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OCTOBER, 1945

Your New World of Tomorrow

With 25 Illustrations

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With 6 Illustrations

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Your New World of Tomorrow

BY F. BARROWS COLTON

IN THE WORLD of the future," a rocket research man told me, "we can probably send mail by rocket across the Atlantic Ocean.

"Such rockets, traveling thousands of miles per hour, could make the trip in perhaps 40 minutes. Because of the difference in time between Europe and the United States, mail leaving at 1 p. m. Paris time would arrive in New York at 9 a. m. eastern standard time—four hours earlier!"

Fantastic? Not so much as you might think. The German V-2 rockets shot across the English Channel against London reached a maximum velocity of more than 3,600 miles per hour, or 6,000 feet per second, which is five times the speed of sound. Mail already has been carried by rockets over short distances in Europe.

Such transatlantic rockets won't come right away, but the mere fact that they're being talked about shows how science is remaking our world and scrambling our old ideas of geography.

The Age of Atomic Power

Even more sensational is the new age of atomic power, ushered in when the first tremendous atomic bomb exploded over Japan.

The awful power of the atom bomb is the same almost inconceivable power that keeps the universe running, the same energy that has kept the sun and all the other stars burning and shining with terrific heat for millions of years.

This energy is what holds together the infinitely small cores, or nuclei, of atoms, the tiny building blocks of which all things are made. When atoms are broken up, the energy is released. So far, we have learned to extract this energy only from the atoms of one kind

of uranium and a few other elements. When these atoms are smashed, the source of this colossal energy of the universe is partially unleashed.

The atom bomb explodes in a way comparable to setting off a whole chain of firecrackers by lighting the fuse of the first one. A tiny neutron, fragment of an atom, is shot into the nucleus of a uranium atom. The atom breaks into two parts, and a few neutrons fly out of its core. They smash into two other uranium atoms. These in turn are broken, and the neutrons that fly out from them explode four more uranium atoms. These explode eight more; and so on.

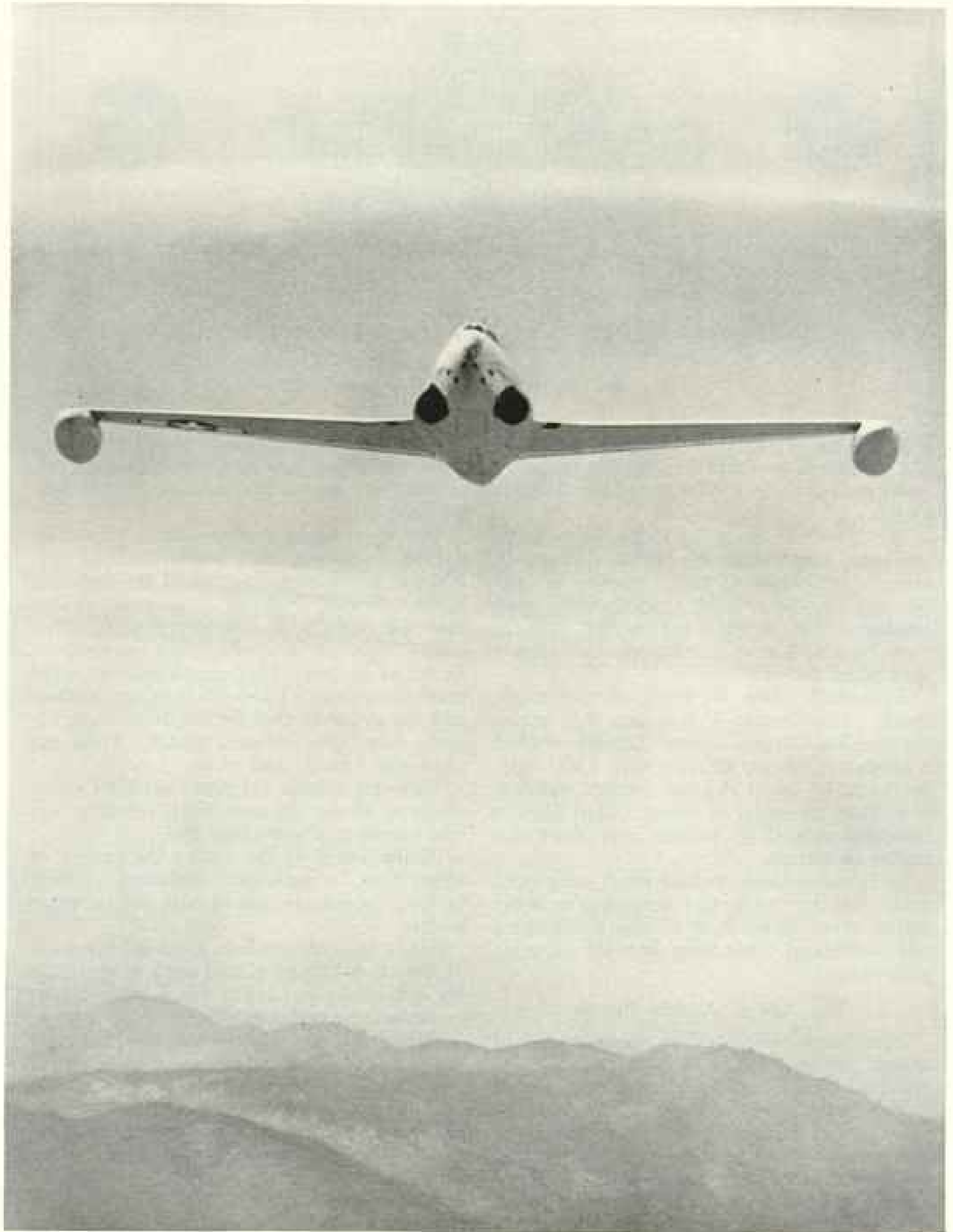
This fast "chain reaction" explodes many atoms at almost the same time, releasing terrific explosive power (page 395).

In the world of the future the energy of atoms may be harnessed, replacing, at least to some extent, the use of coal, oil, or water power.

A few tons of uranium could do the work of thousands of tons of coal or oil in operating big industrial plants, light and power systems, or battleships and ocean liners.

"But first," one scientist told me, "we must learn to control atomic power. In the atomic bomb we have learned only how to release this power. It's like the difference between gasoline in a barrel and gasoline in an automobile cylinder. Anybody can make a barrel of gasoline explode by touching a match to it. But the job of controlling it and making it work for you in an automobile engine is far more complicated."

Uranium, too, is scarce and expensive. Before the war most of the world production came from Canada and the Belgian Congo, though it is also produced in the United States.



Lockheed Aircraft Corp.

Like an "Airship from Mars" Is the New Jet-driven Plane, the World's Fastest

The Army Air Forces' P-80 Shooting Star fighter can flash through space at more than 550 miles an hour. Jet-propelled aircraft have no propellers. Air is scooped in through the round black ducts at the front, compressed, and heated by burning with fuel oil. The resulting jet of hot gases shoots out through a nozzle in the rear. The plane is propelled by its reaction to the force of the escaping gases. Bulges on the wing tips are extra fuel tanks. They can be dropped when emptied (pages 388, 390).



A New-type Helicopter Carries 10 Passengers and Crew of Two

Designed for use by the Navy and Coast Guard in rescue work at sea and for carrying passengers or wounded men, this transport has rotor blades at each end. The fuselage is 48 feet long and 13 feet high. Hovering above the water, it can pick up castaways, and can alight within a 100-foot area on land or, with rubber floats, on water or swamps (page 398).

Meanwhile other inventions, discoveries, devices, and products that will vastly alter our lives are already here—and in use. Many were developed for our Army and Navy under the urgent demands of war.

Civilians now will benefit from this high-pressure research, offsetting somewhat war's terrible waste and destruction. Even before the fighting was ended, the world of the future was already taking shape.

"Within five years after the war, you'll be able to fly from the United States to any place on earth in 30 to 35 hours in fast express airplanes," a leading airline engineer told me.

"Even today you can do it in 55 hours. In five years many commercial aircraft will be flying at 400 miles per hour, as fast as most fighter planes of today. At that speed, and allowing for the difference in time between the east and west coasts, you could leave New York at 6 a. m. and still get to Los Angeles in time for a 9 a. m. business date!"

New Marvels of Radio

Radio, too, will play a leading role in tomorrow's world.* Dr. W. R. G. Baker, of General Electric, sees it this way:

"There is no part of the earth where radio cannot now reach.

"When this global war is ended, the great international short-wave stations—more powerful than ever before—will broadcast sound and radio facsimile pictures of the current events, customs, ambitions, habits, and thoughts of people of all nations for the entire world to hear and see. Radio will make safer all forms of global travel by sea, air, and land.

"Radiotelephone communication between plane and ground, ship and shore, train and depot or signal tower will probably come into early widespread use. Education will be modernized by the intelligent and diligent use of radio and television in schools. They will bring the outside world into the classroom, and classroom and school subjects into the home. Radio-equipped police cars and a national chain of police radio stations will protect us from the lawless."

Sooner or later you'll probably buy a television receiving set. It will cost no more than did the first home radio cabinet sets. From a

* See "Winged Words—New Weapon of War," by F. BARROWS COLTON, NATIONAL GEOGRAPHIC MAGAZINE, November, 1942.

farmhouse in Nebraska or Indiana you'll be able to watch the "Follies" being performed in a Chicago theater, or witness the latest movie at home when the snow is too deep to drive to town.

A city housewife can see, in a television "ad" at home, bargain offerings in a department store before she goes downtown—a new kind of "window shopping." Television in color is now possible.

The Future of Television

Here is how the future of television is seen by Ralph R. Beal of Radio Corporation of America:

"It will be no trick at all to glance across the country. New Yorkers, after seeing the sun go down over the Hudson Palisades, can watch it set again three hours later by television over San Francisco Bay.

"Television cameras will pick up almost any scene visible to the human eye—the last quarter of a football game played on a November afternoon, night baseball games, theater performances, and opera. Transcontinental news-casting by television is ahead. News as it happens, whether in New York, Washington, Chicago, or Los Angeles; a parade up Broadway; a Presidential inauguration; or a political convention will be telecast sky high over the Great Divide" (pages 392, 394, 396, 402).

With FM (frequency modulation) radio you'll hear your favorite symphony or opera with far greater perfection. FM brings you the full range of high and low notes audible to the human ear, from the bass drum's deep boom to the piccolo's squeal. FM does away, too, with static, fading, and station interference.

Quick Trips to Far Places

These are just samples of the things to come.

