VOLUME CII
NUMBER FIVE

# THE NATIONAL GEOGRAPHIC MAGAZINE

NOVEMBER, 1952

From Sagebrush to Roses on the Columbia
With Map and 32 Illustrations — LEO A. BORAH
24 in Natural Colors — RAY ATKESON

Our Navy's Long Submarine Arm
With 26 Illustrations — ALLAN C. FISHER, JR.
13 in Natural Colors — DAVID S. BOYER

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With Map and 36 Illustrations
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Marineland, Florida's Giant Fish Bowl
With 20 Illustrations — GILBERT G. LA GORCE
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In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico The Society and the Smithsonian Institution, January 16, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola a ton of scientific instruments and obtained results of extraordinary value.

A notable undertaking in the history of astronomy was launched in 1949 by The Society in cooperation with the Palomar Observatory of the California Institute of Technology. This project will require four years to photomap the vast reaches of space, and will provide the first sky atlas for observatories all over the world.

In 1948 The Society sent seven expeditions to study the sun's eclipse on a 5,320-mile arc from Burma to the Aleutians.

The National Geographic Society and the Royal Ontario Museum in 1951 explored and measured newly found Chubb meteor crater, 11,500 feet in diameter, in northern Quebec.

The Society granted $25,000, and in addition $75,000 was contributed by individual members, to help preserve for the American people the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California.

One of the world's largest icefields and glacial systems outside the polar regions was discovered in Alaska and Yukon by Bradford Washburn while exploring for The Society and the Harvard Institute of Exploration, 1935.

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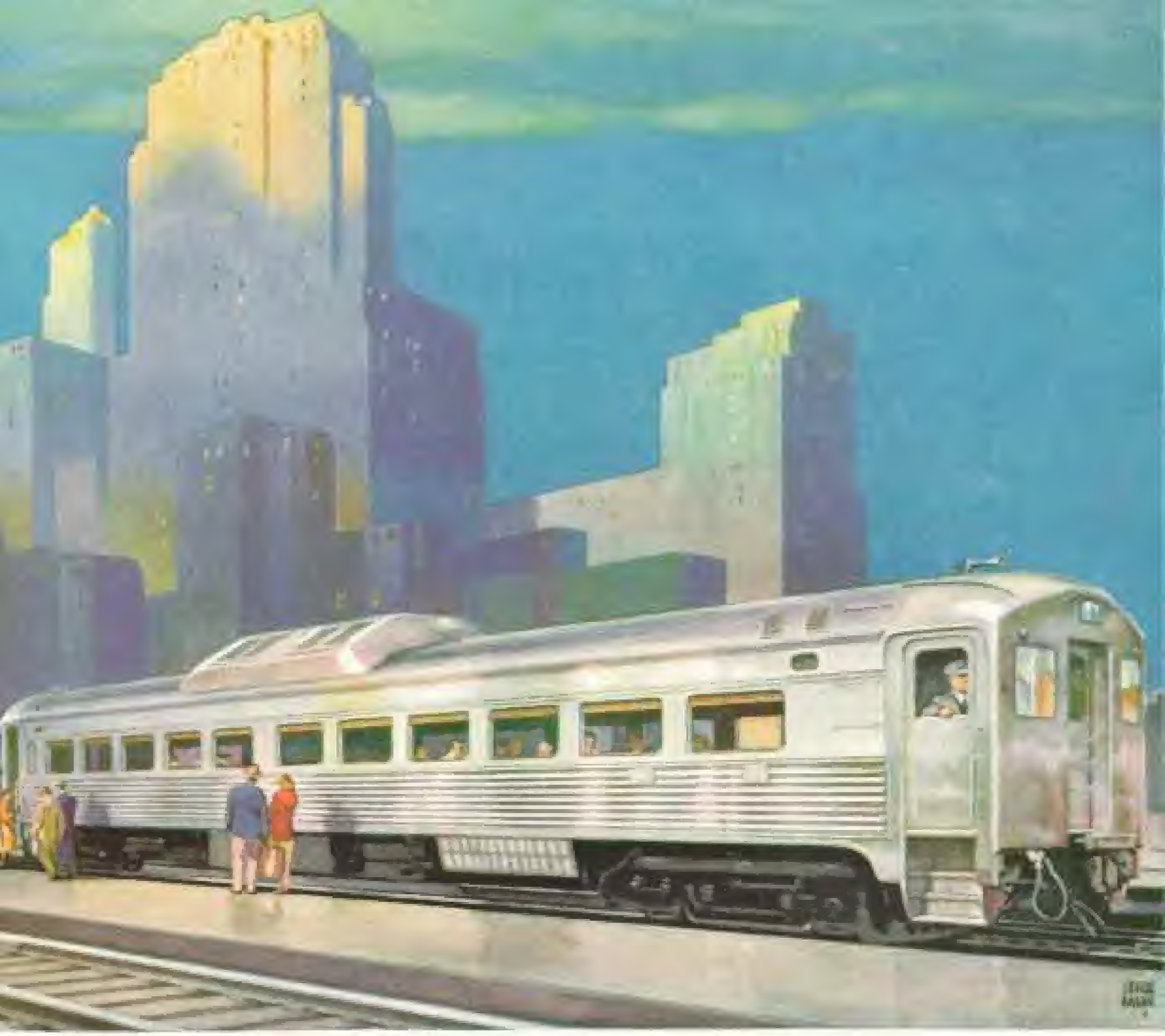

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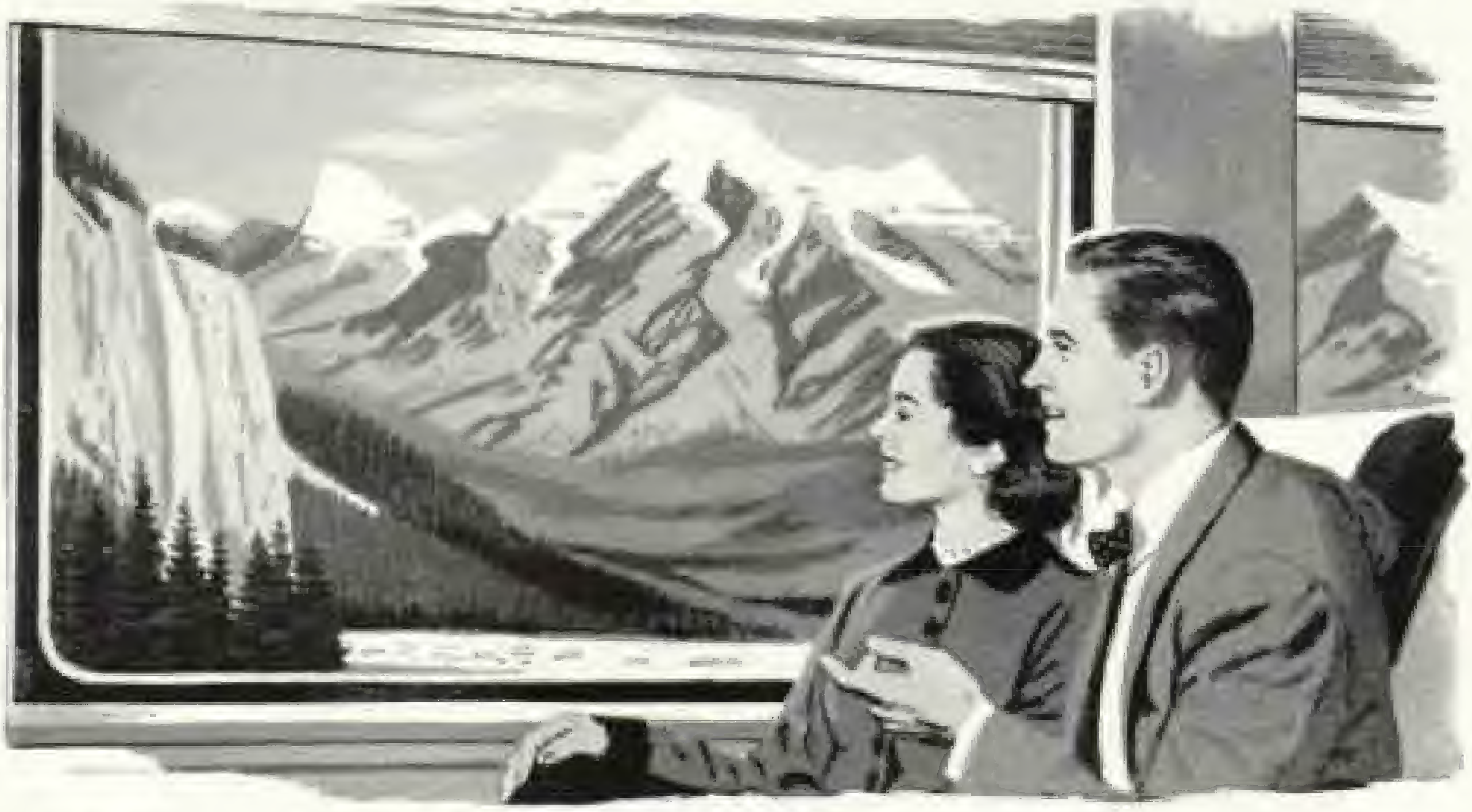

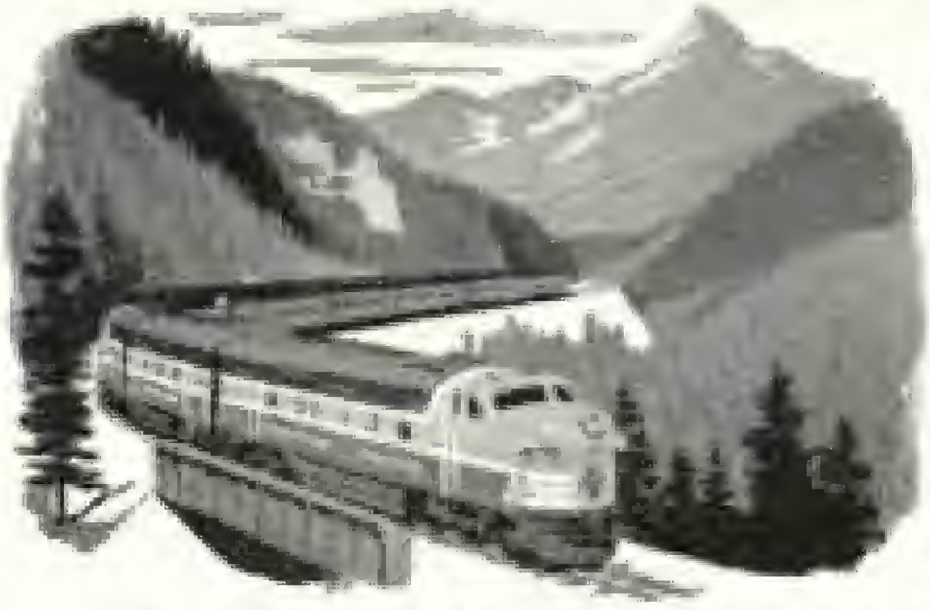

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Longfellow's works were translated into many foreign languages and he was the first American to be commemorated in the Poets' Corner in Westminster Abbey.

When, to Longfellow's distress, the local government cut down the "spreading chestnut tree" immortalized in his poem about the village blacksmith, the schoolchildren presented him with a massive armchair carved from the wood. In acknowledgment, he composed "From My Armchair" and on this "ebon throne" each young contributor sat and received an autographed copy of the poem.

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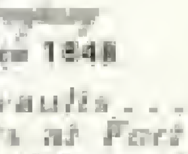

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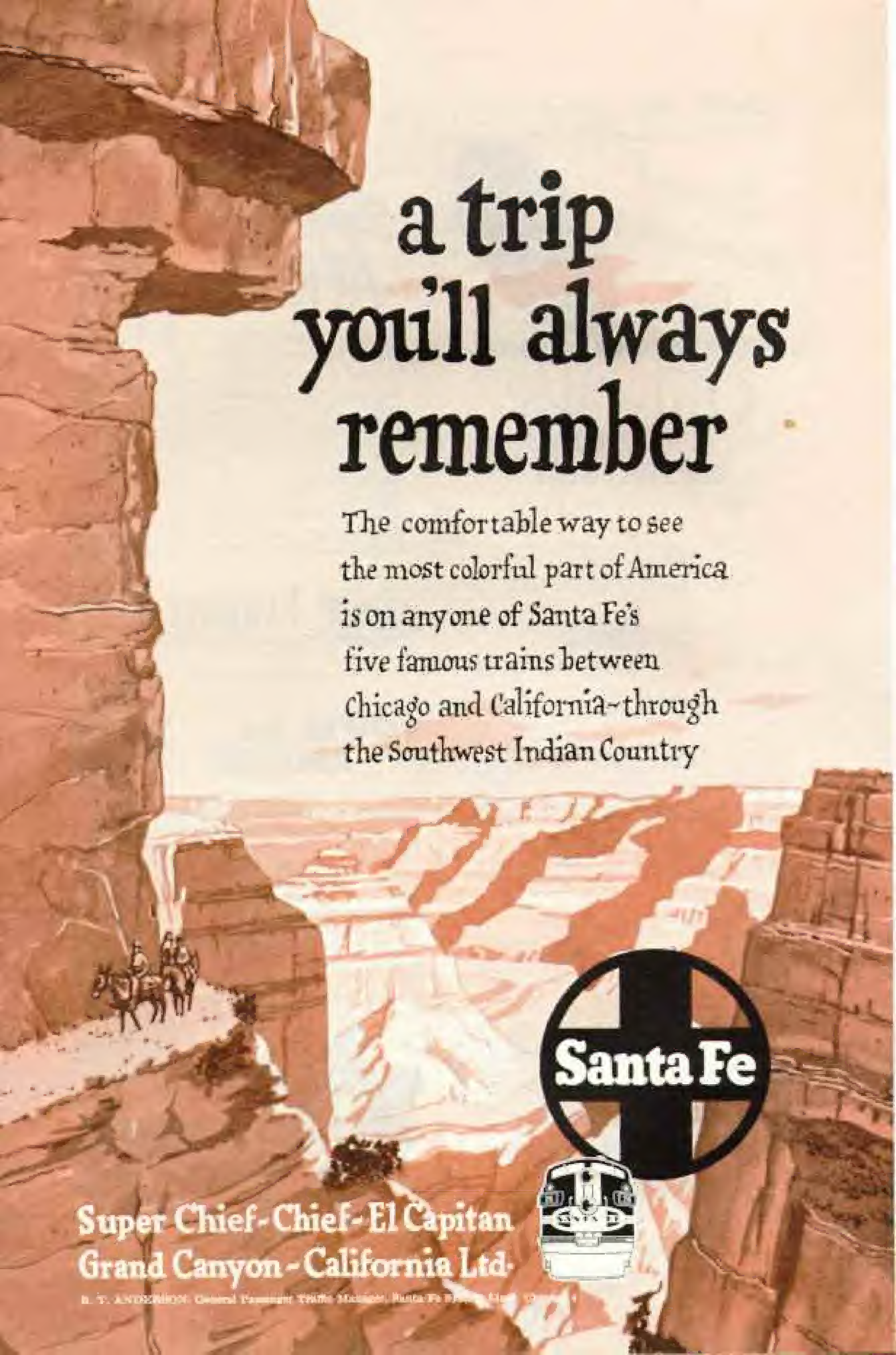

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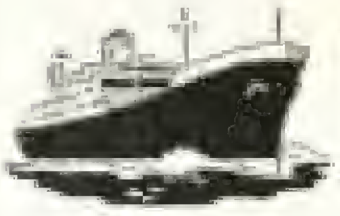

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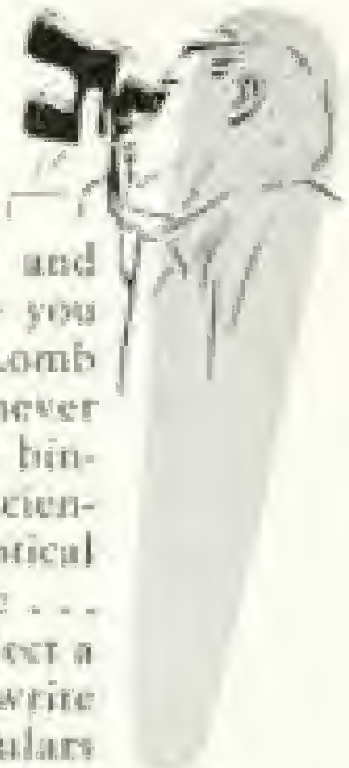

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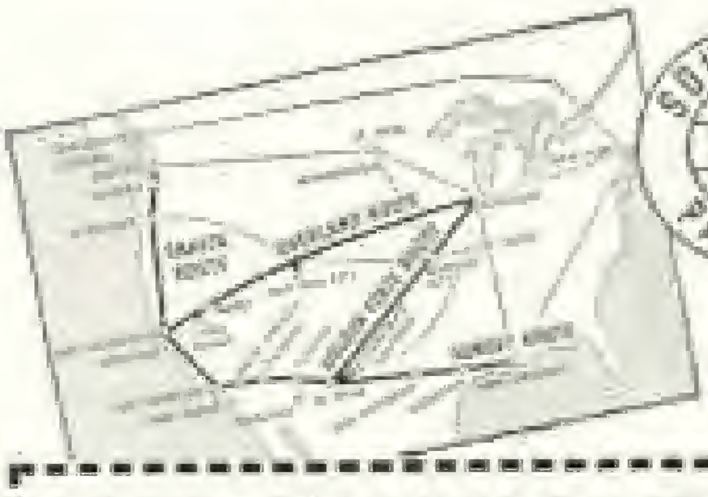

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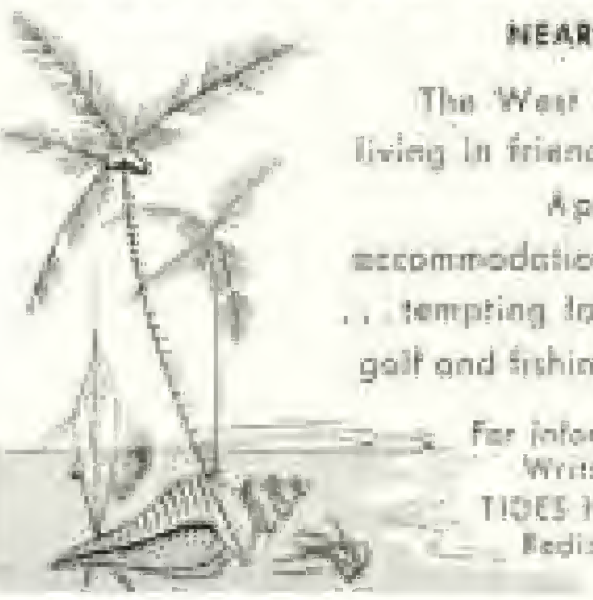

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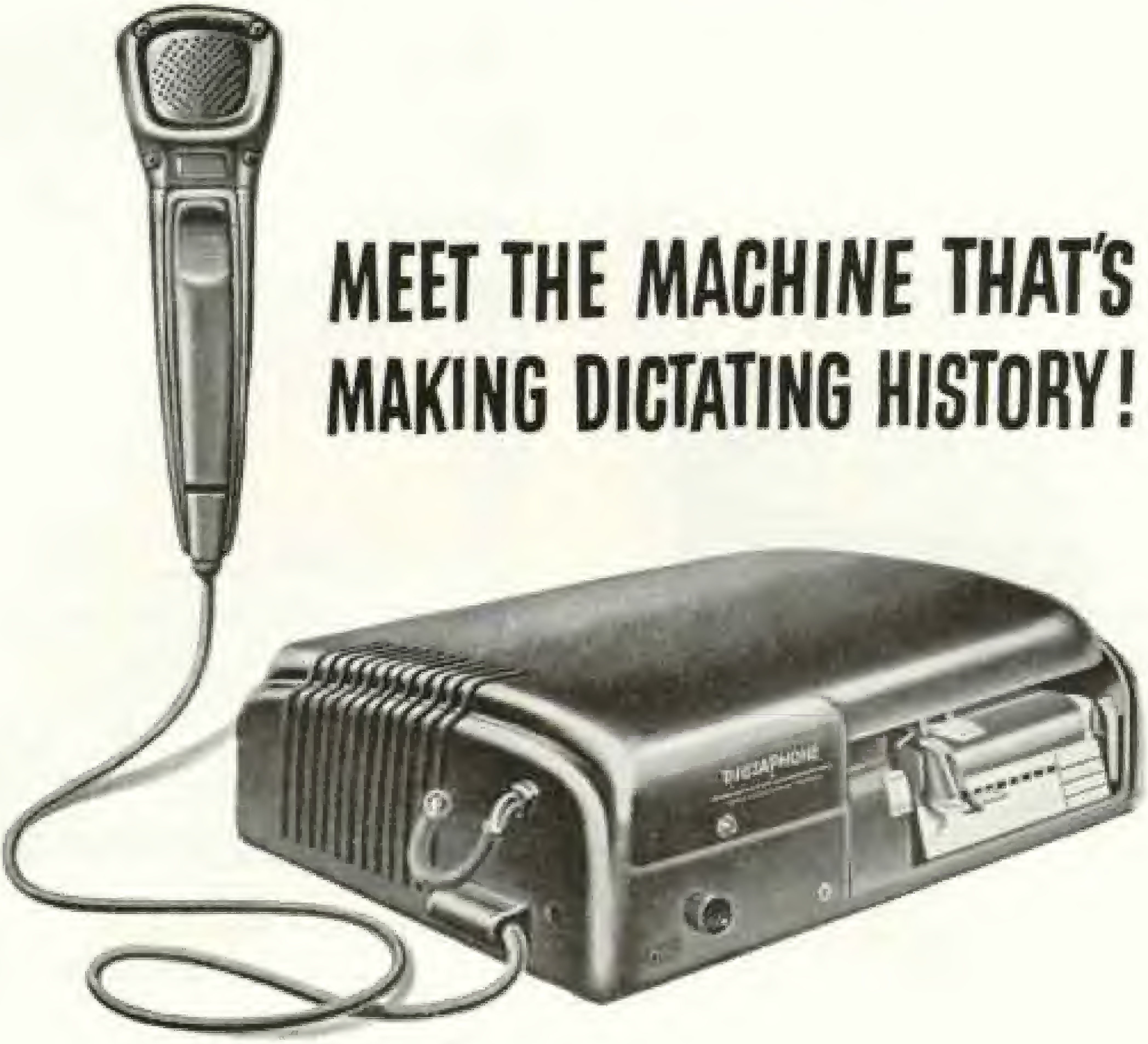

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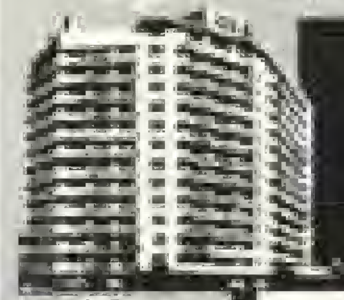

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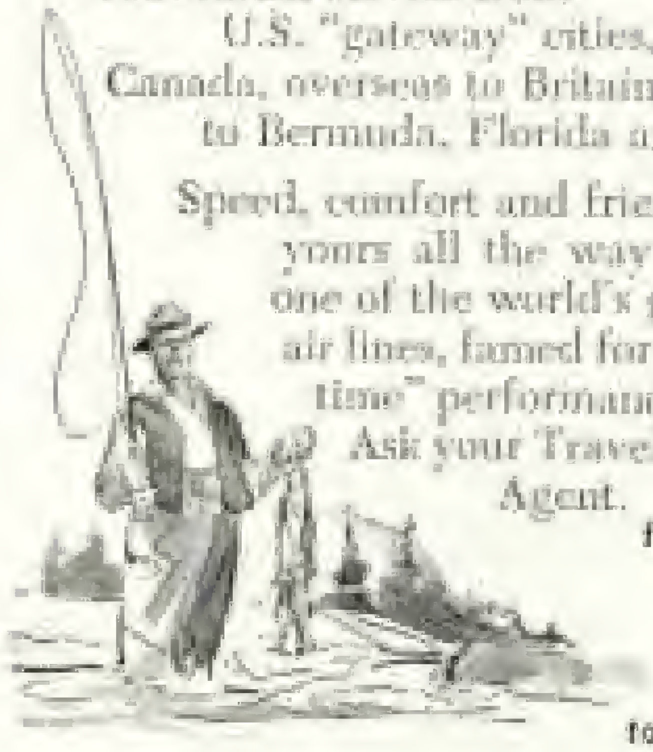

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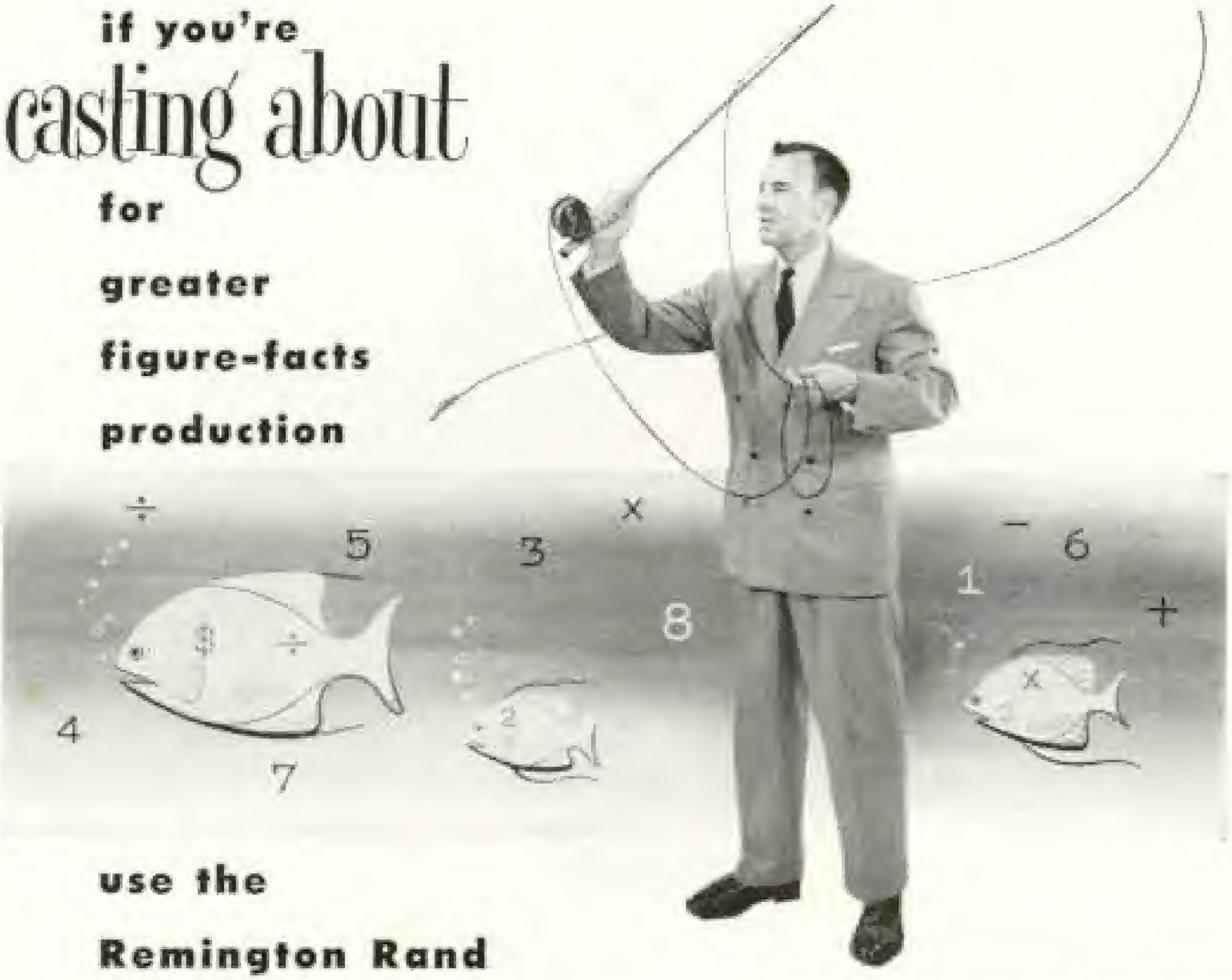

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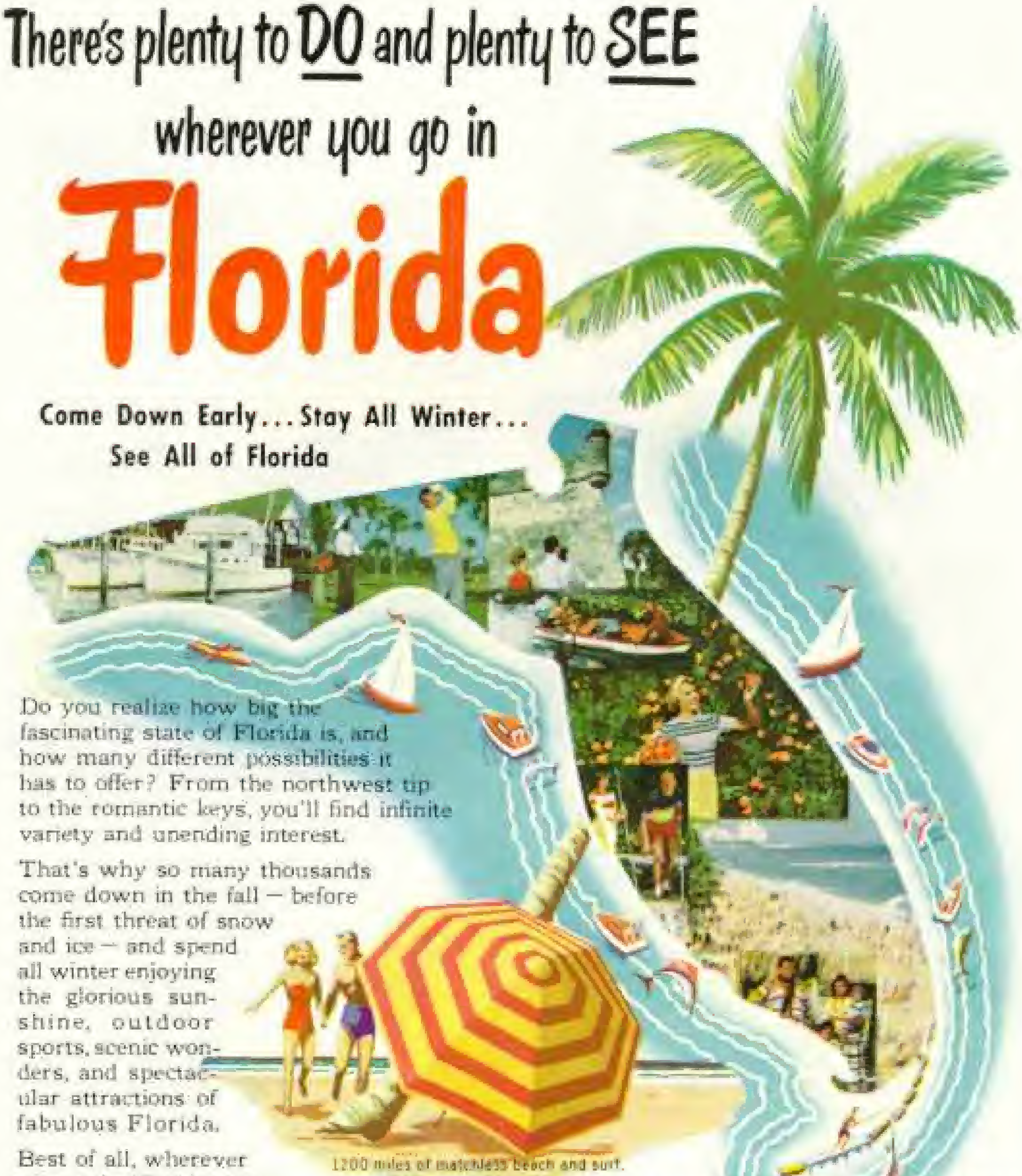

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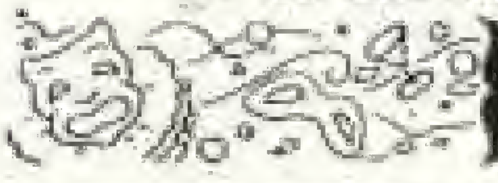

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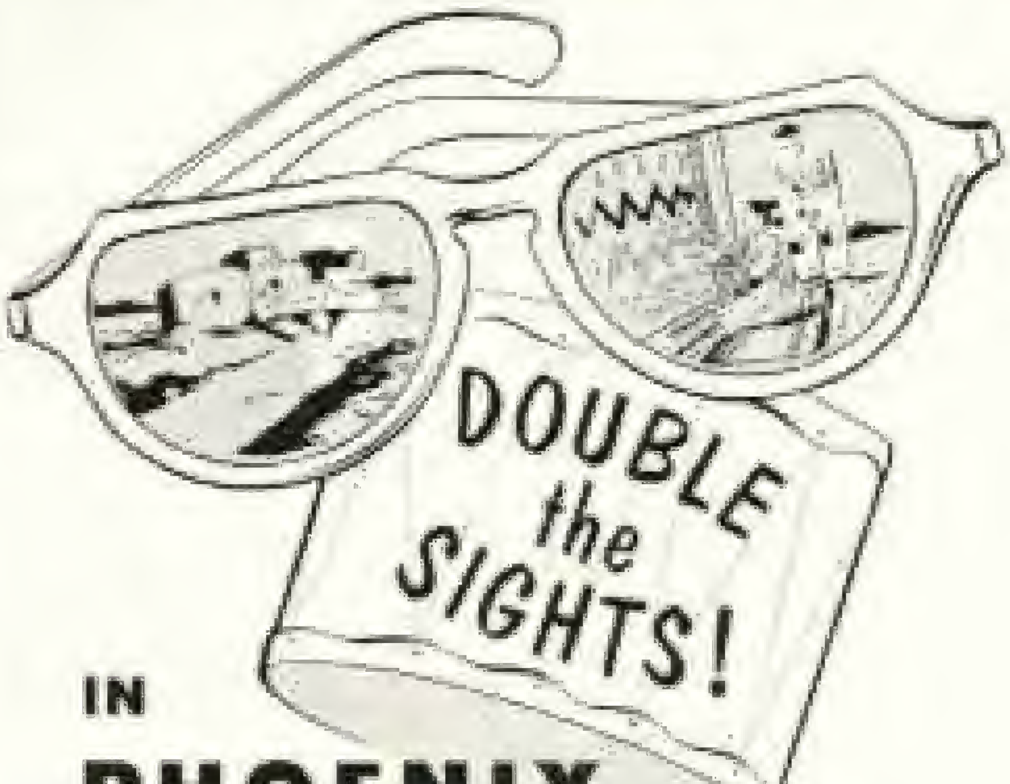
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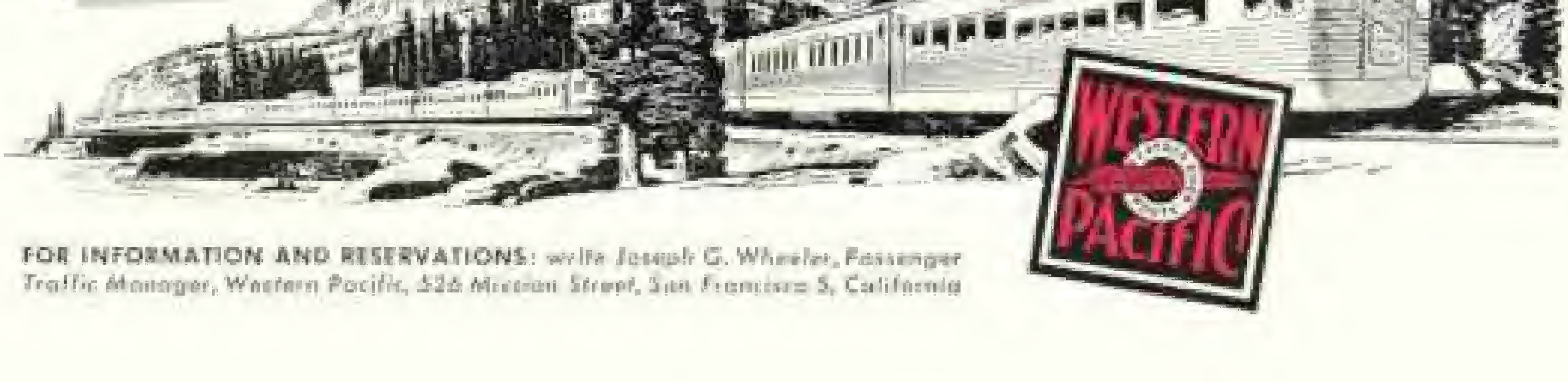

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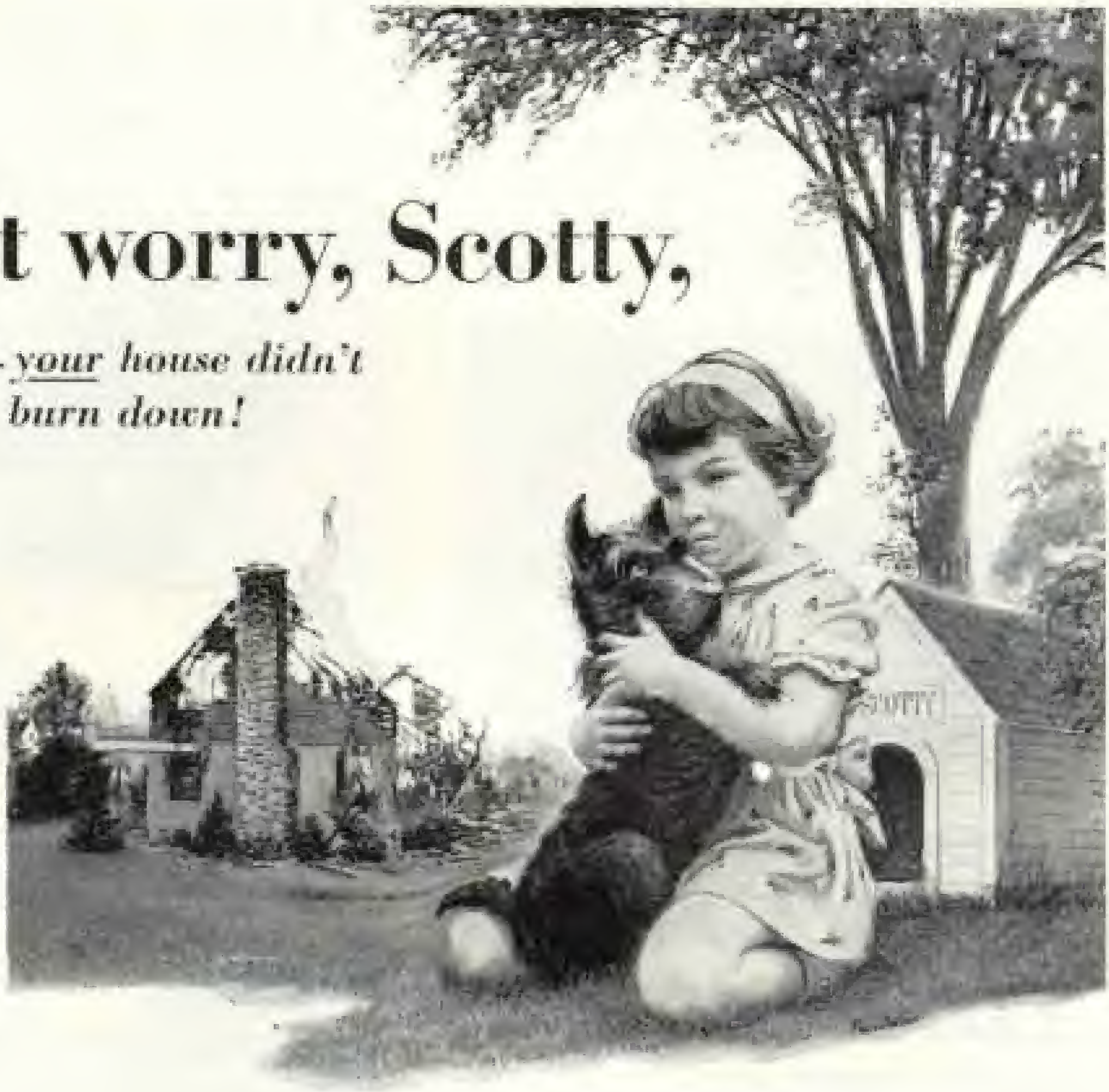

SCOTTY's house was just about the only thing that didn't go up in flames.

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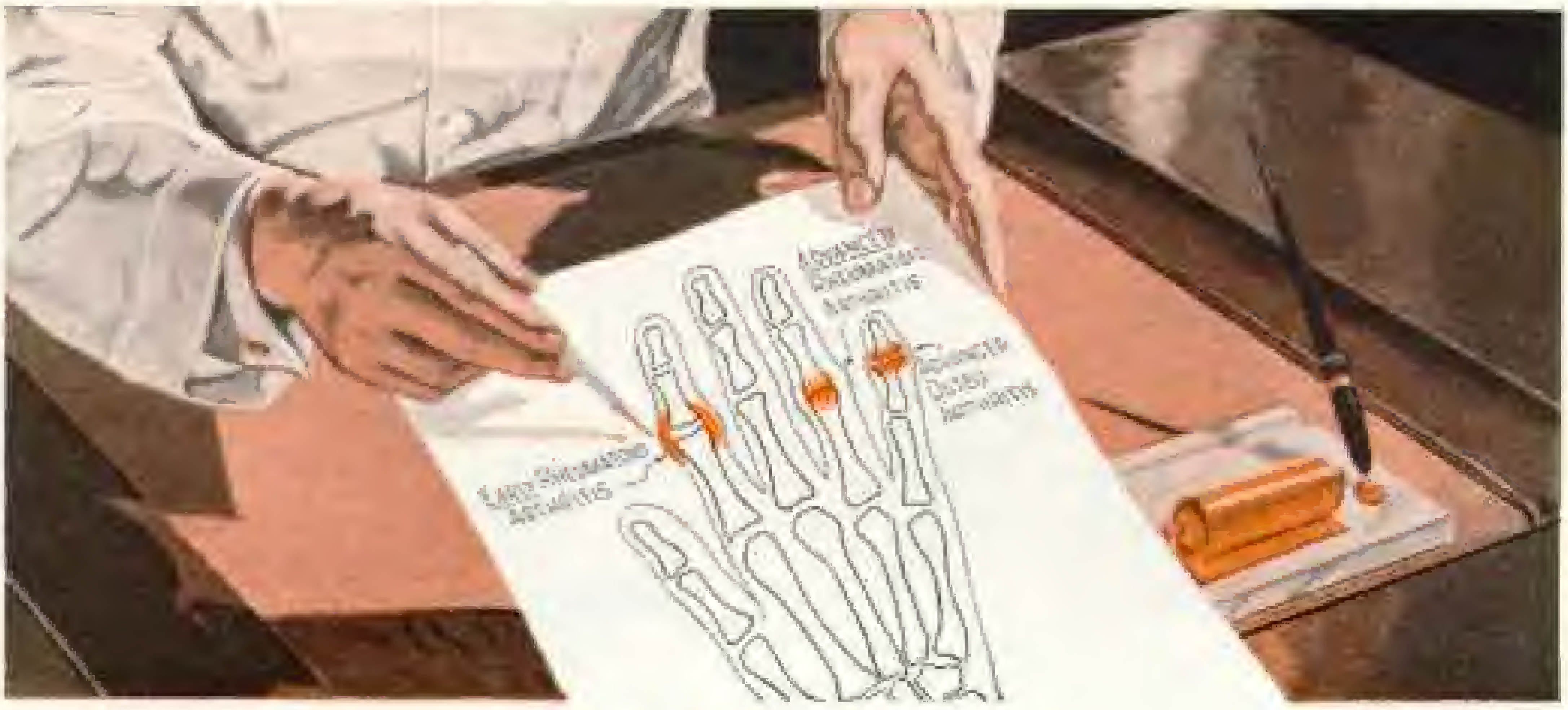

# ARTHRITIS

**Today the outlook** for most people with arthritis—particularly those affected by the rheumatoid type—is encouraging. This is because medical research has uncovered new facts about this disease, and provided more effective drugs for its treatment.

Such advances are heartening because the arthritic diseases are not only widespread but are second in disabling effect among all diseases in the United States. In fact, the Public Health Service recently reported that more than 10 million people in our country have some form of this disease.

In the sketch above, some basic facts about the two most common forms of chronic arthritis—*rheumatoid arthritis* and *osteoarthritis*—are illustrated. The joint-swelling, which is characteristic of early rheumatoid arthritis, is shown on the index finger. Since the joint itself is not damaged, *prompt* treatment may bring complete relief.

The effects of *advanced* rheumatoid arthritis are shown on the third finger. Here an overgrowth of bone has caused a complete stiffening of the joint. Even at this stage, however, patients can often be helped.

The little finger illustrates the enlarged ends of bones and the diminished joint spaces caused by osteoarthritis. It is primarily the result of aging and generally does not cause severe crippling.

Doctors do not consider rheumatoid arthritis simply a disease of the joints. They say that the person who has this condition generally shows signs of disease of the *entire* body. This may be evidenced by loss of weight, fatigue, anemia, infection, emotional upsets, nutritional deficiencies, and sometimes by other more serious conditions.

Whenever signs of rheumatoid arthritis occur, a *thorough physical examination* is needed. Only in this way can an exact diagnosis be made and treatment outlined to meet the patient's *individual* needs.

There is no known cure as yet for rheumatoid arthritis. Medical authorities believe that standard treatment—*if continued persistently*—can prevent serious complications in 70 percent of cases, and even completely relieve the painful symptoms in many cases. This treatment includes rest, good nutrition, physical therapy, and other measures.

To help prevent arthritis—or lessen the effects if it should occur—*one should not neglect seeing the doctor whenever persistent pain occurs in any joint.* Moreover, it is most important for the patient to realize that relief from *any* type of arthritis depends largely on close and faithful cooperation with the doctor in all phases of treatment.

Above all, arthritic patients should take an optimistic attitude toward this disease, because worry and mental strain may intensify symptoms. Today it is reassuring to know that *the great majority of arthritis cases can be greatly helped.*

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VOL. CII, No. 5 WASHINGTON NOVEMBER, 1952

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# From Sagebrush to Roses on the Columbia

By Leo A. Borah

FULFILLMENT of a 35-year dream—the official turning on of water to start a million-acre State and Federal irrigation project in the Columbia River Basin—began near Moses Lake, Washington, on May 29, 1952. It is like adding a new State to the Union.

Out of sagebrush desert which, save for some ill-fated attempts at dry farming, had lain desolate and useless for centuries, I saw spring in 24 hours a fertile farm, plowed, graded, leveled, seeded, and fully equipped with buildings, livestock, irrigation ditches, and sprinklers.

This almost magical "farm-in-a-day" was complete even to furniture, groceries, clothing, and children's toys. Farm and equipment were donated by private business organizations, and the Veterans of Foreign Wars chose Donald D. Dunn from thousands of nominees as the veteran most deserving of the gift.

A minute after midnight fireworks had signaled the beginning of the day's labor, and more than 300 volunteer workers had fallen to with a will. They built an ultramodern three-bedroom house, large machine and cattle sheds, and other farm structures on concrete foundations poured in advance (pages 604, 605). With 70 pieces of heavy machinery raising blinding clouds of dust, they cleared off sagebrush, plowed and leveled 80 acres of irrigable land, and planted alfalfa, pasture, oats, red clover, corn, and beans.

### First Irrigation from Grand Coulee

The modest 30-year-old veteran received the deed to the property, debt-free, from an official of the State Columbia Basin Commission.

Then came the dramatic moment for which people of eastern Washington had been waiting since World War I. The Commissioner of the federal Bureau of Reclamation turned on the water—the first drawn for irrigation from the lake backed up by Grand Coulee Dam.

As sprinklers began to shower part of the tract and rills to run through the rest of it, what had been sun-baked, dust-ridden waste became in a moment well-watered cropland.

The water came from a vast, sealed equalizing reservoir into which it had been raised by gigantic pumps. Gravity canals and siphons will carry it to 1,029,000 thirsty acres of potentially rich agricultural land.

The reservoir millenniums ago was the temporary bed of the Columbia River. Blocked by an ice sheet, the stream changed its course. Then the ice receded, and the river reverted to its former bed, leaving high and dry its temporary canyon and the sheer cliff of a mighty cataract. Dry Falls, near Coulee City, is now a Washington State Park.

### Farseeing Men Dreamed of This Day

Lands to be watered from Grand Coulee are of course only a small portion of the vast Columbia Basin. The Basin includes in its 259,000 square miles (219,300 in the United States) western Montana, nearly all of Washington, northern and eastern Oregon, much of Idaho, and smaller portions of Utah, Wyoming, and Nevada. The remaining 39,700 square miles are in Canada (map, pages 576-7).

Though the Basin has only a fiftieth of the national population, it contains approximately seven percent of the area of continental United States and 40 percent of the country's potential hydroelectric power.

As I stood on a windy hill with Charles E. Johns, a Washington State official, and looked down on the Dunn farm, we recalled James O'Sullivan, pioneer irrigation enthusiast, and Rufus Woods, farseeing publisher of the *Wenatchee Daily World*, who are deservedly called fathers of Columbia Basin irrigation.

When I went to Spokane as a high school teacher just after the end of World War I,

Rasmussen, U. S. Bureau of Reclamation

**Columbia Basin Carrots Grow Like Jack's Beanstalk**

Proving the amazing fertility of reclaimed sagebrush soil, this specimen took on gigantic proportions when harvesters neglected to pick it. It was produced in the Hunt Irrigation project near Jerome, Idaho. Young Michael Weatherwax finds the vegetable an armload.

these men were being laughed at as dreamers and crackpots because they advocated pump irrigation to reclaim the land we now saw emerging from desert. Despite discouragement and ridicule, however, the two enthusiasts continued their campaign. Neither lived to see the dream accomplished, though the big pumps were under construction at the time of Mr. Woods's death in 1950. One of the major subsidiary dams has been named for Mr. O'Sullivan. In 35 years what critics branded as preposterous has become reality.

### A Vast Empire to Be Developed

Today Spokane, the "Capital of the Inland Empire," proudly advertises itself as the "Gateway to the Columbia Basin" (page 610). Power from the Spokane River, which flows through the center of the city, and trade with farming and mining communities have insured steady growth. Now the opening of the Grand Coulee project gives added impetus. Since 1940 the population has increased from 122,000 to more than 160,000.

The country around Grand Coulee Dam will not bloom gardenlike overnight. This year only about half of 950 80-acre farms received water. Others will be added at the rate of some 60,000 acres a year until the entire project is under cultivation. Meantime authorized irrigation plans will be developed elsewhere in the Columbia Basin. Possibilities of this enormous future empire stagger the imagination.

The day before the Moses Lake ceremony I had flown out from Washington, D. C., to the Seattle-Tacoma Airport, where Charlie Johns and his assistant A. F. (Tony) Raiter, Jr., met me. We stayed overnight in the phenomenally growing city of Seattle and early next morning drove over Snoqualmie Pass to the Columbia River Basin.

No matter how often I make that trip, I always marvel at the sudden change of climate and vegetation as the highway crosses the summit of the Cascade Range. One moment we were in the lush fir, spruce, and cedar rain forest of the Pacific slope; the next in dry reaches of western pine. Here rainfall drops from an annual average of more than 100 inches on the west side to less than 10 east of the divide.

Just over the summit we passed Keechelus Lake in a cuplike basin with steep, timbered sides rising 1,000 feet. A dam at the south end of this lake helps regulate the flow of the Yakima River for irrigation.

At Ellensburg, seat of the Central Washington College of Education, we were in the lovely valley of the laughing Yakima River. The town, started in 1867 as a trading post by William Wilson, renegade white leader of a band of Indian raiders, was once called "Robber's Roost." Today the only reminders of wild West days in this city of nearly 10,000 are an annual rodeo in late summer, some Indians dressed in tribal finery on gala occasions, and a few descendants of Chinese miners who followed an early gold rush.

Irrigation from the Yakima River is the source of present prosperity. In the shadow of sere brown mountains, all kinds of fruits and vegetables thrive. The incredibly rich soil was cast up eons ago as volcanic ash when Mount Rainier, which lifts its detruncated snow crown on the horizon, erupted and blew off about 2,000 feet of its top.

Yakima, less than an hour's drive to the south by a highway winding along the river canyon through breath-taking scenery, is truly a wonder city, the center of a green oasis conjured by irrigation from the sagebrush. Here are produced enormous quantities of peaches, apricots, plums, apples, pears, cherries, grapes, and nuts as well as vegetables, sugar beets, wheat, hops, and other crops.

Hundreds of railroad refrigerator cars move out of Yakima in the fruit season, and the smooth paved highways are crowded with trucks carrying produce to Seattle. In the autumn big apple-boxing and shipping plants employ armies of workers, and canneries hum with activity most of the year (page 592).

Community spirit is remarkable. In the early 30's construction was started on a big hotel. Depression halted the

Pomeroy, U. S. Bureau of Reclamation

**Tall Corn Waves → Where Sagebrush Grew**

This hybrid corn grows on the Bureau of Reclamation's experimental farm near Moses Lake. Its growing season is 130 days, and the yield is 100 bushels or more to the acre. Though virgin soil is 18 to 30 inches deep, it is lacking in nitrates and humus, and fertilizers must be added for most crops.

work, and for years a concrete skeleton stood gaunt against the skyline. Outside capital was sought to finish the building a few years ago, but Yakima leaders decided the price was too high. By local subscription they raised money to erect in 1949 a new 14-story aluminum hotel.

### Petrified Trees 10,000,000 Years Old

We made a short detour from the highway between Ellensburg and Moses Lake to visit Ginkgo Petrified Forest State Park, a tract of 5,980 acres containing opalized trunks of trees, most of them of prehistoric species.

"Geologists say this forest was buried in molten lava about 10,000,000 years ago," Charlie told me. "Wind and rain through the centuries have uncovered it."

Moses Lake farmers have proved that land in this arid region needs only water to produce fine crops. For several years they have been irrigating their fields by ditch and sprinkler systems fed from the lake and from wells.

The country immediately surrounding the booming little city is refreshingly green. Farther away dust devils dance over flat, monotonous sagebrush plains. Not a tree is in sight for miles save in the town and its environs.

At Moses Lake the U. S. Air Force maintains Larson Base where the latest and fastest jet bomber planes, the B-47 and B-52, built by the Boeing Airplane Company of Seattle, underwent preliminary flight tests. A large part of the aluminum in their construction comes from the reduction plants in the Columbia Basin.

Another big national defense establishment in the Basin is the Hanford Operations, Washington, about 40 miles south of Moses Lake. There the Atomic Energy Commission is producing vital war materials.

After the farm presentation near Moses Lake, we headed west for Wenatchee. Ray Atkeson, taking pictures to illustrate this article, was fighting clouds of dust down on the farm-in-a-day.

Between Moses Lake and Quincy the dust storm became so thick that Tony, driving the car, had to turn on his lights. Most of the land along our way was freshly plowed, and the high, chill wind was whipping it unmercifully. When we reached Quincy, however, the air was clear. This town is another thriving community that irrigation has created and made prosperous.

Beyond Ephrata, Columbia Basin administration headquarters, we momentarily mistook for snow huge heaps of fertilizer shipped in from Idaho to enrich reclaimed land. Concrete-lined irrigation canals and big siphon pipes for lifting water over ridges were ready to receive the flow from Grand Coulee.

Next morning, Memorial Day, we went back to Ephrata. The town, gaily decorated with flags and bunting, was putting on a "Little World's Fair" in celebration of the turning on of irrigation water (page 609).

George D. Zahn, one of the members of Washington State's Columbia Basin Commission, gave us maps and made arrangements for us to be guided through Grand Coulee Dam.

As we started for the dam, Charlie reminisced about the early days of the Columbia Basin irrigation campaign.

"Here in Ephrata," he said, "Rufus Woods gathered the material for the famous 'Munchausen' story he published in his *Wenatchee Daily World* in 1918 to tell about the fabulous possibilities of irrigation in the Basin desert. That story was what started the Columbia Basin Irrigation League and led to the building of Grand Coulee Dam."

Our road took us through the popular resort town of Soap Lake on the shore of a body of mineral water. There a water carnival was in progress to celebrate the starting of Grand Coulee irrigation.

### Dry Cliff of Prehistoric Waterfall

The great dam backs the Columbia River into long, narrow Franklin Delano Roosevelt Lake, which extends to the Canadian border, 151 miles upstream. If a treaty agreement were to be reached with Canada, the river would be backed up farther and the Arrow Lakes of British Columbia could be utilized for water storage.

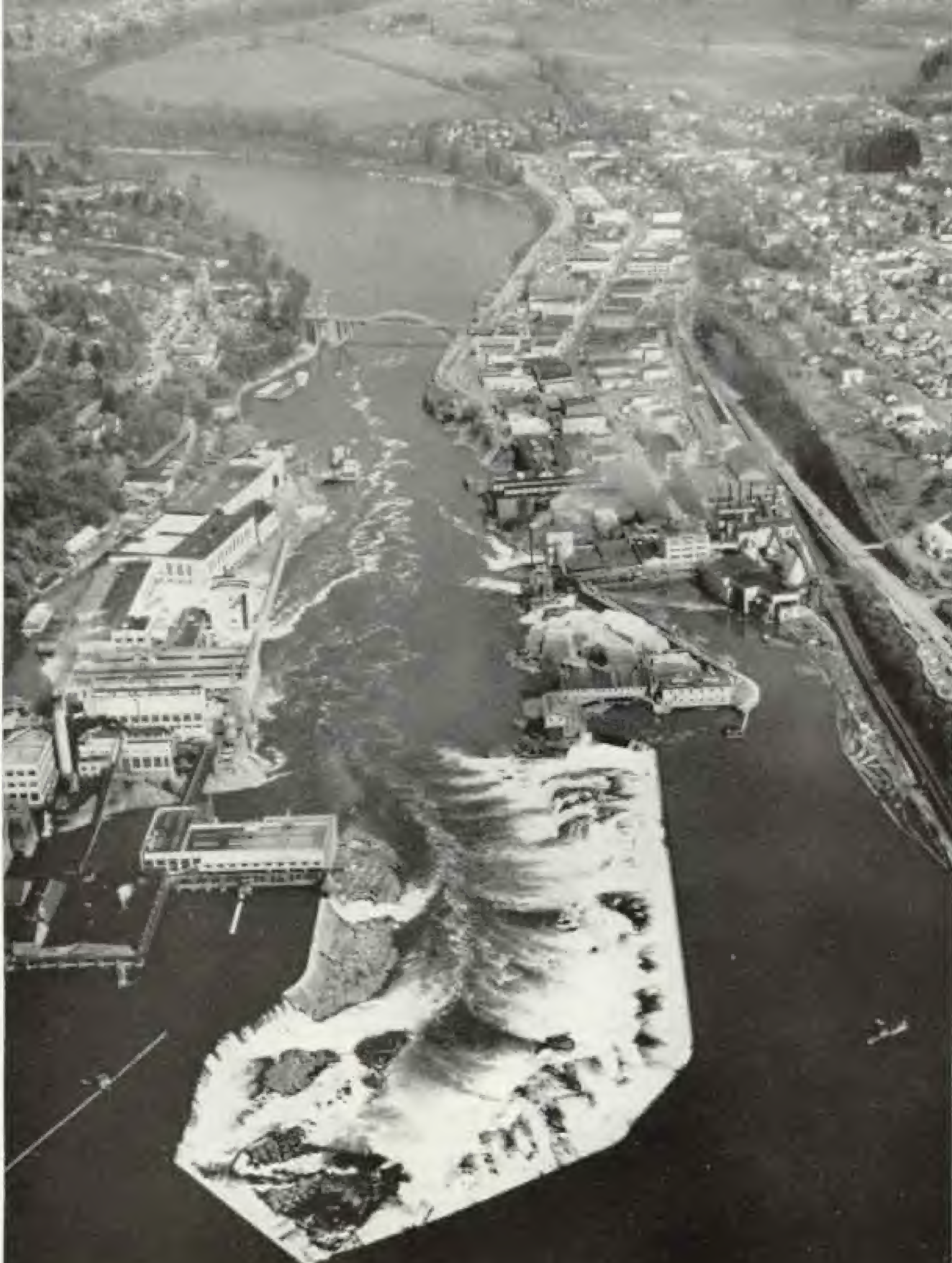
We skirted the shores of the chain of three lakes in Sun Lakes State Park and climbed by twisting switchbacks to the brink of Dry Falls, the 417-foot cliff nearly three miles wide over which the Columbia poured in prehistoric times.

By-passing Coulee City, our highway took us for nearly two miles along the top of the South Coulee Dam (newly rechristened Dry Falls Dam) of the equalizing reservoir. This long rock- and earth-fill structure seals the lower end of the reservoir and will keep irrigation water from inundating the town and wasting itself over Dry Falls. A similar dam seals the north end of the reservoir.

At times when power produced exceeds the demand, the excess is used to pump water into the equalizing reservoir; there it is stored until needed for irrigation.

Though the reservoir was not full, there was a considerable depth of water in part of it. Steamboat Rock, a landmark I had ridden past often in the 30's on the old State highway, stood now as a cliff-sided island in a rippling blue lake.

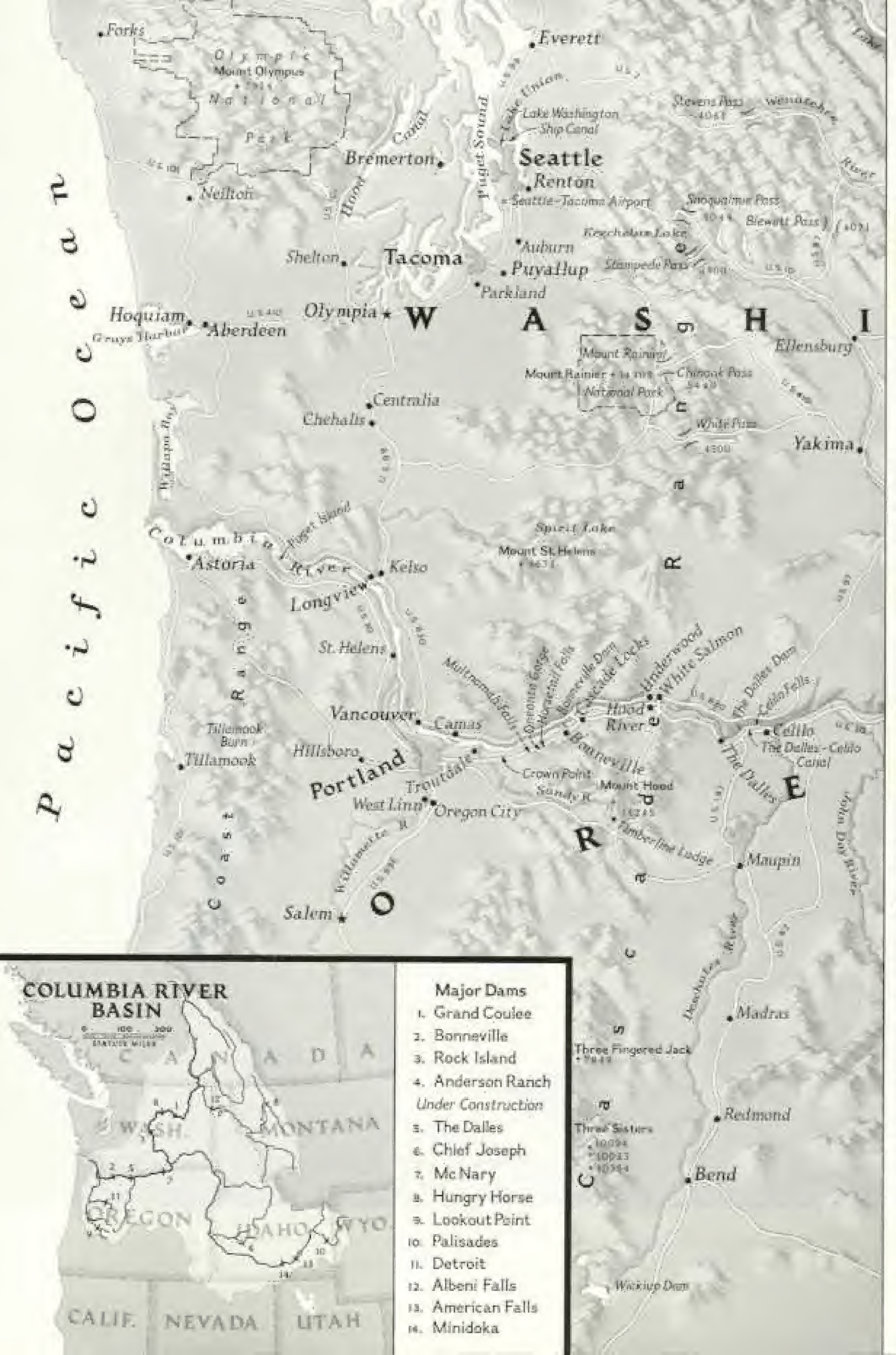
At the north end of the reservoir our way dipped steeply through the town of Grand

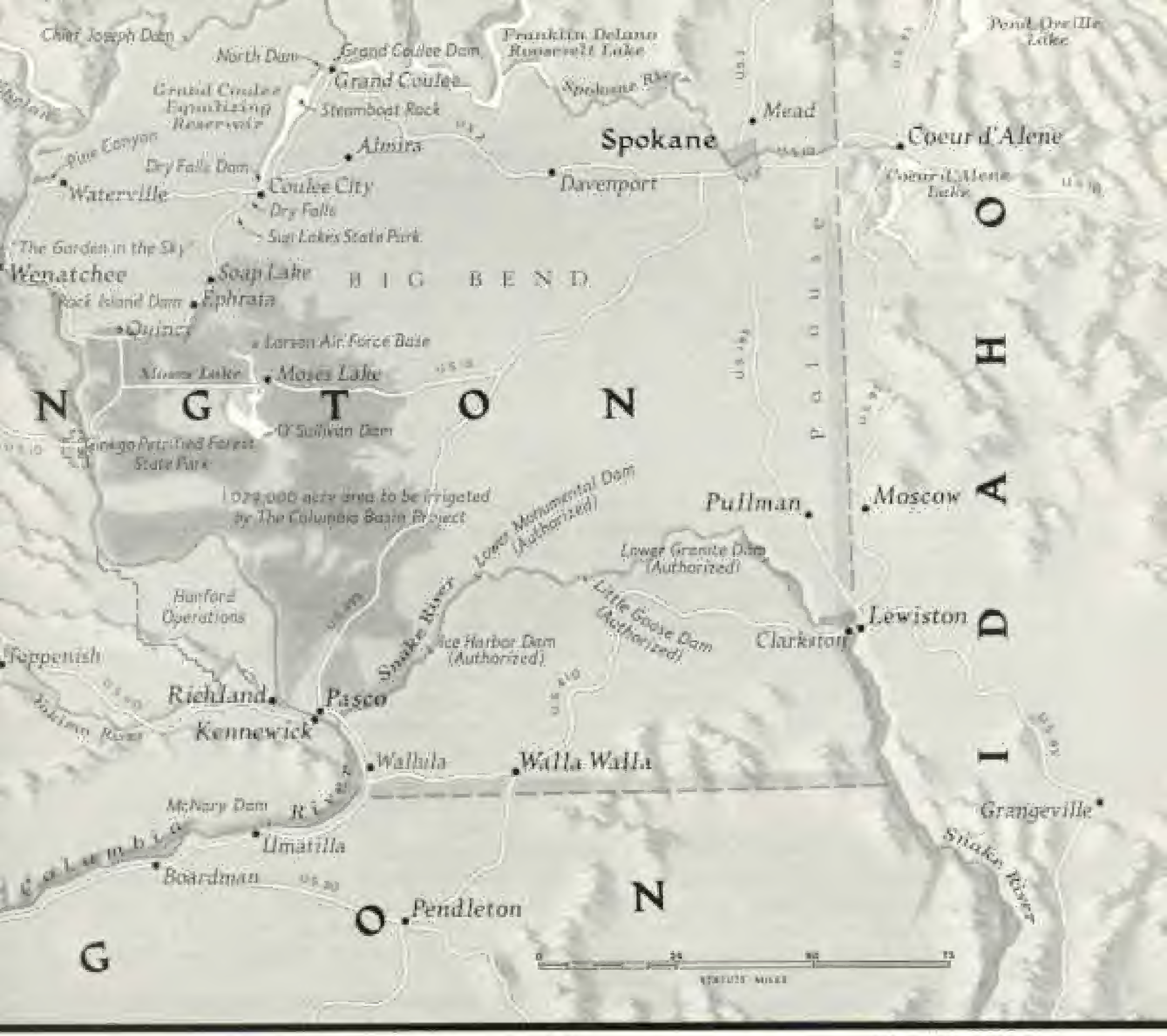


Ray Atkeson

**Cascading, the Willamette River Turns as White as the Paper Produced by Its Power**

Crown Zellerbach Corporation (pages 594, 596) manufactures newsprint at its West Linn, Oregon, plant (left). Oregon City stands across the stream.


Pacific Ocean
Forks
Olympic National Park
Mount Olympus
Everett
Lake Union
Lake Washington Ship Canal
Stevens Pass
Wenatchee River
Hood Canal
Puget Sound
Bremerton
Seattle
Renton
Seattle-Tacoma Airport
Snoqualmie Pass
Blewett Pass
Keechelus Lake
Neilton
Shelton
Tacoma
Auburn
Puyallup
Stampede Pass
Parkland
Hoquiam
Aberdeen
Grays Harbor
Olympia
WASHINGTON
Ellensburg
Mount Rainier National Park
Mount Rainier
Chinook Pass
White Pass
Yakima
Centralia
Chehalis
Willapa Bay
Spirit Lake
Mount St. Helens
Columbia River
Astoria
Kelso
Longview
St. Helens
Coast Range
Multnomah Falls
Bonneville Dam
Cascade Locks
Underwood
White Salmon
The Dalles Dam
Celilo Falls
Hood River
Vancouver
Camas
Tillamook Burn
Tillamook
Hillsboro
Portland
Troutdale
Bonneville
Crown Point
Sandy R.
Mount Hood
Celilo
The Dalles-Celilo Canal
The Dalles
West Linn
Oregon City
Timberline Lodge
Willamette R.
Maupin
John Day River
OREGON
Cascade Range
Salem
Deschutes River
Madras
Three Fingered Jack
Three Sisters
Redmond
Bend
Wickiup Dam
COLUMBIA RIVER BASIN
STATUTE MILES
CANADA
WASH.
MONTANA
OREGON
IDAHO
WYO.
CALIF.
NEVADA
UTAH
Major Dams
1. Grand Coulee
2. Bonneville
3. Rock Island
4. Anderson Ranch
Under Construction
5. The Dalles
6. Chief Joseph
7. Mc Nary
8. Hungry Horse
9. Lookout Point
10. Palisades
11. Detroit
12. Albeni Falls
13. American Falls
14. Minidoka


Chief Joseph Dam
North Dam
Grand Coulee Dam
Grand Coulee
Franklin Delano Roosevelt Lake
Grand Coulee Equalizing Reservoir
Steamboat Rock
Spokane River
Pend Oreille Lake
Pine Canyon
Dry Falls Dam
Almira
Waterville
Coulee City
Dry Falls
Sun Lakes State Park
Davenport
Spokane
Mead
Coeur d'Alene
Coeur d'Alene Lake
"The Garden in the Sky"
Wenatchee
Soap Lake
BIG BEND
Rock Island Dam
Ephrata
Quincy
Larson Air Force Base
Moses Lake
Moses Lake
WASHINGTON
O'Sullivan Dam
Ginkgo Petrified Forest State Park
1,029,000 acre area to be irrigated by The Columbia Basin Project
Lower Monumental Dam (Authorized)
Palouse
Pullman
Moscow
IDAHO
Lower Granite Dam (Authorized)
Hanford Operations
Snake River
Little Goose Dam (Authorized)
Lewiston
Clarkston
Ice Harbor Dam (Authorized)
Toppenish
Yakima River
Richland
Pasco
Kennewick
Wallula
Walla Walla
McNary Dam
Columbia River
Umatilla
Boardman
Grangeville
Snake River
OREGON
Pendleton
0 25 50 75
STATUTE MILES

A National Geographic Map

Columbia, North America's Fourth River in Volume, Leads in Power Production

Fourteen major dams are in operation or under construction (inset). Shaded area shows the million-acre tract, larger than Rhode Island, to be irrigated by Grand Coulee. Of all the rivers on this continent, only the Mississippi, the Mackenzie, and the St. Lawrence surpass the Columbia in flow.

Coulee to the foot of mighty Grand Coulee Dam. An official guide escorted us up to the highway which runs across the top of the towering structure.

Stepping to the rail on the spillway side, I looked with a shudder down the steep wall to the white spray raging a dizzy distance below me. Water gushing 14 feet deep from 11 drum gates was a pale emerald so clear that I could see through it tiny discolorations on the concrete face of the dam. I crossed the road and looked over the opposite rail into the still depths of Roosevelt Lake.

### Biggest Concrete Structure on Earth

"How deep is it?" I asked.

"About 480 feet," the guide replied. "The river is high now. Sometimes in winter it gets so low that no water goes over the spillways. Then all of it passes through the turbines. The overflow you just watched spouting from the drum gates is going to waste. This summer the plant is peaking at two million and a quarter kilowatts."

Although not so high as Hoover Dam (726 feet) on the Colorado River or so long as Garrison Dam (2¼ miles) on the Missouri in North Dakota, Grand Coulee Dam is the largest concrete structure in the world. It is 4,173 feet long and 550 feet high from the granite bedrock on which it rests to the 30-foot-wide highway that crosses its top. Containing 10,230,776 cubic yards of concrete and weighing about 22 million tons, it is a mass that even the Columbia in spate cannot tip over or slide on its base (page 603).

Within the dam are miles of inspection galleries and shafts. The spillway—half as wide and twice as high as Niagara Falls—is flanked by two powerhouses. At the west end behind the main structure is a wing dam, the base for the pumping plant.

We went into one of the roadside towers and took an elevator to the bottom to watch one of the 18 giant turbines turning a generator. For each generator there is a group of three transformers outside the powerhouse. These transformers take energy from the generator at low voltage and deliver it to outgoing lines multiplied nearly 17 times. Eventually the power goes by long-distance transmission lines to the Bonneville Power Administration, which sells the entire output from both Bonneville and Grand Coulee.

An elevator in a tower near the opposite end of the dam took us to the depths of the pumping plant where two of the huge pumps were in action. Although discharge pipes for all 12 pumps are in place on the hillside above the dam, only six are now being installed. The original intention was to irrigate a million acres in the Big Bend wheat country, but inasmuch as some of this area is already producing bumper crops under dry farming, that part of the plan has been deferred for the present. The two pumps I saw in action and four others being built are sufficient for the initial stage.

### One Pump Would Supply Chicago

Each operated by a 65,000-horsepower motor, these pumps take water from 80 feet below the surface of Roosevelt Lake and deliver it into a feeder canal 280 feet above. At full power each pump lifts a billion gallons of water every 24 hours—an amount which would be more than enough to supply the needs of the city of Chicago.

We drove up the hill above the dam to the headworks of the feeder canal. Bursting from the mouths of two discharge pipes 12 feet in diameter, constant streams of water went roaring down the canal, slightly less than two miles long, to plunge into the equalizing reservoir.

"We could fill it fast," our guide said, "but it has been dry for thousands of years, since the Columbia River deserted it, and we want to give the floor time to become thoroughly soaked and waterproof."

Besides the Grand Coulee Dam pumping plant, the Columbia Basin irrigation project includes two smaller ones lifting water 167 feet directly from the river to irrigate 5,500 acres near Pasco, Washington. These pumps will be salvaged when the gravity system is completed.

As a proving ground for the main system, the Pasco project has been valuable. Forty-five young farmers started working irrigated land there in 1948. In 1950 their average gross income was $123 to the acre.

Pasco, which grew from less than 4,000 population in 1940 to more than 10,000 in 1950, was celebrating the Grand Coulee opening. It is 130 miles from the big dam and would have waited 10 years for water had not the Bureau of Reclamation installed the small pumps and located experiment farms there three years ago.

For carrying life-giving water to the main irrigation project (it is approximately 80 miles from north to south and 60 miles from east to west) a stupendous network of canals, earth-fill dams, tunnels, and siphons is required. The four subsidiary dams measure more than six miles in length. The eight principal canals total nearly 500 miles. There are seven miles of tunnels and 28 miles of siphons.

At my comment on the clarity of the water I had seen at the spillway and in the feeder canal, the guide told me: "The mountain rivers that feed the Columbia flow through lakes where the sediment settles out of them. For this reason, sedimentation of Lake Roosevelt is no problem. And because the water is so pure, it causes very little wear on the pumps."

