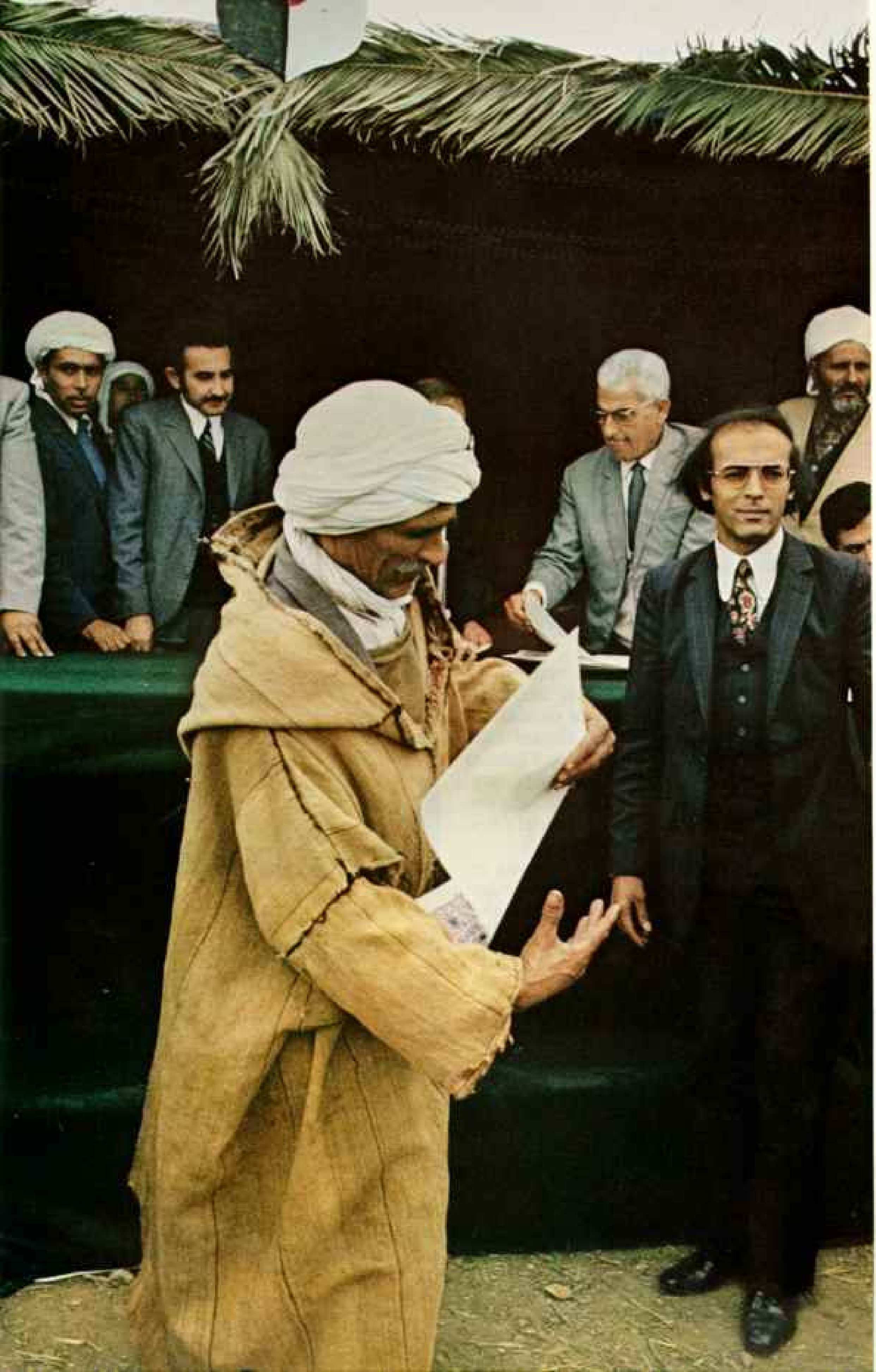
I reached my small hotel as the muezzin called evening prayer, signaling the end of the day's fast. I broke mine with some leftovers and recalled the lesson Ramadan teaches the more fortunate: To a hungry man, a crust of yesterday's bread can taste like cake.

The first seeds of Islam were planted in Algeria in A.D. 682 by Arab armies sweeping across North Africa from the Nile to the Atlantic. Along the accessible coastal lowlands Moslem religion and culture rapidly took root, but in remoter pockets of the Atlas Mountains many of the indigenous Berber communities remained apart. They ultimately adopted Islam, but stubbornly guarded their own language, art, and tribal codes down to our day. Nowhere is this more evident than in the mountains of the Kabylia, which lie to the east of Algiers.

From Tizi Ouzou I took the asphalt road that zigzags steeply up through Berber towns with names like Tamazirt, l'Arbaa Nait Irathen, and Ait Hichem into the Kabylia's heart. Each sharp bend unrolled a panorama to rival Switzerland's. Tiny fortress villages capped every hilltop, tight clusters of stone houses with red-tiled roofs, set off against the snowy peaks of the Djurdjura Mountains

Open sesame to a brighter tomorrow, heavy industry wins a major slice of the national budget. Algeria hired a West German firm to set up this tractor factory at Constantine and to train assembly-line workers.



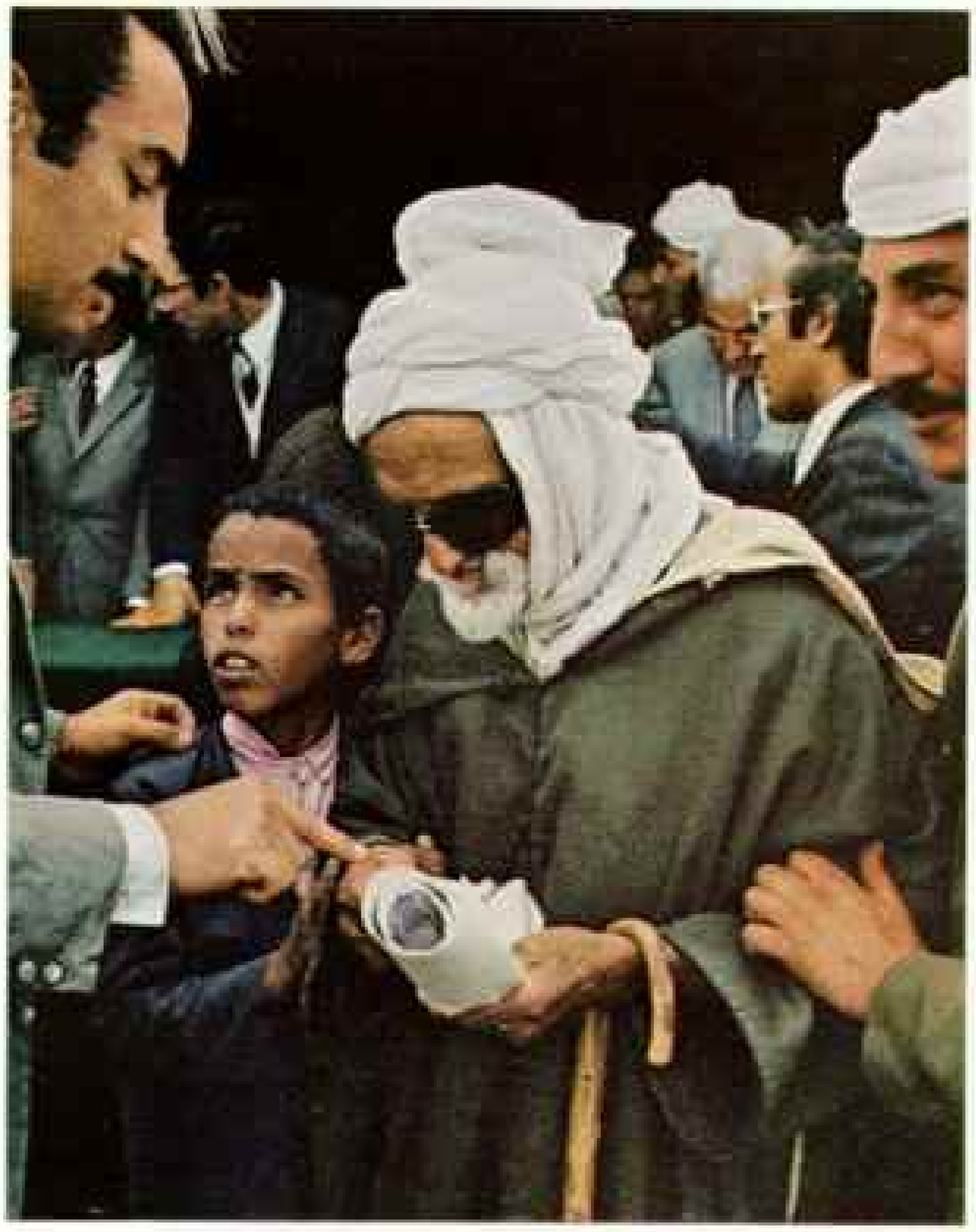


"Agrarian reform means social justice"

A BANNER UNFURLED in the village of Ouled Mimoun (**below**) proclaims hope to the men clustered beneath it. Algeria's farmers in the past, if not dispossessed by the colons, usually owned only a few arid acres. Others worked as laborers on French estates or as tenants for wealthy Algerians.

With independence, leaders promised "land to those who work it," and the words become a reality for 60 farmers here. Business-suited officials parcel out acreage appropriated from absentee Algerian owners, as well as from foreigners. A peasant (**left**) receives a deed to 30 fruitful acres.

Guided by a grandson, a blind elder (**right**) accepts the document registering in his name the fields his son will till.



Claustrophobic task of cutting foggaras, underground aqueducts, falls to the Haratin people. This digger cleans an entrance to irrigation channels that water the oasis of Ideles. Former serfs of Tuareg and Arab landowners, the Haratin now earn wages cultivating dates and barley, and, under agrarian-reform programs, are slowly becoming landowners themselves.

(pages 214-15). Below each village a patchwork of gardens led down to small orchards of figs and olives, the region's main crops.

With me was a transplanted native of the Kabylia, Sadek Ben Hibouche, of the Aitouyahia clan. Like many Kabyles, Sadek worked in Algiers, 75 miles to the west, but regularly the hills pulled him back. Now, during the busy harvest season, we could expect to find many of the clan gathered at his grandmother's house in Taka. Lowering clouds had snuffed out the afternoon when we finally reached the 2,800-foot-high village.

Lack of Jobs Separates Families

"Marhava yessun!" the old woman greeted us in the Berber language: "Welcome!"

Tasadit Aitouyahia was a remarkable woman. Her first name means "bearer of good fortune," and to her enormous family she had lived up to it. The firelight danced on a kindly face, lined yet lively for all its 90 years. Her forehead bore a *tafzint*, the small tattoo Kabyle women may wear after they have borne their first heir. That had been long ago; now Tasadit was queen bee of four generations totaling 71 offspring.

"When my family gets together, we make a whole village," she laughed. She spoke only Berber, which Sadek translated into French. "But we are so scattered. Our men must go to Algiers to find work, or to France. Alas, without the money they send back, the Kabylia could not survive."

Tasadit's house, like most in the Kabylia, was a spartan one-room stone bungalow. A third of it was partitioned off for sheep and goats; oak planks above the small stable made a sleeping loft. Only one window pierced the thick walls, to let out smoke from the fire pit.

"The Kabylia is poor," said Sadek, as we ate our modest fare. "We work the land carefully, hoeing patches too steep to plow. But there is not enough to live on. Land is scarce, an average of four acres a household. Sometimes a single tree has several owners, each branch carefully accounted for."

As a principal refuge for guerrillas during the war, these mountains suffered heavily. The French ravaged orchards and dynamited whole villages to rubble. But despite the hardships it has endured, the Kabylia remains one of the most densely populated rural regions in the world, averaging some 640 people for each square mile.

The Kabylia is Algeria's dilemma in microcosm: a heavy commitment to agriculture, with too many farmers on too little arable land. Although the country is vast, 95 percent of Algeria's 15 million people crowd into a tenth of its land area, fertile pockets along a 100-mile-wide coastal strip. Bare mountains and desert cover the rest (map, page 204).

The Algerian part of the Sahara, a desolate area three times the size of Texas, was always looked upon as a hostile world of scattered nomads and remote oases. But in 1956 French exploration teams found rich reservoirs of petroleum under the sands and changed all that. Today Algeria ranks among the top oil-producing nations. New roads lace the Sahara, networks of pipelines speed oil and natural gas north to the Mediterranean.

Supertankers now anchor off the once-dozing port of Arzew, a booming petrochemical center that quadrupled in size almost overnight. More than 1.7 billion dollars was recently committed to Algeria to develop a 25-year natural gas source for the United States East Coast.

Hundreds of miles southeast of Algiers I followed a narrow ribbon of asphalt that flanks the shifting dunes of the Great Eastern Erg to Hassi Messaoud. Once a remote water hole known only to a handful of caravaneers, Hassi Messaoud is now the country's biggest oil field, with 300 wells producing three-fifths of Algeria's petroleum revenue—more than a billion dollars in 1972.

Automation Invades the Sahara

I spent a day as a guest of SONATRACH—the government's oil and gas monopoly—in the air-conditioned mirage of date palms and oleanders at the "Base 24th February." (On that date in 1971 Algeria nationalized the majority of French oil interests.) Here I trekked through a gas-separation plant—a ten-acre plumber's nightmare of screeching pipes and caldrons lighted by a bank of gas flares that outshone even the Sahara sun.

In the control tower I watched French-trained production operator Baba Benbaba running the complex from a panel of buttons and flashing lights that monitored temperatures, pressures, and flow rates deep within the monster's automated entrails.

"The Sahara is changing fast," young Benbaba said. "I grew up in the oasis of I-n-Salah, 400 miles southwest of here. My father's knowledge of engineering never went beyond

Vibrant waves of color symbolize oil's fiery energy at Arzew, a coastal terminus of pipelines from the Sahara. The painting decorates a refinery being built by the Japanese, who also trained this road-grader operator. Petroleum income, including royalties and taxes, may reach 1.3 billion dollars in 1973. Revenues finance social programs, as well as the search for still more oil and gas.

Spartan lives unfold in the densely packed, mountain-girt Kabylia

region, home to thousands of indigenous non-Arabic-speaking Berbers.

Hands are the shuttle as a Kabyle woman weaves a rug, her fingers darting lightning fast through the warp. The traditional pattern represents water.

After the Arabs conquered North Africa in the late seventh century, the mountain-dwelling Kabyles and other Berbers adopted Islam, but to this day retain their own law code, language, and arts.

The Kabyles in 1871 led an unsuccessful revolt against the French, who retaliated by confiscating a million acres of their best land. During the Algerian war for independence, these Berbers fought alongside the Arabs, turning their mountains into guerrilla strongholds.

the well pulley and the blacksmith's forge."

SONATRACH recruits many workers from the desert as part of a government effort to improve life for the long-neglected citizens of the "other Algeria." In 1966 it began an intensive Sahara development program, dispatching capable men south to carry it out. One, the peripatetic *sous-préfet*, or district governor, of Tamanrasset, Enwer Mérabet, greeted me in his "working clothes," gray slacks, cardigan, and tennis shoes. His chic razor cut, his sunglasses, the ever-present cigarette reminded me of French film star Jean-Paul Belmondo. From his mud-brick capital of Tamanrasset he was running, at the ripe old age of 30, a territory larger than Spain.

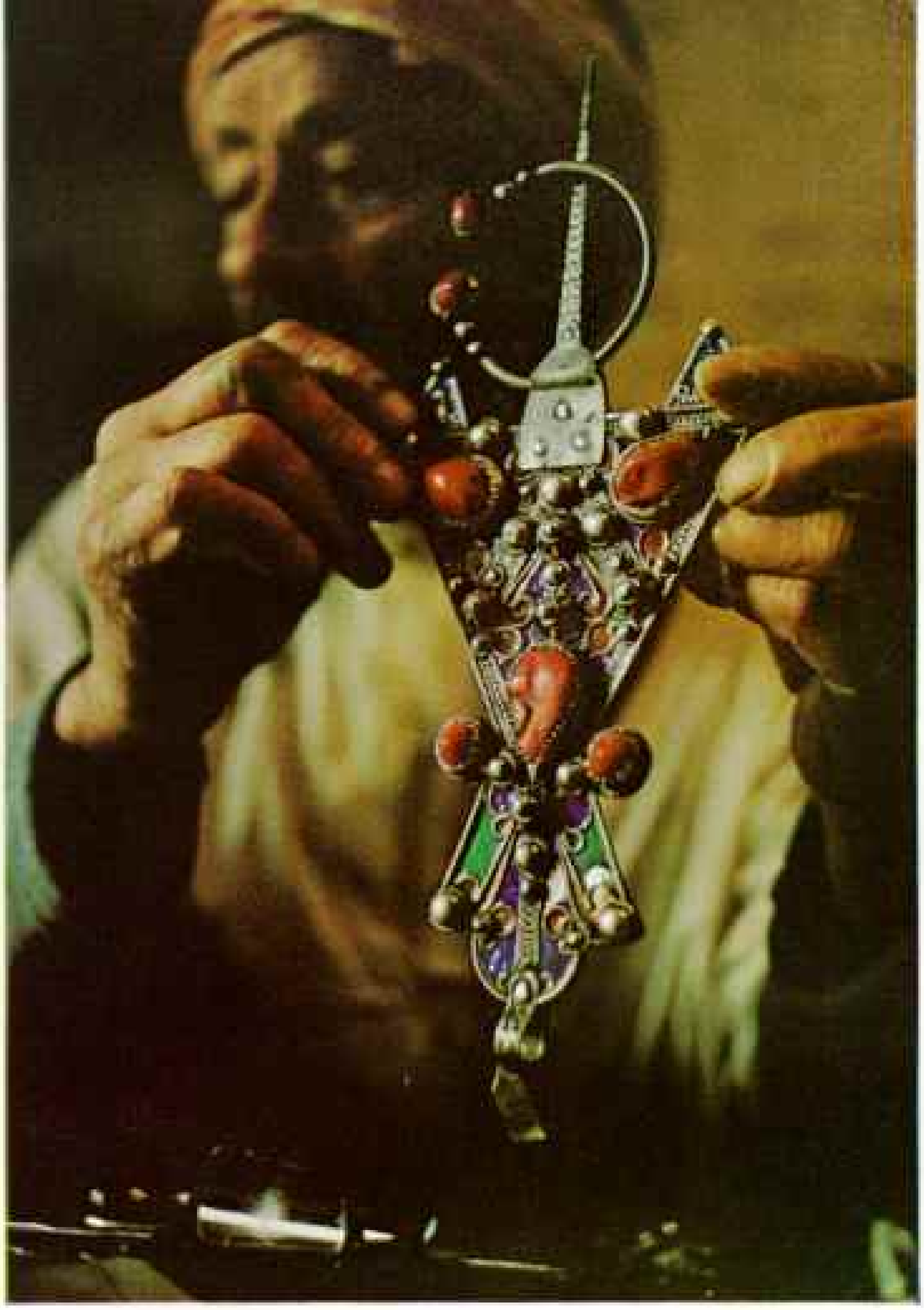
"We have our hands full," he said, with relish. "We have 200 new housing units under construction. We are enlarging the oasis schools and, in the larger villages, providing electric power.

