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THE NATIONAL GEOGRAPHIC MAGAZINE

Life in Our Fighting Fleet

BY F. BARROWS COLTON

"DOUSE that light!"

An officer hissed the words in my ear and poked my side.

The green-shaded flashlight in my pocket had come on by accident.

The United States Fleet, completely blacked out, was steaming at sea on night maneuvers. Not a light showed. Porthole covers were clamped shut, hatches screened, voices hushed. Even below decks all was dark save for the dim blue battle lights which now and then faintly revealed a sailor hurrying wraithlike on some errand.

The giant battleship surged through the water like a great gray ghost, and as silently. From high up on the darkened bridge it was hard to sense that below us 1,400 men were quietly manning their battle stations, standing ready in gun turrets, deep in the magazines, or tending the throbbing engines.

Now and then the moon peeped through clouds to reveal dimly other battleships behind us, cruisers far off on either side, and our outer screen of destroyers, barely discernible in the distance.

John Paul Jones Would Be Surprised

The "father of the American Navy" might have felt quite at home there on the bridge that night. On many such nights, a hundred and sixty years ago, Jones' fast frigate *Ranger* must have plowed dark and hostile waters, with lookouts peering anxiously ahead and gun crews standing to quarters, just as ours were doing.

But the similarity would end there. Could the doughty old Revolutionary hero see our Navy of today, he surely would be amazed, and probably more than a little shocked!

In his time, captains fought their ships at point-blank range, fed their men on salt pork and hardtack, kept them happy on a daily ration of rum.

Today the Navy fires its guns around the earth's curvature to hit targets out of sight below the horizon, feeds its men on steak and apple pie, and keeps them happy aboard ship on nothing stronger than soda pop, movies, and—perish the thought!—today's able sailormen even play bridge!

So recent a naval hero as George Dewey would feel behind the times at sight of Navy dive bombers dropping three miles in 30 seconds to "lay their eggs" with deadly accuracy; dual-purpose cannon that fire with equal ease at ships or planes; and as many aircraft carriers in the modern United States Navy as all the fighting ships he had at Manila Bay.

Today's Navy fights not only upon the surface of the sea, but in the skies above and the depths beneath. Some say tomorrow's admirals may direct their fleets in battle from airplanes, where they can see the whole action spread out below them like men on a chessboard. The modern naval officer is almost more scientist than seaman, and nearly every sailor is an expert in some special field.

On a Navy bomber in which I flew, there was a well-thumbed book of comic strips detailing the latest adventures of Buck Rogers and Superman. Perhaps that was prophetic!

If tomorrow's Navy fights with rocket guns and fleets of space ships, they will hardly be more amazing than some secret gadgets that already exist in the Navy of today.

The Navy is changing fast. The magnetic type of compass, stand-by of navigators for over 1,000 years, is sidetracked now for the more accurate gyroscopic compass. Hammocks and tattooing are on the way out. Vitamins are measured out as carefully to the modern seaman as the rum ration used to be.

Official Photograph U. S. Navy

"Battle Wagons" Wheel into Line, While Fighter Planes Soar Above

Five of the fleet's battleships, whose heavy guns form the backbone of its fire power, execute an intricate maneuver in which they turned first right, then left, as shown by their wakes. Planes escort the fleet to keep off hostile bombers. Destroyers and cruisers form a screen on either flank to ward off torpedo attacks.

Photograph by Acme

Secretary Knox Dedicates to Defense the First Battleship of the New "Two-ocean Navy"

Speaking at the commissioning of the U.S.S. *North Carolina*, on April 9, 1941, in the Brooklyn Navy Yard, he declared that "We are foreshadowing with this ship the greatest Navy the world has ever seen." Seated, left to right, are Rear Admiral Adolphus Andrews, Commandant of the Third Naval District; Governor J. M. Broughton of North Carolina; Admiral Harold R. Stark, Chief of Naval Operations; Captain Olaf M. Hustvedt, commanding officer of the ship, and Chaplain T. B. Thompson.

Yet tradition lives on. Though the sailor now quenches his thirst from an electrically refrigerated drinking fountain instead of a water cask, it's still called the "scuttle butt," as in days of sail. Sailors still say the historic "Aye, aye, sir" in response to an order. A sign at a naval station auto-parking space reads "Park bow in only!" At night the ship's master-at-arms still reports "all galley fires out," though now it's just a matter of the cook turning a switch on his electric stove!

Calories and Vitamins Essential Weapons

In the Navy today, the science of gastronomics ranks close to that of gunnery, because good diet makes good sailors. When I ate noonday dinner with sailors on one battleship, we had chicken noodle soup, crackers, fried chicken, giblet gravy, mixed sweet pickles, mashed potatoes, buttered peas, head lettuce salad, 1000-island dressing, mixed fancy olives, cherry pie, bread, butter, and coffee—and it wasn't Sunday! (In one day the sailor gets 4,000 to 5,000 calories, ladies!)

The same week's menus had such items as fresh oranges, marshmallow cream pie, corn on the cob, grilled steaks, and—yes, you were right—beans, pot-baked, oven-baked, and boiled! (Pages 678, 686, 689.)

The stirring bugle call, reveille, still wakes today's sailor at 5:45 a.m., but it comes out of a loud-speaker. The seaman eats in a cafeteria, bathes in showers, and when he goes ashore is likely to engage in such untraditional sports as archery, horseback riding, or sight-seeing. He views a free movie every night on deck (same ones you see ashore) and turns in at 10 p.m. on a bunk that boasts mattress and pillow. He sleeps in his "skivvies" (underwear) and rarely wears garters.

But his life is far from soft. "How many hours a day do we work?" I heard a future sailor ask a recruiting officer.

"Twenty-four, if necessary!" was the reply. From the time the sailor, barefooted, scrubs the decks before breakfast, his day is full.

Stripped to the waist, he may be heaving 100-pound powder bags at a loading drill in a

Official Photograph U. S. Navy

From His Post of Command the Admiral Watches the Fleet on War Maneuvers

Four stars on the shoulder straps of the officer in the center show that he is a full admiral, commander in chief of the fleet. At his left is a captain, denoted by four stripes on the shoulder straps; at his right a lieutenant, with two stripes. They are on the flag bridge. In battle they would be stationed in the heavily armored conning tower.

gun turret; he may stand watch in the fireroom, where in the Tropics the temperature hits 116° or over, where even the door handles are hot, and men must eat salt tablets and drink up to four times the normal amount of water to keep from wilting. He may be doing such un-seagoing jobs as repairing typewriters or overhauling airplane engines.

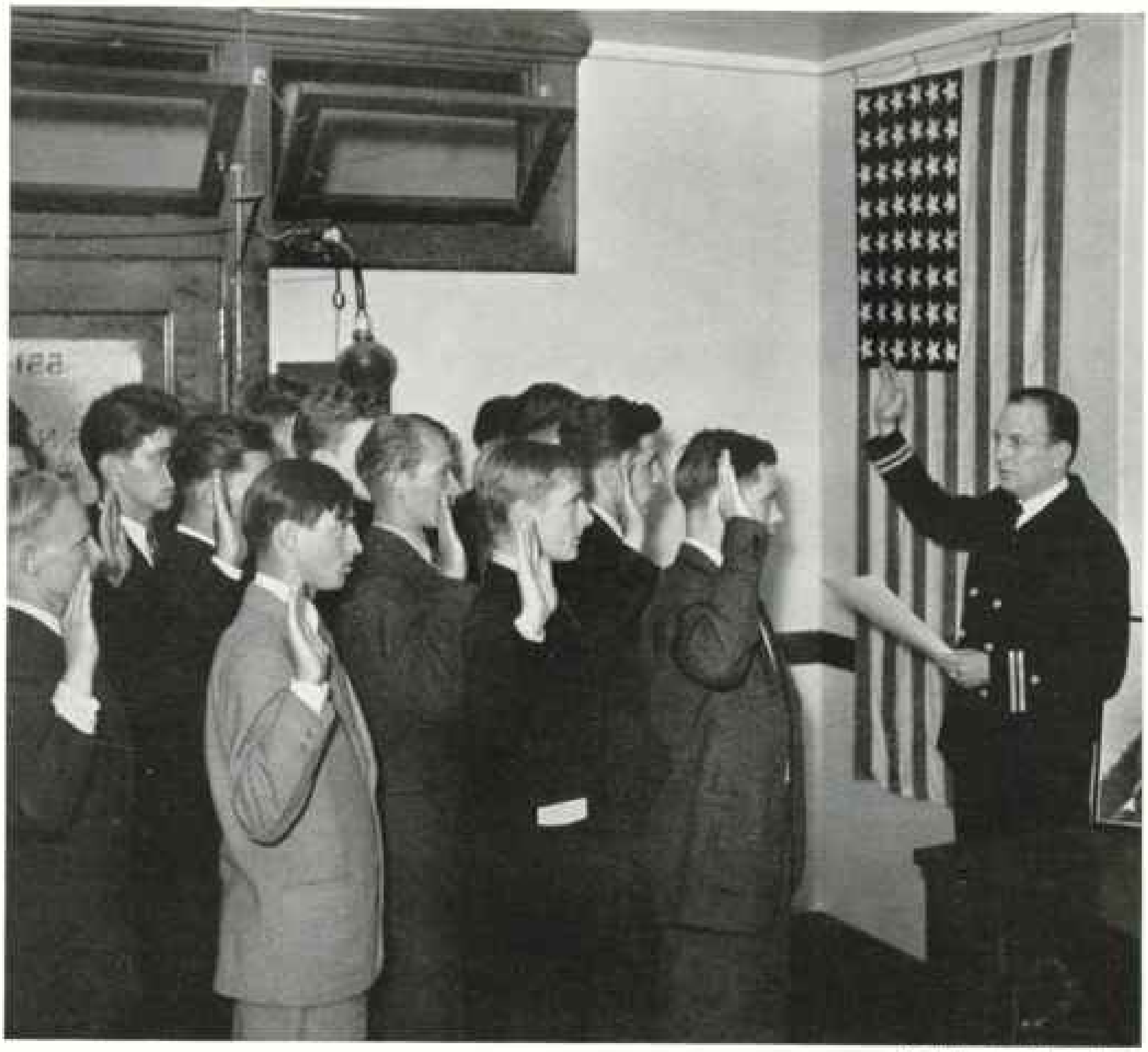
In his spare time he may even, though it seldom happens nowadays, be chasing rats! In the daily bulletin of the battleship *Texas* I saw the following item:

"Two rats have recently been observed aboard this ship. If they are male and female, and nature takes its course, we can expect them to have 50 young in a year. Rats carry disease and consume much food. The ship offers a bounty of 25 cents per rat. But they must be genuine U.S.S. *Texas* rats—no dead ringers from shore! How good are you? Can you outwit the rat? Come on, *Texas!*"

Cleanliness, of both ships and men, is rated at least equal to godliness in the U. S. Navy. Down a line of recruit food handlers, standing at stiff attention, I walked with an inspecting officer (page 677). Even their fingernails came under scrutiny. A mere smudge on a white jumper brought the question, "Been using that jumper to swab the deck?" In such ways are lessons driven home.

"Recording Angel" of "Field Day"

On one ship, when an engineer officer offered to show me the engine room, I suggested it might be wise to change from white linen suit to khaki pants. His face fell.



Official Photograph U. S. Navy

"I Do Solemnly Swear That I Will Bear True Faith and Allegiance to the United States"

Taking the oath is the final step in joining the U. S. Navy (page 679). Boys of 17 may now enlist, their term expiring on their 21st birthday. Those over 18 enlist for six years. Recruits are trained at San Diego, California, Great Lakes, Illinois, Newport, Rhode Island, and Norfolk, Virginia. The training period, usually 12 weeks, has been reduced to six weeks or less because of the Navy's pressing need for more men.

"You won't need to change," he said in a hurt voice. "It's just as clean as the rest of the ship." And it was!

Seeing the phrase "Field Day" on a ship's daily schedule, I had visions of all hands going ashore for sports and maybe a picnic lunch. It meant just the opposite—everybody stayed aboard and "cleaned house," preparing for weekly captain's inspection, when the "old man" goes over the whole ship, passing out both compliments and criticisms. His eagle eye notes everything from a lack of shine on a sailor's shoes to spots on the galley stove.

With him walks an officer whose white handkerchief seeks dirt in odd corners, and a yeoman (Navy clerk) who notes down, like St. Peter, both the good and evil that the "skipper" finds.

"Why are you scrubbing this compartment?" one sailor asked another. "Is it going to be inspected?"

"It has been inspected," was the doleful reply!

Only by enforcing strict standards of cleanliness can a naval vessel be kept a decent and healthful dwelling place for the hundreds of men who are packed aboard.

Navy discipline is strict but fair, with a minimum of military folderol. Punishment for minor offenses is meted out at "captain's mast," the police court of the ship, a term dating back to the days when it was held at a sailing ship's mainmast. Sometimes "mast" has its lighter side.

There's the story of Riley, a petty officer who was efficient and hard-working aboard

Official Photograph U. S. Navy

"The Admiral Says . . . We Sail for Panama at Dawn"

Messages are sent from ship to ship with wigwag or searchlight signals by day and with blinker lights at night. The sailor at left peers through a telescope to read the reply to the signals being sent, while the man at lower right takes down the message.

ship, but who always got into trouble on his infrequent shore leaves. Soon after a new captain took command of the ship, Riley went on a spree and was summoned to mast.

"Riley," said the captain, "I've looked up your record and find you're a valuable man aboard ship and only get into trouble occasionally. If you'll promise me to cut out these sprees, I won't punish you this time. But, in turn, I'll promise you that if you do get in trouble again, you'll receive a severe punishment from a general court-martial."

"That's agreed," said Riley, "and thank you, sir."

But six months later Riley went on another spree and again had to appear at mast.

"I thought," said the captain, "you promised me this wouldn't happen again."

"Yes, sir, that's correct."

"Have you anything to say?"

"Well, captain, as long as I broke my promise to you, I won't hold you to your promise to me, sir!"

There's the story, too, of the negro mess attendant whose wife wrote to his captain that her husband had deserted her. Summoned to mast, he was asked if it were true.

"Cap'n," he replied, "if you knew dat woman like Ah does, you wouldn't say Ah'd deserted her. Ah's a refugee!"

One captain offered a standing reward of a dollar to any culprit at mast who had an excuse he hadn't heard before!

Bread and Water for the Sailor Soul

Only minor offenses may be punished at mast. A man may be reduced in rating, restricted to the ship for several days or weeks, or confined to the "brig" on bread and water.

"The only way to reach some men's souls seems to be through their stomachs," said an officer. "That's the reason for the punishment of bread and water. They get all the bread and water they want, though, and every third or fourth day they're given a standard ration of three square meals."

It's a far cry from the old days when so many lashes with the cat-o'-nine-tails was a standard Navy punishment. From the days of flogging, incidentally, comes the term, "room to swing a cat."

Strangely enough, when flogging was done away with in the U. S. Navy in 1850, the chief objectors were the sailors themselves. They protested that if the "cat" were abolished,

Coffeepots and Men Alike Must Be Clean as a Whistle in the Navy

In spotless uniforms, a group of mess cooks (who are not cooks but food handlers) undergo their daily inspection on the battleship *Arkansas*. Capacious coffeepots reveal the Navy's love for "java."

Official Photographs U. S. Navy

"Make Mine a Sundae, Jack, and Don't Spare That Chocolate Sauce!"

A daily ration of rum, long since abolished in the U. S. Navy, has given way to the soda fountain, where a sailor can satisfy his thirst or his sweet tooth with soft drinks, milk shakes, and ice cream at nominal prices (page 689). Profits from the sales go to the ship's welfare fund.

Photograph by Willard R. Culver

Eating Is the Sailor's Favorite Sport, and Loaded Food Trays Show You Why

The second man from left has just burned his tongue on some hot soup, the photographer says! Plenty of good food is the best insurance of high morale, the Navy has found, and sailors, on the whole, are fed better than officers. Meals are usually served cafeteria style on stainless-steel trays, which are sterilized with steam after use (pages 673, 689). Coffee cups have no handles. In Navy slang, stew is "slum"; chicken or turkey, "sea gull"; flapjacks, "collision mats"; tomato catsup, "red lead"; hash on toast, "mud on a shingle."

there would be no way of forcing lazy men to do their share of the work!

But the high type of men in the Navy today makes punishment a minor problem. The average modern recruit has had at least three years of high school. It takes a smart lad to be trained to run a calculating machine, repair a watch, set hairline sights on a modern gun, mix a doctor's prescription, repair a turbine or telephone, operate a radio set, or handle any of the other myriad specialties in a modern naval vessel. Some 55 trades are taught in the Navy today.

Good Teeth and Keen Eyes

In a large recruiting office I watched the Navy select its men. Two dozen boys, in every conceivable costume, including a tall Texan in high-heeled cowboy boots, nervously awaited their turns.

Genially, but without ceremony, a petty officer jabbed a tongue depressor in each one's mouth to examine his teeth, then gave a quick test for color blindness. Some were eliminated then and there. Sailors must have teeth enough to chew their food, and be able to distinguish colored signal flags correctly.

"Why are you joining the Navy?" I asked one lad on the anxious seat.

"Well, I'll give you my life story," he said shyly. " I come from Pennsylvania, and my father's a coal miner. I graduated from high school, and I didn't want to be a miner, but the only job I could get was bus boy in an automat. If I get into the Navy, I'm going to study to be a pharmacist."

Three days later I saw him at the naval training station, pleased as Punch that opportunity had opened for him.

A proud father, sitting among the would-be recruits, said:

"I was in the Navy myself for 11 years, and my boy has always wanted to join. But I wanted him to go in with his eyes open, so the other night when he and his chum were asking me about it, I told them first all the unpleasant things about the Navy that I could remember.

"They took it all in, but my boy said, 'You

might as well tell us the good things, Pop, because we're going to join anyway!' I think it'll do him good, as it did me. He'll learn to take orders, and give 'em too. So you're from THE GEOGRAPHIC, eh? Say, that's the finest magazine published!"

In an anteroom the recruits went through a quick and efficient physical checkup—eyes, ears, heart, lungs, blood pressure, muscular co-ordination, many other things.

One boy, whose eyes were weak, pleaded, "Couldn't they use me on a submarine? That takes only one man with good eyes—at the periscope!"

Tests Like a Quiz Program

Next comes an intelligence test with one hundred questions. Here are two samples (not the hardest):

"John is older than Tom; Tom is older than Frank. Who is the youngest?"

"Here are three proverbs: (a) Do not count your chickens before they are hatched; (b) One tree does not make a forest; (c) All that glitters is not gold. Which of the three means the same as: One swallow does not make a summer?"

Moral background of recruits is looked into. Their fingerprints are checked with the F.B.I. One boy, rejected at first because of a juvenile court record, hitchhiked across the entire United States to plead his case in person at the Navy Department in Washington.

"Yes, we took him," said an officer. "Any boy who is that anxious to join the Navy must be all right!"

At least one girl has tried to join the Navy. She wanted to be a flyer, and among her qualifications she listed her good looks!

Taking the oath of allegiance is the final step (page 675). The excited crowd of boys became suddenly quiet as a grave-faced, uniformed officer entered the room.

"These Are Troubled Times"

"Before you take the oath," he said, "I must remind you that these are troubled times. The day may come in your naval service when some of you may be called upon to lay down your lives for the United States. . . . If anyone here wishes to change his mind about joining the Navy, he may leave now, and nobody will think any the less of him."

No one moved, but in the rear of the room two women spectators dabbed at their eyes.

"Raise your right hands," said the officer, "and repeat after me:

"I do solemnly swear that I will bear true faith and allegiance to the United States of America, and that I will serve them honestly and faithfully against all their enemies whomsoever, and that I will obey the orders of the President of the United States, and the orders of the officers appointed over me, according to the Rules and Articles for the Government of the Navy. . . ."

"You're in the Navy now!" A smile broke across the officer's face and the tension relaxed.

Next day at the training station, the boys began to learn that there is more to being in the Navy than wearing bell-bottomed pants.

Lined up with numbers painted in Mercurochrome on bare chests for quick identification, they underwent another and stiffer physical examination (page 680).

A keen-eyed psychiatrist weeded out a few undesirables. Each man stenciled his name on his newly issued clothing.

Boys as young as 17 may now enlist in the Navy. For a few, never away from home before, the first weeks are an ordeal. In its handbook for recruits the Navy offers them good advice:

"Choose your new friends carefully . . . Write to your parents often, at least once a week. . . . Practically every man in the service has known homesickness, and you need not feel that you are different. When the pains of this emotion come to you, get busy. Your new friends are your best allies to fight off homesickness."

Watching the training process, you wonder how anybody has time to be homesick.

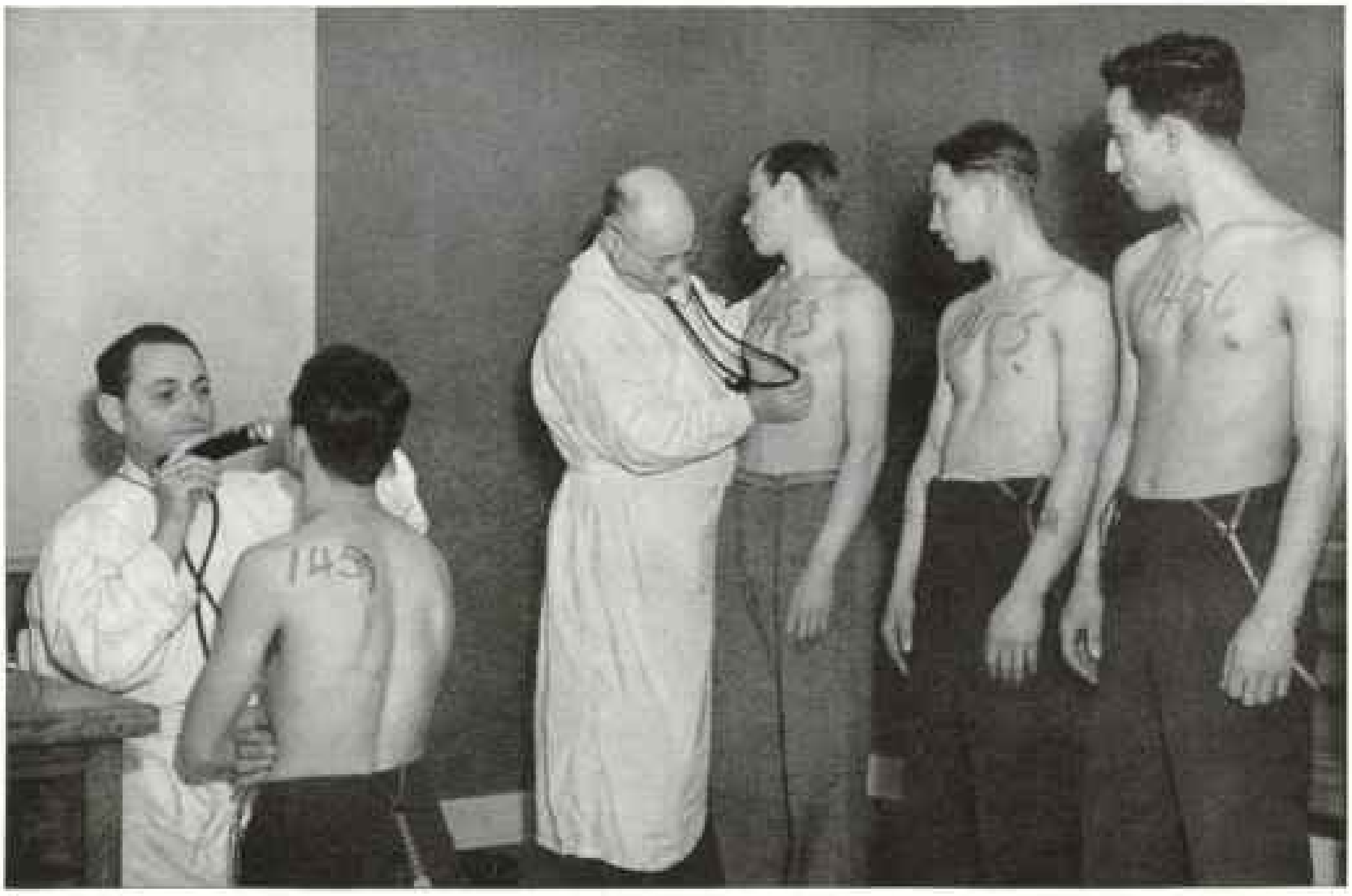
In an indoor rowing tank a group of "boots"—Navy slang for recruits—were learning to row. The instructor watched their awkward splashing with a look of patient resignation. "A lot of these guys never saw an oar before, and we gotta teach 'em in half the time we used to have! Yep, they learn to swim, too. Can't leave the training station till they can do 50 yards" (page 700).

In the yard outside, my officer escort's arm worked like a pump handle answering salutes.

"These kids love to salute and never miss a chance," he said, "but it's tough when you have to acknowledge 'em all! On board ship, sailors salute an officer only the first time they see him during the day, except for the captain, who rates a salute at all times" (page 690).

A Recruit's Life Is Busy

A typical day's program of instruction for recruits includes: manual of arms, school of the squad, battalion drill, rowing, aptitude tests for Navy trade schools, chemical warfare, knot tying, lectures and drills in signals, ship's rigging, haircuts (the whole company gets them at once), rifle firing, lifesaving, swimming.



Photograph by Willard R. Culver

When the Navy Doctors Finish with Him, the Recruit Has Few Secrets Left!

Numbers painted on chests and backs refer to the men's individual physical examination blanks. A doctor may call out "Number 1459, inflamed tonsils," and a yeoman quickly notes it on 1459's record (page 679).

Official Photograph U. S. Navy

Holystones and Elbow Grease Combined Keep a Man-o'-War Spick-and-Span

Once a week, on "Field Day," shown here on the cruiser *Northampton*, decks are rubbed with soft sandstones, named "holystones," perhaps because they are porous and full of holes. Each morning before breakfast the decks are swept and scrubbed. Sailors' trousers are bell-bottomed so that they can be rolled up easily.

Official Photograph U. S. Navy

"All Together Now!" Cleaning a 12-inch Gun Is a Man-sized Job

A battleship's rifles, no less than a hunting piece, must be cleaned and oiled after use. A big gun of the battleship *Arkansas*, after firing, is "lapped" out with a huge brush, which these men are pulling through the bore. When such a gun has been fired about 150 times, the wear on its interior reduces its accuracy, and it must be relined.

"Recruits gain from 10 to 20 pounds in the training period, and fat ones train down to normal," said a medical officer.

"Some never had decent food in their lives before. Country boys usually are heavier, stronger, and have better teeth than city boys, but the city lads have better immunity to diseases, because they've been exposed to more things. We encourage the boys to report to the doctor even if they only think they're sick."

Navy recruits must launder their own clothes in a bucket, and many a sailor, home on leave, has proudly taken over the family wash. In their free time, bowling, table tennis, books, and athletics provide entertainment. Even in his sleep the recruit is learning—how to sleep in a hammock! (Page 689.)

Lest a single moment be wasted, the Navy even paints flags of all nations, signal code flags, and insignia on walls of drill halls, and posts copies of the Declaration of Independence and the Bill of Rights on barrack bulletin boards.

"You'd be surprised," said an officer, "how much knowledge they pick up that way.

"Some of the kids don't half appreciate this country."

Patriotism in the Navy is a real and living thing, not something trotted out only on special occasions. Every officer and sailor, when boarding or leaving a ship, pauses at the head of the gangway ladder, faces astern, and salutes the Stars and Stripes floating there.

The Navy tradition seems to run in families. Famous throughout the service are the Patten brothers, seven of whom are already on the battleship *Nevada*, with an eighth preparing to enlist. One day, in a ship's bulletin, I saw this item: "The executive officer extends best wishes to the Taylor triplets on their 21st birthday."

Whenever possible, the Navy keeps brothers together.

With training over, the "boot" gets nine days' leave, then either goes to a Navy trade school for a time or joins the fleet at once.

Boarding a modern battleship for the first time, his reaction is likely to be somewhat like that of one boy who wrote to the officer who enlisted him:

Official Photograph U. S. Navy

Decks Awash, Battleships of the Pacific Fleet Forge into a Heavy Sea—U.S.S. *Oklahoma* and *California*

Photograph by Willard R. Culver

Tying Knots Still Is Something Every Sailor Must Learn, and Ex-Boy Scouts Usually Lead the Class!

Recruits watch a petty officer (corresponding to an Army corporal) demonstrate at the Naval Training Station, Norfolk, Virginia. Though the days of sail are gone, sailors still use rope lines for slinging hammocks, hoisting gear, securing heavy objects in rough weather, even for fastening spare clothing in neat rolls.

Photograph from Pathé's Inc.

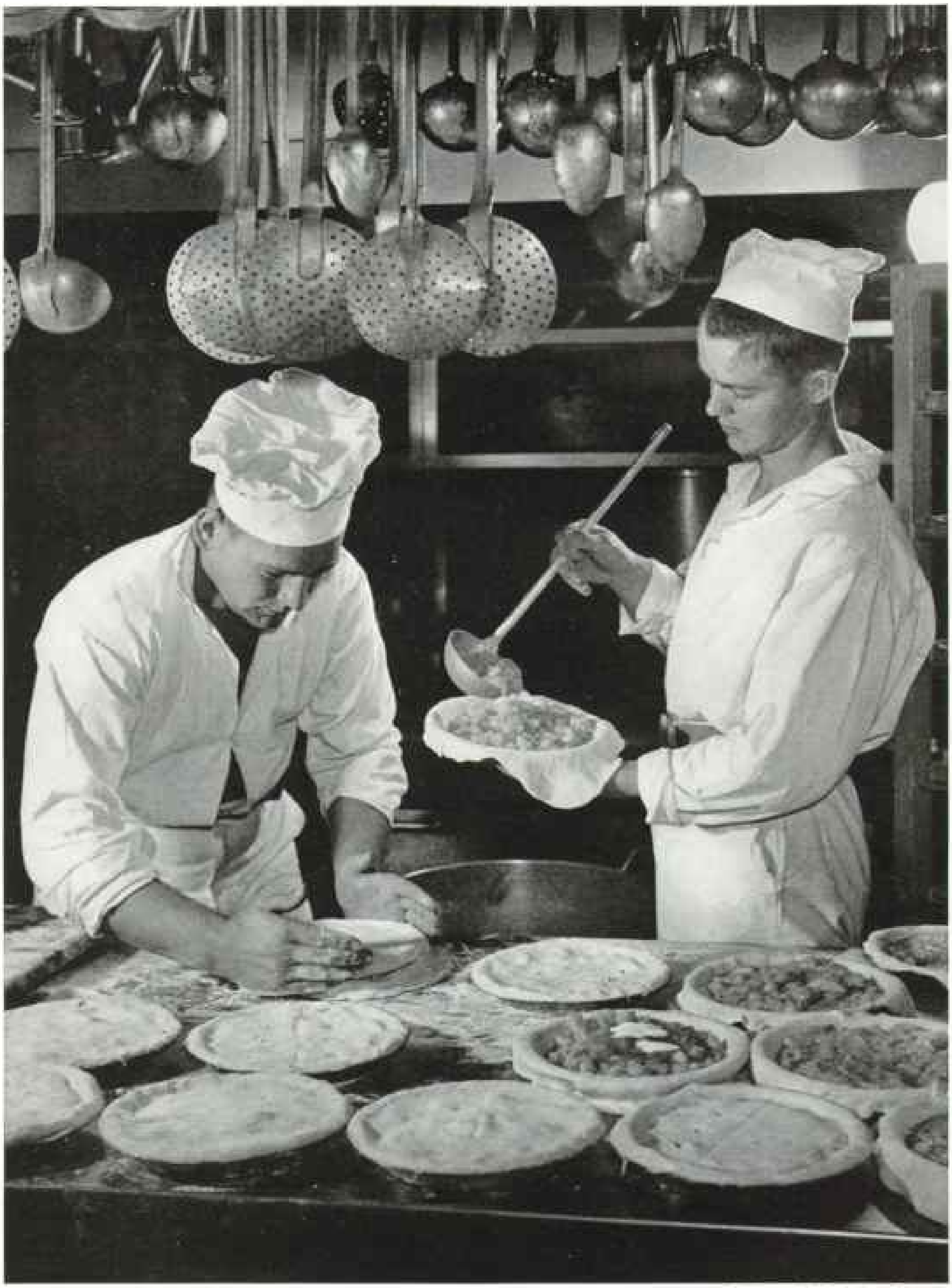
Hard to Ride as a Bucking Bronco Are the Vicious Little "Mosquito Boats"

They can dash in close to an enemy ship in a surprise attack at terrific speed, let loose their torpedoes and skip away (page 695). In a heavy sea their crews take a severe pounding. These boats, cruising down the quiet Potomac River, reveal how torpedo tubes are placed on the sides, with antiaircraft machine guns in turrets. The letters "PT" mean "patrol torpedo boat," but a woman visitor asked a sailor if they stood for "pint boats"! Their insignia is a mosquito riding a hurtling torpedo.

Official Photograph U. S. Navy

With a Smashing Roar, the *West Virginia* Fires Her Two Forward Turrets

When this mighty battleship lets go her whole broadside of 16-inch guns, eight tons of destruction can be hurled 20 miles. A single shell and the powder to fire it cost $1,500. The projectile travels so much faster than sound that a sailor on an enemy ship would never hear the blast of the gun that killed him. Commissioned in 1923, the U.S.S. *West Virginia* is the flagship of Rear Admiral Walter S. Anderson, Commander Battleships, Battle Force, Pacific Fleet.



Photograph by B. Anthony Stewart

Pie Like Mother Used to Make, and Maybe Even Better!

Marine Corps cooks turn out apple pie on a mass-production basis at San Diego. When the author asked a group of sailors at dinner what was the Navy's favorite dessert, the unanimous answer was, "Cherry pie!" Aromas from a battleship's bakeshop, busy before dawn, tantalize the nostrils of the men on night watch.

Official Photograph U. S. Navy

Guardian of Far-flung Sea Lanes—a Giant Patrol Bomber Lands in Choppy Water

Planes like this huge four-engined Consolidated ship are used by the Navy to scout far out over the Atlantic and Pacific (page 699). Truly boats that fly, they can land in the open sea for refueling from tenders. Squadrons of them, each plane carrying two or three tons of bombs, could attack an enemy fleet hundreds of miles off the coast. The floats on either side are retracted to form streamlined wing tips in flight. The bombers carry crews of 8 to 10 men, or more.

"I was never so startled in all my life as I was the night I first laid eyes on the *California*. I still frequently look at her from bow and stern and wonder what great achievements man has made. . . . I am working each day and eating twice as hard, and I can hardly imagine that we are fed so well!"

A modern battleship is a truly startling combination of fighting power, intricate scientific devices, and engineering skill. Her crew, equal to the population of a small town, lives comfortably and healthily within an unbelievably small space.

Out of 1,400 men on one battleship I visited, there were only 20 on the sick list; their ailments included appendicitis, athlete's foot, catarrhal fever, sinusitis, burns, jaw fracture, sore muscles, and an impacted tooth.

A battleship exists for one purpose only—to fight. And all the training of her crew has one sole object: to take their ship efficiently into action and smash the enemy, whoever he may be, with her great guns. Endlessly the Navy drills for that day, if it must come.

When alarm bells clang and bugles scream the exciting call *"General quarters!"* every man on the ship becomes a cog in the fighting machine. Three-fifths of the crew are actually manning guns, handling ammunition, or working at the range-finding apparatus.

Bandsmen become stretcher-bearers, negro mess attendants hurry down from the officers' quarters to pass powder bags deep in the magazines. The chaplain takes his place at the main dressing station. The dentist assumes charge of a first-aid crew.

In battle, men with minor hurts will be treated before those with serious wounds, so they may return quickly to their posts and help keep the ship in action. Today's Navy still holds to that ancient slogan: "Fight her till she sinks, and don't give up the ship!"

Drama of a Gunnery Drill

Heart of the Navy's striking power is the mighty turret guns, and the husky crews who work them are drilled to machinelike perfection. In a 14-inch gun turret I watched a crew in action. Stripped to the waist, they stood poised and tense in the hot, cramped space.

"Load!"

One quick heave on a lever and the ponderous breechblock swung open like a vault door.

Official Photograph U. S. Navy

"In the Case of a Woman, Be Sure You're Right, and Then Don't Write!"

The sailor at left looks as though he might have just repeated that admonition to his shipmates. Sailors are encouraged to write letters home. Since a naval vessel, wherever located, is United States territory, letters mailed on board take only a three-cent stamp. Ships' post offices are branches of either the New York or San Diego post offices.

A sailor glanced quickly into the yawning tube. "Bore clear!"

That meant no burning fragments of powder bags were left from the last charge to set off the new one prematurely.

The ¾-ton shell bumped heavily from hoist to loading tray. With a deafening rattle the snakelike electric rammer shot out and shoved the projectile far into the gun. Men with wrestlers' bulging shoulders plumped huge powder bags behind it. The breechblock slammed shut. Screaming gears, powered by an electric motor, quickly tilted the 52-foot gun to firing position.

"Ready" lights blinked on. The crew steadied themselves on the narrow shelf where they stood. With frightening speed the giant mass of the gun kicked back. There was a loud but muffled boom. The foot-thick steel walls of the turret shook. An acrid powder smell filled our nostrils. The sweating gunners relaxed.

"This is more fun than playing football," grinned one.

The whole thing seemed a marvel of speed and precision, but the gun captain was apologetic.

"We're still three seconds too slow in loading," he said ruefully. "Half of my men are green. We'll have to buy ice cream for number two gun's crew again! They're still faster than we are."

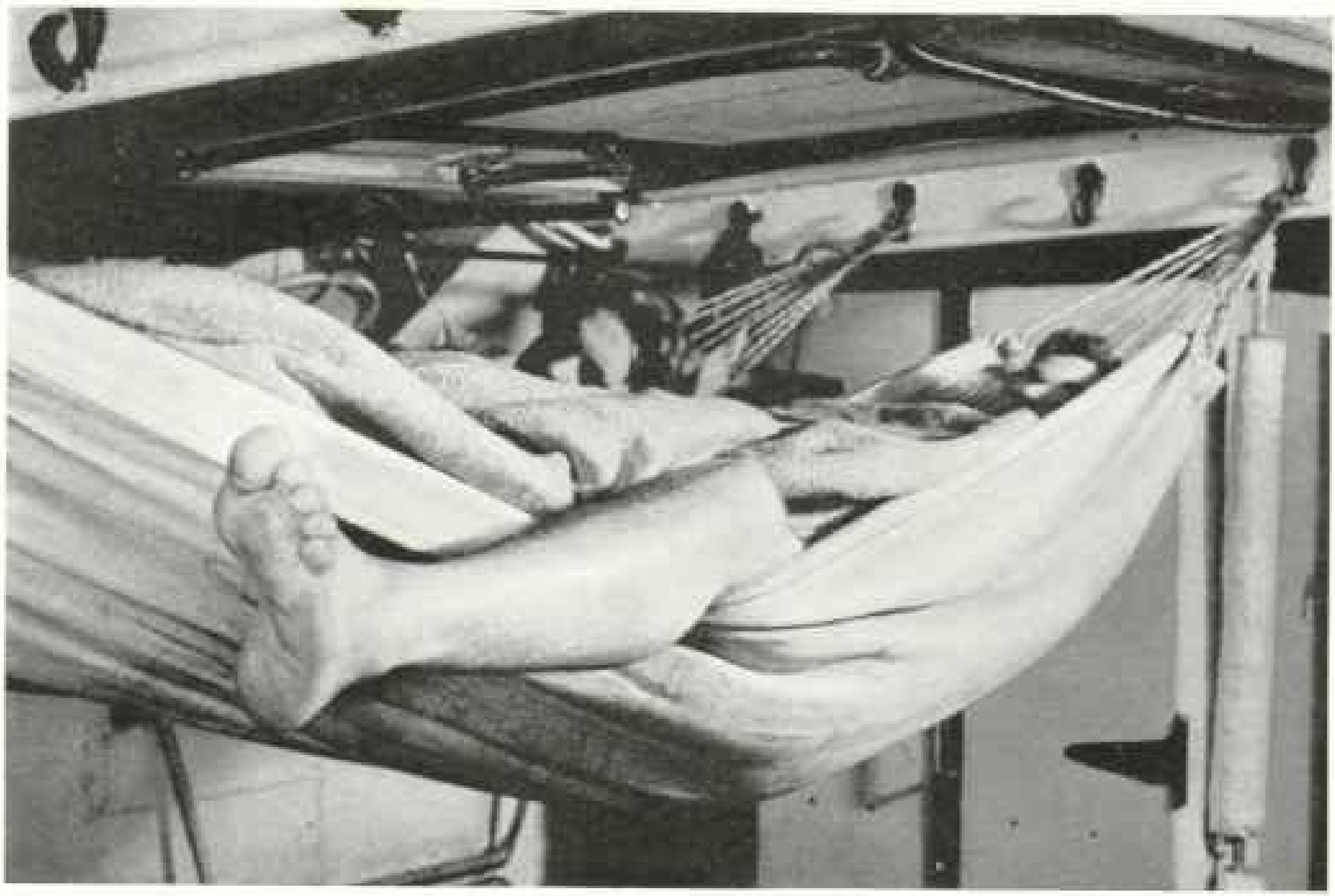
When the guns are fired, the noise and shock within the turret are comparatively slight. But outside, if a man is standing too near the guns, the concussion alone may rip off all his clothes. It has happened.

Battleship a Seagoing Community

A ship may be in the heat of battle only a few hours, but everyday life aboard her goes on year after year. The men in the compact little community within a battleship's hull live a life far removed from the average landsman's, yet in many ways not so different.

The battleship has almost every utility, public service, or amusement, and more trades and professions than you'd find in an average town of 1,400.

The six chairs of the barber shop are busy long hours each day keeping 1,400 heads of hair within the two-inch length prescribed by regulations. A haircut or shampoo is 20 cents; shave or tonic, 15. The laundry does all a



Photograph from Gillon

No Inner-spring Mattress, But Plenty Soft Enough for a Weary Sailor!

Hammocks still are widely used in the U. S. Navy, though newer vessels have folding bunks. Often a sailor sleeps and eats his meals beside the gun he serves. During the day, hammocks are rolled up and stowed away in the nettings. Every recruit learns the tricky art of sleeping in the swinging canvas bunk at a training station. Mattress, blanket, and pillow are furnished, but no sheets.

sailor's washing for a dollar a month, though some men scrub their own dress whites in salt water for extra whiteness.

"When my hitch is up," said one ship's head laundryman, "I'm going in the laundry business ashore if I can get somebody to back me."

Many a mechanic, radioman, electrician, carpenter, steam fitter, or movie operator, now in civil life, learned his trade in the Navy. There's a tailor shop, shoe repair shop, and dentist's office, where the buzz of the drill is exactly like that you've heard ashore.

Stoking the Sailor

Because the blacksmith shop is always cool from the forced draft of the forges, sailors call it the "millionaire's club." A soda fountain sells ice cream, sundaes, milk shakes, soft drinks (page 677). The galley (ship's kitchen to you) turns out such meals as these:

Breakfast: fresh oranges, baked meat hash, tomato catsup, scrambled eggs, bread, butter, coffee.

Dinner: beef and noodle soup, crackers, baked spiced ham, boiled potatoes, boiled cabbage, buttered turnips, dill pickles, lettuce salad, French dressing, pumpkin pie, bread, butter, lemonade.

Supper: spaghetti, tomato meat sauce, boiled kidney beans, corn on the cob, peach and cabbage salad, sweet dressing, fruit pudding, bread, butter, coffee.

Yet, they say, some bluejackets go straight from breakfast to the soda fountain! With the enlistment age now reduced to 17, many a sailor today is still growing.

About the only thing you don't get regularly at sea on a naval vessel is fresh milk. Roman Catholic sailors, by special dispensation, are permitted to eat meat on Friday. Meals are served on metal trays with compartments for different foods, so the only dishes needed are soup bowls and coffee cups. Coffee is the Navy's stand-by. Officers and men alike drink it at all hours, an average of five or six cups a day per man.

In the canteen and ship's service store you can buy, at reduced rates, such things as cigarettes, candy bars, stationery, sun glasses, razor blades. Canned baked beans are a popular item. Big sellers are silk pillow tops decorated with "Mother" and a picture of the ship.