At present no land is open for homesteading in the project. About 90 percent of the area is privately owned. Farms up to 80 acres of first-grade land can be bought at low prices (the Government prohibits speculation), but the prospective purchaser must add to his investment the cost of irrigation and annual water rent.

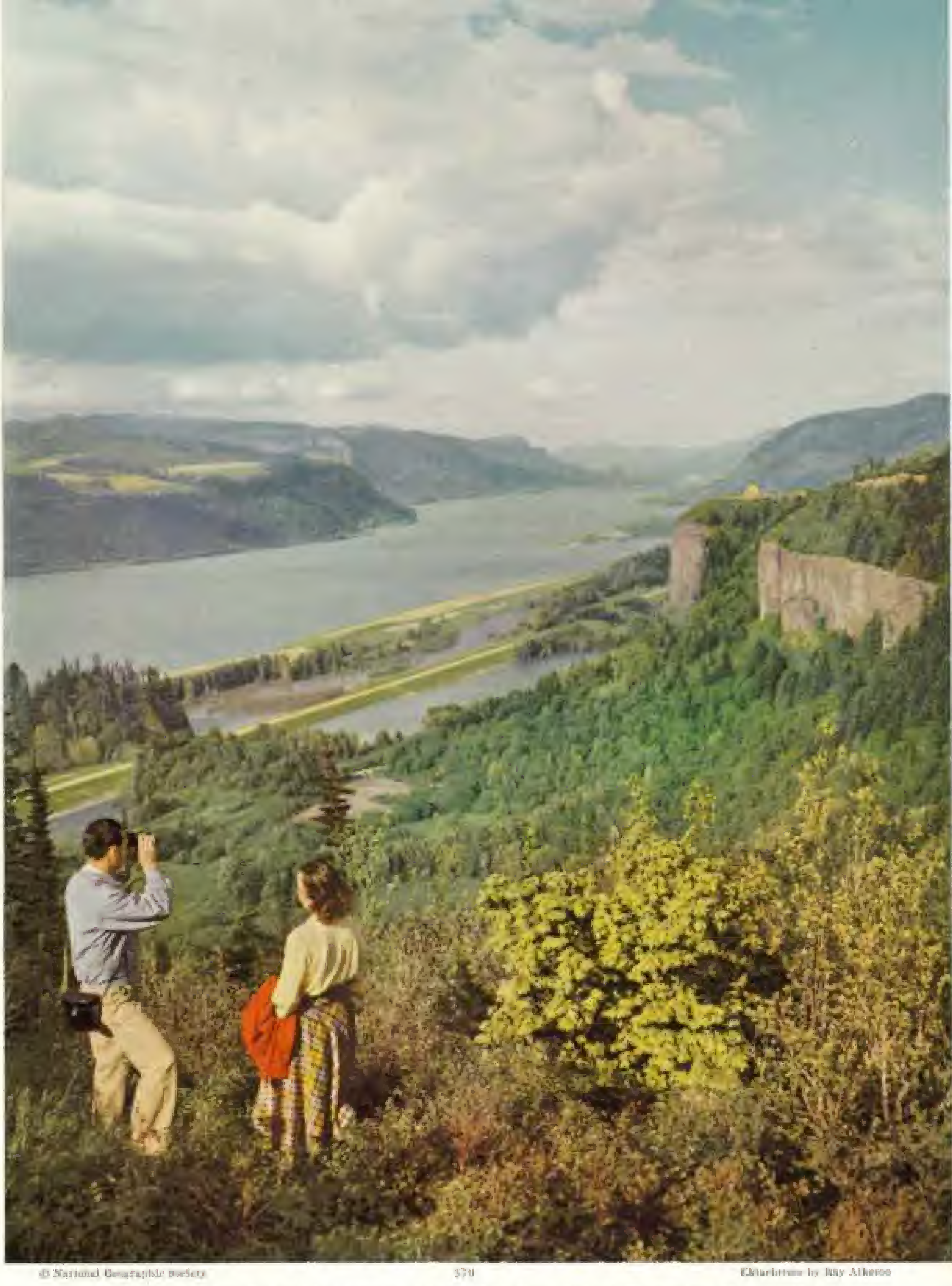
For experienced farmers, irrigable land in the Columbia Basin represents excellent opportunity, but it is not cheap, and buying it means almost certain ruin for tyros in agriculture.

Dams already in operation and under construction in the Columbia Basin will produce more than 8,000,000 kilowatts of power (map, pages 576-7). Additional ones authorized by the Federal Government and scheduled by private companies will bring the amount to nearly 13,000,000. As markets for power increase, the authorized dams will be constructed and new irrigation projects will be opened. There is an estimated minimum of 30 million kilowatts of potential power in the Columbia River and its tributaries.

### To an Apple Capital of the World

If the authorized dams on the Snake River in eastern Washington (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) are completed, light-draft vessels will be able to carry goods all the way from Portland, Oregon, to Lewiston, Idaho.

Charlie, Tony, and I drove back to Wenatchee from Grand Coulee by a route I



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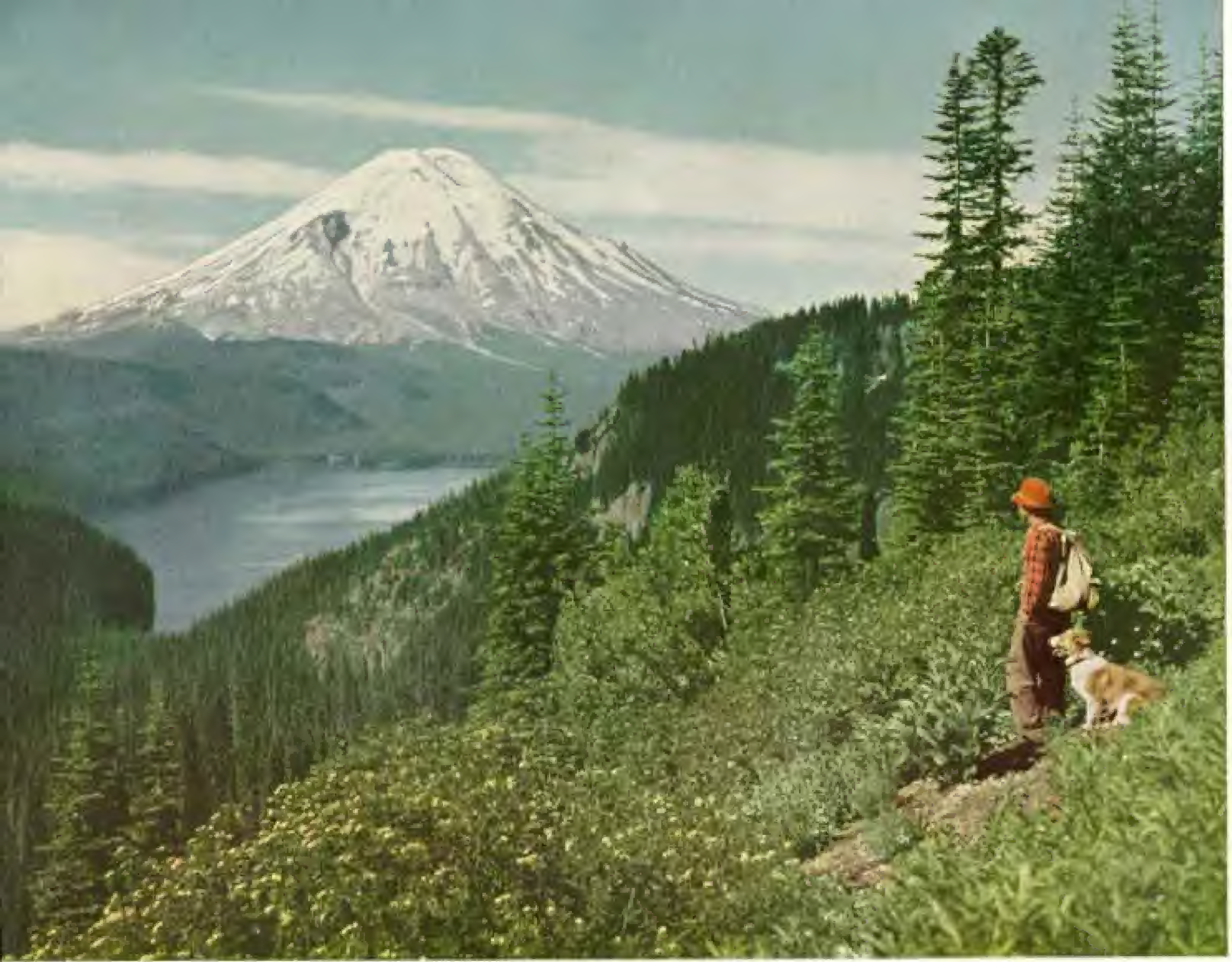
Ektachrome by Ray Atkeson

**Majestically the Columbia Sweeps Along, 725 Feet below Towering Crown Point**

Famous Columbia River Highway swings out to Vista House atop the basalt promontory (right); thence to a mid-air ledge on the cliffside. In 17 miles it passes nine spectacular cataracts gushing hundreds of feet above it. Horsetail Falls drops so close that spray drifts across pavement. This couple, having left the old road, looks down on the new Columbia highway.



## Mount St. Helens and Spirit Lake Sit in Virgin Wilderness

Paradise for hikers and sportsmen, this rugged area in the high Cascade Range of southwestern Washington remains almost as Nature made it.

Mount St. Helens, the snowy cone of an extinct volcano, reaches an altitude of 9,671 feet. An eruption about 1840, scientists believe, cast up white pumice which forms the bottom of crystal-clear Spirit Lake. Indian legend, inspired by weird noises heard in the forest, peopled the region with ghosts of departed warriors; hence the name.

## ▾ Indians Net Celilo Salmon

Perched on flimsy platforms overhanging the Columbia where it rages in a 70-foot drop, they capture the big chinook struggling upstream. An old treaty between their ancestors and the United States Government guarantees them exclusive rights to fish here.

Indians land their catches with dip nets on long poles. Counters from 1947 to 1951 ascertained that, out of every 100 salmon passing Bonneville Dam 62 miles downstream, the Indians took 27.

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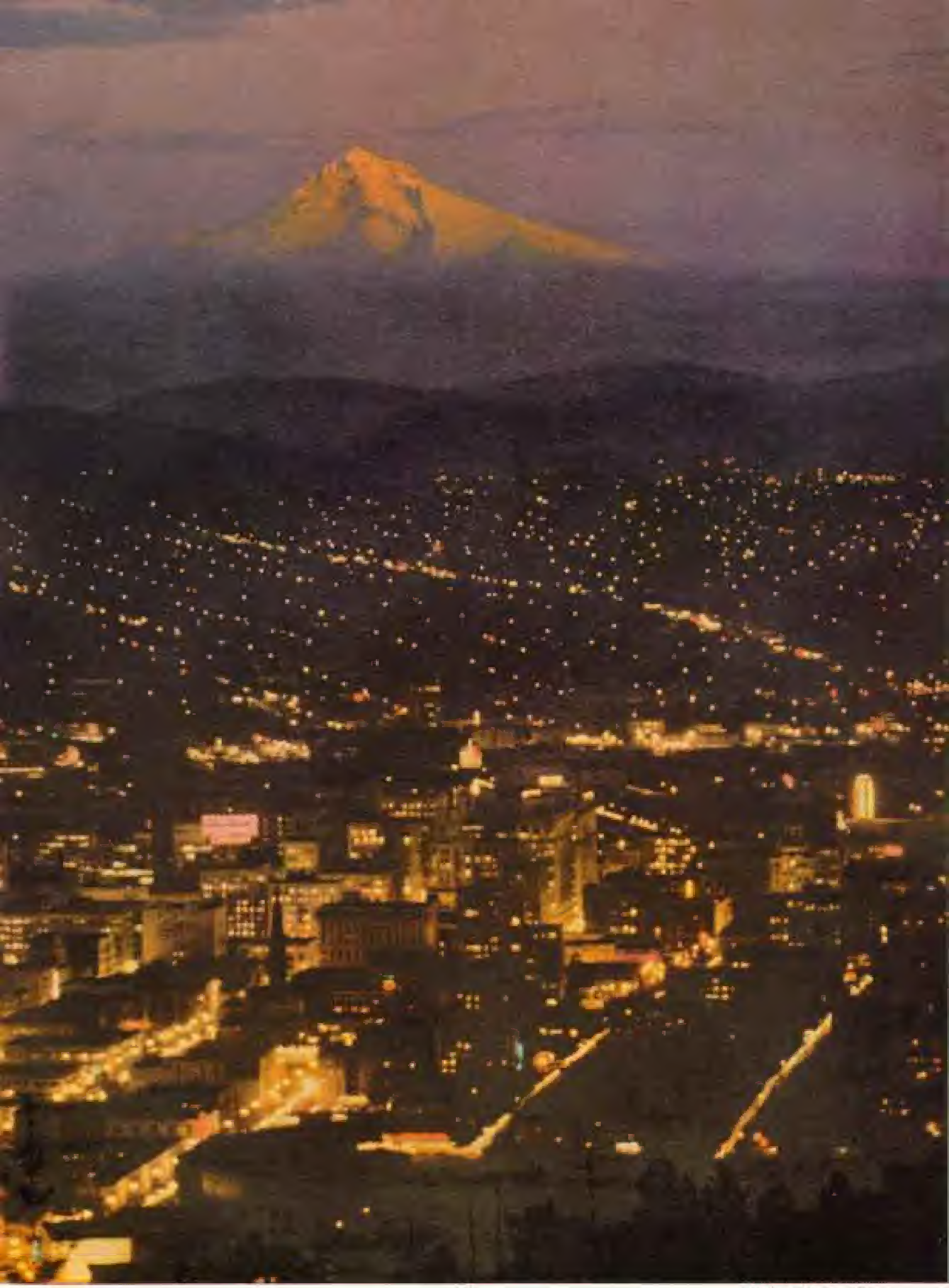
**Portland's Myriad Lights Bloom Out to Dispel the Gathering Darkness**

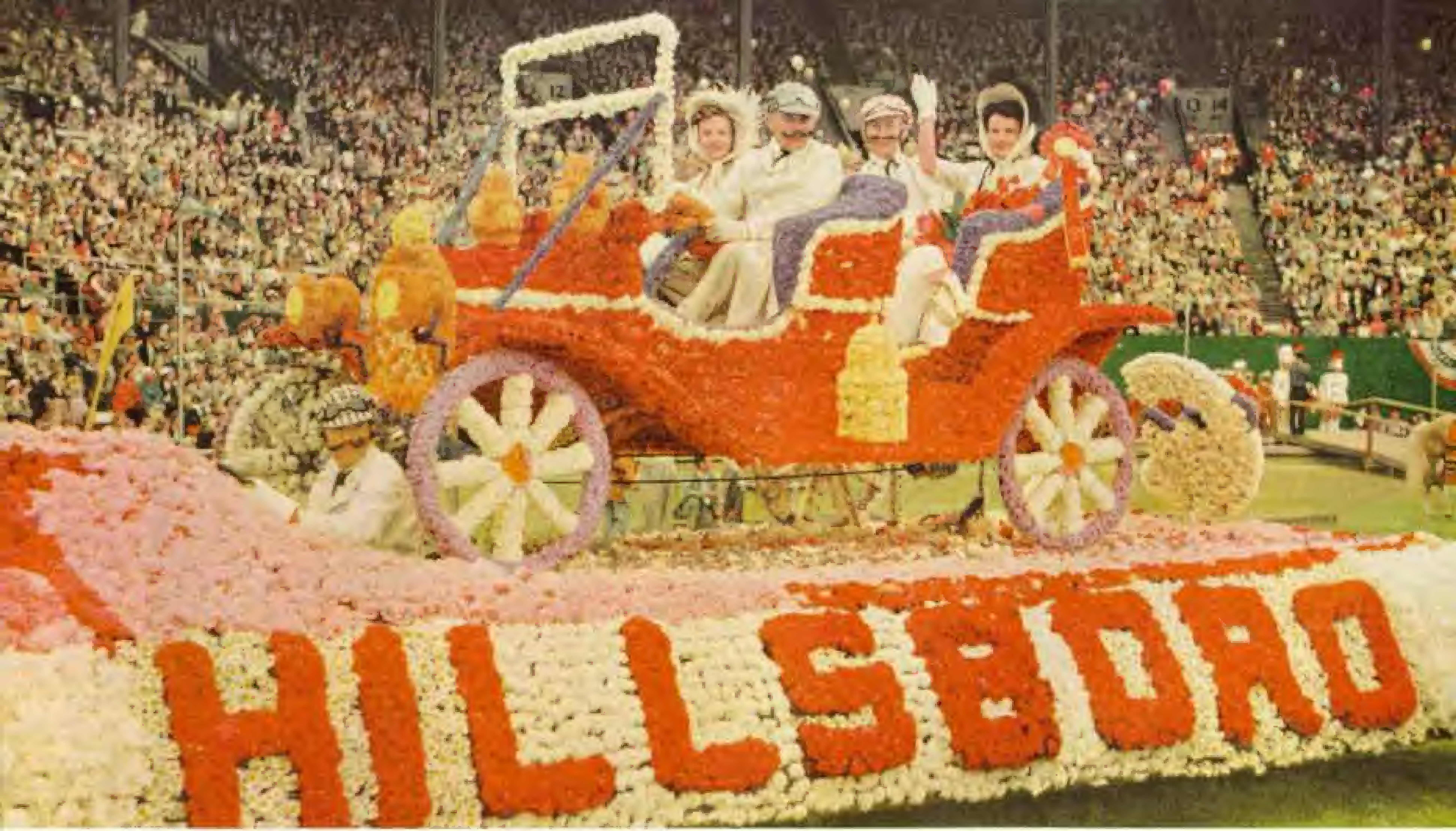
The city's business center lies on the floor of Willamette Valley, which is surrounded by ever-mounting hills. Many homes are built with picture windows framing the mountains.



Kodachrome by Ray Atkeson

Mount Hood's Snowy Crown Glows in the Westering Sun's Last Rays

Evening shadows first engulf the lowlands, then rise gradually to the heights, until the gleaming peak seems to float like a disembodied wraith brooding high above its blacked-out forest slopes.



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Hillsboro's Entry in Portland's Annual Rose Festival Revives Motordom's Pioneering Days

Some 30,000 spectators in Multnomah Civic Stadium and 400,000 more on the streets watched this float and 44 competitors take part in a two-hour parade. Opposite: A flower-bordered lawn in White Salmon, Washington, looks across the Columbia at Hood River, Oregon, and Mount Hood.

Kodachrome by Ray Atkeson

had not traveled before. From the dam we went south to Almira and thence across the Big Bend wheat country to Waterville.

The country near Coulee City was of course still desert, but up on the plateaus green fields of wheat rippled to the horizon. In Waterville it was pleasant to drive along shady streets. We had seen few trees on our trips elsewhere.

Beyond Waterville the highway enters Pine Canyon and descends by switchbacks 2,000 feet in a few miles through magnificent forests of yellow pine. Views from some of the hairpin turns were glorious.

### Orchards Crowd the Countryside

Apple-blossom time was over in the Wenatchee country, and tiny fruit was appearing on the trees that crowd to the roadside along the Columbia River. Everywhere sprinklers were going. The land by the river was fresh and green, though hills in the distance loomed forbiddingly brown.

In Wenatchee apple growing is more than a science; it is a fine art. Orchards occupy every available space for miles along the Columbia and Wenatchee Rivers. When the city holds its annual Apple Blossom Festival in early May, the whole countryside is a fragrant fairyland.

Apple trees were first planted at Wenatchee in 1872, but it was not until after the turn of the century that pump irrigation made them thrive. Now the city ships out every fall some 20,000 carloads of Delicious, Winesap, Stayman, and Jonathan apples. As we drove through the orchards, we saw cherries ripening here and there, and some other fruits, but apple trees far outnumbered all the rest.

Every scientific method of improving quality and yield of fruit is practiced at Wenatchee. In fall the trees are carefully pruned, and the cuttings are chopped and worked into the soil as mulch. Spraying is done with power machines, airplanes, and helicopters. After years of experiments a new Golden Delicious apple with a spicier flavor than other types has been developed.

On a high, rocky hill overlooking the confluence of the Wenatchee and Columbia Rivers is the "Garden in the Sky," a remarkable 5-acre rock garden developed as a hobby by Herman Ohme and his family. Mr. Ohme hauled soil to the top of this 1,250-foot promontory and planted in it flowering mosses and other low-growing plants. Interspersed among the flower beds are 14 varieties of evergreen trees, specimens of kinds that grow in the Pacific Northwest.

To keep the garden growing, the owner pumps irrigation water up the height. A rock-built lookout affords a panoramic view of the sparkling rivers, the clean little city, and the great orchard valley.

"One day in Apple Blossom Week we had 18,000 visitors up here," Mr. Ohme told me.

The garden is a blaze of color from early spring to late fall. Seen from the highway below the hill, it looks like an artist's palette splashed with all the hues of the rainbow.

Wenatchee has only about 13,000 population within the city limits, but it serves a thickly settled suburban area. The late Rufus Woods's *Wenatchee Daily World* had a daily door-to-door delivery circulation of 17,000 when the town had fewer than 12,000 people.

Like Yakima, Wenatchee proves the fertility of the dry Columbia Basin under irrigation. It is hard to believe that this orchard city was sagebrush desert little more than 50 years ago.

We drove to Seattle over beautiful Stevens Pass, one of five highway passes crossing the Cascades in Washington between the Columbia Basin and the Pacific slope.

Portland, metropolis of the Columbia Basin, was my headquarters while I was making surveys of the lower reaches of the Columbia River. In November, 1951, I was fortunate in having for a traveling companion V. A. (Mac) McNeil, who had gone all over Oregon with me in 1945 when I was gathering material for an article on the State.*

### Columbia Gorge Revisited

One bright morning we drove out of Portland on the famous Columbia River Highway, skirted the Sandy River, where Portland goes fishing during the spring smelt run, and were soon in familiar Columbia Gorge (pages 579 and 602). The highway winds along for miles halfway up the forested sides of basalt cliffs overlooking the Columbia River.

Vista House atop Crown Point lured us to pause briefly for a view of the majestic Columbia from the 725-foot promontory. Then on we went past waterfalls gushing from the heights above us: Multnomah Falls, dropping 620 feet into a tree-encircled basin near the road; Oneonta Gorge, cooled by constant breezes stirred by the lofty cataract that feeds its foaming creek; Horsetail Falls, casting spray across our road. We

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← Idyllic Oneonta Gorge Invites the Traveler to Cool Off

This enchanting spot near the Columbia River Highway is a favorite with picnickers. Trout, which used to abound, have dwindled, but the beauty of cliff walls clothed with lichens, ferns, and golden mimulus remains unchanged. A lacy waterfall at the head of the gorge stirs air-conditioning breezes.

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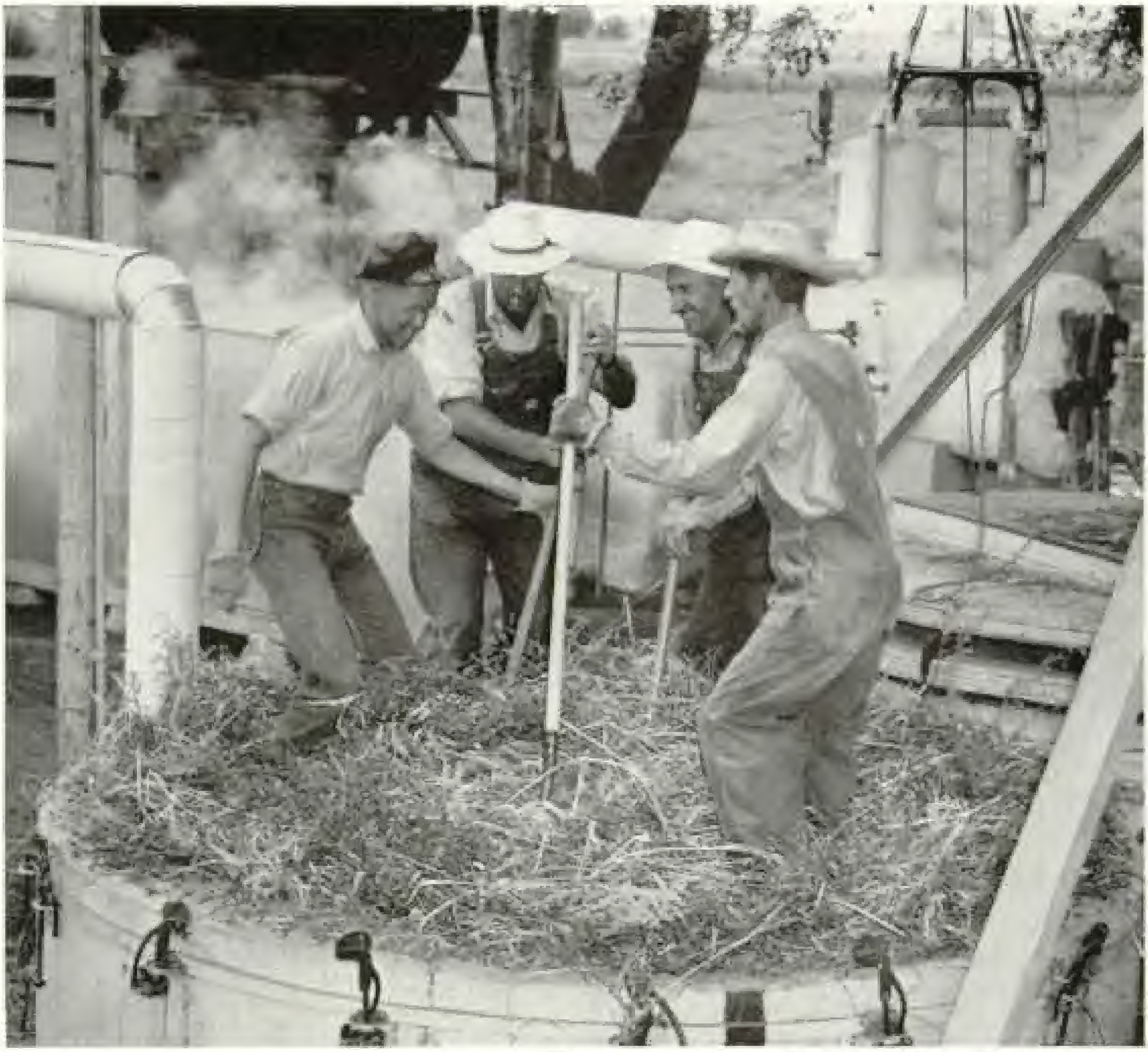
* See "Oregon Finds New Riches," by Leo A. Borah, NATIONAL GEOGRAPHIC MAGAZINE, December, 1945.



Rasmussen, U. S. Bureau of Reclamation

**Kennewick, Washington, Farmers Tamp Mint Hay into a Distilling Vat**

Mint has become an important crop in Washington and Oregon. Some mint is grown on Puget Island in the Columbia, 20 miles east of Astoria. Safeguarding the flavor, growers take the utmost pains to keep fields clear of weeds. Steam will extract the oil from this hay; cooling vessels will condense it.

passed nine graceful waterfalls in 17 miles on this enchanted highway.

We did not stop at Bonneville Dam, for at that time visitors were prohibited because of security regulations (pages 598-9).

"How is the salmon count in the fishways around the dam?" I asked.

This barrier, I was told, has had no material effect on the salmon runs—proof that dams are not causing complete ruin of fishing.

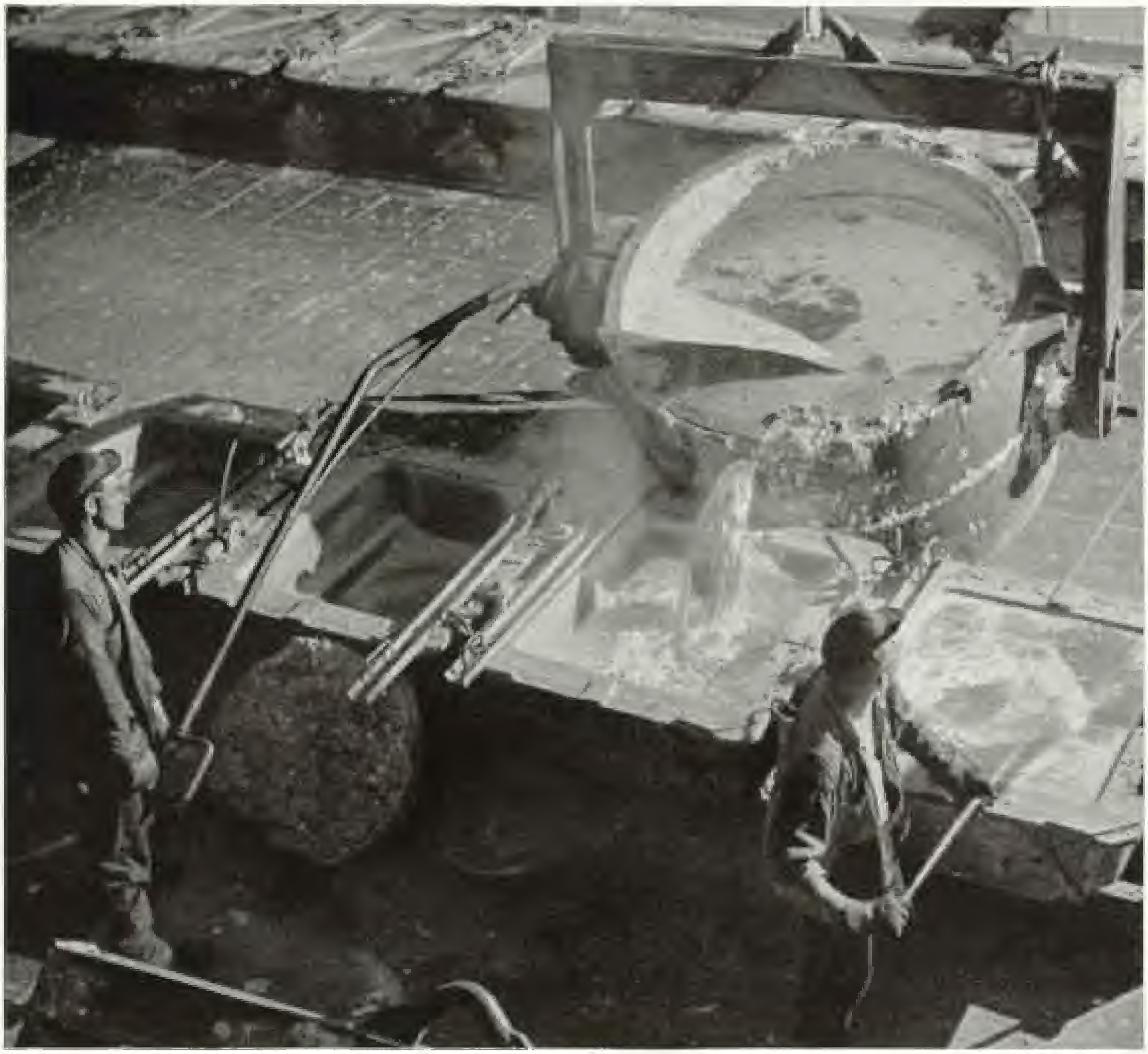
Many fish fall victim to the crowds of Indians who have had exclusive treaty rights to take salmon at Celilo Falls (page 581). They capture an estimated 27 out of every 100 fish that get by Bonneville Dam.

As we passed Boardman, built on the homestead once farmed by Samuel H. Boardman, former State parks superintendent, we raised our hats out of deference to Oregon's Grand Old Man. Mr. Boardman has created 181 parks and picnic areas, kept advertisers from obscuring views with signboards, and made Oregon highways lanes of beauty through unspoiled scenery.

"How Sam loves this gorge," Mac said. "He has parks and picnic spots all along it. Remember the day he led us up over a pile of sharp-edged rocks to see a prehistoric Indian fort? He was stepping out sure-footed as a goat, and you and I were crawling."

### Walla Walla, Place of Many Waters

A few miles above Umatilla, Army engineers were building enormous McNary Dam. The chief engineer showed us over the project. At that time the tetrahedrons, huge blocks of concrete, were being set in place by cranes to divert the flow of the river. Around this



Dean Brennels

**Molten Aluminum Pours into Molds for Casting into 1,000-pound Pigs**

Just as iron ore goes to coal, so does refined bauxite move to cheap power for reduction. Columbia Basin's abundant electricity makes it economical to move alumina powder from Louisiana to this Mead, Washington, plant. Here the Kaiser Aluminum & Chemical Corporation reduces it to metal (page 590).

dam, as at Bonneville, fishways and electrically operated fish locks will be constructed.

That evening we had dinner in Walla Walla, Washington, center of one of the richest vegetable farming districts in the world. Alfred McVay, public relations man, had gathered irrigation and power experts to discuss Columbia Basin development.

Walla Walla, 270 miles inland, is strongly in favor of immediate construction of Ice Harbor Dam and eventually the three other Snake River dams authorized by Congress. If these dams are built, light-draft ships can ply the river north of Walla Walla and carry produce and grain to world markets.

Near Walla Walla in 1847 occurred the famous Whitman massacre, when Indians killed the missionary Marcus Whitman and his colleagues. Whitman College, founded by the Reverend ("Father") Cushing Eells, Congregationalist missionary, in memory of his friend, is one of the distinguished small colleges of the West. It has an average enrollment of some 800 students.

In Walla Walla, now grown to more than 24,000 population, are some of the most modern vegetable canneries and quick-freezing plants in the West. Asparagus and peas are leading exports.

Though the country around the city is well watered (Walla Walla means "Many Waters"), considerable irrigation is practiced. The lush fields produce bountifully, and the district is like a vast garden.

Talk of river transportation at Walla Walla brought to mind exciting tales of early steamboat days on the Columbia. In the middle part of the 19th century when Oregon settlers

were coming into the Willamette Valley, many of them avoided toilsome overland routes past Mount Hood by loading their goods on river steamers and portaging around Umatilla, Celilo, and Cascade rapids.

Nowadays numerous tugboats drawing big barges ply the Columbia between Portland and Umatilla. They pass Celilo rapids by The Dalles-Celilo Canal and Locks. When the McNary Dam is finished, river traffic will go around it by similar locks.

Materials for building the new dam were being brought to Umatilla in barges at the time of our visit. On the return trip to Portland, the hulls which had carried cement to the dam were loaded with wheat. Tall elevators at the riverside filled the holds by long spouts swung out over the water. Oil barges were taken downstream empty.

River transportation, flood control, and reclamation of desert lands, though economically important, cannot alone justify construction of the tremendous system of dams in the Columbia Basin. Production of hydroelectric power to satisfy the phenomenally growing demand of new industries in the Pacific Northwest is a major reason.

### Six Aluminum Plants Now Operating

When I was in Oregon in 1945, I had learned about large deposits of laterite, low-grade aluminum-bearing ore, near Portland.

Although the aluminum companies have acquired land and tested the laterite beds, they have done no actual mining there. The alumina, a white, granular powder, now being used in six reduction plants in Oregon and Washington is shipped from bauxite-refining plants in Arkansas, Alabama, Louisiana, and elsewhere. Eventually the laterite may be used, but for the present imported and domestic bauxite is cheaper.

In 1939 the Aluminum Company of America built a huge plant at Vancouver, Washington, just across the Columbia from Portland. In 1941 the Reynolds Metals Company began reduction at Longview, Washington, 40 miles downstream. To meet war needs, the United States built a third plant at Troutdale, Oregon, which it subsequently sold to Reynolds.

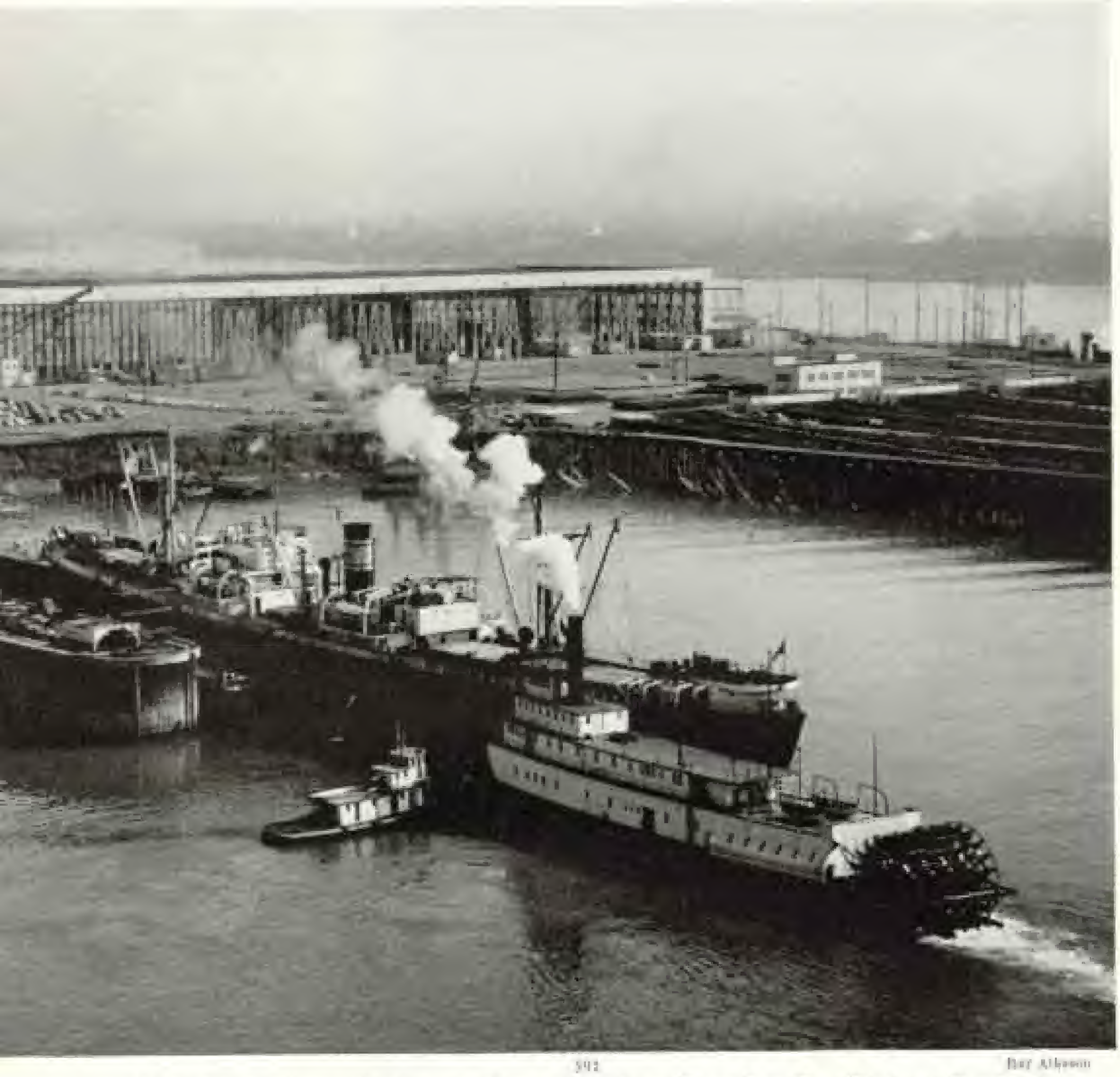
From the Government the Kaiser Aluminum & Chemical Corporation purchased two other wartime reduction plants, one at Mead, near Spokane, and one at Tacoma. The Aluminum Company of America has completed a sixth plant at Rock Island Dam near Wenatchee.

At present these Pacific Northwest reduction plants have about 40 percent of the Nation's capacity to produce new aluminum, material vital to the national defense. The great Boeing airplane factory at Seattle is their biggest Northwest customer. By far the greater part of the output, however, goes to eastern markets.

Mac and I went through the Alcoa mills at Vancouver to watch alumina pass through intricate processes and emerge as pig aluminum. It is taken in solution in a molten cryolite bath, and an electric current is passed through it to reduce it to metal—aluminum.

Aluminum melts at about 1,300° Fahrenheit, a temperature considerably lower than that required to melt steel. Cooling, it is cast into pigs and then into ingots.

From the reduction plants we walked into a rod and bar mill where the ingots were converted by machines into aluminum cables with cores of fine steel wire. I had seen many such cables on the long-distance transmission lines carrying power from Grand Coulee. They are highly efficient conductors of electricity. The steel cores strengthen the cables and prevent sagging and breaking.



Ray Atkeson

**Pushed by a Stern-wheeler, an Ocean Freighter Goes into Dry Dock at Portland**

The cargo ship, which lost its rudder in a storm at sea, is helped into the Swan Island repair basin in the Willamette River by the *Portland*, a vessel modeled after Mississippi River steamboats (page 611).

In the office a company official explained to us some of the things we had seen.

"It takes four to six pounds of bauxite," he said, "to make two pounds of alumina, and from two pounds of alumina we get one pound of aluminum. In making a pound of aluminum we use about three-quarters of a pound of carbon electrode and 10 kilowatt-hours of electricity.

"Thanks to the Columbia, the electric power so important in making aluminum is relatively cheap. We get most of ours from the Bonneville Power Administration."

Vancouver, oldest settlement in Washington, started in 1824 as a Hudson's Bay Company trading post under the famous Dr. John McLoughlin as factor. The following year old Fort Vancouver was built. This became a part of a United States defense system in 1848, and it was not deactivated until 1947. The historic barracks and grounds are now a well-kept city park.

Vancouver was incorporated as a town in 1857. Today it is one of the fastest-growing cities in the United States. It had a population of only 18,788 in 1940. In 1950 the census recorded 41,664 within the city limits.

### Longview, a City Made to Order

At the end of World War II, H. J. Kaiser's Vancouver shipyards closed down, but expansion of the Alcoa mills, completion in 1949 of the Carborundum Company plant, and establishment of a score of smaller concerns gave employment to most of the laborers thrown out of shipbuilding jobs.

Ray Atkeson

**Miss Yakima Packs Gift Apples**

Sorting the red Delicious and the newer Golden variety, this beauty makes up Christmas boxes. Yakima County, the Nation's leading apple producer, is famous also for peaches, pears, plums, apricots, cherries, grapes, and hops.

Longview, the planned city built by the late R. A. Long of Long-Bell Lumber Company in 1923-24 on land reclaimed from a swamp, leaped into being like Minerva from the brow of Jove. Though uninhabited wasteland 29 years ago, it now has more than 20,000 population.

In Longview two leading manufacturing concerns are the Long-Bell Lumber Company and the Weyerhaeuser Timber Company.

Long-Bell makes finished lumber, manufactures knockdown furniture for wholesalers, turns out creosoted poles and piling, and produces hardboard from waste wood.

Weyerhaeuser, the world's largest single integrated plant making forest products, has, besides its sawmills, two pulp mills (one for fine papers and one for kraft), a plywood plant, and factories producing valuable products from bark and sawdust.

Mac and I went through both plants. In the 560-acre wooded grounds of the Long-Bell Company we were surprised to see a score of wild deer browsing in the very shadow of the creosoting mill. A company official told us they were descendants of a pair given to a watchman several years ago.

Long-Bell wastes nothing. Even the once-despised slabwood was being shredded and cold-pressed into hardboard.

On the Weyerhaeuser property near by, I saw bark being ground into powders to be bagged and sold as basic elements for plastics, adhesives, insecticides, and mud stabilizers useful in oil-well drilling. Another department was making fireplace "logs" from sawdust.

Somewhat terrifying to watch was a hydraulic barker tearing the thick outer coating off gigantic fir logs with water jets forced by 1,300 to 1,500 pounds' pressure to the square inch (page 597).

"If a man should fall into those jets, all the flesh would be stripped from his bones in ten seconds," our guide told us. Of course the company's rigid safety precautions prevent such an accident.

Down on the water front, giant railroad cranes of the port of Longview were unloading into the Columbia River logs brought from distant forests on flatcars. Bundles of a dozen or more big timbers bound together by steel bands were swung over the dockside and dropped intact into the water. They were bound together because some of the logs were too heavy to float alone and because more could be carried this way than with an ordinary surface raft. The booms being towed to the sawmills looked like fleets of high-piled barges.

### Astoria and the Fishing Industry

To obtain firsthand information about the fisheries which for generations have been a major factor in Pacific Northwest economy, Mac and I visited Astoria, the town founded by the John Jacob Astor party in 1811 near the mouth of the Columbia River. It was the first permanent settlement in Oregon.

Today Astoria has a 20-million-dollar-a-year fishing business and ships wheat and flour. In 1951 its harbor received calls from 192 ocean-going ships.

Annually in late summer and fall millions of salmon come from the Pacific Ocean into the Columbia River and fight their way upstream to the places where they were spawned two to four, sometimes six, years earlier. They do not eat after they leave salt water, but will strike viciously at shiny objects in their path. To catch them, anglers use spoon hooks without bait. Commercial fishermen descend upon the hordes of migrating fish with nets and take enormous toll.

Unlike the Atlantic salmon, these anadromous wanderers of the Pacific are destined to spawn and die. They return to the same streams of their birth at the end of their life cycles. There the

Photo Art Commercial Studios

This 53-pound King Salmon Didn't Get Away

The angler, who fought the fish for nearly three hours, jumped into the river to land it.

females dig shallow nests in gravelly stream bottoms and deposit their eggs. The males fertilize the eggs with milt. The females then cover the nests by brushing gravel over them with their tails. When spawning is completed, both males and females are so weakened that they drift downstream and die.

### Salmon Return to an Artificial Home

The unerring homing instinct of salmon was demonstrated dramatically at the University of Washington School of Fisheries recently. In the fall of 1948 eggs taken from silver salmon were fertilized and placed in tanks at the University in Seattle.

Eighteen months later fingerlings hatched from these eggs were marked and released in concrete pools constructed near the Lake Washington Ship Canal, which passes the front of the fisheries buildings. A temporary fish ladder was built to enable the fingerlings to get out into the canal. From the canal fresh water is piped into the pools.

The released fingerlings swam down the ladder, passed through the canal, crossed fresh-water Lake Union, and went through the locks into Puget Sound.

In the fall and winter of 1951, 75 mature silver salmon, unmistakably marked, threaded that difficult way back to the artificial pool in front of the fisheries buildings. There their eggs were removed and fertilized to complete the cycle.

This successful experiment proves that it is possible to "plant" salmon in streams where they have not been known previously. A program of stocking tributaries of the Columbia below the power dams has been under way for several years (page 601).

In talks with heads of the big fishing companies at Astoria, I found that opinion on the effects of dams on salmon runs is divided. Some of the fisheries men are bitterly opposed to construction of dams. One successful independent operator told me he has no quarrel with the dams and expects the new stream-stocking program to keep the salmon industry going.

Of the $20,000,000 annual income from fishing at Astoria, somewhat less than half is derived from Columbia River salmon. The rest comes from tuna, bottom fish, and other species taken offshore.

### "Trees Forever," Timbermen's Slogan

One day I went with chief forester Clarence W. Richen of the Crown Zellerbach Corporation through the tree farms his organization operates near Astoria. By fire protection, selective logging, reseeding from helicopters, and planting of seedlings, Crown Zellerbach is insuring a permanent supply of timber. The big timber operators realize that their future depends upon sustained-yield logging, and they are sparing no expense to keep forests growing.

On our way back to Portland we passed through a part of the famous "Tillamook burn," where a forest fire destroyed 245,000 acres of virgin timber in 1933, and subsequent blazes took 55,000 acres more. Disaster occurred again in 1939 and in 1945.

Now the Oregon State Board of Forestry is engaged in a campaign to rehabilitate the area. School children help plant seedlings (opposite page).

To protect their own green forests from fires that might start in the whitening stumps still standing on the burn, Crown Zellerbach has bought large sections of the burn and removed thousands of dead stumps.

Unfortunately, little cutover land except that lying along stream bottoms is good for general agriculture. Growing trees as a crop is the one sure way to derive value from it.

One crisp Saturday in November Mr. and Mrs. McNeil and I took the 61-mile drive to Timberline Lodge, high on the slope of Mount Hood. Fresh snow had fallen there, though the lowlands were still green, and late flowers lingered in Portland gardens.

On Sunday 3,000 skiers were ascending the mountain on the mile-long chair lift and rope ski tows and coming down with the speed of the wind past the half-buried ground-floor windows of the lodge. Children were tobogganing down a steep slope in front of the great log and stone building.

The view over unbroken forest from the window of my room was unforgettable. Below me the dark-green timber swept away down the side of Mount Hood and up facing steeps to a skyline etched with the snow-capped peaks of Three Fingered Jack, the Three Sisters, and other giants of the Cascades.

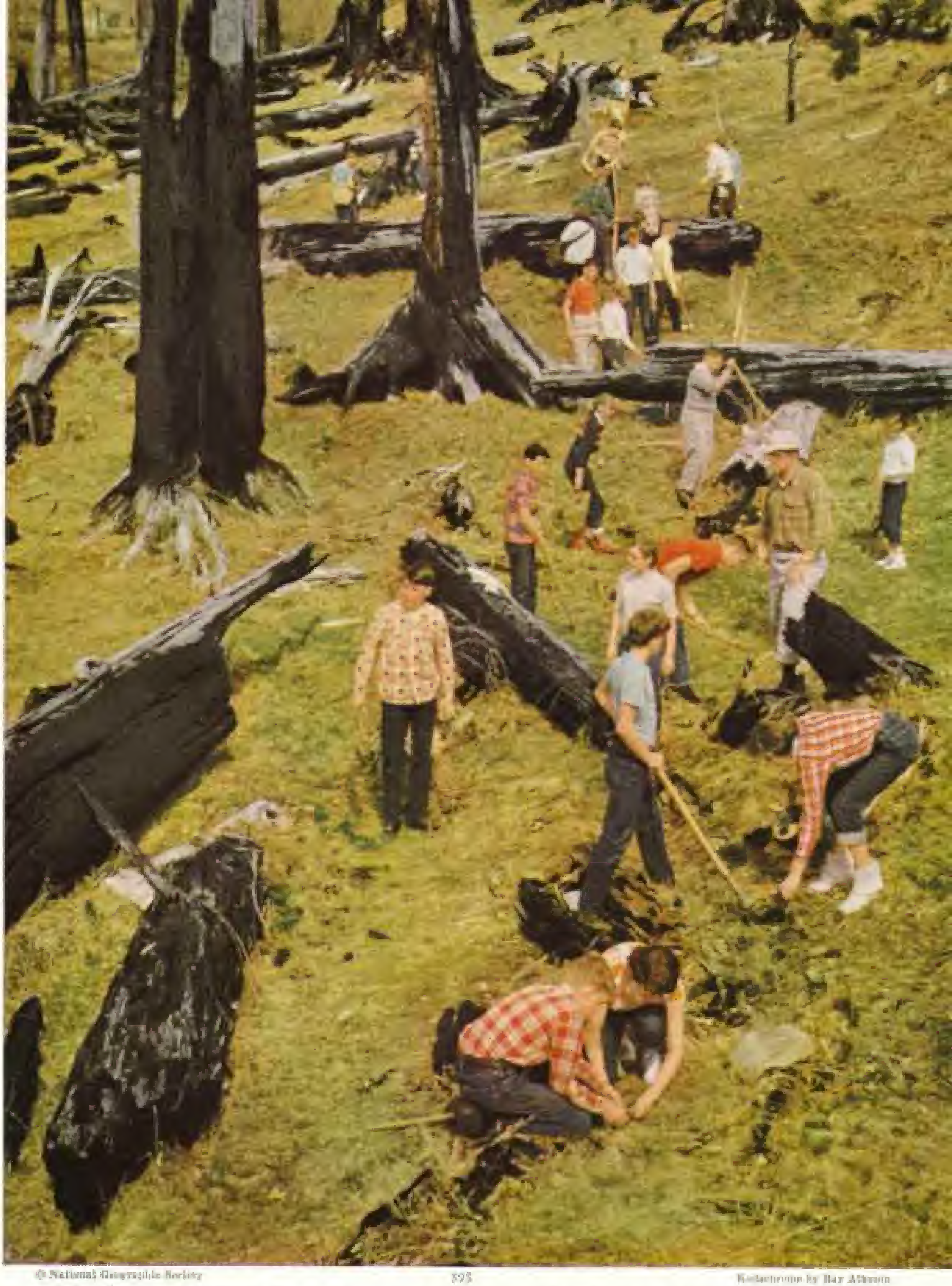
### A Stone That Pops Like Popcorn

When I drove from Portland south to Salem to see S. H. Boardman, I found him enthusiastic as ever about new parks. At present he is advocating establishment of a State park to contain 40 miles of white water on the Deschutes River in central Oregon.

He told me about an unusual mine near Maupin in the desert country north of Bend.

A day or two later a mining expert and I drove over the shoulder of Mount Hood and down to a village in a deep canyon of the Deschutes. We crossed the river on a hand-operated ferry to a mining community carved out of the side of a mountain. Some 1,500 feet almost straight up from the mining company offices is an outcrop of pearl-gray stone.

"That," said the mine manager, "is perlite."



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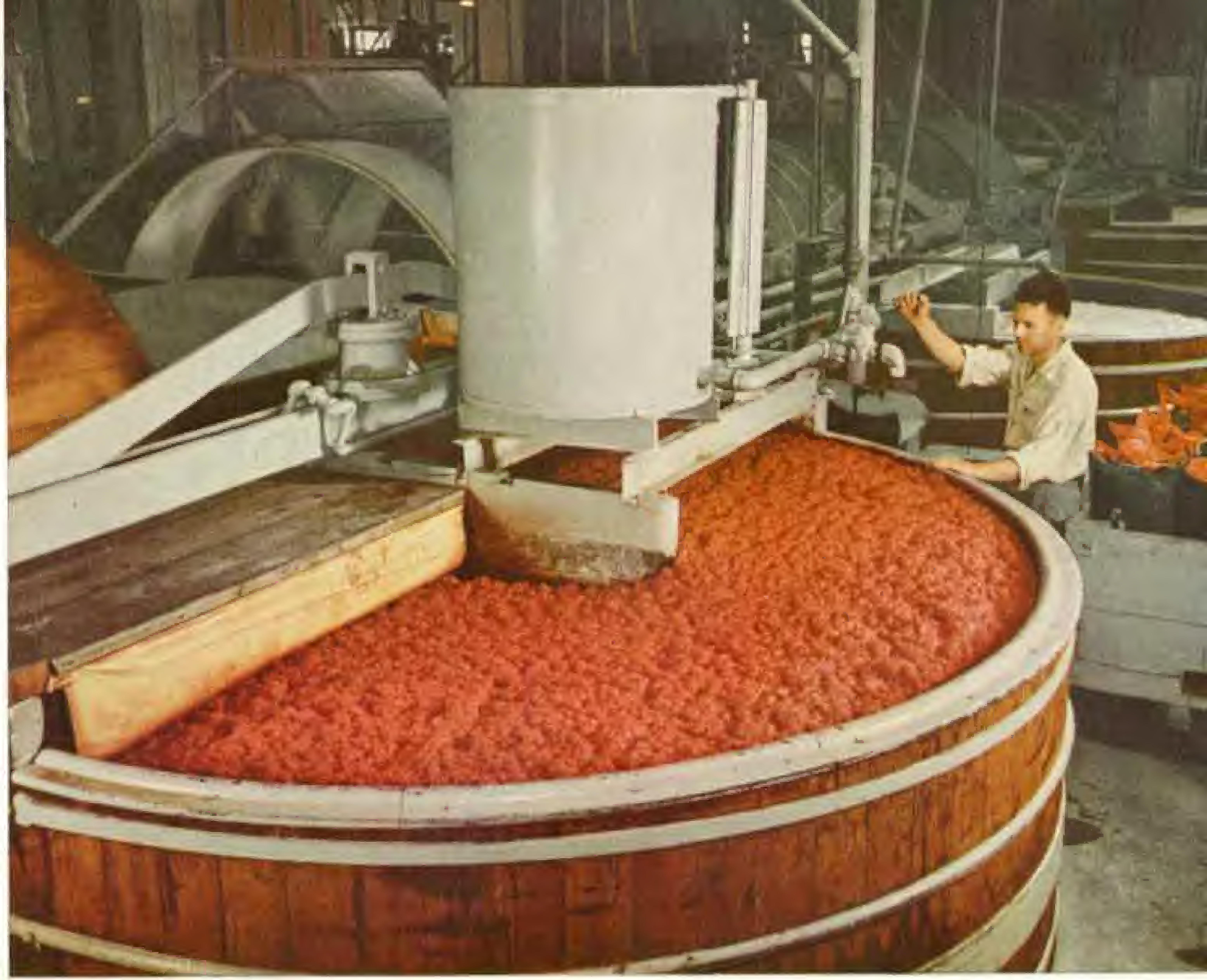
Kodachrome by Ray Atkeson

**School Children, Planting Douglas-fir Seedlings, Help Reforest Tillamook Burn**

Fire has repeatedly swept this vast area between Portland and Tillamook. In 1933 an uncontrollable conflagration destroyed 245,000 acres of virgin timber, and subsequent blazes brought the total to 300,000. Disaster struck again in 1939 and in 1945, razing second growth and consuming humus in the soil. The Oregon State Board of Forestry is rehabilitating the land by scientific methods. Charred stumps and logs remain a fire hazard.



## A Witches' Brew Turns Wood to Frothy Pulp in a Paper Mill

The kraft, or sulphate, process cooks chips in a broth of sodium sulphide and caustic soda. After 1½ hours or more, the lignin, sugars, resin, and mineral salt dissolve, leaving the cellulose. This raw fiber, which constitutes about 50 percent of the wood, is washed repeatedly to remove the last vestiges of the liquor. It is then screened and suspended in water, passed through a beater which treats the fibers so that they mat together on the paper machine. Chemicals bleach the red pulp.

Crown Zellerbach Corporation, which operates this Camas, Washington, plant, is one of the world's largest paper manufacturers. To fill its pulpwood needs, it maintains nine large tree farms, harvesting timber on a sustained-yield basis.

The corporation logs its tracts so as to leave blocks of mature trees to serve as seed sources for cutover lands. If new trees sprout too slowly, helicopters scatter seeds, and men plant seedlings.

Half-burned stumps are useless for paper, for charcoal specks defy bleaching.

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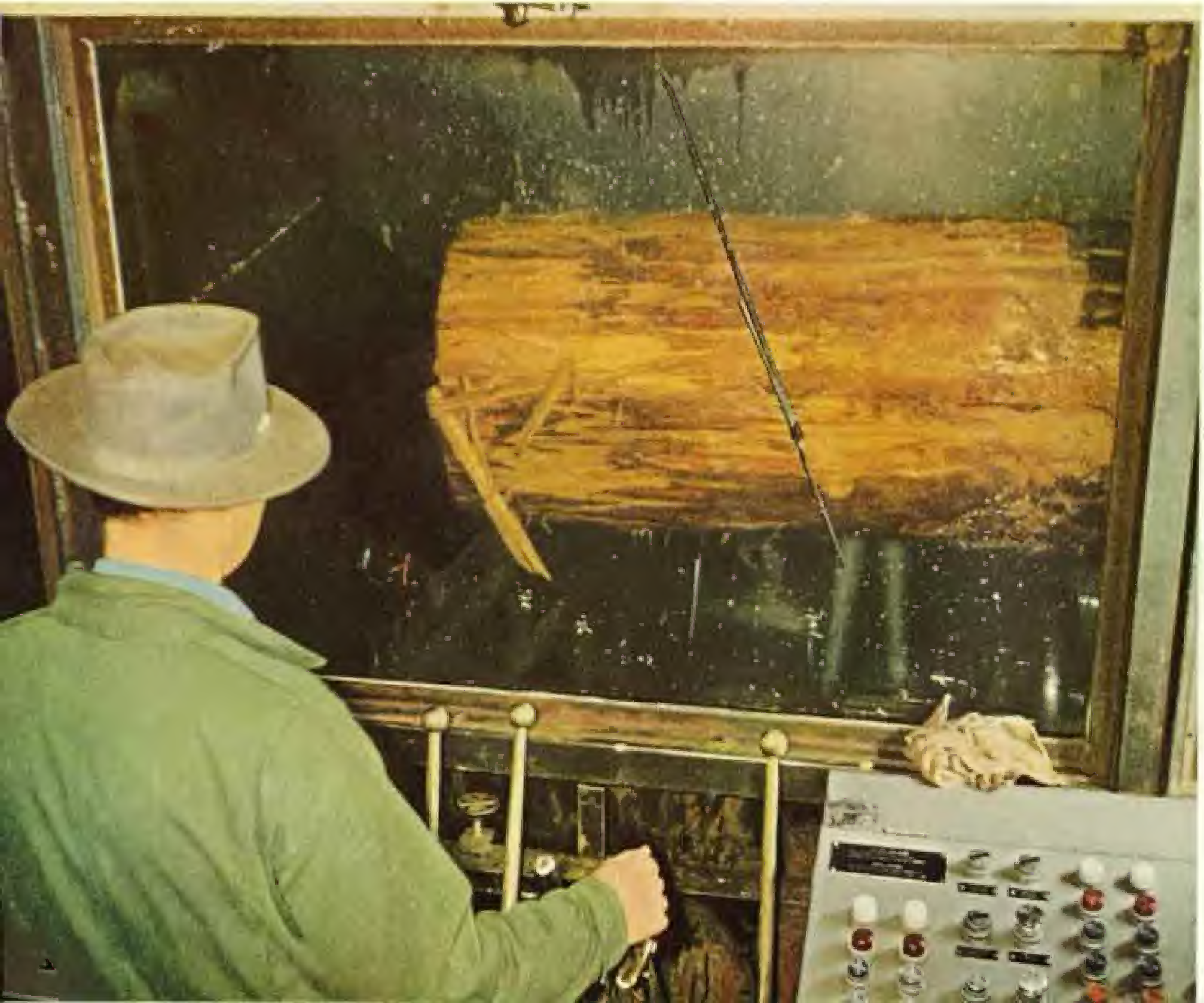


## Bark Is Washed Off Logs by Powerful Jets of Water

Logs at the Weyerhaeuser Timber Company's Longview, Washington, plant are hydraulically stripped by jets of water under 1,400 pounds' pressure.

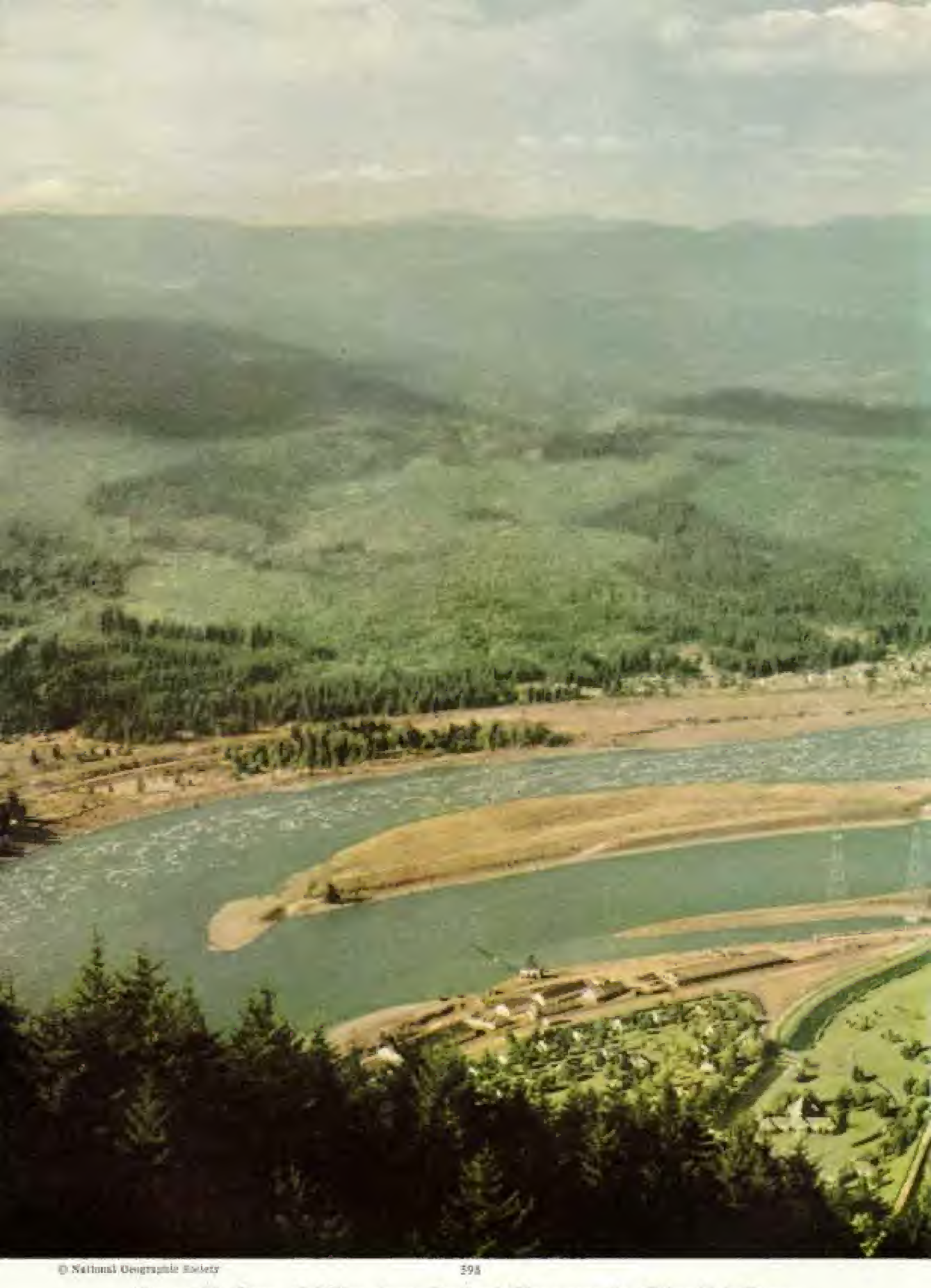
When round logs are cut up into squared lumber, the sides remain as bark-covered leftovers. Such slabs cannot be used for pulp or wood-fiber products until the bark is removed. Bark-free logs can be sawed to get maximum yield with minimum waste.

Uses have been found even for the bark. Some of it, dried and ground to powder, becomes a component of plastics, plywood adhesives, and the mud stabilizers of oil drillers.

Like the meat packer who proverbially utilizes every part of the pig but the squeal, Weyerhaeuser wastes nothing. Every log coming to the plant is put to economical use as lumber or by-product.

Longview, with 20,250 inhabitants, is the planned city conjured by the Long-Bell Lumber Company out of diked land along the Columbia River, adjacent to vast stands of Douglas fir, cedar, and hemlock.

Kodachrome by Ray Atkeson



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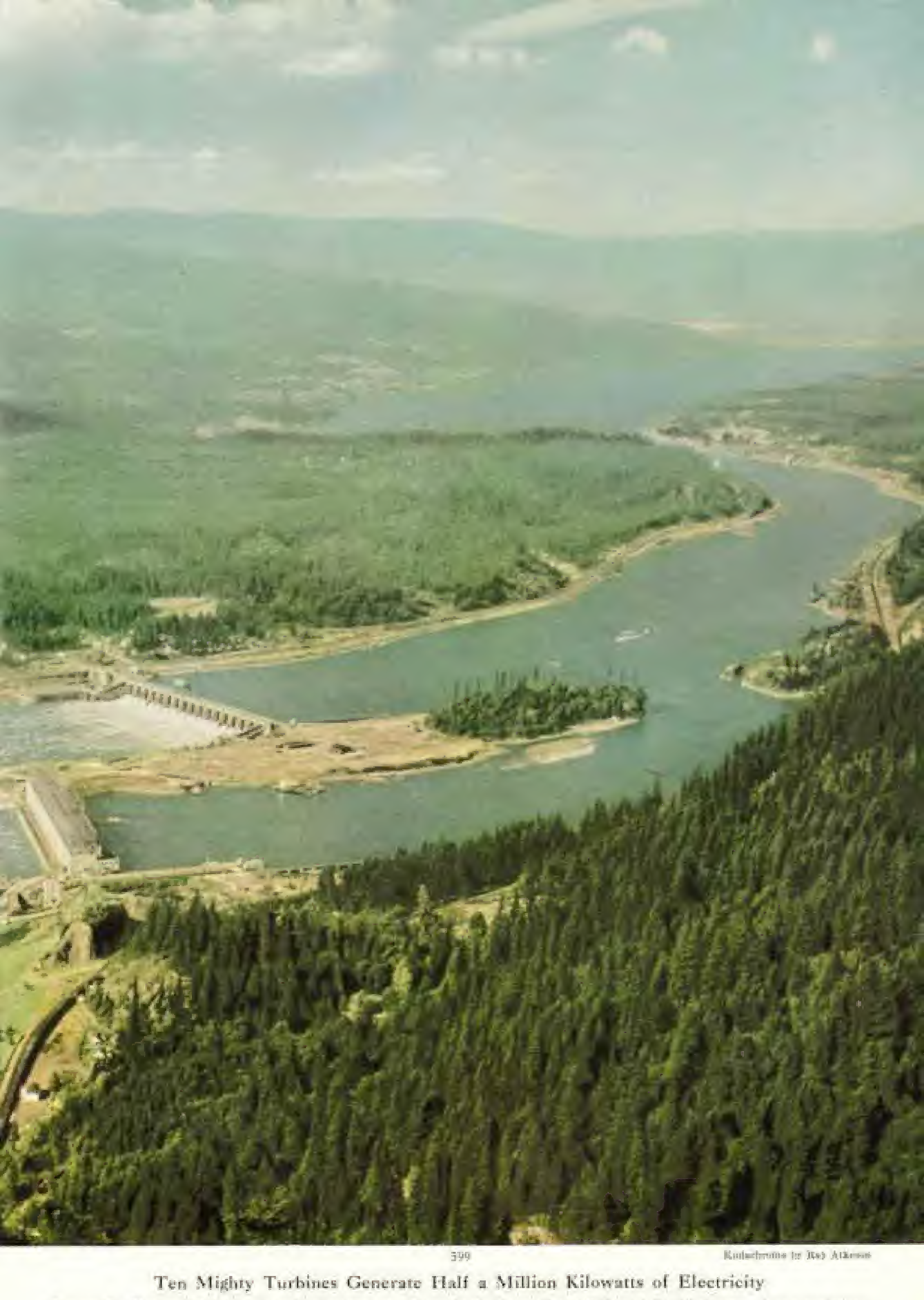
**Bonneville Dam, 42 Miles above Portland, Harnesses the Columbia's Power**

One hundred and ninety-seven feet high, the dam stretches 1,100 feet from Bradford Island, Oregon, to Washington (far shore). Fish ladders, bypassing the barrier, permit the passage of salmon.



Kodachrome by Ray Atkeson

Ten Mighty Turbines Generate Half a Million Kilowatts of Electricity

Bonneville Power Administration distributes power from both Bonneville and Grand Coulee Dams. Army engineers, who built the structure, now are completing McNary Dam and Chief Joseph Dam, both on the Columbia.

## Portland Goes Fishing When the Smelt Run Hits the Sandy

In spring millions of smelt surge in from the Pacific to spawn in the shallow river flowing east of Portland.

The moment the news is out, highways become jammed with cars headed for the Sandy River. Avid fishermen use dip nets, buckets, even woven-wire bedsprings and window screens to scoop up the fish. The veriest beginner can net his legal 25 pounds a day within a few hours. Put into a home freezer, the catch lasts for months.

For unexplained reasons, the smelt have failed to run 11 times during the last 33 years.

Large runs of salmon used to enter the stream, but their numbers have declined to a few thousand. Now the Federal Government plans to improve river conditions and build up the Sandy's salmon industry. A fish hatchery was completed recently.

Lewis and Clark, exploring Oregon in 1805, commented that the Sandy resembled the Platte River in its shallowness and tendency to build sand bars.

Today the river flows peacefully through a fair countryside. It sees real excitement only when smelt and fishermen rush in.

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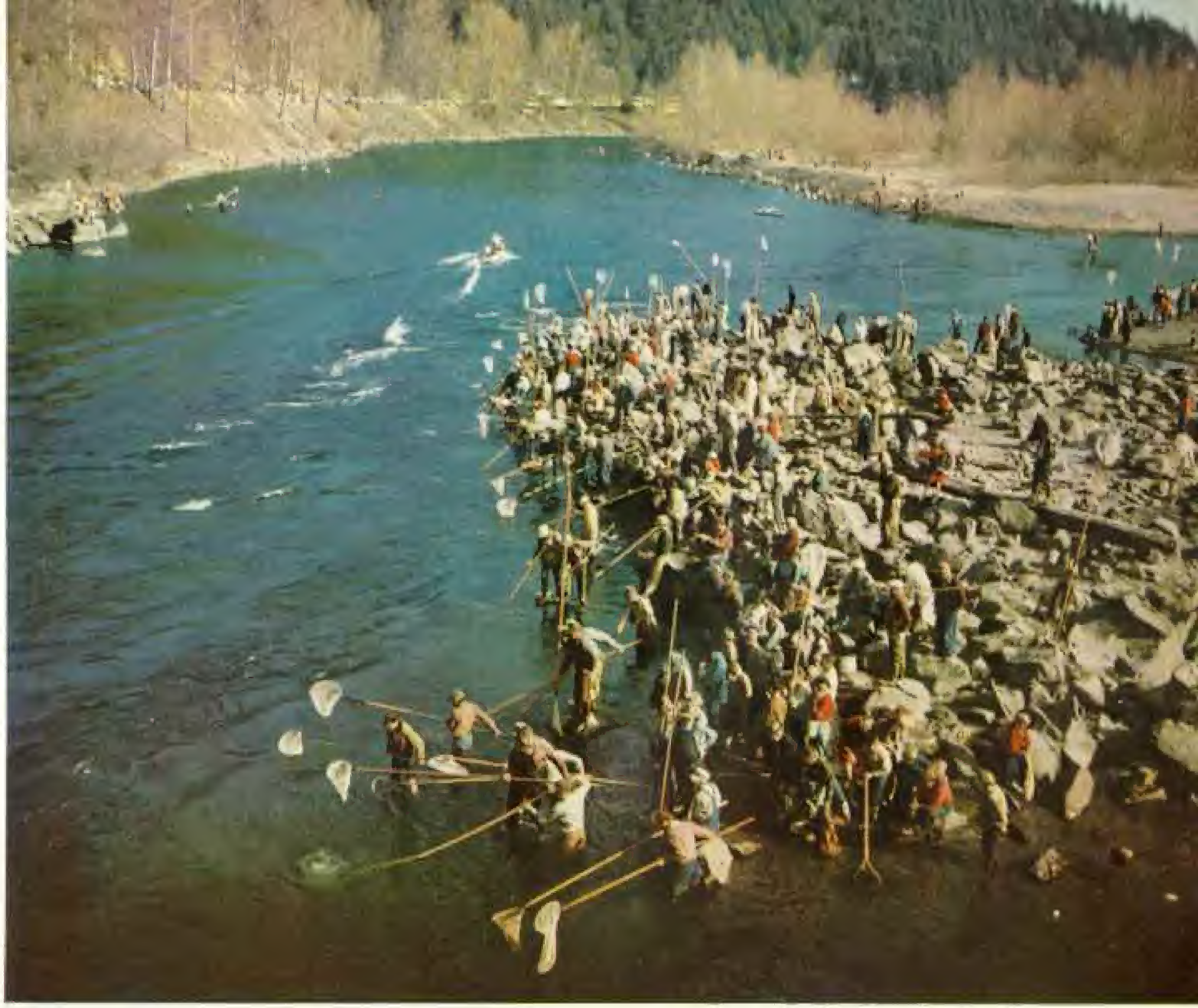

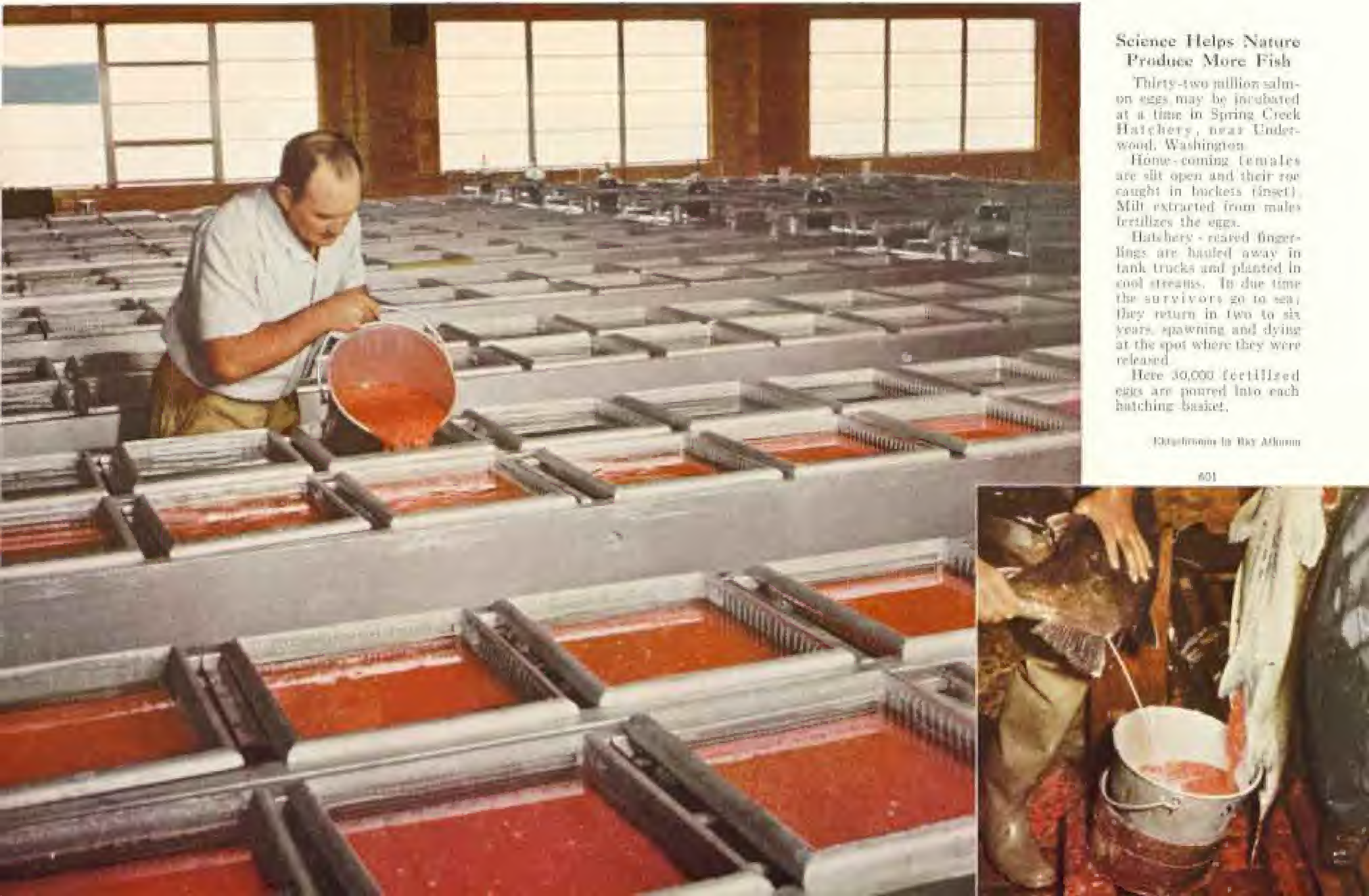

## Science Helps Nature Produce More Fish

Thirty-two million salmon eggs may be incubated at a time in Spring Creek Hatchery, near Underwood, Washington.