It will take time for all of them to come true, but think what they will mean in terms of opening up the world's remote corners, annihilating time and space, getting alien peoples acquainted, putting new life in that over-worked phrase, "international understanding."

Places you've always wanted to visit, which formerly seemed too far away, now will be easy to reach. Likewise the world's plague spots and trouble centers, once remote and easy to ignore, now will be "just across the street" by air. Perhaps, as a result, their problems will be sooner solved.

In big new postwar airplanes, you'll be able to go to Europe on an ordinary two weeks' vacation by flying to London or Paris in nine hours, overnight. You can fly both

ways or fly only one way, if you wish, and travel by steamer the other, to get the relaxation of an ocean voyage.

Some of the transoceanic planes may carry 75 to 100 passengers in luxury, or up to 200 passengers with less elaborate accommodations. Some planes will have small "club car" lounges and may have even a few state-rooms. Schedules already worked out call for flying to Moscow or Rio de Janeiro in 19 hours, to Sydney, Australia, in 42, to Singapore in 45.

Fares will be comparable to first-class rates on steamers. Pilots of the Air Transport Command and Naval Air Transport Service have made so many thousands of flights across the seas during the war that ocean flying is "old stuff" now.*

World Now Has 15,000 Airports

One direct benefit from the war is that there are now estimated to be 15,000 airports in the world, a very great increase since before the war. Many have been greatly enlarged and improved. Some are in remote places, off the beaten track, but around many of them new settlements and trading centers of the age of flight may grow up.

Here at home the big new Boeing C-97, transport version of the B-29 bomber, already has flown across the United States nonstop in six hours and four minutes. You can best appreciate this speed from a passenger's description:

"One hour out of Seattle we were over Lake Coeur d'Alene, Idaho. Two hours out, we were south of Great Falls, Montana; three hours out, the Missouri River was crossed at Moberg, South Dakota. We caught the lights of Chicago through a high, thin overcast when we were about four and a half hours out of Seattle. In another half hour we were streaking south of Toledo, Ohio. When the clocks showed we had been exactly six hours in flight, we were just 30 miles out of Washington, D. C."

But even this speed is slow compared with those in prospect when the new jet-propelled aircraft are further developed (pages 386, 390).

Jet-propelled fighter planes in existence today can outstrip any plane powered by propellers and gasoline engines. They can do this because propeller-driven aircraft cease to be efficient when their propeller tips reach the speed of sound (about 1,200 feet per second). Jet planes do not have this handicap.

* See "American Wings Soar Around the World," by Donald H. Agnew and William A. Kinney, NATIONAL GEOGRAPHIC MAGAZINE, July, 1943.



Hughes Aircraft Co.

High as a Three-Story Building, the Hughes Flying Boat Hull Will Hold a 60-ton Tank

Seen from the halfway point looking aft, its size is indicated by the men's figures. The hull has almost the same dimensions as the Holland Tunnel, which carries New York City vehicular traffic under the Hudson River. The craft was designed to carry large loads of essential war materials across the Atlantic when submarines menaced shipping (page 391).

A jet plane has no propeller. It is driven by its reaction to a jet of hot gases which shoots out through an exhaust pipe in the rear. It works on the same principle that makes a rifle butt kick against your shoulder when you fire. Hot gases coming out of the gun barrel force the gun back in the opposite direction.

In the jet plane the outward flow of hot gases is continuous, so that the plane moves steadily through the air. Air is scooped in by the jet airplane as it flies, is compressed, heated by burning with fuel oil, and the resulting hot gases shoot out in the rear. Before the hot gas is ejected, it also turns a turbine which operates the air compressor.

Jet motors may eventually be built for use on commercial airplanes. At first they probably will be used only on high-speed planes making few stops.

Radar "lighthouses" on mountain tops, to warn postwar airplanes away from danger, are

predicted by aviation engineers. They may also be used to warn ships away from dangerous coasts. Guided by radio beams and other radio aids to navigation, airliners are expected to arrive and leave as regularly as railroad trains, despite thick fog or snow.

Airplanes will be able to fly in almost any kind of weather because icing will be less of a problem, thanks to new ways of heating wings, tail surfaces, and propeller blades, which already are in use on military aircraft.

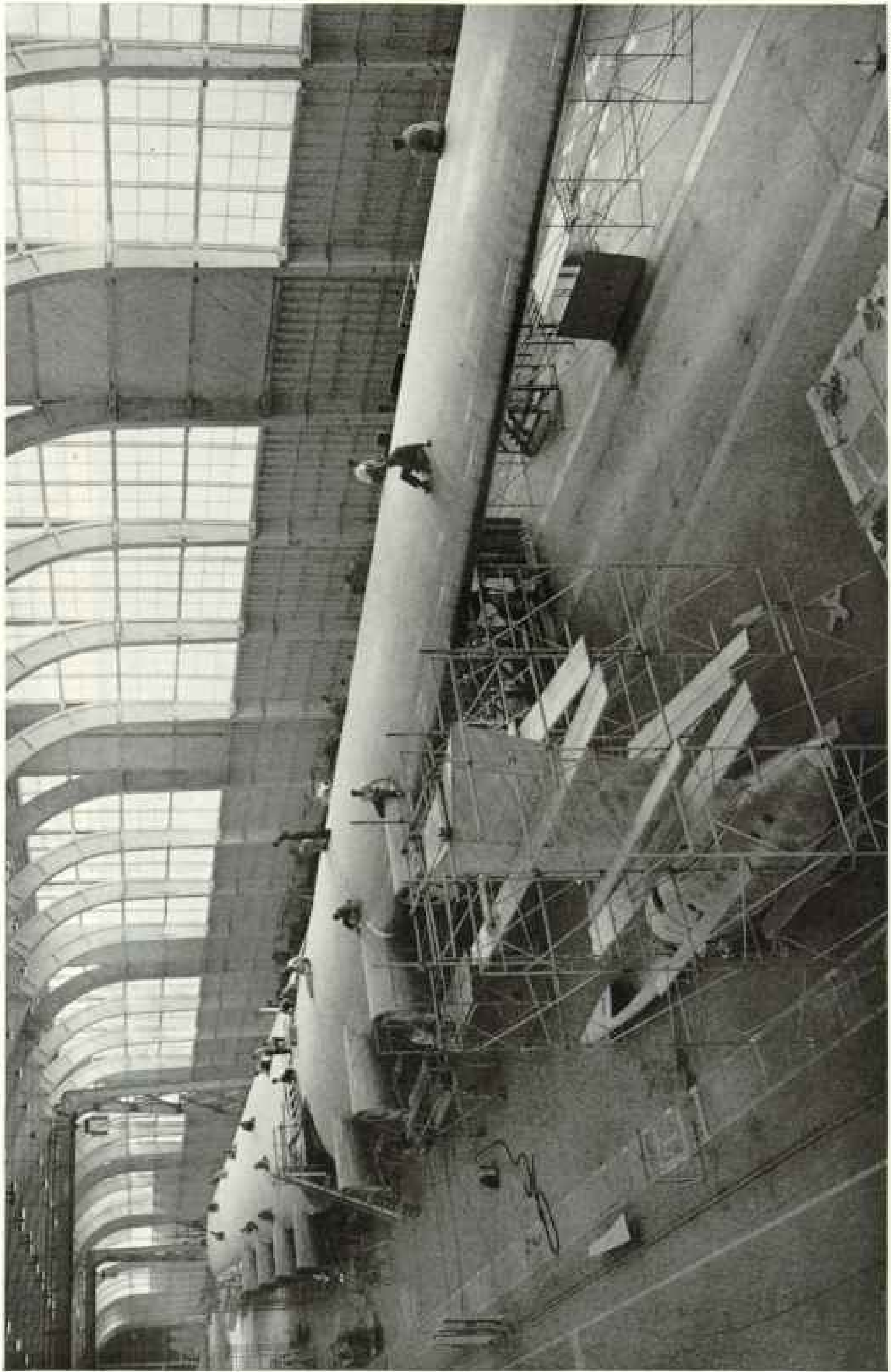
Airplanes operating over long distances will fly at high altitudes where they will be above much of the bad weather and can take advantage of favorable winds. Some will operate at 30,000 feet or more, but inside their "pressurized" cabins the passengers will breathe air compressed to the equivalent of an altitude of 8,000 feet or less, so that they will suffer no lack of oxygen or discomfort from fast climbs or descents.



U. S. Navy, Official

Rocket Power Drives a Navy Flying Boat Skyward with a Shorter Run at a Sharper Angle

"JATO" (jet-assisted take-off) units attached to the fuselage help trails of smoke. They are really small rockets and assist the plane's regular engines during take-off. Length of the take-off run is reduced by 53 to 60 percent, a big advantage on decks of aircraft carriers and fields with short runways (pages 386, 388).



Hughes Aircraft Co.

Wingspread of the 8-engined, All-wood Hughes Flying Boat Is Longer Than a Football Field

The wings are 13 feet thick where they join the hull. The aircraft is built almost entirely of laminated wood, mostly birch, because metal was scarce when it was planned. It has millions of glued joints. Each of its engines has 3,000 horsepower, and the fuel tanks hold 14,000 gallons of gasoline (page 389).



