VOL. 138, NO. 4 OCTOBER 1970

NATIONAL GEOGRAPHIC

CANADA'S HEARTLAND, THE PRAIRIE PROVINCES
W. E. GARRETT 443

GROWING UP WITH SNOWFLAKE
ARTHUR J. RIOPELLE 491
MICHAEL KUH

LONE SAILOR COMPLETES HIS GLOBE-GIRDLING VOYAGE
ROBIN LEE GRAHAM 504

ORISSA: PAST AND PROMISE IN AN INDIAN STATE
BART McDOWELL 546
JAMES P. BLAIR

WORLD WAR I AIRCRAFT FLY AGAIN
HARVEY ARDEN 578
HOWARD SOCHUREK

A New Geographic Book
THE RENAISSANCE, MAKER OF MODERN MAN
FRANC SHOR 588

SEE "ZOOS OF THE WORLD" TUESDAY, OCTOBER 13, ON CBS TV (page 503A)

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

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WASHINGTON, D. C.

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Long-dead Chanchán, Peru, a study in urban sprawl

AT THE CITY'S CORE dwelt the cloistered rich, their courtyards and elegant halls adorned with works of art (right). Beyond this hub of lavish homes in walled enclaves (above) sprawled the flimsy houses of the poor.

Home to 70,000, Chanchán flourished near Peru's northern coast before Columbus reached the New World. With National Geographic Society aid, Harvard University anthropologist Dr. Michael E. Moseley (kneeling at left) studies the once-powerful Chimú empire, conquered by the Incas 500 years ago. Desert-preserved ruins offer clues to social life during the rise and fall of a city—and even give insight into today's urban problems.

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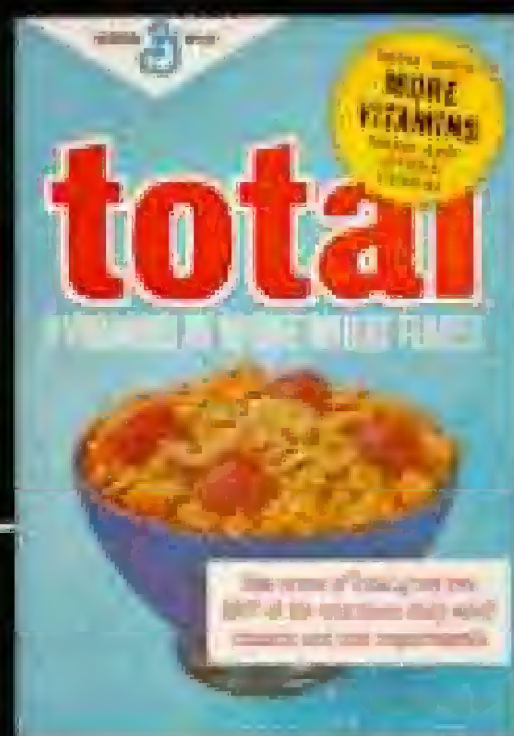

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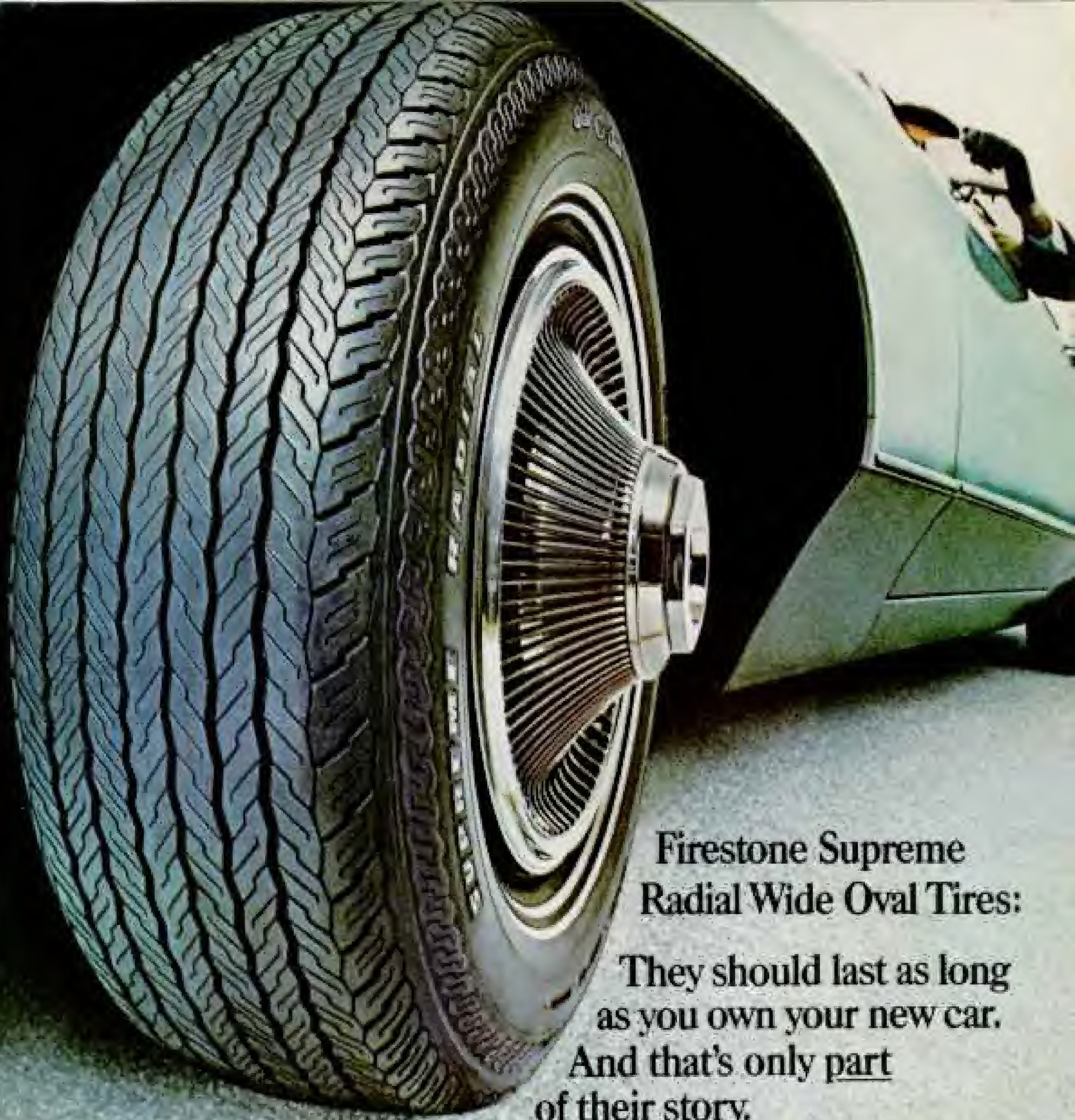
BURLINGTON NORTHERN

Going places in the American West



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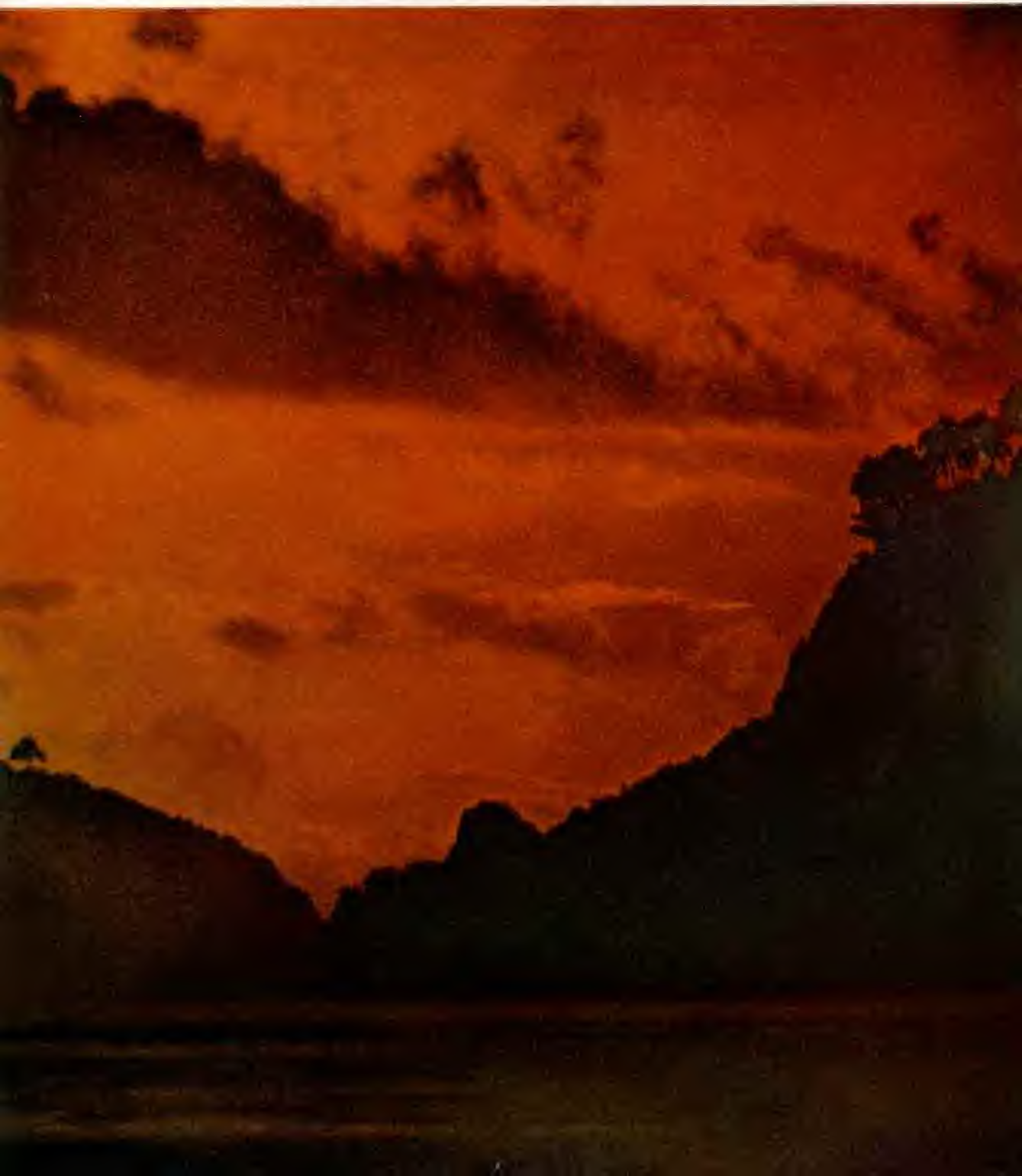

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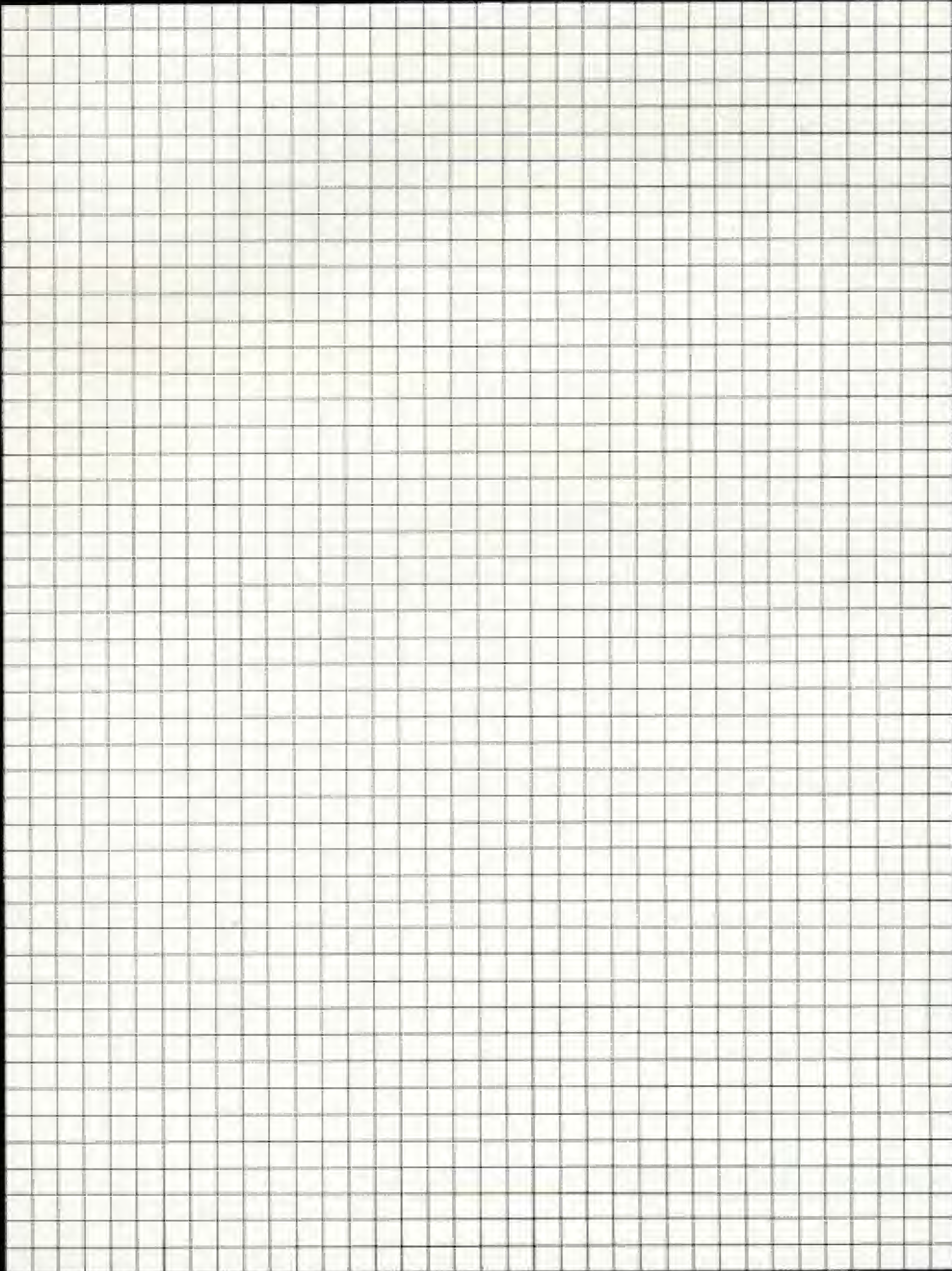

Each square equals 2′.

What kind of world

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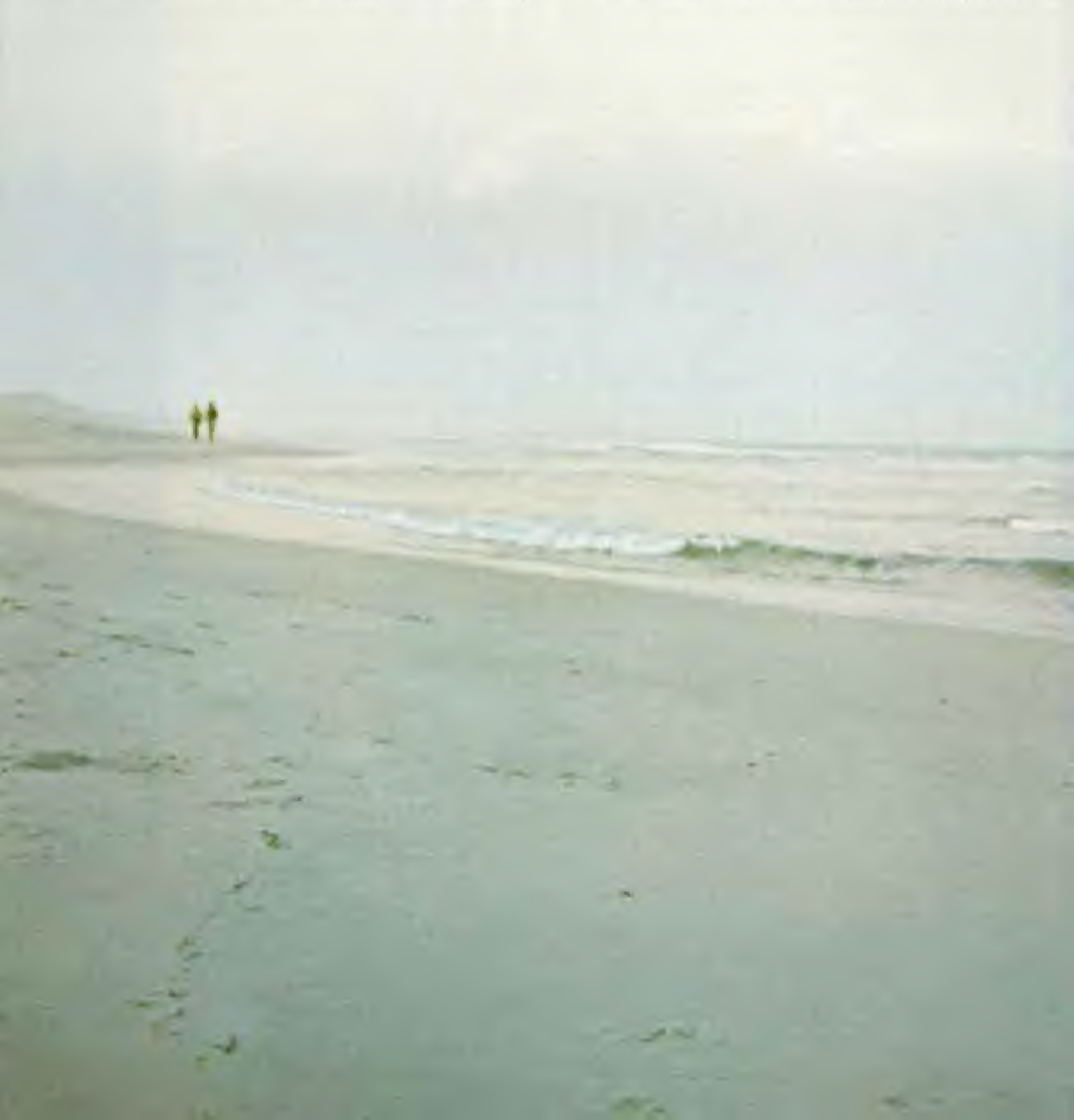
Our affiliates are building special plants in Venezuela and Aruba to take sulfur out of heavy fuel oil used by our eastern cities.

We have spent millions of dollars to improve the environmental performance of our refineries and chemical plants, new and old.

Real accomplishment. Enormous cost. But there is much more to be done.

The search for and production of oil by



will we leave them?

Jersey affiliates must continue to be accompanied by vigilant care for the ecology.

Our refineries will be looked at again and again for ways to improve their environmental performance.

We will continue to seek ways to improve our transportation methods on land and sea.

It will take continued dedication and effort to solve our problems. But all industry, indeed all citizens and their municipalities, will have to act with equal concern.

To improve the total environment will take time. It will take billions of dollars. And the cost will have to be shared by all of us.

We intend to do what one company can do to improve the quality of life on this planet.

It will be a long and difficult battle for all of us. But this is a battle we must win.

Standard Oil Company (New Jersey)

ESSO

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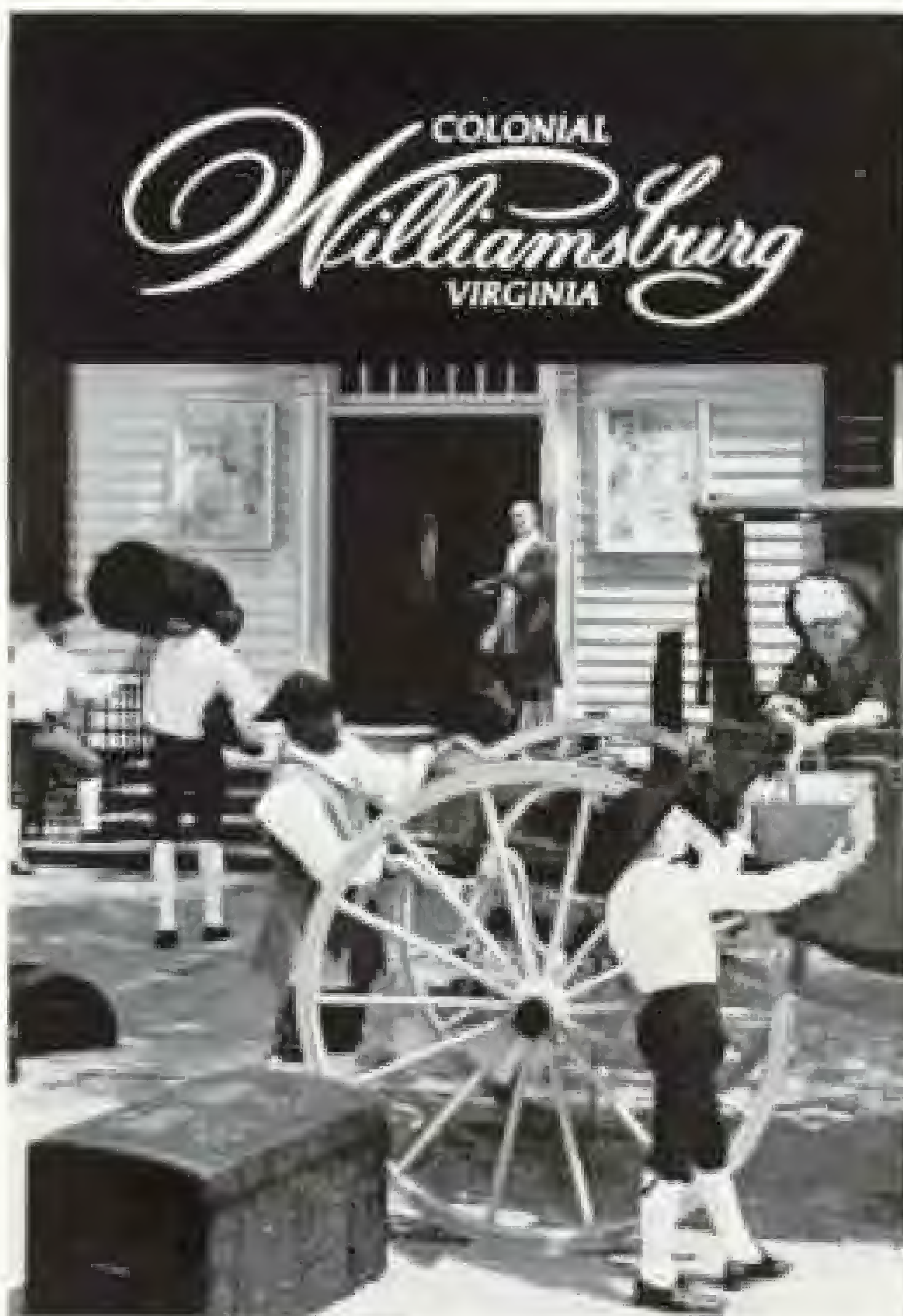

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Lifetime guarantee.

There aren't many guarantees in life, but here's one that's ironclad. We'll guarantee there's a lifetime of pleasure in playing the piano.

There's a challenge to it. An intellectual, artistic, even a physical challenge that never dims. Whether you are a child seeking a set of values to live with or an adult simply looking for relief from the prosaic demands of living, that kind of challenge is vital. Naturally we hope you will buy a Yamaha piano. They are among the finest, richest sounding, most responsive in the world.

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RCA's Solid State AccuColor: built to last and backed in writing.

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This is the best color TV ever built by RCA. It combines the pin-point accuracy of our new AccuColor system with the outstanding reliability of solid state components. The result is color TV designed to deliver years of crisp, lifelike color.

100% SOLID STATE

The chassis contains no tubes that can deteriorate and cause colors to fade, shift or wash out. Every tube has been replaced with cool-running solid state components, the most reliable, most long-lived kind of components used in television today.

MOST VIVID COLOR IN OUR HISTORY

But reliability is only part of the story. These sets also feature a dramatically advanced picture tube with more-radiant phosphors, to deliver brighter color and sparkle.

And the tuning system features AccuTint, our one-button automatic. Gives you more natural flesh tones and consistent color on all channels. It's fiddle-free tuning!

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We have such confidence in 100% solid state AccuColor, we are including all of these 16 models under our new Purchaser Satisfaction program—"PS" for short—covering both parts and labor for a full year (see box).

If you are even thinking of buying color TV, you must consider 100% solid state AccuColor: the most dependable, most vivid, most consistently accurate, and most automatic color in our history.

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PS For one full year from the date of purchase, RCA Corporation warrants to the first retail purchaser that it will pay all labor charges for repair of defects and will make available replacements for any defective parts in AccuColor "Trans Vista" models. (If the picture tube becomes defective within two years, it will be exchanged for a rebuilt picture tube.) Installation and set-up, foreign use, antenna systems and adjustment of customer controls are not included. To obtain warranty benefits contact your RCA dealer or the service agency of your choice with your Warranty Registration Card.

RCA Solid State AccuColor

The Toyota Corona was ahead of its time. It led the new wave—economy cars that offer more than just a bare set of wheels. We intend to keep it ahead.

So, we've improved it. Quite a bit.

First, we gave it twenty percent more horsepower. For greater acceleration and speed. We did this with an overhead cam engine that still gets up to 25 miles to the gallon. It's not only more powerful (108 hp), it lasts longer. Because of fewer moving parts.

Also, a lot of aluminum is used in our new engine—where it makes sense. To lighten the car and to dissipate heat faster (which also reduces wear).

It has a five bearing crankshaft, instead of the previous three. And dual exhaust manifolds, instead of one.

Then we gave the Corona a power braking system with front discs. For greater stopping power.

And a newly engineered suspension system, front and back, for a smoother ride. And also to deaden sound.

Inside, the seats come two ways. Buckets with the 4-on-the-floor stick shift. And with the column-mounted, 3-speed automatic, you get a full bench seat.

There's more leg room, more hip room and a bigger trunk.

The four doors are still there. So is the flo-thru ventilation, the nylon carpeting, the tinted glass, the courtesy lights, the whitewall tires and the locking glove box. All standard equipment.

And the options are the same. Factory air conditioning, AM/FM radio, stereo tape deck and automatic transmission.

What all this adds up to is the new Toyota Corona.

For drivers who are in love with the best.

Until it's improved.

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You loved it the way it was for five fantastic years. So we made it even more lovable!

Manufacturer's suggested retail price, 4-Dr. Sedan, $2126. Accessories, options, dealer preparation, freight and taxes extra.

Diet tip:

Nibble on a cookie about an hour before lunch.

Sugar keeps your energy up–and your appetite down.

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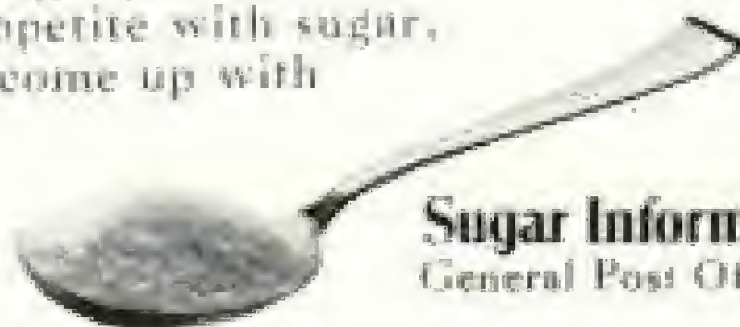
And guess where it's at? In sugar!

Sugar works faster than any other food to turn your appetite *down*, turn energy *up*.

Spoil your appetite with sugar, and you could come up with willpower—the willpower you need to eat less, and maybe even weigh less.

Sugar . . . only 18 calories per teaspoon, and it's all energy.



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In Lexington, Mass., there's a service station of the people, by the people and for the people.

Lexington, Massachusetts, is rich in colonial history.

200 years ago, the great and near great swept through Lexington.

Men like George Washington, Benjamin Franklin, Samuel Adams and John Hancock.

And on practically every corner stands a landmark, or a famous colonial home.

The Hancock-Clarke house built in 1698. The old Monroe Tavern on Massachusetts Avenue, where George Washington was wined and dined in 1789.

The people of Lexington are deeply committed to their heritage. And, needless to say, they wanted to preserve it.