"In the north they are trying to stop the flood of rural immigrants into the country's overcrowded cities," he said. "Here, it's just the opposite: We want to entice the Tuareg nomads to come in and settle. We feel we must help them find a new way of life to replace their traditional one, which is fast becoming outmoded."

For centuries the tall, veiled Tuareg were undisputed masters of the Sahara. Their caravans controlled most of the trade. The tribes roamed, grazing their flocks, while the Haratin, black serfs brought from the southern Sahara, farmed the Tuareg-owned oases for a one-fifth share of the crops.

"No more," the young governor said. "One big Berliet truck can haul as much as a hundred camels. And our land reforms will eventually benefit the peasants of the oases.

"The new trans-Saharan road, scheduled for completion in 1976, the 800-bed tourist



Ornate brooch, a heavy antique pin is offered for $125 in Beni Yenni. The silversmiths of this Kabyle village still use the patient techniques of their ancestors to produce intricate ornaments. Women build up savings accounts by collecting the jewelry, made from coral, local silver, and enamel.

Crafts supplement meager farm earnings in the Kabylia. The government encourages artisans by forming cooperatives and seeking foreign markets. But to make ends meet, many Kabyle men emigrate. More than 400,000 Algerians in France wait on tables, carry bags, and clean streets to send home $300,000,000 a year.

hotel we are planning—all will help provide jobs," he continued. "And there is the new million-dollar mineral laboratory that SONAREM, the government mining monopoly, is building. The cornerstone laying is today."

The governor, I assumed, would officiate.

"No time for ceremonies," he grinned, signing away the last of his morning paper work. "I have business in the desert. Come along if you like."

Nomads Slow to Adopt Change

I followed the governor in my Land-Rover, chasing him across the plains to a Tuareg encampment at Hassi Izernene, along a sandy wash in the Ahaggar Mountains.

Sheik Yahia bin Mohammed, a tall bony man veiled in white, led us to his hilltop *zariba*, a sheltered compound made from mats of woven reeds. As our host boiled pots of heavily sugared tea, the men of the camp joined our circle around the fire (page 228). One of them, Mahdi bin Mohammed, spoke Arabic and translated the governor's business into the Tuareg language. Governor Mérabet needed workers for his road crews in northern parts of the mountains. Three signed on for 20 dinars (about $4.65) a day—good money for the Sahara—half to be paid in cash, half in wheat.

Mahdi was clearly different from the rest of his nomadic tribe. He led me down to his home, a sturdy, permanent house made of mud brick. Encouraged by the governor, Mahdi had dug out a small well, cut irrigation ditches, and planted three acres of wheat and vegetables. So far, he had little to show for his labors, only a few pounds of dried tomatoes. As we walked around his small plot, I noticed his fellow tribesmen watching us skeptically from the hill.

The whole camp came to the governor's

Gold and silver in a hungry land: Juicy oranges (**left**) travel by horse cart from a cooperative orchard to El Asnam. Top-quality fruit goes to canneries that export juice and preserves. Workers offer second-grade fruit to local markets and divide among themselves whatever may remain.

A seaman off-loads shimmering fish from a seiner at Beni Saf (**above**). Plants on the Mediterranean coast process shrimp, sardines, anchovies, and tuna brought in by the small Algerian fishing fleet.

Citizens of a forgotten world survey the ruins of Timgad (**opposite**), a trade center from A.D. 100 to 400, when Rome ruled North Africa. From here carts loaded with wheat, olive oil, leather, and lumber clattered over surfaced roads to ships bound for Italy. To this day Algerians call foreigners "*roumi*," an old word for Roman.

Land-Rover to see him off. Three well-scrubbed young boys dashed over from Mahdi's house and clambered in. They were headed back to the boarding school for nomad children in Tamanrasset. Sheik Yahia gave him letters to mail, and Mahdi gave him baskets of dried tomatoes to take to market. Then the busy governor sped off, trailing a plume of dust.

That night around the fire in Sheik Yahia's zariba, we dipped our spoons into the common pot of *tikhammazin*, pellets of wheat flour boiled with goat butter. Then we munched on the dates I had brought, washing it all down with muddy water from Mahdi's well.

A Tuareg man never removes the *tagilmust* that covers his face—not even when he eats. To do so in front of guests would be especially impolite. Discreetly the men lifted their spoons and glasses up under the veils to their mouths.

Tuareg women, on the other hand, do not cover their faces. Sheik Yahia's wife came with firewood and stayed to warm herself while her younger sister plaited her long hair into dozens of braids.

The sheik's young daughter, Khadija, cleared away coals from a second fire nearby. Smoothing a hollow in the hot sand, she laid down a batter of whole-wheat dough and covered it with the sand, then with the coals. After it was baked, she brushed it clean, then wrapped it in a cloth and put it aside for tomorrow. Before the sun rose, she would set out to graze the goats in the distant hills. The small loaf was her lunch.

"Perhaps we Tuareg have outlived our time," the tall sheik said as we sipped the last of the tea under the cold desert stars. "Maybe Mahdi has the answer with his farm.

"First the soldiers came and took our swords. Then the trucks came; our camels were no match. Socialism claims our ancestral oasis lands. We have nothing but our freedom and our flocks. If we sacrifice them, our way is gone forever."

Desert Attracts Tourist Bounty

More and more visitors from Europe are discovering new beauty and adventure in the world's largest desert, bringing with them welcome francs and German marks. Many take the ferry from Marseille, then drive south from Algiers some 1,200 miles to Tamanrasset, a tamarisk-shaded oasis with a population of more than 7,000.

Returning to my Land-Rover from Tamanrasset's bazaar with a bag of oranges, I was stopped by a young Tuareg lad asking if he could accompany me to Ideles, a small oasis 100 miles out in the desert. He had his information wrong, I told him; I had just come from there. In fact I was looking for some way to send these oranges to the hospitable French schoolmaster who had put me up there a few days earlier. We were interrupted by a German tourist and his wife. Would I tell him (how the word gets around!) about the road to Ideles? I introduced them to the Tuareg hitchhiker. *Et voilà!* The Germans had a guide, the young man had his ride. And Monsieur Barrière—if Allah so willed it—got his oranges.

For safe Sahara cruising off the beaten track, a four-wheel-drive vehicle is essential. For my month-long, 4,000-mile turn through the desert, I fitted my Land-Rover with an auxiliary gas tank, extra jerry cans, a roof

Hands gleaming darkly with the indigo dye that colors her robe, a woman of the Tuareg—wandering Berbers of the Sahara—clasps her traditions close (**facing page**). The incised brass key marks her as guardian of the family's saddlebags.

Another kind of bag becomes the responsibility of a young girl (**left**), who rocks a skin full of goat's milk into butter. Like all Tuareg females, she will never veil her face.

Swaying desert taxi, a camel cruises Tamanrasset's dusty main street. In the fast-growing desert center of 7,000 residents, braying animals still joust with honking autos.

Horned specter with bulging biceps looms behind a running antelope and a floating figure. The rock paintings and engravings of the Tassili-n-Ajjer point to a succession of peoples who left their marks on the now-deserted plateau between 6000 and 1000 B.C. Scarification on the figures (**below**) resembles that of some African tribes today. The thousands of paintings here form one of the world's finest portfolios of primitive art.

rack, shovel, steel mats for driving out of deep sand—and spare axles, springs, and fan belts. In this wasteland, gas stations are often more than 400 miles apart. Algerian law requires motorists in the Sahara to file a route plan with the police, and to carry water, emergency rations, a first-aid kit, and a compass. Few signs mark the desert tracks, which often split off in all directions.

From Tamanrasset, on another visit, I took the little-traveled track northeast toward the Tassili-n-Ajjer. Pages of my notebook on this long cross-country stretch to the plateau reflect the desolation of the landscape, as well as its beauties and surprises:

Mile 60. pass, alt: 7,550 feet. stark lunar beauty of the Ahaggar Mountains, brittle basalt cores of long-dead volcanoes. Mt. Tahat, 9,573 ft., Algeria's highest. Road strewn with six-inch stones.

Mile 79. spring. Oleanders in bloom, palms. deserted.

Mile 144. before-sunup surprise: 3 graceful gazelles darting up steep gravel.

Mile 198. camp among dunes no. of Mt. Telerhteba. Lazy evening cooking onions.

garlic, powdered soup, and camel meat—excellent "camel Stroganoff."

Mile 244. Serouenout, ex-Foreign Legion outpost. ruins.

Mile 264. tree.

Mile 313. roof rack crashes off at 30 mph. terrible road. 2 jerry cans burst.

Mile 382. stuck in deep sands. 2-hour dig.

Climatologists agree that the Sahara was not always the bitter land it is today. Fossil spores show that olive, lime, and oak trees once grew here. During my Saharan travels I had often seen mysterious rock paintings —elephants, giraffes, cattle—left behind by cultures that had flourished under a more clement sky. The Tassili-n-Ajjer, according to one archeologist, ranks as the finest museum of prehistoric art in the world (above).

It may also be the most difficult museum in the world to reach. My guide, a native of the plateau, was impatient to start climbing the sheer wall of the Tassili's southern rampart before the sun's heat. Weighted with backpack and cameras, I strained to keep up with the wiry Tuareg. A Madak tribesman, he had told me his name was Almeen, but little else.

Fickle sculptor, the wind each day reshapes Sahara dunes. These 150-foot-high waves flow across the Erg Bourarhet region. Sand covers less than a fifth of the vast Sahara; the rest is a harsh world of gravel plains, stark mountains, and dry salt lakes.

A road sign (**below**) warns that sand often blocks the curve ahead. Most of the 1,770-mile trans-Saharan road route avoids sandy stretches where drifts form. Algeria expects to pave the remaining 900 miles of its share of the uncompleted highway by 1976.

He was a distant sort of fellow, wrapped to his eyes, of course, and he rarely spoke.

Not until late afternoon of the second day of our climb did we reach our goal, Sefar, hidden deep in the plateau's tormented heart. We found the ancient spring and set up camp, leaving time before nightfall to study the first tableau in Sefar's immense gallery.

It was a splendid hunting scene: A band of dashing bowmen—delicate figures no more than ten inches high—showering arrows on a trio of scurrying antelope, each limned with verve and grace. Other scenes showed herds of crescent-horned cattle and a woman seated beside her round reed hut.

My two days at Sefar were not nearly enough. The beauty, and sheer number, of the paintings is overwhelming. But thanks to Almeen, who knew every cranny of the labyrinth, I was able to see and photograph hundreds of the magnificent murals—an exciting illustrated history of the lost plateau.

Artists' Origins Still a Mystery

The earliest paintings date back to about 6000 B.C. Typical was a ten-foot horned giant surrounded by praying women and strange disks like flying saucers. The bulbous heads on some of these figures were interpreted by one imaginative investigator as space helmets —proof, he thinks, of a prehistoric visit by astronauts from other worlds.

Hunters and herdsmen in later works reminded me of the Fulani tribes I had seen in Niger; still later, horses and chariots predominate, and the beginnings of more geometric figures become detectable. Circles, triangles, and lines—the first signs of writing symbols —emerge in clearer form as the artistry evolves into its final stage, with its emphasis on camels.

What kind of people inspired these splendid, mysterious paintings? The answer awaits the archeologist's spade. But Almeen had his own explanation.

"*Kel Asuf!*" he said: "Genies!" They haunt the plateau. Most were friendly genies, he had assured me, but around his neck he wore three powerful amulets just in case. Through the long nights we encountered none of the spirits, only their distant cousins: our firelight stealing across the grotesque rocks above us, and the low moaning of the wind.

Of the many mysterious cultures that still flourish in lost corners of the Sahara, none casts a stronger spell than that of the oases of

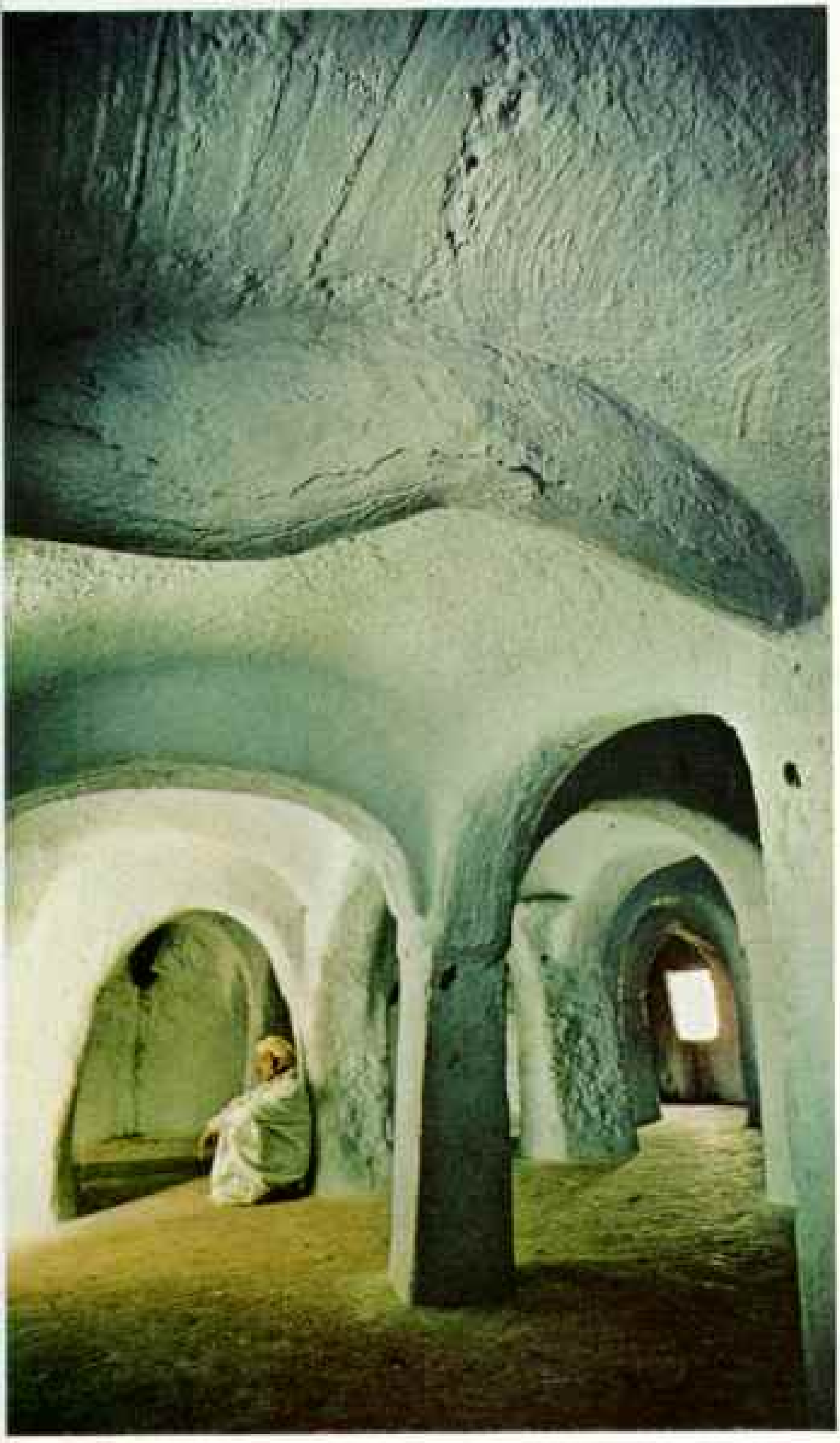
Warm circle of desert fraternity grew when these Tuareg goatherds welcomed the author to their shelter at Hassi Izernene. By custom they remain masked, drinking their tea by slipping the glass beneath the veil. One clansman, with government aid, has settled here to raise tomatoes.

Penned in a pit—protection from beasts of prey—bleating kids await breakfast. Tuaregs milk the nannies to obtain their own food before releasing offspring.

Barefoot pilgrim almost disappears as her burnoose blends with a limewashed tomb near Ghardaia, desert sanctuary of the Ibadites, a puritanical Moslem sect. The woman brings a food offering—a pre-Islamic custom—to honor Sidi Aissa, a sainted leader of her people.

Thick unadorned walls (**below**) assure a calm, cool spot for meditation in a mosque dedicated to Sidi Bou-Gdemma, 11th-century founder of Ghardaia.

Most Algerians follow the orthodox Sunni branch of Islam. The secular state encourages a religious revival, restoring mosques once used as cathedrals and broadcasting lessons in the classical Arabic of the Koran.



Oued Mzab. Back in the 11th century a band of Moslem fundamentalists, the Ibadites, settled in this remote pocket of desert, 300 miles south of Algiers, to escape persecution. Over the centuries the hardworking puritans turned a sterile hell into a lush paradise.

Rare is the traveler who, after plodding for days toward a colorless horizon, fails to be moved by the sudden green of a quarter of a million palm trees. Above the emerald groves pale blue and ocher houses cluster on conical hills, each spiked with a single minaret: the five magic cities of Mzab.

Ghardaia, the valley's capital and commercial center, has overgrown the wall that circles its hill. Modern shops, banks, government offices, and a first-class hotel line new, wide boulevards.

I climbed a steep street toward the mosque on the summit. Privacy is sacred to the Mozabite, and foreigners do not enter the heart of the city without an escort. Mine was Mohammed Bazine. He wore the white skullcap of the region and a loose-fitting *gandura*.

Mozabites Mastered Form and Function

"In each city the mosque was built first, atop a high promontory," Mohammed said. "From the very beginning it was more than just a place of worship. It served as a fortress, a watchtower, and a grain storehouse as well. The city grew down the hill around it."

Mohammed's forefathers were talented architects as well as skilled city planners. He led me down vaulted steps into the cool depths of the Sidi Ibrahim Mosque, just outside the walls of El Ateuf, the oldest of the Mozabite cities. Through half-round windows, slanting rays of the midmorning sun played on the ice-blue arches and the rows of niches cut into the thick walls for the worshipers' shoes.

"Many modern architects have learned from the Mzab," Mohammed said. "This mosque inspired Le Corbusier's famous chapel at Ronchamp, in France."

Later we strolled the Mozabites' enchanting gardens. In one grove we were hailed by one of Mohammed's friends harvesting dates in the leaves above us. He dropped down a handful—delicate golden morsels, the sweetest I had ever tasted.

"We call them *diglat nur*—dates of light," the gardener said.

The Mozabites often refer to the date palm as their "aunt," and no wonder. Trunks furnish the roof beams for their mosques and houses. From leaf midribs they construct their simple furniture. Leaves are woven into floor mats, bark fibers into baskets. Stems are used for brooms; pits are ground into fodder.

Despite their skill as gardeners, the Mozabites could never have survived without their bent for commerce. Hardly a town in Algeria today is without its prosperous Mozabite grocery; fleets of Mozabite trucks now ply Saharan routes their camel caravans once ruled. Many from the valley made fortunes in the northern textile industries. But always they returned, to marry, raise their sons in the local Koranic schools, and tend their gardens.

Dr. Salah Merghoub was a case in point. After finishing medical school in France, he returned home with his talents. Patients now come to him from all over the Sahara.

"I have a mission here," he told me at his sumptuous villa near Ghardaia. "Have you noticed how many of our people wear thick, tinted glasses? They are suffering from trachoma, an eye disease that is rampant in this dusty climate. I am doing research in the cure and prevention."

Algerians Welcome a New Destiny

It is the same sense of mission that today unites all Algerians, I thought as I drove back toward the capital. For centuries Algerians, though they never left their homes, had lived in a foreigners' land. Now they seek their destiny in a return to their origins.