Profits of the ship's service store go to buy

library books and athletic equipment, to finance ship's dances and parties ashore, and for loans to sailors who need money in emergencies. The ship has a postoffice and mailboxes exactly like those on street corners ashore (page 688).

On a large ship there may be as many as 200 individual radios, including portable sets (they don't interfere with the ship's radio communications).

Chaplain Dispenses Morale—and Detective Stories

The chaplain, besides conducting formal religious services, is welfare worker, comforter of homesick boys, adviser of sailors in trouble, editor of the ship's newspaper, and librarian. Sailors read many mystery novels but few sea stories.

The ship's paper contains news items, jokes, a sports section, and much "poetry," written by sailors and even sometimes contributed by their girl friends. A sort of Walter Winchell gossip column engages in not-too-gentle kidding.

When a ship visits a foreign port, the paper explains the monetary system, local customs, and gives information on taxi fares, local sights, even the price of beer! Usually, too, it has a brief article about the region's history, geography, and points of interest.

"I often use THE GEOGRAPHIC's files for source material for these articles," said one chaplain.

Church services are held aboard ship each Sunday (page 697). In port, if the chaplain is Protestant, Catholic sailors go to a ship with a Catholic chaplain, and vice versa, whenever possible. There's the classic story of a petty officer, struggling to separate the "church detail" into its various denominations, who ordered:

"Methodists, stand fast. Catholics, one step forward. Fancy religions, one step to the rear. *March!*"

A sailor's life is about as private as that of a goldfish. With ships as crowded as they are today, he may sleep in a string of hammocks (page 689) or tier of folding bunks four high. His only personal shrine is the inside of his small steel locker. A hard-boiled sailor, showing me his, apologized for its alleged untidiness as profusely as a housewife showing her parlor to an unexpected caller.

Sailors become able to sleep any time, anywhere. About the ship, during the day, you will see men off watch catching forty winks on a coil of rope, a workbench, even on the hard deck. In the Tropics, if you walk about the ship at night, you need to be careful not to step on sleeping men who have taken their mattresses on deck for coolness. In wartime, when action is imminent sailors sleep at their posts in turrets, conning tower, etc.

In that section of the ship known as "officers' country," life is only a little less goldfishlike. An officer enjoys some privacy in his tiny stateroom, though two junior officers may share a cabin. But officers eat together in a large "wardroom," which also serves, between meals, as conference room and club lounge. Here prevails an atmosphere of breeding, good-fellowship, and politeness like that of a fine gentlemen's club.

Officers pay for their own clothes and meals. Sailors passing through "officers' country" remove their caps. Officers passing through crews' quarters at mealtime likewise remove theirs.

Things an Officer Must Know

Life is no soft yachting cruise for the naval officer. Heavy responsibility rests upon him. He must have an expert knowledge of everything—navigation, engineering, gunnery, and many other things. He is a brainworker, often subjected to severe nervous tension. His is no "nine-to-five" schedule: he may often work before breakfast and after supper.

At sea or on maneuvers he is likely to be up all night or at best catch only a few hours of sleep at odd moments. On his decisions may depend the lives of many men. He is subject to discipline just as is the sailor.

You've wondered, perhaps, how officers could stand wearing their white hot-weather uniform jacket, tightly buttoned, with high choker collar (page 674). The secret is, they wear only an undershirt beneath it.

Tradition of the sea requires that the captain of a naval vessel, in ships larger than destroyers, shall live alone and somewhat aloof. Lest he seem to show favoritism to some officers, he usually eats his meals by himself, with only the mess boy who waits upon him for company. He is the symbol of authority and discipline; therefore he is the only officer upon whose approach all hands stand to attention and salute at all times.

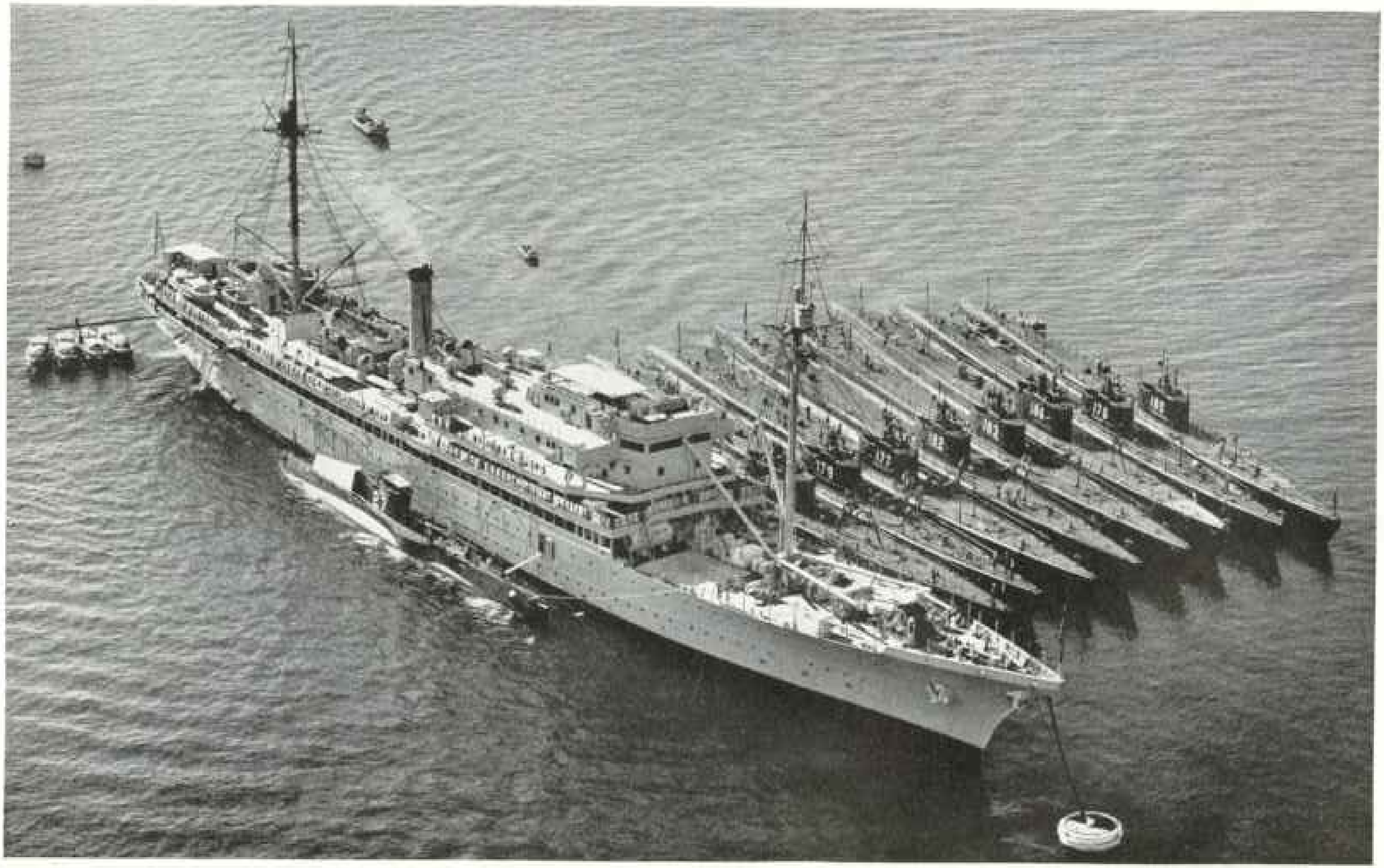
He is ultimately responsible for the safety of the ship and all her people; hence, when she is under way, he seldom leaves the bridge, even sleeping there in a tiny cabin on larger ships. If the ship runs aground, or is otherwise seriously damaged, the captain is liable to face a court-martial.

Partly for this reason, naval vessels entering harbors always take soundings. Two midshipmen, the story goes, were detailed to this duty one day. One of them fell overboard.

Official Photograph U. S. Navy

"I Joined the Navy to See the World, and Now Look at Me—Chippin' Paint!"

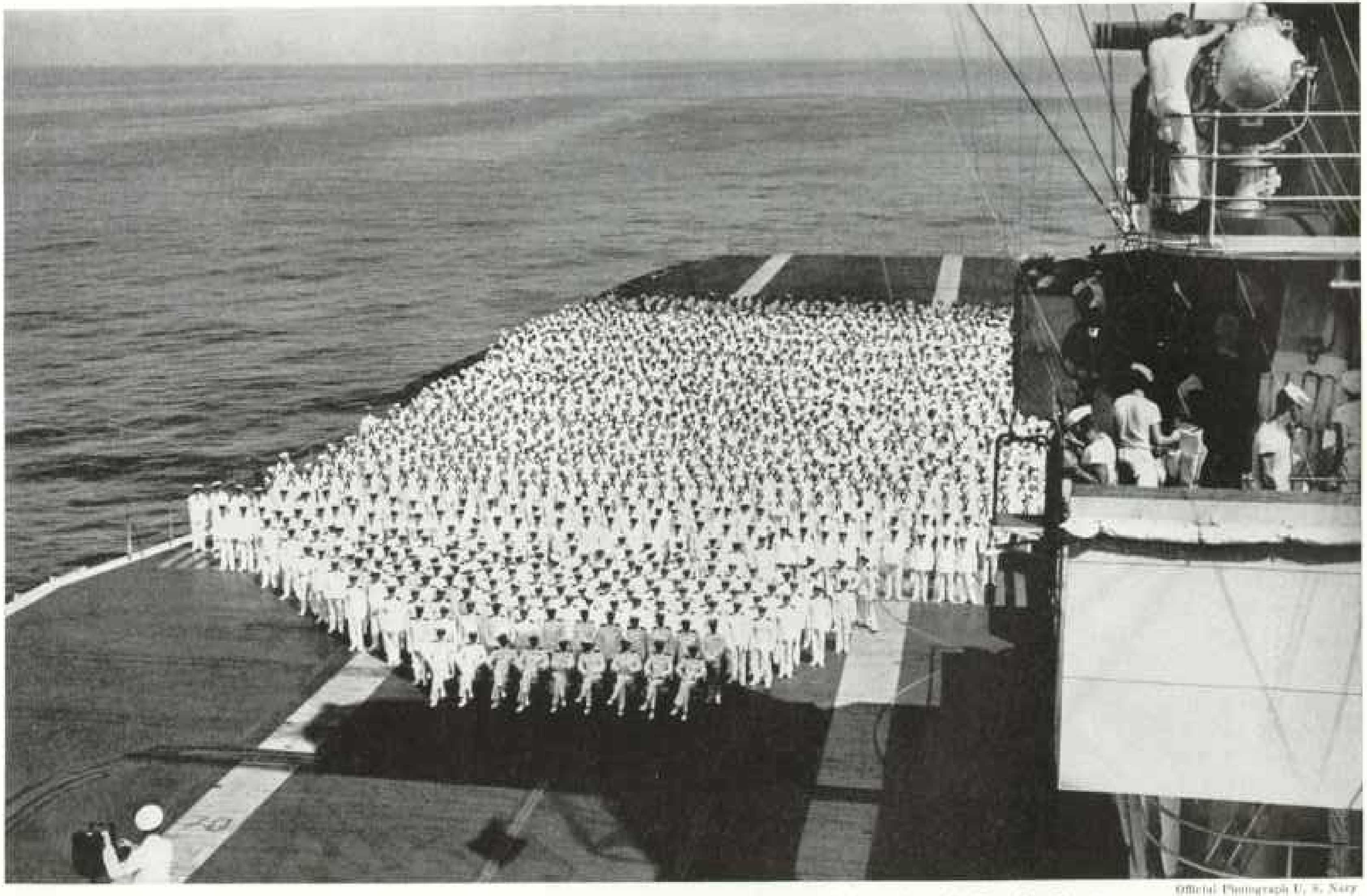
Such has been the reaction of many a sailor who has discovered that Navy life isn't all romantic cruises and thrilling battle drills. Old paint is laboriously removed from the ship's side before a new coat is applied. At sea, polishing brightwork and painting go on continually to counteract corrosive effect of air and salt water.



Official Photograph U. S. Navy

Like a Brood of Grim, Black Sea Monsters, a Squadron of Submarines Hovers Beside Its Mother Ship

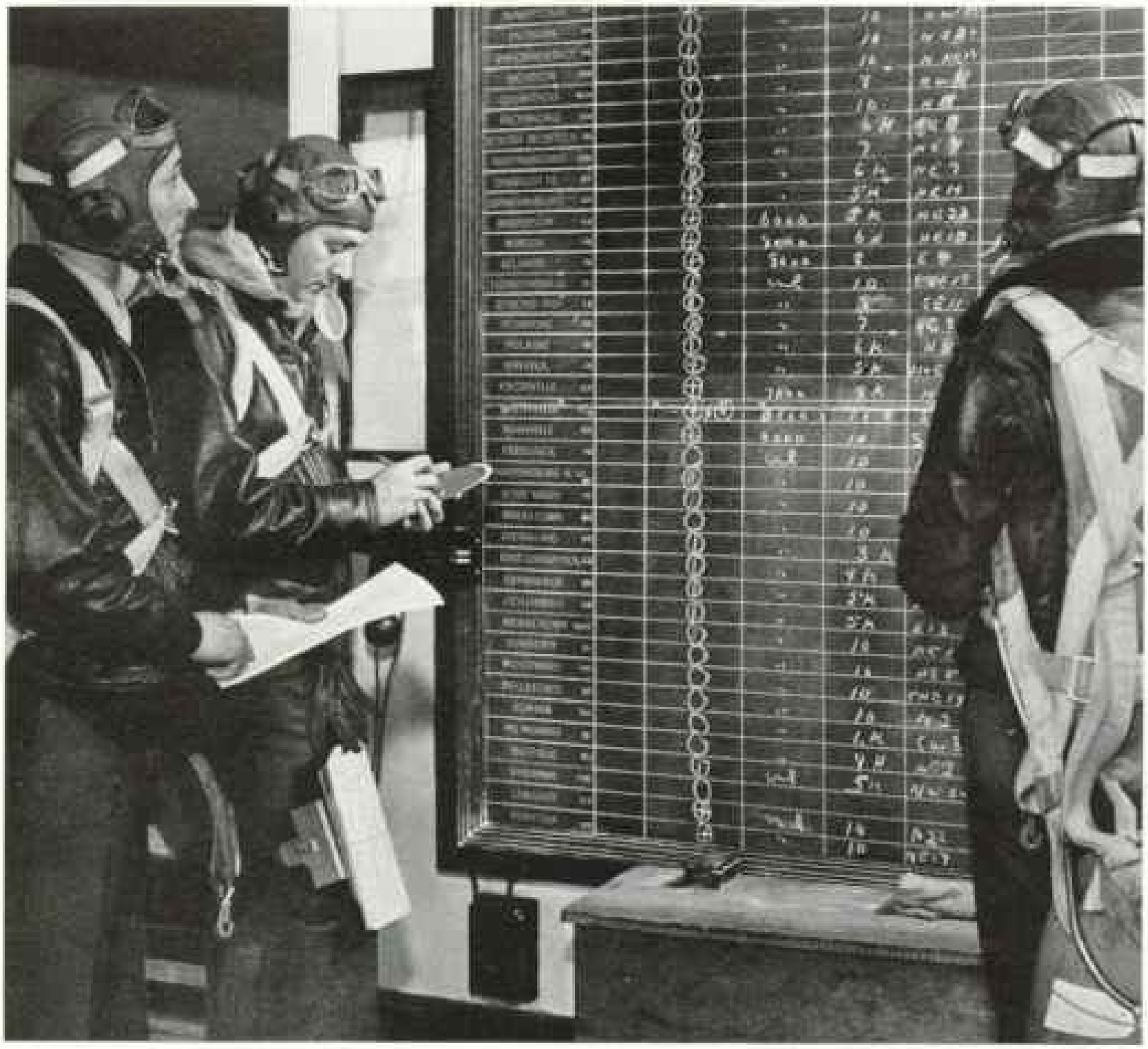
After long cruises the "pig boats" (page 693) return to their "mother" for food, fuel, and repairs. The tender is a floating machine shop and department store, ready to fix an aching tooth, a broken bearing, or balky radio, and to supply fresh water, toothpaste, or chevrons for a newly promoted seaman. Flung over the rail of this mother ship, U.S.S. *Holland*, are hammocks, mattresses, and blankets, for the orders on this sunny day are "Air bedding."



Official Photograph U. S. Navy

2,000 Men Fill Only a Small Part of the Huge Flight Deck of the Aircraft Carrier *Lexington*

Unlike other ships, the carriers have mast, bridge, and control stations set on the starboard side in an "island," visible at right. Smokestacks also are at the side. Lines painted on the deck of this floating airport help guide flyers in landing and taking off. Petty officer at left is taking a photograph (page 696).



Photograph by Willard R. Culver

"What's the Weather at Boston?" Navy Flyers Check Before a Distance Flight

On a bulletin board at Anacostia, in Washington, D. C., as at other naval air stations, weather conditions at points all up and down the seaboard are listed and kept up to date by frequent reports. Aircraft carriers have weather observers who chart conditions over a wide radius, to prevent the ship's planes from encountering unexpected storms or getting lost in clouds. Reports from shore stations, other ships, and planes are studied to make the weather picture complete.

Just then the captain shouted down from the bridge, "How much water have you?" The other midshipman instantly replied, "Mr. Smith has just gone over the side to find out, sir!"

On duty on the bridge, the captain is likely to wear a preoccupied expression, to speak a little curtly—a man not to be approached with light or trivial matters. But in his cabin, relaxed, he will reveal himself as a charming gentleman, a man of sentiment, who may keep a pair of baby shoes on his desk and family photographs all over the walls.

In his lonely spare moments he consoles himself with hobbies. One captain I met was teaching himself to calculate with the Chinese abacus. The commanding officer of a ship is always addressed as "captain," whatever his actual rank may be.

The Geography of a Battleship

You could spend days exploring a battleship and not see it all.

Deep in the bowels of the ship are the magazines, storehouses of death and destruction, with giant shells stacked like cordwood and powder bags stowed in fireproof, waterproof, airtight cans. A ventilation system keeps the temperature from rising above a certain point. In a rack near the door are bottles containing samples of powder and strips of litmus paper. If the powder begins to deteriorate, it will form acid fumes that will change the color of the litmus.

Each night, as in John Paul Jones' day, the keys to the magazines are sent to the captain, and returned in the morning to the chief gunner.

The fattest man I saw in the fleet was a cruiser's chief engineer, despite the fact that his engine room seemed hot enough to peel pounds off any man who stayed there long! The fireroom, though cooler than in the days of coal burners, is still a small edition of inferno. Here oil is heated to 170° before it's ignited, so it will burn easier. At full speed the turbines are driven by steam superheated from 725° to 850°!

Oil, spouting from burners, spreads bright roaring fingers of flame under boilers that generate up to 100,000 horsepower in the newer ships. Half-naked perspiring men watch dial faces, shout to be heard above the roar of the oil burners, test samples of boiler water to be sure it remains fresh, drink water and coffee endlessly.

Through a periscopelike device they can see the smoke going up the stack. If it's white, the fires are getting too much air; if black, too little. It's desirable for the ship to steam without showing any smoke at all.

On duty outside the captain's door, standing guard in various parts of the ship, manning some of the 5-inch guns and antiaircraft batteries on all larger Navy ships, you'll find marines.

Sailors have a saying that "the Army had first choice, so they took the mule, and the Navy had to take the marines!"

And the marines have a rhyme that starts:

"Ten thousand gobs laid down their swabs,
to lick one sick marine."

Rivalry there may be, but here and now let's nail the ancient libel that there's any real ill feeling between sailors and marines! It just isn't so.

The Fleet Marine Force, a special unit of the Marine Corps, is the Navy's private army. It is a strong, hard-hitting landing force that travels on transports and includes planes, tanks, field artillery, parachute troops, and infantry, prepared to establish a foothold on hostile soil.

Total strength of the Corps is about 50,000.

Mosquito Boats Are Navy Speedsters

Newest, smallest, fastest, and most uncomfortable of all the Navy's fighting craft are the motor torpedo boats, or "mosquito boats" (page 684). Skimming the surface at terrific speed, they can dash in close to an enemy ship, let loose their torpedoes at short range, and rush away before hostile guns can be brought to bear upon them.

"Riding these boats is like riding an aquaplane behind a speedboat," a young officer told me. "Everybody gets black and blue from the constant pounding. Overhead structures are padded to protect the crew's skulls. Only young men can stand the gaff. Nobody gets seasick, because those who do are eliminated right at the start!

"We have bunks, but we give up all idea of sleeping on a long run at sea. You can't even stay *in* the bunk when the boat is dropping 15 to 20 feet every time she goes from the crest of a wave to the trough! Cooking is out, too. We just hang on with one hand and eat sandwiches with the other.

"To save weight the crew carries no extra clothes, and we even use special lightweight dishes. At high speed we wear masks to protect faces and throats against the wind. Our only defense is our speed, unless we can come up in the dark or fog."

But if mosquito-boat men need physical toughness, the submarine sailor is just as much in need of stamina of another kind—psychological. Men of the "pig boats" are specially chosen for steady nerves and ability to live and work congenially in the cramped space (pp. 692, 700). All are trained to escape from a sunken submarine with the "Momsen lung."

The men about to escape stand in a partially flooded compartment with their heads in an air pocket above water. Each one then ducks under water, passes into the next compartment, which is completely flooded, and out of the submarine through the escape hatch.

Meanwhile he is breathing oxygen from the bag of his "lung." He rises to the surface slowly, hand over hand, on a rope that extends upward from the submarine.

If he becomes panicky and allows himself to shoot all the way to the surface at once, his lungs will literally explode and he will die. But by rising gradually he will suffer no ill effects.

Submarines can dive safely to 250 or 300 feet, and stay down 24 to 36 hours. You can get seasick in a submarine under water. There is some motion noticeable as deep as 100 feet.

Onions—Peril of Submarines

Submarines have some minor discomforts unknown on other craft. If the cook is peeling onions during a dive, the fumes will be carried all over the ship through the ventilation system, and the whole crew will be weeping.

Submerged, a submarine is blind, but its sound detectors reveal when other ships are near. A man who is expert with the sound detector can distinguish between different types of naval vessels passing near, by the difference in the sound of their engines. But

Official Photograph U. S. Navy

Landing on a Hostile Coast Is the Specialty of the United States Marines

Many times in their long history, boatloads of "leathernecks" have gone ashore in troubled spots, soon to send back that famous report: "The marines have landed and have the situation well in hand." The marine is trained to fight on both land and sea. As Kipling wrote: "There isn't a job on the top of the earth the beggar don't know, nor do. 'E's a sort of bloomin' cosmopolouse—soldier an' sailor too!"

a submarine can reduce its own noise to almost nothing, making it difficult for surface vessels to spot it by sound alone.

Unless the water is phosphorescent, a submarine leaves no visible wake when moving under water. Even when the periscope is above the surface, its wake is hard to distinguish if there are whitecaps.

Strangest ship in all the history of the sea is the aircraft carrier, a floating, movable airport, a wicked nest of deadly dive bombers, fighters, and torpedo planes (page 693). It is almost as speedy as a destroyer, longer than a battleship, and the only kind of ship in the Navy with space enough below decks to have movies on rainy nights!

You notice a subtle difference between the officers on a carrier and those of a battleship. There's a look in the eyes of the carrier men, a kind of tenseness, something hard to describe. Though their arklike craft is a ship, and they run it well, you can see that airplanes are their first love.

"An airport manager would go crazy if he had no more space than the area of our flying deck," chuckled an officer. "It has only about five per cent of the area of an average airport runway. That deck looks mighty small even in the daytime, when you're coming in to land, but we land on it at night, too!

"Don't forget, also, there aren't any landmarks on the open ocean, so our flyers must be crackerjack navigators to get back safely to the carrier.

"This 'movable airport' has some advantages, though. We can always keep the runway headed into the wind to help planes take off, and if there isn't any wind, we can make one by speeding up the ship."

Danger is always just around the corner on a carrier. Whenever any flying is to be done, the "crash beds" in the sick bay (hospital)

Official Photograph U. S. Navy

Chaplains Conduct Divine Services on Larger Ships of the Fleet

Part of the main deck becomes a temporary church, and music is furnished by the ship's orchestra. When circumstances permit, officers and men may attend services on other ships which have chaplains of their preferred denomination (page 690). Destroyers and submarines carry no chaplains, but there is usually one on each squadron tender. Protestant and Catholic chaplains are appointed in proportion to the number of men of each faith in the Navy.

are made ready. They are cots covered with canvas curtains, and the enclosed space is heated by a battery of powerful electric bulbs. In case of accident, the injured flyer is certain to suffer from shock, for which heat is the best treatment; hence these preheated beds.

Ready on the flight deck are fire fighters, doctors, stretcher-bearers, and the famous "hot papas," clad in asbestos suits, ready to rush into a flaming wreck to rescue a man.

As pilots approach to land on the carrier, they are instructed by signals from an officer who stands on one corner of the deck. If an incoming plane threatens to knock him down, there's a canvas chute ready for him to jump into and slide safely to the deck below. But actually there are few accidents.

"How big does a battleship look to a dive bomber when he starts his dive from high above it?" I asked a pilot.

"Dives may start from different heights," he said. "But if you place a foot rule on the floor between your feet, stand at your full height, and look down at it, you'll get some idea."

"Do you Navy pilots believe you could sink a battleship with bombs?"

"Sure, if we could drop enough bombs on one, but that's not easy."

"Would a bomb down the smokestack finish her?"

"Probably, but the lad who does that is just plain lucky!"

Take-off from an Airplane Carrier

The great hangar deck below the flight deck of a carrier seems more like a convention hall than part of a ship. The whole crew of nearly 2,000 men, attending movies, fills only a part of it. Giant elevators, among the world's

Official Photograph U. S. Navy

"Ship-of-all-work" Is the Slim, Sleek Destroyer, Always Hurrying on Some Mission

A destroyer at sea is ever rolling, her masts swinging pendulumlike across the sky; yet these little ships can ride through any weather. When the ocean gets rough, their crews often must eat standing up—if they feel like eating at all! Modern destroyers carry small-caliber guns, to be used against ships and planes, and many torpedo tubes. They hunt submarines, scout ahead of the fleet, lay smoke screens, escort convoys, or do any odd job (opposite page).

largest, move the planes up to or down from the flight deck at high speed.

So huge is the flight deck that orders are given there through the "bull horn," which amplifies the human voice to truly stentorian power. Officers and men jump into action when the bull horn bellows:

"All hands man flight quarters stations!"

Pilots don flying togs and hurry to the "ready rooms," where they receive orders and information. Deck crews take their positions. At intervals the bull horn roars:

"Pilots man their planes!"

"Stand by to start engines!"

"Stand clear of propellers!"

"Start engines!"

The resulting din drowns out even the bull horn.

Pilots signal with thumbs up that they are ready. The huge ship turns her head into the wind. A whistle blows. Planes taxi to their take-off positions. One at a time the dispatcher waves them off. With a mighty roar the squadron is on its way.

Oxygen and Rubber Boats

When the planes climb to 12,000 feet, the flyers' oxygen supply is turned on. Each plane has a rubber boat, complete with bottled gas to inflate it quickly, patches, a pump, paddles, and flares.

Before the planes left the carrier, the meteorological officer had estimated what kind of weather the flyers could expect over their objective. "The Navy needs to know what the weather will be day after tomorrow a thousand miles away," one said to me (page 694).

If dive bombing is the squadron's mission, they'll come screaming down from different directions upon their target, to confuse the defending gunners.

As they dive, the pilots may yell loudly to help equalize the rapid change of pressure in their ears. Close to the target they'll release their bombs and pull out of the dive, partially blinded for an instant when the sudden change of direction causes blood to rush from head to stomach.

No race-horse trainer looks after his charges more carefully than an aircraft carrier flight surgeon watches over his flying personnel. Flyers' digestions are easily upset because of the nervous strain of flying and the long periods of sitting still without exercise; so heavy, gas-forming foods are kept out of their diet. On days when they're to fly, they breakfast only on fruit, cereals, poached or boiled eggs—no fried foods.

If a flyer's diet lacks vitamin A, he may suffer from "night blindness." Men with hyperacute vision are constantly sought to serve as bombardiers.

Young, high-strung, reckless men make the best pilots of fighter planes, but for bombing the Navy prefers the quiet, unexcitable, introspective types who can concentrate upon their highly complicated task. In bombing from great heights, the bomb aimer must allow for many things—speed, course, and altitude of his plane, and the direction and speed of wind currents at various levels between him and the surface of the sea.

So fast are modern bombing planes that, if they are not seen before they are within five miles of their target, there is hardly time for defending gunners to fire at them.

Patrol Bombers Pride of the Air Force

Pride of the Navy air force is the great patrol bombers, truly boats that fly (page 687). These planes can range 2,000 miles out to sea from their bases and stay in the air 30 hours or more. Since the European war began, they have patrolled all the Atlantic waters from Cape Sable to Trinidad daily with a minimum of engine failures.

Life can be quite comfortable for the six or eight men on these big ships. They have room to move about, bunks to sleep in, and an electric cookstove.

"There's usually a mild feud between the radio operator and cook," said an officer. "The stove won't work when the radio's running at full power, and it always seems as if there's an important message to be sent just before mealtime! One of the mechanics usually doubles as cook."

"Are all flying mechanics good cooks?"

"They'd better be!"

"Doesn't the noise interfere with your sleep?"

"Not a bit! We get so we don't wake up unless the engines stop."

But, for all the bombers and battleships, you wouldn't have a Navy without destroyers (opposite page). The bobbing, rolling "tin cans" are manned by men who like to consider themselves a class apart and who take pride in the name "destroyer sailors."

Even Veterans Get Seasick Aboard a Destroyer

The destroyer sailor is truly what the Navy calls "seagoing." He knows what it is to live for days on coffee and sandwiches, eating standing up, with one arm hooked around a stanchion, because it's too rough to sit at table. After a siege of rough weather, his arms and hands may be stiff and weary just from the effort of holding on to things. He knows

Photograph from Press Assoc., Inc.

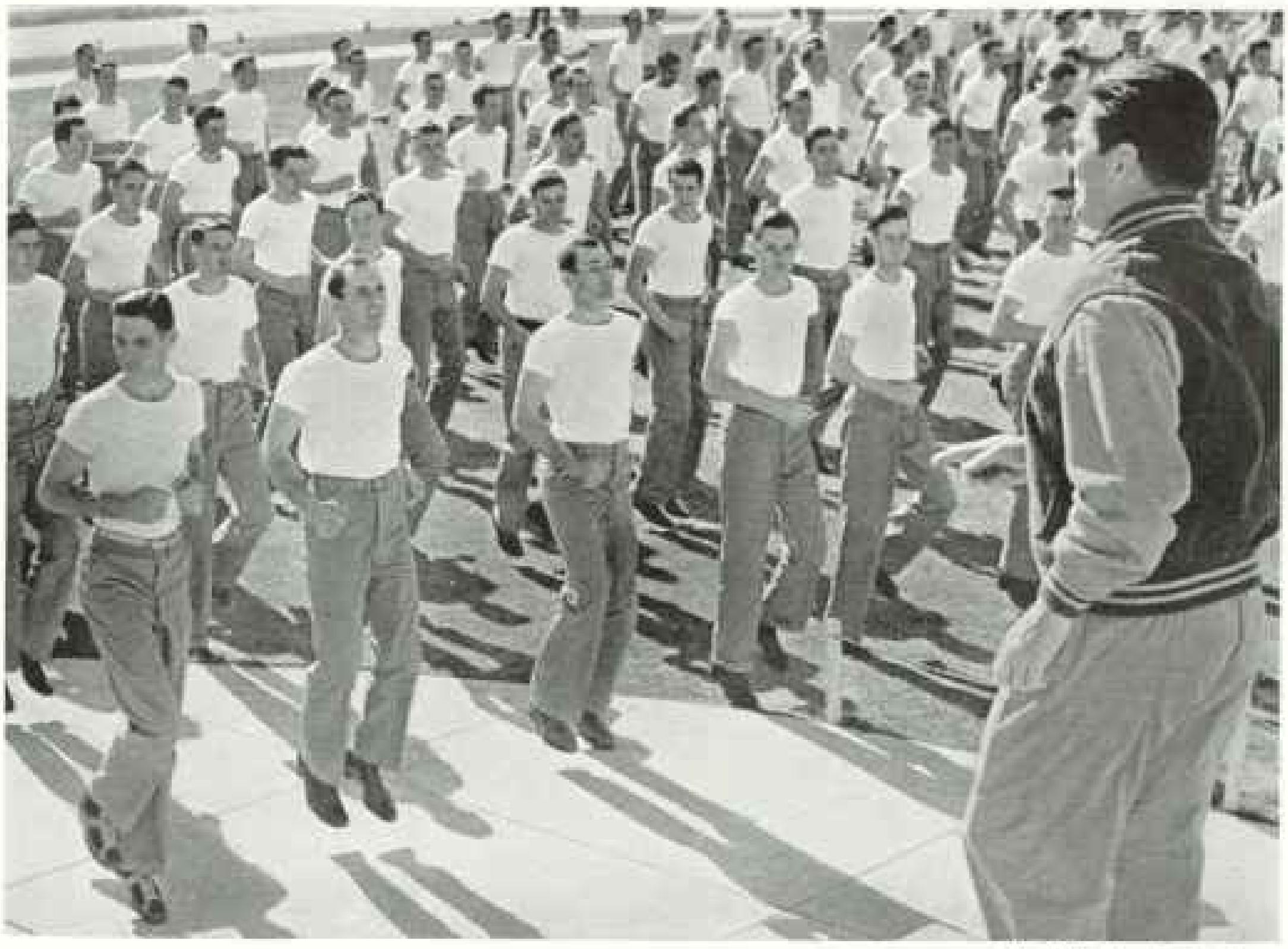
"Get That Kick Down Pat, Sailor, If You Want to Join the Fleet!"

Navy recruits must be able to swim 50 yards before they can go to sea. This will enable them to keep afloat until rescued, should they fall overboard. Naval Training Station, San Diego, California.

Official Photograph U. S. Navy

Like a Man-eater Baring Its Teeth, the Submarine *Shark* Breaks the Surface

Water pouring from the freeing ports gives a ferocious appearance to this undersea vessel. Almost as large as a destroyer, with a crew of more than 50, these newer submarines can cruise hundreds of miles into hostile waters (page 695). Submarines in the U. S. Navy are named for fish and aquatic animals.



Official Photograph U. S. Navy

"Put Some Pep in It!" An Ex-Champion Gives Navy Flying Cadets a Workout

Lieut. Comdr. James J. (Gene) Tunney, U.S.N.R., himself a former marine and now athletic director for the Navy, leads calisthenics at the Naval Air Station, Pensacola, Florida. Chosen originally for their near-perfect condition, the cadets must keep fit to stand the physical and mental strains of flying.

that on destroyers even veterans get seasick.

Though modern destroyers are almost as large as light cruisers, they're still built primarily for speed (40 knots, or 46 statute miles an hour), which means they're long and narrow. In a rough sea, therefore, the captain may find his dinner sliding into his lap, but at least he'll have some company to enjoy the laugh, for a destroyer captain eats in the wardroom with his officers.

The destroyer sailor has more jobs and faces greater risks than the men of almost any other surface craft. Destroyers scout ahead of the fleet, protect its flanks when steaming in formation, hunt submarines, lay smoke screens, fight other destroyers, do convoy duty, or any odd task that comes along.

Since armor would cut down speed and make them top-heavy, destroyers have little protection for their crews. They operate often well within range of the guns of larger hostile ships, and are vulnerable to air attack. They carry no chaplain, no dentist, no doctor, though each has a well-trained pharmacist's mate who can handle emergency "repairs."

The destroyer sailor has a certain cocky pride. One day a destroyer, running low on fuel, hailed a battleship to obtain an emergency supply. Somewhat patronizingly, the battleship captain shouted down from his lofty bridge:

"What can we do for you?"

"Five gallons of gas and a quart of oil!" came the sarcastic reply.

Tender, the Squadron's General Store

For all his independence, however, the destroyer sailor soon or late must come back alongside his dumpy, slow, unlovely squadron tender.

From somewhere in her ample hull he may obtain not only canned goods and ammunition, but (if he needs them) such things as mosquito nets, auger bits, hammers, locks, safety pins, towels, and even spare propellers.

Showing me endless well-filled shelves and bins, the supply officer of a destroyer tender said he had 3,200 different items in stock—but no alarm clocks! (The Navy doesn't need them.)

Photograph from Wide World

Goodby to Wives and Sweethearts—for How Long, Nobody Knows

These sailors are leaving San Diego for Hawaii. Only single men may enlist in the Navy, and sailors are not encouraged to marry until they have achieved a rating with sufficient pay to support a wife. Navy wives must endure months of loneliness. To one who wrote to complain of her husband's long absence, a sympathetic admiral recently replied: "There are times when our country demands the sacrifice of separation in the interests of the Game . . . Keep smiling. Write happy letters. Keep the flag flying and your chin up and some day, we all hope, this old world will take on a more normal routine."

"We can do anything for those 'tin cans' except put 'em in drydock," he said with pride. "Why, we could put diapers on 'em if they needed 'em!"

Such is the spirit of the "train," that unsung, unglamorous but indispensable fleet of tenders, tankers, tugs, ammunition and supply ships that keep the Navy fed, fueled, and ready to fight.

The men who work the guns and navigate the ships are only a part of the Navy.

Behind them are mechanics who overhaul intricate engines. Goggled welders repair ships at shore bases. Supply Corps men buy potatoes and onions in carload lots. Scientists knit their brows over new inventions, officers maneuver toy fleets for better knowledge of strategy, doctors devise improved methods of selecting aviators.

Thousands of petty officers, warrant officers, and reserves study and strive for better knowledge of their specialties.

Without all these, there could be no fighting fleet.

Today's World Turns on Oil

By Frederick Simpich

ROB US of oil, with its grease and gasoline, and our life rhythm would freeze.

Every truck and automobile in the United States—more than 31,000,000 of them—would die in their tracks without fuel and lubricants made from petroleum.

Planes, "out of gas," would be forced down all over the land.

Every ship in our Navy and every ship in our whole merchant marine would lie useless at dock, or halt somewhere at sea to roll helpless as dead whales in the troughs of the waves.

All Army tanks and trucks, all guns and motorized cavalry would stop; soldiers would go back to shaving mules' tails, currying horses, carrying baled hay and shoveling manure. The whole mobile Army would slow down, from 40 miles an hour to the plodding four miles of horse-drawn days.

Millions of us would shiver in our homes, before we could change all our oil heaters back into coal furnaces.

Factories and mills would shut down, too, from coast to coast, else their wheels would catch afire from friction and burn, because there is not enough castor oil, lard, or tallow to grease all their axles. Every railway car would stop.

Without oil to grease its wheels and cheat friction, mass production itself could never have come to pass.

Of course we had wheels and machines long before we struck oil. But about the time man found oil and began to make axle grease from it, the then "machine age" had reached a peak. Power we had, in plenty; but the problem of friction had reached the point where all the grease we could get from tallow, castor beans, pig fat, and fish was not enough.

By the time oil was struck in Pennsylvania, in 1859, the steam engine, the sewing machine, reaper, elevator, etc., were already in their early stages. But already, too, millmen, makers of machines, and inventors were balked by friction, which they had not enough good grease to overcome; hence, no one product ever invented set free such a rush of mechanical inventions as did the advent of petroleum grease.

Today in the United States we make about 57 percent of all the world's lubricating oil; and the story is current that Germany's war machine suffers more from lack of good grease for its wheels than from lack of fuels for its motors.

Britain still builds many coal-burning merchant ships because she has no domestic source of fuel oil.

If all the million oil wells bored in the United States since 1859 were added together, they would make a sizable tunnel clear through the earth at the Equator.

Where Oil Comes From

From the 375,000 American wells producing in 1940, we took out 1,354,423,000 barrels of crude oil, which was almost two-thirds of total estimated world production of 2,147,000,000 barrels. Outside of the United States, most oil in 1940 was produced in Russia, Venezuela, Iran, the Netherlands Indies, Romania, and Mexico. Output in Mexico, however, has declined enormously in the last 20 years.

Earth oil, as fuel and medicine, has been used since ancient days.

Natural gas lit the "eternal" fires of Zoroastrian temples. With asphalt, akin to crude oil, Noah calked his Ark, and it lined little Moses' basket when he floated among the bulrushes (page 740).

Nebuchadnezzar's masons used asphalt as mortar in his Babylon palace. I saw their fingerprints, as plain as if made yesterday, in that great banquet hall where the Hand wrote, "Mene, Mene, Tekel, Upharsin."

Oil, seeping from the ground, was used by American Indians as salve and internal medicine. Pioneer whites in Pennsylvania paid $20 a quart for this "Seneca oil"; yet some lived to see oil-field booms pound the price down to 10 or 15 cents a barrel!

Until famed "Colonel" E. L. Drake sank his pioneer well in Pennsylvania in 1859, it seems Americans didn't think of boring for oil.

In 1829, at Burkesville, Kentucky, a man drilling for salt water, to make salt, brought in an oil gusher. It caught fire, and burning oil flowed for miles down the Cumberland River.

"I've struck Hell itself! May God have mercy on me!" yelled the driller as he fled the scene.

Even before Drake's well, we had made "coal oil" from coal. But as wells multiplied, oil got cheaper; men couldn't use it all for medicine, so they began to distill it for use in lamps. Here again, an old art was applied. Men knew how to distill before Christ; some ancients hung a wool fleece in the steam from boiling liquids; when it cooled, they wrung out the condensed liquor.

Photograph by G. La Tour and Son

This Big Hook Can Pull a Mile of Pipe Up from the Earth

Stacked at right are the long "stands" or sections of pipe just drawn from this California well. Drill pipes must be brought to surface now and then to change the bit or repair a twist-off or other mishap. The "tower man" wears a safety belt and a helmet. The day before this picture was made, a tower man, failing to fasten his belt, fell from this platform, 85 feet above ground, and was killed.

Today's magnificent "bubble tower" stills cost millions and cook everything out of the crude oil, from gasoline and kerosene to fuel oil, paraffin, and asphalt. But they use the same principle that Arabs used with the fleece.

When Gasoline Was a Nuisance

Kerosene—and the lowly axle grease—were all we wanted from oil in early days. We got gasoline, too, but then it was only a nuisance; ignorantly we squirted it away into the air, or dumped it into rivers, till the police stopped us!

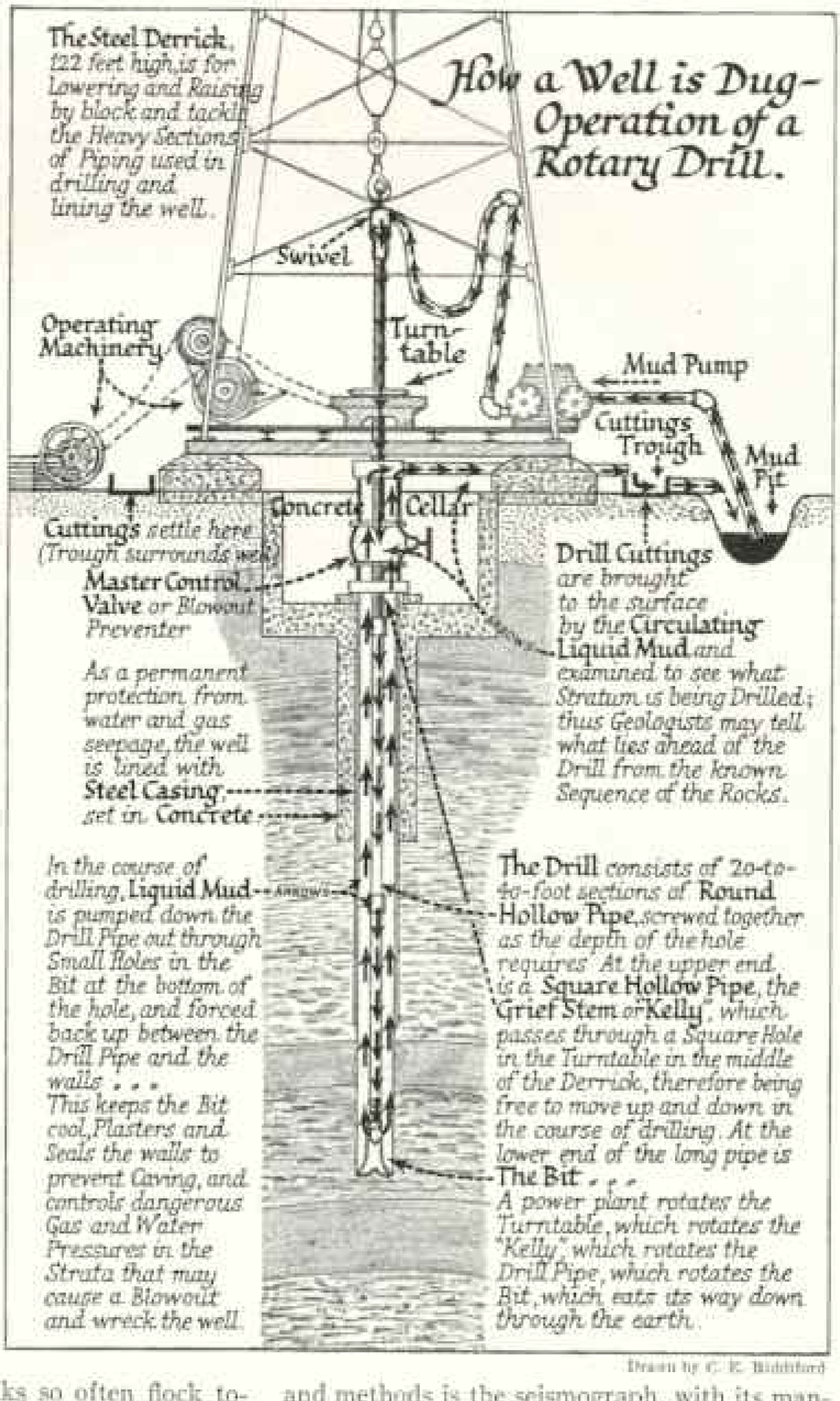
Then came the gasoline engine. It banished the horse, put the world on rubber tires, and gave men wings. Gasoline, once despised, became worth more than "coal oil."

