VOLUME LXXVII NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

FEBRUARY, 1940

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

$3.50 A YEAR 50c THE COPY

VOL. LXXVII, No. 2 WASHINGTON FEBRUARY, 1940

THE NATIONAL GEOGRAPHIC MAGAZINE

OUR MOST VERSATILE VEGETABLE PRODUCT

Rubber Drops from Millions of Tropical Trees Are Transformed by Genii Chemists into Myriad Articles, from Tires to Teething Rings

By J. R. HILDEBRAND

IN AN Akron, Ohio, rubber factory I watched machines punch out, from a big sheet of rubber, paper-thin disks that looked like Lilliput doughnuts.

"They're cap liners for fingernail polish bottles," the operator explained. "They are thinner than a horse's hair; it takes a hundred to weigh an ounce."

Another machine was lathe-cutting speck-like washers for electric refrigerators. The manufacturer wanted 3,084 of them, which total weighed in at exactly three-quarters of a pound.

A Passaic, New Jersey, plant has a cathedral-like room higher than a 3-story building, with more floor space than New York's Grand Central Station waiting room, so overhead-track cranes can shuttle about rolls of conveyor belting that weigh 30,000 pounds and measure 12 feet in diameter. Wound on one roll may be more than a quarter of a mile of 5-foot-wide belting.

Such a conveyor belt is the biggest thing in rubber—and the costliest. You can order one for the price of about 20 luxurious limousines (pages 144-5).

Of course when a customer wants nine miles of belting, such as that which carries coal through a 4½-mile tunnel beneath a mountain near Pittsburgh, from mine mouth to river-bank tipple, the factory has to send out experts to splice the 15-ton pieces.

At a latex plant I saw cans of specially compounded liquid rubber addressed to a Hollywood movie studio.

"What for?" I asked.

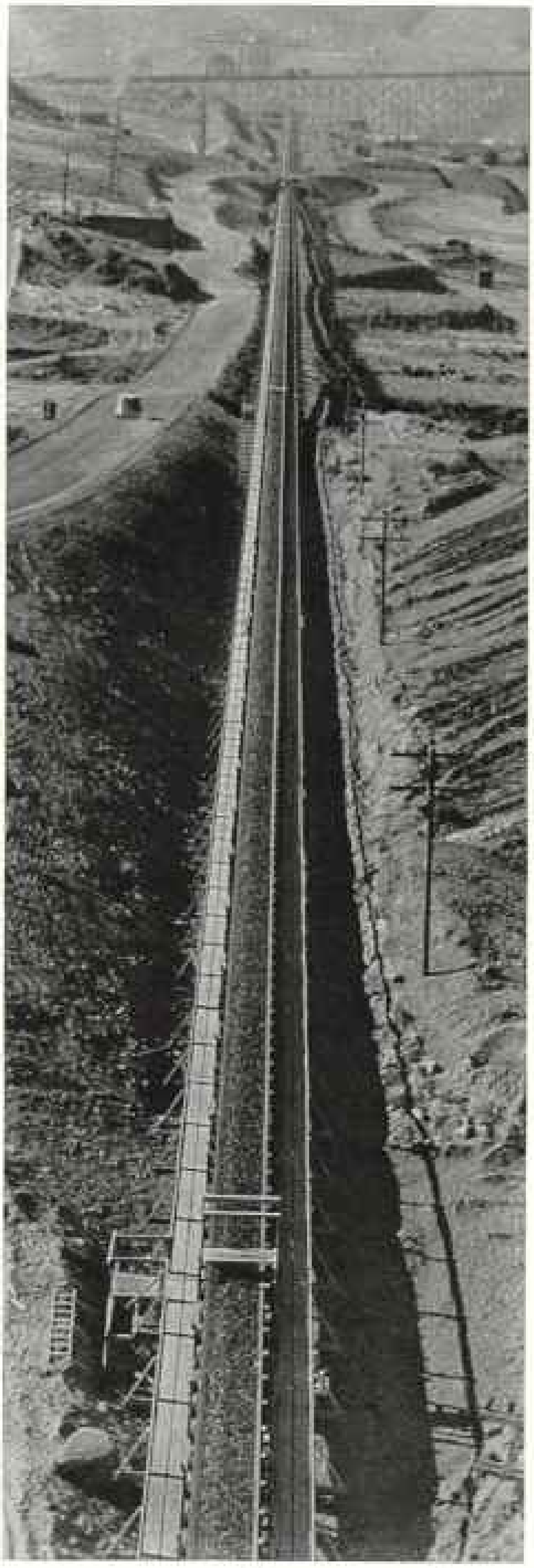
The foreman did not know, but the studio director promptly wired back: "To make the saber cut on Ronald Colman's face in *The Light That Failed*. We used latex on Akim Tamiroff's eyelids to give him a Chinese make-up in *The General Died at Dawn*.

"Also, to keep Claudette Colbert dry in *Midnight*—even her silk stockings were waterproofed. The axes in *Union Pacific* were rubber, also the alligator heads that appeared out of the swamp to snap at Bob Hope in *The Cat and the Canary*."

RUBBER DINOSAURS AND COBWEBS

Consider the chameleon versatility of rubber products: gossamer threads for cobwebs and palm-tree leaves on movie sets, mammoth balloons to help scientists explore the stratosphere, rubber horn protectors for pedigreed bulls, a rubber gasket that clamped the chamber to the sunken submarine *Squalus* to rescue 33 brave men, rubber dinosaurs for museums, de-icers for airplanes, and hunting boots—literally more kinds of rubber things than there are words in *Alice in Wonderland*.

One company alone, B. F. Goodrich, makes 32,642 rubber products, if you count all the sizes, colors, and styles. No man in the organization knows all of them; no



A MILE-LONG "RUBBER BAND"

It would take ten freight trains of 60 cars each to haul the 10,000 tons of sand and gravel this conveyor pulls up daily at the Grand Coulee Dam.

catalogue contains them all, because no individual or corporation could conceivably be a customer for all the classifications.

Possibly the manufacturers who have put from 280 to 330 rubber parts in your automobile or 400 pieces in a two-engine airplane might be interested in golf balls. But an insulation engineer would not be buying jinricksha tires, nor would a surgeon customer for rubber gloves be a prospect for sand-blasting helmets or 600 rubber horses (seven inches high) for *The Charge of the Light Brigade*.

FROM DIVING HELMETS TO FOOTBALL FACE GUARDS

A reconnaissance stroll through a mechanical goods and sundries plant hinted at the enormous diversity of rubber products. The superintendent, like a train dispatcher, was scheduling his foremen to start on 600 orders for that day.

Here, under one roof, you see them making rubber parts for dishwashing machines and plate racks for restaurants, door seals, storage battery containers, diving helmets, and face guards for football players.

Rubber gloves ranged from tissue thinness, nine-thousandths of an inch, for surgeons, to sturdy electricians' gloves, nearly a tenth of an inch thick, tested to withstand 16,000 volts (Plate V).

Piles of odd-looking parts were for electric refrigerators; there are from 4 to 30 rubber parts in your "electric icebox," depending on the make. They save one violent complaint from a lady who said her purchase "don't make no ice at all"; it developed she had put in no water. "The salesman said electricity done it all," she wrote, still disappointed.

Men feed batches of blue, red, and yellow rubber between crunching calender rolls to make mottled designs for beach balls, bathing caps, and decoys (Plate II).

Suddenly you come upon a menagerie—ring-tailed monkeys, elephants, geese, leering crocodiles, and gawky giraffes. You see items for the seasonal trade, red devils for Halloween and Easter bunnies. In July here it is Christmas, with mounds of Santas and rubber dolls.

From glad to gruesome you keep on, and see cadaver sacks, headrests for coffins, and shoes for corpses. Then surgical goods: rubber bulbs, syringes, catheters.

"Sixty-five regular kinds of bulbs and syringes," the manager tells you.

Photograph by U. S. Bureau of Reclamation

LIKE PAPER FOR GIANT PRESSES, TWO MILES OF BELTING UNROLL

Moving over a mile-long stretch, these 80 tons of 4-foot-wide belting made of two vegetable products, rubber and cotton, carry sand and gravel from the washing and screening plant to stack piles near the Grand Coulee Dam, in Washington State. Its eight sections were vulcanized together on location. A conveyor system more than nine miles long is planned at Shasta Dam, California.

"What item do you put out in largest numbers?"

"Rubber bands. Sometimes 12 million a day. We make 150 standard kinds; many more varieties on special orders."

A RAINBOW OF RUBBER BANDS

Rubber bands would cost more if human hands had to lay 50 or 100 side by side and then tie them with another rubber band.

Instead, there is a bundling machine into which they dump bushels of bands of many colors. They fall through slits of a revolving drum; some catch on a spiral wire, others drop on a belt that feeds them into the drum again.

From the spirals they drop onto a collecting wire, mounted on a pivot and balanced by a weight. When the loaded wire topples off a bundle, a girl grabs them and deftly wraps a band around their middle.

"What's your most delicate job here?"

"Piston cups for hydraulic brakes on automobiles," the manager replied. "If a cup is wrong, your brake won't work. Then, maybe, sudden death."

The parts are only a quarter of an inch thick, about 1¼ inches diameter; a hundred of them weigh 2½ pounds. Here they make some 16,000,000 a year.

There are seven ingredients in the compound. Each ingredient must pass four tests. They mold the cups between shiny chromium and stainless steel.

Each must be accurate to two-thousandths of an inch—less tolerance is allowed them than anything else in rubber, except golf balls (page 191). They must fit a ring gauge for exact diameter and pass a micrometer test for height. Each must withstand up to 600 pounds' pressure to the square inch suddenly applied when you throw on your brakes.

In a scientifically lighted room alert, keen-eyed girls peer through microscopes and throw in a "no-go" basket every piece

RUBBER MAKES COBWEBS FOR A MINE IN THE MOVIES

The synthetic strands are rubber cement blown from a spray gun. Goodrich engineers calculate that a pint of the cement yields a slender thread that would stretch from Los Angeles farther eastward than Denver. This scene shows the bulkhead of an abandoned mine in the 20th Century-Fox production, "The Jones Family in the Grand Canyon."

that has the tiniest nick, blister, or speck of dirt. The good ones go into a dark room for X-ray examination.

And, after all that, they sell for a factory price of from 1½ to 3 cents apiece!

On we walked, past recoil bands for butt ends of shotguns; "acid fingers," which are acid-resisting rubber tips for laboratory instruments; canners' gloves, including special prick-proof "pineapple mittens" for Hawaii; masks for beauty parlors; myriad tiny tires, down to a half-inch diameter for toy autos, and then into toyland. Here's a paradise for any child—50,000 toys a week; one week they molded 25,000 Ferdinand the Bulls.

BUYING RUBBER UNAWARES

So swiftly crowd in new uses of rubber that day by day we are purchasing rubber unawares.

Buy salt, cocoa, bread, canned vegetables and fruits now, and you may be buying rubber, too. For rubber film on pasteboard replaces the tin that once kept salt pouring and the cocoa flowing.

Rubber supplants soldering to keep the vacuum in tins and jars so that you may eat asparagus in January and California cherries in Maine or Manila.

"Why in the world don't they invent rubber type, so we can squeeze everything in?" joked an editor.

They have done so, although you can't compress it. Rubber-coated paper, printed with rubber type, protects your daily bread loaves.

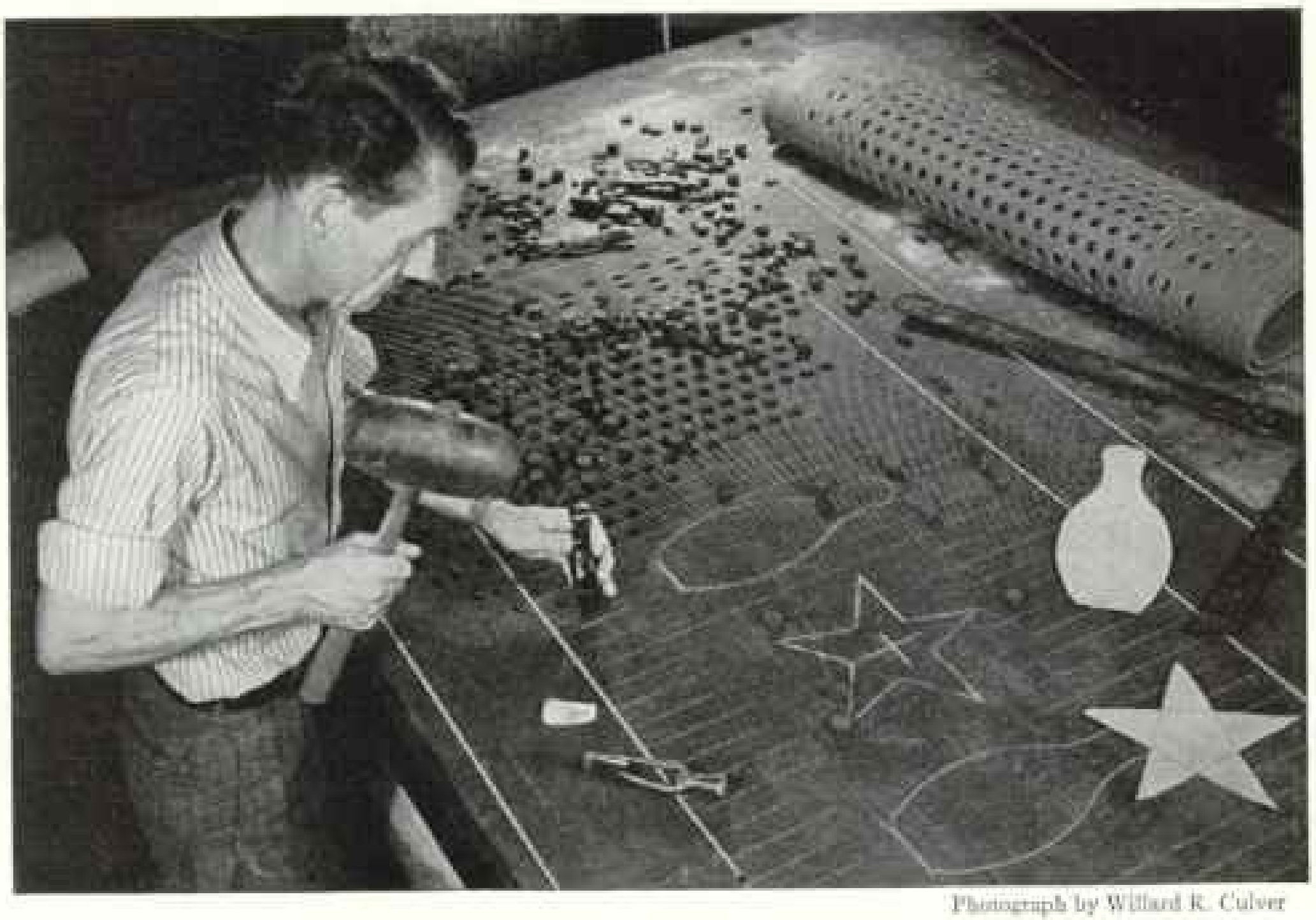
Posters, Christmas cards, popcorn bags, paper napkins, even a couple of novels now on sale, have been printed from the new rubber-type plates.

From "idea men" and inventors pour in requisitions for new articles they propose to make of rubber. One was for rubber covers on watches, another for a rubber-tired hoop. There were orders for rubber doorsills, rubber kneeling pads for churches, rubber washers for communion glass holders on the

Photograph by J. Baylor Roberts

TREES OF 1876 STILL THRIVE IN LUSH CEYLON

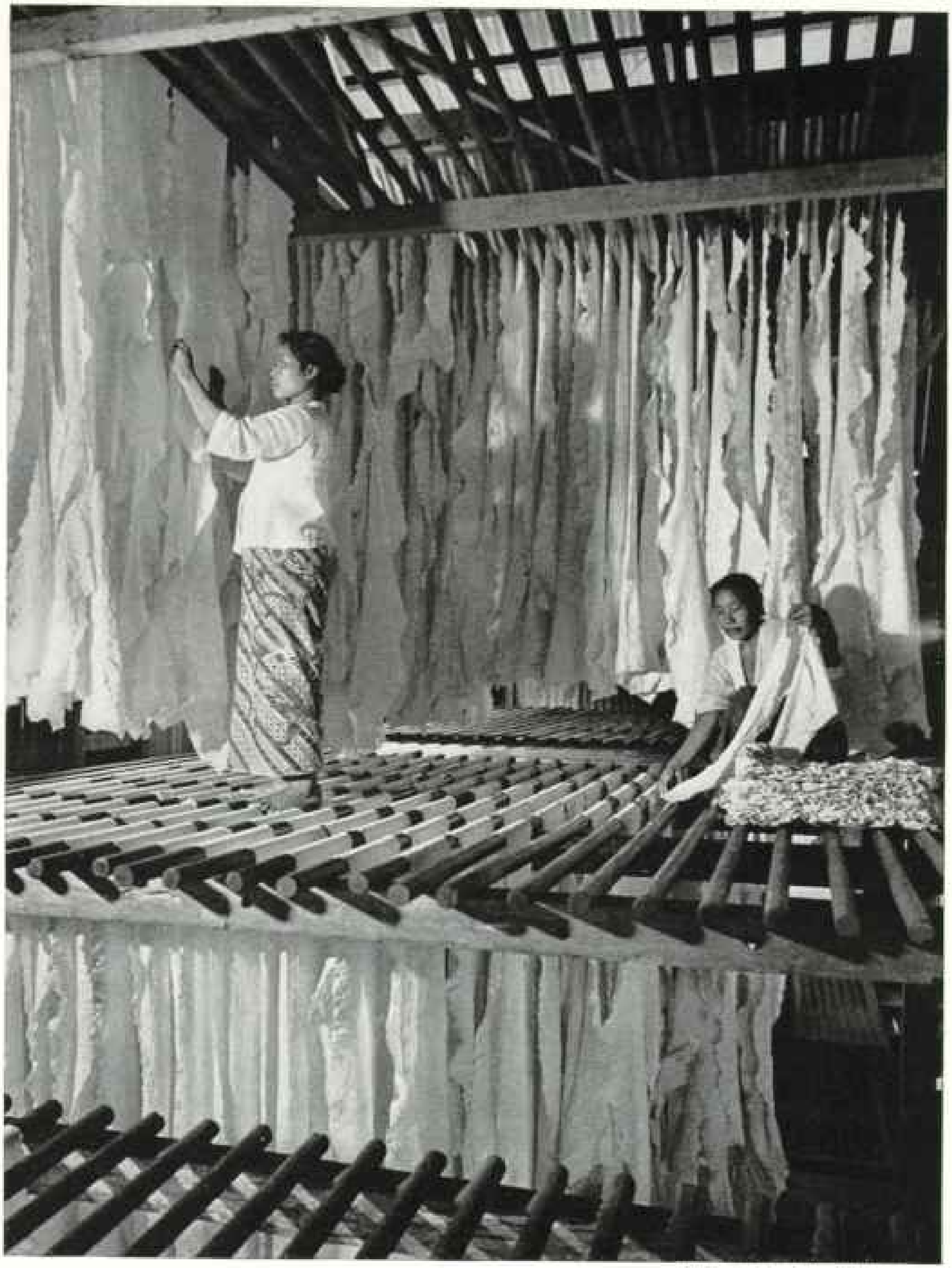
In the year Alexander Graham Bell demonstrated his telephone at the Philadelphia Centennial Exposition were planted near Colombo the trees that yield rubber so essential to wire communication. Still alive here in the Government Botanic Gardens are originals transplanted from Kew, where they grew from seeds brought from far up the Amazon by Sir Henry Wickham (page 158).



Photograph by Willard R. Culver

HE TAPS IN DOUBLE TIME ON RUBBER MATS

The operator sketches designs on the surface, then punches them out at high speed with unerring eye and hand. A slip spoils the sheet. "I could do 'Welcome' with my eyes shut," sighed one worker.



Photograph by J. Baylor Roberts

IN SHEDS THEY DRY CREPE RUBBER, MUCH AS TOBACCO IS CURED

After sheets of pale crepe come from coagulating tanks and mills, they are hung up for two to four weeks. The poles must be teak or some other hard wood which will not splinter easily. The barefoot Javanese women can't wear shoes, lest they blemish the rubber or slip off the cross-poles. The unsmoked sheets are used more and more for thick, light shoe soles. To obtain plantation photographs, including those in color, the National Geographic Society sent a staff photographer to the Malay Peninsula and the Netherlands Indies.

Photograph by Paul Fryer

PRICELESS ROSETTA STONES OF THE RUBBER INDUSTRY

The closed book is Charles Goodyear's *Gum-Elastic*, printed in 1855 on rubber pages, with a cover of hard rubber on which is carved a scene of natives tapping trees in the Brazilian jungle. The inventor's notebook lies open at pages on which he sketched "umbrella coverings" and a device for "improved umbrellas." The watch, chain, key, and seal, made of hard rubber and set with gold, diamonds, and rubies, are duplicates Goodyear made for his wife of similar jewelry presented to the Empress Eugénie. All are exhibited at the Smithsonian Institution, Washington, D. C. (p. 158).

backs of the pews, sheep masks for rams so they can't see their rivals but still can eat.

Rubber is a key industry not only because it is the ally of steel, petroleum, and glass production for automobiles. It is the handmaiden of practically every modern electrical device—lights and telegraph, radio and power lines, vacuum cleaner and refrigerator. It enters amazingly into farm and factory, what with belting for driers and conveyors, hose for spraying crops, fighting fires, drilling for gold, and stopping trains; linings for tank cars, and mountings for heavy machinery.

NOW THEY BLOW HOLES INTO RUBBER, AND STICK IT TO METAL

If the shapes and kinds of rubber products, and the unexpected places it pokes its elastic head surprise you, consider the way the magicians of the laboratory tame it to so many uses.

For years chemists worked to make the humble rubber band stretch more and last longer. Now they also make a band of rubber deliberately timed to disintegrate after several weeks' exposure to open air and sunshine. These are used in grafting trees—even for bud-grafting the rubber tree itself (page 151).

Since Charles Goodyear scraped his first vulcanized batch off his kitchen stove lid, manufacturers have wrestled with the impish propensity of rubber to stick to some metals.

"Let it adhere, and use that property!" exclaimed a chemist one day to his laboratory assistants. His suggestion opened a whole new field of rubber utility.

At the New York World's Fair crowds gathered around an exhibit of a 4,800-pound automobile suspended in mid-air by a piece of rubber no thicker than a man's arm, stretched to ten times its normal length, and adhered to metal at each end. Some of the spectators rode toward Long Island on an Eighth Avenue subway car wherein noise and vibration have been reduced to the minimum by employing that principle—and exactly 1,004 pieces of rubber.

Having solved the problem of keeping rubber free from "pinholes," thus making it watertight and airtight, chemists soon were hunting ways of putting more holes in rubber.

They worked on that one for eight years or more; now companies are selling chemical filters and cushions with millions, not mere thousands, of microscopic canals. Battery separators have upwards of 500 million pores. Mattresses caress you with as many as 250,000 air cells to the cubic inch (Plate XIV and page 168).

Some recent rubber products have taken five, seven, even more years from the gleam in a chemist's eye to buyer's shopping bag, and cost a quarter million dollars before the first article was sold for a few cents.

IDEAS THAT COME IN THE NIGHT

In 1933 a chemist who couldn't go to sleep in a Pullman upper berth started for the washroom for a smoke and tore off the glazed paper wrapper of a cigarette pack. He fell to speculating about making a transparent sheet of rubber. For many uses such sheets would have to be sunlight-proof.

Two men worked for two years on such a compound; then four months more to make up the material to experiment with. After 2½ years a small pilot plant was set up to turn out a few hundred pounds a day.

Then came around the inevitable auditor to calculate costs. When the management saw that $200,000 had been spent on the insomnia idea, the curt order went out, "Sell something or quit."

So they started selling. Bottle caps took the entire output for a year. But today some 150 kinds of garments are being made of Pliofilm, and hundreds of other products —card-table covers, baby pants, shower-bath curtains, beauty-parlor bibs, umbrellas, and aprons.

They also are experimenting with rubber violin strings, tennis rackets, fish lines, flowerpots, and rugs.

Pliolite was a laboratory curiosity in 1927, dormant until 1931. Now one popular household product formerly put up in tins is sold in pasteboard coated with rubber film three ten-thousandths of an inch thick at a saving of three-fifths of a cent a package. You can figure that economy on one hundred million packages sold in a year.

For all these they had fortified rubber against enemy sunshine; next, they removed every trace of odor. Now they are wrapping cheese, cake, and fruit, and sealing pills and powders for tropical drugstores, in rubber.

For 15 years one man has been working on improving belts for carpet sweepers—the small belts which connect the motor with the revolving brush. He developed compounds that will stand up under 5,000 revolutions a minute, and will withstand friction when the sweeper gets caught on a rug corner and stalls up to four minutes.

WHY RUBBER IS DIFFERENT

"Rubber manufacture is different and difficult," a chemist explained, "because you don't turn out a standardized product from a standard raw material.

"Raw rubber is the most variable raw material known to man. The same kind of rubber trees growing on opposite sides of a hill yield different kinds and quantities of latex (page 156).

"To raw rubber you add other raw materials, sometimes a dozen or more, until you get your compound. This compound is the raw material of rubber products; usually the compound is the major problem."

"Give some examples," I requested.

"When electric refrigerators came out, rubber was called upon to stand cold on one side, heat on the other. They solved that one, but then housewives complained that rubber parts blackened their cloths when they scrubbed their refrigerators, and stained the finish when they touched metal.

"Finally came reports that the rubber smell affected food, especially ice cream and butter. While one company was taking the odor out of rubber, they had a group of ice cream sniffers and butter tasters who smelled and ate tidbits day after day."

The chemist leafed through a pile of requisition sheets, and continued: "Here's one department head ordering a conveyor belt to operate in the open and carry hot slag at 320 degrees Fahrenheit. What he is asking for is a compound that will defy three major enemies of rubber—heat, sunshine, and oxygen.

"And here's an order for a hundred thousand molded rubber dolls. These must be so tough that children's teeth cannot shred them, the chemicals must not be injurious when put in the mouth, they must keep their color when washed, and not discolor baby's clothes (page 169).

"Rubber bones for dogs to play with must be even tougher, and noninjurious, too.

Photograph by J. Baylor Roberts

A COOLIE ADMINISTERS FIRST AID TO BETTER TREE "MILKERS"

Deftly he wraps muslin, waterproofed with paraffin, around a bud patch, after the bud has been inserted into the incision between the cambium and the cutaway bark of a sapling (page 169). From the little twig near the skilled worker's thumb a big and high-yielding rubber tree will grow straight and tall, even though it starts its life humpbacked almost at right angles to the seedling. Later the cloth is removed so the bud can sprout, and ultimately the seedling trunk will be chopped off above the graft. Rubber bands timed to disintegrate in about two weeks sometimes are used. Each cut in the stick on the ground represents a bud that has been removed for grafting.

"On the more serious side, take the rubber plunger in a hypodermic needle; waterproof, chemical-proof, and it has to be exactly three-tenths of an inch in diameter and 18-hundredths of an inch thick, to fit snugly."

Your pigskin gloves and wallets are better now because a designer perfected a hog-beater paddle for dehairing hogs after they are killed and steamed. It had to be hard enough to tear off the hair, but not cut the hide.

A FICKLE JADE—OF INFINITE VARIETY

Rubber may be a fickle jade, but in this infinite versatility lies its provocative charm for the chemist.

It can be made rigid as a poker chip, soft as a feather bed, unyielding as a car wheel, pliable to fit a debutante's contour as she does the rumba, sheer as a silk stocking, or hard enough for whetstones to sharpen metal scythes and knives.

Each of the big rubber companies employs at least 500 chemists, engineers, and other specialists engaged in development and research. The industry has experts on friction, on cotton, on typography, on styles, on surgery, even on acoustics, to keep the hum out of tires. At one plant a psychologist was trying to find out why so many women prefer their heels to click.

"Why don't you wear rubber heels?" a company asked its own employees.

Photograph by J. Baylor Roberts

NATIVES OF THE FEDERATED MALAY STATES HANG THEIR OWN RUBBER SHEETS OUT TO DRY

"Aristocrats of the East," they are called, because many scorn working on big estates, preferring to own small patches of four or five acres. Plantations import many Tamil Indians (Plates II and III). Beyond the spreading branches of a rubber tree are rice paddies.

© Merlin Minshall

HARD LUCK, THAT BLOWOUT! BUT A BOON TO THESE ALGERIANS

It's an even bet among explorers whether kerosene cans or old tires reach more remote places of this planet. Taking the hint, perhaps, from Chinese coolies and African tribesmen, American manufacturers use more and more reclaimed rubber from old tires to make thick soles (page 178).

Photograph by J. Baylor Roberts

TWO CANS CATCH RUBBER DROPS FROM THIS HIGH YIELDER

The Javanese on a Goodyear plantation in Sumatra is pouring one cup of milky latex into his tapping can. The angle of the cuts usually is about 30 degrees to permit free flow. Ordinary tapping does not hurt a tree; only sturdy ones can stand such double duty.

Photograph by J. Baylor Roberts

"THEY'VE TAMED OUR TREES AND MADE THEM MARCH IN ROWS!"

So exclaimed an Amazon Indian when shown such a picture of plantation *Hevea brasiliensis*. These Sumatra 8-year-olds "march" 10 feet abreast in columns 20 feet apart; their service stripes are the diagonal tapping cuts. Across the coolie's shoulder is a "picul stick" balancing his latex cans, the square one an old kerosene tin reinforced with iron strips. The parade of the rubber trees, about as tall as maples, is over ground planted with a cover crop to prevent erosion and noxious weeds.

FROM THE AIR FIRESTONE'S VAST LIBERIAN PLANTATIONS LOOK LIKE A NONSKID CARPET OF RUBBER

To Africa's negro republic in 1928 Harvey Firestone tenderly transported 16 high-yielding strains which now have been multiplied over 70,000 acres. All supplies, from tacks to tractors, had to be imported for this biggest Hevea tree tract outside the Middle East. Tank trucks run over 210 miles of private road to collect latex.

Photograph by J. Baylor Roberts

A "TREE-BURNER" HAULS TANKS OF TREE DROPS

Sometimes even wood from rubber trees fires the locomotives with the big smokestacks on vast American-operated estates near Kisaran, Sumatra. The tender has a roof to protect the forest fuel from the heavy rains essential to thirsty rubber trees. The United States Rubber Company has nearly 100,000 acres. The company provides all the facilities of a small city for its 18,000 laborers—houses, hospitals, stores, water supply, and electric current. It even erected a Hindu temple, with exquisite carvings of native gods, for Tamil workers, and maintains it at company expense.

"I like people to know I'm coming," replied a stenographer. "High heels now are so small that I feel I would topple over on rubber," said a secretary.

RUBBER, RUBBER, EVERYWHERE—BUT HAVE YOU EVER SEEN ANY?

All these tricks of the rubber trade, grave and gay, illustrate the paradox of rubber—rubber, rubber, everywhere; yet few products sold in the United States contain rubber in its natural state.

Virgin rubber, or latex, is the incredible magic wand of chemical laboratories. Every rubber article you buy, from beach ball to hot-water bottle, is the product of a formula.

Each of the major companies has some 800 active recipes for tire rubber alone; all have compounding supply rooms that look like a druggist's prescription shelves.

Latex is the whitish fluid—not to be confused with sap—contained in cells between the bark and wood of many plants. Some botanists surmise that it helps the plant bend to the wind and heal its own minor injuries. Milk from discontented trees, the layman might call it.

It flows from broken stalks of milkweed and goldenrod, and from scores of other familiar plants, but so far in commercially profitable quantities principally from *Hevea brasiliensis*. Hevea latex contains up to 40 per cent rubber; three seedling trees in a year drip enough rubber for one average passenger-automobile tire.

PLAYFUL INDIANS' BULBS AND BALLS

All this leads back to the adventurous history of rubber. And there is no hardship in considering that, for the rubber rush has all the wild glamour of California's gold rush, with steamy jungles of two continents for its lush and lusty setting.

Before Columbus came, Amazon Indians

Photograph by J. Baylor Roberts

THEY'RE OFF ON RUBBER TIRES TO GATHER MORE RUBBER FOR TIRES

On the handle bars hang their tapping cans and baskets for bark shavings and scrap rubber (page 169). Javanese are largely employed on Sumatra plantations, such as this at Dolok Merangir, just as Tamils from India are imported to work Malaya estates. Besides building houses and mosques, for many are Mohammedans, the plantation owners provide football fields near here where inter-estate games are played. The coolie in the foreground seems not too comfortable with his "new-fangled smoking pipe"; all are much more accustomed to cigarettes made from locally grown tobacco.

made bouncing balls, shoes, and water jars of rubber (page 172).

These aboriginal chemists turned out two other surprising rubber products. One was a quiver cover for poison darts; the other, pear-shaped syringes with quill tubes for enemas. These bulbs, early explorers relate, they also concealed at jungle parties to squirt jets of water playfully at unsuspecting guests.

Spaniards wrote home from Mexico about "the sport at Ball, called Tlachtli, like our Tennis. The Ball was made of the Gum of a Tree that grows in hot Countries, which having Holes made in it distils great white Drops, that soon harden, and being work'd and moulded together turn as black as Pitch."

From Brazil the Portuguese sent back waterproof boots and a tarlike rubberized fabric coat to their King Joseph. Sailors carried away sticky rubber bottles as souvenirs, but the historic export was the first pair of "Indian rubber shoes" sent to the United States in 1820. Three years later 500 pairs of the gilded rubber footwear, gaudy with their long, pointed toes and very clumsy, were unloaded at a Boston dock.

FROM HELL-FIRE TO VULCANIZATION

In the next three decades hundreds of thousands of these "gum elastic" boots were shipped to New York and Salem. A Roxbury factory was chartered to make rubber life preservers, clothing, and wagon covers. Before the novelty wore off the rubber did, too. It became sticky in hot weather, and cracked in cold. The plant had to dig a big pit to bury in the dark of night the articles returned as unsatisfactory. Europeans experimented with raincoats, caps, erasers; yet in 1830 the whole world consumed only 156 tons of rubber—all from Brazil.

However, into the hands of a Connecticut

Yankee fell an Indian water bottle, and later a pair of shoes. The frail young man had turned from thoughts of the ministry to opening up a hardware store in Philadelphia—one of the first in the United States—but he went bankrupt.

His father had been an inventor—he made the metal buttons for American uniforms in the War of 1812—so his son turned to invention. He had a "presentiment," he wrote, that rubber, if properly manufactured, might be useful to mankind.

Again and again he was declared bankrupt; he borrowed thousands of dollars for experiments and dimes for bread; he pawned his umbrella for ferry fare and used his patient wife's last silk petticoat to make rubberized hats; he was thrown into debtors' prisons and died insolvent—and his name is immortal: Charles Goodyear!

Human and touching tales of his struggle are related in his *Gum-Elastic*. This Gutenberg Bible of the industry, printed on rubber pages, is a precious possession of the Smithsonian Institution, at Washington, D. C.* (page 149).

The amazing fact about the volume is that it predicts practically every important use of rubber since developed, except the principal one, automobile tires, for the "horseless carriage" had not yet appeared.

TWO MAJOR PROPHETS OF INDUSTRY

Only two inventors have so completely foretold the ultimate application of their discoveries—Goodyear with rubber and Bell with the telephone.

Years of experiment by Charles Goodyear and his Thomas Watson, who was Nathaniel M. Hayward, culminated in the conclusion that rubber and sulphur, when "charred," would "divest the gum of its native adhesiveness," just 101 years ago at Woburn, Massachusetts.

From this Boston suburb the romance of rubber flashes back to the sleepy Amazon, suddenly jolted awake to be a tropical Klondike. Then it jumps halfway around the globe to clear the jungles and to spread plantations over Malaya and the Indies, builds an American city at Akron, Ohio, and helps change the road maps over the face of the whole inhabited world—all in the span of a century!

It is a temptation to linger with the black gold boom which erected opera houses and broad boulevards in remote Pará and Manáos; that sent canoes swarming far up the spider-web tributaries of the vast Amazon Basin to bear rubber down to swiftly sown main-stream settlements; and stern-wheel steamers plying upriver with grand pianos, champagne, and golden candlesticks for gaudy mansions in malarial clearings.

Adventurers rode to enormous fortunes as rubber soared to more than $3 a pound; one Panama hat peddler amassed claims to some 14 million acres. Native farmers and fishermen were recruited to tap trees until tins of sardines and salmon sold for a dollar a can along rivers alive with fish, and Iquitos barons even imported sweet potatoes from Virginia.

All that, however, is a closed chapter in rubber annals.

AGRICULTURE'S COSTLIEST MIGRATION

One of those little-sung heroes of plant exploration, Sir Henry Wickham, changed rubber destiny, and world history.

Far up the broad Amazon he collected some 70,000 "heavy oily seeds" of wild Hevea trees, and with patient tenderness placed them between layers of dried wild banana leaves.

Past the city which rubber boomed to dizzy luxury, Pará (now Belém), he carried them in the hold of the England-bound *Amazonas*, "slung up fore and aft in their crates, free of danger of ships' rats."

A night goods train awaited the precious cargo at Liverpool. Meanwhile, Sir Joseph Hooker had thrown out rare orchids to make room for propagating the new seeds in the Royal Botanic Gardens of Kew.

In numerous writings about rubber, reference is made to Sir Henry Wickham's "smuggling," "pirating," even to "stealing" rubber seeds from Brazil.

This unfortunate folklore about a historic botanical achievement has just been effectively refuted in a report secured by the Ministry of Agriculture of Brazil from the Commercial Museum in Belém, Pará,

* Charles Goodyear, of New England, "father of vulcanization," and Thomas Hancock, of "Old England," worked on many rubber problems simultaneously and successfully. Hancock has been called the "father of the rubber industry" because he devised the first rubber masticator and the first sheeting machines. Gracious tribute was paid to the American, Goodyear, by R. W. Lunn, of England, and to Hancock, the Englishman, by Alfred A. Glidden, of the United States, in comprehensive papers read before the American Chemical Society meeting in Boston, Massachusetts, September, 1939.

 Kodachrome by J. Baylor Roberts

RUBBER MURALS ADORN THE STATION OF SINGAPORE, CITY OF TIRES AND TIN

Every time you open a tin can or blow out a tire, you help business in this tropical Liverpool of the East. Ribbed smoked sheet prices here regulate the world rubber market. Less than half a century ago the site of this British port and stronghold was a jungle island. Now it is rubber capital of a plantation empire which represents one of history's mightiest crop migrations—from far up the broad Amazon to the pendulous Malay Peninsula and the teeming Indies. More rubber trees grow in the Middle East belt than you could plant on all the dry land of Massachusetts and Connecticut combined.

 Kodachrome by Willard R. Culver

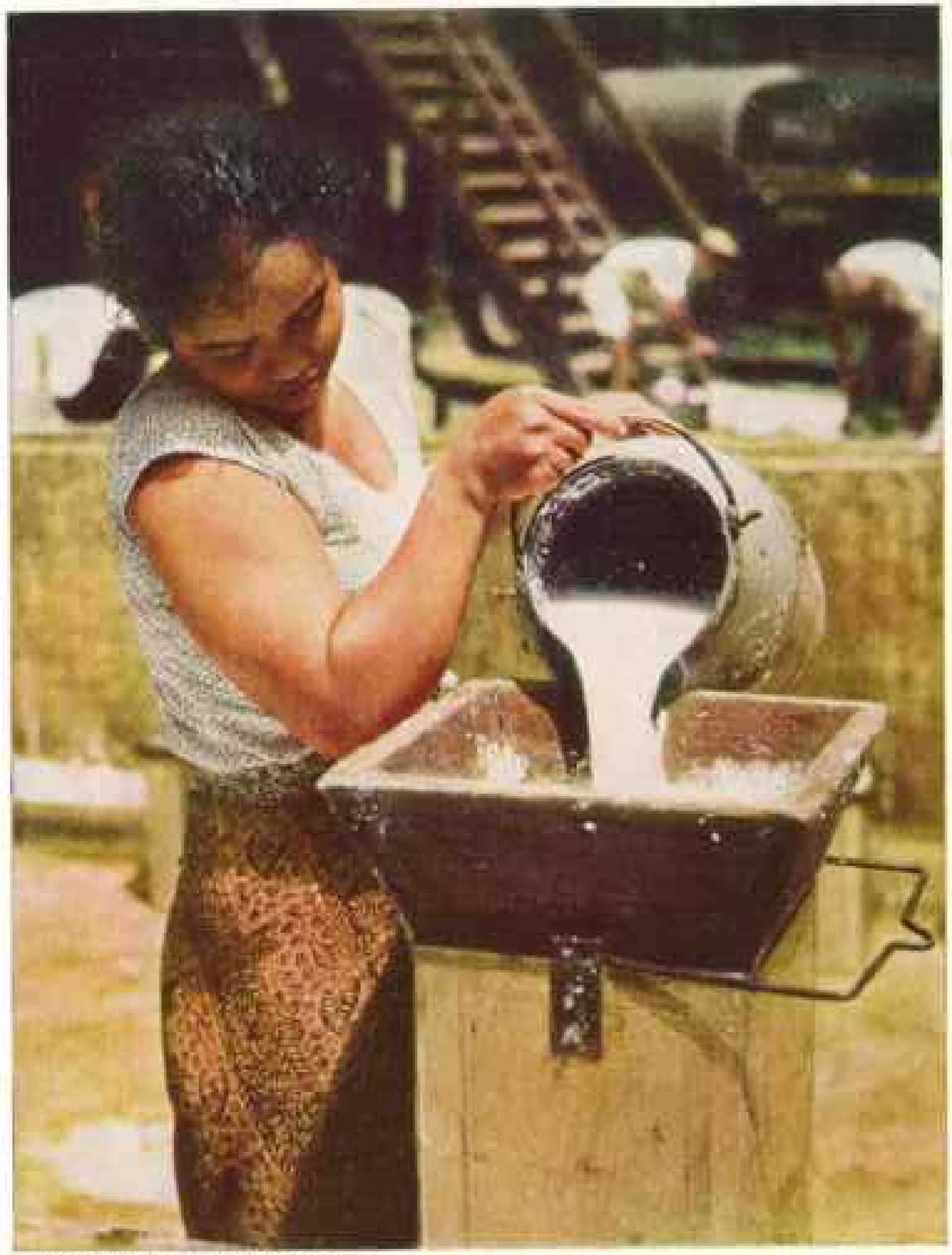
COLOR AND CRACKLE MARK THE MAKING OF FLOOR TILE

Like giant jaws grinding mammoth wads of chewing gum, this calender mottles and presses out compounded rubber. Kitchen and other wall designs also are blended in this way before the sheets are vulcanized.

Kodachrome by J. Baylor Roberts

HERE'S WHERE YOUR TIRE BEGINS

A ribbed smoked rubber sheet is displayed by a Tamil Indian on an estate of steamy, tropical Malaya. Size of the sheets has not varied since they first were shipped in tea chests.



SHE STRAINS RUBBER MILK, AS ON A DAIRY FARM

Javanese men and women work on the vast Sumatra plantations of the Goodyear Company. It takes three years' dripping from a healthy rubber tree to make a medium-sized passenger auto tire.

Kodachromes by J. Baylor Roberts

RUBBER-MILK MAIDS BRING IN THE DAY'S TAPPING

Tamil Indian women work on experimental estates at Kuala Lumpur, capital of the Federated Malay States, maintained by a special tax. Can labels denote the block, section, and "task," or number of trees tapped.

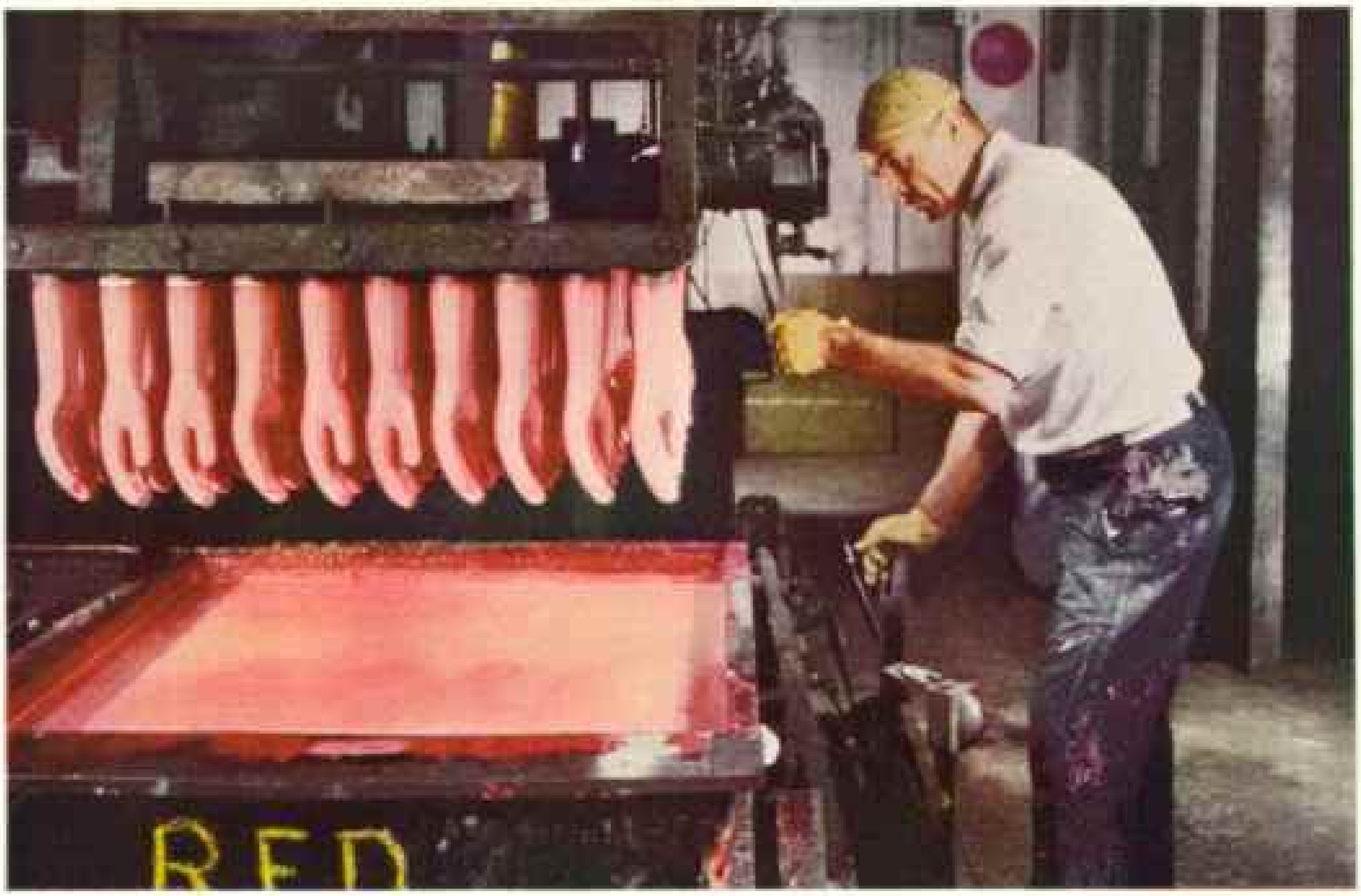
HERE'S BALM FOR MANY ILLS THAT FLESH IS HEIR TO

This ministering Goodrich factory angel is inserting the metal-threaded collar in the necks of hot water bottles after they have been vulcanized.

