VOLUME LXXV NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

FEBRUARY, 1939

Forty Pages of Illustrations in Full Color

PUBLISHED BY THE
NATIONAL GEOGRAPHIC SOCIETY
HUBBARD MEMORIAL HALL
WASHINGTON, D.C.

$3.50 A YEAR 50c THE COPY

VOL. LXXV, No. 2 WASHINGTON FEBRUARY, 1939

THE NATIONAL GEOGRAPHIC MAGAZINE

CALIFORNIA'S COASTAL REDWOOD REALM

Along a Belt of Tall Trees a Giant Bridge Speeds the Winning of Our Westernmost Frontier

BY J. R. HILDEBRAND

STARTING north from San Francisco along the Redwood Highway, we drove across the rock-cleft Golden Gate on the world's largest and loftiest suspension bridge, looked out upon the world's biggest man-made island, and entered the coastal realm of Nature's oldest and tallest living things, the redwood trees.

Treasure Island, they call the 400 acres of new United States soil dredged from the bottom of spacious San Francisco Bay. This year it is crowned by the walled city of the Golden Gate International Exposition, built around the mammoth edifice which will be a permanent airplane hangar after the Chinese pagodas, old masters' paintings, and Balinese dancing girls are shipped back home (pages 134 and 184).

Early-morning light also etched grim, gray Alcatraz, Uncle Sam's Devil's Island for incorrigible criminals. Prisoners on the Rock, who never smile, they say, are more tractable now because they covet the cells that overlook the insular site of the Exposition's Great Gay Way.

The road and the bridge have opened up a literal last frontier, stretching a distance equal to that of Baltimore from Boston, along a unique belt of "ever-living" trees, *Sequoia sempervirens* (map, pages 138-9).

This coastal country from San Francisco to Grants Pass, Oregon, imprisoned between lofty mountains and the broad Pacific, was explored more than fifty years before Jamestown and Plymouth were founded. Yet you can see there today "thirty-niners" still winning, settling, and touring the West.

Their covered wagons now are shiny streamliners (40 hours from Chicago), or mammoth sleeper buses (which they still call "stages"); their trading posts surround gasoline stations; they camp in factory-made tents or sleep in "motels" (a word of western coining), or at neat inns which capitulate to slacks and shorts by advertising "Come as you are."

HIGH BRIDGE! AND HIGH TREES

At the San Francisco threshold of the Redwood Empire, man and Nature seem to strive for superlative engineering feats.

Plant the tallest redwood on a floating island beside a lofty tower of the Golden Gate Bridge, which rises 746 feet above water, and the tree would be a little less than half as high. Yet, days later, driving farther north, the broad macadam corridor seemed a jungle trail threading endless shaded acres of forest patriarchs.

One visible bridge tower extends a hundred more feet beneath the Bay's surface and there rests upon the world's largest underwater foundation, long enough, and within five feet of being wide enough, for a football field.

Bedrock at each end of the bridge consents to clutch massive concrete anchorages which sustain a 250,000,000-pound pull of the incredible span, four-fifths of a mile long. But ages ago the rocks resented in-

Photograph from Wide World

ON TREASURE ISLAND LOOM THE TOWERS AND PALACES OF A PACIFIC PAGEANT

Ferries, speedboats, and a causeway leading off the 8¼-mile Bay Bridge at Yerba Buena Island transport visitors to the man-made island site of the Golden Gate International Exposition. Enough black sand to build six Great Pyramids of Egypt was pumped from bay-bottom into three miles of sea wall surrounding the magic city. The Tower of the Sun courts rise above lagoons and vast exhibit halls. Volcanic lava, quarried in Napa County, was used in cement plaster to fireproof their walls. To the right are the giant Elephant Towers which amused President Roosevelt as he walked between them to dedicate the site last summer (pages 133 and 184).

vasion by throwing up a rampart on the Marin County side, so that men had to pay a million and a quarter dollars to grade and surface the 3.6-mile Waldo approach, and a tunnel cost $614,000 more.

OFFICES AND TRAFFIC CONTROL

"Is there a minimum speed limit to keep drivers from loitering along to see the view?" I asked.

"No. An optical illusion does the trick. We're going 50; now I'll slow down to 25, and you'll see. Or, rather, you won't see."

At less than 35 miles an hour the upright metal pales below the guardrail appeared opaque. We sped up again, and had an uninterrupted view to the west of open ocean, unbroken except for the fog shroud of the Farallon Islands.

To the east, beyond Alcatraz and Treasure Island, festooned from a third island, Yerba Buena, stretched the 8¼-mile silvery ribbon of the Bay Bridge. Behind that rose the massive "mainland" amphitheater of cities—Berkeley, Emeryville, Oakland, Piedmont, and Alameda (page 140).

Battleships anchored there that day looked like toy boats beneath the mighty bridges. Ocean liners, ferries, barges, and fishing boats spread ribbons of foam on the vast waters.

A telephone cable barge, top-heavy with a cumbersome derrick, told a story of San Francisco's constricted geography, deep-water rimmed, like Manhattan, on three sides.* Eight of ten telephone calls in and out of San Francisco are transmitted through underwater cables. Divers from a

* See "Northern California at Work" and "Out in San Francisco," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE, March, 1936, and April, 1932, respectively.

barge, not linemen from a repair wagon, were working to keep these lines in repair.

Twelve cables stretched under four miles of water carry the heavy conversation traffic to Oakland and other east Bay cities; three others run for a much more hazardous mile across stormy Golden Gate.

Photograph by R. Anthony Stewart

HE LOVES HIS WORK—SOMETIMES!

Collectors in 14 booths of busy Golden Gate Bridge drop bags of coins, mostly silver dollars and halves, down chutes to a tunnel-like vault below. The receipts are poured into counting machines, then an armored truck hauls them to the bank—some 267 pounds of currency on an average day.

A TOLL BRIDGE IS BIG BUSINESS

There's romance in the old-fashioned toll bridge of boyhood memory where a shabby collector, with corncob pipe, would amble forth to exact tribute. There's romance of the Machine Age in this bridge giant, with its 14 fan-wise toll lanes.

When an alert collector in trim uniform takes in a half dollar, or more, he presses a button that flashes the classification of the vehicle on an indicator visible from the windows of the modernistic bridge-plaza office building, and also transmits the transaction to a 20-inch-wide ticker tape of a locked recording machine in a locked room (page 136).

Meanwhile, the vehicle has passed over a treadle which registers the number of axles. Thus there is a minute-by-minute record, on 14 machines, of the 14 collectors' tolls, all balanced like the last column of your hotel bill by these clicking, inanimate bookkeepers.

Silver dollars are classic currency in San Francisco—easterners carry shiny ones home for souvenirs—but half dollars now weigh down pockets and handbags.

"Why?" I asked, the first time I was given a pile of fifty-cent pieces in change for a $10 bill.

"Bridge tolls," explained the water-front restaurant cashier.

Hotels and stores have money-washing machines to keep the coins bright and clean.

THE PERILS OF PAINT

Men who wielded paintbrushes from swinglike staging, swaying scaffolds, and

© Spence Air Photos

DELICATE AS A SPIDER WEB SEEMS THE COLOSSAL CROSSING MEN WOVE OVER GOLDEN GATE

In this graceful structure builders used a hundred thousand tons of steel, enough wire to girdle the earth three times, and concrete sufficient to erect eight solid shafts of Washington Monument size. The center span of about four-fifths of a mile is held some 250 feet above the restless tides by two enormous cables, each made up of more than 25,000 strands. The towers from which they hang like a necklace on display rise above the water nearly as high as the Woolworth Building in New York City. Beneath the long shed in the foreground spread fanwise the 14 toll-collection lanes (page 135). To their left are bridge office buildings, which also house fire-fighting and emergency auto repair equipment. Sight-seers park to the right and walk across

bosun chairs, in queer, lofty places, looked the size of a corps of Charlie McCarthys.

"How much paint did it take?"

"Five hundred tons to start with," an official computed. "And one hundred tons more for repainting every 18 months. We have 40 painters on the regular payroll."

High winds, not high places, are the painters' nightmares (Plate II). At first the Navy complained of splotches on trim decks and occasional red blobs on officers' uniforms. The San Francisco fishing fleet welcomed the added touches of color to its rainbow craft.

Speeding along California's costliest three miles of highway and emerging from the tunnel, we came upon myriad folded hills, crumpled on all sides like a huge army blanket. In spring they are as green as the emerald carpet Corrigan saw in Ireland; by early July they are platinum blond.

Below us nestled Sausalito, "little willow" city of stairways and hillside gardens, and, across Richardson Bay, the cliff-climbing suburbs, yacht-harbor Belvedere, and trim Tiburon perched on a peninsula pointing like a massive forefinger toward Angel Island, the Ellis Island of the Pacific coast.

Over there you live on the high road, the middle road, or the lower road, and you climb up or down flagstone steps through rock gardens to your front door.

Shores of the bay northward past frowning San Quentin State Penitentiary afford nests for sport sailing and nooks for rod and gun clubs.

"Alcatraz, San Quentin—do all California prisons have such pretty names, and overlook the water?" exclaimed a visitor.

A "WATER-GRANT COLLEGE"

Along this coast, too, is an unusual educational institution, supported by the State with the help of Federal funds, a sort of "water-grant college."

When we visited the California Nautical School the college was anchored north of Tiburon—a converted steamship, 4,500 tons displacement, with "dormitories," classrooms, and "campus" all on board her. Some 130 students take the three-year courses in navigation or engineering.

Each January the training ship starts on a cruise, usually around the world, flying the Stars and Stripes and California's Bear Flag (page 143). The students learn geography first-hand, as well as adjusting compasses, handling cargoes, or tending boilers.

Marin is a county of myriad mountains, piled around San Francisco's front, or golden, gate. Soon we crossed Richardson Bridge, appropriately all redwood, even to the massive piles.

Looming ahead was majestic Tamalpais in a purplish haze, and south of it lay a dark-green redwood forest primeval, Muir Woods National Monument.

To reach it we drove off the Redwood Highway, on serpentine roads where cattle grazed on sheer hillsides, once Spanish grant lands, now flecked with eucalyptus trees, ill-advised imports from Australia. Still we were less than an hour's ride from San Francisco's Embarcadero, where ships of the world come to dock.

THREE PROFESSORS DIG IN

One Sunday morning, up toward San Rafael, we came upon three dignified and distinguished professors patiently digging pailfuls of soil.

"What for?" we inquired.

"To send to New York," laconically replied the historian of the group, and kept on digging. And thereby hangs a detective story of modern research.

One day in 1936 a young man from San Francisco drove out to the Marin County hills on a picnic—week ends find most Bay residents outdoors—and picked up a tablet of solid brass, about eight inches long, five inches wide, and an eighth of an inch thick.

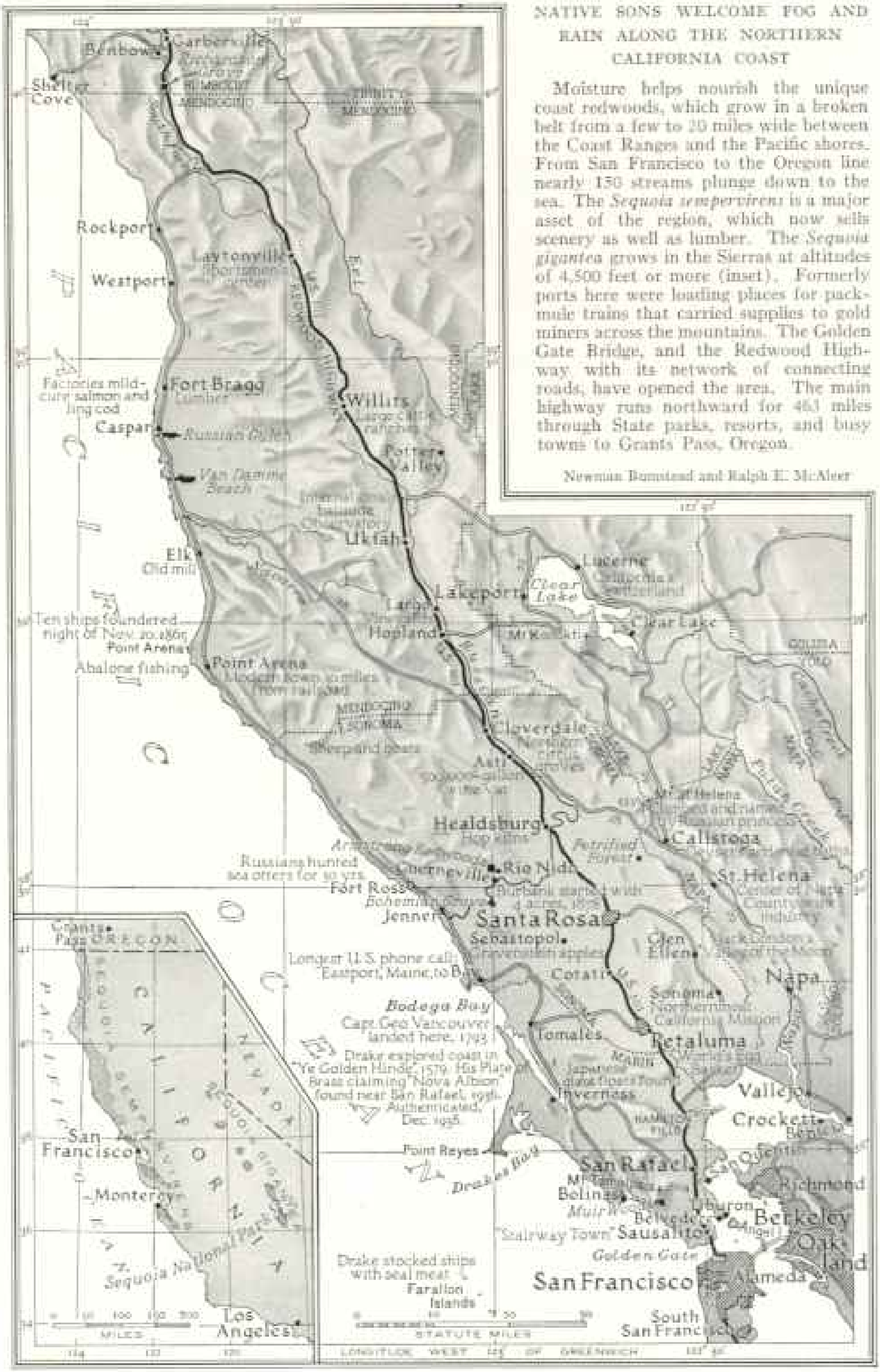
He thought it was iron, of about the right size to patch a hole in his automobile. A month passed before he scrubbed the black metal and revealed the word "Drake."

When he finished there stood out this startling inscription:

BEE IT KNOWNE VNTO ALL MEN BY THESE PRESENTS
IVNE 17 1579
BY THE GRACE OF GOD AND IN THE NAME OF HERR MAIESTY QVEEN ELIZABETH OF ENGLAND AND HERR SVCCESSORS FOREVER I TAKE POSSESSION OF THIS KINGDOME WHOSE KING AND PEOPLE FREELY RESIGNE THEIR RIGHT AND TITLE IN THE WHOLE LAND VNTO HERR MAIESTIES KEEPEING NOW NAMED BY ME AN TO BEE KNOWNE VNTO ALL MEN AS NOVA ALBION.
FRANCIS DRAKE

Friends told him, "You may have something there; better show it to the people over at the University." So he took it to Professor Herbert E. Bolton, who, with the aid of the California Historical Society, acquired it for the University of California.

For more than 350 years historians had been seeking traces of the "Drake tablet."



NATIVE SONS WELCOME FOG AND RAIN ALONG THE NORTHERN CALIFORNIA COAST

Moisture helps nourish the unique coast redwoods, which grow in a broken belt from a few to 20 miles wide between the Coast Ranges and the Pacific shores. From San Francisco to the Oregon line nearly 150 streams plunge down to the sea. The *Sequoia sempervirens* is a major asset of the region, which now sells scenery as well as lumber. The *Sequoia gigantea* grows in the Sierras at altitudes of 4,500 feet or more (inset). Formerly ports here were loading places for pack-mule trains that carried supplies to gold miners across the mountains. The Golden Gate Bridge, and the Redwood Highway with its network of connecting roads, have opened the area. The main highway runs northward for 463 miles through State parks, resorts, and busy towns to Grants Pass, Oregon.

Newman Bumstead and Ralph E. McAleer

Drake's fluent Chaplain Francis Fletcher related in his famous chronicle how the navigator had anchored in a "conuenient and fit harborough" along the California coast in 1579—the "harborough" now thought by many historians to have been the inlet called Drakes Bay.

That was after the navigator had captured a vessel off Valparaiso containing 1,770 jars of wine and gold worth $24,000, and filled the remaining space in his hold with "silver bars as big as brickbats" from a vessel he boarded near Guayaquil.

Drake had intended to head across the Pacific for the Moluccas, but he delayed overlong for favorable winds, and dared not risk the far-from-pacific waters with a dead cargo of thirty tons of precious metal, in addition to ten tons of cannon and arms.

So he put into the "fit harborough" north of San Francisco, converted and clothed the Indians, reconditioned the *Golden Hinde*, and nailed to a "faire great poste" a brass plate bearing an inscription.

THE MYSTERY OF THE BRASS PLATE

So much is history. But was this brass plate authentic?

"It must be a fake," pronounced an amateur historian. "Otherwise it would have been signed 'Sir Francis Drake.'" However, newspapers pointed out that Drake was not Sir Francis in 1579. Californians began arguing about it until the Drake tablet issue grew into controversy akin to "funny money," relief, and irrigation. Learned American and British historical journals discussed it.

Meanwhile, the University and the California Historical Society concluded the mystery of the tablet was worth investigating.

Historian, chemist, lexicographer, geologist, and other experts were called in to help trace the clues.

Elsewhere Drake spelled words of the inscription differently; for example, *Vungland*, *Kyng*, *Quene*, *knoll*. Also, why would the platemaker who could cope with "svccessors" and "possession" drop the final *d* of "and"?

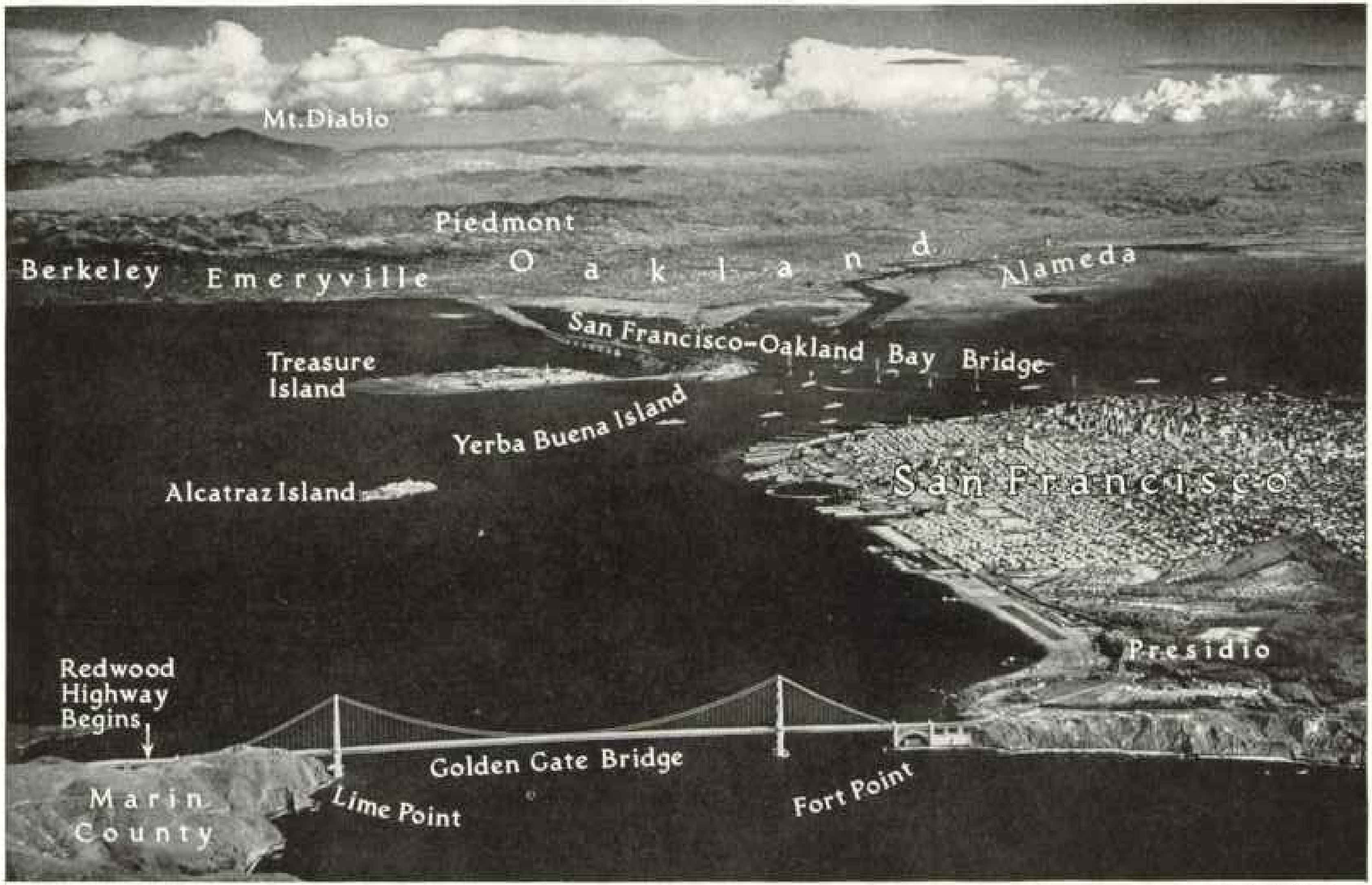
The plate was sent to New York, where a metallurgist studied whether it originally was rolled or hammered. He went to England to determine whether the brass was sixteenth century or later.

Returning to New York, he wired Dr. Bolton, in effect: PLEASE SEND SOIL OF ALL PLACES TABLET MAY HAVE BEEN STOP WISH TO TEST EROSION AND ANALYZE THE DEPOSITS STOP

That is why the three professors were digging pailfuls of soil.

Months later, in December, 1938, press associations flashed the experts' historic verdict: "DRAKE PLATE AUTHENTIC."

Back on the Redwood Highway, we drove north to Petaluma, where a massive plastic chicken alongside the road proclaims "Petaluma lays for you!"



WITHIN SIX YEARS MAN HAS WROUGHT HERE THREE WORLD MARVELS OF ENGINEERING

By the 8¼-mile Bay Bridge San Francisco is linked to five "mainland" cities, and historic ferries have dwindled. The lofty Golden Gate Bridge has made more accessible the coastal redwood belt clear up into Oregon. Treasure Island, dredged from bay-bottom, is the 400-acre walled city of the International Exposition of 1939. This new United States soil will become a permanent airport. Nearly two million people inhabit the area shown in this view taken from 6,000 feet aloft.

Photograph by Clyde Sunderland

LIKE SHIP MODELS IN A PLAY POND SEEM UNCLE SAM'S HEAVY CRUISERS, INBOUND BENEATH MASSIVE GOLDEN GATE BRIDGE

When the fleet enters "man-of-war row," San Francisco's vast harbor is far from crowded. All the navies of the world could anchor there. Marin County's crumpled mountains thrust down lean fingers to the sea, Point Diablo (nearer), and Point Bonita.

Photograph by B. Anthony Stewart

UKIAH'S "STARGAZER" STUDIES THE SKIES TO DETECT EARTH'S WOBBLING

Stand stock-still, as you talk with him, and you will grow dizzy as he tells how you are hurtling through space seven ways at once. For so-called "solid earth" simultaneously is rotating on its axis, revolving around the sun, revolving with the moon around the gravity center of the two bodies, speeding through space with the rest of our solar system at 12 miles a second, and changing direction of its own axis along a circular path that requires 26,000 years to complete. Take a deep breath, and consider that there are two other motions! One of these displaces the Equator and therefore causes a variation of latitude. Year in, year out, the lone astronomer of this lonely hilltop observatory takes observations throughout the night to compare such variations with those of other stations of like latitude around the world (page 173).

Tiers of red-roofed henhouses line the knolls about town like miniature cottages of a Swiss village. By night they are electric-lighted to make the hens eat more and lay more. "Thus," to quote a local record keeper, "we dynamited 323 eggs out of one hen in 1937." Top irrigation, with countless sprinklers spraying the kale and other greens for chicken feed, converts streets that otherwise would be lined with lawns into acres of fountains.

The farmer who hatches his own chicks, broods them, then takes their eggs to market is as extinct here as a setting hen. Petaluma specializes in hatching day-old chicks and shipping them all over the West, to other specialists (Plate X, and page 163).

These other specialists are represented here, too; first, by the "pullet grower," who buys day-old chicks and raises them for three months or so. He may sell to the "commercial egg man," who brings them up to production age, about six months, and markets infertile "eating eggs." Or he may sell to the "breeders" who produce fertile eggs for the hatcheries. Also, there is the "broiler man" who buys day-old cockerels and raises them to eight or nine weeks old.

AN EGG MAY BE ONE OF 14 KINDS OF EGG

Handling the "eating eggs" is a factory operation, what with 400 employees at one co-operative engaged in candling, weighing, grading, and "dipping" for distance shipping or sand-cleaning for local use.

This biggest egg-handling plant in the world ships to 28 States, and your breakfast before you set forth to see the hula in Hawaii, or cruise through the Canal at Panama, also may include Petaluma trademark grades.

Gertrude Stein may consider that "an egg is an egg, is an egg," but for this plant an egg may be any of 14 grades of egg—grades involving smoothness of shell, size, weight, placement of yolk, quality of white, depth

of air cells, and various other factors.

Such specialization brings other specialties in its wake.

Chickens have their feed packaged now; one baby chick brand has 11 ingredients, including sardine oil for its Vitamin D. The "chicken grocery" sales of a single plant exceeded 38,000 tons in a year.

Because chickens must have Vitamins G and B, dried milk is mixed with their feed, and a large condensing company here has a laboratory to experiment with making this dairy product, as well as casein, lactose, and condensed buttermilk.

"It's down by that load of milk bags," directed a citizen, pointing to a truck of bulging burlap sacks which, it developed, contained powdered skim milk.

"No, we don't have guinea pigs; we use chickens, in person," explained the chemist in charge, as he showed us rows of 60 test pens, 10 to 15 hens to a pen.

"Why, they let these fellows buy pure Vitamin G at $8,000 an ounce, then they audit my salesmen's expense accounts down to the last penny," grumbled the sales manager, good-naturedly.

However, the highest-paid specialists in Petaluma are the sharp-eyed young chicken-sexers, often just out of high school. They are the lads who examine the day-old chicks to determine their sex. They can do from 700 to 800 chicks an hour, averaging 95 per cent accuracy. The trick is not to injure the chick. The technique, practiced here since 1934, the operators freely admit they learned from the Japanese.

UNDER SIX FLAGS

From egg-basket Petaluma we drove eastward toward Sonoma—only 14 miles from the Machine Age era, which has harnessed the cackling hen to quantity production—into the variegated strata of California's complicated history.

Sonoma County has experienced the sovereignty of six flags. Here converged the soldiers and settlers of Britain, Spain, Russia, Mexico, and the United States up to the eventful month when all California's ultimate allegiance hung in the most hair-trigger balance American history records.

Here also met the two major streams of the early Christian church after half circling the world in opposite directions.

The adobe mission in the town of Sonoma, and the fortified Greek chapel built by Russians at Fort Ross, on the coast of Sonoma County, remain today as the remote outposts of these historic faiths.

The town of Sonoma is a Concord of California history. Here was made the first Bear Flag, partly from a red petticoat. The mission is the northernmost of the amazing chain of 21 missions, the last bead in a rosary loosely strung to be a day's ride apart from the parched Mexican borderland, along fog-drenched ocean estuaries, and into this fertile valley of vineyards and geysers.

THE EPIC OF PADRE SERRA

The pain-wracked little priest of fiery spirit who established the chain now is memorialized in Statuary Hall of the United States Capitol.

Junipero Serra, born on the island of Majorca, yearned to convert the "heathen Indians." On shipboard bound for Mexico, he denied his frail body full rations of water to train for desert hardships.

"The secret of not feeling thirsty," he concluded, "is to eat little and talk less, so as not to waste the saliva."

At Veracruz he declined the usual transport and walked all the way to Mexico City, thereby adding lifelong ulcers to his other physical infirmities.

When humane Gaspar de Portolá and his "leather jackets" started for Upper California, he refused to board the ships with the Mexican soldiers and other missionaries. He arose from his sick bed, had two men lift him on a horse, and set out overland with two soldiers, a servant, and a mule.

His leg became too swollen to proceed; a mule doctor poulticed his sores with herbs. Ultimately he joined the ships and overland expeditions at San Diego.

That was in 1769. For half a century the mission chain was patiently, heroically pushed northward until, in 1823, after the death of Padre Serra, the Mission San Francisco de Solano at Sonoma was founded.

AND VINEYARDS WERE BORN!

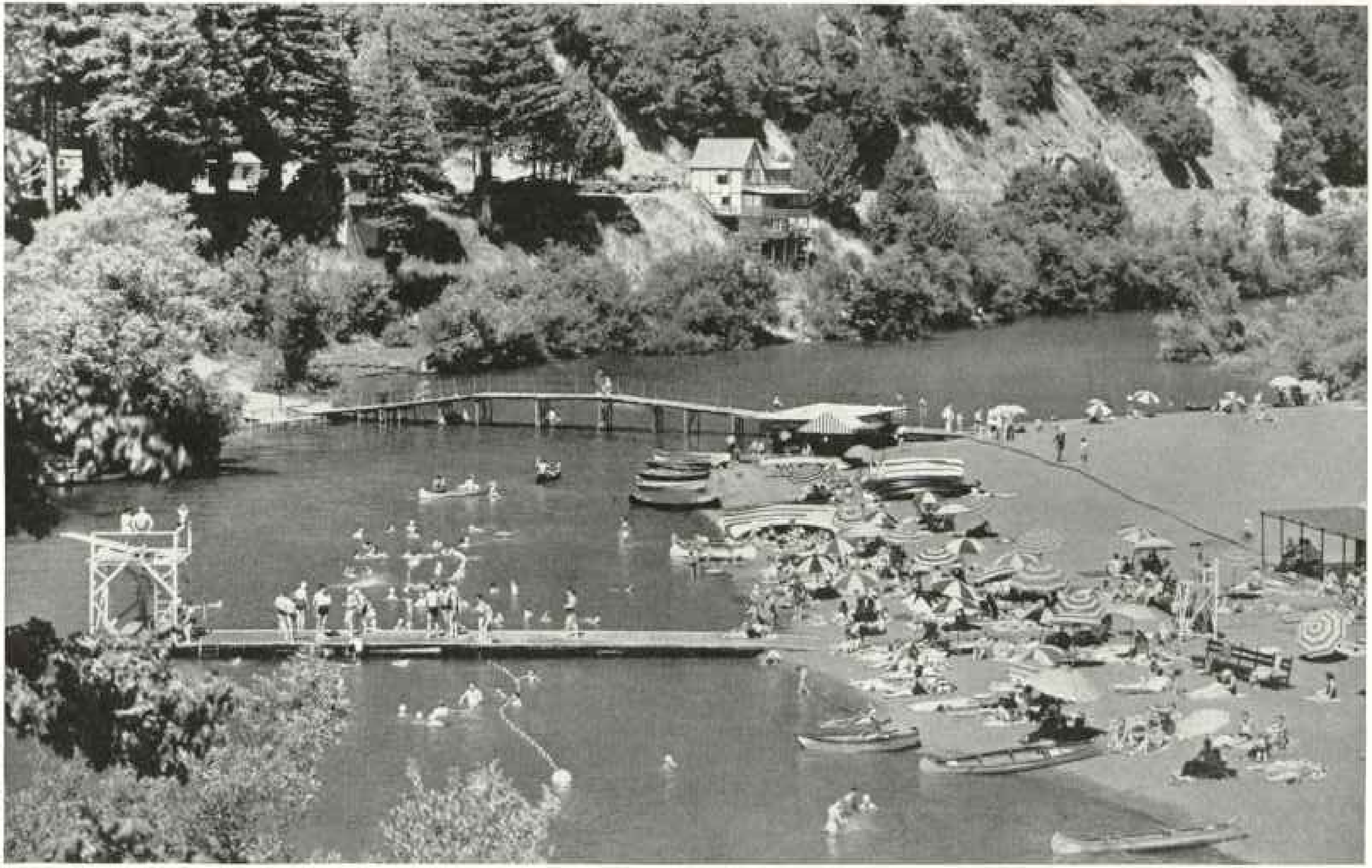
The California "mission period" was an era of colonization. Here at Sonoma, as elsewhere, an island of culture and crop cultivation grew up in the wilderness. Carpenters, tailors, smiths, shoemakers, and weavers were brought from Mexico. Indians tilled the soil and cut timber.

By 1830 Sonoma had 2,000 cattle roaming rich pastures, some 4,000 sheep were herded on grazing lands, 725 horses were

Photograph by William L. Morgan

THE SEA OTTERS' STRANGE RETURN RECALLS FUR-RUSH DAYS

When Monterey was Spanish California's capital and San Francisco still was Yerba Buena, Russians caught, and New England skippers sold, otter furs in Europe and China for as much as $500 apiece, until the animals became almost extinct. A herd suddenly appeared south of Carmel last summer and alert young men mounted telescopes and others rented field glasses to hundreds of visitors who motored out to the sequestered mouth of Bixby Creek to watch their queer antics. The awkward creatures, with heavy heads and short forefeet, carry their young on their backs, slap the water with their paddlelike hind legs, and even grasp their tails in their mouths and roll around like hoops. Here some float lazily upside down in the kelp, a habit that made them easy prey for the early hunters (page 166).



Photograph by R. Anthony Stewart

RIO NIDO IS A LITTLE LIDO WHERE TRAPPERS AND GUIDES HELD SWAY ONLY A FEW DECADES AGO

Between the belt of coastal fog and the dry summer heat of the Sacramento Valley lies the cool, clear Russian River resort region. Thousands of San Francisco families have cottages here. A major industry is running boys' and girls' camps where parents pay goodly sums so their children may live outdoors, sleep in tents, and cook their meals over open fires. Near here is Bohemian Grove, scene of the famous San Francisco club's alfresco "high jinks."

Photograph by B. Anthony Stewart

GEYSERS AND MUD MAKE CALISTOGA A KARLSBAD

Here The Geographic's representatives found a friend buried in a mud bath with only his head and hands sticking out as he read stock quotations. An airplane control board seems no more complicated than this establishment's array of polished faucets and levers that control thermal and chemical waters in sprays, showers, or needles. For steam baths they literally "turn on the geyser."

stabled there, uncounted hogs were fattened, vineyards carpeted scores of acres—and the wine industry was born!

Packet boats brought embroidered shawls, filmy linens, high combs, and Baja California pearls for the ladies; and fine laces for the ruffles of the men. Musty records that sound like society reporters' accounts of modern weddings tell of pointed bodices and flowing skirts with gold spangles, colored slippers with high wooden heels, Roman sashes, and topaz necklaces. Leisurely ladies then, as now, argued whether to wear their hair down at the back (in nets), or high on their heads (with tall jeweled combs).

Twelve years after Sonoma Mission was founded there arrived a 25-year-old Mexican soldier of Castilian blood with the formidable name and title of General Mariano Guadalupe Vallejo, Military Commander and Director of Colonization on the Northern Frontier of Alta California.

Immediately he began to lay the groundwork for the principal purpose of his appointment, expelling the Russians who were rolling up riches by trading in furs.

To the white adobe, red-roofed mission at Sonoma, Vallejo quickly added the presidio, brought his wife to be the gracious hostess of a newly built home, erected fortifications, paraded his troops on a parklike plaza, and entertained in the grand manner.

HISTORY IN HAIR-TRIGGER BALANCE

Thus it came about that the sickly Serra and the gallant Vallejo helped shape the destiny of California and the history of the United States. A mere recital of dates tells why: Russians departed, 1841; Captain John C. Fremont, U. S. A., "the Pathfinder," arrived on his "surveying mission," 1845; the "Bear Flag" raised at Sonoma, and the Stars and Stripes three weeks later, at Monterey, 1846; the treaty with Mexico

ceding California to the United States signed, 1848; the gold rush was on, 1849.

Had Mexico not established herself sufficiently here to sign the Treaty of Guadalupe Hidalgo in 1848, would Great Britain, Russia, Spain itself, or even France have acquiesced in the cession to the United States of rich territory where a wealth of furs and fruits already had been disclosed, and rumors of gold were rife?

Or had there been a delay of a few years in the American annexation coming to a head, would Great Britain, with Drake's spacious claims to New Albion, and Mexico owing England a substantial debt, have consented to the arrangement?

"Call it Providence, fate, or plain luck," mused a mellow historian, "I don't recall another case of such perfect timing."

Photograph by B. Anthony Stewart

A GRACIOUS SONOMA LADY IS A LIVING LINK WITH CALIFORNIA'S COLONIAL HISTORY

Fifteenth child in a family of sixteen, Mrs. Luisa Vallejo Emparan lives at Lachryma Month ("Tear of the Mountain," because of the natural springs). Still standing is the Swiss chalet, a Mount Vernon of California, which her father imported in pieces around Cape Horn. General Vallejo, last Mexican administrator at the shrine of the Bear Flag War, became a distinguished American citizen after California plunged from Mexican sovereignty, without any territorial interlude, direct into American statehood (page 148).

FRONT PAGE NEWS OF 1848

In an editor's museum of the Blue Wing Hotel, first hostelry north of San Francisco, once a bandit rendezvous and gaming place for high stakes, a faded newspaper, *The Californian*, published at Monterey March 15, 1848, gave the editorial emphasis on events of that time.

First page news was a notice: "All persons desiring to send letters or papers *to the United States*, will please forward to our Office prior to the first day of April. Postage on letters, 50 cents; on newspapers, 12½ cents; to be paid in advance."

Worthy only of a "stick" at the bottom of the second-page column was the item "GOLD MINE FOUND: In the newly made raceway of the sawmill recently erected by Capt. Sutter, on the American Fork, gold

has been found in considerable quantities. One person brought thirty dollars' worth to New Helvetia, gathered there in a short time. California, no doubt, is rich in mineral wealth—great chances here for scientific capitalists."

"A historic example of understatement of California's opportunities that has not been repeated since," chuckled a native son. "We don't make the same mistake twice!"

DAUGHTER OF A BEAR FLAG WAR GENERAL STILL LIVES

Tenderly replacing the faded news sheet in its case, the editor of dry wit inquired, "If Lord Baltimore's daughter still were living, would you like to interview her?"

Mystified, I admitted, "Yes."

"Then let's go over and call on Mrs. Emparan. She's the daughter of General Vallejo."

Amazing lesson in the youth of the Golden State!

"Interesting, yes, but a bit pathetic," was the unspoken surmise. "Probably a frail, feeble lady they display in a wheel chair."

Mrs. Luisa Vallejo Emparan, age 82, gayly held out both hands to greet us, apparently as happy to welcome five men as when she was the belle of her father's household of fifty servants (page 147). And she did not begin with reminiscences!

"When are we having the next ball?" she demanded of the editor.

But her clear memory runs back, on request, to the spacious days when California was trail's end for the greatest of modern migrations.

After her father's release from imprisonment by the hotheads of the virtually bloodless Bear Flag War, he continued to be a friend to Americans, administering his landed estates and entertaining in the fashion of Old World courts.

"I heard those songs often in Mexico," remarked one of her callers, pointing to music of *Estrellita* and *Siboney* on the piano.

"Sit down, gentlemen, sit down; I will sing them for you."

With scarcely a quaver in her voice, this ageless lady of a glamour era, who seems endowed with eternal joy of living, played and sang both songs in Spanish.

"I speak now for a dance with you at the next ball," petitioned the editor as we departed through the garden she still tends.

"That's a date," called the amazing lady of Lachryma Montis.

From Sonoma we headed north through the sequestered "Valley of the Moon," which, with its big barns, sleek cattle, and stone fences creeping over rolling hills, might be mistaken for Lancaster County, Pennsylvania, were it not for fringes of lacy moss on the trees and the saw-toothed ridge where the Indians used to count the moon coming up seven times a night.

Near Glen Ellen we came upon the ranch where Jack London retreated to work the "regular hours" he recommended to writers, in a hewn-wood den lined with erudite books, both of which facts belie the popular impression of a haphazard genius.

Beside his California laurel desk, with its oil-burning student lamp and a crude dentistry set he had aboard the *Snark*, is preserved his neat "morgue," as writers call their reference library. He had filed magazine articles and newspaper clippings galore in typewriter-paper boxes.

We read some of the titles: "clay pigeon shooting," "plots," "hunting horses, dogs, saddles," "sun sickness," "prison data," "ethnology," and paused at one marked "kite twine."

"Jack's hobby was flying kites," explained Irving Shepherd, our host. "Up here he would write a while, then fly kites by the hour, and go back to write some more. Yes, open up the box."

In it we found, among strings and other kite paraphernalia, a well-worn copy of the NATIONAL GEOGRAPHIC MAGAZINE of June, 1903, with one article marked in many places. The article was a noteworthy contribution to pioneer aeronautics still referred to by scientists, "The Tetrahedral Principle in Kite Structure," by Dr. Alexander Graham Bell, then President of the National Geographic Society.

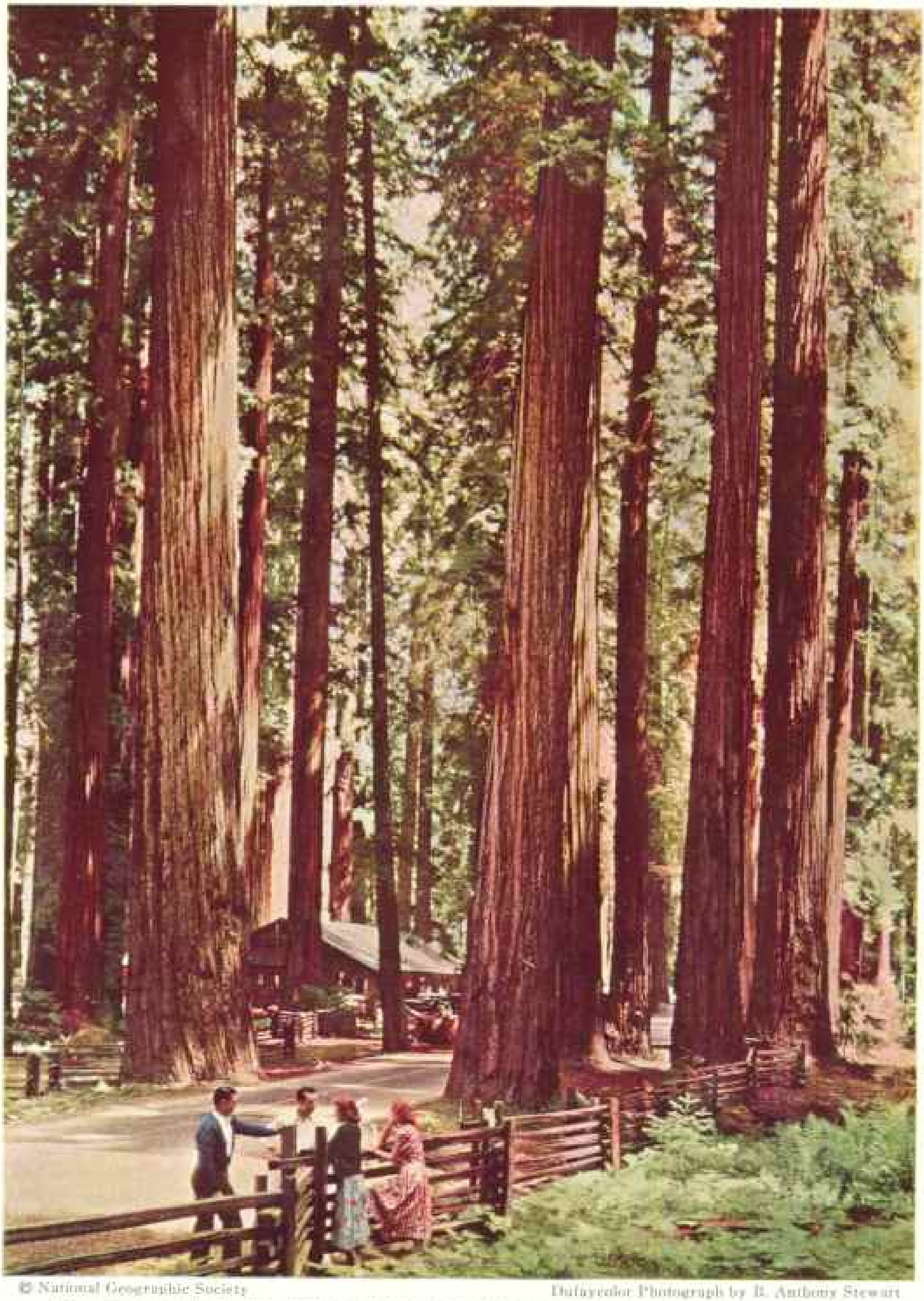
A REDWOOD STUMP IS A SHRINE

Veering back to the Redwood Highway, we saw signs in Santa Rosa inviting the public to join a motor caravan to church services at "The Stump of the Tree."

"What stump of what tree?"

"The stump of the tree from which the First Baptist Church was built," we were told (page 165).

Expecting to find a freakish edifice, we drove instead to a dignified house of worship with a well-proportioned spire. The church seats 300 people; the redwood motif is carried out in the rich stained-glass windows.



 Dufayredor Photograph by R. Anthony Stewart

"THESE GREAT TREES SEEM FORMS OF IMMORTALITY AMONG THE TRANSITORY SHAPES OF TIME"

The average redwood is taller than the Statue of Liberty from pedestal to top of torch; some were saplings when Christ was born. Those of the coastal species (*Sequoia sempervirens*), here shown in Richardson Grove, near Benbow, are higher than the monarchs of the Sierras (*Sequoia gigantea*), but not so massive. Fence, cabin, the furniture in it—all are redwood.

© National Geographic Society

PAINTING A BRIDGE RED IS A CONSTANT JOB

Not the high place, 700 feet above the Golden Gate's restless waters, but high wind is the chief handicap of the 40 "tin hats" (painters) employed.

Kodachrome Photographs by B. Anthony Stewart

A FLOWER-LOVING STATE LANDSCAPES ITS ROADS

Near Eureka the motorist is tempted to exclaim the city's name as he emerges from redwood groves upon this rainbow fringe of lupines.

Kodachrome Photograph by B. Anthony Stewart

"BRING YOUR SHOVELS AND GO CLAM-DIGGING AFTER THE DANCE"

Thus read newspaper notices inviting visitors to Clam Beach, near Trinidad, where 3,000 people have been counted during an early morning "clam tide." Nature banks yellow lupines with a florist's skill against the dunes, sedge grass, and pines (Plate XII).

Dufaycolor Photograph by B. Anthony Stewart

PINK RHODODENDRONS SPLASH IN THE JUNGLELIKE GREEN WHERE THE SUN SHINES THROUGH

California rose bay (*Rhododendron californicum*) is found only along the northern coast where summer fogs prevail, as here near Trinidad. Sword fern, often five feet high, abounds in the redwood region (Plate VI). The trees are red alders, which grow in dense thickets along this coast.

THE FRUIT THAT REFRESHES, ON RODEO DAY

A Sonoma girl in a ranch costume loyally displays the big red "bings" that flourish in this valley. At roadside stands and street corners they sell cherries, also plums, apricots big as peaches, and oversize grapes.

