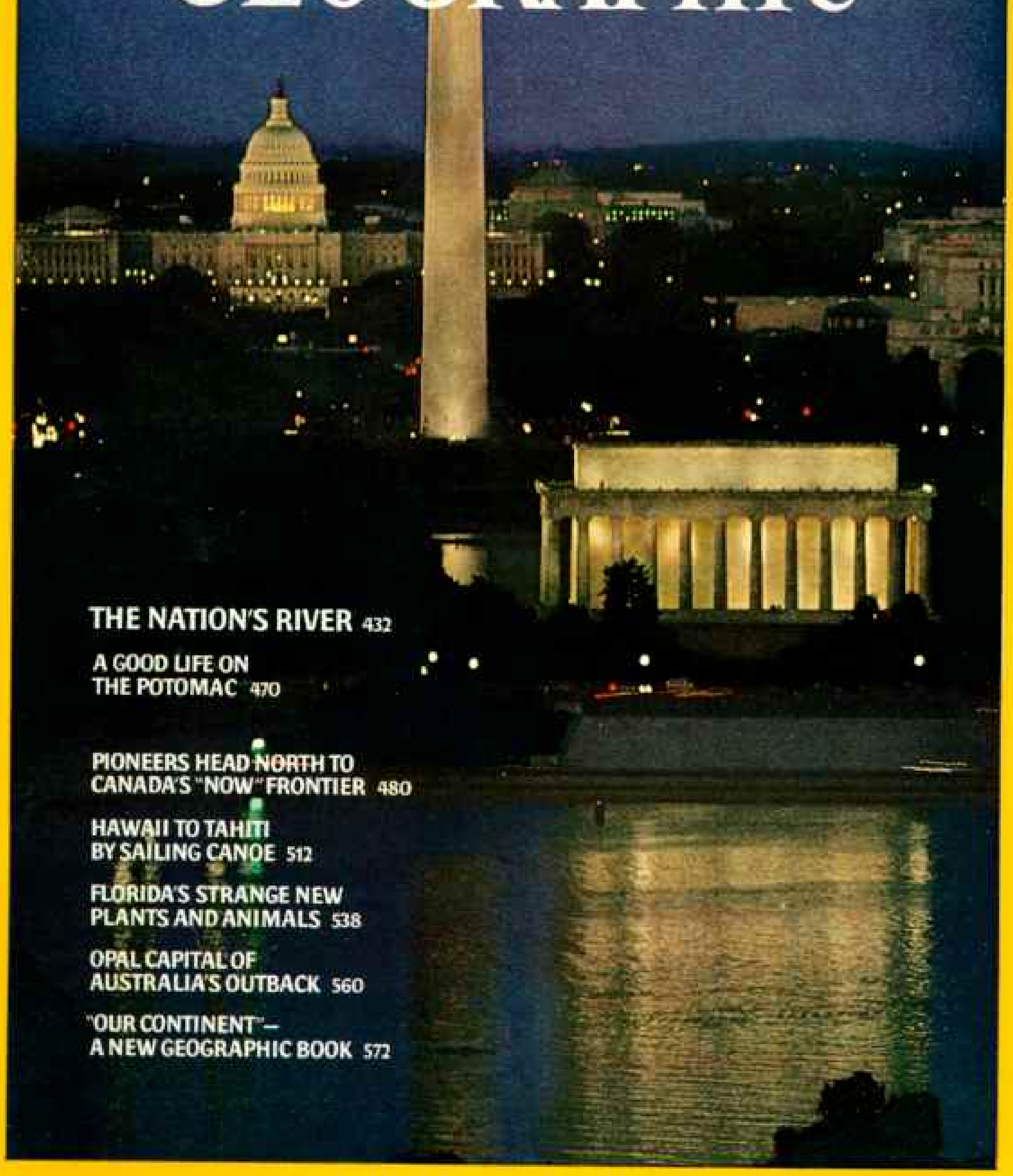
"CLOSE-UP: U.S.A." — MID-ATLANTIC STATES

VOL. 150, NO. 4 OCTOBER 1976

NATIONAL GEOGRAPHIC



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

IT WAS A SCENE of staggering emotion. A crowd of 15,000 people, the largest assembly in the history of Tahiti (pages 534-5), swarmed around and even into the waters of Papeete harbor to greet the living symbol of a proud past. The sailing canoe *Hokule'a* had just completed, without modern navigational aids, a 3,000-mile voyage across the open Pacific.

But what should have been the warmest of welcomes was shadowed by press reports and ugly rumors of racial tensions aboard the canoe, a fistfight, a radio smuggled aboard.

A small transistor radio was found long after departure from Maui, but no navigational use was ever made of it. A fragmentary radio report did reach *Hokule'a* inadvertently en route; what it may have revealed of the canoe's location to the crew was far less precise than the navigator's own dead reckoning.

The crew itself was not composed, as it might have been in times gone by, of homogeneous members of a village or an extended family, but rather of a disparate collection of tough, durable men; few of them had had experience in deep-water sailing. There were 17 people aboard a 60-foot canoe, baked by the sun of the doldrums or constantly drenched in salt spray.

It seems a small miracle that only one scuffle occurred. That was a matter of three or four punches thrown by a crew member who had sampled some champagne tossed aboard (against orders) the day before *Hokule'a* reached Tahiti, when the success of the voyage was assured.

Was it a symbol of deeper and more profound racial tensions that are building in Hawaii as *haoles*—non-Hawaiians—continue to pour in and the original culture feels the terminal pressure of development? Perhaps—but on this voyage, it did not represent the fierce ethnic conflict that appeared in early press accounts.

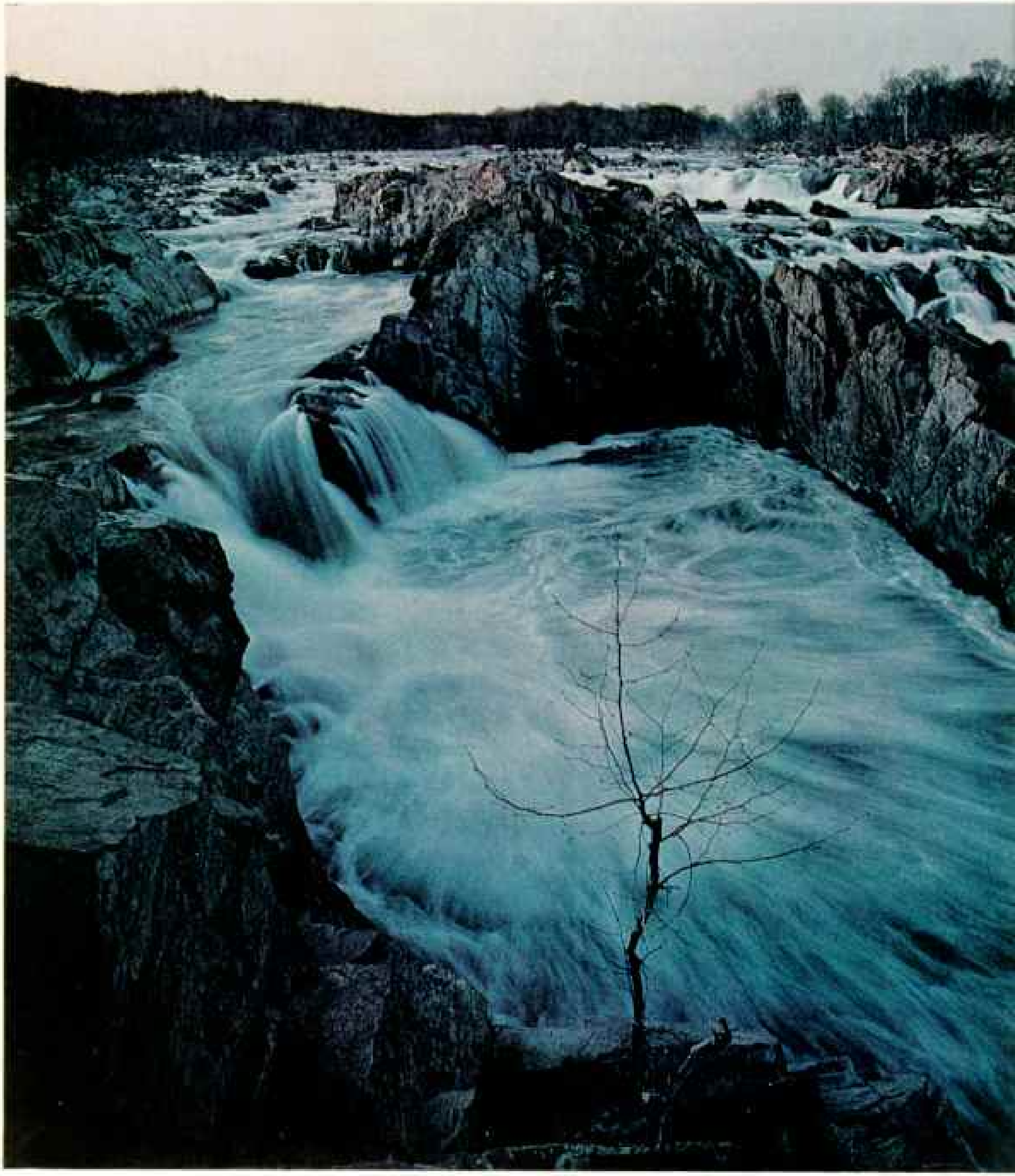
We feel that author David Lewis has fairly presented both the trials and the triumph of the voyage. Like him, we also feel that the transitory frustration of a few men who had been through an ordeal should not discredit or obscure a genuine achievement. Did not Columbus himself, on the most famous of all voyages of discovery, experience similar difficulties with a fractious Spanish crew? His troubles have long been forgotten in the triumph that followed. I feel that history will do the same for the voyage of *Hokule'a*. When all is said and done, this crew *did* sail 3,000 miles, without instruments, in the wake of their Polynesian ancestors.

Melville Bell Grosvenor

NATIONAL GEOGRAPHIC

October 1976

COVER: *Marking its transformation from swift mountain stream to slow-flowing estuary, the Potomac glides past Washington, D. C. Photograph by James L. Stanfield.*

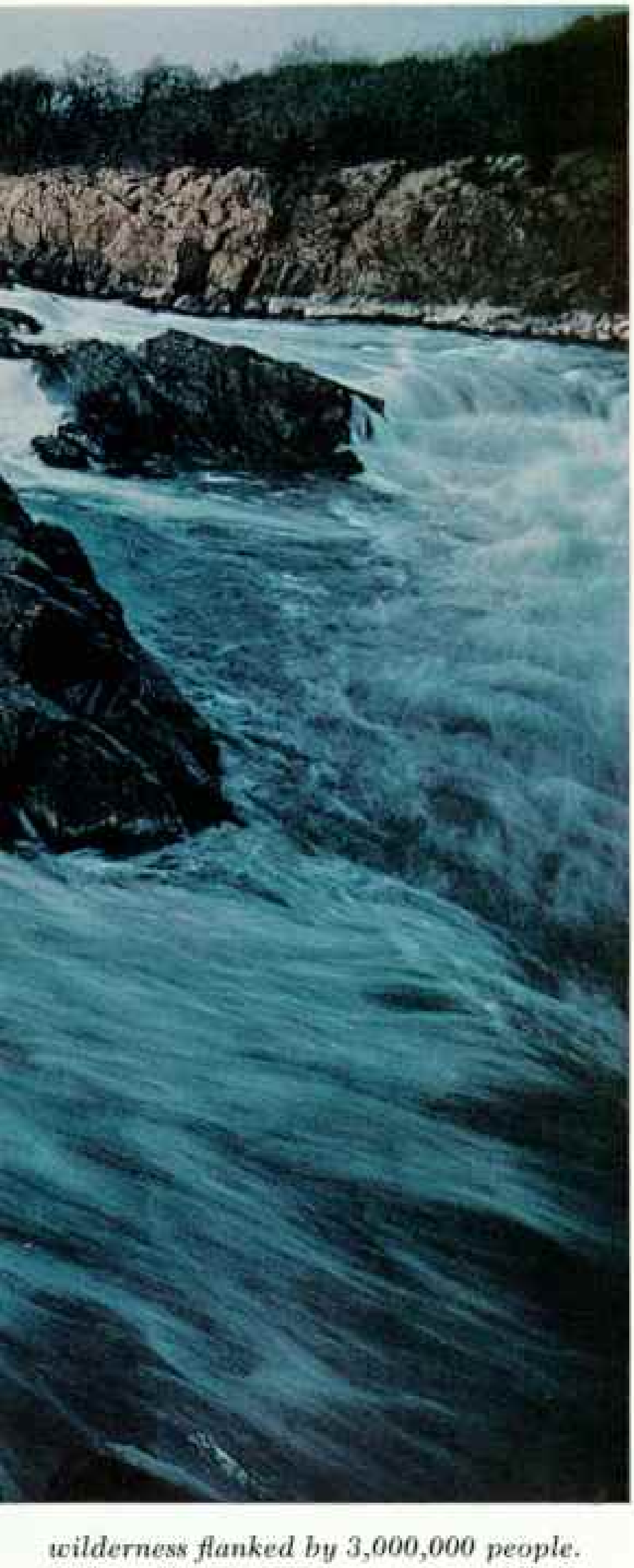


Just above Washington, D. C., the Potomac explodes over Great Falls in a remnant

THE NATION'S

By ALLAN C. FISHER, JR.
SENIOR ASSISTANT EDITOR

Photographs by JAMES L. STANFIELD
NATIONAL GEOGRAPHIC PHOTOGRAPHER



wilderness flanked by 3,000,000 people.

RIVER

IN THE APPALACHIAN HIGHLANDS, where mountain and sky embrace in clean and enduring intimacy, springs are born, and they in turn give birth to the South Branch and North Branch of the Potomac River. But these dual headwaters of what is often called "the nation's river" are ecological opposites, as starkly contrasting as midday and midnight, or right and wrong, or —quite literally—living and dead. They have little in common but their eventual intermingling and the passion for sea level that urges their waters on through chasms, valleys, and estuary to the Chesapeake Bay.

Sources of rivers are often debatable, for headsprings may be multiple and they usually lie in bosky, hidden places. So it is with the Potomac's South Branch, which has two forks with their own remote sources. But for me and for many the South Branch begins at the head of its main stem in a spring on the farm of Jacob Hevener, 3,150 feet above the sea, near the tiny crossroads hamlet of Hightown, Virginia. There, from an embowered crevice in a hillside meadow, the first drops seep and gather and trickle.

I crouch above the Potomac's first pool, only 11 inches wide, but in my mind's eye I see the river's mouth, more than 11 miles across from Point Lookout to Smith Point; I see it as I have all too often before, a maelstrom of white, a fury of wind and wave smashing at my sailboat and my courage. What a contrast to the initial mustering of the river's forces in the meadow's shadowed and silent dell.

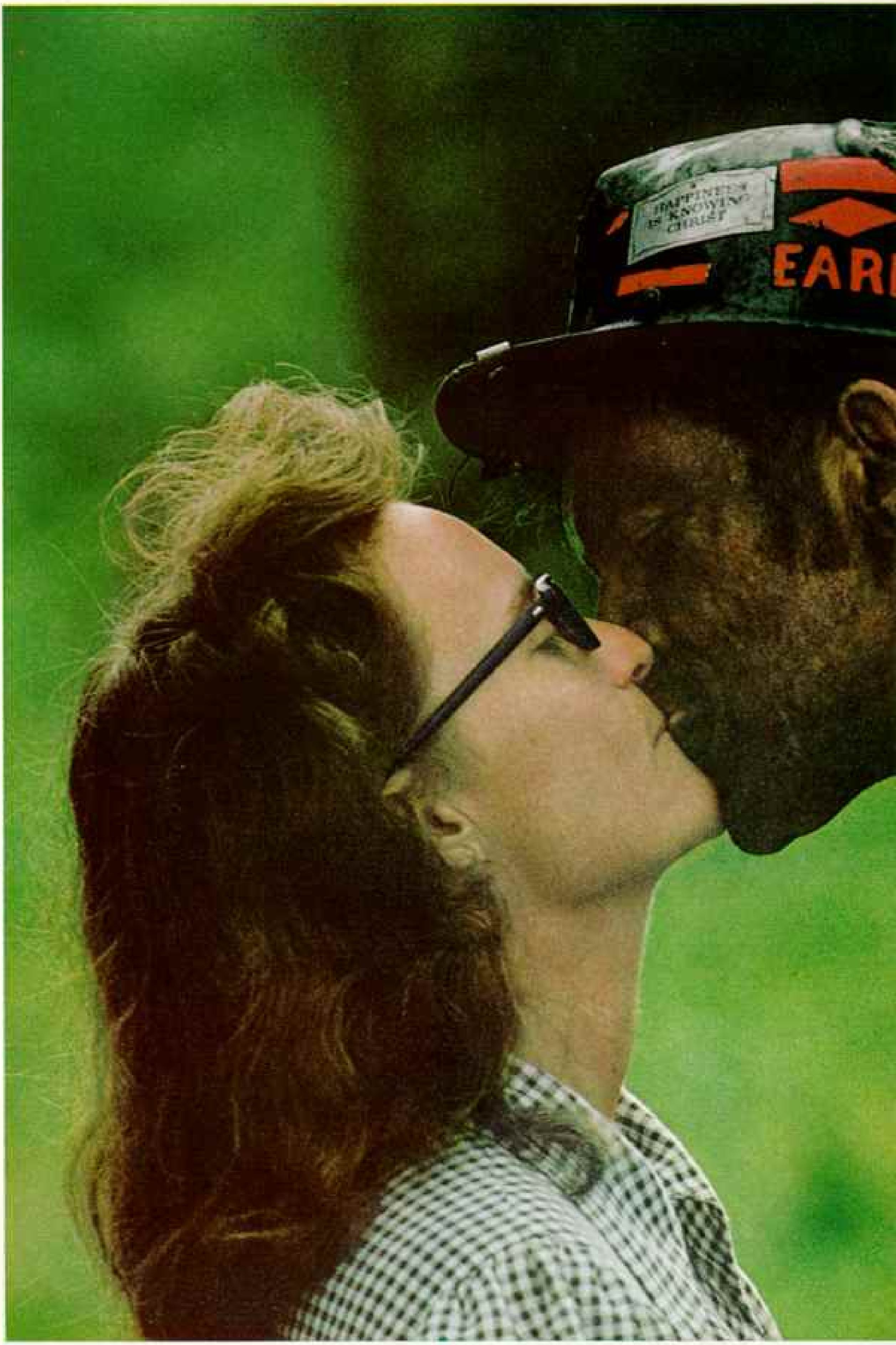
The water of this first spring courses quietly down the widening floor of Bluegrass Valley, and from the high, inviolate hills on either side other springs tumble to join the stream. These are swifter, noisier waters; not for them the muted susurration of the lowlands; they burble and plash and brawl. Where they join the main, pools form, their surfaces green with watercress, and then the waters rush on, down rapids that are now crystal staircases for trout, through meadows where black cattle browse below white farmhouses. Bluegrass Valley . . . as lovely and as tranquil as the reaches of Eden.

The South Branch continues pure and appealing throughout its 133-mile length. This is the stream of my boyhood summers. Once I knew it *(Continued on page 437)*

Cutting its first channel, the infant Potomac frisks through a notch near Hightown, Virginia (**above**), on an icy morning. Here the South Branch begins to gather and widen along a northeast course, companion to fenced pastures (**right**) and hardwood forests.

From its crystal mountain solitude, it flows on as one of the nation's most studied and debated rivers. The Potomac runs from fresh to brackish, here polluted, there clean, pressed by urban use, or flowing in lonely reaches under the wings of osprey and heron.

Federal law states that by 1983 the river should be everywhere fit for swimming and fishing and be pleasing to see and use. But the problems are many, and the deadline may not be met.



intimately, but it has changed little since I first fished its waters with stick and string and borrowed hook half a century ago.

LITTLE HAS CHANGED on the North Branch, either, though I find no pleasure in that fact. Like its counterpart it begins as a spring in a hillside meadow, near the storied Fairfax Stone that once marked the westernmost boundary of Lord Fairfax's immense land grant; the stone lies near the southwestern extremity of Maryland where it adjoins West Virginia. This first spring flows hesitantly, as if it knows what lies ahead. Finally it passes from meadow into woods—and within a few thousand feet of the Fairfax Stone the stream receives its first lethal admixture of acid drainage from a coal mine.

Acid—the curse of the North Branch since coal was first discovered on one of its tributaries, Georges Creek, in 1782. Coal is still king in part of the Potomac Basin, but by far the greatest pollution comes from more than a thousand inactive mines that honeycomb the area. In their dark recesses water reacts with pyrites and air, forming sulfuric acid and other noxious brews that the old shafts spew out into creeks. Often their beds become coated with garish, toxic mineral salts known to miners as "yellow boy" (pages 444-5).

Virtually nothing will live in these waters —not one minnow, one water bug, or even a single bacterium of the kind that normally cleanses streams. At times more acid than vinegar, the North Branch is a biological desert for most of its 97-mile-long course.

What sad irony. Walk the North Branch, and you pass through magnificent country: high, rugged ravines and hillsides and thick woodlands, a land made for sweet waters. I am Maryland hill-born, and these are my remembered highlands, where a part of my heart will always be. Once again I hear my father's voice as we fish some little tributary torrent, still clean and living: "We can't go

Home again from the mine, home to his wife, Nancy, and their small farm near Bayard, West Virginia, Earl Meddings is a working man once more after two back operations. A cave-in five years ago left him 60 percent disabled, according to doctors' testimony that won him compensation.

The Potomac: 382 miles winding out of the past

SCOUTING UPRIVER IN 1608, England's Capt. John Smith found a path for Europeans to follow. Lord Baltimore's ships, *Ark* and *Dove*, landed in 1634 at St. Clements Island in the estuary, then founded a Roman Catholic settlement at St. Marys City in Maryland, first American colony to proclaim religious tolerance. George Washington drew his first and last breath by the river, whose banks he chose as site of the Capital City. James Monroe was born nearby, as was Robert E. Lee, son of Washington's comrade-in-arms, "Light-Horse Harry" Lee.

Both before and after British warships cruised the river in the War of 1812, projects were begun to extend commerce west by canal—the canal on the Maryland side faring better than the earlier version in Virginia.

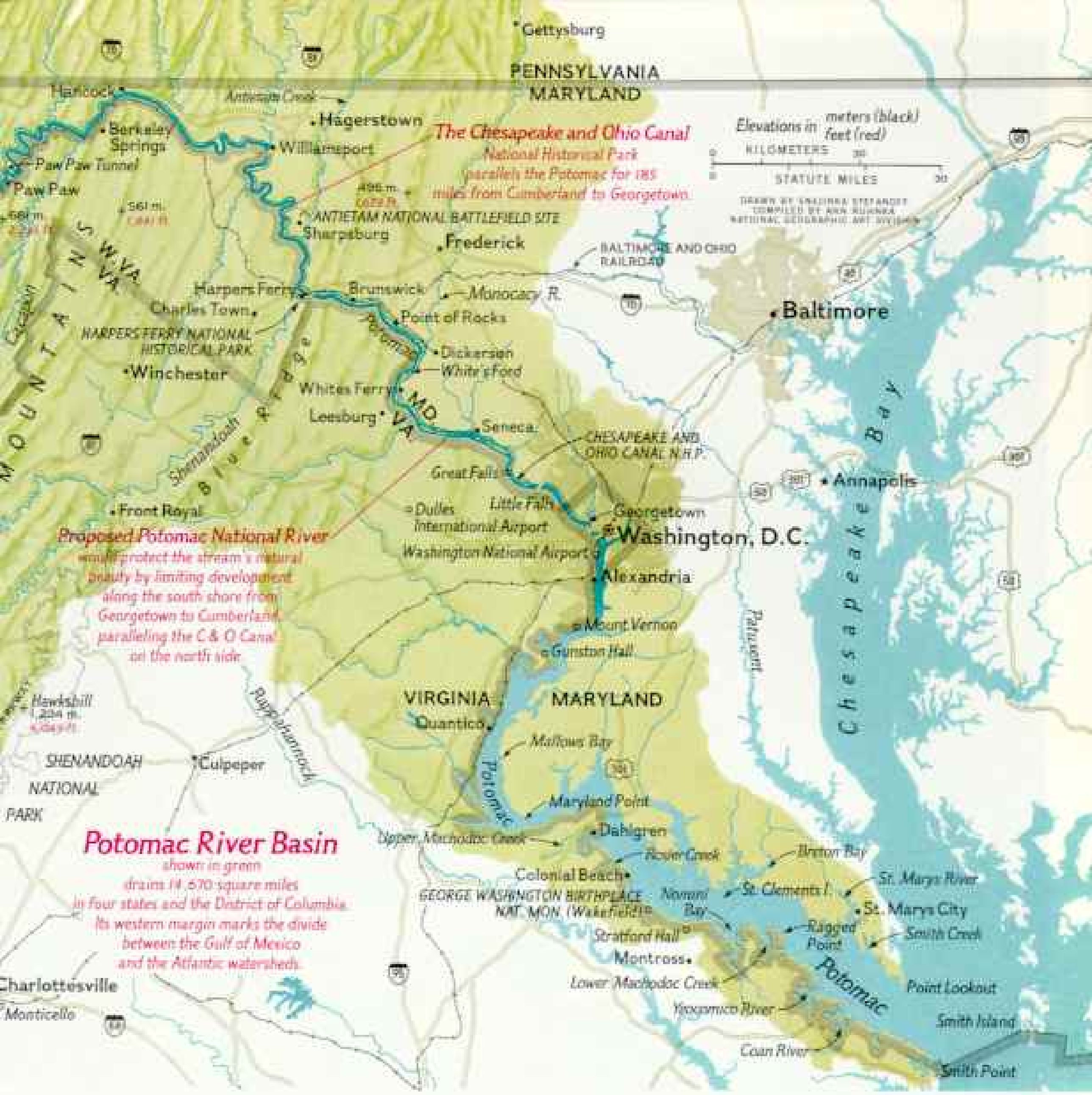
John Brown's 1859 raid on the Federal Armory at Harpers Ferry for weapons to liberate slaves foreshadowed the coming of civil war. Across the river, blue and gray armies pursued each other, clashing in crimson at Antietam. After Gettysburg, Lee withdrew across the Potomac for the last time, his cause and his stately home overlooking Washington irrevocably lost. Today on the green lawn below the colonnaded portico spread white markers of soldiers, known and unknown, in Arlington National Cemetery.

farther downstream, son; there's mine drainage around the next bend." But the North Branch itself—dead then, dead now, with even the hush of death because birds shun it.

Many years ago I carried into those hills a little volume by British poet John Drinkwater, and, sitting beside the poisoned North Branch, I committed to memory a verse that spoke for my heart too:

When you defile the pleasant streams
And the wild bird's abiding-place,
You massacre a million dreams
And cast your spittle in God's face.

The Potomac's schism is all too typical of our rivers, though sewage and other pollutants are more common than acid, which is a special and very difficult problem. Yet I have long been astonished at the Potomac's resilience. The clean South Branch, a longer and larger stream than the North, so dilutes the acid and other wastes when the two merge 18 miles southeast of Cumberland, Maryland, that fish and people can cavort in the main river all the way downstream to the Washington metropolitan area. There things get a bit sticky again, almost literally, for the Nation's Capital is a notorious polluter. But not far down the broad estuary the river cleanses itself again and becomes a fecund environment



for oysters and numerous species of fish.

From near the Fairfax Stone to the Chesapeake, 382 miles, the meandering river forms Maryland's southern boundary, a line more erratic than the squiggle of a seismograph. The river bypasses mountains, cuts through others, and wanders across piedmont and valley. At Cumberland, my hometown, and again at Hancock, it surges toward the Mason-Dixon Line and almost garrotes Maryland, before relenting and bearing off to the southeast.

Maryland, however, has this compensation: It owns the river. King Charles I gave it to Lord Baltimore, all the way across to the Virginia shore. A United States Supreme Court decision later drew a line from headland to headland along the serrated Virginia side of the estuary and gave that state title to its interior waters, leaving Maryland firmly astride the main stream.

President Lyndon B. Johnson called the Potomac "truly the American river." He ordered a cleanup that will continue for years. President Johnson also proposed an ambitious development and recreation program that would have formally created the "Potomac National River." Nothing much came of the plan, but two bills to make the name-change and preserve part of the river's shoreline are pending before Congress.

Winding through the Virginia hamlet of Blue Grass on an October day, the

South Branch heads for West Virginia and confluence with the North Branch.

President Johnson justly described the Potomac as "the river rich in history and memory." Even more than the James and the Hudson, it cradled and nurtured our early settlers; it formed the first highway to the beckoning West; it became the bloody boundary in a fratricidal struggle that still grips the minds and hearts of Americans as no other conflict in our history.

When I sail the Potomac, hike its shores, paddle its headwaters, I see ghosts, all of them giants:

• Stocky, florid Capt. John Smith. In 1608, a year after the landing at Jamestown, Smith led a bargeful of starving, near-mutinous men up the Potomac and bullied and cajoled them all the way to the head of navigation near what is now the District of Columbia. He foiled an Indian ambush, traded with and made enduring friends of other Indians, and filled his followers' bellies. The latter must have been easy, for one of the crew recorded fish "lying so thicke with their heads above the water, as for want of nets (our barge driving amongst them) we attempted to catch them with a frying pan; but we found it a bad instrument to catch fish with. . . ."

• Resolute Father Andrew White, the English Jesuit who reached America in 1634 with Maryland's first settlers. In his report, *A Briefe Relation of the Voyage Unto Maryland*, he stated: "This is the sweetest and greatest

"Washed all to pieces" by Potomac floods, buried under rock slides, and "curves, all curves," the tracks of the Western Maryland Railroad kept Gallery Spitzer (**above**) busy at repairs for 44 years. Born and now eight years retired in Gormania, West Virginia, he enjoys gardening and fishing—but not in the North Branch. Coal mines there "killed everything out" by draining acid discharge into the river.

Old Glory brightens the faded glory of a former coal-company house in Shallmar, Maryland (**right**). Despite a new coal boom in the Potomac Basin, the seams of unemployment still run deep.

river I have ever seene, so that the Thames is but a little finger to it." Father White went fearlessly among the Indians, and when sent back to England, he tried for years to return to his beloved river.

• George Washington, the nonpareil, who probably knew the Potomac better than any leader of his day. Born on its banks at Wakefield, he swam in the river, fished it, sailed it. At 16, as a surveyor for Lord Fairfax, he explored the headwaters. His beloved Mount Vernon overlooked the Potomac. He saw the river as a trade route to the interior, and headed a canal company that bypassed its falls. He chose the sites of the National Capital, the armory at Harpers Ferry. The spirit of Washington is everywhere on the Potomac.*

• Grave, gray Robert E. Lee, fated to become the symbol of the lost cause. He too was born on the banks of the Potomac, at Stratford Hall (pages 466-7), and he too swam and fished in it, off his boyhood home in Alexandria. But when I think of Lee and the river, I see him astride his gray horse, Traveller, watching from the shallows as his lean veterans cross into Maryland at White's Ford while bands play "Maryland, My Maryland." The Battle of Antietam lies ahead. And again, when Gettysburg has turned back the high tide of the Confederacy, the incomparable

*See "George Washington: The Man Behind the Myths," by Howard La Fay, GEOGRAPHIC, July 1976.

general watches impassively as his men retreat across the river, singing "Carry Me Back to Ole Virginny."

The parade of Potomac ghosts goes on: Thomas Jefferson, who traveled the river and wrote glowingly about it; George Mason of Gunston Hall, author of the Virginia Declaration of Rights; Robert E. Lee's distinguished forebears at Stratford Hall, Thomas, Arthur, Francis Lightfoot, and Richard Henry Lee, and Robert's martial father, "Light-Horse Harry." Such giants give the Potomac unique distinction among American rivers.

CONGRESSMAN Gilbert Gude of Maryland has long maintained an ardent love affair with the Potomac, even to the point of hiking, biking, and boating its entire length during the summer of 1975. He is the principal architect and sponsor of one of the Potomac National River bills. Mr. Gude sees the river as a greenbelt and recreational area of incalculable importance; he believes that not just the bodies and minds but perhaps the very souls of our people need such breathing space.

"I am very troubled," he says, "by our plastic culture: suburban subdivisions with thermostats, air conditioning, and humidity controls that almost wall out the realities of the world; the automobiles that carry us through nature but not in it; the shopping malls under one roof; the Disneyland type of developments.

"Such artificial environments take us further and further away from nature. It is not good. We must develop a broader social consciousness toward the natural environment—save it, cherish it, use it wisely."

Basically Mr. Gude's bill would provide a green sheath of protected shoreline of no less than 200 feet inland along the Virginia-West Virginia side between Washington and Cumberland. This green space would complement the 185-mile-long Chesapeake and Ohio Canal National Historical Park on the Maryland side. The old canal, a proud engineering achievement of the young nation but long ago abandoned by commerce, hugs the river through wooded and pastoral landscapes of idyllic beauty. Its towpath has become one of the nation's most popular hiking trails.

Under the proposed bill, land across the river from the canal would be protected

The sidewalks of hell, if doused with acid and cobbled by heat, might approximate this forsaken pond once used for trapping neutralized coal-mine wastes (**above**).

The reaction of air and water with pyrites in coal mines yields noxious compounds, including sulfuric acid. These trickle down creeks to the Potomac's North Branch. One of the most foul, Mill Run (**left**) deposits blazing mineral stains called "yellow boy." Waters like these make life uncertain for semiaquatic newts (**right**).

Mostly steam, mostly clean, plumes rise from Westvaco's paper mill at Luke, Maryland (**above**), where more than 35 million dollars has been committed to air- and water-pollution abatement. Foliage in the foreground grows again on what had been "Old Baldy."

Although West Virginia produces much coal, here loaded in hopper cars at Keyser (**right**), the Potomac Valley supports little industry to make use of it.

Water-pollution problems vary widely. New sewage-treatment plants in the Washington area and better sediment control promise a cleaner future.

wherever possible by zoning and scenic easements rather than by federal purchases. In addition, a plan would be developed by the Department of the Interior to reclaim the ravaged North Branch and preserve shores of the estuary.

The Potomac drains almost 15,000 square miles in four states and the District of Columbia. Yet Washington is the only large city on the river or its tributaries. Industrialization has been minimal. Fifty-five percent of the Potomac Basin remains forested; 39 percent still supports cropland and pasture.

So most of the river is still just as beautiful as its headwaters. It flows through five distinct physiographic provinces: the highlands, where some flora is identical to Canadian; a rugged region of elongated vales and spiny ridges, including a fertile limestone "great valley" of rare pastoral loveliness, called Shenandoah south of the river, Cumberland to the north; the barrier Blue Ridge; a piedmont of rolling farms and wooded hillsides; and finally, below Little Falls, the coastal plain and its estuary with more than 950 miles of shoreline, a maze of ancient "drowned rivers." (See **Close-Up: U.S.A.—The Mid-Atlantic States**, a supplement to this issue.)

MUCH OF THE HIGHLANDS lies in West Virginia, the state that describes itself as "Almost Heaven."* Here, water on one side of a cloud-scraping ridge may flow westward to the Mississippi and on the other side eastward to the Atlantic. By similar quirk, half of the roof atop Jacob Hevener's barn near Hightown, Virginia, drains into the Potomac, the other half into the James.

Development can mar the delicate balance of a watershed. Two planned reservoirs for power generation in the high Canaan Valley, which drains westward, have posed a problem, and so has a land rush by city folk buying mountain lots for second homes.

With development comes pollution, a never-ending concern of the watchdog West Virginia Highlands Conservancy. "It's like fighting brushfires," says Bob Burrell of the conservancy. "When you have one thing taken care of, something else blazes up."

But so far the South Branch has been kept remarkably clean. Those springs gushing

* "Turnaround Time in West Virginia," by Elizabeth A. Moize, appeared in the June 1976 GEOGRAPHIC.

Dunk in a riffle invigorates hikers Liz Harmison and Bob Harrigan (**left**), chairman of Citizens for the Potomac National River. They joined a fun-and-fact-finding river exploration led by Maryland Congressman Gilbert Gude.

One unassailable fact: When the Bloomington Dam (**below**) is completed across the river, the face of the North Branch will change drastically. Backing up a 43-billion-gallon lake, the dam is designed to help control floods and provide the Washington area with adequate flow in periods of low water. This, proponents say, will also dilute pollutants. Conservationists are wary of additional dams.

from a hundred hills form brooks so cold and pure they support trout farms. For example, Howard Halterman of Highland County, Virginia, runs a fair-size spread with about 12,000 head of rainbow trout, most destined for big-city restaurants.

"Not a bad sideline," said Mr. Halterman. "The hatchery brings the fish here when they're 6 to 8 months old. I feed 'em twice a day and keep 'em about a year."

He threw pellets made of granary waste, fish meal, and yeast into his three raceway pens. The surface exploded as thousands of trout thrashed about in a feeding frenzy, as voracious as piranhas shredding a carcass.

WHEN ENOUGH of these mountain freshets and torrents join forces, canoeists can't resist the challenge. So each year in early spring Petersburg, West Virginia, and the Canoe Cruisers Association of Greater Washington, D.C., sponsor White Water Weekends on the North Fork (page 455). To a summerphile like myself, it seems a bit mad to run slalom and wild-water races through rapids that would give goose bumps to Mr. Halterman's trout. Especially in the annual April Fools Race, limited to "anything that floats that is not a boat."

The most recent running (if that's the word) drew 83 entries, 300 crewmen, and more than 30,000 spectators. But the first race, in 1967, had only four contestants. One of them, Sull McCartney, recalls it all too well.

"Leon Wilson was conned into it first; he came to see me, and of course he brought a jug," says Sull. "'No way am I going out on that river,' I told him. Well, the next day I regretted getting into that jug because there I was, on the river. Leon rode a coffin liner, and I welded together a couple of car hoods and sat on 'em. He turned over, but I picked him up, and all four contestants finished. Wayne Lewis won on something he'd made to paddle around a swimming pool with."

That set the tone for later events. Sull still shakes his head in wonder over his favorite contestant of some years ago: "She was a little old grandmother, and she had an icebox with a toilet bolted to the top, and she sat on that john with a Sears, Roebuck catalog hanging beside her. Guess she'd never tested that rig; as soon as they pushed her offshore, it sank."

I found Grandma's spiritual descendants

at the starting line at Smoke Hole Caverns bridge last April 4. One young man perched on a toilet precariously balanced atop ten inner tubes. A father and son manned an outhouse strapped to a raft. Each craft seemed more bizarre than its rivals: a plywood coffin stuffed with Styrofoam; a brass bed on inner tubes; Snoopy, the comic-strip dog, in a rocket.

In sunny-cloudy-windy-rainy weather, I watched the race at Ruddles Rock, a midstream boulder big enough to sink an ocean liner. Nero and the Marquis de Sade would have loved that spectacle. Inner tubes and rafts smashed against the rock with gratifying frequency, dumping men and women into the icy water. Most clambered back on their craft and continued, but several swam ashore, and firemen pulled one man out with a rope.

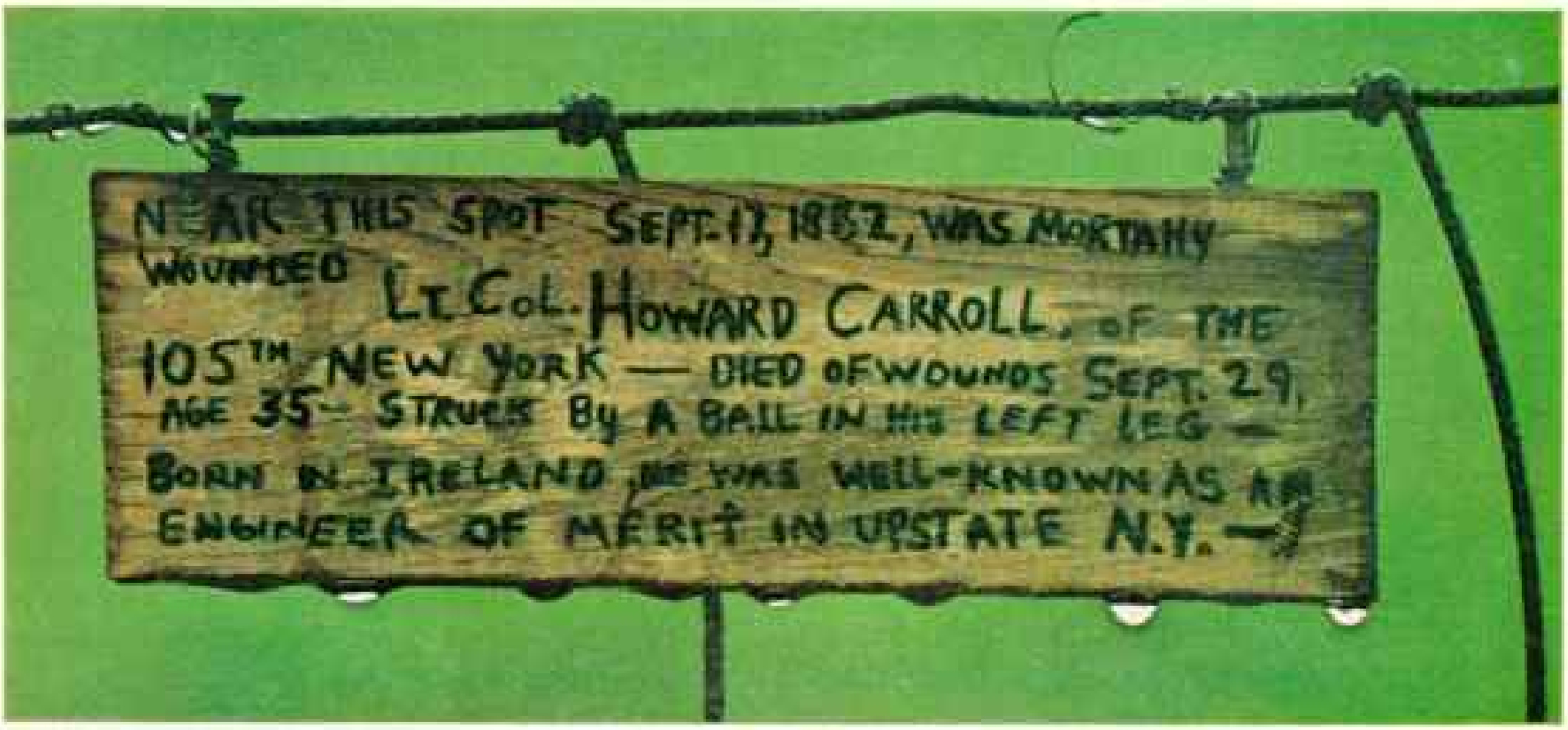
The race had two divisions, one for speed, the other for novelty. When the carnage ended, I sought out the finishers. No one had been seriously hurt, but an ambulance carted off one exposure victim. In the speed division, a group from Ohio won with "Riff Raff," made of plastic drainpipe. A big, floating Bicentennial birthday cake, bearing the words "Happy Birthday, U.S.A.," won the novelty division for its crew of nine men from Charleston, West Virginia.

MY OWN white-water venturing consists of putting my rubber dinghy into the upper Potomac—in summer, of course—to float and paddle through miles of semi-wilderness. Recently, for old time's sake, I ran the South Branch's Trough, a six-mile canyon with steep 1,500-foot walls. No road, not even a path, threads the canyon; a little-used railroad spur clings precariously to one wall, and you can go in that way if you don't mind walking the ties of an open trestle.

Nearly everyone does mind. But my father didn't, not with fish to be caught, and he took me once when I was small. He grasped me by the back of my belt, his friend Bill Claus held me by the front, and they lofted me over any ties my feet missed on that giddy trestle. But my mother found out about it, and I never made a second trip.

With misgivings, but good-naturedly, my longtime colleague Ralph Gray, a skilled canoeist who wrote of his cruise down the Potomac in the August 1948 GEOGRAPHIC, joined me in my chubby dinghy for the canyon run. As always, the rubber craft proved slow and hard to paddle, but it steered reasonably well, and medium water volume carried us effortlessly through rapids.

Anyway, we thought it a sacrilege to hurry.



He "enlisted" at age 5, when his parents gave him a Civil War suit—and he's been a buff since. John Repass (**left**), with his wife, Reda, plays a Confederate private in a recreation of Stonewall Jackson's attack on Harpers Ferry. That victory secured a route into Maryland for Lee's armies. McClellan attacked Lee at Antietam, where 23,000 casualties earned their red badges of courage on the Civil War's bloodiest day. They are not forgotten, as a homemade plaque testifies (**above**).

An epic work of nature, unmarred and untrammeled, can arouse the same feeling as a great cathedral. Mill Creek Mountain and Sawmill Ridge walled us into an almost straight chute, and on and on the river flowed, now golden, now shadowed, like the aisle to God's distant altar.

I FIND MUCH to admire in the descendants of that area's early settlers. Often of old English stock, a typical Potomac mountaineer is staunchly, even fiercely, independent, laconic in speech, lean as an old hound, hardworking, rough-hewn but devout and polite, and often with a chew of tobacco (locally known as "West Virginia coleslaw") in one cheek. He's a loyal friend, but a bit distant and suspicious with strangers; he's conservative and parochial, in a sense the prisoner of his hills.

That pretty well describes Richard Sites, 52, who farms 238 sky-high acres in the remote hills behind castellated Seneca Rocks. Indeed, those hills are so remote no one lives back in there; each day Mr. Sites leaves his house at Mouth of Seneca, crosses the North Fork on a sagging suspension footbridge, and trudges more than two miles up Roy Gap to his farm.

Photographer Jim Stanfield and I found Mr. Sites, his younger brother, Wade, and their 13-year-old nephew, Daris, stacking hay in a precipitous meadow.

Richard Sites often walks to the farm with a hundred-pound bag of grain on his shoulder for his cattle. "We haven't had a deep snow for the past five or six years, but 15 years ago I waded in snow up to my waist to get in here," he said.

His family has owned that beautiful but flinty land for generations, and you could see the love of it in Richard's eyes every time he leaned on his pitchfork and swept his gaze around the green hills and the distant crags of Seneca Rocks.

Had he ever been away from his hills? "Only down to Texas in the Army; that's as far as I've ever been," he said. His brother, too, had traveled little, and I wondered if young Daris would have wider horizons.

"Do you ever think about what's beyond these hills and want to go there?" I asked. He looked surprised at the question and said, "No, I don't. I just like it here."

The next morning I drove down the South Branch Valley to Springfield on a journey back through time, back more than 45 years. Could it still be there? I found the right road out of Springfield and later, to my surprise, instantly recognized the dirt side road winding over a hill. It hadn't changed. Neither had the farmhouse or the track winding down to the river. And there, sheltered by the same tall trees, I came upon an empty cottage, still recognizable even though the sleeping porch had been enclosed.