© National Geographic Society Kodachromes by Willard R. Culver

MIRROR-POLISHED METAL MOLDS MAKE WATER BOTTLES

After being run out of a calender in sheet form, two pieces of rubber are placed on each side of the core (left). In the mold they are vulcanized under hydraulic pressure.



GLOVES START WITH MILKY RUBBER ON PORCELAIN FORMS

Use of latex direct has speeded up glove-making. Thickness is determined by exact timing in dipping the revolving molds into the tank of liquid rubber compound.

 Kodachromes by Willard R. Culver

IN THE ROOM OF A THOUSAND MUTE SALUTES

This "roller" is turning back the wrists of gloves to keep them from tearing. Next they are vulcanized, then a deft "stripper" takes them off the forms.

Kodachrome by Willard R. Culver

FABULOUS FERDINAND SNIFFS FOR FLOWERS IN A FIELD OF CONTENTED—AND SEEMINGLY OBLIVIOUS—CATTLE

This mammoth figure of Munro Leaf's hero was designed by Tony Sarg for Macy's Thanksgiving Day Parade in New York City. On Broadway his horns reach a fourth-floor level. He holds 4,500 cubic feet of helium and is made of the same rubberized fabric used in constructing the Goodyear-built National Geographic Society-U. S. Army Air Corps' stratosphere balloon.

Kodachrome by Willard R. Culver

THE BIGGEST PNEUMATIC TIRE EVER MADE WILL CRUISE A LIFELESS CONTINENT

Six such tires and tubes were turned out for the snow cruiser designed by Dr. Thomas C. Poulter for the U. S. Antarctic Expedition under command of Rear Admiral Richard E. Byrd. Polar exploration has been made on foot, with dog teams, ships, and aircraft—this party will travel in part on rubber. The 12-ply tire is 10 feet in overall diameter, and weighs nearly 700 pounds.

Kodachrome by Willard R. Culver

GONE WITH THE WIND—ON RUBBER TIRES

Nearly 60 treat styles are made by manufacturers for some eight million bicycles now used in the United States. They are far more popular now than in the gay nineties of "the bicycles built for two."

© National Geographic Society

Kodachrome by J. Baylor Roberts

SEEDS FROM THE FIRST RUBBER FAMILIES OF SUMATRA

Pigeon-egg-sized seeds of numbered clones germinating in a plantation laboratory get all the care of a thoroughbred dog. A clone is a descendant of a single high-yielding mother tree—a pedigreed rubber plant. The family name of plantation strains, *Hevea brasiliensis*, hints their Amazon origin.

and transmitted to E. G. Holt, Chief of the Leather and Rubber Division of the U. S. Department of Commerce:

"As, in the period of these first experimentations, no one was thinking of the possibility of acclimating 'Hevea' in other regions for the purpose of later competing with the rubber from the Amazon, no law existed in Brazil prohibiting the exportation of the seeds of this valuable plant.

"The truth is that Henry Wickham transported the boxes of seed after despatching them as he would any other merchandise.

"There was no illegality in this—and the best proof that there was not is in the fact that there were shipped in this same period many hundreds of young stalks of Hevea that there were no means of hiding when they were carried on board."

SEEDLINGS SHIPPED TO CEYLON

Two months after Sir Henry Wickham's seeds arrived in London, nearly 2,000 seedlings were shipped from Kew to Ceylon. That was in 1876. Some of the Colombo trees were first tapped in 1882 (page 147).

Then began, in British Malaya and the Netherlands Indies, especially Sumatra and Java, a long, tedious period of experimentation. Some of the imported trees, with ironic justice, were put out on dying coffee plantations, supplanting the crop that was to compensate Brazil for her lost rubber riches. Even in 1900 only four tons of Eastern rubber showed up in world trade.

Figures and dates dramatize the rest of the story. Thirty years ago, in 1910, Brazil and other wild rubber accounted for 83,000 tons of the world total of 94,000 tons. By 1937 the world was buying more than 1,135,000 long tons of rubber, and of that less than two per cent came from Brazil.

RUBBER RETURNS TO RUBBER RIVER

Now for the sequel to the Brazil rubber epic, the climax of which no man yet knows.

Early in 1934 there arrived at Belém as strange a cargo as Wickham's seeds shipped from there in 1876. Aboard ship were some 5,000 buddings of plantation trees from Malaya, Sumatra, and Java. They were packed in boxes of sterilized sawdust, from which they drank moisture, and fed on the reserve of their own stumps.

All the way from Singapore, through the Mediterranean and across the Atlantic, a modern botanical Noah, Dr. James R. Weir, watched their temperature and moisture, and guarded against infection, drying out, and decay.

Here at Belém he supervised their transfer to a steamer which bore them 500 miles up the Amazon to the mouth of the Tapajóz, and then 130 miles more up that tributary to Fordlandia.

Home again! There these lineal descendants of trees from the seeds Wickham had carried away were transplanted back in the very Tapajóz River area where Sir Henry had collected the seeds.

Today they are thriving at Fordlandia, and on even larger acreage of the newer Ford plantation at Belterra.

In 1935 the Goodyear Tire and Rubber Company planted 500 acres on Gatún Lake, in Panama, with stock from their 2,500-acre plantation in the Philippines. They grew so well that a thousand more acres were put out last year. Goodyear has other tracts in Costa Rica.

Last year Firestone used ten million pounds of rubber from the company's 70,000-acre plantation in Liberia (p. 155).

Meanwhile, chemists have developed rubberlike materials which, for some uses, have advantages over the tree-grown latex.*

All these as yet are experiments in America's effort to produce rubber commercially in rubber's native continents. Ninety-seven per cent of all rubber still comes from the Middle East, and the United States usually buys more than half the whole world's total.

THE FIRST FAMILIES OF LATEX

Introducing plantation rubber into Brazil and Central America was no mere carrying latex coals to a rubber Newcastle.

Every plant brought back home was a member of a clone clan. A clone is a family consisting of a mother tree and its vegetative offspring—its children produced from buds and not from seeds. Such a pedigreed tree yields from three to four times as much rubber as an unselected seedling (Plate VIII).

Like thoroughbred horses and dogs, these first families of rubber have registered names—Dolok Merangir No. 152; Scot-owned Glenshiel No. 1; Tjirandji No. 1 (a War Admiral of the clones), and Prang Besar No. 23—which means "Great War," so named by a British war veteran.

* See "Chemists Make a New World," by Frederick Simpich, NATIONAL GEOGRAPHIC MAGAZINE, November, 1939.

NOW THEY PUT HOLES IN RUBBER AND TAKE OUT THE ODOR, FOR EASIER SITTING AND SOUNDER SLEEPING

Here Firestone's vulcanized cushions and mattresses pass through a final washing tank where the workman rinses them in pure water, just as laundered clothing is rinsed before hanging out to dry. The wooden wringer rolls (center) squeeze out much water; centrifugal drying machines and baking ovens remove the remaining moisture (Plate XIV and page 150).

Photograph by Willard R. Culver

THE PARADE OF THE RUBBER TOYS

Figaro the Cat, from *Pinocchio*, casts a wary eye at Big Bad Wolf. To the right are goggle-eyed Pluto the Pup, dainty Snow White, who seems proud of her moving head and arms, laconic Dopey, quizzical Elmer Elephant, and brash Donald Duck. For these products chemists of the Seiberling Latex Products Company had to devise compounds and colors that won't make Johnny ill if he chews or licks them, nor rub off on Sister's new Christmas frock (page 198).

The high-yielding, disease-resisting clones which make plantation rubber better and cheaper have been developed, in part, by bud-grafting (page 151).

With botany begins the story of that complex vegetable product—largely the child of rubber and cotton plantations—which you buy so casually, your automobile tire.

Picture a native Malayan or Sumatran, or a Chinese who never has seen China, skillfully cutting an oblong incision in a year-old rubber seedling. Then he loosens a bud from a stick of the "mother tree."

He pulls back a flap of bark from the seedling and gently inserts the bud patch, trimmed to fit the panel. With strips of rubber, or cotton cloth previously immersed in paraffin, he bandages the bud. Sometimes he ties leaves over the gauze to protect the bud patch from direct sunlight.

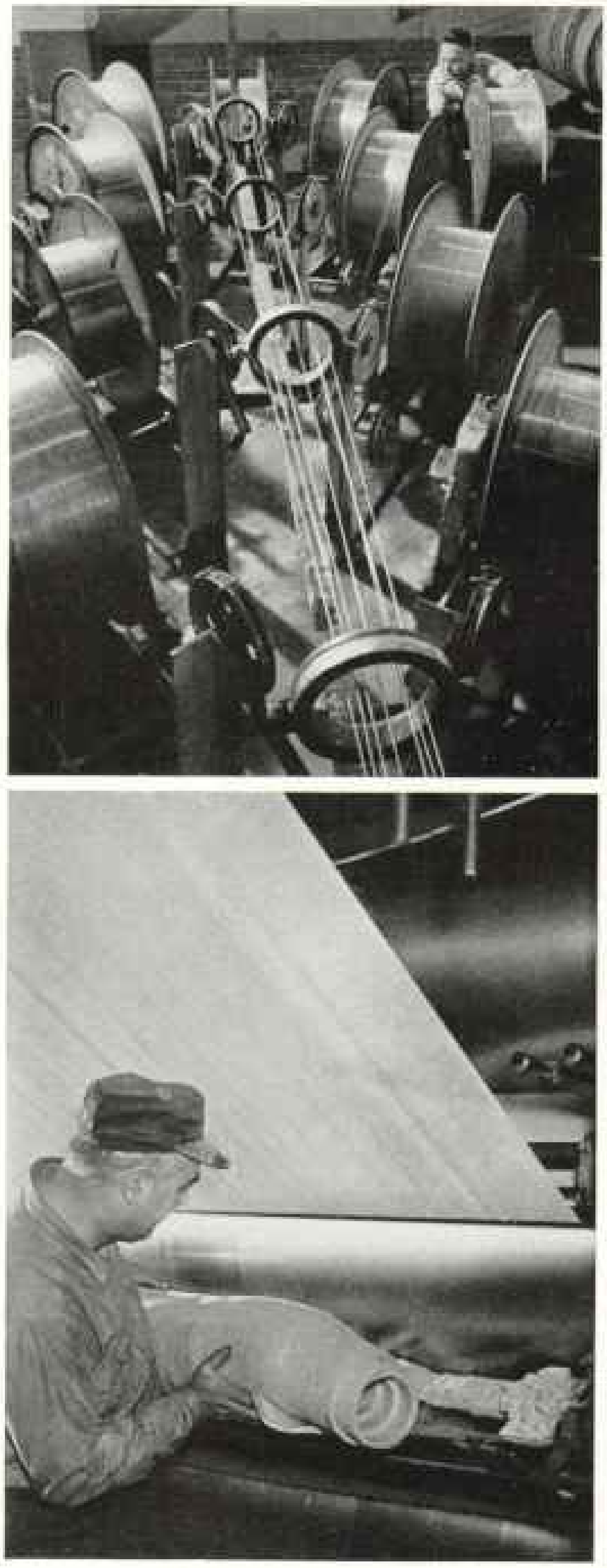
In ten days or two weeks he removes the bandage. Two weeks more, and the top of the old tree is cut off about two inches above the graft.

Shortly thereafter, the bud sends out a sprout at right angles to the bud patch. Gradually it curves upward until, in about a year, the sprout becomes the trunk of the new tree.

By the time the bud-grafted tree is ready for tapping, in 6 or 7 years, it will show virtually no sign of its operation.

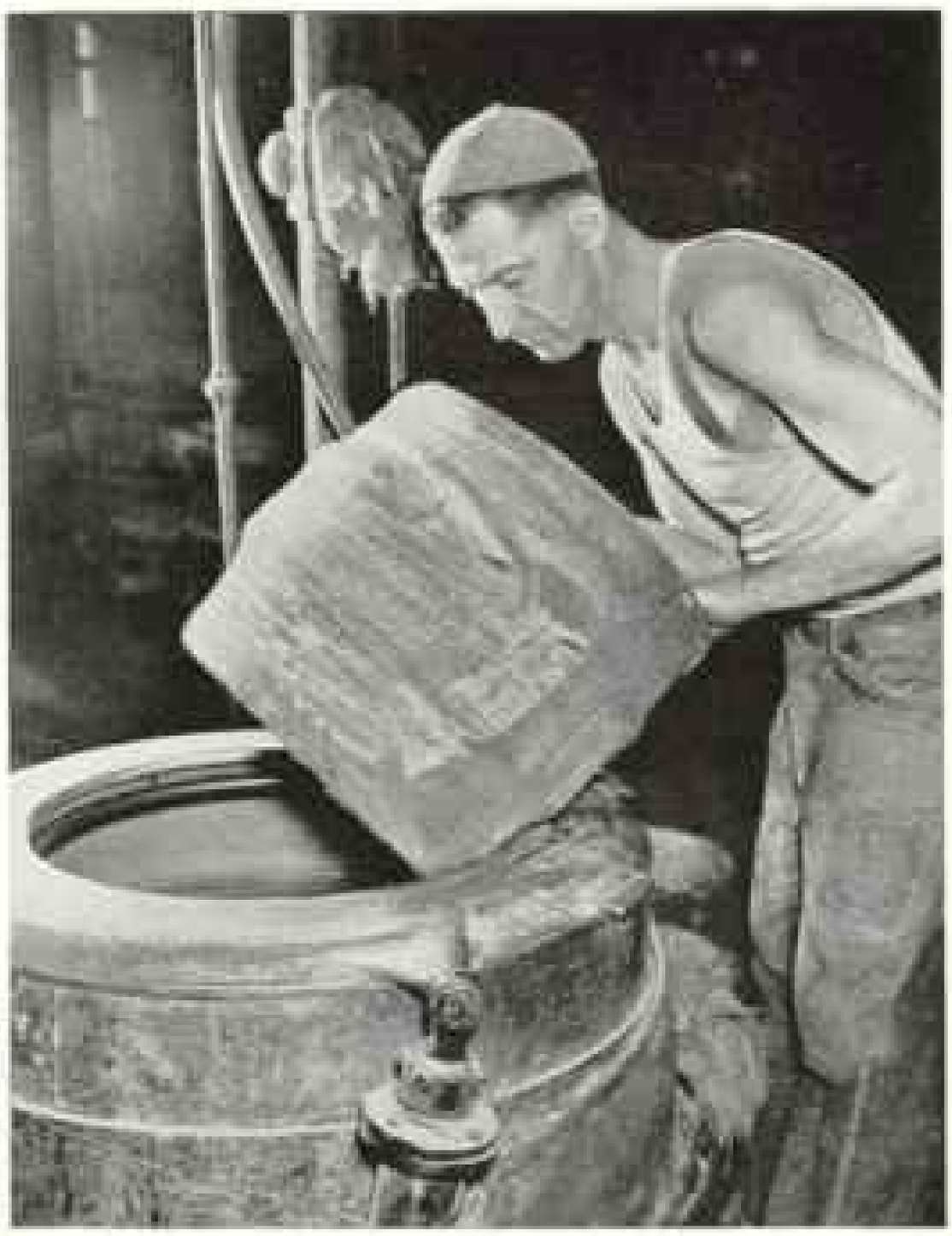
A DAY IN THE LIFE OF A TAPPER

On its 40,000-acre Wingfoot Plantation, in Sumatra, the Goodyear Company grows such pedigreed trees, averaging 150 to the acre. Here live 6,000 workers, mostly Javanese, on the "coolie lines," or rows of two-family, company-built houses. These communities of tapper families are scattered over the "orchard," two-thirds the size of the District of Columbia, within walking or cycling distance of their trees.



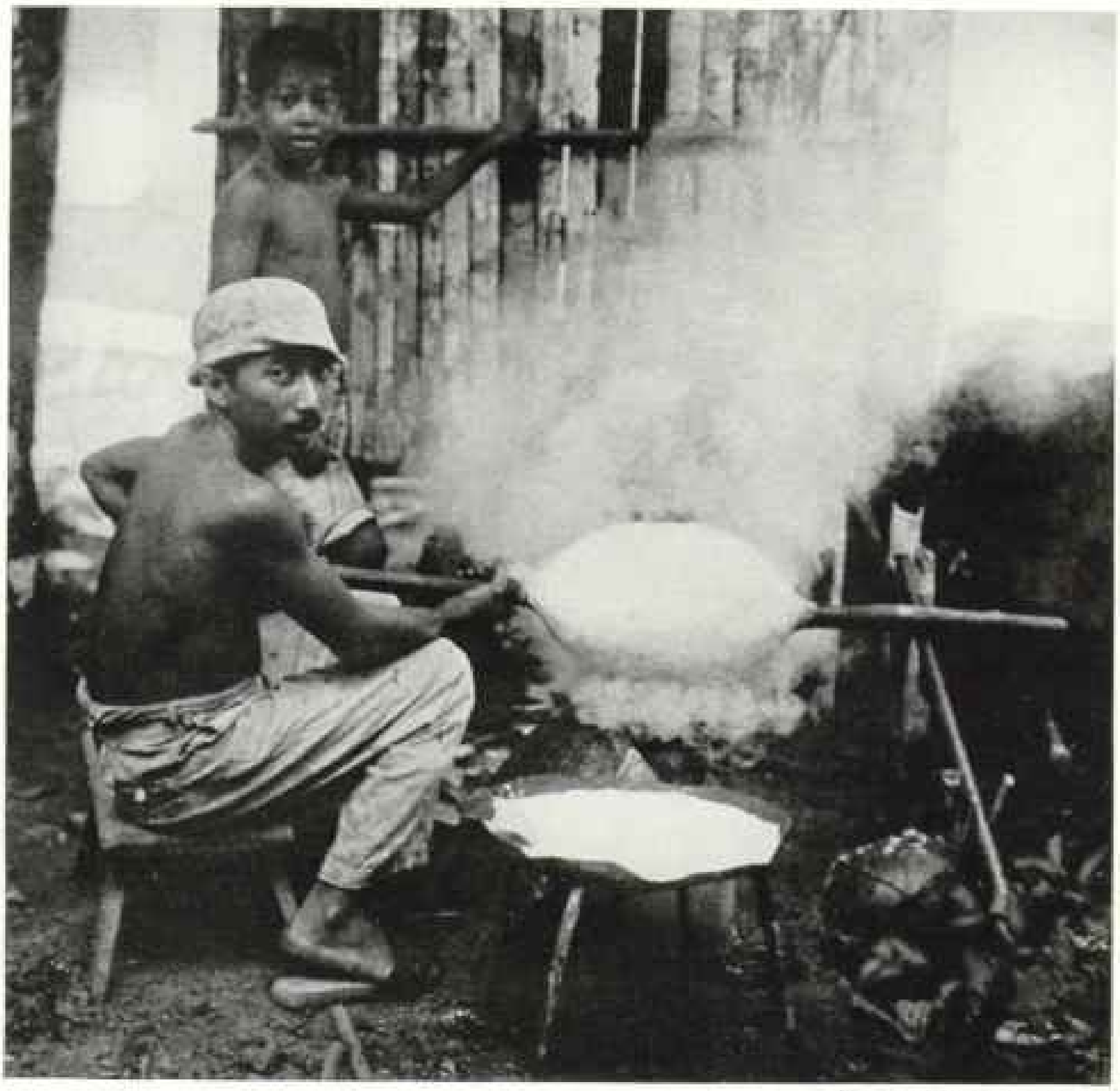
A SIMPLE-SEEMING TIRE IS A MECHANISM OF MANY PARTS

Here are shown four major operations—there are many more—preliminary to assembly (page 176). Rubber-encased steel wire is fed from huge spools to building machines to be the wire beading which clutches tire to rim (upper left). Myriad cotton threads are run through eyelets to be laid side by side, preparatory to being rubberized for ply fabric (upper right). A calender (lower left) grinds out rubberized fabric for the plies by pressing rubber into the cords, to make them adhere and yet keep them separated. A powerful machine forces rubber stock through a die to form treads of proper size (lower right), later to be cut to the desired length.



TO THE LAYMAN BUILDING A TIRE IS LIKE A JIG-SAW PUZZLE

A workman places the plies for a 4-ply tire, cut on the bias at 45 degrees, on a building drum (upper left). Into a chamber is plunged a headless "barrel" containing all parts of the tire. An air bag has been inserted to force the tire against the mold for vulcanization (upper right). The tire is removed from a watchcase mold (lower left) where, under heat and pressure, it has been "cured" and the tread design formed. Conveyor belts deliver completed tires to inspection tables where each is examined and marked (page 176). These views of stages in tire making were taken in different factories; methods vary greatly in many plants.



Photograph by Hugh B. Cott

HE SMOKES RUBBER AS INDIANS DID BEFORE COLUMBUS CAME

This native of Marajó Island, Brazil, taps jungle trees for the milky latex, which he pours over a stick he revolves above a palm-nut fire. The sphere grows like a snowball. Each slow revolution hardens the fluid until the ball may weigh fifty pounds (page 156).

Half the tappers here now have bicycles with rubber tires made in the Java branch of an Akron factory to pedal forth daily and tap trees to get more rubber for Akron.

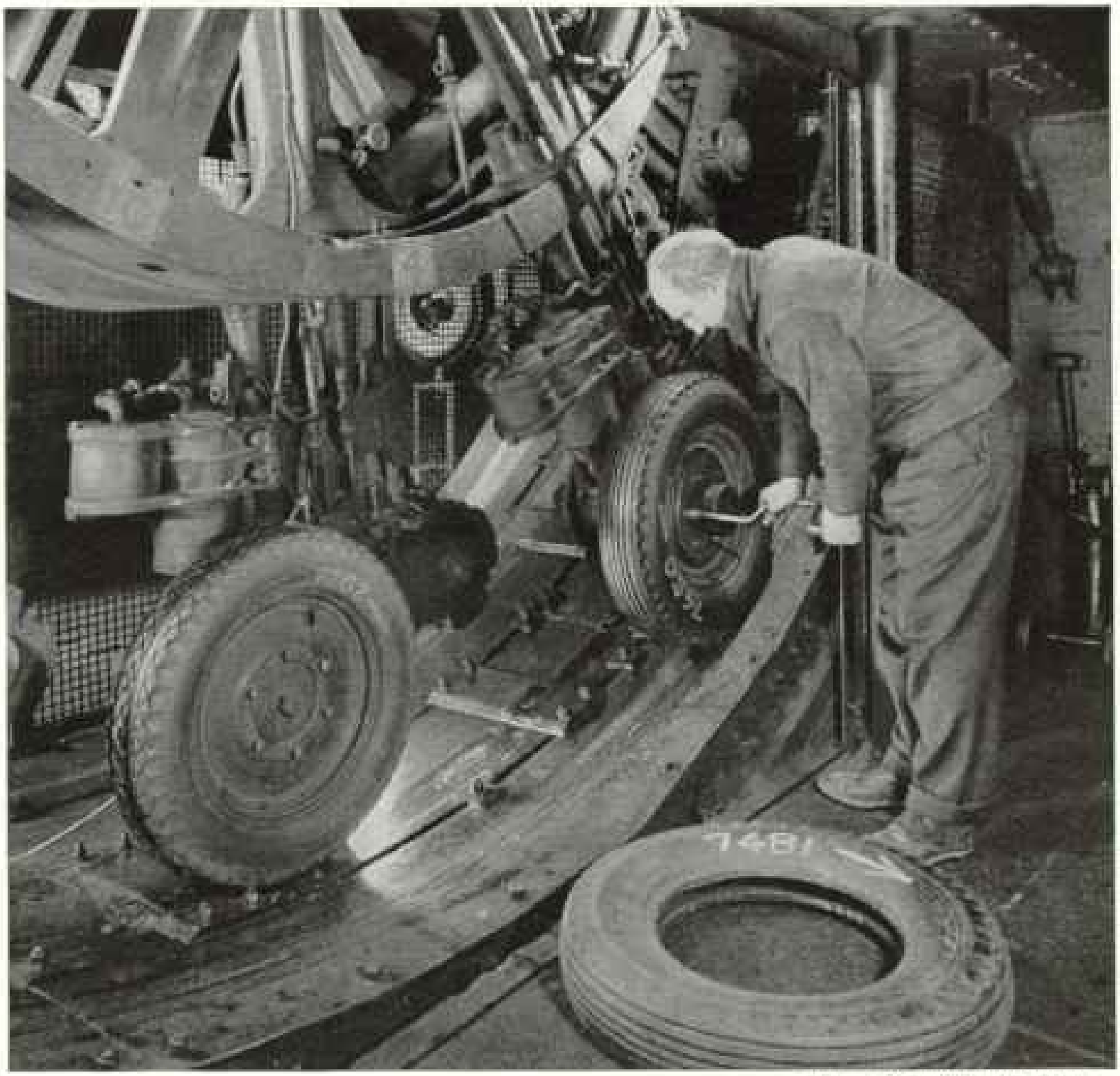
After their early breakfasts of rice, dried fish, and tea the tappers swarm out from the "lines" to the trees, many still wearing rainbow sarongs and singlets—striped cotton shirts—while others have adopted prosaic overalls or shorts.

Afoot or awheel, each tapper balances on one shoulder a bamboo stick, with a rattan basket swinging at one end and a "milk can," usually an old kerosene container, at the other (pages 154, 157).

When he reaches his trees he first pulls off the strips of rubber coagulated there from the previous day's tappings. (Usually tapping is done every other day.) He puts this "tree scrap" in one compartment of his basket to be used for "off grade" rubber.

Next he shaves off a sliver of bark—taking care not to wound the wood—and puts a cup in place beneath a spout stuck into the bark at the lower end of the diagonal cut. The peel-off he throws into the other half of his basket, for "bark scrap" also makes low-grade rubber.

In making the cut, the tapper pulls his oddly shaped knife toward him, about half way around the tree trunk. He leaves his collecting can at the first tree, and taps from 350 to 400 trees until the hollow-log gong sounds, about 9 o'clock.



Photograph by Willard R. Culver

FOR TESTING, TIRES SPEED OVER AN ENDLESS SQUIRREL-CAGE ROAD

The smooth-steel surface of this internal track, 18 feet in diameter, may be set with any type of paving, and also with the equivalent of sticks, stones, bumps, ruts, and even glass or nails. Fleets of cars make actual road tests over all types of highways in all kinds of weather.

Returning to his first tree, he begins emptying the cups of milky latex into his collecting can, resting his basket there until he is ready to carry basket and can back to the station (Plate III).

After his rubber milk is weighed, he pours it through a dirt-removing sieve into a dilution tank that will hold from 500 to 5,000 gallons, elevated so the latex may flow by gravity to the coagulation tanks below.

These tanks are slotted at the sides to permit insertion of thin aluminum sheets. Acid is added to speed coagulation, and aluminum sheets are dropped into the slots while the latex is still liquid.

Overnight the latex jells to form tough, wet curds about 1½ inches thick, 3 feet long, and 15 inches wide. Next morning they take out the aluminum separating sheets and float the rubber slabs onto rollers which press out water from the curd.

Then these tough sheets are hung on racks and put in smokehouses to dry for three or four days. Smoke from burning wood cut from dead rubber trees prevents fermentation while they are drying.

One of many reasons why rubber lends itself to plantation production is the aluminum-lined tank with its sheets, costing $1,500. It is a long quadruple commercial play here represented in your tire—Pittsburgh to Sumatra to Akron to Detroit.

Most rubber is shipped in these ribbed smoked sheets, which look and smell like

A PLUCKY BOY BREATHES WITH A RUBBER "LUNG"

A six-year-old is smiling through, with his back to his bed, though he is in a tight spot. At a hospital in Windsor, Ontario, a rubber-sealed emergency breathing apparatus from the General Tire and Rubber Company's laboratories was first tried out on this victim of infantile paralysis. Placed over the patient's chest, the rubber ring and sponge-rubber flap, encircling the transparent "lung," seal it tightly to the body.

slices of home-cured ham (Plate II), lesser quantities in pale crepe (unsmoked), which resembles dried codfish (page 148).

Every year now more and more liquid latex is shipped direct to the United States. Before it is poured into drums, the liquid rubber is run through a centrifuge, like a milk separator. To the rich "cream," containing up to 60 or 65 per cent rubber, ammonia is added as a preservative.

DRIP, DRIP, DRIP OF THE RUBBER DROPS

Wingfoot is only one of Goodyear's Sumatra tracts. Each morning when the 9 o'clock gong rings, more than three million trees have been tapped on all of them.

Twenty locomotives and 50 cars haul rubber over 50 miles of track on the Goodyear plantations; launches tow 14 steel lighters down the Bila River to the sea at Laboehan Bilik, on the Strait of Malacca, where European explorers sought spices in the era before refrigeration.

More than 2,000 separate buildings and 125 miles of motor roads have been constructed in areas which were untamed jungles in 1928. In two company hospitals an average of three or four native sons and daughters is born daily.

Stand beneath the tall trunk of a rubber tree and count the drip, drip, drip into the collector's cup—two drops a second from each of an estimated 800 million trees.

These tiny globules are the raw material of the mighty volume of rubber, more than 1,100,000 long tons, which the rubber drops pile up each year. You think of the slow accumulation of minute polyps that build up a coral island.

By narrow-gauge railway from the big plantations, and by bullock carts, often rubber-tired now, from myriad native patches, the bulk of this rubber comes down the rivers to the sea at such ports as Singapore and Penang, in the Malay Peninsula; Belawan, in Sumatra; Batavia, in Java, and Colombo, rubber shrine city of Ceylon (page 147).

Before shipping, smoked and crepe sheets are graded, like wheat, so you can buy sight unseen in primary markets for consignment to any destination.

Photograph by Paul Pryor

"GOOD QUEEN BESS" ALSO YEARNED FOR A WASP WAIST

The Elizabethan corset of whalebone stays and padding, covered with tan-gray cotton fabric and trimmed with bright-red morocco leather, worn by the girl at left, is preserved in the Folger Shakespeare Library in Washington, D. C. Round rubber thread of the more supple girdle to the right now is a mainstay of foundation-garment makers. The thread is made direct from liquid latex. Manufacturers are trying out rubber-thread evening gowns.

Buyers at Akron's big factories sit in rooms with snakelike ticker tapes writhing into wire baskets, piling up sheaves of radio messages and cablegrams, watching fractional-cent changes in New York prices and charting fluid exchange rates of strange moneys.

Three-fourths of the rubber which reaches the United States goes into making four tires apiece and spares for each of nearly 30 million motor vehicles speeding over roads of the United States. The tire is the culmination of one of man's greatest all-time inventions, the wheel.

Most any high-school boy can explain fully the working of an automobile. One was telling me all the points he checked before buying a second-hand-car bargain.

"Fine, son. And how do they make tires?"

"Well, I never thought of that." He hesitated. "I suppose they just cut 'em out like Aunt Nellie does her doughnuts, and then blow 'em up."

The familiar "doughnut" container for compressed air which you buy in one simple-seeming piece has a dozen or more parts and at least a score of ingredients.

Into the flexible wall of a tire go more engineering, chemistry, brains, and sweat than into almost any other part of your car.

A TIRE HAS MANY INGREDIENTS

A tire taps not only rubber trees, but cotton fields, coal, iron, and zinc mines, sulphur deposits, and gas wells.

In a passenger-car tire there are some 6,000 *miles* of cotton fiber, 140 feet of steel wire, while soot composes nearly a third of the tread. Sulphur and zinc oxide are there and—hold your breath—such chemical jawbreakers as mercaptobenzothiazole and dibetanaphthylparaphenylenediamine.

A purchasing agent's map showing sources of raw materials had dots from 39 of the 48 States—gilsonite from Montana, hardwood pitch from Tennessee, whiting from Indiana, litharge from Ohio—and so on until the list looks like a dictionary of chemistry and metallurgy. In addition, there were shellac from India, palm oil from Africa and the Philippines, coconut oil from

the South Sea, cork from Spain, asbestos from Canada, and tung oil from China.

One company let me see its total purchases for a year: nearly 22 million pounds of cotton, more than 20 million pounds of carbon black, 6,512,000 pounds of zinc oxide, 3,341,400 pounds of sulphur. The total bills for organic accelerators, based on 20 different chemicals, totaled $380,000. Antioxidants cost slightly more.

Compounds with all these strange ingredients help make your tire go farther and cost less. How much so is startling. Adult motorists recall when tires were guaranteed for 3,000 miles. Now they expect eight or ten times that mileage.

Thirty years ago the average United States car owner's annual tire bill was $174; in 1939 it was $17. In 1908 a dollar bought 50 miles' worth of tire travel; in 1939 more than 2,000 miles.

A 4,000-per-cent increase in purchasing power of your dollar is a record few industries can surpass.

A LONG FACTORY WALK

They smiled when I said I would like to follow all parts of the tire, from creel room, bead-wire machines, treads, chafing strips, ply fabric, and everything.

When we finished I knew why they laughed: a pedometer registered 5½ miles of indoor hiking. This factory spreads over 125 acres, has 165 acres of floor space and 14 acres of glass windows, mostly blue-tinted to cut out actinic rays.

Through two miles of tunnels scurry 75 tractors and some 600 trailers hauling raw materials around. In a year these tractors move two million loads a total distance equivalent to 29 times around the earth.

To see how a modern tire is made, you ferret out the cavernous, deliberately darkened storeroom of the tire plant. Like mammoth stalagmites are piled high 250-pound bales of pallid crepe, or pungent smoked sheets.

First step in manufacture is to pitch these bales into a "pie-cutter" where a hydraulic ram presses them against electrically heated blades which slice them into pieces.

The slices are mechanically "chewed" between corrugated, water-cooled rollers to make the rubber "tacky" enough to absorb ingredients to be added later.

The resultant rubber sheets are cut into slabs which are hung on racks to dry, and then the slabs, looking like frozen codfish, are ready for the mixing mill.

The mixing mill is the Aladdin's lamp of the rubber industry, whether they are making tires, shoes, garden hose, or teething rings. Here rubber, already far from primeval latex, in effect ceases to be rubber, and prepares to take on the diverse properties the chemist's wand dictates.

Big-company laboratories stock more than 900 chemicals.

The chemist, like a doctor, types out the prescription; the compounder, among the most highly paid skilled labor in a rubber factory, is the pharmacist who weighs out the ingredients.

Mill men pour the mix batches between two hollow cylindrical rolls with walls four inches thick to withstand tremendous pressure as the cylinders rotate in opposite directions at different speeds.

"Gee! I wish I could make my gum crack like that!" exclaimed a youthful visitor.

In many factories internal mixers, known as Banburys, of far larger capacity, do the same work as the mixing mill. In some plants ingredients are weighed by electric eye and compounds are made automatically by pressing buttons.

THE ANATOMY OF A TIRE

Cut through any pneumatic tire and the cross section will reveal five major sections, some composed of many pieces (Plate XIII and pages 170-1).

Beneath the tread is the breaker, one or more pieces of fabric and rubber assembled to resist bruises and separation.

Next is the body, or carcass. This foundation of the tire, which must withstand the weight of the car and constant flexing, is composed of layers or plies of cord, insulated in rubber.

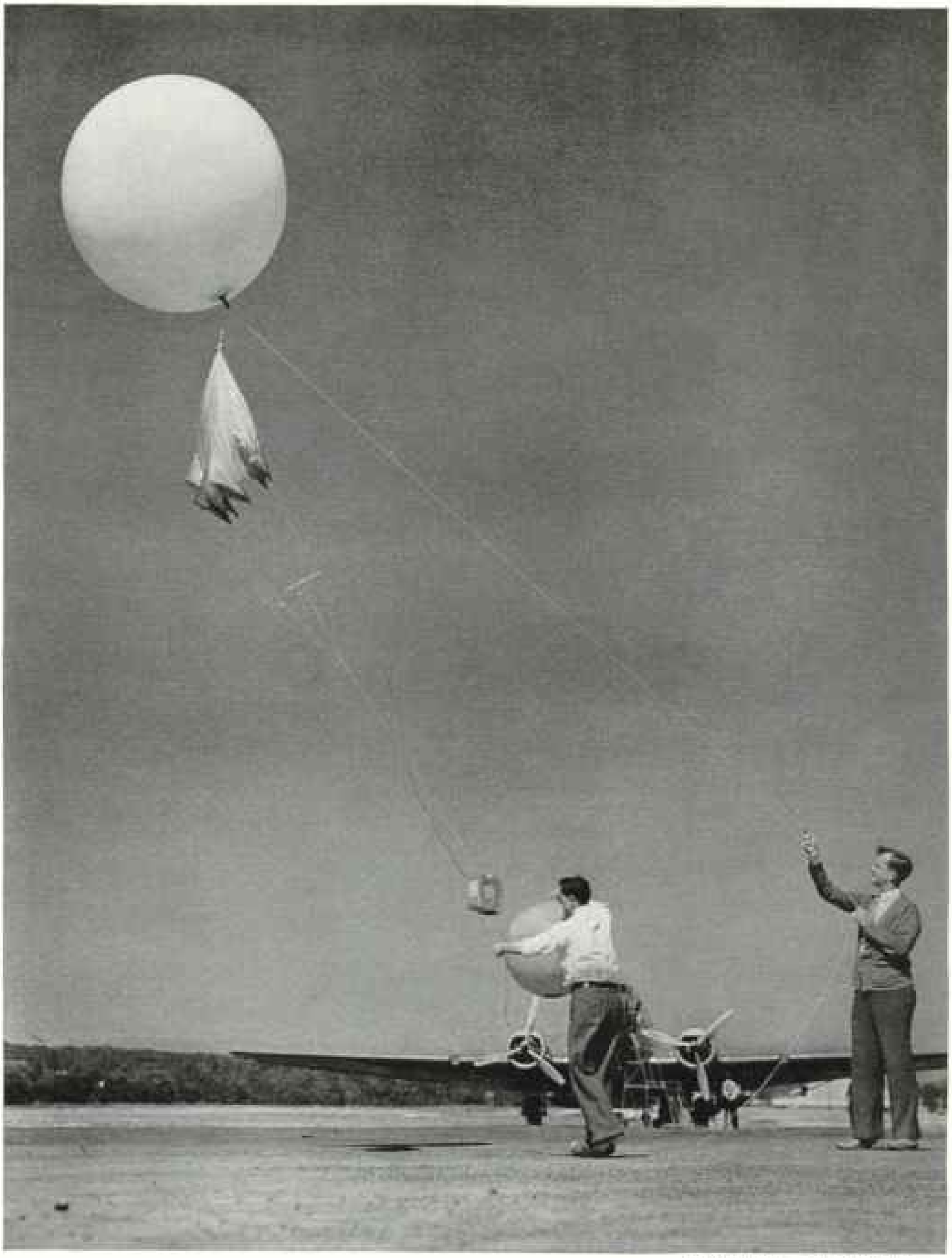
The base of the sidewall, where the tire fits on the rim, is the bead. Here steel wire, imbedded in rubber, helps inflation clamp the tire securely to the rim.

"Flippers," they call the fabric strips wrapped around the wire to hold the beads to the body of the tire.

THE "FIVE TOES" OF A TIRE

Treads, bodies, breakers, beads, and flippers—the "five toes" of a tire—all are manufactured in different parts of the factory. They might as well be in five different factories, since they are so dissimilar.

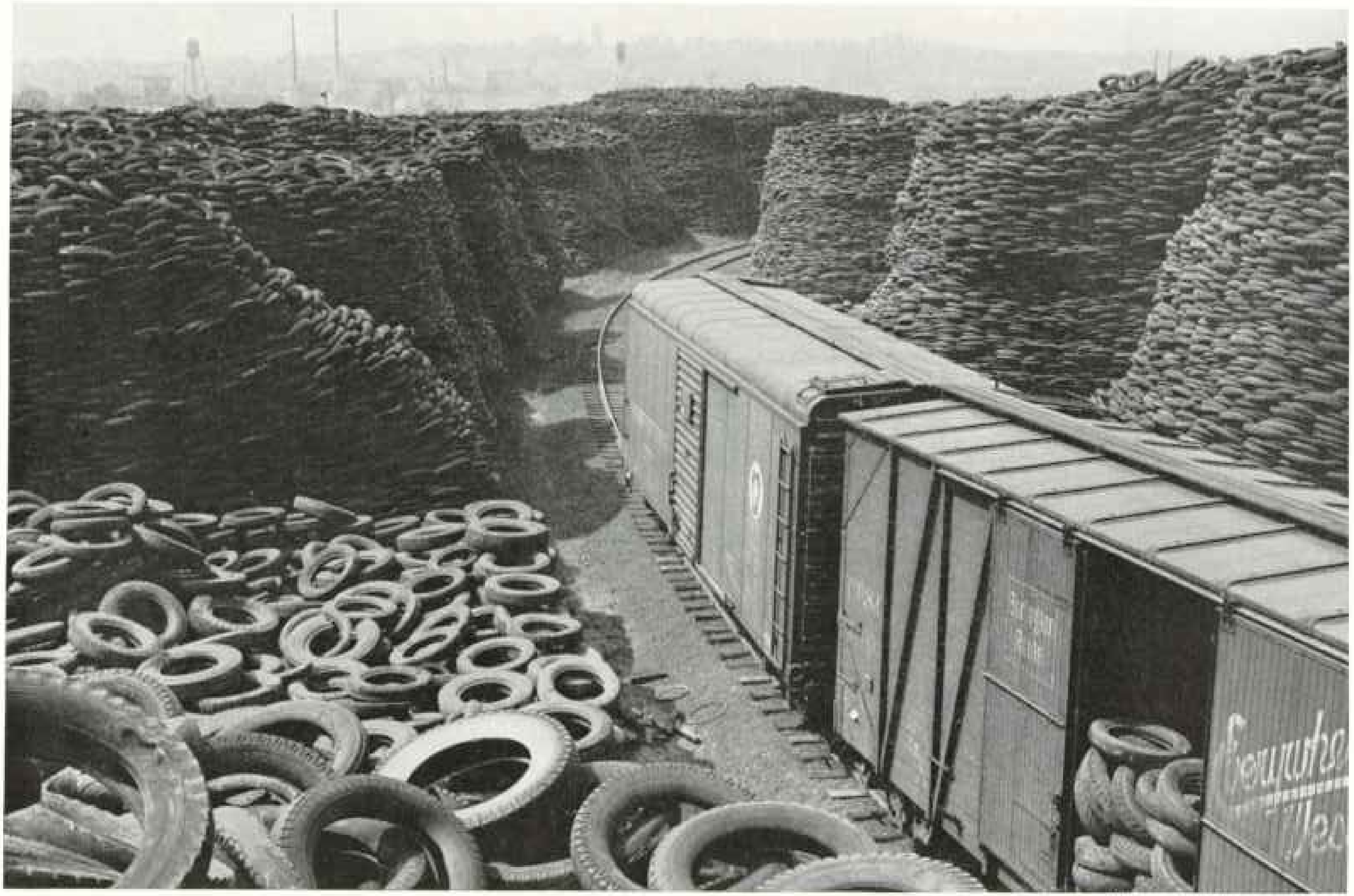
After milling, the rubber for tire treads is forced through screw-fed dies into long black ribbons that look like magnified flat



Photograph by J. Baylor Roberts

FAIR TOMORROW? OR CLOUDY, WITH INCREASING COLD?

Thirty such helium-filled balloons, released every morning throughout the United States, help get data for weather forecasts. The square object near the man to the left is a two-pound radio transmitter which makes a continuous record of pressure, temperature, and humidity. In his hand is a smaller drag balloon loaded with sand. When it bursts at two or three miles, the sand ballast is dropped and the bigger sphere soars to 12 or 15 miles. Inflated to five feet to start with, the main balloon reaches a diameter of 14 feet before the lessened pressure at high altitude explodes it also. Instruments float safely down by the parachute.



Photograph by Willard R. Culver

FROM THIS 8-ACRE TIRE "FARM" GROW YOUR SPORT SHOES AND HEELS, JAR RINGS, BATTERY BOXES, AND TOYS

Ten thousand tons of old tires "planted" here at Akron, Ohio, are raw material for thousands of products. "Second-hand rubber" does not go into first-grade tires.

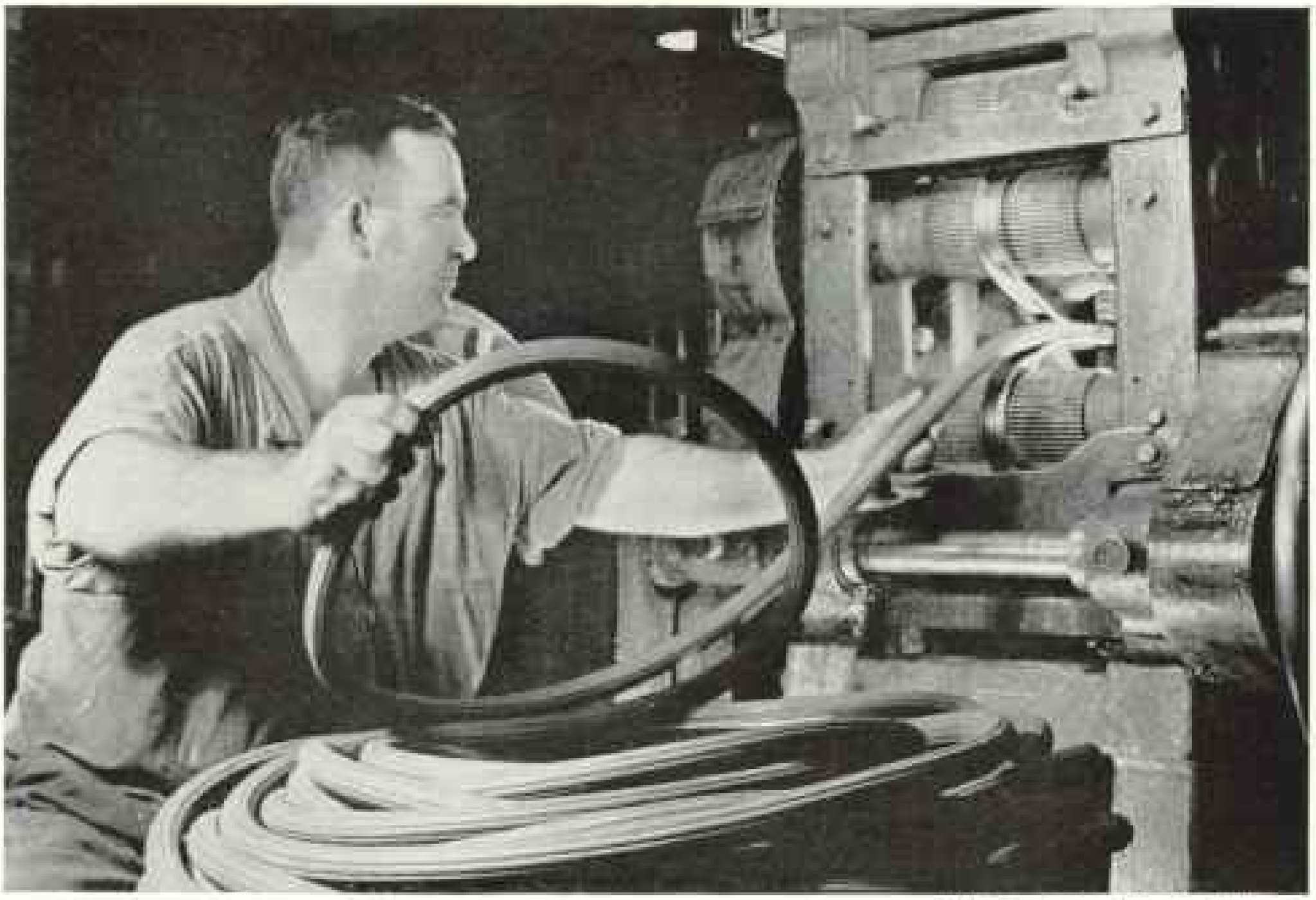
AT DIZZY SPEED RUBBER HOSE IS BRAIDED WITH COTTON CORD

Tubing from the pan to the left writhes snakelike into the machine and up through the center of the circles of spools. Automatically the machine weaves a fabric around the tubing, which then passes up to the take-off wheel and down into coils on the pan to the lower right (page 199).