But, you ask, what *is* oil, anyway, and how do we find it?

Oil itself, some scientists say, was formed ages ago, from dying fish, animals, and plants.

To get it, men bore wells deep into the earth.

But where? How do you know your $40,000 hole will hit oil-bearing sands?



Drawn by C. R. Riddiford

And why do oil derricks so often flock together, like sheep, when there's plenty of room for more wells just across the road?

That's because oil is where you find it. How you find it nobody can say exactly. "We can't tell you where oil is," say the geophysical crews, "but we can tell you where it ought to be."

It's truly a job for science now. The days of the "doodlebug," as the forked stick and other unscientific devices were known, are practically gone.

Most frequently used of scientific devices and methods is the seismograph, with its man-made earthquakes. With it field crews explode dynamite in a bored hole; on a special truck, parked some distance away, radio devices record the vibrations of the shot from far down in the earth (page 720). From figures so received, oil geologists draw a chart; on it are lines which indicate how the rocks or salt domes are lying, far below, and locate geological structures that might hold oil.

These geophysical crews, with their trucks, boats, and "swamp buggies" (page 723)—range all over the world, probing for new oil

sources. Their "swamp buggy" is a seagoing amphibious-looking vehicle. Its 10-foot-high wheels are equipped with fat, fin-studded oversized tires which act as propellers; when the odd vehicle leaves the land and takes to water, it begins to swim.

Other oddly named oil-seeking instruments are the torsion balance, magnetometer, gravimeter, etc.

One method of hunting oil now is by core drill. Samples of rock thus brought up may hold fossils, clues to deep earth formations and possible oil pools. This study of fossils is most useful to geologists.

Just as astronomers take pictures of stars and planets to outline the universe, so with fossils geologists build up a picture of a world structure that was, long ago. They find earth history written thus—fish, ferns, giant clams, dinosaur tracks, and saber-toothed tiger bones frozen in primeval mud.

Some oil hunters make airplane picture maps; others look for surface seepages. A yet newer way is soil analysis. With this method they dig a hole just deep enough to get some fresh earth not too near the air. They analyze the gaseous and solid hydrocarbons found in the samples and so get infinitesimal signs of oil or gas that may have worked their way up from far below.

So, with doodlebug or dynamite, the hunt goes on. Each year we bring in some 20,000 new wells. Since Pennsylvania drilled our first well, the hunt has marched across Ohio, Indiana, out to Oklahoma and Texas, on to California, and now it's bounced back East for a brand-new boom in Illinois.

Best news for Uncle Sam is that today his proved oil reserves are the greatest in history—about four times what they were 15 years ago.

To pump this oil up and into tanks would keep 12,000 average wells busy thirty years! And, if you must be statistical, it would load a line of big tankers, lying bow to stern, about 16,000 miles long!

What Is an Oil Well?

Familiar enough is the high steel derrick that rises over an oil well. It works the drills, holds the gear that lifts long lengths of hollow pipe that go into the oil well, and may house the pumps that lift up the oil.

Wells are drilled in two ways: either by lifting the drill and letting it fall, so its weight punches the hole ever deeper; or by rotary drill. This rotary now is most popular. With it you make your hole by rotating a sharp drilling bit set at the lower end of the string of pipe (pages 705, 717, and 718).

As the hole gets deeper, you screw one joint of pipe after another on top of the ever-lengthening drilling pipe. In deeper wells this pipe may come to be more than two miles long.

Sometimes the pipe twists in two, and you have to fish out your drill or start a new hole.

Sometimes you hit high pressure, from gas, oil, or even water, and the tools come flying violently back in your face, maybe wrecking derrick and all.

Titanic indeed was such an outburst of oil at a Mexican field in 1908. Pressure was so terrific that the very earth quaked when oil was struck at 1,824 feet. Oil and gas shot from cracks that opened in the ground 250 feet from the well.

Somehow the gas caught fire, and for 58 days flames shot a quarter mile up into the heavens. So bright was the fire a paper could be read at midnight eleven miles away; two million tons of earth flew up into the air, along with the oil and gas.

Finally the fire was put out by pumping sand on it, but a crater was left of more than a million square feet.

In rotary drilling the bit may get so hot that it fuses. To avoid this, special fluid mud is pumped down through the hollow pipe. This mud, thus circulating, also brings ground earth particles up out of the hole and has a plastering effect on the side of the wall. Likewise, the mud's weight may control the flow of gas and oil, if they are struck.

The kind of "mud" used depends on conditions met with deep down in the earth.

"Mud Trouble"—Two Miles Down

At 9,629 feet down, one California well had "mud trouble."

Of this well, Dr. Gustav Egloff says: "It was reported that approximately 62,000 pounds of Aquagel (a mud), 1,160,000 pounds of dry mud, 65,000 pounds of cement, 6,300 pounds of a fissure-sealing compound, 660 sacks of cottonseed hulls, 781 sacks of sawdust, and 23 bales of hay went into this hole" before drilling could be resumed.

In ten days wells 3,600 feet deep have been sunk. To drill some deep wells may take from six months to a year.

The deepest well ever bored is near Wasco, California. Sunk by Continental Oil Company to a depth of 15,004 feet, temperature encountered rose to 270° F. It was plugged back to 13,000 feet, at which depth 3,000 barrels of oil a day were obtained. The world's deepest active well at present is the Fohs Oil Company Bourg Well 1, DeLarge Field, Terrebonne Parish, Louisiana, producing at 13,254 to 13,266 feet.

Kodachrome by B. Anthony Stewart

Mother Sews by Lamplight, Awaking Fond Memories to Millions!

From pine knot to tallow dip, candle, whale oil, and kerosene—that was the story of light till gas and electricity came. One big oil company gave lamps free, in China, to boost kerosene sales. Despite today's wide use of electricity, two million U. S. homes, even some in New York City, are still lit by kerosene lamps.

These "Hot Papas" Work in Fireproof Suits

At El Dorado, Arkansas, asbestos-clad fire fighters show how carbon dioxide will extinguish flames. Expert American oil-fire fighters have been called abroad to extinguish wells that had been burning for many months.

Kodachromes by B. Anthony Stewart

When the Hostess Lights Her Centerpiece

Novelty candles, made from paraffin wax, look like water lilies floating on somebody's goldfish bowl. Smaller flowers of wax float in the finger bowls. From paraffin still other decorations are formed, such as fruits and figurines.

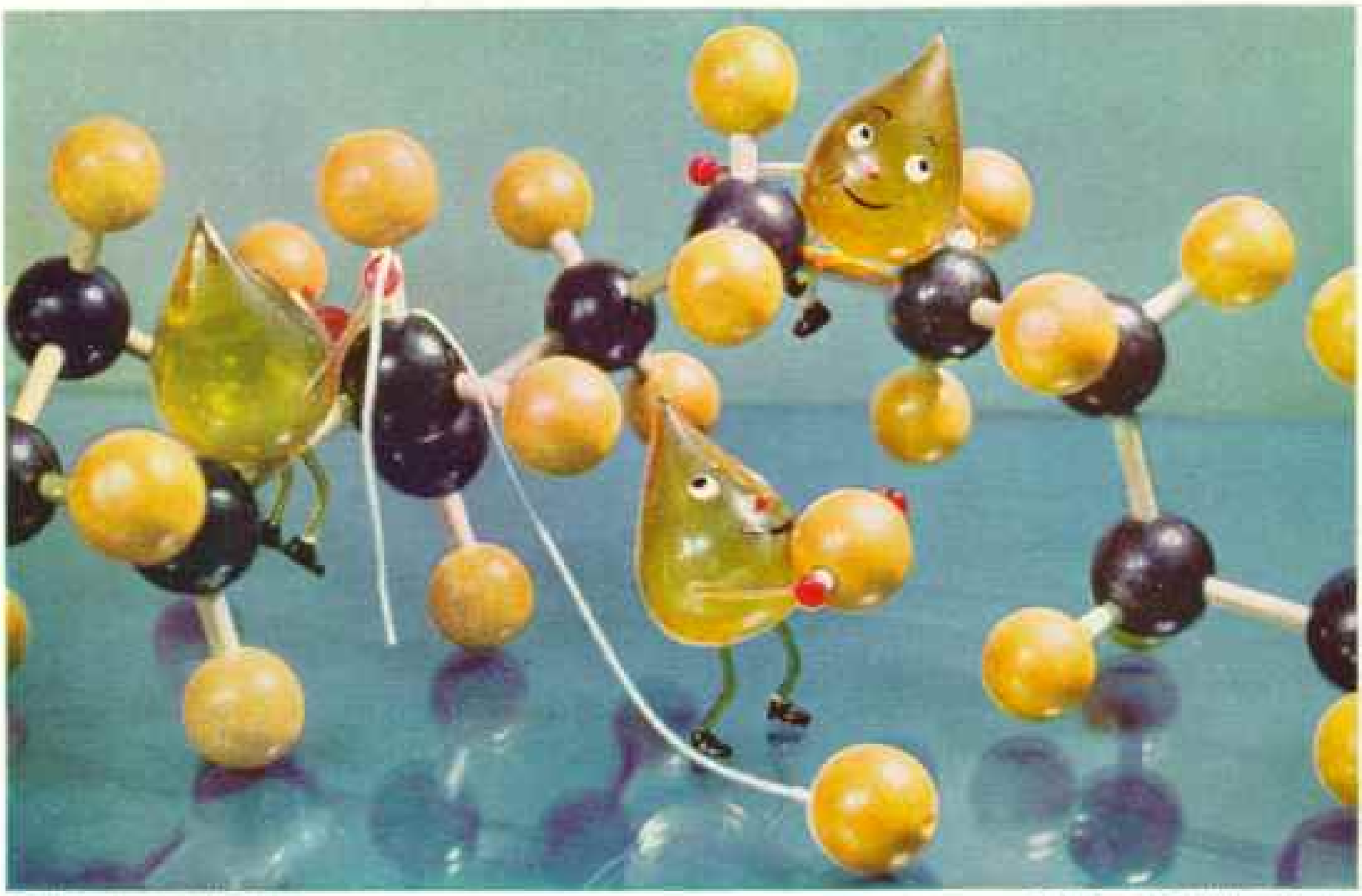
Kodachrome by B. Anthony Stewart

High Above Long Beach Homes Towers the Derrick Forest of California Oil Wells, Yielding Fabulous Fortunes

In boom towns derricks often crowd almost into family kitchens. If one man drills and strikes oil, his neighbor at once drills, too, lest the first drain the pool. This is one cause of overproduction. But, since "oil is where you find it," your neighbor may get rich while you bore only a dry hole.

Film Actress Joan Leslie Gets Made Up in Warner Brothers' Hollywood Studio

Petroleum jelly and "white oil" form the base of many face creams in the cosmetic trade.



 Redachromes by R. Aldous Stewart

Fantastically, These Figures Suggest "Chain" Groupings of Oil Atoms

Set up by chemists in the Shell Laboratories at Emeryville, California, part of an oil molecule is represented by the black and yellow balls, the black standing for carbon and the yellow for hydrogen atoms.

 Kodachrome by B. Anthony Stewart

Neither Bullfighter nor Ambassador Wears Finer Feathers Than This Candlemaker

Popular Los Angeles character, José Herrera operates his shop in Olvera Street, Mexican center. With its tamale cafes, guitar players, castanets, and smiling señoritas, this colorful quarter reflects Latin life like that in Guadalajara. He pours 150 to 200 coats of perfumed colored wax on each wick to make the average 12-inch candle. Herrera played the candlemaker in *Lost Horizon*.

Kodachrome by B. Anthony Stewart

Ammonia Made from Oil Is Used Now to Fertilize Farms and Orchards

Ancient Egyptians enriched fields with ammonia extracted from stable sweepings. Today laboratories in California recover ammonia from oil and use it as a fertilizer. From cylinders on the truck, ammonia is taken and mixed with irrigation water, which carries it through orchard ditches to tree roots.

Kodachrome by B. Anthony Stewart

Bright Drums of Petroleum Products Are Piled About the Shell Research Laboratories at Emeryville, California

Besides gasoline, kerosene, various fuel oils and lubricants, science knows now how to make hundreds of other useful things from oil. These range from drugs and cosmetics to rubber and plastic goods. First subjected to great heat and pressure, and then released, oil hydrocarbons reunite to form new materials.

 Kodachrome by H. Anthony Howell

Oils Mixed with Poisons Make Deadly Sprays Against Insects that Prey on Fruit Trees

From tall hydraulic jacks citrus growers in Redlands, California, direct poison blasts against treetop strongholds of their insect enemies; in this case red spiders and scale insects. Without man's constant war on them, "bugs" might in time threaten the world's food supply.

First thought dry and useless, some wells have been made to flow by sending down cans of nitroglycerin and firing these off to crack open the porous rocks and let the oil flow into the hole. But nitroglycerin is tricky stuff; more than once subterranean heat has prematurely fired the charge.

As wells got deeper, how to keep the hole straight became a problem. Or again, how deliberately to "bend" a deep hole to get under a church, a graveyard, or even out under a body of water, became yet another problem. Men finally worked this out by photography.

At Huntington Beach, California, where wells slant far out under the sea, we saw how cameras help keep track of which way a crooked hole is going (page 727). In the bottom of a hollow steel tube is set a compass; just above it is a tiny flashlight and single-shot camera controlled by a small clock.

"It'll take 20 minutes to let that tube down to the bottom of our hole," said the driller. "So we'll set the clock to 'go off' in 20 minutes."

Pulled back up later, we took the camera out of the tube, to develop and print its disk-like film.

"See here," said the driller. "This picture of the compass dial shows that our hole is drifting northwest, and that it is 40 degrees off the vertical. Look at the chart here, where we show the position and direction of a dozen other near-by wells, and you can determine just exactly where our hole is going, away out there under the Pacific Ocean."

Good oil stories include a hillside drilling job in Pennsylvania, wherein the runaway drill turned up under a brewery and tapped a beer vat. A cartoon in the Petroleum Engineer showed foaming beer gushing from the well and drillers running with buckets to catch it!

Science Adds to Our Oil Reserves

To drill a well today costs anywhere from $16,000 to $200,000.

Deeper drilling—down to two and three miles—now finds new oil pools below those already tapped.

Also, old pools once thought exhausted are being brought back into production by "repressuring": that is, by pumping in air, gas, or water to restore lost pressure and thus start oil moving up again.

Our future oil supply is also being expanded by the steady increase in the volume of refined products we get from a barrel of crude oil.

Natural gas—to which we must advert—comes also from oil fields.

So many different solids, liquids, and gases come now from cracked oil that even to find new names for them is like naming Pullman cars. Long ago, nomenclature was simple. What we know as "asphalt," for instance, which is oil in its solid form, Bible writers called "pitch" and "slime" (page 740).

The ancients also used oil in various forms in warfare. A precursor of our modern flame thrower was the "Greek fire" of the Byzantine Greeks, used with telling success against enemy fleets. It became one of the most powerful military weapons of its age, and the secret of its composition was guarded for centuries. It was probably a self-igniting mixture of oil and quicklime.

One pioneer use of gas was when somebody piped the gas into his cabin and made a burner of an old gun barrel—and cooked over it! Such gas, in time, caused the rise of glass and other factories of Ohio and Indiana.

"Dry Ice" from Wells Bored for Oil

"Dry ice" comes now from some holes first bored for oil. You've seen broccoli, beans, and peas packed in it. Latest marvel is near Brawley, in California's melon- and vegetable-growing Imperial Valley. Fortuitously, wells drilled here have yielded carbon dioxide; so lucky farmers find cheaply at hand plenty of dry ice in which to pack their crops for shipment to market.

In the East most dry ice is made as a "by-product" of industrial plants.

To put out an electric or chemical fire now, you can also use dry ice. In city streets, if you read signs on passing ice trucks, you may see the words "carbon dioxide." For fire fighting, a gun-shaped device is attached to a cylinder of this compressed gas. "To operate, pull the trigger." Released gas turns to a blizzard of dry ice—at 110 below zero—and puts out the fire!

"One of the strangest wells ever drilled," said Dr. Gustav Egloff, "was at Walden, Colorado. It blew out what looked like yellow snow. This piled up in hills and proved to be a mixture of solid carbon dioxide, or 'dry ice,' and petroleum." Other such wells have been drilled in Mexico, New Mexico, and Utah. From some of them dry ice is sold.

Stranger things than ice have shot from freak wells. An elephant—or the ancient wreck of one, says the Los Angeles Times—blew up some years ago out of a well on La Brea tar pits. From this same spot scientists eventually took the old skeletons of hundreds of other animals and birds (page 740).

"Another case is on record," said Dr. A. G. Loomis of Shell laboratories, "wherein stalag-

Photograph from Tulsa Daily World

In This Oklahoma Fire the Owner of the Well Was Burned to Death

Paul Vites, a California "wildcatter," came to Oklahoma, drilled this well, and struck oil. One day he took his family out to see it. Accidentally, he let his cigarette fall; the gaseous oil was ignited. His family escaped but Vites perished. For three weeks the fire burned, until Myron M. and Floyd Kinley, famous Tulsa fire fighters, extinguished it.

mites came flying up from a well. . . . Drillers sometimes hit caves far down in the earth."

Fountains of mud have shot into the air from other freak wells. From one comes hot salt water—100,000 barrels a day.

When oil was first produced, the "wet" gas that often comes with it was wasted. Now we capture such gas and make it serve us in multifarious ways.

For years glassworks, and the copper and brass industries, sought homes near gas fields to get fuel for cheap but intense heat. But pipe lines now carry natural gas for hundreds of miles from desolate districts, where it likes to hide, to distant centers of population where it can be used instead of wasted.

Here it is sometimes liquefied and stored in tanks insulated with two feet of cork, a frigid lake of liquid energy much colder than dry ice.

Other gases from petroleum, butane and propane, are easier to liquefy and are moved about the land, even delivered from door to door, in small containers like old-fashioned Prest-O-Lite. Farms use them for heating, cooking, and refrigeration; trucks run on them, and they are also used in metal cutting, heat treating, annealing, and air conditioning. In large lots, tank cars haul these gases around the country.

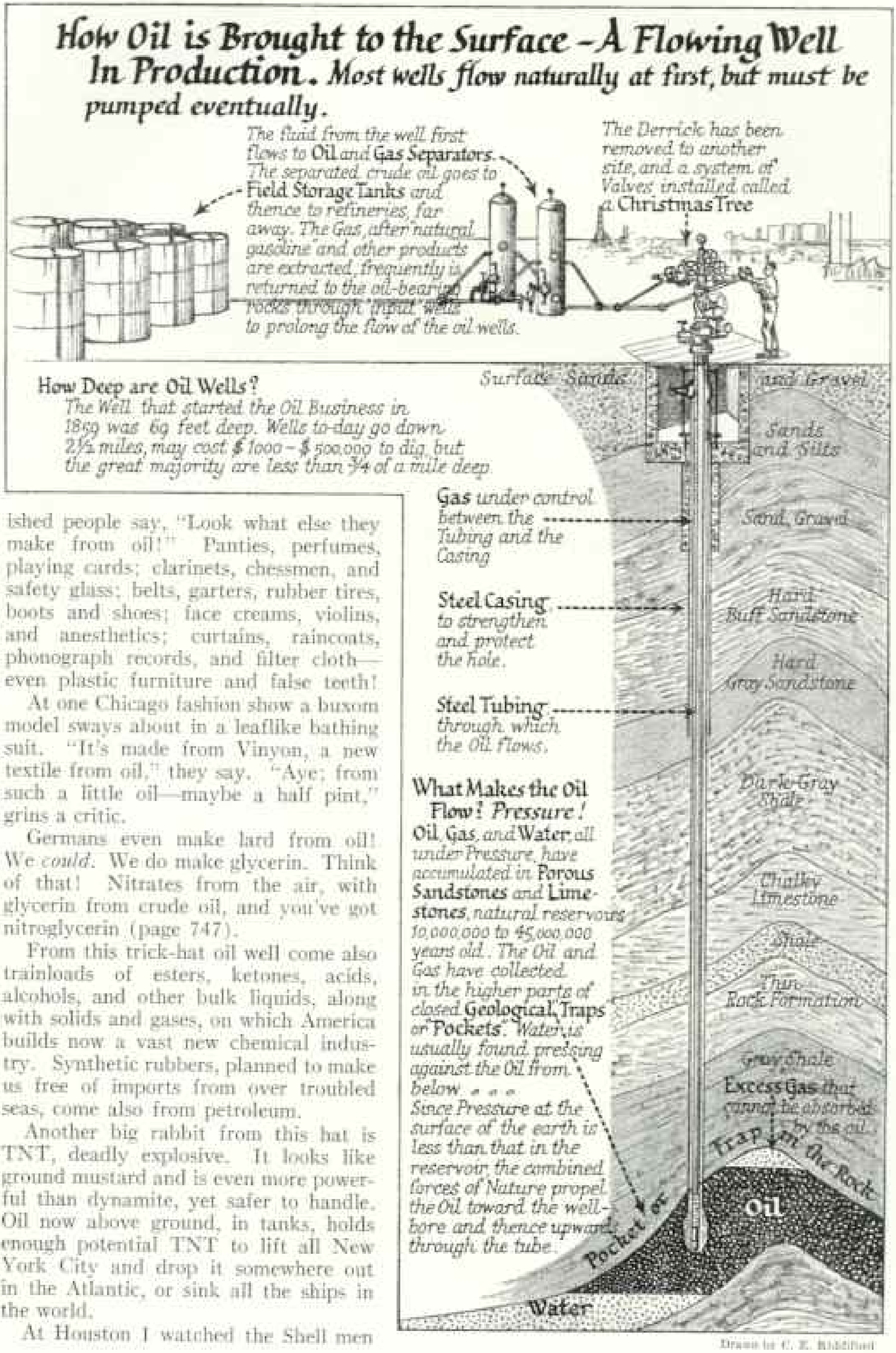
When reacted with other chemicals, the related gases, butylene and propylene, go into the making of paints, cosmetics, antifreeze solutions, explosives, dyes, synthetic resins, artificial fabrics, and a host of other useful things.

"White Rabbits" from Oil Wells

The astonishing fact is that now, from crude oil, we can take the very same hydrocarbons as are found in coal tar, which, as everybody knows, is the almost miraculous source of so many things, from perfumes and flavors to rubber heels and headache tablets. And there are large quantities of many kinds of hydrocarbons in oil that hardly occur in coal tar at all.

So today's oil well is like a magician's hat. From it science pulls white rabbits of vital aid in our fight for food, clothes, and national defense.

So odd, so incredible are some things made from oil that even when you see them in shop windows, it's hard to believe your eyes. Over and over aston-



Drawn by C. E. Riddiford

ished people say, "Look what else they make from oil!" Panties, perfumes, playing cards; clarinets, chessmen, and safety glass; belts, garters, rubber tires, boots and shoes; face creams, violins, and anesthetics; curtains, raincoats, phonograph records, and filter cloth—even plastic furniture and false teeth!

At one Chicago fashion show a buxom model sways about in a leaflike bathing suit. "It's made from Vinyon, a new textile from oil," they say. "Aye; from such a little oil—maybe a half pint," grins a critic.

Germans even make lard from oil! We *could*. We do make glycerin. Think of that! Nitrates from the air, with glycerin from crude oil, and you've got nitroglycerin (page 747).

From this trick-hat oil well come also trainloads of esters, ketones, acids, alcohols, and other bulk liquids, along with solids and gases, on which America builds now a vast new chemical industry. Synthetic rubbers, planned to make us free of imports from over troubled seas, come also from petroleum.

Another big rabbit from this hat is TNT, deadly explosive. It looks like ground mustard and is even more powerful than dynamite, yet safer to handle. Oil now above ground, in tanks, holds enough potential TNT to lift all New York City and drop it somewhere out in the Atlantic, or sink all the ships in the world.

At Houston I watched the Shell men

Photograph by W. Eugene Smith from Black Star

Whirling Teeth of a Rotary Rig Bite Swiftly Through the Hardest Rock

Most bits are casehardened or faced with hard alloys to withstand wear. Sometimes black diamonds are used for cutting "cores," or samples, from far down in the earth's bowels. To keep the bit from getting so hot it might fuse, special fluid mud is pumped down through the hollow pipe (page 706).

rushing work on a giant toluene plant, where millions of gallons of this fluid will be made for Uncle Sam's use in TNT.

This chemical wizardry started when men learned to "crack" oil. When you "crack" oil you get a result similar to that when you drop bacon fat on a hot stove—some gasoline-like fume goes off in the air, and some coke sticks to the stove.

In these products from oil, science finds many of the same hydrocarbons as in coal tar. So now, if we had no coal, we could also make from oil the same long list of drugs and medicines, from aspirin to anesthetics, as well as all the dyes, perfumes, and flavors that come from coal tar. How versatile the chemist!

Carbon black is but one of the many useful things we get from gas. They make it by burning gas jets against overhead steel plates, then scraping off the soot—which *is* carbon black.

Most of our annual output of 262,000 tons or more is made in Texas. Fly over Breckenridge or Kermit some windless day, and the vast black cloud that hangs over those cities makes you think the whole place is on fire.

Rain clouds hid these Texas towns, when lately I flew over them. High up where we were, the sun shone, glistening on vast white cloud fields. But we could tell exactly where Breckenridge was, and Kermit, too, for smoke from their carbon works had floated up and blackened big ragged patches in the snowy clouds below us.

Carbon black works may cover 50 or 100 acres and include storage silos 150 feet high.

Many Uses of Carbon Black

This now prodigious industry dates from long ago. Early Chinese printed from wood blocks, using some kind of carbon in their inks. Some kinds of printing inks contain carbon black and oil (Plate XII).

America's printing industry today has grown to such vast size that, without carbon black, it might collapse. Modern high-speed multiple presses must have an ink that flows freely and makes an instantaneous jet-black impression of every hairline of the type and halftone.

Bombs of carbon black powder were taken by Admiral Byrd on his third Antarctic trip, to be dropped on the snow as markers in aerial survey work.

Because the Antarctic wastes have no rivers, trees, towns, or other customary landmarks, the use of these bombs—which make big black spots when they hit the snow—helps mapmakers get quicker, more accurate overlapping of aerial photographs.

Tire makers buy most of our carbon black; they use 45 to 50 parts of it by weight to every 100 parts of rubber in the treads. This adds to a tire's strength, resiliency, and mileage.

In the making of rubber hose, heels, surgeon's gloves, floor coverings, etc., much carbon black is also used.

Pharmacists say America's first oil refinery was started by Samuel M. Kier, a Pittsburgh druggist. He built a small plant in 1855 to make a medicine he called "Kier's Rock Oil." That was the historical background for today's huge drugstore trade in mineral oil, cosmetics, etc.

Oil for Drugstore Shelves

Among oil products used by the drug trade, including paraffin wax, petroleum jelly is most prominent. Drugstore history says it was first made by Robert Augustus Chesebrough in 1870. He also coined the word "Vaseline," and registered it as a trade-mark for his product. Today this jelly is a common ingredient of salves and ointment formulas.

Responsible pharmacists are of course critical of the raw materials they use, and today's best petroleum jelly is a long way from the "axle grease" of horse-and-buggy days. Consumption is enormous.

In its output, for example, the Eli Lilly Company, of Indianapolis—one of the world's largest makers of pharmaceuticals—buys high-grade jelly in metal drums holding 400 pounds.

You see them melt this and strain it through cloth, before the medical ingredients are sifted into it. After this is milled and ground, they inspect it with a magnifying glass, to insure maximum fineness.

Like deft human fingers, you see "ointment filling machines" at work in Lilly's factory. They measure out just the right quantity, pour it into a collapsible tin or aluminum tube, then seal it up—all in 1¼ seconds! What a change, since Arabs first took "pitch" from the old wells in Hit of the Hittites to salve their camels' saddle galls, rub out their own rheumatism, or cure sore eyes!

From an oil well to a beauty shop is a long walk! Yet tons of petroleum jelly, mineral oil, and other petroleum products go into fancy face creams and skin lotions.

How interesting to think that on some girl's dressing table there's a fancy jar for "painting the lily"—whose perfume, color and "cream" may have come from the same oil well from which came also a henhouse roof or a pair of rubber heels!

Drugstores sell other medicines which are now made synthetically from oil. There's

Photograph from The Texas Co. for Bost. Yarnall Ritchie

Prospecting for Oil, a Seismograph Crew in Oklahoma Fires a Nitroglycerin Shot

Another car, part of this outfit, is parked some distance away; in it radio and other instruments record the time required for the vibrations from the shot to bounce back from where, down in the earth, the shock waves struck against dense rock formations. From these data, geologists can compute distances and draw a map showing underground formations that suggest where oil sands may be found with the drill (page 705).

ephedrine, used for centuries in China as a nose medicine. Now we make it by nitrating the ethane in natural gas and use it with oil sprays to clear out the head.

From that versatile gas, propylene, set free when oil is refined, comes now a new anesthetic, Cyclopropane. Pleasing in smell and inducing sleep without suffocation, it causes smooth, easy breathing.

Dust that flies when we spin wool or card cotton is kept down by the use of spindle oil produced from crudes and made also when refiners separate paraffin wax from petroleum.

"London fog" for use in realistic screen-play scenes is made by spraying spindle oil from giant atomizers over the actors. Foggy waterfront scenes in *Passage West* were thus treated with oil.

This same light oil keeps rust off razor blades and prevents glassware from sticking to the mold when being formed. It impregnates paper for making cheap lampshades; it is used to lubricate binder twine and ordinary rope, making them easier to handle and more durable.

Bakers use this light oil on their pans, to keep bread and cake from sticking; tanners use it to soften leather, and miners employ it as a flotation agent in separating ores.

Oil Clears Milk of Weed Tastes

If your cow eats garlic or ragweeds, her milk tastes bad. Remedy? Pour in a few drops of mineral oil; they rise to the top and bring the bad tastes along. Skim off the oil, and your troubles are over.

Photograph by Robt. Yarnall Richie

This Odd Gun Shoots Holes into the Sides of Wells So Oil May Flow In

Let far down inside the well casing to the depth of the oil formation, the "perforating gun" fires heavy bullets. They pierce the pipe and adjacent oil sands and leave channels through which oil, urged by gas pressure, flows into the well. Each aperture in the vertical gun holds a loaded cartridge, fired electrically (p. 717).

Photograph by Chicago Architectural Photo Co.

Visitors at Chicago's Museum of Science and Industry Are Fascinated by This Model of an Oil Refinery

The miniature bubble tower at right, reproduced in glass, shows how crude oil, vaporized by heat, gives off its products from one "plate" or platform to the next. Gasoline, lightest of all, rises to the very top. Kerosene, fuel and furnace oils, etc., are derived from other levels in the towers. Asphalt, or other residue known as the heavier "ends," rests on the bottom (page 739).

Photograph by B. Anthony Stewart

To Oil Prospectors This Odd Vehicle is a "Swamp Buggy"

Since "oil is where you find it," men exploring for new fields must also search through marshes and even under shallow coastal waters. So, its fat tires set with fins, this buggy runs over dry ground, mud, or water with equal ease (page 705).

Paraffin wax itself has been called the Jack-of-all-trades of the oil business. Older people recall when it was used in cheap chewing gum, or merely to seal up fruit jars.

Churches use much wax for big altar candles and for those long ones carried in religious processions (Plate V).

Those artificial fruits and flowers on your host's table may be of wax. Newfangled milk bottles by millions are made now by the American Can Company from wax-coated paper. Containers from the delicatessen, which hold cream, pickles, mayonnaise, potato salad, butter, and cheese are made in the same way. One breakfast-food firm uses 35 tons of wax a week to coat its paper food containers.

Coating fruits and vegetables with wax is standard practice, especially in the case of exported apples that must make a long sea voyage. On the cut end of a turnip or carrot you may see where the dealer has stamped his own trade-mark and then waxed it over. Pacific coast mills make waxed-paper wrappers to put on fruit that may go anywhere from China to Argentina.

If you build a new house and want a full-grown tree brought and set out, the landscape gardener will haul it to your yard all embalmed in wax to keep it fresh and green. Full-grown trees, all coated with wax, were moved to the New York World's Fair grounds and safely set out.

Rose bushes, uprooted in the fall, are kept alive all winter with wax, instead of having to be stored in a hot, moist greenhouse. Some women spray the pine Christmas tree with wax to keep needles from littering the floor.

Wax helps pick chickens. Melt this wax, dip a chicken in it, let it cool, and you can strip off all the feathers at once, just as a woman peels off her zipper dress. Some poultry packers handle fowls this way on a big scale, a conveyor belt carrying them over a dipping vat.

Oil Helps Whip Weeds and Bugs

Fire-squirting weed killers flash over some western railroads. One of these oil-burning dragons, speeding over the prairie and spraying blazing oil right and left beside the tracks, kills weeds—also owls, snakes, and rabbits—faster than a whole army of section hands could cut them down with scythes (Plate XVI).

Lakes of oil, such as kerosene or in some other form, mixed with poison such as

In California's Barren Elk Hills the Pattern of Derricks Outlines Roughly the Borders of the Underlying Oil Deposit

Withdrawn from all forms of sale, entry, or settlement by the Federal Government in 1912, this area, since known as Naval Petroleum Reserve Number One, was not developed until 1919. It gets its name from the tule elk, which used to run here. Most of these animals have since been moved to a game refuge in the Owens River Valley, where about 230 of them now live. Oil wells here are about 3,000 feet deep.

Photograph courtesy Scientific American

A Cementing Crew Works Furiously to Keep Subterranean Water and Running Sand from Getting into a Well

Since this California well is more than two miles deep, where temperature may be near water's boiling point, they must hurry to get the cement in place behind the casing before it sets. In a recent record-breaking feat, one California crew mixed and pumped 1,400 sacks of cement in 30 minutes and 30 seconds.

Photograph from Caterpillar Tractor Co.

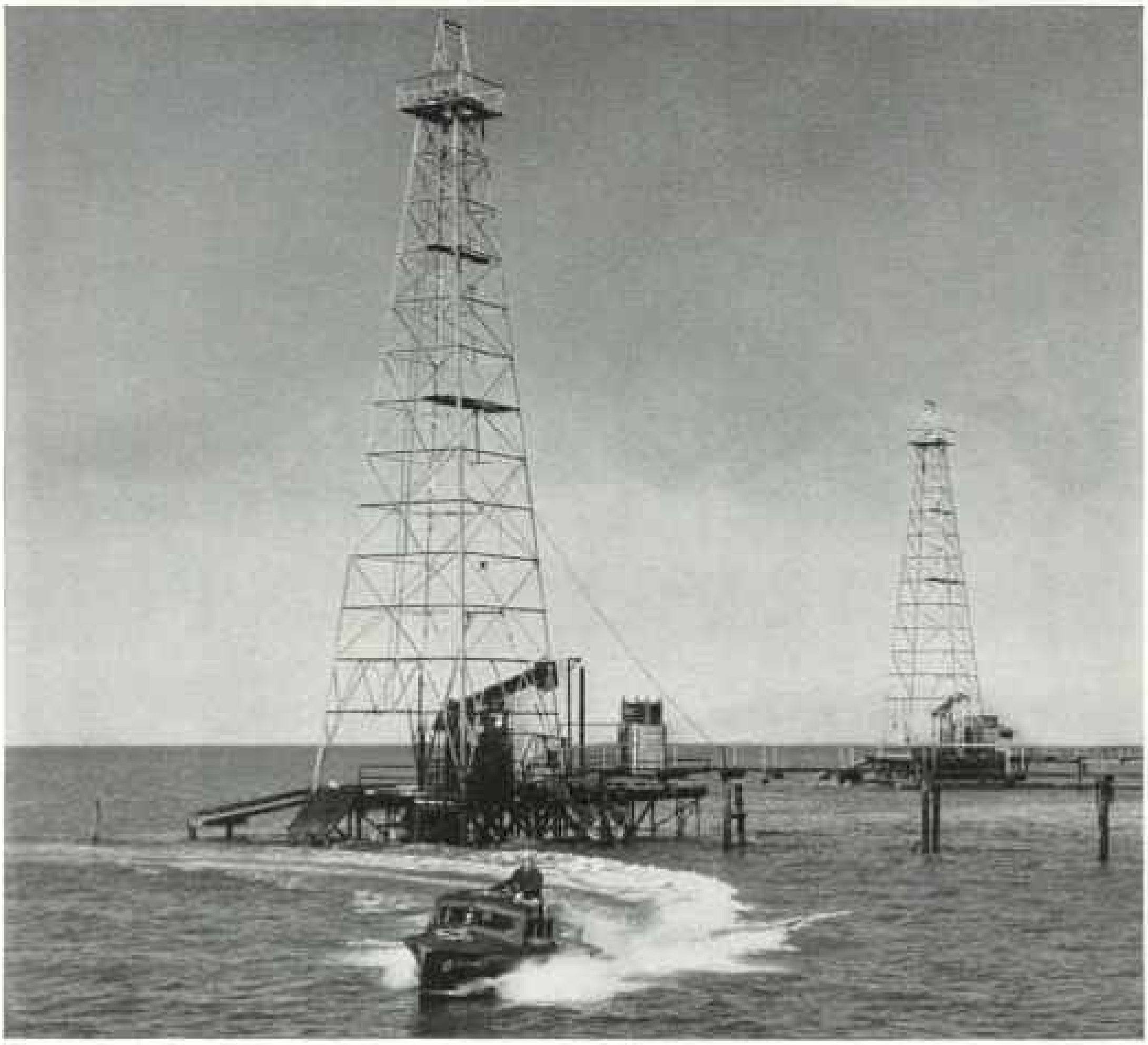
The Natural Gas Pipe Line Company of America Lays a 20-inch Line from Oklahoma to Milwaukee

This crew is working near Annawan, Illinois, on the 100-mile section between Geneseo and Belvidere. Such lines may run far from roads or highways, making short cuts across country. Farmers who surrender right-of-way across their fields are indemnified. Total length of oil, gasoline, and natural gas lines in the United States would make a big iron snake 321,000 miles long (page 730).

© Spence Air Photos

Hugging the California Coastline at Huntington Beach, Oil Pumps Work Without Ceasing Night and Day

But these wells don't sink straight down. Instead, by directional drilling, they slant as much as 45 degrees out to sea, where they strike oil 4,000 feet below the Pacific's bed. To keep track of where their drill is going, workers use a compass and a tiny flashlight camera set in the hollow drill pipe (page 715).



Photograph by B. Anthony Stewart

In Southern Louisiana, Oil Derricks Rise Like Lighthouses from the Waters of Lake Barre

When petroleum is found under coastal waters, as at Huntington Beach, California, wells are drilled on shore and slanted out to submarine oil deposits (pages 715 and 727). Here wells are bored straight down through the lake bed. A superintendent makes his rounds by motorboat.

pyrethrum or derris root, are sprayed on crops and orchards every year, in man's grim war to keep bugs from eating all his food. The Union Oil Company of California ships such spray oil to orchards as far away as South Africa, India, and Palestine (Plate VIII).

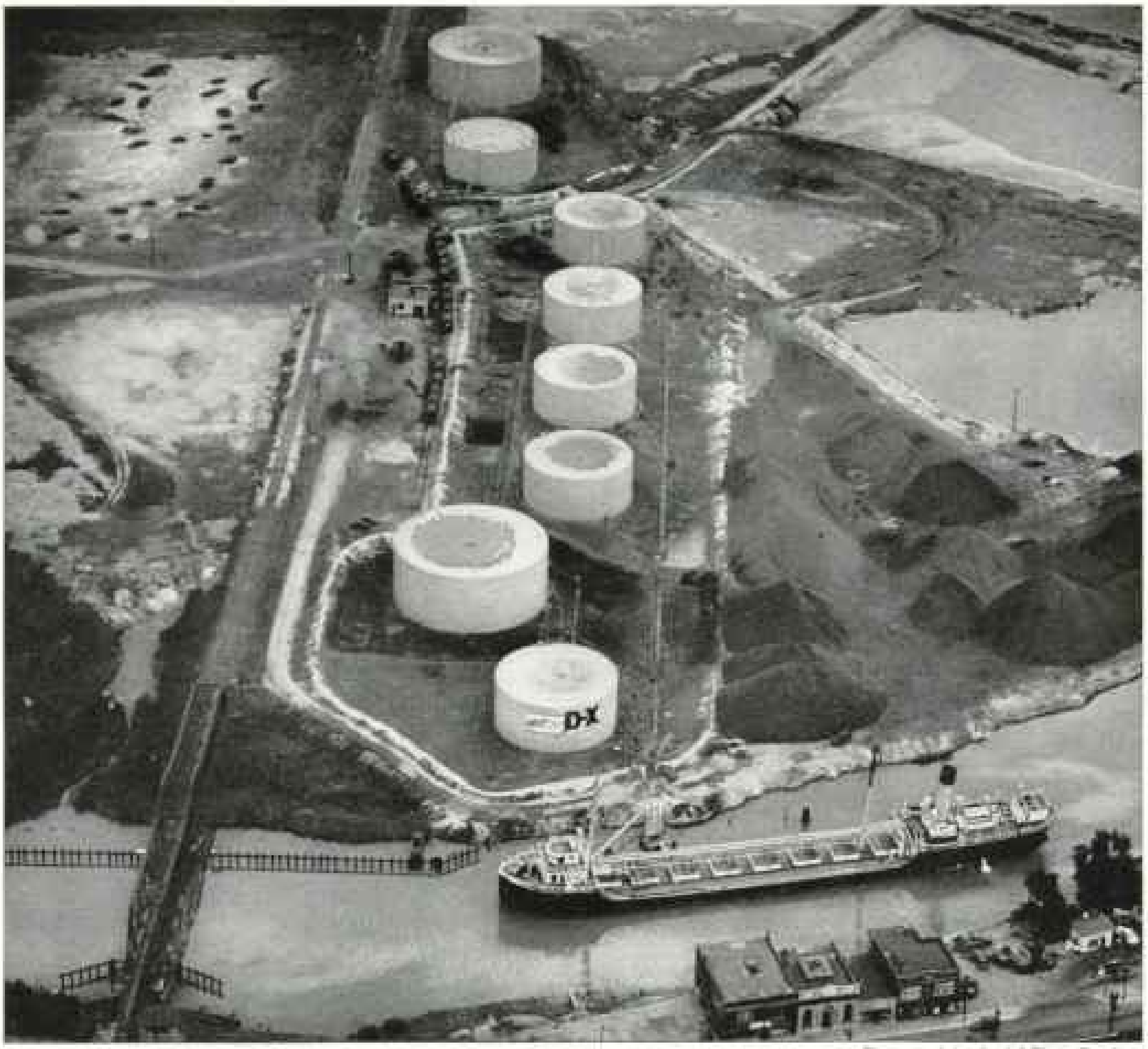
Poison bait, mixed with oil, is set for grasshoppers, Mormon crickets, and army worms. Southern Illinois recently scattered such cricket bait from speeding airplanes.

