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One long factory from the Hudson to the Delaware, the Garden State holds enough variety to surprise even its own residents

I'm From New Jersey

By JOHN T. CUNNINGHAM

Illustrations by National Geographic photographer VOLKMAR WENTZEL

EACH DAY hundreds of thousands of visitors speed across New Jersey's narrow waist; their visits usually last exactly as long as it takes train or automobile to run between New York City and Philadelphia.

Few tarry, but they think they see New Jersey: a factory-lined flatland, characterized by smokestacks, steel rails, and express highways. Such a land is easy to forget.

Reporter Covers a State-wide Beat

Occasionally Jerseymen encounter these visitors, say in New England, where great numbers of New Jersey people go each summer in search of change and quiet. The casual question, "Oh, you're from Jersey?" can put the Jerseyman on guard; he is uneasily aware that the other probably means no compliment.

I know. As a native of New Jersey I used to find myself constantly on the defensive—explaining, for instance, whence the nickname "Garden State." I usually failed, because I, too, knew little of the real New Jersey.

Then, one April day in 1948, the State became for me a full-time job. To my surprise and delight I found the land beyond the railroad tracks well worth the knowing.

It was this simple. My newspaper, the *Newark News*, assigned me to write a series of articles on New Jersey's history and vitality. Now, some 350 articles and a million words later, I'm still at it—and I'm *not* on the defensive!

The years have taken me across every one of New Jersey's 7,856 square miles, through hundreds of factories, across thousands of acres of farmland, into the offices of 30 college presidents, and along 130 miles of Jersey shore in every season of the year.

I've seen giant machines spew forth beer bottles and bridge cables, and I've watched painstaking fingers make a gold brooch. I've seen corn picked under floodlights at 4 a.m., and I've seen Miss America crowned at midnight. I've been with muskrat trappers in the lonely Salem County marshlands, with trackwalkers in the crowded Hudson County railroad yards, with an orchid grower inspect-



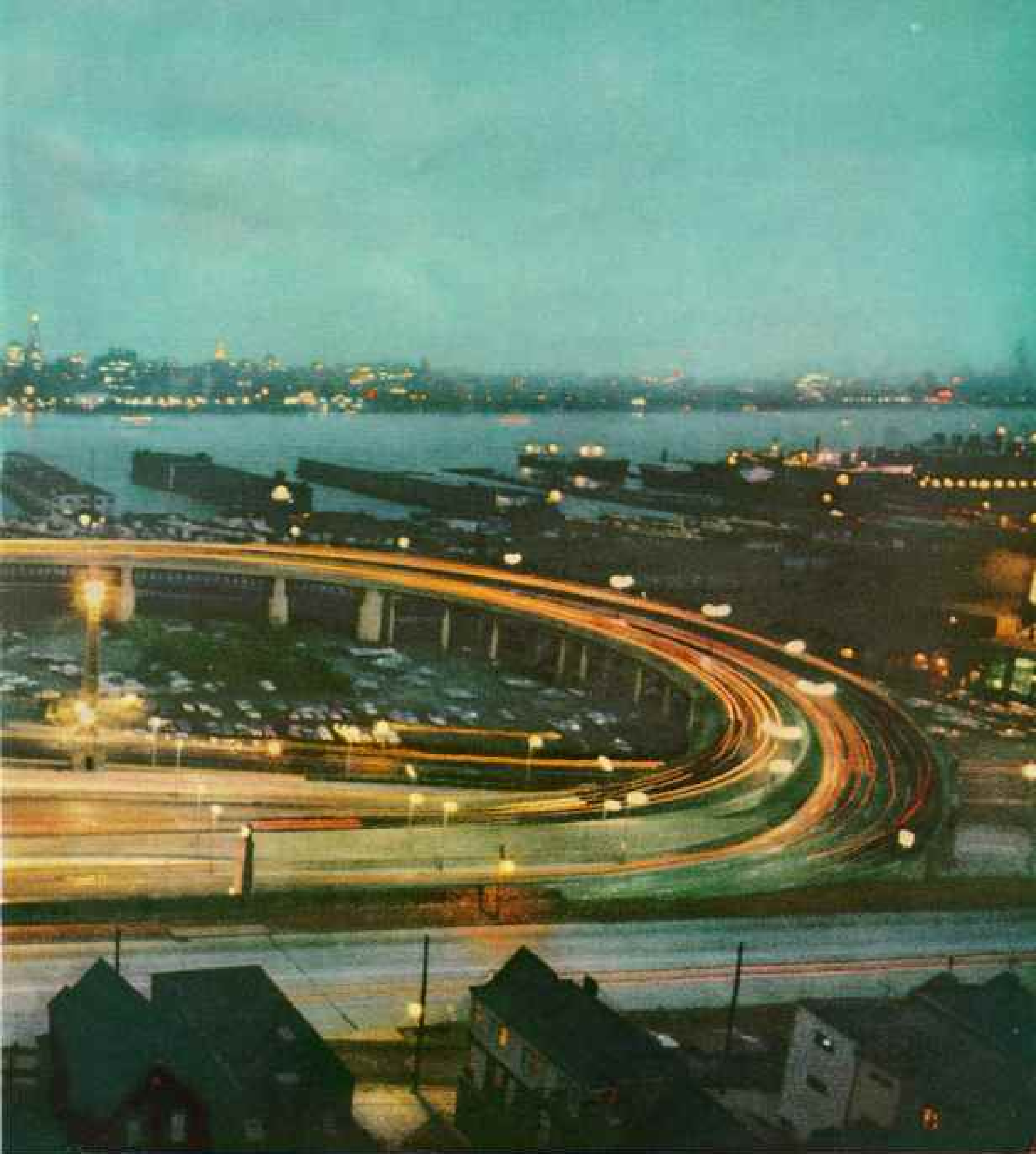
At Weehawken, rivers of cars flow in and out of Lincoln Tunnel under the Hudson.

ing his seemingly endless hothouses in Middlesex Borough, with farm boys driving cows homeward on deserted Sussex County roads.

Giant trucks hem me in on the superhighways, but I know country lanes that lead to mountains and back roads that end at Atlantic beaches. Along these roads I've seen maple trees tapped for sirup in the spring, blueberries plucked in summer, cranberries harvested in fall. If I despair at weekend traffic,

I try to remember that New Jersey has been a pathway for 300 years, one of the most strategic, most fought over, of the Thirteen Colonies in the Revolution.

Certainly I neither scorn nor dismiss the familiar view of New Jersey from a train window. Those smoking factories, freight-clogged rail yards, and crowded highways all add up to economic importance, even if they obscure the fact that off beyond eye's view



EXCERPT BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS VOLKMAR WENTZEL AND BATES LITTLEHALEY © N.G.S.

Across the river at twilight blaze the Empire State Building and lesser Manhattan towers

there is both quaintness and charm for the finding.

Visitors who cross New Jersey by air see some of its two million acres of forestland. Invariably they exclaim: "Why, it's a beautiful State! I wouldn't have believed it had so much space!"

New Jersey's personality still is difficult to spell out, even for one who knows it as well as most men know their back yards. Actually

there are two Jerseys, in fact, if not in name: "north" Jersey and "south" Jersey—as dissimilar as day and night (map, page 10).

North Jersey is a land of low mountains and dairy farms, commuter towns and lake-dotted forests, bubbling trout streams and rivers dashing down to sea over boulder-strewn beds.

South Jersey, in contrast, is flat truck-crop farmland and ocean-front vacationland, covered in its central core by nearly 1,900 square

miles of pine wilderness. From these Pine Barrens cedar-colored streams meander slowly east, west, or south, heedless of direction, ignorant of time. Through these same pines, and scarcely seeing them, speed millions of July and August vacationists headed for the Jersey shore.

Differences go deeper than topography. They go as deep as the New England Puritans who first arrived as colonists in 1665 and left behind in many north Jersey towns a heritage of New England-like village greens and tall church spires. Or as deep as the Quakers who built the scores of brick homes still standing in much of south Jersey after 200 or more years.

Between north and south slants a 15-mile-wide corridor on a diagonal between New York and Philadelphia, holding more than three-fifths of New Jersey's 5,740,000 residents. Here are some 60 percent of the State's 12,000 factories, most of its 500 industrial research laboratories, and all but six of its 38 colleges and universities.

Away from that teeming, often frenetic, strip is the New Jersey where I find escape—sometimes as simply as knocking at the doors of the past.

Morristown Worse Than Valley Forge

My family and I often go back to relive Morristown's striking role in the American Revolution. Twice General Washington led his weary troops to this colonial town for winter quarters. A casual glance at a relief map shows why: At his back Washington had hills filled with iron ore for munitions; before him he had the natural earthworks of the Watchung Mountains.

The American Army first found sanctuary in the town in January, 1777, after victories against heavy odds at Trenton and Princeton. Washington returned in the winter of 1779-80 at a time when fortunes ebbed even lower than the despair of Valley Forge.

Long afterward Washington's biographer, the late Douglas Southall Freeman, wrote:

"... the winter of 1779-80 at Morristown and Jockey Hollow was a period of far worse suffering than the corresponding months of 1777-78 at Valley Forge.

"This evidence is not going to upset tradition... though one finds it somewhat perplexing to know why the hunger and shivering of Morristown have been so nearly forgotten while the miseries of the gloomy camp on the Schuylkill are known to every child in the fifth grade."

Did Molly Really Bring a Pitcher?

Dr. Freeman was pessimistic; Morristown isn't forgotten. Each year more than half a million people visit Morristown National Historical Park. Nor is the brilliant episode at Trenton on Christmas night, 1776, a faded thing (pages 12-13).

Washington had little reason to expect success that night. His army on the Pennsylvania side of the Delaware River was ragged, hungry, cold, low in morale. The Hessians in Trenton were comfortable, perhaps too comfortable. The Americans crossed the ice-clogged river, marched nine miles over snow-covered roads, and struck the dazed Hessians at dawn. Then, victory won, the troops marched north and crossed the icy stream back into Pennsylvania.

But Washington wasn't always cold in New Jersey. In the Battle of Monmouth both sides suffered as much from summer temperature as from enemy fire.

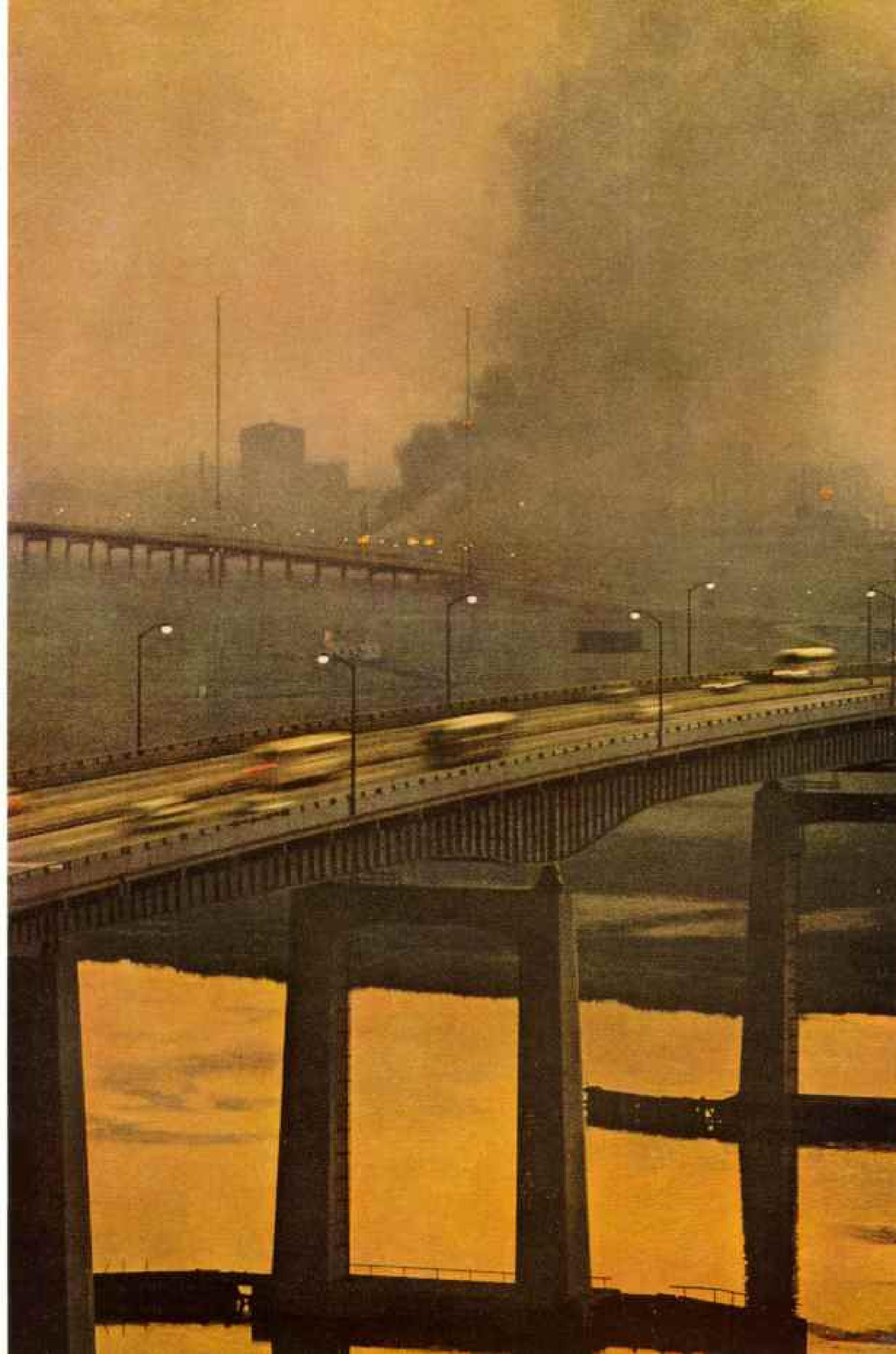
The savage sun brought to the fore an American heroine of legendary proportions—Molly Pitcher. Molly busied herself bringing water to the parched soldiers, and when her soldier-husband John fell, she took his place at the cannon and blazed her way into immortality.

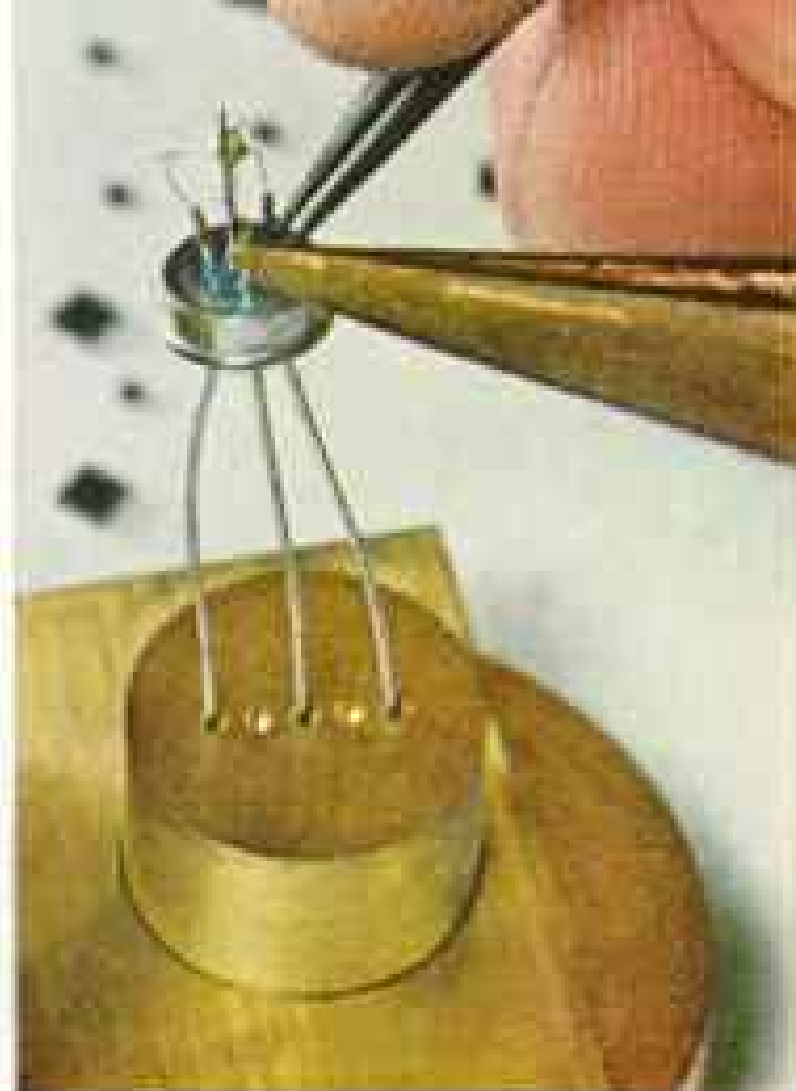
Was there a Molly Pitcher? There was; her name was Mrs. Molly Hays. Did she

Sunset and Smoke: New Jersey Turnpike Leaps the Hackensack

In the accompanying article the author, a reporter for the *Newark News*, describes the two faces of New Jersey. One is the industrial giant familiar to every American; the other, a land little known even to Jerseymen, a region of historic shrines, prodigal farmlands, and quiet country roads.

Jugular vein of Garden State commerce, the 132-mile New Jersey Turnpike links New York and Philadelphia across one of the most highly industrialized areas on earth. Handling a million vehicles a week without a single stop light, the superhighway speeds on their way such varied New Jersey products as orchids and soup, hot dogs and beer bottles, electronic brains and frozen broccoli, pen points and rocket engines.





Birth of a transistor crystal (far left) takes place at Radio Corporation of America's David Sarnoff Research Center, Princeton. Technicians grow a large crystal of gallium arsenide by submerging a tiny "seed" crystal in a melt of the same material heated to 1,250° C. Platinum filaments rising from the liquid prevent clouding by condensation.

Assembling a transistor, metal fingers attach the crystal to hair-fine filaments. Completed, the tiny transistor can replace a vacuum tube.

Huge Tank Farms Pump Power to Oil-hungry Cities

Petroleum tanks and refineries in New Jersey's northeastern corner provide a vast gasoline station for New York, Newark, Jersey City, Elizabeth, and dozens of other cities.

Millions of gallons of crude oil, fuel oil, and gasoline from fields all over the world daily pour into the reserve, whose flood of energy turns the wheels of ocean liners, cargo ships, trailer trucks, diesel locomotives, and airplanes that serve the Nation's largest city.

This aerial view shows a tanker unloading on the Raritan River at Hess Reserve Terminal, Perth Amboy. Distant Outerbridge Crossing jumps the Arthur Kill, a narrow channel separating Staten Island from New Jersey.



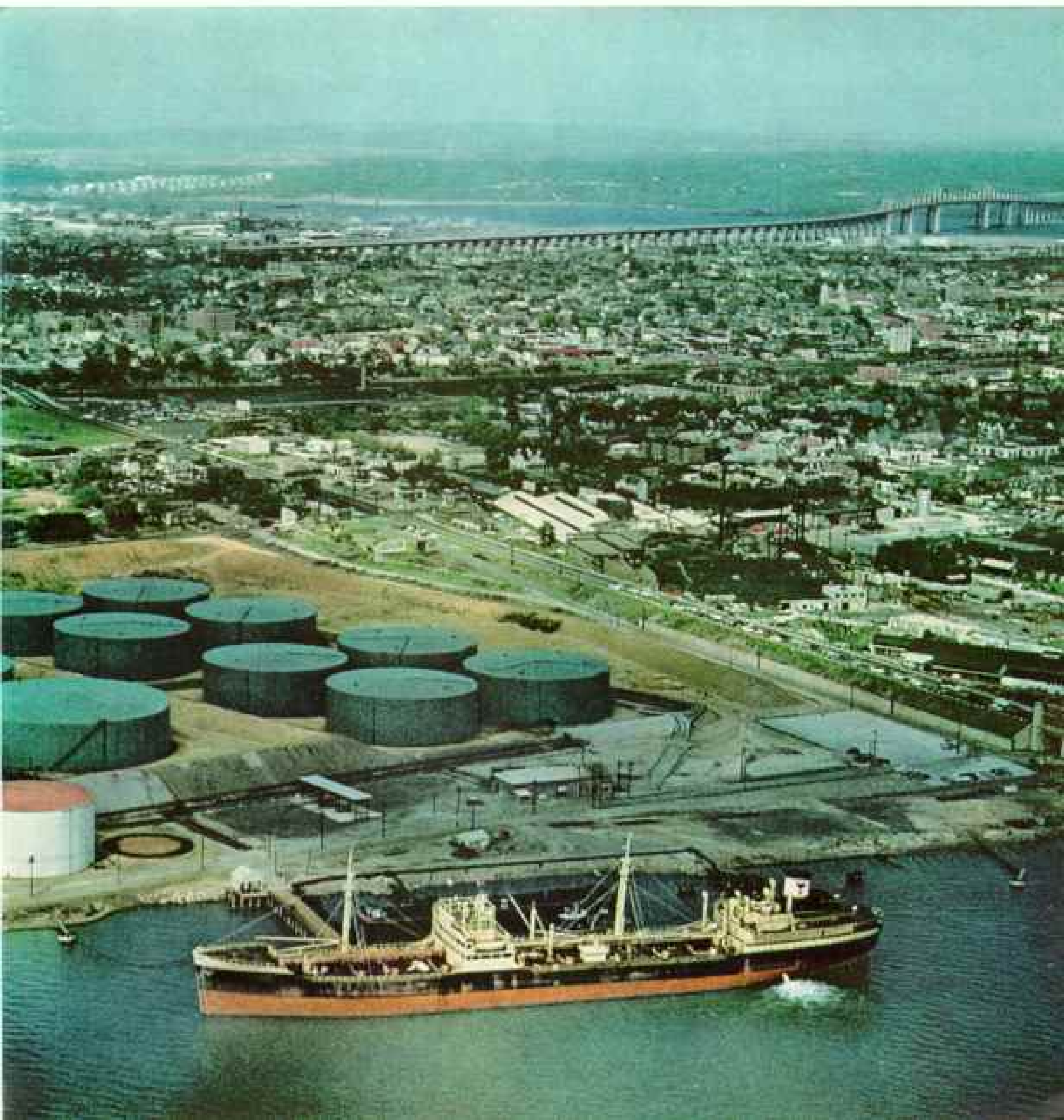
Teardrop of molten glass festoons the tip of a blowpipe at Kimble Glass Company, Vineland, makers of rod, tubing, and precision laboratory glassware.

This glass blower roughs out a gas-generator funnel by pulling and trimming heated glass at the end of his four-foot-long blowpipe. Then he will shape the taffylike 1,500° F. gob by blowing it to exact dimensions in an iron mold.

Five years' training is required before such an artisan is considered proficient.



TOP: ANSCOROM (ARUP) AND SODALIMERS © NATIONAL GEOGRAPHIC SOCIETY



carry water? Probably. At least it was hot enough, and I've been shown two spots where "she dipped her pitcher."

New Jersey's Revolutionary War significance hinged on its location between the vital ports of New York and Philadelphia. That placement is still of utmost significance. New Jersey is an industrial State of top importance—only six States turn out more goods annually—and that importance is in large measure due to those near-by cities, offering both markets and unexcelled transportation facilities.

Industrial variety is almost endless in New Jersey. I've seen jewelry and machine tools and beer and sharkskin leather goods made in Newark. I've watched filmy nightgowns

and workaday shirts being sewed in Paterson, sulfa drugs packed by the hundredweight in Bound Brook. My tours have carried me through Trenton plants making dolls and exquisite china and brake linings and light bulbs.

In a single day I saw in Camden the making of soups and aircraft carriers, pen points and electronic brains. I've toured giant petroleum refineries in Bayway and Perth Amboy and copper refineries in Middlesex County. I've stood by machines rolling off adhesive tape by the mile near New Brunswick.

What does New Jersey make? Pipes, snuff, cigarette paper, cigars. Wall-to-wall carpeting, linoleum, electric trains, bowling balls. Hot dogs, automobiles, television sets, suspension bridges, soap, sulphuric acid, airplane motors. Perfume, rocket engines, sewing machines, kitchen sinks, and yachts.

Recently, before a high school assembly, I said, "We make just about everything—from lipstick to explosives." The teen-age audience laughed—on the premise, I suppose, that lipstick and explosives aren't far apart at all.

Whole World Sired the Jerseyman

But there was seriousness when I talked of another facet of New Jersey: the many countries that from the start have contributed their sons and daughters to this State. Rare is the New Jersey gathering, junior or senior, where widely different nationalities are not represented.

The Dutch first gave the region attention, when Henry Hudson in 1609 sailed his *Half Moon* up the river that bears his name. Soon after, on lower Delaware Bay, the Dutch and the Swedes and Finns vied for supremacy. They vied in vain; by 1664 the English gained control of the entire colony. They named it New Jersey after the island of Jersey in the English Channel.

German ironworkers came before the Revolution. English and Scotch arrived in Paterson by 1800 to make the machine shops hum. The Irish built the railroads and canals between 1830 and 1860, and another wave of Germans came at the same time to make wine in south Jersey and beer in Newark.

Others arrived through the years: from England and France and Italy to make Paterson's silk, from Armenia to make Freehold's carpets and rugs, from Scotland to make Kearny's linoleum. They came from Switzerland to establish in Union City a schiffli-loom embroidery industry, and from the Slavic

FORRESTHORN © NATIONAL GEOGRAPHIC SOCIETY



Acres of orchids bloom under glass at Thomas Young nurseries, Middlesex Borough. Among the largest in the world, the orchid farm cultivates 400 varieties of the *Cattleya* genus. Each year its gardeners snip more than a million blooms.

This nurseryman admires a *Brassocattleya*.



EDUCATION BY NATIONAL GEOGRAPHIC PHOTOGRAPHER VOLKMAR WENTZEL © N. G. S.

Wild-haired and Wide-eyed, Doll Heads Await a Date at the Beauty Parlor

Horsman Dolls, Inc., in business since 1865, has introduced such well-known models as the Campbell Kids, Buster Brown, Ella Cinders, and the HEbee-SHEbee doll. Here, in the firm's factory at Trenton, baby faces sprout from clothes trees before visiting the hairdresser. The wigs, made of synthetic fibers and rooted in vinyl plastic heads, will be smoothed with a pomade and styled according to little-girl fashions.

countries to be the muscle of Jersey's ceramics industry.

During World War II displaced persons came to work at Seabrook Farms near Bridgeton, including Estonians from Europe and Japanese-Americans forced to evacuate their west coast homes. Many of the Nisei returned to California at war's end, but hundreds of Japanese families stayed on (page 33).

College Comes to the Chicken Coop

The story of the small business and professional men who fled persecution in both Russia and Germany and started chicken farms in Cumberland, Monmouth, and Ocean Counties is especially intriguing. A poultry specialist at the Rutgers University College of Agriculture introduced me to their story:

"They knew nothing about poultry. They figured that if a man could make a good living out of a thousand laying hens, he could make ten times as good a living out of ten thousand—just as in making suits or overcoats."

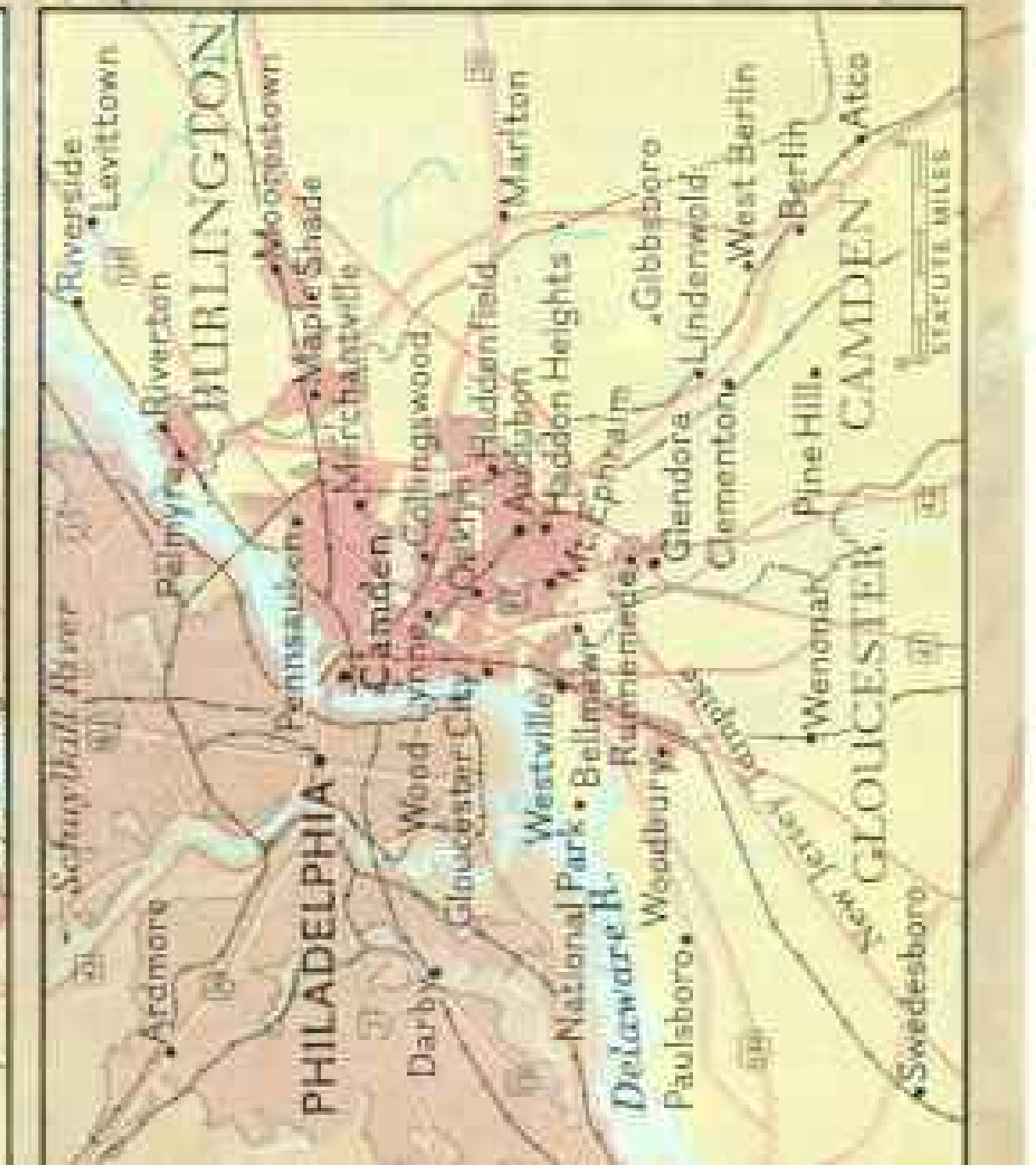
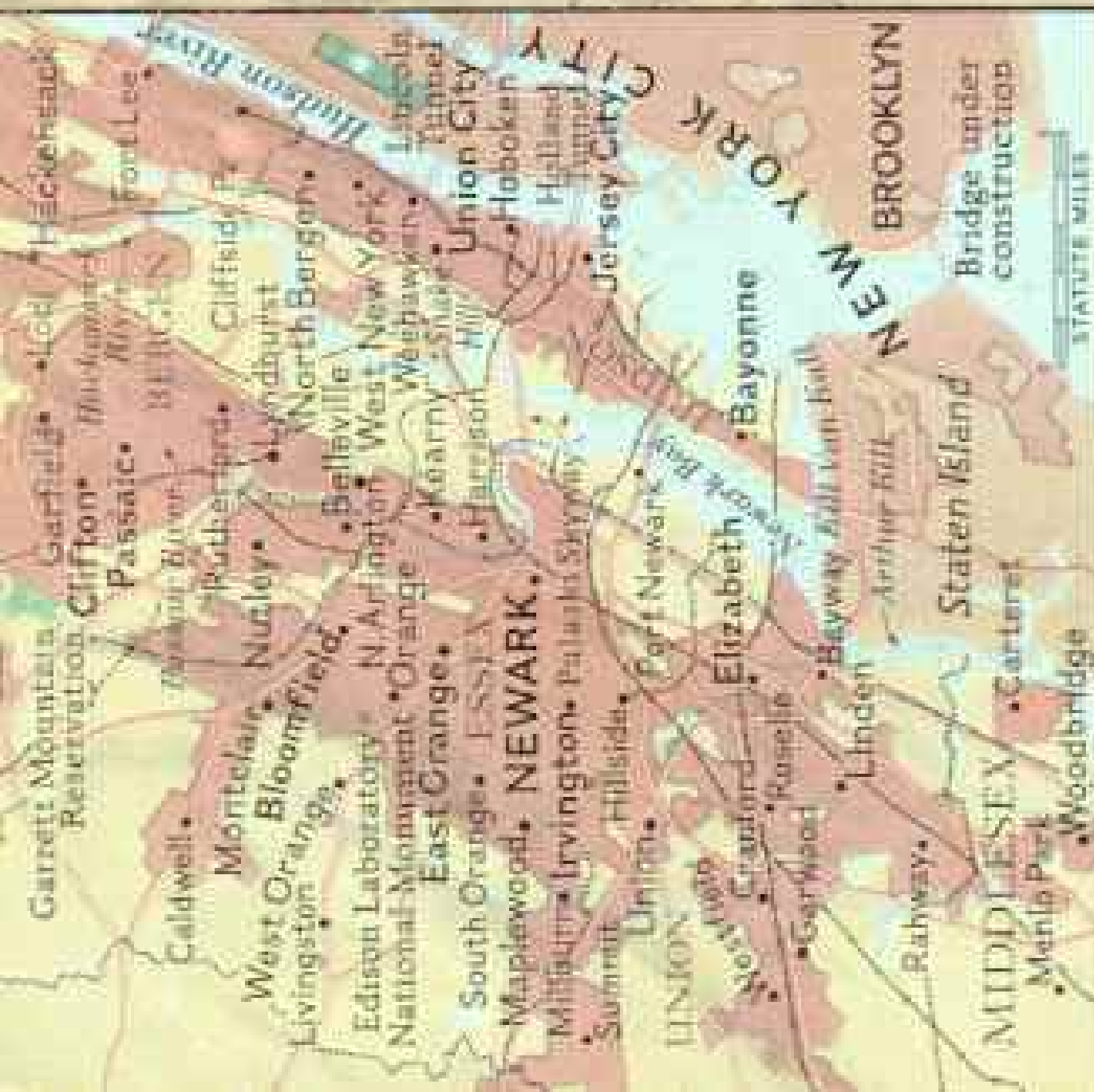
Poultry experts were appalled. Until then the best advice had been to limit flocks to two thousand.

Many of the newcomers succeeded despite their ignorance. Rutgers helped them—by giving poultry lectures in foreign tongues and by translating poultry bulletins into several languages. Thanks to these people's daring, chickens and eggs today account for a third of all New Jersey farm dollars.

With M. A. "Mac" Clark, veteran Monmouth County Agricultural Extension Agent, I visited several of the refugee chicken farmers. On one farm we caught an aromatic whiff of chicken cooking in the kitchen. Mac sniffed appreciatively.

"That's a wonderful smell," agreed the farmer. "In the old country when you smell chicken cooking, it means one of two things—either somebody is sick, or the chicken was! Here, is nothing; chickens are healthy—and so are we."

Settled among the refugee chicken farmers





PAINTING BY LT. COL. WILLIAM E. FEDDICK, OWNED BY THE OLD BARRACKS ASSOCIATION, TRENTON

near Farmingdale in Monmouth County are New Jersey's most recent newcomers, the Kalmuks, direct descendants of western Mongol tribes who fought against the all-conquering armies of Genghis Khan.

How pitifully true is the word "Kalmuk," meaning "remnant" in their language. Today the known world population is only 135,000, and some 250 of them live on the 30-acre Kalmuk tract near Farmingdale.

"Remnants" Become Good Jerseymen

I came to know Freewood Acres' Kalmuks through a pleasant-faced, stocky young man wearing a sweatshirt on which the faded words "American University" were imprinted. His smile revealed splendid white teeth as he introduced himself: "I'm Alexey Ivanchukov, chairman of the Kalmuk Society in the United States."

The sweatshirt? "That's my kid brother's; he's a senior at American University, in Wash-

ington, D. C.," he explained. "I'm attending Columbia."

Alexey proudly showed me through the little Buddhist temple his group built four years ago (page 33). The brilliant colors of ceiling hangings and altar decorations made the interior glow even in the light of flickering candles. A solemn priest fingered his prayer beads near the altar. He paused to smile hospitably as Alexey presented me, but he did not speak.

"Please sign the guestbook," my guide urged as we left the temple. I did—directly beneath the names of three visitors from Calcutta, India, who had been there the day before.

Outside the temple with its centuries-old traditions, I could hear the roaring symbols of the 20th century as automobiles sped to and from the Jersey shore on crowded U. S. Route 9. A late-model car stopped. Alexey leaned through the window to remind three pretty Kalmuk girls of a picnic on Saturday.



Washington Directs a Dawn Attack on the Hessian Garrison in Trenton

Crossing the icy Delaware on Christmas night, 1776, the Continentals marched against the sleeping enemy. When an officer reported that his powder was wet, Washington crisply replied: "... use the bayonet. I am resolved to take Trenton."

The American surprise was complete. In less than an hour of fighting, the Continentals mortally wounded the Hessian commander and captured some 950 prisoners. Washington lost not a single man.

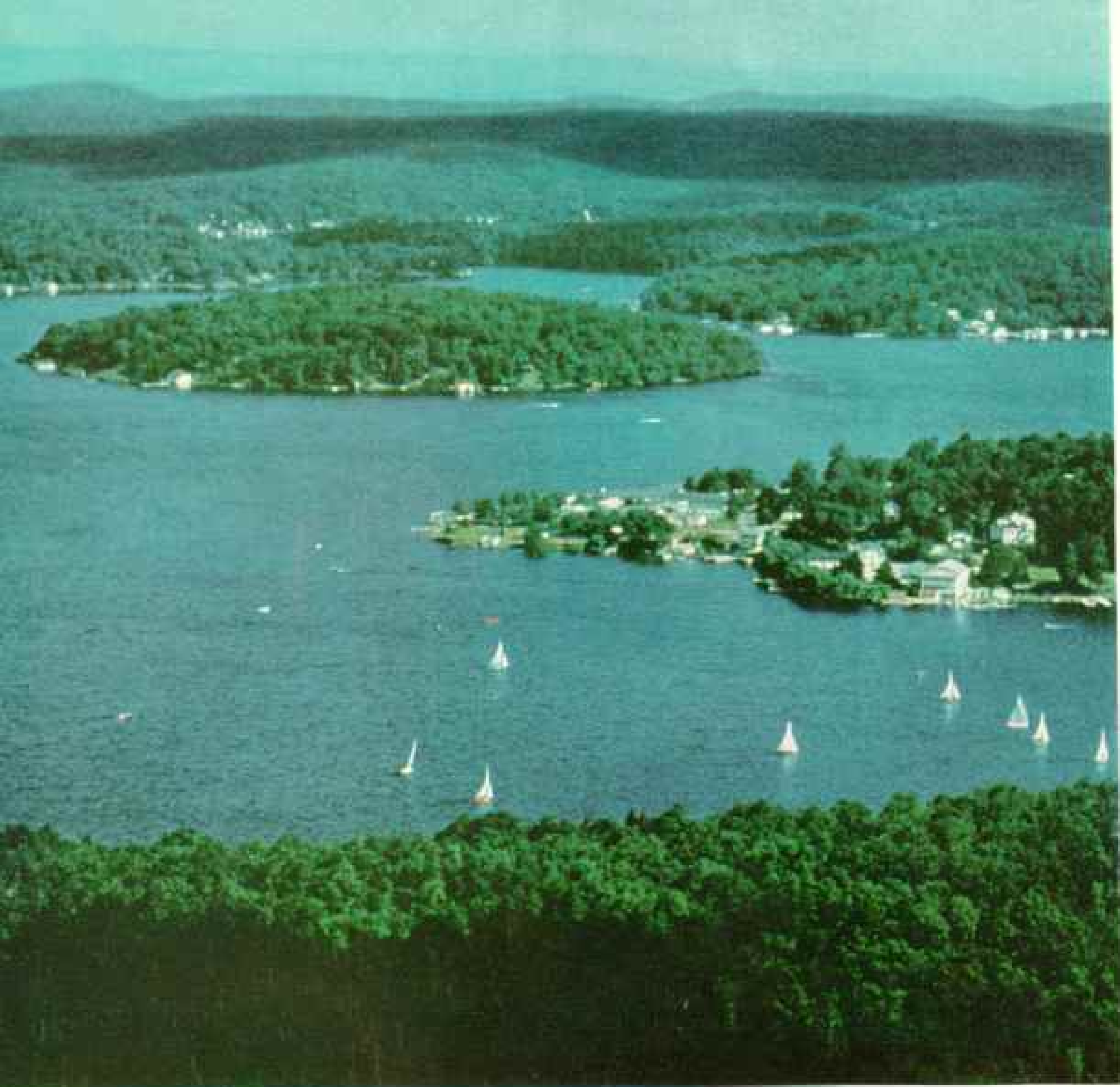
A turning point of the Revolution, the electrifying victory lifted the gloom that followed the loss of New York and gave the colonists new heart for the struggle against King George III. "Our hopes were blasted," a British statesman admitted, "by that unhappy affair at Trenton."

A 150-foot granite shaft rising just north of the Trenton business district marks the spot where Washington placed his artillery. In eight years of fighting, nearly a hundred battles and skirmishes raged across New Jersey.

Morristown saw George Washington reorganize a freezing, starving army during the terrible winter of 1779-80. Headquartering here in the Ford Mansion, the general wrote: "Eighteen belonging to my [official] family and all Mrs. Fords are crowded together in her kitchen and scarce one ... able to speak for [their] colds. ..."

RELL P. BAYNE





**Like Gulls in Flight, Sailboats
Skim Across Lake Hopatcong**

New Jersey's largest lake, the Indians' "honey water of many coves" lies among tree-clad hills.

A priest walked slowly around the temple exterior, revolving a prayer wheel. The elders strive mightily to preserve their Buddhist teachings, and many young people, such as Alexey, seek to help them.

Materially, the Kalmuks are doing well. Americanization is everywhere: in late-model cars, in TV aerials atop ranch houses, in gum-chewing, teen-aged Kalmuk girls reading movie magazines, in little boys playing marbles, and in a lay leader wearing a faded college sweatshirt like any other college boy home for the weekend.

The Kalmuks and all these other varied

peoples have found room in tiny New Jersey—and it is tiny, a fact impressed on me by a visitor from California.

"Why," she said, "I think San Bernardino County could hold all of New Jersey!"

I went to an encyclopedia. She was right. San Bernardino *could* hold all of New Jersey—and have room left over for Massachusetts, Rhode Island, and Delaware!

Waterfall Built a City

I usually take visitors through the north Jersey forest and lake country. To make the contrast between well-known industry and



HOPATCONG © NATIONAL GEOGRAPHIC SOCIETY

Clear water and invigorating air beckon hundreds of thousands of visitors each summer. These

Star-class boats race in the Lake Hopatcong Yacht Club regatta, a north Jersey event.

little-known upland charm most striking, we drive to Garrett Mountain above Paterson.

Here the Watchung Mountains dive precipitously to the plain. At this fall line the Passaic River plunges 70 feet down through a rocky gorge. The furious power of Passaic Falls prompted Alexander Hamilton to found Paterson in 1791 as America's first planned industrial city.

Paterson grew by the falls, following a path of recurring boom and bust. Cotton, railroad locomotives, silk, airplane motors—each of these has dominated the city in turn. Now hundreds of small industries hum in the old

brick factories that once gave Jersey's third-largest city an all-eggs-in-one-basket economy.

Paterson always attracted men of vision. Samuel Colt manufactured his first revolver in the Paterson Gun Mill in 1836. Eccentric schoolmaster John Philip Holland sent his first submarine on a trial voyage in the Passaic River in 1878. In Paterson's West Side Park the *Fenian Ram*, Holland's successful 31-foot submarine built for the Irish Fenian society in 1881, today rests as a monument to the inventor.