Dufaycolor Photographs by B. Anthony Stewart

A FLOWER THAT TRAPS INSECTS

Split open the pitcher plant (*Darlingtonia*), and within its pastel walls you find a charnel house of flies and other captives lured to its gummy maw. Around Gasquet they call it "cobra plant," because of its sinister pose.

 Dufaycolor Photograph by R. Anthony Stewart

PAGE RIPLEY! HE IS DRINKING FROM A SPRING IN A TREE

Such hollow redwoods are called "goosepens." The shallow, spiderlike root system of this giant overlies a crystal spring which flows through the "doorway" below the girls' feet. The Spring Tree is on Cathedral Trees Trail of Prairie Creek Redwoods State Park. Sword ferns have an even older ancestry than the redwoods, which date back to the era of dinosaurs. "Let fallen logs lie" is one creed of the park forester. Clearing logs and underbrush destroys the balance of nature which for centuries has nourished the redwood groves and their rich flowering plants, such as the oxalis, the inside-out flower, and the deer-foot. The California huckleberry and the creek dogwood also are abundant.

Kodachrome Photograph by B. Anthony Stewart

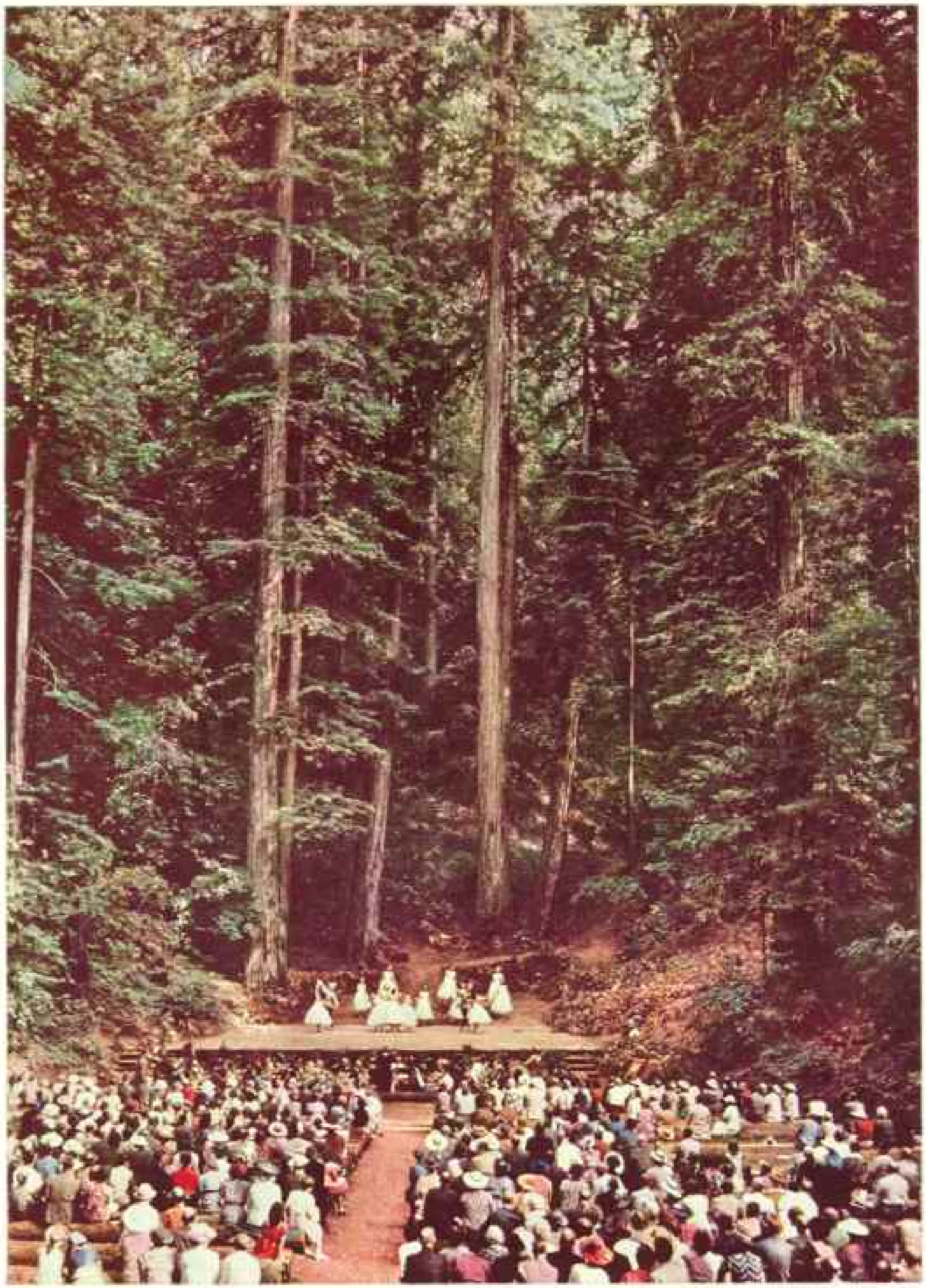
CRACKLES, THUNDEROUS CRASH, AND TWO 5-ROOM HOUSES ARE BORN

Foresters estimated 25,000 board feet of lumber in this fallen giant near Scotia, enough to shelter two families. Four people could sit comfortably around a bridge table on this stump.

 Dufaycolor Photograph by B. Anthony Stewart

HE MAKES LITTLE ANIMALS FROM BIG TREES

Major botanical mysteries of redwoods are the burls—protruding growths that sometimes weigh many tons. Crescent City craftsmen fashion California bears, salad bowls, statues, vases, even ash trays, since the burl, like all redwood, is hard to burn.



© National Geographic Society Dufaycolor Photograph by R. Anthony Stewart

THESE DANCERS HAVE "THE LOFTIEST BACKDROP IN THE WORLD"

At Armstrong Grove, near Guerneville, the Santa Rosa Symphony Orchestra accompanies the steps of the San Francisco Opera Ballet. This outdoor theater in the Russian River resort area seats 4,000 people and is the scene of plays, pageants, nature talks, and concerts almost nightly all summer long.

© National Geographic Society Autochrome Photograph by B. Anthony Stewart

EUREKA'S COURTHOUSE IS FRAMED BY PALMS AND RHODODENDRONS

The date palm was imported, as were panels of a Chinese temple for a lumber baron's mansion. A famous "prefabricated" store, brought in pieces from China, was set up again in the business center. The red ball on top of the Courthouse, lighted by night, is visible across Humboldt Bay and far out at sea.

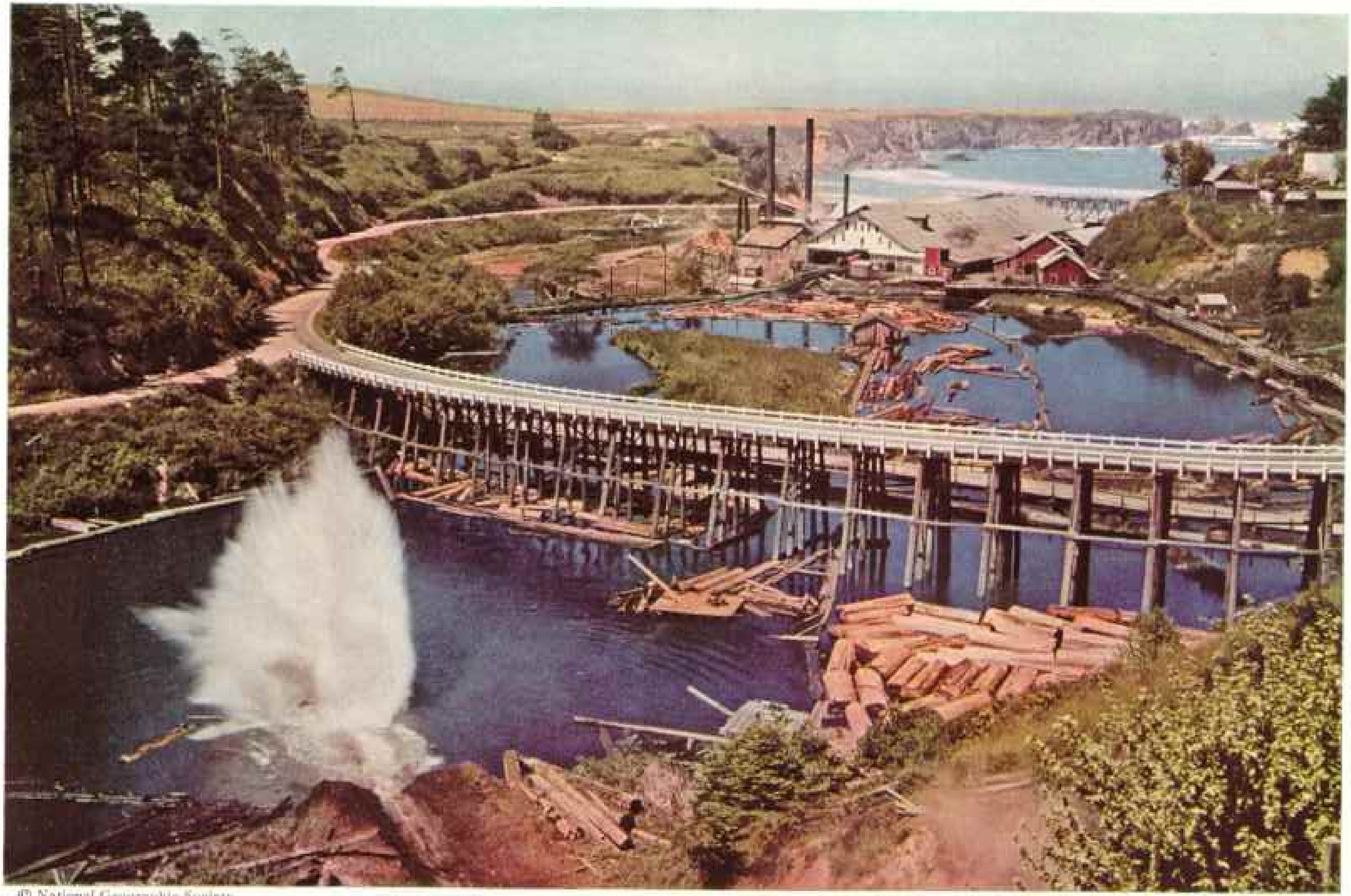
SONOMA ROUNDS UP THOSE WHO FORGET IT'S RODEO DAY

Citizens achieve much merriment — and publicity — by corralling those who won't "play ball." A newspaper editor at the extreme right needs little make-up other than his long coat to impersonate Lincoln.

Dufaycolor Photographs by B. Anthony Stewart

"FIRST EDITIONS" ROLL FROM AN INCUBATOR

This mechanical "setting hen" at Petaluma "mothers" 9,300 eggs at a time. Keeping even temperature and humidity, it turns the eggs regularly, and deposits the hatched chicks in a tray at intervals of three or four days.



Dufaycolor Photograph by B. Anthony Stewart

WITH ARROW SPEED A 20-TON LOG SHOOTS DOWN THE HILLSIDE AND CUSHIONS ITS LAST FALL WITH A RESOUNDING SPLASH

Men on rafts sometimes have to use a grapple iron and tackle to dislodge a monster, or its pieces, from the bottom of this millpond at Caspar. Here they are shoving the giants beneath the highway bridge. The logs are rolled off flat cars as they creep along the top of the 250-foot hill.

"BUTTON" TAKES TIME OFF FROM THE MOVIES FOR THE SONOMA RODEO

The pinto cow pony (left) was featured in "The Girl of the Golden West," along with his trick rider, Mrs. Montie Montana, wife of the owner. The white pony has the strain of the early western cayuse.

 Kodachrome Photographs by B. Anthony Stewart

"HURRY, OR YOU WILL LOSE HIM!"

The agile *razor* clam can bury itself beyond shovel reach by eight or ten movements in seven seconds. When you tap the surface with a spade, *Siliqua patula* betrays its presence by digging down, causing a slight pit in the wet sand. The variety is abundant here at the Little River's mouth, near the bold headlands of Trinidad (Plate III).

The builder had a sense of drama, for it was not until the dedication services, one Sunday in 1873, that he announced to the congregation that their commodious church was built entirely from a single redwood. After it was completed there was enough lumber left over to erect a five-room house near by.

WHEN FORD TOLD ABOUT HIS TRACTOR

At Santa Rosa I chatted long with the blind newspaper man, now State senator, who scooped the world with the story of Henry Ford's first low-priced tractor being ready to market.

For here Luther Burbank "invented" his plants, here he lies buried beneath a cedar of Lebanon, and here came the immortal cronies, Edison and Ford, for a visit with their friend.

As a compliment to Mr. Burbank's home town, Mr. Ford that day casually related to the reporter—those were the days before public relations' counsel with long mimeographed statements—the news that lifted the face of American agriculture.

Later an editor there showed me a clock for which an early settler traded several hundred acres of rich farm land in the early forties when the land flowed with milk and meat, fruits and wine, but mechanical devices were as rare as they are today in the heart of China.

Along the Redwood Highway, north and south of Santa Rosa, a predatory traveler might collect a table d'hôte dinner—fruit tramps have landed in police stations for trying it.

MAKINGS OF A TABLE D'HÔTE DINNER

We sped past a fruit-cup panorama of apple, peach, plum trees, and date palms, into a veritable salad bowl of potatoes, tomatoes, green vegetables, and vivid yellow mustard, while sheep and dairy cows roamed ranches that roll away across the hills in wavy patterns and changing colors.

Big fields disclosed row after row of small spheres that looked like discolored golf balls. They were onions, set out on top of the ground, later to be covered with the good earth. Cloverdale announces its citrus groves, away up here north of San Francisco, with a mammoth painted orange as big as Petaluma's roadside hen.

The imaginary meal may be accompanied by your choice of 22 wines made from the 16 kinds of grapes that grow in one vast vineyard—nearly 2,000 acres of grapes—of the Italian Swiss Colony at Asti.

There we paused to see the "Wine Barrel Church," a chapel with its roof shaped like the round containers that store raw wine which awaits bottling, and chatted with a veteran and vigorous winemaker from Italy's sunny vineyards.

"It's the red fingernails of American girls, and their stiff backs, that's wrong with this country," he told us. "They wear girdles, and stand up straight, until they can't bend their backs to work in the fields any more; and now they paint on nail polish so they can't wash dishes."

Around Sebastopol the Gravenstein is the major variety of nearly 15,000 acres of apple orchards. They ship out the apples, upwards of 2,000 carloads a season, and 40,000 tons more after drying. Fruit here also is raw material for industries such as making cider, vinegar, apple brandy, canning, and especially for apple pectin.

By the Aladdin's lamp of modern chemistry this "water jelly" may be contained in your toothpaste, ice cream, hand lotion, fruit sundae, fudge candy, and even in the cotton evening dress of your dancing partner, for it is used to stiffen cloth before burning off the fiber.

BUDDHIST TEMPLE AMID ORCHARDS

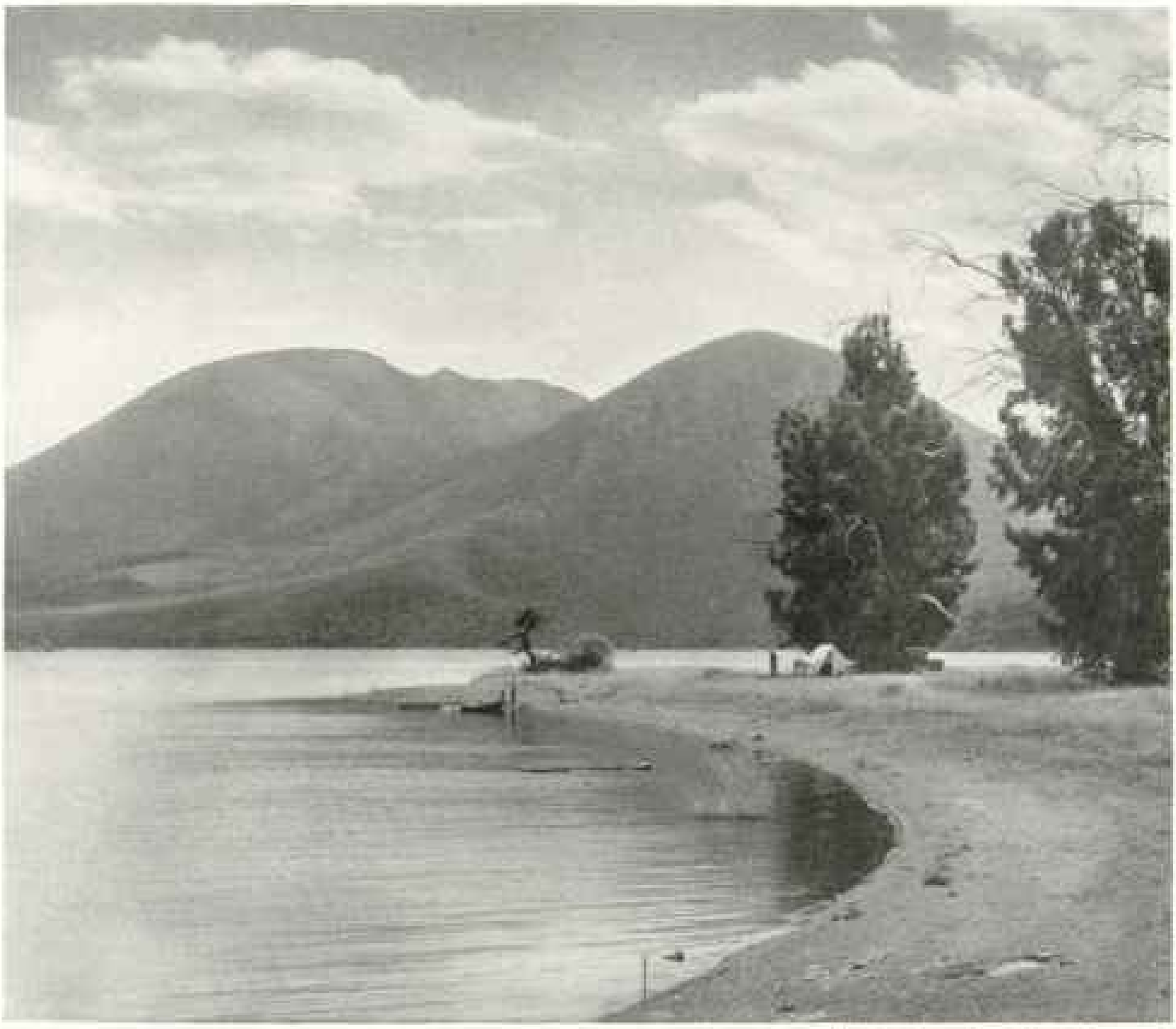
After hours among whirring "apple machinery," it was restful to sit in a richly carved Buddhist temple, a "knockdown" shipment from Tokyo to the Chicago World's Fair, and thence reshipped to Sebastopol and assembled again to remain as a permanent good-will gift in a grove of Japanese cherry trees.

It is easier now to drive westward through Guerneville to the fishing village of Jenner, where the Russian River sprawls out to meet the sea; one stretch of road which turned 47 times in three miles is being straightened. A heavy truck crunched along, piled high with bicycles for summer camps at places where only a few years ago hunters and fishermen engaged guides.

At Jenner-by-the-Sea we watched scores of men, women, and children scooping up surf fish with handnets. The talk is all about striped bass, salmon, and steelheads.*

"What do you year-round residents live on?" I asked an old-timer.

* See "Treasures of the Pacific," by Leonard P. Schultz, NATIONAL GEOGRAPHIC MAGAZINE, October, 1938, and page 185, this issue.



Photograph by B. Anthony Stewart

SCENES AND NAMES IN LAKE COUNTY SUGGEST SWITZERLAND

Clear Lake, with Lucerne nestling along its shore, is famed for its black bass, calico bass, fork-tailed catfish, yellow catfish, several kinds of perch, and many carp. In the background looms Mount Konokti, its sides dotted with vineyards and fruit orchards.

"On the sport fishermen, and we catch mussels and abalones. When the tide's out, mister, our tables are set."

DRAKE'S "NEW ENGLAND"

Thence north the coast road climbs dizzily up and down bold headlands that reminded Drake of the cliffs of Dover, so that he called this country "New Albion."

Only ten years ago parts of this coast virtually were cut off from the world. Then to travel along two miles of a roller-coaster dirt trail near Fort Ross they hitched two horses to a buggy or four horses to a wagon—and made it in 2½ hours.

Watering troughs hewn from redwood logs still are plentiful; ramps across the highway protect sheep that graze on steep hillsides. Valiant redwoods pick out pockets which meet their specialized requirements for moisture, shelter, and sunshine.

Fort Ross, once bonanza of sea-otter and fur-seal trade, now is a deserted village. The rectangular fort rides high on a lone plateau, a hundred feet above the pounding surf. Its restored chapel, with two mismated towers, double cross, and ornate altar, still is a landmark from land or sea. Two blockhouses and the dismantled officers' quarters remain; the redwood-picket palisade has been restored.

There is no other trace of the 59 buildings—homes, granaries, workshops, and huts for the Aleut fishermen—where bricks, barrels, and ropes were made, hides were tanned, and articles of iron and leather were fashioned for the flourishing, though forbidden, trade with the Spanish missions.

The rich furnishings, carpets, glass windows, carved chairs, even pianos, envy of the music-loving Spaniards, were dragged and floated here all the way from Moscow,

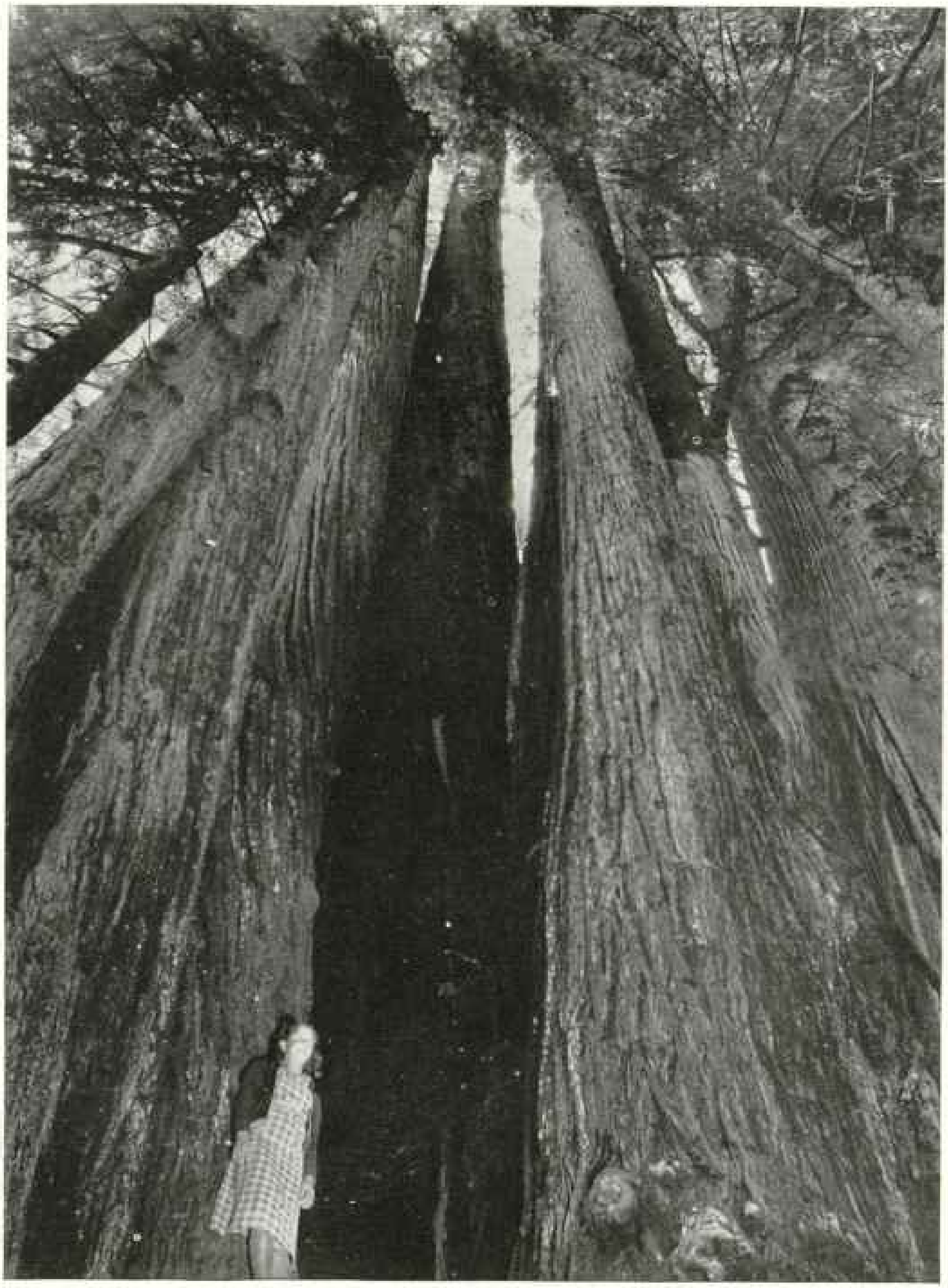
"PETALUMA LAYS FOR YOU!" SAYS A SECOND SIGN

One hatchery here has a capacity of 1,500,000 eggs. "That would make three acres of omelet," computed a chef. A single incubator in another hatchery handles 65,000, enough "frieds, sunny side up," to make a small building lot resemble a field of dandelions (Plate X and page 139).

Photographs by E. Anthony Stewart

A REGISTERED PHARMACIST FILLS PRESCRIPTIONS FOR CHICKENS

Farmers may believe it or not, but chickens do not get bronchitis; they contract laryngotracheitis. While this picture was being taken in the chicken pharmacy at Petaluma, the proprietor was treating, in the laboratory behind, case No. 950,442 with a vaccine propagated in New Jersey.



Photograph by B. Anthony Stewart

TREES GRAFT THEMSELVES TO FORM A "CATHEDRAL"

The giants, separate when young, have been crowded together by their growth until their bases have merged like Siamese twins (page 167). Sometimes a score or more rise in such formation. These specimens in Prairie Creek State Park are about 250 feet tall. A boy's face seems to be peering from the trunk at right.

Photograph by B. Anthony Stewart

THIS EDIFICE WAS BUILT FROM A SINGLE REDWOOD TREE

The sequoia that yielded 78,000 feet of lumber for Santa Rosa's First Baptist Church grew near Guerneville, in the Russian River resort region (page 148). Its stump, 18 feet across, is a shrine where the congregation holds memorial services annually.

across Siberia or Panama to Sitka, and reshipped in provision boats. They were bought, lock, stock, and barrel, by John A. Sutter when the Russians departed in 1841.

That pioneer California promoter and land speculator hauled his purchases by ox-carts and river sloops to Sacramento, where a few remnants—a threshing floor, heavy doors, and several cannon—are on exhibition at the Fort Sutter Museum.

HER EYELASHES HELPED MAKE HISTORY

A tender, tragic love story is entwined with the coming of the Russians to California, and the Monroe Doctrine is involved in their leaving.

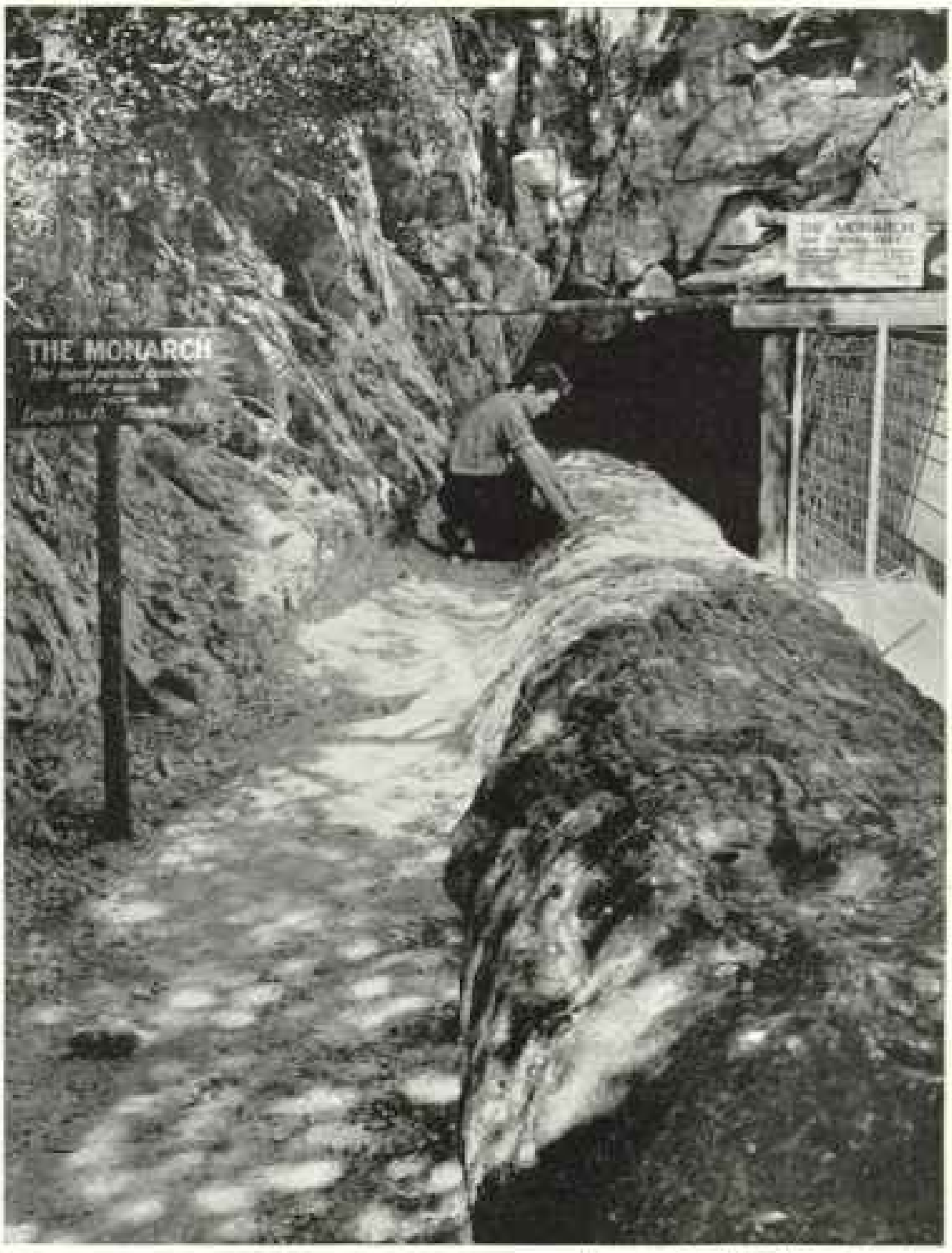
Tall, handsome Nikolai Petrovich Rezanov, chamberlain of the Tsar, arrived at Sitka, Alaska, in 1805 to find his countrymen there on the verge of starvation, barely kept alive by devilfish, crows, and scant hoarded rations. Promptly he bought a bark from a Yankee skipper and sailed down to San Francisco Bay for provisions. There he got supplies, but he was detained overlong by admiration of the sea otters, the fertile soil—and the daughter of the port commander.

Señorita Concepción Argüello had the jet-black hair and ivory skin of Castile, and eyelashes so long she wished to cut them off. A wise priest advised her, "My child, do not interfere with the works of God!"

Although the suitor was a Russian and a member of the Greek Church, Rezanov sailed with troth plighted to the beautiful Spanish girl. However, their parting was forever, because the tall Russian died on the steppes of his native land.

When Señorita Argüello ultimately had the sad news, she became a nun, and then mother superior, of the convent at Benicia. For her ministrations to the poor and patient teaching of the unlettered she became the first heroine of California history.

But Rezanov had not devoted his entire time to courtship. He wrote home about the riches in furs and the dependable sup-



Photograph by B. Anthony Stewart

THE GREAT STONE FACE OF A GIANT REDWOOD

Preserved in Nature's safe-deposit vault of lava from volcanic eruptions of uncounted millions of years ago, fine fossil specimens have been excavated in the Petrified Forest, near Calistoga. Some date back to an era when the tall trees ranged through North America, western Europe, and eastern Asia (page 180). The Monarch, though broken, preserves perfect form. It is 126 feet long and has a mean diameter of eight feet.

plies to be had in the Bay region. His glowing letters culminated in the sending of an expedition of Russians and a convoy of Kodiak Indians with sealskin canoes and kayaks to California.

From their settlement at Fort Ross and fishing base at Bodega Bay the Russians entered upon a fur trade of enormous profits and far-reaching political consequences. Boston skippers sailed around the Horn to bring down more Aleuts and kayaks from Sitka and take back thousands of skins to New England, Europe, and even China.

Year by year the Mexican governors of California grew more concerned.

But it was not the anxiety at Monterey or Mexico City that makes this noble promontory a shrine of American history. It was the apprehension at Washington, D. C., which resulted in formulating a national policy in 1823 which is potent in 1939.

A SHRINE OF THE MONROE DOCTRINE

We are accustomed to think of the Monroe Doctrine in its present-day application to Latin America. But it was the Russians who furnished President Monroe the immediate occasion for enunciating that "the American continents are henceforth not to be considered as subjects for future colonization by any European powers."

Even after the Russians departed, up to the close of the Civil War, sea otters were killed. Then they virtually disappeared.

Suddenly one day last summer a herd of more than a hundred was reported south of Monterey. That was headline news. Photographers came by plane and train to take their pictures; scientists arrived for the rare chance to study their odd habits. The State Fish and Game Commission rushed wardens to protect them (page 144).

"The otter ought to be on our State flag instead of the bear if they want to show a

mammal that made California history," remarked a historian who had brought his students to watch the mysterious creatures.

IF YOU DON'T LIKE THE CLIMATE, DRIVE ON HALF A MILE!

North of Fort Ross we drove along a veritable Corniche road, twisting around sheer headlands and dipping into ravinelike valleys with pocketed fog. Merino and Shropshire sheep grazed on tundra-like hillsides or huddled around brave, wind-blown trees.

We shivered the July day we halted at wind-swept Elk to view the enormous crescent of sheer cliffs and high tides churning white foam around snaggle-toothed rocks.

We sought welcome shelter and hot coffee in a village store and there saw a perspiring sheepherder mopping his brow.

"Give me a long, cold drink," he was saying. "It's too hot up in the hills to be chasing sheep around on a day like this."

"How far up?" we asked.

"About half a mile."

A hand-lettered sign advertised a town hall dance to begin "at dark."

"What time will it break up?"

"Oh, at daylight, except for the boys who have to get home to milk the cows. The rest of us will stay for breakfast."

Photograph by R. Anthony Stewart

REDWOODS BUILD THEIR OWN SHOWCASE FOR AN EXHIBIT

The apparent single stump attests the growing together of five seedlings which grafted as they increased in diameter (page 164). The young trees started on top the fallen redwood. Then their roots reached down like tentacles through and around the moist bark and decaying sapwood until they penetrated the ground. A shrub beside the man is a third growth atop the prolific pyramid. The fallen tree was more than a thousand years old when it toppled over. The upright trees were about 600 years old when they were cut.

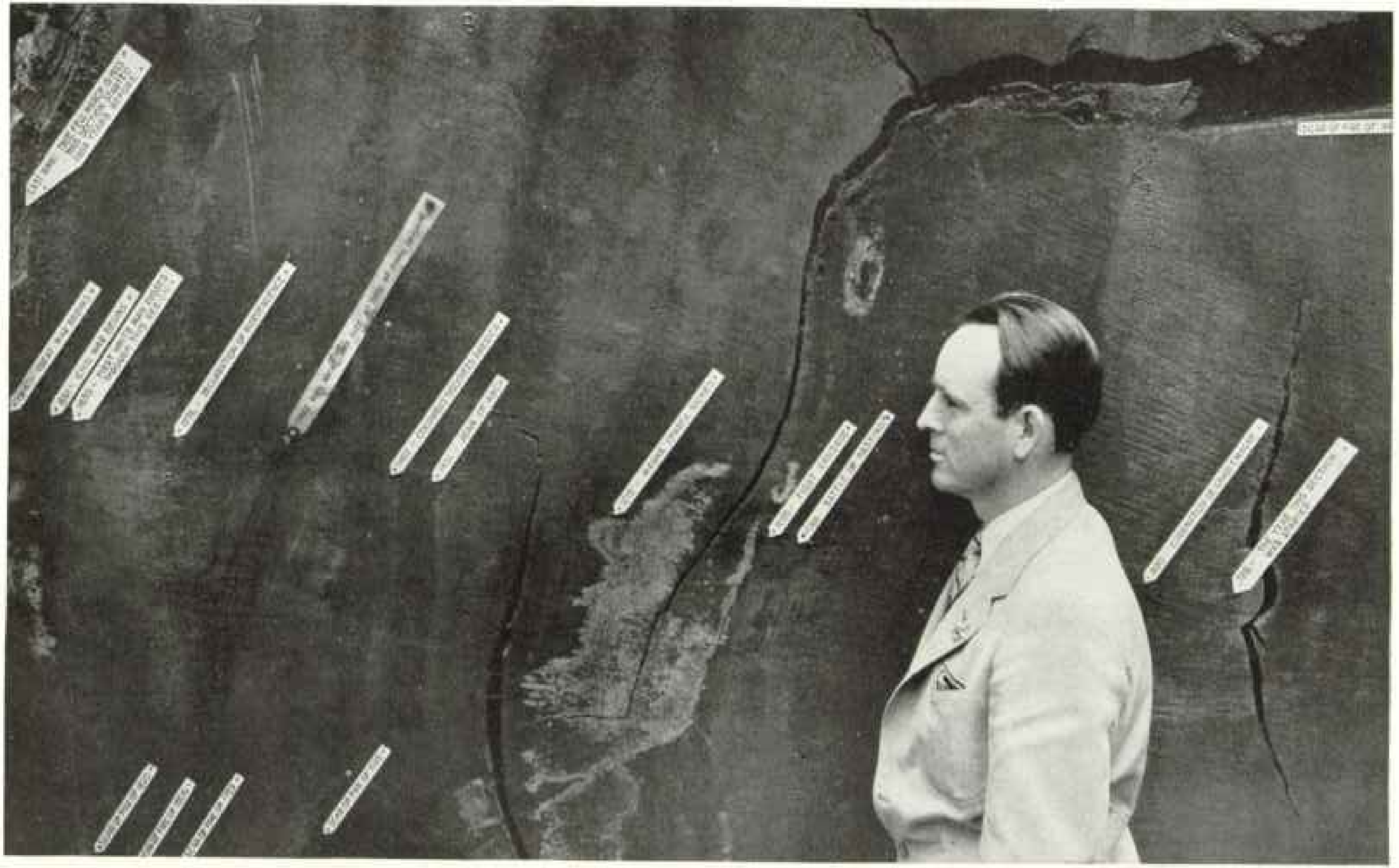
We were in spacious Mendocino County, half as large again as Delaware. Here the "Wild West" is untamed over wide areas.

A week before we had seen in a downtown San Francisco office building a State sign: "Lion Hunters Wanted. $110 a month plus bounties on pelts." Duties included "tracking, treeing, and shooting lions; training and caring for lion hunting dogs." The notice emphasized that the position was "open to men only." Apparently Mrs. Martin Johnson need not apply!

Photograph by R. Anthony Stewart

A FALLEN REDWOOD BECOMES A ROADSIDE UNIVERSITY

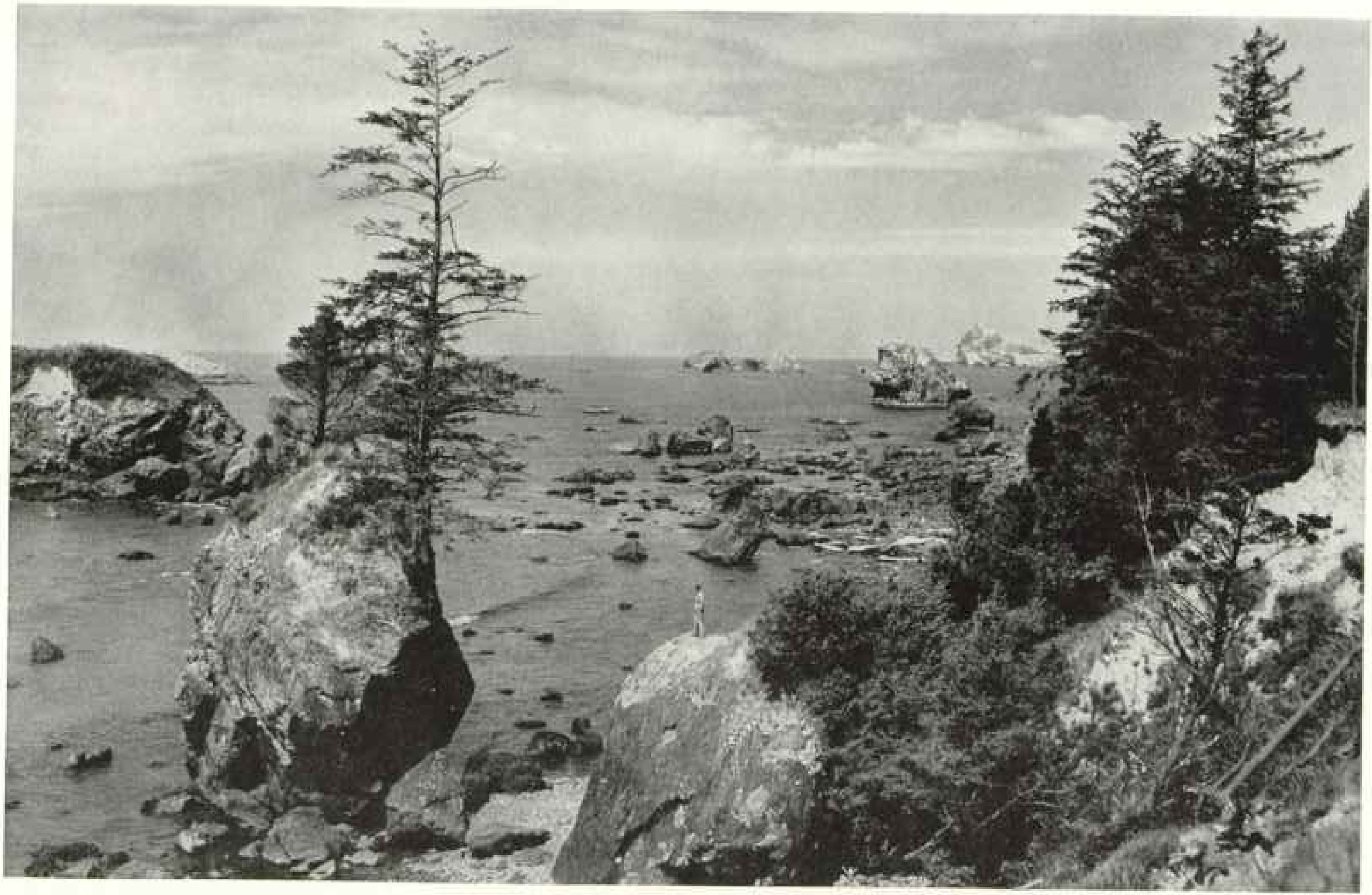
Daily in summer hundreds of visitors cluster about this Richardson Grove educational exhibit prepared by Professor Emanuel Fritz, of the University of California, for the Save-the-Redwoods League. The small markers (right) show how the tree developed new root systems at new ground levels after each of seven major floods. Few trees could survive the deposit of so much soil. The redwood has no taproot. On the sawed-off stump face is the calendar of events pictured on the opposite page.



Photograph by R. Anthony Stewart

A REDWOOD STUMP SPANS TWELVE CENTURIES OF HUMAN HISTORY

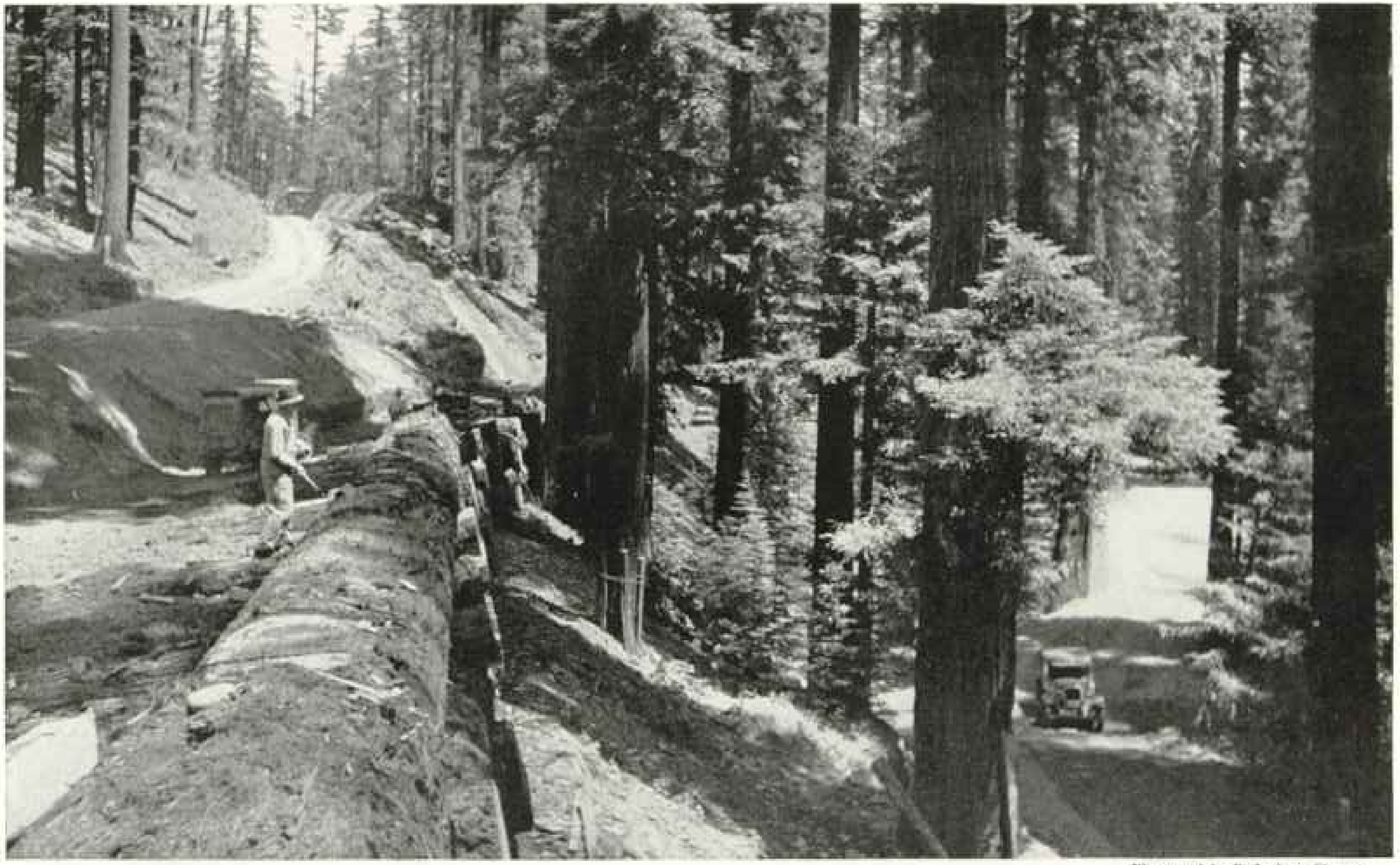
Big as the side of a bungalow is this cross section of a stump facing away from the root system shown on the opposite page. Because a tree adds yearly a new layer of wood outside the old it is possible to correlate events by counting the rings. This tree was 340 years old when William the Conqueror landed in England. It was mature when the Magna Charta was signed and venerable when American independence was declared. It fell in 1933. Some coast redwoods are more than 2,000 years old.