Nothing else had changed—not the adjoining cornfield, or the shingle where rowboats landed, or the ledge barely submerged in midstream. Time had been reversed, and I pictured a boy of 11, very thin and not well. He knew he faced an operation, but he didn't know he had only a 50 percent chance of survival. In preparation he had been taken from school to live here in the fresh air and sun, part of the time with only gruff-voiced, kindly old William, cook and confidant.

Summer . . . the boy fished, hiked, rode the farmer's fat pony, and grew brown. Autumn . . . flocks of birds wheeled erratically over the meadows, the woods blazed, and guns of squirrel hunters sounded along the South Branch. Then, on a cold gray morning, the murmurous passage of the river sounded louder, harsher, and ice rimed the banks. That day William walked down to the shore for the boy, saying, "They've come for you." And the boy picked up a waterworn stone, a talisman of his river, and he kept it with him through all the weeks of pain that followed.

Summer people still live in that cottage on holidays and weekends, and I hope they, too, love it. I turned back to my car and away from the boy I had been. It seemed the mist had come early to the riverbank that August eve.

YOU WON'T SEE many summer cottages on the North Branch, and the people in this part of Appalachia—often unsmiling, a bit dour—seem to reflect the blight on their waters. Population has dwindled since the early 1900's, but the energy crisis, with its demand for coal, has brightened economic prospects. The Potomac Basin holds an estimated 1.6 billion tons of coal.

Island Creek Coal Company operates two deep mines in the area. Today, thanks to federal and state laws, the company treats

its waste water with hydrated lime to counter the acid and with aerators and clarifiers. Yet an Island Creek executive told me as we toured one of the mines, "In the early 1950's, when I went to college, mining engineers were taught very little about environmental considerations."

I visited a treatment plant that the company said could cleanse more than a million gallons of effluent a day. But a miner confided to me: "The plant ain't always workin' right. Sometimes it just dumps stuff and lets it run off. Mister, there ain't never gonna be no fish in these streams. But at least the deer huntin's good."

Later a Federal Government expert told me that Island Creek's plants near Bayard and Henry, both in West Virginia, were "overloaded and only intermittently effective."

MOST NORTH BRANCH COAL comes from surface, or strip, mines. Maryland and West Virginia passed model laws to control such mines. Operators must treat runoff, and must post bond that they will restore the ravaged landscape. In country very like the green hills of Wales I watched power shovels denude a hilltop. But a few miles away the mineowner showed me a restored area so carefully contoured and planted that only the immaturity of vegetation betrayed what had happened.

Ironically, treated water from the strip mine passed into a run polluted by raw drainage from abandoned shafts. Sealing hundreds of abandoned mines against water and air would be extremely difficult. Experimenters have tried to fill tunnels with sludge or pump them full of nitrogen to prevent the oxidation that forms acids. No sure cure has been found. The alternative to sealing shafts would be treatment plants on all the major streams at staggering cost.

Meanwhile, the U. S. Army Corps of Engineers proceeds with the 150-million-dollar Bloomington Dam on the North Branch; it will impound a magnificently scenic reservoir in which nothing can live. But planners say the reservoir will help control floods and bolster the river's flow at Washington, which takes its water supply from the Potomac. At one time the engineers advocated the building of 16 dams in the Potomac watershed, but only Bloomington is under construction,

Her time by the river gone, an Indian woman (**top**) was buried on a Potomac island before Europeans came. To preserve a sense of the primeval river, various plans have been championed. Congressman Gude (**above,** right) proposes that the Potomac be made a national river and a margin on the south bank be protected to complement the Chesapeake and Ohio Canal on the north.

and two others may receive approval later.

Although the dam won't be completed until 1981, Shaw, West Virginia, has become a ghost town. Eventually it will vanish under 43 billion gallons of water, and all its 130 souls have been relocated except John Tressler, a worn little man who lives in a worn little house and keeps vigil over contracting equipment.

"This was my parents' place," he said, gesturing vaguely around his cluttered kitchen, "and they lived here for forty years. I'm a bachelor and never wanted to move, but it don't do any good. The Government gave me only $6,200 for the house and $8,000 for relocation, but I don't know where to go."

Mr. Tressler offered an apple. "I've got more than 40 fruit trees," he said. "I don't like to think of them being under 200 feet of water. I don't mind the house so much, but I do mind my nice trees."

Besides acid, the North Branch gets an infusion of raw sewage from small communities. Take, for example, the depressed Maryland town of Kitzmiller, where jobs are scarce and incomes are low. It had plans for a sewage and water system that would cost each household about 23 dollars a month, but that price tag proved nearly double what residents could afford.

A SAD IRONY lies behind the conscientious water-quality controls of the big Westvaco paper mill at Luke, Maryland (pages 446-7). It makes a thousand tons of paper a day, including some of the high-quality stock used for NATIONAL GEOGRAPHIC, and draws 60 million gallons of water daily from the Potomac. Most of that water must be cleansed before it can be used. During use, some of the water becomes highly alkaline, but Westvaco again treats it and returns it to the river. In the old dirty days, Westvaco's alkaline effluent reduced the river's lethal acidity; now, in the good clean days, it doesn't.

Not so gently down the stream row the women's eight of Alexandria's T. C. Williams High School (**above**). Their sunrise practice paid off with a 1975 national championship. Upstream in West Virginia, the bowman in a decked competition canoe digs into the water (**below**) to veer away from the poles of a slalom gate. The annual Petersburg White Water Weekends draw canoe and kayak contestants from across the nation.

Delicacies for Europe come aboard as John Oord swings an eelpot onto his boat (**above**). His father-in-law, George Robberecht, first exploited the lower Potomac for this continental favorite that few Americans have eaten. He ships up to two million pounds of eels a year, flying some across the Atlantic live. Now his success has brought competitors and a glutted market.

No profit, but more fun, comes from netting white perch (**left**) or dangling a line for panfish in the C & O Canal (**below**).

Fortunately, the industrial city of Cumberland, the largest community upstream from Washington, has recently added efficient secondary treatment of its sewage. So by the time the North Branch flows past Cumberland, it has begun its recovery, and when it joins the clean South Branch, the Potomac becomes a living whole.

THANKS TO THE OLD Chesapeake and Ohio Canal's towpath, you can hike in woodsy solitude from Cumberland all the way along the riverside to Washington, with only occasional intrusion by such small Maryland towns as Williamsport, Brunswick, and Point of Rocks. President John Quincy Adams turned the first spadeful of earth for the canal's construction on July 4, 1828, at Little Falls, Maryland. It took 22 years, 22 million dollars, 74 locks, 11 stone aqueducts, and 7 dams to take the waterway to Cumberland.

Yet it was outdated long before completion. On the same day President Adams launched the canal, construction of the Baltimore and Ohio Railroad began with similar ceremonies at Baltimore. The B & O reached Cumberland eight years before the canal did and took the lion's share of freight; the waterway, though it operated until 1924, never fulfilled expectations.

It has been a national historical park since 1971. Floods and time have ravaged its banks and locks, and at present only two segments are intact and watered for boating, a 22-mile stretch from Seneca to Washington and a short section near Oldtown. But the National Park Service plans to restore six areas as "national interpretive centers" and refurbish some historic structures along the way.

Everyone has his favorite section to hike. For many it is the area around Great Falls, not far from Washington, where the Park Service maintains a museum and visitors' center. Here you can leave the undemanding surface of the towpath and take Billy Goat Trail down into the rocky defile. From a width of more than 2,000 feet, the Potomac narrows to less than 200 and crashes through great masses of rock. Only low-flying jet airliners following the river to National Airport remind you that Washington lies just downstream.

One of my favorite sections has long been spooky Paw Paw Tunnel east of Oldtown,

where the canal bores 3,120 feet through the heart of a mountain in order to cut off a six-mile bend in the river. Workmen, including Welsh miners, hacked away the stone from 1836 to 1850, then lined their tunnel with brick. It's an easy walk with a good flashlight, and there's a stout railing to clutch.

WHEN THE CIVIL WAR turned the Potomac into a virtual no-man's-land, Confederates repeatedly crossed the river to rip up portions of both canal and railroad. Skirmishes, invasions, counterinvasions . . . the river suffered them all, including a battle that stands as the single bloodiest day of the war: Antietam, fought near the little village of Sharpsburg, Maryland.

On September 5 and 6, 1862, Lee's troops, ill fed but fresh from decisive victories in Virginia, threw their gray coils across the Potomac in the first invasion of the North. Marylanders did not flock to the Southern cause, as Lee had hoped, and on September 17 Gen. George B. McClellan forced a battle on rolling farmland between Antietam Creek and the Potomac.

Today much of that ground is hallowed, a national battlefield site. Perhaps 600,000 people will tour the battlefield this year, drawn by mystic cords to the scenes of fratricide: North Woods . . . the Cornfield . . . East Woods . . . West Woods . . . Bloody Lane . . . Burnside Bridge . . . blood-drenched places that achieved a special horror. In a single day's engagement 23,000 men died or were wounded; 2,200 of them in just 20 minutes.

John Brown, bearded patriarch and martyred abolitionist, with madness in his eyes and fire in his soul—his is another name written in blood on the shores of the Potomac. On October 16, 1859, Brown and 18 followers attacked the Federal Armory at Harpers Ferry and seized several strategic points, hoping to foment a slave uprising. They barricaded themselves in the firehouse, until a contingent of marines under Col. Robert E. Lee and Lt. J. E. B. Stuart stormed the place, killed a number of raiders, and seized Brown. The State of Virginia hanged him for murder and treason, and Longfellow wrote prophetically, "This is sowing the wind to reap the whirlwind, which will come soon."

Today Harpers Ferry stands out as a Potomac showplace, a national historical park where the Government is restoring the 19th-century village with its blacksmith shop, general store, apothecary shop, armorer's home, saloon. This year more than a million people will visit the town.

Harpers Ferry lies beneath craggy mountains on a peninsula that juts into the confluence of the Potomac and another rock-strewn river with one of our loveliest Indian place-names, Shenandoah, popularly translated "Daughter of the Stars." Here the combined rivers break through the last major mountain barrier and surge on toward the sea.

Traces of early man in the Potomac Valley date back to about 9000 B.C., and when the white man arrived, many Indian villages lay along both sides of the estuary. In the Algonquian language Potomac may have meant "Trading Place." Lowland Indians traded shell currency, arrowheads, dyes, and other articles with interior tribes, usually near Great Falls. Even copper from the Lake Superior region found its way down the Potomac.

MID-REACHES OF THE RIVER remain lightly populated, but if the side opposite the C & O Canal is to be protected effectively, help must come soon. Fly above those huge, looping bends of the river and you see that many recreation and retirement homes have sprung up along the West Virginia side between Hancock and Harpers Ferry. Development has been indiscriminate. Not a single county in the West Virginia part of the Potomac Basin has zoning regulations, and the state has no sediment-control law.

Downstream, the Nation's Capital has a long and ignominious history as a polluter of the river. Just before the turn of the century some 80 sewer pipes emptied directly into the Potomac at Washington. A sanitation engineer once said the river at Washington was as dirty as though seven million dead mules were dumped into it every year.

That statistic makes me doubly appreciative of Teddy Roosevelt's celebrated hardihood. He used to steal away from the White House to go skinny-dipping in the Potomac. One time his companion, the French ambassador, forgot to remove his gloves before taking the plunge. "I think I will leave them on," he said. "We might meet ladies."

President Johnson promised that people would be able to swim in the Potomac off

Washington without health hazard by 1975. But you can't. Present law sets a goal of swimmable, fishable waters by 1983, but that date may not be met either.

Yet the Environmental Protection Agency and other groups have mounted a determined attack on pollution. In the Washington metropolitan area several highly efficient sewage-treatment plants are planned or being built; more than 1.5 billion dollars may be spent on water-quality controls for city and suburbs.

Paul Eastman, executive director of the Interstate Commission on the Potomac River Basin, says he is optimistic. "I'm also patient," he adds. "It isn't going to happen tomorrow, but by 1980, maybe earlier, we are going to see a much cleaner Potomac. By then we will have a wider variety of fish, and the river will be free of odors and unsightly solids and algae blooms."

For years Washington has depended upon the Potomac for its water supply, siphoning from the river above the city's sewage-plant outfalls. But the record high demand for a single day has exceeded the river's record low flow. "If those two happenings should ever coincide, you would have a definite shortage," said James E. Crews, head of the Urban Studies Branch of the Corps of Engineers, Baltimore District. "We're living with water roulette in the Washington area."

In dire emergency Washington will draw water from the polluted supply in its estuary. Meanwhile the engineers plan a pilot plant for cleansing estuary waters.

EARLY BICKERING and ultimate compromise between North and South put our Capital on the Potomac. Congress authorized President Washington to pick a site on the river. In 1790 he chose an area, largely wilderness, that included the colonial ports of Georgetown, Maryland, and Alexandria, Virginia. However, aristocratic Alexandria and its environs never felt at home with the raw federal enclave across the river, where the streets were unpaved and pigs ran free, and in 1846 Congress returned to Virginia the land it had given for the District of Columbia.

But George Washington picked a site with beauty and potential for his city (following pages). Even today this area is remarkably free of industry and unsightly development. Here sight-seeing vessels, canoes, and pleasure boats crowd the waters each good weekend, and here hydroplanes compete each year in the President's Cup Regatta.

Downstream from Washington the tidal river flows slowly, grandly, with broad vistas and filigreed shores. It is an enormous estuary, 207,000 acres of water surface; yet nearly all its green landscapes and fecund waters remain very much the province of the farmer and professional waterman.

When our muddled and troubled century weighs upon me, I often vanish with my boat in the maze of the estuary, slipping into the past as if it were a sanctuary. Coan River, the Yeocomico, Nomini Bay on the Virginia side; Smith Creek, the broad and beautiful St. Marys River, Breton Bay on the Maryland side. . . . These and a score of other waterways lure me on and on, past estates and farms with histories much older than that of the nation. Until World War II trading schooners still served innumerable hidden landings and villages on the Potomac, carrying lumber and produce to market. They're all gone now, those workhorse boats, their bones rotting in tidal marshes, but their ports of call still have the same look and savor.

SOME OF THE CRUMBLING PAST is rising again, at lovely St. Marys City just 65 miles south of Washington. Leonard Calvert, younger brother of Lord Baltimore, took the *Ark* and the *Dove* up the St. Marys in 1634 to found Maryland's first settlement. The "city" fell to ruin after the seat of government moved to Annapolis in 1695, but Maryland has painstakingly reconstructed the 1676 State House. Meanwhile, archeologists of the St. Marys City Commission, aided by a grant from the National Geographic Society, have been unearthing the remnants and foundations of vanished structures.

History is open to the public all year on the Potomac's Virginia side, at Mount Vernon, Gunston Hall, Wakefield, and Stratford Hall. Naval vessels still toll their bells in tribute as they sail past George Washington's tomb at Mount Vernon. The drive down the Northern Neck, Lord Fairfax's old domain, to Wakefield and Stratford Hall takes you past fields that have been continuously cultivated for nearly 350 years.

The Potomac's old farming families, with

In shining indifference to matters of state, the Potomac slides past Washington.

From the Capitol, broad avenues stretch like arms reaching for last light.

Catchword with a view, Watergate began as a lock on the C & O Canal, and later became the name of a bank of luxury apartments like that of Greek economist Costa P. Caranicas and his wife (**above**). Their balcony offers a Potomac panorama that stretches from the John F.

their mechanized efficiency, are determined modernists compared to the professional fishermen, oystermen, and crabbers. They follow family watermen traditions rooted in colonial days. To me they *are* the river in a way its farmers and townspeople can never be.

"There's something about the river that gets in your blood," says Capt. Richard Herbert, 93, of Coles Point, Virginia. "For one thing, you're independent. You don't take any sass, you don't watch a clock, you don't take orders from nobody. And the harder and longer you work, the more you get."

I spend as much time as I can with such people, absorbing their lore and their yarns. Unlike the mountaineer, a waterman is loquacious—if he accepts you. I've been lucky enough to make friends of Captain Herbert's nephews, Roy Jenkins and his brother Bill. Roy, a licensed master of oceangoing yachts, lives in Florida now, but we fish together when he visits his Virginia relatives. Bill, a charter-boat fishing captain and oysterman, epitomizes the homespun waterman.

Bill is too polite to admit it, but he regards amateur boatmen as dilettantes and worse. I've impressed him only once. We had a date to fish for blues, and I arrived off Coles Point on that magnificent relic, the 205-foot *Christian Radich*, a square-rigged training vessel for Norwegian maritime cadets. She had been to Washington on a goodwill visit, and I hitched a ride. Unfortunately, not a breath of wind ruffled the river that hot August day, and Capt. Kjell Thorsen took his white-hulled beauty prosaically downstream under power, though later his teenage crew did set mizzen, staysails, and foresails, more for the

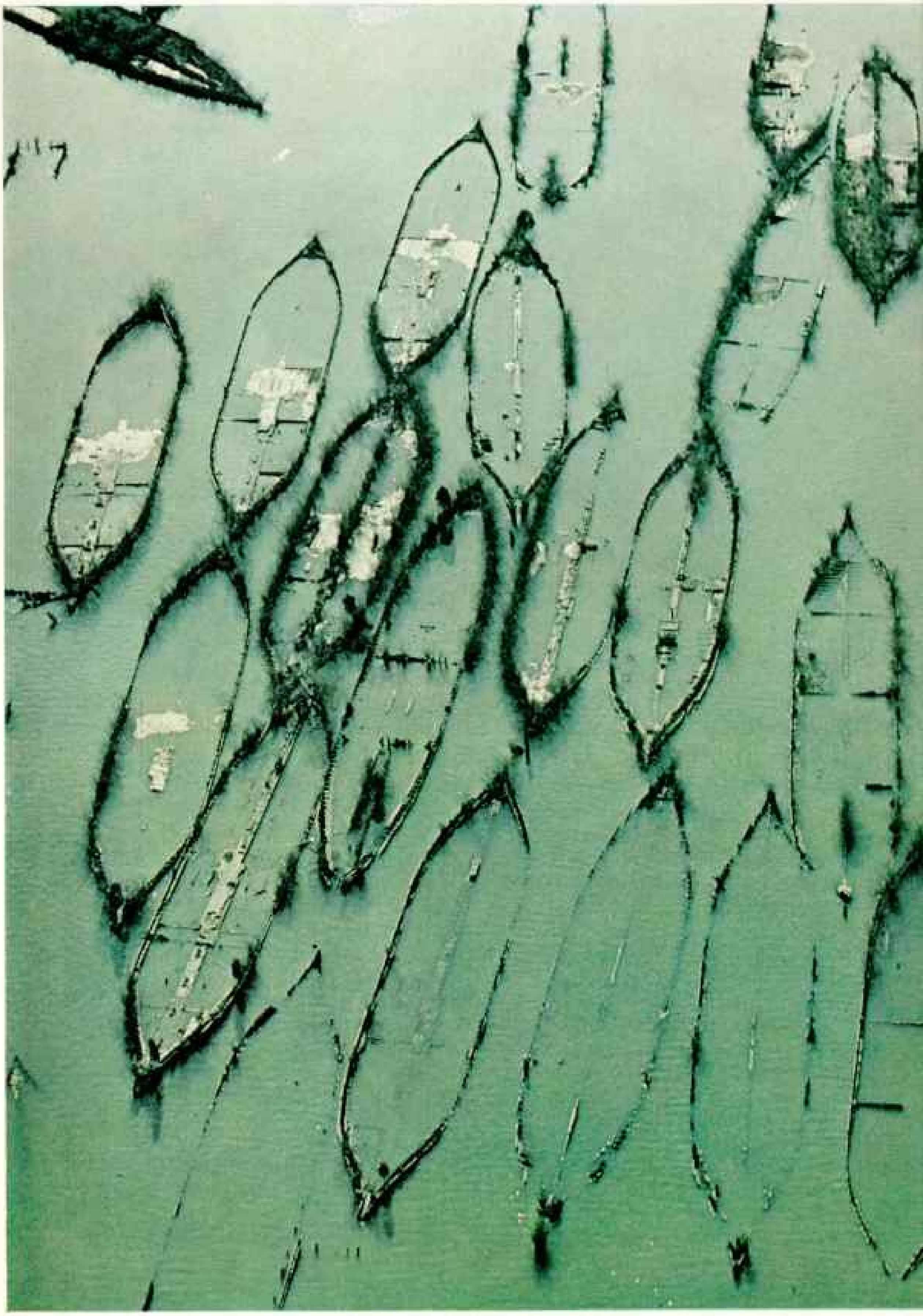
Kennedy Center for the Performing Arts to an intown forest, Theodore Roosevelt Island. The complex also includes a hotel and offices, shops and restaurants. And, of course, Watergate has entered the atlas of political scandal along with Tammany Hall and Teapot Dome.

entertainment of guests than for any help from the wind. Near Ragged Point Light I shinnied down a rope ladder and Bill promptly came alongside in his boat with Roy and plucked me off the *Radich*'s hull.

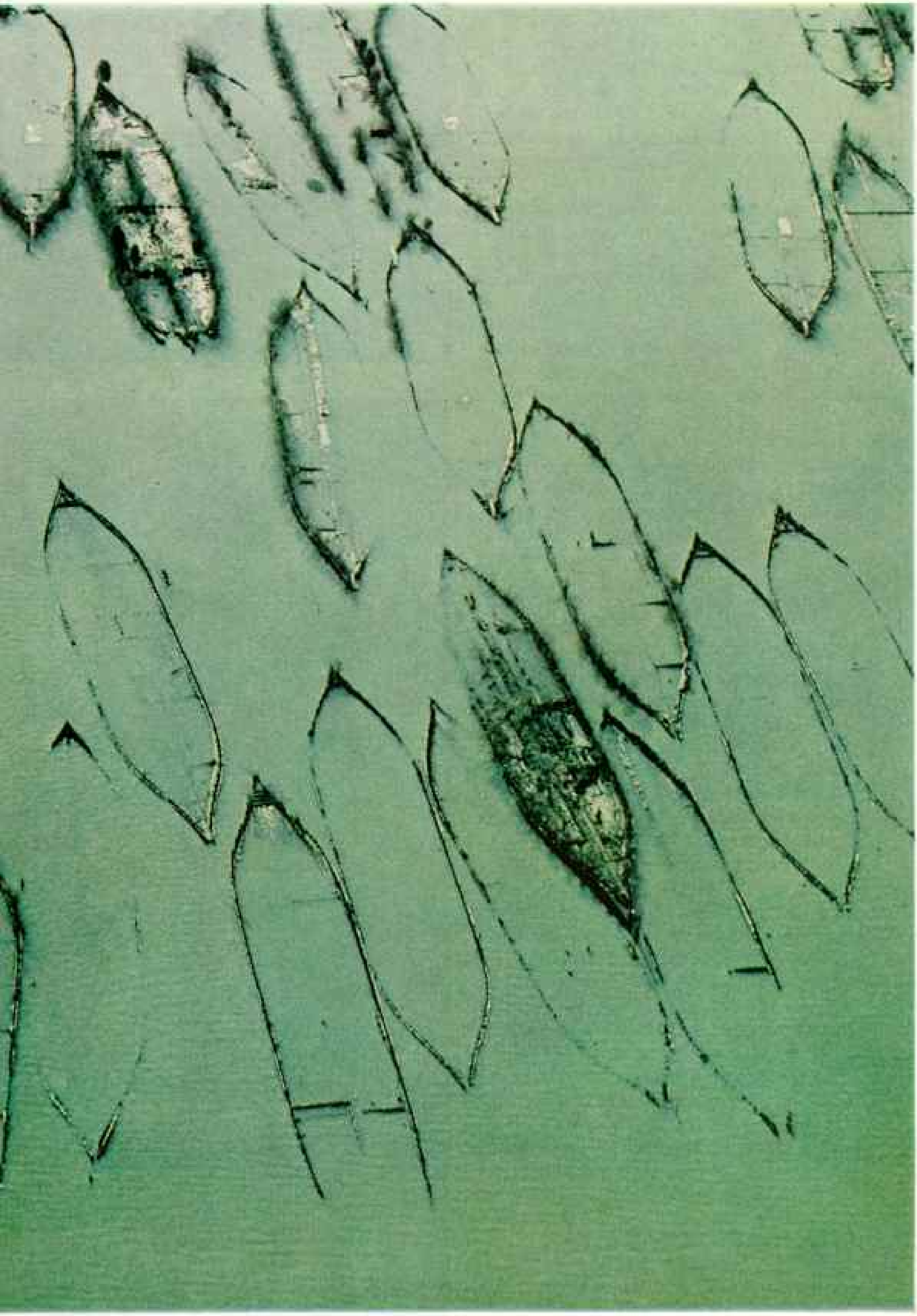
BETWEEN FIGHTS with bluefish, the Jenkins brothers reminisced to me about the notorious "Potomac oyster wars." A figure of speech? No indeed. Less than twenty years ago conservation officers armed with rifles, pistols, and machine guns fought pitched battles with oystermen. The law forbids taking oysters by dredge in the Potomac. You must scoop them from shallow beds with tongs on long wooden handles. But any waterman will admit he'd rather "drudge" for his "arsters" instead of "tungin' for 'em." It's easier and more profitable.

"We used to drudge at night without any lights, and some nights we caught 100 to 150 bushels," Bill said. "One night two Maryland police boats chased us; we tried to get back into Virginia, to Lower Machodoc Creek. But one of those Maryland captains had a three-inch cannon and a machine gun on his bow, and he opened up with them and a rifle. When we stopped and he come alongside, there was 17 holes in our deck and Lord knows how many in the hull. We'd of been killed if we hadn't laid down behind the engine."

Indeed, in 1959 one young poacher was killed and several were shot. A Virginia marine policeman, a poacher himself in those days, told me: "Just about everybody was taking arsters illegally. Poachers had fast boats, and Maryland and Virginia police didn't have much of anything. They was



Hulks of 300-foot troop transports built for World War I litter Mallows Bay, 30



miles below Washington. None of the wooden vessels ever made it "over there."

always being outrun until they armed and started shooting. Sure, I poached too. We'd make maybe 500 to 600 dollars in one night, then we'd go to a hotel in Richmond and spend all of it. Yeh, they knew that when I became a cop. Guess they figured it takes one to catch one."

A compact in 1958 between Maryland and Virginia doomed illegal dredging. It established the Potomac River Fisheries Commission, which can call upon police and agencies of both states to enforce its regulations.

From earliest days Maryland and Virginia watermen feuded over fishing rights. "They used to fight right here at Ragged Point Rock," Roy Jenkins said. "Potomac watermen didn't like anybody from the Eastern Shore, but most of all they didn't like those furriners from Smith Island, way out in the bay. It was a Smith Islander that kept drudgin' across the bow of Uncle Dick's brother, Capt. Ernest Herbert. He was a real heller, Uncle Ernest, and he hauled out an old horse pistol and started firing at that skipjack's waterline. Sank her too."

OYSTER LARVAE require a delicate balance of salinity, and Hurricane Agnes in 1972 poured so much fresh water into the Potomac Basin that oysters were nearly wiped out. A decade ago the bistate fisheries commission licensed 3,000 tongers; today only 300 work the river. But the commission has been replenishing oyster beds and expects a good yield in 1977.

With nets, fishermen take from the river catches of shad, menhaden, herring, and white perch. Pots trap eels and crabs in quantity. Sport fishermen find large schools of rockfish (striped bass) and bluefish. But Robert Norris, executive secretary of the fisheries commission, feels that pollution from the Washington area is gradually overtaxing the estuary's recuperative powers.

"Sediment is filling in the river and the streams from Maryland Point to Washington," he said. "The spawning area for striped bass has been reduced and is moving downstream, and I don't see how the shad and herring can find places to spawn. And we suspect chlorine from sewage treatment and industry harms the spawning and setting of oysters.

"I foresee a gradual lessening in the production of seafood from the Potomac unless

Staunch as her sons, the Lees of Virginia, Stratford Hall (**left**) commands the lower Potomac. Young Robert E. Lee doubtless came to the kitchen for special treats. There, Mrs. Julia Newman (**below**) answers the question visitors ask most often: What are the two copper vessels connected by tubing? "Now that's a still. In those days they made their own."

there is an improvement in water quality. If things continue as they are, I think the river's marine life is doomed."

Many oystermen tend to agree, among them two from Colonial Beach, Virginia, Cornelius "Nealy" Little, a boyish-looking 30-year-old, and Albert "Catfish" Rollins, 48, a waterman since boyhood.

One blustery March morning we rolled at anchor off the Maryland shore in Nealy's *Miss Jean II* while the two watermen probed the bottom with rakelike tongs on 18-foot wooden handles. Every now and then they would take a good "bite" with their tongs, pull them up, and dump muddy oysters on a culling board, where young Glenn Vaillancourt kept the legal three-inch size and swept others overboard. Cold, backbreaking work, in water so rough it threatened to pitch Little and Rollins overboard.

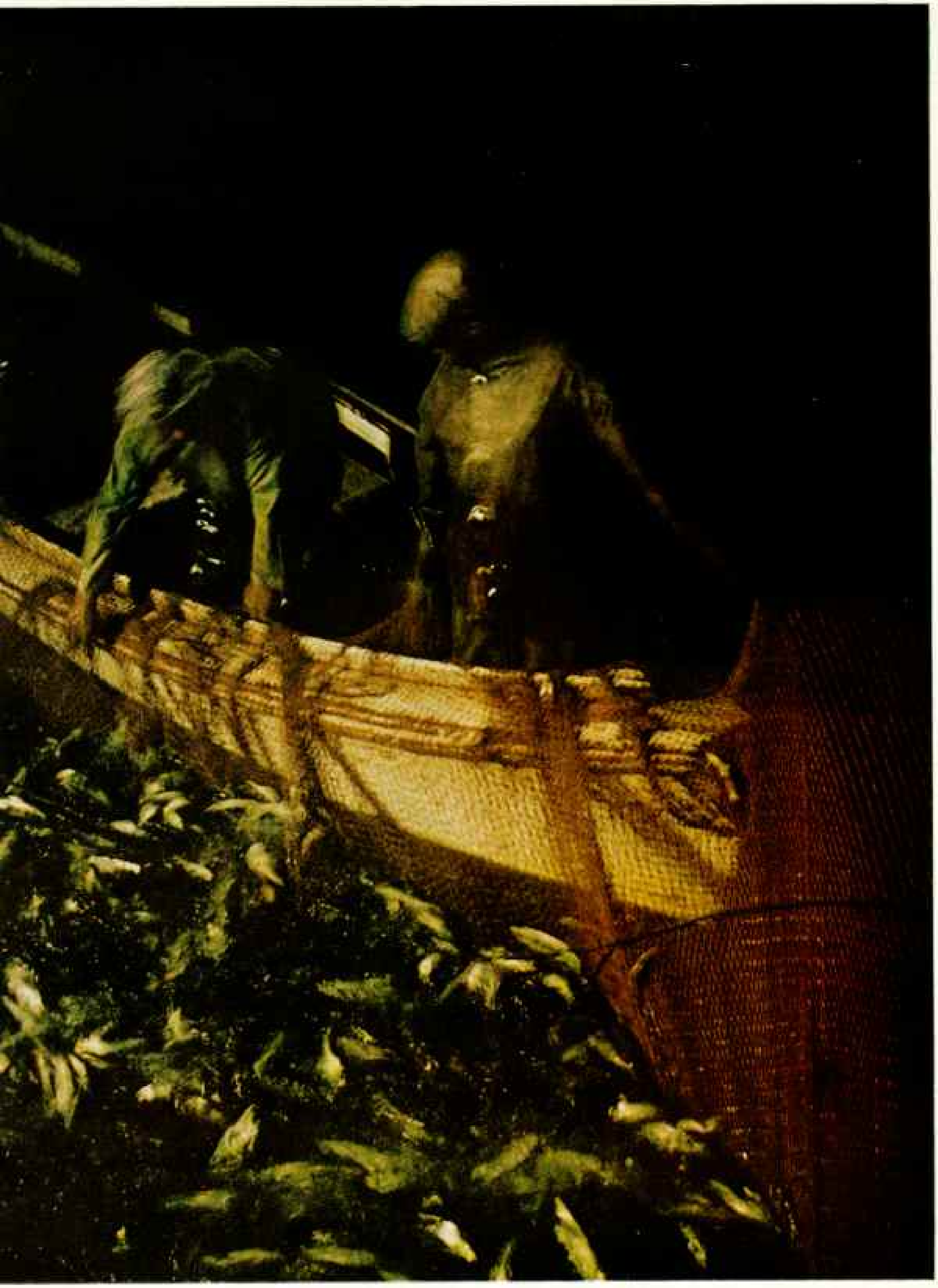
"It's a good life but a hard one," Catfish said. "My granddaddy done this, my daddy done it, and now my son, George, says he's gonna do it. It's all we know. But I urged my son to learn a trade. Why? Because this river is playin' out. It's goin' to die."

PERSONALLY I'm not that pessimistic. The Interstate Commission on the Potomac River Basin is developing a monitoring program to determine just what happens to the estuary's water and what needs to be done to protect it. In the meantime, improved sewage treatment has already begun the river's recovery.

Nealy and Catfish worked only an hour. By then it was blowing "seven kinds of spit," as watermen say. The Potomac can be very nasty. In the War of 1812 the captain of a British warship in the estuary recorded incredulously that a squall blew off his jib boom at the same time his mizzen drooped in a dead calm. On this day, however, whitecaps swept down the entire river in phalanx after phalanx.

But, like her watermen, I love the Potomac in all her moods. As we beat back to the Virginia shore, I thought how long and intimately my own life had been a part of this river: Born on her shores, reared on her headwaters, I knew I would hike her trails and sail her lovely estuary as long as time permits. For she's my river, the alpha and omega of my years. □

Hauling from their skiff, watermen net



baitfish destined to lure that paragon of Potomac seafood, the blue crab.

A Long Life, a Good Life on the Potomac

"No more deep water for me—I came back to farming"

A PICTURE STORY BY
JAMES L. STANFIELD
NATIONAL GEOGRAPHIC PHOTOGRAPHER

AT 88, CAROLINAS PEYTON *shakes hands with a grip that could crack a walnut. But as a boy, "they never thought they'd raise me—two doctors give me up." He couldn't keep his food down, so his older brother took him into the woods and gave him a chew of tobacco. "I was drunk all evening, and foolish. My feet wouldn't stand to go ahead, wouldn't stand to go backwards." From that day he's been chewing tobacco and has never again seen a doctor.*

*That was before he was kidnapped by Chesapeake watermen, before he began a journey from Virginia's Rosier Creek on the lower Potomac that took him around the world. He came home more than fifty years ago and has been farming the same way ever since. He draws from the same sweet well, feeds his chickens (**above**), and teaches his great-grandson Thomas all about a way of life that has mostly disappeared from the Potomac's banks.*

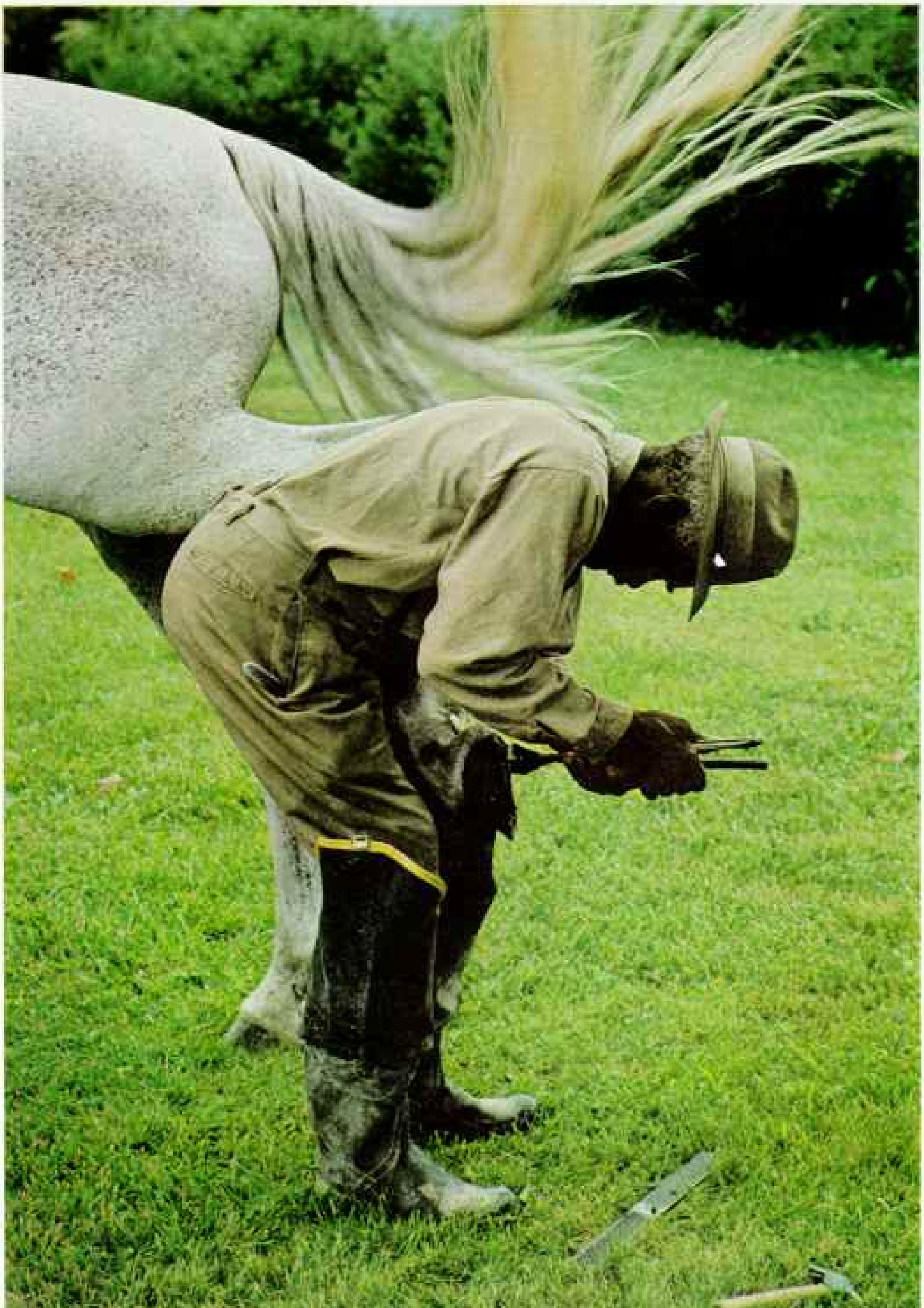
The watermen who tricked him aboard

their boat—he was 10—and took him across Chesapeake Bay to Virginia's Eastern Shore weren't too bad, even if it was "half slavery." But another bunch who kidnapped a white boy were "mean as dogs." Carolinas told that boy to "keep his tongue in his teeth," and helped him escape. He also aided the flight of a black boy, some two years before he could make his own getaway. Later he signed on as mate, then captain, of a single-masted bateau that hauled oysters up the bay to Baltimore.

His curiosity took him to Sweden and apprenticeship as blacksmith and wheelwright. On he went as cook aboard a freighter—and saw Europe, Africa, and Asia. Back in the United States he did some farming and trained as a boxer, working out with a fighter who once "knocked me about four feet"—the great Jack Johnson.

Wanderings done, he returned to Rosier Creek, built a house all of heartwood from timber he felled himself, married, and took to farming with mules (following pages).

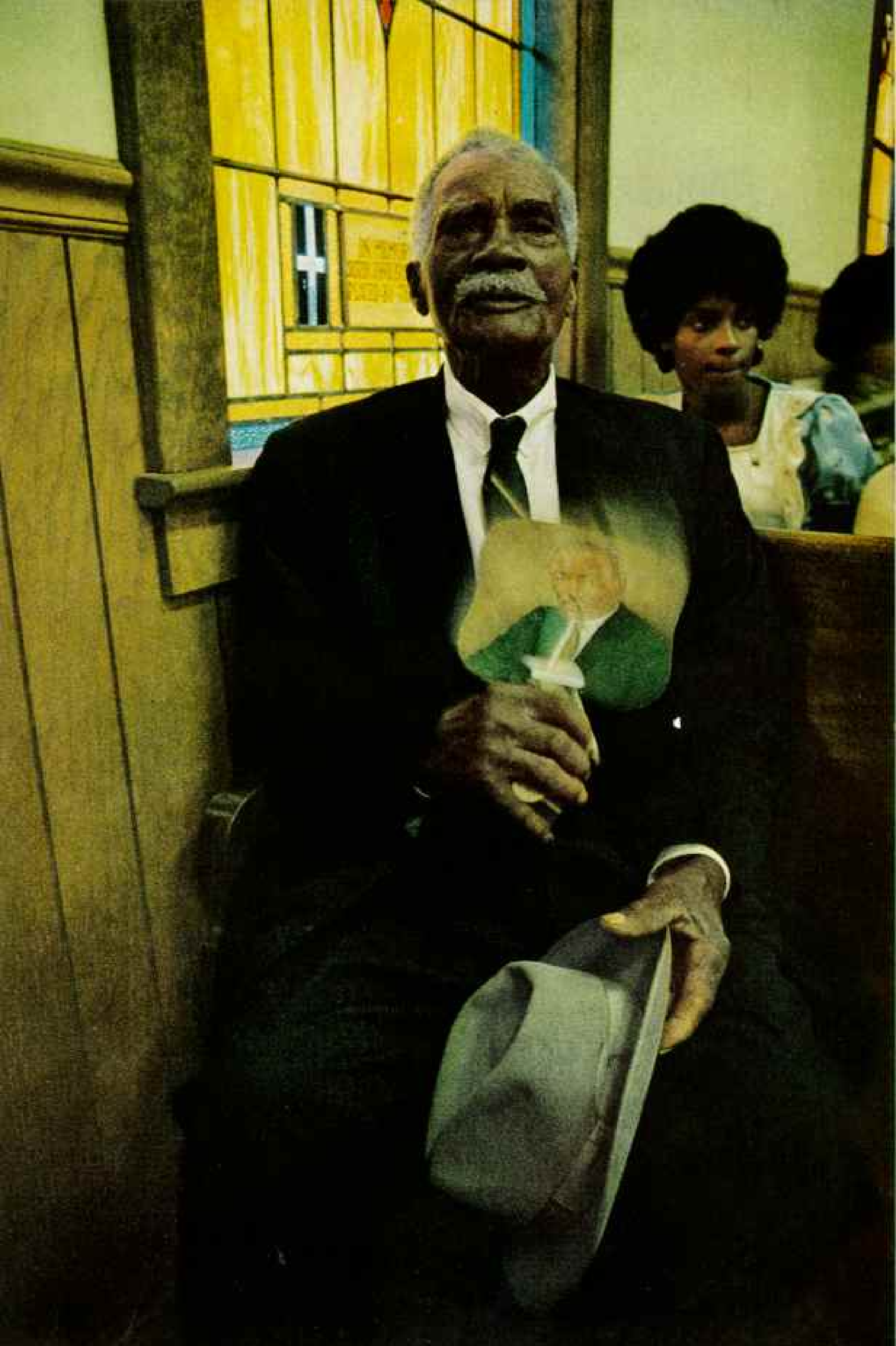
*"DID I GET HIM? Yes, I did." Mrs. Lydia Franklin, Carolinas's only daughter (**left**), took the double-barreled 16-gauge shotgun to a chicken hawk just the same as to any varmint after the flock. The 50-acre farm, called **Marengo** since slave days, supplies everything from vegetables to beef and pork, which they pickle and salt. "No man has his hand in my pocket," says Carolinas. Only now and then will he still trim a horse's hooves (**below**). "When you take a man that gets 88 years old, it's time to come home from blacksmithing. Yes, sirree."*



"NOW IF YOU DON'T KEEP UP WITH HIM, *he'll drag you clear over the earth,*" *Carolinas says. That's a mule, and that's why great-grandson Tony, at his young age, sticks with hoeing* (**above**). *Carolinas favors mules like his Pete and fly-bitten Queenie* (**right**) *over horses. "If you've kind to them, they'll do anything in the world you want them to. But if you're gonna beat them, they will kill you on the first chance." Some people didn't believe Carolinas when he told them that. Now they're "dead as a hammer."*

*WHEN RALLY DAY COMES to Good Hope Baptist Church, it's like a homecoming. Kinfolk and old friends gather from afar for preaching, music, and dinner. Lydia joins in the clapping and singing (**below**), but after a few hours Tony falls asleep. "Yes," she says, "he does that all the time." As a deacon, Carolinas sits apart, cooling himself with a fan that bears the likeness of the Reverend Martin Luther King, Jr. (**right**). All his life, all over the world, "I don't care where I was at, if there was a church, I'd go. You never catch me home on a Sunday."*

With no man's hand in their pockets, with a farm on a quiet tributary of the Potomac where the wind blows fresh even on a sultry day, they lead a rich life without much bother about money. As Lydia says, "Every man for himself and God for us all." □



Pioneers head north from Edmonton, gateway to Canada's "Now" Frontier

By ROBERT PAUL JORDAN ASSISTANT EDITOR

Photographs by LOWELL GEORGIA

Gay '90's froufrou sets the tone for Klondike Days in Edmonton, oil-rich capital of Canada's Province of Alberta. Each July tourists and Edmontonians alike dress up in old-time garb to commemorate the prospectors who tramped through Edmonton on their way to Klondike goldfields.

Today Edmonton and its skyline glitter with new energy (**foldout, following pages**). Prospectors still press north from the city, but now they're oil and gas explorers bound by jet for northern Alberta and the Northwest Territories with its islands near the top of the world.

WE SHUFFLED AHEAD in a cheerless private terminal at Edmonton International Airport, about 25 of us catching the world's-end commuter plane. At the baggage counter a flinty attendant abruptly told a young roustabout in front of me to leave the line.