Columbia Broadcasting System

Broadcast by Television, a Play Is Picked Up by Two Cameras While Director (Left) Supervises Action

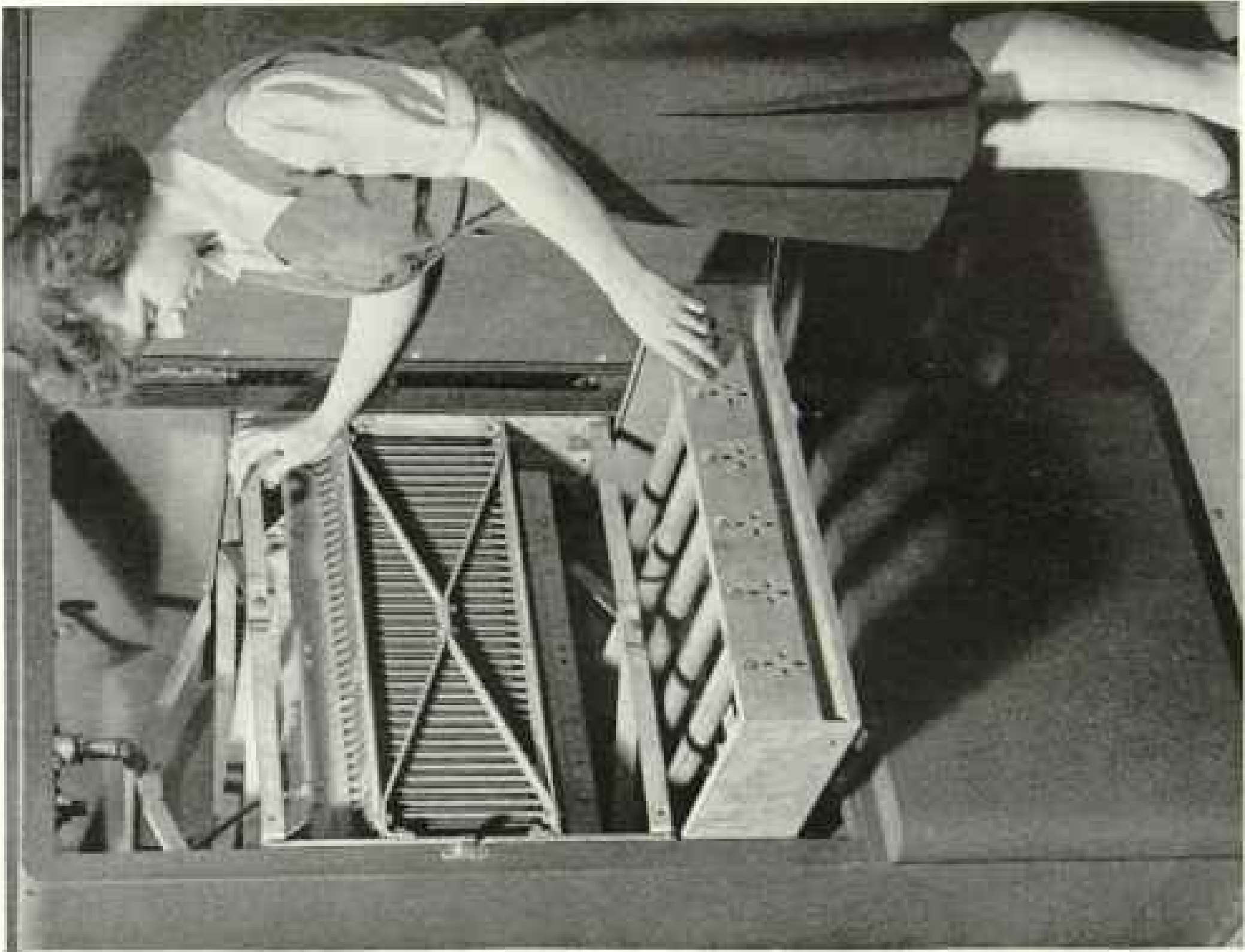
On the three screens are the moving pictures picked up by the two cameras on the stage. "On the air" is the action shown on the center screen. Meanwhile the images on the end screens are being "tuned," ready to be telecast as the action changes (pages 387, 404).



Illustration by William H. Carter.

"Hot Off the Air"—a Newspaper Comes to Your Home by Radio

A tabloid with news, ads, and pictures is "printed" in the facsimile receiver attached to a home radio. A page is converted into signals sent by radio or wire, then reproduced on sensitized paper fed out of the receiver. Thus people in the country may get their morning paper as early as city dwellers.



Westinghouse Electric Corporation

An Electronic Housemaid Guards Your Home from Dirt

If windows are kept closed, and air fed into the house through a central ventilating or heating system, this Precipitron diminishes sweeping. As air rushes through the "drawer" open at the bottom, dust particles are electrified by tungsten wires, then filched out of the air stream by charged metal plates.



Kurt Kretschmer

A Television Camera at a Penn-Navy Football Game Brings a Line Plunge Right into Your Living Room

A play-by-play description accompanies the pictures telecast to fireside fans from high up in the stands at Franklin Field, Philadelphia. Games have been televised from here for five years. Sports events are likely postwar subjects for television (pages 388, 404).

A new, safer aviation gasoline now exists, which will reduce the danger of fire in both private and commercial airplanes. You can drop a lighted match into this gasoline and it puts out the flame! The new gas, developed by Standard Oil Company (N. J.), is safer because it does not vaporize until heated to a temperature of 100° Fahrenheit. Except in very hot climates, this temperature is seldom reached on the ground and never in the air; so there is less danger of gasoline vapor being ignited accidentally, either while a plane is refueling or in flight. Vaporized in the engine, the fuel burns as efficiently as regular 100-octane gasoline.

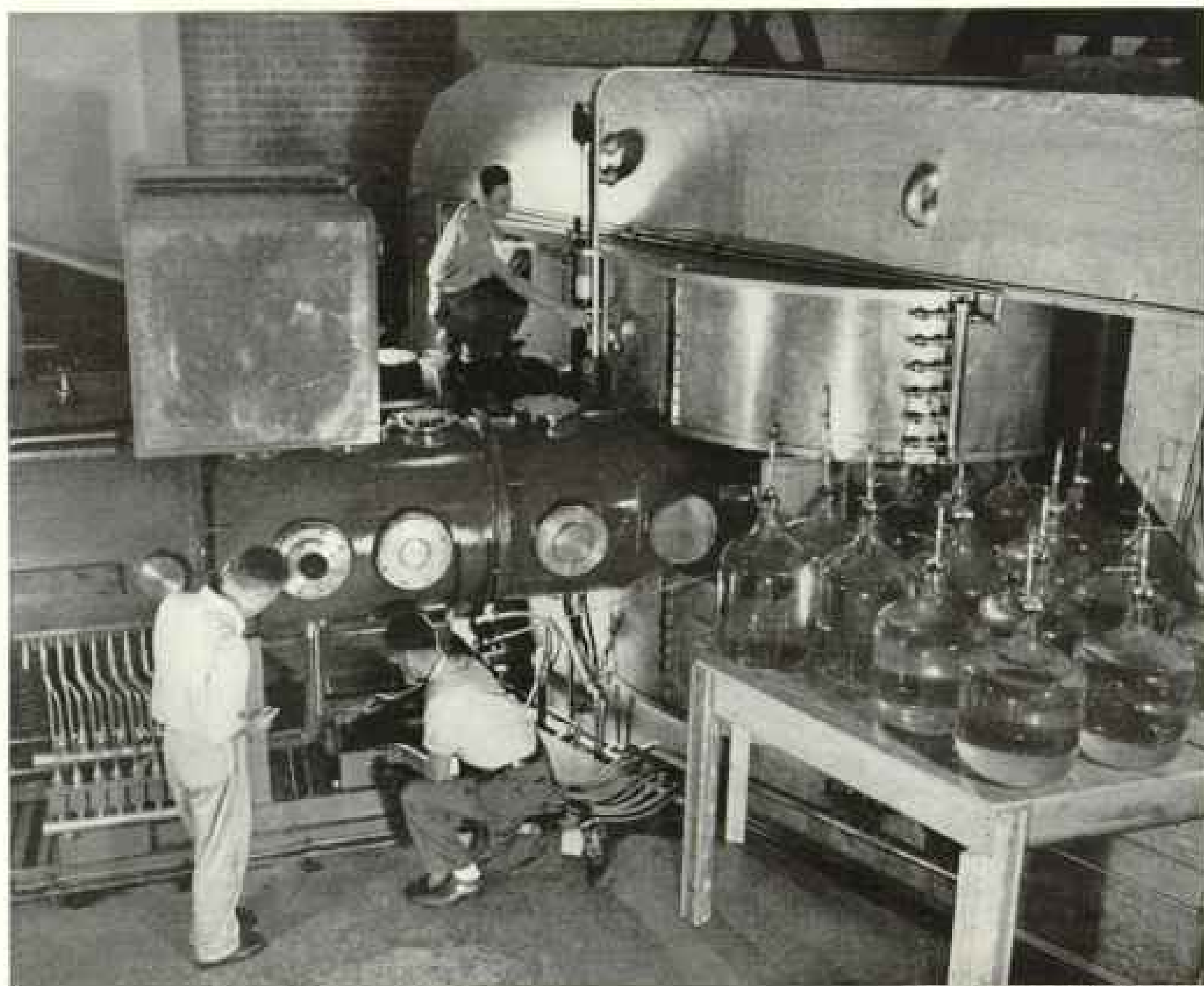
Air Routes of Tomorrow

Postwar air routes from the United States to all parts of the earth already are charted. At first they will follow mostly old trade routes between nations and big cities, because that's

where business is. But our shrinking world will alter some old travel practices. Airliners on nonstop flights overseas will start direct from inland cities such as Chicago and Detroit as well as from such seaboard points as New York or San Francisco.

"It is likely that air transport will make great changes in world trade and travel routes," says William A. M. Burden, Assistant Secretary of Commerce for Air. "For example, the old overland caravan route for trade from Turkey across Asia to China and India was abandoned when invention of the mariner's compass made it possible to sail cargo ships around the Cape of Good Hope. But, paradoxically, with the development of the airplane, that old Asiatic overland route is again coming to the fore.

"Just as ocean shipping created new trade routes, so will the airplane create new passenger travel routes, such as the short great-



Staff Photographer Willard B. Carter

Giant Cyclotron, Atom-smashing Machine, Unlocks Secrets of the "Atomic Age"

Scientists of the Carnegie Institution of Washington, D. C., check their apparatus before turning on the tremendous power that breaks up atoms. Such machines, used in experiments prior to 1941, led to the development of the atomic bomb. A beam of atomic particles is built up to terrific velocity inside the drum-shaped chamber at right and through a chain of reactions is fired at other atoms in liquids in the glass jars.

circle course to Asia over Alaska and Siberia. Some cities hitherto unimportant in foreign trade will become well known to the international traveler."

A postwar British airline, which is already planned, will circle the Northern Hemisphere, serving Oslo, Stockholm, Leningrad, Moscow, Omsk, Peiping, Vladivostok, Fairbanks (Alaska), Vancouver, and Chicago.

"Many of the postwar flights to Europe will probably be in sleeper planes, because the trip will only be overnight and flying over the ocean by day may become monotonous," one airline official told me.

"Think what the new airplane speeds will mean to business. Salesmen will be able to travel all over the world now, quickly and easily, without loss of time between calls. A customer in Stalingrad, Buenos Aires, or Chungking is much more likely to buy an American icebox, lathe, or locomotive if he

knows that in case of trouble new parts or even a repairman can be flown in from Detroit or Pittsburgh in a couple of days.