In the mountains I passed one of the many small military cemeteries, decked with Algerian flags, where soldiers of the revolution lie buried, all facing toward Mecca. A plaque at the gate reads in Arabic: "Sleep, martyrs, we will fulfill our covenant."

In its crowded cities and its far-flung countryside—from Kabylia to the Casbah, from the Sahara to the sea, Algeria strives to forge a nation that can keep that promise. □

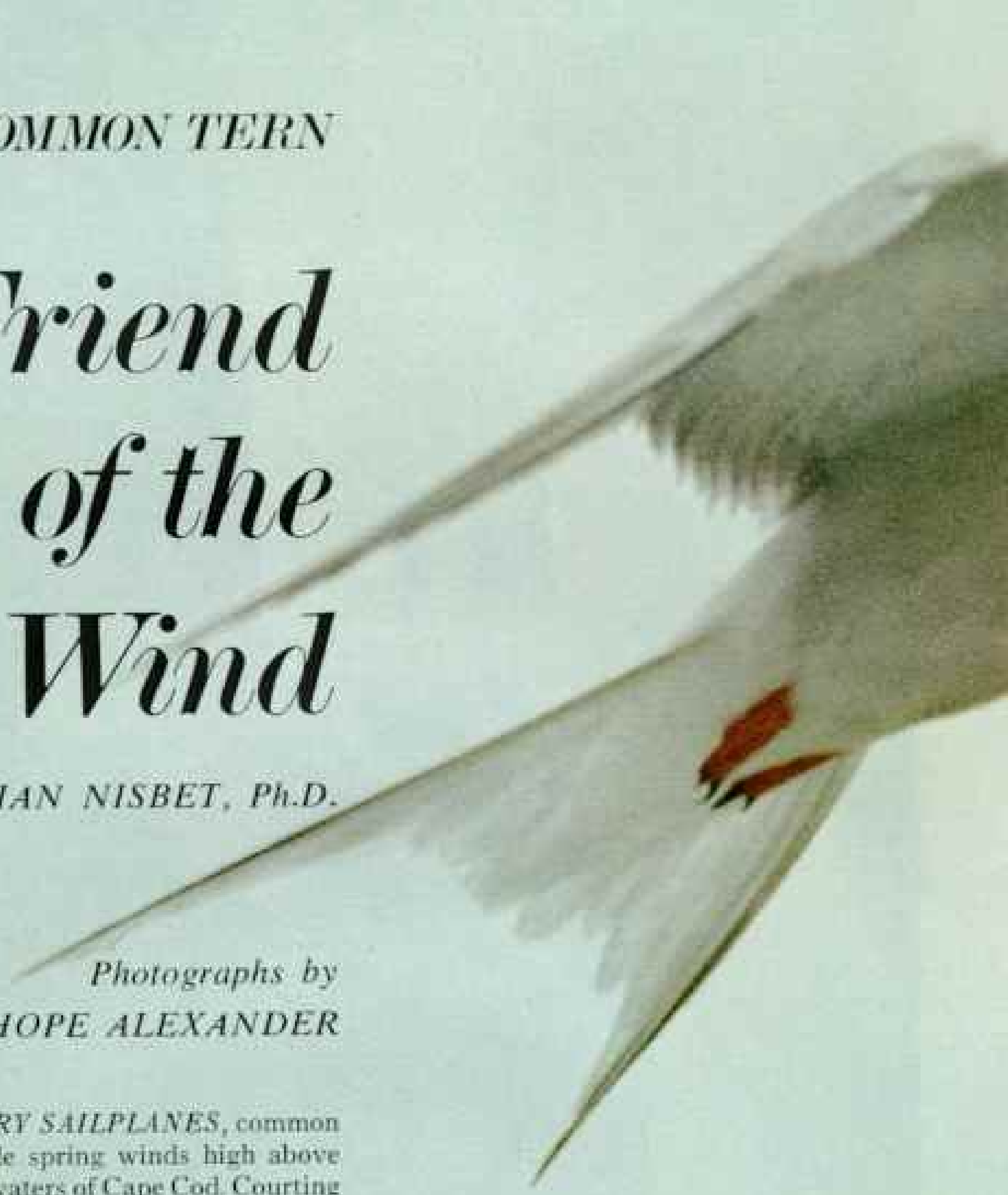
Veiled women, closed doors, secret thoughts: The famous Casbah, heart of old Algiers, still represents shadowy romance to outsiders. Here Algerians kept alive Islamic culture during generations of foreign rule; here resistance gained strength and the nation's present-day socialism took hold.

THE COMMON TERN

Friend of the Wind

By IAN NISBET, Ph.D.

Photographs by
HOPE ALEXANDER



LIKE SILVERY SAILPLANES, common terns ride spring winds high above the cold waters of Cape Cod. Courting pairs weave zigzag patterns as they glide down toward their nesting colony. I watch their aerial ballet with the envy of the earthbound as I row toward Tern Island.

Unfortunately, the population of these delicate fliers is declining here. Forty years ago 60,000 nested on the Cape and neighboring islands. Today fewer than a quarter of that number return each spring from winter retreats in South America.

To study the nesting behavior of the terns and to discover the reasons for the decrease in their population, I have visited Cape Cod for the past four years as part of my work with the Massachusetts Audubon Society. Last year Hope Alexander, a young and creative photographer, accompanied me and captured these living moments in the terns' world of sky and sand and sea.

SKIMMING THE ROCKING WAVES, a parent leaves the nesting colony in search of food. The long-winged aerialist may spend up to 12 hours aloft, covering 200 miles, if food is scarce. Swinging to and fro like a bobbing kite, it patrols until it spots its prey, then hovers intently overhead until the quarry swims near the surface. Pulling in its wings, the

tern plummets beakfirst into the sea. Even the most accomplished of the red-billed fishers may miss three out of four times. Unlike herring gulls, which prosper on garbage and flotsam from fishing boats, terns eat only live food. They favor small fish such as silversides and young herring, which often roil the waters in panic while fleeing schools of hungry bluefish or striped bass.

NECKS STRETCH in a ritual of recognition as paired birds meet (**top**). The amenity reduces tension among a species prone to hostility and aggressiveness. Long courtships help the nervous birds become more at ease with each other (**upper center**). Like a sovereign nation, the male stakes out and protects a territory—usually two to three square yards—and defends the airspace above it. A defender spirals up to launch a screeching attack against an intruder (**right**), who flies too low over the selected domain.

In May or June, the female lays two or three eggs, pale brown with camouflaging spots, usually in a shallow nest scooped from the sand. The parents then share the three-week egg-warming duties. So strong are the brooding instincts that a change in shift often necessitates a head-bumping shoving contest to dislodge a dutiful mate, as from this nest and its hatchling (**left**).

Chicks mature to flying size within a month but demand food for several more weeks, until they learn to hunt the shallows on their own. Fluffy fledglings, some fatter than their parents (**bottom**), gain muscle to face the perils of their first migration south. Pairs that successfully raise young usually remate the next spring, and some nest together year after year.

FLUSHED FROM A TIDAL RETREAT, common and roseate terns scatter low over the shallows. The black-billed roseate, whiter than its common cousin, earns its name from a distinguishing

blush it wears on its breast in mating season. There is little competition between the two species; the roseate, *Sterna dougallii*, nests in denser vegetation and prefers different types of fish.

BUSY WITH THE CHORES of parenthood, a flying fisherman (**left**) brings home a sand launce to feed a hungry brood. A few days after hatching, the speckled young scurried to hiding places in the beach grass. Now, recognizing parents by their voices, they rush to snatch incoming dinners, the more avid and active reaching the morsels before slower brothers and sisters. Another colonist (**below**) totes an eggshell away from the nest. Left lying about, it could reveal the camouflaged home to sharp-eyed gulls or crows, who easily spot the white lining of the shell. My study of tern colonies suggests that the birds' steady decline in numbers is not due to predators so much as to shortages of food, probably caused by pollution, overfishing, and the filling and draining of salt marshes.

MENACING EYE and beak of a defending male cause an intruder to put on the brakes in midair, averting a territorial squabble. Some disputes over nesting sites result in battles of grasping bills and beating wings, but most are settled when one bird backs down.

In spring, small coastal islands fill to overflowing with angry males defending their territories. Tardy arrivals, too late for a prime homestead, must risk nesting on low-lying beaches washed by storm tides.

Every time I splashed ashore on Tern Island and ventured among the nests, the home guard apparently thought I was about to establish a beachhead, and, with harsh cries, would swoop down on me, pecking repeatedly with sharp bills. Tern-watching, claims photographer Hope Alexander, is "strictly hard-hat work. Those birds could punch a hole in your head." I must agree.

SECURE IN A CRADLE of sand and straw, a days-old chick peeks from beneath its mother (**above**) and eyes a proffered meal. The snack is too big to swallow; father will learn to provide smaller fish to fit the baby's miniature mouth. Females generally tend the chicks for the first four or five days, while males forage. When chicks grow large enough to find nearby hiding places, both parents begin to hunt. Nowadays only the most skillful catch enough fish from dwindling schools to feed their entire brood. Many chicks, usually the youngest and weakest, die. Even while the young gobble meals, parents must stand guard (**left**) against other adult terns who, like feathered pirates, swoop down to snatch food. The young that survive the first critical summer and migrate spend two or three years in South America until they, too, return to Cape Cod. As a concerned conservationist, I find it sad that fewer do so each year. □

Diving Beneath Arctic Ice

By JOSEPH B. MACINNIS, M.D.

Photographs by WILLIAM R. CURTSINGER

In the frigid blackness of polar depths, the author, right, and a fellow scientist slip into a "telephone booth" on the floor of Canada's Resolute Bay (**right**). Thrusting their heads into the air-filled dome, they can change air tanks, remove mouthpieces to talk to each other, or speak to their cohorts encamped on the ice 35 feet above (**left**). The Sea-Shell is one of four spotted around an eight-foot plastic bubble called Sub-Igloo, first manned research station under Arctic ice.

Dr. MacInnis, a Canadian physician who specializes in diving and its effects on the body, organized a 15-man team to conduct last winter's daring experiment. They dived for a grueling month, testing equipment and men in a harsh and almost unknown world.

A FILIGREE OF ICE BEGINS TO FORM inside my face mask. I lean forward and let in a trickle of seawater to swish the frost away and clean my lens. The frigid brine burns painfully across my skin.

Ahead, faint in the seemingly celestial light fringing the work area, a transparent plastic dome rotates slowly on the tension of barely visible control lines. Then it begins a curved descent toward the sea floor—an adagio movement that hints of the touchdown of some ghostly spaceship.

A second diver silhouettes in the blue-black water and gives the dome a gentle shove. It swings over to a large bright aluminum ring supported by 16 silvery struts attached to ballast trays. Beneath the ring another plastic hemisphere, partner to the dome, is already in place. I am looking at Sub-Igloo, about to become our new underwater workshop 35 feet down in Canada's ice-covered Arctic waters. Sub-Igloo, one of the most inventive technological advances in two decades of under-ice diving, will be the first manned dive station in the northern polar sea.

In the cone of golden light beneath the three-foot-thick ice overhead, the diver struggles to join the two hemispheres in a

watertight fit. Beyond the electric radiance of Sub-Igloo lie the endless midnight hallways of Resolute Bay.

For a moment I am caught in an acute awareness of our location. Resolute is almost 600 miles north of the Arctic Circle (map, page 252). If I could extend my gaze south for a few miles, I would see into Barrow Strait—the northern corridor of the fabled, ice-choked Northwest Passage.

We are only 125 miles from the north magnetic pole. The rest of the world's compasses point toward it, and yet our own rotate endlessly and uselessly, seeking a pole that is confusingly near. We are so far north that a week ago I stood on the ice outside our tent and saw the northern lights in the southern sky!

Vast Domain Awaits Man's Gaze

We have come here at the calling of an unknown dominion—the northernmost continental shelf. It is so immense that in Canada alone it covers almost a million square miles, but of this huge maritime estate, human eyes have seen less than a few city blocks.

There is much to be learned in these wet polar corridors—about arctic marine life, underwater ice structures, the composition of the bottom, the extent of pollution, the possible existence of new resources. But men must first learn more about diving, and surviving, in what is certainly one of earth's most inhospitable environments.

The ice world above us is no less daunting: No sun during the day, temperatures to 45° below zero F., punishing winds. While we were putting up the dive tent, the wind suddenly gusted to 35 miles an hour; that gave us a wind-chill factor of some 80° below zero.

One of our team, Dick Birch, is from the Bahamas. "If that wind had been blowing south, I would have used the tent to set sail back to the islands," he says. "Working on this ice and wearing all these clothes is backbreaking. I never would've believed any place in the world could be so unearthly cold and black." Dick stays, of course, like the rest of us, convinced that what we are doing is worth staying for.

The chief purpose of our study is to come to grips with the problems of scientific diving operations in the Arctic and to test both equipment and human performance. When we finish, we will have made more than

(Continued on page 256)

As if loading a cannon, Dr. MacInnis feeds 50-pound iron pigs down a pipe (**top**) to ballast Sub-Igloo's frame. Each sends a geyser back up (**above**). The job required eight tons.

Tense moments come as a surface crew lowers the top hemisphere (**right**). Despite the hindrance of silt roiling up from the bottom and the awkwardness of foam-rubber gloves, divers bolted the halves together in only 15 minutes.

Scientists assault a new frontier

SITE OF WINTER DRAMA, Resolute Bay off Cornwallis Island lies 600 miles north of the Arctic Circle. The Sub-Igloo adventure in November and December 1972 marked a return to Resolute for author MacInnis. Two years earlier he and several fellow scientists had dived beneath the

bay's winter ice for the first time. Inland, the village of Resolute offered a nighttime base as well as an airstrip for flying in the expedition's 30,000 pounds of equipment and supplies.

In a composite panorama of Sub-Igloo activities (**right**), two divers man the spherical air-filled station. Team at far right photographs a jellyfish; their breathing units, recirculating the air, make no bubbles to disturb the quarry. Biologist at left, using conventional scuba gear, pursues specimens as a colleague descends to join him. Below them stands a Sea-Shell communication station.

Atop the ice, tents hold equipment and provide a daytime workshop. The scientist at right leans over a panel that monitors sensors worn by the divers to record their temperatures and heartbeats.

JELLYFISH, CYANEA CAPILLATA (ABOVE AND RIGHT), 10 INCHES; AMPHIPODS, HYPERIA MEDUSARUM (RIGHT), 8/10 OF AN INCH

Skirts billowing, a lion's mane jellyfish drifts beneath the ice vault (**above**), trailing a skein of stinging tentacles. Photographer Curtsinger, a Navy-trained veteran of several polar diving expeditions, found a profusion of the lacy invertebrates in the bay.

As if riding a sun-tinted cloud, amphipods sprawl on the soft umbrella of the jellyfish (**right**). The crustaceans, which flourish in Arctic waters, may use the jellyfish as a mobile restaurant, sneaking scraps from food it catches or, at times, turning hungrily on their host itself.

As lights penetrated the dark world around Sub-Igloo, biologists found an amazing concentration of life, fostered by the abundant nutrients and oxygen characteristic of this icy water.

200 dives and studied problems of suits, helmets, breathing gear, a diver-propulsion vehicle, and even watches. Having worked as a diving physician for ten years, I have a particular interest in learning just how much a skilled diver can attempt in these waters, where the temperature sinks to a subfreezing 28.5° F., and accidental exposure can bring death in as little as five minutes.

Voices Pierce the Gloomy Depths

As I am about to join the diver who is assembling Sub-Igloo, a clear Arkansas drawl reaches my ears without benefit of headphones. It is Chuck Cantrell, our topside supervisor, talking to me via a new underwater speaker that radiates sound 300 feet.

"Once the dome is in place over the hemisphere, give us two tugs on the line, and we will give you some slack," Chuck tells me.

I duck my head into the air bubble of a nearby Sea-Shell (page 249), one of our four plastic communication-refuge stations. I pull my mouthpiece forward and speak quietly into a microphone floating on the icy water. "OK. Doug is just centering the two hemispheres at the equator. I'll let you know." Doug Elsey is an ocean engineer and my buddy on this dive. He is one of 15 diving scientists I have brought with me into this severely beautiful but awesomely hostile ocean.

Now a new voice comes through the darkness. It is Birger Andersen, who directs the expedition's human-performance program. "When you two are free, would you return to the dive hole for a body-temperature check and status report?"

"Roger," I reply, and am reminded of the electronic pill I swallowed yesterday. Its function is to measure my "core" temperature from deep inside my body and send out a continuous radio signal. But the batteries had been weakened by the cold before I swallowed it, so I must often return to the surface to have my temperature read. Any drop in core temperature is cause for concern.

For this dive I also wear a device that senses my heart rate and pulses it through the water to a surface receiving set. As expected, the searing cold underwater upsets this delicate wireless equipment and sometimes prevents the physiological signals from reaching the surface. But we generally get enough data recorded to confirm that our bodies continue to work normally behind the thin cushion of air held by our suits. What is not measured is the suppressed anxiety we all feel about the hidden ruthlessness of these cold black waters.

It is time to give Doug a hand. I duck below the aluminum rim of the Sea-Shell and push off. Because I want to be slightly less buoyant, I release a stream of air from my suit. For good reason, I wear no swim fins and, as I "moon-walk" across the sea floor toward Sub-Igloo, my feet settle softly into the amber sediment that boils up into small clouds. We have discovered that wearing swim fins near the bottom creates large dark thunderheads that reduce visibility to zero. Thus I dance finlessly forward like the helmeted diver of time past. Later in the expedition, former Astronaut Scott Carpenter will join us for a few days, and I will watch

(Continued on page 261)

MARGARITES HELICINUS, 1 1/4 INCHES

At ease in their bubble, the author, top, and engineer-aquanaut Douglas Elsey test Sub-Igloo as an underwater workshop. Cradling a telephone, Dr. MacInnis talks via satellite with his friend, Canadian Prime Minister Pierre Elliott Trudeau. Mr. Elsey holds a watertight transfer capsule used to bring the phone and other items from the surface to the sphere. An opening in Sub-Igloo's bottom admits divers; air pressure holds out the sea.

Carrying its own "sub-igloo," a sea snail with iridescent shell grazes on the algae coating a kelp frond (**left**). Expedition members found scores of the little mollusks, which sparkled like stars on the sea floor.

Oddities from inner space drift and pulsate in the gloom. Like a half-inflated football, a three-inch-long ctenophore (**left**) glides beneath the ice. Often confused with jellyfish, the invertebrates abound in most of the world's oceans.

"Like a flashing rainbow," marveled photographer Curtsinger of a ctenophore (**right**), here enlarged 1½ times. Light from his flash ripples down the two dangling feeder tentacles, each a-bristle with sticky cells for catching food.

Cigar of the sea, a shell-less snail, shown twice life-size (**below**), swims slowly upward by flapping stubby "wings." Such snails, known as sea butterflies, begin life with shells but lose them as adults.

GENUS BEROE (OPPOSITE); CLIONE LIMACINA (LEFT); AND PLEUROBRACHIA BRUNNEA (ABOVE)

him take this same "weightless" seabed walk.

As I near the glowing Sub-Igloo, an exotic jellyfish with garish "neon" skirts drifts into the light (page 254). This undulating animal is a living symbol of these ocean pastures. When I brought my first expedition to Resolute Bay in 1970, I was amazed at the vast numbers of sea animals and plants on the floor beneath the ice; like most people, I had expected to see an underwater desert.

