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THE NATIONAL GEOGRAPHIC MAGAZINE

Miracle Men of the Telephone

BY F. BARROWS COLTON

In observance of the centennial of the birth of Alexander Graham Bell, inventor of the telephone, on March 3, 1947, the NATIONAL GEOGRAPHIC MAGAZINE presents this story of the Bell Telephone Laboratories, which carry on the work that Dr. Bell began. Dr. Bell was one of the original members of the National Geographic Society when it was founded in 1888. While President of The Society, 1898 to 1903, he initiated the extension of its membership and the popularization of its Magazine. He contributed to the NATIONAL GEOGRAPHIC MAGAZINE and served as a trustee of The Society until his death in 1922. Mrs. Bell and her family gave The Society its first building, Hubbard Memorial Hall, in memory of Gardiner Greene Hubbard, first President of the Bell Telephone Company and first President of the National Geographic Society.

IN A quiet room in downtown New York I sat one day with a scientist and a man who had been totally deaf from birth. He never had heard a human voice.

Before us were a small luminescent screen, a microphone, and some complicated electrical apparatus. Turning so that the deaf man could not read his lips, the scientist spoke into the microphone. As he talked, a series of patterns of dull greenish-yellow lines and shadows moved slowly across the screen, rising and falling, now blurred, now sharp.

Watching the screen, the deaf man smiled and repeated aloud the words the scientist had spoken—words he could not hear. "All of it was perfectly clear," he said. "I can read those patterns now about as easily as print."

What he was reading was "visible speech," a by-product of the never-ending study of transmission of the human voice carried on at Bell Telephone Laboratories. With it, spoken words are turned into visible patterns on a screen that it is possible to learn to read. Like shorthand, they are patterns not of words but of sounds. They provide a new way of studying speech and, better still, a new way for the deaf to "hear by seeing" (pages 300, 301).

"Visible speech" is only one of the countless achievements of the more than 2,000 scientists and engineers of the Bell Telephone Laboratories. They, with as many more associates, carry on today in this great research institution the work begun more than 70 years ago in a Boston attic by Alexander Graham Bell, inventor of the telephone (page 281).* These men today are "inventing" the telephone of tomorrow.

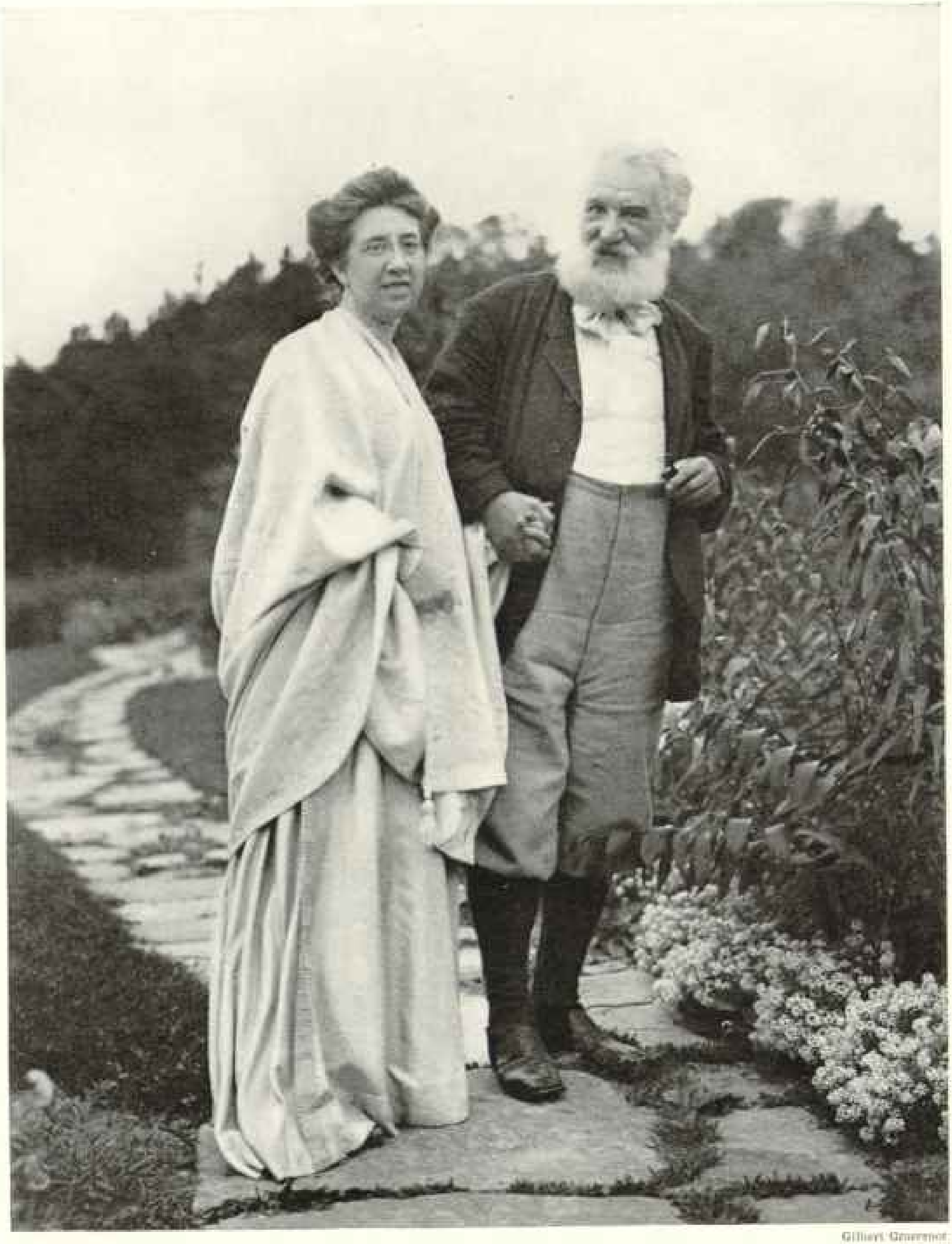
Amazing things they do make them seem indeed like "miracle men." Yet, like all scientists, they actually get results only by long, hard work, over months and years.

"Our job, essentially, is to devise and develop facilities which will enable two human beings anywhere in the world to talk to each other as clearly as if they were face to face and to do this economically as well as efficiently," Dr. O. E. Buckley, President of Bell Laboratories, told me.

"To this end we study everything from the most fundamental matters, such as the mechanism of speech and hearing and the molecular structure of copper wire and rubber insulation, to the detailed design of equipment. We're equally interested in an operator's enunciation and in building her switchboard for long life."

Everything that happens to human speech between the brain of a speaker in Los Angeles and the brain of the man he is calling, either

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Miracle of Talking by Telephone," by F. Barrows Colton, October, 1937, and "Prehistoric Telephone Days," by Alexander Graham Bell, March, 1922.



Gilbert Grosvenor

Alexander Graham Bell and Mrs. Bell in Their Garden at Baddeck, Nova Scotia

The inventor of the telephone was born at Edinburgh and became a citizen of the United States and resident of Washington, D. C., in 1882. Until the day of his death, August 2, 1922, his active mind delved into an amazing variety of subjects, including aviation, sheep breeding, distilling fresh water from salt, high-speed motorboats, and many others. Mrs. Bell (Mabel Hubbard) became totally deaf at age four from scarlet fever. She and Jennie Lippitt were the first children in America to learn to read the lips and converse like hearing people.

in the next block or in far-away Portland, Maine—or even Paris or Shanghai—is the concern of Bell Laboratories people.

That includes such diverse things as taking movies of human vocal cords in action; choking off mischievous round-the-world radio echoes that occasionally distort transoceanic telephone talk; and harnessing the energies of countless electrons which are so small that no one ever has seen one and which, in fact, may not have any definite form at all!

Out of all their work has come not only the world's finest telephone system but many other useful things not connected directly with the telephone. Among them are many phases of radio broadcasting, talking movies, and public-address systems.

Out of telephone research, too, came the electrical gun director, which gave Allied anti-aircraft batteries in World War II almost miraculous accuracy; the mirrophone, which shows you how your own voice sounds, so that you can improve your speaking or singing; and of course "visible speech."

How Alexander Graham Bell, born in Scotland 100 years ago, March 3, 1847, would have rejoiced at "visible speech"! He was originally a teacher of the deaf, and it was his quest for better means of teaching them to speak that led him to invention of the telephone (page 282). Bell himself once tried with only modest success to work out a similar idea as an aid in teaching his deaf pupils to utter sounds properly.

Though not yet ready for general use, modern "visible speech" has great possibilities. Deaf people can and have learned to read it, and thus use it to "see" what others are saying. Hooked on to a telephone or radio, it would serve the same purpose, though that is still in the future.

Teaching the Deaf to Speak

Better still, deaf people can use it to improve their speech, a difficult task normally for those who are deaf from birth or early childhood, for they are unable to hear the proper pronunciation of words and their speech is likely to be harsh and unnatural.

With "visible speech" they can practice by watching the patterns of their voices on the screen and comparing them with patterns of normal speech, until they learn to speak correctly. Its use in teaching deaf children to speak is now being carefully studied by specialists at the University of Michigan.

All the "miracles" of telephone engineers have come from the study of electric waves, which are among the most sensitive and temperamental things in the Universe.

Electric waves used in the telephone have only about one-millionth of the power that lights the electric lamp beside your chair. Nursing these nebulous waves along, delivering them strong and clear over thousands of miles of wire or through the air as radio waves, passing them safely through millions of connections and relays, and doing it always better and faster, is the main task of Bell Laboratories men.

In doing that job, they have reached out through 93 million miles of space to study the sunspot cycle and to learn to forecast the showers of electrified particles from the sun that periodically disrupt radiotelephone channels across the oceans. They have probed into the mysteries of how electrons, dancing inside the atoms of a copper wire, transmit the energy of speech from one end of the wire to the other.

Bell men's problems are never-ending and ever new.

Inside the mouthpiece of your telephone, for instance, behind the little holes that you talk into, a thin diaphragm of duralumin is vibrated by the energy of your voice. To protect it from rust-producing moisture, it used to be covered with a membrane of oiled silk. But cigarette and cigar ash, mixed with the moisture of people's breath, got inside and made a caustic deposit that ruined the oiled silk. So Bell men worked up a synthetic rubberized protector that is impervious to that caustic action.

They've developed a paint for telephone operators' chairs that won't snag the girls' stockings or rub off on them.

They've raised termites to find out what those pernicious insects *don't* like to eat, to help find a preservative for telephone poles in termite-infested country. In the process they discovered that termites will pine away, refuse food, and even digest themselves if their colony is disturbed. Maybe that will be some comfort to you if you have termite trouble!

They have a movie camera in which the film runs 70 miles per hour, taking up to 8,000 pictures a second, to slow down the movement of fast-acting automatic switches to see just how they work, or why they don't. Those cameras, incidentally, were used to photograph still-secret details of the atom bomb tests at Bikini Atoll.

You've wished sometimes (except when caught in the bath!) for a television set beside your telephone to let you see the person on the other end. Bell scientists 20 years ago built such a combination and had it working for a while between two buildings in New York. But installing it for general use today would

Metal Is Rolled to Calling-card Thinness

Walter S. Gifford (right), President of the American Telephone and Telegraph Company, watches while permalloy is fed into a machine which compresses it into strips 14/1000 of an inch thick. These are used in relays that are the heart of the telephone dial system.

be too costly to be practicable. Bell men, too, put on the first television demonstration between New York and Washington in 1927.

Constantly delving into endless secrets, solving countless problems, searching for knowledge that will be useful in ways as yet unknown, Bell Laboratories is typical of the many great industrial research institutions of the United States which have helped give this country its high standard of living and its leadership in many fields of science and technology.

Coal Grains Make Your Telephone Work

To tell all the things that Bell men do would take up volumes of this MAGAZINE, but a few examples will give you an idea.

Consider the coal in your telephone. Yes, coal—about 50,000 finely crushed granules of it, in a pea-sized box just behind the diaphragm inside the mouthpiece (Plate IV). Through these bits of coal flows the current that carries your voice over the wire.

Coal is used because it's carbon, and carbon is not only a good conductor but quite elastic. As your voice vibrates the diaphragm, pressure of the granules against each other changes the area where they touch. That varies its resistance to the current passing through, and translates your voice waves into waves of electric current.

But that coal, though it is specially selected from only a few deep mines in Pennsylvania, has its drawbacks. Probably you're satisfied with the way it works, but the Bell scientists are not. It gradually deteriorates, and replacing it costs around $250,000 a year. More important, the tiny lumps are rough and uneven, providing a rather variable contact. Round grains, like tiny balls, would work better.

You can't make coal that way, though; so the Bell scientists have found a way to make tiny balls out of silica sand, so small that even under a microscope they look smaller than BB shot. Heated methane gas is passed over the globules. It deposits on them a layer of carbon only one-millionth of an inch thick.

That thin layer of carbon works just as well as the solid carbon of the little lumps of coal, and, unlike real coal, its quality can be controlled and never varies. Eventually that "synthetic coal" may be in your telephone, making it work even better than now, and lasting longer, too.

When you talk today by telephone between some large cities, your conversation may travel with several hundred others, all moving together inside the new "coaxial" cable (page 300). They all travel on currents of high frequency, each conversation using a different band of frequencies, or wave lengths, just as each station you get on your radio has its own band of wave lengths.

That combination of wave lengths, or frequencies, traveling over the cable is like the white light in a theater spotlight, containing within itself all the different colors — red, blue, green, etc. To throw a red light on the stage, you use a red filter which lets only the red rays pass through; a blue one for a blue light; etc.

Staff Photographer Willard R. Culver

Styles Have Changed in Operators' Headsets Since 1880!

Girl at the right, in a costume of 65 years ago, wears the "Gilliland harness," which weighed six and one-half pounds. The box contains the transmitter. Operator at the left wears the latest headset, weighing only five and six-tenths ounces. Transmitter remains before the mouth when the head is turned.

Man-made Crystals Improve on Nature

You separate out single telephone conversations in the same way with electrical filters. Heart of each filter is one or more quartz crystals, each of which vibrates an unvarying number of times per second. The crystal filter lets through only the one conversation to which it is tuned. Those crystals are made from a special grade of quartz found almost exclusively in Brazil.

That brings up the story of how Bell scientists actually "improved on Nature" and made artificial crystals better for some purposes than the natural Brazilian kind. Those artificial crystals played a big part in helping to win World War II.

When German submarines began sinking Allied vessels wholesale, the Navy issued an urgent call for a device better than those then in use for locating submarines under water. Best way to locate a submerged submarine is to send out sound waves through the water which strike its hull and bounce back to their source. When converted into electrical waves, they reveal the distance and location of the submarine.

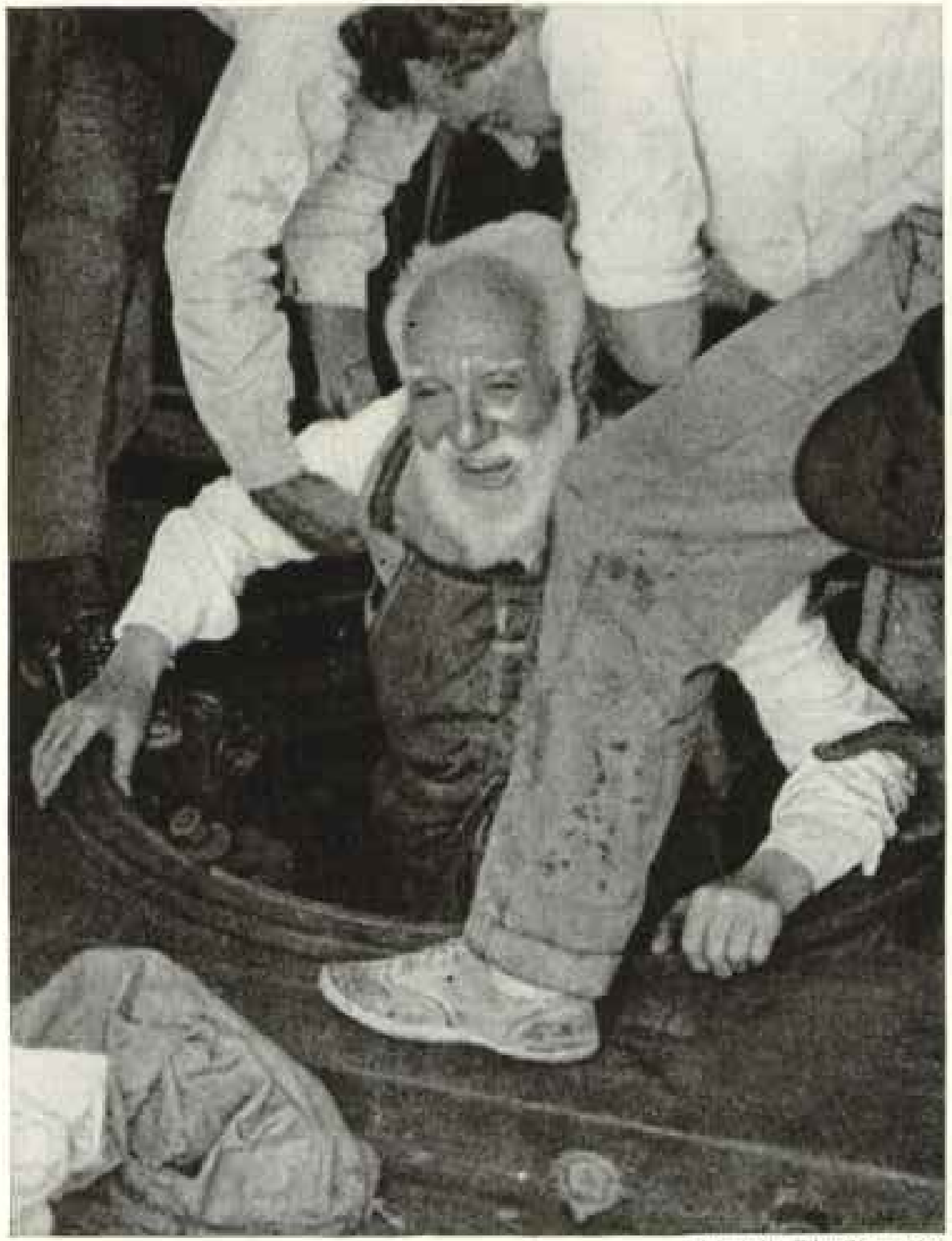
To convert the sound waves into electrical waves precisely enough to locate a submarine accurately, the best method is to use crystals which vibrate at a very precise frequency. Crystals of natural quartz had some limitations for the purpose and also were scarce, and those two facts made it essential to find a better way to do the job.

Bell men saved the day with artificial crystals. If you put a little water containing salt in a saucer and let it sit in the sun, the water

Frederick Schutz

At the Telephone's Fortieth Birthday Party, 800 National Geographic Members Took Voice Voyages to the Four Corners of the U. S.

For the first time in history, through headphones each guest heard Pacific rollers breaking on California beaches; Prime Minister Sir Robert Borden in Ottawa sent heartiest greetings from Canada; and Brig. Gen. John J. Pershing, commanding the Mexican Expeditionary Forces, reported from El Paso on the Rio Grande, "All's quiet on the border." The black "box" on the table was an exact duplicate of the first Bell telephone. At the speaker's table on this great occasion, March 7, 1916, in Washington, D. C., are, left to right: Mrs. Lane; Thomas A. Watson (who built the first telephone and to whom Bell addressed his first words, Plate 1); Gilbert Grosvenor, Editor and Director National Geographic Society; Maj. Gen. Hugh L. Scott, Chief of Staff and Actg. Sec. of War; John J. Carty, Chief of Eng. Staff, Am. Tel. and Tel. Co.; Dr. Alexander Graham Bell; Theodore N. Vail, President Am. Tel. and Tel. Co.; Sec. of Interior Franklin K. Lane; O. H. Tittmann, President National Geographic Society; Sec. of Navy Josephus Daniels; U. N. Bethell; Postmaster General Albert S. Burleson; Rear Adm. Colby M. Chester, USN; N. C. Kingsbury; Mrs. Burleson; and Sen. Joseph E. Ransdell. In the foreground, extreme left corner, Prof. Edwin A. Grosvenor, of Amherst College, and Theodore W. Noyes, 38 years Editor, Washington *Evening Star*. At extreme right, Harvey W. Wiley, father of pure food laws.



Submarine Film Corporation

Up from Davy Jones's Locker Comes a Smiling Dr. Bell

On his visit to Nassau in the Bahamas, the 75-year-old inventor descended in a submarine tube to study sea life on a coral reef. His friend, Charles Williamson, originated this device, a flexible tube with an observation chamber at the bottom.

Gilbert Grosvenor

The Inventor Examines One of His Twin-bearing Sheep

Since ewes usually bear a single lamb each year, Dr. Bell increased their yield to help farmers of Nova Scotia. Working for 35 years, he developed a flock in which ewes bore twins and triplets half the time. Dr. Wilfred Grenfell, Labrador medical missionary, in center.

Dr. Bell's Prediction Comes True. He Talks to a Man "in a Distant Place"

The inventor of the telephone, in 1892, opens long-distance service between New York and Chicago over 800 miles of open wire line. Only 14 years before, in 1878, he had predicted that some day "a man in one part of the country may communicate by word of mouth with another in a distant place." Today all New York-Chicago connections are in underground cable, also forecast by Bell. The man with full beard is John E. Hudson, then President of the Bell Telephone Company.

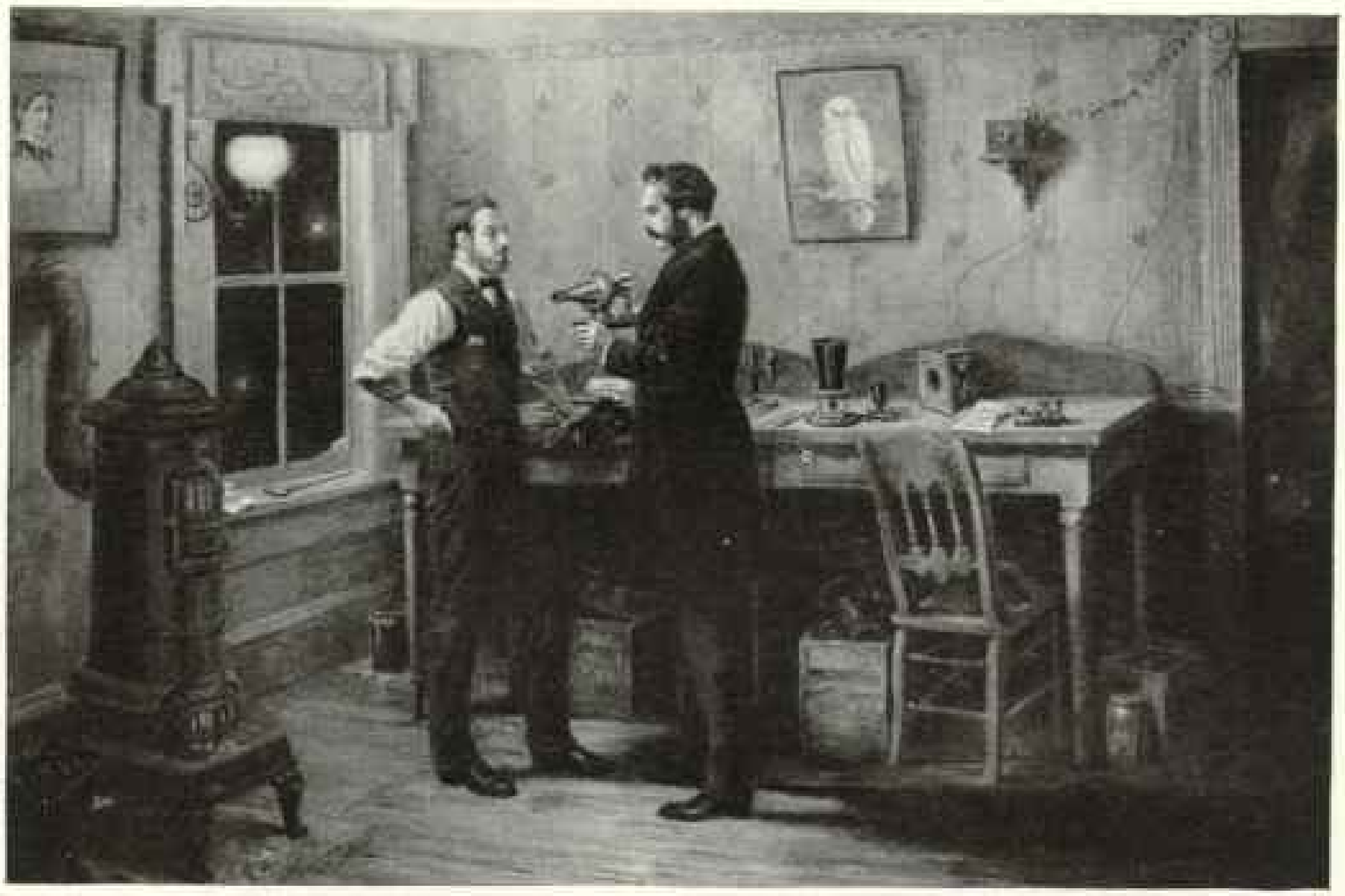
evaporates and you have some salt crystals left in the dish.

The Bell men began the same way, but instead of ordinary salt they used a chemical solution that contained ammonia, hydrogen, and phosphoric acid. They evaporated a little of it, and what they had left was a small crystal. This was too rough and imperfect to use in submarine detectors, but it served as a "seed" to build larger and better crystals.

If you revolve a crystal seed in a tank full of the chemical solution, more of the chemicals will come out of the solution and deposit on the seed (Plates XII and XIII). Gradually a large, clear synthetic crystal is built up. When it's large enough you take it out, cut off the good part, and use the seed over again to build another crystal.

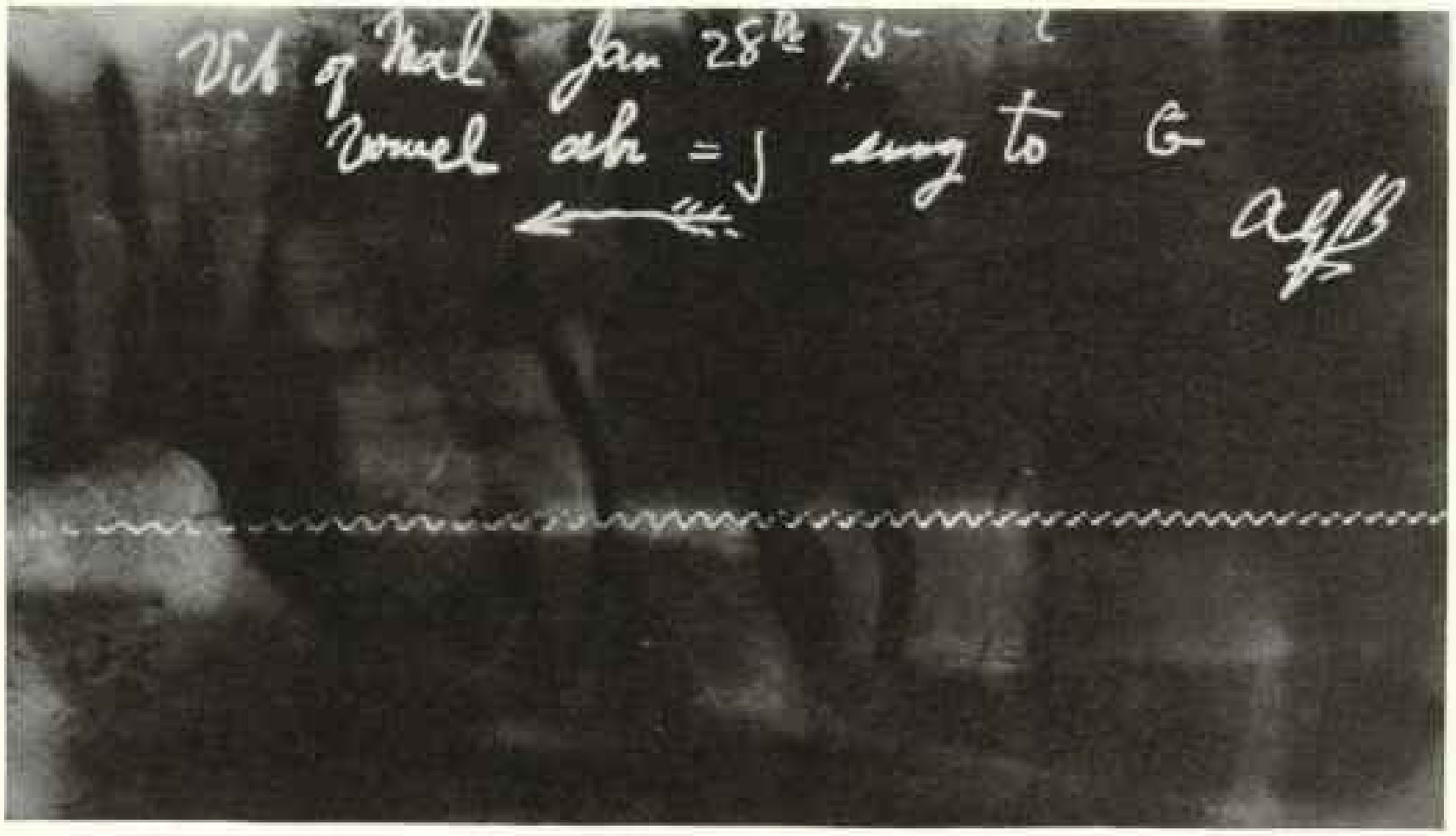
Those synthetic crystals are not quartz, but they are built in almost the same way that Nature makes quartz crystals. But Nature takes uncounted thousands of years, while the scientists do it in days.

More than a million of those synthetic crystals went to war. Built into the Navy's famous submarine detector known as "sonar"



In This Improvised Laboratory Alexander Graham Bell Invented the Telephone

The painting by W. A. Rogers shows one of the rooms used by Bell at 5 Exeter Place, Boston, Massachusetts, as it appeared in March, 1877. Dr. Bell is shown discussing a telephone instrument with his assistant, Thomas A. Watson (left), in jest at his habit of working late. The picture of the owl was painted by Mabel Hubbard, Bell's fiancée. The first sentence transmitted by telephone was sent from this room.

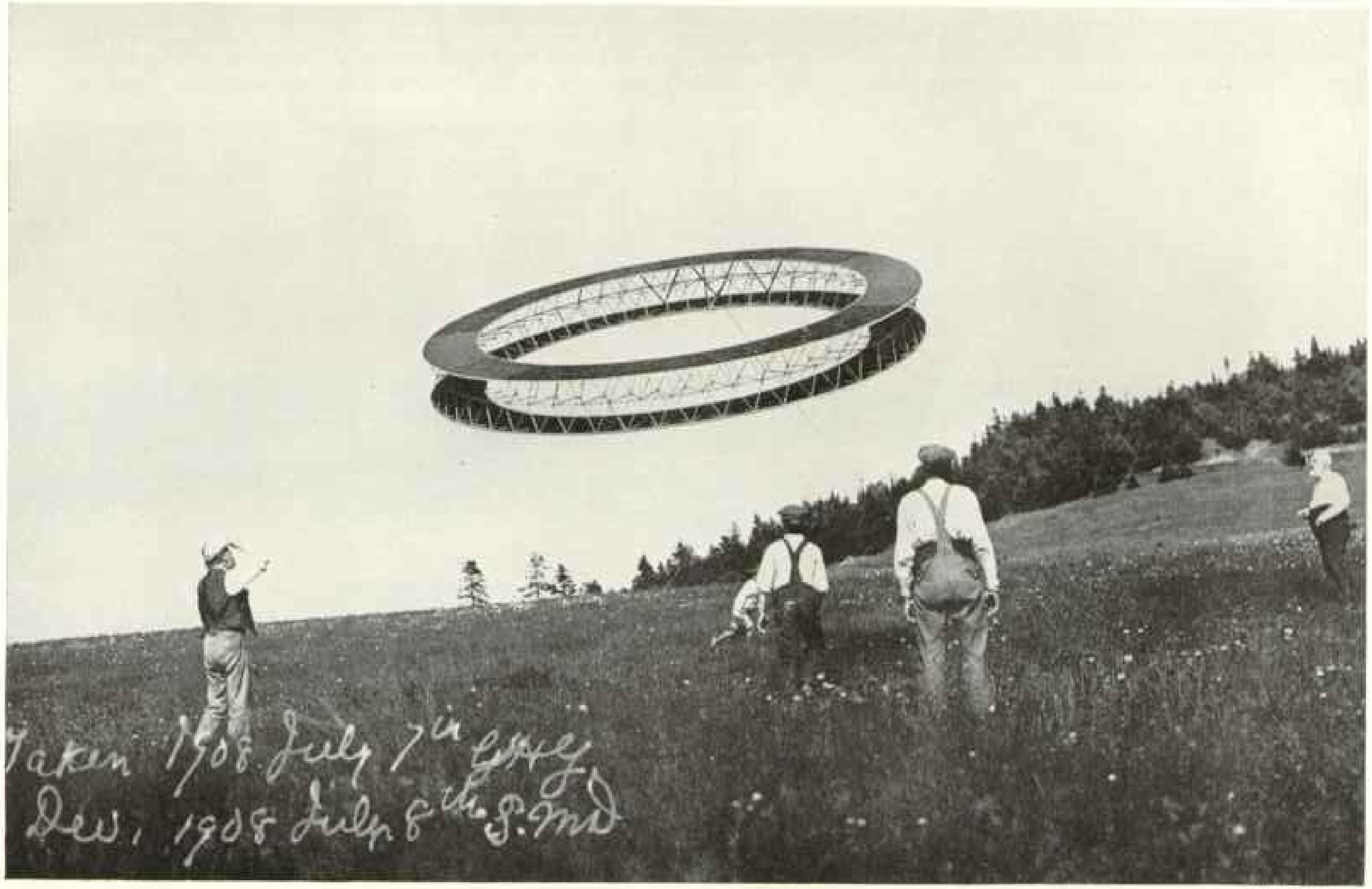


Singing into a Human Ear, Bell Recorded This Sound Wave on Smoked Glass

Hoping to make photographs of sound-wave patterns to help teach his deaf pupils to speak, Bell secured a human ear through a friend, Dr. Clarence J. Blake, and attached a straw to it. When he sang into the ear, the straw recorded the vibrations of the eardrum on smoked glass. The wave pattern shown here is that of the vowel "Ah" sung to G, as indicated in the notation signed with Bell's initials (page 288).

Alexander Graham Bell (Right, Top of Steps) First Taught American Deaf Children at This School in Boston

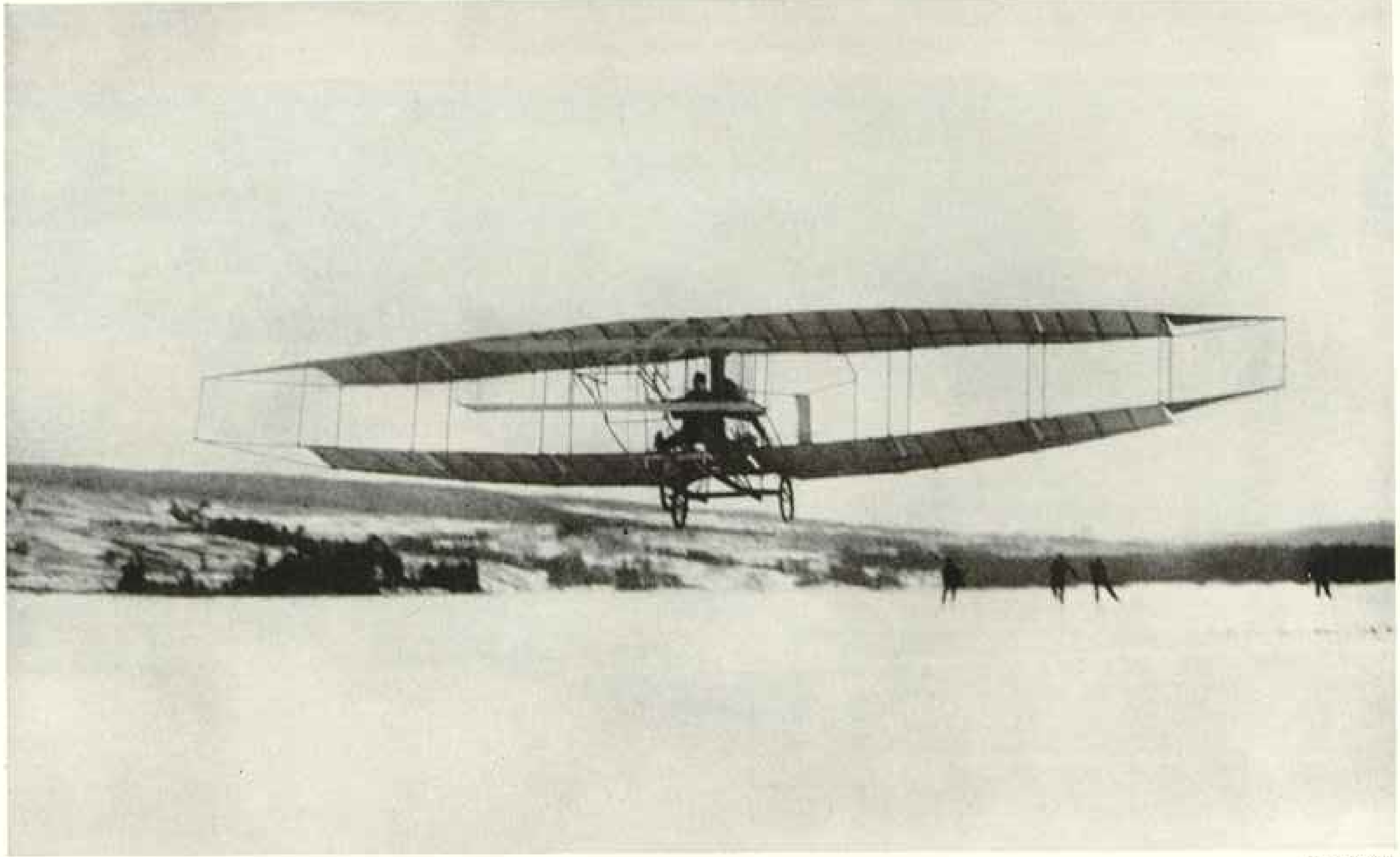
His pupils learned to read lips and associate symbols with the vocal processes of forming various sounds, a method of "visible speech" developed by his father, Alexander Melville Bell. It was a forerunner of Bell Laboratories' modern electrical "visible speech" (page 300). This group of pupils and teachers of the Boston School for the Deaf (now the Horace Mann School) was photographed June 21, 1871. Bell was then 24 years old. Top left is Rev. Dexter King, founder of the school. Sarah Fuller, principal, fourth row, second from left.



Gilbert Grosvenor

Flight of an Experimental Wheel-shaped, Multicelled Kite Is Watched by Dr. Bell (Extreme Right) in July, 1908

Dr. Bell was interested in developing an airplane that would take off at slow speed for safety's sake. He reasoned that if a kite could be made to develop a certain lift in a ten-mile wind, it would be possible to build a plane that would take off at ten miles per hour. His laboratory at Baddeck recorded the date on each negative.



H. M. Bunker

"Feb. 23, 1909. McCurdy Flew over Baddeck Bay in the *Silver Dart* About Half a Mile—First Flight of a Flying Machine in Canada"

Thus Dr. Bell recorded the historic event in the annals of the Aerial Experiment Association, financed by Mrs. Bell and of which he was chairman. The other members included such well-known pioneers in aviation as Glenn H. Curtiss, F. W. Baldwin, J. A. D. McCurdy, and Lt. Thomas E. Selfridge, U. S. Army, the first person killed in an airplane crash. The *Silver Dart* had a 49-foot wingspread and was powered by a 50-horsepower engine turning a pusher-type propeller.

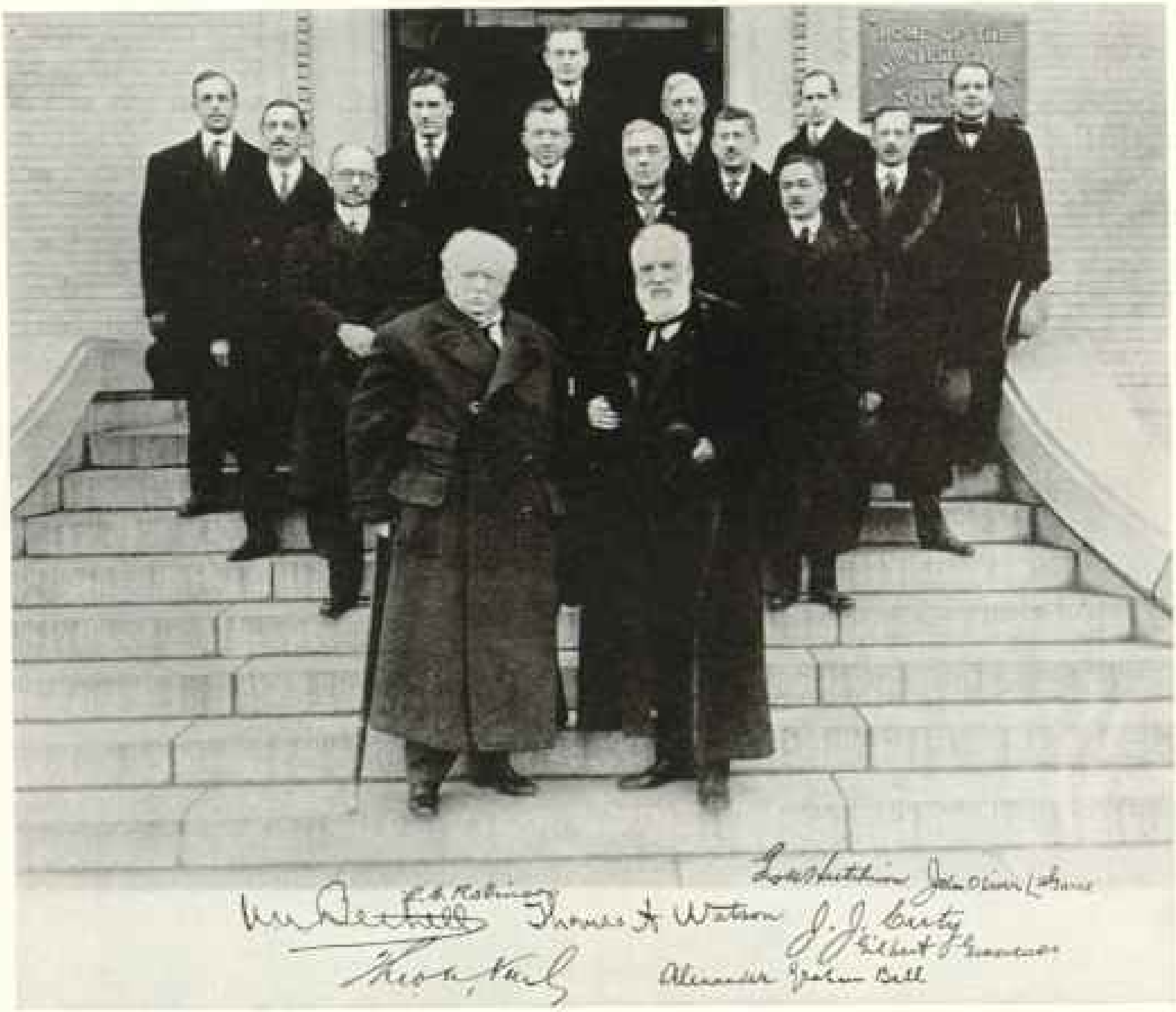
A Picture of Concentration, Dr. Bell Studies Performance of the HD-4's Hydrofoils as It Speeds Toward Him—September, 1920

Steel planes, or hydrofoils, were arranged in sets like the rungs of a ladder, graduated from large ones at the top to small ones at the bottom. The faster the boat traveled the higher it rose out of the water until its weight was carried entirely by the lower planes.

Gilbert Grosvenor

Like a Giant Water Bug, the HD-4 Roars Across Baddeck Bay at 1920 World-record Speed—71 Miles an Hour

As the boat gained velocity from its propellers, the hull was lifted clear, as if on stilts, thus cutting down resistance and permitting high speed.



Men Who Developed the Telephone Visit National Geographic Society, March 8, 1916

In front are Alexander Graham Bell (right) and Theodore N. Vail, principal organizer of the Bell System in early days. Others, left to right: H. D. Arnold, director of research, Bell Laboratories; H. E. Shreeve, engineer who took part in first transatlantic radiotelephone conversation; U. N. Bethell, president New York Tel. Co.; C. A. Robinson, vice president Chesapeake and Potomac Tel. Co.; E. H. Colpitts, executive vice president Bell Telephone Laboratories; O. B. Blackwell, assistant vice president Am. Tel. and Tel. Co.; Thomas A. Watson; A. W. Drake, commercial manager, Long Lines, Am. Tel. and Tel. Co.; G. A. Campbell, research engineer for Bell Laboratories; John J. Carty, vice president Am. Tel. and Tel. Co.

(sound navigation and ranging), they helped to locate a great many of the 996 enemy undersea craft sunk during the war. They helped clear the seas for the troopships and cargo vessels that made possible the successful Allied invasion of the Continent. Later, American submarines used sonar to hunt down Japanese ships.

Now that the war is over, artificial crystals are still being made, because the large sizes needed in filters in the telephone system are rarely found in natural quartz, even if there were enough quartz, which is doubtful.

Another example of how little things helped win the war is the story of the molecules of gold. In all the countless radio sets in airplanes, tanks, command cars, ships, and gun batteries, crystals of natural quartz were used to select out the different wave lengths on which these radios operated.

To make a crystal vibrate at a certain frequency, so that it will receive messages on one certain wave length, you have to cut the crystal to certain exact dimensions. But achieving just the right thickness to pick up the higher radio frequencies is too delicate a job to do accurately with tools.

That's where the molecules of gold came in. Bell scientists cut their crystals an infinitesimal amount off the required thickness. Then, by heating a tiny bit of gold, vapor was boiled off from it and deposited on the crystal in a layer a few molecules thick, until the crystal was altered to produce just the right frequency.

Gilbert Grosvenor

Dr. Bell Lends a Hand in Hauling Down One of His Big Man-lifting Kites

This is the same type of kite that lifted Lt. Thomas E. Selfridge, U. S. Army, to a height of 168 feet in 1907. It is built of tiny tetrahedral, or four-sided, cells, each of the four sides being triangular, a shape which provides great strength. Dr. Bell experimented with various kinds of kites at his summer home at Baddeck, seeking to solve problems of flight. A grandson, Melville Bell Grosvenor, aids in the foreground.

Not long ago a man riding in an automobile in Washington, D. C., picked up a telephone on the dashboard and talked to his wife in England, learning, incidentally, that their grandson had had his first tooth.

That was a demonstration of the new mobile radiotelephone service which is rapidly being put into use in large cities and on major highway routes in this country (Plate III). With this service you have in your car a telephone with its own number.

If you are a salesman, for instance, out around town in your car, the boss may want to tell you right away about a new good prospect for a sale. He merely calls your car telephone number, the call goes by wire to a radiotelephone station, then through the air to your car. A bell rings and a light flashes on your dashboard. You pick up the phone and carry on a conversation. Later, if you want to call the boss to tell him you put over the deal, you can call him direct from the car.

If you're out on the road between New York and Philadelphia, the boss can get you by calling long distance, giving your car telephone number, and saying he thinks you're about 20 miles south of Newark. The toll operator routes the call through the radiotelephone station that is nearest to that locality. If you don't answer, she tries the next station on down the road.

You can see this system's usefulness for salesmen, police, doctors, buses, newspapers, delivery trucks, and public utility repair crews.

Telephoning to passengers or the engineer on a moving train also will be possible. Eventually, you may be able to talk this way from one train to another in different parts of the country or even of the world, and probably between passenger planes and the ground.

Just delivering your voice anywhere you want it sent, over the existing maze of American telephone wires, is a big enough job. To transmit a human voice over the telephone, you need first to know how the voice works and what it can do, and to make it heard at the other end you need to know how the ear works and what it can and cannot hear.

Alexander Graham Bell, in one of his early experiments, sang songs into a human ear obtained from a medical school. He attached a thin straw to the inner part of the ear, fixed so one end rested against a plate of smoked glass.

When he sang into the ear, the sound waves set up by his voice vibrated the eardrum, and the straw made wavy lines on the smoked glass. In this way he obtained a picture of sound waves that helped in his invention of the telephone. You can still see those old glass plates with the wavy lines on them, preserved at the Bell Laboratories (page 281).

Today Bell scientists are still experimenting with the human ear. Between 20 and 40 thousand nerve fibers connect the ear to the brain. These nerves, telling the brain what the ear hears, form the last link in the process of transmitting the voice over the telephone.

New knowledge of deafness and what to do about it also has come from these studies of the human ear. A device to measure the hearing of a whole roomful of school children at once was developed by Bell scientists.

The children listen to a series of numbers spoken with steadily diminishing loudness, and write them down as long as they can hear them. The last number written indicates the degree of the child's deafness, if any. These tests, now widely used in schools, have shown that one of every 15 American school children is handicapped in his school work by some degree of permanent or temporary deafness.