Photograph by B. Anthony Stewart

"SUDDENLY FROM AN ARCHED AVENUE OF THE GIANTS YOU DRIVE INTO DAYLIGHT AND THE RHYTHM OF POUNDING SURF"

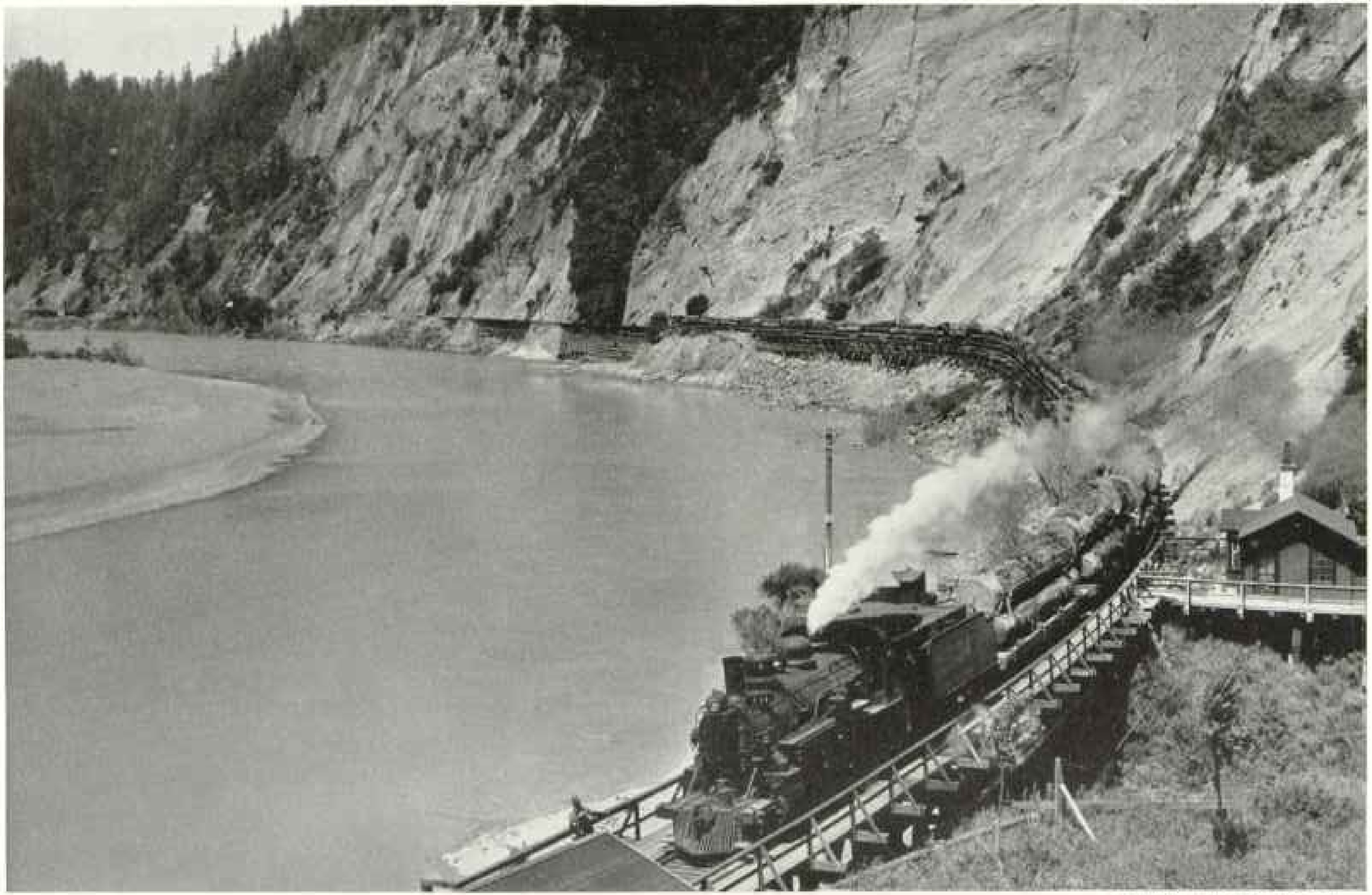
Stalwart Sitka spruces defy high winds and thrive in the salty moisture of the rocky headlands near Crescent City. This stretch of ocean long has been a mariners' nightmare. Sheep from enormous ranches all along the jagged coast yield a premium wool for Boston, where it is made into golf suits and sport clothes.



Photograph by H. Anthony Stewart

REDWOOD LOGS HELP BUILD THE REDWOOD HIGHWAY SO THAT VISITORS MAY SEE THE REDWOODS

Every precaution is taken to protect the trees while the wider and higher road is put through 30 miles north of Garberville. Split stakes form a "lagging" around the tree of largest girth to prevent abrasion from wire ropes. Redwood logs felled from the right-of-way make cribwork to hold earth fills along their namesake roadbed.



Photograph by R. Anthony Stewart

HERE COMES THE "LOGGER," AROUND A BEND OF THE TWISTING EEL RIVER

These logs are small; otherwise there would be only one 40-foot giant to each 40-foot flatcar. They are riding from the camp near Freshwater to the Scotia sawmills, 44 miles away (page 173). Rising beside the Northwestern Pacific's rails are fossil beds of shellfish from the time when all this area was ocean bottom.

Photograph by R. Anthony Stewart

AN 8-TON "SINKER BUTT" WRITHES AND BUCKS LIKE A JUNGLE ELEPHANT FIGHTING ITS CAPTORS

A gaunt loading boom lifts the "yarded" logs struggling from the pile and swings them over to flatcars for their last ride down the mountain to the sawmill (opposite page). The method of "clear-cutting," evident in the background, is rapidly being replaced by selective logging which leaves immature trees uniformly distributed over the area.

I looked up the chief of game conservation to ask where lions were still killed, and how many.

"Mostly in Humboldt and Mendocino Counties," he said. "In Humboldt 882 since 1907, and 506 in Mendocino."

Along this coast road were the only ghost towns I saw in California, relics not of departing, but of centralized lumber mills. They hark back to the days when there was a sawmill in every gulch for logs brought down the canyons on narrow-gauge railways to perilous shipping coves.

THE "RED GOLD RUSH"

A shipwreck started lumbering here. In 1851 a vessel laden with silk and tea was driven ashore and the party sent to salvage the freight took back word to San Francisco of the massive trees. Within a year a brig landed an engine and boiler from Norwich, Connecticut, and the "red gold rush" began. Before 1880 the settlement of Beaver alone had more than a score of mills.

Fort Bragg now is the coastal nucleus of the spiderweb of rails over which long trains of flatcars screech and grind downgrade with ponderous piles of logs (p. 172).

The mill of the Union Lumber Company, founded 52 years ago, spreads over 740 acres, and employs 1,200 workers.

At the mill we watched the train move slowly beside the "dump" at the millpond. An agile young man pushed off the cumbersome logs with a "gill poke," a swinging boom like that of a sailing ship.

"Pond men" wearing sharp-calked boots scrambled about on acres of floating logs, pushing some toward the "haul-up," a trough with an endless-chain belt that takes the peeled forest monarchs to the sawing floor (Plate XI).

Up goes the log, rebelling and seemingly struggling to outwit its captors, to the log deck. Once there, the trapped giant's fate is as sure as that of a Thanksgiving turkey.

TONE POEM OF A SAWMILL

The composer who wrote "A Day in an Iron Foundry" should do something with the strident hum of a redwood mill—like the strumming of myriad bass viols amplified to a deafening roar, and kettledrum thuds as logs are dropped and turned.

"What will become of the pieces they are cutting now?" I yelled above the din.

"Depending on size and quality: barns, coffin boxes, doll houses, soda bars, bridges, camping cabins, office walls, cigar boxes," he shouted back, like a train caller.

Tropical countries buy redwood heavily for railroad ties, telephone poles, and even houses, because the wood resists termites.

"How long here from pond to pile?"

"The time varies, of course, but it averages about an hour."

North of Fort Bragg the landscape becomes almost vertical and your neck tires looking at it, as in gazing at New York skyscrapers. In places the road is a safe but serpentine ledge carved along the mountains that plunge down to the ocean.

Signs warn "men and equipment working." State Highway cars shuttle back and forth over single-file stretches with convoys of autos behind. Here, as elsewhere, we marveled at the engineering wonder of building and maintaining the roads of the redwood realm. Along this coast and north of Eureka where the Redwood Highway itself curves down to the ocean's edge, slipouts and slides keep men and machines always working in rainy weather.

Sometimes the restless rocks and fluid soil of the geologically young area, which still is settling, slide down and bury stretches of highway. After the 18-day rains of February, 1938, sections of new road washed out to sea. Storm damage last winter on the Redwood Highway alone was $948,517.

KEEPING THE ROADS OPEN

Highways are the lifelines of many Redwood Empire places.

Days later I sat in the office of the Director of Public Works at Sacramento where telephone, wire, and radio reports were charted instantly, so this general of the roads could marshal his army of maintenance men.

Acres of warehouses and huge laboratories revealed the complicated machinery and constant testing necessary to keep up the smooth roads the modern motorist takes for granted.

Special stripe-markers, paint tanks, crack fillers, sand spreaders, and oiling trailers were devised in these shops and, here in California, they were repairing dozens of snowplows and slide bars to slope high snowdrifts!

In the laboratories mechanical tampers were pounding away to pack material at its consistency when laid. Like a movie studio were arc lights to simulate blazing sun and create "artificial weather"—rain, heat, and

cold—applied to road-building samples.

In the "fog room" specimens have been kept ten years or more to await cracking or crumbling. Pressure machines were driving down 250,000 pounds of weight to find the breaking point of concrete. Drillers bring in boxes of soil for study taken as far down as 700 feet below the road surface.

Test tubes were trying out samples of oils, sand, soap, paint, stone, latex, cloth, steel, and more than a hundred other commodities bought for road work and workers.

BULBS AND LATITUDE

After our cross-country visit to Sacramento we returned to the Redwood Highway at Santa Rosa, where we had left it to follow the coast road to Rockport.

Speeding north again we halted at Ukiah, peaceful shopping and resort center of Mendocino County, seemingly far from the swift pace of modern living. Yet here we found an astronomical observatory that links up with stations of like latitude around the world, and a bulb grower who ships rare specimens to England, India, Japan, British East Africa, Australia, Italy, and even to the Netherlands!

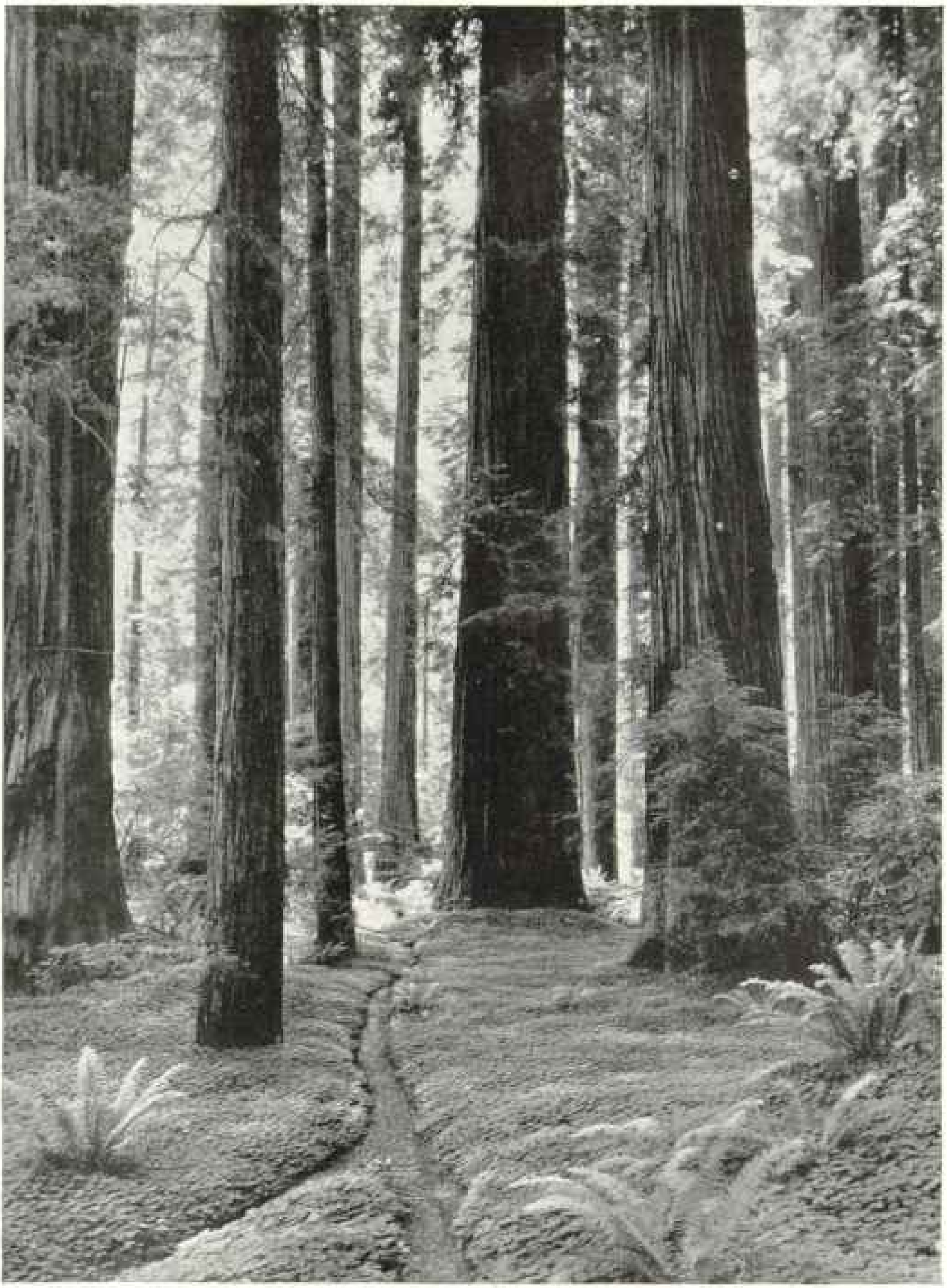
"The stargazer of Ukiah" they call the lone astronomer whose life work for 17 years has been nightly to detect variations of the axis of the earth in relation to the stars. This station of the U. S. Coast and Geodetic Survey compares its observations with those of four similar stations at Mizusawa, Japan; Kitab, Turkistan; Gaithersburg, Maryland, and Carloforte, Italy—all near latitude 39° 8′ north (page 142).

Carl Purdy came out here in 1873 to fill an eastern seedman's order for 50 bulbs. He remained; and in one year has shipped

Photograph by B. Anthony Stewart

STARRY-EYED "FLOWERS" OF THE CALIFORNIA DOGWOOD OFTEN REACH THE SIZE OF A SAUCER

Blooms as big as six inches across spread their creamy whiteness against the dark green of redwood groves. Though the tree resembles the flowering dogwood of the East, it is generally smaller, the blossoms larger, and there are six "petals" instead of four. Brilliant red are clusters of fruits which appear after the petal-like bracts drop off. Strangely, its scientific name, *Cornus nuttallii*, honoring botanist Nuttall, was bestowed by an ornithologist, John James Audubon.



Photograph by Gabriel Moulin for Redwood Empire Association

REDWOOD FAMILIES—PARENTS, OLDER CHILDREN, AND INFANTS—GROW HAPPILY HERE

Carpets of the tall trees' home in Pepperwood Flat, as elsewhere, change with the centuries. Just now oxalis is the predominating floor covering, with sword ferns adding to the decoration. Botanists believe the oxalis is a temporary stage in plant succession, perhaps following fire, and that it will gradually be replaced by other plants until eventually this tract may become a jungle of young trees.

75,000 bulbs of that one kind, in addition to hundreds of other varieties. Mr. Purdy showed us orders for rare plants that have been in his files for many years.

"Oh, yes, I'll fill them; it may be next year, or ten years more, though, before I find what they want," he told us.

"Some of my shipments go as far afield as copies of the NATIONAL GEOGRAPHIC MAGAZINE. For several years I shipped growing perennials to the wife of a British factor for Chinese customs on the Tibetan border. The parcels took two months to get there; for the last 400 miles they were carried on the heads of Chinese bearers. They arrived in good condition."

THE AVENUE OF THE GIANTS

North of Willits the Redwood Highway begins to justify its name by plunging into the heart of redwood forests. As we drove along this literal avenue of giants, shaded and twilit beneath the midday sun, my memory harked back to twenty years ago when I visited a famous Iowa editor at Des Moines.

Above his cluttered desk, there in the Corn Belt, was a framed copy of the photograph, "The Oldest Living Thing," published as a supplement to the NATIONAL GEOGRAPHIC MAGAZINE of April, 1916.

"Why?" I inquired. "Are you a native of California?"

"Never even been there," he replied. "I keep that to show people who are in too much of a hurry to change the world over. They all come here—teachers, politicians, preachers, reformers—wanting this and that done right away. I point to that picture and tell them it takes time for things to grow."

The tree portrayed over the editor's desk was a *Sequoia gigantea*, "big tree" of the variety which grows in isolated groves at altitudes above 4,500 feet on the western slopes of the Sierra Nevada Mountains (map, pages 138-9). The most magnificent stand of this species is the Giant Forest of Sequoia National Park, which members of the National Geographic Society helped save by contributing some $100,000 toward the purchase of the precious tract.*

The trees we were driving through have a much more extensive habitat along 450 miles of the coast belt, and were the *Sequoia sempervirens*, or "coast redwoods."

Both kinds are sequoias, both are redwoods, both are "big" and "old" and very similar. Hence there is much confusion about them.

"What are the differences between the two?" I asked an expert.

"For one thing, the coast redwood lives in a mild climate and matures its cone and the enclosed seed in one year, while the Sierra redwood, in a region of severe winters and heavy snows, takes two years.

"Apparent to the observant layman are other differences. The coast trees have tough bark, spraylike foliage with needles about three-quarters of an inch long ranked on both sides of the stem, and they are taller. The mountain trees have soft bark; short, sharp needles distributed all around the twig, and the trunks are larger in diameter.

"Everywhere you see coast redwoods sprouting from roots, trunks, even from stumps. The *gigantea* does not sprout."

"What questions do they ask you most?" I inquired of a forester.

"The biggest, the tallest, the oldest."

"And the answers?"

"Here are two, all typed out." I read:

"World's tallest tree, the Founder's Tree, in Dyerville Flat, Humboldt County, 364 feet high. A coast redwood (*Sequoia sempervirens*). World's most massive tree, Sherman Tree, in Giant Forest, Tulare County, 37.4 feet in diameter. A 'big tree' (*Sequoia gigantea*)."

TREES OLDER THAN CHRISTMAS

There are many fantastic tales about the age of redwoods. Despite the name *sempervirens*, they do not live forever. But some are more than 2,000 years old. One specimen scientifically measured was a redwood felled within a mile of Dyerville. Its ring count showed a life span back to 266 B. C.

That night as the winds whined through the lofty branches of these patriarchs among all living things, I leafed through a history.

The fallen giant was a sapling when Julius Caesar set foot on the British Isles; it had reached maturity when William the Conqueror arrived, and, in butterfly human reckoning, was a graybeard when Columbus discovered a new hemisphere.

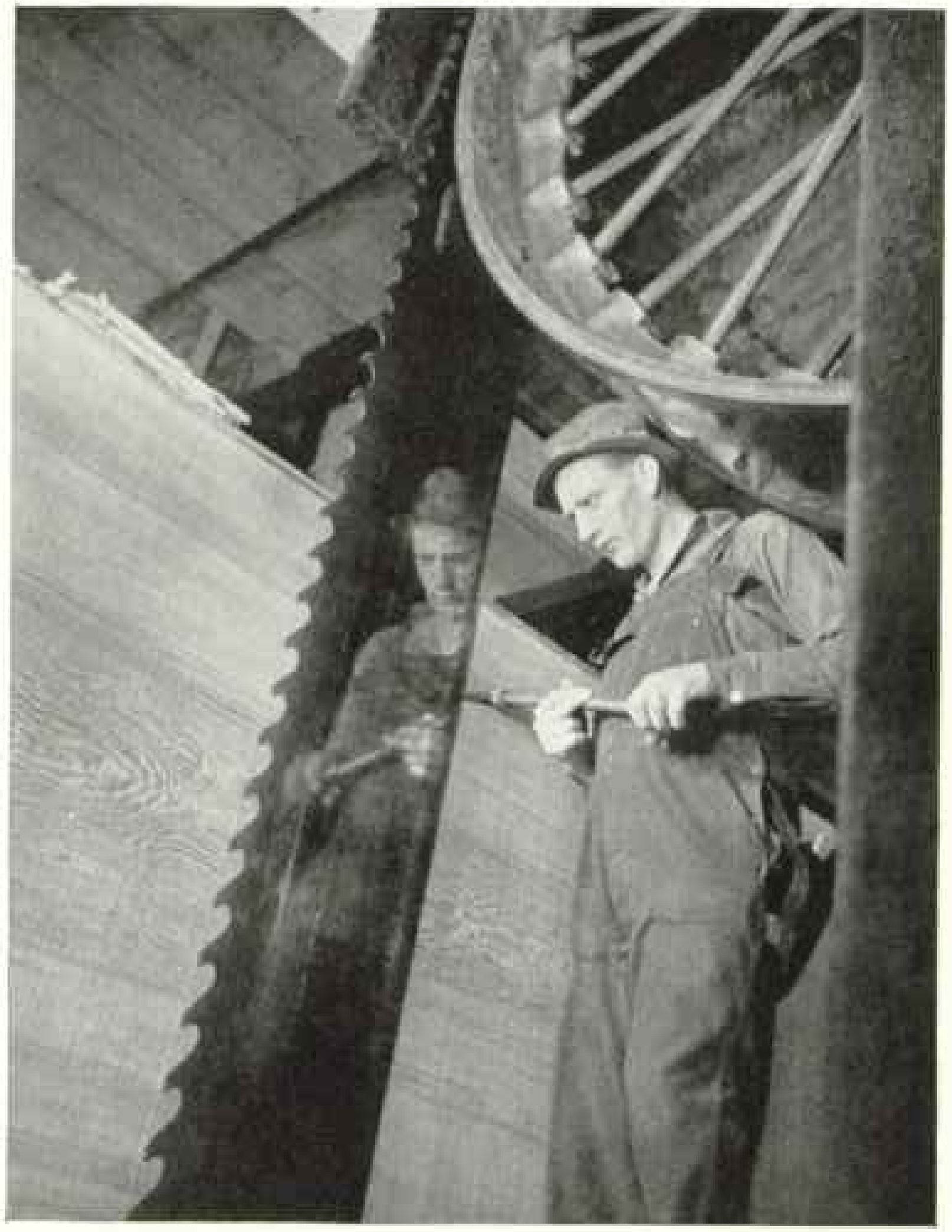
"What a story if you could interview that piece of timber!" exclaimed a newspaper friend. "Ask it whether Helen of Troy really was worth it all, and if Cleopatra was still pretty when she went barging down the Nile. Get some real background on the

* See "Among the Big Trees of California," by John R. White, NATIONAL GEOGRAPHIC MAGAZINE, August, 1934.

Photograph by B. Anthony Stewart

TWO HOUSES THAT REDWOOD BUILT, AND LUMBER TO ERECT MANY MORE

The castlelike home is a showplace of woodworkers' skill. Each of the large rooms is finished with a different wood. Panels once decorated the walls of a Chinese temple in Peiping. The interior of the home to the right is equally amazing for its interior walls of redwood burl of many fantastic designs. Members of the pioneer Carson family here in Eureka still occupy the "Castle." Layers of lumber piled for drying are separated from other layers by "stickers" to give ventilation.



DINOSAUR STEEL TEETH SPEED TWO MILES A MINUTE

The mirrorlike band saw in a Scotia mill is 65 feet long and 16 inches wide. The "molars," one and a quarter inches deep, are set three inches apart. They are changed every three hours to keep their keen edge. The workman waits to raise the tail of the plank which will be sliced off on the log's return trip.

Photographs by R. Anthony Stewart

90 MILES, 12 HOURS, $10

"First thing I did after a trip was pick up dozens of women's hairpins," recalled the former driver of this stagecoach. "The road was rough; how we banged, bumped, and bruised those passengers!" Leather straps tie the rugged framework to enormous springs and high axles (page 183).

Photograph by Charles Martin

LIKE A CHILD TO SEE THE PASSING PARADE, A SITKA SPRUCE PERCHES ON A REDWOOD STUMP

From the air about it and ample moisture in the decayed stump center the tree on a pedestal "drinks" heavily. But its roots strike down to Mother Earth for the miscellaneous minerals taken in with the water. From sunshine, air, and water is fabricated 99 per cent of all conifers, even the mightiest redwood. Burn a tree and a pailful of ashes represents the only solids in its make-up. The sun's rays provide power for its food factory, the leaves. Famed Charles F. Kettering annually makes Antioch College (Ohio) a substantial grant to carry out his laconic instruction, "Find out why a tree's leaves are green."

Chinese situation, if it had first-hand news of Marco Polo. It ought to remember the wild doings when the Vandals sacked Rome. It was around 725 years old then."

THE SEQUOIAS' FAMILY TREE

And, in serious vein, "Think of anything being alive from the time Jesus went up to the Temple at Jerusalem until Godfrey captured the city in 1099 and General Allenby entered it during the World War!"

"All that's a late afternoon extra in the tribe of the sequoias," retorted a geologist. "If you are hunting real history, look up the sequoias' ancestry."

With his help I did.

The sequoias' family tree, recorded in rocks by impressions of leaves and cones, and preserved even more legibly by pieces of petrified trunks, runs back some 140 million years when grotesque dinosaurs roamed an earth no human eye of today would recognize.

Queer plants with enormous leaves which grew then are mostly extinct. Continents had far different shapes from their present forms. Even our mightiest mountains had not elevated their seemingly timeless masses. The Himalayas, the Andes, the Alps, and the Rockies are newcomers compared with the early redwoods.

Long after mammals had inherited the earth, and before man came, the sequoias defied changes in terrain and climate. They spread their eerie forests over western Europe, eastern Asia, and North America. Mammoth reptiles with armored backs and spiny tails, and horned, hairy mammals lunged through fabulous ferns of redwood

forests over the dank sites of Stockholm, Paris, and Rome.

Only great ice sheets that crept down over the Northern Hemisphere and made them white worlds such as Greenland remains today could mow down the redwoods. The European trees could not migrate across the Mediterranean and Near Eastern seas, so they disappeared from what we now call the Old World.

WHEN REDWOODS "ROAMED" AMERICA

In North America they were pushed south. When the last ice age receded, hardships of their migration back north extinguished all but the two species surviving today in northern California and one county of southern Oregon.

In Humboldt County the Redwood Highway winds through cool lanes of even denser redwoods, sometimes unbroken for stretches of 30 miles. Shafts of subdued light ricochet through lofty branches and form figures like those of your schoolbook geometry. A "peace that passeth understanding" descends even upon the motorist, who cannot speed if he would because wise roadmakers have twisted and curved the highway to avoid stately groves.

"Why do these trees live so long?" I asked a forester.

"Redwoods are immune to any killing fungus of consequence," he said. "Their durable heartwood resists rot; their thick bark resists fire, and cushions the tree against abrasion.

"The redwood's three worst enemies are man, storm, and itself, when it gets top-heavy. And have you ever seen two trees fighting? You can hear them far away on windy nights, growling like wild animals as they rub and grind together, tearing each other's thick hide, or bark."

While the redwood resists fire, it is not fireproof. A park superintendent tells of one that kept burning for four months. Signs warn, "One tree can make a million matches, but one match can destroy a million trees."

One night we drove head on into the sight of a lifetime, a redwood forest fire. Trees 200 feet tall were pillars of flame. Lofty tongues of fire crackled like machine-gun shots. We climbed a hill and saw scores of acres of flames flaring up into the smoke-blackened sky.

A few days later we drove back that way. Underbrush was charred, bark of the trees was singed, but not a redwood had fallen.

Traces of worse fires of a hundred, five hundred, even a thousand years ago, we saw later at a lumber camp. For new wood enfolds the burns, the tree lives on, and the sawmill suffers from the imperfection when finally it is cut down.

Everywhere you see examples of the redwoods' amazing vitality. At Scotia they built a bank with redwood pillars, the bark left on. For months they had to keep clipping off the sprouts from the First National's Grecian redwood columns.

Along Elk River we counted eight trees growing from a redwood log. They were limbs, technically, but tall and straight as an elm or spruce. One man runs a busy gift shop in a hollow, living tree; once they raided a still in another, and from a third chased out eleven men in a poker game.

Native sons point out old homesteads of early settlers in trunks of trees. Pioneers lived in hollow trees until they built redwood cabins.

From landscaped Benbow, north through forest-girt Dyerville, immaculate Fortuna, and toward Eureka, the Redwood Highway winds through a series of State parks and skirts the cascading waters of the Eel River.

TREES FOR POSTERITY

"The biggest real estate man in California," they call the secretary of the Save-the-Redwoods League, through the efforts of which some 30,000 acres north of San Francisco, costing about $6,000,000, already have been acquired for State Parks.

Bull Creek Flat has the heaviest stand of redwood timber in the world. Sometimes there are fifty or more giants to the acre, which could yield a million board feet. One tree north of here would build 22 bungalows.

You can hike for days through vast Prairie Creek State Park, and forget doorbells, war rumors, newspapers, ticker tape, and radio news flashes.

Inevitably you succumb to the spell of peace, serenity, timelessness. Botanists have counted more than 800 kinds of flowers here, nearly 500 kinds of mushrooms, and some of the 14 species of ferns grow taller than a 6-foot man.

"You even have to climb 150 feet to pick our huckleberries," says the park superintendent, with a straight face. Then he takes visitors to redwoods where berries grow on bushes in lofty crotches of tall trees.

At Scotia we drove out of the forest, plumb into acres of lumber piled to dry or ship. Hotel, church, movie theater, hospital, bank, homes—all are built of redwood in this neat lumbering city.

Behind his redwood desk the president of the big company talked with poetic fervor about his favorite trees, the need for selective logging, the wisdom of not cutting trees along the highway. The days of ruthless logging are about over; conservationist and mill owner discuss whether timber stands are worth more as scenery or board feet.

The Pacific Lumber Company owns ten locomotives and 336 logging and lumber cars, all standard equipment, to haul logs down from the mountains over 50 miles of private railway lines to its huge electrically operated mills here at spotless Scotia. The log pond is really a small lake, covering 31 acres. Electric cranes shuttle over more than six miles of track in the yards.

THEN CAME THE DANES

From Scotia's screeching saws and clattering cranes you come suddenly upon a level, peaceful land of orchards and berries around Fortuna, where local pride decrees a flower garden for every home.

West of Fortuna lies Ferndale, a dairy city which illustrates again the diverse nationalities that settled northern California's coast. When Prussia seized Schleswig-Holstein in 1864, a colony of Danes fled to Canada, then migrated to Michigan, and later to the hills of Humboldt County. They were shunted down to the narrow valley where "nothing could grow." The diligent Danes soon carpeted the fields with clover, and today operate huge dairy farms with Portuguese and Italian labor.

The telephone book is mostly Rasmussens, Hansens, Pedersens, Jørgensens, and other Danish names. A clothier's daughter was wearing Jansen earrings, and homes have memorable pieces of Copenhagen china. If you are invited to dinner there you will be served with *rødgrød*, fruit juice and starch pudding; *kødboller*, meat balls; fluffy *aebleskiver*, apple pancakes baked in special pans, or, for a light lunch, *smørrebrød*, an assortment of open-faced sandwiches, geometrically overlaid with smoked fish or pickled meats.

Approaching Eureka, flat meadows reach out to Humboldt Bay. We saw seagulls following tractor plows along the furrows in the fog-drenched fields. Eureka is an amazingly modern city, up here where the redwood belt dips down to the sea, with many traces of pioneer days (Plate IX).

WHERE CHROMIUM MEETS LOG CABIN

In a business block is a once-luxurious theater, with faded velvets and brocaded tapestries, where famous opera stars and players were brought from Broadway, via Panama and San Francisco, at the behest of lumber barons.

From Eureka to Crescent City the Redwood Highway becomes a 90-mile shoreline drive, running in and out of trees to skirt steep headlands and cross spacious lagoons on redwood trestles. Famed for scenery, as well as for the fishing described elsewhere in this issue by Leonard P. Schultz, is the Klamath region, where Indians still live on a steep promontory overlooking the long rows of windbreaks for fishing camps and treacherous sandbars of the river's mouth.

Here, at the southern limit of the Port Orford cedars, they make battery separators and Venetian blinds. But the chief industries of Klamath center about sport fishing—factories that can the fish you catch, and stores with window displays of spoons and spinners in all the bright shapes and colors of women's costume earrings.

Suddenly from an arched avenue of the giants you drive into daylight and the rhythm of pounding surf; ahead lies the half-moon harbor of aptly named Crescent City. Men came here in the fifties to establish a trading post for the gold-mining camps across the mountains.

APPLE PIE, $1 PER SLICE

For years the only communication with San Francisco was by boat. The passenger cabin rate was $40; the "steerage" fare was $20. It cost $3 to shoe a mule's front feet; restaurants charged $1 for a piece of apple pie. Once goods worth $10,000 were unloaded and bought "cash-and-carry" direct from the beach.

Pack trains of 50 or 60 mules, led by a bell mare, meandered through mountain passes to carry supplies to the camps. Under a canvas canopy the beasts with blinders were loaded by packers—Indians, Chinese, Mexicans, and various crossbreeds. Their profane babel mingled with the braying of the mules they called "Hunkin Joe," "Squaw She Ann," and less delicate names. They lashed to the animals kegs of nails

and beer, hay, flour, smoked meats, even circular saws six feet in diameter.

Let map makers do what they will, the expressive old names for streams on the mule-pack trails still are used here: Ragged Bottom Creek, Hardscrabble Creek, Jumping Joe River, Rowdy Creek; and Mad River is the official commemoration of a controversy among early explorers.

"Unspoiled by abstract terms, the Indians' language still is poetic," remarked a merchant. "They call my desk lamp 'campfire on the table.' When I explained about a telephone line to one, he replied, 'I see. Long string for talk.' Another asked, 'You grow grapes. You eat 'em or you drink 'em?'"

Photograph by B. Anthony Stewart

A TON OR SO OF RAW MATERIAL FOR MYRIAD SOUVENIRS

Botanists define a burl but cannot fully explain it (Plate VII). The growth is a compact mass of stunted buds. If any one had "grown up" it would be a branch of the tree. Thousands form the protuberance. Such masses arise from a division and redivision of a single bud originating in the center of the tree.

Still living in Crescent City is a veteran stagecoach driver of the time when it was a day's journey over the 90 miles to Grants Pass, now the terminus of the Redwood Highway (page 179).

"On Saturday nights at Waldo two fiddlers sat on sugar barrels, and passengers flung silver dollars in their hats," he recalled.

"Horace Gasquet, who was a cook on Hardscrabble Creek, started the town of Gasquet when he planted a vineyard, made his own wine, opened a saloon, then a store, and finally a hotel.

"He furnished little stepladders to help passengers to climb into his high beds. Rooms were heated with pans of coal.

"One time the store was short of gum boots. The first lot came, all number sixes for the left foot. Then another bunch arrived, all nines, for the right foot. After three weeks the miners got tired waiting and wore the sixes on one foot and the nines on the other.

"The first auto stage ran in 1907. The roads were so wet we always had chains on all four wheels. Sometimes we wore out two tires on a run. The tires cost $65 apiece, and the first summer we paid out $1,950 for tires alone."

Photograph from Golden Gate International Exposition

WITHIN THE COURT OF THE MOON IS A "MILLION DOLLAR MOUNTAIN"

Visitors to the Golden Gate International Exposition enter the Mines, Metals, and Machinery Building through a "valley" between miniature ranges set up to portray all phases of western mining. Tunnels and shafts; railroads, elevators, and mills; gold dredges and hydraulic nozzles; even a mining town of gold-rush days will be reproduced in small-scale detail. This south entrance re-creates a Persian garden temple. The concave surface will enhance the night illumination (pages 133-4).

Out on a farm near Smith River we drove past a sign which said, "Watch out for the cows and children," and had Sunday dinner with "Aunt Mary," the gentle, gray-haired little lady who used to have food and hot coffee ready for the stagecoach passengers when they stopped over at Gasquet's about two o'clock in the morning. Three of her brothers carried the mail between Crescent City and Grants Pass. For days at a time in winter they had to go on snowshoes.

"She has never turned away a hungry man or a stray dog," a friend told us, and we could well believe it, after making our way through barking pointers, setters, deer dogs, bear dogs, and hound dogs.

Her modest home is a veritable museum, with old mustache cups, "sadirons" weighing eight or ten pounds, Seth Thomas clocks, hand-painted oil lamps, and quaint samplers.

As we drove away we crossed the concrete bridge over Smith River and paused to read the bronze plate in honor of her cooking and her kindness:

Dedicated to
Mary Adams Peacock
A Pioneer
Presented by the Women's Club of
Crescent City, 1952.

We recalled that, toward the southern end of the redwood belt, a convent memorializes the beautiful maiden with the long eyelashes who became a mother superior and lady bountiful of the mission period (page 165). Perhaps it is fitting that up north, in the country of the gold rush, which has been called "the greatest stag party in history," the heroine of mining-camp days should be a cook.

FISHING IN PACIFIC COAST STREAMS

By Leonard P. Schultz

Curator of Fishes, United States National Museum

MY EARLY fishing experience was confined to sitting on a railroad bridge and coaxing sunfish, rock bass, and catfish to take a hook baited with angleworms, or going with my father to a lake and angling from a boat for bluegills and yellow perch in southern Michigan. Now, after summers in Glacier and Yellowstone National Parks, and several years on the Pacific coast, I am converted into an enthusiastic fly fisherman.

Unlike many fishermen, I did not limit my interests to the trout, but sought all the other species of fresh-water fishes that occur in western North America. A few of these are discussed in this article.

NO FUR ON FISHES

In Glacier National Park I did not find the celebrated fur-clad trout that old-timers describe to gullible tenderfeet. Fish do not grow fur, despite the rumors; they are, however, provided with scales, spines, plates, naked skin, and prickles. Some, such as catfishes and sturgeon, have "whiskers," but these are long fleshy barbels, without the slightest resemblance to a hair.

When trout have not responded to artificial lures, I have searched the submerged rocks, logs, and vegetation for natural fish foods. The tiny clams that live in the mud or sand bottoms of lakes and streams are not readily taken by trout. However, crustaceans, such as the fresh-water shrimp, amphipods, and crayfish, as well as aquatic insect nymphs or larvae of stone flies, May flies, caddis flies, and worms, make excellent bait. Land insects, especially grasshoppers, are attractive, too, causing trout to strike when they refuse artificial bait.

The salmon and trout of western North America, family Salmonidae, are of the greatest interest to sportsmen, fishermen, and scientists, not only for their recreational and economic value, but for their grace, beauty, and absorbing life stories. To maintain the supply of these species, the several States and the United States Bureau of Fisheries artificially propagate each year many millions and distribute the eggs, fry, and young fish to the streams and lakes, in some cases dropping them from airplanes (page 212).

In addition to this restocking, some streams in western national forests and parks have been improved by the establishment of environments attractive to trout. Covers or shelters have been built, and current deflectors have been made of stones, logs, and brush, causing pools to form. In streams with soft sand bottoms little food grows, but on gravel or rubble much develops, so that devices to remove the sand and expose the gravel greatly improve trout and salmon habitats.

Clearing streams of snags and brush or straightening them to enhance their beauty is a mistake from the fisherman's viewpoint. Such changes remove the natural shelters for fish and for the production of fish foods.

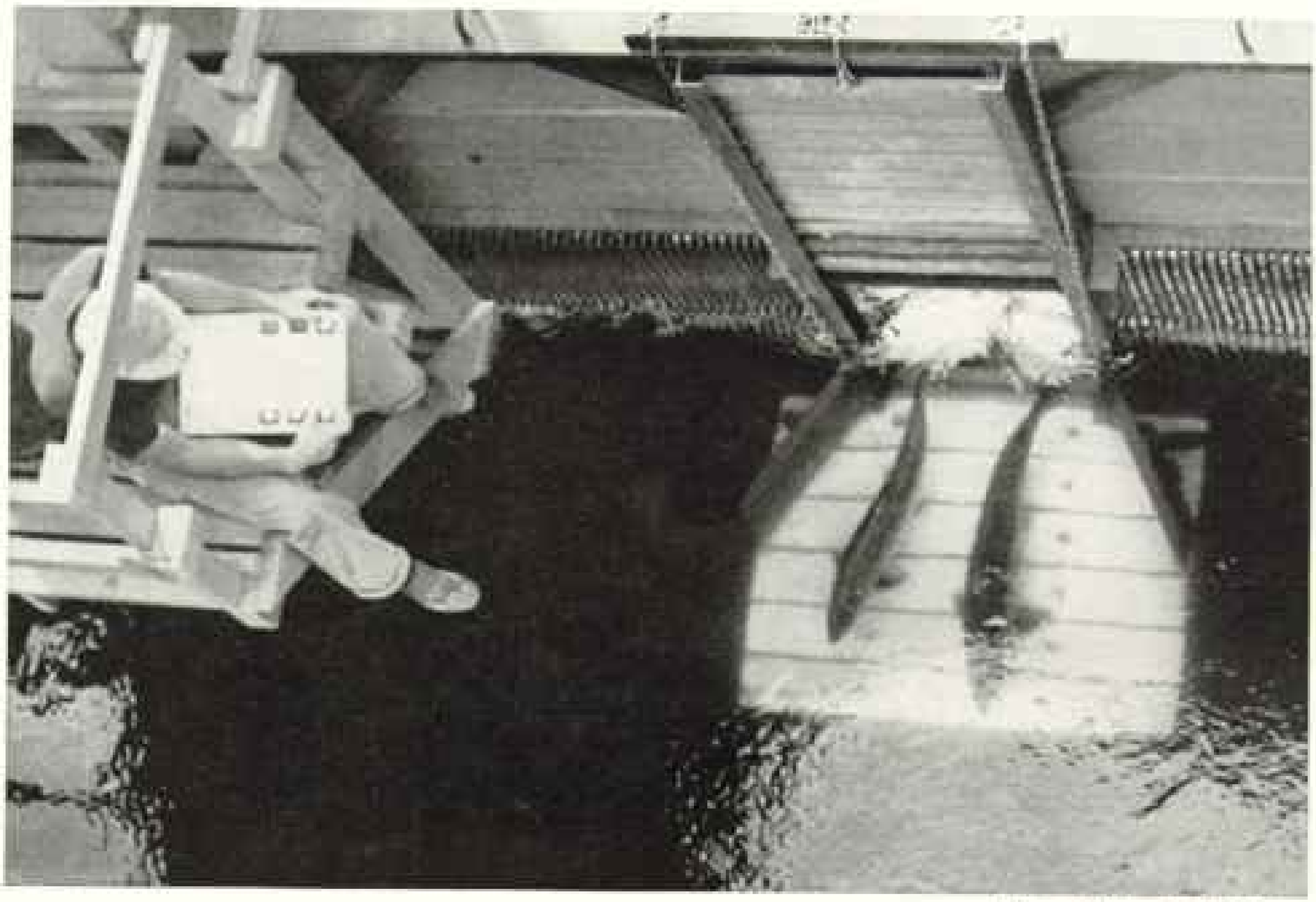
Salmon fisheries extend from Monterey Bay, California, to the Yukon River in Alaska, and westward to Kamchatka and northern Japan. In North America alone the average annual pack of canned salmon exceeds nine million cases (48 one-pound cans to the case); and usually more than four-fifths of this is canned in Alaska.

The total market value of fresh and canned salmon caught in North American waters in the last decade goes beyond a half billion dollars. This tremendous fishery, which took nearly eight billion pounds from 1927 to 1936 and gave employment to thousands, is confined to five species of Pacific salmon (Plates VIII to XI).

CHINOOK A BETTER NAME FOR SALMON

The name "salmon" was first used in Europe for the Atlantic salmon *(Salmo salar)*, closely related to the steelhead trout of the Pacific coast (Color Plate III). Unfortunately the term "salmon" was applied to these fish of the Pacific, when the local Indian name "chinook" would have avoided confusion with the wholly different Atlantic salmon.

The spawning migration of salmon is anadromous, or from the sea to fresh-water streams. This is the reverse of that of fresh-water eels, *Anguilla*, which have a catadromous migration, or from fresh-water streams to the sea. In the Yukon River the late Dr. C. H. Gilbert discovered that some chinook, or king salmon (Plate VIII) go upstream about 3,000 miles. Their mi-



Photograph by W. D. Staats

CENSUS TAKERS COUNT FISH AS THEY REACH THE TOP OF THE "WATER STAIRS"

A submerged white platform shows up weary salmon as they cross the upper "landing" of a Bonneville Dam fishway. During the first six months' actual count, almost half a million salmon and steelhead trout passed the dam on the way up the Columbia River (pages 187 and 190).

gration is probably longer than that of any other species of salmon or trout. The pink salmon (Plate X) migrates least of all Pacific salmon; it spawns only a few miles above salt water.

In trout, *Salmo*, and charrs, *Salvelinus*, the migratory instinct is definitely developed, but these forms pass most or all of their lives in fresh water, and thus there is no necessity for their migrating so far.

The salmon, in their urge to reach the proper place to deposit their eggs, often wear themselves out trying to navigate waterfalls or fish ladders placed in dams. Pacific salmon will jump vertically four times their length or more (page 190).

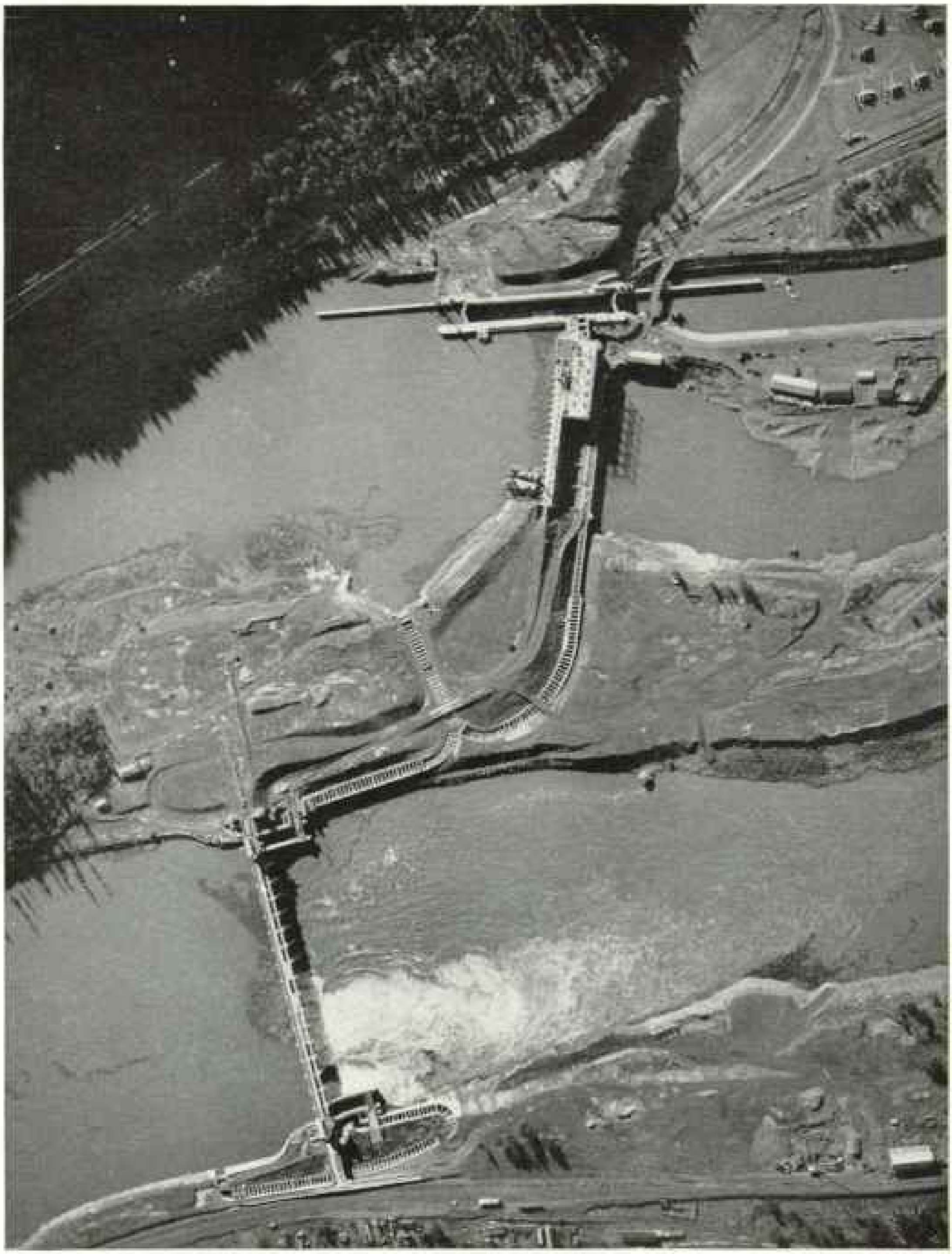
Sometimes they are killed by falling backward and striking sharp rocks. If not seriously injured, they continue to leap until they either go over the obstruction or drift exhausted downstream to fall prey to birds, bears, or other predators. By the time they have spawned, both salmon and trout are weakened and often emaciated.