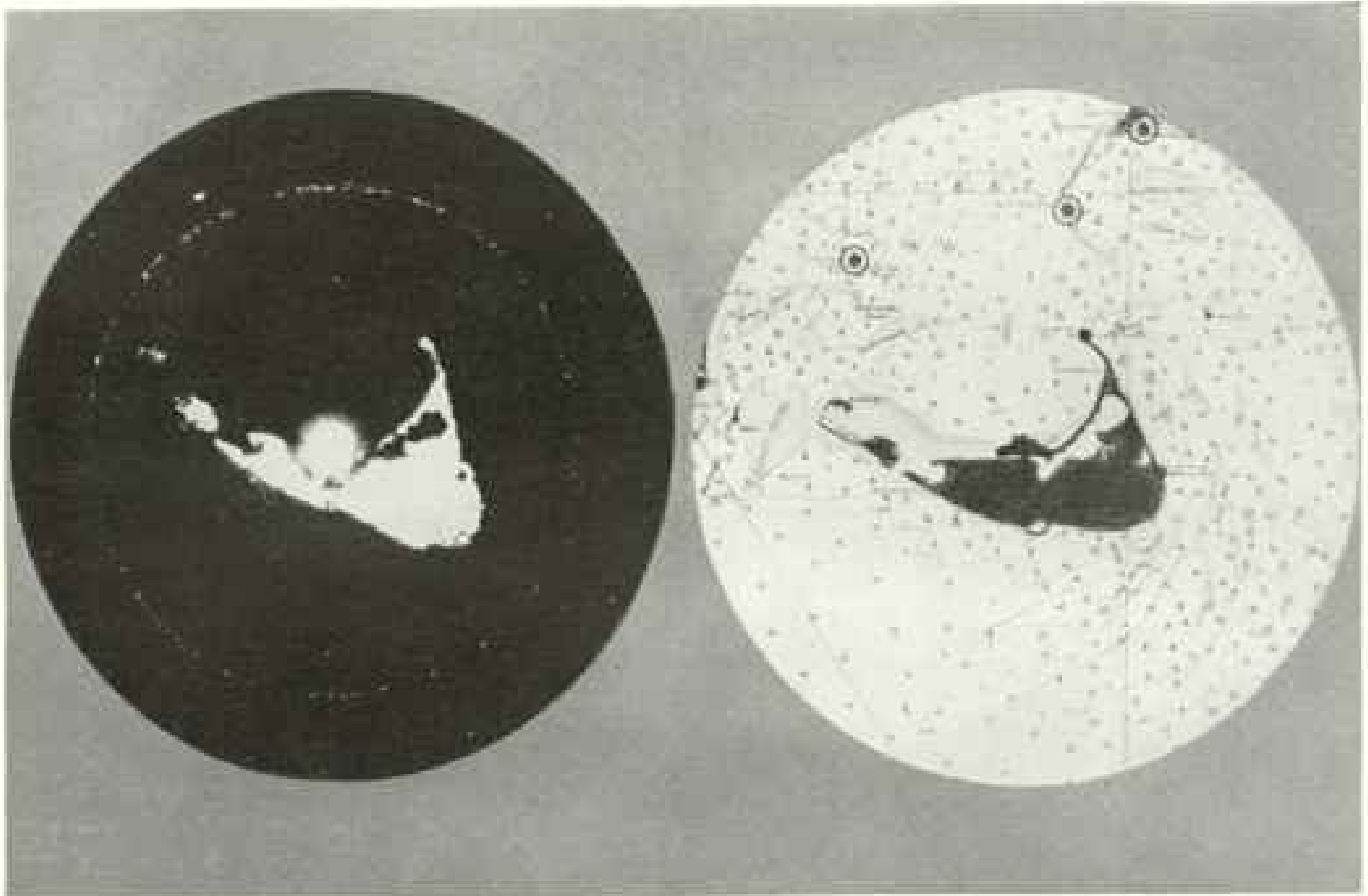
"It may mean, too, that more American salesmen will be boning up on Russian, Chinese, Spanish, Hindustani, or other languages."

One airline official said to me: "Our line doesn't plan to operate overseas after the war, but of course we'll fly regular schedules to Hawaii and Alaska, because they're part of the United States."

It did not seem at all strange to him that the crossing of 2,400 miles of water to Hawaii is now just a "domestic" hop, not "overseas" any more! Nothing illustrates better how aviation is shrinking distance and changing our thinking about geography.*

Plans are being considered for more than

* See "Aviation in Commerce and Defense," by F. BARLOWE COLTON, NATIONAL GEOGRAPHIC MAGAZINE, December, 1940.



U. S. Army Air Force, Official

Nantucket Island, Seen on Radar "Scope," Shows Airplane Pilot What's Below Him

The radar image, left, is identified by a chart of the island at right. High-frequency radio impulses, sent down from the plane, are reflected back up and reveal the island's outline, even though the ground is obscured by clouds or darkness. Thus pilots can find surface landmarks at any time.

twice the present number of airports in the United States, making about 6,300. Many existing airports must be enlarged to accommodate the huge airplanes of the future.

Commercial transport planes as large as the B-29 bomber, perhaps larger, will carry passengers on the longer hops. To accommodate such aircraft many airport runways must be lengthened and their pavements strengthened.

Blanketing the entire United States will be a uniform system of 100,000 aerial route numbers and markers, already designed, comparable to the system now in use for marking highways.

The signs will be worked out in large letters and numbers 10 to 20 feet high. They will be painted on roofs and on the surfaces of highways, marked on mountain sides with crushed rock, laid out on lawns and road intersections with small shrubs, delineated in deserts with enamel-coated metal strips elevated on posts.

The markers will show the name of the town, its latitude and longitude, direction of true north, and distance to nearest landing field. Of course they will be useful only in fair weather.

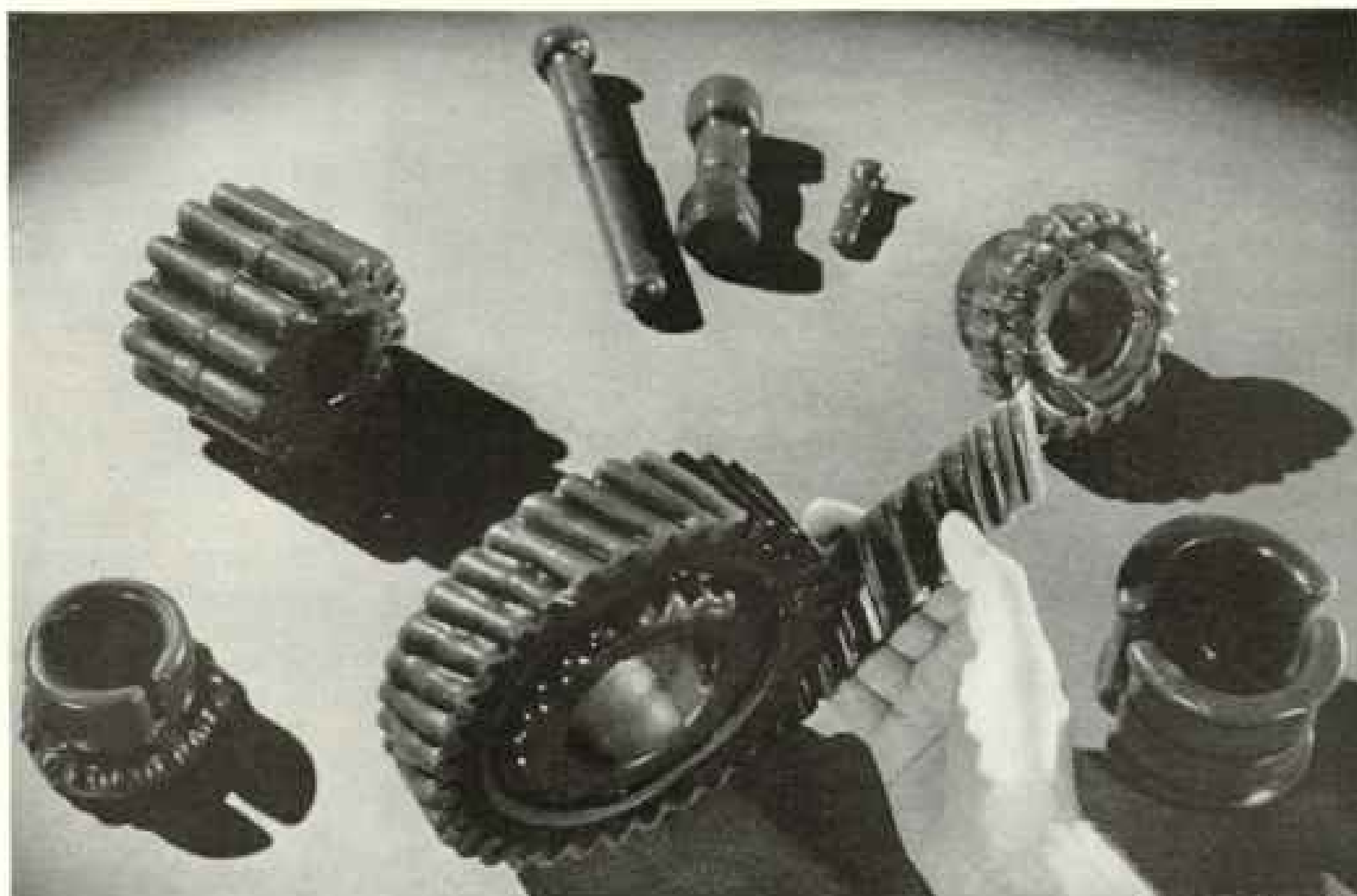
So heavy is airline traffic expected to become

that it is predicted that airport control towers will have radar devices showing on screens the relative positions of all airplanes within a radius of 25 miles. Control points on the ground and planes in the air will be equipped with radio-operated devices and distance indicators showing how high planes are and how far they are from other planes.

Regular commercial cargo airplanes already are running in this country. They carry mostly mail and express, but other commodities are shipped by air when value or urgent need justifies the relatively higher rates. Such items include clothing, newspapers, spare machine parts, medicines, movie film, valuable papers, flowers, gold, and jewels (389, 391).

New uses for airplanes, many born of the war, are developing. The Civil Aeronautics Board has applications on file now from people, many of them ex-service men, who want to operate flying moving vans, flying refrigerator cars, air taxis, air ambulances, airplane sight-seeing services, and delivery trucks.

All first-class mail that can be expedited thereby will be carried by air before long, aviation people predict. Letters posted in any large city, addressed to any point in the United



Dow Chemical Company

Plastic-coated Gears, Nuts, and Bolts Stay Rust-free Until Ready for Use

Metal parts of guns, trucks, machinery, and other equipment shipped to the moist, humid climate of the South Pacific are protected by such coverings. Parts are dipped in molten plastic composition or sprayed. The tough, tight coating keeps out moisture and dirt.

States, may be delivered the next day by air mail. Air parcel post is forecast.