Our biologist, Dr. Alan Emery, was also surprised on his first dive. "I found plants and animals more abundant than I ever expected, though compared to the tropics, these waters have much less variety. Without actually diving into the cold depths, we would never have realized how plentiful Arctic marine life really is, and yet how painfully slowly it grows, moves, and reproduces."

Final Act Beset by Dangers

I reach Sub-Igloo and begin to work beside Doug, fastening the bolts that clamp the domes together. We have been underwater for almost an hour, and my hands ache from cold. I slow my breathing and try to work smoothly with my wrench and bolts. It is not easy with my fingers in half-inch-thick soft rubber gloves. But it would be impossible to work bare-handed in these waters. In seconds hands would become stiff and feel as if they had been slashed by jagged iron.

In spite of the cold, we press on. The triumphant moment when we fill Sub-Igloo with air is tantalizingly near. But it will also be a dangerous moment. Sub-Igloo will become a giant bubble trying to reach the surface with an upward force of eight tons. We hope the eight tons of ballast in the trays anchoring the struts will keep the whole structure from roaring to the surface.

We must also be careful not to break our bubble. As Doug, who assisted in Sub-Igloo's design, once said, "There will be tremendous potential energy held captive by that fragile-looking globe. If we drop a heavy tool or weight belt on it, it might shatter."

If Sub-Igloo works, it will be the world's first diver-assembled manned station in the Arctic. It requires no heavy lifting equipment to handle and our divers can readily take it completely apart underwater and move it to a new position.

Sub-Igloo is like an explorer's tent. It provides the same kind of base—for storing our equipment, communicating with each other, and providing an easy refuge for a diver in trouble. More important, it is an extraordinary window on the underwater world. We can sit inside—comfortable and relatively warm, free of our breathing apparatus—and study the ocean floor, the water envelope around us, and the ice overhead.

Suddenly Doug and I look at each other. It is one of those unspoken and unpredictable communications that frequently occur between divers. It is our sixth-sense way of overcoming our inability to speak easily to each other underwater. We nod agreement. It is time to surface. We are both cold.

Doug motions toward the ice above us with his thumb, and shared laughter echoes faintly behind our face masks. We both know it is "upside-down" time. Time to stand on our heads and walk on the underside of the ice to the dive hole.

Doug and I lean away from Sub-Igloo, fall gently backward, and depress a round valve on the front of our inflatable suits. I feel a soft hiss of air on my chest and the beginning of an effortless buoyancy.

Heading Home, Bottom Side Up

From below, the massive ice barrier, flat and almost featureless, resembles a faded pearl ceiling. Huge clusters of our spent breathing air compressed against it reflect the lights like thin pools of silver-blue mercury.

I realize I am going too fast. I empty air from my suit. Too late. Legs and arms outstretched, I hit the ice with a balloon-like bump and set off a soft explosion of displaced crystals. I let out a little air and kneel on the flat underbelly of the ice.

I am about to stand erect, head downward, defying gravity with the aid of buoyancy. Slowly I orient myself. The ice becomes a floor, and the seabed becomes my new ceiling (facing page), from which Sub-Igloo seems to hang like a chandelier.

Promenading on an upside-down pavement, the author clowns with an umbrella on the underside of the ice. Overinflated legs of his suit hold him against the frigid surface. The divers found that they oriented quickly to the topsy-turvy world. Slight springing motions sent them bounding along with the kangaroo gait of astronauts on the moon.

The smooth ice floor is broken only by the glow of warm light from three 100-watt lamps suspended near the dive hole. But Doug and I are not alone here. Living animals are embedded in the loose, complex crystals on the underside of the ice. My light picks out two copepods clinging together. Their light-brown bodies are motionless, and their inarticulate clinging underlines the crushing cold of this great lonely sea.

Suddenly my ears awaken to an inexplicable roaring. I wonder if this is a prelude to dizziness or nausea. Did I come up too fast?

Doug's eyes are wide and concerned and I suspect he too has the same problem. The sound changes tone and begins to drop. Then I realize it's not in my head but on the ice. We have stopped just below our tracked vehicle, parked only three feet away, with its engine running. Because water is an excellent conductor of sound, noises can be heard with frightening clarity even over long distances.

A Game for Underwater Recess

From my kneeling position, I attempt to stand with my feet on the ice above me. It is not easy. I feel awkward. The legs of my suit fill with inrushing air. My 50-pound weight belt shifts slightly toward my head. Any quick action will tip me over backward.

All at once I am standing—upside down. The ice stretches out ahead and fades into a blurred horizon. To preserve my equilibrium, I move forward with awkward stiffness.

As Doug and I begin a wooden shuffle toward the dive hole, there is a flash of light. It is photographer Bill Curtsinger filming animals just below the ice. Slowly he rolls into a ball, places his fins squarely against the ice, and straightens, so that he too is hanging upside down. He begins to focus his camera on our bizarre walk.

We are something to see in our bright red suits, hanging in the pale light, our legs swollen to elephant-size with air. Our exhaust bubbles stream incredibly toward our feet to splash on the ice and flatten into thin disks.

In a burst of exhilaration, Bill begins to jump away from the ice. We all laugh, discover a new game, and begin to bounce like three red bears with springs hidden in our feet.

Then I see the square outline of the dive hole and the warm yellow ceiling of the tent. Three faces stare through at me. The inviting opening is below me. I dive into it, headfirst.

Suddenly I am reoriented. A blaze of light,

AMPHIPOD, STEGOCEPHALUS INFLATUS (LEFT); GAMMARACANTHUS LORICATUS (BELOW); LEBBEUS POLARIS (ABOVE)

Unwilling host, a shrimp 2¼ inches long (**above**) bulges with a parasitic isopod—a smaller crustacean—which in turn is swollen with eggs. The lifetime symbiotic relationship apparently does no harm to the shrimp.

Boldly patterned amphipod crawls over a bulbous anemone (**left**), enlarged three times. When feeding, the anemone unfolds tentacles from around its puckered mouth.

Three sea fleas (**right**), amphipods 1½ inches long, converge in midwater. Crustaceans all, amphipods and isopods differ in body shape and the movement of their legs.

Ever the avid collector, biologist Tim Turnbull uses time between dives to scoop up crustaceans drawn by the thousands to surface lights. Styrofoam seat and flooring insulate him from the ice's implacable cold. Foot-level temperature hovers at freezing, while hot air rising from the tent's powerful heater causes the divers' heads to swelter in 85° F. warmth.

Daddy longlegs of the sea, a gangling isopod (**right**)—usually found in dark ocean deeps—was captured by Curtsinger's camera in shallow Resolute Bay. Long, fragile forelegs enable the crustacean to walk on silty bottoms; shorter, paddle-shaped hind legs propel it backward through the water.

Expedition biologists collected nearly a hundred species of invertebrates, largely mollusks and crustaceans, but fewer than a dozen fish species.

and voices greet me. It is the topside team welcoming me back to the realities of the surface. Phil Nuytten reaches down to help me. He is the surface supervisor for this dive. With water streaming off my suit, I slide up onto the glistening wet floor of the dive tent. I push off my mask and a wave of warm air caresses my face. Someone strips off my gloves and pours warm water over my numb fingers. A cup of hot chocolate is offered, and I gulp down its heat.

The surface team moves smoothly and quietly, assisting me in every way. A fresh tank of air is slid into my harness and someone adjusts my face mask, readying me for the next dive. We try to have at least one man on the surface responsible for each diver in the water. To give everyone as much experience as possible, we change roles often. Today's diver becomes tomorrow's helper or supervisor, and vice versa.

Doug and I sit side by side at the edge of the ice hole, gaining back some of our lost heat. We take advantage of the break to check over some of the ongoing work with our teammates. Tim Turnbull (above), a doctoral candidate in marine biology, and one of the two men helping me with this dive, wants to go under as soon as we have put Sub-Igloo together. He is making a photo survey and specimen collection, concentrating on the symbiotic relationships of small ocean animals. While he is down, he plans to do some checks on our closed-circuit breathing system, a very advanced kind of underwater equipment we are testing.

Roger Smith, the expedition geologist, is laying plans to take more core samples of the soft sediment near a kelp bed. Ches Beachell, the mechanical genius who has set up all our lighting and communication equipment, is wiring phone connections to Sub-Igloo.

Doug and I, of course, are planning the final assembly of Sub-Igloo. "We'll just tighten a few more bolts, and the hemispheres will be secure," I say. "Then we'll fill her with air and slip inside."

Doug looks worried. "We will *if* the bonding at the equator, between the plastic and aluminum, holds. It's never been tried before at this low a temperature."

Our conversation is interrupted by a geyser

MYSIDOPSIS TYPICA, BODY LENGTH 1/2 OF AN INCH

of bubbles and water in the dive hole. A diver's head and shoulders shoot up and out of the foam. It is Rick Mason, who has been filming the highlights of the expedition, mostly underwater, for the National Film Board of Canada. Quickly he flips back his mask. His breathing is fast and labored.

After a while he explains. His regulator froze in the closed position and he made a fast emergency ascent, venting the expanding air in his suit. That's what caused the geyser. "Sorry for all the splash," Rick says. "I'll get another regulator and get back to work."

His calmness is impressive. Like all of us he has quickly learned to handle the hazards of Arctic diving—not only mechanical failures and physical privation, but the psychological stresses: the darkness that can swallow a diver in seconds, the fear of confinement under the icy expanse.

But we have no occasion to preen ourselves. Compared with the Eskimos, we are softies. Simon Idlout, who lives in a nearby Eskimo village, relates a tale that humbles us all. One day in spring he was crossing the ice near shore when his brand-new rifle dropped off his sled into the water. He went home for some rope, and, with his brother, returned to the site and stripped to his shorts. While the brother held one end of the rope, Simon wrapped the other around his waist, grabbed a large stone, and down he went some twenty feet. He stayed 50 seconds and did it again, looking around without benefit of goggles. He found the gun and trudged home to warm up. Obviously our friends in the North have much to teach us.

Final Moment Draws Nearer

Doug and I now slip back into the water and make the long glide to Sub-Igloo. We tighten the last bolts and then begin to fill the eight-foot sphere with air. A huge bubble boils into Sub-Igloo and drives the displaced water down and out through the open bottom hatch. As the air fills past the equator, we are relieved that there are no leaks. But occasionally I feel the structure tremble with tension; the potential lifting energy grows with each cubic foot of air entering the sphere.

The air is now down to the level of the circular plastic bench, well below the equator. It

GENUS PAGURUS (LEFT); LIPARIS ATLANTICUS

Arctic wonders, animal and human: A vivid holothurian, shown life-size, thrusts out branching tentacles in search of plankton (**left**). Wrapped in its own tail as if for warmth, a 1½-inch-long snailfish clings to kelp with suction-cup ventral fins (**above**). A diver's ballooning suit fascinates Eskimo children visiting the site from their nearby school (**top**).

With the success of Sub-Igloo, the author next envisions establishing a workshop beneath a drifting iceberg or under the ice of the open sea to further advance the exploration of Canada's little-known Arctic waters.

is time to go inside. I slip up through the hatch. My head breaks the surface. I remove my mask and hear the echo of my sigh. Cautiously I look around.

The water level is just below my chin, and I see small cakes of ice floating away on the wind of my steamy breath. The walls of Sub-Igloo seem not to exist.

I climb up on the bench and sit quietly. Three divers outside wave. One points beneath the bench. I lean over to look and see two small fish swimming there. I am in the Arctic's first undersea fishbowl. But the implications are larger than that.

The cold, clear water around me, so long the hidden home of arctic mammals and fish, is allowing us to probe its mysteries. This new tool, though, must be used with reverence. Yesterday an old Eskimo came into our tent, looked down the dive hole and said, "You will not scare our seals away, will you?"

Success Prompts Underwater Toast

Sub-Igloo is also, of course, a tool that has yet to prove itself fully. It is a prototype, and we must test it over long periods and in varied locations. But we now know that a device like this, which can be assembled so easily underwater, does work and will be useful.

In a few moments other divers will enter Sub-Igloo, and we will celebrate its successful Arctic christening with a champagne toast. Four of us will raise our glasses—after a battle with the stubborn cork. Awkward in our bulky gloves, we finally use a knife to pry the cork loose from its bottleneck.

In a few days I will experience another thrill—a 50,000-mile phone call from Sub-Igloo to Ottawa, to report our success to Prime Minister Pierre Elliott Trudeau, also a diver. Our words, carried by cable to Resolute, will be beamed from there to the new Anik I satellite—in orbit 23,000 miles above the earth's Equator—and then bounced back to the Toronto area, to be relayed to Ottawa.

But for now I am alone, breathing resonantly inside the sounding sphere. And breathing, too, a silent thank-you. Our expedition has been a tremendous chain of planning and logistics. It began more than a year ago, 2,000 miles away in southern Canada, and it has involved aircraft, tracked vehicles, and men. Above all, men. Without my teammates' thousands of hours of effort, I would not be here, looking through this amazing window at the wonders of inner space. □

Gotland: Sweden's

By JAMES CERRUTI
SENIOR ASSISTANT EDITOR

Photographs by
ALBERT MOLDVAY

Gem of the Baltic's jewel box, Visby charms 200,000 summer visitors with its churches, warehouses, and red-roofed cottages. Gotland's only city has changed little from its medieval days of glory.

AN INVENTORY of the riches of the Swedish island known as Gotland might run like this:

Literal: Seven hundred hoards of gold and silver unearthed—mostly from Viking days.

Architectural: The mighty 13th-century Wall of Visby, and that capital city itself, still much as it appeared when it was one of the great trade centers of northern Europe.

Treasure Island

Ecclesiastical: Ninety-two medieval parish churches, each a jewel still shining in use.

Archeological: More than 700 colossal Bronze Age ship-form stone graves and burial cairns.

Geographical: Largest island in the Baltic, 75 by 30 miles, with Sweden's sunniest summer weather and fine sand beaches, playground of sophisticated Stockholmers.

But this would be an entirely inadequate audit, because it fails to account for Gotland's greatest treasure: the 54,000 Gotlanders. Though Swedes are traditionally typecast as reserved and even dour, Gotlanders are sunny as their summer clime.

An artist at his easel in Fiskargränd, Visby's most picturesque old lane, limned the Gotlandic character for me in a few broad verbal strokes. "It is commonly said that the friendliest people in Scandinavia are the

Way-stop for traders, Gotland prospered as a crossroads of commerce as early as the Bronze Age, archeologists believe. Today, forgotten by merchant shipmasters, the island in the nearly tideless Baltic lives by farming, small-scale industry, and tourists lured by its numerous sunny summer days.

Treasure from a Viking ship attests the far-flung wanderings of the Norsemen, who knocked at the gates of Asia. Arab coins and coils of silver, along with smaller German coins, date from about A.D. 1000. Unearthed by a gardener in 1943, the cache now glitters in a Visby museum.

NATIONAL GEOGRAPHIC PHOTOGRAPHER GORDON W. GAHAN

Danes," Kurt Werner observed. "Well, I am a Dane, and I have been coming to this very same lane for 23 years. Why? Because the Gotlanders are the friendliest people in Scandinavia. This island is like a family. If you come here once, you are a member."

In the month my wife, Hannah, and I lived on Gotland, we too were adopted into the family. At the very start there appeared our most unwicked landlord, Alvar Hallgren, and his wife and two beautiful daughters, taffy-blond Åsa, 20, and golden-blond Eva, 19.

While tidying up the already spotless four-room apartment, the girls decided what we should see and do on Gotland. They promised, especially, to take us to a place that had the "old" dances—meaning the fox-trot and waltz. They abhorred the rock-and-roll that Visby's cellar discotheques dispense to Stockholm longhairs (page 288).

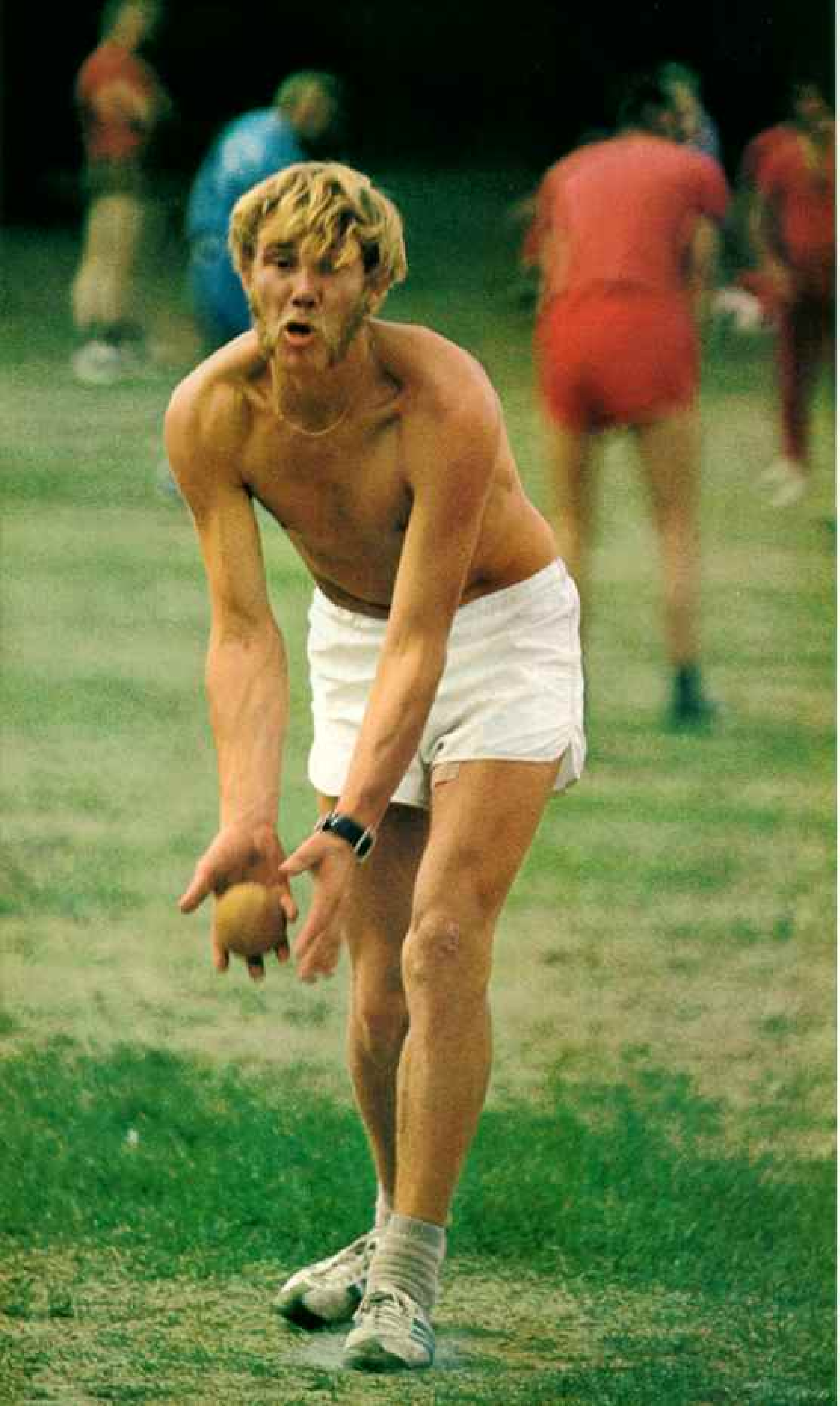
"And we really like to be with the old people," Åsa confided. (How could we ancients take offense? For later she and her fiancé, Kenneth Jacobsson, did indeed dance us around to the rhythms of our youth.)