This worn-out condition is not, however, the chief cause of the death after spawning of the five species of Pacific salmon. They have reached the end of their life cycle, and even fish in good condition die soon after their reproductive period is completed. Trout, steelhead, and charrs may spawn for several successive years.

One remarkable trait of salmon is their "homing instinct," their mysterious ability to return to the stream in which they developed as fry and fingerlings. When eggs have been taken from females in one river and transferred to another stream for development, the young produced have gone through their life cycle and returned to spawn in the waters where they were hatched rather than in the habitat of their parents. Returning of tagged or marked fish and study of their scales have proved that most salmon return to their "home stream."

LIVE FISH RELATED TO FOSSILS

The Alaskan blackfish, a close relative of the Washington mud minnow (page 189), lives in the coastal tundra regions of Alaska in ponds and streams. It is barely distinguishable from a similar form living across the Bering Sea in Asia.



Official Photograph U. S. Army Air Corps

COSTLY FISH "ESCALATORS" HELP SALMON PASS HUGE BONNEVILLE DAM

Blocking of the Columbia River by a vast power project threatened the salmon industry. If the fish could not reach their spawning grounds upstream the myriad salmon runs would be reduced. So United States Army engineers, assisted by biologists, planned this intricate system of fishways and fish elevators that cost more than six and a half million dollars. From high in the air, the three main "ladders," up which the salmon can swim and jump, look like curving staircases. Cross walls divide these flumes into "steps," each 40 feet wide and 16 feet long, and one foot higher than the next below (page 190). Two of the fishways curve up on Bradford Island, one from the foot of each dam, and unite, halfway, to continue as a single passage (center). A third ladder encircles the end of the dam at the bottom of the picture. Powerhouse and ship lock are seen above.

Photograph by H. S. Lawton

"GEE! WHAT DID YOU USE FOR BAIT?"

A few minutes before posing unawares in this scene of rural boyhood, the big trout was swimming in swift waters of the Feather River in the Sierra Nevada of California. The prize is a brown trout, native to Europe, but now introduced widely throughout the United States.

The Washington mud minnow, *Novumbra*, which would make an excellent aquarium fish, is found only in the Chehalis River of western Washington. It has, besides the Alaskan blackfish, two relatives in eastern North America and one in Europe. No doubt the mud minnows are relics of a fish fauna that once occupied much of the Northern Hemisphere.

Abundant fossil fish remains have been found in the Miocene deposits or diatom beds at Lompoc, Santa Barbara County, California. These deposits contain forms such as the herrings, flatfish, top minnows (cyprinodonts), and many species of spiny-rayed bony fishes.

Other formations, such as those at Soledad Pass, Los Angeles County, and the Eocene Green River shales of Wyoming, contain a wealth of ancient relics.* Much of the present fish fauna of the West was derived from forms that lived in past geological periods and are found fossilized in the above-mentioned deposits.

BLOODSUCKERS OF THE FISH WORLD

The lampreys of the western streams are of two types, the nonparasitic brook lamprey and the parasitic lake and sea-run lampreys. The latter, which reach a length of nearly three feet, migrate up the coastal streams in late spring and early summer for spawning in gravel riffles.

These lampreys excavate saucer-shaped nests by picking up stones in their suctorial mouths and carrying them a few feet away. The tiny white eggs, deposited in the bottom of the nests, hatch in about two weeks, and the little grayish larvae work their way into the sand and soft mud with only the mouths projecting. Blind and without teeth, they remain there for about three years, feeding on the minute plant and animal organisms that drift near their funnel-shaped mouths.

After metamorphosis, at which time teeth form and eyes appear, they migrate down to the sea and then become parasitic on fishes. They rasp off the skin of their luckless victim with their sharp teeth and suck its blood. I have found the tooth marks of this lamprey in the skin of the opah, or moonfish (*Lampris regius*).†

* See "'Compleat Angler' Fishes for Fossils," by Imogene Powell, in the NATIONAL GEOGRAPHIC MAGAZINE for August, 1934.

† See "Treasures of the Pacific," by Leonard P. Schultz, in the NATIONAL GEOGRAPHIC MAGAZINE for October, 1938.

The fresh-water sculpins, or bullheads as they are known in the West, are common little fishes of the streams and lakes. Some species are found only among stones in rapidly flowing water. My favorite way of collecting them is to place a 6-foot seine on the riffle and vigorously kick the stones about, allowing the swift water to carry my prey into the net. Sometimes the long-nosed dace and tadpoles of the tailed frog *Ascaphus* also are swept into the net.

The faunas of the Pacific coastal drainage systems have much in common, yet the species differ among the river systems and lake basins.

Fish of the isolated lakes of southeastern Oregon and of the Lake Lahontan Basin are distinctive. Some forms found in the Columbia River are represented by similar forms in the Sacramento-San Joaquin system, but in both rivers are species found nowhere else.

The fish fauna of the Great Salt Lake drainage system is characteristically that of the Snake River, a tributary of the Columbia. That of the Fraser River is similar to that of the Columbia, too.

In none of the streams west of the Continental Divide in the United States occur endemically such species as the paddlefish, the bowfin, the pirate perches, pickerel, the gar pike, darters, and yellow perch. But such fish as the cyprinids (minnows and dace), centrarchids (basses and sunfish), the ling, sculpins, trout, and whitefish, are found on both sides of the Divide.

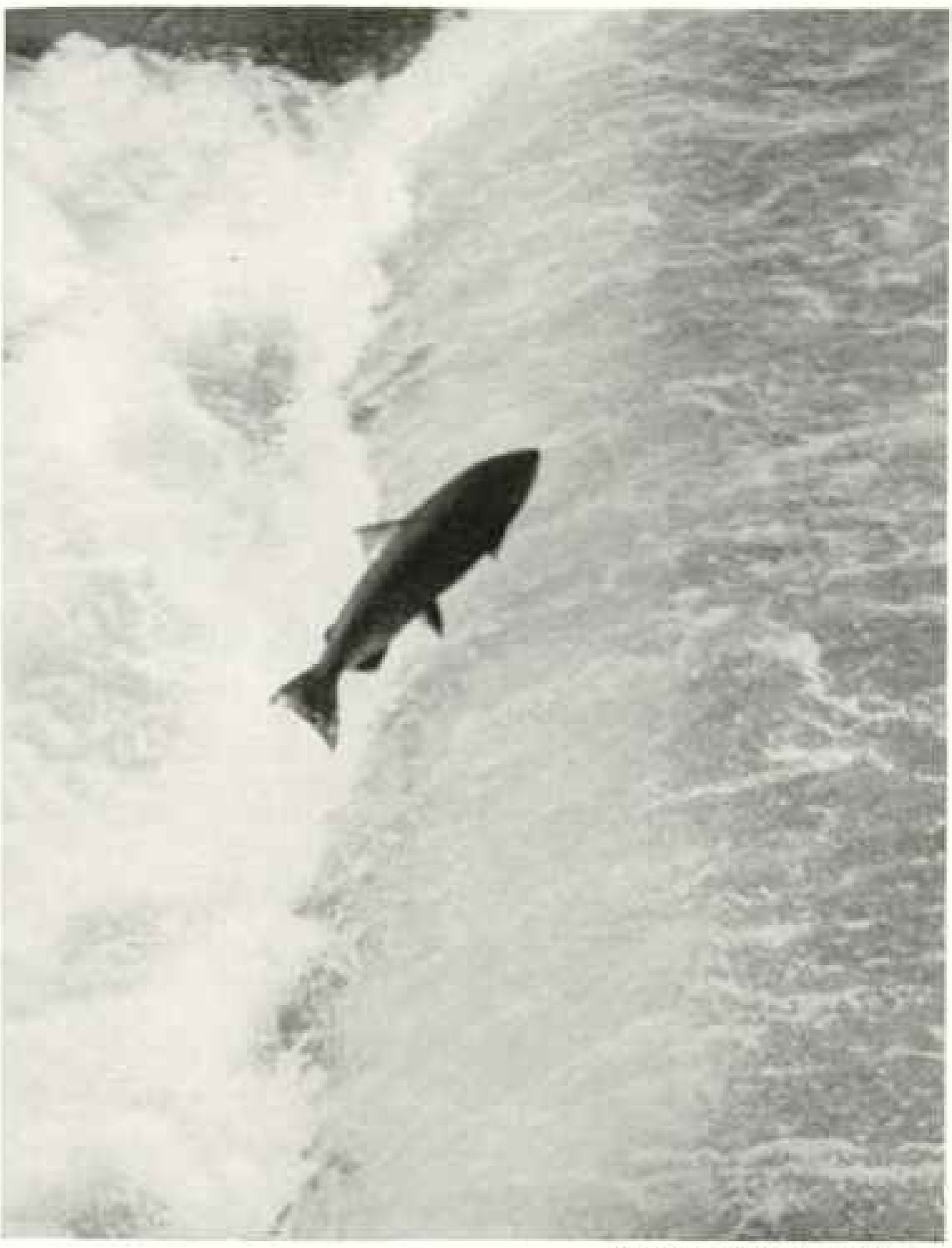
Among the fresh-water fishes of the Pacific coastal streams are to be found the largest minnow in North America, the squawfish (Plate V), and the largest anadromous fish, the white sturgeon (Plate VI).

In the Sacramento-San Joaquin drainage system occur 40 endemic species, as contrasted with 46 in the Columbia system, 15 of which are common to both streams. In addition to the endemic forms, 18 species have been successfully introduced into the Columbia and 19 into the Sacramento-San Joaquin, 17 of which are reported from both stream systems.

South Fork Golden Trout

(Salmo agua-bonita)

The golden trout of California was named for Agua Bonita Falls (now Volcano Falls) in Volcano Creek (now Golden Trout Creek) under the supposition that the first specimens came from there. Actually, however, the species was found originally only in the headwaters of



Photograph by Les. T. Ordeman

A FAT SALMON "TAKES STEPS" TO GET UPSTREAM

In one of the broad fish ladders at Bonneville Dam on the Columbia River, a shapely swimmer leaps over a riser in the "moving staircase" (page 187). Water cascades from pool to pool and also pours through submerged openings in the partition walls. Most fish prefer to swim through the underwater gaps rather than leap over the chute as this one is doing.

the South Fork of the Kern River, south of Mount Whitney, a high mountain area to which it was confined by impassable falls (Plate I).

Usually less than 10 inches long, it belongs to the rainbow series of trout, lacking the "cutthroat" marks, a pair of red color bars, one on each side of the underpart of the head along the inner edge of the lower jawbones.

These beautifully colored mountain trout, which occur in pools and rapids, may be taken in any sort of weather with artificial flies or on hooks baited with insects. During midday they frequent the deeper pools, lying in the shadows of overhanging rocks. They feed on aquatic insects, worms, and flying insects that alight on the stream. Aquatic caddis-fly larvae and midges make up more than 80 per cent of their diet.

Piute Trout

(Salmo seleniris)

This form of the cutthroat trout—length not more than 10 inches—was found originally only east of the Sierra Divide in the small streams of Fish Valley, at the headwaters of Silver King Creek, California, above Llewellyn Falls. It differs from other cutthroats in the absence of the black spots on the body and the retention to maturity of parr marks—vertical blackish bars on the sides (Plate I).

The fish readily take any kind of fly, almost irrespective of season or natural food present. They strike hard and, like other cutthroats, do most of their fighting under water. They also take hooks baited with pieces of grasshopper and other insects.

To reach this remarkable trout, a leftover stock of ancient Lake Lahontan, which covered a large area in what is now Nevada, the traveler must journey 14 miles by horse or on foot from the nearest automobile road. Perhaps its inaccessibility explains why it can be found today in its original form, unmixed with other cutthroat trout.

Coastal Cutthroat Trout

(Salmo clarkii)

The coastal cutthroat trout is common in coastal streams and lakes from Alaska to northern California (Plate II). In the Columbia River Basin in Idaho and in the northern Rocky Mountain States it is replaced by a close rela-

tive, the Yellowstone, or Montana black-spotted, trout, *Salmo lewisi* (page 192 and Plate IV). Some coastal cutthroats which have migrated to salt water and grown to large size are called locally "steelhead cutthroats."

In clear, cold mountain streams this trout is abundant, hiding among the rocks in riffles, in deep pools, under logs, and beneath overhanging bushes. During early spring it migrates into smaller streams, and when breeding grounds are reached male and female pair off over gravel riffles.

The female excavates a nest two or three inches deep by turning over on her side and vigorously flexing her tail against the bottom, the motion carrying her a little upstream and loosening some sand and gravel. The material disturbed is carried downstream by the swift current, the smaller particles farthest and the larger stones but a few inches.

Photograph by B. Anthony Stewart

PROOF OF THE FISHING—IN A CAN!

At Requa, northern California, stands a packing plant where sportsmen bring their fresh-caught salmon to be tinned. Individual labels tell the folks back home that *you* caught the succulent contents with your own rod and line. From far and near, the angling brotherhood flocks here to the Klamath River during the early fall salmon run. The silvery giants are caught by trolling from rowboats.

After some courtship activities the eggs are laid and fertilized, whereupon the female immediately covers them with gravel by digging with her tail at the upper edge of the nest. Seepage of water among the small stones of the nest bottom supplies ample oxygen for the development of the baby trout. In from three to six weeks the eggs hatch, the period in warm streams being shorter than in cold.

A week or more after hatching, and when the yolk, or the food stored in the egg, has been nearly used up, the little light-brown trout make their way up through the gravel into the stream and soon begin to feed on minute organisms on the stones and in the water.

Stomachs of cutthroat trout show that these fish in general eat whatever they can obtain—aquatic insects such as May flies, stone flies, caddis flies, midges, black flies, and their nymphs or larvae; land insects which fall into the stream; such fresh-water crustaceans as crayfish, fresh-water shrimps (amphipods), fairy shrimp, and water fleas; and fish eggs, mostly those of salmon and trout.

Cutthroats rise to the fly during the warmer seasons, or will take a small spinner. In spring a fly cast over a deep pool, near an overhanging bank, or among eddies in rapids, is almost certain to be struck. The gamy fish does most of its fighting below the surface.

In most small streams the average size is from 7 to 12 inches, but sometimes in large streams and in lakes an 8-pounder is taken. The record is about 12½ pounds. Many game fish records change from year to year, as sportsmen well know. The largest cutthroats feed almost wholly on small fishes.

Rainbow Trout, Steelhead Trout

(Salmo gairdneri)

Most-sought game fish in the western United States are the rainbows or steelheads of the Pacific coastal streams (Plate III).

The rainbow trout of the Atlantic drainage system was transplanted from our western waters, first from certain streams flowing down off Mount Shasta in northern California, but later from Oregon and Washington. Now the several breeds are so thoroughly intermixed that ichthyologists no longer can detect the anatomical characteristics of the race from the Mount Shasta region.

Rainbow trout are widely distributed, mostly because of the activities of fish culturists.

The difference between a steelhead and a rainbow is principally in habit, since there is but one species. The steelhead lives and grows to a large size in salt water and then returns to the fresh-water streams to spawn. It has a steel-blue or gray back and silvery sides. The rainbow does not go to sea at all.

The spawning migration of steelheads usually occurs in late summer, autumn, or winter, the eggs sometimes being deposited as late as early spring in saucer-shaped nests in the gravel riffles of streams.

Dr. Paul R. Needham, of the United States Bureau of Fisheries, and Mr. Allan C. Taft, Division of Fish and Game, California, found that after some courtship activities the eggs are laid when the female drops back in the center of the nest in its deepest part. The male instantly moves into position parallel with the female, and eggs and milt are extruded at the same instant, the whole process requiring not much more than two seconds.

The eggs are covered in the same manner as those of the cutthroat trout (page 191), and after a few weeks the young emerge from the gravel. They stay in the stream for at least a year before going to sea.

My experience in fishing for rainbows and steelheads in Glacier and Yellowstone National Parks indicates that a fly rod about nine feet long is best. The line must be heavy enough to carry the lure and leader to the distance desired in casting; and the flies most useful are Royal Coachman, Gray Hackle, Black Gnat, and one or two other designs on about a size-12 hook. Of course a reel and other equipment are necessary, but the amateur trout angler can have great sport with a modestly priced outfit.

In the Skykomish River of Washington heavier rods are needed, for fishermen there have taken many 10- to 20-pound steelheads. The largest thus far recorded was 42 inches long and weighed 26½ pounds.

Yellowstone, or Montana Black-spotted, Trout

(Salmo lewisi)

The Yellowstone trout (Plate IV), only game fish in Yellowstone Lake, is closely related to the coastal cutthroat (Plate II), but has fewer anterior and more caudal black spots. It is common in the mountain streams of much of British Columbia and the northern Rocky Mountain States.

In springtime these gorgeous trout take nearly any kind of bait. Yellowstone visitors with hook and line catch annually several thousand of an average weight of three-quarters of a pound. Sometimes it is possible to catch a trout in the cold water of Yellowstone Lake and, without moving a step, boil the fish in a hot spring on the shore.

In the Flathead River adjoining the west side of Glacier National Park, this black-spotted trout is caught by hundreds of visitors. Some hardy enthusiasts hike up to the headwaters of the tributary creeks or to mountain lakes where fishing cannot be excelled. There I have taken on a fly ten 1-pound trout in a little more than 15 minutes. An 8- or 10-pound cutthroat is considered of record size.

The fish spawn in May or June in the smaller creeks to which the adults have migrated as soon as the ice is gone. In gravel riffles the females excavate saucer-shaped depressions, in which the eggs are laid.

The eggs hatch in from four to six weeks and the fry, or baby trout, soon begin to feed. The large adult trout usually move back into the lake soon after spawning, leaving their progeny to the care of Nature. Perhaps if they stayed with them in the streams they would begin to eat the little fellows they so carefully planted as eggs in the nests.

Three-spined Stickleback

(Gasterosteus aculeatus)

The sticklebacks, family Gasterosteidae, of which there are several species in both salt and fresh waters, inhabit the Northern Hemisphere. The three-spined stickleback, found in Asia, Europe, and North America, is so named because of the sharp isolated spines on the back. Other sticklebacks have from five to twelve or more such spines (Plate IV).

Everywhere sticklebacks are known for their ability to build nests from available vegetation and débris, with front and back entrances leading to a tubular hallway. The male alone builds the small nest, or barrel-shaped house, out of "vegetable bricks" and cements them together with a sticky,

Painting by Hashime Murayama

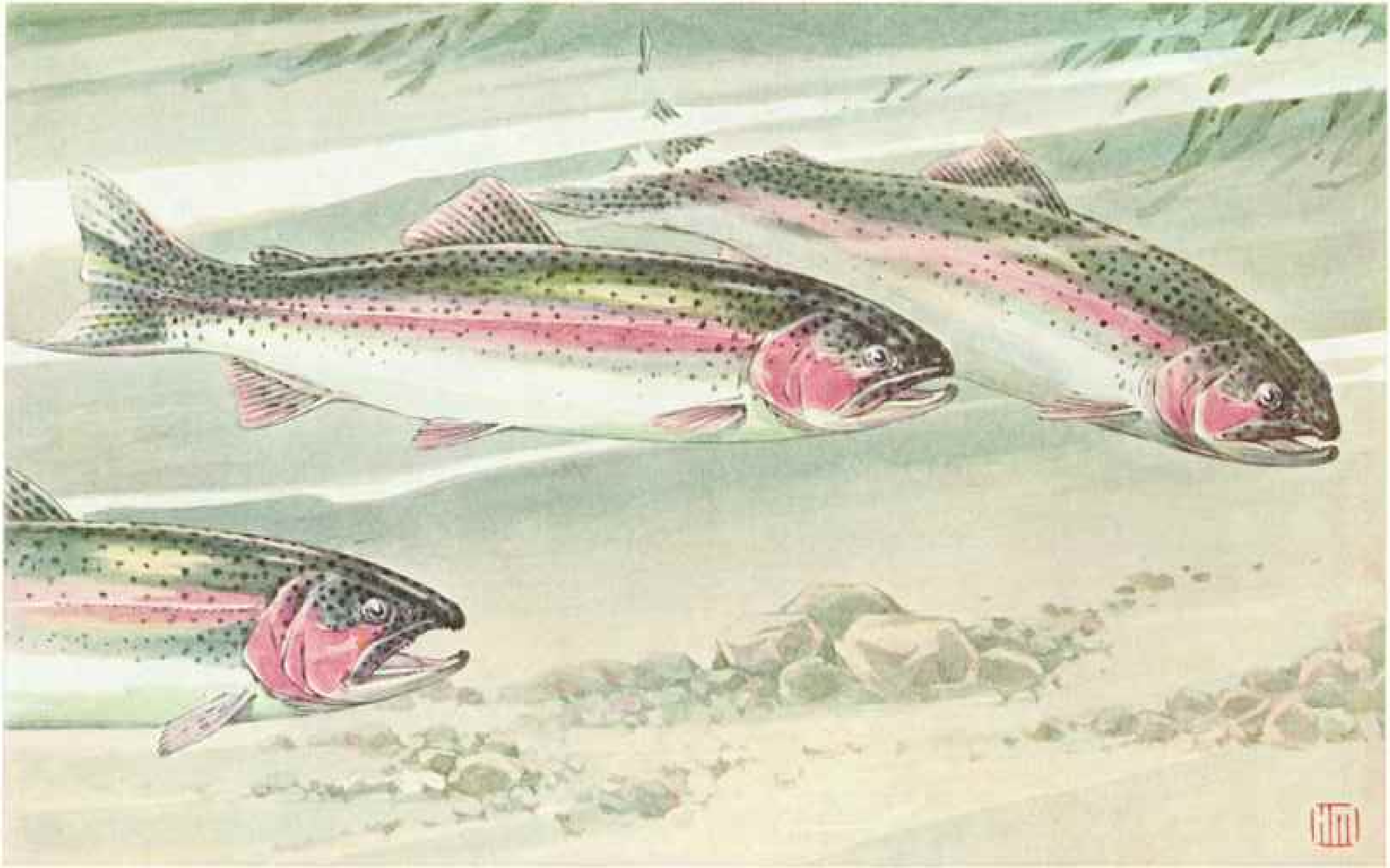
HIGH AMONG SIERRA SNOWS THEY DART AND WHIRL AND SPARKLE

Native only in a few small streams of Fish Valley, in Alpine County, eastern California, the graceful PIUTE TROUT (*Salmo seleniris*, upper pair) lacks the black spots characteristic of most trout. The glittering SOUTH FORK GOLDEN TROUT (*Salmo agua-bonita*, lower pair) was originally found only in icy mile-and-a-half high waters of Kern River, near Mount Whitney, California. Like the Piute, it retains the parr markings, or dark daubs, to maturity. Both are hard-fighting game fish. Hashime Murayama, National Geographic Society staff artist, spent many weeks in research on the West Coast before painting these dramatic water colors of Pacific slope fresh-water fishes.

Painting by Hashime Murayama

TWO RED STREAKS ON THE LOWER JAW WON FOR THIS COMMON WESTERN TROUT THE UNMERITED NAME "CUTTHROAT"

From Alaska to northern California, in every suitable river and lake of the area adjacent to the Pacific, is found the COASTAL CUTTHROAT TROUT (*Salmo clarkii*). A popular prize of anglers, it is abundant in clear, cold mountain streams, hiding behind rocks in riffles, in deep pools, and under logs and overhanging bushes. When the species runs to the sea, it is called a CUTTHROAT STEELHEAD.



Painting by Hashime Murayama

PRINCE OF SWIFT MOUNTAIN STREAMS, THE LEAPING RAINBOW TROUT IS A FAVORITE OF THE FLY FISHERMAN

Originating west of the Rocky Mountains and the Sierra Nevada, from Alaska to northern Mexico, the RAINBOW TROUT (*Salmo gairdneri*) has been transplanted to the eastern United States and Canada, to Europe, and, with particular success, to New Zealand. When it goes to sea, this species is known as the STEELHEAD TROUT. An important food fish that may attain a weight of 25 pounds, the steelhead variety reproduces in fresh water, but, unlike Pacific salmons, does not die after spawning. Both landlocked and sea-run variants take the fly readily and put up a sturdy and acrobatic battle.

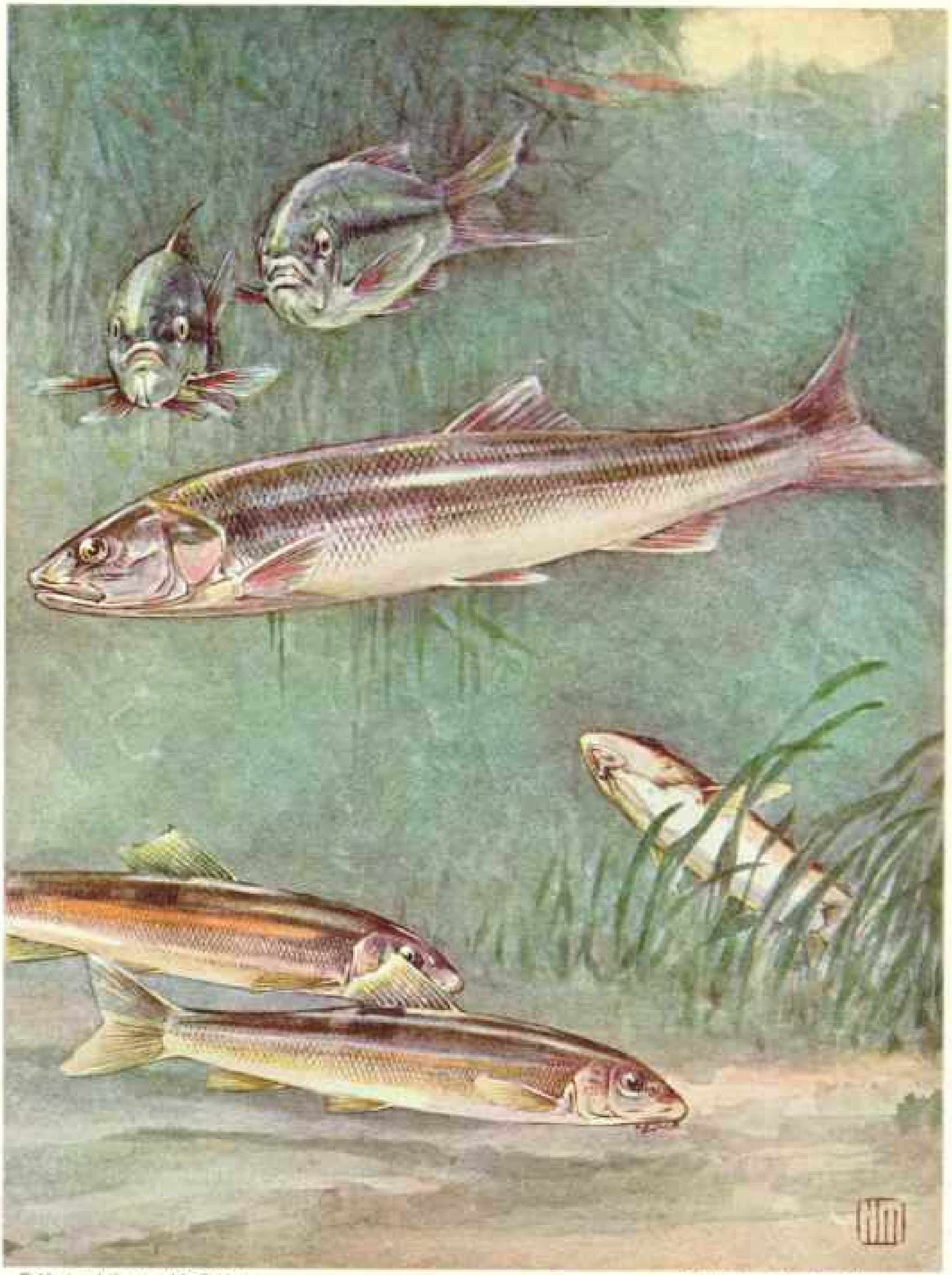
IN YELLOWSTONE PARK, A LOCAL WHOPPER MAY SNATCH YOUR LURE

In streams and lakes throughout the park and adjacent regions is found the YELLOWSTONE TROUT (*Salmo lewisi*), one of the numerous species of cutthroat (Plate II).

© National Geographic Society — Paintings by Hashime Murayama

AN UNDERWATER ARCHITECT GUARDS HIS IGLOO-SHAPED NEST

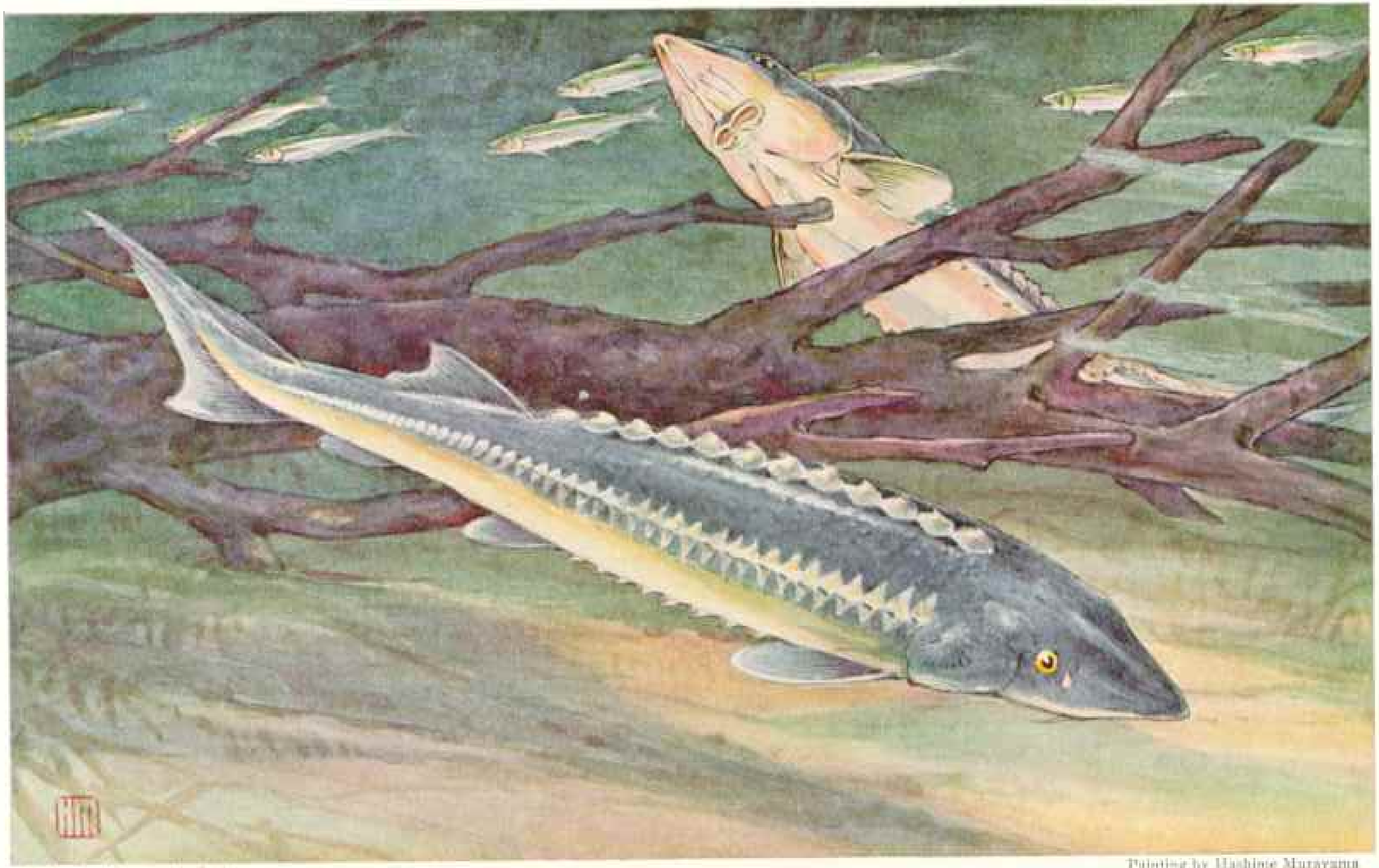
Tiny male THREE-SPINED STICKLEBACK (*Gasterosteus aculeatus*) builds a house of bits of roots and stalks of water plants. Cementing is done with a sticky substance secreted by special glands. Several females lay their eggs within the nest, each deposit being fertilized in turn by the finny polygamist.



 Painting by Hashime Murayama

WESTERNERS CAN TRUTHFULLY BOAST OF MINNOWS THREE FEET LONG

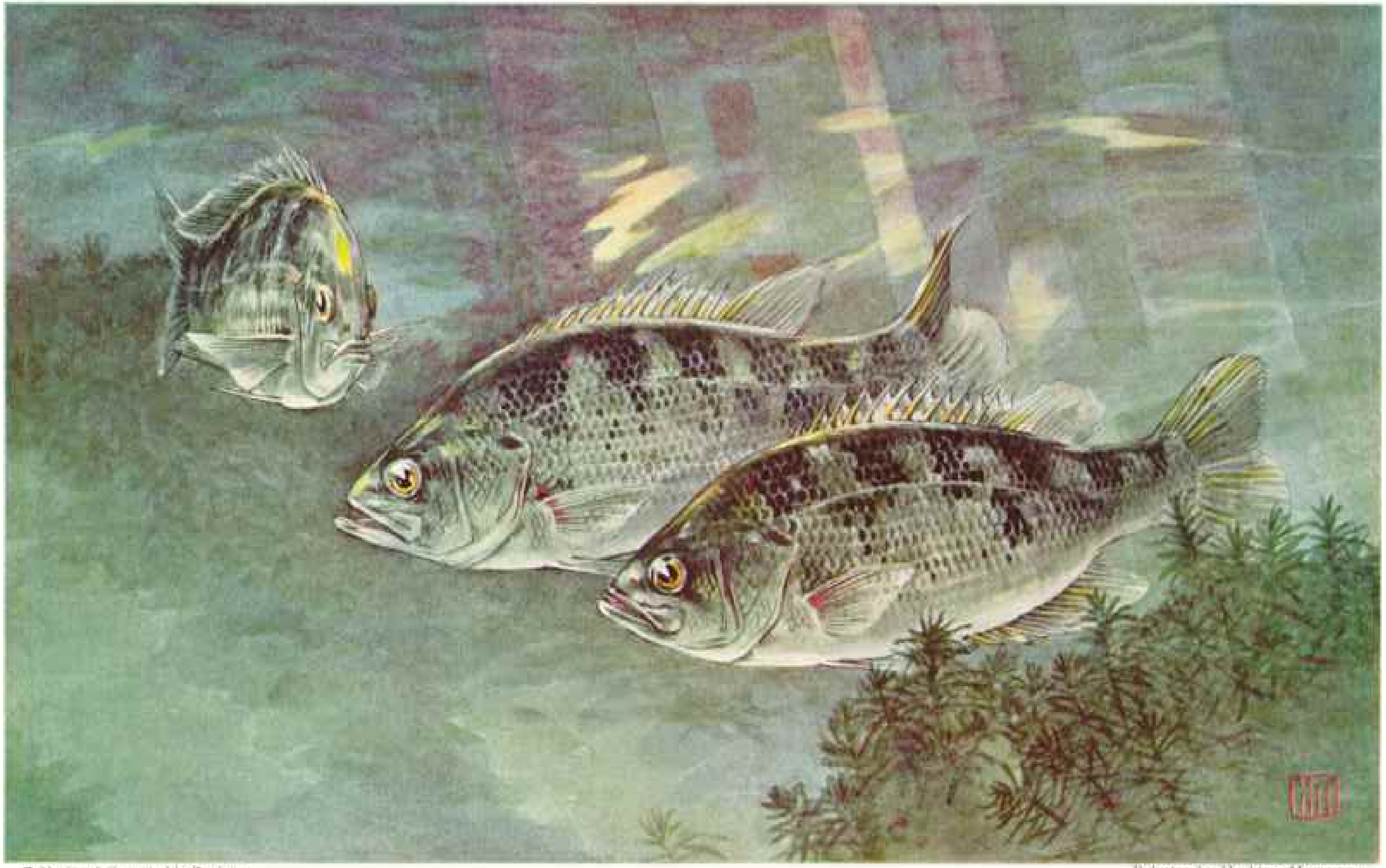
They have only to point to the toothless SACRAMENTO PIKE (*Ptychocheilus grandis*, upper three), of the Sacramento-San Joaquin River system of central California, and other similar species of aquarfish inhabiting the Colorado and Columbia Rivers. All are voracious feeders, very destructive to other fish life. Also confined to rivers of the second largest State is the SACRAMENTO SUCKER (*Catostomus occidentalis*, lower trio), a bottom feeder with a "vacuum cleaner" mouth that draws in small aquatic animals and algae.



Painting by Hashime Murayama

ARMORED WITH PLATES, SPINES, AND ROWS OF BONY BUCKLERS, THE MAMMOTH STURGEON PATROLS MURKY RIVER DEPTHS

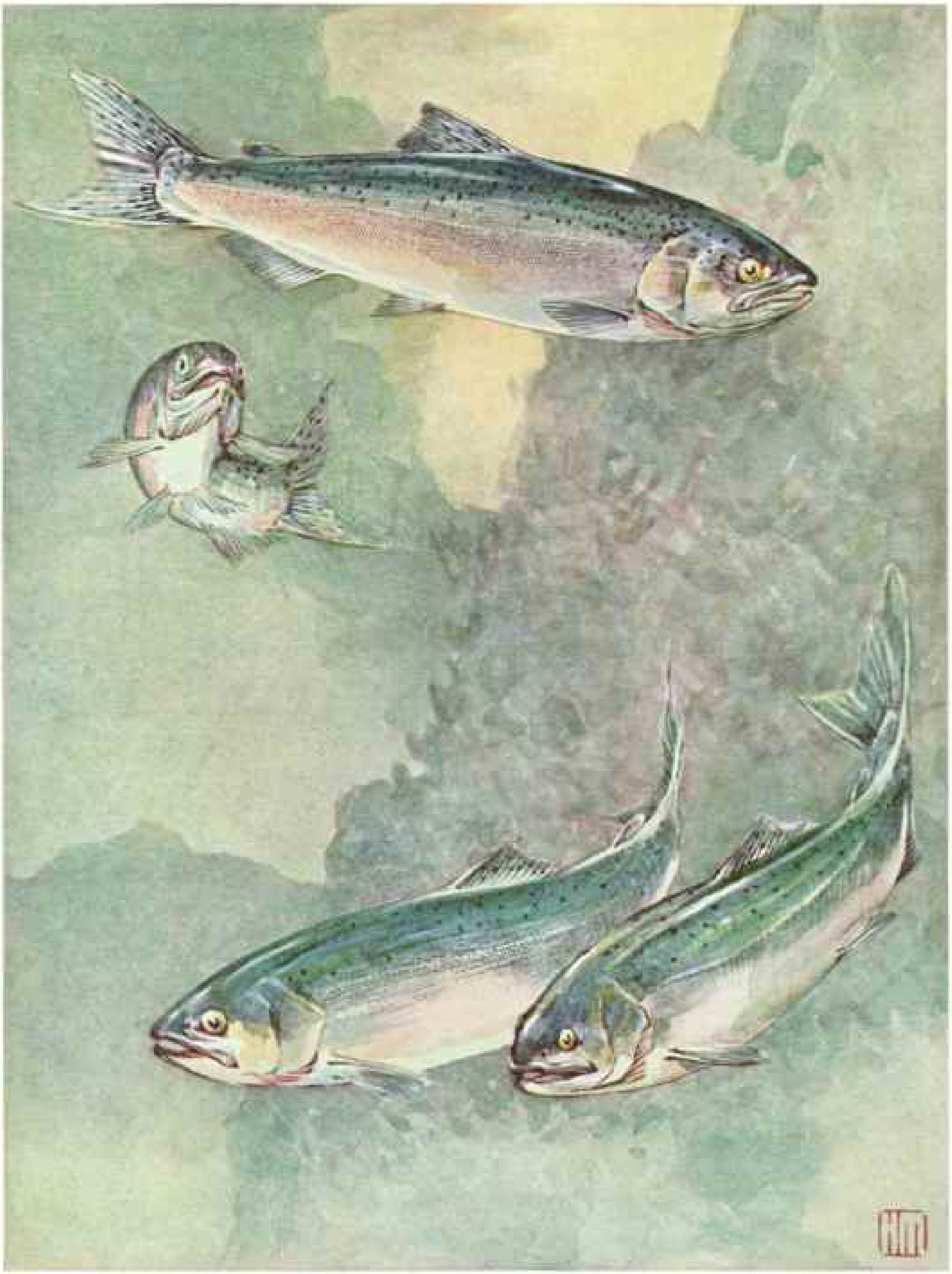
In Pacific slope streams from central California to Alaska runs the WHITE STURGEON (*Acipenser transmontanus*). Because of its scarcity, this species does not compete with the Russian form whose eggs provide the finest caviar. The sturgeon is the largest fresh-water fish in North America. A record Columbia River specimen weighed 1,285 pounds and was 12½ feet long. Four long feelers hang in front of the suckerlike mouth. Besides small aquatic creatures, the sturgeon may swallow the eggs, deposited on the stream bottoms, of EULACHON (*Thaleichthys pacificus*), schooling in the background.



Painting by Hashime Murayama

WEST OF THE ROCKY MOUNTAINS, THE PLUCKY BASS TRIBE HAS ONE LONE NATIVE REPRESENTATIVE

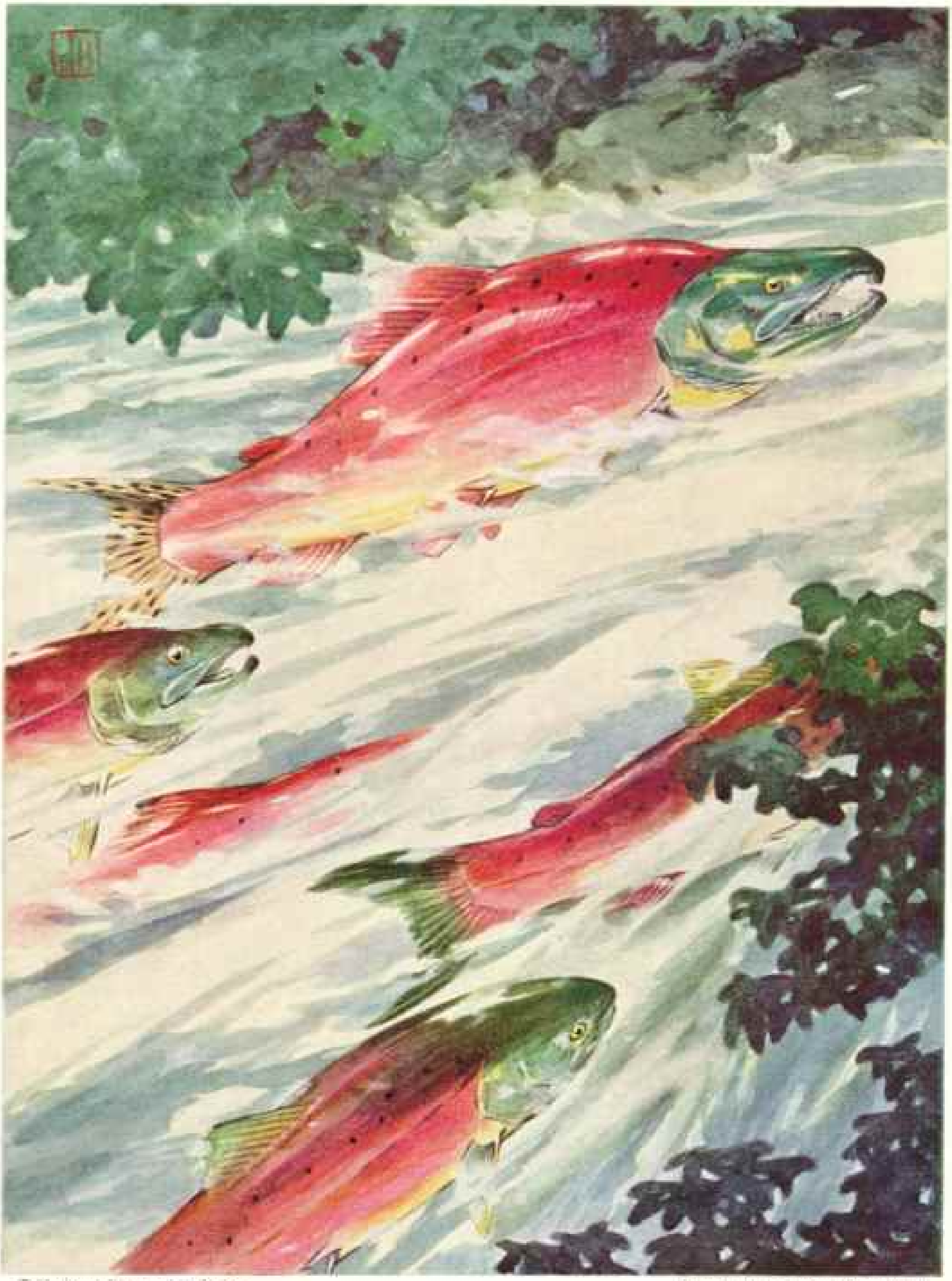
With artificial or live bait, Pacific coast anglers outwit the large and gamy SACRAMENTO PERCH (*Archoplites interruptus*) which, like its eastern kin, is also a delicious pan fish. Long strings of her eggs, "glued" together by a gelatinous substance, are draped by the female over submerged roots and branches. The perch has been greatly reduced in numbers by the introduction to its Sacramento River range of carp and catfish that eat its spawn.