Home-coming females are slit open and their roe caught in buckets (inset). Milt extracted from males fertilizes the eggs.

Hatchery-reared fingerlings are hauled away in tank trucks and planted in cool streams. In due time the survivors go to sea; they return in two to six years, spawning and dying at the spot where they were released.

Here 30,000 fertilized eggs are poured into each hatching basket.

Ektachromes by Ray Atkeson

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Columbia River Rolls Toward Mount Hood Between Oregon Lava Cliffs (Left) and Washington Hills

◆ Grand Coulee Dam backs up Roosevelt Lake 151 miles to Canada. Its impounded irrigation water turns desert into farms (pages 604, 605). Ultimately, huge pumps (outlet pipes on far side) will lift more than 12 billion gallons 280 feet to an equalizing reservoir (background). Eighteen generators' rated capacity is 1,944,000 kilowatts

Ektachromes by Ray Atkeson

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★ Leveled, Plowed, Seeded, and Equipped with Buildings and Livestock, This Farm Sprang from Desert in 24 Hours

More than 300 volunteers, working at masonry, carpentry, grading, and planting, made ready the "farm-in-a-day" near Moses Lake, Washington, on May 29, 1952, for the first official irrigation water from Grand Coulee Dam reservoir (page 603). Lower right: Donald Dunn (speaking into microphone) was chosen from thousands of candidates as the veteran of World War II or Korea most deserving of the gift. He received the farm debt-free. Veterans of Foreign Wars conducted the contest.

Kodachrome by Ray Atkeson

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Oceans of Winter Wheat Reaped by Fleets of Combines Roll over the Palouse Hills

Kodachrome by Ray Atkeson

Fenceless Lands Yield Rich Harvests. Even Without Irrigation, Crop Failures Are Rare

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Ektachrome by Ray Atkinson

## Water Returns to Grand Coulee, Ancient Bed of the Columbia

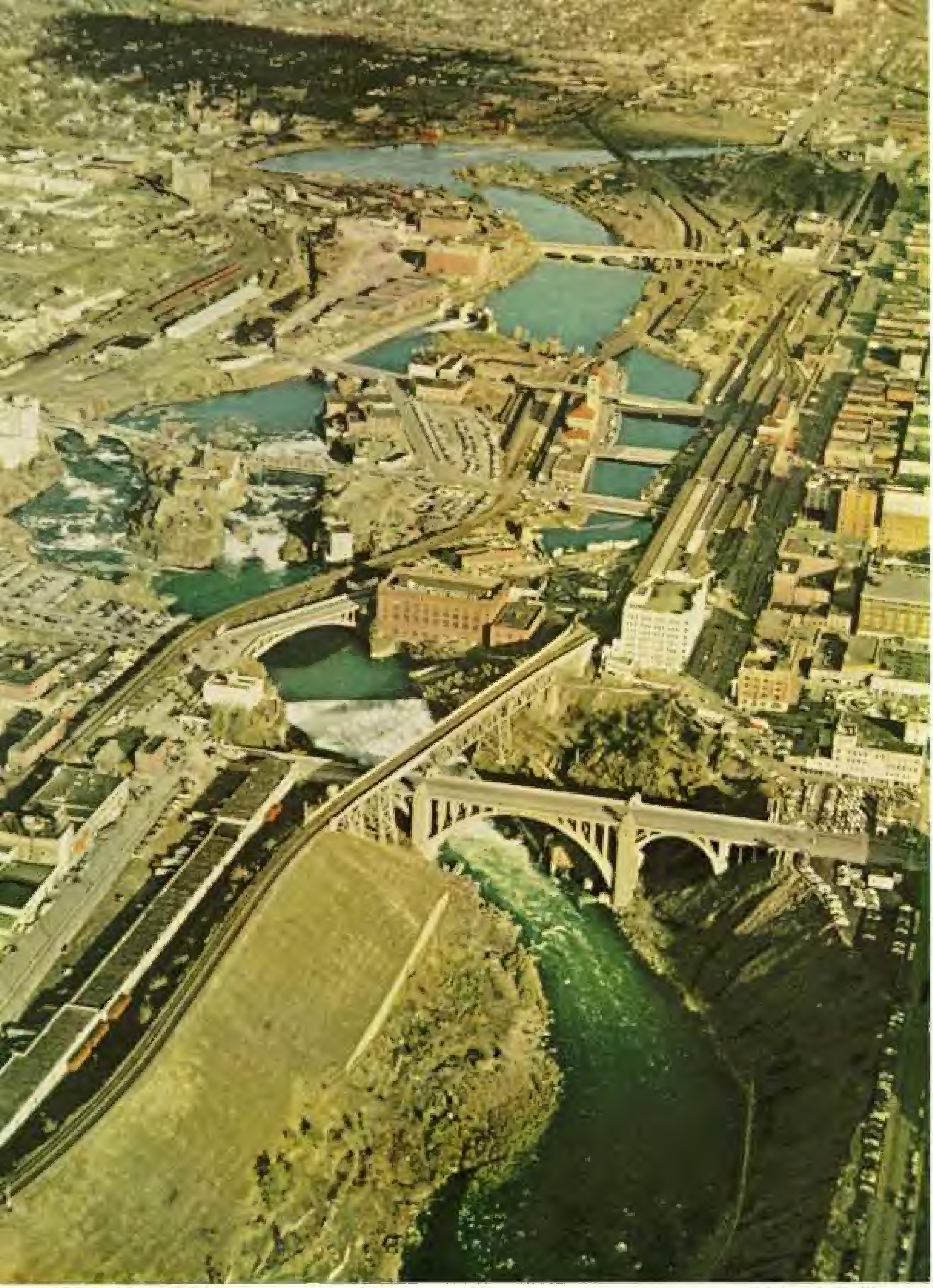
↑ Ages ago a glacial block turned the river out of its channel, and the diverted stream cut this valley, plunging over a stupendous cliff a short distance to the south. When the ice melted and the river resumed its original course, it left the arid coulee 600 feet above its bed. Dry Falls, now a Washington State Park, remains a memento of the roaring cataract that once poured over it. Today water from the lake backed up by Grand Coulee Dam is being pumped into the old channel, which has been sealed at both ends to create a huge reservoir.

## ← 23 Nations Take Part in Ephrata's Fair

Celebrating the turning on of irrigation water from the Grand Coulee, Ephrata entertained representatives of 22 foreign countries.

↓ Delegates to Ephrata's "Little World's Fair" inspect a concrete ditch leading from Grand Coulee's reservoir to areas included in a million-acre irrigation project.

Kodachromes by Ray Atkeson



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Kodachrome by Ray Atkeson

Spokane River Thunders in a White Cascade Through the Heart of Its Namesake City

Only 92 miles from Grand Coulee Dam, Spokane expects a trade boom as the irrigation project lands are settled. Dams and turbines here develop power where Indians used to spear salmon.

I climbed into a decrepit army truck with the manager, and we chugged up the perilous height by twisting switchbacks.

Carrier scoops were bringing tons of ore to a crusher near the road. In this crusher the rock was broken into pieces about as large as walnuts.

By successive flights of descending stairs we went through the mountainside plant. On each level, crushers were grinding the ore smaller till pieces were the size of wheat.

Now an astonishing thing happened. The grainlike substance was put into furnaces and subjected to a blast of flame at 1,900° temperature. The kernels of stone popped like popcorn, to emerge a fluffy meal.

"The perlite up at the mine weighs 85 pounds to the cubic foot," the manager told me. "This stuff weighs less than seven."

From the popped perlite lightweight plaster and acoustic tiles are made. The product saves thousands of pounds of weight in building construction, and acoustic tile made of it is one of the most effective sound deadeners ever discovered.

The mining expert who had accompanied me explained that, according to one school of thought, perlite stone is a rhyolite which poured from a volcano in molten state ages ago and cooled quickly in some prehistoric lake. Quantities of water were imprisoned in it when it crystallized, and it is this stone-locked water that expands under terrific heat and causes particles of the ore to pop.

### Columbia River Has Made Portland

One day I asked Arthur Farmer, Portland civic leader, "What do you think most important in the development of this city?"

"If we ever get around to building a civic monument," he replied, "we ought to dedicate it to the engineers who dredged the Columbia and Willamette Rivers and gave us a harbor for ocean-going ships.

"We used to be an inland town with no chance for world markets. Now with our 35-foot channel we are trading with Alaska, the Orient, and the rest of the world."

Great steamers from afar now come into Portland harbor in ever-increasing numbers. Though the channel of deep water is wide enough for them to turn around on their own power, the port provides tugboats to help them maneuver when their boilers are cold. Most efficient of these boats is the *Portland*, a Mississippi River-type stern-wheeler (page 591). It is strange to see the anachronistic-looking craft pushing around the most modern ocean liners.

The shipyards which made Portland boom during World War II are closed down, but there has been no diminution in the tempo of the city. With new industries springing up every day, there is work for everybody. Portland has never been a boom town save for a few years during the war. Primarily it is a pleasant home-town place of steady, healthy growth and leisurely habits.

People find time to cultivate and enjoy fine lawns and flower gardens. On the hillsides, houses ranging from mansions to bungalows are built with picture windows framing Mount Hood.

To me the friendly city is one of the most delightful in America. Most of the factories are run by electricity, and consequently the air is usually free of smoke. Business is brisk, but people always have time for visitors.

### Portland Parades Half a Million Roses

For sheer beauty there are few spectacles to compare with the Portland Rose Festival (page 584). I sat enraptured in Multnomah Civic Stadium on June 13 as 45 flower-decked floats, interspersed with a score of bands, moved up the ramp in the two-hour parade of the 44th annual celebration of this event.

On the theme "Childhood Memories," entries ran the gamut from *Mother Goose* to Bible stories. The winning float represented a circus parade. It consisted of five sections with ringmaster, cages of animals, and calliope, all done in red and white roses. More than 70,000 flowers were woven together to decorate the float.

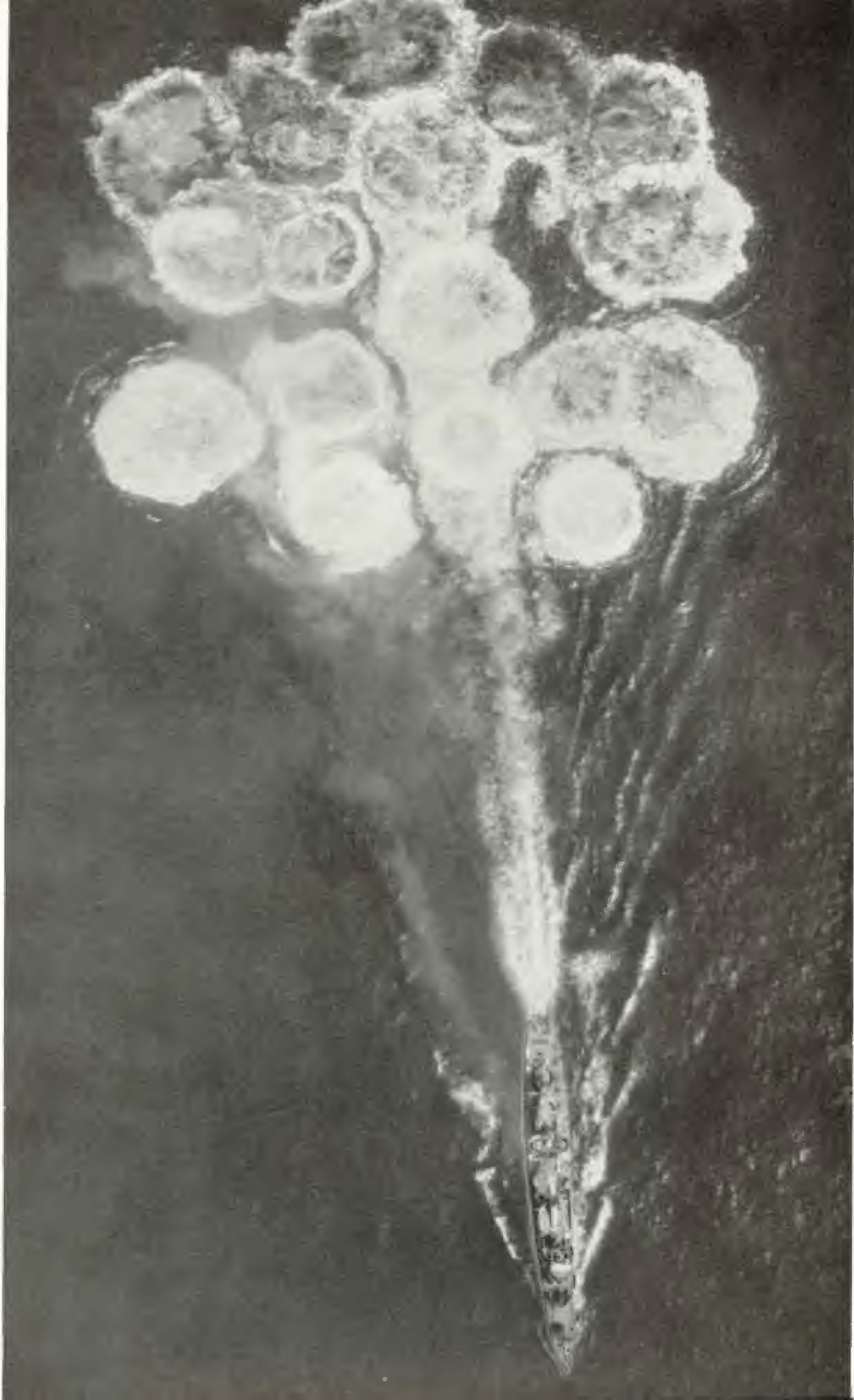
An exquisite pageant of Cinderella going to the ball in her magnificent coach-and-four was done in white daisies and pink roses. Blue flowers edged the carriage wheels and the harness. This float with 50,000 flowers was adjudged second in the competition.

Never before had I seen such masses of flowers. A conservative estimate would place the number of blossoms on the 45 floats at half a million. Most remarkable to me is the fact that virtually all these flowers are grown in Portland gardens.

The day after the main parade, 10,000 school children marched in a Junior Rose Festival. Their floats, pulled mostly by hand, were small models of some of the finest displays of the grownups' parade. Unfortunately rain poured incessantly on the procession, and make-up ran down the cheeks of the child actors. Costumes were sodden, but the youngsters were game.

I boarded a plane at the airport just at sunset. As evening shadows lengthened, I saw lights come on in the valley, but the snowy crown of Mount Hood still glowed in golden sunlight (pages 582-583).

On the cover of a folder someone had left in the seat next to mine was the caption, "For You a Rose in Portland Grows."



# Our Navy's Long Submarine Arm

## Snorkel-equipped Prowlers Bring a New Era, and the Atomic Sub Now Being Built Promises a Far Greater Undersea Revolution

By Allan C. Fisher, Jr.

"TAKE her down!" *Ah-ooo-ga! Ah-ooo-ga!* Two blasts of a raucous horn signalled the command. Men who had been stationed on the bridge of the U. S. S. *Sablefish* plunged down the conning tower hatchway like rabbits jumping into a hole. The last man slammed and locked the hatch.

For nearly an hour our submarine had been cruising on the surface off New London, Connecticut. Now, with the sounding of the diving alarm, we were about to submerge for a test of her snorkel, the ingenious breathing tube that enables today's deadly steel sharks to remain underwater for weeks at a time.

### Three Weeks Under the Sea

The snorkel, a Dutch invention perfected by the Germans, luckily was not quite ready to be unleashed against Allied shipping in World War II. Simple in principle, it consists of two pipelike cylinders. One sucks in air from the surface, while the other expels engine exhaust into the water.

"Snorkel," a postwar addition to the dictionary, is generally supposed to come from the German *Schnörkel*, meaning spiral or twisted ornament. Another version is that it stems from the colloquial German word *Snorchel*, meaning animal's snout. The British call the device a "snort."

Until the snorkel revolutionized submarine warfare, Diesel engines, requiring air, could not be used when the boat was submerged. To recharge batteries needed for underwater propulsion, the submarine had to surface frequently. Now, with the snorkel, Diesels can be run at periscope depth. Batteries, still needed for deeper operation, can be charged without venturing up to the open air.

Thus the modern submarine can stay submerged for many days, greatly increasing its chances of avoiding detection. World War II subs, when surfaced, often were easy radar targets. The snorkel breathing-tube head, however, is no bigger than a cottage chimney. It is hard to detect, particularly in a rough sea.

One of our Navy's snorkel submarines, the *Pickerel*, has cruised all the way from Hong Kong to Pearl Harbor, Hawaii, without once coming to the surface in 21 days and 5,600 miles. Although the cruise underscored the new elusiveness of the submarine, it was undertaken primarily as a test of equipment and, above all, men.

"Snorkeling" creates serious physiological problems for crewmen. The air-intake valve, when struck by a wave, closes automatically to prevent flooding. But the Diesel engines keep gulping air like a vacuum pump until the snorkel is clear and its valve reopens.

This results in rapid variation of air pressure within the submarine. Crewmen sometimes experience an uncomfortable ear-popping, head-filling sensation, though in time they become conditioned to it and simply ignore the occasional discomfort. I was to find out for myself what a headache snorkeling can be.

### 20 Minutes Enough for a Landlubber

As the *Sablefish* nosed under, I could feel the deck tilt slightly. There was no other sensation to indicate we were slipping beneath the waves. Once submerged, nothing I could detect suggested our forward motion.

Climbing to the conning tower, I joined Comdr. Julian T. Burke, the sub's skipper, at the periscope. Above us the day was overcast and mild, with just enough sea swell to give the air induction valve a good workout. An order sent the hydraulically operated snorkel tubes to the surface.

"Now watch the altimeter," Burke said.

In a fraction of a minute the gauge needle swung to 800 feet. A command for more power went to the engine room, and the needle crept higher, to 900 feet, 950, then 1,000. Our huge Diesels were eating up air within the submarine, whisking us from sea level to rarefied mountain atmosphere.

When waves closed the snorkel valve, the altimeter raced higher and the temperature in the submarine became noticeably cooler. When the valve opened, the needle fell and the air turned humid.

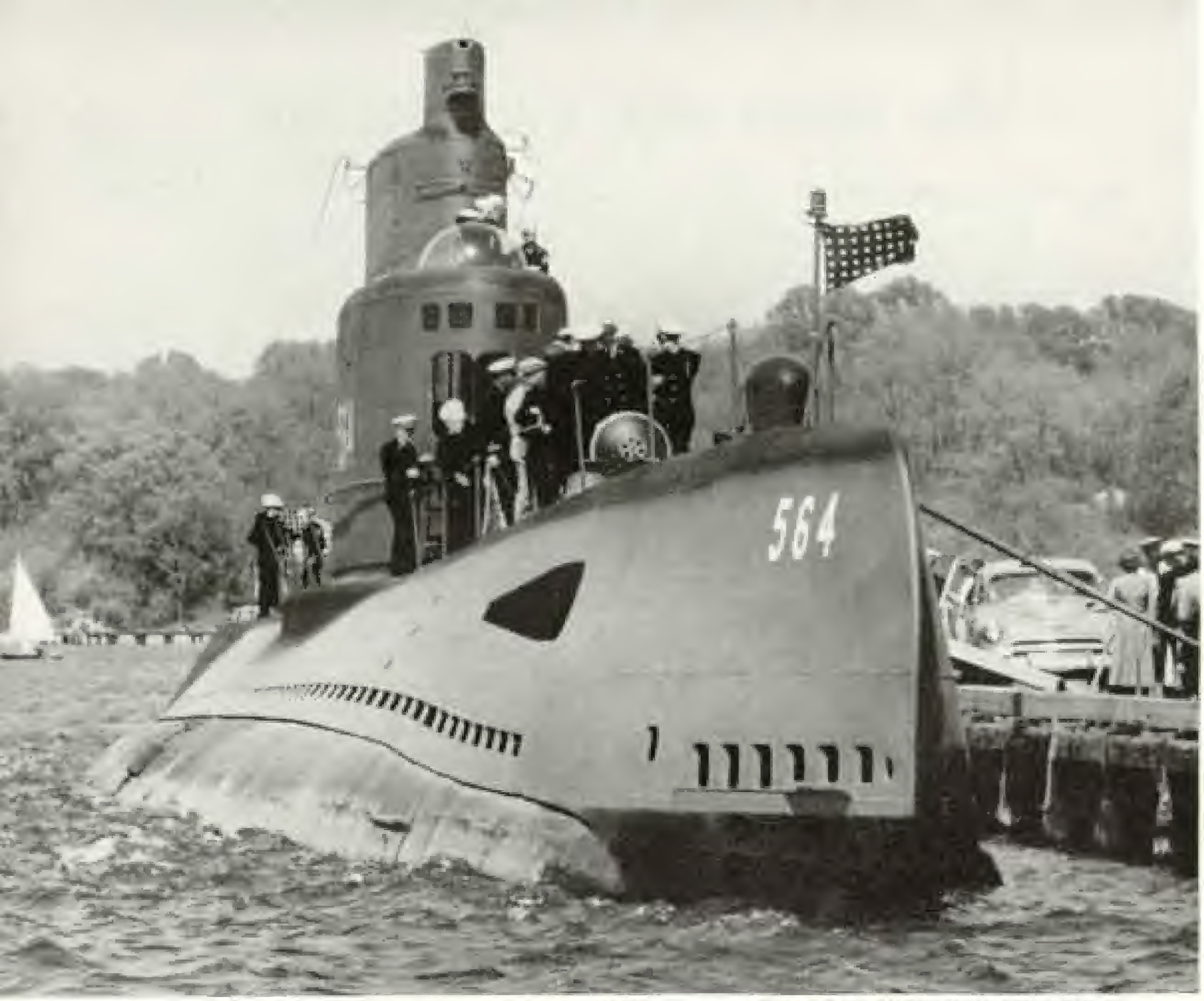
My ears ached like a bad tooth until Burke suggested, "Hold your nose and blow. It will open up your head."

---

U. S. Navy, Official

◄ **A Destroyer Escort Lays Down a Rosette of 17 Depth Charges**

In two world wars depth charges had a demoralizing effect on U-boat crews. Deadly "ashcans" shook submarines violently, though they often failed to destroy their targets. The hedgehog, a newer weapon, has proved more effective (page 626).



National Geographic Photographer Willard R. Culver

**Midshipmen at Annapolis Tour U.S.S. *Trigger*, a Deadly New Attack Submarine**

Snorkel tubes enable modern submarines to stay underwater for weeks. Streamlined hulls and improved power plants give them astonishing speed when submerged (page 617). *Trigger*, one of six new attack-type submarines, actually travels faster beneath the water than on the surface.

For 10 more minutes the altimeter seesawed back and forth, like an erratic compass. Finally Burke said:

"I guess that's enough. The boys at lunch below deck are probably blessing us out. It's sometimes difficult to swallow while the pressure is constantly fluctuating."

It is also difficult to sleep, Navy physicians told me later. Men are often awakened by pain or discomfort in ears and sinuses.

Twenty minutes of this proved enough for me, and I regarded with added respect the men of our undersea fleet.

### Both a Weapon and a Threat

In four weeks of watching submariners in action, from Connecticut to Key West, Florida, I saw how fleet-type subs of World War II, though still effective, are destined for the fate of the Model T Ford. Newer and even deadlier types, streamlined and capable of high submerged speed, are joining the fleet. Some are conversions from old vessels. Others have been constructed from the keel up and embody a host of innovations in armament and equipment.

I saw, too, something of our countermeasures, including deadly little submarine-killer subs, for the snorkel is a two-edged weapon that could be used against us.

"We make a vast mistake if we assume our potential enemies cannot challenge our supremacy at sea," said Admiral William M. Fechteler, Chief of Naval Operations, in a lecture before members of the National Geographic Society last February in Washington, D. C. "I refer specifically to the submarine threat.

"We came perilously near to losing World Wars I and II by reason of German unrestricted submarine warfare in the North Atlantic.

"Germany commenced World War II with only 50 submarines of relatively low speed and poor operating characteristics. The Germans greatly improved their submarine design as the war progressed.

"Russia today has between three and four

National Geographic Photographer David S. Boyer

**Crewmen Let Down Bunks and Watch a Movie in *Amberjack's* Forward Torpedo Room**

Normally the submariner works four hours and takes eight off. Each sub carries a 16-millimeter motion-picture projector and late-issue Hollywood films. When circumstances permit, sailors gather on deck or in quarters and enjoy a show. Card playing is equally popular, and letter writing whiles away lots of time.

hundred submarines. We do not know what the characteristics of these submarines may be, but we do know that after the war Russia obtained some of the most modern of German submarines together with the east German shipyards in which they were constructed and the technicians who constructed them. We must assume, therefore, that the Russian submarine fleet consists of ships which are not only more numerous than the original German fleet, but are, in part at least, equal to or better than the submarines of latest and most improved German design.

"We have made good progress in devising means of meeting the submarine threat," Admiral Fechteler assured his audience, "and the results of our tests and exercises lead me to conclude that we are prepared to meet the challenge if it comes, but not without sustaining losses, particularly in the early days of a conflict." *

Strange though it may seem in view of the demonstrated effectiveness of undersea warfare, no navy has ever had a "true submarine," one capable of operating independently of the atmosphere for long periods. All present types are better described as submersible torpedo boats, for they can remain below snorkel depth only a limited time.

### First "True Sub" Now Possible

Although the snorkel boat (in crew parlance the submarine is always a "boat," never a "ship") is not a true submarine, that term may apply to the world's first atomic-powered sub, U.S.S. *Nautilus*, now being built at the Electric Boat Division of General Dynamics Corporation in Groton, Connecticut (page 635).

Uranium, the fuel which would be "burned" in an atom sub, does not require air for its reaction. Submarines thus could cruise indefinitely at great depth. The time would be limited only by the crew's endurance and their supply of oxygen for breathing.

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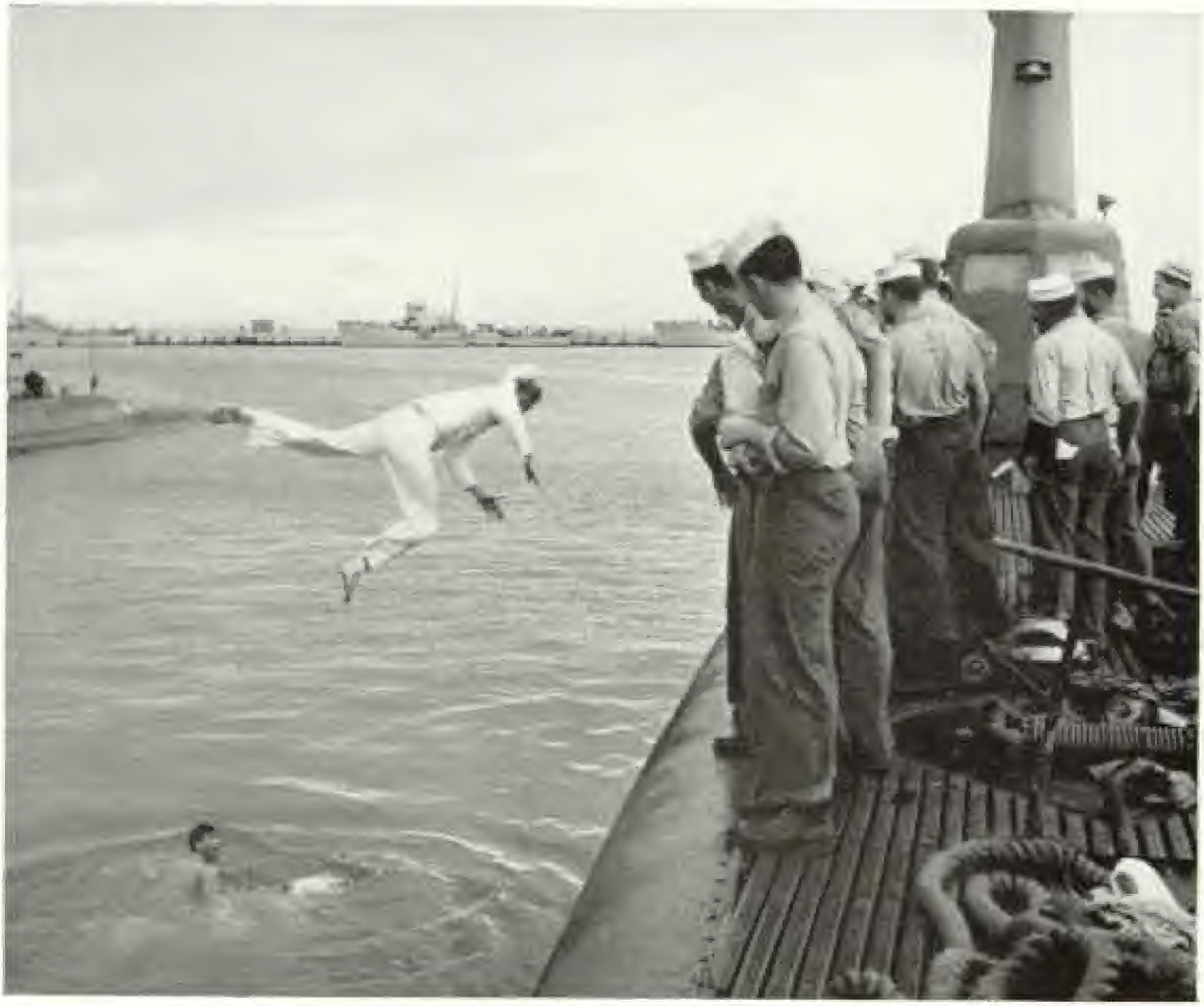
* See also "Your Navy as Peace Insurance," by Fleet Admiral Chester W. Nimitz, NATIONAL GEOGRAPHIC MAGAZINE, June, 1946.



John E. Kreutzck

**"Congratulations on Your Promotion!" Sailors Say It by Tossing Shipmates Overboard**

When a submariner rises to chief petty officer, custom decrees that his buddies heave him from deck into harbor. The practice, formerly widespread, is declining because most dockside waters are polluted. Key West, Florida, witnessed the dunking of these hapless chiefs.

Energy particles released by atomic fission give off tremendous amounts of heat. Present plans call for harnessing this heat to a steam turbine in the atom sub. A new heat transfer agent, possibly a liquid metal, would be used to prevent radiological contamination of steam conduits or boilers.

### Atom Sub's Fuel May Last a Year

It has been estimated unofficially that the first nuclear-powered submarine probably would be capable of making 35 knots submerged—considerably faster than the top speeds of our latest-model subs and of most surface warships.

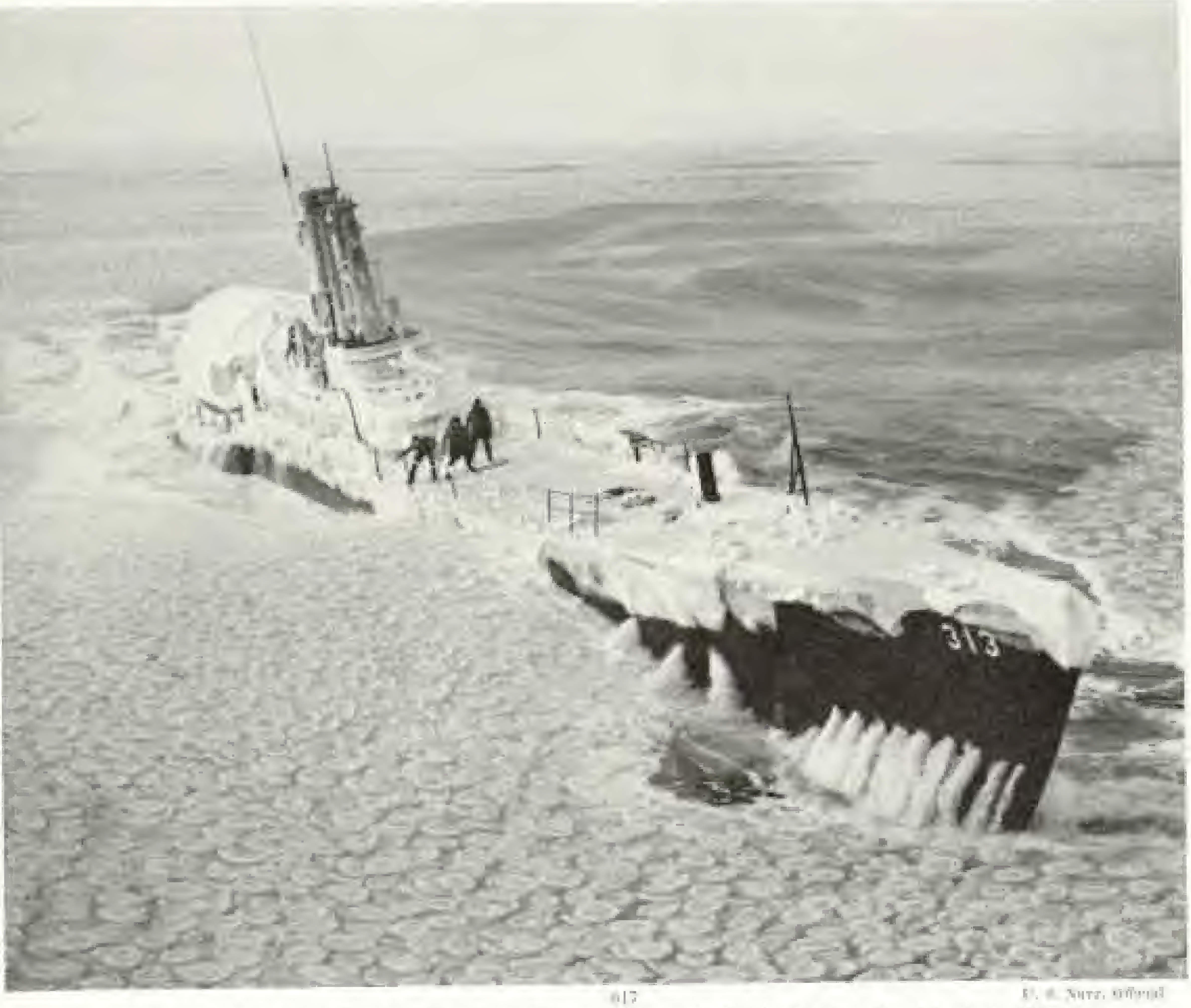
Since the energy packed into uranium is dissipated at a very slow rate under controlled conditions, a boat thus powered would need refueling only once a year, or even less often.

Meanwhile the Navy is steadily improving its Diesel subs. Former submariners now in civilian life would hardly recognize their old World War II craft after conversion into the new streamlined beauties called "guppies." Deck guns and cluttered bridge are gone, replaced by a single knifelike fin topped by snorkel and periscope (page 620).

Before remodeling, these craft could make only eight or nine knots submerged. Navy spokesmen are guarded about their new speed, but it is considerably faster.

In addition to the guppy-conversion program, our Navy is remodeling some World War II submarines as prototypes of special auxiliary vessels. Among them are oilers, troop and cargo carriers, mine layers, radar picket boats, and guided-missile launchers. They would be used in enemy-controlled waters where surface ships, preferably used for such missions, could not venture.

During the war Germany's high command conceived the idea of a submersible raft which could be towed by a U-boat across the Atlantic. While still well out from shore, raft and U-boat would surface to fire a buzz bomb on New York City. This ambitious plan was



U. S. Navy, Official

**U.S.S. *Perch*, a Troop Carrier, Plows Through Pancake Ice in Alaskan Waters**

Submarines can take troops through enemy-controlled waters where surface ships dare not venture. Coming up, the subs send men ashore for reconnaissance patrols and raids (page 631). Here crewmen chip ice from *Perch's* rolling deck during cold-weather maneuvers.

never tried, but it proved the progenitor of our own missile-launching submarines.

The *Loon*, an improved American version of the German buzz bomb, was first fired from a submarine in 1947 off Point Mugu, California. New and better guided missiles are in the planning and testing stages. Submariners envisage a day when, if necessary, they could shower these long-range weapons on enemy concentrations, or even direct them against aircraft.

### Small Boats with Big Ears

Our lethally armed "submarine-killer submarines" were developed for the specialized job of ambushing enemy undersea craft.

Three "K-boats" have been built. Chubby and only 195 feet long, they little resemble the slender, 311-foot fleet type. All three will carry supersensitive electronic "ears" to detect their quarry, and improved torpedoes to finish him off (page 636).

One such weapon, the homing torpedo, operates on an acoustic principle. When released, it runs unerringly to the target, guided only by the enemy's sound. A second type, the pattern-running torpedo, heads for the target area and then begins to weave through the water, seeking a victim.

Of the killer's mission, Rear Adm. Charles B. Momsen, commanding Pacific Fleet submarines, says: "There is no foe that strikes more terror in the heart of a submariner than an enemy submarine lurking in the same waters."

Six new attack submarines—the *Tang*, *Trigger*, *Trout*, *Wahoo*, *Harder*, and *Gudgeon*—also are being built (page 614). They are the first we have produced which are capable of going faster submerged than on the surface. Like the K-boats, these deadly raiders are chubbier and shorter than the fleet type. Naval architects redesigned the interior to obtain more room for secret electronic equipment and high-powered batteries.

"They were built to give our antisubmarine warfare boys a real workout," said a Navy spokesman. "They, too, will carry the new, improved torpedoes."

"We've come a long way in submarine development," he added, "but without highly skilled crews these boats are no more lethal than a child's cap pistol. Our men are specialists, and we train them constantly."

### Volunteers Man the Undersea Fleet

My acquaintance might have prefaced the word "specialist" with "carefully selected," for all of our submariners are volunteers who must meet rigid standards. Because of the hazardous nature of their work, they receive as much as 50 percent extra pay.

By official Navy edict, the sprawling, 500-acre submarine base on Connecticut's Thames River calls New London its home. Actually the address is a postal rather than a geographic fact. Long wooden piers and busy repair shops line the Thames above Groton. New London lies across the river.

On a hill overlooking the water front are the campuslike lawns and modern buildings of the U. S. Submarine School and Medical Research Laboratory.

Every officer in the submarine force, and nearly all the enlisted men, are graduates of this school, the only one in the Navy for the training of submarine personnel (pages 621, 630, and 633).

Because of the secrecy which veiled its wartime operations, this branch of the Navy earned the nickname "the Silent Service." Hence, the New London base has become popularly known as the "Annapolis of the Silent Service."

Gilmore Hall, with its busy classrooms and administrative offices, is a living memorial to the 374 officers and 3,131 enlisted men who were lost in submarines in World War II. It bears a proud name, that of Comdr. Howard Gilmore, Medal of Honor winner.

His submarine, the *Growler*, was badly battered in 1943 during a surface battle with the Japanese. Lying wounded on the deck, Gilmore ordered his men to "Take her down!" Though her captain was lost, the *Growler* lived to fight for nearly two years more, until listed as missing in action.

This sign above a doorway greets all students entering the building:

> THEIR WANT OF PRACTICE WILL MAKE THEM UNSKILLFUL, AND THEIR WANT OF SKILL TIMID. MARITIME SKILL, LIKE SKILLS OF OTHER KINDS, IS NOT CULTIVATED BY THE WAY OR AT CHANCE TIMES
>
> —Thucydides, 500 BC

"That saying is just as true today as it was nearly 2,500 years ago," said Rear Adm. Stuart S. Murray. "It sums up the whole purpose of our training program."

Admiral Murray, who commanded Atlantic Fleet submarines at the time of my visit to New London, is now Commandant of the 14th Naval District and Commander of the Hawaiian Sea Frontier.

It isn't easy to enter the submarine school—and it is even more difficult to remain.

"Our applicants—and there are more than we have vacancies—come from other branches of the Navy," I was told by Capt. William B. Sieglaff, school commandant (now commander of the base). "All are rigidly screened for physical, mental, character, and personality qualifications, as well as naval skills, before they ever arrive."

Officers take a six-months' course in such subjects as engineering, ordnance, tactics, communications, and submarine construction and operation. Enlisted men go through a rigorous eight-weeks' training period, part of which is dubbed the "School of the Boat." They must become thoroughly familiar with each compartment in a submarine and know their own particular station as intimately as they do the faces of their wives and children.

"We believe a man retains more of what he sees and does than of what he hears," Captain Sieglaff said. "So our course is about one-third in classrooms with lectures, one-third in training devices and equipment, and one-third at sea."

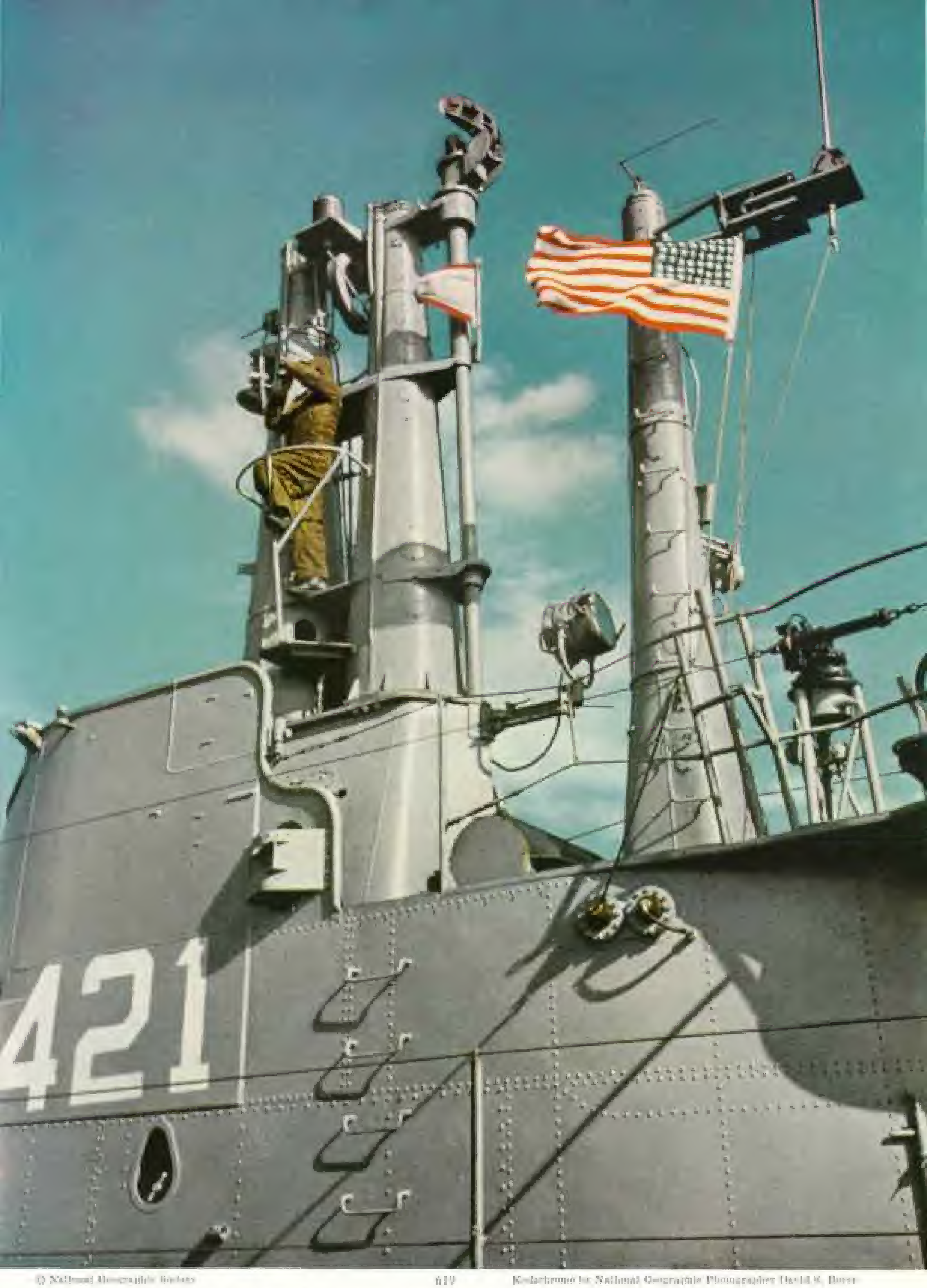
Since the school was established in 1917, more than 5,000 officers and 50,000 enlisted men have taken the basic training. There are also advanced courses, in which a captain may find himself rubbing elbows with a junior-grade lieutenant.

Touring the school, I watched three enlisted men operate an exact replica of the bow and stern diving controls found on a submarine. Their cubicle tilted realistically as the men twirled wheels and levers. Behind them an instructor created problems of course and depth, correcting the men when they failed to maintain proper angle and balance. Near by other enlisted men shifted huge levers controlling the speed of battery-fed motors and twin 1,600-horsepower Diesel engines.

### Training for Escape

Despite many safeguards, diving a submarine remains a dangerous business. Collision, a crew member's mistake, equipment failure, any of these may cause a sub to flood and sink. If this happens, some men may be trapped underseas in undamaged, watertight compartments.

To teach its students how to save their lives should disaster strike, the New London school built one of the most unusual classrooms in



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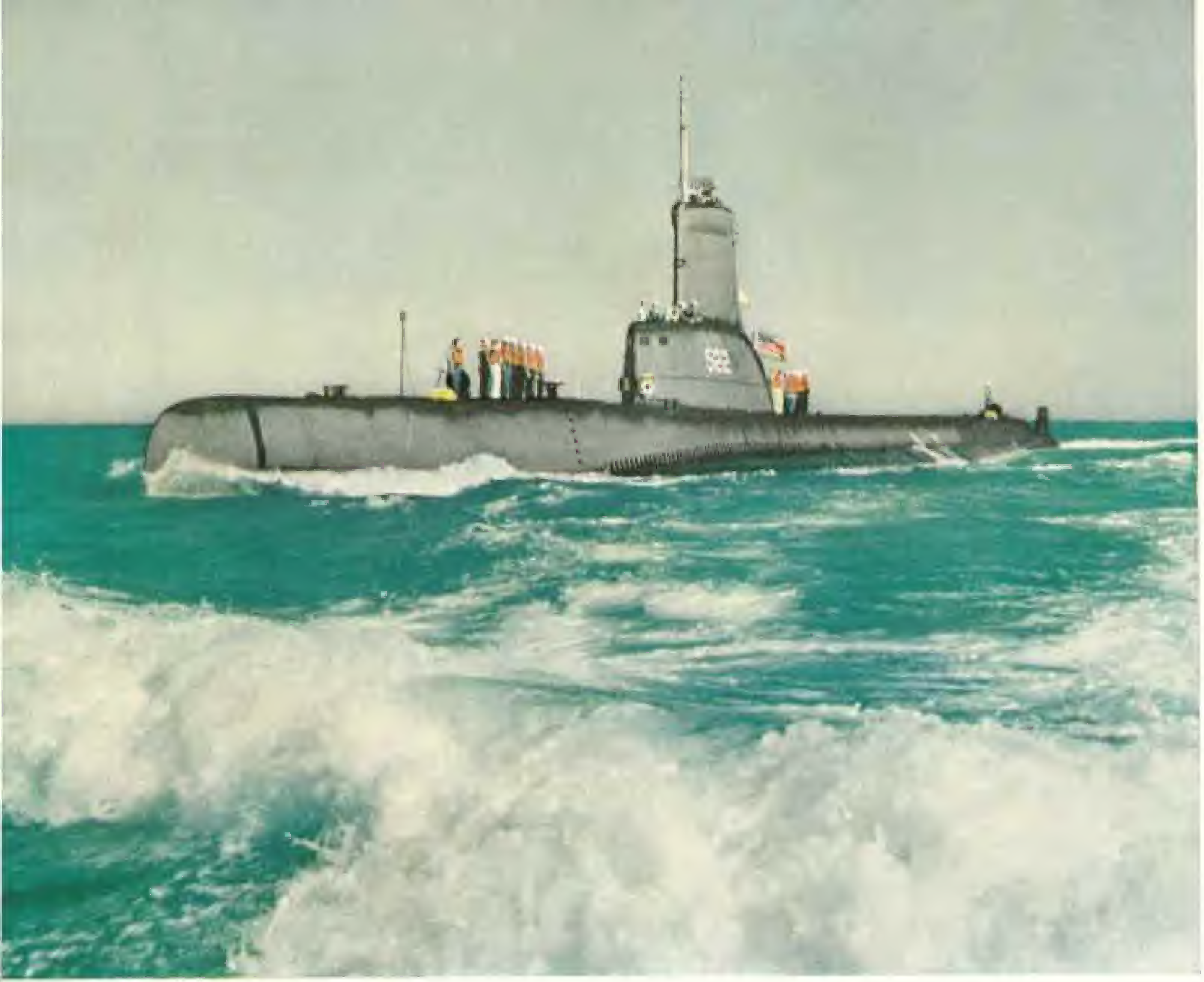
U. S. S. *Trutta's* Lookout Scans the Sea for Approaching Ships

*Trutta's* open bridge identifies her as a World War II sub. On later models a streamlined fin houses bridge and superstructure (page 620). The signal pennant says a division commander is aboard.



## A Sleek Guppy Sub Cruises Off the Florida Keys

United States Navy submarines of World War II, though still deadly, make only eight or nine knots submerged. Exposed decks and superstructure contribute to their slowness (page 619).

Shipyards are converting many of these older vessels into lean, fast killers called "guppies." Their slim decks are free of guns, railings, and other impediments to underwater speed. Superstructures and conning towers are streamlined.

In earlier submarines powerful Diesel engines, requiring air, could not be used when submerged. Crews surfaced frequently to charge batteries needed for underwater propulsion. Guppies minimize this problem with the snorkel breathing tube. This device sucks in air, enabling a sub to run Diesels and charge improved, high-performance batteries while at periscope depth.

Here a line-handling crew aboard U. S. S. *Amberjack* awaits docking orders as the submarine nears her home port, Key West. Senior men of the formation salute a passing ship. All but a few wear orange-colored Mae West life preservers.

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## Color Specialists Mix New Paints for Sub Interiors . . . A Radio-controlled Model Noses Toward a Miniature Pier

To lift crews' morale, Navy researchers at New London, Connecticut, are introducing bright paints and colorful materials in submarines, replacing sober black and white. Left: John Verges grinds pigment and Lt. Comdr. Dean Farnsworth checks experimental hues against a color chart. Right: This seven-foot model teaches ship handling. Officers issue commands; the control-panel operator maneuvers the sub.

Kodachromes by National Geographic Photographer David S. Boyer

COLOR
in submarine operation

### "We Eat the Best Food in the Navy," Submariners Boast

Uncle Sam provides his undersea warriors with a bountiful, wholesome larder: thick steaks and chops, fresh vegetables, tasty pastries—even ice cream made aboard ship. Navy food is generally good, but submariners stoutly maintain that their cuisine tops all others in the service.

When at sea sub crews have little to divert them from the tedium of their dangerous jobs. Next to "sack time," meals are the most important events in their day. Tempting food boosts morale and increases efficiency.

The snorkel poses a mealtime problem. Its use results in rapid variation of air pressure. Heads clog and ears pop, making eating difficult.

Here *Amberjack's* men dine on fried chicken, corn, salad, and apple pie. The messroom seats only 24. Since there are 72 in the crew, meals are served in three shifts.

A picture of the amberjack fish, for which the sub is named, decorates a bulkhead. The big urn (right) supplies hot coffee 24 hours a day.

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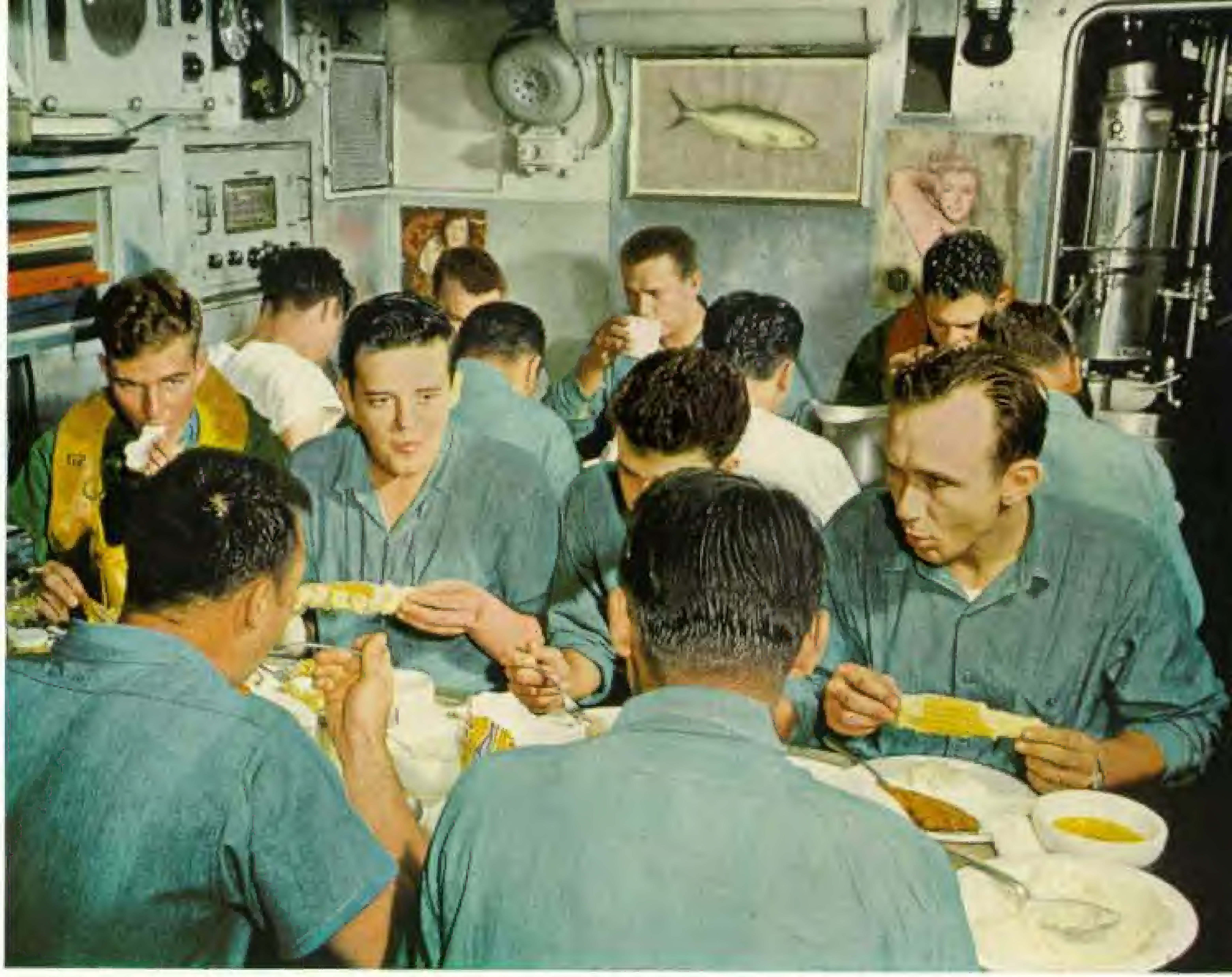
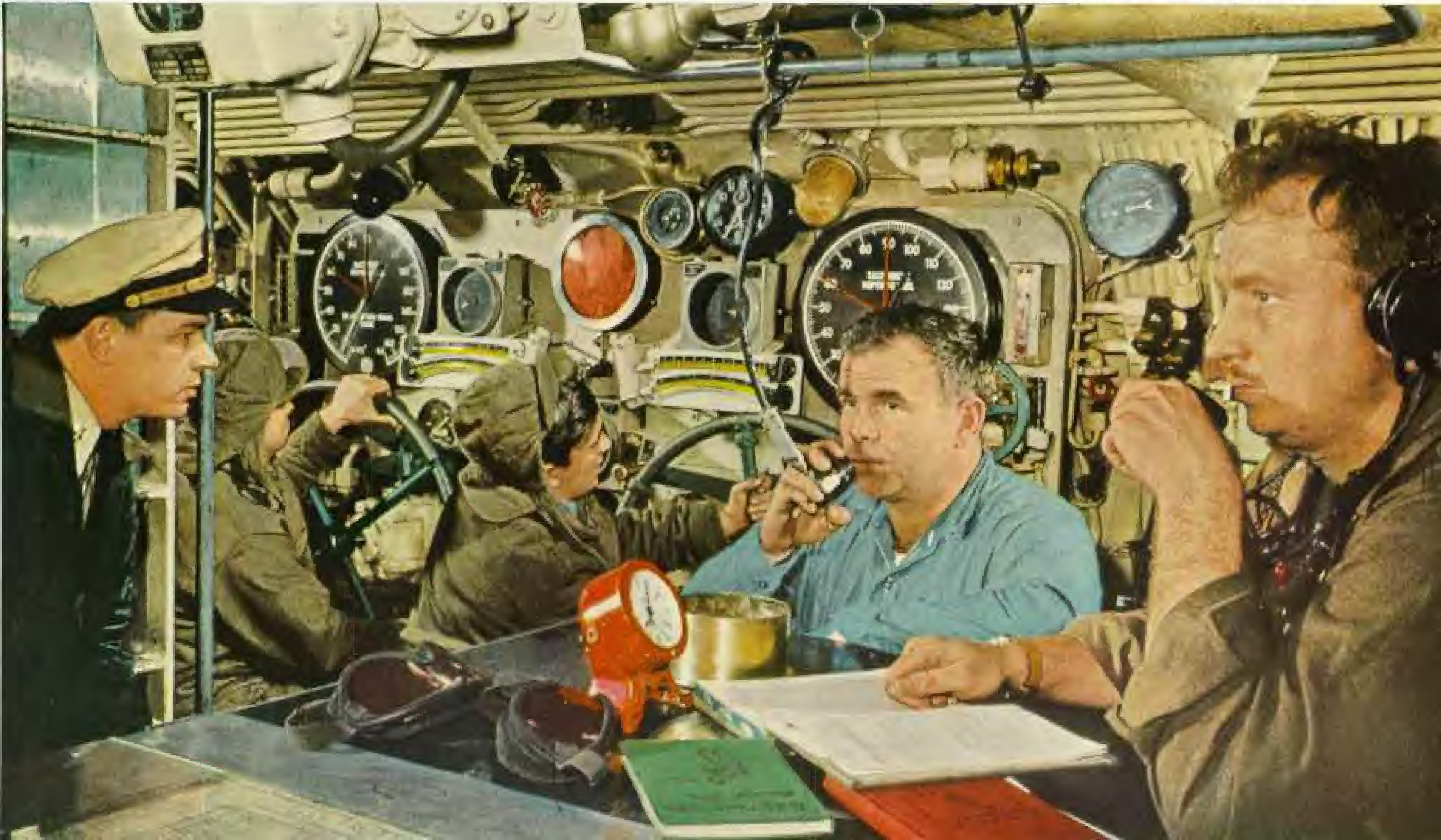
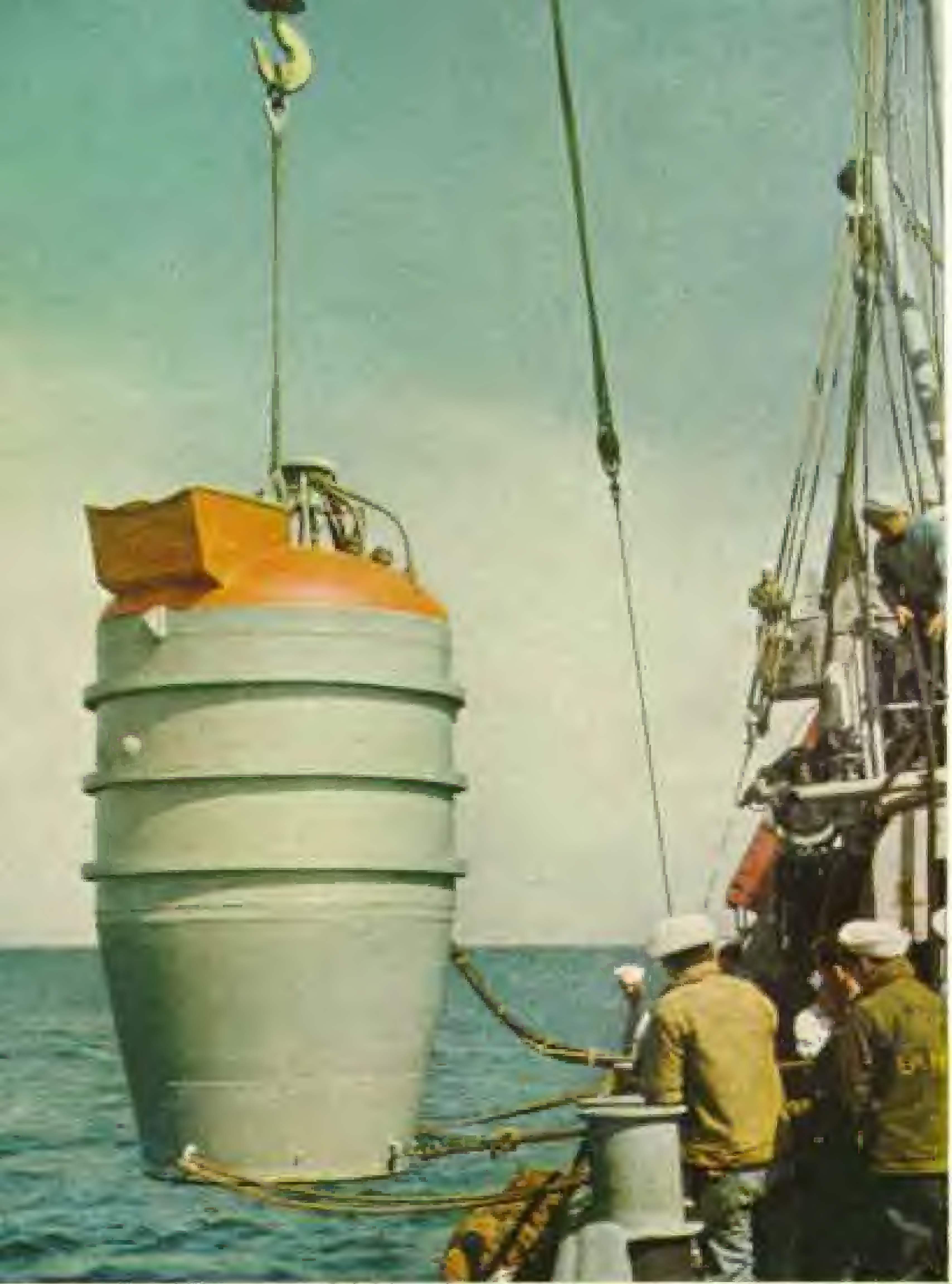


*Trutta's* Control-room Crew Takes Her Down in a Practice Dive. Submergence Requires Less than a Minute

Submarine crews perform more than 40 split-second operations when diving. Helmeted seamen operating bow and stern diving planes here nose *Trutta* under. An officer scans instruments; enlisted men talk with crew members in other compartments, receiving reports and transmitting orders and information on the progress of the dive

Kodachrome by National Geographic Photographer David S. Boyer





## U. S. S. *Skylark* Tests Her 11-ton Submarine Rescue Chamber

Peacetime submarine disasters, though infrequent, occur in every navy. If a sub floods and sinks, part of the crew may be trapped in undamaged compartments.

To rescue such victims, the United States Navy developed an ingenious diving chamber. Powered by a compressed-air winch, the steel bell descends on a cable to a submarine's escape hatch and locks on tight. In 1939 such a device brought up 33 survivors from the sunken U. S. S. *Squalus*.

The author made a 70-foot bell descent off New London with crewmen of the rescue ship *Skylark*. Submerging, they found the hatch ajar. Water poured in for a few tense seconds before the operator could reach the hatch and close it.

◄ A deck crane lowers the chamber to *Skylark's* side for outfitting with air hose, downhaul cable, and electrical connections.

▼ The bell surfaces. A guideline reels it in to the ship, where passengers emerge.

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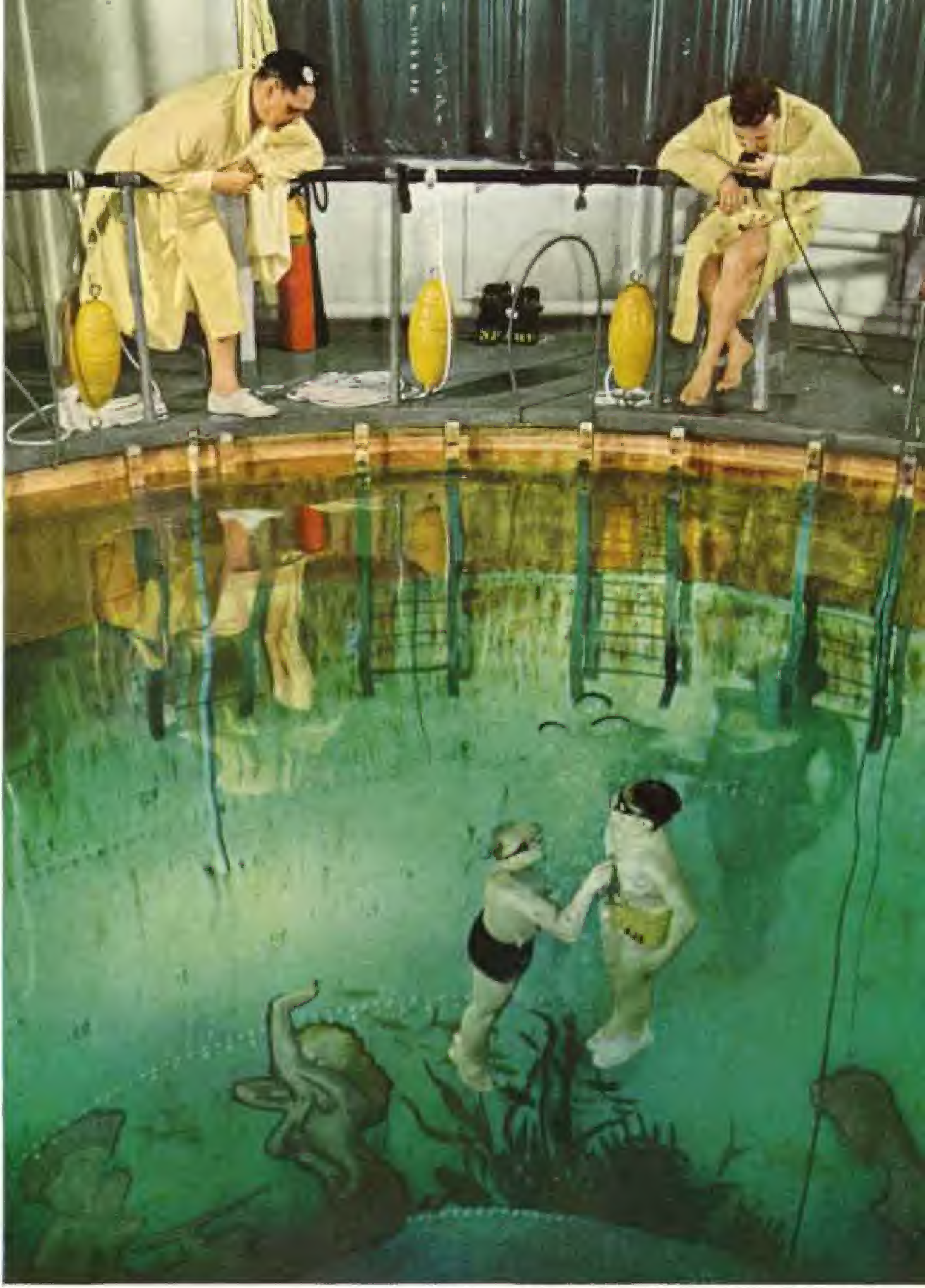
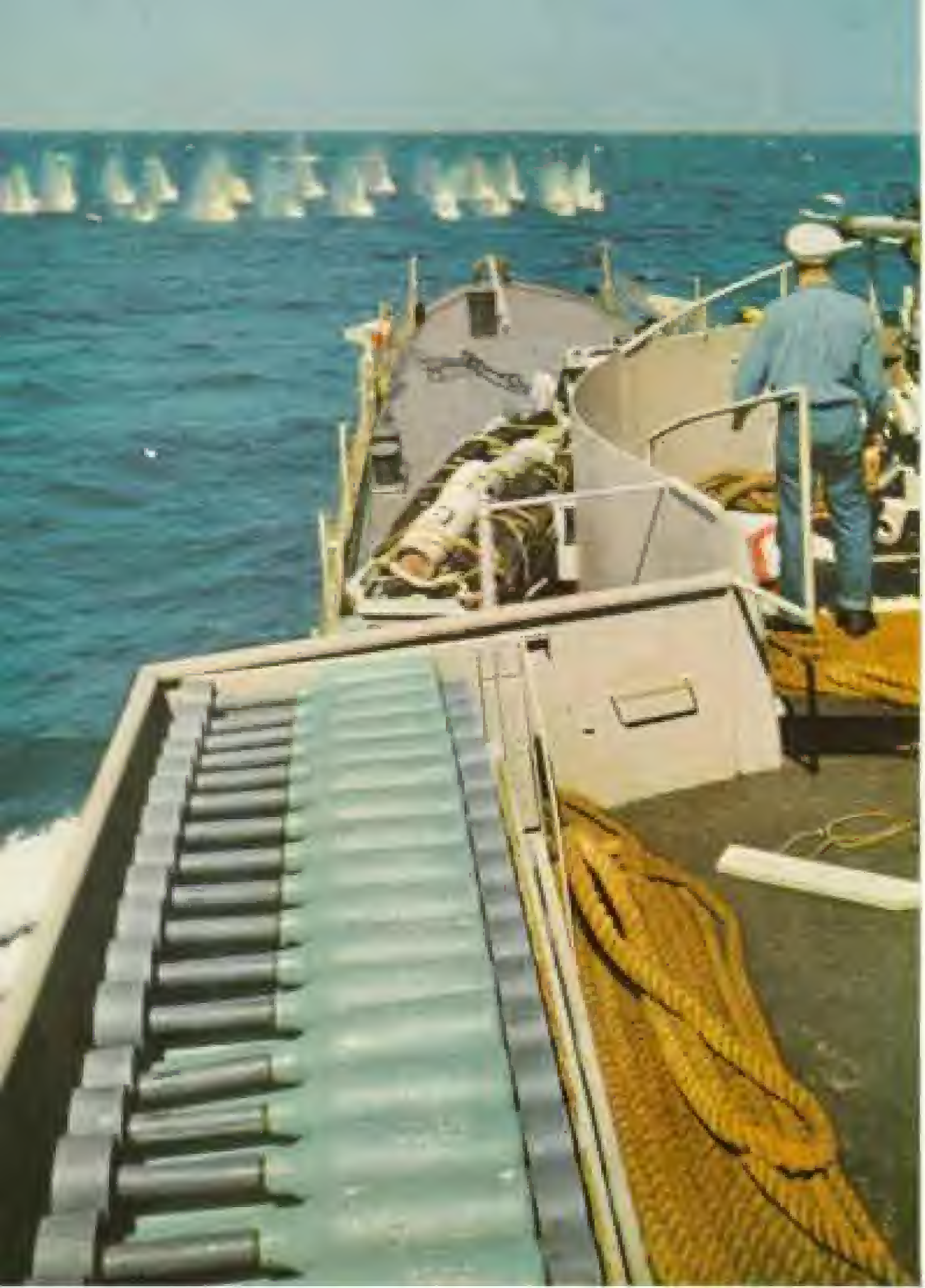


Kodachrome by National Geographic Photographer David S. Boyer

**Buoyant as Corks, Submariners Pop to the Surface of a Training Tank 100 Feet Deep**

New London trainees learn individual escape techniques. Instructor (giving hand signal) and pupil breathed compressed air in a lock before entering tank. Now they exhale while rising. Painted mermaids decorate the tank.



## Dummy Hedgehogs Shower Around a Submerged Sub

United States Navy forces work constantly to perfect their defenses against undersea raiders. Hunter-killer ships frequently are pitted against submarines in mock battle off our shores. Research work in new antisubmarine weapons and detection gear centers at Key West, Florida.

Hedgehog projectiles were introduced toward the end of World War II. Unlike depth charges, they explode only on contact with a sub or other hard object.

◄ Here the destroyer escort *Wilke*, stalking a guppy in Florida waters, tosses a circular pattern of 24 experimental hedgehogs. Instead of explosives, these weapons contain a harmless plastic material.

▼ Sailors load *Wilke's* mortar-type projector. After firing, green dye from hedgehogs marks the attack point.

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Kodachromes by National Geographic Photographer David S. Boyer

the world, a huge, silolike escape-training tank filled with 100 feet of water.

On each submarine there are two escape hatches, one at either end of the boat. The training tank duplicates these hatches in specially constructed locks at the 18, 50, and 100 foot levels (page 625).

Enlisted students must make an ascent from 50 feet, and officers from 100 feet, in order to qualify for the service. They wear a weird-looking appliance resembling a gas mask.*

Once charged with oxygen, it enables a man to breathe normally underwater for an average of 10 minutes. A special filter removes carbon dioxide, and a flutter valve permits excess oxygen to escape.

On the day I visited the tank, a group of advanced course trainees were learning a newer technique, the "free escape" without artificial breathing aid.

The hazards involved in this method caused Navy officials to suspend it from the curriculum not long after I left New London.

From an enclosed platform atop the tank I watched men drift slowly up through the floodlit water without moving a muscle, relying only upon the buoyancy of lungs and body.

### Lungs May Burst Like a Balloon

"You rise to the surface simply by exhaling air from the lungs," said Lt. James Heg, officer in charge of the tank. "If you don't get rid of enough air on the way up, it's possible to rupture the tissue of the lung."

Heg explained that air within the locks (or within a sunken submarine) must first be adjusted to the outside water pressure before the escape hatch can be opened. Men making a free escape fill their lungs with compressed air before entering the water.

An adult male's lung capacity at atmospheric pressure is about 5,000 cubic centimeters. A submariner leaving the 50-foot lock level has two and a half times that much compressed into the same volume. As he rises, the air in his lungs expands.