One Person in 10 Is a Little Deaf

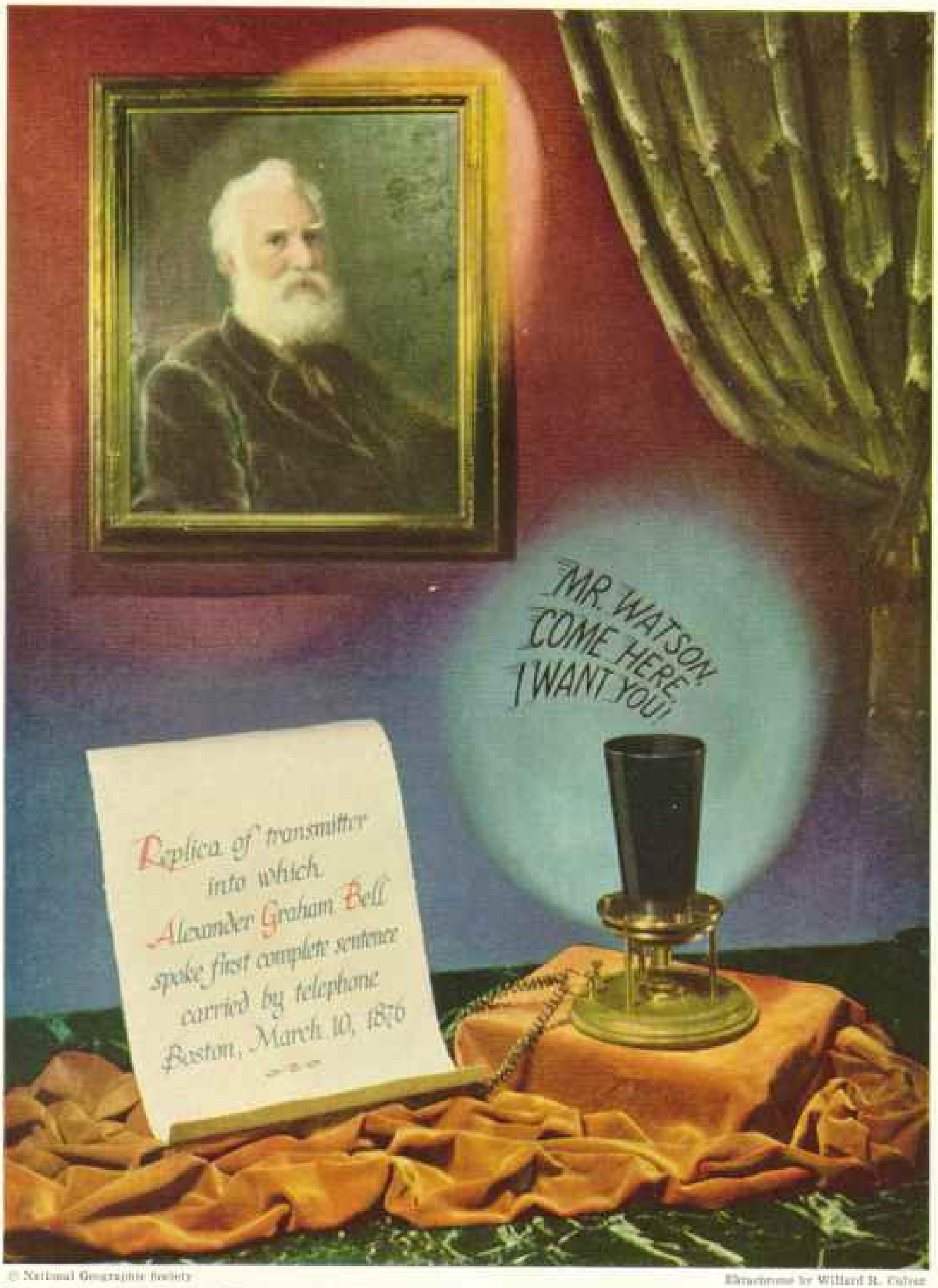
The hearing of more than half a million people was tested in the same way at the New York and San Francisco world's fairs of 1939-40, the first tests ever made of the hearing of a large cross section of the population. Results showed that one in every 10 persons is deaf to some degree, but that some people have supernormal hearing.

Speaking, of course, is just as important as hearing in the telephone system. It begins with the larynx, which contains the vocal cords. They really are not cords but two curtainlike membranes, in your throat behind your Adam's apple, that vibrate when you talk.

Seeking to learn how the vocal cords work, to see if the telephone transmitter was properly designed to handle the sounds that the cords give out, Bell Laboratories scientists took the first high-speed movies ever made of the vocal cords in action (Plate II). People used to think that the cords vibrated like a banjo string, but the movies, run in slow motion, showed that they really have a sort of wavelike action, somewhat like clothes flapping on the line on a windy day.

From the movies they learned, too, that sound comes from the vocal cords in puffs. Since the telephone was already designed to handle this type of energy properly, no changes were needed. The movies revealed that a person with a well-trained voice keeps his vocal cords closed until air pressure is built up in the chest and expelled strongly. In a person with an untrained voice the cords are open most of the time.

Birthplace of Telephone Magic



Rhodotrome by Willard R. Culver

2,000 Scientists Today Carry on the Work of Alexander Graham Bell, Inventor of the Telephone

In the vast Bell Telephone Laboratories they have produced near-miracles in telephone improvements and scientific weapons of war. Dr. Bell, whose portrait above was painted three years before he died in 1922, invented the telephone at the age of 29. First sentence was transmitted when Bell called to his assistant in the next room.

Photograph by Willard R. Culver

While She Says "Ah-h-h," He Shoots Fast Movies of Her Vocal Cords in Action, to Learn How the Voice Works

Strong light at the girl's left is reflected from the large square mirror to a dental mirror in her mouth, then down to her vocal cords. High-speed "Fastax" camera shoots through the hole in the large mirror to photograph the reflection of her vibrating vocal cords in the dental mirror.

© National Geographic Society

"Having a Lovely Drive, Dear. We'll Be Home by Seven"

New mobile radiotelephone sets installed in passenger cars or trucks make it possible to talk between a moving vehicle and the home or office. Telephone in a vehicle has its own number.

Photograph by Willard R. Culver

She Needs a Microscope to Adjust Tiny Vacuum Tube Parts

Magnification shows whether fine wires and other delicate parts are properly placed and tightly welded together. In assembling experimental tubes, gloves are worn because perspiration can corrode metal.

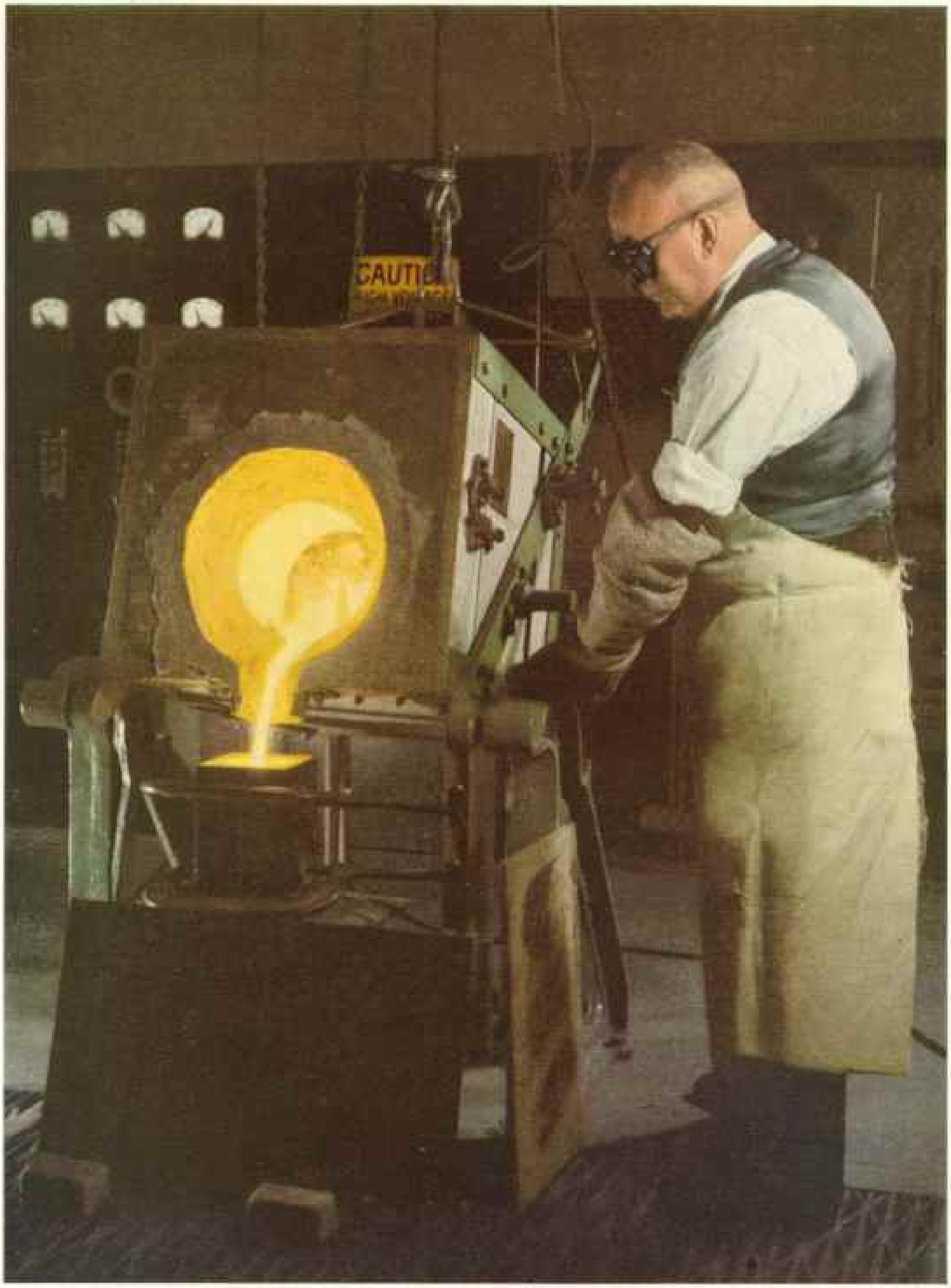
Telephone Pole Diseases Get Expert Study in Bell Laboratories' "Clinic"

Test poles, left to right, have been damaged by fungus, a woodpecker, carpenter ants, and rot caused by fungus. Scientist is removing spore-bearing organs of the fungus for study to find a method of protecting poles.

Illustrations by Willard R. Culver

50,000 Coal Granules, Used in Every Telephone, Cover Only a Playing Card Spot

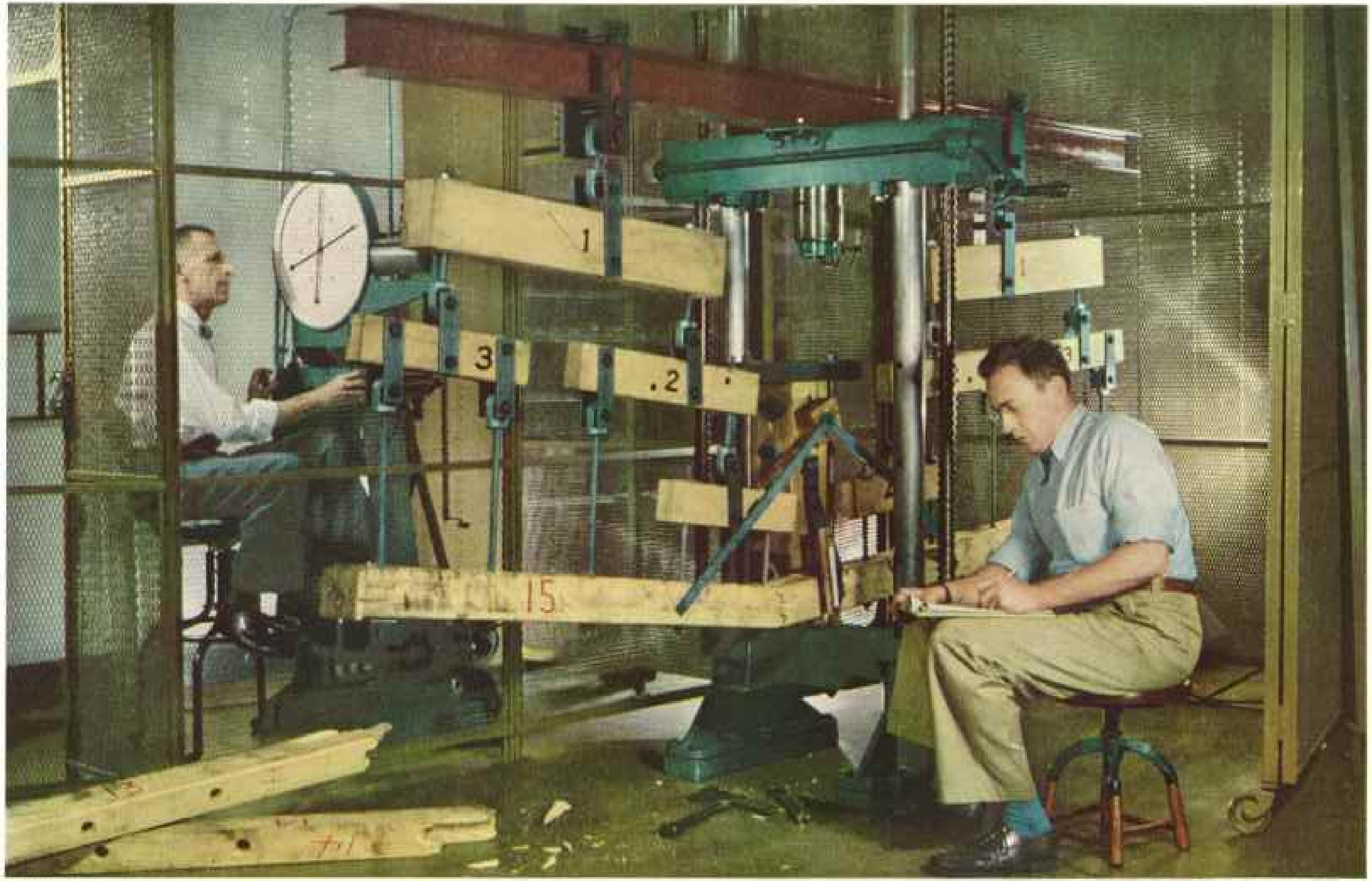
Tiny, specially treated particles, crushed from anthracite like the lump at right, conduct electricity and translate voice vibrations into electric waves on wires. Granules are held in transmitter in container in girl's hand.



 Ektachrome by Willard R. Culver

New Metal for Trial in Telephone Magnets Is Poured from "Self-heating" Furnace

Glowing golden at a temperature of 2,900° F., an experimental alloy of cobalt, nickel, and aluminum is run into a mold. Heating in the furnace is done by the induction process, in which electric current is generated in the metal. Resistance to the current's passage raises the metal's temperature to the melting point.



Kitaoshuma to Willard R. Culver

How Much Weight from Ice-laden Wires Will Break a Crossarm on a Pole? Hydraulic Machine Gives the Answer

Engineers test a crossarm to the breaking point. They use the machine to determine the strength of the various types of wood available for crossarms. Southern pine and Douglas fir crossarms, recently tested, broke under an average load of about two tons.

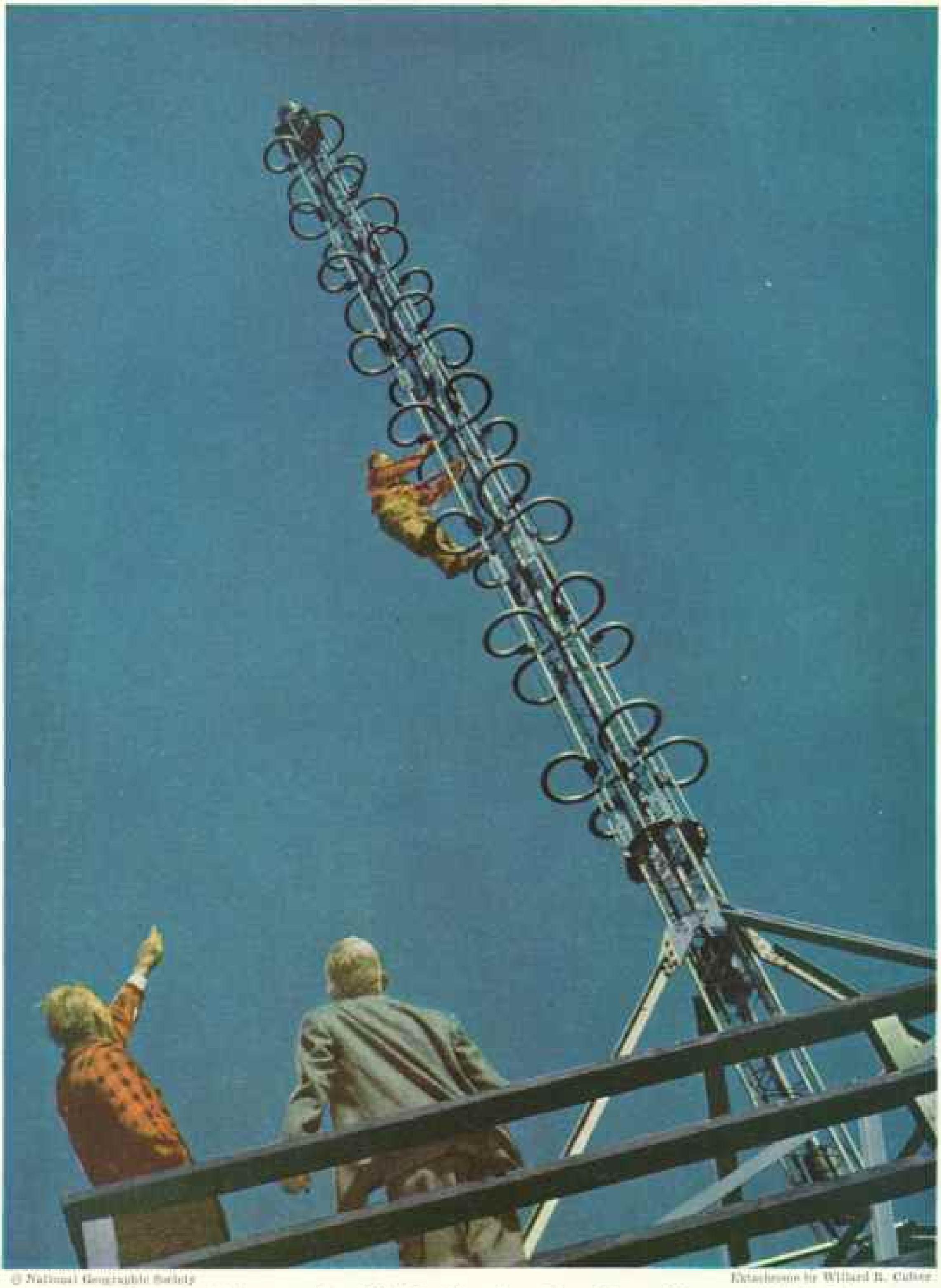
Charting Her Head Shape Makes Her Headset Fit Better

Seeking a more comfortable operator's headset, scientists measured skull contours with this device, nicknamed "crown of thorns." It showed human heads vary from almost flat to dome-shaped; so headsets were made adjustable.

Electronics by Willard R. Culver

Bells That Ring Your Telephone Are Tuned to Meet Your Needs

A scientist mounts gongs on a turntable on which they revolve. The arm at left swings a microphone in an arc to pick up the sound from all angles for analysis of the bells' quality and power.



 Extachrome by Willard R. Culver

New "Cloverleaf" Antenna for FM Broadcasting Cuts Down Waste of Radio Energy

It was developed by Bell Laboratories for the new frequency modulation broadcasts, which give more lifelike reception and are free of static. From the antenna, radio waves are radiated horizontally, concentrating them toward receiving stations, with fewer sent upward to be lost.

Women's vocal cords are shorter than men's, and this is the reason why their voices are higher-pitched. Opera singers have had their vocal cords photographed by the Bell people in efforts to improve their performance. Doctors are using the high-speed camera to photograph diseased vocal cords.

"First step in making a telephone work right is getting your voice into it," one of the Bell engineers told me. "That's not as simple as it seems. When you talk, the sound waves resonate in the cavities of your mouth and throat and are shaped by your teeth, tongue, palate, and lips.

"About half the sounds you utter are made within the mouth, the other half coming from the vocal cords. When the sounds come out of your mouth, they billow and eddy all around your head, besides traveling straight forward.

"To find out how the voice behaves and how it is transmitted, we use an artificial voice which reproduces all typical voice tones (Plate IX). We found that our efforts to make voices more understandable over the telephone tended to reduce naturalness, and so we try to strike a happy medium. The human voice ranges over about five or six octaves, but not more than about four octaves need to be transmitted over the telephone for good hearing. To transmit the other octaves would be unnecessarily expensive and complicated.

Artificial Voices at Work

"Incidentally, we have artificial voices working regularly as part of the telephone system. Sometimes from a dial telephone you may call a number which is in an exchange where operators handle the calls; so, when you turn the dial, it starts an artificial voice speaking, and this repeats aloud in the operator's headset the number you have dialed. This is done with numbers recorded on sound movie film, and the dial system selects the numbers to be 'played.'

"To do its job well, the telephone mouthpiece should be right in front of the mouth, and the receiver end of the handset should be right by your ear. That means the handset has to be just about the proper length to reach from the average ear to the average mouth. The connecting piece has to fit around the face. We measured hundreds of human heads, big and little, fat and thin, male and female, to design a handset that fits them all.

"How many times have you dropped your telephone on the floor? How many times in a year do you bang it down on the hook when you finish talking or get a busy signal? Not long ago a woman in Washington, D. C., hit a holdup man on the head with her telephone when he tried to stop her from calling the police. It didn't break.

"We make the handset tough by baking the plastic with an electronic process that generates heat inside the material, heating it equally all the way through. On a testing machine we can bang down a handset on the hook enough times in 24 hours to duplicate the wear it gets in 40 years of use" (page 314).

Why is it hard to understand women? That, too, is a problem for Bell Laboratories men. It's not a matter of "advice to the lovelorn" or trying to figure why ladies change their minds. It's why women are somewhat harder to understand over the telephone than men.

The answer is that higher-pitched female voices disturb the inner membrane of the ear in only half as many places as the lower voices of men. The higher frequencies of their voice tones are not heard because the ear is less sensitive to them. Yet the telephone must overcome this handicap as well as possible.

When you telephone today in any good-sized city, your voice is directed to its destination by a mechanical brain that works faster and in many ways better than any human brain ever could (Plate X). This "brain" is part of the "dial system," developed in its present form by Bell Laboratories engineers.

When you pick up the telephone and start to turn the dial wheel, the "brain" goes into action. First it notes the number you're calling, which is, say, Elmhurst 6-6352. Then it hunts through the maze of telephone channels for a clear route from your own exchange to Elmhurst. It sets controls to keep that route clear, connects you to Elmhurst, finds the terminal of the 6352 line, connects you to it, and then drops out to handle another call, all in a matter of seconds.

If in setting up a call the "brain" runs into trouble in getting through, it turns on a set of lights to show where the trouble is and rings a bell in the wire chief's office.

Relays Run the Dial "Brain"

Electrical relays play a large part in making the dial "brain" work. A relay may have as many as 60 electrical contacts which can open and close much as you open and close your thumb and forefinger. Part of each relay is an electromagnet made of a coil of wire wound on an iron core. When current flows through the coil of wire, the iron becomes a magnet and pulls the "thumbs and fingers" of the relay together. Current then can flow through and on to another relay, where it activates another magnet, thus closing another contact; and so on.

Gilbert Grosvenor

No Man Left the Ground to Build Dr. Bell's Tetrahedral Tower at Baddeck

Wanting a lookout on his mountaintop, he invented this type of construction using tetrahedral cells. Two legs of the tower were constructed on the ground from ¾-inch pipe and joined together. As the third leg was built and jacked up, the tower was hoisted until erect. The 54-foot structure was exceedingly strong and weighed only five tons. The inventor is buried here overlooking the Bras d'Or Lakes.

When all the relays between you and the number you're calling are closed, the current carrying your voice can travel all the way through. When you hang up, the current stops flowing, the relays spring open and are ready to handle another call.

On an average call in the latest type of dial system about 5,000 such contacts operate to make the connection. Each contact is really a pair of bars only 1/16 of an inch long. When the thumb and finger of the relay close, those two bars must meet firmly.

If a single relay fails to close, or to spring open again when the call is ended, or if the two contacts do not touch properly, or are worn, or dirty or tarnished, trouble will result.

Relay contacts used to be made of platinum, because, like all precious metals, it does not tarnish and will not melt under the heat generated by current passing through it. But platinum is costly, and hard to get in time of war when foreign supplies may be cut off. So Bell engineers developed a contact of palladium, another precious metal, also tarnish-proof and much less costly than platinum.

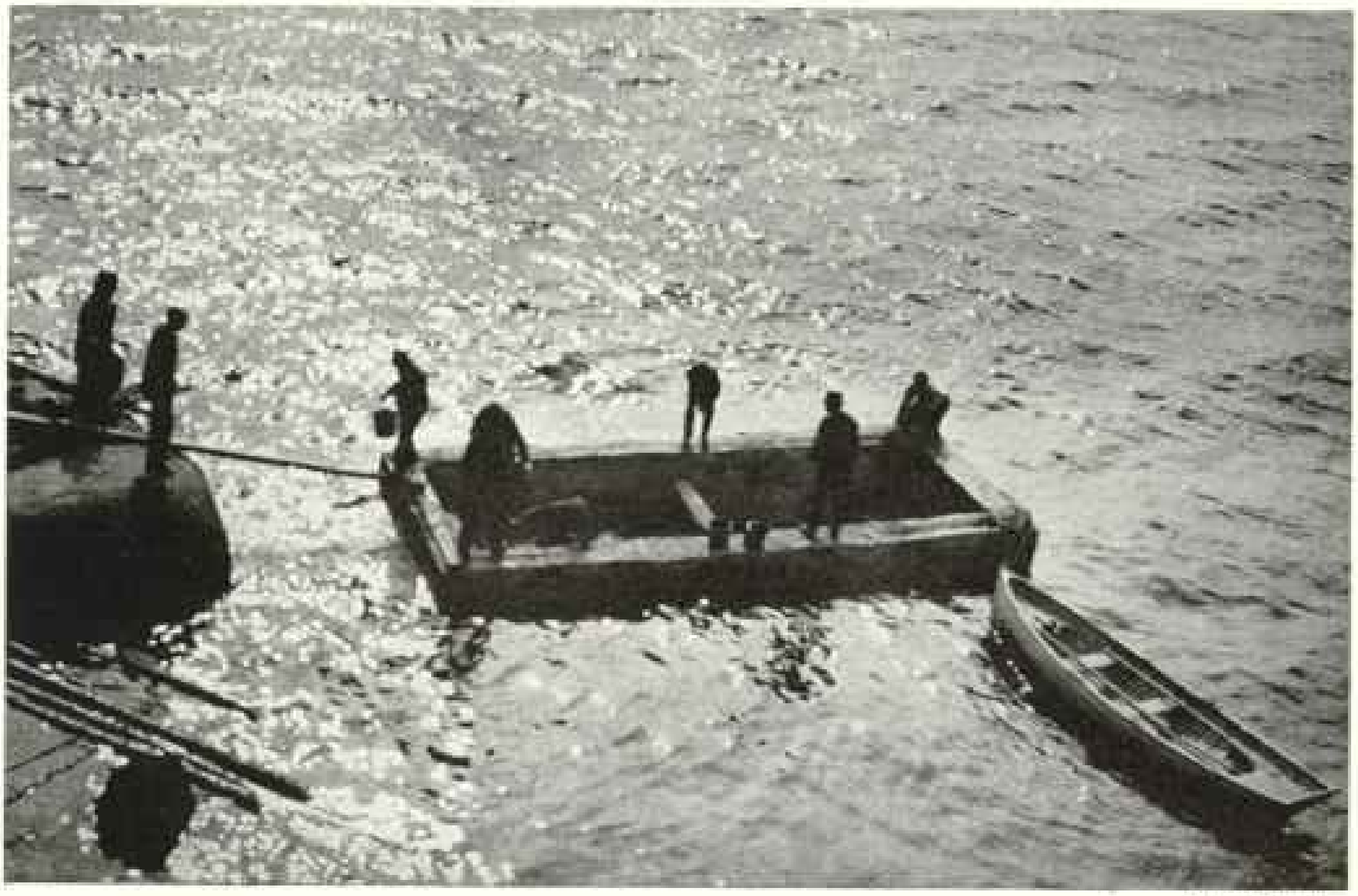
But dirt may collect even on palladium. Dirt on a contact interferes with smooth passage of current and may stop its flow entirely. This puts unwanted noise in the telephone and may even make it go dead. In their intensive war on dirt, Bell scientists have taken dust off contacts and analyzed particles of it weighing as little as 24 millionths of an ounce.

They've had to deal with cotton lint blown on contacts from a near-by laundry ventilator, and with gases and smoke particles present in the air in some industrial cities. To cut down this kind of trouble, air is filtered before it enters the rooms where dial "brains" are working.

As a further safeguard, contacts now are built in twin arrangements so that, if dirt

Dr. Bell Devised a Concrete "Mulberry" Like Those Used in the Normandy Invasion

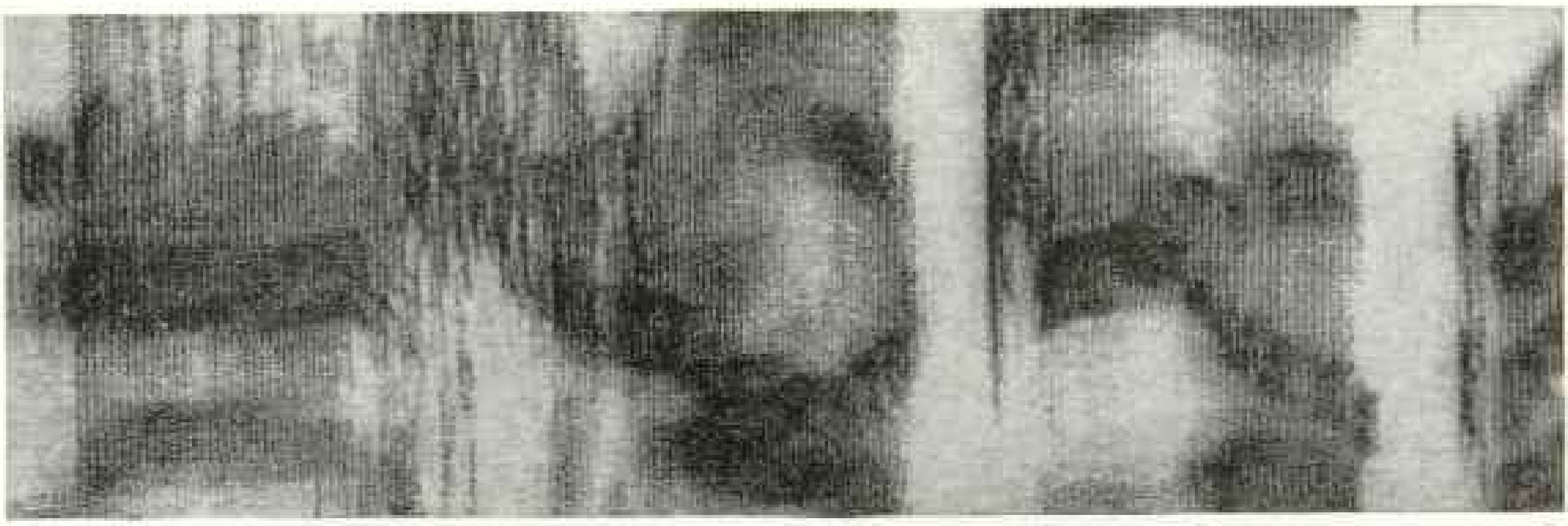
He and F. W. Baldwin (left) designed it in 1916 to use as a dock on steeply sloping rocky bottom where piles could not be driven. After being launched like a ship, the concrete caisson was towed into position and sunk, as were the larger "Mulberrys" that formed artificial harbors for the Allied landings of 1944.



Gilbert Grosvenor

In Position, the Caisson Is Sunk by Pulling a Plug in Its Wooden Bottom

Its underside was shaped to fit the contours of the lake floor as determined by soundings. Filled with rocks and topped with concrete, the dock served for many years at the inventor's summer home.



In "Visible Speech," the Words "National Geographic Society" Take This Form

With an apparatus developed by Bell Telephone Laboratories, spoken words are transformed into visible patterns which can be read. They form lines and shadows of varying shape and intensity which represent not letters but sounds. Note the similarity of the patterns made by the short "A" sounds in "National" and "Geographic." Music, bird songs, and noises also can be made into visible patterns.

spoils the working of one pair, the other can handle the entire load of current. By cutting down the size of contacts, the cost of the twin arrangement has been made less than that of the former single contacts.

Today the dial brain is even handling many long-distance calls. A man in Philadelphia, calling a Richmond, Virginia, number, gives the number to the Philadelphia toll operator. She dials a code number that connects her with Richmond and then dials the Richmond number direct from Philadelphia. This method is already in use in several large cities and eventually will be extended over the whole United States.

Giving Your Voice a Boost

Electrical energy rapidly dies away as it travels along a wire, and the smaller the wire or the higher the frequency of the current, the faster it dies. In some cases it may die away to one millionth of its starting energy in only seven or eight miles! In Alexander Graham Bell's day people used to speak loudly to overcome this loss on local calls, but on a transcontinental call that wouldn't help.

In old times they used wire as thick as a pencil to cut down the loss, but with the number of telephone lines in use today such wire would be outrageously costly. Bell Laboratories men overcame that hurdle with the vacuum tube amplifier, or repeater, which in effect takes the faint dying whisper of your speech and turns it into a mighty shout that carries as far as the next amplifier.

On a typical New York to San Francisco call it takes about 180 repeaters, spaced every 16 miles, to boost your voice along, like a series of men on mountaintops, each one hearing the faint call of the man to the east and bellowing it on to the next man to the west.

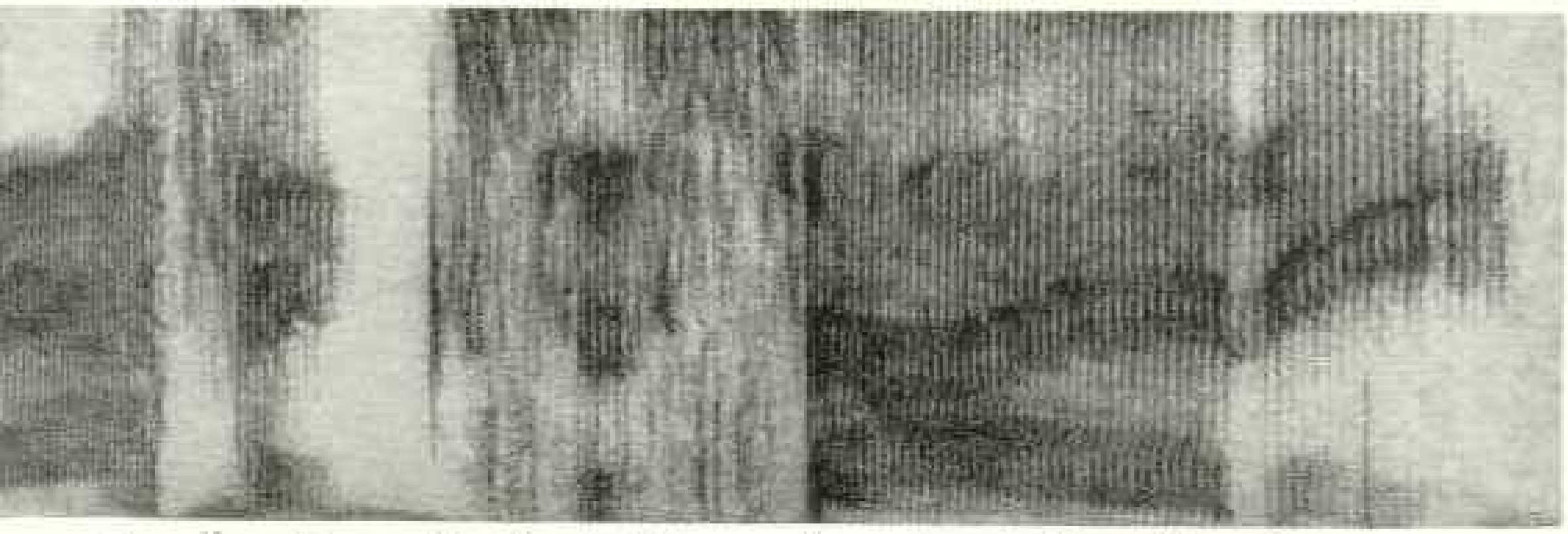
You must not let the voice's energy die away too much before amplifying it, however, for then it gets fainter than the noise of the electrons eternally dancing inside the circuits which carry your voice. Then, when you amplify, you amplify the noise, and the voice is lost in the vastly magnified roar of those dancing electrons, which otherwise no human ear ever hears.

Amazing as it may seem, on a cross-country call voice tones echo back along the wire from the other end of the line, a real transcontinental echo. Even though your voice travels thousands of miles a second along a wire, there is sufficient time lag so that the man on the other end hears both you and your echo, a kind of confusing double talk. Bell men finally licked the echo with a device that stops it from returning while you're talking.

Ever since Alexander Graham Bell telephoned his first sentence over a wire between two rooms in 1876, telephone talk has traveled over ordinary parallel wires. But today such wires cannot do the whole job.

Bell scientists are developing brand-new ways of transmitting your voice. One of them is the new coaxial cable, consisting of several hollow tubes with a single thick wire inside each tube. This cable is already in service between a number of large cities and is being extended to cross the continent.

Still other ways to transmit your voice, without using wires at all, also are being



Bell Telephone Laboratories

This Invention May Help the Totally Deaf to Speak More Clearly

Many people who have been deaf from birth or early childhood do not speak well because they cannot hear the correct pronunciation of words. With "visible speech" they can compare patterns made by their voices with those of correctly pronounced words until the two match. In a similar way the device can be used for teaching pronunciation of foreign languages (page 273).

studied by Bell men. They are experimenting with very short electric waves vibrating billions of times per second. Such waves won't stay on wires. They must either be shot off into space as radio waves or captured and guided along the inside of a hollow conductor or pipe.

Some day these extremely short waves may be carrying hundreds or even thousands of telephone conversations at the same time, each on its own wave length, without interfering with each other, over a single electrical pathway.

Television, too, is coming more and more to the fore. Television can be broadcast through the air only a few miles around each broadcasting station. To travel any distance it must be carried over some kind of channel or pathway, and the telephone system provides a network to do this (Plate XV).

But, to transmit a television picture, you must transmit almost instantaneously all the degrees of light, shadow, and perhaps color in each of several hundred thousand different parts of the picture, and do it all over again 30 times each second. It takes a broad band of frequencies to do this job, and such a broad band cannot travel more than a short distance over ordinary telephone wires.

Telephoning Without Wires

So new kinds of telephone pathways, which can carry many telephone conversations at once, and television programs as well, are coming into use. One is the coaxial cable, already mentioned, with its hollow tubes or pipes with a thick wire inside each. Through such a cable, using six different tubes at once, you can send 1,000 telephone conversations and several television programs, all at the same time.

Another new kind of telephone pathway is radio-relay, which uses a tight, straight, pencil-shaped beam of very short radio waves instead of wires or cables. These waves are largely free from static.

Bell engineers see the time when many hundreds of telephone conversations or as many as half a dozen or more television programs may be sent over this beam at the same time.

Radio-relay uses short radio waves that travel in straight lines and, unlike longer waves used in broadcasting, do not follow around the curvature of the earth. Beyond the horizon these short waves go off into space; so, in order to transmit them any distance along the earth's surface, they must be picked up at a line of sight distance on the horizon and relayed on again to the next horizon. Thus they move in a series of short jumps between towers on mountaintops or other high points.

Radio-relay is now being installed by Bell engineers between New York and Boston. A radio-relay network eventually may spread all over the country, supplementing long-distance telephone cables.

Still another new kind of telephone pathway, a revolutionary new way of transmitting electricity, is the "wave guide," which is really just a hollow pipe. Electric waves travel through it like sound waves through a speaking tube.

It can handle very short waves that would

Gilbert Grosvenor

Alexander Graham Bell with Three of His Grandchildren on Cape Breton Island

With his white beard and portly figure, the inventor in this pose resembles a jolly Santa Claus. He is clad in one of the homespun working suits that he always wore while at his summer home, Beinn Bhreagh (Gaelic for "Beautiful Mountain"). Here, in a private laboratory staffed with skilled workmen and technicians, he carried on much of his tireless experimenting, keeping detailed notes on everything. With two other noted scientists, S. P. Langley and Simon Newcomb, he once spent hours dropping a cat from his porch trying to discover why a cat always lands on its feet.

In a Characteristic Pose, Dr. Bell Plays with a Grandson

On the porch of the Bell summer home at Baddeck, Nova Scotia, the inventor entertains the boy by causing "an earthquake," collapsing his knees suddenly. Dr. Bell is survived today by two daughters, Mrs. Gilbert Grosvenor and Mrs. David Fairchild, nine grandchildren, and 19 great-grandchildren.

quickly die away in a wire; so someday, using such waves, it may be possible to send through the wave guide thousands of telephone conversations at one time and many television programs.

Some time, perhaps, wave guides may be used for long-distance telephoning, supplementing present-day cables, so that your voice would be "piped" to its destination instead of "wired."

As electric waves come out of the end of a wave guide, they can be focused by a special metal lens so that they form a narrow, tight jet or beam, just as a glass lens focuses a searchlight beam. You can aim that beam to hit something, or move it around to find something, as you would a searchlight beam.

Talking over a Radio Beam

Such a beam is used in radio-relay telephoning and in radar. In radio-relay you can aim the radio beam to hit squarely a small 10-foot receiving antenna 30 miles away on the next mountain. In radar you can sweep the beam around to find hostile planes or ships, or to locate other planes or ships in fog or darkness.

But wave guides, radio-relays, and coaxial cables are not much good unless you can amplify the waves that they carry. Those waves, just like the waves that travel on wires, need a good strong boost every so often to help them on their way.

Bell scientists are experimenting with a new way to do this by using a sort of "electron wind." This "wind" does its work in a new kind of vacuum tube, the "traveling wave tube." Short waves carrying your voice or television signals are fed in at one end of the tube and travel inside it through a coil of wire.

An electron gun at one end of the tube shoots a stream of powerful electrons down through the inside of the coil. Just as a wind blowing past ripples in a pond makes them into bigger waves, the electron "wind" gives a boost of energy to the electrical waves traveling through the coil, sending them on with new power.

Other Bell Laboratories men, meanwhile, are doing things perhaps easier to understand, such as finding how tree branches rub insulation off wires and how to make insulators for telephone poles that won't break when small boys throw rocks at them. Such things may happen right in your own yard, a little closer to home than the mysteries of the electron.

On a 100-acre "test farm" near Chester,

New Jersey, is a dense grove of young birch trees among which are strung strands of "drop wire," the kind of wire that connects your telephone to the main line along the street. These little birches quiver and sway in the slightest breeze and their branches rub on the wire, to show whether they will rub through new, tough kinds of insulation.

Even out in the open where no branches rub on it, insulation on a drop wire sometimes breaks down. Bell scientists found it was caused by ultraviolet light from the sun and ozone in the air causing a chemical reaction in the insulation. In the laboratory they made new kinds of insulation, bathed them in artificial ultraviolet light and man-made ozone until they had something that would stand up.

Only "crop" on the Bell test farm comes from a bed where various kinds of fungi grow in a low, moist, shady place. Driven into the ground in the bed are stakes made of samples of all kinds of wood, to test how fungi in the soil may cause the wood in telephone poles to rot and how various kinds of chemicals protect the wood from this attack.

On a near-by hill are set up rows of full-sized poles, some treated and some not, to see how they resist moisture and rot (Plate IV). Poles are impregnated with creosote under pressure to prevent rot, but Bell men found that fir poles are best treated when green, while poles of southern pine need to be seasoned first.

Dancing Wires Make Trouble

Out in the West's "great open spaces," and in other exposed places, strong winds often set wires and overhead cables to swinging. As wires swing, they may make contact with one another, spoiling the transmission of telephone talk. Swinging cables may crack the protecting lead sheath.

This Jersey farm has machines to swing wire and cable artificially, just as the wind does it, over and over, millions of times, at the same time checking the number of hits when the "wind" blows at various speeds. From this Bell scientists figure how far apart to string wires so that they won't hit each other.

They've even taken movies of wires dancing in a high wind and then run them in slow motion. They slip sections of rubber hose over wires, too, to imitate the effect of icing, to see how much more leverage this gives the wind in swinging the wires and how much strain built up in this way is needed to break a wire.

Here, too, they bury samples of cable, conduit, and other things used under ground in the telephone system, to learn how they stand up and whether water will seep in. Once a neighboring farmer, seeing two scientists digging up a piece of cable about dark one evening, thought they were gangsters hiding a victim's body and called the State police!

Meanwhile, other Bell engineers are making plans for a new and better telephone link between America and Europe, a telephone cable under the Atlantic, first transoceanic telephone cable ever laid.

You can telephone across the Atlantic now, of course, by radio. Most of the time it works well enough. Radio waves that carry your voice travel in a series of bounces between the earth and the ionosphere, an electrified region of the upper air between 50 and 250 miles aloft.

But when sunspots are numerous, showers of electrified particles shoot off from the sun and disrupt the ionosphere. Instead of bouncing back down from it, the radiotelephone waves are absorbed in it or go on through and are lost in space. Sometimes, too, different components of the radio waves arrive at slightly different times, causing fading and distortion.

In a cable this wouldn't happen. You may ask, then, why a telephone cable wasn't laid long ago, since transatlantic telegraph cables have been in use since 1866. A telephone cable was designed, about 1930, but it could carry only one conversation at a time. Some radiotelephone circuits now are handling three at once to Europe.

To make an ocean telephone cable that can carry that many or more conversations at once, you need to put repeaters along it, the same as on long-distance cables on land, to pick up the dying power every so often and give it a new boost onward. On land the repeaters are above ground where you can get at them to make repairs and replace the tubes and batteries. You can't do that on the ocean bottom.

But now Bell men are working on a telephone repeater that fits inside a cable and can be wound on a cable drum without being damaged. They've designed a new, tiny, but long-lived vacuum tube for these repeaters which has every prospect of lasting many years inside the cable on the ocean bottom. They plan to send power out to the tubes from land along the cable itself and hope the cable will carry up to 20 conversations at once.

Radar, Child of the Telephone

When the Nazi menace began to grow in Europe and while most Americans still were arguing about preparedness, scientists of the Bell Laboratories cooperating with the Army

Birthplace of Telephone Magic

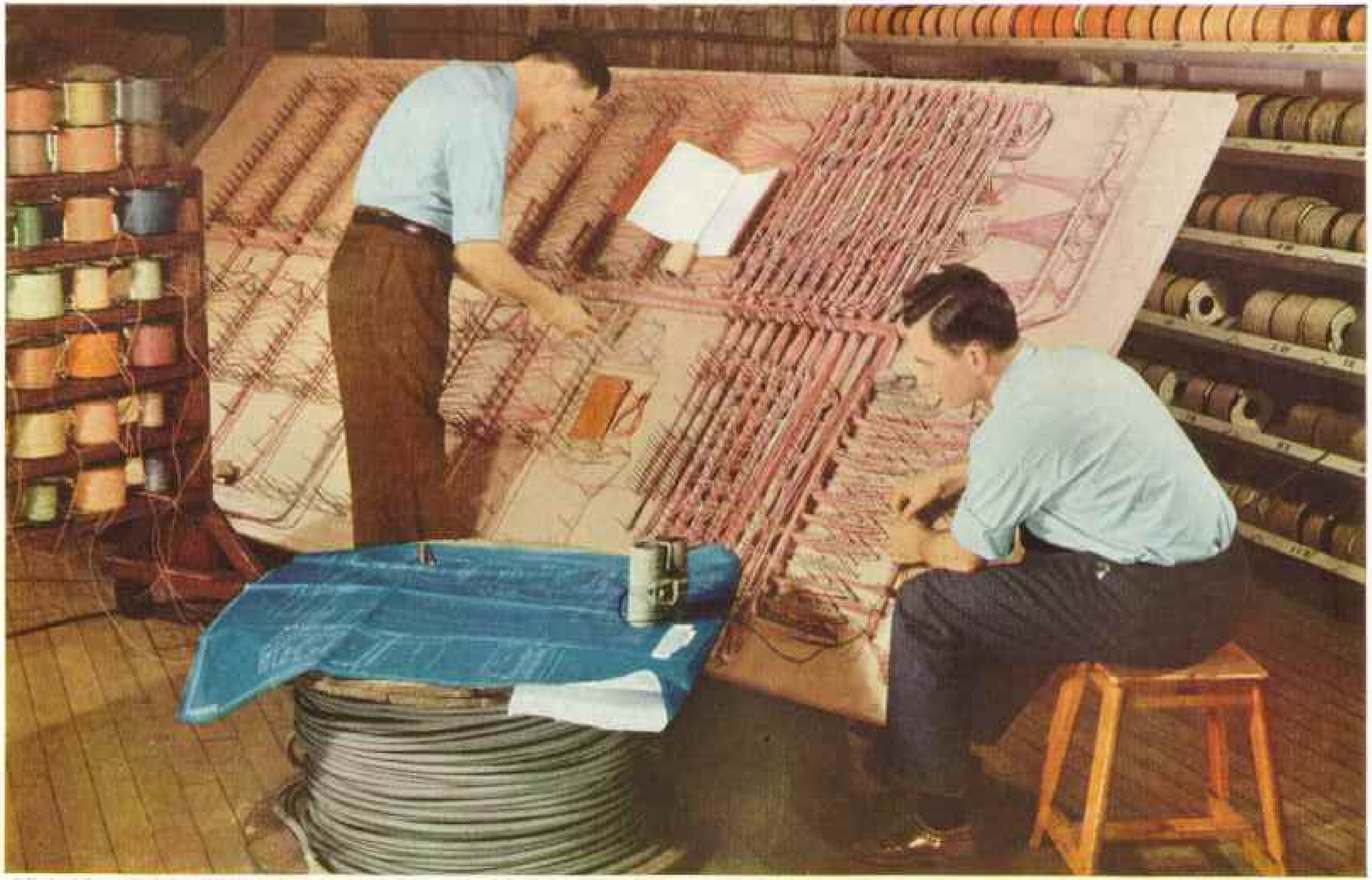
1,500,000 Vacuum Tubes, from Peanut to Coffee-urn Size, Work in the Telephone System

Two largest "overseas" tubes boost the voice across oceans. Overland amplifiers send the voice across country. Power plant tubes charge batteries. Magnetron tube on black base in radar group was a "secret weapon."

 Photograph by Willard R. Culver

For Best Results, Hold Your Telephone Close to Your Lips

The telephone's ability to pick up speech at various distances from the mouth is tested in a soundproof room. A loud-speaker inside the dummy head emits typical human words and sounds.



Ektachrome by Willard R. Culver

Ever Try to Design a Nervous System? They're Doing It Here, with a Wire Pattern for a Dial Telephone Apparatus

Stringing hundreds of wires in a complicated arrangement on nails driven into a large board, Bell Laboratories' engineers assemble a working model for an automatic telephone exchange panel that handles calls without operators' aid. Pattern is laid out from the blueprint. Wires are matched by their colors.

Photograph by Willard R. Culver

When She Drops In a Coin, He Listens to See if the Signal Tells Clearly Whether It's a Nickel, Dime, or Quarter

Because service is speeded up if an operator knows unmistakably what coins are being dropped into a pay-station telephone, Bell Laboratories' scientists make careful tests of the signals' clarity. This experimental setup simulates a telephone office circuit.