Photograph by Willard R. Culver

MEADOW, FOREST, AND FIELD HELP MAKE A BASKETBALL

The girl is applying rubber strips on top of the winding, which in this Spalding ball consists of nearly a mile and a half of rubberized cotton thread. Panels for the cowhide cover are separately skived and do not vary in thickness more than the diameter of a human hair.



Photograph by Willard R. Culver

KNIVES SPLIT THE LEAD MOLD FROM GARDEN HOSE

Seemingly simple hose involves the highly complicated manufacturing operations of putting on a lead covering and then taking it off after the hose has been vulcanized in its form-fitting metal jacket. Here a continuous sausagelike link flows from the cutter as the lead casing is slit. Corrugated rolls above and below tear the lead apart. The hose will be cut into desired lengths, and the lead chopped into small pieces to go back to the melting pot.

licorice strips you still see at country stores.

The tread is the shoe of the tire, a reinforcement following Nature's example of padding the soles of animals' feet. Carbon black forms 30 per cent of this part of the tire, adding enormously to its wear.

It takes a sizable tank to hold 4,500 cubic feet of natural gas—the amount burned for 4½ pounds of carbon black in an average tire.

In petroleum fields you see gas-black houses where natural gas burns to collect the smoke. A New York dealer in carbon black proclaims on an inked strip across his letterhead, "200 tons of smoke a day."

At a massive machine, the calender, common to all tire plants, rubber meets its vegetable sister, cotton, to form the plies that make up the body of the tire.

The calender is an assembly of hollow metal rolls, through which water or steam is forced to regulate the temperature. These rolls, in effect, squeeze the rubber in between the cords.

Mixer and calender belong on the coat of arms of any tire maker.

The mixer symbolizes the years of patient chemical research which added accelerators to cure tires quicker, antioxidants to make them wear longer, and fillers for other special properties.

The calender represents the physics principle that cords laid side by side and insulated with rubber escape the friction generated by flexing of cross threads in woven fabric.

BUILDING TIRES ON MERRY-GO-ROUNDS

"Let's start at the beginning of some of these tire parts and follow them through," I suggested on my first tour of tire making.

"How far back do you want to go?" asked my mentor quizzically. "To a cotton mill in Georgia, a steel plant in Pittsburgh, or a sulphur mine in Louisiana?"

"I get your point," I capitulated. "On to the merry-go-round."

The merry-go-round corresponds to the assembly line in an automobile plant. Toward it conveyor belts pile in the parts deft workmen build into the tire as the building drums roll past on the colossal "carrousel."

Photograph by Willard R. Culver

FIGURE-EIGHT COVERS GO ON A TENNIS BALL

Melton Mowbray, England, famous for its pork pies, also gave its name to "melton," which the trade calls the woolen cloth here shown at the plant of A. G. Spalding and Bros., Chicopee, Massachusetts. The covers are die-cut on a "dinker," and are rubberized on the inner side.

Here were nine drums on this merry-go-round of the U. S. Rubber Company. Like a train announcer, my companion explained the operations at each "station."

"Watch the first man collapse the building form, or drum. He applies the bead wire and the flippers to the bead rings of the drum. The drum is the scaffolding of the tire. The next man expands the drum into circular shape. The first ply is applied and spliced, then the second ply.

"Note how each layer of cord is fitted at a 45-degree angle with the bead; thus two layers are at an angle of 90 degrees with each other.

"Now number four closes up the bead rings and turns the flippers down on top the second ply. Then number five sets the bead rings and turns the first and second plies up over the bead wire.

"That man is putting on the third and fourth plies. This is to be a 4-ply tire—bigger tires, for buses, trucks, earth-movers, might have 10 or 12; up to 28 or 30.

"On go the chafing strips and breakers.

"Here comes the tread. Watch how number eight knits it down to all the plies. Then he takes the third and fourth plies and tucks them under the bead wire.

"The last man collapses the drum. Off comes the tire, and he hooks it to the conveyor belt."

READY FOR THE "CURE"

The cylinders moving in slow procession away from the drums look more like squat barrels with the ends knocked out than they do like tires.

Each is fitted snugly into a steel container, the forming box, and then a rubber waterbag is jammed into the hollow inner portion of the tire. Internal air pressure shapes the tire against the walls of the box.

Then comes vulcanization—the "cure," tire men call it. The shaped tire is laid in a steam-jacketed mold into which the tread design has been cut. Here, under steam heat and pressure, this conglomerate of many pieces becomes a tire.

Curing may be done in individual, or watchcase, molds. Or a number of the molds may be lowered into a steel chamber into which steam is forced.

A pipe leads to each waterbag valve. First the bags are filled with steam, to be displaced with hot water at high pressure.

Then steam is forced into the vulcanizers. Thus the heating which cures the tires comes evenly from the steam surrounding the molds and from the hot water within the bags. Also, the pressure inside the bag forces the tire against the mold and welds the parts firmly together.

Automatically the tire is removed from the mold, and the waterbag is extracted.

"Whiskers" of overflow rubber are removed from the tire and it gets its "beauty treatment" by "ragging" (cleaning), and painting.

Then it is ready for the inner tube.

Making inner tubes is comparatively simple. In one process compounded rubber is forced through dies and extruded as a tube (page 199). This tubing is cut to desired lengths, and valve stem and protecting pad are inserted. The two ends are spliced and the tube vulcanized.

This is the story of one of many ways of making one of hundreds of kinds of pneumatic tires. It seems oversimplified; yet each major stage is there.

THE ACID, AND OTHER, TESTS

All the while, they are testing mixes, parts, and tires as a whole.

Dumbbell-shaped test pieces, cured from each batch, are rushed from mixer to laboratory. A machine pulls out strips to gauge load and stretch at break. Emery-cloth wheels rub samples thousands of times so their loss of weight may be measured. Other samples are flexed between two disks rotating off center at temperatures as high as 400 degrees Fahrenheit.

Whole tires are mounted in a "squirrel cage" or a "Ferris wheel" and run under pressure against circular tracks with surfaces built up to simulate ruts, bumps, stones, even nails. Last year tires ran more than a million miles on the wheels of one laboratory (page 173).

"How do you prove anything?" I asked.

"By creating special conditions, and recording the exact effects. This cleated wheel is for measuring separation. It runs 40 miles an hour, 600 bumps a minute, at 15 per cent overload.

"That machine studies front-wheel geometry, which includes stability, caster, camber, toe-in, and steering angle. We have one which can wear any passenger tire smooth in 24 hours."

In one test they plunge test pieces into oxygen at 100 pounds' pressure per square inch, at 157 degrees Fahrenheit; 48 hours of that are equivalent to two years' aging.

They expose products to artificial sunlight and ultraviolet rays. They "footprint" tires to record road contact under any given pressure. Others they put into pounding machines which hammer them with nubs. One factory has a guillotine rigged up through seven stories to drop 40-pound weights on mounted tires.

A CLINIC FOR SICK TIRES

When a dealer sends back a tire as defective, it is not merely thrown on the reclamation pile. It goes to the clinic to be cut up by the tire surgeon's knife and diagnosed. Most sick tires fall into about 30 trouble types. Common diseases are blowouts, broken fabric, ply separation, tread separation, rupture, rim bruise, breaking above the bead, and spot breaks—especially in bus and truck tires.

Buttonholing a production engineer, I had him count all the tests there were in his plant.

While he reeled off suggestions over three telephones about adding more stearic acid to this batch, rejecting that shipment of clay, and cooking sample 76,895 two minutes longer, he jotted them down.

His notes added up to 49 different chemical methods and procedures raw materials might undergo in that one factory, and to 44 different physical tests. For the finished tire, he calculated, there are 54 standard physical tests, and 40 service tests.

This plant makes 1,324 motor-vehicle tires of various constructions; another one puts out 142 different kinds of tires for airplanes. One problem of the latter was to develop a tire which would resist cactus punctures in forced landings on the arid mesas of the Southwest.

Complicated designs on tire treads are not surrealist decorations. They represent years of experiment to meet varied conditions. This fact is emphasized in tires for export and special uses: big "balloon" tires to "float" in the rice fields of Louisiana and the Ganges Delta, sturdy tires to haul heavy loads of bananas in Colombia, snow tires for icy roads in Switzerland, thin carriage tires for Java and the Philippines.

One company makes three tires for Egypt trucks: one to take hold in sand, another to ride the mud, and a third to combine these features. Some are used on beer trucks drawn by camels. In Puerto Rico sugar-

BEST BALLOON SELLER IS "MICKEY," IN EDITIONS OF MILLIONS

Abstruse chemistry is involved in making him from latex direct, and precise physics calculations help him blow up evenly. Girls at the Oak Rubber Company plant, Ravenna, Ohio, stamp him on with special rubber ink which expands as he is inflated.

 Kodachromes by Willard R. Culver

YOU COME OUT OF THE VALLEY OF THE SHADOW, OR FLY HIGH, WITH AN OXYGEN MASK

Cumbersome oxygen tents are eliminated by this new assembly. Such equipment is used regularly by Army planes on high-altitude flights. Mask, tubing, and breathing bag are made from latex.

RAW MATERIAL FOR THE BASEBALL KINDERGARTEN

Rubber play balls for children too young for solid ball and bat are dipped into harmless pigments floating on the surface of a liquid, and dried on a rack.

Kodachromes by Willard R. Culver

REMEMBER THE BALLOON MAN OF THE CIRCUS?

Three generations of the Zingaros (this is Florindo) have had concessions since the original Barnum and Bailey pitched their big tent.

Kodachrome by Willard R. Culver

"LET'S GO FISHING IN THE RUBBER BOAT!"

In a few minutes the girls unpacked the craft from a case no larger than a traveling bag and inflated it with a hand pump. They are taking their sectional wooden oars along with the outboard motor. Similar rubberized fabric boats, equipped with an automatic inflation device, are used for life rafts on Army and Navy airplanes. Many German and British aviators have been saved by air rafts after being forced down on the North Sea.

RUNNING A COLOR BATH FOR A TANK OF EMBRYO TOY BALLOONS

Red pigment is added to liquid latex for the mix that will make blowups for children of all ages. "Barkers," "pitch men," and street venders will help sell them. Using the "milk" shipped direct from plantations has revolutionized the making of thread, gloves, and many other products.

© National Geographic Society Kodachromes by Willard R. Culver

TWO PILLS MAKE A TOY BALL BIG AND STRONG

Suction cups sheeted rubber into the mold (lower half); another sheet forms a rubber biscuit. Then water is added to the pellets, which dissolve and form nitrogen gas. Inside pressure rounds out the sphere.

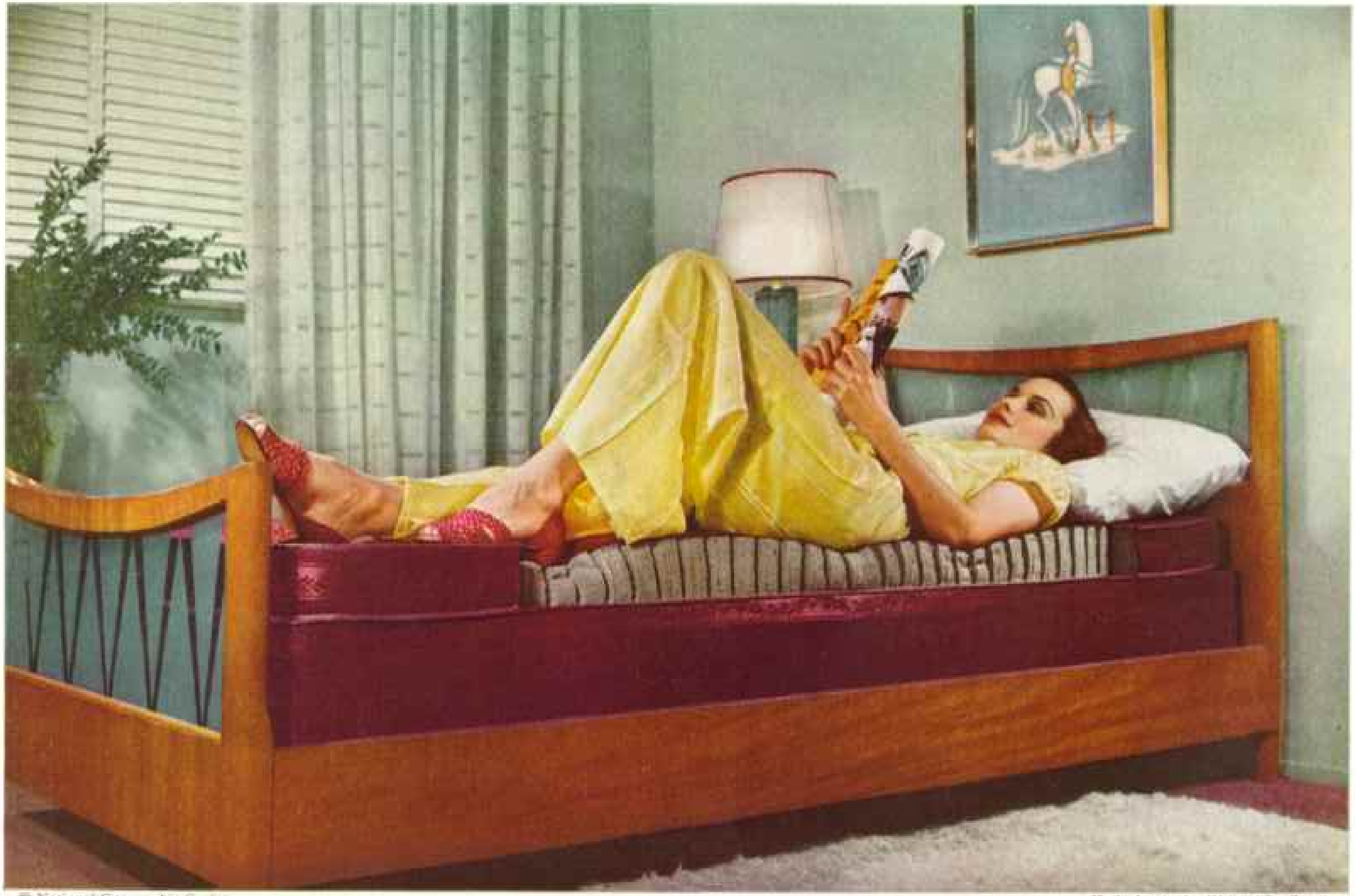
IN THE 8-YEAR SPAN OF THIS BOY'S LIFE THESE FARM TIRES DEVELOPED

Each Firestone design here was made for a special purpose, from the wheelbarrow tire (on ground, left) to those for front tractor wheel (left of row standing) to the extra-deep earth-gripping tread for swamps and soft soil (extreme right). "Rubberized farming" represents the biggest new use of rubber.

 Kodachromes by Willard R. Culver

SAFETY FIRST IS PROMOTED BY A SECOND TUBE

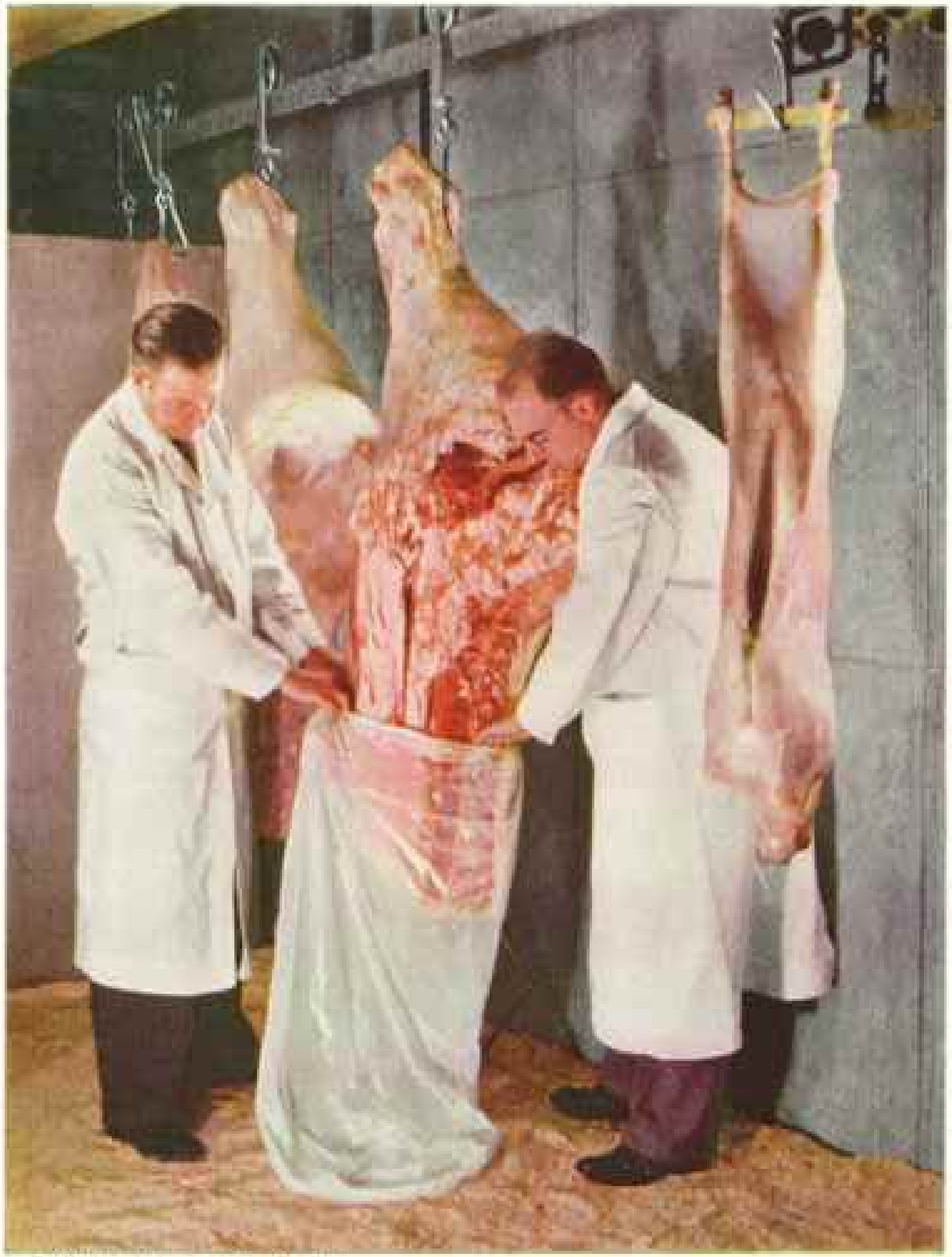
The "Lifeguard," Goodyear calls this two-in-one device whereby if the outer envelope is punctured the inner carries on. Equal air pressure is regulated by the side wall valve (at technician's left hand).



Kodachrome by Willard R. Culver

THEY SLEEP ON SUCH MATTRESSES IN LUXURY AIRLINERS—AND IN THE BALTIMORE CITY JAIL.

Pullmans of the rail and sky use them for comfort; penal institutions because they may be sterilized quickly and often. Here one side of the mattress, processed by the U. S. Rubber Company directly from liquid latex, is cut away. There are a quarter of a million air cells in a cubic inch.



NOW THEY WRAP YOUR ROAST IN TREE DROPS

A rubber bag made from liquid latex is inflated to balloon size; then, when air is drawn from the bag, it fits a side of beef, or a fowl, like a glove. Australia is shipping tons of rubber-wrapped beef to war-rationed England.

Kodachromes by Willard R. Culver

YOU LAUNCH THIS FLOATING ZOO WITH A BICYCLE PUMP

By hand girls cut beach toys from raw rubber sheets, compounded to be salt-water-proof. Then they cement the parts so the animals will float upright. After vulcanizing, the swan will be ready for blowing up.

© National Geographic Society — Kodachrome by Willard R. Culver

THEY'RE ALL BOUND ROUND WITH RUBBER STRING!

Each bathing suit contains half a mile of Controlastic yarn made from liquid latex, encased in about three miles of cotton thread. These advance models for next summer's swims represent one of the earliest uses of rubber, that of waterproofing. Raincoats still are called mackintoshes for the Scottish chemist who experimented with waterproof rubber fabrics more than a century ago.

cane carts often have tires that cost more than the carts—but only two or four oxen now are needed instead of eight to twelve.

Around the Jordan River and age-old Damascus you see camels pulling Bible Land vehicles piled high with tires for agents' stores. Thousands of Asiatic bullock carts creak less on tires, and one company has high hopes of expanding the India market, having carefully estimated there are six million carts in that land alone.

Tire makers have to study American geography, too.

In passenger tires they combine many elements—traction, freedom from vibration, nonskid, dampening of noise—to avoid tread wear on rough roads, bruising on rocks and cobbles, blowouts at high speed on good roads, and heat blowouts in the sunny southwestern United States.

IT TAKES A MONTH TO MAKE THE ELUSIVE GOLF BALL

It requires only one working day, or less, to turn out a tire; it takes a month—two months for some brands—to make a golf ball, which you may lose in a split second (pages 194-5).

The rubber thread around the core, or sac, starts as a sheet for which the compound is mixed, kneaded, calendered, and vulcanized. Then the sheets are stretched on a drum for cutting—1,152 strands to the sheet I was following, each strand a sixteenth of an inch thick, a hundred yards long.

Skeins of threads that look like masses of tangled seaweed must be laid parallel and combed, then wound on spools to await wrapping about the center.

Sacs are made on aluminum forms automatically dipped by the scores into latex compound; immersion time measured with a stop watch determines their exact thickness. After they are plunged into acetic acid to solidify them, and vulcanized, girls strip the sacs from the forms.

A filling machine "kicks out" the right amount of "paste"—one manufacturer uses pure honey—and girls tie the necks with rubber thread. Other workers cut off the necks and cement them.

At this stage the cores are egg-shaped. Again they go into molds, are frozen at temperatures as low as 150 degrees below zero, and they come out rounded and ready for wrapping.

Wrapping is started by hand and taken over by winding machines ingeniously set off-center so thread intersections do not pile up, one above the other. A second winding with finer thread makes the core ready for the cover.

For shell or cover material gutta-percha is mixed with Hevea rubber and chemicals to form a strip that looks like a whitish piece of taffy. These pieces are preheated, put into molds, and under high pressure and low temperature the hemispherical shells are shaped.

The center, or wound core, is inserted into the two half-shells and the completed ball is pressed out under heat and plunged into a cooling room. The entire ball must be vulcanized again to cure the cover. Then it is ready for brushing, testing, painting, and boxing.

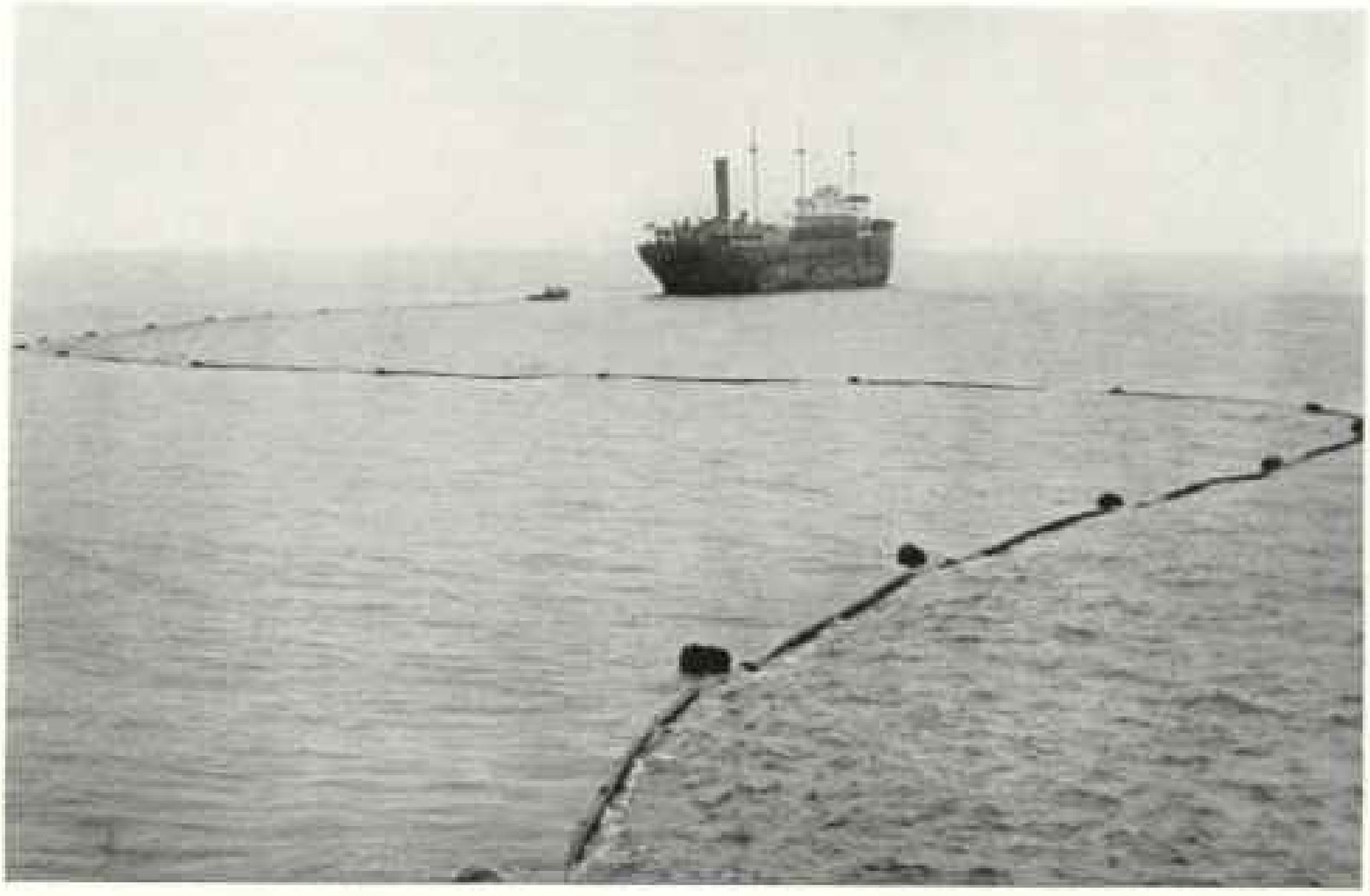
This description of golf-ball manufacture, like that of tire making, is simplified, and narrates only the major steps for one type of ball. I kept score around this factory golf-ball course—there were 74 handling operations. The laboratory tally showed 80 tests for raw materials, 18 processing tests, 19 control tests—117 possible tests for one golf ball!

In the finished ball are at least 35 raw materials and chemicals; ten or twelve more are used in stages of manufacture. If a "pro" wishes to cultivate deliberation, perhaps he should have his learners pronounce "polymerized trimethyldihydroquinoline" or "tetramethylthiuramdisulfide" before they drive, and they would be less likely to land in a water hazard.

Weighing, and measuring the ball to a ten-thousandth of an inch diameter, and the cover to six-hundredths of an inch, are simple compared to taking X-ray shots for roundness, mercury-balance baths for location of center, jamming 300 pounds down on the ball for compression, and operating "meat ax" machines which test resistance to cover tears should you top your ball, and calculating resiliency and rebound angles.

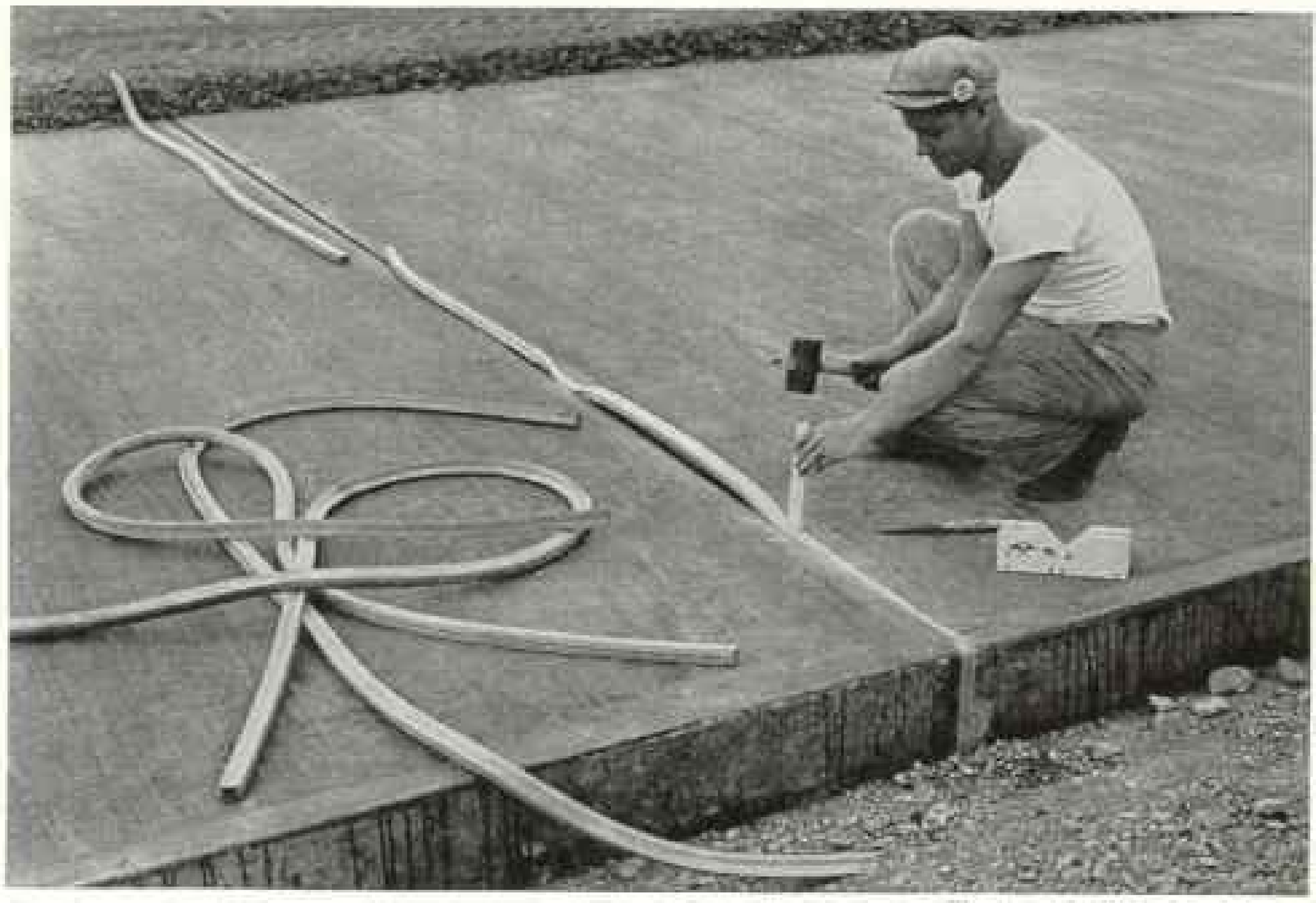
One of many testing devices for the finished ball is the driving machine which suggests a Rube Goldberg cartoon. It drops a ball into a chute beneath which an automatic tee raises the ball into a position to be struck by a hard-hitting mechanical golfer. The busy ball bounces against one steel plate, rebounds to a second plate, and then through a hole into a net, and onto a mat which simulates turf.

Back into a hopper it rolls to go through



A THOUSAND-FOOT RUBBER "STRAW" SIPS UP A THREE-MILLION-GALLON DRINK

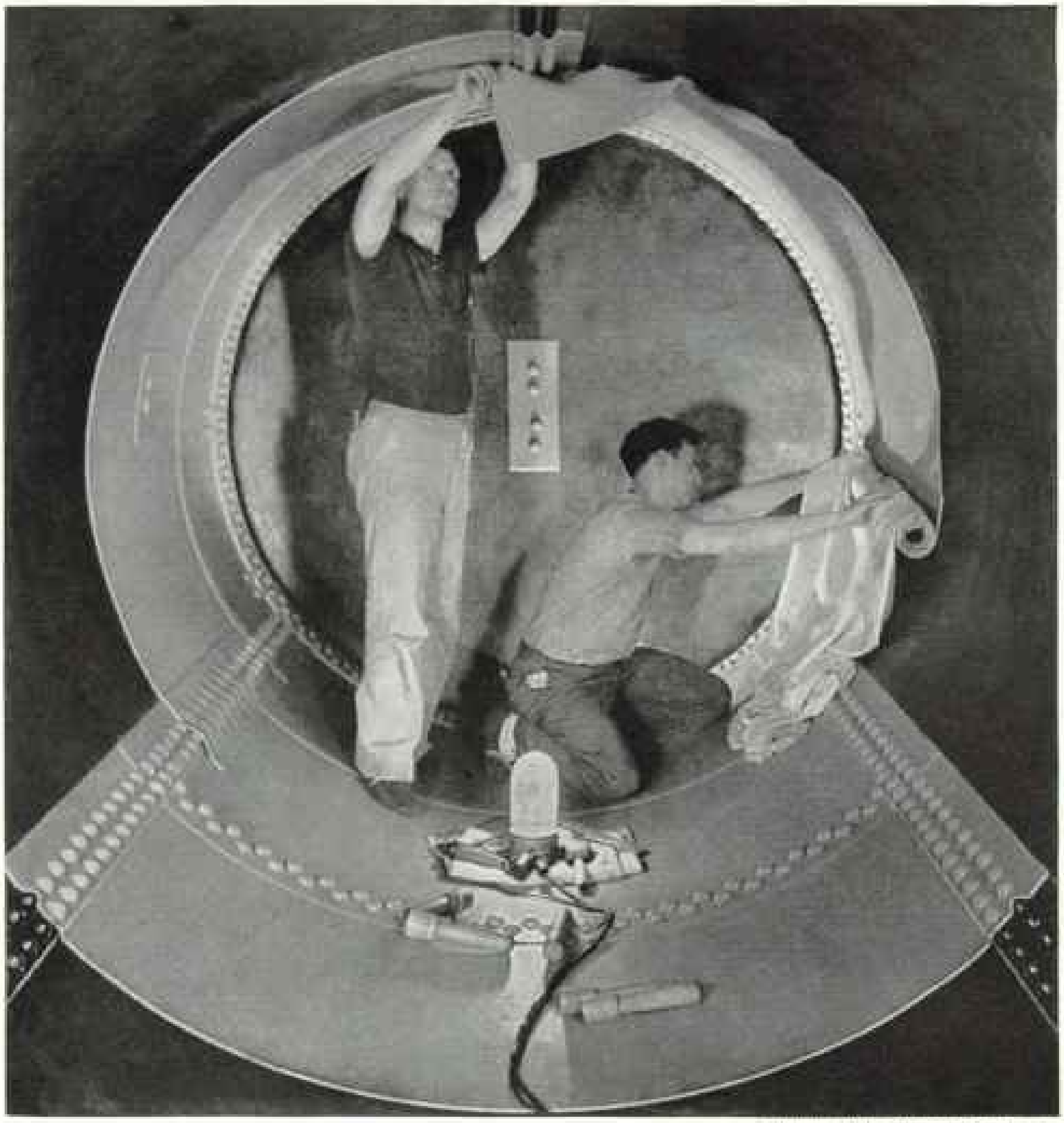
Hose developed by Goodrich stands high pumping pressure, yet is light enough to be floated to a tanker a fifth of a mile off the California coast. It takes 18 hours to pipe in a full load.



Photograph by Willard R. Culver

RUBBER TIRES GLIDE OVER RUBBER STRIPS ON MANY ROADS

Narrow spaces at intervals across highways provide for expansion and contraction of paving at varying temperatures. Goodrich hollow fillers were designed to take the place of liquid tar or asphalt, which often cause bumps in hot weather.



Photograph by Willard R. Culver

"RUBBER-PAPER HANGERS" LINE AN ACID-PROOF TANK CAR

One of the many miracle properties of rubber, other than elasticity, is its resistance to acids that "eat up" metals. Here a tank car for hauling hydrochloric acid is being rubber-lined. After the inner surface is blasted, adhesives are "painted" on, and workmen "wallpaper" the interior with sticky strips of unvulcanized rubber. Hand-rolling with the tools in the foreground insures even contact. Closed rubber-lined containers are vulcanized by squirting steam into them; others are run into a mammoth vulcanizer 50 feet long and 15 feet in diameter. The process, known as Vulcalock, was worked out by chemists of the B. F. Goodrich Company.

its paces five times. Previously it has been soaked in water 12 hours to exaggerate this test. If it rebounds offside, or misses the hole, it falls into the rejection hopper.

COLLOIDS AND TOY BALLOONS

Most parents who buy Junior a balloon at the circus or the zoo are unaware that the toy represents one application of years of research in abstruse colloidal chemistry.

Formerly the toy-balloon maker, like the tire manufacturer, worked with coagulated tree drops—which seems a tenuous enough basis for a two-and-a-half-million-dollar industry. Now, in effect, he deals with minute pear-shaped particles of the latex drop—particles so tiny it would take 25,000 to span an inch.

By the old method molds were dipped into viscous cement and then cured in

RUBBER BLOCKS MARK THE BIRTH OF A GOLF BALL

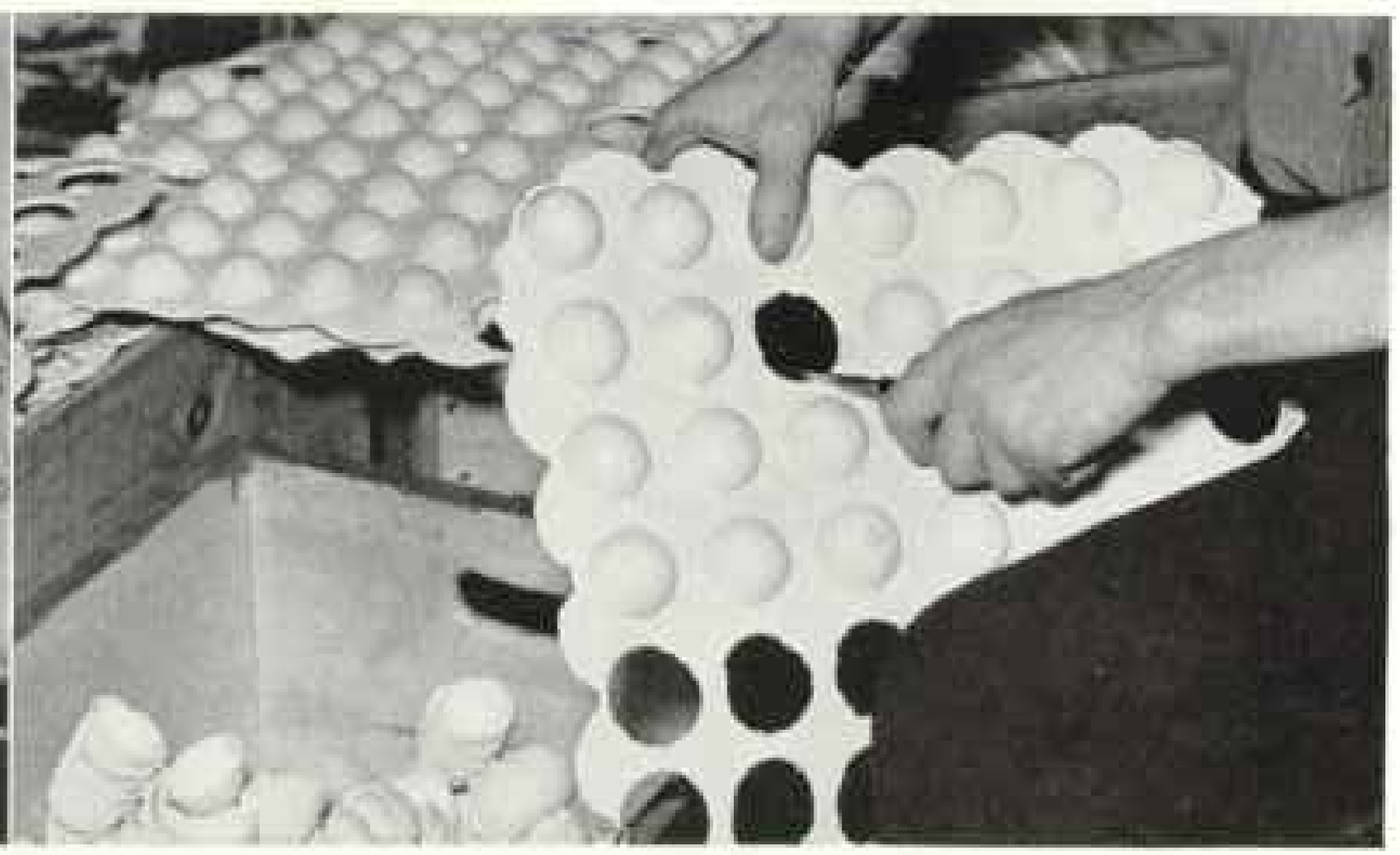
A pill mold presses the cubes into spheres (page 191).

SOLID CORES ARE UNLOADED AFTER VULCANIZING

Sometimes hollow centers are filled with liquid.

GUTTA-PERCHA IS MOLDED FOR COVERS

This kind of latex from several varieties of Malaysian trees, not *Hevea brasiliensis*, gives great resiliency and toughness.



CUPLIKE COVERS ARE CUT FROM SHEETS

The game of golf originated in Holland. Formerly the balls were covered with leather and stuffed with feathers.

A DEFT MACHINE WINDS GOLF-BALL THREAD OF RUBBER
Cores (right) are kept in dry ice to prevent melting.

WOUND CENTERS ARE CUPPED IN COVERS
Each assembly goes under pressure of a ton to a ball.

CHILLED BALLS COME FROM THE "CURE"
Heat and pressure have united the wound center with the cover. Then the spheres are shrunk with ice water for lifting from the mold.

Photographs by B. Anthony Stewart, courtesy Acushnet

SIZE IS GAUGED TO A HAIR'S BREADTH
In the United States a standard golf ball must not be less than 1.68 inches in diameter, nor more than 1.62 ounces in weight.

SUBWAY CROWDS NOW RIDE MORE EASILY, AND APARTMENT DWELLERS SLEEP MORE SOUNDLY

A test installation on a New York underground resulted in miles of Firestone's rubber tie plates being put in. On one subway curve claims for $150,000 were made against the company for alleged damage by vibration to near-by apartment buildings. Since rubber tie plates were placed under the rails, no claims have been presented.

sulphur vapors. Now cradles with a thousand molds run from vat to vat on rails, automatically immersing the molds into soapstone, latex compound, and coagulant. They reach the required thickness in five seconds; the old cement-dip method took two hours.

Still riding rails, they go through the washing machine, the drier, and into the "tunnel" for vulcanizing at some 200 degrees Fahrenheit.

Girls strip them from the molds; other girls blow them up for testing, in a room where the pop-pop-pop of the defectives sounds like firecrackers. Decorations are printed on the balloons with rubber ink because it will stretch, too (Plate IX).

One factory abandoned a million maplewood molds that originally cost $100,000 for the aluminum and glass molds required by the new process. The same plant spends as high as $35,000 for machinery to make figure balloons that sell for half a cent and may be out of vogue in six months.

Quantity production and fractional-cent profits pay dividends on the 60 million pieces made there last year in 52 styles.

Balloon makers must work fast and secretly, like Paris dress designers, lest a novelty be outmoded or copied before it reaches the market.

When a New York dealer had the idea for a Mickey Mouse with inflatable ears, he jumped into his car and drove night and day to an Ohio plant. There physicists worked 24 hours a day in relays on the design problem. It was found the ears' volume must equalize that of the head, and

Photograph by Zintgraff

THEY'VE FOUND A WAY TO STOP THE WAR OF THE RAMS

Firestone's rubber mask permits the animal to see its food but not its enemies when the head is lowered in fighting position. One Texas sheep man ordered 18,000 masks to declare an armistice in his flock, and reported thousands of dollars saved from customary casualties in the "fighting season."

the body volume equal that of the head and ears, so the entire balloon would blow up evenly.

60 TONS OF HOOFS FOR FERDINAND

Here I saw them unloading 60 tons of pasteboard hoofs for Ferdinand the Bull balloons. Six million Ferdinands were delivered last spring to a food company to be used as premiums to get children to switch from hot cereal to cold. A soap maker distributed 26 million premium balloons to persuade Johnny to wash behind his ears.

In hard times premium orders soar. More stable is the time-honored outlet through the "trailers" who follow the circuses, parades, and county fairs, and the "pitch men" who take their stands at street corners and amusement parks (Plate X).

The "boys," the makers call these venders of all ages. The "dean of the boys" is an 84-year-old Italian in New Orleans, whose knowledge of "what the kids want" is uncanny. Even he can't always spot a winner.

"A new balloon at Coney Island is as much of a gamble as a Broadway first night and sometimes represents a bigger investment," explained a sales manager. "We have flops, too; trying to put propellers on balloons was one. Too complicated, I guess.

"The 'squawker' is about out. Stick and string balloons are giving way to the 'toss-ups'—the ones that land on a paper base. Half of all balloons made are red.

"Our biggest new idea? One was the serpentines. Youngsters thought they were getting more for their money, and for a time we shipped out half a million a day. Another was painting flowers on balloons. The kids liked the colors, and teachers encouraged the idea.

"Fastest sales are at the circuses and the

Photograph by Willard R. Culver

"THESE ARE SIMPLE SHOES—ONLY 52 PARTS TO A PAIR!"

Many single rubber shoes contain more pieces than that, a production manager explained. These sport models of the United States Rubber Company's plant at Naugatuck, Connecticut, are known as Dutchboy Sabots, because of the bulky sole, which, however, is far lighter than those of the traditional Netherlands wooden shoe because it is made of a cork-and-rubber compound. The young woman is attaching the outsole to the shoe with a latex adhesive, before vulcanization (page 199).

zoos. World's fairs are not so good. I suppose visitors think they can buy balloons at home."

A "WIZARD OF OZ" SETTING

Mickey Mouse is the *Gone with the Wind* of one plant. He has been a best seller for six years, and is still going strong.

At one factory they were piling up Pinocchios long before Walt Disney's publicity men had gotten busy on that picture. Like publishers, the balloon makers scout out popular films, comic strips, and children's books (page 169).

A special mold room looks like a *Wizard of Oz* set—thousands of grotesque "corkscrews," long-billed ducks, Snow Whites, rabbits, Popeyes, figures of animals, of fiction, and of sheer imagination run riot.

The export department is a lesson in human geography. They ship balloons to Turkey for the feast of Ramadan, black and white ones to Nicaragua for funerals, Christmas blowups for the Netherlands Indies showing St. Nicholas on a white horse followed by a negro page boy with a cash-box, and stringed spheres to Oslo with the legend "Buy Norway products."

Ferdinands are tabu in Latin countries where bullfighting still is a national sport, but South America is a heavy market for small carnival balloons filled with perfume which swains throw at their ladyloves.