Thus, when Shell arrived in Lexington to redesign a service station, some questions were raised.

The people feared a station that would be a complete contradiction to their community. Its character and its history.

But their fears were unnecessary. Shell engineers submitted a number of pleasing designs to the town's Historical Architectural Board. And the people on the Board selected one.

The result: Shell has a thriving, attractive station. With a portico and a quaint belfry.

And the people of Lexington have a station that blends in with the town's history and its scenery.

Shell, as a company, is committed to enhancing the environment. Not detracting from it.

That's why our new stations are specifically designed to blend in. Older ones are remodeled. Dilapidated ones, torn down.

And station clutter, such as banners and pennants, are outlawed.

Shell wants to keep America the Beautiful... beautiful.

October 1970

NATIONAL GEOGRAPHIC

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Canada's Heartland, the Prairie Provinces

ARTICLE AND PHOTOGRAPHS BY W. E. GARRETT ASSISTANT EDITOR

FROM A 600-FOOT TOWER in Calgary, a bustling young city on the Canadian prairie, I looked down at a monument to a man who made a monumental blooper.

His name was John Palliser; he was an adventurous Irishman who, in 1857, led a British survey party across the vast flatlands of western Canada, then owned by the Hudson's Bay Company. He reported that much of the land was "desert, or semi-desert . . . which can never be expected to become occupied by settlers."

Seldom has a prophet proved more wrong. Today Canada's fastest growing cities swell into farmlands so bountiful that neither markets nor storage can be found to absorb their harvests. Calgary, Alberta, flaunts its success in the face of the prediction by naming a new urban center Palliser Square. The tower, topped by a revolving restaurant, rises from the square (page 484).

Within a decade after Palliser returned to London, Canada had become a nation. On July 15, 1870, by purchasing the vast unsettled west from the Hudson's Bay Company, she expanded to become second in size only to Russia among the world's nations.

Palliser went west with only a hint of what he would find. When I traveled the Prairie Provinces—Manitoba, Saskatchewan, and Alberta—this past year, their hundredth under the Canadian flag, I too came unsuspecting. I shared what one Canadian called "America's benevolent ignorance of Canada."

My guidebook impressions were dated and as relevant as a gaudy poster in an art exhibit. I pictured the Prairie Provinces as a huge, contented—even dull—breadbasket to the world, where Indians guide fishermen to secret lakes and policemen in scarlet jackets pose for tourists' cameras.

If you can imagine an art buyer meticulously peeling off poster color to reveal a masterpiece, you can share the excitement as my "benevolent ignorance" flaked away.

I found the secret lakes and the Indian

Land of lonely reaches dwarfs the author's camper bus, parked by an arrow-straight highway between Saskatoon, Saskatchewan, and Edmonton, Alberta. Mile upon mile of fertile plains give the Prairie Provinces—Alberta, Saskatchewan, and Manitoba—their name, though mountains, lakes, forests, and tundra cover almost two-thirds of the sparsely populated region (map, pages 452-3).

KODACHROME BY W. E. GARRETT © NATIONAL GEOGRAPHIC SOCIETY

guides—but I learned that some of the lakes were so polluted by "civilization" that fishermen were warned not to eat their catch.

Instead of a contented breadbasket, I found a farm crisis so acute it is forcing wheat growers out of business; to many it is frighteningly reminiscent of the depression of the 1930's. Rumbling through the crisis comes political unrest. Angry farmers march on provincial capitals. There is widespread talk of separation from eastern Canada.

The breadbasket itself is there, of course—flat miles of wheatland, an expanse half as broad as the continent (left). Only by driving across these prairies did I feel how big they are. For endless hours the road dissolved into the horizon's haze. I seemed trapped on an asphalt treadmill, going nowhere; only power poles and occasional slope-shouldered grain elevators moving past the car assured me that I was making progress.

Despite this vast stretch of sameness, the word "prairies" brands the three provinces unfairly. In the northeast they boast more streams and lakes than people; the waters that bore the birchbark canoe still offer the only network of paths through the north woods. In the southwest the plains erupt, like thunder on a still night, into the spectacular folds of the Canadian Rockies.

FOLLOWING the example of the first white men to visit Canada's west, I began my exploration at the Prairie Provinces' only seaport, Churchill, Manitoba. There, on a January Sunday, I called on a retired trapper, Angus MacIver, and his wife Bernice.

Outside, the wind blew off Hudson Bay as it always has, its fury challenged only by a scattering of stunted trees on the barrens. The MacIvers' furnace had quit that week when the oil congealed in the cold. Some of Churchill's 1,700 townspeople kept wood or coal fires under their fuel tanks. Angus's thermometer registered 48° below; with winds up to 40 miles an hour, the chill factor sank to minus 120° F.

For most of his 85 years, Angus fought a living from this frigid wasteland as a trapper. The colder the weather, the silkier the fur. He and Mrs. MacIver, a former Toronto schoolteacher, are enthusiastic students of Manitoba's history; they read it, write about it, and collect rare books and old records.

The history began along these shores. The search for the fabled Northwest Passage brought Europeans; fur profits held them. Violent competition and plain curiosity lured them across the continent. Dissension, disease, and climate cut them down. Hardships drove Henry Hudson's crew to mutiny as he explored the bay in 1610. Cast adrift on its waters, he was never seen again.

Two years later, in 1612-13, Capt. Thomas Button and crew, looking for China, suffered through a scurvy-ridden winter at the Nelson River, 150 miles south of Churchill. They found no passage to Asia, nor did they trade for a single fur. Half a century was to pass before the British realized the northland they struggled to bypass might be as rich as the China they sought.*

Then, in 1668, the British ketch *Nonsuch* sailed to Hudson Bay to seek trade. It returned to London loaded with beaver fur—much in demand in Europe as a source of felt for hats. On that evidence King Charles II, to exploit the fur resources, conferred upon a private company one of the richest natural prizes in history. To the "Governor and Company of Adventurers of England tradeing into Hudsons Bay," he granted propriety over all the lands draining into the bay—in effect, all central Canada to the Rockies. Prince Rupert, Charles's cousin, was the company's sponsor and first governor.

Three hundred years ago the Hudson's Bay Company opened for business. One hundred

*The dramatic story of this giant nation hewn from the wilderness is told in a National Geographic Special Publication, *Exploring Canada From Sea to Sea*. Published in 1967, the 208-page book may be ordered from the Society, Dept. 61, for $4.25 plus postage. See also, in NATIONAL GEOGRAPHIC, "Canada, My Country," by Alan Phillips, December 1961, and "Canada Marks Her First Century," by Melville Bell Grosvenor, May 1967.

KODACHROME © N.G.S.

Reaching for distance, a ski jumper soars above the skyline of Edmonton, capital of Alberta. Eight tows lift skiers to the tops of runs along the banks of the North Saskatchewan River, practically in the heart of town. Major gateway to the developing mineral-rich north, Edmonton has seen its population nearly triple in the past twenty years to more than 430,000.

K
CRESTVIEW
ERIC ROLAND
DOUG ALLEN
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CHUCK WAGONS CLATTER *in a figure eight around infield barrels, then pound down the track as drivers vie for $44,000 in prize money. Winner Bob Cosgrave lurches around the marker at center. It's all part of the ten-day Calgary Stampede, "when it's Saturday every night," says the author, "and Canada's number-one cow town relives its boisterous past."*

EKTACHROME © N.G.S.

years ago it sold its 2½-million-square-mile Rupert's Land and North-Western Territory to Canada. In time the young nation carved the provinces of Manitoba, Saskatchewan, and Alberta from the tract, with enough left over for the Yukon, the Northwest Territories, and most of present-day Ontario and Quebec (map, pages 452-3).

To the men of the Hudson's Bay Company and to the colonists who followed them, the rugged north country offered the challenge of adversity and the hope of profit. Strong men responded to both; they met the challenge, and they prospered.

TODAY the north still challenges, with new chances for profits, with new adversities and problems. And I found a new breed of "adventurers" meeting the challenges.

This July near Winnipeg Queen Elizabeth II and the royal family helped Manitoba mark its centennial year. The Queen collected rent on the Bay Company's concession as required by its charter—"two Elkes and two Black

Modern prairie schooner, the author's camper glows at dusk amid the "hoodoos," weirdly eroded formations in the badlands of Alberta. Caps of hard stone preserved the soft pedestals.

EKTACHROME © N.G.S.

Beavers whensoever and as often as Wee our heires and successors shall happen to enter into the said Countryes. . . ."

The company sold its rights to the land for £300,000, or 1,460,000 Canadian dollars. This year it recorded sales of $450,000,000 in its retail stores alone. It still is the world's largest fur dealer; it has interests in minerals, oil, liquor, and tobacco. To mark its tricentennial, the company built a replica of the ketch *Nonsuch* and brought it to Winnipeg to stay. After 300 years in London, it also moved its executive headquarters there.

Despite the royal concession, fierce competition came from French and Scots, and from other Englishmen. Hardy men crisscrossed the region, bringing guns, knives, axes, beads, brass kettles, and nails to barter with the Indians for pelts. They also introduced brandy and rum, smallpox and tuberculosis.

The taste for alcohol still curses the north. Joe Saddleback, an Indian teacher, told me, "We taught the white man to smoke—you taught us to drink. You smoke too much. Indians drink too much. When we drink, it kills the wiseness in our heads."

Sgt. J. P. R. Beaudette, head of Churchill's Royal Canadian Mounted Police, agreed. "Liquor is still the base of most social problems here."

Another problem from the past landed in the Mounties' office while I was there. A team of sled dogs had swerved into a front yard and killed a little girl's pet dachshund. Sergeant Beaudette declared the team innocent, since the law, which still favors working dogs, decrees that pets must be kept leashed.

I talked to the sled dogs' owner, Mrs. Jane Sherman, an English immigrant who races her team as a hobby. She admitted their reputation for viciousness, but added, "The small dog most likely attacked the team. Little dogs have a suicidal tendency."

Yet she preferred her team to snowmobiles, which have replaced dogs throughout much of the north (page 462). Even where their utility is doubtful, the machines serve as

EKTACHROME © N.G.S.

status symbols, the noisier the better. Canadians manufactured 370,000 last year and reported 60 fatalities involving them—including a decapitation by an unseen wire.

"You can drive a snowmobile farther in an hour than you can walk in days," Mrs. Sherman said. "If it breaks down, you may be out of luck. My dogs won't stop until they're home. If the weather is so bad you can't move . . . well, you can't eat a carburetor."

When the ice melts in late July, Churchill comes alive briefly as a seaport. Wheat long ago replaced furs as the chief export. The shipping season lasts only three months; then ice blocks the harbor again (pages 456-7).

Cliff-walkers of the Rockies, a mountain goat and her kid pause at a salt lick along the "Icefield Highway" connecting Banff and Jasper National Parks.

The water sparkling below eventually will flow into Hudson Bay, 1,000 miles to the east. In 1670 King Charles II of England awarded his cousin Prince Rupert and fellow investors of the Hudson's Bay Company all the land drained by the bay. Two centuries later the company sold to Canada 2½ million square miles of territory—today's Prairie Provinces plus the Yukon and Northwest Territories and parts of Ontario and Quebec. The price: 10 acres for a cent!

Canada's Prairie Provinces

ALBERTA: Doorstep of the Rockies: wheat, cattle ranches, mineral riches, bison. **AREA:** 255,285 sq. mi. **POPULATION:** 1,561,000, 46% British origin, 14% Germans, 8% Ukrainians, 2% Indians. **MAJOR CITIES:** Edmonton (437,000), capital, industrial center; Calgary (375,000), oil and cattle.

SASKATCHEWAN: Grain and grazing, world's richest potash deposits, oil, gas, and timber, northern forestland and lakes. **AREA:** 251,700 sq. mi. **POPULATION:** 948,000, 40% British, 55% French and other Europeans, 3% Indians. **MAJOR CITIES:** Regina (140,000), capital; Saskatoon (130,000).

MANITOBA: Gateway to the west, lake and river path of early voyageurs; wheat

fields and grain elevators; copper, zinc, nickel, water power. **AREA:** 251,000 sq. mi. **POPULATION:** 979,000, 43% British, 11% Ukrainian, 9% French, 10% German. **MAJOR CITIES:** Winnipeg (534,000), capital; Brandon, Thompson, Flin Flon.

Oddly, Churchill's "other industry" benefits from the ice, not the thaw. It is the Churchill Research Range, which specializes in rocket studies of the aurora borealis.*

Its director, Tom McGrath, explained, "For nine months of the year the ice gives us the largest unpopulated impact area in the world. No towns, no people, and, in winter, no ships." This June a withdrawal of NASA and Canadian funds and a slackening of aurora activity forced a cutback from a staff of 250 to as few as 65, a blow to Churchill's already marginal economy.

I had planned to leave Churchill by train. The agent said, "We normally have triweekly service, but, in the winter, we try weekly to get through."

That week they failed. Unusual cold caused the rails to shatter like glass when a train rolled over them. Ten cars were derailed; most of the pieces on one quarter-mile section of track, according to a trainman, could have been carried away in buckets.

During a week in Churchill I froze the tip of my nose where it pressed against a camera, the underside of my chin where it touched the zipper of my parka, and, somehow, the edges of both ears. The rocket-range handbook for prospective employees warns that only the hardy and wise survive. I survived my carelessness with no scars, but a deeper respect for the people—like the MacIvers—who pioneered this north and still come to challenge it.

Northerly winds average 15 miles an hour year round, causing all the branches on the stunted trees to point south, like a hint from nature. I took it.

In an hour the daily commercial flight brought me from Manitoba's oldest to its newest town—Thompson.

*See "Rockets Explore The Air Above Us," by Newman Bumstead, NATIONAL GEOGRAPHIC, April 1957.

The Canadian Shield, a mantle of mineral-rich Precambrian rock, angles across northern Manitoba and Saskatchewan and nips the corner of Alberta (map, preceding pages). To mine one of the world's richest nickel deposits, the International Nickel Company colonized its lease on the shield. In 13 years the brush thicket around the mine has grown into one of Manitoba's largest cities.

Mayor A. Brian Campbell told me, "We don't know how many live here. It's already more than 20,000. We need workers so badly a man in a trade can move up fast. And racially, we have one of everything."

HANK LIGHT, an officer in the Manitoba Department of Northern Affairs, commutes by bush plane from Thompson to Indian villages across northern Manitoba, all of them inaccessible by road. Hank, a sort of circuit-riding city manager, serves as a link with government—advising, checking, prodding, and protecting the rights of the villagers.

He invited me to go along on a tour that included Brochet, 200 miles northwest of Thompson. The Commissioner of Northern Affairs' Community Fact Sheet lists the population of Brochet at 691; of these, 321 are Chippewas, 112 Crees, 234 Métis (mixed bloods), and 24 whites.

For two hours we flew over an unrelieved mantle of snow. The free-form pattern of lakes and woods occasionally was scratched with the straight, purposeful trails left by survey crews or supply trains. Throughout the winter, tractor trains—one or two crawlers pulling a string of freight sleds and a caboose for the crew—move across the snow to supply remote villages. In summer the mucky muskeg is virtually impassable.

One set of tracks ended on the lake ice in front of Brochet, a cluster of wooden buildings (pages 460-61) where a train of supplies for the Bay Company store was being unloaded. It was probably the busiest day of the year for store manager Joe Everett, but he graciously took time to make us feel at ease

Square-sailed freight boats of the "Governor and Company of Adventurers of England trading into Hudsons Bay" carried furs, baggage, and barter goods. In the 1840's, Canadian artist Paul Kane depicted the laden vessels threading a

PAINTING COURTESY ROYAL ONTARIO MUSEUM, TORONTO

wind-tossed river as they head toward Hudson Bay. One sail bears an Indian motif. Beaver was the lure, and men from the British Isles and Europe joined the search; the stay-at-home "Company of Adventurers" reaped the profits. Intrepid voyageurs portaged their *canots de maître*, big freight canoes, through biting cold over backbreaking terrain, from river to river, lake to lake, ever boasting, "no water, no weather, ever stopped the paddle or the song."

Outpost of empire, Fort Prince of Wales took the Hudson's Bay Company forty years to finish; in 1782 it surrendered to the French without a shot being fired. Beyond the Churchill River sprawls the town of Churchill, founded on fur. Wheat is today its chief export. Freighters load grain during three ice-free months beginning in late July.

Fake furs of Du Pont Orlon, costing a fraction of the real thing, attract buyers at the Hudson's Bay Company store in Edmonton. Still the largest fur dealer in the world, the company finds these coats popular among economy- and conservation-minded customers.

EKTACHROME (BELOW) AND EKTACHROME BY W. E. GARRETT © N.G.S.

and offered me bed and board for the night. Hank stayed with friends.

Like all the company's northern managers, Joe looks after the store, advances credit, buys furs, and serves as a community leader. Unlike most, Joe is an Indian.

Robert Cook, supervisor of 70 Bay Company stores in central Canada, had told me, "Our future in the north is in the hands of the natives." It has not been easy for Joe; he told me that he suffers from ulcers. But at headquarters in Winnipeg they say he's doing a fine job.

That night he invited me to a hockey game between two local teams. As their Manitoba centennial project, the people of Brochet built an outdoor rink, complete with lights. When I was there, only a dozen or so fans showed up—but it is a small town, and it was 35 degrees below zero. The game didn't lack excitement, but I left before it ended to attend Hank's meeting with the village council in the warmth of the parish house.

THE ELECTRICITY that lights Brochet's hockey rink comes from the same company that powers Thompson's huge nickel mining, smelting, and refining complex: Manitoba Hydro. In Winnipeg, Kris Kristjanson, assistant general manager of this Crown corporation, told me Thompson already uses more power than Winnipeg.

The tall Icelander seldom smiled—at least when discussing Manitoba's potential. "People sometimes call this the 'have-not' province," he said. "No oil, no potash. People and water are our resources."

The Kristjanson family proves the human potential. Kris and five brothers, sons of an Icelandic immigrant, all earned doctoral degrees at the University of Wisconsin and returned to Canada.

"Manitoba's use of power doubles every seven to eight years," Kris explained. "We are at the bottom of a drainage basin that goes west all the way to the Rockies and south into the States. The Nelson-Churchill Rivers'

potential is five times our present demand."

This potential will not be reached without a fight. One plan involved a project to divert water from the Churchill River to the Kettle Rapids dam on the Nelson (map, page 453), flooding 480,000 acres. Conservationists opposed the plan, and the issue so stirred the people that some credit it with the recent change of government. The New Democratic Party, which opposed the project, won the last election and leads Manitoba into its second century with its first socialist government.

IN NORSE LORE the blessed live in a heaven called Gimli. When Icelandic emigrants fled to Canada in the 1870's to escape hard times and volcanic eruptions at home, they founded New Iceland and called its main settlement Gimli. It still serves as port to Icelandic fishermen on Lake Winnipeg both winter and summer. I found it neat, small, and not growing.

The lake, larger than Lake Ontario, covers 9,465 square miles, and its winter ice forms a fishing platform. Gusti Jacobson and Raymond Smith invited me to join them.

"Fishing used to provide a good living," Gusti Jacobson told me. "There were hundreds of outfits. Now there are only eight."

The partners worked from a tracked snow vehicle formerly used as a school bus. They drilled holes in the ice and set almost a mile of nets before noon (pages 468-9). A wood stove warmed the snowmobile cabin. The men shared their moose-meat sandwiches with me, and Gusti explained the small catch.

"The fish are gone. Some say we overfished, others say it's pollution. All I know, they're scarce, and they're full of mercury."

Within a few months the mercury content forced the government to ban commercial fishing in Lake Winnipeg, and to warn sports fishermen against eating their catch. No one can be sure where all the mercury comes from. Some industries discharge it in wastes. Applied as a fungicide to seed grain, it controls wheat smuts, but it is so poisonous that Sweden and Japan have sharply limited its use, and U. S. concern has mounted.

Last year the Alberta government found the mercury level in the flesh of Hungarian partridges and ring-necked pheasants exceeded safe limits for human consumption (page 477). It was forced to cancel the fall hunting season on the birds—a five-million-dollar loss to the province.

A government chemist, testing human cadavers for DDT as well as for mercury, told me, "Human flesh retains so much DDT we would be unfit for cannibals. Even mothers' milk is unsafe."

Last year eight wild geese suddenly fell out of the sky over Calgary and were found dead within little more than a city block. Dr. John

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EKTACHROME © N.G.S.

Teamed for survival, man and his dogs still work together. This team competes in the World Championship Dog Derby at The Pas, Manitoba (pages 464-5). They strain ahead in below-zero weather during a 50-mile lap of the three-day race.

Winter's answer to sand-lot baseball, an impromptu hockey game takes over a street at Fort McMurray, Alberta, built atop the fabulous Athabasca tar sands. The 30,000-square-mile deposits are potentially richer in oil than all other world reserves combined.

Howell, a poultry-disease specialist of the Alberta Department of Agriculture, found by autopsy that the geese had eaten still another of man's poisons—strychnine, used by farmers to control gophers. In some animals the poison causes muscle spasms, which can be triggered by loud noises. Dr. Howell believes such a sudden noise may have knocked the geese out of the air.

When the three-year-old Canadian Confederation bought the Hudson's Bay Company land in 1870, it closed one of the finest real-estate deals in history. With the purchase,

Icebound in the Canadian outback, the Indian village of Brochet shivers beside Reindeer Lake, 75 miles from the nearest road. In winter, tractor

trains bring supplies for inhabitants and a small Hudson's Bay Company store. The people—chiefly Chippewa and Cree Indians—fish and trap much as their ancestors did. Glittering rectangle, center, marks a new hockey rink, built in celebration of Manitoba's 1970 centennial.

Dogless carriage, a snowmobile provides transport for Mrs. Mike Chuiak, an Indian of Granville Lake. She and her husband, whose parents emigrated from central Europe, brighten their trading post by painting it in the bold colors favored by Manitoba's Ukrainians.

Flailing sticks knock wild rice into a canoe on a Manitoba lake. This Indian couple from Winnipeg spend their vacation at the harvest, earning some $45 a day. Indians have first picking rights.

Firewater and paddles don't mix, a misspelled sign declares.

it multiplied its land area six times, at a price of one-tenth of a cent per acre. But its neighbor to the south was in an expanding mood. The United States had already acquired by treaty half the Oregon Territory from Britain, and rumors had it that U. S. interests wanted to buy the entire domain.

To protect its purchase and put the land to work, Canada needed people. The fur trade had faded, but fertile land lay practically untouched. Pamphlets printed in 20 languages advertised for immigrants and offered subsidies, including 160 acres free, to lure them to the New World.

In the 1871 census the French and the British formed Canada's two largest ethnic groups, and Ukrainians were not even listed. Now Ukrainians outnumber French in the Prairie Provinces.

At Dauphin, northwest of Winnipeg, I attended the National Ukrainian Festival, ate the Ukrainians' stuffed cabbage, and enjoyed their singing and dancing. Although the first Ukrainian immigrants arrived only 79 years ago, the sod houses they built, the oxcarts they used, and the hard times they endured form no part of the life of their grandchildren.

Mrs. Walter Bialobzyski, past director of the Ukrainian Fine Arts Centre, explained that Canada's recent upsurge of French nationalism had stirred other minorities to an interest in their heritage. "We're not so concerned that our children speak the language, but we want them to remember their background. I can still smell the sweat on my father's back. We're not ashamed of the work of our fathers."

MANITOBA'S MINERALS and its future may lie in the north, but its past, its capital, and its money rest in Winnipeg.

Scots and Irish first settled the area in 1812. The Bay Company moved its Canadian headquarters here from York Factory on Hudson Bay in 1878, and early prairie growth funneled through Winnipeg. This dowager of the west leads the newer cities in manufacturing, cattle sales, wheat markets, and cultural activities.

When the rush of immigrants slowed after 1910, the city turned conservative. Today she looks through lace curtains at the swaggering growth of the young bucks of the prairies: Calgary, Edmonton, and Saskatoon. Once Winnipeg ranked as Canada's third largest metropolitan area, after Montreal and Toronto.

EKTACHROME (ABOVE) AND KODACHROMES © N.G.S.

Reminder of an old-timers' rendezvous, the annual Trappers' Festival at The Pas, Manitoba, pits rugged northlanders in a four-day contest for cash and prestige—mostly the latter. Title of "King Trapper of the North" goes to the man who best demonstrates such practical skills as snowshoe racing, log-cutting, tent-raising, tea-boiling, trap-setting, and bannock-baking. Many entrants are active trappers, heirs to a tradition that goes back to the old voyageurs.

Roger Carriere (upper left), 1970's King Trapper, steadies a piece of cardboard as a heat reflector while he bakes a loaf of bannock, an unleavened bread that has sustained snowbound trappers for centuries. Judges (below left) sample another contestant's steaming hard-crusted loaf.

Most grueling event of all: the "flour-packing" contest. Winner of the ladies' division (above) lugs four 100-pound sacks 25 feet, straining against a tumpline over her head. Her reward is the 400 pounds of flour.

Knees buckle as a male contestant (right) fails to equal the herculean feat of the winner, who carried a record 1,000 pounds.

Now it ranks fourth, passed by Vancouver.

Though it hosts no National Hockey League team, hockey is Winnipeg's game. Boys who may go barefoot in summer have skates in the winter. Many skate by the time they walk. Winnipeg hockey fans describe it as a city with nine months of winter and three of bad skating.

My family joined me for their summer vacation. When they reached Manitoba with our camper, ideal July vacation weather greeted us. Canada's midnorth and midwest in midsummer offer excellent lake fishing. Good roads, dotted with free campsites, lead to cool nights and warm days, although the scarcity of human blood donors leaves the mosquitoes voraciously thirsty.

Just beyond the mining town of Flin Flon, Manitoba, the road north ended at Pelican Narrows, Saskatchewan. Here Cree Indians, with government help, have built Camp Misto-Nosayew (meaning "big fish") to encourage tourism on their reserve. Cabins of peeled spruce logs strung along Pelican Lake provide privacy and easy access to the water.

Sons Mike and Kenney and I paddled along the isolated shores, teased the fish, and whittled sticks. Chief Peter Linklater guided my wife Lucille and me around the village to the little fish-freezing plant that provides a few jobs, and to a street where new houses replace the old overcrowded shacks. He dug away leaves to reveal the footings of an old trading post—the first building his grandmother ever saw, he said.

Traders unaccustomed to Cree and Chippewa names chose new ones for their customers, the chief told us—some from respected Scots families, names like Linklater and Ballantyne. Other names, still used today, were whimsical—Highway, Nighttraveler, Saddleback, Gunpowder, and even Bakingpowder.