After its tumbling fall at Paterson, the Passaic becomes placid again, eager to serve

the hundreds of industries clustered along its banks as it winds to a quiet merger with the salt waters of Newark Bay to the south.

But let's face it, a person quickly can get his fill of industry. We leave for the near-by Ramapo Mountains, scarcely less wild today than they were in the days when Revolutionary War outcasts found a haven there.

Halfway up from Oakland, the Skyline Drive takes a curve. Ahead, a raccoon leads her brood across the road, letting a mere autoist know that her kind was there first.

Rattlers Roam the Ramapos

I stop the car. Wilderness surrounds us. Off to the southeast, some 20 miles away, the skyscrapers of New York seem to grow out of the trees between. My guests scramble to pick the daisies among the boulders. That's not wise: I remember the advice of the guide who first took me through the Ramapos.

"Place is full of rattlers and copperheads," he said. "Stick to the roads."

We pick no daisies. Instead, our car rises to where the drive dips down to the west. Patches of deep blue in the valley below dot the hardwood forests.

These wooded highlands, where streams run clear and cold, give water to several north Jersey cities. That closest patch is Wanaque Reservoir, seven miles long and capable of supplying 85 million gallons of water daily.

Reservoirs are numerous because water is everywhere in these highlands. The very names of rivers make it evident that the Indians knew them, too: Musconetcong, Passaic, Raritan, Pequannock, Pequest.

Dozens of lakes snuggle in glacier-built pockets. The largest is called Hopatcong, loosely interpreted as "honey water of many coves."

Lake Hopatcong, only six and a half miles long, has so many coves and inlets that the shoreline winds some 35 miles. In summer the white wings of sailboats dot the surface; in winter iceboats skim the frozen lake (page 38). Scores of ice fishermen cluster in River

Styx cove. Dense woods close in on the lake; from the air it is a sapphire in a setting of green (page 14).

Loftiest spot in New Jersey is High Point, close to where New York and New Jersey touch borders. At 1,803 feet, High Point perhaps rates as little more than a foothill to a Coloradan, but it is rugged and steep enough to test neophyte mountain climbers.

The Appalachian Trail runs down the backbone of the Kittatinny Mountains between High Point and Delaware Water Gap. At Sunrise Mountain, a craggy ledge easily reached by automobile, we hikers-on-wheels can park and, by walking a few paces, get a magnificent view.

Sunrise Mountain looks eastward across the Kittatinny Valley, a region of lush dairy farms. Harry Dorer, retired *Newark News* photographer who talks about New Jersey the way really boastful Texans talk about Texas, first took me to Sunrise Mountain.

"Wonderful, wonderful," Harry said, as he always does. "Look at those barns! You know, Sussex County has more cows than people—and that's good!"

People at Last Outnumber Cows

Whether it's good can be debated, but from Mr. Dorer's viewpoint, the county has slipped. The latest figures show more people than cows in Sussex, by several thousand head. Nevertheless, life still revolves around milking time. Often I've waited while sun-tanned farm boys or girls drove cows barnward across the road in late afternoon.

Between the Kittatinny and the Delaware is a land few outsiders visit—a fertile land of independent folk. There I go whenever I seek a leisurely pace and a measure of self-sufficiency. There, near villages like Flatbrookville and Wallpack Center, men still trap and hunt and gather in country stores to swap yarns beside wood-burning stoves.

Joe Taylor, of Columbia, considered a kind of Paul Bunyan among trappers along Big Flat Brook, has led me through the area. Joe is

Governor and Mrs. Meyner Cool Off After a Tennis Match

Morven, the Governor's official residence, stands in Princeton, 10 miles from the State Capitol at Trenton. Robert B. Meyner, who was married in office in 1957, sips iced tea beneath a portrait of Richard Stockton, a descendant of the man who built the house in 1701. His wife Helen, a distant cousin of Adlai Stevenson, fondles a black poodle. Gladioli flare from the sterling silver bowl, a wedding gift. The antique plaster group beneath the lamp, appropriately entitled "Politics," shows a woman interceding in an argument between two whiskered men.



an intelligent, articulate State trapper whose job is to catch beavers and deer and muskrats and raccoons in areas where they aren't wanted and to transfer them alive to spots where they are welcome.

One fall day Joe showed me how he traps foxes. We walked down a woods road where foxes run seeking food. Joe knelt down, carefully placed a trap and lure, expertly sprinkled dirt to conceal the trap.

He looked up. "Did you know most foxes are right-footed?" he asked.

"No," I replied doubtfully.

"Yup. I put a little scent on the right side of the trail and the trap on the left. While Mr. Fox digs for the scent with his right paw, he puts his weight on his left—square into the trap."

Little things like that escape the beginner. Little things like that also make a day with Joe Taylor something for which I will return to Wallpack Center at every chance.

Three centuries ago Dutch miners came down this valley and mined copper at Paha-quarry in the Kittatinny. They lugged their ore overland to what is now Kingston, in New York State. Some authorities claim that the Old Mine Road, built in the mid-1600's, was the first true highway in the United States. The old copper mine is still open, though today it is part of a Boy Scout camp.

Old Mines Still Yield "Black Stone"

Those Scouts hear Indian tales of the days when the country was young, when the Delaware River took on the rocky Kittatinny and wore them down. That victory gave an everlasting gift to scenery: the Delaware Water Gap, a thing of beauty, where the river twists between craggy, tree-covered slopes.*

In days long past the north Jersey moun-

* See "Today on the Delaware, Penn's Glorious River," by Albert W. Atwood, NATIONAL GEOGRAPHIC, July, 1952.



tains near Dover served ironmasters; more than 200 iron diggings were worked after the first "black stone" was mined in Morris County about 1710. Weeds now choke the entrances of all but a few of the mines. Still, more than a million tons of ore is extracted each year; mines at Mt. Hope and Mine Hill go down more than 2,700 feet—two of the deepest mine shafts in the East.

A million tons of iron ore is as nothing to the needs of New Jersey industry. Actually, the State's natural resources cannot begin to satisfy Jersey industry's enormous appetite. Transportation is the great equalizer, the link in the beginning with sources of raw materials and the link in the end with markets the world over.

New Jersey relies on its outlets to the sea. Docks jut into the Hudson River at Jersey City, Hoboken, and Weehawken, calling for trade in rivalry with the docks of New York, just a river width away.

REPRODUCED BY NATIONAL GEOGRAPHIC SOCIETY



Wharves as far up the Delaware as Camden likewise lure ocean ships. Heavily laden hulls supply the State's many chemical plants.

Three plants, two in Perth Amboy and one in Carteret, provide a third of the Nation's copper refining capacity. The basis of this major New Jersey industry is simple: copper concentrates come in by boat; the refined metal goes out by barge.

On a visit to one of the plants, I heard constant talk of "by-products" in the copper concentrates. "By-products?" I asked.

"You know," said a spokesman, "gold, silver, platinum, iridium. Things like that."

Totals generally are closely guarded secrets, but I learned that in 1958 one Middlesex County plant recovered gold and silver worth \$56,000,000. By-products, indeed!

Salt Marshes Fend Off a City

Traffic in Jersey's industrial corridor probably is unrivaled. The New Jersey Turnpike alone carries a million vehicles a week! Between New Brunswick and Jersey City runs some of the heaviest rail traffic on earth.

Fortunately, nature left a great open area for maneuverability—the Jersey Meadows, thirty thousand acres of scarcely conquered swampland within full view of skyscrapers in both New York City and Newark.

Once the bottom of a glacial lake, the Meadows now are flooded daily by changing tides. Sedges seven feet tall wave like a green lake in summertime, turning to crisp, dry stalks in winter. Billboards scream the merits of New York hotels and Broadway plays. Beneath them, muskrat trappers roam.

The Meadows are ringed now with industry tied to hundreds of rail sidings. Transportation pulls out all the stops at Port Newark, which only 50 years ago was muskrat marshes and garbage dumps. Sea, truck, railroad, and air facilities meet at the port.

Similarly, transportation accounts for the industry of Jersey City, Bayonne, Hoboken,

Farms Lay a Green-and-gold Carpet; Distant Hills Roll to the Delaware

New Jersey cropland yields more cash per acre than that of any other State, a distinction made possible by men who farm like scientists and compute like businessmen. This harvester mows unripened Indian corn. Fermented in silo or trench, the ears, leaves, and stems are fed to livestock.



Elizabeth, Linden, Rahway, and half a dozen other cities within 10 miles of Newark. It accounts, in substantial measure, for Newark's unquestioned position as the financial, business, and industrial heart of the State.

Newark is the nerve center of Essex County, where nearly a fifth of all New Jersey people live. Founded 296 years ago, the city eyes the future: more than a billion dollars in public and private funds has been committed since 1955 to build a "new" Newark.

Colossus of Baubles and Beer

Newark boasts that it is unmatched anywhere for the variety of its manufactures—a claim not easy to prove or to disprove.

Much of the production goes on in ancient buildings, many containing 10 or more small industries. Some 300 types of goods are made in the city, from delicate electronics instruments to gaudy plastic toys, from electrical machinery to chemicals, from leather to paint.

Out of the welter of products, I know Newark industry best for two things—gold jewelry and beer.

Just as Providence, Rhode Island, is noted for its costume jewelry, so Newark is recognized as the center of the country's fine gold jewelry manufacture. Few realize this, even in the city, because most of Newark's work is done in unprepossessing old buildings along the railroad tracks.

Once Newark jewelers stamped "Paris" or "London" on their wares. Such guile is no longer necessary; "Newark" in the trade today carries just as much assurance of quality.

Consider, too, Newark's beer.

The city's big breweries always smell good to me, reminiscent of hot bubbling cereal. The "cereal" in the highly burnished copper cookers ultimately winds up in six million barrels a year of Newark-made beer and ale—making Newark a Milwaukee of the East.

Six million barrels is a lot of brew. One



REDBACKTONE © NATIONAL GEOGRAPHIC SOCIETY

Cook-out Near Wallpack Center Follows a Swim in the Delaware

The 280-mile river and its bay establish New Jersey's western and southern boundaries and give the State a superb inland vacationland. Here the stream flows placidly past the hazy Pocono Mountains, in Pennsylvania.

clanged, and beer bottles streamed out. My face must have shown my awe. The foreman spoke up:

"I stand here myself for five minutes and wonder where all the bottles go. Who in the world drinks all that beer?"

I could tell him that millions of bottles go to Newark. But who in the world drinks all that beer I still don't know.

Jersey industry, I discovered, thinks nothing of production in millions. Take, for example, the Joseph Dixon Crucible Company, of Jersey City, across the Hackensack and Passaic Rivers from Newark. A pioneer in writing implements, the company turns out more than a hundred million pencils a year!

Spinach Pickers and Ticky-benders

New Jersey seems much longer than its 166-mile length. Cape May Point is on the same latitude as Washington, D. C.; High Point is on a line with New Haven, Connecticut. Hence, on an early November day when spinach is being plucked in Cumberland County, Sussex County boys may be running ticky-benders—foot races—on the first ice of north Jersey's lakes.

Occasionally I get the feeling that New Jersey is really a northern State with a southern accent, a feeling most keen when I delve into the State's role in the Civil War.

One-third of New Jersey is below Mason and Dixon's line (or where the line would be if it extended from the Maryland-Pennsylvania border to the Atlantic). That sets a tone, but the reasons why New Jersey twice refused Abraham Lincoln full support go deeper. The State had been a major supplier to the South, and its political leanings were heavily Democratic—and thus antiwar.

Princeton University was known in the 1850's as the "northernmost of the southern universities." After Fort Sumter, the students split almost evenly between Blue and Gray.

The first time I toured Nassau Hall, Princeton University's 200-year-old administration building, Dan Coyle of the university's staff stopped me in front of a panel honoring Prince-

day a white-haired brewmaster fixed that firmly in mind for me. He turned to me as we stood by a bottling line in P. Ballantine & Sons, a Newark brewery since 1840.

"Offhand, now, do you know how many glasses of beer there are in six million barrels?" he asked. I shook my head.

"About three billion glasses," he replied.

"That's startling!" I exclaimed.

His blue eyes twinkled. "Positively staggering, you might say," he responded dryly. Obviously I wasn't his first straight man!

Newark's foaming eminence answers one of two questions put to me by a foreman in a Bridgeton glass factory. We stood by an automatic bottle-blowing machine in the Owens-Illinois Glass Company plant, where hundreds of thousands of bottles or jars are made daily.

This hot July day the hissing, clattering machines pounded out beer bottles. Molten "white metal" dropped into molds, machines



PHOTOGRAPHS BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS SELMAE WENTZEL (TOP) AND E. ANTHONY STEWART AND JOHN S. FLETCHER (B) N. G. S.



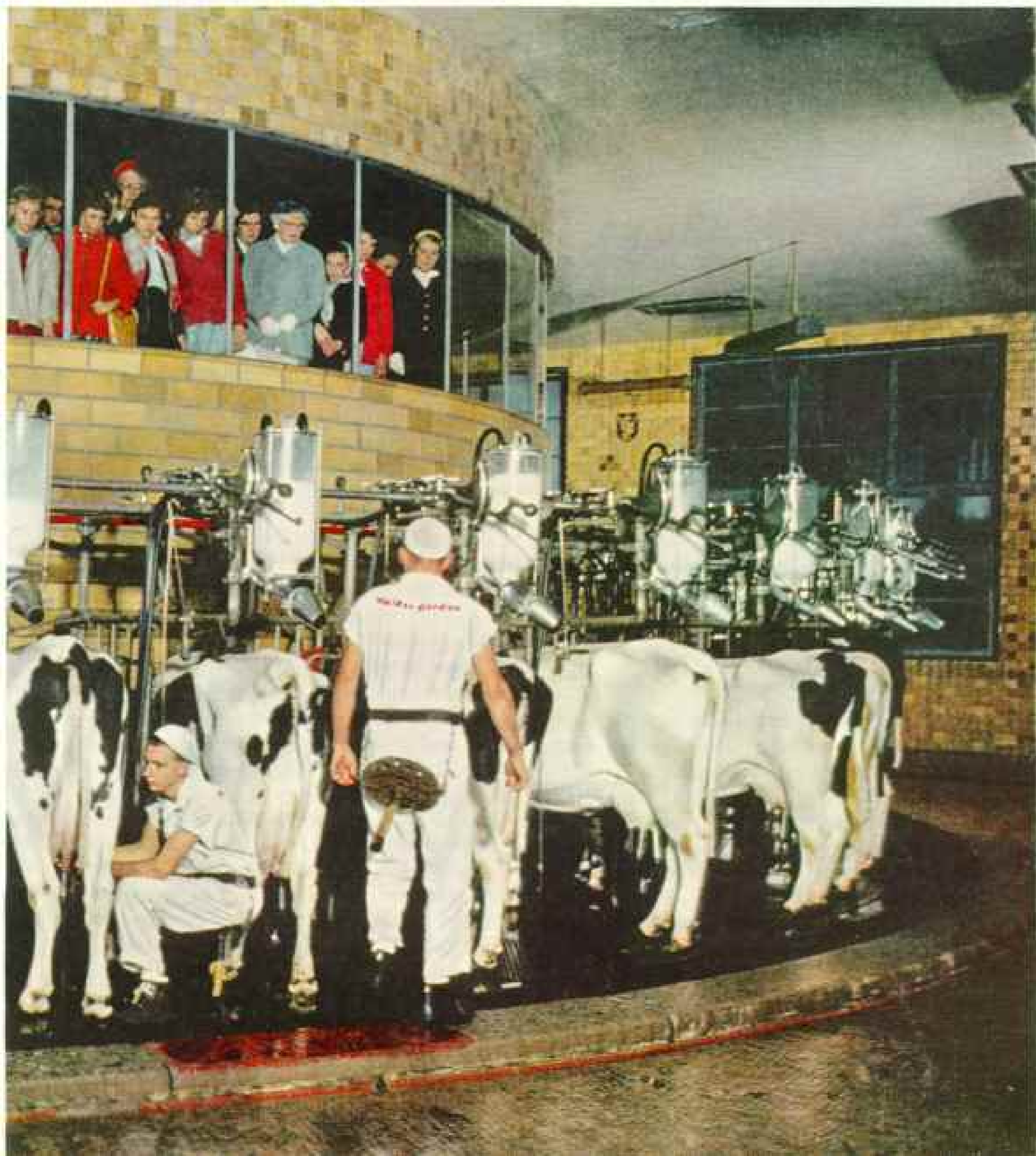


Jerseys Watch the World Go By; Holsteins Ride a Merry-go-round

Walker-Gordon's milk farm, at Plainsboro, milks about 1,650 cows daily on the Rotolactor (lower). More than a hundred thousand visitors a year witness the operation. A revolving platform, the Rotolactor makes a complete turn every 10 minutes, swinging the cows through stages where they are washed, dried, foremilked, and finally drained by machines.

Flowing through a sterilized system of tubes, the milk passes from udder to overhead jar to bottle without coming in contact with the outer air.

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Music From an Old Wax Cylinder Delights Children in Edison's Laboratory

Thomas A. Edison's genius bloomed at this West Orange workshop, now a national monument. Tests made here during his last 44 years led to 520 patents for such marvels as the motion-picture camera, long-playing record, and the alkaline storage battery. The battery alone required more than fifty thousand experiments, perhaps explaining why Edison described genius as "one percent inspiration and 99 percent perspiration." In his youth he perfected the light bulb and phonograph at near-by Menlo Park.

ton's 70 Civil War dead. "Fascinating thing," said Dan. "Thirty-five of them were Union, thirty-five Confederate. That tells as much as anything about how things were here during the war."

Ghost Towns Hide Amid the Pines

North and South merge in the Pine Barrens, about 1,900 square miles of little-used south Jersey pine and scrub oak growth.

Botanical literature of the Pine Barrens tells of trees and flowers seldom found south of New England growing side by side with trees and flowers rarely found north of the Carolinas. I have seen, for one, the delicate southern yellow orchis in the Barrens, 250 miles north of its normal habitat.

Few get to know this frontier, covering nearly a fourth of the State. Broad highways slice its dense walls of trees, and along those highways speed millions of people bound

to or from the Jersey shore. Rare is the traveler who struggles up the narrow side roads to its ghost towns. It's just as well; those sandy tracks can be as treacherous as a country lane after a blizzard.

A few natives still lead the simple life deep in the thickets. They gather sphagnum moss in the cedar swamps, pick and gather laurel and pine cones, or sometimes cut a load of pulpwood. They find their markets where they can, and they leave other people alone, asking only to be left alone in turn.

On one trip to the Pine Barrens I heard of Asa Pitman of Mount Misery. "Rattlesnake Ace" he was called, because he caught and sold rattlesnakes for a living.

Ace had a story which merits—and gets—much retelling. "The missus and me had just got into bed," said Ace, "when I hear a noise in the garret. My snakes was loose! I shook the missus and we went up there in the dark

and all. Had a devil of a job gettin' 'em all back without hurtin' none of 'em!"

The Pine Barrens call me back at all seasons of the year. Especially is this true, however, in spring, when there is a richness of bloom and beauty, and in Indian summer, when chattering birds harvest wild berries and seeds amid fall foliage.

On such a bird-chattering day I ventured into the Barrens to look at the Wharton Tract—95,000 acres of State-owned forestland northwest of Atlantic City. Joseph Wharton, the Philadelphia "nickel king" who once controlled America's supply of that metal, began putting the big tract together in the 1870's. He hoped to use the area's water for Philadelphia, but New Jersey law thwarted that ambitious plan. In 1954-55 the State bought the land to protect the water rights of its citizens.

Joseph J. Truncer, general manager of the Wharton Tract for the State Department of Conservation and Economic Development, waited for me at Batsto, the old village of early ironmasters and glassmakers. When I arrived, Joe was carefully sorting a pile of recently acquired blacksmith tools and fittings. His face shone like a small boy's at Christmas; with such equipment Donald Streeter, a veteran blacksmith from Vineland, has fitted out the blacksmith shop almost as good as old.

Bog Iron Smithy Echoes the Past

"Batsto is from an old Indian name, *Baatstoo*, meaning 'bathing place,'" Truncer told me. First it housed the ironmakers who smelted the bog iron ore—a variety of limonite—from the near-by swamps and streams. Later, when that industry died, glass blowers occupied the settlement.

Batsto's Mansion, or Big House, still stands on the hill. "We'll preserve it as a reminder of how people lived years ago," Truncer said as we walked toward it.

Between the Big House and the company store I noticed a walk with flagstones of odd sameness. I said as much.

Truncer laughed. "Those 'flagstones' are pieces cast from bog iron!" he said. "They used it for everything—including headstones in local cemeteries."

Forty miles of canoe streams twist through Wharton Tract. On those streams—the Mullica, the Batsto, and Wading Rivers—there is rare peace and quiet, despite the fact that only minutes away motorists jam the

highways between Camden and Atlantic City.

Truncer bounced me over a woodland road in a much-abused jeep, heading for a meander in the Mullica. Only canoeists, tract workers, natives—and an occasional writer—ever reach the spot. There we watched the river moving slowly seaward through the bayou. The dark, rippled water looked like highly polished mahogany.

Garden Spot of the Garden State

My route lay west to Hammonton, where spring turns the landscape into a sea of peach blossoms and where, in July, Italians throughout the East gather to celebrate the Feast of Our Lady of Mt. Carmel. Hammonton is on the edge of a broad arc north and west of the Pine Barrens, an arc in which the soil is rich and deep.

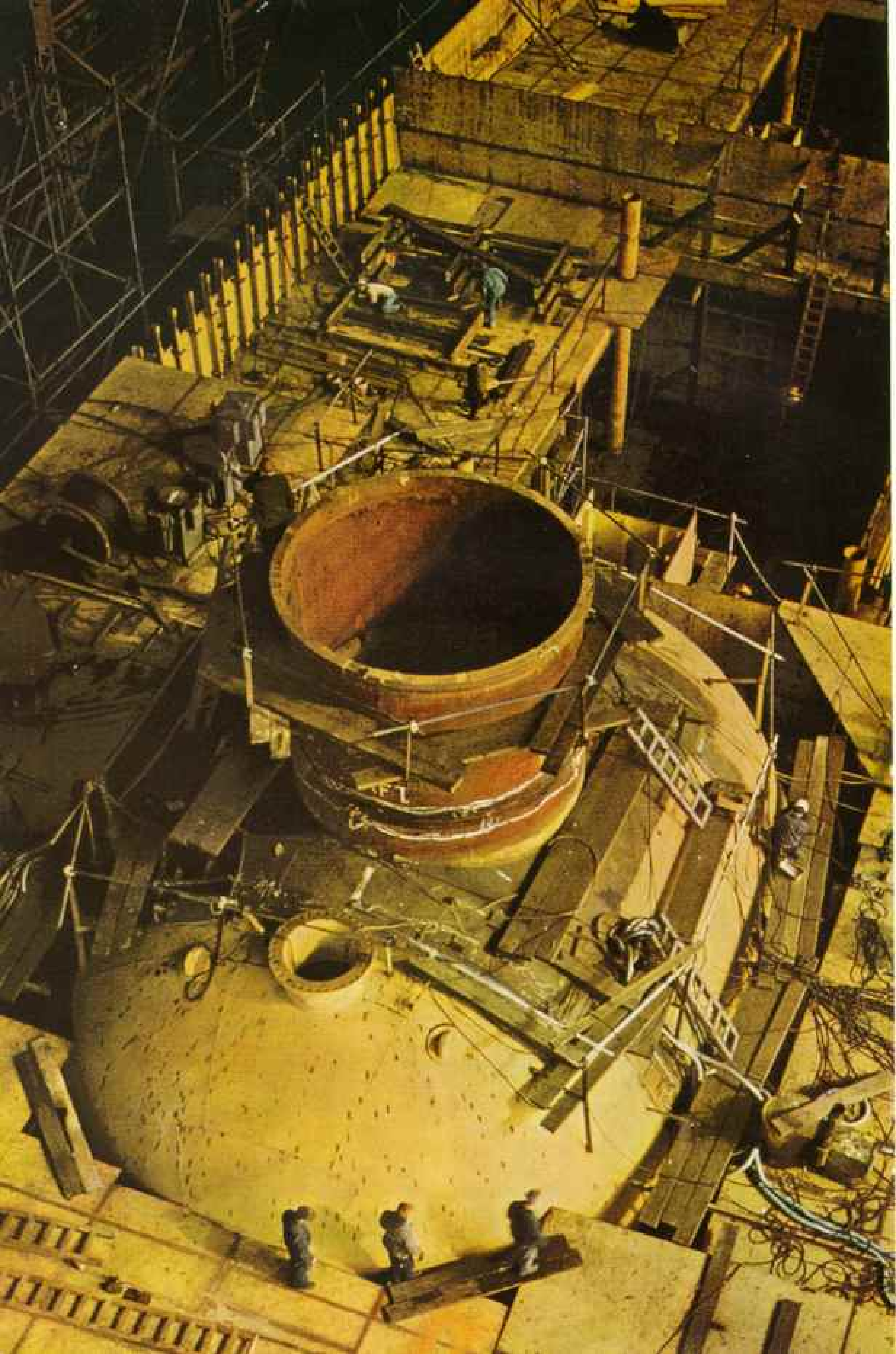
This is New Jersey's "Garden Spot of the Garden State," a region cutting across parts of 10 counties. Here is a land that produces fruits and vegetables for markets and packing houses from the time the first tender dandelions are cut in March until the late spinach is plucked in November.

Color always brightens this garden. In the spring the fields are green with asparagus shoots and yellow with lettuce. June brings rich strawberry color, and, as that fades, the brilliant yellow of tomato blossoms glows on hundreds of thousands of vines. Always there is color: the blue-black of the eggplant, the rich crimson of the pepper, the delicate pink of the peach.

Farming is big time in south Jersey. Plantings are so widespread and harvests so vast that a sizable army of migrant workers must move into the State every summer. Twenty thousand migrants compose the army: half of them are flown from Puerto Rico to New Jersey in a giant airlift between the island and south Jersey airports.

Jersey farming reaches its apex at Seabrook Farms near Bridgeton, one of the Nation's largest mechanized vegetable gardens (page 34). The giant concern processes crops—both its own and those of contract farmers—from 41,000 acres, a fourth of New Jersey's total vegetable acreage.

The mechanization at Seabrook Farms is hard to believe. Machines do almost everything: dig beets, slice off spinach, pluck ears of corn, thrash peas and lima beans from their vines. Crop-dusting planes sweep over enriched fields, tilled by 75 tractors. I'm espe-





Savannah Towers Over Her Launchers at a Camden Shipyard; She Pioneers a Nuclear-powered Merchant Fleet

A chain reaction in 657 pounds of uranium-235, an atomic fuel, will provide the energy of nearly a million tons of coal, enough to propel the *Savannah* 14 times around the globe. The revolutionary vessel will steam at 21 knots with 60 passengers, 9,400 tons of cargo, and a crew of 110. Launched last July by New York Shipbuilding Corporation, the \$40,250,000 craft may make her trial runs next summer.

Egg-shaped tank holds *Savannah's* atomic furnace. This view shows the ship's deck before workmen lowered the 110-ton reactor into place through the funnel-like port atop the container. Blankets of lead, concrete, water, and polyethylene prevent radioactive leaks. In the event of trouble, engineers will be able to shut down the reactor instantly.



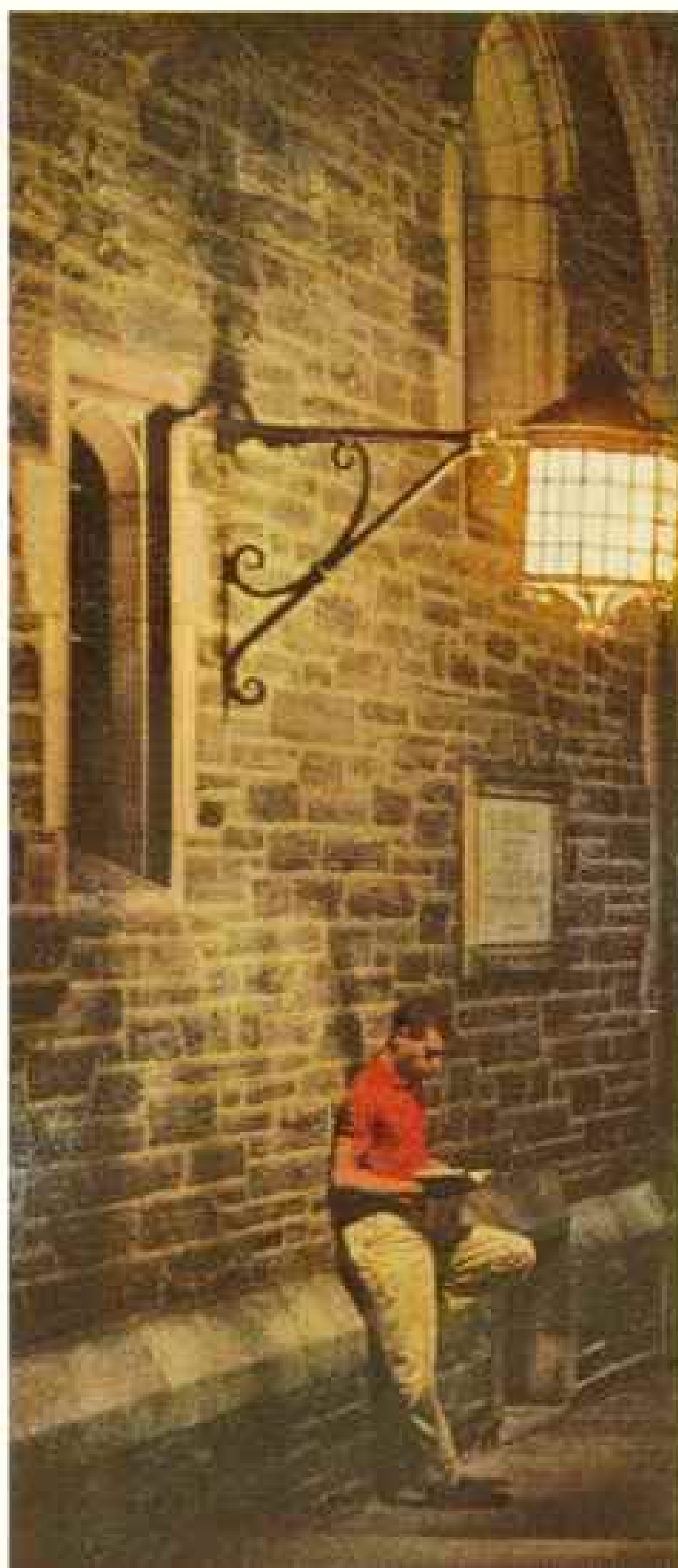
EDITHROMS BY NATIONAL GEOGRAPHIC PHOTOGRAPHER VOLBRAE WERTZEL © N.G.E.

Princetonians Relive Days of 1933 with the Families They Acquired in 25 Years

Each spring the university welcomes some five thousand old grads. In 1958 one of them, Dr. Charles R. Erdman, attended his class's 72d reunion. The blazered seniors of 1933 met at seminars, cavorted at a "fun-and-kicks" dinner, and strutted in the "P-rade."

Blair Hall's Gothic arch frames Lockhart Hall, a Princeton dormitory, seen across the quadrangle. Finished in 1897, Blair set the collegiate Gothic style that dominates the 2,200-acre campus.

Princeton enrollment is about 3,750 men. Woodrow Wilson, class of '79, served as the university's president from 1902 to 1910.



cially fond of south Jersey in August and September, when long lines of trucks, piled fantastically high with baskets of tomatoes, rumble endlessly over darkened streets on the way to canneries in a dozen towns.

Aromatic spices and herbs fill the damp night air to make a visitor sleep well—or, if he doesn't like catsup, to make him see red.

Far and away the largest tomato user is the Campbell Soup Company (pages 34-35). Campbell was founded in Camden in 1869; today the company has plants in nearly a dozen States and in Canada, England, and Italy.

Executives Double as Food Tasters

Politely turning aside questions on production statistics, Campbell constantly stresses quality. Each day Campbell plants throughout the country speed samples of their output to Camden by air. Each day the samples are tasted by experts, who often are joined by company brass in a long-standing company tradition. If the slightest flaw is detected, out goes the faulty item.

Campbell influence in tomato growing is widespread. An executive told me that "half the tomatoes grown for processing in the United States today can be traced to our research."

Agriculture remains vital in south Jersey, but since World War II, industry and home development are rapidly encroaching upon this land once reserved solely for crops. The pace has picked up markedly since completion of the New Jersey Turnpike in 1952.

Some of the industry has jumped clear across the Pine Barrens to locate close to the shore, a prime illustration being the new multimillion-dollar plant of Lenox China Company in Pomona, near Atlantic City.

Potters Learn What the Polishers Do

Lenox maintains its old plant in Trenton, where Walter Scott Lenox began making fine china in 1889, but in the Pomona installation, opened in 1954, a cup or saucer takes less time to make. Stepped-up operations mean no lessening of quality. However, the long one-story building spreads out its intri-

cate operations so widely that the company sometimes wonders if the front end of the building knows what the back end is doing.

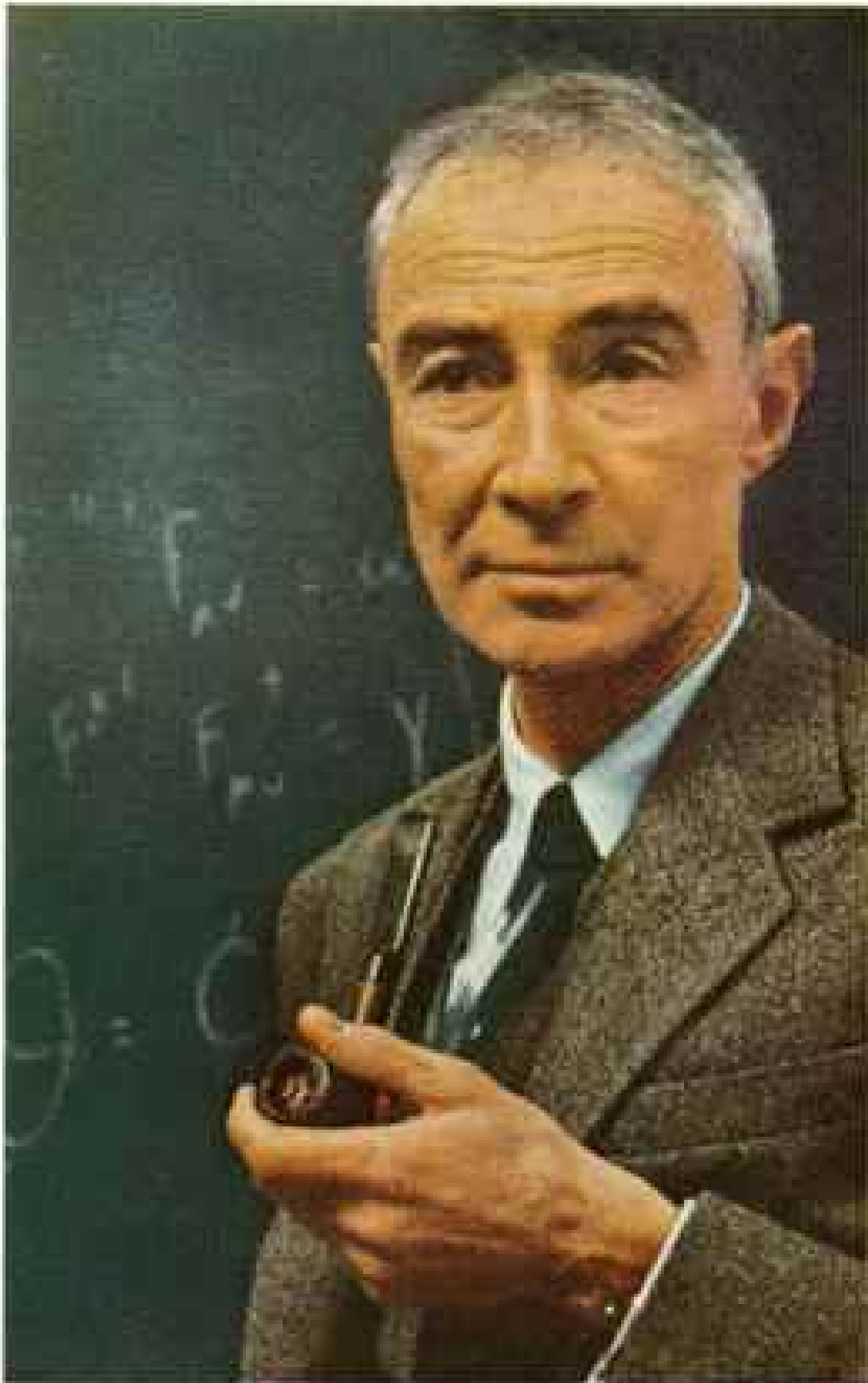
One morning H. Norman McCullough, Pomona plant manager, showed me through the huge plant—through the mounds of raw materials, past the spinning potters' wheels, by the long lines where hands molded the green clay.

We watched the china being fired and then skillfully decorated. As I handled a finished plate, it seemed a far cry from the unsightly raw materials.

McCullough smiled. "You've discovered something that worried us," he said. "We know that the people who are working with the messy green clay can't have a clear idea of what they are working toward unless we show them. That's why we have a constantly changing exhibit in the cafeteria—to tell

SCOTT W. HARRIS FOR NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS REEDER © N.G.S.





Physicist Dr. J. Robert Oppenheimer, one of the creators of the atomic bomb, directs the institute, which he describes affectionately as an "intellectual hotel."

Faces of Learning: Staff and Scholars at the Institute for Advanced Study

Professors hold no scheduled classes, students take no examinations, at this academic retreat in Princeton, the only one of its kind.

Gifted scientists and philosophers, including Nobel prize winners, have come from all parts of the world to develop theories on mathematics, astrophysics, cybernetics, history, and philosophy. One young physicist remarked that he often discussed his own project with his wife. "I talk to her, describe it fully, and she doesn't understand a word. But sometimes, when I'm through, I do."

Mathematicians relax with the music of Mozart. Professor Hassler Whitney and Dr. Eugenio Calabi play violins. Dr. Leonard Gillman the piano. "Not surprisingly, they performed superbly," reports photographer Wentzel.

Mrs. Calabi and the Aldo Andreotti family form the audience.



Famous mathematician Dr. Oswald Veblen is an institute trustee and professor emeritus.





Former envoy to Moscow George Kennan is writing a book on U.S.-Russia relations.



British scientist Dr. Derek J. Price examines some ancient astronomical instruments.



everyone along the way that what he is doing is a part of making fine china."

South Jersey has not had to wait until now to claim diversified industry. For years the area has boasted of production "from pen points to battleships." That would be Camden, home of Esterbrook pens and the New York Shipbuilding Corporation (pages 26-27).

Camden: From Pens to Proud Sea Giants

Rare is the middle-aged American unacquainted with Esterbrook points; the company made 325 million of them in the peak year of 1919. Now in its 102d year, Esterbrook still makes millions of carbon-steel points for world-wide distribution, but the bulk of production is in fountain pens, including hundreds of thousands of desk pen sets.

If Esterbrook deals in numbers, however, the New York Shipbuilding Corporation specializes in bulk. When I stopped by the shipyard at Camden, the first vague outlines of the huge carrier *Kitty Hawk* were taking shape in a deep, specially built graving dock. Far below, men swarmed like ants over the giant steel skeleton, affixing great steel plates with precision.

A shipyard is a place of many sights and a place to test a man's endurance. I hustled for hours after my long-legged guide as we climbed up and down and across the long ways—each 850 feet long, the only covered ways of such size in the country.

One held the beginnings of a submarine. Near by, a merchant ship was only days from launching.

Eventually we reached the drafting room. As far as the eye could reach, men sat under fluorescent lights working at drafting tables.

"How big is this room?" I asked.

"Oh, about an acre or so," my guide said offhandedly, as if all industries had "an acre or so" of draftsmen.

Science Works Tomorrow's Wonders

Painstaking research and planning builds ships in Camden. Such research is a New Jersey hallmark, the State's link with tomorrow's industrial production. Roughly a tenth of the country's industrial research laboratories are located within the State's borders.

Research activity is especially intense at Princeton, partially because of the university's noted graduate school and partially because of pure scholarship at the Institute for Advanced Study (pages 30-31).

Founded in 1930 through a \$5,000,000 grant from the Bamberger family in Newark, the institute has become an acknowledged gathering place for the world's top thinkers. It awards no degrees and holds no scheduled classes. Its work centers in two broad areas—mathematics and historical studies.

Poet T. S. Eliot wrote part of his play *The Cocktail Party* at the institute, and Arnold Toynbee worked there on his 10-volume *A Study of History*. In all, some 4,000 publications have been partly or completely produced at the institute, including works by Nobel prize winners.

Another famed New Jersey institution is the Bell Telephone Laboratories on a hilltop at Murray Hill, one of the world's largest industrial research laboratories.*

Naturally Bell research concentrates on communications—on such things as telephone handsets, wire, and telephone poles—but it knows few bounds. Out of Murray Hill has come basic work in synthetic crystals. There, too, was developed the transistor (page 6), which won its three-man team of perfecters the Nobel prize in physics in 1956.

Nickel Plays Edison's Favorite Tune

Organized research in Jersey began in 1876 when Thomas A. Edison and his team opened a laboratory at Menlo Park. Edison received patents for 300 items developed at Menlo Park, including the incandescent lamp and the phonograph, before he moved to West Orange in 1887. That West Orange laboratory, now part of the National Park System, is open for all to see (page 24).

Visitors can listen to an Edison jukebox (a nickel in the slot produces music), hear his favorite recording of "I'll Take You Home Again, Kathleen," and see his original movie equipment. Near by stands a reproduction of his "Black Maria," the tar-papered movie studio that pivoted to face the sun and give insensitive films of Edison's time the greatest possible amount of light.

Edison's desk is just as he left it at his death in 1931, crammed with thoughts and ideas. The cot where he napped so sparingly is in a corner. A model of the original incandescent lamp stands on the desk. Significant is Edison's chemistry laboratory, where

(Continued on page 38)

* See "New Miracles of the Telephone Age," by Robert Leslie Conly, NATIONAL GEOGRAPHIC, July, 1934.



REPRODUCED BY NATIONAL GEOGRAPHIC PHOTOGRAPHER VOLKMAR WESTZEL © R. G. I.

Robed in red and saffron, a lama leads Kalmuks in Buddhist worship; their temple occupies a cinder-block garage. Refugees who acknowledge Tibet's Dalai Lama as spiritual leader, they survive in Freewood Acres as one of the last remnants of a Mongol tribe.

Japanese-Americans, honoring their ancestors, take time out for refreshment. These girls, whose parents work at Seabrook Farms, danced at the O-Bon Festival, at which, by Buddhist teaching, the souls of living and dead rejoice together.