Strategy, too, figures in this insect war. Take the leaf hopper, which devours sugar beets. Science pursues him, not only in the beet fields, but in adjacent foothills to which the pest migrates in the mating season. In this honeymoon retreat, among the Russian thistles of California hills, men hunt this bug down and spray him with oil, using spray enough to cover thousands of acres.

Oil anoints the epidermis of cattle and hogs. Live cattle, driven up here from Mexico, must dive into oily baths at the border to kill any fever ticks.

Lazy pigs like to scratch their backs. While scratching, they can now spray themselves with insecticide by rubbing against a specially built post that releases the oil when they push against it (page 745).

In some tropic hotels you see white-clad servants step softly about with a squirt gun. They shoot oil spray into dark corners, where mosquitoes lurk; they even get down on all fours, crawl under dinner or bridge tables, and spray the ankles of ladies in evening dress.



Photograph by Aerial Photo Service

To Michigan, Almost Surrounded by Water, Boats Annually Deliver Gasoline by Millions of Gallons

This storage plant of the Thelsen-Clemens Company at St. Joseph is one of many similar facilities scattered all about Michigan's coast towns and along its waterways. Most gasoline reaches Michigan from the Chicago area. To the right of the white tanks are huge piles of coal (page 730).

Carpet-eating beetles, hungry moths, cockroaches, fleas—even the bedbug which gentlefolk never mention—all get shot in the face with squirt-gun oil in man's fight against these gangsters of the bug's underworld.

Chemical and oil companies such as du Pont, Shell, Texas Oil, Standard Oil Development Company, etc., maintain special laboratories to study insect control. The du Ponts, for example, buy bushels of live Japanese beetles, purely for experimental research.

A Fly Worth $500

Flies are hardest of all to kill. Playing with them, one big oil company painted many flies a gilt color, at its "fly farm," and liberated them from airplanes to see how they would scatter. Prizes were offered for their recapture, so that flies' travels might be studied.

One ringleader fly, painted with gold and named "Big Butch," was among those set free. A woman in Omaha caught him, when he had flown only 12 blocks, and gained a $500 prize.

Using airplanes as pens, men write on the sky with oil and chemicals for ink.

Giant white strokes against the azure curtain spell out advertising slogans.

This sky-writing was originated in England during the first World War by Major John C. Savage of the R. A. F. With it he conceived a plan to send military messages when other lines of communication were cut. Its first use as advertising came in 1922 when Captain

Cyril Turner, British ace, wrote "Daily Mail" over the heads of astonished race-track fans at Epsom Downs Derby.

"Writing" letters at 150 miles an hour, from a pattern reversed like text reflected backwards in a mirror, is no picnic. Capital letters in such a text are a mile high, and small letters measure half a mile.

At 15,000 feet up a message itself, to be easily read from the ground, may stretch for 8 or 10 miles across the sky. To cross a "t" or dot an "i," a pilot may have to fly back for five or ten miles, and then be careful that the backwash from his propeller doesn't rub out the words he's just written; and he mustn't skip any letters in his pattern.

One sky-writer was hired to go up over a fair and write "Air Show." He left out his "h" and wrote "Air Sow!"

Moving gas and crude oil from wells to refineries and distributing finished products from there form major tasks in transportation.

Fleets of tank trucks, familiar to motor-conscious America, deliver millions of gallons of petroleum products, even in remote places.

Pipe Lines—One-way Common Carriers

Some 321,000 miles of invisible underground pipe lines crawl about the United States map. They form an exceedingly flexible transport system, and one an enemy would find it almost impossible to bomb (page 726).

By pipe we pump oil, gasoline, and natural gas halfway across the continent. Texas is urging a line now that will carry natural gas all the way to New England. You hear of food "untouched by human hands." Oil is like that. From the very well itself, until that day in the filling station when the man holds up your oil stick and says, "You need a quart," the public seldom sees much of our enormous oil stream.

Pipe lines prove this invisibility. You walk, ride, and fly over this vast net every day; yet, unless you happen to see where a pipe crosses a creek or runs through a pumping station that steps up its flow, you don't even suspect its existence.

Through deserts, swamps, and rivers, over mountains and through cities go our oil and gas pipe lines.

At Tripoli and Haifa on the Mediterranean, and on our California coast, pipe lines run out over the beach and under the sea. Here, at buoys, visiting tankers fish up the submarine hose and their tanks are pumped full.

Gravity alone moves oil through some pipes. In other places, pumping stations are at work to "shove" the oil along. Sometimes pipes have to be cleared. Then they send a "go-devil" through—a circular scraper, like a big auger.

Law says oil and gasoline pipe lines are common carriers, though they carry only these products, and only in one direction.

Railroads feel pipe line competition keenly. There are still more than 146,000 tank cars that haul our oil and gas by rail (page 744). But because daily output of crude oil is around 3,500,000 barrels, railroads couldn't possibly haul it all.

It is true, too, that without branch pipe lines many oil fields would never have been developed, because it wouldn't have been economical to build in a railway merely to haul out the oil.

Streamlining the Tankers

Therefore, much oil moves by water, in the holds of tankers (pages 729, 741, 746, and Plate X). Most foreign lands depend on ocean transportation for all or the greater part of their supply. The larger tank vessels move about a third of America's national production of oil and oil products, and the percentage is much greater if you include the smaller river boats and oil barges. We now have some 2,000 tank vessels of all kinds plying the seas, our canals and bays, our northern lakes and western rivers.

To navies the tanker fleet is a seagoing filling station of vital importance. But today's tanker is not the foul, sluggish, clumsy oil-carrying craft of yesterday. Modern tankers may cost from two to over three million dollars, especially if their construction includes national defense features such as high speed, gun emplacements, and U. S. Navy navigational instruments. Some of our newest tankers can make a sea speed of 16½ knots, or more.

Many are now well equipped for the safety and comfort of their men. Piped ice water, smoking rooms for the crew, fireproof quarters with only two men to a cabin, plus fathometers, radio direction finders, automatic steering control, automatic SOS receivers—they have all these! And they can load or unload five and a half million gallons in less than a day.

Sometimes a tanker stands by a wreck or a disabled ship and pours oil on the sea to quiet the waves. Once I saw some thirty steerage passengers washed overboard from a barge in rough Atlantic seas, at São Miguel, in the Azores. Our skipper on the old *Canopic* dumped barrels of oil to quiet the waves. We rescued the whole party; only one was hurt, a boy with a broken leg.

Think of the world's 500,000 wells as one big cistern, holding oil instead of water.

Kodachrome by B. Anthony Stewart

To Whip Jack Frost, Oil Heaters Burn in Citrus Groves on Chilly Nights

For years smudge pots were used, but they gave off offensive smoke that hung in clouds over orchards on frosty mornings and besmirched the community far and wide. Now smokeless oil heaters have come into use. When cold threatens, elaborate alarm systems warn fruit growers to light up. Redlands, California.

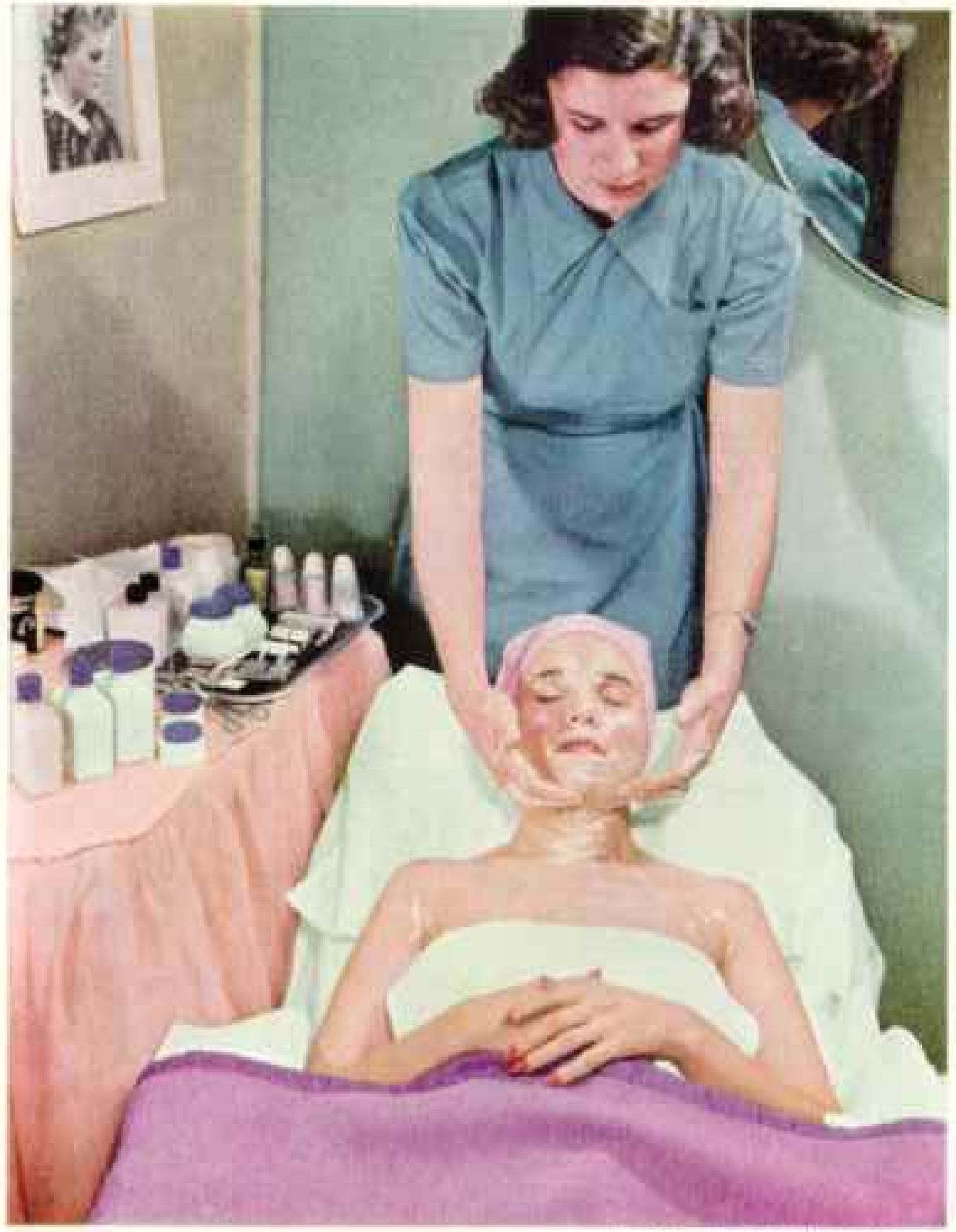
Kodachrome by B. Anthony Stewart

At Port Arthur, Texas Pipe Line Terminal, Tankers Load and Oil Barges Leave by the Intracoastal Canal for Mississippi Ports

On the Great Lakes and on 29,300 miles of inland waterways, the oil barge is a familiar craft. More than 80 per cent of the larger petroleum-carrying vessels are owned by the oil companies. Recently, for naval use, huge tankers of exceptional speed and crew comfort have been launched.

© National Geographic Society

Some City Dwellers Use Ear Stoppers Made from Oil to Shut Out Street Noises



Kodachromes by B. Anthony Stewart

From Pure Petroleum Oils Come the Creams that Make Milady Beautiful

Ink for Paper Cartons Flows from a Three-roller Mill in Washington, D. C.
With a spatula, the mill hand keeps this mineral oil and resin varnish ink flowing smoothly.

 Kodachromes by B. Anthony Stewart

Gas Costing 40 Cents Will Turn Yellow a Carload of Green Bananas

Fruits and vegetables in a tightly closed room filled with ethylene, a nonpoisonous gas, ripen in half the usual time, leaving no noticeable taste or odor. This process also lessens loss of moisture.

Paint's Durability Is Tested by Exposure to All-year Weathering

Paint wears longer in the climate of Boston than in Panama. Du Pont's "Paint Farm," Wilmington, Delaware.

© National Geographic Society Kodachromes by B. Anthony Stewart

Comparing Six Grades of Lubricating Oil at an El Dorado, Arkansas, Refinery

When grease was first made from petroleum, there no longer was enough lard, tallow, castor and fish oil to lubricate "machine age" cogs, axles, and bearings.

Kodachrome by B. Anthony Stewart

Faster than 400 Miles an Hour, Lockheed's New P-38 Intercepter Is One of the World's Swiftest Planes

Here at busy Burbank airport in southern California the new aircraft fuels up with 100-octane gasoline and 120-grade oil. Beyond the truck stands a Hudson bomber, with circle markings of the R. A. F., and second from the left a four-engined Boeing "strato-plane." In national defense, nobody's work is more valuable to Uncle Sam than the oil man's. Happily, the United States has not only ample oil reserves, refinery equipment, and pipe lines for safe transport, but also technical skill not surpassed by oil chemists anywhere.

Kodachrome by B. Anthony Stewart

When This Hoarse-voiced Monster Whirls Its Streamlined Train Across California, It Burns Eleven Gallons of Fuel a Minute

Here at Los Angeles terminal, fuel oil and water are fed to the giant locomotive, which draws the "Daylight" to San Francisco. Each year the Southern Pacific alone fires 14,000,000 barrels of fuel oil in its steam locomotives. Besides oil for engines, valves, switchlights, journal boxes, etc., it uses 1,621,000 pounds of grease.

© National Geographic Society

Kodachrome by Luis Marden

Dragon-wise, an Oil-burning Weed Killer Snorts Out Its Deadly Breath

Squirting a wide, fiery swath, this Missouri-Pacific juggernaut in Texas burns all weeds off a Rio Grande Valley right-of-way. It also blisters all toads, snakes, and owls that lurk by the wayside. For decades drought and floods, gunmen and cow thieves troubled this border, but till now it never saw a gun that shot burning oil!

From this cistern we draw oil and distill it in refineries to make gasoline, etc.

That mysterious upended cylinder that rises beside smokestacks in refineries is the "bubble tower." If it were glass, or if you could tear off its iron jacket, you would see it is a series of platforms, one above the other like floors, and all tied up outside with miles of hot pipe that curl about like smoking intestines (page 722).

Crude oil, starting hot at the bottom, sends its vapors moving upward; the lighter they are, the higher they go. Gasoline comes out on top. Somewhere along the line, each on its own platform, or bubble tray, you get kerosene, spindle oil, Diesel oil, oil for your furnace, lubricating oil, etc.

At the very bottom, heaviest of all, lies asphalt, if the crude oil being worked has an asphalt content.

Selling a Bad Smell

From this refinery come also certain gases, like propane, which may later be liquefied and also put to work. Here even the smell is useful! One California refinery smelt so of hydrogen sulphide, or "rotten egg" gas, that some men wouldn't work there.

"Let's sell that bad smell to our neighbors, who make chemicals," somebody suggested. So they did, running it off in a pipe. From it the chemical works now make sulphuric acid, which they sell back to the once troubled owners of the original stink, who use the acid in refining gasoline!

Gasoline itself can also be made from natural gas or from gas that escapes when crude oil is distilled.

When bubble towers separate oil into various products by distillation, only a physical change occurs: that is, you could take all these things and run them back together, and again have something like crude oil.

Not so in "cracking." Then a chemical change occurs, and you couldn't blend all your products and be back where you started. Your coke would be left over.

Cracking, in fact, subjects crude oil to such intense heat and high pressure that its molecules fly apart. When this pressure is removed, molecules go together again, but into new and different configurations which make new, different materials. That is the difference between distilling and cracking.

But cracking yields us incredible benefits. It more than doubles the amount of gasoline you can obtain from a barrel of crude oil; that means it also conserves your quantity of crude oil in reserves left in the earth for future use.

Some crude oil, though rare, is so much like gasoline that you can fill your tank with it and drive off. But most gasoline has to be distilled from crude oil, condensed from natural gas, or made from refinery gas.

Since men learned how to crack oil, about 53 percent of the crude has been made in the U. S. into gasoline. This is four or five times the previous yield. What a huge saving! That means that science has multiplied our oil reserves four or five times!

No feat of oil chemistry outshines this astounding improvement in the quantity and, in addition, the quality of our gasoline above that which Nature has provided.

Remember the foul, dirty fuel of twenty years back. Every car that started shot back a cloud of smelly blue smoke. How we had to grind valves and scrape carbon!

In the old days some refiners sneaked gasoline (no market for it) into kerosene, a trick which resulted in many fires and explosions; in the roaring twenties kerosene was sneaked into gasoline. But no longer!

Today the quality of gasoline to burn in an engine without "knocking" is measured by what chemists call its "octane number."

Ten years ago a chemical compound called "iso-octane" was considered the gold standard of motor fuels. It was the "100" in the antiknock scale, and a laboratory curiosity that cost $30 a gallon. Today millions of gallons are sold at about 30¢ a gallon, and it has become a very important source of fuel for airplanes (Plate XIV).

In the manufacture and blending of modern fuels for today's high-compression automobile and airplane engines, various chemicals are mixed with gasolines of lower antiknock rating. Widely known of these is Ethyl Fluid, or tetraethyl lead.

Though we crack, primarily, to get more gasoline, this process also yields vast lots of hydrocarbons that go into the making of many useful things, from rubber to phonograph records. It forms, indeed, the basis for a whole new chemical industry.

In the past 24 hours, at more than one million American service stations, men in caps have poked a synthetic rubber hose into the gas tanks of 12,000,000 motor vehicles and "filled 'em up" with some 60,000,000 gallons of gasoline.

How big this business is!

Again tomorrow, and day after tomorrow, and so on, this not only repeats; it steadily increases. There seems no end.

Even to talk with oil workers you need a new tongue: paraffin accumulations; rate of penetration data; inhibitors; catalysts; ca-

Photograph by R. Anthony Stewart

Prehistoric Animal Effigies Are Grouped About Asphalt Pits in Southern California

Oil seepages may turn to asphalt. Thus La Brea Pits, in Los Angeles, were formed. Saber-toothed tigers and other now extinct animals, accidentally mired in this sticky asphalt, were thus preserved. Effigies represent animals perishing here from 20,000 to 50,000 years ago.

thodic protection; galvanic corrosion; plastering behavior—what a strange language!

To you and me, all it means is that science is simply finding new ways to do things better in the oil business.

Fossil remains of saber-tooth cats, camels, mastodons, mammoths, and other prehistoric animals, also birds, found in Rancho La Brea asphalt pools, in Los Angeles, have been preserved there for 20,000 to 50,000 years. "Seldom, indeed," says the Los Angeles Museum of these famous tar pits, "are conditions found so favorable for the reconstruction of a life record of the past."

Asphalt—from Mummies to Levees

At creation's dawn, when so much world was under water, life consisted of microscopic animals and plants.

These died, through the ages, leaving sediment on ocean floors. When lands formed, the ocean beds shuffled, and heat and pressure turned the sediments to petroleum and gas, says one theory.

When oil finally seeped up on the new-formed continents, its volatile parts—kerosene, etc.—evaporated into the sunlight; left behind by inspissation were the hydrocarbon solids from primeval days—asphalt.

How indestructible asphalt is! Ur of the Chaldees had gutters lined with asphalt, built 5,000 years ago—and they're there yet!

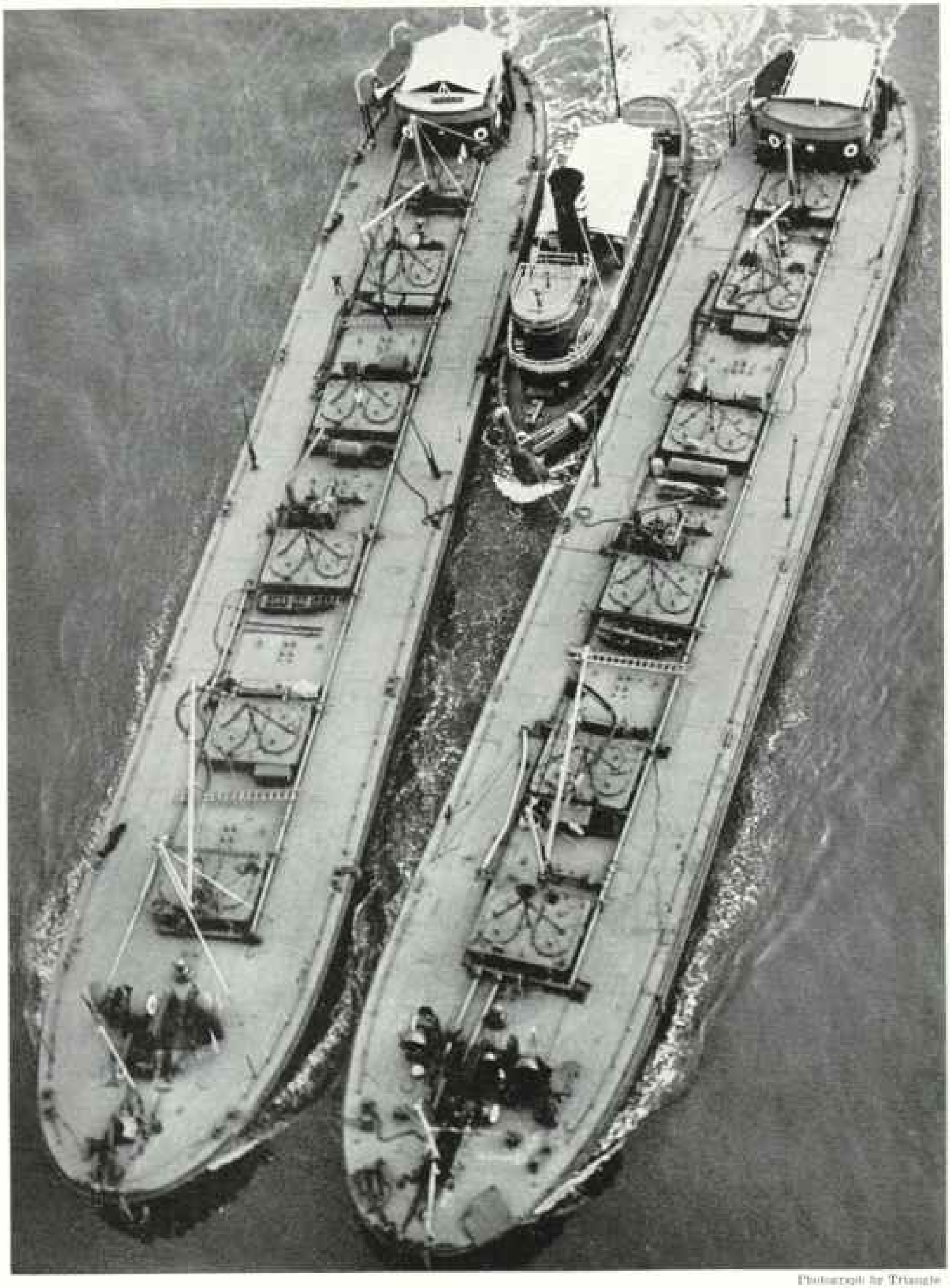
Egyptians used asphalt to embalm mummies; in fact, the Arab word for mummy is the same as that for asphalt. Assyrian kings built asphalt dikes to keep the Tigris out of Nineveh.

Today Army engineers use asphalt mats to keep the Mississippi River from breaking through its levees and swamping New Orleans (page 743).

Early American use of asphalt was a paved sidewalk about the old Merchants' Exchange in Philadelphia. London paved Threadneedle Street in 1869. Washington, D. C., paved some streets with asphalt in 1876—and they're still so paved.

First commercial asphalt came from that natural lake in Trinidad, which may *not* have been discovered by Sir Walter Raleigh in 1595, as often said.

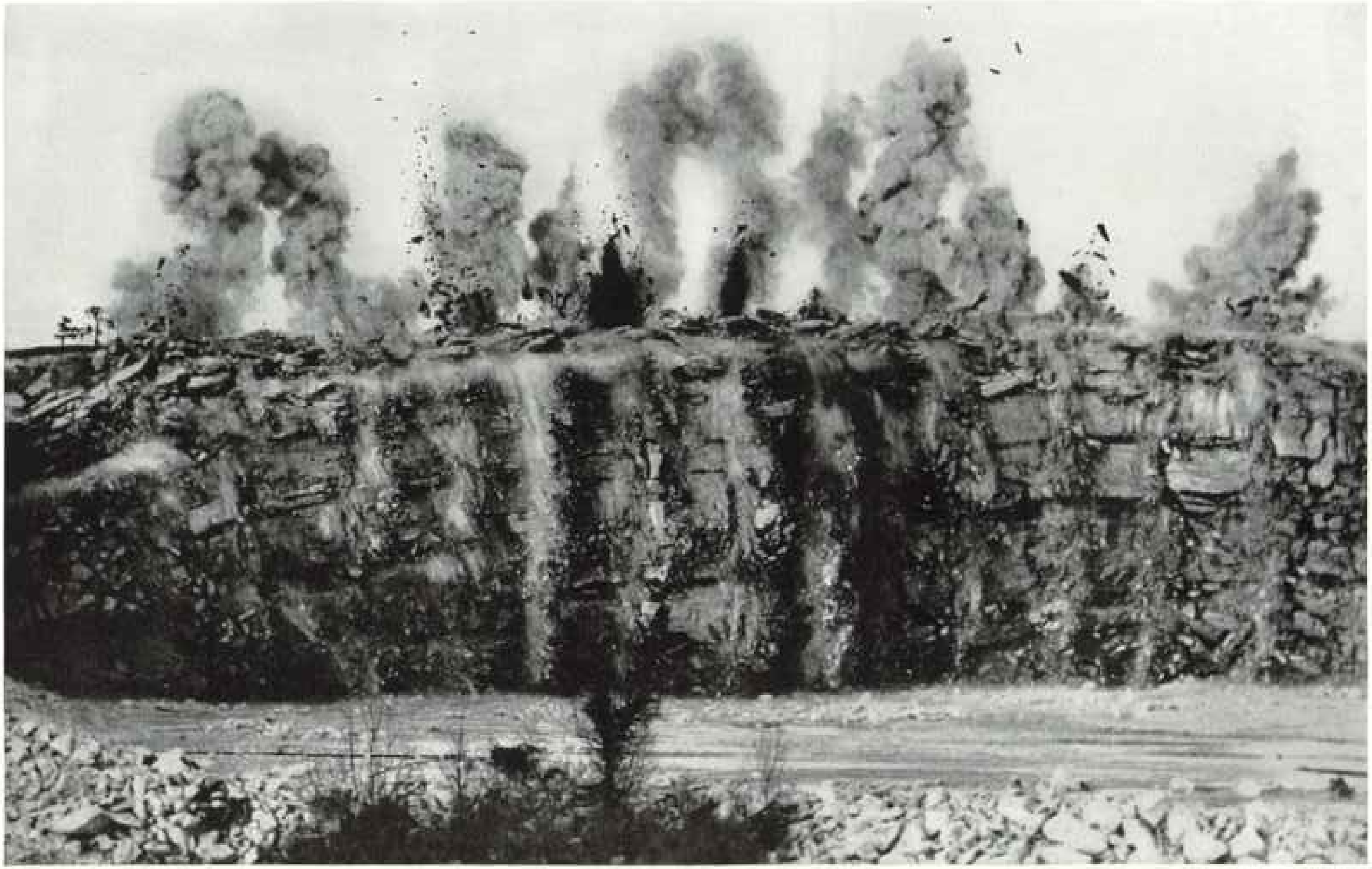
Now most asphalt used here comes from oil refineries. At first, however, asphalt, as a residue at refineries, was a sticky, dirty nuisance; oil men didn't know how to get rid of it.



Photograph by Triangle

Prodigious Quantities of Oil and Gasoline Are Moved by Sea, by Rivers, and Canals

Normally, nearly one-third of the water-borne imports and exports of the United States is made up of oil and its products. Here are the floating filling stations which serve the United States. A Socony tug pushes two huge oil barges into New York City's crowded waters (pages 730, 746).



Photograph by Kenneth Rogers

From a Granite Ledge Near Lithonia, Georgia, 69,360 Tons of Rock Were Blasted Off in One Shot

Du Pont "Nitramon" blasting agent, which contains paraffin, among other things, was used in this quarry shot. To dislodge the huge granite mass, 14 holes were drilled, ranging in depth from 108 to 131 feet, about 32 feet apart, and 13 feet back from the cliff's edge. Then 19,266 pounds of Nitramon, packed in tin cans two feet long, were put down into these holes and fired simultaneously. So, for each pound of blasting agent, 3.6 tons of rock were blown off (page 747).

Photograph by Corps of Engineers, U. S. Army

Army Engineers Make a Giant Asphalt Mattress Which Will Keep Old Man River from Caving in His Banks

Hot asphalt is laid on the barge floor, which has been lubricated to prevent sticking. After one section of the huge mat is completed, and sprayed with water, it is lowered over the metal cylinder into the river. More sections are added, until gradually they cover the bank and part of the river bottom, near Westwego, Louisiana. Warm and flexible, they fit into the contours of the bank. Some mats are 100 feet wide and 300 feet long (page 740).

Photograph from Standard Oil of California

At Los Angeles Municipal Airport Road-making Machines Mix, Smooth, and Pack 1,000 Square Yards of Asphalt an Hour

Photograph by R. Anthony Stewart

Tank Cars Sidetracked at the Ponca City, Oklahoma, Refinery of Continental Oil Company

Most crude oil and some gasoline move through pipe lines. Enormous tonnage of refined products is hauled in these cars, of which the United States has some 146,000.

Photograph by H. Anthony Stewart.

To Keep Off Flies and Other Insect Pests, Lazy Pigs Are Sprayed with an Oil Mixture

Sometimes when cows, switching their tails at biting flies, will not let down their milk, they, too, are sprayed in this way. Some farms have rubbing posts, by use of which livestock automatically greases its own epidermis. A California model piggery near Redlands (page 728).

Photograph by B. Anthony Stewart

Like Boa Constrictors, Fat Oil Hoses Crawl Aboard a Texaco Tanker at Port Arthur, Texas

Larger, faster, and more commodious than this big ship are the twelve new tankers built for the Standard Oil Company by agreement with the U. S. Maritime Commission. All have been requisitioned by the U. S. Navy. These twin-screw vessels, of 19½-knot maximum speed, are 553 feet long. Each can carry 150,000 barrels of oil.

Since 1900 its use has multiplied thousands of fold. Of the 3,000,000 miles of roads in the United States, about 85 percent now have or have had asphalt coatings. At least 40 percent of all city streets are still covered with it; Detroit alone has the equivalent of more than 37,000 miles of 18-foot asphalt streets.

In roofs, tennis courts, sidewalks, floors, reservoirs, tree surgery, roads, harbor works, etc., this "ugly duckling" of the oil business is used by thousands of tons.

Planes start and stop on wheels, not on wings. The new Washington National Airport's four huge asphalt runways, with taxiways and aprons, equal in area 81 miles of 18-foot road.

Emulsified asphalt, mixed with cork, rubber, and bagasse, makes a good "springy" tennis court. Some Forest Hills, Long Island, courts are being converted with this new colored material.

Engineers performed a neat job of dentistry on Mother Earth near Dublin, Virginia. To protect the Claytor Dam on New River against leaks or earth movements, they drilled a 150-foot hole in the river bank, to which the dam is anchored, and poured in 4,500 tons of hot asphalt and crushed stone.

Oil Storage and Naval Reserves

Above ground in the United States man has built tanks that hold more than one billion barrels and hedged them about with costly safeguards against fire, lightning, and explosions. Despite these precautions, some of our most spectacular fires occur in "tank farms."

In Mexico, and even in Arkansas, much oil has either overflowed or been purposely stored in earth ponds or ravines diked off to form pools.

But this method of storing oil, in earthen basins, is obsolete. Now we have some 45,000 or 50,000 big steel tanks of different shapes that hold stored oil. In some places concrete reservoirs are used. California has nearly 300 of these. Some are over a quarter of a mile long and 498 feet wide, covering twenty-one and a half acres. These hold veritable lakes of oil.

It took 100,000 slaves 30 years to raise the Great Pyramid of Giza. But such stupendous modern dams as Boulder and Grand Coulee go up in a fraction of that time, because now we have explosives to break and move rock. In mines, oil wells, stone blasting, digging tunnels, etc., we use about 150,000 tons of commercial explosives made from oil each year (page 742).

In all this industrial effort, nitroglycerin is a big help. Long made from hotel garbage and as a by-product of the soap process, glycerin now comes also from petroleum. Besides its use in explosives, such as the familiar dynamite, glycerin goes into cosmetics, the treatment of skins and furs, the dyeing of fabrics, and the preservation of biological specimens. We use it, too, in making chewing gum, cigarettes, candy, medicine, films, shoes, lipstick—many things.

Tons of "Rubber" Made Now from Oil

What must become some day a leading American industry is the making of synthetic rubber.

First, men had to find an inexpensive raw material available in large quantities. Since molecules from crude oil hydrocarbons could be given configurations similar to those of natural rubber, petroleum was found to be a ready, ample source of supply for this new synthetic rubber industry.

Four or five famous corporations have already set up laboratories and factories for this work. Dow Chemical Company has made "Thiokol," from oil, for several years. It was discovered, accidentally, in a hunt for an antifreeze agent. Goodrich has long made "Koroseal."

Latest entry into this field of unlimited possibilities is the Phillips Petroleum Company. Joining with Goodrich, it has set up the Hydrocarbon Chemical and Rubber Company to make "Hycar" and "Ameripol."

Standard Oil Development Company is preparing to market a "Buna" type of rubber. Shell ships butadiene to rubber factories in Akron.

Thousands of automobile and truck tires are already made and in experimental use. Proved, and now on the market, are many varieties of synthetic rubber hose, belting, heels, soles, floor covering, hospital sheets, shoes, raincoats, curtains, gloves, etc.

In normal years we import more than half a million tons of natural rubber from the Far East. Should that supply be suddenly cut off, production of synthetic rubber would shoot up. But even if nothing happens to cut us off from Singapore, we are undoubtedly and inevitably embarked on a growing synthetic rubber industry, because for so many uses man-made rubber is superior to Nature's product.*

Greatest growth in our chemical industry in the past decade has come from the rise of synthetic chemicals made from oil and natural gas. From oil one company made 4,500 tons of ammonia in 1931; it made 27,000 tons

*See "Our Most Versatile Vegetable Product (Rubber)," by J. R. Hildebrand, NATIONAL GEOGRAPHIC MAGAZINE, February, 1940.

Photograph by Rowena Frith

You Might Tell 'Em Apart—If One Had a Hat On, or Something!

"Mineral Oil—Doctor's Orders." This picture gained Honorable Mention at a national exhibition of photographs pertaining to the oil industry. Says the photographer: "These girls are mirror twins and are so very much alike that even when I asked their parents to initial some proofs, showing which girl was which, the negatives came back indorsed only by question marks!"

in 1939; in the same period this company's annual output of solvents rose from 90,000 pounds to 57,000,000 pounds.

On farms synthetic ammonia finds its chief use.

On irrigated lands farmers use it as a fertilizer in liquefied form, the ammonia being carried into the soil in solution with water in the irrigation ditches (Plate VI). On non-irrigated land it is applied as a fertilizer in the form of ammonium sulphate. Much of it is used, too, in ice-making, as a source of nitric acid for making explosives, cellulose nitrate, etc., in purifying city water supplies, and in oil refineries.

The rise in the output of alcohols, esters, ketones, etc., for use in making plastics, varnish, printing inks, safety glass, artificial leather, resins, photographic film, and lacquers is equally astonishing.

In 1922, for example, only 37,500 gallons of alcohol came from cracked petroleum; by 1939 this output had risen to 27,500,000 gallons.

Now, in 1941, amid our supreme effort at industrial production, these alcohols and ketones, base materials for many things made by chemical synthesis, are even more in demand.

One good gas well can yield more alcohol a year than could come from 100,000 acres of corn.

Hence, spectacular as this magic oil-work has been, tomorrow must hold even greater surprises. In dozens of laboratories men toil day and night, to see "what else they can do with oil."

The Columbia Turns on the Power

By Maynard Owen Williams

THE Columbia River inspired early exploration by sea. It helped Lewis and Clark cross the continent. It transported foot-weary settlers over the last lap to Oregon Territory. It thrust two-ocean greatness upon a nation which once considered Thomas Jefferson a westerner. Now it turns on the power.

Around its widespread drainage basin, national parks form a diamond horseshoe of lake and snow peak, geyser and glacier.

Here is hoarded the boundless energy of rain and snow. Here life-giving water is kept in cold storage until lowland fields turn thirsty under the summer sun.

Most of this power has hitherto gone to waste. Through a winding lava canyon, far below the level of the almost rainless land of the Inland Empire east of the Cascades, the Columbia River leaked away to the sea.

Biggest of All Masonry Dams

Now, about halfway down the river's 1,214-mile course, water is rising in a man-made lake, and the largest of all masonry dams stands ready for 18 generators—each ample for a city—and 12 pumps, any one of which could meet the domestic water requirements of New York City.

On March 22, 1941, Grand Coulee Dam turned on the "juice" from two small service generators. In August one of the 150,000-horsepower turbines will start to hum. Soon after that another, and another. When the country called for power, Grand Coulee Dam, seven years in construction, was ready.

From the White House, President Roosevelt wrote to Supervising Engineer Frank A. Banks:

"I want to congratulate the Bureau of Reclamation upon putting the great Grand Coulee Dam to work two years ahead of schedule. It is a fine job well done. . .

"A tremendous stream of energy will light homes and stores; it will ease the drudgery around the farmhouses of the Pacific Northwest. . .

"Water will flow to lands now dry and barren but which one day will be made fertile by irrigation. . .

"Floods will be curtailed and navigation will be improved so that much of the commerce of this new empire may cheaply be waterborne."

Last summer, by motorcar, I followed the Columbia from source to sea. Before starting downriver I attended the dedication of two new highways which open hitherto inaccessible areas to casual travel.

On June 29, 1940, the forest-bowered road around British Columbia's Big Bend was opened (page 752). Two days later, a motorcade from Victoria semiofficially inaugurated the spectacular Columbia Icefield Highway between Jasper and Banff.*

At lunch in the delightful new chalet at Sunwapta Pass, between Banff and Jasper National Parks, motorists sat and watched dark moving specks high up on the Athabaska Glacier. They were "dudes" on horseback, riding for fun (page 751).

Close to the glacier's dirty snout on this first-of-July stood scores of cars whose passengers, some in high-heeled shoes, were tramping on the ice.

Lewis R. Freeman rightly called the Columbia Icefield the "Mother of Rivers."† From this snowy rooftree of our continent the Columbia flows into the Pacific; the Athabaska into the Slave, thence to the Mackenzie and the Arctic Ocean; and the Saskatchewan into Lake Winnipeg, the Nelson, Hudson Bay, and the Atlantic.

Today from this field of "white coal," culminating in the Snow Dome (11,340 feet), countless tons of frozen water must fall more than two vertical miles to reach the sea. In doing so, this water can be made to produce hydroelectric power.

Putting it to work does not lessen the extent of the icefields or impair the beauty of the Evergreen Empire. On the contrary, man-made lakes as charming as glacier-dug Chelan are superseding ugly lava chasms, and our western dams are themselves feature attractions. In 1940 more than 300,000 people visited Grand Coulee Dam (page 776).

Most Powerful American River

The might of the Columbia, most powerful of American rivers, has many sources. Officially, the headwaters are at Canal Flats, about 80 miles north of the Idaho-Montana—British Columbia border.

Those who wish to see the icefields at their best should temporarily desert the Columbia for a superb detour over the 72-mile Windermere-Banff Highway, the 192-mile Banff-Jasper Highway (Plates I and IV), and the

* See Map Supplement "Northwestern United States and Neighboring Canadian Provinces."

† See "Mother of Rivers," by Lewis R. Freeman, National Geographic Magazine, April, 1925.

Photograph by Ray Atkeson

Majestic Mount Hood, from Cloud Cap Inn, Here Fills the Southern Sky

Comfortable resting place on the Timberline Trail (page 792) is this lodge, three miles from the snowy summit of Oregon's highest mountain. The conical peak, decked out in ermine cloak and hat, was first seen in 1792 by Lieut. William R. Broughton and named by him in honor of Lord Hood, a hero of the British Navy. Oregonians, to whom Mount Hood is "our mountain," often use the Indian name, Wy'east.

spectacular 57-mile run down Kicking Horse Canyon from Lake Louise to Golden (page 753).

In this beautiful region moose lift long, dripping muzzles above lush feeding beds (Plate III), and bears beg for sweets. Here lie the mighty glaciers that feed many rivers, and over these Rocky Mountain passes ran the arduous trails of the fur brigades from Fort William and Montreal.

From Windermere Lake (page 774) to Golden the Columbia is a quiet, absent-minded stream, aimlessly meandering between homestead and haystack. But at Golden the easy-going Columbia comes to life under the swift impact of the Kicking Horse, a r'aring, tearing river down whose canyon the Canadian Pacific trains roll from the Great Divide.

To this point the Columbia has dropped only 72 feet in 124 miles. Now, combined with the milky-green Kicking Horse, it becomes headstrong and powerful. An American civil engineer, who descended the entire river alone in a 17-foot rowboat in 1921, lists 29 rapids between Golden and Revelstoke.

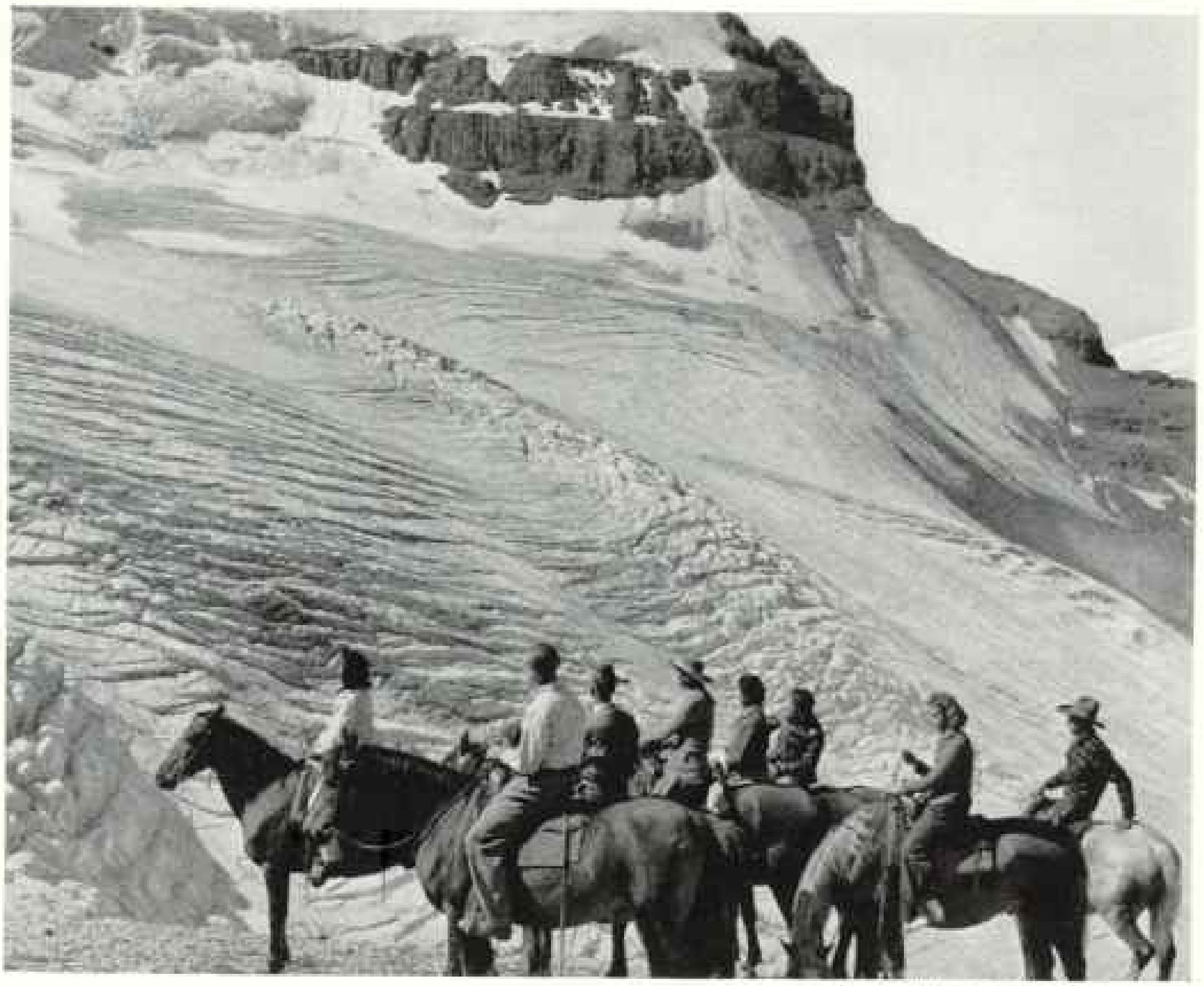
In this hydraulic escalator, the Columbia drops 1,087 feet in 207 miles.