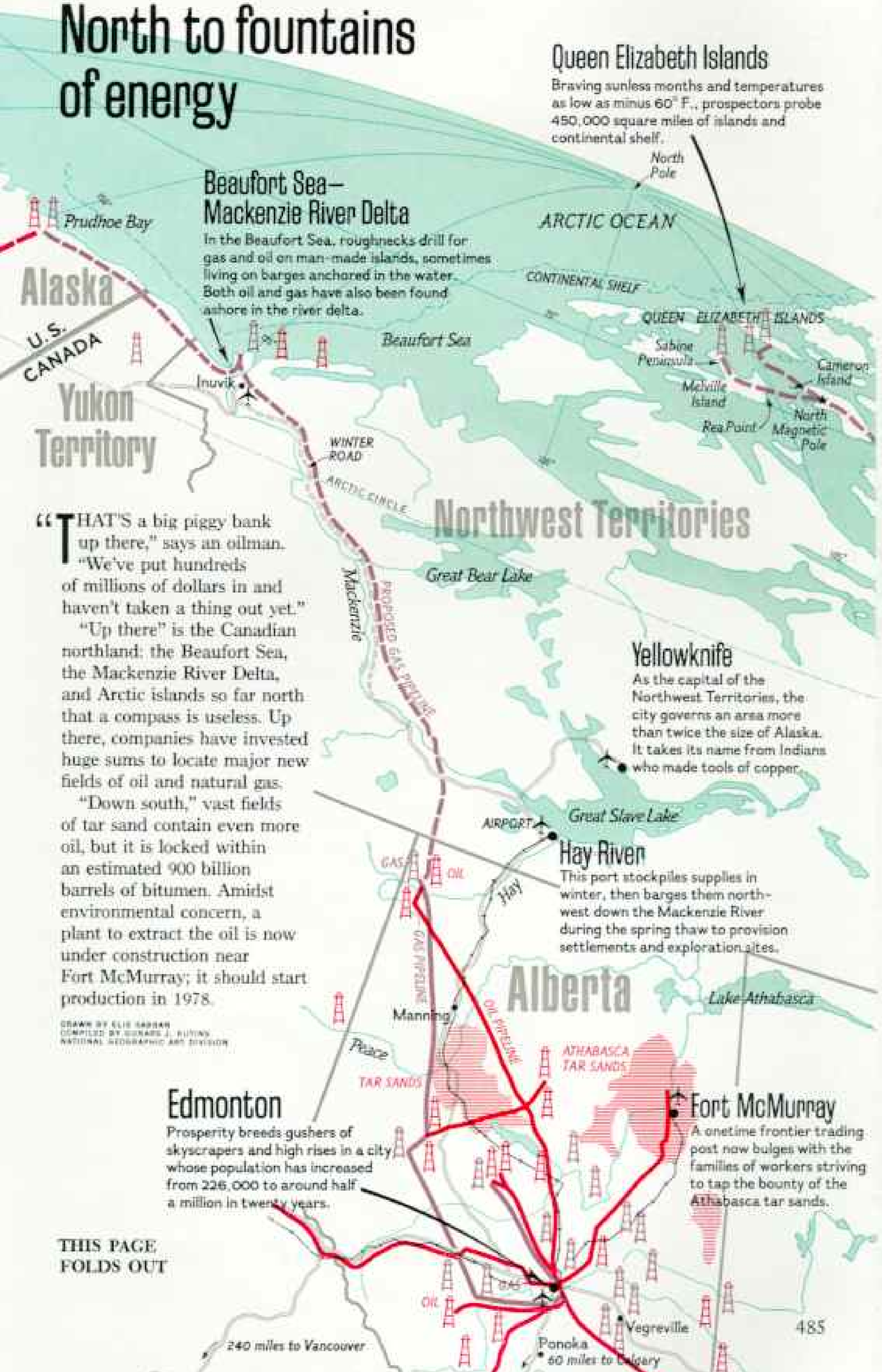
"You can't go like that," he decreed. "Hair." It is foolhardy to wear long hair around drilling rigs and heavy equipment. A quest for scissors began.

My turn. I set my carry-on bag before the attendant. "Open it," he commanded. I showed him a camera, lenses, tape recorder, notebooks. He prodded my duffel bag. "What's that?" "That" was a rolled-up map. "Why the search?" I asked, a shade testily. Surely we were a known quantity, a routine change of shifts. Not at all the ordinary untrustworthy commercial passengers undergoing a security check.

"Booze," he snapped. Alcohol is prohibited in the bleak gas and oil exploration camps where we were headed. One serious mistake is all you make in the hostile polar islands of Canada's Northwest Territories.

Then we stepped aboard a Lockheed Electra of Panarctic Oils Ltd. and the roustabout was among us, shorn and glum. North we flew that wintry morn across and beyond Alberta, the turboprop's four engines droning through a darkening sky into the midnight country. Muskeg and forest yielded to a desolation of bush and frozen lakes, then to a desert of snow and ice. All of this I made out increasingly dimly, but of humanity I saw nothing. My seatmate, a *(Continued on page 489)*

North to fountains of energy



DRAWN BY ELIE SARSAM
COMPILED BY DONALD J. PATTEN
NATIONAL GEOGRAPHIC ART DIVISION

"THAT'S a big piggy bank up there," says an oilman. "We've put hundreds of millions of dollars in and haven't taken a thing out yet."

"Up there" is the Canadian northland: the Beaufort Sea, the Mackenzie River Delta, and Arctic islands so far north that a compass is useless. Up there, companies have invested huge sums to locate major new fields of oil and natural gas.

"Down south," vast fields of tar sand contain even more oil, but it is locked within an estimated 900 billion barrels of bitumen. Amidst environmental concern, a plant to extract the oil is now under construction near Fort McMurray; it should start production in 1978.

THIS PAGE FOLDS OUT

King winter reigns in Canada's Arctic islands, where a token summer supports little more than mosquitoes and scanty vegetation. Even in June the vista is forbidding (**right**). Geologists estimate that beneath this barren but beautiful land lie from 40 to 240 trillion cubic feet of natural gas, and up to 20 billion barrels of oil.

Getting this oil and gas to markets thousands of miles away is a problem for such far-reaching companies as Panarctic Oils Ltd., whose headquarters camp lies at Rea Point on Melville Island (**below**). Panarctic is considering pipelines and supertankers, although both may be far in the future. The company has already located nearly

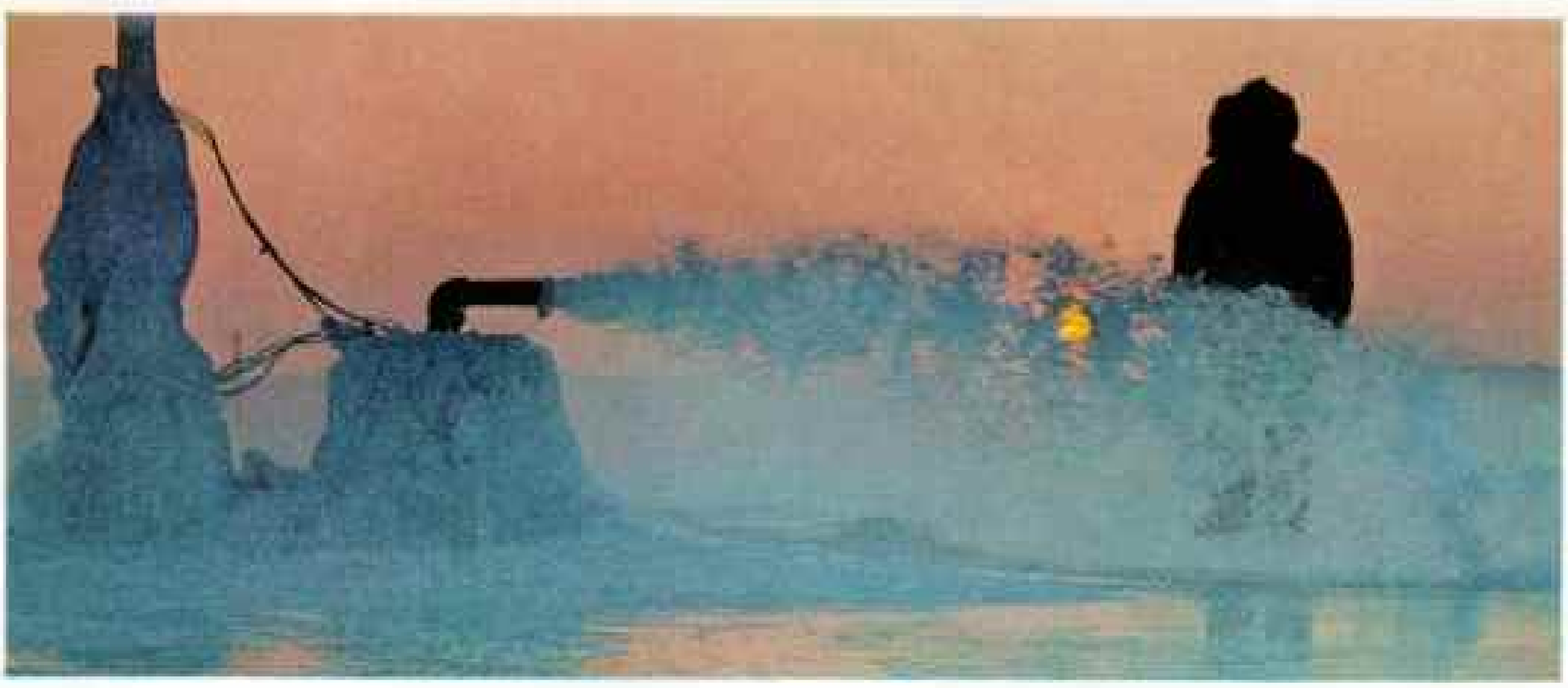
PANARCTIC OILS LTD.

enough gas to justify construction of a pipeline. The project may be proposed to the Canadian Government as early as next spring. Deliveries could commence by 1983. Nearly 800 miles to the southwest, another possible pipeline would bring gas from the Beaufort Sea and the Mackenzie River Delta up the valley of the Mackenzie.

To get the gas and oil out, Panarctic had to invent new techniques for drilling offshore. Workers pump seawater onto the ice (**below**) to increase its thickness to 16 feet, enough to support a 500-ton drilling rig. Off Melville Island the drill was lowered through 1,000 feet of water to the seafloor and 2,000 feet down from there to find six trillion cubic feet of gas—Canada's largest field.

Steam rises from a drilling camp on Melville Island's Sabine Peninsula (**bottom**). The well proved dry. "Only one hole in ten is a producer," says a Panarctic spokesman, "but when we strike, we usually strike big."

A gas well blazes in the Arctic night on King Christian Island (**lower left**), melting most of the rig. The three-month blowout consumed more natural gas than Edmonton uses in four months.



(Continued from page 480) husky Caterpillar driver, yawned, bored with the monotonous ride.

"It's a good 1,500 miles," he said, "and I've made the trip more times than I can remember. We work 12 hours a day for two weeks, then shuttle home for a week." He nudged me with an elbow. "We got it easy up here, aye?"

Four and a half hours out of Edmonton—some commuters had begun the trip farther south in Calgary or even in distant Vancouver—the lights of a runway pierced the gray-blue void. Down we glided to Rea Point, on Melville Island's east coast near the 75th parallel. From here Panarctic Oils Ltd., a consortium of 29 oil and mining companies and the Canadian Government, explores one of America's last great petroleum frontiers (map, page 485). Men, fuel, drilling materials, food, and supplies, mostly from Edmonton, fan out by airlift to lonely huddles of prefabricated huts scattered across hundreds of empty miles.

Low over the frozen ocean, seconds before touchdown on the snowy runway, my neighbor cinched his seat belt tighter. "We lost an Electra here," he said. "Hit short and crashed through the ice into the sea. Thirty-four men were aboard. Only two survived."

Youthful Energy Builds the North

In winter and summer I have come to know and admire many rugged frontiersmen like that Cat skinner. They spring from all over Canada, and other countries too: Indians and Eskimos, Englishmen and Germans, Ukrainians and Dutch. The patois of French Quebec sometimes collides with the Scottish burr.

While some men, and a few women, chase adventure and the big oil dollar—a top equipment operator can make $30,000 Canadian a year—others take up different challenges in this raw land of opportunity. I plowed virgin earth with homesteaders, watched gold miners toil nearly a mile underground, talked with crewmen on heavily laden barges. They and the construction workers, cooks, and newspapermen wear one characteristic like a badge: the vitality of youth.

I found Canada's modern-day pioneers spread over a vast triangular chunk of the country. The triangle's northwestern tip extends beyond the Mackenzie River Delta on the Beaufort Sea at the Alaska border. From there the top leg runs northeast across the

Spring inside, October outside

Shoppers flock to the opening of the Garden Court (**facing page**) in Edmonton Centre, where they can browse through eighty shops—or listen to a concert by the Edmonton Symphony Orchestra.

In Alberta's Legislative Assembly (**above**), Premier Peter Lougheed, a former professional football player for the Edmonton Eskimos, leans forward to field a question from the opposition.

Arctic islands beyond the north magnetic pole to Ellesmere Island.

Along this axis, both at sea and on land, energy companies recently have made significant discoveries of natural gas and oil, and seismic searches point to many other promising areas. Panarctic's drilling alone has already located about 15 trillion cubic feet of gas; the industry says 20 trillion would justify construction of a pipeline.

Edmonton, long the supply and distribution center of Alberta's own oil and gas empire, anchors the triangle's southern tip. To an outlander, it is a startlingly attractive and energetic city, bright with gleaming skyscrapers, prosperous and pleased with itself as the lifeline to far-flung dependencies. Its drumbeaters boomed away at me: "Gateway to the North" and "Crossroads of the World." If you take off in the general direction of the North Pole and keep going, the next city you'll come to is Omsk, in Siberia.

Nine out of ten Canadians live within 200 miles or so of the United States border. "They used to be *so* smug," chortled an Edmonton businessman. "Particularly back east. They would say, 'Go north and you'll fall off the end of the world. Nuthin' up north anyway.'"

New Wave of Pioneers Predicted

Not many people, true. Only 38,000 or so dwell in the Northwest Territories, a region a third as big as the entire United States. Fewer than 200,000 reside in Alberta north of Edmonton, an area bigger than Montana.

But a tide of newcomers appears inevitable. The proposed Mackenzie River Valley gas pipeline, requiring about 7,000 workers, greatly worries the native peoples—Eskimos, or Inuits, as they prefer to be called; Indians; and Métis, or mixed bloods. They demand settlement of their land claims before construction begins, and many remain fearful that a pipeline will destroy their way of life.

Visiting a Dogrib Indian band on Great Slave Lake, I learned that its dynamic chief, Arrowmaker, was urging his young men to turn their backs on the white man's ways and return to the bush. "How good we used to live—hunting, fishing, trapping," an elder remarked sadly.

It is too late for some natives; they find themselves hopelessly trapped in the clash of cultures. But others adapt to work schedules and make the best they can of both worlds.

Many Edmontonians, however, consider the unexploited north a kind of fiefdom and their greatest asset. Terry Cavanagh, His Worship the Mayor, enthusiastically outlined his viewpoint during an interview.

"We have limitless potential," the mayor told me. "The tar sands, the growth of the north, the proposed pipelines—we're talking about billions of dollars. And most of it will be funneled through Edmonton."

He sat back, eyes tracing the high glassy monoliths stalking away beyond his windows. "This is the jumping-off point. This is the source of the engineering expertise and the lunch-bucket people. There's nothing but good planned growth ahead. Mind you, we're around half a million population now. We'll reach a million in 25 years."

And the Rich Get Richer

If tomorrow belongs to Edmonton, Alberta owns today. In recent years the province has grown wealthy beyond its dreams. It grows richer every day, piling up a billion dollars and more annually in petroleum royalties. Alberta contains nearly 90 percent of Canada's crude oil and 80 percent of its natural gas—most of it flowing from fields around Edmonton and northward. Those reserves are being depleted; the search to strike new fields intensified during my rounds.

A different kind of oil, however, waits in awesome plenty. The bitumen in Alberta's vast deposits of tar sands contains more crude oil—an estimated 600 billion barrels—than the total reserves of the Middle East. At least 25 billion barrels are economically extractable.

Covering about 19,000 square miles scattered across several northern areas, the sands lie in sedimentary beds up to 2,500 feet deep. Today's technology strip-mines shallow deposits, cracks the bitumen into crude oil, then refills and replants the denuded area with grass and trees. The great challenge will be to recover oil from the deep deposits, economically and with minimal environmental damage. Controversy mounts on the latter. How do you flush bitumen in great quantities from depths of half a mile without greatly altering the face of the earth and poisoning the air and water? Research continues.

Surface mining has produced only a comparative drop so far. The Great Canadian Oil

Sands plant, owned by Sun Oil Company Ltd., extracts up to 50,000 barrels a day from the Athabasca tar sands near Fort McMurray. Syncrude Canada Ltd. presently will begin strip-mining nearby on an unprecedented scale, more than doubling today's output. It will still merely scratch the surface.

Thanks to their petroleum wealth, Albertans enjoy many benefits. They are able to spend the most per capita on provincial health and education. They pay no sales tax. In 1975 their income taxes and unemployment rate were Canada's lowest; some jobs go begging for lack of skilled workers.

"We have been blessed," Premier Peter Lougheed said quietly when I called on him at the Alberta Legislative Building in Edmonton. A trim, handsome man in his late 40's (page 489), he greeted me in shirt sleeves and spoke informally.

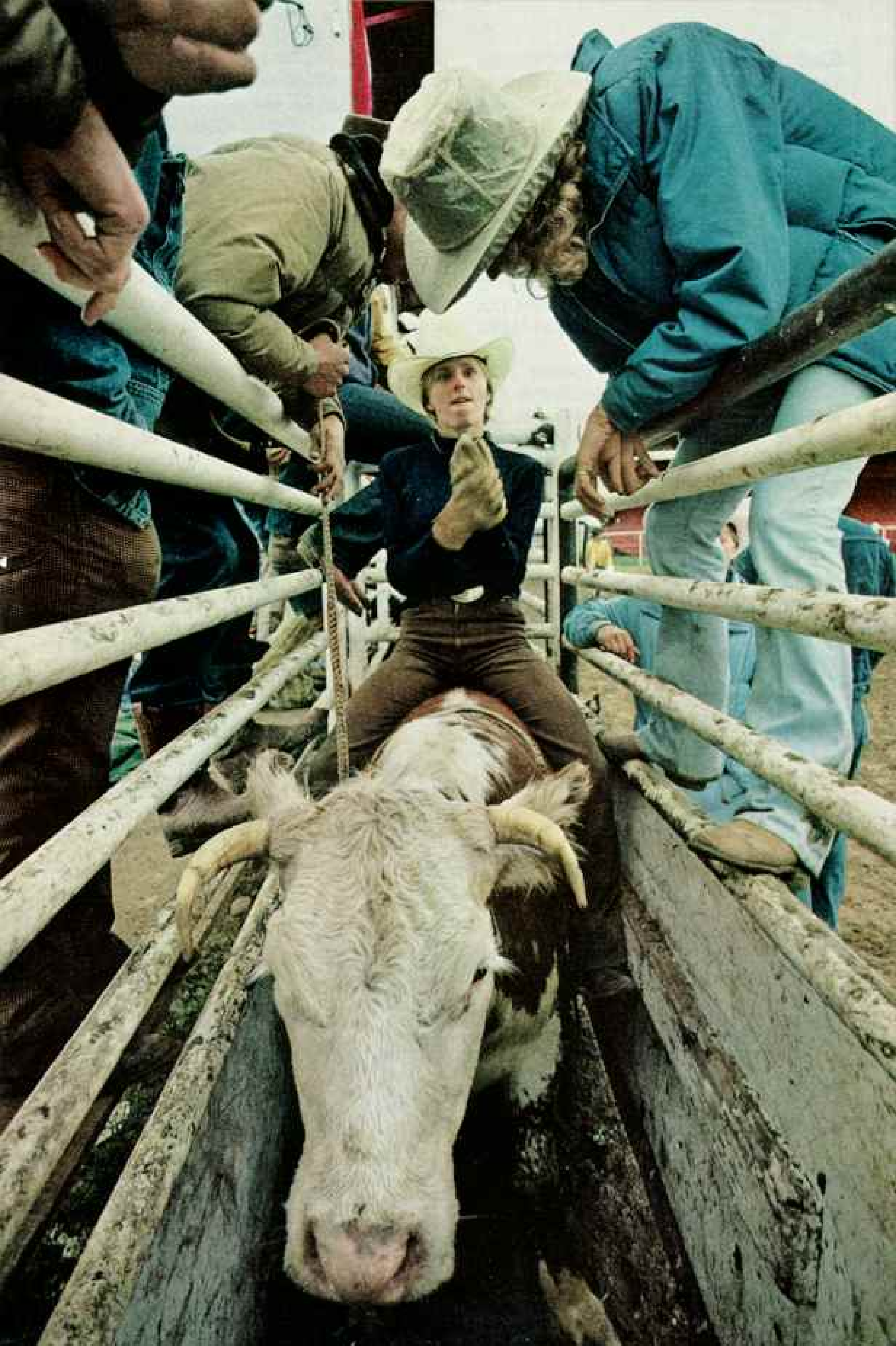
"We want our children to have the same prosperity," he said. "That means we must invest our surplus oil royalties carefully. We have set up a 1.8-billion-dollar trust fund, and we are diversifying our economy. With irrigation we can produce a lot more food; we want to process it in Alberta instead of shipping it down the rail. We are broadening our industry and manufacturing. We are tackling transportation problems."

The premier paused a moment. "Many Americans do not understand that Alberta owns the gas and oil beneath its surface. When our oil production declines, in ten years or less, we'd better have built the trust fund and the economy wisely. Old-timers impatiently called Alberta the 'Next Year Country.' I call it 'Now Country.'"

It is both, I believe. Canada, for instance, may be consuming a billion barrels of oil annually by 1985. Tar-sands oil will not attain that quantity for many years, if ever; the output should be less than a hundred million barrels annually as this decade runs out.

"Nobody listened, nobody cared."

Frustrated by limited opportunities, Slavey Indian Chief Daniel Sonfrere, right, persuaded the federal government to give his band 52 square miles at the town of Hay River. Now the Indians have been offered huge sums to lease part of it for barge tie-up facilities, but the town is suing Canada to gain control of that 400-acre area.



Discoveries in the Arctic islands, the Mackenzie River Delta, and the Beaufort Sea area likewise remain years away from reaching market in important amounts because of transportation. A fleet of ice-breaking Arctic tankers is a distant prospect, and a pipeline requires much time and great sums of money.

In hard fact, transportation of whatever kind tends to be restricted in the northern vastness, except for snowmobiles. As one observer told me with a straight face, "This is an absolute Garden of Eden for the Skidoo."

A couple of years ago, with the high north making increasing demands on Alberta's goods and services, the provincial government strengthened its air link there. For 37 million dollars, Alberta simply bought the bulk of Pacific Western Airlines' shares of stock on the open market.

Boomtown Brings a Cultural Shock

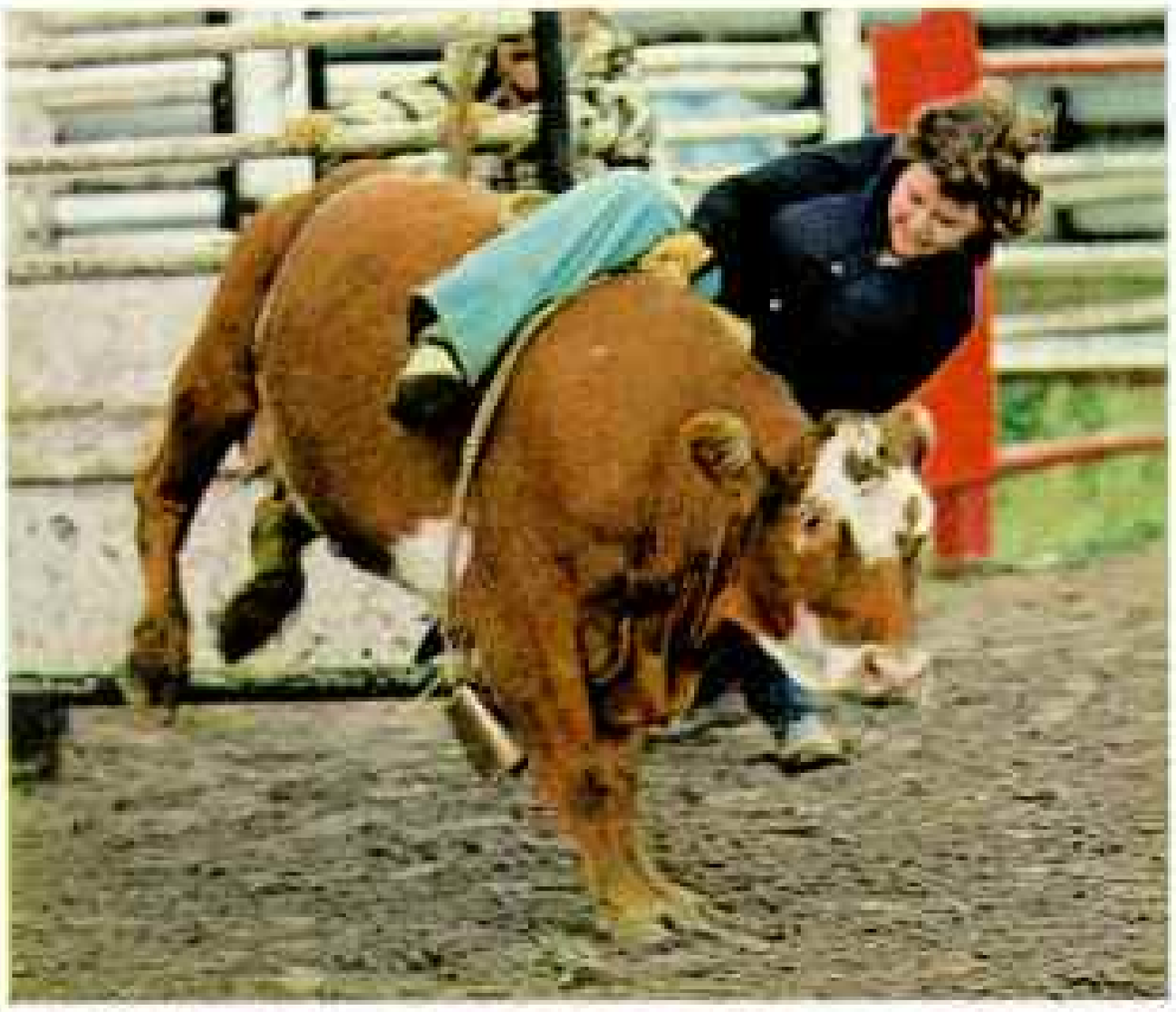
Basing myself in Edmonton, I made my way, usually by Pacific Western, to the city's distant satellites. I remember the day I hopped a PWA jet to the tar-sands hub of Fort McMurray. Killing time, my neighbors and I played the airline-nickname game. "Please Wait Awhile," suggested Aisle. "Pray While Aloft," countered Middle Seat. "Probably Won't Arrive," submitted Window Seat.

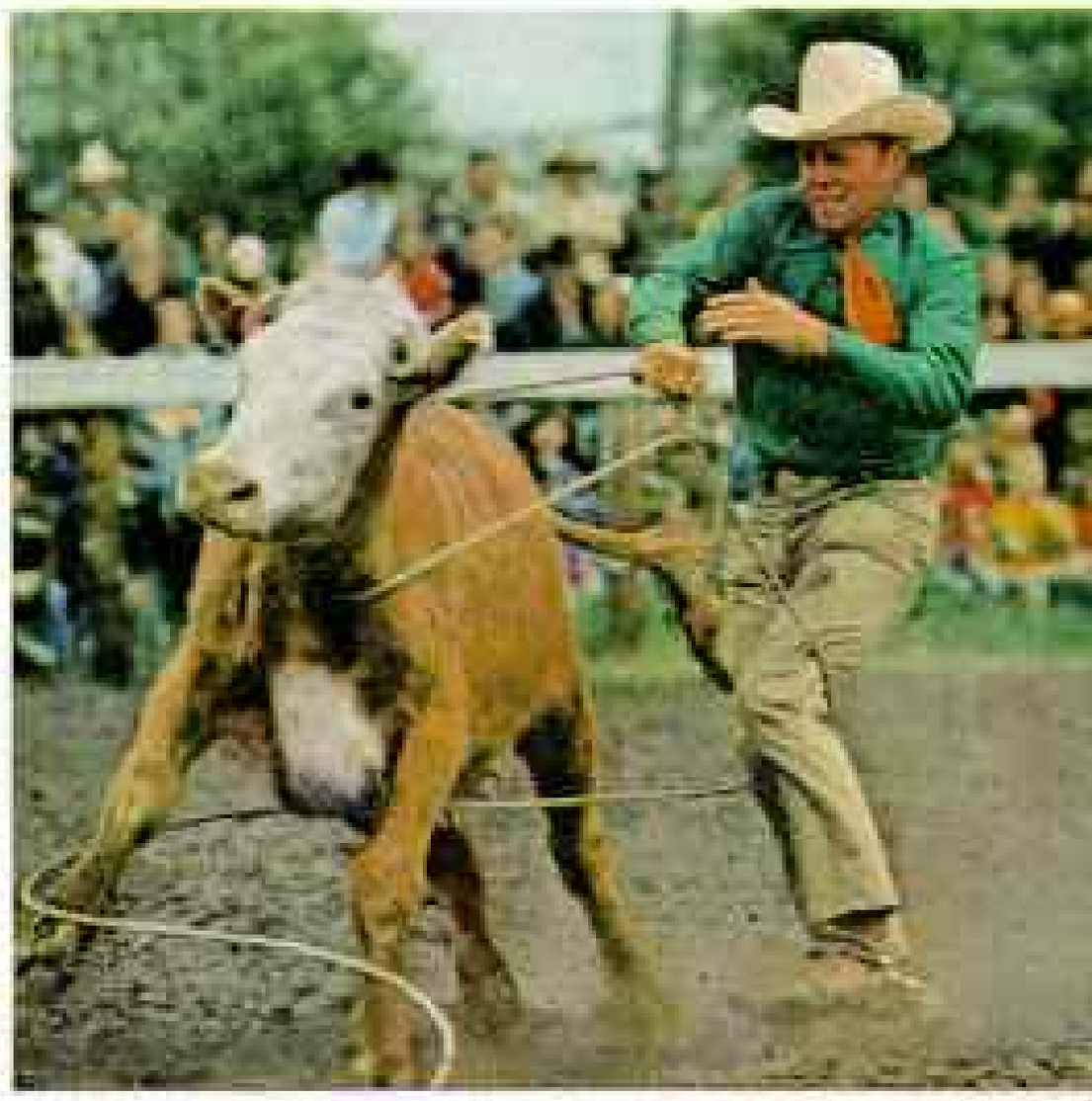
Arriving, I picked up a rental car and soon came upon an explosion of humanity. Choked with about 16,000 residents where 1,200 lived a dozen years ago, and expecting 14,000 more by 1978, Fort McMurray already was a million dollars short of paying for the year's minimum services—new schools, roads, a new hospital.

It would never be able, I concluded, to overcome what earlier pioneers called cabin fever. The community reverberates in a wilderness of muskeg, tamarack, and black spruce. The bright lights of Edmonton, the nearest city, beckon 275 highway miles southwest; some people make the run in under four hours, Friday pay burning their pockets.

"My wife cried when we first came to town," newspaperman Peter Duffy, 32, told me. "It was one cultural shock to drive down that main street. I felt like heading back home all the way across the country to Nova Scotia and civilization."

Windows rolled up against a haze of dust, we jolted through Fort McMurray's potholes, jousting with pickup trucks and heavy equipment. The sights skipped past, a kaleidoscope of bars, tipsy men on the sidewalks, seedy movie house, motels, coin laundries, Hudson's





Cowpersons at work

On the plate, Alberta beef is tasty and tender. On the hoof, it's unforgivingly tough, as a rider (**above, left**) discovers at Ponoka's all-girl rodeo. Another contestant awaits her turn (**facing page**). At the St. Albert rodeo (**above, right**) a cowboy lassoes a calf and ropes himself.

Bay Company store, fried-chicken palace, bright new Safeway. Trailer homes by the hundreds nested in concentric ranks on the river flat; on the hills crews hurriedly pieced together precut houses, racing against the onset of winter.

At one of the town's four traffic lights an unmuffled engine rose to a triumphant crescendo. When it subsided, Peter Duffy resumed. "A lot of people have said, 'The hell with this place.' Many wives don't like Fort McMurray. They hate the dust. They can't keep anything clean. The bars are the social centers. Bullets have flown."

But the Duffys had stayed on. . . ?

My friend tugged at his beard. "We've grown accustomed. We've come to like it more. One reason is that we're about to move into our new house on Beacon Hill." As we parted, he said, "We haven't all accepted the frontier mentality. Many of us are trying to implant civilization here, the way of life we left behind. People are starting to stand up and make something of the community."

Burgeoning Businesses Jostle for Space

The next man I talked with laughed when I asked what had brought him to Fort McMurray. Crew-cut Glen Bowden, personable president of the Chamber of Commerce, replied: "Almost every businessman in Edmonton told me I was nuts to come here. That was

about seven years ago. Businesses were going broke right, left, and center." He thumped the desk in his real-estate and insurance agency. "Now you can't find a square inch of space in a closet anywhere to put a commercial venture or an organization."

He handed me a chamber brochure. It named more than a hundred clubs, for tennis players, golfers, writers, skiers, figure skaters. Around six hundred business licenses were issued last year, he went on, but for one line of work there wasn't much call.

"Without an undertaker," Mr. Bowden mused, "you run into some pretty strange situations. When I first got here, a friend of mine died in a crash. I helped dig his grave with a pick in the middle of winter. It gets down to 50 below zero.

"Few old people live in Fort McMurray. The town's full of young people who have come to improve themselves." But the area expanded so rapidly that the accidental death rate finally did attract an undertaker last spring. Until then, the nearest one had lived 175 highway miles south.

The direct cause of Fort McMurray's chaotic prosperity is the Syncrude project's huge need for people, materials, and services. Half an hour's drive north, this joint venture of Imperial Oil, Canada-Cities Service, Gulf Oil Canada, and the governments of Canada, Alberta, and Ontario is constructing a plant for

Special men, special women

His own pride, his son's contentment, and a 575-acre farm near Deadwood are the harvest of hard work for homesteader Stanley Zatelny (**left**).

A field of rapeseed—used to make cooking oil and margarine—ripens where trees grew when Zatelny came more than a decade ago. He had to pull out roots by hand, haul water, endure summer mosquitoes and winter freezes. "You don't stick it out," he says, "if you're not the right kind of man."

Or the right kind of woman. More than two hundred miles to the east at Fort McMurray, Mrs. Thomas Waddell smiles, though she and her family have to live in a school bus (**right**). Her husband works at the Athabasca tar sands.

Canada's only reindeer herd forages in snow-covered tundra near Inuvik. The animals are descendants of stock imported from Alaska in the 1930's. An Eskimo who purchased

the reindeer from the Canadian Government three years ago operates the herd of 7,000 as a business, slaughtering them and shipping the meat to markets in the south.

the extraction of oil that will cost more than two billion dollars.

I turned up there on a sunny day, donned a hard hat, strode off across the 7,000 acres to be mined, and plunged knee-deep into sticky black sand. "Tar sand is basically a gucky mess," observed photographer Lowell Georgia, lending me a hand.

Indeed. No one knows how the bitumen it contains was formed, only that the sands were part of an age-old sea bottom that teemed with marine organisms. Indians once used the tar to seal their canoes. Now thousands of construction workers were preparing what may be the world's largest open-pit mine; in 1978 giant draglines will begin gouging that ancient seabed to a depth of 200 feet.

Though costly, the production process is simple. Mountains of tar sand move by conveyor belt to the extraction plant. There the bitumen is separated by hot water and steam. Upgraded by 900° F. heat into a low-sulfur crude oil, it is piped to Edmonton for refining.

How Much Will the Land Suffer?

During the mine life expectancy of 25 years, draglines will cut a three-by-four-mile swath deep enough to hide a 20-story building. What of the land and environment? It is a question of great concern to Canadians, and the subject of continuing studies. In time, other tar-sand mines and colossal extracting facilities will go into operation. I took this matter up with H. B. Scott, Syncrude's tall, soft-spoken president.

"We are convinced," he replied, "that human use of the environment need not be destructive. We will do everything possible to protect wildlife, vegetation, appearance, and air and water quality. The mine will be fully reclaimed. We'll refill, level, and contour it into a well-drained, gently rolling plain, and cover it with grass and trees."

Still, mine reclamation won't begin for years, and it may take a century for full-size spruces to reappear in this slow-growth region. And some alterations will be irrevocable: a system of dams, one more than two miles long, built to hold wastewater and tailings.

In Canada's northland man has always wrested what he wanted from the earth with unremitting toil. More than 200 miles due west of Fort McMurray, in the wild and hauntingly beautiful Peace River country, a strong, tanned homesteader named Stanley Zatelny (page 494) spoke ruefully to me of his long contest with the land.

"That's mine," he said, pointing to a 300-acre field of barley billowing in an easy breeze. "That was all bush—spruce, black and white poplar, and willow. I cleared it, piled the timber, waited for it to dry, and burned it. Then I broke the ground and grubbed out the roots."

He studied me narrowly, sizing up a city man. "Isn't anything much harder than cutting out roots by hand. Now we have root harrows. But it's still hard work."

Only the Hardy Need Apply

Stanley Zatelny uttered certifiable truth. I clung to a bucking tractor that day as it struggled to pull a scarred steel plow through virgin soil. The thick clay resisted mightily, stumps and roots forcing the tractor into roaring agony.

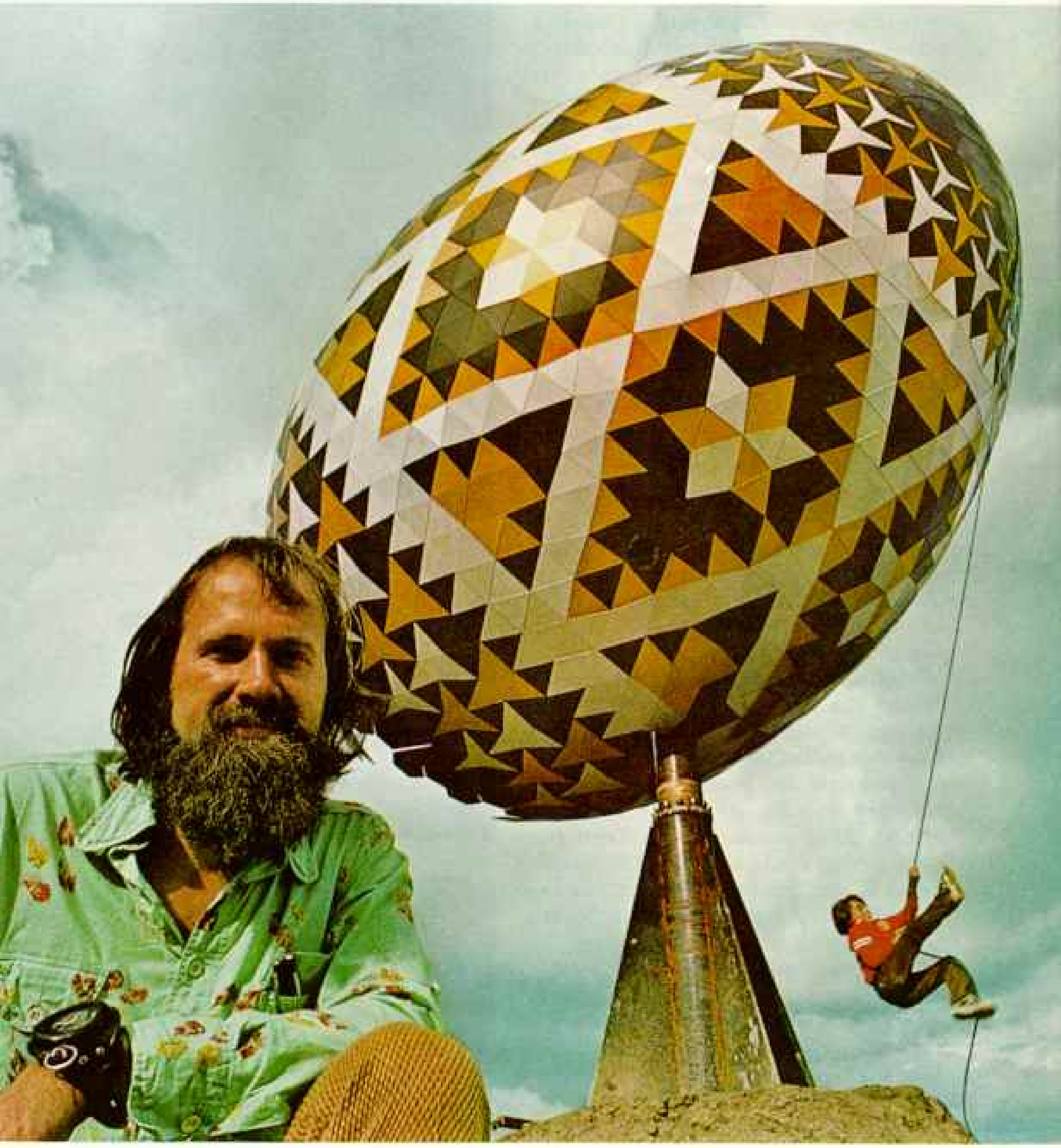
Slowly, man worked his will on nature. The furrow lengthened, a V-shaped incision eight inches deep slowly turning into a 200-acre field. It would be fine for crops of flax, wheat, barley, grass seed, or rapeseed, all of which grow rapidly.

They must. Stanley plants around the first of May, when winter's effects have gone, and harvests at the end of August, before cold weather returns.

"It's a big gamble all the time," said the 41-year-old farmer, "and the farther north you go, the bigger the gamble. It's tough just getting started homesteading. You have to be a Canadian, and an Albertan for one year. When I found my land, there was no road to it; took us all day to get in with a tractor. You should build a shack that costs at least $1,000, and live in it. Haul your own water. Mosquitoes are terrible. Stick it out for about five years and the land's yours."

When we returned from the fields I paused before the old homestead, a small log hut. Nearby stood a new one-story frame house. "Built most of it myself," said the homesteader, pride in his voice. "Three bedrooms plus one in the basement. I sawed the lumber from our own spruce. I put so much work into it—I'd rather cut out roots than build another house. Let's go in."

Inside, Mrs. Elizabeth Zatelny introduced



But where's the chicken?

This egg was "laid" by a computer. In 1973, when citizens of Vegreville wanted a gigantic Ukrainian Easter egg to mark the centennial of the Royal Canadian Mounted Police in Alberta, architects and engineers scoffed. But Vegreville found its man, Professor Ronald Resch (**above**), a computer scientist at the University of Utah.

Two years and 12,000 man-hours later, Resch and joyful area residents put 2,732 aluminum triangles and stars together to make the world's largest Easter egg—25.7 feet long. Resch, still at the university, now hatches new ideas for NASA.

me to their four children, all blond, barefoot, and bashful. Then this attractive young homemaker, substitute teacher, 4-H club leader, and peerless baker seated me at the kitchen table and served coffee and superb poppyseed cake. Some of the Zatelnys' scarce neighbors joined us and we talked farming.

"Wheat'll run 20 to 30 bushels to the acre if it rains."

"Hasn't rained for weeks."

"I broke the land in '55, and I've been broke ever since."

"What gets me, I'm allergic to the pollen."

"What grows good up here is kids."

The Little Purple Schoolhouse

I moved on, into the Northwest Territories via Pacific Western Airlines. Touching down at the transportation center of Hay River, population 4,000, the plane bounded along the uneven runway like an Arctic hare fleeing a wolf. "Ladies and gentlemen," purred the stewardess over the loudspeaker, "there is no extra charge for that landing. It is just one more of Hay River's attractions."

Other attractions impress visitors more favorably. The Town Hall, strikingly modernistic, and the attractive, well-stocked library please the eye. But the high school, nightmarishly contoured and colored a sickly purple, challenges credulity. A 16-story apartment building, tallest structure in the Territories, looms incongruously over the flat country. And in a land full of mosquitoes, "no-see-ums," black flies, and horseflies, Hay River's voracious insects seem unexcelled.

The degree of human thirst also is notable. In the Ptarmigan Inn's lounge, a customer said to me, "The last beer in this place was drunk last night." A waitress set two bottles before us. "The new shipment arrived today. We never run out." We clicked glasses.

I stayed at the inn and introduced myself to manager John Pollard, a brisk young Englishman. "You can live in a city and hardly meet anyone," he said. "Making friends here is easy. Mind you, it's frontier. There are a lot of fights. That's the kind of place it is. I tell 'em, 'Fellas, please go outside if you have to fight. You can come back in. Just don't mess up the furniture.' "

Sitting on the southern edge of Great Slave Lake, nearly 700 road miles north of Edmonton, Hay River assembles barges and receives

Grit, grunts, and gold medals

Water-polo teams fight it out at the Alberta Summer Games, held last year in Red Deer (**above**). For four days athletes cycled, canoed, ran, rowed, sailed, swam, and even parachuted to victory in 26 events.

In the winter just about every town ices a hockey team. Goalie Jackie Laurent (**left**) of the Ardrossan girls' team awaits the attack.

Playing in the snow—what else?—dark-jerseyed Edmonton Eskimos tackle the Winnipeg Blue Bombers (**right**).

freight by truck, rail, and plane throughout the long winter. Early in June, tugboats push barges into the northwest-flowing Mackenzie River and descend to its mouth as the ice breaks, resupplying northern settlements and the isolated gas and oil exploration camps.

Some barges carry containerized goods and supplies—sleds, snowmobiles, washers, dryers—or haul half a million gallons of oil each. Some off-load cement and drilling mud at man-made islands in the Beaufort Sea; others deliver pipe to Alaska's north shore. All should be back in Hay River by mid-October, lest ice capture them. Freezing weather arrived three weeks early in 1973, trapping a fleet all winter.

Yellowknife Lives in an Icy Vapor

Across Great Slave Lake from Hay River lies the city of Yellowknife, capital of the Northwest Territories. Some of its people view development with misgivings. "We must take care of our own needs first," they say. "We don't need more immigrants."

I first set foot in Yellowknife, a community of about 10,000 souls, on a January day when it looked like hell frozen over. The thermometer was holding at minus 46° F. In the still, stiletto-sharp air, white plumes drifted straight up over the snow-shrouded city as if from the campfires of some ghostly host. Every car exhaust left its trail. The exhalations of people and buildings added their mist. People here moved in an icy steam manufactured by themselves. They did not seem to mind. Mostly, they kept indoors.

I found earnest government bureaucrats going about their duties in the impersonal paper-strewn cubicles of their profession. We ranged far in our talks: How native hunters were getting $300 for a prime wolf pelt, and $1,000 for a polar bear skin; whether the town of Inuvik deserves to be called a Babylon; how the *Edmonton Journal* sometimes arrives the same day it is printed; why dog teams are preferable to snowmobiles in the bush (you can eat dogs); whether better fishing can be found anywhere in the world; how apartments vibrate when gold miners blast thousands of feet beneath the city, and how some vow you can hear the men's voices. . . .

I reported early one bitter day to the Con Mine at Yellowknife and dressed myself in long underwear, coveralls, two pairs of socks, rubber boots, hard hat and lamp, and gloves. Then an elevator, dropping 800 feet a minute, carried me and superintendent Barrie Hancock to the mine's 4,500-foot level.

We stepped out into dismal gloom relieved only by sullen ceiling bulbs and our lamps. My glasses fogged over in the tunnel's 90 percent humidity; water sloshed ankle-deep, helping to lay dangerous silica dust. The temperature stood in the 70's. Face glistening, a miner wielded a pneumatic drill against a face of quartz, a ton of which contains around half an ounce of gold. He cut his drill, doffed earmuffs, and cheerfully appraised his situation.