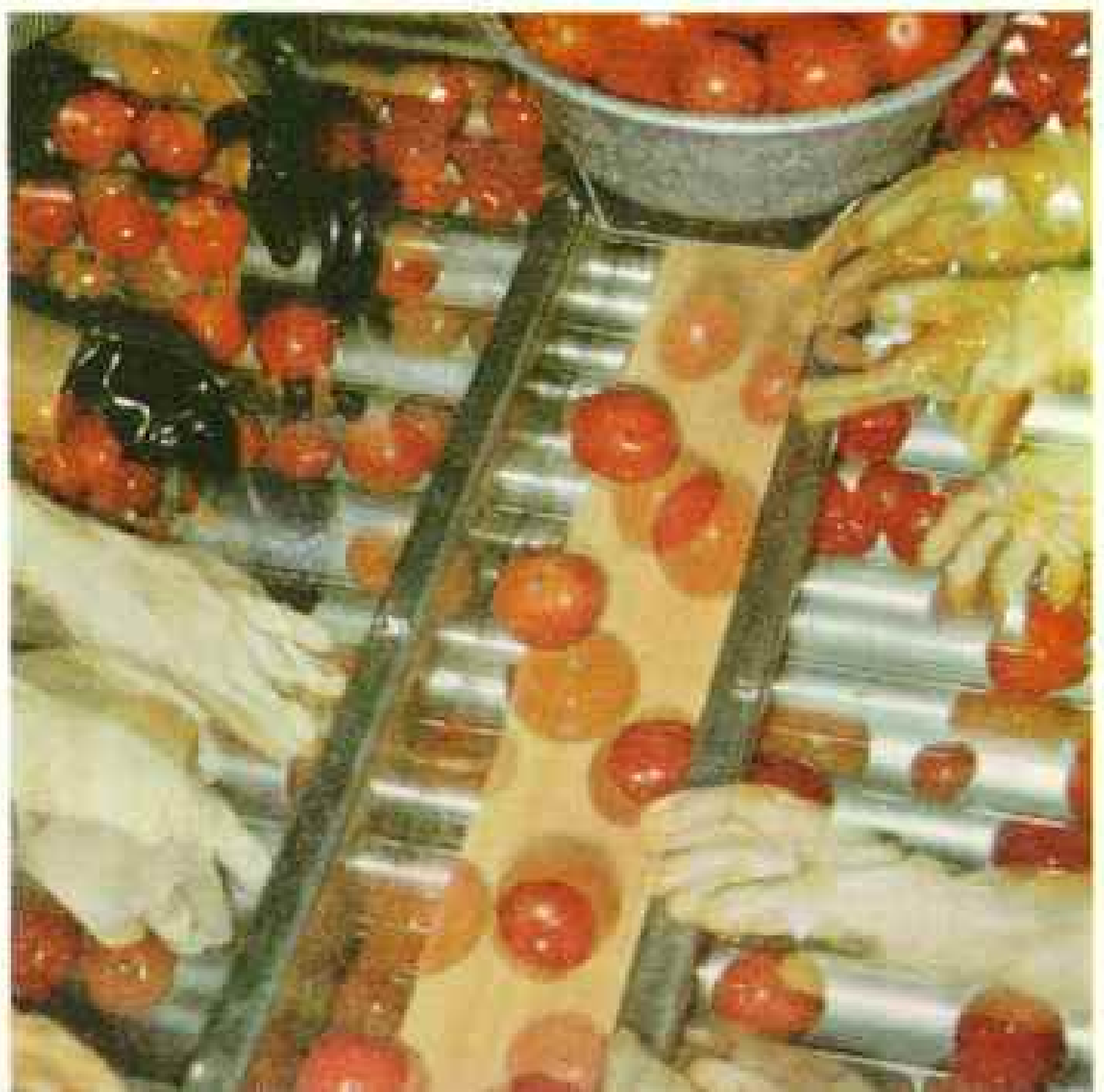


PHOTOGRAPHS BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS

Slicker-clad Workers Soak a Thirsty Crop of Broccoli

Millions of packages of frozen fruits and vegetables come from Seabrook Farms' 16,000-acre mechanized plantation in southern New Jersey. Distances on the farm are so great that supervisors communicate with headquarters by radiotelephone. Assembly-line methods employing 500 workers, 200 trucks, and 75 tractors harvest the crop.

These irrigators operate powerful rotary sprinklers that can deluge fields in a 14-million-gallon-a-day rainstorm.





D. ARTHUR STUART AND VOLKMAR WERTZEL (LOWER LEFT) © R. S. S.

Tomatoes by the Truckload Head for the Soup Tureen

Tons of gleaming fruit in a seemingly endless caravan pour into the Campbell Soup Company's grading station at Camden. The company buys its tomatoes on contract, selling plants to growers at cost and purchasing the entire harvest. Improved fertilization and new varieties bring yields of 20 tons an acre in good years.

An ice-cream vendor on his pedicab takes advantage of this traffic jam.



Ghostly hands in a double exposure sort tomatoes, dropping culls onto the conveyer belt and ripe fruit onto rollers leading to the skinning section.





In the dressing room: *Show Boat* actresses apply finishing touches to face and hair,

Show Boat Sails Beneath a Tent at the Neptune Music Circus

In the summer of 1949 a striped tent rose on a hill near Lambertville. A few nights later the strains of Lehar's "Merry Widow Waltz" drifted across the Delaware Valley. Thus impresario St. John Terrell opened his first music circus. The idea of staging musicals-in-the-round in a tent-enclosed arena swept the Nation; within a decade 13 million turned out to see such shows.

Here Terrell's actors delight a full house.

Behind the scenes: designers paint a hex sign for a musical production at Lambertville.





Ice yachts spread fabric wings on Lake Hopateong. Razor-edged runners allow them

before his death he had extracted rubber from goldenrod.

Chemical research meant Edison was abreast of a phenomenon of the 20th century: the incredible rise of the American chemicals industry. Nowhere has that rise been more marked than in New Jersey, where chemicals manufacture has as many branches as an untrimmed crab-apple tree.

Representing more than a billion dollars annually in the State's economy, the industry centers in Hudson, Essex, Union, and Middlesex Counties. Most noteworthy, however, is the E. I. du Pont de Nemours Chambers

Works at Deepwater in semirural Salem County, near where the New Jersey Turnpike approaches the Delaware Memorial Bridge by the banks of the Delaware River.

Du Pont began the Deepwater plant in 1917 and risked \$43,000,000 in 10 years without a cent of profit. "Deepwater, for sure," grumbled stockholders. "There's no bottom to the need for money!" But today Deepwater prospers as one of the largest chemical plants in the Western Hemisphere.

Edison's work stimulated early electronics production in New Jersey, and World War II bounced it high. Electronics manufacturers





SAFETY ANTI-CORROSION BY REAL P. DAVIS © N.E.E.

to fly four times faster than the wind; the world record is 144 miles an hour

are found now throughout New Jersey, but the largest of all is Radio Corporation of America, with division headquarters in Camden and branches at 40 other sites throughout the State.

RCA's beginning involved an enterprising machinist, one Eldridge R. Johnson, of Camden, to whom Emile Berliner brought a "talking machine" in 1896. It sounded, Johnson wrote, "like a parrot with a sore throat," but he became interested "as I had never been interested in anything before."

So interested, indeed, that he founded the Victor Talking Machine Company in 1901.

Receipts totaled a tidy \$100,000 the first year; then, as Johnson relieved the machine's sore throat, income rose astonishingly to about \$1,000,000 by 1905—a jump of 900 percent in four years!

Today nearly twenty thousand men and women work for RCA in the Camden area. Production at this original site no longer includes "talking machines" or phonograph records, but instead ranges from pocket-size two-way radios to mammoth electronic computers, which anyone with the need and \$1,000,000 or so in ready cash can buy.

In looking ahead, RCA has not turned its

thunderous surf breaks only a few hundred yards from the resort's summer cottages

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KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER R. ANTHONY STEWART © N.E.E.



back on its heritage. The famous old trademark of Nipper with an ear cocked to His Master's Voice still stands in the tower of one of the buildings where it has served as a landmark for nearly 60 years.

Much of RCA's future will derive from its neatly landscaped David Sarnoff Research Center in Princeton, where such things as the electron microscope, an atomic battery about the size of a matchbox, and a solar battery to harness the sun are being perfected.

Human Tides Flood the Jersey Shore

Sooner or later most Jersey men—be they north or south, factory workers or farmers or researchers—go to the Jersey shore. There they become part of a throng from all over the land.

What the visitor seeks he can find at some 60 resort towns along the New Jersey coast. If he wants bustling boardwalk life, tense with noise and excitement, he goes to Atlantic City, Asbury Park, Long Branch, Point Pleasant, Wildwood, or a dozen smaller resorts.

If he wants comparative quiet, perhaps even a bit of Cape Cod or Newport atmosphere, that's available in a score of locations—Cape May, Avalon, Stone Harbor, Long Beach Island, Bay Head, Sea Girt, Deal, Spring Lake, Ocean Grove, to mention a few.

Nearly a quarter of all Jersey shore visitors find their way to Atlantic City (pages 42-43). I prefer a quieter spot in summer, any of half a dozen Cape May County resorts. In winter, quite the other way, I like Atlantic City very much.

That's because Atlantic City knows how to entertain. Nothing is too big, nothing is too small, for the city of amusement. All fall and winter, when other resorts hibernate, Atlantic City stays alive, catering to every species of conventioner—doctor, lawyer, labor leader, industrialist, policeman, legionnaire.

Atlantic City impresses me by its ability to take the crush of a crowd, then recuperate and leave no outward sign that anything un-

usual has happened. Last fall I sat with 300,000 others in specially erected boardwalk bleachers to watch the Miss America Pageant parade. We dropped papers, tossed away programs, shelled peanuts, let gum wrappers fall.

Late that night, as I walked to my hotel, the crowd had vanished, leaving behind only its debris. Crews of workers moved silently through the night, putting the Boardwalk to rights. By morning nothing remained to indicate that even an early-morning bather, much less a huge crowd, had passed that way.

Miss America symbolizes Atlantic City's devotion to promotion. As Miss Ada Taylor of the Claridge Hotel once put it to me:

"We live on ocean, emotion, and constant promotion!"

After seeing earlier pageants via TV, I didn't know if I could enjoy this continuing bit of seashore folklore (it has been going on since 1921). But I did.

Three preliminary nights dragged, true, but as the finals moved to a close in the tremendous auditorium on Saturday night, the emotional atmosphere heightened (page 44). A blase New York newspaperwoman leaned over toward me as stately Miss Mississippi walked alone down the runway, the newly crowned Miss America of 1959.

"By gosh," said the writer, almost in amazement at herself, "she *really* is a queen!"

Beauty of Many Sorts Crowns Jersey

Miss America is beauty to be remembered year in and year out. But the man who takes the trouble to discover New Jersey finds inspiration in many other things as well.

He finds it in the big oyster fleet which sails at dawn each day in season from Bivalve into Delaware Bay. His imagination is quickened by tramping across the Salem County marshes, where trappers each year bag tens of thousands of muskrats. He thrills to the sight of herons and egrets coming home against the setting sun to roost in the holly trees at Stone Harbor's sanctuary. Certainly

Diving Horse Scores a Bull's-eye From a 40-foot Tower in Atlantic City

Down into 12 feet of water plunge Marion Hackney and her mount Lorgah, a Texas cow pony. They learned the stunt from Lorena Carver, who first made the leap in 1912 at the age of 11. Now retired after a quarter century of diving and 25 broken bones, Miss Carver brought diving horses to the resort's steel pier in 1930. "In the old days," she recalls, "I simply grabbed a handful of mane. If it pulled out, I beat the horse to the water." This photomontage shows Miss Hackney clutching a safety harness. A clown teeters on the rim of the 22-foot-wide tank.



Gingerbread Castles Built on Sand Line Atlantic City's Surf-swept Shore

Largest of New Jersey's seaside resorts, Atlantic City plays host to 16 million visitors a year. Sightseers dance to name bands, shop for Irish lace or Chinese jade, dine in fine restaurants, and frolic in the ocean's foam. Each summer lifeguards rescue some 1,200 swimmers.

As many as three hundred thousand fun seekers jam the famous Boardwalk in a single day. Sixty feet wide and more than five miles long, the strip creates an ocean-front midway of noise and neon. Dating back to 1896, the structure will be rebuilt for the 1960 season.

Founded 106 years ago, Atlantic City perches on an island stabilized by wooden piles against the nibbling of the sea. Its temperatures gentled by the huge thermostat of the Atlantic Ocean, the resort attracts many winter conventions.

This view shows a stretch of the Intracoastal Waterway beyond the cupolas and gilded domes of beachfront hotels.

Ride in a roller chair takes three board walkers off their weary feet. Iron-legged pushers wheel two thousand of the wicker-covered perambulators through the Boardwalk's confusion.

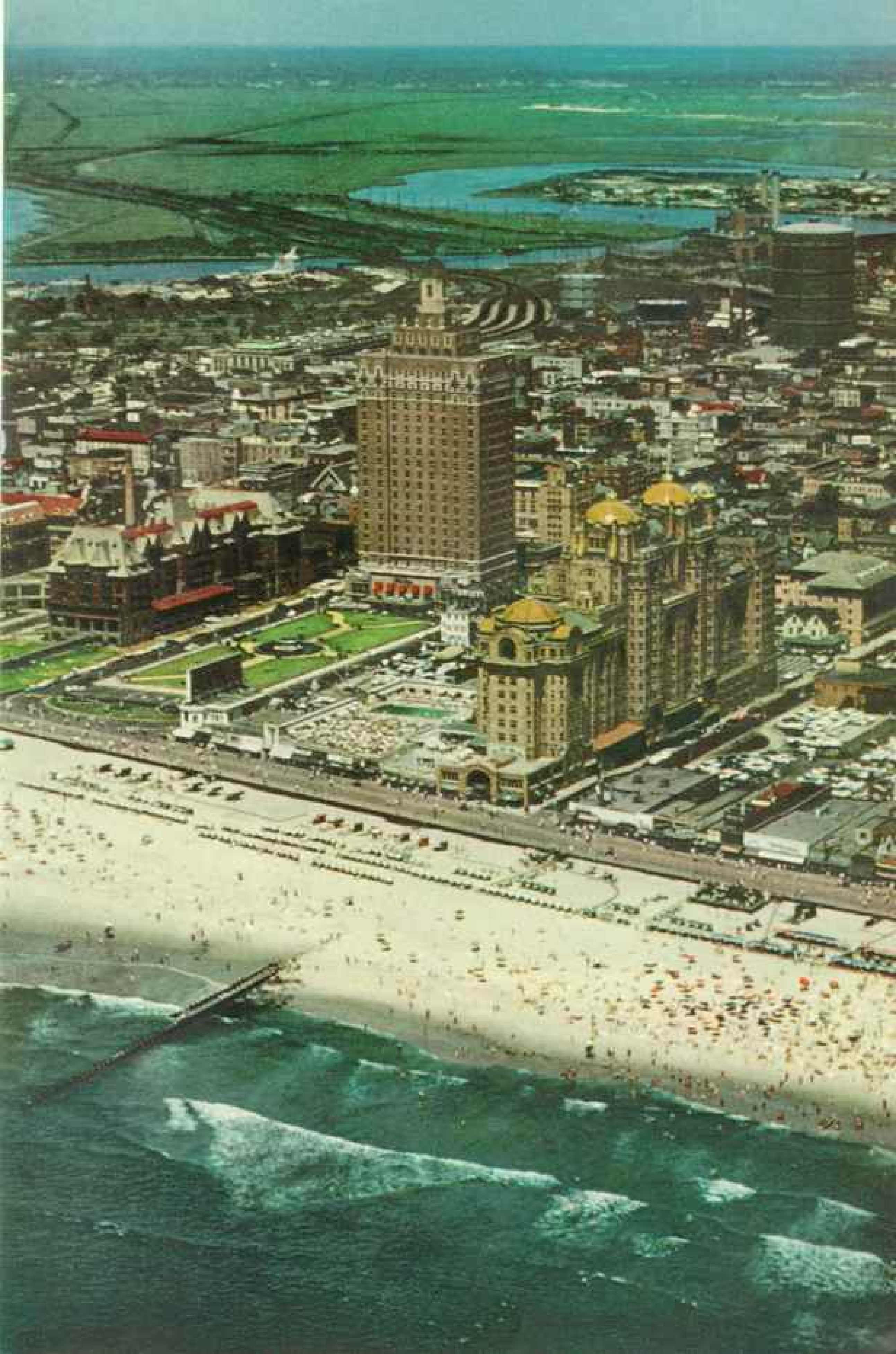
Originally reserved for convalescents, the chairs made their debut in the 1880's.

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KODACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © A. G. I.







Atlantic City Selects a Miss America in a Dazzling Nighttime Spectacle

he finds beauty in the north Jersey orchid greenhouses, where more than two million orchids blossom annually (page 8). Many a young Texan or Californian has taken a bit of New Jersey with her to her first ball.

Traveling back-country roads can bring a man to Hope, Harmony, and Tranquility, all close together in the hills of Warren and Sussex Counties—and those three villages are as pleasant as their names would imply.

During the four-day contest at the seashore, State champions vie in exuding charm, exemplifying poise, conversing knowledgeably, and per-

Equally, however, a man can find Double Trouble in Ocean County, although the cranberry bogs bordering the village scarcely deserve the ominous title.

There are always surprises in New Jersey—and at times it takes an outsider's viewpoint to bring the lesson sharply home. Driving through the State with B. Anthony Stewart, chief photographer for the NATIONAL GEOGRAPHIC, I told him of New Jersey's reputa-



RODACRYONE BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © R. G. S.

forming creditably as singers, dancers, instrumentalists, or actresses. Here, at last, they move across the stage simply as beauties. Ten finalists

parade the runway, each hoping to be acclaimed Miss America. During her reigning year the winner will earn more than \$60,000.

tion for breeding fine thoroughbred horses. He seemed interested, but not impressed: he had photographed Kentucky's blue-grass country.

One golden September day Tony Stewart and I went down to the Helis Stock Farm in Jobstown, northeast of Mount Holly. Miss Peter Cole, field secretary of the Thoroughbred Horse Breeders' Association of New Jersey, took us across the 1,500 acres of pastureland and showed us stables with stalls for more

than 200 horses. We saw a half-mile covered track where horses can be raced year round. Outside, white fences contrasted handsomely with lush green grass where brood mares and colts nibbled. I liked it, being a New Jersey enthusiast, but Tony Stewart needed only to react with polite professionalism.

Instead he said softly, "I've seen horse country in a dozen States, but not like this."

New Jersey never seemed better.

Once a great kingdom, "the Land of the Million Elephants and the White Parasol" faces its struggle for survival with energy and hope

LITTLE Laos

NEXT DOOR TO RED CHINA

By ELIZABETH PERAZIC

A LEGEND OF VIENTIANE, capital of the Kingdom of Laos, recounts a strange attack against the city centuries ago.

An army of the king of Luang Prabang lay outside Vientiane's tall sandalwood fortifications. It was the tenth day of the siege, and the men from the north were growing impatient. Showers of arrows from their crossbows had not brought surrender.

Inside the city, confidence reigned. The defenders felt able to hold out indefinitely.

Suddenly a stream of golden arrows flashed over the walls. Unbelieving, the besieged warriors picked them up and found that the arrowheads had been dipped in molten gold and were heavily plated.

More Arrows—Then Sudden Death

Next the watchmen reported excitedly that the attackers were packing up their equipment and melting into the forest. As they withdrew, they fired more volleys of golden arrows. Many stuck in the walls.

"A tribute to an unconquerable foe!" the defenders thought, as they waited until long after the enemy disappeared.

Carefully at first, and just a little, they opened the gates. Soldiers ran through to pry the arrows loose. This was too much for the guardians of the gates; they joined the rush. Then, like bees a-swarming, the arrows came again, this time bringing sudden death. In moments the city was taken.

Today Vientiane and all Laos again are



Rain in Nam Tha Pelts Lao Troops
Returning From a Jungle Patrol



RESEARCHED BY JOHN W. KESHLEMAN, M.S. © NATIONAL GEOGRAPHIC SOCIETY

Vulnerable Laos shares 1,000 miles of frontier with Red China and North Viet Nam. Communist influence is strong in several areas. France

trains and the United States equips the 25,000-man Lao army. Since 1955 the U. S. has sent more than \$225,000,000 in aid.



threatened. The golden arrows now are Communist propaganda and infiltration. By its very geographical position, as next-door neighbor to Communist China and North Viet Nam, Laos finds itself in the front line of the struggle against Communist expansion.*

My husband and I came to Laos four years ago in connection with the American aid program, whose mission is to help this small nation strengthen its economic and social structure.

Before leaving the United States, we tried to learn what we could about our home-to-be. There wasn't much information available in English, and not a great deal even in French. For example, there are no reliable population figures; estimates range from 1,500,000 to double that many.

Lao Boot Lacks a Toe

We did learn how the people pronounce their country's name: the "s" is silent, so that Laos rhymes with "how." On the map we could see that it is shaped somewhat like Italy, except that the boot lacks a toe (map, page 50). It is about 650 miles long and from 55 to 300 miles wide, covering an area of some 91,000 square miles. Forested mountains make up two-thirds of the country. Two large plateaus, the Bolovens in the south and Tran Ninh in the north, together with the Mekong Valley, provide almost its only level areas.

For about 500 miles between Laos and Thailand, the Mekong River serves as a border. Here there is scant need for defense, though this was not always so. But on the critical north and east, where wild peaks jut six to eight thousand feet into the sky, border defense can be a military nightmare.

We went to live in Vientiane, the economic and administrative capital. (The royal and religious capital, the town of Luang Prabang, lies an hour's flight farther north.) It was hard to think about invasions and the Communist menace the day Nick, my husband, took me for my first sightseeing tour.

Though it has more than 60,000 people,

Vientiane is really a big overgrown village nestling at a bend of the Mekong, which at low water splits into two brown streams.

It was February, toward the close of the dry season, and a light wind, blowing off the broad expanse of dry river bed and clifflike banks, sifted red dust over us. The same red dust lay thickly on the thatched houses of the Lao working people.

Yellow stucco buildings with weathered red roofs—almost a trademark of the French throughout Indochina—stood at intervals along the main street, the old Rue Maréchal Foch, renamed Setthathirath.

We passed the hospital, the police buildings, the Ministry of Public Works, the Post, Telegraphs and Telephones office, a movie house, the Bank of Indochina, and scores of the little open-fronted shops of the Chinese and Indian merchants.

Children played in front of the shops or squatted contentedly, eating noodles and shredded vegetables from little bowls with blue-and-white china spoons. All the smaller children toddled naked in the white sunshine. We saw more than 40 *wats*, or temples, their roofs of blackened tiles decorated with undulating gilt nagas, the serpent guardians of the kingdom.

Strange Americans Take No Nap

Today a new sense of destiny animates this sprawling city. In a few years the town has burgeoned from a quiet Oriental village half asleep in the sun to a bustling place with roaring automobiles and trucks, though not yet nearly enough roads. Hundreds of bicycles bear what are surely the world's most hazardous riders.

Many new buildings reveal hasty construction. Altogether there is an air of racing to catch up with the second half of the 20th century—except for the hours from noon until three o'clock, when almost everybody but the

* See in the NATIONAL GEOGRAPHIC: "War and Quiet on the Laos Frontier," by W. Robert Moore, May, 1954; and "Indochina Faces the Dragon," by George W. Long, September, 1952.

Face the Camera! Soldier Coaxes a Lens-shy Akha Girl Into View

Generations ago, bands of Akha peoples migrated south from China to the hills of northern Laos. Often called Kha Kho, they are not related to the Kha tribesmen of Indonesian descent who originally occupied the land.

The photographer, Dr. John M. Keshishian, spotted this girl beside a food vendor in Muong Sing. An obliging soldier persuaded her to pose. Her headdress of silver beads, and shells identifies her as an Akha.



Landlocked Laos lies open to invaders on north and east. Communists have held areas in Sam Neua and Phong Saly provinces since 1954.

Laos, Cambodia, and Viet Nam entered the 20th century as parts of French Indochina. Laos won independence in 1953. Only twice the size of Pennsylvania, the little nation stands as a buffer between its free neighbors and the menace of Red China.

strange Americans sensibly goes to sleep.

Laos has some catching up to do. Seldom in modern times has a nation faced the future with so little of the world's goods and so few men trained to guide her through the critical years ahead.

Vientiane—the name is a French version of the Lao “Vieng Chan”—was once the capital of a rich and powerful kingdom called Muong Lan Xang Hom Khao—Land of the Million Elephants and the White Parasol. From the 14th to the 18th centuries it was a power in Southeast Asia, with borders far beyond its present ones. Many Lao still call their country Lan Xang.

Eventually the kingdom split into factions, and part of it was ruled by Thailand. Then came half a century of French rule, followed by World War II and a series of disasters from which Laos has not yet recovered.

The country was first occupied by Japanese,

then by Chinese troops. The burdens of occupation, followed by Communist invasions in 1953-54, left the nation depleted and poor, her livestock industry and agriculture largely demolished, and with only a handful of men capable of taking over the reins of government.

At present the United States Operations Mission, the United Nations, and France, among others, are helping Laos rebuild. But the process is time consuming, as we were to learn.

House Hunt Leads to Fish Story

First thing after our arrival, we had the job of house hunting. In the early days of American aid the director and his few assistants lived in tents. Finally, after 18 months of living with friends and in a makeshift apartment, we got our home, a new cement-block house about four miles from town.

Strangely, our early house-hunting expeditions provided an introduction to one phase of the Lao economy—fishing. A friend had told us about a house for rent on the airport road. When we went to see it, the landlady remarked chattily that its front yard flooded in the rainy season, making it necessary to wade to and from the road. She pointed out, however, that we could catch plenty of small edible fish in the pool.

Fish in a rain puddle? I found this hard to believe, but when the first rains came soon after, I discovered that the hard, dry rice fields do, in fact, come alive with small fish. Almost any afternoon we could see the women and children with baskets or nets garnering the small catches.

Fish is a main source of protein in the Lao diet, and as we traveled over the country, we learned the numerous methods of fishing.

It was a joy to watch the fishing boats on the Nam Ngum, their huge nets shaped like geometric spider webs. The boats are called *kampan*, large craft often roofed over with woven palms which make them look like covered wagons (page 66). Nets are let down into the river by a pulley arrangement.

Noise Fails to Frighten Catfish

At Ban Mouang, in southern Laos, we saw smaller nets used. I was always astonished that anything was caught because of the racket made by the assembly of fishermen and kibitzers. But some large catfish and a good many small fish were trapped each time the net was lowered.

Most impressive of all Lao fish is the monster called *pa beuk*, found in the upper Mekong. It weighs as much as 450 pounds.

I formed the habit of arising about 5 a.m.



JOHN W. FERRIS/ANSA/RETNA

Bound for the Front, a Plane Loads Supplies for Air Drop to the Army

From the airport at Luang Prabang, the de Havilland Beaver will fly 130 miles east to Sam Neua, scene of heavy fighting between Lao and Communist troops. Airlift provides the only practical supply line for armies in the hill country. Says the photographer: "You may walk four days to reach a point 20 minutes away by air."

and found that my Lao neighbors rose as early. The mornings were cool, and the bright-blue sky, with its ever-changing cloud formations, beautiful beyond telling.

While Nick and I had early tea, we watched the Lao women light charcoal braziers and cook glutinous-rice and fish for the morning meal. Our neighbors rarely had tea or coffee; usually they drank only cold water.

About six-thirty I visited the market run by women, mostly Vietnamese. Strolling the stalls, I got a close-up of the crowds.

Here a Lao peasant woman squatted behind her tray of yellow mangoes, her gray hair cropped short and standing straight up. Thus she served notice on the male population that they no longer claimed her interest, as she had passed the age of childbearing.

Lao women, in Western-style blouses and dark silk skirts with broad silver or gold bands near the lower edge, shopped for leaf lettuce, string beans, eggplants, or papayas. They wore their hair drawn back tightly from the brow and arranged in an intricate knot high on the back of the head and slightly to one side (page 60).

Stout Chinese women, in pants and tunics, bought vermicelli, or shopped critically among the shallow enamel pans full of live catfish and eels. A sari-clad Indian girl or one of the wives of the local Pakistani merchants smiled fleetingly as she led a smoky-eyed youngster by the hand.

And always the slender little Vietnamese women, in black sateen pants, long white tunics, and lampshade hats, smiled, chattered, and bargained. Adding to the noise and color were French and American women with their cooks.

Black Thai Fled Communist Rule

Thai women servants, their hair bobbed and curling about their faces, made careful selections from the roughly hacked meat. By some legerdemain they bring it to table looking like a handsome filet. The best of them work an added miracle by making it tender.

Walking among the shoppers, I noticed a stately Thai Dam (Black Thai) woman, her softly rounded face and slightly slanted eyes reflected in the solemn-faced baby she carried on her back.* She was one of the group that fled when Communist terror flowed

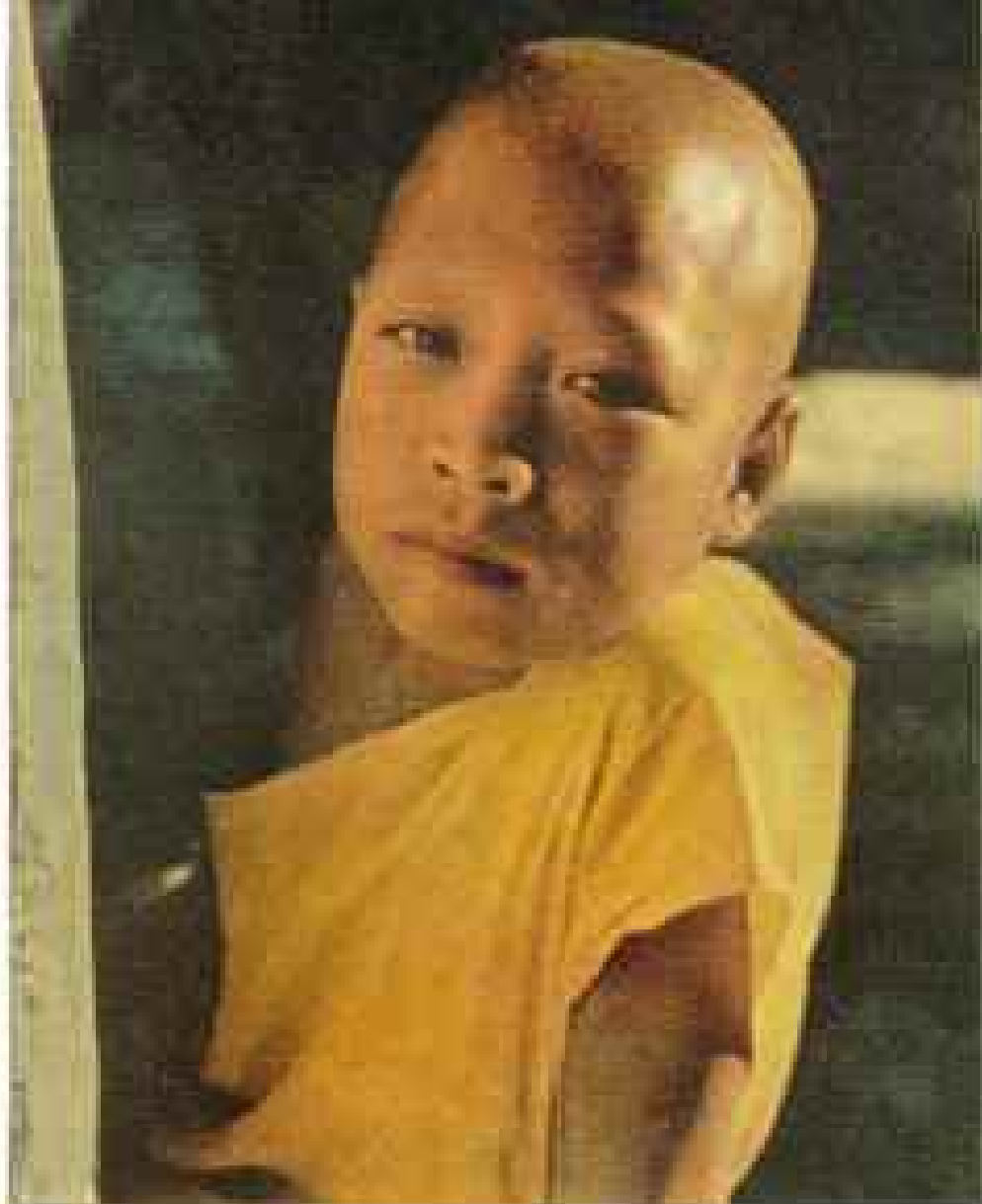
over the northern villages and now is settled on land given by the Royal Government near Vientiane and Luang Prabang.

She was dressed in a bright blouse and tubular black skirt; her hair was swept up into a knot to show that she was married. Over it she wore a black headdress edged with red embroidery and little crochet balls.

When I finished shopping, I was surrounded by *samlor* (three-wheel) boys in dark-blue uniforms and chauffeur caps. Jouncing along in my little tricycle carriage, I saw sights that fall strangely on Western eyes. One I remember with pleasure was of a baby no more than a year old, naked,



* See "New Guinea to Ball in Fawkes," by Irving and Electa Johnson, NATIONAL GEOGRAPHIC, December, 1959, page 793.



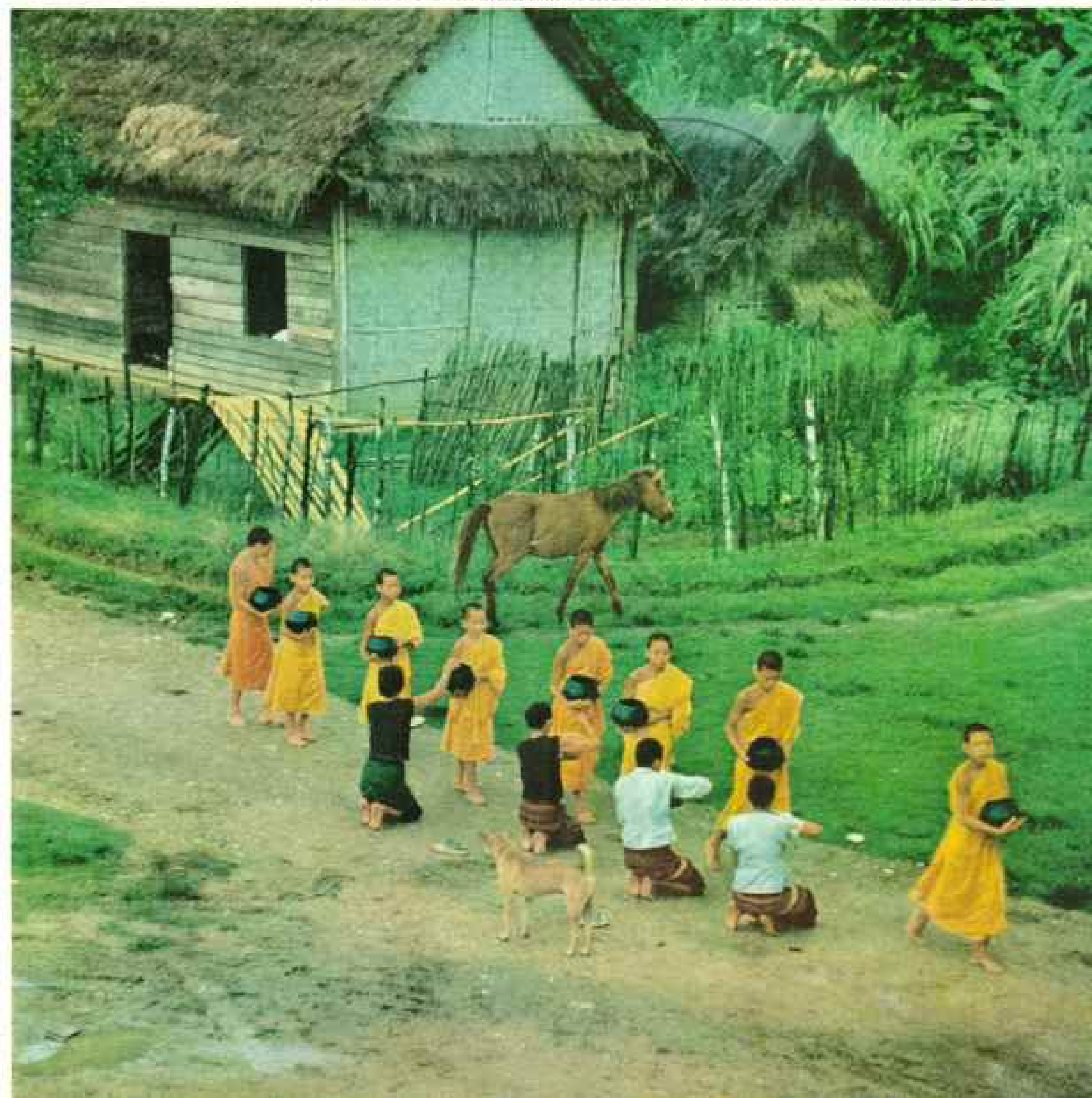
Shaven Head and Saffron Robe Mark a Boy as a Buddhist Novice

Most young Lao men spend at least a few weeks in a monastery before marriage, a custom designed to help them become good husbands. They may become novices in childhood years, but entry into the priesthood takes place only after 20. Bound by no vows, apprentices may abandon the yellow robe at will.

Novices accept breakfast from women who kneel along a Nam Tha street. The donors drop food into each youngster's bronze bowl. The boys will return to their cells to eat and pray. By feeding or caring for a *khouba*, or monk, Buddhists believe they store merit for life after death.

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PHOTOGRAPHS BY W. ROBERT MOORE, NATIONAL GEOGRAPHIC STAFF (LARRY) AND JOHN W. KEENEHORN, M.D. © N.G.S.





PETER FORBESON © NATIONAL GEOGRAPHIC SOCIETY

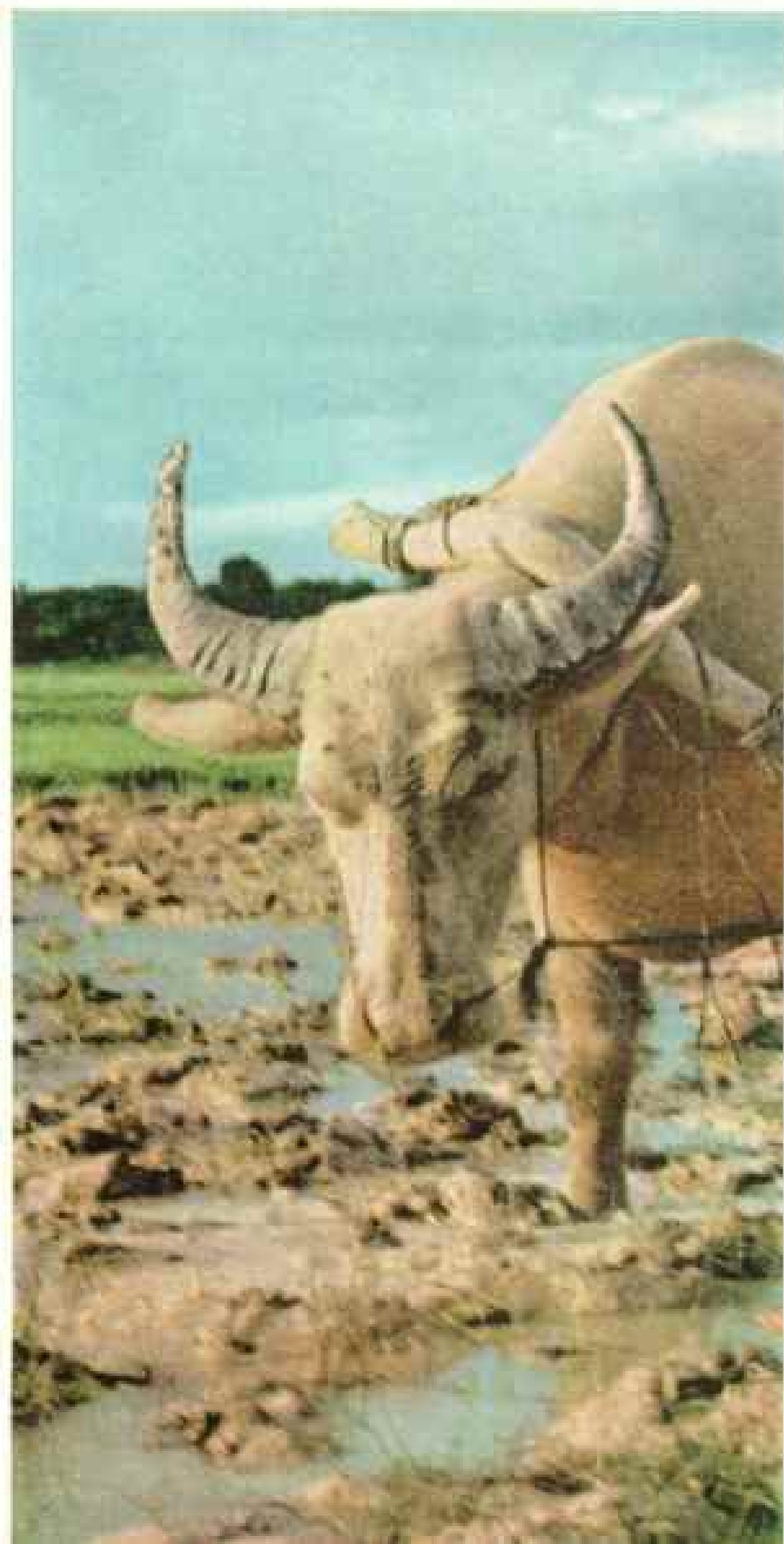
Harvest starts after the monsoon ends in October. The Lao eat "sticky" rice, a glutinous variety used in other countries to make pastries and alcohol. This girl balances rice sheaves on a bamboo pole. Silver in her belt came from old Chinese coins.

Hoek-deep mud slows a plowman and his buffalo in this Mekong Valley rice field. Heavy rains and occasional floods water the thirsty crop. Wooden plows, some with metal blades, bite deep furrows. Hill people, unlike valley folk, use the *hai* method to grow upland rice or maize. They burn off their fields just before the monsoon and plant in the ashes.

squatting like an adorable little Buddha on the back of his young mother's bicycle. I recall another youngster, equally bare, wearing a beanie with a whirling windmill on his skull. On my way home, too, I usually saw little boys trotting off to the temple schools where they learn the principles of Buddhism from the *khoubas*, the yellow-garbed monks.

The Lao learn an enviable philosophy of life: respect for elders, for the priesthood, for king and authority; abiding family and village loyalties, love of gaiety, a gentle patience, and a desire to share with others. Rarely does one meet children as obedient yet not subservient, as well-mannered and charming and still full of mischief, as the children of Laos.

The number of invitations we received and



had to return, and the laborious gadgetless housekeeping, made a servant or two necessary. So we hired Houane (pronounced Wan), and started from scratch. This kind of housekeeping was new to me and, I found, to Houane.

He came dressed in an incredibly ragged army uniform. His sole other possession was a treasured pair of black shoes. So Nick and he went shopping to buy khaki shorts, a few work shirts, and (with the entertaining in mind) a pair of black pants, a white shirt, black bow tie, and socks.

Smilingly, Houane started to teach me the language by pointing to objects and telling me their names. Under his tuition I soon learned to count in Lao and to know the

names of many fruits and vegetables. Most educated people speak French. The priests speak Lao, Pali (the sacred language of Buddhism), sometimes French, and, increasingly, English. So with a melange of three languages, I made myself understood.

Second King Helps Lao Monarch

As we got to know the country, we found that the Lao comprise only about half the population, though politically they are the dominant group.

The ruling house of this constitutional monarchy is headed by aged King Sisavang Vong, at Luang Prabang; but in addition the Lao also have what is known as the Maha Oupahat, or Second King. This is an unusual

BARBARA HERR © NATIONAL GEOGRAPHIC SOCIETY





PETER ROBINSON (LEFT) AND JOHN J. BEGAN © NATIONAL GEOGRAPHIC SOCIETY

Awninged Ox-carts Thread Terraced Fields Near Vientiane, the Lao Capital
 Laos has no railroads and few highways. Several airlines serve the country. In some remote areas elephant caravans carry loads, but most cargo moves by river boat, ox-cart, or porter. Outsized wheels lift these wagons above muddy roads in monsoon season.



Yao tribesman, from the hills of northern Laos, visits Muong Sing to barter peanuts and maize for rice and bright clothing, such as his red turban.

office, created originally to attend to all kingly duties that fell beneath the personal attention and dignity of the king.

Actually, since the king is ailing and Prince Phetsarath, the Second King, is getting old, the greater part of the royal duties devolve upon Crown Prince Savang Vatthana, who last September was named regent (page 58).^{*} The royalty, plus a cluster of prominent families, constitutes the elite of Laos. Officials at top level are drawn from these and from good families a little lower on the scale.

There is good reason for this: virtually no one else is competent to do the work. Secondary officials, also, are usually related by blood or marriage to the prominent families. Of this elite, many are widely traveled men.

There is a small but slowly emerging middle class composed of government clerks, minor bank officials, store clerks, and others of similar occupations. After these come the peas-

^{*}As we go to press, news is received of the death of King Sisavang Vong and the accession of the Crown Prince.

ants, more than 90 percent of whom are illiterate.