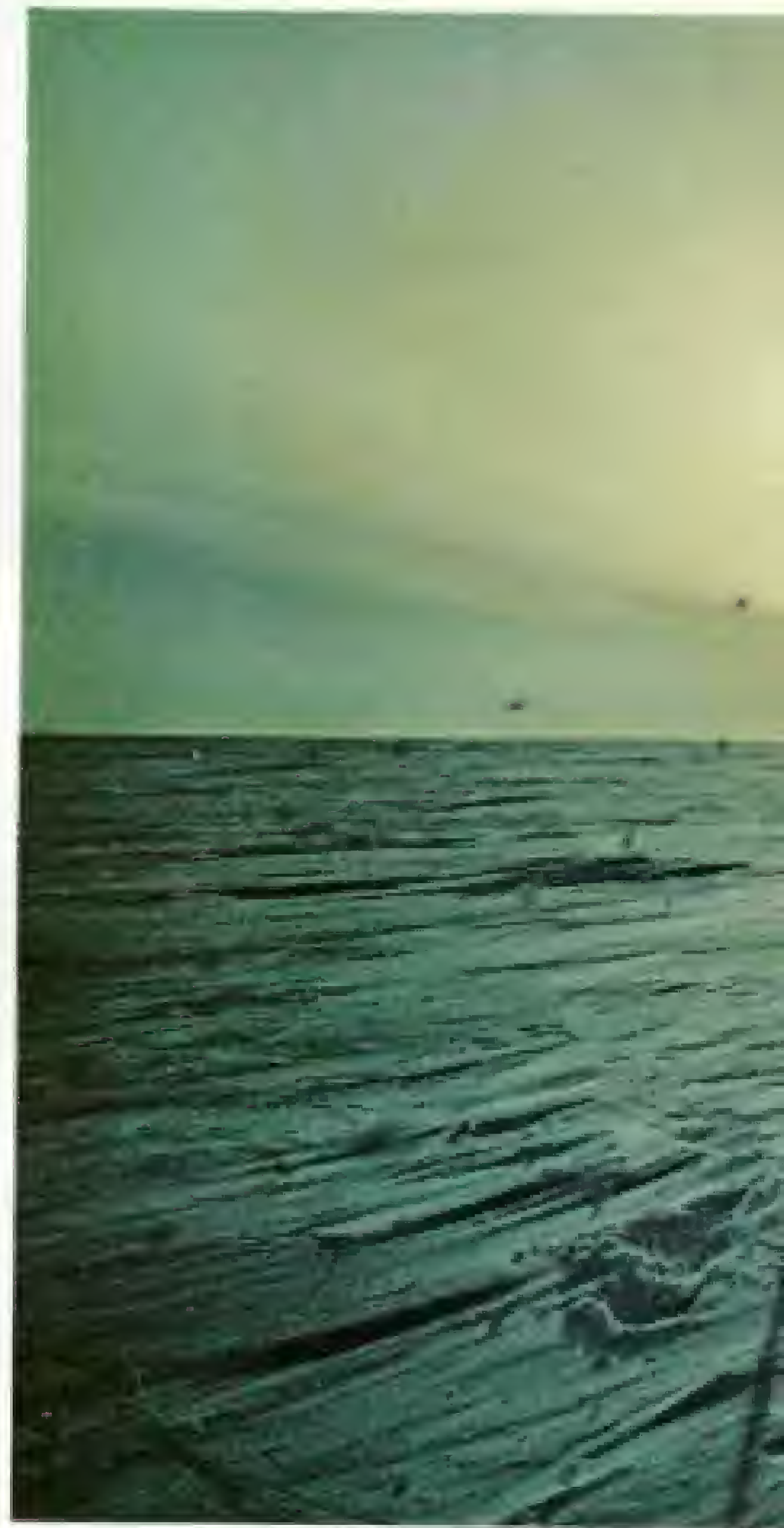
The iron men of the early days lived on the Indian's terms and left legendary tales of strength and daring. They also left behind "bits of brown," as Sir George Simpson, most

(Continued on page 473)

Vanishing Indian art: Practicing the rare skill of bark biting, handed down from her Cree ancestors, Mrs. Mary MacCallum of Pelican Narrows, Saskatchewan, pierces birch bark that has been folded four times (below). When unfolded (lower right), it reveals a snowflake. In the past, Cree craftswomen may have created such designs to use as patterns for ornamental beadwork.

Old World elegance lives on: Shirley Buchy uses dyes, beeswax, and infinite patience to decorate Easter eggs in the manner of her Ukrainian forebears at a festival in Dauphin, Manitoba. A variety of ethnic groups homesteaded the Canadian midwest during the late 19th and early 20th centuries. Cherishing their traditions, they have created a mosaic rather than a melting pot.

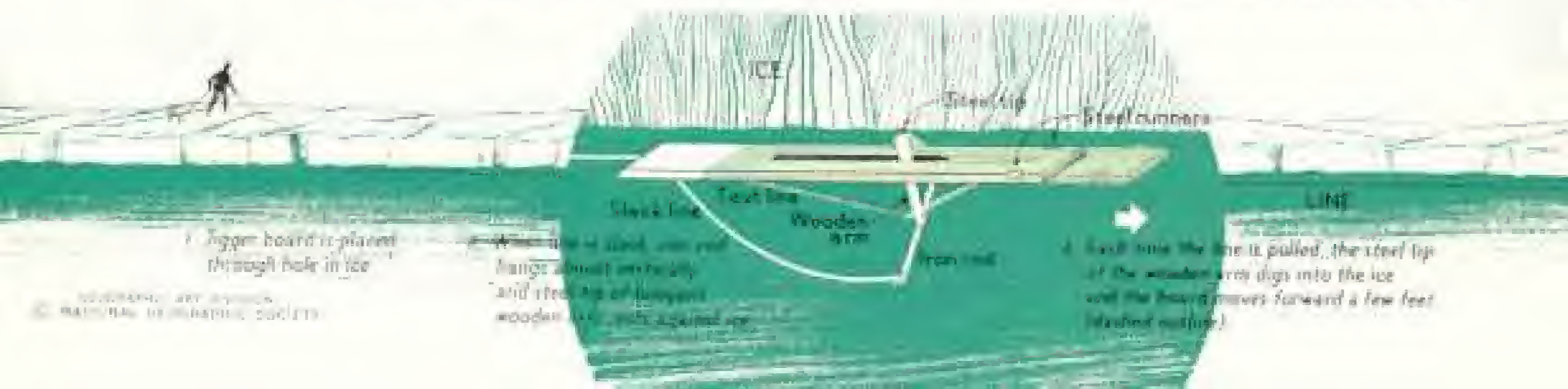
KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY



Netting fish in wintry waters, like those of Lake Winnipeg, presents a problem: How do you string 300-foot nets under a layer of ice several feet thick? A canny Manitoba fisherman-blacksmith in 1912 hit upon a solution with an ingenious device called a jigger.

First, drill a hole in the ice—a task done fast and furiously nowadays with an auger powered by a snow vehicle (upper right). Next comes the jigger, a six-foot plank equipped with a steel-tipped wooden arm hinged to an iron rod (below). The operator puts the jigger through the hole, so that it floats with the steel tip against the ice. Then he pulls at a line attached to the rod, shoving the plank forward. When he releases the line, the rod sinks, moving the wooden arm forward to bite into the ice again.

A companion follows the jigger by listening for its faint scratching under the ice. When it has advanced a net's length, the men drill a second hole to



retrieve the device and its attached line.

Now a fisherman at the first hole (right) pays out the net hooked to the line while his partner tugs at it from hole number two. Later they haul the net and remove entangled fish (upper left), frozen stiff a few seconds after leaving the water.

Since these photographs were taken, the government has banned commercial fishing in 9,465-square-mile Lake Winnipeg because of the high mercury content in the catch (page 477).

KODACHROMES BY W. E. GARRETT © NATIONAL GEOGRAPHIC SOCIETY

4. About 100 yards away from the first hole, a partner cuts another hole and retrieves the line. With it he hauls the net under the ice. The first fisherman moves to the second hole and the operation is repeated.

Racing the onset of winter, ghostly combines work into the night on the Lorne Byrnes farm near Richlea, Saskatchewan (right). Early snow sometimes forces Canadian farmers to leave their wheat unharvested until spring.

Still busy at midnight, the Byrnes family piles wheat on the ground after filling all their bins. The glut poses a problem. Foreign lands that had been buying grain now grow most of their own with new high-yield strains. No one knows when—or if—the market will boom again. This year the Byrneses switched largely to oats and other field crops.

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EKTACHROMES © N.G.S.

Back to the days of barter: A farmer trades overabundant wheat for two tickets to a Saskatchewan Roughriders' football game in Regina. Rather than have empty seats, the Roughriders accept a two-bushel bag per ticket. Normally worth about $3.00, the surplus wheat may bring only $1.20 as feed. Farm-implement dealers and other businessmen also accept wheat.

Here a Calgary Stampeder quarterback rolls out for a pass. Canadian football features a bigger field, three downs, and other variations from the U.S. game. But the tumult and the shouting are the same.

(Continued from page 466)

famous Hudson's Bay Company governor, referred to his half-breed, or Métis, offspring.

The Métis now outnumber the Indians, but to this day they find themselves isolated from both white and native cultures. Until the railroad arrived, they served as the teamsters of the prairies, carrying freight in their two-wheeled wagons.

The heyday of the fur trade was over by 1870. The bison followed soon. The Indians needed both to survive. Poor, sick, and beaten, between 1874 and 1905 they agreed to treaties placing them on reserves.

Having one of the highest birth rates and one of the lowest death rates in the world, Indians here are now more numerous than when the white man arrived. Most, however, exist on welfare. Though superbly equipped for survival in the primitive north, they have not adapted to the white man's ways.

René Poitras, a Métis in Saskatchewan's Indian and Métis Department, asks for time and understanding for his people. "We detest welfare, but we need a crutch. We have to assimilate at our speed and in our way. We're not troublemakers, never were."

Another young Indian commented bitterly, "Canada shows more interest in preserving its whooping cranes than its Indians."

Premier Ross Thatcher admitted problems exist in Saskatchewan. "The white man put Indians on little bits of rock and expected them to make a living. The reserves are ghettos. I'm proud of our program to integrate Indians. More and more they get away and into our schools."

The educated Indians seek economic and political integration. Like other minorities, many find pride in their past and intend to remain a part of the mosaic of modern Canada without losing racial identity.

CANADA SHARES few of the violent traditions of our Old West. Its lore glorifies no gunslingers—outlaw or lawman. The North-West Mounted Police preceded most settlers and, quietly, with little individual glory, "maintained the right" and built a legend. They traditionally "got their man" using a minimum of violence—with one notable exception.

A force of Mounties, sent to handle a group of dissident Métis led by one Louis Riel in central Saskatchewan, clashed with his followers at Duck Lake, near Batoche, in March 1885. Before they got him, Canada suffered something close to a civil war.

The French-speaking Catholics in the Hudson's Bay Company domain had resented the transfer of the west to Canada. They feared persecution and loss of their land.

Riel, one-eighth Indian, had helped lead Manitoba to provincial status in 1870, but was later exiled as a troublemaker. He went to the United States and took American citizenship, but returned in 1884.

Though the Mounties lost only 12 men at Duck Lake, the defeat loomed bigger in the east than Custer's massacre. Ottawa quickly recruited a 5,000-man army and sent it west on the new Canadian Pacific Railway. The Colt Arms Company contributed its Gatling gun for testing against the rebels.

Some 600 Métis and Indians fought well, but lost; 26 militiamen and more than 50 rebels died. At Batoche in May 1885 Louis Riel ended the only major battle, and the war, by surrendering. His general, Gabriel Dumont, escaped and eventually performed in Buffalo Bill's Wild West Show.

An all-white, all-English, all-Protestant jury declared Riel guilty of treason, but recommended mercy. He was sentenced to hang. To pleas for pardon, Prime Minister Sir John A. Macdonald reputedly answered, "Riel shall hang—though every dog in Quebec bark in his favor."

Riel, wearing his beaded moccasins, mounted the scaffold at the police barracks in Regina. Eight months after they first went after him, the Mounties got their man.

Now a Canadian stamp and a statue in Regina honor Louis Riel's memory.

Tooth-jarring juggernaut, a continuous mining machine (left) chews its way through walls of potash, formed by evaporation of a prehistoric sea. Multiple exposure captures the constant vibration endured by the driver.

Far below Saskatchewan's tossing grain, miners honeycomb the world's largest known bed of potash—40 percent of the world's reserves. Discovered by oil drillers in 1943, the deposit was not tapped for nearly twenty years. Estimates for 1970 production exceed 10,000,000 tons, worth some $75,000,000 as fertilizer.

Today western tempers flare again, but the issues differ. Many feel oppressed politically and economically by the east. The west's sparse population gives it few votes in parliament. The University of Lethbridge, Alberta, and the Lethbridge *Herald* sponsored a national conference in May to discuss unification of the Prairie Provinces into one powerful province.

In January businessmen and lawyers in Calgary, Alberta, formed a group "to study the economic, financial, and political aspects of an independent Western Canada." They pictured the new nation as part of the Commonwealth and loyal to the British Crown.

Farmers' associations in Alberta and Saskatchewan are conducting similar studies. A Saskatchewan official told me, "Canada ends on the Ontario border, as far as I'm concerned."

CROP SUCCESS, not failure, plagues farmers. Canada's wheat harvest last year exceeded 1968's by 5 percent, despite a 15 percent drop in acreage. Saskatchewan reaped its highest yield per acre in history.

But ironically, the same modern methods that worked in Canada—hybrid grains, fertilizers, plus some good luck—also produced bumper crops elsewhere. China and India, once among Canada's best customers, became more nearly self-sufficient. World production soared, and prairie farmers were left with a billion-bushel glut of surplus wheat.

With so much wheat and so little money, grain became a medium of barter, bringing little more than a third its usual value. Bartered grain became animal feed. The University of Saskatchewan accepted $300 worth of wheat against a semester's tuition, and the government traded wheat worth $450,000 for a betatron to treat cancer.

During a visit to the west, Canada's Prime Minister Pierre Elliott Trudeau responded to hecklers, "Why should I sell your wheat?"

Last April, thousands of farmers, angry and organized, marched on the provincial capitals of Winnipeg, Regina, and Edmonton

demanding help. In Alberta a thousand farmers met with the premier, as Mounties stood by to control the crowd. Some feared another Riel-type rebellion.

In Richlea, Saskatchewan, I met Lorne Byrnes, an optimistic, or at least realistic, Saskatchewan wheat farmer. "A lot of the noise is calculated to call attention to the problems," Byrnes told me. "The squealing wheel gets the grease."

Byrnes's problem entitled him to make a little noise. He was storing 60,000 bushels of No. 1 wheat under cover, and last fall dumped another 20,000 on the ground (page 470). For him and his wife, this crisis evoked memories of the "dirty thirties".

Triggered by the crash of 1929, depression stalked the prairies for years, with nature as a partner. For almost a decade, drought, hot summers, early frosts, wheat rust, grasshopper plagues, and earth-moving winds destroyed crops and thousands of farmers. Topsoil became the west's only export. Dust clouds cast a pall over the land, and the grit sifted into the very soul of the prairies. Weathered homes still can be found with battered utensils on the shelves and faded pictures on the walls, untouched since the owners fled.

Mrs. Byrnes showed me hundreds of arrowheads and flint knives her father collected. "They were easy to find—the topsoil blew away and left them lying on the hardpan."

THE WINDS of the thirties began a winnowing of the people as well. Saskatchewan has registered little growth in the past four decades, and last year its population dropped 13,000. With normal growth it should have doubled in 40 years; in effect, more people have left than have stayed.

The Byrnes family stayed, survived the thirties, and prospered, but found that hard work and faith alone wouldn't balance the books. To increase efficiency, Lorne and his two sons, Glenn, 29, and Jim, 27, have incorporated as Agra Enterprises Ltd. They scientifically farm 5,200 acres. Glenn earned a degree in agriculture, Jim in engineering. Lorne leads the company with experience and a business sense tempered by the thirties.

On a hot and dusty September day, they were in the field by seven. Lorne and Jim drove combines; Glenn trucked the grain to the storage area. Three times during the day and evening their wives served meals in the shade of the combines.

By midnight the team finished combining the 280-acre field, and 10,000 bushels of wheat worth $15,000 lay on the ground. Unless a drastic and unexpected upsurge came to the market, it would remain there; the harvest had been mainly to clear the land. Throughout the province last fall, mounds of grain, silhouetted like pyramids on the flatlands, lay exposed to birds, rodents, and rot. Much of it is still there.

"It doesn't pay to borrow money to build storage for wheat we can't sell," Byrnes said. "We overproduced. We depended on the Asian

EKTACHROME (ABOVE) AND KODACHROME BY W. E. GARRETT © N.G.S.

Back from the verge of extinction, five whooping cranes feed in a stubble field in Saskatchewan. They pause en route from Canada's north to winter quarters at Aransas National Wildlife Refuge in Texas. Fearing that hunters may mistake the mottled brown young for sandhill cranes, Canada and the United States close the hunting season on sandhills when their rare cousins take to the migratory flyways. Latest count on endangered *Grus americana:* 56 in the wild and 23 in captivity, up from a total of 15 in 1941.

Victims of lethal grain, ring-necked pheasants and Hungarian partridges died from eating seed treated with a mercury fungicide. Scientists in Edmonton check the amount of mercury in the tissues. Levels far above the limit for human consumption forced Alberta to close its 1969 hunting season on the birds. Officials have called for stricter control over use and disposal of mercury-treated grain.

To heal a Thoroughbred, a surgeon at the University of Saskatchewan's Western College of Veterinary Medicine removes a bone chip from the race horse's knee. Student assistant at right examines an eye to check the effect of the anesthetic, as other students observe. The school, outstanding in its field, serves all three Prairie Provinces.

Window in his side lets a steer named Oscar save other animals' lives at the school clinic. When cattle founder from eating too much grain, the first stomach, or rumen, must be emptied surgically, and vital bacteria are lost. Contents of this Holstein "rumen donor's" stomach restart digestion. Between donations, a plug seals the porthole.

EKTACHROMES © N.G.S.

markets. We're glad to see them doing so well. But we're in a short-term crisis, and something has to be done here."

This spring the government offered to pay $6 for each acre left fallow and even more if a forage crop replaced wheat. The plan, funded at $100,000,000, reduced wheat acreage by eight million acres in 1970.

Efficient corporations like Agra Enterprises will survive the bad years and grow in size and efficiency. But some farmers will give up and contribute to the growth of the cities.

FOR YEARS Saskatchewan, with 40 percent of Canada's farmland, produced 60 percent of its wheat and little else. Now it supplies a quarter of Canada's oil production and all its potash. The potash, 40 percent of the world's supply, lay 3,000 feet underground, unnoticed until 1943, when oil drillers found the red potassium salts in their cores. Now ten mines make Saskatchewan the world's leading producer of potash for fertilizer (pages 474-5).

Plunk in the middle of the sea of wheat and atop the potash swells one of Canada's fastest growing cities, bearing the rhythmic name of Saskatoon, Saskatchewan. Teetotalers of the Ontario Temperance Colonization Society, who founded the city 88 years ago, would feel there's a generation gap or two if they could see it today. The place swings. The saskatoon berry which gave its name to the town has fermented into wine.

For years the town sprawled pleasantly along the banks of the South Saskatchewan River and provided a sedate home for the University of Saskatchewan. It expanded with the booming wheat markets and now, fertilized by potash, is growing faster still. Its 130,000 citizens include a number of successful farmers who, lured by urban conveniences, live in town and commute to the fields.

With such prosperity the city bounces like a frisky colt set free to run. Not simple optimism but chest-thumping cockiness characterizes it. Its people even accepted Mayor Sidney Buckwold's challenge to build themselves a mountain. The mayor and Dennis Fisher, manager of radio station CFQC, took me out one morning to see it.

"We wanted the 1971 Canada Winter Games, but there was no place to ski," the mayor said.

"Someone suggested we build a mountain. People thought we were crazy at first," Dennis added, "but the mayor has been named 'Salesman of the Year' for selling the idea."

Around the clock, earthmovers roared up the huge dirt pile and dumped their loads. When I saw it, "Mount Saskatoon" had grown to nearly 300 feet. It won't embarrass the Rockies, but it did the job. The city got the winter games, to be held next February.

For years the Canadian National tracks divided the town down the middle, physically and socially. The mayor eliminated "wrong-side-of-the-tracks" discrimination by moving them west of town, thus giving the downtown section breathing space.

Dennis Fisher called late at night to invite me to a prebreakfast search for some migrating whooping cranes reported to be nearby. Within an hour of leaving my hotel, Dennis spotted nearly one-eleventh of the world's wild population: four adults and one brown-and-white immature bird feeding in a wheat-stubble field. In hushed excitement, aware of our rare privilege, we photographed the elegant white birds—like ghosts returned from extinction (pages 476-7). Intensive conservation efforts have raised their numbers from a total of 15 in 1941 to the present 56 wild and 23 captive birds.*

The owner of the farm where they rested had seen them, but assumed they were white turkeys. He "thought he might shoot one to see how it tasted."

Was he joking? No. He asked, "What are they, some kind of duck?"

He seemed unimpressed that whooping cranes had visited his field.

"All I know," he said, "they were big enough, so I thought I might get on one and ride south with him."

FROM SASKATOON we drove west along the new Yellowhead Route, a northern leg of the Trans-Canada Highway (map, page 452). Just before reaching Edmonton, Alberta, we saw another creature saved from extinction by conservationists, the plains bison.

Fifty million of them grazed the North American plains in the 1840's. Within 40 years only a few hundred survived in both Canada and the United States. Now Elk Island National Park maintains a herd of 550; 12,000 to 15,000 more roam Wood Buffalo National Park, 300 miles farther north.

One bull at Elk Island won a victory over man a few years ago with a flip of his head. He tossed an automobile upside down into a ditch with its four tourist passengers inside. The owner sought damages from the park, but left quickly when warned he could be held liable if the animal had suffered an injury.

*See "Whooping Cranes Fight for Survival," by Robert Porter Allen, GEOGRAPHIC, November 1959.

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KODACHROME © N.G.S.

"Johnny Pineseeds" plant forests of the future on lands logged by a pulp mill near Hinton, Alberta. College students run in four- or five-man teams, one man backpacking racks of seedlings (right), others punching holes with steel rods and inserting lodgepole pine seedlings (above). A team can plant as many as 8,000 trees a day, earning $40 per man.

Also utilizing natural reforestation (left), the company logs another stand in alternating swaths, allowing the remaining trees to reseed cutover areas. The Athabasca River slices through the checkered landscape.

Superintendent Tom Smith verified the story and explained, "The bison's head weighs about 100 pounds. He develops powerful neck muscles."

Tourists needn't fear—the bison haven't bothered a car or a visitor since. But Tom worries about tourists who think a bison standing still is tame and can be petted. Don't try!

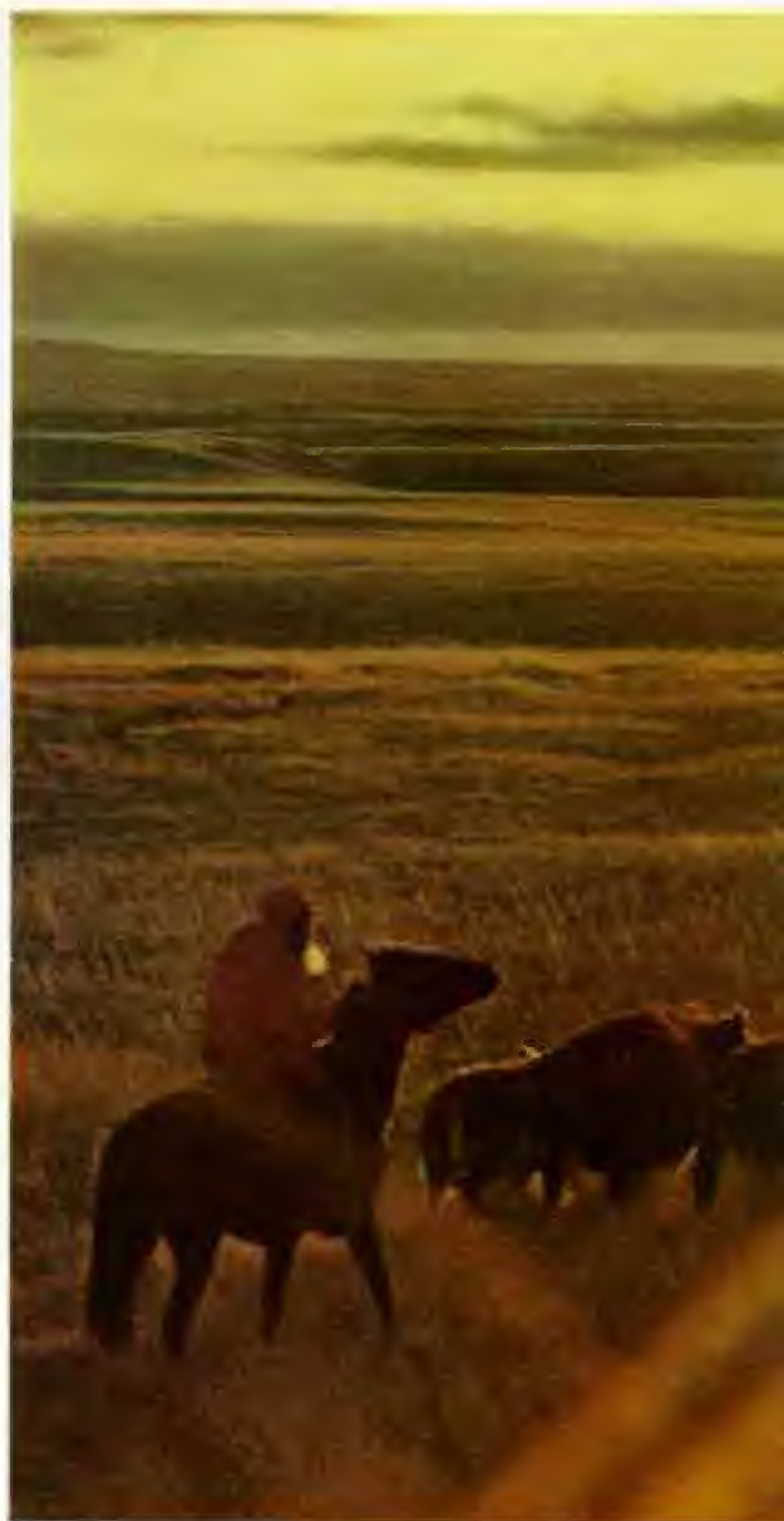
Conservation efforts have also revived the beaver, the amphibious rodent whose fur brought the white man into the north. He's a hardy beast with an ancestry going back to the age of mammoths—but then he was almost eight feet long and weighed 400 pounds.

THE JUNGLE of oil refineries we passed in entering Edmonton, Alberta, prepared us for the city. Where trappers and traders built a frontier outpost in 1795 stands a swaggering, brash city today—the very image of a strapping young buck in Levis with oil on his hands and money in his pockets, money he'll bet on the future. The city does a lot of bragging, and you can't be sure the tales aren't true.

Leo LeClerc, as industrial coordinator for the city, makes bragging his business; he sells Edmonton's virtues to prospective industries. He sizzles with nervous energy and spews claims like a carnival barker: "More building permits issued in 1968 than in all Manitoba. No smog. No ragweed. This may soon be the Prairie Provinces' biggest city."

Oil fueled the first stage for this rocketing growth. It has been less than a quarter of a century since the first well blew in southwest of town. Now each day 900,000 barrels of oil leave town through a 6,000-mile web of pipelines to the east.*

Exporting natural resources had become the local business before the white man arrived. By 1720 Indians were canoeing 1,500 miles to Hudson Bay to sell furs. They also



*See, in the GEOGRAPHIC, "Alberta Unearths Her Buried Treasures," July 1960, and "The Canadian North: Emerging Giant," July 1968, both by David S. Boyer.

Golden fingers of afternoon sunlight transfigure an Alberta scene that might have been lifted from the pages of a Western novel—an old-fashioned cattle drive. Rancher Bob Cosgrave and his crew round up the steers each autumn on 13,000 acres of land near Drumheller and drive them 45 miles to the 3,000-acre family farm near Rosebud (pages 448-9 and text, page 488). There they are fattened and trucked to market. Cosgrave nostalgically preserves the traditional drive because it affords a congenial get-together for his family and their neighbors. In wide-open spaces like these, the spirit of the Old West still has room to roam, and often a Texas accent is heard on Alberta's range. As ranchland dwindled in the U.S. Southwest, many cowboys rode north to start their own spreads.

Soaring symbol of oil-fueled progress, the Husky Tower—named for the Husky Oil Company—holds a revolving restaurant 600 feet above cocky Calgary, Alberta. Here more than 400 petroleum-industry firms, many U. S. owned, maintain headquarters. To house their offices, new high-rise buildings continually climb against the horizon, rimmed 70 miles to the west by the Rocky Mountains.

knew about oil and used it. North of Edmonton they would pause to seal their bark canoes with a sticky black tar oozing from the banks of the Athabasca River.

The Athabasca tar sands lie just under the muskeg surface. Leo LeClerc told me they contain more oil than all the rest of the world's known reserves combined.

A flying trip to Fort McMurray, 230 miles northeast of Edmonton, convinced me there's a lot of oil. Sun Oil Company of Philadelphia has built a $300,000,000 plant and now extracts up to 45,000 barrels of high-grade crude per day. Syncrude, a group of oil companies, will soon begin a similar mining and refining complex.