"In summer, up top, it's mosquitoes. In winter it's snow and frostbite. None of that bothers me here." He grinned. "You can't have everything. Nobody's politicking for my job, and this air is great."

Great, I thought, if you like working in a steam bath.

Half a mile distant laterally and a hundred or so feet deeper, I shook hands with George Schulz, a miner almost half his 42 years. He wore a wool shirt, sleeves rolled, and plainly preferred to keep working.

"What I mind," he said, "is coming out. It's pretty bad when you come out and it's 40 below. I keep busy, and sometimes the time is too short. If a man's gonna earn a few bucks, he's gotta move." And he did.

Back on the surface, Barrie Hancock explained. Miners need up to three hours of their eight-hour shift just getting to and from their stations. They are on contract; the more tons they mine, the higher their pay. They generally work alone, with headlamps often their only light.

"We look to George Schulz for a thousand tons a month," said the 36-year-old superintendent, himself once a coal miner in Wales. "He's one of our best. A top-notch miner can make a hundred dollars a day or more."

Inuvik's Sun Rises at Lunchtime

Yellowknife, as the territorial capital, watches over its huge domain only with difficulty. Bush planes, often sturdy De Havilland Twin Otters, workhorses of the north, carry people to lonely hamlets and camps.

But Inuvik, Canada's northernmost incorporated town, about 130 miles north of the Arctic Circle, is accessible by scheduled

A freewheeling spirit induced businessman Jack Cohen (**left**) to offer his Rolls Royce—with himself as chauffeur—to the highest bidder in a fund-raising campaign to support the arts in Edmonton.

World's most expensive "credit card"? A 24-karat gold medallion (**below**), minted by Sherritt Gordon Mines Ltd. of Fort Saskatchewan, Alberta, identifies VIP's at the Egan restaurants in Toronto.

Pacific Western flights. I landed there one February night to an eerie display of northern lights and next morning heard schoolchildren at recess playing in darkness—the sun finally flared above the horizon as noon approached.

Inuvik—Eskimo for "Place of Man"—is the far north's headquarters and jumping-off spot. Government people, scientists, trappers, oilmen, workers jam the Place of Man; trucks, cars, and snowmobiles throng the streets; Indians, Eskimos, and whites flock to the bars.

The town, population about 4,000, works hard and plays hard, as Father Joseph Adam well knows. At the igloo-shaped Our Lady of Victory Church, Father Adam told me about the place and people he has served.

"The spirit is good. We still say hello on the street. This town will not go down. Yes, it has problems." The white-haired, white-bearded priest fixed me with the eye of an Old Testament patriarch.

"The number-one problem? Drinking. Most of the trouble is caused by alcohol."

Why so much drinking among the natives? I heard many answers: dislocation, cultural erosion, unemployment, racial discrimination. Father Adam had his own viewpoint:

"I think it is weakness," he said. "Some of our native people have never learned the virtue of temperance. And when the government came with the welfare and all that, the natural leadership was destroyed. Now people think that as long as the government is there, they are secure.

"Another serious problem is education. The modern system says that the child should not be interfered with. That is nonsense, and so we are raising little monsters. Education, though improving, is too permissive. There is not enough discipline yet.

"Eskimos have had a simple and good traditional philosophy. The man of the house was bringing in the food; he was the teacher of the boy. The woman kept house, teaching the girl. Together they were responsible for

teaching their children. Now others are taking responsibility from parents. Some parents come to me almost crying."

For me, such sadnesses fell mercifully away at the edge of town, where civilization ended. Beyond lay the void, which I welcomed: the bleak land of shrieking gales and driven snow and distances stretching away to infinity. You penetrate this polar desert by air, cocooned in a helicopter or plane, even in a Hovercraft, and you strain to see signs of life, knowing life is out there.

Life Is Basic for Reindeer Herders

By helicopter one afternoon I went looking for the only reindeer in Canada, a semi-domesticated herd of 7,000 browsing not far from Inuvik (pages 496-7). The rolling country hid them for more than an hour. When we found them, we landed beside their herders, five Eskimos who were making a new camp. In minutes they raised their tent, anchored it to the ground with snow, and installed a stove and pipe.

They were men of few words. They told me that reindeer skins were their beds, reindeer meat their food, melted snow and ice their water. I noticed some rifles. "Many wolves," a herder said. I waved and lifted off in my whirligig, in seconds part of a different world.

Next day I rode a Twin Otter of Imperial Oil Ltd. to watch an artificial island take shape seven miles from land in the frozen Beaufort Sea (pages 508-9). We landed near a barge that served as the construction crew's living quarters. A couple of large dogs romped in the snow beside the plane.

"Why the huskies?" I asked a grizzled fork-lift operator.

"They guard against polar bears."

Then he gave me the tragic rest of it. A month earlier a bear had silently climbed aboard the barge. In the darkness he mauled a lone man on the deck, took his victim off

"Crops'll be good, if...."

Peace River country is now a panorama of plenty, like this field of rapeseed near Manning, rimmed by grain elevators. But when the first sodbusters came, bringing their families, furniture, and optimism, it wore a full beard of trees. Nearly twice as large as England, Canada's northernmost major farming region has the usual four seasons, plus an "if" season. This begins around the first of August, when farmers say to each other, "If it doesn't freeze before September, we've got it made."

Near Carstairs, just north of Calgary, where the first freeze comes later, a farmer harvests barley in late evening (**right**).

the barge and out a short distance on the ice, and ate him. At noon sunrise, a search party found the remains and the bear. Only Eskimos are issued permits to kill these animals; the Royal Canadian Mounted Police flew in an Eskimo hunter for the job.

Watching for polar bears, I proceeded to the site of the future drilling island. "Exploration is hard, hard, costly, dangerous work," reflected an Imperial construction technologist standing beside me. "These guys are fantastic. They're here to do a job."

This job was prodigious. Heavy equipment labored to slice seven-ton blocks of ice from the sea and carry them away, leaving an ever-growing hole of open water, here only five feet deep. Into it gravel fill was being poured. In less than two months a two-acre island would stand ten feet above the surrounding ice, with 57,000 sandbags girdling it against erosion. And on it a rig would be drilling.

Imperial hoped to strike oil and gas beneath the island. Later I learned that the hole cost six million dollars, and proved dry.

But energy companies—Shell Canada, Gulf Canada, and Sun Oil, as well as Imperial—*have* found gas and some oil in the Mackenzie River Delta. Imperial also has discovered gas and oil at sea; it has built nine islands thus far. I traveled to several of them one day in a Hovercraft as it shuttled crews.

Touches of Beauty Everywhere

A Hovercraft at rest squats on the beach like a bloated frog washed up by the tide, low, wide, and ugly. A collapsed rubber skirt wraps it. When the pilot throws a switch, the hulk's turbine engine roars, and a miracle happens. The rubber skirt hangs straight to the ground as the ship majestically rises four feet. Turning to sea, she glides daintily away on fan-driven air held in by the skirt. At fifty miles an hour she skims the ocean, hauling up to 33 passengers or 12,000 pounds.

My Hovercraft hauled a special passenger that day, to the pleasure of us all. At Imperial Oil's Camp 3, a living-quarters barge seven miles at sea, we picked up a dozen workmen —and one comely young woman. She wore slacks and blouse, a trace of eye shadow, a bit of lipstick, and a big smile.

"I'm going for the ride," announced Betty McKinnon. "I've got to get off that place for a little while. After you've been on the barge long enough, you could call it Alcatraz."

In her 20's, Betty is a cook's helper, teaming with two other women on the barge. She works 18 days, then takes 10 off. She receives about $1,200 a stint. With her savings, she said, she planned to resume studies at the University of Alberta in Edmonton.

"I like it up here," she told me, "though it does become dull. The men are easy to get along with—they watch their language around us. As long as the food's good, there's no problem. It's just that you get tired of living on a barge and seeing nothing but old movies and videotape TV."

Never Challenge a Pilot

Everywhere I traveled, camp life's containerized, carpeted monotony did agree with me, especially after a trying day afield. A Twin Otter flight one fine evening leaps to mind. "What would happen if you lost an engine?" I asked the pilot. He shrugged, moved some controls, and pointed out the window. The starboard propeller no longer turned. But the plane flew smoothly on.

I should have known then that this airplane driver was not one to back away from a challenge. As our landing strip, long and inviting, loomed up ahead, I jogged him again from the copilot's seat. "Suppose you were on instruments and low on fuel, and the wind was blowing so hard across the runway that you could not land. How would you get the plane down?"

Silence. He banked the Twin Otter sharply, circled, and nosed steeply at the runway—crosswise. Into the gale that wasn't there. We struck the strip, rolled all of its 200-foot width, and thundered to a halt within spitting distance of a hangar. But I couldn't spit.

I unwound that night at the regular 8:30 post-shift movie, a horror called *Drink the Blood of Dracula*. I played some pool, tossed a few darts, watched a table-tennis match,

"These were our fields."

Fedosia Loukianovna Verigin came to Canada in 1899 from southern Russia, one of about 7,500 Doukhobors, a persecuted religious sect. Thrifty, self-sufficient, they built prosperous communes in western Canada, but often defied land, tax, and education laws. Now 89, Fedosia stands in grainfields by an abandoned barn near Shouldice, Alberta, where a splinter group of moderates established a communal farm that disbanded in 1942.

Prospectors go to sea: Imperial Oil Ltd. builds an artificial island to support a drilling rig. When winter freezes the shallow Beaufort Sea, heavy machinery hoists up the ice (**above**) in seven-ton chunks. Then gravel is poured into the hole. After six weeks or so, there stands an island, complete with rig and camp (**top**). Workers commute in a Hovercraft (**right**) from living quarters on the barge *Siniktarpok*—Eskimo for "home away from home."

and padded down the hall in stocking feet toward my quarters—boots are always removed and left at the entrances to these interconnected buildings. A coffee urn and some oven treats rested on a table outside the dining room, and a cook stood alongside. "Try some cupcakes," he invited. How nice, I thought. Another man spoke up. "If they're like the last ones, you could use 'em for hockey pucks."

Frozen Ocean Supports a Gas Rig

Of all the camps I visited, I liked best Panarctic's Rea Point staging base, more than 600 miles north of the Arctic Circle on Melville Island. The activity never ceased; up to 150 men were being accommodated, some of them Eskimos working as laborers, carpenters, electricians. The airstrip was handling as many as 150 movements daily.

Most of those flights carried men and supplies to drilling sites and exploration camps as far as 350 miles away. I landed one morning on the frozen ocean eight miles off the Sabine Peninsula. Panarctic here was flooding the ice, approximately doubling its thickness to 16 feet, to support the 500-ton weight of a drilling rig.

While the pump spewed water over the ice, I turned to Don Connelly, Arctic foreman, a bluff veteran of polar work. The tremendous task intimidated me. To him it was routine. He nodded confidently. "Oh, the gas is here. We know it's here. We're just beginning." He squinted at me. "You've got a white spot on your cheek. It's freezing."

Another day, on a barren land frontier northeast of Rea Point named Cameron Island, I climbed onto the platform of a derrick with drilling foreman John McGillicky. Panarctic was probing for its first commercial oil well. Amid a constant roar, a tungsten-carbide bit with 45,000 pounds of weight on it turned at 80 revolutions a minute; grinding through hard rock, it sank only a foot every eight or nine minutes.

Gas and oil prospectors rank high as optimists. John McGillicky said: "This is our second hole on Cameron Island. We think we just missed a good strike with our first—it produced 500 barrels a day, not enough to be economical. Now, 2,000 or 3,000 barrels a day —*that* would be a big strike."

Then, fieldwork over, I flew back to Rea Point, packed my bag, and caught the workers' commuter plane back to Edmonton.

Here's one foxhole that doesn't have to be dug: an Arctic fox hides in an

oil-well casing at Rea Point.

I found the city carrying on as usual. Tunnel rats were burrowing beneath downtown streets for the 64-million-dollar-plus first phase of a rapid-transit system. New skyscrapers grew taller. Work began on the six-million-dollar Citadel Theatre.

The Edmonton Opera Association presented Bellini's *Norma* to a full house; the set alone cost $26,000. Swank Edmonton Centre, one of Canada's largest shopping-and-office complexes, opened 45 more stores for a total of eighty, and embellished them with a Garden Court decorated with fig trees (page 488). Subterranean "pedways" were branching out; this city builds down as well as up, and lines its underground thoroughfares with smart shops and restaurants.

All of Canada Looks to the Arctic

Roaming Edmonton, I thought about my friends in the polar islands. Had they discovered gas beneath the ice platform they made on the frozen ocean? Did they find big oil on Cameron Island? To get the answers, I took the short airbus flight south to Calgary.

As Edmonton serves as the supply and manpower center for the petroleum industry, so Calgary functions as its main office. Many gas and oil companies headquarter in this sophisticated and sparkling city. I made my way to the offices of Panarctic Oils and called on its president, Charles R. Hetherington.

"The ice-platform well turned out beautifully," the quiet-spoken executive said with a smile. "A fine producer. It extended the gas field eight miles out into the ocean." His smile broadened. "Cameron Island? It's a first-class discovery. It tests at 3,000 barrels of oil a day. We think that we're still not in the main part of the field."

I asked Mr. Hetherington to look into the future. "I do it all the time," he replied. "I believe that the Arctic islands can provide adequate future supplies of gas and oil for Canada—as well as for export. But the federal government must establish an economic climate that will encourage exploration."

Premier Lougheed had spoken of Alberta as "Now Country." Now change and conflict were stirring the wild and challenging country to the north. The world was running out of frontiers. This one, I could only hope, might survive the encroachment of man and his machines better than most. □

IT WAS NEARING three o'clock in the afternoon, although none of us could be certain of the time. We had already surrendered our watches, for they would be potentially useful instruments in navigating the 3,000 empty sea miles that lay ahead.

On the shore at Honolua Bay—a tiny, deep, and lovely cove on the northwest coast of Maui—a *kahuna*, or Hawaiian priest, touched each of us in turn and spoke the final blessing: "You belong no more to the land; you are now dedicated to the sea. . . ."

We went down to stand knee-deep in the water, whence we were ferried out to *Hokule'a* in a specially consecrated outrigger canoe. Henceforth, until we reached our destination, we must not go ashore again.

And so 17 men and the poi dog, Hoku, left Hawaii for Tahiti on May 1, 1976, some 800 years after the last great *wa'a kaulua*—double canoe—had made the voyage.

The 60-foot, twin-hulled *Hokule'a* carried claw-shaped cotton sails on her two masts. She was built largely of modern materials, but her lines were ancient—reconstructed from sketches by Captain Cook and others, so that her performance paralleled that of Polynesian voyaging canoes of long ago.

"Hokule'a" Follows the Stars to Tahiti

By DAVID LEWIS

Photographs by
NICHOLAS DEVORE III

Without charts or instruments the sailing canoe *Hokule'a* sets out from Hawaii for Tahiti. The voyage confronts an intriguing question: Could ancient Polynesians regularly have navigated the 3,000-nautical-mile route, one of the longest in the Pacific? Here, as *Hokule'a* rides northeast trade winds, Dukie Kuahulu mans an immense steering paddle. Barely visible on the horizon, the ketch *Meotai* carries radio and emergency supplies—but gives *Hokule'a*'s navigators no hint of their position.

We were sailing under the auspices of the Polynesian Voyaging Society, as an official Bicentennial project of the State of Hawaii.* Our purpose in retracing this ancient sea route in a re-creation of a 12th-century craft was to gain insight into how such voyages might have been made many centuries ago.

Above all, we would be testing the accuracy of long-distance navigation entirely without instruments, as well as the canoe's ability to deal with head winds and currents. If successful, we would be demonstrating that ancient Polynesians were, indeed, able to sail purposefully and repeatedly over vast areas.

The Polynesians had brought with them in their canoes the dog, the pig, and the chicken. We, too, carried these animals, and an important object of the voyage was to learn how to feed and care for them at sea.

Hoku Li'i Li'i (Tiny Little Star), our little golden poi dog, was born in the Honolulu Zoo and represented an attempt to breed back to the original Polynesian barkless vegetarian dog used for food. The zoo had also bred razor-backed pigs and Polynesian chickens,

*Herb Kawainui Kane wrote of the prelude to this voyage in "A Canoe Helps Hawaii Recapture Her Past," NATIONAL GEOGRAPHIC, April 1976.

Clipping along at six knots, *Hokule'a* in brisk winds logs more than a hundred miles a day. Built by the Polynesian Voyaging Society, the 60-foot

double canoe with crab-claw sails re-creates the Polynesian vessels admired by Capt. James Cook in the 1770's before their disappearance from the Pacific.

but at the last moment the director decided they were ill-prepared for the voyage and declined to let them sail with us. So Maxwell, a white and very domestic pig (he was disadvantaged on both counts, we were to discover), and a cock and a hen were hurriedly purchased for the voyage.

There were plants, too, aboard *Hokule'a:* sprouting coconuts, breadfruit, sweet potatoes, sugarcane roots, and a dozen other useful species that ancient Polynesian explorers had introduced into empty Pacific islands, including Hawaii. Our specimens were bundled in layers of damp moss swathed in tapa cloth and stowed in the hulls.

On the eve of our departure we had been purified in a sacred kava ceremony; until the taboo was lifted by our arrival in the Tahitian archipelago, wine and women would

One last aloha: Dukie Kuahulu hugs a well-wisher at departure from Maui on May 1. For seven months *Hokule'a*—Star of Gladness—had cruised the 50th State, reviving an interest in Polynesian traditions and training her crew. The 17 men included a Micronesian, a New Zealander, two U. S. mainland photographers, and 13 who reflected Hawaii's rich racial mixture.

be forbidden. Then the navigator and sailing master, Mau Piailug of Satawal, one of the distant Caroline Islands of Micronesia, addressed the ship's company. We were a mixed group of Hawaiians (mostly expert watermen, surfers, and paddlers) and *haoles*—non-Hawaiians. But only a handful of us, Piailug knew, were experienced offshore sailors.

"I wish to speak to the whole crew, how they should conduct themselves in the deep sea," he said. "Before we sail, we must throw away all things worrying us. On the ocean all the food, all the water, is under the control of the captain . . . everything the captain says to do, we follow. Only the captain tells us when to change course.

"When you are on the ocean you cannot see any islands. Only the things we bring with us help us to survive. We act together. That is all I have to say. Remember, all of you, and we will see that place we are going to."

Perhaps, in the weeks to come, his words might have been better heeded.

Constant Spray Makes Sleep Uncertain

Conch-shell trumpets blared from shore as Capt. Kawika Kapahulehua ordered *Hokule'a*'s sails unbrailed and her anchor raised.

The heavily laden canoe, reverently garlanded in ti leaves for good fortune, pitched into the seas as she came out from under the land and headed north on the first of the long series of tacks that would take us past the "Big Island" of Hawaii.

Far behind followed *Meotai*, a large ketch that would "shadow" us during the entire voyage. We would talk to her frequently by walkie-talkie (we could not communicate directly with land), but *Meotai* was strictly forbidden to provide any navigational data or hint of our position.

Volleys of spray swept the canoe's deck platform, and we soon found that neither the *hale*—the thatched shelters—nor the canvas spray covers fitted over the hulls offered much protection. That first night some of the crew laid plastic sheets or rubber storage bags over the slatted decking and rolled themselves in spare sails; others strung hammocks under the thatch. Hoku was tucked into her specially made sleeping bag. The chickens seemed content in their coop, but Maxwell lay miserable and seasick in his bamboo cage.

I was among those who chose to sleep in a

puka, one of the six-foot-long spaces between bulkheads in the hulls. I wore oilskins "down below," however, for jets of water spurted constantly through insignificant openings in the canvas cover. I christened my puka the "water bed," but I slept soundly there, for the seawater was warm—in marked contrast to some I have known.*

The navigator, Mau Piailug, rarely left the stern, where he later strung a hammock of knotted cords between two spare steering paddles. He did not stand regular watches; day and night he remained alert and watchful, studying the stars and the waves. When all was quiet he slept, but he slept lightly.

Piailug was, of course, the central figure in our navigation experiment. On his home island, Satawal, ocean voyaging in sailing canoes without instruments is still the way of life.† Now 44, he is stocky and short; his nickname, "Mau," means "strong" in Satawalese.

His formal training began when he was only 6 years old and ended at 18, when he was initiated as a fully qualified *ppalu*, or star-path navigator. He has since roamed far and wide through the central Carolines. In 1974 he navigated his 30-foot outrigger sailing canoe from his home island to Saipan in the Marianas and back, without chart or compass—a distance each way of about 500 miles.

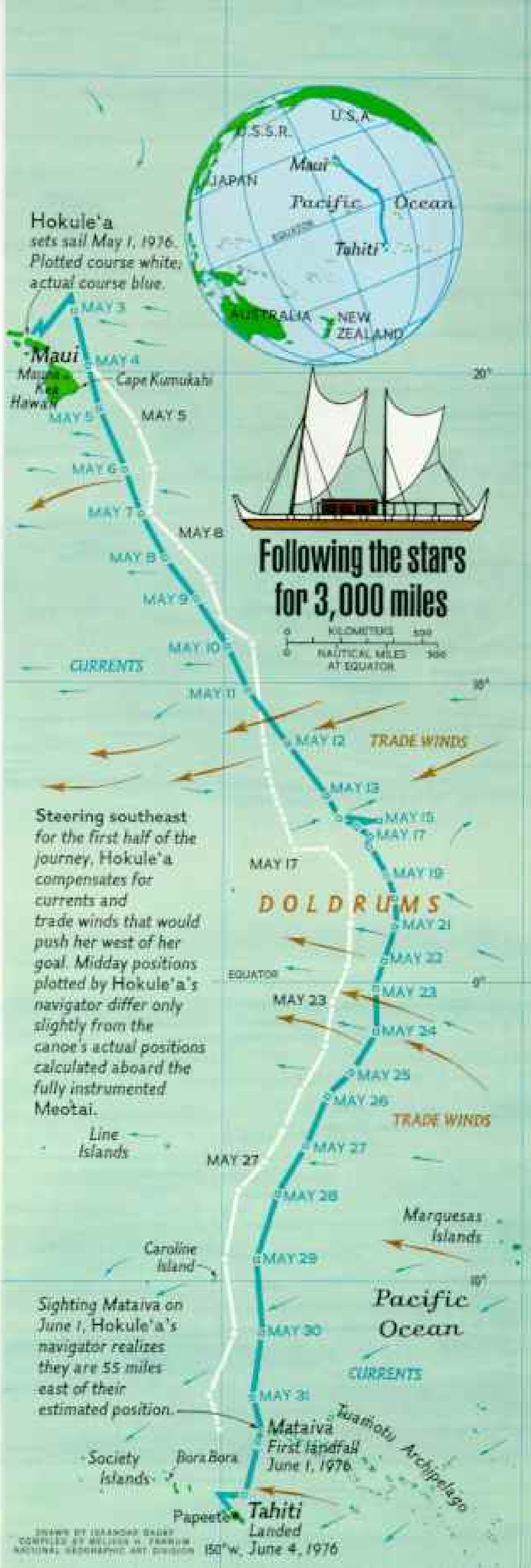
Seasoned Navigator Sets the Course

The Carolinian system of navigation is a "closed" one: distances (in days of sailing) and bearings (in star "compass" points) are learned by heart for hundreds of islands.

How would Piailug's system fare in unfamiliar waters? An old-time Hawaiian or Tahitian navigator would have had data for our voyage equivalent to Piailug's familiarity with his own widespread archipelago. It fell to Rodo Williams, a Tahitian former schooner skipper, and me to help Piailug extend his geographical range. We would provide such knowledge as the distance (six times that of his Saipan voyage), and the location and bearing of distant *etak*, or reference, islands, such as the Marquesas (map, right).

*See David Lewis's "Alone to Antarctica" and "*Ice Bird* Ends Her Lonely Odyssey," NATIONAL GEOGRAPHIC, December 1973 and August 1975.

†In "Wind, Wave, Star, and Bird," NATIONAL GEOGRAPHIC, December 1974, mariner Lewis described the millenniums-old methods Polynesians used to navigate across vast reaches of the Pacific.



In voluntary confinement, *Hokule'a*'s crew work, sleep, and eat on the 9-by-40-foot deck. Songfests, card games, and macrame help pass the hours. Only once, on the last day out, did the tension of living in such close quarters erupt in a scuffle.

John Kruse (**left**) waters Maxwell, the pig brought along because Polynesian colonizers carried livestock.

Over a fire of coconut husks (**right**) author David Lewis fries banana fritters under the eye of Clifford Ah Mow. The big canoe was amply provisioned with Polynesian staples—sweet potatoes, dried fish, bananas, and coconuts. The crew nonetheless drew on *Meotai*'s canned rations, abandoning the experiment that called for using only foods available to their ancestors.

Rodo and I agreed with Piailug's strategy: "First we go northeast, go around Maui and Big Island, Hawaii. This be maybe three days." Next we must head toward the star point called *Tumur*, the place where Antares rises. This heading would aim us considerably east of Tahiti to compensate for strong currents that could sweep *Hokule'a* westward 30 miles or more in a single day.

Determining longitude would be the trickiest part. We would have to rely on the informed guesswork of dead reckoning. This, in turn, depends on a close judgment of speed. My own method was to count approximate seconds as the canoe passed a patch of foam: Seven seconds indicated five knots; six seconds meant six knots. Piailug merely looked at the water sliding past, but the result was the same.

Latitude can be determined without instruments to within 60 miles, and usually much closer. The first night out of Maui, Piailug confirmed our latitude by judging the altitude of the North Star, Polaris, with the span of his thumb and forefinger loosely extended at arm's length. "Just a very little bit under one and a half *ey-ass*," he pronounced. One ey-ass is equivalent to 15 degrees; 1½ equals 22½ degrees. Maui lies at 21 degrees north; accurate enough!

First Meal: Sweet Potatoes and Eggs

About 9 a.m., some three hours after sunrise, the canoe began a 24-hour offshore tack. Maxwell recovered his formidable appetite and enthusiastically munched strips of dried fish. The cock crowed and pecked happily at grated coconut. Not so Hoku. She was fretting, and it was to the kindly Dukie Kuahulu that she turned for comfort. She consented to drink a little water out of a coconut shell, looked with distaste at the sea, and retired again into her sleeping bag.

Hokule'a's fireplace was a steel pan (the old voyagers had used a wood frame) lined with coral gravel. Over a fire of coconut husks Piailug cooked the first meal: sweet potatoes boiled with coconut milk; and eggs boiled in coconut shells. We ate our meals together, one of us offering a *pule*, or prayer.

We carried enough fresh food for the first few days, but the bulk of our provisions consisted of hundreds of coconuts, sun-dried fish, dried sweet potatoes and bananas, and sour

FRANK MARSELL (RIGHT)

Star-path navigators guide *Hokule'a* across the trackless sea. From his home in the Carolines, Mau Piailug (**above**, right) brings the haven-finding skills passed down from the ancient mariners of the western Pacific. New Zealander David Lewis, left, veteran of solitary Atlantic and Antarctic voyages, has studied with such traditional navigators in Tonga and in Micronesia. Now on *Hokule'a* he contributes his understanding of zenith stars and geography while Piailug spots familiar stars rising on the eastern horizon.

Here the team locates Spica, a star passing overhead at latitude 11° S. "Most people in the West are so geared to technology," says Lewis, "that they don't realize what an accurate compass the sky really is." On overcast days Piailug finds direction in the pattern of ocean swells (**right**).

fermented taro poi. Drying and fermentation were the classic Polynesian methods of preserving food.

The ship's complement was divided into two watches, one under the captain and the other under the mate, David Lyman. Piailug and the expedition's two photographers were not included. Watches were timed by sun and stars—a system that led inevitably to a certain acrimony. The situation was not without humor, however. One black night Piailug was awakened to adjudicate the timing of a change of watch. He barely glanced at the impenetrable and uninformative overcast and announced, "Five minutes to four."

Ship's Mascot Finds Her Sea Legs

In the first few days out of Maui the trolling lines brought in three 30-pound *mahimahi*, or dorado. The crew grated coconut and squeezed out the milk, in which thin slices of the fish were marinated to be eaten raw. They also sliced steaks from the fish to be boiled and served with sour poi. Both were delicious. To everyone's relief, Hoku thought so, too; she had by now also developed a taste for coconut meat. She had found her sea legs, and walked the deck with the rolling gait of a veteran sailor.

On May 3, with *Hokule'a* sailing as near southeast as the trade wind would allow, Piailug told me, "Tomorrow we be east of Hawaii." My notes next dawn assumed we had made 115 miles southing in the previous 24 hours, and my own prediction was that we should be abreast of the Big Island about 3 p.m. The snow-capped summit of Mauna Kea, two and a half miles high, broke through the clouds at midday some 40 miles to the southwest. The beautiful volcano stood sentinel over the canoe the whole afternoon.

Next morning, when growing daylight extinguished the glow of Kumukahi Light, we left Hawaii astern. Winning clear of the islands had been a wearying chore, but we had gained much of the easting we would need. From here on we would still be sailing stubbornly close-hauled, but at least we were headed generally toward our goal.

"*Hokule'a, Hokule'a,* this is *Meotai,*" suddenly squawked the little walkie-talkie. "We've got some bad news for you folks."

One of our hosts at a farewell on Maui the week before had contracted infectious hepatitis. Presumably every one of us had been exposed; any or all aboard the canoe might come down with the debilitating illness long before we reached Tahiti.

Within hours a U. S. Coast Guard plane was circling *Hokule'a.* A watertight packet slung from a small parachute drifted down to us: gamma-globulin serum. As ship's doctor I soon found myself laying out swabs, syringes, and ampules on the heaving deck.

Willing helpers facilitated the task of inoculating everyone. Finally only I was left. David Lyman rubbed his stinging arm, and I thought that his great mustache creased in an unseemly grin as he performed on me. That night Boogie Kalama unshipped his guitar and entertained us with a creditable improvisation he called the "Hepatitis Blues."

May 8 marked the end of our first week at sea. We had reached a position, Piailug estimated, 330 miles southeast of the southernmost tip of the Big Island. The North Star had been mostly obscured by clouds, but the Dipper was now certainly lower and the Southern Cross noticeably higher.

"About the same as in Saipan," said Piailug. Saipan lies at 15 degrees north latitude. I put our position at 14° 30'. *Meotai,* using instruments, put us at 14° 06', we learned later in Tahiti. The largest discrepancy among our three estimates was 54 miles.

Wet Becomes a Way of Life

Hokule'a continued to plow southward in squally weather under overcast skies. As she pitched endlessly into head seas, breaking waves swept her length, penetrating every crevice. In my oilskins I thought of those voyagers of long ago, taking far worse and wetter buffeting wrapped in shaggy ti-leaf cloaks, or rolled up in *lauhala* mats to sleep.

Dukie Kuahulu took on most of the cooking chores—a time-consuming process, at best. He sat cross-legged for hours before the flaring "stove," carefully feeding in strips of coconut husk, but not even the stinging smoke could extinguish his infectious grin. As often as not, Hoku would be nestled against him.

A favorite meal that had many variations was dried fish boiled in seawater or, alternatively, in fresh water mixed with grated coconut. It was served as soup or with taro, sweet potato, or sour poi. The inventive crew had by this time fashioned a wide variety of

coconut-shell bowls and bamboo spoons; it helped pass long days of close confinement.

I am generally content at sea, and in fair weather I spent hours in the netting at *Hokule'a*'s bows watching rainbows shimmer and dance in the sunlit spray. With 17 men aboard, ship-keeping chores were minimal: checking lines for chafing, occasionally adjusting sail trim, keeping gear stowed.

Steering was the main task of the duty watch. The technique that we perfected aboard *Hokule'a* through trial and error may well have been the very same developed in the remote past by the Austronesian ancestors of the Polynesians.

Instead of being rotated to alter direction, the steering paddle was raised or lowered. When the blade was pushed down into the sea, the canoe's draft was increased aft, and the wind pressure on the sails caused the craft to pivot downwind. Conversely, when the paddle was raised, the canoe turned up into the wind. Auxiliary paddles and sweeps could be brought into play for sharp changes of course, as in tacking.

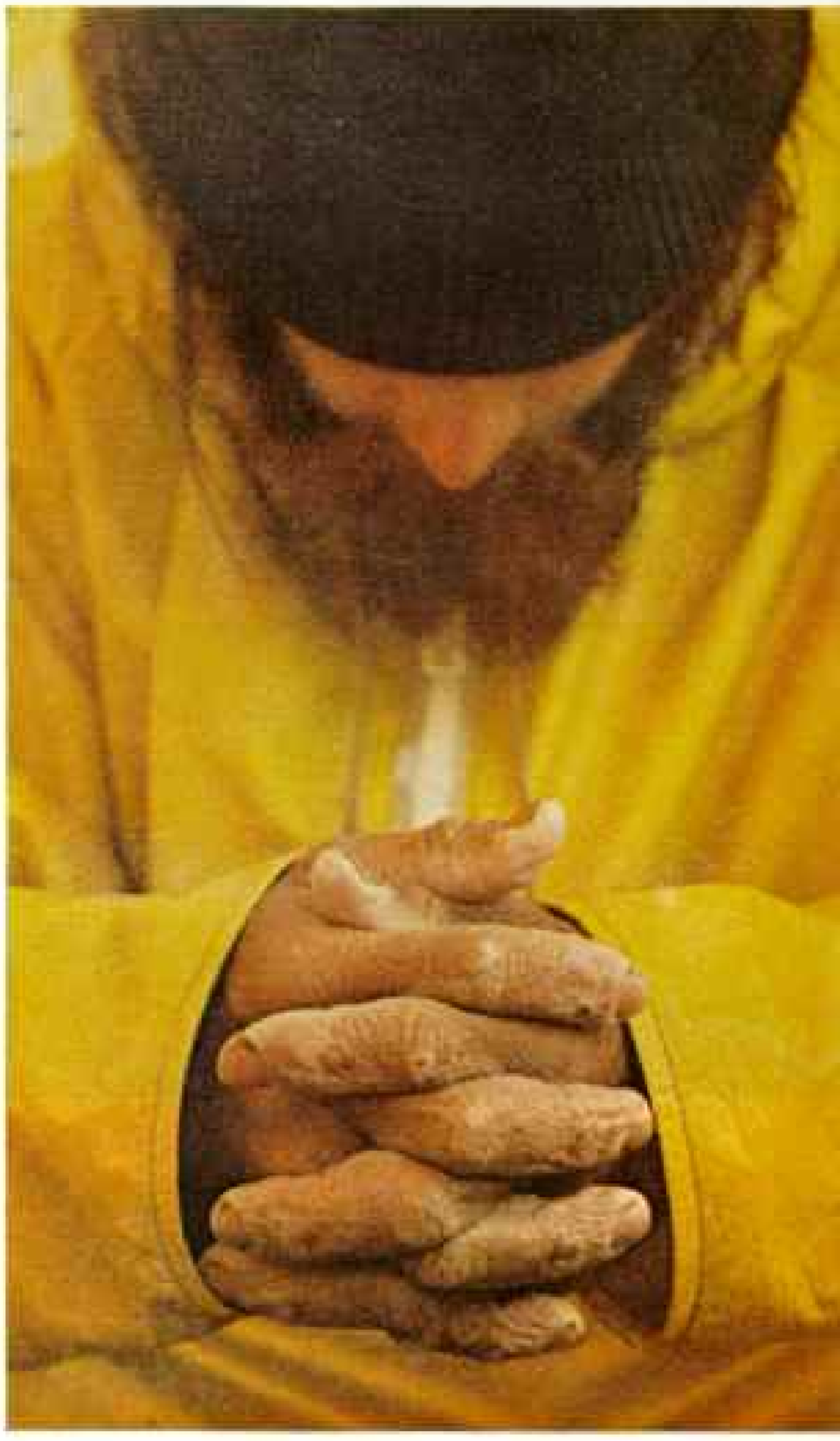
Sails Show Virtues of Ancient Design

Few people realize the great antiquity of sail in Oceania; today's little paddling dugouts are a far cry from the big planked vessels of the early voyagers. When man first ventured out into the open Pacific, his canoes were sail-powered and had been for 2,000 years. The earliest islanders to sight Hawaii —more than 1,200 years ago—already had 4,000 years of sail behind them.

Hokule'a's sails were copies of those depicted in Hawaiian petroglyphs. They were the claw-shaped sails of the Polynesians' great migrations east and west from Samoa; their contour minimized stress and spilled the wind in squalls. On her shakedown cruises, the general cut of *Hokule'a*'s canvas had taken some getting used to. But it is a tribute to the wisdom of long-dead Polynesian mariners that not one of our canoe's flexible *hau*-wood spars ever broke after the traditional claw-shaped sails were adopted.

Hokule'a's progress during the second week continued to be good, with daily runs of 120 to 130 miles. Piailug had analyzed the pattern of the ocean swells into five components, from the north, northeast, east-northeast, southeast, and south, although not all were apparent at the same time. Most noticeable was the one that rocked us from the port beam—the northeast—every half minute or so. Cloudy skies prevailed, and as often as not we had to steer by these swells; it was here that the crew, experienced watermen that they were, came into their own.

On our watch one black night, helmsman Sam Kalalau found the canoe swinging stubbornly into the wind. A square-jawed, powerful man, he wrestled with the nine-foot-long



After twenty days on the open sea, Shorty Bertelmann bows in prayer. Salt spray, chafing ropes, and chill winds keep skin withered and sore. But for Shorty, a construction worker, the voyage becomes an apprenticeship. He shadows Piailug to learn traditional ways of navigation.

"The doldrums have us in their clutch," photographer Nicholas deVore writes in his journal on May 18, "but sunrise is incredible." In a ritual at dawn each man checks to see that the chase boat, upper right, is still in sight, that they are not abandoned.

As humidity rises and winds die, Shorty Bertelmann rigs a shade against the sun (**right**). Crew members quickly realize that paddling at a mile an hour will not move the vessel out of this shifting belt of calms north of the Equator. They grow edgy as days pass. One evening a coconut-shell cup dropped overboard drifts out of sight astern; the next morning it is floating by the bow. "Kinda spooky," a crewman confides.

Earlier, fishing lines brought in more than a hundred pounds of tuna and bonito; clearly few early Polynesians starved on such voyages. Or died of thirst. Brief doldrum squalls brought *Hokule'a* thirty gallons of water. All the while, almost imperceptibly, puffs of wind are carrying the ship forty miles a day toward Tahiti.

steering paddle. "I can't hold her on course, Lyman," he complained to the mate.

In the morning Buffalo Keaulana and John Kruse discovered the reason. They noticed that *Hokule'a* was down by the head and deduced that the supposedly watertight *manu*, the end compartments of the hulls, must be leaking. Sawing through the forward bulkheads, they found both manu flooded.

When the water was pumped out, *Hokule'a* was a different ship; a few minutes' pumping night and morning was a small price to pay for her improved performance. With the improved trim the canoe steered herself to windward, and a constant hand on the helm was no longer necessary.

Day after day we were visited by mid-ocean birds like petrels and shearwaters. But brown boobies also followed us; one day we counted no fewer than 13. This was unprecedented in Piailug's experience as well as my own. Boobies are usually found no more than

50 miles from land, yet these were a good 700 miles from the nearest shore, in the Line Islands to the west.

The trolling lines brought in an occasional fish—tuna, albacore, dorado—and two small flying fish came aboard by themselves, to Hoku's thorough enjoyment. Once a squid jetted onto the deck to become (sliced and marinated) a welcome raw hors d'oeuvre.

Counterbalancing this, the sour poi was found to be flyblown; the plastic containers had unwisely been opened in Maui and now harbored maggots. Much of the supply was jettisoned, even though it would have been perfectly palatable cooked, and in any case was much to Maxwell's taste.

Boredom obviously was setting in, and the crew showed signs of dissociating into two groups. On the one hand were Piailug himself; Shorty Bertelmann, who had become his disciple and a budding star navigator; the magnificent seaman Sam Kalalau; Tommy Holmes, who had charge of the plant and animal experiments; Rodo Williams; and David Lyman. The others had already found the hankering for familiar foods too hard to resist and had petitioned *Meotai* for supplies of corned beef, flour, and rice.

Piailug remained silent about all this. He had earlier expressed doubts about the willingness of this crew to live on sour poi, dried fish, and dried bananas, but—with the dignity of a true Pacific islander—he never put forward an opinion more than once. It was already clear that his admonition to the crew in Maui had fallen on some deaf ears.

Smuggled Radio Goes Unnoticed

The captain, good-natured Kawika Kapahulehua, exercised minimal authority, and decisions at times were made by an emotional group lacking in open-ocean experience. A few failed even to appear on watch.

Only later did I learn that someone, unwilling to face a month's isolation at sea, had smuggled a small transistor receiving set aboard. Fortunately no clues to our position that might have been obtained by radio ever reached the navigator or his assistants—something that would have seriously compromised our experiment.

We entered the doldrums on May 13 in what I judged to be latitude 6° 30′ N. (*Meotai*'s log later showed it was actually 60 miles farther south.) Calms, variable light winds, and torrential rain squalls now became the

Abandon ship—but just for fun. Boogie Kalama leaps into the windless Pacific, a welcome diversion from the monotony of a nearly becalmed ship. Later the men scraped barnacles from the hulls until a sharp-eyed lookout spotted sharks, ending both scraping and skylarking.

Serenaded by creaking spars, Boogie dreams of Waikiki Beach, where, as an outrigger captain, he guides tourists through the thrills of the surf. At other times on this voyage he entertained the crew with guitar improvisations, beachboy ditties, and Hawaiian chants. Finally *Hokule'a* leaves the doldrums behind. On May 31, homing terns and the abrupt halt of the southeast swell signal land nearby.

order of the day. One shower alone yielded 13 gallons of rainwater to refill some of our plastic jugs.

Between showers the sun blazed down out of a cloudless sky. All hands, including Hoku, took to the water. In one unscheduled swim, Clifford Ah Mow set out on his surfboard to rescue the plastic bag containing my notes that I had carelessly let slip. Laundry that usually trailed astern now dangled limply below the surface. On the other hand, washing ourselves—with buckets of seawater and household detergent—became more of a pleasure in the warm sunlight. Skin that had erupted in saltwater sores responded to applications of cornstarch and Mercurochrome.

Hobbies like square knotting (macrame) and model building became general. *Hokule'a* continued to creep southward at an average of 40 miles a day. Frustrating as this was, it was clear that paddling would have gained us little or nothing.

In the Doldrums, Crew Prays for Wind

Tempers began to fray as days slipped slowly by. Under the most favorable of conditions, 17 men crammed aboard a 60-foot boat could scarcely avoid getting on one another's nerves. Buffalo Keaulana's laconic prayer before one meal summed up all our feelings: "Thank you for the food. Give us some wind. Amen."

In two days of feverish activity the ship was lightened by dismantling the two side shelters and replacing them with a light central *hale*. While there was little effect on performance, morale was raised and the canoe certainly became drier.

Altogether, we were a week traversing the doldrums before we met the southeast trades in 2° N. (I was getting better—only six miles off this time.) But to our dismay, the wind turned unseasonably southerly so that we were driven off course to the west. To what extent the current was aggravating this displacement we could not be sure, but on some days we must have lost 60 miles of easting.

I logged the crossing of the Equator at 1 a.m. on May 23. *Meotai's* navigator put our crossing at 4 a.m. We had covered, Piailug and I agreed, nearly 2,000 miles; Tahiti lay 1,000 miles south and a little west.

A school of porpoises surfaced and played alongside. Furious barking startled us. Hoku, hackles up, had found her voice and was

loudly berating the intruders. Her initial reaction was much the same to a booby that sailed toward us. But as it glided nearer—and its true size became apparent—Hoku prudently turned and scampered into the hale.

Hoku's trials were as nothing compared to Maxwell's. Growing at the rate of about a pound a day, he outgrew his bamboo cage, a good portion of which he ate. Under the equatorial sun his white skin became badly burned. A piece of sail was draped protectively over the remains of his cage. To our distress, we found him lying on his side next morning, forlorn and coughing. He had eaten the sail!

We had no idea how to treat a pig with acute dyspepsia, and for several days had fears for Maxwell's life. Eventually, however, his remarkable constitution came to his aid. He resumed his ravenous consumption of dried fish as if nothing had happened.

As we sailed farther south the wind freed, and we won back precious easting. In one 30-knot squall, crewmen stood by to slacken the sheets, but *Hokule'a* footed through it

handily, all sail billowing. If anything, she was undercanvased; an old voyaging canoe would have carried nearly twice as much sail and put half her crew out on balance boards in this sort of wind.

My log for this time is filled with notes about latitude estimation by overhead, or zenith, stars. On the night of May 29 I peered up along the mast while the star Spica slowly mounted to its zenith. I had advised a special lookout that night because uninhabited Caroline Island (not to be confused with the Caroline archipelago in Micronesia) lay in 10° S., very near our latitude. I knew that Spica's declination, or celestial latitude, was 11° S. Therefore, when it ultimately passed over not more than half a degree south of the masthead, I knew we must be something like 10° 30′—in short, we were safely past the atoll and could relax.

Birds Signal Journey's End

At the end of the fourth week at sea Piailug put us 180 miles north of the Tuamotus and 350 from Tahiti. We still had no way of knowing for certain whether we were west or east of our goal. Piailug outlined an effective strategy.

Today was Sunday. "I think we keep this tack till Thursday," he said. "If no see land, we be south of Tahiti for sure. Then we tack back northeast." He sliced one hand across the other to indicate an oblique course through the Society Islands and the Tuamotus. The plan would certainly have worked.

Toward evening on Monday, May 31, however, the familiar swell from the southeast abruptly cut off. It could mean only one thing: We had sailed into the shelter of the Tuamotus lying to the southeast. Then Rodo Williams, the Tahitian navigator, pointed to a pair of soaring terns. "You see *itatae?* We find land soon—this bird never fly more than 30 miles from land!"