The Lao probably first migrated into their present territory from Yunnan in China between the 11th and 13th centuries. They came as trespassers into the kingdom of the Khmer, the rulers of Cambodia. Finding the edge of this domain thinly populated by primitive racial groups, they pushed them back into the forests and mountains. They called them all Kha, meaning slave or barbarian. Some Kha are slender faced and fairly light; others are darker skinned.

A true Lao has a clear light-brown color, fine unslanted dark eyes, straight or slightly wavy black hair, well-formed mouth, and sturdily built body. Lao women are taller than average for Southeast Asia and are noted for their serene beauty.

Laos Achieving National Unity

An assortment of other tribesmen—the Ho, the Black, Red, and White Thai, the Lu, Akha, Yao, and Meo—now occupy the mountains. All are more recent migrants from southern China. On a jeep trip to Muong Kassy in the mountains of northern Laos, we saw many of them and learned something of the odd geographical stratification of the people.

Driving along the Mekong, we passed stilt-raised *bans* (villages) of the Lao dotted among their rice fields. Farther on and at higher elevation we passed through the neat bamboo-fenced habitations of the Black Thai.

Dipping, a couple of hours later, into the mountain valley of the Nam Lik, we came upon more Lao villages. Then, six or seven hundred feet higher, we found the Kha, poverty stricken, dirty, and primitive.

Above Vang Vieng we met the Meo, nicknamed "cat people." They build their houses without stilts on the sides or tops of the mountains, seldom less than three thousand feet up, where, as the Lao are fond of saying, "even the Kha wouldn't live."

This isolation of groups is a situation the government is trying to correct. In charge of the job is the energetic Secretary of State for Social Affairs and Public Health, Lt. Col. Oudone Sananikone.

The colonel knows his country and its many races, and he gets around. He is a realistic anti-Communist who knows what he is fighting. And he knows that to resist Communism, Laos must develop national unity.

"We are trying to wipe out the tribal nicknames," an official told me. "We use the name Phou Lao—Mountain Lao. Naturally,



Frangipani blossoms crown Kha-Kho men. Cloths wound around their heads hold the flowers.

Silver chokers, the wearer's bank account, ring a Meo girl's neck like horseshoes. The Meo, opium-poppy farmers, dwell high in the mountains in scattered groups.



W. ROBERT MOORE, NATIONAL GEOGRAPHIC STAFF © N. G. S.

the people known as Meo resent being called cat people, and the tribes hate the word Kha, which brands them as slaves. We are, in the final analysis, all one people of many races—just as you Americans are."

While on our trip to Muong Kassy, our party was stopped by an old man at a Kha Mu village beyond Vang Vieng. He led us to a house on stilts, past a group of ragged vil-

lagers among whom malaria, goiter, tuberculosis, and skin fungus were painfully evident.

Inside, a young man lay on a sleeping mat beside a fire set in a pan. One of his legs was terribly swollen and purple as a plum. The father, who spoke a little Lao, explained that the lad, Bah Lin, had been slashed with a machete in the forest. He had been kept alive for two months by a "tea" prepared by the

Royal Visitors, Flanked by Sword-bearing Guards, Leave a Vientiane Temple

Head bowed and hands clasped, the then Prince Regent, Savang Vatthana, now king, steps toward his white parasol, a symbol of royalty. Red-and-gold sashes also adorn Prince Boun Oum Na Champassak, in the gold-brocade *sampot* (right), and Prince Souvanna Phouma. Attendants with Lao flags kneel beside the steps of the Wat Ongtu.

HANNAH REED © NATIONAL GEOGRAPHIC SOCIETY



local medicine man, but wasn't getting better.

One of our party had brought some antibiotics. We gave the boy a couple of tablets and left the rest with instructions to swallow one every four hours. From our jeeps we got blankets and food. Then we arranged for him to be driven to the hospital in Vientiane—a two-day trip over the rough road.

By the time we returned to Vientiane, Bah Lin had become our responsibility. After our first visit to the hospital, Nick and I decided that the patient badly needed a bath. We heated water and also collected soap, towels, a sheet, and a pillow.

The other patients watched with interest as I washed Bah Lin's face and shoulders, and then Nick gently sponged his skeletal body. When he reached the sore leg, he was afraid of hurting the boy, so I took over again.

Bah Lin loved the pillow and the sheet spread over the palm mat on the iron bedstead. Though it was a long time before he could eat a meal, he enjoyed the American tidbits I fed him. Eventually, under the care of the hospital's French surgeon, he recovered, and returned home a celebrity among his fellow villagers.

Lao With a Yao Accent

Happily, the rural Lao folk today are benefiting by increasing medical aid. The ebullient Dr. Tom Dooley (page 67), a former U. S. Navy medico who himself recently returned to the United States for a serious cancer operation, has done much for Laos. He first established a hospital at Vang Vieng, set up a second at Nam Tha, and now operates a third at near-by Muong Sing. Here, a stone's throw from the Chinese border, Dr. Tom's work is so largely with the tribes that he has discovered he speaks his Lao with a Yao accent.

It is routine for people to carry a patient for four or five days across the mountains to see Dr. Dooley. It would be hard for a Communist propagandist to convince one of these people that Americans "want to steal the country" or "exploit the people of Laos."

Another friend of Laos is Oscar Arellano, a Filipino architect who a few years ago recruited young doctors and nurses for an Asian-to-Asians program he calls "Operation Brotherhood." His recruits furnished medical relief to the refugees in South Viet Nam; now he has nine teams working in Laos. These groups have set up spotless

though simple hospitals around the country.

The Filipinos learn Lao rapidly. When asked about the Americans, they respond in their generous, good-natured way: "Well, look at us! The Americans ran our country for fifty years, then moved out when we were ready to look after ourselves. We have schools, hospitals, universities. You can make the same advances if you work at it."

Deep Wells Bring "American Water"

Though Laos is a land of many rivers, it still lacks adequate means of conserving water for dry months or of providing a sanitary supply. Once, in company with a government official, we saw people washing in a puddle of water (*nam*) by the roadside.

"You see," our companion remarked, "how desperately our people need wells."

Where American well-digging crews have been at work, as around Pakse, the people call the water "American nam." They walk long distances and line up to pump the pure water from the deep wells. Because they are drilled for the benefit of all people, these wells have built up much good will.

In the rainy season, on the other hand, there is too much uncontrolled water. Thatched roofs and light split-bamboo walls are not proof against the torrents of the monsoon; land under the houses remains flooded for the duration of the wet season.

Religion and superstition complicate medical problems: The Lao peasant believes that his body is inhabited by 32 souls and that the departure of any of these causes sickness. It can be brought back by sorcery, a shot in the arm at the dispensary, or a whiff of opium if the soul has departed from his stomach.

Life, we discovered, moves with the weather in Laos. The climate is humid all year round, even in the dry-season months from October or November through March. April is the hottest month, with occasional rains that only tantalize. From May through September the monsoon's rains refresh the land.

Just before the rains come, a beautiful thing happens to Vientiane. All over town the flame trees bloom (page 63), transforming shabby old buildings, hiding brash new ones, and framing That Dam, the great black stupa enshrining a hair of the Buddha, in orange and gold.

During the rainy season, the Buddhist monks go into retreat. One still sees them every morning, pacing in single file along the

green roadsides in their orange robes, their shaven heads sometimes protected by black umbrellas, and their sandaled feet squelching in the mud. The leader is usually an old man, while at the end of the line trudge lads only five or six years old.

Regardless of age, the monks live on two meals a day. Breakfast is donated by kneeling women, who ladle a little fish and rice into the begging bowls (page 53). Lunch comes before noon; the faithful bring it to the temple, usually at the striking of a great barrel-shaped buffalo-hide drum.

Practically every Lao man spends some time as a monk, often in his childhood and again for a week or so before his marriage.

Nick and I became enthusiastic addicts of the *bouns*—the religious and secular festivals held in the grounds of the wats, or temples.

Each wat has at least one *boun* of a week's duration during the dry season, to raise money. With forty-odd wats in town, it adds up to a lot of festivity (pages 62 and 64).

Over-the-counter Courtship

One of our first *bouns* was at Wattay, a large temple on the airport road. We were greeted by a bevy of pretty girls who presented us with small banana-leaf cornucopias holding sweet-smelling white flowers and tiny white candles. We gave them a little wad of *kip* notes—eighty kips equal a dollar—as our contribution.

One side of the broad path leading to the wat was set aside as a courtship area. Counters had been improvised from planks and boxes, and on them were spread quantities of food: cut-up roast chicken, little banana-leaf-

Shimmering Brocades and Hand-woven Silks Attract Vientiane Shoppers

Silkworms thrive on mulberry trees along Lao riverbanks, and women weave the lustrous cloth on hand looms. Hundreds gather each morning to shop for food and clothing in this open-air market, one of several that serve the city's more than 60,000 residents. Gold and silver threads lend sheen to these brocades.





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Luang Prabang Housewives Cook a Rice-and-pepper Meal for Holy Men
 Monks enter Lao homes to pray at housewarmings, weddings, and funerals. When the *khouba* conclude their chants, these women will carry the trays into the dwelling.

wrapped packages of chopped meat and rice, sliced liver sausage, brilliantly pink sweetmeats, and sections of sugar cane.

Behind the counters sat more young girls. In front of each was placed a seat for a prospective suitor. This arrangement affords the boys and girls the opportunity to meet with propriety and at the same time helps raise money for the temple, for the boys must pay for what they eat. Should the courtship be successful, parental approval must be obtained, and the families take over all marital arrangements and celebrations.

On the opposite side of the path, strategically placed to keep an eye on the budding romances, mothers had their own counters, selling soft drinks and more foods.

Under the palm trees we found groups of gamblers playing the popular *phay tong*, a complicated card game; others played a game resembling checkers. Still more celebrators crowded a roped-off area to watch a boxing match in a ring set on a platform of boards laid atop gasoline drums.

One of the most charming sights at a *boun* is the *lam vong*, a compromise between ancient and modern dancing. The girl, her face utterly still, dances with short rhythmic steps, her arms, hands, and fingers moving in a

series of lovely gestures. The boy dances around her, not touching her, making expressive hand motions of his own.

The *lam vong* is performed on a platform; the musicians play beside it. The most popular instrument in Laos is the *khene*, constructed of a double row of bamboo-reed pipes of graduated lengths—four, five, or seven pipes to a row. Other instruments include cymbals, xylophones, flutes, and drums.

Festival Music Shatters Sleep

But the gayest, most lilting music, and the one whose decibel count is most surely guaranteed to get you out of bed if you've decided to forego a *boun*, is that provided by the *mo lam*, the singer, who puts his or her heart, a fine pair of lungs—and often, nowadays, a loudspeaker—into the songs that accompany the *lam vong*.

As I lived longer in Laos, I learned to watch for signs that mark the changing seasons. After the first rains in May and June, the patient buffaloes plod the rice fields dragging rude plows, the farmers wading behind, bespattered to the shoulders (page 55).

After a month the small seed beds become lush green carpets, and the shoots are ready for transplanting. Men, women, and the

older children carry thick clumps of stalks to the flooded fields and carefully set the single plants about nine inches apart.

The tender young rice, rising through the shining brown water, makes a picture of unforgettable beauty. It is also one of great importance, for rice, along with forests and livestock, is a mainstay of the Lao economy.

On a visit to Salakham Rice Station, I splashed through the mud with tall, slim M. Phanh Ngaosyvathn, then Director of Agriculture for Laos, and listened as he explained what the ministry is doing to improve rice culture. Some 540 different plantings of glutinous rice, so popular in Laos and northeast Thailand, grew in frames at our feet.

American Dams Create New Farms

"We keep records of the productiveness of each planting," he said, "and send the best-yielding seed to the farmers. We're teaching them to get better results from their labors." He rubbed the fat brown seeds from a panicle and dropped them into my hand.

Later, at Ban Tha Ngon, we inspected fields of corn, sorghum, vegetables, and other crops the ministry is developing. The object is to help farmers diversify their agriculture. Small dams, built with local labor under American guidance, are opening a good many areas of the country to additional production.

M. Phanh's experimental orchards of pomelos, limes, tangerines, mangoes, custard ap-

Fiery Blossoms of Flamboyant Trees Overhang a Festival's Rocket Shoot

A riotous fertility fete, the Bang Fai celebrates the birth, enlightenment, and death of the Buddha. Held in May, before planting begins, it seeks to ensure a bumper crop.

Temples and business firms sponsor 30-foot skyrocketers of bamboo and paper. Garlanded with pennants and flowers, the rockets represent the naga, or cobra, that once spread its hood over the Buddha to protect him from a flood.

A legendary wedding of a Lao princess provides the link between fireworks and fertility. When rockets fired by the wedding guests threatened to set the sky afire, the inhabitants of heaven appealed to the Hindu god Indra, who poured water over the fireworks. Thus the Lao believe the firing of rockets at the sky brings rain for the crops.

This crowd, chanting and drumming, bears a gunpowder serpent through Vientiane.







Golden Candlelight Tints the Pensive Faces of the Buddha's Worshipers

More than 40 temples dot Vientiane. Each has its own *boun*, or festival, where the Lao feast, dance, gamble, and watch plays far into the night.

Peter Robinson's camera captured this glowing scene during the Festival of the Pirogues, as canoes raced along the Mekong and fireworks lit the night. The cries of merry-makers rang near by, he recalls, as the girls paid silent homage to the Buddha by bowing three times and lighting candles.

ples, and mangosteens made me think of a surgical ward. Almost every tree bore egg-shaped balls of clay bandaged in fiber or canvas strips to protect the grafts of new, better-yielding scions onto more plebeian stocks.

We saw more fruit growing in southern Laos when Prince Somsanith, then Director General of Police, invited Nick and me on an inspection tour.

Climbing to the Bolovens Plateau, we saw new peach and apple orchards at about two thousand feet above sea level. Pineapple fields spread over the hillsides, the dark-green fruit weighing several pounds apiece and bursting with juice. We saw tea, coffee, and rubber plantations being restored after the ruin of war. Indeed, almost any crop will grow at some point in this region: The climate ranges from tropical in the valleys to quite cool on the plateau, four thousand feet up. And there's plenty of rain.

Elephants Haul Huge Logs

Rain forests, elephants, teak, lianas, . . . All the romance of tropical logging bounced around in my head one morning in the dry season when I started out with M. Bouaphat Chanthapanya, Director of Waters and Forests. With us were M. Khamdeng Sananikone, his Provincial Chief for Vientiane, and a jeepload of foresters. We were bound for a forest 25 miles from Vientiane.

In the forest I watched an officer select the trees to be felled. He was followed by a laborer with a razor-sharp ax who blazed the bark. Another daubed green paint to indicate where the cut was to be made.

A couple of men with long-handled axes started the cut; another pair with a crosscut saw completed the felling. Other men moved in and debranched the tree; then more teams cut it into 13-foot lengths.

Finally a pair of elephants, jangling with heavy chains, came up to the logs. Their drivers, whose leathery toes reached only to the lobes of the elephants' ears, sat on little canvas seats on the animals' necks.

Roads Vanish at Monsoon Time

After the great animals had pushed the logs apart with their foreheads, axmen gouged a hole in one end of each log. A heavy chain was threaded through this and attached to the elephants' traces.

The beasts then dragged the logs to the loading area, where the massive timbers were hoisted onto trucks.

"We do all the trucking we can during the dry season," M. Khamdeng told us. "Preserving our roads is a big problem. The rains wash most of them out in monsoon season.

"Forests are the country's most valuable natural resource," the director added, "but conservation is a constant problem. The Meo, Kha, and other hill people slash and burn sections of the hillsides, destroying thousands of trees. They cultivate the land for about three years, then move on to repeat the cycle."

When I asked about reforestation, Director Bouaphat revealed his ingenious solution.

"When the Kha burn an area of brush for cultivation," he said, "we bring them teak seedlings and pay them to plant them along with the rice. By the time they move on, the

trees need professional care; and we take over."

Problems of livestock, the third of Lao agriculture's big three, are in the hands of Dr. Chao Sinh, head of the government's Veterinary Services Department.

Lao Cows Enjoy Ripe Old Age

The doctor told me indignantly he was tired of being reminded that the livestock industry of Laos is run down, the cattle scrawny, the pigs sickly and sway-backed, the chickens all skin and bone.

"What is expected of us?" he asked. "For years we had war. The Japanese Army lived off our cattle. When the Chinese got out, they drove our herds before them. Before the wars we exported cattle to our neighbors. We were the area's meat suppliers."

He waved to a clerk and spoke a few words in Lao. The boy hurried away, returning with a photograph album. Dr. Chao Sinh handed

Solid-gold Buddha stands in the royal palace at Luang Prabang. For years the two-and-a-half-foot figure lay hidden in the Mekong. Layers of gold leaf pressed on by cure seekers have blurred its features.



Purification rite precedes the Bang Fai fete (page 63). Perfumed water pours over monks kneeling beneath the serpent-shaped spouts.

W. ROBERT MOORE, NATIONAL GEOGRAPHIC STAFF (1960-61) AND PETER BODINSON © U. S. S.





HANNAH WERE © NATIONAL GEOGRAPHIC SOCIETY

Mekong Boatmen Sink Fish Traps Beside a Thicket of Mooring Poles

One of the world's longest rivers, the Mekong winds 2,600 miles from Tibetan highlands to the South China Sea. Between dry season and monsoon, its depth may vary 30 feet. Rapids limit navigation. Most Lao live along the Mekong or its tributaries.

it to me. "Look any place in it," he said. He started turning the pages. On them were pictures of huge wide-horned bulls that would have done credit to a Texas ranch, fine buffaloes, Brahman cattle, pigs and poultry.

"That was what we had developed twenty years ago," he said. "After the war it was almost all gone, but we are building again. You do not repair a livestock industry in a day or a year."

With a rueful grin he explained why Lao meat is so tough. "We have a law that a buffalo cow cannot be slaughtered until she is nine years old. We cannot risk losing any progeny. No cow, in fact, may be killed while she can still produce."

The Lao celebrate the start of the new year in April, when the sky thunders and the promise of rain hangs in the air.

Through the courtesy of our friend Prince Somsanith, we have been invited each year to the New Year's festivities at the royal palace in Luang Prabang. We eagerly re-

ceive the large white envelopes, embossed in the upper left-hand corner with the three-headed elephant and white parasol. His Majesty's secretary general shows no discrimination between the sexes. Nick gets his invitation, and I get mine.

Plane Delivers New Year's Guests

Flying north from the plain of Vientiane, we see the mountains spread before us as jumbled and sharply angled as if some god had emptied a stupendous bowl of green lump sugar over the land. Through this fantastic landscape winds the lovely Nam Lik.

We follow the rusty ribbon of the old French road, rebuilt by the Americans; then more mountains, and finally the Mekong, curving sinuously among blue and green hills heaped about Luang Prabang. Another river, the Nam Khan, joins it here, turning the town into a small peninsula.

Like a pivot in its center rears a high pagoda-crowned hill, known as the Phousi.

At the hill base, behind a double row of fuzzy sugar palms, stands the long, low royal palace, looking like a pleasant country home.

The royal town is much smaller than Vientiane, but it boasts movies, a social club, and a number of thick-walled cool old French homes now occupied by Lao officials. Temples are scattered everywhere. The long main street is lined with the usual little Indian and Chinese shops displaying groceries, dry goods, tinware from Japan, baskets, and other miscellany.

Here, too, are goldworkers who supply the ladies of the aristocracy with the beautiful pins and pendant chains that dress the Lao coiffure, and the solid-gold belts of many medallions. Whenever visitors arrive, groups of village women swarm the porch of the Phousi Hotel to display their Lao- or Lu-

designed scarves or skirt lengths of fine silk.

One can climb the Phousi for the view or settle for the Buddha's Footprint, which the Enlightened One—he must have been tall as the hills—implanted above the town.

Or one can visit Wat Pa Khē, which besides having wonderful gold and black wooden window panels, boasts the famous "Dutch" doors. These are decorated with gilt figures wearing Dutch hats and clothing; they commemorate the visit of a group of Hollanders in the mid-17th century.

New Year's celebrations go on for about 10 days, though only three are considered important. Religious processions move from the temples around the town, the older priests borne on palanquins draped with orange cloth. Musicians go ahead, playing small drums.

The royal elephants, magnificently capari-

Dr. Thomas Dooley Gives a Piano Recital for an Audience of Kha

Before his recent return to the United States for medical care, 32-year-old Dr. Dooley treated as many as 100 patients a day in his Muong Sing hospital. He became interested in Indochinese medical problems in 1954, when as a Navy doctor he helped refugees flee from Communist North Viet Nam. Dooley-trained Lao operate two other clinics established by him. A talented musician, Dr. Dooley plays daily to relax. Hill folk wander in and out; woman at right wears the knee-length Kha skirt.

ILLUSTRATION BY JOHN W. REEDER, M.D. © U.S.S.



soned, are also paraded. As part of the fun and the purification ceremonies, everybody splashes everybody else with water. We tried in vain to dodge these dousings; I carried my camera wrapped in a shower cap.

The king himself or, if his health does not permit, Crown Prince Savang Vatthana, pours water from a silver bowl over statues of the Buddha at several temples, while the priests perform the same rite at others.

The historic gold Prabang (page 65), the most sacred Buddhist statue in the kingdom, is taken from the palace to Wat Mai, where it, too, is ceremonially sprinkled by the king or crown prince. It is carried in a lavishly decorated gilt palanquin by bearers in strange, ancient-style scarlet uniforms, and accompanied by royal guards in scarlet and white.

The high point of the celebrations, of course, is the formal soiree at the palace. An official of the royal household greeted us at the palace gate and escorted us to the garden, where the crown prince and princess stood to receive their guests.

We enjoyed a superb buffet supper at which the rice was served in traditional covered baskets. As did everyone else, we plunged in a hand, scooped up wads of sticky rice, squeezed them into rolls or balls, and dipped them into one of the murderously hot Lao sauces or in *nam pa*, fish sauce.

Bamboo Canes Forecast Future

Afterward we adjourned to the palace veranda. Before us, on the broad, lighted terrace, a huge square of linoleum waited for the barefoot dancers. In the warm dusk all eyes were turned on the Phousi, whose steep slope faces the palace. In former years it was the custom for the naga, the sacred serpent, to appear in the form of a long line of children winding down the hill bearing torches.

This time the format was changed. Out of the darkness came a three-headed elephant, led and followed by the children, to make a bow before the royal audience. I had seen this beast in the temple grounds the day before—an enormous stuffed model.

How the youngsters managed him I do not know. But suddenly there he was. And there they were, in their beautiful handwoven silk costumes, dropping to their knees and bowing their little foreheads to the ground before the crown prince who acknowledged their homage. A long and fascinating program of classical dancing followed.

Visitors who have stayed awhile in Laos usually take away with them a handful of



Dropping their bundles, Akha wayfarers call

strangely marked bamboo sticks, or canes, processed in only two Lao villages in the province of Sayaboury.

Women cut and dry a particular type of slender bamboo. Men letter and print designs and animals on the skin of a banana plant, dip this in a saltpeter solution, and wrap it around the cane. It is then dried



KODACHROME BY JOHN W. KODACHIKER, N. C. KODAK

a halt in Muong Sing for lunch. Foothills of Communist China rise seven miles away

over a fire, and the markings become imprinted in brown and white on the bamboo.

The skill required for this work is such that the first words imprinted are the name of the artist and his village. Below is a series of checkerboard squares, marked with the days of the week. Groupings of dots in the squares give guidance to travelers: warnings of danger,

predictions of happiness, and other prophecies.

We have a collection of these horoscope canes given us by our Lao friends. But from them we can make few predictions either for ourselves or for Laos.

We can only hope for the freedom and peaceful progress of this little nation squeezed in a corner of Southeast Asia.



Knife-edged mountains of shifting sand scallop the Empty Quarter of Saudi Arabia. Flying over the wasteland in their single-engine airplane, the authors felt "like the first people to reach the moon."

*Continuing their flight to adventure,
two young Americans seek new goals
in the mountains and deserts of Southwest Asia*

Sky Road East

By TAY and LOWELL THOMAS, JR.

With photographs by the authors

SOME OF THE WILDEST, most rugged mountain country we had yet crossed rolled beneath our wings. It boasted few settlements or roads—nowhere that a small plane could land should our one engine cease its steady droning.

Down below, more than 20 centuries before, Alexander the Great and his Macedonian legions had slogged, countermarched, and hacked their way into the ancient Persian world against the chariots of Babylon. Now an aerial chariot nicknamed Charlie, pushed by a strong tail wind, was hurtling us into that same world at 190 miles an hour. We kept a lookout for a par-

Wool helmet warms copilot and navigator Tay Thomas as she plots a course across mountainous Afghanistan. She sits in the cabin of Charlie, the authors' Cessna airplane.





Royal interview introduces Tay Thomas to the Shah of Iran, Mohammed Riza Pahlevi, in his marble palace.

Rug washers of Chasneh Ali, near Tehrân, soak Persian masterpieces beside a rock-rimmed spring whose mineral-rich waters are believed to preserve and brighten the colors. So famous is the pool that customers send their rugs here for washing from as far away as Germany.

Bas-relief on the cliff, a monument to a 19th-century shah, follows the style of carvings at Persepolis, ancient capital of Darius the Great.



REPRODUCED BY IRIS WORTH, BRISBANE (OPPOSITE), AND TAY AND LOWELL THOMAS, JR. © N.G.S.

ticular valley amid all the others, where seven years earlier I had bounced and ground my way on a jeep tour of eastern Turkey. Suddenly I saw a settlement that looked familiar, perched on the edge of a razorlike crag.

The mountains tilted and came up at us. Then, across a ridge, the town of Bitlis appeared in its deep, narrow gorge, just where map and memory said it should be.

Charlie Follows a Conqueror's Route

Down we went, twisting and turning, rock walls on either side. Bitlis flashed past, followed by the crumbling towers of a cliffside fortress. It seemed remarkably insignificant from the air, more like a granite outcrop than a work of man. At last we felt that we had properly embarked on our eastward adventure: from here on, our route would often cross Alexander's path to the boundary of his empire, the distant Indus River (color map, page 76).

We were three: Tay—my wife, copilot, and navigator; myself; and Charlie, a heavily loaded little single-engine Cessna, model 180. The plane's nickname came from the international registration number painted two feet wide on its wings—N2343C—and from its abbreviated radio call signal, "four three Charlie."

Charlie had already carried us more than 26,000 miles in a great swing from France and Spain down and around the sandy ocean of the Sahara, across the equatorial waistline of

Africa, down the Nile, and over the caravan routes of the Arabs to Istanbul on the Bosphorus.* Now, as we climbed back out of the Bitlis gorge, the second major leg in our winged odyssey was just beginning.

We flew on over the blue waters of Lake Van, with cloud-crowned Süphan Dağı soaring 14,547 feet just to the north, and over the city of Van, once the very heart and center of old Armenia. Then, beyond the lake, we circled the ruins of a great citadel where seven years earlier I had found cannon balls scattered about the plain below; from there we flew up and east to the Iranian frontier. By the time we reached that rugged border, Charlie had climbed to 10,000 feet.

Iranian Skies Offer a Rough Welcome

The air was bumpy, for a 40-knot wind was blowing from behind and across the tumbled ridges. Tay had the controls; her stomach always behaves better when she does the flying in rough air. But despite the normal precaution of slowing down and fastening our seat belts, we both banged our heads occasionally on the cabin ceiling.

I think we actually crossed into Iran about 10 miles south of the frontier "gateway" that Turkish authorities at Ankara had instructed us to use. But no border guards fired at us, so far as we know.

* For the first half of the Thomases' aerial saga, see "Flight to Adventure," by Tay and Lowell Thomas, Jr., NATIONAL GEOGRAPHIC, July, 1957.



**Charlie Explores Umm a' Sabaan Island
as Lateen-rigged Dhows Cruise the Coast**

Once inside the border and above Lake Urmia, I tried raising Tehrān on our high-frequency radio. Although the distance was all of 400 miles, the answer came back at once. I reported that we would refuel at Tabriz and expected to reach Tehrān two hours later. Tehrān control asked our position, altitude, and point of departure; they wanted regular reports.

Ahead, rimming the Caspian Sea, Iran's snow-capped Elburz Mountains rose dimly to 15,000 feet. Stretching eastward, they reach an altitude of almost 19,000 feet in Mount Damāvand—the Everest of the Near East. As we approached our goal, we saw the peak shining pink in the late afternoon glow.

The sun had barely set when Tehrān's Mehrāhād International Airport flicked on its runway lights for us; more out of courtesy

than necessity, and our wheels touched down at the capital city of modern Persia.

I felt pleased as Tay and I stepped from Charlie. Five years earlier I had landed at Tehrān on a Dutch KLM airliner, forlorn because, as a bachelor, I had left my sweetheart on the other side of the globe. Now she was with me, and we had come in our own airplane.

Lack of space limits Tehrān purchases

I found this colorful city of more than a million people has grown and changed tremendously. Until a couple of decades ago a wall surrounded Tehrān, and the Firdausi—a street named for a famous Persian poet—twisted unpaved and narrow to the wonderful palace of Gulistan, the "place of flowers."

Now the wall is gone, the principal streets



ILLUSTRATION BY RAL THORNBURG © NATIONAL GEOGRAPHIC SOCIETY

boat, the Thomases cleared a 400-yard airstrip and marked it with bushel baskets. Then they brought Charlie in—the first airplane ever to

land here. Standing beside the cabin door, whose painted flags record the countries they have visited, the authors plan their outbound flight.

are paved, and even the ancient water system of oversize gutters along the streets has been replaced by up-to-date underground mains.

Tay went wild over the silver and brassware, inlaid boxes and turquoise jewelry, ivory and camel-bone work, and Persian rugs of unbelievable beauty in the city's many shops. But Charlie's weight limitation and lack of space dampened her enthusiasm; she finally settled for a pair of earrings, which she sneaked past me in her pocket.

We were honored by being granted an interview with His Imperial Majesty, Shah Mohammed Riza Pahlevi, in the marble palace. Remembering the formalities and protocol of other courts we had visited, we asked friends in the American Embassy what to wear for the occasion.

"Don't worry about etiquette or apparel

here," we were told. "The Shah likes informality." True to report, His Majesty received us casually in gray slacks and a jacket.

Shah Shows His Crystal Ballroom

The Shah, we discovered, is an aviation enthusiast, and we were soon discussing the pros and cons of single-engine airplanes, of retractable landing gear, and other technical matters. He seemed impressed by Charlie's performance, and even appeared a little envious of us.

Then he took us down a corridor to the fabulous crystal ballroom of the palace, its walls studded with thousands of tiny pieces of glass. When he turned on the lights of the many chandeliers, the twinkling and sparkling were breath-taking.

From there we went to the garden to take photographs (page 73). Afterward we said





goodbye, as informally, I think, as if to acquaintances back home.

After a brief visit to the Caspian Sea, we took off from Tehrān on our next hop eastward across northern Iran. We were bound first for Mashhad, capital of the Iranian province of Khorāsān, and then for Afghanistan, still farther east.

Sun Time Sets a Trap

And now, through no fault of Charlie's, I flew into a near-fatal trap.

We planned to follow the main road; it would serve not only as a guide, but as a place to land in case of trouble. By this route Mashhad lay 500 miles away, well within Charlie's maximum range without refueling.

We intended to take off by 1 p.m. and land before sunset, for the city's gravel airstrip had no lights. But by the time we had worked our way through all the usual pre-flight chores and had cleared customs and immigration, it was 2:15.

As we taxied out to the runway, Tay prudently suggested that perhaps we should

wait until the next day. But I was hot, a bit short of temper, and determined not to go through the whole official routine again.

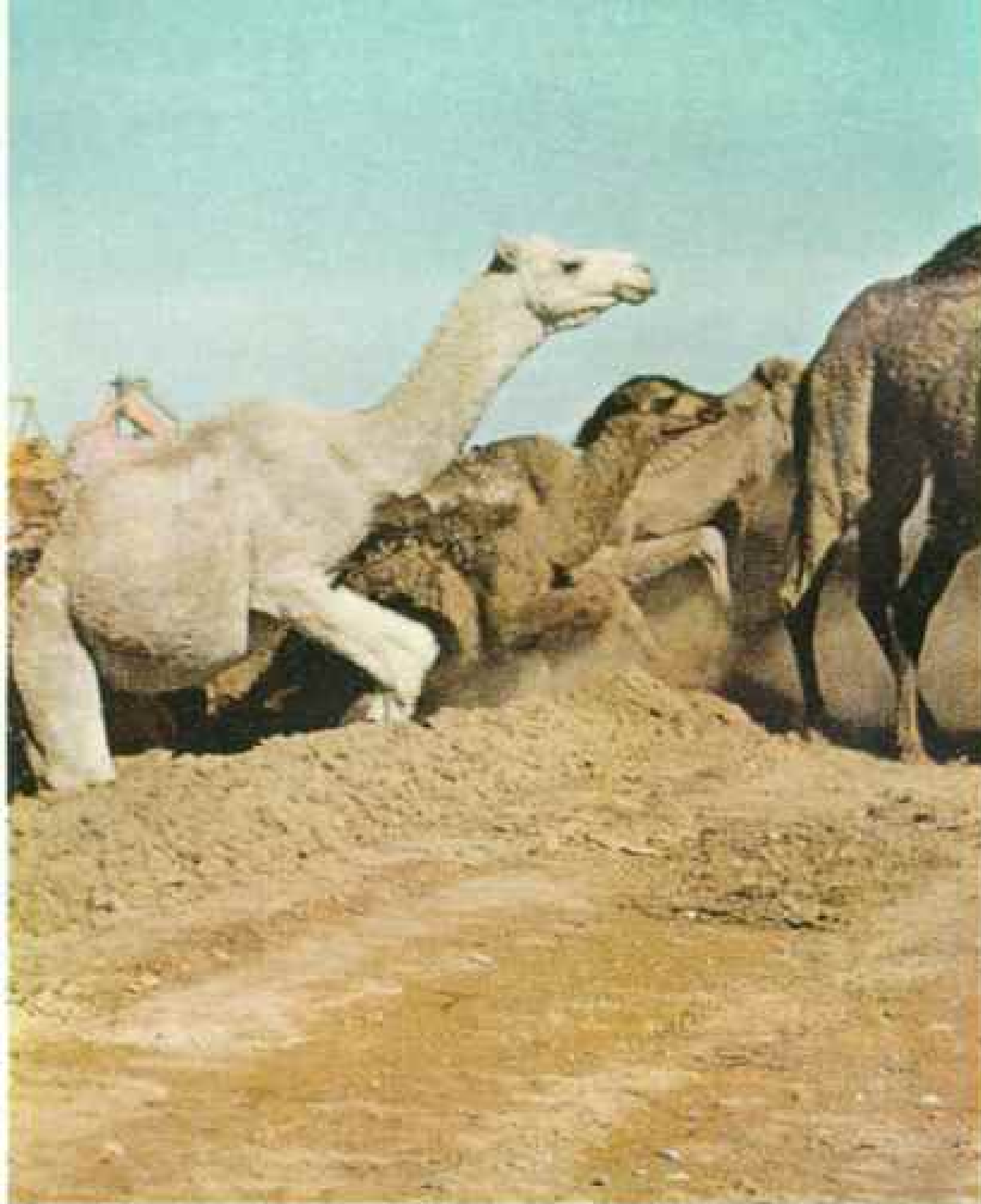
"Relax," I said. "We can still make it before dark. We're supposed to have a tail wind the whole way."

A slow climb to 10,000 feet put us nearly 100 miles out, coming up on the town of Semnān. Behind us and to the left, we could still see snowy Mount Damāvand. Beyond Charlie's right wing the Dasht-e-Kavir, an utterly barren salt desert as large as New Hampshire and Vermont combined, shimmered white on the horizon.

"Weather" had told us we could expect a 25-mile-an-hour tail wind. But over Dāmghān, 75 miles farther, a quick check showed that we were making only 150 miles an hour, our normal cruising speed. It was 3:30, and we still had more than 300 miles to go.

Then I remembered something a United States consular officer, David Nalle, had told me a few days before in Tehrān: "It's pretty dark by five at Mashhad," he had said.

I had not paid much attention, for we



**Camels in Afghanistan
Yield Right of Way
to Giant Earth Movers**

Near Kandahar the Thomases encountered a huge irrigation project being built by Americans for the Government of Afghanistan. Plans call for conversion of sections of the Registan desert into farmland for some of Afghanistan's two million nomads.

Cameleers drive this herd toward the village of Chah-i-Anjir, or Well of the Fig.

Lesson in irrigation absorbs a young Afghan as father opens a new canal in the Registan. The huge project includes storage dams, giving Afghanistan potential hydroelectric power for home and industry.

Morrison-Knudsen Company, an international construction firm with headquarters in Boise, Idaho, has directed the engineering work for 14 years.





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Tents Forever Folded, Yesterday's Nomads Adopt Village Life

Many Registan settlers own land and homes for the first time. These men in pin-striped vests and twisted black headdress relax with their children in Chah-i-Anjir. Vase-like water pipe stands ready for tobacco and a live coal.

had landed at Tehrān at six o'clock, coming from Turkey, and there had still been enough light to see the ground clearly.

But now I suddenly began to realize what two weeks in the fall can do to the time of sunset, and, even more important, how much earlier the sun sets at Mashhad than in Tehrān—a difference of 33 precious minutes.

Over Sabzevār, 130 miles short of Mashhad, ominously long shadows stretched below. I put Charlie into a gradual descent to within 1,000 feet of the ground, not wanting to lose touch with it. Fifty minutes to go.

Charlie Races the Coming Night

About then Tay quietly suggested we land on the road and spend the night in our sleeping bags. But with our heavy load I had no desire to risk that narrow, rutted track unless our lives depended on it.

"There'll be enough twilight to find the field," I said confidently. "There's bound to be."

By the time we passed Neyshābūr, 80 miles farther, the fast-gathering gloom already

hid the potholes in the road, making any landing extremely hazardous. The trap had snapped shut. The time was 5:10 local.

Twenty-five miles south of Mashhad, according to the map, the road made a 90-degree turn to the left. Maybe it did, but we never saw the turn. It was too dark.

Our radio direction finder was set on the Mashhad beacon, but the white needle kept searching around the dial. Our piloting guide classified the beacon as "unreliable," and it was proving just that.

From our position a few minutes back—if we had still been over the road—I figured that by turning almost due north we should soon raise the lights of Mashhad.

But what if the town had no electricity? I found myself thinking: only 47 miles beyond—less than 20 minutes at 150 miles an hour—lay the U.S.S.R. What sort of welcome would we get if we flew on into Russia?

I called Tehrān on our high-frequency transmitter to confirm the Mashhad airport's position as two miles south of the city.

"Please stand by," came a voice. "This

is Bahrain. You are blocking out an Air Force plane."

Bahrain, nearly 900 miles away on the Persian Gulf, in a land of pearls and oil! I was too busy to marvel at how far our light-plane transmitter was reaching. Nor was I standing by for anybody but Tehrān.

The Tehrān operator answered, saying he would look up Mashhad in his airport directory.

Then, directly ahead, the lights of a city glowed. Near the outskirts flickered two short rows of fires, and the headlights of two cars winked on and off. Tay was the first to see the vague X of the field's two strips. I blinked our landing lights in answer.

"Tehrān Control," I said into the microphone. "This is four three Charlie. We are over Mashhad airport now, about to land. Thanks very much. . . . Four three Charlie out."

Tehrān acknowledged as we let down slowly and made a steep, full-flap final approach to

clear any unseen wires or trees. Our wheels touched sooner than I expected, and we bounded back into the air like a jumping bean. The last flare fell behind, for they had been strung only along the first 100 yards of the strip. We bounced again and then were down to stay. Not a landing to brag about, but one we wouldn't forget.

Headlights bobbed up and down in the dust we had raised. As Tay and I jumped out, the first car stopped and a man stepped to the ground.

"Glad you folks made it!" came the voice of the American consul.

Air Route to the Asian Past

Mashhad, the most important city of north-eastern Iran, is "the place of martyrdom" to the Shiite Moslems. Near here, Ali al Riza, eighth Imam of the Shiites, died A.D. 818. His followers believed he was poisoned and built a shrine to him at Mashhad. It soon became the most venerated spot in all Iran,

Heads Whirling, Hair Flying, Afghan Dancers Hark to the Drumbest

Nomad custom excludes women from the dance. These Pushtun tribesmen, their hair fashionably greased with goat's butter, shuffle softly in the sand near Khost. Long locks whip the air as they jerk their heads in short arcs. The drummer's cartridge belt typifies the uneasy truce existing among Afghanistan's hill tribes.

ALL ILLUSTRATIONS BY TAY AND LOWELL THOMAS, JR. © N. G. S.



attracting pilgrims from the length of the Moslem world.

Though the city has spectacular mosques and market places, we spent little time sight-seeing. We were far too eager to get on with the next part of our journey: a flight into Afghanistan.

That wild and long-isolated country was still a new land to travelers from the West, a land without railroads and with few paved roads.* At the time of our visit it lacked even an airline, though several now serve the country.

The difficulties facing us were considerable. For one thing, our American air maps were none too accurate. There were no radio beacons to guide us, and there might be no search and rescue should we be forced down.

Desert Fuel Dump Saves the Day

Aviation gasoline was almost impossible to find, and Charlie didn't quite have range enough to carry us on our planned route—from Iran to Pakistan by way of Kabul—without refueling. We would have been stymied, but for a remarkable stroke of luck.

Earlier, at Beirut, Lebanon, we had met one of the few people in all the East who could help us. He was an American, manager of a two-plane airline that once had flown Afghan Moslem pilgrims to Mecca. And he said we were welcome to some tins of 100-octane gasoline he had stored at a desert airstrip near Kandahar.

Over the 500-odd miles from Mashhad to that ancient Afghan city we followed a white ribbon of trail across dry brown plains and timberless mountains of red rock. Here and there we saw ruins of some old fort or caravansary. Charlie's shadow flitted over travelers on the trail—travelers who must have been conscious that whatever law existed on this road rested, at least in part, on the rifle slung over each man's shoulder or the knife thrust into his belt.

This has been a high road since the dawn of history, churned to dust by one army after another—Scythian, Persian, Mongol, and Durani, 18th-century founders of the Afghan nation. Alexander the Great, out beyond the known bounds of the Greek world on his way to India, came by much the same route we were taking.

At Kandahar we found our gas. We also visited the headquarters of the Morrison-Knudsen Company, an American construction

firm working for the Afghan Government. Its engineers had just completed two enormous dams on the Arghandab and Helmand Rivers north and west of the old city (map, page 77).

Later, on our way back from Kabul to Karachi, we visited reclamation and resettlement projects made possible by these two dams. In the Registan desert to the south, hundreds of nomad families were taking up new lives in villages of mud brick linked by networks of irrigation canals (page 79).

Now, however, we wanted to reach Kabul. We flew northeast this time, angling more and more deeply into mountainous Southwest Asia. As we went, the barren earth kept rising, until at 9,000 feet above sea level we were barely skimming the trail.

For hours the road below held scarcely a sign of life. After a time, however, we saw in the distance something that looked almost like an invading army—a long column twisting over mountain trails and passes. When we caught up and swept over it at 500 feet we found that it was a migration—a river of nomads, with flocks of sheep and goats and heavily laden camels.

A little later, through a notch in the mountain wall ahead, we caught the glitter of sunlight on windows—Kabul!

Forbidden Land Opens Its Doors

Kabul's old quarter is most definitely of the East, the narrow streets crowded with camels, veiled women, and men who look like turbaned descendants of Tamerlane.

But, despite Kabul's undeniable appeal, one thought was foremost in our minds: to visit, if possible, a band of migrating tribesmen. During an interview with the Prime Minister of Afghanistan, Sardar Mohammed Daoud, I asked for permission. Somewhat to my surprise, he thought it was a fine idea.

So it came about that a few days later we flew southeast from Kabul to the town of Khost near the Pakistan frontier. With us we took Amin, a young Afghan Government official, to act as interpreter.