Crossing minor valleys where early trails once lined down off the roof of the continent, we passed Bush Lakes and crunched to a stop. Other motorists were looking steeply down to the river, its smother of rapids split by a tree-topped islet.

"What a surprise!" breathed a smart youngster in slacks.

"Surprise Rapids" they were named long ago.

To motorists this tumble of white water, the roughest, toughest rapid on the Columbia, has fantastic allure. But it sucked many an unwary *voyageur* (French-Canadian trapper) to sudden death.



Photograph from Canadian Pacific Railway

Athabaska Glacier, Not Yet on Many Maps, Is Already a Popular Playground

When this Alberta ice river was pictured in the NATIONAL GEOGRAPHIC MAGAZINE in April, 1923, it took an arduous pack trip to reach it. Down the glacier, ice and snow move from the vast Columbia Icefield—Mother of Rivers—which drains into the Arctic, the Pacific, and the Atlantic. Now a 192-mile motor highway, between Banff and Jasper, opened July 1, 1940, carries thousands of visitors close to the icefield, from which the road takes its name.

Below seven-mile Kinbasket Lake, a 25-mile stairway of dangerous water splashes along to where Mica Mountain frowns down on a new steel span over the Columbia's northernmost curve, approximately 15 degrees from the Arctic Circle.

The Big Bend Highway

Here, under the Canadian colors, the Union Jack, and the Stars and Stripes, British Columbia's Prime Minister opened the Big Bend Highway to through traffic across western Canada (page 752).

Weeks later I tramped through miles of dripping forest to Boat Encampment, to see for myself the rallying point of the fur brigades from Jasper House and Montreal.

Here they reached their boats, lit their fires, and savored the companionship of friends. Because of the fine birch bark on its banks, they called one stream "Canoe River." Yet David Thompson's boat was of cedar planks sewed together with pine-root fibers (p. 774).

In a deserted cabin, a jar of salt, a bit of firewood, some bottled-up matches, and a tin stove suggested old days. A spotted mattress hung out of reach of rodents and in one corner was a pile of papers. Looking up, in rotogravure, were the eyes of Ann Sheridan.

Swaying in the Columbia's current was an upended oar with a smashed blade, and in a backwater I saw a fat beaver tugging at an unwieldy bit of birch. To me, this was the finishing touch, for the beaver, most of all fur bearers, made this lonely spot a historic rendezvous.

The beaver spread rich mud packs to protect the fair face of our continent from ugly wrinkle and spreading scar. His pelt established fortunes which still endure. His captors

Photograph by Maynard Owen Williams

Under the Flags of the United States, Canada, and Britain, Big Bend Highway Is Officially Opened

Following the rapidly descending Columbia for 193 miles from Golden to Revelstoke, British Columbia's section of the Trans-Canada Highway enables motorists to drive from the Great Lakes to the Pacific without leaving Canada. Here pictured are dedication ceremonies at Boat Encampment Bridge on June 29, 1940.

wrote our early history in word and deed. His tail, which looks like a cross-hatched file, was an early delicacy.

From Beaver, Alaska, to Beaverville, Illinois, his name outnumbers even the Washingtons in the United States Postal Guide. Now a humble worker in the Soil Conservation Service, he is efficiently helping at flood control.

The beaver's pelt bought sharp knives and steel traps, which were baited with his own seductive musk, or castor. Reaching for the irresistible lure, he was ensnared.

When the fat fellow with the "dental chisels" was almost extinct, the silkworm brought aid. About 1832, when the Beau Brummells of Mayfair went in for silk hats, John Jacob Astor, then in London, noted the trend in toppers. "Hats of silk in place of beaver!" he gasped—and retired from the fur business.

Stable of the "5900's"

River-born Revelstoke now centers about a roundhouse. I saw not a single rowboat. But in the 18-stall stable for iron horses were several of the powerful "5900's" which haul Canadian Pacific trains over the Selkirks. King George and Queen Elizabeth rode in the cab of "5919" while on their royal tour.

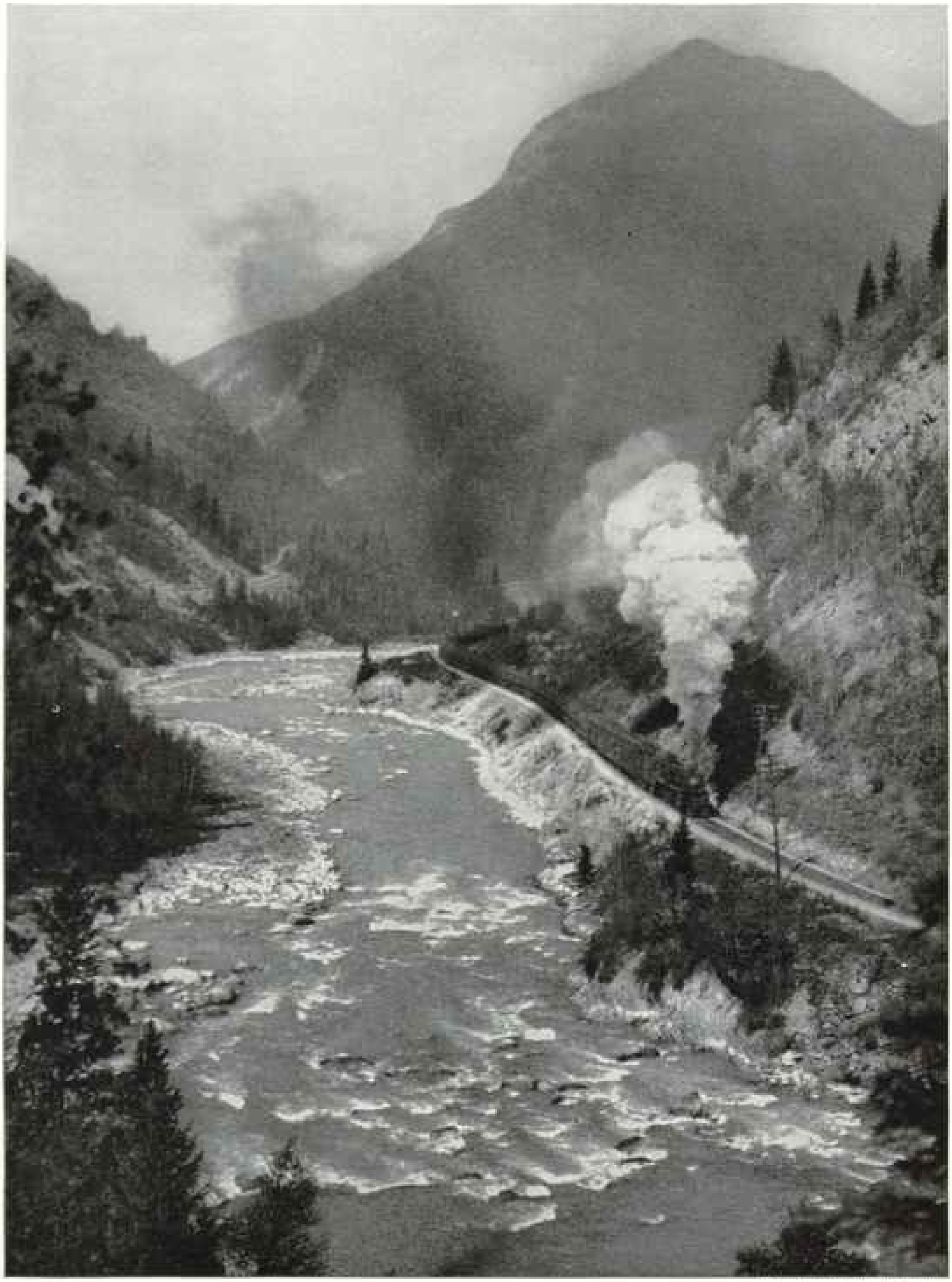
Below Revelstoke there are no rapids for 150 miles, and it will soon be smooth sailing most of the way to Grand Coulee Dam.

On the placid waters of the Arrow Lakes we enjoyed a two-day cruise, with our car as freight. The *Minto*, well on her way into a second million miles, keeps going, winter and summer.

One Sunday morning, south of Slocan, I saw a Dukhobor girl carrying a bright bouquet across lots to a half-finished dwelling where women in head shawls and silk aprons were singing Slavic songs. This seemed the Caucasus, the Old World background of these nonconformist immigrant farmers.

The singing and bouquet were for a funeral. Friends and relatives were chanting solemn harmonies about the body of a tall, thin boy, while men fashioned a rude coffin from green boards.

We climbed a dusty trail at Crescent Valley and came to a village like many a mountain hamlet I had visited in the Caucasus. The headman said:



Photograph by Byron Harmon

With a Huff and a Puff a Canadian Pacific Train Climbs Kicking Horse Canyon

Bound for the Continental Divide, big locomotives, between Golden and Field, lift long trains 1,500 vertical feet in 35 miles. The swift Kicking Horse turns the sleepy Columbia into a wild and powerful river blocked by rapids and packed with power. This pass lies in Yoho National Park, west of Lake Louise.

"Too bad you weren't here fifteen minutes ago. We just had a nude party."

Not a blush on the young faces about us. In honor of a large group of visiting Molokans—also dissenters, whose name and strength come from milk—the Dukhobors had undressed. Before Adam and Eve donned fig leaves, they say, the world was Paradise.

Along narrow benches, far above water level, they have laid out well-tended farms and orchards. Portable motor pumps putt-putt-putt. Automatic sprinklers water their colossal cabbages.

Seeing a memorial inscription in Russian on a rugged boulder, I mumbled off a few words. This was not the thing to do. The young Dukhobor girl who was showing me around protested, "I can read," for the Dukhobors, resisting government schooling, are often accused of illiteracy.

Beside the Dukhobor apple orchards at Brilliant, the clear, dark-green Kootenay, having spent much of its force in the power stations at Bonnington Falls, humbly joins the Columbia.

From Castlegar to Trail's smoking smelters there are only minor rapids. Trail is one of the chief industrial centers of wartime Canada, and armed guards inspect every car, reinforcing their sawed-off shotguns with disarming courtesy. Even here, a United States license plate is a passport to friendliness.

Detouring through Rossland to Northport over an unfortified international boundary marked by a firebreak, we returned to the railway bridge at Waneta, below which the Pend Oreille joins the Columbia.

Some geographers assert that the true source of the Columbia is up this river, on the watershed below the billion-dollar hill of copper at Butte, Montana. But where the Columbia and Pend Oreille unite, the Columbia contributes 77 per cent of the combined flow.

Since Grand Coulee Dam backs up the water to the Canadian boundary, one might think that flood damage in the upper valley would be increased. But our engineers, removing obstructions in the Little Dalles, have actually *lowered* the flood level.

Bulldozers and Big "Cats"

Around the 500-mile shoreline of the still-unnamed artificial lake above Grand Coulee Dam, we found W.P.A. workers tidying up the banks so that debris will not impede navigation or clog the trash racks.

While last-minute placer miners rescued bright flakes of gold, we watched bulldozers push over tall trees and saw great "cats" claw off high spots, dump the dirt, and repeat, while dusty surveyors squinted through transits and waved their arms.

From 50,000 acres of prospective lake bottom, 30,000,000 board feet of commercial lumber had been cut. Twelve hundred buildings had been razed or moved uphill. Roads and railways had to scramble to higher ground. After a final dance at one riverside town the guests turned the whole shebang into a bonfire.

Felt-hatted "braves" solemnly witnessed the decent transfer of the bones of their ancestors, described in dramatic pages of Lewis and Clark, and Washington Irving.

Indians Hold Farewell Powwow

Before rising water stilled the roar of the cascades the Indians celebrated a final powwow at their historic fishing station beside Kettle Falls.

From this beauty spot, cluttered with the material for two bridges, one road follows the Columbia, passing labor camps, bunkhouse barges, and drowned town sites.

The other passes through Chewelah, undeveloped center of the large magnesite deposits. It continues to Spokane between rolling hills where 16 horses, harnessed in fours, were reaping golden grain (Plate VIII).

Long ago an ice lobe, creeping down the Okanogan Valley, blocked the Columbia River channel. The impounded water, finding an outlet over the left bank, began carving a second channel—the Grand Coulee, or Big Spill. When the ice dam melted, the Columbia returned to its original chasm (page 775).

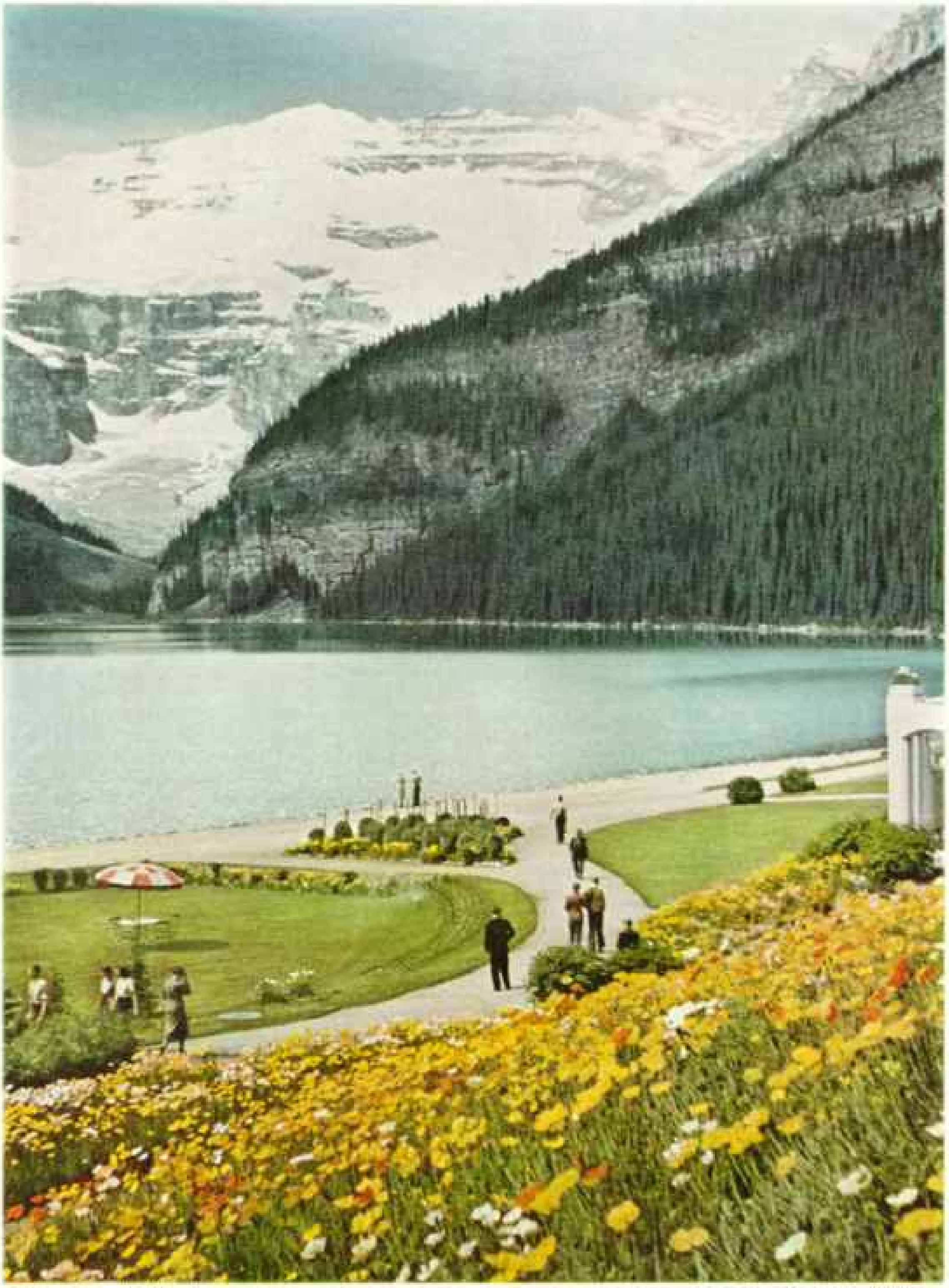
Many men dreamed of replacing the vanished ice dam with concrete, but cost and international complications intervened. Such a dam would flood vast areas in Canada. Engineers wrestled with the technical details. A mere power dam would be too low for irrigation. The ideal dam would furnish enough hydroelectric power to pay for itself and also drive the necessary pumps for irrigation.

In the end, the altitude of the river at the Canadian border determined the height of Grand Coulee Dam, which raises the water 355 feet, to 1,292 feet above the sea.

This level is still far below that of the irrigation reservoir to be built in the prehistoric spillway—Grand Coulee—which gave the new dam its name. To lift water the necessary 280 feet, engineers designed such pumps as the world has never known.

Spokane has been power-conscious for decades, since it owes its very being to midcity waterfalls. Electrical gadgets filled Spokane store windows when older cities were still turning their toast by hand (page 777).

Using Spokane River water for generating



Like an Emerald Set in Diamonds Is Lake Louise, Cupped in a Ring of Snowy Peaks

Seen from the gardens at Chateau Lake Louise, Mount Victoria, five miles away, seems shrouded in a light fall of snow; yet the white patches are glaciers 200 to 250 feet thick. Discovered in 1882 by a Banff guide, the lake was named for Princess Louise, wife of the Duke of Argyll, then Governor General of Canada.

Kodachrome by Maynard Owen Williams

The International Peace Park in Which Going-to-the-Sun Mountain Stands Is a "Good Neighbor" Symbol

In 1932 Canada's Waterton Lakes National Park and adjoining United States Glacier National Park were united for international good will and pleasure. Highest spot on the highway system is Logan Pass, where visitors enjoy a frontier area free from guns and shared between two nations devoted to friendship.

Kodachrome by Maynard Owen Williams

Beside the New Columbia Icefield Highway, a Cow Moose Shatters a Mirror Pool with Her Long, Dripping Muzzle

Kodachrome by Maynard Owen Williams

Glacier-Green Peyto Lake Strikes the Color Note for a Majestic Region of Snowy Peak and Evergreen Wood

Bow Pass, 6,800 feet above the sea, is the high spot on the 150-mile Columbia Icefield Highway from Lake Louise to Jasper. A short climb reveals this view of the Mistaya River Valley stretching away toward Sunwapta Pass.

Kodachrome by Maynard Owen Williams

Like a Golden Product of the Mine It Serves, This Yellow Bus Seesaws Up and Down Steep Slopes at Lake Chelan

Bordered with orchards and teeming with trout, glacier-gouged Lake Chelan has become a highway for miners and ore concentrates from the Holden gold mine.

Kodachrome by Maynard Owen Williams

"Ride, Tenderfoot, Ride" Might Be the Theme Song for the 36-mile Timberline Trail Around Mount Hood

Like a wide-looped lariat around Oregon's highest peak, a horseback trail circles Mount Hood. From it one has inspiring views of distant peaks, the Hood River Valley fruit bowl, and the deep gorge of the Columbia River.

Kodachrome from Photo-Art Studios

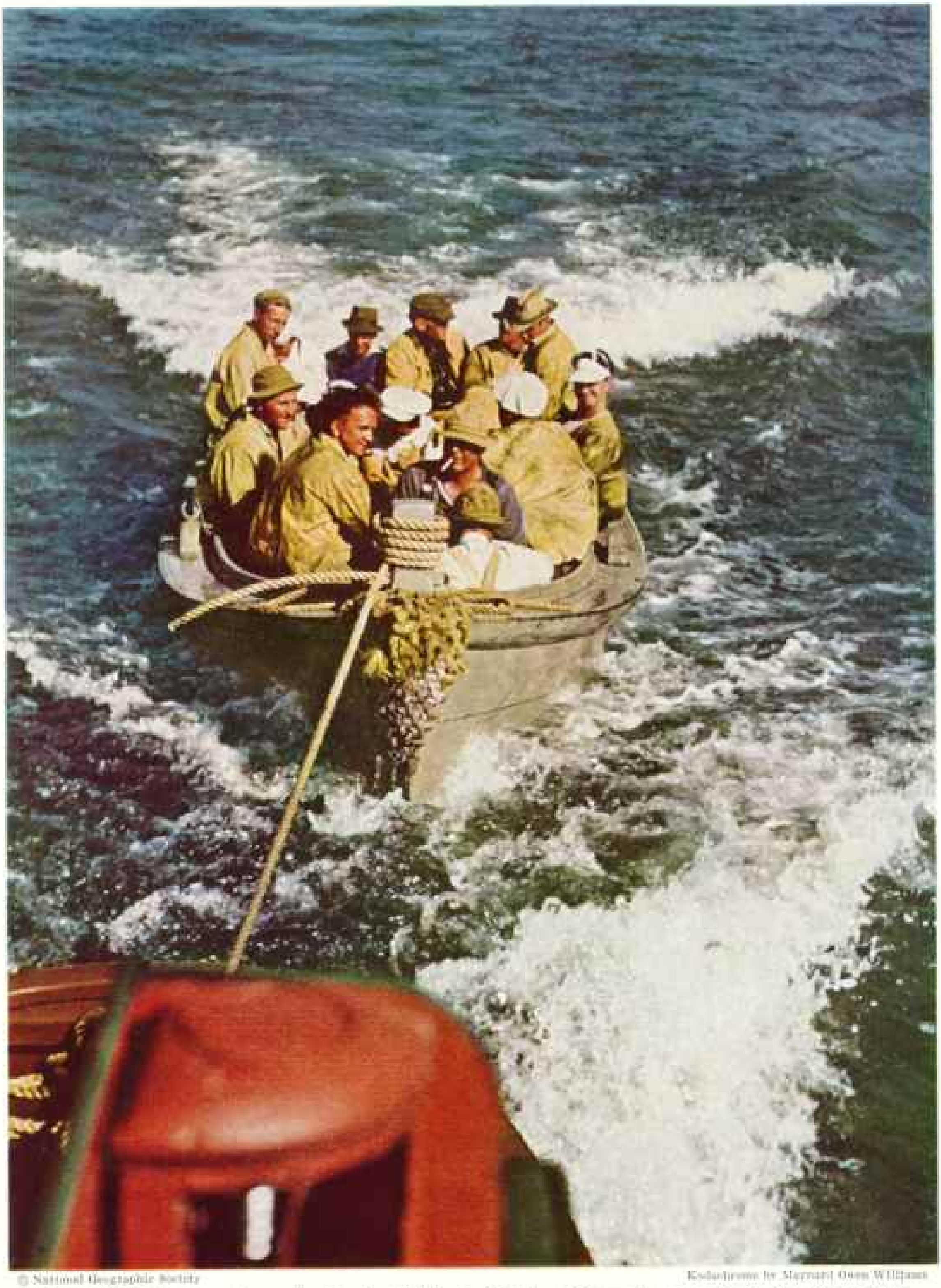
Favorite View Up the Columbia Is This Wide Gorge Between Washington and Oregon, Seen from Crown Point

Far up the river is Bonneville Dam, at the head of tidewater. Highways, railroads, and airplanes now follow the route carved by the Columbia ages before it served as a water trail for pioneer settlers coming to Oregon Territory.

From Snowy "Albatross" to Scarlet "Wurtembergia," Oregon Gladioli Run the Color Gamut
East of Portland are flower fields as colorful as tulip time in Holland or anemones in Galilee.

Kodachromes by Maynard Owen Williams

Sixteen-horse Combines Still Reap Golden Grain Near Spokane



Kodachrome by Maynard Owen Williams

Astoria Fishermen Race the Falling Tide to Netting Grounds on a Sand Bar Near the Columbia River's Mouth

Strangely, Chinook salmon, seeking to spawn far upstream, choose ebb tide, when the current is strongest against them, to begin their journey; hence these canny seiners time their fishing by the tides (Plates X and XI).

Kodachrome by Maynard Owen Williams

These Horses Are Stabled All Season in a Floating Hulk Moored to a Shoal on the Columbia

When the tide is low enough, the marine "stable" grounds, the horses are led down to the sand bar, and the fishing begins (Plate XI). While splashing teams haul in one net, men in long waders arrange another. It takes quick work to make three hauls on one ebb tide. Founded as a fur-trading post by John Jacob Astor's men, Astoria is now a leading salmon-canning center and lumber port. On Coxcomb Hill in the distance rises the Astor Column with its historical frieze (Plate XVI).

Kodachrome by Maynard Owen Williams

Off Astoria, Big Flopping Salmon Are Tossed Aboard as the Horse-drawn Net Closes In

Sweeping in a wide curve, a bit upstream, a launch lays the seine. Then both ends are hauled in by teams of horses while the net slowly moves downriver. If the salmon run is good and the timing right, a ton of fish is brought to the boat and tossed over the side.

Kodachrome by Maynard Owen Williams

Tugs and Barges Carry Motor Fuel Where Lewis and Clark Saw Indians Portage Their Canoes Past Celilo Falls

Kodachrome by Ray Atkeson

Indians at Celilo Falls Have Changed Buckskins for Gym Shirts, But Kept Their Jobs as Early Explorers Knew Them

A treaty guarantees the rights of the Indians to spear or net salmon fighting their way up Celilo Falls. Platform sites persist from year to year, and aerial cable cars carry the fishermen from shore to island (Plate XII, upper left). Here a salmon of 15 to 20 pounds is flexing the arm muscles of an Indian.

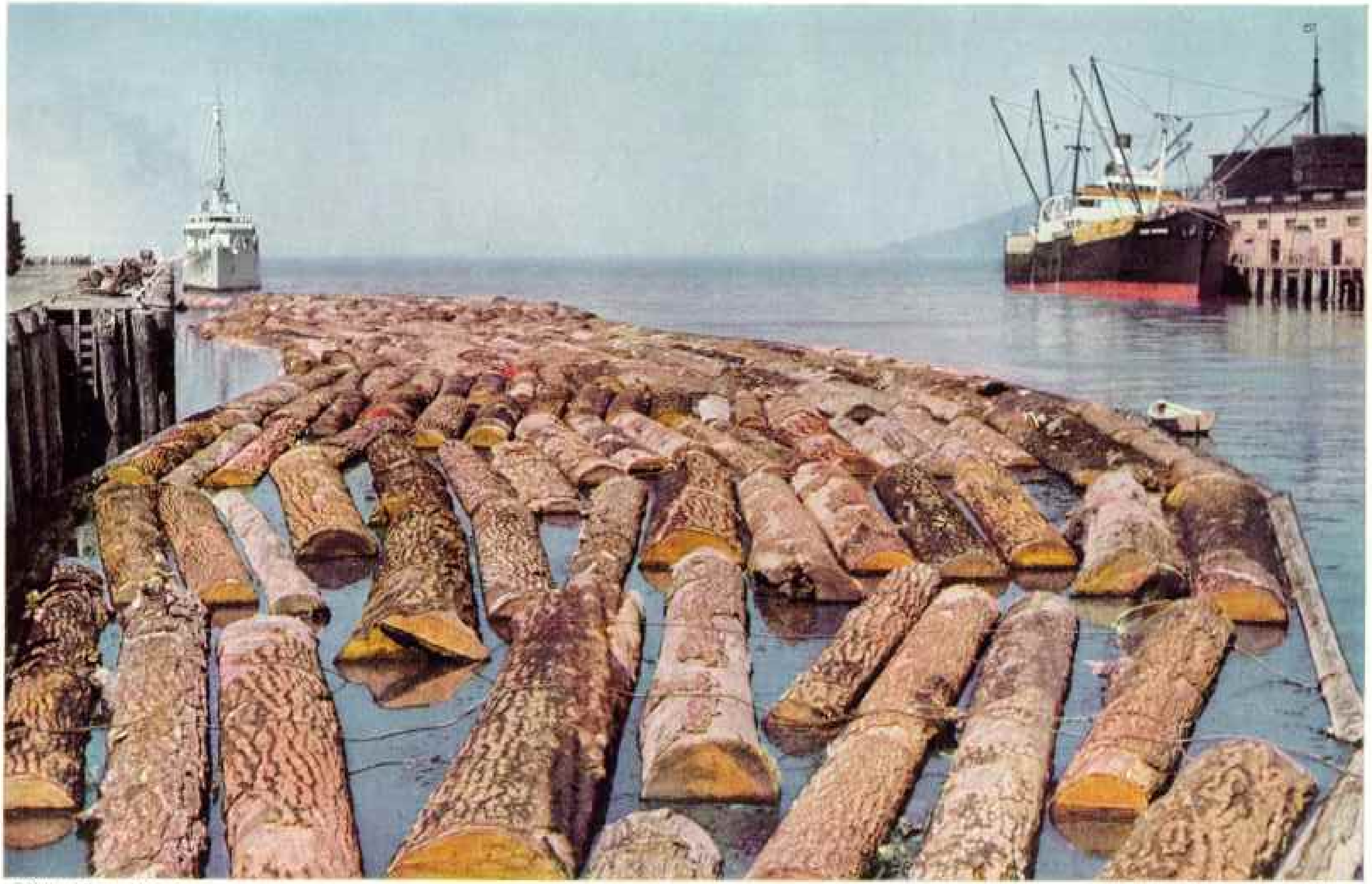
How's That for Good Measure?

On the way to Timberline Lodge an Oregon girl climbs on a truck to show the size of a load of Douglas fir logs bound for Oregon City.

Kodachromes by Maynard Owen Williams

The Bell Heard Round the Horn

Preserved in the Willamette River at Portland is the *Oregon*, which raced around Cape Horn in '98 to help win the Battle of Santiago.



Kodachrome by Maynard Owen Williams

Logs Float in the Columbia River Where John Jacob Astor's Fur Traders Landed from the *Tonquin* in 1811

The trading post which furnished Washington Irving with material for his thrilling *Astoria* is now a city of canneries, sawmills, grain elevators, and fishing fleets. Captain Gray saw the site in 1792, and his men here bought "two salmon for a board nail." U. S. destroyer *Breese* (left) has been converted to a mine layer.

 Kodachrome by Maynard Owen Williams

The Astor Column, Swathed in History, Marks the First Settlement in Oregon Territory

Early history runs like a scroll about this 125-foot monolith on Astoria's Coxcomb Hill. Beginning with the forest primeval, the pictorial record twines up past the discovery of the Columbia by Gray, the arrival of Lewis and Clark, the founding, loss, and restoration of Fort Astoria, to the coming of the covered wagon and train.

electricity left an ugly valley, where lava and ice floods had long since made their mark. This has been transformed into a riverside parkway where basalt boulders and dark canyons alternate with pine groves shading rustic tables. Signboard arrowheads direct the visiting motorist along a 25-mile scenic route.

Youngsters have a choice of free swimming pools. One bears a line from Shakespeare's *Tempest:* "Sir, he may live: I saw him beat the surges under him, and ride upon their backs."

264 Fires in a Day

Spokane is a strategic center for fighting forest fires. From a vast warehouse, supplies for 9,000 men can be rushed to the danger zone. When a lookout or pilot spots a blaze in some inaccessible region, parachute fighters drop in with light radio transmitters, and the battle begins. On July 15, 1940, 264 fires were reported; all were brought under control.

From Spokane I rode west for 94 miles to regain the stony trench of the Columbia River at Grand Coulee Dam.

Beside this 4,300-foot-long gesture of prodigious power, that at Boulder Dam, for all its showmanship, is second, and the United States' share of Niagara a mere drop in the turbine bucket.

Last March, Grand Coulee Dam began to feed power into the transmission system it shares with Bonneville (page 785). Contracts have been let for an interchange of power with the municipal plants of Seattle and Tacoma. Soon the Columbia, the Lewis, the Skagit, and the Skokomish Rivers will cooperate in meeting the call for hydroelectric energy devoted to defense. The Machine Age has come like a flash to our western rivers.

On my first visit to Grand Coulee Dam, following an adventurous voyage down the Salmon River in 1935, men were asking, "What'll they do with all this power?" (pages 778-9).

Today's question is, "When can we get it?"

At the end of 1940, Bonneville was turning out 86,400 kilowatts; had applications for about a million. To meet today's need, Grand Coulee dirt began to fly more than seven years ago.

Cheap power, level factory sites on tidewater, and a reliable labor supply drew aluminum manufacture to the Columbia, on whose banks aluminum factories at Vancouver and Longview are being rushed to completion and hurriedly expanded.

The hydroelectric energy used in making a single pound of aluminum would drive a streamlined streetcar nearly two miles in normal service. The combination of water power and electrochemical aluminum reduction is a "natural."

This affinity was clearly shown by our Army engineers in their 1932 report, on which Columbia River power development was based.

In 1884 the 100-ounce tip of the Washington Monument was the largest aluminum block ever cast. If Grand Coulee Dam's potential power were wholly devoted to making aluminum, ten solid-aluminum Washington Monuments could be produced in a year.

Electric pumps, stoves, and washing machines, hot-water heaters, and refrigerators are already changing rural life in the Northwest and providing a widespread market for electrical equipment.

What does the Columbia's stupendous power mean when translated into breakfast toast, home laundry, reading light, roast turkey, ice cubes, or hot showers?

The common standard of electric measurement is the kilowatt, or 1,000 watts. That much energy, used for an hour, is a kilowatt-hour, or kwh. That amount would run your washing machine four hours, your electric mixer or student lamp ten hours, your toaster 100 minutes, your roaster 50 minutes, your storage hot-water heater 20 minutes.

Power Enough for 6 Biggest Cities

Grand Coulee Dam's total power production, if used day and night, would supply as many people as there are in our six largest cities—New York, Chicago, Philadelphia, Detroit, Los Angeles, and Cleveland.

Grand Coulee Dam baffles description because it baffles the eye. "Can an ant see an elephant?" one reporter asked.

Mason City, the electrically heated, chimneyless constructors' town; Coulee Dam, the immaculate home of the Government engineers; and Grand Coulee, huddle of dance hall and drugstore, shanty and hotel—these are but satellites of the mighty dam (page 775).

Against that wide water-wall, at high lake level, the *Queen Elizabeth,* the *Queen Mary,* the *Normandie,* and the *Rex* could all berth at once.

Across its front, the Great Pyramid of Cheops could be flanked by United States Capitols, two on a side. Down its center at high water will pour a cascade more than twice the height of Niagara. But only by walking like a fly along its monolithic mass or using a dime-in-the-slot field glass can your mind make your eye believe it.

Out there in space a tiny figure swings from the frail derrick arm of a toy Erector set. Below the smooth-faced dam is a soft, yeasty churning of green-white water.

Photograph by Maynard Owen Williams

Lumber Elevators Save Back-breaking Toil

Boards are loaded by the man at left, pass over the top, and are easily unloaded at any height. Planks are separated so that they will season evenly. Near Wenatchee, Washington, golden sawdust piles rise high close to fruitful orchards.

That puny puppet is a brawny man, dumping 16,000 pounds of concrete with a twist of his wrist. That fluffy foam has the deadly kick of a million mules. That concrete wall, largely under water but about as tall as the Washington Monument at its deepest thrust to bedrock, contains enough material to build 275 Washington Monuments.

Even more dramatic was its building when 7,000 men excavated, blasted, poured cement, welded steel, and froze a slipping hillside. They imbedded 2,000 miles of cooling water pipe in the heat-forming concrete. More tons of earth and rock were removed than there was concrete poured.

Into the mixing house came graded sand and four sizes of gravel, deposited about 20,000 years ago by accommodating glaciers. Cement was blown, water flowed in.

With tight kisses of steel and rubber lips, giant machines united to mix each batch as it was automatically weighed, timed, and recorded for the Argus eyes of Government engineers, at as much as 30 tons a minute, night and day.

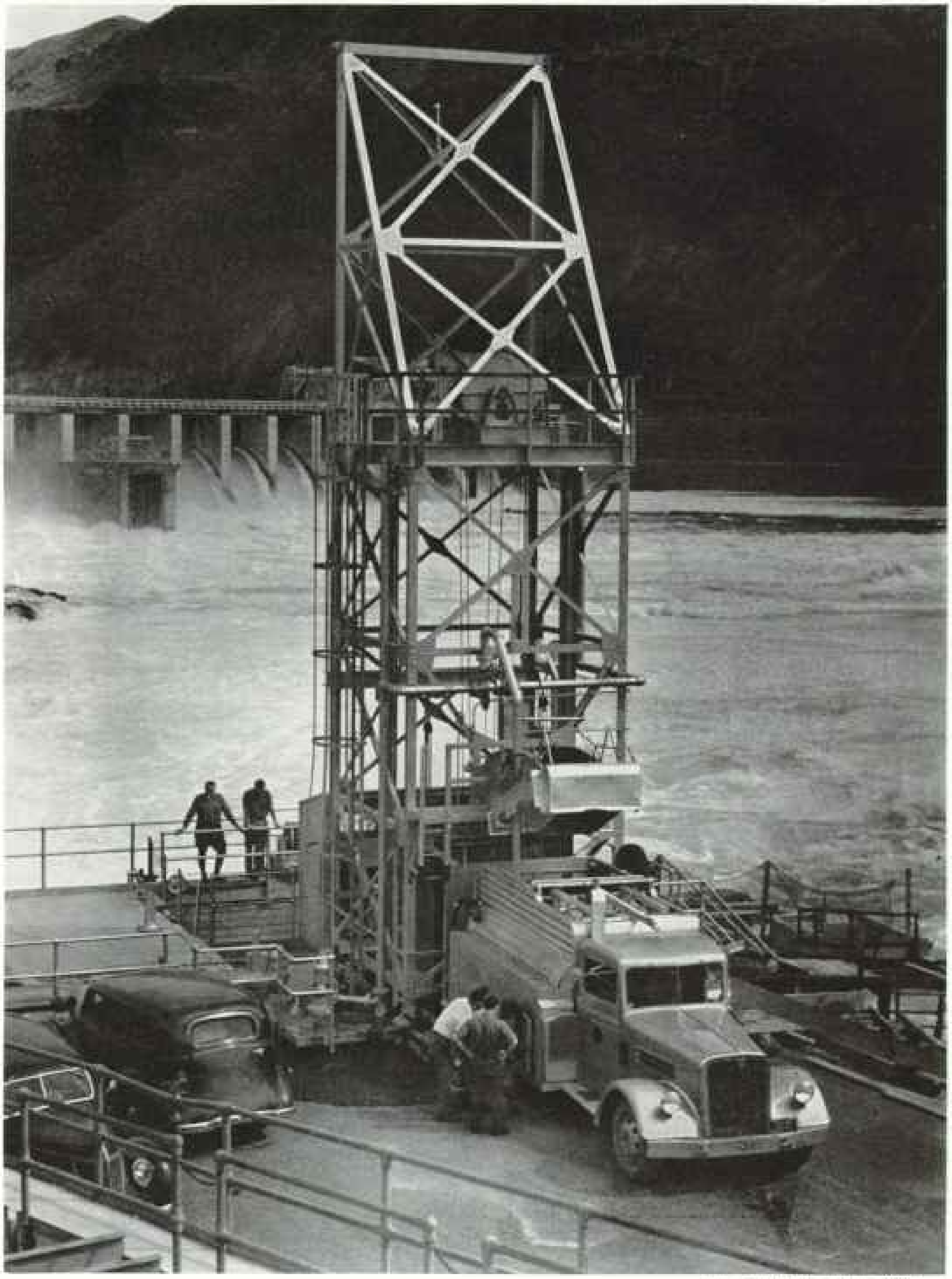
One day I looked into a newly assembled section of an 18-foot penstock which a streamline train might use as a tunnel (page 780). The entire battery of 18 such water-mouths would carry 26 gallons a day for every human being on earth; yet, during June and July, five times that much water will pour over the spillways, unused.

"The Desert Shall Rejoice"

In the glacier-fed Columbia, the peak flow comes from May to September when electric power will drive the pumps to spread the fruitful prophecy of Isaiah—"The desert shall rejoice, and blossom as the rose"—across 1,200,000 acres of sagebrush and mirage. In an oasis nearly as big as Delaware there will some day be three times as many people as Nevada has now.

I have seen Egypt's sweating peasants lift water by the leather bucketful; heard the drone of water wheels on the Orontes; felt the stark nakedness of Timgad's fallen glory, and breathed the dust of dead Central Asian cities that dried up and blew away. To me the conservation work of our Bureau of Reclamation is stirring in its foresight and in its scientific approach to the age-old problem of helping the earth serve mankind.