I heard instructors warn the students that they would have to exhale constantly all the way up, or risk having a lung break like an overfilled balloon. The men were cautioned that air embolisms, resulting from rupture of the lung, could cause paralysis if they lodged in brain or spinal cord.

Just such an accident occurred minutes after I left the tank. The man was rushed to the tower's recompression chamber. Air pressure was increased until the bubble literally was squeezed to nothingness, relieving the paralysis. Navy physicians said the man would recover.

More recently, however, there were two training tank fatalities from air embolisms. As a result, free escapes now are made only on an experimental basis.

The technique, though dangerous, serves an important purpose. It teaches men how to save themselves in the event they cannot find an escape appliance during a disaster, or if they lose their rubber mouthpieces while ascending.

More than 300,000 safe ascents have been recorded in the New London tank, most of them made with the appliance. Safety precautions are stringent, and a doctor is always in attendance. But, unfortunately, there is as yet no positive way of determining whether a man is expelling sufficient air while making a free escape.

### Diving Bell to the Rescue

Individual escapes are not possible at great depths or in extremely cold water. If circumstances permit, the best method of rescuing trapped men is with the Navy's ingenious submarine rescue chamber, an 11-ton diving bell. This device was used to bring 33 men from the *Squalus*, which sank May 23, 1939, off Portsmouth, New Hampshire.

Wherever United States submarines operate in peacetime, rescue chambers are near. They are carried on the decks of small oceangoing vessels equipped for rescue and salvage operations at sea. Some of these craft are specially designed for the work; others are converted tugboats.

"Event 1000," the Atlantic Fleet's code signal for a submarine disaster, speeds these mercy vessels and other auxiliaries to the scene.

Early-morning sunbeams were dancing on the Thames when I boarded the tug *Skylark* to witness a simulated rescue operation at sea. Our destination was Block Island Sound, where the chamber—or bell, as the crew calls it—would be put overboard in 70 feet of water.

"We're going to make what we call a 'false seat,'" explained Lt. Comdr. Romolo Cousins, captain of the *Skylark*. "We will lower to the bottom an exact replica of a submarine escape hatch, then send the chamber down."

"Incidentally," he inquired, "would you like to make the trip?"

Somehow I managed a faint "yes," then wandered across the deck for a look at our bell. It proved to be a pear-shaped metal monster, 14 feet high. Inside its steel hull were two compartments. The upper, watertight, had air and electrical connections; the lower was open to admit the sea.

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* For an account of the development and use of another device for breathing under water, the Aqua-lung, see "Fish Men Explore a New Undersea World," by Capt. Jacques-Yves Cousteau, in the NATIONAL GEOGRAPHIC MAGAZINE, October, 1952.

Here's how the bell works: To descend, ballast tanks are flooded and a compressed-air motor reels the chamber down on a cable, which divers attach to the submarine. When the bell is on the escape hatch, water is blown from the lower compartment with compressed air. Operators then open valves which release the air into their own compartment.

Now sea pressure becomes an ally. Like a suction disk against a wall, the bell is forced down upon the escape hatch, making a watertight seal.

A small door to the lower chamber can then be opened and 10 or more men can be brought from the submarine. The lower compartment is closed and flooded, ballast tanks are blown, and the bell reels itself back to the surface.

### A Trip to Davy Jones' Locker

Towheaded Bill Russ, a Navy diver, would attach our downhaul cable. Three sailors helped him into his heavy canvas suit and lowered the glass-fronted, valve-studded helmet onto his head. Five minutes later he was over the side.

For training purposes, Russ was breathing a helium-oxygen mixture not ordinarily used at the relatively shallow depth of 70 feet.

Despite every precaution, divers face the occupational hazard of bends. If they return to the surface too rapidly, decreasing pressure may cause the nitrogen in their systems to bubble like champagne, with painful and sometimes serious results.

Comdr. Harry Alvis, a Navy physician, kept in constant touch with Russ through a ship-to-diver communications line.

"How are you, Russ?" Alvis asked.

The voice that answered was a perfect imitation of Donald Duck.

"Everything okay down here," it squawked.

"That's due to the helium in the mixture he's breathing," Alvis explained. "Helium is a less dense medium than air and changes the transmitted qualities of the voice."

Soon Russ was back on deck after attaching the cable.

"Time for your ride," Cousins announced.

Four men were to accompany me: Lt. Glenn Heller, Chief Petty Officers Frank Coupal and John Peterson, and Journalist First Class Dan Reilly.

Reilly, a quick-witted youngster with an active sense of humor, had been my guide and escort in New London. Now he assured me:

"I'm only doing this because my orders are to bring you back alive!"

One by one we clambered over the ship's railing and dropped through the chamber's upper hatch.

Viewed from the outside, the bell had seemed huge (page 624). Now the five of us were encased in a tiny steel cell with just enough headroom to stand. Sloping walls were covered with pipes and valves.

The overhead hatch slammed shut. With a sudden lurch the chamber left the ship's side.

While Peterson called off a procedure check list, Coupal and the lieutenant operated valves and confirmed each order. A loud-speaker picked up their words and relayed them to the surface.

"Blowing main ballast" . . . "Main ballast blown . . ."

Suddenly a stream of dark water poured into the chamber from above, sloshing from my shoulder to the deck.

"Get the hatch!" Peterson shouted.

Lunging past me, Heller spun a metal wheel above us, securing the hatch cover. It had been unseated just enough to assure us a humid ride the rest of the way down.

"Are you all right?" Reilly asked me. I nodded, not trusting my voice.

Steadily the depth gauge hand crept downward—30 . . . 40 . . . 50 feet. Our compressed-air winch chattered noisily.

Finally we stopped at 70 feet.

Through a tiny, round window underfoot I could see the lower compartment begin to boil like a caldron as compressed air forced out the water. My ears ached as the pressure was suddenly vented back into our own steel cell.

Coupal opened the entrance to the lower compartment. There, about five feet below and plainly visible in the glow of our electric lights, was the submarine hatch cover.

We had made our "false seat."

"Ordinarily," Peterson explained, "we would bolt ourselves down to a submarine as a precautionary measure."

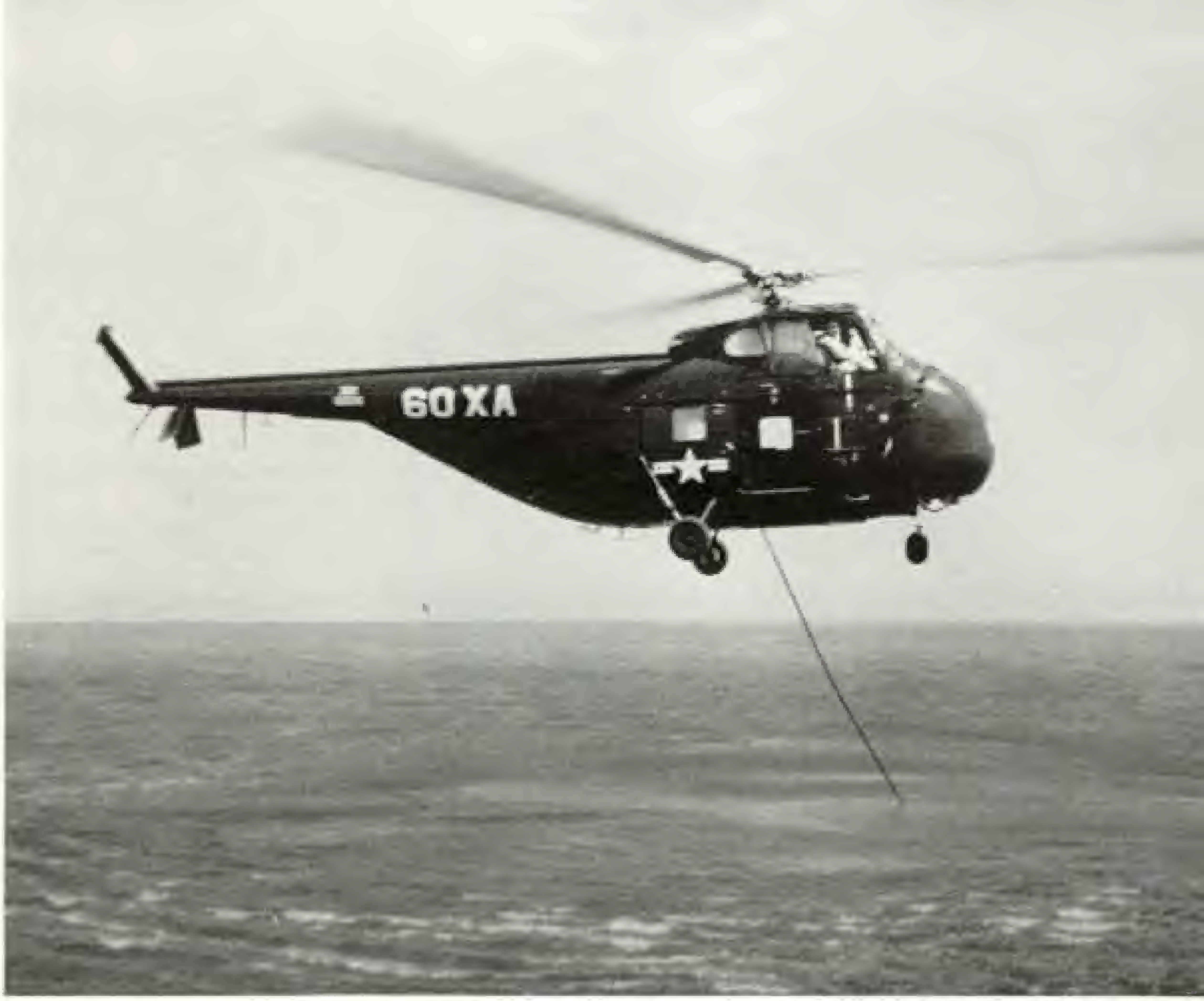
"That's it," said Heller. "Let's start back up."

Our return trip was smooth and uneventful. When we reached the surface, the *Skylark's* crew reeled in our slender guide line. For a few minutes we canted sharply to one side, bobbing on the waves, before we reached the ship's side.

### Mistakes Can Be Fatal

After our 43 minutes in the bell, *Skylark's* small deck seemed spacious as a carrier. I breathed gratefully of the good salt air as the little tugboat headed for home.

Once New London students master their shore lessons, they are sent to sea for intensive drilling in their specialties. Aboard the sub *Cavalla* I watched trainees operate the diving controls. A veteran crewman stood at



Allan C. Fisher, Jr., National Geographic Staff

**A Navy Helicopter, Stalking a Sub, Lowers Its Hearing Aid Beneath the Sea**

Sonar, the Navy's word for underwater sound gear, is the most effective means of detecting submerged submarines. Engineers have developed compact gear which ship-based helicopters, hovering above the sea, lower on an insulated cable. Navy men call the new technique "dunking sonar" (page 636).

the side of each student to guard against mistakes.

"There are more than 40 operations in diving a submarine," said Lt. Howard Unangst. "Flub any one of them and you may lose your boat. Whether you like your shipmates or not, you must have faith in them."

After a period of sea duty, New London graduates win the prized service-record notation, "qualified in submarines." But qualification is only the first step in their rigorous training. Fledgling submariners, and veterans also, polish their techniques through innumerable combat exercises.

To learn more about the training methods of our undersea Navy, I boarded the U.S.S. *Bang* for a sub's-eye view of a grimly realistic mock battle, fought in the gray waters of the Atlantic off Newport, Rhode Island. Comdr. Eugene Hemley, the sub's skipper, explained to me our mission.

At approximately 0800 hours (8 A.M.) the 27,100-ton carrier *Tarawa* would leave Newport, escorted by 10 destroyers. *Bang* and two other fleet-type submarines, *Cobia* and *Cod*, would attack, firing green flares from their tubes to simulate the release of torpedoes.

While we were leaving the harbor, Hemley turned me over to crewmen for a pre-battle tour of the boat.

### In "Enemy" Waters

Every visible nook and cranny on the *Bang* seemed crammed with pipes, dials, valves, and equipment. A fleet submarine, though longer than a football field, is no place for victims of claustrophobia.

We inspected the officers' tiny, Pullman-like staterooms and small wardroom, the crews' comfortable bunks, the galley and messroom, and the torpedo tubes in bow and stern.

Upon nearing "enemy" waters, Hemley gave the order to submerge. In the control room, crewmen moved with quick precision, closing some valves against the sea and opening others

National Geographic Photographer David S. Boyer

**Student Submariners Patch a Leaky Hull**

Trainees at the New London submarine school learn damage-control methods in this replica of a conning tower. Capping a break, the crouching sailor holds a patch while his companion locks it in place with a wrench.

which flooded the diving tanks. One operator released compressed air into the boat while an intent officer eyed a gauge. It reacted promptly to the increase in pressure, indicating all hull openings were closed.

Near by a chief petty officer scanned a panel of green lights. A red light on that panel would have warned of an open vent or valve which might flood a compartment.

Climbing from the control room to the conning tower, I learned that our quarry, now near by, had far too many solicitous guardians. Escort vessels searched the waters overhead like a pack of excited terriers.

### The Hunter Becomes the Hunted

From a post by the helmsman I watched our conning-tower crew plot the attack. Methodically, with the ease of long practice, a dozen men busied themselves with charts, sound-detection equipment, and electronic fire-control gear, all in a space no bigger than a cluttered kitchen.

Twice during the hour which followed we barely escaped from patrol craft. Then, suddenly, the climax of this undersea drama was at hand.

"This looks like the main formation," Hemley said from the periscope. "One, two, three, four destroyers and a large ship astern.

"If they straddle us we'll be all right."

Moments later he suddenly announced:

"We're in a good position to get rammed here. Fire the green flare!"

*Bang* nosed down to a safer depth. Then my ears seemed to play a trick on me. The rapid *clack-clack-clack* of a locomotive, chuffing across a trestle, filled the conning tower.

My open-mouthed astonishment drew a grin from Lt. Comdr. Richard Phipps, the *Bang's* executive officer.

"Down here, that's what a destroyer sounds like," he said. "One just went over your head."

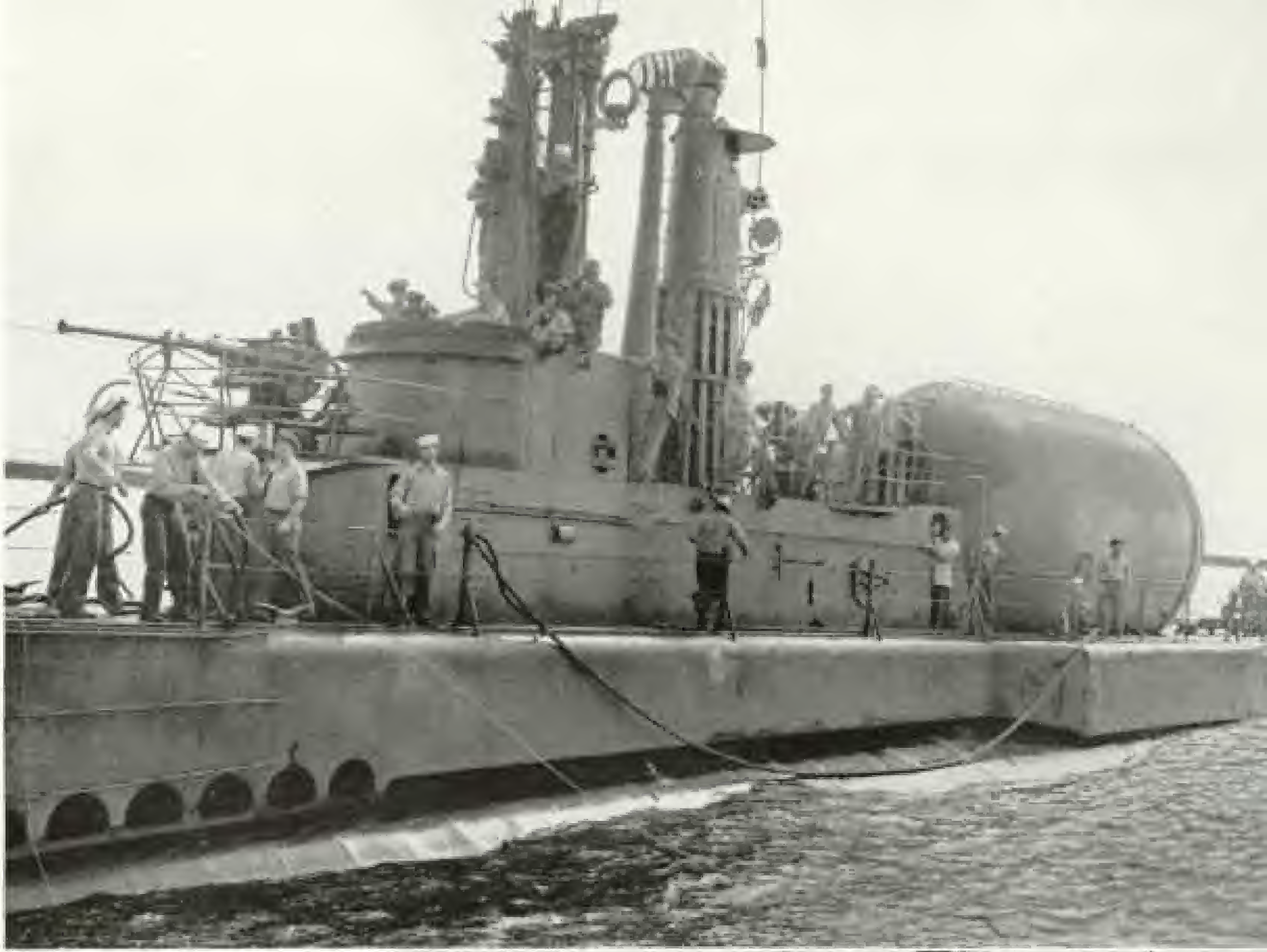
For the remainder of the contest we were pinned down deep. Several times destroyers made "passes" overhead, sweeping across our position to simulate attacks.

Later, during an evaluation of the training mission, I learned that our flare had bagged a destroyer. We, in turn, had been "killed" by other escorts, and the *Cod* had been kept deep.

But the *Cobia* found happier hunting. She got the carrier!

Within the spotless Medical Research Laboratory, physicians and scientists are constantly seeking better means to determine a man's fitness for submarine duty. Part of the program is original research in a great many specialized medical problems, such as the limits of night vision, color discernment, hearing, the physiological effects of air pressures, psychological factors in submarine life, and the development of physical standards for personnel. Another major function of the laboratory is to pass judgment upon all men seeking admission to the submarine school.

"We try to judge the man as a whole," said Comdr. Gerald Duffner, laboratory chief.



## *Perch* Practices a Reconnaisance Landing Attack

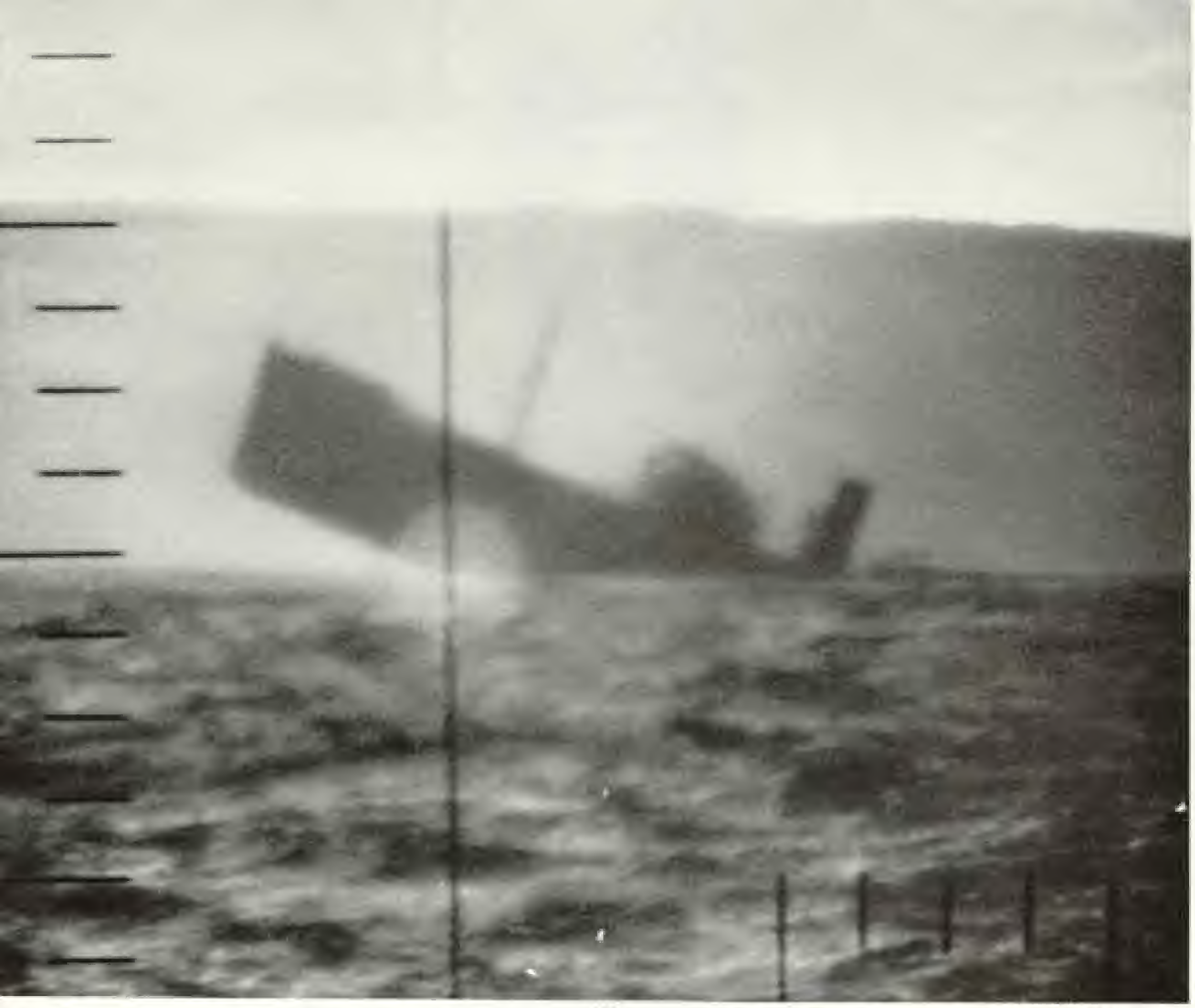
With the Marine Corps looking over its shoulder, the Navy stripped torpedo racks and other equipment from several submarines to convert them into troop carriers. They have been aptly called "floating foxholes" from which Leathernecks can emerge for lightning shore raids.

Venerable *Perch*, a World War II submarine, carries more than 100 Marines and their equipment. The sub's specialized task does not permit deck streamlining, but, like the racy guppies, she has a snorkel.

Here *Perch* approaches a pier after a day at sea. A watertight blister houses an amphibious landing craft (above, right).

➤ Marines heave an inflated raft over the side. Members of the reconnaissance platoon will clamber aboard and paddle ashore.

U. S. Marine Corps, Official



U. S. Navy, Official

**A Japanese Freighter, Torpedoed by U.S.S. *Guardfish*, Slides Beneath the Waves**

Our submarines sent to the bottom more than one-half of Japan's merchant fleet, a total of 1,113 vessels. This freighter was ambushed in enemy waters and her picture taken through *Guardfish's* periscope.

"After tests, physical examinations, and interviews, we decide whether an applicant is wrong for the service, acceptable, or borderline. All borderline cases are submitted to the commanding officer of the school for a final decision."

Despite the high standards of this elite corps, rejections average only 12 percent, largely because of the screening applicants undergo before being sent to New London.

One of the laboratory's most interesting research projects involves the psychological effect of color combinations, now being introduced experimentally in a few United States submarines. Traditionally the inside of a sub has been painted in gray and white.

"Now we're trying to change the interior so it doesn't look like the inside of a boiler," said Lt. Comdr. Dean Farnsworth, in charge of the color project (page 621).

"In psychological terms, gray and white in submarines is very bad. The men were always trying to do something about it. They would buy paint and use it in their boats at the risk of being found 'not regulation' at inspections. This indicated a need in their lives for color."

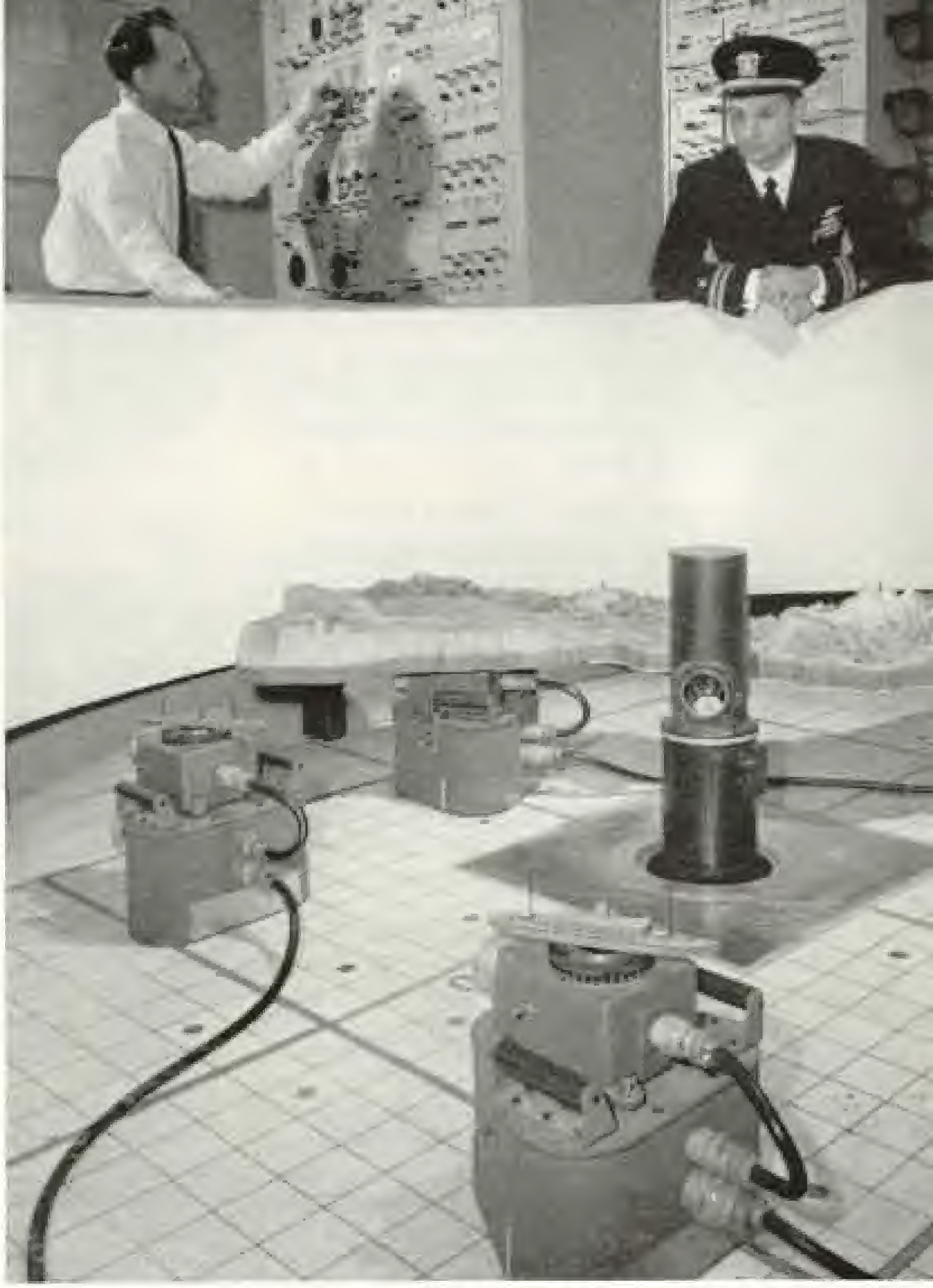
With the aid of volunteer professional color specialists, the Navy has been experimenting with new chlorinated rubber paints, easily washable, new plastic table and deck covers, nylon bunk covers, and improved illumination.

"Greens, if not too light, are well liked by the men," Farnsworth added. "They will take light reds and oranges, but they don't like odd colors."

### A Secret Project in "Siberia"

General Dynamics' Electric Boat Division lies just a few miles downstream from the submarine base. Under escort I was permitted to tour most of the company's huge plant—outfitting docks, foundries, machine shops, and administrative buildings, all darkly weathered by more than forty New England winters.

Dodging ponderous railway cranes, we ventured out on a pier for a look at recently launched *Trigger* and *Trout*. Near by their



National Geographic Photographer David S. Boyer

**Miniature Ships Sail a Make-believe Sea**

Using New London's ingenious Attack Teacher, submariners stage realistic battle exercises which would be extremely costly if duplicated at sea. Here two ship models, mounted on electrically driven carts called crabs, creep across a tile floor. Vacuum tubes simulate propeller sounds. One story below this level, men track the models by sonar gear or watch them through the periscope (center right). The panel operator controls ship movements.

sister sub, the *Harder*, was still on the ways, receiving finishing touches to superstructure and hull. Here the machine-gun chatter of chipping hammers rose and fell in an overpowering din.

Elsewhere among the sprawling sheds and shops, in a closely guarded area which employees call "Siberia," engineers were building the atomic sub *Nautilus* (page 635).

"That boat promises to usher in a new era in naval warfare," said Comdr. Edward L. Beach, smart young skipper of the *Trigger*. "A number of submariners—and that includes me—foresee the day when all warships must be able to submerge, or court disaster."

Beach had prefaced his surprising statement by conceding that many would dismiss it as absurd, fantastic. But, said this former naval aide to General of the Army Omar N. Bradley, just such skepticism greeted those who prophesied the deadly role of aircraft and the great striking power of fleet carriers.*

"An atomic sub," he added, "will ultimately attain speeds which, until now, have been considered impossible for any kind of vessel except a speedboat.

"Eventually, I believe, the surface of the oceans will become a sort of no man's land, to which ships in wartime will resort only in an emergency, and where their danger will be great. In short, the submarine will inherit the seas."

Such a forecast sounds incredible today. Yet I talked to a surprising number of young officers who agree emphatically with Commander Beach.

### Subs Fight Daily Battles

Marine engineers know that under certain circumstances a submerged submarine encounters less resistance in moving through the water than does a surface craft, which is buffeted and retarded by both wind and wave. It is possible, some officers now believe, for nuclear-powered submarines ultimately to outspeed surface vessels.

That day, if it comes, will be years hence, Beach and others stress. It is far from just around the corner. Many complicated problems would have to be solved first.

These uneasy years of peace find our Silent Service and antisubmarine warfare units wedded in a firm partnership. ASW development is one of the types of warfare with the highest priority, receiving one-sixth of all Navy research and development funds.

Blimps and airplanes can scan a vast

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* See "New Queen of the Seas" (Aircraft Carrier), by Melville Bell Grosvenor, in the NATIONAL GEOGRAPHIC MAGAZINE, July, 1942.

expanse of ocean with our new radar sets, whose screens provide ten times as much coverage as the old World War II equipment. Large objects can be picked up at great distances. Within certain lesser areas, even as small an object as a snorkel head can be detected.

Radar, however, cannot penetrate the ocean depths. To find submerged submarines the Navy relies primarily upon sonar (sound navigation and ranging).

### Tracking Down Undersea Raiders

Unlike radar and light waves, sound travels much better through water than through air. Most of us discover this fact as youngsters while learning to swim. Remember your annoyance when some friend knocked two stones together underwater while you had your head beneath the surface?

A sonar projector sends out supersonic waves, or "pings," which are reflected back from underwater objects. Receivers magnify the sound and measure the time lapse between ping and echo, thus determining ship-to-object distances.

Trained operators can tell whether the echo is from a submarine, a submerged rock, a school of fish, or other objects. If it proves to be a sub, electronic equipment will give range, bearing, speed, course, and depth.

Once a contact is made or suspected, planes and blimps may drop a pattern of sonobuoys. These expendable robots transmit sonar intelligence by radio. Aircraft also use Navy MAD equipment, magnetic direction finders which react to a submarine's metal hull.

Like radar, all these devices have certain range limitations. That's one reason why hunting down a submarine remains a large-scale undertaking and a matter of teamwork.

The research center for ASW techniques is Key West, our southernmost city, where the pace of naval activity is rapidly accelerating. Here are located a Fleet Sonar School, the Advanced Undersea Weapons School, and a number of air and surface units engaged in highly secret experimental work.*

### Key West Keeps Pace with Subs

Installations built during World War II, such as the air center at near-by Boca Chica, now dwarf the fenced-in barracks and clapboard houses of the original naval station, site of President Truman's rambling Winter White House.

In the warm, pastel-green waters off Key West, students from the Sonar School fight hunter-killer mock battles, such as I recently witnessed from the destroyer escort *Coolbaugh*.

As we put out into the Straits of Florida, a sister ship, the *Greenwood*, and the patrol craft *Mole* joined us astern. Somewhere ahead, cruising submerged, was the guppy submarine *Chopper*, our quarry.

Lt. Comdr. Clifton Southworth, a sonar instructor, sketched in the details of the day's plan. Our three-ship team would fire dummy hedgehogs—plastic-loaded projectiles stained with green dye to mark their point of entry into the water.

After each attack the *Chopper* would release an air bubble to indicate its position. If bubble and dye stain proved close, students manning the detection gear could be credited with a hit.

We climbed below to inspect the sonar control room, an equipment-crammed cubicle deep in the bowels of the ship. Crewmen greeted me with a "welcome to Torpedo Junction!"

### "I Am Attacking!"

Operators had begun "pinging" for a possible contact. An illumined sonarscope, marked like a compass, gave them a visual bearing on each object struck by the sound beam.

Three decks higher, we visited the underwater battery plot. Here sonar contacts were fed to an array of electronic calculating machines. A combat information center, located near by, kept a record plot of each contact.

Reaching the bridge, we found that the *Chopper* had been pin pointed and the chase was on.

*Greenwood* hoisted a flag, signalling "I am attacking!" Black smoke poured from her funnel as she turned abruptly and bore down on the target area.

A muffled report indicated the firing of a hedgehog. Seconds later a telltale dye ring appeared in the sea, but binoculars failed to detect an answering air bubble. *Mole* tried a similar run. The bubble, when it appeared, was some distance from the dye. Then it was the *Coolbaugh's* turn.

Water boiled from our bow as we moved in to attack. The hedgehog mechanism thundered; a projectile arched ahead and disappeared in the sea. This time a bubble burst to the surface within the green-stained circle (page 626).

*Coolbaugh* had scored a hit.

Attacks continued for more than two hours, until *Greenwood*, in tactical command of the day's operation, finally gave the signal to turn for home.

Commander Southworth had kept a box score on our ship's hits and misses. The

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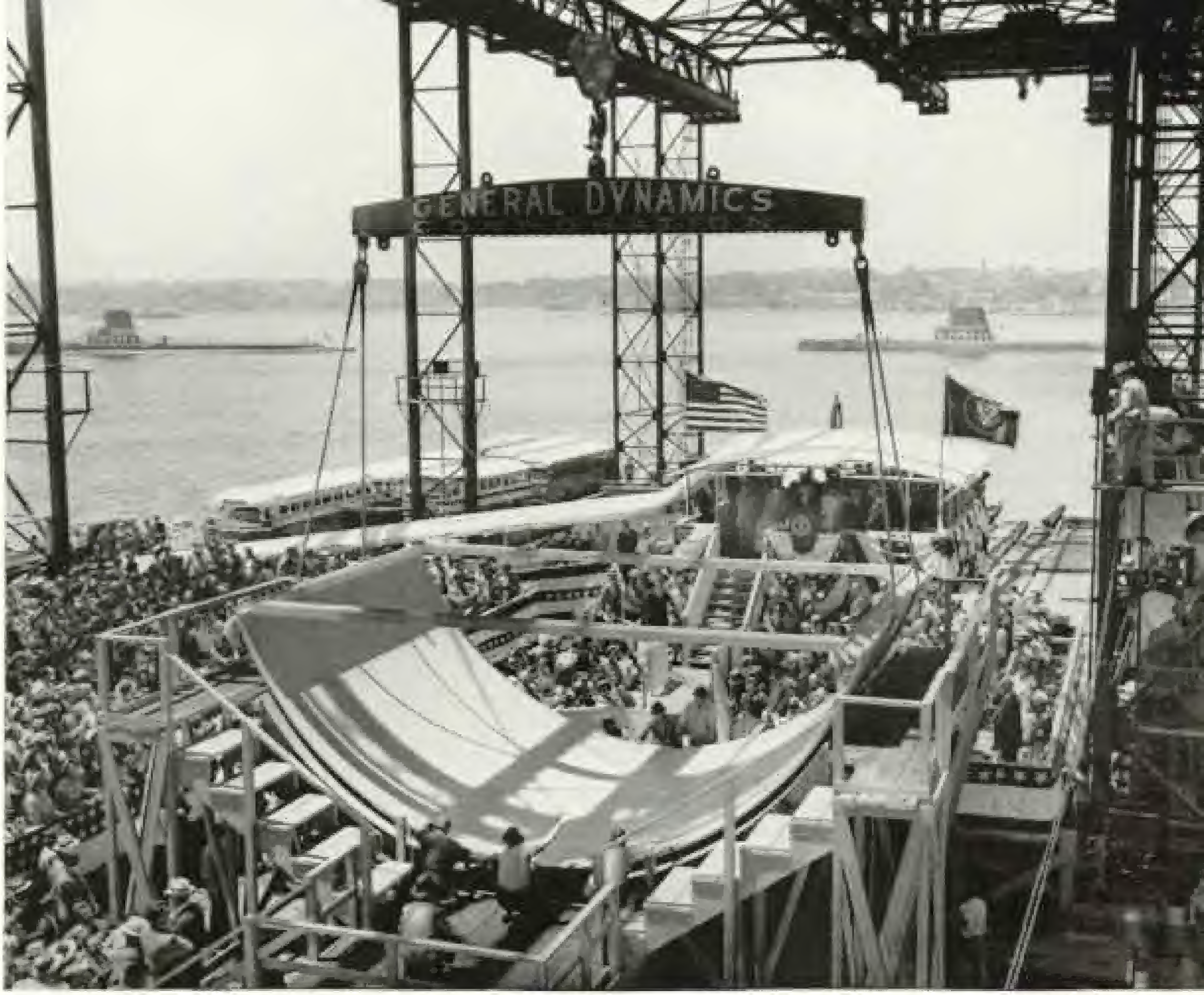
* See "From Indian Canoes to Submarines at Key West," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE, January, 1950.



Wide World

**U.S.S. *Nautilus*, the First Atomic Submarine, Will Grow from This Keel Plate**

Fast uranium-powered submarines threaten to revolutionize naval warfare. Rid of air-breathing combustion engines, they are expected to cruise indefinitely at great depth (page 615). Their fuel supplies may last a year or more. *Nautilus* is one of two atomic submarines being built at Groton, Connecticut. Her keel-laying ceremony took place June 14, 1952. *Irex* (left) and *Becuna* stand by in the Thames River.

students had been successful in more than half of their attacks, a good day's work for trainees.

### Musicians Make Good Sonarmen

Both officers and enlisted personnel are trained at the Fleet Sonar School. Last year the school graduated nearly 3,000 men, more than during the peak years of World War II. Instructors told me that their best students are trained musicians.

"A sonar operator must be able to recognize sounds that are actually fractional notes," explained Comdr. George Dawson, the school's executive officer. "As a target approaches, its echo increases in pitch; a lower pitch indicates the target is moving away."

Sound recordings, played in classrooms, test pitch discrimination among new students. Other recordings introduce them to many strange underwater sounds which they must learn to recognize instantly.

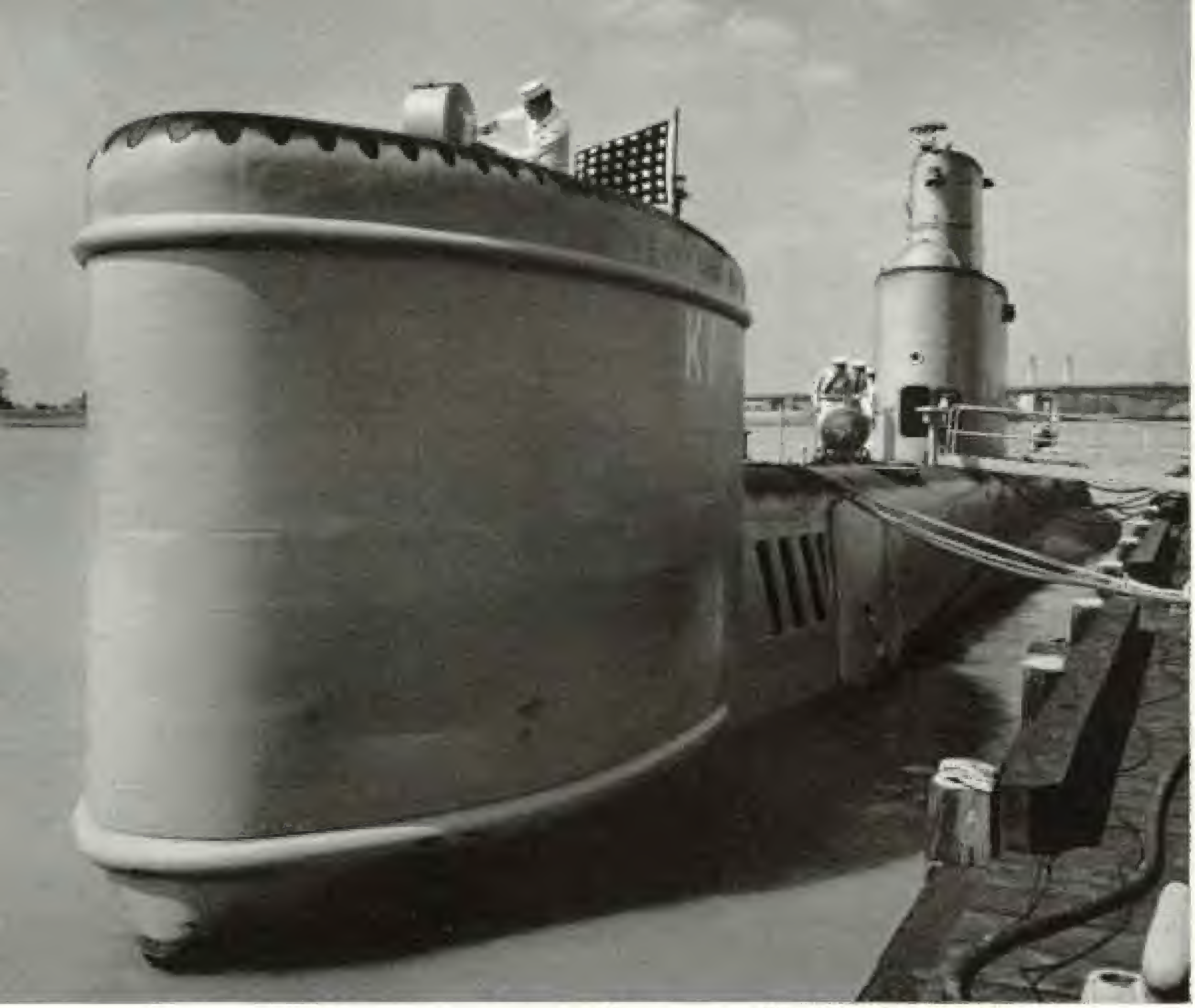
Listening to some of these noises, I found that a ship's wake has a soft, tentative echo, whereas a submarine hull gives off a crisp, metallic ring. A bed of shrimp, often heard by sonar operators as background "static," sizzled and crackled like bacon frying in a pan.

Navy officers are frankly and openly enthusiastic over the tactical possibilities of two new ASW developments now in the testing stage.

One is the acoustic homing torpedo. This weapon has proved to be a two-edged sword, adaptable to use by both the submarine and ASW forces. It can be set to "home in" on a submarine.

The second development is a new use for sonar. Scientists have developed a compact listening device which helicopters and blimps, hovering above the sea, can lower underwater on a rubber-insulated cable (page 629).

New-type torpedoes can be fired from a considerable distance beyond the effective listening range of escort vessels screening a convoy. Helicopters and blimps will lessen



National Geographic Photographer Robert F. Sisson

**A Huge Nose Identifies *K-1* as a Lethal New Killer Submarine**

Killer submarines were designed from the keel up for one specialized job: to lie quietly in wait for an undersea enemy and torpedo it. Other submarines are named for fish, but killer subs bear only the letter K and a numeral. Three 195-foot-long killers have been built. Crammed with equipment, they provide scant room for their 51-man crews. *K-1*'s bulbous bow contains sonar gear for tracking her quarry. Homing torpedoes enable her to destroy an enemy while both are submerged. Here the sub docks at Washington, D. C.

that advantage by combing surrounding waters with their sensitive underwater ears.

Navy men refer to the new technique as "dunking sonar." I witnessed a demonstration from the rear seat of a helicopter operating above the Straits of Florida. Somewhere beneath us was the guppy sub *Chivo*.

While our 'copter hovered like an ungainly hummingbird, flashing blades lifting spray from the water, Lt. G. G. McKee pressed a button which lowered his sound gear. I watched it vanish beneath the green waves.

### A Good Day's Hunting

For several minutes McKee listened on his earphones. Then a grin broke over his face and he nodded to me, indicating he had located the *Chivo*. The gear was drawn back and our pilot, Lt. Comdr. John R. Thompson, moved on.

Five "dips" were made before we called it a day. McKee informed me he had recorded three definite contacts and one probable.

Eighty-three years have passed since Jules Verne published his highly imaginative novel, *Twenty Thousand Leagues Under the Sea*. He wrote of a mysterious undersea craft, the *Nautilus*, which cruised the bottom of the sea, exploring its wonders.

Captain Nemo, commander of the *Nautilus*, proclaimed:

"The sea does not belong to despots. . . . Below its level their reign ceases, their influence is quenched, and their power disappears."

Verne's hero proved to be a very bad prophet. Two world wars have shown that submarines, in the hands of a relentless enemy, can wreak terrible havoc on the forces of freedom. Despite the ingenuity of modern science, there is as yet no panacea, no one sure countermeasure, for the submarine.

*This article and its accompanying illustrations were approved for publication by the Security Review Branch of the Department of Defense.*

# Pakistan, New Nation in an Old Land

## Carved out of Ancient India, the World's Most Populous Moslem Country Celebrates Its First Five Busy Years

By Jean and Franc Shor

*With Illustrations from Photographs by the Authors*

BONFIRES blazed in the Khyber Pass, and fireworks shattered the muggy stillness of the East Bengal jungles in August of 1952. Baluchistan desert tribesmen flourished lances in tent-pegging contests, piercing pegs in the ground as they rode horses at breakneck speed. Millworkers and shopkeepers danced in the streets of booming Karachi and Lahore. The new nation of Pakistan was celebrating its fifth birthday.

Pakistanis had reason to celebrate, for above the sounds of merrymaking rose the steady clatter of looms, the whir of thousands of new cotton spindles, the drone of light industry. Pakistan, which less than a decade ago was only a dream in the minds of a few determined men, had won a place as a stable and prosperous member of the British Commonwealth of Nations.

The 76 million citizens of this new state make it the most populous Moslem country and the world's seventh nation in number of inhabitants.

### Religion Changed the Map of India

"We had to struggle for a nation of our own," a Pakistan Government official told us in Karachi. "We were widely criticized when we demanded separate countries for Hindus and Moslems. People insisted that the subcontinent was an economic and geographical unit, and that partition would mean disaster.

"But man does not live by geography alone. Europe, North America, and South America are also natural units. But in all those continents individual nations have existed, and have grown great.

"We were sure of our ground. The Moslems had ruled India for three hundred years before the British came. Under British rule we withdrew from governmental affairs. The Hindus came to the fore. They held nearly all civil-service posts, controlled banks and business houses, and had far more educated men and technicians. They would have controlled a united continent.

"Religion was the most important issue," he emphasized. "The basic differences between the Hindu faith and Islam make it difficult for our people to work together. They regard the cow as sacred; we eat it. We have no caste system. Mohammed Ali Jinnah, the Father of Pakistan, summed it up in a single sentence:

" 'One hundred million people,' he said, 'are too many to be a minority!' "

Jinnah had his way, and became the first Governor General of Pakistan. He lived for only a little more than a year, however, and Prime Minister Liaquat Ali Khan, his successor as leader of the nation, was murdered by a fanatic in 1951.

### "Go See for Yourselves"

The present Prime Minister, Khwaja Nazimuddin, smiled across the luncheon table when we told him we had come to report on Pakistan for the 2,000,000 members of the National Geographic Society.

"You will find a country of strange contrasts," he said. "You must remember that while we are a new nation, we are a very old land. You will see turbaned tribesmen driving new American cars through streets crowded with camel carts. Modern factories stand next to the stalls of native craftsmen. Bullocks turn water wheels in the shadow of huge hydroelectric projects.

"There are contrasts in our Government as well. Our central administration is based on Western models, and our new constitution will combine the practices of democracy with the historic tenets of Islam. Yet, in our tribal areas, people are still ruled by laws which were old when America was discovered.

"But you are travelers. Pakistan is not a set of facts and figures; it is the sum of its people. Go see for yourselves."

We accepted the Prime Minister's invitation. For five months we traveled through every section of Pakistan. We rode trains and elephants, trucks and camels, airplanes and jeeps, river steamers and dugout canoes. We lived and talked with the people of Pakistan, and found them friendly, proud of their progress, confident of their future.

The picture is not all bright. We found famine in the Sundarbans jungles of East Bengal, and saw food riots in Lahore. We saw the police fire on crowds of students in Dacca during a demonstration demanding that Bengali be made an official language. But in every case we found the Government taking prompt and effective action.

David Peskin

**Karachi's Port Trust Building Administers the Overseas Commerce of a Thriving City**

Tall, ungainly, sad-looking camels do a big job transporting everything from cotton bales to this load of rattan. Sometimes a cart staggers under freight loaded 12 feet high, the driver perching on top and holding a single rein. Sunday's off-duty cameleers hold cart races; betting is heavy.

"This is the only country in the East where there is no threat of communism," said an official of the American Embassy in Karachi. "There are communists—but not enough to worry about."

### Building a Nation While Living in It

A Karachi newspaperman summed up the story of Pakistan in a single anecdote.

"The hotel where you live isn't finished yet," he said. "It is modern in every respect, but it is being built by ancient methods. Women carry concrete in baskets on their heads, and workmen shape bricks by hand. We need space so badly that someone moves into each room the day it is completed.

"That is Pakistan. We're building a new country while we live in it!"

Mohammed Ali, Pakistan's Minister of Finance, pointed out that for the fifth straight year his country had lived within its means, despite heavy expenditures on armed forces and resettlement of Moslems from India.

In 1947, when the new nation was organized, it found itself with only two real assets. The first was the vast area of rich grain- and cotton-producing land in the western Punjab, and the rice paddies and jute fields of East Bengal (map, pages 640-641). The second, and perhaps the most important, was the spirit and determination of its people.

"The survival of Pakistan in those first

George F. Wiese

**Parading Pakistanis Celebrate the Birth of Their Five-year-old Nation**

Each August 14 the people pay tribute to the founders and, like Americans, enjoy feast and fireworks. Completely independent, the country chooses to remain a part of the British Commonwealth of Nations. These banners proclaim, "Learn civil defense" and "Kashmir is an arm of Pakistan."

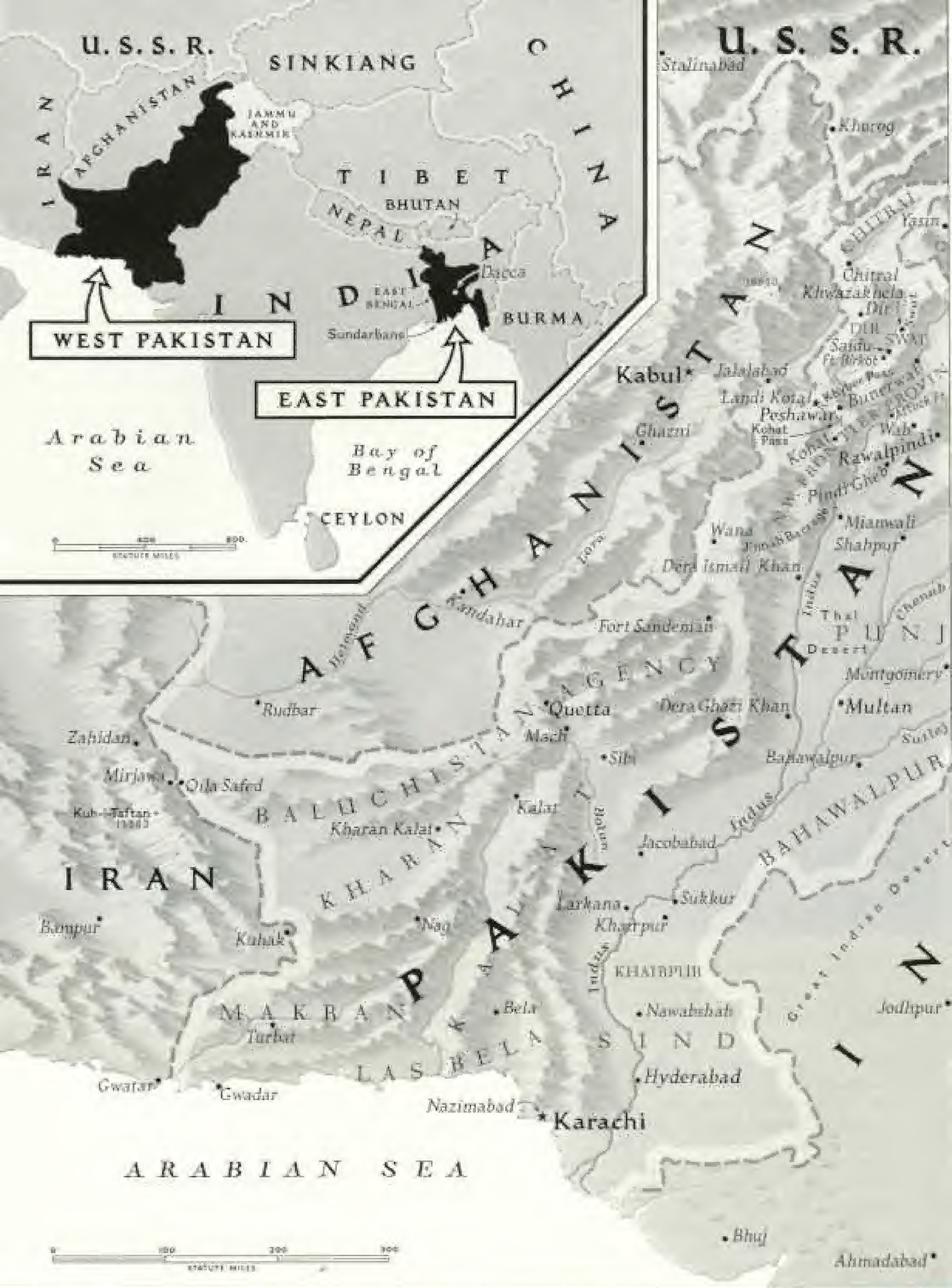
terrible months was a miracle," a Karachi businessman told us. "I was in Lahore, in the Punjab, when partition was announced. Countless people were killed in riots on both sides of the border. More than five and a half million Sikhs and Hindus streamed out of western Pakistan. Six and a half million Moslems poured in from the Indian side.

"That was staggering enough, but departure of the Hindus had completely upset the life of the province. Nearly all the trained men in the Lahore electric plant, for example, were Hindus. The same thing was true in the waterworks, the railways, the industrial plants, and the financial institutions. In a few days those trained men were gone, and the country was threatened with collapse."

He paused, and smiled proudly.

"That is where the miracle occurred," he said. "A man-made miracle! Those plants had to be operated, or Pakistan could not survive. And they *were* operated—by the little people, the untrained but faithful men who had spent years in subordinate jobs. The need was there, and they met it.

"A lineman, a man who had spent 20 years in the electric plant and was making $40 a month, came to the city officials when the trained staff fled. 'I think I can keep the plant running,' he said, and they told him to try. He did try, and he did run it, and the power never failed in the city of Lahore.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WEST PAKISTAN
EAST PAKISTAN
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Bay of Bengal
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Stalinabad
Khorog
CHITRAL
Yasin
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SWAT
Saidu
Ft. Birkot
Kabul
Jalalabad
Landi Kotal
Bunerwal
Peshawar
Kohat Pass
Kohat
Wah
Rawalpindi
NORTH-WEST FRONTIER PROVINCE
Ghazni
Pindi Gheb
Wana
Jinnah Barrage
Mianwali
Shahpur
Dera Ismail Khan
Indus
Thal Desert
Chenab
PUNJAB
Kandahar
Helmand
Fort Sandeman
Montgomery
Multan
AFGHANISTAN
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Kuh-i-Taftan 13,03
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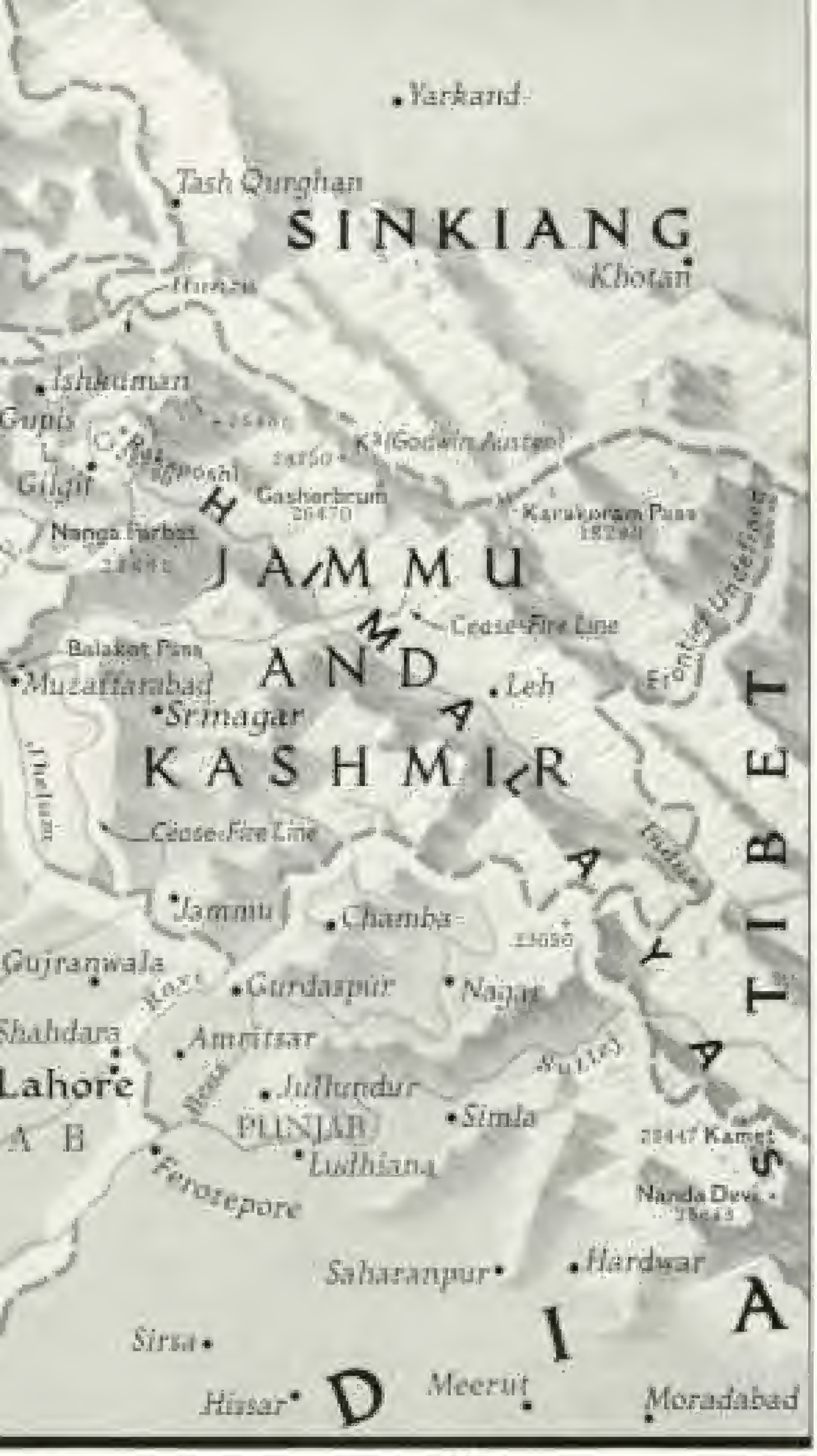
STATUTE MILES

A National Geographic Map

West and East Pakistan, 1,000 Miles Apart, Maintain Communications by Air and Sea

Eighty-six percent of the 76 million people are Moslems; 13 percent are caste Hindus and Untouchables.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26470
Karakoram Pass
18290
Nanga Parbat
26660
JAMMU AND KASHMIR
HIMALAYA
Cease-Fire Line
Balakot Pass
Muzaffarabad
Srinagar
Leh
Frontier Undefined
Jhelum
Indus
Jammu
Chamba
Gujranwala
Gurdaspur
Nagar
Shahdara
Amritsar
Sutlej
Lahore
Beas
Jullundur
PUNJAB
Simla
Ludhiana
Ferozepore
25447 Kamet
Nanda Devi
25645
Saharanpur
Hardwar
Sirsa
Hissar
Meerut
Moradabad
TIBET
INDIA

"The same thing happened throughout the country. That was the miracle of Pakistan—the miracle of the little man. He saved our nation."

### Women Drop Veils, Rally to Help

Nor were the men alone in their answer to the call. For hundreds of years Moslem women have been secluded, sheltered from any contact with public life. But in those days of disaster, when refugees had to be fed and the sick and wounded cared for, the women of Pakistan laid aside their veils and came to the assistance of their nation.

"We called for them to come out and help, and they came by the thousands," said Begum Liaquat Ali Khan, widow of the Prime Minister. "The women of Pakistan learned, in those hectic days, that they had a real part to play in the life of their country. They have never forgotten it."

Begum Liaquat helped organize the All-Pakistan Women's Association, and today that group of earnest Moslem ladies is one of the most progressive forces in Pakistan. It is devoted not only to relaxing the restrictions of purdah, under which some 20 percent of Pakistan's women still live in rigid seclusion, but to education, social reform, and giving women a place in Government.

"When you educate a woman, you educate the whole family," the Begum has said.

Many women have left purdah in the past three years. Women have won seats in provincial and national legislatures. A woman has presided over the sessions of Pakistan's National Assembly.

But the fight against purdah has widespread opposition. Pakistan's more orthodox Moslems are bitterly opposed to relaxation of the restrictions. Even two women who have been elected to one of the provincial legislatures sit in curtained enclosures and wear the burka, a heavy veil which covers them from head to toe. Only their eyes are visible, through tiny embroidered holes.

### From Crowded Karachi to Desert Waste

In many ways the capital, Karachi, is typical of Pakistan. It is booming, changing every day, crowded with all the polyglot races of the country (page 658).

In five years the city has grown from 300,000 to 1,200,000 people. New buildings are going up by the hundreds (pages 648 and 651). In some cases, two or three families are crowded into a single small dwelling. The city is surrounded by acres of mud and straw huts in which unsettled refugees eke out a miserable existence.

Light and water facilities are strained to the breaking point. Public conveyances are crowded. Streets are jammed (pages 646 and 662). Prices are high. The city is paying the price of the country's development.

From Karachi we traveled by train to Quetta—northward across Sind, and into the heart of Baluchistan Agency. This desert province occupies more than one-sixth of the total area of Pakistan, but its rocky wastes support fewer than a million people. Seen from our train window, the desert resembled the moon—stark sand and rocks, sheer, barren hills, ragged gulches.

But Quetta, set in a ring of rugged mountains at 5,500 feet, is crowded and colorful (page 649). It was almost completely destroyed in the great earthquake of 1935, which killed more than 24,000 people. The new buildings are one-story structures of adobe and concrete.

In late February we drove a hundred miles southeast to Sibi, winter capital of Baluchistan. The road was lined with migratory tribesmen. They winter near Sibi and in early spring move families and livestock 200 miles to summer pastures. Tents, blankets, furniture, and even chickens were piled atop the camels and donkeys.

Near Mach we stopped to chat with a

family which had camped for the night. We had sleeping bags, and asked if we could stay with them, furnishing our own food.

"You are welcome to share our camp," said Latif Khan, "but you will also share our food. In the desert a traveler is a guest."

Our hosts were Brahui tribesmen (pages 652 and 653). Every man is armed, but they are friendly. Their ancient, muzzle-loading rifles have curving stocks inlaid with brass, and the hilts of their great curved swords are bright with semiprecious stones.

The women grind flour for each meal on flat stones. This they mix with water, baking flat chapatties on a stone over glowing camel dung. It is their only food on migration, and we insisted on adding to the supper.

We heated two tins of spaghetti and two of corned beef. The tribesmen ate the meat with their fingers. The spaghetti they found too slippery, so they drank it from bowls.

"Very good," said Latif Khan, "but very hard to catch!"

Jean started to bury the empty cans. The tribesmen yelled an anguished protest, grabbed the cans and flattened them into sheets.

"Metal is more precious than food," explained Latif Khan.

In the morning our friends packed their beasts and started their sheep along the trail. Most of the women wore battered metal waterpots on their heads, like helmets.

"Imagine," said Jean, "going into a shop and saying: 'I'd like to try on a waterpot!' "

At Mach, on the railroad, camels carried coal from dozens of open-pit mines to huge piles on the rail siding.

"We have tripled coal production in this area in three years," the stationmaster told us. "Modern machinery has been ordered, but Pakistan needs coal desperately, and we are producing it by hand."

### Tent with Twin Beds, Two Baths

At Sibi we were welcomed by Mian Amin-ud-Din, Agent of the Governor General, chief of civil administration in Baluchistan and the tribal states of Kalat, Makran, Las Bela, and Kharan. He had invited us to the annual Durbar Week, telling us we would be accommodated in a tent. We were, but the enormous canvas structure had twin beds, easy chairs, Oriental carpets, and two bathrooms where servants brought hot water at any hour.

At a dinner which featured three kinds of curry, each hotter than the last, the AGG told us of the modernization of Baluchistan.

"This is a food-deficit area," he said. "But it won't be for long. Work is under way on a $13,000,000 dam and irrigation project on the Bolan River which will bring 225,000 acres under cultivation."

Two smaller irrigation projects are also planned. Farmers have been taught improved farming methods, and better seeds and breeding stock are being furnished by the Government.

"A desert area doesn't have to be poor," said tall, Oxford-educated Amin-ud-Din.

Begum Amin-ud-Din, a gracious woman with a sparkling sense of humor, is a leader in the All-Pakistan Women's Association. Her job is difficult, for the tribesmen cling firmly to their traditional way of life.

"We move slowly," she told Jean, "but the movement is spreading. We have provided a market for the beautiful embroidery done by the women, and they are earning money. When a husband finds his wife adding to the family income, it has a fine effect on his attitude toward the responsible organization."

She showed us the famous embroidery done in Baluchistan. Tiny mirrors are embroidered onto the cloth. Some women, she told us, are too poor to buy scissors, so they bite the thin sheets of mirror to proper size.

"We furnish cloth for them to make costumes," she said. "They use the new material for the front, but the back is always of patched material. 'No one will look at a poor woman's back,' they insist, 'so why should we waste good cloth?' "

### Durbar Like a County Fair

Durbar Week brought thousands of tribesmen to Sibi. The occasion was like a county fair at home, with races and judging of stock and exhibits.

On Durbar Day scores of khans, nabobs, chiefs, and subchiefs appeared to receive their annual grant. Border tribesmen are not subject to Pakistan laws, but are ruled by "Customary Laws," based on tribal practices. The chief of each tribe is responsible for the maintenance of law and order, and is rewarded with an annual cash payment.

Many tribal leaders wore the traditional formal dress of the desert—a long white shirt and baggy trousers containing many yards of

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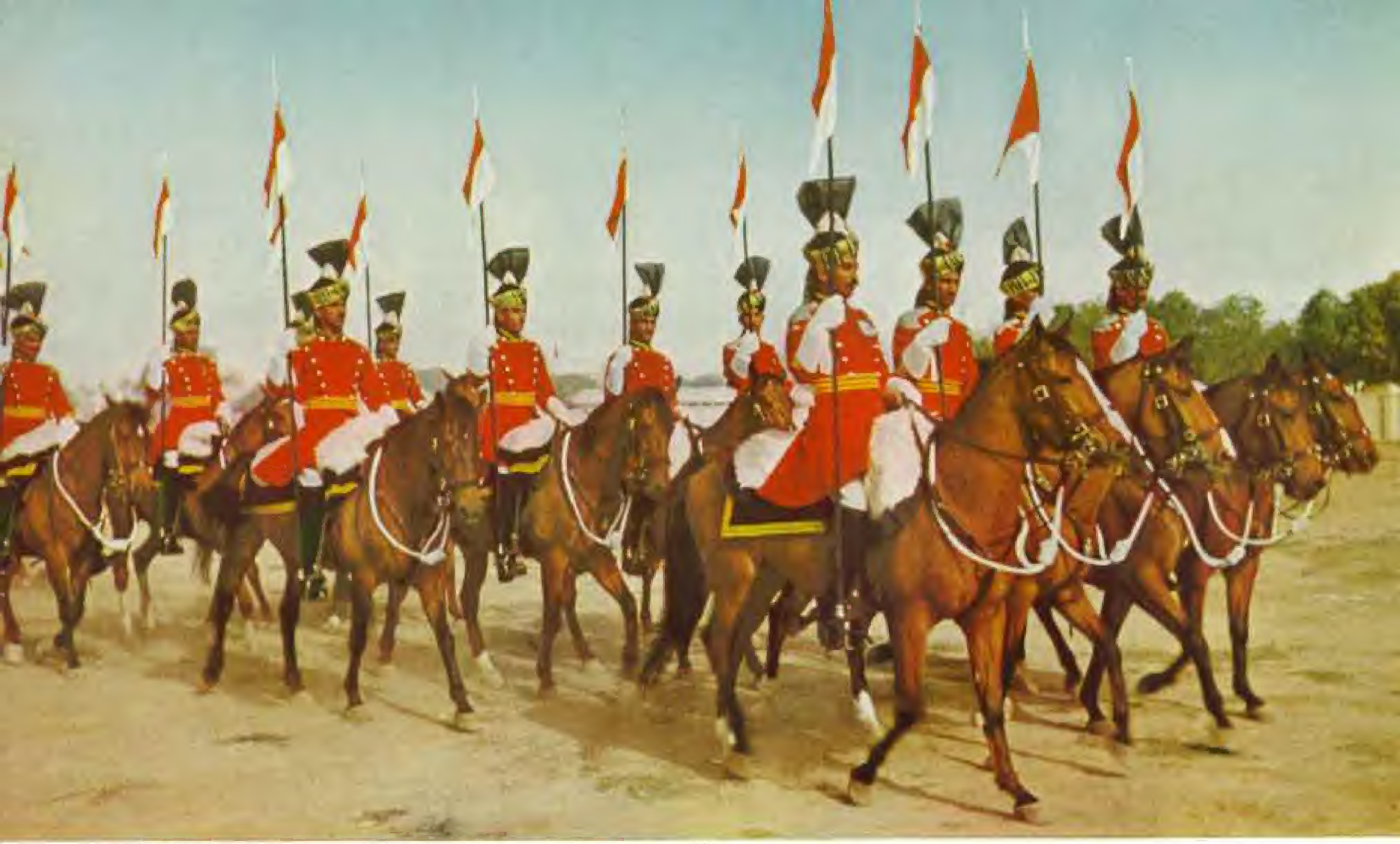
**Beneath the Tasseled Turban Stands → Six-feet-six of Pathan Guard**

Pakistan assigns to its Governor General a personal bodyguard of 24 crack cavalrymen, who escort his state coach and stand watch outside his residence in Karachi (page 644).

These elite guardsmen are carefully selected from Pakistan's regular military forces. Each must be at least six feet two; one of them is seven feet. Uniforms are similar to those of the Bengal Lancers.

This mustachioed trooper, who sometimes stands guard in 120° heat, wears a 20-pound outfit, including wool uniform and high boots. Regulations permit the safety pin securing the peak of his turban.