Khost lies in a region normally barred to foreigners, for it is the home of fierce, almost independent Pushtun tribes that wander back and forth across the Afghanistan-Pakistan border, paying allegiance to neither country.

(Continued on page 88)

* For a safari on wheels through Afghanistan, see "West from the Khyber Pass," by William O. Douglas, NATIONAL GEOGRAPHIC, July, 1958.



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Nimble Toes Assist Fingers in the Netmaker's Trade

A Pushtun woman braids a camel cargo net from plant stems. Bright clothes, silver earrings, necklace, and nose ornament proclaim her a well-to-do matron.



Blankets Swathe a Young Nomad on Camelback

To safeguard children on long migrations, tribesmen bundle the young in piles of blankets and lash them atop camels. This boy accompanies his people on the month-long trek from the mountains of Afghanistan to winter pastures along Pakistan's Indus Valley. The authors spent three days with the migrants.

Fur-coated passenger maintains an uneasy balance atop his mount. Among the nomads, young animals, children, the sick and aged are exempt from walking. The Thomases saw one camel carrying two baby lambs; another hauled a rooster.

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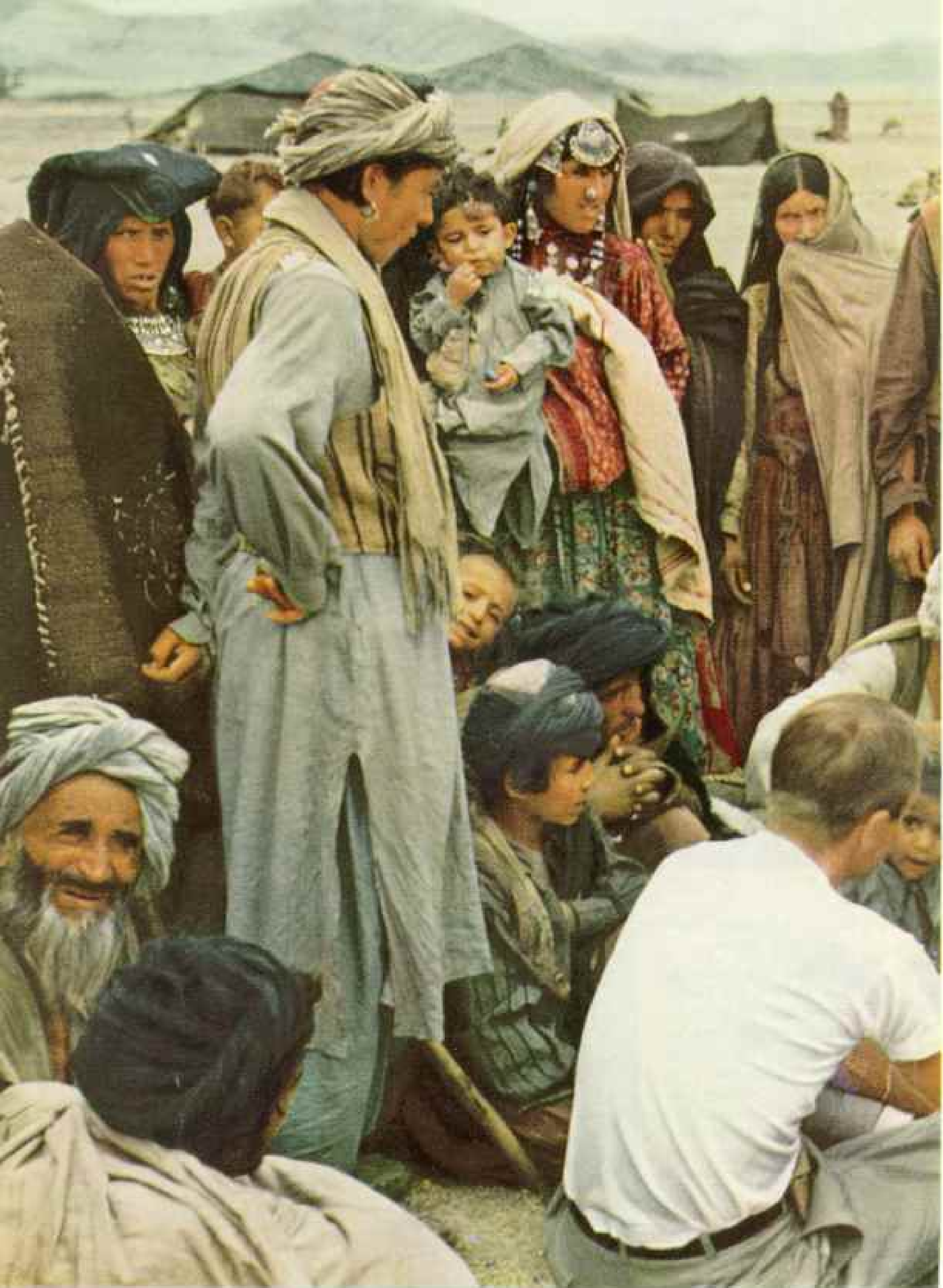


Weary Migrants Trek the Dusty Miles

Viewing the caravan from the air, the Thomases at first mistook the nomads for an army on the march. To Tay, the crawling column of tribesmen, plodding donkeys, and swaying camels suggested a scene from the Bible. Sunrise finds these wanderers already on the trail.

Provocative eyes peer over a veil snatched up as Lowell took a portrait. Few of the nomad women bothered to cover their faces when Tay aimed the camera.





**Tape Recorder Steals the Scene
at an Outdoor Concert**

The authors' nomad friends were captivated with the little box that echoed music and repeated conversations. Landing Charlie beside the trail,



Bandoleer and Shotgun Arm an Afghan Settler

The Thomases encountered this Helmand Valley farmer while making a film of the Morrison-Knudsen reclamation project near Kandahar. Unlike most settlers, whose draft animals consisted of camels and donkeys, the man owned a spirited horse.

"He seemed friendly to us," wrote Lowell, "but when the horse began acting up, he took off his homemade hat and butted the animal under the chin. The blow restored order."

High pommel suggests the Western saddle.

From Khost, with the help of Governor Abdul Rahman, we were able to locate a band of nomads. We drove by jeep some 30 miles west. At a camp set up in a dry stream bed, we were met by dozens of tribesmen in robes and turbans, with bandoleers of cartridges across their chests and rifles over their shoulders. They were polite, but there was no excess cordiality at first.

We walked up to a group of elders, who rose as we neared the tent before which they had been sitting. They had an air about them of "Who the devil are these funny people?" but they shook hands warmly with us.

The eldest, in his bearded seventies, beckoned us into his tent, and his women, when we entered, hurried to spread rugs for us to sit on. The tent, I noticed, was made of the same dark goat hair as the tents of the Sahara.

Our wrinkled host, who spoke for the group while everyone stared at us, was a colorful character (opposite). His name, he told us, was Safy. His face was round and genial, his teeth stained. He wore a dusty white turban, a faded, ankle-length robe, and leather sandals that showed some mileage. Speaking in Pushtu through our interpreter, he said Allah had directed us to his tent, that he was happy—and that we were a feast for his eyes.

I replied by saying that we hoped his tribe had had a prosperous summer. And had he seen our plane over the mountains?

"Yes," he replied. "We were just coming through the pass. You were higher than the birds." From this we knew that the long procession of animals and people we had seen in one of the gorges included this very band.

Allah's Protection Extends to Guests

We came to the point slowly, as one must in the East. We hoped, I said, that we might pass some days with his band so that we could tell the people of America how the nomads live. Would it be possible?

Without a moment's hesitation our host replied that he and his people would be happy to have us, whether for a day, a month, or a year. Whatever was theirs was ours. Allah and they would be our protectors.

And so they were. They helped us pitch our borrowed tent. They woke us the next morning at light of cold dawn, and we passed the next two days plodding with them through deep dust or jogging on horseback toward a valley the nomads called Black Water.

When we passed through the villages, town dogs snarled at nomad dogs, town children taunted the caravan offspring, and everyone looked at us—the two *faranjí* (foreigners)—



Safy, the Nomad Leader, Calls at the Authors' Tent

Entering (below) with a wide-eyed escort, Safy fingers his prayer beads. He asked a blessing on the visitors and told them they were "a feast for my eyes." Tay (above) boils water for tea. Boulders anchor the tent's guy ropes. Lowell's camera tripod rests on the desert.

EDDORCHER BY IRE AND LOWELL THORNE, JR. © NATIONAL GEOGRAPHIC SOCIETY

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wondering, perhaps, whether we were captives or just crazy.

These nomads, I learned, belonged to two clans, one of the Dowlatzai, the other of the Taghar. They numbered 16 tents, or about 120 people. Their tribes were large—the Dowlatzai alone totaling about 11,000 people—and increasing in numbers.

This band had traveled 60-odd miles with their herds and more than 100 camels, moving from high summer pastures west of the town of Gardez. Their migrations, in fall and spring, take about a month each way, with pauses to graze their animals.

When I asked Safy how many years his people had traveled this route in search of grass, he named eight generations. Beyond that the past was shrouded in mist, for there are no written records.

Tribal Warfare Not Like It Used to Be

"What about tribal warfare?" I asked.

"Not like it used to be," Safy told me. "Everything is peaceful now."

"Why, then," I asked, "do your men carry rifles and daggers?"

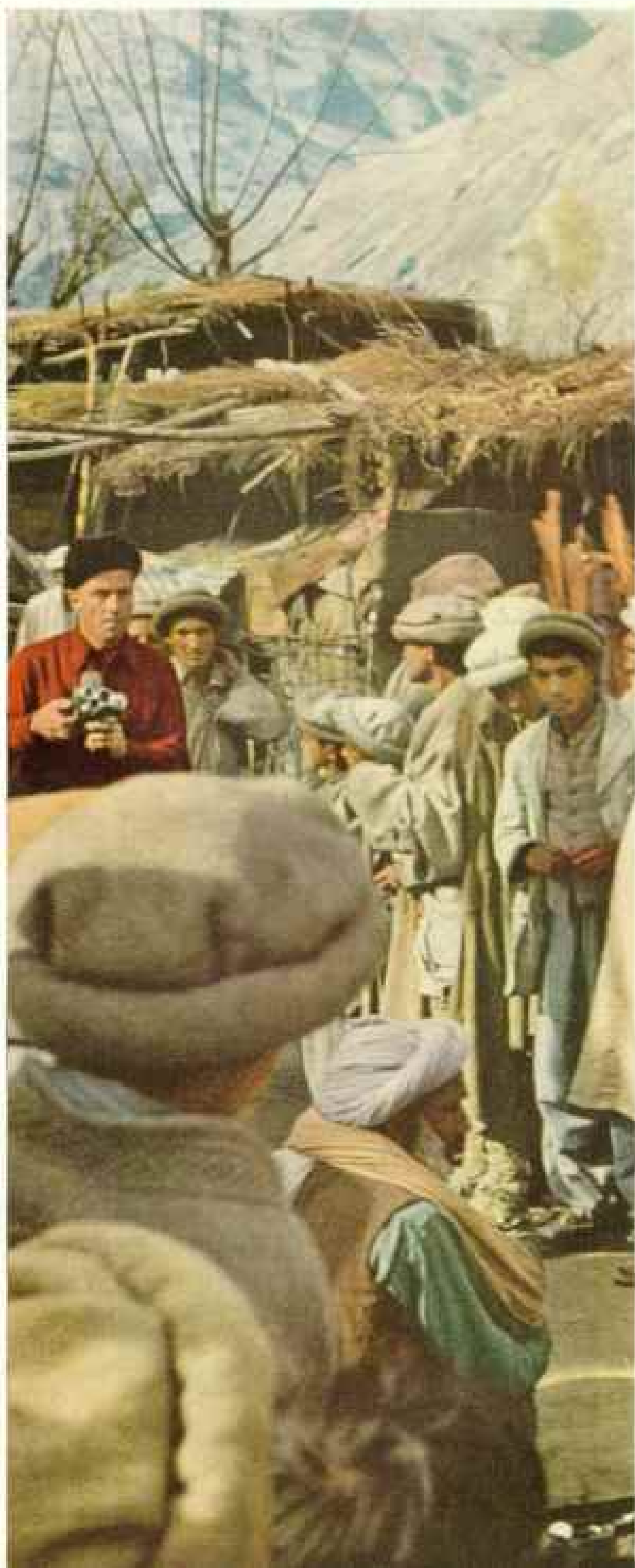
Safy grinned. Both families and herds needed protection, he explained. Everything they owned went on these migrations.

This was evident each morning at five as the nomads loaded their complaining camels and donkeys. Once under way, the one-humped pack camels stopped their gurgling growls and accepted their fate. They plodded the trail with babies and chickens lashed to towering loads of blankets, tents, poles, and cooking pots (page 85). A wizened old woman sat cross-legged under a tentlike black shawl on one camel; a pair of lambs too small to walk thrust their heads from another's load.

As we passed through settled areas, the women and little girls fanned out on either flank, scouring already harvested fields for anything that might burn in the evening's

campfires—dry twigs, strips of bark, or sun-dried dung—all of which they dumped into upturned aprons.

It seemed to us that these people lived on a near-starvation diet, their meals consisting mainly of bread, curds, and, occasionally, rice. We wondered where they found enough energy for the hard lives they led. It troubled us to see the children scrape our empty food



Fingers Speak for Tay Thomas on a Bargain Hunt in Gilgit

Planning their trip to remote Hunza Valley (page 94), the authors bought supplies in Gilgit, a border town high in the Karakoram Range. Lowell (left) films his wife as she dickers in sign language in the bazaar. Bystanders wear the mountaineers' round hats of coarse wool. Tay's sister, Mrs. Frances Haws, who joined the expedition in Pakistan, took the Kodachrome.

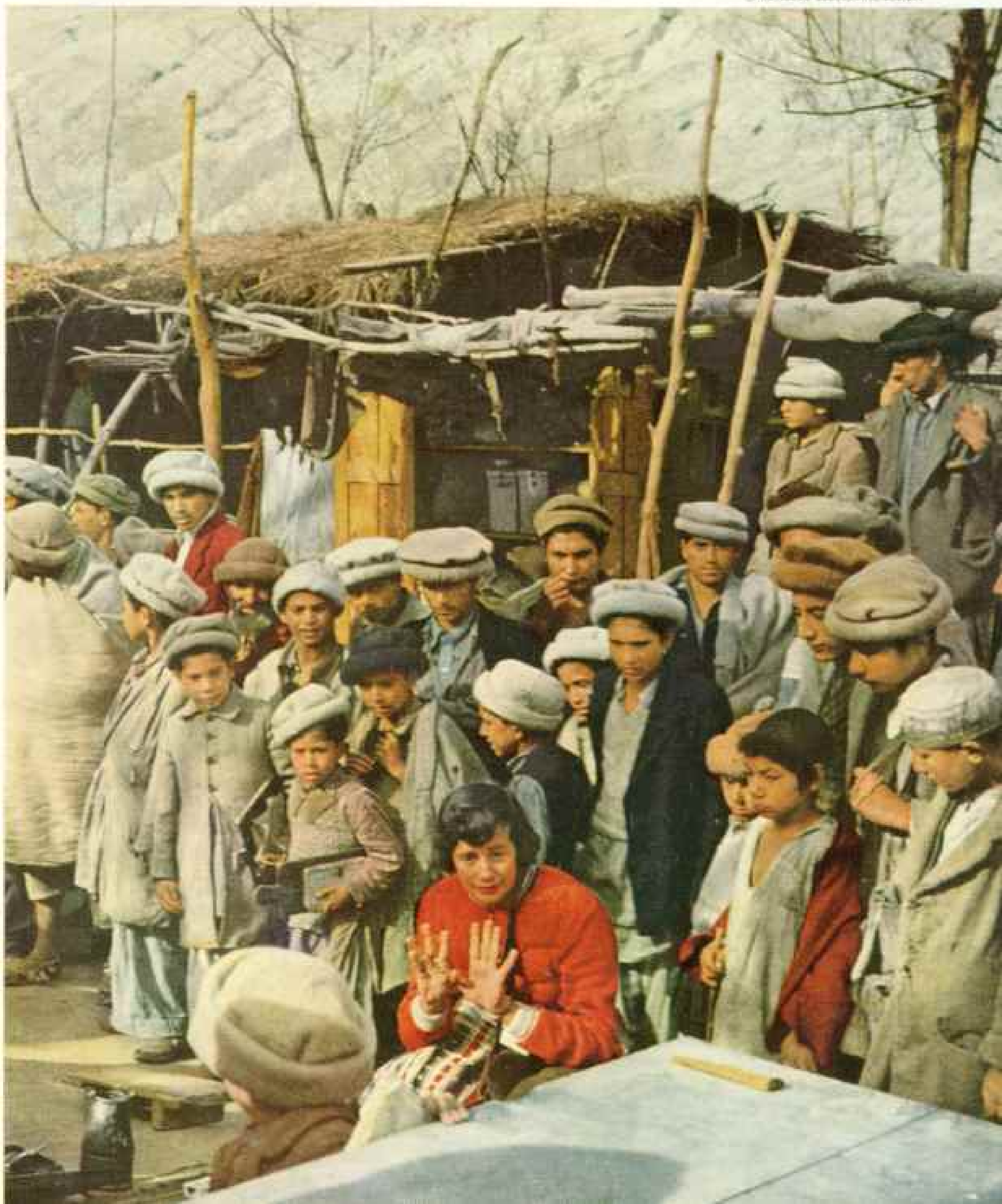
cans and fight over our leftovers—melon rind, bits of tomato, or moldy bread. They drank water straight out of muddy irrigation ditches; those who did not die in infancy obviously developed powerful immunities. How otherwise did they survive?

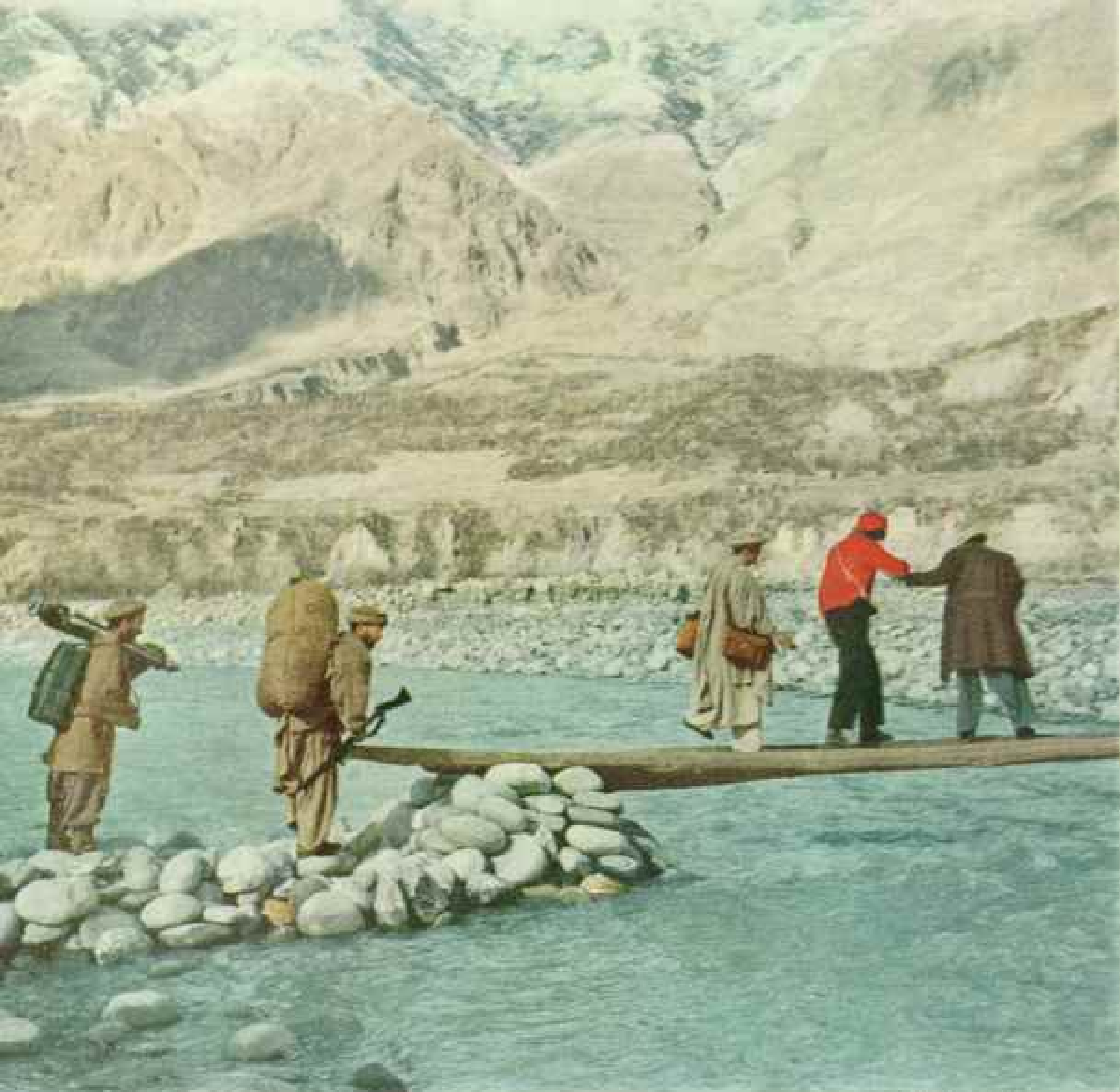
"Do any of your children," I asked Safy, "ever give up this life for the village or the city?"

"Never," was his answer. But he went on to say that what his people want above everything else is land of their own.

The nomads' route led back toward Khost, and the second day Amin and I hiked into the town to bring Charlie up to the camp. We landed on a 200-yard level area we had previously cleared of large rocks.

Almost before I had taxied into camp and





KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Porters Escort Tay Across a Shaky Log Catwalk Spanning the Nagir River

Leaving Charlie in Gilgit, the party packed into the isolated valley of Hunza by jeep and ponyback. This stream cuts across the semiautonomous principedom of Nagir.

shut off the engine, the plane was surrounded by staring nomads. Most were content merely with their first close-up of an airplane, but a few could not resist touching the upholstered seats and shiny metal—delicately, as if Charlie were the most fragile thing in the world.

We left the next morning, after camp had broken. As we circled over the strung-out caravan, in imperceptible motion across that nearly waterless tableland, we felt that our eyes had been opened. For generations these people have been described by outsiders as quarrelsome and distrustful. We had not

found them so. A few days earlier we had come to them as strangers; when we left, we were friends.

Hunza—Land That Stands on End

Retracing our route via Kabul and Kandahar, we pointed Charlie toward Karachi, capital of Pakistan.

Over the Registan desert and the mountains of Baluchistan we flew for hours above desolate regions of sand and rock where a forced landing might well have been our last.

In Karachi we paused only long enough to interview Prime Minister Mohammed Ali

and to get permission to visit Pakistan's wild, strategic hinterland.* We were bound for "the land that stands on end"—the fabled Hunza Valley in the Karakoram Range, which lies just across the frontier from Red China's Sinkiang province.

Hunza had been one of my objectives ever since I crossed the Himalayas to Tibet with my father in 1949. Like Tibet, it is also "out of this world." Few have visited it.

Mountains Blaze the Route to Gilgit

From Karachi we flew north-northeast for 100 miles or so to the wide bend of the Indus River, then followed a tributary, the Chenab, to the city of Multan. Here we found the two airport runways made entirely of bricks—millions of them—all laid as neatly as on the best suburban terrace in America!

Refueled, we followed river and railroad on to Rawalpindi. The next day we took off, again northward, for Gilgit.

Rawalpindi had produced no maps to check our own. But there was little question of los-

ing our way; it led up the great gorge of the Indus, perhaps the most stupendous ravine on earth. Colossal 20,000-foot mountains stood like snowy markers in the sky.

As we entered the gorge—miles wide at its mouth—sparsely wooded slopes rose above our right wing to 9,000 feet. Far to the west, 19,000-foot peaks lay hidden in gray mist. But here the air was smooth and the sky clear. Farther on, the great walls of gray rock closed in more and more, and the air grew turbulent. I added power and climbed to 11,000 feet, reaching not only smoother air but a vastly widened panorama.

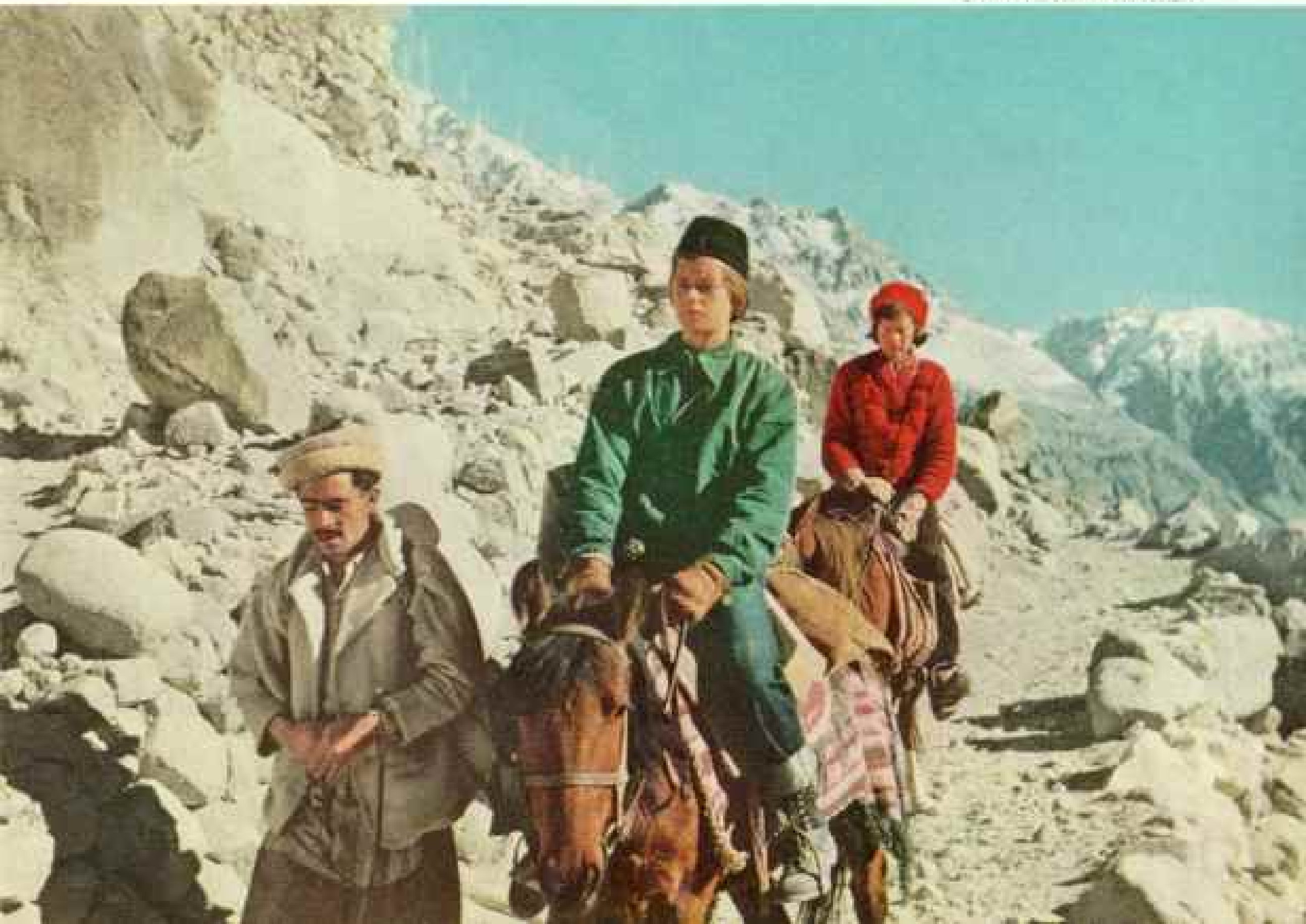
The Indus turned 90 degrees to the east, the gorge broadened, and there, 60 miles ahead, towered Nanga Parbat, ice-crowned killer of 31 mountaineers. High cirrus clouds concealed the 26,660-foot summit, but we could see nearly all of its four-mile rise from the river below.

* See "Pakistan, New Nation in an Old Land," by Jean and Franc Short, NATIONAL GEOGRAPHIC, November, 1952.

Boulders Teetering on the Verge of Avalanche Beset the Trail to Hunza

Guided by the Mir of Hunza's porters, Mrs. Haws precedes her sister Tay. The authors will never forget "the most dangerous path we faced in all our travels."

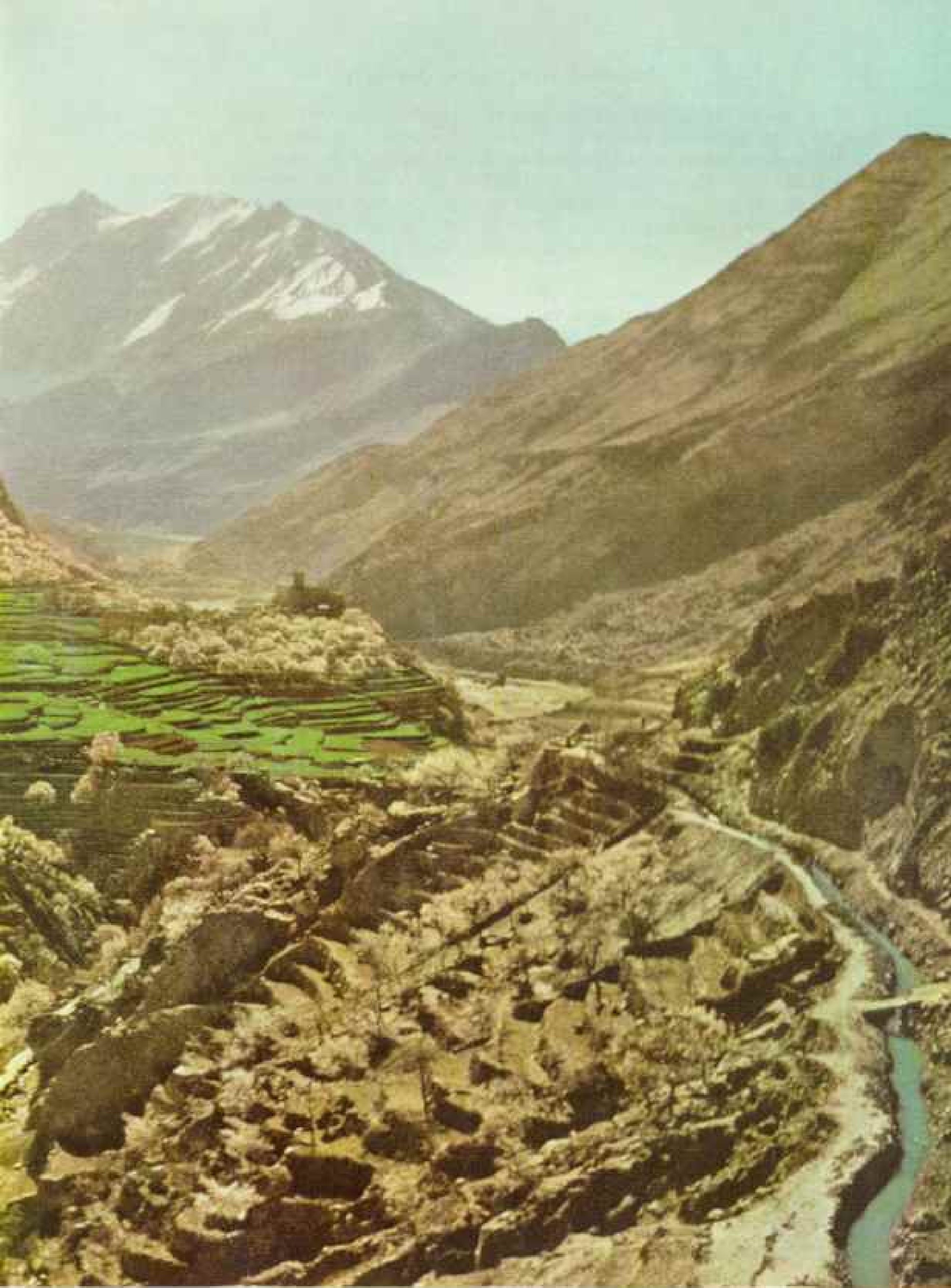
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Terraces Shingle the Slopes
of Mountain-rimmed Hunza Valley

Snow-fed irrigation works and overlapping grain fields attest the engineering genius of Hunzikut farmers. This view at Altit looks down the rocky



PHOTOGRAPH BY FRANK SMITH, NATIONAL GEOGRAPHIC STAFF © 1963

gorge of the Hunza River with its embroidery of flowering apricot trees—the backbone of Hunza's agriculture. Glacier-patched Rakaposhi, often

called Goddess of the Snows, rises behind Altit Fort, a royal castle now used as a winter storehouse for grain and dried fruit.

With one of its hanging glaciers just off our wing tip, we banked steeply north again. Now the gorge closed in fast. Ahead lay a fork in the river—the confluence of the Gilgit and Indus Rivers. Up the former, past an ugly 20,000-foot peak shaped like a deformed tooth, we sighted the town of Gilgit at the head of a canyon.

That landing gave us the creeps. We first had to head for an abrupt 9,000-foot mountain wall, turn, come in over a sheer rock ledge, and land straight toward a 16,000-foot peak rising at the other end of the runway.

Jeep Hugs a Terrifying Trail

At Gilgit we were joined by Tay's sister, Frances Pryor—now Mrs. Robert Haws—who had flown from New York to Rawalpindi to make the trip to Hunza. The three of us set out for Chalt, about 30 miles' jeep ride over a boulder-strewn mountain road. At the Hunza River the trail zigged and zagged upward at an incredibly steep angle. Barely wide enough for our jeep, it was hewed into sheer shale walls or built out from the cliffs on props. The view often led almost straight down 500 to 1,000 feet to the muddy

rapids of the river. Riding on the outside, I winced each time the wheels came within six inches of the edge.

At Chalt we switched to shaggy little ponies, after lunching with the Mir, or ruler, of the principedom of Nagir—Shoukat Ali Ghazi Millet, C.B.E. Hunza and Nagir, the Mir told us, are sisters lying largely on opposite sides of the Hunza River. Legend relates that they were founded about 500 years ago by two Persian princes. The states once fought almost constantly; now they are joined by a royal marriage. Each numbers about 20,000 people. Both are Moslem, but the citizens of Nagir are orthodox Sunnis, whereas their Hunzukur neighbors are Ismailis, followers of the Aga Khan.

Chalt, winter capital of Nagir, clings to the sun-drenched western slope of the valley. The summer capital, the village of Nagir, lies 25 miles up the Hunza and Nagir Rivers. It took us two days of tortuous, often terrifying riding and walking along cliffside trails to reach it. Ahead and above, snow-capped peaks reached into the deep-blue sky, topped by 25,550-foot Rakaposhi—Goddess of the Snows (page 94).

Hunzukur Schoolboys, Lacking Their Own Primers, Learn Persian A B C's
Burushaski, the language of Hunza, bears no known relation to other tongues and has no written form. These pupils at Baltit, the capital, read their textbooks in an outdoor class. Woolen clothes and December sun ward off the cold.

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American and Hunzukut Chat Near the Rooftop of the World

Within sight of Hunza rise some of the world's highest peaks. Lowell and 12-year-old Naibullah Beg practice English beneath the 25,530-foot crown of majestic Rakaposhi.

"We felt we were walking in another world," Tay wrote later of this stage of our journey. "We knew it was snowing on the slopes above us, and it was so still that I imagined I could hear the snowflakes falling."

The trail, usually four to five feet wide, often narrowed to half that where it made its way over *rafts*, balconylike galleries of stone slabs wedged into crevices in the cliffs. There were no guardrails, and we were told that both pack animals and people fall off all too frequently. It far surpassed in sheer terror the lofty Himalayan route my father and I had followed five years earlier from northern India to Lhasa.

Late the second afternoon, we rounded a curve and faced a long column of 18,000-foot mountains. The wide, terraced valley beneath them was Hunza. Across the Hunza River itself we could make out the ruler's palace high on a hilltop, outlined against the brown rock of the mountainside.

It was long after dark when, shaken and weary, we finally sighted Nagir and the Mir's

summer palace ahead, faint and silvery in the moonlight.

We were greeted by the Mir's small son, Barket Ali, who listened to us politely, smiling and nodding, though he spoke not a word of English.

Dinner was announced shortly, and we followed the little fellow through a dark hallway to a dining room as cold, it seemed to me, as a freezing locker. Tay shivered visibly, and even the little prince's teeth rattled a time or two.

Ordeal by Tightrope Bridge

We spent the next day recovering from our trek, and then backtracked down the trail to cross over from Nagir into Hunza and its capital, Baltit. On the way we were overtaken by the sound of drums and piping, and then by a royal caravan. The Mir's family, including the heavily veiled Rani, his wife, were on their way to join the ruler in the winter palace at Chalt.

We crossed the boiling Hunza River by a

Pounding Hoofs and Flailing Mallets Thrill Polo Fans in Gilgit

Superb horsemen, Hunzukuts excel at the sport, thought to be an import from ancient Persia. Gilgit Scouts and challengers from the town of Skardu here converge on a goal beneath the Karakorams.

horrifying suspension bridge—100 feet high, 300 feet long, and 3 feet wide—made of nothing but thin, widely separated tree branches supported by cables. The whole fragile affair bounced up and down like a worn-out trampoline.

Ponies awaited us on the other side, and we were met by a boy carrying a cloth-covered platter of apples—a wonderful welcome for tired travelers! There was also a letter of welcome from the Mir of Hunza:

“My dear friend,

“I hope you will be kind enough to excuse the trouble in my house during my absence. . . . (We had known that the Mir was away on a tour of the frontier regions bordering China.)

“I hope you both. . . will feel this poor home like at home, and you can ask anything you need which will be a great pleasure to me and my wife. . . .

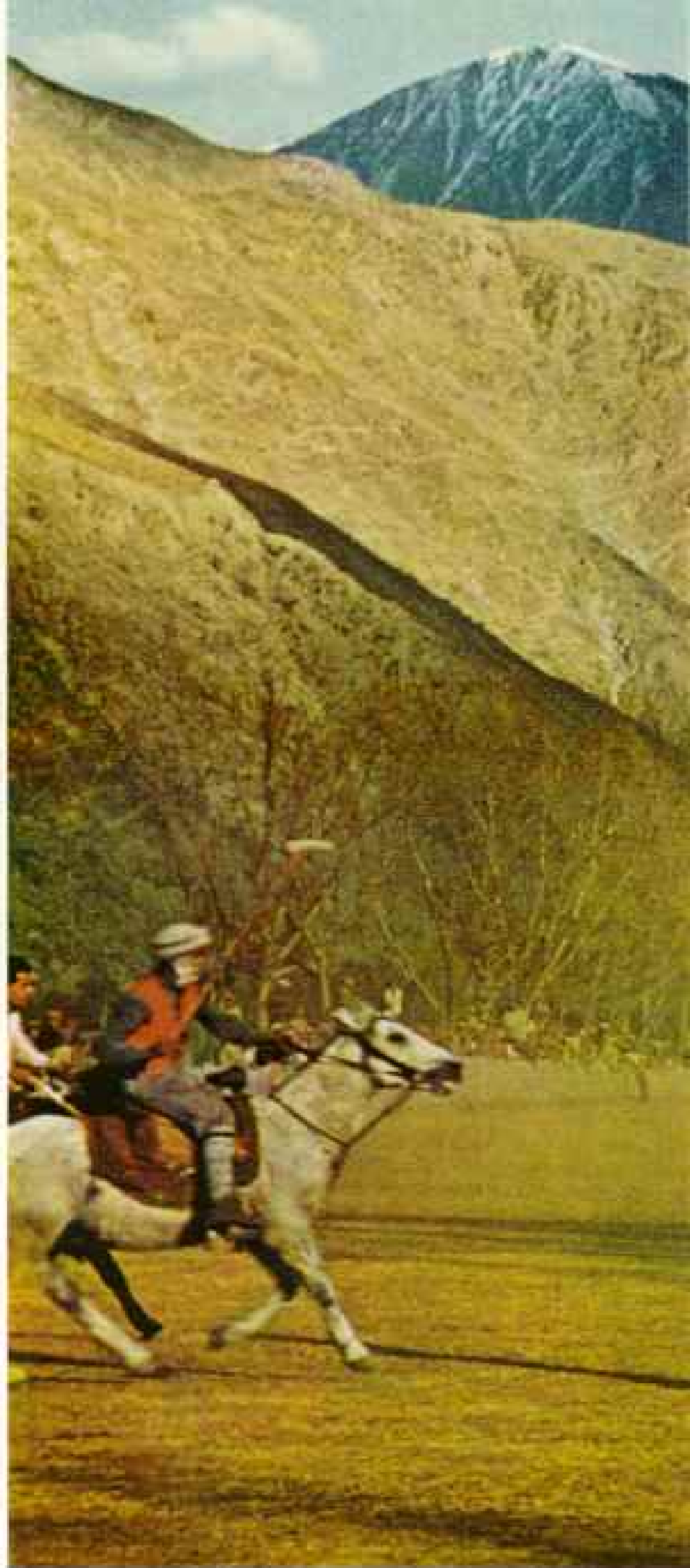
“I am cutting short my stay and will reach Hunza on 15th December.

“Colonel H. H. The Ruler of Hunza.”
(The “H. H.” stood for “His Highness.”)

Good News Changes the Schedule

The Mir’s new palace was a three-story gabled building of wood and stone. His aide showed us our upstairs quarters and brought us an armful of wood—about enough for half an hour, we thought. But we learned that it was supposed to last a whole day in fuel-scarce Hunza, where precious, life-giving apricot trees must be cut for firewood, and the constant choice the people face is “More fire? Or more food?”

We found the Karakorams so cold in early December that we weren’t out of our clothes once in our two-week expedition, and we took off our heavy jackets only when we crawled into our sleeping bags, which we rolled out on the floor before our little fire. We wore every bit of clothing we could find—including our fur caps—even when we ate our meals in the unheated palace dining room. There was a thermometer on the wall, and I once read it at 32° F.

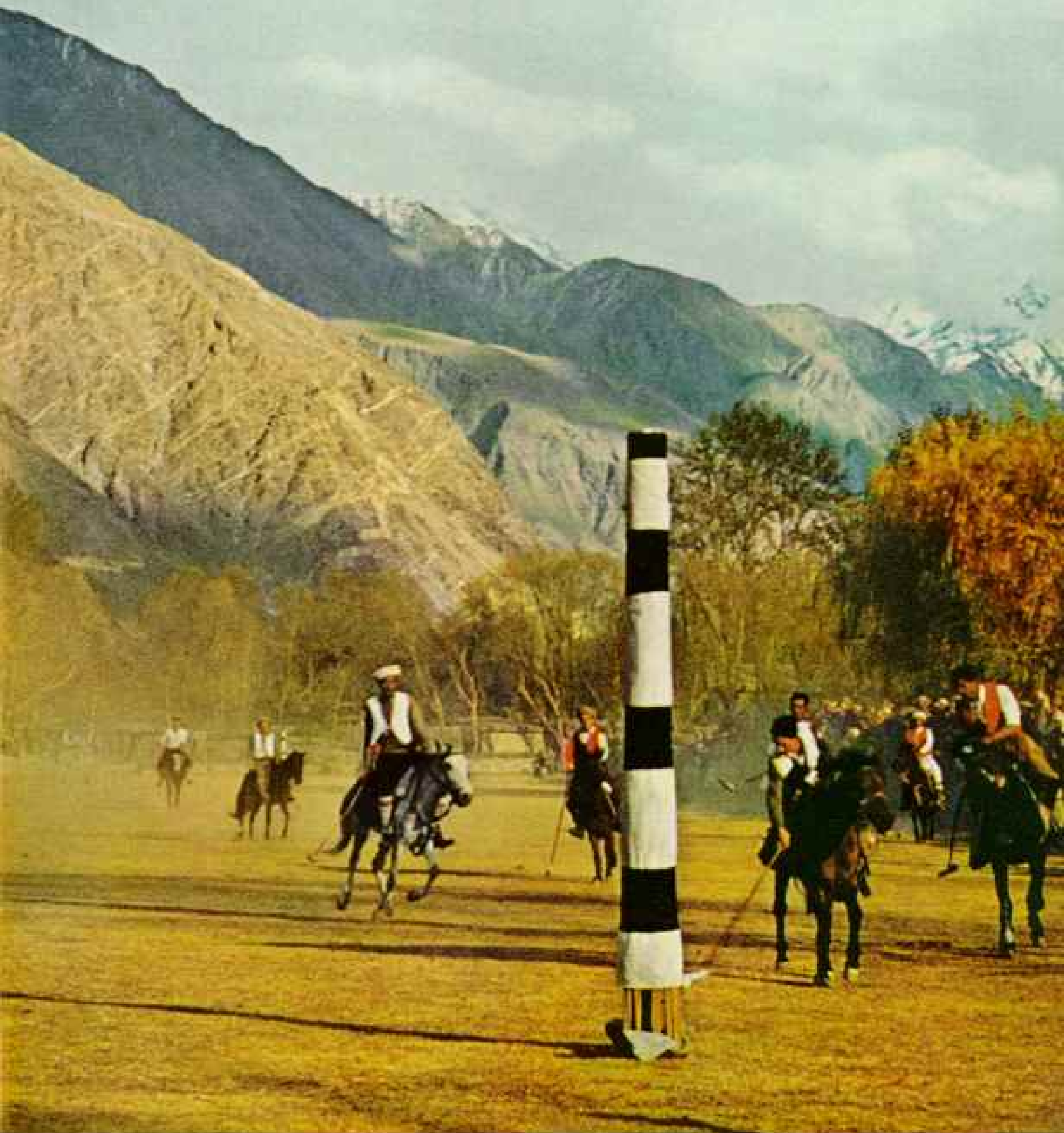


On our first morning in Hunza, Tay nudged me awake with a startling announcement.