Two open-pit mining machines, each ten stories high, gobble up 150 tons of tar sand a minute. Huge washers, tumbling like a housewife's machine, separate the oil. The world's largest man-made sand pile returns eventually to the pit to be covered and landscaped.

The tar disappears into a maze of pipes and refining towers as basically the same material the Indians daubed on their canoes. A plant official proudly showed me a sample of the honey-colored refinery product.

"It's ridiculous to call it crude," he said. "It's really sweet—no corrosive products, and all the sulphur is removed."

THAT EVENING at dinner a Canadian oilman asked, "When do you think the United States plans to take over Canada?"

I seemed to be the only guest shocked by the question. When I assured the group I had never heard the subject mentioned, they seemed surprised.

More of my "benevolent ignorance"? Probably. I hadn't realized how much some Canadians resent the shadow we cast. Half the assets of Canada's 400 largest companies are in U. S. hands. Many, like Greater Canadian Oil Sands Ltd., which employed my host and his guests, are almost wholly owned in the States. Canadians read our newspapers, magazines, and books and watch our movies and TV. One complained that in contrast, "The only thing Canadian in the American newspapers is the pulp they're printed on."

LeClerc defended the partnership. "Many roads lead south from here, but only one goes east. We visit the States for business and fun. Western Americans understand us better than eastern Canadians. Other countries say, 'Yankee go home.' We say, 'Yankee come here.' We needed capital to develop the west, and the States had faith in us. More than half the plants here are U. S.-owned, and we love it."

Maclean's magazine, surveying its readers early this year, found that 13 percent favored all Canada except Quebec joining the U. S.

SOUTH 170 MILES, Edmonton's twin city taunts and challenges its claims and rivals it in rapid growth. Like relatives, the two fight until a common enemy or opportunity appears. Edmonton serves the front lines of the oil industry with shops, warehouses, and pipelines. Calgary hosts the front offices and does the banking for 400 firms engaged in the Alberta oil business (opposite).

The white-collar town reverts to jeans during its famous Calgary Stampede. Each summer, cowboys—real and drugstore—parade with Indians who are sometimes real cowboys. Residents and visitors team up for street dances. Fancy livestock are brought to town and prettied up like beauty contestants to compete for blue ribbons and money.

Before and after the Stampede, Calgary resembles a Texas town: Oilmen lunch at their club, and at dinner restaurants flame everything but the soup. Five percent of Calgary's residents are United States citizens, and Texas accents are as common as Stetson hats.

The first U. S. businessmen in this area built a stockade called Fort Whoop-Up. Through a barred window they accepted furs and ladled out the original Kickapoo joy juice, raw whiskey laced with boiled tobacco, red pepper, ginger, and molasses. The fort protected their liquor, their furs, and their lives as the Indians whooped it up outside.

Cross section of prehistory: The Red Deer River carved its way through more than a hundred million years of geologic deposits to create the badlands of southern Alberta. The yawning chasm drops off abruptly from today's level wheatlands near Drumheller. A treasure house of fossils, the layered walls have yielded numerous skeletons from the age of dinosaurs. One gigantic carnivore, a relative of *Tyrannosaurus rex*, was named *Albertosaurus* when its fossilized bones were found here.

Like a western Ben Hur, a Canadian charioteer guides a fast-footed team of ponies past a blur of spectators during a rodeo at The Pas.

KODACHROMES BY W. E. GARRETT © NATIONAL GEOGRAPHIC SOCIETY

Canada recruited a force of 300 "young men of good character," chartered them as the North-West Mounted Police, and dispatched them to drive out the Yankee whiskey traders. That was the beginning of the Mounties. The force marched west for three months, to find the traders had fled.

The Mounties built a fort of their own north of the old trading post in 1875 and called it Calgary. With the coming of the railroad it grew into a farming and ranching center.

AT THE STAMPEDE I met Bob Cosgrave, winner of the chuck-wagon race (pages 448-9). He and his wife Bernice farm 3,000 acres of wheatland at Rosebud, Alberta, and above the badlands around Drumheller they run a 13,000-acre cattle ranch. Bob maintains a hundred miles of fence and on occasion borrows a neighbor's plane to hunt strays.

Each fall the Cosgrave family run one of the few cattle drives left in the west (pages 482-3), bringing their herd 45 miles from the high summer range to the farm at Rosebud.

Bob invited me to join the drive. He provided me with a horse and a chance to try my hand at being a cowboy. I found it wasn't my hand that was being tried. It was after dark the first day when we bedded down the herd. As soon as I could get the bows out of my legs, I put them in a sleeping bag.

Bob had coached me on the basics of my job. "Ride behind the cattle and keep 'em movin'. They know the way. Won't go the wrong way even if you want them to."

One steer came the 45 miles home all alone, Bob told me. After three days I knew that most cattle lack that much intelligence and ambition. They dawdle until goaded on, then, bawling indignantly, squirt out of the herd like wet fish through your fingers and into the nearest thicket.

Three days behind the herd gave me a new view of the romantic life of a cowboy. Yet the relaxed pace left time for people to become friends and friends to become people. The jostling that pained flesh and muscle massaged the soul. There was time to contemplate the shell I picked up in the badlands, vacated by its oyster 85 million years before. The days of our lives we remember forever are few, but for me those with the Cosgraves will be among them.

Being "broken to the saddle" proved valuable a few weeks later when Steve Kun, Superintendent of Banff National Park, invited me to join a wilderness trail ride.

When I arrived at the eastern gateway to the Canadian Rockies, 70 miles west of Calgary, I was surprised at the yawning October emptiness of the Banff townsite. In August it had resembled a light bulb at a moth convention. Summer crowds offer a standing ovation to the unsurpassed beauty of the Rockies and their popularity.*

Only once did I meet a person who disagreed. In Regina a girl raised on the prairies told me, "When I go to the mountains, I get claustrophobia. I feel trapped. My stomach is upset, and I have to leave."

With the recent completion of the Yellowhead Route (part of Alberta's Highway 16) across the north end of the chain, Jasper may soon match Banff's popularity. Six million tourists and travelers passed through Banff and Jasper National Parks last year. They were easily absorbed in the vastness.

The "Icefield Highway" between the two serves as a display window. With a rented tape player as our tour guide, we drove the 142 miles. Animals came down to watch the tourists watch the scenery. The tape, timed to match a 60-mile-an-hour cruising speed, provided facts on the peaks, waterfalls, and glaciers we could see, and advised us when to turn off to side-road attractions.

The audiovisual tour whetted my appetite to enjoy more. Steve's wilderness ride permitted it. His seven guests were entrusted to seven dependable horses, which duly delivered us to our camp at the foot of the peaks dividing Alberta and British Columbia.

*See "Canadian Rockies, Lords of a Beckoning Land," by Alan Phillips, GEOGRAPHIC, September 1966.

EKTACHROME © N.G.S.

Anachronism of the north, a sled dog hunkers down during a 30°-below-zero dawn. Here in the Indian village of Brochet (pages 460-61), where the magic wands of oil, nickel, potash, and tourism have not touched people's lives, dogs still work for a living, helping their owners in the losing struggle to survive by fishing, trapping, and hunting caribou.

The first night a near-zero cold froze my breath in tiny icicles on the tent just above my face. They tinkled down on my eyelids when wind flapped the canvas. It was almost morning of a starry night before I solved the mystery of the "leak" that kept waking me.

Hoarfrost sparkled on every blade and leaf until brushed away by the sunlight advancing across the meadow. All day we zigzagged upward, riding switchbacks that seemed from below to be only scratches on the slopes of snow and rock. Elk disturbed by our presence bugled in irritation and peeked at us from thickets.

Ahead loomed Mount Assiniboine, Banff's highest peak. From its far slopes water flowed west to the Pacific. The snow beneath my feet would melt in the spring and begin the long flow east to Hudson Bay. Three-quarters of a million square miles and three and a half million people separated me from my starting point in Churchill. I had reached the end of the lands draining into the bay, and the end of the Prairie Provinces.

GROWING UP WITH Snowflake

By ARTHUR J. RIOPELLE, Ph.D.
Director of Tulane University's Delta Regional Primate Research Center, Covington, Louisiana.

Photographs by MICHAEL KUH

AERIALIST AND ACROBAT, the star attraction at the Barcelona zoo takes a turn on stage, then pauses to await audience reaction. Impatient for applause, he beats his chest and claps his hands, a frost-colored Puck with a leprechaun face and a Santa Claus belly. The world's only known white gorilla, he has won thousands of hearts with such impish performances. From the box seat of scientific inquiry, I have become perhaps his most devoted observer.

Copito de Nieve—Snowflake—was captured four years ago in Spanish Rio Muni, now part of the Republic of Equatorial Guinea, and flown to Spain. For three years, with support from the National Geographic Society and the National Institutes of Health, I have commuted between the United States and Spain as director of an in-depth study of this rare albino.

To compare Snowflake with a normally pigmented gorilla, the zoo obtained Muni, a black male of equal size and age. Our research has the invaluable cooperation of the zoo director, Antonio Jonch Cuspinera, who has granted us almost unlimited access to the gorilla cagemates.

We have measured them and weighed them, given them a wide variety of intelligence tests, and set up unusual situations to observe their reactions. We have compiled a photographic and written record of their day-by-day behavior in relation to each other, to a female gorilla, and to humans—both children and adults. Already we have learned much about the gorilla from these two contrasting examples. We are now evaluating our findings for detailed publication.

Snowflake is the ham, the crowd-pleaser with

EKTACHROME BY MICHAEL KUH (OPPOSITE); KODACHROME BY ARTHUR J. RIOPELLE © N.G.S.

BALANCING ON EXERCISE BARS, a curious Snowflake, nearly 4 years old, stretches to see over a wall at the zoo in Barcelona, Spain. At age 5 (left), he poses with Muni, a normally pigmented male gorilla. Both beasts, now 6, still enjoy a close companionship.

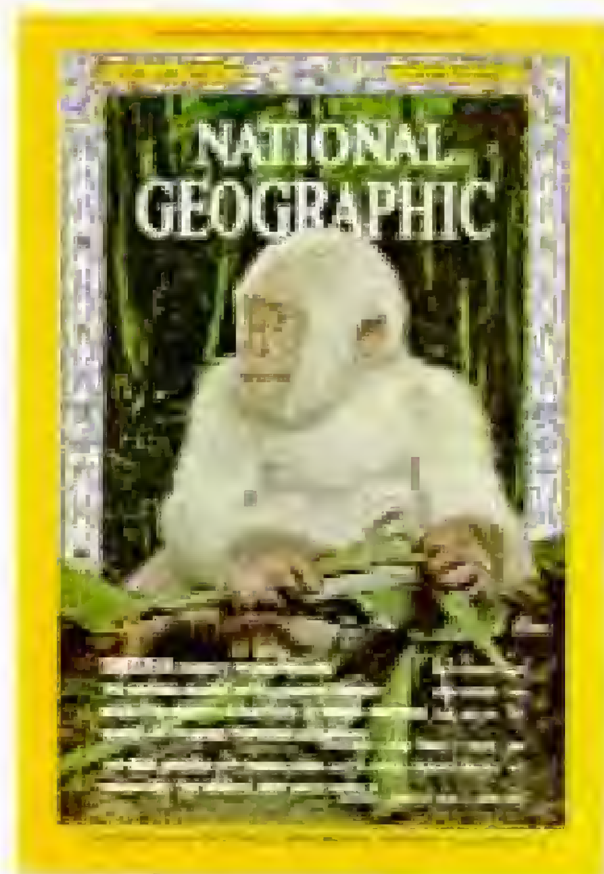
the persistence of a circus clown. He enjoys people as much as they do him. Time and again I have seen him stand erect to look at us through the window glass of his cage, hands shading his blue eyes like a shopper peering into a showcase. A sly grin creases his pink face, and the thought strikes one with a jolt: Are *we* on display?

While Snowflake plays to his audience, Muni is a gorilla's gorilla, leading in their games and pioneering their explorations, while behaving with almost complete indifference to spectators.

In a rare genetic coincidence, a recessive trait inherited from Snowflake's parents prevented his pigment-producing cells from synthesizing the dark substance called melanin. The result is a startling distinction, but one readily accepted by the normally colored Muni.

We have paid particular attention to Snowflake's albinism to answer the question: "Is he different from other gorillas?" Happily, we believe not, except, of course, for his color and for his slightly impaired daylight vision, often a side effect of albinism. With the excellent care he gets, he could live for another 30 years and eventually weigh more than 500 pounds.

Now a husky 6-year-old adolescent weighing about 100 pounds, Snowflake sometimes nearly topples me with a playful tug of his strong arms. Caution may soon put an end to my playtime with this milk-white friend, but his contribution to man's knowledge of primates has only begun.



TWO-YEAR-OLD Snowflake peers from the cover of the March 1967 NATIONAL GEOGRAPHIC. In that issue, Dr. Riopelle broke the news of how the world's first white gorilla had been discovered in Río Muni, then an African province of Spain, where the scientist was conducting a Geographic-sponsored study of lowland gorillas.

MEETING HIS PUBLIC, Snowflake delights Spanish school children of his own age. Lest the ape's boisterous friendship alarm the youngsters, keeper Fernando Terrer, left, and veterinarian Dr. Román Luera Carbó keep a firm hold on his powerful arms.

[illegible]

KODACHROME BY MICHAEL KUH © N.G.S.

With the washroom enthusiasm of a freckle-faced boy, Snowflake submits to a scrubbing.

Bath time turns into a romp

KODACHROMES © N.G.S.

ALL IN A LATHER, Snowflake discovers that water can be fun (left). Suds flying, mouth agape, he splashes with both hands. The bath was given to test his memory of his first and only other dunking, experienced shortly after capture three years earlier. He resisted then as at the beginning of this bath (opposite). But the second time he finished with a burst of horseplay.

WRAPPED IN A TOWEL, Snowflake gaily swings around a pole (left).

HELMETED LIKE A JUNGLE KING, Snowflake turns his bathtub into a toy and scampers up his exercise bars (above). Testing the gorilla's memory of another early experience, Dr. Riopelle confronted him with Señora Luera, the veterinarian's wife who took in the newly found orphan and cared for him like a baby until he moved to the zoo. Though he hadn't seen her for 20 months, Snowflake nearly bowled her over in an ecstasy of recognition.

Furrowed brow helps shield sensitive eyes

WIZENED LOOK of an old gentleman (right) creases Snowflake's face. He often frowns when light dazzles his eyes because of their below-normal pigmentation. Albinism results from a deficiency in the formation of pigment, but an albino can have this deficiency in any degree. The blue tint of Snowflake's eyes indicates a slight formation of pigment in the irises.

LOOK-ALIKE DOLL becomes a playmate. Within half an hour after being introduced to a toy white gorilla, Snowflake had adopted it—cradling it, patting it, and rubbing it against his body. Dr. Riopelle later took the toy apart. Arms and legs elicited no response from Snowflake; the torso evoked some interest. But the head obviously was the visual element that he found most attractive.

Time out for a checkup

KODACHROME © N.G.S.

WATCHING with the clinical interest of a matron in a shoe store, Snowflake allows his foot to be measured by Dr. Luera (left) as part of a continuing study of the gorilla's growth rate. Here, at 4½ years old, his broad sole would fit into a boy's shoe, size 2E—if the prehensile big toe were not separated from the others. The zoo's staff biologist, Mrs. Rosario Nos de Nicolau, records the data.

CLAPPING WILDLY, Snowflake expresses elation. With the increasing activity of both Snowflake and Muni —each now weighing about 100 pounds—the scientists must bring to their laboratory sessions the patience of preschool teachers and the strength of lumberjacks. Often frustrated in their efforts, they have no choice but to allow their charges to escape to their own pleasures.

WHY WEAR SHOES? Muni tries to untie Dr. Riopelle's shoestring, but succeeds only in thoroughly knotting it as the author attempts to jot down a note (lower left).

Well adapted to captivity, the two gorillas are healthier than many of those in the wild, which suffer from parasites and, as vegetarians, often lack high-quality protein in their diet.

Today the captives' appetites approach King Kong proportions. At their main meal, served about 1:30 p.m., each eats two pounds of bananas, a pound of apples or pears, half a pound of quince jelly, half a pound of boiled ham or roast chicken, and a quarter pound of bread. Three lighter meals add raw beef, yogurt, hard-boiled eggs, rice, and cookies to their diet.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Follow the leader

CROSSING THE CAGE on ropes, Snowflake hesitates behind the bolder Muni. Too heavy for most tree limbs to support, gorillas climb very little as adults. Poor day vision may rob the albino of confidence, resulting in Muni's leadership and dominance in most activities. When they play horseback, Snowflake always rides; when they "waltz," clasping arms and facing one another, Muni leads the dance.

Mirror, mirror . . .

TEETH BARED, curiosity and fear distorting his face, Snowflake beats on his reflection in a mirror as if testing the image's reality. He ran from a previous encounter with the glass.

Muni's reaction, a remarkably different one, reflects his take-on-anything attitude about life. Immediately after Dr. Riopelle introduced the mirror to the cage, Muni strode directly to it. Fascinated by his image (far right), he examines parts of his body that he cannot ordinarily see.

KODACHROMES BY MICHAEL KUH © NATIONAL GEOGRAPHIC SOCIETY

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Serious student becomes an ardent suitor

FRIEND IN DISGUISE: When six-year-old Arturo Nicolau Nos entered the cage wearing a gorilla mask, Snowflake studied the lad for five minutes before he figured out the masquerade. Muni quickly ripped the false face away.

DEEP IN CONCENTRATION, Snowflake pulls the correct chain to win a piece of carrot (left), demonstrating that if he has a central blind spot, occasionally found in albinos, it creates no problem for him.

STAKING HIS CLAIM, Snowflake for the first time defies Muni's dominance. When Afanengui, a young female presented to the zoo by the National Geographic Society, was placed in the cage, Snowflake repeatedly drove Muni away. Although the albino is at least a year from sexual maturity, his interest leads Dr. Riopelle to believe that he will eventually mate, starting a strain that might produce other white gorillas.

KODACHROMES © N.G.S.

Novel safari explores the animal kingdom

BATES LITTLEHALES (BELOW) AND THOMAS NEBBIA © N.G.S.

Peanut tossers fail to excite bears, whose taste runs more to sweets. Some zoos sell packaged tidbits.

Rapport blooms between a baby elephant and a comely attendant at San Diego's famed Children's Zoo.

Giraffes roam a private estate at Longleat, England.

An-An, a rare giant panda, lunches at the London Zoo.

NICHOLAS H. EDWARDS (BELOW AND CENTER)

THOMAS J. ABERCROMBIE

All white tigers now in zoos descend from this male captured in India 20 years ago.

JAMES A. SUGAR

Red light converts day into night for nocturnal animals like this fox at the Bronx Zoo.

ROUND UP THE SMALL FRY for a trip to the zoo with National Geographic as your guide! On Tuesday evening, October 13, the Society presents "Zoos of the World," first in its 1970-71 series of color TV documentaries. At the San Diego Zoo children romp with young animals. People swarm like ants through the huge insect exhibit at Tokyo's Tama Zoo. Animals at the East Berlin Zoo live royally on the grounds of a former palace. Once mere menageries, zoos now provide greater animal freedom and serve as havens for threatened species.

Narrated by Joseph Campanella, the documentary is produced by the Society in association with Metromedia Producers Corporation (MPC). Sponsors are Timex Watches and the Foundation for Full Service Banks.

Tear out this page and keep it near your TV set as a reminder

WATCH "ZOOS OF THE WORLD" ON MOST OF THESE CBS TELEVISION STATIONS

Zoos of the World

SEE IT IN COLOR, TUESDAY, OCT 13

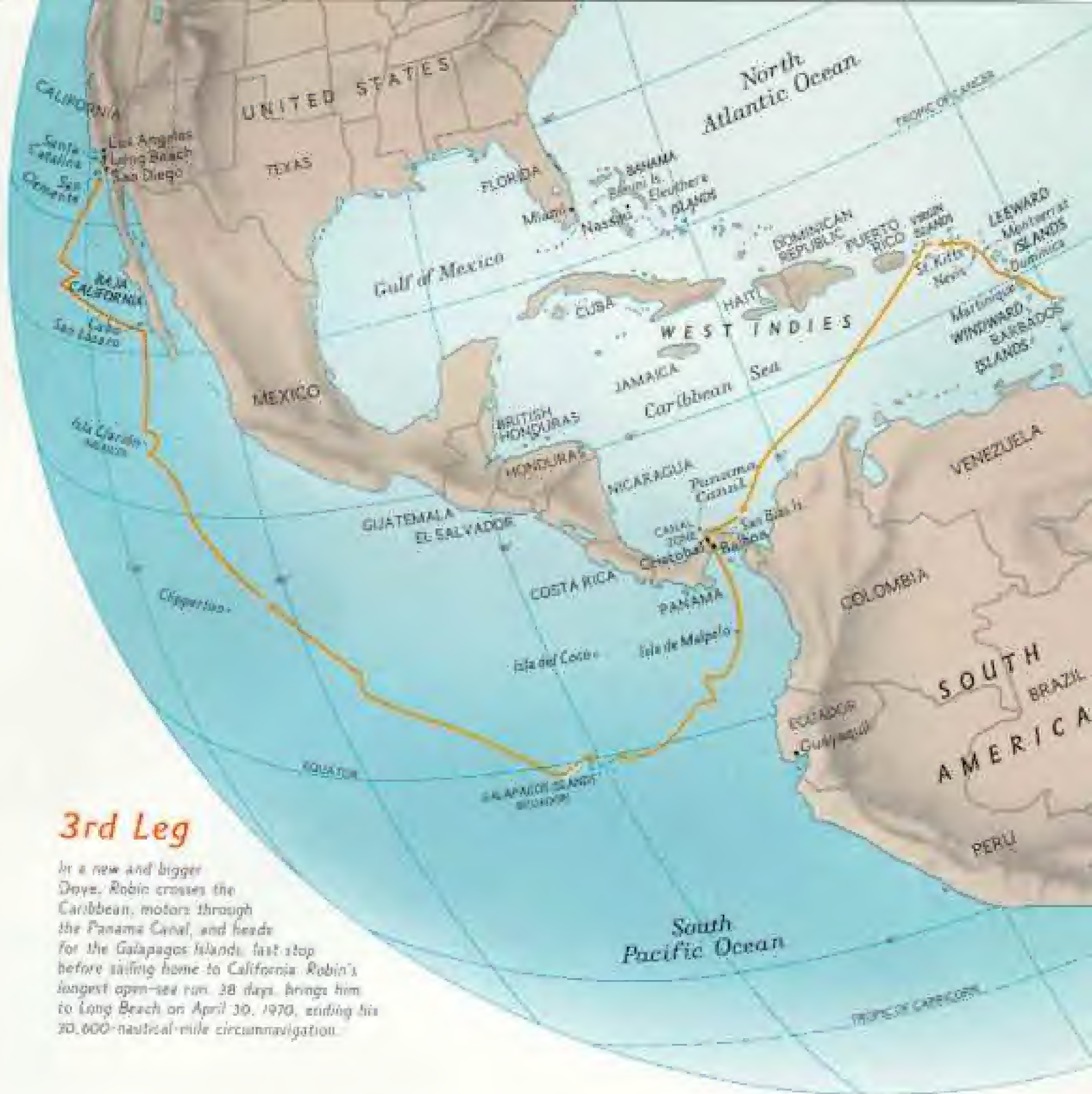
ON THE FINAL LEG OF HIS FIVE-YEAR VOYAGE ALONE AROUND THE WORLD

Robin Sails Home

ARTICLE AND PHOTOGRAPHS BY ROBIN LEE GRAHAM

BECALMED IN THE DOLDRUMS, *the youthful skipper impatiently awaits a breeze. Progress proves tantalizingly slow in this stretch of the Pacific, northwest of the Galapagos Islands. More than a month away lies California and the end of Robin's remarkable solo voyage.*

KODACHROME TAKEN WITH A SELF-TIMER © N.G.S.



3rd Leg

In a new and bigger Dove, Robin crosses the Caribbean, motors through the Panama Canal, and heads for the Galapagos Islands, last stop before sailing home to California. Robin's longest open-sea run, 38 days, brings him to Long Beach on April 30, 1970, ending his 30,600-nautical-mile circumnavigation.

THE SEA IS GLASSY CALM. If I lean over the rail I can see my sweat-streaked face in the water. The sails droop and flap in hazy, glary air that hurts my eyes. I'm barely moving, getting nowhere.

But up ahead, over the curve of the world, is my journey's end. The next shore I stand on will be California's, which I left nearly five years ago, a schoolboy in a small boat, sailing westward alone. I've been going westward and westward ever since, leaving California farther and farther astern. Now it's on my bow, and getting nearer and nearer. So I guess the world is really round. I mean, it's one thing to know that, and another to experience it.

This is my last and longest leg. The Galapagos Islands are not far astern. How far to go? About 2,500 nautical miles, as the gull flies; but not as the sailboat sails, especially beating to windward. Call it 3,500, for a guess. How many days before I see another human face? Thirty, with miraculous luck, which I never count on, even though I've had my share of it. No, let's say forty, or maybe fifty, or it could be sixty.

A Sailor Takes Stock

So now I wait, and sweat, and think ahead to life in the United States (a hard thing to do; I've been a long time gone) and back to all the things that have happened ever since I went to sea. . . .

Taking an over-all look at it, my round-the-world voyage seems to fall into three parts, both geographically and personally.

2nd Leg

Favorable winds and fair weather help Robin on his Atlantic crossing as he returns to the Northern Hemisphere, described in "World-roaming Teen-ager Sails On," April 1969 NATIONAL GEOGRAPHIC. By the time he reaches Barbados, he has logged 22,800 nautical miles in 38 months in the 24-foot sloop Dove.

1st Leg

Setting sail from Los Angeles on July 27, 1965, Robin Lee Graham island-hops through the Pacific to Australia, then rides the trade winds across the Indian Ocean to Durban, South Africa. His story "A Teen-ager Sails the World Alone" appeared in the October 1968 NATIONAL GEOGRAPHIC.

Around the world in 1,739 days

First came the run out through the Pacific and Indian Oceans to Durban in South Africa, in which a very young sailor and a very small boat managed somehow to get halfway around the globe. During the weeks we spent at the bottom of the African continent, the boy I was took a long step into maturity: Patti Ratterree and I were married after a leap-frog courtship across the Pacific. My boat, *Dove*, a 24-foot day-sailer modified for cruising, was modified a lot more in South Africa to make her safer and easier to sail on the open sea.

The second stage found *Dove* and me crossing the South Atlantic, both of us better equipped than we'd ever been for an ocean passage. I had more to live for, and my strengthened boat was more likely to keep

Running before the wind, Robin leaves the Virgin Islands behind and cuts across the Caribbean. On this last leg of his journey—from Barbados to Long Beach, California—he and his new, larger *Dove* traveled 7,800 nautical miles in 328 days.

me living. But the changes in *Dove* weren't great enough to match the changes in me. I'd outgrown her, physically and psychologically. I was sick of the boat, sick of the sea. By the time I reached Surinam in South America, I knew I couldn't face another long haul in *Dove*. I wasn't sure I could go on at all.

I did manage to keep going to Barbados, in the West Indies. Patti met me there. In that lovely serene island we rested and played. And we worked out plans for me to finish what I'd started. My third and last chapter began in the Barbadian sun.

We managed to find a neat little apartment right on the leeward shore of Barbados. The sea off the beach was protected and calm, so I anchored *Dove* there. I brought Kili and blind Fili ashore (they're the kittens given to us in South Africa), and we all settled in.

Next to being back with Patti, what I wanted most was hot fresh-water showers, fresh food, a home that held still, and the bone-deep pleasure of sleep. I mean real sleep, not the restless catnaps I had at sea where I dozed with one ear and half a mind tuned to wake me at every change of sound or motion. I wanted quiet, and sun, and friendly people. And pretty, changing country to make up for memories of a thousand similar seascapes.

Rest Brings Renewed Resolve

We toured around by motorbike (below), riding for miles between stands of eight-foot-high sugar cane and along the rocky headlands and shell-sand beaches of the island's windward side, where the big surf breaks. There was a place we really liked, up on a grassy hill, where the trees had been shaped and bent by trade winds. Sometimes we took picnics there, and we'd eat and lie around feeling good.