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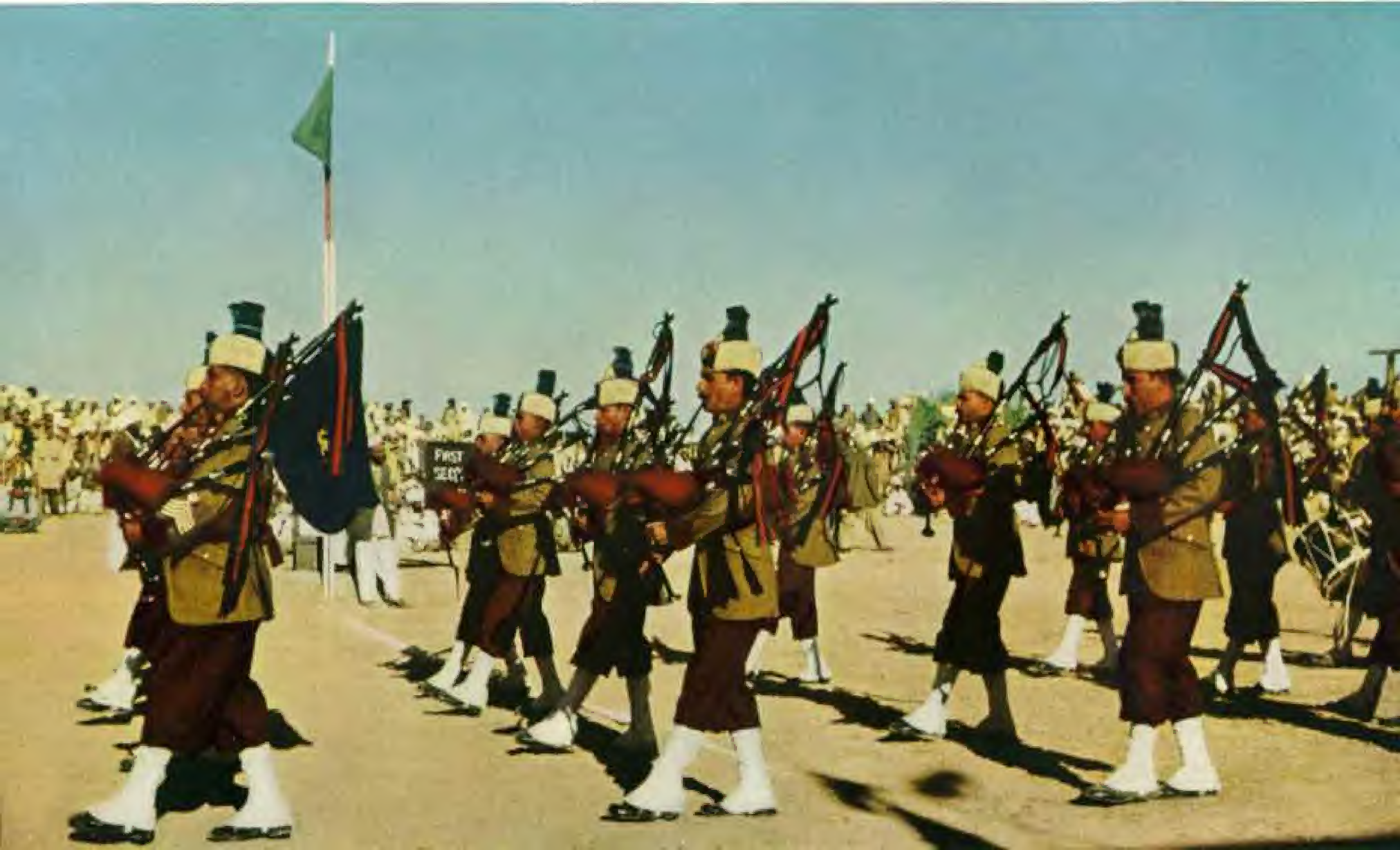
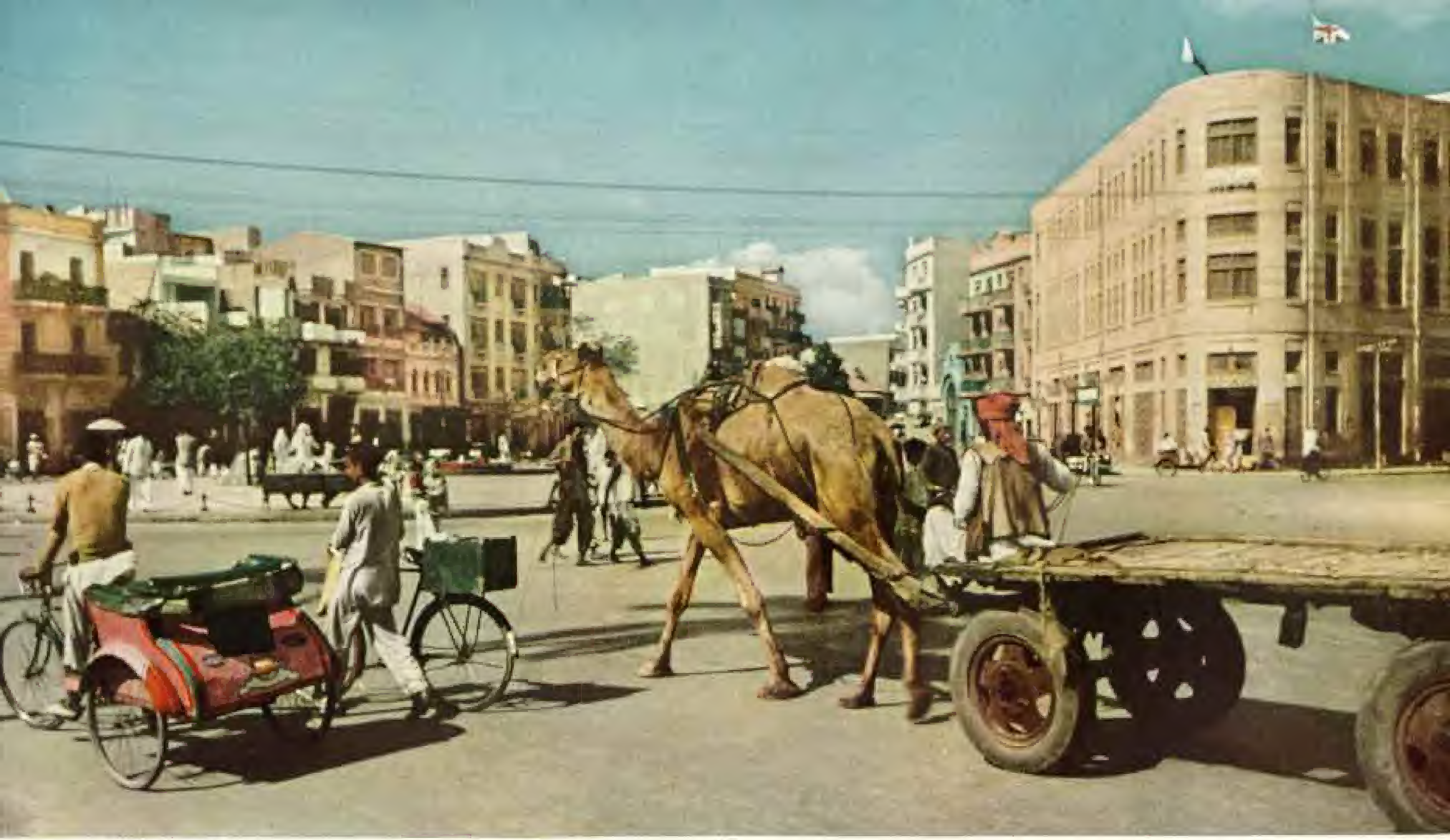
Pennants Hang from Lances as the Governor General's Bodyguards Walk Their Horses in Review: Karachi

Baluchistan's Police Pipe Band, Parading in Sibi, Skirls Scottish Airs, a Heritage of British Occupation

Kodachromes by Jean and Franc Shor





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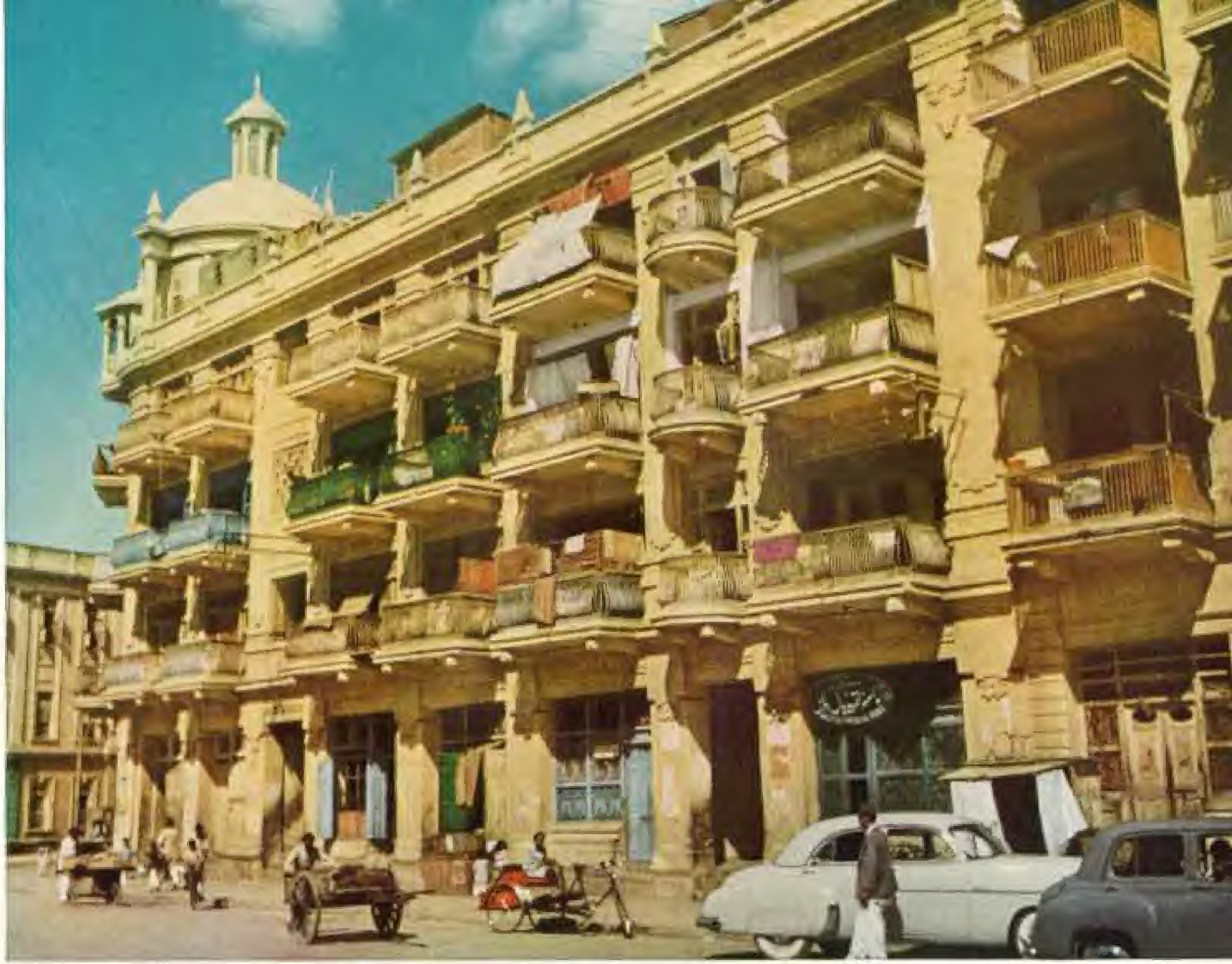
Karachi's Traffic Is Complicated by 18 Types of Registered Transport, Including Pedicab, Cycle, and Camel Cart

↓ A Karachi basket merchant reads the Arabic script of his newspaper to a young visitor. His cane products will hold bread and fruit for the table, make brooms and floor and sleeping mats. ↓

Kodachromes by Jean and Franc Shor



**Painted Balconies Brighten a Karachi Apartment Building**

Since India's partition in 1947, Moslem refugees from Hindu territory have swelled metropolitan Karachi's population from 300,000 to 1,700,000. Lacking permanent homes, many newcomers are forced to live in mud huts and mat-walled shelters on the streets and outskirts.

State aid enables many families to acquire land and build their own homes. The Government houses thousands of other refugees in temporary aluminum-walled structures.

Nazimabad, a model community growing just outside Karachi, will house 10,000 families. Plans envisage six more such towns in the capital area.

The city's building boom includes many modern apartments, but demand still exceeds supply.

This pre-partition structure strives to harmonize modern construction with the Mogul tradition of domes and curves. Stores line the ground floor.

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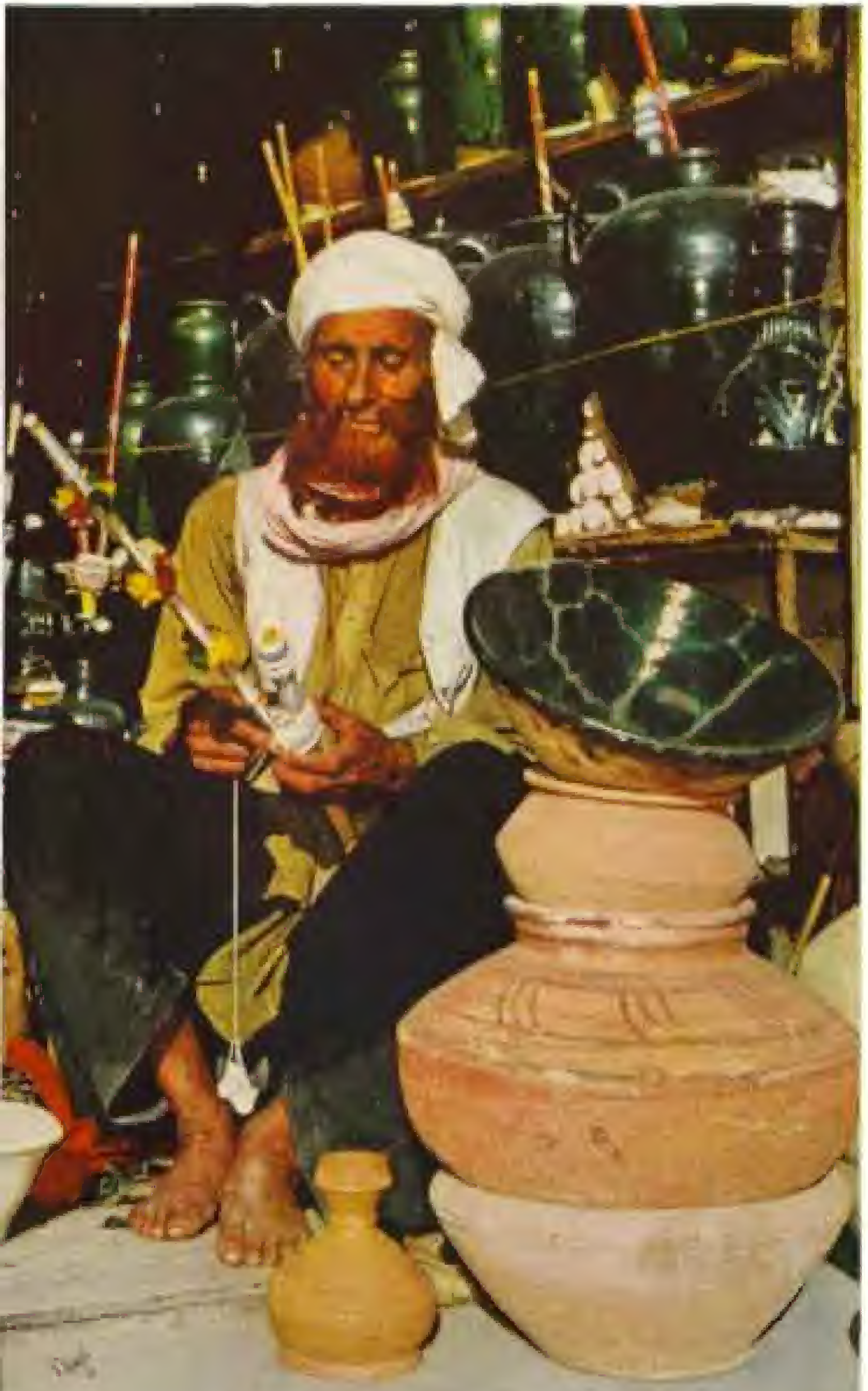


## ← A Quetta Merchant Decorates His Hubble-bubble

Using the hookah, or hubble-bubble, Pakistanis get a cool smoke. The pipe bowl fits into a container of water. Each puff draws smoke through the water, producing a sound like *hubble-bubble;* hence the name.

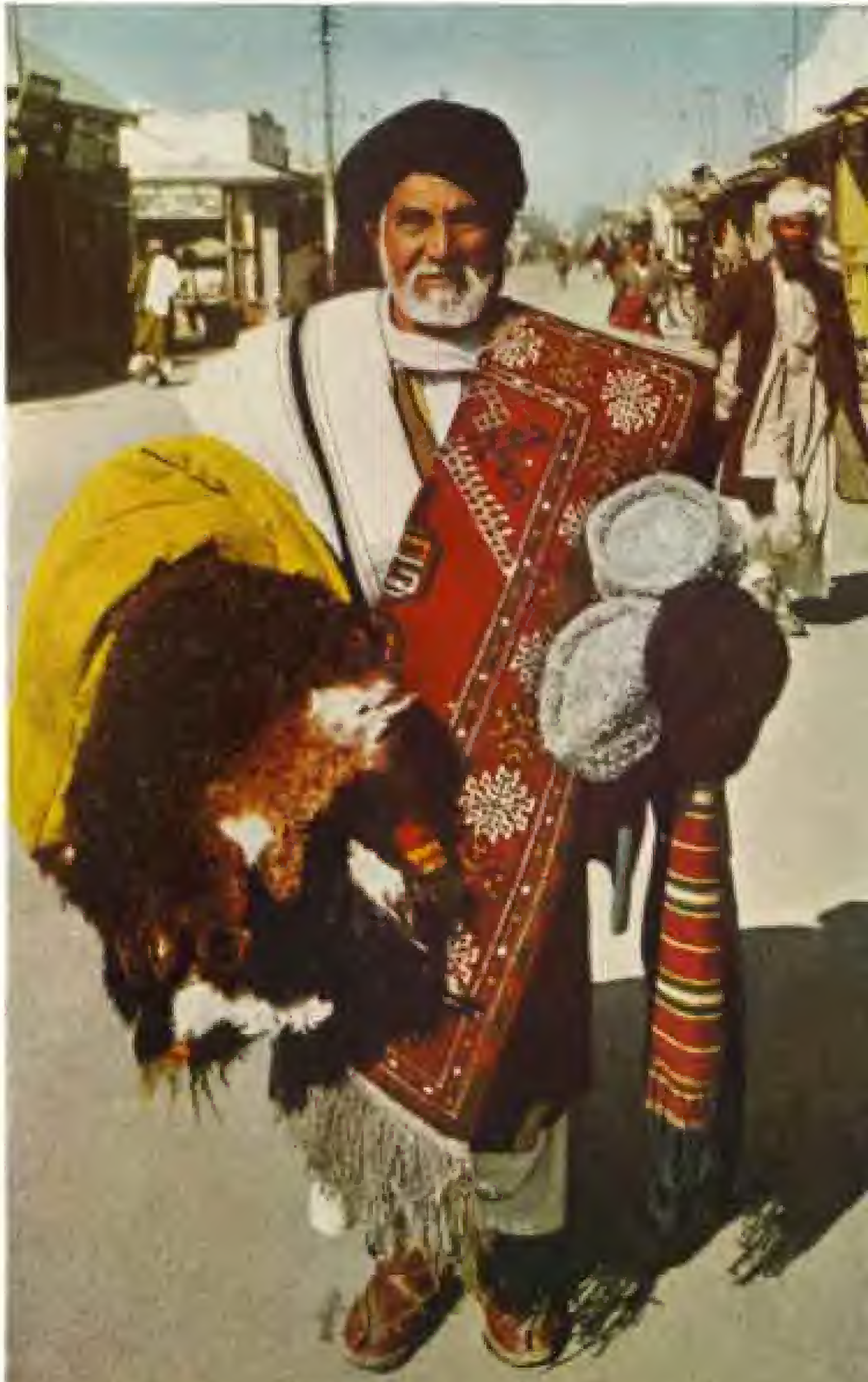
Smokers pack their pipes with strong, moist native tobacco and light up with live coals. Some hubble-bubbles are of gold, silver, or copper, with enamel decorations, but this one has a clay bowl and wooden stem. The potter-pipemaker winds decorative cord around the base.

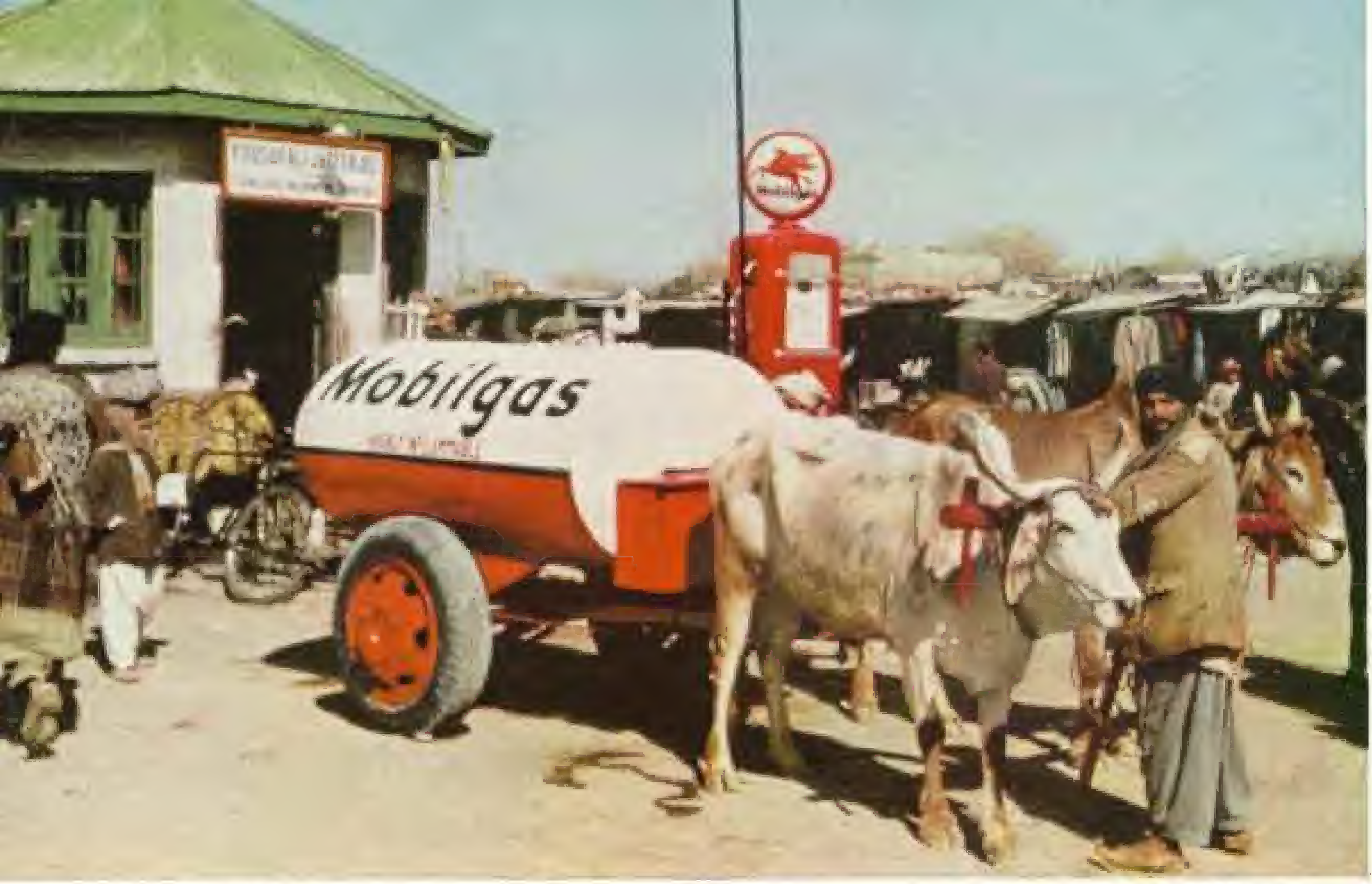
## Skins, Rugs, and Hats → Drape a Peddler

Each winter hundreds of nomadic salesmen descend on Quetta from Afghanistan's passes and snow-covered hills. Some operate low, open-front stalls in the crowded market area; others vend wares on the streets. Summer finds them back in their homeland.

This Pathan crosses the Pakistan-Afghanistan border as business and the spirit move him. Kabul's streets are as familiar to him as Quetta's.

Kodachromes by Jean and Franc Shor





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Kodachromes by Jean and Franc Shor

↑ Old and New Blend in Quetta: Cattle Draw Rubber-tired Gasoline Carts

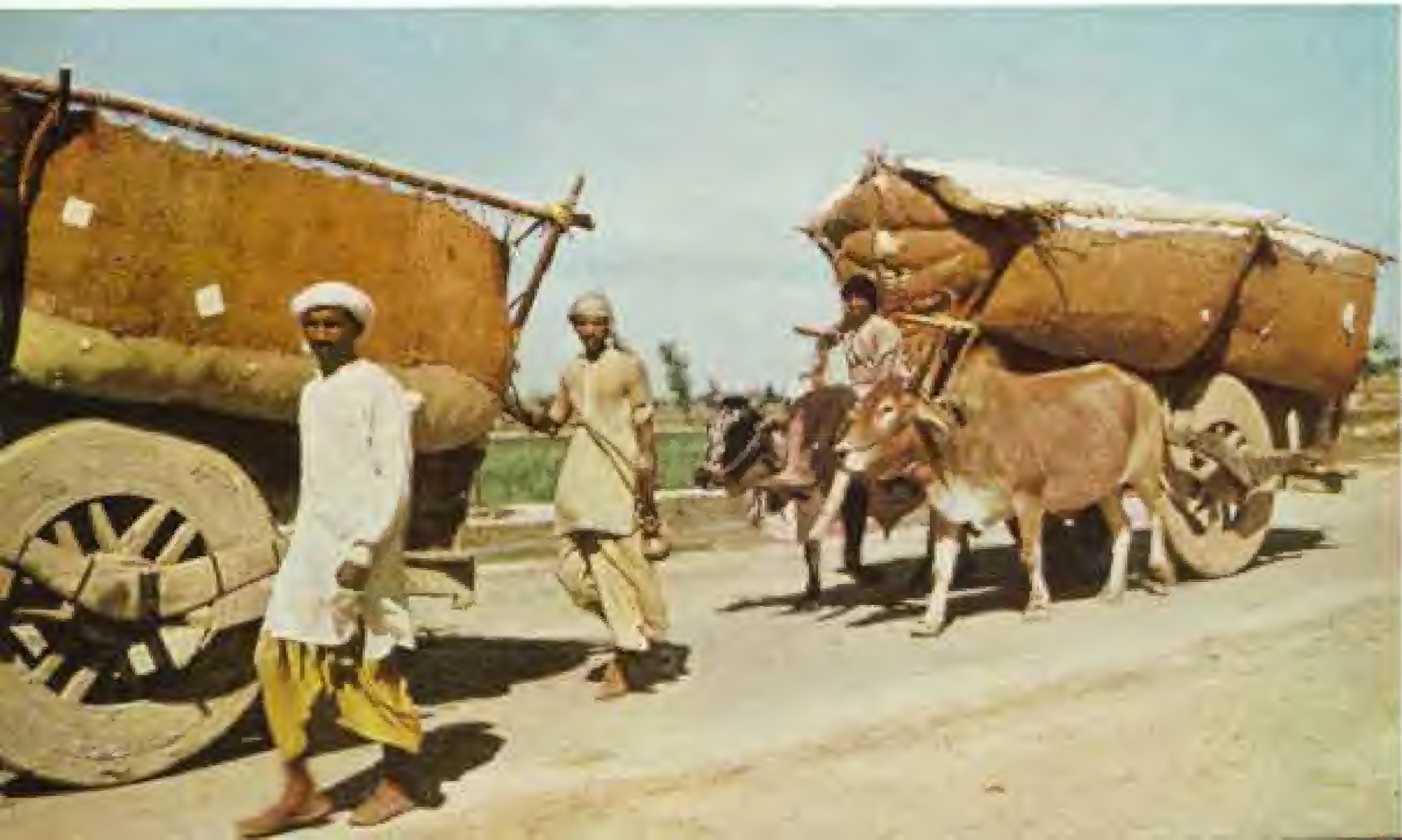
Brand-new American automobiles, some operated by tribal chiefs in turbans and flowing robes, drive up for gas, but the station's tanks are filled by oxen, still the most economical form of transportation in Quetta. Rubber tires, doubling the animals' towing capacity, are a blessing, for the old wooden wheels tortured human ears (below).

→ Like an endless belt, Karachi men and women pass pans of concrete up a scaffold to build Pakistan's National Library. Flipperlike gauntlets protect their hands.

Kodachrome by National Geographic Photographer J. Baylor Roberts →

↓ Wooden Wheels Shriek as Oxcarts Haul Huge Loads of Cotton near Shahpur

Here in the Thal Project area of the Punjab, irrigation water from the Jinnah Barrage (dam) is transforming 1,500,000 acres of desert into fertile farms. Last year more than 100,000 acres were brought into cultivation, and 8,000 tons of cotton were grown. Government aid has set up homesteads for 10,000 families, many of them Moslem refugees from India. Here ox drivers can afford no rubber tires, for every penny counts. One farmer carries a bubble-bubble, which his companions share at rest stops.



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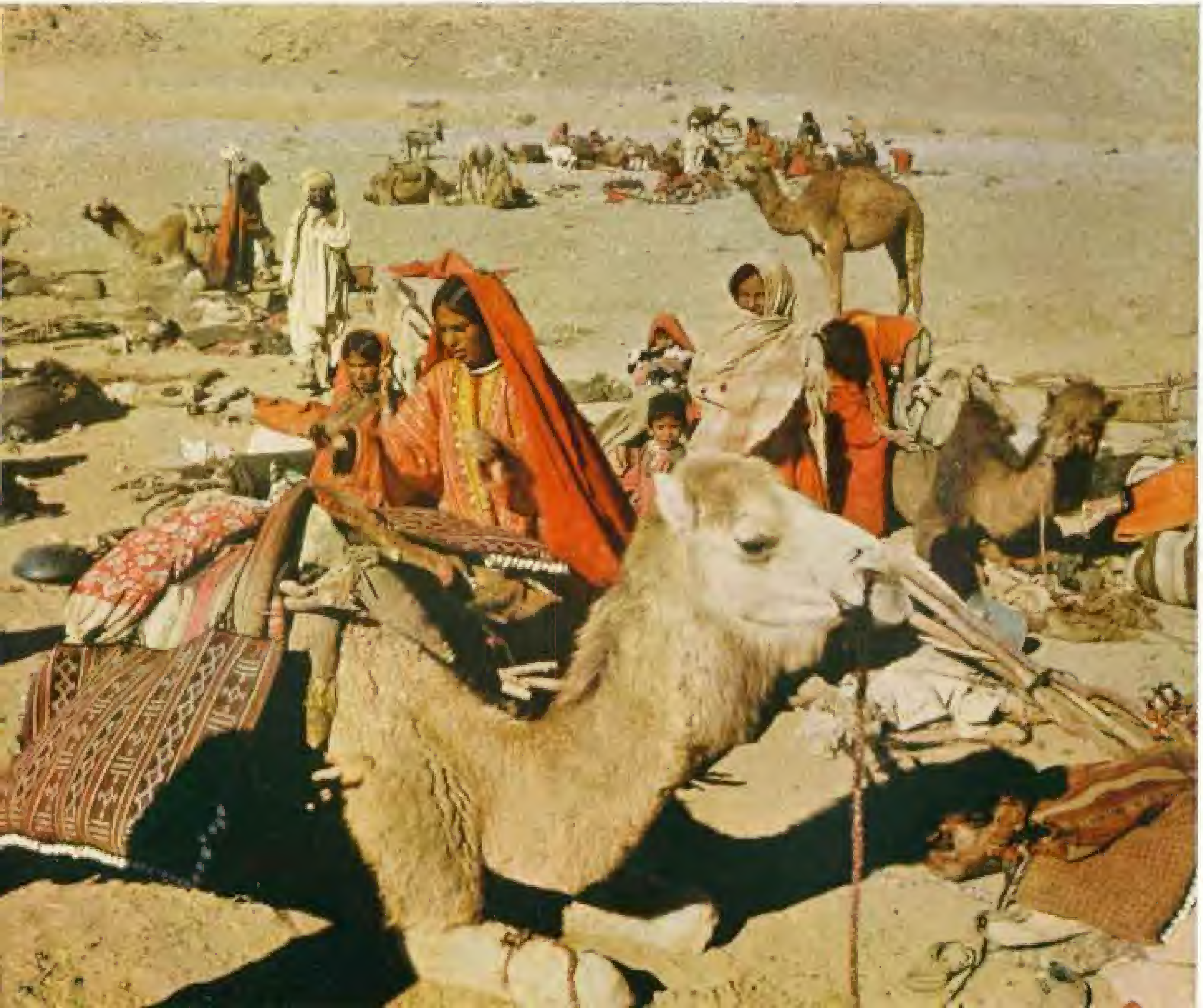


## Baluchistan Tribesmen, Donkeys, and Camels Migrate Twice a Year

Each February-March these members of a Brahui family, together with some 100,000 others, leave pastures near Sibi and travel 100 to 250 miles to high ground above Quetta. In October they return.

The authors stopped a couple of caravans to take close-ups, paying for the privilege with cigarettes. They found the men, many with henna-dyed beards, armed with veritable museum pieces—brass-bound rifles and silver-hilted swords.

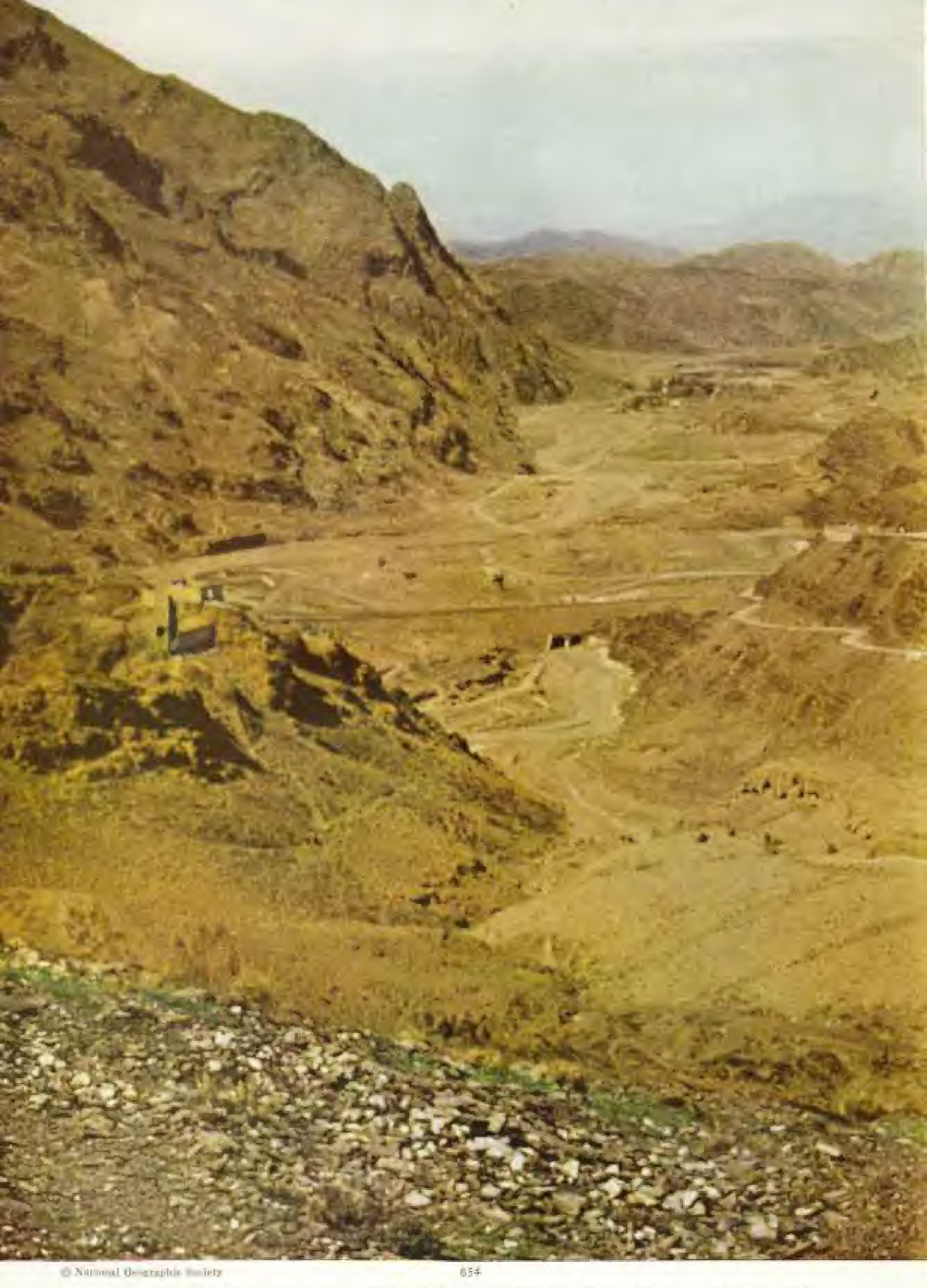
Opposite page, top panel: All livestock and possessions go on the trek, children riding the donkeys. The authors saw one camel with a bed atop his back, a sheep and a woman on either end. One walking mother here wears an aluminum cooking pot like a hat.

Above, lower left: Beasts must eat, too; so, when fodder ran short, this woman fed the camel flour and water out of her own bowl.

Above, right: A crusty, pancake-flat loaf is cooked over dry camel dung. This bread, together with an occasional bit of mutton, forms the sole diet during migrations. The goat-hair tent is pitched so low that occupants have to stoop.

◀ Tribesmen halt for a night's rest. Women unload camels, men huddle around the distant brush fire and pass the hubble-bubble.

Kodachromes by Jean and Franc Shor



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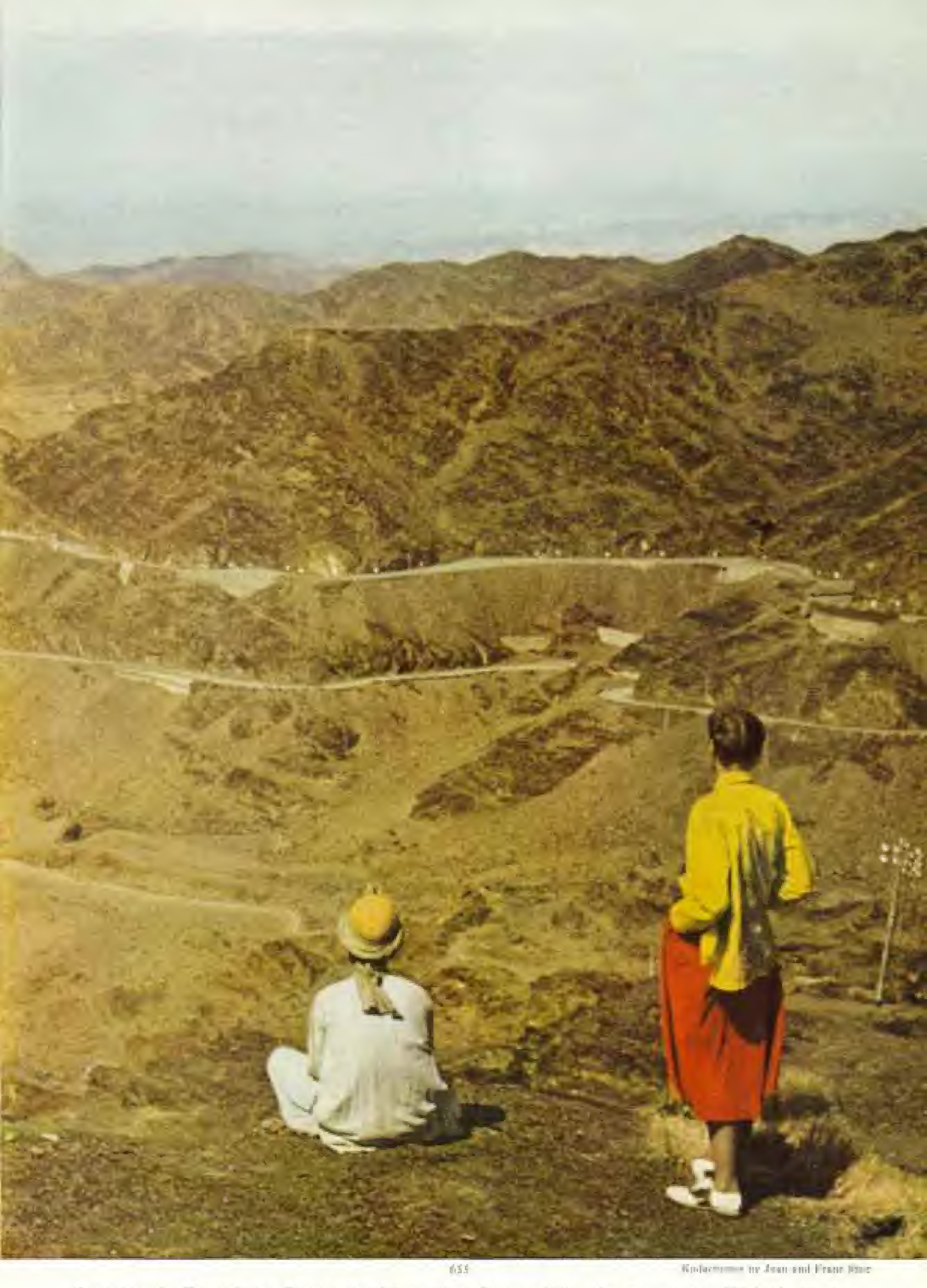
**Armies for Centuries Have Poured Through Khyber Pass, Gate to Central Asia**

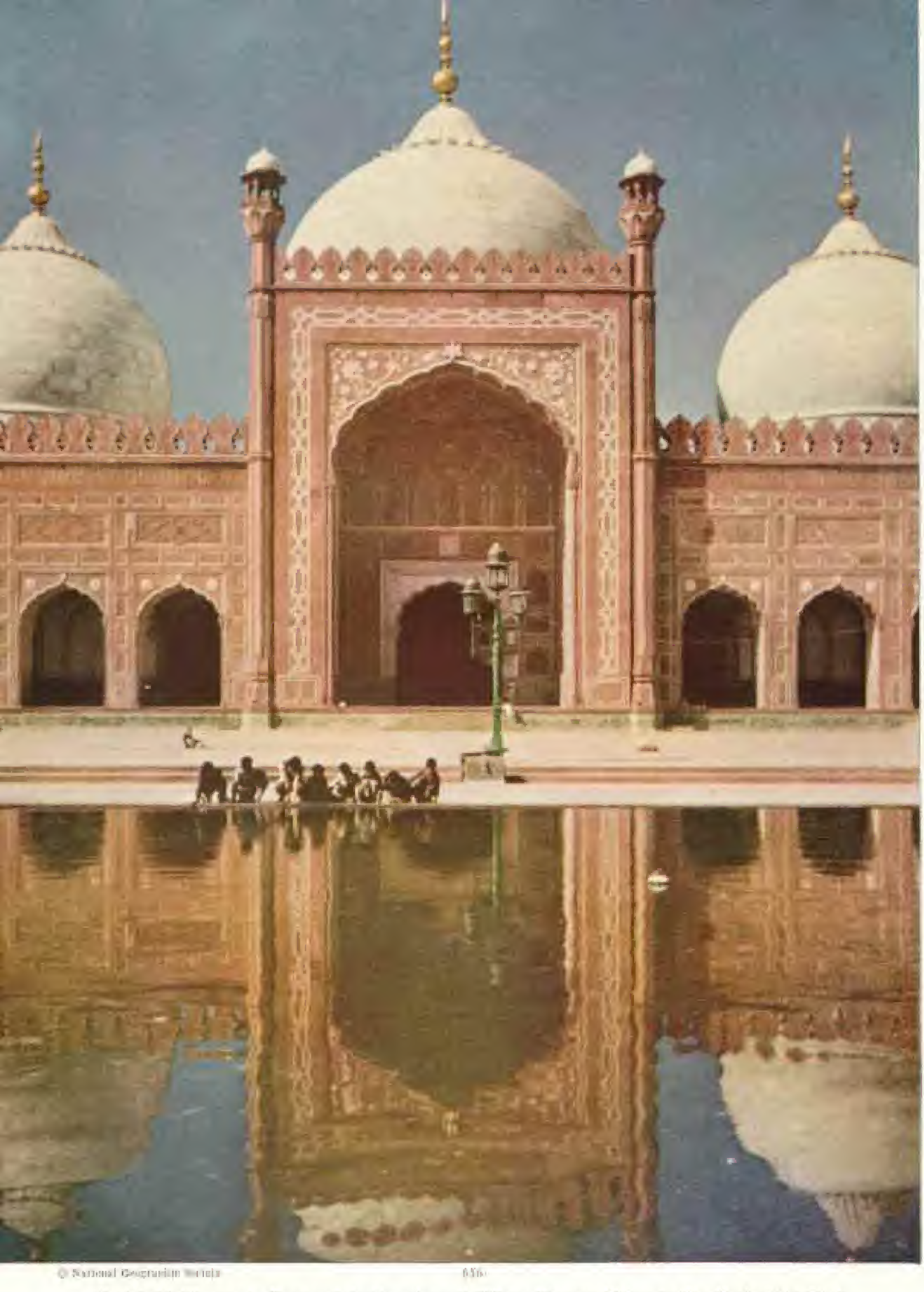
Invading Aryans, Alexander's Greeks, the Tatars of Tamerlane, the Moguls, and the British all trod this blood-stained ground. Migrating tribesmen by the tens of thousands cross the gap each year.



Kodachromes by Jean and Franc Shor

Two Roads Thread the Defile, the Upper for Automobiles, the Lower for Pack Animals

Here Pakistan looks into Afghanistan. The distant cluster of buildings marks the border. Small forts at left center stand abandoned because wild, marauding frontier tribes have kept the peace in recent years.



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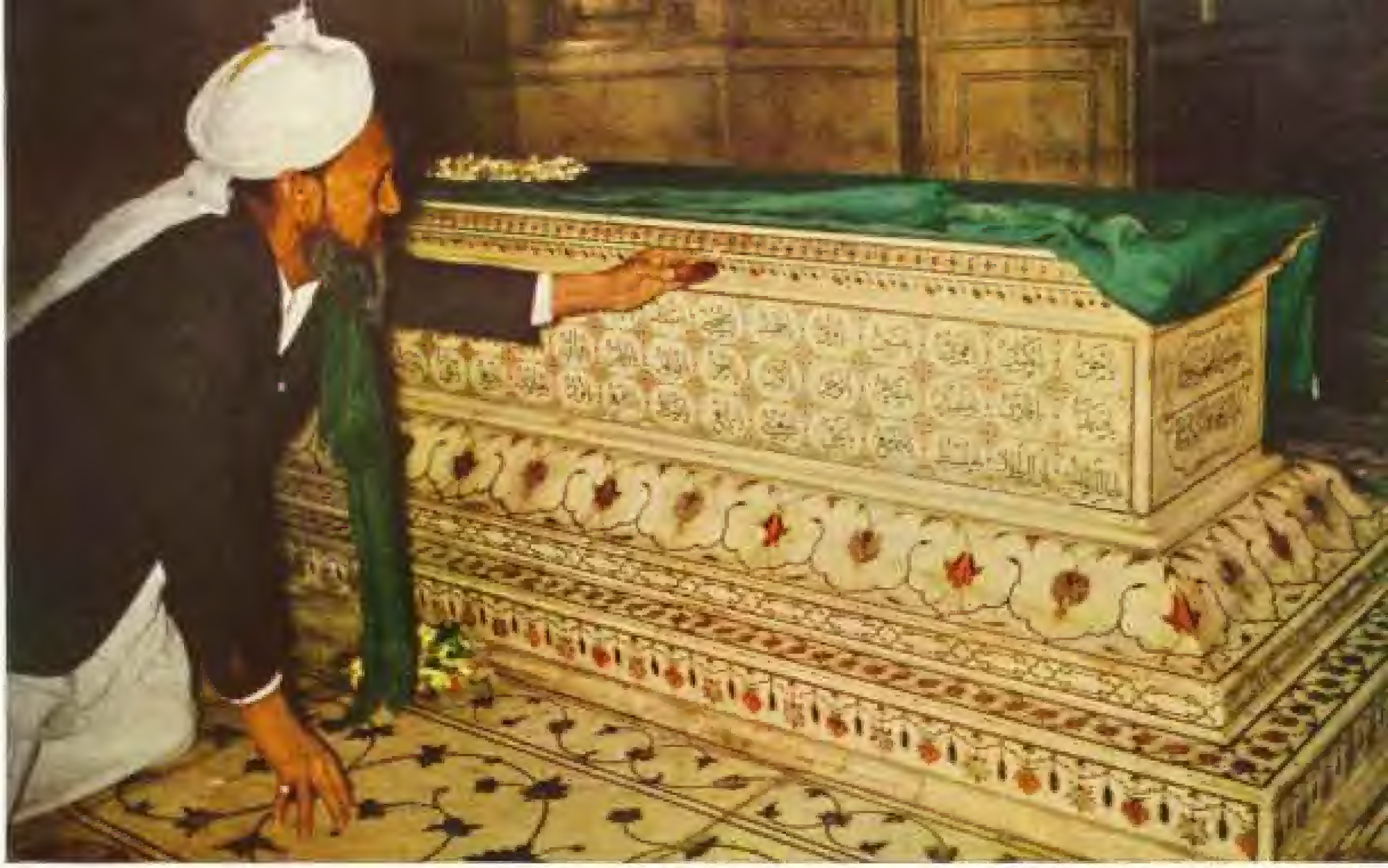
**Badshahi Mosque's Dusty-pink Façade and White Domes Shine in Its Reflecting Pool**

Doubly sacred is this edifice in Lahore. Aurangzeb, last of Islam's great Moguls, built it in 1674, and the poet-philosopher Mohammed Iqbal, who preached the creation of Pakistan, lies entombed near the gate.



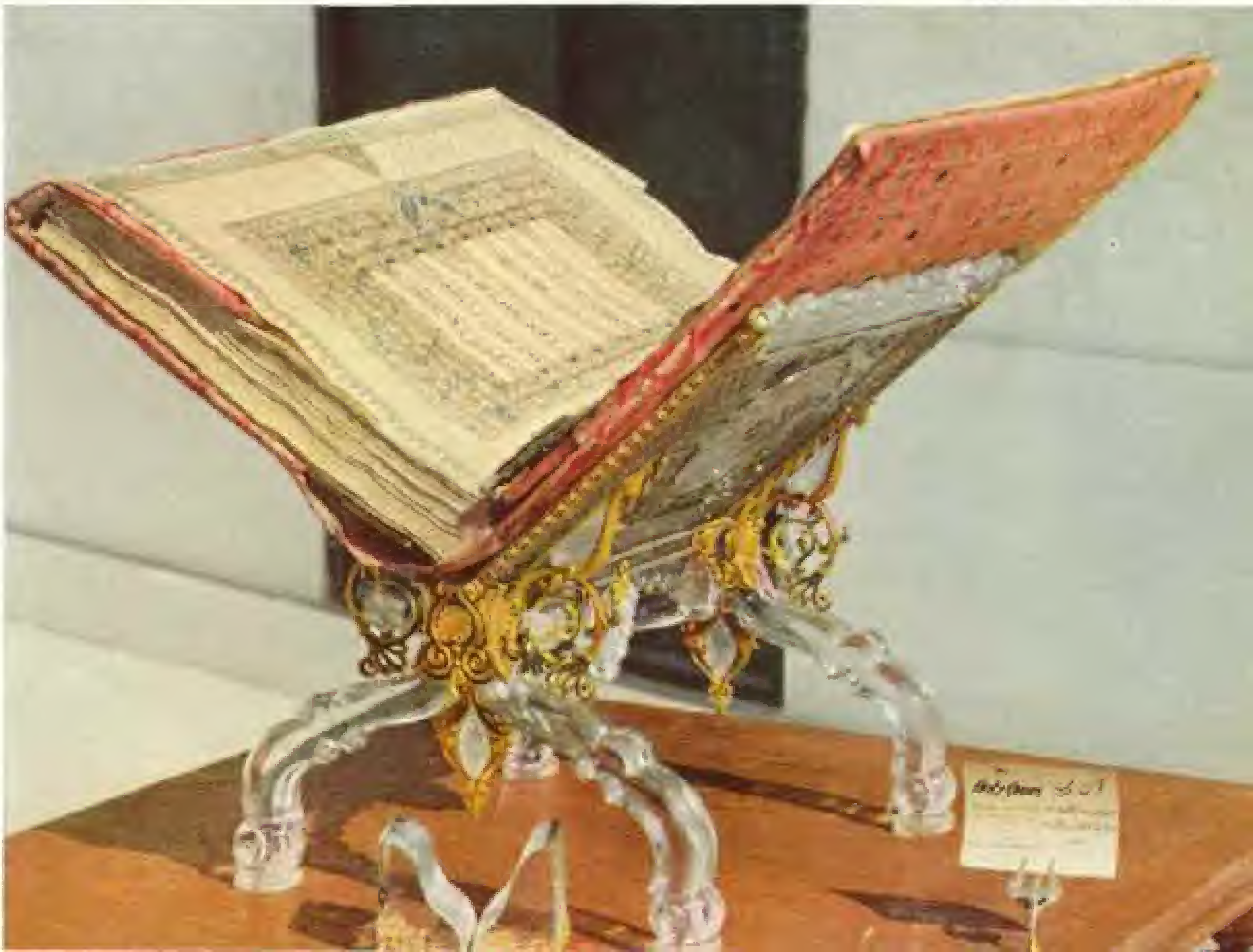
Kodachromes by Jean and Franc Shor

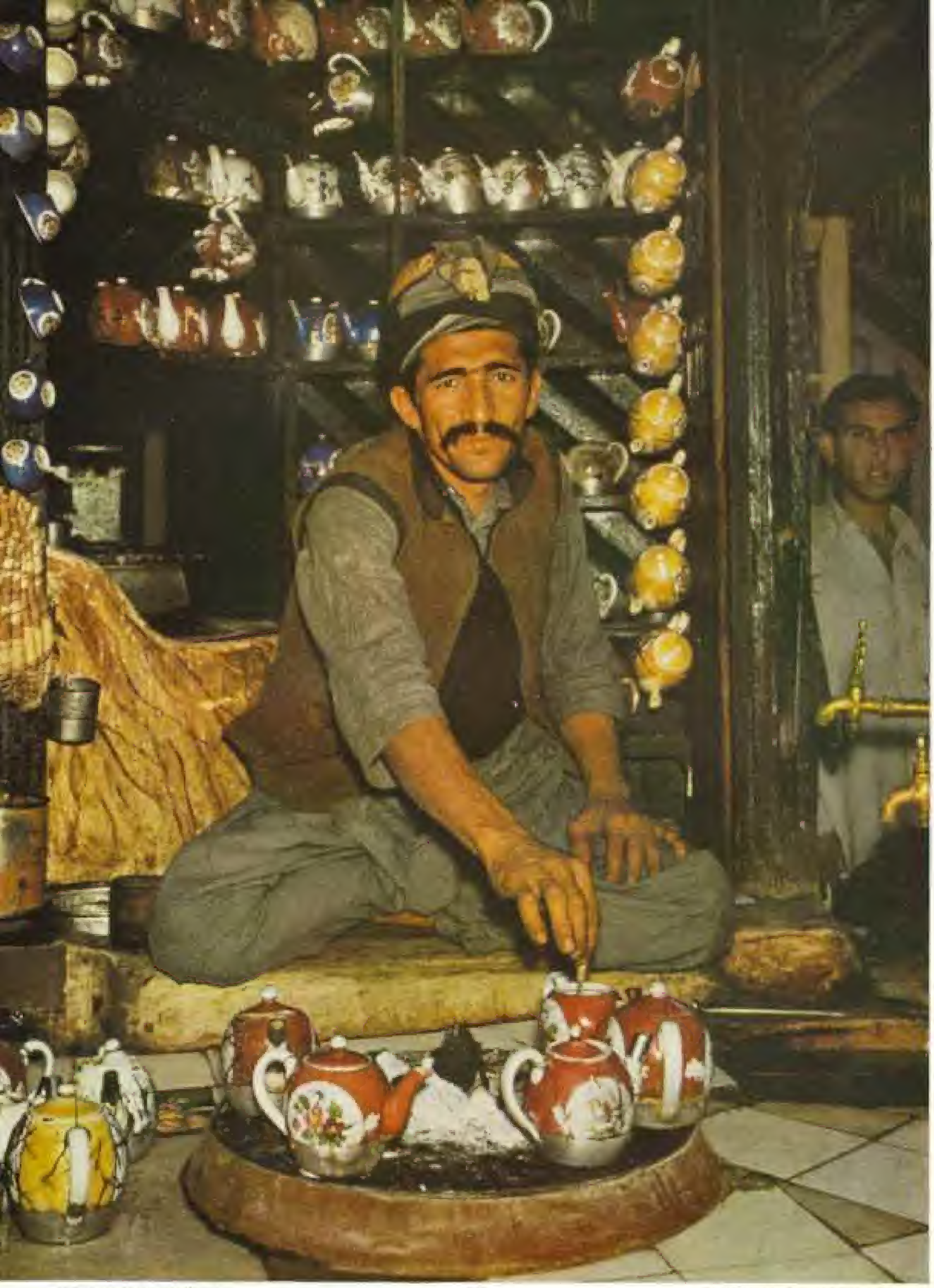
**A Bearded Mullah's Oil Lamp Lights Up Jahangir's Tomb near Lahore**

Magnificent marble, inlaid with semiprecious stones, cloaks the fourth of the great Moguls. On it are engraved tradition's ninety-nine names of Allah.

▾ This beautifully illuminated copy of the Koran, or Quran, Islam's holy book, rests in the palace museum of the Nawab of Bahawalpur. The bookstand is designed for readers who commonly sit on the ground.

Ektachrome by David Probin





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Kodachrome by Jean and Franc Shor

**Tea, Hot, Strong, and Sweet, Is Peshawar's Brew. This Shopkeeper Has the Pots for It**

Masculine social life centers around the teashops. Businessmen drop around every hour or so for a drink. Broken pots are rarely thrown away: the fragments are painstakingly wired together.

material. Nearly all had magnificent beards; some wore their side locks hanging to their waists in the ancient fashion.

There was a stir in the crowd, and Jean looked up from her camera.

"If we weren't way out here on the desert," she whispered, "I'd swear that woman who just came was Mrs. Roosevelt."

It was. She had arrived in Karachi the day before and flown up for a two-hour visit.

In the front row of the ranking chieftains sat two remarkably handsome young men, tall, with neatly groomed spade beards. Our host's son identified them as the Nabob of Marri and the Nabob of Bugti, leaders of two of the principal tribes. Later he introduced us.

Both spoke perfect English. The Nabob of Marri grinned at our astonishment and explained that he was a graduate of a Lahore college. I thought how fortunate it was that so well-educated a young man should be the leader of 65,000 primitive tribesmen. Surely his rule would be progressive.

Our talk turned to the problem of purdah. Jean asked if he was relaxing the restriction in his tribe.

"Certainly not," he snapped. "We hope to make it more strict!"

### Death for Talking to a Strange Man

While we stood in open-mouthed amazement, he explained that if a Marri girl over 10 years old is seen talking to any man other than her husband or a blood relative, both are killed instantly.

"Any male relative of the girl or her husband can put them to death on the spot," he said. "There is no penalty. It is his duty."

"But it must happen very rarely," I suggested.

"We have had half a dozen cases in the past two months," he said.

Among the Bugtis and Marris, as well as other Baluchi tribes, wives are still bought like cattle. A young man of marriageable age selects any girl of eight or ten, and bargains with her father. When the price is paid, he takes her for his bride. In some cases, a government official told us, a man who cannot pay is given the girl for nothing, agreeing that her first daughter will be returned to the grandfather for subsequent sale.

In many ways the Customary Laws of the primitive border tribes vary widely from civilized standards. Murder may still be punished by a fine of less than a hundred dollars. Blood feuds are recognized. However, the Government has declared its intention of bringing tribesmen under the Pakistan legal code.

We left by train for Lahore—and awoke in a different world. Our train had crossed Bahawalpur State during the night, and now we were running through the Punjab. Mohammed Ali Jinnah called this great plain, with its 62,000 square miles of rich agricultural land and its tall, hard-working and hard-fighting citizens, "the Heart of Pakistan." Our train ran through miles of rich grain and cotton fields. Factories and cotton mills rose above the industrial cities of Multan and Montgomery. Orange groves appeared.

Lahore, capital of the Punjab, we found to be the loveliest city of Pakistan. It is justly proud of its universities, libraries, and historic monuments (pages 656, 657, 674). But when we started to take a picture of the stately High Court building we were confronted by a soldier with fixed bayonet who ordered us to put away our cameras.

"Why?" we asked.

"Military security!" he snapped. Sadly we walked into the nearest bookstore and bought a post-card view of the building, apparently taken when the world was a little more sane.

### Thal Project Creates Farms from Desert

From the Punjab comes much of Pakistan's strength. Its grain feeds the nation; its cotton clothes it; and the Punjabi are the mainstay of its army. But the Thal Project is Pakistan's greatest pride.

Thal is a great expanse of sandy desert covering five million acres in the west central Punjab. The $100,000,000 development includes the Jinnah Barrage, an enormous dam across the Indus River (page 663), two hydroelectric plants, and hundreds of miles of canals which will irrigate a million and a half acres.

The project was begun under British administration, but development was halted by the war. In the past three years 300 miles of canals have been completed, and 300,000 acres planted to crops.

American tractors were breaking out great blocks of sandy soil, and we saw an odd example of progress in reverse.

"Agriculture normally progresses from the bullock to the tractor," pointed out Col. M. A. Akmal, coordinator of the Thal Project. "Here it goes the other way.

"Tractors are the cheapest way to break out large blocks of new land, but it is then divided into 15-acre tracts and allocated to farmers who lost their homesteads after partition. They can't afford tractors, so they farm with bullocks."

More than 10,000 refugee families have already been settled in the Thal area. South of Mianwali we visited Hazrat Hussain, who fled with his family from the Indian Punjab in 1947. He received his homestead in 1950.

**Pakistanis, Who Love to Travel, Jam the Karachi Mail in Lahore**

Third-class passengers are limited only by the cars' cubic content. Baggage crams the aisles several feet deep. The authors saw people entering windows feet first to save their heads. One man thrust his belongings into a window only to have the train leave before he could fight his way in.

"It is Allah's blessing," he exclaimed, when we asked if he was happy. "I came with nothing, but the Government put me in this little house and provided me with bullocks, tools, and seeds." He added that he had a generous length of time to pay for all this.

"The soil is wonderful. I have made good crops. This year I will finish the payments on the bullocks."

He patted one of the animals affectionately.

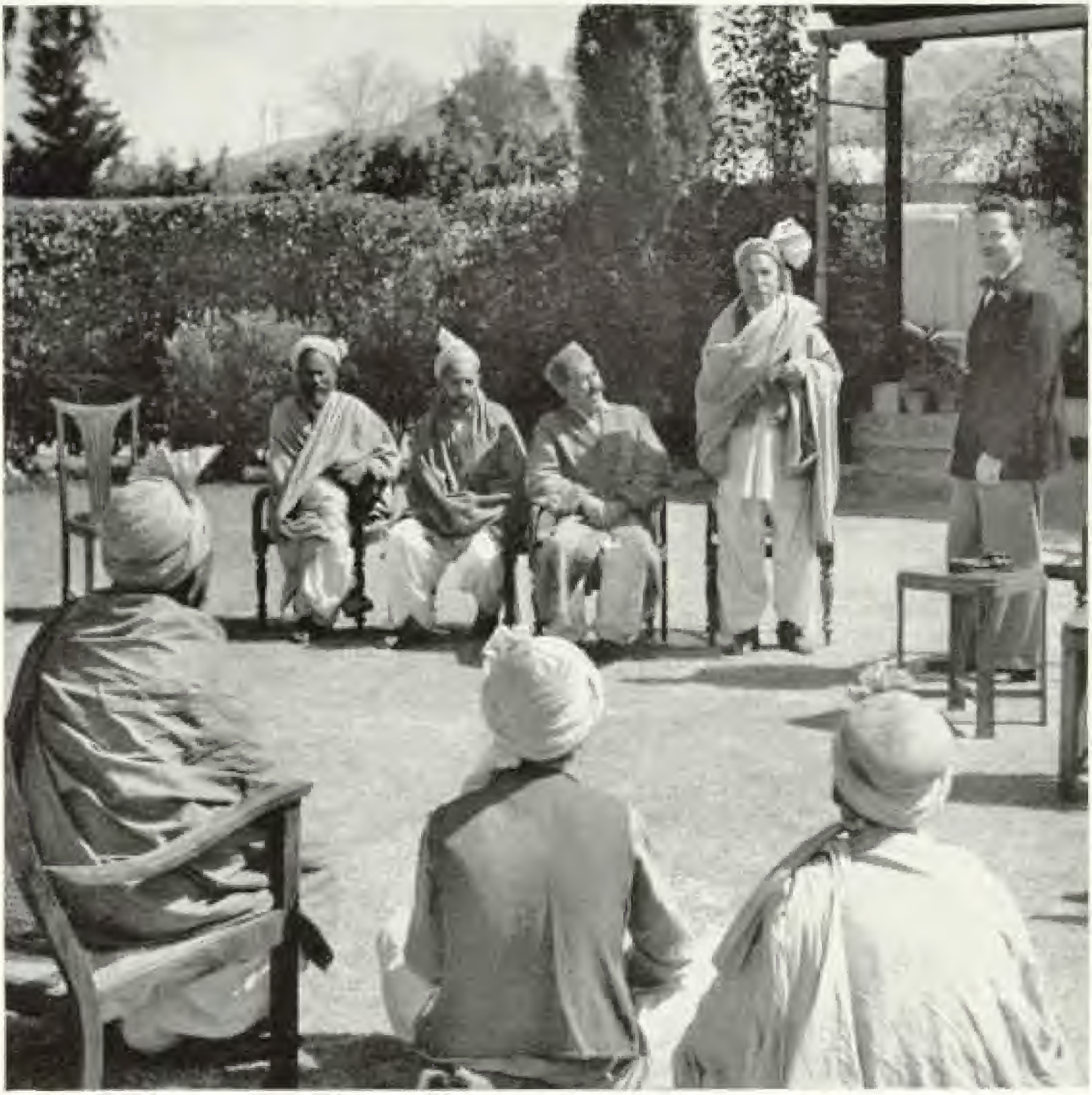
"It will be good to know they are mine," he smiled. "And I have made my payments on the house and land, and have a little money in the bank."

He waved toward a low adobe building.

"That is best of all," he said. "The school! I cannot read or write. But my three children are all studying, and already the two oldest can read the newspapers."

Hussain's wife was working in a near-by cooperative cotton mill. We found 40 women, wives of neighborhood farmers, busy weaving cloth.

"We keep enough to clothe our families," Begum Hussain told us. "The balance is sold, payments made on the government loan, and the rest divided among the workers. I helped make our payments on the house and land this year. It is the first time I ever earned money."



**Khyber Pass's Turbaned Tribal Leaders Entertain Mr. Shor at Tea in Landi Kotal**

For years the Khyber was bloodstained by the raids of hill folk, who exacted tribute from caravans, but today the pass is calm. "Please tell Americans," said one of these chieftains, "that they will not find savages here, but friends." The author (right) makes an answering address (pages 654-5 and 664).

"I have a little bank account of my own now," she said, smiling at Jean.

"When I want something for myself or the children, I do not have to ask my husband. It is a wonderful feeling, isn't it?"

Jean gave me a meaningful look.

"I wouldn't know," she said, and I took her away from there before Begum Hussain revealed any more of her secrets.

### Purdah Not for the Poor

"Why is it," Jean asked Akmal as we drove back to Lahore, "that the countrywomen and those in the smaller villages aren't veiled? They work side by side with their menfolk. Why no veils? Aren't they good Moslems?"

"Of course they are," Akmal laughed. "But purdah is a luxury. It was originally practiced only by wives of rulers. The middle class copied it. But where every pair of hands is needed, people can't afford it."

Our friend Syed Nur Ahmed met us in Lahore, excitement written on his lean face.

"You are invited to a garden party," he said. "You'll never guess who it is for."

"Who?" we asked.

"Mrs. Roosevelt!" he said.

At the party three beautiful black swans swam proudly about a pool in the garden. We stayed to take a picture, but, as the last

## Karachi's City Hall Surveys Pavements Athrob with Life

To hundreds of refugee merchants from India, the curbside is a home without walls and without privacy. They buy a cot and spread it on the pavement. During the day it serves as a chair, and at night as a bed.

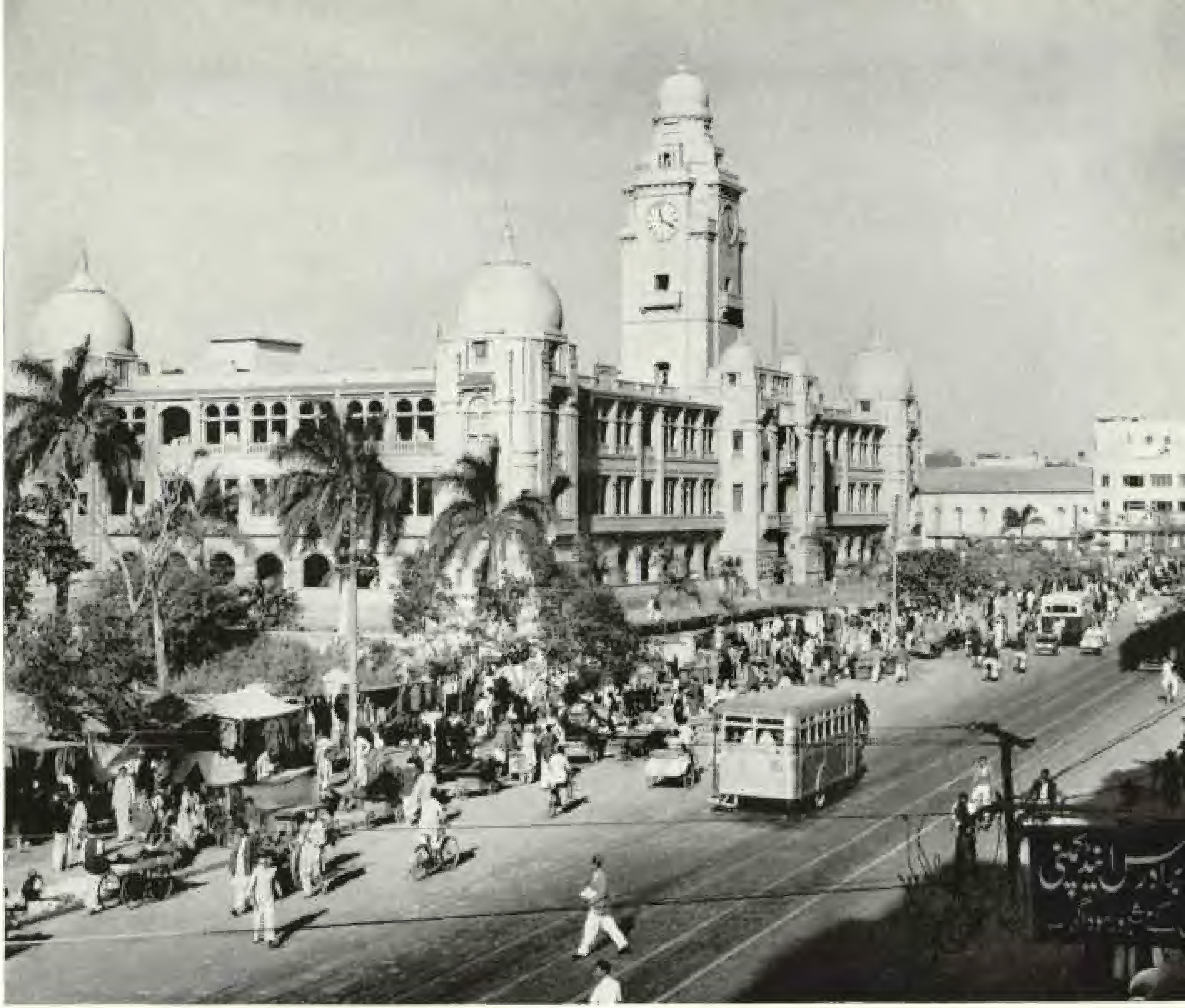
Salesmen along the walk display trayful of wares mounted on bicycle wheels. Beneath his jute awning, the tailor plies his trade next door to a cook serving meat and bread. Pavement barbers clip hair, and pavement photographers deliver in 10 minutes three finished likenesses in post-card size for 30 cents. Others dye cloth and stretch it to dry.

Some of these refugees owned factories in pre-partition India; now they preside over shanties. But everyone is optimistic. "We're getting by," they smile.

Karachi's Municipal Corporation Building, which houses the city authorities, is built of light-red sandstone. Its clock tower dominates the domes at each corner.

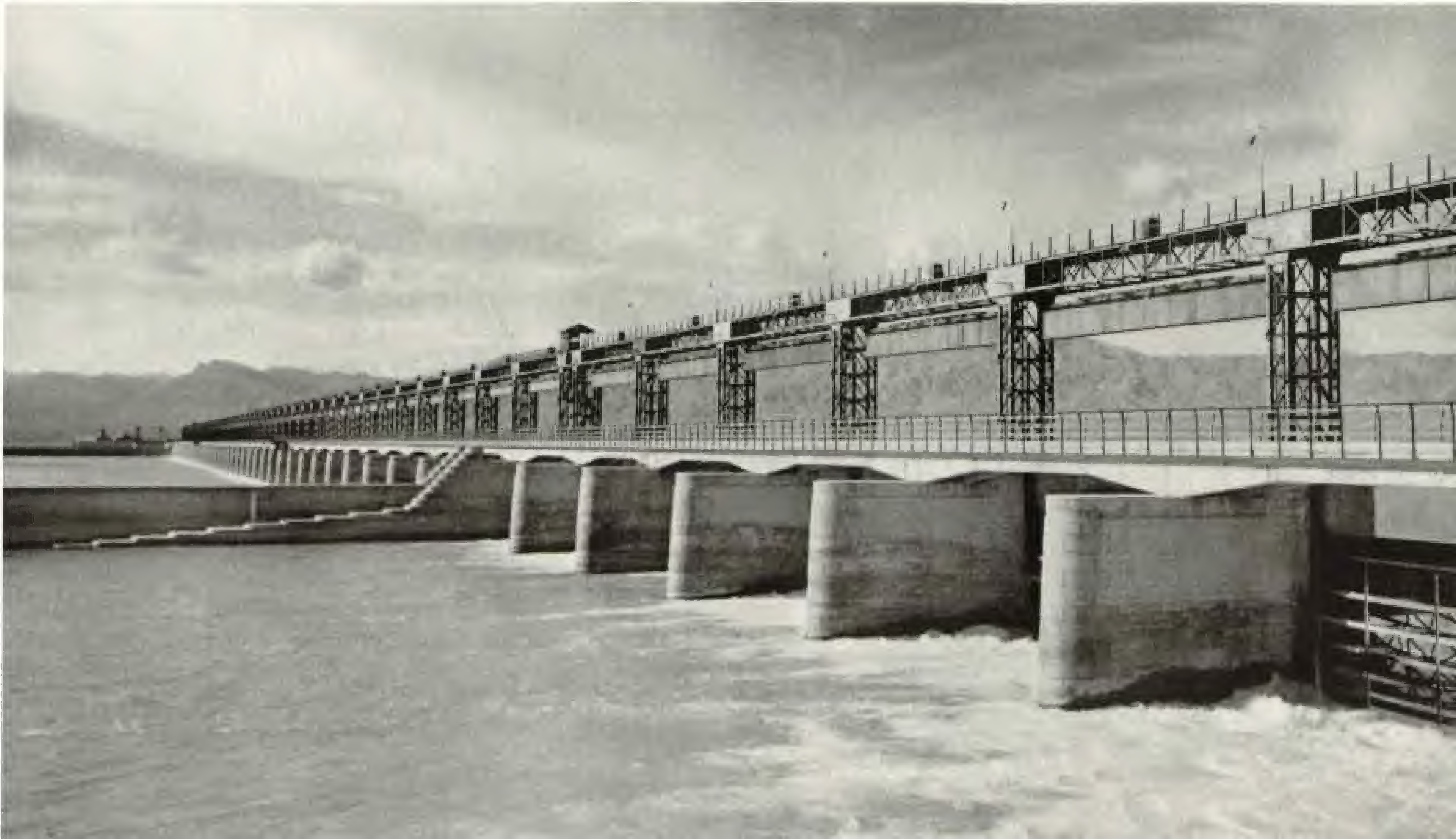
Traffic on Bunder Road, one of the city's main thoroughfares, streams past in the shape of bicycles, pedicabs, horse-drawn victorias, streetcars, and buses. Automobiles are mostly of American or British manufacture.

David [illegible]



**Irrigation Waters of Jinnah Barrage, Which Dams the Indus River near Mianwali, Turn the Punjab Desert into a Garden**

Thousands of refugees from India settle on farms made possible by the dam. Britons started the $100,000,000 Thal *Project*; Pakistanis developed the canal system



guest departed, three coolies waded into the pool, tucked the protesting birds under their arms, and started off.

"What's this?" Jean asked our interpreter. "Swan-napping?"

"The birds were rented by the hour for the party," he explained. "They're going back to their owner."

A train carried us 275 miles north and west, across the Chenab, the Jhelum, and the Indus, three of the five great rivers which rise in the Himalayas and water the Punjab.

Morning found us rolling through miles of blossoming fruit trees outside Peshawar, capital of the North-West Frontier Province. Peshawar's role in the British-Afghan wars has made it, and the near-by Khyber Pass, known to every American schoolboy.*

Peshawar's narrow, winding streets were crowded with a wild array of Afridi, Shinwari, and Pathan tribesmen. Tall men, bearded, with deep-set fiery eyes and hawk noses, they wore tall turbans, colorful robes, sheepskin vests, and shoes turned up at the toes.

### Fiery Tribesmen Guard the Khyber

With Agha Faquir Shah, a government official, we drove to the historic Khyber. For 35 miles the road twisted crazily up through narrow, rocky gorges, where the marauding Afridi once ambushed travelers and challenged numerically superior British forces. We passed dozens of armed tribesmen.

"Almost every family among the 10,000 people in this area has a blood feud," Agha Shah explained. "They shoot an enemy on sight. Under the Customary Laws, the only punishment is a heavy fine."

Bronze plaques dot the granite cliffs, commemorating British and Indian Army regiments which fought here. The roadside is lined with concrete tank blocks, set up by the British after the Germans attacked Russia in 1941.

There was no sign of cultivation, and we asked Agha Shah how the tribesmen lived.

"For years," he said, "these tribesmen have been paid to keep the peace. Pakistan has continued the practice. It sounds like blackmail, but it goes much deeper than that.

"This land cannot produce crops. There is no water. So these tribesmen 'farm' the pass. For centuries their ancestors have collected toll from passing caravans. Those who did not pay were murdered and robbed. It is their land; we simply pay for the use of the roadway."

We gazed westward for many miles into Afghanistan, looking down the narrow valley through which has rolled the tide of history (pages 654-655). Today brightly colored trucks carry loads of pomegranates and cotton from Afghanistan through the narrow defile.

"It's peaceful country now," said Agha Shah. "Since Pakistan was established, the tribesmen have been quiet. We keep only a very small garrison—less than a tenth of the former force."

### Not Savages but Friends

At Landi Kotal we were surprised to find a reception prepared. Agha Shah had telephoned ahead, and the tribal leaders had arranged a tea. We had crisp roast partridge instead of cakes. Then a tall, fierce-looking chieftain twirled his white mustaches and made a speech (page 661).

"Before Pakistan," he said, "we knew little of Americans. We are happy to meet your people. We feel your visit is proof that Americans are interested in us.

"We are told that your Magazine speaks to millions. Please tell them that while they may have heard that in the Khyber they would find savages, it is not true. They would find friends."

Mohammed Saidu Khan, a tribal chief, translated our thanks and walked with us to our car. "Only a few years ago," he said, "Americans were unknown here. But you are the second to visit us this week."

"Who was the other?" we asked.

"Mrs. Roosevelt," he answered.