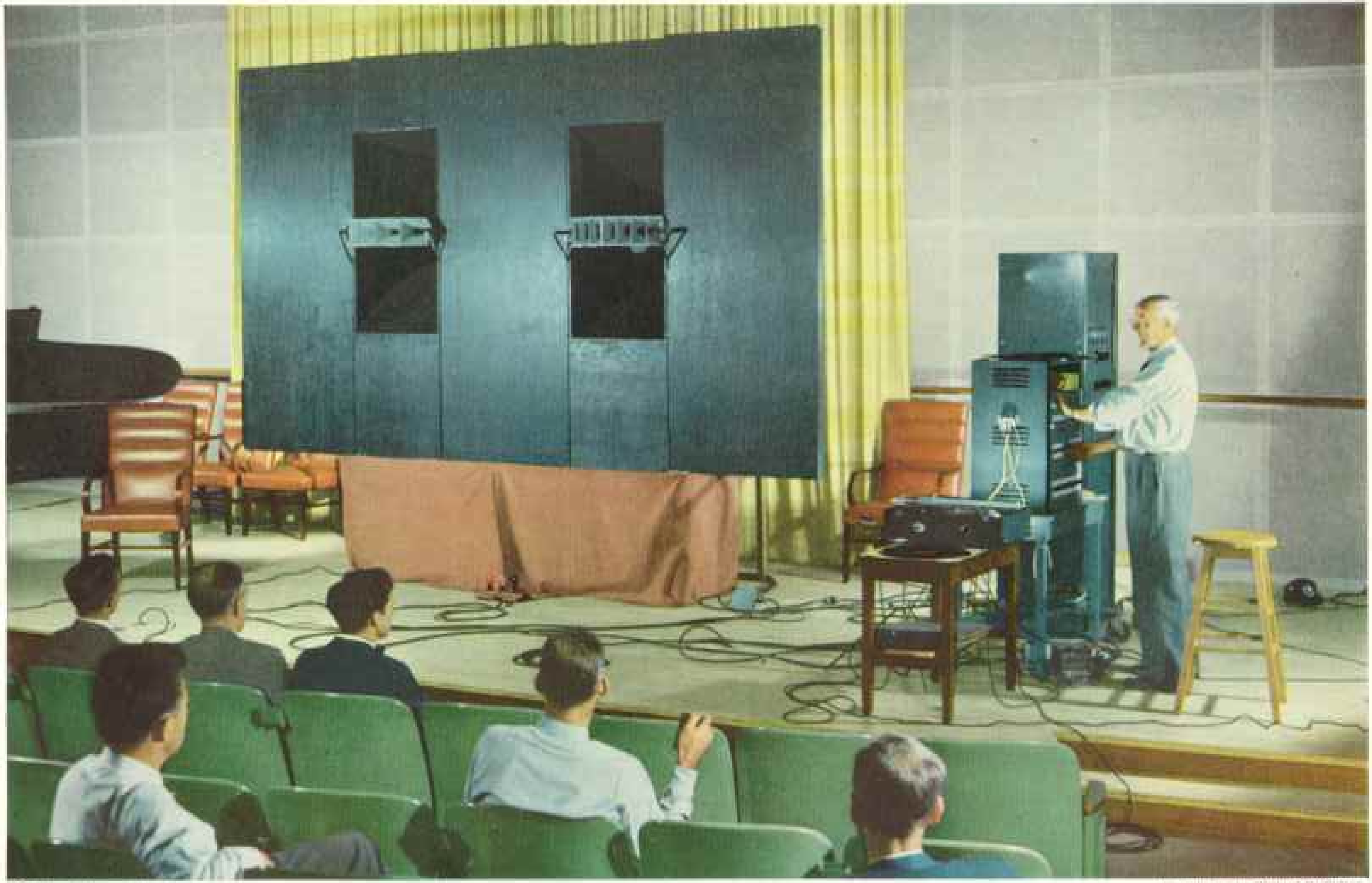
Man-made Crystals, Better in Some Ways than Natural Quartz, Are "Grown" in Chemical Tanks for Telephone Use

Crystals are grown by rotating "seeds" (Plate XIII) in a chemical solution. Chemicals deposited on the seeds build them up to desired size. Because plates cut from crystals vibrate at precise frequencies, they are used to filter out single conversations from the many that travel together over telephone lines.

 Ektachrome by Willard R. Culver

Synthetic Crystals Used in "Sonar," Submarine-detecting Device, Helped Defeat U-boats in World War II

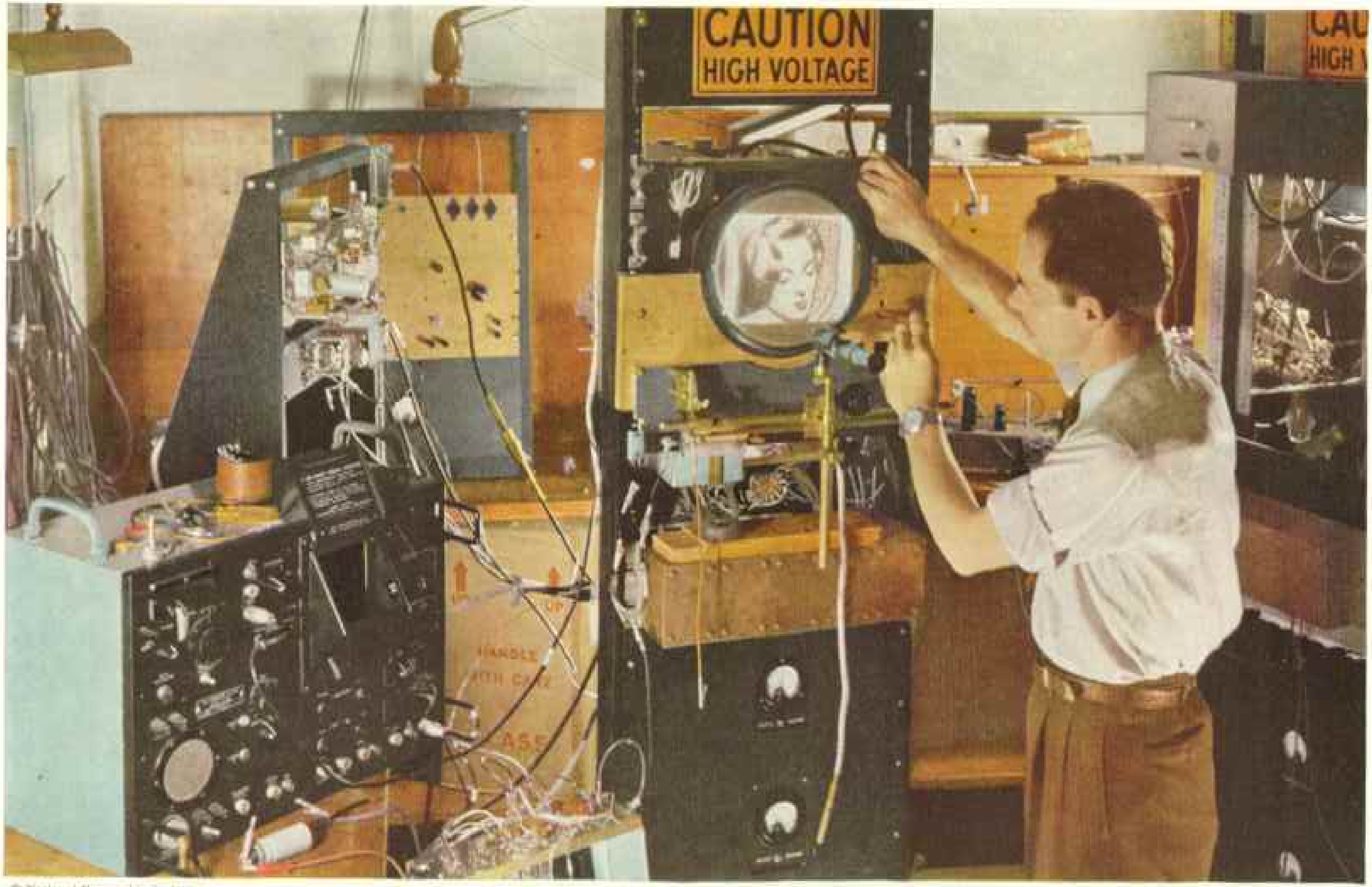
Thousands of the two-pound production-type crystals (foreground) were grown during the war, and plates cut from them were used as oscillators in sonar. Tiny "seeds," made by evaporating chemical salts, are used to build up larger seeds from which crystals are grown (Plate XII). Big 43-pound crystal is experimental.



Kindachrome by Willard R. Culver

Critics with "Golden Ears" Hear New Loud-speakers Designed to Reproduce Music and Voice with High Realism

Selected as good judges of musical reproduction, these men check performance of two units for use in theaters and halls. High-frequency notes come from the groups of horns in the center, and low frequencies from larger horn openings above and below. Audition is in the Bell Laboratories' auditorium, designed for acoustical research.



Illustrations by Willard R. Culver

Checking the Quality of Television Pictures Sent over Telephone Lines Will Be the Job of This New Receiver

Because television broadcasts can travel through the air only as far as the eye can see, they must be sent over longer distances by the new coaxial telephone cable. A Bell Laboratories' engineer tunes in on a program to check how his experimental apparatus is working.

Oil painting by Willard R. Culver

This Radar That Spots Planes 100 Miles Away Came from Telephone Men's Design

The hook-shaped wave guide sprays radar pulses against the antenna, which sends them out. Echoes bouncing back from the target are caught by the antenna and carried by the wave guide down to the "scope" where the target's image is seen. Bell Laboratories used telephone knowledge to develop many types of radar.

and Navy quietly began to get ready for war.

Since 1937 they had been experimenting with radar, but no one had found a way to generate short waves for the radar beam that would reflect back an accurate image of what it found, so that you could tell whether your radar had picked up a battleship or merchantman, a bomber or a fighter plane.

One day in 1940, long before Pearl Harbor, when England stood alone against the Germans, some English scientists brought to America a new kind of vacuum tube, the magnetron, which they had developed. It was a new, powerful generator to produce short waves that would bring back a more accurate image of what the searching radar beam found. Bell men, cooperating with the British, developed and improved the magnetron even further.

Radar was "right down Bell men's alley." Working in peacetime to improve the telephone, they had developed new gadgets and "know-how" that fitted into radar like pieces of a puzzle. Radar sets used many of the same things that Bell men had developed for the telephone system.

Vacuum tubes, used in radar to amplify the faint returning echo, were developed from similar tubes that amplify telephone signals. Saucer-shaped antennas, used to direct radar waves outward and catch them when they echoed back, are near kin to antennas used in telephoning by radio-relay (Plate XVI).

And the wave guide, already mentioned (page 301), which was used to carry the more sensitive types of radar waves from generating tube to antenna, grew out of Bell Laboratories' search for ways to transmit electric waves of very high frequency.

What radar did is well known. One U. S. warship, with radar-aimed guns, sank an enemy vessel eight miles away at night with only two salvos. At Anzio beachhead radar-equipped guns and planes broke up German pattern bombing. Radar-directed guns shot down all but three of 105 buzz bombs launched one day against London.

Radar in America was jointly developed by Bell Laboratories, the Government's Radiation Laboratory at Massachusetts Institute of Technology, the Naval Research Laboratory, the Army Signal Corps Laboratory, and other Government, industrial, and university laboratories.

All cooperated fully, and, together with British scientists, they gave America and her Allies radar sets better than the enemy ever had. Undoubtedly radar greatly shortened the war and saved countless lives.

When the Germans invaded France and the Low Countries, nothing seemed to be able to stop their air force. Antiaircraft fire was not much more accurate than it had been in World War I, when it took an average of 17,000 shots even to hit a hostile aircraft.

One Bell scientist, who like many others had been worrying about the Germans' successes, happened to be working on a potentiometer, or voltage-measuring device, used in connection with sending currents through long-distance telephone cables.

Scientist's Dream Helps Win the War

One night this scientist had a dream. In the dream he saw a potentiometer mounted on the trunnion of an antiaircraft gun, and the gun was automatically "tracking" or following the flight of an airplane.

Unlike most dreams, this one stayed with him. When he woke up he jotted it down, and in this way was born the idea of the amazing electrical gun director, which gave American and British antiaircraft guns almost unbelievable accuracy. It was developed entirely by Bell Laboratories men, based directly on work they did to improve the telephone.

You can appreciate what the gun director had to do if you've ever shot ducks on the wing or tried to swat an elusive fly. You know how hard it is to figure in advance where the ducks or the fly are going to be the next second so that you can put your bird shot or your fly swatter in the right place at the right time.

Think how much bigger a job it is to fire an antiaircraft shell so that it comes near a plane flying 300 miles an hour, and with the fuse set to explode when it is near enough the plane to do some damage.

To score a hit you have to know the height of the plane, its speed and direction of flight, and the distance from the gun to the plane, which is constantly changing. You must know also the velocity of the shell leaving the gun, the speed and direction of the wind blowing against the shell, the temperature of the air, the pull of gravity on the shell, and the effect of air friction.

All this helps determine how far ahead of the plane to aim, so that shell and plane will meet. When you're shooting at a flock of ducks flying past, you may "lead" them with your gun by three or four yards; but you often "lead" a bomber formation with your antiaircraft guns by three or four miles!

When you have all the data, you have to perform an intricate mathematical calculation, and from the result you aim your gun. If you did this by ordinary methods, the planes would be long out of sight by the time you finished.

Staff Photographer Willard R. Culver

"Drop Test" Helps Make Handsets Hard to Break

Dropping nearly six feet down a slide, this one bounces unharmed off an iron anvil. Others, on the floor, illustrate how some samples fail when carried to destruction in this type of test. Modern handsets are molded from plastic powder electronically preheated to increase strength (page 297).

But the Bell Laboratories men developed an electrical brain that does all the calculating in a fraction of a second. Its working is not really hard to understand. Into the calculator is fed so much voltage for the plane's speed, so much for its height, so much for the shell's velocity, pull of gravity, force of the wind, etc. You might say that each intake of voltage in effect turns the gun a little to the right or left, or pulls its muzzle a little up or down.

When all the voltages have finished pushing and pulling on it, the gun is pointing so that the shell it fires will hit the target. The electrical brain does all this pushing and pulling in a fraction of a second. It also operates the fuse setter, which adjusts the fuse on each shell to make it explode at just the right time.

A Hit for Every 90 Shots

When the gun director went into action, American and British gunners shot down enemy planes with an average of only 90 shots instead of thousands. When the Germans started shooting buzz bombs at the great Allied base at Antwerp after the Normandy invasion, the gun director enabled our guns to shoot down all but a few of the 4,856 known to have been launched.

Best of all, the idea behind the gun director has great potential uses in peace as well as war. Out of it has come new knowledge of how to build new high-speed calculators to solve in a few minutes mathematical problems that would take weeks for a man with paper and pencil. The principle of the gun director's electrical brain also may find new uses in blind landing systems for airplanes and in control of the heavy airplane traffic around airports.

Another "secret weapon," ready for action when the war ended but never used, is a device that can detect a man just by the heat of his body a quarter of a mile away, and locate ships and the chimneys of factories at night by the heat they radiate.

You can sweep this device around a darkened landscape and it will pick up the heat of anything, such as a man hidden in the bushes, that is only slightly warmer than its surroundings. From a high-flying plane it can indicate the pattern of a river by the difference in the heat radiated from land and water.

This device is built around the "thermistor," developed in peacetime by Bell Labora-

tories engineers to offset changes in temperature that cause variations in the loudness of speech traveling over long-distance telephone lines.

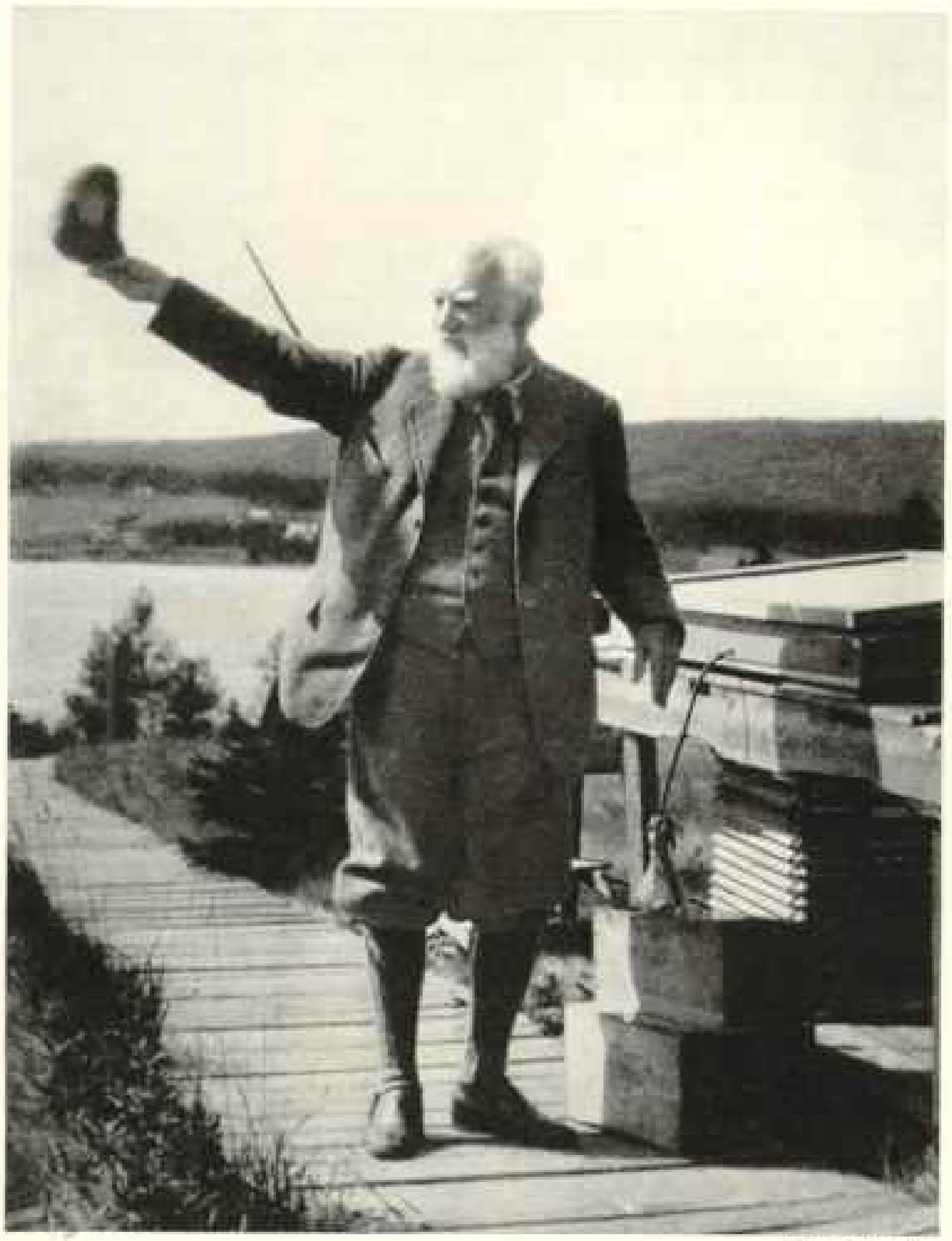
Thermistors are made of peculiar materials that conduct electricity well when warm and poorly when cold—just the opposite of most good conductors, such as copper. Tiny specks of thermistor material are imbedded in a glass bead the size of a pinhead and connected to the amplifiers along the telephone line.

They are so sensitive to heat that they can detect variations in temperature as small as 1/1000 of a degree centigrade. As the cable grows warmer or colder, the loss of power in the transmitted waves goes up or down. The thermistor regulates the amplifiers so that they keep the telephone signal always at the proper loudness and conversations are passed on with unvarying clarity.

Mine that "Remembers"

Still another almost-magic weapon, the magnetic mine that "remembers," was made possible by permalloy, an easily magnetized alloy developed originally for telephone use. This mine played a large part in helping defeat Japan by sinking her merchant ships. Since it rested on the bottom of ship channels, it could not be swept up.

When a steel ship passed near, it caused a change in the earth's magnetism that set off the mine. But its best feature was that it could be set to let one, two, three, or any desired number of ships go by unharmed and then explode under the next one. Thus the Japanese never knew when a waterway was clear of mines.



Gilbert Stevenson

Dr. Bell with One of His Water-distilling Devices

He was interested in finding a way to provide fresh water for fishermen lost at sea in small boats, long before the problem became urgent in World War I. In this apparatus moisture evaporated from salt water heated by the sun was condensed on a sloping pane of glass. Pure distilled water trickled down the small tube and into the bottle. Six of these stills supplied his house with drinking water when tap water became contaminated. Dr. Bell also condensed fog with a bellows actuated by the rise and fall of the waves.

One of Bell Laboratories' biggest contributions to winning the war was the development of special telephones for tanks and giant planes. The frightful noise that accompanies modern war presented a whole new problem to engineers, unlike anything they had to deal with in designing telephones for use in civilian life.

An ordinary telephone that worked well in a quiet home or office was useless against the tremendous roar of hundreds of airplane motors on a great bombing raid or the deafening din of a 400-horsepower engine inside the

steel walls of a tank. It was often a matter of life and death for a pilot or tank driver to hear correctly a radiotelephone message above the roar of the motors in his ears, and equally vital that his own words spoken into the telephone transmitter should not be drowned out by the noise around him.

Shutting out surrounding noise in order to hear clearly was not so difficult. Bell scientists developed a soft rubber pad for the earpieces of telephone headsets which fitted tightly against the ears and cut down outside noise well enough to permit satisfactory hearing when there was no static on the radio. Such earpieces were used in aviators' helmets and in tank crews' headgear. But keeping unwanted noise out of the telephone transmitter or microphone was a tougher problem.

One solution was the throat microphone. Unlike ordinary telephones, in which a diaphragm picks up vibrations of the air set up by the voice, the throat "mike" had the diaphragm strapped tightly against the user's neck. When he spoke, the diaphragm picked up the vibrations set up by his voice in his throat walls, and other noise was largely shut out. But the throat microphone was not entirely satisfactory, because it did not transmit the speech sounds formed in the nose and mouth which are important for complete clarity (page 297).

To overcome this difficulty the Bell engineers built a microphone with a shield which covered the nose and mouth. This excluded outside noise and permitted the user to speak in the normal way with all the speech sounds transmitted. This type of microphone was built right into aviators' oxygen masks, which formed a noise shield in themselves.

Still another antinoise device was the lip microphone. It operated on the principle that if sounds strike both sides of a telephone diaphragm they will cancel out its vibrations and will not be transmitted; but if they strike only one side they will be. The diaphragm of the lip microphone is placed very close to the mouth. Surrounding noise still strikes both sides of it and cancels out, but the voice strikes only one side, and so the diaphragm vibrates and transmits the voice sounds. The lip mike was used in directing landing operations above the noise of battle and in persuading enemy troops to surrender.

Altogether, the Bell Laboratories worked on 1,200 military projects during the war, some of which are still so secret that Bell men don't even mention them to each other. Its staff was expanded from 5,000 to 8,000 men and women during wartime, and $150,000,000 was spent on war developments.

To train Army and Navy officers and men in the operation and maintenance of the new weapons developed there, the Laboratories operated a school in which more than 4,000 students received instruction. So numerous were the instruction books for these scientific weapons that during the war the Laboratories became, next to Uncle Sam, the Nation's largest book publisher in number of titles. What a far cry from the days when all a soldier needed to know was how to load and fire a squirrel rifle!

Telephone By-products

From telephone research have come not only these many scientific weapons but also many other by-products for peacetime use which have helped make Bell Laboratories famous.

Bell men developed the orthophonic process of recording sound electrically, and "auditory perspective," a method of picking up the music of a symphony orchestra from several different points, to make it sound more natural when reproduced over loud-speakers. They made the first radiotelephones used on commercial air lines.

Bell men's research made possible new ways to measure accurately the noise in subways, traffic tunnels, airplanes, and factories, and cut it down; and improvements in acoustics of auditoriums (Plate XIV).

Vitamin B_1, or thiamin, so essential to health and now put into many "vitamin-enriched" foods, was first produced in pure form by a Bell chemist in his spare time. Later he and his colleagues determined its chemical structure so that it could be made in vast quantities synthetically.

Prospects for the future seem endless.

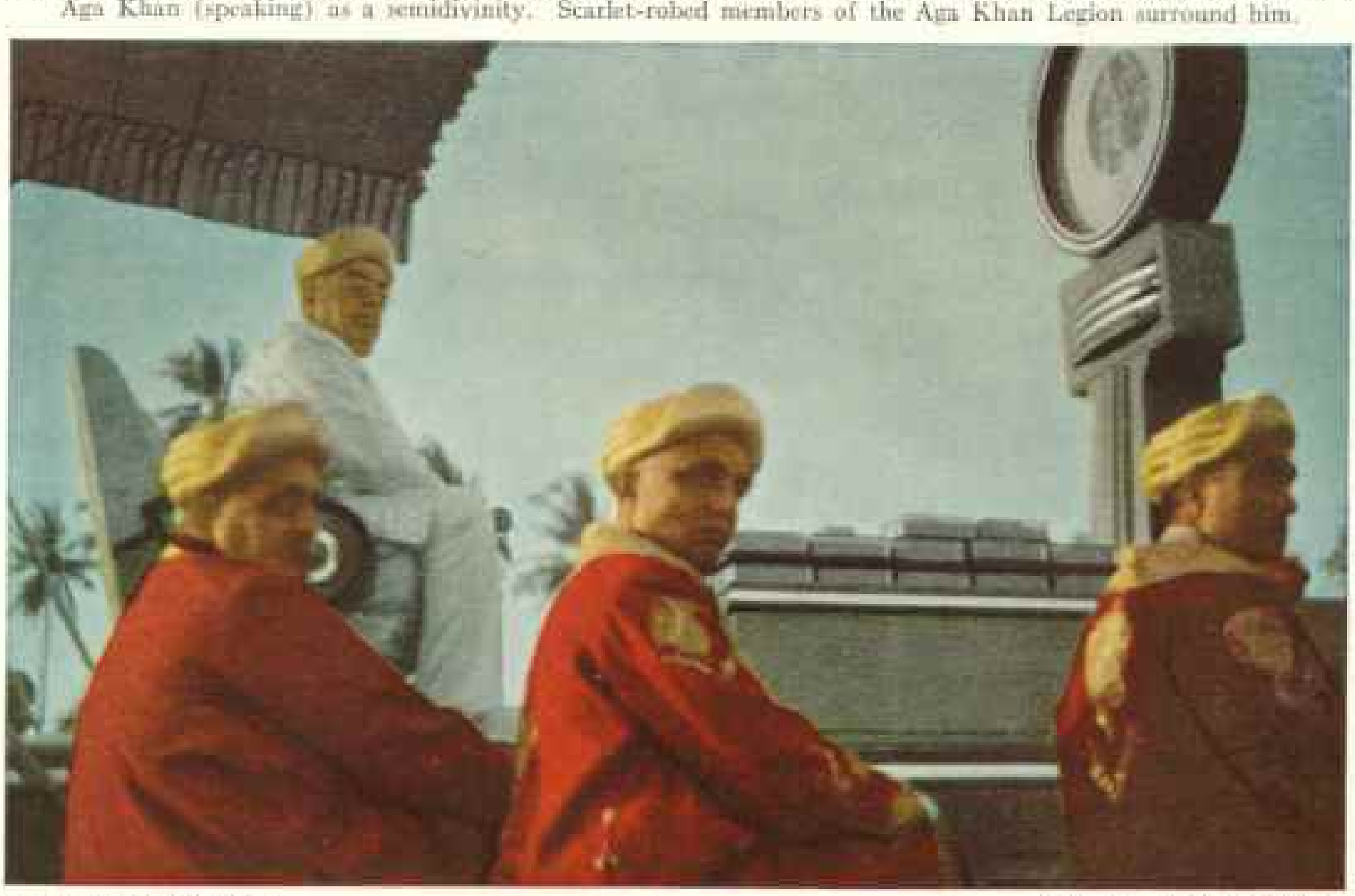
"Most of the fellows on our staff are dreaming about 'day after tomorrow' even while they concentrate on telephone problems of today," one Bell engineer told me. "They're free to use their imaginations, to look far ahead, to think up new ideas. In their brains today are being born things that you and I haven't even imagined."

Walter S. Gifford, President of the American Telephone and Telegraph Co., in his 1946 annual report said: "The further we progress in the sciences underlying telephony, the greater becomes the promise of future benefits. The areas which we have under exploration are steadily expanding and the possibilities . . . of electrical communication seem to excel anything achieved in the past."

Weighing the Aga Khan in Diamonds

On His Diamond Jubilee Mohammed's Spectacled Heir Speaks English into a "Mike"

The setting is Dar es Salaam, Tanganyika, East Africa, a stronghold of the Ismaili Moslems. They venerate the Aga Khan (speaking) as a semidivinity. Scarlet-robed members of the Aga Khan Legion surround him.



Kodachromes by David J. Cartwright

For Charity, the Aga Khan Balances 243 Precious Pounds Against $1,400,000 in Jewels

Bulletproof caskets of transparent plastic rest on the scale. These contain industrial diamonds on loan from London for the weighing. His followers give the cash equivalent to the Aga Khan for his benevolences.

Kodachrome by Dwyd J. Cartright

In His Brocaded Swivel Chair the Plump Aga Khan Sits Majestically and Matches Pounds Against Carats

Europe knows the Aga Khan as a former president of the League of Nations Assembly, three-time winner of the English Derby, and husband of a French wife. India, his home, knows him as the princely pontiff of the Ismailis. They regard him as infallible and ascribe miraculous cures to his bath water.

Kodachrome by David J. Cartwright

Guests Enter the Weighing Field Through a Ceremonial Arch. Bandsmen (left) and Honor Guard Line Their Carpeted Way

From Madagascar to Central Asia, Ismaili pilgrims converged on Dar es Salaam last August 10. Five months earlier many saw a similar weighing in Bombay. During the interval the Aga Khan lost a valuable half pound. Here two Indian ladies lead the way. A bearded Sikh attends as a visitor.

© National Geographic Society

European Helmets and Oriental Turbans Shield Heads from the Equatorial Sun

Ismailis, regarding the Aga Khan as Mohammed's direct descendant through his daughter Fatima, call him "our holy Imam" (sign). They take their name from Ismail, whom they regard as the rightful seventh Imam, or leader.

Kodachrome by David J. Carnegie

Fezzed Tanganyika Police Keep Order and Guard a Fabulous Diamond Treasure

East Africa contains a growing colony of Ismailis, whose headquarters are in Bombay. Others live in Syria, Burma, Iran, Iraq, and Afghanistan. English, as on the arch, serves as their unifying language.

Kodachrome by David J. Cartwright

Merchant Princes, Viziers to the Aga Khan, and Their Ladies Occupy Ringside Seats

Ismailis tithe their incomes to the fabulously wealthy Aga Khan, owner of a ruby collection reputedly worth $200,000,000. He, in turn, distributes their gifts of cash, gold, or diamonds among hospitals, schools, and other institutions. Almost no *Khoja*, or Indian Ismaili, is ever left in want.

Kodachrome by David J. Cartwright

A Weighing Machine's Quiet Drama Stirs Pilgrims as No Football Thrill Ever Moved a Packed Stadium

Dar es Salaam, home of 74,000 Africans, Indians, Arabs, and Europeans, was taxed by the crowd of visitors. To house them, sackcloth huts were thrown up below the coconut palms. Streets became so congested that automobile traffic was limited. Merchants enjoyed a sales boom.

A Dark-eyed Indian Beauty Ushers Notables to Reserved Seats

Coming from cosmopolitan Bombay, she wears a Hindu sari, not a Moslem veil. Her tolerant leader champions women's education; opposes their segregation in purdah. Ismailis look on heaven as knowledge, hell as ignorance.

Kodachromes by David S. Cameron

A Princess of the Faith Wears a Filmy Sari Trimmed with Jewels

Gentle Ismailis may trace their sect back to aberrant grand masters who in medieval times spread terror through Islam. Their "Old Man of the Mountain" kept the hashish-drugged killers who gave us the word "assassin."

I Become a Bakhtiari

By Paul Edward Case

As assistant to Dr. Luther M. Winsor, formerly an American adviser on irrigation to the Iranian Government, Paul Edward Case was given a wartime assignment to meet the chief of the Bakhtiari, a practically ungoverned tribe of central Iran, and to obtain their cooperation for construction of a road and a dam in their territory. He relates how, with the help of an Iranian business man, he accomplished his job.—The Editor.

"THE PEOPLE of Isfahan can't manage with the small supply of water they now have," I said to my friend in Iran. "Dr. Winsor has told me to get packed and see the Chahar Lang chief. Wish me luck. Anything you can tell me will help."

This friend had been a long time in Iran and had excellent judgment about the management of the assignment I had at hand. We both had worked for more than a year among the Arab sheiks of the south while facilities were being improved for the shipment of war supplies to Russia through Iran.*

A Mission Fraught with Danger

Because of the bad reputation of the Bakhtiari, this projected work had a strong atmosphere of adventure. All I knew was that there were two tribes, the Chahar Lang and the Haft Lang (Four Feet and Seven Feet).

On a bright Thursday in April I left Tehran in the cab of an American truck. We drove out the lower end of town into the Iran I love.

With many buildings of Western architecture, Tehran is European in appearance, but Iran outside the city is different in every way. I never feel that Tehran is really Iran (Plates I, III, IV, VI, VII, X).

The incessant hornblowing of the city eased off until none was heard. As we drove over a railroad crossing bridge, farms stretched far ahead of us and on all sides. To my left was the shining gold dome of a small mosque.

Looking back toward the east, I saw the pure white peak of Demavend, rising 18,550 feet into a puffy cloud (map, page 329). Fragrance of clover was wafted to us across elm-shaded lanes and waterways. Wheat and barley grew in thousands of acres corrugated by irrigation ditches. Farmers followed their rude wooden plows, preparing fallow land for crops of grain, potatoes, and beans.

Many passing trucks had palm leaves from the south stuck in the radiator guards. Now and then the regular mounds of *qanat* lines stretched toward the mountains, from the base of which clear, cool water is brought to the barren desert by these underground tunnels—an irrigation system of great antiquity in Persia. Here real plant life (and, for that matter, all life) extends to the last irrigation ditch only; beyond are the thorny dwarf forms of the desert. Snow-covered mountains fringed our view on all sides.

By 9 p. m. we reached Qum.

I remained there overnight in the hotel erected by the late Shah to accommodate visiting buyers of the produce of the large weaving mill he also built near by. Qum is noted for a kind of glazed pottery, a form of molasseslike candy, and the magnificent shrine of Fatima, sister of Imam Reza. Long before the city is seen from the desert, its gold dome glistens in the sunlight (page 328).

To me, Qum is memorable also for delicious *kebab* (barbecued lamb).

After a breakfast of sour milk, flat pancake bread, fried eggs, and tea, I was off for Isfahan, handicraft center of Iran. An old king, Shah Abbas I, put his stamp on this city and left behind more real beauty than numerous heroic planners of other lands, ancient or modern. Some of the design motifs used in the Middle East have their origin in his patronage.

An Iranian Bath Is Thorough

Since I did not know when my next bath would come, and virtually no hotels have bathing facilities, I went to one of the special *hammams*, or bathhouses, common to cities and villages.

I undressed in a small room, then entered an adjoining room of the same size to wash under a shower. Men came in to "massage" me, treating me first to a perfunctory stretching of arms and legs, and after that a vigorous rubbing of the complete body with a canvas mitten.

Surprisingly large rolls of skin and dirt are accumulated under the mitten even from those who think themselves clean. I suspected part of these rolls were from the mitten.

The massage finished, the attendant put the soap I had brought with me into a white cloth bag about the size of a salt bag. I had showered my raw body to wash away the scraped-

* See, in the National Geographic Magazine, "Lend-Lease and the Russian Victory," by Harvey Klemmer, October, 1945; "Mountain Tribes of Iran and Iraq," by Harold Lamb, March, 1946; "Iran in Wartime," by John N. Greely, August, 1943; and "Old and New in Persia," by the Baroness Ravensdale, September, 1939.

Paul K. Cass

Two Loves Has Cheragh Ali, His Son and His Rifle

Without gun and bandoleer, no Bakhtiari considers himself dressed. This rifle may have cost $700 or nothing, depending on whether it was bought from a smuggler or snatched from an ambushed soldier. Darius, the infant prince, bears the name of an ancient Persian monarch. His father befriended the author (page 332).

off dirt and was lying flat on a raised-tile, benchlike part of the floor. After dipping the bag containing the soap into a pan of warm water, he held it over me and blew it up as a child inflates a toy balloon and squeezed out of it huge blobs of soap bubbles until my naked body was covered with a mass of foam.

He washed me thus three times all over, then invited me to shower and emerge into a dressing room. Fortunately, I had my own towel and thus escaped being swathed in one only half dried from the preceding victim. Wooden-soled sandals with a single leather strap across the toes were offered for the few steps to my dressing room.

Upon returning to the hotel for dinner, I met Mr. Stemal, Iranian contractor for the preliminary work which we had begun in the Bakhtiari country. He invited me to go with him in his car to Darun, where he was working, and where began the part of the Bakhtiari lands controlled by the Chahar Lang.

I readily accepted his invitation for the 9-hour ride. I usually traveled by Army vehicles when possible because of the prohibitive cost of repairs. For a single tire the price was $2,100, and I heard of a new Buick selling for $28,000 in Tehran.

Darun on the Edge of the Unknown

Darun, though a typical farm village of central Iran, has a telephone to Isfahan and twice-weekly bus service to Isfahan and Sultanabad ('Iraq), both large cities. The latter is on the railroad from Tehran to the south—a railroad with numerous tunnels and with bridge after bridge over the deep canyons between tunnels.

In Darun houses are of mud exclusively, and each of the older ones is built with a one-and-a-half or two-story turretlike tower on one corner for defense against raids. Rifle holes surround the upper half, and stones often show through the mud. Dried camel grass edges the roof, which is pitched inward toward an opening for the exit of rain water.

The streets are twisting lanes, rough from constant passing of sheep and cows. When I got out of breath hurrying along the street to post a letter, I realized that the altitude is 7,000 feet. Trees had been in full leaf in Isfahan. Here the buds were just beginning to break.

About thirty Iranian soldiers were quartered

in the town, and their horses were tied to rings along the mud wall of a house.

That night we planned our trip to see Salar, the Chahar Lang chief, who, the townspeople said, was not far away.

The Bakhtiari lands begin about ten miles from town and spread west to the railroad, perhaps more than 90 miles, and south nearly as far. On the existing road automobiles could travel only a few miles.

Early Shahs Tried to Harness Karun

We hoped to extend this road some 46 miles to a valley in the high mountains. There, more than three centuries ago, some of the Shahs, following the example of Darius, King of Kings, had undertaken the work we were now planning. We were to construct a large dam across the Karun River, which had ample water, tunnel through a mountain, and deliver this surplus water into the Zaindeh, which feeds Isfahan.

Shah Abbas the Great tried to cut a V-shaped channel through the mountain, but the undertaking had been too big for him. Our plan for the tunnel was much less ambitious.

A hostile population, sparse though it was, would be a serious handicap to our operations. Not even tax collectors had penetrated far into Bakhtiari lands.

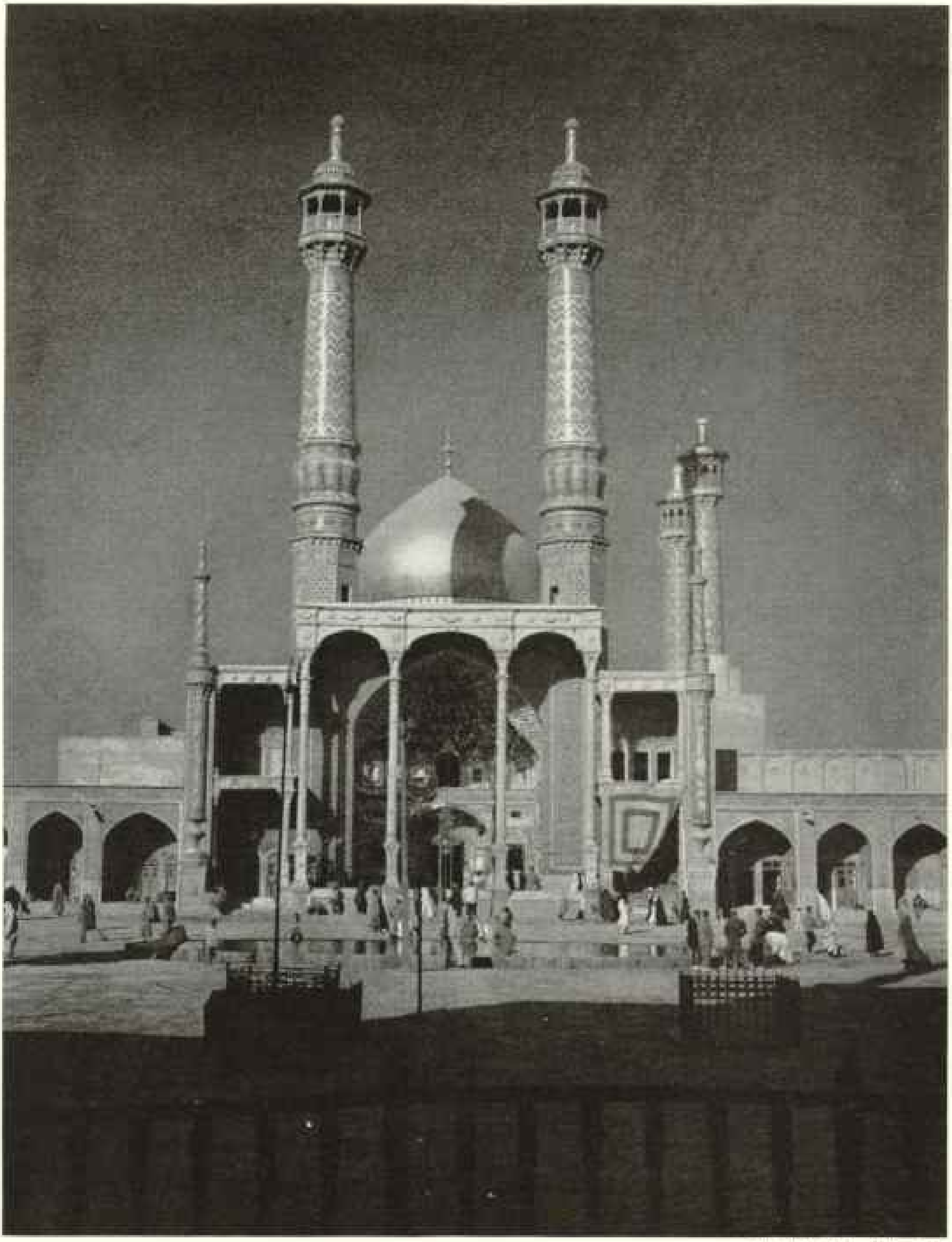
In Tehran people were pessimistic about our project. The road, they said, would make it easy for the Iranian Army to enter the country, with their dread machine guns and fieldpieces.

I went to bed that night full of ideas as to how I should present the case of the Department of Irrigation. Imagine the U. S. Department of Agriculture sending a man to the Southwest to beseech citizens not to shoot up workmen on Boulder Dam! I wanted to keep the dignity of the department; yet, if Salar said "Scram," just what did one do?

Paul E. Case

An Anthony Eden of Bakhtiari Land

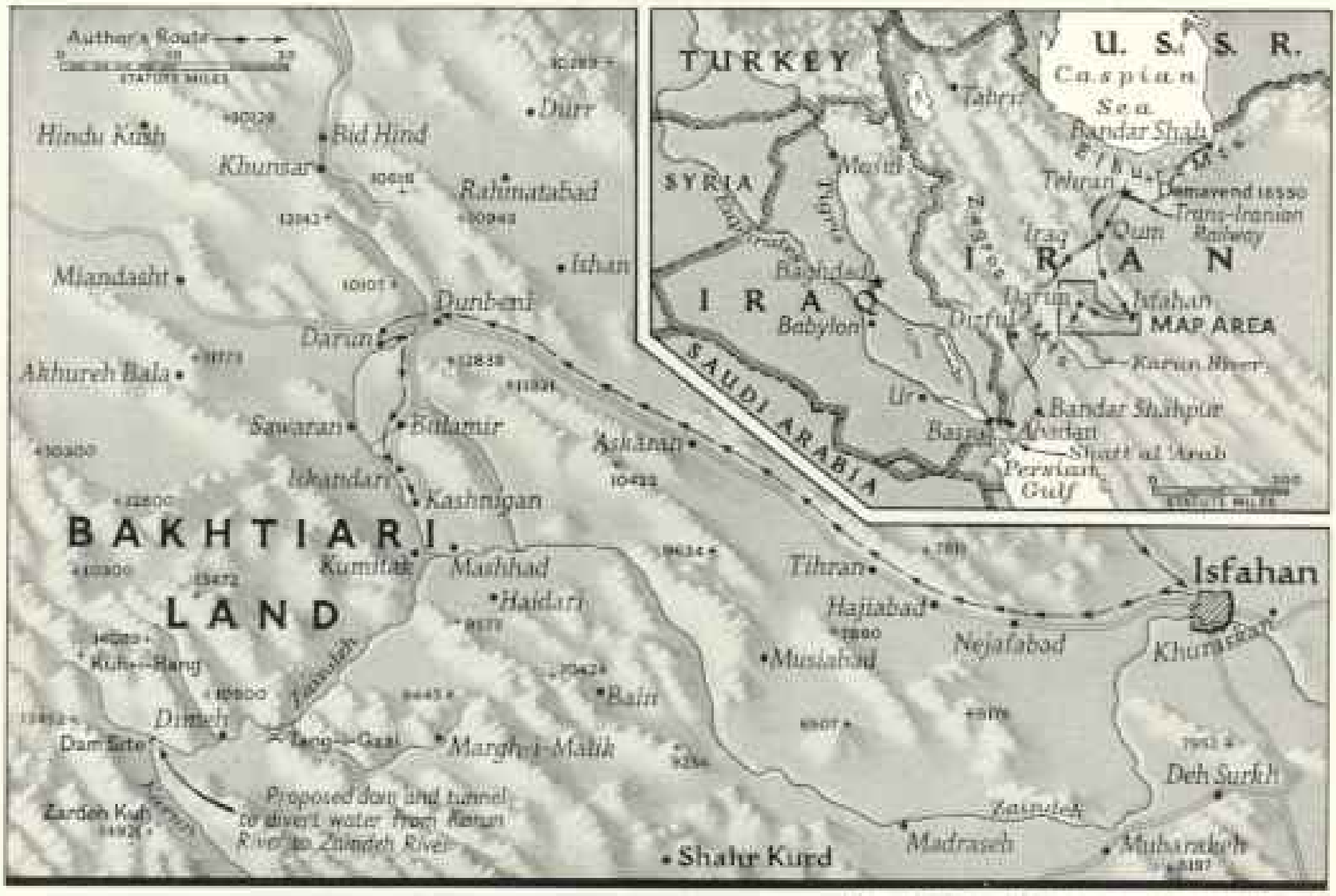
Some 3,500 years ago his Caucasian ancestors rode horses into Persia. They were the Aryans for whom Iran is named. For centuries they dwelt in feudal isolation. The new generation reacts to modern ways; witness this checked coat, shotgun, and cartridge case. Skullcap, silk pantaloons, and white-canvas shoes remain trademarks of the clan.



Joseph Covello from Black Star

Skyscraper Minarets and Golden Dome Guide Travelers to the Bakhtiari Country

At Qum stands the shrine of Fatima, sister of Imam Reza, both saints of the Shia sect of Moslems. Fatima, dead since A. D. 816, lies within. Each Friday, says tradition, she is visited by her devoted brother, a pilgrim from his own shrine at Meshed. Among living pilgrims the place is particularly holy to women. The shrine owes its gold to a youth who vowed to embellish it if ever he ruled Persia; he was Fath Ali Shah (1797-1834). Glittering in the sun, the dome was a beacon to the author (page 325).



Drawn by Herbert K. Eastwood and Irvin K. Altman

Bakhtiari Tribesmen Inhabit the Rugged, Roadless Lands West of Isfahan

On his trip into the hills the author sought the tribe's permission to build a highway through its domain. Such a road would facilitate building a dam on the Karun River to tunnel surplus waters into the Zaindeh and irrigate thirsty farmlands to the east. By becoming a Bakhtiari, Mr. Case won his case. Completion of the project has been delayed, however. Some of the early Shahs started a similar scheme (page 327).

Early Sunday morning Stemal and I had breakfast at the home of his engineer, M. Matussevitch. Madame Matussevitch was an accomplished M. D. who with her husband had lived long in France and for some time in the Belgian Congo.

Here in Darun she treated the sick as a pastime, entirely on her own, and, I suspected, at Stemal's expense. She spoke French, Russian, Spanish, German, and Persian. To my delight her husband spoke English.

As we ate, patients came to squat at Madame's door to await her attention. Syphilis, tuberculosis, and other kinds of nasty infections predominated, as well as rheumatism. Some of the people had walked miles for the benefit of her service. She was told by old women and men that the wind brought their troubles.

Doctor's Prescription—One Bath

From their appearance none ever bathed. Now and then even her experience failed her, and she prescribed a bath before she could continue beyond her first look.

A boy came this Sunday morning with a severe burn down his side from ear to knee. He was in great pain. The boy's aged father and mother swore he had received the burn from lightning two days before, but Madame's keen eye detected a hot water burn only a few hours old. Such made-up stories were common.

One of her greatest worries was the care her patients gave their wounds and sores at home. Often they would appear at later visits, after her careful dressings, with bits of paper, sheepskin (wool side down), or sheep grease covering the sores they expected to heal. Through it all she showed a loving care and great competence.

Matussevitch proved to be ideally suited to the work in this section. With only hand labor available and crude tools in common use, it was most fortunate to have a man in charge who understood the problems involved.

Breakfast finished, Stemal, Matussevitch, and I got into Stemal's car and started for the Bakhtiari country. The first town was Bulamir, an hour away on a road across desert mountain slopes and through wheat fields farmed by Bulamir farmers. Beautiful flowers grew in the bare soil, still moist from the melting snows of the mountains. On our left

Ernest B. Schoedsack

Twice Each Year the Nomadic Bakhtiari Scale the Snow-clad Zagros Mountains to Find Grass for Their Flocks

Plateau snow and valley drought dictate these migrations. Everyone, from babies to lame old men, makes the dangerous journey, part of it across raging rivers.