New Comforts for Train Travel

People in a hurry will travel more and more by air, but railroads, buses, and private autos will continue to carry most of the travelers in the United States, and they too will be different and better (pages 404, 405).

I rode to Chicago the other night in a new-type sleeping car, the "duplex-roomette," which railroad men say will entirely replace the old-type sleeper with upper and lower berths. Instead of the usual berths, it has 24 tiny but comfortable individual private rooms, complete with seat, bed, toilet, wash-bowl, and sliding door that locks.

The bed is made up before the train leaves and slides away in a recess until you want it. Then you pull it out and climb in whenever you please—no waiting for the porter to make up your bed, no climbing a ladder to the upper berth, no cramped undressing in bed.

Private rooms always have been available on trains, of course, but were comparatively expensive. The duplex-roomette will sell for little if any more than the present price of a lower berth.

In day coaches, too, comforts and conveniences will be equally improved, as fast as new cars are built. There are plans for adjustable reclining seats, leg rests that pull out of the seat ahead, radios built into the seat cushions so you can listen without disturbing your neighbor.

Some railroads are considering a public-address system on trains through which sights of interest along the route could be pointed out and described, menus in the diner announced, with prices, weather at the next stop reported. All new cars will be air-conditioned.

Another innovation will be a popular-priced three-tier sleeper, having compartments with long seats crossways of the car, each one seating three people, and the aisle along one side. At night three berths, lower, middle, and upper, will be made up above the seats. They will resemble present Pullman berths, but will sell for a much lower price. These newer-type coaches already operate on some trains.

You'll probably see more streamlined trains, built largely of aluminum alloys or stainless steel. One western railroad already is re-laying track, straightening curves, and easing grades so that passenger trains can run up to 125 miles per hour in safety. Some freight



U. S. Army Signal Corps

Before Lighting, Soak in Water 6 Hours!

Just before striking, this match was removed from the glass of water. Its head and most of the stick have a waterproof coating. Such matches were devised for soldiers who swim rivers or stay out in soaking rains. They will be ideal for campers, hunters, and for other outdoor uses.

trains will run as fast as passenger trains do now, giving "overnight" delivery of goods.

If you've traveled much by bus, you'll be glad to know that postwar long-distance buses are being planned with toilets built in, more comfortable seats, and air conditioning. Driver and dispatcher will talk to each other by radiotelephone, so that help can be summoned quickly in case of a breakdown or accident, and buses rerouted promptly to avoid traffic jams or blocked highways.

Your Postwar Automobile

You may even eventually see helicopter or airplane buses flying passengers on local short

trips, if the Government grants applications already on file.

Your postwar auto will be much like the prewar models at first, but improvements are on the way, stimulated by lessons learned in war.

One reason why British fighter planes won the Battle of Britain in 1940 was that their engines burned 100-octane gasoline, better than the fuel the Germans had. Out of that may come better auto fuels.

Tire inner tubes made of synthetic rubber will hold air three times as long as present-day tubes. What a boon to filling station men! Footballs and basketballs will hold air longer for the same reason.

The postwar jeep is already here (page 408). Tough, easily cleaned synthetic fabrics will make it practicable to use bright colors and fancy designs in auto upholstery, even in convertibles and station wagons. Strangely enough, they were first developed as part of

the lining in self-sealing gas tanks for fighter planes. Nonglare glass, better brakes and shock absorbers, developed during the war, are expected in future autos.

With so many men—and women—trained to fly during the war, many more private planes probably will come into use, and experts say they'll be safer, simpler, easier to fly. Eventually almost every small town is expected to have its own airport.

Aviation people forecast a demand for up to 400,000 private planes soon after the war ends. As yet, however, aviation authorities say, there's no cheap "family airplane" in sight.

How about helicopters? They've been used in the war for rescuing men from the sea and

evacuating wounded from places where airplanes could not land. So far, at least, they're more difficult to fly than a conventional airplane and more expensive. But they will be useful in rescue work, for dusting crops in small fields, for inspecting power and oil pipelines, in aerial photography, for finding lost cattle, and for fighting forest fires by dropping bombs containing fire-smothering chemicals (page 387).

All this adds up to more, faster, easier movement over the earth's surface, more mingling of peoples and understanding of what other folks are like. But, in a way, you'll hardly need to travel when all the amazing devices of electronics get into full swing.

"Electronic Age" Is Here

All the modern wonders of aviation, television, radio, and many other fields are made possible largely by the new, fast-developing science of electronics. Scientists say we are entering now upon the "electronic age."

You'll be hearing a lot about electronics. It is a potent force in remaking our world. Already it is opening up all kinds of new jobs, products, gadgets, industries. Your boy may want to become an electronics engineer, repairman, or salesman when he grows up or returns from war.

What is electronics? It is essentially the harnessing of the electron, just about the smallest particle of matter in the universe—so small that 30 thousand trillion trillion electrons weigh less than one ounce. Everything is composed of atoms, as a house is composed of bricks, and electrons are parts of atoms.

They are also particles of electricity. Once



Westinghouse Electric Corporation

Bend Down, Sister, Open Your Mouth, and the Electric Eye Will Turn on the Water

Leaning toward the drinking fountain, the girl cuts off a beam of light between two uprights. Thus she breaks an electric circuit flowing through an electronic tube in one upright and signals a tiny motor to turn on the water. "Electric eyes" do hundreds of jobs, such as turning on lights, opening doors, sorting cigars (page 400).

harnessed, they can be put to work and made to do all manner of things.

Electrons are harnessed in the electronic tube, which is essentially the same as the tubes in your radio set. With the electronic tube it is possible to detect electrical impulses too small and too weak to be seen, heard, or felt by any human means and to amplify them up to the point where they are strong enough to operate radio loud-speakers, television receivers, or complicated machines.

This is done by controlling the flow of electrons inside the tube. The electrons flow from a heated filament across to a metal plate. This



An Electron Microscope Explores New Worlds of Smallness

Dr. V. K. Zworykin and James Hillier, of RCA Laboratories, study disease viruses and other tiny objects too small to be seen with the most powerful microscopes of the usual type. The electron microscope uses magnetic fields instead of glass lenses, and streams of electrons instead of light. It has made visible a single molecule about one-quarter of a millionth of an inch in length (opposite, and page 406).

electron flow is a real electric current, although it passes through space instead of along a wire. The electron flow goes through a metal screen, or grid, which acts like a valve, or gate, stopping, starting, or varying the electron flow. A small change in the "opening" or "closing" of the grid makes a big change in the flow of electrons through it.

That is how amplifying is done. For example, tiny, weak radio impulses, coming in over the air, flow through the grid of a radio tube. These weak impulses are multiplied 25 billion times before they are transformed into the current operating the loud-speaker.

Wonders of the Electric Eye

You can put an electronic tube in an electric circuit and control the flow of current more speedily and accurately than by any other means.

The grid in the tube can start or stop the current with greater accuracy, smoothness, and more gradations than any mechanical device. It can measure time in thousandths of a second. It can control hundreds of thousands of watts of power passing through the circuit with only a tiny fraction of a watt of power applied to the grid or valve.

Electrons also are harnessed in the photocell, or electric eye (page 399). In it electrons are made to boil out of a metal by shining a light on it. The metal is potassium, very sensitive to light. When more light strikes the metal, more electrons flow out; when less light falls on it, fewer electrons flow. Since this flow of electrons is also an electric current, you can vary the current by varying the light.

Photocells do all kinds of work. For example, a door can be made to open when you walk through a beam of light falling on a photocell. This breaks the beam, the electron flow in the photocell stops for a moment,

RCA

the current is interrupted, and the door opens. You've seen this perhaps in Pennsylvania Station in New York, in hotels, and other places. In factories it opens doors for trucks or for people with both hands full.

By the same principle lights are turned on automatically in schools and factories when daylight drops below a certain minimum. Heat in open-hearth steel furnaces is regulated by electric eyes that stare into them and react to changes in the color of the flames.

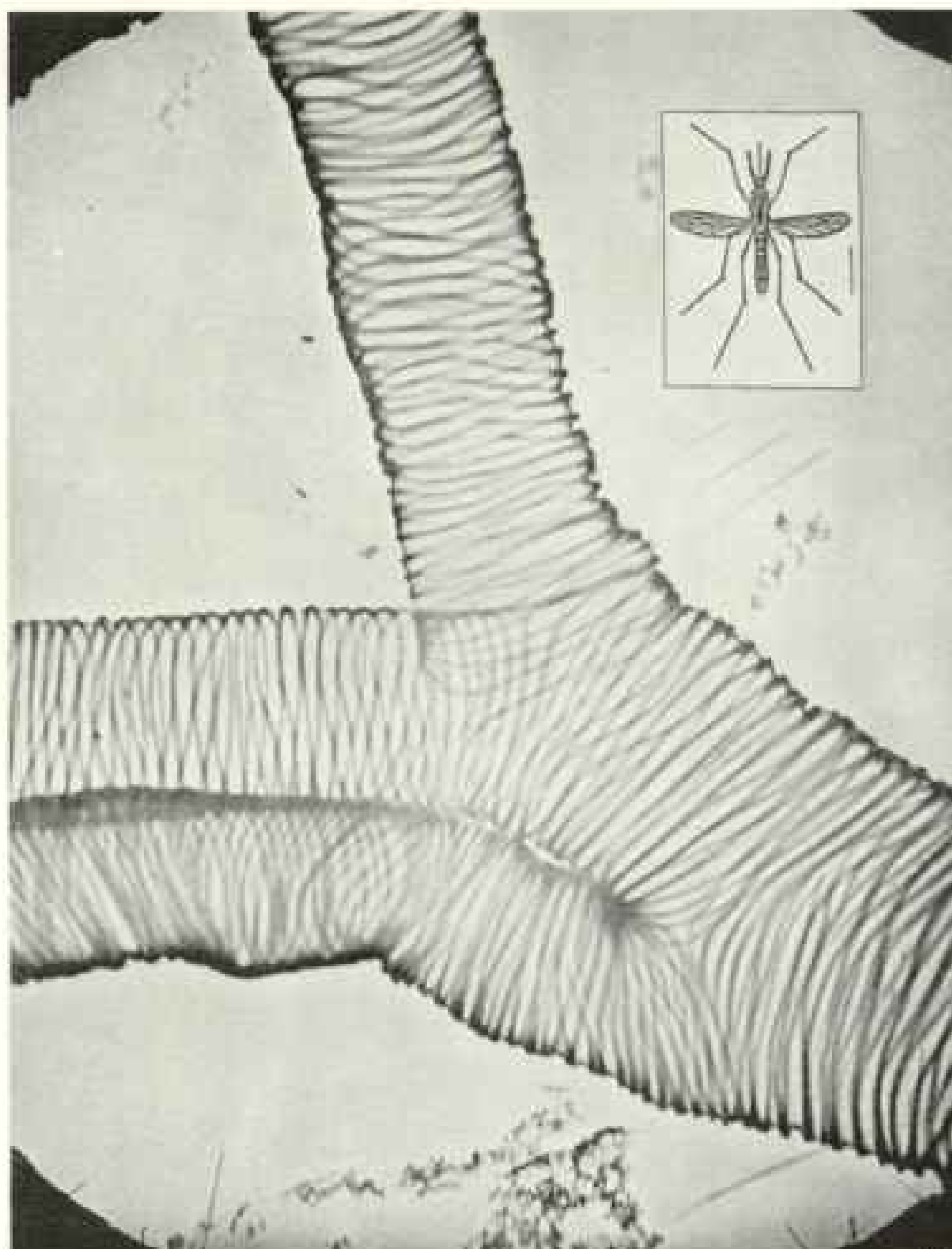
Electric eyes count autos passing on a highway or sticks of gum in a factory, fill ginger-ale bottles to the proper height, and make elevators stop level with the floor.