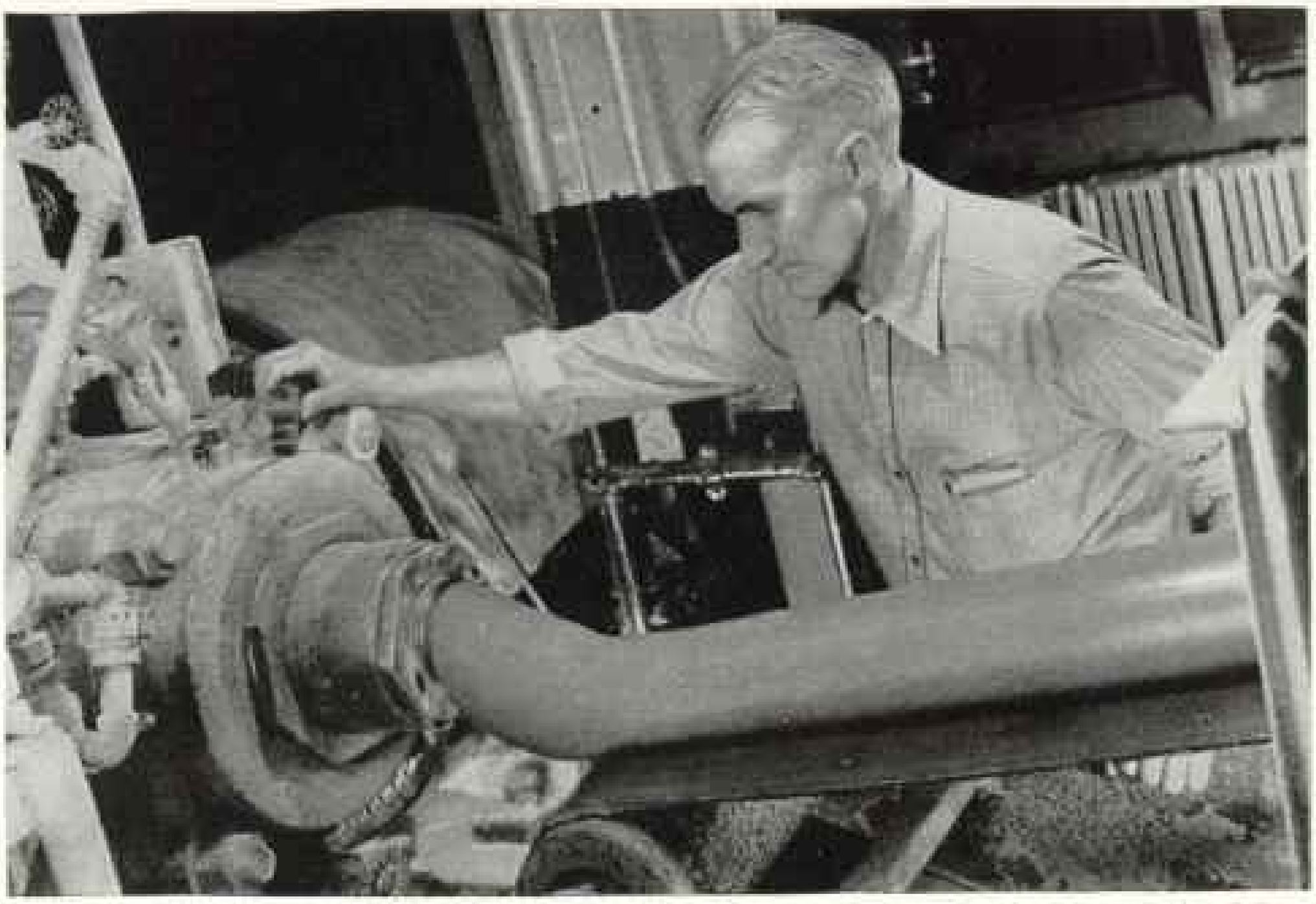
"We had 400 gross on the high seas to celebrate the birth of King Zog's baby, but they were a dead loss because Italy took over Albania before they arrived," lamented the export manager.

HOSE FOR FIRES IN LONDON

First big rubber war order last September was for three million feet of fire hose, allocated among American companies. London asked quick delivery for emergency lines to draw water direct from the Thames should bombing break the mains.

Fire hose was one of rubber's earliest commercial products to replace and outlast the leather hose used by many of the historic volunteer companies from Maine south to the port of Georgetown before there was a District of Columbia.

Garden hose perhaps is the most familiar of the hundreds of kinds of hose they make



Photograph by Willard R. Culver

TIRE BODY, TREAD, TUBE—THEY ALL HELP YOU RIDE ON AIR

"They might just as well call the auto an airplane," mused the philosopher of the inner tube department. "In the skies the wings grip the air; on the ground the inner tube rolls its own air along." Here a hollow "air-holder" is being made by forcing rubber stock through a "meat grinder," which regulates thickness and diameter, and also blows soapstone on the inner surface to keep the sides from sticking together (page 182).

now—and the simplest to manufacture. Even that is much more than a hollow piece of rubber, and making it entails the devious process of encasing it in lead and then cutting the lead off again (pages 179-80).

A Cambridge, Massachusetts, firm makes hose ranging from pieces an eighth of an inch inside diameter for bicycle pumps to dredging hose of four feet inside diameter. The cost varies from a cent a foot to more than $100 a foot.

10,000 GALLONS OF SWIM SUITS AND ELASTIC GIRDLES

In 10,000-gallon tanks originate alluring swim suits, women's girdles, and now the new rubber-thread evening gowns.

After the latex is compounded in jar mills that rock and roll like a salmon-fishing boat, homogenized in a magnified sort of ice-cream freezer with paddles whipping around 4,000 times a minute, it is fed into slender tubes that look like nose droppers.

On the pay roll here are glass blowers to make the nozzles for these machines.

Along each "race track" 480 threads dry for 60 feet, are vulcanized for 30 feet more. A hundred feet from where each strand started as a liquid jet it is wound on spools. One machine can turn out 12,000 miles of thread a day.

On an average day the United States Rubber's Providence plant makes 25,610 miles of Lastex—enough to encircle the earth without stretching. For wrapping they buy more than two billion yards of cotton a week.

For years they have cut rubber thread from sheets—they still do for golf balls—but such thread is square and coarse. By "spinning" from liquid latex, they can make the strands round, or any shape by changing the nozzle, and as fine as a cobweb.

A rubber shoe, like a tire, seems a simple unit. Then you visit Naugatuck, Connecticut, where the first vulcanized rubber shoes were made in 1843. Charles Goodyear's relatives still work there in the Footwear Division of the United States Rubber Company (page 198).

You still see the sign "Goodyear's Metallic Rubber Shoe Co." at the entrance to

Photograph by Wide World

PREPAREDNESS TODAY DEMANDS RUBBER TIRES

This United States Army 75-millimeter gun is essentially the same as it was forty years ago, but it would be obsolete now if towed on the steel-rimmed wheels of its old carriage. With heavy pneumatic tires to take up the shock, it can be hauled over rough terrain at a speed of 35 to 40 miles an hour, keeping pace with the motorized column.

the enormous plant comprising more than 50 separate buildings. Some single buildings are as large as many a factory, but it would tax any one of them to store all the 379,615 lasts.

As for simplicity—one pair of women's waterproof shoes has 104 separate parts. You see eleven girls working on the assembly line for the buckles of a popular style—8 parts to each buckle, 8 buckles to a shoe, 64 parts for buckles alone.

RUBBER REMAKING OUR WORLD

The sun never sets on the economic empire of the big rubber companies. Their order sheets tell the story of man remaking his world: special tires which won't tarnish the silver-plated wheels of an India potentate's limousine; belts to carry off hot sawdust after tanning extracts for Boston are distilled from quebracho trees of Argentina; molasses hose for Puerto Rico sugar plantations; old tires tied to bables on the Yangtze houseboats, and others cut up to shoe water buffaloes of Indo-China.

Coolie carts creaking over age-old roads deep in the unchanging heart of Cathay, cut 20 or 30 feet down in the loess soil by centuries of wooden wheels, now bump along a little less crazily on American-made wheels and tires. Man-power, which still transports more goods than sail, rail, or road, continues to pull them, but the carts carry twice their former load.

Then there are air hose for drilling in 8,500-foot-deep gold mines near Johannesburg, dock fenders to protect Madras jetties from banging boats during monsoons, artificial breasts for flat-chested movie stars, sponge rubber which cushioned the grinding machines for the Palomar telescope, 10-foot stomach pumps for pedigreed horses, and belts for Massachusetts Tech's 2,500,000-volt atom smasher. They make knob matting for pea hullers, crutch tips, teats for milking machines, confectioners' bags to squirt "Happy Birthday" on anniversary cakes, and tires for tractors, corn pickers, potato planters, and threshers.

This last-mentioned field of putting rubber on the farm, in which Harvey Firestone pioneered (Plate XIII), and the fast-growing use of liquid latex direct in many products, from women's girdles to Pullman mattresses, are two recent major rubber developments in the United States.

FRANCE FARMS AS WAR WAGES

An American Explores the Rich Rural Region of the Historic Paris Basin

By Harrison Howell Walker

With Illustrations from Photographs by the Author

FRANCE farms for life.

Wars with world changes come and go, but France follows the plow and looks to the pasture. Fundamentally, this is an agricultural country, with a large rural population which subsists on its land in much the same way whether times are good or bad.

Today, sons of the soil answer the national calls to arms. But many fathers, and mothers, sisters, wives, and very young brothers remain on farms to continue the work that nourishes the Nation.

Paris Basin, roughly a region within a 200-mile radius of the capital, cradles a rich agricultural area. Here beats the heart of rural France. Here wind the roads I traveled at random (map, p. 202).

Rounding the stately Arc de Triomphe in a secondhand Renault, I left Paris by the Porte de Neuilly, a west gate. I might have driven north or south or east; but I wanted to feel the sinking sun full on my face. The afternoon was cold.

BIRTHPLACE OF A CHEESE

Night in Normandy felt warmer as I sat in Vimoutiers's Inn of the Golden Sun (Plate IX, and page 235).

"Camembert? About three miles from Vimoutiers," said the innkeeper. "Excuse me, but why do you want to go there?"

"I'm fond of Camembert cheese, and I'd like to see how it's made," I replied.

My host smiled because I reminded him of another American who had erroneously thought that Camembert cheese still came from Camembert.

In 1926 a New York doctor arrived with a flower wreath the size of a life buoy. Camembert cheese had cured the doctor's stomach-ache. On a mission of gratitude, he journeyed from America to decorate the creator's tomb. But none knew offhand who had invented the original recipe.

Musty records finally showed that a Marie Harel deserved the tribute (page 203). During the French Revolution a priest escaped to Camembert and hid in Marie's house. Watching her make cheese, he offered suggestions. Perhaps if she added more salt, eliminated pressure, increased ripening time—at any rate, Camembert cheese was born and baptized under religious supervision.

Still standing today, the Harel farmhouse helps a few homes preserve a pleasant hamlet whose name delights cheese-eaters around the world.

Cheese factories scattered over Normandy now carry on where Marie Harel left off. One I found at Livarot, not far from Vimoutiers (Plate XIV).

Every day, including Sundays and holidays, dairy carts from many farms rattle up with cans of milk to be tested at the factory's laboratory. In a vast vat, the milk is stirred and thickened before running off to curdle.

Women distribute it to molds that resemble tomato tins without tops or bottoms. Unlike many other cheese processes, pressure is never applied. After a light salt sprinkle, there is a lull for several hours; then women reappear to invert the molds and salt the other cheek.

Abandoning the metal form after two or three days, the independent young cheese grows its own fuzzy white mold. On a shelf it ages for three weeks.

Hasty hands wrap it in paper, box it, and send it down for the count.

"We produce 6,000 cheeses a day," the superintendent said. "Shipments to America are hurried off, for you prefer soft, young cheese; we like it harder and older."

ORCHARDS LABEL THE LANDSCAPE

I went to Livarot's principal hotel for lunch. To reach the dining room it was necessary to pass through the kitchen.

Here shining bronze pots, pans, and pitchers hung against white walls or embellished rustic red shelves. At a stove set in the great fireplace, a chef, incidentally proprietor, commanded a fleet of steaming vessels.

No scribbled menu puzzles the diner who makes his choice on crossing the kitchen. Look at that crunchy bunch of radishes,

Drawn by Ralph E. McAfee

HEART OF FRANCE IS THE FERTILE PARIS BASIN WHERE THE NATION WAS BORN

France was cradled in Paris when pioneer settlers found a river crossing and built a stronghold on the Ile de la Cité in the Seine where Notre Dame now stands. Railroads and highways radiate from the capital and the area surrounding it. To the west lies Normandy, with its apple orchards and cows. To north, south, and east spread vast grainfields—except for the vineyards of the Champagne district.

the crisp raw carrots, pickled beets and crystal onions; rolled-up herrings, and crayfish resembling miniature lobsters! Hors d'oeuvres come with the napkin as naturally as the bread. But which smells better? Trout or tripe? Skillfully filleted beef or subtly sauced chicken, "lightly tossed in the pan"?

That vegetables rate separate plates is clear to anyone's palate. You'll eat spinach, and you'll like it. Cider and cheese and apples always, or else—or else a native pinches himself to see whether he's still in Normandy.

Generally, France fills glasses with wine. But down the throat of Normandy cider flows in a golden stream that knows no drought. Apple orchards, not vineyards, label the landscape.

From October to February, one mill in Livarot presses enough apples to make 79,500 gallons of cider a day. In addition to barreling ordinary cider, the plant bottles a finer type under high pressure. It tastes and sparkles like mild champagne.

We entered a veritable labyrinth of vats that reached from floor to ceiling.

"These rooms have a storage capacity of 22 million gallons," superintendent Marchand explained.

"Why are they kept so cold?"

"Because freezing stops fermentation."

Mild cider pleases Normans most. A glass of it has approximately half the alcoholic content of an equal amount of ordinary wine. Dry cider, distilled without sugar, becomes *calvados*, a sort of apple brandy.

In oaken casks, bearded with cobwebs, the brandy mellows for months, years, generations.

CHARLOTTE CORDAY'S HEARTH STILL GLOWS

Pays d'Auge, meaning trough country, rolls over green hills and slides down into greener valleys nourished by living waters. A pastoral paragraph of Normandy, it is capitalized by apple orchards and punctuated by cows.

Dr. Jean Boullard of Vimoutiers examined my secondhand car with a professional eye.

"I'm not sure its heart will stand the

A STATUE IN STONE HONORS A PIONEER IN CHEESE

Because Camembert cheese had cured his stomach ailment, an American doctor journeyed to its birthplace to lay a wreath on the tomb of its first maker, but none there knew the creator (page 201). A search through musty records revealed Marie Harel made the first mold in the 18th century. The statue, erected more than a decade ago in Vimoutiers, shows Marie and her farmhouse, which still stands in Camembert.

THE MAIL GOES THROUGH—THE WINDOW

Ordinarily, carriers deliver to front doors. Here in Bernay a grateful recipient offers a loophole for saving steps. This postman rides a bicycle, as indicated by his trousers, which are bunched at the ankles.

roads we're going to take," he said at last.

On a hilltop we stopped to look down on the hamlet of Les Champeaux (Plate IV). As in most villages of Pays d'Auge, only a few houses huddle around a church. Because it is primarily pastoral country, people live in scattered farmsteads.

"A magnificent view, isn't it?" The doctor was enthusiastic.

"Magnificent," I echoed, but I was really watching country folk, plodding up a path, pause before a crossroads crucifix.

Near Les Ligneries we walked through a crude gateway toward a half-timbered farmhouse (page 216).

"Charlotte Corday was born here in 1768," my friend said. "Of course you remember reading of her."

"Well, I . . ."

"The excesses of the Revolution maddened her," he continued. "So she went to Paris and fatally stabbed Marat, whom she considered responsible for so many deaths on the scaffold."

Today a young farmer and his wife live here, warmed by the same hearth that kindled Charlotte's patriotic glow.

VISITING A LANDED PROPRIETOR

Dining with the Boullard family one evening, I met Monsieur Ribard. He invited me to spend a day at his manor, ten miles from Vimoutiers.

Country gentleman Ribard met me in his shirt sleeves. He had been working on a well.

Together we walked toward the 16th-century *manoir*, which was still surrounded by a moat.

A stationary structure, however, had replaced the drawbridge. Mellow red brick, charmingly askew, and oaken beams gray with age supported a mossy tiled roof. Two smaller buildings of the same style, a chapel and refectory, formed a court with the big house. Long ago, monks lived here.

Twin boys, aged ten, fled from stalemated mathematics into fresh morning air

to greet us (Plate XIII). Children of gentlefolk learn their earliest R's at home.

With Ribard I walked over some of his 140 working acres. This land, plus a house, he rents to a farmer.

"I myself am not a farmer, but a landed proprietor," my host explained.

Yet he didn't sit back and wait for returns. He worked as hard as any hired man.

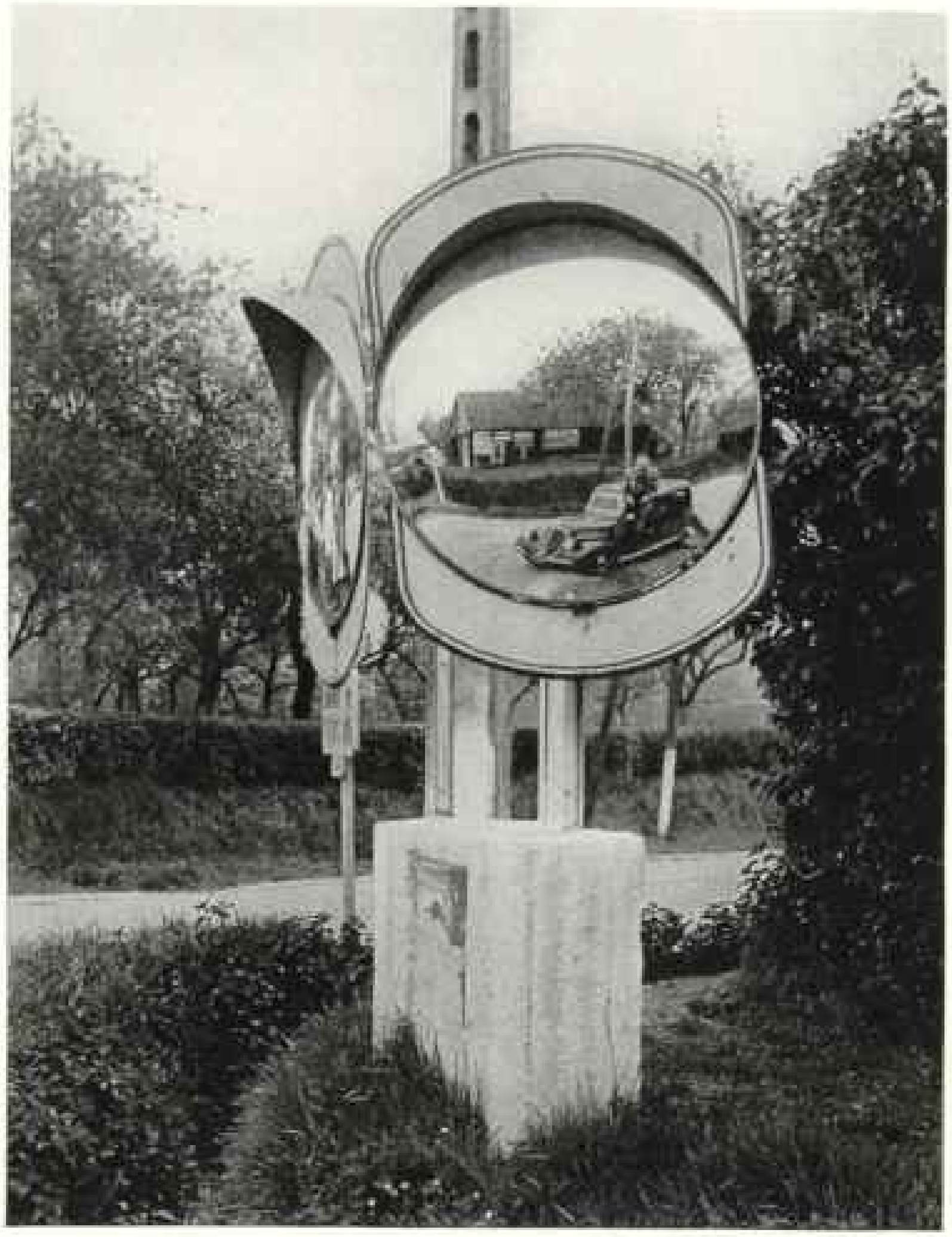
Constantly inspecting his orchards, he even took part in transplanting or grafting. Just plain apples weren't good enough for him; he wanted the finest. Upon his nursery trees he lavished the tender care of a mother.

"I must stay on the job, or else we couldn't eat mushrooms." He smacked his lips at the luxurious thought.

Virtually self-sufficient, Ribard shoes his own horses, repairs his own windows or woodwork or farm machinery. Even the guardrails for precious saplings come from his forest to be fashioned in his workshop.

A centuries-old press on the premises makes cider for sale and home. Around the circular trough a horse drags a stone wheel that crushes apples to pulp. A massive oak beam as big as a tree bears down to finish the job.

Not all proprietors live on their land as does Ribard. Many dwell in cities, entrusting success to tenant farmers.



EXIT DANGER—THROUGH A LOOKING GLASS

Convex mirrors let motorists see around corners at bad intersections. Here at Fromentel a main highway from Paris to Brittany crosses a north-south road that links Falaise, traditional birthplace of William the Conqueror, with Bagnoles-de-l'Orne, popular watering place. Visors shield the glass from straight-falling rain. Reflected in the mirror is the author taking this picture.

Gently I wound with the River Vie southward from Vimoutiers. In Exmes, pronounced M, I stopped at a Shell gasoline station for 15 liters (nearly 4 gallons). Next door, three pairs of newly made wooden shoes were seasoning on a window sill.

I poked my head through the open doorway. Piles of wood and primitive tools, blocks and shavings and half-finished shoes cluttered the tiny shop; even a varnish smell hung in the air. Only the master was missing.

"Where's the shoemaker?" I asked the garage man.

"He's gone to fetch his evening milk. His cow pasture is on the other side of the village. If you wait, he'll be back in about half an hour."

The shoemaker came down the middle of Main Street, swinging two milk cans suspended from a yoke.

He gouged out shoes with T-shaped chisels braced on a shoulder and the back of his neck. Handwork, perhaps; but he put almost every muscle of his body into it.

In addition to making wooden shoes, the shoemaker operates a small dairy.

A RURAL FESTIVAL

Préaux has a church, a few houses, and orchards of space for a *fête champêtre*, or rural festival. Once a year more than 4,000 people come from every direction to celebrate the Feast of St. Sebastian. They arrive in two-wheeled carts, automobiles, on bicycles, on foot.

At nine in the morning, trailer editions of traveling circuses had already pitched their tents. Florists spread brilliant potted plants in the shade of old apple trees. Bakers hid behind barricades of bread piled high in the sun. Butchers decorated their stands with sagging chains of sausages. Even rich pastry attracted attention so early in the morning.

Over there, a band struck up a martial air to boom a juggling act.

In ripples of red, white, blue, gold, and black, a religious procession followed a gleaming cross into the near-by church. Hundreds surged behind and hundreds pressed around the doors outside. Uncomfortably, but devoutly, they paid homage to St. Sebastian.

Noon came with a big appetite. On grass in the sun, at tree-shaded tables, in restaurant-tents, under high-wheeled carts, everyone picnicked. I bought bread and cheese, tarts and cider, and joined a party under the trees (Plate VII).

A camel casually watched men bowl down wooden pins for silver stakes. Well-trained ponies awaited their turn to perform on raised platforms. Dogs looked confused. And children forgot to watch their steps.

The sun and I went west together, but crowds remained at Préaux.

Not with the intention of a week's stay, I drove from Vimoutiers to a farm near Orbec. But I stayed.

"It's 4:30 o'clock." Jacques, one of Farmer Couteau's sons, knocked on my door at daybreak. "Time to milk."

We reached the pasture before the sun. Already one of the hired men and two maids crouched at work on three-legged stools. In an hour and a half a donkey cart, laden with milk from 24 cows, creaked back to the house.

Everyone gathered for breakfast at 7 o'clock; and it wasn't just a cup of coffee. Eggs, sausages, pâtés of duck or rabbit, lots of bread and butter, and even cider crowded the long kitchen table.

Nine o'clock is midmorning for farming folk. They stop work long enough to eat a hunk of bread with butter or jam, and drink a glass of cider or coffee. A substantial meal at noon sustains them till 4 o'clock. Then a collation, similar to that of the morning, breaks the long afternoon.

By 7:30 in the evening the third and last milking has been completed; men are home from the fields; Monique has put a fresh dress on four-year-old Marie Madeleine, and Mother Couteau has prepared supper.

We sat down to a table that stretched across the great kitchen (page 219). From a large bowl each dipped his own soup. Monique reached into what I thought at first a woodbox and withdrew a loaf of bread almost a yard long and a foot wide (Plate I). Everyone except the child carved his own slice. To do this, I had to borrow Farmer Couteau's pocketknife. Cider, poured from a rustic oak pitcher, washed down meat and potatoes.

Even little Marie Madeleine knelt with the rest for the Rosary. Equally ritual were good-night embraces in which grown brothers showed their affection for each other. Not a cheek went unkissed to a well-earned bed.

Frogs in the pond where cows go to drink croaked me off to heavy sleep.

OFF TO MARKET

"I'm going to market at Bernay," Couteau said one Saturday morning. "Would you care to come?"

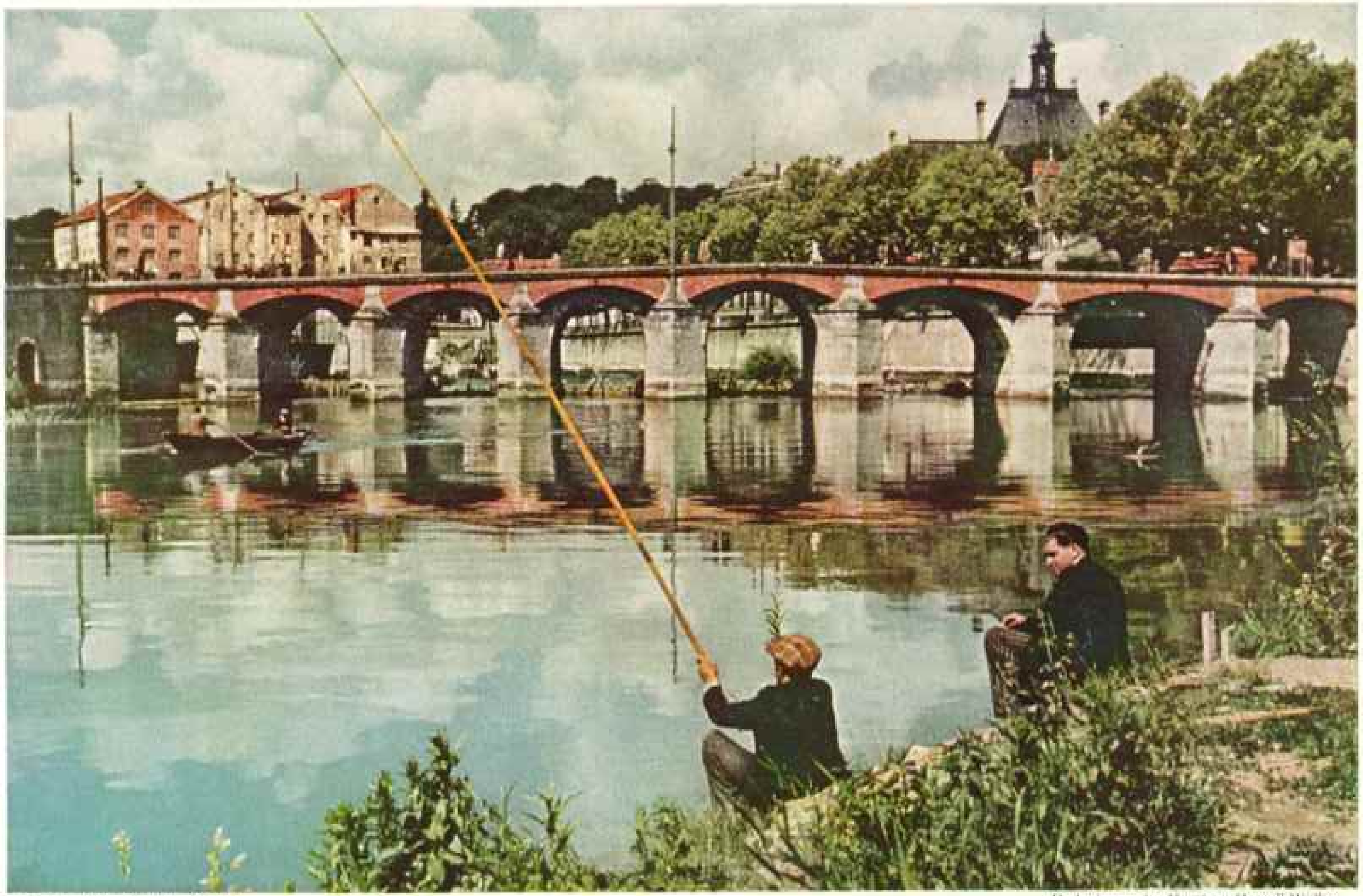
High as a stagecoach, Couteau's car rolled with old-fashioned dignity into Bernay. Farm machinery attracted my friend, while I merged into the crowd.

Between stands of fruits and vegetables I dodged pushcarts, baby carriages, and bicycles wheeling fat baskets. I brushed

© National Geographic Society Kodachrome by Harrison Howell Walker

NO LOAFING UNDER A LOAF LIKE THIS

Daughters of Normandy have no easy job bringing home loaves almost a yard long and a foot wide. Four-year old Marie Madeleine and Monique carry them to a kitchen chest larger than an ordinary woodbox. Half a loaf, sometimes more, is consumed at a meal. Using short, sharp-bladed knives, diners carve slices big as plates. Wednesdays and Saturdays a baker from Orbec supplies the Couteau farm, where the author lived a week.



Kodachrome by Harrison Howell Walker

BATTLES NEAR MEAUX ON THE RIVER MARNE TURNED THE TIDE IN THE FIRST WORLD WAR

In 1914 British soldiers destroyed two arches of the bridge to check advancing Germans. This action preceded the First Battle of the Marne in which three German armies were repelled from the outskirts of Paris. The Hôtel de Ville (town hall) peeks from trees at 16th-century mills (left).

Kodachrome by Harrison Howell Walker

MILDEWY COTTAGES, COMPACT AS CHEESES, RIPEN UNDER MOSSY-TILED ROOFS

To the musty fringe of Pithiviers, milk-white modern buildings add a fresh frosting. An urban oasis in vast grain plains, the town is Paris to outlying farmsteads.

Kodachrome by Harrison Howell Walker

HURRYING HOME FOR SUNDAY DINNER, NORMANS PAUSE BEFORE A CROSSROADS CRUCIFIX

Bristling poplars throw welcome shade over the dusty lanes near the hamlet of Les Champeaux-en-Auge. Often trees are closely trimmed, the branches making fuel for cottage hearths. Foliage grows out again thicker than ever.

HER ONE-ROOM HOUSE SETS A MODERN PACE IN SAVING STEPS

At the fireside bakery, Madam Picard makes bread for villagers of Ardoux. With the long-handled shovel she reaches into the oven's deep recess.

Kodachromes by Harrison Howell Walker

"WHISTLER'S MOTHER" ABANDONS HER FRAME

Living alone in a cottage at Longny, this 90-year-old woman gathers fagots for her fire, fetches water, washes dishes, and scrubs the floor.

Kodachrome by Harrison Howell Walker

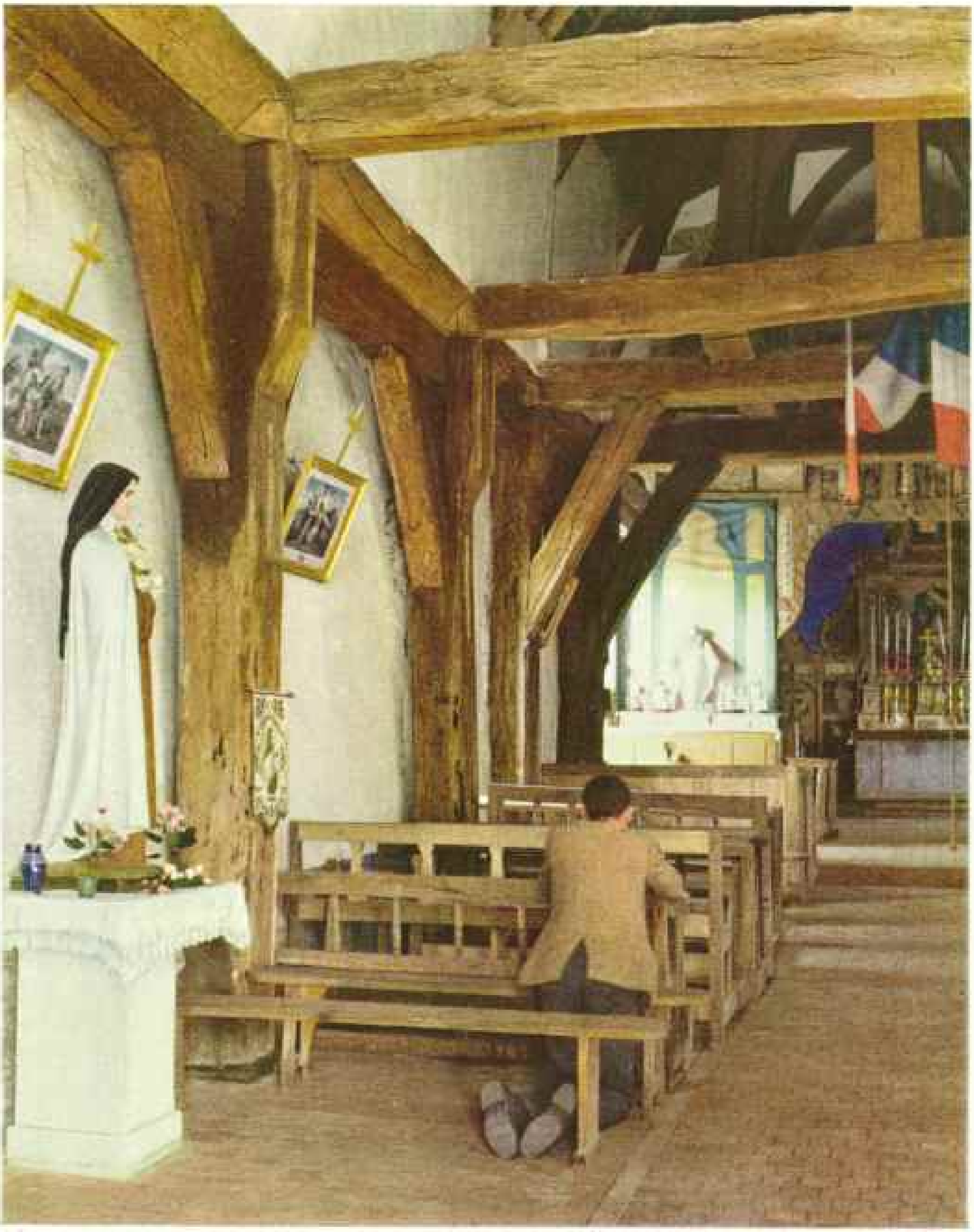
WITH HIS WELL-TRAINED DOG NIPPING THE FLANKS OF STRAYS, A SHEPHERD GUIDES HIS FLOCK TO MARKET

Apple trees, farms, and an old church form the setting for many Norman landscapes. Umbrella and boots are precautions against April's fickle skies.

Kodachrome by Harrison Howell Walker

"A TOUCH FOR MY GLASS, MONSIEUR," PIPES PIERRE, AS HANDS ACROSS A PICNIC CLOTH MEASURE OUT GOOD CHEER

At Préaux's rural festival, held annually to celebrate the feast of St. Sebastian, families lunch on the grass in apple orchards. More than 4,000 persons arrived in two-wheeled carts, automobiles, on bicycles, and on foot. Eating, drinking, laughing, and love-making suggest scenes of rustic picnics painted by certain Flemish artists.



 Kodachrome by Harrison Howell Walker

BEAMS, SPANNING AGES, BRACE STONE WALLS CENTURIES OLDER IN THE CHURCH OF LES MOUTIERS-HUBERT

Several hundred years ago a fire left only the building's sides standing. Rebuilt with timber, the interior of the chapel is one of the few in wood to be found in Normandy today. Behind French flags floating from the rafters hangs a rope for ringing bells that call farming folk to church. The family shown taking their mid-afternoon snack (Plate XV) worships here.

by bargain racks of clothes and stumbled over shoes spread on cobbles.

Past a shed where fish and fowl, beef, butter, and cheese kept cool, I weaved to a clothing shop for slight repairs.

When the stout tailor had done the job, I reached into my pocket. He only chuckled good-naturedly and would not accept a sou.

"Perhaps, then, one American cigarette, if you please," said he, because I would not go.

LIFE ON A NORMAN FARM

Instead of returning home for lunch, we drove to a farm near Thiberville, between Bernay and Lisieux. Here Henri, one of Couteau's sons, lives in a 16th-century Norman farmhouse. He rents it with land from the owner of a near-by château.

We were welcomed into a colossal kitchen overhung with heavy oak rafters. Farm hands were already eating; a couple of children scrambled over the floor. As guests, we sat in the company dining room. Its spotless, unaired condition reminded me of a handsomely bound volume that leaves its shelf only for dusting.

While Couteau and I lingered over coffee, our hosts went upstairs to dress for Lisieux's Saturday-afternoon market.

In the car with us bounced 30 pounds of butter, churned that morning from cream saved during the week. To take it into town Henri had to pay a few francs at a tollhouse on the outskirts.

High-gabled, half-timbered houses leaned over to watch marketers milling in narrow cobbled streets. A link in the chain of horse-cart traffic, we dragged to the butter market. An inspector weighed Henri's contribution, then sniffed it, buttering his bushy mustache. From him Henri took a slip of paper to a cashier's window where he received three crisp 100-franc notes.

Before he even folded the bills, Henri deposited them in a bank. And that show of conservatism made the walk I took over his fields all the sadder. One afternoon's cloudburst had washed out a season's work.

Through hail-whipped wheat and rain-beaten beets, broken oats, and ravaged forage, I followed two long shadows. Couteau stooped to examine worthless flax, shook his head hopelessly. Henri pulled a handful of rye and counted every broken strand. Together they bent in discouragement over devastated land, still soggy like a beach after ebb tide.

Henri scarcely heard me when I bade him good-bye. His whole being had cracked with his crops.

On our way home Couteau spoke little. His heart was too heavy with sympathy, his mind too busy with a design for encouragement. For Henri's 26th year was his first of independent farming.

The Couteaus did not want me to leave, nor would they let me pay for my week's stay. When I finally thrust twice the sum they reluctantly suggested into the farmer's jacket, it was but a tenth of what they really deserved.

Southeast I drove to dodge a storm hovering in the west. And on the shelf of a plain I stopped to view an unexpected valley. A village below appeared all roof, except for crowded streets. Faintly, like a music box playing in another room, old-fashioned tunes fused with echoes and floated up to me. La Ferrière was having a fair; but as I saw it, framed in apple trees, it set the stage for a puppet show.

When a merry-go-round ceased its jingle-jangle, a band before the blacksmith shop stirred couples to dance in the street. Women without beaux paired for a whirl; men wearing caps tripped it together; even little children jiggled in the forest of legs.

RUSTIC PADDLE WHEEL KEEPS INDUSTRY SPINNING

Near-by Conches crowns a shell-shaped hill tossed up from a green sea of fields. But that's not the roar of waves you hear; it's a train, rushing like an undercurrent through a tunnel beneath the town.

Yet modern inroads of steam and steel fail to stir cobbled Conches from its medieval drowse.

An old woman, vending vegetables on a cart, moves almost stealthily from door to door. A man scrapes his shovel on the stony street, then disappears with a bucket through a garden gate. Chimes sound the quarter hour; the village yawns vacantly and goes back to sleep.

Quietly I coasted north from Conches, down the road to Louviers. Respect for its early architecture keeps Louviers looking old. Ancient inns are renovated, not modernized (Plate XVI). Young builders follow 16th-century plans in 20th-century construction. Even the new home of a modern travel bureau copies a style born

CHARLOTTE CORDAY'S PATRIOTIC GLOW WAS KINDLED BESIDE THE HEARTH OF THIS HALF-TIMBERED FARMHOUSE

Born here at Les Ligneries in 1768, she left to enter a school in Caen at the age of ten. Excesses of the French Revolution stirred her to go to Paris and fatally stab Marat, whom she considered responsible for so many deaths by the guillotine. Four days later she was executed.

COWS BEAR THE BURDENS IN THE MOUNTAINOUS MORVAN REGION

Just in with a load of hay, the cows stop by a stone barn in Les Jallois. The farmer wants his mid-afternoon snack, but his wife thinks it will rain and advises storing the hay at once (page 233).

NIMBLE FINGERS DEFY MACHINES IN CREATING THE LACE OF ALENÇON

For centuries the town has been famous for its exquisite *dentelle*, still worked by nuns in an old convent (page 221). Valuable pieces started from here for New York's World Fair last spring, but the treasures were destroyed when the liner *Paris* burned at its pier in Le Havre.

eons before the first tourist, and exterior timbers show sculpture like that which flourished under Gothic masters.

True enough, I had running water and electricity in my hotel bedroom. But at the woolen mill, a few doors away, a rustic paddle wheel churned the River Eure to keep industry spinning.

Top-heavy houses, supporting each other, staggered along narrow streets to welcome me to Dreux. Chatty women were washing clothes in canals. To emphasize particular points of gossip, they gave the linen extra hard whacks with wooden bats.

In a boys' school more than a century old, the headmaster showed me a brand-new, well-appointed dormitory.

I visited classes attended by boys ranging in age from 7 to 19. Up at six o'clock, they study away a great part of the day. Half-hour lunch, an hour of games, and midafternoon recess for bread and honey are not lengthy interruptions. In winter, bedtime comes at eight; forty minutes later in spring and early summer. Thursday, holiday from classes, is given over entirely to baths and showers.

From Dreux, a growing town, I slipped southwest down to earth again, to the lonely lanes and the soil.

EVERYBODY WORKS AT THE FAIR

I left my car outside an inn of Longny, because stables, sometime garages, were full of horses for the next day's fair.

In the village square merchants were setting up tents and benches, women doing the heavy work. I watched a mere girl swing a sledge in securing an iron stake to support a vast canvas fly. Her mother unloaded clumsy cases from a van. Another daughter manhandled planks to make

INTO THE OVEN GOES DOUGH FOR FRENCH BREAD BASKETS

From molds in a crisscross stack a baker of Alençon feeds the oven with a wooden shovel. France ranks high among the world's bread eaters. Wheat now covers about ten percent of its total area; the Nation grows about one-fifth of all the wheat produced in Europe outside Soviet Russia. As a wartime measure to conserve wheat, millers must now mix two per cent rye with the white flour ordinarily used in breadmaking. The resulting "black bread" goes in carloads to feed soldiers at the front, and it becomes an even more staple diet for those at home.

TABLE TALK GOES A LONG WAY IN THE COUTEAU FARMHOUSE

Family and farm helpers dine together at a table that stretches across the kitchen. Farmer Couteau leans over his soup to tell a funny story to farmhands at the other end of the room. Madame Couteau laughs too hard to eat. The big loaf of bread, baked in near-by Orbec, lives a short life in this Norman household. France generally fills glasses with wine, but in Normandy, one of the world's foremost cider-producing regions, famous also for *calvados*, a sort of apple brandy, oaken pitchers of the local beverage appear at every meal in farming circles (pages 202 and 206).

LE NEUBOURG'S STOCK MARKET CORNERS THE FRONT YARD OF THE CHURCH

Farmers corral their calves for a cattle fair in the principal square of this village, which is a center of stock raising in Normandy. Pigs have a rendezvous behind the church. France's first operas traditionally were performed before Louis XIV in the local castle. Above the tallest tower of the 16th-century church the inevitable cock surveys miles of the flat countryside (Plate IX).

NIGHTMARES DON'T DISTURB HIS STABLE SLEEP

A hired man on Quineau's farm, not far from Longny, "hits the hay" within hoof-reach of the horse he works with by day. On the wall by the lower berth of his double-decker hangs a clock which calls him so early that he must dress by the light of the kerosene lantern. Toilet articles line the fender of the upper berth, while his clothes hide under the horse's breakfast.

platforms on which to spread the goods.

When ready, their outdoor annex of a department store offered the variety of a five-and-ten. Other merchants arranged flowers, hung meats, unpacked cheeses, stacked wooden shoes, rounded up escaping geese or chickens, ducks, or rabbits; shined up hardware, and unfolded clothes for countryfolk (page 235).

Monsieur Beaufils was more than an innkeeper; he became my personal friend and helpful host. Through him I gained easy entrée into the cottage of a 90-year-old woman living alone and doing all her own work (Plate V). Through Beaufils I met Farmer Quineau, who showed me over his property. He was proudest of his fat cows and wheat fields, while Madame Quineau would have me see a caged ferret used for hunting rabbits. Next to sitting by Quineau's family fire, I enjoyed most seeing a hired man's bed in the stable within kicking distance of a stall.

The little hotel in Alençon, a town famed for lace, differs only slightly from a French home. After a few meals, the usual diners accept a stranger as one of themselves. That means a handshake before soup, general conversation at one long table, another handshake on parting. Every day the same formality follows an old friendly custom.

One morning I came down earlier than usual for breakfast. Maids were mopping the dining room, so I ate with the proprietor and his family at the kitchen table.

Pierre, 12-year-old son, stared blankly at schoolbooks spread before him. He should have been preparing lessons; actually, he racked his dark little head for places and things that might interest me in his town.

"Have you been to the house where they make lace—the famous lace of Alençon?" he asked.

Once 8,000 workers in the region stitched *the* lace of France. Today, a small con-

vent carries on, determined that machines shall not take Alençon's most exquisite industry from needle-skilled hands.

In a large, bright room, I watched women's nimble fingers fashioning fairy-like webs (page 217). So delicate is the lace that often a single horsehair serves to hold it together. I saw one piece with many designs, three of which exacted 35 hours each of painstaking stitching. Some of the best Alençon lace ever worked started for the New York World's Fair last spring. But at the convent I was sadly told that when the liner *Paris* burned at its pier in Le Havre, the world lost the treasures.

THE NEWS WALKS

South of Alençon, Beaumont sits on a hill, watching its reflections in the River Sarthe. A group of men near the church attracted me. Their day's work done, they relaxed with a game of bowls under shade trees (page 232). One player rolled a wooden jack about the size of an orange. Others tried to bowl as close to it as possible with solid bronze balls slightly larger. Keen competition brought contestants into huddles, quibbling with measuring sticks.

I lingered on a bridge by Beaumont. From an open window softly floated a woman's gentle song. A lighthearted boy, passing by, picked up the tune in a whistle. And I myself went away, humming it on the lonely road to Montmirail.

The rattle of a drum brought women to windows and doorways; men looked up from their work; the few people in the few streets stopped in their tracks.