### Guns, but a Modern Hospital, Too

We drove south of Peshawar, over the sheer Kohat Pass, to the little city of Kohat. Along the road we visited the famous tribal gun factories. Here, with only hand tools, the tribesmen turn out 3,000 weapons a month, each an exact copy of a modern piece, complete to proof and arsenal marks. We watched prospective purchasers testing the rifles, which sell for about $20, and found them quite accurate.

"Are they really as good as the originals?" I asked our guide.

"Certainly," he said, "except that if you fire them too rapidly the barrels have a tendency to bend double!"

In Kohat we saw Ghulam Mohammed, the Governor General of Pakistan, dedicate a strikingly modern 100-bed hospital. With him we toured the clean, airy wards, and saw the well-equipped operating rooms and X-ray laboratory.

At a tea following the dedication, Jean chatted with Begum Zari Sarfaraz and Begum Mumtaz Jamal, members of the North-West Frontier Province legislature.

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* See "South of Khyber Pass," by Maynard Owen Williams, NATIONAL GEOGRAPHIC MAGAZINE, April, 1946.

National Geographic Photographer J. Baylor Roberts

**Razia Ghulam Ali, Pakistan's First Woman Industrialist, Gives an Order to a Foreman**

Wife of an engineer and mother of several children, Mrs. Ghulam Ali owns a cement-pipe factory in Karachi. Touring the United States, she was impressed by the skyscrapers and Hoover Dam. "We are beginning to realize that America has better methods," she told the NATIONAL GEOGRAPHIC MAGAZINE.

"They're remarkably intelligent and well-informed," she told me later. "I asked if they didn't find it incongruous to be in purdah while taking part in public affairs.

"'Perhaps,' replied Begum Sarfaraz, 'but, like your congressmen, we must think of our voters. They prefer us in purdah. But come back in five years; you'll find things changed. Women are coming to the fore.'"

### Off to See the Wali of Swat

Back in Peshawar we met the Chief Secretary of the independent State of Swat, a tall, distinguished gentleman with the single name of Ataullah.

"You have seen areas under provincial and central government rule," he said. "You must visit a native state. The Wali of Swat is a member of the National Geographic Society. He'd be happy to have you visit Swat."

It is difficult to resist an invitation to meet a man called the Wali of Swat, so, with Ataullah, Jean and I drove 100 miles north across a 6,000-foot range to Saidu, capital of Swat (map, pages 640-641).

"The half-million people are all members of the Yuzuf Zia (Sons of Joseph) tribe," Ataullah said. "For years they fought bitterly among themselves. In the 1920's the father of the present Wali consolidated his position as strongest of the chiefs, was proclaimed Wali, and set about building a progressive state."

The first Wali, a Saidu official told us, was a stern man. His methods were dictatorial. Theft was punished by death, and today locks are seldom seen in Swat. A public official convicted of graft had his head removed the next morning, and Swat's public administration is famed for its honesty.

Training begins early. Even the walls of the schools are painted, in English, with such slogans as "Honesty is the best policy," and "Virtue is its own reward."

For a week we toured the 400 miles of fine new roads which lead to every part of the 1,800 square miles of Swat. Driving there is a pleasure. Elsewhere in the East a driver must dodge crowds of pedestrians. In Swat people walk on the side of the road (page 668). A man caught jaywalking, we were told, is forced to run down the roadside at top speed until he drops from exhaustion.

### "Soil Needs Sleep"

Ancient customs still exist in the valley. A modern irrigation system has increased crop production fivefold in 20 years, but in the eastern part of the state we found no irrigating canals.

"It is not good for soil or man to have outside assistance," a farmer explained. "Both become lazy."

"These people have another belief which compensates for that one," our guide told us. "They say that soil, like men, needs sleep. They let a field lie fallow every other year."

Every Swat village has a school, where attendance is compulsory for both boys and girls. We took a picture of one group, and a little boy came shyly up to Jean, pushed a bunch of pink and white wild flowers into her hands, stammered "Thank you, please," and dashed back into the crowd.

Swat is an archeologist's paradise. Dozens of unexcavated Buddhist ruins dot the valley. With the Wali's permission, we spent a day digging in an ancient stupa, or memorial mound, and found Buddhist carvings and small statues showing strong Grecian influence. Swat was once ruled by Grecian kings, and Birkot, a small fort which was besieged by Alexander the Great himself, still stands at the foot of the valley.

The father of the present Wali turned the administration of the state over to his son three years ago and retired to a life of religious contemplation.

"We have made improvements in agriculture," the young Wali told us. "Now we are developing light industries and processing plants. We are bringing in machinery for sugar mills, to give our people more cash income."

### Farmer's Son Goes to Medical College

We stopped one evening to photograph the mud-and-timber home of Ali Yusef, a short, henna-bearded farmer. He insisted that we stay for supper. Over rice, chapatties, and fiery curried mutton, he told us how life had changed in Swat in 25 years.

"I had no education," he said. "As a boy, I never saw chapatties and rice on the same table. We eat well now, and all my children are educated. My oldest son is in medical college at Peshawar; the state is paying for his education. We have good hospitals. Taxes take only one-eighth of my crop—my father paid from one-third to a half. It has been wonderful."

At lunch the Wali discussed plans to develop Swat as a tourist resort.

"With magnificent scenery, good fishing and hunting, and a fine hotel," he said, "we should attract vacationers. Have you any suggestions?"

"Why not build a museum near the ancient ruins," I said. "Get a trained man to supervise excavation. You might even let tourists help dig. The finds would stock the museum."

"Good idea," he said, and spoke briefly to a secretary.

"I'd like to take your picture," I said. "Could you put on your state robes tomorrow morning?"

"Sorry," he laughed, "but I'm probably the only ruler on the subcontinent who doesn't own a costume. I'm too busy for fancy dress."

When we said goodbye to Ataullah the next day, he also asked if we had any suggestions for the state's tourist development.

"Only the idea for the museum," I said, thinking it had been forgotten.

"That's already been taken care of," he said. "Didn't you hear the Wali speaking to his secretary? He told him to start construction of the museum and arrange for a trained man to supervise excavations."

### Old Red Fort—and Modern Bridge

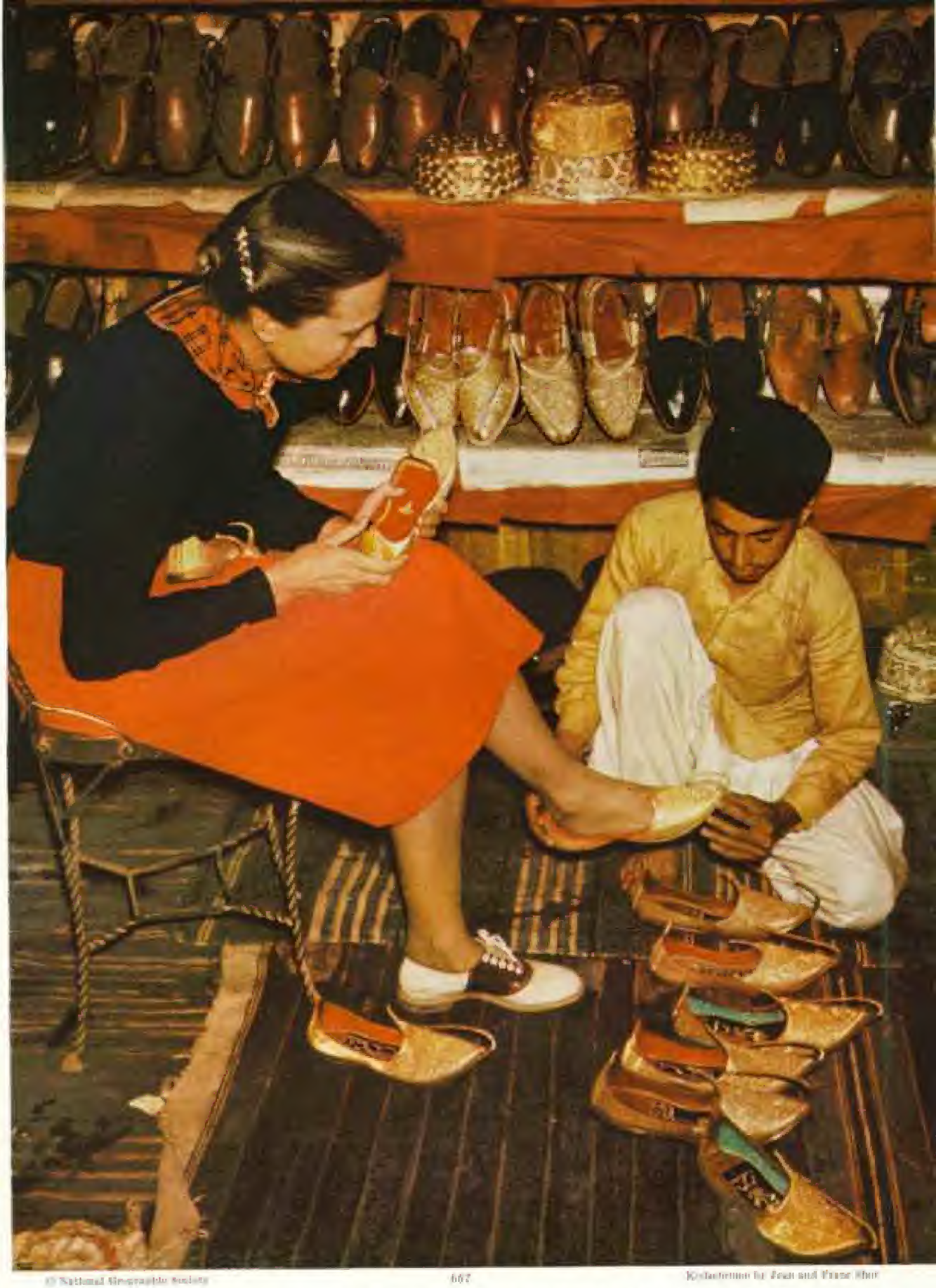
The Government-operated bus system carried us comfortably over excellent roads back into the Punjab. We crossed the Indus at Attock Fort, one of the most romantic fortresses in the world. Built nearly four hundred years ago by Akbar the Great, it protected the vast breadbasket of India.

Here, too, is a great railway and automobile bridge, another souvenir of British development.

Twenty miles outside Rawalpindi we passed a Government ordnance factory which sprawls for miles beside the highway. Millions of square feet are already under cover, and thousands of neat houses are rising for the workers.

"What a pity," a fellow passenger said, "that, when Pakistan needs civilian goods so badly, we are forced to spend more than half our budget on military preparations."

At near-by Wah one of the largest cement plants in Asia has just gone into production. In the shadow of its huge stacks we ate a



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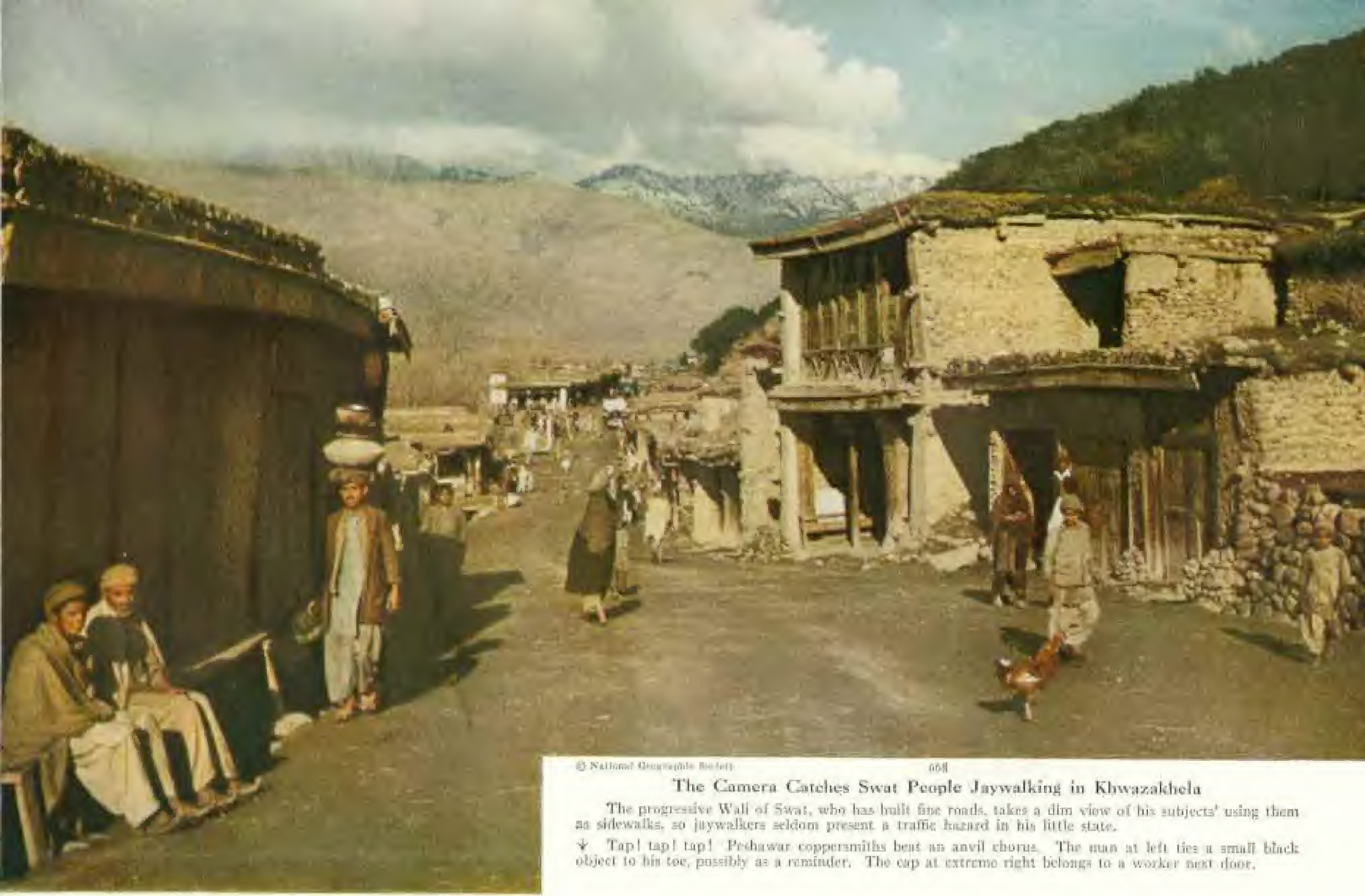
Kodachrome by Jean and Franc Shor

**Jean Shor, Shopping in Swat, Buys a Pair of Gold-embroidered Shoes for $6**

Pakistan's old-style shoes seem to come out of *The Arabian Nights.* These have toe tips like the antennae of an insect. "They fit just fine," Jean reports, "if you don't mind walking around with your toes turned up."



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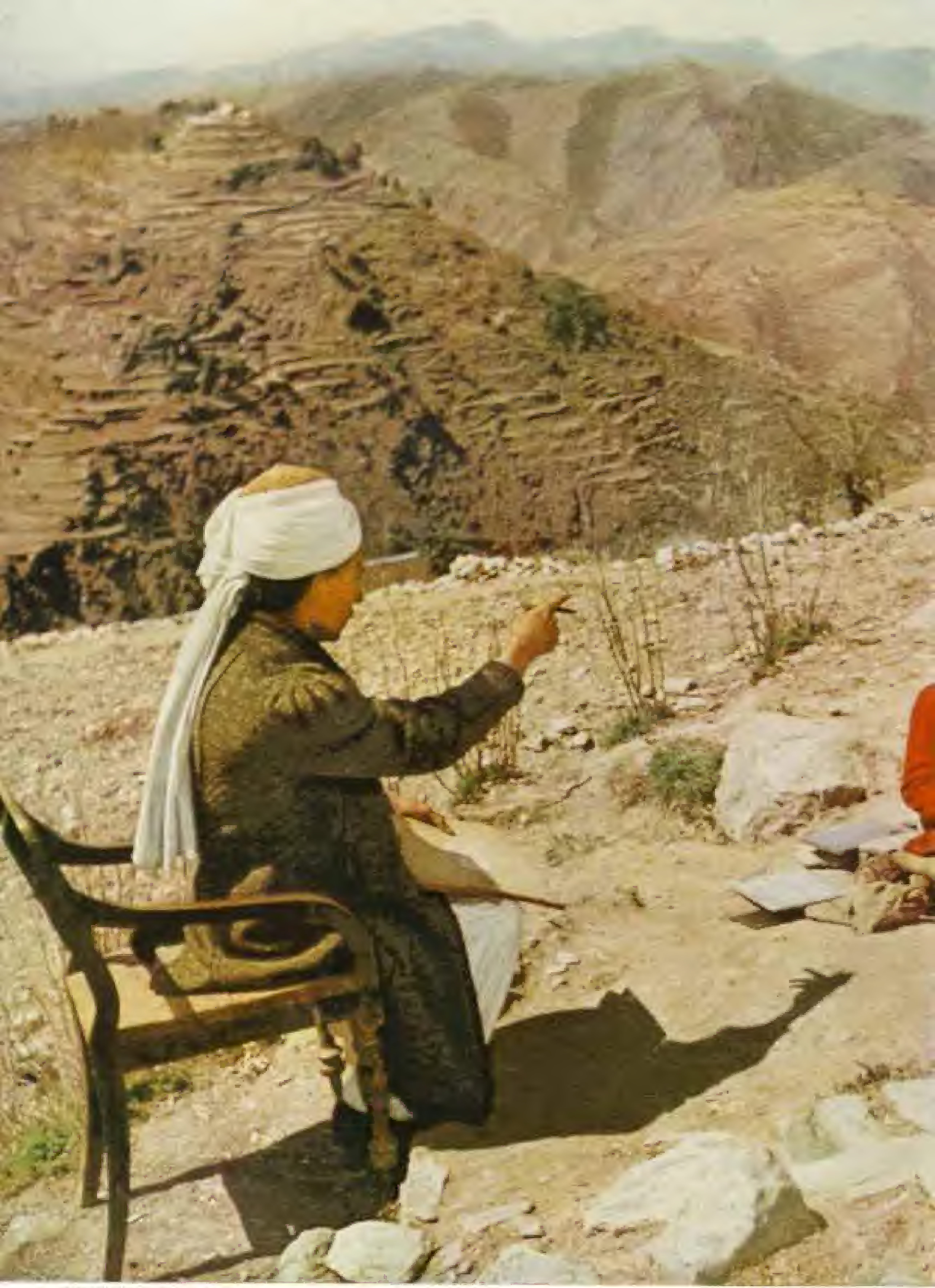
The Camera Catches Swat People Jaywalking in Khwazakhela

The progressive Wali of Swat, who has built fine roads, takes a dim view of his subjects' using them as sidewalks, so jaywalkers seldom present a traffic hazard in his little state.

↓ Tap! tap! tap! Peshawar coppersmiths beat an anvil chorus. The man at left ties a small black object to his toe, possibly as a reminder. The cap at extreme right belongs to a worker next door.

Kodachromes by Jean and Franc Shor



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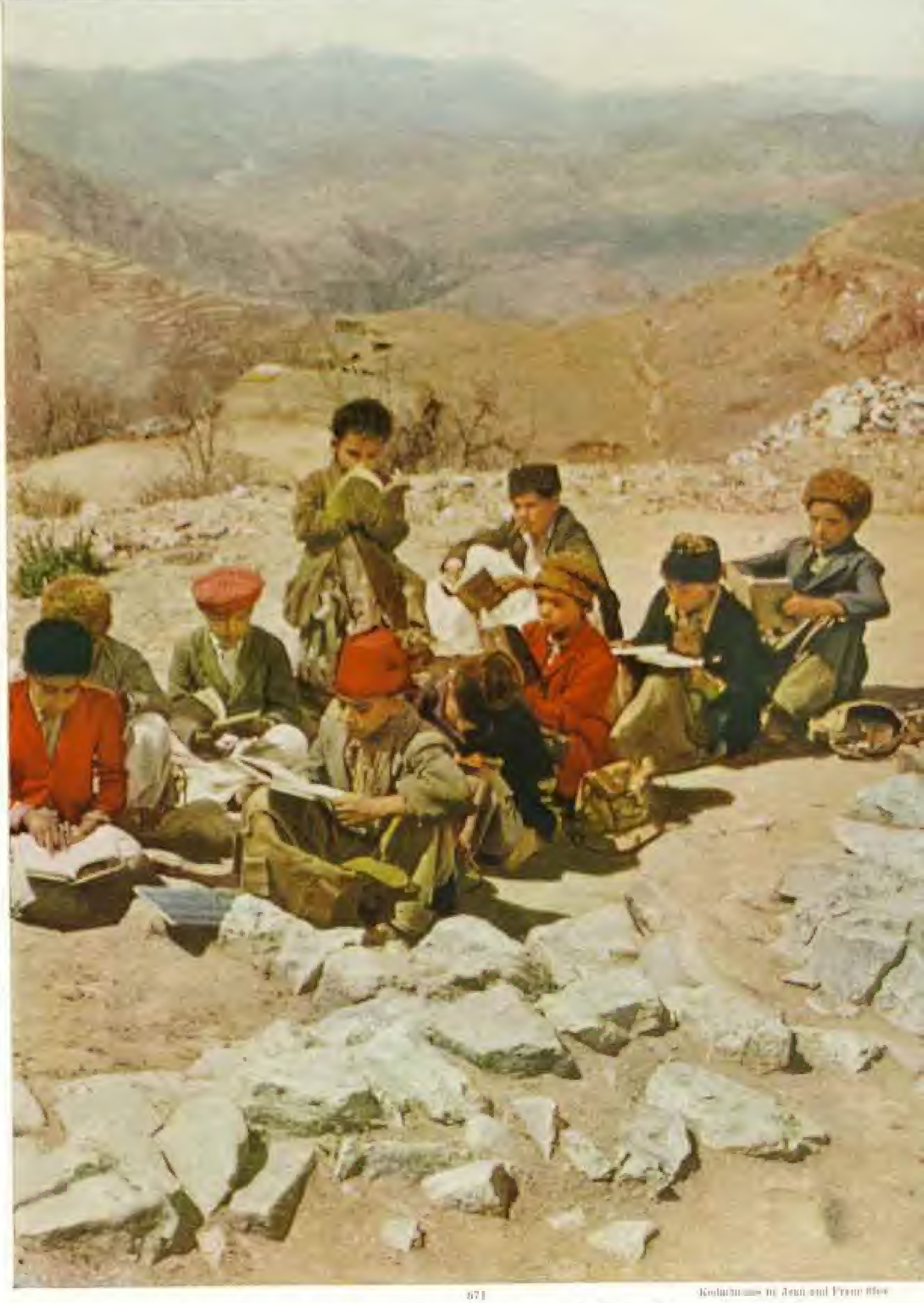
**Teacher Wags a Finger; His Pupils Recite in Unison. Their Education Is Free**

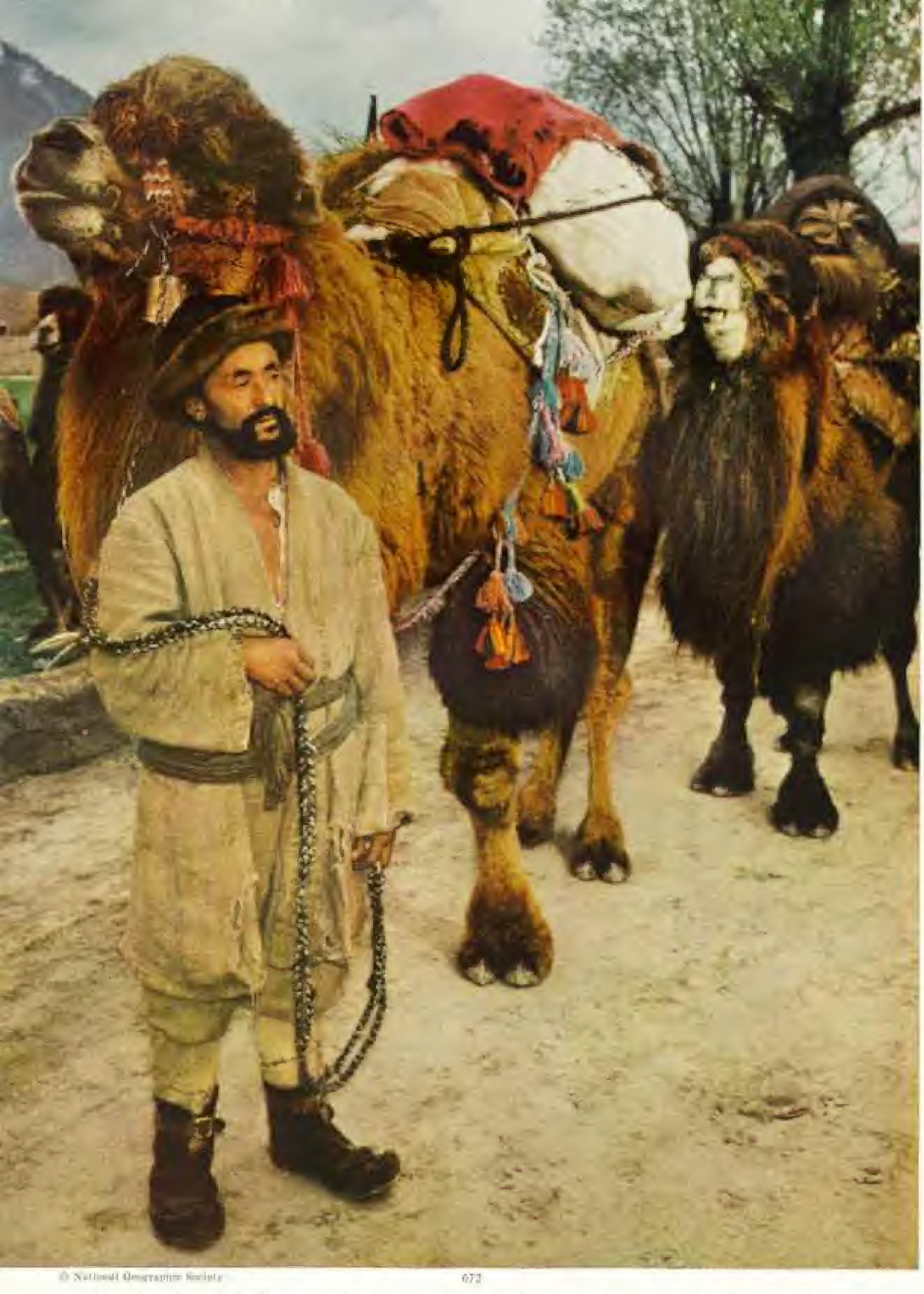
Everywhere, from the jungles of Bengal to the deserts of Baluchistan, Pakistan's children are going to school.



Kodachrome by Jean and Franc Shor

**Terraced Farms Stagger to Mountaintops; Every Arable Inch Goes under Cultivation**

Boys said their parents could not read. This difference between two generations measures Pakistan's swift progress.



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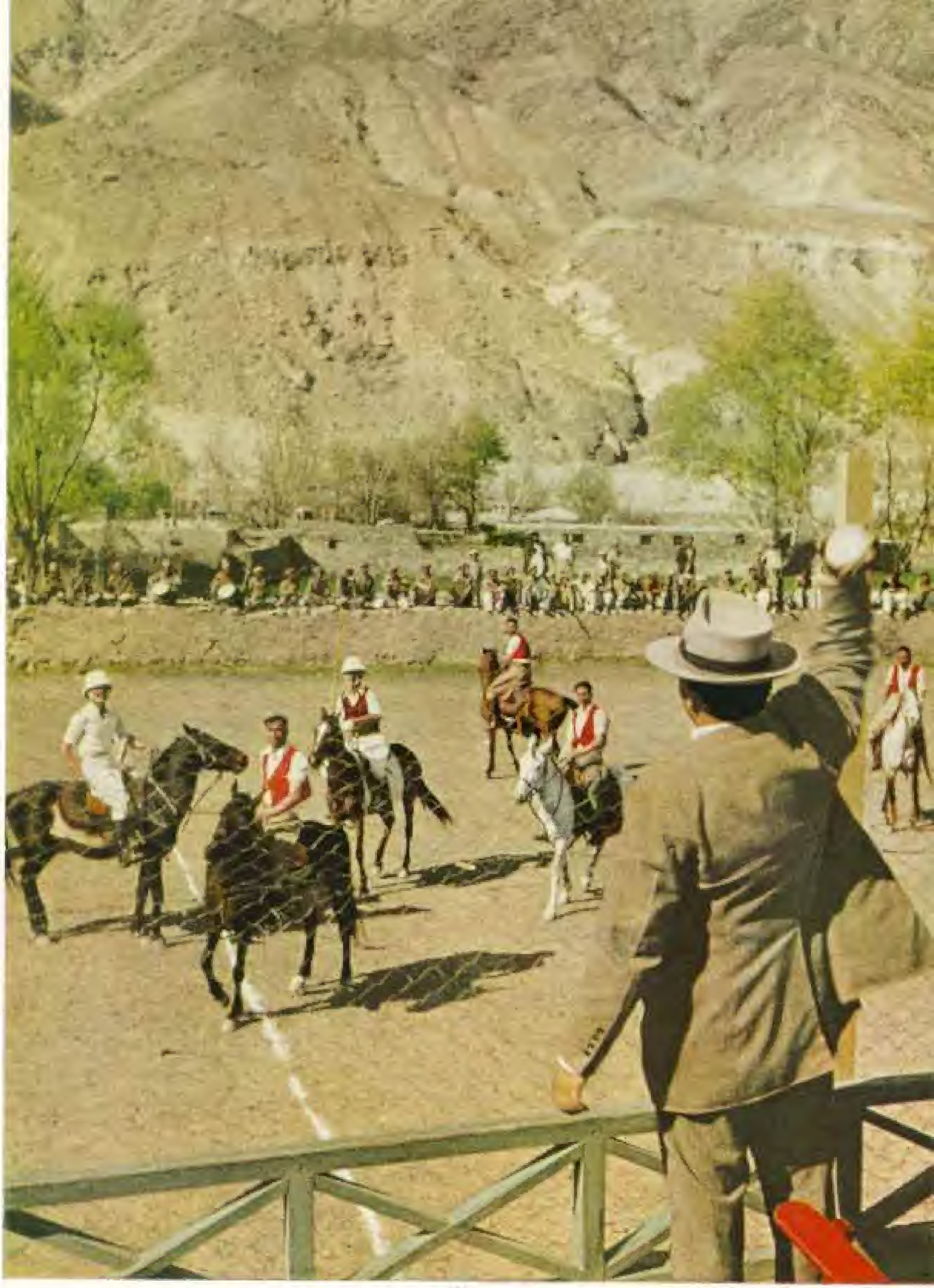
**Tugging Goat-hair Reins, a Caravaneer Leads His Shaggy Bactrian Camels into Gilgit**

This Central Asian in homespun bears little resemblance to his Pathan neighbor, but Islam's mystic bond links both men, loyal Pakistanis. Man and camels have journeyed from Chitral across lofty, snowy passes.



Kodachrome by Jean and Franc Shor

The Polo Ball Is Thrown Out; Gilgit Tribesmen Start a Bone-crushing Game

Anything goes; there are no fouls or penalties. Any player who catches a ball in flight may ride with it through the goal. His opponents use every device to unhorse him. Gilgit has played polo almost since the game began.

picnic lunch in a garden built by Jahangir.

Rawalpindi is headquarters of the Pakistan Army, the darling of a people who have always prided themselves on their fighting qualities. We dined with the Commander in Chief, Gen. Mohammed Ayub Khan, a giant of a man with fine mustaches, and Sir Douglas Gracey, first commander of the army and now an advisor to the general.

"Man for man," the general told us, "the Pakistani soldier is a match for any in the world. Our army is well-trained and well-equipped. It has great spirit. It is ready for any eventuality."

Sir Douglas, soon to retire from his advisory duties, told us he plans to stay in Pakistan and go into business.

"There is no limit to the opportunities to be found in this country," he said.

A government information official arranged for us to visit Azad (Free) Kashmir, on the Pakistan side of the cease-fire line. The dispute with India over the State of Jammu and Kashmir is, of course, the most important problem in Pakistan today.*

With a madman for a driver, we raced over 70 miles of tortuous mountain roads to Muzaffarabad, capital of Azad Kashmir. Our driver turned off the engine and coasted down miles of cliffside road at breakneck speed. "Gasoline very dear," he explained.

"Neck also very dear," said Jean. "Turn on that engine and go slowly!"

He did, but with a look of contempt.

Some of the most remarkable terraces in the world cling to the sides of Azad Kashmir's rugged mountains. Wherever there is a little soil, rock walls support tiny fields. Despite its mountainous terrain, the area produces a food surplus.

### Piano Goes by Air

In every village we saw schools. Some were in whitewashed mud huts, others simply little groups of teachers and students on rocky hillsides (pages 670-671). Pakistan's promise of education for all is being fulfilled.

From Rawalpindi we flew 180 miles northeast to Gilgit on one of the most thrilling and dangerous air lines in the world. Until a few years ago, only pack trains linked the little district of Gilgit with the rest of the country. The trail was open only a few months a year, and it took twenty days for horses to make the perilous trip. Now three war-weary American-made C-47 aircraft make as many as ten sorties a day.

"We carry food, medicine, gasoline, cloth, and a hundred other things to these isolated people," one of the pilots told us. "We even flew in a piano for one of the hill rajahs. Coming out, we bring hides and sheepskins and dried fruits."

There are no weather stations in the area, and no directional radio beam. The planes have a service ceiling of 15,000 feet, but such peaks as Nanga Parbat and Rakaposhi rise more than 25,000 feet along the way. The pilots fly by sight—and sometimes the weather closes in so rapidly they must fly blind through the narrow passes.

### Polo in the Game's Cradle

Pakistan maintains a political agent at Gilgit to watch over the affairs of the native states. Syed Faridullah, a buoyant, jovial Pathan, met us at the mountain-ringed airfield and whisked us by jeep to a polo game which had been arranged in our honor.

"This isn't polo like the Americans play at Meadowbrook on Long Island," he said, "but it's more authentic. These mountains are the cradle of the modern game. It's the hill tribes' favorite sport: every little mountain village has its own team."

The game was the most thrilling we have ever seen. There are no fouls, no rest periods, and no changes of ponies (page 675).

After this rough game it seemed appropriate to visit the Gilgit hospital, where two Pakistani doctors bring modern medical service to the hill people. As we left, Faridullah pointed to the rickety wood cart which serves the hospital kitchen.

"The members of your Society helped buy that," he said. "The wheels are from the 'Silver Crescent' which was left here by the Citroën-Haardt expedition."†

Syed Faridullah took us by jeep over 20 miles of rocky road to a great canyon, where thousand-foot rock walls rose sheer above a tumbling river. As we halted, a blast rocked the jeep, and a shower of rocks flew from a corner of the canyon.

"A new irrigation canal," said the political agent proudly. "There are hundreds of acres of fertile land in the valley which need only water. This job was too difficult for primitive methods, and the people were too poor to

© National Geographic Society Kodachrome by Jean and Franc Shor

**← Pakistani Girls Studying To Be Doctors Illustrate a Peaceful Revolution**

Ten years ago no proper Moslem girl would have gone to public school. The thought of nursing, let alone practicing medicine, was abhorrent. Today, responding to the needs of their country, some 300 daughters of Pakistan's best families attend Fatima Jinnah Medical College for Women in Lahore.

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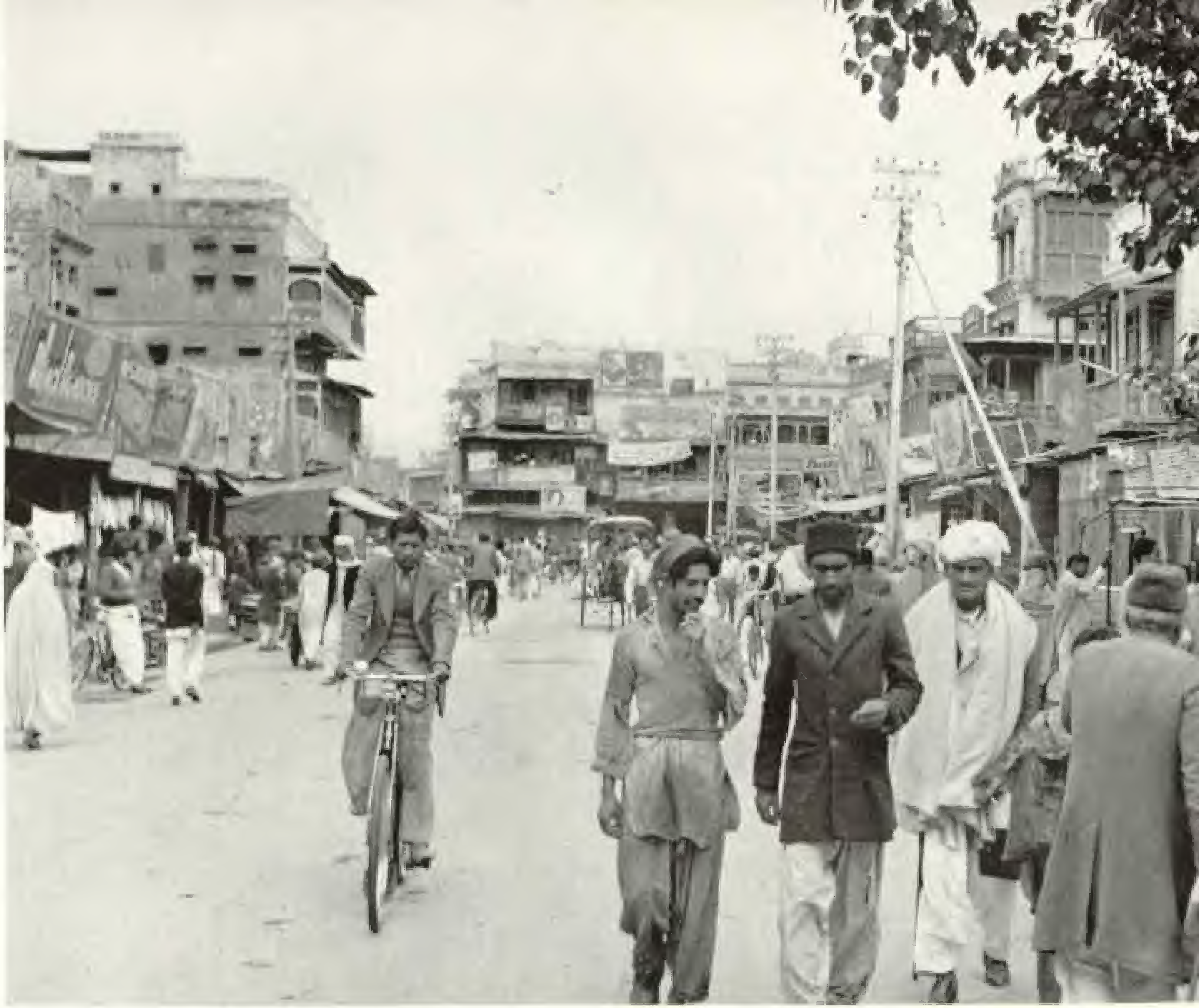
* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "New National Geographic Map Shows Changes in Asia and Europe," March, 1951; and "The Idyllic Vale of Kashmir," by Volkmar Wentzel, April, 1948.

† See "First Over the Roof of the World by Motor," by Maynard Owen Williams, NATIONAL GEOGRAPHIC MAGAZINE, March, 1932.



**Rawalpindi Does Its Daily Shopping in Rajah Bazaar**

"Seeking a place from which to make an altitude shot of the bazaar," the authors write, "we knocked on a door and asked if we might use the balcony. We were met by a physician, who not only granted our wish but insisted we stay for tea. Introducing us to his wife and son, he told us the story of their flight from India during the communal riots. There they abandoned three houses and 800 acres of land. Here they lived in two rooms above the noisy street.

"'But I am fortunate,' said the doctor. 'I lost my property, but my profession can never be confiscated. I am able to build a new life and at the same time serve my own people.'"

Here three men wear the Jinnah cap, a karakul headpiece named for the late Mohammed Ali Jinnah, Pakistan's founder (page 637). They are followed by a tonga, a horse-drawn carriage used as a taxi. Though Rawalpindi has motor cabs, many people prefer the cheaper tongas.

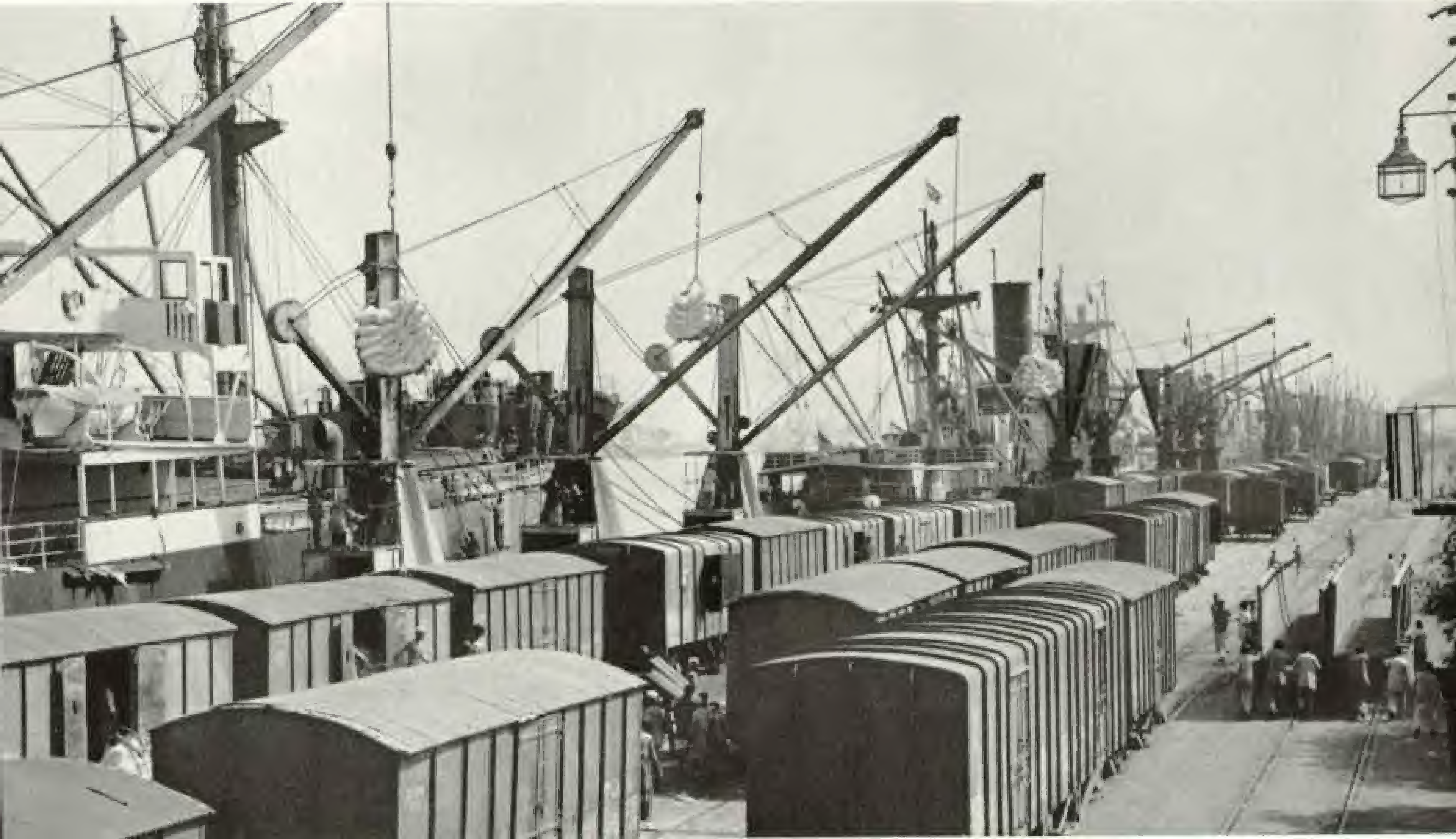
Rawalpindi, next to Lahore, is the largest city in the Punjab. For years it quartered British India forces keeping order in the North-West Frontier Province; now Pakistan's army makes the place its headquarters (page 675).

Formerly the city carried on a flourishing trade with Srinagar, but the clash over Kashmir dried up that commerce.

**Commerce Is Booming in Karachi Harbor. Ships, Trains, and Cranes Cram Five Miles of Piers**

Here the photographer saw Pakistan exporting wheat and rice to India even as the two nations were clashing over Kashmir. As fuel is expensive and labor is cheap, men push the switching car in the lower right.

National Geographic Photographer J. Baylor Roberts



afford dynamite and modern equipment. We are furnishing those, and they furnish the labor. In a year we'll have added 15 percent to our food supply."

We climbed back into our plane with 14 teen-age Gilgit boys.

"They've just graduated from our local school," Syed Faridullah explained. "They're going to Peshawar to take the Cambridge secondary examinations. Those who pass will be sent out for advanced schooling."

### Rough Ride to Rawalpindi

Gilgit very nearly lost a large percentage of its educated population on that flight. The wind shifted just before our take-off, and our pilot, a bearded Pole who had flown with the RAF during the war, hesitated for a moment, then swung the plane around.

Instead of taking off across the flat bed of the Hunza River, we raced up the field toward town, barely cleared the low trees, stood on one wing tip as we banked against the walls of a dead-end canyon, and wobbled out over the grain fields at the edge of town.

"I've always wondered if I could get off in that direction," laughed the pilot, who had invited us to share the cockpit.

His smile didn't last long. The shifting wind brought sudden clouds, and within 30 minutes we were flying blind. We radioed Gilgit that we were returning. "Don't come back," came their reply. "Field closed in."

"Go back and make sure those kids are strapped in," the now grim pilot told me. "We'll have to go down and try to follow the Indus, and it'll be rough."

It was. As we twisted through a narrow gorge, trees whipped past only a few feet from our wing tips. Suddenly the plane seemed to stand on its tail, the engines labored as if in their death throes, and the frame shuddered as we climbed steeply to avoid an unexpected cliff.

The students never lost courage. Half a dozen were very airsick, but I never saw a look of fear on a single face. I doubt if they could say as much for me.

An hour out of Gilgit the pilot checked his maps and shook his head. "Don't dare stay down here any longer," he said. "The gorge gets too narrow. We'll have to go up into that soup. I think we can clear the pass. If I've figured right, we'll go over at 12,000 feet. If I haven't—well, here we go."

He put the plane into a steep climb and the clouds closed around us. The windows were patches of murky white. The engines droned a deeper song.

For 15 minutes we flew blindly ahead and up—always up. Then the clouds seemed to thin out. In a moment we were in the clear. Two hundred feet below, the jagged peaks of the Balakot Pass seemed to reach up for the fragile skin of our little plane.

"As I told you," laughed the pilot, wiping his forehead, "never a dull moment. We'll be in 'Pindi in half an hour."

We were. Never have I enjoyed a walk so much as I did that 100-yard trip from plane to airport.

We had planned to fly back to Karachi. Somehow, however, we felt that we had seen enough of airplanes for the moment.

On the Karachi Mail we rattled south for two days, down the 900-mile length of the country. The roadbed was rough, the coach swayed and jolted, and it was so hot we kept a 200-pound block of ice in the compartment and let the fans blow over it day and night. But we didn't complain.

"A little rough," said Jean, "but it's so nice to know there won't be any unexpected mountains on the track."

### Briton Says Pakistanis Learn Fast

We shared our compartment with a British businessman, an importer of heavy machinery.

"I've been out here for 25 years," he said. "When Britain gave up India, I thought I was through. Then a Pakistan official, a man I'd known for 20 years, came to see me.

"'Don't leave,' he said. 'We need you. We have an enormous amount of building to do, and we need your know-how and the experience of the technicians on your staff. We can work together, and we'll all profit.'

"He was right. Last year was the best in the history of my business.

"We are training Pakistanis in a lot of jobs for which we used to bring in foreigners. They're learning fast. They're eager, and they are willing to work hard. That's half the battle, any place in the world."

We left Karachi feeling that we had witnessed a great adventure in western Pakistan—the development of a new nation. (The eastern part of this remarkable country—divided physically but united in spirit—requires another article.)

As the Prime Minister had told us, this is a new nation in a very old land. And the hard-working Pakistanis, proud of their history and confident of their future, are turning that old land into a modern, prosperous nation where more people can lead better lives than they have ever known before.

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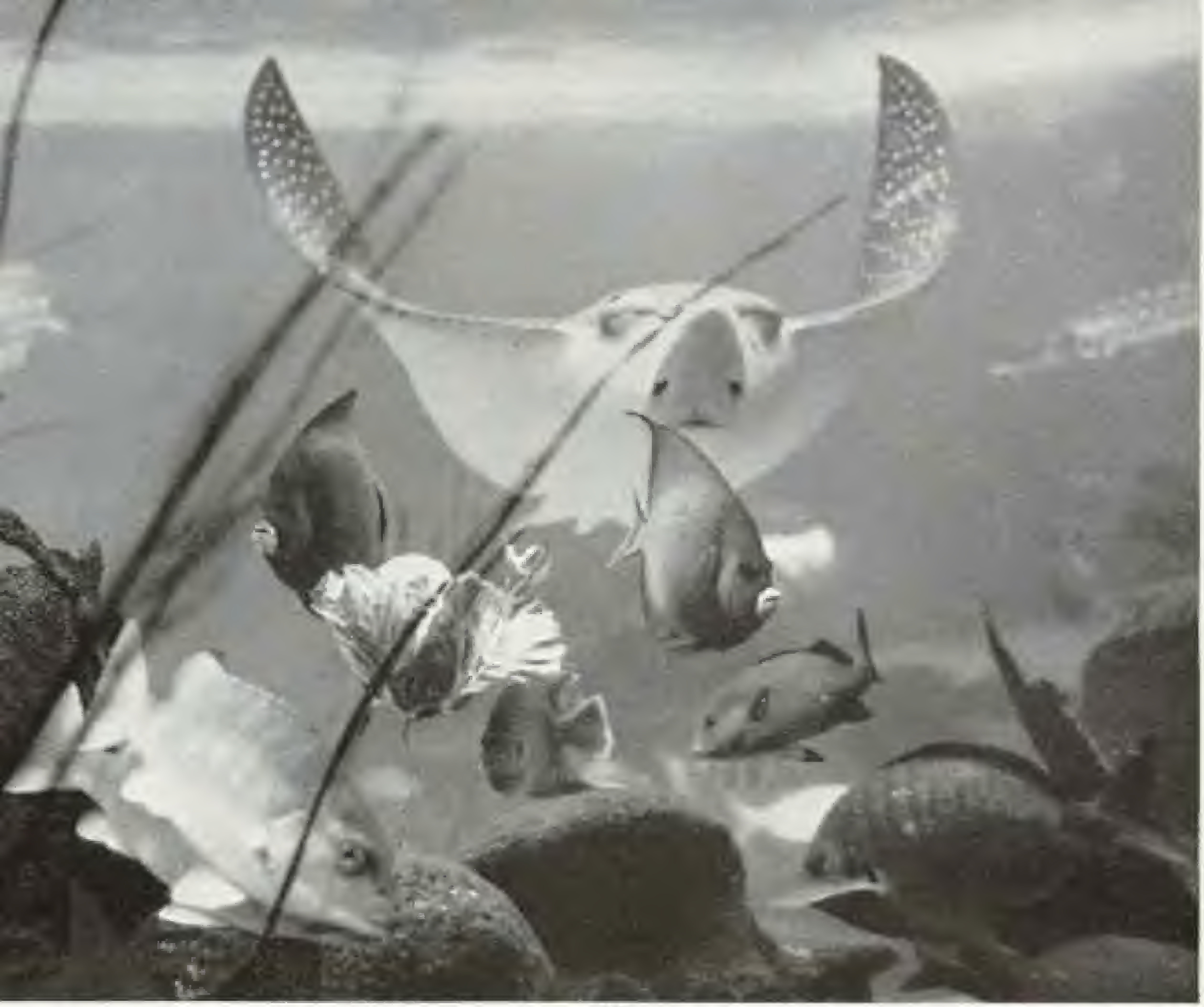
**A Shark Walker Revives a Captive in Florida's Marine Studios** →

Grabbing a fin and shoving, the diver restores vitality to an exhausted shark captured at sea and transferred to the big rectangular oceanarium in Marineland, Florida. Fresh sea water flowing across gills puts oxygen back into the blood stream (page 694).

# Marineland, Florida's Giant Fish Bowl

By Gilbert Grosvenor La Gorce

*With Illustrations by Luis Marden, National Geographic Staff*



**Pig-faced Spotted Whip Ray, Flapping on Batlike Wings, Appears to Fly Through Water**

Rays often feed on clams and oysters, cracking shells with crushers in their mouths and expelling the fragments like boys spitting melon seeds. Akin to sharks and sawfish, they have cartilaginous skeletons. Some species carry poisonous barbs on tails, using them with deadly accuracy against enemies. The cabbage "growing" on the oceanarium's floor was planted for certain vegetarians, among them angelfish and triggerfish.

MAN has amused and instructed himself by watching fish in aquariums since ancient times. But not until our day has it been possible to stand a few inches from the predatory tiger shark, the vicious barracuda, and the malicious moray eel and watch them together in surroundings like those of their natural habitat.

Today at Marineland, between St. Augustine and Daytona Beach, Florida, 10,000 fish live in a scientifically designed "oceanarium," not separately as in aquariums, but together in two huge tanks connected by a flume. The tanks are carefully planned and maintained to approximate conditions of marine life in the open sea. Through 200 portholes along the sides and beneath these giant "fish bowls," the scientists and visitors observe the drama of undersea life.

In the clear blue-green water, pumped from the ocean at the rate of five million gallons a day, swim silver tarpon, undulating rays, lumbering turtles, and a myriad of schooling fishes from the coral reefs and spawning grounds of the Gulf Stream.

Here too are bottle-nose dolphins, or porpoises, as they are commonly called. Known and beloved by mariners, these friendly air-breathing, warm-blooded mammals were first introduced into prolonged captivity here at Marine Studios. Photographer Luis Marden and I met them personally as we toured this simulated ocean floor.

At fish level, far below the surface, we strolled along the blue-lighted corridors that rim the big tanks. Through specially tempered glass ports we peered into a kaleidoscopic world of sunlight and shadows. Sea fans and shells, graceful waving plumes, and brightly darting tropical fish reflected the filtered rays of a brilliant Florida sun. Cavernous man-made rock grottoes, a 7-ton artificial coral reef, and the barnacle-encrusted remains of a sunken vessel, complete with rusting anchor, made the scene a convincing corner of Davy Jones's locker.

If the Ray Looked Out of His Tank, He'd See These Girls Looking In

Marineland's rectangular tank, which holds many varieties of ocean life, has 97 portholes. Almost every time a chartered bus drives up, scores of boys and girls pile off and rush up to the glass windows. Before their eager eyes swim lordly silver tarpon, dangerous barracuda, tropical reef fish, and many others. High-school biology students earned classroom credit for this field trip.

Suddenly, out of the haze beyond the wreck, appeared the Martian figure of a deep-sea diver. In the stream of air bubbles cascading from his helmet swam a school of bumper fish. Near by a 400-pound jewfish, sensing the diver's progress, moved backward a few inches beneath the shattered timbers of the ship's hulk that is its domain.

### Divers Hand-feed Some Fish

Then into our view glided the shadowy figure of a tiger shark. Twelve feet of sinewy muscle circled about to survey the scene. Involuntarily the diver stepped back, holding his wire feeding basket filled with chopped mullet before him to help ward off a possible attack.

We watched, electrified. Man and shark eyed each other for a few seconds; then the monster flipped his powerful tail and disappeared into the central gloom of the tank, leaving a swirl of bubbles in his wake.

"Several times a day a staff diver must make the rounds of the two tanks, inspecting his charges and feeding many of them by hand," an announcer explained to us and the other visitors (page 687).

"Look there!" he urged. "At the base of the rock grotto . . . see him? That's a moray eel."

The thick-bodied, sharp-toothed creature ribboned its way out of one hole and quickly slithered into another, leaving only its voracious head protruding. Morays can inflict nasty bites. The diver skirted this fellow warily, continuing his rounds.

"Isn't that a cabbage head?" asked someone in the crowd.

It was. The announcer explained that several species of fish are vegetarians. Cabbage and lettuce heads are placed daily in the 100- by 40-foot rectangular tank to supply needed forage for these non-fish eaters (opposite page).

In this tank the spectrum is reproduced in ever-changing pattern on fish forms, beautiful and grotesque. Our gaze followed the schools of common jacks, or crevalles, as they passed at varying levels, massed in response to the schooling instinct. We tried to spot others as the announcer called them out.

"Those are angelfish . . . Here comes a parrotfish, with sheepshead just below it . . . These are triggerfish, with a school of young blues next in line."

Near the water's surface, clouds of beady-eyed shrimp snapped backward as they swam in little spurts. Since many fish prize them for their flavorful meat, they have short lives in the tank.

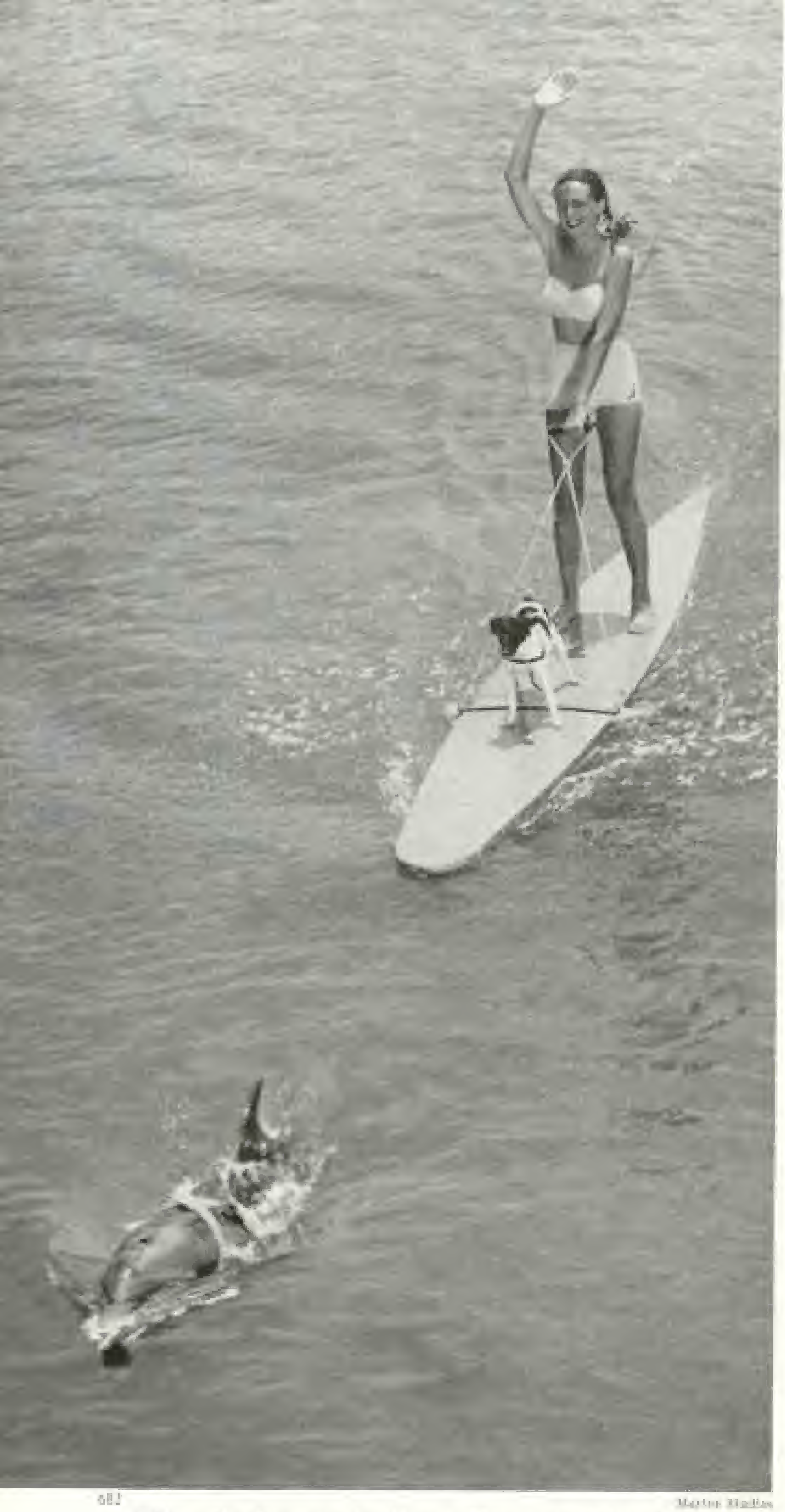
"We even have the makings of an orchestra," the guide said with a smile. "Here you'll find a guitar fish, a cornet fish, a bass fish, and a drum fish!"

### Porpoises Are the Star Performers

But by far the most popular with the public are the porpoises. Porpoise feeding time at Marineland is a major performance. In addition to learning to accept food from an attendant's hand in the water, the creatures learn to leap high into the air to take the fish from the outstretched hand (pages 689, 690-691).

There are 22 species of porpoises in Atlantic and Pacific waters, the most common in this vicinity being the gray bottle-nose dolphin (the inshore porpoise), *Tursiops truncatus*. In the 75-foot-diameter circular tank are also specimens of the deep-sea, long-snouted dolphin, or spotted porpoise, *Stenella plagiodon*.

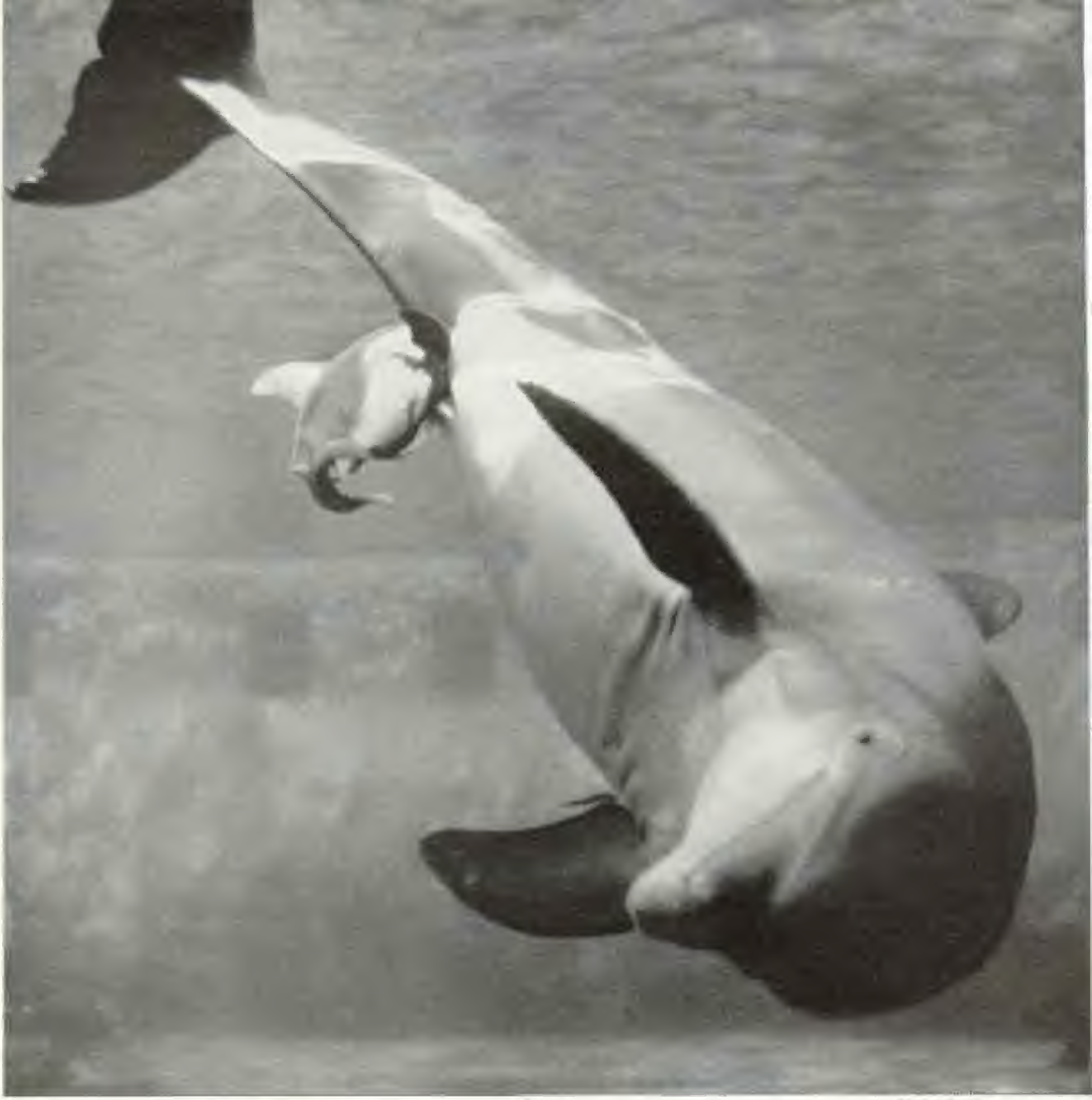
"It takes about two



Marine Studios

Flippy the Porpoise Is Always Happy to Oblige Friends or Please a Crowd

Marineland's favorite performer here tows Pat Dale and his trainer's dog, Duke, the first two ever to ride a porpoise-powered surfboard. Flippy, only porpoise to do this trick, wears a harness like a dog's (pages 684, 685, 688).



Marine Studios

**Porpoise, Mammal That She Is, Gives Birth to Fully Developed Young**

Four baby porpoises have been born alive at Marineland. This captive, unable to bite the umbilical cord as most warm-blooded animals do, severs it with a quick, jerky whirl. Baby enters the world able to swim, but has to depend on mother for milk and protection (page 655).

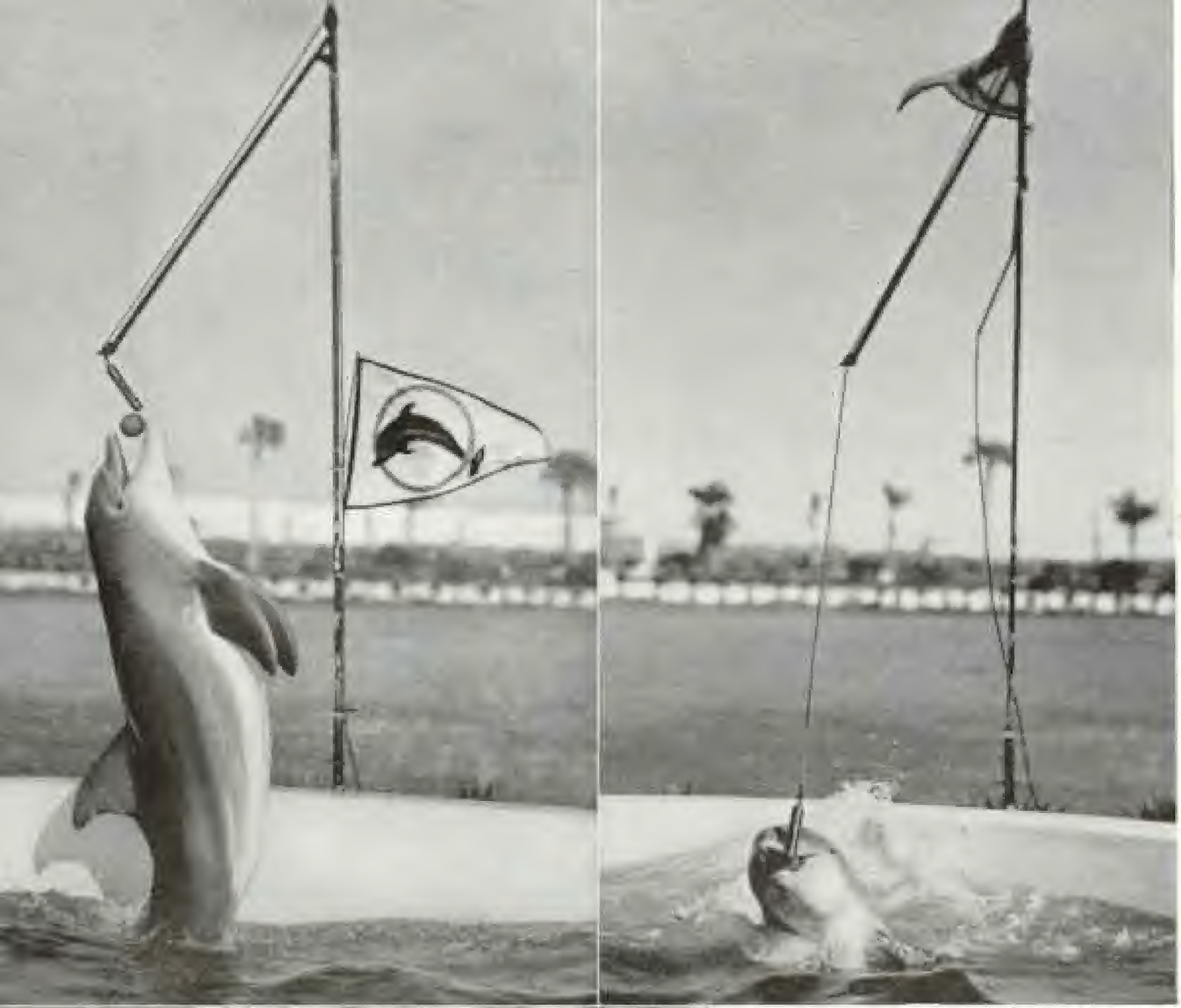
weeks to tame sufficiently a newly captured porpoise," a Studios scientist explained. "It will then begin to accept food from the attendant's hand."

The inshore porpoises are captured in nets strung in channels between points of land, where the animals feed in tidewaters. The new arrival is carefully transported by sling to the flume, its body kept dampened to prevent its skin from cracking and to maintain the proper body temperature while out of its natural element.

"Although frightened at first," our informant continued, "none has ever attempted to bite or otherwise attack the collecting crew."

Offshore specimens are captured with a tailgrab, an ingenious and harmless lariat snare. Only a few miles at sea, the collecting crew sails one of the powerful sea skiffs on a porpoise hunt. The frolicsome animals appear, sooner or later, surging along at the boat's prow. It is a tricky maneuver for the collector to thrust the mechanical lasso, with its forcepslike jaws, over the small of the porpoise's body just above the tail. A hempen line, threaded through the "iron," automatically forms a double loop.

The staff is quickly withdrawn, and the line is snubbed and secured. Then the roped porpoise tows the boat over the ocean. Usually wearying in less than half an hour, it is finally drawn alongside.



Marine Studios

### ▲ Flippy Yanks a Lanyard and Raises a Pennant

Marineland's playful porpoises like to push giant sea turtles across their tank, nibble at sharks' tails, and nudge Pete the Pelican as he paddles about. If Pete drops a feather, they chase and retrieve it.

The porpoise's clever method of fishing impresses scientists. Saving a dead mullet handed out by the diver, he takes it down and drops it as a lure. When fish appear, the mammal tries to catch them, not in hunger but in play. Failing once, he tries again.

Flippy, the educated porpoise, rolls over and over at command, blows a horn by biting a rubber bulb, and retrieves thrown sticks. The lanyard-and-pennant trick baffled him at first because he did not bite the ball firmly enough.

◄ Like a circus performer, Flippy confidently bursts through a paper-covered hoop suspended three feet above water. He shuts his eyes for this stunt. The apparent smile is his natural expression (page 658).

Marine Studios

**Flippy Cheerfully Leaves the Water for Weighing, Measuring, and Doctoring**

Training the porpoise to enter the sling hoist required patience. Now he confidently lies motionless even out of his element. Left: He accepts lotion for his sunburned brow. Right: He enjoys a fish tidbit as a reward.

Being air breathers, porpoises replenish their oxygen supply normally at least once every thirty seconds, although they can stay under water up to seven minutes. Usually they rise to the surface at such intervals, clear the blowhole on top of the head, and expel the air in their lungs before the next intake.

Porpoises are natural clowns. They love to tease other specimens in the oceanarium. Frequently they nip at the tails of little fish that hide in the rocky crevices. Occasionally they will devour one whole, for porpoises feed only on species of fish they can swallow without chewing. Their teeth are capable of inflicting damage, but they reserve these tactics for each other and, on occasion, for annoying some of the sharks.

### Porpoises Ram Sharks to Death

When aroused, porpoises become tough adversaries, ramming the sides of their finny opponents until death ensues. They are extremely powerful. Often one will shove a loggerhead turtle up and down and around the tank until the 200- or 300-pound creature develops an expression of quiet desperation.

Porpoises in the oceanarium have weighed more than 450 pounds. Their seemingly effortless speed has been clocked at 35 miles an hour in the open sea.

In this tank the Studios staff has witnessed the successful births of four baby porpoises (page 683). The mother nurses her baby for about 12 months before the little one learns to eat fish.

But even new babies are able to swim along with the others. The mother, sometimes aided by a female friend, shields her offspring with her body to protect it from possible attack by males or by the bigger sharks that might favor young porpoise steak.

The high level of porpoises' ability to learn has been recorded at this unique marine biological laboratory. For the past two years, experiments have been conducted here to determine the extent to which one of these animals could be trained.

Mr. Adolph Frohn, an experienced animal trainer, undertook the task at the direction of Mr. W. Douglas Burden, president of Marine Studios, who is also a trustee of the American Museum of Natural History, New York. Mr. Burden and Col. Ilia A. Tolstoy were the co-designers of Marineland, first opened in 1938.

"I'll ask Mr. Frohn to put Flippy through his paces for you," said the vice president and general manager of the Studios, William F. Rolleston. "We are rather proud of this animal."

The training was done in a special tank. Later, in an enclosed lagoon, the porpoise learned to tow a surfboard while a girl and a dog rode as passengers (page 682).

We met Mr. Frohn, a friendly, keen-eyed man, whose sure approach to his job and masterful handling of his pet prove his years of experience in animal training. One immediately sensed the bond of friendship between the trainer and his charge.

"Flippy!" Mr. Frohn called. The young fellow, weighing about 200 pounds, had spotted us as we approached his tank. He thrust his head out of the water and swam to his trainer's outstretched hand. After patting him for a moment, the trainer slipped him a morsel of fish.

"I use the feeding incentive system," he told us. "It seems to work well with all animals."

After each trick, Flippy gratefully and delicately accepted the proffered fish tidbit. We could plainly hear him whistling through his blowhole as he cavorted around.

### Flippy Gives a Command Performance

"Watch how he blows this bulb horn and then ceases at my command," Mr. Frohn remarked.

Seemingly pleased at this particular trick, Flippy dutifully stopped biting it at the proper signal. He resumed his honking only when ordered.

"He would wear it out if I let him keep it up," the trainer said with a laugh.

In addition to leaping up and pulling a cord that ran up a pennant on a jackstaff, the porpoise gracefully jumped through a three-foot hoop suspended above the water (page 688). Then he performed the same act after the hoop had been covered with paper (page 684). As his head burst through, Flippy actually seemed to grin, as if approving our own pleased expressions and comments.

When not under command, Flippy watches his trainer constantly, head partly out of water, eyes and ears at attention. When we stepped back from the tank, Flippy popped up over the edge, resting his jaw on the rim while he surveyed Mr. Frohn solemnly.

"He looks as if he wants to climb right into your arms," I remarked.

"One time he did," replied our host. "I was working out of a skiff in the lagoon. As I offered a morsel of fish, Flippy, in his exuberance, jumped clear of the water into my arms. He is only about four and a half years old, but he's some baby to hold!"

Flippy then went through his repertoire: rolling over and over at the command; surging out of the water to grasp a rope and ring a bell; retrieving a thrown stick; backing up, head out of water, at each successive wave of his trainer's hand; and then expertly catching a thrown rubber ball, which he promptly returned to his master.

One trick was a supreme show of confidence and trust on the part of the animal. Mr. Frohn suspended a canvas sling over the tank, then lowered it beneath the surface. At his command, Flippy swam obediently onto the sling and lay there motionless. Mr. Frohn then hoisted the sling clear of the water. The porpoise remained absolutely still, except for the intermittent opening and closing of the blowhole atop his head.

### A Porpoise Can Get a Sunburn

"I don't keep him out too long in this sun. Porpoise skin sunburns quickly," the trainer said (page 685). "He got a bad case of sunburn on his head during the surfboard training period. I rubbed petroleum jelly on it to soothe the burn. My little dog watched the process with interest. Then when Flippy thrust his head out of water near our boat in the lagoon, the terrier would try to lick off the jelly. Flippy seemed to enjoy it, for he repeated the ritual frequently."

We learned that the Studios are planning to introduce a young female to this training program. Might she and Flippy produce a race of particularly talented porpoises?

"Who knows?" replied Mr. Frohn. "We might discover that Flippy is actually a rather dumb specimen." He added quickly, "But he's a lovable one."