 Painting by Hashime Murayama

SPRING DRAWS THE SALMON HORDES FROM OCEAN DEPTHS TO RIVER MOUTHS

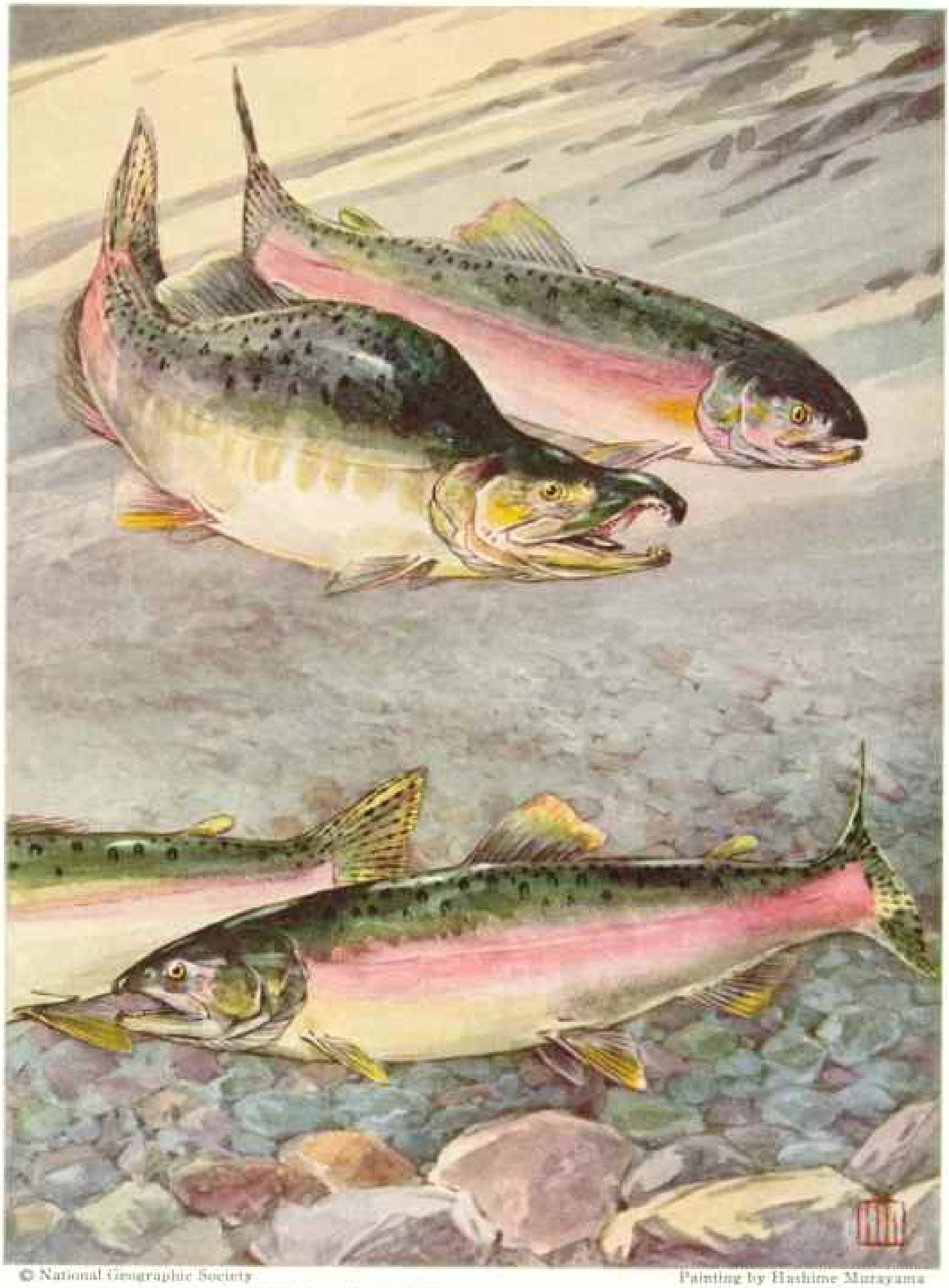
In 1936, the Pacific salmon fishery of the United States and Alaska ranked second among all commercial species in volume of the catch, and first in value to the fishermen. Every year, in salt water along the shores of northeastern Asia, Alaska, western British Columbia and the United States as far south as central California, millions of the splendid fish are captured in seines, nets, and with hook and line. Two of the most valuable are the CHINOOK (*Oncorhynchus tschawytscha*, upper pair), largest of Pacific salmons, averaging about 22 pounds, and the SILVER (*Oncorhynchus kisutch*, lower two).



 Painting by Hashime Murayama

TO REACH THE SHALLOW HEADWATERS, SALMON OFTEN MUST CLIMB CASCADES

Costly fishways preserve for them an all-water route to upper reaches of many rivers blocked by dams. Sometime between the third and seventh years of their life, and between March and November, most salmon swarm back to fresh water to reproduce. This RED SALMON (*Oncorhynchus nerka*) differs from its kin, since it spawns in streams tributary to lakes. Soon after emerging from the eggs, the young move down to the lakes for a one-to-three-year stopover before going to sea. This species is much sought after because, when canned, its flesh is deep red and especially flavorous.



 Painting by Hashime Murayama

AFTER SPAWNING ON GRAVEL BEDS, ALL PACIFIC SALMON DIE

On suitable riffles in clear, fresh water, the females scoop out shallow depressions in which the thousands of eggs are deposited. Simultaneously, the males shed their fertilizing milt over the spawn. Aided by the stream, the fish cover their nests with a layer of gravel. Smallest of our Pacific species, the PINK SALMON (*Oncorhynchus gorbuscha*) spawns in small streams not far above tidewater. Fry of this kind and of the chum salmon (Plate XI) migrate to the sea a few months after emerging from the nests. From the lump on the back of the breeding males, the species is often called "humpback."

 Painting by Hashime Murayama

BABY SALMON GROW RAPIDLY AFTER RUNNING DOWN TO THE FOOD-FILLED SEA

Surviving smolts of all species migrate to salt water after spending from a few months to three years in the rivers or lakes. Feasting on herring, anchovies, and other small fish, or on the abundant small animal organisms of the ocean, they quickly reach adult size. In contrast to the chinook and silver species (Plate VIII), which provide excellent sport when hooked on a troll, the Chum Salmon (*Oncorhynchus keta*) is rarely taken by the rod-and-line fisherman. Upon entering fresh water, the male salmon develops a hooked upper jaw.

 Painting by Hashime Murayama

STRANGE IS THE BOND BETWEEN A DICKENS HEROINE AND AN AMERICAN FISH

After the English novelist visited the United States, there was a craze for the pink-flowered calico supposed to resemble a pattern worn by Dolly Varden, the lively, brightly dressed character in *Barnaby Rudge*. Heir to her name is the red-spotted DOLLY VARDEN TROUT (*Salvelinus malma*), common in Pacific coastal streams and lakes. This shapely fish is not the equal in gameness of the cutthroat or the rainbow trout. It is a voracious feeder, devouring the natural foods and young of preferred species. In Alaska, Dolly Vardens are destroyed by the thousands every year because they feed largely on salmon eggs and fry; bounties are paid on their tails.

threadlike secretion from his body. The nest is concealed in vegetation or in rock pools where there is a moderate flow of water.

The male continually goes in and out of his house, working the marine glue from his body over the inner sides, where it hardens. Upon completion of the nursery, he searches for a mate, and after elaborate courtship induces her into the nest, often by poking her with his snout or spines.

After eggs are deposited and fertilized in the nest, the male guards the entrances and charges furiously against all comers. Although the male stickleback is seldom more than 3½ inches long, he does not hesitate to attack fish two or three times his size.

The front and back entrances allow water to flow over the eggs, the current being aided by the movements of the fins of the guarding male. After the eggs hatch, he guards the tiny young for a time and keeps them in the nest or cradle until they swim so strongly that he no longer is able to take the truants in his mouth and return them to the nest.

Sticklebacks are of no value as food for man, but in salt marshes, along shores of lakes, and in streams they keep down mosquitoes by eating the larvae. When other fish attempt to swallow sticklebacks, as they often do, the results are likely to be fatal for both predators and victims. The stickleback's pelvic fin spines lock into outthrust position and this causes him to lodge in the throat of his foe.

Sacramento Pike, or Squawfish

(Ptychocheilus grandis)

To the family of minnows and carps, the Cyprinidae of the fresh waters of Europe, Asia, North America, and Africa, belongs the Sacramento pike, alias the squawfish. It and its close relatives, from which it is barely distinguishable, are common in Pacific coastal streams from central California to British Columbia (Plate V).

The squawfishes are the largest minnows of North America; in the Colorado River they are said to reach a weight of 80 pounds. Frequently those taken in the Columbia River system are nearly three feet long and weigh from six to ten pounds.

They are voracious minnows with pikelike habits, the adults feeding mostly, if not exclusively, on other fish, including young trout and salmon. Like all other minnows or cyprinoids, they are without jawteeth, but they are quick enough to capture fish with their large mouths and to crush them far back in the throat by using their pharyngeal teeth.

Squawfish have a poor reputation among sportsmen. They are greedy for salmon eggs, worms, and insects, and will readily take artificial lures as well as frogs. The young make excellent bait for rainbow trout and bass.

They are so destructive to young red salmon in certain British Columbia lakes that the Provincial Government has taken steps to reduce their numbers, and the result has been an increase in downstream migrating red salmon young. Squawfish spawn in the spring in the gravel of streams and along lake shores.

Sacramento Sucker

(Catostomus occidentalis)

Several species of suckers, so called because of their peculiar mouths, occur in North America and Asia, but the Sacramento sucker and its close relative, the coarse-scaled Columbia River sucker, are confined to the coastal streams of western United States and British Columbia. By protruding their fringed, or papillate lips, these fish feed on small organisms and plants growing on the rocks of stream bottoms (Color Plate V).

Sacramento suckers may reach a length of nearly two feet, but average about 15 inches; the larger ones weigh several pounds. Because of their odd mouths and feeding habits, they are seldom taken on hook and line. They are not at all gamy and are of slight commercial value, except locally. Below dams along the Wenatchee River, Washington, Indians snag them with hooks attached to poles and salt or dry them for winter use.

The Sacramento sucker spawns in the early spring, migrating from lakes to the gravel beds of streams or from the big rivers to the smaller tributary streams. The males frequent the gravel riffles at these times, usually in greatest abundance at night. Apparently spawning occurs whenever a female is ready to deposit her eggs. At this time she ventures on the gravel riffle and is attended by one or more males, the eggs and milt being shed as the spawners, vibrating rapidly, swim a few feet upstream.

The pale-yellowish eggs are very sticky when first laid, attaching themselves firmly to the stones of the stream bottom. Hatching occurs in a week or so, and the almost invisible young make their way to the edge of the stream, where they live in the shallow, quiet water and in protected sloughs. Often young suckers occur in countless numbers along margins of lakes, or in pools left by a stream which has changed its channel.

White Sturgeon

(Acipenser transmontanus)

The white, Columbia River, or Sacramento, sturgeon, found in both fresh and marine waters along the Pacific coast from Alaska to Monterey, California, is the largest fresh-water fish in North America (Plate VI).

A specimen from the Fraser River, British Columbia, measured 10½ feet in length and weighed 1,015 pounds. One from the mouth of the Yakima River, where that stream empties into the Columbia, was 11½ feet long and weighed 826 pounds. Near Vancouver,

Washington, in June, 1912, the largest on record was caught—a 12½-foot female weighing 1,285 pounds and containing 125 pounds of roe, which was made into caviar.

Now, however, the day of the big sturgeons is probably over in the Columbia River, and virtually all the caviar sold in this country is made from the reddish eggs of Pacific coast salmon. Modern power and irrigation dams may prohibit adult fish of this size from going upstream to deposit their eggs, or, if the journey is accomplished, the young may find it impossible to reach the sea by way of fish ladders built for salmon and trout migrants.

At present the total commercial catch of sturgeon for the Pacific coast of the United States is from 75,000 to 150,000 pounds annually. When the country was first settled, so many sturgeon were caught that they were hauled on shore and disposed of as a nuisance.

Sturgeons are bottom feeders, eating worms, insect larvae, small fishes, small clams, and aquatic plants. Spawning is said to occur in the spring in the lower courses of the rivers.

Eulachon, or Candlefish

(Thaleichthys pacificus)

Similar to the salmon, the eulachon, a member of the smelt family, Osmeridae, migrates into fresh-water streams to deposit its eggs in the late winter or early spring. It is common from Bering Sea to the Klamath River in northern California (Plate VI).

Fish of this species, called locally Columbia River smelt, occur in February and in early March in the lower Columbia River system. Near the mouth of the Sandy River, Oregon, and in the Cowlitz River, near Kelso, Washington, large catches are made with dipnets, seines, rakes, all sorts of buckets, and even window screens and woven bedsprings as the fish congregate to spawn in the shallow water over gravel riffles and sand bars.

The eggs, of which each female bears about 20,000, hatch in 10 days to two weeks, but the larvae are seldom seen in fresh waters, nor is it known at just what size they migrate to sea. Occasionally young fish two inches long are captured in plankton nets at moderate depths in Puget Sound. The average length of the adults is from five to eight inches.

The flesh of these smelt is of a delicate flavor, and highly esteemed as food. Because of the oily nature of the eulachon the Indians formerly dried them and used them for candles; thus the name "candlefish." They burn readily, giving off much light, a little smoke, and an undesirable smell.

After going to sea, the eulachon feeds on oceanic plankton, small animals and plants floating in the sea water. The commercial catch of the species makes up a fair portion of the three million pounds of true smelt taken along our Pacific coast.

Sacramento Perch

(Archoplites interruptus)

The Sacramento perch is the only member of the sunfish and bass family, Centrarchidae, occurring endemically west of the Rocky Mountains. It is confined to the Sacramento-San Joaquin River Basins (Plate VII).

Presumably this fish is a representative of the ancient fauna which extended across the North American Continent prior to the elevation of the Rockies. Fossil remains of this fauna are found in the Eocene Green River shales of Wyoming.

The California Fish and Game Commission has found that introduced carp and catfish have badly depleted the Sacramento perch by eating their spawn. Because the perch are not so pugnacious at spawning time as are their sunfish and bass relatives, the eggs and young are less protected.

The perch do not build nests on the bottom in sand or gravel as do sunfish or bass, but spawn among submerged objects. The eggs are held together by a gelatinous substance and laid in long strings, somewhat like those of the common yellow perch in the East. They are draped over submerged roots, old limbs of trees, and branches sunk in the water.

This species is said to reach a length of two feet, although the average size is from 8 to 12 inches. It takes the hook readily and ranks high as a game fish. Its food consists mostly of worms, insects, and small fishes.

Chinook, or King, Salmon

(*Oncorhynchus tschawytscha*)

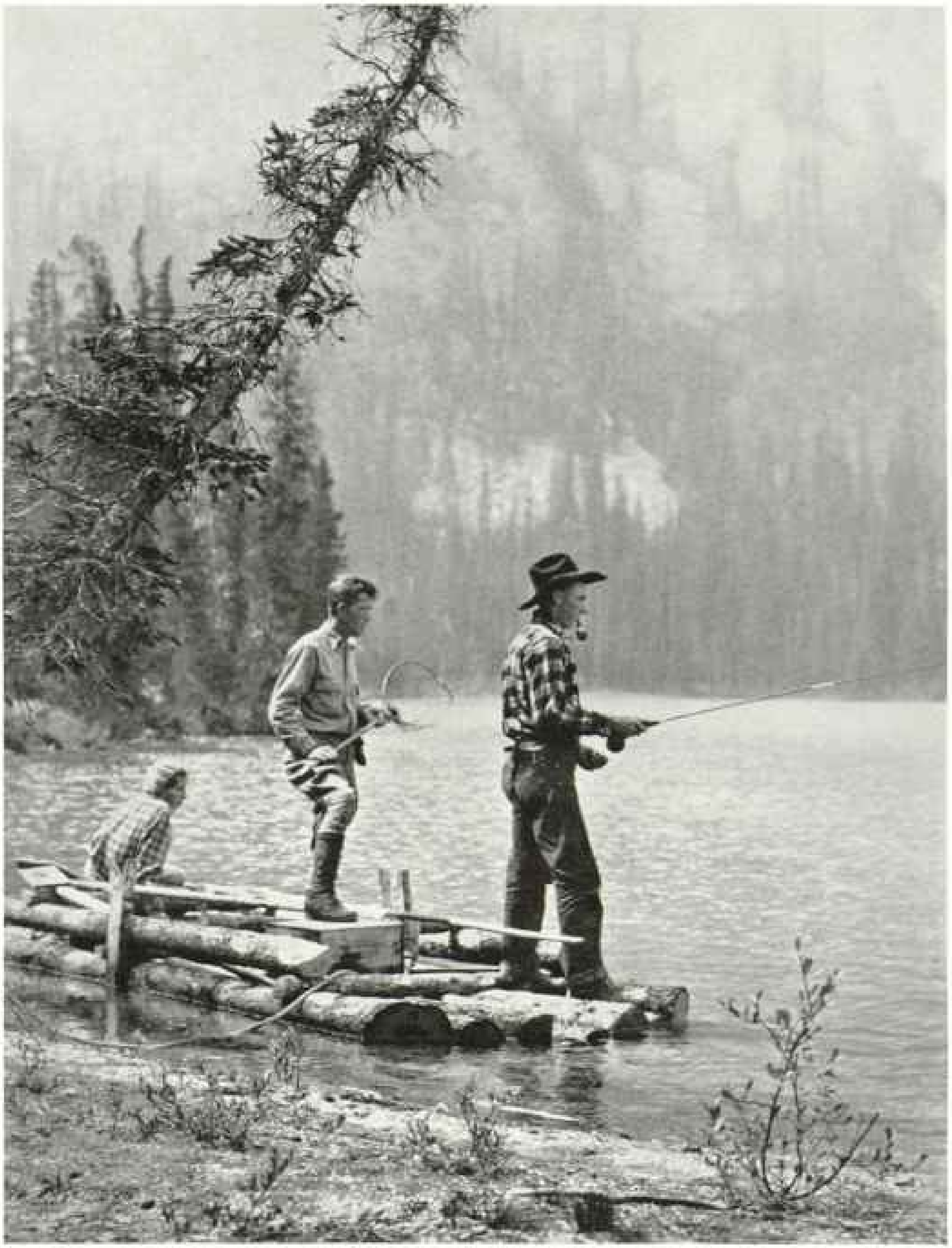
Largest of the species of Pacific salmon in the genus *Oncorhynchus*, family Salmonidae, the chinook, or king, salmon occurs from northern Japan to Alaska and southward to Monterey Bay, California (Plate VIII).

Its average size is about 22 pounds, though a record fish taken at Klawock, Alaska, weighed 101 pounds without the head. Usually the flesh is a deep salmon-red, but in some localities it is pinkish.

The chinook salmon usually migrates in the spring, April to June, and another run occurs in the autumn, August to November, the time of the migration depending on the river. In the larger rivers, such as the Columbia, an additional migration takes place in the summer, with stragglers going upstream most of the time.

These fish enter the smaller tributaries, where they seek gravel riffles on which to spawn. The average female produces from 3,000 to 11,000 eggs, which, buried in the gravel at the bottom of the nests, hatch during the winter or in the spring.

The young remain in fresh-water streams for a year or two, feeding mostly on aquatic insects and worms, and when a few inches in length migrate to the sea. They usually return to spawn in their fourth or fifth year.



Photograph by H. Armstrong Roberts

TO THE REMOTEST MOUNTAIN LAKELETS, ANGLERS PURSUE THE WARY TROUT

Because no boats are available, this party in Jasper Park, Alberta, has constructed a raft. Rainbow and Dolly Varden trout abound (Plates III and XII). Most western trout rise readily to the fly, though bait is best for certain waters. Every year in Pacific and Rocky Mountain States millions of hatchery-raised game fish are distributed to the more heavily fished streams and lakes. Some of the more remote lakes are stocked by dropping parachute-equipped cans of baby trout from airplanes (page 212).

Photograph courtesy U. S. Army Engineers

FISHERMEN EMPTY BIG SALMON FROM A DRAG SEINE, AFTER HAULING IT IN THE CURRENT OF THE COLUMBIA

On a float at the right is a motor-driven drum which winds in the net. A horse, partly hidden by the man with the fish, assists.

Photograph by Les. T. Ordonsan

A RECEPTION COMMITTEE OF ANGLERS WELCOMES THE SPRING RUN OF CHINOOK SALMON TO OREGON'S WILLAMETTE RIVER

Hundreds of families from near-by Portland, Oregon, troll for the savage fighters by anchoring their boats in the swift stream (Color Plate VIII). Since the salmon do not feed in fresh water, they apparently strike the wobbly spinners because of anger.

In the sea they feed voraciously on herring, anchovies, and other marine animals. They are caught in traps, purse seines, haul seines, gill nets, and by trolling. The total commercial catch for this species along the coasts of the three Pacific Coast States averages some 33 million pounds annually, with a value of $1,500,000 to $2,500,000.

King salmon are caught on spoons, spinners, dead whole herring or sardines, and other small fishes fixed on large hooks attached to wire leaders with sinkers that will carry the lure to considerable depths as it is trolled behind a boat.

Silver, or Coho, Salmon

(*Oncorhynchus kisutch*)

Along the coastal regions of the North Pacific, from Japan to Alaska and southward to Monterey Bay, the silver, or coho, salmon, average weight five to eight pounds, is taken commercially by trolling and in haul seines, purse seines, gill nets, and traps (Plate VIII).

The flesh, which varies from pinkish to deep salmon red, is canned extensively. About 20 million pounds are taken annually in the United States, the value of the catch ranging from a half million to nearly a million dollars.

Large quantities of the fish caught are quick-frozen and glazed, then stored in modern refrigerator plants, where I have seen them piled up like cordwood. As the market will absorb them, they are shipped to the East. Some coho salmon is smoked, or kippered, making a delicious product. Eggs or roe of this species are used in making salmon caviar.

Although the silver salmon does not grow so large as the king salmon, it is a little more gamy when caught on hook and line, usually making several long, swift runs and two or more leaps from the water. The king salmon does most of its fighting under water.

The life history of the silver salmon is much like that of the other Pacific salmons. Spawning occurs in fresh-water streams in late summer and autumn, the time varying according to latitude from August to December. In Alaska the migrations occur in summer. After a year or two in fresh-water streams, the fingerlings, then from two to four inches in length, migrate to sea, where they remain from one to three years. They come back in their fourth or fifth year to spawn.

The ages of these salmon, as of the other species, can be read with fair accuracy from their scales. During the growth of the scale permanent concentric rings are laid down in the material of which it is formed. In seasons of rapid growth these rings are spaced farther apart, but in winter months, when growth is slow or at a standstill, they are closer together and irregularly spaced. Thus each season leaves its record in the scale rings, much as the age of a tree is recorded by rings of annual growth.

Red, or Sockeye, Salmon

(*Oncorhynchus nerka*)

The red, or sockeye, salmon, also known as blueback salmon, is similar to the other Pacific salmons, occurring from northern Japan to Alaska and southward to San Francisco Bay, California. It averages about five pounds, with a maximum of twelve pounds, and a length of about three feet (Plate IX).

It is taken commercially in purse seines, haul seines, traps, and other nets, but not by trolling, since it rarely strikes bait. The flesh is deep red and, when canned, is of excellent flavor. Annually in the United States from 7,000,000 to 25,000,000 pounds are taken, with a market value of $500,000 to $1,500,000.

The sockeye differs from other Pacific salmons, in that its eggs are usually laid in streams tributary to lakes. The young, after emerging, descend to a lake where they live from one to three years, or occasionally four years, before migrating to sea.

In the lake they feed upon plankton, mostly copepods and cladocerans, and do not grow fast unless there is an abundance of food. They migrate to sea at a size of from two to seven inches and continue to feed on the animal organisms making up the oceanic plankton. Usually they stay two to three years in the sea and return to spawn in fresh-water streams in their fourth to seventh year.

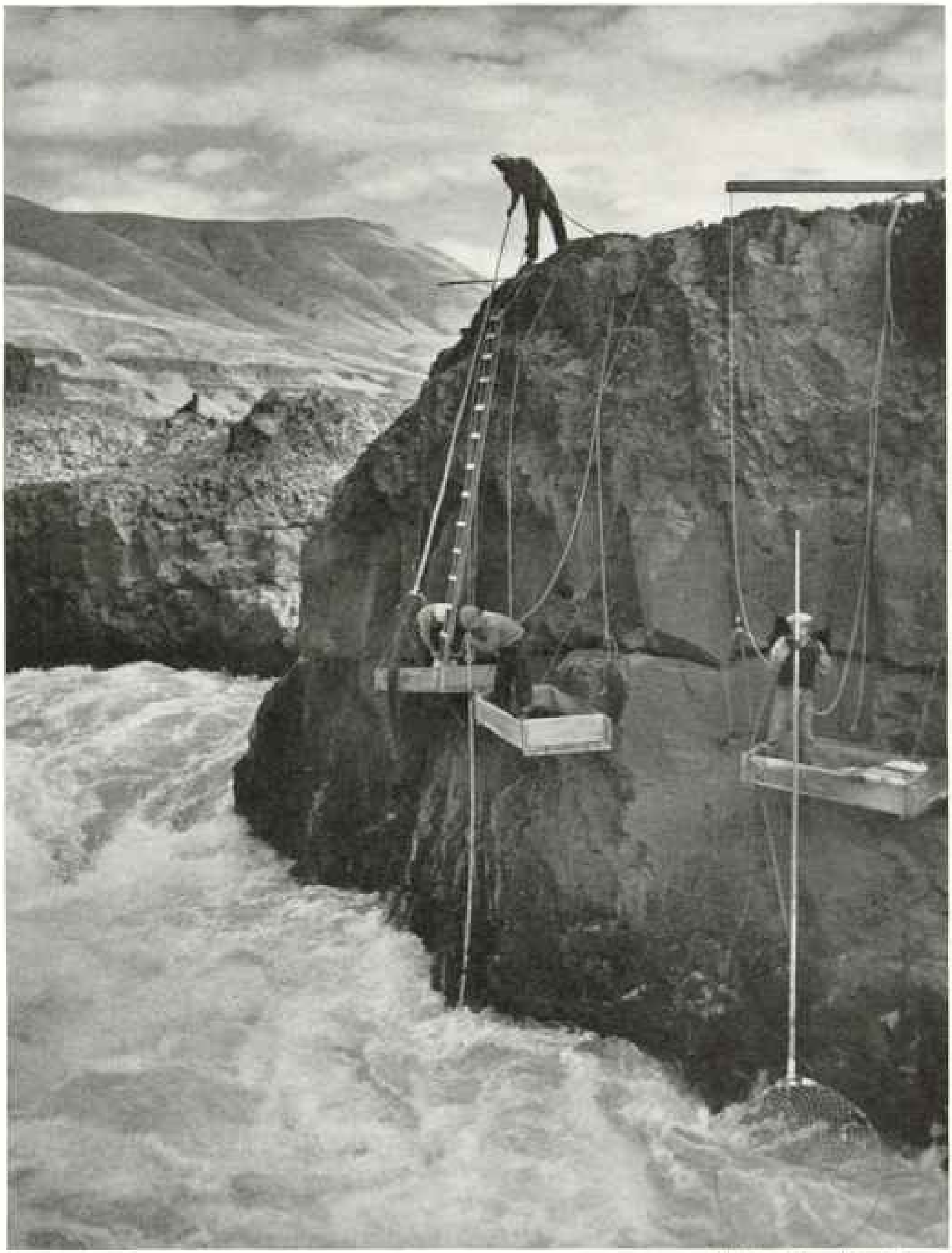
Some of the red salmon are landlocked in lakes, never going to sea, although they could. These landlocked red salmon, or redfish, just like their larger seagoing brothers and sisters, engage in normal nest building when unmolested by other fish.

The nests are continually changing, because after the female deposits a portion of her eggs she covers them with gravel, and, as she progressively excavates one or more new nests upstream, some of the excavated material of the new locations covers the eggs in the older nests—a real conservation of energy.

Both male and female defend the nest against invading fishes. Sometimes when an unwelcome male approaches, he is escorted away by the male owner of the nest. The defender will swim slowly toward the invader and, when a foot or so away, turn nearly parallel to him. The two then proceed slowly upstream for a few yards, before the invader either goes his own way or makes a dash for the nest. Should the latter happen, the escorting act may occur again.

If the invading male can drive away the original owner, he takes possession. Several males usually pair off with the female owner of a nest before she has laid all her eggs.

Courtship activities occur, too, as part of the breeding behavior of redfish. The male will often touch his head or snout to the female's body or move his body toward and against hers. Frequently the male will swim



Photograph from Three Lions

ROPED FOR SAFETY, INDIANS LIFT SALMON FROM THE ROARING COLUMBIA

The wide-mouthed dipnet is repeatedly swept down with the current until an upward-bound salmon is caught. Then the net is hauled up hand-over-hand to the fisherman's stand, firmly moored to the rocks. A big, fighting salmon sometimes upsets a fisherman's balance and would tumble him into the rapids were he not protected by ropes attached to his belt. The man silhouetted against the sky has let down a ladder to one platform and is about to pull up a catch. Several fat salmon lie in the box at the right.

back and forth over the female when she is resting near the bottom of the nest, or he will nudge her in the side with his snout. Spawning occurs in the nest, the eggs and milt being shed at the same instant.

At one time the greatest of all sockeye salmon streams was the Fraser River of British Columbia. The main part of the catch by Puget Sound fishermen was made as these fish were migrating to this magnificent salmon stream. But in 1913 and 1914 heavy slides occurred while a railroad was being built, blocking the migration of the sockeye to their spawning grounds. Up to the present the sockeye have not regained their former abundance in this river, even though the obstructions to their migration have been removed.

To remedy the lack of rebuilding of the sockeye salmon stock in the Fraser River, the United States and Canada, on July 28, 1937, ratified a treaty for the study of this species.

Pink, or Humpback, Salmon

(Oncorhynchus gorbuscha)

Though pink, or humpback, salmon are found from northern Japan to Alaska and southward to central California, they are taken commercially in large quantities only from Puget Sound northward. Throughout their range they pass part of their life cycle in the sea and part in streams (Color Plate X).

In southeastern Alaska these fish begin their migration from the sea in late June and continue until late September, but do not migrate far upstream to deposit their eggs. They usually spawn in the smaller streams not far above tidewater, or in the smaller tributaries near the mouths of the larger rivers.

Spawning does not begin in the streams until the middle of August, and the fry remain all winter, emerging from the gravel of their nest the next March or April, when they migrate directly to the sea at a length of about one inch. They remain in the sea for a year and a half and return to spawn at two years of age.

While at sea they grow to an average of three to eight pounds. An 11-pound pink salmon is considered record size. Thus the species is the smallest of the Pacific coast salmons.

It differs from the other species of salmon in having very small scales, even smaller than those found on the steelhead trout.

The name "humpback" is derived from the hump found on the back of the male while on its spawning grounds. A hooked snout, too, develops on the male as soon as it enters freshwater streams for spawning. The humpback is caused by the sudden formation of cartilaginous tissues between the back of the head and the beginning of the dorsal fin. The hooked snout results from rapid elongation of bones in its upper part.

For these and other salmon to be of commercial value they must be caught while on their way to the stream mouths before they enter fresh water. Their flesh loses its best flavor by the time the humpback and hooked snout have developed.

Only about 200,000 pounds of pink salmon were caught in the Pacific Coast States in 1934; nearly 300 million pounds were landed in Alaska that year. The fish is taken commercially in purse seines, haul seines, and traps. Since it does not take the hook like the silver and chinook salmon, it is not considered a game fish.

Chum, or Dog, Salmon

(Oncorhynchus keta)

The chum, or dog, salmon occurs from northern Japan to Alaska and southward to the Sacramento River (Color Plate XI).

Like fry of the pink salmon, the young go down to the sea immediately after they emerge from their nests and remain there until maturity. In their third to sixth year they return to the fresh-water streams of their birth to spawn and die. This migration occurs in Alaska from June to November.

At spawning time they have attained a length of from two to three feet and a weight of from 5 to 12 pounds, never more than 16 pounds.

The careful observer has little difficulty in distinguishing the sexes of breeding salmon and trout, for the breeding male is usually more highly colored than his mate and his body is compressed (sides flattened), while that of the female is more rounded. Usually the snout is somewhat hooked or arched in the male; that of the female is normal.

Experienced fish culturists are able to tell the sex of spawning salmonids by feeling them with their hands, the males having on the underside of the abdomen two hard ridges.

The chum salmon builds nests on gravel riffles of streams and deposits its eggs in a manner similar to that of other species of salmon and trout. Eggs and milt are discharged at the same time, and Nature has so beautifully co-ordinated each step in the breeding activities that the eggs, or ova, are fertilized the instant they are shed. Otherwise they would probably not be fertilized at all, for the current would carry the sperm downstream from the nest.

The chum salmon is not sought by sportsmen, since it does not take artificial lures or bait. The commercial catch is taken in traps, purse seines, and other nets.

The flesh is pale pink and, when canned, rather light yellowish. It is especially good for freezing, salting, and smoking, but is of an inferior quality when canned. In former years the chum salmon was not taken very extensively for commercial purposes, but in more recent times, for example in 1934, more than 73 million pounds were caught in Alaska and nearly 11 million in the States.

Photograph from Art French, Seattle Post-Intelligencer

LIVE FISH PERFORM A SUCCESSFUL PARACHUTE JUMP

To test the stocking of remote lakes by airplane, baby trout were dropped into Lake Washington, Seattle. Hatchery officials found that none was killed. Those recovered were uninjured. Subsequently, cans of fish were parachuted into an isolated mountain lake from heights of 150 to 1,000 feet. Strapped to boards "quilted" with cushions, the containers overturned when they struck the water and the fish swam free.

Dolly Varden Trout

(*Salvelinus malma*)

Like its nearest relative, the eastern brook trout, the Dolly Varden belongs to the charrs. These two species differ from other trout (*Salmo*) in having light spots on a darker background instead of black spots on a lighter background. Also they have on the sides of the body a few scarlet spots, which are never present in rainbows, cutthroats, or salmon (Color Plate XII).

Dolly Vardens occur from northern Japan to Alaska and southward to northern California. Throughout this vast area they inhabit the coastal streams, often going to sea as "steelhead Dolly Vardens" and growing to large size. In most Alaskan streams they occur in schools. They are found as far up as the headwaters of the Flathead River in Glacier National Park, and I have also taken them in the headwaters of the Saskatchewan River.

Fish measuring two and a half feet and weighing from 8 to 10 pounds are common, and some reach a weight of 20 pounds or more. Voracious feeders, they strike almost anything that moves in the water, living mostly on small fish such as salmon and trout. Because they prey on young trout and salmon, they are out of favor with sportsmen.

They will take lures, such as artificial minnows and spinners, and will rise to a fly. The flesh, which is delicious when properly cooked, is often of a pale pink color similar to that of the Yellowstone black-spotted trout (Plate IV). Thus both of these species are known in some localities as "salmon trout."

The Dolly Varden trout is an autumn spawner. The adults pair off over gravel riffles and build saucer-shaped nests in which the eggs and milt are deposited at the same instant. These are then covered, and hatching occurs some weeks later. After spawning, the large adults usually go back downstream to lakes or to deeper holes of larger streams and remain most of the year. The young, found in the streams in summer, feed on aquatic insects, worms, copepods, and other small animal organisms.

HAPPY LANDING IN BERMUDA

By E. John Long

ONE brisk spring day I walked down a long gangplank at Port Washington to the float where the red-winged *Bermuda Clipper* was moored. With a score of other passengers I went aboard through a hatchway near the tail. Each of us was assigned to a seat preselected according to our weight.

The engines opened up with a roar that became a dull, steady whine as we lifted gracefully from the surface and wheeled over Long Island. Climbing steadily, we soared above country estates, truck farms, and finally the narrow strip of white sand that was to be our last sight of land until we raised Bermuda's outer reefs, nearly 775 miles southeast.

After the first half hour's novelty of looking down 9,000 feet on a sun- and cloud-dappled sea, most of the passengers began to read, and one or two dozed.

Presently the steward spread the table for luncheon, a four-course meal that included olives and celery, hot mushroom soup, chicken à la Maryland, salad and ice cream, followed by coffee and mints. This is the famous "300-mile luncheon"—the distance covered during the serving. The big Sikorsky (S42 B) plane rode so steadily that not a drop was spilled.

For some time after lunch the sea was hidden by an undulating blanket of gray vapor, but once, when the clouds opened up, we saw the liner *Queen of Bermuda* plowing a white track through the blue sea. From our dizzy height the 22,000-ton vessel seemed a toy ship.

"The *Queen* left New York yesterday afternoon and she reaches Bermuda tomorrow morning," the steward told us.

Breaking through a mottled ceiling of clouds, we saw far ahead of us a dark patch on the horizon, Bermuda. But my gaze was drawn irresistibly below, for we were now over the outer reefs, those dread barriers in the days of early sailing ships and later Bermuda's bulwark against marauding pirates and privateers (pp. 216-7).

There was scarcely time for a glimpse before we were coasting down on the north shore, with its white-roofed cottages set among green hills and gardens, and all tied together with ribbons of coral road. Skimming past Government House and the white city of Hamilton, the capital (page 232), we glided over the still harbor and settled to a stop in a cloud of spray opposite the steel hangar and concrete ramps on Darrell Island (page 233).

While instruments were being checked and baggage unloaded, I had a chance to look at the base which Imperial Airways has built here in preparation for the day when Bermuda may be a stepping stone on a Middle Atlantic air route to Europe. Other bases are planned for the Azores and Lisbon, Portugal.*

"WE BROKE A RECORD!"

We broke the record! Pan American announced it officially as 4 hours and 14 minutes—46 minutes under the scheduled five-hour Port Washington-Hamilton run. A launch took us to the Hamilton water front.

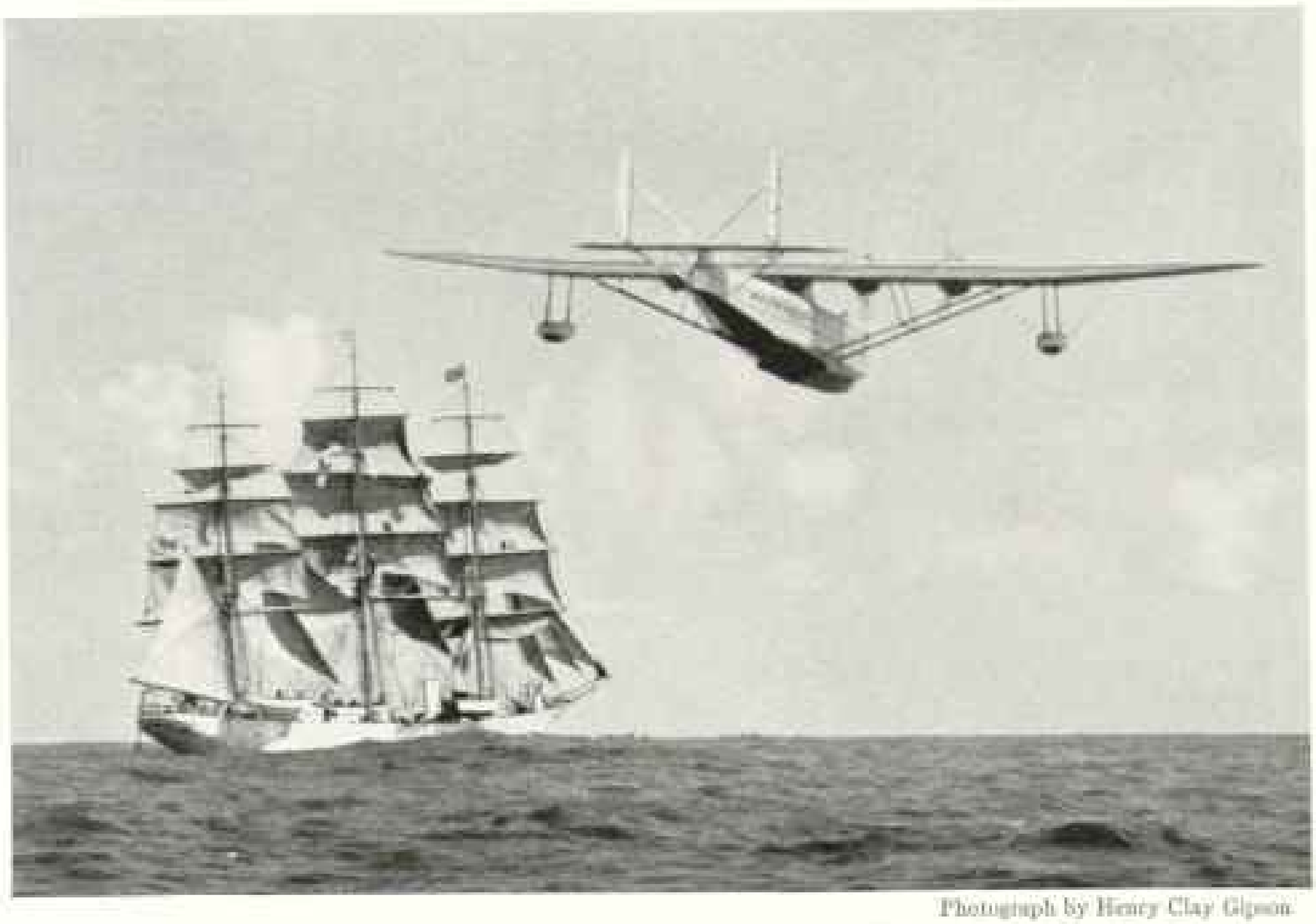
Breakfast in New York; afternoon tea in Hamilton! In place of automobile horns, factory whistles, traffic lights, skyscrapers, subways, and hurrying throngs, there was the clippety-clop of horses' hoofs, the jingle of bicycle bells, carriage drivers wearing pith helmets, "bobbies" directing traffic that keeps to the left, business men in shorts, veranda cafés, the dazzling cleanliness of pastel-colored buildings and low, white-roofed houses.

The Atlantic has few islands; none is near Bermuda. The sea hereabouts quickly drops off into depths of from 12,000 to 15,000 feet. If Bermuda were lowered only 300 feet, it would not show on the map.

"Why is Bermuda?" Geologists reply that its aeolian limestone hills and coral reefs rest on the top of a submarine volcano. Delicate stalactites and stalagmites in Bermuda caves have been forming undisturbed for an estimated 100,000 years or more. Almost all of visible Bermuda is limestone, which ashore is covered by thin layers of reddish-brown earth and on the sea shelf by a veneer of living tropical coral—the farthest north the latter is known to grow.

Governmentally, Bermuda is one of those British anomalies which are confusing to outsiders. It is not a Crown Colony, like British Honduras or Fiji, nor is it a Dominion like Canada or New Zealand. Rather,

* See "European Outpost: The Azores," by Harriet Chalmers Adams, National Geographic Magazine, January, 1935, and "Castles and Progress in Portugal," by W. Robert Moore, February, 1938.



Photograph by Henry Clay Gipson

OUTWARD BOUND FROM BERMUDA, CLIPPERS OLD AND NEW PASS AT SEA

A remarkable contrast in transportation was afforded in September, 1937, off St. David's Head, when the full-rigged ship *Seven Seas* was overtaken by the *Bermuda Clipper*, giant Sikorsky plane of the Pan American Airways. The latter reached Port Washington, New York, five hours later; the *Seven Seas* arrived off Newport, Rhode Island, in seven days.

it is a colony with representative government somewhat like that of 17th-century England. Bermuda manages most of its own affairs, but only 10 per cent of its citizens vote; the franchise is restricted to adult males, white or colored, owning $300 or more worth of property.

Although the Governor has the power to dissolve the Colonial Assembly and to veto bills, he has little control over legislation. The present Governor, for instance, has made several requests for permission to obtain a motorcar, pointing out that garbage may ride, but not he. His petitions have been denied.

Bermuda's much-publicized motor laws make it illegal to *operate* automobiles on the public roads. As most roads are public roads, the statute in effect bars the general use of motor vehicles (page 215).

Yet Bermuda has kept step with the times by motorizing its fire department, ambulances, sanitation and highway trucks. There is also a motor lorry for hauling freight too heavy for wagons. Private cars spin over nearly two miles of private roads in the Mid Ocean colony at Tucker's Town.

My rented cottage, in the Pitt's Bay district overlooking Hamilton Harbour, like many others in Bermuda was built of limestone dug from the ground (page 236). The house had the characteristic "cake frosting" roof made of thin slabs of the same material, whitewashed until it was dazzling in the sunlight, and blue jalousies —shutters opening from the bottom.

WHY ROOFS ARE KEPT CLEAN

A clean roof is important. From it is collected the water used for drinking, cooking, bathing, etc. Until recently Bermuda had no waterworks, and the present one, with horizontal instead of vertical wells, serves only Hamilton and vicinity (p. 237).

Because a porous soil allows surface water to seep through quickly, there are no springs or rivers. I arrived during one of the periodic droughts. Water was imported as ballast in ships from New York and distributed by tank wagons and highway trucks. Part of the incidental intelligence I picked up in Bermuda as a cottage-renter during a drought is that it requires five gallons of water to flush a toilet!

Photograph from Bermuda News Bureau

NOT A BREAKDOWN; HE FORGOT TO APPLY FOR A SPECIAL MOTORING PERMIT

Not until the steamer delivered a beach bus in Hamilton did the manager recall that he had not yet obtained a pass to drive it to the hotel. As the Police Department requires a 24-hour wait before issuing a permit, he decided it would be easier to have a team of horses haul the car. Bermuda law does not bar motor vehicles from the Colony; it simply prohibits their operation over public highways. This rule does not apply to Government road trucks, garbage trucks, fire engines, and ambulances. Automobiles are permitted on private roads also.

The water tank may be buried in the yard, or it may be a barrel-roofed cistern above ground. Electric pumps raise the water to kitchens and baths. In my cottage electricity was used for cooking, refrigeration, heating water, lighting, ironing, etc. Power, produced by huge Diesel engines in Hamilton, now is carried to every parish in the Colony.

Bermuda shops and some 2,500 homes have automatic dial telephones. Bermuda is a telephone pioneer, having opened a line between Hamilton and St. George eleven years after Dr. Alexander Graham Bell invented the telephone in 1876.

Because Bermuda's climate is semitropical, spiders and toads assume terrifying proportions, but are harmless. Chief noisemaker in the garden is a tiny frog, no larger than your thumbnail, whose raucous "bleebleep" makes the first night or two sleepless.

Every Bermuda cottage has a garden, whether it be simply a few plants and shrubs growing in an old quarry, or a whole hillside of exotic blooms and strange trees. Generations of seafaring men have brought to its hospitable red soil nearly every tree and plant that will grow in the subtropics.

My cottage had a dozen trees and little better than the average diversified flower garden; yet I identified the pride of India, ebony, Bermuda cedar, date palm, coconut palm, sago palm, palmetto, papaya (locally called "pawpaw"), tamarisk, lemon, loquat, bay grape, hibiscus, poinsettia, night-blooming cereus, morning-glory, match-me-if-you-can, croton, pink oleander, coralita, star-of-Bethlehem, red lily, white lily (Plate VI), rose, and periwinkle.

The railway winds through the heart of Bermuda from St. George to Somerset. After long and stormy debate in Parliament, and dire forebodings, the line was opened in 1931. It has become so firmly entrenched that I heard no criticism of it, except that "statutory trains" run mostly at times no one wants to ride them.

"What are 'statutory trains'?" I asked.