A little man in big wooden shoes importantly cleared his throat. Tucking the drumsticks under an arm, he flourished a white sheet of paper and began to read. When finished, the village crier of Montmirail clattered off to repeat the procedure farther down the road (page 236).

"It's terrible, all this talk of war," remarked a woman to her neighbor.

"More and more men are being called up," and a mother watched anxiously after her son as he walked away toward the fields.

Surrounded by field after field of wheat and oats and beetroot, Pithiviers springs from the plains, an urban oasis. I took a tangy taste of spicy old streets, bumpy as pickles; cottages, compact as cheese, mildewing under wrinkled roofs; irregular windows reflecting old age, their sills flush with the sidewalk (Plate III). But I returned to a plain diet when I went north through sweeping farmland.

National banners, flying from lampposts, public buildings, and monuments, flagged me to a halt in Beauvais. And posters of a woman with a hatchet peered from every point.

"Why all the decorations?" I asked a man in the street.

The kindly fellow took time to tell me in detail. In 1472 Charles the Bold attacked the town. Womenfolk helped male citizens beat back invaders. Bravest of all was Jeanne Laisné, who defended the walls with a hatchet and a spirit unmatched by any man. Because of her weapon, she became known as Jeanne Hachette. Celebrations in memory of the heroic defense take place annually.

Visions of Beauvais's medieval warfare melted into machines. Entering battlefields of the First World War, I imagined tanks and airplanes, barbed wire and machine guns, steel helmets glistening in the bursts of bombs. I was traveling a road that once ran red with blood to shell-razed Montdidier.

Except for a few forest-flecked acres, everywhere the countryside flourished under complete cultivation.

Montdidier smoldered in its ruins about twenty years ago. I found it glowing, a brand-new Montdidier. Shiny brick buildings and wide, well-paved streets alter the face so disfigured by war.

A MEMORIAL FOR A POTATO PATRON

One monument, however, turns the modern trend back to 18th-century earth: Antoine Augustin Parmentier rates a statue in his home town because he introduced the cultivation of potatoes into France.

The pall of war still hangs over Noyon, almost totally destroyed in 1917-1918. Gamely, many of the battered houses put up new fronts; yet bombarded buildings continue to crumble. And winds bluster through holes in the Cathedral's only tower left standing.

Farming cast a fresh green mantle over the fields of battle. Hastily I headed for open land, skimming the sadness of towns and villages. Glad to turn south again with the sun, I rolled to Meaux on the Marne.

I sat in the Café des Moulins (Café of the Mills). Quietly three old men played

 Kodachrome by Harrison Howell Walker

STANDING ON TOP OF THE WORLD, THE COCK OF FRANCE CROWS VICTORIOUSLY

Perched on a symbolic stone ball, the national bird crowns the Vimoutiers monument to World War heroes. On market day, flowers compete with bicycle parts along crowded sidewalks. Fruits and vegetables splash the village square beneath shadeless, close-cropped trees. Canvas keeps candy from weeping in the midday heat, and saves silks and cottons from bleaching. To the Halle au Beurre (butter hall) close by, farmers bring butter and eggs and cheese for auction.

Kodachrome by Harrison Howell Walker

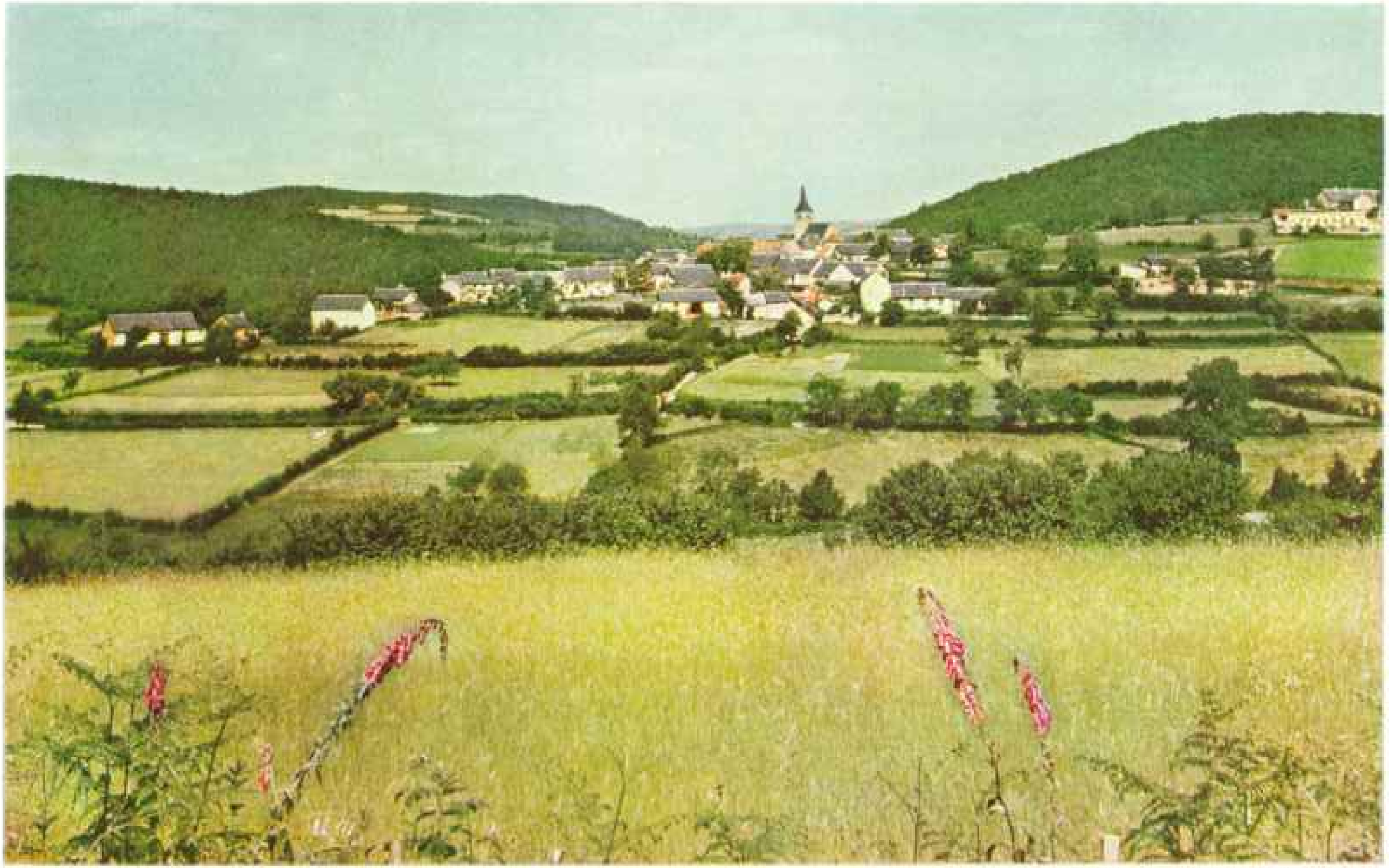
THROUGH THE NARROW STREETS OF ST. PÈRE-SOUS-VÉZELAY, SLOW-GOING CART WHEELS HAVE ROLLED FOR CENTURIES

Flowers brighten windows and doorways in hoary homes built of stone, frequently laid without any chinking. Steps buckle and break under the weight of years. The farm wagon creaks on wheels almost as high as a man.

Kodachrome by Harrison Howell Walker

A MONK HERDS COWS INTO THE FARMYARD OF THE FIRST TRAPPIST MONASTERY

From the parent house at La Trappe, near Longny, 72 monasteries have spread around the world. Trappists work together in their own carpenter shops, dairies, and bakeries; they also cultivate vegetable gardens and farm lands. Flesh, fish, and wine are tabu at their frugal board.



Kodachrome by Harrison Howell Walker

BELL-LIKE BLOSSOMS OF DIGITALIS POINT SHAKING FINGERS AT CORANCY

From the wild purple foxglove comes a medicine for stimulating weak hearts. When a dam, about five miles down the near-by Yonne River, is completed, it will form a lake almost lapping at the village's doorstep. The reservoir is to regulate the Seine's waters, which fall too low in summer, rise too high in winter.

ONE ROSE REFLECTS ANOTHER

Nicole and Marie enjoy Sunday at father's country place near Vimoutiers. No school, plenty of cakes and candies under the trees, and visits from grandparents make it their favorite day.

Kodachrome by Harrison Howell Walker

THEY MIRROR LAUGHTER

Twin brothers even dress alike for chapel at their 16th-century manor home in Normandy, five miles west of Orbec. Timber beams in the building's sides sandwich tiles squeezed into rakish designs.

 Kodachrome by Harrison Howell Walker

IN ONE-HUNDREDTH OF A SECOND THE CAMERA RECORDS IN LIVAROT AN AVERAGE FRENCHMAN'S LIFETIME

He grows up on bread and wine, and attends the local school; weds in the church; buys food and clothing at market; becomes a soldier; goes to war; and perhaps his name appears on the monument erected to those who died for France. His son carries on.

Kodachrome by Harrison Howell Walker

A NORMAN FAMILY OF THREE BREAKS THE AFTERNOON AT FOUR O'CLOCK WITH CIDER, BREAD, JAM, AND CHEESE

© National Geographic Society Kodachrome by Harrison Howell Walker

STAGECOACHES, NOT BICYCLES, FORMERLY ROLLED UP TO LOUVERS

Raising high eyebrows at modern architecture, the Great Stag Inn retains its original style after renovation. No present-day vogue gives the roof its permanent wave. Seemingly weary with years, the hardy stag (left center) rests on his haunches. A few yards away, an outdated red topper and a blue glove direct men to an up-to-the-minute clothing shop. The schoolgirl cycles home for a midday meal, while textile workers hasten from factories to spend lunch hour at family tables.

cards at the next table. In a corner a girl with hair tumbling over her shoulders recited lessons to mother, the proprietress. Two soldiers came in casually. I looked through the door toward the river.

Marne plus soldiers recalled the local battles of 1914 and 1918. Meaux escaped with relatively little damage (Plate II). The river's name, not the town, reminded me of war. Peace in Meaux is ripe as its Brie cheese that ages between layers of hay.

Meaux has gristmills that have been grinding since the 16th century. They rise on piles from the river they almost bridge. Heavy with massive timberwork, the mills anchor peace to this loop of the Marne. On the banks, men static as mooring posts secure the calm with threadlike fishlines.

Along canals and rivers of France I have watched anglers for hours. They never seem to catch anything. Once I overheard two fishermen.

"How's that for good luck?" asked one, proudly showing a catch that barely covered the bottom of a small pail.

"Not bad for hors d'oeuvres," replied the other.

Villages vividly daubed the pastoral that is the Aube Valley. In Autricourt, about ten miles north of Châtillon-sur-Seine, I stopped for the night.

"Where is the hotel?" I asked three women standing by a gate.

"You just passed it," one answered.

I had missed it because roses virtually hid the whole building. Through a vine-smothered doorway I could see men at a table, drinking white wine.

"May I have an omelet?" apologetically, for it was after suppertime.

"But yes," promptly replied a good-looking woman, and disappeared into the kitchen.

CHEESE EATEN WITH A SPOON

Brittle fagots crackled. Pans rattled. And quick as magic, a great golden omelet appeared.

"Will you have cheese now?" seeing me scrape the plate.

She put a pail of *fromage blanc* on the table and gave me a spoon. Fromage blanc is somewhat like cottage cheese, but a bit smoother and not so sour. It is pure white, milky rather than creamy.

Music, like distant bells tinkling, drifted through the door with a summer evening's breeze. It grew louder and still more musical. From my place at the table I watched cows pass on the road that was main street. All wore bells.

Slender, almost delicate, cows of this region wear a startled expression. Their long, thin horns turn in wild twists. Of a fawn color, they seem gently deerlike, not bovine.

Encouraged by supper, I inquired about a room. The proprietress went to the village well for a pitcher of water, then led me around back to a rustic stairway. I took the pitcher and climbed to my little low-ceilinged chamber. With no other sound to compete, a clock ticked me off to sleep.

Early in the morning a few voices sounded under my window, which looked out on a field. Farmers were beginning their day before the sun even rolled over. With rising mist the talking faded as men went back to the soil. Once again the hamlet lay still and silent as the stones of its houses.

The older homes of Autricourt are built of stones chinked with mud. Cold and gray and primitive, perhaps, yet gentle and warm under wraps of roses. The mellow red of tiles on roofs defies the most dismal weather.

I spent a morning in Autricourt's school. In its one room, about twenty-five pupils, aged 6 to 14, sat together, two girls to a desk, two boys to a desk. I had a desk to myself. Morning classes began at 8 o'clock, ended at 11.

The children went home for lunch, returning at one for three more hours. Two boys, however, gave their schedules a shake-up. Because they waged a pinching bout, the teacher demanded overtime.

By chance I fell with night on Époisses, southwest of Châtillon. One heavy stroke in the church tower sounded half-nine as I drew up to an inn.

The Inn of the Golden Apple is also the village bakery. One son—the one who told me that he always wanted to travel—delivers bread in a horse-drawn cart. The other sells it over a counter in the kitchen. And it all comes from an oven in the courtyard. There a single baker, stripped to the waist, rolls his own dough, keeps the fire going and a keen eye peeled for a perfect golden brown (page 218).

Tradition in Époisses lives by more than its delicious bread. The past feeds on a feudal château, half-destroyed in the Revolution. Descendants of the earliest noble

RIVALS IN A GAME OF BOWLS SETTLE CLOSE SHOTS WITH MEASURING STICKS

Men of Beaument gather at a hard-packed clay court after their day's work. Teaming up, they roll bronze balls toward a wooden jack (page 222). From bowls they turn to glasses in a near-by café. The losers pay for the winners' drinks.

occupants still spend summers in its great cool halls. In canopied beds they dream, perhaps, of Madame de Sévigné, a frequent 17th-century guest.

Leaving the château's shaded lawns, I returned to the Golden Apple well before mealtime to please the punctual proprietress.

"I'm going to the garden to get lettuce for lunch. Do you care to come?" she invited.

We crossed the courtyard, walked down a back street, went through a gate that she unlocked. Vegetable gardens seldom occupy backyards of village houses. Often they lie a half-mile distant.

From Époisses I entered the Morvan. The name, of Celtic origin, describes the region. It means "black mountain." If an artist faithfully reproduced the somber hills I drove through that day, critics would sniff at artificiality.

Toward evening, dull skies fled from a fire in the west. The day ended with a red period as I began a new paragraph in the mountain hamlet of Chaumard.

Having no place for me in her café, Madame Bruandet led me across the road to another house. She showed me upstairs to a tiny room not much wider than the window.

VALLEY VILLAGES TO BE DROWNED

Next morning I looked east over a valley smoking with mist. Against the lazy haze fir trees stiffened like spinsters in mourning. A brown dirt road wound away into black mountains. From one chimney a slender wisp of blue smoke drifted up to meet the day coming over eastern hills. Other cottages slept on in a stillness that only a rushing rivulet disputed.

Framed in my window, the vague pastel

turned to a vivid motion picture. Behind two white cows, a farmer in wooden shoes moved with the mist up the brown road. A woman folding back window blinds paused for an instant to watch the sun burst on a new day. From a cottage door a barelegged boy ran down to the stream, rattling his pail. He took a short cut home through the meadow, and I knew how the wet grass felt on his ankles.

FLOOD CONTROL ON THE SEINE

That meadow is doomed—but not because a barelegged boy cut across it with a pail of water. The Government and Department of the Seine plan to flood it with a reservoir.

About three winding miles from Chaumard, I watched men and steel and concrete working to make a lake in a fertile valley. I thought of an artist who twists a landscape to fit his fancy.

High as a ten-story building and about as long as the liner *Normandie*, the dam will close up the Yonne Valley like a colossal gate between hillside portals. The *Barrage Pannecière*, begun in 1936, should reach completion in 1941. It will make a huge artificial lake.

"For hydroelectric purposes?" I asked an engineer.

"Yes. And for controlling the Seine. In winter the river has too much water; in summer, not enough. We hope to regulate the flow by damming the Yonne, largest of southeastern tributaries."

While the engineer enthused over the reservoir's potential capacity of more than 21 billion gallons, I gazed toward a lonely hamlet in the valley. Centuries blended it with the land. Born by a river, nourished by a river, it lived on a river. The same river would rise up and drown it one modern day.

The engineer must have guessed my thoughts, for he said:

"The Government and Department of the Seine have amply remunerated the people whose homes and lands will disappear when the lake takes shape. Already some are moving to higher ground; others are leaving the region altogether."

Politely I turned from the clutch of thatched cottages to look at a new model village. About twenty houses, all alike, sheltered employees engaged at the dam site. A Café de Paris boosted the community's metropolitan stock.

Work in Chaumard generally keeps men outdoors. They till their fields or go to thick forests to cut timber for fuel or lumberyards. A hard rain, however, will drive them to the café. Some play cards; most of them talk and joke and laugh very loudly. An air of conviviality fills the place.

On one side of the room, a fellow rises and begins to sing. Everything else stops, everyone listens. At the close of his song, if well-sung, he is applauded. A singer from the other side takes his turn. He, too, is applauded. Then follows a dispute. Who sang better? And so time passes with the rain.

One rainy day they got nowhere, because votes for singers were evenly divided. They turned to me.

"Monsieur, you have been quiet and have listened well. Which one sang better?"

"It has stopped raining now," I said.

They all laughed and went back to their work.

COWS, THE BEASTS OF BURDEN

Farmers and woodmen of Chaumard seldom use horses for heavy work. White cows, yoked to plows or logs, wagons or carts, bear the burden in mountainous Morvan (page 216). It's the cow that hauls hay from field to barn, grain to flour mill, lumber to sawmill, or stones from quarry to construction. And the same cow gives the milk that nourishes the hardy Morvandeau.

I even rubbed shoulders with a cow at a café. Her master was drinking coffee inside, while she waited with her head in the doorway.

In the whole commune of Chaumard, which includes hamlets lying within a radius of three miles, there are only five horses. One belongs to Roger, eldest son of the Widow Bruandet. Easing through light work on level land, the horse has a white-collar job compared with the uphill pull of cows under heavy wooden yokes.

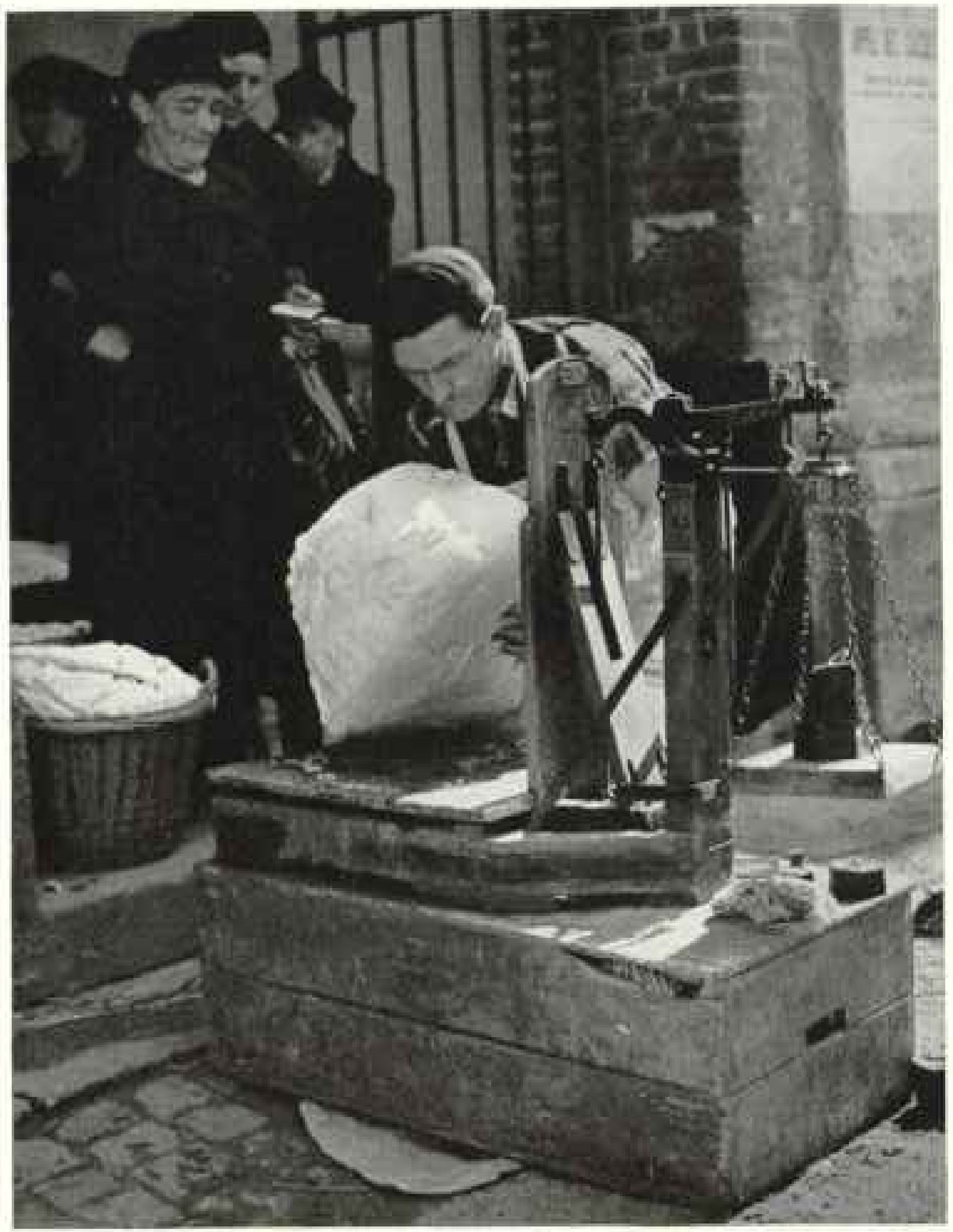
Under a thatched roof in Ardoux I talked to Monsieur des Moulins.

"I live alone here," said he. "My wife died several years ago. I do all the housework myself—clean, make my bed, and cook. My vegetable garden keeps me busy, too."

He opened a wall cabinet to show me a phonograph and a collection of records.

A CASH-AND-CARRY ON WHEELS PROVISIONS SHOPLESS ENFER

The driver blows a horn to call customers. Housewives purchase anything from cookies to canned goods, including American soap flakes and California-grown asparagus. Formerly, Enfer thrived as a market town; frequent fairs attracted hundreds. Today the population has dwindled to about thirty persons. Roofs fall into deserted homes, walls crumble, and vines try to hide the hamlet's sadness (page 237).



HIS BUTTERFINGERS WON'T LET THIS BUTTER BALL SLIP

Dairywomen bring their churnings to the weekly market in Vimoutiers. Weighed and tested for quality, the butter goes to Paris or foreign dealers (Plate IX).

"SO YOU THINK FIVE FRANCS IS TOO DEAR, EH?"

Bargaining makes purchasing an art, not just a trade. These women haggle at Longny's street market. Goods from clothing to padlocks are displayed.

WHERE LIFE IS NOT PRESSED, THE NEWS WALKS AND TALKS

Beating his drum to muster the public, the village crier of Montmirail broadcasts reports and announcements. Women come to cottage doorways and windows to hear what's new in the world; farmers wait for a rise in the price of wheat; now young men listen anxiously to military summons. The crier clatters off to repeat farther down the road.

"It's the only one in Ardoux," he smiled proudly. "When I play it, many neighbors come in to listen. Then I have plenty of company."

Family pictures decorated the walls. On a table were snapshots of Indo-China, taken by his son on military duty.

"Now come around to the side, and I'll show you my workshop."

Here he made his own wooden shoes with well-worn tools he let me handle. I ran my hand over the hardwood surface of a plane, polished smooth by years of use. Cool and mellow, a mallet's haft melted in my grasp. And my fingers gripped a primitive chisel that had been in the family for generations.

One evening I returned to his cottage. Near the phonograph he crouched like a Buddhist before an image of his god. He bade me come close so as not to miss a sound. Tino Rossi sang; there were Spanish waltzes, Tyrolean yodels, tangos, and classic French favorites. The kerosene lamp reflected a gleam of contentment on the old man's face as he kept time by tapping his wooden shoe.

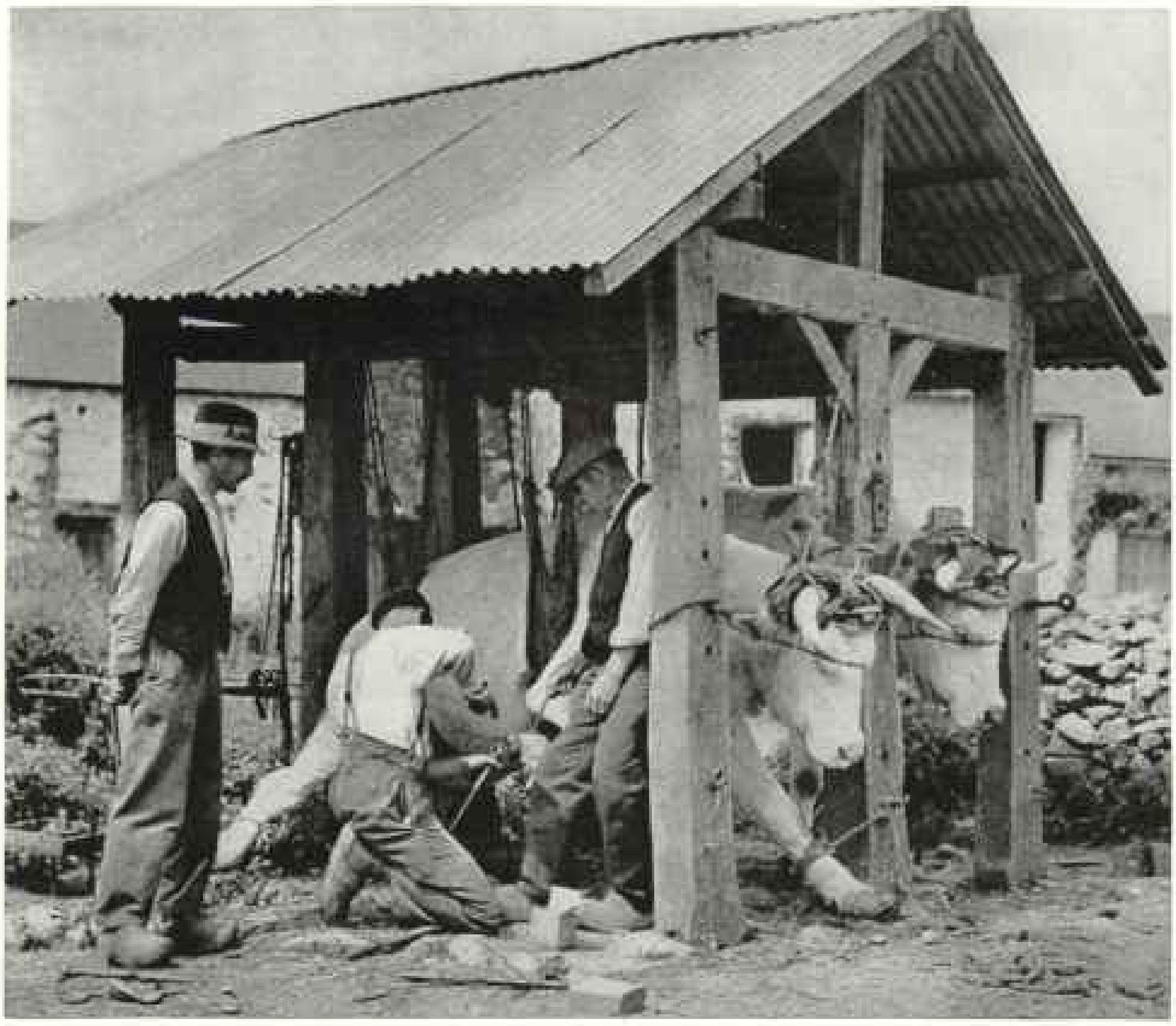
A BAKERY IN THE BEDROOM

Neighbors had heard the music and began to gather. Joining a discussion on baking, Picard, who lived next door, said his wife would bake in the morning.

Next day I found Madame Picard pushing a long wooden shovel into an oven built in the chimney (Plate V). An appetizing fresh-bread smell filled the room.

"You are too late," she scolded, good-naturedly. "I've almost finished."

She also made *semoule*, a sweetish sort



DOUBLE-DUTY COWS, BOUND HORN AND FOOT, ARE SHOD IN THE ENFER SMITHY

Morvan farmers and woodmen depend on cows, yoked in pairs, for all heavy work as well as for milking. Because of stony roads, the animals' hoofs are protected with iron shoes. The few horses of this region are used for light work (page 234).

of bread, which I tasted while it was still warm.

"Take more than that. You can't tell what it's like from such a small piece," she insisted.

Knowing that the Picards depended on baking for a livelihood, I did not wish to eat into their capital. But she cut a big hunk of semoule, wrapped it in paper, and made me take it.

"Try some later on when it has cooled and crusted. It tastes better then."

The Picard cottage has one room. Close to the chimney stands a large bed covered with a cheerful red quilt. Hams, socks, and a kerosene lamp swing from smoky rafters. Flowerpots fill window sills. Old chests line the walls. And, as in most Morvan homes today, a cookstove heats the house in winter.

It was any Sunday morning. Folk from farms and communities near Chaumard converged at its church. Men wore their best corduroy breeches, newest wooden shoes, and carefully brushed, wide-brimmed black hats. Black draped the women in prewar styles. Children, wearing white stockings and fresh linen, behaved like the starch in their clothes.

An automobile roared through the valley and up the hill to Chaumard. Two little boys rushed to ring bells that would announce the priest's arrival. With many others, I filed into church and took a back pew. Children pattered after parents over the stone floor. Late, because she had to walk from a distant village, a woman with a wooden leg stumped up the echoing aisle. Then a hush fell softly as sunlight sifted through stained-glass windows.

Midway in the service, two boys rose from their places in the front. Ceremoni-

ously they marched down the aisle toward the rear where long ropes hung from the tower. Only after much violent tugging did the heavy bells ring out. To check their momentum, the lads climbed the ropes. They looked like jumping jacks on strings as the still-swinging, still-ringing bells pulled them up and down.

Sunday brought men together from scattered farmsteads. After church, many congregated in the café. They discussed crops, weather, war. Perhaps they arranged to sell a cow or some land. The priest was there, too, buying bonbons for children.

A FARMER'S SON READS MILTON

On higher hills behind Chaumard the village of Ouroux straddles a ridge. One sunny morning I strolled in that direction. I had not intended to walk the six miles, but at noon the village had drawn me so near that I continued.

Above bowl-like valleys wound the dirt road, twisty as an apple peeling. Cloud shadows, chasing patches of sunlight, darkened verdant hillsides. Through a screen of daisies and digitalis blossoms I looked down on a valley—a rumpled carpet, it seemed, where a child had carelessly left his toy houses. Only breezes moved this world: swayed the flowers, flew the clouds, brought the smell of burning birch to me. No butterfly flickered in uncertain flight. Not even a bird streaked the sky.

At Ouroux's inn, kept by a farmer and his wife, I lunched late and lightly. That in itself, aside from my accent, gave the woman her cue as she said:

"I think that you are not French."

"I am American."

"My son would enjoy talking to you. He has just taken examinations for teacher of English at a school in Paris. I'll call him if you don't mind."

Georges Matz sat down at my table. While I finished my salad, he quoted lines from Milton's sonnet, *On His Blindness*. He liked Jack London's *Call of the Wild*. He had dipped into Oscar Wilde, and found particularly amusing an American humorist whose name he could not remember.

Georges accompanied me part of the way back to Chaumard. We stopped to examine a reddish-purple, bell-like flower that grows on a long stalk (Plate XII).

"Why is it called digitalis?" I asked my friend.

"Because you can fit your fingers so easily into the blossoms, I suppose," he answered.

Georges also told me of its commercial value. From the flower comes a medicine used as a heart stimulant.

When my companion had turned back, I branched off to Mont. In the minute, mountainy community I watched a man thatching a roof with rye.

"My grandparents used to put more rye in their bread than on their roof. But that is not the case today," said he.

"Why so?"

"Because rye is too dear." He paused in his thatching and looked down from the ladder. "A thousand kilos cost 300 francs."

In our language, that's about $9 for some 2,204 pounds.

Dawn awakened me for the last time in Chaumard. I closed my eyes again to see whether I could remember everything in the picture my window framed. Yes. But I forgot that all too soon the barelegged boy with the pail would have no meadow to cross. And the rushing rivulet would drown in the lake it fed.

Yellow signs with black figures almost shouted the ever-decreasing distance to Paris. Involuntarily I slowed down to watch red poppies nod farewell from golden wheat. I was leaving the soil.

Women with forks used perhaps by grandparents helped men pitch hay in a near-by field. Their long, late-afternoon shadows fell toward the road. A truckload of soldiers rumbled by. The workers waved and went on with haying.

© Suomen-Matkat by F. Rundberg

HELSINKI'S TALL, MASSIVE BUILDINGS MAKE TARGETS FOR SOVIET AIRPLANES

Last November 30, Russian aviators opened the invasion of Finland by bombing the capital. Among prominent landmarks is the pink granite railroad station, with its four colossal figures—one of Europe's most modern terminals. Eliel Saarinen, the designer, now heads the Cranbrook Academy of Art, near Detroit, Michigan. The new general post office, background, was completed last year. (See "Finland, The Farthest-North Republic," by Alma Luise Olson, NATIONAL GEOGRAPHIC MAGAZINE, October, 1938.)

MASSED HERE IN HELSINKI'S GREAT SQUARE TO CELEBRATE FLAG DAY ARE SOME OF FINLAND'S HEROIC DEFENDERS

The photograph was made on May 16, 1939, a national holiday, when war seemed remote. The troops face the Lutheran Church of St. Nicholas, where onlookers crowd the forty wide granite steps. The bronze statue of Tsar Alexander II (right) remains in the square because, in the days of his reign, when Finland was a Grand Duchy of Old Russia, he was friendly to the Finns and sought to maintain their constitutional rights.

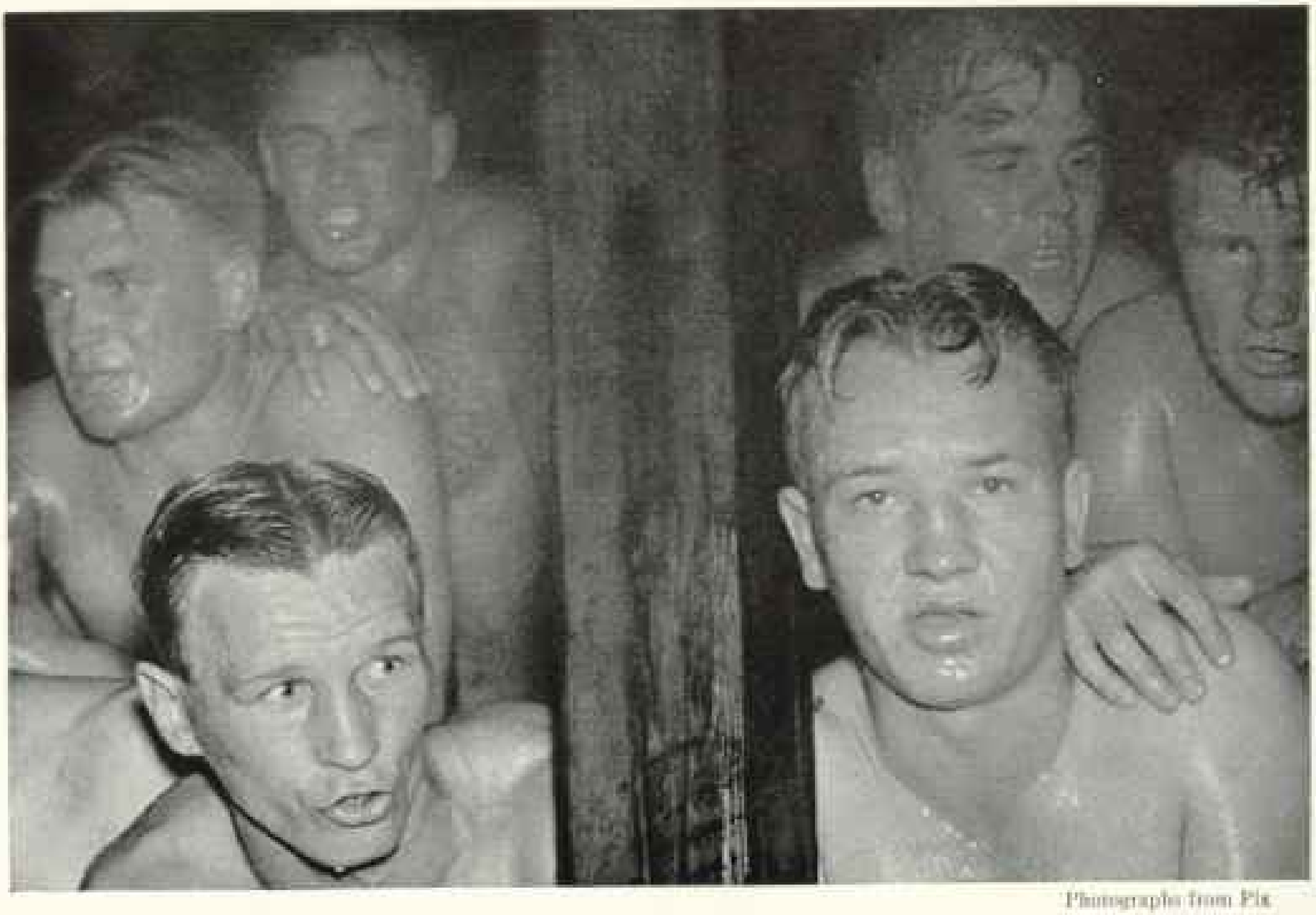
Photograph from Pix

TROOPS SWING DOWN A STREET IN THE SHADOW OF FINLAND'S NEW PARLIAMENT BUILDING

When the plucky Nation's territory was invaded by Soviet Russia last fall, every available man was called to the colors. They reinforced a standing army of only 33,000. These infantrymen are equipped with the latest rifles. Modern artillery and antitank guns also served them in good stead when they opposed the enemy's advance. Parliament House stands in Töölö, a recently developed section of Helsinki.

"COME ON, MAKI, LAST LAP!"

Finland's latest 10,000-meter sensation is winning the 1939 national championship. The crowd fills every seat of the vast stadium in Helsinki, which the Finns enlarged for the 1940 Olympic games, now canceled. It was bombed on the first day of the Soviet invasion.



Photographs from Fix

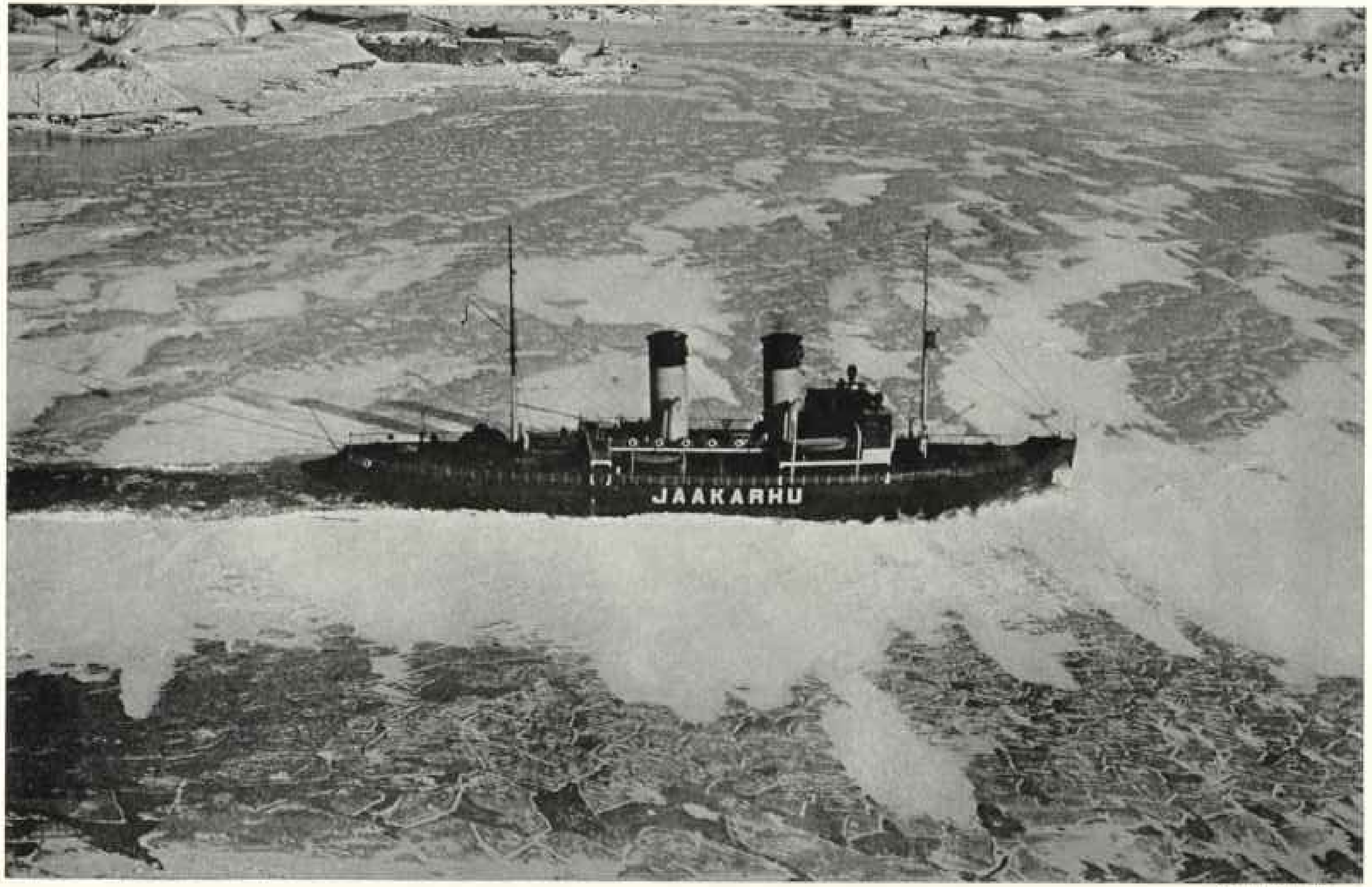
FINNS WHIP THEIR SKIN WITH BIRCH WHISKS AS THEY STEAM IN THE BATH

On farms the vapor is produced by pouring cold water on hot stones. In cities modern methods are used.

Photograph by R. Schleifer from Three Lions

ÅLAND ISLANDS MEN MAY PREFER SAIL TO STEAM, BUT GIRLS ADOPT ZIPPERS

The blond maiden lives on the strategic archipelago midway between Sweden and Finland, at the mouth of the Gulf of Bothnia. Nearly all her menfolk are seafaring. Here is the home port of the last fleet of large sailing ships. (See "Where the Sailing Ship Survives," by A. J. Villiers, in the NATIONAL GEOGRAPHIC MAGAZINE, January, 1935.) The islands, ceded by Sweden to Russia in 1809, were awarded to Finland after the World War. Now the Soviet wants them for a naval base.



© Newfot from Echo

FINLAND'S BIGGEST ICEBREAKER CRASHES THROUGH CLEAR ICE THREE FEET THICK

With her powerful engines and solid bow, the ship breaks up Baltic pack-ice belts in eight- to ten-yard drives. Before the present war, the *Jaakarhu* smashed open paths to Tallinn, Estonia, during cold weather, with a string of freighters following in her wake.

© Sammen-Matkat by Pientiinn

DAUGHTER SPINS, MOTHER WEAVES, FATHER READS, AND BABY PLAYS OF AN EVENING IN A FRUGAL FINNISH HOUSEHOLD

This scene in a Karjalohja home could be duplicated nearly anywhere in Finland's interior. The girl is spinning wool yarn from which her mother makes rugs on the old-fashioned loom. Overhead, large doughnut-shaped loaves of bread are strung on a pole. As the Finns retired before Soviet advances they burned many such country homes in the path of the invader.

Photograph by B. Schleifer from Three Lions

WORLD NEWS COMES BY RADIO TO AN ÅLAND ISLANDS PARLIAMENT MEMBER

The Swedish grandfather's clock, suggesting a woman with old-fashioned skirts, and the rocking chair contrast with the wireless set in the home of Miss Fanny Sundström. In 1921 the League of Nations settled a dispute between Sweden and Finland over the Åland Islands. The League upheld the Finnish claim to them, but provided that they be granted a large measure of self-government. Their neutrality was guaranteed and it was agreed not to militarize them.

Photograph by B. Schleifer from Three Lions

HOPES AND FEARS OF ÅLAND ISLANDS MAIDS ARE BOUND UP WITH THE SEA

Photograph by Pantenburg from Three Lions

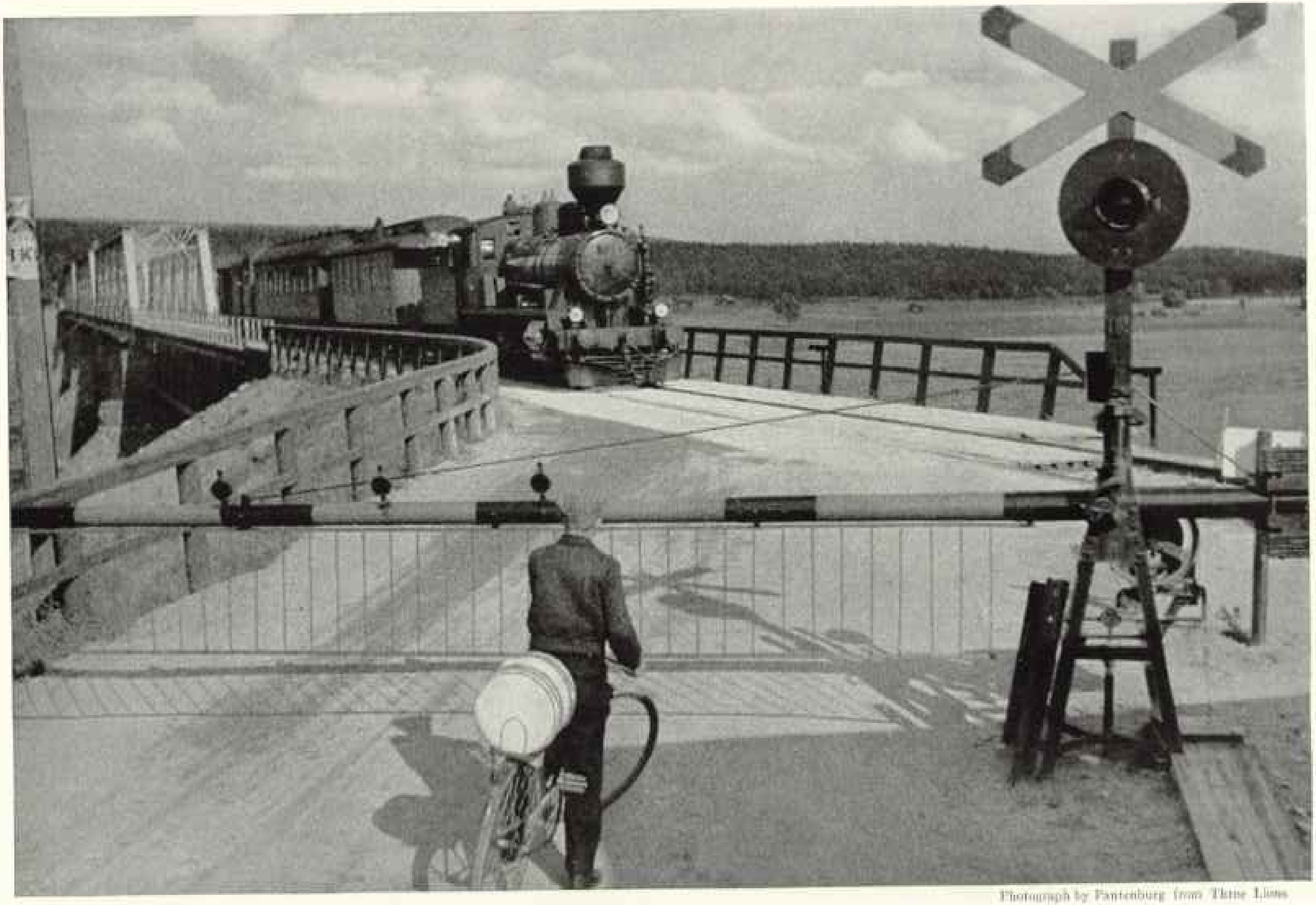
NATIVE COSTUMES STILL SURVIVE ON THE ÅLAND ISLANDS

Up-to-the-minute guns and ammunition poured into the archipelago in December, 1939, when Finland frantically fortified her demilitarized islands after the Soviet invasion.