With the electronic tube and electric eye, electrons can be made to see, hear, feel, and count, to inspect, measure, record, and memorize. They can distinguish and match two million shades of color (the human eye can detect only about 10,000). They can perform tasks that are too fast for the human eye or hand to do. They control the speed of giant motors in factories and measure tiny electric currents generated in the human brain.

Electronic tubes help stack pillowcases neatly in laundries, give warning when a city's water supply becomes too turbid or when smoke from a furnace is too thick; they operate drinking fountains, detect pinholes in tinplate, sort discolored beans from white ones, control the perforation of sheets of postage stamps, and even catch burglars.

Generating "Invisible Fire"

Electronic tubes also can create an amazing new "invisible fire," a new way of generating



RCA

Not a Fire Hose but a Mosquito Larva's Windpipe Magnified by an Electron Microscope

The enlargement is 7,500 times, compared with the minute anatomy of the adult mosquito figure at upper right. Smallest structural details shown are less than one-half millionth of an inch in size. Spiral hoops prevent collapse of the almost-transparent breathing tube.

heat inside an object. High-frequency radio waves do this almost-miraculous job. Instead of heating from the outside in, as is done with steam, stoves, ovens, flames, etc., heat is *created inside* wood and plastic, and even within the human body to treat deep-seated disease (page 407).

Electronic heat works more quickly than most other forms of heat and can be controlled with great accuracy. You can use it where other forms of heat cannot be used, where you don't want a flame to touch, for electronic heat has no flame.

Industries are beginning to use this new heat to mold plastics, to caseharden metal



Westinghouse Electric Corporation

Soon a Home Freezer Will Keep Your Meat in Cold Storage

In this experimental model, resembling a conventional electric refrigerator, a steak is being transferred from the freezing section to the storage compartment. With home freezers housewives can keep perishable foods on hand for long periods, shop less frequently, and even cook meals far ahead of serving time.

parts (hardening the outside but leaving the inside soft for greater toughness), and to dehydrate foods.

Electronic heat helps dry penicillin in 30 minutes, whereas old methods took 24 hours, greatly speeding up production of this drug.

Airplane propellers, laminated or built up from thin layers of plywood and resin, can be securely bonded in a few minutes with electronic heat, compared with hours needed when ovens were used.

With electronic heat, too, it is predicted that rubber may be cemented to wood or plastic, cloth stitched, food and drug packages sealed, seams on rain garments and shower curtains made tight, and foods sterilized after they are

sealed in glass or plastic containers which are nonconducting.

Geography of an Electronic Tube

There's a lot of geography in electronic tubes. Into them go potassium from Spain, beryllium from Brazil, strontium from Britain, cobalt from Canada, chromium from Cuba, tantalum from Africa, platinum from Russia, magnesium from Michigan—altogether 37 different elements from all over the earth. This is another illustration of how closely our modern world is knit together.

Most thrilling use of electronic tubes is in television. Even before the war ended, a "television highway" was being built across the United States.

This highway is a new coaxial cable, being laid underground by the American Telephone & Telegraph Company. Along it television pictures will flash from coast to coast, enabling you to see across the continent without leaving home.

Another kind of television highway, a series of radio relay stations that pass television pictures through the air from one station to the next with the speed of light, already exists between New York, Philadelphia, and Schenectady, New York. Such relay systems will be extended soon to other cities.

Television pictures, like sound radio, can travel either by wire or through the air. But when sent through the air they stay "down to earth" only as far as the horizon, then fly off into space. So, if they're to be sent more than about 30 to 40 miles, the signals must be picked up at the horizon by a relay station, retransmitted to the next horizon, again relayed; and so on.

Hold a ruler flat on a globe, and you'll see why this is so. The ruler represents the straight path of television waves. Instead of following around the curve of the globe, they go straight off into space.

Newest proposal for broadcasting radio and television programs may do away with the need for relaying the signals every 40 miles or so, however. This plan calls for several large airplanes circling at altitudes of 30,000 feet above various parts of the United States. The planes would receive television and FM radio signals beamed upward from ground points and re-broadcast them back downward. From such a high altitude, the broadcast from each airplane would reach a circular area 420 miles in diameter, and it is estimated that about 14 such aerial stations could cover 51 percent of the geographical area of the United States and 78 percent of the population.

Television starts with a camera, which picks up the image of what is being sent. Inside the camera is an electronic tube that changes the picture viewed by the camera from light into electricity. A beam of electrons "scans" the picture, in much the same way as you read this page, following one line all the way across, then the next; and so on.

Meanwhile an electric impulse is going out continuously from the camera. When the electron beam hits a black area in the picture, this impulse is weak; when it hits a gray space, the signal is stronger; when a white spot is scanned, it's stronger still. The impulse thus varies in strength with the highlights and shadows of the picture.

On the receiving end, another electron beam



Westinghouse Electric Corporation

Did the Laundry Scorch Your Shirts? Just Put Them under a Sun Lamp!

Original whiteness is restored by dampening them and placing them under an ultraviolet-ray lamp that forces moisture back into the parched fibers of the cloth. The lamp is similar to that used for indoor sun tan. It was developed primarily for commercial use and needs a skilled operator.

picks up the impulses and transforms them back into light, on a fluorescent receiving screen. On this screen the electron beam paints a black spot where the incoming signal is weak, a gray spot where it is stronger, a white spot where it is stronger still. In this way a picture is built up, bit by bit, reproducing the picture picked up by the camera on the sending end.

The secret of television is that all this happens literally at split-second speed. The whole picture is recorded in the camera, sent out, and reproduced on the receiving screen 30 times every second. It happens so fast you don't see the process at work. A complete picture,



Burlington Lines

A Glass "Dome" on a Railroad Car Gives an All-round View

Passengers can look skyward, too, from the 24-seat "penthouse" installed experimentally in a Burlington Lines day coach running between Chicago and other western cities. Two layers of glass with air between keep out the sun's heat and glare (page 397).

in motion, is always before you. Eventually it may be done in three dimensions—pictures with depth.

Television will change our lives in numerous ways, many not now imagined. People may rearrange their living rooms so that everyone can sit and watch the television screen. You'll see as well as hear candidates for office when they speak, and the effect on politics may be tremendous. Millions of school children may see and hear the best teachers via television.

Television "Commercials"

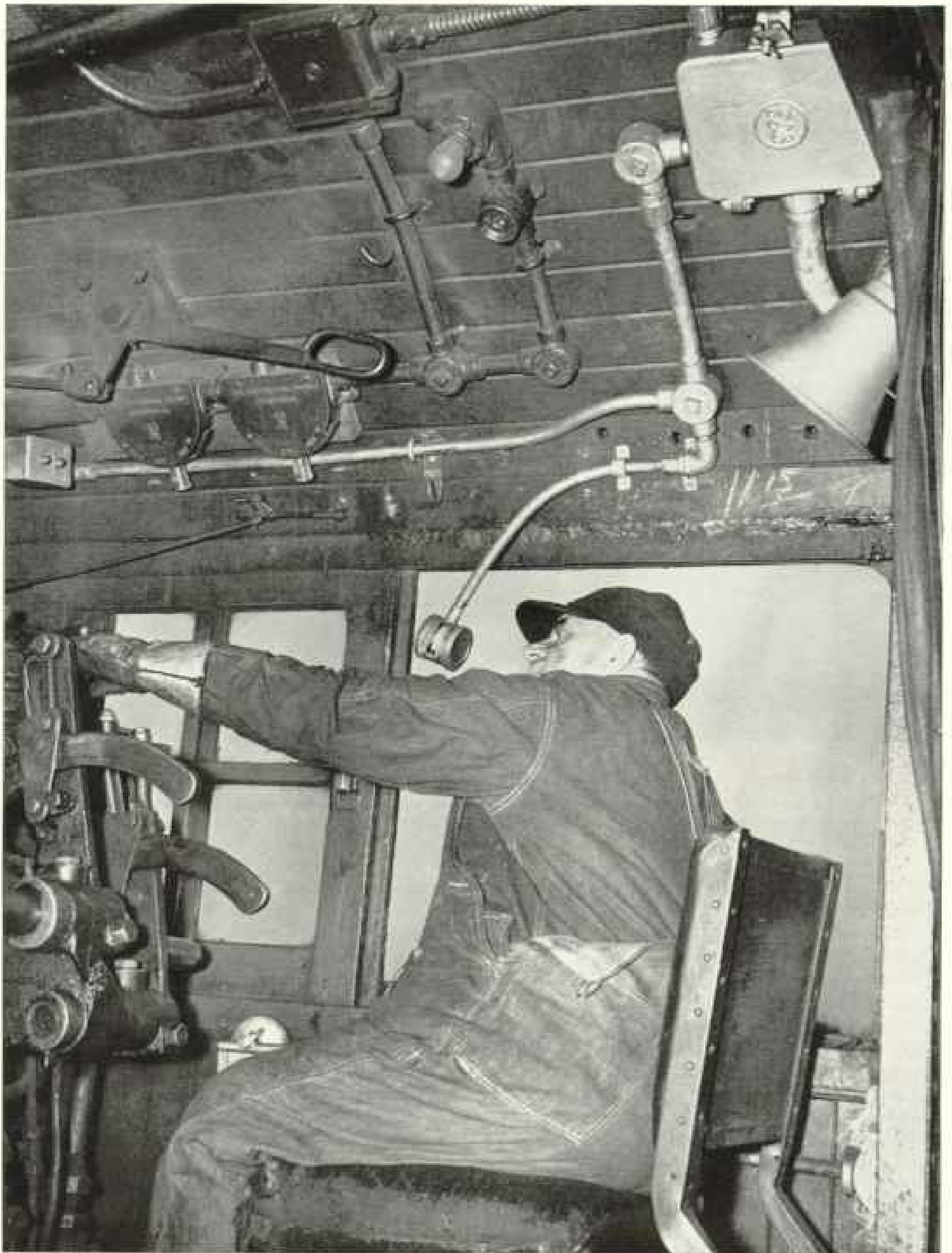
Regular programs will be broadcast by television stations, as radio programs are now, and special events will be put on the air (page 394). When a big fire breaks out during the evening, for example, portable television cameras will be rushed to the scene and you can watch the blaze from your armchair while it's happening. If the fire occurs after midnight, while you're asleep, movies of it will be

taken instead, and these pictures then will be televised for you to see while eating breakfast next morning.