"To obtain a franchise the railway agreed to run three to six trains a day at a reduced

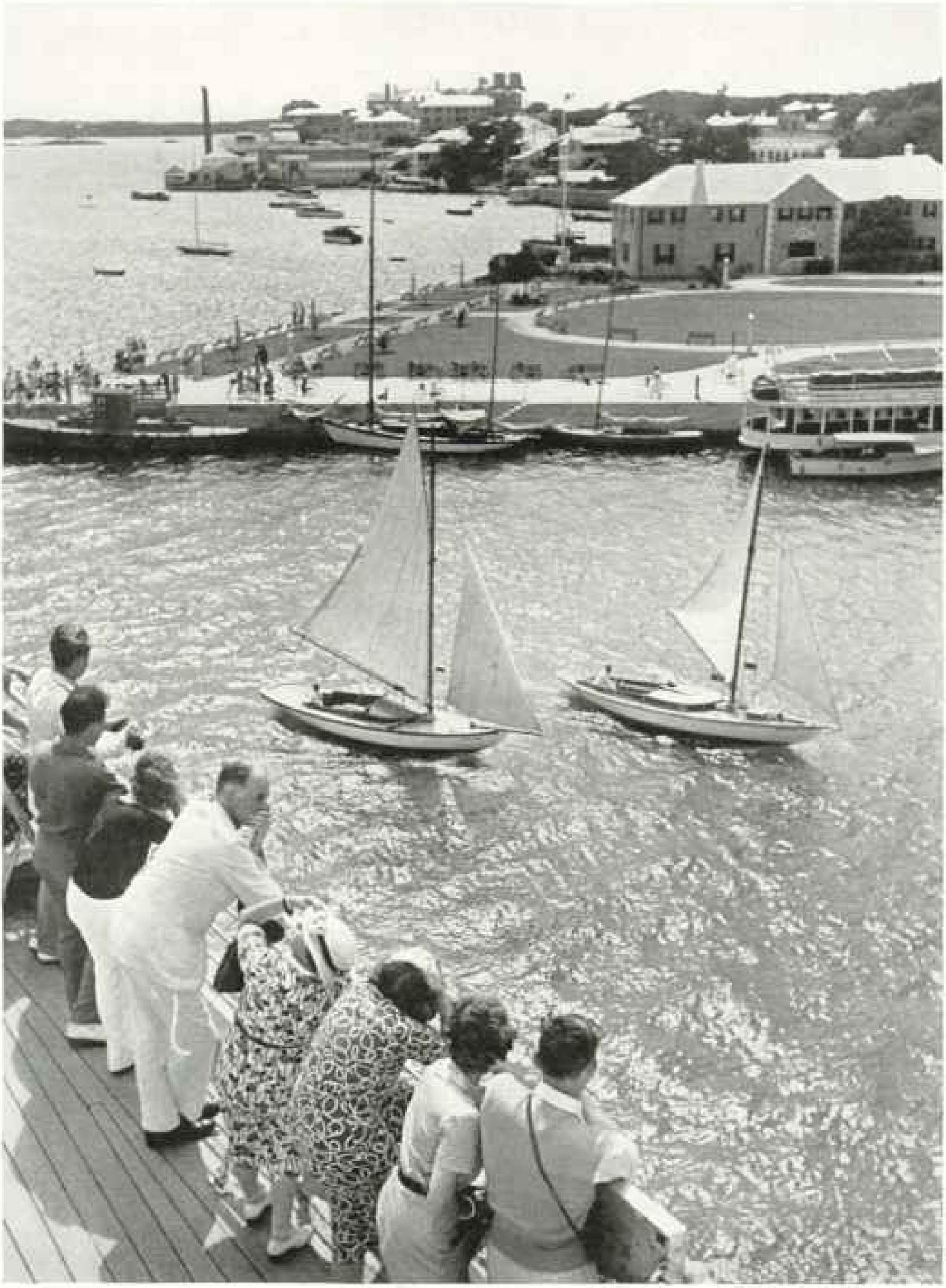
A FEW SPECKS ON THE LIMITLESS EXPANSE OF THE BROAD ATLANTIC

To make this unique photograph of the entire Colony on a single negative, the National Geographic Society sent Mr. J. C. Gregory especially to Bermuda in November, 1938. Through the courteous co-operation of the Royal Air Force squadron stationed at Ireland Island (hidden by clouds), a seaplane piloted by Flight Lieutenant W. H. C. Manson was provided. After patiently waiting for nine days for clear weather, the flyers took off, soared to an elevation of 13,000 feet, and made this exposure 25 miles east of Bermuda.

Photograph by J. C. Gregory, courtesy of Royal Air Force

ALL OF BERMUDA IN ONE EXTRAORDINARY AERIAL PHOTOGRAPH

The island group rises abruptly from abyssal Atlantic depths 640 miles from the nearest land, Cape Hatteras. The larger islands in the foreground, from right to left, are St. George's, scene of the first settlement, St. David's, Cooper's (with white beach), Nonsuch, and Castle. The biggest, Hamilton, is partly obscured by clouds (left). Through a rift (left center) peeps Somerset. Although its climate is semitropical, Bermuda is nearer to Nova Scotia (765 miles) than it is to Miami (1,040 miles).



Photograph by Knopf from Pix

SAILING CRAFT SALUTE "RAILBIRDS" ON A DEPARTING LINER

Bright mid-afternoon sun sparkles across the blue waters of Hamilton Harbour. The low building facing the little park is the new home of the Royal Bermuda Yacht Club, which, with the Cruising Club of America, sponsors every other year a sailing race between the United States and Bermuda.

Photograph by Henry Clay Gipson

ALL THE THRILLS OF AQUAPLANING, WITHOUT GOING AN INCH!

Bermuda has no rivers, but through the inlet at Flatts Village a tidal current swift as a mountain stream rushes several times a day. It is the only outlet for vast, spreading Harrington Sound. The bridge affords a handy place to attach a surfboard if you cannot afford a speedboat. Through the cedars in the background are the buildings of the Government Aquarium (page 229).

fare," a railroad official replied. "These are officially known as 'statutory trains'—at times humorously referred to as 'stationary trains.' There is no difference in equipment, however, and they make the same number of stops."

If you like to be on the go—and who does not in these "Isles of Rest"?—the bicycle is your ultimate steed, as it was mine. Every Bermudian—rich man, poor man, merchant, lawyer, doctor, housewife, judge, and maid—has one. Bermudians ride bicycles to work, to the stores, to movies, to church, and even to formal parties (pages 230-1).

My first bike safari was via the Middle Road from Hamilton through Devonshire, Flatts Village, and Tucker's Town to St. George. The sun was so bright the glare from the white road would have been blinding without dark glasses.

Weaving in and out among the carriages, wagons, and bicycles of busy Front Street, I came to the long, steep grade that climbs to Prospect Camp, British Army headquarters in Bermuda. For such a small, low-lying island, Bermuda has hills that rise like mountains—to cyclists' eyes and legs!

My first stop was at the Watlington Water Works, down a shady side road leading to Devonshire Marsh. Bermuda has long depended upon water caught on roofs or hillside watersheds.

Vertical wells are not practical because sea water seeps in from beneath. About a decade ago Henry W. Watlington noticed that fresh water from hills surrounding Devonshire Marsh "floated" on underlying salt water because fresh water has less density than salt. So he suggested the idea of horizontal wells made of porous pipes

laid in the marshy soil to "skim" the fresh water off.

When the Colonial Parliament would not advance money for the project, the doughty proposer bit on his pipestem, ignored scoffers, and raised the funds himself. The scheme worked and the company now supplies the Hamilton district. For this and other services to Bermuda, Mr. Watlington was knighted by King George V.

The water works is a low-roofed building where water is pumped in from the porous underground pipes. Here it is purified, softened with chemicals, and raised to storage tanks on the hills. Over the door an inscription in Latin, *Diripit Petram ex Flexerunt Aquae* (I Struck Rock and Water Flowed), explains why Sir Harry is known also as "a Bermuda Moses."

In Bailey's Bay, near the junction of the north and south shore roads to St. George, I saw one of Bermuda's flourishing new industries—the extraction of perfumes by the *enfleurage* process, still widely employed in France. I watched while fragrant blossoms—oleander, passionflower, lily, jasmine, sweet pea, and gardenia—from near-by gardens were placed on trays of prepared fat, which, after many repeated applications of fresh flowers, became saturated with flower odors (Plate VI).

An alcohol solution next absorbed the flower material. Blending with a fixative, civet from Ethiopia, musk from Tibet, or ambergris, followed. After aging four months, the bottled perfume is packed in small chests of mahogany and native cedar.

With the wind whistling in my ears and tires whirring, I gave my bike free rein on the smooth downgrade past the Blue Hole to the Causeway. A long series of small bridges and raised embankments crossing upper Castle Harbour, the Causeway is the only road link with St. George.

A little farther along I could see white verandas and the laboratories of the Biological Station, where I spent an August with Dr. William Beebe, noted oceanographer, during the National Geographic Society Deep-Sea Expedition. In Dr. Beebe's cottage *Nonsuch*, near by, the world-record Bathysphere dive, in which the National Geographic Society co-operated, was planned and the fascinating record of hitherto unknown submarine creatures was written.*

However hackneyed, no word describes St. George as well as "quaint." Bermuda's first town, this fragment of the Old World retains much of its 17th-century charm. Even the railway, as if hesitant about intruding, stops far short of Market Square.

Most of its streets are winding, narrow lanes, bearing such curious names as Shinbone Alley, Old Maid's Lane, Featherbed Alley, or One Gun Lane. Squat cottages and tiny shops, their thick walls softened with the patina of age, crowd each other closely in the center of town, but those up the hillside hide behind gardens and white walls, overrun with bougainvillea, frangipani, and flaming hibiscus.

Founded in 1612, only five years after Jamestown, Virginia, St. George was Bermuda's capital until 1815. During the American Revolution, when Bermudians wavered between loyalty to George III and sympathy for American cousins, St. George was the scene of a "gunpowder plot." In the dead of night a party of Americans landed near the town and quietly rifled the British military stores on Government Hill. The powder was used in the fighting around Boston in 1775.

During the American Civil War, St. George awoke to find itself in the blockade-running trade. Swift, rakish Confederate raiders and blockade runners piled its wharves high with baled cotton and dashed back to Southern ports on cloudy, stormy nights with munitions, medical supplies, and food transshipped from Europe.

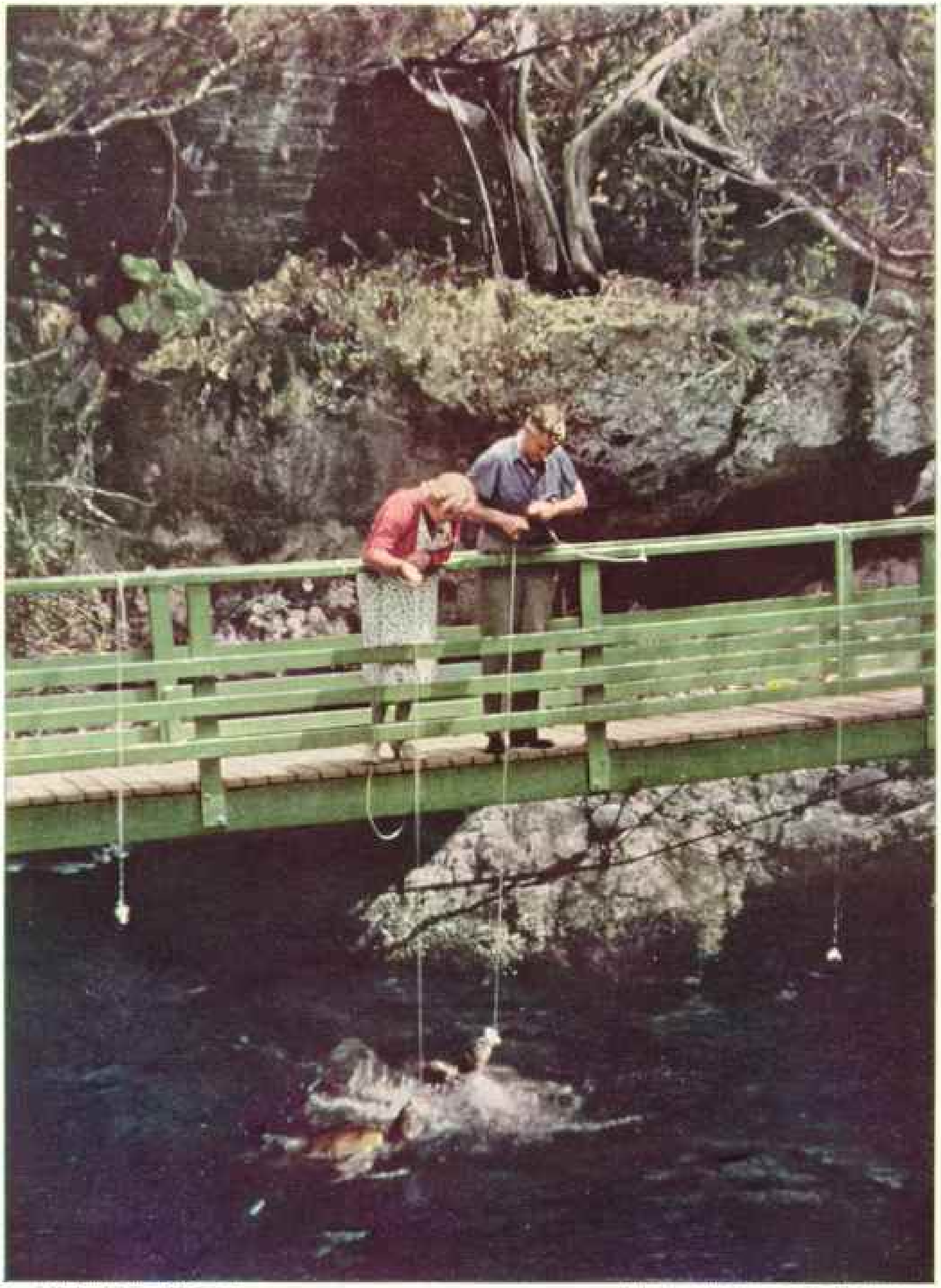
Along the St. George water front noisy grogshops and taverns seethed with intrigue, plots and counterplots. Here gathered the "Rhett Butlers," or their agents, to contract and bargain. Brawling sailors, adventurers, spies, and Secessionists spent their gold so freely that merchants often brushed it uncounted into a box beneath the counter, shoveling it into a safe at the end of the day.

For nearly three years high adventure ruled this crossroads of the Atlantic, but the boom collapsed with the Confederacy.

St. George's newest addition is the Meteorological Station. From the bastions of old Fort George, 150 feet above sea level, its signal-light poles and flagstaffs raise their arms, sometimes in salute, sometimes in warning when a hurricane comes roaring up from the south.

It is a short ferry ride across St. George's Harbour to St. David's, the most primitive and the least known of the larger islands of

* See "A Half Mile Down," by William Beebe, NATIONAL GEOGRAPHIC MAGAZINE, December, 1934.



 Kodachrome Photograph by E. John Long

TURTLES KEEP THE LINES BUSY AT THE DEVIL'S HOLE

Hookless tackle, baited with pieces of dried meat, attract groupers, snappers, turbots, angelfish, and other swimming creatures at this natural aquarium near Harrington Sound. Generally the big turtles crowd out all rivals for the bait. The "catch" lets go as soon as it is pulled out of the water. The Devil's Hole was named by early inhabitants, who were awed by strange noises made by the water entering through subterranean passages at low tide.

READY FOR A CALL ON DAVY JONES IN HARRINGTON SOUND

Some of Bermuda's finest "scenery" lies under the ocean, where brilliantly colored fish swim among coral reefs, sea anemones, sea fans, and old wrecks.

Kodachrome Photographs by E. John Long

FRAGRANT CEDAR MAKES FINE SOUVENIRS

One of Bermuda's "oldest inhabitants" is the native juniper, usually called cedar, which once fostered shipbuilding. Early houses were built from it.

Kodachrome Photograph by E. John Long

CRUMBLING BASTIONS OF FORT ST. CATHERINE FROWN DOWN ON A CORAL STRAND—BUT ITS ONLY BATTLES HAVE BEEN WITH WAVES

Bermuda has many sheltered bathing beaches such as this sunny cove on St. George's Island. Built early in the 17th century by Bermuda's first governor, Richard Moore, the fort was one of eight that guarded the original capital, St. George. The islands' history really began in 1609 when the *Sea Venture*, bound for Virginia with a load of colonists, was wrecked near this spot. From native cedars the castaways built two pinnaces in which they continued their voyage to Jamestown, leaving two deserters who became Bermuda's first settlers.

 Kodachrome Photograph by E. John Long

A STRANDED PORTUGUESE MAN-OF-WAR ATTRACTS A BEACH AUDIENCE

Following a storm, strollers along Coral Beach may find many strange creatures washed up by the sea, such as sea ferns, sea bottles, sargassum weed, bits of white and pink coral, and lovely iridescent jellyfish (lower left).

Kodachrome Photograph by Konstantin J. Kostich

THE DIVER'S LIFE LINE, THE BLACK AIR HOSE, GUIDES HIM BACK

Sense of direction may be quickly lost in the swirling eddies and pale-green twilight of Neptune's realm. To move, the diver leans forward and then takes a slow, gliding step like dream walking.

Kodachrome Photograph by Konstantin J. Kostich

THE LIFE OF A SAILOR IS "THE LIFE OF RILEY" IN BERMUDA

With so many bays, sounds, and inlets close at hand, hundreds of Bermudians own sailing craft and launches. Holidays are spent afloat—fishing, racing, or sailing to outlying islands for swims and picnics.

© National Geographic Society

Kodachrome Photograph by E. John Long

WITH A BLAST OF HER SIREN THE "MONARCH" SHOVES OFF FOR NEW YORK

Visitors are Bermuda's chief "industry." Luxury liners and planes bring thousands annually from the United States, Canada, and England. The delivery boy on the bicycle symbolizes all Bermuda on "Boat Day."

 Kodachrome Photograph by David Knudsen

SYMBOL OF EASTER IS THE BERMUDA LILY

Like vast glaciers, in a land that never sees snow, are the valleys in March and April when the lily is in bloom. Thousands of potted and cut blossoms are shipped each spring to the United States, Canada, and England. This fragrant Japanese lily has flourished here for a century.

Kodachrome Photograph by E. John Long

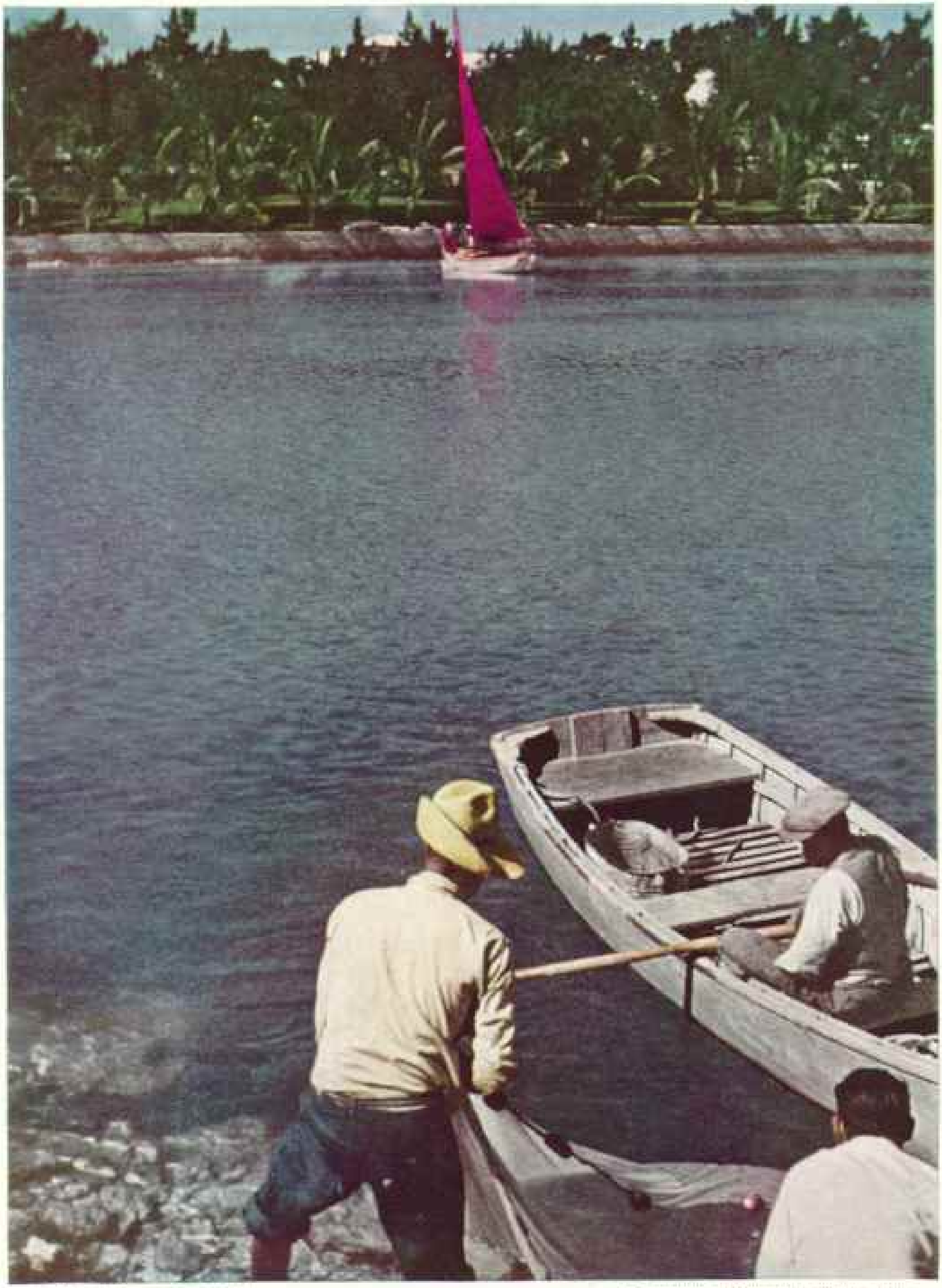
THE FIRST STEP IN THE MAKING OF PERFUME

A new Bermuda industry is the extraction of perfumes from native flowers. Here at Bailey's Bay passionflowers are being placed in a tray of fat which will absorb the flower odor. Other scents are oleander, lily, jasmine, sweet pea, and gardenia. When bottled, they are packed in cedar boxes.

Kodachrome Photograph by E. John Long

CRISP ORGANDIE, PRINTED CHIFFON, AND LEGHORN HATS BLOSSOM AT THE GOVERNOR'S GARDEN PARTY

Representatives of many American State and city garden clubs strolled among the palms, oleanders, and other tropical foliage in the grounds of Government House during a reception and tea given by His Excellency, Lieutenant General Sir Reginald Hildyard, Governor of Bermuda, and Lady Hildyard. Government House, on a hill, commands a panorama of the capital, Hamilton, its harbor, and the sea (left). The archdeacon (right center) wears knee breeches and silk hat.



 Kodachrome Photograph by E. John Long

CATCHING FISH FOR THE FISHES OF BERMUDA'S AQUARIUM

With a fine-mesh seine small fry are taken daily, rain, blow, or shine, from the placid inlet at The Flatts. The haul is usually whitebait and anchovies, much of which is fed to the penguins. The Government Aquarium, which has one of the finest collections of tropical marine fishes in the world, can be seen dimly beyond the red-sailed boat and the line of waving coconut palms.

Bermuda. A new steel bridge also links it with St. George's, but the island still has few roads and no hotels.

The pilot station commands a magnificent view of the channel approaching Bermuda. Near by rises St. David's Lighthouse, surrounded by rolling green fields where arrowroot, once the principal crop, still is grown. In recent years thousands of Easter lily bulbs have been planted. At Easter time St. David's valleys resemble belated snowdrifts, in a land that never sees snow.

WHERE BERMUDA HISTORY BEGAN

Commander Landman pointed out a shoal area off St. George, known as Sea Venture Flat. Here Bermuda's history as an inhabited island began. On these reefs the *Sea Venture*, flagship of the Virginia Company's third expedition to America, came to grief June 28, 1609. The party of 150 men, women, and children spent 9 to 10 months in Bermuda before two boats of native cedar could be built to take them to Virginia.*

Out on the horizon I noticed a liner that seemed to be making no progress.

"Can it be anchored so far from shore?" I inquired.

Commander Landman laughed. "It is anchored all right—throughout its keel," he replied. "That is the *Cristóbal Colón*, a Spanish ship. Going from England to Mexico to get supplies for the Spanish Loyalists in October, 1936, the *Colón* was 'listening for radio instructions from Madrid' and did not receive our warning that North Rock Light was not operating. She hit the outer reefs on a clear moonlight night and stuck fast. We tried to tow her off, but her bottom was torn out and her holds full of water."

Reaching for a spyglass, he asked me to look at the wreck and to notice that the ship, otherwise intact, had no funnel.

"Thereby hangs the tale of one of the strangest shipwrecks in Bermuda history," he continued. "Five months after the *Colón* ran on the reefs the Norwegian freighter *Iristo* was approaching Bermuda through a driving rainstorm. Her captain had a chart and was following it carefully. The squall lifted a moment, and he saw the *Cristóbal Colón* far ahead.

"The chart called for a turn, but the *Iristo's* captain, assuming that the *Colón* was a ship under way and that his chart must be wrong, altered his course to follow her. In a few minutes the *Iristo*, too, struck the reefs. Although she was later pulled off, the ill-fated vessel sank before she could be towed into St. George.

"Such Lorelei tactics on the part of the *Colón* aroused the sporting instincts of Bermudians. A shipwreck that didn't look like a shipwreck? Well, something should be done about that! So on July 11, 1937, the single funnel of the *Colón* was cut off with torches and dropped into the sea!"

Dr. Louis L. Mowbray, director of the Government Aquarium and noted ichthyologist, wanted some specimens near uninhabited Castle Island and invited me to go along. In the Aquarium's ketch *Iridio* we sailed down the Flatts Inlet and set our course for St. Catherine Point (Plate III). Passing Sea Venture Flat, scene of Admiral Somers' shipwreck, we skirted Cooper's Island and came up into Castle Harbour.

Here spreading coral formations and great purple sea fans alternate with rocks and patches of white sandy bottom. No buoys mark the channel, but a lookout on the bow indicated with a wave of his hand which way the boat should be steered.

"We have fifty holes in the bottom of this old scow, but I don't want any more," Dr. Mowbray casually remarked.

"Fifty holes!" I exclaimed. "How in the world do you keep her afloat?"

"The holes were drilled there to let sea water into two sections amidships, which we use as storage tanks for specimens taken in nets or in the fish traps."

Passing Nonsuch Island, Dr. Beebe's headquarters during his first deep-sea dives with the Bathysphere, we anchored under the fortress-crowned head of Castle Island, rising steeply from the water.†

In a bobbing dory we came up under the north precipices and hopped ashore at a tiny stone landing lodged in a cleft of rock. Steps carved from the rock wound up to the plateaulike top of the island.

Crumbling walls, bastions, and parapets rise from every headland and crawl around the edge of every dizzy cliff. Guns and scarlet-coated grenadiers have gone, but in musty dungeons the dull boom of the surf, the sharp cries of whirring longtails, or tropic birds, and the wind whistling among

* See "The Islands of Bermuda," by William Howard Taft, in the NATIONAL GEOGRAPHIC MAGAZINE, January, 1922.

† See "Round Trip to Davy Jones's Locker," by William Beebe, in the NATIONAL GEOGRAPHIC MAGAZINE, June, 1934, and "A Wonderer Under Sea," December, 1932.

Photograph by Rutherford from Galloway

OFF FOR THE PARTY—ON A BICYCLE NOT BUILT FOR TWO!

In taxi-less Bermuda one of the most startling sights is a wheeling squadron of men and women in evening dress dashing down the road to a formal dinner or dance, the men with coattails flapping in the wind and the women with dresses tucked up out of the way of the wheels. Especially appropriate is the name of the overhanging bush, "match-me-if-you-can" (*Acalypha Wilkesiana*), so called because no two of its leaves are supposed to be alike.

stunted cedars and prickly pear recall the days when pirates and privateers haunted the Spanish Main and Bermuda was never safe from sudden, bloody attack.

Begun in 1612 and armed with one of the two cannons retrieved from the wreck of the original *Sea Venture*, these massive works, which must have meant many months of arduous toil under the hot sun, were abandoned before 1680. They never saw a serious fight.

Bermuda's Aquarium, at The Flatts, has one of the world's largest and finest collections of marine tropical fishes and a small zoo with brilliantly colored birds from many parts of the world, huge turtles from the Galápagos Islands, penguins, and monkeys.

But to me the Aquarium's prime attraction is the diving helmet (Plates II and IV). A small fee admits you to a new world; in fact, the largest of all, the domain of King Neptune. It is just a peek, to be sure, but a diving helmet offers the thrill of being as nearly like a fish as you will ever be—and live to tell the tale.

In a bathing suit, an old pair of shoes, and a weighted copper helmet that fits loosely on your bare shoulders, you walk down steps into the clear waters of Harrington Sound. When you are neck-deep the helmet is lowered over your head. A man on shore pumps air into the helmet through a hose.

"Don't lean over too far or the air will spill out of your helmet. Hold a loop of the air hose in your left hand." These are your only instructions.

There was a rush of air from the hose, and the water rose inside the helmet as I turned and wobbled slowly down a sandy undersea path. But the air pumped from above stopped the water just short of my chin. I swallowed several times to equalize the pressure.

Being nearly buoyant, I could take giant steps, and a drop off a ledge meant merely a slow-motion glide downward.

The two glass windows in the helmet revealed only a small area ahead, and every current and eddy swayed me about. Suddenly I recalled the vicious-looking green morays and barracuda I had just seen in the Aquarium tanks, and wondered if any of them lurked behind that jagged reef, just ahead in the greenish haze.

But no, there were only pale sea anemones, waving their flowerlike fronds, bits of red sponge, and purple sea fans. I was disappointed that at first I saw no fishes, but the fishes were there. Striped sergeant majors, red squirrelfish, and grunts, all so conspicuous near the surface, blend their markings so perfectly with the shimmering blue-green depths and the reefs that they at first escape notice.

Photograph by Knopf from Pix

FOR TWELVE CENTS YOUR BIKE CAN GO, TOO

Bermuda's railway carried cyclists and their wheels before bicycle excursions became Sunday features on United States railroads. Opened in 1931, after long and stormy debate in the Colony's Parliament, the railway has become firmly entrenched in island life (page 215). It has 22½ miles of track, from St. George to Somerset, via Hamilton, the capital.

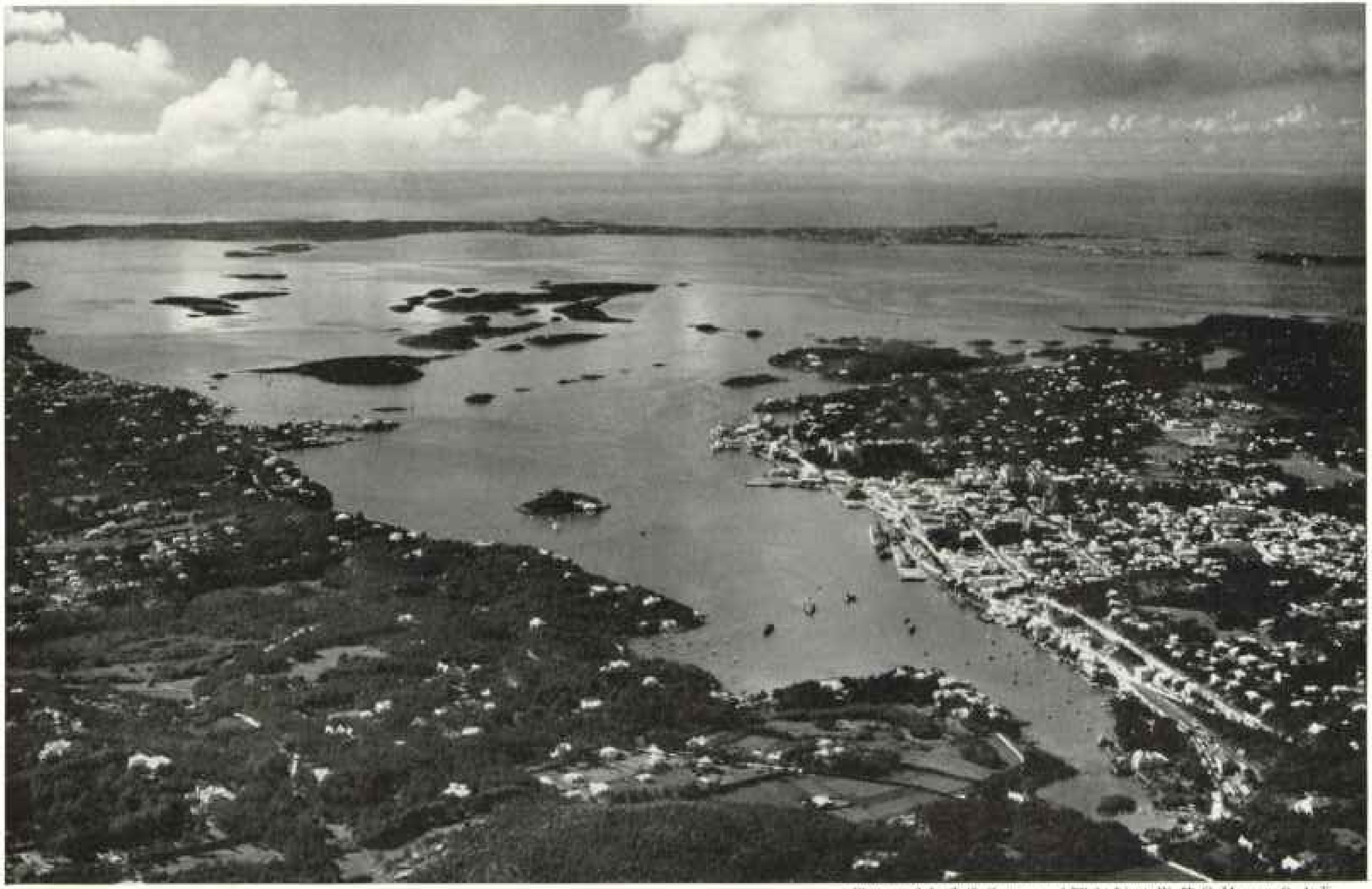
A BELATED SCARE

When I returned to the surface I asked the attendant if anyone had ever been bothered with morays, barracuda, or sharks.

"No, we've never had any trouble here in the Sound," he replied, coiling the air hose and disconnecting the pump. "The other day, however, a small octopus swam by while a lady was down. I thought she saw it, but she didn't make any fuss. When she came up I asked her about it. Well, she thought it was a tame one, belonging to the Aquarium, and when she learned it wasn't, she had quite a belated fright! But it wouldn't have harmed her."

The four western parishes—Paget, Warwick, Southampton, and Sandys—are different from the sections I had just visited. Like every other visitor to Bermuda, I was amazed at the sharp contrasts in an area of less than twenty square miles.

Paget and Warwick are residential districts, with some of the largest homes and



Photograph by J. C. Gregory and Flight Lieut. W. H. C. Manson, R. A. F.

THE WHITE-ROOFED CITY OF HAMILTON AS IT APPEARS TO VISITORS ARRIVING BY AIR

Bermuda's capital stands at the head of a well-sheltered, island-studded harbor. Steamers thread a narrow dredged channel from the ocean and tie up to the docks. Planes land on the water at the upper left, and passengers are brought by launch to Hamilton.

Photograph from Wide World

ON THE STILL, BLUE WATERS OF THE SOUND, THE OCEAN-FLYING BOATS REST AFTER 775-MILE FLIGHTS FROM NEW YORK

Both the Pan American *Bermuda Clipper* (left) and the Imperial Airways *Cavalier* await towlines off the new air base at Darrell Island, a short distance from Hamilton, the capital. These four-engined airliners are luxuriously equipped, serve hot meals aloft, and make the journey in five hours or less. Bermuda may some day be a stepping stone on the southern air route to Europe.

© S. J. Hayward

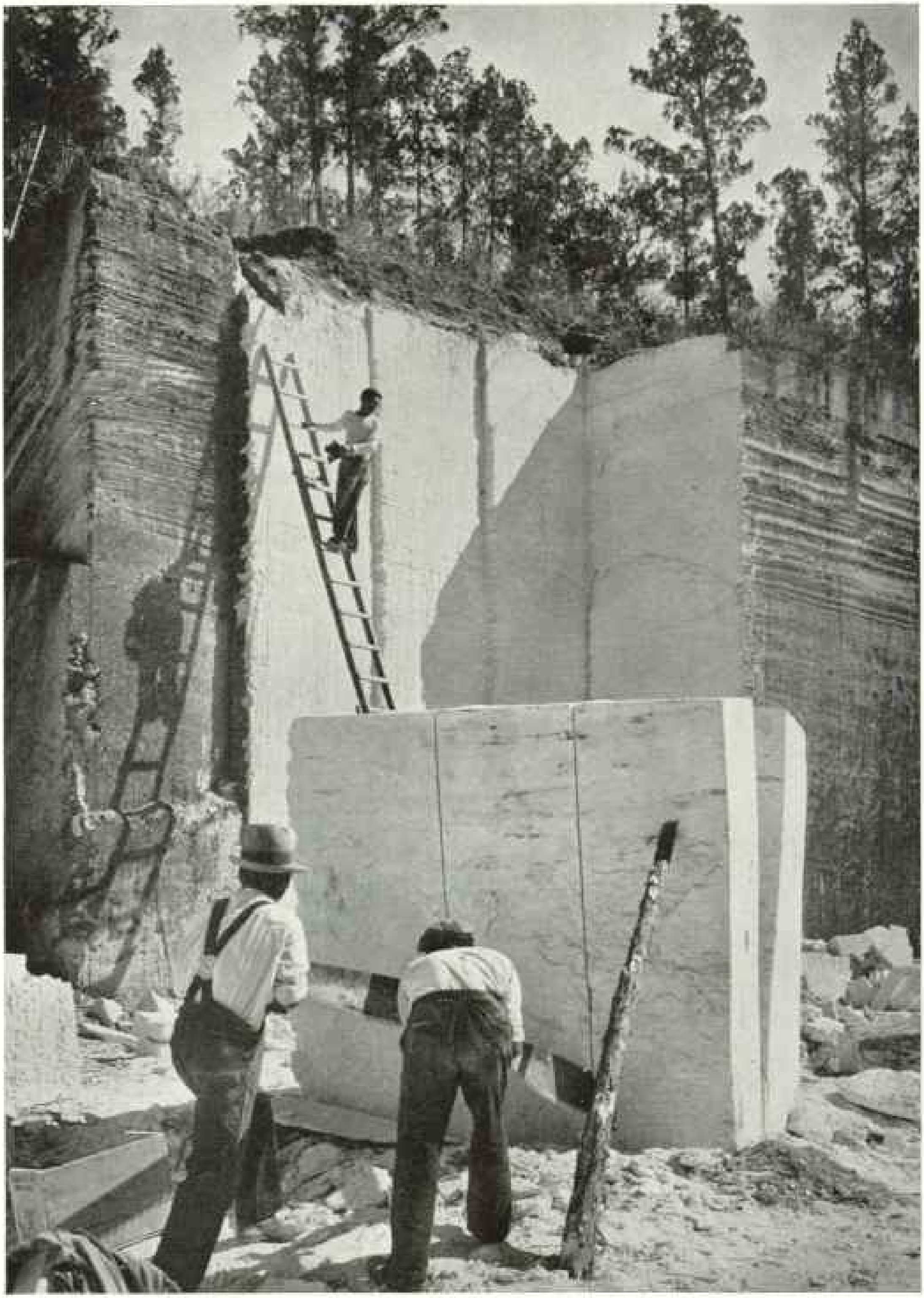
DAZZLING WHITE CHURCHES AND WHITE LILIES SYMBOLIZE BERMUDA'S EASTER SPIRIT

Acres of loveliness transform the hills and valleys of the Colony during late March and April. Bermudians see only a part of the flowers grown in the islands, however, because large quantities of cut flowers, green buds, and lily bulbs are shipped annually to the United States and Canada to decorate homes and churches.

Photograph by Rutherford from Galloway

ON BOAT DAY IN HAMILTON EVEN HORSE-AND-BUGGY TRAFFIC MOVES A LITTLE FASTER

Carriages form a line along Front Street awaiting visitors from the New York liner being warped into its dock. Business men on bicycles hurry to their offices and shops. From the four-masted schooner, *Alvena*, of Jacksonville, Florida, stevedores unload lumber. The tracks in the roadway are the "main line" of the Bermuda Railway.



Photograph by F. S. Lincoln

BERMUDA HOUSES ARE LITERALLY SAWED FROM THE GROUND

While some creamy-white stone used for building and roofing is cut from large quarries such as the above, many houses are built from the material excavated to make the cellars. Almost as soft as cheese when first taken from the ground, this coral limestone soon hardens when exposed to the air. It can be separated into big blocks for walls or sliced thin to make roofing "slates" (page 314).

Photograph by Henry Clay Gipson

BERMUDA LAW REQUIRES THAT ROOFS BE LIMEWASHED AT LEAST ONCE A YEAR

The dazzling whiteness of housetops is not merely for effect. Roofs must be kept clean because most householders get their water supply from rain that falls on them and drains into covered tanks frequently inspected by health authorities. Bermuda has no rivers or wells capable of meeting its water needs, but recently a water works, employing "horizontal wells," was opened to supply hotels and homes in the vicinity of Hamilton (page 214).

estates in the Colony, and the haunts of visiting honeymooners. They have also the most popular bathing beaches, three of the largest hotels, several guesthouses, and three golf courses. Southampton is largely farmland, while Sandys (generally called "Somerset") attracts the novelist, artist, gardener, and naval officer. Here the tennis tea is enshrined, and life is leisurely and gracious. Sandys ends at Ireland Island, headquarters of the British Fleet.

A few days later I left Hamilton on my bicycle for the south shore. Bermuda has no municipal beaches, with boardwalks, lifeguards, and sand artists. All seashore is privately owned.

Coral sand of the south shore is different from that of beaches in the northern United States. Its structure is animal skeleton, such as coral or limestone, rather than pulverized quartz or silica. Pick up a handful and you will notice that it is mostly white, but mixed with it are enough red coral grains to give the beach a tinge of pink—especially noticeable in contrast with white foam and cerulean water (Plate IV).

Returning to the harbor side of Paget, I stopped at a little peninsula called Salt Kettle. Here salt from the Bahamas was stored in the 17th century.

I had taken the north road to visit one of Bermuda's oldest homes. Turning in at the gate opposite the ferry landing at Darrell's Wharf, I was shown through its beautiful terraced gardens. Surrounding bright flower beds were papaya, lemon, and coffee trees.

The estate's chief claim to fame, however, is an exquisite "tray" ceiling in the dining room. Many old Bermuda homes employ this device, which makes the ceiling look like an inverted serving tray, to give a room height and spaciousness in spite of low eaves.

Beyond the Belmont Manor golf course is *Spithead*, Bermuda home of Eugene O'Neill, where, in a small cottage by the gate, overlooking the myriad islands of the Great Sound, he wrote nearly all of *Strange Interlude* and several other plays.

Passing Riddle's Bay, I began the long climb to Gibbs' Hill Light. It is a breath-taking push up the oleander-shaded road,

Photograph from Bermuda News Bureau

"VINCENT," FIRST GALÁPAGOS PENGUIN BORN IN CAPTIVITY

Dr. Louis L. Mowbray, director of the Government Aquarium and distinguished ichthyologist, holds the down-covered chick hatched May 27, 1936. To avoid sterile eggs, Dr. Mowbray fed wheat germ oil, obtained from Chicago, to the parent birds, which were presented to the Bermuda Aquarium by Vincent Astor. Since then two other chicks have been born, and all three are thriving.

and a "second wind" is needed for the 190 steps to the lantern of the round iron tower. Spread out like a colored map, Bermuda lies at your feet. The lamp in the lighthouse is 362 feet above sea level.

The Middle Road continues north past pleasant little farms, where hedges of pink and white oleanders and scarlet hibiscus separate patchwork fields of potatoes, beans, tomatoes, carrots, and, yes, the famous Bermuda onion. Bermuda still grows onions, although onions from southern States have captured the American market. Most of the farmers are industrious Portuguese, who now comprise the second largest group of outsiders in Bermuda, being exceeded only by persons from the British Dominions.

At any time of the year the early-morning activity of the water front at Hamilton is a pageant of life and color, when the tide of Bermuda business ebbs and flows in a maze of carriages, carts, and bicycles (page 235).

Gaily dressed visitors mingle with sidewalk throngs. Some seem hardly ashore before they blossom forth in rainbow-hued shorts, halters, polo shirts, and babushkas.

A policeman may halt the young lady whose shorts are more than two inches above the knee, and give her a "ticket," but nothing is said if a wrap-around skirt is worn, even though the skirt may fly open with every passing breeze to reveal shorts far above the legal limit!

The thirsty young man may find that his companion's abbreviated costume will be passed at a popular Hamilton cocktail bar, but if he tries to enter without a coat, even in the daytime, he will be halted by a polite waiter, who will offer him a white coat loaned by the house.

Once so remote that it was unnoticed by the world at large for months at a time, Bermuda now prospers as host to thousands of visitors from the United States, Canada, and England each year. Yet, even under the impact of airplanes, luxury liners, telephones, electric lights, radio, swing bands, and other aspects of modern life, Bermuda has kept some of the innate conservatism of its British heritage. *Quo fata ferunt* ("Whither the fates may carry") is the buoyant challenge on the Colony's coat of arms, expressing an optimistic spirit that speaks well for the future.

TIME AND TIDE ON THE THAMES

By Frederick Simpich

LIKE a "life line" across England's old palm flows the Thames; scenes along its banks reveal the nature of the English people.

An ideal English career, it has been said, might be lived wholly on the Thames. Such a good life might begin at Eton or Oxford; triumph in public service in the Houses of Parliament, or gain distinction in the marts of London; enjoy royal honors at Windsor and the final tribute of burial in Westminster Abbey.

"To run down the Thames is to run one's hand over the pages in the book of England from end to end," wrote H. G. Wells.*

Here neolithic man flourished; across Thames fords Romans threw their roads; Danes and Saxons invaded its valley, and Benedictines built their great abbeys, baptized pagans, and spread civilization. It saw the Civil Wars, and King John signing the Magna Charta at Runnymede. On its banks at Oxford rose that ancient university; it has its boat races (page 243), Tower, its famous bridges, locks and tunnels, Houses of Parliament (page 262), Westminster Abbey, Hampton Court, Reading's giant biscuit works and seed farms—and the Port of London, with all its vast docks, factories, and means of distribution.

"Give us this day our daily bread" is a strong line in the Lord's Prayer. That is the chief function now of the Thames—to bring in food for millions. The sea made Britain a world power; the Thames makes London the world's greatest market.

BENEDICTINE MONKS DEVELOPED FARMS

For centuries the medieval monastic foundations owned and farmed vast estates here, and built abbeys and other structures. In this thumbnail Thames tabloid is no space to discuss all these monastic works; briefly, they stretched from London upstream almost to Thames Head. To this Benedictine Order, in the gap between Roman occupation and the Dark Ages, routine farm and market life owes a lasting debt, writes Hilaire Belloc.

Chief among such foundations active along the Thames were the abbeys at Abingdon, Chertsey, and Westminster. Coeval with Christian beginnings, civilization spread from these centers of wealth and learning; today only Westminster survives.

How others were seized by Henry VIII and Thomas Cromwell, the horseshoer's son, and given to favorites is a highlight in the history of the Dissolution.

Except for old walls, or a gate, and their names, little remains of these once-powerful foundations.

AROUND THAMES HEADWATERS

Exactly where the Thames rises is still debated. Some say in Thames Head Spring in Trewsbury Mead; others insist the true source is in the Seven Springs near Cheltenham. In summer so little water flows in this upper reach that local people call it merely "The Brook" (page 241).

Through lush, lovely meadows, past sleepy villages, yet across a region soaked with historic events since the days of Danish raids and Saxon wars, the stream winds on to Cricklade and Lechlade. The stretch between Godstow and Medley is the "Varsity Waters," or upper river. From here down to Oxford, pleasure punts, canoes, and skiffs are numerous in summer weather.

Of Oxford it has been said that its buildings have no more to do with its qualities than a glass has to do with the taste of the wine that's in it. The crowd of boys, with all their hopes and follies, who pour through old streets and quads and colleges, make the real Oxford.† Holiday had released all students when we were there, so we lunched at the 700-year-old Mitre Hotel and came on downstream. Below Oxford's Folly Bridge you see long rows of college boat-club barges and houseboats tied to the banks (Plate V).