Privileged Place "Within the Wall"

Mr. Hallgren hoped we were not too disappointed with the apartment. We could not have been happier. From our top-floor balcony we looked down on Visby's harbor, where car ferries from Sweden and passenger ships from Finland backed and filled to enter the narrow port. From our windows we could scan the antique city full circle. In the east, Visby's Wall, with its 37 towers, some 70 feet high, marched to the Baltic in a two-mile arc (pages 276-7). We lived "within the wall," as only 2,700 of modern Visby's 20,000 residents do, and marveled that in medieval times possibly 10,000 people crowded in there.

Closer to our view, the tall gray skeletons of ruined churches yearned heavenward. At Visby's medieval apogee, 17 churches—some nearly cathedral-size—shouldered each other on the quarter square mile within the wall, for every foreign trading group in old Visby wanted its own place of worship. When Germans from Lübeck, early commercial rival of Visby, sacked the city in 1525, they burned a number of churches, but left St. Mary's, the church of German merchants, still in use.

On Visby's three terraces, medieval skyscraper warehouses up to seven stories high dazzled our eyes. Visitors arriving by ship 600 years ago gasped at the skyline, as tourists do



Whack of a fluffy bludgeon provides lighthearted relief at the Viking games (**left**). In a tendon-stretching event of more ancient vintage, a farmer (**below**) heaves a 57-pound pole in the *stångstörtning*, similar to Scottish caber tossing.

NATIONAL GEOGRAPHIC PHOTOGRAPHER WINFIELD PARKS (ABOVE AND RIGHT)

Fast and frenzied, the game of *pūrk* calls forth intense concentration from a contemporary Norseman (**left**) at Stånga's annual Viking "Olympics." The traditional contest pits two teams of seven in a battle for points and territory.

Islanders cling to such games of old, but they also relish the roaring mayhem of modern motorcycling. In the heat of a race outside Visby (**above**), Polish and Swedish speedsters —proudly wearing their countries' crests—careen into a turn. The two nations alternate in hosting the annual rivalry.

at New York's. Gentling this grandeur, roses rioted everywhere, as they do from June sometimes through Christmas, for Gulf Stream offshoots give Gotland, at the latitude of northern Labrador, a mild climate year-round.

With all this "city of ruins and roses" outside our windows, and elegant contemporary Swedish decor within our own walls, I was astounded at Mr. Hallgren's concern. Especially since the rent was only $55 a week. But Mr. Hallgren continued to worry, and when, a few days later, he invited us to his lovely vacation house near the beach at Botvaldvik, he said, "When you get cramped in that little apartment, please come and take this house for as long as you like."

Such hospitality is instinctive with Gotlanders. Shortly after our first meeting with Marianne Korsman, Gotland's Assistant Conservator of Churches, we were guests of honor at a traditional August crayfish party in her home. A willowy young intellectual with corn-silk hair, tender eyes, and three university degrees, Marianne is not only a restorer of churches, but also painter, rugmaker, stage-set designer, and proprietor of a Gotland handicrafts shop.

Marianne lives in a medieval house within the wall. In her small dining room, with 17 other guests around two tables, we began the crayfish ritual. And ritual it must be, for the nutritional value of a crayfish, a tiny

Faces bright as bridal bouquets greet Birgitta Lindström after her wedding in the fishing village of Gnisvärd. Cheery islanders relish celebrations and heap hospitality on even the newest of comers to their homeland.

freshwater crustacean extravagantly prized by Swedes, is negligible. After the claw meat (the size of half a toothpick) and a minuscule back strip have been consumed, there is nothing further but dill sucking. The creatures, boiled with fresh dill, are broken in half and symphonically slurped.

But one does not go hungry at a Korsman crayfish party. While the red crustaceans, garlanded with dill flowers, cooled in the center of the table, to be admired and anticipated, the real nourishment was passed round: Big oval loaves of crusty bread that Marianne had baked herself, spicy red sausage, and six kinds of herring, including "rotten" herring, which reeks and tastes like Gorgonzola cheese. *Starköl* flushed all down, a dynamite of a beer that is generally labeled "Export"—presumably in the hope that it will destroy foreigners rather than Swedes.

And then to the crayfish. Tradition demands that with each claw a glass of schnapps be downed, and it is a toss-up which is the greater extravagance. A fifth of aquavit costs $12 in the monopoly state liquor store; a pound of fresh Swedish crayfish costs $6. Though frozen crayfish from Turkey or Rumania cost only $2 a pound, no patriotic Swede eats them without chagrin. A patriotic Gotlander is even choosier. Marianne apologized, "I am sorry—these are not Gotland crayfish; only Swedish."

Riches Won by Trading, Not Raiding

Such wry chauvinism is typically Gotlandic. When, later, I met Marianne's boss, Erik Olsson, Conservator of Churches—a mighty man, painter, sailor, fisherman, a Viking tall and brawny, with a dashing moustache (page 286)—he told me, "Only in Gotland are men free, no, not in Sweden."

This sense of apartness and independence has deep roots. In the Viking Age (from A.D. 800 to 1050)* the Gotlanders were the equals, and the envy, of Swedes, Danes, and Norwegians. By trading, rather than raiding, Gotlanders became the richest Vikings of all.

When their neighbors went a-viking (plundering) in Russia, they often stopped at Gotland to take aboard a pilot. Gotlanders and Swedes had pioneered the trade route down the Western Dvina and Dnepr Rivers, all the way to Constantinople, which they called Miklagärd, the Big City.

One story has it that other Vikings steering for the Byzantine capital took aboard at Gotland not only the pilot but also the renowned Gotland *dragöl*, or "pull beer," complaining always of the high prices Gotlanders charged for it and everything else. This extra-strong brew (no doubt labeled "Export") was an essential for the week's portage from the Dvina to the Dnepr. The Viking crews themselves dragged their longships over the back-breaking course. The ordeal was such that not even a Viking could endure it sober.

Dragöl is still home-brewed on Gotland (pages 280-81). I tasted it, a bitter, flat beer, at the farmstead of Fredrik Wehtje. "This is the Gotlander's Scotch," Mr. Wehtje explained, "made from smoked barley malt."

Modern Gotlander A-viking Goes

While Gotland's men sailed to Miklagärd, the women tended the farms so well that the island became known as the "Farmers' Republic." Envious of the Gotlanders' success with soil and sail, their piratical neighbors grumbled, "Gotland swine eat from silver troughs." So at every wind-borne hint of a berserker roar, the farmer-republicans buried their treasure, and many did not live to find it again (page 271).

Today Gotland men can rarely sail off to Miklagärd, leaving their women behind. But the mighty (and married) Erik Olsson, a few years ago, went a-viking, Gotland style, trading on his talent as Conservator of Churches. His "Miklagärd" was Herat, in Afghanistan, where UNESCO sent him to work on the mosaic facade of the Friday Mosque.

According to Erik, he made the most of the opportunity. Cracking a cat-o'-nine-tails across a tabletop, he said, "With this I kept my 300 wives in order."

Then he noticed a small, plump lady standing in the doorway of the studio. "I forgot to say that I have 301 wives. This is the big, chief one. . . . And as for what I have just said to Mr. Cerruti, my dear, you realize that it is the very same kind of story he will tell about Gotland when *he* gets home."

Of all the restorations Erik has done, he is proudest of Kovik, a few hundred feet from his house—a little fishing village, looking as it did half a century ago, except for its vanished fishermen.

* "The Vikings," by Howard La Fay, appeared in the April 1970 NATIONAL GEOGRAPHIC. Mr. La Fay also wrote a 200-page, richly illustrated book on the same subject; it is available for $4.25, plus postage and handling, from the National Geographic Society, Dept. 61, Washington, D. C. 20036.

Walled heart of a vanished empire: Visby, ruled by German and Gotlandic merchant princes in the 12th century, became the capital of a medieval mercantile republic that joined with other northern European trading centers to form the Hanseatic League. At the height of its commercial

greatness, Visby dominated the Baltic. A fortified wall rose to protect the foreign merchants—not from sea-roving pirates, but from Gotlanders themselves, who resented their eventual loss of control over the island's commerce. Visby began crumbling in the 14th century, when the Hanseatic capital was transferred to Lübeck, Germany. A shift in trade routes to the south also contributed to Visby's decline. To preserve the city's historic flavor, current building or reconstruction within its wall must be approved by the town government and harmonize with existing architecture.

"People care about old churches and Viking treasures but not much about the history of their own times. So I decided to put this village back the way I remembered it as a boy, when my papa was a poor fisherman here. All my neighbors helped me."

In one of the village's *snäckshusen*, Erik said, "This boathouse is where my papa kept his boats and gear. That is his stone anchor. Some years he earned only 300 kronor [about $80 at that time]. We had no money—but the best food. What you get from the earth is good, but herring—that is food for *men!*

"Until 1920 we had 150 of these fishing villages, with 40 boats in some; only a few are working today. The snäckshusen have become tourist cottages."

Gotland's modern fishing industry—85 percent herring and salmon—centers on the port of Herrvik (map, page 270). It is still marginal. About 150 fishermen in 40 boats earn an average of only $2,600 a year.

Like the small fisherman, Gotland's small farmer is under pressure. Though Gotland is one of Sweden's most agricultural counties, with 20 percent of the population in farming, its 2,400 farm families are dwindling. With too little money and too little land to mechanize, they have been leaving the soil at the rate of 100 a year, many to receive unemployment compensation, since Gotland lacks industry enough to put them to work.

Farmer Excels at Viking Games

To survive, a small farmer must be something of a superman. I met one such at Stånga, center of Gotland's unique Viking games (pages 272-3). Farmer Erik Hedin—six-feet-three, 220 pounds, age 45—has been champion of the games since 1952, having won the pentathlon in 19 out of 21 *Stångaspelen*.

Among the pentathlon events in which Erik excels are *varpa* and *stångstörtning*. He pitches the varpa, a ten-pound disk of stone or metal, at "aim sticks" 65 feet away. The big granddaddy of our effete horseshoe pitching, varpa may have begun as a workout for Stone Age soldiers. In stångstörtning, which resembles the Scots' caber tossing, Erik has hurled the 57-pound log 27.17 feet, a record distance for this event.

A few days after seeing Erik in the field, my wife and I visited his farm near Havdhem. There his sister Margit, a tall, motherly woman, at once engulfed us in Gotland hospitality. First, she offered us black currant juice from her own bushes, then coffee with pastries, including *gorån*, crisp wafers full of eggs and butter, pressed and baked in an iron form of intricate design.

Walking round the farm with Erik, I began to revise my conception of him as a "small" farmer. On 100 acres, Erik has pasture for 10 milch cows and 20 yearlings, and fields of hay, wheat, barley, rye, oats, rape (for margarine oil), and sugar beets. He also has 25 acres of wood for cutting. I asked how many hands it took to tend all this.

"Just the family," he said, "myself, Margit, another sister, and mama. So I get my training for the Stångaspelen without effort."

Retired Executive Breeds Rare Sheep

A really big farmer, like Fredrik Wehtje at Klintebys farm, employs about ten people on 900 acres of fields, plus woods and pasturage. The retired managing director of Sweden's venerable Rörstrand ceramics factory, Mr. Wehtje has a thousand of the island's 75,000 sheep. He is proudest of the 20 rarities he has bred for four horns—two thick horns curling up, two thin scimitars curving down.

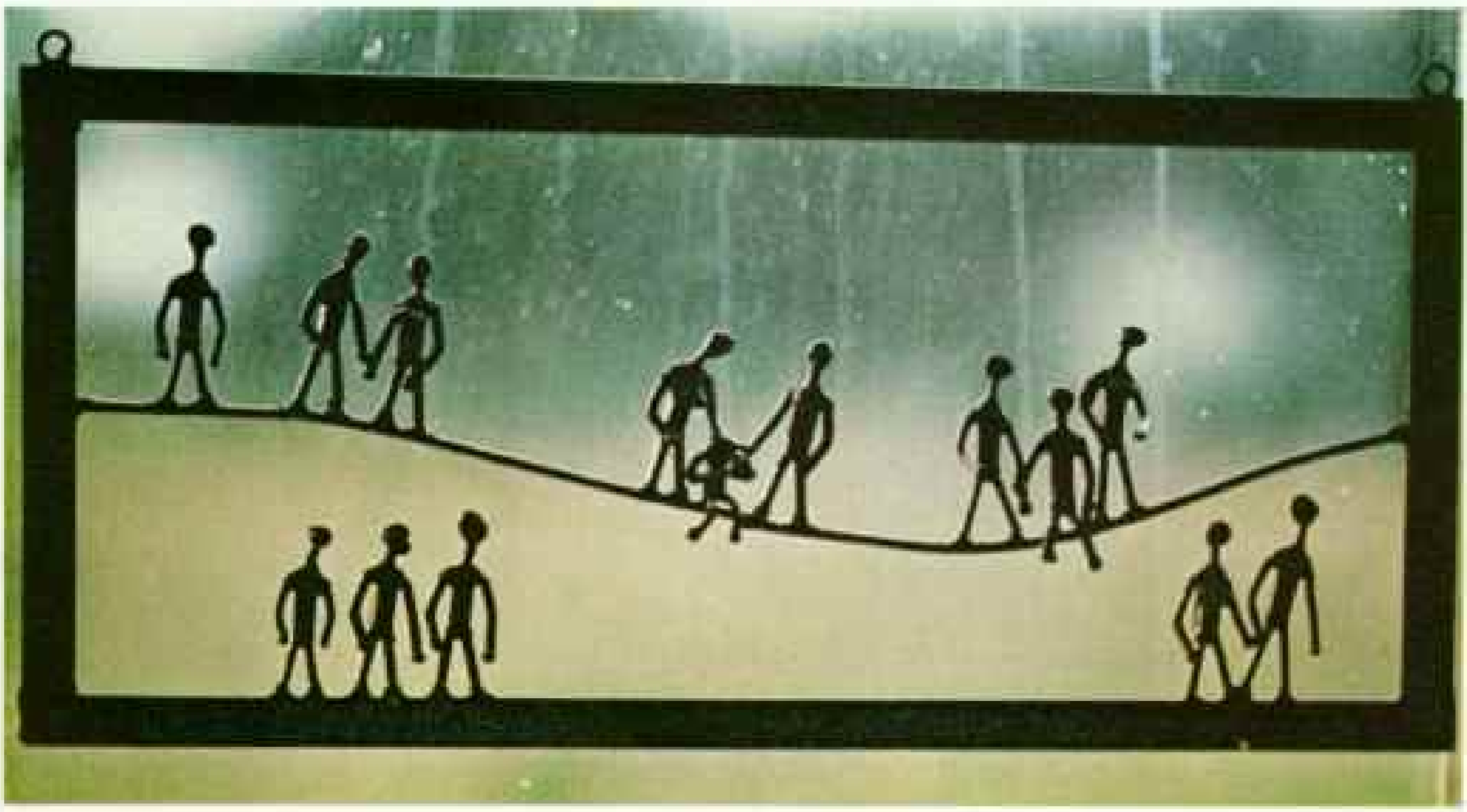
Old Gotland sheep—which are a distinct breed, with coats varying from predominant gray to black and nearly white—had two horns, sometimes four, rarely six. Because the horns made them hard to handle, Gotlanders have bred for no horns. Mr. Wehtje does not want the ancient breed to die out, but he also sees commercial possibilities in it.

"I may make a business of the meat," he said. "The four-horned animals are like the wild prehistoric sheep, and their flesh is like game—dark and sweet."

Mr. Wehtje also breeds 150 *russ*, the diminutive horses the Vikings may have ridden (page 285). Only about 12 hands high, russ are prized as children's ponies, and their size hints that the mighty Vikings of old, though tall to the southerners they plundered, were shorter than the average Scandinavian today. As with his sheep, Mr. Wehtje strives to strengthen rare old qualities in the russ. He showed me one herd with palomino coats, another with Dalmatian-like spots.

Such feats of ingenuity as Fredrik Wehtje has performed with russ and rams, Alex Kebbe has achieved with pears, plums, apples, and saltwater irrigation. His 23,000-tree orchard, with the largest pear yield in Sweden, produces more than a million pounds of fruit a year on 125 acres by the Baltic.

Sculptor with a torch, Calevi Tenhovaara fashions imaginative designs in metal. A renovated dairy in the small village of Barlingbo serves as the cooperative workshop-home of the award-winning Finn and other artists. During dark winter months they create a stockpile of pottery, jewelry, and wood and metal sculpture to fill their two shops—one in their home, the other in Visby.



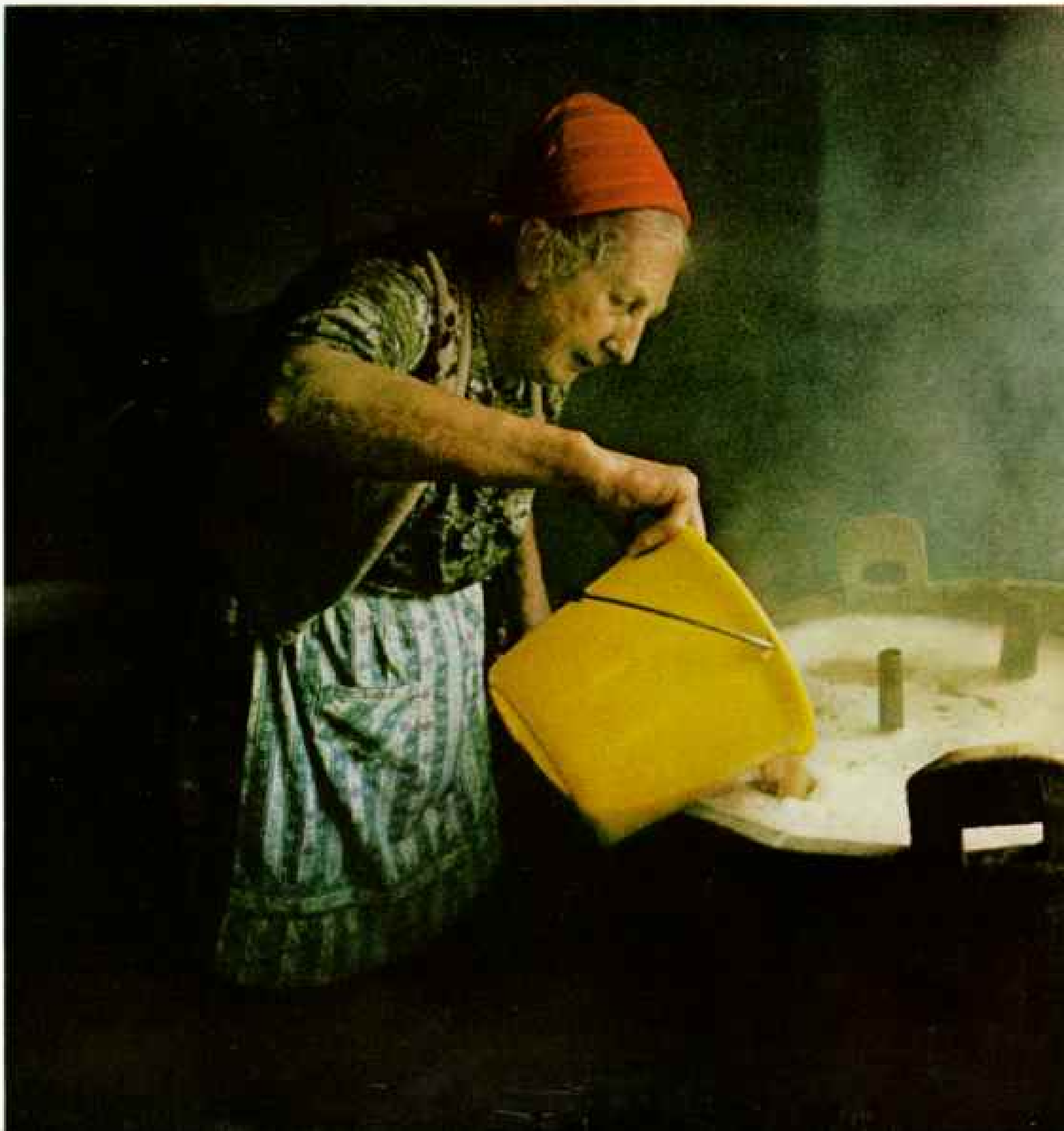
The first farmer to use Baltic water for irrigation, Mr. Kebbe gambled on its low salinity. The Baltic, originally a freshwater lake, was formed some 12,000 years ago by the melting of the ice cap. It still assays at only six-tenths of one percent salt. Through 18 miles of tubing, Mr. Kebbe drips the Baltic to the tree roots—6,000 pounds of salt an acre every year; most leaches away, but what remains could mean trouble.