Often we took the bus into Bridgetown, the

After the grueling transatlantic run, Robin relished his month-long stay on Barbados. His bride Patti had preceded him by boat. Renting a motorbike, the two toured the verdant little island, easternmost and most densely populated of the Caribbees. Here they ask directions of a couple in a donkey

capital, and went shopping, looking for delicious things to take home and cook. We went diving, too, in the dead-clear water offshore, and found out that Barbados is as beautiful under water as above it.

After we'd gotten well settled, my mother came from California to visit us for a few days, which was great. I hadn't seen her for three years, and she had never met Patti.

Once my raw edges were smoothed out by rest and happy times, I became convinced that I could carry on if I could get the right boat. She should be more than 30 feet long, so that she could weather almost any storm and would have full headroom below. She should be less than 40 feet, because the sails on a boat that size or bigger are just too bulky for a single-hander to manage easily.

She should be made of fiberglass, which requires less maintenance than wood, and her power must be diesel, for reliability, economy, and safety: Diesel fuel is far less explosive than gasoline.

To find this dream boat, we'd have to leave Barbados. Florida, with its hundreds of marinas, would be the place to start looking. We buttoned up *Dove*, left our gear aboard, took the cats, and flew northwest.

It took us a long time to find what we wanted, at a price we could pay. We had some money saved up, and we knew about how much little *Dove* would bring. Beyond that, we'd have to work out loans or advances, and find a manufacturer interested enough in my trip to sell me a boat at a price I could afford.

The advances came from the Geographic, as partial payment for my second and third articles. The interest came from the Allied Boat Company, Inc., of Catskill, New York, which also manufactured a 33-foot sloop that we liked better than any boat we'd seen. She had just about all the features we wanted,

cart before continuing down a rural road lined with sugar cane that ripples in the trade winds.

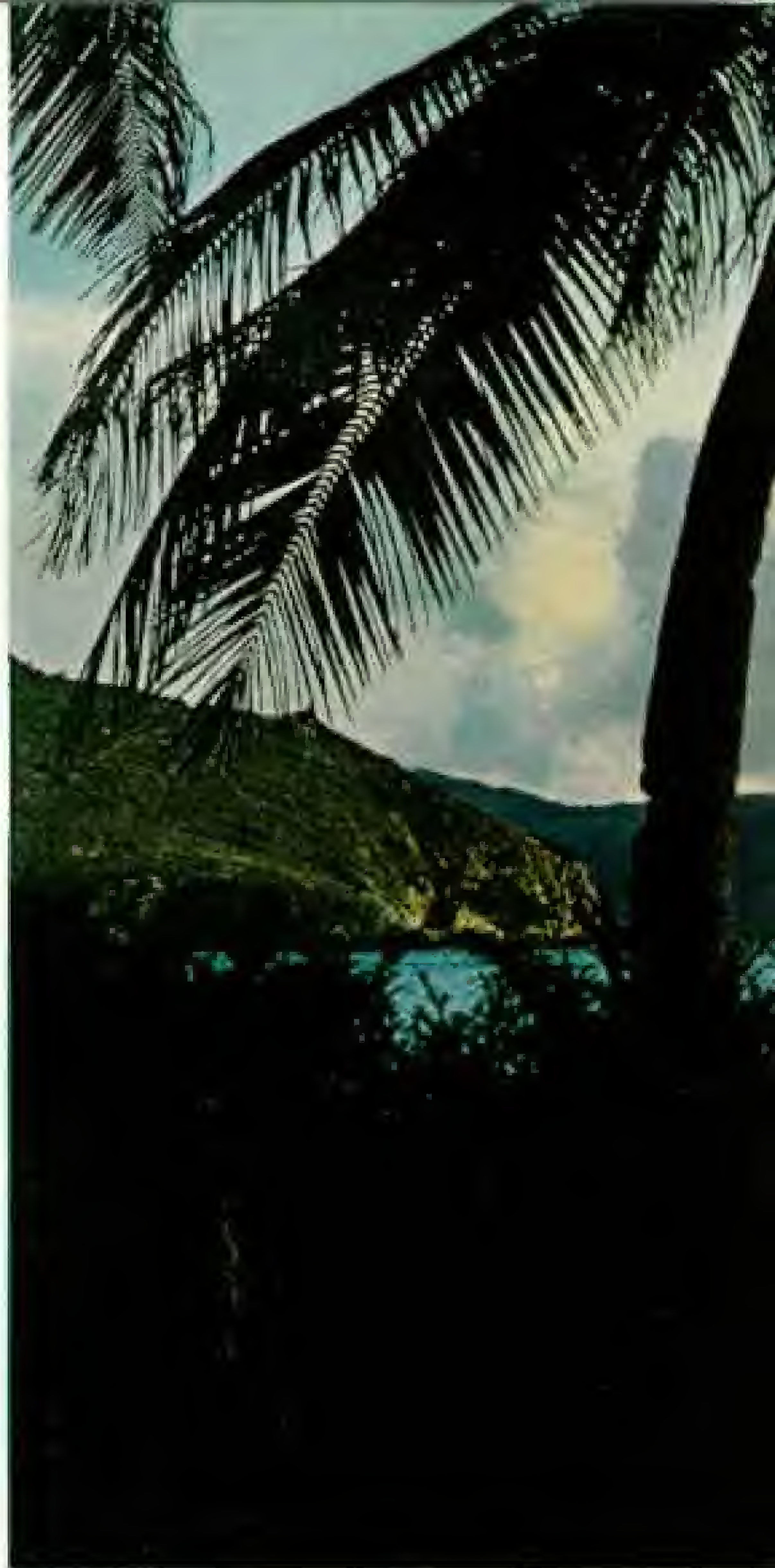
Learning the limbo, a popular Caribbean dance, Patti twists under a bar to the beat of a steel band at a hotel near Bridgetown, Barbados. "She was good, far better than I," recalls Robin, "but the costumed performers could clear the pole in its lowest position."

KODACHROMES BY DAVID CUPP © N.G.S.

Tale of two boats

ROBIN'S 24-foot sloop *Dove* served him well; she carried him more than three-quarters of the way around the world. But she had never been big enough below deck, and after four years of hard use Robin seriously doubted if she could still weather a bad storm. In Barbados he decided to sell her, and after much searching he bought a new boat, a 33-foot sloop built by the Allied Boat Company, Inc., of Catskill, New York. Robin named her *The Return of Dove*, and from Florida he and Patti sailed her to the Virgin Islands.

Later, Robin flew to Barbados alone and sailed little *Dove* to the Virgins. At Deadman Bay on Peter Island (right), the two *Doves* lie at anchor. In St. Thomas Harbor (below) Robin recalls shared adventures as he prepares to paint the interior of the smaller boat before selling her.



but I added a few pieces of extra equipment to help me single-hand her. One was a self-steering rig. Another was roller-furling gear for my two headsails, which would allow me to roll them up like window shades, or let them out as much as the wind permitted, all without leaving the cockpit.

For safety's sake, I ordered a depth-sounder to measure water depth near shore, and installed a radiotelephone. And I asked that a kerosene stove be put in. Kerosene is much less inflammable than alcohol, the usual stove fuel, and it's easier to get in remote places.

When Allied had finished, our new boat was fully equipped and ready to sail. She was shipped overland to Florida. We launched her, christened her *The Return of Dove*, and rigged her.

KODACHROMES BY ROBIN LEE GRAHAM (ABOVE) AND PATRICIA GRAHAM © N.G.S.

She was beautiful, and she lived up to all our dreams. When we took her out to try her, she seemed tremendous compared to little *Dove*. But she sailed wonderfully in light air and strong winds, and she gave me a fine feeling of security. She felt strong and comfortable under conditions in which little *Dove* would have been taking a beating and giving me one. She could make six knots in a good breeze that would have pushed *Dove* at four and a half. That would mean a lot on the long hauls ahead. Also, to windward the new boat could keep sailing in winds as high as forty knots. Little *Dove* had to be hove to when the winds got over twenty in the open sea.

Patti and I decided to sail together through the Bahamas to the Virgin Islands and base there for a while. I'd fly to Barbados and bring *Dove* back; we'd have a much better chance of selling her in the Virgins while we rested and worked there, getting ready for the next leg of my trip, the thousand-mile run to Panama. Also, this would save sailing *The Return of Dove* (we were calling her big *Dove* by now, or just *Dove*) to Barbados (map, page 506). That long beat to windward would be really a pain.

Our trip from Florida to the Virgins wasn't part of my circumnavigation of the earth, so I won't dwell on it. We visited North Cat Cay and North Bimini, crossed the Bahama banks to Nassau, and sailed on to Eleuthera on the edge of the Atlantic deep. On the long sail to St. Thomas we hit 60-knot squalls that proved big *Dove* a great boat and Patti a real sailor. She never wavered until the stormy day

when I suggested canned oysters for lunch.

We got into St. Thomas on May 26, 1969, after a rough, miserable passage. We cleared customs, found ourselves a mooring, and began to fix what little needed fixing. We found boat people we knew, and made a lot of new friends. The cats had a ball running around on the docks (even Fili, the blind one, though we couldn't understand how she managed it).

After eleven days I flew to Barbados to sail little *Dove* back. She felt like a toy after the big boat. It was comforting to know that I'd be near islands all the way to St. Thomas. That would make navigation easy, too. I hadn't bothered to bring my sextant and book of tables. No need to shoot the sun when you can see the land.

I only had about 500 miles to go, and I didn't stop once. The winds were good, right where I wanted them. I left Martinique to port, then got in the lee of the Leewards. When I passed downwind of Dominica, it smelled like one big flower.

The only trouble with this trip was that, being so close to land, I had to stay awake all the time—or try to. Off Montserrat the wind died. I fell asleep at the tiller and woke up only a mile off the island's reefs.

Little *Dove* gets a Beauty Treatment

Beyond Nevis and St. Kitts, I had an 80-mile run to the Virgins across open sea. I came into St. Thomas toward dusk on June 11, just as the lights were going on ashore. I pulled up alongside big *Dove* and surprised Patti. She hadn't expected me until morning.

For four weeks we worked on little *Dove*, restoring all her brightwork and painting her hull. When we were done, she looked prettier than she ever had. We put a "For Sale" sign on her, and it kind of hurt.

With that job finished, we took off and sailed around the Virgins in big *Dove*, exploring and diving for fun and food. I've always taken time to have a good look at each new region along my route, which is why my

Night run for cover! When forecasters report Tropical Storm Anna is heading directly for St. Thomas, Robin decides to quit the shelter of that port and head for a more protected cove—Hurricane Hole off St. John Island. Here, towing little *Dove*, big *Dove* cleaves the Caribbean as Robin replaces a bulb in the stern light.

A time to relax

AT A COOKOUT on Culebra, the U. S. Navy's target island off Puerto Rico, Robin and Patti, with friends Bill and Randy Runion, broil freshly caught groupers, grunts, and snappers.

Robin dives to spear a lobster amid the rocks (below). In Hurricane Hole (right), he climbs the mast to check the spreaders, then leaps into the water. Six lines hold big *Dove* against Tropical Storm Anna. Fortunately, the tempest missed the Virgins.

KODACHROMES BY DAVID L. ARNOLD (UPPER LEFT) AND THOMAS [illegible] © N.G.S.

journey has stretched across almost five years. We found nice inlets and anchorages with clean, warm water and usually plenty of fish and lobsters.

We were having a fine time, but we weren't getting much work done. So we sailed big *Dove* to Peter Island, anchored her bow and stern, ran a line from the masthead to a big rock ashore, and winched her over. That way we were able to scrub and paint along the waterline. After that we went back to St. Thomas Harbor and tackled the smaller chores.

Then along came a buyer for little *Dove*. By the time we got her sold, we were well into August and the hurricane season. I'd planned to leave alone for Panama before the season began. But now it seemed wiser to wait. In three more months it would be over. So we iced up, and took on water, and got food aboard, and headed out to see more of the Virgin Islands.

In mid-August, while poking around in Gorda Sound, we saw a little resort being built on the shore of Virgin Gorda. We rowed in to look at it, and one of its owners, Basil Symonette, offered us a job. He needed people to

help finish the place—he called it The Bitter End. We enjoyed a last lazy holiday, then took the job (below).

I put up walls, installed windows, worked on a refrigerator, made shelves, and rebuilt a dinghy. Patti helped with painting and put in a garden. When we finished at The Bitter End, we'd learned enough to build a place of our own, when the time comes.

We worked for two months; then we sailed away. The hurricane danger was just about past, and it was time to move on.

I had the boat hauled, and painted her bottom. While she was on the ways, I decided to install refrigeration. It took me a week, and I did most of the work myself. I ended up with a fair-sized deep freeze that ran off the engine and would keep things frozen if I ran it for just one hour a day.

Alone Again, Bound for Panama

Early on November 21, Patti left on the S.S. *Lurline* for Panama. We planned to meet in Porvenir, one of the Panamanian San Blas Islands, 960 miles from St. Thomas. I got under way that noon with the sails set and Gandalf doing the steering. Gandalf is what we call the new self-steerer; it's the name of the wizard in J. R. R. Tolkien's *The Hobbit*, and seemed appropriate, because the self-steerer is kind of a wizard itself. It steers the boat by the action of the wind on a vane.

I made a cool drink with the first ice produced by my new freezer. Then I got out my tape recorder. Being alone, I felt like talking.

"It's good to get moving. I'm doing very well, making better than six knots on a broad reach. A little while ago it rained, and I got a really nice bath."

Next day, November 22, the wind began to blow out of the southwest, exactly where I wanted to head. By nightfall I was beating right into it, in the rain, with the genoa reefed to the size of a dinghy bottom.

Then Gandalf broke his leg—that is, the wooden oarlike blade that sticks into the water. I had only one spare. I desperately hate to steer, so I made a note to be sure to order new spares in Panama. I didn't relish the idea of having to steer by hand for a month or two in the Pacific.

By the twenty-fifth the wind got back where it belonged; that is, out of the east. Things began to look up. By radio I talked to Patti aboard the *Lurline*, which was great. And I was making good speed on half-reefed jib and staysail, set wing and wing. In the evening a tern came in to rest on the furled mainsail (page 521).

On the twenty-sixth I saw four ships. One passed so close to me during the night that it turned its searchlight on to see what I was. You don't get much sleep when you know ships are around.

Sailor turned carpenter, Robin helps build a cottage at a new vacation resort called The Bitter End on Virgin Gorda island. He took the job while waiting out the worst of the hurricane season; his new *Dove* lies at anchor beside a barge at left. Robin, who enjoys working with his hands, here adjusts a power saw. With his wages, he bought refrigeration equipment for the boat.

On my seventh day out, the twenty-eighth, the wind dropped and I turned on the engine. It was really neat to be able to keep right on going, wind or no wind. I had fuel enough in my tanks to run about 300 miles.

I figured I'd see land early the next day—some of the San Blas Islands. But I waited and waited and waited and then, in the afternoon, I saw trees in the distance. I got into Porvenir at five o'clock, after eight days and five hours of sailing. I'd gone 1,099 nautical miles by my taffrail log, which records the distance I go through the water. The straight-line distance was 139 miles shorter, but you can't always sail in a straight line.

The charts for these islands aren't too accurate, and the light was fading. I came in slowly and found a safe place to anchor. Then I looked around to see if I could see Patti.

That may sound strange—looking for one person in a harbor from a boat at anchor—but Porvenir is a very small cay. It has an airstrip on it, and airplanes land at one end of the island and stop at the other. Just.

I didn't see Patti. I got in the dinghy and rowed in with my papers to clear with customs and see if the tiny hotel there had a reservation for her. Out of the hotel came Patti, flying.

Except for the hotel and a few government buildings and a lot of palm trees, there isn't much on Porvenir. Most of the Cunas—the local Indians—live on other islands. But the land and water are pretty and the people are

clean and pleasant. They come to Porvenir to sell things to the tourists who fly out from mainland Panama to see them.

Patti and I would explore the Panama islands and canal together, living on and off the boat and going on short sailing trips, as we had in the Virgins. Our sightseeing interlude would end on the Pacific coast of Panama; from there I'd set out alone on the next leg of my voyage.

First we visited an island plantation that wasn't more than half a mile long but had hundreds of coconut palms, three or four thatched shacks, one man, and a whole bunch of women to harvest the crop. The whole San Blas economy depends on coconuts.

After a few days, we went on to Tigre Island, just off the mainland, where we saw several of the albino Indians for which these islands are famous. There were so many when the Spaniards came that they thought they'd discovered a tribe of whites.

We made other stops, one at Pidertupo, where an American couple, Tom and Joan Moody, had built a pretty little resort in native style, another at a ramshackle old hotel full of character and creaking planks, built out over the harbor at Pico Feo. Then we powered into Cristobal in the Canal Zone.*

Sandy Beach No Place for a Luau

It was good to get ashore. Fili, the blind cat, thought so too. How she got off the boat we don't know, but she did. She vanished on December 22. We searched everywhere, even went around showing people her picture. Then, two days later, she showed up again —right in the yacht club entrance—with a raffish-looking tomcat.

Christmas came along, and some Americans we'd met invited us to spend it with them. It was nice to see Christmas celebrated with a Christmas tree.

We were stuck in Cristobal, waiting for

*See "Panama, Link Between Oceans and Continents," by Jules B. Billard, GEOGRAPHIC, March 1970.

Wing and wing under double headsails, *Dove* heads out from the Virgins into a squally Caribbean. The boat rolls under this rig, making one sail appear as if backwinded. Alone once again—except for his two cats—Robin sets a course for Panama, a thousand nautical miles southwestward. Furling gear allows Robin to roll up the two headsails like window shades without having to leave the cockpit.

KODACHROME BY JOSEPH J. SCHERSCHEL © N.G.S.

The storm that wasn't supposed to happen

"HURRICANE SEASON was over, or so I thought," relates Robin, "but two days out I was brushed by the fringes of one that blew up suddenly off Panama." In 20-foot swells and 40-mile-an-hour winds, he casts an anxious eye aft; everything in the boat is battened down. Robin takes his photograph by pulling a string attached to the camera. Wind vane on the stern turns an oarlike blade that automatically steers the boat, letting Robin take care of other chores or get much-needed rest.

In the eight-day passage from St. Thomas to Panama, *Dove* received only one visitor: a tern (right) touched down on the furled mainsail just before dusk. By morning it was gone.

"What did you learn about weather on your long voyage?" Robin was asked upon his return. "That it's unpredictable," he replied, adding with understated humor, "If the barometer is falling fast and there are dark clouds on the horizon, that means it might—just might—rain the next day."

EKTACHROMES BY ROBIN LEE GRAHAM © N.G.S.

spare parts for Gandalf the self-steerer and some other gear we needed. So we decided to have a luau. That's a Hawaiian cookout with a roast pig as the main attraction.

We didn't find a pig right away, but we came across a real character—a big black man, all dressed in homemade tin armor. At a distance he looked like Balboa himself. He told us there were no pigs around there.

Later we managed to buy a pig and built an *umu*—an underground oven—on a beach. We didn't know how long to cook the pig, and when we took him out his head fell off. He was overdone. Also, we learned, you should never make an umu in the sand. You can't keep the sand off the pig.

We had about 35 guests at our luau. Even though they had to eat overdone sandy pork, everybody had a good time. There wasn't any sand in the beer.

Dove Takes On a Five-man Crew

By mid-January our spare parts had arrived and the boat was ready to go. The Panama Canal Company pilot came aboard at 8 a.m. on January 17, and we started through Gatun Locks with him and four linesmen aboard. You don't just sail your own boat through the canal (page 524). It's a tricky business because the water in the locks gets really turbulent as the level changes. The canal company handles the transit.

Sailboats can get to rolling and bang their masts and spreaders against the wall if they're in the side position, so we went through the first lock with a tug between us and the wall. In the others we managed by getting lines ashore on both sides to hold us clear. We got to Balboa, at the Pacific end of the canal, without any damage.

It was getting to be time for me to set out again alone, bound now for the Galapagos Islands. Patti and I spent a week by ourselves at Taboga Island, a few miles offshore. We came back on the twenty-ninth, tied up to the fuel dock, fueled up, and went ashore to do laundry. In the morning some friends came and picked up Patti and her gear. She would catch up with me at my next stop, traveling by ship and plane. At 7:30 on the morning of Friday, January 30, I headed out to sea.

I powered free of land, then hoisted sail and ran all day before an east-northeast breeze, making about six knots. Darkness came, but it brought me no rest. In the morning I talked to the tape recorder.

"I didn't get much sleep last night. I felt on guard all the time, waiting for something to happen. The cats are listless. It's very lonely, and I'm really starting to miss Patti.

"It was hard to get going again this time, even with the fine new boat. If I'd still been in little *Dove*, I don't think I could have made myself leave at all.

"I made 153 miles from noon yesterday to noon today. Great going!"

The good winds held through February 2, then quit. The next morning they were right on my nose. I beat to windward for two days, going through a lot of water, but not making much mileage toward my destination.

On the sixth day, February 5, the sun came up beautifully and the seas were calm. I powered directly toward San Cristóbal in the Galapagos, still 250 miles away. In the afternoon of the seventh day I changed the engine oil and changed the oil filter—two completely unexciting, terrible, dirty, awful jobs, especially when you do them at sea. But oil is the blood of the engine. I wanted mine healthy.

Depth-sounder Aids in Night-time Entry

My tape for February 7 says: "I made 119 miles noon to noon and saw San Cristóbal, one of the Galapagos Islands, at midday."

And later: "I got up close to San Cristóbal as day ended, but couldn't find any shelter. I kept going, dark or no dark. I got into the main harbor, Wreck Bay, by depth-sounder readings. Kind of nerve-racking! It was 11:30 before I dropped anchor. It seemed to me a very lonely place. I felt better about it when an Ecuadorian Navy man (the Galapagos belong to Ecuador) took the trouble to row out to suggest a better anchorage."

I didn't go ashore right away. There were repairs to be done. But after a couple of days I rowed in, bought some buns and limes and got 2½ gallons of water, and came back.

I'd had no word from Patti, but on the

Shy but curious, Cuna Indian girls peer through the latticed frame of their house on one of the San Blas Islands off Panama's northeastern coast. One wears gold nose ring, black beauty line, and traditional *mola*, a blouse of multilayered cloth. These palm-shaded islands, little more than sand bars, are numerous as the days of the year. Coconuts provide the Indians with their chief source of cash.

EKTACHROME © NATIONAL GEOGRAPHIC SOCIETY

sixteenth I got a cable saying that she was flying out from Guayaquil the next day. The Galapagos airport is on Baltra Island, almost 50 miles from where I was, so I ran to the shore, rowed to the boat, put Gandalf together, got my safety harness on, pulled the dinghy aboard, took up my anchor and 150 feet of chain, and got underway just at dark. I powered most of the night.

I got into Baltra, anchored, and walked up to the airport. The plane came in. No Patti. I walked back to the beach. Three days later the plane came again, and this time it brought Patti. It turned out that she'd been bumped off the earlier flight. With her were her father and stepmother, Allan and Ann Ratterree. It was just great.

Sea Lions Act Like Playful Pups

Once again I took time off for local cruising and exploring before traveling on alone. The four of us went first to Plaza Island, a strange and wonderful place with bare rocks and green lichens and red-leafed plants—also land iguanas and sea lions. We went diving with the sea lions, and they played just like dogs (pages 528-9). They'd pick up things in their mouths and drop them again, and come and dart and roll around and look at us. We could touch them, but not hold them. On shore the bulls would chase us if we got too close to their harems.

The land iguanas weren't so playful. They stood around looking like small dinosaurs, and we fed them banana peels and cactus flowers.

We decided to leave *Dove* in Academy Bay, on Santa Cruz Island, and visit nearby islands on a local boat, the *Vagabond*. We took Kili and Fili with us, and on the day we left Fili had her kittens. Two died. We named the other two Piglet and Pooh.

On the *Vagabond*, I didn't have to sail, so I was free to get a good look at the weird world of the Galapagos. I'd stopped off here, partly because it's the last inhabited place you can put in to on the offshore route from the Canal Zone to California, and partly because there's no place like it in the world.*

One of our first stops was Cormorant Point on Santa Maria Island (map, next page). There's a little bay there, and back of it are lots of flamingos, pompous and clownish in their slow strutting, but graceful in flight.

Later, on Española Island, we saw mockingbirds so thirsty they'd climb into your hands to get water if you held some in your palm. There were masked boobies, with furry, fluffy young ones, tame as kittens, and marine iguanas, beautifully colored in reds and greens for the mating season. A blowhole near the

*See, in NATIONAL GEOGRAPHIC, "In the Wake of Darwin's *Beagle*," by Alan Villiers, October 1969; and "The Galapagos, Eerie Cradle of New Species," by Roger Tory Peterson, April 1967.

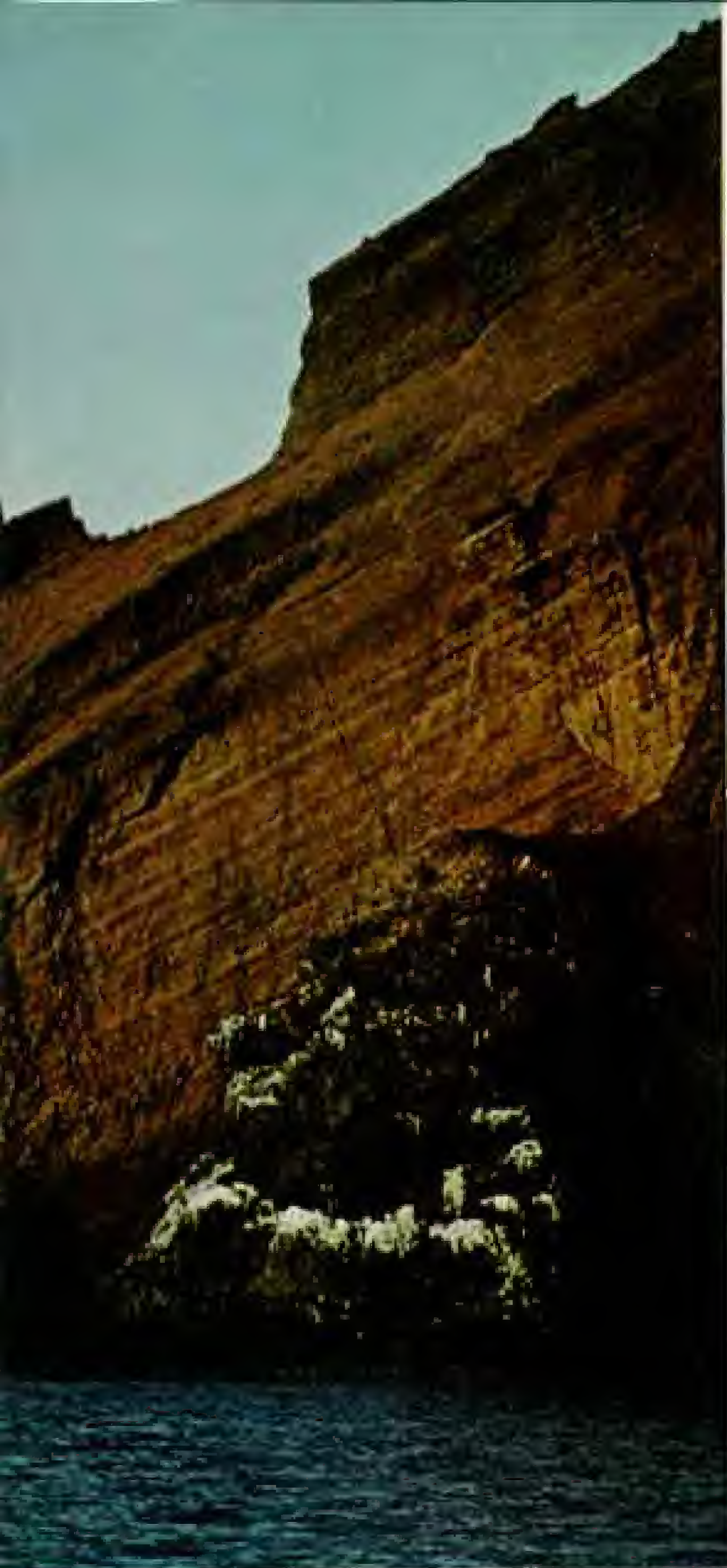
Threading the Panama Canal, *Dove* appears as a speck between the gates of Pedro Miguel Locks, photographed from 1,500 feet. As required by law, a pilot and four linesmen join Robin on deck, the largest party ever to travel aboard *Dove*. Four miles beyond Miraflores Lake, at center, lies the city of Balboa, on the shore of the Pacific.