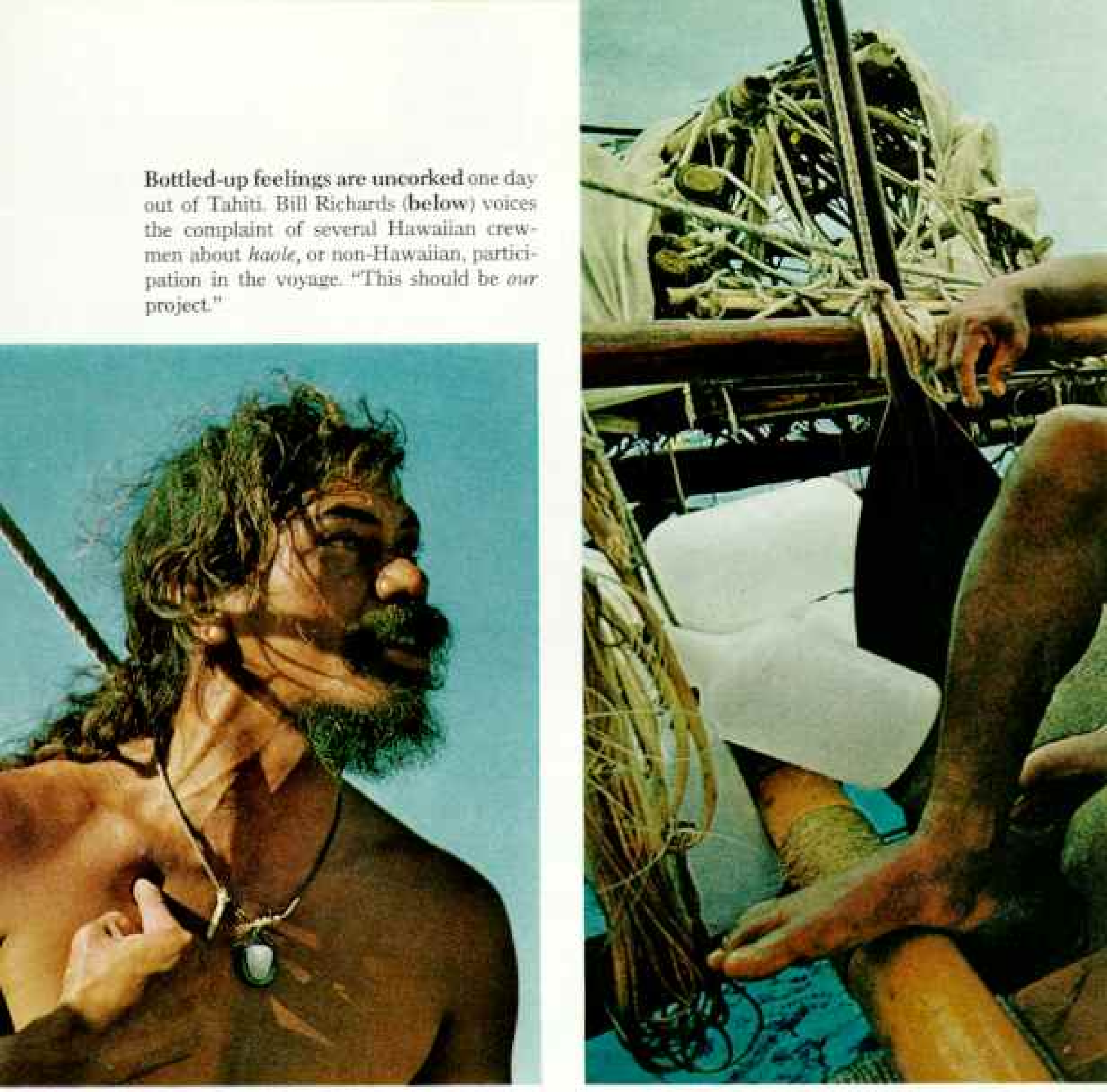
That night the watch on deck—cautioned to keep a sharp lookout—stared intently into the darkness. About 3 a.m., June 1, a black line became visible on the port bow. It steadily grew denser and more solid—for certain, now, an island!

We hove to to await daylight. Speculation was rife, but there were only two real possibilities in this latitude, something under 16° S. —an atoll north of Bora Bora, or Mataiva in the Tuamotus. *(Continued on page 536)*

Landfall at last! *Hokule'a* gets a royal welcome at Mataiva in the Tuamotus. Islanders standing in the shallows mark the reef as motorboats tow the ship to shore. The ship's dog, Hoku, whines in excitement.

All 150 Mataivans left work and school to play hosts at feasts and ceremonies. The fact that this voyage repeated those of old came with a shock of recognition to these people; an ancient Tuamotuan chant sings of the "road of the winds coursed by the Sea Kings to unknown lands." Next day (**right**) islanders wave the crew on their way to Tahiti, now only 170 miles distant.

Bottled-up feelings are uncorked one day out of Tahiti. Bill Richards (**below**) voices the complaint of several Hawaiian crewmen about *kaole*, or non-Hawaiian, participation in the voyage. "This should be *our* project."



Calm through it all, Piailug wins respect from every member of the disparate crew. "When Piailug sleeps, you sleep," Buffalo Keaulana recalls. "If he puts on his raincoat, you know a squall is coming." But the gulf between the traditional Pacific navigator and the modern Hawaiian crew proved too great. Disenchanted, Piailug returned to his home from Tahiti rather than guide *Hokule'a* back to Hawaii as planned.

Fatigue and tension shadow the faces of author Lewis, from left, anthropologist Dr. Ben Finney, president of the sponsoring Polynesian Voyaging Society, and mate David Lyman. Nevertheless, all the men agree that reaching Tahiti makes the trip a resounding success.

Bravo *Hokule'a!* The largest crowd in the memory of Tahiti—some 15,000 strong—swarms out to greet the mariners on June 4 (**following pages**). Many hang from trees or wade into the sea. Spectators trying to scramble aboard almost sink the canoe.

Flower-crowned heroes, the crew of *Hokule'a* strides ashore at Papeete for the first of numerous celebrations. "Hawaiian friends, you are home," proclaims the governor of French Polynesia. On July 4, with instruments and a crew of 13, *Hokule'a* set out for Hawaii. Three weeks later she completed her remarkable round-trip voyage.

(Continued from page 530) Rodo put us somewhat farther east than I did. Dawn confirmed his judgment. Here was a solitary atoll with no towering Bora Bora standing behind it—Mataiva.

Houses appeared under the palms as we closed the land, and two boats emerged from the narrow pass through the reef. A dog swam vigorously out through the surf toward us while Hoku whined with excitement. Once we were inside the pass, islanders rushed out to manhandle *Hokule'a* and festoon us with leis. Despite our vow at the start that we would not set foot on land until we reached Tahiti, we stayed overnight at the hospitable atoll. Next morning we set out on the last 170-mile leg to Tahiti.

Tensions Mar a Triumphant Arrival

Excitement grew as we neared our goal. The following day a boat from Tahiti drew alongside, and its occupants tossed bottles of champagne and cans of beer aboard *Hokule'a*. After a month of close confinement at sea the tension had grown almost unbearable for one or two members of the crew. Grievances—real or fancied—were loudly aired, and one crewman swung several punches before reason finally prevailed.

But no one could sustain ruffled feelings in the warmth of our welcome when next morning *Hokule'a* sailed triumphantly into Papeete harbor. I think all Tahiti was there to greet us—the water swarming with canoes, the shores packed with people. None of us will ever forget the scene (preceding pages).

From *Hokule'a*'s sternposts we unlashed carved wooden tikis, the images that had seen us safely through this 3,000-mile voyage, and carried them ashore. There we were met with lavish ceremonies and grand speeches.

Hokule'a had reached her goal.

How to sum up this historic voyage? The navigation experiment had been an unqualified success; man's knowledge and use of stars and swells alone had guided us safely to Tahiti.

Hokule'a, carrying far less sail than the ancient vessels after which she was patterned, showed that they had sufficient speed, capacity, and windward ability to make long voyages. Our experience also indicated that only under sail—not by paddling—could these high-sided double canoes have covered such vast tracts of the Pacific.

Our transporting of plants and animals, as

ancient Polynesians must have done, was equally successful. Even those plants that had become soaked in seawater were still viable and ready for planting in Tahiti. Hoku and the chickens were lively and content; Maxwell had gained at least 30 pounds.

Although the abandonment of the food experiment was a disappointment, it was not critical. There is no doubt that all of us could have survived in good health entirely on the old-style provisions.

The generally excellent outcome was due largely to the remarkable navigational skill and traditional seamanship of Mau Piailug—a Pacific islander of the old school, a direct heir to millenniums-old arts. While most of the crew were no longer true Pacific islanders in this sense, for this very reason the feat was all the more to their credit. Though untrained in the ancient skills, they had—with justifiable pride—confirmed the achievements of their ancestors. □

Florida, Noah's Ark for Exotic Newcomers

By RICK GORE NATIONAL GEOGRAPHIC STAFF
Photographs by DAVID DOUBILET

Tarzan's gone, but the show goes on. Near Silver Springs, free-ranging rhesus monkeys survive as a legacy of movie crews that came to Florida to film ape-man

I HAD COME TO FLORIDA to see the invaders—a host of alien plants and animals that have been infiltrating the state as silently as the popping of a seedpod on a fast-spreading weed. They have arrived in the holds of freighters, in the baggage of travelers, and in the cargoes of nurserymen and animal dealers. They have left their natural enemies at home and taken root. Some, it seems, are taking over.

A 1974 U.S. Department of the Interior report said about fifty foreign animals, not counting insects, mollusks, or crustaceans, had taken up residence in the state. Exotic plants are almost too numerous to count.

A south Floridian could conceivably watch a walking Siamese catfish crawl out of a canal choked with the Asian weed hydrilla, while Colombian iguanas scampered through Australian pines beneath a squadron of Amazonian parakeets. Meanwhile, a jumbo South American toad might be poisoning his dog

sagas. A tourist attraction, the monkeys-gone-wild create no obvious problems. In stark contrast, other exotic animals and plants are now disrupting the state's ecology.

I was born in Florida, and still have friends and family there. For years I shrugged off their animal stories: "You won't believe what we've got down here now! A giant African snail that eats the paint right off a house!"

Now I have seen many of these alien life forms. They are real, and they are plentiful. They are more than oddities. The walking catfish now numbers in the millions.* Exotic weeds snarl boat traffic in Florida's lakes and canals. The Australian melaleuca tree is poised to overrun the Everglades. Flocks of fruit-eating parakeets may threaten the state's massive citrus industry.

"Nothing can be done about many of these creatures," Florida Atlantic University biologist Walter R. Courtenay, Jr., predicted. "Some of their populations are so large now that there is no hope of eradicating them."

They Fly Now, We Pay Later

Introduced life is not Florida's predicament alone. Starlings, sparrows, Japanese beetles, and roughly half of the United States' major agricultural pests have come from foreign lands. On the other hand, the North American muskrat overran Europe, and the European rabbit nearly ruined Australia. Our jet-age ability to speed creatures around the world has aggravated the problem.

Florida's warm climate fosters tropical wildlife in particular; it has made the state the capital of the animal-import industry. And so, more than most places, Florida has ended up with the world in its backyards.

As a returning native, I could view these exotics not as a blight so much as a symptom of a deeper crisis. The state has been biologically traumatized. When I was a boy, my hometown of Fort Lauderdale had a population of about 63,000. Today, twenty years later, it is the center of a metropolitan area of 887,000. Drainage canals that now crisscross the state are great breeding grounds for many of the new animals and plants.

As ecologist Jack Ewel of the University of Florida explained to me: "Whether an alien can invade a new environment, like Florida, is not really a question of whether it can get here from Africa or Asia. Rather it's whether the environment has been tampered with. In a healthy ecosystem, all the resources are being fully utilized. The probability that it can be invaded by a new species is low. Unfortunately, healthy ecosystems are not the kind we have in Florida anymore."

It is not surprising that while exotic animals and plants have been thriving, 100 native species have been put on the state's endangered list, and the ranges and populations of many others have shrunk dramatically.

Aliens Flourish in Florida Waters

Tropical fish are the most populous new animals by far. Some 120 million a year pour into the country (right). Many end up in Florida's 600 fish farms, source of 80 percent of the nation's aquarium fish. It is a 35-million-dollar-a-year business. Some inevitably escape. Florida's lakes and canals now teem with 29 newly established species.

What is little and charming in an aquarium is not always so appealing when it grows up and gets loose. The infamous walking catfish, for example, was imported from Thailand as a delightful two-inch novelty.

"No one knew they could walk," said Larry Sallgren, an employee at Penagra Aquariums, the fish farm where the walking catfish got its first big break. "There was a heavy rain one day, and they just got up out of one of these tanks and walked away. Now we've got 'em in all the ditch pools. You can't poison them, 'cause they'll crawl out and walk off."

Since the mid-1960's the catfish has proliferated spectacularly. Walking catfish now cling by the thousands to the sides of ditches and canals throughout south Florida. They have almost reached Walt Disney World to the north. And to the south they have been seen marching across the Tamiami Trail into Everglades National Park.

*See "New Florida Resident, the Walking Catfish," by Clarence F. Idyll, NATIONAL GEOGRAPHIC, June 1969.

Fish fancier's delight or Pandora's box? At Miami International Airport, gateway for some 36 million tropical fish annually, state wildlife inspector Pat McIntosh checks for illegal varieties. Demand for exotics such as South America's fierce flesh-eating piranha keeps smugglers in business—with dangerous results. Largely through careless handling, 29 species have become established in Florida waters.

HUSH
Live Tropical
Fish

How to strangle a lake: Import hydrilla and give it time. The plant can grow an inch a day to lengths of 50 feet. Introduced only two decades ago, it rides to new waters on boat propellers (**right**) or on the feet of birds, thus defying a multimillion-dollar-a-year control program.

In an attempt to combat the pervasive weed, Florida has imported the white amur, a gluttonous Oriental grass carp (**below, right**). But if it proves able to spawn in Florida waters, the carp could produce 200,000 freckle-size fry at a time (**below**)—formidable threats to desirable water plants.

HYDRILLA VERTICILLATA

CTENOPHARYNGODON IDELLA, 90 CM (THREE FEET)

Because the catfish, *Clarias batrachus,* can breathe directly from the air, it can survive where other fish cannot (page 546). And if a water hole dries up, it just strolls to another.

Walking catfish eat insect larvae until the larvae are gone; then they turn on other fish, including sport fish like bass and bluegill.

"Freshwater sport fishing is a tremendous industry in this state," Jerry Banks of Florida's Game and Fresh Water Fish Commission said. "Anglers spend about 500 million dollars a year here. You can see why we get shook up when these things come along."

My first look at a walking catfish came on a mosquito-ridden night along a canal near Fort Lauderdale. I accompanied Ray Waldner and several other Florida Atlantic graduate students on a *Clarias* catch. The students were analyzing the stomach contents of catfish to determine how seriously the fish will compete for food with native species.

"Clarias!" shouted one of the students, scanning the dark canal with a flashlight.

"Want to catch him?" Ray asked. He handed me a miner's lamp and two electrified nets on long fiberglass poles.

I spotted the *Clarias* swimming amid a clump of hydrilla. I dipped the electric nets in gently on both sides of the slow-moving fish. Zap! A hundred twenty volts stunned the creature. I scooped him out onto the ground. Gradually, the gray, whiskered, sluglike creature began to walk. It was actually half walk, half slide, but faster than I had imagined. It looked as if it were swimming across the grass.

The catfish was not the only exotic fish in that canal. Pugnacious, rapid-breeding rascals called black acaras were there too.

The black acara of South America was nudged out of the aquarium trade in the late 1950's by more colorful imports. Fish farmers then apparently *(Continued on page 547)*

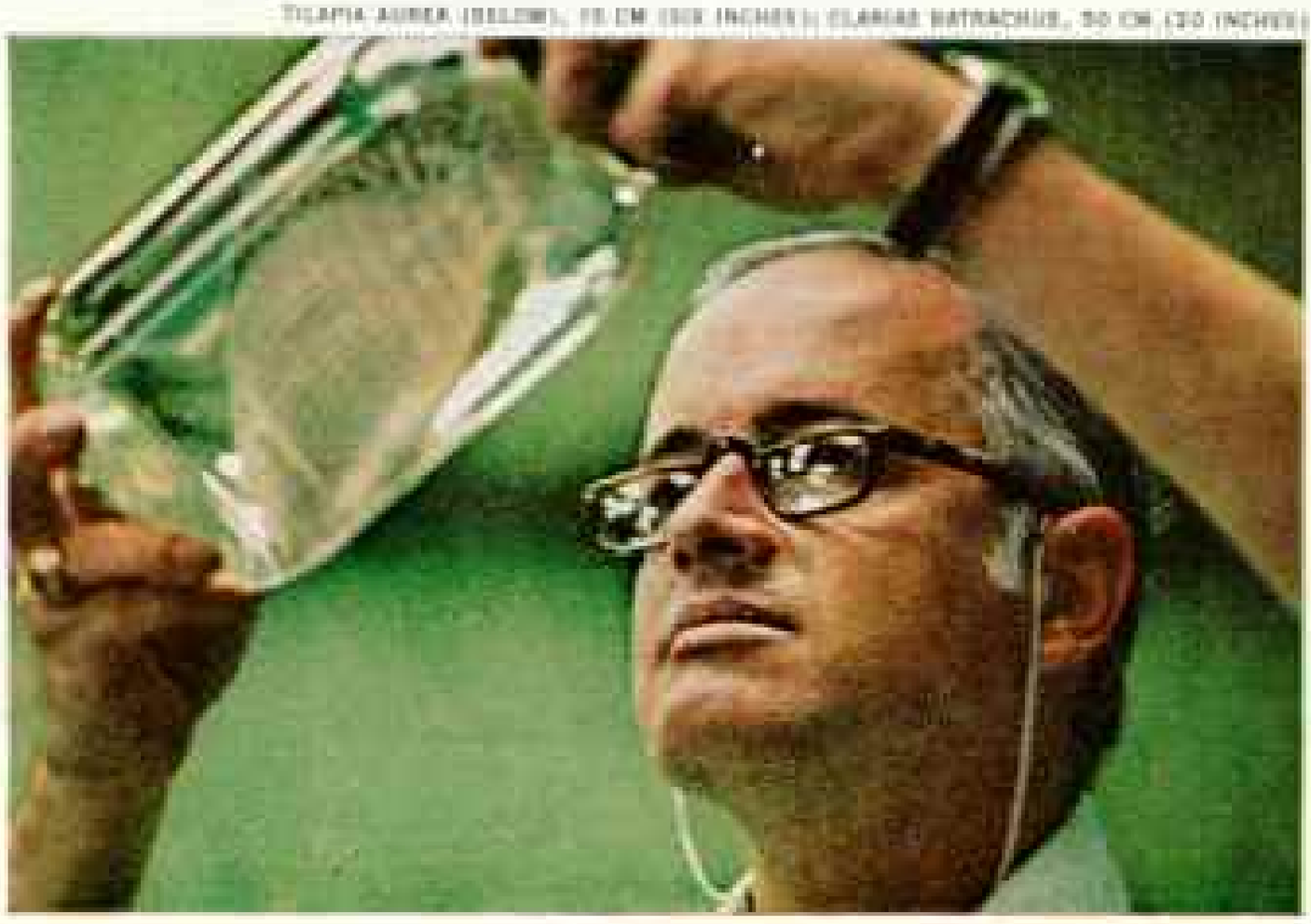
Feathered showmen, macaws at Miami's Parrot Jungle seldom fly far from their camera-clicking audience. Some hundred other species of tropical birds, however, have

been sighted in Florida, many in trees imported from homelands. Most simply beautify the landscape, but fruit-eating canary-winged parakeets could damage citrus groves.

March of the Siamese catfish demonstrates a peculiar talent. Using lunglike organs to breathe air for 12 hours or more and spiny pectoral fins as legs, the fish crawled from a fish farm to nearby waters in the mid-1960's. Now numbering in the millions, they compete for food with bass and other edible fish.

Just as prolific, the algae-eating African blue tilapia, held by ichthyologist Walter R. Courtenay, Jr. (**right**), now teems in polluted lakes. Unlike the new catfish, tilapias make a tasty meal.

TILAPIA AUREA (BELOW), 15 CM (6 INCHES); CLARIAS BATRACHUS, 50 CM (20 INCHES)



dumped the acaras. The fish now range throughout much of south Florida. They reproduce so rapidly that FAU's Dr. Courtenay predicts the black acara will soon become the dominant fish in Florida's canals (page 551).

"In some canals they already make up 90 percent of the total weight of fish," he explained. "They unfortunately occupy the same spawning grounds as many of our native fish. To make matters worse, the acaras spawn every month, not just once a year, and the parents guard the young. They are very territorial and very aggressive. If you put your hand in the water, they'll bite you.

"Where a pond has been very productive of sport fishes, the acaras will spill in and devastate it. People often call me, all upset, about this 'weird little fish with a black line down the middle and two spots on each side that's taken over my lake.'"

Even while I was visiting Dr. Courtenay, his phone rang. The caller warned that a Miami importer was sneaking in an illegal shipment of piranhas from South America. Dr. Courtenay alerted a wildlife officer.

"This importing outfit needs constant watching," he said, shaking his head. "They've been smuggling freshwater stingrays in too."

But what about the piranhas?

"A lot of them are being sold here on the black market," Dr. Courtenay replied. "They'll bring $40 a fish."

He showed me an aquarium with a six-inch piranha swimming nervously about.

"Fellows like this have been found in a Miami rock pit and canals," he said. "So I feel they are in Dade County now. Whether they are reproducing, we don't know. A recent paper reports that they can withstand our winters, so if enough of them get dumped in, they can make it."

Algae, Not Worms, Entice Tilapia

Farther north, central Floridians are getting to know still another exotic. This one is the blue tilapia (left). Many lakes in mid-Florida have been ruined for sport fishing by urban sewage and massive runoffs of fertilizer from citrus groves. These effluents promote algae, which can make the water look as thick as pea soup and deplete its oxygen. The tilapia, an algae eater, is one of the few fish that thrives in these waters. And thrive it has. In Lake Effie, for instance, tilapias made up less than one percent of the total fish biomass in 1968. But by 1972 that had risen to 93 percent.

The tilapia, a native of Africa and the Middle East, was first put into some phosphate pits in 1961 by the state game and fish commission to eat excess algae and to be tested as a sport fish. Local newspapers played it up as an angler's dream. Which in retrospect is laughable; tilapias will seldom take a hook. Nevertheless, impatient fishermen stole tilapia fingerlings and stocked several lakes. Since then, tilapias have spread throughout central Florida.

"We don't know if they are a detriment," the commission's Jerry Banks told me. "We sure wouldn't want to release more of them, but if they only inhabit these lakes that have gone to pot, what harm can they be?"

They may actually prove a benefit. Tilapias are good eating. A few seine fishermen now net them commercially near Lakeland. As Banks put it: "If you want to take these waste waters and grow protein, why, you can feed half the country."

An intriguing prospect. I asked an old friend of mine, Eddie Mae Golphin, to fry up some tilapias bought at a Fort Lauderdale fish market. They cost a mere 79 cents a pound, and were as sweet, white, and succulent as any fish I have tasted, albeit a bit bony.

Armored Escapees Find a Home

Mammals are not nearly as fecund as fish and take longer to establish sizable populations. Most are extremely elusive. It would have been futile, for instance, for me to search for the Central American jaguarundi that now prowls middle Florida. Only luck brought me a glimpse of the red fox, imported by hunters as more sporting prey than native gray foxes. Hunters, too, brought in coyotes.

Western jackrabbits, introduced to teach racetrack greyhounds to chase rabbits, are more visible; they hop freely around the runways of Miami International Airport (page 559). Biologists warn that the jackrabbits could spread along the grassy embankments of new freeways out into the improved pasturelands of Florida's great cattle ranches.

"Then someone would probably suggest that we introduce more coyotes to control the jackrabbits," quipped Jim Layne of the Archbold Biological Station in Lake Placid.

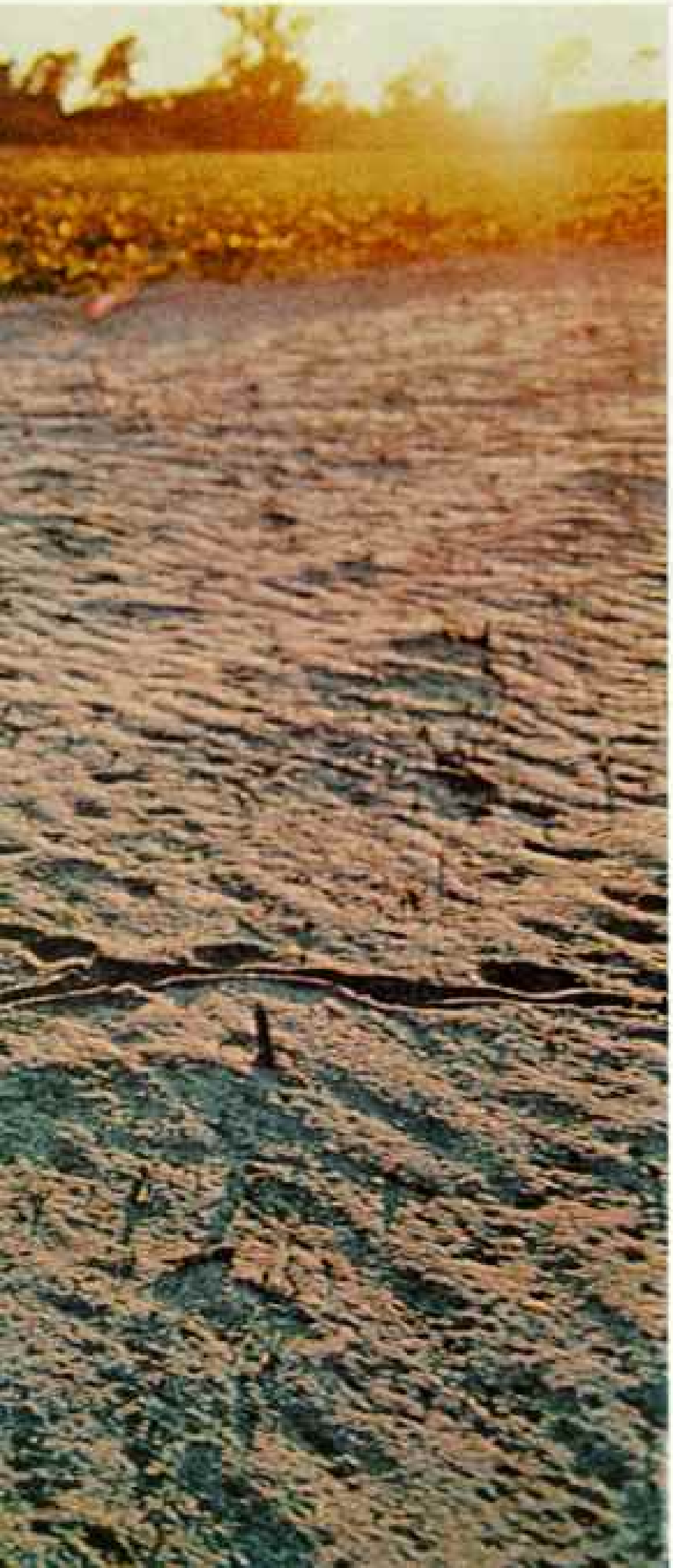
The most successful new mammal is the

Number 7 heads for home, marked and watched by biologists studying the habits of Florida's army of armadillos (**below**). Descendants of escapees from a private zoo and a traveling circus, the small armored mammals from Mexico annoy man by an insistent habit of digging—through lawns, under crops, and across grazing land, where their burrows can break the legs of horses and cattle. In contrast, the Haitian anole (**right**), introduced into Florida by a Miami scientist, has, in ten years, never strayed from its small neighborhood.

DASYPUS NOVEMCINCTUS (BELOW), 61 CM (19 INCHES); ANOLIS CYBOTES, 33 CM (EIGHT INCHES)

Freighter stowaways or onetime research subjects, lizards from the Caribbean fill available niches in the ecology of Florida, a geologically young land missing some of the fauna of more mature regions. A Cuban anole flies a scarlet dewlap from its throat (**right**). Another Cuban immigrant, the sharp-toothed knight's anole (**right, middle**) is a relative of Florida's own color-changing "chameleons." The Colombian green iguana (**right, bottom**), a shy giant that can grow to six feet overall, probably came in through the pet trade.

ANOLE SAGREI, 18 CM (8 INCHES)



ANOLE EQUESTRIS, 18 CM (7½ INCHES)

IGUANA IGUANA

nine-banded armadillo (preceding pages). Armadillos have been migrating from Mexico into Texas and the western Gulf Coast for years. Peninsular Florida armadillos, though, are all descendants of escapees. In 1924 several were freed when a hurricane destroyed a private zoo in Cocoa Beach. Then in 1936 a few more ran away from a circus truck that overturned near Titusville. There are now hundreds of thousands of armadillos.

On a cool day you may see these peculiar, nosy little creatures rooting up grubs along central Florida highways. My first look at one came while I was canoeing the Santa Fe River with old schoolmates Jeff and Louise Barker. They wanted to show me the newly arrived Asian river clam, which has caused considerable damage in other states by clogging irrigation and water-treatment pipes. Floating amid a patch of the ubiquitous South American water hyacinth was an armadillo —with a bullet through its head.

"They are killed in great numbers," Jim Layne later explained. "Most people dislike them. Ranchers are afraid their cows and horses will break a leg in a burrow. And a rooting armadillo can tear up a lawn or garden. People shoot them or club them to death."

Tarzan's Friends Delight Visitors

Floridians do not always receive their new animals so inhospitably. The rhesus monkeys near Silver Springs, for instance, are given star treatment (pages 538-9). Which is deserved. They bring tourists flocking.

The monkeys are descendants of those imported from India in the 1930's to play bit parts in the many Tarzan films made at Silver Springs. Some were released and formed a colony downstream. This colony today is a highlight of Silver Springs' jungle cruise.

In a boat with primate behaviorist Bill Maples, I watched these furry new Floridians peer down from the shoreline treetops like suspicious munchkins.

"Here monk! Hey monk!" Bill called, tossing out a few slices of bread. All the monkeys' suspicions evaporated, and dozens of the chattering, quarreling beggars bounded out of the trees toward us.

Bill is studying this semiwild colony of monkeys, and is also interested in some renegades that have recently fanned out from Silver Springs, giving Florida its first truly wild

Wildfire growth of Amazon water hyacinths has triggered a ceaseless struggle. Here on a major Everglades canal, a specially adapted boat clears out the vegetation. Unfortunately, the decay of displaced plants puts more nutrients into the water, promoting even lusher growth of water hyacinths. Under ideal conditions they can double their mass in two weeks.

Raising trouble, a fierce black acara guards just-hatched fry (**right**). In only 15 years, the prolific South American import —capable of spawning year-round—has spread to a third of south Florida's lakes and canals. It hogs breeding grounds used by other species and feeds on the young of freshwater game fish.

CICHLASOMA CRASSUPES (ABOVE) AND CICHLASOMA BIMACULATUM, 15 CM (SIX INCHES)

monkeys. They have been spotted many times in the past few years by game wardens and fishermen in the deep woods and marshes along the nearby Oklawaha River.

"The idea that they've spread downriver is really exciting," Bill said as we chugged along. "Here's an animal going into a totally different environment, and it adapts! How does it plug in to a new ecology? How do its foods and habits change? How does it respond to new seasonal patterns?"

Unfortunately for Bill Maples, there simply are not yet enough wild monkeys to study. "It's like looking for ghosts," he complained.

Furtive Immigrants Elude Author

I pursued other ghosts in Florida. In vain I kicked through brush piles in Key West looking for the yellow-headed gecko, a Caribbean lizard that has found a home in urban environments. Without success, I scanned banyan trees in the vicinity of Coral Gables' Miracle Mile for the 15-inch, bright-green lizard, the Cuban knight's anole, that inhabits the high branches there.

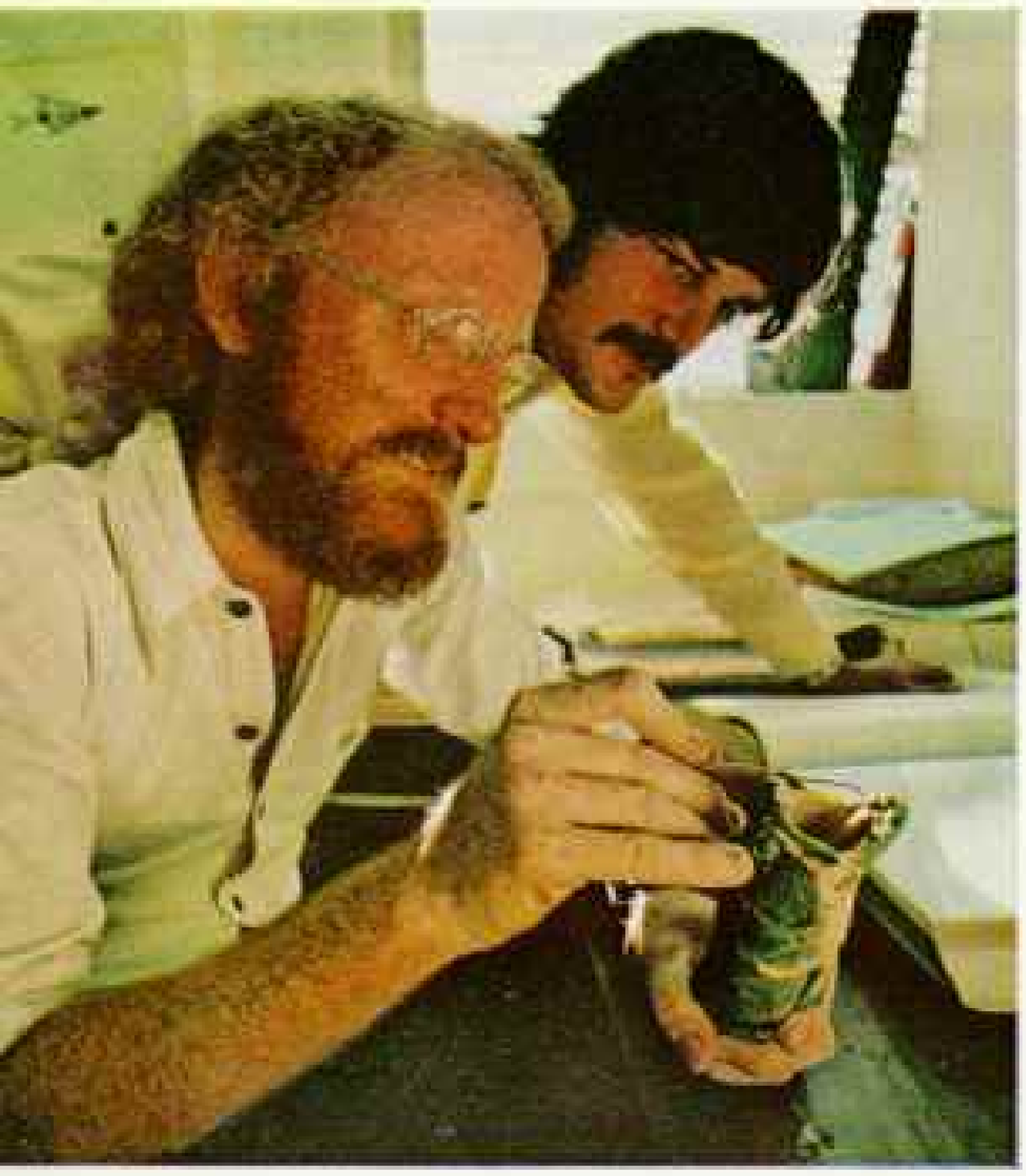
Lizards of many nationalities now leap and scurry about south Florida (pages 548-9). Anoles from the West Indies threaten to supplant the familiar, many-hued Florida "chameleon" that I used to chase after as a child. Iguanas, imported mostly from Colombia, now also run freely around Miami.

"We get calls every other week or so asking us to come get an iguana out of someone's tree," said Lewis Ober, head of the biology department at Miami-Dade Community College. "I tried it a couple of times, but it took half a day to catch the beasts. So I decided I wasn't in the lizard-exterminating business."

Out of professional curiosity, Ober has himself introduced one lizard, the Haitian anole. He wanted to know whether it could survive the winter in Florida. It did. The Obers also have Indian house geckos in their home. Just as in India, the four-inch geckos prowl the walls looking for insects.

House geckos were brought to Florida in the early 1960's by scientists returning from an Indian Ocean expedition. So far they have confined themselves to several small sections of Miami. Professor Ober predicts, however, that they will spread slowly throughout south Florida. Not everyone will enjoy having them in their homes as much as the Obers do.

The amphibian kingdom's main contribution to introduced life in Florida is *Bufo marinus*, the giant toad. These warty, Latin-American creatures of the night can grow to be nine inches long and weigh a pound. In the 1950's a group of them hopped away from a



HOPLIAS MALABARICUS, 30 CM (12 INCHES)

Wide-eyed "sleep-sleep," this voracious Brazilian fish (**above**) earned its nickname by appearing to nap while awaiting prey. Biologists Dannie Hensley and Derril Moody (**left**) identified the predator in Tampa waters. It may have arrived in a shipment of tropicals to one of Florida's 600 fish farms. When rains flood breeding ponds (**right**), exotics can swim to freedom and, in many cases, proliferation.

damaged crate at Miami International Airport. Southeast Florida is now crawling with the giant toads, which will eat anything from bugs to garbage. One of the toad's favorite meals, however, is pet food (below).

"It's amazing how much they can eat. They bloat up like spheres," said Jim Bohnsack, a graduate biology student at the University of Miami, as we watched a troop of bufos clean out the cat's dish on his back porch.

"These guys are funny to watch," he said. "Their eyesight's not very good. Sometimes they jump and miss the bowl. They look so clumsy you wonder how they manage to survive. It must be their poison."

It is indeed the poison, called bufotoxin, in the big glands behind the bufos' heads that keeps the giant toads from becoming dog and cat food themselves.

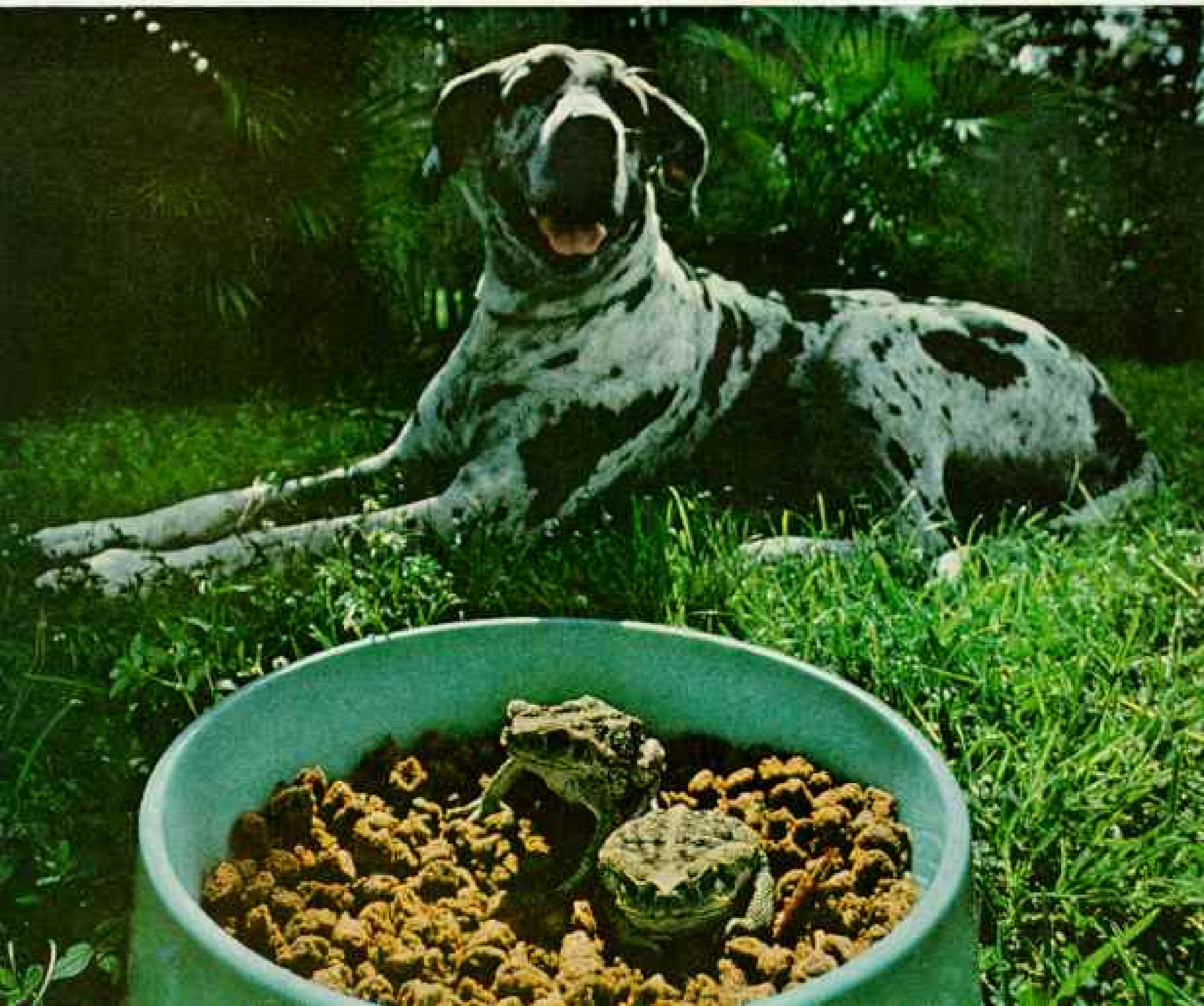
"The poison'll make a big dog sick," explained Miami-Dade biologist Albert Schwartz. "My pointers have learned not to monkey with the bufo. And I have seen a dachshund at the vet's literally at death's door from mouthing one of them."

The poison rarely causes problems for humans. A far more chilling prospect is that venomous Asian cobras may have been introduced. Twice recently cobras have been found near Miami, although there is no evidence that they have become established.

Costly War Waged Against Weeds

To those who measure problems in dollar signs, unquestionably the most troublesome exotics are vegetable rather than animal. Aquatic weeds, many of them of foreign origin, now infest perhaps 400,000 acres of Florida's waters. The two most important, water hyacinth and hydrilla, cost at least 15 million dollars a year to combat.

The water hyacinth, a Brazilian plant with a dainty lavender-and-yellow flower, was brought to Florida in the 1880's by a woman returning from a cotton exposition in New Orleans, where hyacinths had been given as



dinner favors. She placed one plant in a lagoon near her home in Jacksonville. Today water hyacinths blanket as many as 200,000 acres of Florida canals and lakes (pages 550-51). Hyacinths thrive in fertilizer-enriched waters. They impede boat traffic and shade out other plant life, sometimes to the extent that the water receives virtually no oxygen and biological deserts are created.

Compared to hydrilla, however, water hyacinths are well behaved. Vinelike hydrilla—perhaps a native of Malaysia or Africa that was brought into Florida as an aquarium plant in the 1950's—has within the past few years turned into an ecologist's nightmare.

Hydrilla is an extremely adaptable plant. It grows an inch a day, can double its weight in a week when young, and thrives in almost total darkness (page 542). When its long green tentacles reach the surface, sometimes from a depth of 50 feet, they form dense mats that can stop an outboard motor dead. It simply overwhelms native plants.

Hydrilla spreads by attaching bits of itself to boat propellers, birds' feet, and other objects that move from lake to lake. One tiny piece regenerates into a new plant. Consequently, in only a few years it has clogged some 150,000 acres of waterways, and has moved into most other southern states. So far, it has been found as far north as Iowa, and biologists fully expect it to spread throughout the country.

Hydrilla's reproductive potential is so great that it cannot be eradicated, just controlled. The chemicals to fight it can cost three hundred dollars an acre, and must be applied at least twice a year. No wonder Floridians are looking at another new exotic, this one a voracious weed-eating fish called the grass carp, or white amur, to clean out their hydrilla.

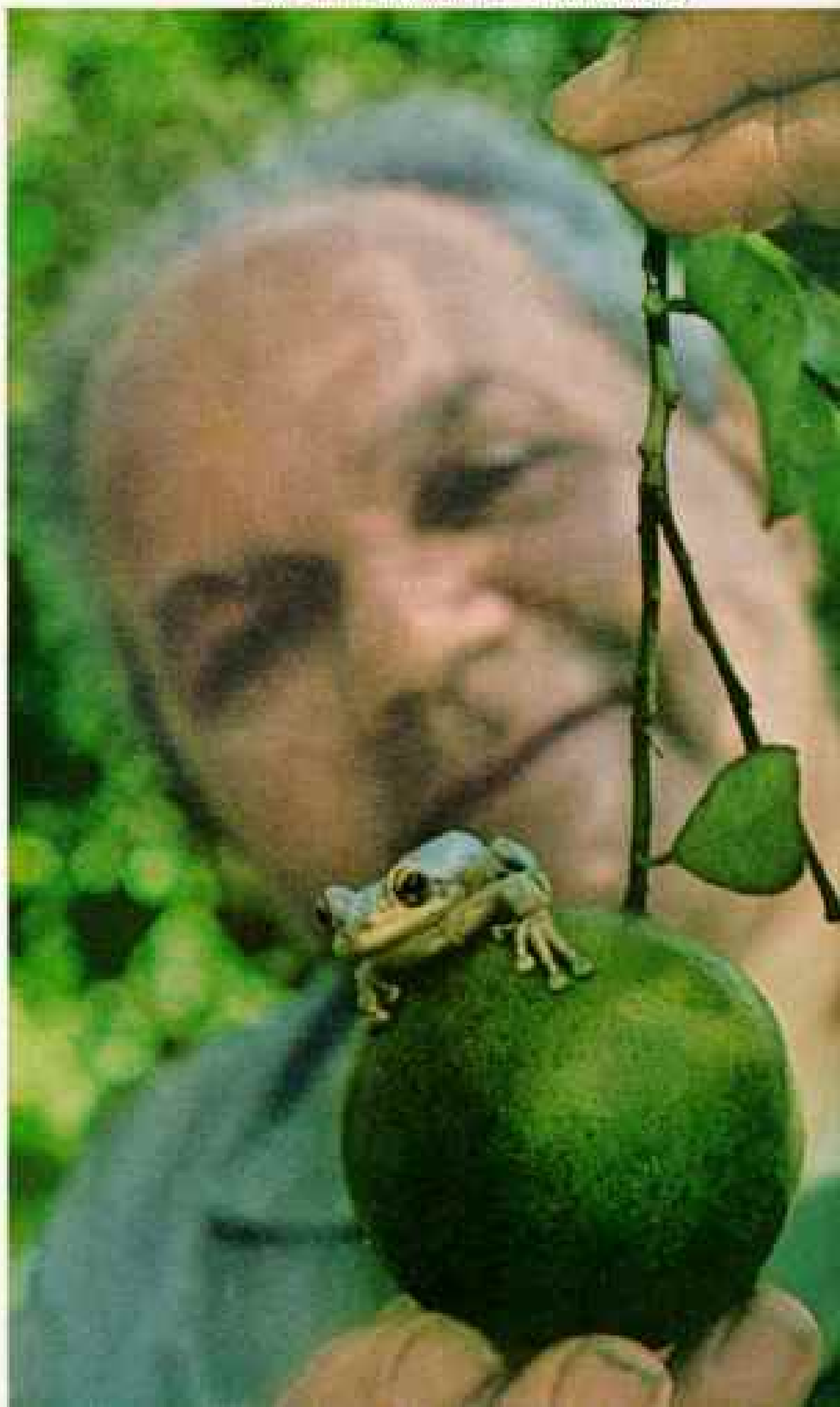
The Oriental grass carp, which resembles a big silver-colored goldfish and can weigh 100 pounds, has been a hot issue (page 543). Confronting the severe hydrilla problem, concerned state officials favor releasing the grass

BUFO MARINUS

When giant toads hop in for dinner, a wise dog abandons its bowl (**left**). Glands on the South American amphibians' backs (**above**) secrete a milky poison that has killed hundreds of small dogs. People, too, can be affected if the toxin gets into their mouths or eyes. The everlastingly hungry toads gobble almost anything in sight—insects, pet food, or whatever man eats.