Paul E. Case

"American Khan," the Author, Is Initiated by the Bakhtiari

To earn his soldier's regalia, Mr. Case manfully ate roasted lamb's head with his fingers. Politeness compelled him to change costume before the banquet guests. As he disrobed, they fingered each American garment with curiosity.

Staff Photographer Maynard Owen Williams

American and Persian Build a New Iran

Dr. L. M. Winsor, by using the methods of his State, Utah, brought water to the thirsty farms of Iran. There he served as Director of Irrigation. Because of his white goatee, the Bakhtiari called him *Purzan* (mountain goat).

was a 12,838-foot peak, glistening white in the sunshine.

At the top of the divide we looked down upon a broad valley of breath-taking beauty. Towering mountains edged its green fields, which were crisscrossed by irrigation ditches. I wished that I had a book to tell the names of the handsome plants that carpeted the land.

The sight of Bulamir around the bend of the valley brought me back to my work. Tall poplar trees and round-headed willows rose between mud houses crested with camel grass. To the right, higher up the hillside above the village, was an old fortlike structure badly broken down. To the left of the town, which had about 100 houses, was a larger, newer-looking building of two stories.

Winding along the horse-trail road, we drove across a brook to the big house, where a crowd of men stood around a large piece of red canvas spread out on the ground. They were erecting a tent for the summer use of Salar, one of whose four homes was at Bulamir.

As we drove up, two men of obvious importance separated from the group and approached us. They introduced themselves as Ali Murad Khan, head of Bulamir, and his younger brother, Cheragh Ali Khan, both brothers of Salar (page 326).

We were received with ceremony and escorted up one of the carved stone stairways which rise at each end of the front of the house. Leading the way, Ali Murad Khan drew aside at the steps to give his place to Stemal and me, an honor, I soon learned, of no small importance among the *Khans* (p. 339).

We went up the high steps—each riser was at least a foot high—to a wide porch overlooking the whole valley and several villages. At our feet a garden stretched inside the walled yard. We were ushered across the porch and through the French-window-like doors of a large living room.

Luxury Amid Bricks Without Straw

The outside of mud and sun-dried brick had hardly prepared us for the magnificent carpets, heavily upholstered chairs, hand-embroidered silk table scarfs, and—of all things—a radio. From pictures high on the walls the Shah and his beautiful Queen looked down on us, as did a handsome man in fancy brocade coat and large black mustache. Ali Murad told me later this was his father.

Likenesses of the King and Queen of England were in another frame, and a large map of Iran hung at eye level on a far wall. On the front wall was an oil painting of a farm girl walking a lane in a lovely rural countryside of England or America.

Tea was served us in glasses held in silver holders. Cheragh Ali Khan sat stiffly in one corner, while Ali Murad Khan obviously was keen to know what brought us. Stemal introduced our subject. Since he was an Iranian, his Persian was naturally far superior to the few badly mangled words I could muster.

Tribesmen Keep Poker Faces

He addressed his talk to Ali Murad Khan, telling him that I was an American in the employ of the Iranian Government (eyebrows went up), an assistant to Dr. Winsor, who had visited here last year, and that I was here now to arrange with them the building of the road to Tang-i-Gazi, so many years in discussion. He himself, he said, was the contractor for the road, which he had begun at Dunbeni and was pushing on to Bulamir.

Watching their expressions keenly, I tried to see pleasure or displeasure, but the brothers kept poker faces. After all, Salar was the boss. What he said went.

As Stemal and Ali Murad Khan continued to discuss the type of road being built, I turned to Cheragh Ali, who sat next to me, and asked where I could see Salar. He beamed a broad smile and told me Salar was at Kumitak. Somehow from that moment he and I became close friends.

Other Bakhtiari had come into the room one by one, or stood on the big porch, all looking and listening. Many had on heavy leather bands of cartridges and carried rifles suspiciously like those of the Iranian Army.

Cheragh Ali told me we could travel by auto to Kashnigan, about seven miles distant, but could not reach Kumitak by car. After instructing us to go on to Kashnigan with Cheragh Ali as our guide, Ali Murad sent a note by horse rider to ask Salar to come to Kashnigan at his earliest convenience.

Cheragh Ali put on a band of cartridges, took a fine well-cared-for rifle from a servant, and indicated he was ready. He wore a Bakhtiari coat of gray wool with thin, black vertical lines woven into it to form a skyscraper design on the back across the shoulders.

Like all the other Bakhtiari, he had on black-silk trousers fully 30 inches wide and sharp-pointed white-canvas shoes with a bit of the sole leather curved over the center of each point. On his head was the typical black hat, which is not unlike a derby without a brim.

About two miles out of Bulamir a horseman suddenly approached the car and spoke in Bakhtiari dialect to Cheragh Ali. The man was six feet tall and extremely impressive in his gray coat adorned with bandoleers of

cartridges. Taking a hurriedly scribbled note from Cheragh Ali to be delivered to Salar, he started off ahead at full gallop.

His elbows rose and fell to the rhythm of the horse's movements, so that with his canvas-shod feet sticking out on each side he seemed a fair compromise between something regal and Ichabod Crane.

Between Kashnigan and Bulamir is Iskandari, a river village near which we planned to build a bridge. I had just finished inspecting the bridge site when Cheragh Ali told me the *Rish Safid* ("white beard," or village chief) of Iskandari was coming down to see us.

Sure enough, half a score of men were walking toward us, and on Cheragh Ali's advice we went to meet them and returned to their village for the inevitable tea.

It is considered discourteous to pass through a village without having tea with its chief, whether he be a Rish Safid, a *Kad Khoda* ("village god," hence chief), or a *Khan*. The Khan ranks highest and rates like a prince or minor king. The other two seem to be equal in importance, but the title of Rish Safid is saved for older leaders.

Meeting the white-bearded Rish Safid halfway down, we continued on foot with him to his home. The news of a bridge to be built where his makeshift one now stood was clearly agreeable to him. Each flood took out his structure, he said, even though it was now supported by the gravestones of some departed Chahar Lang.

The Home of the Rish Safid

The home of the Rish Safid was only a little larger than the other 50 or 75 of the village. Passing through a wooden doorway in a mud wall, we crossed a courtyard deep in dust and dried dung and mounted a steep stairway seemingly carved out of the mud of the walls of the building.

The rooms surrounding the courtyard were of several sizes and at many levels, the whole arrangement decidedly without definite plan. Here, too, camel grass edged all the roofs. At the top of the stairway an elderly servant, truly Bakhtiari in his wide black trousers, showed us to a room overlooking the courtyard and the beautiful valley to the south.

Since this was a poorer family, there were no chairs. We sat cross-legged on fine thick carpets, our backs eased by large bolsters of pillows covered with homespun cloth. Product of Iskandari, the bright-hued carpets owed their colors to dyes from plants and fruit skins available near by.

The son of the Rish Safid sat on one side of me and the Rish Safid on the other, both talking across me constantly in their dialect.

At length the son, who knew a little English and wished to practice it, asked me to stay there that night and go hunting with him the next day. I thanked him and replied that we were on our way to see Salar, but that I would be glad to accept his invitation later on when I was there with our engineers.

When the elderly attendant began passing tea, the Rish Safid warmed up his opium pipe. The attendant's shoes had been left at the doorway, as had all of ours. I noticed several holes in his socks, just like those in mine. This business of living in a foreign country with one's wife in America has dozens of disadvantages.

All villages grow the poppies for opium and collect it, selling part to the Government and turning over the rest to the village chief for his use or sale. The Government operates a monopoly on opium and tobacco.

The juice of the seed pods is collected from cuts made in the pod. The half-dried juice is then kneaded to the consistency of molasses taffy, and flattened into cakes about three inches square and a quarter inch thick. Squares of one-half inch are marked out on the surface of the cake, which when dried a bit more is ready for sale.

Though each square is considered a full pipe charge, some smokers consume three or four squares at one sitting.

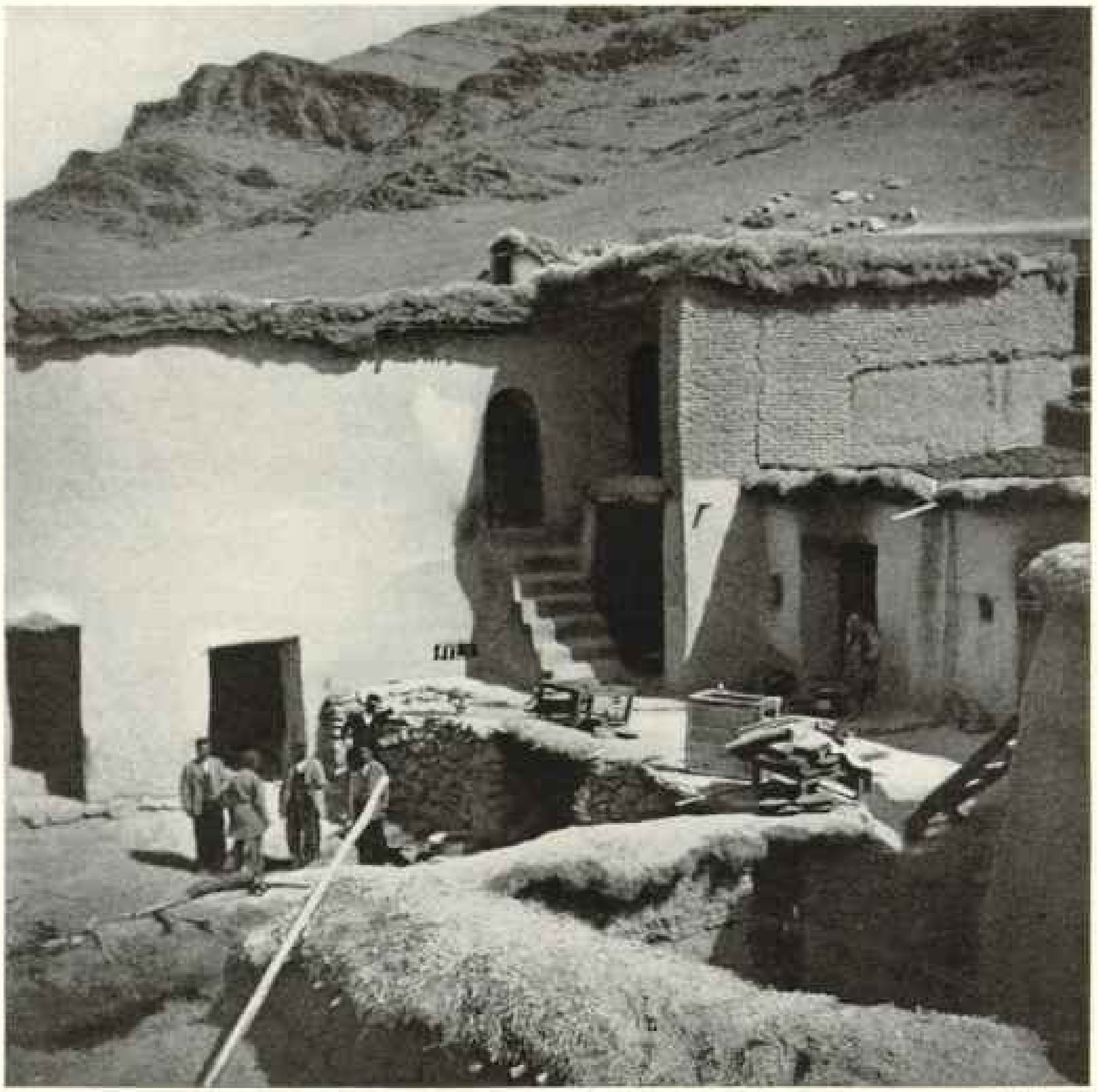
Virtually all Khans and village chiefs smoke the pipe three to six times a day. One aged 57 smoked more than the rest. Cheragh Ali Khan tried and tried to get me to smoke, but I in turn asked him to begin. He, I found, was not a smoker.

When the old man's pipe was finished, we rose and indicated we would go to Kashnigan. Thanking him and promising the son I'd return after a week or two, Stemal and the rest of us took our leave.

The Political Grapevine

Stemal told me, as we got into the car, that he had learned from Cheragh Ali that Salar was in communication with the other half of the Bakhtiari about the work we planned and that letters had passed between them only a month before.

Beautiful farms stretched out on all sides of us. The river wound its course in and out of oxbows cut in the deep, fertile soil. Plantings of poplar trees here and there dotted the river edge. A huge eagle flew over Iskandari, circled twice, then headed down the valley as if to herald our coming. A flock of lambs crossed the road in front of us, and the shepherd boy, his soft canvas knapsack bulging



Paul K. Case

Dreary, Windowless Mud Walls Give No Hint of the Graceful Living Within

In such an adobe home the author was surprised by magnificent carpets, upholstered chairs, silk table scarfs, and a radio (page 337). Roofs serve as storage bins, workshops, and observation platforms. After each rain the dry mud must be rolled to seal cracks. Camel grass trims the eaves.

with flat whole-wheat breads, urged them on, while he munched some of the bread from his pack.

We entered Kashnigan by car and drove as far as we could through the narrow lanes toward the Khan's house.

Cheragh Ali guided us.

After the hot, dusty ride, the cool shade of the big room of the Khan's house was welcome. Mohammed Ali Khan, the owner, was out hunting, as are all good Khans most of the time. His first in charge put the place and its contents at the disposal of Cheragh Ali Khan, who in turn gave it over to us.

When Cheragh Ali told the man to bring food, each pair of us received a 3-foot tray full of many things. Cheragh Ali and I shared one. There was a bowl of sour milk, a dish of apricot jam, a large flat metal dish with eight or nine fried eggs on it, buttermilk in a large, queerly shaped bottle, and a bowl of other buttermilk containing chopped-up greens. Large pancakelike breads were given us in our laps.

We sat cross-legged and ate, leaning slightly over the tray. No spoons or forks were provided, but my past experience in the south had taught me to eat with my fingers, using a piece of the limp bread as a spoon.

Much to Cheragh Ali's amazement, I man-

aged fairly well. He, I think, had expected me to flounder through the meal, but when he found I knew a bit about his methods, he drew himself nearer in a gesture of closer friendship.

As each of us finished, a servant brought a big silver bowl and a long-spouted silver pitcher of water to wash our hands. A bright-colored homespun towel was offered us as we washed. Other servants had removed the trays and had brought in three braziers with teapots nestled at the edge of the charcoal embers.

Soon the opium pipes of three of the party were brought in.

We were all served tea in glasses set in silver holders. Following Cheragh Ali's lead, I took three lumps of sugar, put one at a time into my mouth, and sipped the tea through the sugar. The three lumps just lasted out the full glass.

As the tea was finished, I noticed the opium pipes being warmed up. Cheragh Ali turned to me and said, "*Mush mush?*" This is a dialect expression for sleep.

I said I felt like going out for a walk. All looked drowsy, and I saw Stemal already dozing in his corner against a big bolster.

Word of Salar's Approach

As I picked up my camera, Cheragh Ali told me that a man had just galloped up from Kumitak with word that Salar would arrive before suppertime. Salar was coming to us! That was an indication of friendship, I thought. Or was it to stop us from traveling farther into his territory?

All the lesser Khans had been genuinely kind and hospitable; could Salar be so greatly different from his brothers? I put on my shoes and went out through the doorway and the dirty courtyard to the street.

A throng of children and men stood around our car. It was the happening of the year for a car to come to Kashnigan. Seeing my camera, the children begged me to take their pictures. I did take some and had a hard time explaining that I couldn't give them the prints then and there.

As I walked uphill along the lane back to Kashnigan, I saw farmers carrying long-handled shovels or using them to divert water through the irrigation ditches.

Each day a different section received water on these farms. Every seventh day the men would be back on this same piece of land they now were tending.

There was no main street in Kashnigan, but as I passed the Khan's house I turned in front of the bathhouse and wandered down a crooked, well-traveled alley to a cobbler shop, where three men were making native shoes with leather sides and amazingly serviceable soles of hard-compressed rags.

I asked how much a pair of shoes would cost for each of my children. While I was persuading the cobbler to lower the fantastic price he demanded, the village barber suddenly poked a small mirror in front of my face. He was a jolly fellow with a neatly trimmed gray beard, big brown eyes, blue-denim Bakhtiari trousers, a knee-length coat of the same material, and a Bakhtiari hat of black felt. A long, hand-knitted woolen scarf made at least two circles around his middle. In the folds of the scarf were stuck three hair clippers, a comb, a pair of scissors, and two razors.

His sales argument was the customer's impression of his face in the mirror, a practical application of Confucius' saying, "One look is worth a thousand tellings." I watched a sale being made after I politely turned the barber down.

Women Dress Up to Do the Washing

At a widened part of the stream which ran through the village, women were washing clothes. They wore their best, for each wished to appear well in the eyes of her friends.

Washing offered a grand place to learn the latest news or gossip. Silver and brassy-looking gold bracelets clinking, the women hit the laundry on flat stones with wooden paddles. Now and then I caught a glimpse of gold earrings hanging amid folds of hair.

These women did not wear veils, as do most Iranian women in the cities. They are distant from cities and probably feel as if the village is one family. They turned bashfully when I came along and giggled no end as I watched them at their work.

I had on a windbreaker with fur lining and a zipper down the front. With great shyness the oldest and ugliest of the group overcame her embarrassment enough to point to the fur and zipper. I took off the jacket and helped her put it on, while the rest stopped their washing and all made a circle around us.

By the time my elderly Bakhtiari woman was fully zipped up, we were entertaining about fifty women and men, young and old.

All at once a horseman rounded the corner of the alley, and then many more came behind them. It was Mohammed Ali Khan, the Khan of Kashnigan, returning from a hunt. A large mountain goat lay across the saddle of one of his followers. All were heavily armed.

The poor old woman frantically struggled with the zipper, trying to get off the jacket

Paul E. Case

"You Can Build Your Road," Says Salar, Equestrian Chief of the Chahar Lang Tribe

To break this mountaineer's independent spirit, a tyrannical Shah jailed him for seven years. Notwithstanding, "We will forget what our memories tell us," Salar told the author. "We wish to be Iranians first." As a patriot, this Bakhtiari granted irrigation right of way through tribal lands (pages 337, 358).

and away from the scene. I pulled the tab down and helped her out of the coat. Mohammed Ali Khan, his soldiers, and the whole crowd were laughing so loudly that it sounded like a cheering squad at a football game. The woman ran at full speed toward her house. The other women had long since left.

Walking forward, I introduced myself to Mohammed Ali Khan. He was very handsome in his hunting clothes and was mounted on a beautiful dappled-gray Arabian stallion.

Finally quieting his laughter, he said he had heard we were at his house and had cut short his hunt to return to see us. He apologized that he had to go to the next village below and said he would come up with Salar later in the afternoon.

As they all rode past me, I shook hands with each of his men and looked for a minute at the big horns of the goat. Its beard was prized as an ornament for the clothes of young boys of the Khans, for it was said to bring good fortune. Cheragh Ali had told me I must shoot a goat and send the beard to my boy in America. We had a date for that hunt later.

Prize Sheep Killed for the American

Inside the courtyard of Ali Khan's house a sheep had just been killed, and the carcass was being hung upon a tripod of three poles. At respectful distances two typical wolflike dogs and several cats watched anxiously.

A strong young farm boy in blue denim lifted the sheep into the noose an older man had tied at the top of the tripod. He chased away a dog from the bleeding head. After the hind feet were in the noose and the old man had started skinning, the boy picked up the head and put it on a tray near the scene of operations.

"Mohammed Ali Khan told us to kill a sheep for the American," he said. "Are you the American?"

I said "Yes," and asked if it was a good sheep. He assured me it was the best sheep in Kashnigan, and added that tonight I would eat the finest *kebab* I had ever tasted.

He grabbed the sweetbreads, indicating they would be put on a spit and specially roasted for Salar and me. Even if I didn't build the road, kebab for that night seemed assured.

The farm boy showed me the kitchen, where women were baking pancakelike loaves of bread. A girl offered me one. It was warm and good. Still grinning, the boy accepted half of my bread while we walked out.

Cheragh Ali, who stood in the courtyard as I came out of the kitchen, took my hand and suggested a walk. It is the custom for men to walk hand in hand.

Reaching a hilltop, we stood talking about the country, the crops, hunting, and almost everything of the Bakhtiari everyday existence. My friend urged me to tell him all about America. Did we have mountain goats? Did we have dogs? Did we have horses? Did I have children? Did all Americans have a million dollars? Did all Americans have false teeth?

That last is a subject of never-ending interest. I have a bridge and must use much ingenuity to keep from having to show it at every meeting. A gold fastener gives it away.

As we talked, Cheragh Ali kept his attention on a tiny black spot on the road far down the valley near the narrow pass. I thought it some cows or sheep coming home after a day of wandering, but Cheragh Ali said, "Salar."

Salar Arrives amid Pomp and Circumstance

Soon the tiny dot became a group of men on horseback, perhaps twenty or thirty. Two front men rode about 500 feet apart and a half mile ahead of the main force. Even in the distance I could see that all the horses were fine looking and the riders well able to handle them. The glint of the sun on cartridge belts and rifles showed that all the men, even the leader, were heavily armed.

The lesser Khans of the village had also seen Salar's approach and had called Stemal and the others from the house. There was a considerable crowd when we arrived on the field in front of Ali Khan's house. Cheragh Ali began to dust off his clothes while a servant rubbed his shoes.

Seeing Stemal, I asked him to stay near me and to nudge me if I should say or suggest anything he knew to be against custom. He smilingly told me he'd help all he could and reminded me he also had a big stake in the outcome of this meeting.

About six of us stood together, a bit apart from the large crowd of villagers, which was increasing in size minute by minute. Salar's coming, I have no doubt, was enough to cause interest, but to have some strangers waiting to see him made it doubly important.

Also I had tried to have it generally known that we were engineers for the long-planned road and Karun dam. That meant work, and work meant money.

The two advance riders finally reached the far end of the long flat field. They rode stiffly up toward the house and so directly past us. Cheragh Ali returned their greeting as they rode by us. Stemal and I also nodded to them. I moved closer to Cheragh Ali.

Another man rode on to the plain, and then another, on a marvelous gray stallion.

"There is Salar," Cheragh Ali told me quietly, and he became stiffly distant all of a sudden.

Salar rode straight toward us. He was followed immediately by Mohammed Ali Khan. In front of us he drew rein. Four Bakhtiari jumped from the crowd and held the bridle of the horse, while the others held the stirrup, took Salar's gun, and finally led away the horse toward the house.

By this time Mohammed Ali Khan and many of Salar's soldiers had ridden up and dismounted. Servants led the horses away to stables while the dazzling group of Khans, soldiers, and peasants milled around us, all shaking hands and exchanging greetings.

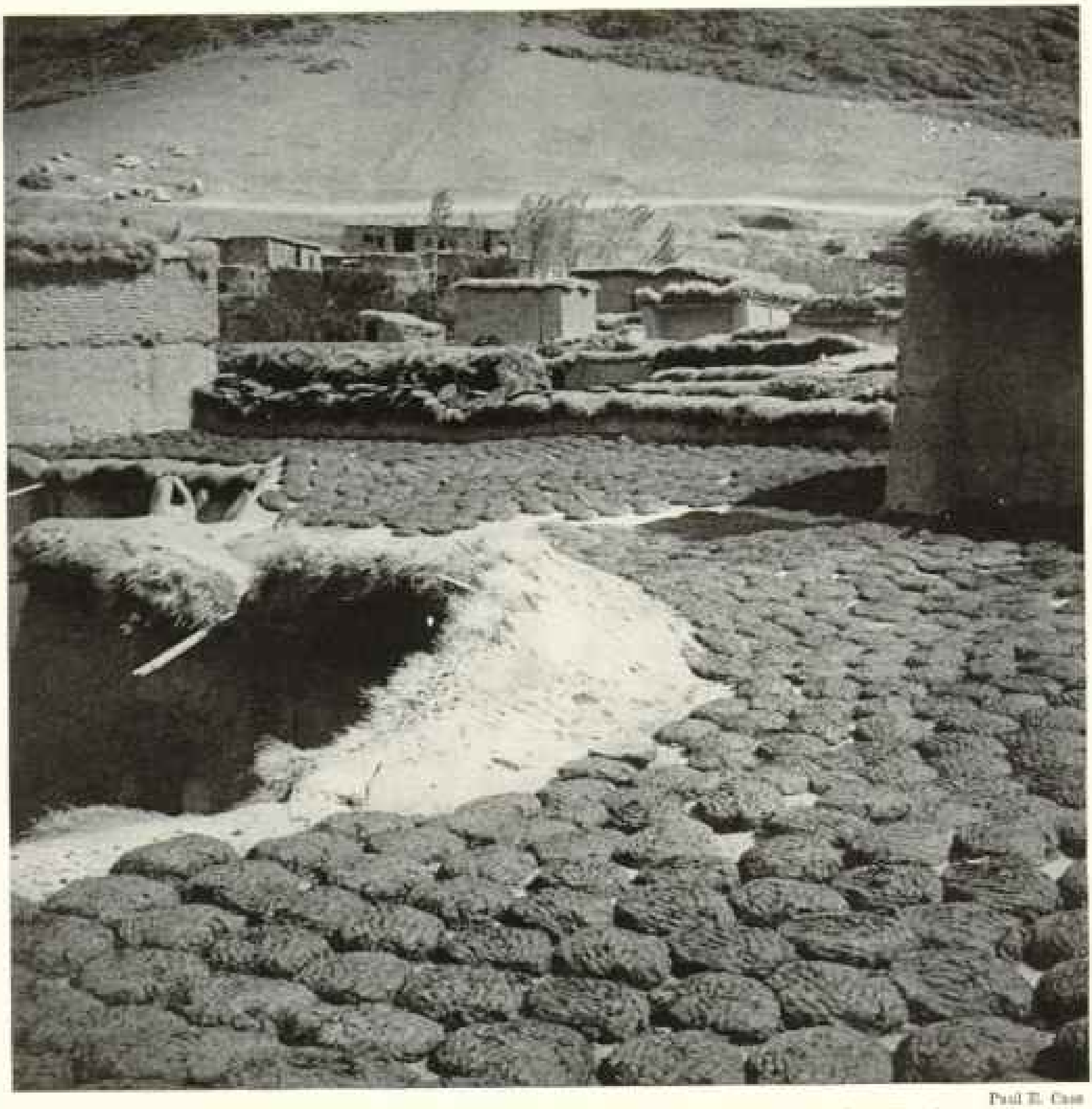
No colonel ever faced a general with greater respect and obedient attitude than Cheragh Ali faced Salar. He stiffly introduced us to his chieftain brother.

Salar was shorter than Cheragh Ali, perhaps 5 feet 8 inches tall. He was about fifty years old and muscular. He had a handsome sunburned face with large brown eyes that appeared able to penetrate everything they saw. In a slate-blue suit and with trousers tucked into tan golf socks, he stood in front of me, a seeming bundle of muscle and vitality. His smile was broad (page 336).

"You Will Be One of Us"

He extended his hand in a generous manner, then went the rounds, greeting all in our immediate group. The handshaking he ended quickly, and, taking my arm and the arm of Cheragh Ali, he headed us away from the crowd toward the far end of the field.

Could I speak Persian? French? What a pity! He wanted to talk to me directly. Cheragh Ali put in that I could speak Persian, but I said that he would soon see that it was very little.



Paul E. Case

Lacking Wood, the Bakhtiari Dry Briquettes of Manure for Fuel

These patted cakes, cured on a sunny rooftop, will burn slowly, evenly, and smokelessly. For quick, hot fires in their ovens, the Bakhtiari burn dry camel's-thorn.

"Bakhtiari land is most beautiful," I said.

Salar quickly turned his face to me. "You like our country?"

"I more than like it. I love it. I do not wish to leave."

"Very good. You will be one of us. You will have a suit and a pair of trousers and a hat. I will give you a horse and we'll hunt every valley."

Salar became more generous with each sentence. Not letting a chance to make friends pass, I at once fumbled in my pocket, bringing out a *10-rial* note (about 30 cents).

"Here! I pay you my first taxes," I said, giving him the note.

The sally was greeted by strong laughter. "You are a Bakhtiari!" Salar tightened his arm in mine and said, "I like you very much."

At that time I couldn't realize how lucky I was that the conversation had turned to those channels. Later this line of talk was to help me greatly. It was just one of those accidents which later make one believe in the full power of a good clean rabbit's foot.

Luck Is with the American

We stayed long on the field, talking about the country of Salar's men and about America. As shadows lengthened, Salar turned us around toward the village.

"You work with Dr. Winsor?" he asked suddenly.

I said I did.

"*Parzan?*" Salar asked with a sparkle in his eye, pulling at an imaginary handful of chin whiskers. The word means "mountain goat" and is not at all disrespectful (page 331).

Salar said he had seen Dr. Winsor the year before when he first came to plan the road. I didn't follow this up. Perhaps Salar might talk more about it and I could get his feeling before I floundered into an error.

He changed the subject, however, and we were talking guns by the time we reached Stemal and the Khans.

Mohammed Ali Khan stepped forward and asked us into the house. There is a definite setup of ownership among these tribes. The Khan owns all the houses, the people, the farms, the supplies, everything living and inanimate in the village; and the chief owns the Khans; so, rightfully this was Salar's house, lived in by Mohammed Ali Khan.

Precedence and Protocol

If I went to a shop in a village, it was disrespectful to pay for anything I bought. It was the Khan's shop and I was a guest of the Khan. If the Khan was with me, he would tell the shopkeeper to see the *Kad Khoda*, or village chief, for his pay.

While I was a Khan's guest, he temporarily turned over all his possessions to me.

Salar led the way to the house, but at the door we all backed up and each said, "If you please."

It was a deadlock. Salar was chief. He rightfully should enter first. He was giving his place to me and also to Stemal.

I took Salar's arm and firmly pushed him with me so that we entered together. All laughed, and we proceeded to the room where we had eaten. Since it was now dark, two tall kerosene lamps stood in the center of the room, illuminating it with soft light.

In filed the rest after us: Stemal, his engineer, Mohammed Ali Khan, Cheragh Ali Khan, Askandri Khan, three or four other Khans, many bodyguards each loaded down with cartridges and a very businesslike-looking gun, and finally some servants.

No women, of course, were in sight. They are never seen by a visitor except around the village streets. Outside I could see the scurrying of the help back and forth in the courtyard. We all took places around the edge of the room, and with another "If you please" from Salar we all sat on the floor. Our shoes we had left at the door.

I drew a lovely yellow and red carpet to sit on and unconsciously rubbed my hand over its pile. Mohammed Ali Khan smiled at me in appreciation of my interest.

Salar had arranged the seating. He sat at the end of the room near a mantellike shelf of small lamps and photos, his back propped against a bolster. Stemal came next.

I was supposed to sit there, but quickly crossed to a place on the yellow and red carpet opposite Salar so that I could watch his face. I pleaded that Cheragh Ali was my interpreter.

Cheragh Ali was on my left. Mohammed Ali Khan sat next to Stemal, opposite Cheragh Ali and myself. I could see Stemal and Salar well, since the lights were between us and to my left. It was nearly 7 o'clock.

Like the rest of us, the soldiers sat cross-legged. They had on their bandoleers of cartridges, and their guns lay across their knees. They kept on their hats and shoes. The Khans, too, had kept on their hats, although they shed the cartridge belts and guns to servants.

Five braziers of burning charcoal embers were brought in, and each Khan was handed his own opium pipe. The Khans began to slide together in easier access to the nearest brazier. Pipes unwrapped, they were laid against the coals to warm the china bowls.

Head of a Mountain Goat

Salar had been talking about needing one more rain for the best ripening of the wheat and barley then heading out in this valley of Kashnigan. Mohammed Ali began to tell how he had shot the mountain goat. The other Khans jokingly told him he never even saw a mountain goat, and teased him until he ordered a servant to bring in the head.

In a short time the trophy appeared on a silver tray. They all admired the bloody beard and then told me I must shoot one with them.

So the talk went. Stemal was asked about prices in Tehran. I was cross-examined about America. My shoes were picked up and handed around. More questions followed amid the puffing of opium smoke.

Mohammed Ali Khan started to unwrap his pipe. When the pearl-handled pin used for poking the hole in the china bowl dropped out, he first began a thorough job of picking his teeth with it.

One Khan asked me what time it then was in America. That started a half hour of talk, which became more and more confused.

Impatiently I bided Salar's time to talk our business. I was in no mind to rush things, for Stemal had advised against that procedure. I fidgeted on my numbing legs.

Tea was brought for all in the same silver-holdered glasses we had used at lunch. Opium smokers drink endless glasses of highly sweetened tea. Slowly it drew toward 9 p.m.

I began to get terribly hungry. I suspect Salar had the same feeling, for he caught my eye and, holding his hand to his stomach, asked, "Eat, eat?"

I nodded and rubbed my stomach also.

He immediately said something in dialect to Mohammed Ali Khan, who repeated the message to a servant. Evidently the pipe smokers heard the order, for they all puffed loudly trying to rush the departure of the pill they were then smoking. Soon servants came in to take away the braziers, pipes, and tea glasses.

After a short time a tall servant appeared at the door of the room with a large white cloth folded under his arm.

All the guests slid back against the walls, and the servant spread the tablecloth on the floor. After smoothing it and making its corners come to Salar's and my feet, he stood in the center barefooted.

"Come," he called in a deep voice.

Other servants entered with the three-foot trays, filled with bowls, glasses, bread, bottles, and many other things. First the big fellow took the bread from one man. He carefully put one large round loaf at the edge of the cloth for each Khan and for us. At the far end of the cloth he put them down like shingles overlapping each other to accommodate all the soldiers.

The Prize Kebab Good as Promised

Still standing in the center of the cloth, he began to place the dishes in a somewhat symmetrical pattern.

A large dish of rice heaped high came first. This was sprinkled with rice which had been boiled in yellow saffron.

Another dish of rice and lentils followed; then a bowl of pot-roasted lamb in a sauce containing cherries (I found out they were cherries later by biting into the pits); an omelet on a silver plate; a puddinglike cake of spinach; a small plate with four little hearts of wild celery from the mountains; a deep dish of thistle sprouts, dug also from between the rocks of the slopes near by and cooked in thickened buttermilk; bowls of *mast* (clabber); large bottles of plain buttermilk and some buttermilk with chopped greens in it; a dish of rice fried to a crisp in butter; roasted chicken; and the prize—a flat dish an inch deep in rice on which reposed upside down a roasted lamb's head, skull and all.

Only we near Salar had the celery and the lamb head. Silver plates were put on top of the breads.

Salar took a broad, flat spoon and heaped my plate with rice. Soft pieces of lamb fell out of the pile as he dished it up. He then took some for himself and motioned me to the other things.

The big servant leaned over Salar's shoulder to put a folded pancake of bread between us. I saw pieces of roasted meat in the folds of the bread. Looking out of the door over the heads of the eaters, I could see the grinning farm boy. He had accomplished his promise. It was the special kebab.

There were no forks or spoons. All dived in, taking the food in their hands. Compressing it with their fingers, they pushed it into their mouths with bent thumb. I managed as best I could, using the limp, warm bread as a folded spoon.

Breaking the Lamb's Head

Cheragh Ali told me to take the lamb's head. I passed it to him; for breaking it open was a trick I had often seen accomplished but had never tried myself. He tore off two pieces of bread, put these on each end of the head, and pushed downward. The head broke in half. He held the neck end and offered the broken end toward Salar.

Salar, using his index finger, dug out half of the warm, soft brains. I next did likewise for the other half.

Cheragh Ali knew other good parts which he took for himself. Mohammed Ali Khan took the tongue. The rest disappeared down the cloth.

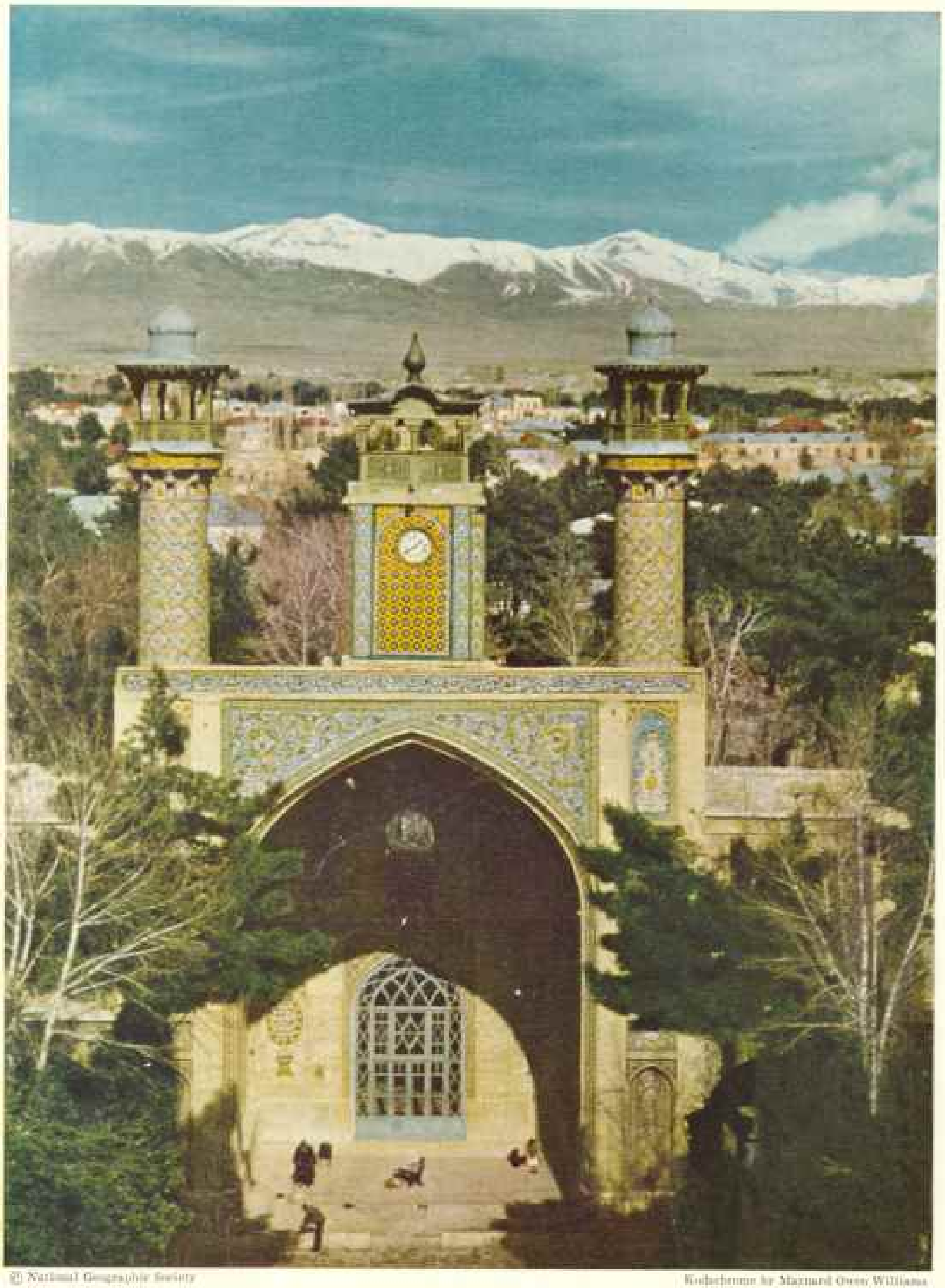
Salar put one piece of the celery on my plate, Stemal's, Cheragh Ali's, and his own. We all ate and drank mostly in silence except for the sound effects of the eating operations.

As they finished one by one, the Khans got up with no excuse and walked toward the other end of the large room to take turns washing their hands.

Salar and I stayed till last. A servant brought us the bowl, pitcher, and towel. The food was then taken away. The cloth containing the overflow of fallen rice, bones, bread, and so on was folded up and taken away. Braziers and tea were again brought in, as were the opium pipes. All settled back against the bolsters for tea.

"You have eaten with us; now what do you think of us?" Salar questioned me.

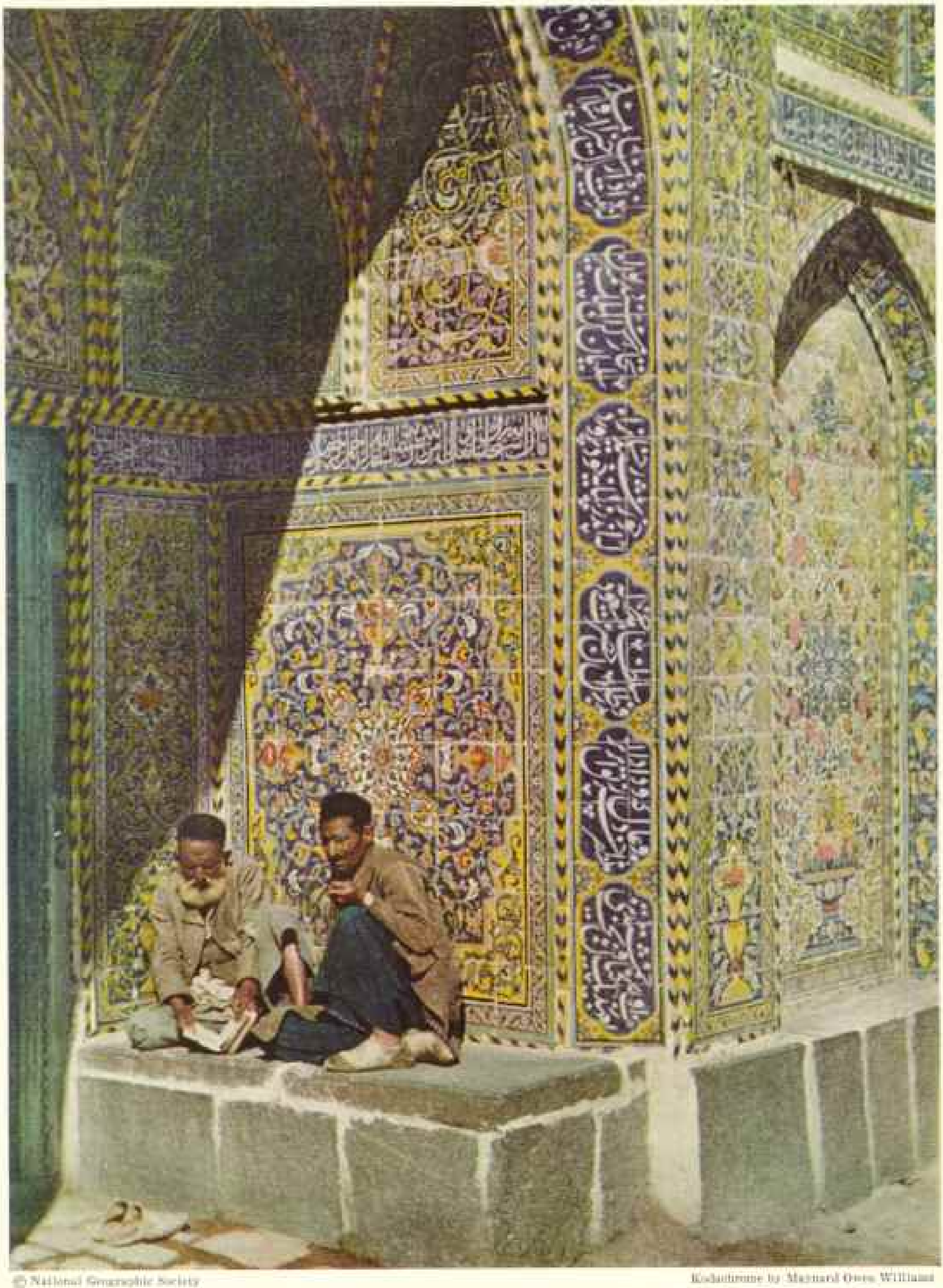
All turned toward me. It was said in a different tone and in bookish language. I looked inquiringly at Stemal. Because I wanted to have the proper meaning, he translated for me.



 Kodachrome by Maynard Owen Williams

On the Plain below Snowy Elburz Sprawls the Colorful Capital of Iran

Beside the courts of Sepah Salar Mosque is housed the theological faculty of Tehran University. Beyond stands the former Baharistan Palace, the present Majlis, or Parliament. Iran became a constitutional monarchy in 1906, but Reza Shah Pahlevi limited popular government. His son, Mohammed Reza Pahlevi, now rules.



Kodachrome by Maynard Owen Williams

In a Sheltered Nook Warmed by the Sun, an Old Moslem Thumbs His Well-worn Koran

Sharp contrast to this old tiled mosque are Isfahan's modern airport and textile mills. Most of Iran's Moslems belong to the Shia sect, some of whose rulers descended from Ali, cousin and son-in-law of the Prophet. Reza Shah, maker of modern Iran, built many government schools and weakened the power of religious leaders.

In a Tehran Shop Window He Studies Pictures of Historic Buildings

Many he knows at first hand. As he has grown up, the lad has seen newly erected modern buildings change the face of the capital.

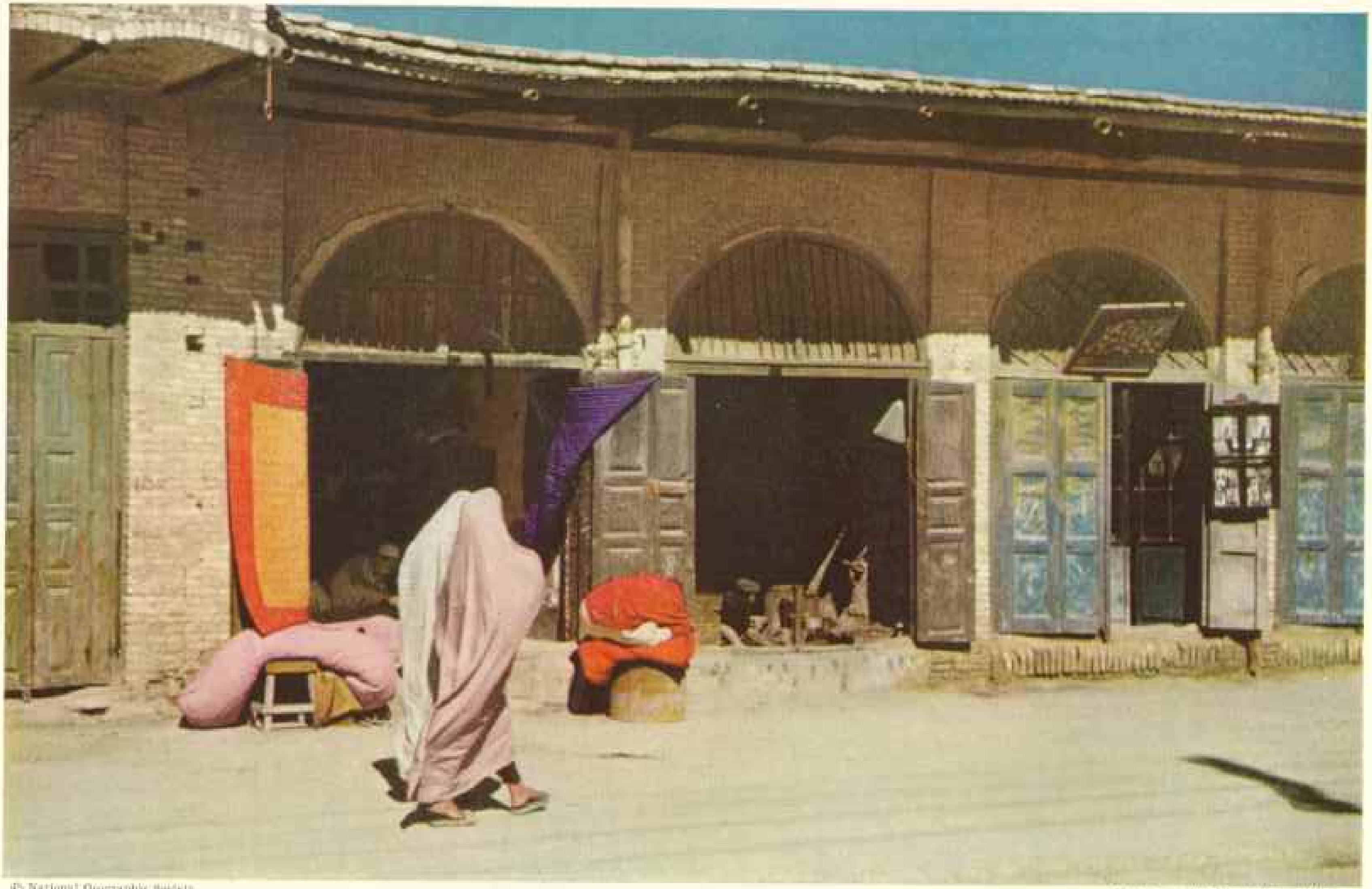
Modern Buses, Linking Tehran with Its Suburbs, Line Up at the Maidan, the Central Square

With the cost-of-living index about ten times normal, cars and tires are almost priceless. Fortunately, bus service is good, for taxicabs are unbelievably dear.

Kodachrome by Maynard Owen Williams

Reza Shah Pahlevi, Deposed Leader of Modern Iran, Gazes at the Splendid University He Created

Located between the old city and the Elburz Mountain wall, the 12-year-old University of Tehran has Schools of Liberal Arts, Medicine, Law, Industry, and Theology. Buildings were designed by the archeologist André Godard. Near the mountains was Camp Amirabad, headquarters of the U. S. A. Persian Gulf Command (Plate VI).



© National Geographic Society

Kodachrome by Maynard Owen Williams

Although the Veil Was Abolished in 1936, These Figures in the Bazaar of Abadan Cling to Loose, Concealing Robes

Queen Fawzieh, who enjoys table tennis and skiing, dresses in the height of Paris or Hollywood fashions, but peasant women, without breaking the law, find ways of masking face and form. Industrial Abadan, busy in refining oils, lacks the conveniences of the capital.