© Neofot from Echo

FRIENDLY BEAMS OF A LIGHTHOUSE CHEER MARINERS IN THE VAST LONELINESS OF THE POLAR SEA

Light gleams from the isolated station not far from Petsamo, Finnish outlet to the Arctic Ocean. The town is 65 miles from the Soviet port of Murmansk, head of the world's northernmost railroad and haven of refuge for the German luxury liner *Bremen* in the early months of the present war.



Photograph by Pantenburg from Three Lions

GATES STOP VEHICLES WHEN A TRAIN CROSSES THIS COMBINATION BRIDGE AT ROVANIEMI, ON FINLAND'S ARCTIC HIGHWAY AND RAILROAD

Photograph by Pix

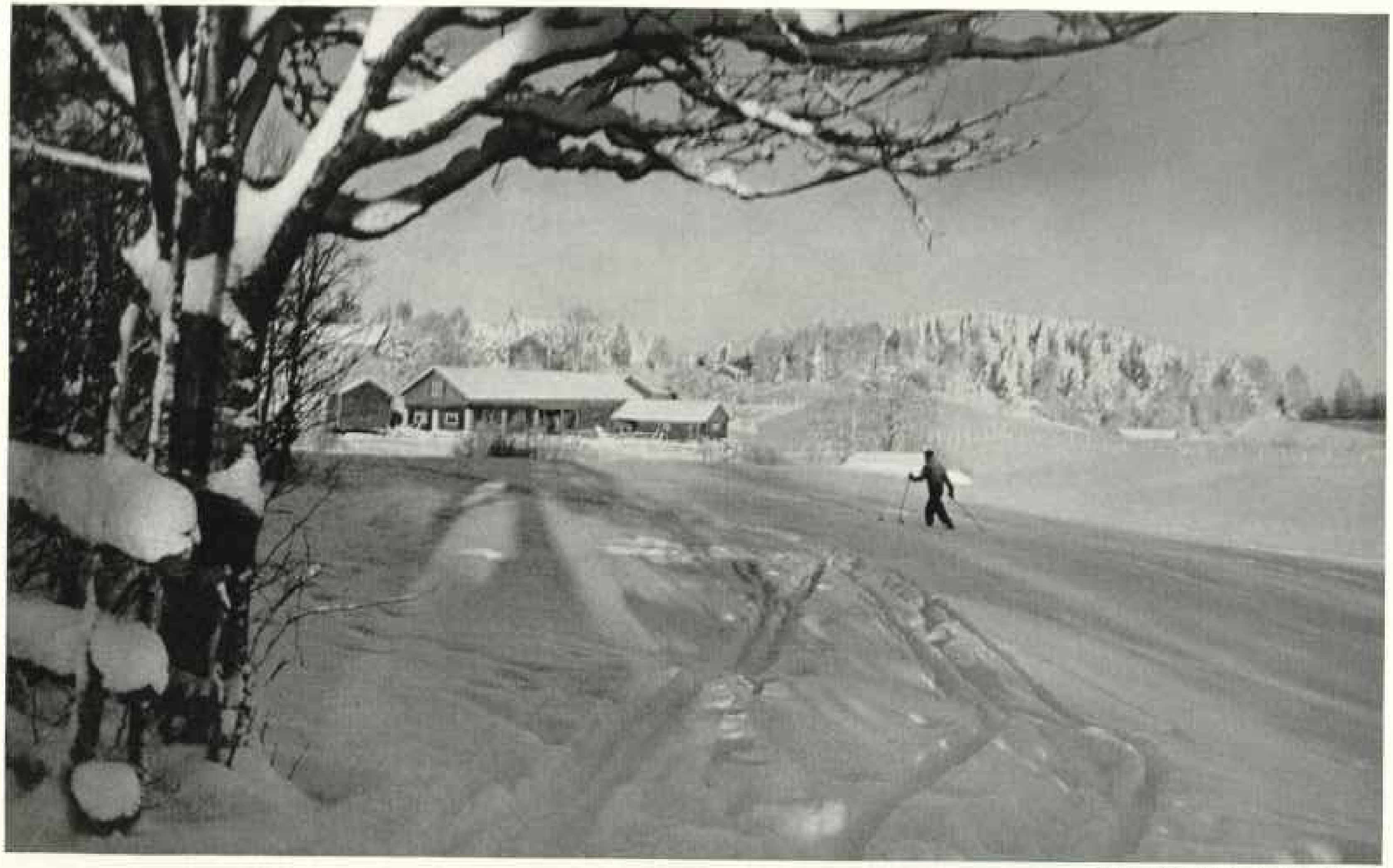
WRITTEN INSTRUCTIONS, HANDED TO A MEMBER OF THE WOMEN'S AUXILIARY, MEAN A SPECIAL ASSIGNMENT

This military organization is performing tireless service during the war with Soviet Russia. Co-operating with Finland's Civic Guard, the gray-uniformed women give first aid, supply food, and help in any way they can, except in bearing arms. Here they line up with cups and plates to receive orders of the day before breakfast.

Photograph by R. Schlaifer from Three Lions

A SMÖRGÅSBORD IN THE ÅLAND ISLANDS WHETS THE MOST JADED APPETITE

Nearly the entire population of 27,000 is Swedish, which accounts for the popularity of the huge delicacy-laden tables. Fancy sliced cold meats, pickled herring, sardines in spicy sauces, are only a few of the many appetizers.



Photograph by Soiuel from Three Lions

"NO CLOUD ABOVE, NO EARTH BELOW—A UNIVERSE OF SKY AND SNOW"

Whittier's description of a New England winter landscape might well be applied to the Åland Islands. Although most inhabitants are seamen or fishermen, many cattle are raised on small farms. Sometimes sailors own the farms, which the women and children operate when the menfolk are at sea.

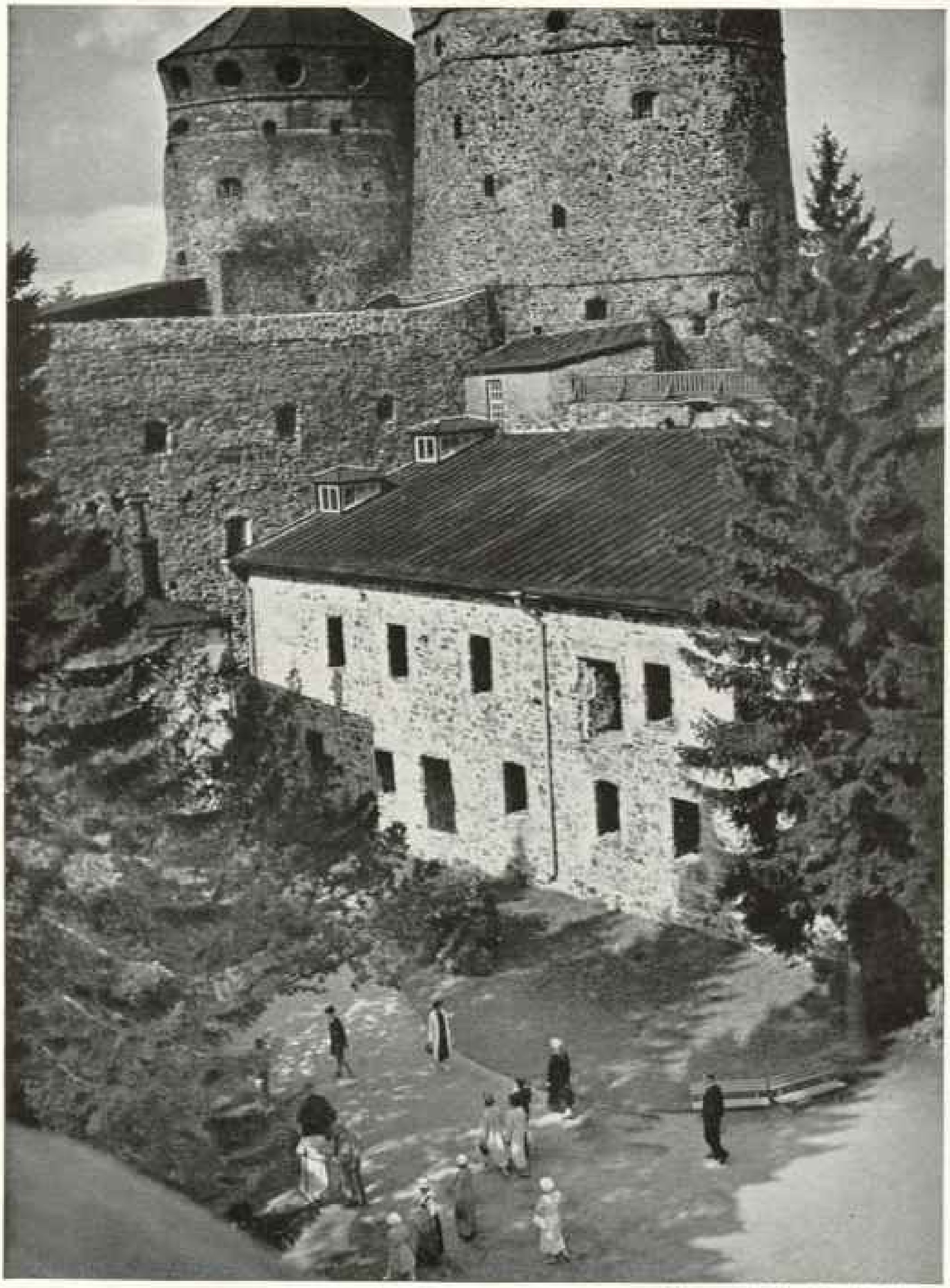
THESE LITTLE PIGS MAY STAY AT HOME

Five out of the average Finnish farmer's annual litter of about a dozen porkers are kept for home consumption. The other seven go to market.

Photographs from Fix

A SELF-TAUGHT FIDDLER ENLIVENS BARRACK HOURS

This hussar plays only Finnish folk songs. His heroes are Paavo Nurmi, world-famous athlete, and Jan Sibelius, renowned composer.



Photograph by Marvin Breckinridge

MODERN ARTILLERY COULD SOON DESTROY OLAF'S CASTLE, FORMERLY ONE OF EUROPE'S STRONGEST

Only the footsteps of guides and sight-seers echo through this vast pile in normal times. It stands at Savonlinna, not far from Lake Ladoga. Old inventories show that 13,000 candles were burned yearly to light its dim rooms and it boasted only three towels in the sixteenth century. The castle has changed hands frequently. It was built by the Swedes, taken by Russia, ceded to Finland, retaken by the Tsars, besieged by a Swedish-Finnish army, and finally handed over to the Duchy of Finland a century ago.

BEHIND NETHERLANDS SEA RAMPARTS

Dikes and Pumps Keep Ocean and Rivers at Bay While a Busy People Carries on Peacetime Work

By McFall Kerbey

STEAM up the placid New Maas to bustling Rotterdam; cross from Belgium or Germany over any of a dozen railroads or a score of highways; swoop down by air from north, east, south, or west—in any of these ways you can come easily to the hospitable, centralized Netherlands, neighbor to most of western Europe.

But there is still another doorway. Passing through its portals will put you into a mood the better to understand this lowland country and will dramatize facts and forces that have molded its geography and history and the traits of its people (map, p. 261).

If you sail from the North Sea at high tide through the massive locks at IJmuiden, one of which is the largest yet built, your ship will be let *down* to the level of Amsterdam's great harbor (page 272).

When you have made this passage or have watched a procession of ships—tugs, freighters, palatial passenger steamers in the Indies trade—tripping down this water step or climbing up it to the sea, you understand why this country is named "nether lands."

A CITY BELOW SEA LEVEL

"Don't you ever worry about living in a city below sea level?" I asked a native and lifelong resident of Amsterdam.

"Of course not," he answered, laughing. "In the first place, you have overstated the case. Our city isn't below normal sea level.

"True, the water in our harbor and in our canals is lower than high tide in the North Sea; but at low tide during most of the year water will flow naturally from the harbor to the sea. And of course, as you can see for yourself, the street level here (we were standing within a stone's throw of the Palace) is more than half a man's height above the water of the canals."

I had just come from an interview with a city official whose duty it is to keep tab on water levels. He had given me a diagram showing that when high tide and winter storms raise the North Sea's waves and send them battering against the sand-hill bulwarks of the Netherlands' western shore, the water level is as high as the second stories of buildings in the highest part of Amsterdam.

I reminded my friend that averages are not very comforting at such times, but he made the practical point that Amsterdam is quite secure behind its bulwarks and its pumps, and that it has not suffered from really serious floods for more than a century.

WATER HEIGHTS TELL COUNTRY'S "BLOOD PRESSURE"

While we were discussing water levels—as important to this country as are blood circulation and blood pressure to an individual—we walked over to a near-by canal and I received my introduction to the mystic letters, N. A. P., which one sees neatly painted or carved on posts and boards and canal walls all over the Netherlands.

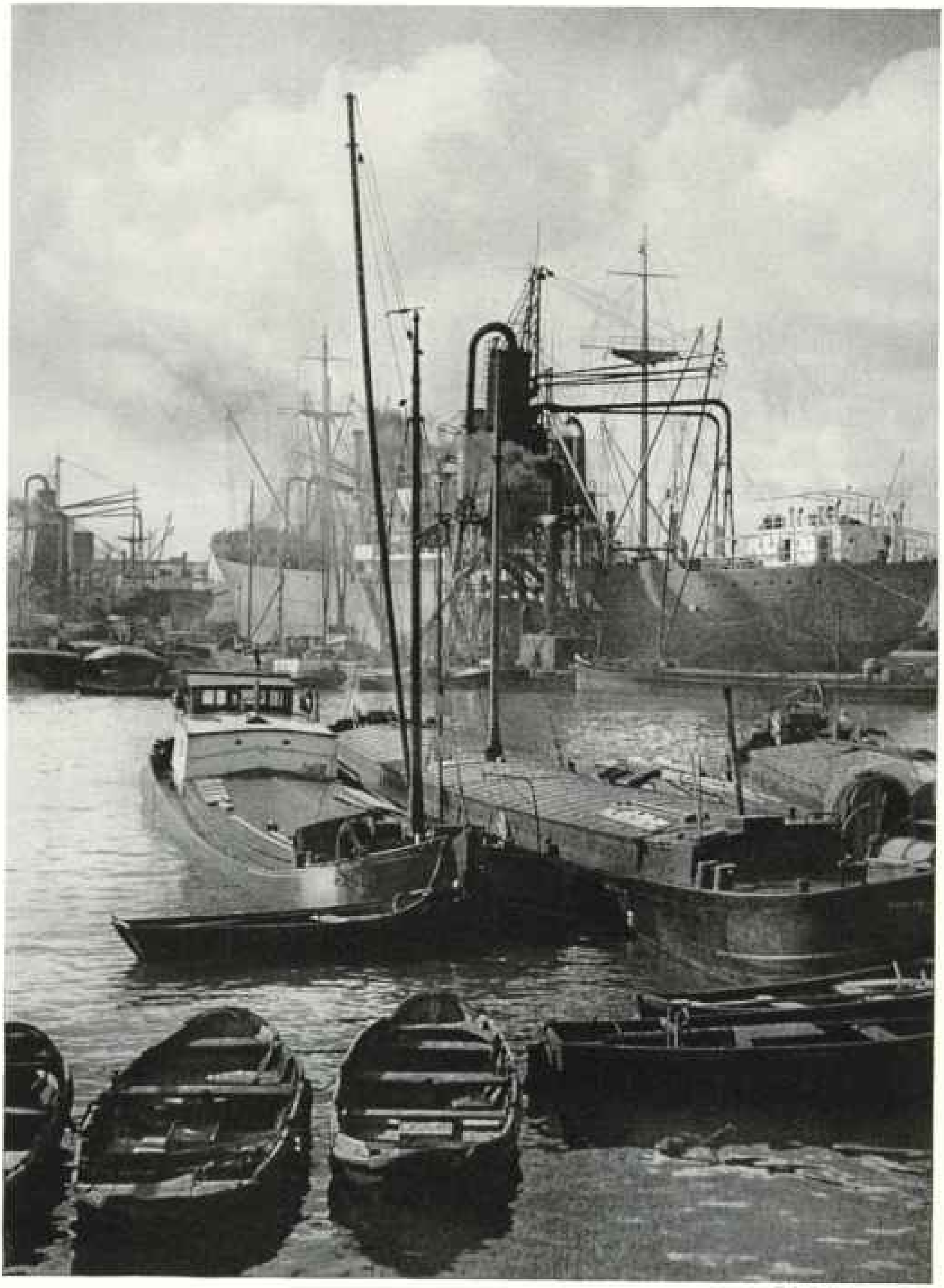
There was a white line on a post in the canal about a foot and a half above the water and beside it were the letters. They stand for *Nieuw Amsterdamsch Peil*, meaning the "New Amsterdam Level," or, in effect, sea level at average high water in the old harbor.

The idea behind these three letters is as fundamental to Netherlanders as is the North Star to a mariner. All the complicated engineering that has built the Netherlands and keeps it functioning—the vast maze of dikes and polders and canals at varying levels—takes on a fuller meaning when it is explained in terms of N. A. P.

It is news in the western Netherlands when you are above N. A. P.; no news at all when you find yourself wandering about dry-shod in well-drained fields with busy farmers or on green meadows dotted with sleek cattle where signs tell you that you are two, three, and even five meters *minus* N. A. P. (roughly 6½, 10, and 16 feet below the Amsterdam water level).

With a knowledge of N. A. P., you have a better understanding of the big central statistic about the Netherlands that you are constantly encountering: that nearly two-fifths of the land of this Kingdom lies below sea level.

To this fact must be added two more: if all the dikes were torn down, an additional



© J. F. H. Rooyens

A TANGLE OF MASTS AND PIPES PROCLAIMS ROTTERDAM'S SHIPPING ROLE

Here in Rhine Haven, a huge floating elevator sucks grain from the hold of the freighter and whisks it into barges. In normal times many of these laden boats are towed directly up the Rhine to German and Swiss ports. Others are shuttled over the Netherlands' network of canals for home use. Some ships tie up to quays where the grain is pumped directly into railway cars. Since the outbreak of the present war, the Rhine traffic has been seriously crippled. Only ships with grain for Netherland use reach Rotterdam, and hundreds of barges are tied up in the harbor (page 274).

Photograph by Bransom De Cou from Galloway

THIS LITTLE MISS IS FROM MIDDELBURG—HER HAT PROVES IT

The widespreading headdress with its corkscrew pendants and coinlike bangles tops a costume worn on festive occasions for centuries. For everyday she wears ordinary clothing.

large area would be only a foot or two above high water, and subject to inundation during storms; and still other areas, safe from the sea, are below the levels of the Rhine and the Maas Rivers, which transport through the Netherlands annually hundreds of millions of gallons of fresh water from extensive drainage areas in Germany, France, Switzerland, and Belgium.

READY TO FIGHT WITH WATER

Busy during times of peace in fighting their age-old enemy the sea, Netherlanders have ever been ready, when armies threatened invasion, to call their traditional watery enemy to their aid.

Several times during the long revolution of the provinces against Spain in the 16th and 17th centuries dikes were broken deliberately, not only in the hope of engulfing the Spaniards, but also to furnish water on which Dutch boats operated effectively as an inland navy. The soldiers of Louis XIV of France were kept out of Amsterdam by flooded fields in 1672.

Today, when soldiers are mobilized in neighboring countries and concentrated near the borders, the military authorities of the Netherlands make no secret of the fact that they have complete plans for quickly flooding certain areas of their country should alien troops cross their borders. They have even made test inundations.

Picturesquely, it is said that the sea would help in the defense of the Netherlands; as a matter of hard fact, it is Rhine and Maas River water (page 285).

For one thing, salt water would cause damage to the soil, whereas river water would not. For another, some of the land that must be flooded to ward off would-be invaders is not below sea level; but it is well below the level of the rivers and their canals, and is close to them.

A "MAGINOT LINE" OF POLDERS

Nor is the area extensive that would first be flooded.

Certain polders (dike-enclosed areas) have been thrown into groups to form, when flooded, a band of water six or seven miles wide extending from the Maas River northward across North Brabant and Utrecht Provinces to the southern shore of the old Zuider Zee, east of Amster-

© K.L.M. Royal Dutch Airlines

AMSTERDAM'S "GROWTH RINGS" SHOW PLAINLY FROM HIGH IN THE AIR

The city grew up in rings around the Dam (small white spot, right center), built over seven centuries ago across the Amstel River. The stream (entering at top) now flows through the city's canals, and the Dam has become a city square (page 259). The black area across the bottom is the harbor, separated from IJssel Lake (formerly the Zuider Zee) by the locks at left. At the right the harbor narrows down into the North Sea Canal, which leads west 18 miles to the coast.

dam.* This would cut off the eastern and southeastern Netherlands from some of the richest and most heavily populated parts of the country: western Utrecht, and South and North Holland.

The flooding plans call for only a moderate depth of water on the land—not a sufficient amount to float sizable boats, but enough to cover the innumerable canals and ditches which would serve as hidden traps for troops and any mechanized military equipment that attempted to "wade" across.

FORTS DOMINATE "WATER LINES"

If the invaders managed to make their way across the first flooded land, other areas could be put under water in front of them. And to make matters still more difficult for the water-harassed enemy, numerous strong forts are strung along the inner edge of each flood zone.

The peacetime traveler has no barriers to hurdle in entering the Netherlands. Passport and customs requirements are simple; the country is small—about the size of Maryland—and one can move about easily and rapidly, especially in the western half where the majority of Netherlanders live and where most of the visitors tarry.

My traveling companion and I decided that centrally located Amsterdam was by far the best headquarters from which to make our many excursions; and within little more than an hour after we walked down the gangplank of our transatlantic liner in

* See "New Country Awaits Discovery" (Draining the Zuider Zee), by J. C. M. Kruisinga, NATIONAL GEOGRAPHIC MAGAZINE, September, 1933.

SEVEN STREETS AND THREE CANALS MEET AT THE BRIDGED MINT SQUARE

Familiar to world travelers is this section in the heart of Amsterdam, famous for its fine shops, hotels, and theaters. The square takes its name from the Mint Tower (center), left standing when the old fortified walls of the city were torn down about 1865. Coins were minted in the tower during a siege. The Amstel River pinches down to canal size in the foreground.

Rotterdam we had been whisked to the Netherland metropolis by a streamlined electric train.

When you reach this big city of nearly 800,000 people, with its charming mixture of the very old and the very new, with its bustle of commerce and industry, its rich history, its importance in such varied fields as world finance, material wealth, art, and the business of successful living, you begin to solve the paradox of why the Netherlanders insist that Amsterdam is their capital, although the executive, legislative, and judicial activities of the country are centered at The Hague, the city to which foreign diplomatic envoys are accredited.

At times in its long history, Amsterdam has stood virtually as a city-state within province and nation. Today it is still the largest center of population and wealth; and despite being outranked as a port by Rotterdam and as a governing center by The Hague, it proudly maintains its position as premier city of the realm, municipal heart of the Nation.

AMSTERDAM HAS GROWN IN RINGS

Look at a map of Amsterdam as it lies now after more than seven centuries of growth, and you will agree that it is like half a cross section of a tree, the straight side formed by the harbor. The tree rings are the important canals of this "Venice of the North"; and there are even the radial "cracks" that develop in a seasoned tree trunk, in the form of minor canals and streets.

The city actually grew as a tree does by adding well-defined rings or zones of territory from time to time.

Photograph from Three Lions

THIS MASSIVE DAM MARKS THE FIRST VICTORY IN THE CONQUEST OF A NEW PROVINCE

The huge dike, extending 20 miles between North Holland and Friesland, now makes a fresh-water lake of the old Zuider Zee. One section of the new IJssel Lake (left) has already been surrounded by dikes and pumped dry to make farm lands. Trucks, buses, and automobiles use the broad dam top as a highway; even a white paved path for bicycles is provided at the right.

Drawn by Newman Bumstead and Ralph E. McAleer

THE NETHERLANDS IS SURROUNDED BY CUSTOMERS IN PEACETIME, BY POTENTIAL ENEMIES IN TIMES OF WAR

Only Germany and Belgium have common land borders with the Netherlands; but Great Britain (inset), France, Switzerland, Norway, Denmark, and the Baltic countries are close by. The Rhine "gets lost" in the Netherlands; after crossing the border it breaks up into numerous diked streams. Practically all of North and South Holland and Zeeland lie below sea level. The large areas (polders) to be reclaimed from the IJssel Meer are shown by broken lines.

The tiny acorn from which mighty Amsterdam has grown was a dam thrown, about the year 1200, across the Amstel River, close above its meeting point with the IJ(Y), an arm of the Zuider Zee, so that fisherfolk might have a small area of dry ground rising from the marshes on which to build their huts. Such dams, always equipped with sluice gates, were not designed to stop the outward flow of streams but to keep the sea from flowing into them at high tide.

Behind their barrier the citizens of Amstelredam, as the early settlement was called, dug canals and received three boons at once: they helped drain the marshland, they furnished channels for boat traffic, and the mud and sand were built up between the canals to raise the ground level.

Amsterdammers followed this simple procedure for centuries. When the city needed to expand, they dug a new ring canal outside the old borders and piled up the

© A.B.C. Press Service from Black Star

BULLETPROOF GATES SWING SHUT ON A RHINE BRIDGE NEAR NIJMEGEN, CLOSE TO THE GERMAN BORDER

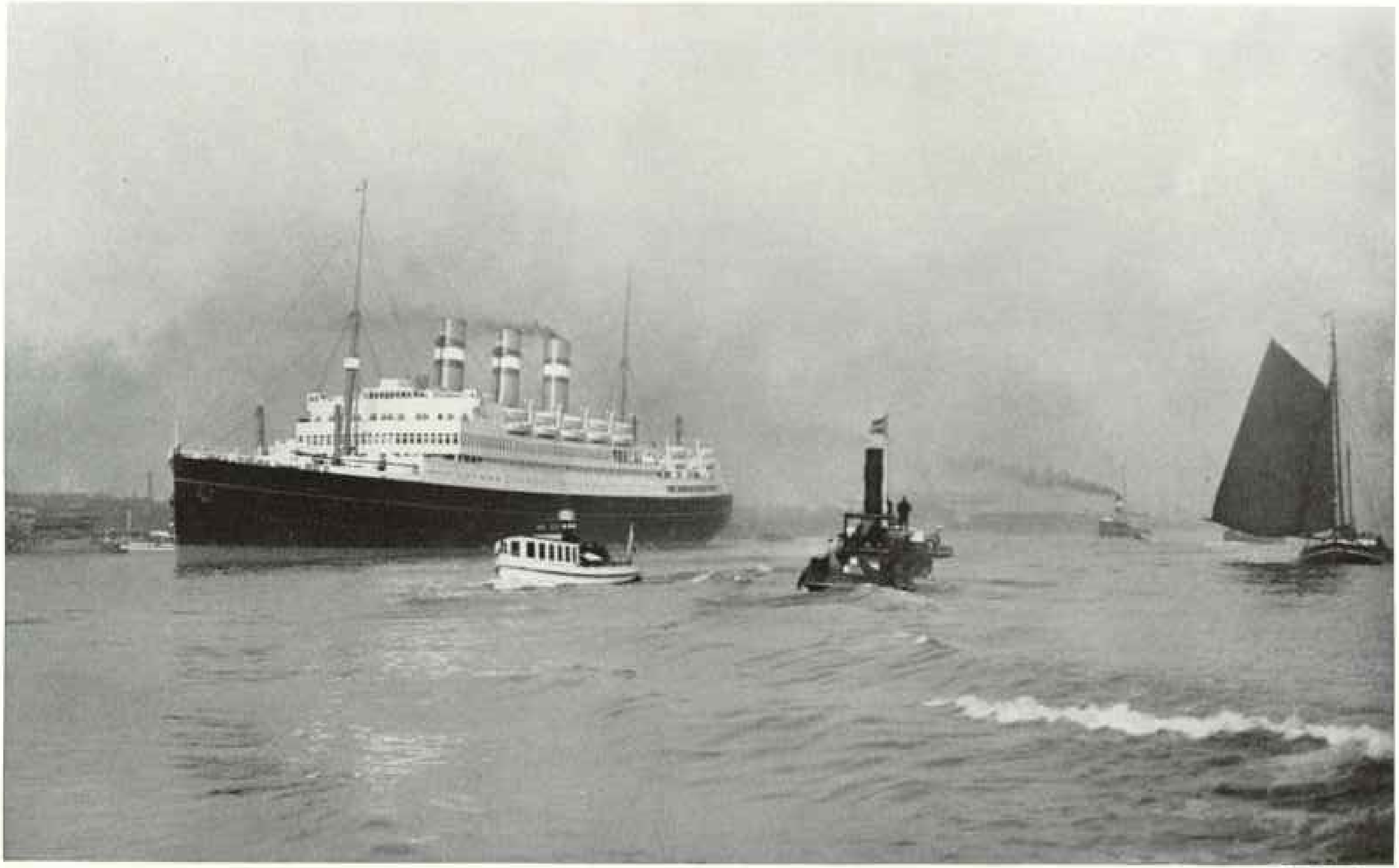
Photograph by Eisenstaedt, from Pix

BOUND FOR AN OUTING, NETHERLAND GIRL SCOUTS PASS IN REVIEW ON THEIR BICYCLES

Photograph by Fix.

GUARDS IN THE RIJKS MUSEUM, AMSTERDAM, PRACTICE TO SAVE A MASTERPIECE FROM FIRE OR BOMB

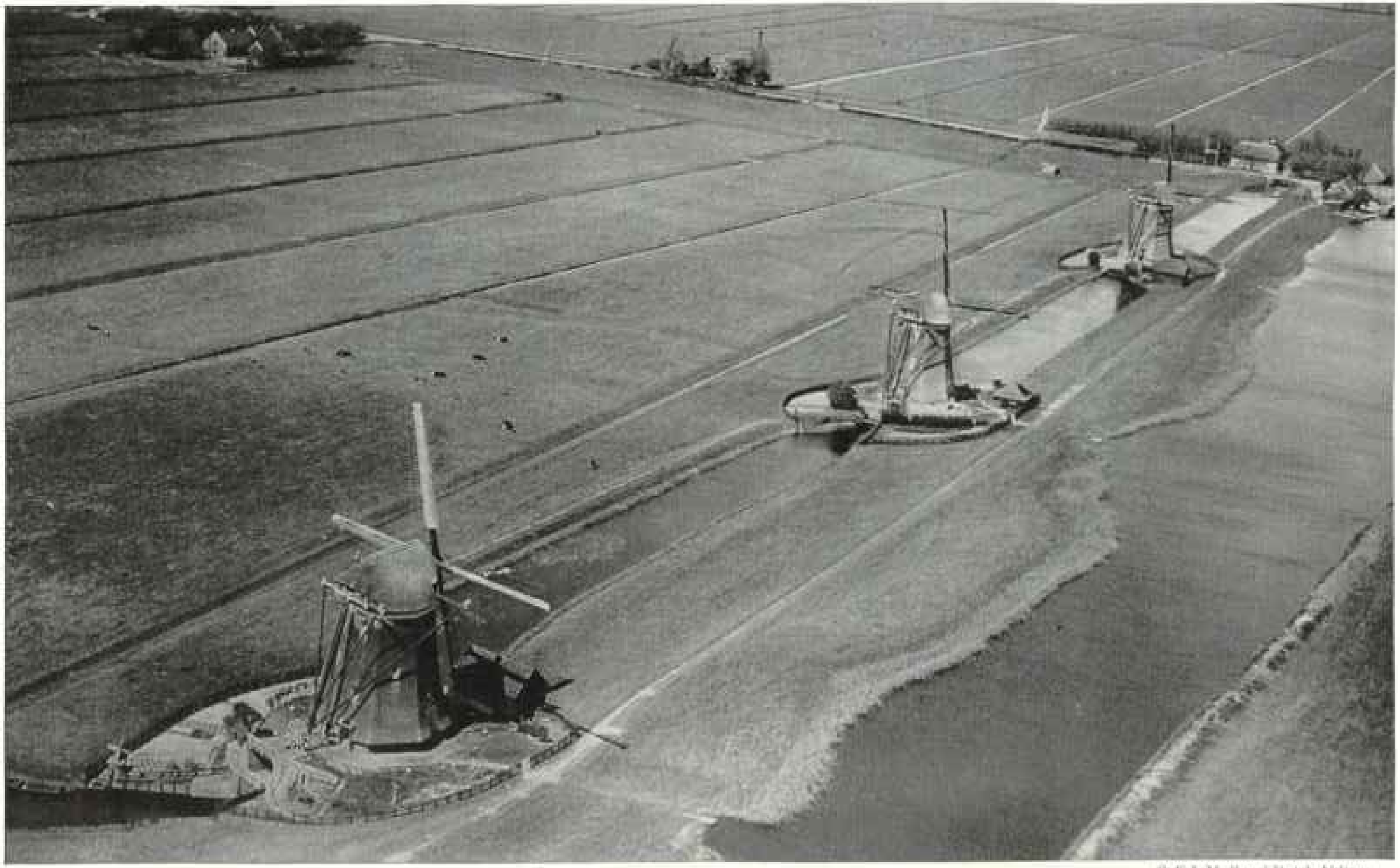
This Bartholomeus van der Helst painting can be stood upright in the box, ordinarily concealed beneath the floor, and lowered to a waiting truck (page 288).



© Van Agtmaal

UP THE MAN-MADE 20-MILE WATERWAY TO ROTTERDAM STEAMS THE MAJESTIC "STATENDAM"

Entering the ship canal at the Hook of Holland, the big liner threads a busy artery of fishing vessels, tugs, yachts, and tramp steamers to the Netherlands' chief seaport.



GANGS OF WINDMILLS, WORKING IN RELAYS, DRAIN THIS RICH DAIRY REGION IN SOUTH HOLLAND

A single mill can raise water efficiently only a few feet. This polder, lying eight to twelve feet below sea level, requires several to create an ascending "water stairway."

YOUNG NETHERLANDERS LOVE A PARADE—IF THEY ARE IN IT

Every Sunday morning dozens of marching clubs leave Amsterdam, each with a band or drum corps. This group was photographed from a canalboat bound for Marken. Their flag bears the coat of arms of Amsterdam and the slogan "I want to win."

Photographs by McFall Kerbey

PARKED BICYCLES AND PASSING PEDESTRIANS SHARE SIDEWALK SPACE IN THE HAGUE

Taking care of the Netherlands' three million bicycles is a major traffic and storage problem. Many shops provide free parking and in the cities "garages" care for the bicycles. Cyclists are licensed and must obey all traffic regulations (page 279).

Photograph by Brannum De Cou from Galloway

ROTTERDAM CLINGS TO A MECHANICAL BENEFACTOR OF THE PAST

Once mills like this helped keep the city's head above water and ground its grain. Now such services are performed by modern drainage works and steam mills. But the old "wind engine" is still kept in perfect operating condition in the heart of the city.

precious earth on each side of the latest ditch to make sites for new houses.

Don't think you can find anything recognizable as a dam set across a river in the heart of old Amsterdam. The end section of the river, through the centuries, has been choked, divided, filled in, and pushed away from its old position. The Dam lives on in name, to be sure, but it is a broad, cobblestoned open space, Amsterdam's central square, through which now sweeps a heavy wheeled traffic.

Facing the Dam on one side is the Royal Palace, once the Town Hall of Amsterdam, in which the Queen lives for about a week each summer while making her annual official visit to the commercial capital, a custom that has almost the force of law.

Virtually every building in Amsterdam rests on piles. Amsterdammers never fail to tell visitors of the somewhat appalling number that had to be driven to serve as a foundation for the Palace—13,659 of them. That was in 1648, and the piles, soaked in water and mud and so preserved, continue to bear their heavy burden. When the best construction methods are followed, piles reach to firm sand which in places is as much as 60 feet below the water level.

"NEW" CHURCH BUILT 500 YEARS AGO

Facing the Dam also is the great Gothic New Church. As is the custom of Netherlands sovereigns, Queen Wilhelmina jour-

Photograph by Branson De Cou from Galloway

CANAL BOATS SERVE AS FARM TRUCKS IN THIS CORNER OF FRIESLAND

In most parts of the country roads parallel canals; but here there are none. Harvested crops, cows on their way to and from pasture, and horses and plows must be moved by boat between field and barn.

neyed from The Hague to take the constitutional oath there when she came to the throne in 1898.

The name of this church reminds you once again that Amsterdam has a long, long history; for the "New" Church was built in 1408 and underwent its most recent major rebuilding in 1645! The Old Church, on the eastern side of the city, was erected about 1300 when Amsterdam was a mere stripling of only 100 years. Despite Its canal-bank site, it is still in good repair.

We experimented with living quarters in Amsterdam. First, a large hotel surrounded by paved streets. It was noisy. Then a pension near a park. It was too far from beaten paths. Finally we realized, as we should have from the first, that sojourners in Amsterdam such as we, eager to learn all we could, should live where characteristic forces of this unique city's life play about them. So we moved to a hotel on the bank of a busy canal.

It was a happy choice. Each morning we breakfasted beside a window that hung over the canal; and boats and barges, as they swung around a bend, almost brushed our wall. It was a varied parade we looked down upon: barges full of sand and gravel for construction work, loads of the ever-necessary piles, boats stacked with bales and boxes and drums whose contents we could only guess, potted plants and flowers for the informal flower market on the canal bank two bridges and half a square away. (In this amphibious city you must speak in terms both of water and of land.)

With Venice in mind, we had imagined before we reached Amsterdam that there

Photograph by McFall Kerbey

POST BOXES ON STREETCARS KEEP AMSTERDAM MAIL MOVING

Every tram line that runs to the Central Station carries such boxes on its cars. At the Station Plaza special postmen "rob" each arriving container and rush the mail to outgoing trains.

must be some sort of water craft for passengers, to take the place of graceful gondolas and the little passenger steamers that ply the Grand Canal.

GOODS, NOT PASSENGERS, MOVE ON AMSTERDAM'S CANALS

We soon learned that there are virtually no pleasure craft or passenger boats used on Amsterdam's canal system. About the only exception is the small fleet of gasoline motor launches, expressly for visitors, which make sight-seeing trips every hour or so along certain of the broader canals, on the Amstel River, and about the harbor.

Although many of the canals, lined with fine old elms, add much beauty to the city, they are really for utility. On many of the waterways freight boats and barges ply, delivering goods practically to front doors of shops and storehouses. But there are other canals, faced by residences, whose placid, shady surfaces may be undisturbed by boats for days at a time, and then perhaps only by strings of municipal barges carrying away ashes and other refuse.

Along the majority of the canals, between their confining walls and the building lines, is sufficient space to serve for both vehicles and foot passengers. Automobiles and trucks, while not nearly so numerous as in American cities of similar size, have nonetheless taken over much traffic that formerly moved by water. Sometimes motorcars desert their proper element, and the Amsterdam fire department has a special truck-mounted crane for fishing them out of canals (page 284).

A really busy waterway is at the eastern edge of the city, where the Merwede Canal meets the main harbor. This canal was finished in 1892 to bring Rhine River

traffic across country for some 44 miles directly to Amsterdam.

The big heavily loaded Rhine barges come during normal times in a seemingly unending procession to bring stone, timber, steel, chemicals, and dozens of other commodities (page 283). On their return trips they take away for up-Rhine ports raw materials from the colonies, products ranging from rubber to spices.

THE CITY'S WATER PLAYGROUND

We went one day to see a handsome new bridge across the Amstel River in the outskirts of the city and stumbled onto the pleasure craft so obviously missing from the canals. Under raised plazas at the ends of the bridge the municipality has built boathouses and turned them over to boating associations.

It was a delightful summer afternoon, after office and shop hours, and scores of young people were making the most of it on the broad Amstel in a variety of water craft, including long, slender racing shells.

The Amstel has been a favorite playground ever since a considerable number of citizens of the growing city attained wealth and leisure by sea trade back in the sixteenth and seventeenth centuries. As we watched present-day pleasure seekers on the river, we thought of the playtimes there of earlier Amsterdammers. A few evenings before, we had been the guests of a gentleman who has made it his hobby to collect books, engravings, and prints dealing with the rich history of his native Amsterdam.

OLD PRINTS AND A NEW BEVERAGE

One print showed a gay winter festival on the frozen Amstel a century ago with hundreds of skaters skimming over the ice. In the background horses, two abreast and drawing heavy sleighs, trotted over the frozen surface.

One of the old engravings pushed time on the Amstel back more than two centuries. It showed fine ladies in canopied pleasure barges, sitting about little tables and sipping an exotic and exciting new beverage that had just been brought to Amsterdam from the far Orient by Dutch navigators—tea.

Within easy strolling distance of our hotel was one of the most characteristic features of Amsterdam's life on dry land, Kalverstraat, the city's chief shopping street. Narrow and tortuous, Kalverstraat is medieval in form, but faced by reasonably modern buildings that house distinctly modern wares. Part of its meager width is devoted to sidewalks, but they might as well not be there.

During business hours the stream of pedestrians that flows along Kalverstraat fills it from bank to bank. Bicyclists must push their machines along. The street is not a thoroughfare for automobiles, but now and then one eases its way in half-furtively to drop a guest at a hotel, then dodges out again at the nearest cross street.

You learn things about Amsterdam and the Netherlands by window-shopping along Kalverstraat: that their silversmiths and lapidaries and makers of china and glassware are among the best; that ten-cent stores, by another name, are here to greet you; that drugstores are really drugstores in this land. You go elsewhere even for toothpastes and cosmetics, not to mention books and sandwiches and alarm clocks.

Coming from a nation of inventors, you somehow feel more at home as you gaze into shop windows filled with intricately fashioned machines that will peel an apple when you turn a crank, can openers of unfamiliar types, and gadgets for fishing broken corks from bottles. Farther on is a tobacco shop with strange metal cabinets against the front wall higher than the door top. They are vending machines for cigarettes, cigars, and matches. At closing time they are lowered on springs and pulleys and left on the sidewalk to garner coins while the tobacconist sleeps.

Netherlands money, incidentally, is a solace for those American visitors who have become befuddled with shillings, francs, lire, and marks. The Netherlands guilder is divided into a hundred units called "cents," and you make your small purchases familiarly with five, ten, twenty-five, and fifty-cent pieces.

CHEESE FOR BREAKFAST

We found that there are adventures to be had among foods. We had never thought of eating cheese for breakfast at home; but we found it a delightful addition to morning meals in the Netherlands (page 276).

A typical breakfast is an assortment of slices: three or four sorts of sliced cheese, an equal number of kinds of bread, and sliced sausages and other molded meats. You are given a generous supply of good

© Donald McLeish

A KEY TO BABY DIRK'S FUTURE IS THE MODEL OF A DUTCH FISHING CUTTER

Walcheren Island, the lad's homeland, is a farming country, but its ports, Flushing and Veere, have for centuries been centers for fishing and overseas trade. Simple, sturdy furniture, the mantel panel of old tile, and the traditional costume of the girl, with bonnet, close-fitting bodice, and coral necklace, are characteristic of Zeeland homes. The coal fire in the grate is fed economically, lump by lump, with the spoon on the wall.

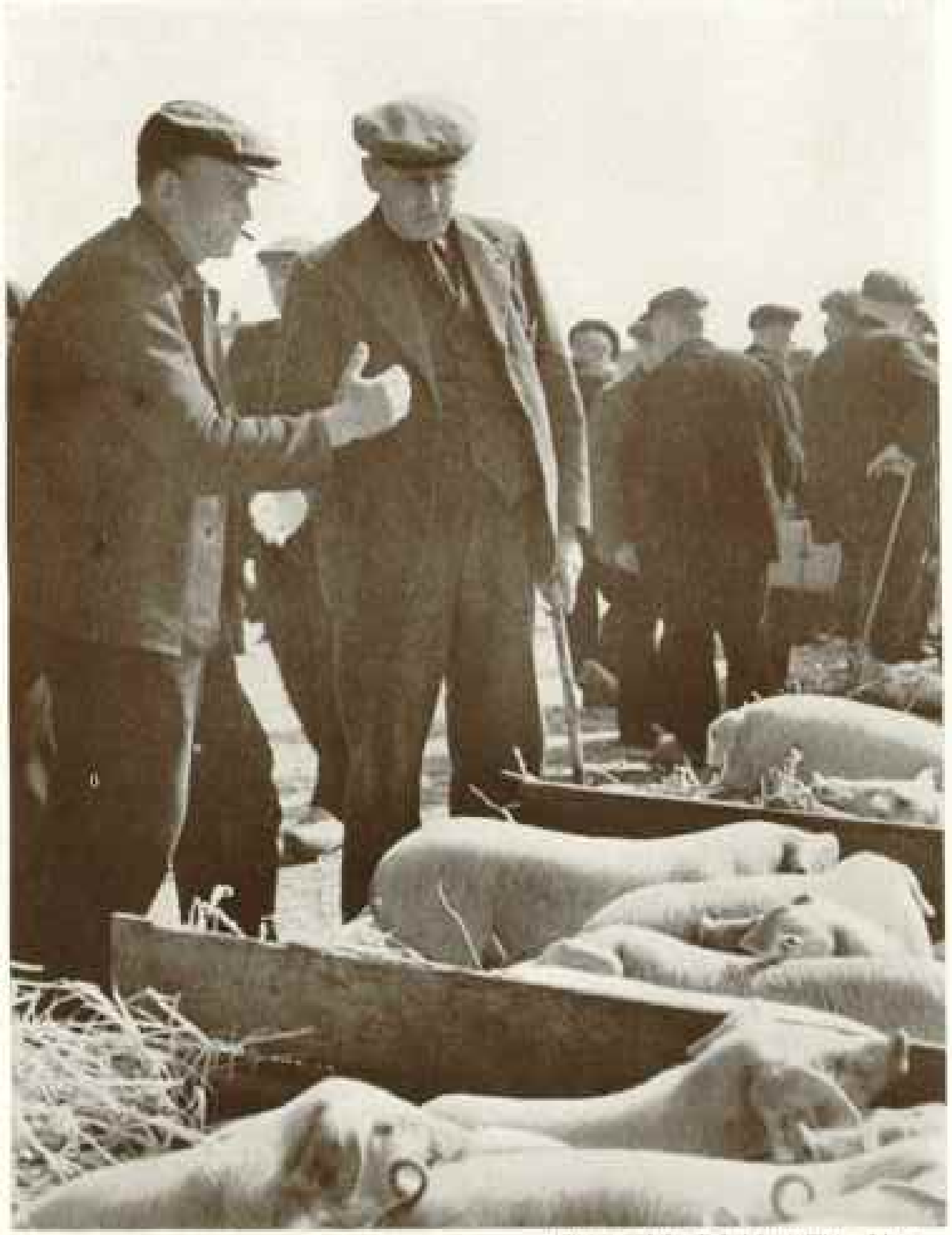
WATER CRAFT FROM LINERS TO BARGES COMPETE FOR SPACE IN AMSTERDAM'S BUSY HARBOR

The large ship steaming ponderously through the harbor flies the flag of the Nederland Company, which maintains regular service to the Netherlands Indies, far-eastern colonial realm about 60 times the size of the motherland. In the foreground are ferry slips on the De Ruyter Kade (Quay) behind the Central Railway Station. Free ferries are operated by the municipality to tie old Amsterdam to the new industrial sections across the harbor.