All eyes and appetite, a suction-fingered Cuban tree frog (**right**)—largest in the U. S.—intrigues Miami herpetologist Lewis Ober. It preys on native tree frogs that consume insects harmful to citrus trees.

OSTEOPILUS SEPTENTRIONALIS, 8 CM. (THREE INCHES)



MELALEUCA QUINQUENERVIA

Inheritors of ravaged lands, dense stands of Australian melaleuca trees (**above**) crowd out native plants in drained and burned south Florida swamplands. In the 1930's seeds were sown by air, in hopes of making "useless" swamps productive and of fostering a timber industry. Not until canal digging accelerated, however, did the trees launch their explosive invasion—now displacing vegetation needed by wildlife.

Skimming a saw-grass sea, botanists in the Everglades (**left**) survey the melaleucas. No way has been found to control the trees.

carp in problem areas. Most biologists I talked with are opposed to the idea. True, the grass carp will consume great quantities of hydrilla. But it will also eat desirable plants, and it could easily spread to other waters.

"Grass carp clean out nearly everything in a small lake if you get too many," said University of Florida agronomist David Sutton. "You must put in just the right number."

"If they were to reproduce, heaven help the native vegetation," Walter Courtenay said. "We think the carp need streaming water to spawn, so they might not breed in Florida. But they've spawned in Mexican reservoirs."

"If they spawn, they will be a dangerous species," warned the game and fish commission's Jerry Banks. "What will our fish and waterfowl that depend on rooted aquatic vegetation do? What would the bullfrog do if it didn't have cover?"

Weed-control authorities in Arkansas and Iowa have already released grass carp into the Mississippi watershed, and there is fear the carp have spawned there. Fishermen in Missouri have begun catching them. Michigan officials have launched a program to poison every pond that has grass carp; farmers in that and other states mail-ordered the carp, which had been widely advertised as a miracle cure for weed-filled ponds.

New Tenants for Damaged Landscape

Beyond grass carp and hydrilla, there is the melaleuca tree. The Australian melaleuca, which is commonly planted as an ornamental tree, has begun to march through former southwest Florida swamplands that have been disturbed by drainage and fires. The melaleuca seems to take to this disrupted land better than native trees do (left). The graceful melaleuca has a thick fire-resistant bark that looks like a thousand layers of parchment. The trouble with melaleuca is that it can rapidly transform native landscape into an alien one.

University of Florida graduate student Ron Myers showed me where a field of pines and cypresses near Fort Myers had been burned out six months earlier. Thousands of melaleuca trees had sprouted, while the only pines and cypresses in view were charred stumps.

No one knows how far the melaleuca will advance. Everglades National Park biologist Larry Bancroft did say, however, that

"melaleuca is one of the most serious long-term threats to the park. Water is a big problem, but the melaleuca could be worse."

Actually, Florida has had surprisingly few problems from the thousands of exotic trees and shrubs used to beautify homes and gardens. Roots of Australian pines occasionally crack beachside roads and intrude into the nesting areas of turtles and the rare American crocodile. Brazilian holly has spread along roadsides, and now accounts for much of the yard trash hauled in Miami.

Alien Birds Like Alien Plants

These plants have given many of the exotic birds of Florida a bit of their homeland. The red-whiskered bulbul, for instance, can feed, roost, and nest upon some of the same plants it uses in India.

Birds are in many ways the most striking class of newcomers. "I've seen close to a hundred species of exotic birds here in the past ten years," University of Miami ornithologist Oscar Owre said. "The whole area is bouncing with them."

Not all the birds are established, but among those that have begun reproducing are the bulbul, the hill myna, the little multicolored budgerigar, which we commonly miscall a parakeet, and a host of parrots, which include many true parakeets. Most are escapees from the pet trade.

Bulbuls eat mangoes, and compete with native mockingbirds for berries. Mynas vie with woodpeckers for nesting cavities in trees.

"And we think the parrots are danger signs flying," Dr. Owre said. "They have extremely strong jaws; they can bite right into oranges. They are building up populations in the urban areas now. I don't see anything to stop them from getting into our farmlands and citrus groves."

The most abundant parrot is the canary-winged parakeet, a familiar cage bird. Flocks of hundreds of the bright canary-wings now flutter about all over the Miami area. One of the largest flocks has its roost in 14 large royal palms in front of the Miami City Hall.

When I arrived at City Hall, an hour before sunset, my eardrums throbbed with the screeching of at least a hundred green-and-yellow birds already perched in the branches of a big ficus tree nearby. More birds arrived each second, some alone, others in squadrons of 25 or more. The tree was a flurry of restless wings, a beehive of parakeets, waiting, it seemed, for a cue to take off for the nearby royal palms.

In some imperceptible way that cue was given. Groups of parakeets zoomed off, still shrieking, to alight moments later on one of the many large fruit clusters dangling from the tops of the palms. The clusters resemble huge bunches of grapes, and scores of parakeets, bickering and fighting for space, crawled into each one. The noise and spectacle were astounding.

Man's Tinkering Tests Nature

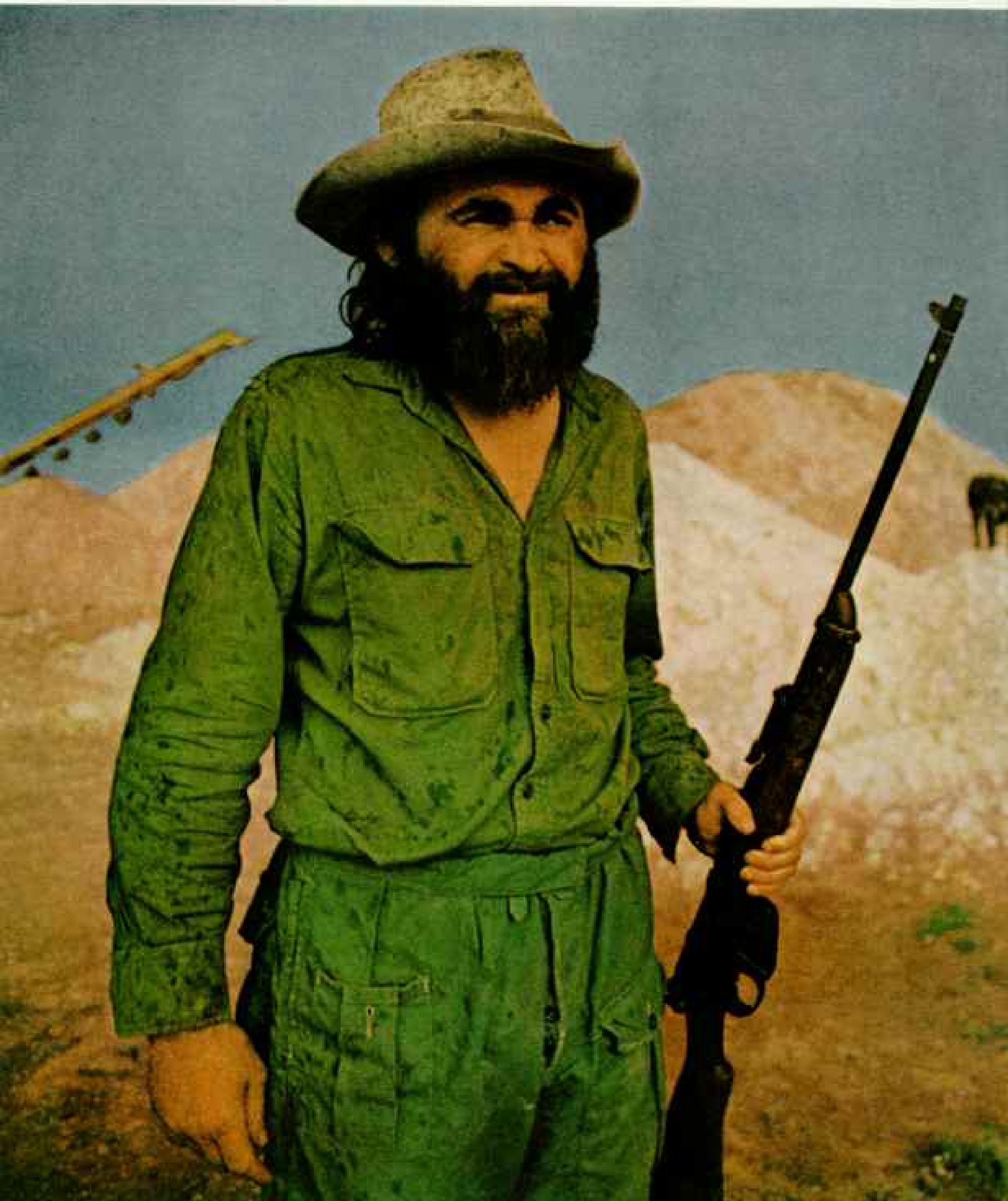
What can be done about the alien invaders? Very little, although one never knows how nature will step in to correct a sudden population imbalance. Diseases may set in; predators will discover some of the aliens. An unusually cold winter would help check the tropical animals, but it could also build up cold-tolerant strains of creatures.

But it is unrealistic to blame the animals for Florida's exotic crisis. I paused for a day at Walt Disney World near Orlando to watch Mickey Mouse, the biggest introduced animal of them all, strut down Main Street. The Mouse and the crowded artificial kingdom built out of a wilderness to house him symbolized for me the basic problem of introduced life in Florida.

"We have been introducing too many of ourselves into the wrong places," concluded biologist Charles Elton, in his classic book *The Ecology of Invasions*. Or as Jerry Banks of the game and fish commission put it: "If you want to talk about introduced animals in Florida, you've got to talk about man. He's the most important one." □

Faster than a speeding greyhound, western black-tailed jackrabbits escaped in the 1940's from a dog-track training ground. Now concentrated around Miami International Airport, the population of a few hundred hares could explode if it reached the pasturelands of Florida cattle country—yet another example of why many scientists seek tighter restrictions on imported plants and animals.

Coober Pedy: Opal Capital of Australia's Outback



By KENNY MOORE

Photographs by
PENNY TWEEDIE

WE CROUCHED on red, graveled hardpan, our backs to winter's cold southwesterly wind. "Now use the sharp eye," said opal prospector Danny Serdar. "Look for the white."

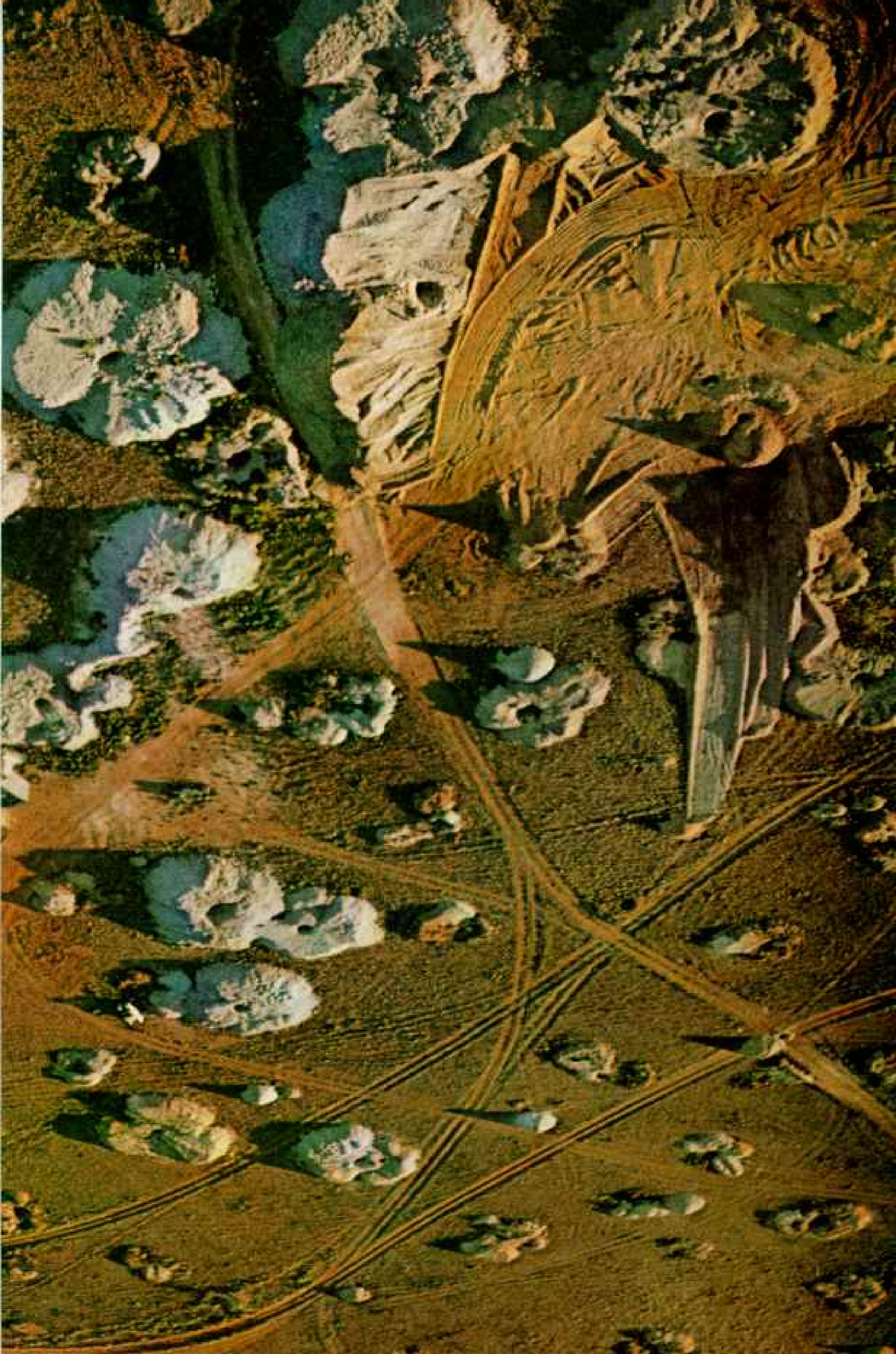
We had come twenty miles out from the rugged little settlement of Coober Pedy in South Australia. We had gone beyond most of the working opal fields, with their generators and bulldozers and tunneling machines, and were now on the endless plateau.

"Australia all around the edges is touched, closed, spoiled," Danny said in his thick Croatian accent, "but in the center is open, is waiting." He had explained that careful prospecting meant searching dry watercourses or depressions for surface opals, called "floaters," marking where each was found, then working to higher ground until no more appeared. Somewhere near the last loose stone must be their source, the spot where a seam of opal meets the surface.

Danny bent to one side, stood, and handed me a whitish pebble that sparkled with pink and green. I stared at the stone. He had found an opal lying out in plain sight. "Look for the white," he repeated.

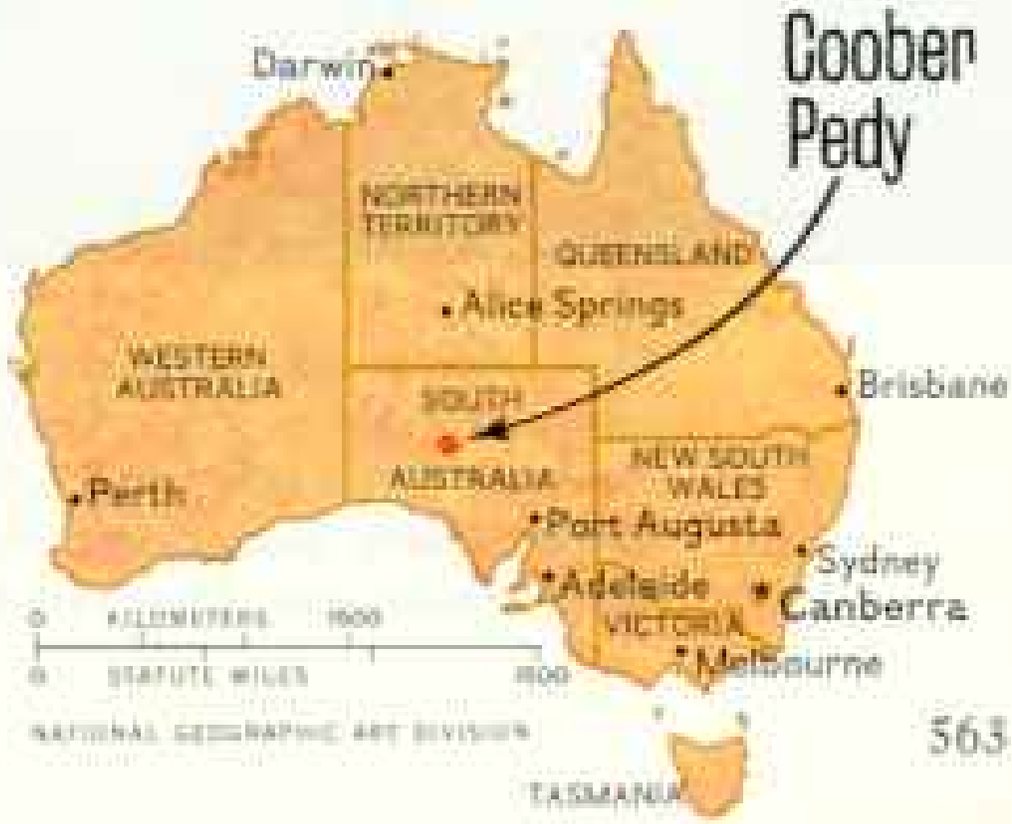
I scrambled after him and began glaring at the ground in earnest. At length I found a bit of gray "potch"—common opal without fire. Then a bit more. Finally, with a whoop, a glimmer of milky orange. By that time Danny had filled a handkerchief with quality stones, one an opalized fossil shell.

Armed and dangerous—to thieves only—Josef Boucek of Czechoslovakia and Alice Burke of Ireland guard an Italian owner's claim in Coober Pedy, site of the world's richest opal field. Miners from 43 nations have congregated in this rugged boomtown in the desert of South Australia. All speak the same language, however, when it comes to the lure of shimmering, uncut opals (**above**).



BOTH BY CARL PURCELL

Monuments to the opal rush, piles of mine rubble pock the Coober Pedy plain (**left**). Most miners climb down shafts at least fifty feet deep to work the seams with pick and hammer. Other prospectors use bulldozers (**above**). Law allows each miner one 165-foot-square claim, thereby excluding large mining firms from this isolated area (**map below**). Partnerships and sales are sealed with a handshake.



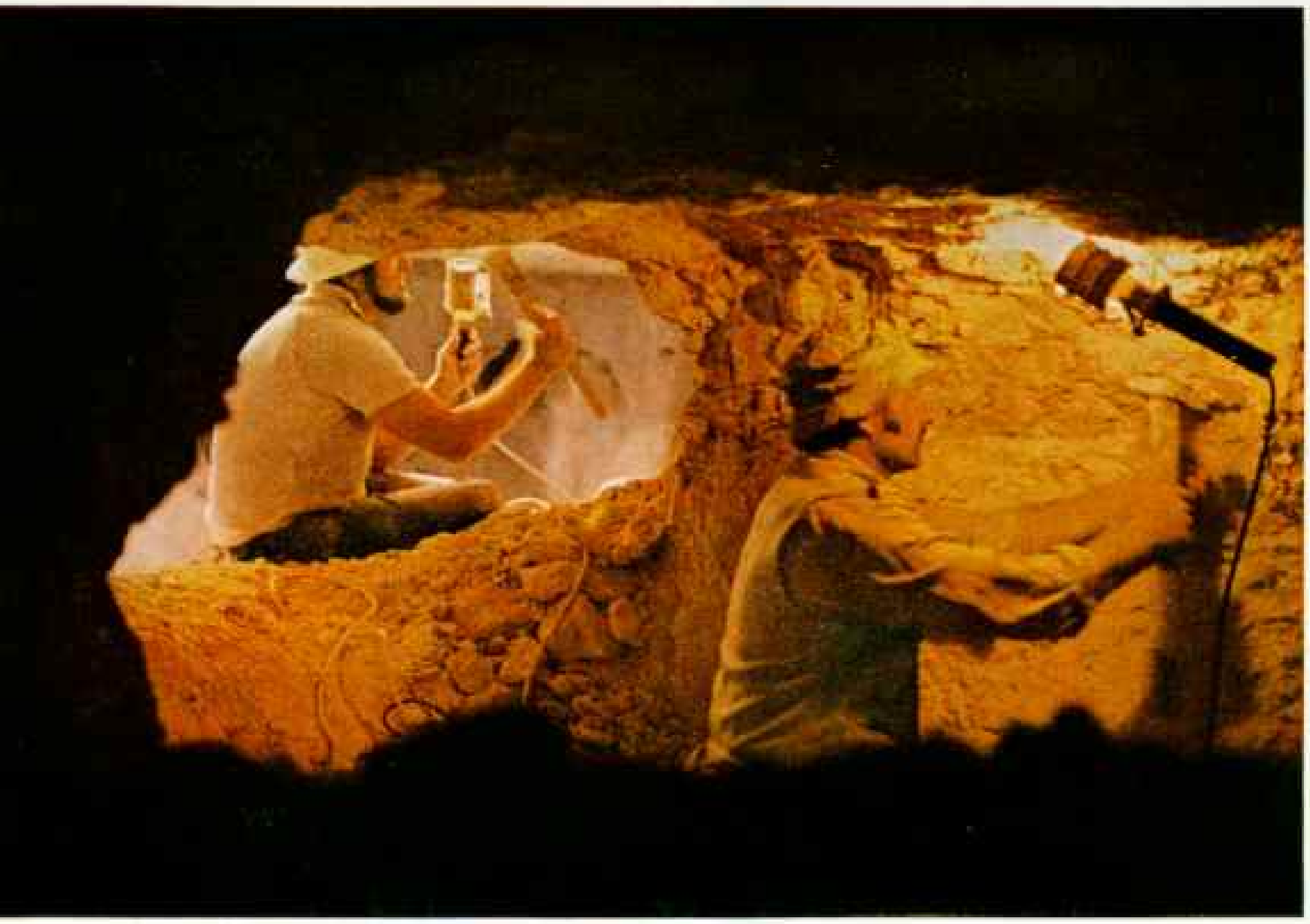
We kept on through the morning, oblivious of time and the cutting wind. So I was introduced not only to the first steps in mining Australia's national gem, but also to its fever.

In fact, we were reenacting history. In 1915 J. R. Hutchison camped at the base of an escarpment called the Stuart Range, and went out to look for water. His son, meanwhile, amused himself by finding floaters. Thus the field later to be named Coober Pedy (pronounced COO-ber PEE-dee, from the Aboriginal dialect meaning "white man in a hole") had yielded its first opals. It has been producing ever since, now supplying more than half the world's gem opals.

From the air the dump heaps of Coober Pedy mines appear as ashes scattered on an immense tawny rug of outback. The township sits in the center of South Australia, 480 miles northwest of Adelaide, 375 south of Alice Springs (map, page 563). The pilot of Opal Air's eight-passenger Cessna flight from Adelaide told of dust storms 15,000 feet high that howl for days.

"You can see down through the dust," he said, "but when it comes time to land, you can't find the strip because you have to look for it horizontally. Sometimes we wish there were another plane up top to make sure we're headed for the runway." Had I not been so involved with the landing he was then making on Coober Pedy's rocky airstrip, I might have asked how that second plane could get down. Instead, I was deposited in mute relief in what seemed a haphazard, impoverished community.

Corrugated metal sheds, surrounded by drying laundry, formed its suburbs. Except for a main street of bitumen, roads were unbelievably rutted and often lined with worn



Flash of color means pay dirt for Trevor Weatherill, left, and David Genat, ex-insurance men of Adelaide, as they delicately chip at an opal seam. In Coober Pedy—an Aboriginal phrase for "white man in a hole"—the most valuable stone displays a dense array of hues against a glassy background. No sure method exists to detect opal in the earth. But local lore offers one way: Drop your hat over your shoulder and dig where it lands.

tires and broken glass. The commercial center consisted of pub, miner's store, bank, motels, gas stations, and a supermarket. The surrounding area was splotched with saltbush, scrubby mulga, and wild flowers, but inside the town almost nothing grew. Persistent, clinging flies refused to be brushed from my eyes and mouth.

Once past this initial impression, I found Coober Pedy a succession of cheering surprises. "Our wealth, and most of our beauty, is below ground," boomed Faye Nayler, a 15-year resident. "Ah, the tin sheds. Remember, they're not meant to be permanent. Those are for miners here to make it big and get out. The permanents live tremendously."

Faye, who runs an opal shop, offered as an example her own home, a dugout. This remarkable kind of dwelling is carved into the soft clay stone of the area. Because summer temperatures average 100 degrees Fahrenheit, it is highly advisable to live underground, and nearly half the people do just that. Faye Nayler's dugout had several levels, wall-to-wall carpeting, a wine cellar, and a small green swimming pool (following pages).

There is often a temptation to enlarge one's home, whether the family is growing or not. Danny Serdar showed me veins of potch and color in the walls of his kitchen and bedroom. "This house cost about $4,400—that's in your U. S. dollars," he said, "but we found $2,600 worth of opal while we were digging it. And a few years ago I dug a new bathroom and found $900 more."

Opal Fever Creates a Melting Pot

Perhaps 15 percent of Coober Pedy's approximately 4,000 people are Australian born. "We're so cosmopolitan it's ridiculous," said Faye Nayler with a fierce pride. "The world thinks we're bums up here. Sure, the reason a lot of us came was greed—but once here, people lose sight of the quick quid; they put aside the fact that they're Greek or Pakistani or Dutch and become opal miners. Yes, the mine ratters [thieves] are here, but that's been going on since King Solomon's mines. It's not the real story of this town."

Part of that story is pay-as-you-go self-sufficiency. Coober Pedy has no real local government, although the state police maintain an office there. Instead, the Coober Pedy Progress and Miners Association, which was started to provide amenities, has found itself responsible for fire fighting, road grading, and sanitation. A federally funded hospital, having no resident doctor, relies on the Royal Flying Doctor Service from Port Augusta, 300 miles to the south.

The association is supported by the Coober Pedy Drive-In Theatre, the town's chief entertainment. Yet even on a night out, one is never far from the basic work of mining opal. Witness the message flashed on the screen prior to each feature: "Patrons are asked not to bring explosives into this theatre."

Miners' Disputes Keep Officials Busy

I had the good fortune to dine at the pub one evening with Tony Starke and Fred Horie of the South Australia Department of Mines. Tony was the mining warden, and he rode a circuit, coming to Coober Pedy every six weeks to sit in judgment over local disputes. Fred, then district inspector of mines, lived in Coober Pedy and was charged with enforcing safety regulations. Both had plenty to do.

"The miners still make their agreements by word of mouth," Tony said, rolling his eyes in some dismay. "No paper whatsoever. Consequently, disputes are inevitable."

"Miners are essentially gamblers," said Fred. "They'll gamble their lives as well as their money by undercutting a bulldozed face, or using a poor ladder or a bad winch."

A bottle of wine, which none of us had ordered, arrived at the table. The waiter indicated a beaming man in mud-caked overalls across the room. "Ah," Tony laughed, "perhaps it's a bit of a bribe from one of tomorrow's litigants. This sort of thing used to bother me." It clearly did not now.

I asked the total value of all the opal taken from Coober Pedy in a year. Tony sighed. "We get our figures from buyers. A few years ago we had an influx of buyers from Hong Kong who prefer to underestimate." So officially about 25 million U. S. dollars a year is taken in opals, but the actual amount is probably nearer 55 million.

No large corporations engage in opal mining. "The law," said Tony, "says one man, one claim. Claims are limited to 165 feet square, and no more than four can be joined in a partnership. The government feels that this should be one place where a man might come with nothing and hit it rich."

Harsh as the fortune dealt most miners, the climate often sends dust storms howling through town (**right**). Since little vegetation grows in Coober Pedy, a resident welded together an iron tree (**below**) for children to play on.

CARL PURCELL

Residents dig for comfort as well as for opals in Coober Pedy, where nearly half the population of 4,000 live in homes carved into sandy clay stone. Economical to fashion, the dugouts provide relief from the 100° F. heat of summer. One owner has installed wall-to-wall carpeting, a wine cellar, and even a swimming pool (**left**). Leading vigorous social lives, townspeople divide their time between neighborhood parties (**right**), pub, ethnic clubs, and drive-in movies. The town has become a popular tourist attraction; more than 40,000 sightseers passed through last year.

"Have you ever thought of staking a claim?" I asked.

Tony and Fred turned to me and answered, "Never! Too unpredictable."

Doug Atkinson, who took up opal mining after a successful business career, has accepted the risks and challenges with zest. "I was in furniture manufacturing," he said. "I was obsessed with man-hours of labor. But up here there is no relation between how much you work and what you make because it takes work *and* luck to find opal. A geologist can't help you a bit. He may assure you there's no opal in an area, and you may find $100,000 in your first cut. Why? Because the geologist dug his holes in the wrong place. This is not like gold or silver mining where you know if you move enough earth you'll get so much per ton. You have to be careful. Gold dust is just as good as gold nuggets, but opal dust is worthless."

The nature of opal mining, calling for competitive, independent men, has colored the character of the town. But school principal Craig Cameron said: "Contrary to the rough-and-ready reputation of this place, it's good for kids. We have less vandalism and delinquency than anywhere else in South Australia. The kids aren't hemmed in. They can spend excess energy 'noodling' [picking through the dump heaps for opal missed by the miners], or just out in the country."

How accurate are reports that Coober Pedy life has its violent moments? "Exaggerated," said Craig. "In five years we've had one suicide and a couple of drunken soccer players down a mine shaft. One was killed. There is a brawl now and then. And I once saw a pistol

Selling water and renting bulldozers provide a living for desert entrepreneur E. G. Kruse (**left**). Arriving in Coober Pedy during a drought in 1969, the Australian jack-of-all-trades sank bores to reach needed water. His bulldozers bring $50 an hour, but he likes to bargain for a share of the miner's find. On the fringe of the mines live some three hundred Australian Aborigines, some of whom dwell in broken-down vehicles (**below**) and restrict their prospecting to "noodling"—poking through rubble.

drawn in the pub. Of course there had to be a busload of tourists in. They dove for the floor and all that. No harm done, though."

Thirteen Months' Work—Eight Dollars

Having seen the surface Coober Pedy, I now descended into the miner's world. Trevor Weatherill, David Genat, and Owen Daw were working a claim in the "15-mile field." (Fields are usually designated by their distance from town.) I drove out with Trevor, a large, spirited man with an Abe Lincoln beard.

"The way it was a few years ago, a sane person wouldn't have come," he said, "but we did." He and David had been insurance men in Adelaide. "We put aside enough to live on for two years, convinced our wives we'd send for them soon, and started sinking holes by hand." Thirteen months later they had found opal worth $8. "Then we struck a parcel and it's been easier."

The men gave me a hard hat, escorted me to the dark mouth of their 60-foot shaft, started a generator and air compressor to power lights and drills, and directed me down a cold steel ladder. It was dangerously slick with talcum-fine dust, and I will admit to a tightening in my chest.

Once safely down, Trevor showed me through long rooms and "drives," horizontal tunnels that had followed seams. Work that day was at a face showing two veins of potch. Trevor took up a pneumatic "jack pick" (jackhammer) and like a shearer began slicing away white clay stone and gray alunite. The dust from the soft rock frosted his beard and eyebrows.

When several feet of space under the seams

had been cleared, David and Owen eased out chunks of gray, translucent potch with small hand picks. "This is what it all comes to," said David. "You dislodge a bit, and there's always the hope that when it comes away there will be a red eye staring at you."

I asked if most miners would keep on laboring in a shaft like this one after clearing out a big parcel. David looked up from licking a stone (examining it for "color"). "That's where the magic of it comes in," he said. "Once you've found it, you think you can again. Sometimes you can't."

"But sometimes you can give up too soon," Trevor said. "We owned a mine in the Olympic field southwest of town, drove a hundred feet, and gave it away. Some Yugoslavs came in, went six feet farther, and found $125,000."

Everyone went quiet as Owen's pick struck something. "It's when you hear that china clunk," whispered Trevor, "that you perk up." Owen pulled a sparkling opal out of the seam and handed it to Trevor, who looked at it with satisfaction. "That's about a tenth of an ounce. Maybe $35." By noon the partners' plastic sack was full of colored stones.

David explained that the stones in the sack were lead opal, so called because it occurs in gray and opaque potch. "The best Coober Pedy opal is crystal opal," he said. "You can hold it to the light and see the colors and see through it as well."

MARTIN ROGERS

Prized for their vivid hues, opals command retail prices from $5 to $3,000 a carat. The value of this 155-carat white opal in the Smithsonian Institution is $10,000. In Coober Pedy, opals were formed some 30 million years ago as groundwater laden with silica slowly evaporated through clay stone. The dancing color is a prismatic effect resulting from light bending around the silica.

Aborigines Cash In on Opal Bonanza

In town a miner receives between $1,000 and $4,000 an ounce for top-grade opal. Cut and shipped to Japan, Hong Kong, or the United States, it will retail for up to three times as much. The finest opals have become more expensive than many gems, though the ingredients of opal are commonplace stuff. Coober Pedy's opal, born millions of years ago, was deposited when groundwater containing particles of silica seeped into cracks in the bedrock. As the water evaporated, the particles became cemented together. Light bending around the silica produces the variety of glowing colors.

Trevor drove back to town a different way, and miles from any other diggings we passed a few old bulldozer cuts—a kind of opal strip mine. They were ringed by rusting automobile wrecks, most turned up on one side. "A fellow made these cuts about 18 inches too shallow," said Trevor, "and went away broke. The Aborigines came in, scraped a bit, and found thousands. The cars? That's where they lived." The Aborigines on the reserve near Coober Pedy average about $4,000 apiece each year from just such noodling.

Trevor pointed to a rise near the 8-mile field. "A miner there had no winch, so he dug his shaft with the help of a spiral staircase. Every can of rock was carried up those stairs on his back!"

We stopped at the tin shack Trevor and David had lived in at the 8-mile field. Nostalgia rolled over Trevor. "Ah, it was good out here. The stars—there's nothing like them anywhere. And that deafening quiet. . . . It's bigger than men."

Yet despite his love for the simple, hard life of earlier times, Trevor's is a voice for change. "The town is still divided on the

question, but we do need local authority. Hygiene is a basic problem. We have no power to tell people to haul their rubbish. The street is a disgrace. We lack adequate sewage. The state says, 'We're sorry, you're not a local government—get lost.'"

Once, in Adelaide, Trevor had interviewed applicants for Progress Association secretary. "I asked one fellow what he'd heard about Coober Pedy. He said, 'It's hell on earth, and any man who takes his wife there has no respect for her.'" Trevor said this as we pulled up before his own split-level dugout, his own attractive wife, Kate, stepping out to meet him. "He didn't get the job, of course."

In spite of such domesticity in Coober Pedy, frontier violence is not unknown, as Farid Khan, a buyer who has exported more than two and a half million dollars in opals, can testify. A few years ago, in Coober Pedy's Opal Inn, he had, in his words, "a bit of an accident." As he slept, thieves entered his room. He showed me the scar where they cut his throat. "But I fought my way out," he said calmly, "and kept my money." He was saved by the flying doctor service.

Old-timer Survives Six-day Ordeal

"Accidents" lacking any criminal element can be just as hair-raising. In a tiny, rattling shed amid a maze of dumps at the 8-mile field lived Jim Ledgard. One night a few years ago, Jim fell into an old mine beside his hut, coming to rest on an oil drum wedged in a shaft 40 feet down. Six days and six nights he waited there, flyblown and dehydrated, having chewed off the brim of his felt hat to keep saliva in his mouth. He was 77 years old.

When I visited him in his hut, I asked, "What was it like to be down in that shaft for six days?"

"Well, I just kept thinking, 'I hope I soon peg out if I don't get found.' I was bummed, you see. My shirt and trousers were full of blood. I had blowfly maggots in my left hand. Once I tried to climb. I got up twenty feet, but my arms wouldn't hold me and my legs were crook. It was terribly cold. And only a chain away from people. My voice was just about flat. Dogs came and looked in; they could hear, but all the silly others thought about was opal, opal, opal. But I knew old Binke, my old friend, would find me.

"And he did. He came down and asked if I was dead. He put me in mind of Daniel in the lion's den, he looked so frightened. They tied me in a chair, and I was singing. There was a nurse waiting on top. 'Turn the other way,' I said. 'I don't know that my clothes cover me.' Then I said, 'Thank you, good friends. This certainly put the Lord to the test.'"

Recently I learned Jim passed away several months ago. During my visit with him he had said: "I mean to keep on working. I'll die here. But I'm not much afraid of death now."

A Sumptuous Picnic in a Blooming Desert

The Lord was kind to all Coober Pedy during my stay, sending an unusually abundant rainfall. The desert bloomed, and to show me its beauties, the Weatherills, Genats, and Atkinsons loaded hampers, babies, and me into three sturdy Holden sedans and set out over rough tracks to picnic in Mickey Swamp, 35 miles away.

We passed through creek beds overflowing with lavender flowers, and finally reached a many-fingered body of beige water, crowded by low ti and coolabah trees. A pit was lined with coals, and a foil-wrapped wild turkey shot for the occasion was placed in it and covered with more coals and sandy earth. To help fend off starvation until the bird was done, steaks and sausages were grilled and served with pumpkin, fresh bread, onions, potatoes, and salad, eased along with beer or claret. The turkey came out steaming and juicy, served with roasted bananas and liqueurs topped with cream. As we all sat back, pulled at the turkey carcass with greasy fingers, and sipped our Tia Maria, even the flies seemed forgivable.

"A godforsaken country," rumbled Trevor Weatherill.

"Oh, yes," said David Genat. "Oh, yes. Hell on earth." □

OUR CONTINENT takes you back 4.6 billion years . . . backward toward cataclysmic beginnings . . . deep, deep into the time when earth was born.

Learn of the ancient rift that tore our land from the supercontinent called Pangaea. Discover how our mountains and hills, beaches and swamps, forests and grasslands were formed . . . how nature's forces still shape the restless crust on which we live.

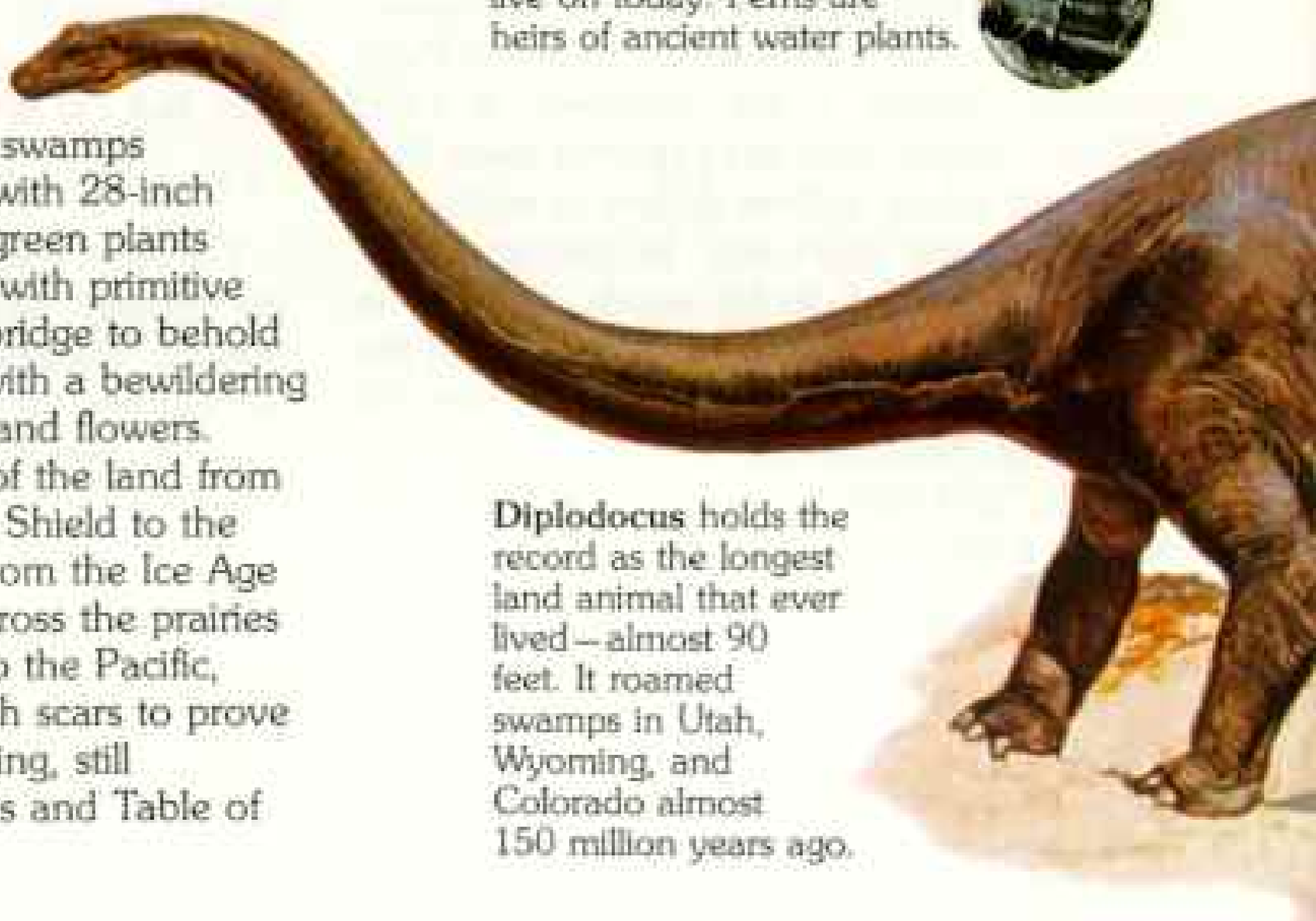
Follow the grand procession of life from microscopic organisms to primitive sea lilies, corals, fishes, amphibians, and the incredible dinosaurs that reigned supreme for a hundred million years.

In *Our Continent* you visit swamps where predatory dragonflies with 28-inch wingspreads flew over great green plants that turned to coal. You trek with primitive man across the Bering land bridge to behold a continent already blessed with a bewildering diversity of birds, mammals, and flowers.

Then you explore the lay of the land from the glacier-gouged Canadian Shield to the remote Mexican highlands, from the Ice Age moraine that is Cape Cod across the prairies and mountains and deserts to the Pacific, where earthquakes leave fresh scars to prove that the continent is still moving, still unfinished. (For further details and Table of Contents, see page 574.)

Witness the emergence of life

Plants existed for eons without flowers, and many, including ferns and mosses, live on today. Ferns are heirs of ancient water plants.

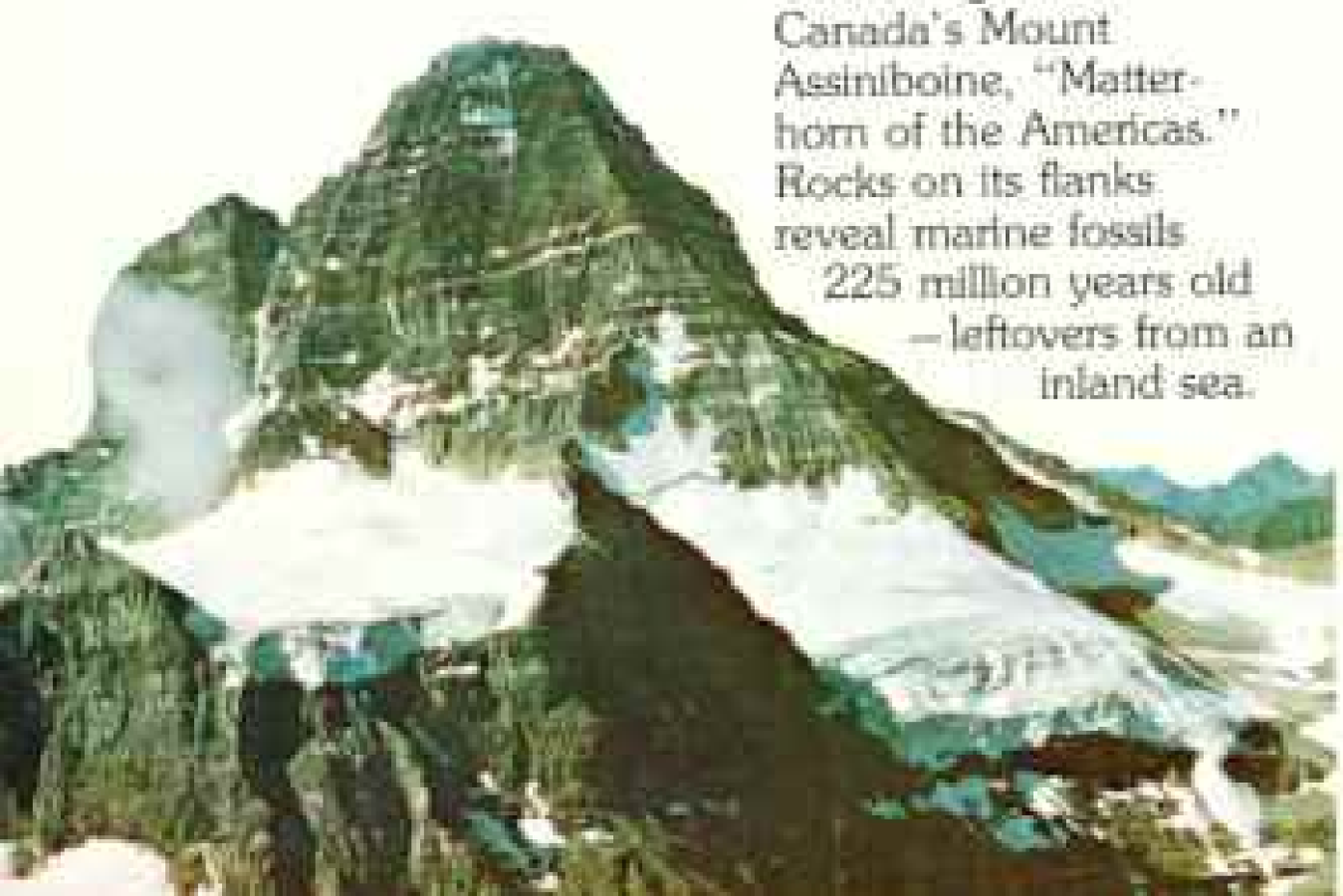


Diplodocus holds the record as the longest land animal that ever lived—almost 90 feet. It roamed swamps in Utah, Wyoming, and Colorado almost 150 million years ago.