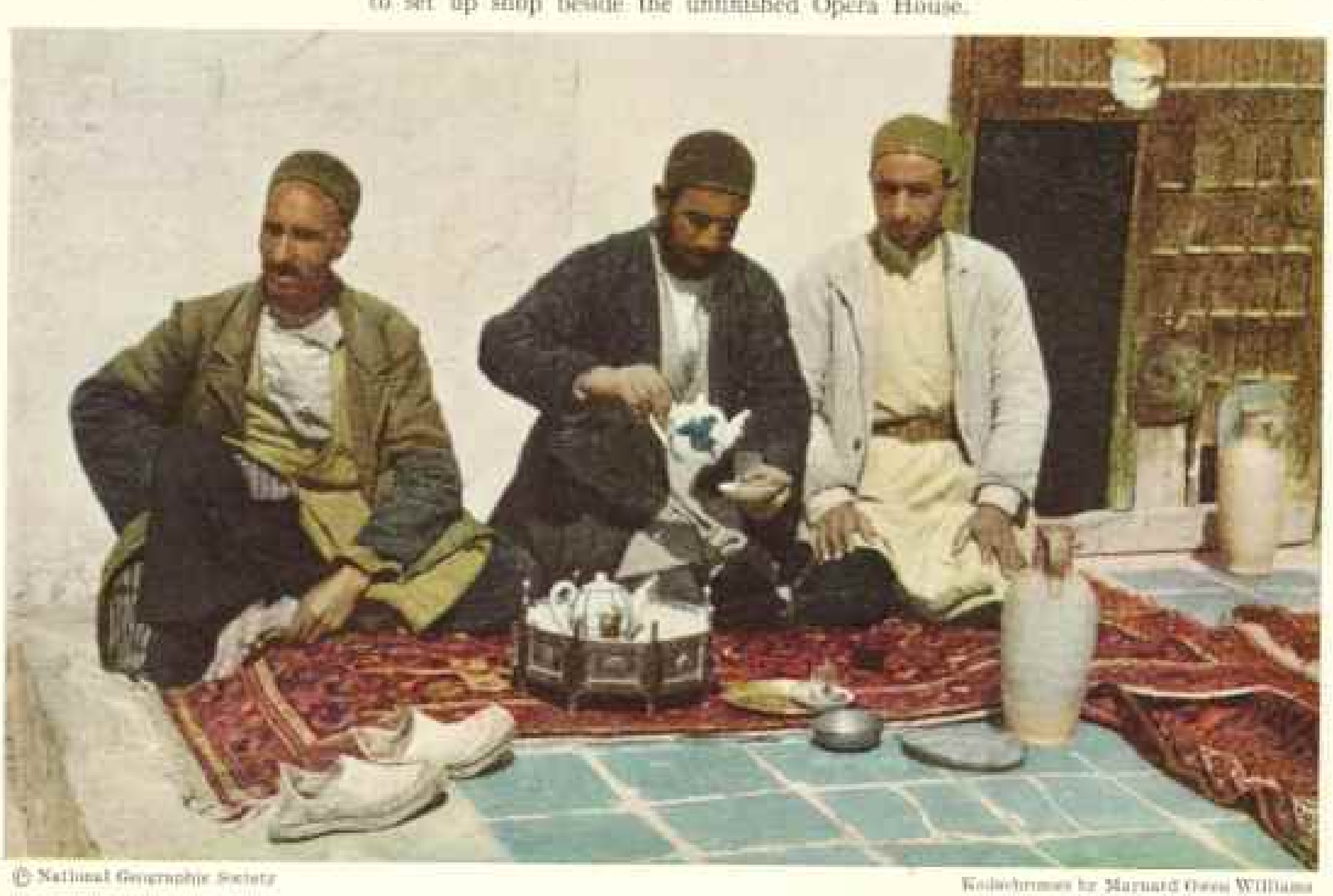
 Kodachrome by Maynard Owen Williams

Old Glory Waved above Camp Amirabad, Headquarters of the Persian Gulf Command

From here, near Tehran, was directed the transport of Lend-Lease matériel to embattled Russia. Despite desert heat and mountain blizzard, nearly 4,500,000 tons of supplies sped over rutted roads and crowded rails. American troops pulled out of Iran in March, 1946.

Fresh Roast Potatoes Combat Iran's High Cost of Living

To help curb Tehran's black-market operations, the Government allows vendors of soap, oranges, and vegetables to set up shop beside the unfinished Opera House.



Kodachromes by Maynard Owen Williams

Soft Carpets and Hot Tea Add Comfort to Iran's Traditional Hospitality

No effeminate party this, as one of the bewhiskered trio pours. Bare feet, not muddy shoes, touch the lustrous pile of a Persian rug in the courtyard of a mosque at Isfahan.

New Grain Shoots, Sprouted on a Plate, Welcome the New Year to Tehran

On March 21 begins the 13-day springtime celebration, known as *No Ruz*. Her face no longer veiled, this elderly woman turns her head to avoid the camera.

Kodachromes by Maynard Owen Williams

Native Boats Float in Iraq, but Scratch Keels on the Soil of Iran

The international boundary follows the Iran shore line along part of the Shatt al 'Arab. Such simple craft, called *belems*, follow patterns dating from the days of Ur and Babylon (Plate XIV).

 Kodachrome by Maynard Owen Williams

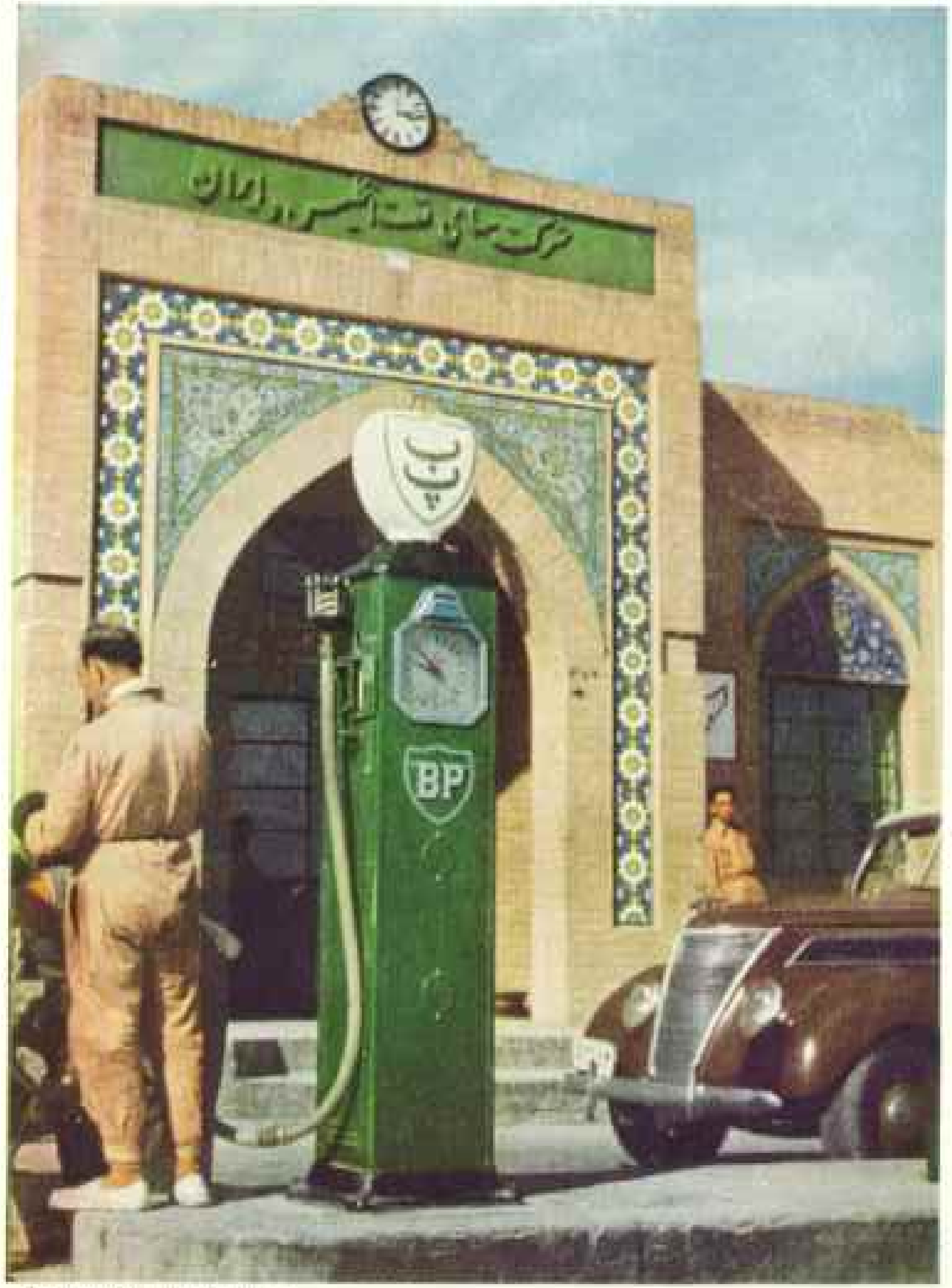
In Palm-leaf Baskets, Dried Dates Arrive at a Packing Plant below Basra

Between Eden's river and the desert, a green band of geometrically aligned palms provides three-fourths of the world's crop. In 1944, Iraq exported nearly ten million dollars' worth of dates. In the shallow, muddy waters, boatmen pole, rather than row, their graceful craft.

Kodachrome by Maynard Owen Williams

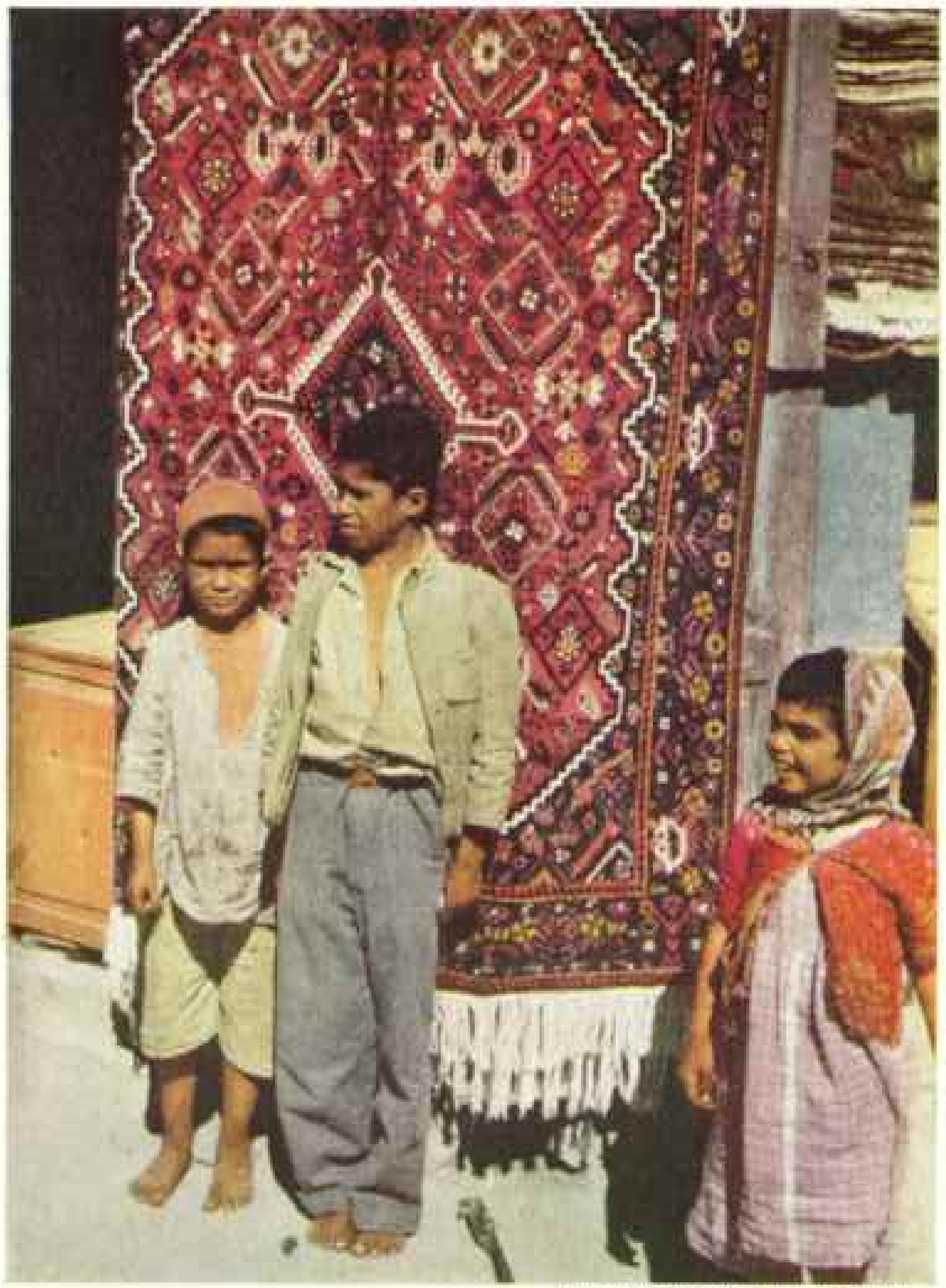
Iron Fence in Front of Bank and Post Office Serves as Display Rack for Old Rugs on Sale in Tehran

Oriental rugs have an all-purpose use; they serve as the bedroll and valise, picnic rug, display counter, and shop decoration in Iranian life.



In Arabic Script or Latin Letters "BP" Means Gasoline

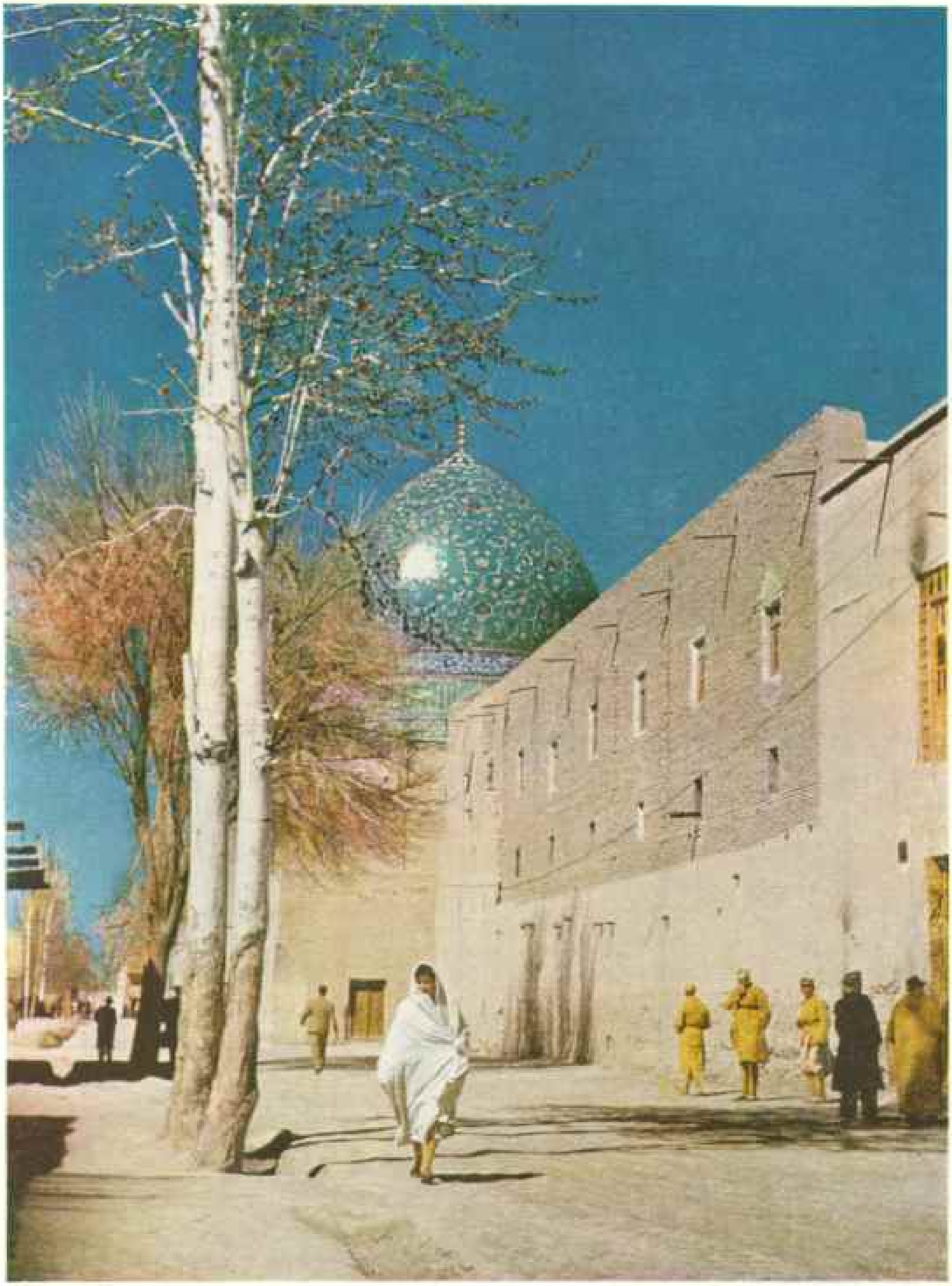
The abbreviation stands for either "British Petrol" or "Benzine Perse." Travelers accustomed to buying five-gallon tins welcome such pumps.



Kodachromes by Maynard Owen Williams

Persian Rugs Add Art to Abadan's Shop Fronts

Grocery shops, bakeries, and barbershops hang them at their entrances or lay them flat for customers to sit on. Abadan is hot, muggy, and muddy.



 Kodachrome by Maynard Owen Williams

Nearly 250 Years Old Is This Turquoise Dome of Isfahan's Madrasah Chahar Bagh

It was the last elaborate structure built by the Safavi kings when Isfahan was capital. Inside the tall wall, almond blossoms drop pale petals in the placid pool of a theological school. Down the street, at right angles, runs the Chahar Bagh, main shopping avenue. Soldiers stand near the entrance to large barracks.

Sisters Ride on a Meek-eyed Donkey in Dizful, "City of the Blind"

In summer, residents of this "Hottest Inhabited Town on Earth" sleep uneasily in caves and damp cellars. Not far away, at Andimishk, mechanics assembled airplanes for the Russian front in World War II.

Kodachrome by Maynard Owen Williams

Near Abadan's Big Refineries, Nuts and Raisins Gather Dust in the Bazaar

Iran's oil helped the United Nations win the war. In striking contrast to its modern installations are the primitive conditions in the native town. From the air, Abadan seems a fairy city, jeweled by lights at night.

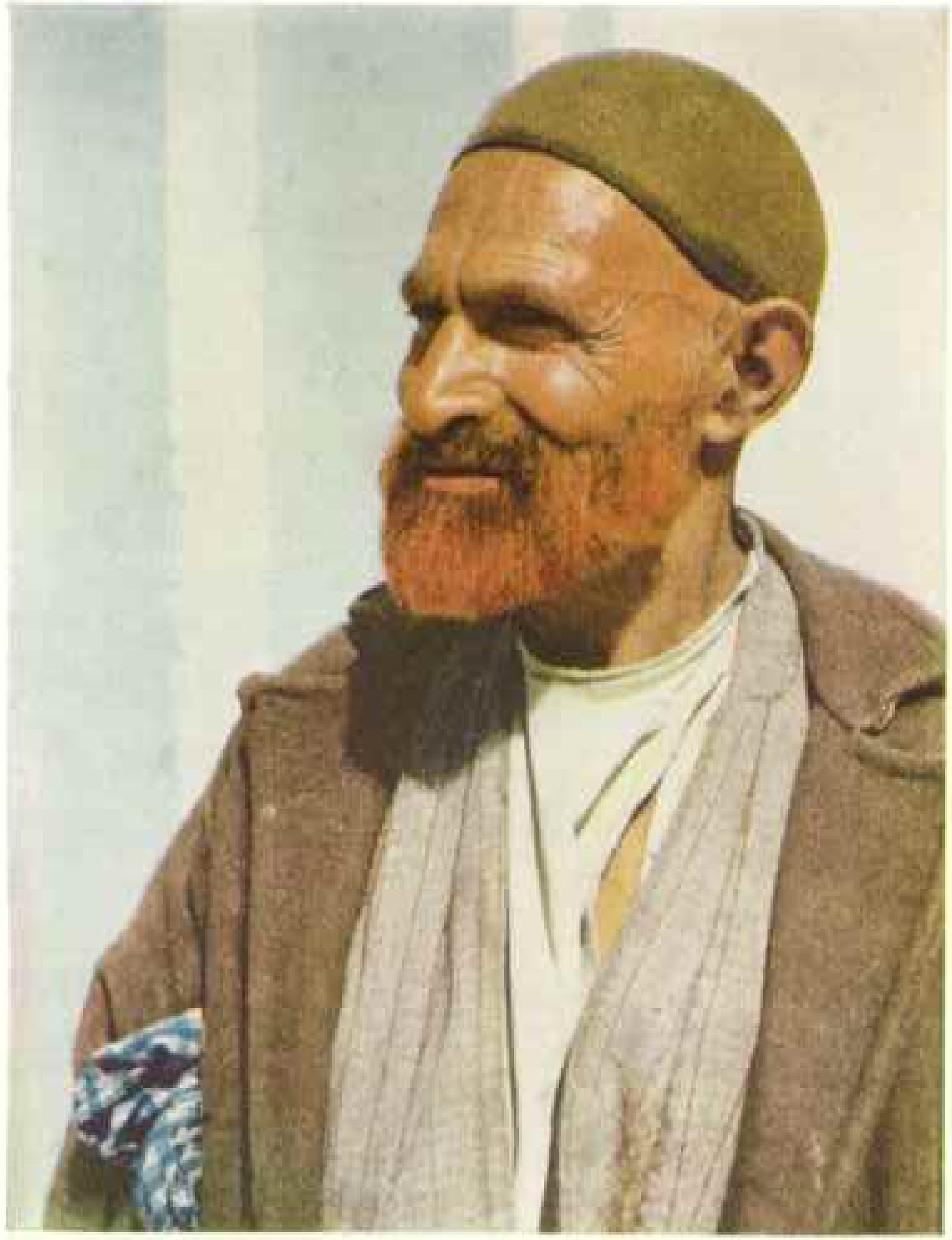
Kodachrome by Maynard Owen Williams

Graceful *Belems*, Shaped Like Ancient River Craft, Serve as Ferries in Basra, City of Sindbad the Sailor

Higher upstream a modern bridge affords a river crossing near Basra's splendid airport. But here, near the bazaar, a large barge for transporting motorcars and scores of graceful water taxis shuttle back and forth across the storied river. The Shatt al 'Arab is formed by the junction of the Tigris and Euphrates Rivers.

An Arab Wears Goat's-hair Crown and Robe with Easy Grace

His thin summer cloak lets the air sweep through; his winter robe is heavy and warm. When the sleeves are extended, the robe is rectangular. Head coil must be of correct size; the shawl protects the face against sun, dust, and wind.



Kodachromes by Maynard Owen Williams

This Smiling Isfahani Again Dons His Old Skullcap

During Reza Shah's reforms, such headgear gave way to the visored Pahlevi cap. Then came felt hats in European styles. With war shortage and Reza Shah's abdication the felt "pot" reappeared. It may serve as base for a turban.

Palm-thatched Piles of Dates Frame a Young Iraqi Girl and Her Elder Brothers

During the shortage of shipping, dates piled up from groves below Basra and slowly soured. A major export of Iraq, they are also a staple in the diet of the frugal Arab.

Kodachromes by Maynard Owen Williams

Like Laborers Hauling Building Stone, Basra Porters Juggle Baskets of Dates

Baskets are made of palm leaf. After being unloaded, the sticky cargo will be sorted and repacked for shipment to India. Waste is heavy and methods of handling seem crude.

"I have paid my taxes to you; I am of Chahar Lang," I replied. "This wonderful meal has made me only more happy that you have accepted me. When I go to Isfahan, I shall buy cloth for trousers and a coat. I shall wear your clothes."

I said this in English so that Stemal would tell Salar my exact words. I couldn't do that in Persian. All laughed, as did Salar. He nodded his head in approval. He turned to Mohammed Ali Khan and talked in dialect. Many Khans entered into the discussion. Salar faced me again.

"We have a suit for you. It is coming."

All this time Salar had been unwrapping his pipe. As he took it out, I saw it was a different one, with a beautiful blue bowl and a gold band where the china bowl and wood stem joined. He fumbled in his pocket for his knife. Since he couldn't find it, I offered him the new Army knife my wife had just sent me.

He scraped the bowl and then began to inspect my knife. It was the last I saw of it as my own. He fastened it on his key ring and proudly displayed it to all the Khans.

The American Becomes a Bakhtiari

About that time the tall servant appeared with my costume. Laughing, Cheragh Ali moved the oil lamps and demanded I put it on in the center of the room. Salar entered into the spirit of the act and urged me up. There was no getting out of the situation.

Cheragh Ali and Askandri Khan took it on themselves to dress me—or rather undress me. They indicated they wanted me stripped down to underwear.

Each piece as I took it off was passed around for the inspection of everyone. They even went through my pockets. My blue light-wool shirt pleased them all. The belt got a minute going over.

First they put on me a pair of heavy black-silk trousers. There was a waistband covering the pleats at the top. Because I was now much thinner than when I left America, the waist just fitted me. The trousers were voluminous.

Next they put on me a silk shirt, then a coat, then the heavy gray-wool topcoat with 6-inch sleeves.

A black hat was brought, but it did not fit. Cheragh Ali took off his and put it on my head. All cheered. They had forgotten the canvas shoes, but I didn't remind them. Cheragh Ali shook my hand, as did Askandri Khan and all the rest in turn.

Moving closer to Stemal, Salar indicated I should sit next to him in the space he had made. "You are Khan now," he said as I sat down (page 331).

"American Khan is my name. You have now Khans of two countries."

Salar went back to the pipe. We all sat in silence for a short time.

The Direct Approach

"What have you come here for?" was the thunderbolt Salar used to break the silence.

"To ask your cooperation in building the road to Tang-i-Gazi and the Karun dam," I replied through Stemal.

"What will you do if I say we don't want the road and that I will stop you?"

I broke out in a cold sweat. This directness had taken me by surprise. It was not the custom. Usually there were a lot of compliments and round-the-bush talking, and finally each gathered the other's idea. This wasn't in the books.

"You will say such things only when they hurt Chahar Lang," I replied. "This work will not hurt Chahar Lang and will help the people—your people and Isfahan people. If it would hurt Chahar Lang, I would not work for it myself. Even though we laugh, I am proud to be of Chahar Lang. I would not work against my own people."

All the Khans and soldiers leaned forward in interest. Outside, the doorway was jammed with lesser men and servants.

"Can you say that the Army will not use this road to repeat the terror they spread through our village only a few years ago?" Salar demanded.

"Do you know that nine years ago they took that boy [he pointed to Cheragh Ali] when he was only 16 years old and led him barefooted ten miles through deep snow to Darun and imprisoned him? Do you know they hunted us all down like dogs, taking money for our release only to laugh at us when tens of thousands of *tomans* were given? Do you know they took our crops and our animals without pay, leaving my people to starve?

"Have you heard that I spent seven miserable years in their jails and more years running in exile like a desert dog?

"No, you can't know this. You don't have such things in America, but we have had them here."

Salar had laid down his pipe. He had drawn himself up straight in an air of defiance. His eyes blazed. He was indeed very commanding in this fiery mood.

"That king has gone," I said quietly, still looking at the embers in the brazier. "That government has gone. I have not been sent

Frank B. Salisbury

Herders' Wives Spin the Wool of the Bakhtiari Flocks

Some 20 percent of the 300,000 Bakhtiari still commute across the mountain passes. On the hoof go their food and clothes—vast herds of sheep and goats (page 350).

by anyone wanting to bring harm here. Dr. Winsor sent me. I cannot discuss this government with you, for I have given my word in my contract not to do that. But you know it is all different now."

Salar sat in a long silence. The Khans hardly moved an eyelash. My attention was centered on the burning charcoal in the brazier.

"You Can Build Your Road"

After almost ten minutes Salar put his hand on my knee. He turned his face to me.

"You are right. It is different now. Although our wounds are still raw and even bleeding, I have already promised myself that if we ever have a government which will help us and be friendly to us, it will see that the Bakhtiari are big men.

"We wish to be Iranians first. We wish to help our neighbors the Isfahanis. We know they need water. We will forget what our memories tell us. We will put the past behind us. We will give our hand in friendship. Our fathers have been among the greatest men ever born in Iran. Their stock is still alive. They have ruled Iran. We will help our country.

"You can build your road. You can tell the chief of Haft Lang that Salar gave you his cooperation for the good of Iran. May Allah be guiding me in this action!"

Suddenly I became limp and tired.

I turned and said good night to Salar. I thanked him for the meal, for the clothes, and for allowing us to be such close friends.

He replied, "I like you very much. We will hunt together."

INDEX FOR JULY-DECEMBER, 1946, VOLUME READY

Index for Volume XC (July–December, 1946) of the National Geographic Magazine will be mailed to members who bind their copies as works of reference.

Shad in the Shadow of Skyscrapers

By Dudley B. Martin

With Illustrations from Photographs by Staff Photographer Luis Marden

AT THE very threshold of America's biggest city there flourishes a commercial fishery that does an annual business of a quarter of a million dollars. This "big business" is done entirely in the few weeks each spring when the shad find the Hudson River tempting and swarm in from the ocean for spawning.

Here is one of those old aspects of New York which help make the ever-changing city tolerable to its more rustic residents and fascinating to those who enjoy exploring its byways.

For the most part, however, New Yorkers pay little heed to this remnant of a day when the city fed itself from its own lands and waters. If they do cast a second glance, they are likely to be as mystified as was the young lady who, homeward bound to New Jersey over the George Washington Bridge one afternoon in wartime, asked a friend if those poles sticking out of the water down there didn't have something to do with stopping enemy submarines!

No wonder she was mystified. Little ballyhoo attends this enterprise carried on in the shadow of the world's tallest buildings.

The shad men would just as soon stay in the shadow, for, hard and honest though their toil is, some of them seem to feel that the netting of fish in the world's most important harbor survives only by virtue of oblivion.

Shad Harvested for Some 300 Years

But the Hudson River shad fisherman is about as much a poacher among us as the American Indian. For some 300 years white men have worked these watery furrows for such harvests.

One early account states that "the river teemed with the finest fish, among which was the shad and many kinds scarcely less delicious . . . there were plenty of sturgeon, which the Christians do not make use of, but the Indians eat them greedily . . . herring were in myriads."

Another surviving account of the Hudson in early days concerns the voyage of Richard Wells, an Englishman who traveled up the lower Hudson in 1769. The journal entry remarks the unrestricted fishing, stating: "Mr. Wells bought Ten small Rock Fish for 12 coppers. . . . at Beekman Manor . . . 2 shad cost 6d. . . . these Fishermen draw their nets oftener than ours, not stopping between the Draughts."

If the colonial shad men kept up anything like the pace of their present-day successors, they were busy, to say the least.

Water Front Bustles with Preparations

In the middle of March, about the time the Carolinas are getting in most of their shad harvest (some families still salting away the fish in barrels, as in olden days), the Hudson's fishermen start preparing for their turn, their interruption of the life cycle of this river-ascending fish.

By then the Atlantic coast shad season is about half finished in point of time, for north Florida folk begin sifting the St. Johns River for the greenbacks in December. In volume, however, the season is just getting going, for Chesapeake Bay, its tributaries—among which is the Potomac—and the Hudson come in quickly, one after the other, as winter gives way to spring.

Nowhere else in their appearances in thirty-odd rivers of the North Temperate Zone—as far up as the St. John, in New Brunswick, and even the St. Lawrence—do the shad, or rather man's efforts to capture them, afford as striking a contrast with the environment as in the Hudson. (Some persons, especially mariners, call the lower Hudson the North River, a relic of Dutch days when the Delaware, at the other end of New Netherland, was the South River.)

Along the New Jersey water front, amid some of the busiest commerce and largest industries of the metropolitan area and directly across the river from the teeming West Side Highway, the shad men dig from the low-tide slime of the river bed the 60-foot hickory poles which they interred for preservation ten months before.

On the beach under the bluffs whose twenty miles of traprock are famous as the Palisades, they see to the gill nets, the iron anchoring rings, and other gear, or calk the boats and build the shacks which are to be bases for operations in the short weeks ahead.

The sturdy poles, shaved, pointed, and replenished (for there's a heavy loss to the elements and river traffic), are now set out in the river in rows as straight as possible, the better to snare the shad as they head upriver past the Empire State, Chrysler, and other spires.

Unsubstantial as a Dream, Manhattan's Towers Look Down on Fishermen

As on the Sea of Galilee, men haul their nets in the shadow of teeming "Baghdad on the Hudson." Eagerly they peer at the dark river as they draw the nets supported by 60-foot hickory poles. What will the waters yield? One startled shad fisherman saw horns and hoofs, thought his time had come (page 362). In center background towers the Empire State Building, world's tallest.

Atop the pole farthest out on each row is put a red flag and at night a lighted lantern. These signals must be large enough to be seen three miles away by crews of ships plying the channel near the east bank with oil and other cargoes for Albany and lesser Hudson ports. Since the river is about a mile wide here, things have to be figured out carefully. The Army Engineers take care of that.

By this time, about March 25, it is a matter of waiting and keeping a close eye on the river for the run. A short length of fine linen mesh, a fraction of the 1,200 feet that many of the nets measure, is strung out in the river as a trial net.

Meanwhile, the talk is of the weather, manpower, boats, trucks, smaller paraphernalia, and, strangely, of the church calendar.

No, the shadders are not particularly concerned with ecclesiastical matters, but they do have a pecuniary interest in how early or how late Easter comes. The more shad they can catch before Lent is over, the richer they will be. The later Easter comes, the better. In fact, a fish caught before then is worth, in market terms, three times as much as one caught afterward.

Hudson Shad Run Starts About April 1

The handicapper in this race, besides the moon, is the weather. If winter was wintry and departed on time, and if spring is warm and dry, the shad can be expected in the Hudson about the last week of March.

While the greenbacks are in salt water they live singly or in small groups; but when the time comes for them to seek quiet fresh water to deposit their spawn, they "school up." Thus it is that some time around April 1 the cry goes up along the Jersey water front, "The shad are running!"

And it's no April fool. Just watch. Out

"A Couple of Hours Ago, Sonny, She Was Swimming in the River"

Shad and roe fresh from the Hudson draw customers to Floyd Clayton's pinup-decorated floating store at Edgewater, New Jersey (page 375). More valuable than "bucks" are females, or "roes," each of which carries 25,000 to 30,000 eggs. Some have 100,000, or even 156,000. The larger shad are females.

goes the rigging, and along the 17 miles from Weehawken, New Jersey, to the New York State line the rows suddenly become a pattern of toiling men, nets, rowboats, and an occasional motor launch, the mother boat. Under way now are seven to eight weeks of fishing, a regimen of toil given over to the tides and the fish they bear, no matter what the hour of day or night.

On the "slack of the flood," when the tide starts receding from high water, the nets are lifted. And there's no guesswork about it. The bottom of the river is a half hour ahead of the surface. From long experience the shad man knows just the moment when he must start hauling in the quarry, and he and his helpers must be out by the stakes with time to spare (pages 360, 363, 365).

For the "lift," a shad boat carrying three or four men, one or two of them rowers, is towed to the innermost pole. There two men in the stern start pursing the net—bringing the bottom up to the top to form a bag and spilling out the squirming fish into the boat.

Largest American member of the herring family, the shad has a usual length of 18 to 24 inches.* The green and silver fish glitter in the sun. Strayed scales dot the thwarts and the men's oilskins like fallen pearls.

Only about half the captive shad have actually been gilled, and these are yanked out of the mesh, with a grunt or an oath if the hold is stubborn. All the while, the oarsmen keep the boat in position, and anyone who knows the Hudson's tides, rising and falling about five feet, will appreciate this task.

The elements often play tricks on the shad men. An onshore wind, for example, can blow hard enough to make one rue the day he sank his first dollar into the river. It drives the current upstream and makes the net baggy.

*See *The Book of Fishes*, edited by John Oliver La Gorce, published by the National Geographic Society.

"This Big One Will Look Even Better on a Platter"

Shad, oversize members of the herring family, run about a foot and a half to two feet in length when full-grown. Since thousands are caught before they can lay their eggs, the wonder is that the fish escapes extinction. The tousle-haired fisherman is one of the men of Scandinavian origin employed by George Kotze, long the president of the Hudson River Shad Fishermen's Association (page 366).

A snagged net means loss of fish, sometimes the whole catch.

At every low water there is a "setting." This operation, too, has to be timed precisely. The net, which had been "boxed" last time it was taken ashore and dried, is now let out from pole to pole. It is allowed to sink by the iron rings so that the concave side will face all comers that happen to be swimming or drifting north with the incoming tide anywhere between the 5-foot clearances given the surface and the river bottom.

"All comers" is right, within the bounds of the 5½-inch stretch of the mesh, for all kinds of things turn up in the nets. In fact, these oddments provide many an evening's storytelling between seasons for such river veterans as "Captain" Fred Truax, John Adams, Harry Lyons, Floyd Clayton, and William Ingold.

Although the Hudson is less and less the depository of refuse, thanks to the increasing industrial use of waste for by-products and to the spread of municipal incineration of garbage in the last few years, it is still host to myriad things of wing and hoof.

Horns and Hoofs in the Hudson

One day the lordly waterway was even believed to be possessed of the Devil himself. It wasn't the wind or tide, either, although some "strong water" of another kind did speed the spirit.

But let Harry Lyons, operator of two rows of nets just above George Washington Bridge, tell the story:

"It was a nor'easter, rainin' and blowin' and gettin' dark on the river. We're comin' to the second space. I'm on the oars. Paul Dunphy's at the net. He's a Nova Scotia Irishman—very superstitious, y'know. Suddenly, Dunphy stops haulin'.

"Gettin' More Roes than Bucks Today"

Although males and females run about equal in numbers, the egg-laden roe shad usually account for about two thirds of the wright of the catch because of their larger size (pages 361 and 366). While in fresh water, adult shad eat little or nothing, so cannot be tempted with baited hook.

Cover the Top Two Inches and This Could Be a Rustic Scene Far from Skyscrapers

Shad fishermen are washing their nets on the New Jersey side of the Hudson River, with George Washington Bridge and the soaring apartment houses of New York's Washington Heights as a backdrop. One New Jersey miss thought the poles supporting the nets were wartime antisubmarine obstacles (page 359).

On the "Slack of the Flood" the Lift Is Made

These fishermen near George Washington Bridge were ready for action at the moment the tide began to recede. Pursing the net, the two men in the stern drew it into the boat and began extracting the gilled shad. With the aid of a line from a tholepin to the net-supporting pole, the oarsman keeps the boat steady.

"'The queer feller,' he says. Nothin' more. Dunphy's lookin' me straight in the eye. He's stiff, and yet kinda limp, too, like he's through, made his peace.

"I look o'er the stern. In the half-dark I see the horns, plain as day, a pair of 'em stickin' out of the water! Moment later there's the clove hoofs. I'm not so much on drink, but I begin to feel washed up, too.

"Then, sudden, I remember. The ferryboat collision with the cattle boat, a few steers o' board. Just a dead beef, that's all this Devil is. . . .

"Did Dunphy come to? Sure, he's very much alive. Think he's on one of the fishing schooners."

In the living room of his field-stone house on Undercliff Avenue, up the hill from Edgewater's No. 2 firehouse, Mr. Lyons poured forth local lore, telling the ways of the river and its banks like some schoolboy at Saturday supper. (And many's the schoolboy he has fished out of the river near a capsized canoe.)

Little would one guess that Mr. Lyons was "retired," that he had stopped taking his perennial shadding leave of absence, come the vernal equinox, from the firehouse below.

When spring approached one year and the big red engines had strange hands, wartime auxiliaries, swarming over them, Harry Lyons opined it was time to take a pension. Now he can wander farther—to Maine, for instance—in his carefree quest of fish and fun.

But it was of the Hudson, the river he has played on and worked on all his life, that Mr. Lyons talked. It was of the "river cleaning up" lately, spelling not only a shad comeback but bringing in also to the nets, traps, and hooks such a salt-water assortment as butterfish, fluke, flounder, whiting, bluefish, weakfish, and blackfish, not to mention a dozen or more fresh-water fishes.

"Once I caught a 51-pound cod," Mr. Lyons recalled. "Traded it for a gallon of wine."

Scales in Scales—Weighing Fresh-caught Shad

Thirty-seven of the 3,000,000 to 5,000,000 pounds of shad caught in the Hudson River each spring are recorded on the dial (page 374). In a typical catch the males weighed from about 2 pounds 4 ounces to 5 pounds, while females ranged from 3 pounds 11 ounces to 7 pounds 14 ounces. Some whopper roes register 8 or 10 pounds or even more.

A mile and three-quarters south of George Washington Bridge, past shanties, barges, sunken ferryboat and other hulks, and a few boat and canoe clubs making a brave stand amid decay, is the Colonial Tavern. Here, if anywhere, is headquarters of the lower Hudson fishery, with all the bustling, bibbing, chattering, and feasting of a shad season.

Planked Shad Fresh from the River

Before he caved in under the strain, one could find here also a large man, the proprietor and obviously the boss, George Kotze.

A builder turned tavern keeper, Mr. Kotze went into the shad business on the side only twenty years ago. His seniors, however, made him president of the Hudson River Shad Fishermen's Association, for they considered him a forceful personality to look after the interests of the group. The Association presents its point of view to legislators at Trenton and Albany and also to the Interstate Park Commission, whose decision a few years ago to make the shad men pay for riparian rights jolted a dozen fishermen who thought they had inherited from their fathers and grandfathers certain spots under the Palisades.

Mr. Kotze has found fun, however, not as a lobbyist but rather as a host, a server of planked shad. It's said to be the best along the river, and I dare say, having partaken of some, there's none better anywhere.

So steep is the hillside bearing the Colonial Tavern that, when you go up the stairs near the River Road entrance, you come not only to the dining hall but also to a little plateau or terrace, about 15 by 40 feet, behind the kitchen.

The spring evening when the National Geographic photographer and I called at George Kotze's to see the gathering of the New Jersey Police Chiefs' Association, there glowed on this earthen floor out back a mound of burning charcoal some 20 feet long and 3 feet wide. The shad bake was on!

That afternoon a man—a specialist if ever there was one— had come out from New York on the 125th Street ferry, a quarter mile south, and boned the shad, part of a catch just out of water (page 371).

The gleaming white halves, or fillets, crossed with bacon strips as if to make a culinary coat of arms, had been pegged on inch-thick

oak planks and set around the fire in an oval (pages 373 and 374).

Now, while cooks and waiters hustled about, while the roe of the shad simmered separately in a huge broiling pan inside, while the arriving police chiefs bellowed helloes, the wood smoke of the shad bake curled up the cliff, and the fragrance was sniffed enviously by several youngsters and a cat perched on rocks above.

The melting bacon soon started basting the fish, and care was taken to upend each plank every few minutes to give the fillet an even cooking.

When the shad had had almost an hour of this hot fire and word had come that the diners were finishing their clam chowder, the planks were taken up, one by one, and put on a serving table athwart an entrance to the dining room. Here several nimble hands apportioned the browned fish, besides the roe and vegetables arriving from the kitchen, and waiters helped garnish the food and the plates before whisking the result off to waiting palates.

He Can Repair a Gill Net with His Eyes Shut

Behind most of the Hudson's fishermen lie years of experience in catching fish in many waters of the world. Independent and happy-go-lucky, hundreds follow the fishing north from Florida with the advancing season. Many are of Scandinavian or Portuguese origin.

Itinerant Fishermen Follow the Fishing

Too bad, we thought, that the remarkable Andrew, the big Swede who is Mr. Kotze's head fisherman, wasn't there to see these embellishments. But Andrew—Andrew Anderson of Bergen Beach, Brooklyn—probably was happier having a cat nap or a snack in the shack on the beach three miles up the river. And the crew's cook, a Norwegian, didn't have to make anything fancy.

These hired fishermen, most of them Scandinavian and some Portuguese, have a boisterous and haphazard life. Typical, perhaps, of their outlook is the time the bulky Andrew was hauled off to a hospital with pneumonia and a dangerously high fever after he had keeled over on the beach.

Later the same day he reappeared down the cliff, protesting: "All dat crying enough to make anybody sick. I get dressed und valk out!"

A thousand or more itinerant fishermen like Andrew follow the fishing as it progresses up the coast from Key West to Kennebec. They go seining off Atlantic City, scalloping out of New Bedford, trawl fishing off Hampton, Virginia, tilefishing in the Gulf Stream south of Ambrose, and pound fishing off the Jersey coast.

They know the ins and outs of their suc-

Food Disappears Like Snow in Spring as Hungry Fishermen "Fall To"

Shad fast while on their spawning run, but not so the men who catch them! Young and old, of many racial origins, these fishermen know the "good feeders" among the riverside employers. Experienced fishermen last year drew $300 a month, plus keep.

cessive employments, and they know the "good feeders" from the bad among the master fishermen. Their pay on the Hudson last year jumped to $300 a month, with keep, and boat captains like Anderson got $400. Before the war the wages were $100, all found.

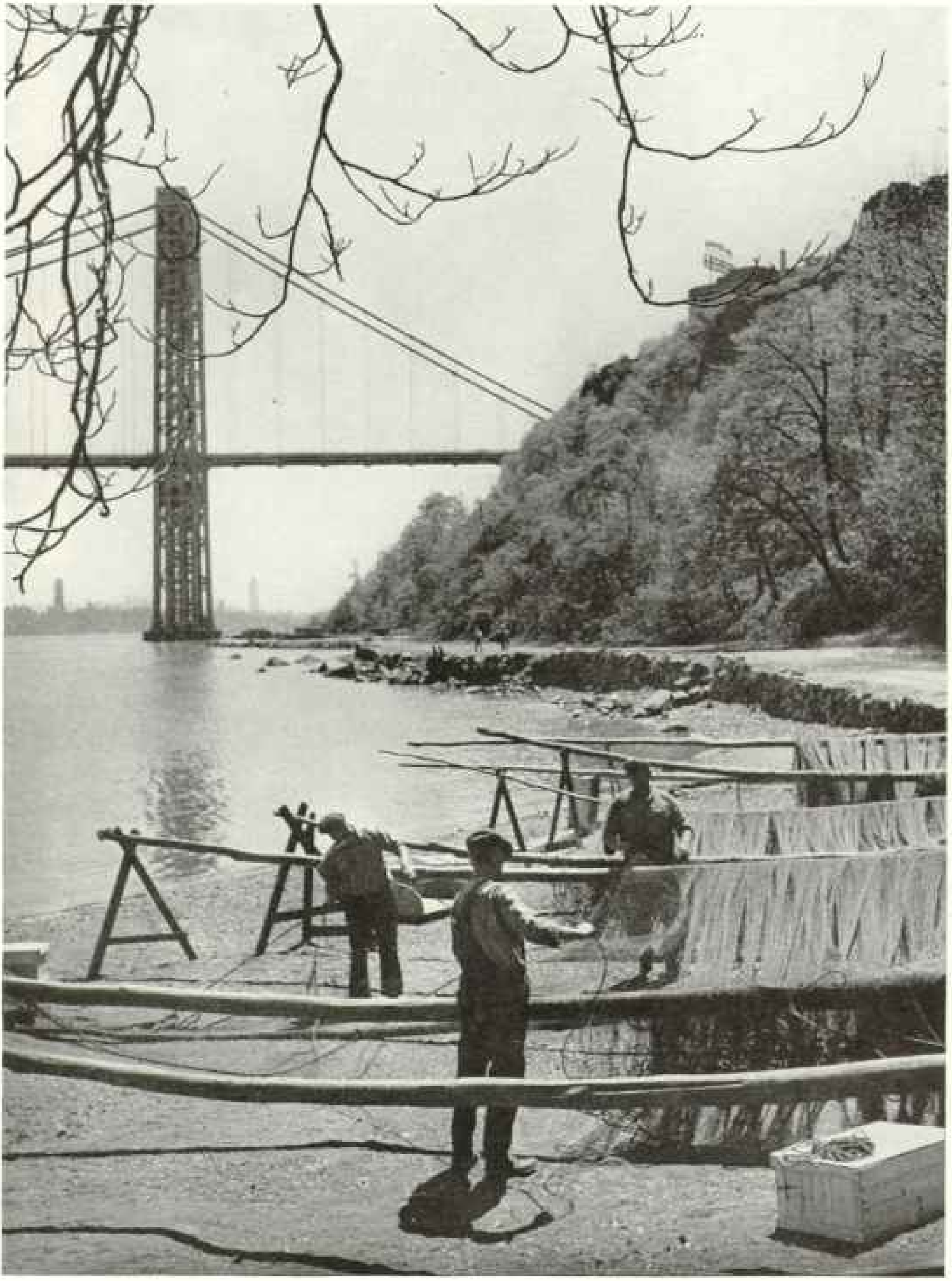
A few blocks uphill from the Colonial Tavern lives the dean of the Hudson fishermen, Fred Truax. He has been pulling shad out of the river for 63 years and is still spry enough, come spring, to go out with a drift net, just to keep his hand in. Three years ago he sold his two rows—those nearest the 125th Street ferry—to Joseph Smith and William Ingold.

In his youth Captain Truax "ran a rig" back of the Statue of Liberty, whose erection on Bedloe's Island in 1886 he remembers. His father, Isaac, began shadding in the river about 100 years ago.

Captain Truax, who for many years operated a traveling circus, talked to me of the days when his nephew Harry Lyons (now 62) and Floyd Clayton were "just kids" learning the ways of the river; of the Hudson-Fulton Celebration in 1909, and other great events along the river. The old man spoke also of the perseverance that he and other shadders needed to carry them through many money-losing seasons.

That was before conservation and good management of the fisheries, imposed by the Albany and Trenton authorities with the assistance of the Federal Government, made for the great comeback of the shad to a cleaner river. Then the picture was so dark that A. N. Cheney, New York State fish culturist, wrote in 1895: "It is extremely doubtful, under the present law, and present manner of fishing the river, if the Hudson can be considered a self-sustaining shad river."