Flippy's enthusiastic public acceptance has prompted an expansion program. Plans for next year call for construction of a "porpoise stadium" seating 1,000 visitors. This will surround an exhibit pool, 100 by 30 feet, where future aquatic stars can perform daily. Four connecting tanks will serve as training pools for Flippy & Company. More than 100 new portholes will be added to the oceanarium walls.

The Studios' expanding exhibits provide a visual educational opportunity for thousands of visitors annually touring Florida. Marineland presents a never-ending drama of the daily underwater life of colorful fishes and animals of the mighty Gulf Stream.

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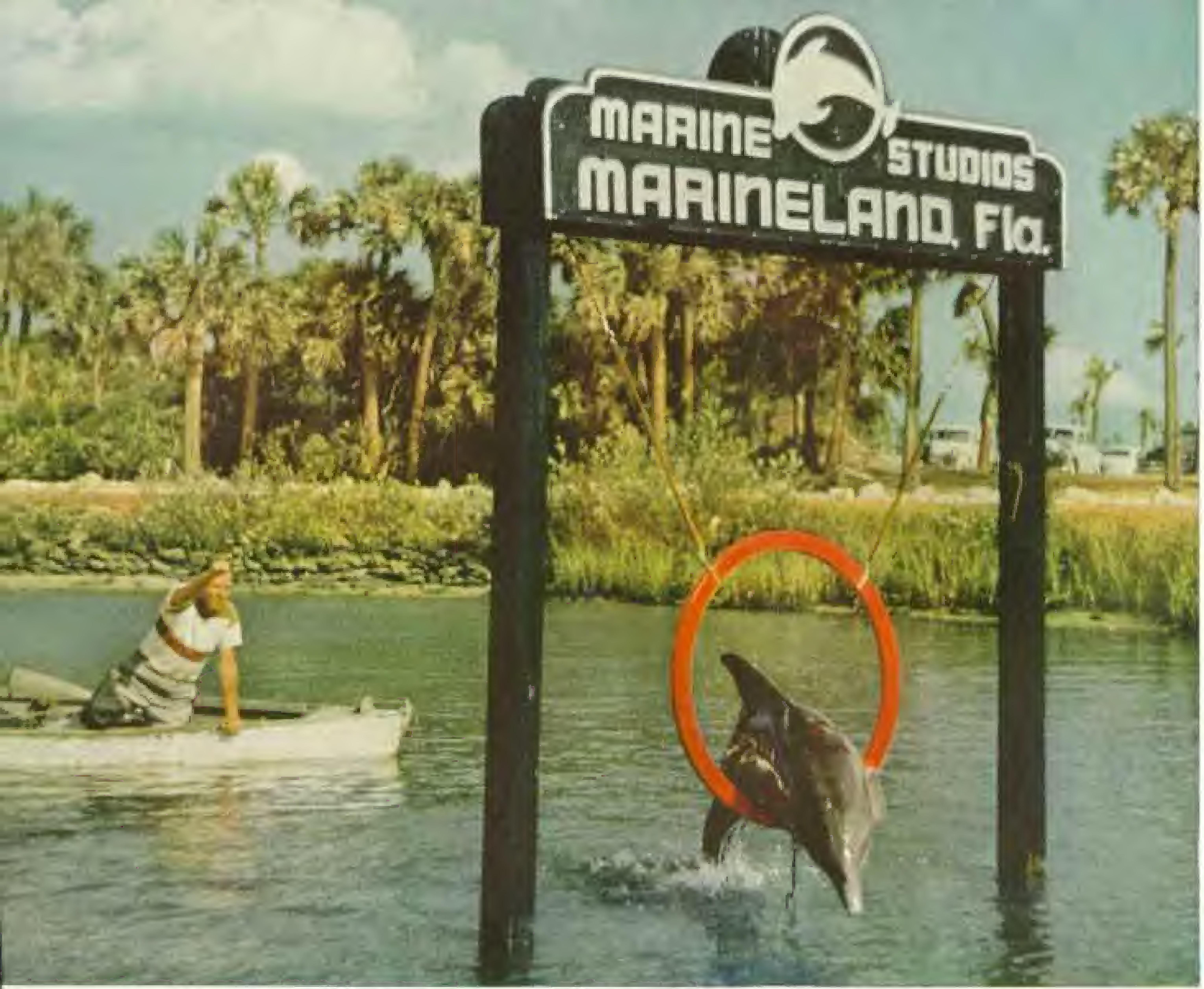
**This Diver Caters to 10,000 Fish; → Guests Gather for a Free Meal**

Marineland divers spend working hours prowling about two underwater wonderlands, feeding and inspecting their voracious charges. Here a green moray eel, attracted by the tinted gear of Albert W. Taylor, Jr., slithers from his coral-rock home and hungrily eyes the dead mullet in the gloved hand. Other fish are a lookdown (upper left), Bermuda chub (upper right), and two angelfish (lower left).

© National Geographic Society
Kodachrome by Luis Marden, National Geographic Staff



## Flippy Spears the Hoop at His Trainer's Command

Adolph Frohn (left) spent two years teaching this friendly bottle-nose dolphin, or porpoise, his bag of tricks.

Mr. Frohn applied the accepted technique of first winning his pet's confidence through feeding rewards. Now 4½-year-old Flippy obeys visual commands implicitly.

Once the porpoise playfully leaped aboard a skiff into his trainer's arms.

Flippy has proved so entertaining that Marineland has made plans to erect a "porpoise stadium" where he and others of his kind will amuse 1,000 visitors at a time.

Flippy was netted south of Daytona Beach in a section of the Intracoastal Waterway, a favorite feeding ground of inshore porpoises, which ride the flooding and ebbing tides to prey on school fish. A 7-foot 270-pounder, Flippy has gained one foot and 120 pounds in captivity.

In ability to learn, some observers rate the porpoise close to the chimpanzee, which scientists consider the smartest mammal next to man.

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## A Porpoise Leaps for Fish as a Trout Rises to a Fly

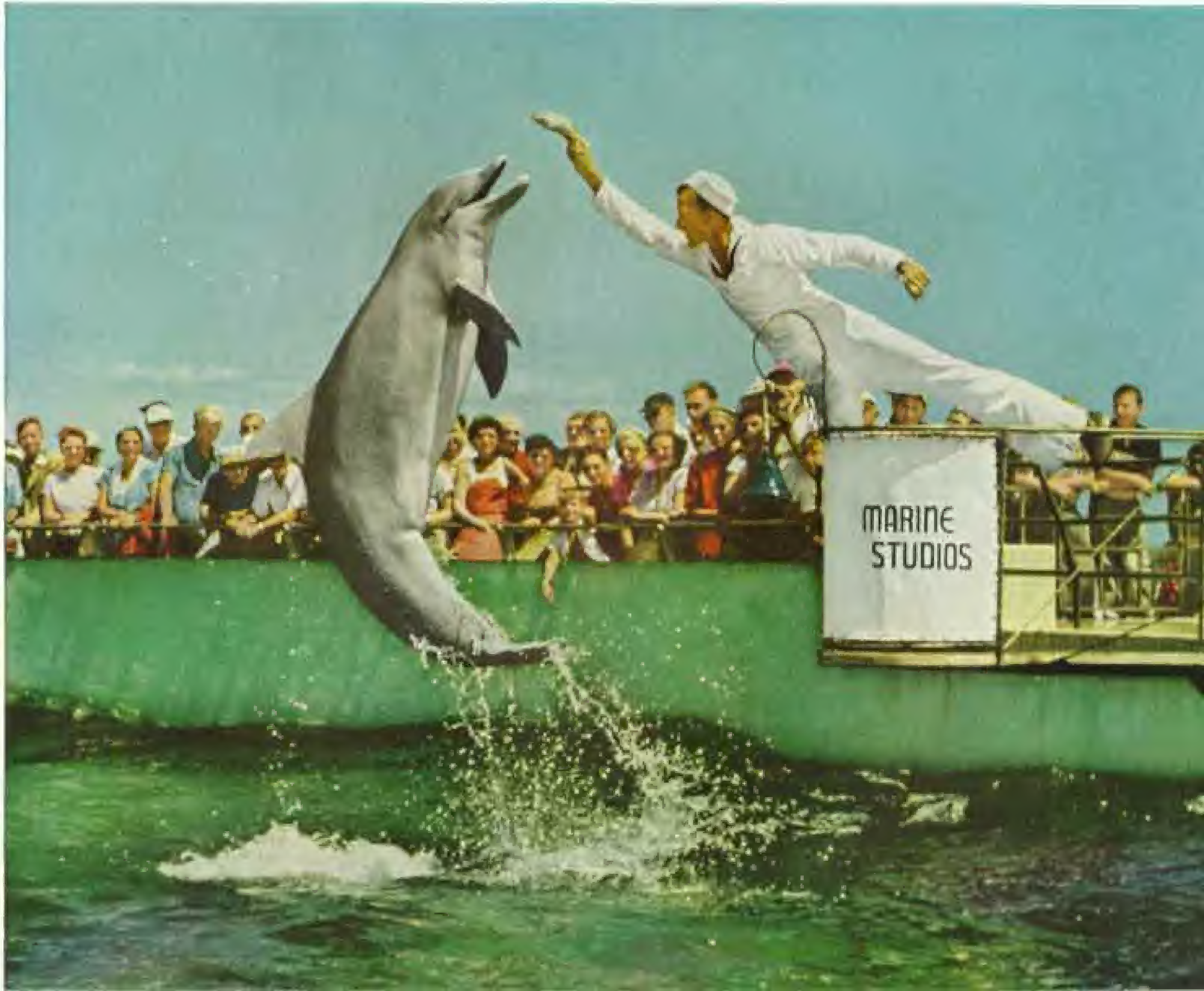
Porpoises at sea have been clocked at 35 miles an hour. Powerful flukes at the end of the tail give them speed. Unlike the vertical tails of fish, the porpoise's propellent blades are horizontal like those of its cousin, the whale.

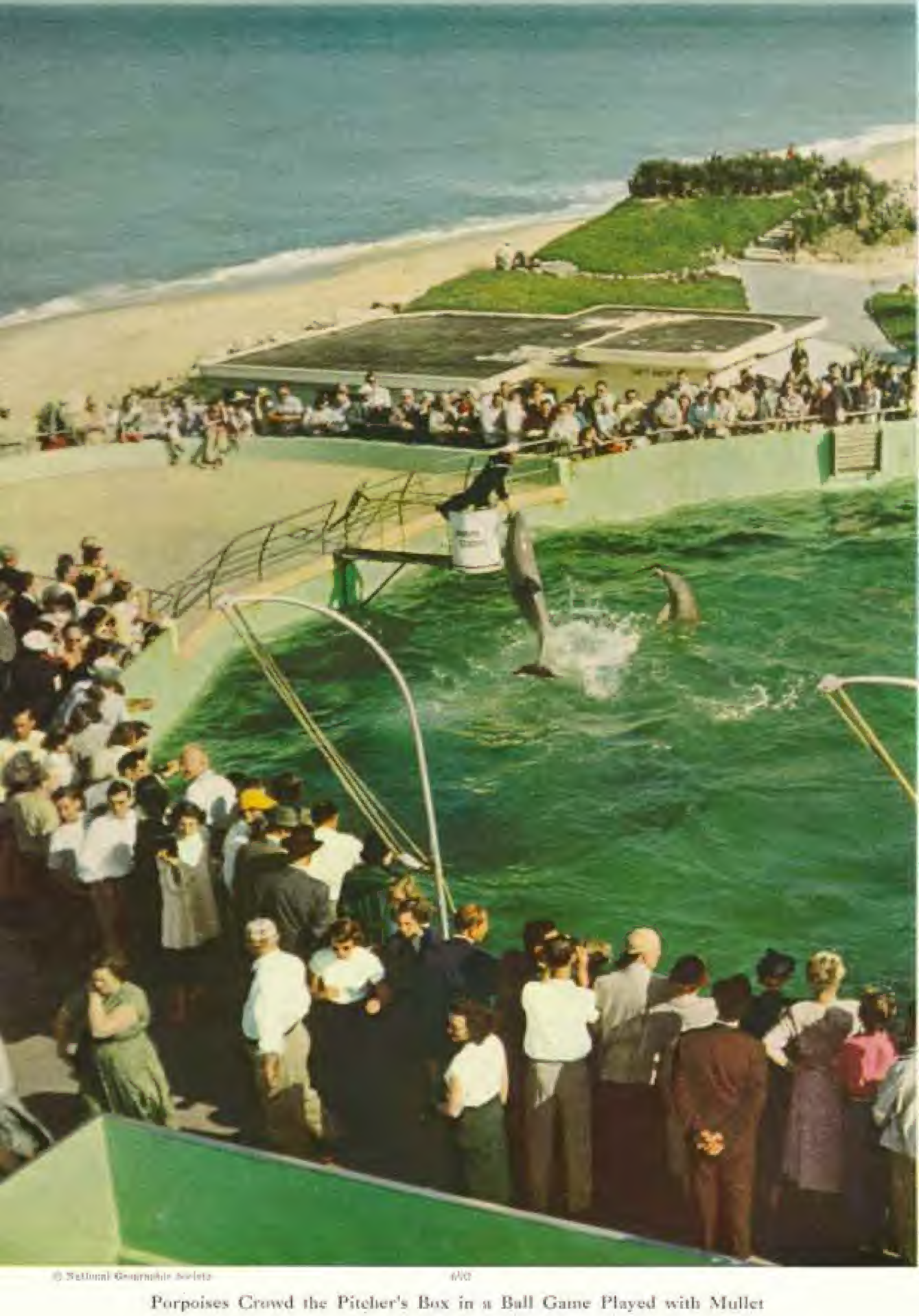
Largest captives exceed 450 pounds. One of these living torpedoes can kill a shark by ramming its sides and damaging vital organs.

Porpoises, which lack external ears, can readily detect water-borne sounds; and so, when the dinner gong rings, they herd below the pulpit, look up, and, gathering momentum in water, erupt into the air, each one politely taking its turn at snatching a morsel.

Ten-foot leaps highlight the six shows a day. The mammals seem to walk on water as thrashing tails propel them up to the feeder's hand. Attendant Mitch Lightsey has permitted them to grasp fish held in his mouth. Not a feeder has been bitten. Friendly by nature, the porpoises gauge their jumps so as to hurt no one. But visitors standing too close sometimes receive showers of sparkling sea water.

Kodachrome by Luis Marden, National Geographic Staff





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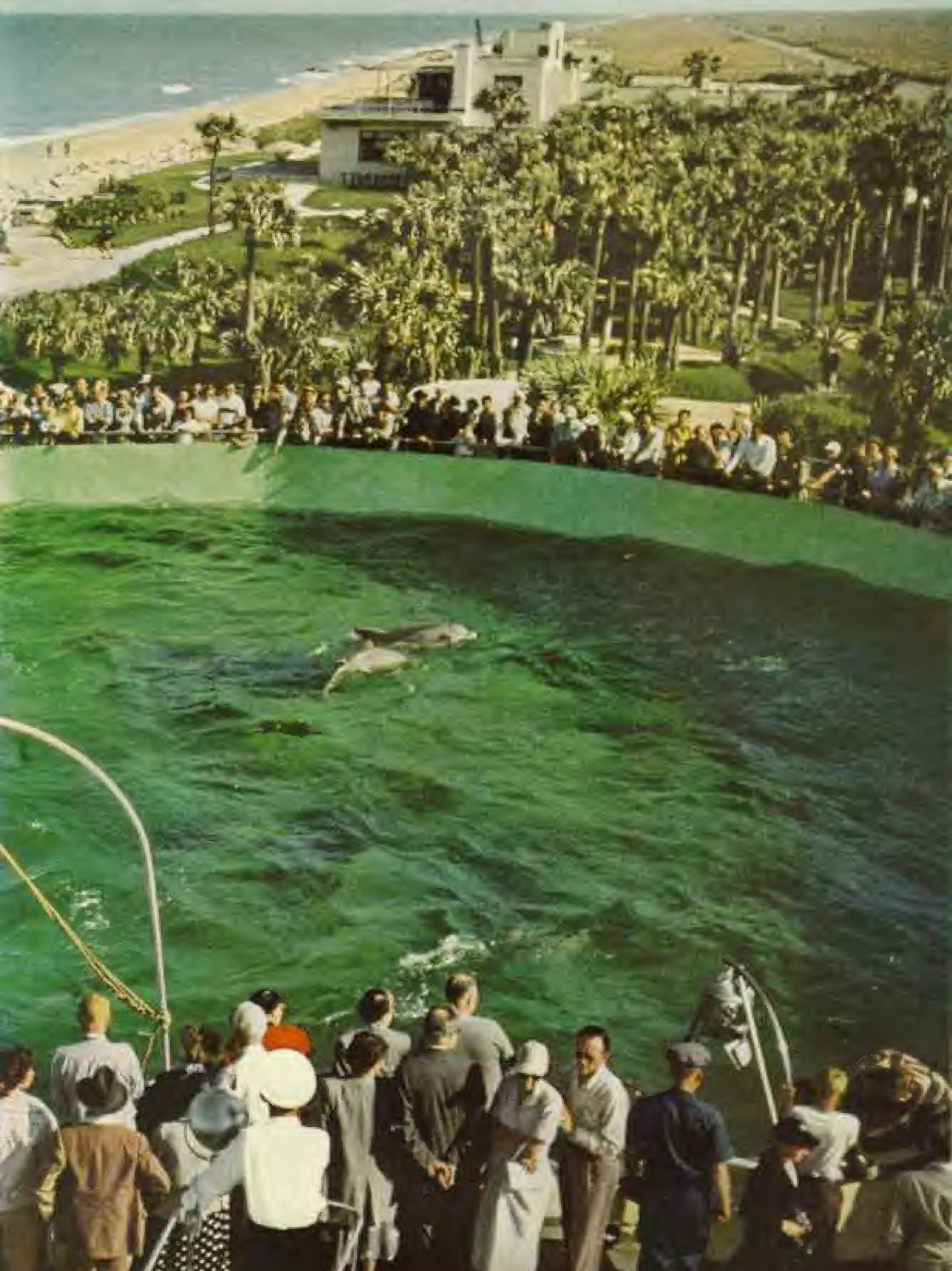
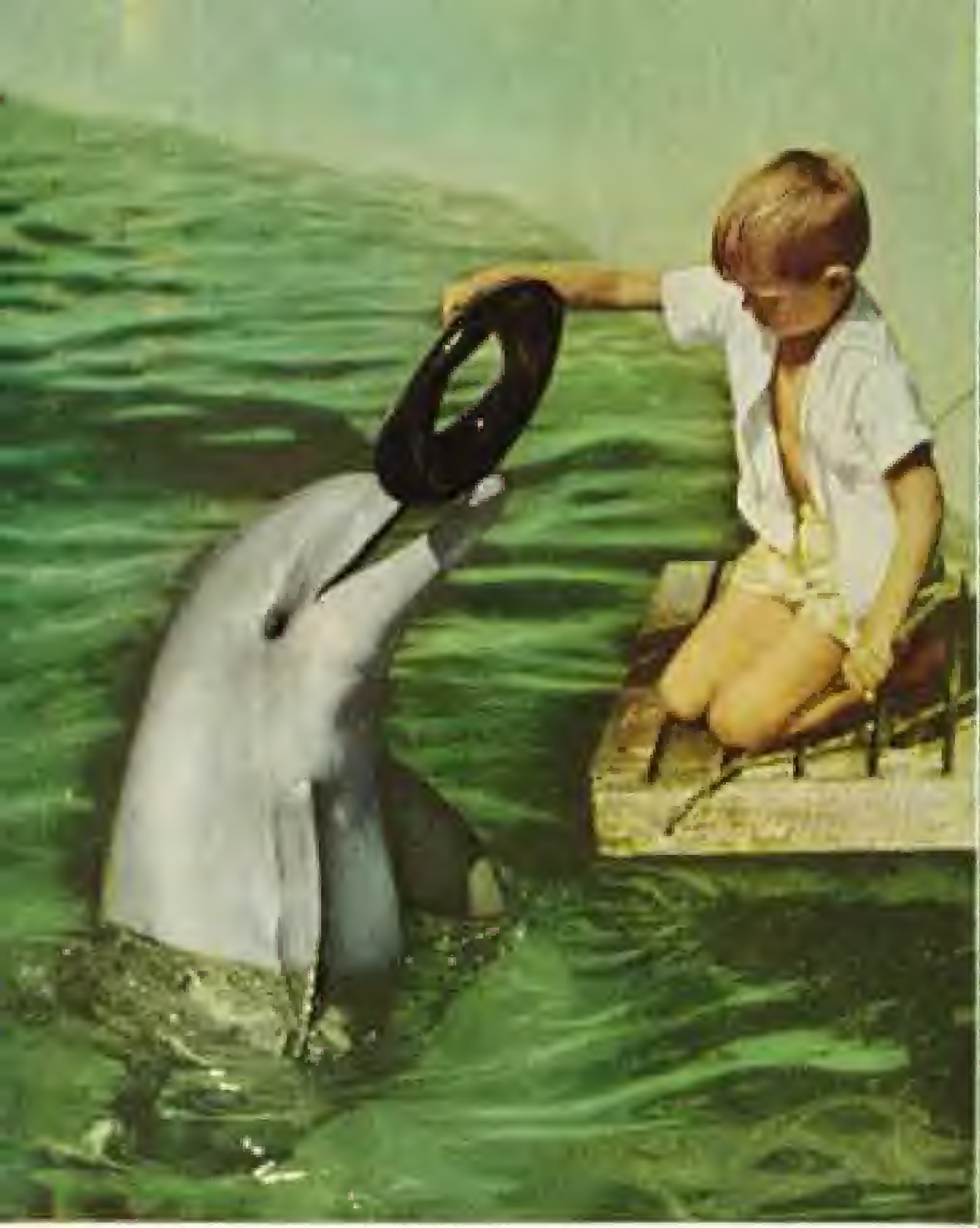
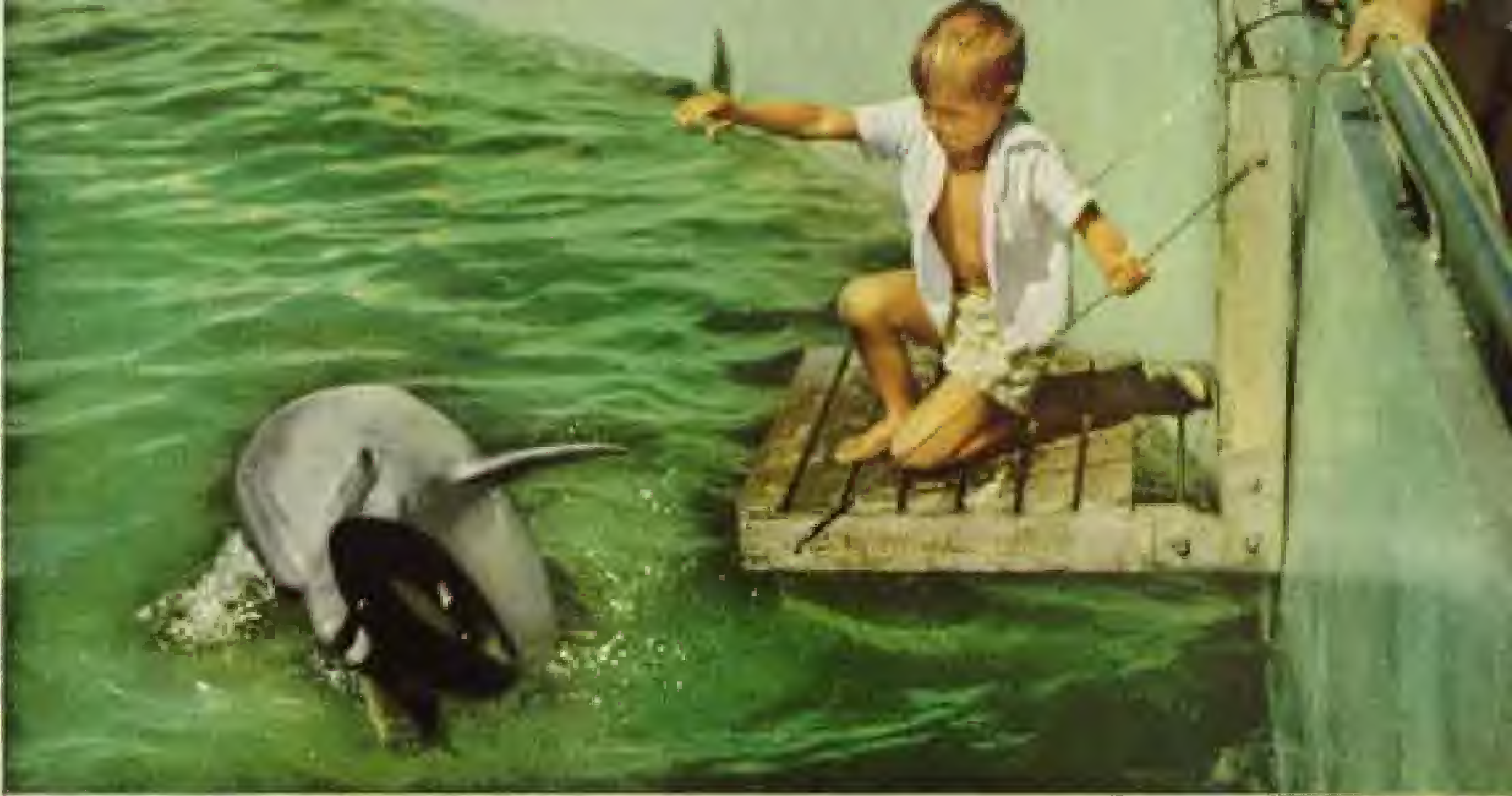
Porpoises Crowd the Pitcher's Box in a Ball Game Played with Mullet

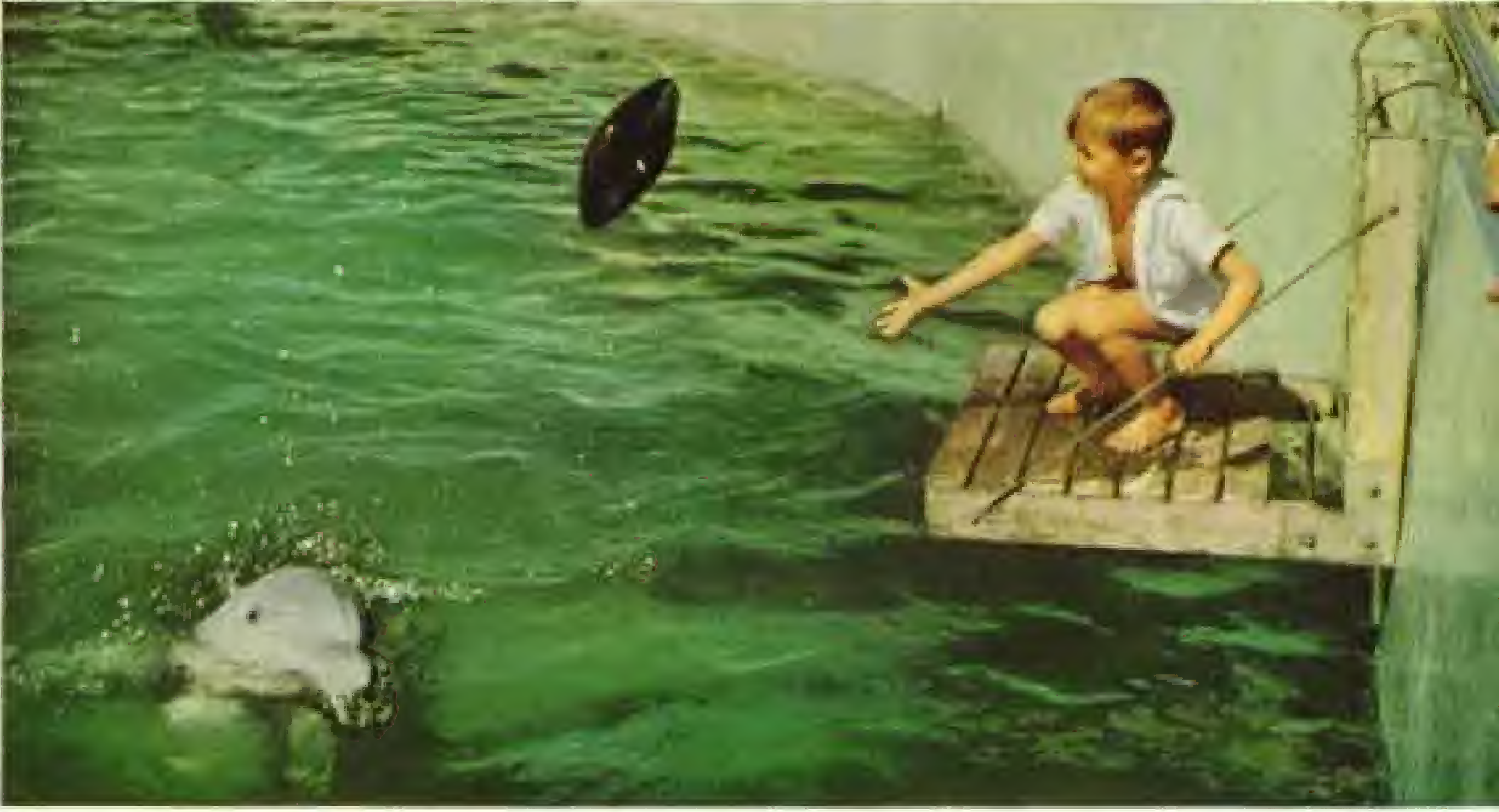


Kodachrome by Luis Marden, National Geographic Staff

Fielders Show Flashing Speed Retrieving Fish Tossed to the Outfield







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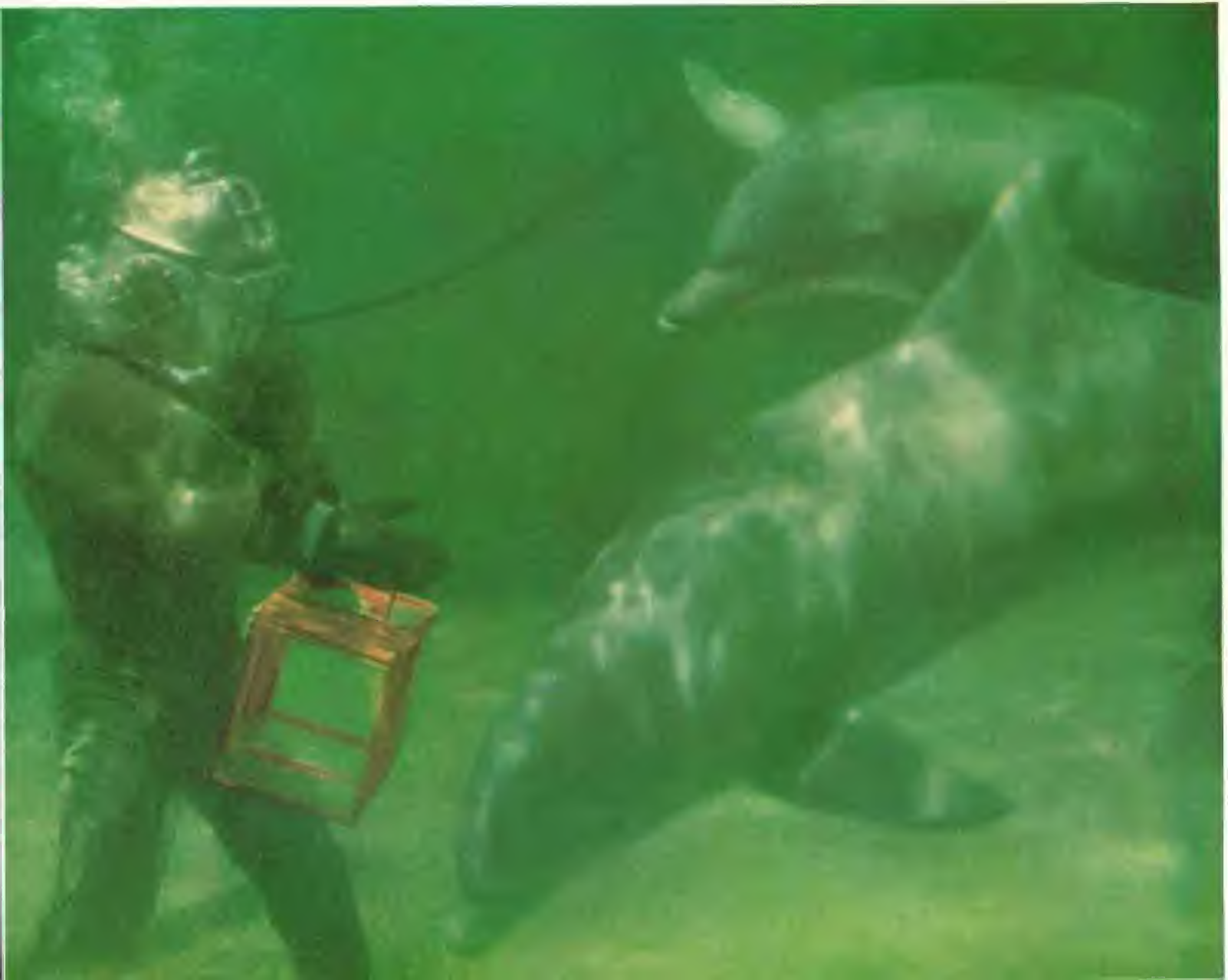
When the Ring Is Tossed, the Young Dolphin Catches It and Hurls It Back

Playful *Tursiops truncatus*, the gray dolphin or inshore porpoise, is warm-blooded, just like man, his fellow mammal. An air breather, he surfaces approximately every 30 seconds to inhale, though he might remain submerged seven minutes. He was born in water, not from an egg like most fishes, but alive like a baby. Soon his mother began suckling him.

Pitching the inner tube is a favorite pastime. If it is thrown from a group, this performer returns it to the tosser's hands



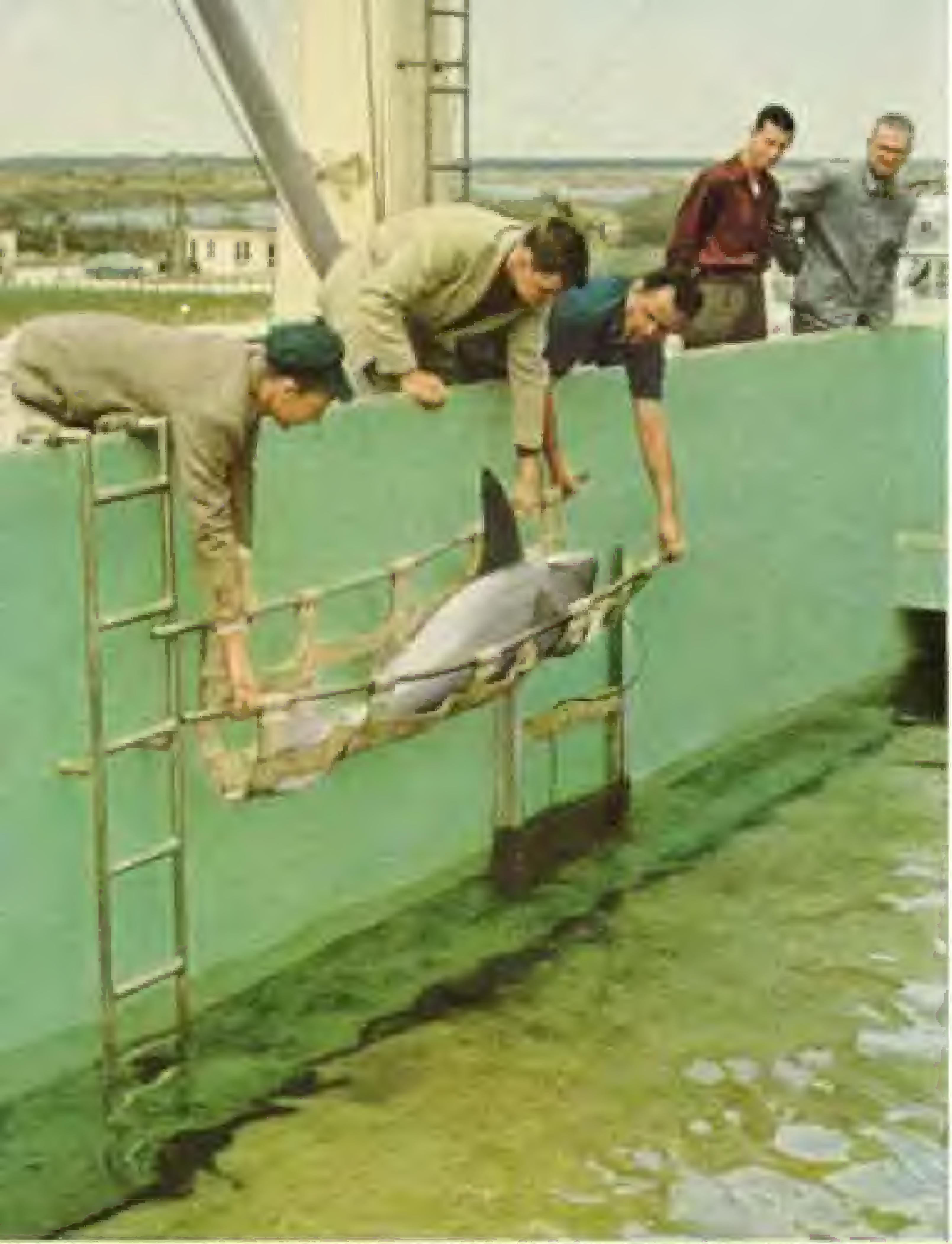
## Sad Looks Reflect the Diver's Empty Feeding Basket

Marineland has greatly increased the public's knowledge of marine life. Its walled-in pools, refreshed daily with 5,000,000 gallons of sea water, represent an approximation of the ocean itself; winter temperature in the tropical tank is a constant 70° F.

The Marine Studios' collecting crews catch *Tursiops*, the inshore porpoise, by stretching nets across tidewater channels. *Stenella plagiodon*, the deep-sea porpoise noted for frolicking around ships, is captured by boatmen, who loop a noose just above the tail with the aid of a harmless, forcepslike device. Within two weeks captives become tame enough to accept food from the hand.

Here Florida sunshine floods the diver's bubbling helmet six feet below the surface of the circular tank. These porpoises, fed by hand in water, sheer off because the fish supply is exhausted. Medicinal capsules are sometimes tucked into their feed to keep them healthy.

Kodachromes by Luis Marden, National Geographic Staff



## A Newly Caught Shark Gets a Stretcher Ride

Florida's warm seas teem with an apparently inexhaustible supply of marine life, but replenishing Marineland's oceanariums with fresh faces requires a constant struggle.

Sharks are caught in thousand-yard nets or on half-mile baited trotlines and transported by barge in a live well.

Equipped with an oxygenation pump, the barge has an entrance port cut below the waterline. Specimens are introduced into the live well without removing them from their natural element.

← This fish out of water accepts his fate quietly because he suffers a failure of oxygen. He goes into a shallow connecting tank, his sanctuary until he regains strength.

↓ Shark walking, like baby sitting, is a recognized job at Marineland. Comatose captives are towed by the fins to insure a steady flow of oxygenized water through the gills. Using this form of artificial respiration, diver Floyd Adams revives two tiger sharks. This job may require as much as two hours.

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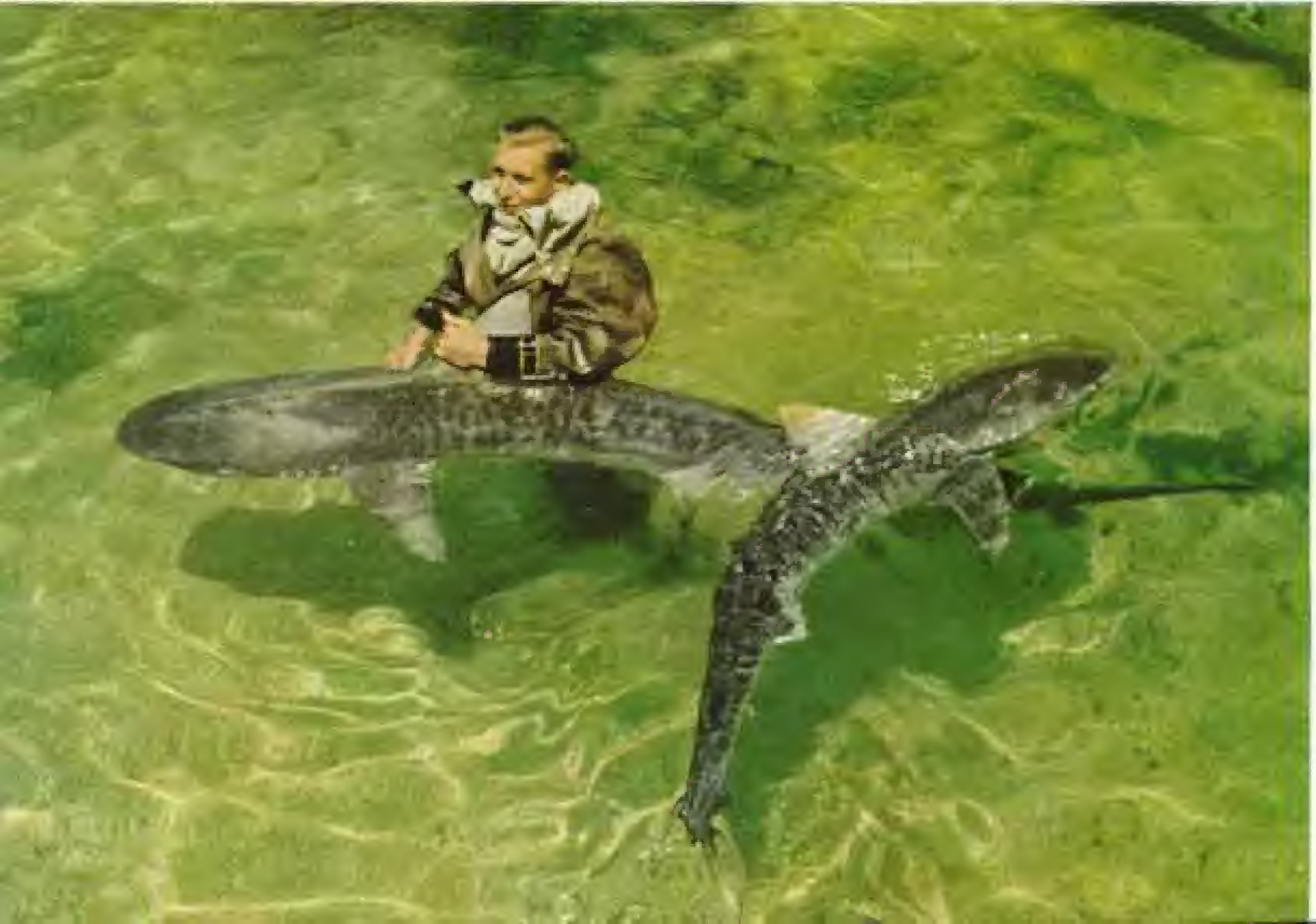


# The Jungle Was My Home

## To a Lone Adventurer Hunting Jaguars with a Spear, the Years Bring a North American Wife and a Jungle-reared Family

By Sasha Siemel

*With Illustrations from Photographs by the Author*

FOR 32 years I lived in the jungle of the Mato Grosso, or Great Woods, of Brazil. My purpose: adventure. My occupation: chiefly hunting man-eating cats with spear and bow and arrow.

I have heard my jungle called a "green hell." I found it neither a green hell nor a green heaven, but simply home: an odd home, perhaps, yet the only one I knew from my twenty-fourth year, and more friendly than most.

Now I live, for a part of each year, on a small farm near Philadelphia. There are animal noises to wake me in the morning and to rouse me at night, but I find that I am waiting for others: the bawling of alligators on the riverbank, the chatter of monkeys in the trees, the throaty love call of a jungle cat, the shrill scream of a macaw.

Friends have said, "But at least you are less lonely now." I was never lonely in the jungle. I have been far lonelier in a city. In the jungle, even most animals are friendly, if you know how to behave toward them.

Did I miss the refinements of life? Well, it is true that until my wife joined me in the jungle with her sewing machine, my clothes often lacked repairs. But I survived.

After she came, things became positively civilized. Our children played tiddlywinks like any other kids. Of course the chips were alligator (cayman) teeth, but the game was much the same.

And we had a piano. It suffered somewhat from the jungle's dampness, but it remained adequate for Sunday-morning singing and for "Holy Night" on Christmas—with the temperature more than 100° F. outside!

### On a Winding Road to a Jungle Life

No, I cannot say I ever missed what city folk call civilization. I left it willingly on a cold, wet day in November, 1914, and, if I had to relive my life, I would trudge again today that winding road up from Pôrto Alegre, in the southern tip of Brazil, to Passo Fundo and the rocky plateau of the Mato Grosso, a thousand miles inland (map, page 699).

When I first traveled that road as a youth, it comprised little more than two wheel ruts cut in the reddish-brown soil by countless oxcarts carrying supplies to settlements and lonely ranches in the interior. Under dripping skies, with only a few hummocks tufted with grass to break the cheerless monotony of the countryside, I journeyed toward the jungle.

I had just come north from Buenos Aires by tramp steamer, landing at Pôrto Alegre the night before. I had not expected the cold rain. For some reason, I had not realized that Brazil, which stretches from 5° north latitude to 33° south, a distance of nearly 3,000 miles, can offer the traveler anything from the blazing heat of the Equator to the chilly winters of the lower Temperate Zones.

My immediate destination was a small farm owned by a German family I did not know. It was not until several months later, when I reached Passo Fundo and found my brother, Ernst Siemel—who had been in the Mato Grosso—that I decided to go with him into that remote interior, one of the wildest regions on earth.

### Drawn by the Lure of Diamonds

The lure that drew my brother and me there was one of the oldest known to man—hidden treasure. Brazil's rock-crusted highlands are one of the world's great repositories of diamonds, both gem and industrial stones.

To the average person, the Brazilian diamond is not so well known as its African or Indian counterpart, although diamonds were found in Brazil a century before the diggings at Kimberley and Bultfontein in Africa. Generally, the diamonds are not large, and they vary in color from pure white to pale gold, green, blue, and smoky. Many have a yellowish tinge, which has given them a reputation for cheapness. But a pure-color Brazilian gem diamond ranks carat for carat with the best stones found elsewhere.

One area where diamonds are found, the southwestern part of the Mato Grosso, is, to say the least, not easily accessible. On the west it is guarded by the towering Andes and on the east by truly rugged jungle. Only the most adventurous and hardy souls go in there.

The *garimpeiro*, Brazilian equivalent of an Alaskan sourdough, digs for diamonds in much the same way early prospectors dug for gold in California and Alaska, sifting them from gravel dug out of the stream bed (page 698). In some streams or rivers he drives poles into the bottom, in water as deep as 30 feet, and climbs down headfirst to get buckets of gravel from the bottom sand and silt.

This gravel is poured into sieves made of wood with fine wire in the bottom. These sieves let water and silt sift through, but catch the larger gravel. Then this residue is washed in a wooden pan such as gold seekers use. Diamonds, found among the coarse grains of gravel, are washed to the conical center of the pan by a rotating motion.

The diamond camps themselves are rough "boom towns," not unlike the frontier towns of the North American West. The men who inhabit them are hard and rugged—wind-burned cowboys from the southern plains, riffraff from the ports, veteran garimpeiros who have spent a lifetime prospecting for diamonds, and, of course, the usual complement of gamblers and camp followers, with a sprinkling of thieves and murderers.

During my first years in these camps I wandered from place to place as a gunsmith and dispenser of medicines. I had learned the mechanic's trade in the Argentine, and later an old one-eyed "thief taker"—one of the semiofficial law-enforcement officers of Brazil—had advised me to pursue this business in the diamond fields.

"Any fool can find a diamond," he said, "and he will pass it on to the gambler, or the storekeeper, or a woman. But a man who lives by a trade will keep what he earns."

I found this to be sage advice. During the years I spent in the diamond camps I saw men acquire sudden wealth from the glittering gems—and lose it as fast as they found it. But the storekeepers, the diamond buyers, and the gamblers always prospered.

Only once did I deviate. In the little town of Areia, where I established myself in a small hut and made fairly good money repairing guns and providing such medicines as I had, I heard of a diamond strike one day. A Negro brought word from the upper country, near the Manso River, of a creek where diamonds could be scooped up by hand. Ernst and I joined the rush, as the entire camp emptied out on the trail to the north.

### Spear Sometimes Safer Than Gun

It was my last attempt to follow the diamond camps. Within a few weeks I saw two men murdered and was attacked twice, by a knife thrower and a professional gunman. I had enough of the allure of Brazil's hidden treasures. In the summer of 1923, when my brother left to return to the diamond fields, I became a hunter.

Not for sport, you understand; killing animals for pleasure has never appealed to me. I killed only to eat or to defend myself or to protect the cattle of the great ranches along the Paraguay and the Paraná Rivers.

These ranches, some of them the size of a small European country, lose as many as 6,000 cattle a year to the ravages of *tigres*, or jaguars. Naturally, the ranchers turn to native hunters, either half-castes or Indians, to run down these jungle killers and shoot them. I decided to join the profession.

Only the Indians are real experts, and they hunt the tigre with a spear. So I too learned to impale the big cats and also to shoot them with a bow and arrow. I decided that spear hunting was not merely more exciting than using a gun; it was safer.

The reason that it sometimes is safer to spear a jaguar than to shoot him is comparatively simple, once the fundamentals are understood. The area where the tigre roams is chiefly tall grass and jungle thickets. A tigre charging a man with a gun gives away only the initial advantage; if the first shot fails to drop him, the hunter may not have another chance. Frequently the charge comes so fast, and out of such complete cover, that the hunter is struck down before he can shoot. The spear hunter, on the other hand, meets the tigre in equal combat—his razor-edged spear against the animal's claws. If he is clever enough, the man will always win.

### How to Track a *Tigre*

I learned my spear work from a wrinkled old Indian named Joaquim Guato, and I believe I am the only white man who ever did acquire this art. I met Guato at a small sugar plantation on the Rio São Lourenço. He was then about sixty, but a fabulous hunter. He moved in the jungle with the swiftness and silence of the jaguar itself.

From him I absorbed more on one trip into the jungle than many hunters pick up in a lifetime. I learned that, in tracking a jaguar, the paw marks are to be found near the edge of pools, in wet ground. If there is water above the foot mark in the swamp, the animal has passed within three hours; if the ridges around the toe marks are still wet, he is close by. In the open ground, or in sand, the time since the cat made the foot mark must be gauged by the amount of dew covering it or by cobwebs formed over the impression.

The tigre, he told me, is most dangerous in thick cover on the ground, when he is silent; in the open he will snarl when at bay; but in the tall grass he will growl and perhaps slink away. Seven out of ten will climb a tree; the other three will charge. A female with cubs almost always will charge.

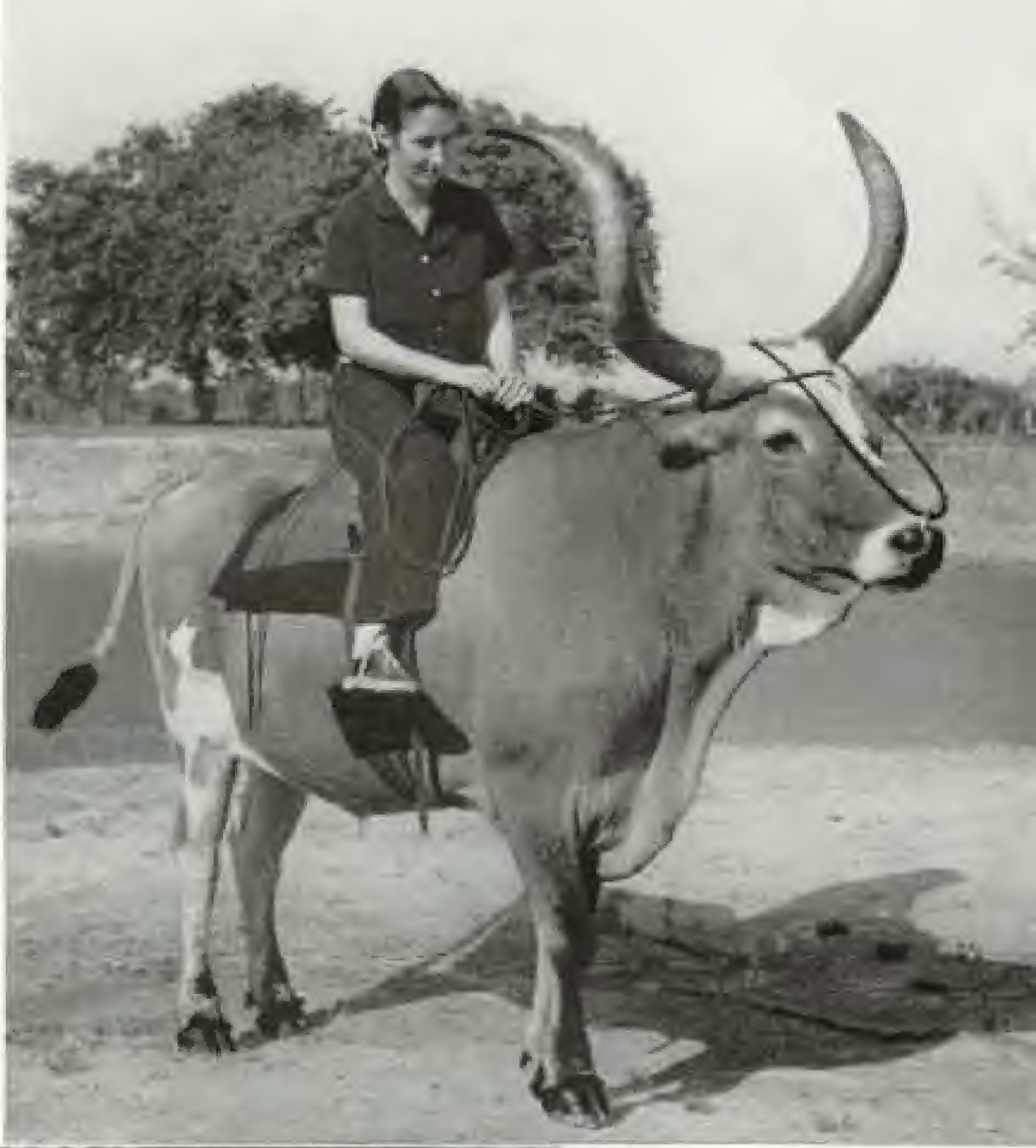
Once, hunting with Guato, I saw him forced to deflect his spear as the jaguar turned in its charge. Leaping past him, the cat wounded

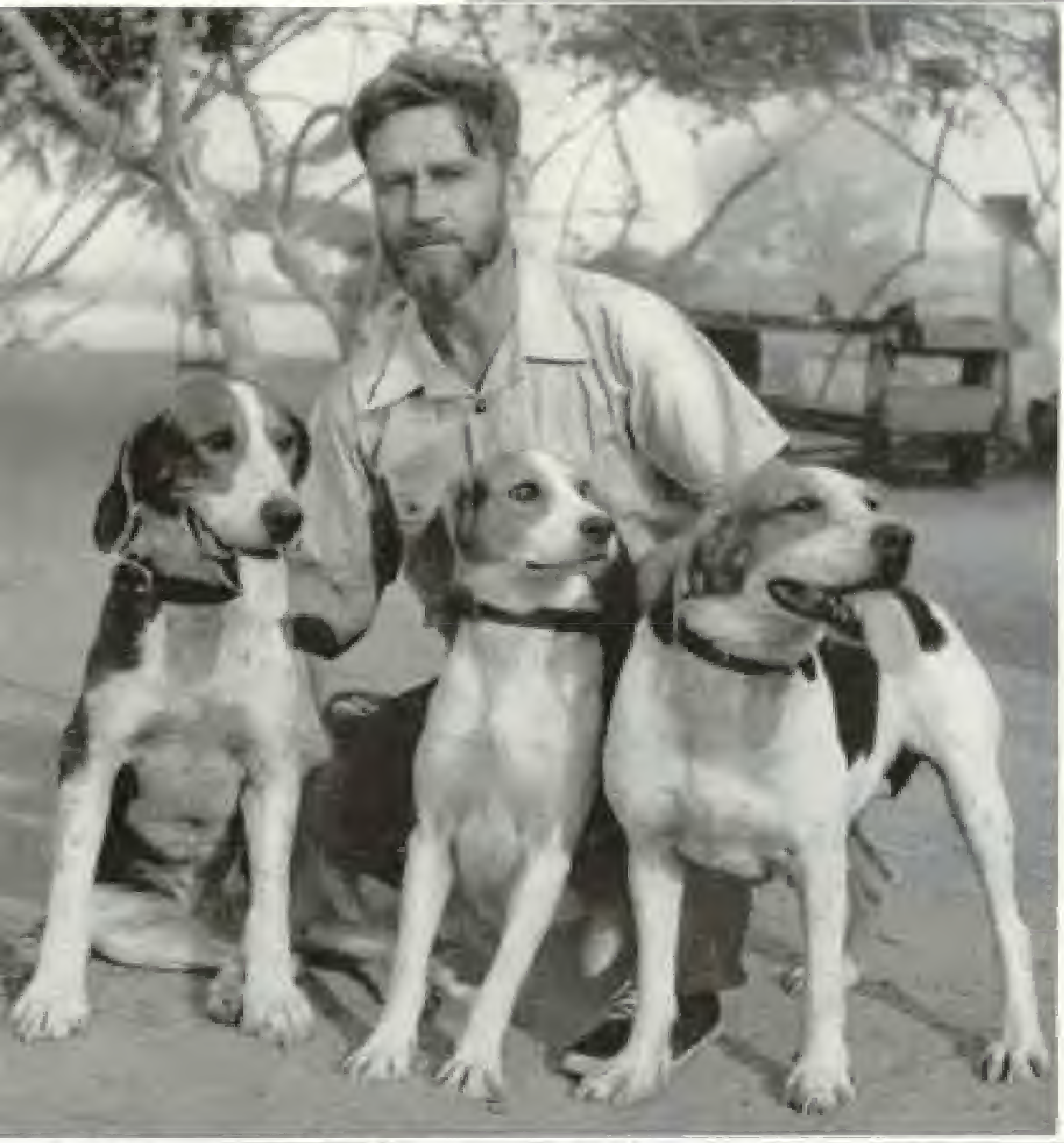
## Author's Wife Rides a Strange Mount

Edith Bray went to the Mato Grosso sector of Brazil in 1939 to stalk *tigres*, or jaguars, with Sasha Siemel, Latvian-born expert in the Indian's art of spearing jungle cats. She returned to marry him and raise a family in one of the wildest and remotest regions of South America (page 700).

This long-horned ox has just carried her across the upper Paraguay River. Though too slow for tigre hunting, the trained ox earns its fodder in the rainy season. Split hoofs enable it to traverse the muddy, flooded countryside with rider or heavy load more easily than mule or horse.

A single rein is attached to the nose ring.





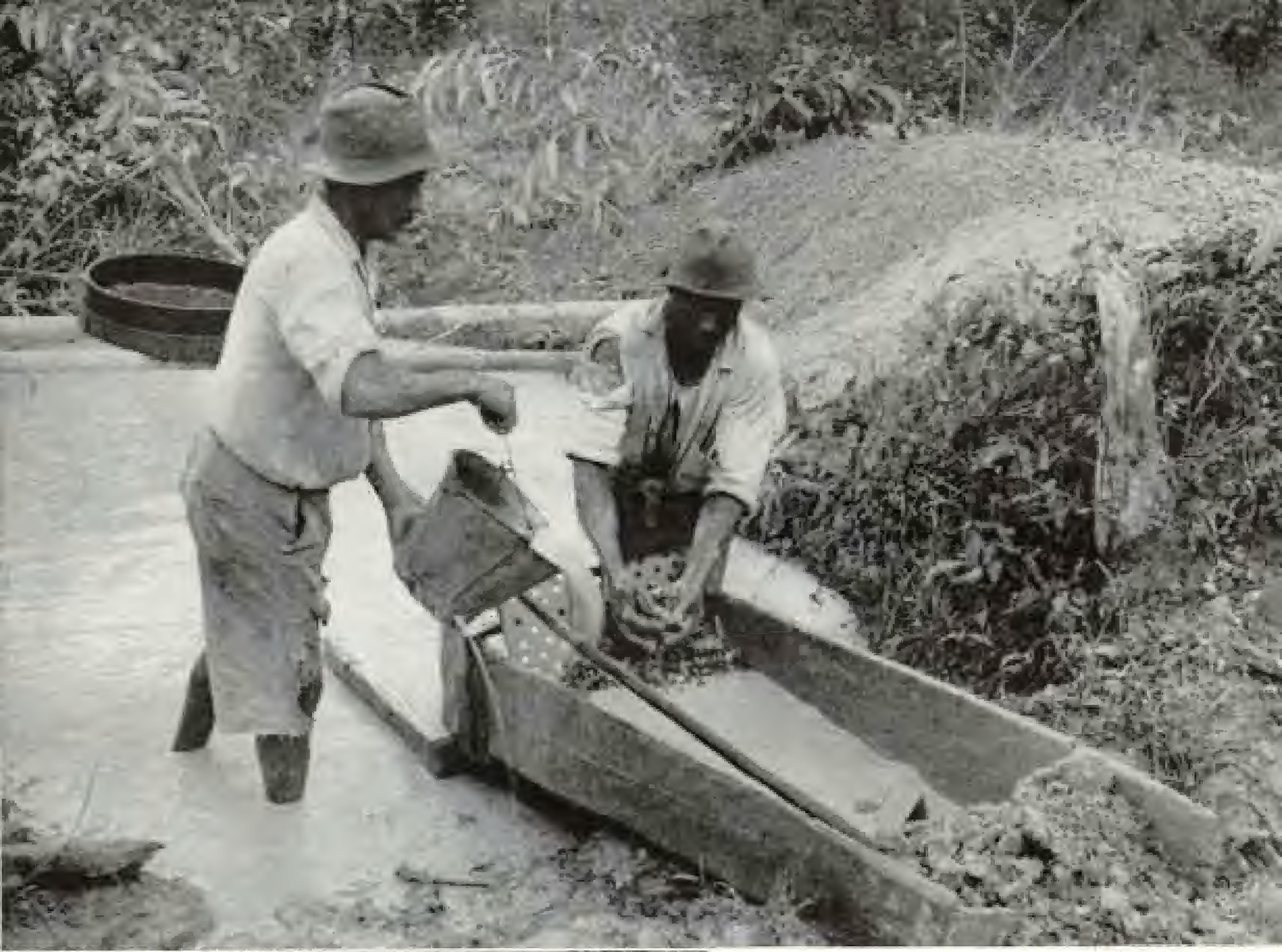
## Siemel's Dogs Strain to Go Hunting

Big Brazilian cattle ranches adjoining the jungle annually lose as many as 6,000 head apiece from jaguar raids.

Sasha Siemel, the author, earned his living for years by tracking down the Mato Grosso's big cats and killing them with spear and bow and arrow. He found dogs indispensable in picking up the tigre's scent and pinpointing it in the brush.

These three purebred foxhounds, the gift of a Pennsylvania friend, learned their jungle trade quickly. But ticks, mosquitoes, and heat soon gave them a run-down look.

Mr. Siemel, breeding the dogs to jungle-inured mongrels, produced a strain with the native's stamina and the foxhound's nose and tongue (page 702).



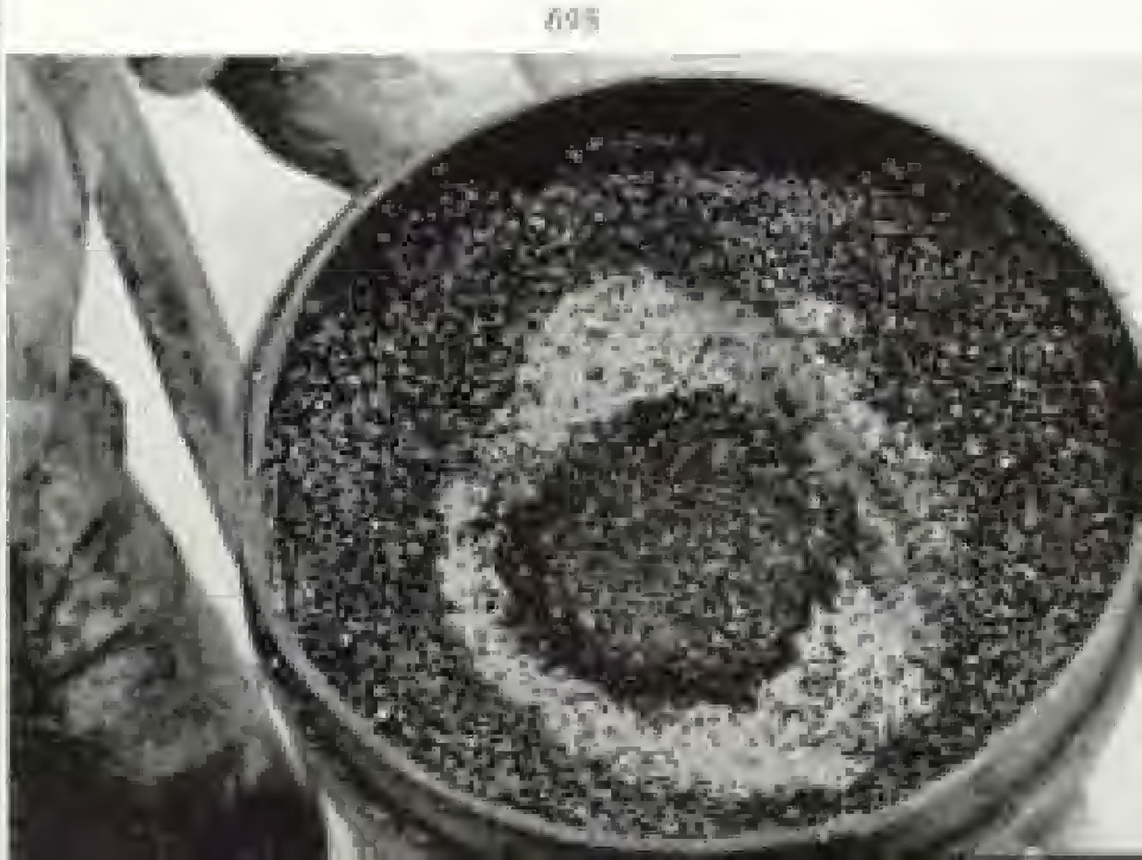
E. W. Chamberlain

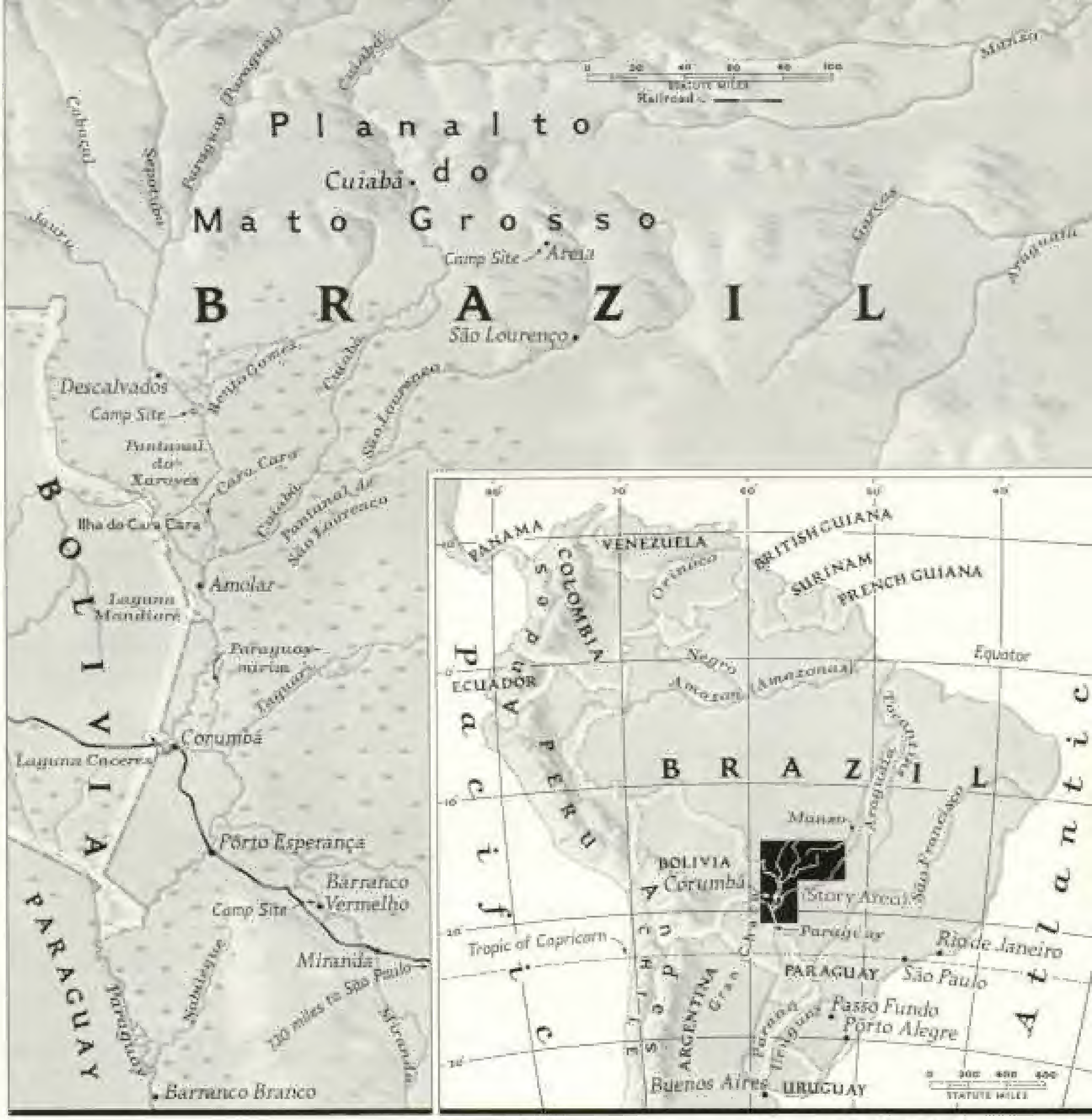
**Diamonds Emerge from This Muck**

Diggers who screen the sediment of South American river bottoms rarely get rich. Even when a good-sized stone bobs up in the sluice box, the miners usually pass on most of the profit to middlemen. After paying debts and splurging for a few weeks, they trudge back to the creek beds, impoverished but still optimistic.

These British Guiana diamond hunters flush mud through an iron screen (above). Jigging then concentrates the smaller stones in the sieve's center. Here, if anywhere, the miners spot their diamonds in the rough.

The author in his youth followed the Brazilian diamond camps, but abandoned them when he saw two men murdered within a few weeks (page 695).




Planalto do Mato Grosso
BRAZIL
BOLIVIA
PARAGUAY
Cuiabá
Camp Site
Arêia
São Lourenço
Descalvados
Pantanal do Xarayes
Ilha do Cara Cara
Amolar
Laguna Mandioré
Paraguai-mirim
Taquari
Corumbá
Laguna Caceres
Pôrto Esperança
Barranco Vermelho
Miranda
720 miles to São Paulo
Barranco Branco
Cuiabá
Paraguay
São Lourenço
Cara Cara
Pantanal de São Lourenço
Cabaçal
Sepotuba
Jauru
Garças
Araguaia
Nabileque
Aquidauana
Statute Miles
Railroad
PANAMA
VENEZUELA
COLOMBIA
BRITISH GUIANA
SURINAM
FRENCH GUIANA
ECUADOR
PERU
BRAZIL
BOLIVIA
Corumbá
(Story Area)
Manáus
Equator
Tropic of Capricorn
PARAGUAY
São Paulo
Rio de Janeiro
Passo Fundo
Pôrto Alegre
ARGENTINA
Buenos Aires
URUGUAY
Pacific
Atlantic
Andes
Orinoco
Negro
Amazon (Amazonas)
Tocantins
São Francisco
Gran Chaco
Paraná
Uruguay
Statute Miles

Drawn by William N. Palmstrom

**Down the Paraguay River and Up the Miranda: the Siemels' 750-mile Migration Route**

Descalvados, a ranch on the edge of the Paraguay, proved too isolated for the author, who needed closer contact with hunting parties which he guided. So he loaded wife, children, servants, and animals aboard houseboat and barge and set off for Barranco Vermelho, the "Red Cliff" (pages 706, 707).

his dog. The old Indian knelt before the dying animal, cradling its head in his arms. I have never seen such a stricken look in the eyes of any man.

### Man Against Man-eater

Old Joaquim taught me how to deal with a charging tigre. He taught me to crouch, firm-footed but with my knees loose and flexible, taking the charge and "giving" slightly. The head-on impact of a 350-pound jaguar, he said, would otherwise sweep me off my feet, no matter how truly I planted my spear.

This spear is usually a foot-long blade with a 3-inch crosspiece, fitted to a 6-foot shaft. The crosspiece prevents the spear from penetrating the body of the animal so deeply that its razor-sharp claws can reach the spearman.

The first time I witnessed a spear fight between a man and a tigre was on the edge of the jungle near São Lourenço. Joaquim was wearing loose-fitting boots that gave him the appearance of a forest gnome. His brown skin rippled over muscles amazingly tough for a man of sixty. The hunter had followed his dogs, led by my Valente (which he had given me) into a patch of palms. The tigre we had been trailing suddenly appeared at the far end of the patch, facing the dogs and Joaquim. As he charged, Joaquim's heels seemed to sink into the ground. This thin, bent little man, I felt sure, would be whisked into oblivion by the flailing claws.

I held my bayoneted rifle, not daring to shoot toward the whirling mass. Suddenly it became a fantastic wrestling match, as if the two were vying for possession of the spear upon which the cat had impaled itself. Then —it seemed to be minutes, but it was only a matter of seconds—the tigre rolled over, and Joaquim was above the animal, pinning it to the earth.

### First of 30-odd Spear Conquests

My first individual conquest of a tigre with a spear came many months later, when Joaquim had gone off on a hunting trip for a man-killing tigre in another area.

I was in the bush country, which is extremely dangerous for the hunter, since he cannot see the tigre until it charges. My dogs, running ahead, were baying at a cat in a thicket of brush. As I came up, I could hear its warning growl, which seemed to say, "Leave me alone, and I will leave you alone!"

I had left my gun behind, and with only my spear I probed the thicket. The throat rumble seemed to come from several points; I was unable to locate the exact direction from which the beast would charge. Suddenly I saw a flash of tawny color at one side and swung my spear. The tigre came in low, which I had not expected, and I barely got my spear around in time to catch it in the throat.

With a frightful snarl the cat retreated, then came on again. This time, remembering Joaquim's warning to keep the spear low, I caught it in the chest. Within a few seconds I had turned it on its back and had my first kill with a spear.

Since then I have impaled more than 30 cats and shot more than 200 with bow and arrow or gun; but I have never quite experienced again the thrill of that first victory.

When I was "discovered" by Julian Duguid, the English writer, in the late 1920's, I had lived nearly 15 years in the Mato Grosso, almost out of contact with the civilization I had left. Duguid was traveling through the upper Paraguay country with two companions, one of them Mamerto Urriolagoitia, who later became President of Bolivia. Duguid heard of me first as a "Russian engineer" who lived like a wild man in the interior, hunting tigres for the ranchers.

I could understand the bit about my being Russian. The natives had never heard of my native Latvia, and when I told them that it was close to Russia they just called me a Russian.

But I was no wild man. I lived in the jungle, it is true; but my neighbors were small ranchers or men who worked as outpost riders for the bigger cattle ranches. Nor was I a homeless nomad. I had built a hunting camp on the banks of the upper Paraguay River, with my own hut made in native fashion.

*Acuri* palm leaves were woven over lattice poles for a roof, and thick stakes, driven vertically into the ground, supplied the walls. Six or seven layers of palm leaves made the roof rainproof, and the walls, though well ventilated, were strong enough to keep out animals at night. The cabin was 12 by 18 feet, slightly larger than the huts of my camp helpers.

I had, in short, the necessities of life—a good roof over my head and plenty of food, including beef prepared the native way. The flooring of my cabin was packed with mud from termite "anthills." The saliva of the insects makes the dirt hard and firm, although not so hard as cement. Outside I rigged my kitchen under a lean-to.

Duguid and his companions planned to cross the Gran Chaco of Bolivia, which lies west of the Paraguay River and is in many ways a counterpart of the Mato Grosso of Brazil. It is a formidable region, with long stretches of waterless country, and is peopled with fierce Indians in the dense jungle interior. Few white men had traversed the Chaco, and Duguid and his friends felt the need of help and guidance.