"For 13 years I've tested," he said. "By now every acre has accumulated 4,000 pounds of salt, three times as much as when I began. Still no salt has reached the leaves, where it could be fatal. But who knows in another 13 years? Salt farming is tricky."

Tricky is the word for Gotland farming, salt or not. Per-Anders Croon on his 350 acres at Lummelunda produced crops that brought his family—a working wife and two children—$5,800 in 1971. It was his best year, at the age of 33, after almost a decade of farming. "My biggest year till then was 1967—but not from farming. I plowed into a little hill and silver shot out all over."

It proved to be the largest hoard ever found, cached 800 years ago: 17 pounds of silver bars and 3,000 silver coins weighing almost 6 pounds. Enjoined by Swedish law to turn in this treasure, farmer Croon was entitled to the current value of the silver, plus an eighth. But since the find was so important, the government awarded him more: $3,600.

"I had never earned so much in any year of farming," he said. "But then the government ordered me to pay income tax on it—to give back half or more. I am still fighting this in the courts."



That most of the silver coins in farmer Croon's hoard were German was no coincidence. German merchants played a large role in Gotland's rise, and in its fall. In the 12th and 13th centuries, many settled in Visby, and established the Company of Gotland Travelers, a trade association. They drew in traders from various states around the Baltic, and out of this developed the Hanseatic League, a medieval common market with warships.

Visby reached the peak of its power within the league toward the end of the 13th century. The Gotland farmer-republicans, seeing their mercantile supremacy toppled by foreigners, rose in fury in 1288 and marched against the city. The Visby merchants were ready. The wall, which they had begun in the mid-13th century to keep the hostile farmers at bay, served its purpose admirably.

Then came Valdemar, King of Danes, intent on sacking Gotland. Defeating an army of farmer-republicans, he drove its pathetic remnants to the wall—1,800 souls, including cripples, women, and children. The Visby merchants refused to open the gates to their troublesome neighbors, and watched from the ramparts as Valdemar's forces caught up. The faded Latin inscription on Valdemar's Cross, a stone memorial an arrow's flight from the wall, tells the story: "In the year of our Lord 1361, on the third day after St. James, before the gates of Visby, the Gotlanders here buried fell into the hands of the Danes. Pray for them." All 1,800 of them.

The merchants opened the gates to Valdemar, and he extorted tribute and sailed away. But Visby had small gain from the farmers' rout. The city had become the commercial "Pearl of the Baltic," because trade with the eastern lands was safer via the Baltic and the rivers of Russia than through the stormy Atlantic and pirate-infested Mediterranean. When Mongols closed the passages across Russia, traders switched to the more direct sea route. Visby, bypassed, fell into decline.

Annexed by the Swedes in 1645, wealth and glory gone, Gotland became a peaceful, pastoral place. And, except in summer, when 200,000 tourists pile in, it still is.

First the Lakes, Then the Birds

Kenneth Jacobsson told my wife, while waltzing her around, "You must love Gotland—it is so nature." Still 44 percent woodland, the island is fresh with the scent of pine, spruce, and juniper. Though the landscape is flat (highest elevation 272 feet), it is vivid. Clumps of white-barked birch, masses of wild blue chicory and pink "tar blossoms," 35 kinds of orchid, golden grainfields, and red farmhouses accent the pervading greenery.

But the blue of a lake is a rare sight. Hungry for arable land, farmers have drained Gotland of a score of its lakes, and with the lakes have gone the variety of bird species

Fit to quench a Viking's thirst, *dragöl*—a potent, bitter beer—bubbles in an island farmstead. Nearly one in four families husbands the limestone soil, raising sheep, sugar beets, grain, fruit, and vegetables. But lack of land and of capital for modern machinery turns many away from farming and swells the island's payments to the unemployed.

GORDON W. GAHAN

that once frequented them. To be awed today, bird-watchers must go to Stora and Lilla Karlsö, islets two to three miles off the southwest shore (map, page 270). There 100,000 birds, predominantly guillemots and razorbills, nest from spring to midsummer.

In spite of recent outcries that the Baltic will be dead from pollution in ten years, the bird colonies have not been affected, and bathers still dip in Baltic waters with impunity. Dr. Lennart Hannerz, Director of Research of the National Swedish Environment Protection Board, told me in Stockholm that pollution is a serious—though not insoluble—problem along the Baltic shoreline. "But if you want the story of the pollution problem of the Gotland waters, it will be a short one: Out there in the open Baltic, almost none."

Long-lost Swedes Return With Bells

So Gotlanders look forward to many summers of profitably crowded beaches, and the tourists will continue to alternate soaking up sun and soaking up culture. "The whole island is our museum," said Gunnar Svahnström, Director of Gotland's Fornsal—Hall of Old Things—in Visby. Here visitors gawk at the piled-up treasure hoards, while out in the countryside they wonder how ancient men put together the 147-foot-long ship-form monument at Gnisvärd. The biggest of more than 300 such cremation graves, it was built by Gotlanders at least 2,500 years ago with huge boulders freighted from the mainland.

Some tourists have even visited all 92 of the medieval parish churches. We "did" 22, and each was worth the time for some surprising detail—the most surprising to us being the bell tower of Roma Kyrka. It was built to house two bells from Gammalsvenskby (Old Swede's Village) in Russia's Ukraine.

Karl Hoas, born there in 1913, and now a retired captain of the Swedish Armored Service, told me, "We brought those bells with us when we left Gammalsvenskby in 1929. Our people had lived there since 1780, and before that in Estonia.

"We were 900 Swedes surrounded by millions of Russians. They hated Germans, and they called us 'bloody Germans.' When we explained we are Swedes, they sang the 'Poltava Song'—about how the Russians defeated our King Charles XII at Poltava. And that was not sweet to Swedish ears. Finally, we decided to go home."

About a third of the Ukrainian Swedes

"Hall of Old Things," the Fornsal in Visby, once a warehouse, now shelters a priceless collection of works by medieval artists. Gotland's masters, commissioned by prosperous merchants and farmers, enriched the island's 92 churches with their creations. A 15th-century wooden statue—probably St. George armored to meet his dragon foe—dominates one of the Fornsal's rooms.

Heralds on horseback trumpet nostalgic notes (**left**) as an annual children's parade winds merrily through Visby's narrow lanes.

came to Gotland, where they were received as long-lost brothers. The Guta Saga, a 14th-century legend, tells how, about A.D. 500, because of overpopulation, Gotlanders drew lots to determine who must emigrate. The losers, a third of the population, moved to Estonia, Russia, Miklagård, even Greece. These people of Gammalsvenskby spoke very old Swedish; therefore Gotlanders like to believe they are the remnants of the lottery losers, come home after 1,500 years.

Only One Way to Appease the Elf

For long, historians thought that those fifth-century pariahs, resisting deportation, had entrenched themselves on Torsburgen cliff, near Gotland's east coast. There stands a massive fortification, a mile and a third long. Natural clefts in the wooded limestone cliff were closed with dry-stone barricades up to 50 feet high, forming a solid rampart.

Agne Jonasson, Gotland's ebullient chief guide, took me to see it. It is still a wild place. "I know it since childhood," he said, "but during World War II, when my major sent me to map here, I got lost in the woods for five hours. They say *byssen*, the elf, puts a spell on you to keep you in. The only way you can break it is to turn all your clothes inside out. I was starting with my blouse when I bumped into the major."

Gotland's Chief of Archeology, Erik Nylén, thinks Torsburgen may be wrongly dated by two thousand years too late. "We can see it took thousands of people many years to make Torsburgen. But the political organization of the A.D. 500 period was not up to this. Gotland was all scattered farmhouses. There was no concentration of power in one hand.

"I am inclined to a surprising solution. I will guess that Torsburgen was built by an advanced Bronze Age civilization about 1500 B.C., under a strong military chieftain. Those people have left 400 cairns here, and in one, at Lärbro, we excavated a ten-foot tower that has construction features similar to Torsburgen. For anything comparable elsewhere, you have to go to the Mediterranean of the second millennium before Christ.

"I have a theory that Gotland was a Hudson's Bay for the Mediterraneans. Perhaps they sent their younger sons up here with bronze implements to trade for furs, and left a little culture behind."

The influx of young sons (and daughters) to Gotland continues, but chiefly from nearby Stockholm rather than the Mediterranean. Gotland elders are apprehensive that these Beautiful Young People may be leaving behind not a culture but a cult. Grandmotherly Ingeborg Lingegård, who has created a *kruusmyntagård*, a delightful medieval herb garden near Brissund, was distraught. "The other night some youths stole half a dozen of my witchcraft plants." Among them, *Cannabis sativa*, better known as marijuana.

The drug cult does not entice Anki Lindgren, a beautiful young reporter for *Gotlands Allehanda*, but she finds the sophisticated Stockholmers' candor and independence congenial. Speaking for Gotland's avant-garde, she said, "I *hope* we represent the 'corrupt' youth of the 20th century. We are not afraid to show what we feel—to touch each other when we wish."

She invited us to a pajama party at the Rock 'n' Roll Circus, a cellar nightclub Stockholmers favor. "Here," she said, "you will find all the Gotland people who like to move." I did indeed become fond of the group. It all reminded me of the pajama parties my children threw years ago—just as innocuous, just as loud with the identical music. As for touching, no dancer came within two feet of his partner (page 288).

Couple Gets Half-married in a Tree

With their farming and Lutheran backgrounds, Gotland youth are generally conservative, but some parents are bothered that they practice *samvetsäktenskap*—marriage of conscience, or "half-marriage"—as do many other young Swedes.

Åsa Hallgren and her *fästman*, Kenneth, got half-married up a tree. "Everybody was always exchanging rings under that tree and carving hearts and names in it, so we did something different," Åsa explained.

The informal exchange of rings, without benefit of clergy, is a firm union, and can include children. Later, if both partners are ready, there may be another exchange of rings before a minister. To back out of a half-marriage is a serious matter, and the commitment to monogamy is absolute.

Having seen a lovely Gotland girl flirting with a handsome youth, I asked teasingly, "Well, you tell me he is half-married—why can't you half-marry the other half of him?"

She recoiled in horror. "You don't understand. He is married. His wife is about to have a baby."

The popular institution of half-marriage has economic roots. For one thing, young half-married people would rather go on living with parents, saving toward a house of their own, than pay rent.

Why Such High Local Taxes?

Economic disadvantages are much on Gotlanders' minds. Governor Torsten Andersson told me, "Because of the many old failed farmers and the unemployment rate among the young, double the Swedish average, Gotland has to levy the highest local taxes but has the lowest income of any Swedish county. To survive, we will need 3,500 new jobs in the next five years."

But Gotland's industries—telephone equipment, cement, sheepskin garments, beet sugar, grindstones, and a slaughterhouse—have all the help they need. The biggest industrial employer, the L. M. Ericsson Telephone Company, provides a thousand jobs.

Paradoxically, the "poor artists" can probably claim the soundest economic base on the island. They sell enough to tourists in summer so that they don't have to look for nonexistent work in winter.

I visited with Calevi Tenhovaara (page 279), a young Finnish sculptor who has put an especially sound economic base under the *vie bohème*. In an old dairy he has established an artists' cooperative. In downstairs studios, he sculpts, Sigge Lindberg carves wood, Tellarvo Voutilainen throws pots, and Brittan Hecktor polishes and sets stone jewelry. Upstairs, they each have a room and share all chores and food costs.

They sell their creations both at the dairy and in their Visby shop. By mid-August they are sold out and already engaged in the winter work of producing for next summer.

The most famous artist-in-residence, filmmaker Ingmar Bergman, lives on the island of Fårön, just off northeastern Gotland, where his neighbor is *sommargotländning* (summer Gotlander) Olof Palme, Sweden's Prime Minister. Both find there the privacy they crave; Fårön is a military zone and only

With a back-bending pucker, a youngster catches the eye of a *russ*, one of an ancient breed of shaggy-maned horses native to Gotland. Protected by conservationists, almost a thousand of the pony-size steeds roam island moors.

"**Some years papa earned only $80,**" remembers Erik Olsson (**above**), son of an island fisherman. To honor Gotland's men of the sea, Mr. Olsson and his neighbors have restored their village of Kovik. Some 6,000 boats once searched the Baltic

for herring and salmon. Faced with competition from modern fleets of trawlers, most of the fishermen beached their small craft to seek other work.

Vacationists (**right**) explore the pebbled shore of Fårön, a small island separated from the northeastern corner of Gotland by a narrow strait. A gull's flight from Gotland's southwestern coast, the islets of Stora Karlsö and Lilla Karlsö offer sanctuary to thousands of migrating birds that nest there in spring and summer.

Customers perform at the Rock 'n' Roll Circus, a popular Visby discotheque that reverberates to the beat of amplified tunes. Gotland's lively night life draws thousands of young visitors, who spend their days on the island's many beaches or hiking through the fields of wild flowers and evergreen forests of this popular Scandinavian resort.

Swedish citizens may visit it and use its beaches, Gotland's best.

Mr. Bergman is blessed by the Gotlanders because he recently made Fårön his permanent residence and is producing most of his films there. Now his considerable local taxes go directly toward the welfare of his friends, the hard-pressed people of Gotland.

Chimney Sweep Heralds Summer's End

The dean of Gotland's artists, Friedrich Mehler, 76, has brought music as well as money to his island. "I came here from Germany intending to stay two weeks," he said, "and here I am 51 years later."

In 1929 he and his late wife put on the first *ruinspel* in the ruins of Visby's St. Nicholas church. Mr. Mehler wrote the music for this operatic pageant, based on the life of Petrus de Dacia, a 13th-century prior of St. Nicholas. It has so far had 474 performances. Many roles are played by Gotland folk; some are grandchildren of the earliest performers.

A gentle, warm man, Mr. Mehler led me out to see his garden where, like a true Gotlander, he grows 150 varieties of roses. It was the end of August, and when we glanced up at his roof, we saw a soot-streaked chimney sweep at work.

"There," said Mr. Mehler sadly, "now we know that summer is over."

When summer begins, Gotlanders sing:

I'm so glad the sun is shining,
I forget the snow that fell last year.

When summer ends, their hearts are too heavy for song. In that last week of August, as the days shortened and the tourists faded away, we met our Visby friends in the chilly, silent streets. Sharing with them the encroaching dark, knowing that by Christmas the sun would set at three and not rise again till nine, we felt in our bones what it was to be part of the permanent Gotland family. And we understood, finally, what a miracle the sunny Gotland temperament is. □

COVER: A common tern scans Cape Cod shallows for a seafood meal (pages 234-47). HOPE RUSSELL

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"I must go where the wild goose goes"

NATURAL-HISTORY photographers Jen and Des Bartlett (**right**), here concealing their cameras inside goose decoys, found those words from a popular song of the fifties to be the story of their lives. For two years they studied the hauntingly beautiful snow goose and its frequent companion, the blue.

After raising a small flock of orphaned goslings near Hudson Bay, the couple and their feathered protégés followed the central flyway across Canada and the United States to the Gulf of Mexico. The graceful birds, drawn to the only parents they had ever known, often flew at lens level behind the Bartletts' station wagon (**lower**). The couple's story will soon appear in NATIONAL GEOGRAPHIC. Nominate your friends for membership so they too can travel south with the snow geese.

JULIE BARTLETT (ABOVE) AND JEN AND DES BARTLETT

Readers of the National Geographic are invited to

Enjoy collecting a stirring panorama preserved for future generations.

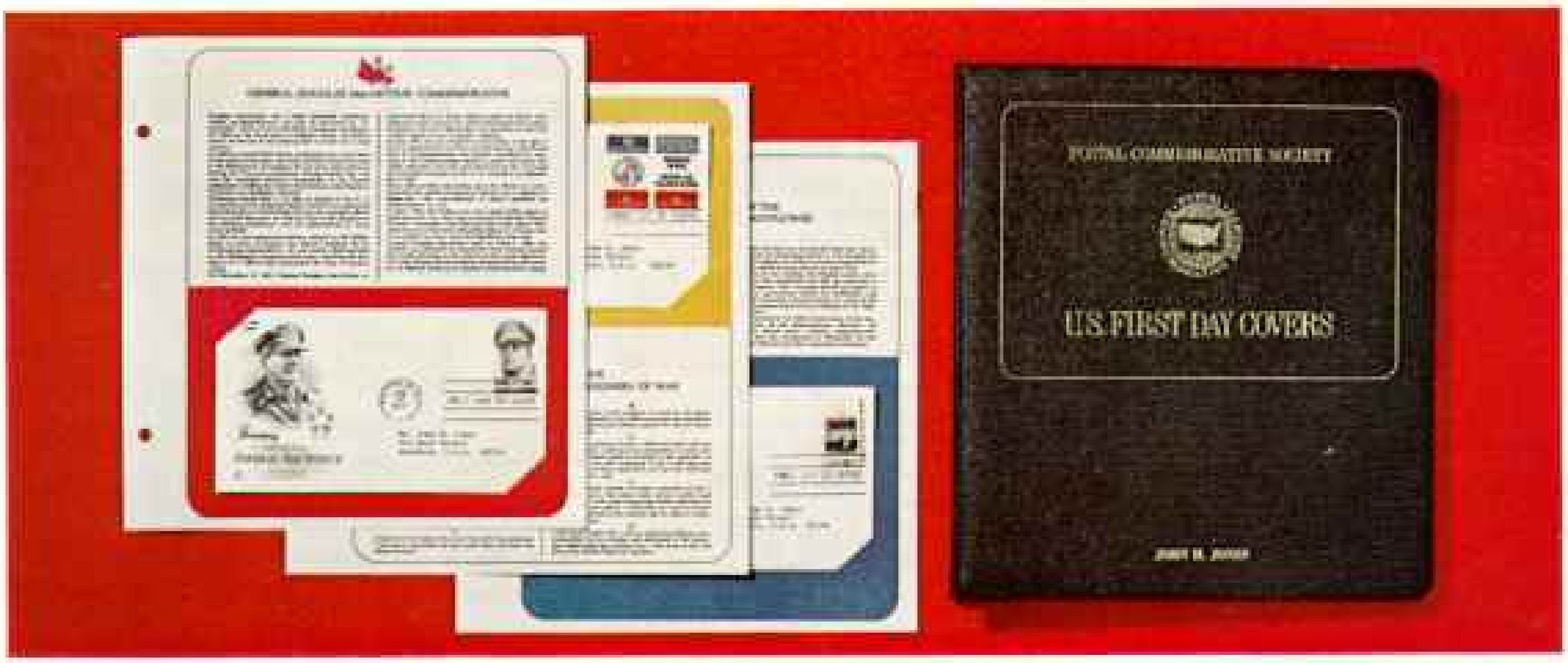
- At a surprisingly modest cost, you can receive beautiful First Day Covers for every new stamp issued by the United States.
- Each First Day Cover will be individually addressed and sent automatically to the name and address you designate.