Yes, Captain Truax and many other old-timers gladly conceded that through the week-end fishing closure and other measures the

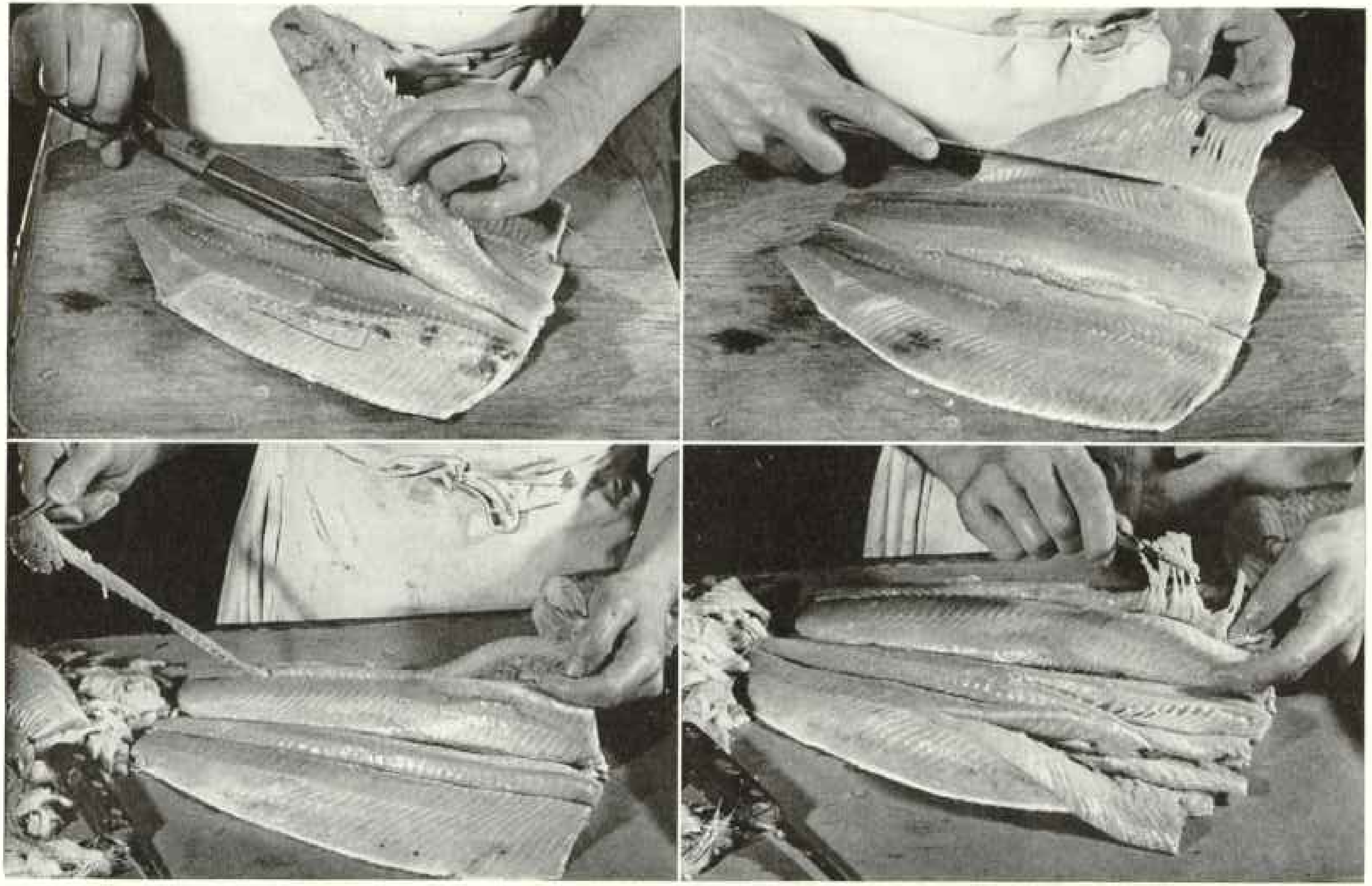


Beside Towering George Washington Bridge, Beaches Bustle with Fishermen Drying Their Nets

When springtime brings shad in from the ocean to spawn in the Hudson River, fishermen catch them in gill nets. The fish are enmeshed when they run their heads into the nets on the way upstream with the incoming tide. This is George Kotze's fishery beneath the New Jersey Palisades (page 366).

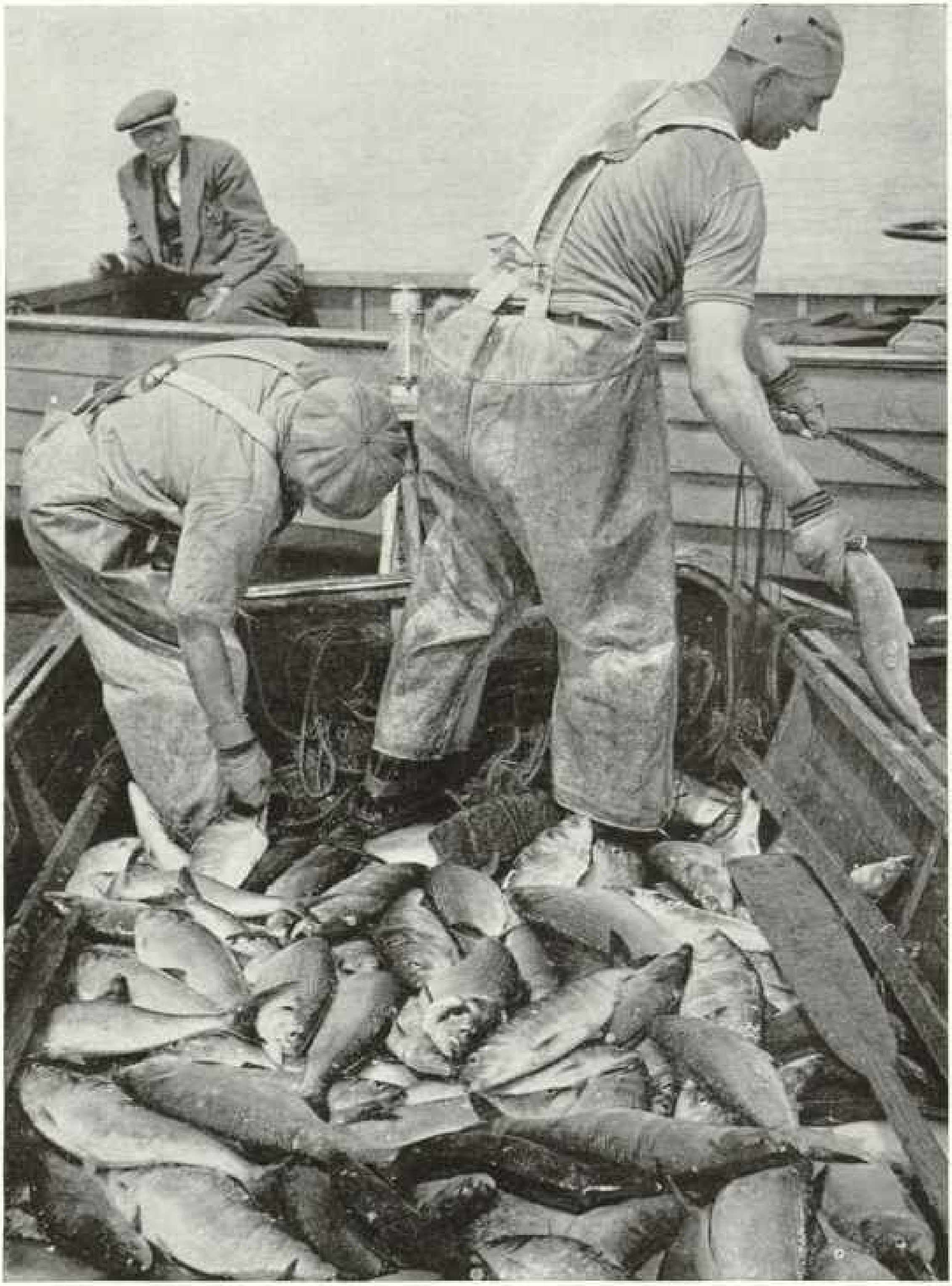
Through the Misty Air Hurtles a Shad as a Tugboatman Collects a Toothsome Dividend

In the boat at left the fisherman who threw it almost goes overboard with the follow-through of the pitch to the cigarette-smoking boatman on deck. "Share-the-shad" scenes are frequent on the Hudson, where some fishermen say those who refuse are more liable to find that a tug has run afoul of their nets (page 373).



Shears, Knife, and Tweezers Aid in Boning Shad, the Job of a Specialist

Hundreds of bothersome bones which long kept the tasty shad from achieving maximum popularity are here deftly removed by one of the few persons who have the knack. First, scissors help in extracting the backbone. Then a sharp knife, fingers, and tweezers remove the last few barriers to enjoyable eating (pages 373, 374).



Flapping "Greenbacks" in the Boat Mean Folding Greenbacks in the Pocket

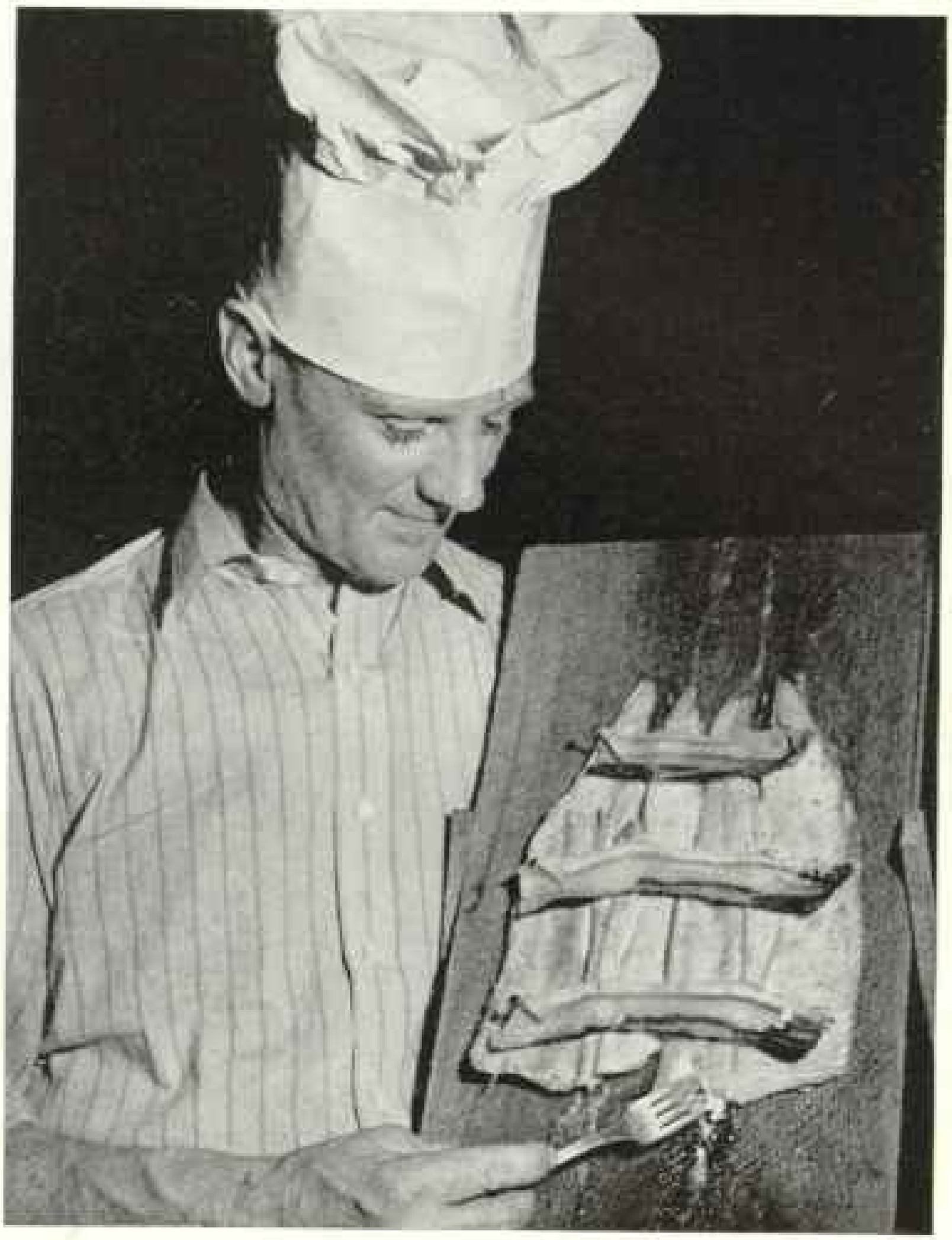
As two of Floyd Clayton's men pluck shad from the mesh of the gill net, the boat becomes ankle deep in the silver-sided, olive-backed fish. The shad fishery in the Hudson near New York is a quarter-million-dollar-a-year industry, though it flourishes only about two months—April and May. Astern lies the "mother boat."

conservationists had restored a fishery that faced extinction, even if they had seemed to get in a shadder's way in times past.

Downhill again and past the Edgewater Garage, run by Bill Ingold and a couple of other part-time fishermen, one can find a frail footway which leads to Clayton's Boat Works, a jumble of sheds held up on piles. Here Floyd Clayton keeps busy most of the year building boats, but spring finds him out on the water wooing the tides for the creatures they bear.

The last time I saw Mr. Clayton he was in the middle of the river, off a New York Central grain elevator, calling the tune for the setting of poles from a pair of scows. The ripples in the river reflected the sun in dancing patterns, and myriad windows in skyscrapers across the way set aflame the eastern horizon.

Capping the contrast of old and new that afternoon, there stood in her berth, seemingly only a stone's throw distant, a giant Cunard liner, a pride of the Atlantic, whose backwash sometimes throws the shad nets over the poles and spills the catch, besides damaging a lot of gear.



Delight of the Epicure Is Planked North River Shad

Nailed to an inch-thick oak board with strips of bacon to baste it, the fish is broiled before an open charcoal fire (page 374). To the author this tempting "design for eating" suggests a culinary coat of arms (page 366).

"Uppie, Downie, Uppie, Downie"

The work tune was a chant. It was "Uppie, downie, uppie, downie" as several of Clayton's men shouted and jumped in unison on the spar, or "riding stick," which was chained horizontally across the shaft being driven into the mud. The river is ten fathoms here, so it is often necessary to splice two of the hickory poles.

Mr. Clayton is the next to last shad fisherman down the river, a position which makes him prey (as it does Ted Thompson, the farthest south) to some tug captains who maneuver alongside and call for a few shad whenever they feel like it. Since nets and poles can easily get in the way of the river-shuttling tugs, the price of good relations is usually paid (page 370).

If "Uppie, downie, uppie, downie" is the work chant of the pole setters, it might also be the theme song of the whole business of taking shad out of the Hudson; for there have been some steep ups and downs for this fishery over the decades.

Scores of long- and short-range factors, including the fortunes of shad fisheries as distant as the South Atlantic's and even the Pacific coast's, have had their effect on this avocational livelihood in Edgewater, New Jersey, and vicinity. But, not to make a pun, the

Planked Shad Crossed with Bacon Strips Are Arrayed Before a Charcoal Fire

The planks are frequently upended to ensure even cooking. After thorough broiling before the open-air fire, the browned fish will be served with roe and vegetables in the wake of clam chowder (page 367). Even science has officially recognized the superlative flavor of the shad by naming it *Alosa sapidissima*, the latter word meaning "most delicious."

net effect of the years on the Hudson shad netters has been to the good.

Although the operator's expenses, his outlay for men and materials, have more than doubled in recent years, the prices he gets have gone up fully as much. Add to that the very resurgence of the fish—the shad's deciding that New York Harbor seems pretty inviting, after all—and you see that the shad man is doing all right, even well.

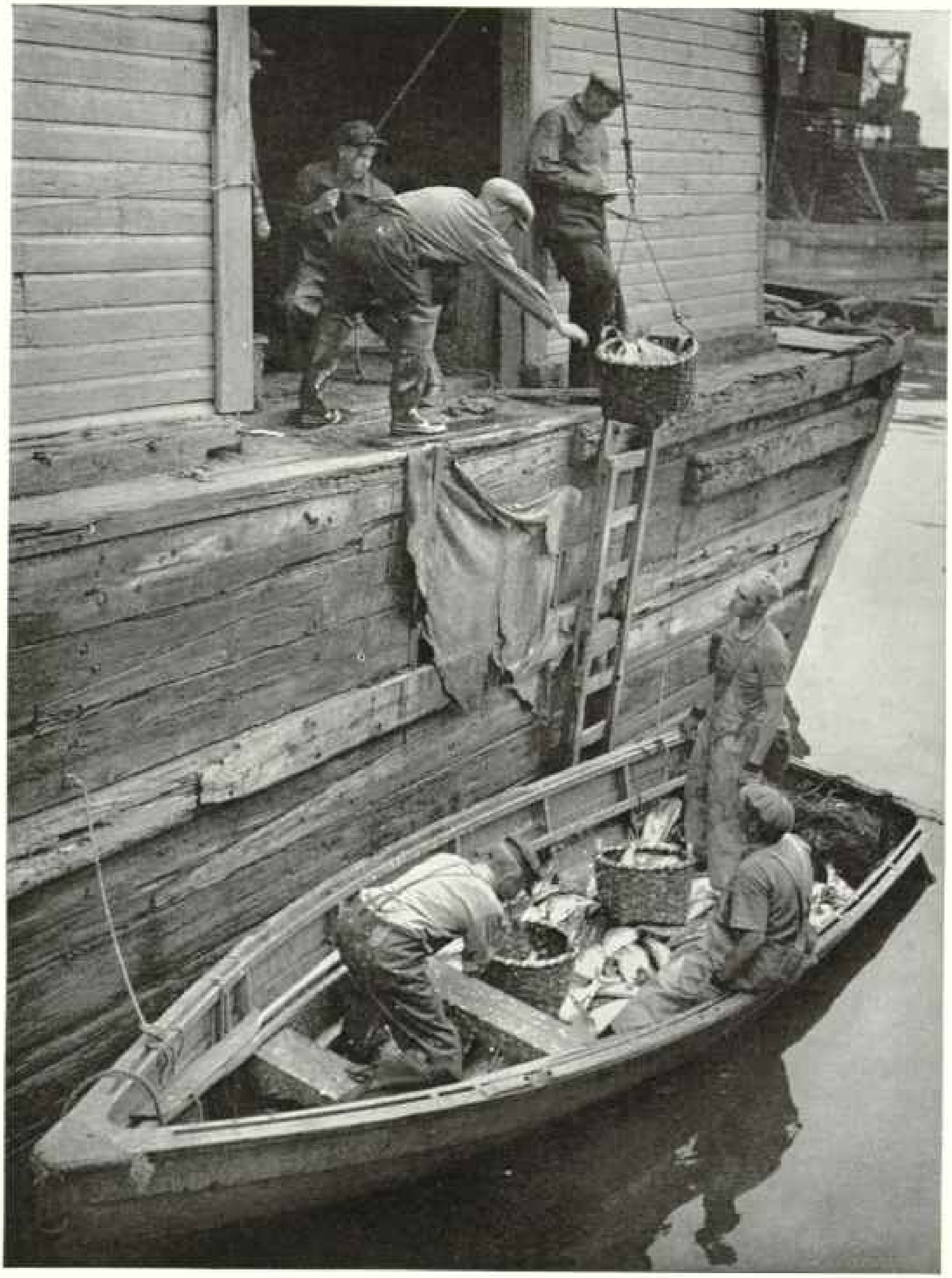
The war and postwar periods, with their upsetting of meat distribution, have lent to fish a better price position. At New York's Fulton Market, a mile up the East River on the other side of Manhattan Island, Jersey shad have risen more than 100 percent in value in the last five years.

The increase has not been as great for shad from the east side of the river (as far up as Rhinebeck), for the smaller catches there are "spawny" as the shad get near their hatching grounds. Moreover, the early market has gone to the Jersey men by the time the fish trickle 50 to 75 miles upriver.

Considering for a moment both the east shore and west shore fisheries, the Hudson during the war brought annual yields of some 3,000,000 to 5,000,000 pounds of shad, compared with 40,000 pounds in 1916, according to Frank Anderson, head of the New York office of the U. S. Fish and Wildlife Service. This volume coincided with the need for meat substitutes and with the higher fish prices.

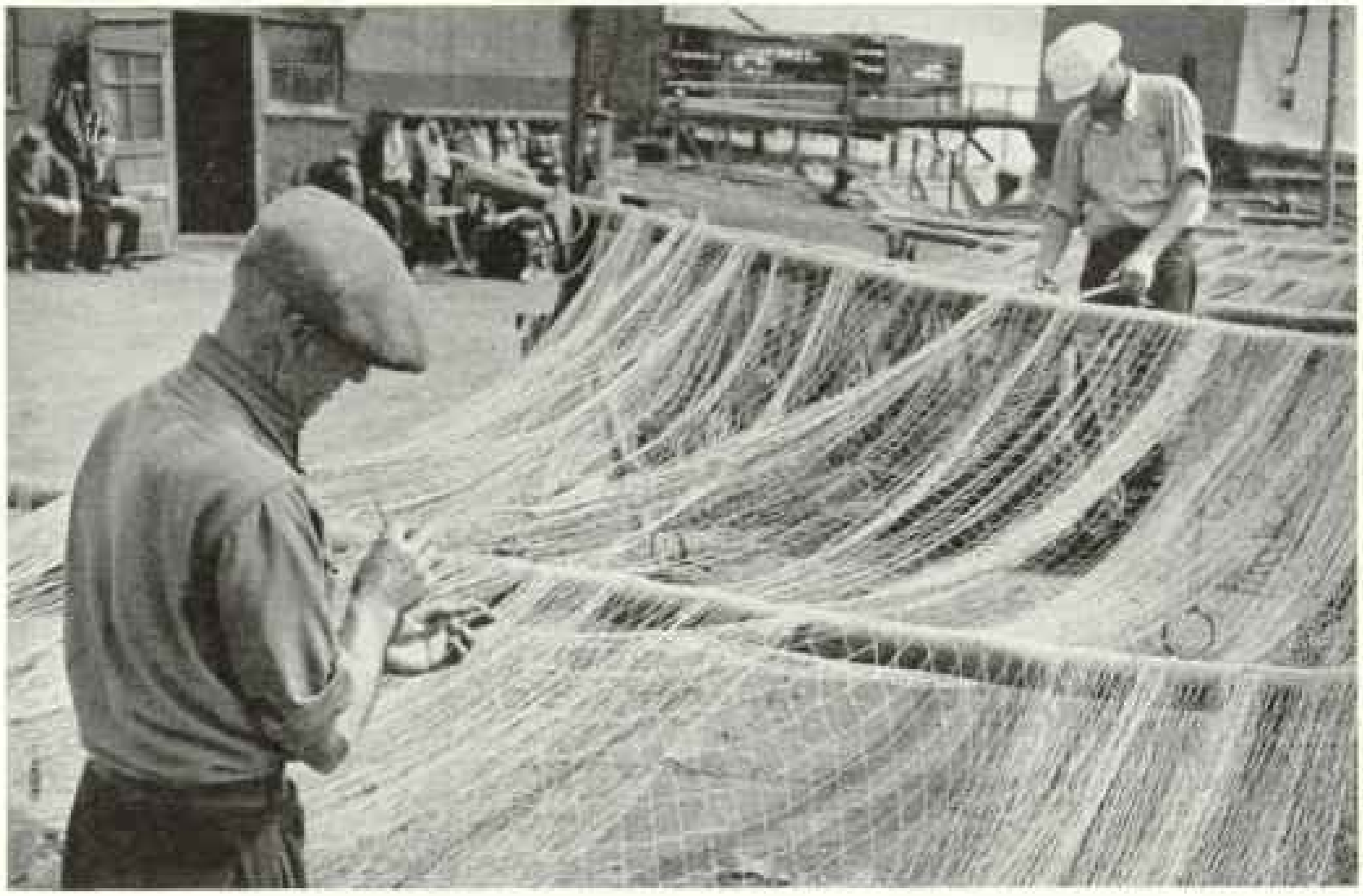
As if to compensate the shad fishermen for military restrictions on fishing areas during the war, when they were banned from about four miles of the river, the years since 1941 have seen a tremendous increase in the filleting, or boning, of shad.

This separation of the tasty flesh from the hundreds of bones, a knack few persons possess, came along about fifteen years ago and



Out of the Hudson Comes Basket after Basket of Succulent Shad

Known to few of New York City's millions is the historic fishery conducted from such river-front headquarters as Clayton's float on the New Jersey side. Yet men have reaped the Hudson's harvest of shad since colonial days, waylaying the fish as they come in from their mysterious ocean home to spawn.



Many Nets in the Hudson Measure 1,200 Feet in Length

Near Edgewater, on the New Jersey bank, fishermen mend rents caused by snagging and by the careless keels of boats in New York's busy harbor. Into the 5½-inch mesh of the gill nets come many things besides fish—even corpses, on occasion. During the seven or eight weeks of the annual shad run, the rivermen work day and night to keep their nets mended and set while the silvery bonanza lasts.

put the shad back on the table in its own right, rather than simply as the producer of eggs, or roe, which had long been eaten as a delicacy (page 371).

Not always were the roe thus esteemed, however, for sometimes in the ups and downs of this fish, *Alosa sapidissima*, the roe were thrown away and only the flesh eaten. This was during the last century, when the Hudson's shad were famous as North River shad.

Beginning in the Sacramento River in 1871, shad from the Hudson were propagated in Pacific coast streams. Nowadays, considerable quantities are shipped east to compete in higher-price eastern markets.

Fulton Market Prices in "Shillings"

The marketing of shad is a story in itself. By the time the Hudson's run is finished, about June 1, Fulton Market has received fresh shad from a dozen States. Most of it arrives by truck. The Hudson's come by ferry or tunnel to Manhattan, and those from distant rivers arrive in huge refrigerator trailers that dash day and night to the rich New York-Philadelphia area where a large part of the country's shad is consumed.

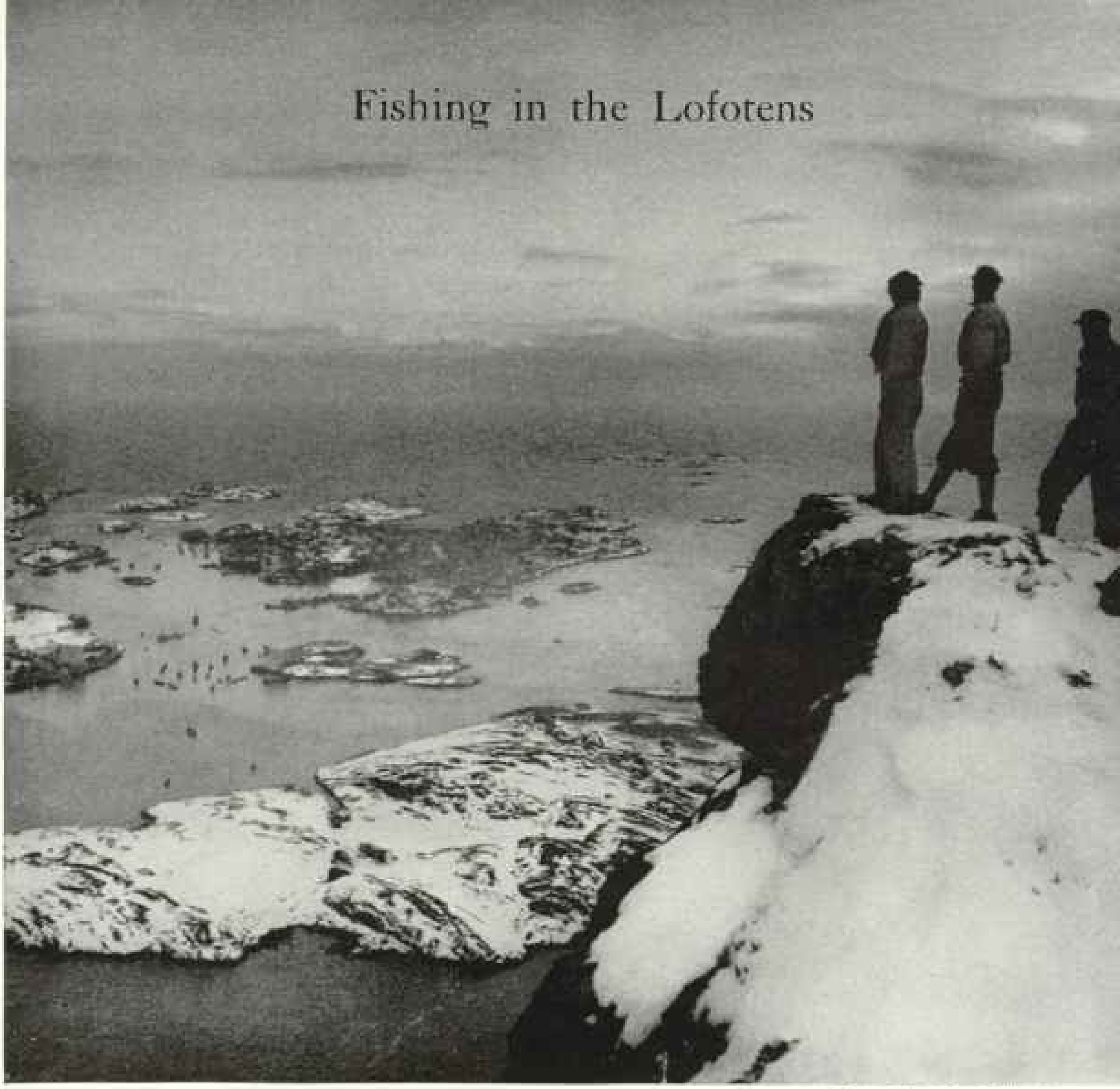
There are two or three shad fishermen of the Hudson who still prefer the old way of taking their catches to market. They sail their skiffs to the foot of Fulton Street and weigh out their shad at the market instead of unloading 100-pound boxes of the fish from trucks.

Numerically, the bucks and the roes are about equal in an average marketing, but by weight the roes approximate two-thirds of the total. (A single female produces 25,000 to 30,000 eggs.)

Even more curious than the taking of fish to market by boat through the busy New York Harbor of 1947 is the Fulton Market dealers' continued use of the "shilling" (12½ cents) as a convenience in quoting prices.

But it's no wonder. With the one important exception of carrying most of the fish to market by motor truck, the whole shadding operation along the Hudson is a pleasant anachronism. Amid the abandonment of old ferries, excursion lines, and other features, the two months' scenes of picturesque activity retain, perhaps, more suggestion of the old distinctive river life than anything else to be seen today.

Fishing in the Lofotens



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Seen from Half Mile Up, 2,000 Fishing Boats Black Out a Tiny Lofoten Harbor (Center)

LIKE the spiny vertebrae of a gigantic, nearly submerged dinosaur, rocky Lofoten Islands emerge from the sea off Norway's fjord-indented northwest coast. Alplike peaks make a mighty backdrop, dwarfing islanders, their boats, and scattered fishing towns.

To the Lofotens, as to all northern Europe, Nature gave one great boon—the Gulf Stream Drift. This mighty ocean current, flowing north between Iceland and Britain, tempers Lofoten climate, keeps ports ice-free, nurtures myriad schools of valuable fish.

Between islands and mainland lies stormy Vestfjorden, 50 miles wide at its southern entrance, funneling northeastward to narrow, cliff-bound straits. Into Vestfjorden every February flows a sea of silvery cod to spawn.

Then gather Viking fishermen from every port in Norway to reap a glistening finny harvest. Fishing towns like Svolvær, Kabelvåg, and Henningsvær (above) bulge with five times their normal population.

During the six-week season the Vestfjorden becomes the world's most concentrated fishing area. Some 7,000 boats bob on its choppy waters. An army in oilskins, 30,000 strong, fights time, wind, and weather to bring in the catch.

Though some North Atlantic fishing banks yield more cod the year around, Lofoten fisheries produce the world's largest seasonal catches. The first postwar season, 1946, yielded a bumper crop of over 165,000 tons for hungry Europe. Fishermen remembered that prewar catches averaged 95,000 tons.

Fishing is all-year work for nearly all Norway's 125,000 fishermen. Leaving Lofoten, some follow cod farther north; others re-equip to catch herring, brisling, saithe, or salmon. Then island towns settle back for ten quiet months.

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Like an Admiral's Staff, Lofoten Skippers Plan Campaigns Against the Cod

BECAUSE the Vestfjorden cod banks are crowded like city streets in the rush hour, Government boats police its waters night and day. To save fishermen's time, sounding devices locate and determine depth of cod schools (page 384).

Government charts, available to all skippers, divide Lofoten grounds into numbered sections. When fish are discovered by patrol boats, the section number and the depth of the school are broadcast on a "fisheries beam" each morning before the fleet puts out. Nearly all fishing boats carry radios.

Lofoten fishing has as many rules as a football game. Boats may not leave port before an 8 a.m. starting signal, must return by 8 p.m. There is no fishing on Sunday. Strong drink is prohibited in the fleet. Boats may change sections, but must report to nearest inspection boat before beginning to fish at a new station.

Cod fishermen use gill nets, set at night and taken up in the morning; long lines, which may reach more than a mile and carry 1,500 hooks; and short hand lines. Sections of the fjord are reserved for each type. Boats may carry only one kind of tackle.

Though fishing may begin sooner, the official season opens March 1 and lasts until about Easter. In spite of careful regulation, grounds become overcrowded, lines foul, tempers rise, and lawsuits abound.

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Smiles and Nearly Empty Pot Prove the Fishermen's Liking for Cod-liver Soup

BUT landlubber Norwegians, great fish eaters, find the soup too strong. Though sight and smell of fish are everywhere, ships' cooks serve cod in a variety of guises three times a day. Only in port on Sundays do the men taste meat. Goat cheese, dark bread, and oleomargarine bulk large in their diet.

Strong coffee brews continually on the ship's stove. It is the fisherman's early-morning eye opener and his constant ally against the fjord's numbing winds. Every trip past the galley calls for another cup.

Native Lofoten fishermen are freedom-loving individualists who take the risks and rigors of their trade as they come. Crew members often contribute to the cost of boat and tackle, receive proportionate shares of profits. Crews choose their skipper, who takes full charge of boat and fishing operations. Often the boat's nominal owner is a crew member. Nevertheless, the skipper is boss.

The Norwegian Government has done much to aid fishermen. It provides low-rate loans, often up to 100 percent, for better equipment and boats; compulsory insurance; free medical aid and hospitalization. It sets a ceiling on cost of bait and puts a floor under fish prices.

The Norwegian Lifesaving Institution, voluntarily manned and supported, maintains a fleet of rescue ships, mostly sail. Its heroic work has saved countless fishermen's lives.

© Lennart Nilsson from Black Star

"How Much for This Zippered Jacket?" Asks a Rowboat Peddler

SWARMS of itinerant hawkers follow the fleet to sell clothing, blankets, watches, or any gadget which may catch a fisherman's eye. The Government tried to regulate the trade by setting prices. But fishermen prefer to haggle and bargain, even though they know they may come out second best.

Often Norwegian manufacturers send products direct to the islands, trade them for fish, ship the fish south to sell in cities like Kristiansund, Alesund, and Bergen. Officials frown on such bartering, but fishermen like it.

Besides peddlers, jugglers, other entertainers of all sorts, and religious groups crowd Lofoten towns in season. Saturday nights are like carnival nights. Dungaree-clad crowds mill in streets, barkers hawk their wares, a holiday spirit reigns. Fishermen with jangling *kroner* in their pockets are out for a good time.

An increasing number of men live aboard their boats. Large Diesel-powered craft have cut down the loss of life which fog, squalls, and treacherous tidal currents caused in the days of sailboat and oar.

Lofoten currents, swirling through narrow straits, are the strongest along Norway's long and rugged coast. Most famous is the Moskenstraumen, immortalized by Edgar Allan Poe in his graphic but imaginative *A Descent into the Maelstrom*.

© Lennart Nilsson from Black Star

Fresh-caught Cod Are Cleaned and Ice-packed for Shipment to Northern Europe's Cities

WHEN cod are running, steamers plying Norway's "inside passage" touch Lofoten ports to take on fresh fish. But the bulk of the catch is dried or salted for export to Europe, Africa, and the Americas (pages 382, 383).

Fishing banks off Norway's west and north coasts are among the world's richest, make it Europe's greatest fishing nation. Nearly two-thirds of all Norwegians depend directly or indirectly on the sea. In prewar years fish and fish products ranked third among Norway's exports. Recent record catches may boost them to first place.

Spawning cod arrive in Lofoten waters in jam-packed shoals often 150 feet thick. The short-lived Lofoten season accounts in normal years for 55 percent of Norway's catch of cod.

Protecting this and other Lofoten harbors from westerly gales stands the steep, snow-mantled "Lofot Wall." Its jagged peaks, some 3,000 feet high, are imposing in a land noted for scenic beauty. Their wrinkled granite faces catch the winter's frequent snowfalls.

In summer snow gives way to shiny moss. The islands, in the same Arctic latitude as northern Alaska and central Greenland, have a mean annual temperature of 38° F. Coldest month is February, but even then the mercury rarely dips below freezing and sheep graze outdoors the year round.

© Lennart Nilsson from Black Star

First-year Fishermen Dunk Cod Twice Before Hanging Them Up to Dry

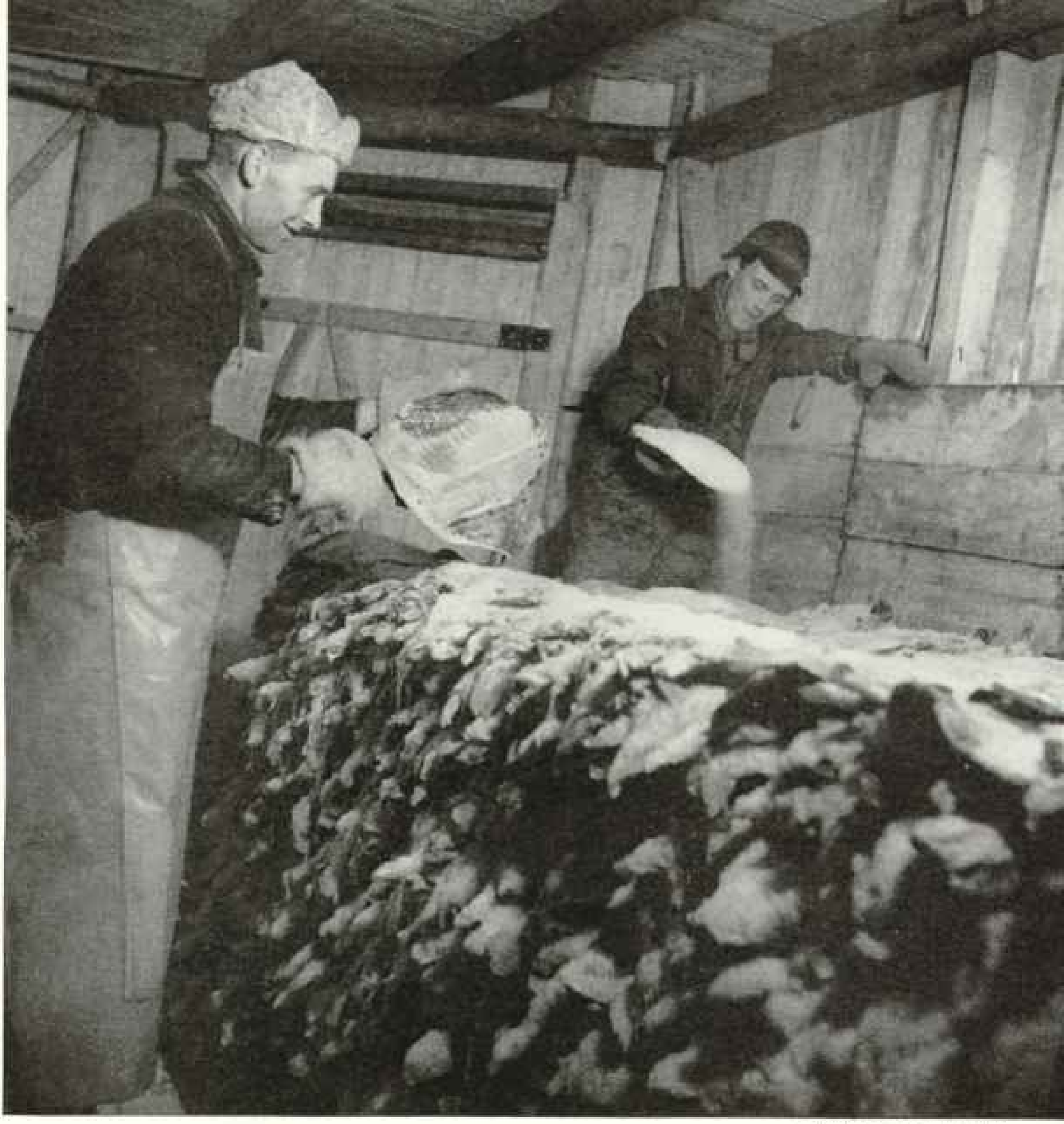
NORSEMEN caught spawning cod in Vestfjorden before there was written history in Norway. For a thousand years Norwegians have exported dried codfish and cod-liver oil.

Originally, fishermen simply cleaned, rinsed, and hung cod in the open to dry. About 38 percent of Lofoten catches are still treated in this way. Prepared thus, they are called stockfish, or *törrfisk* by Norwegians. Tied by the tail in pairs, the cod hang over rough wooden scaffolding for several months. They become stone-hard, lose some 80 percent in weight, will keep for years even in tropical climate. Their flintlike hardness seems impervious to weather or insect attacks. Soaked in water, they quickly become edible.

This natural process is used chiefly in Norway, and even there mainly in the north, where climatic conditions are right. According to custom, stockfish should be hung before April 12 and not taken down before June 12. Kept roughly to this schedule, the fish harden before the flies arrive. Government officials inspect stockfish before sale or export.

Biggest prewar market for dried cod was Africa, where business firms bought them for workers. Italy, the Netherlands, Belgium, Germany, Sweden, and the United States also bought *törrfisk*.

The U. S. market depends largely on Scandinavian people in the north-central States who retain a taste for dried cod. Churches and homes serve it as a Christmas delicacy called *lutefisk*.



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Stacked Like Cordwood, Cod Are Salted Down to Make Norway's Famous *Klipfisk*

FISHERMEN behead and clean the cod and remove part of the backbone. Opened flat, the fish are rinsed, stacked, and covered with salt. According to law, they must remain under salt at least three weeks. Better grades are salted several months. Then daily exposure on rocks to sun and wind completes the curing process. Prepared thus, the cod is a great source of salt and iodine.

Although Norway alone produces *törrfisk* for export, the processing of salted cod is widespread. Chief markets for Norwegian *klipfisk* are Spain, Portugal, Argentina, Brazil, and Cuba. For transport overseas the fish are shipped in wooden boxes or in hermetically sealed tins in wooden cases.

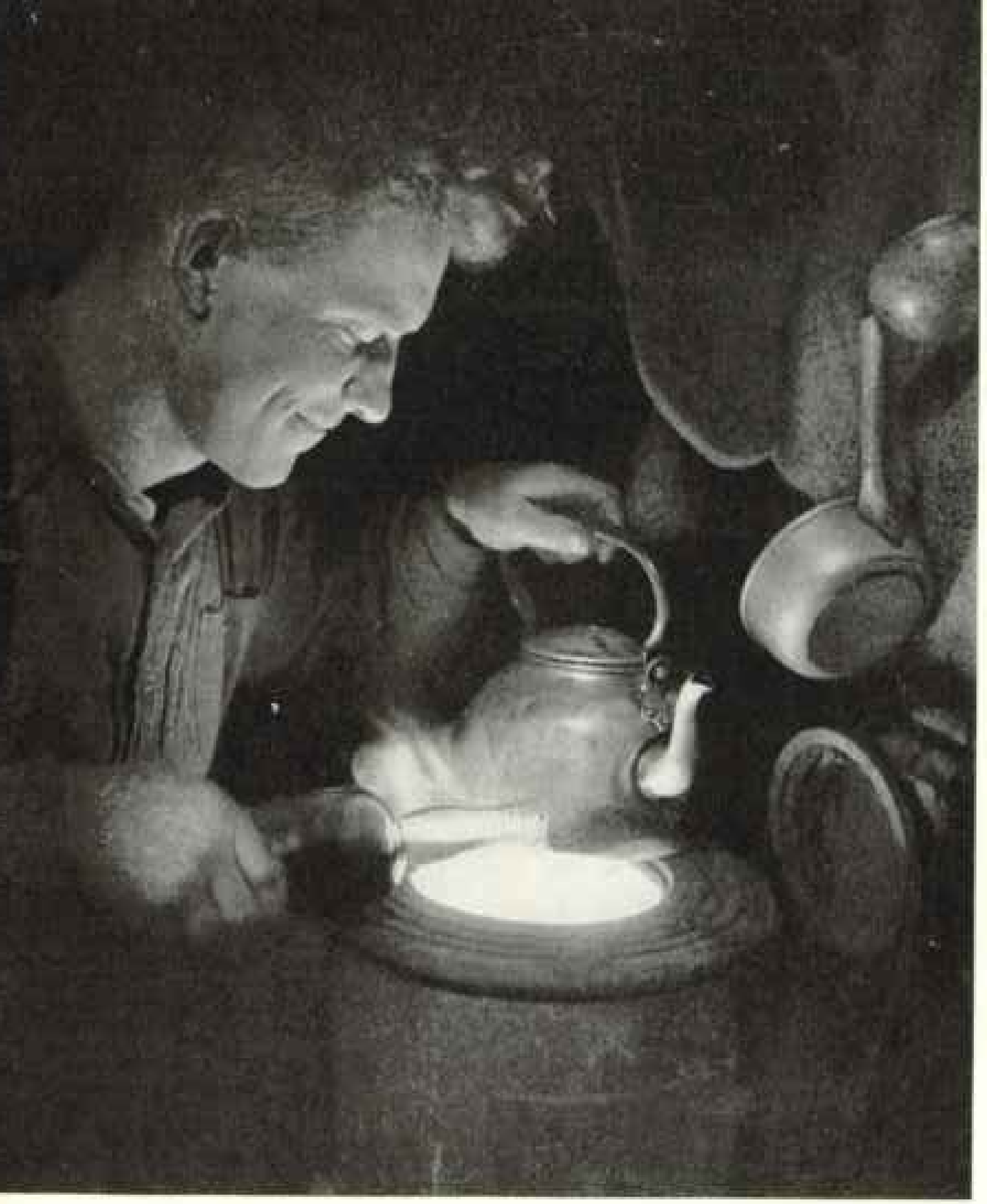
During World War II Lofoten catches fell only 10 to 15 percent. Because many Norwegian fishermen sailed to Britain to fight for freedom, the Germans confined fishing boats to coastal waters, which included the Vestfjorden.

Although Germans controlled the fishing industry, Norwegians handled distribution. They cached thousands of barrels in secret spots throughout the country, though Germans paid fantastic prices for fish in Bank of Norway money.

At war's end Norway was able not only to feed its own people but gave UNRRA more than 3,700 tons of fish and fish products for Europe's hungry nations. In 1946 some 120,000,000 pounds of Norwegian codfish were allocated for export by the Combined Food Board.

Kjaere Familie, Writes a Freshman Fisherman

Echo-sending Depth Recorders Tell Where Fish Are



Hungry for His Predawn Coffee, Olav Hurries the Fire Along

One Man's Business Is Another's in Lofoten Cable Stations

© Lennart Nilsson from Black Star

Beneath Snow-flecked Peaks, Yoked Fishermen Move Mountains of Fish Heads

IN THE spring the smell of codfish pervades the air of island towns. Vast quantities of cod dry on scaffolding or rocks, as if every day were washday.

Factories which extract oil from cod livers or dry heads and offal for fertilizer add their odors to the general redolence. Like the stockyard pig, the cod is used *in toto*.

Norway leads the world in production of vitamin-rich cod-liver oil. Crippled by war damage, it still exported some 95,000 barrels in 1946. Government officials test every batch for chemical content, taste, smell, and vitamin potency.

Sardine fishermen of France, Spain, and Portugal use much salted cod roe for bait. In recent years the demand for canned fresh roes has jumped. France has long appreciated savory cod caviar, which Norway now cans in increasing amounts.

Lofoten cod average three to five feet in length and 10–15 pounds in weight. So compact are cod shoals arriving in Vestfjorden that a dropped sounding lead may rest on the silvery mass.

These fishermen use old-time yokes. Hooks dangling from the ropes hold the heads. Woolen shirts and jackets, trousers tucked into galoshes, and bright-yellow oilskins are standard Lofoten dress. In the background and top foreground hang stockfish (page 382).

© Lennart Nilsson from Black Star

At Suppertime Old Hands Kid the Youngsters Away from Home on Their First Fishing Trip

EVERY boy who joins the fleet knows that for a year he will be the butt of many a joke. After that, he may dish it out to newcomers.