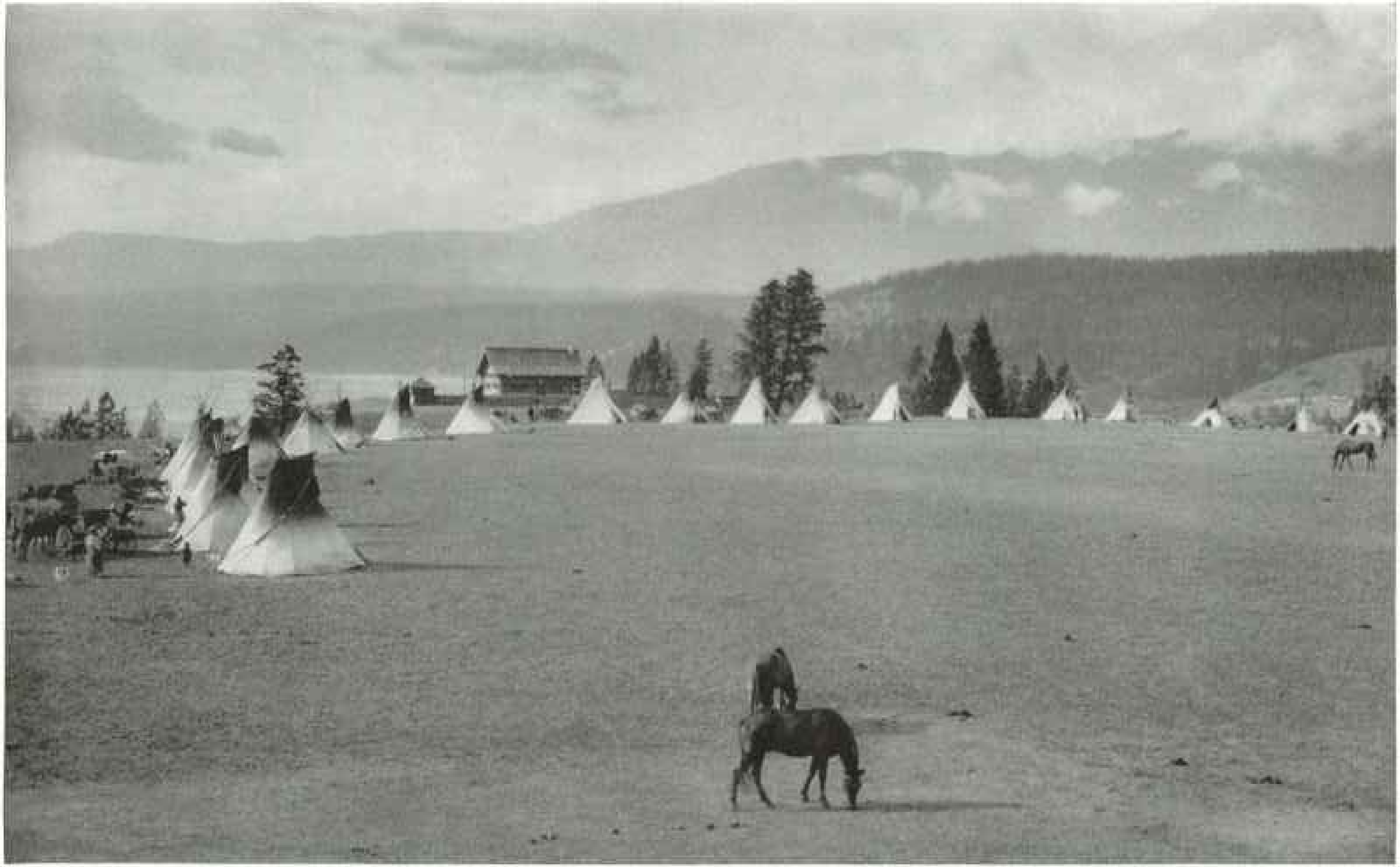
To attain Isaiah's dream, modern science has contributed incredibly powerful pumps. One would supply New York City with all the water it needs for domestic use. Ten pumps and two spares will lift inconceivable floods from the 151-mile lake above the dam



Photograph by Maynard Owen Williams

An Aquatic Elevator Lifts Migrating Salmon into Their Shiny Truck

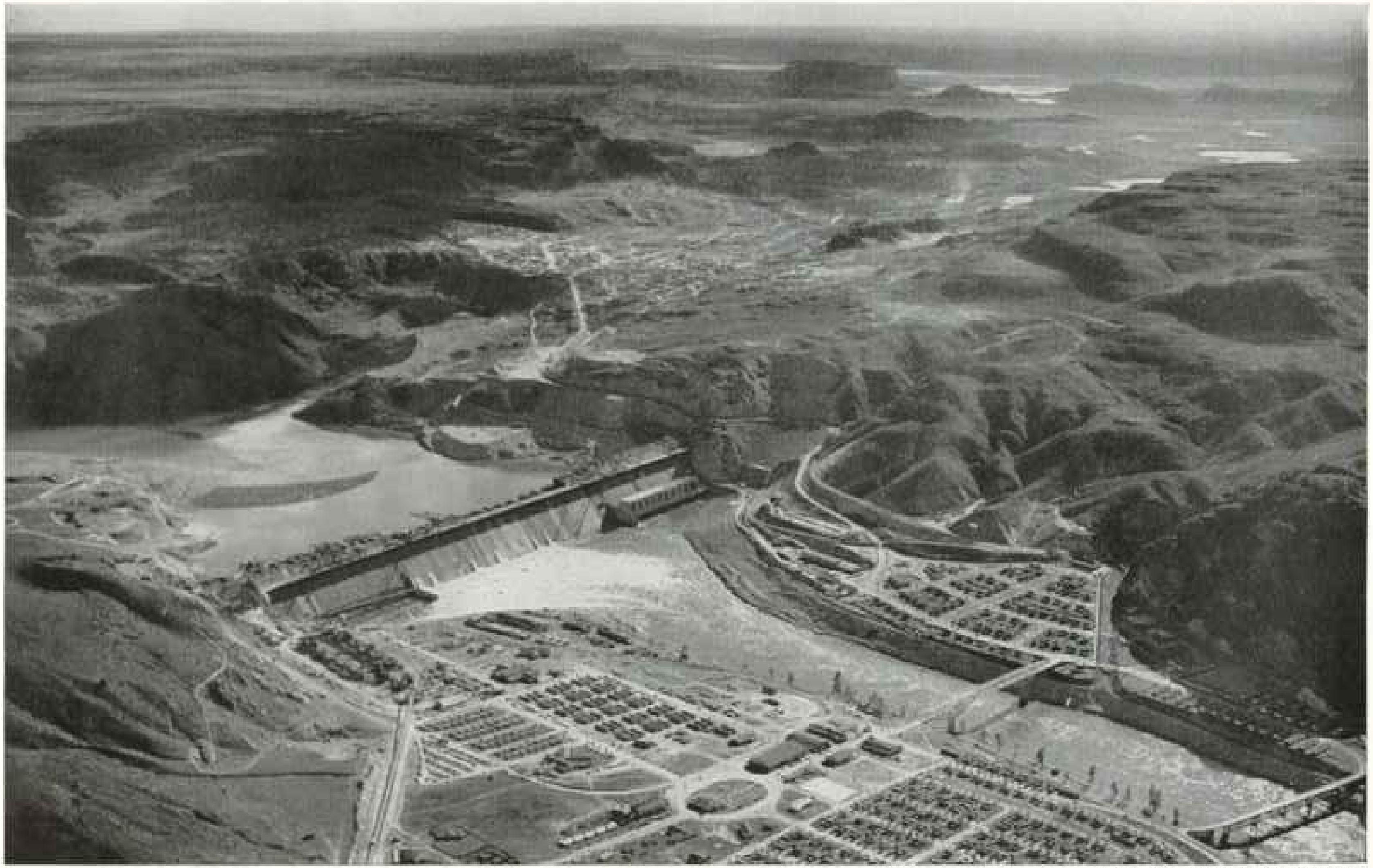
Here, at Rock Island Dam, ladders are so placed and the currents so controlled that the fish enter the elevator trap of their own accord. Many fisheries men believe salmon return to the spot where they were hatched, so these fish are taken to favorable spawning grounds (page 777).



Photograph from Canadian Pacific Railway

Kootenay Indians Gather to Honor a Great American Geographer and Help Found a Town

On Canterbury Point, overlooking splendid Windermere Lake, David Thompson Memorial Hall, resembling a Hudson's Bay Company fort, was built for assemblies, dances, and badminton in 1922. Thompson, early fur trader and first white man to follow and map the whole course of the Columbia, reached this wind-swept site in 1807 and located the first trading post on the Columbia, "Kootenae House," in a sheltered spot on Toby Creek just north of the lovely lake.



Photograph by U. S. Bureau of Reclamation

Man's Greatest Dam, Its Three Satellite Towns, and the Dry Site of a Future Irrigation Reservoir Pack This Air View

Laid out in the foreground is temporary Mason City. Across the Columbia River is "Engineers' Town" (Coulee Dam). Beyond lies the hilltop town of Grand Coulee. In the Ice Age a mammoth frozen barrier blocked the river gorge here. Its overflow carved the barren valley, Grand Coulee (upper right). There irrigation waters, lifted 280 feet from the new lake, will be stored. Steamboat Rock (upper center) will again become an island (pages 754, 771).

Photograph by U. S. Bureau of Reclamation

"The Biggest Free Show on Earth" Was the Building of Grand Coulee Dam

Once every hour, all day long, lectures are given in grandstands at both ends of the dam. The construction drama, prosaically known as P.W.A. Project No. 9, has been going on, night and day, for more than seven years. In that time, enough material was removed to build seven Pyramids of Cheops and enough concrete poured into the dam to construct three such pyramids (page 771).

to the side valley carved by floods in the course of the Ice Age.

Thence the water will flow to 980,000 acres, be lifted by auxiliary pumps to 220,000 more, all divided into farms of not more than 80 acres each.

Trek of the Fruit Wrappers

Coming down through the fruit-rich Okanogan Valley one day on a bus, we stopped for a quick lunch amid the latest in hairdo's, sport blouses, slacks, and feminine footwear.

"Tenderfeet?" I asked the driver.

"Fruit wrappers. At 4½ cents a box, one of those girls can earn $9 a day. When the season's over, they go home and wash off their nail polish in dishwater. From early apricots to late apples they make more money than I do."

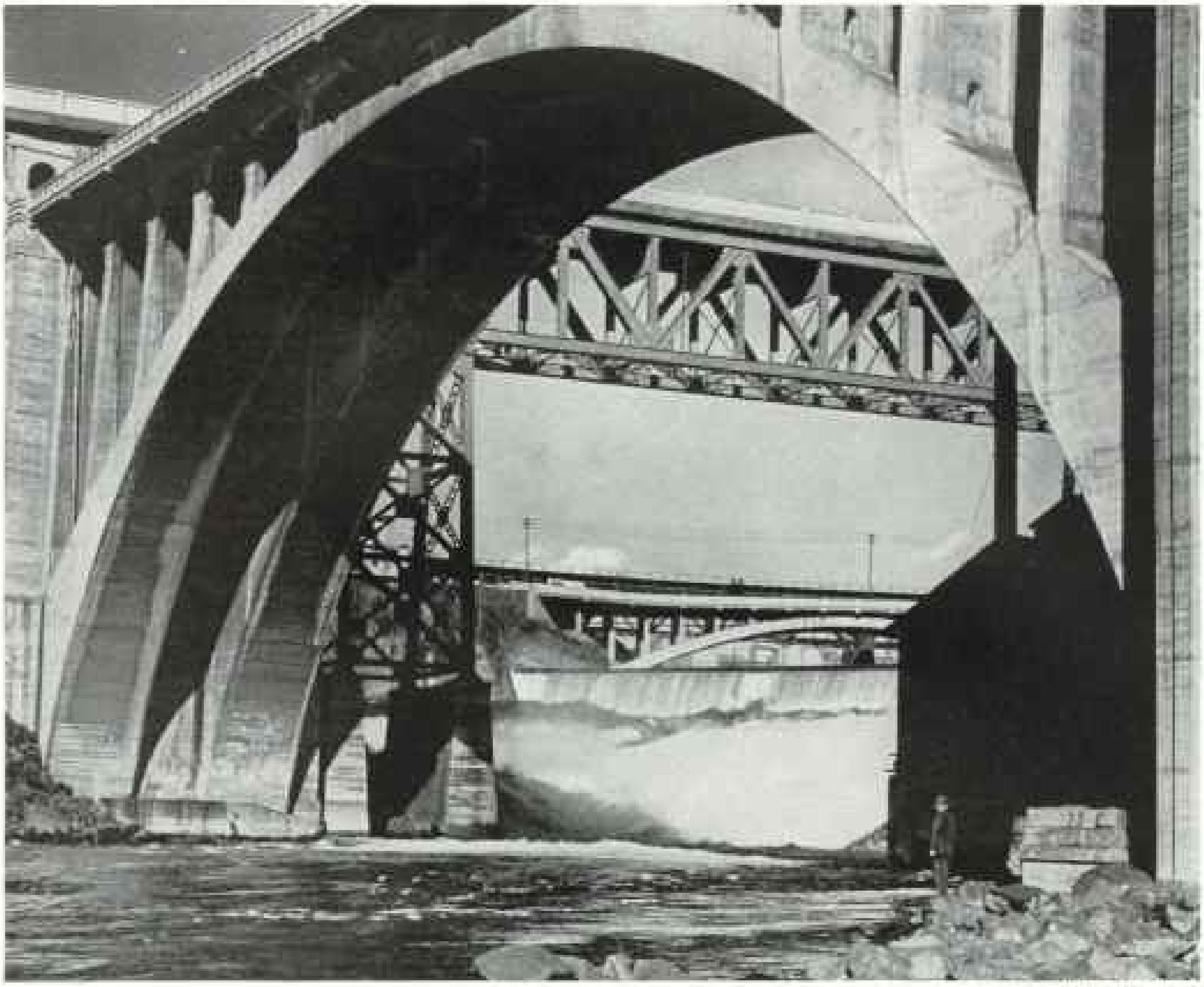
We paid up, shifted gears, and headed for glacier-gouged Lake Chelan.

Apple orchards tuft the banks of deep Lake Chelan, but today's thrill is gold. Concentrates from the new (1938) Holden Mine near Railroad Creek outbid apples for transport. Miners crowd the passenger boat (Plate V).

More than half of Washington's $3,000,000 annual gold output comes from Holden copper ore at the rate of one-twelfth of an ounce of $35 gold and 30 pounds of 12-cent copper per ton of ore.

Wenatchee thinks, talks, even eats apples —wonderful apples: Winesap, Delicious, and Jonathan, Yellow Newtown, and Rome Beauty. Orderly orchards marshal their ranks against brown, barren hills. Along railway sidings are packing houses where the hand-picked fruit is washed and dried, sized, sorted, and boxed for export (page 784).

Apples are almost human in their desire for sunny days and cool nights. Washington's "apple bowl" suits them down to the volcanic



Photograph by Wallace Gamble

Spokane, "Metropolis of the Inland Empire," Grew Up Around These Falls

Framed in a maze of highway and railway bridges, Spokane Falls are the heart of the city. Power generated here contributed to its growth. Widely known for its 53 parks and fine schools, Spokane was founded by hunters and trappers less than 70 years ago (page 754).

ground, and they show their appreciation in 30,000,000 bushels a year.

A "Taxicab" for Fish

Up the vale of Cashmere, bound for the world's largest fish hatchery at Leavenworth, speeds a silvery truck. Having fought their way upstream for nearly 500 miles, climbed ladders, and used the elevator at Rock Island Dam, the salmon are taking their last ride in ice-cooled, air-conditioned comfort (page 773).

Do salmon return to the stream in or near which they were hatched? Will artificial spawning, preventing a terrific waste of eggs, increase the salmon run? Can power and fish share the same river?

No one knows all the answers. The tradition that a salmon has more homing instinct than a pigeon is well established; yet there is a strong minority opinion that "you can lead a fish to water, but you can't make him think."

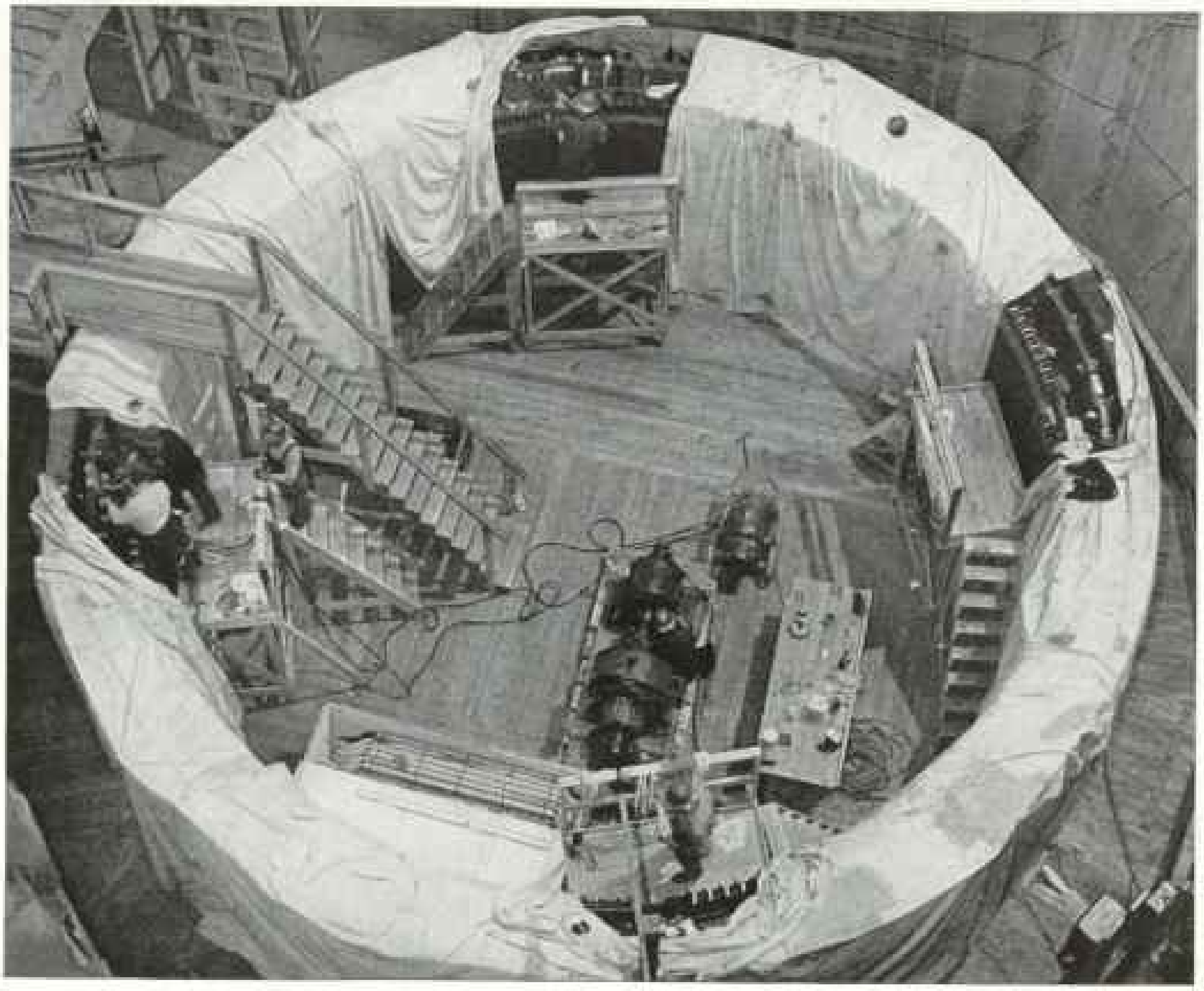
From Rock Island Dam, where the Puget Sound Power and Light Company has built a concrete curve of green-laced spillways, the trapped fish are carried away in $8,000 cars to suitable spawning grounds or storage ponds where milt and eggs are taken and the young are hatched with minimum loss.

A mountain lake was tapped by tunnel to provide water of adequate quantity and favorable coolness in Icicle River at Leavenworth. In cement tanks, grouped like an assembly line, tiny fish mass at one's finger.

Hand-fed Salmon Lose Their Cunning

One expert told me that hand-fed salmon lose their hereditary cunning, rise to the bait, and are easily caught. However, except on Derby Day at Astoria or Seattle, hooks play a small part in salmon fishing (pages 785 and 792).

The spring Chinook salmon is a game athlete, fasting and fighting his way upstream



Photograph by U. S. Bureau of Reclamation

More Potent Than Aladdin's Ring Is This 274-Ton Stator at Grand Coulee

Within the 40-foot circle of hydroelectric magic, a giant rotor will spin to develop more power than any turbogenerator yet constructed. Shipped in four sections from Pittsburgh, the supersized stationary part was photographed on March 18, 1941, and will begin work August 1, 1941.

to spawn and die. Seine fishers dye their nets to challenge these stout-souled fish. The relatively lazy fall Chinook is content with a spawning place near tidewater.

By the time Grand Coulee Dam is finished, and dams at Foster Creek, Chelan, Rocky Reach, Priest Rapids, Umatilla Rapids, John Day Rapids, and The Dalles utilize the river's power, more will be known about whether fish and turbine can profitably share the same water. Sea-bound fingerlings do survive a merry-go-round ride through the Bonneville turbines.

A Plateau of Plenty

Soil experts told me that Yakima's irrigated valley is a preview of what the plateau between Grand Coulee and Pasco may become.

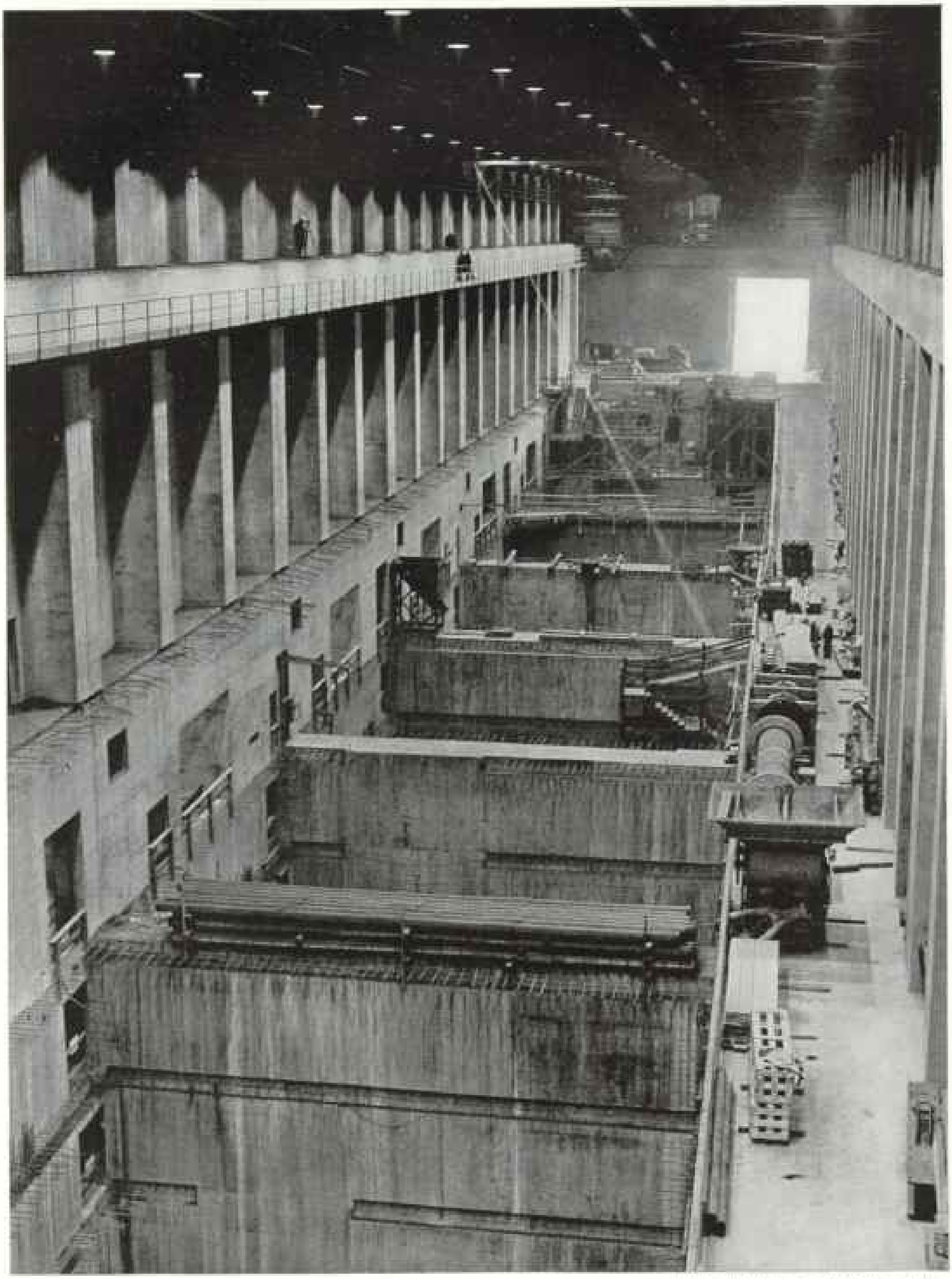
Grainfields there are and orchards galore, hop fields with pickers, "No Admittance" signs, and revival meetings. Beside the road to Mount Rainier are swank fishing lodges. In one field two beautiful Belgian colts gamboled about their thoroughbred dams, and tight-curled karakul lambs butted the udders of black sheep whose forebears immigrated from beyond the Caspian.

Just above the sandspit site of old Fort Walla Walla, a cluster of shining oil tanks at Attalia marks the upper limit of barge navigation.

I rode down to Celilo on a spotless motor-tug of the Tidewater Transportation Company. The prow of the powerful tug fits a notch in the low, bulky oil barge. Two tight tie-lines bind the couple and off they go, through still water and rapids.

The Walla Walla and Umatilla Valleys were pioneer routes. As the *Invader's* barge slid along, almost awash, I thought of old engravings of covered wagons cooling bare axles while tired old wagon wheels lay on crude rafts.

In smelly boxes lined with fish scales I slid across aerial tramways to otherwise inacces-



Photograph by U. S. Bureau of Reclamation

Grand Coulee's West Powerhouse Is Longer and Higher Than the United States Capitol

Whirled by nine 150,000-horsepower turbines, nine generators here will supply enough power for the industries and homes of more than 8,000,000 people. A similar powerhouse at the east end of the dam will be built when needed. One giant generator begins work August 1, another later in 1941, the third in the spring of 1942.

Photograph by U. S. Bureau of Reclamation

A Streamline Train Might Use These Grand Coulee Tunnels: Water Will

The penstock linings, 18 feet in diameter, were fabricated and machined in Chicago, assembled and arc-welded at the dam site. Eventually through eighteen such pipes will flow each hour enough water to supply every person on earth with a gallon. Turbogenerators will then provide as much electricity as now is used by more than 16,000,000 average Americans (page 772).

sible islands amid smoky Celilo Falls, where Indians perch on out-jutting platforms and net salmon as they have for centuries (Plates XII, XIII).

Robert Stuart of the Astorians thought that here an Indian fisherman "would by assiduity catch at least 500 daily."

Catching two or three tons of salmon a day while standing on a shaky perch would require more assiduity than modern Indians like. Some now work in gangs of five, since four can play poker or bridge while the fifth, with a rope about his waist, sweeps the turbulent stream. In the shade of the rocks are Indian hide-outs, cluttered with the same magazines and "funnies" as a frat house.

The salmon fishing at Celilo is one of the sights of the river. Visiting motorists sometimes buy a 20-pound salmon while it is still flopping, stow it atop their baggage, and hope it will keep.

Below Celilo the river tilts up on edge between huge basalt blocks which reminded the voyageurs of the flagstones (*les dalles*) of their French villages.

Less than 200 miles inland and 98 feet above sea level, The Dalles welcomes ocean-going steamers. Most of the ascent from tidewater

Photograph by Ray Atkeson

These Skiers Climb the Steep Slopes of Mount Hood the Easy Way

A chair lift, ski tows, and snowmobiles carry sportsmen to the top of many trails and bowls on the south slope, used by nearly 100,000 enthusiasts during the snow season. At lower left is the roof of Timberline Lodge (page 792). Beyond the upper skier is 10,495-foot Mount Jefferson, 40 miles distant.

Photograph by U. S. Bureau of Reclamation

A Chief's Daughter Broadcasts at the Grand Coulee Opening

Behind Mrs. Ann George is her father, Chief Jim James of the Nez Perce Indians. She is speaking over station KHQ on March 22, 1941, when two small generators began to "spurt juice." Her people at Nespelem will be served by electricity from the Bonneville-Grand Coulee power grid.

is made in one high jump at Bonneville Dam. This potent aid to river traffic has drowned the Cascades and Cascade Locks in a deep, smooth pool 60 miles long.

Almost overhanging the submerged lock system, a shiny cantilever bridge frames the majestic gorge down which the mighty river forced its way to the ocean, thus draining prehistoric Lake Bonneville and other vast areas.

Seeking permission to walk out on the shining span, which had just been raised 45 feet at a cost of $700,000, I played my card. For reply, this 23d of August, the tollkeeper showed me his September Geographic.

"Just came," he said. "Go as far as you like."

Here plodding oxen waded through mire, hauling covered wagons.

Then crude trams rumbled on wooden rails, and an iron horse, the *Oregon Pony*, supplanted mules. Now salt-water sailors look down from their sea-going ships on the waterlogged locks.

Ladder-climbing Fish

At Bonneville Dam visitors watch persistent fish flop up the ladders, seeking a place to spawn.

A scoreboard shows the daily run. In 1938, 471,144 Chinooks, bluebacks, silvers, chums, and steelhead trout were counted. In 1940 the number jumped to 734,935.

Once past this dam, the whole Snake River system and tributaries of the Columbia as far as Rock Island Dam are as open to fish migration as ever.

As civic housekeepers, no one surpasses the Army Corps of Engineers, which not only built the Bonneville Dam but still maintains and operates it. Lawns and driveways, homes, clubhouse, and library are immaculate; yet it is the powerhouse of an industrial area bigger than some States.

Four mighty generators already obey man's slightest whim, two of them added this year. Numbers 5 and 6, out of a total of 10, are now being placed.

Two Famous Highways

Over thin wires agile kilowatts speed forth to brighten farm life or spin the wheels of industry. Opening its 102-foot gates, the largest of single-lift locks swallows ships, barges, or tugs, disgorges them into the pool 66 feet above, at extreme low water (59 feet at normal river stage), and makes a seaport of The Dalles.

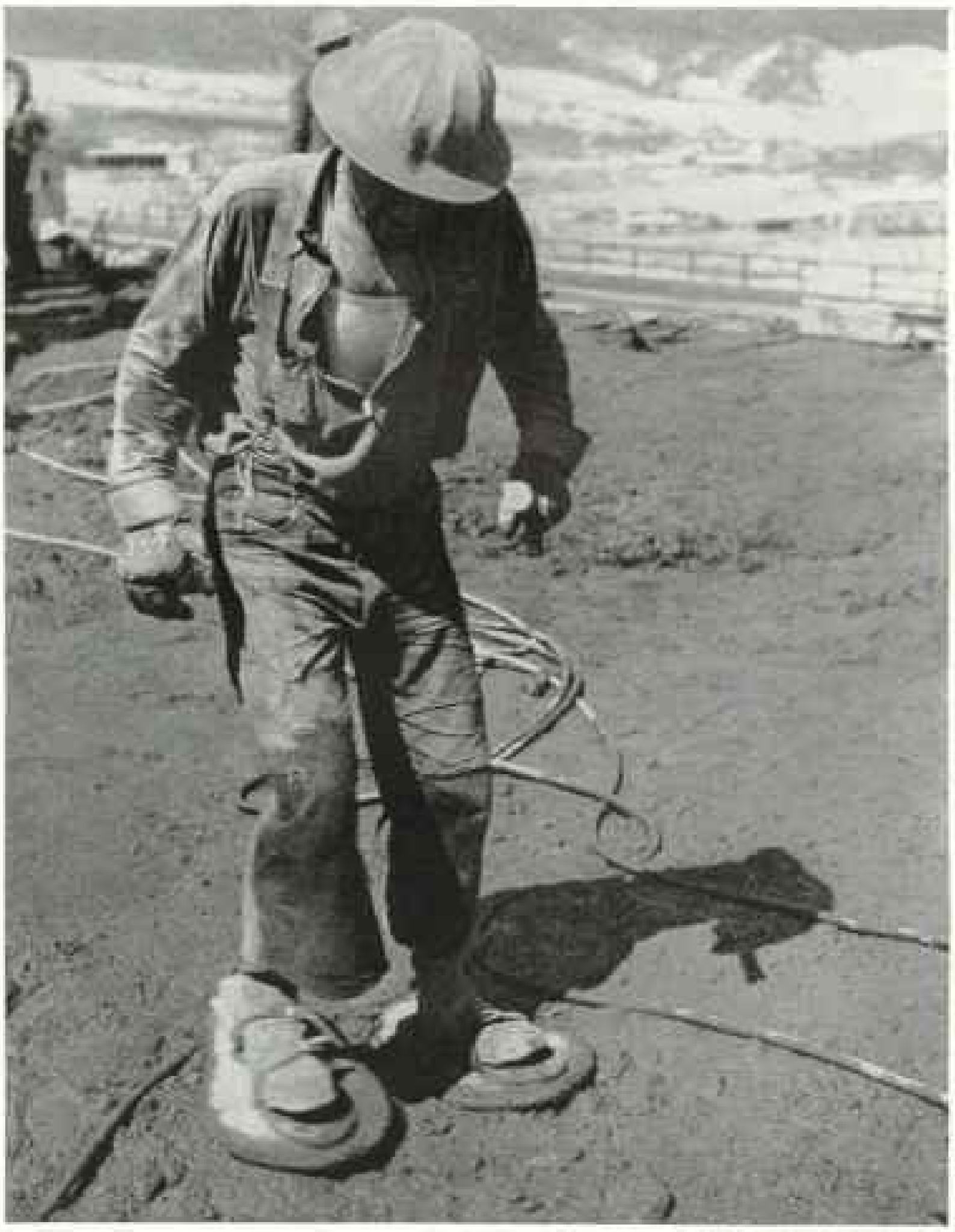
Oregon's Columbia River Highway and Washington's Evergreen Highway are far-famed (Plate VII). Railways and airplanes share this gap where a river carved an airway down Columbia Gorge. Here gigantic beds of gravel and flows of basalt mark paragraphs and chapter headings in the earth's prehistoric story.

Hotels and sylvan restaurants, picnic nooks, and winding trails lure city folk by thousands to these evergreen groves.

Huge trunks that were growing when Europe fought the Crusades are being fed to the saws. But experts say that an annual new growth of ten billion feet is possible (Plates XIV and XV).

At built-to-plan Longview, where aluminum is about to share the spotlight with lumber, I visited two of the world's largest sawmills. Wild deer roam amid ultramodern piling trucks or rest in the shade of golden lumber stacks.

I jumped from log to floating log, saw swift jets of water comb bits of gravel from the time-ridged bark, watched giant trunks sweep back and forth against swift saws, heard lumber played on by trimmer blades, and saw satin-smooth boards tied in bundles.



Photograph by U. S. Bureau of Reclamation

Men Wear Wooden Shoes When Walking on Fresh Concrete

Working in three shifts, 24 hours a day, 362 days a year, thousands of workers pushed Grand Coulee Dam to completion two years ahead of schedule. Safety was stressed throughout. But, during 55,000,000 man-hours of work, 35 men gave their lives to this greatest masonry structure ever built.

A "Lumber Dentist"

What impressed me most was a lumber dentist.

In choice, straight boards his eager eye detected a cavity dark with pitch. Down swept his whirring tool, the cavity was cleaned, and from a handful of slivers one was selected to match, much as a dentist chooses the proper shade of inlay.

With a casein glue the splinter was inserted, and a tiny power plane smoothed the spot where the cavity had been.

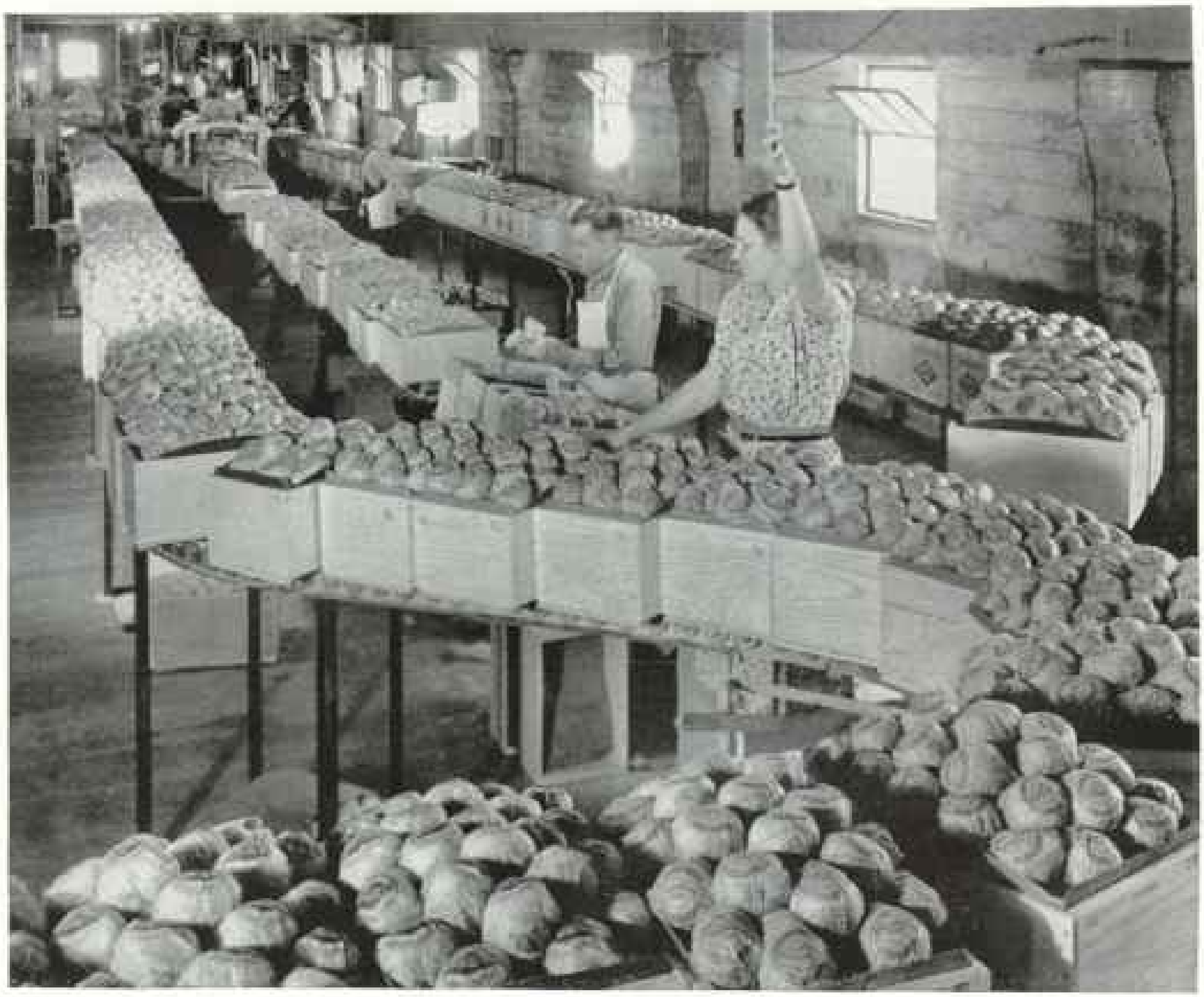
Wood waste fires the boilers, and metal-hard cylinders of pressed sawdust are sold to hearth lovers as termite-free fuel.

The ticket taker at Longview Bridge made me doubt my ears when he said:

"Be sure to park on the bridge and enjoy the view."

Far below flowed the wide, majestic Columbia, on whose surface an ocean liner seemed a mere toy. Along its banks docks, sawmills, and log ponds hardly disturb the sylvan scene. Off to the east rose majestic Mount St. Helens.

The man who took me across Spirit Lake, which mirrors Mount St. Helens at twilight,



Photograph by Photo-Art

The Endless Belt System Comes to Hood River's Garden of Eden

Wrapped by hand and here packed 90 to a box, Washington and Oregon apples and pears travel far. Elaborate spraying methods kill pests, and washing meets international standards, but foreign export of fruit is seriously curtailed. Mail-order sales, bottling of apple juice, and the manufacture of fruit-paste candy help the domestic market (page 776).

loves to hunt and fish. On vacation from his garage job he asked himself, "Why should I go back?" So he didn't.

Now he entertains tourists for profit and has his week-end fun in a neat seaplane, with the scattered lakes of Paul Bunyan's Evergreen Empire as his landing fields.

Sometimes he flies above the clustered chimneys of a huge pulp mill at Camas or over Vancouver Barracks, service post of some of our most famous generals.

Bustling Vancouver, with its eyes on the future, was a place of famous Washington State firsts: civilization, 1825; public school, 1833; Gospel sermon, 1834; marriage of American citizens, 1840; military post, 1849; aluminum plant, 1940.

Patriarch of Columbia River sites is Astoria, which Capt. Robert Gray's men saw in 1792 (page 791), Lewis and Clark passed in 1805, and the Astorians settled in 1811.

In those days Hawaii (Owyhee) was a port of call, and the best sea-otter patrons were Cantonese.

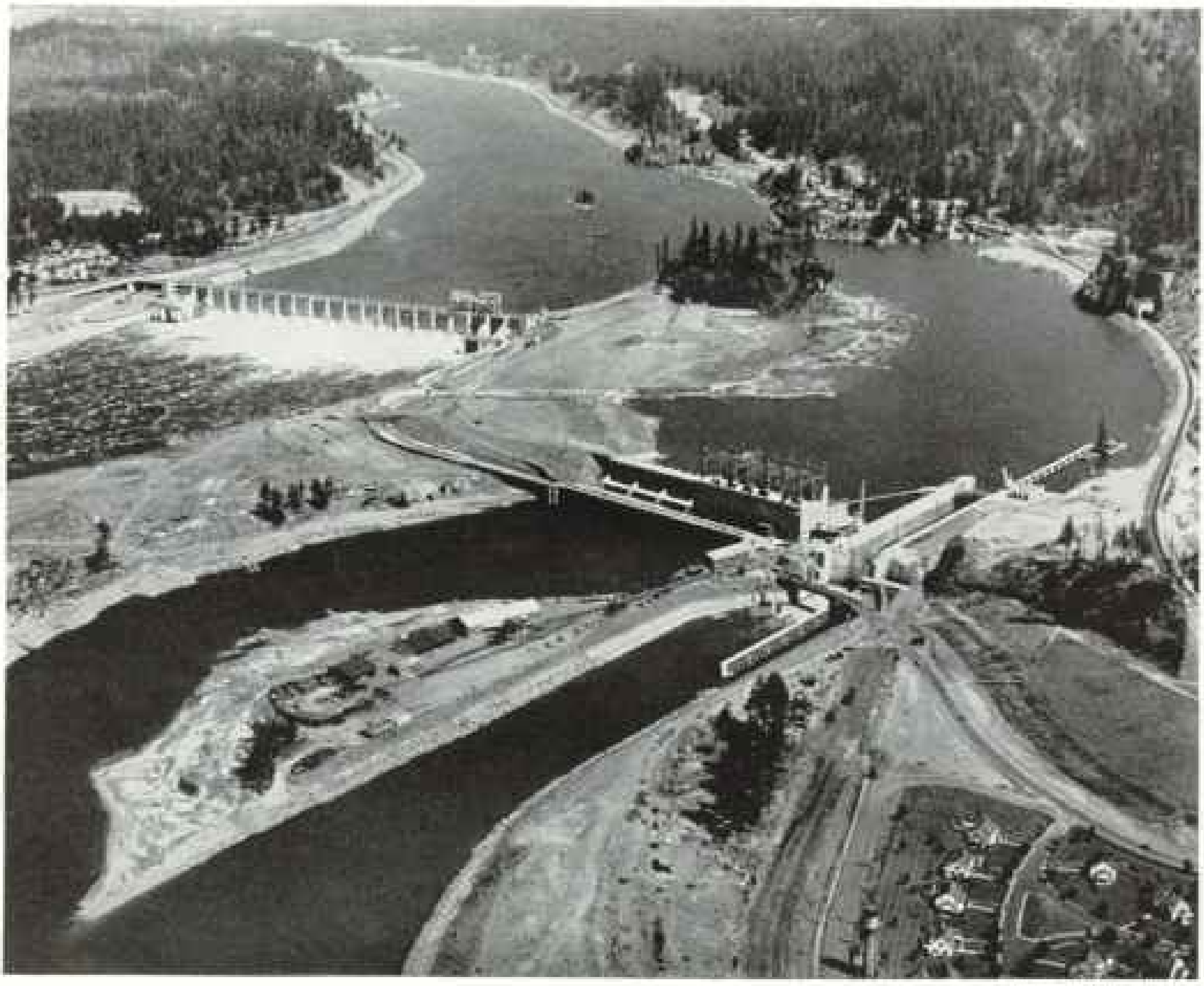
Goods went around the Horn from Boston to Hawaii and the Northwest, furs to China, and tea and silk back to Boston.

A Forgotten Hero

On Coxcomb Hill a spiral frieze of Astoria's early history climbs a column similar to Trajan's in Rome (Plate XVI). On it Captain Gray, Thomas Jefferson, Lewis and Clark, and John Jacob Astor are depicted. But not John Ledyard.

This Connecticut Yankee was with Captain Cook on his third voyage. On the "18th of April in '75," he did not heed the call to Lexington. On the original Fourth of July he was corporal of marines on a British ship. But even so, he served America well.

Such stout patriots as Robert Morris and



Photograph by Spence

Bonneville Dam Produces Power, Helps the Movement of Fish and Ships

To the right of the powerhouse is the largest single-lift lock ever built, which raises ships 66 feet in one operation. Between the two a fish lock is provided for those salmon which do not climb the water ladders on the Washington bank (left) and on Bradford Island (center). The dam, locks, and power plant were built and are operated by the Corps of Engineers, U. S. Army, whose neat houses are set in velvet lawns. One hundred and forty miles of tidal river reach from the ocean to the foot of this dam, above which a pool deep enough for navigation extends to The Dalles, about 45 miles farther upstream (page 780).

John Paul Jones shared his plans. He was a confidant of Ambassador Thomas Jefferson in Paris. Many feel that the Louisiana Purchase and the Lewis and Clark Expedition were born in the vagabond brain of John Ledyard, citizen of oblivion.

He Saw "Sea Horses"

"They say" that a destroyer officer, bound for Portland and seeing horses munching hay in a big red barn just outside his porthole, signed the pledge before hitting the deck.

The horses which draw in the large nets here live all season in a floating hulk. As the tide ebbs and the salmon "climb" the river, horses haul in the seines (Plates IX, X, XI).