“I think I’m going to have a baby,” she said. I was dumbfounded, but naturally thrilled after years of hoping to hear these words.

At the same time, I was frightened. We were far up a treacherous mountain trail in one of the earth’s most remote regions, winter already begun.

“What do we do now?” I wondered.



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It took two agonizing days to contact the Pakistani doctor in Gilgit over a primitive, battery-powered telephone. Between shouting at my end and listening for his faint whisper, I gathered his advice was that Tay should rest a few days, and then take the journey out on horseback in easy stages. If we were careful, it would do her no harm.

Thus reassured, Tay stayed close to her sleeping bag for the next three days; while Frances and I explored the narrow streets of

Baltit. On the roof of the Mir's palace we found the open-air throne where my friends, the far-traveled Franc Shors, must have taken their NATIONAL GEOGRAPHIC pictures of His Highness holding court. The Shors had passed this way five years before while following the trail of Marco Polo.*

While we were marveling at the beauty all

* "At World's End in Hunza," by Jean and Franc Shor, NATIONAL GEOGRAPHIC, October, 1953, gives an intimate view of this remote land.



Goatherd and Flock Leap an Oil Pipeline Beside Ra's at Tannūrah Refinery

A Saudi Arabian boy drives his long-horned goats past construction crane and cracking towers of the Arabian American Oil Company plant, 25 air



PHOTOGRAPH BY AL LITTLE. © NATIONAL GEOGRAPHIC SOCIETY

miles north of Dhahran. The refinery, here only partly shown, processes more than 60 million barrels of crude a year.

around us, a little boy came up and said "Good morning, sir!" He wore the Hunza white cloak of coarse wool, a broad, flat cap, and leather boots. With a warm smile he told us he was Naibullah Beg, aged 12 (page 97). He had been studying English for two years at a local school.

There was no school that day, and Naibullah invited us to see his father's sheep and goats. His father, he told us, was off soldiering with the Gilgit Scouts. We walked about a mile along the valley, studying marvelous networks of canals built to bring glacial water to Hunza's tiny terraced plots.

Naibullah's windowless stone hut housed the family's cows, goats, and chickens in a separate room. In the main room smoke from the family fire escaped through a hole in the flat roof.

In the garden a few sheep and one goat were finding lean pickings; so our friend climbed a fruit tree to shake down the remaining dead leaves. The animals snapped them up as fast as they reached the ground. A tough, precarious existence for humans and animals alike!

Unwilling to wait for the Mir because of Tay's condition, we left Hunza three days later. We had a crystal-clear day for our departure; the sky was sapphire behind the snow-covered giants that encircled us, their peaks trailing white plumes. Four days later we reached Chalt, where the Mir of Nagir greeted us like old friends.

Christmas on an Arabian Isle

The trip back from Chalt to Gilgit, and thence by Charlie's bright wings to Karachi, seemed a swift dream compared with those days on the Hunza trail. We followed the Indus downstream this time—the same way that Alexander took when, faced by possible mutiny among his battle-weary men, he turned homeward at last. Then, from Karachi, where Frances left us, we flew westward over the wild, bleak Baluchistan coast toward the Arabian peninsula.

Sandy beaches and desert waste rolled below, while off to our right jagged, stony mountains rose like enormous arrowheads upended in the ground. Iran's southern coast passed beneath us, and finally we were over the Persian Gulf.

On the Trucial Coast, we stopped overnight at the R.A.F. base at Sharja, a seaport of low clay houses facing the turquoise gulf; then we flew west and north along the desert shoreline. At last we saw black smoke rising



REYNOLDS © NATIONAL GEOGRAPHIC SOCIETY

Lumbering Dhow Beneath Lateen Sail Roams the Persian Gulf

Faras's yard exceeds her hull in length; she flies the flag of Bahrain above her counter. Lowell took a three-day voyage on the *jalboot*, a type of dhow, from Bahrain to Dubayy. He clocked her top speed under sail at six knots.

into the sky—the Bahrain Petroleum Company's flares of burning gas.

We spent Christmas on a tiny island called Umm a' Sabaan—"mother of sea shells" (page 74). It was the home of our close friends, the Thornburgs. Max Thornburg came to Bahrain in the 1930's and was largely responsible for developing the oil fields and refinery there. He and his wife—"Aunt Leila" to us—had transformed a barren 100-acre islet given them by the Sheik of Bahrain into a veritable desert paradise.

To make it all perfect, my father and mother flew out from New York to join us. We swam in the Persian Gulf—it was surprisingly cold—and fished and sailed about the island in the Thornburgs' small dhow.

Mastering the little lateen-rigged craft merely whetted my appetite for a voyage on one of the coastal dhows we had seen in the harbor at Bahrain. I had read Capt. Alan Villiers's article on dhows in the NATIONAL

GEOGRAPHIC and knew just what to look for.*

With the aid of an interpreter, Ahmed Hassan Mannaf, I found her, a 50-ton *jalboot* bound from Bahrain to Dubayy on the Trucial Coast with a cargo of flour, dates, electrical equipment—and Singer sewing machines!

Arab Ship No Place for Women

She was a stately craft, for all her bathtub lines (above). Built of teak, she measured 32 "forearms"—about 50 feet—at waterline, and in a stiff breeze she made six knots. Her name was *Faras*, Arabic for "mare."

With Ahmed's help, I persuaded the *nakhoda*, or captain, to take me along. Tay promptly withdrew from the expedition when she learned that woman's place aboard most Arab vessels is the dark and foul-smelling hold.

Clearing Bahrain under power of our diesel auxiliary, we set sail and coasted down the

* See "Sailing with Sindbad's Sons," by Alan Villiers, NATIONAL GEOGRAPHIC, November, 1948.

Persian Gulf to Dubayy, arriving after a leisurely three-day cruise.

Bidding the nakhoda goodbye, I was honored and deeply touched by his remark.

"It is as though you are one of us," he said, taking my hand. "We will miss you."

It was further proof that peoples everywhere, whether in goat-hair tents on the roof of the world or in age-old sailing vessels on the Persian Gulf, are all the same at heart.

U.S. Village Blooms in the Desert

I caught a ride with an R.A.F. plane at near-by Sharja and was soon back on Umm a' Sabaan with Tay, planning Charlie's next flight.

Tay wanted to see an American doctor before embarking on our first homeward leg. Luckily the Arabian American Oil Company

—Aramco—has a fully staffed hospital at neighboring Dhahran in Saudi Arabia.

Dhahran houses some 3,500 Americans. Another 1,500 are attached to Aramco's huge refinery of Ra's at Tannūrah (page 100). To us, Dhahran seemed straight out of the United States, with rows of houses laid out precisely, lawns and hedges, paved streets and sidewalks, large office buildings, a supermarket, beauty parlor, movie theater, and golf course. Its airfield is home for Aramco's private air fleet of 16 planes.

While Tay underwent a round of examinations, I took Charlie on a side trip 230 miles to Riyadh, the desert capital of Saudi Arabia. There I dined with His Majesty King Saud al Saud in his neon-lighted palace.

On my return, two of Aramco's geologists, Jack Reed and Brock Powers, took me on a

Smiling Passenger and Grim Mate Settle the Fare at Voyage's End

Cost of the 360-mile trip came to 10 rupees, about \$2. Some declined to pay until the skipper, a practiced fare collector, harangued them publicly. Here the mate (left) accepts a fee from a passenger. The captain records payment in his ledger.

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Hurrying to harness the wind, *Faras's* captain lashes sail to yard

flight deep into the Rub' al Khālī, the Empty Quarter of south-central Arabia.

We flew in a single-engine de Havilland Beaver fitted with huge desert tires, piloted by Cotton McGinty, a towheaded ex-Marine and a regular desert fox.

In the Empty Quarter, an expanse of sand about the size of Texas, even the Bedouin and his camel can scarcely find a living (page 70). Until recently it had been penetrated on camelback by only three Westerners—all British explorers who made separate treks across this vast desert: Bertram Thomas in 1931, H. St. John Philby the following year, and, in 1948, Wilfred Thesiger.

Aramco's geologists, however, have been roaming the Empty Quarter on wheels since 1937, even though this immense region still remains a challenge to map makers.

Our first stop was a tiny deep-test drilling camp called Al 'Ubaylah, 325 miles south of Dhahran. From there we flew southeast,

across a great uncharted stretch of reddish-orange sand where centuries of wind have piled up hills hundreds of feet high—in some cases more than a thousand feet.

Finally, after half an hour's search, we spotted a steel radio tower rising from a sand summit. Cotton put the Beaver down on a strip marked with oil drums. In a few minutes we were meeting Charlie Felds, an American, and John LeGrande, a Canadian.

Land of the Singing Sands

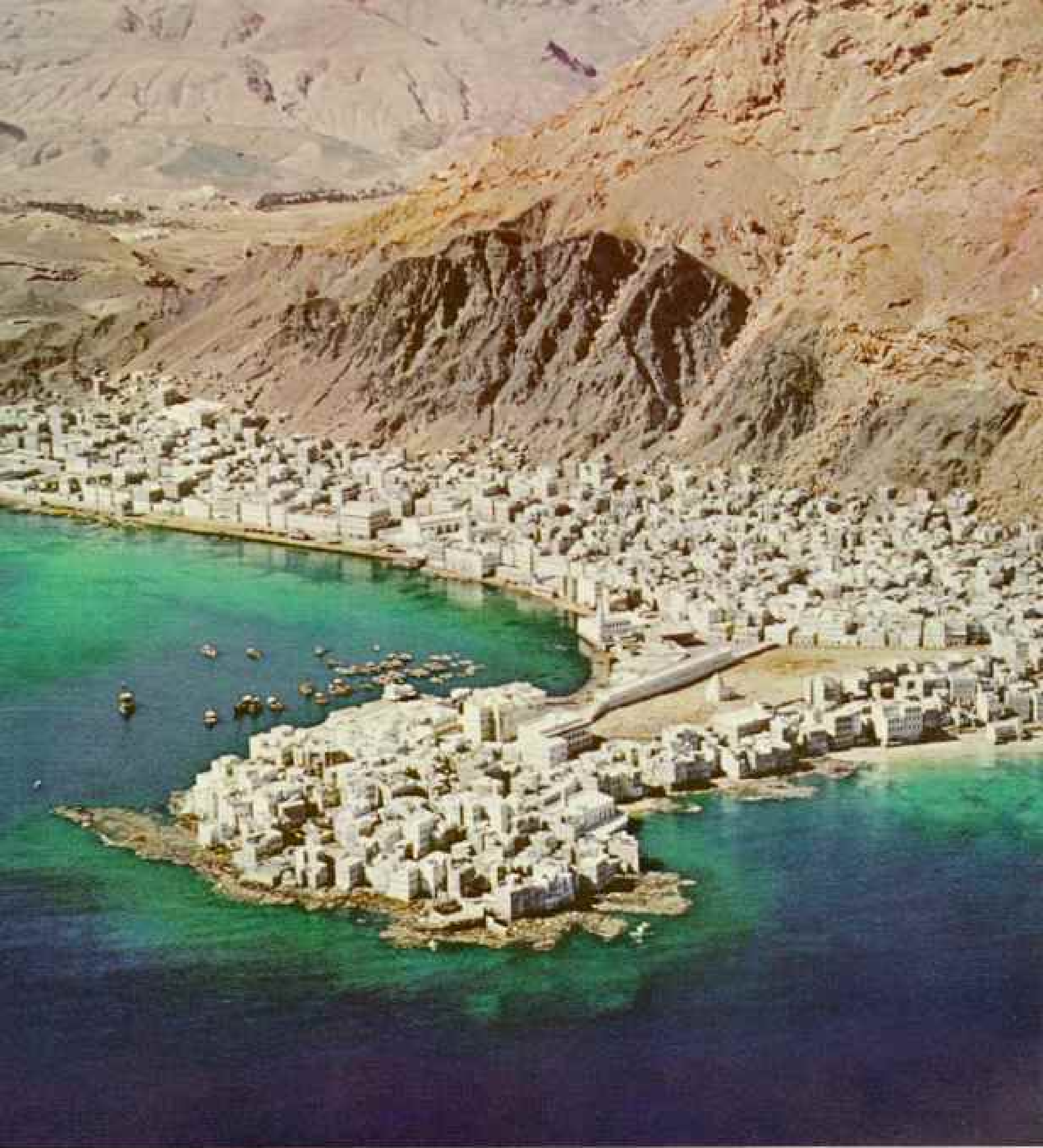
These two young men, together with a few Saudi helpers and guards, operated a shoran station, a radio aid to mapping. Sole inhabitants of that corner of the Rub' al Khālī, they were playing a vital part in Aramco's exploration of the Empty Quarter under concession of the Saudi Arabian Government.

They were glad to have visitors, of course. But what really made their faces light up was Cotton McGinty's gift of a dozen steaks.

Manning the Halyards, Crewmen Hoist Sail to the Rhythm of a Chantey

Lifting the heavy yard with a song, deckhands step gingerly about the passengers' quarters, a narrow section of unsheltered deck cluttered with ship's gear. Like 19th-century American whalers, *Faras's* crew shared profits of the voyage in lieu of wages.





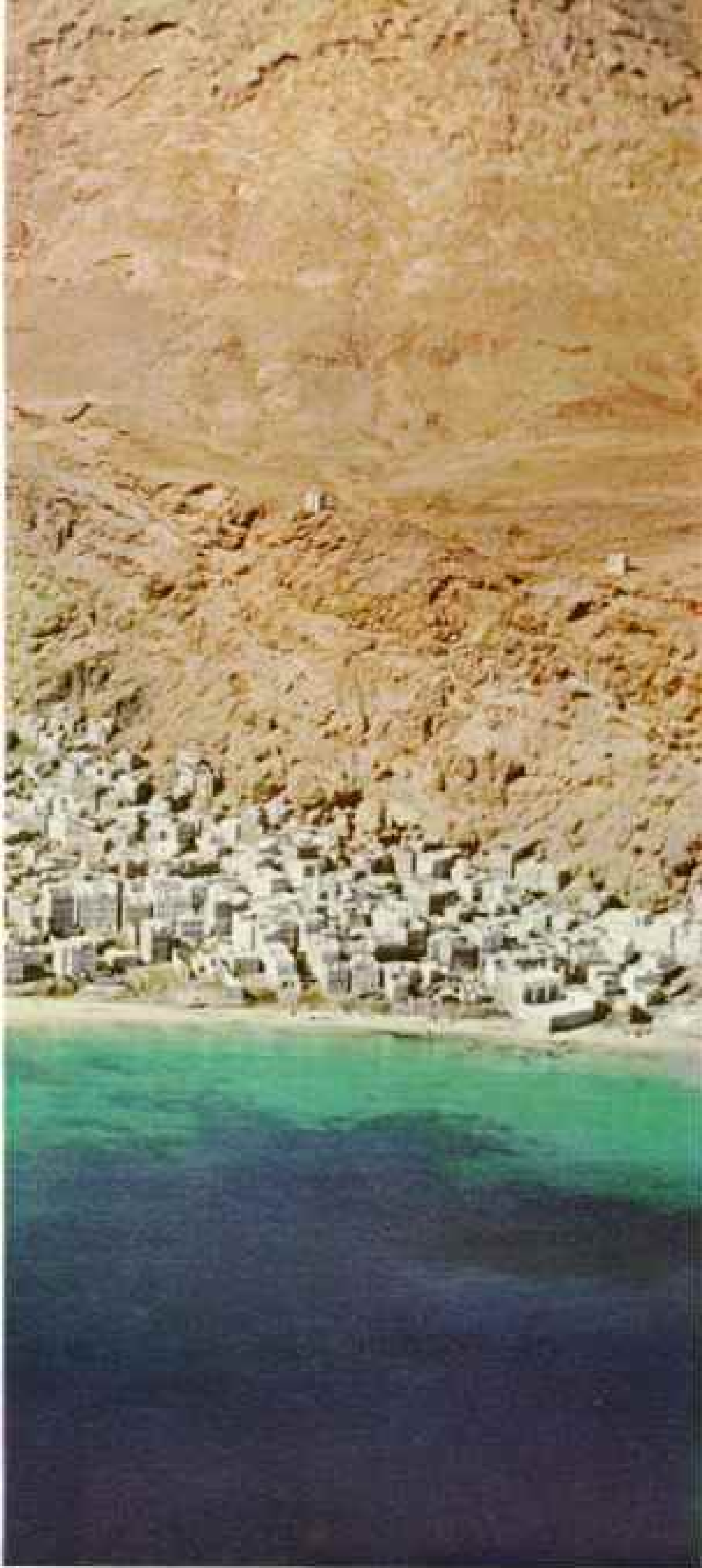
Before dinner, we drove up their sand mountain to the radio tower in a Dodge Powerwagon. With its oversize tires churning up a miniature storm, the powerful vehicle gathered frightening speed on gentler slopes in order to carry the steeper ones.

These mountains of sand forever reflect the force of their maker, the wind. Graceful ripples in symmetrical patterns mark the ever-shifting surface. The sheerest slopes are called slip faces, where the sand is pitched so steeply that it is always on the verge of slid-

ing, like snow on a timberless mountainside.

We all walked out onto one such face, and the sand began to slide under our feet. It did not move rapidly, as powder snow sometimes does, but very slowly. As the movement began, I heard a deep, faint droning sound, as if from planes flying at great altitude.

What I heard were the "singing sands" of Arabia. This phenomenon of the great desert seems to be caused by the sliding of one layer of sand over another, creating so strong a vibration that I could feel it through my shoes.



PHOTOGRAPH BY NATIONAL GEOGRAPHIC SOCIETY

After a night under the stars, we made a stop next day at one of Aramco's mobile drilling caravans 250 miles to the west. These exploring convoys, boring down through the sands and then through thousands of feet of rock to map the desert's subsurface, consist of giant tractor-trailer combinations hauling both a drilling rig and living quarters for the crew (page 108).

The next day we flew on to a second convoy far off in the southwest corner of the Empty Quarter, not far from the Yemen border. At

Al Mukallā Thrusts a Skyscrapered Promontory Into the Gulf of Aden

Centuries before Christ, south Arabia gained fame as an exporter of frankincense and myrrh, aromatic resins prized in perfumery and religious rites. Part of the Aden Protectorate today, Al Mukallā makes its living from less exotic trades: fishing, dhow building, and export of sesame oil. This aerial view from Charlie's cabin shows a fleet of dhows anchored in the harbor beneath gleaming white buildings.

the southern end of a gravelly plain the oil men had found stumps and fragments of a forest perhaps 60 million years old. Tons of reddish, petrified wood lay in the vicinity. Even more fascinating, however, were the arrowheads and spearheads from a later age that lay scattered about.

Geologist Hans Helley thought that perhaps the plain was once a lake bed. Inhabitants of this forbidding land are believed to have chipped and shaped these stone weapons about the time of Christ. What kind of land could this have been when forests thrived where we found only desolation?

No one knows the answers. The Rub' al Khālī guards its secrets well.

Charlie Dares the Empty Quarter

We were scarcely back in Dhahran before I was proposing to Tay a change in our flight to Cairo.

"Why not fly Charlie across the Rub' al Khālī to Salālah on the southern coast? It will save us going around the whole Arabian peninsula."

We measured the distance from Dhahran to Salālah, an R.A.F. base and main city of Dhufar province in the Sultanate of Muscat and Oman. According to our maps, it came to about 700 miles. Tay at first flatly vetoed the idea. But then I told her of Al 'Ubaylah, with its airstrip, radio beacon, and chance to refuel just about halfway to Salālah.

With that convincer, we were soon in the air, headed into a corner of the earth that the fabled Lawrence of Arabia described as "the last unwritten plot of earth big enough for a sizable man's turning in twice or thrice about, before he couches."

Our flight charts were nearly blank, except for Cotton McGinty's penciled notations. They showed only latitude and longitude lines and the symbols for sand and gravel.



**Oil Prospectors Tour
the Desert in an
Oasis on Wheels**

Probing the Empty Quarter's man-killing wastes for oil pools, Arabian American Oil Company geologists ride mobile units whose tractor-drawn trailers house air-conditioned offices, bedrooms, kitchen, and showers.

This search unit, its tractor engines equipped with outside radiators and its vehicles cushioned on low-pressure tires, appears to float across the desert near Al 'Ubaylah.

Desert beach surrounds an artificial pool supplied by the water tanks of a deep-test drilling camp at Al 'Ubaylah. Aramco pilot Cotton McGinty joins Tay Thomas (right) and a geologist's wife at the pool. Distant drilling rig bored a 13,000-foot hole.

PHOTOGRAPHS © W. A. S.





On our trip together Cotton had given me a few pointers in desert flying—how to gauge wind drift from the plane's shadow, how to estimate ground speed, and how to fly a rectangular search pattern in case we missed a check point. These would be few and far between, however, and our flight would have to be made with planned precision.

Charlie was well prepared for his hop. In Dhahran the Aramco mechanics had given him a thorough going-over.

His engine got a 100-hour inspection, new spark plugs, retimed magnetos; all lines and fittings were inspected for tightness. The radios had been checked. Finally, Charlie's aluminum skin, grown dull and clouded in the salty atmosphere of Bahrain, had been polished until it sparkled.

Navigation by Tire Tracks

We leveled off at 4,000 feet, flying southeast along the coast to the angle of the Qatar peninsula, then directly south. This course would intersect tire tracks that Cotton said led straight to Al 'Ubaylah.

We picked up the tracks, plain on the sands below, and turned to follow them. They faded out occasionally—at which point Tay would begin thinking all over again about making a forced landing on the desert—but each time they soon reappeared.

Then we passed a group of tents and a tall, thin radio tower. This was another shoran station, mate to the one I had visited. I radioed back to Dhahran to give this first definite fix, our time and altitude over the station, and our estimated time of arrival at Al 'Ubaylah.

Not long afterward the tire tracks disappeared altogether. As far as eye could see—50 miles or more in all directions—spread the ocean of yellow sand. I still held carefully to the course the tracks had been following, and suddenly I made out a tiny dark splotch below—a camel watering trough.

It showed no sign of life, but after a time Tay leaned forward in her seat.

"Look!" she cried. "There's a car."

Sure enough, a red sedan was bowling over the desert in the direction we were flying. A

little later we spotted some abandoned oil drums which, small as they were from 4,000 feet, stood out boldly against the sand.

Al 'Ubaylah's tall derrick suddenly appeared dead ahead. We jumped with relief.

"HZAP, HZAP," I called on the Aramco radio frequency, giving Al 'Ubaylah's call letters. "This is Cessna four three Charlie. Over."

A voice replied. I reported that we were within sight and would be there in 10 minutes.

Just to show him off a bit, I buzzed Charlie around the oil camp. Then we turned in for a landing on the narrow airstrip, little more than a slot between two dunes. Along each side ran sections of red snow fence—here used to keep the desert drifts in check.

At Al 'Ubaylah, tiny beds of green grass grew in front of three long wooden bunkhouses, set amid machine shops, a power plant, and piles of drill pipe. We saw blossoming oleander and a trellis covered with a green vine. There was even a swimming hole filled with clear, sweet water from a well drilled deep in the desert sand.

We couldn't resist taking a swim in the heart of the Empty Quarter (page 108). As the oil men pointed out, their pool had one of the world's largest bathing beaches.

Over Sand Mountains to the Sea

The next day we took off on one of the most memorable legs of our entire trip. Our route from Al 'Ubaylah to Salalah was just under 500 miles. Cotton McGinty had told me all he could of what lay between.

"About 60 miles east," he had said, showing me his well-worn map, "there's a big white finger of sand running north-south." He marked it carefully.

"That's just halfway to an abandoned airstrip called Tumayshā. You'll see lots of truck tracks, and there ought to be some oil drums marking out the strip."

He also placed on my map the exact location of the shoran station we had visited among the sand mountains. From there to Salalah would be a matter of flying almost due south for another 220 miles.

We took off at 1:10 p.m., climbing through

Soaring Apartments Ring a Minaret in the Town of Shibām

Residents of Wadi Hadhramawt in Aden originally built the eight- and nine-story mud-brick homes as citadels against marauding Bedouin. When the authors approached Shibām by air, the settlement seemed to "rise above the valley floor almost like a butte." Caravan camels rest beside the whitewashed mosque with its cake-frosting tower.



heat haze that blurred the horizon. In 35 minutes we were crossing Cotton's finger of white sand, and an hour out we spotted tire tracks where we thought the airstrip at Tumayshā should be, but no oil drums. I radioed back our position, reporting we were changing heading.

We climbed again to 6,000 feet, and within another 10 minutes sighted the greatest mountains of sand I had seen. Their color varied from burnished gold out of Tay's window to a deep red—almost maroon—out of mine.

Desert Friends Say Goodbye

We did not see the shoran station but passed over more tire tracks leading to it. After half an hour over the ranges of dunes, we crossed a flat gravel plain and came to yellow sand once more.

Now we saw tracks again—many of them, running east and west. Not knowing what they meant, I radioed again. Al 'Ubaylah told me they had probably been made by the Oman border patrol. We were flying over what Oman held to be its boundary with Saudi Arabia, though the line, as we knew, is disputed.

Visibility was unlimited now; the horizon must have been 100 miles away. Before long the coastal range, with Salālah just beyond, loomed above the curve of the earth.

Our earphones crackled as Aramco's main station in Dhabran made its routine afternoon calls to remote camps in the Empty Quarter. Al 'Ubaylah, in turn, reported our southward progress. It was reassuring to know that if anything went wrong and we were forced down, Cotton McGinty knew every detail of our flight. In his Beaver he would surely find us.

Then we could see the ocean between the summits ahead, and finally the beautiful bank of green between the foothills and the sea. There lay Salālah at the water's edge, and just inland the two gravel runways and buildings of the little British airbase.

Though Al 'Ubaylah was now almost beyond range of our small radio, I called to report we had sighted our destination.

"Many, many thanks," I added, "for all your help."

Vaguely I heard someone replying, but the signal was too faint. I repeated the message, and then one of Aramco's mobile units answered from the southwest corner of the great desert.

"Cotton says so long," the voice said, "and have a good trip home."

And home we went, skimming over the storied Wadi Hadhramawt, a shimmering valley of jade-green fields and lush date groves slicing the arid reaches of the Aden Protectorate. Dotted along the valley floor were clusters of mud-brick "skyscrapers," eight- and nine-level structures that have been in vogue since before the days of Solomon and the Queen of Sheba (page 111). Defense was the builders' idea—defense against raiding Bedouin.

On we flew, closing the circle of our flight plan by calling at Asmara, in Eritrea, where we had put down seven months before. It was on this part of the journey that we were unaccountably reported missing. A newspaper article related that "Lowell Thomas, Jr., and his wife, unreported for six days on a flight over the Arabian peninsula, were located today on the Island of Sardinia in the Mediterranean. . . ." We were never able to explain the story, for we didn't get lost and we never came near Sardinia!

But now Charlie had the bit in his teeth. We touched briefly at Cairo and Algiers, then jumped the Mediterranean and landed at Paris, starting point of our yearlong, 45,000-mile odyssey. The most important thing to us now was the baby on the way.

Charlie Wins a Place in the Family

We took with us that faint voice in our earphones, lost in the sandy wastes of the Empty Quarter.

We took also the voice of an unknown American airman aboard a Military Air Transport Service plane, with whom we talked briefly over the western Mediterranean.

"Careful, four three Charlie," he said. "Don't get wet."

And, not least, we took Charlie. We had considered selling our little plane in Cairo to help finance our trip. We had thought about it again in Paris, but each place we seemed to come to the same idea without discussing it.

Charlie, having served us so well, just couldn't be left behind. He came home, dismantled, aboard an ocean-hopping big brother, a four-engine Pan American cargo Clipper, with three thoroughbred Irish race horses as flightmates.

Charlie was to fly us many thousands of miles more around the United States—including our 49th, Alaska—us and a new blue-eyed passenger named Anne.

1880 George Catlett Marshall 1959

AS SOLDIER and statesman," wrote President Dwight D. Eisenhower, "General Marshall devoted his entire life to selfless service to his Nation. To his resolution and strength of purpose, his steadfast courage and wise decision, this Nation, and indeed the Free World, are deeply indebted for survival at a time of great peril. . . ."

Amid the press of his many governmental duties, General of the Army George Catlett Marshall gave generously of his time and talents to the National Geographic Society, of which he was a Trustee. He initiated a National Geographic-Smithsonian Institution expedition to study giant effigies outlined on desert mesas of the West, and, in the June, 1957, issue of the magazine, he wrote a moving tribute to the Nation's fallen sons, "Our War Memorials Abroad: A Faith Kept."

Born on December 31, 1880, in Uniontown, Pennsylvania, General Marshall graduated

from the Virginia Military Institute in 1901. He served as a colonel in France in World War I. As Chief of Staff of the United States Army in World War II, General Marshall was the architect of Axis defeat. To Winston Churchill, he was "the true organizer of victory."

In 1947 General Marshall became Secretary of State. The European Recovery Program that bears his name—the Marshall Plan—saved postwar Europe from chaos and brought him the Nobel Peace Prize in 1953. During the Korean War the Nation called again, and he returned as Secretary of Defense.

On May 18, 1949, General Marshall succeeded his old friend John J. Pershing, General of the Armies of the United States, on the Board of Trustees of the National Geographic Society. With deep sorrow, The Society records General Marshall's death on October 16, 1959. His country has lost a great statesman and The Society a loyal friend.

General Marshall Honors a Colleague Before The Society's Board of Trustees

On the retirement of Gilbert Grosvenor (right) in 1954 as President of the National Geographic Society and Editor of its magazine, General Marshall read the Board's tribute to his fellow trustee. At the far left is Dr. John Oliver LaGorce, who succeeded as President and Editor. In the foreground, Thomas W. McKnew, Executive Vice President and Secretary, and Robert V. Fleming, Vice President and Treasurer. On the General's right are Lyman J. Briggs, Chairman, Research Committee, Melville Bell Grosvenor, H. Randolph Maddox, Vice Adm. Emory S. Land, and William E. Wrather.

WILLARD GUYLER



*A scientist seeks the giant ape of Africa's
high forest haunts, to find
400 pounds of ferocity—and shyness*

Face to Face With Gorillas in Central Africa

By PAUL A. ZAHL, Ph.D.
National Geographic Senior Staff

Photographs by the author

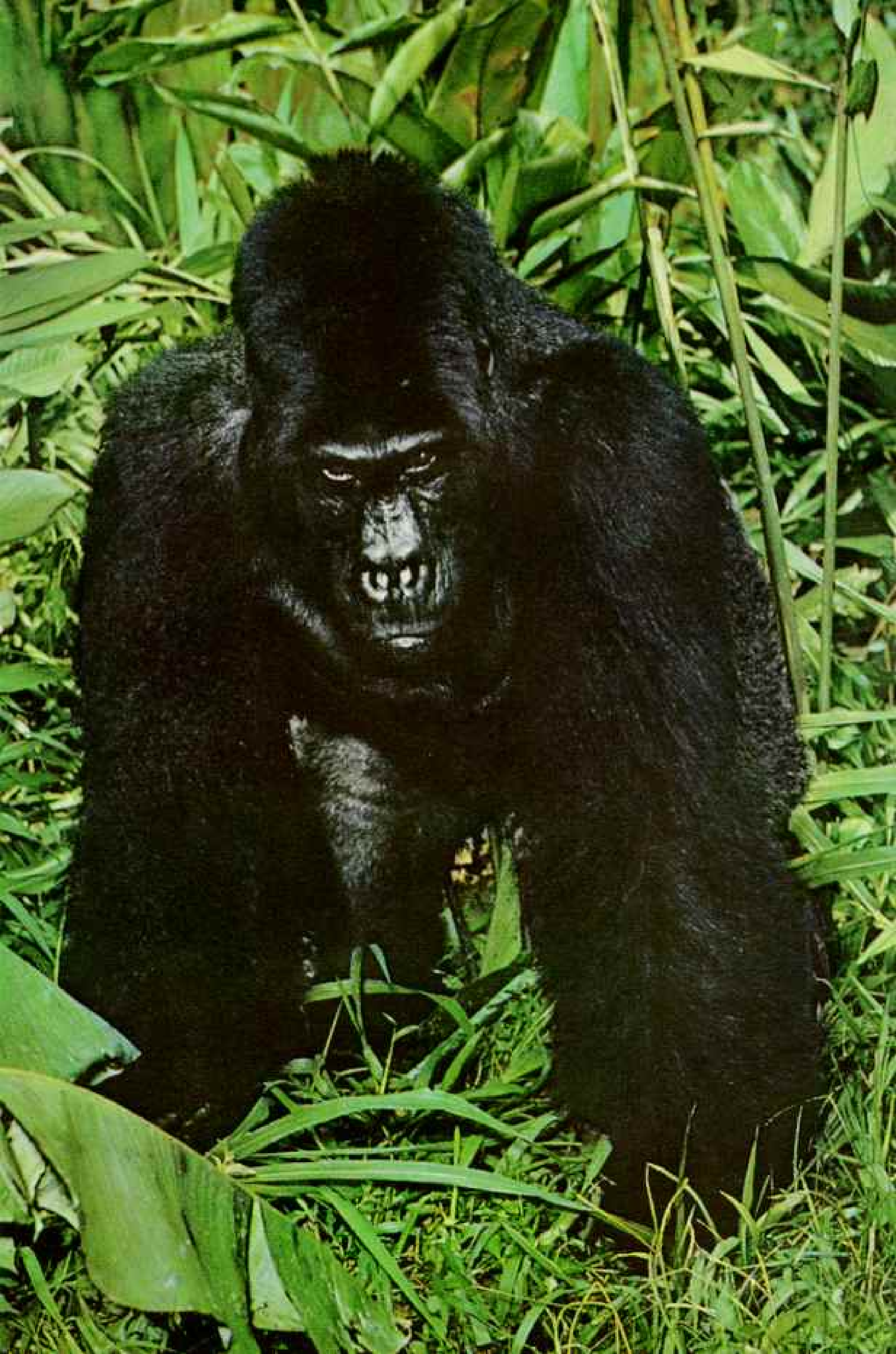
THOSE KNUCKLE MARKS in the soft earth were fresh. Perhaps only half an hour had elapsed since a creature with hands the size of a first baseman's mitt had used this trail, leaving knuckle tracks, not splayed handprints. They provided unsettling identification—gorillas!

Would they resent our intrusion and, if so, what would they do about it? Except for bush knives for clearing the way, we carried no weapons; we were here to observe, not to take life. My hope that these largest of the great apes would reciprocate was based on nervous acceptance of an oft-repeated statement: Gorillas in the wild may charge ferociously but will seldom actually attack.

Here in the center of Africa, on a mountainside 9,500 feet up, we were approaching our quarry through a weird and primeval forest. No sun penetrated the shadowy bamboo; only misty streamers of soft green slanted here and there through the canopy. Tufts of moss and shaggy lichen the color of ashes dripped water on our heads and sometimes brushed, wet and cold, against our faces.

Scowling mountain gorilla digs his toes into the dirt and prepares to charge. Largest of the manlike apes, gorillas may stand six feet tall and weigh 600 pounds. Found only in the highlands of central Africa, the mountain subspecies is outnumbered by its lowland cousin, the variety usually seen in zoos. This captive male, named Munidi (Prince), glowers at the author from a jungle enclosure near Utu, Belgian Congo.







Lake Mutanda reflects the dawn over Uganda. Dormant volcanoes pierce the clouds

The author greets a chief before climbing Mount Muhavura (at left, above) to seek gorillas. Mutwale Paulo, with one of his 20-odd wives and an aide, visits Dr. Zahl's hut in Kisoro, Uganda.





ALL PHOTOGRAPHS BY PAUL A. SARG, NATIONAL GEOGRAPHIC STAFF © N.G.S.G.

above the Virunga range, a home of the mountain gorilla. Ruanda-Urundi lies beyond

Abruptly my guide Reuben, a villager from the valley 4,500 feet below, tensed. He swung his head slowly from side to side, sniffing, then pointed a finger sharply to the left. I sniffed too, and caught a faint odor vaguely like ammonia.

More cautiously now, we eased through the bamboo, two native aides close on our heels. Not another word was spoken; we took each step carefully, so as to break no twig, create no sound. I could not help noticing how firmly my companions grasped their sickle-like bush knives, although such weapons would have been little more effective than popguns against an angry gorilla. Our approach seemed endless.

The ammonialike animal odor grew stronger. Then from the vegetation not far ahead there came a cry. To describe it as a high-pitched bark seems a pitiful understatement. Stentorian shriek would be better. Neither phrase is precisely accurate. It was the most chilling outcry I have ever heard.

"Be off! Danger approaches!" was its

imperative message, not intended for us, I knew, but for the gorilla troop's females and young. I sensed rustlings as the family, still unseen, made a hasty getaway—that is, all but one member.

My blood seemed suddenly choked with ice as a gigantic anthropoid form materialized ahead in the jungle gloom. On all fours it came toward us, crackling through the bamboo, sweeping moss festoons aside. Shoulders three feet across supported a thick, squat neck and a head whose black, prognathous face and hair-crested brow were all the word "gorilla" ever implied.

Man Meets Ape, Face to Face

With nostrils flared and lips curled back to expose fearsome white teeth, the creature stopped short some 20 feet away. Sunken eyes, the essence of savage malevolence, fastened on us. For what seemed an eternity, I could hear the sound of my own rapid breathing. That and nothing else.

I remembered the words of Maj. B. G. Kin-

loch of the Game and Fisheries Department of the Uganda Government when, in Entebbe, I had obtained official permission to stalk gorillas in these wild volcanic mountains. "Do be careful," he had said, adding with typical British understatement, "They aren't zoo gorillas, you know."

I devoutly wished they were during the next long five seconds, as the great male crouched like a padded football player, his fearsome arms stiff from shoulders to the ground, as if ready at any moment to swing the whole awful machine back into action. Low, ominous noises rolled from his throat as his head jerked to one side or the other of the curtaining bamboo stalks for a better look.

Had I not been thoroughly warned against it, I surely would have bolted. Holding one's

Wild celery, a favorite gorilla food, thrives in the African highlands. Great apes strip away the tough outer stalks to get at the tender heart. Reuben, the author's guide, plucked these plants at the 11,000-foot level.



Safari invades the Belgian Congo's

ground, so the theory ran, can dissuade a gorilla from following through on his charge.

That was what happened in this case. Abruptly the 400-pound nightmare turned, and I caught a glimpse of silvery back pelage. Then he was gone.

It was as if his purpose had been to freeze us in our tracks until other members of the family could get away. Once they were safe, he wished no further traffic with us.

Nor did I, at that moment, with him.

Gorilla Lore Mixes Fact and Fiction

Before setting up camp here on the high saddle between the Muhavura and Mga-hinga peaks, I had discussed my plans with Mr. Walter Baumgartel, innkeeper of



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steaming jungle to study gorillas. Cameras are legal, guns forbidden

Travellers Rest in the valley below at Kisoro (page 116 and map, page 127). This quaint hostel with its thatched guest huts is an informal headquarters for gorilla talk in Uganda. Indeed, the Uganda Government has named Baumgartel an honorary game ranger; his duty is to advise and caution any persons wishing to venture into gorilla country.

"The National Geographic will serve a worthy purpose in publishing an accurate report on gorillas," this courtly German immigrant declared when I had explained my mission. "So much nonsense has been written about them."

Our conversation centered on gorilla lore: How around 500 B.C. a Carthaginian navigator named Hanno, sailing down along the African west coast, came back with tales of wild,

hair-covered "men," known to the natives as "gorillas"; how in the early 1600's another traveler returning from Africa told of a creature "...in all proportions like a man... hollow-eyed, with long hair upon his brows."

Gorilla Long Regarded as Myth

Such accounts were generally regarded by scientific folk of the day as fairy tales. But reports persisted of abductions of native women by man-apes, of bodies mangled beyond recognition, and of armies of marauding ape-men.

Not until 1847 did the first scientific description of a gorilla appear, based on skulls that American missionaries had acquired in Gabon. The first live gorilla known to have reached Europe—about 1855—toured Eng-



land with a traveling menagerie, mistakenly displayed as a chimpanzee.

Even as recently as 1861, when the French-American explorer, Paul du Chaillu, described encounters with huge African primates, their existence was widely rejected as a figment of overfertile imagination. Critics accused the explorer of "doctoring" the gorilla skins he brought back for lecture exhibits and of grossly exaggerating his adventures. True, Du Chaillu's accounts seem somewhat colored in the light of today's knowledge of gorillas. But one must concede the courage of this first white man to face the terrifying, little-known creature in the wild.

Forest King a "Nightmare Vision"

Of his first gorilla kill, Du Chaillu wrote: "He stood about a dozen yards from us, and was a sight I think I shall never forget. Nearly six feet high (he proved four inches shorter), with immense body, huge chest, and great muscular arms, with fiercely-glaring large deep gray eyes, and a hellish expression of face, which seemed to me like some nightmare vision; thus stood before me this king of the African forest.

"He was not afraid of us. He stood there, and beat his breast with his huge fists till it resounded like an immense bass-drum, which is their mode of offering defiance; meantime giving vent to roar after roar. . . .

"His eyes began to flash fiercer fire as we stood motionless on the defensive, and the crest of short hair which stands on his forehead began to twitch rapidly up and down, while his powerful fangs were shown as he again sent forth a thunderous roar. And now truly he reminded me of nothing but some hellish dream creature—a being of that hideous order, half-man half-beast, which

we find pictured by old artists in some representations of the infernal regions. He advanced a few steps—then stopped to utter that hideous roar again—advanced again, and finally stopped when at a distance of about six yards from us. And here, just as he began another of his roars, beating his breast in rage, we fired, and killed him."

Rare Mountain Subspecies Discovered

After Du Chaillu's expedition, other hunters and explorers brought back gorilla skins and skeletons for museum study. By the turn of the century, at least a score of attempts had been made to exhibit live young gorillas. Improperly fed and vulnerable to many of man's ills, however, most captives died within a few weeks or months.

Only in recent decades have zookeepers succeeded in maintaining healthy gorillas for public display.

"In 1901," my host Mr. Baumgartel related, "a Captain von Beringe shot a gorilla on Mount Sabinio. Study showed minor skeletal differences between this mountain gorilla and the lowland variety of west equatorial Africa. Moreover, living in the wet, cold forests of the high country, it had somewhat heavier fur, as one would expect."