Ride slowly down this river, its history in mind, and you see how it has cut through the main events of English life (map, 244-5).

Ancient Abingdon, like Wallingford, is a town that "refused to grow up." When a railway was built up the Thames, these places petitioned against its advent and kept the main line from reaching them.

Linked in legend with Roman emperors, Diocletian and Constantine, for centuries Abingdon dominated this region of England. To the Benedictine Order now this

* See "Through the Heart of England in a Canadian Canoe," by R. J. Evans, in the National Geographic Magazine, May, 1922.

† See "Oxford, Mother of Anglo-Saxon Learning," by E. John Long, in the National Geographic Magazine, November, 1929.

Photograph from The Topical Press Agency

KING JOHN GRANTS THE MAGNA CHARTA IN A DRESS REHEARSAL OF "THE PAGEANT OF RUNNYMEDE"

Spectacular and impressive, lasting for days and involving thousands of men, women, horses, war chariots, boats, etc., this pageant at Egham told England's story from pagan days. Scene I: Romans conquer Britain, A. D. 44. Scene III: King John grants the Great Charter; and so on to Scene VII, "Queen Anne opens the Ascot Races," 1711, and to "Rural England after Waterloo," 1817.

is only a ghost town. Little remains of the great abbey but an old gateway.

Today, with its classic county hall, grammar school, and old-style market place, it remains the same serene, satisfied, and secluded town that Ruskin loved.

When the Thames froze over here many years ago, an ox was roasted on the ice and newspapers were full of "historic freeze" stories. In Elizabeth's time, they said, the Thames froze over at London, so that games and races were held on the ice, with a so-called fox hunt, and the roasting of an ox.

Downstream a bit is the village of Dorchester. In the Thames near here Cynegils, first West Saxon king to become a Christian, was baptized some 1,300 years ago. This town also belongs to yesterday; but in the 10th century its religious power was enormous.

Even after the Conquest, Augustinian friars built here their magnificent abbey church of SS. Peter and Paul. Through private generosity this abbey escaped ruin in the Dissolution. Had fighters of long ago used big field guns, few such old structures would be left to admire today.

Dorchester's abbey church is about all that survives, in this upper valley, of once-numerous monastic buildings. Artists and architects come from everywhere to see its famous Jesse Window. Its tower holds a peal of eight bells. On one, cast about 1380, is a Latin inscription: "Do thou, Birinus, protect forever those whom I summon."

Birinus, a bishop, was one of the earliest papal missionaries; legend says he was stung to death by snakes. Now, according to local tradition:

> Within the sound of the great bell
> No snake nor adder e'er shall dwell.

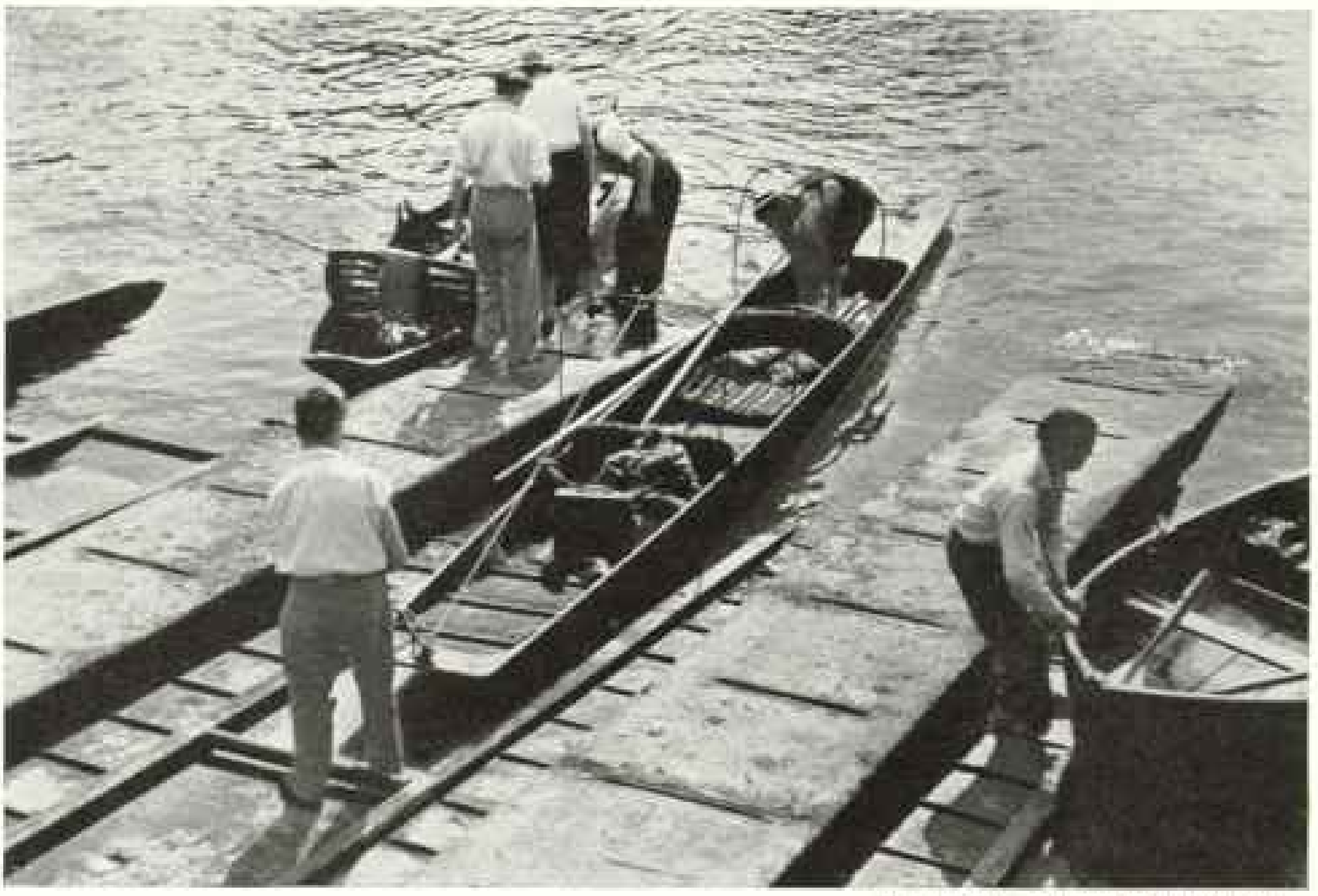
Snuggling behind graceful willow screens are the thatched cottages of Long Wittenham village. In spots trees grow down to water's edge, and leafy limbs overhang the stream, where boating parties find shade, seclusion—and a chance to shatter the quiet with loud gramophone tunes.

From behind elms and poplars you come thus onto Wallingford. Named for its an-

Photograph by R. Anthony Stewart

SEVEN SPRINGS IS CONSIDERED BY MANY THE TRUE SOURCE OF THE THAMES

Protected by walls, these cold, clear springs flow the year round, near Cheltenham. Eleven miles south, near Cirencester, is another source, known as Thames Head, which is sometimes dry. From Seven Springs, in the hills, to its mouth, the river measures about 215 miles (page 239).



Photograph by Maynard Owen Williams

ROWBOATS GO "OVER THE ROLLERS" INSTEAD OF BEING "LOCKED UP" AT TEDDINGTON, JUST ABOVE LONDON

To save time, work, and water, small craft on reaching such upper-Thames locks are pulled over escalatorlike tracks (page 247). Larger and heavier craft pass through water-filled locks.

Photograph from Keystone

SONNING LOCK LOOKS MORE LIKE A PRIZE-WINNING FLOWER GARDEN THAN A MERE "AID TO NAVIGATION"

Artists, busy at their easels, seek such scenes to paint, especially on bright May and June days when Thames flowers are brightest. At Sonning town, near this lock, a colony of artists make their homes (page 247), and just upstream the Reading Working Men's Annual Regatta is held.

cient ford, this town, like so many other old ones along the Thames, saw England conquered in turn by Romans, Saxons, Danes, and Normans. It had its abbey, too; but now the cackle of poultry is heard instead of the chant of many monks, and farmers are more interested in the price of eggs than in ruined monasteries.

Goring and Streatley, in scenery reminding of the Potomac Valley above Great Falls, mark the edge of the London commuter's zone. Hereabouts you begin to meet city folk, retired, and trying country life. Not far below is Pangbourne, a typical Thames resort town, easily reached by crowds over the Great Western Railway. Near here Bradfield College gives Greek plays in an open-air theater in an abandoned chalk pit.

Reminding of some hustling Midwest American town, industrious Reading stands halfway between Oxford and London. Fast trains link it to London; busloads of sightseers bound for Oxford stop off here for lunch and drinks. Here are fragrant Huntley and Palmer biscuit works, and Sutton's prolific seed farms.

Besieged now by salesmen, full of chain stores, gas stations, beauty shops, and movies, with suburban developments carrying new concrete highways, lights, and water out into surrounding country, Reading has a boom atmosphere.

Out at Woodley suburb we spent a typical English summer week end with a family we had known in Mexico. There were tea, tennis, much good-humored "spoofing" about things American, and delightful walks along the Thames.

Photograph from Wide World

ONFORD LEADS CAMBRIDGE BY TWO LENGTHS IN THE FINISH OF 1938

After this greatest of all Thames gala days, London celebrations may last all night. Even persons with no interest in either university take sides and lay wagers. These races, which began in 1829, now are rowed over a 4¼-mile course from Putney Bridge to Chiswick Bridge. Cambridge has won 46 of the contests, Oxford 42, and one was a dead heat.

To guard against rabbits, this Woodley family had their garden enclosed with chicken wire; sad-looking black tin cats with glass eyes that glistened in the sun were swung in air on strings, to frighten birds away from fruit and berries. In the fields beyond, at dawn, incredible numbers of rabbits grazed in flocks, like sheep, and cuckoos called from the hedges. They say this bird winters in Africa.

The cuckoo comes in April
He sings his song in May,
And then in June another tune
Before he goes away.

In lush June days this Thames region below Reading suggests the banks of the Wabash, with many of the same smells, sounds, birds, trees, and flowers.

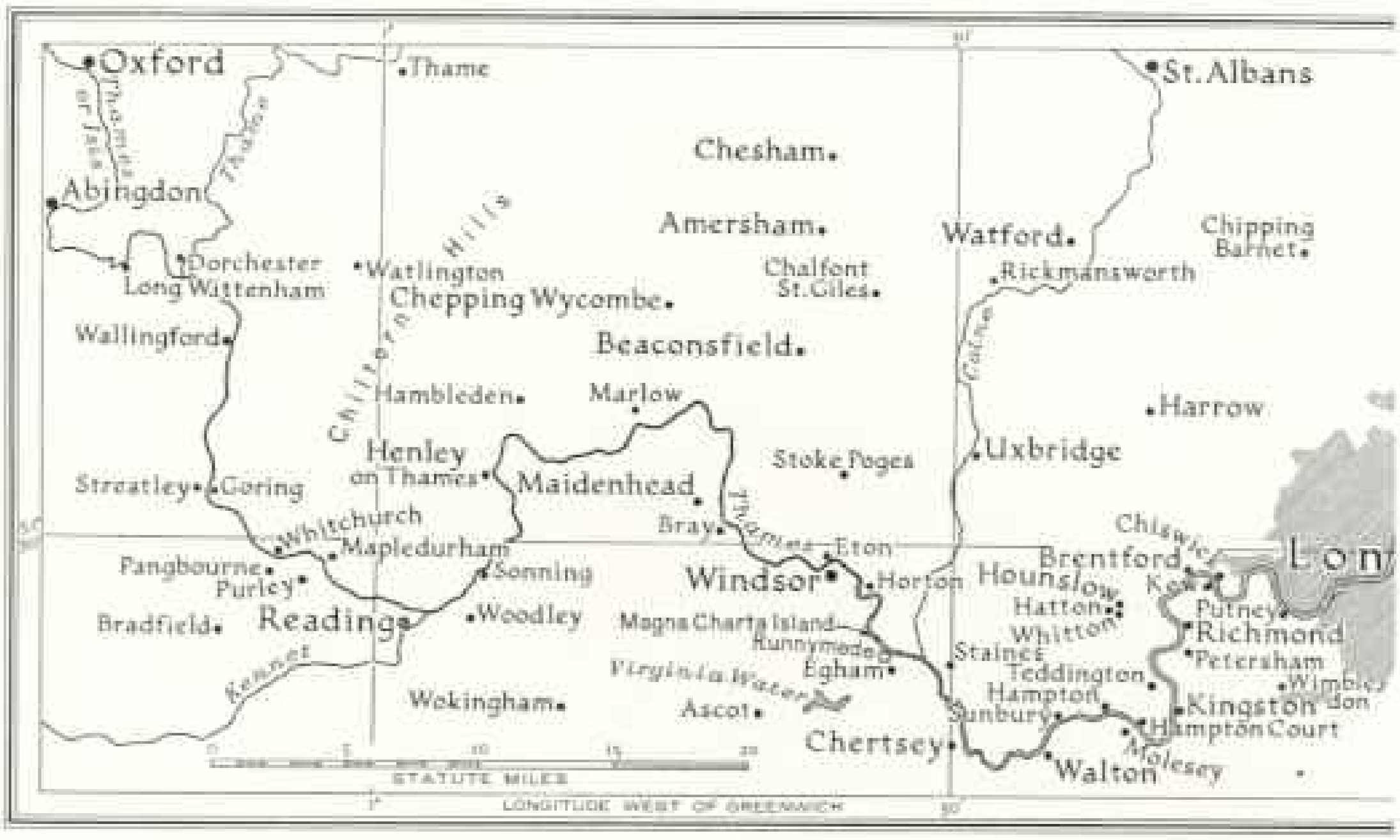
Walking past the White Hart Inn at Sonning, we met with many London boy and girl cycling parties; they wheel up the Thames on fine Sundays. Many riders carried a neat pack—lunch, camera, tennis racket, and raincoat.

"How far do you pedal in a day?" I asked.

"We've done 60 miles and better," one said. "On the roads, the motorcars slow us down, especially if we are riding abreast. More than two abreast are not permitted."

Two or three had easels. Sonning is a Mecca of painters; on any fine day they sit here and there on folding stools and dab to catch a favorite scene. No river anywhere is so much painted and photographed! (Pages 242 and 247.)

Brilliant square tulip beds in many colors lit up the river banks on one farm. These flowers go to the big, fragrant stalls at Covent Garden in London.



HISTORIC SITES AND CITIES DOT THE THAMES FROM OXFORD DOWN TO LONDON:

Groups of London workers, out for a Sunday holiday, hunted wild flowers: I saw one woman fixing a simple bouquet of grass blades to carry home. "It's so fresh and green," she said.

Men lie on the grass, playing cards with a few copper coins as the stake. "We'd rather bet on a horse race, or a football game," said one, "but the card game is better than no gambling at all."

Poultry farms, with White Leghorns, Buff Orpingtons, and Rhode Island Reds, are frequent along the river. "We've got a few turkey farms," a farmer said, "but most turkeys are imported. Still, it's a poor family that has no turkey for Christmas."

We saw few pigs. "We don't have many," said a farmer, "but in the fall we manage to kill one or two, and salt them down."

Badgers raise havoc with goldfish ponds. "One night," said a friend, "I lost twenty fine fish, and next night I watched with my dog and flashlight. As expected, Mr. Badger came back, and dived into the pond. When he came up with a fish, we took care of him. Foxes annoy our poultry; so do weasels and stoats, which I can't tell apart. No, we have no minks here, and few predatory hawks."

As guests of the Chief Inspector of the Thames Conservancy, we cruised downriver from Reading. Swans nested along the grassy banks; some flew overhead. One always feels astonished when this big bird suddenly takes wing (Plate I and page 249). In shady spots sleek, cud-chewing cows stood knee-deep in cool water, switching their tails at flies. Moor hens fluttered up ahead of our boat, flapped their wings and ran away, seeming to trot on the water—actually leaving their tracks on it. On the reedy banks they walked daintily, like our Western hell-divers.

Here and there punts, canoes, and skiffs, some housed over with canvas like covered wagons, poked about looking for a quiet shore spot to eat picnic lunch, to be "together at last," or just to fish.

"Do they catch any big ones?" I asked our skipper.

"No; few fish ever live to reach even the age of discretion in this part of the Thames."

Passing Marlow (Plate III), we saw an air school, with students learning to fly. Small planes took off and landed.

"What digs all those holes in the river banks?" I asked.

"Sand martins," said the skipper, "but kingfishers use them, too; so do big water rats.

"On holidays, when heavy traffic crowds the Thames, we move skiffs and canoes over these 'rollers' that you see beside some

Drawn by Ralph E. McAleer

THROUGH THE BUSY LOWER RIVER LONDON TRADES WITH THE SEVEN SEAS

Photograph by R. Anthony Stewart

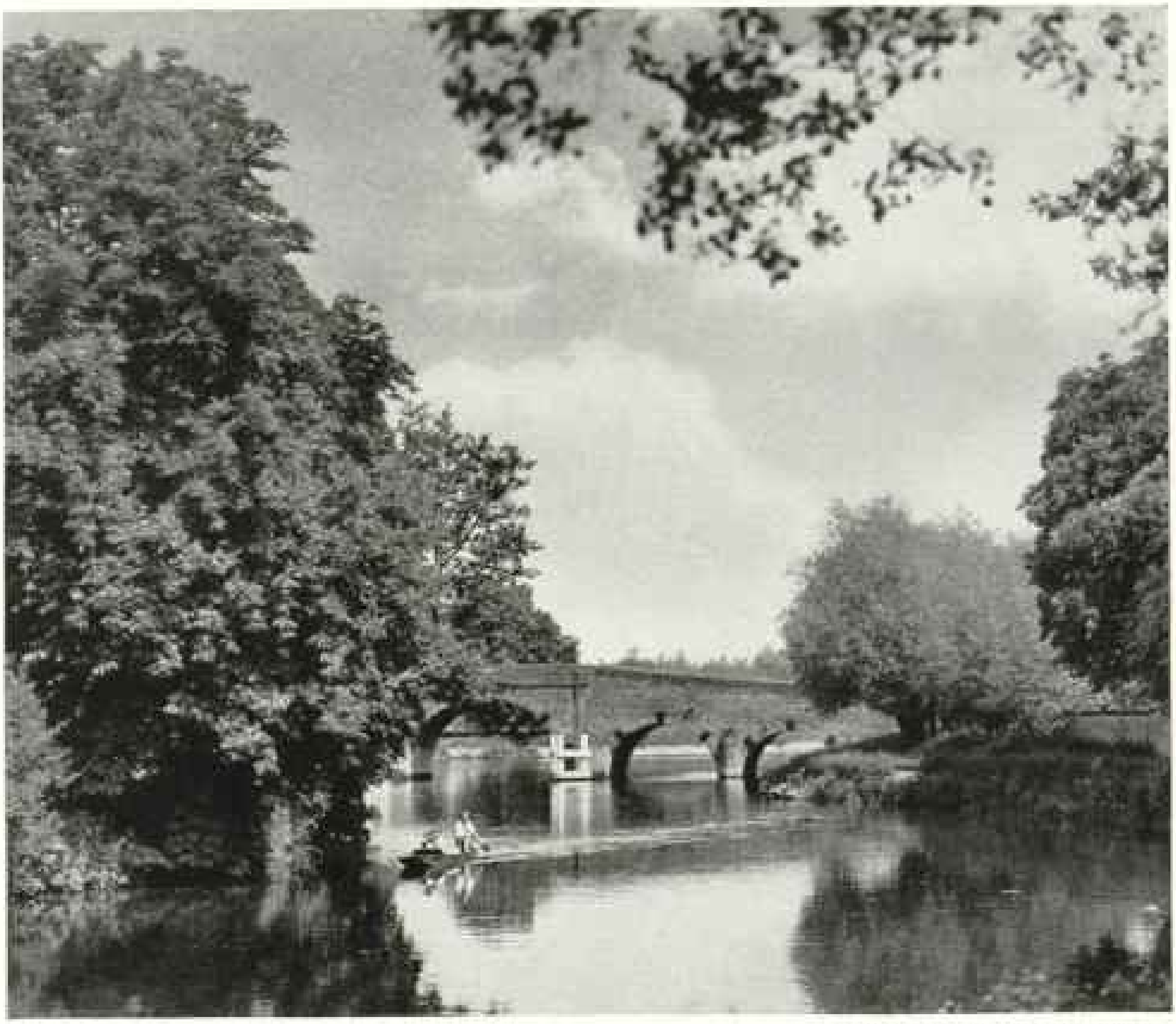
ON THE "EXMOUTH" BOYS ARE PREPARED FOR THE NAVY OR MERCHANT MARINE

An iron reproduction of Admiral Nelson's flagship *Victory*, this training ship, anchored off Grays, provides accommodation for 450 boys from 12 to 16 years old. Since 1870 there has been such a ship in the London river for underprivileged boys. The *Exmouth* gives instruction in seamanship, navigation, and other marine subjects. Joining either the Royal Navy or Merchant Marine, after 16, many of the school-ship boys have in later years gained fame for acts of heroism.

Photograph by B. Anthony Stewart

JESUS HOSPITAL AT BRAY, SAYS THE TABLET, WAS BUILT IN 1627 TO BE CARED FOR BY THE "RIGHTE WOR. (WORSHIPFUL) COMPANY OF FISHMONGERS"

To a former vicar of Bray the village owes its fame from a popular old ballad he wrote: "This is the law I will maintain, Until my dying day, Sir, That whatsoever King may reign, Still I'll be Vicar of Bray, Sir."



Photograph by R. Anthony Stewart

PUNTING PAST ANCIENT SONNING, "AN UPLANDISH TOUNE, SETTE ON A FAIR AND COMMODIUS GROUNDE"

locks. They are dollies, which work like sawmill carriages or escalators.

"We've got more water in the Thames than there was in Roman days," he added. "That's because of the 49 locks between Cricklade and Teddington, a stretch of 136 miles, where the fall is about 200 feet (Plate I and page 241).

"Without these locks, much water would rush out of the upper river. Even the Romans made dams, when their boats came upstream, to get enough depth to keep them floating.

"At some old weirs above Oxford, during low water, boats used to get stuck in the mud. The men would drive a herd of cattle into the narrow stream, thus raising its level enough to float the craft."

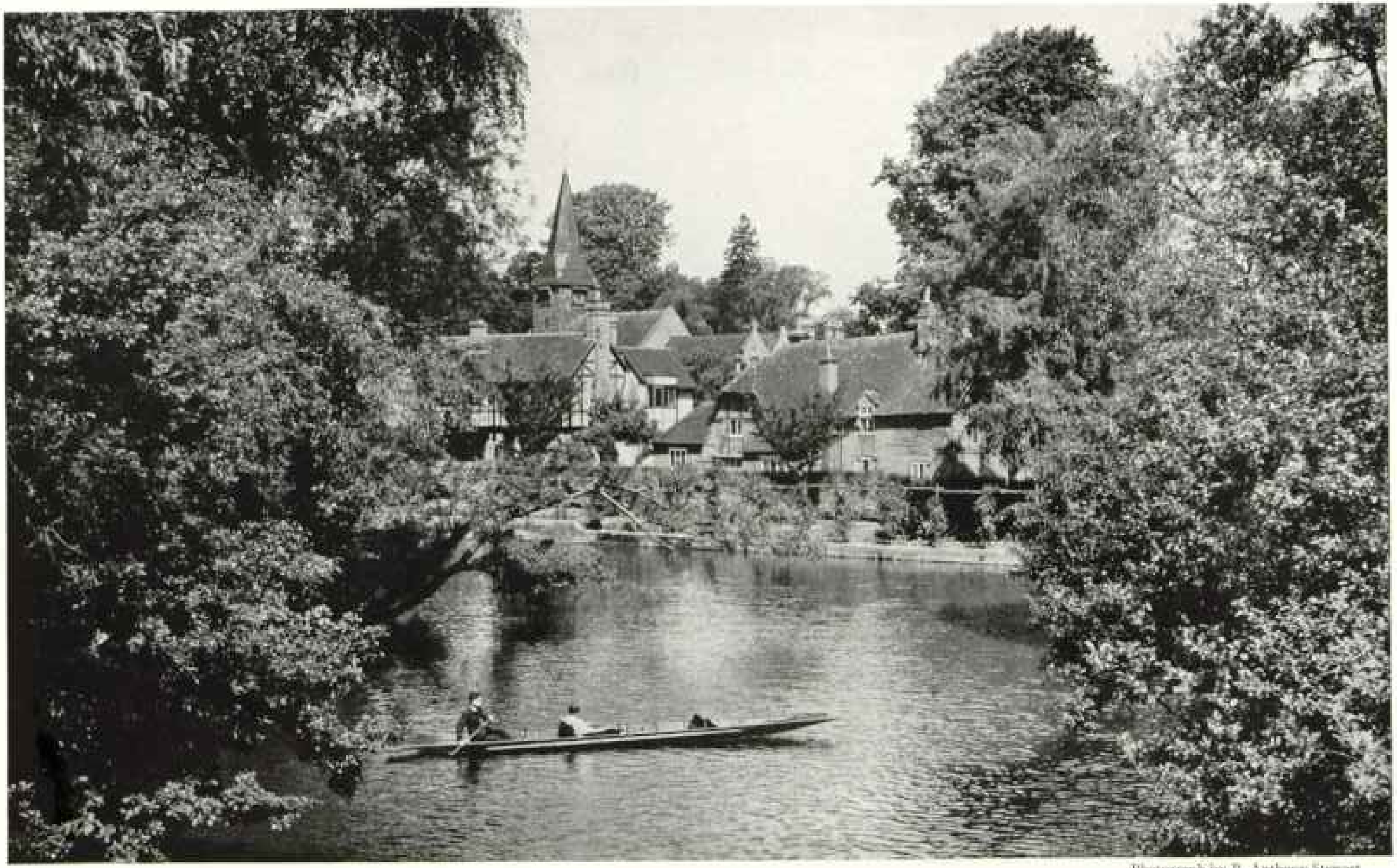
CENTURIES OF FLOOD CONTROL

Man's marks on the Thames banks show that since prehistoric times he has worked to drain marshy fields and hold the river in its channel. While floods still occur, probably no river anywhere has had more intensive study to help make it useful.

All downstream our friendly launch crew kept up a running comment on historic spots along the river. They showed us a place where students say Julius Caesar crossed it. Submerged, sharpened stakes found here indicate that the natives tried thus to sink the Roman invaders' boats or to wound men wading.

On the Missouri's banks, in my youth, written history was almost nil previous to the Lewis and Clark Expedition of less than 90 years before. So it was impressive to move along the Thames and find that here events have been recorded since before the birth of Christ.

Passing a certain town, boatmen pointed out an old abbey. "That's been in the same family 800 years," they said. "But there's



Photograph by B. Anthony Stewart

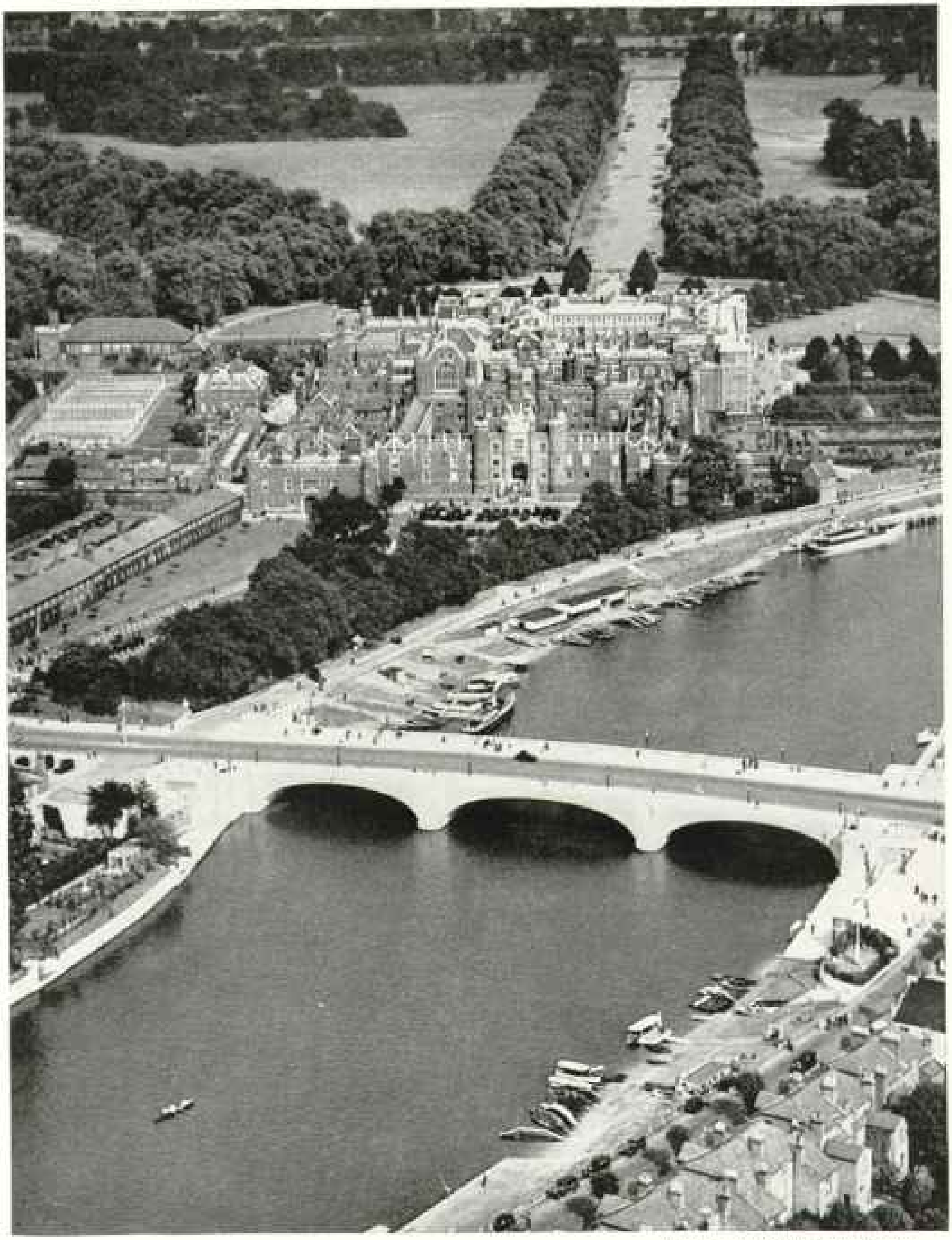
GOLDEN SUNSHINE FALLS ON SYLVAN WHITCHURCH VILLAGE, A PARADISE ENSHRINED IN NOBLE TREES THAT FRINGE THE THAMES

How easy and quiet life seems now, in this friendly region! Yet once invading Danes ravished all the countryside with fire and sword, fighting hand to hand with the West Saxon legion of King Alfred. Only six miles from the peaceful river scene roars and throbs the industrial city of Reading.

Photograph from Topical Press Agency

THE KING'S SWAN MASTER AND HIS CREW BUSY NEAR WINDSOR IN THEIR ANNUAL TASK OF "UPPING"

By "upping" is meant the counting and marking of these waterfowl. Protected now by law, admired by the public, and fed by many children, Thames swans take life easy; in olden times, English people ate them. Nesting in riverside grass, they lay from five to nine olive-colored eggs. In the breeding season these birds attack any invader, pound savagely with their stout wings, and emit angry, hissing grunts (Plate I).



© The Aerial Photographic Company

GEORGE II WAS THE LAST KING TO OCCUPY MAGNIFICENT HAMPTON COURT PALACE

Standing not far upstream from London, this largest English palace was built in 1515 by Cardinal Wolsey. Here Henry VIII pressed his courtship of Anne Boleyn, and here was held the second trial of Mary Queen of Scots. For centuries writers have groped for words about Hampton Court, and hordes have viewed its paintings. Douglas Jerrold, editor and dramatist, writes of lunching at an old inn near by. His host asked him if he noticed grit in the salad. "Gritty!" exclaimed Jerrold. "It's simply a gravel path with a few weeds in it!"

Photograph by Maynard Owen Williams

TAKING IT EASY AFTER TEA ON A DAY IN JUNE

Hordes of London visitors swarm up the Thames on summer holidays, by train, bicycle, motor, and river steamer. Thousands of canoes and punts are for rent, and riverside vendors ply a good trade in "tea baskets"—cups, plates, cutlery, etc., to be returned intact.

a curse on it. Always, the first-born child dies a violent death. Some have drowned, some have been killed by horses. They can't shake off the curse."

Farmers were bringing in wheat to the old gristmill at Hambleden as we passed. The simple scene was like some old country print found in an attic.

"But life in all these quiet-looking homes isn't the easy routine it used to be," insisted one woman we met. "Our servant problem is so acute that we're selling our house and moving to a London flat. My maid, for example, gave notice that she must quit, because her young man objected to her wearing a white cap and apron!

"Many girls today quit housework for jobs at a machine in one of the many light industries springing up along the Thames. These factories make soap, scent, wearing apparel, radios, trailers, sporting goods, camera supplies, toys, sweets—and they pay higher wages than a girl can earn scrubbing tubs or juggling babies."

Nobody who has seen Windsor from the Thames can forget this incomparable view. On how many tons of postcards, paper weights, and other Windsor souvenirs it has been printed! Famous Eton, from whence so many boys have gone to win England's battles in war, trade, and diplomacy, lies just across from Windsor (Plates II and IV and page 267).

Runnymede lies between Staines and Windsor.

One June morning in 1215 the barons swarmed about King John, here at Runnymede, and forced him to sign the Magna Charta (page 240).

New homes built at old Walton and many tents and bungalows on the river banks give the town a boom aspect. In St. Mary's Church is an odd relic, a scold's bridle. It is an iron headpiece, with a spring to keep the tongue from wagging. On it is a date, 1632; before it rusted too much, they say, you could see these lines:

> Chester presents Walton with a bridle
> To curb women's tongues that talk too idle.

A STREAM OF LITERATURE

Molesey had one of England's early golf courses. In 1758 Alexander Carlyle wrote: "David Garrick gave a dinner. He told us

to bring golf clubs and balls that we might play at that game on Moulsey Hurst."

Ideas, like boats, come down this river. From Shakespeare's *Merry Wives of Windsor* to present-day novels and plays, much of England's best literature has been written along its banks. The quiet Thames towns, in easy reach of rich libraries, make ideal workshops.

Not only did Bacon, Pope, Swift, Fielding, Dickens, and Gray live in the Thames Valley, but Shakespeare, Jane Austen, Milton, Shelley, Scott, Thackeray, and many others wrote their thoughts about this river, or laid scenes in various novels along its banks.

Becky Sharp, in *Vanity Fair*, went to Miss Pinkerton's school on "Chiswick Mall," and scornfully threw that gift dictionary out of the carriage window as she quit the place.

At Brentford, in medieval days, husky yeomen practiced archery with their yew bows. Here long stood a famous inn, the Three Pigeons, mentioned in Goldsmith's *She Stoops to Conquer*. "In Brentford town of old renown" Thomas Hood laid *The Duel*.

Whitton village, known now for its Military School of Music, was long the home of Sir Godfrey Kneller, portrait painter. One of his most famous works is the "Hampton Court Beauties." A vain man, it was said of him that he "bragged more, spelt worse and painted better than any artist of his day."

Teddington, noisy now with trams, traffic, and commuters, was the home of Blackmore; here he wrote *Lorna Doone*.

HISTORIC HAMPTON COURT

Hampton Court, where Cardinal Wolsey built the first palace in 1515, is one of the Thames' historic sights. Here, in 1604, Puritans and delegates of the Established Church met in that momentous conference out of which grew the English Bible now recognized as the Authorized Version.

For centuries writers have groped for words about Hampton Court, and hordes have come to see its paintings (page 250).

Sleepy old Sunbury, another river village, appears in *Oliver Twist*. Sikes and Oliver went through it after dark.

London Stone, just outside the historic river town of Staines, once marked the city limits. It used to bear the words, "God Preserve the City of London, A. D. 1285."

Hatton still boasts the Green Man Inn, long the haunt of highwaymen who robbed travelers on Hounslow Heath. It may be that the "James Boys" of that day, courtly Claude Duval, once a king's page, and Dick Turpin, who rode "Black Bess," knew this inn and used its robbers' "hiding hole" behind a parlor fireplace. In Texas, to this day, older cowboys sing a ballad about the "robbers of Hounslow."

Holiday crowds, paddling past Horton, may not know, or care, that Milton lived here; and that in the local church is a stained window showing him writing *Paradise Lost*. Stoke Poges is the scene of Gray's *Elegy Written in a Country Churchyard*. The original manuscript is preserved at Eton. Here at Stoke is an old manor house, with what is said to be a log from the Pennsylvania elm under which William Penn signed his treaty with the Indians. Penn himself, who was expelled from Oxford, is buried in a tiny Quaker graveyard about two miles from Chalfont St. Giles.*

PLANT LIFE FROM EVERY CLIME

It was a dark, foggy day when I went into a glass greenhouse at Kew; it smelt and felt like a Manila garden in the rainy season. In a few minutes you stroll through a variety of vegetable life ranging from tropical palms and orchids to Alpine plants and Scotch bluebells.

But Kew is more than a fragrant show place. It works for the whole Empire as a plant laboratory. Medicine, commerce, farming, horticulture, even some branches of manufacturing, have been benefited by its explorations into the vegetable kingdom. Quinine was nursed here. So was rubber. Brazilian rubber seeds were taken out of that country and brought to these gardens. From these few seeds, moved on to Malaya and developed, came finally one of the world's greatest activities—rubber growing and tire making.

Among the hordes who flock through, swarming at the pagoda, the sundials, or the teahouses, few know what a long arm this garden has.

Even the mutiny on the *Bounty* had what radio men call a "hookup" with Kew. The botanist who went to Tahiti with Captain Bligh to get breadfruit for transplanting to the West Indies was a Kew gardener, David

* See "Penn Country in Sussex," by P. T. Etherton, NATIONAL GEOGRAPHIC MAGAZINE, July, 1935.

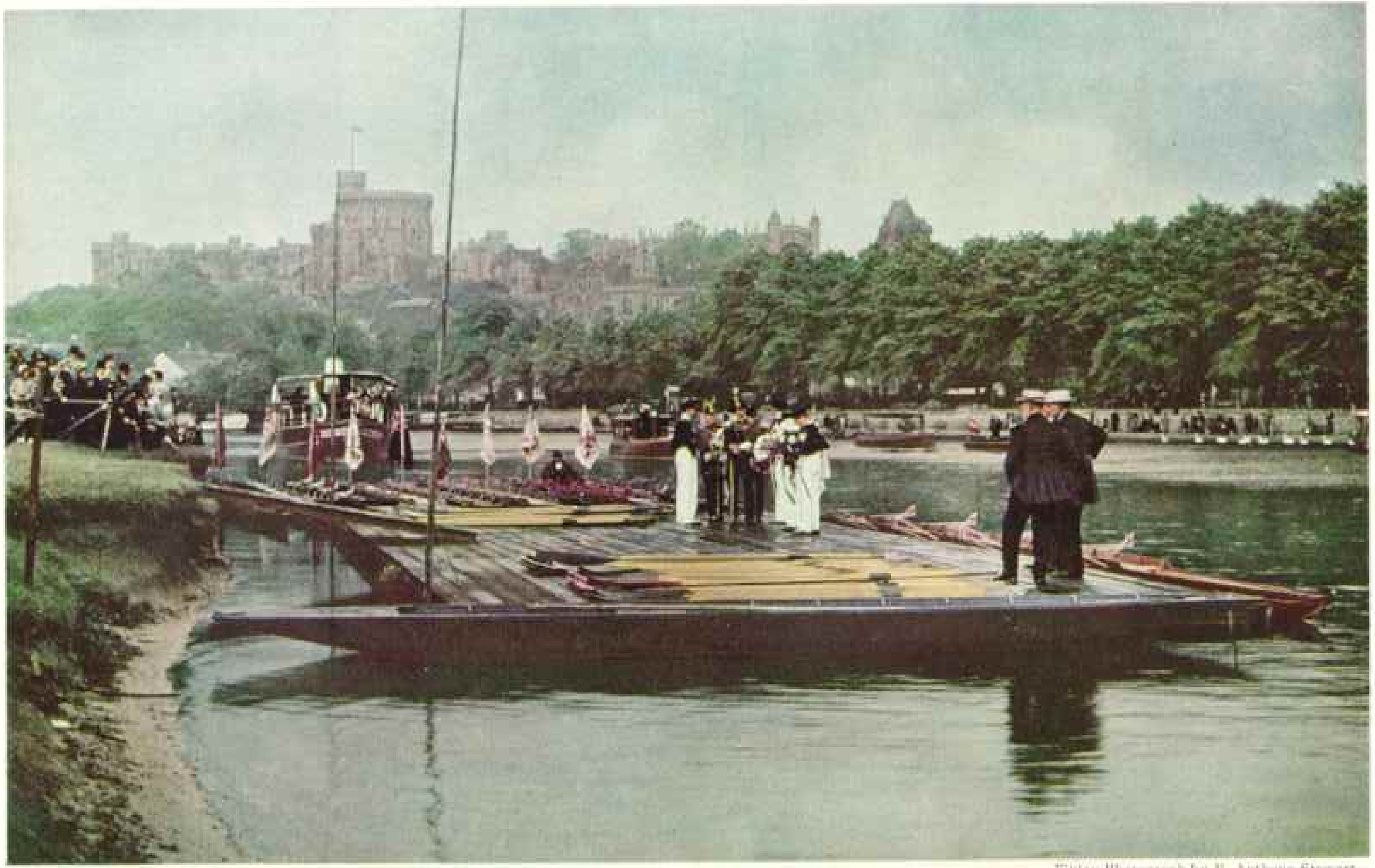
AMPLE BOATING WATER IS HELD IN UPPER THAMES BY 49 LOCKS AND DAMS

Were such barriers as this at Goring swept away, the river, from Oxford down to London's outskirts, would fall so fast that boat traffic would be difficult.

 Finlay Photographs by R. Anthony Stewart

SWANS ADD CHARM TO RIVERS, BUT SOME ARE VICIOUS AND ATTACK HUMANS

Males, in breeding time, have inflicted painful injuries on both adults and children, by pinching with beaks and pounding with their strong wing bones. All Thames swans are "upped" (caught) and marked each summer. By tradition, they belong mostly to the King; all others, to the Vintners' and Dyers' Companies. Girls are feeding a swan family near Walton.



Finlay Photograph by R. Anthony Stewart

ETON BOYS, WITH COXSWAIN HOLDING FLOWERS, TAKE PART IN "FOURTH OF JUNE" CELEBRATION BENEATH WINDSOR CASTLE

Founded by Henry VI, 52 years before America was discovered, this largest of English public schools (it would be called a private school in the United States) lies across the Thames from the royal castle. On June 4, birthday of King George III, boys in special uniforms row their frail boats in procession. As they pass parents and friends watching from the banks, they stand in their shells and salute by holding oars straight up. Windsor Castle is a residence of the kings of England. In St. George's Chapel (right center) lie several British sovereigns, including Edward VII and George V.

Finlay Photograph by B. Anthony Stewart

PLEASURE CRAFT DOCK FOR TEA AT HISTORIC MARLOW'S "COMPLEAT ANGLER" INN AND "AMERICAN BAR"

This serene Thames town, dating from Saxon times, is known for its gardens and old homes, whose velvety-green lawns slope down to the water's edge.

"BATTLE OF WATERLOO WAS WON HERE," SAID WELLINGTON, WATCHING AN ETON CRICKET MATCH

School "uniform" is formal dress. The young Etonian (left), wears a short Eton jacket and Eton collar, because he is less than 5 feet 4 inches tall, but, like his taller schoolmate in tail coat, he dons a silk topper (Plate I).

Finlay Photographs by B. Anthony Stewart

TIME AND THE RIVER ROLL PEACEFULLY PAST THIS SERENE OLD PAIR AT MAPLEDURHAM

English civilization grew up in the valley, and no Thames town reflects it more faithfully than this one. Its Manor House, fine Tudor buildings owned for centuries by the same family, dates from Henry VIII.

Finlay Photograph by B. Anthony Stewart

FOLLY BRIDGE, OXFORD, "END OF THE LINE" FOR LONDON STEAMERS

Where the Thames passes the University and the city of Oxford, it is known as the Isis. Above and below Oxford it becomes the Thames again. Here the river teems with racing shells. The careless boatman may be fined if he gets in the way of a varsity eight. Because the Isis is narrow and winding, races are rowed single file and points are scored by bumping the boat ahead. At the left may be seen the stern of one of the small steamers that carry excursionists between Oxford and Kingston, about 90 miles.

Finlay Photograph by B. Anthony Stewart

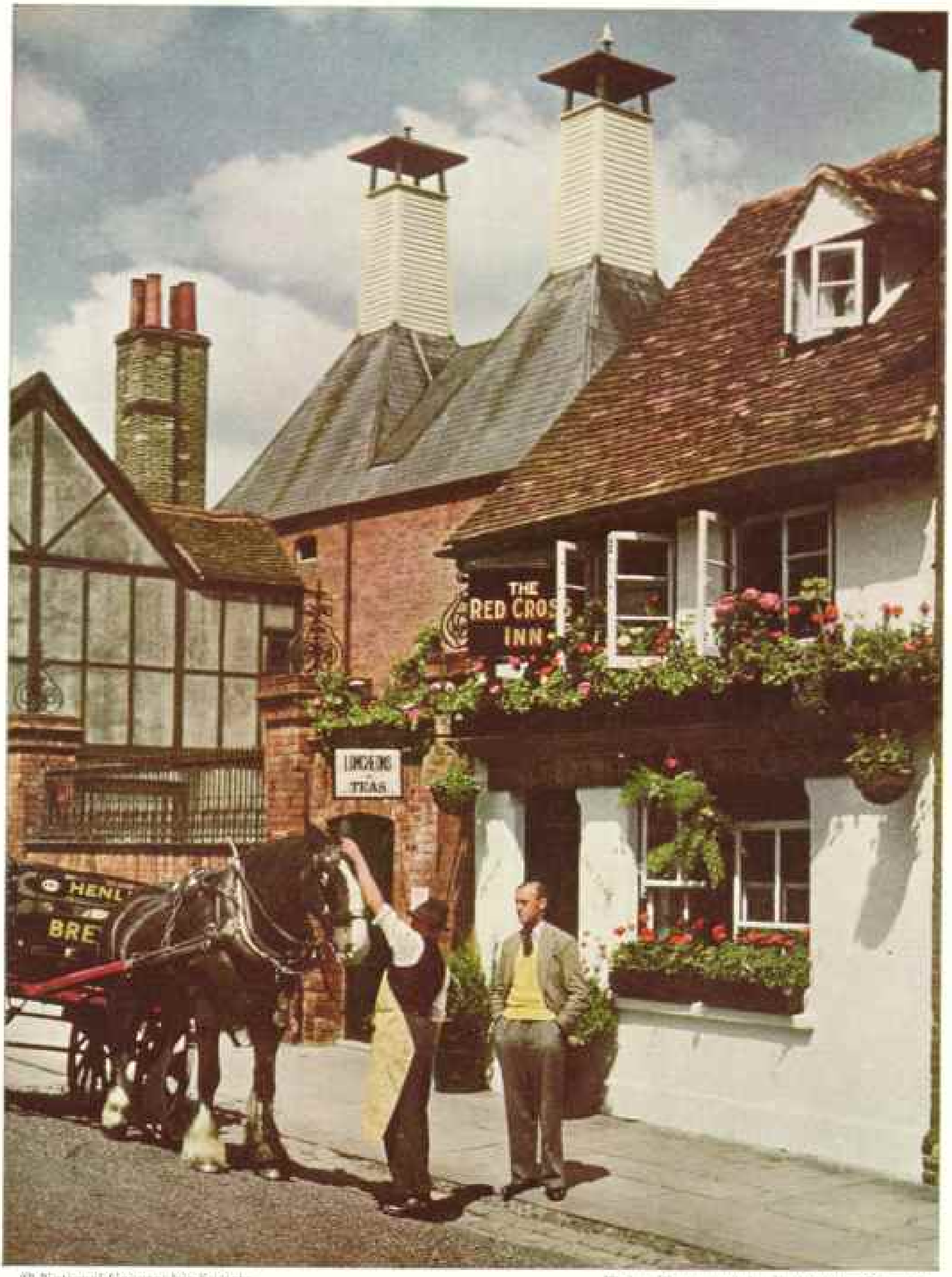
MENTION "HENLEY" AND ROWING COMES INSTANTLY TO MIND

For one week in June this sleepy little Thames-side village comes vividly to life as thousands gather for the famed Henley Royal Regatta (Plate VIII). Founded in 1839, it is the premier amateur rowing event of the world. The contest is held on a stretch of river 1⅝ miles in length, the distance being determined by the longest straight stretch in this part of the river. At the regatta, unlike the bumping races at Oxford, shells row side by side (Plate V).