"Commercials" on television will have more appeal, since they'll be mostly pictures. I saw some experimental ones. To advertise a new unbreakable glass, a man hit the glass convincingly with a hammer. A girl, advertising soap flakes, showed how her brand made more suds than "ordinary" flakes. Pretty models demonstrated how to apply leg paint.

Television will open up many new jobs, careers, and industries. Your boy or girl may want to go into television as an entertainer, director, or servicer. Already there are courses in television program production being offered at Yale, Columbia, New York Universities, and others.

A television studio uses a combination of stage, film, and radio technique (page 392). The stage is smaller than that of the average theater, to fit into the field of the camera.



New York Central Railroad

"Casey Jones" Gets His Orders Now by Radio Direct to His Locomotive Cab

Short-wave radio enables the engineman of a yard engine and the yardmaster to talk two ways while sorting freight cars in the New York Central classification yard at Selkirk, New York. The engineman talks into the "mike" before him and gets orders through the loud-speaker behind and above. Radio communication also is coming into use between the engine and caboose on long freights and between trains and control towers.



U. S. Army Quartermaster Corps, Official

Why Rustle Wood for Your Campfire When You Have This Gasoline Stove?

Two artillerymen heat rations near their gun position with the compact miniature heater, developed by the Army Quartermaster Corps. It burns two hours on half a pint of fuel and weighs only 17 ounces. Such stoves will be a boon to picnickers.

Two or three huge cameras, trailing snaky coils of cable, pick up the scene simultaneously from different angles, rolling forward for a close-up or back for a wider view. The director chooses which picture will be "on the air" at any one time.

Television pictures have crossed the Atlantic Ocean, but so far only under exceptional conditions. That was when signals from England, traveling out into space, struck an unusual condition in the upper air on a few occasions and were reflected back to earth to be picked up by receivers in the United States. Present ocean cables cannot carry television signals.

But television could be relayed by radio across the 55-mile width of Bering Strait; so sometime there may be a link between North America and Siberia and so on across Russia and Europe.

Then, perhaps, Americans could see the proceedings in the British Parliament and the

Russian Congress of Soviets, or watch the Moscow ballet and the British Derby. Our European friends could watch a Texas rodeo or see the American Congress during debate on some great international issue.

Long-distance Dial Phones

Thanks to electronics, telephoning also will have improvements. You'll be able, eventually, to dial long-distance calls direct. Lexington, Kentucky, already plans to install a system on which local and toll calls both may be dialed. Telephones will be extended to more farms, camps, and other remote places by use of radio.

Experiments are under way in telephoning with micro-waves, or very short radio waves, which may make it possible to talk direct to any person you wish without a wire connection and without interference.

Another wonder of the electronic age is the electron microscope, which makes it possible



Staff Photographer Willard H. Carter

In 11 Seconds This Electronic Heater Thaws Three Pounds of Frozen Cherries

Usual methods would take two to three hours and impair the fruit's freshness. Electronic tubes create heat with high-frequency radio waves which make the heat penetrate uniformly throughout, instead of from the outside in. Such heaters bake crustless bread and cook meats evenly. They sterilize food in packages, heat plastics for molding, and dry glue in furniture joints (page 401).

to see things far too small to be visible with the best ordinary microscope. Under its enormous magnification a dime would appear a mile in diameter, a human hair like a giant redwood tree, a blood corpuscle as big as a two-foot pillow (pages 400, 401).

With the electron microscope scientists have learned what the extremely small viruses of influenza and other diseases look like. They have seen the beneficial bacteriophage viruses which attack disease germs in the blood and have watched how they work. A scientist of the RCA Laboratories measured these viruses and found they were 500 *atoms* long!

Molecules have been photographed, though they are only about $\frac{3}{8}$ of a millionth of an inch in diameter.

First pictures of penicillin in action attacking dangerous disease germs were made with the electron microscope. The germs, staphylococci, dangerous invaders of war wounds and

the cause of boils and food poisoning, appeared like large grapes in the greatly magnified pictures. Under penicillin's attack, they shriveled into small wrinkled kernels.

Pictures also have been made of the malaria parasite in the salivary gland of a mosquito, at the stage when the next person bitten would get the parasite in his blood.*

Wonders of Electron Microscope

With the electron microscope it is possible to see particles 50 to 100 times too small to be seen in an ordinary microscope.

Objects can be magnified 5,000 to 10,000 times their actual size, and by photographic enlargement this can be increased to 100,000 times.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE for February, 1944, "Life Story of the Mosquito," by Graham Fairchild, and "Saboteur Mosquitoes," by Harry H. Stage.



Willis-Groeland Motors

War's "Car-of-all-work," the Jeep, Can Haul Plows and Trailers in Peacetime

A new model adapted for civilian use tows a trailer for a family picnic beside the road. The jeep also serves as a tractor to pull plows, harrows, mowing machines or hay rakes, and as a stationary power unit to operate machines for threshing, baling, or shelling and grinding corn.

Health and sanitation in the world of the future are expected to be better than ever before, thanks partly to progress made during the war.

The average life span in the United States could be increased by ten years if all presently available health and nutritional knowledge were adequately utilized, without a single new discovery, according to Surgeon General Thomas Parran of the U. S. Public Health Service.†

Better Health and Medicine

Penicillin, developed under war pressure, and the sulfa drugs help arrest infections. New vaccines are able to immunize against tetanus (lockjaw), influenza, scrub typhus, measles, and meningitis. There is hope, some doctors think, that we may eventually eliminate from the earth both typhus and bubonic plague, the latter the Black Death scourge of the Middle Ages.‡

The metal locator developed for finding pieces of shrapnel in wounded men will be useful in peacetime to find the safety pin that little Willie swallows. Blood plasma, and eventually blood substitutes, will reduce the toll of shock in accidents and injuries. Ex-

perience in rebuilding the faces and jaws of wounded soldiers will result in better-fitting false teeth and more skillful plastic surgery for civilians.

Sterilizing lamps, whose rays kill germs in the air, may be installed in hotel lobbies, railroad stations, auditoriums, and other places where people congregate, to reduce transmission of colds and other infections.

Air entering large buildings will be cleaned with the "Precipitron," developed by Westinghouse scientists, which charges particles of dust, smoke, and dirt in the air with electricity and then attracts them out of the air stream. Smoke, dust, fumes, and particles as small as 1/2,500,000 of an inch can be taken out of the air in this way. In night clubs, restaurants, and meeting halls the Precipitron keeps the air clear of tobacco smoke (page 393).

Dangerous and bothersome insects infesting dwellings and other buildings, especially in the Tropics, can be almost completely eradicated with the new insecticide, DDT (dichlorodiphenyl-trichloroethane), developed in the

† See "Revolution in Eating," by J. R. Hildebrand, NATIONAL GEOGRAPHIC MAGAZINE, March, 1942.

‡ See "Healing Arts in Global War," by Albert W. Atwood, NATIONAL GEOGRAPHIC MAGAZINE, November, 1943.



U. S. Army Signal Corps, Official

Army's Anti-insect Bomb "Liquidates" Mosquitoes

Here a soldier kills the pests in an Arab's North Africa home. The "skeeters" fall dead on a sheet spread over the beds. The bomb contains a mixture of pyrethrum, deadly to many insects, and Froom gas under pressure. Opening a valve releases a cloud of insecticide.

United States chiefly by the Department of Agriculture (page 410).

When sprayed on walls and ceilings, DDT kills flies and mosquitoes that alight there for three months or more afterward. Sprayed in cattle barns, it kills flies soon after they touch the treated surfaces and will help to keep down fly-borne diseases like typhoid fever and dysentery. It kills fleas on dogs and cats and is effective against lice, American roaches, bed-bugs, malaria-bearing mosquitoes, and many garden and crop pests.

But scientists are treading with caution in their use of DDT, because it kills many useful insects as well. If sprayed or dusted indiscriminately in woods and fields, it would kill bees and other insects which spread pollen, without which many crops, flowers, and trees could not reproduce and would therefore tend to die out.

Frozen Foods Only at This Store

I visited a store in Syracuse, New York, that sells only frozen foods. It had meat, poultry, vegetables, fruits, sea food, ice cream, dog and cat food, cooked dishes such as stews, hash, codfish cakes, and chow mein, and even frozen soups and orange juice in solid cakes. You

could buy a whole meal there in frozen form.

Many of the frozen food packages were on display in open-topped refrigerated cases, where customers could select their own. Food in the open cases stayed frozen because the cold air did not rise out of the cases as warm air would do.

More such stores are expected to spring up after the war, and many more grocery stores probably will carry frozen foods. There are about 100 varieties of frozen foods now. Producers claim freezing retains the fresh flavor and beneficial vitamins and minerals in foods.

Housewives of postwar days may be able to buy frozen dishes already cooked, to use at once or keep for emergencies when unexpected guests drop in. This is already being done on Navy planes flying the Atlantic. They carry precooked frozen foods packaged as individual meals and needing only to be heated for 10 or 15 minutes to thaw out and complete the cooking.

Meals from famous restaurants and exotic foods from foreign lands may be frozen and sold everywhere.

Busy women, it is predicted, may be able to cook the family's meals ahead for a week and keep them frozen until served.



Flying and Biting Bugs on Jones Beach Die in a Cloud of DDT, New Insecticide

A truck-mounted fog generator squirts the poison, mixed with oil droplets, over a four-mile area of the New York City playground. Spread by Army and Navy planes and by hand sprays, DDT routed dangerous disease-bearing flies and mosquitoes on Pacific islands. Dusted on almost the entire population of Naples, it killed lice and halted a typhus epidemic. DDT has a drawback—it kills many beneficial and harmless insects, but does not kill all insect pests. Birds and fish which eat large numbers of DDT-poisoned insects may be casualties, too (page 408).