WHAT IS A FIRST DAY COVER?

The United States regularly honors the important men, events and places in its history through the issuance of official U.S. commemorative postage stamps. When a new stamp is to be issued, one, and only one, post office is officially designated to provide . . . on one day only . . . the authentic "First Day" cancellation. The specially designed envelope bearing the new stamp, cancelled on the exact date of issue at the officially designated post office, is a prized First Day Cover.

First Day Covers are highly prized collectors' items. As you can well imagine, the combination of a historic stamp, cancelled on the first day of issue, at an officially designated post office on a specially designed envelope results in a collector's item of the first order. One that has been prized by collectors like Dwight D. Eisenhower, George C. Marshall and Franklin D. Roosevelt, plus others with the foresight to preserve yesterday and today for tomorrow.

The best time to obtain these prized collectors' items is when they are issued. This is now made easier than ever by the Postal Commemorative Society.



Postal Commemorative Society members receive everything they need to build and maintain a personalized "mint condition" collection of U.S. First Day Covers. For each cover issued, the Society provides an exclusive custom designed display page, especially made for the Society's personalized collector's album.

# of U.S. history. To be treasured now and

First Day Covers combine art and history in a tribute to our American heritage. Eisenhower . . . The Battle of Bunker Hill . . . the writing of the Star Spangled Banner . . . the landing of astronauts on the moon . . . such are the subjects chosen by the United States for commemorative postage stamps. Nothing trivial or unimportant or dull is ever chosen for national honor.

Further, the post office chosen for a first day of issue usually bears particular significance to the subject commemorated. For example, a first day cover of the Eisenhower stamp was one cancelled at Abilene, Kansas.

The nation's leading artists and designers are called upon to portray the subjects chosen. Such commissions naturally are highly prized, and bring forth the best efforts of the artists involved.

Membership in the Postal Commemorative Society makes it possible to easily collect First Day Covers as they are issued. The Society will guarantee your receiving a personally addressed First Day Cover of every U. S. commemorative stamp issued. All details of arranging for your First Day Covers to be sent to you will be handled by the Society.

Commemorative stamps normally are issued by the United States at the rate of about 15 a year. You will receive up to this many issues at a basic cost of just $12.00 per year plus an annual membership fee of $7.50 (total yearly cost of $19.50).

As a member, you will also receive the Society's exclusive display page for each new issue. Each beautiful, specially designed page is die-cut to hold the First Day Cover, and contains a full description with all important historical information about the subject of the commemorative issue. *These pages are available only to members of the Society.*

Becoming a member now brings you an important collector's bonus at no additional cost. The Postal Commemorative Society makes available to its members a handsome collector's album with the member's name hand-embossed on the cover. This album, specially designed to hold the Society's display pages, makes it possible for members to keep each new First Day Cover in "mint" condition. *It is yours free, if you join now!*

MEMBERSHIP APPLICATION

NG2

The Postal Commemorative Society
1 Glendinning Place
Westport, Connecticut 06880

Enclosed is $19.50* for a one-year membership, First Day Cover service, plus collector's album. The First Day Covers for this member should be addressed as follows:

Mr., Mrs., Miss _____

Address _____

City _____ State _____ Zip _____

Please emboss the personalized album as follows: _____
(Print name to be shown on album)

This is a ☐ Personal Membership
☐ Gift Membership

(If a gift membership, please provide your name and address on a separate piece of paper. A card announcing your gift will be sent to the member.)

*Connecticut residents add $1.27 tax. Make check or money order payable to The Postal Commemorative Society.

Photography explained...

Imagine a scene, almost any scene. Two people are taking pictures of it. The same subject, the same things happening, the same light. Yet one of those people comes away with a photograph — something worthy of a frame and a place on a wall. The other, a snapshot. An ordinary picture destined to gather dust in a drawer.

The difference can be as subtle as a little extra care in composition. Or the patience to wait for someone to stand in just the right spot. Or for the sun to move lower on the horizon.

The difference can also be the camera. With a simple camera, you can't always get as close as you'd like. You can't shoot in the dim but fascinating light that comes after a sunset. You can't capture the whole of a small room. You can't fill the viewfinder with a distant and unreachable scene.

But with the Nikkormat FTN, you can. You can do all these things, and just about anything else within the realm of photographic possibility.

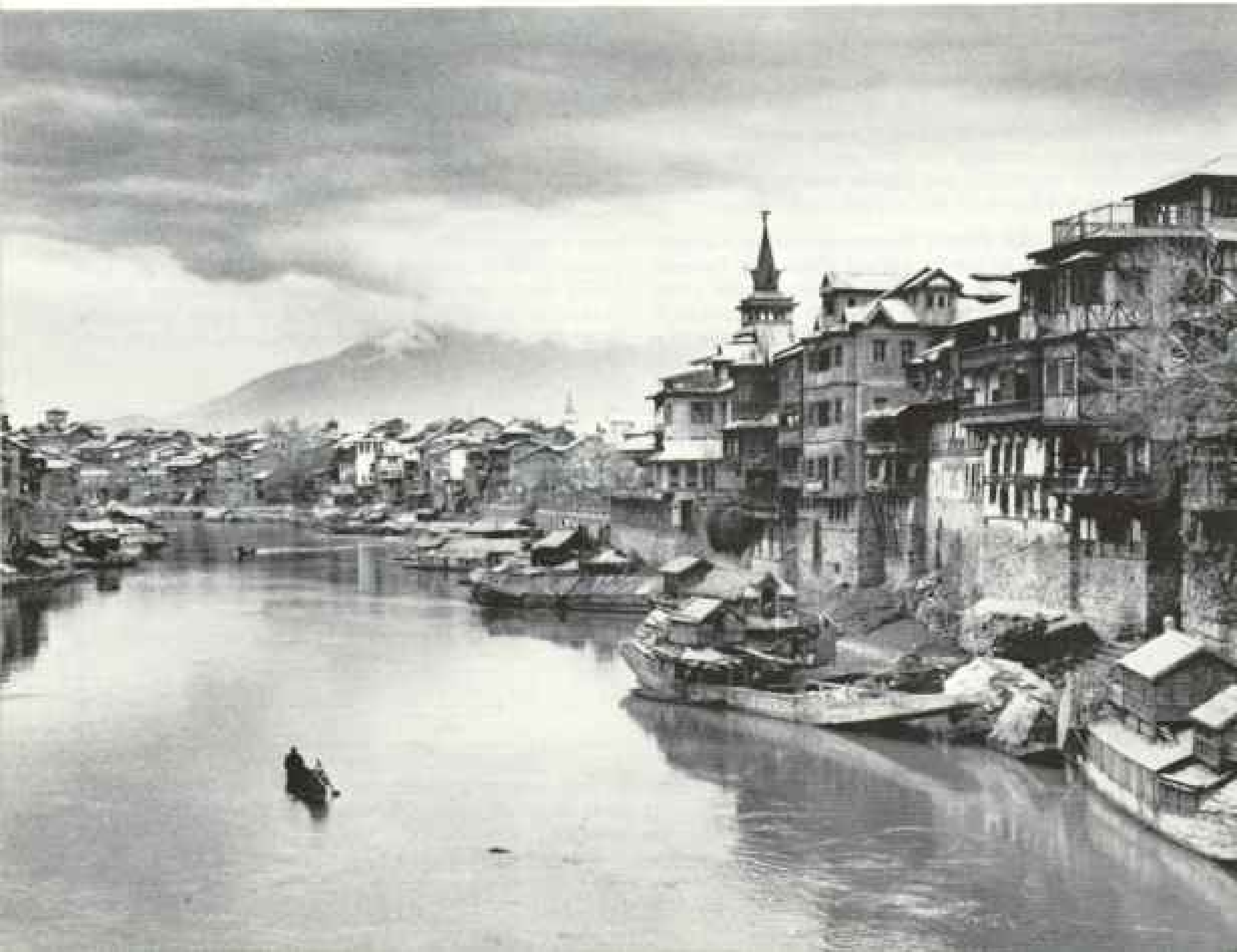
Yet, the Nikkormat is amazingly simple to use. A superbly accurate through-the-lens meter system lets you concentrate on the scene and forget about the camera.

What's more, the Nikkormat is part of the most complete and most respected system in all of 35mm photography. The Nikon System. Over 40 of the world's finest lenses and a boundless selection of accessories. As you become more involved in photography, as your needs and requirements grow, the Nikkormat grows with you, as fast and as far as you want to go.

And the Nikon School of Photography can help. It will be in your area soon. See your dealer, or write Dept. N, Nikon Inc., Garden City, N.Y. 11530. Subsid. of Ehrenreich Photo-Optical Industries, Inc.
(In Canada: Anglo-photo Ltd., P.Q.)

Nikkormat

The beginning of your involvement.



THE WHOLE BODY SHOULD TAKE PART IN THE SELECTION OF A PIANO.

Begin body-testing a prospective piano by examining its craftsmanship with eyes and fingers. Is the workmanship consistent? At Yamaha we make each part of our pianos, and carefully season our *own* woods, for high standards of quality control.

Do you like the tone quality? Each note should sound clear and true, over the full range of the instrument. Also, be sure to ask

how well the instrument is built to stay in tune. (Yamaha pianos have features like a unique tuning pin block of the finest quarter sawed maple, and a sealing system we call "Humidiseal" for enduring tuning stability.)

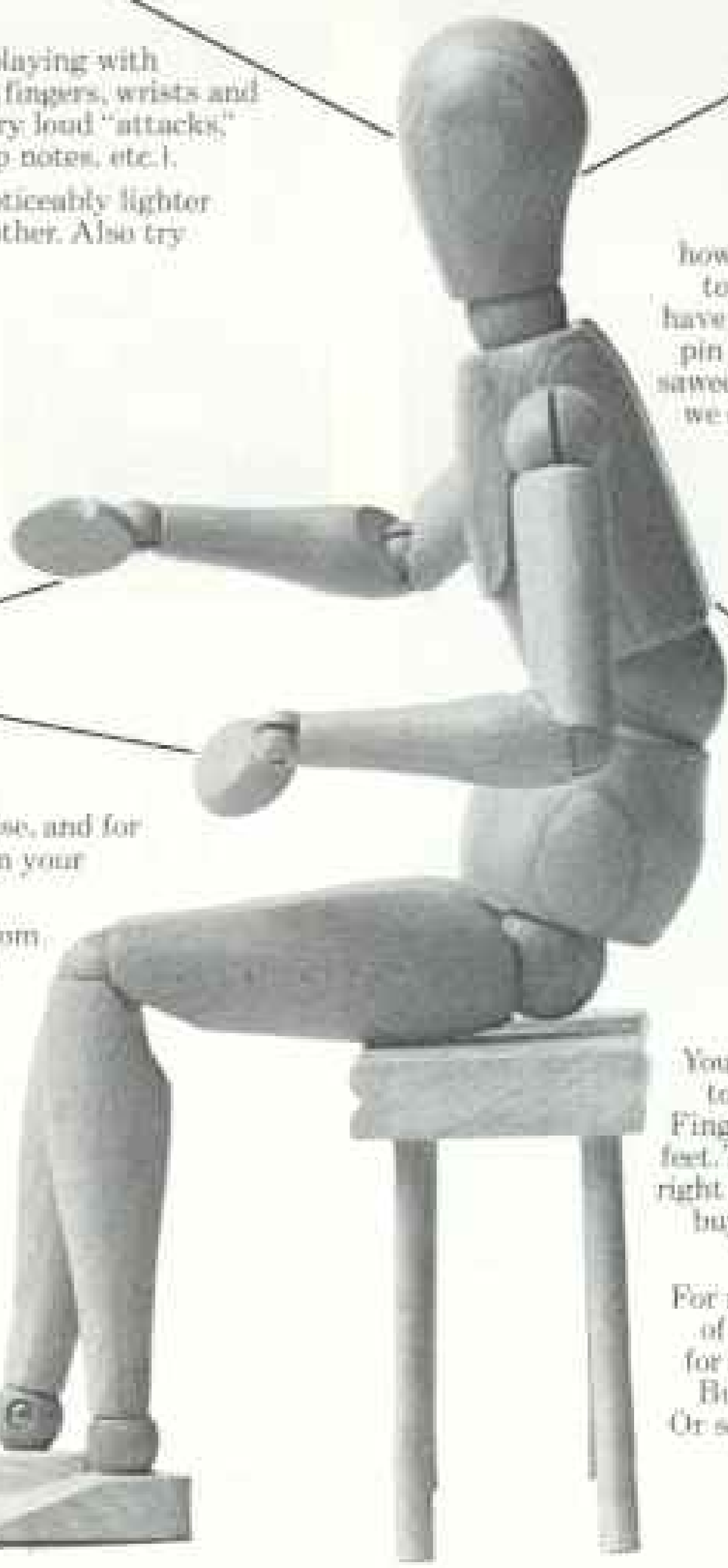
Test the piano's action (or keyboard mechanism) by playing with a variety of touch and pressure (fingers, wrists and elbows come into play as you try loud "attacks," smooth passages, short crisp notes, etc.).

Be sure one key doesn't feel noticeably lighter or heavier to the touch than another. Also try

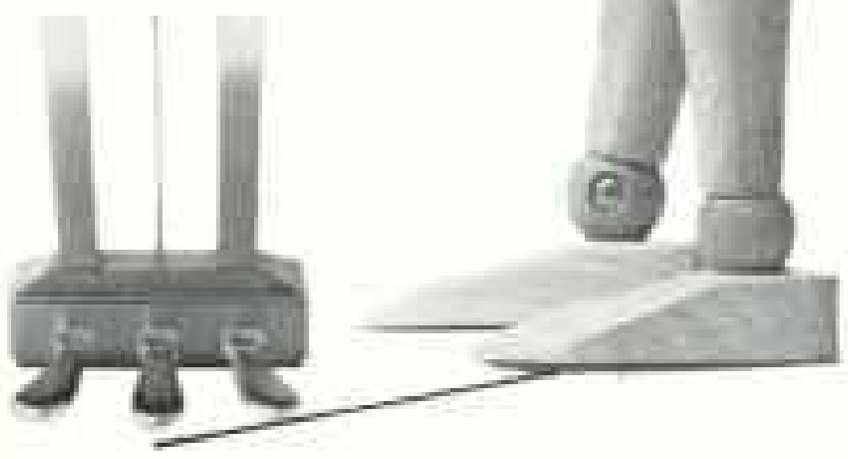
the action for its speed of response, and for sensitive transfer of power from your body to the strings.

Yamaha keyboards are precise from one end to another, and respond to the slightest interpretive nuances.

Each Yamaha keyboard is balanced by an experienced specialist. Choice materials and ultra-precise fitting tolerances are utilized.



Your whole body (and soul) has to respond to the whole piano. Fingers, wrists, elbows, eyes, ears, feet. The piano has to *feel* right, right down to your bones. If it does, buy it. (We know the chances are good it'll be a Yamaha.)



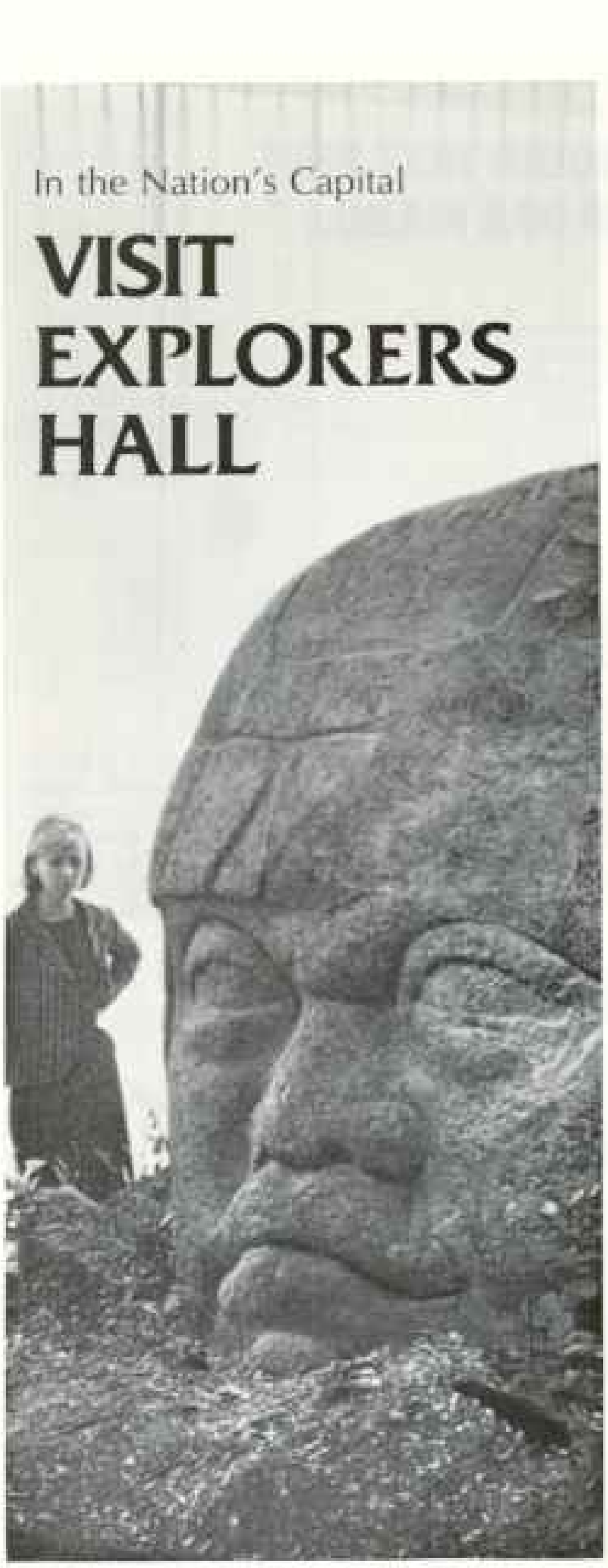
Check the piano's sound when soft-pedaled or sustained. (Yamaha pedals are smooth and responsive.)

For more information on the art of piano buying, write to Yamaha for a free booklet, P.O. Box 6600, Buena Park, California 90620. Or see your nearest Yamaha dealer.

YAMAHA

In the Nation's Capital

VISIT EXPLORERS HALL



SEE THE GIANT STONE HEAD of the lost Olmec civilization . . . two globes crafted by America's first globemaker . . . the tattered U. S. flag that accompanied Peary on his Polar expedition . . . the balloon gondola that held a manned-flight altitude record for 21 years . . . the largest unmounted globe in the world, and other fascinating exhibits of National Geographic researches and explorations. *Explorers Hall* is open every day but Christmas at the NATIONAL GEOGRAPHIC SOCIETY, 17th & M Streets N.W., Washington, D. C.