Today mountain gorillas bear the Latin name *Gorilla gorilla beringei* in honor of the captain. Among the world's rarest animals, they are found in only a few regions of central Africa, including the romantically named Impenetrable Forest around Kayonza and the Maniema Forest on Lake Tanganyika (map, page 127). Their larger cousins, the lowland gorillas, tagged with the monotonous scientific name *Gorilla gorilla gorilla*, inhabit the vast forests of equatorial Africa from the west coast into the Congo Basin.

Munidi Screams Threats, Shakes a Hairy Fist, and Charges the Camera

Strong enough to bend iron bars, a gorilla will fight fiercely if cornered or if his family is threatened. Munidi, a captive at Utu for a few months, charged savagely as the author opened a shutter in the stockade wall (next page). When Dr. Zahl slammed the door in his face, the ape pounded on the fence and howled in frustration.

Reuben Peers Cautiously Into an Ape's Bed of Springy Boughs

Gorillas live like nomads, roaming the jungle for food and spending the nights in different spots. Most of them bed down on the ground in a nest of leaves and branches. Twice the size of a washtub, this bed was occupied the night before. Reuben swings his crescent-bladed *panga* to clear a path through the moss-festooned trees.





Subject for centuries to the hostility of natives, gorillas are today fully protected under international agreement. That part of their range in Albert National Park centered around Mount Mikeno in the Belgian Congo is rigidly barred to human visitors.

Mountain or lowland, gorillas are universally feared by the natives. "But their 'wickedness' has been somewhat exaggerated," Baumgartel told me.

"Certainly an adult male gorilla could twist the head off a man without even trying, but, if not annoyed, he is nonaggressive, at times even demure. So long as you do not corner him or drive a wedge between him and his family, the male may roar and charge but, for all his fierce mien, will not follow through.

"Should a gorilla approach, hold your ground at all costs. Never run.

"Now, as to provisions and carriers for your expedition . . . you will want Reuben, of course."

Reuben Rwanzagire had spent his life in the picturesque Kisoro valley. His frequent contacts with gorillas in the high forests had made him a valued guide and tracker.

"Reuben has just bought a wife," Baumgartel was saying, "and he is still making payments on the purchase price. I am sure you can hire him."

Gorilla Hunters Take to the Trail

When Reuben reported at my hut, he proved to be a spare, keen-eyed African of about 50, decked in a hodgepodge uniform improvised from military surplus (page 118).

He and Walter Baumgartel helped me load my car with camping and photographic gear. Men alerted earlier for porter service—11 in all—emerged from their huts as we passed and trotted behind our creeping car. Women carrying wood or working in the fields hailed us; they knew where we were going. "*Ngagi*," they called, using the Runja-Ruanda word for gorilla.

At road's end by the base of Muhavura, I parked the car in a field of yellow wild flowers and unloaded. The porters heaved 40-pound loads up on their heads, and the

safari wended its upward way. Nightfall found me domiciled in an empty hut on the 9,500-foot Muhavura-Mgahinga saddle, with Reuben and his two assistant trackers occupying another. The porters had returned to their valley homes.

Next day we set out, with no clue to the whereabouts of the nearest gorilla troop. A hundred yards from camp we came upon fresh elephant and buffalo tracks. These beasts share this lofty habitat with the gorillas but, because they feed mainly at night, are rarely seen.

Quarry Leaves Telltale Signs

Equally elusive are the leopards, whose tracks we also encountered. Leopards appear to be the apes' greatest natural enemies. They will never attack a healthy, grown gorilla, but are known to haunt a family troop and to pounce on ailing stragglers or young. Smaller animals also share the gorilla forests: duikers, hyenas, forest hogs, hyraxes, and a variety of rodents. In the days that followed, we observed some sunbirds, a few insects, but not one snake.

Reuben's skill as a tracker approached divination. Leading us into one of the tunnel-like animal trails that honeycomb the bamboo, he would stop suddenly to examine a broken twig; or he would pick up a tiny tuft of hair from the trail, like a housewife finding a bit of fluff on a carpet.

If the twig had been broken in a certain way, or if the hair was gorilla fuzz, Reuben would immediately dispatch our two aides into the thicket on our flanks. On a broad front, we would then slowly advance, seeking additional clues: knuckle or foot marks, excrement, food leavings, crushed vegetation. The man who found such signs would signal a rendezvous with a low whistle. Reassembled, and in total silence, the four of us would file through the undergrowth in search of the next telltale sign.

Because of the enormous bulk of food needed by vegetarians the size of gorillas, families and troops continually wander from one feeding area to another. Seasonal maturing of

Cavernous Yawn Bares a Rain-soaked Primate's Inch-long Fangs

A gorilla's mouth contains 32 teeth, the same number as man's. But the giant apes chew with an up-and-down action, while man grinds each mouthful with a rotary motion. Hunters respect a gorilla's powerful jaws. Early accounts told of cornered apes seizing assailants' muskets and crushing the barrels between their teeth.





edible plants in various parts of the mountain slope probably plays an added part in gorilla movement.

Tracking the quarry, we wandered similarly—along tumbling mountain streams; across clearings choked with bracken, nettles, everlasting, ground orchids, and wild celery; through an endless grillwork of festooned bamboo. Often drenched after hours of pursuit, we might find ourselves merely at the troop's previous night's camp.

Once we stumbled upon a cluster of five concave heaps of branches—fresh gorilla beds, reminiscent of eagle nests but much larger. Four were on the ground amid half-crushed undergrowth, the other perched six feet above on a cluster of bamboo stalks. One of the ground nests, twice the diameter of a standard washtub, obviously was that of an out-sized male (page 120). Others were smaller—the beds of females and young.

Mountain gorillas usually build new beds every evening, abandoning them in the morning. Of several pallets I examined, none supported a claim I had heard: that the gorilla has the sense to tie knots. It appeared to me that before nightfall a gorilla merely gathers leafy branches by armfuls, arranges them in an orderly, comfortable heap, then plunks himself down in the center. Adults perhaps help the young construct beds; infants probably sleep with their mothers.

Beds-on-stilts Boast Inner Springs

The elevated bamboo beds required more ingenuity. A number of bamboo stalks were bent together and their tops crudely interlocked. On the platform so achieved, additional foliage was piled, making it a springy and, I would guess, very comfortable bower.

Such elevated roosts were never the largest of any group; they could not possibly have supported an adult male. Presumably they were for protection of females and young.

I wished to identify and photograph as many as possible of the plants used for food by the gorilla. As a reference work I had an excellent check list of 22 different plant

A pause at the summit. About the size of an adult chimpanzee, this young female gorilla scampers up a bamboo pole in a stockade near Tshibati, Belgian Congo.

Although the gorilla's life cycle remains largely a mystery, mammalogists believe the great apes may mature as early as seven years and live beyond 30. Females never grow so large as males.



Mountain Gorillas Rule a Domain in the Equatorial Jungle of Africa

Discovered in 1901 on the volcanic slopes of Mount Sabinio, the mountain gorilla (*Gorilla gorilla beringei*) roams the chilly highlands, from 5,000 to 13,000 feet, around Lake Kivu.



species, published by Miss J. H. Donisthorpe under the auspices of Prof. R. A. Dart's Gorilla Research Unit at the University of the Witwatersrand, Johannesburg.

Reuben supplied a very special brand of collecting acumen. He spoke no English, and I knew only a few hesitant words of his dialect. During our bush treks, I would point to various plants inquiringly. Reuben would enlighten me by simply chopping his jaws and either nodding or shaking his head.

Evidently the gorilla prefers only the tender central shafts of certain plants, or, in some cases, the soft outer bark. Husks and other hard parts were dropped in a neat pile wherever he happened to be picnicking. These remains, when fresh, always alerted us to the proximity of the troop and the direction of their roaming.

Male Gorilla Rules a Harem

We made four specific contacts with wild gorillas during our sorties from the Muhavura camp. One of them involved the charge already described. The next time, a male approached and barked but did not actually charge. Twice more I saw and heard gorillas, but only as they were hurrying away. Never was there time for photographs.

The largest of the troops consisted of one male, two females, and two immature gorillas. Troops of 18 individuals had been observed here; in the Impenetrable Forest, a troop of several dozen individuals—undoubtedly more

than one family—had been reported living compatibly in the same area.

Gorillas seem to be polygamous, each family consisting of a male, one or more wives, and their young. As the male offspring mature, they may stay with the troop or leave and set up independent units. Incidentally, legends of male gorillas abducting women probably originated in the use of gorilla disguises by amorous native sorcerers.

Some observers have reported individual gorillas living alone, unassociated with any group. These could be males driven off by younger rivals, or aging misfits of one sort or another. There is no social security or old-age care in jungle society.

In late January we broke camp and descended to Kisoro. Within a few days I was bidding farewell to Reuben and to Walter Baumgartel—off for yet another kind of go-

rilla experience. Driving southward, I headed for the point where the Belgian Congo, Ruanda-Urundi, and southwest Uganda all meet northeast of Lake Kivu (map, page 127).

I crossed the Congo border to the north shore of the lake, at an elevation of nearly a mile. Idyllic in its beauty, the country around the lake seems to enjoy perpetual spring.

Scientists Run a Jungle Laboratory

The next night I arrived at the Belgian Government's Institute for Scientific Research in Central Africa (IRSAC), located at Lwiro, overlooking Lake Kivu. I had met the Institute's director, Louis van den Berghe, while he was visiting the United States. He had

invited me to observe and photograph a group of gorillas under study by IRSAC's Department of Mammalogy.*

Established by Belgian Royal Decree in 1947, IRSAC is an ideal research institute—remote from distractions, handsomely equipped, endorsing a scientific program so broad as to be almost universal. Ionosphere physics, protein chemistry, seismology, ethnology, parasi-

* Without the cooperation of IRSAC, which gave generous help to Dr. Zahl, the *Geographic* could not have brought these extraordinary photographs to members of The Society.

Theater audiences in the United States may soon see a color motion-picture film on African wildlife cosponsored by IRSAC and released under the title *Masters of the Congo Jungle*.

Thirsty anthropoid drinks from a grassy pool beside a banana shrub. Weighing close to 400 pounds, he braces himself with Gargantuan arms that measure five feet from elbow to elbow, compared with man's three-foot spread. His silver saddle marks him as an adult male.

Thick fur—a protection against near-freezing nights in the mountains—helps to distinguish *beringei* from the more thinly coated lowland gorilla.

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tology, tsetse fly ecology, rodent distribution, primate biology—these are only a few of the fields under study in the center of what is no longer darkest Africa.

Here, and at branch stations located throughout the Congo, scientists of many nationalities work together with a corps of native aides. The chairman of IRSAC is none other than Leopold, former King of the Belgians. A lifelong student of natural history, His Majesty is no mere honorary official. He has been a frequent visitor at Lwiro and has also participated in expeditions to Indonesia and Central America.

For all of IRSAC's modernity and scope, a visitor to the area does not forget that he is still in Africa. Colorfully robed African women stroll along road and trail; there are still thatch-roofed mud huts, native markets, drums, and laughing, naked children.

Swiss-born mammalogist Dr. Urs Rahm drove me to the Institute's branch for experimental zoology at Tshibati, about a mile inland.

Here was an enormous outdoor stockade at least 250 feet across, enclosing pure and untouched jungle, the gorilla's natural habitat. Climbing to the top of an observation platform, I spied several familiar figures prowling about in the vegetation.

With some pride, and in excellent English, Dr. Rahm commented: "Here we can study gorillas as perhaps nowhere else in the world. Problems of diet, hygiene, and general care concern us at the moment; later the program will include experimental studies on gorilla physiology and psychology."

I watched the movements of the two adult and two immature apes there in the enclosure, marveling at the lack of zoo atmosphere. "Where did these come from?" I asked.

"The Utu area, 125 road miles west of here, where the Mitumba Mountains descend into the Congo Basin," Rahm replied.



"I think best when I'm chewing on something." Potbellied and threadbare, an old man gorilla nibbles the soft pith of elephant grass (*Pennisetum*). His diet includes fruit, berries, bamboo shoots, wild celery, and an occasional bird's egg or grub. Dainty despite his bulk, the ape drops husks and inedible stalks in a neat pile.

"Charles Cordier, the Swiss-American animal collector, was authorized by the Belgian Government to capture them for us."

Where the mountains descend? That intrigued me, for having observed mountain gorillas in the upper extreme of their vertical range, I was eager to see them in its lower limits as well. I expressed this thought to Rahm.

Bottle Feeding for a Jungle Orphan

"It so happens," Rahm said, "I'm going to the Utu camp to visit IRSAC gorillas recently collected for us by Cordier. Dr. Van den Berghe has suggested that you join me."

Before many days had passed, two cars carrying Rahm and myself, and also IRSAC staff members Mr. M. G. V. Macot and Mrs. Frank Lambrecht, were twisting over the great Mitumba range west of Lake Kivu.



Foster mother diapers her playful baby. Noël, an abandoned seven-month-old waif,

pampered baby gorilla enjoys her bottle more than her orange juice, vitamin drops, oil rubdown, and daily baths. Found orphaned and wailing in the jungle, Noël lives with Mrs. Emy Cordier, wife of an animal collector, in Utu, Belgian Congo.

Despite the gorilla's high mortality rate in captivity, zoos pay as much as \$5,000 for young specimens. Fewer than 60 of their kind may be seen in the United States. Mrs. Cordier (with kerchief, above) and Mrs. Frank Lamhrecht put finishing touches on Noël's costume.





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weighs 10 pounds. Pink splotches on hands and feet will darken with age

At dusk we entered the eastern drainage of the mighty Congo, which, with its dozens of tributaries and hundreds of lesser streams, draws water from about 1,400,000 square miles of central Africa. Our road now passed through towering jungle—hot, dim, airless. But on our arrival at the Cordier camp, we were all supremely diverted from the heat as Mrs. Emy Cordier, in her jungle-girl bungalow, demonstrated an ordinary maternal routine on a most extraordinary subject.

"Now for some baby oil . . . and a sprinkle of talc," she was saying, deftly suiting action to word, "and we are ready for a fresh diaper. Safety pin, please. Ah, there! Little Noël is all ready for supper."

Tenderly, Mrs. Cordier transferred the infant from the table to her lap and reached for a baby's bottle. She tested the milk temperature on her wrist, then plopped the nipple into the eager little mouth. Like babies the world over, Noël sucked, jerked, and squirmed. I was appalled at the rate at which the milk

level in the bottle sank (opposite). Seven-month-old Noël weighed 10 pounds. She had big brown eyes as soulful and demure as those of any baby on a magazine cover—a natural history magazine cover, that is. Noël was a gorilla.

I recalled Toto, the famous circus gorilla, who as an infant in the 1930's had fallen into the hands of another collector's wife, deep in the bush of the Congo. Far from synthetic baby food, the wife had enlisted the aid of a native wet nurse. Growing and prospering, the foundling accepted the human breast as though it were that of its own mother.

Noël Joins the Cordier Household

Infant Noël had been brought to the Utu camp in the Belgian Congo five months before. Natives had found her, weak and wailing, in the jungle, where her mother had either died or been killed.

Mrs. Cordier had gladly accepted foster motherhood, and was finding Noël just as de-

manding as the real thing. With baby food, bottles, and nipples quickly supplied, there was no need for a wet nurse. But, inevitably, there were the round-the-clock feedings, burpings, baths, diapers, bottle sterilizings.

"And to think, I never had one of my own," said Mrs. Cordier, her eyes beaming affection on little Noël.

Charles Cordier was then roaming the Congo on a collecting safari. He had left his wife in charge of the camp's 22 native helpers and a menagerie of rare birds and animals destined for zoos in Europe and America.

Next morning Mrs. Cordier led me to a high-walled structure like the gorilla enclosure I had seen at Tshibati. One climbed a ladder to peer over the top, or slid back a heavy plank covering a peephole in the wall.

"They are feeding just now, so take only the briefest glance," Mrs. Cordier whispered. "If disturbed, they may not return to their meal."

She eased back the peephole plank a bare quarter of an inch. I put my eye to the slit. At liberty within, two adult gorillas, a male and a female, tore at stalks and branches their captors had provided. These specimens had all the magnificence of the gorillas I had encountered in the highlands of Uganda. Quickly Mrs. Cordier shoved the peephole barrier back into place.

Nets and Poles Bring Gorilla's Downfall

Most gorillas now in captivity were young orphans when taken. But how, I wondered, did Cordier manage to capture incredibly powerful adult specimens weighing hundreds of pounds? The feat, I knew, was once regarded as impossible.

As we strolled back to the encampment, my hostess explained her husband's methods. First, hundreds of yards of tough, coarse netting are strung through the jungle in a known gorilla haunt.

Then scores of native beaters (most of them mortally afraid of their prey) slowly drive the great beasts toward the trap.

When a gorilla blunders into the half-hidden mesh, he fights furiously to escape,

often to find himself hopelessly entangled. The beaters approach cautiously. Each carries no more than a stout pole; the struggling animal, for all his ferocity, must not be injured. One after another the natives press their poles across the massive body, finally pinning it securely to the jungle floor.

Now, in the procedure's most delicate maneuver, a cage is drawn alongside and the poles are relaxed, one at a time, easing the exhausted animal into prison. "It's dangerous," Mrs. Cordier conceded. "But Charles and his crew know their business."

Ape Versus Prize Fighter

That evening at dinner, shrill cicadas outside the screen and a hyrax whistling somewhere in the bush provided background music for a discussion of similarities and differences between gorillas and men.

Someone mentioned Carl Akeley, whose observations on Congo gorillas in the 1920's have become classic, and who generally is regarded as the father of present-day gorilla conservation.

"I believe that the gorilla is normally a perfectly amiable and decent creature," Akeley wrote.* "I believe that if he attacks man it is because he is being attacked or thinks that he is being attacked. . . . I believe that, although the old male advances when a hunter is approaching a family of gorillas, he will not close in if the man involved has the courage to stand firm. In other words, his advance will turn out to be what is usually called a bluff."

This remarkable hunter and naturalist, who once barehanded fought an attacking leopard to the death, and on another occasion survived being pinned between the tusks of an enraged elephant, nevertheless added:

"I believe, however, that the white man who will allow a gorilla to get within ten feet of him without shooting is a plain darn fool. . . ."

Akeley once listed the dimensions of an adult gorilla for comparison with those of the

* *In Brightest Africa*, Doubleday, Page & Company, New York, 1923.

At Bay in Belgian Congo Treetops, a Frightened Family Faces Capture

Collectors for the Belgian Government's Institute for Scientific Research in Central Africa felled the tree, threw nets around the struggling apes, and took them alive for scientific study. Gorillas, whose feet closely resemble man's, reach such weight they cannot swing gracefully from limb to limb. They are the slowest of the great apes. Although able to stand upright, they usually move on all fours.



famous American pugilist, Jack Dempsey:

	Gorilla	Dempsey
Height	5' 7½"	6' 1"
Weight	360 lbs.	188 lbs.
Chest	62"	42"
Upper arm	18"	16½"
Reach	97"	74"
Calf	15¾"	15¼"

The gorilla selected by Akeley for this comparison was only moderately large. One specimen had an arm spread of 110 inches.

Drumbeats against the chest express excitement. This captive protests the interruption of his meal. Crewcut hair atop a flange of bone gives him the adult's characteristic crest.

Caged gorillas' greatest foes are such age-old enemies of man as pneumonia, tuberculosis, and the common cold.

Mbongo, who died in the San Diego zoo in 1941, weighed more than 600 pounds. Circus-famed Gargantua in his prime was of similar bulk.

The obesity of caged gorillas is due in part to a pampered, inactive life. Wild specimens generally weigh less than 500 pounds.

"Speaking of weight," Mrs. Cordier broke in, "have another slice of homemade bread."

"Thank you," I replied, helping myself. "It's delicious. Your own recipe?"

"Yes," said Mrs. Cordier, with a broad smile. "What you are eating is first-class gorilla food. It's loaded with eggs and vitamins. Our captives love it."

Our table talk drifted to other related subjects, among them how gorillas—just like people—display distinctive appearances and personalities. They may be tall or short, heavy or spare, clever or slow, volatile or placid; they may show marked variations in skull structure and pelage. Rahm noted that such differences had led to early confusion in classifying gorillas. At one point, as many as 32 races were described.

Finally, in 1929, the Harvard mammalogist Harold J. Coolidge proposed that all should be regarded as belonging to a single species embracing both the mountain and the lowland subspecies.

Munidi Uses Scare Tactics

Gorillas are thought to mature at 10 to 14 years of age and live beyond 30. The former figure may need revising, however, for in 1956 at the Columbus, Ohio, zoo a female from the Congo gave birth at age seven. The gestation period was 259 days, only 11 days less than that for humans. Weight at birth of the baby—the first gorilla ever live-born in captivity—was less than five pounds.

The gorilla brain is about



W. L. T. WOOD, 1954



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Snarling defiance, an enraged female challenges a trespasser in her berry patch

a third the size of a man's. As to what it can do, initial observations suggest that the gorilla lags behind the chimpanzee and orangutan in certain mechanical tasks, but may surpass them in other respects. Gorillas have excellent vision, but apparently smell and hear only moderately well.

As to temperament, I was constantly impressed by the edgy nervousness of gorillas. Any foreign sound or movement would cause a sudden jerk, sometimes bodily trembling, on the part of even the most ferocious-seeming of males. This reaction, suggesting simple fright, could, however, quickly be replaced by one of calculated belligerence.

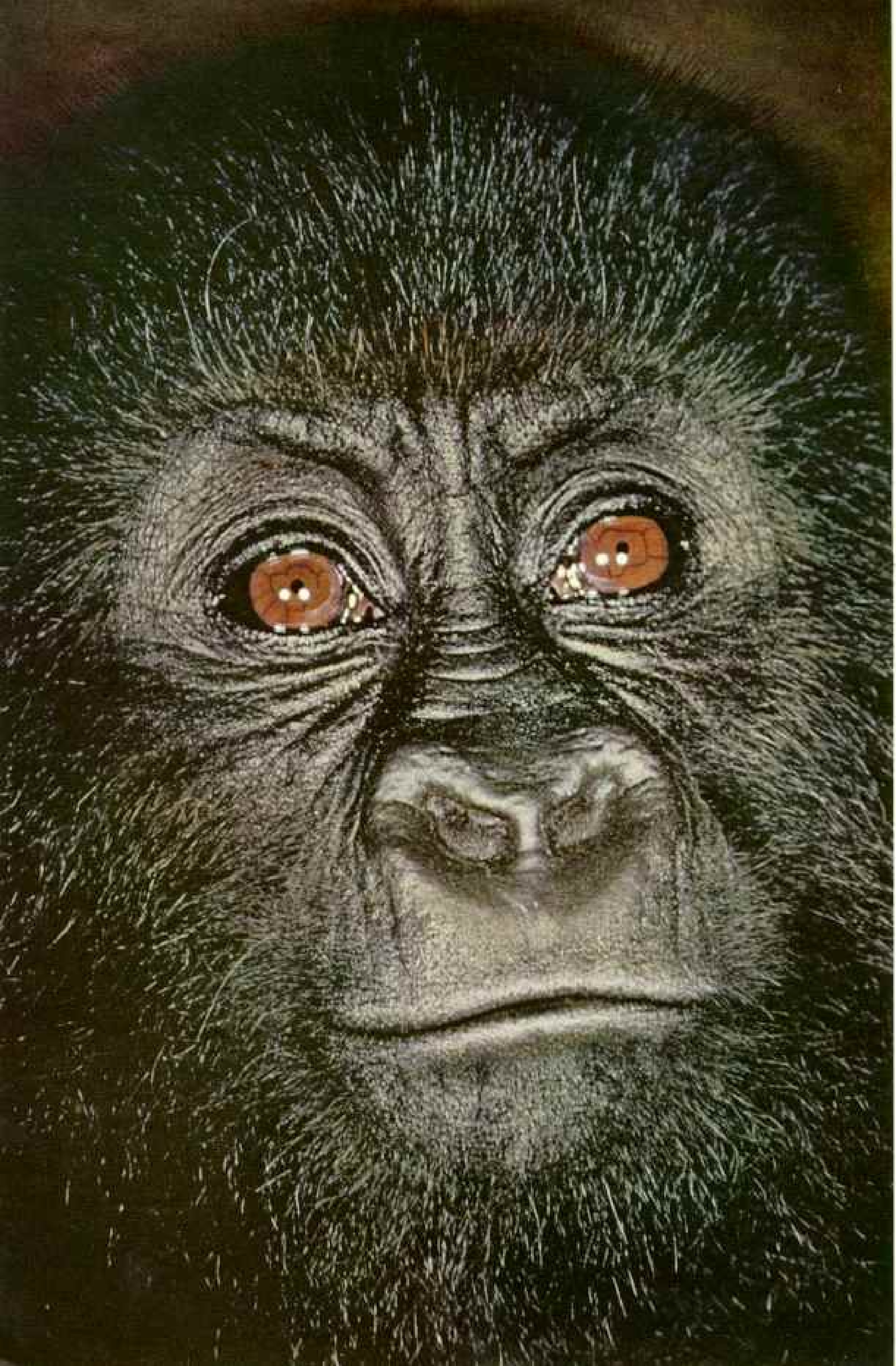
I spent several days observing the Cordiers' great male—known to the native helpers as Munidi (Prince). As he fed on the far side of the enclosure, only his head and shoulders showed above the vegetation. Almost fastidiously, he bit the outer husk from stalks

of forest plants, crunched with his powerful jaws, then gobbled the soft, nutritious inner parts.

At times he would sit dozing under a banana shrub, the picture of contented idleness; or he might wander over to a pool, put his elbows to the ground, and lower his mouth to the surface to drink (page 128).

Whatever Munidi's activity, a cough or a movement of my head at the peephole and he would at once become the sensitively alert and instinctively defensive beast of the jungle.

If my inquiring face and probing camera lingered too long at the peephole, Munidi might begin a series of low staccato barks, rapidly growing in pitch and intensity. As they crescendoed to a roar, he would rise to his feet and, with blood and malevolence in his aspect, suddenly come charging across the enclosure grounds toward the offending peephole (page 122).



En route, he would thunder cupped hands against a hairless, glistening chest like a kettledrummer approaching a triple-forte climax. Hastily I would shove the plank back into place, then wait for the lunge of the mighty body against the wall or the hammering of those great hands.

Such exhibitions of untamed wildness were aimed to scare me out of my wits. Needless to say, they invariably did.

Sometimes, before reaching the wall, Munidi would abruptly check his charge, reassume an all-fours position, and sulk away. Other times, he would furiously beat his cheeks or his thighs or the bare ground, without charging. Whichever form the drumming took, it was clearly a show of strength.

Danger Lurks in Gorilla's Bluff

Once I decided to call his bluff, shoving the plank all the way back to expose an opening in the wall about 10 by 18 inches; then I stepped back out of reach. A second or two later a great hairy fist and an arm of appalling proportions flew through the aperture. The arm strained and the fingers groped.

Failing to contact me, the fearsome limb withdrew. I was grateful for that sturdy wall; moreover, I had learned that at least this particular gorilla was not as much of a bluff as charging gorillas are generally supposed to be. The thought of what that groping hand would have done to my neck has not yet left me.

Official movies had been made of mountain gorillas collected for IRSAC by the Cordiers. My attempts were to be among the first still color pictures permitted there for publication, a courtesy graciously extended by IRSAC's Director Dr. Van den Berghe and facilitated by Charles and Emy Cordier.

But the job had little in common with shooting fish in a barrel. I recall the time I set up camera and tripod at the peephole, and Monsieur Macot of the IRSAC European staff eased back the plank.

There, not 10 feet away, crouched 400 pounds of suspended violence. Tense and

aware, Munidi had been listening to our preparations beyond the wall. Now, spotting the source of the disturbance, he let out one of those screaming-guttural cadenzas, simultaneously charging full speed.

"*Attention! Attention!*" I yelled to French-speaking Macot, at the same time jerking back my head and camera. Only a fraction of a second separated the snapping shut of the viewing aperture and the thunder of gorilla bulk against the wall.

When things had quieted, we slid the plank aside again—this time, only an inch. I pressed my eye to the chink, wondering into which part of the enclosure the prisoner had retreated.

He hadn't retreated at all!

Instantly his head was level with mine; I could feel his breath and body warmth. For a moment one of his eyes, only inches away, gazed deep into its human counterpart.

Recovering my wits, I slammed the plank back into place, lest the gorilla get his powerful fingers into the crack and rip it aside again. There was no clawing or pounding this time; only a rustling and shuffling as the animal returned to his banana shrubs.

Eye to Eye Across the Eons

I should only dubiously choose to give human motive to the reactions of a beast. Yet it was as if, having met me face to face, the gorilla recognized some vague evolutionary kinship which served, for a moment, to soften his primitive impulses.

Evolutionists deny, of course, that man descended from these great apes. Present thinking suggests that apes and men sprang from a common ancestral stem, diverging, however, at least twenty-five million years ago to pursue independent and, thereafter, unrelated evolutionary paths. Nevertheless, ape and man are still sufficiently similar to be classified as primates.

Here, deep in the Belgian Congo jungle and in uncomfortable proximity, two primates had locked eyes in a gaze that spanned a crucial fragment of evolutionary time.

Beard and Wrinkles Belie a Youngster's Tender Years

Gorillas show an astonishing range of shapes and sizes. They may be thin or fat, and their facial expressions vary greatly. Some reveal marked family likenesses, just as people do. They tend to grow cantankerous with age. Only four years old, this brown-eyed male already has a contrary streak. The Cordiers keep him in their house, but he refuses to play with anyone except a Congoese boy. Dr. Zahl snapped the portrait while the lad held the 30-pound ape in his arms.

*Nearly two miles down in the Pacific,
scientists find currents on the ocean floor
and almost get trapped in a rocky gorge.*

Deep Diving off Japan

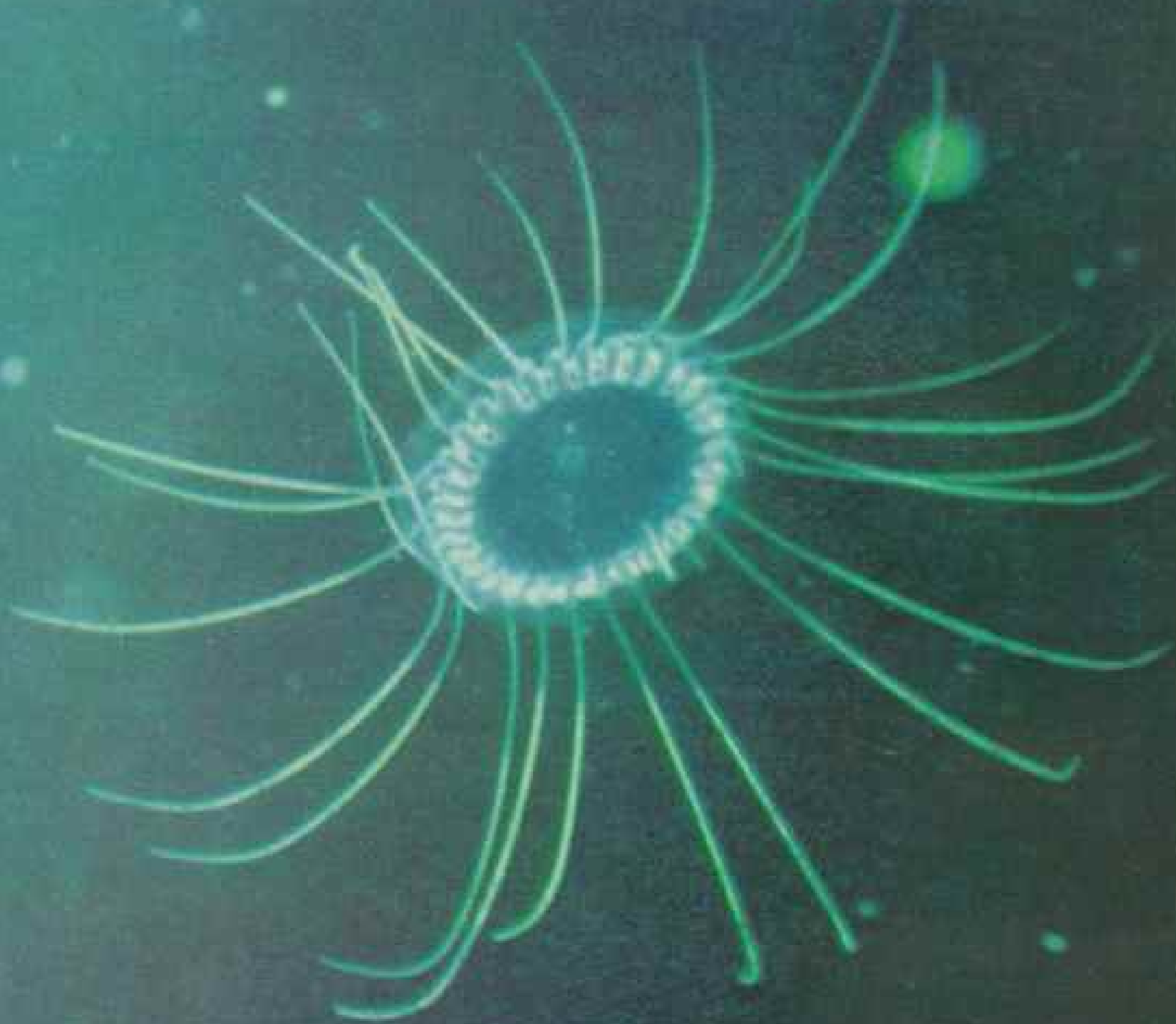
By LT. COMDR. GEORGES S. HOUOT

Commander, French Bathyscaphe *F.N.R.S. 3*

“HELLO, *Shinyo Maru*. Hello, *Shinyo Maru*. This is bathyscaphe calling.” The bathyscaphe has just surfaced in the Pacific, and I am telling our tender by radiotelephone that the dive is over.

Beside me in the cast-steel sphere, Professor Tadayoshi Sasaki is putting his equipment and papers in order. He carefully reties them in his *furoshiki*, the rectangle of cotton cloth often used in Japan in place of a briefcase. Today we have descended 9,850 feet to the floor of the Pacific. For the first time in history the largest of oceans has now been observed by man at a depth of nearly two miles.

Plankton and starlike jellyfish, triple life size,
spangle flashlit depths off Japan at 3,300 feet



My second in command, Lt. Gabriel O'Byrne, replies from the Japanese vessel's bridge: "Hello, bathyscaphe. We see you. We are proceeding toward you."

Fresh Air Welcome After Dive.

I open the door of the sphere, climb the ladder from the chamber, open the hatch, and burst forth into the open. It is good to inhale great breaths of fresh air. It is late afternoon. The weather is fine, and the sun sparkles on the calm, blue waters of the Pacific, which,

for once, indeed deserves its peaceful name.

I scarcely have time to wash before we are interviewed by the press (page 149). Not speaking Japanese, in this case, is an advantage: Professor Sasaki does most of the talking. He can now testify, on the evidence of his own eyes, that even at this great depth distinct currents creep across the Pacific floor.

This is important news. True, it applies only to a tiny portion of a great ocean. But it touches upon what is today a vital question: the movement of water in the great deeps.



Why so vital? Because serious thought is being given to disposing of "high-level" atomic wastes from nuclear reactors—highly radioactive liquids that are the by-products of fission—by enclosing them in steel and concrete and dumping them into the oceans. This method is already in use to get rid of "low-level" wastes—less radioactive materials, such as isotopes used in medical treatment, contaminated test tubes, and bodies of laboratory animals.

In my opinion, and I do not wish to commit



SEAN O'BRYEN

Giant Crane Lowers the Bathyscaphe Into Yokohama's Crowded Harbor

Invited to Japan by a committee of scientists, the *F.N.R.S. 3* arrived aboard the *Atsuta Maru* (right). The French bathyscaphe made nine dives off Japan, the deepest to 10,500 feet. Its thin hull holds 20,000 gallons of lighter-than-water gasoline to give buoyancy. A spherical gondola for the two-man crew hangs beneath the hull. Its 3½-inch steel walls can withstand pressures of 9½ tons to the square inch.

Bouquet and a bow from a kimono-clad girl welcome Commander Houot (left), Lt. Gabriel O'Byrne, and others of the crew. Onlookers wave French and Japanese flags. 141





ALL REPRODUCED BY GEORGE S. HUDDY © NATIONAL GEOGRAPHIC SOCIETY

Sea spider, 2,600 feet below the surface, struggles through a "marine snow" of plankton. On the bottom, such pycnogonids stalk on legs as long as 24 inches.



Jellyfish's fragile parachute floats away from the camera at 3,900 feet. Umbrella of *Aequorea coerulescens* spans 8 inches.



Feather star (*Heliometra glacialis*) waves its arms from the Pacific floor, 3,900 feet deep. Tentacles crown the jellyfish above it.



Prickly Sea Urchin and Spindly Starfish Lie in the Ooze at 3,280 Feet

Many of the strange creatures that swam before Commander Houot's eyes defied scientific identification. He sighted this orange sea urchin on his final descent. Electronic-flash units of his cameras turned black depths to day.





Japan Trench: Deep Enough to Hold 6 Grand Canyons Atop One Another

Lying off Japan like a moat, the furrow marks the apparent spawning ground of earthquakes that shake the islands four times in the average day. With the bathyscaphe, men for the first time explored its deeper slopes. If 29,028-foot Mount Everest were inverted and dropped into the trench's V-shaped Ramapo Deep, nearly a mile of water would cover its base.

anyone but myself in this assertion, the dumping-into-the-ocean method can be valid for high-level atomic wastes only if there are no currents in the great deeps.*

Who can inspect these containers at a depth of 20,000 feet or more? Can one be sure that pressure and erosion will not force them open before the materials inside have lost the greater part of their radioactivity? Might not then some deep current sweep these lethal materials along slowly and scatter them thou-

sands of miles from where they fell? So far all our dives—including the one near Dakar to 13,287 feet, the greatest depth reached by man to this day—have revealed currents in the deeps.†

Professor Sasaki, a specialist in physical oceanography, was eager to observe the deep-sea currents off the coast of his homeland. Although his current gauge failed to function, he was able to report afterward:

"I found flowing water on the bottom at 5,100 meters in the Japan Trench. I measured the marine snow passing just in front of the window, by stop watch. The average flow velocity was two centimeters per second [four-fifths of an inch per second, or 240 feet per hour]." It was a great day for the professor and for me.

Our story had begun months earlier. I was overhauling the bathyscaphe in Toulon when I had a visit from the professor, who had gone down 980 feet into the Pacific in an underwater observation cylinder of his own invention, called the *Kuroshio*. "Would the French authorities favor a bathyscaphe mission to Japan," he asked, "to allow Japanese oceanographers to make some dives?"

I reflected. Had we not intended our bathyscaphe to serve world science? Its very name—*F.N.R.S. 3*—stands for National Fund for Scientific Research, a Belgian organization of which this bathyscaphe is project No. 3.

* Editor's Note: At present, says the U. S. Atomic Energy Commission, low-level waste is placed in 55-gallon steel drums weighted with concrete and dumped at approved locations into water at least 6,000 feet deep. The containers are estimated to last about ten years, during which time radioactive decay will have destroyed most of the radioisotopes inside. Even if a container disintegrated much sooner, no danger is envisioned. The British, in fact, believe that they could safely pump liquid low-level waste into the Irish Sea at a rate of up to 10,000 curies a month. (One curie is the radiation given off by one gram of pure radium.) Smaller quantities are already being discarded in this way; water so dilutes and disperses these wastes that there is no appreciable increase in radioactivity in the Irish Sea.

High-level wastes, on the other hand—such as waste from the production of plutonium or the nuclear production of electrical power—may give off many million times as much radiation as low-level waste. Such materials are at present stored in liquid form on land, in underground steel tanks of "cup-and-saucer" construction: What may leak out of the cup will be caught in the saucer. Elaborate alarm systems would warn of such leakage. These tanks are estimated to remain intact for 20 to 30 years. After that, the waste materials will be transferred to new tanks, unless research has by then found new ways to make them harmless or put them to use.

† See in the NATIONAL GEOGRAPHIC: "Two and a Half Miles Down," July, 1954; and "Four Years of Diving to the Bottom of the Sea," May, 1958, both by Lt. Comdr. Georges S. Houot.



STOCKHOLM © NATIONAL GEOGRAPHIC SOCIETY

Camera's Sudden Flash Freezes Startled Fish Patrolling the Ocean Floor

Ultrasensitive retinas and the water's faint phosphorescence let some fish see at depths that render man's eyes useless. Here a foot-long rat-tailed fish (upper) with bulging eyes and triangular dorsal fin swims with an eel-like companion (*Ophichthus urolophus*) at 3,300 feet. *Coelorhynchus kishinouyei* begins life in the sunlit ocean but on maturity migrates to the depths. National Geographic Society grants helped Dr. Harold S. Edgerton design the deep-sea cameras that captured the scene.



Aqua-Lungers Make a Life-or-death Check Before Each Bathyscaphe Dive

Clad in black rubber suits, the divers remove the safety locks from electromagnets that hold the ballast in place. Without this precaution, the bathyscaphe would be unable to dump its ballast and rise. Professor Tadayoshi Sasaki (right) examines his current meter; the author awaits an all clear from the divers.

Soon came word that Professor Sasaki's proposal had official French approval, and with the aid of the newspaper *Asahi Shimbun* he and his colleagues at the Universities of Tokyo and Nagoya obtained the necessary funds. We were ready.

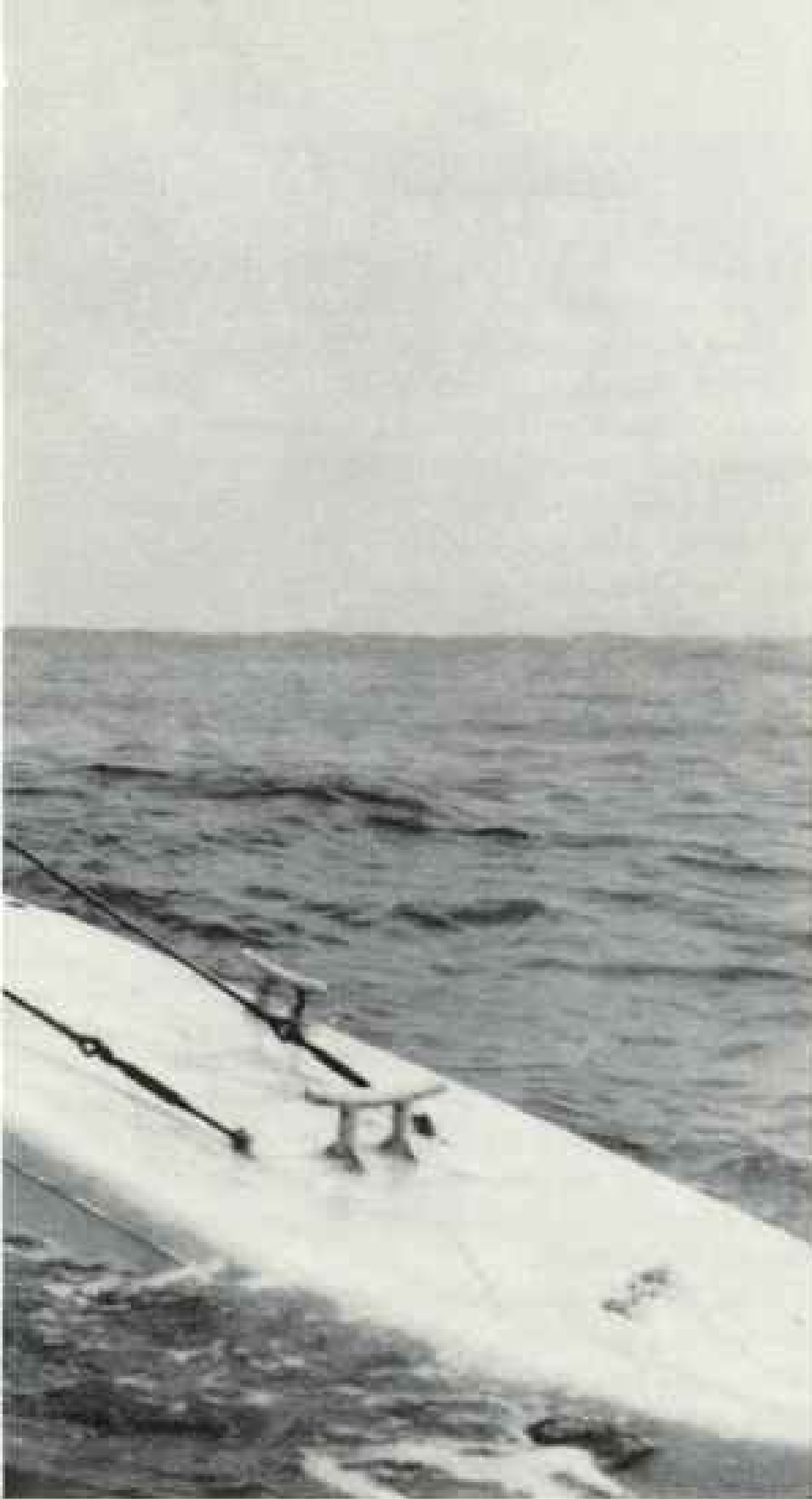
Lieutenant O'Byrne, the young French submarine officer chosen to take the trip with me, barely had time for three training dives before the Japanese freighter *Atsuta Maru* arrived at Toulon to take on the bathyscaphe and our three petty officers; all were delighted to be passengers without having to work.