© Relang from Three Lions

TWO VOLENDAM MAIDS GO STROLLING ON THE DIKE

Tops of earth banks are the chief streets in Netherland villages. This paved road is level with the second floors of houses the wall protects.



Photograph by Pabel from Three Lions

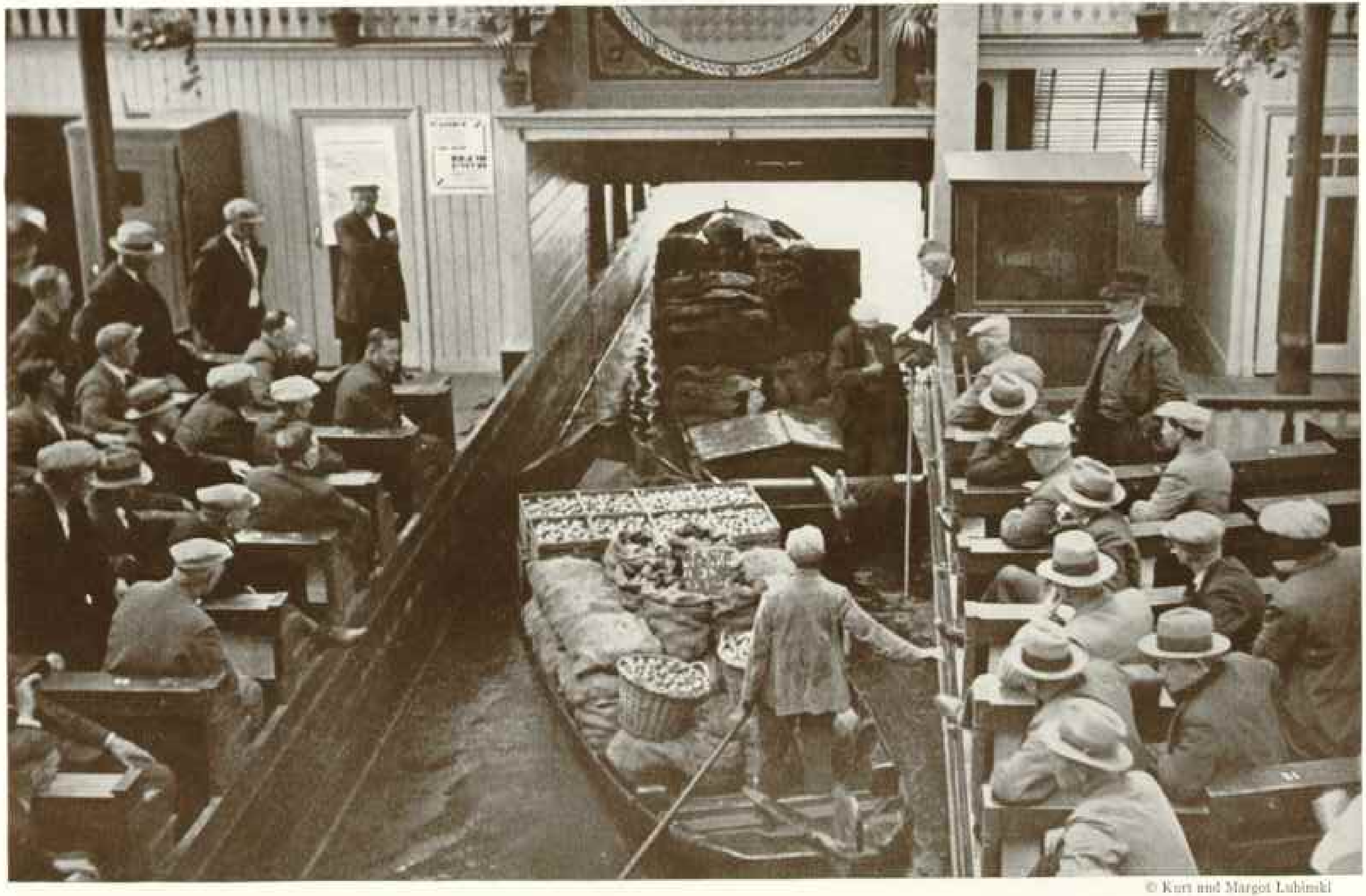
1 BID 5 GUILDERS.—NOT ENOUGH.—SIX?—ACCEPTED!

The Meppel buyer emphasizes his bid by briskly slapping the seller's hand. A single return clap refuses the offer, but three strokes mean a sale.

© K. L. M. Royal Dutch Airlines

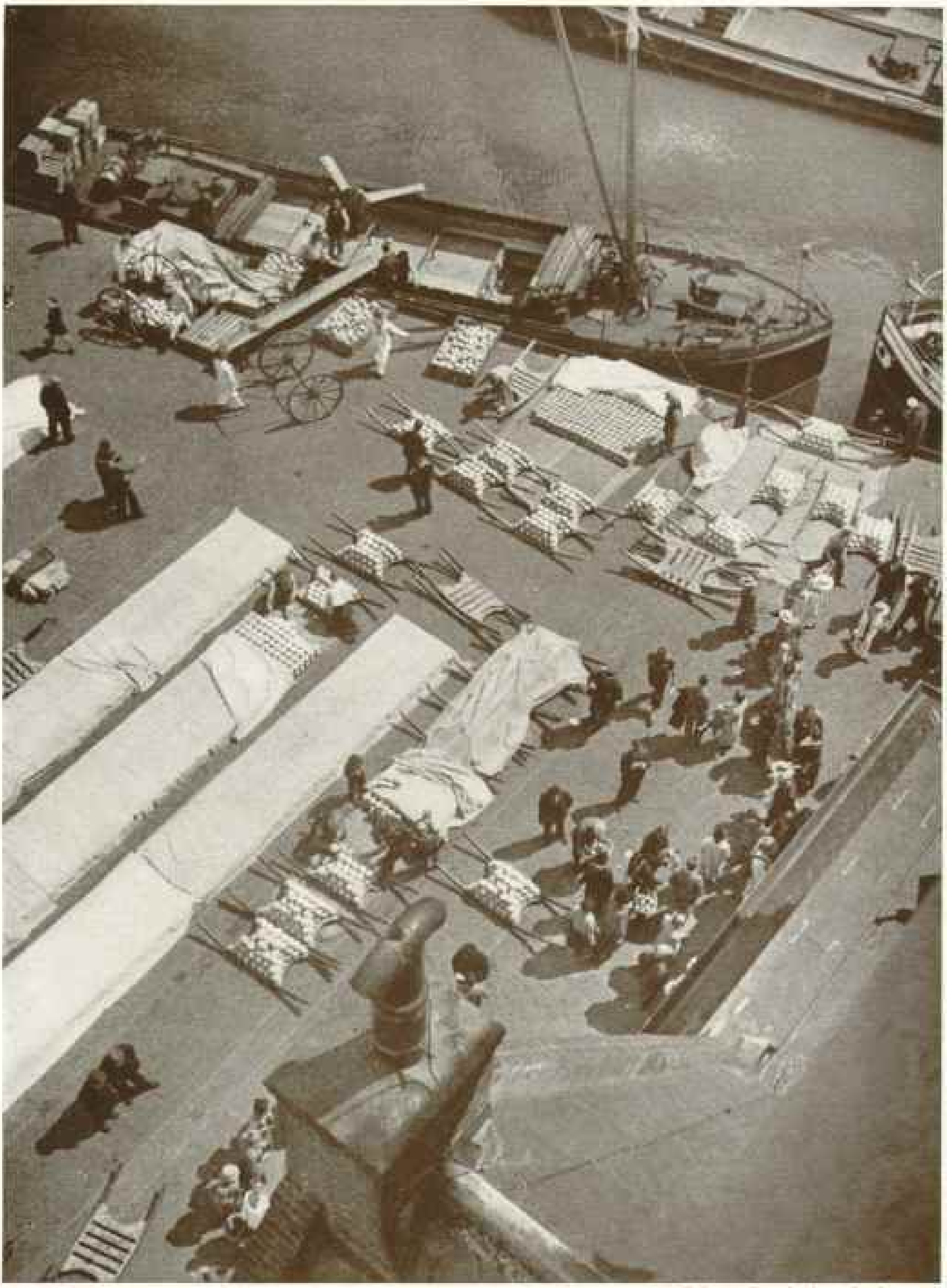
THROUGH ROTTERDAM'S LIQUID HIGHWAYS FLOWS WATER FROM THE RHINE, WHICH FRAYS OUT LIKE A ROPE END AFTER IT LEAVES GERMANY

Across this railway bridge, spanning the New Maas, roar the expresses which connect western Netherlands with Brussels and Paris. Noordereiland, an artificial island lying between the waterways, was made of mud dredged from the channels. A part of Rotterdam, the country's second largest city, about the size of Washington, D. C., lies in the background; and Feijenoord, a suburb, in the foreground.



IN THIS STREAMLINED POTATO AUCTION MARKET NEAR ENKHUIZEN, NORTH HOLLAND, THE CLOCK REGISTERS SALES

Along a canal dividing the bidders, boatloads pass quickly; tubers are disposed of at the rate of 200,000 pounds a day. This electric system of auctioning was invented in the Netherlands. Bidders press buttons on the desks to record the prices they are willing to pay. Part of the clock face appears above.



© Screen Traveler from Gendreau

EDAM CHEESES ARE PILED LIKE CANNON BALLS IN ALKMAAR'S MARKET SQUARE

These Edams are light yellow, their natural color. Only the American and a few other foreign markets want red cheeses, so some spheres are carefully tinted to meet this demand. On the oddly shaped "rockers," or hand barrows, the cheeses are carried by two men to be weighed in the public Weigh House, from the tower of which this picture was made. A barge is being loaded by rolling the balls down a trough (upper left).

VOLENDAM HARBOR BECOMES A SKATING RINK

Only during exceptional winters does the IJssel Lake freeze over. The girls wear everyday costumes, marked by black peaked caps.

Photographs by de Haas from Three Lions

MENDING "RUNS" IN FISH NETS IS WOMEN'S WORK AT SCHEVENINGEN

This fishing village lies side by side with a crowded resort of the same name, on the seashore near The Hague.

© A. B. C. Press from Black Star

SPRAY "GOES OVER THE TOP" WHERE TRENCHES GUARD AGAINST LANDING PARTIES FROM THE SEA

In much of the Netherlands, such military trenches cannot be used because of the low, moist ground. Only in the coastal sand dunes and in relatively high ground in the east and south are they feasible.

Photograph by de Haas from Three Lions

PEACE-LOVING NETHERLANDS PREPARES TO DEFEND ITSELF

Here, amid sandbags, Amsterdam residents read their country's call to a protective mobilization.

solid butter. Besides coffee and tea, there is chocolate, always a safe choice in this country with tropical colonies both in the East and in the West.

BREAD A "FOUNDATION FOOD"

At light luncheons, we soon learned, the first order of business is to butter generously a complete slice of bread and to place it butter-side up on your plate. On this foundation go almost any other foods that come along: salted raw herrings, for example, considered a great delicacy.

On a second slice of bread you may place pieces of cheese, or perhaps meat. Eventually you progress to a sort of pre-dessert of buttered bread plus jam. All these combinations are eaten with knife and fork.

In wandering about in Amsterdam and in other cities of the Netherlands, we were amazed at the part that the bicycle—*rijwiel*, "riding wheel," to the Netherlander—plays in the daily lives of the people.

The Netherlands is virtually a nation on wheels. Queen Wilhelmina and other members of the royal family frequently ride bicycles on the streets of The Hague. We saw high military officers and enlisted men, priests, women in the habits of religious orders, policemen, tradesmen, mechanics with their tools, painters carrying open buckets of paint, laborers, ladies on shopping expeditions, clerks, students—all classes and ages, pedaling along singly and in droves (page 262).

At luncheon time and in the late afternoon in Amsterdam, bicyclists almost clog some of the streets. All riders are required to take out licenses and all scrupulously observe traffic regulations on an equal footing with drivers of automobiles. The 8,640,000 Netherlanders own more than 3,000,000 bicycles.

A high percentage of Netherland bicycles has baskets for packages in front of the handle bars; and many are equipped with a small chairlike extension behind the operator's seat. On these, young children, some of them mere toddlers, sit, their legs dangling, their hands clutching the skirts of their pedaling mothers. We always eyed these youngsters nervously, expecting to see them tumble to the pavement.

In Amsterdam and other large cities are numerous rijwiel "garages" where thousands of bicycles are stored, lubricated, and kept in condition. Shops provide racks of various sorts in which customers can "file" their cycles while shopping (page 266). We saw, too, shops selling only bicycle parts, where mechanically minded folk can spend a few guilders and "build their own."

There was a flood of summer blossoms in Amsterdam which we decided to track to its source, so we went early one morning to the wholesale flower auction at Aalsmeer, ten miles southwest of the city.

A NOISELESS AUCTION

With growing interest, and then with positive fascination, we watched the simplest, the most efficient, the most rapid—and the least nerve-jangling—auction system we had ever seen. Once again our hats were off to Dutch ingenuity, for this noiseless, electric "clock" method of auctioning goods, which we first encountered at Aalsmeer, was invented by a Netherlander and is used all over the country to sell a variety of products.

On one wall of the small, high-ceilinged auction room was a gigantic clock disk with a single hand. Facing it across an open space was a steeply sloping bank of 200 seats, all occupied, an arrangement that reminded me of a surgeons' amphitheater in a hospital (page 280).

The clock face was marked off progressively with figures to indicate prices. From a glass-enclosed booth the operator would ring a warning bell, whereupon the pointer would begin moving swiftly around the clock. By pressing a button any seat holder could stop the hand at a price he was willing to pay. The same pressure of the button flashed an identifying number on an indicator above the clock, showing to whom the sale had been made.

An important feature of the system is that the clock hand moves backward, passing to lower and lower figures. When the indicator comes down to a price that well-informed buyers think is justified, a score of fingers may jab at the buttons almost in unison. The man who can act a tenth or a twentieth of a second quicker than his fellows or who is willing to pay a shade more than they, gets the goods.

There was no talk. As soon as a wheeled table of flowers came to a stop in front of the bidders, a card was held up identifying the lot and indicating the unit of sale. Then the hand was started. By the time the buyer's number flashed on the wall a few seconds later, the sold flowers were being pushed out of the room and a new

Photograph by Hilmar Pabst from Three Lions

AALSMEER'S NOISELESS FLOWER AUCTION IN FULL SWING

Facing these buyers beyond the truckloads of blossoms is the auction clock (pages 275 and 279). Its moving hand can be stopped electrically at a bid price. The buyer's number is flashed on the wall at the same time, and the sale is completed. Flowers from the market are sent all over Europe, large quantities moving by airplane.

tableful was in place for the next sale. It was a pace, we agreed, which even the clipped jargon of an American tobacco auctioneer could not maintain.

GOODS TELL STORY OF COLONIES

I had the good fortune to make a tour of Amsterdam's big, well-equipped harbor with one of the harbor officials. We taxied about in a launch, passing beside liners whose open decks, awnings, and barefooted, turbaned deck stewards proclaimed them to be from "somewhere east of Suez." We skirted timber boats from the Scandinavian countries, a Greek freighter unloading tobacco and tanning materials, oil tankers flying Netherland flags, and tramp steamers under British colors. We saw no ships under the Stars and Stripes, and my host told me that relatively few American vessels were visiting the harbor at that time.

Although its transit trade is considerable, Amsterdam's harbor is particularly important as a place of storage for goods, especially those from the colonies.

We visited several of the great warehouses that rise all along the harbor's rim. One was devoted exclusively to tea—90,000 chests of it. Experts were examining and grading samples of the leaves arranged on trays in neat, dark little piles. In quarters close by, a group of men with an unusual profession and highly trained taste buds —tea tasters—were putting the samples through the final test that is the proof of beverages no less than puddings.

At a covered wharf in another part of the harbor, we left our launch and wandered

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NETHERLANDS CREATES THE NEW IN ARCHITECTURE, PRESERVES THE OLD

A costume parade winds around the modern Town Hall at Hilversum, a summer resort near Amsterdam. The town has grown up on an island of hills above sea level. Millions of radio listeners throughout the world tune in on "Hilversum," chief broadcasting station of the Netherlands.

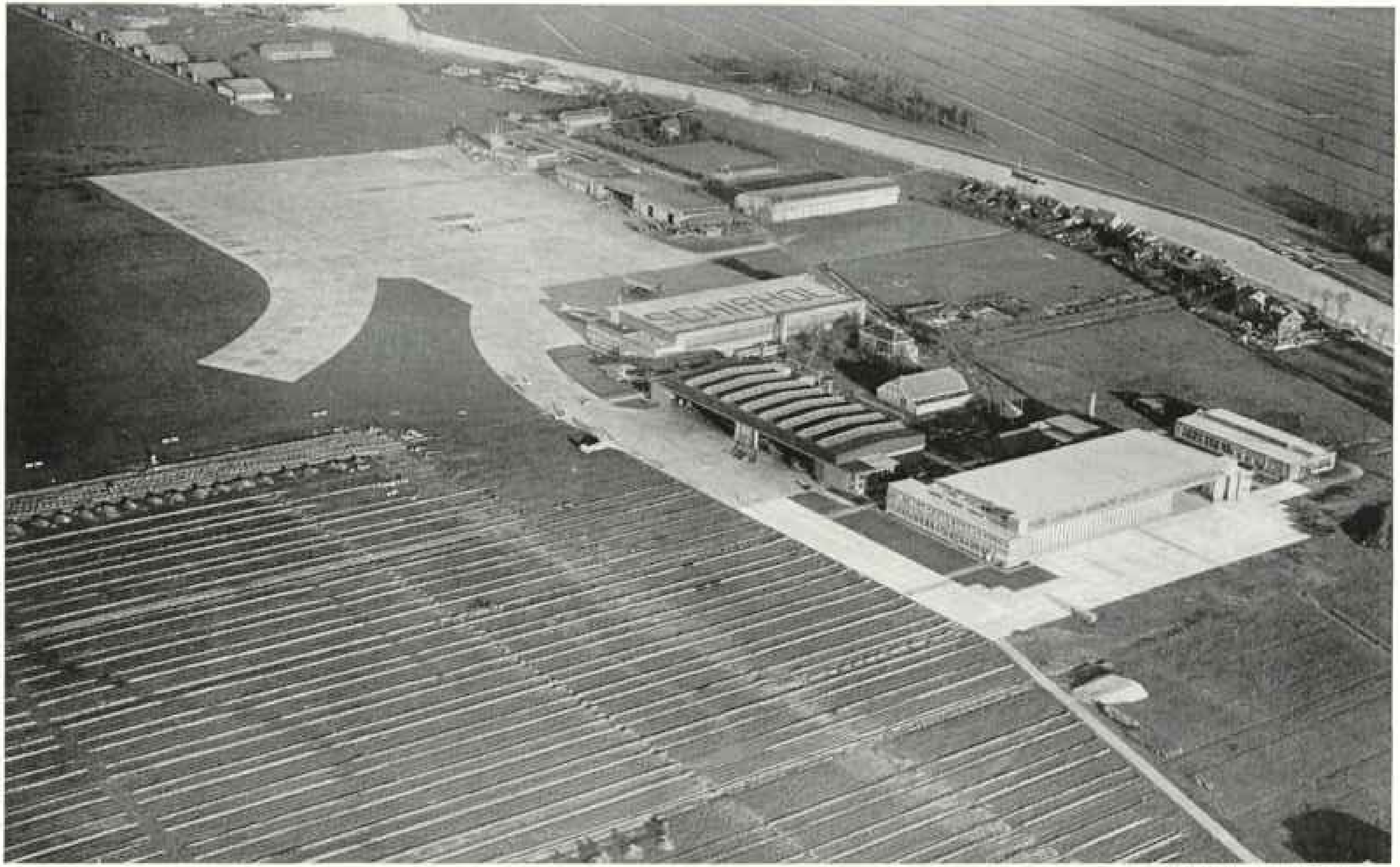
for nearly a quarter of a mile from room to room among a variety of packages whose contents gave only a poor sample, my guide told me, of the stream of commodities that pours into and through Amsterdam's harbor. There were piles and rough bundles of raw hides (smelling none too good), mostly from Sumatran water buffalo. At a little distance bales of sisal fiber were piled, and near by bolts of cotton cloth.

PEPPER SACKED LIKE WHEAT

A queer half-sweetish, half-rancid odor in the next room came from bins of copra and copra pulp, the forms in which most coconut meat finds its way to the Western World. These materials were destined to be made into oils and ointments and cooking fats, with the residue going into cattle feeds.

Rattan was the next import we came upon, long bundles of flattish strips bound for the furniture trade. Then big, bulging jute bags that I thought were filled with wheat. But my companion forced a thumb and finger into a slightly ripped seam and brought out black pepper—unground, of course. Sacks made of coarse jute did not seem appropriate containers for the fabulous spices of the Indies; but apparently shippers have found them adequate, for soon we found similar bags filled with cloves. Cinnamon was packed in roughly cylindrical bundles, like short logs of wood sewed up in individual burlap coverings.

We came upon a shipment of licorice from Italy. The next room was piled ceiling-high with cases of canned fish from Japan. Java coffee, New Guinea mace, Borneo rubber, and tea from Ceylon, China,



© K.L.M. Royal Dutch Airlines

TO THIS PATCH OF CONCRETE, BELOW SEA LEVEL, COME SHIPS OF THE AIR FROM EVERY QUARTER OF THE COMPASS

Schiphol, Amsterdam's newest airport, has become important for passengers, mail, and express by air. In normal times several hundred airplanes a day land here from European capitals, and from Africa, Asia, and Australia (page 290). The field is 13 feet below the sea and, like most land in western Netherlands, is perfectly level. In the foreground, trenches for new drainage pipes have been dug where the field will be extended.

LITTLE TUGS AND GREAT BARGES WEAVE A PATTERN OF TRAFFIC THROUGH NETHERLAND WATERWAYS

Grain and tropical products from overseas bound for Germany and Switzerland, coal and ore for the Ruhr, and numerous other imported goods are towed along canals and up the Rhine in peacetime. Downstream come fertilizers, steel, and manufactured goods. In carrying this international traffic, the Waal is the most important of the streams into which the Rhine splits up after reaching the Netherlands. On the stern of each barge is a tidy home for the barge keeper's family.

Photograph by McFall Kerbey

FISHING MOTORCARS FROM CANALS IS A FIREMAN'S DUTY IN CENTRAL AMSTERDAM

Automobiles occasionally roll off the streets into eight feet of water. Then a truck of the Fire Department, fitted with a power crane, rushes to the rescue. A diver with light diving helmet drags out trapped motorists.

Photograph by de Haas from Three Lions

GOLDEN "HORNS" AND PLEATED BONNET MARK HER A FISHERWOMAN FROM SCHEVENINGEN

The earrings, too, are characteristic of the village costume. She is the daughter and wife of fishermen and has six brothers with the herring fleet. The "streamlined" bonnet is practical in the windy sand dune region where she lives.

Photograph by Royal Dutch Air Service

NATURE CAUSED THIS FLOOD: NETHERLAND SOLDIERS COULD DUPLICATE IT BY BREAKING DIKES IF AN ENEMY THREATENED INVASION

The flooding IJssel River, an arm of the Rhine, has broken through the main dikes (beyond the motor barge), but is held back from the fields (background) by secondary embankments. Planned floodings for military protection would use river water instead of sea water so that the soil would not be ruined. As the enemy advances, 6- or 7-mile-wide strips between protecting dikes would be flooded, rather than vast areas (page 257).

and the Netherlands Indies added to the unbelievable hodgepodge of stuffs and countries of origin.

An old acquaintance was kapok, featherlight vegetable fiber used to stuff cushions, life preservers, etc.; for the moment it was stuffing scores of large brown bags.

MOSQUITO LOTION BY THE BARREL

In the last room we inspected before again boarding our launch was a score or more of metal drums about the size of barrels, which, I learned to my surprise, were filled with oil of citronella. Although it is used in scenting soaps, to most persons citronella is merely a smelly liquid to smear on wrists or ankles to drive mosquitoes away. Seldom does one see more than an ounce or two of the oil at a time; yet here, in a single consignment, a casual part of Amsterdam's stream of imports, was enough to supply most of the apothecary shops of Europe.

"Now that you have been over our harbor," said my host as we cruised toward our starting point, "you will understand why we place so much value on a stable water level. In contrast to open ports, there is no rise and fall here with the tides, because the influence of the sea is locked off at both ends. The harbor is practically a single huge, placid wet dock. That, as you have seen, is a great advantage to both ships and barges. They can load and unload without altering the positions of gangplanks and goods-handling machinery."

To learn something of conditions when the harbor was in effect a part of the Zuider Zee, I spent most of a day at the fascinating Scheepvaart Museum, which consists of exhibits devoted entirely to shipping. With paintings, photographs, maps, books, relics, and cleverly constructed ship models, the museum tells the story of Dutch efficiency and might on the seas. In particular, you are reminded of Admiral de Ruyter, who was repeatedly victorious over the British and in 1667 took his fleet up the Thames, forced an entrance into the Medway, and threw London into a panic.

"CAMELS" CARRIED SHIPS OVER SAND

Many exhibits show Amsterdam's long, stubborn, successful fight to remain a daughter of the sea. During the first few centuries after the establishment of the town, ships were small and sailed easily through the relatively shallow Zuider Zee and into the Y. Thus the rich trade of Amsterdam's Golden Age was developed in the late 16th and in the 17th centuries. You see models of the little ships that brought the city its prosperity, pictures of the harbor with its forest of masts.

But bigger ships were coming into use; and at the same time a sand bar was growing in the Zuider Zee just outside the mouth of the Y. In a first effort to solve the problem, wheeled cradles were placed under the larger ships and they were dragged through the shallows by main force.

But this procedure proving unsatisfactory, Dutch ingenuity got to work in earnest; and you see the result in models of the next device, the Scheepskameel—"ships' camel"—so dubbed because it carried ships "over the sand."

The "camels" were little more than a pair of bargelike pontoons connected side by side. After the two halves were maneuvered into position against opposite sides of a ship's hull, water would be let in until their decks were awash, and they would be connected by a cradle of chains and hawsers under the ship's bottom.

Laborers would man the pumps (as many as 20 on each half camel) and as the barges were emptied of water, they would rise, lifting the ship with them. Then the whole awkward-looking combination would be towed over the bar. For decades Amsterdam had to carry on its valuable world commerce in this makeshift fashion.

Ships became still bigger and things looked black for Amsterdam. But the museum's exhibits and records carry the story on to today's happy ending when gigantic ships, which even the deepest parts of the Zuider Zee never could have floated, are brought in through the North Sea Canal to a deep, modern harbor.

MODEL OF THE "HALF MOON"

In the Scheepvaart Museum are many reminders of the ties that bind the Netherlands and the United States: a model of Henry Hudson's *Half Moon*,* pictures and maps of New Amsterdam, yellowed reports and letters from its officials to the home government.

One map title told so much history in three lines—yet with the last chapter pathetically missing—that I copied it: "Nieuw Amsterdam onlangs Nieuw Jorck genaemt

* See "Henry Hudson, Magnificent Failure," by Frederick G. Vosburgh, NATIONAL GEOGRAPHIC MAGAZINE, April, 1939.

Photograph from Wide World

AMSTERDAM BIDDERS SCRAMBLE TO BUY CHOICE "MAKINGS" FOR SMOKES

Fine tobacco comes to the Netherlands from its own colonies and from Turkey, Egypt, Greece, and the United States. Amsterdam is the largest tobacco market in the world. This photograph won first prize in a recent international exhibition in Amsterdam.

en nu hernomen bij de Nederlanders op den 24 Aug. 1673"—"New Amsterdam lately named New York and now retaken by the Netherlanders on August 24, 1673."

One is prepared to expect technical training in the engineering field in the Netherlands: it might almost be said that the Dutch had to become good engineers, or drown. But it is equally marked in other fields, scientific research, for example, where Netherlanders have earned far more than their country's statistical share of the Nobel prizes for scientific accomplishment.

HANDMADE NETHERLANDS IS MACHINE-MAINTAINED

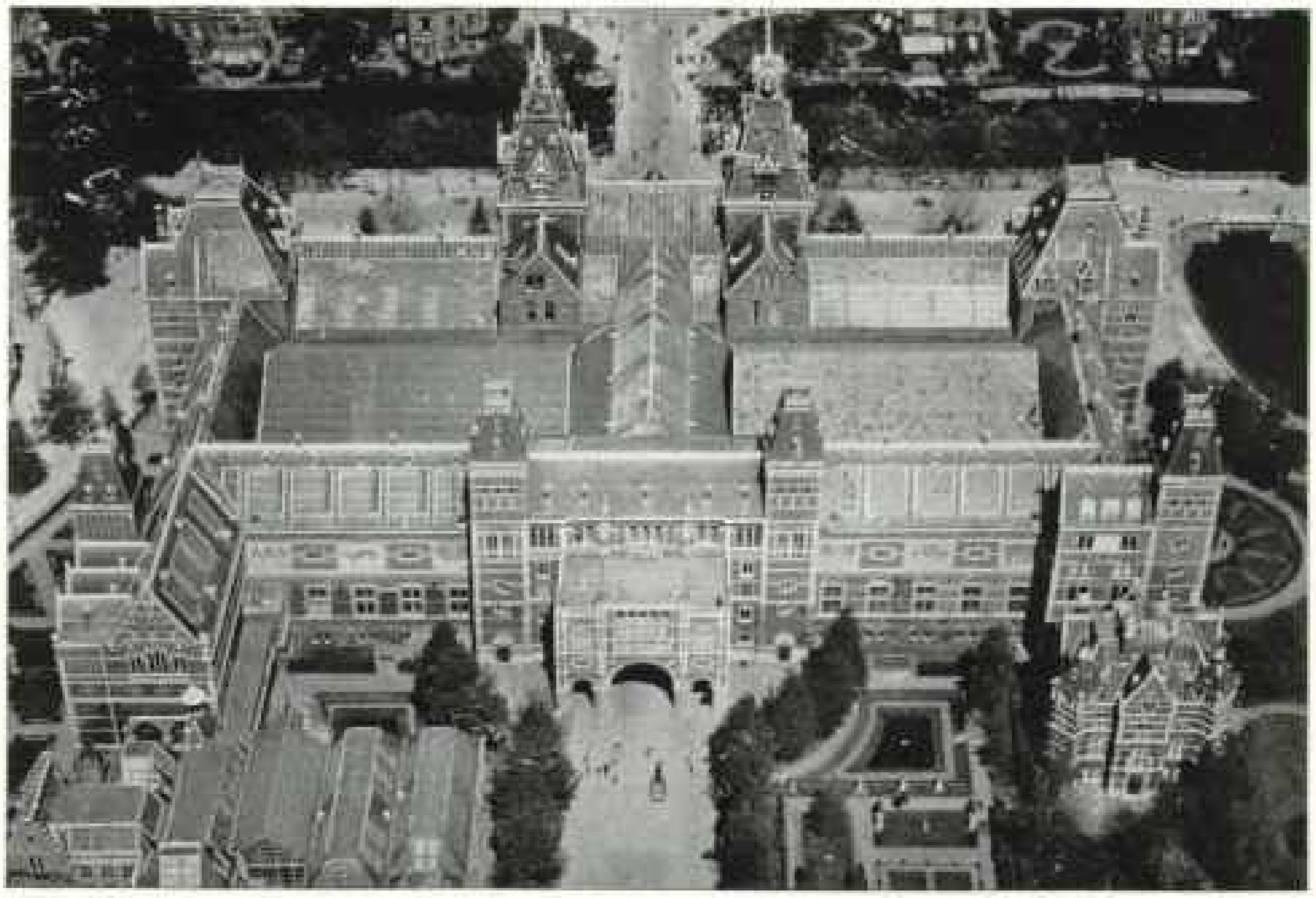
In medicine and sanitation, too, the Netherlands has ranked high ever since the School of Medicine at the University of Leiden rose to international fame early in the 18th century. One fruit of this interest in medicine you see today in the spotless, well-equipped, and efficient hospitals of Amsterdam and of other large cities of the Netherlands.

Truly, much of the Netherlands is handmade: protective dikes thrown up, drainage ditches dug, soil of sizable fields put together as handily almost as small batches are compounded for greenhouse pots and trays. But even more truly this handmade land is machine-maintained. Stop the pumps for a few days, and seepage and rainfall would make unproductive bogs of regions worth hundreds of millions of dollars (pages 265 and 267).

The limits of reclamation by hand—by dike building and gravity drainage—were reached probably 600 years ago. Then the windmill was introduced for pumping sometime in the 14th century; water could at last flow uphill, and the power of the Netherlanders to "make" land was tremendously increased.

For centuries the windmill slowly conquered countless ponds and small lakes and marshes, each made into a polder by an enclosing dike.

But the more ambitious jobs that have presented themselves in recent times were



Photograph by Royal Dutch Air Service

A GLASS ROOF COVERS THE MASTERPIECES IN THE RIJKS MUSEUM AT AMSTERDAM

In its exhibit halls, lighted by thousands of square feet of skylights, are paintings by Rembrandt (page 263), Rubens, Van Dyck, Van Gogh, Hals, Jan Steen, Vermeer, and other famous Dutch and Flemish artists. In addition, there are fine collections of miniatures, tapestries, sculpture, costumes and laces, furniture—even coaches and sledges.

Photograph by Marvin Breckinridge

THE WOODEN-SHOE SALESMAN MUST NOW GO TO HIS CUSTOMERS

Though not generally worn in the Netherlands today, wooden shoes are still useful to garage mechanics who work on oily floors, to fishermen on wet decks, and to farmers on moist soil.

Photograph from Fix

STALKS OF STEEL "ASPARAGUS" SPROUT FROM FRONTIER HIGHWAYS TO REPEL TANKS

To erect the barrier, soldiers uncover sockets in the road surface and insert the blunt ends of inclined posts. Highways and bridges in border districts in eastern Netherlands are being equipped with the devices.

too much for the wind engines. Steam pumps were first used on a big project about 90 years ago to empty Haarlem Lake; and of course only power-driven pumps of tremendous capacity could today empty portions of the Zuider Zee.

Even in the day-by-day pumping jobs in relatively small polders, steam and electric and Diesel power have proved to be more efficient than that furnished by many ordinary windmills. As a result, windmills have been rapidly replaced during recent decades by characterless little pump houses.

A SOCIETY TO "SAVE THE WINDMILL"

We were struck by the long distances that one may travel now without seeing a single mill, and we began to understand the fear that the Netherlands will lose all of the stately and graceful structures that have lent beauty to its landscape for more than half a millennium.

Later we learned to our joy that something is being done about it, and in a characteristic, thoroughgoing Dutch way. A society exists—"De Hollandsche Molen"—for the sole purpose of "preserving the mills of the Netherlands." Polder authorities who are tempted to do away with their mills in the search for efficiency are shown by the association's experts how to alter the wing design of the mills so as to get added power under varying wind conditions. Perhaps there is a recommendation for an auxiliary motor that can be tucked away out of sight in the millhouse; and, when necessary, the society will help arrange the financing of the changes that save the mill.

Groups of windmills are not so easy to

reach now, but we saw half a dozen fine ones together, all with their arms busily threshing the sky, just outside Alkmaar, on the road to the great sea dike near Petten. One problem which I tried without success to solve in the Netherlands and which came into mind whenever I saw a mill in motion, is why windmills turn to the left, or counterclockwise; most other things that rotate in our civilization turn to the right. Apparently the answer lies buried in the past; left-handed the mills came to the Netherlands, and left-handed they have remained.

NORTH SEA HELD AT BAY

We counted the trip to the Petten sea dike one of our most interesting excursions because it made so real the country's fight against the great sea. Moving about in the well-scrubbed villages and the well-groomed countryside, you come to believe that the battle against the sea is a thing of the past; and, as a matter of fact, most of the reclamation work of recent decades has been against the inland sea (the Zuider Zee) and inland lakes.

At the Petten dike you come face to face with the real water enemy that had to be overcome before the smaller-scale "mopping up" operations could be carried out. Here is a break in the sand hills that fortunately rim most of the west coast of the Netherlands.

For more than three miles the natural bulwarks are missing and man has tossed into the breach a hill of his own fashioning. You climb a steep earthen slope and look down to where the North Sea surf is hammering against the dike's outer face. The broad surface, which slopes gently into the sea, is paved with heavy stone blocks. Out of the surface near the water line protrudes a forest of wooden posts to break up the massed attack of the waves.

As insurance against all this surging power, Dutch engineers built not one but three dikes. The straight one on the battle line, constantly turning back the sea, is popularly called the "Watcher." The second, a heavy earthen rampart curving inland in a shallow crescent, is the "Sleeper," resting but ready. The third, also of earth, curving more deeply, is the "Dreamer," to be roused only in case of dire necessity.

"Don't fail to visit Schiphol," a friend in Amsterdam had warned when he learned of the errand that brought me to the Netherlands. "You'll find more geographic thrills at Schiphol than anywhere else in the Kingdom" (page 282).

Schiphol, just outside the city, is the municipal airport of Amsterdam and one of the most important flying fields in Europe.* It is on the floor of old Haarlem Lake, drained some 90 years ago, and is 13 feet under N. A. P. (page 255). Every plane, therefore, flies below sea level.

We sat in a comfortable lounge in the air-terminal building beside large windows overlooking the airfield. Planes swooped in from Berlin and took off for Paris; from Stockholm and Copenhagen bound for the British Isles; from Paris, Brussels, Vienna, London, Rome. The high point of the afternoon for us was the arrival of the big K. L. M. ship from the Netherlands Indies.

The passengers came down the steps as casually as if they had flown in from Rotterdam; but two carried pineapples and a third, a brightly colored tropical bird in a reed cage. Their plane had left Java only five days before and, in one of the longest flying services yet established, had flown 8,700 miles over Sumatra, the Malay Peninsula, Siam (Thailand), Burma, India, the countries of the Near East, the Balkan Peninsula, Hungary, and Germany.† Our friend was right; Schiphol assuredly brings you face to face with world geography.

It all seems very logical to watch "ships in the Indies trade" "docking" at Schiphol. It comes down to this: man has discovered a new sea and invented new ships; and, quite naturally, Netherlanders have gone up into that sea in ships and are giving a good account of themselves. Ships are in the blood of this people; whether they sail seas of water or seas of air matters little.

The trim young officer who walks off his silver bird at Schiphol is a blood brother to a long line of Netherland navigators who have gone before: ship captains who rounded and named Cape Horn, whose ships' wakes crisscrossed the Atlantic and the Pacific, who pushed into the ice of the Arctic, and who spent weary months sailing around Africa to those same Indies that lie now only five days over the sky lanes from Amsterdam's newest harbor.

* See "Looking Down on Europe Again," by J. Parker Van Zandt, NATIONAL GEOGRAPHIC MAGAZINE, June, 1939.

† The present service halts at Naples, Italy.

NATIONAL GEOGRAPHIC SOCIETY

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ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded fifty-two 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, 1933, 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 $35,000, 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.

"CAN YOU HOLD THE 'CENTURY' 5 MINUTES?

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I only wish my birthday had come about thirty days sooner.

• • •

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LUETTA. 17 jewels. 14K natural gold. 18K applied gold numerals. Gold-filled fittings. $55

CELIA. 17 jewels. 10K white or natural gold-filled. Raised numerals. With bracelet, $42.50

WILSHIRE. 17 jewels. 14K natural gold-filled. 2-toned dial, markers and Roman numerals. $50

BOWMAN. 17 jewels. 14K natural gold-filled. With 10K applied gold numeral dial. $32.50

DUNKIRK. 19 jewels. 14K natural gold. 18K applied gold numerals. Choice of dials. $125

Do You Want to Keep Your Daughter?

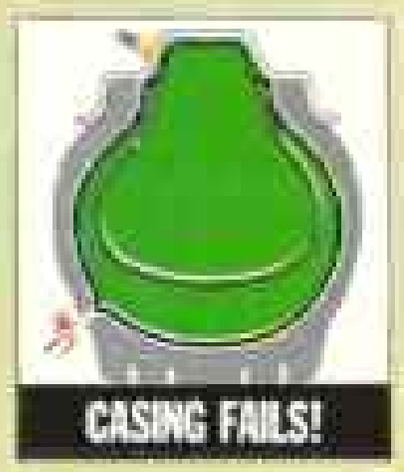
ACCIDENTS are no respecters of persons. Your daughter ... your wife ... yourself ... all are in equal danger of serious accident if a tire should suddenly collapse ... unless your car has protection against blowout accidents such as Goodyear LifeGuards provide!

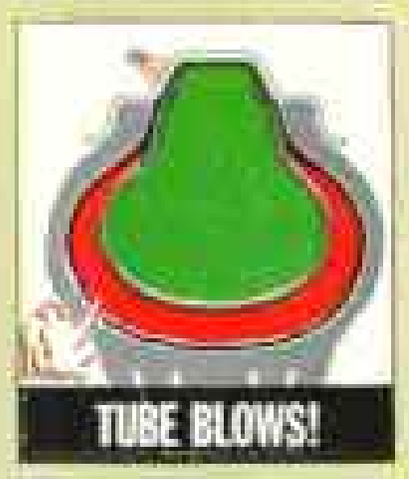
No pneumatic tire is blowout-proof. Even a new tire may be cut or bruised so as to cause a dangerous blowout ... if not immediately then weeks or months later when you least expect it.

But you needn't gamble with safety any longer. Add to your peace of mind when motoring by joining the hundreds of thousands of safe LifeGuard families who find them the best kind of insurance ... *because they prevent accidents!*

See your Goodyear dealer and learn how, in sizes available, LifeGuards can be used in tires now in service as well as in new tires ... how you can pay as you drive. Or if you are buying a new car, have your car dealer add them.

You can't stop all motoring accidents ... *but you can help to stop the toll of life and limb due to blowout accidents* ... by giving yourself, your family, your car this LifeGuard protection.





LifeGuard is a 2-ply safety tire built inside an extra-sturdy tube. Replaces conventional tube. Should outer tire and tube collapse, LifeGuard remains inflated, enabling you to brake and steer safely.

For Complete Safety ... 4-Wheel Brakes ... All-Steel Body ... Safety Glass ... and

GOODYEAR LIFEGUARDS

LIFEGUARD is a trade-mark of The Goodyear Tire & Rubber Company.

"I WAS TRAPPED IN A BLAZING INFERNO!"

A true experience of MRS. LILLIAN POKEDOFF, *Brooklyn, N. Y.*

"AN OMINOUS, CRACKLING NOISE awoke me the first night I was visiting in a strange farmhouse," writes Mrs. Pokedoff."Choking and coughing from smoke, I groped for the bedroom door and staggered out into the hall.

"IN THE THICK, BILLOWING SMOKE I couldn't locate the stairway. Then I heard a muffled shout from below and a beam of light bored through the darkness, showing me the way to safety.

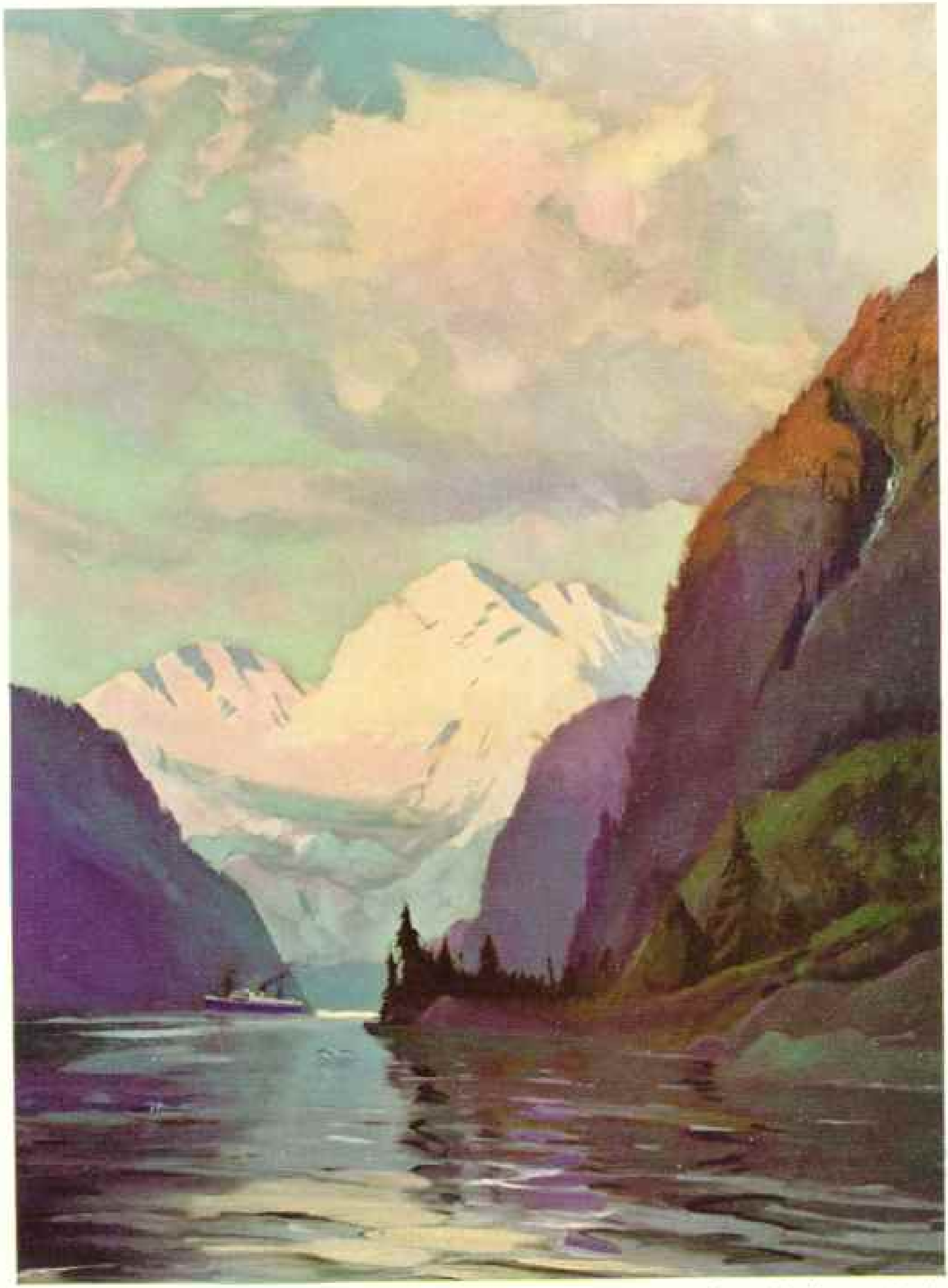
"I STUMBLED DOWN THE STEPS just in time—for a kerosene tank exploded and the house burned to the ground! I sincerely say that I owe my life to those powerful and dependable 'Eveready' *fresh* DATED batteries!