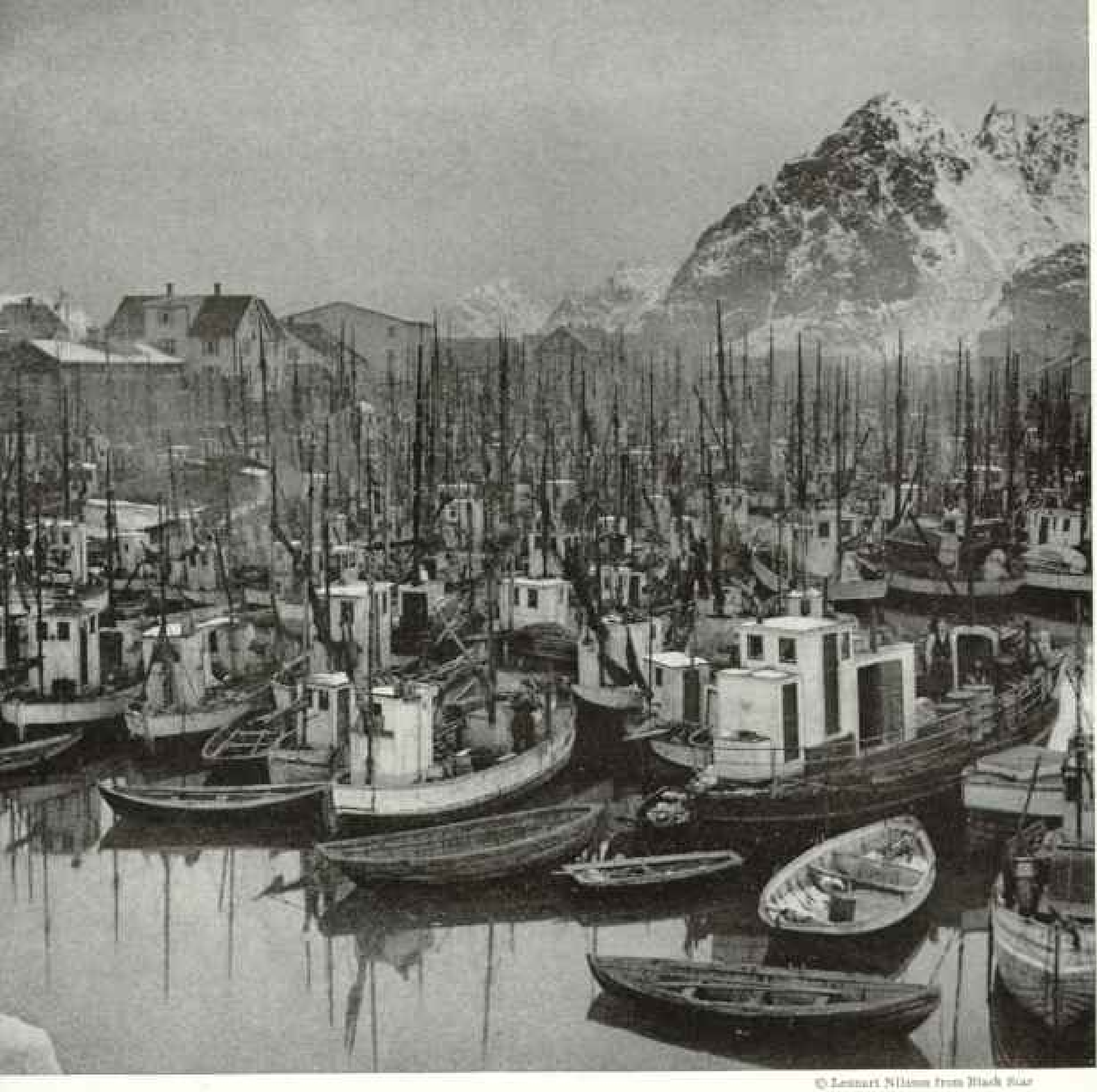
These men are roughing it in a *rorbod*, one of many fishermen's shacks which solve the islands' seasonal housing shortage. Built near or over the water, they sleep some 20 men. Six to ten built-in bunks line the walls. Gear and clothing hang everywhere; accommodations are the simplest, but suffice for the short season.

Men in partnership, as most crews are, bunk together. Usually they hire a Lofoten woman to cook. A potbellied stove heats the food and warms the hut.

Few trees grow on the Lofotens; islanders import wood for building and fuel. Visiting fishermen bring firewood from home and enough food to last until the first catch.

Not all fishermen live in *rorboder*. Some stay with Lofoten friends or relatives; others, in the few rooming houses. Larger boats of recent years accommodate an increasing number of men.

The life of Lofoten fishermen, and the boom-town feel of the cod season, are caught in the pages of Johan Bojer's realistic novel, *The Last of the Vikings*. It pictures the days before power-boats, but otherwise life in these remote northern islands has changed little.



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Though the Lofoten Season Is Short and Rushed, the Sabbath Is a Day of Rest

THIS Sunday jam of craft in Henningsvær harbor shows the change in the fleet that fishes the Vestfjorden. Gone are the open Nordland boats with rectangular sails, similar in design to old Viking ships. Sturdy Diesel-motored smacks, cutters, and schooners replace sail and oar. Much of the romance and danger has gone; but catches are bigger than ever.

Henningsvær houses some 400 people all year. By March 1, 2,000 fishermen may tax its limited facilities. Sundays and evenings the harbor disappears beneath their craft. Even seasonal population fluctuates; for at night fishermen who sleep aboard put into whatever port is nearest.

Twice the Lofoten Islands flashed into war headlines in 1941. Daring British Commandos, guided by Norwegian volunteers, made their first sizable strike at Nazi-dominated Europe near Svolvær March 4. Chief objectives were plants where Germans extracted fish oil for making high explosives and lubricating delicate war mechanisms.

The raiders, on Norwegian soil 6½ hours, suffered no casualties and met little opposition. They sank 18,000 tons of German shipping, fired oil-storage tanks, blew up a seaplane base, captured 215 Germans and 10 quislings, and took 323 Norwegian volunteers to Britain.

Germans played down the raid, but burned the homes of volunteers, shot islanders who helped the British, slapped a large fine on Svolvær.

On December 26 Commando forces, aided by Norwegian and Polish naval units, again struck at military objectives in the islands. Unmolested during most of three days, they leveled war-important installations.

War's end came too quickly for German forces to do extensive damage in the Lofotens, as they did in Norway's far north.

In Manchuria Now

By W. Robert Moore

With Illustrations from Photographs by the Author

"WE'VE a buggy ride for you," said an American colonel at Executive Headquarters in Peiping. "There's a special flight going up to Manchuria tomorrow. Can you be at the airport by 6 o'clock in the morning?"

I could—and was there early.

Long after V-J Day, Manchuria was still in turmoil. It had felt the shock of not only one war, but two.

In the final days before Japan had sued for peace, the Soviet Union had unleashed a swift attack against Japanese forces stationed here. Then, following the long-delayed Soviet withdrawal, both Nationalist and Communist-led Chinese armies had moved in and were challenging each other's right to rule these rich northern provinces (page 401).

Among the American officers with whom I was to fly north, some were assigned to the task of assisting in evacuating Japanese civilians back to their defeated homeland. Others were members of a "truce team" to help supervise the fulfillment of cease-fire orders that had been issued to the rival Chinese forces.

An Earlier "Mukden Incident"

War is not new to Manchuria. I had been in this land beyond the Great Wall just before one other war. Only days before the "Mukden Incident" started, I had ridden over the rails that the Chinese were accused of blowing up on the evening of September 18, 1931, to give Japan her excuse for the conquest of Manchuria and establishment of the puppet State of Manchukuo.

Often in the past, warring armies have rocked this "cradle of conflict." From here rose wild Tatar tribes who set up Asian empires centuries before the American continents were even known. From hereabouts, too, rose the hard-riding Mongols, whose hoofbeats not only shook Asia but made Europe quake.

Right at our take-off at the Peiping airport we had a quick glimpse of still another chapter of bygone Manchurian history.

Circling for height, we wheeled over the onetime Summer Palace of "Old Buddha," Empress Dowager Tzu Hsi, colorful figure of the Ching, or Manchu, dynasty.

Early-morning sunlight flashed on its elaborate courts, pavilions, temples, and limpid man-made lake. A "woman's $50,000,000 whim" it has been called, but the money which Old Buddha diverted from the Chinese Navy for its building gave Japan one of its first expansion victories in Manchuria and China in 1894-5.

Below us, a few moments later, slipped the maze of glittering golden-tiled roofs of the moat-encircled Forbidden City in the heart of Imperial Peking.*

Here, from the Dragon Throne within its stately halls, Manchu emperors ruled all China for more than two and a half centuries. Here, too, they grew soft and decadent in luxury and intrigue and finally fell when the pitiful boy-emperor Henry Pu Yi was ousted by republican revolutionaries in 1912.

It was this same Pu Yi whom fate overtook the second time after Japanese overlords of Manchuria had reseated him on the throne in the land of his ancestors.

The Great Wall from the Air

Flying northeastward toward Mukden, we passed high over the mountain barrier that shuts off Manchuria and Jehol Province from North China (map, page 393). Atop its rugged crests I spotted the winding ribbon of the Great Wall, upon which for centuries the Chinese had relied without success to stave off invasions from the north.†

Then came the plains, a vast expanse of rolling land patterned with fertile farms. To Mukden, later to Szepingkai, and on to Changchun we rode above a panorama which, save for the smaller size of the farms, reminded me of our own Middle West.

Fifteen years before when I visited Manchuria I had seen hordes of peasants from China flocking into this land of plenty. Quitting crowded Shantung and Hopeh, they had surged northward by steamer, by sailing junks, and by railway. Some even trekked the long, dusty land trail on foot.

In the 1920's this mass migration of colonists into the wide, fertile Manchurian plains

* See, in the National Geographic Magazine, "The Glory That Was Imperial Peking," by W. Robert Moore, June, 1933; "Approach to Peiping," by Maj. John W. Thomason, Jr., February, 1936; "Peking, the City of the Unexpected," by James Arthur Muller, November, 1920; "Peiping's Happy New Year," by George Kin Leung, December, 1936; "Peacetime Plant Hunting About Peiping," by P. H. and J. H. Dorsett, October, 1937.

† See "A Thousand Miles Along the Great Wall of China," by Adam Warwick, National Geographic Magazine, February, 1923.

Carriages, Pedicabs, and Pedestrians Cluster in a Fushun Market Place

A Korean woman passes the mother with a baby carriage at right. In the background rise the big cooling towers and smokestacks of the electrical power plant. Smoke issues from only a few chimneys, as several generators were removed and boilers destroyed by the Russians (pages 391, 392, 399).

sometimes reached the staggering total of more than a million persons a year (page 414).*

Even omitting Jehol Province, which the Japanese conquered and included in Manchukuo, Manchuria is more than 400,000 square miles in extent—an area about one and a half times the size of Texas.

Besides the mountains that separate it from North China, other mountains and hills hem the country on the west, north, and east. None of them, however, forms its actual frontiers.

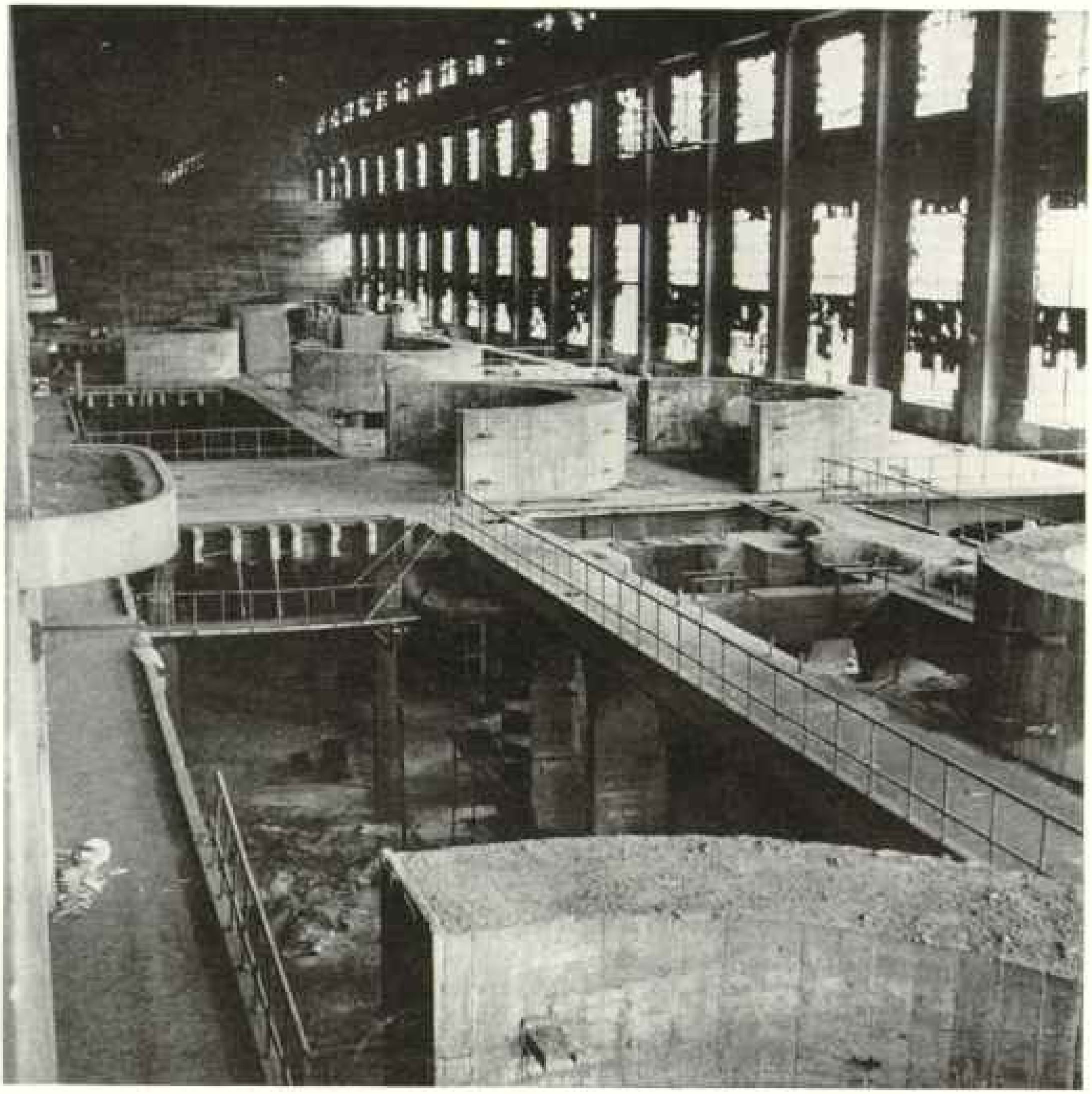
Manchuria's boundary with Mongolia ends vaguely on the plateau west of the Great Khingan Range (Ta Khingan Shan). The wide, looping Amur, which the Chinese call "Black Dragon River," rather than the Little Khingan Range (Hsiao Khingan Shan), is its long frontier with Soviet Russia.

That portion of its eastern frontier which adjoins Korea is marked by the Yalu River, not by the eastern mountains, some of whose peaks pile to heights of 8,000 feet.

A Land of Small Farms

The plain which spreads within this rim of hills embraces nearly a third of the country.

* See "Manchuria, Promised Land of Asia," by Frederick Simpich, NATIONAL GEOGRAPHIC MAGAZINE, October, 1929.



Here Empty Echoes Replace the Sound of Whirring Generators

Soviet technicians stripped the big power plant at Fushun of units producing three-quarters of its 285,000-kilowatt capacity. They left some older generators, which now deliver only a small amount of electrical power to Fushun and Mukden (page 399). The plant operates on coal from the near-by mines.

It is one of the richest agricultural areas on earth.

I quit studying farm patterns with their strips of many-toned greens and splotches of freshly tilled, reddish-gray earth when Mukden resolved itself from the haze on the horizon.

Bigger and bigger it grew until our plane seemed headed straight into one of its big boulevards. Then, like a movie reel jumping its sprockets, we saw factory chimneys, tall business buildings, crowded streets, and low, closely packed homes swirl past the windows at all angles.

"This would be quite a town if we could see it right side up!" shouted an officer into my ear. The pilot was buzzing the city to let headquarters know of our arrival.

I was bewildered by Mukden's expansion since I had last seen it.

Ever since the birth of the Manchu dynasty, and perhaps before, Mukden, or Shenyang, has been the leading city in Manchuria. As a strategic center of trade, it has grown with the increasing fortunes of the country.*

Since railways were built, it has been the focus of the South Manchuria Railway lines.

* See "Mukden, the Manchu Home, and Its Great Art Museum," by Eliza R. Scidmore, NATIONAL GEOGRAPHIC MAGAZINE, April, 1910.

Under recent Japanese rule its business districts had grown bigger, more modern, and more confusing.

Today the old walled town with its onetime Manchu palaces and teeming Chinese streets seems almost like a small courtyard enclosure on the city's big map plan.

In its present confusion probably no one knows how many people Mukden holds, although several officials with whom I talked later hazarded the guess that the population was between 1,200,000 and 1,500,000.

Factories hem the city in a gigantic circle. Here the Japanese had built textile mills, machine-tool shops, chemical factories, cement plants, and a variety of other industries.

Mukden Wounded by War

From the air we had seen many broken and burned buildings. From the ground, as we visited some of these big industrial workshops, we learned how badly the city had been wounded by war. Many had been wrecked, pilfered, or almost bodily carried away. Few of those remaining intact could function because of the shortage of power.

Only a pitifully feeble pulse of electricity coursed through the city's network of wires. Sometimes there was none at all. In the hotel we often lighted our way to bed by candle. All the water had to be carried in buckets, as power pumps couldn't operate.

Streetcars had stopped. To get around town we resorted to battered horse-drawn carriages or pedicabs, those bicycle-ricksha vehicles pedaled by coolies (page 394). Of course one could also walk!

Mukden normally relied mainly upon electricity fed into its lines from generators at Fushun, those at the Sungari River dam (page 406), and units on the Yalu, near Antung.

During the years that the Japanese had held the country, they had built up many hydroelectric and steam-operated plants and tied them together into an elaborate network to supply power to the rapidly expanding industrial towns.

When V-J Day came, virtually all of the industrial setup throughout Manchuria remained intact. During the months of their occupation, however, the Russians systematically stripped the country of essential parts from factories and carted away generators from the electric power plants as "war booty."

At Fushun and on the Sungari I later saw the empty generator rooms and transformer units from which the equipment had been taken (pages 390, 391, 407).

In the subsequent fighting between the Nationalist and Chinese Communist armies many buildings in many cities had been gutted by fire or demolished by shells when one army group or another had used them as barricades. More factories were wrecked or plundered of valuable equipment while standing idle and unguarded.

As the result of this extensive damage, industry in Manchuria has been almost completely paralyzed.

Many of the people I met in the factory districts about Mukden were out of work. Some had had their homes destroyed. Inflation continued to spiral to fantastic heights.

"Flea Markets" Have Most Goods

Busiest spots in town were the "flea markets," those open-street trading places where odds and ends of Japanese goods cluttered small stalls and were stacked on the walks.

From morning till evening these centers were packed almost solid with crowding, milling humanity. How the Chinese second-hand dealers ever kept account of all their miscellaneous goods I shall never know.

Here were much-handled clothes, dishes, cameras, medicines, electrical equipment, suitcases, soft-drink stalls, rags, broken gadgets, and junk (page 400).

Every few feet were Chinese money-changers. Besides the Manchurian currency which was still in use, they had American dollars, Russian occupation rubles, and Nationalist notes whose inflation was such that, to have any value, they bore two or three zeros.

Only when it rained could you elbow your way along even the middle of the street.

One day, when I was over near one of the railway stations to photograph the tall stone shaft topped by a tank which the Russians erected as a war memorial (page 396), I saw a long procession of carts approaching.

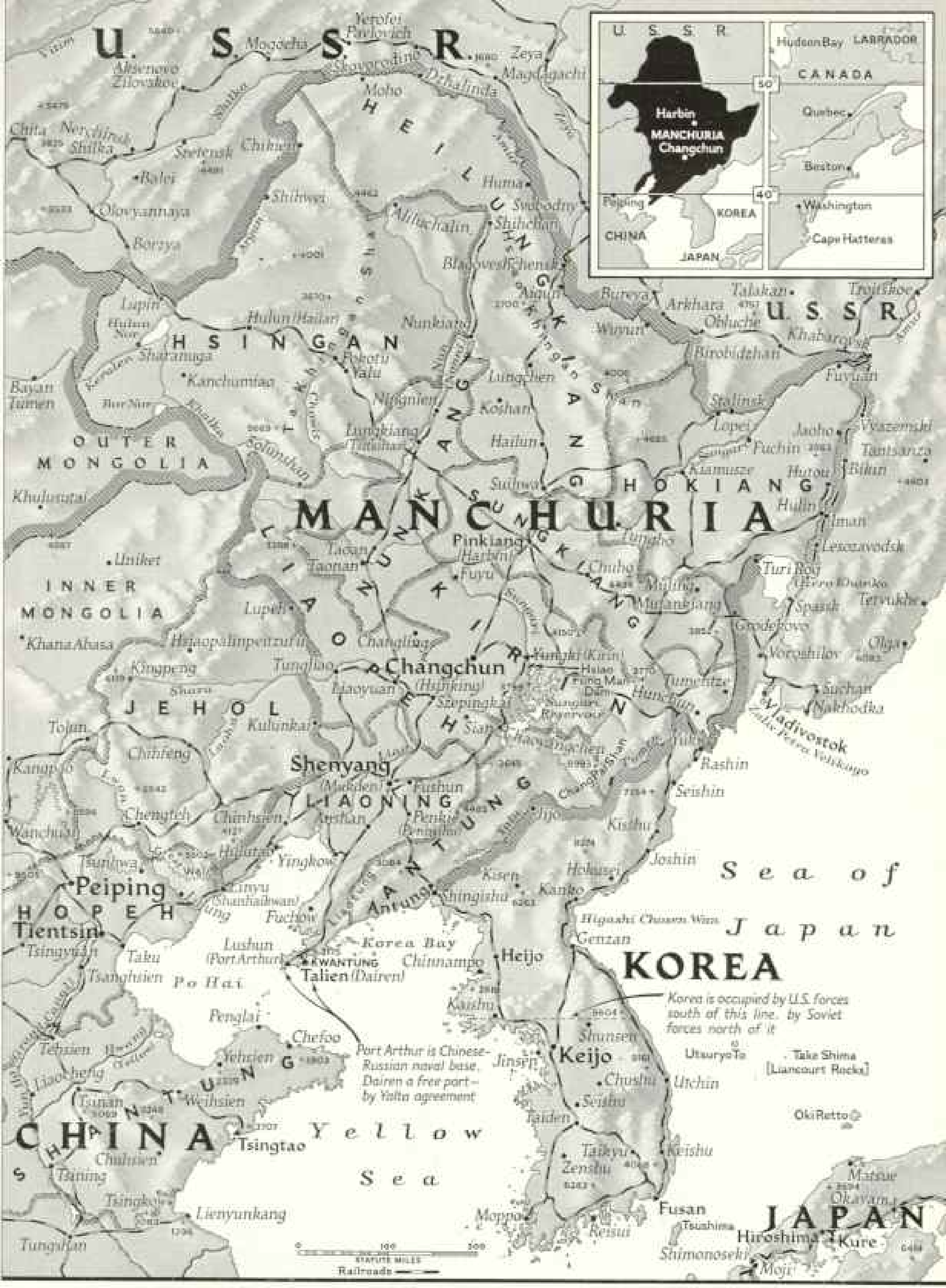
For a moment I thought it was some religious or victory parade, as they were flying banners.

However, the carts were filled with Japanese civilians carrying small bundles of personal possessions. The flags were mustering labels. The men, women, and children were being assembled for repatriation.

I followed the procession to another railway station where the people again were checked and entrained for the port of Hulutao.

Smoothly, and without confusion, Chinese and American officers handled these hundreds of incoming people. I commented on the efficiency of the operation to an American captain.

"We should have a system by now," he



Manchuria, Abutting Soviet Russia, Extends as Far North as Labrador and Hudson Bay

Its capital, Changchun, which the Japanese renamed Hsinking, is about 100 miles more northerly than Boston. The country has vast fertile agricultural plains, extensive forests, and rich deposits of coal, iron ore, and other minerals. Japanese-sponsored puppet Manchukuo embraced Manchuria proper and Jehol Province.

To Guard Against Attacks of Rival Communist Chinese, Nationalists Built Pillboxes in Mukden's Streets

Two city police direct traffic from its roof. Pedicabs, a combination bicycle-rickshaw, approach at left. Droshkies and canopied carts (right) serve in lieu of buses (page 392). Lacking electricity, no streetcars run. In the right background is an ornamental archway near the old Manchu Forbidden City.

Treated to Fiery Chinese Whisky and Peanuts, Workmen Celebrate the Reopening of an Oil Plant

Here at Fushun the Japanese had two plants for extracting oil from shale. After weeks of work, the Chinese succeeded in getting part of the older one into operation. Russians stripped the other of so many parts it was useless. A few Japanese technicians were kept to assist the Chinese in reassembling the machinery (page 397).

Triumphant Soviet Forces Raised This Tank-crowned Monument in Mukden

It stands in front of the Fengtien Station of the old South Manchuria Railway. A similar shaft, topped by the replica of an airplane, was erected in Changchun, the capital. The Soviet Union struck against Japanese forces in Manchuria six days before Japan sued for peace. Much of their occupation took place after the cease-fire order had been issued.

replied. "We handle thousands every day."

"How many Japanese were there in Manchuria?" I asked.

"That's a $64 question I cannot answer," he responded. "All I know is that plans for repatriation called for something like 1,400,000 persons."

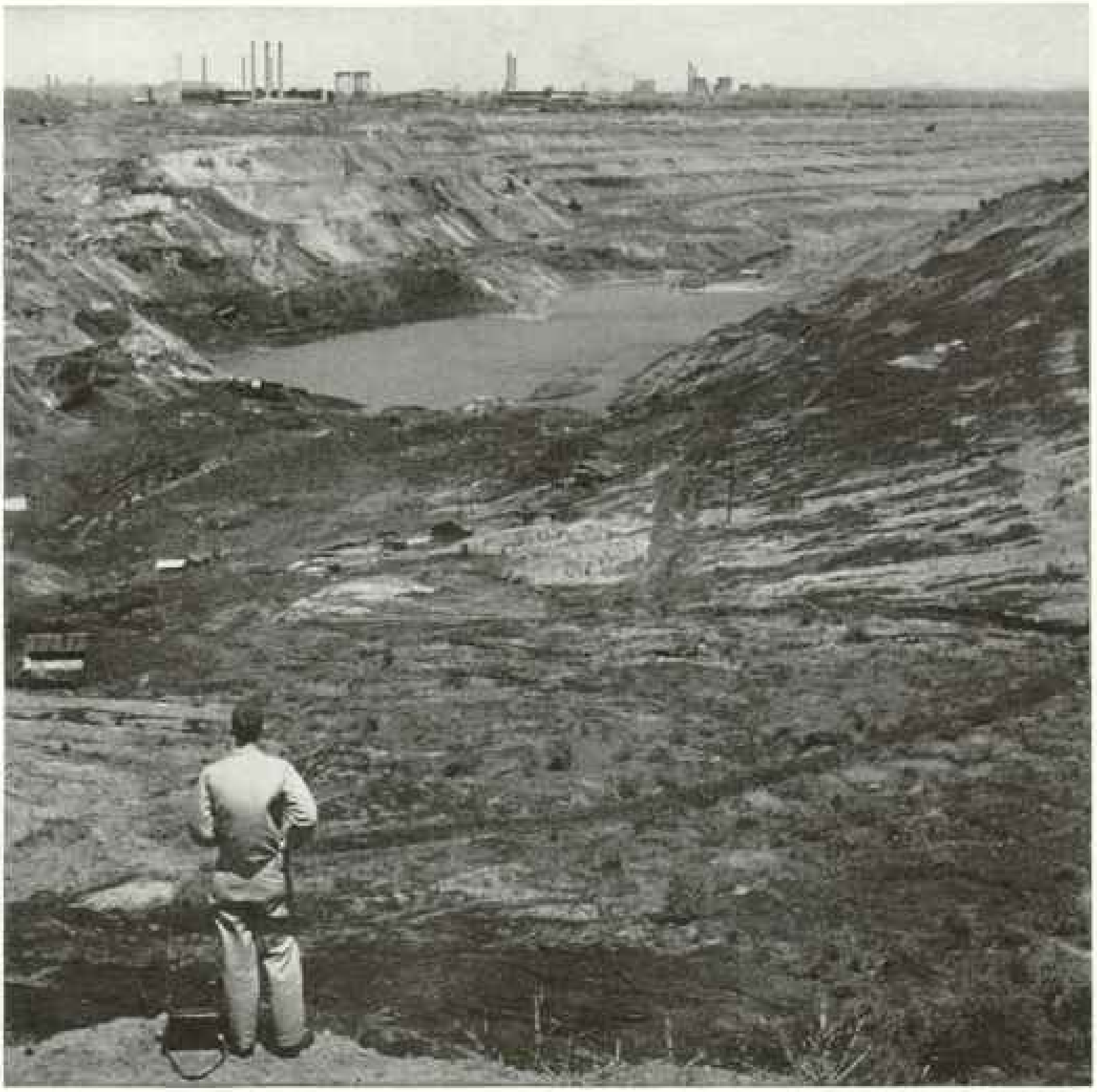
With several other correspondents I went by train to Fushun, 20-odd miles east of Mukden.

A precocious offspring of the South Manchuria Railway, Fushun has grown beside one of the world's largest open-pit coal mines. It also has steel mills, aluminum plants, a cement factory, railway workshops, and large installations for extracting oil from deposits of shale.

The Chinese mayor and mine manager found transportation to take us around.

A Rich Coal Seam

Out at the edge of the city we looked down into the mighty bench-stepped gash in the earth. Millions of tons of coal have been hewn from its huge seam, which is some 400 feet thick at one end and about a third as thick at the other. The vast rent is more than four miles long and nearly a mile wide (page 397).



Coal Diggers Have Hewn a Mighty Stair-stepped Gash in the Earth at Fushun

The huge open-cut mine is more than four miles long and nearly a mile wide. The coal seam is some 400 feet thick at one end and about one-third as deep at the other. Chinese now carry on limited operations and mine about 3,000 tons a day. Overlying the coal is shale, from which the Japanese extracted oil. Beyond the rim rear the oil plants and large electrical power station.

"Japanese records show that 1940 was their peak production year," explained the director. "In that year they produced 7,270,000 metric tons of coal from the open cut and the near-by shaft mine. From that time until the end of the war the output gradually declined, but not from lack of coal. The Japanese had neither equipment nor men enough to keep the overburden sufficiently cut back from the coal face. We'll need new equipment to clear overburden before we can do major mining."

We rode down to the bottom to watch the Chinese miners at work. At the time, their output was only about 3,000 tons a day.

The vein, which tilts downward at an angle of 25° to 30°, has been worked to a depth of 541 feet, but that is less than half the distance it has been explored.

Overlying the Fushun mine is a thick layer of shale, from which the Japanese got Diesel oil, lubricating oils, and gasoline. They had built two plants which had a combined capacity of 210 tons of crude oil a day.

When we dropped in to visit the plants, Chinese workmen were gathered around tables in the yard and were celebrating on toasts of fiery *baigar*. Just that day they had succeeded in restoring operation in a part of the

Japanese Architects Transformed Changchun into a Modern Capital City

They laid out wide streets and parks and built numerous Government departments and large offices. The population rose to 800,000, of whom 250,000 were Japanese. In recent civil fighting, many modern structures were gutted by fire (page 403). Barbed-wire barriers still stand beside this closed store and apartment building.

old plant so that it could produce about 30 tons of crude oil daily (page 395).

The place reeked with the smell of hot oil. Not so the newer plant, for that had been stripped of a major portion of its equipment and could not be recommissioned.

Over at the big power plant we walked through the generator and boiler rooms, which now are almost empty. Remains of a temporary railway still led to a hole in the wall through which some of the heavy equipment had been taken.

"Soviet forces removed generators producing 210,000 kilowatts of the plant's 285,000-kilowatt capacity," explained the engineer who conducted us through the gaunt rooms and over rubble that cluttered the floors (pages 390 and 391).

"Only the older generators are left, but we've kept them in operation. Now we're reconditioning some still older spares which haven't been used for a long time except for local emergency power," he continued, as he led us into an adjacent building. Here men were just finishing the fitting of a new steam main and were renovating some boilers.

Many Plants Destroyed

That night we ate dinner with the mayor and some of the engineers. As we wielded chopsticks through fish, fowl, pork, and rice courses, we heard more about the destruction of other plants.

One engineer estimated that the steel plant we had seen, where the Japanese made sponge iron directly from the ore, was at least half destroyed. The aluminum plant, too, had been heavily gutted in the "war booty" grab.

The industries, local hospital, schools, and even our hotel at Fushun bore the touch of the Japanese-owned South Manchuria Railway, or "SMR." Until the Manchuria Industrial Development Corporation was organized in 1937, to control heavy industry and subsidiary enterprises (page 400), virtually every field of big business in the country was linked with the SMR.

When it was organized in 1906 after the Russo-Japanese War, the SMR's activities were concerned with some 700 miles of railway and the Fushun coal mines, which then produced only 300 tons of coal a day.

It grew into a remarkable enterprise and employed a staff of 300,000.

Running railways became only a small part of its job. This semigovernmental concern mined coal, produced oil, made steel, and even ran earthenware and pottery factories.

It built and operated hotels, libraries, schools, and hospitals; built harbors and warehouses; organized agricultural experiment stations; and conducted research in geology, chemistry, and economics.

Some have dubbed it the "East India Company of Manchuria."

The elaborate development of Dairen was one of its proud accomplishments. By constant dredging the port was increased to 12,000,000 tons' capacity. The city became a show place for planning.

After Japan wrested Manchuria from the hands of the Chinese late in 1931 and early 1932, the SMR assumed the management of all the railways in Manchukuo, including the old Chinese Eastern Railway when, in 1935, the Russians sold their interests for nearly $50,000,000.

More Railways than in China Proper

When the Japanese gained full control, Manchuria had some 3,400 miles of railways. They since had built more, so that the country now has a total of 9,300 miles—a greater network than exists in all China proper.

The SMR also ran ships on the Sungari, Amur, Liao, Nonni (Nun), and Yalu Rivers and put buses on hundreds of miles of highways.

At present, considerable portions of the railway are not in operation, as many bridges have been blown up during the prolonged Chinese conflict. Obviously, no link by ship, rail, or road exists between the Nationalist- and Communist-held territories.

Back in Mukden, I inquired about getting down to Dairen and Port Arthur (which the Japs called Ryojun), on the lower tip of the Liaotung peninsula. These places they got as the result of the Russo-Japanese War in 1904-5.

According to the terms of the Yalta agreement and the Chinese-Russian Treaty of August 14, 1945, Port Arthur is to become a Chinese-Russian naval base. Dairen, or Talien, is constituted as a free port. But with Soviet administrators, technicians, and guards now in possession, I found that correspondents still were unwelcome.

With no Japanese treaty yet signed, Russia still remains technically at war. And it was on this technical basis that she recently ordered a U. S. Navy courier vessel to leave port at the end of the specified time limit.

But one could get down to Anshan, about a quarter of the way. Here, in an area with an abundance of iron ore, the Japanese built a huge steel plant.

Particularly after Japan embarked upon her war program, the installations were intensively expanded. Here they erected a

Mukden's Curb Market Does a Thriving Trade

Street "flea markets" display a bewildering assortment of Japanese kimonos, secondhand clothes, cameras, suitcases, electrical gadgets, and junk. A Japanese woman stands near the center trying to sell some of her possessions. Most merchants are Chinese, as the majority of Japanese had already been evacuated from the city by midsummer, 1946 (page 392).

number of furnaces making pig iron and steel, rolling mills, coke ovens, and many by-products plants. It became by far the biggest industrial offspring in the country.

But Anshan's furnaces now are cold and its rolling mills stopped, at least that portion of them which remains. When I was there, men were prowling through the plants to estimate the damage caused by removal of vital parts.

Over at Penhsihu (Penki), on the Mukden-Antung railway, the Penhsihu Iron & Colliery Company exploited both iron and coal deposits in the vicinity. At the time, however, Chinese battle lines were drawn near the district and "sight-seeing" there was definitely unhealthy. Antung, another town in Manchuria's industrial "Ruhr," lay behind the Communist line and was likewise "out of bounds."

Returning to Mukden from another country trip one day, I met a quiet gray-haired Japanese on the train. We fell into conversation. In precise English he explained that, for the past five years, he had been president of the huge industrial holding company known as the Manchuria Industrial Development Corporation.

This colossal concern, I learned, had controlled 72 types of heavy industry and 150 suborganizations throughout puppet Manchukuo.

The Japanese industrialist was on his way to a conference with the Pauley Reparations Commission. He carried charts indicating the multitude of activities in which his organization had been engaged.

A Land of Fantastic Wealth

On them he pointed out the rich resources that had been explored and actively developed. Talking quietly, and with his pencil

Arthur Mathers

Nationalist Soldiers Pause for a Rest in Their March into Manchuria

Some catch a few moments of sleep. The Nationalist forces hold the southern part of the country; Communist Chinese troops are in control in the north. The "front line" during the uneasy truce between these opposing groups in central Manchuria is along the Sungari River, midway between Changchun, former capital of puppet Manchukuo, and Harbin (page 405).

skipping from spot to spot on the maps, he gave a quick resumé of the fantastic wealth that has been uncovered in Manchuria, much of it unknown until the past few years.

Reserves of coal alone are estimated at 27 billion tons. Much of it is bituminous and lies near the surface, so that it can be worked from open pits.

Some new mines that had been uncovered also produce good coking coal. In all, before Japanese enterprise ended here, 42 mines were in operation and had produced more than 25,000,000 tons of coal annually.

Across the lower part of the Manchuria map my acquaintance indicated an extensive band of iron ore.

"Much of it is low-grade ore, running from 33 to 35 percent iron content; but we found ways to work it on an extensive scale," he explained. "We also uncovered some richer deposits over here in the eastern region, near Chosen (Korea). The Showa works, at Anshan, were our biggest plant, but there were several others producing pig iron and steel."

My Japanese informant termed the reserves of aluminum ore "practically inexhaustible."

Pointing to a place on the map some miles west of Hulutao, "Here was quite a remarkable discovery," he added. "It's molybdenum, something we didn't know we had."

In 1939, while exploring a mine for lead and zinc, Japanese engineers uncovered a molybdenum-ore deposit which one day may compare with the famous Climax mine in Colorado. Before their work was halted, they had put down several mine openings over a distance of six miles to reveal a deposit estimated at 8,000,000 tons!

Hidden, too, in the Manchurian earth are copper, gold, lead, zinc, magnesite, and other minerals. Recently came reports of rich uranium deposits, discovered by the Japanese

Food Hawkers at Stations Are Railway "Dining Cars"

Here while the train pauses passengers grab a quick bowl of Chinese noodles, fruit, hard-boiled eggs, or sometimes a dish of meat. Even when no food is available, youngsters and women always have kettles of tea ready.

during the war, in an area 150 miles northeast of Port Arthur.

Despite these underground assets, Manchuria still is predominantly an agricultural land. Roughly eight out of every ten persons in its population of 40-odd million live in farm households and produce some 70 percent of its normal export trade.

Flying up to Changchun and then covering some of the central plain by train, I saw farmers tilling the warm Manchurian earth. Many worked only with hoes.

It was early summer and some of the crops were just being planted. Other fields were lush with green cereals or marked with rows of soybeans and *kaoliang*, a grain sorghum.

Rains alternated with sunshine over the landscape to afford ideal growing conditions. The long bitter winter of this northern land was well behind.

But in some districts many fields lay fallow. Quite a few farm plots had been plowed and tilled, but were left unsown. The farmers had either been afraid to plant because of the fighting or were unable to secure seed.

Shortage of Tractors and Draft Animals

Some with whom we talked at war-torn Szepingkai complained that there is an acute shortage of tractors and draft animals on the farms. Tractors had worn out or had been taken away. Many of the animals—horses, donkeys, and cattle—were requisitioned by the military or taken to the cities to supply immediate transportation needs.

From an UNRRA director, with whom I traveled through some of the unplanted farmlands, I learned that many farmers had relied heavily on that organization to furnish the seed for planting.

UNRRA, however, had arrived late because of the civil strife between the Chinese. In any event, they would have been prepared to supply only family packets, not grain or beans for wide-scale planting.

To relieve the shortage of work animals, the director had suggested the possibility of importing Missouri mules. But the people were not sure about them—whether they were the right size or would thrive on Manchurian foods.

Furthermore, there was the language problem. Imagine a good old gee-haw Missouri mule, used to a mule skinner's vocabulary, having to learn the commands of a Chinese-speaking master!

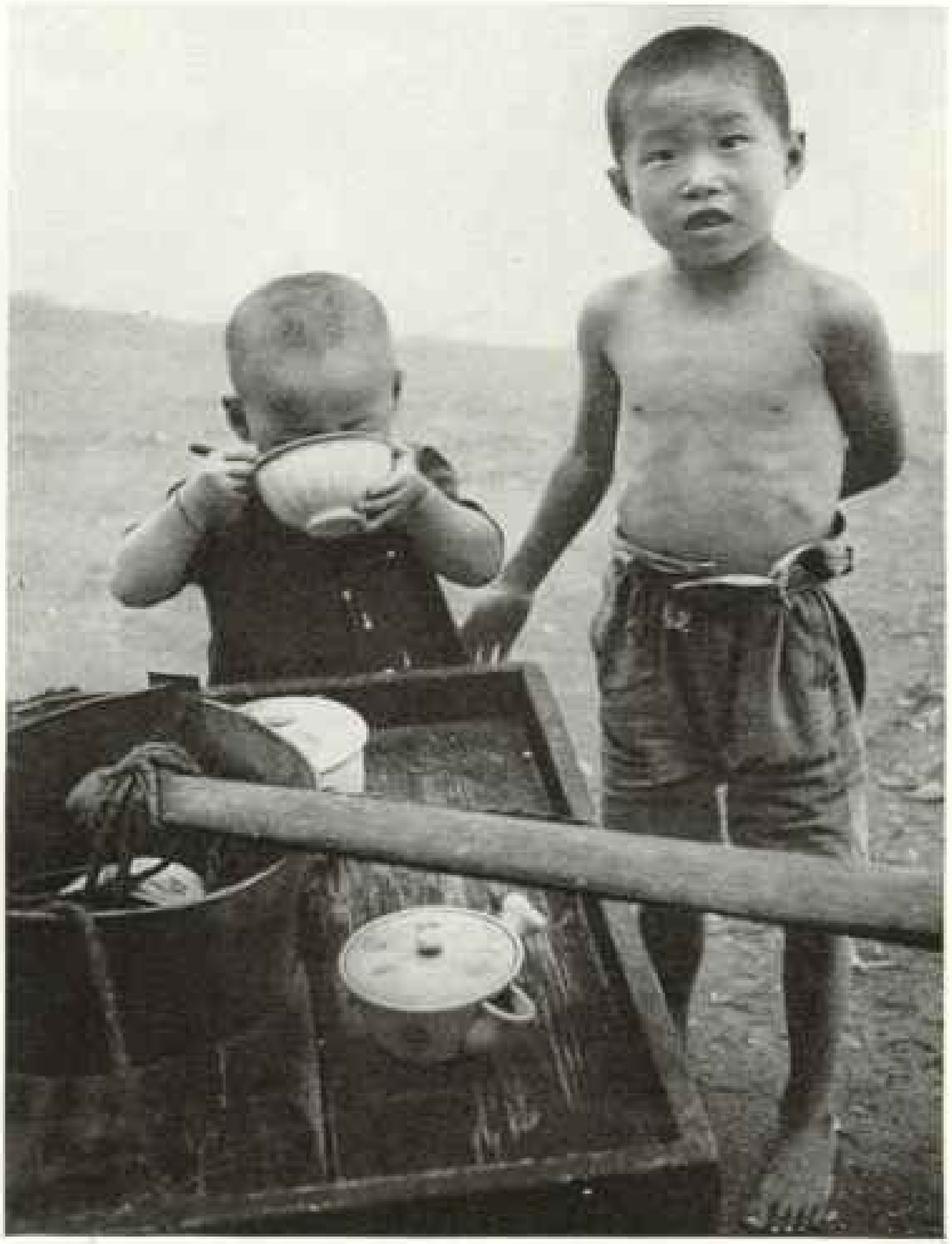
As you ride through the cultivated lands,

two crops stand out—soybeans and kaoliang. So extensive is the cultivation of soybeans that from the amount normally exported you are inclined to believe that Manchuria is the world's largest grower of them.

Both China proper, and recently the United States, however, have produced more. Manchuria normally raises 145,000,000 bushels. Well over two-thirds of the crop was exported as beans, bean cake, or oil in peacetime trade.

Kaoliang actually is the country's biggest crop, although the acreage given to its cultivation is slightly less than that for soybeans. Millet is a close third.

Here, as in North China, the people use kaoliang, millet, and wheat for food, rather than rice. However, during the Japanese regime this latter cereal was brought into steadily increasing production. In the Liao and Sungari River Valleys I saw two rice-land projects which they had under way for Japanese families. Korean immigrants raised considerable quantities over near the Korean border.



Capturing Noodles with Chopsticks Requires Concentration!

With food scarce and expensive, little brother is not missing a single slippery morsel. These Chinese youngsters in the Fushun market place, like many grownups, patronize street vendors who carry portable food kitchens on a shoulder pole. Manchuria, normally a land of plenty, now has shortages because of civil strife.

Among the amazing changes that the Japanese created in Manchuria, the transformation of Changchun is perhaps the most vivid.

When we rode in from the airport, our weapons carrier rolled along broad streets, through trim residential sections, and past blocks of modern office buildings and stores (page 398).

Until a few years ago the town was a motley collection of Chinese shops and drab one- and two-story homes clustered along ill-paved streets. The railway station and a growing group of new structures stood in splendid isolation some distance away.

Then, in 1932, it was selected as the capital city of newly created Manchukuo. Changchun, "Eternal Spring," flowered in a new springtime as Hsinking.

Broad streets, boulevards, circles, and generous park spaces were marked out on the plain, much as infant Washington, D. C., was plotted beside its older Georgetown.

Building boomed. Scattered through the new city and spaced in gardens are numerous imposing Government buildings, distinctively modern in floor plan but in many cases surmounted by roofs inspired by feudal Japanese architecture.

The Japanese military occupied a structure

Humbled by Defeat, a Japanese Colonial Serves as Barber to the Chinese

Working in the shade of a wall on a Changchun street, he gains a slender living until time comes for repatriation to his homeland. No crew cut here, but a quick over-all job with a big-handled pair of horse clippers. Particularly in summer, Chinese often shave their heads.

that makes you think at once of the old castles at Osaka or Himeji. The State Building embodies some of the same lines used in the new Diet Building in Tokyo.

Here, too, are department stores, large business blocks, marble-pillared banks, and Japanese monuments and shrines. The whole town reflects the zeal with which its sponsors set out to create an appropriate capital.

Unfortunately, many of these fine structures were gutted by fire during the fighting between the Nationalist and Communist Chinese troops in the spring of 1946, a few weeks before I was there.

Unlike many Manchurian towns, Changchun luckily still had electricity and its crowded streetcars ran.

The only other transportation, except military cars, was ancient Russian droshkies, seemingly in the last stages of dilapidation (page 413). I saw one lose a wheel when the driver had whipped his horse to a canter!

Relic of Manchu Splendor

The morning after I arrived in Changchun I engaged one of these venerable wrecks to seek out the palace of Emperor Kang Te, alias Henry Pu Yi. The palace is a cream-colored brick structure and has several adjoining stucco buildings. Only a red encircling wall

and golden-tiled roofs indicate that this was the abode of the Imperial Manchu family (page 407).

Here was little of the splendor with which Pu Yi was surrounded when, as a child, he sat on the Dragon Throne in the Forbidden City in Imperial Peking. But physically he was probably more comfortable, as the buildings had steam heat, white-tiled kitchens, and many modern conveniences. The old palaces in the Reserved City of Emperors in Peking, despite their ostentation, must in winter have approached living in a barn!

When I saw it, the Changchun palace was a shambles. Virtually every plate-glass window was shattered by bullets; all the doors had been pried off and carried away. A section of wood flooring had been ripped out for firewood when Chinese troops camped there.

The rooms which have Japanese-styled ceilings had been emptied, sandbag barricades still blocked the front terrace, and Chinese slept in the halls to escape the noontime summer sun.

The palace dominates a low hill in the northeast suburbs of town hard beside the railway tracks and overlooks a few factories and poor mud hovels. It gives you a feeling that, though in the capital, it was little of it.

The city planners, however, had started to build another palace at one end of the mall-like axis of their federal city project. War halted the work shortly after the foundations had been laid.

During the few years that it was capital, Changchun grew to a population of some 800,000 persons, of whom 250,000 were Japanese.

Curfew, Now, for Japanese

At the time of my visit the Japanese civilians had not yet been repatriated. Many were selling their personal possessions in open street markets.

Most of the stores, however, had already been taken over by Chinese merchants. Jazz bands were noisy in "night" clubs, but only in late afternoon and early evening. Japanese hostesses left at 8 o'clock to get home before early curfew.

In the center of one of the chief axial circles, around which are the City Hall, telephone and telegraph offices, police bureau, and central bank, the Soviet forces erected an imposing war memorial. It is a tall pylon, atop which perches a replica of an airplane bearing red-star markings. The dedicatory tablet on it reads: "Eternal glory to the heroes who fell in battles for the honor and triumph of the Soviet Union."

When I was in Changchun, Harbin (Pinkiang) was in Chinese Communist hands. The Nationalist and Communist armies faced each other in uneasy truce along the Sungari River about midway between the two cities. As I write, they still do (pages 401, 408, 411).

With several newspaper correspondents I waited, hoping to see that interesting city and perhaps also get a chance to visit Tsitsihar (Lungkiang), Hailun, and Hailar (Hulun), still farther to the north and west.

One day news came over from Advance Executive Headquarters that American truce representatives were flying with a Communist general to Harbin and that press delegates could go along. Some of those who had sweated out the Manchurian "show" longest were selected.

They went and saw what they could before they were told that their mission had been completed!

Even more than other towns in Manchuria, Harbin savors of the fantastic. It was spawned at the time the Russians built the Chinese Eastern Railway, that short-cut route between the Trans-Siberian near Chita and the port of Vladivostok.

It flourished and was fattened on the trade that was gathered both by the railway and by boat traffic on the Sungari River. The collapse of Czarist Russia during World War I contributed to its fantastic quality when thousands of White refugees fled into Manchuria. Large numbers have stayed in Harbin.

The correspondents saw Russian ballets, were toasted with Russian vodka, ate in Russian restaurants, and photographed the onion-shaped towers of Russian churches.

But they also witnessed huge Chinese Communist demonstrations, haggled with Chinese merchants, and somehow got along on Chinese banquets that have been limited to only 24 courses "because of the war!"

To them both Changchun and Mukden later seemed "rugged!"

By Rail to Kirin

While they were enjoying the fleshpots of Harbin, I boarded a military train and traveled eastward to Kirin (Yungki), over on the Sungari River.

After quitting Changchun the train slowly puffed across the plain and wound through green valleys between low hills. Perched on one hill was a small temple with a shrine at its gateway. About it a crowd had gathered, and flutists were filling the air with wailing tunes.

Many of the men who milled about in the religious gathering wore headdresses of leaves. Whether it was part of the rite or only to keep

The Hsiao Fung Man Dam, a Few Miles from Kirin, Harnesses the Sungari River for Power

Japanese engineers had two generators in operation, four others installed, and the last two partially completed when V-J Day came. Russian workmen removed all except the two already in operation, together with five of the eight transformer units. The top of the dam remained uncompleted, but Chinese engineers continue the work to safeguard the plant against possible floods (opposite page).

the sun from their heads, I didn't know. My interpreter was scarcely more enlightening when he glibly answered, "They do it here."

As we neared the Sungari shortly before reaching Kirin, I saw several large factories sprawled on either side of the river. From the outside they still looked new and whole, but afterward I found that their internals had been stripped away.