Sharing a happy secret. Patti and Robin relax on Taboga Island, a few miles off Panama's southern coast, before he sets out alone again for the Galapagos Islands. A doctor in Panama confirmed that the Grahams could expect their first child in the summer of 1970.

KODACHROMES BY ... © N.G.S.

Close under beetling cliffs of San Salvador Island, Robin anchors in Buccaneer Cove, named for mid-17th-century pirates who headquartered here. He made a landfall on the Galapagos after an eight-day run from Panama; two weeks later Patti flew in. Thus began for Robin one of the highlights of his entire voyage, a month and a half of exploring the remote Pacific archipelago where Charles Darwin gathered information that he later formulated into his theories of natural selection and evolution.

The Archipiélago de Colón, its official name, includes 13 main islands. Five volcanoes, the highest rising more than a mile, spike 80-mile-long Isabela.



KODACHROME BY ROBERT W. MADDEN © N.G.S.

shore spouted sea foam 30 feet into the air, spraying the seals and iguanas gathered around it.

Back aboard *Dove*, we sailed to San Salvador Island, where we hunted pig and goat in the hills. Patti's father baked goat ribs with a barbecue sauce. Delicious!

At night, in Buccaneer Cove, seals rushed at *Dove* through the dark water, looking like torpedoes wrapped in phosphorescence.

We took *Dove* back to Baltra, the airport island, on March 3. Al and Ann Ratterree flew home, after 11 fine days with us. Patti and I sailed over to Santa Cruz Island and found a beautiful little tidal pool to swim in. There was a baby fur seal in it, so tame that he came up to sniff us and bite our hands. We'd shot a parrotfish for the cats, and tried to feed it to the seal, but he thought it was something to play with.

Dove needed new bottom paint. Back near Academy Bay we arranged to tie up in a shallow-water dock where the boat would be high and dry at low tide. I spent March 5, my twenty-first birthday, scraping and repainting, and a pufferfish swam up in the ankle-deep water and bit me on the toe—not the pleasantest way to spend a birthday.

But Patti fixed me a nice cake. It looked queer because the boat was tilted over when she baked it, but it tasted good. She gave me a present, too—a plastic model kit of Sir Francis Drake's *Golden Hind*.

Before leaving Academy Bay, we laid in fresh vegetables and fruit. I added a couple of goats to our meat supply. With our boat full of good fresh food we headed for Fernandina, the westernmost of the main group of islands.

Stitch in Time Helps a Pelican Dine

Fernandina has a raw, rough look to it. It's mostly lava, with a fringe of mangroves near the water. Small fiords cut into it. Inland, there's a 4,902-foot volcano with clouds around it. We found penguins and iguanas and flightless cormorants along the shore. Later, when we threw garbage over the side, a bunch of pelicans flew in to eat it; and here began one of the oddest animal experiences we've ever had.

Among the pelicans was one with a damaged lower bill. The bones that formed the sides were separated at the tip. The skin pouch between them was torn. Everything he picked up just dropped right out again.

We lured him close, and I jumped overboard and grabbed him. With Patti's help I wrestled him aboard. We got some equipment from the first-aid kit and began sewing up the poor guy's mouth. It took about an hour. To finish the job, we drilled through the ends of his lower bill bones and put in stainless steel wire to hold them together. Then we let him go (pages 530-31).

Next day the pelican was back with the others. He could outdo all the rest in catching the scraps we threw. It was really great.

Our time together was running out. I felt I had to get moving again. On March 16 we began working our way back by easy stages to San Salvador, where Patti would be able to catch the interisland steamer *Lina-A*,

KODACHROME (ABOVE) BY PATRICIA GRAHAM; EKTACHROMES BY ROBIN LEE GRAHAM © N.G.S.

Where the wildlife is tame

"LAS ISLAS ENCANTADAS—the enchanted islands"—sailors of old called the Galapagos. Owned by Ecuador, the archipelago lies athwart the Equator, 520 nautical miles west of South America and 700 miles southwest of Panama.

Ecuador declared the archipelago a national park in 1959. Across its eerie heaps of lava roam animals unlike any others, including the world's only marine iguanas and flightless cormorants.

Unaccustomed to man, Galapagos creatures exhibit extraordinary tameness. Robin, with his great love for animal life, delights in a confrontation with a sea lion (left).

Patti, diving off San Salvador Island, engages a playful fur seal in a tug of war (lower left). Carrying Patti's stick into deeper water, the animals continue the game among themselves.

The Galapagos once harbored a large population of these fur seals, but hunters decimated them before the islands became a preserve.

bound for Baltra, from which she'd fly to Guayaquil and board a ship for home.

When we got to San Salvador, we reserved a berth for Patti, then filled my water tanks. I checked my fuel supply: 75 gallons, including jerry cans on deck. I laid in provisions from the *Lina-A:* 10 pounds of flour, 20 of potatoes, 10 of onions, 2 of cheese.

Later we got Patti's gear into the dinghy, and I rowed her to the *Lina-A* after dark. I got under way a little after 2 a.m. and sailed for five straight hours on a favoring wind, almost a record in these windless parts.

I began to talk into the tape recorder:

"It's really lonely. There's a great big emptiness inside me. It's pretty hard to fight back the tears. I keep telling myself I'm on my way to Los Angeles. Far away as it is, it's my next port. This is the last trip, I say, and it will seem to go much faster. But right now that's hard to believe."

It was Monday, March 23, and the wind was great. I reckoned Somebody must be looking after me. If this had been a normal, windless Galapagan day, I don't know whether I could have hacked it. If you've got to go, it helps to be able to go.

Windless Days Bring Emotional Doldrums

The wind fell during the night. Well, it couldn't last forever. On my first full day out I wasn't making more than one knot. I looked

over my charts. I had about 2,600 sea miles to cover (map, page 506).

The calm began to get to me, and I turned on the engine. For one thing, I wanted to keep myself moving so I wouldn't go crazy. For another, I figured I might as well use a good part of my fuel to push me through the doldrums belt, a zone of light, variable winds which stretches along the Equator between the northeast and southeast trade winds. I'd sail whenever I could get a breeze—any breeze—and power between puffs.

It was tough. What made it tougher was that I'd arranged to radio Patti aboard *Lina-A* at a given time. I did. I tried and tried, and I could hear Patti. She couldn't hear me. After a while I heard her say "... can't pick you up ... love you and miss you ... *Lina-A* to *Dove*, out."

It was very disturbing. I didn't want to talk about it to the tape recorder, because I knew I might break up. I talked about other things:

"I made 69 miles today, noon to noon. Not a very good start. The sea is like a mirror. The sails flap. I've got the boom tied out, so it won't come crashing back and forth all the time. These winds are terrible. Not terrible winds, but terrible no winds. I feel like doing nothing. I don't care to eat."

I began getting used to the idea that it would take a long time to get to California.

One trouble with going under power was

KODACHROMES BY PATRICIA GRAHAM © N.G.S.

Shipboard surgery: Cruising in the Galapagos, the Grahams spied a pelican with a foot-long gash in its pouch; everything it tried to eat fell out of its mouth. Leaping overboard (left), Robin captures the wounded bird (above). On deck he operates for an hour, stitching the slit and wiring together the split ends of the lower bill (below). "The next day," reported Robin, "we saw it catch and hold every scrap thrown its way."

that I had to steer by hand all the time. So I didn't get much sleep at first. After four days I filled up my fuel tanks from the cans on deck, and got rid of them. The boat looked shipshape again.

The kittens were getting really playful. When I went below they'd attack my toes.

Five days out, I'd made about 300 miles. I caught myself looking forward, for the first time, to getting home, to doing something different. I used to dread the idea, but now I felt better about it.

Maybe the biggest reason for this change in me was the knowledge that in a few months I'd be a father. In Panama we'd discovered Patti was pregnant, and we were really happy. I had a lot to get home to. My impatience kept cropping up on tape:

"Sunday, March 29, sixth day. I've been sitting here studying the charts, glaring at them. I only made 61 miles today, noon to noon. It's so calm you could put a glass of water on deck and it wouldn't spill a drop."

Later the wind picked up, and I began to make close to five knots. We all felt better; the cats went to sleep. Kili wiggled his whiskers and twitched his paws in some cat dream of beautiful maiden cats and lovely lands. Lands, not seas. He hates the sea.

For Easter I had a special meal, turkey TV dinner. I ate in the cockpit by candlelight. Well, lantern light. Very romantic. Only it wasn't. So ended my first week.

I enjoyed doing things that took my mind off the wind and charts and the passage of time. Whenever I could, I worked on the plastic ship model Patti had given me, and I tried to pass the time by cooking. I kept trying to make bread. The first time I tried, the dough just lay there. Next time it rose a little, but it was still heavy enough to be dangerous if dropped.

Water was no problem. When it rained the main caught the drops and they ran down into the groove of the sail track and out the end of the boom. It just poured out of there. I was able to fill my tanks full up.

New Chart Brings a Hint of Home

April 1 was no April-fool's joke. I was only 525 miles from the Galapagos on my ninth day out. I noted:

"I ran into a flat calm again yesterday, and it's still calm this morning. I started the engine at 3:45, and ran well into the morning.

"It's so hot I'm dripping all the time. I take salt-water showers as often as I can, but when it's this hot, it's hard to keep clean.

"I got a breeze in midafternoon, and for a while I was scooting along at better than six knots. But before midnight it was flat calm again.

"It was really very awful. I had sort of a breakdown at the end of the day. I had trouble taking down the main. Then I found that the line holding the boom out was knotted too tightly to be untied. I was working with a flashlight. I got so mad that I went below and threw the flashlight against the bulkhead and broke it. I grabbed

"I had to prod that horse all the way up. Coming down—when he was heading home—it was strictly nonstop." Robin remembers well the day he and Patti rode up the highest peak on Santa Cruz Island. Leaving the barren coast, they ascended into a rain forest of moss-bearded trees and huge ferns.

The wild, varied beauty of the Galapagos left a vivid impression on Robin. "I'm going back there some day," he vows.

KODACHROME BY ROBERT W. MADDEN © NATIONAL GEOGRAPHIC SOCIETY

a diving knife and went back to cut the jammed line, and I almost slashed the sail up too. I stopped short of that, thank heavens. I have no spare sails."

When the wind was light and variable, the sails would flap and bang horribly as the boat rolled in the little swells. It drove me crazy, and it was hard on the sail seams. But anything was better than not moving at all. So I kept on trying to sail.

On April 3, my eleventh day at sea, I made 34 miles noon to noon. The taffrail log hung almost straight down.

I awoke at 5:30 a.m. on the fourth, and the sea wasn't glassy any more. I couldn't believe it. There were little wavelets all over it. I got up the genoa and the main, and started going maybe five, six knots. The sky was full of trade-wind clouds, little puffy white ones. The wind held, and it blew from the northeast. That had to mean that I was out of the miserable doldrums at last. Noon to noon, 149 miles. Fantastic!

So by the end of my second week at sea things were beginning to look up. I was really moving. I caught my first fish, a bonito (the cats loved it). And I ran off one chart and onto the next.

It was nice not to look at the Galapagos and doldrums belt any more, and to see the U.S. West Coast. Even on paper.

I began to feel more cheerful:

"April 7, fifteenth day. I made 155 miles today. I tried cooking a piece of goat. Part of

it was green, and smelled, but I just cut off the green meat and cooked the rest. I gave Fili some bits, and she threw up. That wiped out my roast dinner."

Three days later the wind went around to the north. That meant I was sailing to windward, but I kept making good progress. The boat was doing fine, pitching a lot but not pounding. And the rail was never under. Wet, but not buried. It was uncomfortable, though. I had to get up several times at night to see that everything was all right.

Little Shipmate Disappears

I approached Clarión Island, a speck of Mexican rock some 348 miles offshore, on April 12. I saw it at 4:15 in the afternoon. I thought I'd have an anxious night, because I couldn't sail near an island I couldn't see. But at midnight the moon set right behind the island, 10 miles away. I kept going.

Next day Fili was gone. She just wasn't on board anywhere. I felt so sick about it that I had no words to tape. She'd come nearly halfway around the world, poor blind little animal. If she could have stayed another couple of weeks, she'd have been safe ashore.

The wind kept on blowing, right from where I wanted to go, which was northwest. Since a sailboat can't sail up the wind, but only about 45 degrees off it, I decided to go north for 400 miles and hit Baja California. The idea of getting nearer to some shore—any shore—was pretty appealing.

I didn't mention it much in my taping, but this whole trip was very lonely. I felt as though something were missing from my life. Even the boat felt incomplete. What was missing was Patti. But it wouldn't be much longer now. Only 900 more miles to go.

On April 15 I could hear a lot of American ships on the radio. I called them, but they couldn't hear me. I was feeling discouraged.

"Piglet peed on my pillow," I taped. "Time is dragging. I'm not making good progress, though I'm beating hard."

The next day I raised somebody on the radio. So far I hadn't had any proof that it was working, since no one had ever answered me. What a relief! It was the fishing vessel *Jinita* out of San Diego. The skipper said he'd try to relay a message to Patti's father in Long Beach. That would really be great, because I wasn't where anybody thought I would be, least of all me. I hadn't planned to head in toward Baja California. Now at least people would know my position.

I was feeling good about this until I went to start up my engine next day, and it wouldn't start. No engine, no generator; no generator, no batteries; no batteries, no radio. Then I

(Continued on page 539)

EKTACHROMES BY ROBERT W. MADDEN © N.G.S.

Dropping anchor in an idyllic cove—Sullivan Bay on Bartolomé Island—the Grahams go ashore to picnic. Button of light at far left marks their beach campfire. On another evening, on Santa Cruz, Robin and Patti watch intently as a friend forecasts the future (below). Roland Ernst of Switzerland dangles a threaded needle above Patti's palm and predicts her first-born will be a girl. His words came true on June 20, when Patti gave birth to 8-pound, 5-ounce Quimby Anna.

Journey's end draws ever closer

FOR 38 DAYS AND NIGHTS—his longest run at sea—Robin pushes northwestward after leaving the Galapagos—and Patti—behind. The doldrums prove exasperating, but finally he begins to make progress, as much as 155 miles in 24 hours.

As spray flies, Robin takes a sight with his sextant to pinpoint his position (right). Weather permitting, he did this four times daily. Time signals broadcast by the U. S. National Bureau of Standards helped him keep an accurate check.

"I'm not much of a cook," Robin readily admits, "and it's no fun eating alone, so I rarely prepared big meals." Here in the Galapagos, Robin creates his only specialty—sandwiches.

Kili the cat traveled nearly halfway around the world with Robin, from South Africa to California. Another, blind Fili, also came aboard in South Africa, but disappeared from the boat on the last leg of the voyage, leaving two kittens.

To wash the face of an old friend—his camera—Robin advances on the lens with cotton and cleaning fluid, snapping his own picture in the process.

EKTACHROMES BY PATRICIA GRAHAM (FAR LEFT) AND ROBERT W. MADDEN (CENTER); KODACHROME (TOP) AND EKTACHROME BY ROBIN LEE GRAHAM © N.G.S.

noticed that I'd forgotten to open the engine exhaust pipe. I guess I was a little excited.

Jinita called back to say she hadn't been able to reach Al Ratterree, but while we talked, a bigger boat, the *Olympia*, broke in and said she could. She got through to Al right away and gave him my message.

Now it was a matter of pushing ahead as best I could and keeping my morale up. On the twenty-fifth day I taped:

"I've been working on my model and puttering around with little things. I find a lot to do without doing much. The weather is gorgeous. It's so calm and sunny I got up nerve to take a bath. I really needed it. The water was icy, but I got clean. I washed my hair and felt about 10 pounds lighter."

At 5:45 a.m. on the twenty-sixth day, April 18, I saw land—Cape San Lázaro, in Baja California. I came about and headed due west, right out to sea. That course wouldn't take me any closer to L.A., but it might get me out to where I could find a decent wind. I made good speed on reefed main and genoa. I put my thoughts on tape again:

"It's getting cold. My feet are freezing. The only time I get really warm is at night, under my quilt. All the cats come and sleep with me these days. No wonder; it gets below 60, and we're all used to equatorial weather. But it's hard to sleep when itchy little whiskers are tickling your face.

"I've got just under 600 miles to go, and I'm communicating with home. But these ceaseless head winds are beginning to get me. I feel irritable, and so does Kili. There's nothing for him to do—no bugs to chase, no green leaves to chew on. The kittens don't mind; they keep eating my ship model. They love the threads, the little spools, everything."

Later I added: "Kili seems to be going crazy. He stares at the wall, then his hair goes up and he gets terrified. If I make a quick motion it really wipes him out. I wear a fishing knife in a leather sheath. He hates leather. Every now and then I feel a little tapping and I look down and there's Kili batting at my sheath. Sometimes he sits down and cries as loud as he can. I don't blame him. There were times when I felt like doing that myself."

Sea of hammered gold silhouettes *Dove* near San Clemente Island off California. The same sunset streams into the cabin of *Jovencita*, at Long Beach (right), as Patti and her father, Allan Ratterree, talk by radio with Robin for the first time in the 37 days since he left the Galapagos.

EKTACHROME (ABOVE) BY DAVID L. ARNOLD; KODACHROME BY ROBERT W. MADDEN © N.G.S.

I had been one month at sea by the 23rd, and conditions were awful. Head winds still plagued me, and they were so strong I couldn't head up much. I figured I'd gone far enough out to sea, so I turned back toward the coast. There was almost a full gale blowing.

Two days later my jib halyard broke, and I had to jury-rig another one. But that afternoon—about 5 o'clock—the wind shifted a little, and I was able to head toward Los Angeles, which was northeast of me by then. I was getting there, and none too soon. The increasing cold was hard to take.

By the morning of April 27, the thirty-fifth day, I was 250 miles in a direct line from Long Beach, the part of the Los Angeles port system I was bound for. And I could sail that direct line if the wind I had would hold.

THE LIGHTS OF HOME! *As dawn breaks over Long Beach, California, Robin charts his course into the harbor. Against the chill of this spring morning—the temperature is 40° F.—Robin wears slicker and stocking cap. For the last time he photographs himself on the deck of Dove.*

 EKTACHROME © N.G.S.

So near, yet so far. Until Robin clears customs at Long Beach, no one can board *Dove;* however, Patti manages to reach across the rail of her father's boat and hand her husband a celebration breakfast of melon, cottage cheese, sweet roll, and champagne. Robin downed it with gusto, then lowered his sails and motored toward the dock.

Happiest landfall: Tired but tanned and fit, Robin answers questions from newspaper, radio, and TV representatives at Long Beach. So numerous were the relatives, friends, and reporters at the homecoming that the floating dock almost sank.

The question most often asked Robin: "What's the first thing you plan to do?" The quick reply: "Take a long hot bath." What was the worst part of the trip? "I guess, off South Africa," he said, "but that was really the best part, too. That's where we got married."

In a joyous reunion at dockside Robin embraces his mother. Mrs. Graham had not seen her son since 1968, when she flew to Barbados for a brief visit with Robin and Patti.

It did hold, but it got close to gale force. I pushed the boat hard, something I rarely do. I could see the glow of L.A. in the sky the next night, the 28th, a little more than 100 miles away.

Next day, my thirty-seventh at sea, I passed San Clemente Island. The idea of getting home began at last to seem real.

It's hard to put my feelings about homecoming into words. My thoughts weren't organized, and I was exhausted. I hadn't made a lot of precise plans. You can't plan dreams, and until now getting back had felt like a dream.

Home tomorrow! I began to feel warm, even though the air wasn't. I took a bath, and shaved for the first time since the Galapagos.

I spoke to the recorder when I could:

"O.K.! Boy! I'm off Pyramid Head . . . Now here's Santa Catalina, good old romantic Catalina . . . The moon rose at two o'clock, red and beautiful. It looked like the moon the cow jumped over . . . I can see the lights of the Los Angeles breakwaters. The wind is gentle now.

"California sure stinks! I'm getting a raw smell off shore, like concrete. Also a pungent smell, very terrible.

"My provisions and supplies made it, just by a hair, with nothing to spare. Same for my endurance. Thirty-eight days! Boy!"

There was so much I wanted to say and didn't. And couldn't. I changed into clean clothes and gave the cats a treat, the last can of boned chicken.

About 7 a.m. on April 30, 1970, I sailed in

through the Los Angeles breakwaters. What lay beyond those waterfront lights was a world I'd hardly known and half forgotten. I'd left that world 1,739 days before, heading out into the open ocean with little money, few supplies, and no firm plans except to keep going. I'd wandered westward, stopping to see new places and people, working when I could, living as best I could off the lands and seas I visited. I'd traveled 30,600 nautical miles, and now my story was coming to an end; I was back where I started.

At 6 o'clock I heard Al Ratterree on the radio, saying he saw me. Next thing I knew he was pulling alongside me with Patti aboard, and our relatives, and half a dozen friends. They couldn't come aboard—no one could until I'd cleared customs. But Patti passed me a melon, some cottage cheese, a sweet roll, and a bottle of "instant tolerance"—in this case, champagne (page 542).

They headed back, to wait for me at the dock. I followed, passing the sailboats of the annual Ensenada Race coming out. Some of the racers waved and hollered, "Welcome home, Robin." I guess a lot of boat radios were monitoring my calls that morning.

EKTACHROME (ABOVE) BY LYLE G. GRAHAM, KODACHROME BY DAVID L. ARNOLD © N.G.S.

A boy sets out; a man returns. Starting his globe-girdling voyage at 16, an excited Robin Graham steps aboard little *Dove* (above) at Los Angeles. Five years older and an inch taller, the smiling skipper relaxes at Long Beach (right). Military draft permitting, Robin plans to enroll at Stanford University in his native California, already having behind him the educational experience of a lifetime.

When I did get to the dock, I was just as glad that customs law kept everyone off. There were dozens of newsmen there, enough to sink *Dove* (preceding pages). Besides, she was a mess inside.

They had a lot of questions, and I didn't have many answers. All my feelings about the ending of my journey, finishing this last leg, getting home safe—all of them just added up to one big sigh of relief.

I found, almost to my surprise, that I remembered the look and feel of things ashore.

The American voices were strange, but the questions were familiar. I'd heard them across the world:

"What made you do it?"

I'm not sure. There were several little reasons (such as liking to cruise and not liking school), but no big one. I think fate started me, and kept me going, and brought me home. I don't know how else to explain it.

"Would you do it again?"

Well, of course not. Why do it again when you've done it once?

"What are you going to do now?"

I don't know yet. Get some more schooling, probably. But Patti and I know this much: Before too long we'll build a little place for ourselves a long way from any city. Not to hide from the civilized world but to enjoy the natural one. We've been closer to nature than most young people, and we love it.

Whatever we might do, wherever we might go, I had memories enough for a lifetime. Some of them were awful, like being nearly run down at night by a ship at sea. But there were others less frightening and more valuable: memories of cheerful, goodhearted people, living in simple societies where a man's kindness counted for more than his rank or riches.

Seeing a lot of different people, and the different things they valued, had probably made me more tolerant than I might have been. Being alone at sea had changed me, too, making me more aware of my own strengths and weaknesses. Probably there are other changes in me, but I can't measure them.

The journey had been an adventure all the way, even when it was an adventure in loneliness. Now it was over, and a new one was beginning.

THE END

ORISSA
Past and Promise

By BART McDOWELL

Photographs by JAMES P. BLAIR

Both National Geographic Staff

in an Indian State

THE TIGRESS LISTENED. In the darkness she heard the big male tiger call. Carefully she made her way through tropical thornbush, over the mud of irrigated rice fields, past the thatch of farmers' houses and the wary barking of their dogs.

Now, close enough to hear the breathing of the male, she leapt a fence, paused, then sprang again.

Only then did she see her error: Bars still separated her from the male—and a wall of wet concrete now stood between her and freedom.

Clawing the concrete, she left enduring scars half an inch deep, and thus she carved her record: the only wild tigress in the world who has successfully broken into a zoo.

Her name now is Kanan and her home—since that night in 1967—is the new zoo of Bhubaneswar, capital of India's State of Orissa. If Kanan herself represents a rarity, so must her surroundings—a region advanced enough to boast a new concrete-moated zoo and sufficiently undeveloped to stock it.

Change Comes to India's "Wild East"

To me, Kanan herself symbolizes her homeland, for Orissa is also wildly beautiful; and Orissa, too, has leapt suddenly—sometimes with claws bared—toward domestication.

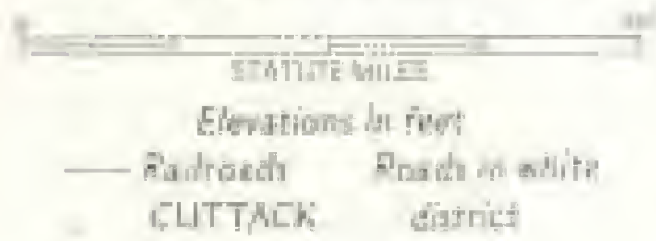
"Orissa?" Indian friends remarked before my visit. "That's the *primitive* part of India. So many tribals live there." The tribals, as India calls her aborigines, comprise nearly a fourth of Orissa's 20 million people.

"Our Wild West lies in the east," one Indian laughed (map, next page). The Eastern Ghats of Orissa are steep, stony mountains;

Joy of learning shines from a seven-year-old's face at a school in Bhursipali, near the Hirakud Dam in northwestern Orissa. He chalks the graceful characters of Oriya, the state's mother tongue and one of 15 official languages of India, a nation proudly respectful of regional diversity.

EKTACHROME © N.G.S.

ORISSA



"**India lives in her villages,**" said Mohandas K. Gandhi, and Orissa is rural India in microcosm. Seven of every ten of the state's 20,000,000 people are rice farmers, living in 50,000 hamlets.

Past adapts to future as a peasant scatters chemical fertilizer by man's oldest tool, the hand. He feeds new rice strains that double former yields. Most farmers till scant plots that produce only enough to feed their families two meals of rice a day. To bring about an economic emergence, national planners graft industrial technology and scientific agriculture onto an ancient way of life.

though relatively small, they resemble the Rockies, and like their American counterparts, they have preserved a frontier atmosphere. Orissa has no city larger than 200,000. By the crowded standards of India, the state's 60,164 square miles (a bit larger than Florida) are actually underpopulated: 332 people per square mile, compared with about 440 for India as a whole (and 108 for Florida).

"Progress is visible in Orissa," said an Indian official in New Delhi, "because it isn't diluted among so many people."

That was one large reason I wanted to visit the state. From India over the past decade have come uncertain accounts of progress and poverty, of modern factories and hopelessly backward villages. Reports from Orissa, one of the least-developed states, have been more optimistic than most. Perhaps its progress would tell something of the future for the subcontinent as a whole.

But Orissa represents far more than a developing frontier. Some of the places held most sacred by pious Hindus are found in this land of many temples. Mohandas K. Gandhi once made a pilgrimage through the state, and Orissans claim that here the frail, great little man found curious inspiration: Orissa's poverty prompted him to shorten his own dhoti, the loincloth that was both a symbol and a uniform in his nonviolent struggle for independence.

In other ways, too, Orissa represents the very essence of the country. With the creak of a bullock cart, Orissa's rural life moves in step with Mother India. More than 80 percent of all the nation's people live in farm villages; these villagers comprise an eighth of all mankind.

Buddhism Spread in a Battle's Wake

Yet for all its typical ways, Orissa stands apart, boasting its own Aryan language —Oriya—a rich literature, a unique culture, and a regional history that once changed the course of the world. I began with that moment, driving from the Bhubaneswar airport to the ancient battlefield of Kalinga.

"The battle was near this spot," said S. M. Gani, the six-foot swart young scholar-translator who was showing me around.