"All this highway building has got to stop."

During construction a new inter-city highway isn't pretty. Ground is torn up. Vegetation destroyed. Private property bisected. Surface water runoff can foul streams.

Why build more? Can't we get by with existing highways? Won't more roads mean more traffic needing more roads in an endless cycle?

The fact is, we don't have enough good, safe roads to handle today's traffic. We haven't completed our interstate highway system. Too many secondary roads date back to the twenties.

The highways we need are essential to the 73% of us living in cities. Farmers can't move food without good all-weather roads. Manufacturers rely on highway transportation to procure raw materials and deliver finished products. And how often do you drive to the supermarket, bank, school, church or to visit family?

We must build roads and interchanges for access to new towns, new industrial parks and new airports. Old roads must be widened and straightened to make them safe.

This has to be done responsibly. Roads must be planned not only to offer convenience, but to protect and complement the landscape. They must be part of a total transportation system. That's why we need a national transportation plan to coordinate, integrate and finance all modes. That plan should have a beginning, time schedule and estimated cost. Its aim: the most good for the most people.

Learn more about highways. Write "Highway," Dept. 3076, Caterpillar Tractor Co., Peoria, Ill. 61602.

There are no simple solutions. Only intelligent choices.

CATERPILLAR

Caterpillar, Cat and the Cat are Trademarks of Caterpillar Tractor Co.

"If it does, we'll all suffer."

This Malagasy boatman steers from here to eternity

He stands over his crew and looks back. He sees a life spent at sea, lightering cargo from ships. And that is his epitaph, sculptured in wood and placed above his grave.

Such Madagascar "tombstones" celebrate life in the Malagasy Republic. One depicts a man beating a drum, another a herdsman tending his cattle. A carving of an airplane denotes that the person entombed once flew. Malagasy chieftains rate a tomb post suggestive of a totem pole. It may be 30 feet high, a panorama of life told in tiers of carvings that show him hunting, protecting his family, slaughtering a zebu, even making love.

Though nominally Christian, the Malagasy cling to ancient beliefs, holding that ancestors dictate health, wealth, and fertility of descendants. From tombs half above ground and half below, the departed are brought into the sunlight every four or five years and wrapped in new silk. Not a sad occasion, the reunion with an ancestor marks a time for singing and dancing. Celebrants joyfully toss the body into the air and catch it again. Cattle are sacrificed, their horns left to adorn the top of the tomb.

The body is re-interred, there to rest until the next *famadihana*, the turning of the dead.

Despite the nearness of Africa, the ancestry of Madagascar's peoples is predominately Malayan and Polynesian. Migrants, historians theorize, sailed across the Indian Ocean in outrigger canoes to colonize an island home like no other on earth. Here they found nightmarish forests of cactuslike *Didierea*. Here roamed monkey-like lemurs with bat's ears and flowing foxtails; primitive tenrecs pincushioned with quills; and aepyornis, the now-extinct flightless bird that weighed half a ton and laid 20-pound eggs.

Independent of France since 1958, Madagascar carves a niche in world society uniquely its own. To follow its saga of development, as well as that of other emerging nations, readers turn each month to the pages of NATIONAL GEOGRAPHIC.

a rare artistic sterling silver medal for less than the cost of the silver alone! Yours for just...

$1.00

(With second medal at regular price)

Medal enlarged to show detail

Danbury Mint Medallic History of America

An invitation to begin an heirloom collection of history, art, and precious metal for just $1.00

Medals shown actual size.

Each medal is 40mm in diameter and contains 525 grains of solid sterling silver.

$1.00 INTRODUCTORY OFFER

We offer you the first medal in this series virtually as a gift to introduce you to the most significant collection of medallic art ever offered.

With your first medal, *Signing the Declaration of Independence — 1776*, we will send you the second, *Washington at Valley Forge — 1777*. Examine both free for 15 days. Decide at your leisure if this series is all we say it is. If you choose you may return both medals and tell us to cancel your subscription and owe us nothing. However, the first medal is yours for just $1.00 if you decide to continue in the series.

AMERICA FROM BIRTH TO BICENTENNIAL

Dwight D. Eisenhower . . . John F. Kennedy . . . D-Day . . . Gettysburg . . . The Star-Spangled Banner . . . Man On The Moon . . . and beyond! These are just some of the highlights that are preserved forever — struck in precious metal from the works of the most talented sculptors in the world. Your series will take you from 1776 to 1976 — year-by-year — to witness the growth of the greatest nation on earth — America!

PRECIOUS STERLING SILVER... HALLMARKED AND REGISTERED

Each medal will bear the distinguished Danbury Mint hallmark to assure the purity, quality and authenticity of the medallist's work. Subscribers receive a Certificate of Registration with a personal registration number to protect the collection's First Edition status.

IMPORTANT PRICE GUARANTEE

The price per medal will remain the same throughout the series, even if the bullion value, alone, goes up so much that it exceeds the subscriber's price. The Danbury Mint will contract for the sterling silver in advance to make this valuable guarantee possible.

GIFTS WORTH MORE THAN $75.00 WITH EACH SUBSCRIPTION!

A personalized, wood display cabinet holds your entire series in individual frames that can be kept together in the chest, or be removed to hang on a wall. **A library-edition history volume** detailing the drama of the history of our nation will enhance your appreciation of this superb collection.

PLEASE ACT QUICKLY

To receive your first medal for just $1.00 in solid sterling silver or 24kt gold electroplated on sterling silver — and to assure your reservation for this First Edition landmark in medallic art — please return the coupon immediately. We would like you to have a place in the most rewarding collection we have ever offered.

The Danbury Mint, a division of Glendinning Companies, Inc., creates and markets commemorative art medals. All such medals are struck for The Danbury Mint by other organizations selected from among the world's leading private mints. The Danbury Mint does not itself produce medals, nor is it affiliated with the U.S. Mint or any other U.S. Government agency.

SUBSCRIPTION RESERVATION

All Reservations Subject to Danbury Mint Acceptance

The Danbury Mint

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Please reserve my subscription to the **Danbury Mint Medallic History of America.** I will receive the first two medals for a FREE 15-DAY EXAMINATION and I MAY KEEP THE FIRST MEDAL FOR JUST $1.00 if I decide to buy the second medal at regular price. If I continue, I will be billed with each monthly shipment of two medals.

Sterling silver medals are regularly priced at $10.50 each plus $.50 postage and handling. 24kt gold on sterling silver medals are regularly priced at $15.00 each plus $.50 postage and handling. I am under no obligation to complete the entire series and may cancel at any time.

I prefer my medals to be minted in: (check one)

☐ Solid sterling silver

☐ 24kt gold electroplated on sterling silver

Name_____

Address_____

City_____

State_____ Zip_____

I am over 21 years of age. 1027

Signature_____

The Goodyear Steelgard gives you what no other
These 5 guards to help

Guard 1: Against Rough Ride. A shock-absorbing polyester cord body cushions the bumps for a smooth, comfortable ride.

Guard 2: Against Penetration Under the Tread. Double steel belts to strengthen the tire under the tread—to help protect against obstacles in the road.

Guard 3: Against Wet Skids. A computer-designed tread with four deep grooves to help channel the water from under the tire.

The Goodyear Steelgard radial tire with its 5 guards is like no other radial tire ever made. Because no other steel-belted radial gives you this combination of features—5 specific guards to help protect you 5 ways for remarkable handling and performance. The confidence of superb ride, strength, traction, cornering and response.

Drive on Custom Steelgard radial tires . . . and feel the difference.

GOODYEAR

Custom Steelgard T.M. The Goodyear Tire & Rubber Company, Akron, Ohio

Available in the following sizes: DR 78-14, LR 78-15, GR 70-15, HR 78-15, HR 78-14, JR 78-15. Other sizes available in the near future.

Radial Tire steel-belted radial can. protect you 5 ways.

Guard 4: Against Loss of Road Contact on Curves. Two special outer grooves help the tread and the sidewall to work independently for firm tread contact on curves.

Guard 5: Against Sluggish Handling. Two special stabilizers stiffen the lower sidewall and help allow recovery on sudden swerves.

Caprice.
For people who want the finer things of life while they're young enough to enjoy driving them.

Perhaps you've said to yourself, I'll buy the luxury car I've always wanted when the kids are grown up or when I get my next promotion. We say, you shouldn't have to wait. Caprice offers the luxury you want—*now*. Caprice's ride, for example, is even smoother, quieter and more comfortable than you'd imagine a Chevrolet could be. And it compares favorably, in spaciousness, in styling, in other important categories with some of the most expensive cars you can buy. You can wait for a luxury car, or you can have it now. Caprice from Chevrolet. **Chevrolet. Building a better way to see the U.S.A.**

GM
MARK OF EXCELLENCE

Chevrolet

Great-tasting nutrition.

Being ready for a new day means starting with a complete breakfast. Like a tasty meal of toast, juice, milk and Kellogg's Raisin Bran. There are two scoops of raisins and 8 important vitamins in every package of Kellogg's Raisin Bran. That's nutrition that tastes delicious.

The best to you each morning.

THE NUTRITIONAL FACTS OF KELLOGG'S RAISIN BRAN

One ounce of Kellogg's Raisin Bran cereal provides these percentages of an adult's officially established minimum daily requirements (MDR):

NUTRIENT	Percent MDR in— Raisin Bran 1 oz. (½ cup)	Raisin Bran with ½ cup Whole Milk*
VITAMIN A	33%	37%
VITAMIN D	33%	45%**
VITAMIN C	33%	37%
NIACIN	33%	34%
THIAMINE (B_1)	33%	37%
RIBOFLAVIN (B_2)	33%	50%
IRON	100%	100%
PHOSPHORUS	10%	35%
CALCIUM	2%	21%
***VITAMIN B_6	0.6 mg	0.65 mg
***VITAMIN B_{12}	1.5 mcg	2.1 mcg
***MAGNESIUM	50.0 mg	65.9 mg

TYPICAL NUTRITIONAL COMPOSITION

	RAISIN BRAN % of Total Weight	RAISIN BRAN Amount in 1 oz.	RAISIN BRAN with ½ cup Whole Milk*
Protein	8.1%	2.3 gm	6.8 gm
Fat	1.8%	0.5 gm	4.8 gm
Carbohydrates	76.7%	21.7 gm	27.0 gm
Calories		101	181

*Whole milk values derived from USDA Handbook No. 8 and USDA Report No. 36.
**Vitamin D fortified milk at 400 USP units/quart.
***Minimum daily requirements have not been established.

A great taste in the morning is such a fine beginning.

Kellogg's
RAISIN BRAN

If Colgate is just a kid's cavity fighter, how come Walt Frazier won't brush with anything else?

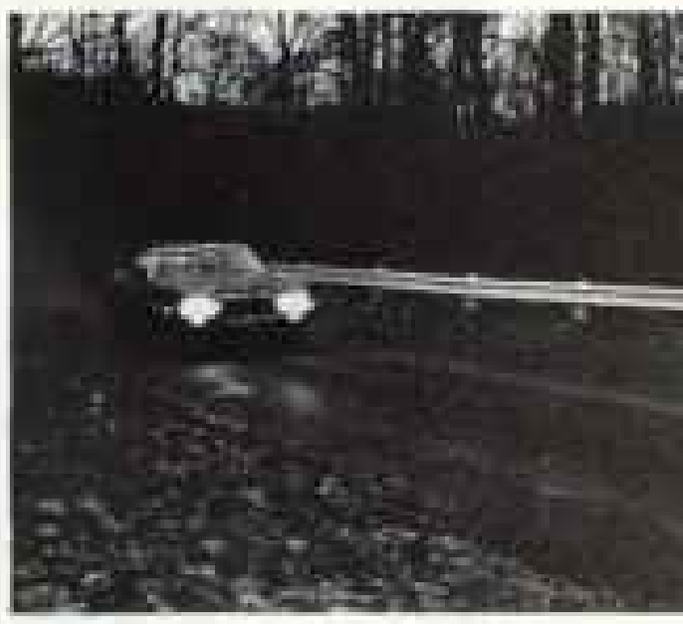
One-on-one, nobody gets past New York Knick star Walt Frazier. Not the biggest guy in the league, not even tomorrow's superstar. But basically Walt is a team player . . . a man who has the knack of getting people to work together smoothly. On the court and off. Maybe that's why Walt Frazier is a Colgate man.

Colgate is a toothpaste for people who get together with people. It freshens breath as long as a leading mouthwash, as clinical test results show. And the taste is brisk and clean.

Only your dentist can give teeth a better fluoride treatment than Colgate with MFP. But a great cavity fighter can be a powerful breath freshener, too.

If you like people, be sure you brush with Colgate. Walt Frazier wouldn't think of brushing with anything else.

Colgate with MFP... the breath-freshening cavity fighter.



*Dial-direct rates apply on all interstate calls (excluding Alaska and Hawaii) completed from a residence or business phone without operator assistance. They also apply on calls placed

The one-minute long distance rate. An inexpensive way to say you got home okay.

When you've something short to say, like "I'm home," we've got a way for you to say it for very little money.

It's our late-night and early-morning one-minute rate for long distance calls you dial direct without operator assistance.

You can use it any time after 11 at night all the way till 8 the next morning. Any night of the week.

And it won't cost very much. Even coast-to-coast. New York to Los Angeles, for instance, is only 35¢, plus tax (additional minutes are 20¢ each).*

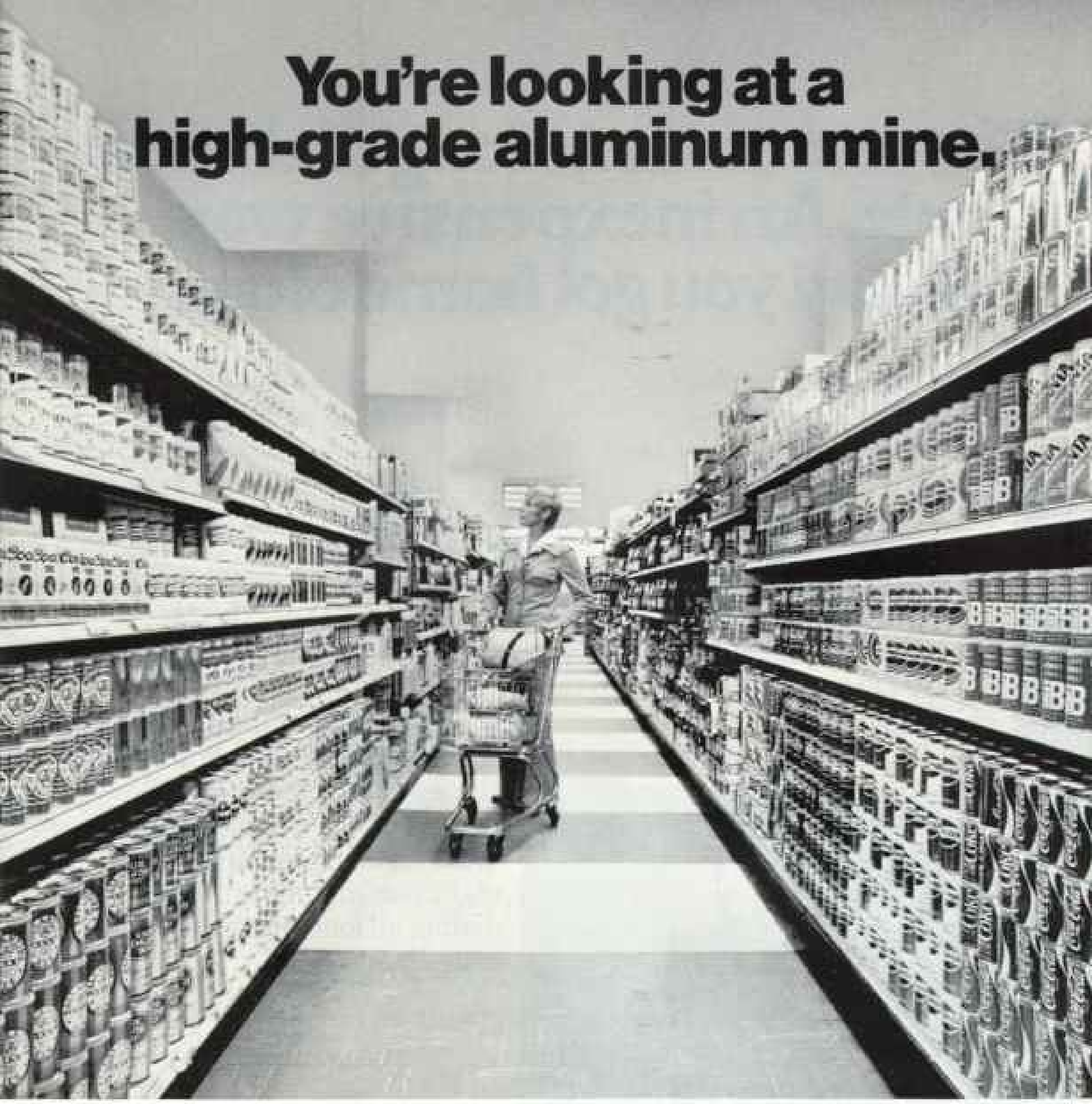
Obviously, most of your calls will take longer, so they'll cost more. But you'll still save money when you dial direct.

At AT&T and your local Bell Company, we want you to know all the ways to use your phone so you can save money. That includes using our late-night one-minute rate and dialing all long distance calls direct.

*With an operator from a residence or business phone when direct dialing facilities are not available. They do not apply to person-to-person, coin, hotel guest, credit card or collect calls, or to calls charged to another number, because an operator must assist on such calls.

We hear you.

You're looking at a high-grade aluminum mine.



Every all-aluminum can in the beverage aisle of your local supermarket can be recycled and remade into another aluminum can. It's being done right now at Alcoa.

And when you recycle aluminum, you save energy. It takes only 5 percent of the energy it takes to make it the first time.

Once it's made, it can be recycled repeatedly, at a tremendous saving in energy.

There's not another beverage packaging material quite like aluminum. Only aluminum has all these things going for it: it's lightweight, chills quickly, keeps things fresh, opens with a snap, has high scrap value and can be recycled repeatedly. It's plentiful, too.

And because it's also good economics to recycle aluminum, Alcoa will pay as much as 10 cents a pound for all-aluminum cans, from any established reclamation center.

Alcoa is doing something to help conserve our natural resources. We would like to tell you more about it. Write for our free brochure on energy and aluminum.

We'll also send you a list of America's aluminum can reclamation centers.

Aluminum Company of America, 815-H Alcoa Building, Pittsburgh, Pa. 15219.

Aluminum: Pass it on

ALCOA

IS YOUR VIEW OF INSURANCE BEHIND TIMES!

YOUR USF&G AGENT BRINGS YOU UP TO THE MINUTE.

There's no time like the present to call your USF&G agent about a program of protection he can develop. Coverages? From office buildings and factories to retail outlets and warehouses. From casualty and fire insurance to commercial multi-peril insurance. From business life and health plans to fidelity and surety bonding. Your USF&G agent is the true insurance professional . . . the independent businessman of highest caliber who can cover them all . . . along with other insurance plans for businesses and individuals. Consult him with confidence as you would your doctor or lawyer. Your USF&G agent . . . listed in your Yellow Pages.

THE USF&G COMPANIES

Baltimore, Maryland. Casualty/Fire/Marine/Multi-Line/Life/Health/Group Insurance/Fidelity/Surety Bonds.