One of the large units manufactured synthetic rubber for Japan's war machine. Another made cement. A third produced oil from the hydrogenation of coal mined near the railway, a few miles to the west.

Kirin itself shows few signs of the quick modernization that transformed Changchun. In recent years it acquired an excellent waterfront wall and several new administrative buildings, but its gray Chinese buildings, untidy shops, and mud-walled homes give it a feeling of age, which indeed it has.

Before Manchuria gained its network of railways, the town was one of the chief trading centers of the country because of its position on the broad, sweeping Sungari.

Both Changchun and Harbin have since outdistanced it, but Kirin remains an important commercial city, its permanence as-

Symbol on the Gate Shows that Here Was the Palace of Puppet Emperor Kang Te

Brass bosses have been pulled off as high as people can reach. The palace is stripped, its windows broken. Sandbags clutter its terrace. Soviet troops captured the unhappy figurehead when they entered Changchun. Later they took him to Tokyo to testify in war-guilt trials and then flew him back to the U. S. S. R. in September, 1946. The palace was damaged later when rival Chinese groups fought in its courtyards (page 405).

sured both by a railway and by boat trade.

And now, too, by hydroelectric power. Just a few miles upstream from the city the Japanese erected a dam across the river to create a reservoir holding more than 14 billion cubic yards of water.

Turning myself over to the not-too-tender mercies of a Chinese tank corps driver, I bounced out in a weapons carrier over the rough, hilly road to look at the huge dam and power plant and talk with the engineers.

The dam is nearly 266 feet high and more than two-thirds of a mile long.

When the Japanese quit, the top of the dam was still unfinished, but they had two generators in operation. Four others in the 300,000-kilowatt project had been installed, and the last two partially completed.

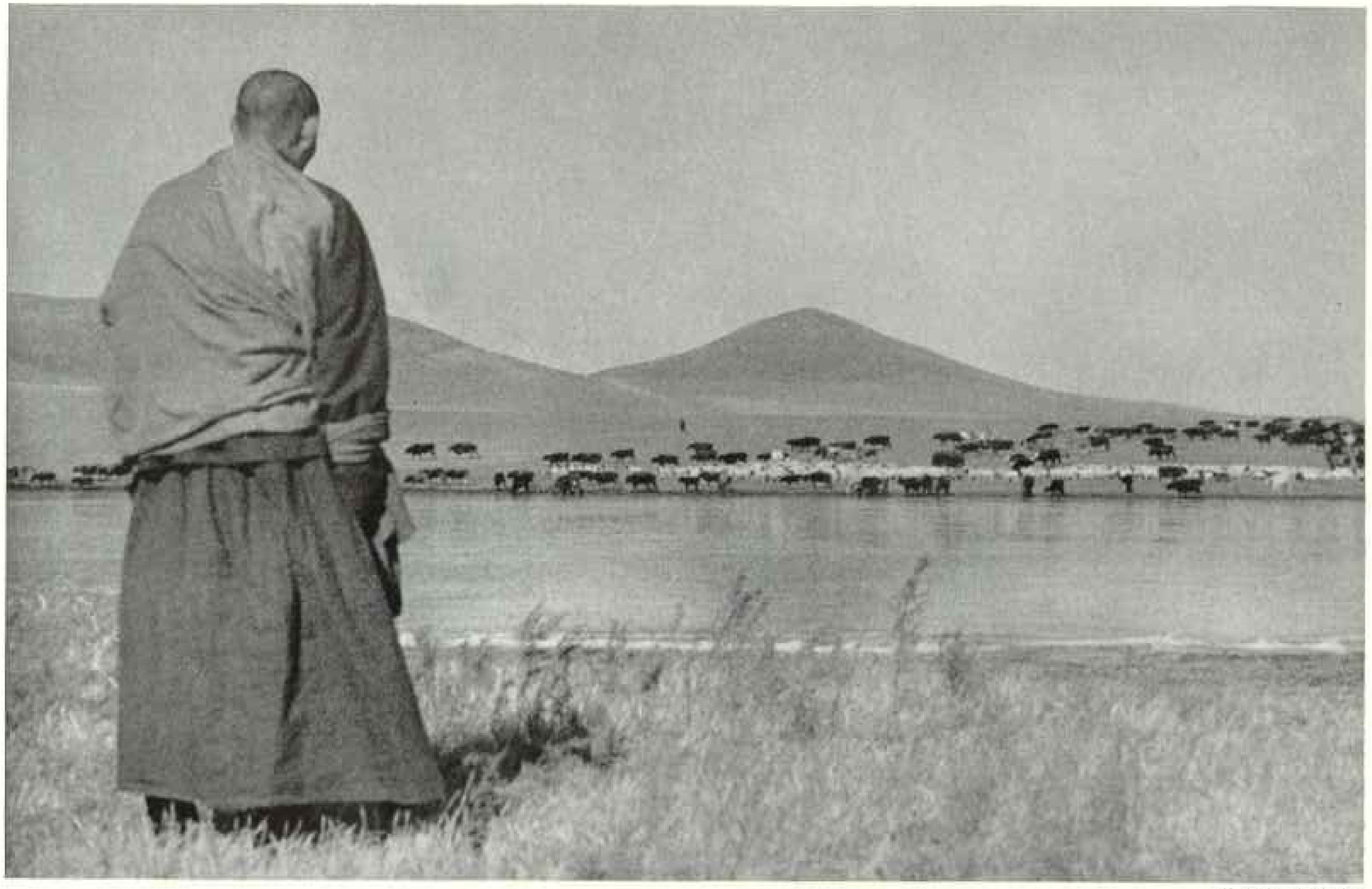
Today, only the two operating generators remain. Soviet workmen took apart the other six and hauled them away, together with the turbines. They removed also five of the eight transformer units and even the control panels not actively in use.

To safeguard what power remained, lest flood waters spill over the uncompleted top of the dam and flood the generator plant, Chinese workmen were busy pouring concrete to finish

Arthur Mallaya

Carrying Fluttering Banners and Flags, Communist Chinese Gather for a Mass Meeting in Harbin

After Soviet troops withdrew in 1946, these forces took over this important city. Harbin was founded a half century ago when Czarist Russia pressed the building of the Chinese Eastern Railway. The bulbous-domed church is a monument of those days. Thousands of White Russians still live in the city (page 405).



Natural from Black Star

Mongol Herdsmen Pasture Large Flocks of Sheep and Cattle on the Treeless Plateau Lands of Western Manchuria

About 1,000,000 of these seminomadic folk inhabit the barren uplands adjacent to Mongolia. They produce quantities of hides, sheepskins, and wool (page 414).

Beside a Wrecked Bridge on the Sungari, Youngsters Hunt for Minnows Hidden among the Rocks

Numerous bridges were destroyed throughout southern and central Manchuria during the civil strife between the Nationalist and Communist Chinese forces as each group sought to gain control over this rich region. The Japanese erected this bridge just below their large hydroelectric dam near Kirin (page 407).

Arthur Mathers

Student Orchestra and Choral Group Give an Entertainment in Communist-held Harbin

Sign above the stage announces that this is the "Harbin Area Celebration of the Double-seventh Victory," referring to the triumph over the Japanese, who launched their attack against China on July 7, 1937. Portraits of Communist leaders flank the picture of Sun Yat-sen (second from right), revolutionary hero of republican China.

"Aw, Shucks, the Schoolhouse Is Wrecked, but We Have Classes Anyway"

While rubble is being cleared from some of the classrooms, these Changchun girls assemble in the shade of a tree. Boys recite under another. The schoolhouse, like many other buildings in the city, was damaged during fighting between Nationalist and Chinese Communist forces.

"Fill 'Er Up," Says the Chinese, but He Means with Soda Water

The hose and pump are part of a portable soft-drink stall, rather than a gasoline filling station. In one hand the vendor holds several bills of China's inflated currency. A glass of soda or syrup-flavored water in the summer of 1946 cost $100 to $200 in Chinese national currency or from 10 to 20 Manchurian yuan.

off at least a protective portion before high water came.

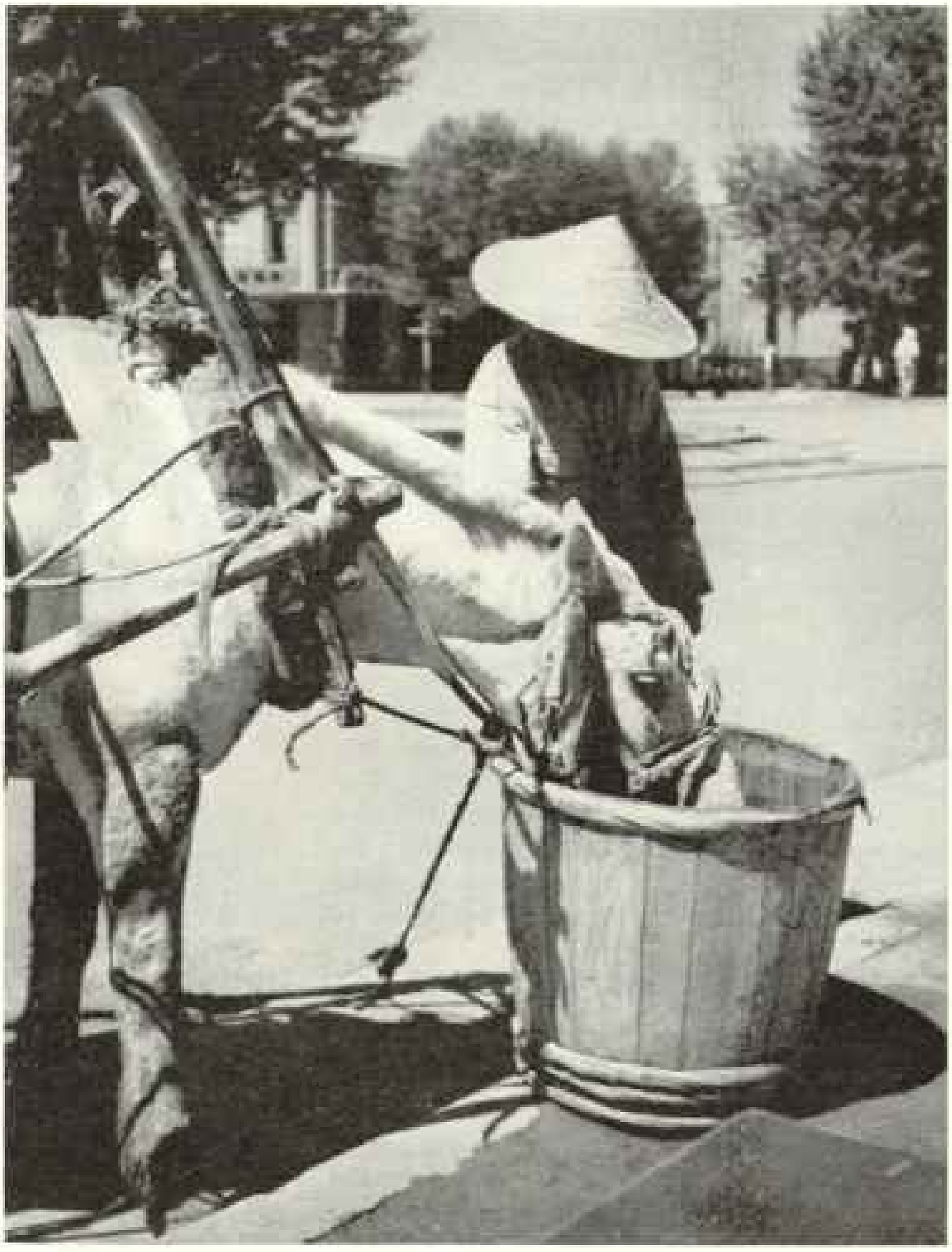
Floods on the Sungari

"Floods come every 20 years on the Sungari," said one of my nonengineering companions, "and this is the year we expect one."

Floods *are* a menace on the Sungari, but they can hardly be predicted with such accuracy! I pointed out that a very heavy one had occurred only 14 years before, in 1932.*

In addition to furnishing power, the dam should help curb some of the wrath of the river. Still another advantage that has accrued from the development is that the reservoir now permits a water approach to the rich timbered country to the east. Kirin possesses one of the five paper mills in Manchuria.

A bridge below the dam, two near Kirin, and several others spanning the Sungari had been blown up during civil strife in the spring of 1946 (page 410). In some, however, only one or two spans were demolished and can be repaired.



In Hot Summer Sun Old Dobbin Welcomes a Drink

All day he pulls a battered droshky around the streets of Changchun. Streetcars are crowded; buses are almost nonexistent, so the Chinese driver picks up many fares (page 404). A Japanese, not yet repatriated, provided the tub of water and was handed a small bill by the cabby.

When I returned to Kirin from my visit to the dam, I found a letter inviting me to dinner with the Governor of Kirin Province, who was also Deputy Commander in Chief, Northeast China Peace Preservation Headquarters. The invitation read "Mr. Northeast Region," as I was accredited to that area!

A Genial Host

Gen. Liang Hwa Sheng was a genial host—so genial, in fact, that one had to watch one's glass against too many *gambeis*, or "bottoms up," through the 10 or 15 courses of dinner!

Here in Kirin, beside the Sungari, I heard the old legendary tale of the origin of the Manchus.

At the very source of the Sungari, high in the Chang Pai Shan, or Ever White Mountains, so the story went, is a pond known as "Heaven Pool."

Here, as she stood on its bank one morning, a maiden of divine origin saw a lovely lotus blossom floating on the mirrored surface of the water. She was commanded to pluck it, and thereby conceived and gave birth to a son, Aisin Gioro, who was to become the first Manchu ruler.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Here in Manchuria," by Lilian Grosvenor Coville, February, 1933.

Either fearing comment or still following command, she placed the infant in a birch-bark cradle and set him adrift on the Sungari, where warring clans found him as he drifted downstream. Forthwith the warriors decided to make peace among themselves and install him as their leader.

Owen Lattimore tells a similar legend, but in the version he heard the maiden supposedly ate a red berry that had been brought by a bird.*

The Strong Man of Manchu History

The strong man in Manchu history, however, was Nurhachu, who welded his people together and established Mukden as the Manchu capital in 1625.

Possessed of a fresh vigor for war that the Mongols, Koreans, and northern tribes had lost, Nurhachu and his successor extended Manchu domination to the west, north, and east. And then, flushed by their quick successes, the armies turned southward and stormed the Great Wall to capture Peking.

The conquest, which led to the complete control of all China, was not, however, due entirely to the Manchus' mastery of arms. The Great Wall was breached partially because of a woman!

A Chinese general who guarded the frontier had become disgruntled at the loss of his favorite concubine to a usurper in Peking and willingly lent his aid to the northern invaders.

For a considerable time during their long rule over China, the Manchu, or Ching, emperors held Manchuria apart for their own people and as a "royal reserve," and recruited here the military Bannermen to guard the Empire.

Gradually Manchuria was sapped of its manpower, and immigration bars were lifted. The entry of Chinese colonists came first as a trickle, then as a stream. After Imperial power fell in 1912, migration into these rich, comparatively empty lands was like flood water from a broken dam.

In the 1920's particularly, Chinese colonists rushed into Manchuria by the millions, a historic mass movement of peoples (page 389).

Even in their heyday the Manchus were never a numerous people. Today, probably not more than six percent of the people who live in Manchuria can be classed as pure Manchus.

Some live in the northern part of the country, but most of the race has been absorbed by the Chinese and dress as do their Chinese fellow men.

Over in the western part of the country, on arid lands bordering Mongolia, also dwell seminomadic Mongols with their herds of cattle and sheep (page 409). In the country, too, are some primitive Tatar tribesmen, Korean immigrants, and White Russians.

But fully 90 percent of the population is Chinese, perhaps more, now that the Japanese are being sent home.

Five Times China Was Invaded from Manchuria

It has been said that whoever holds Manchuria holds a spear pointed at the very heart of North China. Five times in the past that has proved true.

First came the Khitan Tatars; then rose the Nüchens to set up North China kingdoms. Through the Great Wall later rode the Mongols to build the fabulous empire of the Khans. Fourth in turn were the Manchus. And then the Japanese with their "Co-prosperity Sphere" campaign!

Although these latter overlords wrested more wealth and sinews of war from Manchuria than ever had been known before, theirs was the briefest stay of any conquering power.

The Manchurian drama, however, has not ended with their going. At the moment headlines feature civil strife. Rich and strategic, Manchuria is one of those focal spots on the globe that always make news.

* See "Byroads and Backwoods of Manchuria," by Owen Lattimore, NATIONAL GEOGRAPHIC MAGAZINE, January, 1932.

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

The National Geographic Society–U. S. Navy Expedition camped on desert Canton Island in mid-Pacific and successfully photographed and observed the solar eclipse of 1937. The Society has taken part in many projects to increase knowledge of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

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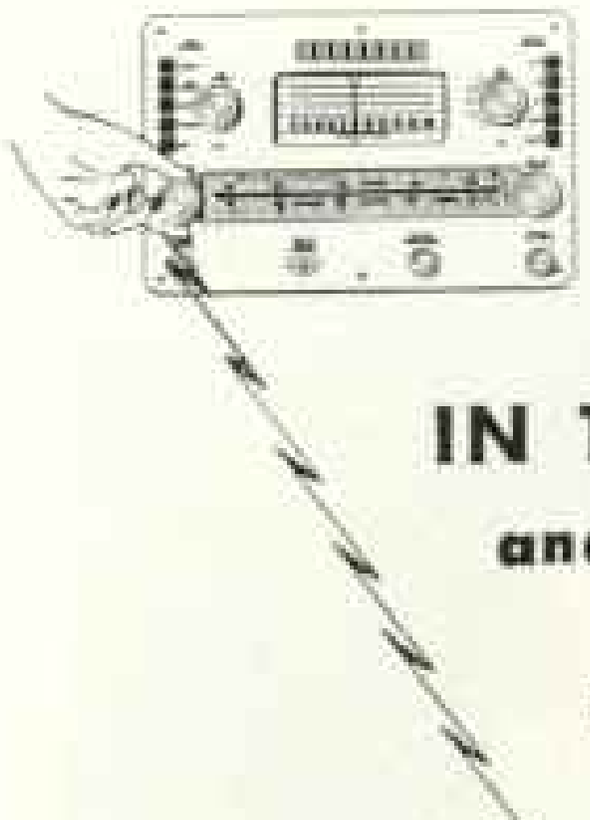

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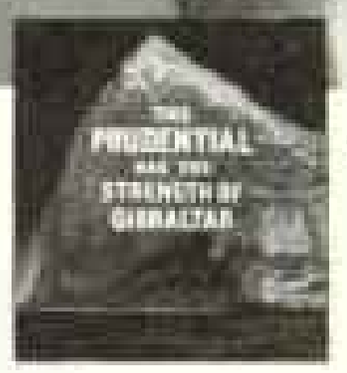

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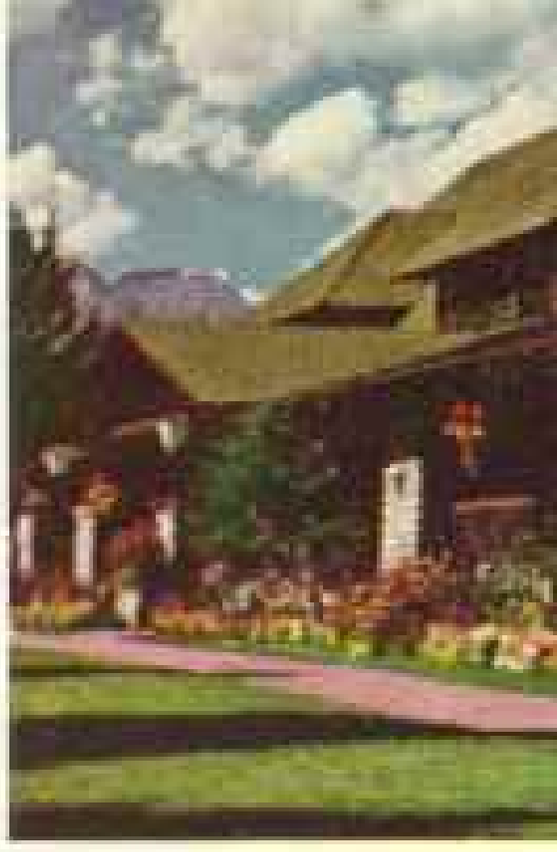


4. **YOU WANT TO STAY** at Canadian National's Jasper Park Lodge. Here famous people from all over the world come each year to loaf, play.

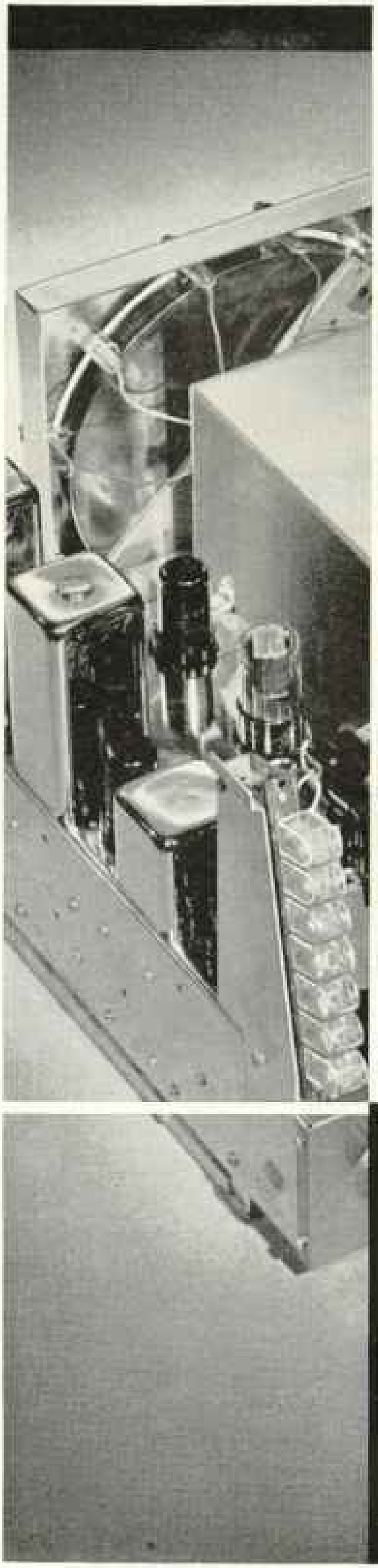
5 big moments of a JASPER VACATION

IN THE CANADIAN ROCKIES

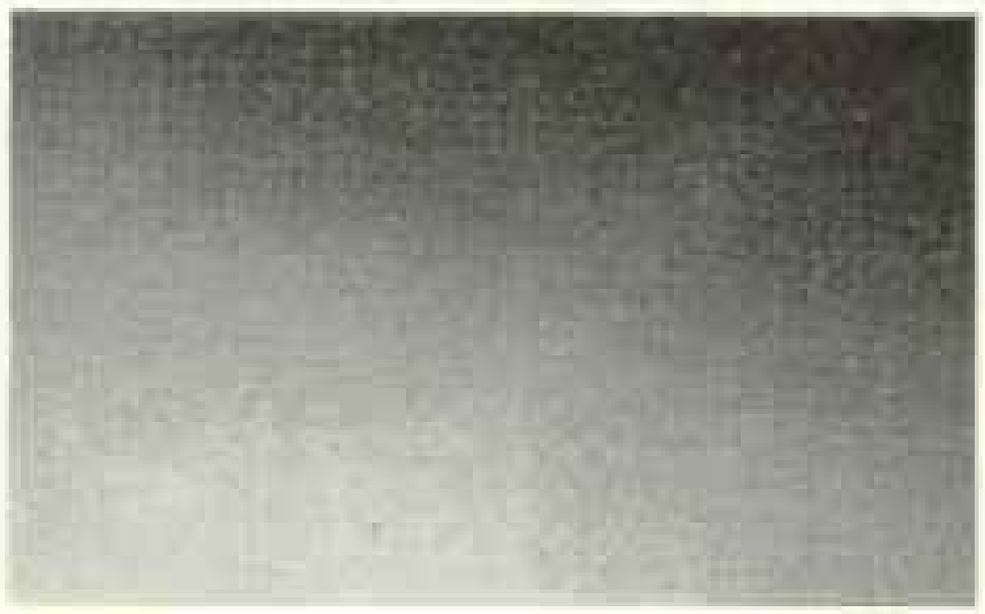
5. **MALIGNE LAKE** in Jasper National Park is acclaimed by world travelers as "the most beautiful anywhere" . . . Make your reservations early for Jasper Park Lodge, Season June 15—Sept. 15. Come by the *Continental Limited*. Write or call now for full information on Canadian National's *Rail-Trail* vacations. No passport needed—Canadian National Railways Offices in the U. S.—Boston, Buffalo, Chicago, Cincinnati, Detroit, Duluth, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, Portland, Me., San Francisco, Seattle, St. Louis, Washington, D. C. In Canada, 360 McGill Street, Montreal.

CANADIAN NATIONAL

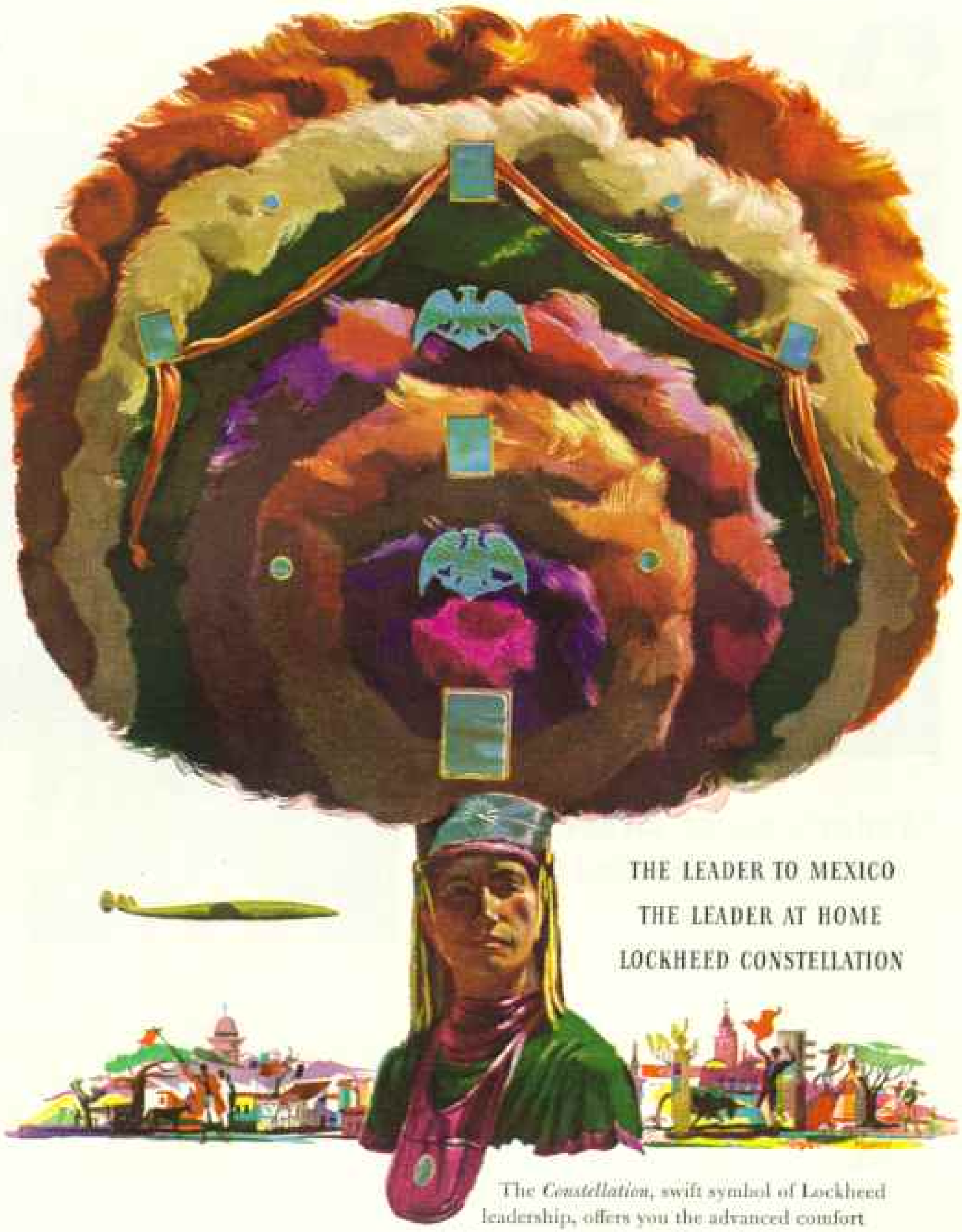
THE RAILWAY TO EVERYWHERE IN CANADA



SCOTT



Naked beauty that excites the *mind*—the capable-looking, chromium-bright tuning chassis of the Scott radio-phonograph. This ultra-modern package of "elegant engineering" says even more for the Scott, we feel, than would some picture of a beautiful woman thrilled by Scott tone *and/or* beautiful Scott cabinet . . . That's why we show it—to excite pride of possession in those who get an honest kick out of owning the best. Scott Radio Laboratories, Inc., 4448 Ravenswood Avenue, Chicago 40, Illinois.



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LOOK TO LOCKHEED FOR LEADERSHIP • YEARS AHEAD IN THE SCIENCE OF FLIGHT •

"Today's magic carpet travels on a railroad track"

"This afternoon the children and I have been planning our vacation trip. We have all of this wonderful country of ours to choose from, and the railroads can take us to any far-away place we pick. Like a regular magic carpet.

"What's more, when we go by train we know we'll get there—swiftly, safely, comfortably—no matter what kind of antics the weather man thinks up. Train travel is inexpensive too—especially since we get round trip rates and the children ride for half-fare.

"Yes, the railroads bring the world to my door all year long to help me run my house. And then, at vacation time, they turn around and put all America within easy reach!"

When you plan *your* next vacation, remember that the day-and-night, all-weather regularity and dependability of the railroads can help make your holiday the best you've ever known.

It will start the moment you board your train. You'll begin to shed tension as you watch a continuous moving picture unroll beyond your window, in natural color and featuring close-ups of the world's most satisfying scenery. You can relax in your comfortable seat. You'll enjoy plenty of space to move around in. And all the while—as you read or rest or sleep—your train will be taking you easily, smoothly, dependably—like a regular magic carpet—wherever in all America you want to go.

ASSOCIATION OF **AMERICAN RAILROADS** WASHINGTON 6, D. C.

IN PARTNERSHIP WITH ALL AMERICA

"Without laboratories men of science are soldiers without arms" — LOUIS PASTEUR

Why some things get better all the time

THE SPAN OF LIFE is increasing. Within the last half century the average length of life of a new born infant has increased over 30%. And many more people over 40 can now expect to live well into their seventies.

Among the reasons for this progress, along with notable advancements made by the medical profession, are the improvements in medicinals and medical equipment.

Synthetic organic chemicals now are used in the production of a host of pharmaceuticals, including penicillin and the sulfa drugs, which have accomplished wonders in the fight against germs. They also are used in repellents to defeat disease-carrying insects. Out of research with gases has come oxygen therapy, an aid to recovery in numerous illnesses. Research with metals and alloys has produced the stainless steel used in hospital and medical equipment.

In safeguarding life—just as in transportation and communications—much of man's progress is traceable to *better materials.*

Producing better materials for the use of industry and the benefit of mankind is the work of UNION CARBIDE.

Basic knowledge and persistent research are required, particularly in the fields of science and engineering. Working with extremes of heat and cold—frequently as high as 6000° or as low as 300° below zero, Fahrenheit—and with vacuums and great pressures, Units of UCC now separate or combine nearly one-half of the many elements of the earth.

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"How can we tell when we get to the South?"

By friendlier smiles? By warmer handclasps? By charming tradition and gracious living? *Naturally!*

But there's another way you can tell when you get to the South these days... by the way business is booming... by the number of new factories being built... by the tremendous industrial activity... by the contagious optimism of Southern industrialists.

In this fast-growing industrial region, new factories are springing up day after day all along the 8,000 miles of the Southern Railway System that "Serves the South." And new plants and old are expanding and prospering... heading toward a still greater, more productive future.

Would your business thrive in this industrial opportunity-land? *Definitely!*

"Look Ahead—Look South!"

Ernest E. Norris
President

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LOOK AHEAD

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The Southern Serves the South

You are invited, too!

Join us for a real vacation — in Florida — this spring! Skip the uncertain weather. Join us in this land of sunshine at its very loveliest. Join us in swimming, in fishing—and in all the other sports and health and fun that Florida offers you. Plan days of sightseeing. You'll discover a world of interesting things to see and do all over Florida. You'll go home feeling like a million dollars, rested and refreshed as never before!

And while you're down here, take time to consider how you and your business might profit from a Florida location where so many costs are lower. Florida is close to important domestic and foreign markets. Florida tax laws are friendly to business—big or small. Employees, too, are happier in The Sunshine State where living is so pleasant and healthful. These are just some of the reasons why you'll want to look twice at Florida—see *all* of Florida. It may hold a sunnier future for you!

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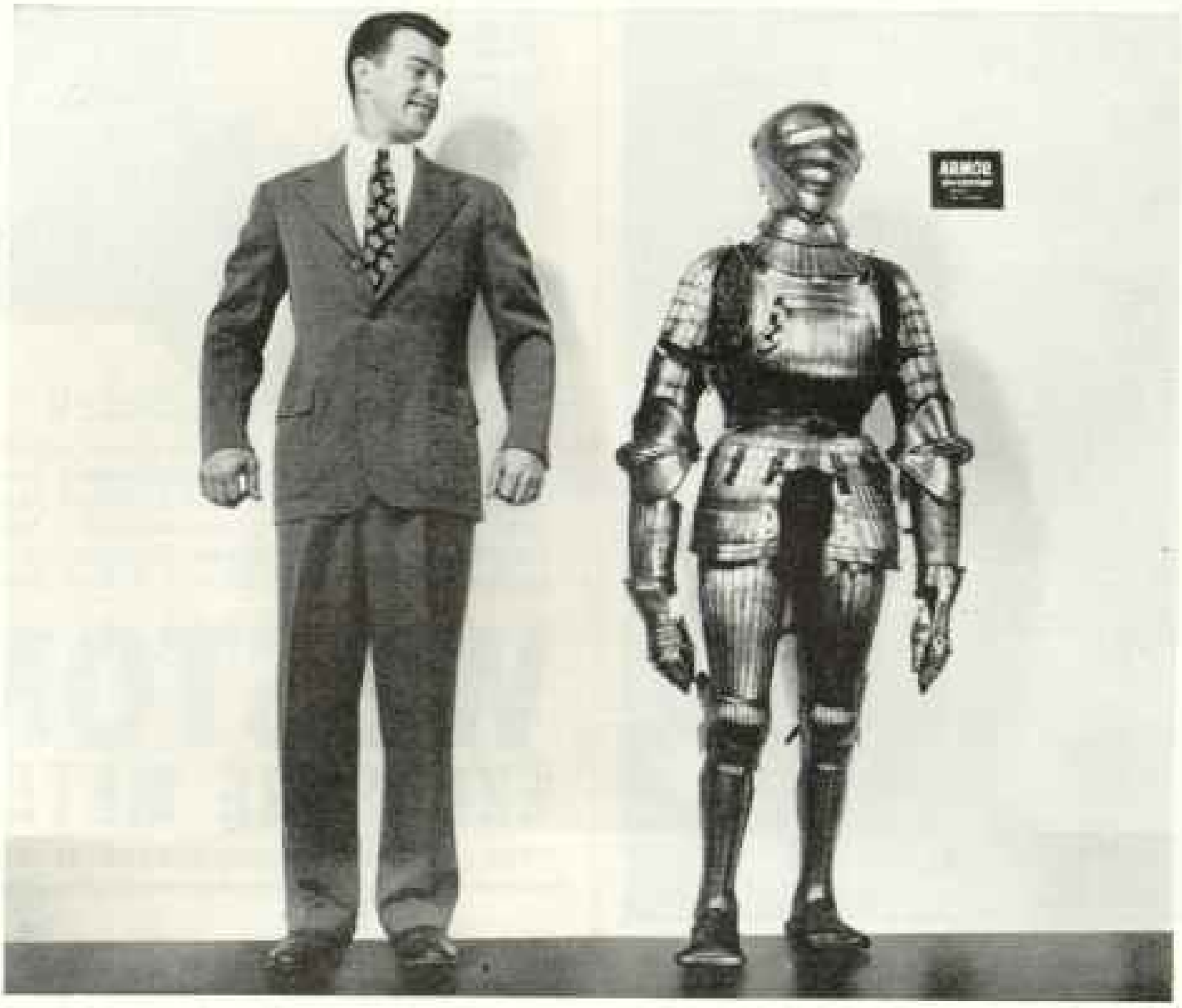

The shell of our former selves!

Stand the average American man next to a knight of old, and you'll discover a surprising fact. By modern standards, our iron-clad ancestors were pretty undersized!

The human race has grown appreciably since medieval times. But the real news is how rapidly it's grown *recently*. For instance, the soldier of World War II—according to Selective Service figures—topped his 1917 counterpart by almost a full inch!

This gain is largely due to the things we've learned about *food*. It's a very tangible result of research in vitamins, minerals, proteins—the myriad complex food substances which help build sound bones and tall, straight bodies.

Because so *many* of these vital substances are found in nature's most nearly perfect food—milk—National Dairy scientists are able to make a unique contribution to the sum of nutritional knowledge.

Behind them is a great organization—and many specialized talents—teamed up to turn National Dairy research into more and better foods for your table. And these, in turn, help advance the health of America. Just watch the *next* generation!

Dedicated to the wider use and better understanding of dairy products as human food . . . as a base for the development of new products and materials . . . as a source of health and enduring progress on the farms and in the towns and cities of America.

NATIONAL DAIRY
PRODUCTS CORPORATION
AND AFFILIATED COMPANIES

No moisture can seep through the seams of these raincoats—thanks to the electronic sewing machine developed at RCA Laboratories.

A sewing machine...without a needle or thread!

Since mankind first began to sew, say 15,000 years ago, seams have always meant "needle and thread."

But when thermoplastic materials came along—developed for waterproof coverings such as raincoats—"needle and thread" seams wouldn't do because of their tiny holes.

Now—thanks to research at RCA Laboratories that constantly seeks to improve even "little things"—goods made out of thermoplastics are "sewn" by electrons and the seams are as strong as the material itself!

This will make possible dozens of new uses for these inexpensive and durable thermoplastic materials. Even today they provide perfect packages for foods, meats and drugs because they're watertight, airtight and transparent. You've probably seen thermoplastic raincoats, tobacco pouches, shower curtains . . .

Research, such as resulted in the electronic sewing machine, is reflected in all RCA products. When you buy anything bearing the name RCA, you enjoy a unique pride of ownership in knowing that you possess one of the finest instruments of its kind science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 2:00 P.M., Eastern Time, over NBC Network.

The electronic sewing machine "welding" seams. Anyone interested in manufacturing this instrument can obtain information by writing to RCA, RCA Bldg., Radio City, New York 20, N. Y.

RCA

RADIO CORPORATION of AMERICA

"ON TIME"

When this man chalks up "On time" on the train-arrivals board, he makes more than a simple report.

It means that businessmen meet their dates. Through travelers make their connections. Homecomers meet those who wait, when expected. On freight it means that materials and products get to their destination promptly.

Thus the amazing record of General Motors Diesel locomotives for being "On time" is tremendously important to millions — besides setting standards hitherto thought impossible.

Records of large railroads show that for all purposes, passenger and freight, General Motors Diesels have met schedules *97% of the time*, exclusive of non-locomotive tie-ups.

In addition to ushering in this new era of prompt railroading — in addition to making faster running time possible—General Motors Diesels also show remarkable operating and maintenance economies.

This means that General Motors Diesels magnificently pay their way. Their savings can help to speed revitalization of lines and advance the luxuries of streamlined transportation which they originally inspired. From this everyone concerned can reap newer and greater benefits.

"Better trains follow better locomotives"

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DIESEL POWER

ELECTRO-MOTIVE DIVISION
LA GRANGE, ILL.
GENERAL MOTORS

...FOR WINTER *FIRE-POWER!*

When numbing, crackling cold swoops down from the north . . . and icy winds swirl around your engine . . . you'll appreciate the superior *Fire-Power* of Texaco Fire-Chief gasoline. Because that means fast starts . . . rapid warm-up . . . smooth, alert performance . . . *in spite of* Old Man Winter. Be winter-wise! Fill 'er up with Fire-Chief today. At Texaco Dealers everywhere.

TEXACO *FIRE-CHIEF* GASOLINE

TEXACO

THE TEXAS COMPANY

TEXACO DEALERS IN ALL 48 STATES

TUNE IN . . . Texaco Star Theatre presents the Eddie Bracken show every Sunday night. Metropolitan Opera broadcasts every Saturday afternoon. See newspapers for time and stations.

New! Exclusive! Only G.E. brings you this Two-Control Automatic Blanket! Wonderful for couples who like different degrees of lull-to-sleep warmth. Two controls—one for each half of blanket—function independently. Husband selects *his* favorite sleeping temperature—wife selects *hers*. No more "family disputes" over amount of covers needed.

Undisturbed slumber—all night, every night—thanks to

G-E AUTOMATIC SLEEPING COMFORT

How you'll love the all-night coziness of slumbering under *one* light G-E Automatic Blanket!

Remember, G.E. *pioneered* automatically controlled blankets in 1936—made the great majority of electrically warmed flying suits worn by our Army Air Forces.

Today's blanket is new, improved. 72x86 inches, fits any bed. In luscious blue, rose, green, cedar. Has more than 200,000 enthusiastic users.

See the newest G-E Automatic Blankets—One-Control and Two-Control models—at better stores. General Electric Company, Bridgeport 2, Conn.

Made to rigid G-E safety standards, and approved by Underwriters' Laboratories, Inc.

G-E Automatic Blankets

FIRST IN SLEEPING COMFORT

GENERAL ELECTRIC

Bedside Control is small, compact, *automatic*. Set it once a season for sleeping warmth you prefer. If room temperature drops, Control sends more warmth into blanket. When room temperature rises, less warmth goes into blanket. YOU dream on, undisturbed!

big savings! ONE G-E Blanket takes the place of THREE ordinary blankets. Saves buying extra bedding, winter night clothes. Saves laundry bills (washing instructions included). Nationally priced, $39.95 for One-Control, $49.95 for Two-Control. Both plus tax.

FALSE TEETH WEARERS

Some things... you just can't "Brush Off!"

DON'T BRUSH DELICATE* PLATES!

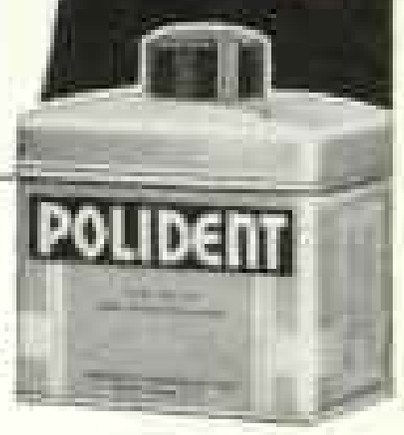
Soak them in Polident to keep them clean, bright, sweet.

*Brushing roughens plate material (60 times softer than natural teeth) making film and food particles cling more tightly. And brushing does *not reach* many little crevices, where food and film hide to taint the breath. Thus, brushing can *cause* unpleasant breath, but can not *cure* it!

Soak your plates in Polident! A Polident bath never scratches or roughens plates, yet reaches *every* nook and cranny. Polident is recommended by more dentists than any other denture cleanser. 30¢ and 60¢ sizes at all drug counters. Costs less than a penny a day.

IT'S EASY! IT'S QUICK!

Add Polident to ½ glass water, soak your plates 15 minutes or more—rinse—and they're ready to use!



Use POLIDENT Daily TO KEEP PLATES AND BRIDGES CLEAN... AND ODOR-FREE!

Overweight may menace your health,

especially if you are over 30,  for it often goes hand in hand with high blood pressure, heart ailments, diabetes, and other diseases.

The chief cause of overweight is overeating.  It rarely results from glandular disturbances or other causes.

If you are overweight,  follow your doctor's  advice for bringing your weight down to normal, or a little below.  Keep it there *-and help assure a longer, happier life!*

For further helpful information, send for Metropolitan's free booklet, 37-N, "Overweight and Underweight."

It contains lists of the calorie values of almost 300 foods, suggested low-calorie menus, illustrated reducing exercises, and a table of ideal weights.

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TO VETERANS — IF YOU HAVE NATIONAL SERVICE LIFE INSURANCE — KEEP IT!

Their guest room was a chamber of horrors

DON JUAN DE OÑATE, Spanish explorer, reached the adobe settlements of the Rio Grande Pueblos in the summer of 1598.

As a gesture of hospitality, the Indians lodged their guests for the night in the tribe's strange, half-underground ceremonial house, or *kiva*. But before they bedded down, the Spaniards took a look around.

Glaring down at them from the walls of their guest room were horrendous, animal-like faces, faces which Gaspar Perez de Villagra, who described the trip, said were "fierce and terrible."

No Indian would have been the least scared at the faces which frightened the Spaniards. To the Pueblos, the faces were those of old friends . . . representations of the masked tribal deities that they had painted on the walls to ward off drought and famine, to bring good hunting and plenteous crops.

The protective paintings of the Pueblos are typical of primitive man's age-old search for a way to make himself safe against the effects of ill fortune . . . a quest never too successful until modern man devised the *scientific protection of insurance*.

Today, through insurance, you can provide yourself and your family with unfailing protection against the effects of all sorts of misfortune, set up a system of security to serve you for life.

You can protect yourself against a lack of income should an accident stop your pay. You can provide now for income in later years when old age reduces your earnings. You can make sure your family will continue to have a decent income after you've gone.

Ask your Travelers agent or broker about a system of security to suit your particular needs.

Color photograph by John Paul Pennebaker

Sheaffer's – tops in its field!

In writing instruments it's always Sheaffer's that set the quality standard . . . STRATOWRITER proves it again! . . . STRATOWRITER is Sheaffer's newest writing sensation—the dependable, trustworthy, quality-clear-through ball-pointed instrument. Neither pen nor pencil, yet possessed of many of the best qualities of each, STRATOWRITER is a gold-filled, precision-built, jewelry-like instrument—with a long-life writing unit which will be replaced in its entirety (including factory-sealed supply of Strato-Ink) at any time by your dealer for only $1.00.

Complete STRATOWRITER $15.00 Federal Tax included.

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LISTEN SATURDAYS to SHEAFFER'S ADVENTURERS' CLUB—CBS Network, 11:30 a.m. E.T.; 10:30 a.m. C.T.; 9:30 a.m. M.T.; 8:30 a.m. P.T.

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After turning your exposed film in to your Kodak dealer, you'll receive your Kodachrome transparencies without charge. Projected on your screen, they are breath-taking—with the brilliance and *size* that come only through projection.

But that is only half your reward. Order gorgeous Kodachrome *Prints*, reasonably priced, in the new, popular 3X size—actual size shown here—or in larger or smaller sizes. They're great to carry and show around, or mail to friends.

Get Kodachrome Film now for your full-color snapshots next week end . . .

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ROCHESTER 4, N. Y.

Kodak

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NO PASSPORT NEEDED

"LUCKY PEOPLE"! (they're headed for Canada!)

It's time to plan *your* family holiday in friendly Canada. Just picture yourself . . . amid the scenic beauties of lake, mountain or seaside . . . enjoying your favourite sports . . . seeing new sights in Canadian cities . . . Canada offers unlimited holiday horizons. And wherever you go you're never a stranger, always a guest. Millions of visitors went exploring in Canada last year. Soon *this* year's northward trek to Canada will begin. *So better hurry and reserve your accommodation!* For information, write Canadian Government Travel Bureau, Dept. of Trade and Commerce

Hon. J. A. MacKINNON, *Minister* — D. LEO DOLAN, *Director*

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Remember . . . *By Highway* means *By* GREYHOUND

How would you answer this question?

We asked a number of people this question . . . *"How much would you say the telephone company makes (after all expenses and taxes) on the money invested in the business?"*

Twelve per cent said "6% or less."
Eleven per cent said "7% to 10%."
Twelve per cent said "15%, 20% or 25%."
Eight per cent said "30% or more."
Fifty-seven per cent had no opinion.

The actual figure is far less than many people think. Even with telephone calls at a record peak, Bell System earnings on the money invested in the business have averaged only a shade over 5½% for the last five years—including the war years. And that's not enough to insure good telephone service.

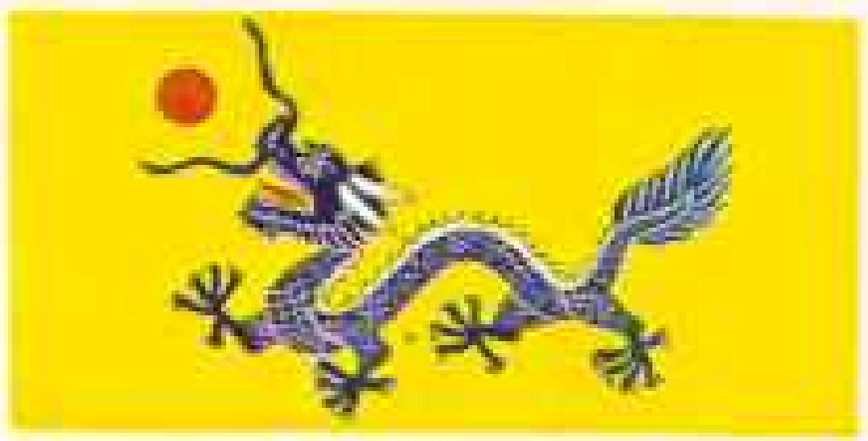
We thought you might like to know in case you have been wondering about telephone earnings.

BELL TELEPHONE SYSTEM

CHINA

—we've been calling there these many years

When you read about the great new luxury fleet we, of the American President Lines, are building (ships with new speeds, new comforts)... when the day comes for *you* to visit the Orient . . . remember . . .



In 1867, youthful Tzu Hsi was Empress of China. Her flag, the Dragon, symbol of strength and goodness. First ships of our predecessor companies played an important part in China's commercial growth . . .

In 1912, China's 5-barred flag stood for the 5 Clans. Its leader: Dr. Sun Yat-Sen. Into its ports regularly steamed ships of our predecessor company, carrying Americans, building American trade.

Someday you'll want to visit China. So plan ahead for it as the world's supreme travel experience. And depend on us to provide new-fleet luxury aboard —old-hand helpfulness ashore.

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