About a month later O'Byrne, Chief Warrant Officer Daniel Rost, and I flew to Tokyo. The bathyscaphe was unloaded at Yokohama (page 141) and towed to the port of Onagawa

on the east coast of Honshu, some 345 miles northeast of Tokyo (map, page 144).

The Japanese oceanographers had decided on a two-part program. In our first series of dives we would probe the deeps on the slopes of the Japan Trench off Onagawa. After several weeks, we would transfer our activities to Uruga, at the southern extremity of Tokyo Bay. There we would investigate another part of these slopes, the chaotic region of earthquakes and volcanoes in the vicinity of Mount Fuji.

We had brought along two little portable houses, which we placed near us on the pier at Onagawa. They served as offices, stores, and workshops as we reassembled the delicate equipment from our packing cases; com-



ALBERT BRIDGES

Listening to signals from *F.N.R.S. 3*, the author waits anxiously as bathyscaphe makes its first dive without him. The submerged craft calls its mother ship in Morse code's dots and dashes.

pressed-air bottles, storage batteries, radios, searchlights, and the ingenious cameras and electronic-flash devices developed by Professor Harold E. Edgerton of the Massachusetts Institute of Technology with research grants provided by the National Geographic Society.

As Society members already know, the bathyscaphe operates as though it were an underwater dirigible. Lighter-than-water gasoline in the ship's thin-skinned "bag" gives the craft buoyancy. To descend, the bathyscaphe takes on sea water. Ascent is achieved by dropping ballast.

A Japanese inn at Onagawa gave us a charming reception and a taste of the Japanese mode of living. What would our admiral have said on arriving at the inn in the evening

to find the bathyscaphe crew, all rank abolished, wearing light kimonos called *yukata*, seated on the floor drinking tea!

Our meals were Japanese, and we became expert in the art of manipulating chopsticks. That was fairly easy when partaking of the local food, largely raw fish, rice, and vegetables cut into small pieces. It was harder when the cook, through pure goodness of heart, supplemented the menu with beefsteaks and whale steaks—not cut up. I shall never forget Lieutenant O'Byrne's expression on receiving, as the result of an awkward movement, two fried eggs on his knees.

On June 14, 1958, we descended to a depth of 3,900 feet, and on June 20 came the first deep dive, down to 9,850 feet.

In each of our four descents in the Onagawa area, as soon as we had dropped below the surface, we were in an extension of the Kuroshio, a current whose surface waters approach 80°. This warmed and expanded the gasoline so that the *F.N.R.S. 3* was almost always too light at the beginning of immersion.

Below the Kuroshio, at about 720 feet, runs the Oyashio—a cold current from the Sea of Okhotsk and the Bering Sea—in the opposite



direction. I remembered this fact from school, but I would never have believed that the separation between two currents could be so marked.

The temperature drops slowly from the surface to about 650 feet, where it is 57°. Then the thermometer falls to 39° while we descend about 50 feet. We pass from one current to the other in a few seconds, and we don't need to read the thermometer to be aware of it: What we see through the viewing port changes completely!

Near the surface, in the warm waters, we find few animals. We have difficulty in perceiving the plankton, microscopic in size and very scattered. Then everything changes abruptly. Large animals become numerous, and the density of the plankton increases incredibly. Millions of white dots appear in the beams of the searchlight, gliding upward before our astonished eyes.

What nutritive wealth this ocean contains! The swarming does not diminish; it often increases as we descend. I remember one dive when, in the immediate neighborhood of the bottom, observation was rendered impossible by the compact mass of plankton. It arrested the light from the searchlights and diffused it in all directions. It almost blinded us. Never during more than 60 dives in the Mediterranean and the Atlantic did I see such a wealth of life.

Undersea Life Amazes Expert

Large animals swim in the midst of all this, particularly jellyfish, as varied in shape as in color. I recognize the *Solmissus* (page 139), just as delicate as elsewhere, just as fragile, as they slowly wave their arms. Beside them I see small brown swimming bells, saucers, and other jellyfish shapes (page 142), many doubtless never before seen by man.

Professor Jean-Marie Pérès, who came to Japan from the University of Aix-Marseille especially to make two dives, was surprised at this abundance. Here is how he described what he saw through the viewing port:

"Besides the jellyfish there are numerous ctenophores [sea walnuts], transparent animals with bodies bearing ciliated plates that resemble combs.

"Some are colorless with enormous appendages shaped like ears, others shaped like cucumbers. Here is one of a brilliant orange color, trailing behind it two large fishing filaments. . . . Some decapod shrimps seem to glide on their long, bent antennae.

"Very few fish. But here is a marine worm

of the genus *Tomopteris*. . . . Of course, that is not rare, but generally that animal is white and measures two inches or a little more, while this one is a bright red and measures fourteen inches. . . . I shout my enthusiasm!"

Of course we again find the translucent gelatinous animals I described in an earlier article. But the shapes are still more numerous and varied here. To be able to speak of them easily among ourselves, we name them by analogy with known shapes, without regard to size. There are the "fire balloons," "rugby balls," and "parachutes." This is not very scientific, I admit, but it is indispensable.

Strange Shapes Dwell in the Ooze

The dives to depths of 3,000 to 5,000 feet were a feast for the eyes. We saw rat-tailed fish ranging in length from two to twenty-four inches (page 145); *Halosaurus*, with long bodies tapering into tails and snouts looking like ploughshares; snake-eels; and *Sebastes*, a kind of rockfish.

We did not know what we admired most—these fish, swimming an inch or two above the bottom, quite undisturbed by our presence, or the serene, immobile starfish and tube worms spreading their varied colors near the sea cucumbers.

The picture was completed by delicately colored sea anemones, large sea lilies, feather stars, and sea pens. All were fixed to the ooze, while small colonies of a sort of coral clung to the smallest pebble.

Close to 10,000 feet we found the spectacle less animated. Our main visitors were small crabs from one to three inches long, busily entering and emerging from holes in the ooze.

As always, we end by landing on the bottom, which looks very much like those we have visited previously: The same ooze, at least insofar as one can judge through the viewing port, the same holes, the same mounds. But, curiously, during our nine dives in the Pacific we never encountered one of those big-eyed yet seemingly blind deepwater sharks, the dogfish, so common on Mediterranean and Atlantic bottoms. Should we assert that they do not exist in these Pacific regions? I am inclined to be cautious in this matter, for I saw them frequently off Toulon in 1953, 1954, and 1957, but not at all in 1955 and 1956. Had they migrated? Did we pass them in the Pacific without seeing them?

On July 5 we left Onagawa for our second base, Uraga. The Pacific was smooth, but these trips on board the *Shinyo Maru*, our companion vessel, offered little rest.

She was an old 235-ton trawler converted to the needs of oceanography by the Tokyo University of Fisheries. The fish hold had become quarters for students, with about 30 double-deck bunks on each side. Designed for Japanese, these bunks could not accommodate a body longer than five feet, seven inches. My length is six feet, one inch. I stretched out on the floor on two mattresses laid side by side. But they did not join well. I disappeared between the two!

Volcanic Bottom Sets a Trap

Beginning July 8, the bathyscaphe berthed in a shipyard in Uruga. It was the middle of the typhoon season, but thanks to the admirable American and Japanese forecasting services, we had nothing to fear while at sea.

In the shipyard the *F.N.R.S. 3* was firmly anchored on the side toward the open sea and moored to the dock. But once, when typhoon Alice swept rain almost horizontally and men were knocked down by gusts of 80 to 100 miles per hour, the bathyscaphe momentarily

disappeared under the waves and the foam. Sometimes we had to wait three, four, or five days before setting sail.

We managed five dives—on July 18 and 30, and on August 3, 7, and 11—to depths between 2,500 and 10,500 feet. The appearance of the bottom was very different here, and so was the sea life. Volcanic regions offer unexpected landscapes and call for increased safety measures. We often heard before a departure: "Be careful, you might put down in the crater of a volcano." Why not? Can one know on the surface that there is not a somewhat active volcano at a depth of 10,000 feet?

During a 9,000-foot dive with Professor Hiroshi Niino, a specialist in deep-sea topography, I saw a great block of stone with sharp edges, as if it had been recently torn from a rock wall. Professor Niino assumed that this rock was there because of some recent earthquake or landslide.

But Lieutenant O'Byrne made the deepest and most extraordinary dive, with Professor

Conquerors of Pacific Depths Meet the Press After a Historic Dive

Diving 9,850 feet on June 20, 1958, Commander Houot and Professor Sasaki became the first men to see the Pacific's floor at such a depth—nearly two miles.

ALAN DIMOND



Takeharu Kumagori. The *Shinyo Maru's* sounder had indicated 10,500 feet. But on reaching 9,500 feet, O'Byrne had not yet detected bottom with the *F.N.R.S. 3's* own sounder, which seemed in good working order. Ordinarily its range is around a thousand feet. Surprised, he slowed the descent.

Nine thousand eight hundred, still nothing. Professor Kumagori, an expert on deep-sea life, did not take his eyes from the viewing port. Suddenly there came a shock. O'Byrne rushed to look.

Caught in a Submarine Crevice

The starboard stabilizer had struck a wall of rock! Peering as far as the viewing port permitted, O'Byrne perceived a section of a rocky cliff, vertical, against which the bathyscaphe had been pushed by a strong current.

He dropped ballast pellets to slow the descent again; the bathyscaphe scarcely moved. The rock was beside them, only a few yards away. Below, they could detect nothing.

Professor Kumagori took over the viewing port again as the descent resumed. More but lighter jolts were felt.

Then an unexpected shock startled the two men. They looked at each other: the *port* side! The bathyscaphe was touching on both sides at the same time!

Underneath there was still nothing. There was no longer any doubt; a current had pushed the *F.N.R.S. 3* into a fault in the rock scarcely wider than the bathyscaphe itself. And the crack had no discernible bottom.

Should one risk remaining wedged between two blocks of rock or being caught under an overhang where it would be difficult to get loose? No. O'Byrne began the ascent.

About six hundred feet up, the starboard aileron scraped the rock wall again. When the bathyscaphe was hauled ashore, we found deep cuts in the two stabilizers.

Volcanic regions, of course, are seldom easy

of access. If we could only extend our visual distance to about a thousand feet, what spectacles might we not witness? But it would require an illuminating power so enormous that for us it is not even to be thought of. Let us merely recall that in broad daylight, in clear, calm water near the surface, a diver usually can see little beyond 60 feet by the sun's rays, far brighter light than any we could provide.

During each of our dives we made the maximum number of physical oceanographic measurements and took samples of water in bottles, for Japanese scientists to analyze.

Our colleagues were satisfied with the scientific results and with the bathyscaphe itself. It had descended to more than 10,500 feet as easily as to 2,300. If we did not go down farther, it was solely because the time for towing to 13,000-foot depths would have considerably prolonged the outward journeys and thus reduced the total number of dives.

Man—Not TV—Observes Best

All observers recognized the advantage of having a man behind the porthole. Some people contend now that it is sufficient to send down television cameras, but I am convinced that the observer must himself enter the environment he wants to study.

Only man can interpret immediately, take samples, measure, decide on a move—in a word, take advantage of all the possibilities of the moment. This is why the bathyscaphe is becoming a veritable submarine laboratory. France has decided to build a new machine of this kind, and the United States Navy has bought Professor Piccard's bathyscaphe *Trieste*.* More than ever, the future of submarine exploration rests with bathyscaphes.

*As this issue went to press, word came of *Trieste's* record-breaking descent to 18,600 feet—more than 3½ miles—in the Mariana Trench off Guam. The U. S. Navy dive by Dr. Andreas B. Rechnitzer and Swiss Jacques Piccard bettered the previous record by a full mile.

Coming in February—Next month's NATIONAL GEOGRAPHIC takes members of The Society to a lost city beneath the Caribbean, looks at the Nation through the eyes of Abraham Lincoln, visits the world's smallest people, and ranges along a 2,600-mile sliver of South American mountains and coastline.

Marion Link reports on underwater exploration of Port Royal, Jamaica, where a recovered watch fixes the moment of a city's drowning from an earthquake. Distinguished poet, biographer, and philosopher Carl Sandburg assesses our 16th President in a memorable address to the Congress; Carolyn Bennett Patterson describes the land that Lincoln loved. Anne Eisner Putnam introduces Africa's Congo Pygmies; and Kip Ross presents the Chile of today.

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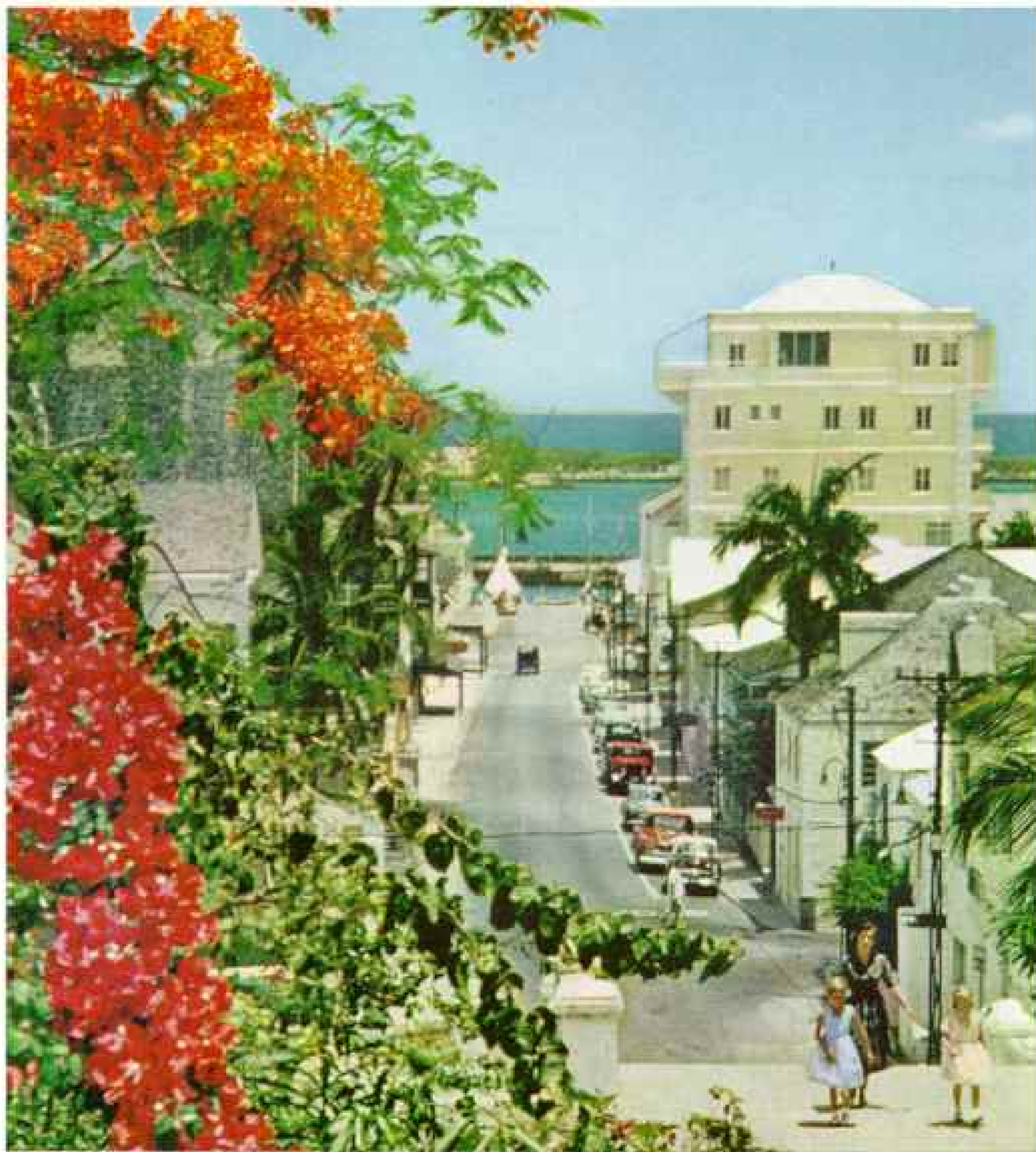
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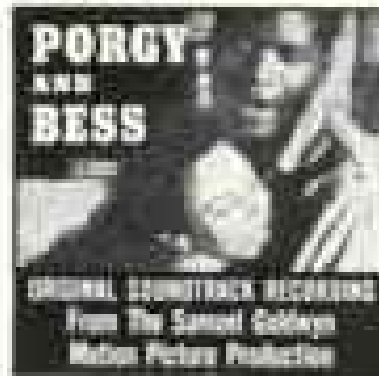
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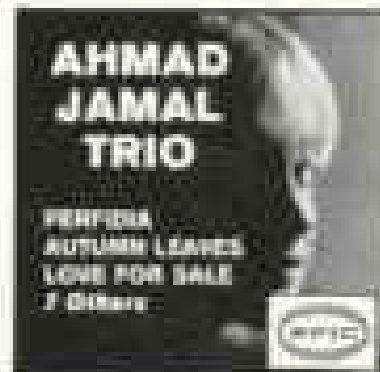
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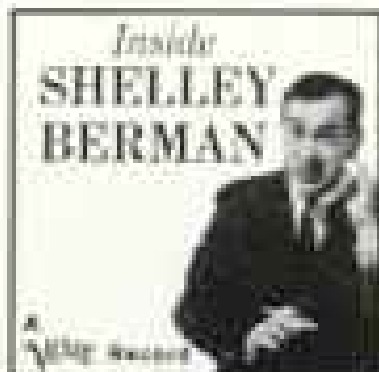
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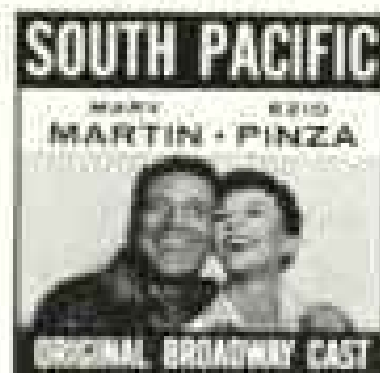
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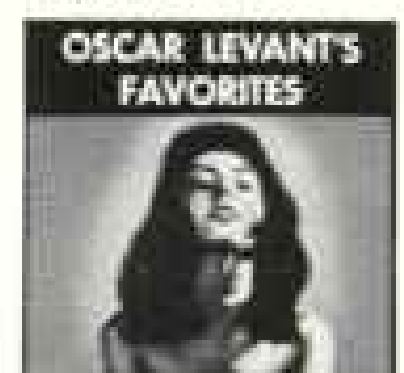
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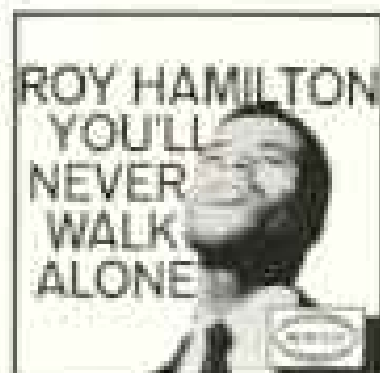
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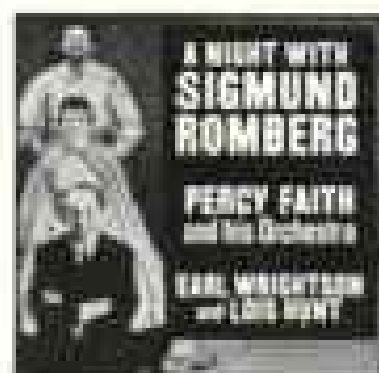
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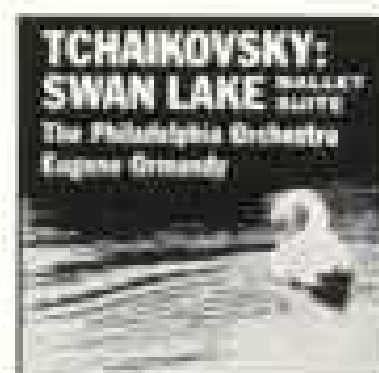
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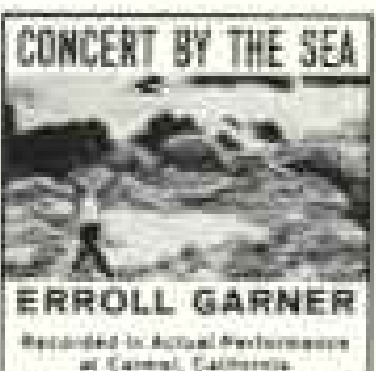
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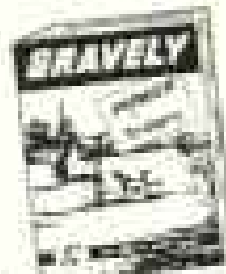
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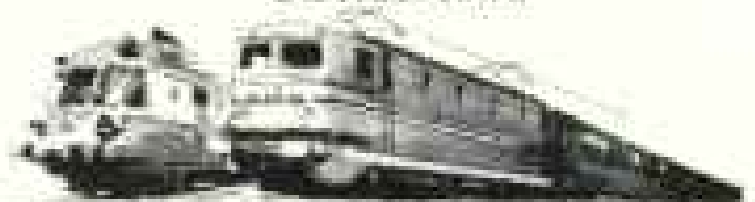
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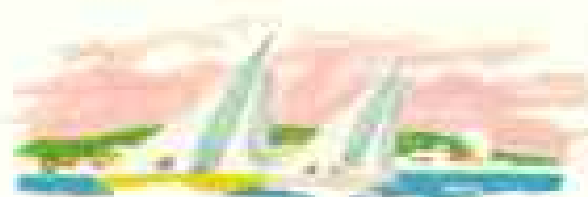
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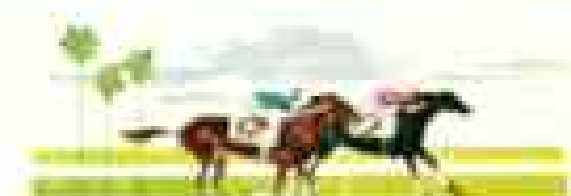


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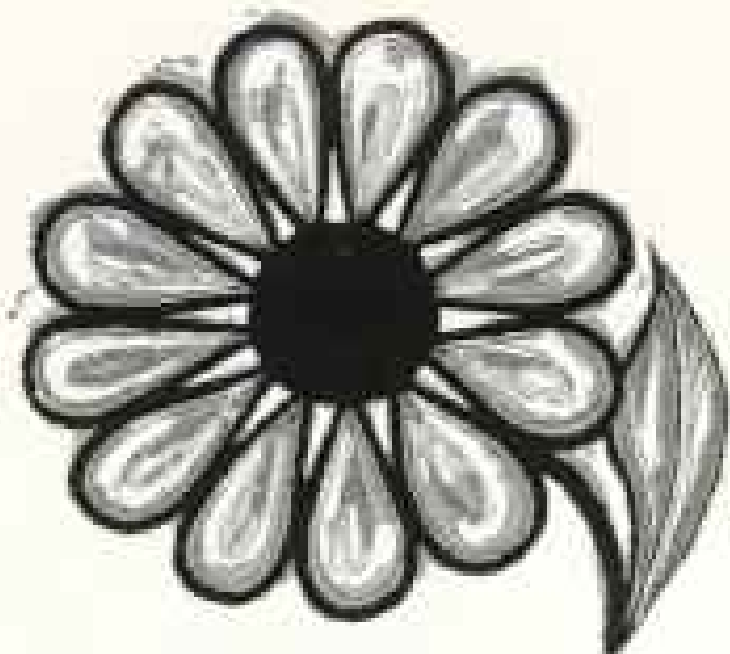
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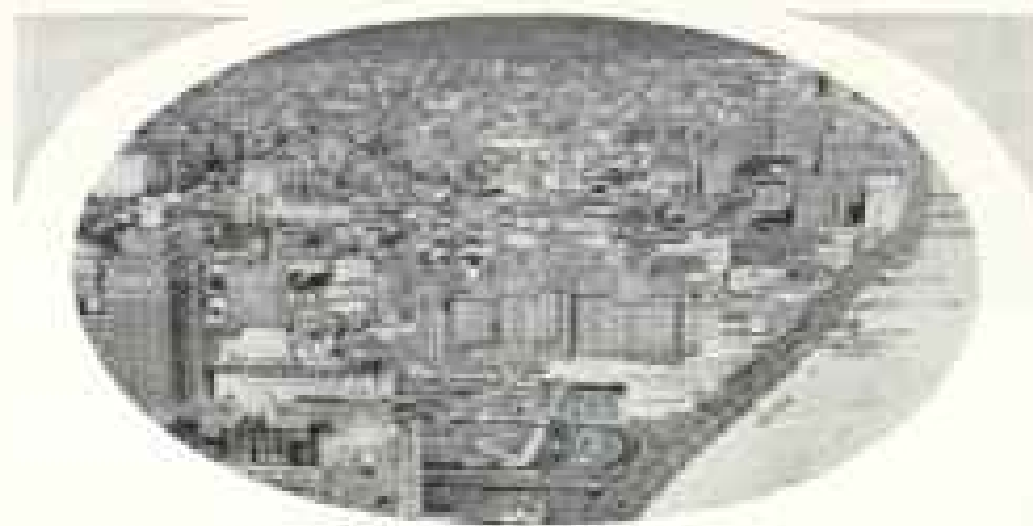


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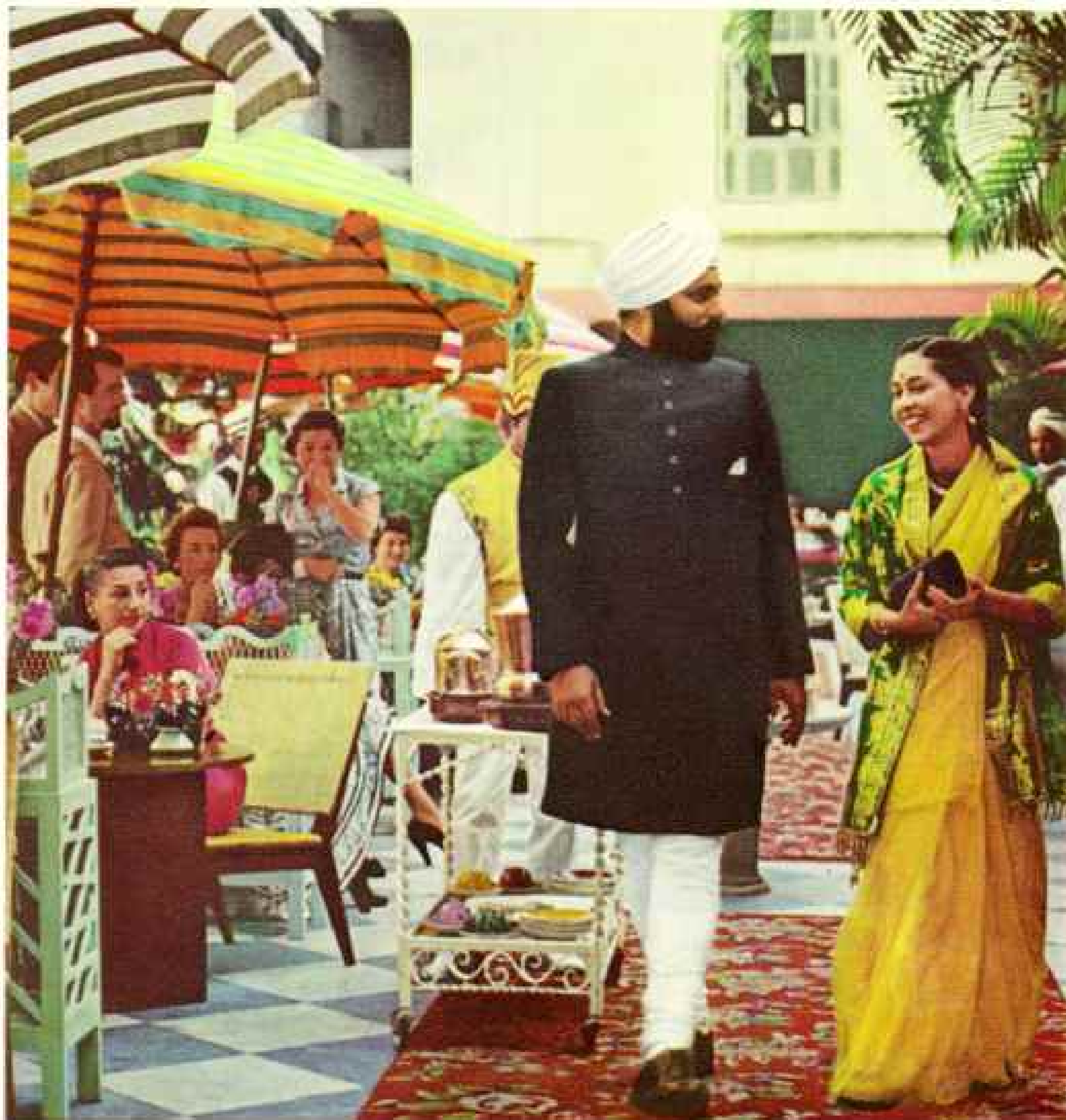


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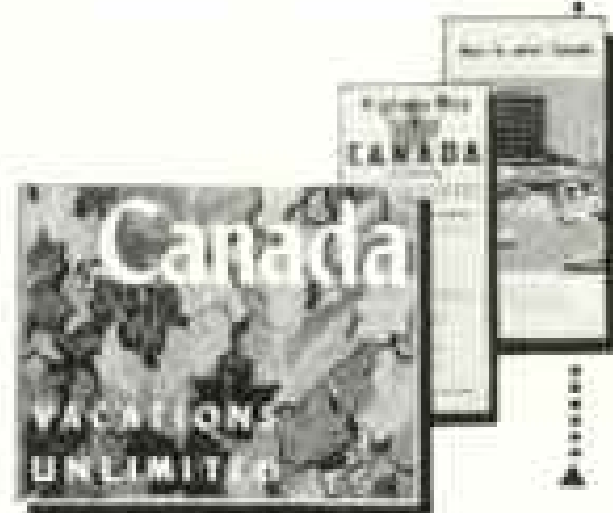
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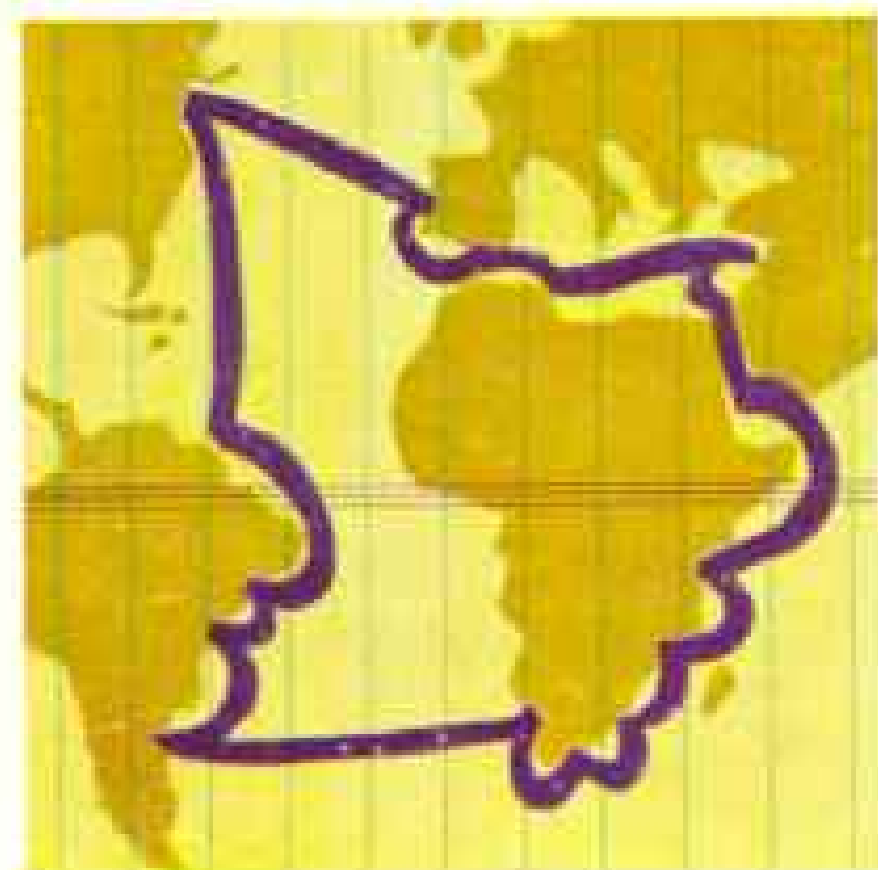
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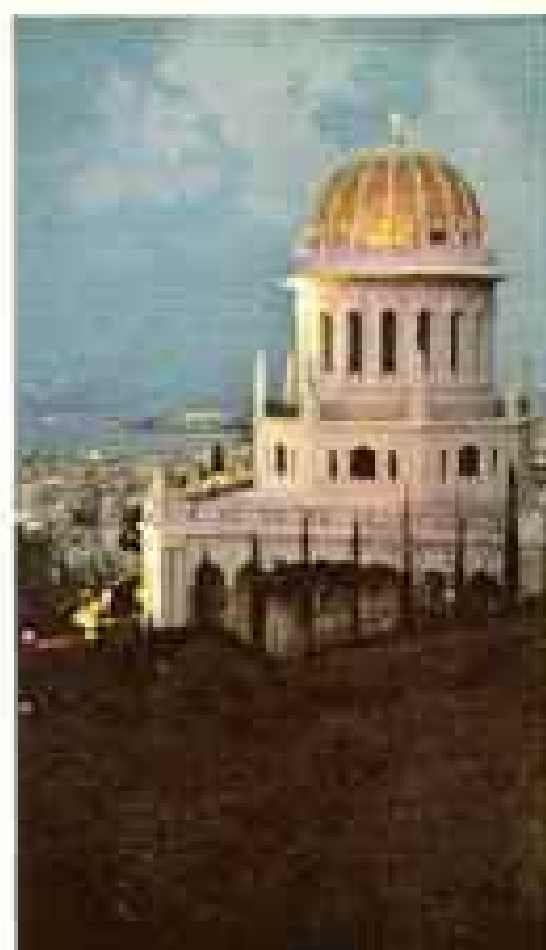
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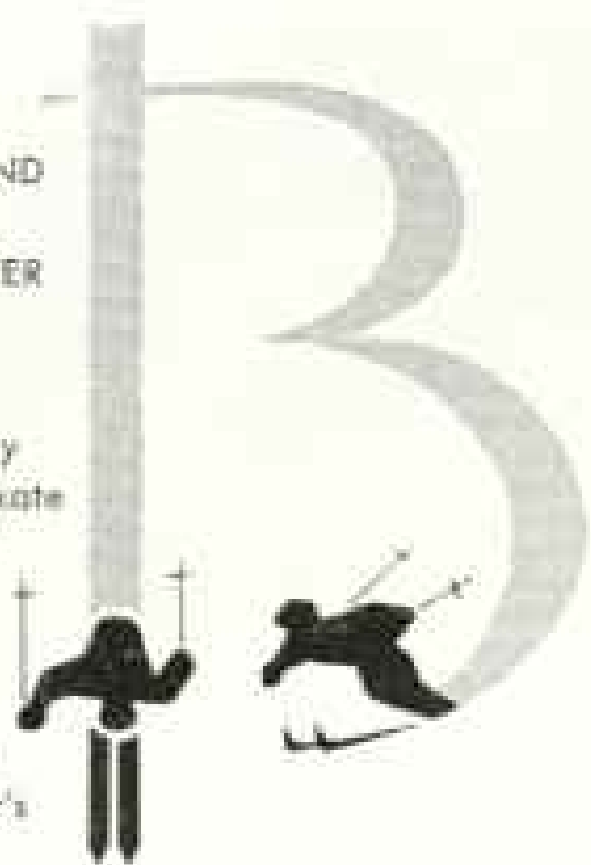


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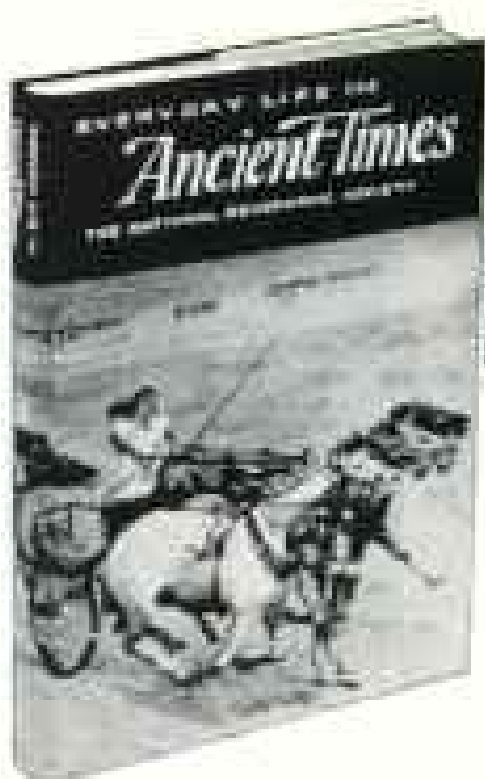
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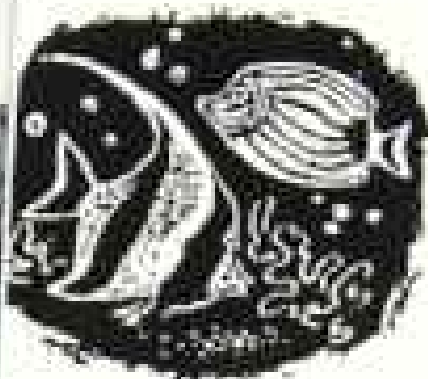
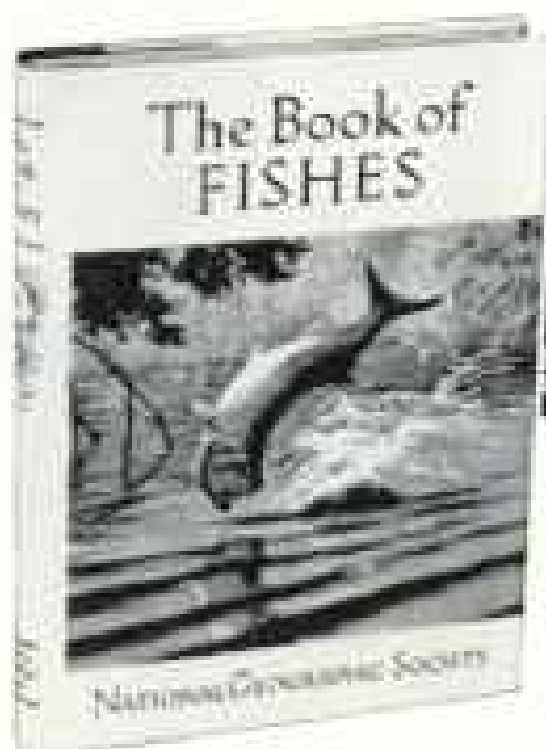
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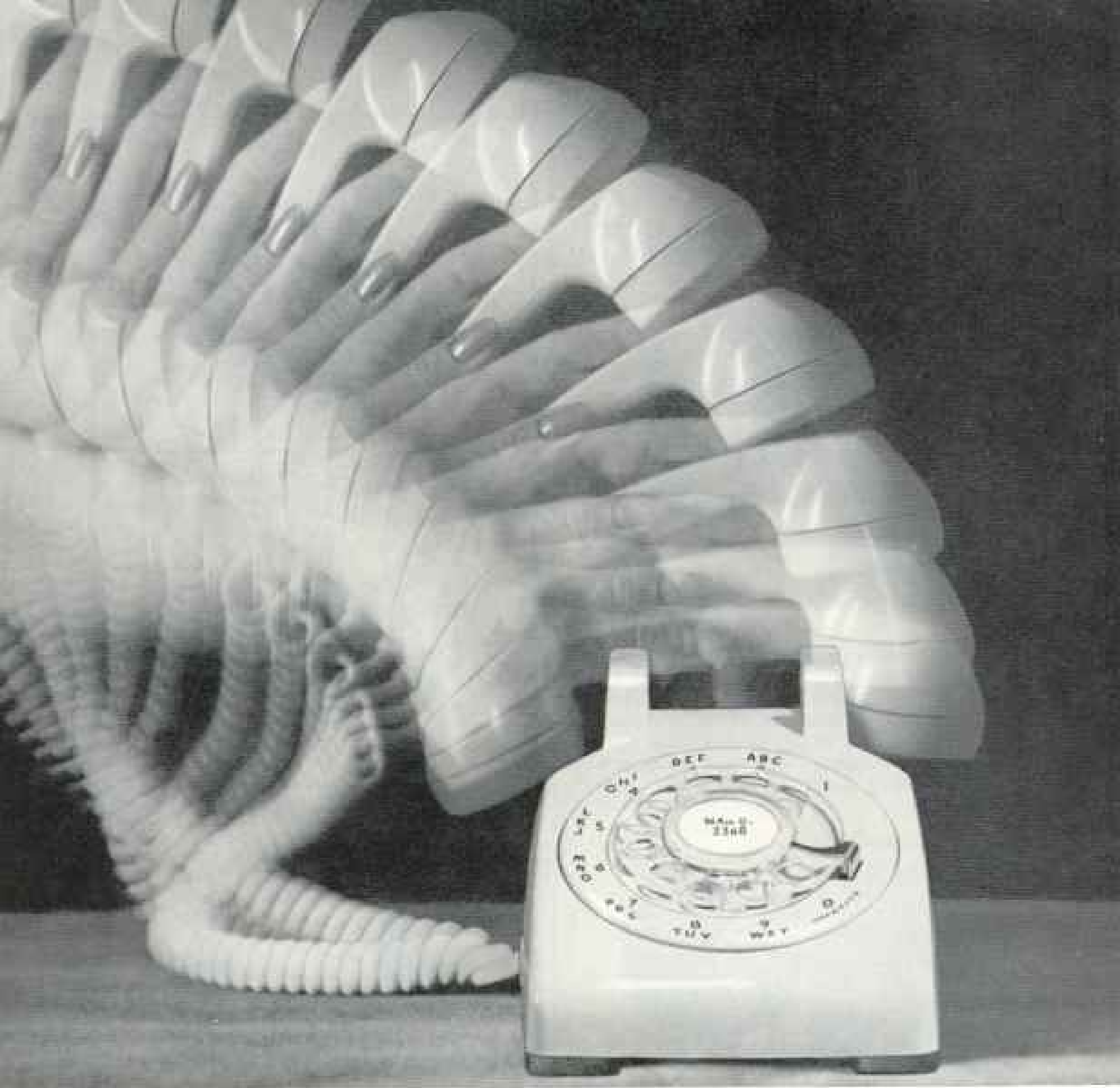
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