(Signed) (Mrs.) Lillian Pokedoff."

FRESH BATTERIES LAST LONGER... *Look for the* DATE-LINE

NATIONAL CARBON COMPANY, INC., 30 EAST 42nd STREET, NEW YORK, N. Y.

Unit of Union Carbide UCC *and Carbon Corporation*



From a Sydney Laurence original

COME—sail Alaska's mountain-sheltered seas! For fully descriptive, free Alaska Vacationland literature write to Alaska Steamship Company, Room 10, Pier Two, Seattle; and book early through one of the railroads listed here.

THE ALASKA RAILROAD — UNION PACIFIC
NORTHERN PACIFIC — SOUTHERN PACIFIC
NORTH WESTERN LINE — BURLINGTON ROUTE
THE MILWAUKEE ROAD — GREAT NORTHERN
ALASKA STEAMSHIP COMPANY

"Silk Stockings in the Morning? Imagine!"

SILK stockings a luxury? Not today, but they were 25 years ago. So was an automobile, and a telephone. An incandescent lamp—not half so good as the one you now get for 15 cents—then cost more than twice as much. And you couldn't buy a radio or an electric refrigerator for love or money.

These are only a few of the things we accept today as commonplace. We expect wide, smooth, well-lighted streets. We want automatic heat in our homes; we clean our rugs with vacuum cleaners. When we go to the dentist we expect him to use an electric drill; we accept without comment an X-ray examination as part of a medical check-up. Luxuries? Not at all; they're part of the American standard of living.

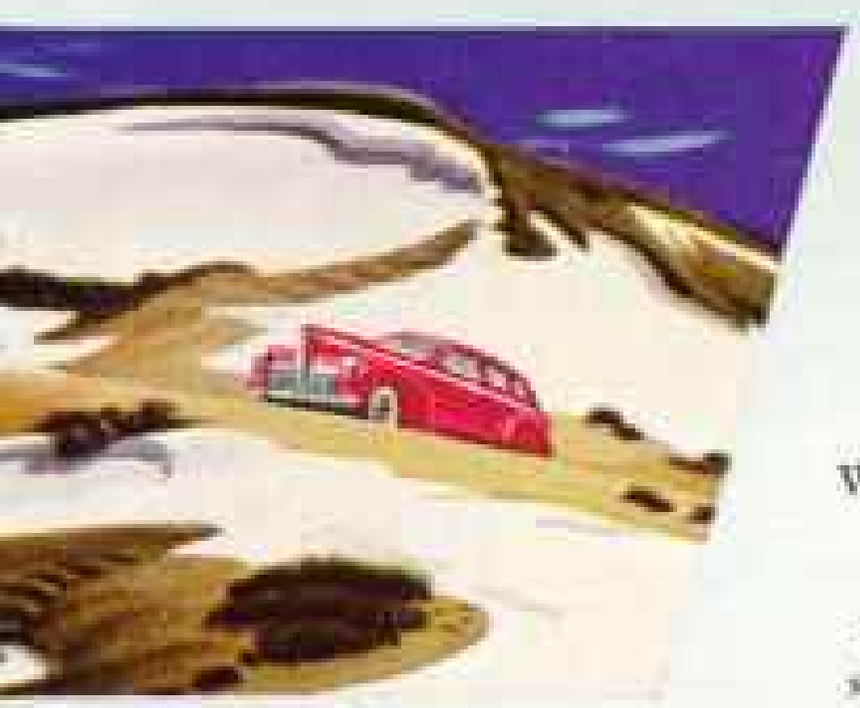
How did they become common in so short a time? Not by some sudden change in our wealth and habits. It was through years of steady work by American industry—scientists, engineers, and skilled workmen developing new products, improving them, learning to make them less expensive so that more millions of people could enjoy them. And so, imperceptibly, luxuries have changed to necessities.

More than any other one thing, the increasing use of electricity in industry has helped in this progress. For more than 60 years, General Electric men and women have pioneered in making electricity more useful to the American people—have led in creating More Goods for More People at Less Cost.

G-E research and engineering have saved the public from ten to one hundred dollars for every dollar they have earned for General Electric

GENERAL ELECTRIC

D WHERE THE FUN IS! In new conditioned air comrt . . . on a miraculous new Nash springing cumnation called "Arrow-Flight". At night, drive the glareless safety of new Sealed Beam lights.



HERE'S A NEW THRILL in the throttle. ick-up of 15 to 50 MPH in 15 seconds, gh gear . . . and a new Fourth Speed ward for gliding speed—with an nbeatable automatic Overtake.

Weather Eye *Magic*

A SHRIEKING GALE has smothered the sun and swept the lake bare of skaters.

You're standing there, chilled to the bone, dreading the journey home.

Suddenly—a flash of light, and laughing faces . . . a whisper of tires on the snow. Someone's brought a new Nash!

You slip into the broad, welcoming front seat—someone twirls a mysterious little dial, and instantly it's June!

With all the windows closed, there's a draftless flood of fresh, invigorating air—exactly heated as "tuned in". Out goes stuffy air, cigarette smoke, the moisture of your breath. The windshield stays clear.

The mercury tumbles . . . the wind howls louder—but stop or go, fast or slow—your comfort is automatically kept the same. That little thermostatic sentinel just inside the windshield never lets a chilly breath slip by. Yes—it's Weather Eye magic that even out-guesses "old man Winter"!

• • •

But that's no harder to believe than a new Fourth Speed Forward with an automatic Overtake that shoots you way ahead of those traffic stragglers.

Or Nash's silent Arrow-Flight ride that lets you relax in comfort over the worst Winter roads. Or that new feather-touch wheel that wields a magic influence over curves and rough spots.

Fact is, you'll have to revise all your ideas of what a car can be—and do. (And that's going to be the thrill of a motoring lifetime!)

It's priced so low, with resale value so high . . . that it will pay to trade away your troubles to your Nash dealer today—and start having year 'round fun!

COSTS YOU LESS to go places. Exclusive Nash engine is a Gilmore-Yosemite Economy winner, with 21.25 miles per gallon. Convertible bed saves lodging costs. Nash dealers everywhere (over 1800) are ready to serve you.

Again... IT'S THAT NEW NASH

HANOVIA ALPINE HOME SUN LAMP

can be yours this winter and all year 'round for many years. Periodic sun baths build resistance against common ailments; increase energy, aid health and give you that glow of well being everyone admires. Priced from $79.50 the Hanovia Alpine Sun Lamp, finest ultraviolet lamp in the world, is a definite help to more pep and smarter looks. *Monthly payments if desired.*

There is only one real sun lamp . . . **HANOVIA.** *So don't waste time and money on cheap imitations. See this lamp in Department Stores, Electric and Medical Supply Shops and at these Hanovia Show Rooms:*

NEW YORK
155 W. 57th STREET

PHILADELPHIA
1718 SANSOM STREET

BOSTON
543 BOYLSTON STREET

NEWARK, N. J.
233 N. J. R. R. AVENUE

DETROIT
5013 WOODWARD AVE.

SAN FRANCISCO
435 POWELL STREET

CHICAGO
77 EAST LAKE STREET

TORONTO, CANADA
86 BLOOR STREET WEST

Send for FREE Booklet, "Your Place In The Sun."

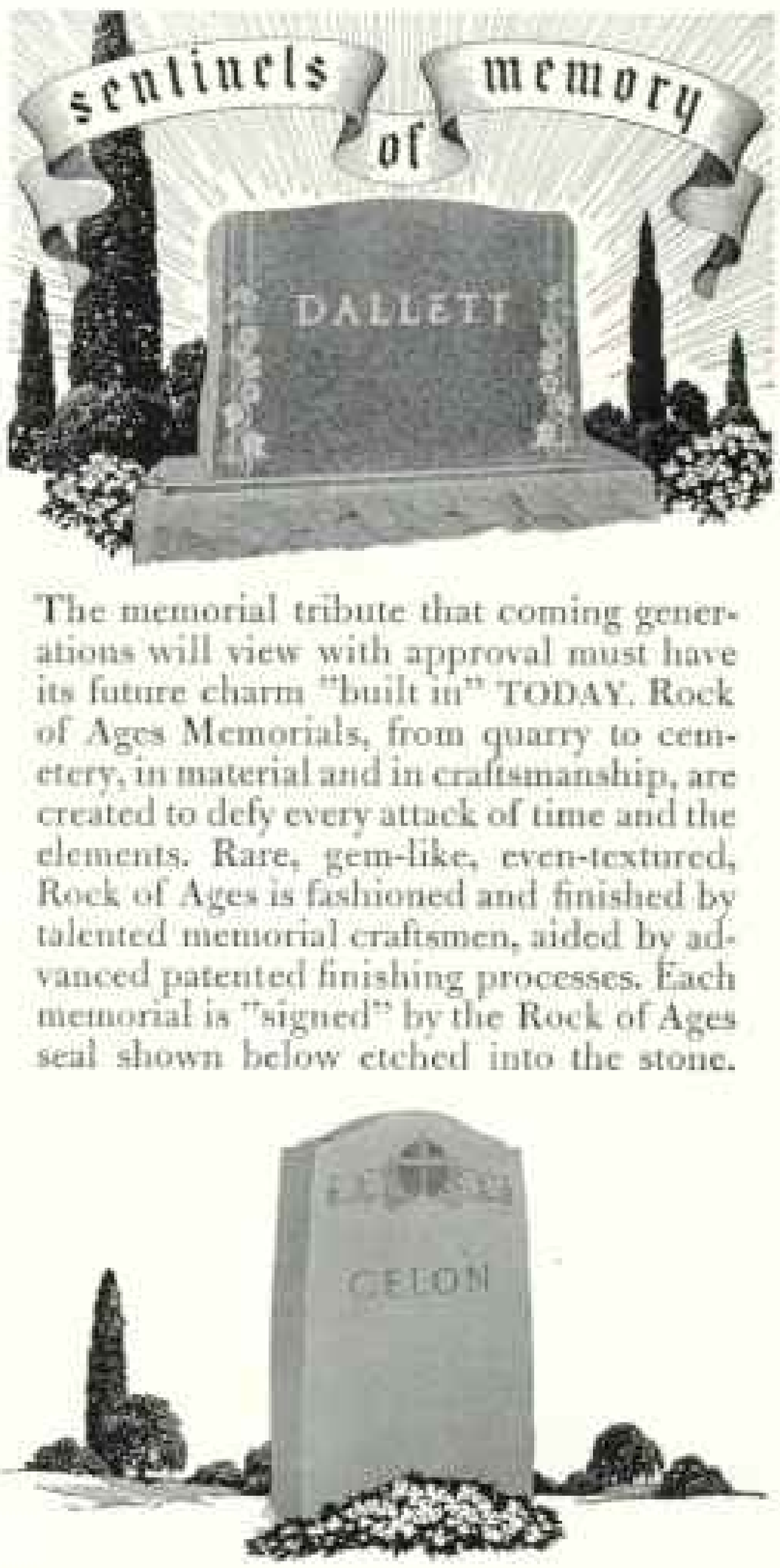
Hanovia Chem. & Mfg. Co., Newark, N. J., Dept. G1

Send booklet describing benefits of Ultraviolet Sun Baths to

NAME .....

ADDRESS .....

Please write clearly.



The memorial tribute that coming generations will view with approval must have its future charm "built in" TODAY. Rock of Ages Memorials, from quarry to cemetery, in material and in craftsmanship, are created to defy every attack of time and the elements. Rare, gem-like, even-textured, Rock of Ages is fashioned and finished by talented memorial craftsmen, aided by advanced patented finishing processes. Each memorial is "signed" by the Rock of Ages seal shown below etched into the stone.

With each memorial goes an Everlasting Guarantee, which is bonded by the National Surety Corporation, insuring permanent perfection. Your nearby Authorized Dealer will show you beautiful examples at prices ranging from a very modest figure for a small marker to family memorials from $150 to $200, $250 to $400 and $600, and up to $25,000 and more.

ROCK OF AGES

For your protection EVERY ROCK OF AGES MEMORIAL BEARS THIS SEAL *etched into the stone*

ROCK OF AGES MEMORIALS

Rock of Ages Advisory Service
Dept. D-2, Barre, Vermont

Without obligation, please send me your 1940 illustrated book, "How to Choose a Memorial," with design suggestions, epitaphs, symbolism, etc.

NAME_____

ADDRESS_____

His name grows with every passing year

"A MAN FOR THE AGES"—Lincoln so greatly exalted in his life all the simple virtues of humanity, that his name grows with every passing year.

Holding fast to Lincoln's principles, the Lincoln National Life Insurance Company has established a conspicuous record for helping thousands to secure vital protection . . . for comforting thousands of families . . . for assuring the many more thousands of present-day policy-holders whose insurance through the Lincoln National now exceeds a billion dollars.

You will find the Lincoln National representative in your community a trained life insurance man, on whom you may depend for unselfish counsel. Consult him on your life insurance needs!

THE LINCOLN NATIONAL LIFE INSURANCE COMPANY

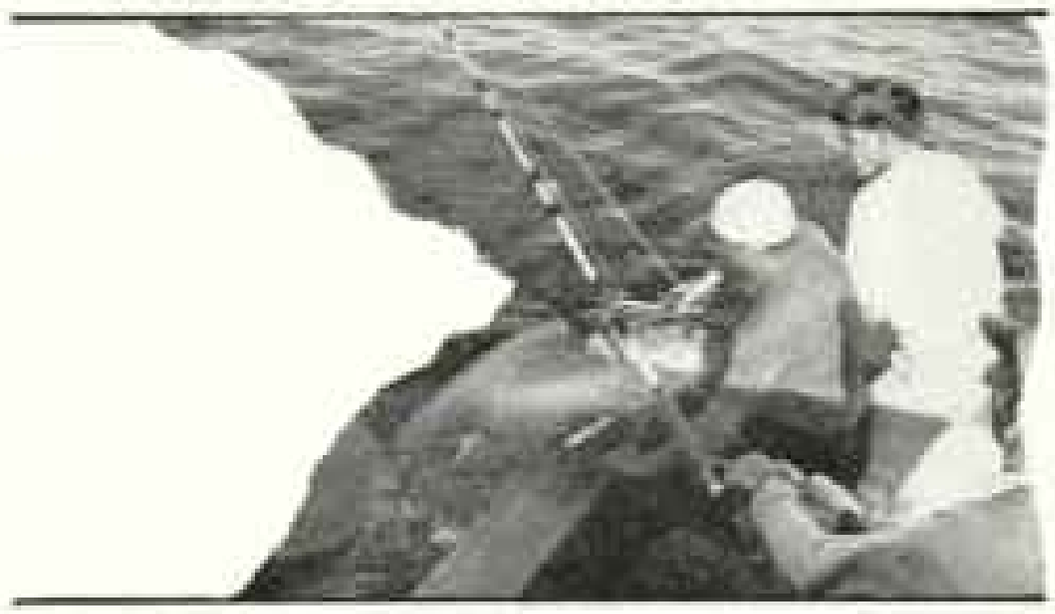
FORT WAYNE, IND.

ITS NAME INDICATES ITS CHARACTER

"Mention the Geographic—It identifies you."

MORE FUN IN '40

JERSEY VACATION DAYS



START EARLY—LAST LONGER

ADDED ATTRACTION!

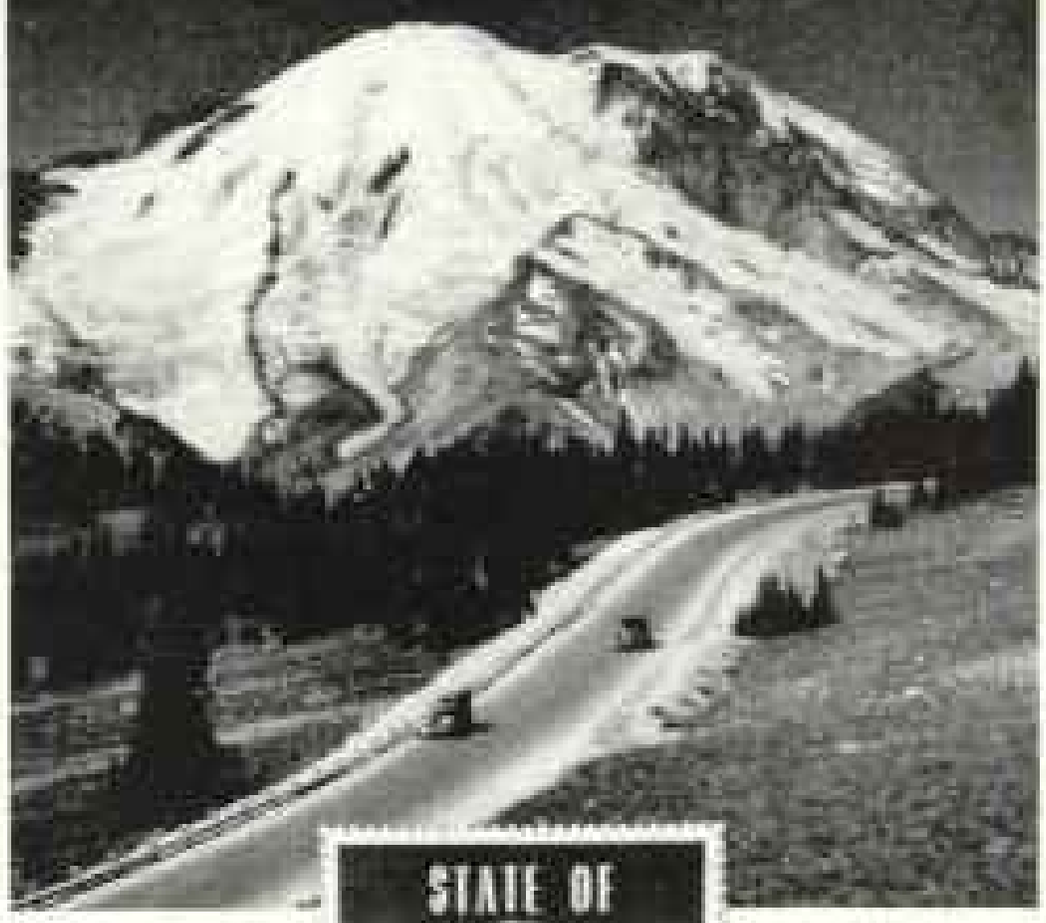
Go early! Plan now! Hotels are open. Golf courses will be green. The water gets warm a month sooner. The fish will be waiting. Your fun begins. Your vacation lasts longer because your money goes further—because you devote less time to traveling—because your days are packed with pleasure. Seashore, lakes, mountains or a trip to the World's Fair—you can enjoy all this in '40 on one vacation when you visit New Jersey. Consult your travel agent or mail this coupon.

NEW JERSEY COUNCIL

New Jersey Council, Dept. N24, State House
Trenton, New Jersey
Kindly send me three booklets giving authentic information for a New Jersey vacation:
(1) New Jersey: "The Nation's Playground"
(2) Hotel Guide (3) Road Map
Name_____
Address_____
City_____ State_____

See America at its Best

IN THE GREAT STATE OF WASHINGTON



Mt. Rainier from Yakima Park

See vivid vistas of unforgetable scenic beauty. Enjoy a holiday variety that pleases every taste. Visit the greatest single-peak glacial system in the U. S. — the largest dam on earth—America's newest national park in the untouched Olympics—the islands of Puget Sound. And more! Be at home in an unspoiled evergreen playground that offers every modern comfort. Plus a cool summer climate. Costs are surprisingly low. Modern transportation and wide paved highways throughout the State. It's America at its best — only a few hours by train, plane, bus or your car from principal U. S. points.

SEND COUPON FOR FREE BOOKLET

State Progress Commission, Room 22
State Capitol, Olympia, Washington.
Please send me FREE guidebook to Washington State.

Name_____

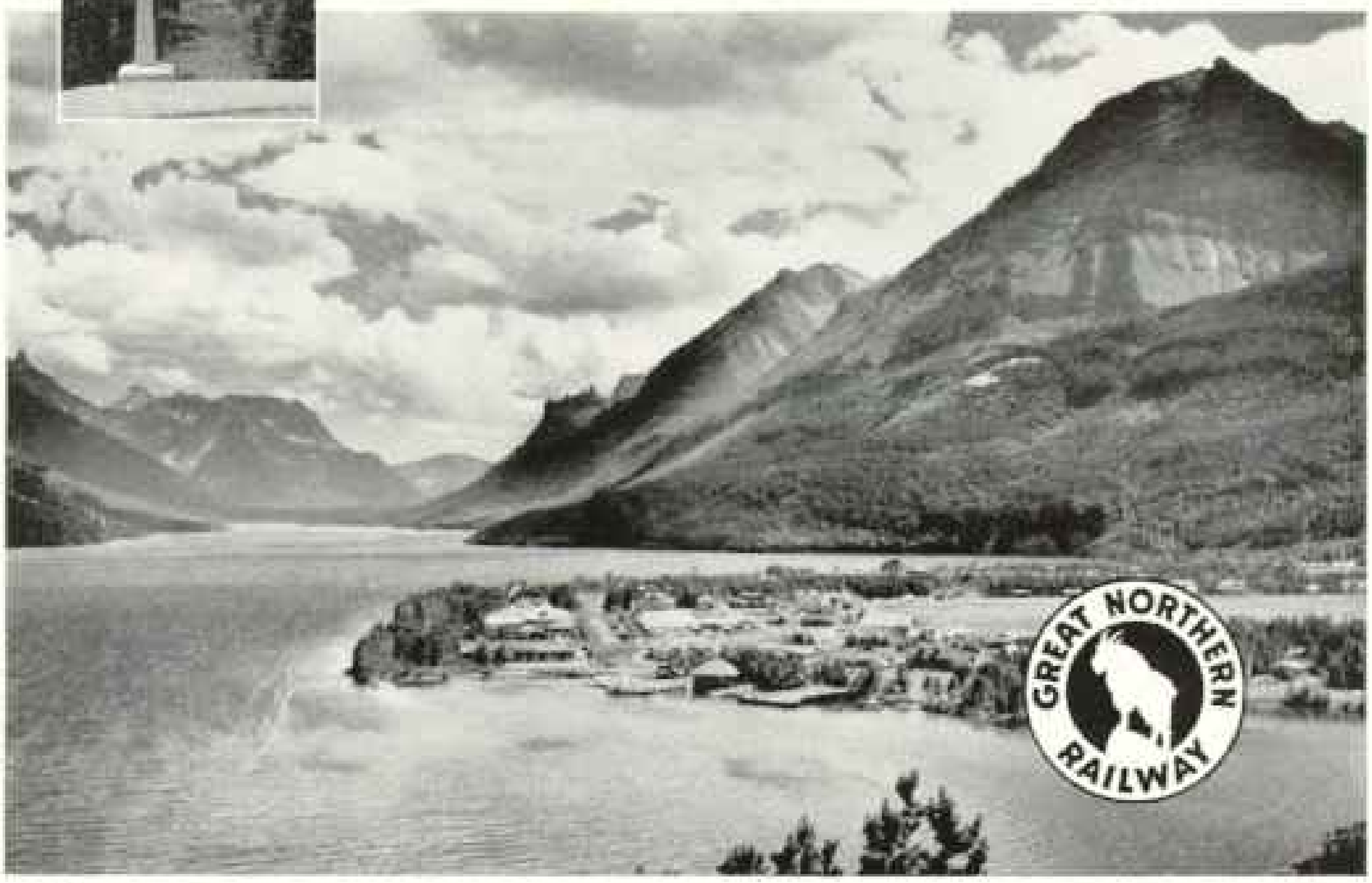
Address_____

GLORIOUS GLACIER PARK

Where the American and Canadian Rockies Meet

SEE AMERICA is the most appropriate advice for 1940. Fortunate are they who decide to spend their vacations in Glacier Park and the adjoining Waterton Lakes Park in Canada. Here are the world's most colorful mountains, lakes and waterfalls. Here is the home of the rare mountain goat—symbol of Capricorn.

Here, also, for one's comfort and enjoyment are picturesque hotels, hospitable chalets and trail camps, each commanding a different scenic principality. For easy inter-park travel there are excellent motor coaches, lake launches and trustworthy saddle horses.



INTERNATIONAL PEACE BOUNDARY BISECTS MAJESTIC WATERTON LAKE

Great Northern Railway entrance at Glacier Park is the spectacular Gateway to Waterton Lakes, Banff, Lake Louise, Emerald Lake, Columbia Icefield and Jasper Park

Glacier Park has long been a favorite stopping-off place for transcontinental travelers bound for Pacific Northwest, California, Alaska, Hawaii or the Orient, and for West Coast people traveling East. Now Glacier Park becomes a gateway to the Canadian Rockies. Its Going-to-the-Sun scenic highway is world famous.

Motor coaches connect with Great Northern's air-conditioned Empire Builder daily, both westbound and eastbound, and provide delightful sightseeing tours to Glacier Park hotels and the Prince of Wales Hotel at Waterton Lakes, and to other parks and resorts in the nearby Canadian Rockies.

Any Great Northern representative will gladly map a western trip for you with full details as to time, reservations and cost. Or mail this coupon for advance information.

A. J. Dickinson, Passenger Traffic Manager
Room 800, Great Northern Railway Bldg.
St. Paul, Minn.

Send me information about a trip to.....

.....

.....

Name.....

Address.....

City.....State.....

even ashore...you sense the difference

And it's a difference that doubles your enjoyment. As a privileged visitor from the Great White Fleet you've the feeling—even in the farthest corners of the Caribbean—that you "belong". People are friendly, courteous, eager to please—you're especially welcome. And your gleaming American Flag liner—so perfect a passport to pleasure ashore—assures equally gay, informal times at sea; designed for tropic cruising and first class throughout.

Cruises to the WEST INDIES and CARIBBEAN

Sailings from New York: Weekly—15 days, $210 up, to Costa Rica, Havana, Panama Canal. 15 days, $210 up, to Colombia, S. A., Jamaica, Panama Canal. *Also: Fortnightly*, 26 days, all expenses, $295 up, including two weeks exploring the Highlands of Guatemala; calls at Santiago, Cuba, and Puerto Cortes, Honduras. Ask about other services from New York and New Orleans.

* * *

For colorful descriptive cruise folders ask or write any Authorized Travel Agent, or United Fruit Company, Pier 3, N. R., or 632 Fifth Ave., New York. Also offices in Chicago, New Orleans, Philadelphia, Boston, Washington, D. C.

great white fleet

IN FULL BLOOM NOW THRU MARCH

BELLINGRATH GARDENS and

Azalea TRAIL

MOBILE, ALABAMA

This month Azaleas bloom in Mobile in a riot of glamorous colors ranging from pure white to deep crimson, palest pink to flame and orange. See this famed flower festival. And take time on your way thru Alabama to visit many other points of interest—historic homes, thriving industries, the famous "Black Belt"—in this, the "Heart of the Deep South."

Write for Illustrated
ALABAMA HIGHWAY MAP
Address Dept. T
ALABAMA STATE CHAMBER of COMMERCE
MONTGOMERY, ALABAMA

GOOD PAVED ROADS Touring the South

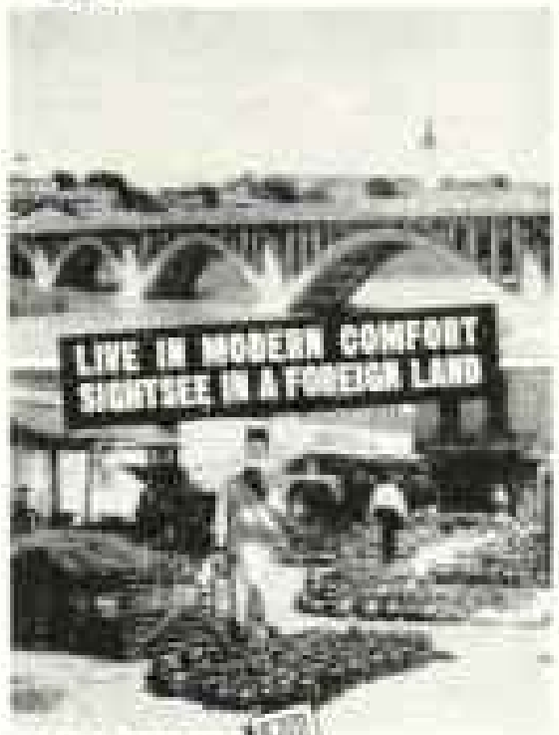
STATE PLANNING COMMISSION

ALABAMA

RIGHT ON THE BORDER DOWN MEXICO WAY

Vacation IN 2 WORLDS IN

LAREDO Texas



There's a new vacationland down on the Rio Grande, where you can fill your days with sports and excitement... or just relax in the warm sunshine. Enjoy the charm and hospitality of the real Southwest in this modern American city. Then motor and sightsee in Mexico just a few minutes away. Let us give you facts, and help you plan a low-cost, sun-filled vacation in Laredo.

FREE MAIL THIS COUPON

LAREDO CHAMBER OF COMMERCE, LAREDO, TEXAS.
Please send me illustrated folder and full information about low-cost sunshine vacations in Laredo, Heart of the Border down Mexico way. T-58

Name_____

Address_____

LAREDO—GATEWAY INTO MEXICO—ON THE NEW PAN AMERICAN HIGHWAY

I see a big

change in your life!

"Aha, my friend, what is this! You are going away....far away from business worries and dull days. I see an exciting change in your life. New friends, new scenery, much fun under palm trees...

"You are basking in a warm sun. You play magnificent golf and see swift race horses and wander through a Mexican village. You hear the mellow bells of Old Missions and see the spreading lights of fifty cities from a mountain top...

"Rich viands brought from the whole world are yours. Your car hums beside an ocean. You walk with celebrities, see curious industries, the great broadcasts and dance under orange blossoms. Aha! I see it now! You are going to Southern California! No other place is so different, so full of things from storybooks..."

ALL-YEAR CLUB "PERSONALIZED" VACATION

GUARANTEES MORE FUN IN

Southern California

The All-Year Club, Southern California's friendly, non-profit tourist organization (18 years experience) announces a new idea in *free* PERSONAL SERVICE for winter visitors. The new plan designs a "custom-made" vacation for you:

1 You mail the coupon. We send you immediately a free "how to plan" booklet. **2** When you arrive, we give you, free, a large illustrated Guide Book. **3** Our unique free Visitors' Bureau in downtown Los Angeles (505 W. 6th St.) helps you work out a vacation custom-made to *your* whims. **4** This same Bureau directs you to the places of your choice—smoothing the way with guest cards, etc. (26 free services in all)—saving time, trouble.

TRAVEL IS FASTER, COSTS LOWER—Even from New York, Southern California is just over-night by plane, 2½ to 3 days by train, 4 to 7 by auto or bus. Vacation costs average 22.8% under those of 20 other leading U.S. resorts. Accommodations for every taste in Los Angeles, Beverly Hills, Glendale, Pasadena, Pomona, Hollywood, Santa Monica, Long Beach and other cities in or near Los Angeles County.

ALL-YEAR CLUB OF SOUTHERN CALIFORNIA

Come to California for a glorious vacation. Advise anyone not to come seeking employment, lest he be disappointed; but for tourists, the attractions are unlimited.

FREE—MAIL COUPON TODAY

All-Year Club of Southern California, Dio. 2-D, 629 So. Hill St., Los Angeles, Calif.

Send me *free* book with complete details (including costs) of a Southern California vacation. Also send free routing by ☐ auto, ☐ rail, ☐ plane, ☐ bus, ☐ steamship. Also send free booklets about counties checked: ☐ Los Angeles, ☐ Orange, ☐ Riverside, ☐ Santa Barbara, ☐ Inyo-Mono Area, ☐ San Diego, ☐ Ventura, ☐ Mission Trails, ☐ Central California.

Name_____ Street_____

City_____ State_____

Do your half-clean plates shout "FALSE TEETH"

avoid "tell-tale" stain

KEEP PLATES LIKE NEW WITH POLIDENT

One thing that can tell everyone your teeth are false—just as surely as if you shouted it—is "tell-tale" STAIN!

But you can prevent it. It's easy to do with Polident. This remarkable powder cleans and purifies false teeth and removable bridges like new—without brushing, acid or danger. It dissolves away every trace of stain, tarnish and food deposits.

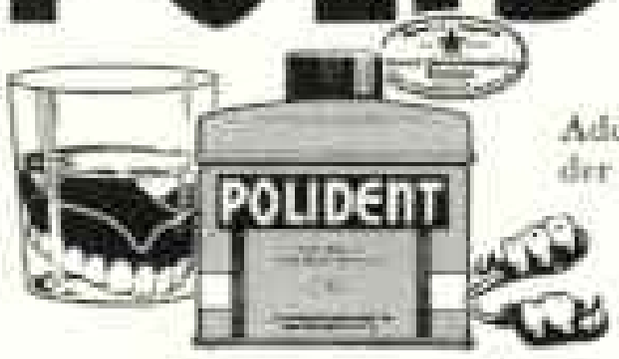
Your plate or bridge looks better and feels better—your mouth feels fresher. For, as thousands of leading dentists will tell you, Polident changes the cleansing of false teeth from a problem to a pleasure.

GUMS LOOK MORE "LIVE"

Food deposits, tarnish and mucin-film often give plates a "dead" look. Millions have now learned that Polident makes gums look more "live" and natural—when brushing and soaking in mouth washes often won't help!

Try Polident today. 30¢ at any drug store. *Your money back if not delighted.* Approved by Good Housekeeping Bureau. Hudson Products Inc., New York, N. Y.

POLIDENT



NO BRUSHING

Add a little Polident powder to ½ glass water. Stir. Then put in plate or bridge for 10 to 15 minutes. Rinse—and it's ready to use.

STYLES CHANGE

• When Sani-Flush was introduced, 28 years ago, dresses hung low, and hair was piled high. This odorless chemical compound freed women of a disagreeable task. It took all the work and muss out of cleaning toilets.

But...

• Although many things have changed, Sani-Flush has not. It is still the easiest and best known way to keep toilets clean and sanitary. Use it twice a week. Cannot injure plumbing connections. (Also effective for cleaning out automobile radiators.) *See directions on the can.* Sold by grocery, drug, hardware and 5-and-10¢ stores. 10¢ and 25¢ sizes. The Hygienic Products Company, Canton, Ohio.

Sani-Flush

CLEANS TOILET BOWLS WITHOUT SCOURING

SHEPARD HomeLIFT

A "LIFT" FOR OLDER FOLK

THE HomeLIFT—automatic, electric Home Elevator—is a priceless boon to all who lack strength or health to climb stairs. *Press a button*—you are upstairs or down as easily as wishing you were there. Operates from lighting circuit at less than a cent a day. Simple—Safe—Dependable—Modest price. Easily installed in new or old homes. Hundreds in use—everywhere. Send for illustrated booklet and details.

THE SHEPARD ELEVATOR CO.

Builders of Finest Office and Hotel Elevators

2432 Colerain Ave., Cincinnati, Ohio

Representatives in Principal Cities

The Original Invalid Elevator Built by Experts

Fighting Another Plague

COUNTLESS AMERICANS TODAY have enlisted in the fight against a great plague—syphilis. They have learned that syphilis can be *cured* and syphilis in the newborn *prevented*—by prompt, proper treatment.

▶ Thanks to this national awakening, *two and one half times* as many cases were reported for treatment in 1938 as in 1928, according to information from the U. S. Public Health Service and private physicians all over the country!

And more Americans now than ever before realize that, while syphilis may be acquired innocently, no one need remain in doubt as to whether he or she has syphilis. They have learned that a thorough medical check up, including blood test and microscopic examination, reveals the truth to the skilled physician.

▶ So in 1938, *five times* as many blood tests for syphilis were made as in 1930!

Every thoughtful citizen, naturally interested in stamping out this menace, should know and help to make known the following cardinal principles concerning syphilis:

1. **Prompt recognition of the disease is vital.**
2. **There is as yet no practical short-cut treatment.**

Self-treatment, non-professional treatment, quack remedies are worse than useless. The guidance of a reputable physician is the first dependable step toward real cure. Proper treatment consists of a systematic series of injections given by a competent doctor over a period of *many weeks*.

In progressive communities throughout the country, examinations, blood tests, and treatments are being made available to those unable to pay for private care. Names of doctors and locations of public health centers and clinics offering these services are readily supplied by local health departments or county medical societies.

▶ So that you may better understand the syphilis problem, let us give you additional information about this disease. For free Metropolitan booklet, "The Great Imitator," write to Dept. 240-N.

* * *

February 1st Is Social Hygiene Day: American Social Hygiene Association Headquarters, 50 W. 50th St., N. Y. C., will gladly send you literature and full particulars.

A Subsidiary Eden . .

Enthusiasm for Hawaii is pretty close to unanimous. This is easy to understand when you've been to Hawaii but most difficult to explain when you haven't been there. That's the reason for making the very air.

It will be a gorgeous morning when you arrive in Hawaii. Ahead of you—huddled into the Pacific—will lie a frontier surrounded by sunlight and white-capped surf.

Tilting toward the sea will be palm trees, done in a spectrum of purples and banana yellows; sunlight will be flowing into the gardens and the unimagined perfume of countless flowers will be flowing into the air; sweet music and necklaces of flowers will descend upon you. Reality will seem to fade. You will have arrived in a subsidiary Eden.

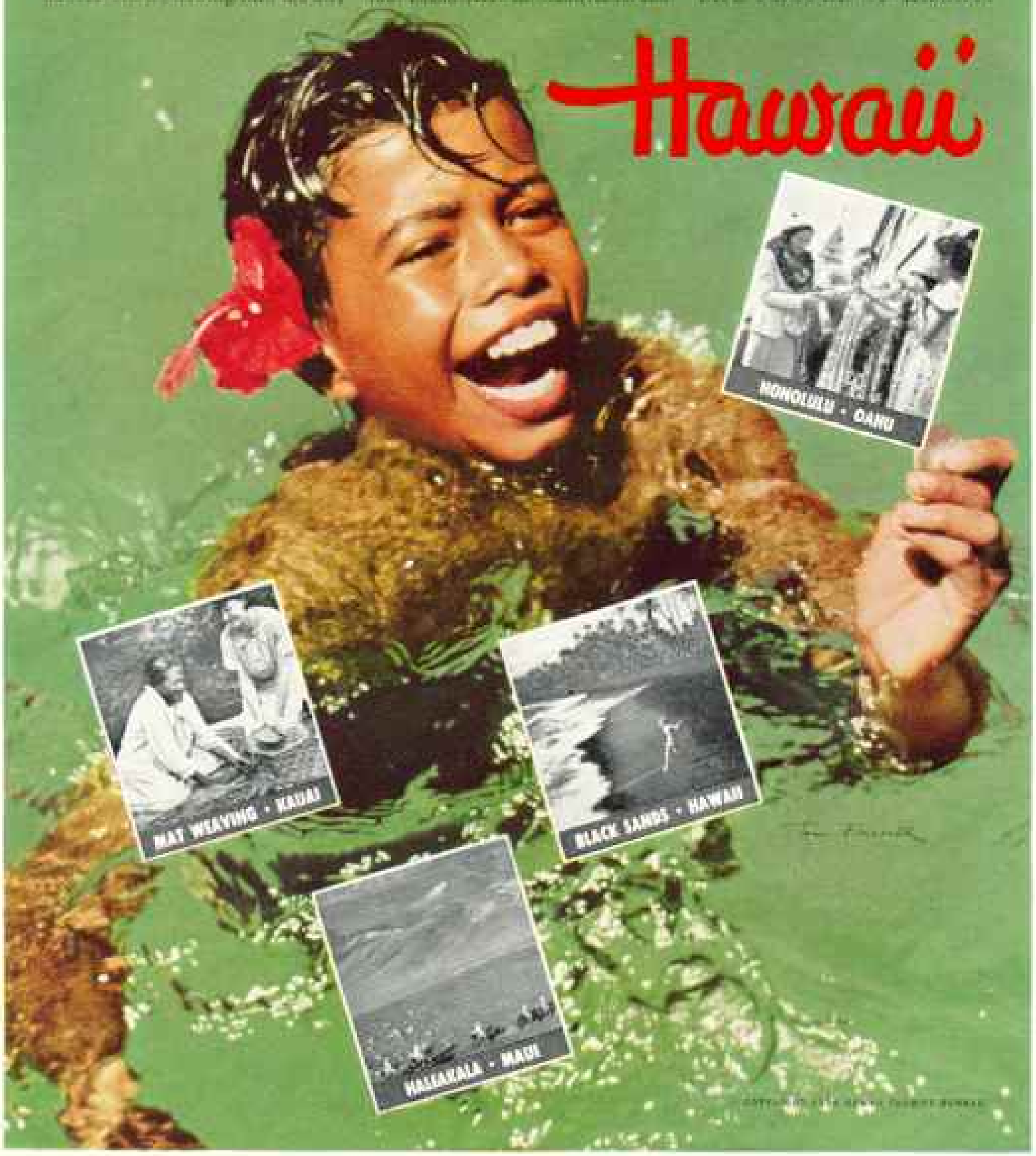
To describe what follows would be impossible in this space and would put the inside strength of superlatives to cruel test. But our pictorial booklet "Nani O Hawaii" (illustrated by natural color photographs) which any Travel Agent will gladly present to you with his compliments—and ours—will give you a comprehensive idea of what it is all about.

Moreover, he can suggest what to do and when to do it. Tell you about the four Islands, Hawaii, Maui, Kauai and Oahu . . . about Waikiki . . . stirring sports and unforgettable diversions . . . the frequent sailings of palatial liners from Los Angeles, San Francisco and Vancouver, B.C. . . . steamer and hotel tariffs . . . and supply answers to your other questions. Really, your Travel Agent can be very helpful.

— — —

This advertisement is sponsored by Hawaii Tourist Bureau, Honolulu, Hawaii, U.S.A. Branches: 209 Market St., San Francisco; 232 Pershing Bldg., Los Angeles, Calif. A non-profit organization maintained for your service by

THE PEOPLE OF HAWAII



Makes a light lunch refreshing

Coca-Cola has the charm of purity. It is prepared with the finished art that comes from a lifetime of practice. Its delicious taste never loses the freshness of appeal that first delighted you,...always bringing you a cool, clean sense of complete refreshment. Thirst asks nothing more.

Your favorite soda fountain, your favorite sandwich, and America's favorite refreshment . . . ice-cold Coca-Cola. Quick-as-a-wink you're refreshed and on your way. That's why you hear so many busy people at lunch saying: "and a Coca-Cola." Try it yourself.

Drink

Coca-Cola

Delicious and Refreshing

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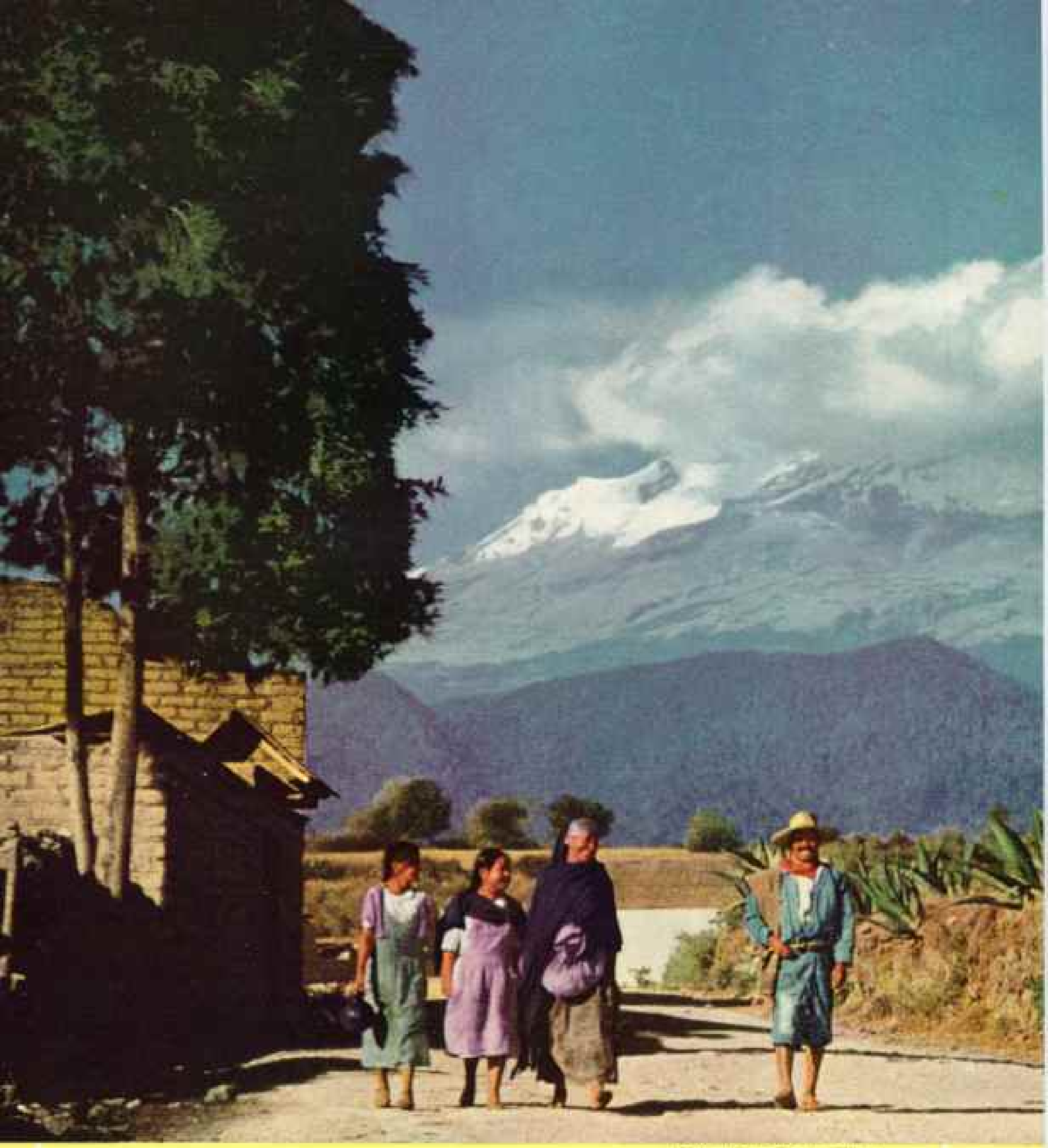

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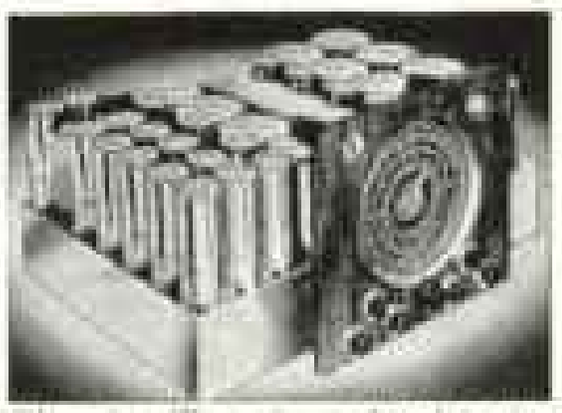

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