I agreed to accompany the party. The trip proved not uneventful, and it resulted in Duguid's book, *Green Hell*. Upon its publication I received many offers to come to the United States and lecture on the wild, little-known country we had traversed.

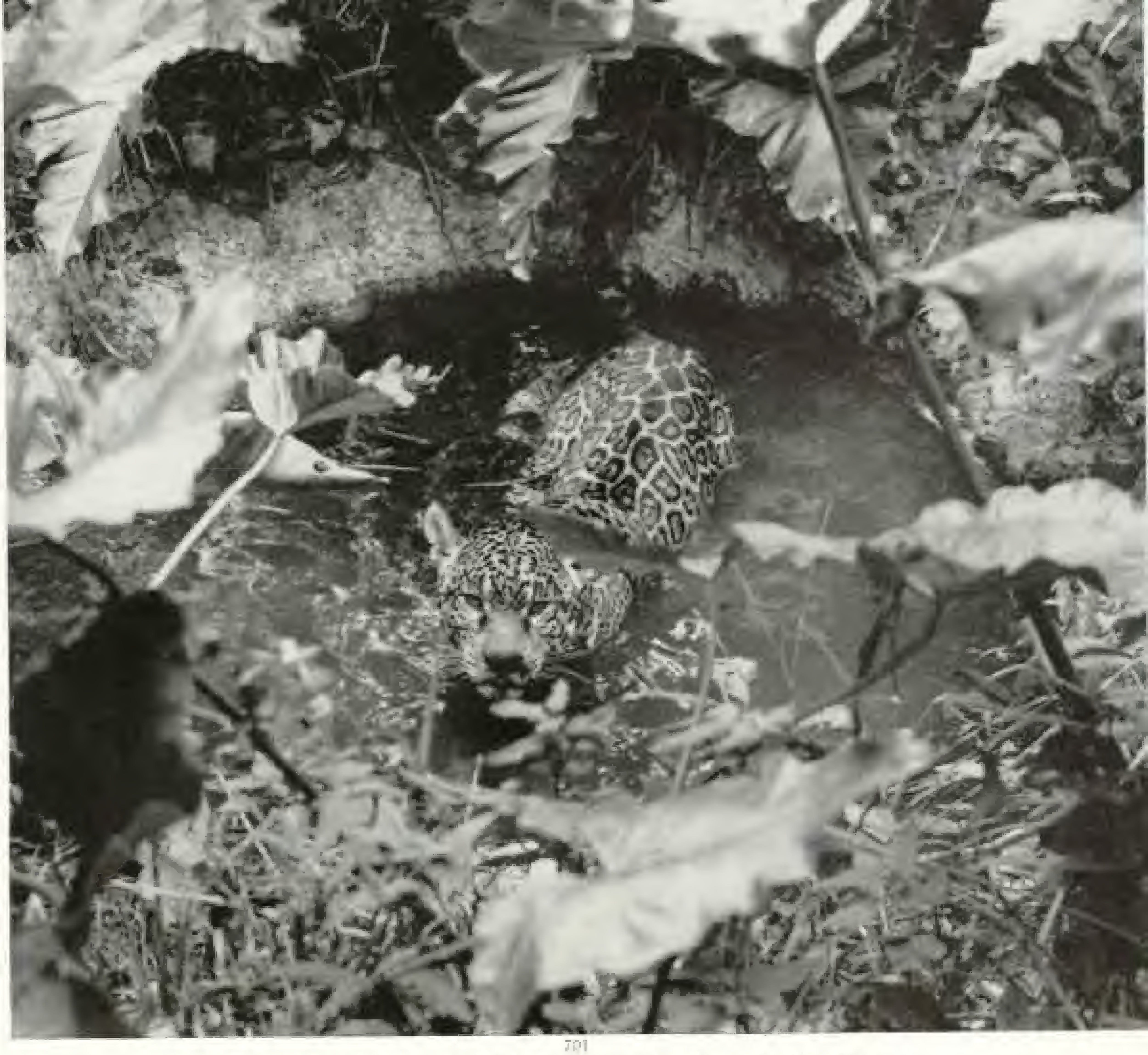
### Romance Comes to the Jungle

It was through these lectures, a decade later, that I met Edith Bray of Philadelphia. She saw my tigre-hunting film and, being slightly skeptical, decided to make the trip to the Mato Grosso and see for herself.

The first trip she and her friend Helen Post made to my jungle camp on the edge of a swamp lasted two months. In those months I began to learn what the calm courage, resourcefulness, and deep sense of beauty of a woman could do to a jungle home.

Later, Edith came back for a longer stay. We were married at Rio de Janeiro in January, 1940, and we found that a white woman, as well as a "wild Russian engineer," could become famous even among the Indians as a hunter of the jungle tigre.

On Edith's first hunting trip we tracked a mountain lion, or puma, until it finally retreated to the branch of a tree. It was still



**A Jaguar, Its Jungle Bath Interrupted, Glares at the Camera**

When rains envelop the Mato Grosso, the tigre must swim floods. If during drought times he finds a water hole, he plunges in and splashes about like a child in a tub, forgetful of the cat's traditional distaste for a ducking. This fellow could have broken the photographer's neck with a blow.

early dawn, with enough light to see the animal but not enough to enable me to take a picture. I asked her to wait a half hour for the sun, and she agreed.

Finally I said, "Go ahead; you can shoot now," but she shook her head.

"I don't want to shoot him—he looks so beautiful!"

I explained that this "beautiful" animal was one of the few beasts that kill merely for the enjoyment of killing. In Patagonia, one mountain lion was known to have killed 80 sheep in a single night—far more than he could eat.

This lion, I added, is a notorious coward, attacking only the more defenseless animals and avoiding men like the plague.

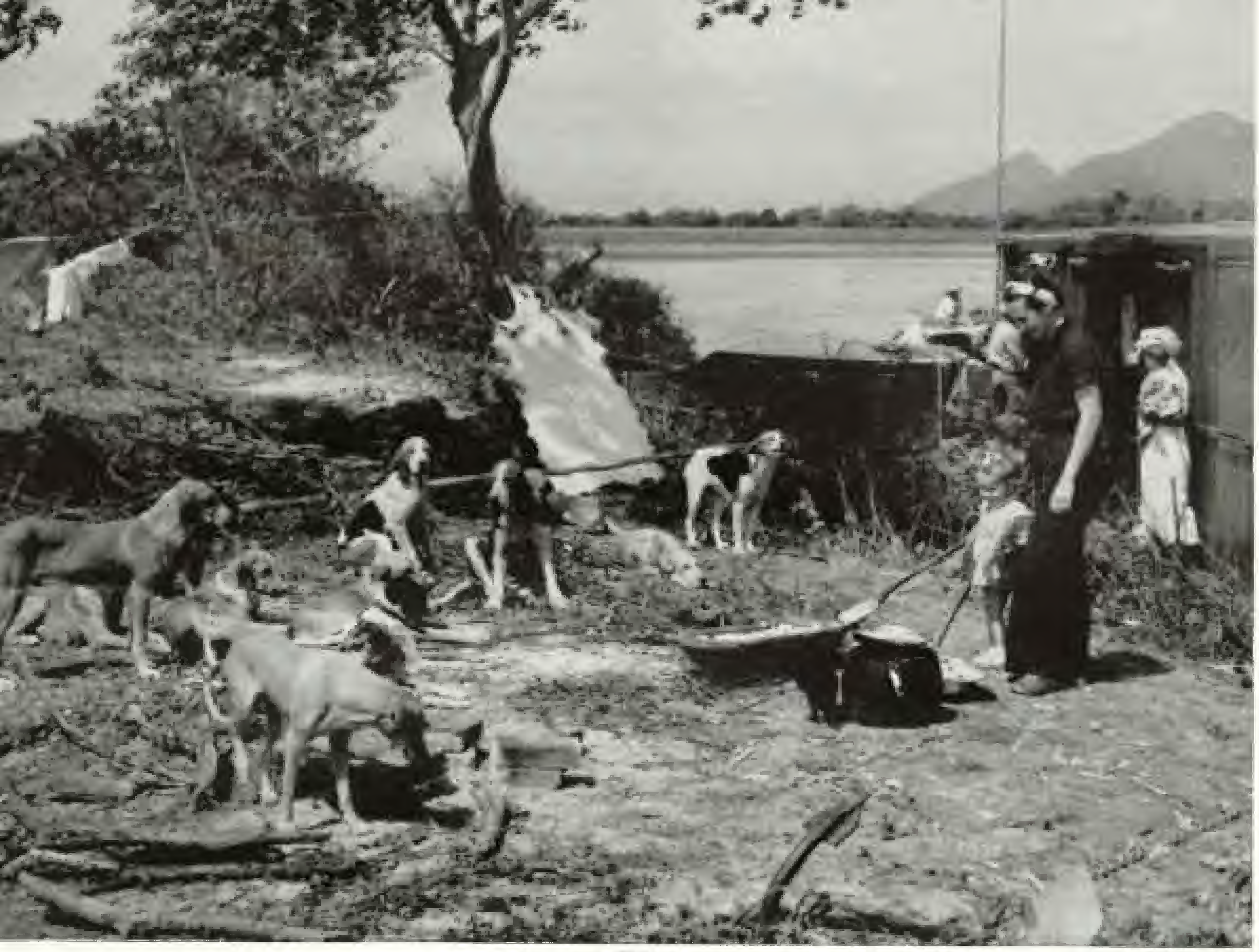
Edith said, "All right. If that's the sort of fellow he is, I'll shoot."

She raised her gun, held it steady an instant, and fired. The mountain lion rolled off the branch, dead before it hit the ground. I looked at Edith. She was calmly reloading. The jungle, I decided, had found a new "white hunter."

### Mail-order Book the Only Doctor

Our first child, Sandra (whom we had prenamed Sashinho, the diminutive of Sasha, in the rather hazy presumption that it would be a boy), was born the following September at the small hospital in Corumbá. For the event Edith and I had traveled downriver in a dugout loaded with a week's supply of food and camping equipment.

It is hard for anyone accustomed to the ordinary availability of hospitals, doctors, and nurses to realize the impact of such an event upon two jungle people, such as we were. Our basic knowledge of the subject had been



**The Author's Hounds Whine as Cooking Odors Sharpen Their Appetites**

Strong winds here forced Mr. Siemel to tie up his houseboat (opposite) and pitch camp beside the upper Paraguay River. The stop gave Mrs. Siemel an opportunity to dry her laundry (left). Daughter Sandra helps mother stir the dogs' food, a mixture of sun-dried beef and cassava flour.

gleaned from a mail-order book entitled *The Expectant Mother*, which came by the monthly mailboat from Corumbá several weeks after Edith had announced the impending arrival.

Cenaria, the plump and practical wife of one of our camp helpers, advised us to throw the book into the Paraguay River.

"There is nothing to worry about," she told Edith. "When a baby is ready to arrive, it will arrive. Nothing will prevent it. The making of babies is a national habit in Brazil."

The first question that arose was, Where should the baby be born?

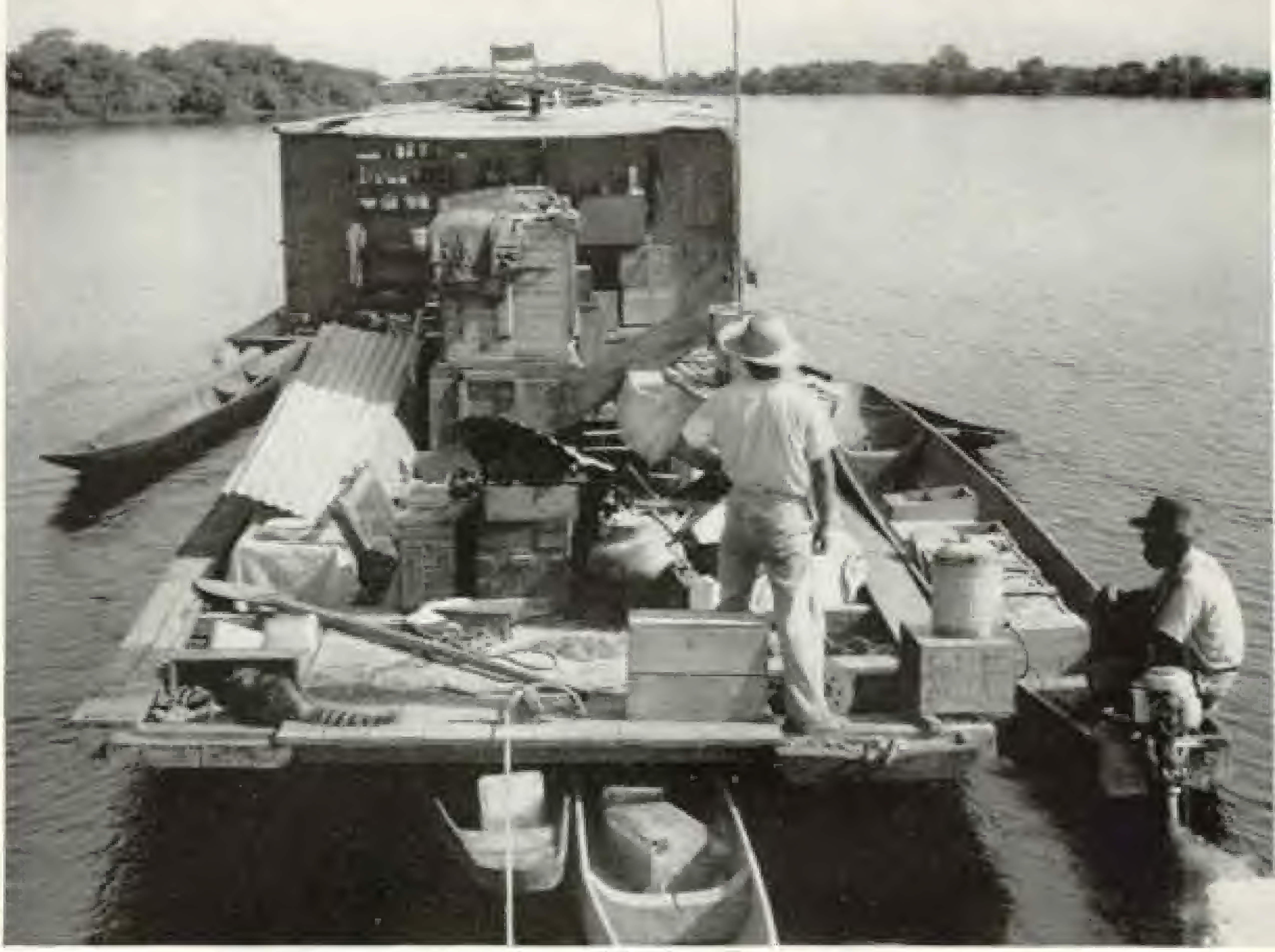
We had already improved greatly upon the crude camp facilities that were available when Edith first arrived. Our camp was on the bank of the river near the Descalvados Estancia, or ranch (once operated by a former Texas sheriff). We had built an addition and expanded my hut into a house, roomy and clean inside and showing the obvious effect of a woman's domestic touch.

However, we decided that the little hospital of the Sisters of Mercy in Corumbá should be the place of our first-born's arrival. Even with the enormous self-assurance of Senhora Cenaria, we placed our trust in the fact that a Brazilian physician would officiate at the affair.

We left Descalvados in the rain and arrived at Corumbá in the rain; and five days later I trudged with Edith down the short distance from the hotel to the hospital, also in the rain. Sandra, the first of our three children born in the jungle, arrived without incident, as Cenaria had confidently predicted.

During the months before Sandra was born, I had decided that even my renovated camp would not suffice. I would build a new home —a houseboat! This we constructed on five mahogany dugouts, each 40 feet long. The hard mahogany was resistant to the termites, which infested softer wood.

The house itself was covered with a tin roof and protected from the sun by acuri palm leaves, which hung like a ragged haircut over the wide eaves. It had large windows, well screened, and the mahogany flooring was clean and smooth. The living room-bedroom combined was 20 feet long and 15 feet wide, with a good-sized room at each end, one to be my workshop and the other a spare bedroom for visiting hunters. At the stern I built two small rooms for Lauro and



**Siemel's "Ark" Chugs Across a Lake. This Short Cut Nearly Stranded the Expedition**

Marshes ahead stopped the voyagers until they pushed the flotilla clear with the poles lashed to the cabin. Living quarters lead the parade. Next come pens for 15 dogs, then the kitchen. Cages on the barge hold monkeys and two grown jaguars. A ring-tailed coati prowls the deck (lower left).

Rosendo, our two camp helpers, and their wives and children.

Tables and chairs were made of mahogany rubbed to a glossy finish with the silicon-bearing leaves of the *lixeira* plant, which make an abrasive used by Indians to polish soft metal. Two roomy bunks, built end to end in the living room, served as beds by night and sofas by day; they too were of mahogany and termite-resistant. In all the construction we used brass screws instead of iron nails, since jungle dampness quickly destroys iron.

Our second child, Dora, was born in 1942, when Sandra was a year and eight months old. Shortly afterward we decided to move downriver past Corumbá and up the Miranda to a new location which I had selected. One reason was that communications depended on very undependable river boats. We went as long as six months with no mail.

This move was indeed a saga in the history of our jungle life. For the first time I began to understand some of Noah's problems in the voyage of the Ark.

Our camp at this time had become quite comfortable and livable. In fact, it had swelled into a tiny settlement. In addition to Edith and myself, with our two little girls, there were also Lauro and his wife, Cenaria, and Rosendo and his wife, Antonia, who lived in near-by huts with their constantly increasing families. Having babies is, indeed, a national habit in Brazil.

The clearing along the riverbank, where my hunting camp had stood when Edith first arrived, was now a bustling compound, with animal cages and pens and the varied accouterments of a jungle camp.

### "Anthills" Make Good Ovens

Edith had wrought great changes. She had introduced the table as one of the social amenities of eating. Prior to her arrival, we had always eaten while sitting on benches, holding our plates in our laps. Edith insisted that it would be much simpler, and infinitely more civilized, to eat at tables. She had followed up that conquest of our daily habits with cloth coverings for the tables.

We did not have wood floors or rugs, because insects invade every covered place in the jungle and would have become a pest. However, we made an exceptionally good job of hammering down the termite-mound mix-

▲ Clogged Marshes Complicate Travel by Houseboat

Stuck in water plants, the Siemel boat might still be marooned up Cara Cara River if the author had not remembered an old trick. He planted an anchor ahead, rigged a winch at the bow, attached a chain, and reeled the craft forward.

▼ Oxcart Blazes a Trail Through Axle-high Grass

Once the flotilla had reached Barranco Vermelho and Mr. Siemel had killed most of the big cats near by, he took his family farther inland for a month of jaguar hunting. High wheels carried the cart over many a rut and mudhole.

ture until the floor was hard enough to be kept smooth and clean.

Even after we moved to the houseboat, which we named *River Gypsy*, we continued to cook ashore, using an outdoor fireplace I built on the riverbank. The fireplace stove was a shallow hole cut into the edge of the bank and lined with rocks which I had chipped into blocks. A grill and iron plate provided both open-fire and stove-top cooking space.

But Edith's pride and joy was her "anthill oven." It consisted of a vacated termite mound six feet high, built like a stubby silo and baked to almost concrete hardness under the tropical sun. It stood on high, dry ground, a few feet back of our hut. To transform it into an oven, I had merely chopped out a door, scooped out the honeycomb interior, and cut a hole for a chimney.

The camp near Descalvados had become home to Edith and me. But besides being in a swampy area, it was remote from civilization, and I had become increasingly interested in guiding hunting parties into the jungle. Few hunters would come to Brazil during the war, and Brazilians would not ordinarily travel so far into the interior to hunt. Our only solution was to move nearer to our customers and to better means of communication.

### "Siemel's Ark" Sets Out

We planned to embark in August of 1942. Our second child, Dora, was then about three months old and able to travel. The houseboat would carry the women and children.

Lauro and Rosendo had roped together several dugouts, making a barge upon which we loaded the animal cages. There were three tiers of cages, housing two jaguars and an assortment of other animals, including an anteater, a sloth, and a coati. We also had a collection of parakeets, macaws, and chickens.

The barge was powered with a 5-horsepower outboard rigged on an 18-foot dugout. My little speedboat, of 72 horsepower, was lashed to the houseboat, and I envisioned its great power maneuvering the *River Gypsy* with ease.

On a bright August day—it was midwinter south of the Equator—our Noah's Ark fleet was ready to embark. A small gathering of cowboys from the Descalvados Ranch collected on the bank to see us off and to help.

The barge, with its load of bawling, cawing, cackling passengers, put out into the stream first and was well on its way downstream, with the dugout chugging manfully on its stern quarter. It seemed a little ridiculous for the tiny scooped-out log to be nudging this bulky craft along the river, and as a matter of fact the barge traveled at little more than the speed of the current. Nevertheless, it looked like a magnificent start.

As I noticed the rather ponderous pace of the barge and its escort, I had a secret worry. I knew that we would meet a rip current at the confluence of the Paraguay and the Miranda, where we would have to turn the craft from downstream on the Paraguay to upstream on the Miranda. It was possible that the chugging dugout might encounter some difficulty in maneuvering at that point.

However, I quickly dismissed the worry. We were about to embark, and I roared cheerfully to the helpers alongside:

"Cast off!"

On the houseboat were Edith and our two children, Dora in her crib and Sandra eagerly watching from the rail of the deckhouse. The wives of Lauro and Rosendo, who were ahead of us on the barge, were also aboard, plus their total of eleven children, plus five cowhands I had hired for the voyage downriver. I stood on the roof of the houseboat, directing operations. Edith was at the helm of the powerboat, which was lashed against the stern.

### Down the Paraguay, in Circles

I had planned to navigate the first few miles from my position atop the houseboat roof. But after a few minutes I was not sure I was going to have anything to navigate. Edith rammed her foot on the starter when I gave the signal, and the powerboat soon roared noisily alongside. But nothing happened. The houseboat remained glued to the riverbank.

"Warp the wheel!" I shouted to Edith.

Edith reversed the steering gear, and the nose of the powerboat turned against the barge. My idea was to drive the stern inshore and point the bow into the river.

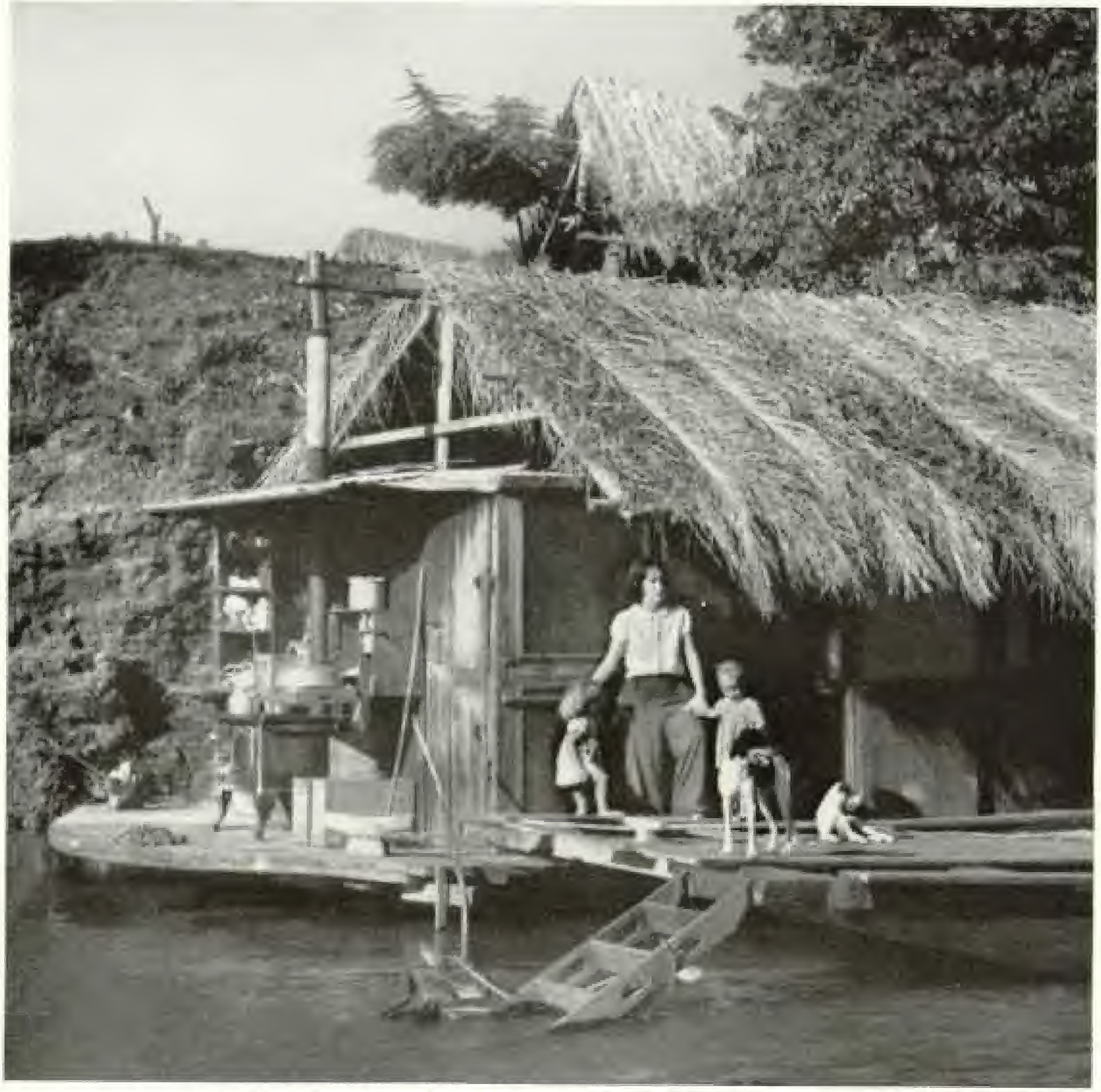
Slowly the big houseboat turned. It continued to turn. Within a short time it had completed a circle, and the prow was pointed toward the bank.

"Take it slowly!" I called to Edith. "Put the wheel over; we're going into the bank!"

Edith, wrestling desperately with the little craft, tried to follow my directions. She managed to get the wheel over, and after a few seconds it seemed as if the powerboat would swing itself into the bank. Then the *River Gypsy* gained way, and we began to revolve in the other direction. The cowboys on the bank shouted encouragement.

Finally I gave up. I called down to Edith to kill the motor. It was obvious that the little powerboat, speedy though it might be alone on the river, was not cut out for the heavy-duty job of guiding the big houseboat.

I climbed down into the powerboat, cast loose from the houseboat, and roared downriver after the barge, which was now around



**One Misstep Here Could Mean Quick Death from Carnivorous Fish**

Arriving at Barranco Vermelho, the Siemel houseboat tied up to shore. Palm fronds thatch its tin roof. A cast-iron stove stands on deck; before the voyage began, baking was done in a hollowed-out termite hill (opposite page). Mrs. Siemel taught Sandra (left) and Dora to swim in a porous box lowered into the river. There they were safe from ravenous piranhas, which could reduce a person to a skeleton within minutes.

the bend. Soon I overtook it. I called out to Lauro, who was at the tiller of the dugout, and explained our predicament. He understood, and slowly the barge wheeled around and headed back upstream.

By midafternoon we had the barge and houseboat securely lashed together—an 80-foot jointed craft that weaved like a fat worm down the river. But we were on our way, with the 5-h.p. outboard placidly chugging along at the stern. The powerboat had been given up as a tug and taken in tow.

The small crowd at the riverbank gave us a second, and final, cheer, and we were off on the weirdest water voyage in the history of the Mato Grosso.

I knew Edith had experienced a pang of sorrow at leaving the little jungle camp. For more than 2½ years we had made it our home, the only home our children had known. I looked back as we rounded the bend; the little group of cowhands, their red ponchos contrasting with the deep green of the riverbank, still huddled in farewell. Little Sandra, standing beside her mother, suddenly asked, "Why are you crying, Mamma?"

Mato Grosso Expedition, Inc.

**Two Howling Monkeys and One Banana Are Enough to Upset a Hammock**

Gregarious howlers convene in the jungle by the dozen. Their strange cries carry like the rumble of a subway train. The Siemels found it impossible to raise howlers in a cage; a tree proved just the thing.

During the first few days we had only one real incident. One of Cenaria's little girls fell into the water, and I had to dive in after her. I wasn't worried about the swimming part of it. I was worried about the piranha, the vicious, flesh-eating fish which strikes in swarms that skeletonize within minutes any body they attack.

### Accident Has Happy Ending

I managed, however, to hold the little girl until Rosendo had turned barge and houseboat in a long arc and brought them alongside. We hauled the half-unconscious child aboard and after a few minutes had her breathing normally. Her mother stood by, alternately weeping and scolding.

I glanced up at Edith. Her face was white. She had stood in tense silence while I was being pulled aboard, knowing that at any instant the piranhas might scent an animal body in the river and make their deadly assault.

All she said was, "Sasha, let me bring you the bottle of rum."

Each night on the voyage downriver we pulled up along the bank and cast anchor. We did not go ashore, although it would have been easier to prepare food on the ground, chiefly because Lauro, Rosendo, and the cowboys wanted no encounters with jaguars.

Fortunately, we had a big iron kitchen stove on the houseboat, and this served to provide food for the entire assemblage, which, including the children, numbered 24.

Our supply of staples included the usual beans and cassava flour, sugar, rice, and *charqui*, the dried beef from which the "jerky" of North America's West derived its name.

In addition, we were able to shoot some game ashore. Along the Paraguay banks are many little colonies of capybaras, large guinea-piglike animals. These are the world's largest rodents. Some explorers have not liked the flesh, but we find it excellent, tasting like pork; it forms a readily available source of fresh meat along the river (opposite page).

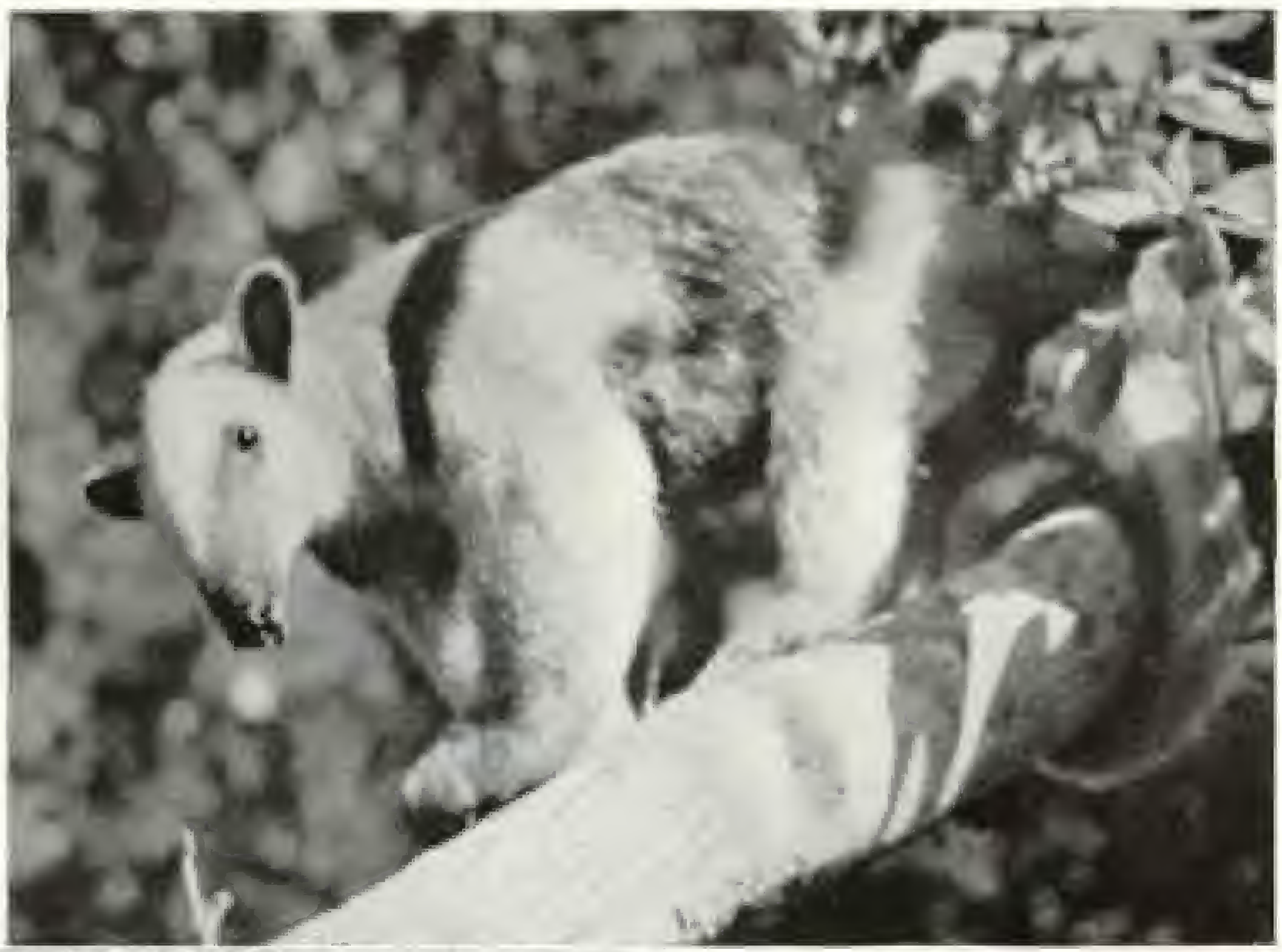
We had been on the way less than a week, and had covered less than a fifth of the distance, when we reached the mouth of Cara Cara River, a cutoff which our pilot, Carlos, assured us would save at least a week of our voyage. The river slices across from the upper Paraguay to the east, and one branch rejoins it above the mouth of the Cuiabá, near the area where Joaquim Guato had first taught me the art of spearing a tigre.

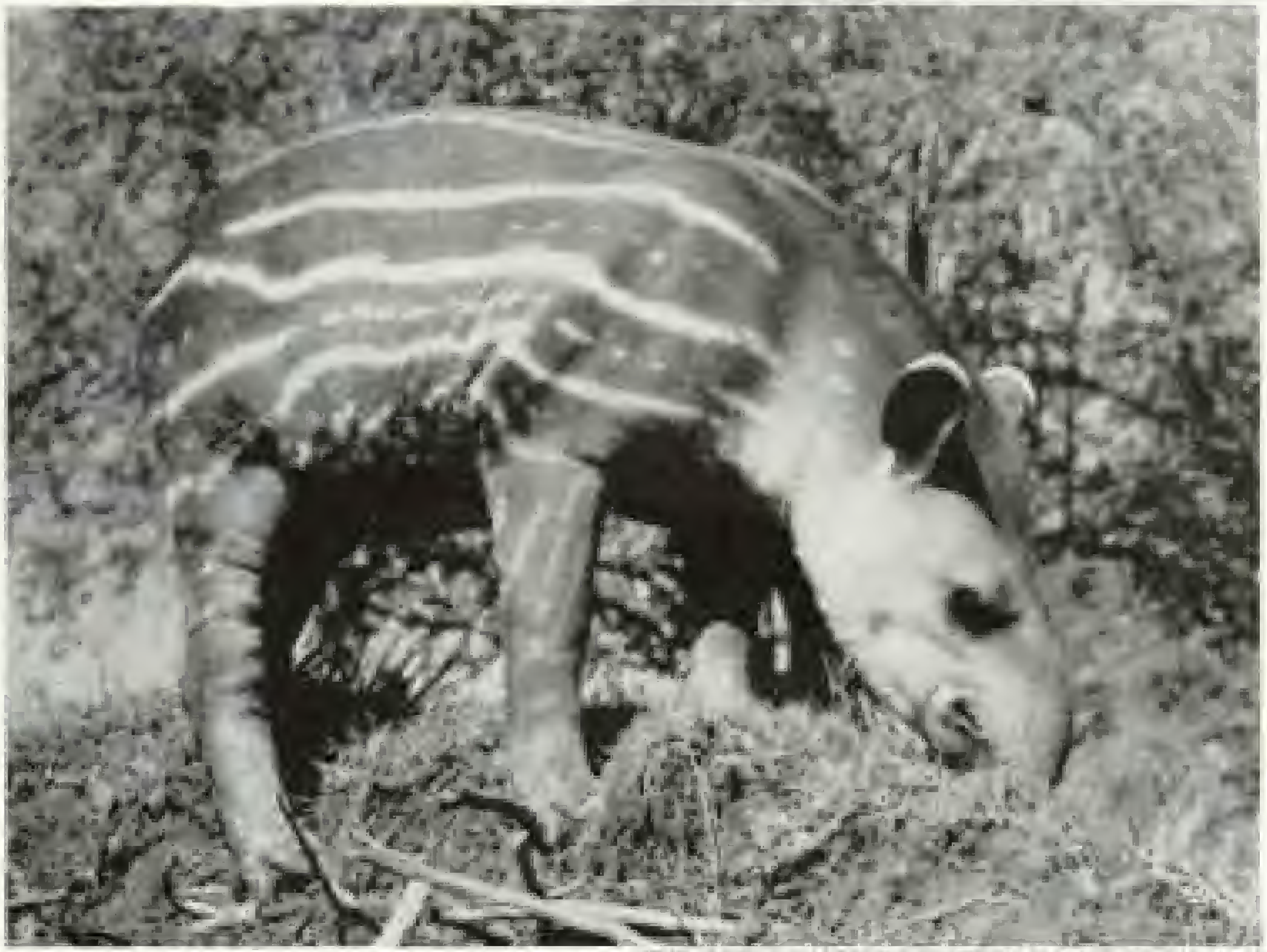
The Cara Cara is not wide, but for the

## Anteater's Tail Is a Fifth Arm

The Siemel children, out for a ride, spotted a tamandua, the lesser anteater, and tried to rope it. Their father finally convinced them it was too grown up and bad-tempered to make a good pet.

The tamandua's razor-sharp claws can inflict nasty wounds. At night it raids anthills and termite-infested logs, licking up the insects with its long tongue. By day the animal wants to do nothing but sleep.





## Tapir's Cousins Are Horse and Rhino

Biggest native mammal in South America, the vegetarian tapir may reach 500 to 700 pounds. Natives prize its flesh for quality as well as quantity. Apparently near-sighted, the tapir becomes dangerous only in its tendency to rush off madly in any direction.

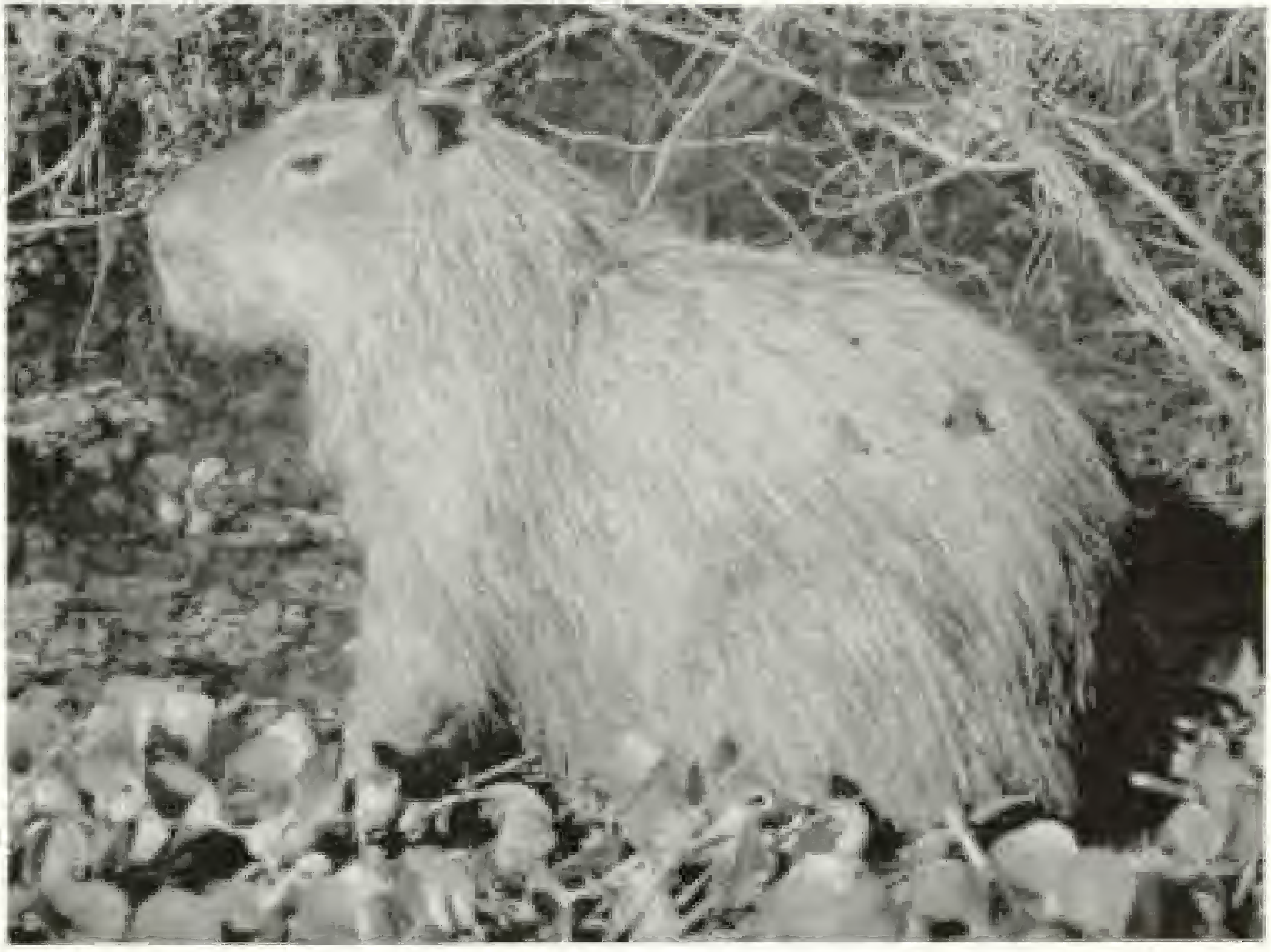
Chief enemies are men and jaguars. To evade them both, the animal relies on camouflage, speed, and ability to swim.

This young beast soon will lose stripes and spots for the adult's dull coat of brownish black.

## The Largest Rodent Grows to 150 Pounds

South America's capybara resembles a guinea pig swollen to nightmarish proportions. Hunted for its hide, which makes admirable gloves, the animal shuns undue publicity in the jungle. It never strays far from water and is always ready to plunge in and disappear.

This fellow lived near the Siemels' camp. They overcame its shyness by letting it strictly alone. In a few years it became sufficiently friendly to waddle along the creek bed and pose for a close-up.



**Jungle Heat and Tree Made of Palm Leaves Fail to Dim the Joy of Christmas**

Mr. Siemel played "Silent Night" on the piano, and his wife read *The Night Before Christmas*, substituting swamp deer for Santa's Donder and Blitzen. But when it came to explaining snow to these children of the Tropics, the parents gave up (page 712). Homemade dolls proved a big success, and so did a tiddlywinks set concocted from cayman teeth. Sandra's pet parakeet (on the floor) shared the excitement.

first few miles it has a relatively clear channel. However, as our strange flotilla moved southward, prodded gently by the little dugout, we began to find patches of shallow water clogged with water lilies and marsh weeds.

Carlos, as pilot, planted himself confidently on the roof of the houseboat, near the forward end, and directed Lauro, who was guiding the dugout. Carlos was a stocky little man, with swarthy features and a black mustache which gave him a singularly ferocious appearance. He took his duties seriously.

It was not long, however, before it became obvious that Carlos was not as familiar with the cutoff route as we had supposed. We threaded the narrow passage and suddenly emerged upon a lake almost completely green with water plants; the roots had matted together to form "islands" of vegetation (page 704). It looked as if the *River Gypsy* would have to become a sled.

I yelled down to Lauro to proceed slowly. Carlos came running back, his dark face a picture of consternation.

"I swear to you, Señor Siemel," he cried, "I did not anticipate this!"

I explained that none of us had anticipated it; and Lauro, growling from below the rail, explained a few things more in Portuguese, which did not increase Carlos's peace of mind.

"You animal!" he roared. "Why do you not dive in and eat the grass ahead of us?"

I quickly pacified Carlos. We were in a serious predicament, and I did not feel that any display of temper would help. Finally we marshaled all hands, and with long poles, known as *zingos*, which Lauro and Rosendo had provided, the boat and barge were pushed gradually across the clogged surface of the lake to clear water beyond.

### "Ark" Hauls Herself Through Water Plants

Our second encounter with water plants occurred a couple of days later, and this was more serious. The *River Gypsy* slipped and scraped over the first obstacles, then seemed to have settled herself for a long rest. The little dugout's outboard churned the water furiously, but neither pole nor motor power budged the ungainly flotilla a foot.

Finally we sent two men ahead to pull the plants from the channel as much as possible (there was still some water between the bottom of the houseboat and the bed of the river), and Lauro and Rosendo rigged the anchor so that it could be carried ahead and fastened in the bottom. Then, using a hand winch at the forward end, we were able to kedge off the marsh bed, yard by yard, until we were clear again.

After hours of work we managed to reach the far edge of the tangled growth of marsh weeds, and once more the *River Gypsy* and her escort rode proudly down the Cara Cara.

A week later, after following a tortuous course through several lakes and creeks, we emerged upon the broad Paraguay. From this point south to the mouth of the Miranda our trip was fairly routine. We veered east of Corumbá, through an estuary known as the Paraguay-mirim, since I did not want to encounter the rush of small boats that might put out from the town to see the floating menagerie I was taking south.

### Trouble at the Rivers' Crossroads

For several days our trip went serenely, until we came to the point where the Paraguay-mirim and the Paraguay merge again. We were now 500 river miles south of Descalvados and 100 miles from the junction of the Paraguay and the Miranda, where I knew our greatest troubles lurked. The river below Corumbá is nearly a mile wide, and the wind often howls along its broad expanse in fierce gusts.

We kept our river caravan close to shore, and at one point, as we passed a settlement near the end of the Paraguay-mirim, we had to lay to for three days while the winds buffeted the open water of the river (page 702).

A hundred river miles below Corumbá lie Pôrto Esperança and the railroad. After we moved back into the main stream of the Paraguay, we hung out running lights at night because we occasionally sighted other boats.

Some 30 miles above Pôrto Esperança the Miranda pours from the east into the Paraguay.

I was squatting on the forward end of the houseboat, with Edith beside me, when I first sighted the mouth of the Miranda, beyond a bend on the eastern shore. This was the most treacherous part of our voyage, since we were now required to turn the *River Gypsy* and its attendant barge into the mouth of the Miranda against the current, before the double force of the Paraguay and the Miranda should sweep us on to the southward.

Our river entourage, which we now called "Siemel's Ark," could move with some ease with the current; but when it came to maneuvering against the current and crossing the rip between the two rivers, I was afraid our 5-horsepower motor might be a little less than adequate.

### Manpower Checks the Flotilla

I called out to Lauro. "Bring out the poles!"

Suddenly, however, the current quickened, and we fairly shot toward the river mouth, with Lauro bawling to the hands to grab their poles from the racks and get set for the crisis. But in the next minute the rip from the Miranda had caught us and swung the 80-foot flotilla broadside. The north bank of the Miranda, where I had hoped to make my turn, swept past and swiftly receded. Suddenly Bernardo, one of the helpers, shouted from the forward end: "Boss! There is bottom! I have reached it!"

He had thrust his pole down to starboard and was lustily pushing on it. Two others, on the same side of the barge, had also reached bottom, and within a few seconds the combined braking power of the poles stopped the forward movement of barge and houseboat.

Slowly they began to edge the *River Gypsy* toward the mouth of the Miranda, only a few hundred yards away. With Lauro organizing the crew, the men worked in relays, pushing their poles along the sides so that the boat moved forward at about the speed they were walking.

Poling a combined barge and houseboat upriver is no child's play, and it proved to be an especially tough chore for my boatmen, who were accustomed to taking the course of least resistance—downstream. Lauro's crew of polemen trudged up and down the narrow deck of the houseboat with growing disgust. Their only relief came at intervals when the dugout, with its heroic motor, proved able to keep the barges under way.

As the river narrowed, the flat country, baking under the spring sun, began to close in on us. It was hot, but beautiful. Along the banks blossomed great patches of scarlet and purple *piuva*, those startling flower-trees which appear like massive bouquets in the tall grass of the marshland.

After many days of this laborious progress our flotilla rounded a bend, and I saw the site of our new home—Barranco Vermelho, or "Red Cliff," crowned as with a royal garland by purple piuva trees.

We found a mooring spot for the *River Gypsy*, and the children, babbling with excitement, clambered down and scurried up the embankment. We were met by a blond man on a horse, Raoul Nesheim, manager of the Miranda Estancia. He waved cheerily the customary greeting of the Brazilian rancher, to whom courtesy is a habit, be he of Portuguese, Spanish, or other descent.

Barranco Vermelho became more truly our home than any other place in South America. It was not as deep in the jungle as Descalvados and perhaps not as wild; but it was sufficiently remote from civilization to lure hunters, and it was filled with a quiet beauty that only untamed Nature can produce.

### Christmas Comes to Red Cliff

The first three years at Barranco Vermelho were hard. The building of a camp is not easy, and Edith and I worked industriously to make our place pleasant, both for the children and for hunters who came to stay with us. Each Christmas we spent at the Miranda Estancia as guests of Senhor Nesheim.

But on our fourth (and, as it turned out, our last) Christmas at Red Cliff, we decided to celebrate the holiday at home. For two weeks it rained. Christmas morning itself, however, dawned bright and clear.

Edith had prepared the atmosphere the night before with a jungle-ized version of *The Night Before Christmas*. For the more orthodox reindeer she had substituted our local swamp deer. But explaining snow proved to be a nearly insurmountable problem. If anyone wishes to test his descriptive powers to the core, let him try to describe snow to children who have never seen the stuff.

However, we fixed up a Christmas tree, which I turned out in my workshop, using a lathe-turned length of mahogany for a trunk. I bored holes in it and pegged in palm leaves for branches. We made the proper trimmings out of tinfoil, with which packages often are wrapped for shipment in hot countries, and cut the tops of cans into glittering disks and stars for ornaments. Candles, of course, were no problem (page 710).

Lauro, Rosendo, and I spent many hours carving toys, creating sets of blocks for Dora and more advanced jack-in-the-box and monkey-on-a-stick contrivances for Sandra. Other gifts included homemade dolls, and parcheesi and tiddlywinks sets contrived from cayman teeth. The women strung necklaces of shells, which delighted the children.

When it came to playing Santa Claus in traditional costume, however, I rebelled. The mere thought of a red-robed Santa with a woolen cap and a pillow, all in a 100° temperature, was enough to send perspiration coursing down my face.

Christmas dinner was unorthodox, too, but savory: breast of guan, a pheasantlike bird, with wild rice; roast *mutum*, or curassow, a bird nearly the size of a turkey; and finally a roasted peccary, the jungle hog, served on a huge wooden slab with cassava cakes around it in place of potatoes and a jungle fruit in its mouth.

Edith and I agreed later that from the moment the children had come pattering into the room in the morning, wide-eyed at the wonders that Santa had carried all the way down from the North Pole, until we tucked the sleepy tots into their beds that night, Christmas in the jungle had been an unqualified success.

The following June, Sashinho was born, and Edith and I decided it was time to let our little family see something of life beyond the jungle. So, in January of 1947, more than seven years after Edith had arrived on her second trip to the Mato Grosso and decided to make it her home, we closed the *River Gypsy*, packed what things we thought we should take with us, crated the animals which I had contracted to deliver to North American zoos, and boarded a downriver launch for Pôrto Esperança and the train to Rio de Janeiro.

### Two Magic Lands

I shall never forget the final scene: our barge, made of dugout logs, piled high with trunks, crates of animals, and general camp equipment; Rosendo at the controls of the outboard motor in the dugout, which was lashed to the barge; Cenaria and Antonia waving from the bank, surrounded by their constantly increasing testimonials to Brazil's national habit; Floridad, the children's nurse, her dark eyes filled with tears as she clasped her own baby and waved her blessing to all of us.

We had left our jungle home and were heading for a wholly different one in the United States. To Edith and me, it meant farewell to a magic land; to little Sandra, Dora, and Sashinho, the magic land still lay ahead.

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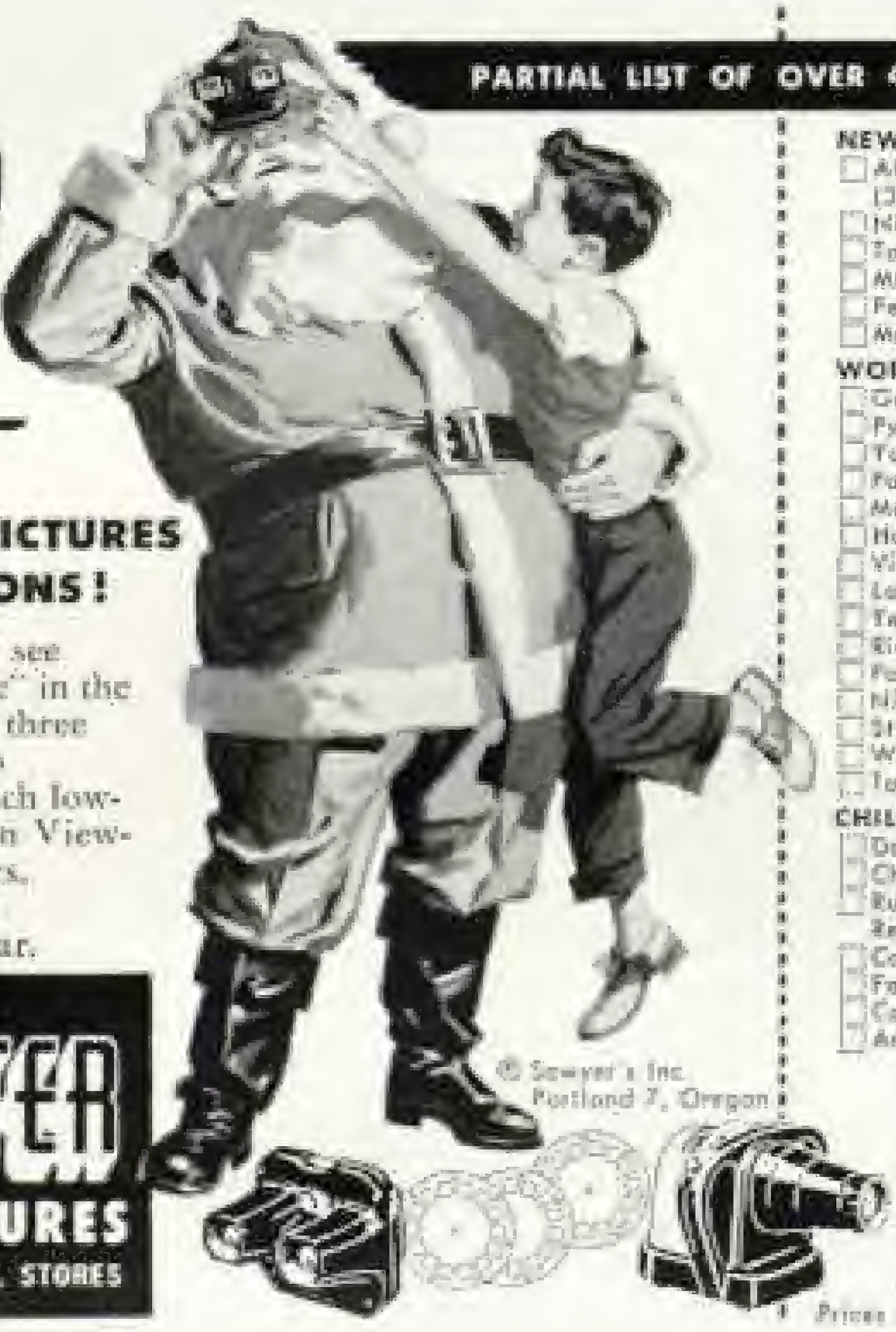

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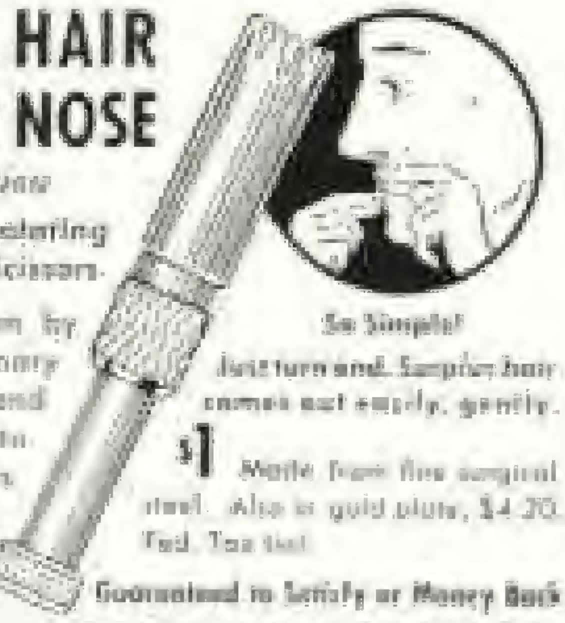

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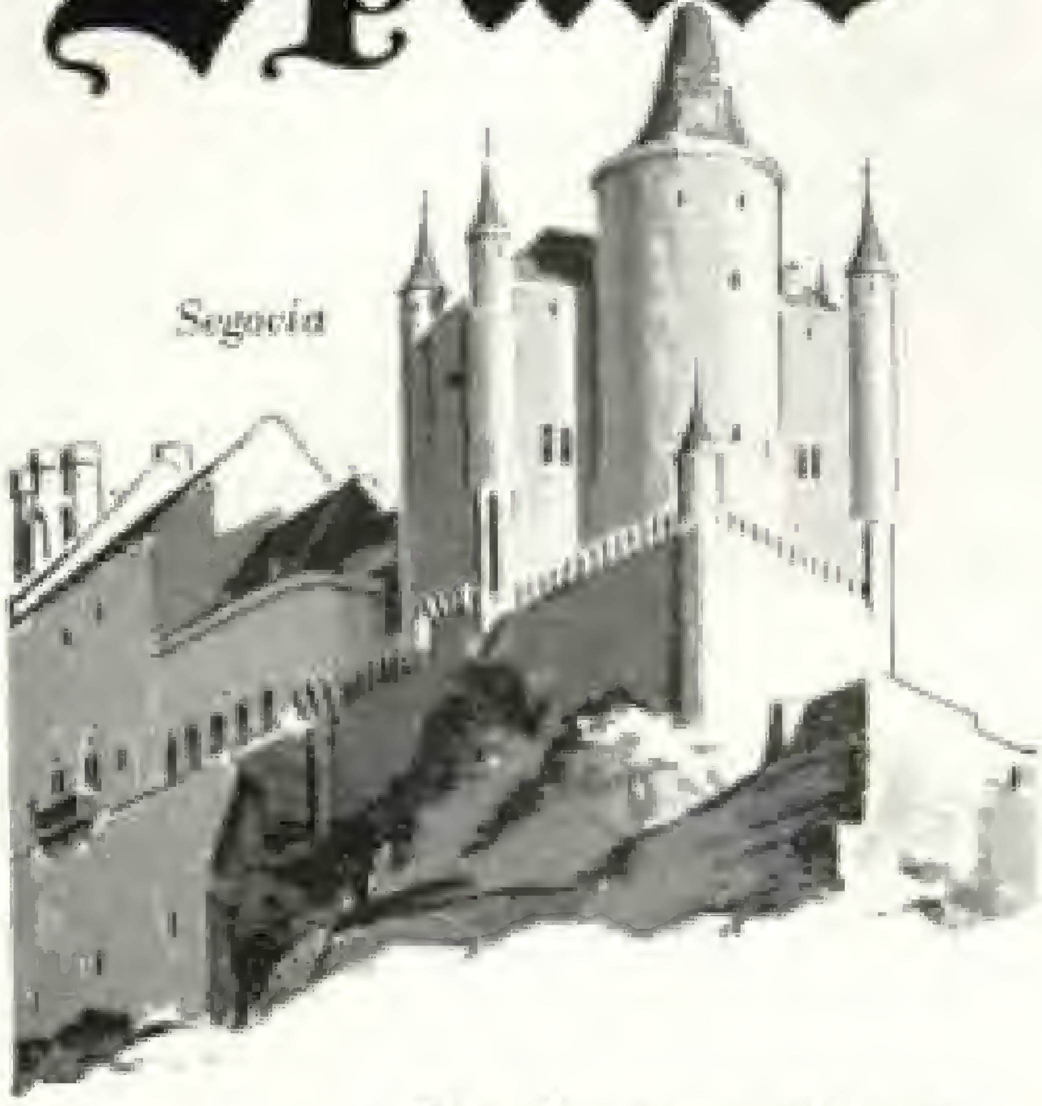

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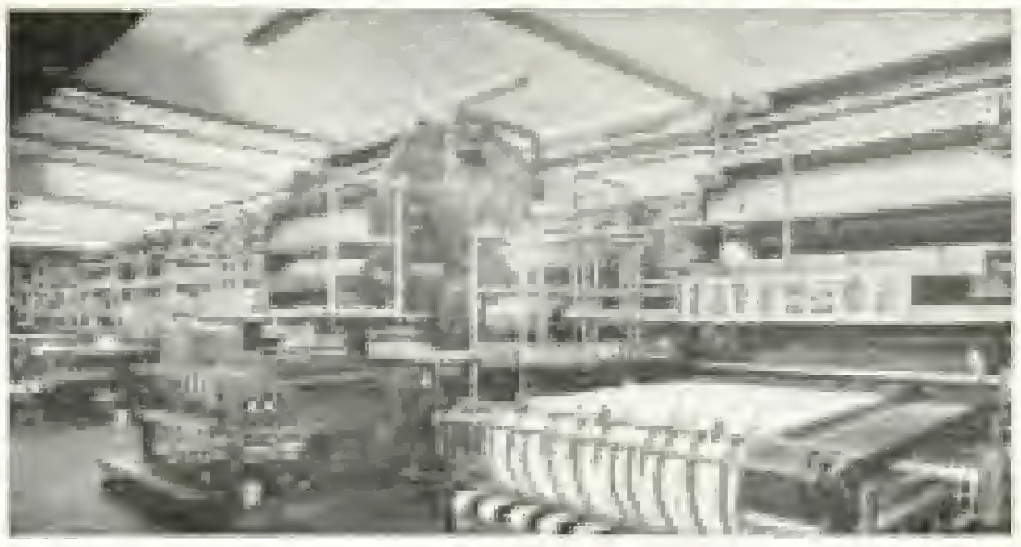

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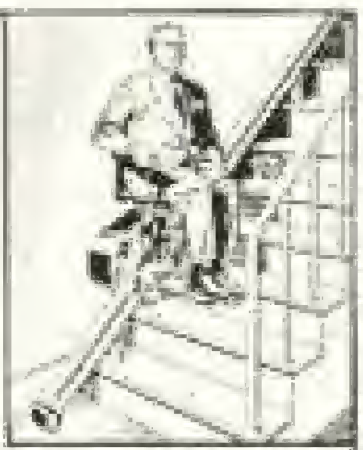

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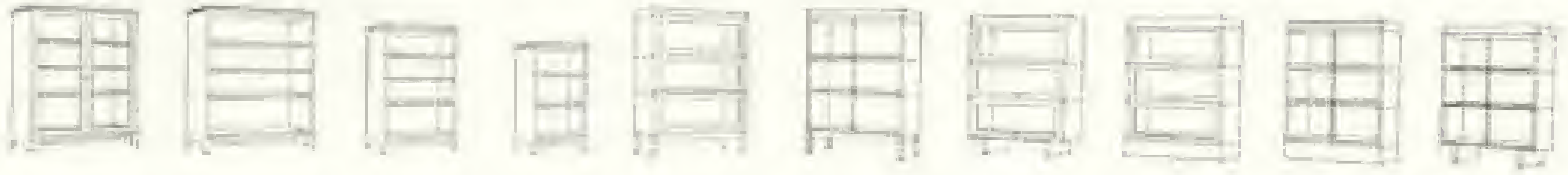

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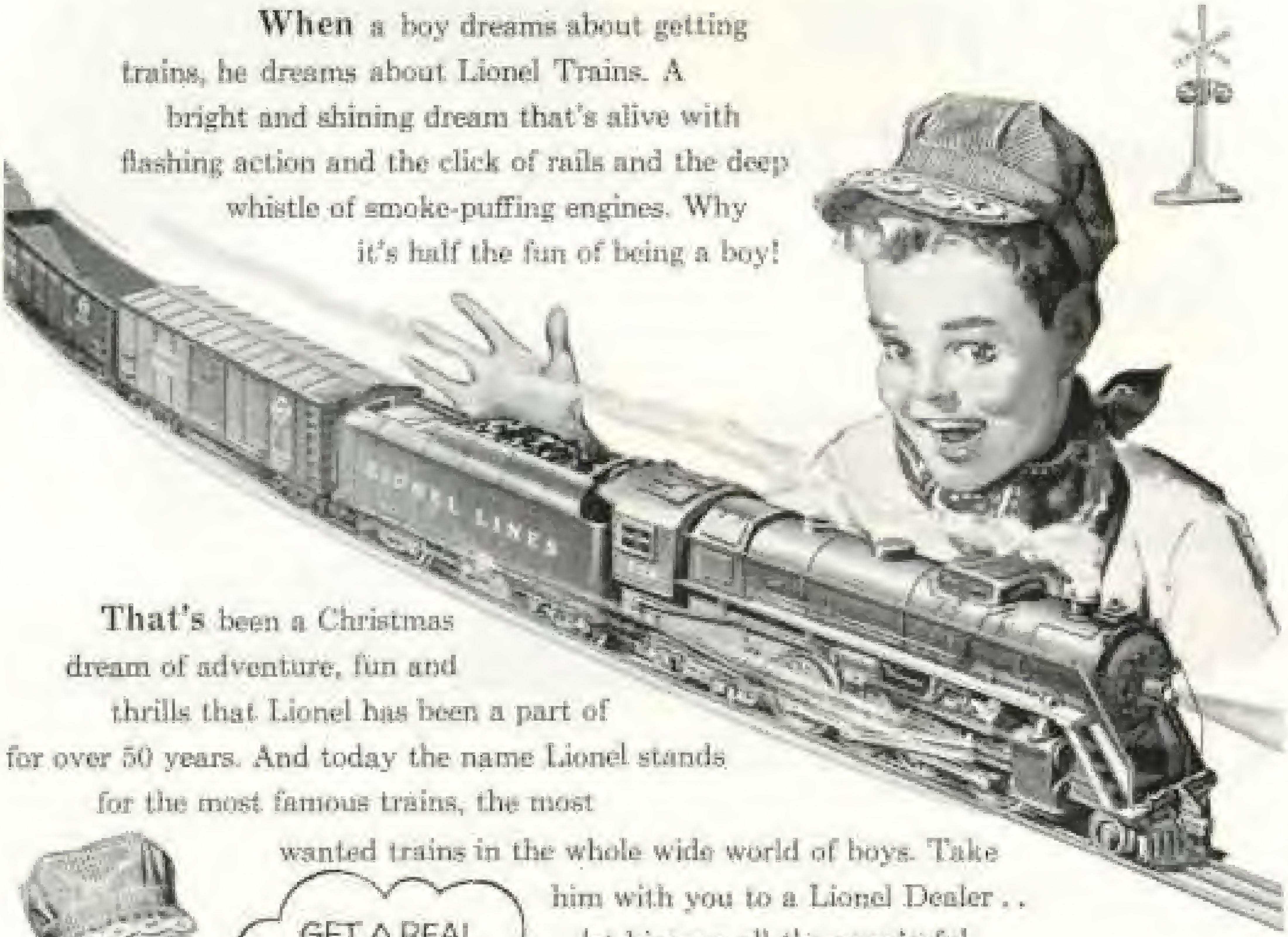
11-52

# Happiest Christmas Dream in any Boy's life...LIONEL TRAINS!

**When** a boy dreams about getting trains, he dreams about Lionel Trains. A bright and shining dream that's alive with flashing action and the click of rails and the deep whistle of smoke-puffing engines. Why it's half the fun of being a boy!



**That's** been a Christmas dream of adventure, fun and thrills that Lionel has been a part of for over 50 years. And today the name Lionel stands for the most famous trains, the most wanted trains in the whole wide world of boys. Take him with you to a Lionel Dealer . . let him see all the wonderful Lionel trains in action.

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✓Check Cap Size here

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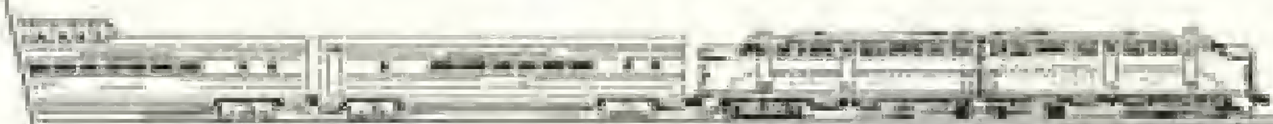

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TWO OFFERS CHECK ONE

☐ I enclose 25¢ for catalog offer below—
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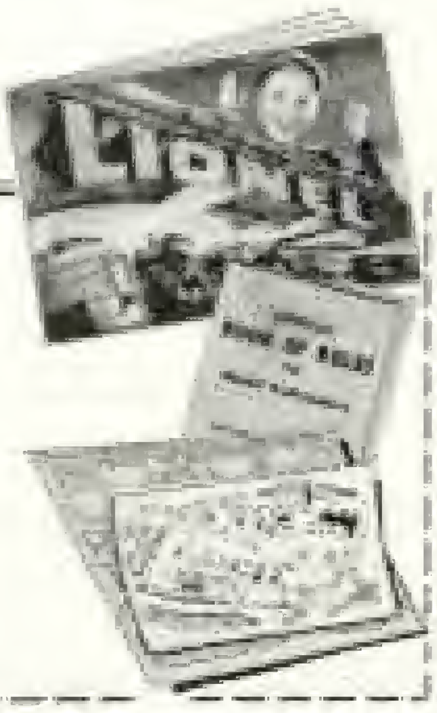


*"THE KICKAPOO RIVER IS LOOSE AGAIN"*

# Heroic Operator helps protect town from flood

**Awarded Vail Medal for courage, initiative and devotion to duty. Honored at civic dinner.**

It was a quiet Saturday morning in Gays Mills, Wisconsin. A steady rain had drenched the town and folks were staying indoors.

Then suddenly a flash came by telephone to Mrs. Wilma Gander, the town's chief operator. "The Kickapoo River is loose again, fifteen miles upstream."

Although Gays Mills did not appear in imminent danger, Mrs. Gander had been through floods before and she had the foresight to see what might happen. So she pressed the button on her switchboard that set off the village fire siren.

Immediately people began calling in and rushing in. "Where's the fire?" they asked.

"No fire," answered Mrs. Gander. "It's a flood. The Kickapoo's over its banks and the flood is headed this way."

Quickly the word was passed. People collected such belongings as they could and made their way to safer places.

Mrs. Gander next alerted the Red Cross, the National Guard and the Army and called in a lineman to help prepare the telephone exchange for high water.

By warning the town, remaining at her post, and keeping telephone service going, she helped to protect the lives and property of hundreds of people.

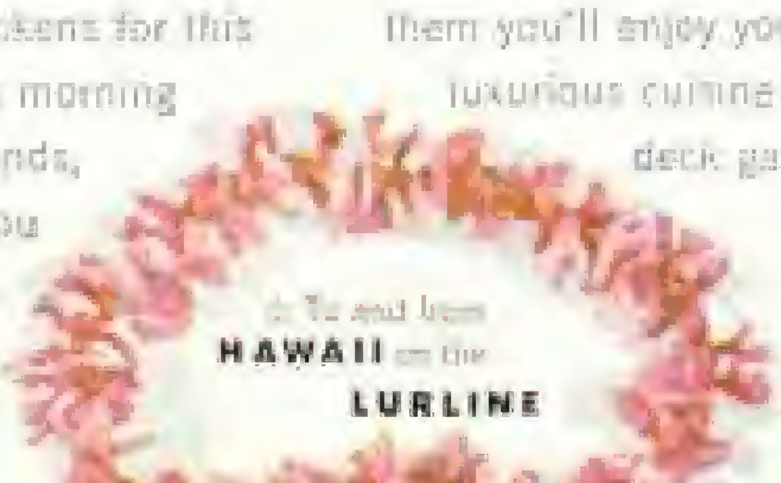
Mrs. Gander was honored by the grateful citizens of the town at a civic dinner. The Bell System awarded her the highly prized Theodore N. Vail Medal and presented a commemorative bronze plaque to the Utica Farmers Telephone Company.

Vail medals, accompanied by cash awards, have been given annually by the Bell System since 1920 for acts of noteworthy public service by telephone employees.

**HELPING HANDS**—This is one of the many stories of the skill, courage and resourcefulness of telephone men and women in times of emergency. . . . Not all of them tell of the saving of a town or a life. But there is scarcely a minute that someone in trouble or urgent need does not turn to the telephone for help. . . . **BELL TELEPHONE SYSTEM**

# *Aloha to the Lurline... and You*

Steaming westward from California, you've gloried in the lazy days and lovely nights of your voyage... then your pulse quickens for this moment: landfall at sunrise... and as morning mists melt away you see those fairy-like islands, rising rose-tinted in the tropic sea... you approach your harbor—where awaits the "Aloha" Hawaii bestows on her beloved LURLINE. ■ You capture many such memories on a Lurline cruise... and sailing homebound, you'll again be with friends who are sharing your pleasure. With them you'll reminisce and recreate Island fun. Like them you'll enjoy your air-conditioned stateroom; the luxurious cuisine and service; the movies, dancing, deck games, parties... that are all included in a Lurline round-trip fare.



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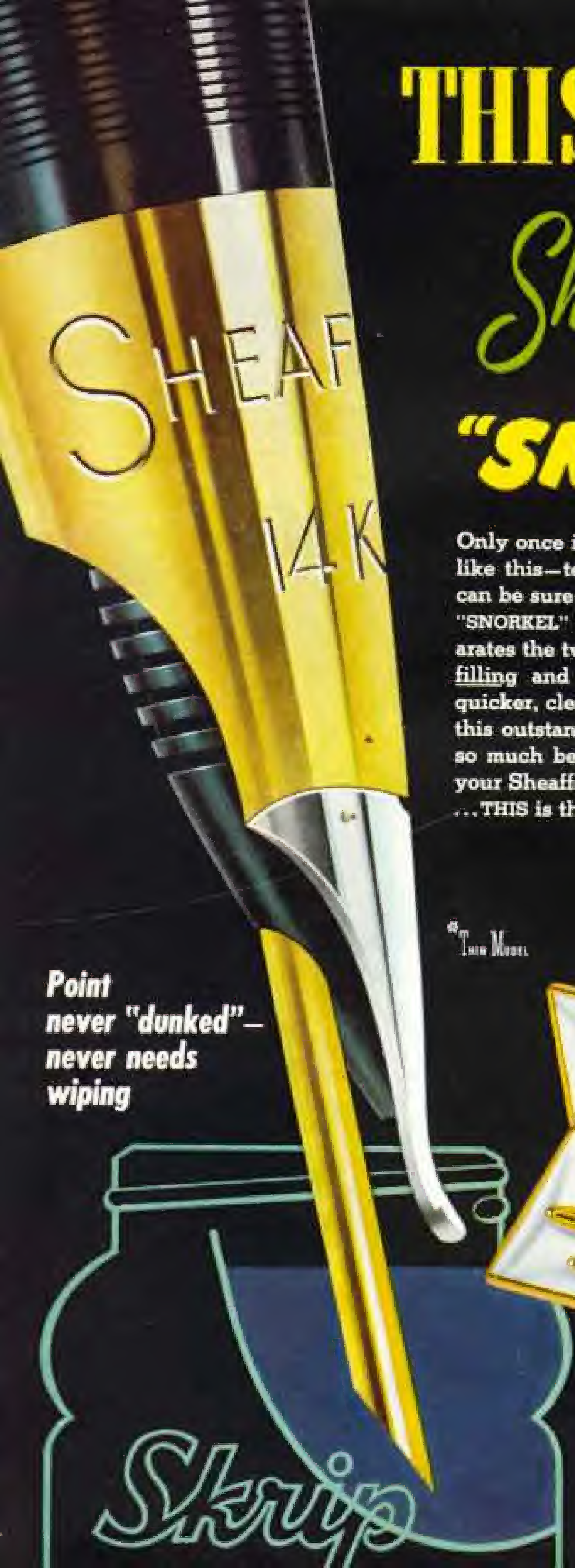

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