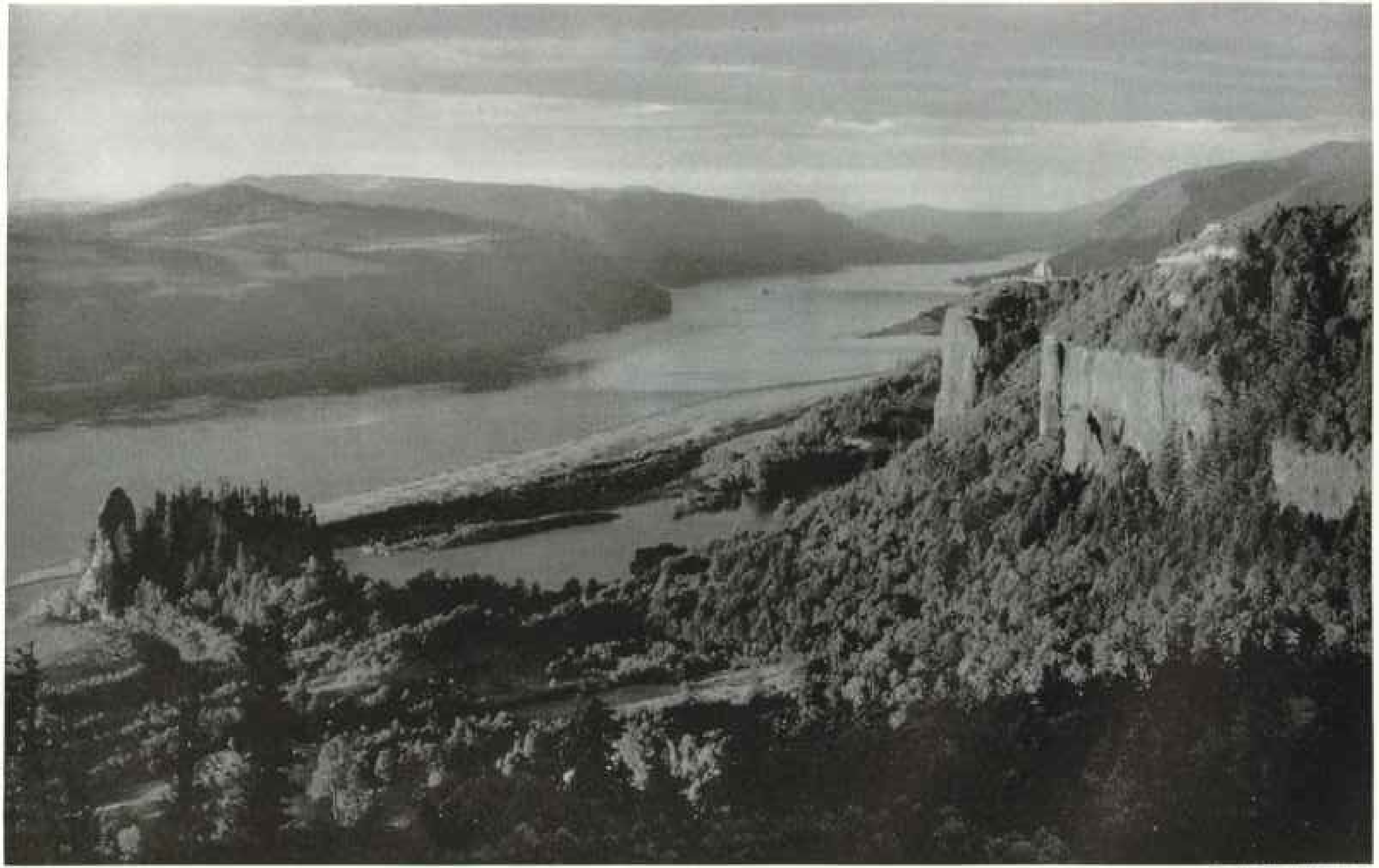
The bunkhouse where I dressed reminded me of a crew float. Many of these athletic seine handlers are college lads who earn their way through school by going fishing. Chunky skipper of my seine boat was a football player from Willamette College.

Time and tide don't "hold it," even for photographers. Neither do seine fishers. I would have shot from the hip, only my hips were under water. It takes snappy work to make three draughts in one ebb tide. When the water is shallow enough, the horses begin to haul the nets. When the water slides off the bar, fishing is over.

As the seine closed in, big fish flopped over the rail in a shiny stream, and one launch, two seine boats, twelve horses, and 20 or so men netted about 3,000 pounds of salmon that tide.

Astoria's Salmon Derby

At the close of the commercial fishing season the amateur has his week of fun at the



Photograph by Photo-Art

Down the Columbia River Gorge, Rushing Waters Carved an Airway to the Sea

In prehistoric times a many-armed lake reached far up the valleys of the Columbia and the Snake. Then the Columbia burst the barrier of the Cascades and a route to the sea was opened for canoes, settlers, roads, railways, and now air lines (pages 754, 788). On the Oregon side (right), 725 feet above the river, Vista House stands on Crown Point.

Photograph by Photo-Art

International Turkey Champions Come from an Indian Council Island in the Columbia

On Sauvie Island, where Lewis and Clark conferred with Indian chiefs, turkey farms now flourish. Fewer than a thousand people inhabit this idyllic island, but duck hunters have blinds along its shores, and fishermen cross on the small ferry to try their luck with still-water fish.

© Brubaker Aerial Surveys

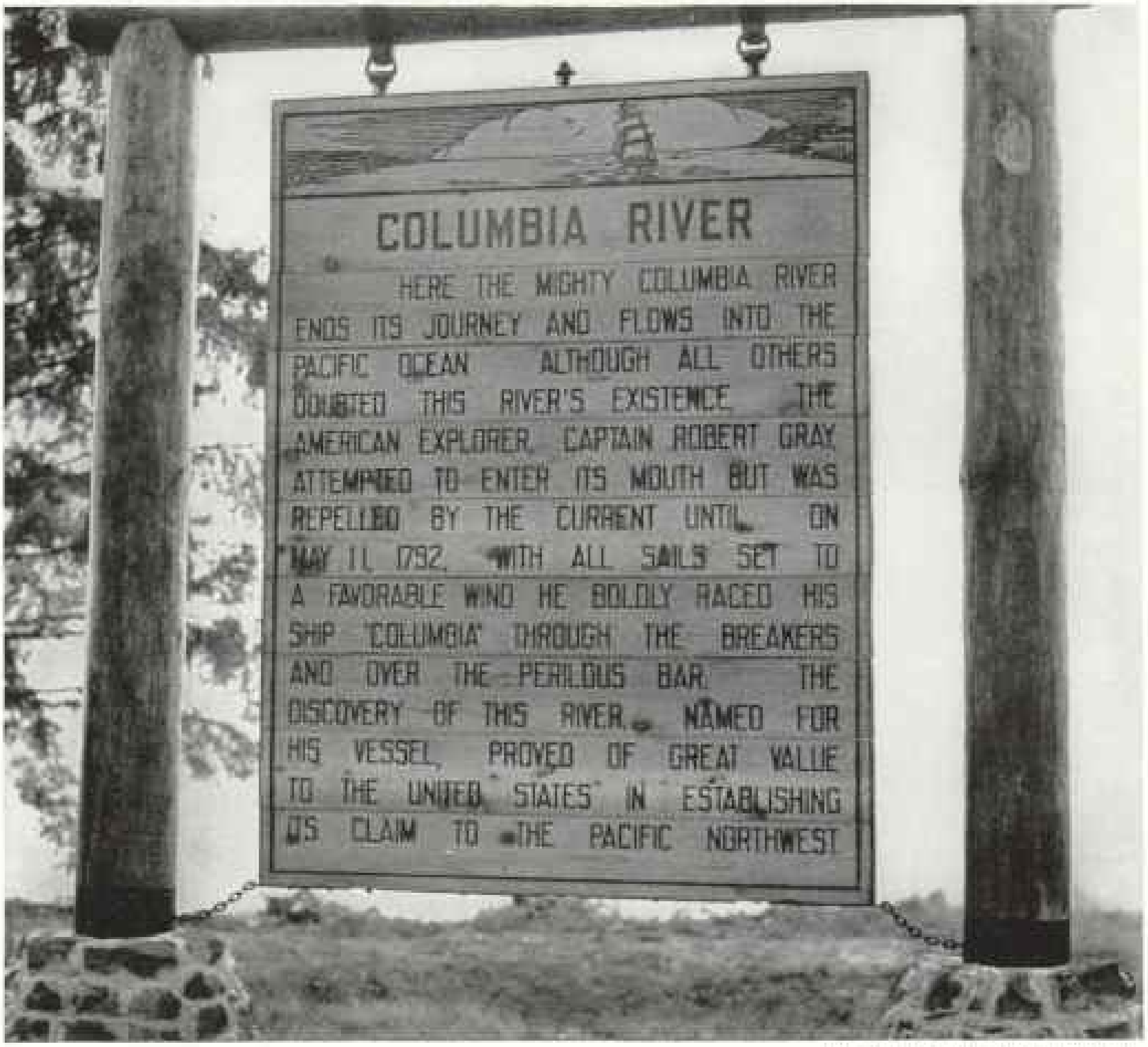
Had Its Waters Been Muddy, Early Explorers Might Not Have Missed the Columbia's 3-Mile Mouth

Many million tons of shipping a year pass between the two jetties; yet the much-sought river was long a mystery (pages 790, 791). Sand Island, on the Washington side, and Clatsop Spit, Oregon (right), have shifted about, but there is now a 35-foot dredged channel to Portland, 113 miles inland. Beyond the jetty (right) lies Astoria, and facing it the sand bar where horse-seining is carried on (Plates IX, X, and XI). In the distance, Mount St. Helens and Mount Adams are almost in line.

Photograph by Photo-Art

Tuna Fishers, Tugs, Gill-net, and Purse-seine Boats Take Time Out for a Regatta at Astoria

One-design sailboats, such as the Crod, "A," and Flattie classes, and cruising yachts spread their white wings in response to the slogan, "Go Nautical in Astoria."



Photograph by Maynard Owen Williams

A Signboard Near the Columbia's Mouth Tells the Story of Its Discovery

Scattered through the Evergreen Empire are such artistic signboards which record the history of the land. This "information board" is on the Washington bank near Ilwaco.

Astoria Salmon Derby. All fish must be caught with rod and reel. The grand prize is a four-door sedan; the daily prize, $100.

A "queen" smiles. An "admiral" salutes. There are fireworks, sailboat races, and log-rolling. But the hero is the captor of the biggest salmon (pages 789 and 792).

A trip through the cannery of the Columbia River Packers Association is an appetizer. Red-fleshed salmon and white-meated tunny are attractive, even in a packing house.

We motored down to Fort Clatsop, where nearly all winter long Lewis and Clark began their daily diary entries with the same word: "Rain." We went to Seaside, where the explorers' "farthest west" plaque is close to pinball, restaurant, and dance hall.

At Fort Stevens an expert mine layer thinks it quite natural that early explorers, conning heavy surf and menaced by unfavorable winds, failed to enter the Columbia.

We saw fog-bound Cape Disappointment live up to its name. After motoring along Washington's "Longest Beach in America," we returned to Portland, metropolis of the Columbia, which isn't on the Columbia at all.

In 1939, with 27 miles of deep-water frontage, Portland handled more than nine million tons of water-borne traffic, was the leading wheat-and-lumber-exporting port of our Pacific coast, and one of the greatest fresh-water harbors in the world.

Gold Dust and "Beaver Money"

Asa L. Lovejoy, of Boston, Massachusetts, and Francis W. Pettygrove, of Portland, Maine, flipped a coin in 1845. Pettygrove won Portland its name.

Photograph by Photo-Art

Between Two Playgrounds—Mountain and Beach—Is Portland, "City of Roses"

Fifty miles to the east rises Mount Hood (page 750). Sixty miles to the west are sandy beaches facing the Pacific. Great fresh-water port, important industrial city, Portland is widely known for its Rose Festival followed by a ski tournament, its summer symphony concerts in the stadium, and its livestock exposition. Home sites on the many hills overlooking the business center are called "view properties" (page 792).

In 1849 gold dust and "beaver money" eclipsed that historic coin. Portland let miners stake their claims, while merchants, selling flour at $8 a buckskin sack, apples at $125 a bushel, and eggs at $1 each, claimed their stakes.

It was hard to keep up with the Columbia, even in those days. Bruno Heceta, a Spaniard, anchored off the river mouth in 1775. Captain Cook turned aside the next year, for sea-otter skins brought back by Bering's starving castaways had whetted the Chinese passion for fine furs.

In 1792, twenty-five years before William Cullen Bryant published the poetic phrase "where rolls the Oregon," Captain Robert Gray of Boston, Massachusetts, had entered the Oregon and named it after his own good ship, the *Columbia Rediviva*—Columbia the Rebuilt.

This was the same ship which, two years before, had completed a voyage which carried the American flag around the world for the first time.

At that time our Capital was "the city of Washington in the Territory of Columbia," and Columbia, honoring Columbus, was the poetic name of our land.

"View Properties" on Portland Hills

Had the Columbia been a muddy river, it might have been discovered by Russia, Spain, or England during the search for a Northwest Passage (pages 788 and opposite).

Photograph from Seattle Times

Major Sports in the Pacific Northwest Are Salmon Derbies

As the contest for hooking the heaviest salmon nears its close, the big fish are spread out on chopped ice for inspection. Forty salmon caught by finalists in the Ben Paris Salmon Derby are here on view at Seattle.

On the steep hills above Portland the realtors feature "view properties." One famous viewpoint is Mount Tabor, 645 feet high but composed of river-laid gravel left by the Columbia long before it had its present shape or name.

The Willamette Valley is a modern Eden, perfect in climate and gorged with crops, with magnificent beaches and steep ski fields within easy reach (Plate VIII).

Driving between gay gladiolus fields, we set out for Timberline Lodge, 63 miles from such Portland attractions as the Public Library, Art Museum, and supersized log cabin; the battleship *Oregon* (Plate XIV), mountainous sawdust fuel piles, and the Boss Saloon, where seagoing sailors, threescore and ten years ago, were shanghaied.

Almost everything at Timberline Lodge, from the Paul Bunyan-sized scrapers outside the half-ton door to the delicate water colors which set the motif for each guest room's individuality, is an original. The very curtain material and harmonizing bedspreads of our "Alpine Fir Room" were woven by hand.

In the courtyard, 6,000 feet above sea level, we saw a car with a canoe on its roof. Sticking through a window were two pairs of skis, with a ski lift close by (page 781).

"My Own, My Native Land"

What a country! Scott expressed it perfectly: "This is my own, my native land." More power to her—courtesy of the Columbia River!

Aided by beaver and abetted by Jefferson, that noble stream opened up young America to two oceans. Now, with the roar of potent waters, she rushes to the defense of the American way of life. Even the roistering voyageurs, who snatched warm kisses at the end of long, cold trails and sent their lusty songs echoing through these vast woods, were less romantic.

Photograph by Peggy Lane from Wide World

Invaders Have Made a Battlefield of This Croat Woman's Beloved Farm

Her homeland, Croatia, is one of half a dozen former Austrian provinces incorporated in Yugoslavia, set up at the close of the first World War. These provinces were united with Serbia and Montenegro to bring the Southern Slavs into one kingdom. The population when Nazi invasion began was about 14,000,000.

Photograph from Yugoslav Tourist Office

Moslem Girls of Southern Yugoslavia Weave a Persian Rug with Oriental Skill

Their ancestors learned this craft during the four centuries that Serbia was under Turkish rule.

© Belang from Three Lions

Lamb Barbecue Done to a Turn—Sure Sign of Spring in Yugoslavia!

Tantalizing aroma from the roasts turning on the spits outside the restaurant door attracts customers.

Photograph by Bertram Brotherton

Lake Bled, Former Playland of Yugoslav Royalty, Lies 5 Miles South of the German Border

The famous resort, high in the Julian Alps, at the nation's northwest tip, was occupied early in the Nazi invasion. Ten miles to the west is the Italian frontier. From the center of the lake juts a tiny wooded islet surmounted by a white church spire. On the crag at left stands a thousand-year-old castle.

A Fisherman Hangs His Nets to Dry Along the Shore of Lake Ohrid, Early Goal of Nazi Invaders, on the Yugoslav-Albanian Border

Serbian Women of Prizren Still Wear Turkish Bloomers

The little girl is on her way home from the neighborhood bakery, where dough kneaded in her mother's kitchen has been baked. Few homes have ovens.

Photographs by Dorothy Hosmer

When Business Is Dull, Serbian Venders Knit and Gossip

In this market place near Skoplje, one merchant displays a roll of wool cloth on top of her head. The other carries a sheepskin jacket.

© Belang from Three Lions

Now Total War Has Engulfed Serbia's Men; in Happier Days Feet Twinkled and Skirts Swished in the Gay *Kolo*

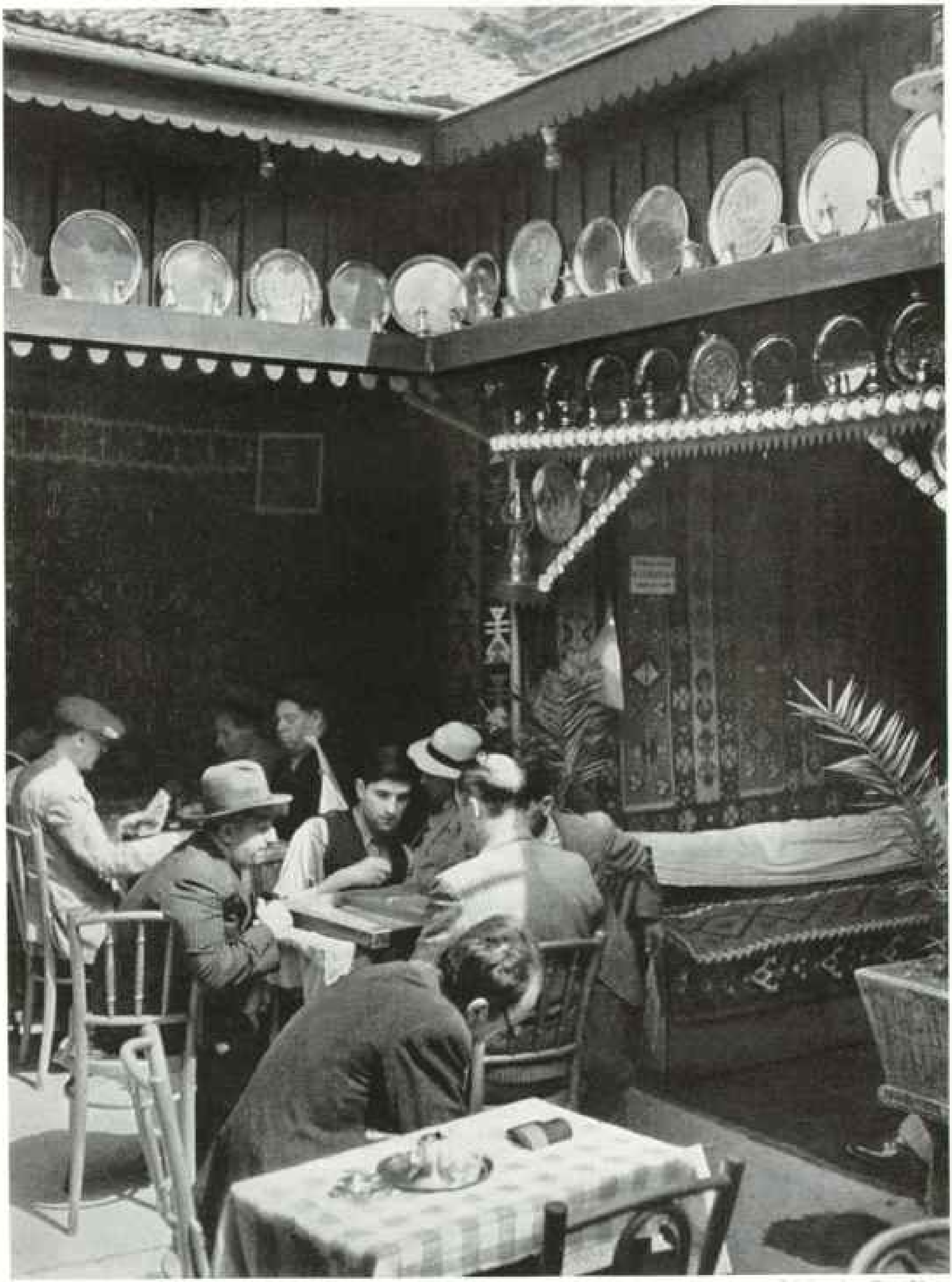
Blond, blue-eyed girls from several villages gathered at the foot of a mountain near Skoplje for a Sunday afternoon dance following the fall harvest. Skoplje, at the head of the Vardar Valley, was one of the first objectives of the Nazis as they drove west from the Bulgarian border, in April, 1941, and thence south to Salonika, Greece.

Century-old Wine for the Oldest Bridegroom

In Bosnian villages many couples set their weddings for the last Sunday before Easter. The oldest newlyweds receive special honors.

Garland and Apple on Back Mean He Is a Newlywed

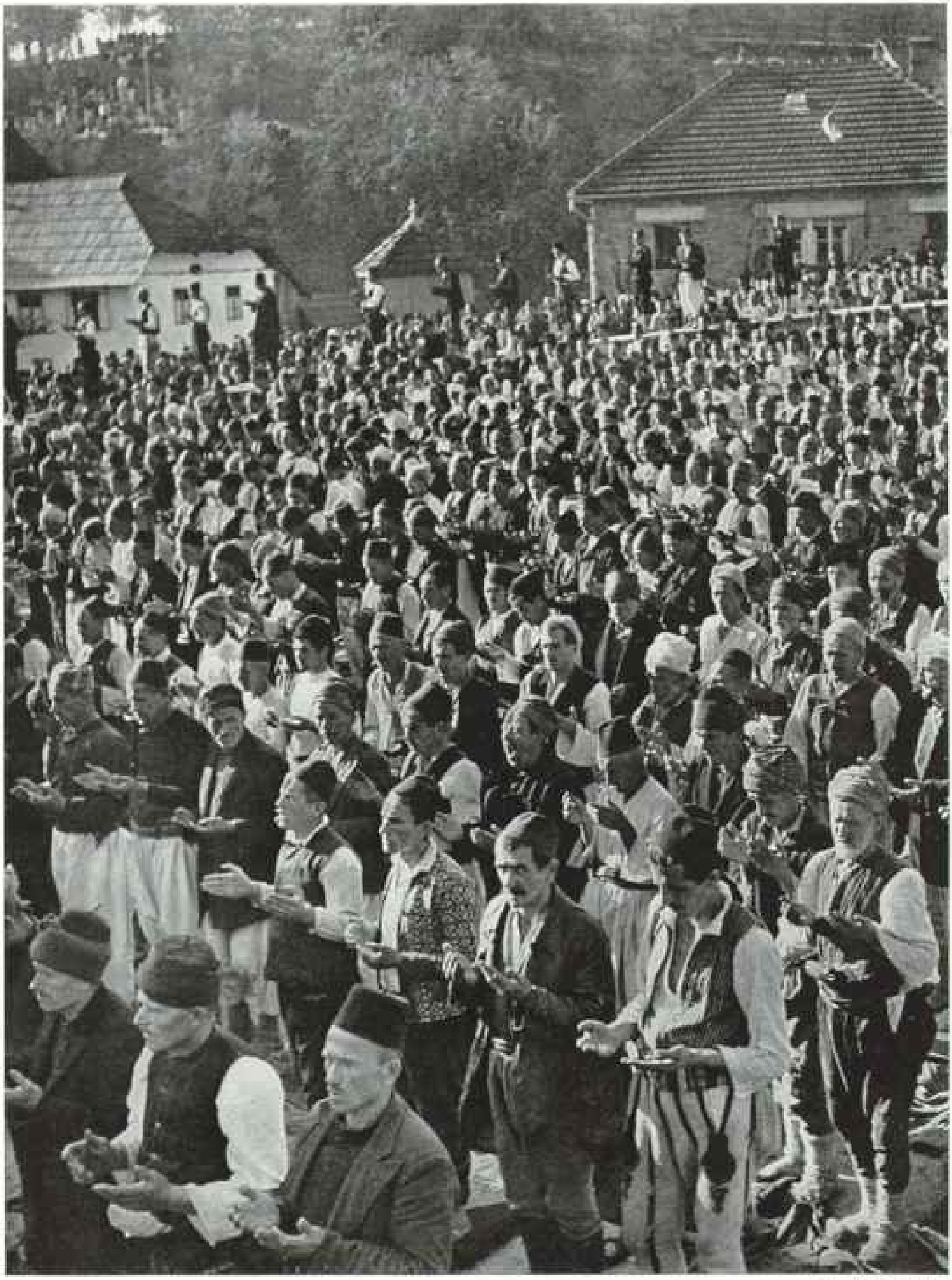
The Bosnian farmer has come into town with his sweetheart, to be married at a mass wedding. The entire countryside celebrates the day with feasting.



© Bolang from Three Lions

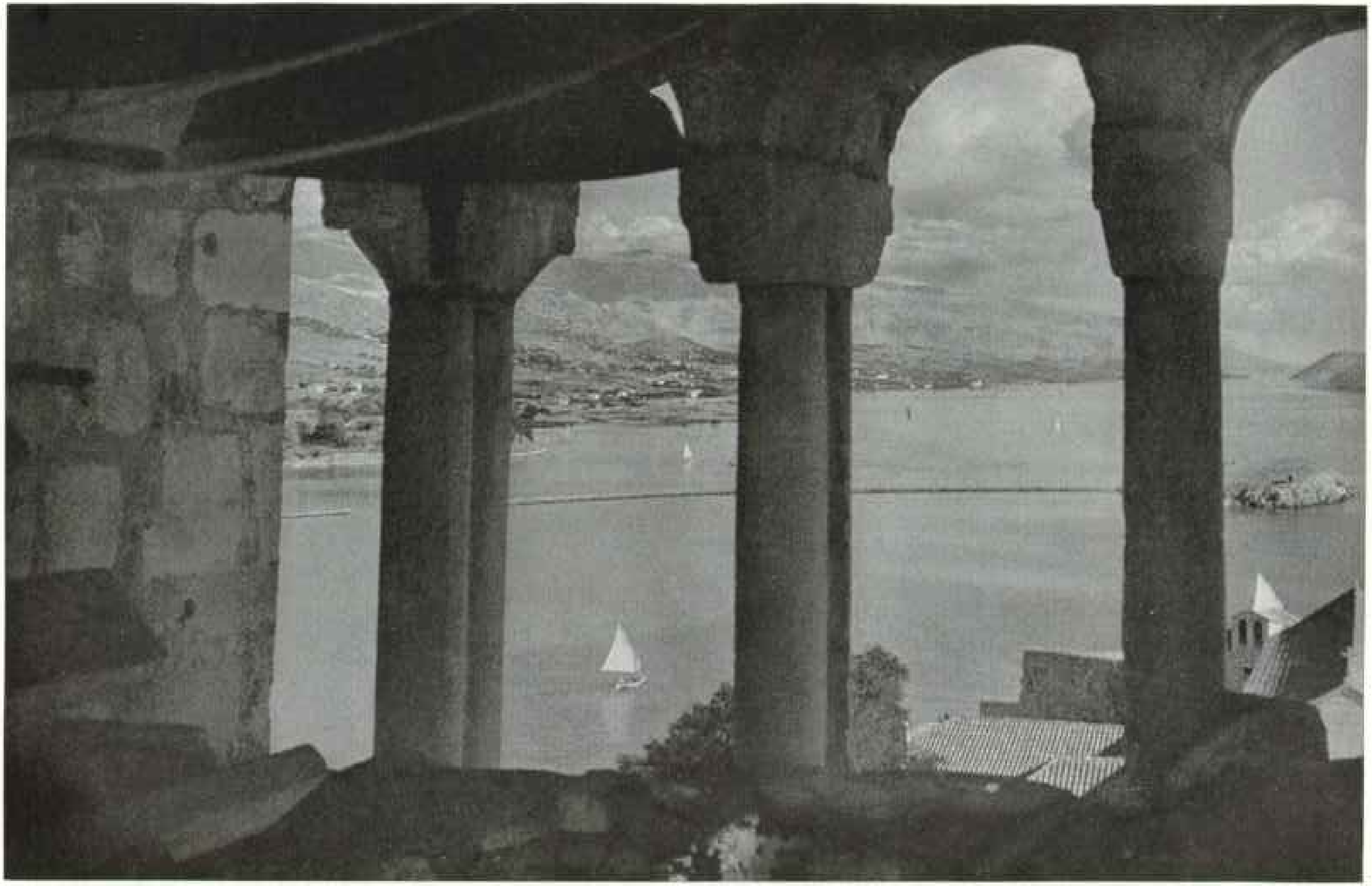
Hub of Business and Pleasure in Sarajevo—the Coffee Shop

When a man considers he has done enough work for the day, he leaves his job and sits at a small table, sipping thick Turkish coffee. Merchants from the bazaar gather here to complete business deals. Friends while away the hours, playing at cards or other games. Such was life before war came.



Bosnian Moslems, Answering the Muezzin's Call, Overflow Their Mosque

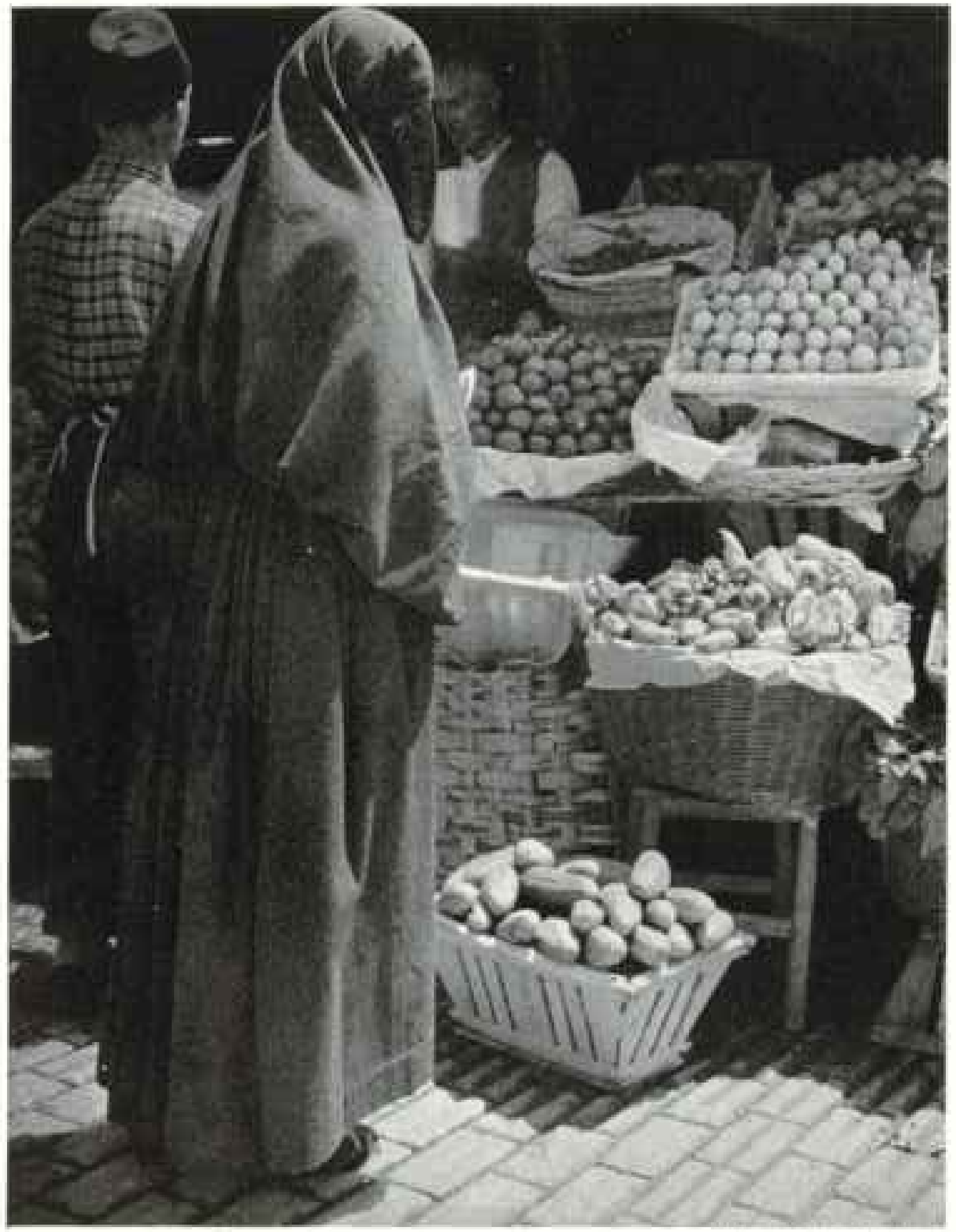
A million and a half Yugoslavs are Mohammedans, whose ancestors embraced that faith under the four centuries of Turkish rule. Today they cling more rigorously to old Turkish customs and dress than modern Turkey. Most Yugoslavs belong either to the Serbian Orthodox or Roman Catholic Churches.



Photograph by Ezio Vidoz

Archways of a 700-Year-Old Campanile Frame Rab, Island Town in the Adriatic

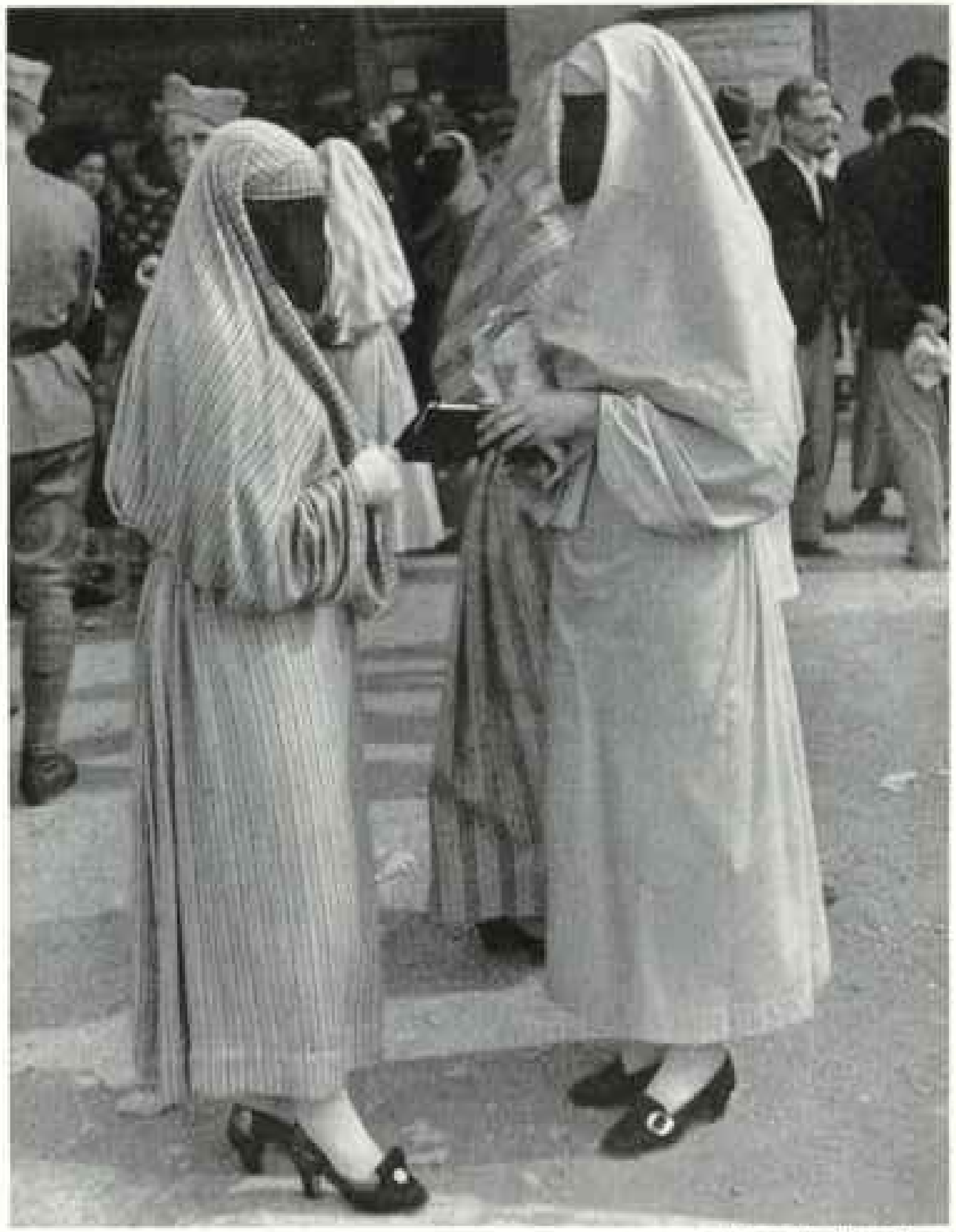
Ancient and modern contrast sharply along Yugoslavia's coastline, which faces Italy across the Adriatic Sea. Ruins of Roman cities, well-preserved medieval castles, and small, bustling harbors dot its shores. Stretching 350 miles as the crow flies, the coast is so indented that its actual length is nearly three times as great.



© Rebma from Three Lions

Paprika, Cucumbers, Tomatoes—Take Your Pick!

This veiled Moslem woman is shopping in Sarajevo. Farming in Yugoslavia is varied, ranging from wheat in the north to rice and cotton in the south.



© Belzeg from Three Lions

Smart Shoes and Handbags Match Heavy Black Veils

Bosnian Moslem women observe old customs on city streets, but at home or on an outing in the country they discard coverall gowns and veils.

© Keystone from Three Lions

This Montenegrin Mountaineer Wears His Fortune On His Back

Here the hefty hillsman takes his ease in a churchyard on a feast day, awaiting his turn for a seat at the banquet table. Costly, festive garb may represent his entire wealth. His homeland is in the mountainous southwestern tip of Yugoslavia which borders Albania and the Adriatic.

The Society Maps Northwestern United States and Neighboring Canadian Provinces

THE great northwestern United States and neighboring Canadian Provinces are mapped in all the richness of their stirring history and scenic splendor in the big new supplement which accompanies this issue of the NATIONAL GEOGRAPHIC MAGAZINE.

Here is a full-length portrait in colors of a vast vacationland and rich repository of natural wealth—a land of mountains, mines, and national parks; of lumber, lakes, and electric power; of wilderness, farms, and busy cities beneath their snowy guardian peaks.

Notes give striking facts concerning places, products, and pioneers. Dotted red lines show routes of explorers and early settlers through the wonder world of the West. In contrast are the latest engineering projects and recreation areas, roads, railways, Indian reservations, and cities mapped in the light of the new United States census.

This unusual international map, 24½ by 36 inches, forms a notable addition to the National Geographic Society's "Rediscovering America" series of decorated, fact-laden charts, which thus far have included Historic and Scenic Reaches of the Nation's Capital, Reaches of New York City, and the Southwestern United States.*

The area shown in the new map reaches from Salt Lake City deep into western Canada and from the Black Hills to the Pacific. It covers the five northwestern States—Washington, Oregon, Idaho, Montana, and Wyoming—and also a section three hundred miles wide running across the Canadian Provinces of British Columbia, Alberta, and Saskatchewan.

Area Strewn with National Parks

Here geography runs wild in some of the most remarkable mountain country on the globe. Within the compass of the map the wide fertile farms of the Great Plains give way to the Rocky Mountains, and the towering backbone of the continent yields in turn to the lesser ranges stepping down to the Pacific.

The region is strewn with national parks.

Yellowstone, father of them all, has the highest large lake in North America, some of the world's most spectacular geysers, and one of the Nation's most arresting river canyons and waterfalls.†

Jasper, largest of the Canadian parks, has magnificent lakes, glaciers, and snowfields, now made much more accessible by the Columbia Icefield Highway (page 749). A note on the map recalls that the park takes its name from Jasper House, early fur-trading post, which in turn owed its name to Jasper Hawse, an obscure trapper.

On both sides of the friendly border is the Waterton-Glacier International Peace Park, with some 75 glaciers, 250 mountain lakes, and deep "U" valleys cut by rivers of ice.

Many of the lordly snow-capped mountains were once fire-spouting volcanoes—Mounts Rainier, Olympus, Hood, Shasta, and scores of others. Such a volcanic cone was prehistoric Mount Mazama, which swallowed its head, leaving the huge depression which forms incomparable Crater Lake in southwest Oregon.‡

Dotting the map are other national parks and monuments, or points of pilgrimage set aside by States and Provinces. They range from South Dakota's Mt. Rushmore Memorial Park, with its colossal figures by the late Gutzon Borglum, to the new Olympic National Park in Washington, "America's last frontier," and Tweedsmuir Provincial Park in British Columbia.

America the Bountiful

From the metal-hearted mountains of these States and their Canadian counterparts come many of the mineral sinews of industry and defense. Shown on the map are some of the sources of copper, lead, zinc, manganese, and other metals, including silver and gold.

Living gold and silver leaps in the streams—trout and salmon sporting in the cold mountain waters. When explorers Lewis and Clark passed the lower Columbia in 1805 they were impressed with the Indian salmon fisheries, and Lewis carefully described the native methods of catching and curing the fish. Today they would find that crude fishery grown to a great Northwest industry.

Of the whole world production of canned salmon, more than two-thirds comes from the Pacific Northwest, and the area shown on this map yields about one-fifth of the world's

* Additional copies of the new map, Northwestern United States and Neighboring Canadian Provinces, may be obtained by writing to the National Geographic Society, Washington, D. C. Prices, in United States and Possessions, 50¢ on paper (unfolded); 75¢ mounted on linen. Outside of U. S. and Possessions, 75¢ on paper; $1 on linen—all remittances payable in U. S. funds. Postage is prepaid. A list of all maps available for separate sale will be sent upon request.

† See "Fabulous Yellowstone," by Frederick G. Vosburgh, in the NATIONAL GEOGRAPHIC MAGAZINE for June, 1940.

‡ See "Crater Lake and Yosemite Through the Ages," by Wallace W. Atwood, Jr., NATIONAL GEOGRAPHIC MAGAZINE, March, 1937.

supply. Big producers, too, are northern British Columbia and Alaska.

Lumber in enormous quantities comes from the region's deep, dark forests. At Longview, Washington, are two of the world's largest sawmills, capable together of cutting nearly three million board feet a day.

During the first World War the Northwest yielded the tough spruce required for the fighting planes of the time. Today cheap electric power generated by the Columbia's Bonneville and Grand Coulee Dams turns crude claylike bauxite into the shining aluminum used in the modern bomber, fighter, and passenger plane.

Some of the finest finished products fly off from the Boeing plant at Seattle, home of the "Flying Fortress," to join the United States Army, to jump the Atlantic for service in Europe, or to ply the airways of peace.

Furs, not minerals, lumber, or fish, lured the earliest white men here.

Thin dotted red lines on the map follow the footsteps of famous explorers who, little more than a century ago, were paddling, poling, and trudging up or down these rivers and over these mountains. Alexander Mackenzie, Lewis and Clark, David Thompson, and John C. Frémont performed prodigious feats to map what was then a gigantic wilderness.

On this map one may compare the systematic trails of these seasoned explorers with the lost wanderings of the overland Astorians, sent by John Jacob Astor to found a fur-trading post on the far Pacific.

The famed Scottish explorer, Alexander Mackenzie, made the first crossing of the continent north of the Spanish colonies in 1793, and twelve years later the Americans, Lewis and Clark, reached the mouth of the Columbia. In 1792 the New England sea captain Robert Gray had entered and named the river.

Rubber Tires on the Oregon Trail

On the map appear the western windings of the arduous Oregon Trail. Just one hundred years ago, May, 1841, a band of settlers headed west from Independence, Missouri, and 32 finally reached Oregon. The following year the real advance on Oregon began. In 1845 some 3,000 settlers went over the trail, plowing axle-deep through the dust along the Platte and the Snake where now big irrigation projects have turned the dust into gardens of sugar beets, alfalfa, and seed potatoes.

The Oregon-bound emigrant of 1845 could expect to find white men in only a handful of forts on the route. Today he could visit Salt Lake City, Spokane, Portland, Tacoma, Seattle, or Vancouver, British Columbia, each of which has a population of more than 100,000.

Wheels still roll west on the Oregon Trail, but they are rubber-tired wheels today—the caravan of cars on U. S. 30, which follows the historic trail throughout much of the route.

Crossed swords mark the spot in Montana where General Custer and his command were wiped out by the warriors of Sitting Bull.

An Indian story of a wholly different type is recalled by a note in the Shoshone Indian Reservation in Wyoming marking the grave of Sacajawea, the Indian girl who served as guide to Lewis and Clark on their long trek.

Explorers Would Find Even Geography Changed

In Montana the flats where Lewis and Clark hunted buffalo and fought with bears are now submerged by a vast artificial lake, Fort Peck Reservoir, which reaches some 180 miles up the Missouri. At Great Falls, Montana, where they spent a whole month portaging and mapping in 1805, they would now see the river harnessed in huge hydroelectric plants.