I looked across the wide, flat delta of the Mahanadi, the sprawling, silt-bearing Great River of Orissa (pages 552-3). Late afternoon sun was stretching the shadows of palms across brilliant-green rice fields. "The second crop this year," said Gani. Our car crossed a bridge, and the waters flashed a reflection of sunset red—aptly, I felt. For in the third century B.C. these banks were stained by a battle notorious for its carnage. India's greatest emperor, Ashoka, had moved his armies here and conquered the kingdom of Kalinga.

As Ashoka's scribes reported, "One hundred thousand were slain there." But the horrible victory deeply troubled Ashoka. In a spirit of battlefield repentance, he embraced the Buddhist faith and sent missionaries throughout Asia, turning a regional cult into a world religion. Ashoka adopted the wheel as a symbol of his conversion, and the flag of modern India bears the same wheel that turned away from violence here 23 centuries ago.

Night-time Fast Merits Daytime Feast

Our road led on toward a barren spot called Dhauli, where gray masses of rock rise in parallel ridges. We climbed a hillock and stared at a chest-high boulder carved as the forepart of an elephant.

"The elephant, of course, was a symbol of the Buddha," said Gani. "So the Emperor Ashoka had it carved with this inscription."

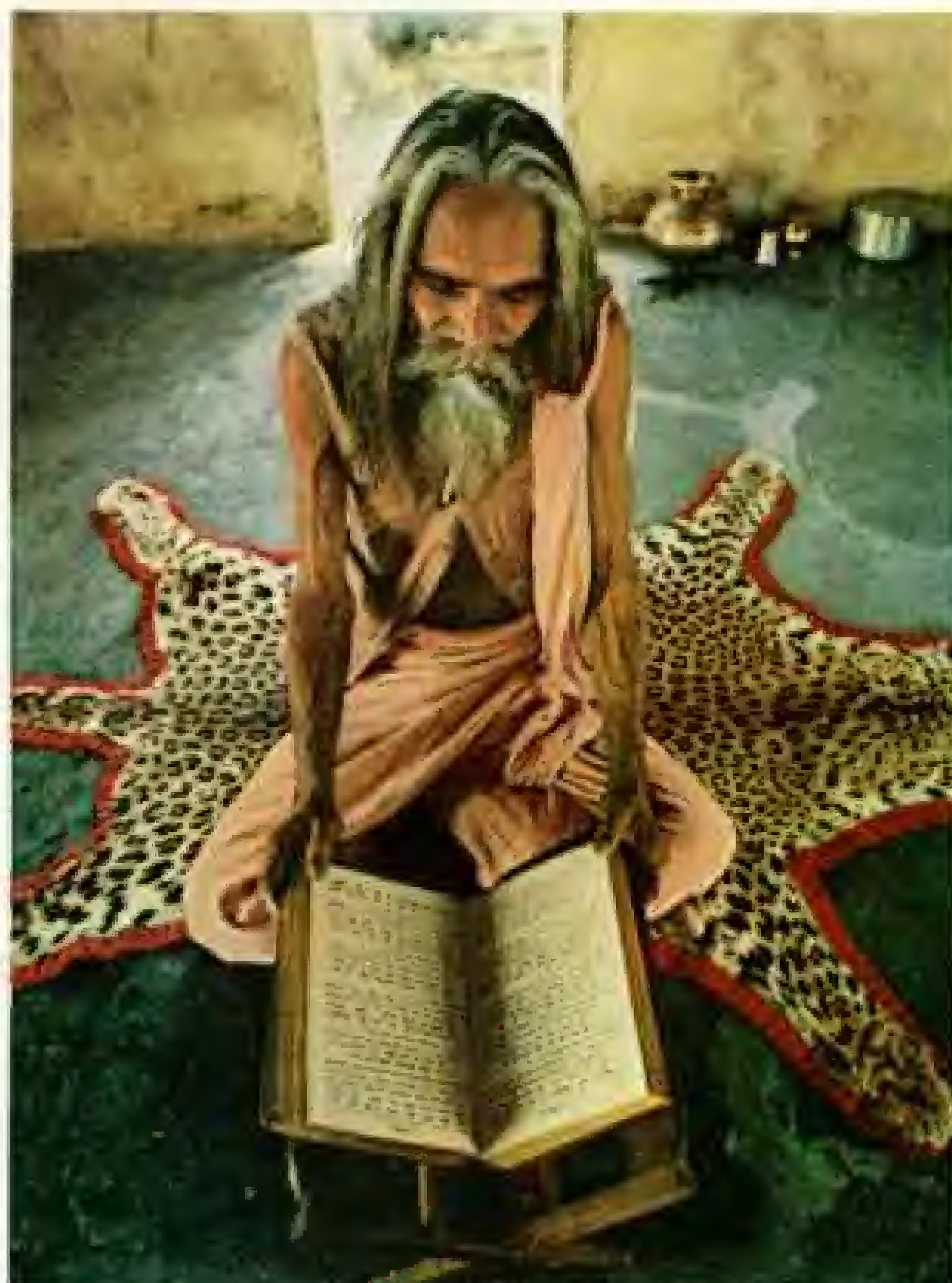
Words in the Prakrit dialect of the region shape one of the first formal documents in Orissa history: "As men are my children, as on behalf of my own children I desire . . . welfare and happiness . . . the same I desire on behalf of all men."

Below us, on a farm pond, waterfowl squabbled their way to nest. The sun slipped lower with tropical abruptness. Herdsmen gathered their cattle; bullocks pulled home their carts. In the poetic language of Oriya, sunset is called *go-dhuli*, or "cow-dust time."

As we drove back, both dust and darkness were settling; our road was choked with traffic as whole families headed toward the capital—the children scrubbed, the mothers wearing their brightest saris, the men in clean white dhotis.

"They will keep vigil all night," Gani explained. "For tonight we celebrate Shivaratri, our annual festival honoring the great god Shiva, member of the Hindu trinity and the particular patron of Bhubaneswar."

The god himself has many representations —from the fierce and awesome role of destroyer to that of joyful king among dancers. On Shivaratri—literally "Shiva's night"—



Solitary search for inner truth inspires this holy man, meditating over Hindu scriptures in a temple at Sonepur.

Mass worship during an all-night vigil lights 900-year-old Lingaraja Temple in Orissa's capital city, Bhubaneswar, during the festival of Shiva, Hindu god of destruction and renewal. Devotees pay homage by lighting lamps of ghee, or clarified butter. Bearing two torches, a priest races through the crowd—creating solid streaks in this time exposure—and climbs the tallest spire to signal the end of a fast. One of the trinity leading the Hindu pantheon, Shiva shares power with Brahma, the creator, and Vishnu, the preserver.

Behemoths in miniature, elephants march across an inch-and-a-half-high palm leaf in an 18th-century manuscript.

ORISSA STATE MUSEUM, BHUBANESWAR

families fast, keep vigil, and thus deserve great feasts the next day.

At the pace of milling pedestrians, our car eased to the side of a crowded street. As we got out, above us loomed the scalloped bulk of the Lingaraja temple tower, outlined in lights, a 900-year-old, 180-foot-high stone masterpiece (preceding pages).

"Sorry, but non-Hindus are excluded from the temple itself," Gani remarked. "Nothing personal. I happen to be a Moslem myself, so I cannot enter either."

Instead, we climbed to the top of a nearby building, from which we could look over the temple wall into the holy courtyard. People sat on the stone pavement clustered into family groups, each sharing a *dipa*, a small candle-size lamp.

"They buy a dipa for 10 paise—little more than a penny—and in it they burn ghee—clarified butter," Gani told me. The flame-lit faces of the children—eager, excited—reminded me of that magic wish-making moment when candles burn on a birthday cake.

Now we descended into an Asian ambience of stalls and hawkers and a street glowing with a jumble of moving lights: the flickering yellow flames of dipas and the naked glare of electric bulbs hanging in streetside shops. Though the Orissan capital boasts only 50,000 people, at least 30,000 had assembled at the temple tonight. Yet the mood differed utterly from the fever of a noonday marketplace. Even the sacred cattle—physically stunted in Orissa—strolled with a gentle aimlessness. Throughout the long evening of vigil no

Throbbing artery of Orissa, the Mahanadi, or Great River, ebbs to a trickle during the dry season, December through April. Near Cuttack in the broad delta, villagers grow crops in the silt, wash clothes, and spread their laundry to dry.

one hurried; and though the people talked and smiled, few laughed. The effect was unsettling, like an underwater fantasy.

Bhubaneswar Boasts a Unique Library

Few foreign tourists see Bhubaneswar, and the city has no hotel in the Western sense. But the government maintains a pleasant tourist hostelry as well as the inexpensive guesthouse where I stayed. My room was equipped with a ceiling fan, a mosquito net over the bed, and good plumbing. The dining room presented a choice of menus—bland Western or fiery Orissan, a cuisine reminiscent of Mexico's rural cookery.

The capital itself remains a formless union of antique and new. Carefully planned for the future, with wide streets and vast distances, new neighborhoods seem oddly isolated from the old part of town. For me, the most instructive spot was the Orissa State Museum. Its statuary alone was a short course in art, archeology, and comparative religion. And its palm-leaf library was unique (page 550).

"The palm leaf explains our Oriya alphabet," said the manuscript director, Mr. N. Mishra. He showed me how scribes etched pieces of the 10-foot-long fronds of the *tal* palm. "You see how the stylus cuts into the leaf? A horizontal stroke would cut all the way through—so our Oriya script employs only rounded strokes."

Indeed, to my eyes newspapers printed in the Oriya alphabet resemble a collection of *O*'s and *Q*'s, so that a page seems to effervesce with bubbles of type.

During the June through September monsoon, the waterway swells to the horizon, becoming more than two miles wide. The Hirakud Dam (page 568) has eased the disastrous extremes of flood and drought that once plagued this region.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

New faces recall an ancient tale: Freshly painted papier-mâché masks transform laughing boys into warriors, gods, heroes, and villains—characters from the Hindu epic *Ramayana*. Sold in a handicraft shop in Puri, the masks reappear in village operas, toy boxes, and tourists' collections.

Lately, those newspapers have regularly printed headlines about India's "Green Revolution," a term used to describe an upsurge in agriculture. New varieties of seed, chemical fertilizers, and modern techniques are indeed improving the national food supply.

"The year 1967-68 was the first to show substantial gain," explained Dr. John P. Lewis, director of the U. S. Agency for International Development's mission to India. "Food-grain production rose from its previous high of 89 million tons in 1964-65 to nearly 100 million. And though the weather turned bad in 1968, production held close to 100 million tons, thanks to the new technology."

AID research men have interpreted this increase as indicating an upward trend of about 5 percent in annual food production—the first significant rise in many years.

"By the end of the 1970's we could have a success story on our hands," says the cautious Dr. Lewis. "We even see a chance that India will no longer need an aid program."

"Taichung Native One" Sires a Revolution

Orissa's progress in farming can best be seen among the emerald acres of paddy outside the city of Cuttack. Here stands the Central Rice Research Institute, where some 250 agricultural scientists and technicians grow 8,000 varieties of rice. Among those plants sprouts a strain from Taiwan called "Taichung Native One."

"That was the first of our great high-yield rices," said Dr. B. Misra, geneticist and botanist. "Now, we have introduced this 'son of Taichung.'" Dr. Misra showed me some fine grains in his palm. "It's called Padma, and it needs only 114 days to mature! So, in theory, a farmer with irrigation here could raise three crops a year. Or, with rotation, you grow rice, then potatoes, and rice again—and you could make a net profit of 5,000 rupees an acre—that's $667. Think! Yields of 4.3 tons an acre. I'm tempted to get a farm myself."

I felt the same temptation on the highway to Puri. All along our 35-mile route from the capital, we passed scenes of superb tropical cultivation, the brilliant green of paddy, the glint of ponds, the luxuriant tangle of betel vines beneath languorous coconut palms. The whole flat countryside seemed blessed.

We passed an old man praying in his rice field. "A very religious region," said Gani. "Many country people, when they approach this highway, fall down and kiss the pavement—simply because it leads to the Temple of the Lord Jagannath."

Throughout the English-speaking world

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

that famous temple in Puri is memorialized by the word that sprang from Jagannath: "juggernaut." Dark stories used to surround the Jagannath festival: That the inexorable image-laden cars moved ruthlessly through dense crowds, and that pious Hindus would fling themselves beneath the wheels to achieve a holy death.

"Accidents were blamed on religion," Gani said. "We've had no deaths at all during recent festivals."

Abruptly we entered Puri along a beachfront, turned through streets of medieval width and clutter, then emerged into the broad Bada Danda, the vast procession route, mall, and bazaar area in front of the Lion's Gate and the Sri Jagannath Temple.

Again we could not enter the temple. But I got a good view of it from a nearby monastery, the Emar Math.

We were received by the 400-year-old monastery's distinguished abbot, or Mohant

Maharaj, a massive man with shaven head and the painted perpendicular marks of Vishnu upon his brow. This teacher, or guru, wore gauzy white robes and spoke English of British excellence.

"National Geographic? Well, how is Jim Blair?" He explained to Gani, "I have a camera, and Mr. Blair is a famous photographer—he is my photographic guru."

With this promising reception, we climbed to a fourth-floor terrace and looked over the temple walls to the complex of stairs and outbuildings within the sacred confines. Workmen bustled everywhere, whitewashing the conical 200-foot tower and clambering over bamboo scaffolds to raise a new addition.

Embodiment of all the arts, say the Hindus, dancing holds an exalted place because the performer must respond to melody, drama, form, and line. Classical dance of Orissa finds a leading exponent in Shrimati Sonal Mansinha. Her angular postures and expressive glances echo the temple sculptures of the famed "Black Pagoda" at Konarak (right).

"May this car bring you happiness," wrote a seventh-century court poet of the chariot of Surya, the sun god. Expressing the vision in stone, a 13th-century king, Narasimha, designed the multistoried temple at Konarak as a celestial vehicle. It rests on twelve pairs of ten-foot wheels, such as this one beside a guardian beast. Carved medallions on the spokes reveal cavaliers hunting, musicians playing, and lovers cavorting. On the sides of the temple, today a ruin by the seaside, dancers sway and elephants march. The scholar A. K. Coomaraswamy saw in the sculptures every "desire of loveliness that binds men to the wheel of life and death."

Soon we were joined by Mr. P. Tripathy, the government-paid administrator of the temple. "Much to do," he said, as he benignly chewed his betel leaf. "Some 10,000 people work here. During festivals, we must feed masses of visitors."

Lord Jagannath, an aspect of the god Vishnu, enjoys a rich mythology. By Hindu tradition, a carpenter once fashioned three images from a miraculous log: the Lord Jagannath and his brother and sister. These are the three figures—regularly renewed by new logs during 10-to-20-year cycles—that are paraded on car platforms each summer (pages 560-61).

"This is our year to renew the images," said Mr. Tripathy. "So we shall have more pilgrims than ever. We are also renovating the temple. The new building? Ah, an extension to our kitchen—the largest kitchen in Asia. We have 650 persons to prepare food."

The Jagannath image is offered various snacks and meals each day, bathed, dressed—"some 25 separate operations," Mr. Tripathy observed. "And each operation is manned by 15 categories of priests—with distinct nontransferable duties. My work is to coordinate.

"If I am late with a meal, the deity is angry. If a nonbeliever enters the temple—or perhaps a dog—all the food is defiled. It must be buried and more food cooked—a delay of five hours. Only a month ago an

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER JAMES P. BLAIR © N.G.S.

Italian woman bribed a priest with 10 rupees to take her inside the temple. A sacrilege!"

Puri may have only 61,000 people, but for bargain-hunting tourists it ranks as the best-endowed spot in all Orissa. In the bazaar I bought for my children some engaging, bright-painted toys—superbly naive animals—a dozen for 5 cents. I found some antique brass figurines, priced only by the weight of the metal, and quantities of *patachitra*—boldly colored folk paintings from the adjoining village of Raghurajpur.

An easy 20-mile side trip from Puri stands the world-famous temple at Konarak, variously called the erotic temple or the Black Pagoda (preceding pages). The structure dominates the coastal landscape for miles.

"Konarak means the 'Sun's Corner,'" Dr. Mayadhar Mansinha told me the morning we set out. Dr. Mansinha—poet, educator, and Orissa's ranking man of letters—had brought along Mr. H. C. Das, a scholar in anthropology from Cuttack, and Mrs. Das.

Our car slipped through the feathery shade of casuarina trees and we parked beneath a banyan. Before us stood the walled temple.

"It was built to celebrate victory," said Dr. Mansinha. "In the 13th century Orissa was the only independent Hindu state on the east coast of India. King Narasimha repulsed the Moslems—and built Konarak in jubilation—the victory of the sun god Surya over the forces of darkness."

Dr. Mansinha calls the temple itself "a grand poem on life" and he hoots at "what the prudes call 'immoral.'" Erotic sculptures there are—explicit and abundant. "And you also find here the best animal carvings in India," insisted Mrs. Das.

The artist Abanindranath Tagore, nephew of famed poet Rabindranath Tagore, summarized this animal vigor of Konarak: "Stones . . . are running like frisky, spirited horses . . . fertile stones have blossomed out. . . ."

Buildings Rise Amid Paradip's Dunes

From Orissa's coastal antiquities we journeyed 65 miles northeast to see the state's coastal future at the new, still-a-building port of Paradip (map, page 548). For this part of the journey our party thinned to three: scholar-guide Gani, driver Amir, and me. We hurried, for soon the hot Orissa summer would arrive.

Most of the way we followed "the greatest highway in Orissa," as Gani called our fine two-lane road. Actually, Paradip will soon be served by a system of good roads over which trucks can bring iron ore to the new docks from mines northwest of Cuttack.

We arrived suddenly, for Paradip looms up amid empty sand dunes—four eight-story "skyscrapers" with 600 residents.

"But wait," said the chairman of the Paradip Port Trust, R. N. Mahanti. "Soon the channel will have a draft of 42 feet. We'll then be taking ships of 60,000 tons. And by the end of 1971 our railway will be complete

EKTACHROME © N.G.S.

As the wheel spins, the pot forms, shaped by a villager's skilled touch. He turns the wheel by pulling on the spokes. Many self-contained hamlets, as here in Bhursipali, have their own weavers, potters, and mustard-seed-oil pressers; a man's function is usually determined by his hereditary caste. The system gives security and direction, but hinders the rise of individual talent and diversity of expression.

to Cuttack. Then consider our position: the only port for 540 miles and even now the eighth busiest port in all India!"

Our next stop was Baripada, seat of the old kingdom of Mayurbhanj. The maharaja's palaces now serve as offices for the local government. His Highness's private zoo gapes empty; I noticed that the tiger cage now houses a small rice shop. Thus has the glamour of one of Orissa's 28 princely states faded into the present.

Poachers and Poison Threaten Tigers

Beyond Baripada we passed some brightly painted red-and-yellow huts on small garden plots. "Houses of Santal tribesmen," said Gani.

We passed more tribal villages; then we moved through the shade of *sal* trees and climbed into the steep ghats. Finally, in the town of Joshipur, we pulled up at a resthouse of the national park service.

"Welcome!" shouted a man dressed in forest green. He was Mr. Saroj Raj Choudhury, state wildlife conservation officer and our host for a tour of the 402-square-mile Similipal National Park. We set off promptly in Mr. Choudhury's India-made jeep.

A year before, I had run across a paper by Mr. Choudhury about a tiger census he had taken. ("We determined that Orissa has 326 tigers.") And so I had asked to meet him. "Of course, our tiger census represents only an estimate," he said. "But we can tell how greatly the tiger is endangered in Orissa. People deliberately poison them. And poachers shoot them even in our wildlife preserves. On the black market a tiger skin can bring hundreds of dollars."

As we drove and talked, Mr. Choudhury's eyes scanned the forest.

"There—a barking deer!" he announced with pleasure. I couldn't see the tiny beast until it dashed across the road. A moment later, he pointed out a red jungle fowl—a bird resembling a gamecock.

Mr. Choudhury, a famed marksman, uses his one rifle only against dangerous animals, and he can tally an impressive score: he has killed seven man-eating tigers, two of them on one hunt.

"Six of those tigers, I discovered, had been wounded by hunters—and left too crippled for natural hunting," he told me. "Hunger had driven them to overcome their natural fear of man. The seventh tiger had also been disabled—by porcupine quills caught in the tendons of its forepaws. A tiger's greatest weapons, you know, are its forepaws."

Once he shot a man-eater that had killed 15 men in a month. When villagers heard that Mr. Choudhury had slain the marauder, they met him with musicians and with water to wash his feet.

"One old woman approached me. Very old—no face, only wrinkles. She patted me gently and bestowed the highest compliment of her people: 'You are my father and my mother,'

Souvenir for a festival, a stylized carving of Lord Jagannath—an aspect of Vishnu—receives a painted face for his holiday (following pages). This woman is a Brahmin, the highest caste, which formalized the social structure and still produces its priests and scholars. When Jagannath's temple at Puri became a site of pilgrimage, Brahmins settled nearby to maintain the temple and feed the tens of thousands it attracts.

EKTACHROME © N.G.S.

she said. 'I am old and I had only one son. That brute killed my boy. Thank you.'"

By morning light we set out again in Mr. Choudhury's jeep, traveling among great orange-blooming flame-of-the-forest trees. Occasionally we scared up wild peacocks—turkey-size blue-breasted birds that take to wing heavily—and carry behind them improbable four-foot-long tails.

Birds Are Good Business for Kharia Tribesmen

Presently we met a group of folk from the Kharia tribe—families washing arrowroot in the river.

"Two men can gather 44 pounds in a day," clan leader Sambhu Dehuri told us. "But soon we shall catch baby myna birds. Good business."

Mr. Choudhury was delighted. "The park promotes this work," he explained. "If a myna chick is taught to speak when it still takes food from your hand, it becomes a great mimic. The tribals climb high to the nests in tree hollows and take the myna chicks very gently; they care for them well. They used to sell them to dealers, but now the park service buys them instead."

Thus Orissa exports nearly 3,000 greater hill mynas each year. Would such exports deplete the myna population?

"Not at all," said my host. "When robbed of chicks, the parent birds breed again. They can raise three clutches a year instead of one. We merely leave one clutch and take two—and the population remains constant. Mynas, you may know, rarely breed in captivity."

What did our tribal friend think of this government myna project? "I used to get only half a rupee for a chick," said Mr. Dehuri. "Now I get 15."

We journeyed abruptly from the forested wilds to the new steel city of Rourkela. As recently as the 1950's Rourkela itself sat in a wilderness, a village of only 97 poor farm families. Now, thanks to nearby deposits of iron, manganese, and dolomite, to coal mines 300 miles away, and to techniques and investments from West Germany, Rourkela is a city of more than 90,000 people producing 1.8 million tons of steel each year (pages 564-65).

"Jai Jagannath—Victory to the Lord of the Universe." Voices of tens of thousands of surging pilgrims call upon the incarnation of Vishnu during the Car Festival at Puri. Each summer images of the benevolent god, his brother, and his sister ride among men on three cars—wheeled platforms pulled by worshipers. The name of the god entered the English language as "juggernaut"—an inexorable force crushing anything in its path—when accidents and suicides were exaggerated into the idea of mass death under the unrelenting wheels.

Morning hour of worship is also the hour of work at Puri, on the Bay of Bengal (following pages). While women on the unseen shore float flower offerings, these fishermen cast their nets. Pulled in from the beach, the nets bring a silvery harvest of mackerel.

KODACHROMES (LEFT) BY HARRY MILLER AND (NEXT PAGES) BY JAMES P. BLAIR © N.G.S.

"Some people suggest we call it Ruhr-kela," Gani said. And indeed, West German credit made this little Ruhr possible: about $300,000,000 worth—West Germany's largest foreign-aid project.

Change Brings Transistors – and Trouble

Just outside the center of town stands a tribal village called Hamirpur. One of the residents is a young family man named Boniface Minj Kissan, an assistant in the construction division of the steel company, and —like half of the unskilled workers there—a tribal. Kissan now proudly shows such possessions as a bicycle, a ballpoint pen, and "the first thing I bought with my first pay packet," a transistor radio.

Swift change has brought Rourkela problems. Many laborers here were Hindu refugees from Pakistan, bitter, confused, uprooted. Their resentments came to a boil six years ago with riots directed against the Moslems in the community. Hundreds met violent death. The government of India classifies such incidents as "communal riots," and attributes 1,130 deaths to them in Orissa between 1964 and 1969.

I asked Gani about the riots. Though a Moslem, he quickly rose to the defense of the Hindus. "These were not educated people who rioted," Gani informed me. "Hindu executives took Moslems into their homes to protect them."

"One reason for the riots," said State Minister of Industry Harihar Patel, "is that our growth had not been balanced. So many crosscurrents of ideas! We had not paid enough attention to our traditions."

Down the highway only a few miles, at Rajgangpur, I encountered Indian ingenuity

of an unusual order. At the factory of Orissa Cement Limited, I saw six female elephants working as switch engines in the railroad yard (right).

"The Maharaja of Gangpur wanted to sell his elephants," said Todiram, chief of the 13 elephant drivers. "The animals had been used for his processions and for the *shikar*, or hunt. But the shunting of railroad cars is not so difficult—and to buy a switch engine one needs foreign exchange. So the cement factory bought these elephants. Would you like a ride?"

I climbed aboard a cow elephant, where I sat ten feet off the ground. "Her name is Lakshmi," Todiram said in reassurance, for my mount was named for the goddess of good luck. I tried to grip with my knees, but Lakshmi had an unhorselike width.

"That one"—Todiram pointed—"is 25

EKTACHROME (LEFT) AND KODACHROME BY JAMES P. BLAIR © N.G.S.

Maharaja's mount turns work horse at Orissa Cement Ltd., in Rajgangpur. When a local prince closed his stable of processional and hunting elephants, the factory purchased some, finding them "better than switch engines." An elephant can push three loaded freight cars and throw track switches with its trunk.

Feeding flames that nourish economic growth, a steelworker stokes an open-hearth furnace at government-owned Hindustan Steel Ltd., in Rourkela. India's lack of capital and trained manpower slows development of vast resources, including an estimated quarter of the world's iron reserves. But help comes to the nation. In the late 1950's West Germany built one of the world's most up-to-date steel plants here.

years old. She cost 6,000 rupees—$800."

And how much would she eat in a day? "Forty-four pounds of grain with salt and many leaves." And why did the cement factory insist on nothing but career-girl elephants? "Because of tusks—males have long tusks that would break on the cars. Males work with timber, where tusks are needed. These may be the only working females."

Lakshmi knelt, and I dismounted, then watched as Todiram fastened a pad to her forehead. With her brow Lakshmi pushed a freight car against another. Coupled, both cars rumbled down the tracks.

"They can push three loaded cars at once," explained Todiram. "Or seven empties." He shouted a command, and the elephant reached down with her trunk to switch the rails. Proudly Todiram made his point. "A locomotive would need an extra man to dismount and switch rails." Lakshmi represented a clear economic gain: conserved foreign exchange—and, look, no hands.

By moonlit night, we drove on toward Hirakud Dam, past dry fields and silhouetted palms. I remembered photographs I had seen of the dam construction in the 1950's—cluttered bamboo scaffolds, hordes of Indian laborers carrying tools and materials to the top. The scene recalled all mankind's timeless building of temples and pyramids.

"I was one of the 45,000 people who helped build Hirakud," engineer S. M. Sahukar told me. "People fainted from the heat, especially in the quarries. I worked there from 1949 until 1961. You see, Hirakud was India's first major development project as a free nation. This was our training school for all the other projects. Once the scaffolding collapsed. Terrible! In all, 129 people died in the construction." But from such sweat and struggle came an august monument to nationhood.

Thousands Prosper on Hirakud's Bounty

I had my first view of the dam and its magnificent lake shortly after sunrise. Hirakud stands 200 feet high and three miles across. Behind it sprawls a giant blue lake of 288 square miles (page 568). And downstream flows the harnessed Mahanadi, the Great River, regimented with canals for the crops of 300,000 thirsty acres (pages 552-3).