Finlay Photograph by B. Anthony Stewart

FREIGHTERS, LINERS, YACHTS, AND BARGES, OFTEN A THOUSAND OR MORE, FORM DAILY PARADES PAST GRAVESEND, NEAR THAMES' MOUTH

Here river pilots on outgoing craft turn the bridge over to "channel" or "blue water" pilots; on incoming craft, the reverse exchange is made. Customs inspectors and quarantine agents board inbound ships. Freighters awaiting London cargoes often lie in this broad stretch until it is time to push upstream to the piers of the world's second largest port to load.



 Finlay Photograph by B. Anthony Stewart

HOP-DRYER FLUES RISE BESIDE OLD HENLEY'S FLOWER-FRAMED RED CROSS INN

Scratching his hairy-shanked Clydesdale's foretop, the beer-wagon driver listens while the innkeeper gives orders for deliveries. At regatta time Henley is crowded with noisy, cheering visitors (Plate VI). Always it smells pleasantly of hops; here for centuries maltsters and brewers have plied their trade.

Nelson. He had the young trees aboard the *Bounty* when he was cast adrift with Bligh and with other survivors finally reached Timor. It was because of another Kew gardener, Christopher Smith, that breadfruit trees finally landed successfully in 1791.

KINGS WERE CROWNED AT KINGSTON

In historic Kingston, where Saxon kings were crowned, no relic of royal days remains except the Coronation Stone. It stands in the market place, with royal names cut on its pedestal. This place saw much fighting in the Civil Wars of Charles I. Now it is just another suburb; only its great oasis of Richmond Park keeps London from swallowing it up.

Here a fine stone bridge crosses the Thames. Under an earlier bridge a ducking stool was used for perhaps the last recorded time. In the *Evening Post* for April 27, 1745, was this item:

> Last week, a woman that keeps the "King's Head" alehouse at Kingston was ordered by the Court to be ducked for scolding, and was accordingly placed in the chair and ducked in the river Thames under Kingston Bridge, in the presence of two or three thousand people.

Vauxhall was "Fox Hall" in Pepys' time. It was here he "walked long and the wenches gathered pinks."

Captain Vancouver, who explored America's northwest coast, has a tablet to his memory in the church at Petersham, set there by the Hudson's Bay Company.

Battersea Park, on the Thames' south bank, with its goat carts, cricket and football grounds, is essentially a poor people's playground. Its lawns and trees look so satisfying, like a stretch of unspoiled country; not as a park made with hands, in the way of the Frenchman who said that all you need to make a park is a load of gravel, a tree, and a green bench with a woman on it!

Ride from Richmond down to the Tower where, through thick glass guarded by slow, growling "Beefeaters," you can see the glistening crown jewels, and there unfolds a magnificent procession of history and architecture. The ecclesiastical palaces of Fulham and Lambeth; Battersea Park, facing old song-and-dance Chelsea, with its doddering pensioners and great flower show; Westminster, Shell Mex Building, the Savoy, the Temple and its peaceful gardens, solemn St. Paul's, clean-lined Wren spires, London Bridge—and, below, all the funnels, masts, promenade decks, and smelly holds of ships from everywhere.

Few of average London folk explore Dockland. They'd rather go upriver and see the Thames country, which is an Englishman's way. A lark, a swan, or a daisy is more to him than "the world's greatest dock system."*

Yet, to rent a canvas chair for tuppence and to sun yourself at midday on the Embankment is a "hayseed's" holiday, and a study in crowds. From Shell Mex and Bush House, from such stone symphonies as the official headquarters of Canada and South Africa in Trafalgar Square, Australia and New Zealand in the Strand, and near-by India House, and from other vast rabbit warrens and rookeries of trade, clerks and stenographers, male and female, flock here to smoke, eat sandwiches, chatter, bask in sunlight, and watch the tooting tugs and bumping barges.

Today the Embankment, compared with old prints of it, is as different in spots as New York's skyline is now from that of 40 years ago.

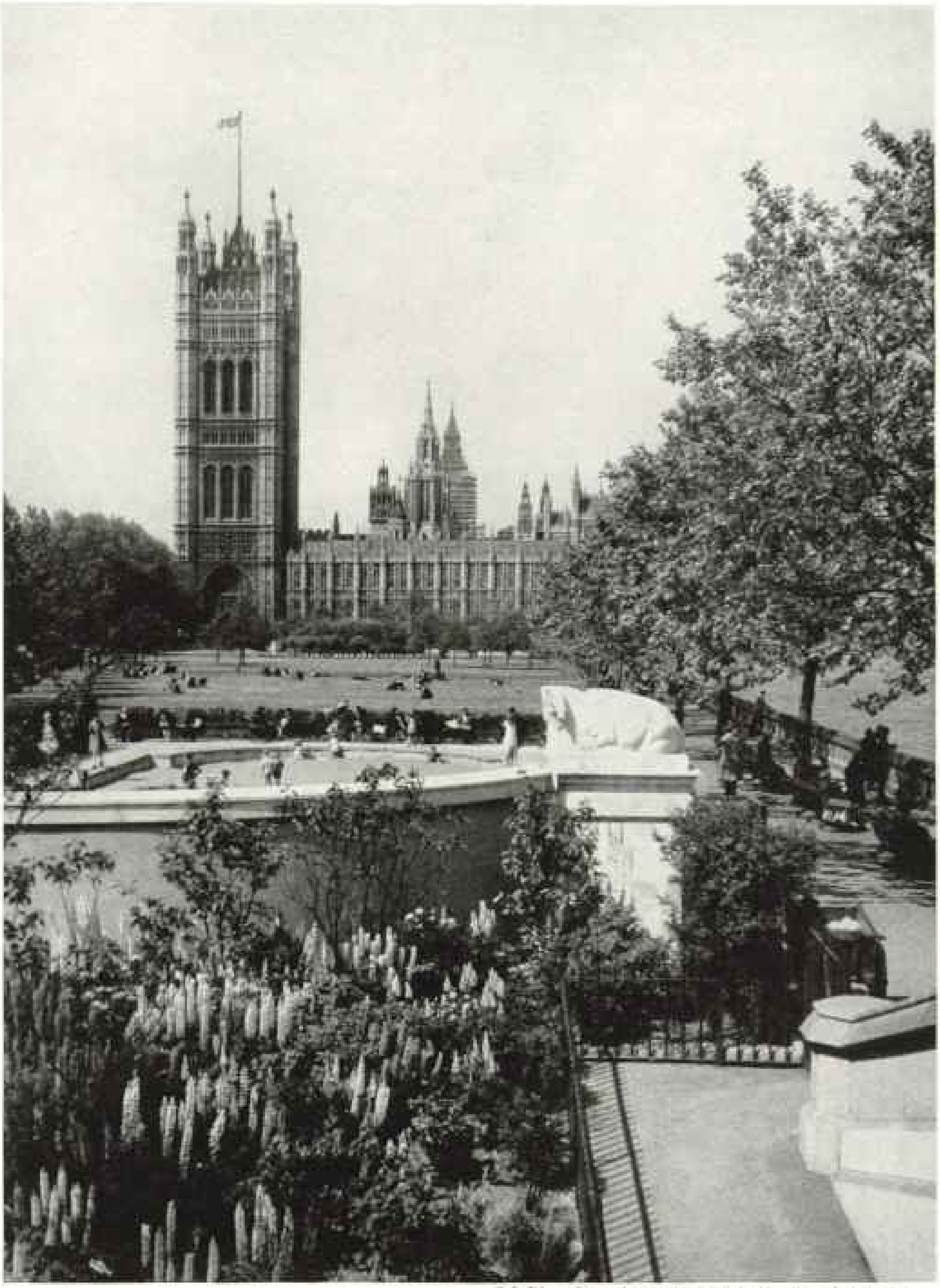
But, any day, old Father Thames may bob up in the news. Even the mud often reveals strange secrets, as when a dredge brought up along with a bucket of mud several handbags of the kind women carry. Each had been rifled and many held a small stone, apparently put there by some Strand pickpocket to make them sink after he had emptied them of their contents.

SHIPMASTERS EMBALMED IN RUM

Sailors coming upriver point out St. Anne's Church, Limehouse; its tower, they say, looks like a ship's rigging, topmast and all. Shipmasters are buried in old cemeteries along the lower Thames. In sailing-ship days, if a skipper or merchant died at sea, the crew often pickled him in a barrel of rum and brought him home that way.

From its so-called "Lower Pool" the Thames makes a giant curve around the Isle of Dogs (page 267) to form Limehouse, Greenwich, and Blackwall Reaches. Sprawling across the Isle are historic West India Docks, built like a fort in 1802 to keep out thieves and smugglers. Much rum is stored here, and legends are thick. In Dickens' tale of Captain Cuttle appears a pious gentleman who was fired by the West

* See "As London Toils and Spins," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE, January, 1937.



© J. Dixon-Scott photograph from Hudson Historical Bureau

LUPINES BLOOM, CHILDREN PLAY, AND FATHER THAMES ROLLS PAST THE HOUSES OF PARLIAMENT

Day and night, humanity mills about this hallowed scene of Britain's might. One day you may see the grave Judges of the House of Lords, marching in single file, in wigs and gowns. After them may come choir-boys in vestments, carrying switches in the old ceremony of "beating the bounds"; or, on Guy Fawkes Day, noisy boys in black-face; or by night, vagrants asleep on benches.

Photograph by R. Anthony Stewart

LAMBS THAT GAMBOLED ON THE GREEN OF AUSTRALIA'S "DOWN UNDER," OR ON ARGENTINE PAMPAS, END UP IN LONDON MEAT SHOPS

Here at Royal Albert Dock tons of mutton are being unloaded. Though native English mutton is excellent, the supply is insufficient. Like grocers' delivery wagons, ships on regular schedule dock here with grain, butter, sugar and fruit, as well as wine and tobacco, to satisfy London's prodigious appetite. Big cargo steamers and motor ships come here for overhaul and repairs.

India Company for "screwing gimlets into puncheons of rum and applying his lips to the orifice."

Giant iron eggs, as big as those laid by some fabulous auk and all painted in fancy Easter patterns, identify the Buoy Wharf at Blackwall for what it is. Walk among these grotesque figures, which look so helpless or dead here, and so strangely alive when tossing on a wave and ringing a bell or winking an eye at night, and you see men chipping off their rust and repainting them.

Buoys of every size and shape are here; some have oil lamps and some acetylene; some are used for marking reefs, shoals, and fairways, and some for marking wrecks or mooring places; some have lamps that wink and some that just stare, and some have bells. What schoolboy has not recited *The Inchcape Rock*, where Robert Southey describes how the ship of Ralph the Rover was wrecked on the very rock from which he had cut the buoy's warning bell:

> Sir Ralph the Rover tore his hair,
> He curst himself in his despair;
> The waves rush in on every side,
> The ship is sinking beneath the tide.

Thames whaling fleets long sailed from near-by Greenland Dock. From this fleet came the historic *Mayflower*. Ships in the American trade dock here now, unloading tobacco, fruits, grain, and motorcars, and women's ready-made frocks from New York.

THE THAMES TUBE

At Blackwall a 6,000-foot tunnel passes under the Thames; to the docks come boatloads of Jamaica bananas.

Coal flows up the Thames in millions of tons, to make power. Beckton Gas Works is the world's largest. Power plants, cement and paper mills dot the river banks for

ONLY WHEN TRADITION DEMANDS DOES THE HISTORIC OAR-PROPELLED ROYAL BARGE NOW APPEAR ON THE THAMES

In this picture, made about twenty years ago, King George V and Queen Mary are shown making a ceremonial journey in state, to the cheers of their subjects on the banks and in boats tied up along the course. During coronation week in 1937, King George VI and Queen Elizabeth made several such water journeys. The Bargemen, garbed in bright-blue uniforms, are members of a proud old order and often march in places of honor in land processions.

© Fox Photos, Ltd.

IN A TRIM, HIGH-POWERED ADMIRAL'S BARGE, THEIR MAJESTIES TRAVERSE THE THAMES TODAY

King George VI returns a salute as he puts out from Westminster Pier, accompanied by Queen Elizabeth. They are on their way to a ceremonial at Greenwich. Appropriately, the King wears the uniform of Admiral of the Fleet, because as Duke of York he served as a naval officer and took part in the World War Battle of Jutland. Crowds mass on Westminster Bridge to see the rulers start their river voyage. The royal standard flies at the bow of the barge.

© J. Dixon-Scott.

TOWER BRIDGE LOOMS ABOVE "THE GREAT STREET PAVED WITH WATER" AND CROWDED WITH SHIPPING

From this river of "liquid history," mud by millions of tons has been dredged. Lifted up in the dredge buckets have come stone and bronze weapons, pots, coins, and a Celtic sword. One bucket brought up a number of empty purses, weighted with stones, apparently thrown into the river after pickpockets had rifled them!

Photograph by Maynard Owen Williams

BOAT DRILLS BY ETON BOYS IN STRAW HATS AND ZEBRA SWEATERS FORM PART OF THE FOUNDERS DAY PROGRAM (PLATES II AND IV)

Photograph from Port of London Authority

DOWNSTREAM FROM LONDON BRIDGE, A RIVER LOOP FORMS THE PENINSULA KNOWN AS "ISLE OF DOGS"

From this stretch sailed Captain John Smith in 1606 with his company of "adventurers" to settle in Virginia; Sir Francis Drake on his voyages, and many another mariner famous in history (page 274). At left lie the historic West India Docks, with Millwall Dock at right.

Photograph from Pictures, Inc.

ALL SAILS SET, THAMES RIVER CARGO BARGES START THEIR ANNUAL RACE AT GRAVESEND

Photograph by R. Anthony Stewart

TELESCOPE LEVELED, THE GRAVESEND HARBOR MASTER IDENTIFIES AND RECORDS ALL CRAFT THAT MOVE IN AND OUT OF THE THAMES

"The road that begins on London River is but one with the River of Ocean that flows around the world. From it diverge the winding lanes and alleyways which form the tracks and courses of ten thousand vessels. Then back they come along the same highway, storm-battered, weary, but rejoicing, to the mother of tall and famous ships, the Thames."

© J. Dixon-Scott from Hudson Historical Bureau

THE THAMES FLOATS AN OLD VESSEL THAT MOTHERS LITTLE SHIPS

Moored permanently to Charing Cross Pier beside London's Victoria Embankment is the *Friendship*, belonging to the Honourable Company of Friendly Adventurers. It contains a collection of historic ship models. Next to the big clock-capped office building stands the Savoy Hotel. Visible in the background just to the right of the ship's spars and masts rises Cleopatra's Needle, an Egyptian granite obelisk 68 feet high, originally erected about 1500 B. C. near Cairo. A companion obelisk now stands in New York's Central Park.

Photograph by R. Anthony Stewart

WHEN THE TIME BALL ATOP GREENWICH DROPS, IT'S 1 P. M. IN LONDON

Captains of Thames River boats, unequipped with radio, adjust their clocks by its fall. Radio signals flash the observatory time across Great Britain and around the world. Skippers, whether they be in the South Sea or the Mediterranean, use chronometers set to G.M.T. (Greenwich mean time) to navigate their ships. Since the Zero Meridian lies here, geographers and mariners reckon all points on the globe as so many degrees east or west of Greenwich (map, page 245).

leagues. At Barking stands a gigantic electric plant. On pylons 500 feet high its cables swing across the Thames.

Ford's motor works loom up at Dagenham, below Barking: hereabouts, developing swiftly, is a good example of how the industrial boom is changing the whole aspect of many communities along the lower Thames. Workmen's fancy homes, built here in a planned model suburb, look like Hollywood sets.

One Dagenham brewery advertisement is cut on the tombstone of the brewery's quondam owner:

> Here lies John Steere
> Who, when living, brewed good beer.
> Turn to the right, go down the hill,
> His son keeps up the business still.

Though you see little shipbuilding here now, in old days there was a lot of it. On the Thames were built many of the fighting craft which helped destroy the Spanish Armada, and thus made England mistress of the seas.

WHENCE WORLD EXPLORERS SAILED

What a starting point this Thames has been in world exploration! You sense this merely in a partial list of great navigators and sea hawks who used its banks—Martin Frobisher, Hugh Willoughby, Francis Drake, Walter Raleigh, Lancaster, Dampier, Grenville, Sebastian Cabot, Captain Vancouver, even Captain Kidd. People forget, or never thought, about how much geographic knowledge was first gained by pirates. They ex-

plored many faraway coasts and islands years before honest traders got there.

Out of the Thames went millions of home-seekers, mostly for the New World. After the World War this mass movement subsided; in fact, since 1930 the balance of migration has been *into* the British Isles.

Significant beyond the promoter's dreams was one historic excursion recorded now on a tablet set at the entrance to East India Docks. It reads that Captain John Smith, "from near this spot, December 19, 1606, sailed with 105 'Adventurers'" to found "the first permanent English Colony in America." They settled at Jamestown, Virginia (page 267). In 1732 another group, led by General James Edward Oglethorpe, sailed from Deptford to colonize Georgia.

Off Woolwich long lay the "floating prisons"—old hulks full of felons, waiting deportation to Botany Bay or Van Diemen's Land. France has its Devil's Island, Mexico its Tres Marias, Russia its Siberia; America never had a distant penal colony, but for decades it was on the receiving end.

Kipling used to sit up in a tiny lookout atop the Tilbury Docks Hotel and watch the ships pass. He liked the "Outward Bound" theme.

GREENWICH STANDS ON THE ZERO MERIDIAN

The old Thames town of Greenwich is famous as the site of the Royal Observatory.

Here John Flamsteed, named "astronomical observer" by Charles II in 1675, began pioneer work that first enabled mariners to find their longitude at sea. Before he could start work he had to build his own instruments, at his own expense.

It was here that chronometers of the British Navy and Merchant Marine were first rated. Naturally and for simplicity's sake the meridian through this observatory was adopted as the starting line for measuring time and longitude.

Here now is the well-known magnetic clock that gives exact time to London's watches (page 271). It was before a Tudor palace here, tradition says, that Raleigh spread his cloak over the mud for Queen Bess to walk on.

Today all Greenwich visitors go to see the new National Maritime Museum, set up by the Society for Nautical Research. Housed in part of an old royal palace, this exhibit holds many priceless maps and 12,000 prints relating to British seafaring life, and the Mercury collection of ship models. In another hall are many relics of Admiral Nelson, such as the diamond plume of honor given to him by the Sultan after the Battle of the Nile.

In the old days of the Greenwich Hospital for sailors, one patient was a globe-trotting goat! Twice it circumnavigated the earth, once with Captain Cook in the *Endeavour*. Some whim moved the Lords of the Admiralty to sign a warrant making this goat a Greenwich Hospital pensioner!

SEAWARD LIMIT OF LONDON PORT

When seagoing ships nose down to Gravesend (pages 268-9), the "mud pilots" turn the bridge over to "channel," or blue water men (Plate VII). On shore stands the Three Daws, a pilots' inn; near by is a sea school where boys are trained for the Merchant Marine (page 245).

Americans like to visit St. George's Church, where Pocahontas is buried. A brass tablet and memorial window to this Indian princess were placed here by the Colonial Dames of America. Married to John Rolfe, a Virginia colonist, after her legendary rescue of Captain John Smith, and after she had had three children by an Indian husband, this daughter of Chief Powhatan died in Gravesend when about to return to America.

Tower Bridge is the last as you go downstream (page 266); during the World War a temporary military bridge was built between Tilbury and Gravesend. It had 70 spans; its miles of board floor rested on lighters used as pontoons till a "neutral" ship ran through it.

Singular accidents often happen on this crowded river. One bargeload of crude rubber got afire; it melted, ran off the boat, and spread flames far and wide, till it looked as if the Thames itself were burning.

From Gravesend you get a fine view of the ocean-going ship parade in and out of the Thames. Counting steamers, barges, tugs, and all, sometimes 1,200 craft a day pass in review. As rivers run, this Thames is short: it is barely 200 miles from source to mouth. But its place on the map, England's supreme dependence on its commerce, and its centuries of profound historical significance combine to make life on its banks a riparian drama without rival in civilization.

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Articles and photographs are desired. For material which The Magazine can use, generous remuneration is made. Contributions should be accompanied by addressed return envelope and postage.

Immediately after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resulting given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

The Society cooperated with Dr. William Beebe in a deep-sea exploration of undersea life off Bermuda, during which a world record depth of 3,028 feet was attained August 15, 1934, enabling observations of hitherto unknown submarine creatures.

The Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole, and contributed $100,000 to Admiral Byrd's Antarctic Expeditions.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

The Society's notable expeditions to New Mexico 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 have solved secrets that have puzzled historians for three hundred years. The Society is sponsoring an ornithological survey of Venezuela.

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 an officially recognized altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

Printed in U. S. A. Entered at the Post Office at Washington, D. C., as Second-Class Mail Matter. Acceptance for mailing at special rate of postage provided for in Sec. 1103, Act of October 3, 1917, authorized July 1, 1918. Cover design and names registered in United States Patent Office. Marca Registrada.

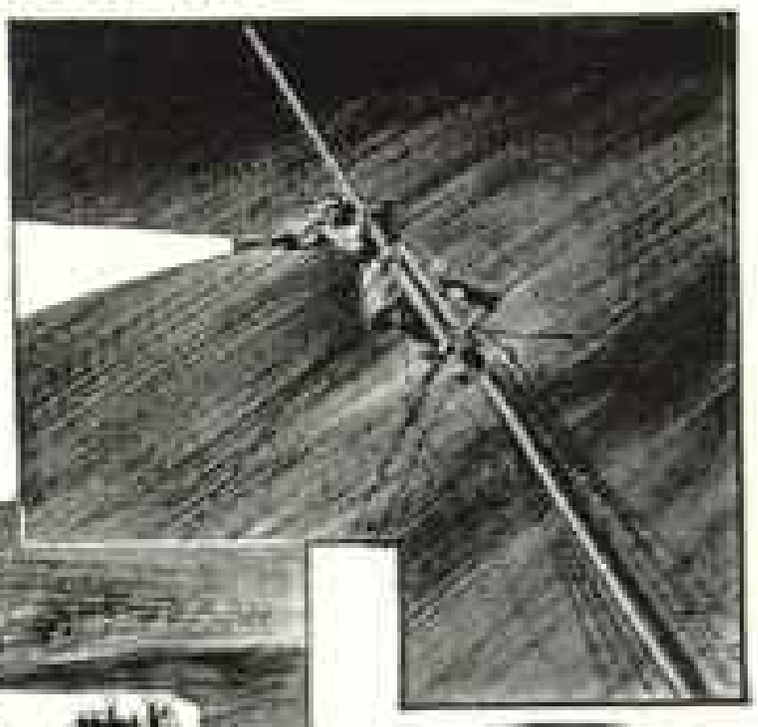
IF I FAILED...WE WERE ALL DEAD MEN

LASHED TO SHROUDS OF SINKING, BURNING SCHOONER, SAILORS SEE HOPE OF RESCUE FADE

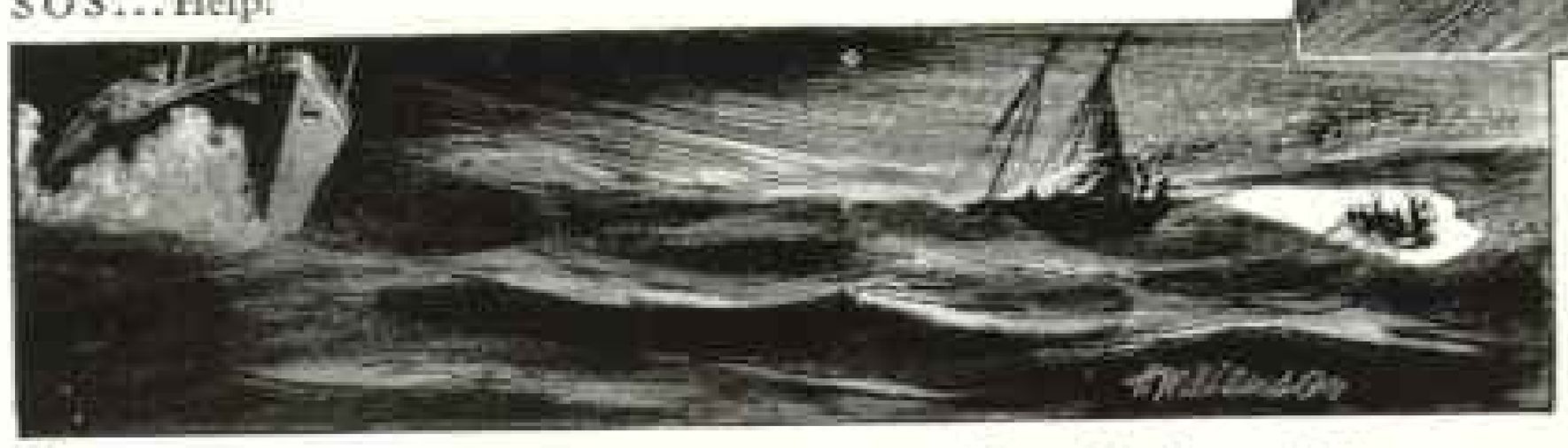
❶ "The dream of my life, for which I had saved since I first went to sea at twelve, had come true!" writes Capt. Hans Milton of 610 West 111th St., New York City. "I was making my first voyage as master and owner of my own vessel, the two-masted topsail schooner 'Pioneer,' when the hurricane of last September caught us 400 miles off Nantucket.

❷ "We were pumping to keep afloat when we passed into the windless vortex of the storm where the waves were leaping and jumping crazily and where they crashed in our companionways and filled the ship beyond hope of saving her. The five of us and the cat scrambled aloft for our lives. Our deck-load of lumber kept us afloat and without fresh water and with almost no food we lived, lashed to the rigging, for three endless days and nights.

❸ "Once a steamer hove in sight—but failing to see our distress signals, went her way. At 3 a.m. on the fourth morning steamer lights showed momentarily over the wild sea. We rigged a huge ball of sails and blankets, soaked it with gasoline, touched it off and hoisted it aloft.



❹ "But the steamer did not change her course. She thought we were fishing. The wind blew burning fragments back on the ship setting her afire in various places. I could see the stern light of the steamer going away from us. *If I couldn't stop her, we were all dead men!* I climbed to the fore-top and in desperation pulled my flashlight from my back pocket and in Morse code signalled 'Sinking... SOS... Help!'



❺ "Slowly, I saw the ship turn! In her last hour afloat, all of us and the cat were saved from the sinking, burning 'Pioneer' by those fine seamen of the United States Liner 'American Banker' and by the power of two tiny 'Eveready' *fresh* DATED batteries that stood by us in the blackest hour of our lives!

(Signed) Capt. Hans Milton"

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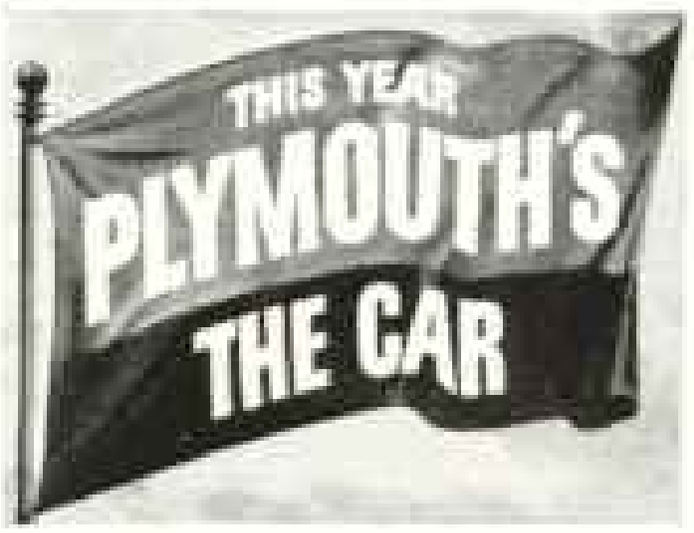

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Plan now to come . . . to Treasure Island and to the fascinating city on its hills across the Bay.

Ride in the bell-ringing cable cars, up from the fabled waterfront to the towered peaks above the sea. Ride through streets decked high with sidewalk flower-stands . . . through the largest Chinatown outside the Orient; over the world's two greatest bridges.

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Four Series of Great Cars, 22 Models . . . 10 Priced Next to the Lowest . . . Delivered at Factory, or Low as $770. Stand. Equipment and Federal Taxes Incl.

*(*Optional Equipment—Slight Extra Charge)*

$770

Car illustrated . . . 4-Door Sedan, 117-inch wheelbase, $840 delivered at Factory . . . Standard Equipment and Federal Taxes Included . . . White Sidewall Tires and Rear Wheel-Shields are optional at Extra Cost.

NOISELESS WINGS. Automatic 4th Speed Forward* buoys you over space. Saves up to 20% on gas.

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THE CAR THAT EVERYBODY LIKES

See America Best!

THE advice is good on triple counts when you make this briskly beautiful Buick your companion-on-tour: Its mighty Dynaflash straight-eight engine will carry you far and wide with the minimum of effort and the maximum of pleasure. The soothing, "full float" restfulness of its BuiCoil springing ride makes back-roads beauties as comfortably reached as the scenic wonders of the main highways. And always you see better, see more, through Buick's stepped-up visibility—as much as 413 more square inches of safety plate glass in some models! Besides—you'll be money in pocket, for this great straight-eight costs less than you'd expect, less than some sixes, and, in some models, as much as $102 less than last year!

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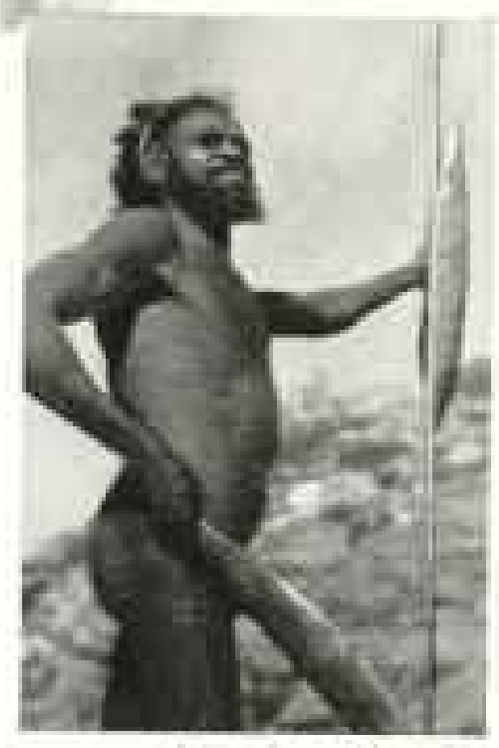

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New Zealand Maori

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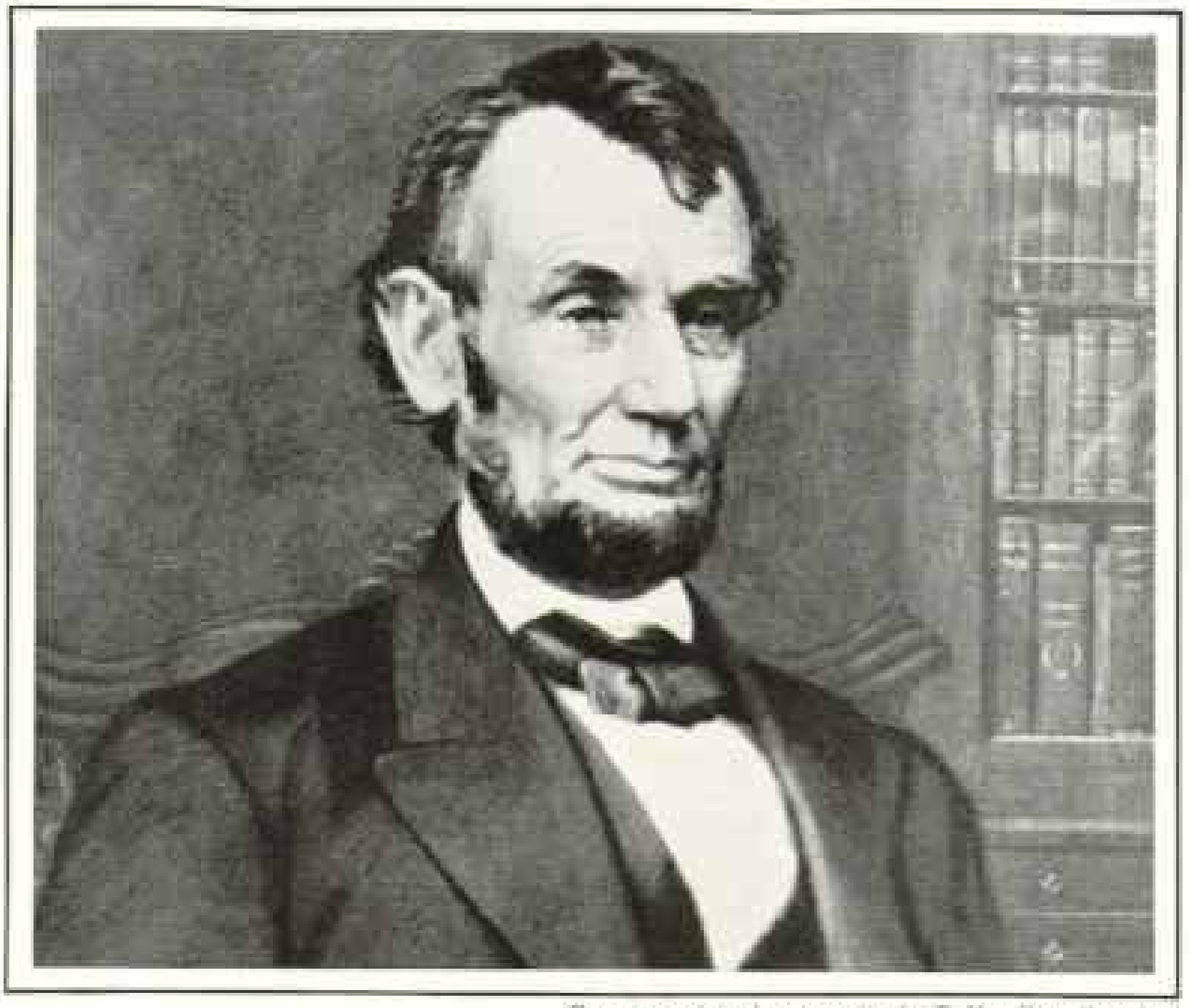

From an original water color by F. Hamilton Crawford

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Freedom from the constant attention called for by investments.

Freedom, above all, from wondering how your family would get on in these changing times should anything happen to you.

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B. W. I. and a visit to the Panama Canal Zone (15 Days—$210 up) . . . *Alternate Saturdays* tours to the Highlands of Guatemala with calls at Santiago, Cuba and Honduras (26 days, all expenses, $295 up) . . . *Ask about other services from New York, Philadelphia and New Orleans.*

Apply any Authorized Travel Agent or United Fruit Company, Pier 3, N. R., or 632 Fifth Ave., New York; 111 W. Washington St., Chicago; 321 St. Charles St., New Orleans; Pier 9, North Wharves, Phila.; 201 Tremont St., Boston.

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How to see
TWICE AS MUCH
on your trip to
CALIFORNIA

for little or no extra rail fare!

1 "AS YOU can see from this map, Southern Pacific's Four Scenic Routes all meet at the San Francisco World's Fair. By going to San Francisco on one of these routes and returning on another, you see an entirely different part of the United States each way. You see *twice* as much of California and the West as you would by going and returning on the same route. Let me give you an example . . .

2 "GO, for example, on Southern Pacific's Golden State Route through El Paso (side trip to Carlsbad Caverns National Park), Southern Arizona and Los Angeles. Ride the famous *Golden State Limited* or the economical *Californian*.

3 "SEE THE GOLDEN GATE INTERNATIONAL EXPOSITION on Treasure Island in the middle of San Francisco Bay, the most beautiful world's fair in all history, with magnificent views of the two largest bridges ever built. On this magic island you'll enjoy the fun and excitement of a trip to the Orient, the South Sea Islands, Hawaii, South America, Australia and dozens of other foreign lands.

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"From most eastern and midwestern places, such a 'go one way, return another' Southern Pacific ticket costs you not 1¢ more rail fare than a trip straight to California and back on the same route. Yet you actually see *twice* as much!"

Southern Pacific

THE WEST'S GREATEST
TRANSPORTATION SYSTEM

5 **MAIL THIS COUPON** today and we will send you free booklets describing the San Francisco World's Fair and our Four Scenic Routes. Address O. P. Bartlett, Dept. NT-2, 310 South Michigan Avenue, Chicago, Illinois.

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Protect Babies before Birth

SYPHILIS in newborn babies, frequently called congenital syphilis, is preventable in most cases. Read what Surgeon General Thomas Parran of the United States Public Health Service says:

"The first thing to do completely, in my opinion, is to *wipe out congenital syphilis*. That is one job that doesn't need to take a generation . . .

"We know absolutely that with good treatment, begun in time, there is only one chance in eleven that the syphilitic mother will not bear a healthy child . . .

"We know that early treatment before birth is vastly more effective than any treatment after the child is born."

A blood test will indicate whether or not an expectant mother has syphilis. If the test is positive, she can take advantage of the almost certain protection for her child which medical science provides.

Every mother-to-be wants her baby to grow to sturdy manhood or womanhood—yet in the United States, authorities estimate, sixty thousand babies are born each year infected with syphilis. Frequently this disease may seriously affect the sight and hearing, or weaken the heart and other organs.

At times congenital syphilis in a child, unsuspected by either parent, may give no outward sign of its presence before maturity, when evidence of the disease may appear. Yet, if a blood test were made part of the examination and prenatal care given expectant mothers by physicians or clinics, congenital syphilis would be a rarity in our country.

The fight to stamp out syphilis gains power and effectiveness every day. Public opinion actively supports intelligent measures for the prevention, treatment and control of venereal diseases. Citizen groups, notably women's clubs, are becoming aroused to the fact that syphilis, scourge though it may be, is not unconquerable.

Most communities maintain clinics to care for those who are unable to pay for treatment. Local health departments or medical societies are prepared to refer those in need of treatment to qualified physicians.

The Metropolitan will be glad to send you its booklet "The Great Imitator" which contains information that you should have about syphilis. Address Booklet Department 239-N.

The American Social Hygiene Association, through its National and State Anti-Syphilis Committees, is sponsoring the third National Social Hygiene Day, February 1st, 1939. On this day, citizen groups and physicians all over the country will meet with health officials to plan the next steps to take in stamping out syphilis—particularly congenital syphilis. This Association, 50 West 50th St., New York, N. Y., will be glad to send literature and full particulars regarding the meetings.

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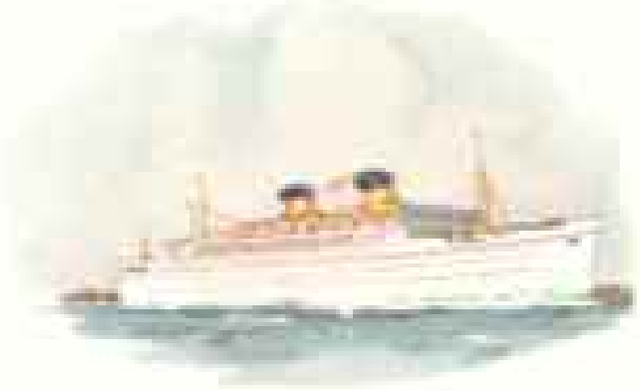

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Details of *Matson Cruises to Hawaii and South Seas*, also *hotel reservations at Royal Hawaiian or Moana*, Honolulu, from Travel Agents or MATSON LINE offices: New York, Chicago, San Francisco, Los Angeles, San Diego, Seattle, Portland.

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eshing

Its taste holds the answer

"Delicious and refreshing."

That's ice-cold Coca-Cola . . . the drink everybody knows. Good things from nine sunny climes poured into a single glass. Your thirst asks nothing more.

THIRST STOPS HERE . . .
FOR ICE-COLD COCA-COLA

"She's so real—you want to pick her up and hug her"

GET movies of your children—all through the different seasons of the year. Have the exciting fun of taking them—the thrill of showing them.

Today in hundreds of thousands of homes, home movies are a vital part of the family life, drawing old and young, neighbors and friends together.

FULL-COLOR KODACHROME... Simply by changing your film—loading your Ciné-Kodak with Kodachrome instead of black-and-white—your movies will be flooded with the brilliant, glowing colors of nature. No fuss, no extra equipment, simple as black-and-white.

ONLY EASTMAN GIVES YOU COMPLETE EQUIPMENT AND SERVICE . . . Ciné-Kodak—the home movie camera exactly suited to your needs . . . Ciné-Kodak Film—black-and-white or full-color Kodachrome . . . processing service that's world-wide and included in the price of the film . . . Kodascope—the projector that shows your movies clearly, brilliantly—Eastman all, and all designed to work together.

Your dealer will show you the range of Eastman home movie equipment and project sample movies for you . . .

Eastman Kodak Co., Rochester, N. Y.

FROM A KODACHROME ORIGINAL

Ciné-Kodak

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TO MAKE 16 MM. MOVIES, Ciné-Kodak "E," the low-priced "sixteen" that has so many high-priced camera features, $39.50. Ciné-Kodak "K," most widely used 16 mm. home movie camera, $88.50. Magazine Ciné-Kodak, 3-second magazine loading, $117.50.

TO SHOW 16 MM. MOVIES, Kodascope Model EE, capable, very low priced, from $57.95. Kodascope Model G, Eastman's newest precision-built projector, from $112.95. Both complete with lens and lamp.

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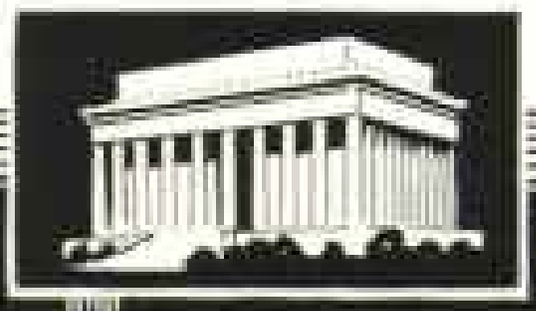

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Listen to the Magic Key of RCA Sundays, 2 to 3 P. M., E. S. T., on the NBC Blue Network.

You can buy RCA Victrolas on C.I.T. easy payment plan. Any radio is better with an RCA Victor Master Antenna. *Price f.o.b. Camden, N. J., subject to change without notice.

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BERMUDA

Belmont Manor and Inverurie

Get the utmost value from your Bermuda winter holiday by visiting one of these hotels, situated in complete resort estates on the waterfront, with their own Beach Club, swimming pool, 18-hole golf, tennis, riding, yachting, deep-sea fishing, famous orchestras. Reasonable rates. Consult your travel agent or address Bermuda Hotels Inc., 500 Fifth Avenue, New York, for Booklet N.

The Princess Hotel and Cottages. A select hotel for a selected clientele. L. A. Twemlow Co. See travel agt. or N.Y. Office, 500-5th Ave. PEnn-nsyl.

CUBA

Havana

The National Hotel of Cuba. finest hotel in the tropics, for a glorious winter vacation. Reservations—travel agents—hotel direct or Plaza Hotel, N. Y. C.

GUATEMALA

Lake Atitlan—Panajachel

Casa Contenta (House of Happiness) Exclusive Hotel; bungalows. Swimming, boating, riding. Bath in every room. Am. plan $5 up. English Magnet. Bklt.

JAMAICA, B. W. I.

Constant Spring

Manor House, near Kingston, 600 feet high in foothills of Blue Mts. Golf course, pool adjacent. Moderate rates. Write R. C. B. Scotty, Manager.

"I Wonder What Time My Daddy Will Telephone?"

"The minute he calls up I'm going to speak to him about Bobby. He's my cousin, and he's just five weeks old. *And they haven't got a telephone where he lives!*

"One of these days his mother's going to run out of his talcum. Or she'll want his father to stop at the drug store on the way home for oil. Or maybe she'll want to ask the doctor about that rash on his back —Bobby's back, I mean.

"Then suppose some week he gains six ounces. Don't they expect to tell their friends news like that?

"Well, how is Bobby's mother going to do all those things besides her marketing?

"I'm going to see if my Daddy can't fix it. He's always saying how good telephone service is—and how cheap."

BELL TELEPHONE SYSTEM

You are cordially invited to visit the Bell System exhibit at the Golden Gate International Exposition, San Francisco, California.

UNTIL YOU DRIVE THIS "TWELVE"—

You'll never know how much more driving pleasure extra cylinders mean—until you get behind the wheel of the 12-cylinder Lincoln-Zephyr.

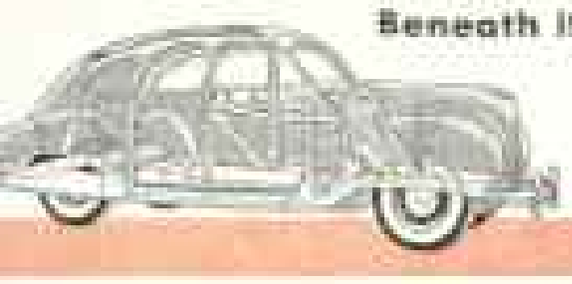
You'll never know what it is to reel off 400, 500 or 600 miles a day, perfectly relaxed and ready for more the next morning—until you point your Lincoln-Zephyr toward the horizon. The perfect balance of this car; and the feeling of road-hugging security brought by its low center of gravity are somehow different from anything you've ever experienced.

You'll never know the full meaning of the words "safety rides with you" until you feel yourself surrounded by this solid one-piece body-frame of the Lincoln-Zephyr, and sense the added visibility of its wide windshield and deep windows. With power a-plenty to go gently, and smooth hydraulic brakes to stop gently, you ride relaxed no matter what.

And what a difference *ample* room makes—what a stretch-out feeling you get in this luxurious interior where six find shoulder room, leg room, *comfort!*

Add it all up—and it reads Lincoln-Zephyr—topped off with an economy unheard of in a car of this size—and so satisfying as the miles roll up. Think of 14 to 18 miles to a gallon—and the less wear on your pocketbook! But—you'll never really *know* this car until you drive it! Lincoln Motor Company—division of Ford Motor Company, builders of Ford, Mercury, Lincoln-Zephyr and Lincoln.

Beneath its outward beauty



Lincoln-Zephyr V-12

A combination of features that makes it the only car of its kind. 1—*Unit-body-and-frame—steel panels welded to steel trusses.* 2—*V-type 12-cylinder engine—smooth, quiet power.* 3—*14 to 18 miles to the gallon.* 4—*High power-to-weight ratio—low center of gravity.* 5—*Comfort for six, "amidships" in chair-height seats—gliding ride—direct entrance—high visibility.* 6—*Hydraulic brakes.*

STYLE LEADER FOR 1939