When Lewis and Clark were working their way up the Jefferson and Beaverhead, they never imagined that each push of their poles in the river sands was stirring quantities of gold nuggets and dust. A few decades after their passage, hordes of men were swarming over this quiet valley, pursuing the gold they had passed. Alder Gulch, Virginia City, and Rattlesnake Creek are some of the names here, redolent of gold-rush romance.

Butte, which lies a little north of the route, is built on one of the richest mineral deposits yet discovered in the world. Beneath the area covered by Butte's 235 miles of surface streets there are well over 2,000 miles of tunnels and corridors through which two to three billion dollars' worth of copper, silver, gold, lead, and zinc has been brought to the surface since 1864.

After crossing the Continental Divide and coming out of the mountains onto the great lava plateau, the explorers would find that they had entered Spokane's rich "Inland Empire," with its wheat, fruit, wool, its timber and minerals. In this area lies the Columbia Basin Reclamation Project.

Such a trip in the tracks of Lewis and Clark leads across the center of the map, but north of the 49th parallel, in Canada, one would find much the same people, doing the same things. The plainsman of Saskatchewan has much in common with his Dakota or Montana counterpart, just as have the miners of Butte and Trail, the orchardists of the Okanogan and Yakima, or salmon fishermen of Astoria, Seattle, and Vancouver.

NATIONAL GEOGRAPHIC SOCIETY

GEOGRAPHIC ADMINISTRATION BUILDINGS

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ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded fifty-three years ago, the National Geographic Society publishes this Magazine monthly. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material which The Magazine can use, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

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

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

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

The National Geographic Society-U. S. Navy Expedition camped on desert Canton Island in mid-Pacific and successfully photographed and observed the solar eclipse of 1937. The Society has taken part in many projects to increase knowledge of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

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 world's largest ice field and glacial system outside the Polar regions was discovered in Alaska by Bradford Washburn while making explorations for The Society and the Harvard Institute of Exploration, 1937-8.

The story of Anne

and how she grew!

(from a mother's diary)

JUNE 15, 1920. Took her home from the hospital today. Jim carried her in mother's clothes-basket. She's so tiny!

NOVEMBER 8, 1920. I was feeding Anne her cereal—something clicked against the spoon. A tooth! Jim made me wake her up tonight so he could see it!

APRIL 4, 1924. We're so scared. Anne fell off her tricycle and cut a deep gash in her forehead. We rushed her to the hospital.

APRIL 5, 1924. Please, God, *please* don't let those stitches show!

SEPTEMBER 5, 1926. Anne started school today. Jim came home early to hear all about it.

JANUARY 17, 1931. We'll have to have Anne's teeth straightened. (I really didn't need that new coat!)

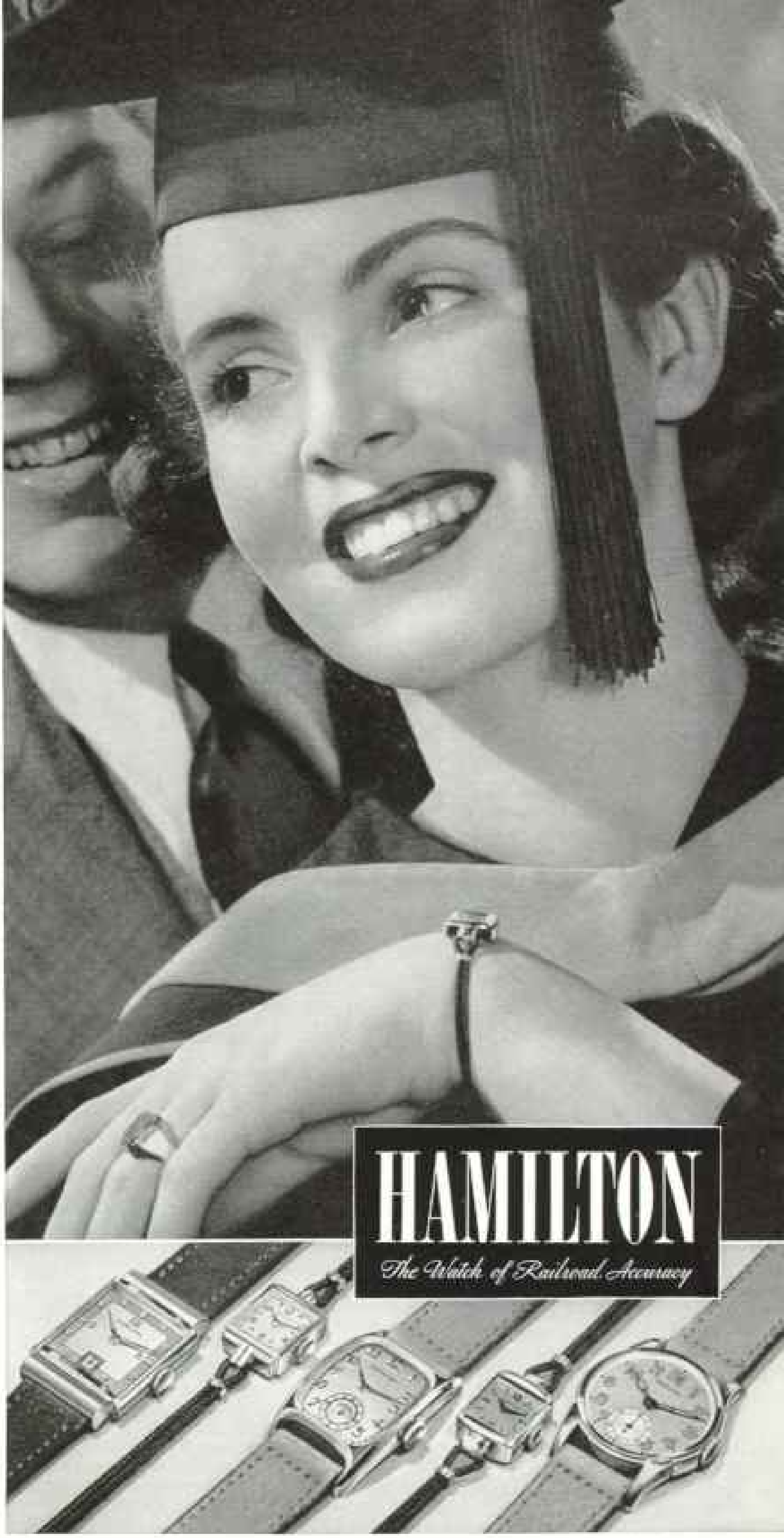
MAY 6, 1933. Anne's first dance. Her first long dress! (Made it myself.) Jim said she looked like a million and went and splurged on two orchids!

JUNE 22, 1937. High school over. Anne got a summer job all by herself. Pretty spunky.

SEPTEMBER 25, 1938. Anne's second year in college. The plucky girl is earning money tutoring.

MAY 2, 1941. In just a few weeks, Anne will graduate from college. We've talked and talked about what to give her. Only one thing seems important enough to show how we feel. It's the one thing she wants—but probably hasn't dared hope for . . . a *Hamilton watch!*

For girl or boy, there's no finer start in life than a Hamilton. All Hamiltons have 17 or more jewels. All are cased in precious metal (except special military watches). $37.50 to $5000. Made in U. S. A. Write for folder. Hamilton Watch Co., 104 Columbia Ave., Lancaster, Penna.



MIDAS. 19 jewels. 14K cased gold, 10K applied gold dots. $100.

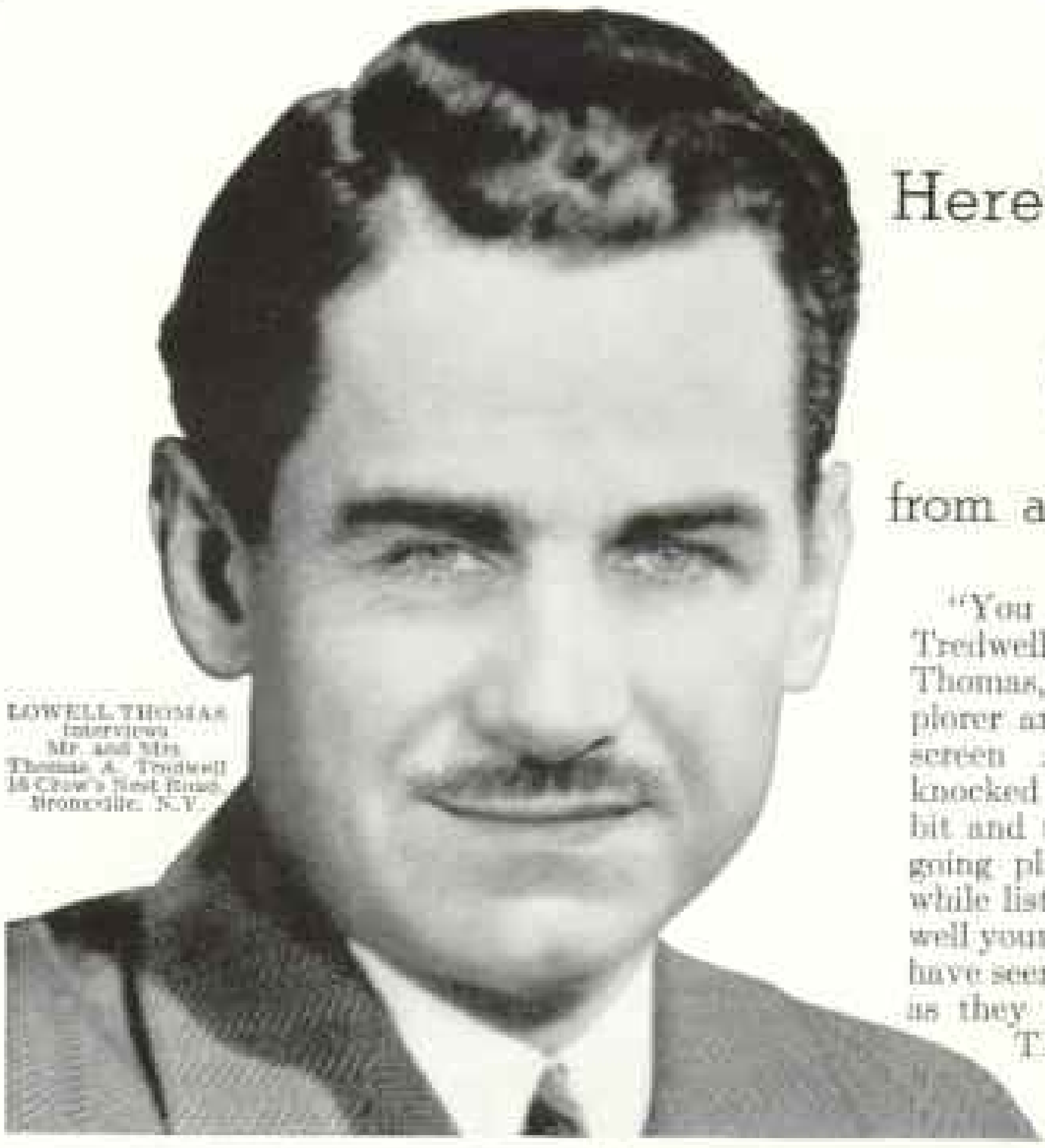
LINDA. 17 jewels. 14K natural gold. Black numeral dial. . . $55.

BOULTON. 19 jewels. 14K natural gold-filled. 10K numbers. $55.

VENITA. 17 jewels. 14K cased gold. Gold-filled fittings. . . $60.

ENDICOTT. 17 jewels, 10K natural gold-filled. $37.50

Hamilton's experience building watches for railroad men insures the greatest possible ACCURACY in every other size and grade.



LOWELL THOMAS interviews Mr. and Mrs. Thomas A. Tredwell 18 Crow's Nest Road, Bronxville, N.Y.

Here's Vacation News about *CANADA*

from an enterprising American family

(as told to Lowell Thomas)

"You should meet the Tredwells," writes Lowell Thomas, famous author, explorer and star reporter of screen and radio. "I've knocked about the world a bit and the thrills I had in going places hit me again while listening to the Tredwell youngsters. You should have seen their eyes sparkle as they described Canada. They lived thrills again; crossing the international boundary; catching their first fish; exploring wayside inns, overnight camps; cooking meals in the open; making new friends, Canadians; hearing French for the first time out of school; in their own way (without realizing it) binding our two countries closer together. There is real vacation news in the Tredwell interview*, important news for every American family."

*A Voluntary Testimonial.

Lowell Thomas: "May I come in? I'd like to tell the American people about your Canadian vacation." **Mrs. Tredwell:** "Why, certainly—but we'll probably get excited all over again, Mr. Thomas. You see it was our great vacation success. It cost less money—gave us a bigger trip—a complete change . . ." **Lowell Thomas:** "Did you plan your trip in advance?" **Mr. Tredwell:** "That was part of the thrill—all five of us worked on it.

I can show you a pile of maps, folders—all kinds of beautiful literature. Even so our trip to Canada was a revelation—the kids didn't want to come home." **Lowell Thomas:** "Was it easy to cross the border?" **Mrs. Tredwell:** "Surprisingly easy—both entering Canada and coming home there was no bother. Just routine enquiries that took a minute or two from the Canadian officials. We had birth certificates to show our officers

on the way home but almost any identification would have done. Listen to our costs—3 weeks for only 160 U.S. dollars—the exchange premium plus low living costs gave us all that value." **Mr. Tredwell:** "Yes, and we travelled 1,600 miles, visited many cities, had our own cottage for two weeks and for the first time spent less than our budget." **Lowell Thomas:** "That is NEWS. Thank you, indeed."

YOU TOO!

Like the Tredwells, *YOU*, *TOO*, can have a big exciting vacation for less money. Rate of exchange is in your favour. Canada *AT WAR* is still the world's greatest vacationland and Canadians welcome you more than ever.

PLAYGROUND OF THE NORTH!

Along every mile of the friendship border, lies a vacation wonderland—rich in old world scenes, unspoiled wilderness, varied languages and quaint customs. You'll find great modern cities, fine highways, palatial inland steamers, railways, and hotels to meet your taste and budget. So when summer comes this year take a tip from the Tredwells. Put a note on your front door saying, "Gone to Canada for a swell vacation."

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USERS CLAIM BIG SAVINGS!

You'd hardly believe the reports Seal-o-matic owners write in. *One taxi fleet operator figures 34.6% more tire mileage. A private owner says his Seal-o-matics, used for three years on three cars, saved him the cost of at least six tires!* Names and addresses of these users furnished on request . . . and for many other amazing experiences, see the latest Seal-o-matic booklet. Write to The B. F. Goodrich Company, Akron, Ohio, Department G-1.

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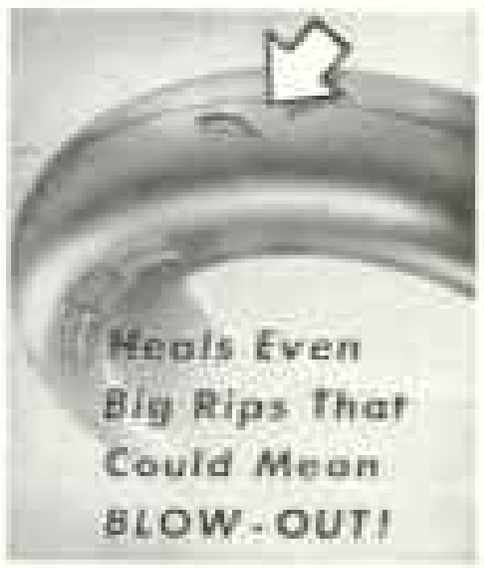

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"HEADS UP!"

Give 'em room—they're moving! Cranemen swinging their giant loads of rank frames and turbine castings . . . operators of massive presses thumping out parts for guns and motors . . . workmen lit by the flare of electric welding—moving to the quick beat of the punch press, to the rumble of the conveyor, to the whine of the whirling lathe. Things are rolling today in America's factories.

Action—that's what we're getting—from the world's best workmen and the world's best production machinery. For the American workman of today is a superman compared with his counterpart of only a few decades ago. Industry has given him as helpers mechanical strong men in the form of power tools and machines. These multiply his effective strength; they help him to produce more—better—faster.

Men and machines—they've made the American standard of living the highest in the world. Now, working together as never before, they're making the things we need to defend that American standard.

Heads up! Industry is on its way—meeting the urgent requirements of the immediate present.

Today, as for the past 60 years, General Electric scientists, engineers, and workmen are finding new ways to apply electricity to multiply the strength of the American workman's muscles—to increase his efficiency—to make America secure. General Electric Company, Schenectady, N. Y.

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Up in the Arctic Lockheeds are performing some of aviation's toughest jobs.

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GUARANTEED BY
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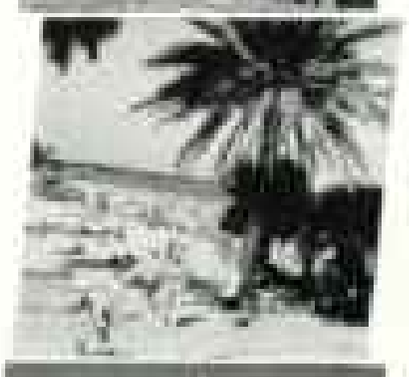

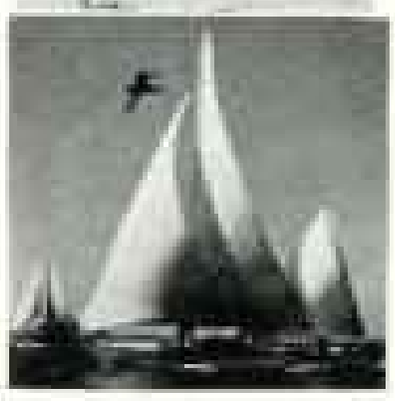

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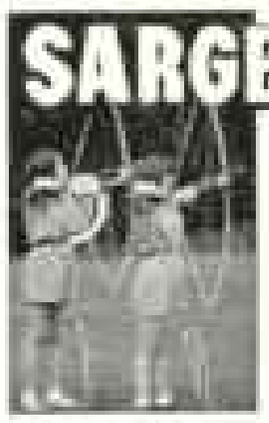

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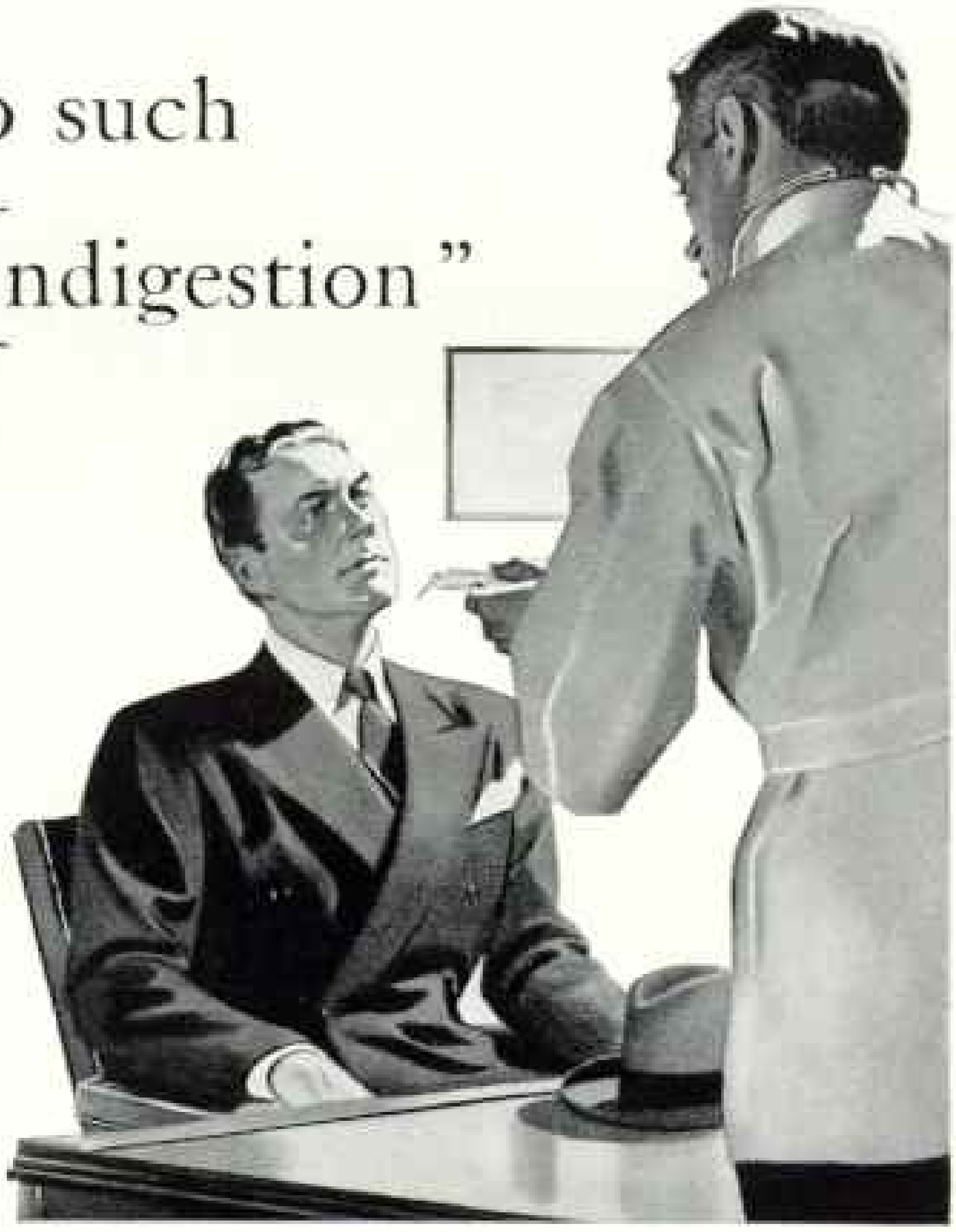


ONE OF THE MOST frequent causes of unhappiness is chronic indigestion, or dyspepsia.

► Contrary to an all-too-common misconception, indigestion should not be considered, in itself, a disease. It is, more accurately, a *result* of some physical trouble or possibly disease.

It is a symptom; an indication that something is wrong. That "something" often may be readily corrected when your distress is caused by faulty diet . . . bad eating or drinking habits . . . lack of exercise . . . excessive smoking . . . fatigue or excessive worry.

Persistent indigestion, however, may be the result of a truly serious disease. For instance:

> Disease of the gall bladder . . . of the kidneys . . . of the heart . . . chronic appendicitis . . . ulcer . . . cancer.

► In fact, the danger that cancer is at the bottom of persistent indigestion becomes an increasing possibility after one has reached the age of 45.

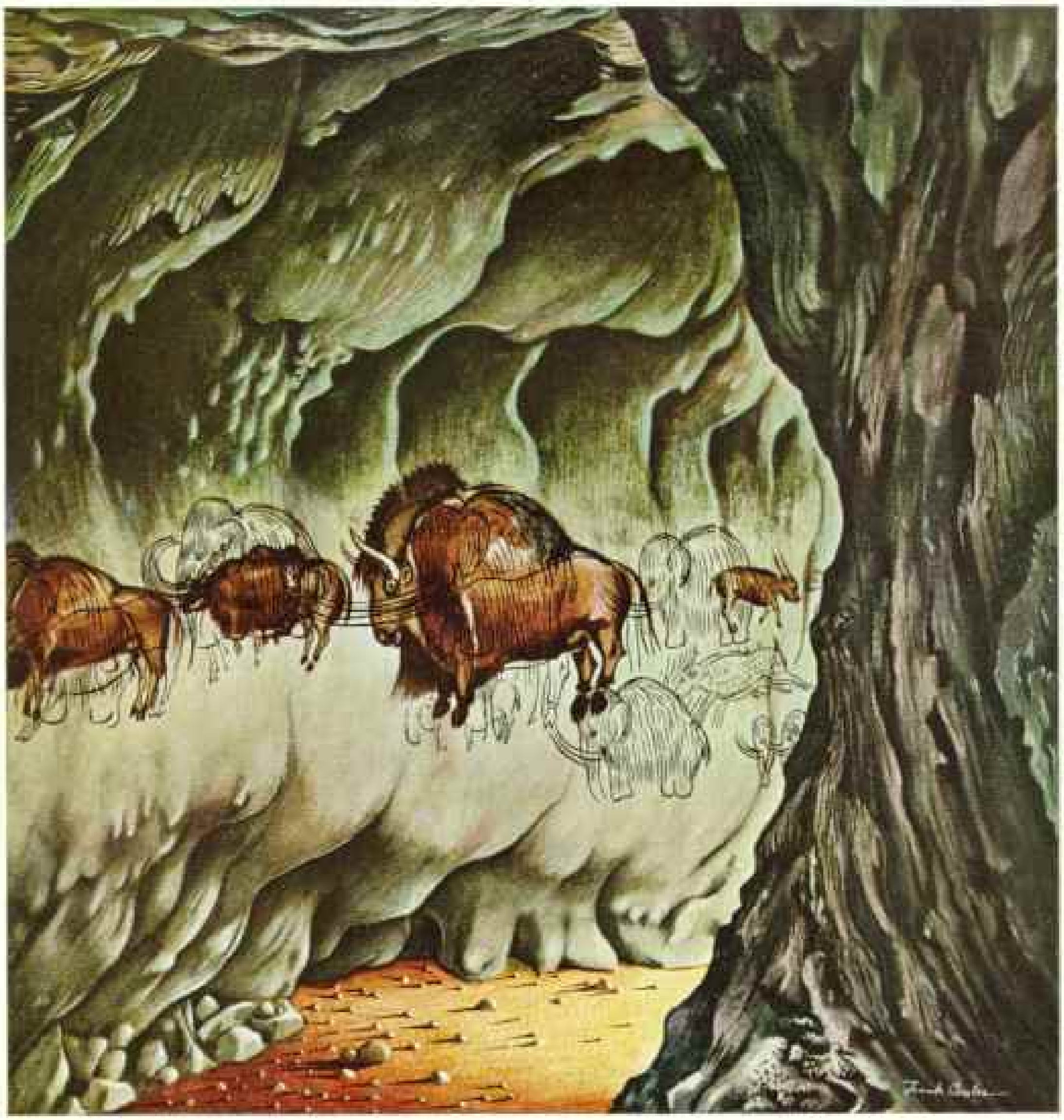
Yet it is also true that most of the serious diseases which cause indigestion—cancer included—can be treated with good chances of success when recognized in time.

► The *worst* way to try to correct indigestion is to indulge in self-treatment. If it *is* caused by disease, self-dosing may be really dangerous—as in appendicitis, for instance. Your medicine closet is not a substitute for the doctor.

Regardless of your age, your doctor should be consulted promptly when dyspeptic symptoms persist. To help him make a proper diagnosis and decide what treatment your case requires, he has at his disposal many modern, accurate methods of examination and analysis. He may use the fluoroscope, the X-ray, or other technical aids.

► But, with all these aids . . . the biggest help your doctor can get in setting you on the road to health is for you to see him *in time!* Then, if it is disease . . . the earlier the diagnosis, the better the chance of complete cure.

*An interesting 10-minute Technicolor movie on food and health—"*PROOF OF THE PUDDING*"—has been produced by Metropolitan in co-operation with the United States Public Health Service. It is a contribution to national nutrition education. See it when it comes to your neighborhood.*



The Moral in the Mural

MANY, many centuries ago, a cave-man artist engraved these animal pictures on the walls of a cave, because he was worried about the future.

That may seem like a strange reason for creating a mural, but this Stone Age citizen probably believed that by drawing the animal he was about to stalk, he would assure himself of a good hunt, and a plentiful supply of food and clothing for his family. With his engraving tools, he was actually recording the things he hoped would happen.

The modern family man, like this early cave dweller, is concerned about the future. But unlike the cave dweller, he has a way of making his hopes and ambitions for the future come true. It is through insurance.

The well-planned insurance program with which you provide yourself is really a portrayal of the future. In it you are able to picture all the good things you would provide for the protection and happiness of your family. And when you have sketched the future in this manner, you may always rest in the comforting certainty that the picture you have drawn will come true.

Moral: Insure in The Travelers. All forms of insurance. The Travelers Insurance Company, The Travelers Indemnity Company, The Travelers Fire Insurance Company, Hartford, Connecticut.

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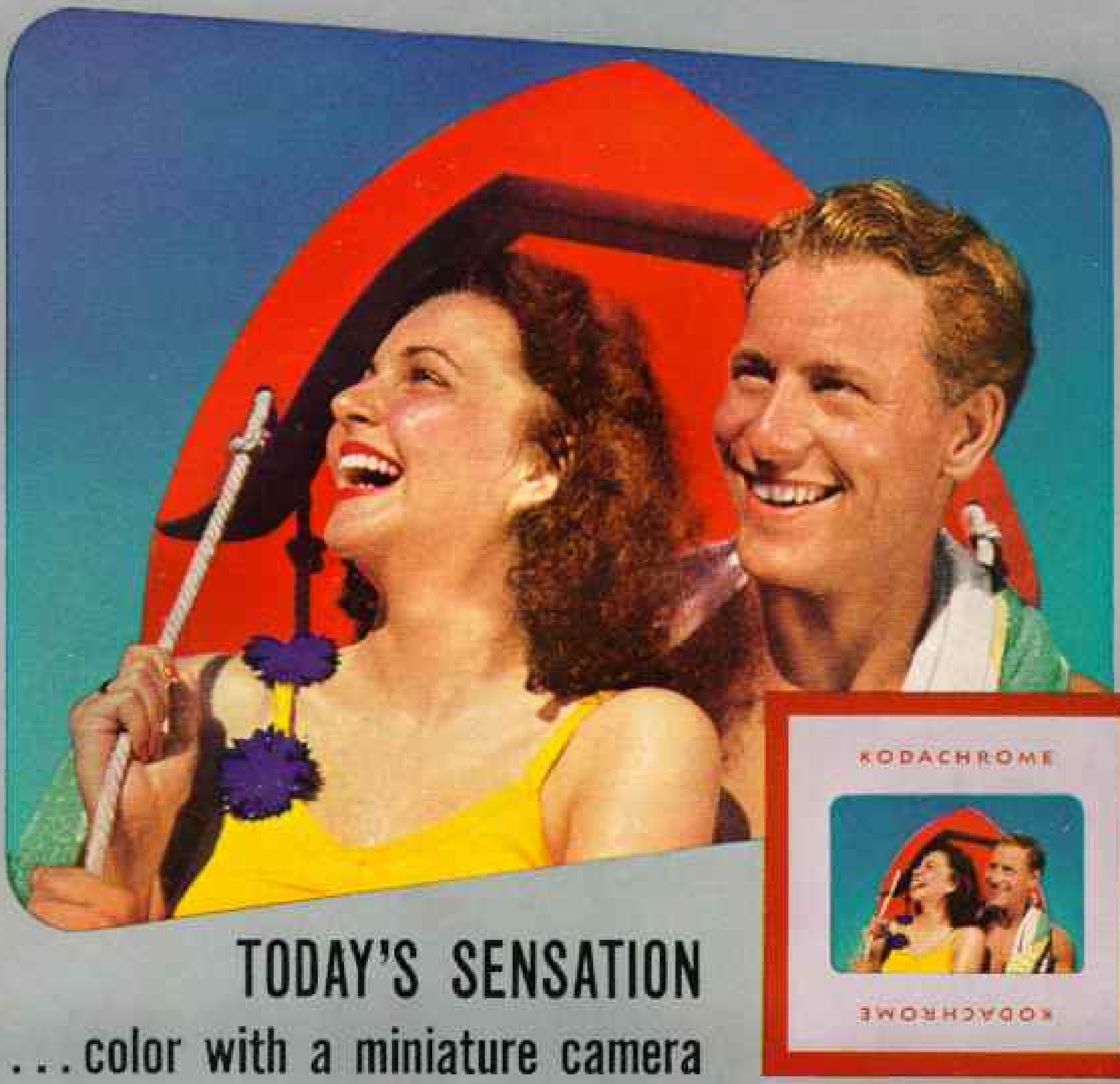
There's one thing everybody will grow this month. They'll grow thirsty.

5¢ When it happens to you, that's a good time to relax and enjoy *the pause that refreshes* with a frosty bottle of ice-cold Coca-Cola. You'll like it.



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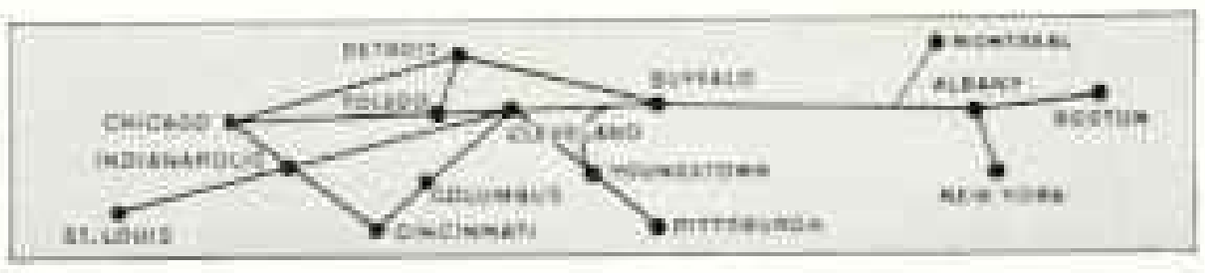

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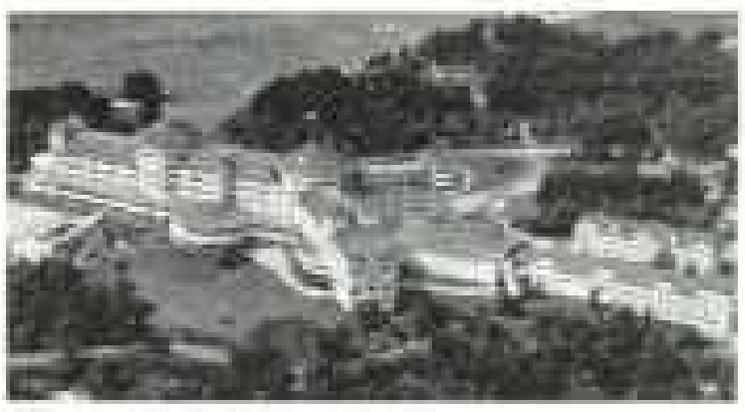

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Bonnie Oaks Inn and Bungalows. Sports. 75 rooms with baths, fireplaces. Baby Oaks, supervised play. May-Dec. Folders. Dr. and Mrs. K. H. Page.

VIRGINIA

Natural Bridge

The Natural Bridge Hotel. Delightful rooms and food. Spend the night here and see the Famous Natural Bridge of Virginia. J. Lee Davis, President.

Virginia Beach

Cavalier Hotel and Beach Club. Open all year. 2 golf courses, tennis, riding, fishing, private beach. Roland Eaton, Mgr. Dir. Write for Booklet "G."

Williamsburg

Williamsburg Inn & Lodge—Visit Colonial Williamsburg. Excellent accommodations at a wide range of rates. N.Y. Office 630 5th Ave. Circle 6-8656.

WEST VIRGINIA

Lewisburg

General Lewis Hotel

A wholesome, old-fashioned hotel in the beautiful Alleghanies of famous Greenbrier County. Early Colonial in architecture, completely furnished with antiques. Thoroughly modern in comfort. A real "find" for motorists touring the Mountain State. Rates are moderately low. European plan. For information or reservations, please address Randolph K. Hock, Manager.

White Sulphur Springs

The Greenbrier Hotel and Cottages. America's most beautiful all-year Resort. 2000 acre estate. All Sports—Tunis Bynbe. L. K. Johnston, Gen. Mgr.

CANADA

Quebec—Montmorency Falls

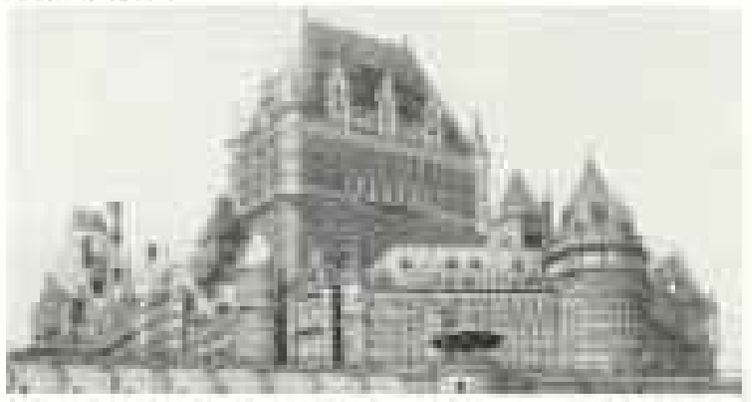
Kent House Hotel in 140 acre estate once home of Duke of Kent, 6 miles from Quebec. 18 holes golf, out-of-town rates. R. L. Desmond, Gen. Mgr.

Quebec—Murray Bay

Manoir Richelieu

One of America's most distinguished hotels at mouth Murray Bay, overlooking the St. Lawrence. Championship golf, salt water pool, tennis, social program. Luigi Romanelli's Orchestra. $8 up per day, room with bath and meals. Your dollars go further in Canada. Apply to Myron H. Woolley, Manager, Murray Bay, Quebec, or consult your local travel agent. Opens June 25.

Quebec



Chateau Frontenac

Glamour Holiday in Friendly Canada! Picture-book vacation that costs no more. Old Normandy countryside. 17th Century walled city. Live in luxury at the *Frontenac* for only $4.50 a day. European Plan. Only 60 miles from U. S. border. U. S. citizens require no passports. See your travel agent or any Canadian Pacific office. In New York, Madison Avenue at 44th.

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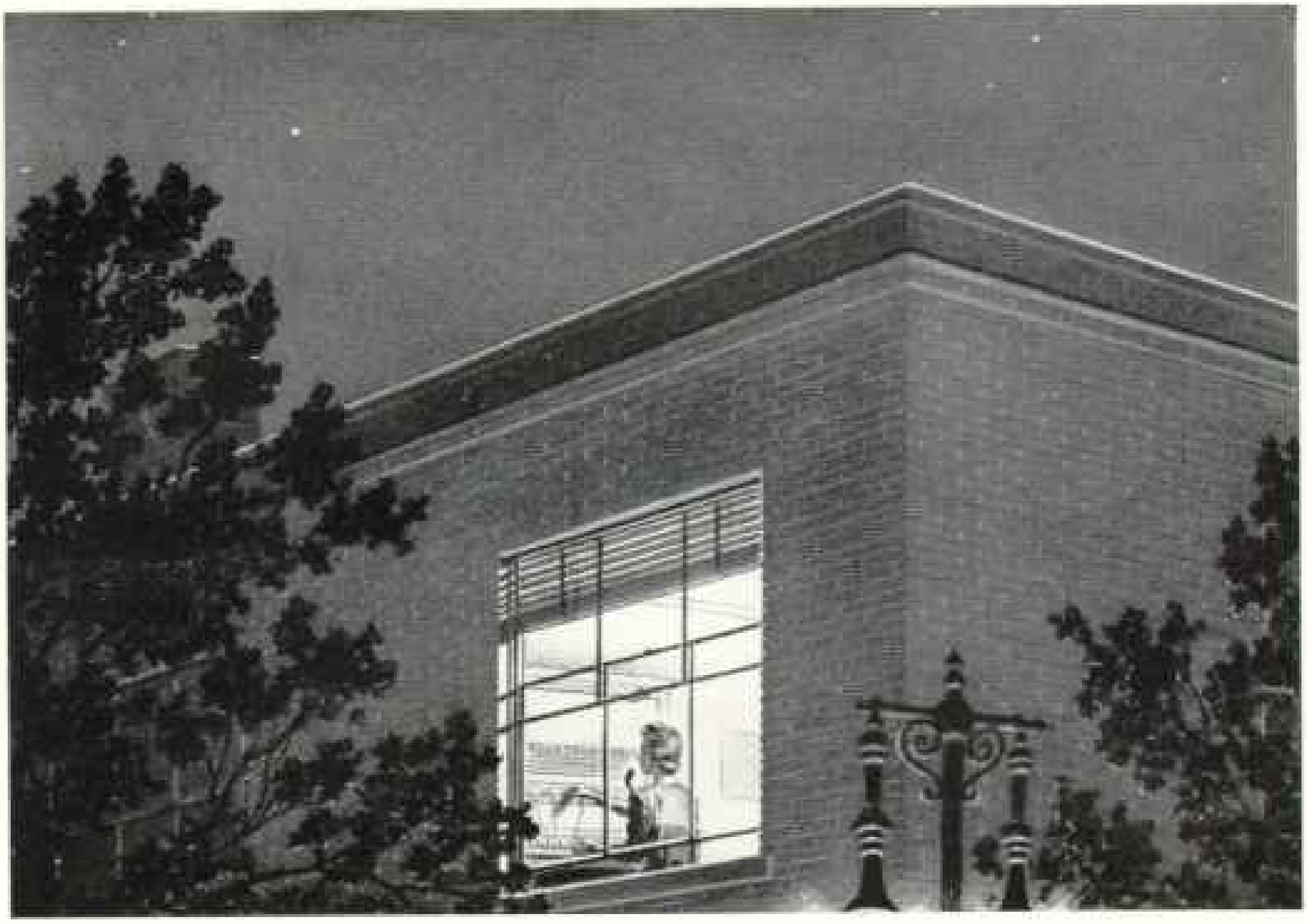
MEXICO

Mexico City

Hotel Reforma. Mexican hospitality at its best. On the beautiful Paseo de la Reforma. Distinguished atmosphere. Superb appointments. Singles from $3.



"I judge the telephone company by the people who work for it"

A little while ago, in a Vermont newspaper, there appeared a comment on the telephone company and its people. It expresses so well the ideals toward which we are striving that we quote it here.

"I DON'T know how big the telephone company is, but it is big enough to exceed my mental grasp of business.

"But I don't find myself thinking of it as a business, even in my day-to-day contacts. Rather, my attention is on the voice that says, 'Number, please.' I find myself wondering if that voice is feeling as well as it always seems to, or if it feels just as hot and weary as I do, and would say so if it wasn't the kind of voice it is.

"The first time the business angle really struck home was when I read that my friend Carl had completed thirty years with the company.

"Now it happens that I know something of the details of those thirty years with the company, and I believe they are a credit both to Carl and to the big business for which he works.

"In 1907 Carl was a high school boy confronted with the need for earning money in his spare time. He happened to get a job as Saturday night operator in the telephone exchange. He worked at this job for three years and then entered the university.

"After graduation, he was hired full time by the telephone company, not in an 'executive' position which some folks think goes with a college diploma, but as a lineman.

"Within a year he was made wire chief of the district, a job which he held for the next ten years. He was then transferred to a larger city as manager of the office — then promoted to sales manager of the division.

"A year later he was sent to another State, as district manager. In less than a year, he was made manager for the entire State.

"I don't know much about the telephone company as a business. I can only judge it by the people who work for it. Just where the dividing line is between a business and the people who work for it, I don't know. I don't think there is any line."

Bell Telephone System

"The Telephone Hour" is broadcast every Monday. (N. B. C. Red Network. 8 P. M., Eastern Daylight Saving Time.)

Fairest of the Fair!

You'll say: "Chevrolet's First Because It's Finest!"—and you'll agree one of the finest things about it is its brilliant new Body by Fisher, shown here on the 1941 Chevrolet Special DeLuxe Sport Sedan. A bigger body inside and out—with full six-passenger comfort—on the new low-price leader by the builder of leaders—Chevrolet—leader of first place in motorcar sales for nine out of the last ten years. And remember:

Only the New 1941 Body by Fisher Has All These Features: New "Flair-flow" streamling with slanted windshield, double-curved lush window. Solid security of Unisteel Turret Top construction with new front and rear reinforcements; more rigid three-channel center pillar. Doors hinged at front for greater safety. Crank-controlled Fisher No Draft Ventilation. Planned Vision with stronger, clearer Safety Plate Glass all around.

YOU certainly get the pick of everything whenever you choose a car with Body by Fisher. It's so easy to relax in all its extra roominess—so flattering to know its sleek new lines are making such a smart impression. What more could you want? The utmost security? Well that, too, you'll find, is amply assured by its newly reenforced Unisteel Turret Top construction. No wonder so many are saying, "Body by Fisher is 'it's guide to better value'"—which leads you, of course, to a General Motors car.

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