Several thousand farmers in this immediate area can tell personal success stories about water and crops. Yet only a few miles farther on, just beyond the reach of the irrigation canals, I saw stark misery—a reminder of old India's vast need. In search of hand-loomed raw silk at the craft center of Barpali, I visited a family of weavers in their thatched,

KODACHROME © N.G.S.

Stark struggle to survive: 40-year-old Kalsama Pradham plows his dry, rocky half-acre while his daughter baby-sits. Recurrent drought severely affects his district, so he must depend on occasional road work to maintain his family of five. Until irrigation programs get under way, such poverty will continue to be commonplace in this central Orissan area.

dark home. Solemn, thin children—some of them toddlers—were tying skeins of yarn in a frenzy of effort. One youngster seemed to be seriously ill, but still he worked. Adults, bony and waxen, kept their looms clacking noisily in the dim light.

"India has been independent for more than 20 years," said B. S. Pradhan, secretary of the weavers' cooperative that the Society of Friends established here. Then, more in wonder than in bitterness, he added, "And still we have not solved the problem of food."

Fortunately Barpali weavers are not typical of Orissa in a year of good weather. Just down our highway, in fact, prosperity had arrived at Bolangir with a new railroad spur.

"We have new rice mills now," said Rajendra Kumar Sahu, assistant district magistrate, "and our forests yield bamboo and teak. Since 1961 the population has increased from 18,000 to about 30,000."

In another way Bolangir has also won fame. The town was the seat of a princely state ruled by a popular maharaja, His Highness R. N. Singh Deo. With Indian independence and the abolition of princely states, the maharaja left behind his royal status, entered politics, and in 1967 became Chief Minister of Orissa—the first maharaja in India to attain that republican rank.

He is a lean, tall man with a strong face and a distinct serenity—a kind of Asian Abe Lincoln. Even on the hot day we met, he seemed cool—no mean feat, I felt, since he was just finishing work on his state budget.

Indian Democracy Comes Full Circle

We talked about new ports and factories, then I made some personal inquiries. On his car he did not use the red license plates that remain a maharaja's due.

"Those things are like our titles—part of the past," he said, smiling as though embarrassed by pomp. But I also asked about his coronation as a youthful maharaja in 1933.

"We call the ceremony *rajya abhishek*," he explained. "Like all coronations, it had a religious and historic meaning. The leaders of the princely state sat around a special sort of seat or throne. I circled round that seat—and asked permission to ascend.

"That gesture was a vestige or a symbol of the old democratic form of our government—from the days when maharajas were elected by their people. Later the office became hereditary. But you see, I have come full circle to democratic elections again." He smiled benignly, and to me, young India seemed more mature.

Our road next led us through dry, stony backlands, and as the country grew wilder, road signs in minor-key English exhorted us toward caution: "Ghat Begins, Drive Carefully" . . . "Do Not Halt at Corners" . . . "Safety First, Speed Next."

"Bonda Feasts End in Murder"

We were approaching the Bonda Hills in Orissa's far south (map, page 548). Everyone had warned me about the Bonda tribes. "The Bondas are extremely aggressive," read an official publication of the Tribal Research Bureau. "Bonda feasts end in murder . . . they occasionally raid the villages of outsiders. . . ."

British-born anthropologist Verrier Elwin once wrote that the Bondas "are regarded as entirely savage, almost the classic savage type," and he especially noted the shaved heads of the women and "the passionate and homicidal temper of the men." In 1943 Elwin had visited the village of Mundlapada—the same place we were headed for now. Elwin had later written a paper about his visit for the British *Geographical Magazine* titled "My Worst Journey." But soon I learned how much times have changed.

Gani swiftly won us full help from local officialdom. We would go up with two agriculture workers, climbing the trail called the Wall of the Jungle.

While our party gathered, I waited inside a thatched kiosklike store and talked with a young man. He was Budradanda Majhi, a Bonda who had become the teacher of the village school. I asked his age.

"About 16, I guess," said Budradanda. He proudly carried a fountain pen like a scepter. Was he married? "Yes, last year I took a girl of equal age."

"Unusual," said Gani. "Bonda boys of 10 or 12 usually marry girls 15 to 18. The bride works for the boy's parents about six years—then goes to live with her husband."

Four other Bonda men came up, resplendent with aluminum bracelets, yellow beads, brass earrings, and loincloths. One wore a cigar behind his ear.

"They are good fellows," the shopkeeper confided. "Except for the one vice of drink."

(Continued on page 575)

KODACHROMES © N.G.S.

Controlled water brings power and plenty

SINCE 1956 Hirakud Dam has harnessed the Mahanadi River to create one of India's largest man-made lakes, a 288-square-mile reservoir. "We moved a mountain and put it across a river," said an engineer of the Indian labor that built the three-mile-long earth, masonry, and concrete dam and its power station.

A few Oriyas doubted; they believed that, even on irrigated land, crops could not grow twice in the same year and that removing electricity from water would leave it impotent. Agricultural information officer K. C. Mohapatra (left) helped villagers to understand. At town councils, a centuries-old institution, he explained how to use chemical fertilizers, irrigation canals, and improved rice seed. Now rice, like the IR-8 strain opposite, produces three crops a year in Sambalpur District, helping to boost Orissa's agricultural income, still among the lowest in India.

[illegible] © NATIONAL GEOGRAPHIC SOCIETY

ସୁଖୀ ପରିବାର

Dispensing ideas with pills, a Public Health Service nurse at Katarbaga holds the child of a pregnant visitor as she counsels on birth control and gives out free calcium. Poster suggests that planned families are happy families.

To improve the quality of life, government planners, with the help of such organizations as the Ford Foundation and AID, supplement agricultural programs with community development: coeducational schools, adult literacy classes, health facilities, cooperatives, and improved water supplies.

KODACHROMES (ABOVE AND FOLLOWING PAGES) AND EKTACHROMES © N.G.S.

Antique art of tie-and-dye weaving lives on in the village of Bargarh. A craftswoman wraps strings around bundles of thread to keep measured lengths free of color during dying. Weavers then fashion the strands into saris like hers, with Orissa's traditional fish-and-lotus pattern. Development programs encourage artisans to form cooperatives and reach wider markets.

Voice of progress, the Radio Rural Forum answers questions submitted by this farm organization of Talpadar. On a temple porch, a secretary records the information. Swedish farmers donated the radio; wall signs advise the use of good seeds at the right time.

Golden garment of rice spreads across Mahanadi delta (following pages). Farmers store the straw in hutlike stacks, foreground, for use as thatch and rope. Orissa dreams of a green revolution in its arid west—one as bountiful as this in the well-watered east. ▶

A people apart: the Bondas

A DRUM PULSES, and Bonda tribespeople step off a spontaneous dance, expressing their pleasure at the arrival of photographer James Blair in their village. To such aboriginal tribespeople, dancing skill is a prerequisite for wooing a mate, propitiating nature gods, and participating in festivals.

Formerly hunters, the Bondas now till terraces of paddy in hilly Koraput District. They sell plantains and jackfruits to buy the aluminum necklaces and beads so prized by their shaven-headed women (right).

In Orissa nearly five million people, a quarter of the state's population, belong to 62 such tribal groups, each with distinctive customs and dialect. But cultural values change and fade as tribes gradually join 20th-century India.

EKTACHROMES BY JAMES P. BLAIR © N.G.S.

The men bought salt and dried fish, and we talked a bit about the grass they were selling for thatch. At last Gani turned to me with a smile. "You have succeeded socially," he said. "When we get to the highlands our Bonda friends have offered you a dinner of their greatest delicacy."

I was pleased, but prudent. What was the delicacy?

"Fattened rat," said Gani.

The eight-mile climb was rocky and steep—some 3,800 feet up—and we were grateful for sunset. Then, until the moon came out, we frugally shared our flashlights.

We arrived at Mundlapada too late and too tired to do anything more than spread our bedding and sleep. I did not wake until dawn. Then sleep left me in one rush of adrenalin. I opened my eyes to see a tribal woman with a shaved head staring down at me. Her neck was ringed with a stack of metal loops (above), and two children stood cautiously beside her, also staring. I bolted upright—and my audience skittered away.

Gani laughed, "She thought you more peculiar than you thought her."

Later that morning we wandered through the thatched village. One woman was skillfully shaving the head of her neighbor. Another wove cloth on a mini-loom. Others pounded rice and cooked over fires.

Sap in the Morning, Wine by Night

I inquired about the Bonda name for the women's bangle-like necklaces. Gani asked our agriculture expert Narayan Panigrahi to translate, but he also needed help. I then realized just how far away from the interview I was—my translator's translator now needed a translator.

The liquor so loved by the Bondas comes from a palm they call salap. Each man has tapping rights to at least one tree. And the juice, drawn in the morning before the men go to the fields, ferments during the day so that each night a man has enough salap wine

"The beauty of the goddess Earth mortal eyes cannot see in its fulness," says the *Ramayana.*

to make him drunk. Most Bonda murders start with quarrels over salaps. I asked about these palms.

"There—beyond the village—see the grove?" said Mr. Panigrahi. "You must taste the sap." Therewith, he sent a man shinnying up 100 feet to fetch a small metal vessel of sap. I hesitated. What if the jealous owner should return? "No, the palm belongs to this man," said Mr. Panigrahi.

I tasted the sap—frothy and lightly sour, but the fermenting was only half done. Which reminded me: mealtime was approaching—and perhaps that "greatest delicacy."

"This drink is one for the road," I said. "We really must be going." And so, like mad dogs and Englishmen, we climbed down from the Bonda highlands in the noonday sun.

I felt lucky to have seen the Bondas when I did. Within a decade their lives may well be utterly changed, for only about 18 miles away the Indian Government is starting the ambitious Balimela Dam on the Sileru River. One day soon these remote spots will

KODACHROME BY JAMES P. BLAIR © NATIONAL GEOGRAPHIC SOCIETY

These fishermen at dawn are favored with glimpses of nature's majesty on Chilka Lake.

seem as modern as Rourkela and Hirakud.

Even today, only 70 miles from those Bonda Hills, we passed the bulky buildings of Orissa's MIG factory near Koraput. As a foreigner, I was not permitted inside, but Gani explained that the Russian-built plant turned out engines for India's MIG fighter planes.

Beyond Koraput, the landscape opened up like the Wild West, with dry space and random boulders as we moved again toward the coast. At Gopalpur we stopped at a luxurious little beachside hotel where salty whitecaps scoured off our dust. Then we drove on, past Chilka Lake, toward Bhubaneswar.

Broad drops now began to spank our windshield, and gusts of wind whipped the coconut palms. Naked children erupted from houses to frolic in the shower. Even old people, watching from doorways, seemed suddenly happy.

"You finish your Orissa travels," said Gani, "and the rain falls—like a blessing upon your work." And upon the hopeful, sacred soil of Orissa itself.

THE END

ON SUNDAY AFTERNOONS from May through October, history does an about-face 75 miles north of Manhattan at Rhinebeck, New York. As spectators at the Old Rhinebeck Aerodrome squint up and gape, knights of the air spur a stableful of antique steeds through the sky's blue pastures—resurrecting aviation's early years.

Visitors who arrive while morning fog still clings to the Hudson River Valley can watch the parked aircraft slowly disengage their tracery of wings, wires, and struts from the dissolving mists. Faded signs halfheartedly caution, "Don't touch the planes." But few can resist the temptation to stroke the varnished hardwood propeller of a 1918 Spad XIII or to tap the taut Irish-linen skin of a Curtiss "Jenny" and listen to the drumlike sound within its hollow fuselage.

As the last fog burns off, a Prussian band

World War I Aircraft Fly Again in Rhinebeck's Rickety Rendezvous

By HARVEY ARDEN
National Geographic Staff

Photographs by
HOWARD SOCHUREK

Latter-day barnstormer, Cole Palen turns back the clock to the World War I era of Rickenbacker and von Richthofen. His Old Rhinebeck Aerodrome in New York's Hudson River Valley features skyborne spectacles of history, nostalgia, and madcap showmanship. Charcoal dust, used to simulate smoke during dogfights, smudges his face. Flying a Fokker triplane (left), he leads a Sopwith Pup on a merry sky chase.

materializes and fills the apple-crisp air with oompah music. Men in World War I uniforms scurry about the planes, snapping recalcitrant propellers until the half-century-old flying machines wheeze into life. The smell of castor oil—the lubricant used in old-style rotary engines—hangs in the breeze.

Now onto the runway strides Cole Palen, creator of this anachronistic sight. A World

(Continued on page 586)

"To the past!"

Vintage airplane buffs in World War I uniforms raise a spirited toast to the era re-created at the Old Rhinebeck Aerodrome.

Mustachioed Dave Fox in a German cavalryman's uniform wears a reproduction of Prussia's highest decoration for military bravery, the Order for Merit, established in 1740 by Frederick the Great.

Other men and uniforms from left: Dick King as a British Royal Flying Corps officer; Bill Dion as a German noncommissioned officer, and Bob Love in a United States

Army officer's uniform once worn by America's "Ace of Aces," Capt. Eddie Rickenbacker.

Above, a 1918 U. S. Curtiss JN-4H skims past a blur of trees. The "Jenny," as the two-seat trainer was affectionately known, gave many an American pilot his first taste of the sky. After the war, Jennys did yeoman service as mail carriers and barnstormers. Charles Lindbergh polished his flying skills in one before his epic solo trans-Atlantic flight of 1927.

Wings of a 1916 British Sopwith Pup (right), built from original plans by Palen's flying cohort Dick King, frame a 1909 Renault automobile jouncing along the aerodrome's runway. Also in view: a 1917 Fokker DR-1 triplane and a yellow-checkered Canadian "Fleet," a biplane trainer of the 1930's.

EKTACHROMES AND KODACHROME (FAR LEFT) BY HOWARD SOCHUREK © N.G.S.

End of an enemy

Red banderole fluttering in the slipstream of his Fokker triplane, Palen takes aim (right) behind twin Spandau machine guns, synchronized to shoot between propeller blades. Such weapons gave the Germans, who first used them, an advantage aloft until the Allies developed similar arms.

At the Old Rhinebeck Aerodrome, however, the Germans never win. In dogfights with Allied planes they invariably nose dive to ignominious defeat behind a convenient hill.

At the bottom of the sky (opposite), Palen climbs out of the Fokker, which has been "fetched up"—tilted by hand to mimic a crash. It was in a similar three-winger, painted blood red, that Germany's fearsome ace Manfred von Richthofen, the "Red Baron," was shot to his death in 1918 after a record 80 kills.

[illegible] © NATIONAL GEOGRAPHIC SOCIETY

Acting the part of a World War I nurse, Judy Myers of Rhinebeck (below) jumps from a 1917 Maxwell ambulance. In the foreground: a De Havilland Tiger Moth.

Blériot gets a push

Fledgling World War I fliers often learned their trade in contraptions like this monoplane. Its designer, Frenchman Louis Blériot, piloted a prototype in the first heavier-than-air flight across the English Channel in 1909. His feat made the plane famous, and it became one of the first mass-produced aircraft in history. Mr. Palen reconstructed this one from the remains of an original that crashed sixty years ago during an air meet at Saugus, Massachusetts.

KODACHROME (LEFT) AND EKTACHROMES © N.G.S.

Captain Rickenbacker favored the French Spad XIII, a mainstay in the Allied air effort during the closing months of combat. Bill Dion, an authority on military costumes, slips into the cockpit of one (above right), posing as a member of the Lafayette Escadrille—the French-commanded squadron of American fliers who faced Germany's aces before the United States entered the war.

Allied pilots considered the cramped cockpit of the Sopwith Pup (lower right) a minor drawback when compared with the easy maneuverability of this British-made fighter. Leather bumper on the machine gun's butt cushioned the pilot against head-smashing jolts, an ordinary pocket watch on the panel told him when his two-hours' flying time had expired, thus providing a double check on the often unreliable gas gauge. The Pup earned lasting fame in 1917 as the first plane to land on the deck of a moving ship.

Spectral squadron of fighter planes rides a sky of molten gold: from left, a 1916 British

(Continued from page 579)

War II infantryman, he took to the skies as a civilian, and in 1951 staked his savings and dreams on the remains of six vintage planes moldering at a Long Island airport. Rebuilding some, cannibalizing others, scouring old barns and attics for parts, he built up a fleet of some two dozen originals and reproductions. Twelve years ago he bought an abandoned farm, hacked out a runway, and began putting on air shows. Today his Old Rhinebeck Aerodrome is a lodestone for silver-haired veterans of the Great War as well as for a new generation of vintage-plane buffs.

Palen has flown nearly all his antiquities. "Surely not that one?" inquires a visitor, pointing to a 1912 Thomas Pusher. "Oh, sure," says Palen. "She flies. Propeller's in the rear so there's nothing in front of you but sky. It's like riding on the edge of a diving board at 40 miles an hour. Great!"

Buckling his chin strap, he clambers into a Fokker triplane. This crimson three-winger is a reproduction of one flown by Manfred von

Sopwith Pup; a 1918 German Fokker D-VII biplane, and a 1917 German Fokker DR-1 triplane.

Richthofen, Germany's "Red Baron"—today also noted as the archetypal foe of Snoopy the dog in Charles Schulz's comic strip, "Peanuts." Two men hang onto each side of the bottom wing as Palen revs the engine. At a signal, they scatter. The red bird lurches down the runway, bumps along uncertainly, then with a mighty wobble lifts into the blue. Every spine in the crowd feels a tingle as the plane clears a line of trees and soars free.

Moments later, a British Sopwith Pup follows the Fokker skyward (pages 578-9). After several passes a dogfight begins. Machine guns flash and crackle with simulated fire. Blue and orange puffs of ack-ack—actually fireworks—blossom with ear-numbing impact. At last the Pup maneuvers tenaciously onto the foe's tail. Rat-a-tat-tat. The Fokker sprouts a long plume of black smoke—charcoal dust in reality—which it drags out of sight in a dying swoon beyond nearby hills. Triumphant, the Pup buzzes the applauding crowd.

Cries a young voice with unrestrained delight, "Hooray for Snoopy!" THE END

"THE BIRTH OF VENUS," BY SANDRO BOTTICELLI, IN THE UFFIZI GALLERY, FLORENCE; SCALA

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In the newest volume of its Story of Man Library, National Geographic portrays a surging age that enriched the world with glorious art, expanded frontiers of the mind, and celebrated the dignity of humankind.

By FRANC SHOR
Associate Editor

MORE THAN twenty years ago in Venice, I held in my hands a fragment of history—the will of Marco Polo. Studying that faded parchment, I reached across seven centuries to the traveler who made the Orient's wonders known to the West.

For nearly a year I would toil across the snowy passes and burning deserts of Asia tracing Marco's route from Venice to Peking. And though I brought back no glittering hoard of gems sewn in the hem of my garments, as he did from Cathay, I returned with profound respect for the bold merchants who followed Marco Polo, to broaden and enrich the dawning Renaissance world.

Galleys brought home China's silks and the spices of the Indies. The pulse of trade quickened. In Venice, Florence, Milan—even on the distant Seine and Thames—new riches gave rulers the freedom to do something extravagant purely for the sake of beauty, or knowledge, or a dazzling life-style.

The explosion of creative energy that transformed the world of the 15th and 16th centuries illumines the Society's new 402-page richly illustrated book, *The Renaissance: Maker of Modern Man*. This grand tour, put together by a team of scholars under the guidance of Professor Kenneth M. Setton of the Institute for Advanced Study in Princeton, New Jersey, portrays a pivotal age that

Princely patron of the arts, Federigo da Montefeltro, Duke of Urbino, ruled a court renowned throughout Renaissance Italy as a center of culture. Here he reads to his richly dressed son.

PALAZZO DUCALE, URBINO

Sun-bronzed gondolas are among the 400 that ply the waterways of Venice. During the Renaissance, when Venetians built an empire of trade that lavishly fostered the arts, 10,000 of the craft swarmed in the port.

WILLIAM ALBERT ALLARD © N.G.S.

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Birth of a New Age

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The World of Leonardo da Vinci

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Men and Cities of the Reformation

The Golden Spain of Cervantes

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THE PONTE VECCHIO, FLORENCE, ITALY
JONATHAN S. BLAIR

WINDMILLS OF LA MANCHA, SPAIN
[illegible]

WITTENBERG CASTLE CHURCH, EAST GERMANY
GORDON W. GAHAN

revolutionized learning with the printing press and warfare with gunpowder; that revitalized antiquity and discovered continents. Above all, in the lives lived to the fullest by its remarkable men and women, the Renaissance revealed the West's cultural capabilities.

Take Federigo da Montefeltro, Duke of Urbino. As famed for humanity and honor as for his military prowess—the Venetians offered him 80,000 ducats (roughly $1,000,000) to stay at home and *not* fight them—he converted a grim fortress on a spur of the Apennines into a graceful palace that became a major center of Renaissance civilization.

Here Federigo set out to create the finest library in Europe. Princes sent their sons to study at Urbino's court, which gave to the world the painter Raphael, the architect Bramante, and the diplomat Castiglione.

Federigo is always portrayed in left profile—he lost his right eye in a tournament (page 589). Yet "this captain of ours with his single eye sees everything," observed Pius II, humanist, diplomat, autobiographer—one of the Popes whose princely realm we explore.

We see dynamic Julius II don armor to recover papal domains, see him harness the formidable talents of Michelangelo, Raphael, and Bramante to glorify the Eternal City.

A Wise Man's Counsel Ages Well

We meet the Borgias—the extravagant Pope who took the name of Alexander the Great, his daughter Lucrezia, and the son he named for Julius Caesar. In Cesare's retinue ride Leonardo da Vinci and a Florentine diplomat whose name will become a synonym for political duplicity—Machiavelli.

We gain unforgettable insights into Cosimo de' Medici, banker, patron and friend of artists and scholars, and his grandson Lorenzo the Magnificent, consummate politician with the

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This authoritative 402-page volume contains more than 400 color illustrations—present-day scenes, superb reproductions of art masterpieces, informative maps, including a 23-by-33-inch map of Italy. It will make learning a pleasure for every member of your family.

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Genius of a golden era, Leonardo da Vinci epitomized the Renaissance man, excelling as artist and architect, scientist and mathematician. A prolific inventor, he designed numerous flying machines, including a spring-driven helicopter propelled by an aerial screw (above). When he died in 1519, seven years after this chalk self-portrait, he left thousands of priceless notes and drawings. Most of them lay unpublished for three centuries.

face of a prize fighter and the soul of a poet. They made Florence an Athens on the Arno.

Other pages and pictures evoke the tumultuous days when French kings reached out to share the glory of the Italian cultural explosion. We meet the men of the Reformation—fiery Luther, severe Calvin, and witty Erasmus whose counsels of tolerance and rationality bear a cogent message for today.

Cervantes. How many of us know the man behind *Don Quixote*, that masterwork of Spain's golden age? We follow Cervantes as he fights the Turks, languishes in an Algiers prison, collects taxes to finance Philip's "Invincible Armada" against England.

Entire Sistine Ceiling Pictured

The England of Elizabeth. What a Renaissance queen she was! Artful in diplomacy, ardent in the hunt, agile in dancing a high-leaping lavolta. And brave. "I have the body but of a weak and feeble woman," she told her troops gathered to repel invasion, "but I have the heart and stomach of a king. . . ."

Elizabeth's realm lives again in these pages, as does the Verona of Romeo and Juliet, and other Renaissance cities that enthralled Shakespeare and his Elizabethan audiences.

The book, a worthy companion to such earlier volumes in the Society's Story of Man Library as *Greece and Rome: Builders of Our World* and *The Age of Chivalry*, brings into your home Michelangelo's entire Sistine Chapel ceiling in an 8-page foldout. And it presents the men behind such masterworks, describing their personalities and contributions.

No one man can raise the average of men's intelligence, but one can raise its zenith. Such a man was Leonardo da Vinci, artist, scientist, inventor, incarnation of the Renaissance dream of a universal man. We follow his footsteps from boyhood in Vinci to his last days on the Loire, show the full range of his art—including the inventive sketches, some of them depicting machines meant to carry man aloft (above).

Leonardo was not alone in his fascination with flight. Nearly 500 years before the voyage of Apollo 11, the poet Ariosto in his Renaissance best seller *Orlando Furioso* described a fiery flight to the moon and the distant view of "Earth's circling seas and land."

In 1492 a Genoese navigator sailed westward across those "circling seas," seeking a strange country described in a well-worn book of travels he prized and annotated. Thus did Marco Polo come with Columbus to the New World.

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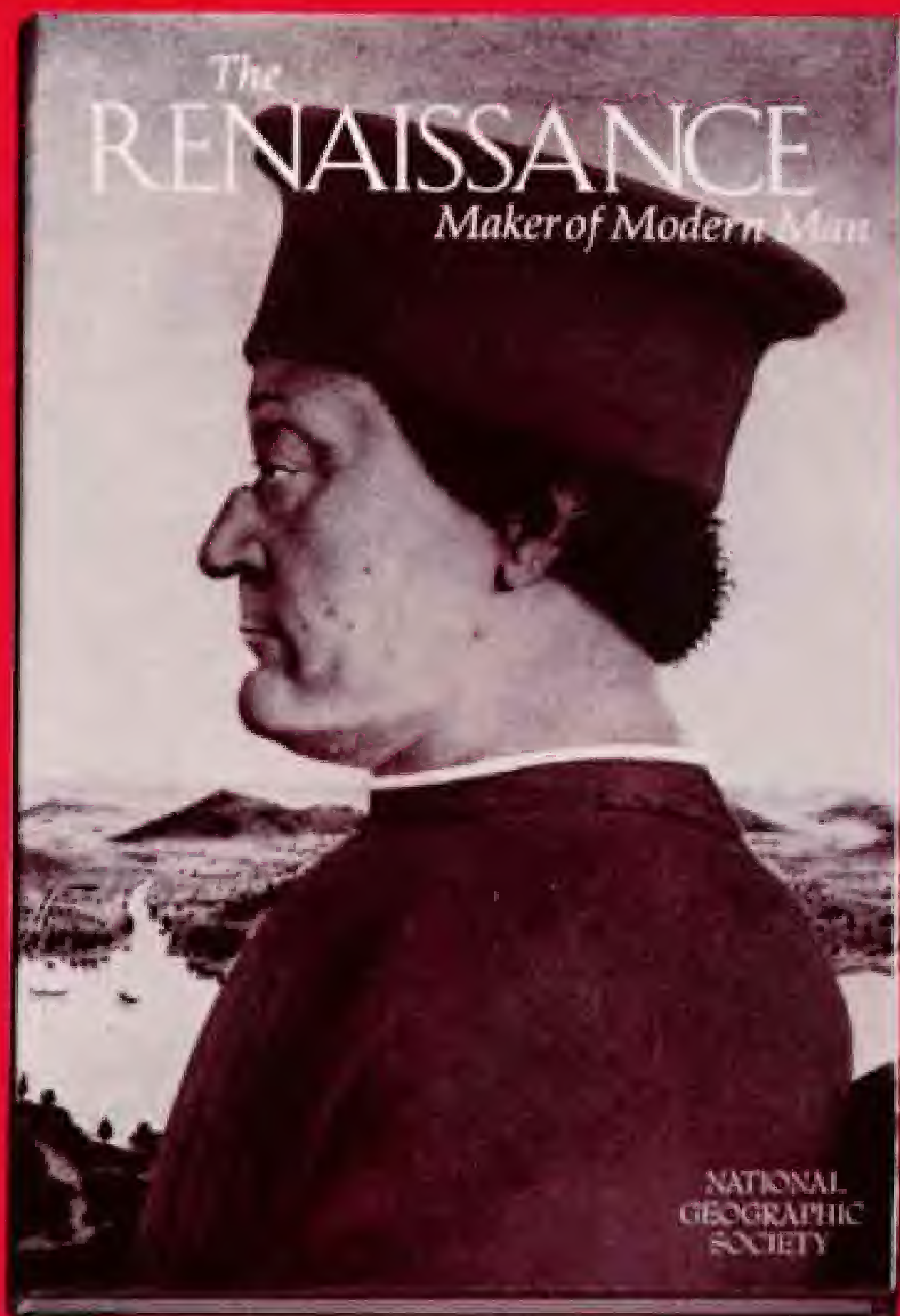

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