Trace the shaping of North America

Volcanoes hint of the awesome power at work in our hot-hearted planet—forces push continents around, build mountains, change oceans.

Compare our globe to a soft-boiled egg: shell-like crust, thick middle layer representing the white, a fiery, partly liquid core equivalent to the yolk.



Glaciers gnawed Canada's Mount Assiniboine, "Matterhorn of the Americas." Rocks on its flanks reveal marine fossils 225 million years old—leftovers from an inland sea.

A lion's mane jellyfish displays its filmy, soft beauty. Persisting for 550 million years, jellyfish have left a scant record because they rarely are found as fossils.

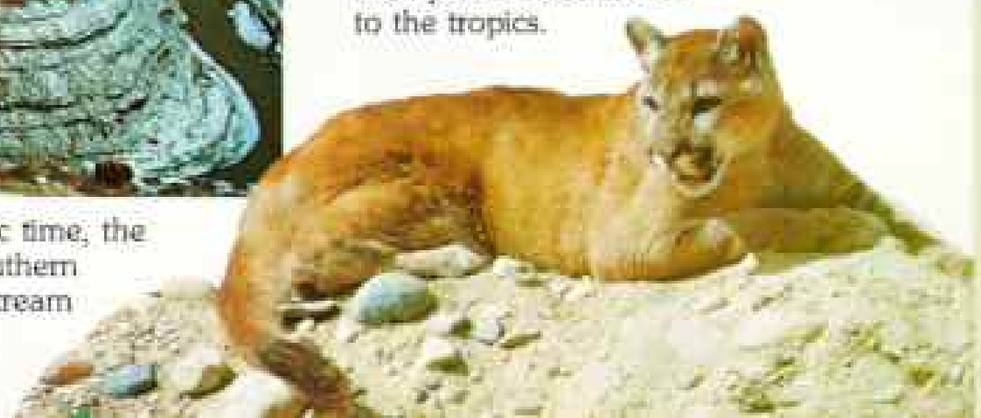
Turtles appeared more than 200 million years ago in the days of early dinosaurs. They survived, though dinosaurs died off.

Blossoms barter pollen for pollination in the long drama of insects and flowering plants. Earth's youngest but largest plant group, flowers have been up and coming for only 130 million years.

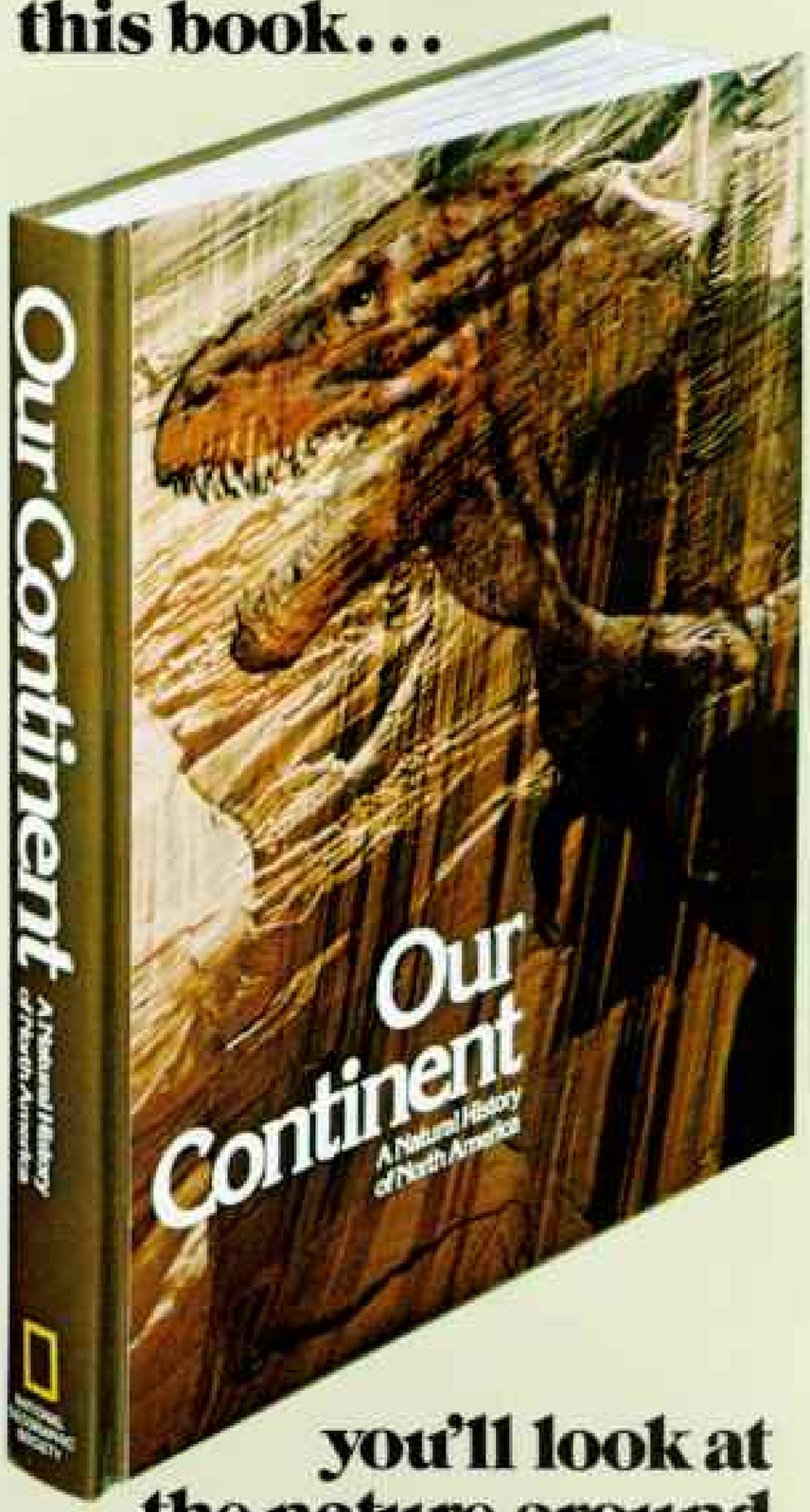
Flamingos fed on an inland seashore of present-day Wyoming about 70 million years ago.

Cutting a snow-frosted layer cake of geologic time, the San Juan River slowly changes the face of southern Utah. Originally winding atop flat plains, the stream kept its gooseneck meanders as land uplifted.

High on the rimrock near Zion National Park, a lithesome cougar rests from the hunt. During the Ice Age, lions crossed from Siberia into Alaska, then pressed southward to the tropics.



Once you've seen this book...



you'll look at the nature around you with a new sense of wonder

398 pages • Actual size 9¼" x 11⅛"
360 illustrations – 248 full-color photographs; 88 paintings, drawings, and diagrams; 24 maps; 14 outstanding authors, today's leading scientists
Bonus feature: The Wheel of Time • Hardcover
Only $11.95!

Mail this order form today!

TABLE OF CONTENTS

An inspiring adventure from bedrock to living land

As *Our Continent* guides you through North America, you encounter the past in the face of the present . . . you find an intricate web of life and land.

Dramatic new scientific findings now enable *National Geographic* to offer you this magnificent, authoritative, up-to-date natural history of our land. You and your family will be proud to own a book so worthy of its subject . . . so colorfully illustrated . . . so expertly written . . . so well researched . . . so thoroughly readable. A wealth of information for readers of all ages!

One section includes a panoramic foldout photograph of the Grand Canyon, where you discover how beautifully the cliffs and canyons bare earth's history.

And tucked into a pocket at the back of the book, you'll find The Wheel of Time – a very special bonus! Use this handy tool to see at a glance the eons of time, major life forms, and geologic events presented throughout this outstanding natural history of North America.

Mail the convenient flap from this page to examine *Our Continent* in your home without obligation. Send no money now!

The New Chevrolet

The handwriting was on the wall.

It clearly said that the time had come for a new kind of 6-passenger car. One that would use fuel and space more sparingly yet still provide the kind of room and ride you've found so comfortable and comforting in our popular full-size Chevys of the past.

The car is here.

It's called The New Chevrolet.

More head room

The New Chevrolet stands a little taller than last year's full-size Chevy, which perhaps explains why it looks so very proud in profile.

Inside, there's a little more clearance for heads and hats and hairdos, both in the back seat and up front.

A new acoustical ceiling helps keep things nice and quiet.

More leg room

We've increased the rear seat leg room by an inch in The Sedan (below) and by nearly two inches in The Coupe.

It will make a significant difference in riding comfort, especially on trips.

The straight-up styling of the car makes it easier to climb into and out of.

More trunk room

The trunk is truly enormous, more than a cubic foot bigger than last year, with a nice flat floor that makes it easy to arrange things.

It's one of many pleasant surprises awaiting you in The New Chevrolet.

More efficient

The New Chevrolet is, by design, a very lean but very strong automobile, with not a trace of flab anywhere on its beautiful body, chassis or frame.

And it pays off at the gas pump.

In EPA tests, The New Chevrolet is rated at 22 mpg highway, 17 mpg city with the new standard Six, auto. trans. and 2.73 axle. Remember, EPA figures are estimates. The actual mileage you get will vary depending on the type of driving you do, your driving habits, your car's condition and available equipment. (In California, EPA mileage figures are lower.)

The New Chevrolet.

We made it right for the times without making it wrong for the people.

You're going to love it.

Chevrolet

Now that's more like it.

The 1977 Caprice Classic Sedan.

GM

SX-70 pictures. Pronto!

Polaroid's light little automatic, for the new Super Color film.

Pronto! *puts SX-70 pictures into everybody's hands.*

This is our easiest instant camera ever. Just set the distance, frame and press the button. This little camera's 12,000 r.p.m. motor propels a big SX-70 picture into your hand, already developing. In minutes, you'll have a beautiful finished color print.

Pronto! *uses the new SX-70 film with Colorlock dyes. These colors are among the most fade-resistant ever in photography. (The battery is built into the film pack. Fresh power every time you load.)*

Pronto! *also uses the SX-70's 10-shot FlashBar. When the FlashBar's used up, the camera won't shoot. When the film's used up, the FlashBar won't shoot.*

An electric eye and electronic shutter set all exposures automatically, even for flash. And you can even get Pronto! accessories such as a tripod mount and self-timer, so you can get into your own pictures.

This 16-ounce camera shoots from 3 feet to infinity. You can take it anywhere. What d'you say? Pronto!

Only $66*

Problems along the pipeline

EVEN PROPONENTS of the trans-Alaska pipeline expected construction difficulties. Now, as the 800-mile line nears completion, scheduled for next year, delays caused by welding and inspection deficiencies turn early concern to costly reality. Near Fairbanks, officials check a section unearthed for repairs (**left**).

To assess the controversial project, writer Bryan Hodgson interviewed the adventurous men and women at work on it. In a boomtown bar he talks with an Idaho rancher-turned-trucker (**right, upper**)—one of thousands scooping up $1,000- to $1,600-a-week paychecks on the $7.7-billion undertaking. Joining a truck convoy, Hodgson and photographer Steve Raymer (**right, lower**) drove the line's 360-mile haul road into the Arctic—usually off limits to unescorted journalists. Their report appears in next month's GEOGRAPHIC.

Share such timely accounts with your friends. Nominate them for membership on the form below.

NATIONAL GEOGRAPHIC PHOTOGRAPHER STEVE RAYMER (ABOVE AND UPPER RIGHT)

HOLLY RECKORD

NATIONAL GEOGRAPHIC SOCIETY MEMBERSHIP

$8.50 CALENDAR YEAR 1977 MEMBERSHIP DUES INCLUDE SUBSCRIPTION TO THE NATIONAL GEOGRAPHIC

ANNUAL DUES in the United States and throughout the world are $8.50 U.S. funds or equivalent. To compensate for additional postage and handling for mailing magazine outside the U.S.A. and its outlying areas, please remit: for Canada, $10.45 Canadian or U.S. funds; for the British Isles, Australia, and New Zealand, $12.50; for all other countries, $12.35 by U.S. bank draft or international money order. Eighty percent of dues is designated for magazine subscription. Annual membership starts with the January issue.

EIGHTEEN-MONTH MEMBERSHIP: Applicants who prefer delivery of their NATIONAL GEOGRAPHIC to start with the July 1976 instead of the January 1977 issue may upon request become members and receive the magazine for 18 months from July 1, 1976, through December 1977. Upon expiration, such memberships will be renewable annually on a calendar-year basis. For 18-month membership check here ☐ and remit: for U.S. and its outlying areas, $12.75 U.S. funds or equivalent; for Canada, $15.70 Canadian or U.S. funds; for the British Isles, Australia, and New Zealand, $19.20; for all other countries, $18.55 by U.S. bank draft or international money order.

LIFE MEMBERSHIP is available to persons 10 years of age or older. The fee for U.S. (including its outlying areas) and Canada is $200 U.S. or Canadian funds; for all other countries, $250 by U.S. bank draft or international money order.

Mail to: The Secretary
National Geographic Society
Post Office Box 2895
Washington, D.C. 20013

CHECK ONE

I WISH TO JOIN the NATIONAL GEOGRAPHIC SOCIETY and enclose my dues $_____ ☐

(FILL IN NAME AT LEFT.)

(GIFT MEMBERSHIP) I nominate and enclose $_____ for dues of the person named at left. ☐

Send gift card signed: _____

I NOMINATE for Society membership the person named at left. (Use separate sheet for additional nominations.) ☐

NEW MEMBER _____
PRINT NAME OF AN INDIVIDUAL ONLY (MR., MRS., MISS, MS.)

STREET

CITY, STATE, ZIP CODE

MY NAME _____
PLEASE PRINT (MR., MRS., MISS, MS.)

STREET

CITY, STATE, ZIP CODE 01076

I may not be the reason you fly Pan Am but I'll never be the reason you don't.

When you or your travel agent makes a reservation with us, you shouldn't have any reservations about the kind of service you'll get.

Because Pan Am reservationists average 8 years on the job. Which means we've been around long enough to know how to handle any travel requirement you may have.

In fact, many of us started before there were machines to help.

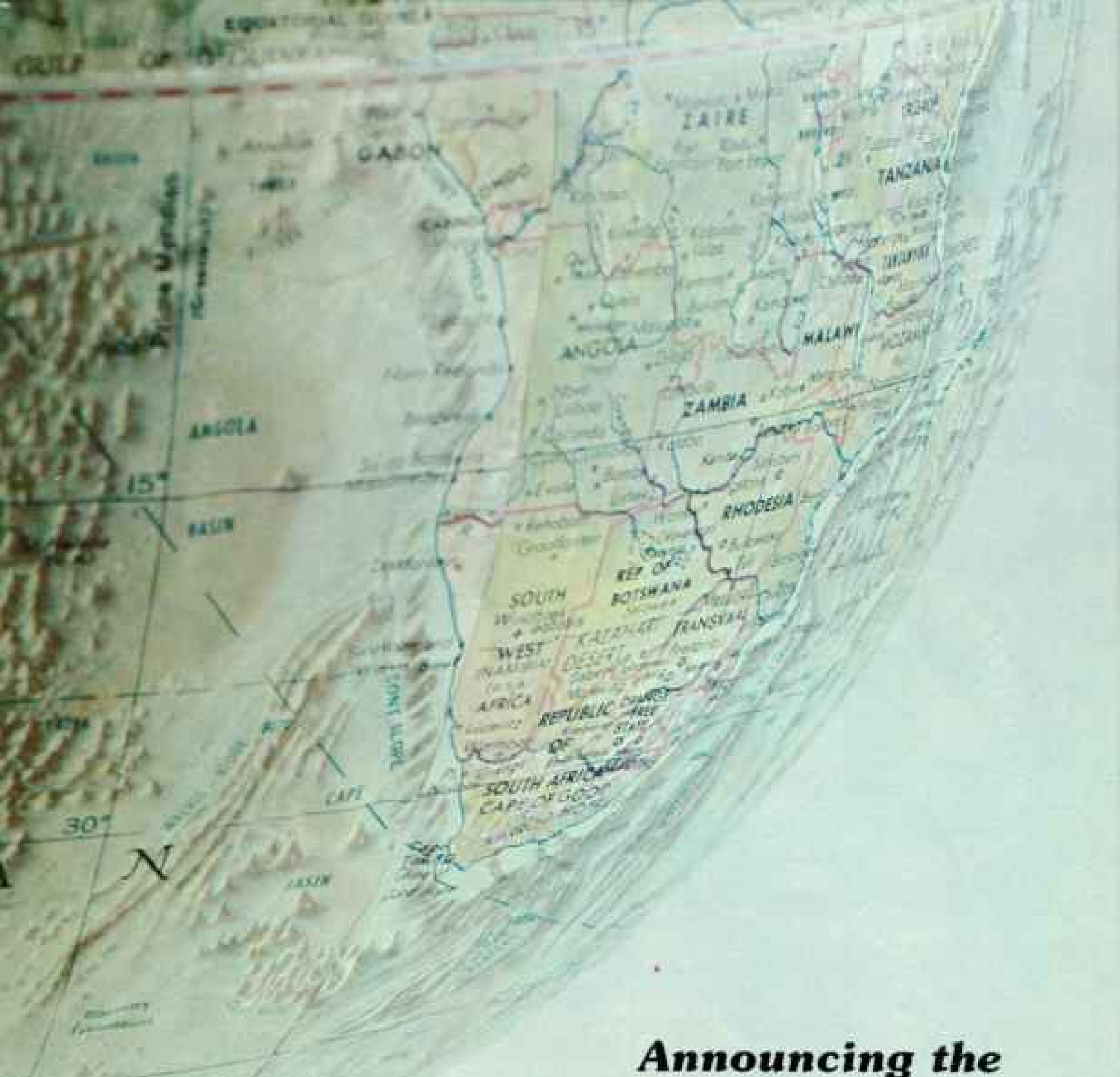
Like our new Panamac® II. The most advanced international computer reservations network in the business. With amazing speed it (and us) can get you flights, hotel rooms, rent-a-cars just about any place in the world.

Or even answer questions you might have, like: What's the temperature in Rio in October?

Come to think of it, if we're not the reason you fly Pan Am, maybe we should be.

PAN AM.
America's airline to the world.

See your travel agent.



Announcing the

First Medallic Collection

Honoring All

The Countries of the World....

The Countries of the World

in Solid Sterling Silver

Medals enlarged to show fine detail. Actual size: 25mm

An outstanding collection of 156 commemorative Proof medals honoring — for the first time in history — all of the countries of the world.

Issued in strictly limited edition.

Limit: One set per subscriber.

Subscriptions must be postmarked by October 31, 1976.

For centuries, the people inhabiting the various regions of the earth remained a mystery to each other. To each group, the world stretched only as far as the great seas or the mountains. Only as wide as the natural boundaries which framed their tribe.

It was for the great explorers to discover the "worlds" beyond the seas and mountains. They carried back stories and goods which established important roadways between the various races and cultures. But the world community evolved painfully, and the people of one country were slow and unwilling to mix with people of another country.

By the 1700's there were less than 80 countries in the world and vast areas were yet to be discovered. Then, in 1776, a group of people in the Americas declared their independence from England and formed a new nation.

The news of this bold action spread quickly across the world. Soon other people in other lands — inspired by the citizen armies of the United States — pledged their allegiance to the common good and declared their own independence. And today, there are 156 countries across the Earth — 25 being formed in the last ten years alone!

An Internationally Significant Collection.

The Countries of the World medallic collection may well be among the most important and valuable collections ever minted. The medals — issued in solid sterling silver by The Hamilton Mint, one of the world's foremost private mints — pay lasting tribute to the rich histories and cultures of the nations scattered throughout the world.

Each medal created exclusively for this collection will bear, on both sides of the medal, a finely-detailed sculptured work of original medallic art. France, renowned for the richness of its wine regions, is represented on its medal by the autumn grape harvesters, their baskets overflowing with the ripe fruit. A fabulous *balladora* and her strolling guitarist form a spirited tableau for Mexico while, on Japan's medal, a traditional Geisha lends an air of quiet enchantment. Afghanistan's medal is especially animated as horses and men take part in an ancient and ferocious game of *buz kashi*. And a famous Devil Dancer, masquerading as a bull, ceremoniously cavorts for all time in the finely-sculptured tribute to Venezuela.

The Hamilton Mint — celebrated for their achievements in creating some of the finest art medals in the world — has invested all its care, skill, and dedication in creating the medals in this landmark collection.

Each medal is fully sculptured on *both* sides, from hand-finished Proof dies. In the individual minting of every medal, these special dies ensure complete fidelity to the original sculptures, so that even the most subtle detail is captured. Because of the importance of this collection, each medal will be minted with a full *Proof* Finish from specially polished dies. Thus, the delicately-frosted sculptured image will stand out boldly against the mirror-like background of the medal.

Issued in Limited Edition.

Each medal in this historic collection will measure 25mm and is *guaranteed* to contain at least 165 grains of solid sterling silver. The original issue price for each of the sterling Proof medals is only $9. For those who desire the feel and lustre of 24 Kt gold, a special Ambassador's Edition is available. This edition will be issued in a full Proof Finish of 24 karat gold-on-silver and is available at just $12 per medal.

These exceptional prices are *guaranteed* to each subscriber for the entire series, regardless of any future increases in the cost of gold, silver, or the minting process throughout the subscription period. The complete collection will be issued on a convenient monthly acquisition plan of 2 medals per month, including the medal of any new country formed during the time the collection is being minted.

At no additional charge, each subscriber will be furnished with a hardwood case and library set of four custom-made albums in which to collect and safely store *The Countries of the World* medals. A Certificate of Authenticity, testifying to the full precious metal content and Limited Edition status of the collection will also be provided.

Subscription Deadline: October 31, 1976.

Because of the international significance of this collection, subscriptions may be accepted at a later date from collectors in other countries. But subscribers in the United States have the opportunity to acquire this important collection *only* until October 31, 1976. The total number of sets produced for subscribers in the United States will be permanently limited to the exact number of subscriptions received by The Hamilton Mint postmarked by October 31, 1976.

Sculptured in superb detail, *The Countries of the World* medallic collection will be a most inspiring tribute to the peoples of the world and, therefore, certain to be cherished by future generations. At no other time in medallic history has an endeavor of such sweeping magnitude been attempted by any mint — either public or private. Together, these 156 original medals create a vast panorama which includes even the remotest nations on Earth.

Those who acquire the collection will possess an enduring and valuable commemorative . . . one that combines great art, great significance, and great rarity with the intrinsic value of solid sterling silver. And now is the *only* time subscriptions can be accepted from collectors in the United States for the sterling silver or gold-on-silver Proof editions.

To subscribe to *The Countries of the World* medallic collection, you must fill out and mail the subscription application and return it to the minter — The Hamilton Mint, Arlington Heights, Illinois, 60004 — postmarked not later than October 31, 1976. Any applications which bear later dates must, regretfully, be declined and returned. It is therefore suggested that applications be entered promptly.

The Ambassador's Edition. . . available in 24 karat gold-on-silver

Advance Subscription Application

The Countries of the World

All orders must be postmarked by October 31, 1976.
Limit: One set per subscriber.

The Hamilton Mint
40 E. University Drive, Arlington Heights, Illinois 60004

Please accept my subscription to *The Countries of the World* medallic collection consisting of 156 Proof medals to be issued at the rate of two medals per month. I am enclosing my remittance for the first two medals, as indicated. I agree to pay in advance for each subsequent shipment of two medals.

☐ I enclose $18.00 ($9 per medal) as payment for the first two medals in solid sterling silver.

☐ I enclose $24.00 ($12 per medal) as payment for the first two medals in 24 KT. gold on sterling silver.

(Illinois and Louisiana residents add applicable sales tax.)

I understand that I will receive a hardwood case and 4 custom-made albums to house my complete collection at no additional cost.

Please charge my order to:

☐ Master Charge* ☐ BankAmericard

Account No. _____ Expiration Date _____

*For Master Charge, please enter four numbers above name here _____

Name _____
(please print clearly)

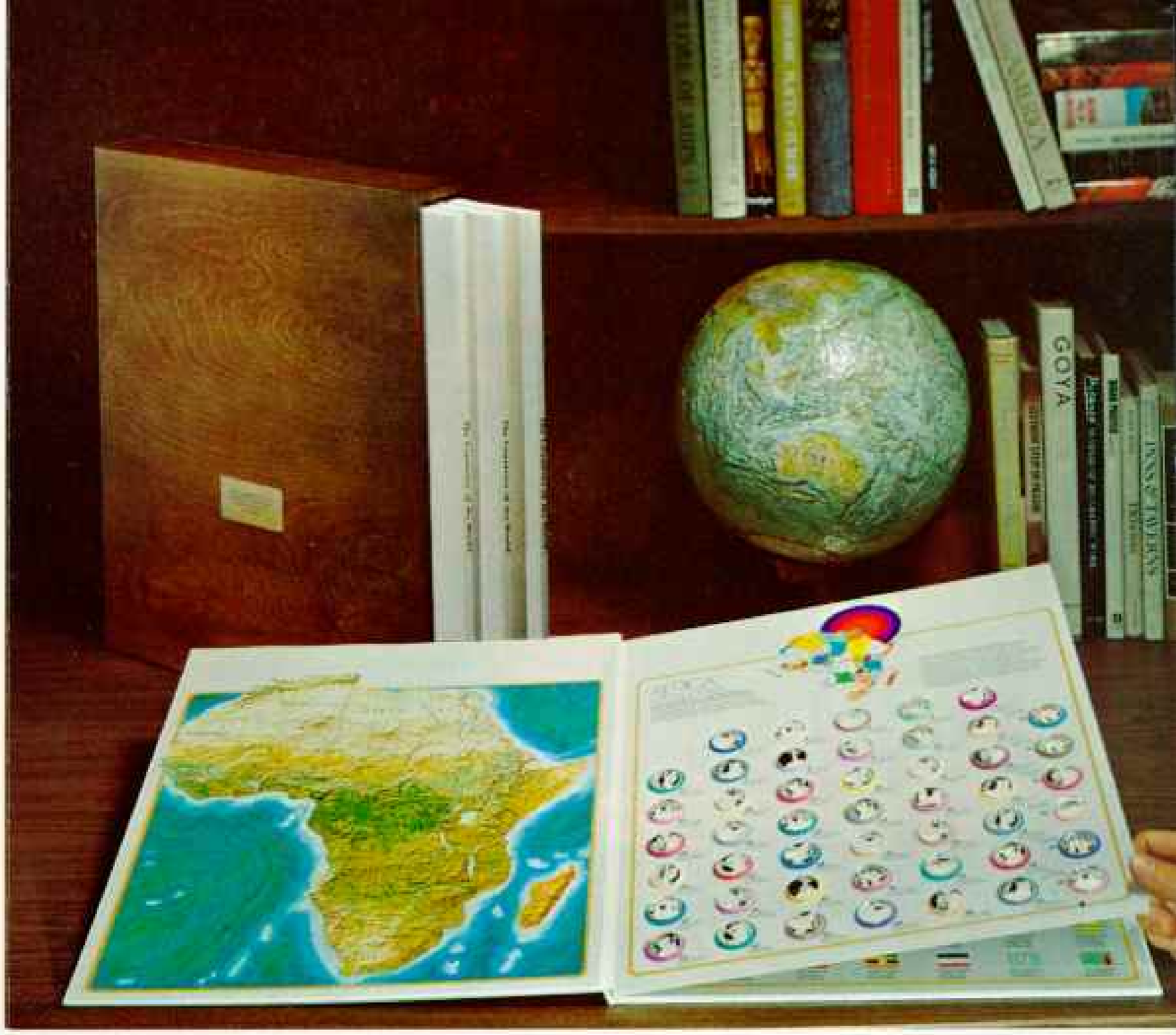
Address _____

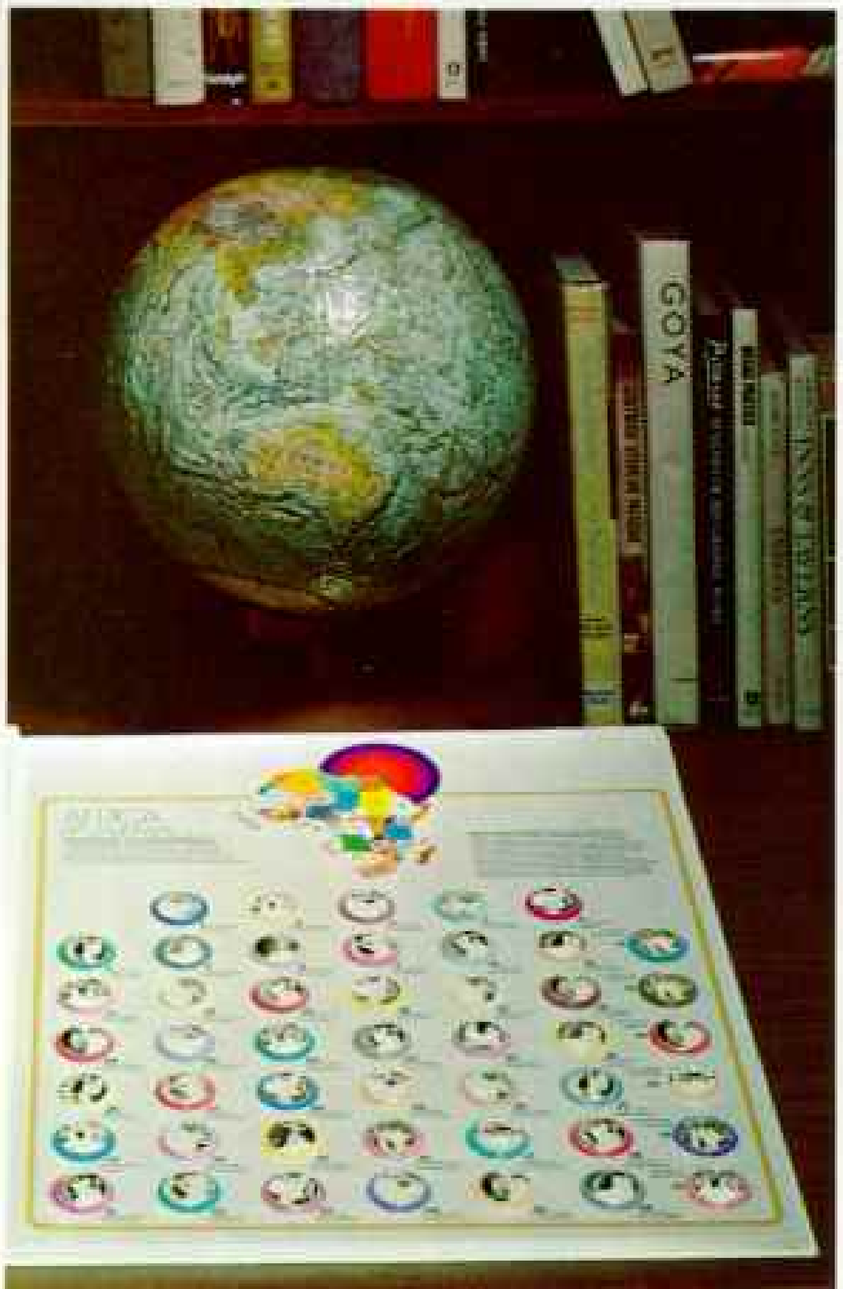
City _____ State _____ Zip _____

Signature _____
(must be signed to be valid)

All subscriptions subject to acceptance by The Hamilton Mint — please allow 6-8 weeks from the closing date for delivery of your first two medals. 9

The Countries of the World will be minted in two Proof editions: Solid Sterling Silver and 24 Karat Gold on Silver. Medals from both editions will measure 25mm and are guaranteed to contain at least 165 grains of solid sterling silver. The 156 medals of the complete collection will be minted for subscribers *only* and issued at the rate of two medals per month. There is a strictly enforced limit of one collection per subscriber, and the absolute closing date for entering a subscription in the United States is October 31, 1976.





THE WORLD'S MOST UNUSUAL ATLAS. A treasury of minted sterling silver medals representing all 156 countries on earth in four hard-bound continental editions: The Americas, The African Continent, Europe and Asia.

Each medal, on both sides, depicts the people, character or lifestyle of one country in impressively detailed bas-relief sculpture. The medals are individually struck in the centuries-old tradition of Fine Art Minting practiced at The Hamilton Mint, one of the world's foremost private mints. Each *Proof* medal is presented in a special transparent capsule to forever protect the proof quality of the medal. The capsules fit into color-coded mountings which key the countries to their geographic location on the full-color map in the album. The reverse panel and inside back cover provides colorful and detailed information on all the countries, including full-color reproductions of the flags of the nations. All four albums are permanently housed in a handsome hardwood presentation chest.

This collection represents one of the most ambitious undertakings in the history of medallic art. A strictly Limited Edition in silver and gold-on-silver to be minted exclusively for advance subscribers. The opportunity to subscribe to this collection is limited to those United States' collectors whose applications are postmarked by October 31, 1976.

THE HAMILTON MINT • Arlington Heights, Illinois 60004

One of the foremost private mints in the world.

This Giant, Library Size Authentic Webster Dictionary Was $39.95—Now Only $19.95

9 Pounds, 2 Volumes, 1,380 Pages, 158,000 Definitions. Recession Special—Send No Money—14-Day Free Trial—Phone Toll Free 800-241-8444

Noah Webster (1758-1843). Father of lexicography and inspiration for founding of our company

Can you imagine The New Webster International Dictionary of the English Language as a victim of the recession? It is true. And just as the automakers offered rebates to drastically improve sales, so does Webster announce an incredible half-price slash to reduce inventory and avoid the high cost of borrowing.

This is the gigantic, library size, 2-volume, 1,380-page, nine-pound, 158,000-definition New Webster International Dictionary of the English Language—including a 196-page supplement with a 51,000 word Thesaurus of Synonyms and Antonyms. Recognized as THE supreme arbiter of the English language. Considered to be a library in itself. Latest 1976 edition, updated to include the newest colloquialisms.

To get your free home or office inspection, send no money. Simply call (toll free) Webster's National Data Office 800-241-8444, anytime, including evenings and weekends. Ask for Operator 516. In Georgia Only it is 800-282-1333. In Canada it is 1-800-261-6362. Use your BankAmericard, Master Charge, American Express.

Or write The Webster Dictionary Company, Inc., Executive Offices, Dept. NGE-G1, 625 North Michigan Avenue, Suite 500, Chicago, Illinois 60611, and mail payment in full with order. In all instances you pay only $19.95 plus $2.00 for shipping. Illinois residents please add 4% sales tax.

Keep it for 14 days at no risk. Thumb through it as frequently as you wish. You must agree that it is the most thorough and comprehensive dictionary ever published. The one that defines every subtle nuance of a living, pulsating language. Two huge, handsome volumes that set on a library shelf will add a touch of grace, splendor, knowledge and erudition to your office or den—or simply return for full refund.

You can't lose. Clip out no-risk coupon as a reminder. This recession-induced, emergency money-raising half-price offer is for a limited time only and may never be repeated. Write or call now. Our toll-free lines are open 24 hours a day, 7 days a week. Allow 3-8 weeks delivery.

PHONE TOLL FREE 800-241-8444 OR MAIL NO-RISK COUPON TODAY

The Webster Dictionary Company, Inc., Executive Offices, Dept. NGE-G1, 625 North Michigan Avenue, Suite 500, Chicago, Illinois 60611

Please send me ..... set(s) of the renowned, authoritative, 1,380-page, 9-pound, 158,000-definition, $39.95 list price New Webster International Dictionary of the English Language at the unprecedented low price of ONLY $19.95!! (plus $2 per set for crating and freight). I understand that if I'm not satisfied I may return it within 14 days and you will return my full purchase price. On that basis here is my order.

(Check one) ☐ I enclose payment ☐ Bill my credit-card account:

Please Print Name _____ American Express # _____

Address _____ BankAmericard # _____

_____ Apt. _____ Master Charge # _____ Inter Bank # _____

City _____

State _____ Zip _____ Card Expiration Date _____

Illinois residents please add 4% sales tax.

There's only one Honda Civic. All five of them.

All five Honda Civic models are very different.

To begin with, there is the basic Civic, available in either sedan or hatchback models.

Next is the sporty 5-speed CVCC* hatchback, the car that got the best mileage of any car in America in EPA mileage estimates.* The CVCC wagon: combines Civic mileage with unexpected hauling capacity. And our CVCC hatchback and CVCC sedan: great mileage coupled with great performance.

But the funny thing about the Civics is the more they're different, the more they're the same.

Same when it comes to mileage; great mileage (check the chart at the right). Great handling too, because all five Civics have front-wheel drive coupled with rack and pinion steering. That means sure-footed traction and quick response.

Same approach to room and comfort. Or to put it another way, all Civics are small on the outside, big on the inside. Room for four adults and luggage. And easy to park in spaces other cars have to pass up.

One last thing. All CVCC engine Civics are so advanced they meet every federal and state emission requirement with absolutely no need for a catalytic converter. And they can do it while using no-lead, low-lead or even regular gas.

The 1976 Honda Civics.

The five and only.

There are over 600 Honda Civic dealers all over the country. Test own a Honda Civic soon. It's an unforgettable experience.

CVCC, Civic and Hondamatic are Honda trademarks.
© 1976 American Honda Motor Co., Inc.

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

** Manufacturer's suggested retail price plus tax, license, transportation charges, optional equipment and dealer's preparation charges.

Civic CVCC 1488cc		Price**	EPA Mileage Estimates* Hwy.	City	Combined Hwy. & City
Sedan	(4-Speed)	$2979	42	32	36
Hatchback	(4-Speed)	$3189	42	32	36
	(Hondamatic)	$3349	33	25	28
Wagon	(4-Speed)	$3419	37	26	30
	(Hondamatic)	$3579	32	24	27
5-Speed Hatchback	(All states except Calif.)	$3469	47	35	40
	(Calif. Model)	$3469	44	31	36
Avg. Sedan/Hatchback (4- & 5-Spd.)			43	32	36
Civic 1237cc (Not avail. in Calif.)					
Sedan	(4-Speed)	$2729	41	28	32
Hatchback	(4-Speed)	$2939	41	28	32
	(Hondamatic)	$3099	30	24	27

HONDA CIVIC
What the world is coming to.

A little more car from Honda.

The Accord.

Accord and CVCC are Honda trademarks. © 1976 American Honda Motor Co., Inc.

*Manufacturer's suggested retail price plus tax, license, transportation charges, optional equipment and dealer's preparation charges.

†5-speed transmission. The actual mileage you get will vary depending on the type of driving you do, your driving habits and your car's condition and optional equipment.

We ask you to compare our imposing list of standard features with any other car in the world today. Then compare our price. $3,995.*

CVCC® Advanced Stratified Charge Engine, Honda mileage (44 mpg hwy/31 city in EPA mileage estimates),† deluxe interior, electronic warning system, 5-speed transmission, tachometer, radial tires, big rear tailgate with remote release, automatic maintenance reminders, AM/FM radio, rack and pinion steering, rear window wiper and washer, four wheel independent MacPherson strut suspension, side and rear window defrosters, flow-thru ventilation system, tinted glass all-around, power-assisted front disc brakes, reclining front bucket seats, wall-to-wall color coordinated carpeting, low fuel warning light, protective side mouldings, day/night mirror, locking fuel filler door, trip odometer, even a coin box. All standard.

HONDA ACCORD CVCC

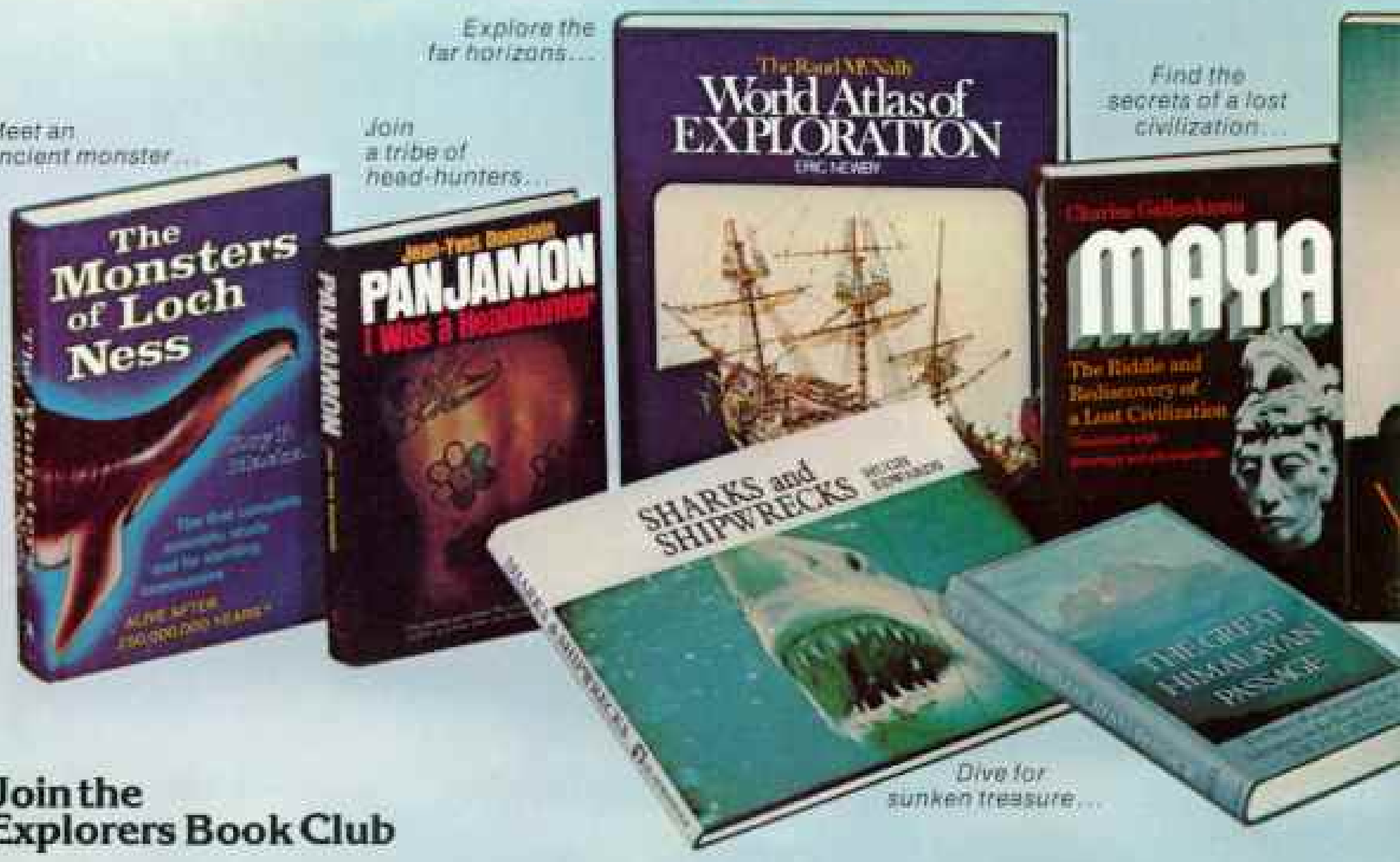
Get away from

Explore the far horizons...

Meet an ancient monster...

Join a tribe of head-hunters...

Find the secrets of a lost civilization...



Dive for sunken treasure...

Join the Explorers Book Club

Come. Climb to the roof of the world...walk on the floor of the sea. Discover every far-flung crannny where the undiscovered lies waiting and strange marvels can be seen for the first time. These are the pleasures that only the EXPLORERS BOOK CLUB can offer. Whether you're a much-travelled adventurer or an armchair explorer, here are books to fire the imagination, suggest new paths to follow, bring you close to exotic peoples. Books from many worlds—primitive worlds, natural worlds, ancient worlds—and worlds beyond our own. All in beautiful books you'll be proud to own—and *delighted* to own at the handsome discounts the EXPLORERS BOOK CLUB gives you. Why not join—and see for yourself!

50583. THE GREAT HIMALAYAN PASSAGE. *Michel Peissel.* Adventure extraordinary—exploring the great unnavigated rivers of Tibet and India. **$8.95**

48390. FATU-HIVA. *Thor Heyerdahl.* The great explorer and his wife recount a year of adventures in a tropical paradise—the Marquesas. **$18.00**

53030. HISTORIC AMERICAN ROADS. *Albert Rose.* From early Indian paths through the Santa Fe Trail. The roads that shaped the nation—and how to explore them today **$12.95**

33300. AMONG THE ELEPHANTS. *Iain and Oria Douglas Hamilton.* The mysteries of the great East African elephants. **$14.95**

78260. SHARKS AND SHIPWRECKS. *Hugh Edwards.* Diving for a fabulous treasure ... a spine-chilling fight between shark and diver ... and more! **$14.95**

87580. THE WORLD ATLAS OF EXPLORATION. *Eric Newby.* More than 300 maps trace the great exploration routes, from Marco Polo to latest Arctic expeditions. *Counts as 2 of your 3 books.* **$25.00**

84380. TO THE BACK OF BEYOND. *Fitzroy Maclean.* The legendary—and forbidden—cities of Asia and Outer Mongolia **$15.00**

57026. JOHN MUIR'S LONGEST WALK. *John Earl.* Beautiful, oversize photographic re-creation of Muir's 1000-mile walk. *Counts as 2 of your 3 books.* **$30.00**

32310. THE ADVENTURER'S GUIDE. *Jack Wheeler.* A how-to by a man who has climbed mountains, explored unknown wilds, and swum the Hellespont **$11.95**

73240. QUASARS, PULSARS AND BLACK HOLES. *Frederic Golden.* Incredible scientific detective story probing the mysteries of outer space. **$7.95**

45050. THE ENDS OF THE EARTH. *Jason Lauré.* Everything about the frozen polar wastes, from their exciting discovery to their effect on world climate. **$15.00**

67070. PANJAMON: I Was a Headhunter. *Jean-Yves Ramonet.* A young scientist captured by head-hunters adopts their life and marries the chief's daughter. **$6.95**

73337. THE RAPE OF THE NILE. *Brian M. Fagan.* The great thefts from the tombs of the pharaohs—from early grave-robbers to greedy adventurers. **$14.95**

88100. YELLOWSTONE. *Ann and Myron Sutton.* Lavishly illustrated in color **$12.95**

58500. LIFE IN A NARROW PLACE. *Stephen Hirst.* How the Havasupai of the Grand Canyon live in one of the tiniest, most inaccessible reservations in America **$11.95**

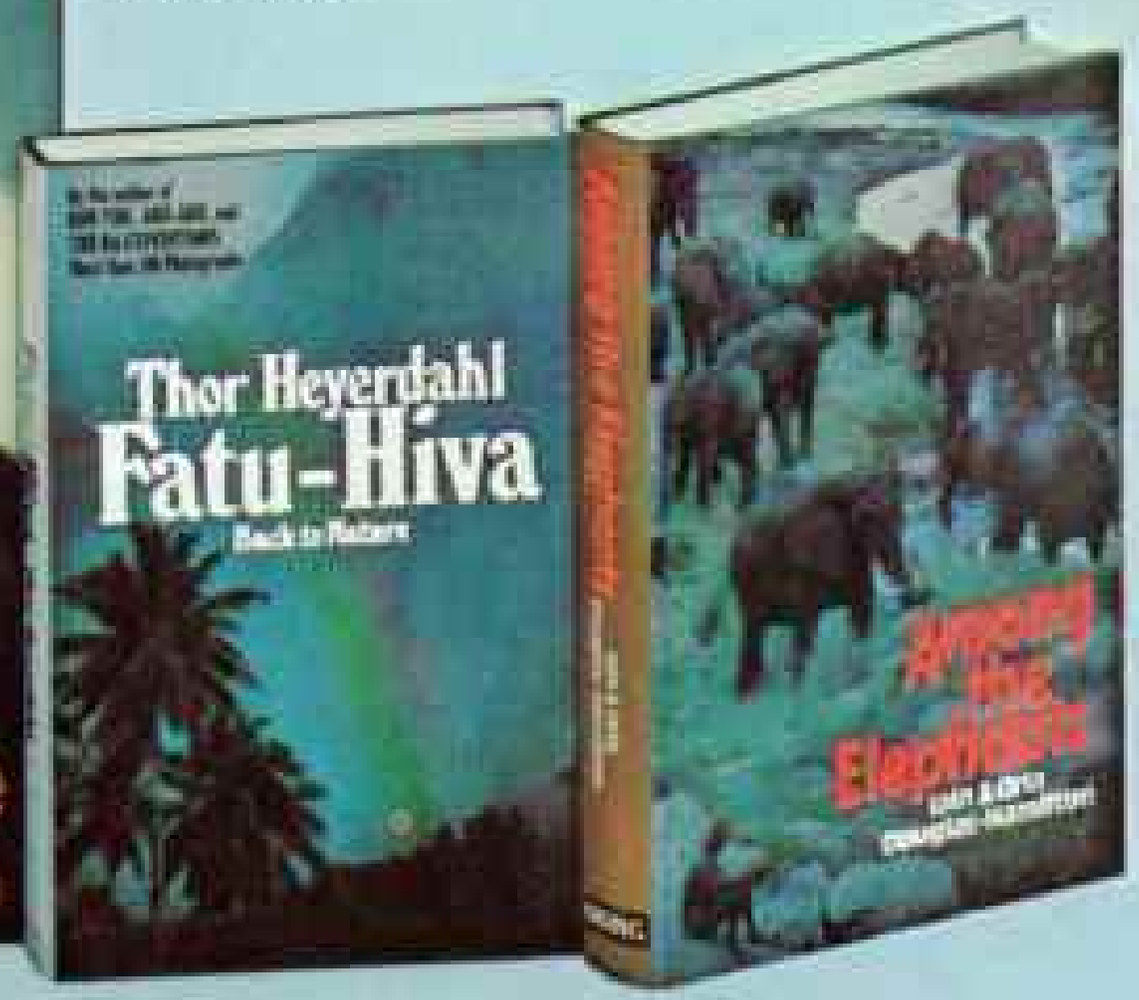
48695. FOR THE LOVE OF AN EAGLE. *Jeanne Cowden.* The full story of a *National Geographic* cover feature—how a woman won the trust of the great wild eagles of South Africa. **$9.95**

(Publishers' Prices shown.)

it all...

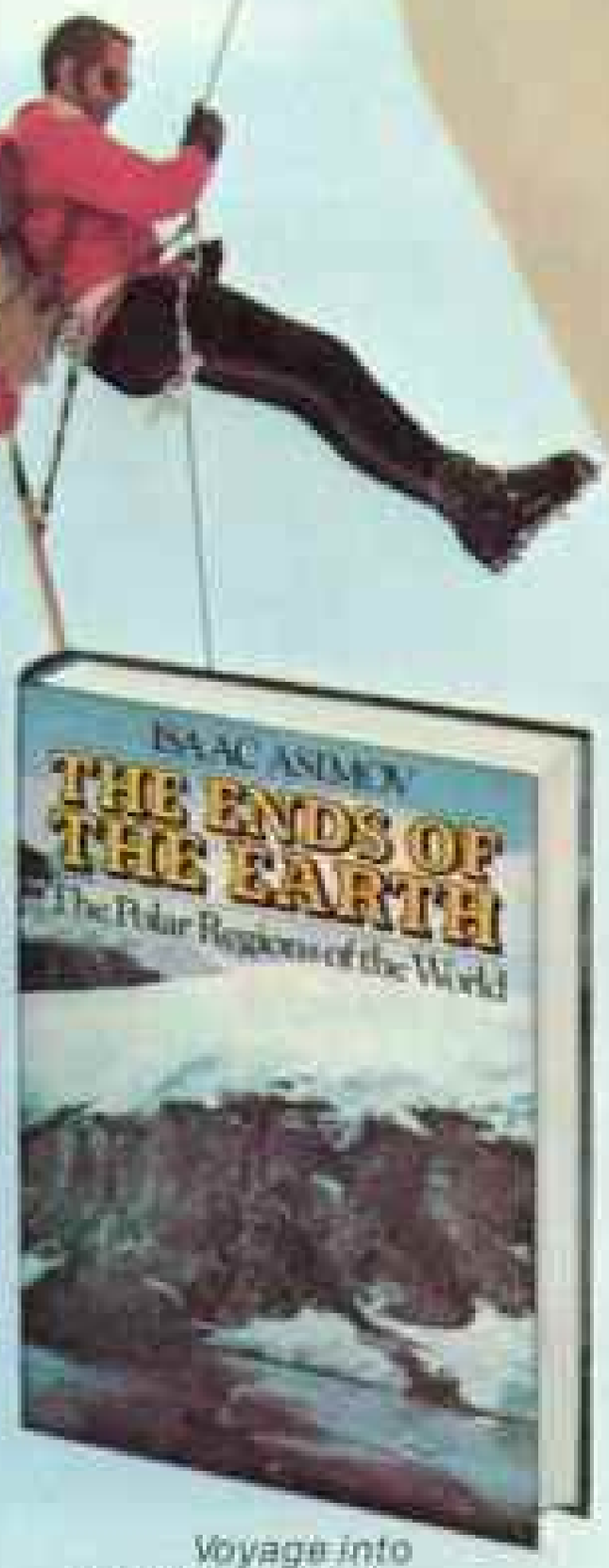
Discover the unknown Yellowstone...

Climb to the roof of the world...



Escape to a Pacific Island...

Roam with the great African herds...



Voyage into the Polar world...

Take any 3 books for only $1 each

(values to $47.95)
as a member of the

Explorers Book Club

if you will join now for a trial period and agree to accept only 3 more books —at member discount prices—within the next 12 months.

50770. GREECE OBSERVED. *André Bonnet.* Breathtaking color photos reveal the archeological wonders of Greece. **$17.95**

42680. DOÑANA: Spain's Wildlife Wilderness. *Juan Antonio Fernandez.* Wander through one of the world's most important wildlife refuges. Over 240 pages of full color. *Counts as 2 of your 3 books.* **$29.95**

63020. THE MONSTERS OF LOCH NESS. *Roy Mackal.* A scientist reveals fascinating evidence that the monsters exist! **$12.95**

58870. THE LONGEST CAVE. *Roger Brucker and Richard Watson.* How a band of intrepid spelunkers discovered the link between Kentucky's Flint River Cave system and Mammoth Cave. **$15.00**

77620. THE SECRET LIFE OF ANIMALS. *Lorus and Margery Milne.* Myth-shattering discoveries about the way animals really behave. Superb color photos. *Counts as 2 of your 3 books.* **$29.95**

77305. THE RAGE TO SURVIVE. *Jacques Vimes.* Suspenseful story of a couple cast adrift on a small raft with no food, oars, compass or sail. **$6.95**

41815. DEEP WATER, ANCIENT SHIPS. *Willard Bascom.* Extraordinary archeological guide to the vast sunken treasure that actually lies at the bottom of the Mediterranean and Black Seas. **$8.95**

50220. THE GENTLE TASADAY. *John Nance.* An intimate look at life among the Stone Age tribe recently discovered in the wilds of Philippine jungles. **$15.00**

61610. MAYA: The Riddle and Rediscovery of a Lost Civilization. *Charles Gallenkamp.* Fascinating discovery and exploration of a mysterious, lost civilization. **$12.95**

How the Club Operates

The Book Club **News**, describing the coming Main Selection and Alternate Selections, will be sent to you 15 times a year at 3-4 week intervals. • If you wish to purchase the Main Selection, do nothing and it will be shipped to you automatically. • If you prefer one of the Alternates, or no books at all, simply indicate your decision on the reply form always enclosed with the **News** and mail it so that we receive it by the date specified. • The **News** is mailed in time to allow you at least 10 days to decide if you want the coming Main Selection. If, because of late mail delivery of the **News**, you should ever receive a Main Selection without having had the 10 day consideration period, that Selection may be returned at Club expense. • Continued membership past the trial period brings you the added benefits of our Bonus Book Plan—an important way to save even more, at least 70% off publishers' prices.

Explorers Book Club

A-1AA

Riverside, New Jersey 08075

Please accept my application for membership and send me the three volumes indicated, billing me only $1 each. I agree to purchase at least three additional Selections or Alternates during the first 12 months I am a member, under the club plan described in this ad. Savings range up to 30% and occasionally even more. My membership is cancelable any time after I buy these three books. A shipping and handling charge is added to all shipments. **Send no money. Members are billed when books arrive.**

3 books for $1 each.

Indicate by number the 3 books you want.

A few expensive books (noted in book descriptions) count as 2 choices.

Name _____

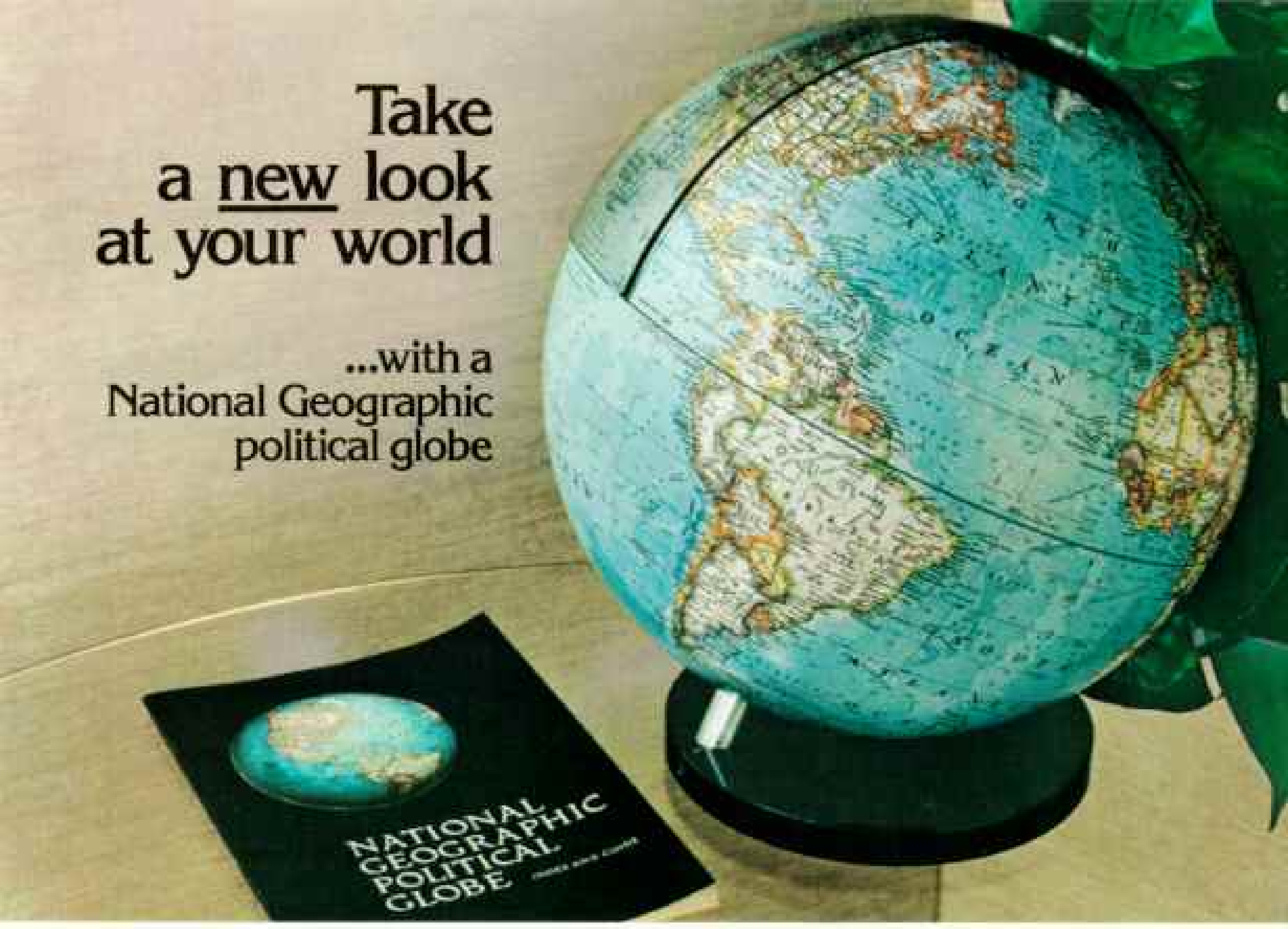
Address _____

City _____ State _____ Zip _____

(Offer good in Continental U.S. and Canada only. Prices slightly higher in Canada.)

Take a new look at your world

...with a National Geographic political globe



Outstanding cartography and superb craftsmanship combine to make National Geographic's *new*, up-to-date political globes the finest instruments of their kind. Striking colors and special lettering identify 158 countries (including 25 that gained independence this past decade) in remarkably clear, readable form.

Stimulates Thinking and Learning

You'll consult your globe over and over again to follow events in the news, to locate places that pop up in business or social conversations, to assist youngsters with their schoolwork . . . or just to study the world in its true perspective.

New, Versatile Geometer

Accompanying your globe will be a unique geometer made of clear, durable acrylic. This completely redesigned measuring device will enable you and your family to make dozens of different calculations about our earth—much as professional geographers do.

You will also receive an illustrated handbook showing how to use your geometer, and containing an index of 5,485 place-names keyed to your globe.

Set on a handsome black acrylic base, your globe will add interest and distinction to any room in your house. An aluminum axis pin holder attaches the sphere to the base at the same angle as the earth's inclination to its plane of orbit. For increased flexibility, you can remove the sphere from its base.

Four Models Available

Twelve-Inch Globe: Scaled at 660 miles to the inch. High-gloss sphere molded from durable pressed composition board. **$29.00**

Twelve-Inch Illuminated Globe: Features stand out vividly; place-names are remarkably easy to read on this translucent sphere of polystyrene. Removable interior bulb. Detachable six-foot cord with built-in switch. UL approved: uses 110 volt house current. **$40.00**

Sixteen-Inch Globe: Significantly more detail; scaled at 495 miles to the inch. Includes *both* a round black acrylic base *and* additional 18-inch-high floor stand (right). **$55.00**

Sixteen-Inch Illuminated Globe: Same superlative detail and additional floor stand as regular 16-inch globe above—plus illuminating features of the 12-inch illuminated globe above. **$79.00**

National Geographic Society
Dept. 1729, Washington, D. C. 20013

Please send me the new National Geographic globe model checked below. Bill me for the amount indicated. If I'm not entirely satisfied, I may return the globe without obligation.

- ☐ 00206 Twelve-inch political globe, **$29.00**
- ☐ 00207 Twelve-inch illuminated political globe, **$40.00**
- ☐ 00208 Sixteen-inch political globe, with floor stand, **$55.00***
- ☐ 00210 Sixteen-inch illuminated political globe, with floor stand, **$79.00***

NAME_____

ADDRESS_____

CITY_____ STATE_____ ZIP_____

These globes available only from National Geographic

*POSTAGE AND HANDLING PAID IN THE U. S. AND CANADA ONLY. MARYLAND RESIDENTS PLEASE ADD SALES TAX

General Telephone & Electronics, One Stamford Forum, Stamford, Conn. 06904

OUR LAZY SIDE GTE

SYLVANIA COLOR TV

Sylvania GT-Matic: it helps keep the picture looking good without any help from you.

Does your TV picture sometimes roll over and over? Or break up sideways? Or change color? Or go dark? Or lose contrast and wash out?

Sylvania engineers have done something about problems like these with the new GT-Matic II. It has special circuits that help keep the picture looking good automatically as it goes from scene to scene or channel to channel. In fact, the GT-Matic™ is the first true self-adjusting color set.

To 27 million people GTE is the phone company. Through GTE Sylvania, we're in television and audio. We're in a lot of other things, such as world communication by satellite.

Whatever we're in, we try to make it easier for people to enjoy watching, listening and talking to each other.

And that takes hard work.

Simulated TV picture

LOOK

AT THE ISLANDS OF HAWAII, A FEAST FOR THE SENSES.

Paradise. In fact, there's a contagious conviviality all over the state. It's called the Aloha spirit and each island of the chain has its own unique way of sharing.

Unique too, each of the Islands. Take a moment to look them over here, one at a time.

Maui. Back in the 1800's Maui was the whaling capital of the Pacific. Today the town of Lahaina has been restored, a tribute to the whalers and their ships. Maui sweeps up from the beach to the top of nine-thousand foot Haleakala, the mountain with a crater big enough to house Manhattan Island! Even the names are romantic. Like the Seven Pools of Kipahulu. (Yes, you can take a dip in all seven) Or Hana, the remote coastal town that makes going back in time beautiful. Inviting too, Maui's Kaanapali Beach and its world-renowned resort area.

Hawaii. It's called the Big Island so as to not confuse Hawaii with Hawaii. Anyway, this is where the Goddess of fire lives — in Volcano National Park. Look down and you'll see molten lava. Look up and there's snow-capped Mauna Kea. The Big Island just doesn't have beaches — it has them in colors: black, green and pearl white. Orchids? Fields of them. And no visit is complete without tasting Island-grown Kona coffee and fresh roasted macadamia nuts.

Kauai. They say it has more beautiful distractions across its verdant valleys than you can count. Like the tropical version of the Grand Canyon, for example. Kauai is called the Garden Isle and if there's anywhere greener, let us know. Here too are beaches for two. Yes, this is where *South Pacific* was filmed.

Molokai. It's called the friendly isle and that it is. Lots of room, few folks. Look for an hour and you'll see more sheer beauty and less cars than believable. Fishing, hunting and relaxing are particularly good here. Enjoy a fantastic trip by mule-train while you're here.

Lanai. They call it the world's largest pineapple platter. It's a gentle island, like a vacation from your vacation. Look at Hawaiian petroglyphs, try to fathom what's been etched in stone long, long ago.

Oahu. This is where Honolulu and Waikiki are. It swings by night and tans by day. Everywhere you go you sense an International flavor reflected in the people and the cuisine.

Although Honolulu is Big City — sophisticated, bustling, exciting, a short ride over a spectacular highway takes you to the Hawaiian-style country, complete with horses, cows and fields of bananas. Live it up or take it easy, Oahu gives you a choice.

Remember, when you've seen one Island, you've seen *one*. And that'll never do. Just ask your travel agent. He knows.

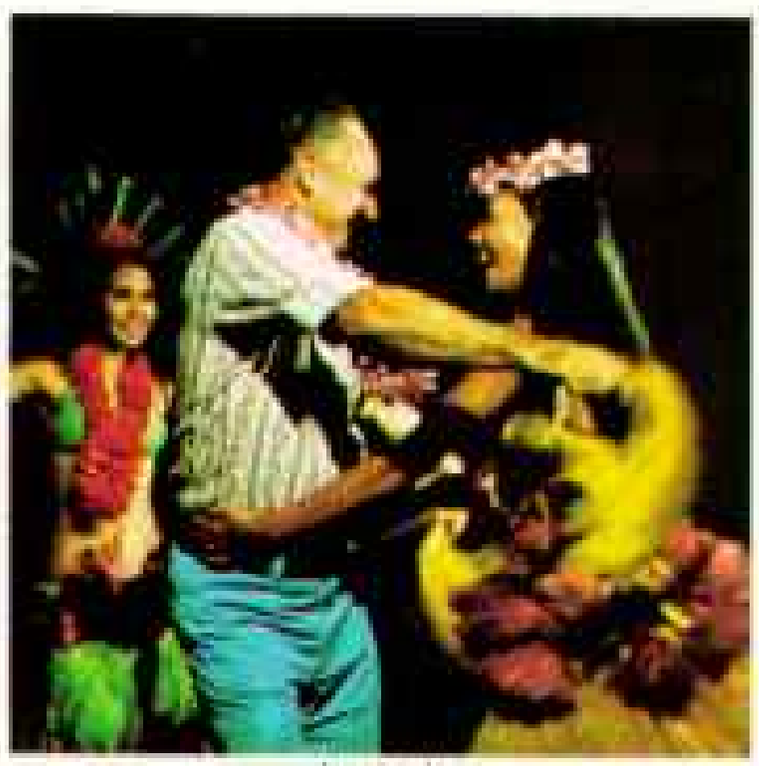
THE HAWAIIAN ISLANDS

More than a pretty place

On behalf of the people of Kauai, Oahu, Maui, Molokai, Lanai and the Big Island of Hawaii.

Look up

Look down



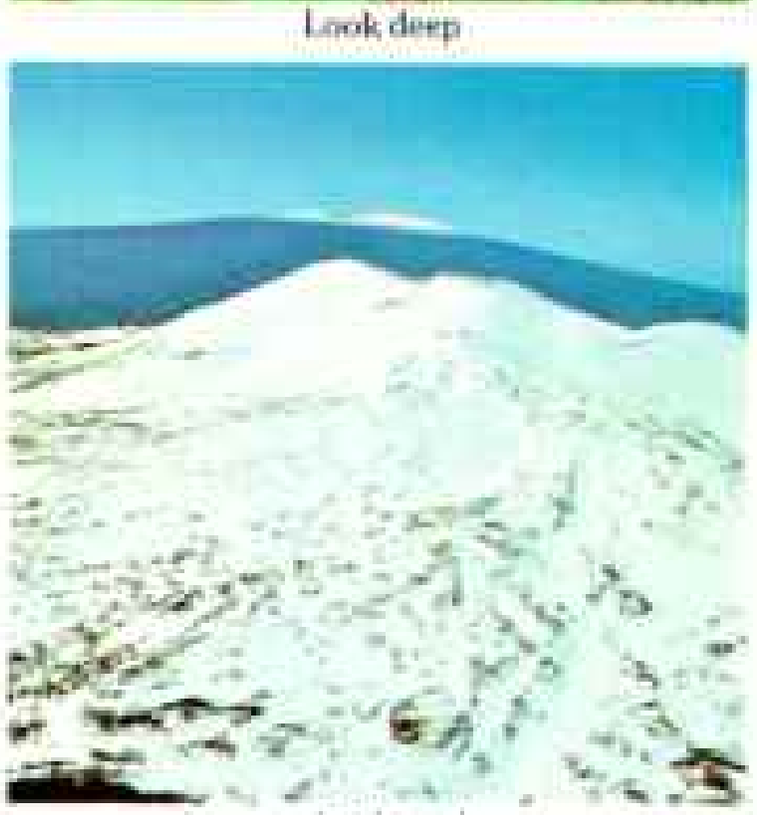
Look alive

Look us over

Look deep

Lookout

Look sharp



Look cool

Look-alike

Look quick

Look again

Look sea

Recent studies have shown that blood levels of vitamin C were as much as 30 percent lower in smokers than in non-smokers.

Alcohol may interfere with the body's utilization of vitamins B_1, B_6 and folic acid. Also, heavy drinkers frequently eat poorly.

If you're dieting or skipping meals, you may be eliminating foods that contain many vitamins including C, E and B-complex.

Scientific evidence suggests that many conditions and stresses of everyday life increase the body's vitamin needs.

With finicky eaters, the sick, the smoker and children, much of the meal and its vitamins often wind up in the garbage.

If you take birth control pills, you may need up to ten times the normal amount of vitamin B_6. Your physician should be consulted.

Six ways you may be robbing your body of vitamins.

Vitamins are essential to life and good health. So you should try to eat balanced, nutritious meals. When you're shopping, read the labels, because today many vitamin-fortified foods are available.

One sure way to get enough. Buy supplements—and make sure you take them daily. After all, vitamins are really low-cost insurance.

For a free booklet: "Are you robbing your body of vitamins?", write Vitamin Information Service, Department N-103 Hoffmann-La Roche Inc., P.O. Box 288, Nutley, New Jersey 07110.

ROCHE

Your health is our concern.

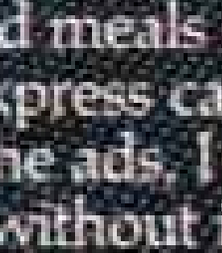
"I made a reservation for Herbert R. Wieth. I got reservations for Herbert R. Wieth. Amazing."

Herbert R. Wieth
Vice President-Sales

"At Holiday Inn, when I reserve a room I get a room. For 20 years now, that's been true. And anything that works right for 20 years is absolutely amazing.

"I think it's because of those 152 Holiday Inn standards that practically guarantee that everything does exactly what's expected. They call it no surprises. In this day and age, I call it amazing.

"I always get a bed that's big enough. A nice, clean room. And a good restaurant that always seems to be open when I want it to be. I don't even need cash. I can charge my room and meals on the American Express card. Like they say in the ads, I never leave home without it.



"Last year I traveled to 50 cities. I travel for a living. And I have only one thing to say to the people at Holiday Inn.

"Thank you."

At every Holiday Inn, the best surprise is no surprise.℠

The 1977 Buicks. Looking at them is impressive. Driving them is a revelation.

THE NEW LeSABRE. This is a family car, friends. With more front seat headroom, more rear legroom, and a bigger trunk than it had last year.

But don't jump to any conclusions. Because LeSabre in motion is going to surprise you. It is eminently maneuverable. Easy to turn. And park. It is solid. And responsive. Qualities you just don't expect from a car that can carry as much as this one.

And because it's a Buick, it is well-equipped to indulge you. With plush seating. Gleaming appointments. An intelligently laid out, handsome-looking instrument panel. Power front disc brakes, power steering, and automatic transmission. All standard.

LeSabre. It's a family car, all right. But it's also a family car that happens to be fun to drive.

THE NEW ELECTRA. When a car this luxurious promises to provide a few grins when you get it out on the road . . . well, that's precisely what you have to do. Because you have to actually drive this car to realize what solid road manners it has.

Mind you, Electra is still the ultimate Buick.

It still indulges you with standard niceties like power windows, a quartz-crystal clock, power front disc brakes, power steering, and automatic transmission.

But this year, there's a slightly different emphasis. A regard for function. A desire to make Electra cope with the times. And to make it as fun as it is elegant.

The car is surprisingly agile. It is tight and solid

under way. The standard engine, a 5.7-litre V-8, has 105 fewer cubic inches to feed than last year. And even the styling is more restrained, trimmer of line.

The 1977 Electra. Luxurious. And more fun than ever.

THE NEW RIVIERA. Riviera has always been designed to live in two different worlds – that of the luxury car, that of the road car. It may surround you with elegance and luxury, but it's still a driver's car.

Its smooth, quiet ride is coupled with the ability to be tough in the corners. The standard suspension includes front and rear stabilizer bars. And special shock absorbers. You can even order disc brakes for all four wheels – something you'll find on exotic racing cars.

As for the luxury half of Riviera's personality, you get new 50/50 front seating with twin armrests. Rich velour fabrics. An elegant instrument panel. New custom wire wheel covers. Power front disc brakes. Power steering. Automatic transmission. And much more. All standard.

BUICK

Dedicated to the FreeSpirit in just about everyone.

6 good reasons (and 1 super reason) why your new washer and dryer should be a Kenmore.®

1 Sears Best Kenmore Washer gets big loads cleaner than the next best-selling brands.*

2 Do more wash at once. Instead of two or three small loads, do one big load a day.

3 Even clothes on top get clean. Exclusive Dual-Action™ Agitator *pulls* clothes down into the wash water to wash them clean.

4 Features women want most: Permanent Press and knit cycles, 4 water levels—including low. Bleach, detergent, and fabric-softener dispensers.

5 Sears Best Kenmore Dryer won't dry the life out of clothes. "Senses" when clothes are dry; shuts itself off.

6 Heating element is more durable than any we've sold before. Really stands up to hard, family use!

7 The Super Reason: Kenmore means Sears service. Sears dependability, value. Ask about Sears convenient credit plans. Only at Sears, Roebuck and Co.

The six good reasons apply to washer Model No. 26936, dryer No. 66936. Also available through the catalog.

*Test results available upon request.

Kenmore. Solid as Sears

So the leading lady's lovely complexion stays lovely—even in the closeups.

So the red helmets on Channel 7's football game look as good as the red jerseys on Channel 9's game.

So the afternoon movie doesn't fade when the sun starts shining in between the drapes.

Zenith introduces Color Sentry. The automatic picture control system.

Zenith's Color Sentry does it all for you: controls the color picture when the scene changes, or the channel changes, even when the room light changes.

Zenith's Color Sentry available on selected 19" and 25" diagonal models, including the Brandon, Model SH2207R, pictured here. Simulated wood grain and TV picture.

You get that great Zenith picture—automatically.

ZENITH®

CHROMACOLOR® II

The quality goes in before the name goes on.®

The unbelievable Dodge Aspen.

A comfortable wagon in a size all its own.

The Aspen wagon performs a simply marvelous feat. It convinces you that it's a much bigger wagon than it really is. (Even people who have never owned a wagon will love it.) How does the Aspen wagon do it? Unique size, for one thing. It carries so much more than the little wagons, almost as much as some of the larger ones. And the Aspen wagon's ride—based on its unique suspension system—conveys the smooth comfort you'd expect from bigger wagons or cars. You get the space and comfort you need and want in a wagon . . . with a more practical overall size. The full option list offers extra comforts, too: from power seats and windows to automatic speed control. All this and a base price that's quite agreeably low. Unbelievable? Only until you've driven one.

The small car at a small price...the unbelievable ASPEN

Dodge

When it comes to buying a color TV, the last thing to trust is your luck.

The problem with the good luck method of buying a TV, is you never know how long your luck will hold out. Which is why it pays to depend on Quasar.

We challenge any other TV maker to make this statement.

In the first 8 months, our records show that during the warranty period, 97% of the new Quasar® 13" and 15" diagonal sets with the Service Miser™ Chassis required no repairs. And we challenge any other television maker to match that.

Ask your Quasar dealer for his facts. Then ask him to show you a Quasar.

That way, when you buy your next TV, you'll finally have a choice. **You can trust the facts. Or trust your luck.**

you can depend on **Quasar**

Quasar Electronics Company 9401 W. Grand Ave., Franklin Park, IL 60131

LAUGH at the COLD!

It's 10° outside . . . Even getting colder. So you bundle up in layers and layers of heavy clothes. First with long underwear . . . then bulky, restrictive thermalwear on top.

Oh, you were warm, all right. Like in a Turkish bath. Because you began to perspire from all your activity. And perspiring in that mountain of clothes is like perspiring in a plastic bag! The perspiration is locked in. So there you are. Wet and miserable.

But now, at last, Damart has solved the problem. Because Damart invented underwear that keeps you *warm, dry and comfortable* no matter how cold it is or how long you stay out. Underwear that's soft and light so you can move easily. Underwear that *lets the perspiration evaporate through* so you always stay warm and dry next to your skin.

Damart does this with a new miracle fabric—Thermolactyl. It not only retains and reflects your natural body warmth it's knitted to let *perspiration out!* No other underwear does this! Damart Thermolactyl is so comfortable that the Mount Everest climbing expedition wears it. So does the Glencoe mountain rescue team and the entire Chicago Bears Football Club.

Our free color catalog tells the full Damart Thermolactyl story and displays the whole Damart line for men and women. Send for your FREE copy now!

The Proof is in the wearing!

SEND NO MONEY . . .

Send for your Free Catalog. Complete selection of styles and sizes. No obligation. Do it now!

TALL SIZES NOW AVAILABLE

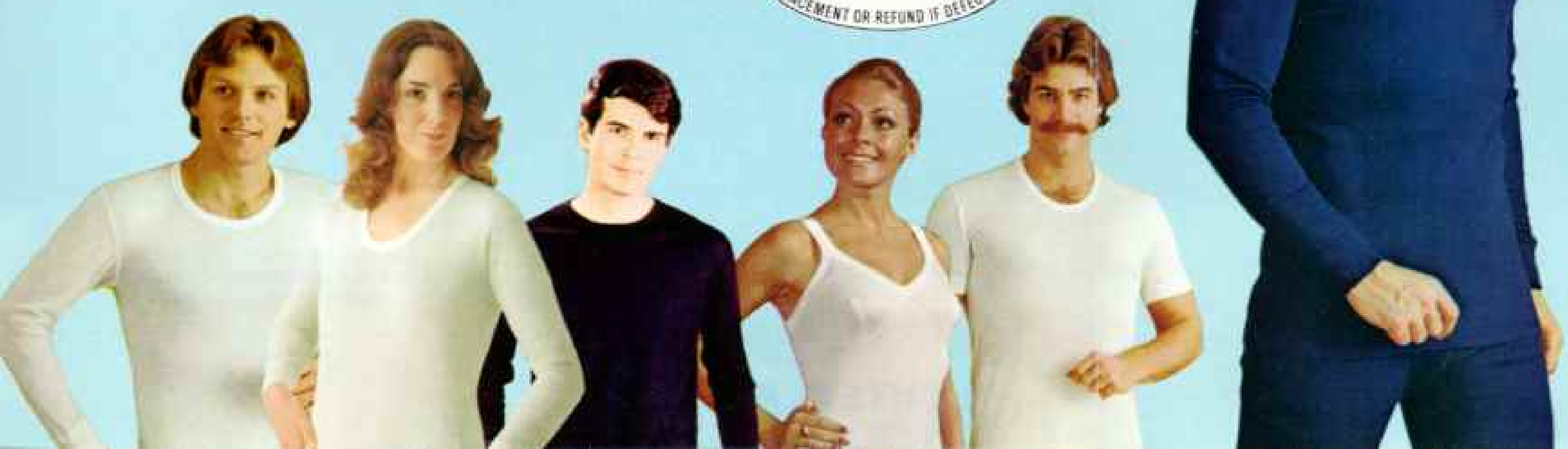
Damart

Thermawear, Inc.

WHEN IN THE BOSTON AREA, VISIT OUR PORTSMOUTH, N.H. STORE. (603) 431-4700

There is no warmer underwear made!

A LIMITED WARRANTY TO CONSUMERS
Good Housekeeping
PROMISES
REPLACEMENT OR REFUND IF DEFECTIVE



at the COLD!

Fill out and send to:
DAMART, INC. Dept. NG106
1811 Woodbury Ave.
Portsmouth, N.H. 03801

YES! Rush me your **FREE DAMART** Catalog . . . I want to enjoy the fantastic warmth of Thermolactyl Underwear, a DAMART® exclusive. (I understand there is no obligation.)

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

NATIONAL GEOGRAPHIC

Send for your passport to Polynesia.

Free Hawaii One-O brochure.

Variety: that's Hawaii One-O vacations. A freewheeling week in Waikiki is just the first choice in this guide to Hawaii. It starts with your private taxi from the airport, and includes a Passport to Polynesia with free admission to four unique Hawaii attractions.

Other-island options are available, including a fly/drive vacation. And Hawaii One-O offers a host of optional excursions around the Neighbor Islands.

In the friendly skies, it's Royal Hawaiian Service for you, with exotic drinks, Hawaiian stewards, Polynesian food . . . all the atmosphere of the Islands.

See the Hawaii of your choice; send for your free guide to a wide range of prices and hotels that are sure to include you.

United Airlines 1000-1000
P.O. Box 27, Dept. 74f
Glenview, IL 60025

Please send your free Hawaii One-O vacation guide.

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

Our little corner of the world.

UNITED AIRLINES

Archeology Proves the Bible

Archeologists in Jerusalem and elsewhere testify that archeology is proving the accuracy of biblical history. Remarkable accounts of archeological findings in Bible lands will give you renewed faith in the Bible. Read the Bible's message of hope relevant to the chaotic times in which we live.

Send for a FREE booklet today

BIBLE ANSWERS, Dept. A-
Box 60, General Post Office
New York, N.Y. 10001

Please send me, without obligation, "Archeology Proves the Bible."

Name _____

Address _____

City _____

State _____ Zip _____

Change of Address?

Please print your new address below:

NAME _____

ADDRESS _____

CITY, STATE, ZIP CODE _____

And attach the address label from your National Geographic Magazine wrapper below, so your records can be updated. Six weeks advance notice should be given.

Paste Label Here

Clip this entire form and mail to:
NATIONAL GEOGRAPHIC SOCIETY
WASHINGTON, D. C. 20036

Natural food fiber and your family's health.

Suddenly natural food fiber is news. You see major articles on its importance to your family's health in newspapers and magazines.

The benefits of fiber. *The fact is, we've known for over forty years that food fiber helps the digestive system run smoothly.*

However, recent observations suggest it may have an important role in general health. And that implies fiber is important to the diet of the whole family, not just older adults.

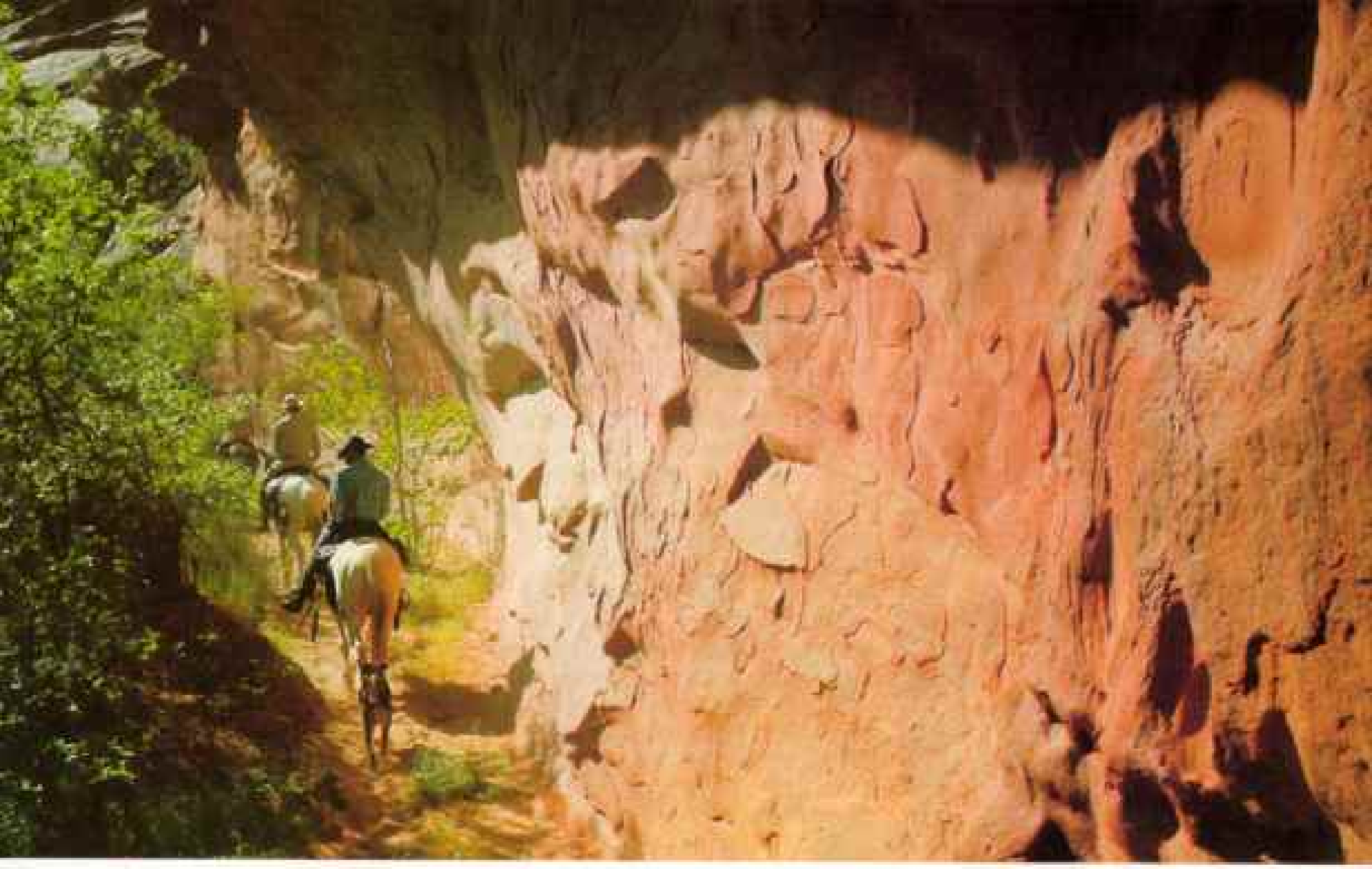
These observations have spurred a lot of research on natural food fiber. But the clinical evidence is not in. So far, the only thing everyone agrees on is that food fiber is of great importance in helping the digestive system regulate itself.

How much is enough? *Is your family getting the fiber they need?*

All the evidence isn't in. But what we do know so far suggests that many Americans aren't getting enough fiber in their normal diet.

Kellogg's® All-Bran® and Bran Buds.® *If you're concerned about food fiber and your family's health, consider adding Kellogg's All-Bran or Bran Buds cereals to your family's diet. They're one of the richest sources of food fiber in the American diet. And they have an honest wheat taste that stays crunchy in milk. So take your choice—All-Bran, in shredded form, or Bran Buds, morsels of bran with a slightly sweeter taste. We do know food fiber is important.*

All-Bran & Bran Buds.
The high-fiber cereals from
Kellogg's®



Enjoy a bigger world of good times. Start with our free adventure kit.

Chances are, you've already enjoyed most of the good time adventures within a 300-mile radius of your home.

Now, you'd like some new experiences. Something beyond the limits of earthbound travelers.

Beechcraft's far-reaching Baron can expand your adventure horizons. Sweep you to a wide new spectrum of events, activities and experiences.

The solitude of a wilderness camping trip. The nostalgia of a ride on a romantic old riverboat. The savory delight of a regional dish cooked where the recipe was born. The fulfillment of seeing unseen sights for the very first time.

The Beechcraft Baron can take you to good times located near all the major airports in this country... or those thousands of airports the airlines don't serve. And, on many of those trips, you'll use less fuel than a standard size car.

The Baron is a limited-production aircraft. Beech carefully blends meticulous handcrafting with the most advanced manufacturing processes. The cabin can be styled to reflect your individual taste in matters of elegance, comfort and convenience.

What better way to get your good times off the ground.

Just to get you started, we've put together an updated and expanded version of our popular Beechcraft Adventure Kit.

You'll find it an informative, entertaining guide to out-of-the-ordinary places and events in the U.S. We'd like to send you one free of charge.

THIS IS NOT A COUPON

But we do urge you to write to us on your letterhead instead.

We'll send your Beechcraft Adventure Kit by return mail, absolutely free. And we know you'll like it.

Write to Beech Aircraft Corporation, Department A, Wichita, Kansas 67201.

Please include name, address, occupation, and title. Also, please let us know if you're already a pilot.

Beechcraft Baron 58P

"The Alaskan pipeline will deliver two million barrels a day."

Two comments on our oil situation. One looks at the size of new discoveries. The other is awed by our total appetite for oil. Which view is most perceptive?

The North Slope strike was America's greatest recent oil find: 9.6 billion sure barrels. And 26 trillion cubic feet of natural gas. In 1977 the line will begin feeding us half a million barrels a day, increasing to 2 million by 1980. And plans to pipe in natural gas are being made. So people ask, "With reserves like this around, is there really an energy problem?"

Others cite our massive use of petroleum. Over 16 million barrels daily. Nearly 40% imported. And 21 trillion cubic feet of natural gas, one trillion feet imported. They point out that the North Slope's 9.6 billion barrel reserve is less than 2 years present oil consumption. We've no guarantee of another major find. With petroleum and natural gas currently providing close to three-fourths of our energy, there is concern.

Surely we will find new oil and natural gas. But demand is growing so fast that new discoveries may not keep pace. Oil and natural gas may be scarce, priced out of sight within our children's lifetime. We must begin looking to the future now with a realistic and definitive national energy policy. A blueprint that defines the rights and responsibilities of consumers, producers, government. A policy that encourages these bodies to develop and use energy resources for long-term economic and environmental well-being of the nation.

Caterpillar machines and engines are used to mine fuels, prepare plant sites, power drill rigs, build pipelines, restore mined land. We believe a responsible national energy policy is essential to America's growth.

There are no simple solutions. Only intelligent choices.

CATERPILLAR

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

"America's daily oil consumption exceeds 16 million barrels."

THE WAGON THAT THINKS IT'S A SEDAN.

A wagon is spacious. A sedan is comfortable. The Toyota 5-Door Wagon thinks it's both. And it is.

The outside looks like a sporty wagon. The inside rides like our quality sedan. A quality wagon with sedan comfort. You got it. The Toyota Corona Wagon.

It's what a wagon should be. Roomy and well-built. It can handle 20 big bags of groceries with room to spare. With unit-body construction and welds instead of bolts. It's built to take punishment. The rear door is one-piece lift-up design you can easily operate with one hand.

It's what a sedan should be. Comfortable. With soft vinyl seats, tinted glass, wall-to-wall carpeting—even in the cargo area. Steel-belted radial tires, a smooth sedan-like ride and more.

The best of both worlds. The unique Toyota 2.2 litre 20-R engine was specially designed to deliver all the power a wagon needs along with the gas mileage of an economy sedan. Note: In 1978 EPA tests, with optional 5-speed overdrive transmission, 34 mpg highway, 20 city. These EPA results are estimates. The actual mileage you get will vary depending on your driving habits and your car's condition and equipment. California EPA ratings will be lower. Automatic transmission available.

EPG
34 HWY 20 CITY

A quality wagon deserves quality service. And gets it from Toyota trained mechanics at any one of 1,500 dealers across the United States. Drive a Corona Wagon. See why we say, if you can find a better built wagon, buy it! Quality. You asked for it. You got it. Toyota.

1,000 DEALERS

YOU GOT IT.

THE TOYOTA CORONA WAGON