Postwar refrigerators will have built-in freezing compartments where frozen foods can be stored (page 402). Farmers have frozen-food lockers in which to store beef, pork, poultry, vegetables, and fruits of their own raising. This may supersede home canning.

In self-service grocery stores of the future you may shop for meat as easily as you do now for breakfast foods or loaves of bread.

Instead of waiting for the butcher at the meat counter to cut and bone your meat, you may select your own meat, already cut, frozen, and packaged in convenient form, ready to take home.

A New Freezing Process

A new process has been developed for freezing meats, sea food, vegetables, and fruits to the low temperature of 150° below zero, Fahrenheit—colder than dry ice. Packed in a

special container, such frozen food then may be shipped in carload lots anywhere for 10 days without needing any other refrigeration and will arrive still frozen.

There isn't room here to begin to mention all the postwar improvements in prospect. There are promises of radios you can put in your pocket, stockings that won't run, pants with a permanent crease, and, for tomorrow's glamour girls, artificial eyelashes of nylon with a permanent "built-in" curl!

Some day, a scientist half-humorously suggested to me, if it starts to rain and you have no umbrella, you can step into a little booth, put a coin in a slot, turn a handle, and stand under a "shower" that sprays your clothes with a waterproof plastic. Then you can walk home dry through the rain and peel off the plastic at the end of the trip! That's not fantastic—the process is already here!

Okinawa, Threshold to Japan

BY LT. DAVID D. DUNCAN, USMC

VISIBILITY over the western Pacific was zero. Rain swished past the windows as we roared from Guam toward Okinawa. The pilot held the giant plane low, nearly clipping the crests of the waves.

Suddenly the wheels unlocked with a rumble, our plane banked, engines thundered, and in we went, splattering mud, scaring horses, and skidding to a stop. The Yontan Airfield on that blustery April morning gave truth to all the dire stories I had heard of Okinawa.

Now, months later, most of us are wondering where such dismal reports originated. We are inclined to believe that it was from the Jap himself. We feel that Okinawa is the most scenic island with the finest climate of any the United States has taken in the Pacific war.

Okinawa is not a big place: it is only 70 miles long and averages about 7 miles wide.* If placed on a map of Florida, it would cover little more than the stretch of sand between Palm Beach and Miami. It has approximately the same north latitude as those two resort cities. The East China Sea, which sprawls between us and Shanghai, vibrates with the same incredible blue as the Gulf Stream.

However, there is one tremendous geographic difference. Were we to fly about 400 miles north, instead of visiting Charleston, South Carolina, we would be in Nagasaki, Japan.

As a base for the knockout of Japan, Okinawa was of high value. Fighter planes and bombers from our many fields could strike in three directions. By-passed Formosa † lay paralyzed only two air hours to the southwest. Four hundred miles separated us from the Jap-occupied mainland of Asia. Up north loomed Kyushu, one of the heavily fortified and industrialized Japanese home islands.

Island Reminds Americans of Home

Okinawa reminds nearly every man of some spot close to his heart at home. Whether from Maine, California, Tennessee, or Virginia, he finds sections which look familiar to him. Eventually, my bet is that Okinawa will remain one of our mightiest Far East bases and become a vacationland.

Flying with Marine artillery control planes behind Jap lines, I had many opportunities to look over the southern end of the island where the Japs were making their final fanatical

stand. Except around flattened Naha and the front itself, ripped by mortar artillery, naval shelling and bombing, this densely populated section remained practically unmarred.

Farms were small, not more than an acre in area. We flew over a vast patchwork quilt of yellows, greens, and browns. Square patches in the pattern were the fields where rice, wheat, and vegetables grow; the background was the rich red soil of Okinawa, and the fringe the unbelievable blue of the East China Sea (Plates VII, XV).

Each tiny farm looked freshly raked and immaculate, yet not a soul was to be seen. It was the same over the farms of Jap-held Bougainville, New Ireland, and New Britain. Crops seemed to sprout, grow, and be harvested by magic. Just how the Japs concealed themselves from aerial observation while farming was one of the mysteries of the war.

North of Naha the picture changed completely. Americans were everywhere, except for the Katsuren Hanto (peninsula) and a few refugee centers for Okinawans. The northern part of the island teamed with Marines, Seabees, soldiers, and hundreds of thousands of tons of equipment.

Bulldozers, steam shovels, scrapers, and other equipment were lifting the face of Okinawa, scratching airfields across its surface. Seabees and Army engineers were blasting and bulldozing four-lane highways the length and breadth of the island (Plate II).

Not a day went by but there was some drastic alteration in the countryside. Frequently Marines returning from the front lines got lost in places where they had known every hut, lane, and tree.

My favorite spot on Okinawa is Hedo Zaki (cape), the northern tip of the island. Penny-sized fields of wheat creep right out onto the cliffs that knife up from the sea (Plates VI, IX, XIV). Scrub palms border each garden.

The heart of Hedo Zaki is a jagged, heavily timbered, cloud-capped pinnacle—formidable, but beautiful as a lonely pagan land.

Here is where I'd like to build a home after the war. Perched on the crest, its windows would open over the Pacific on one side and face the evening sun sinking into the East China Sea on the other. Of all the places I have seen, Hedo Zaki is the most romantic.

* See "Peacetime Rambles in the Ryukyus," by William L. Schwartz, and map of Okinawa, on page 545, NATIONAL GEOGRAPHIC MAGAZINE, May, 1945.

† See "I Lived on Formosa," by Joseph W. Ballantine, NATIONAL GEOGRAPHIC MAGAZINE, January, 1945.

The friendliness of the Okinawans surprised many. We found that they had no fanatical desire to die for Hirohito. In fact, when I asked one family why they didn't commit harakiri, they gaped for a moment, then laughed.

Naturally, some Okinawans fled into the south with the Emperor's defenders. There many were killed. But the vast majority are now wards of Uncle Sam.

The typical Okinawan is rather slight, short-legged, and wears grass sandals and a shabby old suit or tattered blue kimono. He smiles from beneath any kind of hat from a beaten-up derby to a hand-woven conical sun hat. Clean-shaven or bearded, his face is like leather—seamed and weathered (Plate V).

He is either fisherman or farmer. Clutching his few bundled treasures in one stubby hand, he will doff his hat and bow to each troop-laden vehicle as it roars past. His politeness never fades, whether he be drenched in mud or choking with dust.

He and his brothers, friends, and children are poor beyond any understanding of Americans. Seen from a truck, the Okinawan plodding along the road is a pathetic figure. But meet him on the fields or in his home, and he's a different fellow.

My first day out on Katsuren Hanto, a slender eastern peninsula set aside for civilian refugees, a Marine officer and I met a family of Okinawans bound for the paddy fields. Women in ankle-length pantaloons, men bent low beneath a pole with a pig slung in the middle, dirty-faced children gleefully prodding an old billy goat, all presented scenes I wanted to record in color (Plates IV and XI).

Spanish a Common Tongue

Flourishing matches and a chocolate bar, my friend stopped the caravan and we posed the family beside a clump of daisies (Plate I). As I was waiting for grandfather to turn his head, the smallest herder tore off after his goat.

"Venga aquí!" the Okinawan mother called after her boy.

I looked up, startled. Plainly she had shouted *in Spanish*, "Come here!"

"Do you speak the language, madam?" I asked in my best Spanish learned while roaming around Latin America for ten years.*

"Seguro, joven," came the answer. "Certainly I speak Spanish, young man!"

I have no idea who was more surprised, this Okinawa farm woman or I. But from then on it sounded like tortilla time in Tampico.

In the bedlam that followed, I learned their family history and how we happened to possess a language of common understanding.

As newlyweds, the mother and her pig-toting

husband emigrated to Peru. Like thousands of other Okinawans, they had been lured by rumors of fabulous wages. But they found that life as laborers was the same the world over. For 26 years they worked hard and learned the language, but forever they dreamed of the day when they might return to Okinawa.

Finally, eight years ago, they made it. The voyage was heartbreaking, for they sailed in the steerage of an ancient Jap freighter. It took most of their savings, but that didn't matter. They were going home.

When I asked if they liked life in Peru, they nodded.

"Why, then, did you come back?"

The husband replied: "Okinawa is the land of our birth. Our mothers and fathers lived here. Generations of our ancestors lie in the burial vaults. These terraced hills; the twisted pines and wind-swept crags; the paddies, the lilies, and red-tiled huts; the eternal blue of the East China Sea—all of these are Okinawa, our home."

During the following weeks, as I jeeped around the island on my photographic assignment, I met many such Spanish-speaking families. The story was always the same.

Of the thousands who sailed away, only a few returned. These brought back Latin mannerisms, many South American wives and husbands, and a younger generation which spoke Spanish as a mother tongue. Peru, Chile, and Argentina, as well as Hawaii and Brazil, were their temporary homes.

Japs put Okinawa sons in uniform and took them away. Few returned. The islands now seem populated mostly by youngsters, women, and very old men.

Most islanders lost everything they had owned. But being moved to refugee camps from their fields and family burial vaults was the greatest disaster of all.

In recent years Japanese censorship over world news was complete. Okinawans knew nothing beyond the boundaries of their fields. So absolute was Jap rule that they had no memory of self-government, and so expected no voice in the conduct of their affairs. Their allegiance was to the soil. So it remains today.

Judging from the smiles and waving I have seen on every hand, it appears to me that the arrival of our men was the most exciting event in the Okinawans' lives.

* See, by David D. Duncan in the NATIONAL GEOGRAPHIC MAGAZINE, 8 Kodachromes accompanying "Coffee Is King in El Salvador," November, 1944; "Fighting Giants of the Humboldt," March, 1941; "Capturing Giant Turtles in the Caribbean," August, 1943, and "Fiji Patrol on Bougainville," January, 1945.

Okinawa, Threshold to Japan



Candy Helps Yank Convert Youthful Foe to Friend

The Marine officer was dumfounded when the Okinawa lad said, "Gracias, Señor," in return for a chocolate bar. This Spanish-speaking family had lived for many years in Peru, where they learned the language.



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Kalamangas U. S. Marine Corps Official Art Lt. David D. Daman

An MP Shepherds Okinawans to Their Refugee Camp

Quilts for bedding, floor mats, wooden blocks for pillows, light furniture, clothing, and utensils are loaded on the cart. To Americans everything on Okinawa seems in miniature. Even the people are short and stocky.

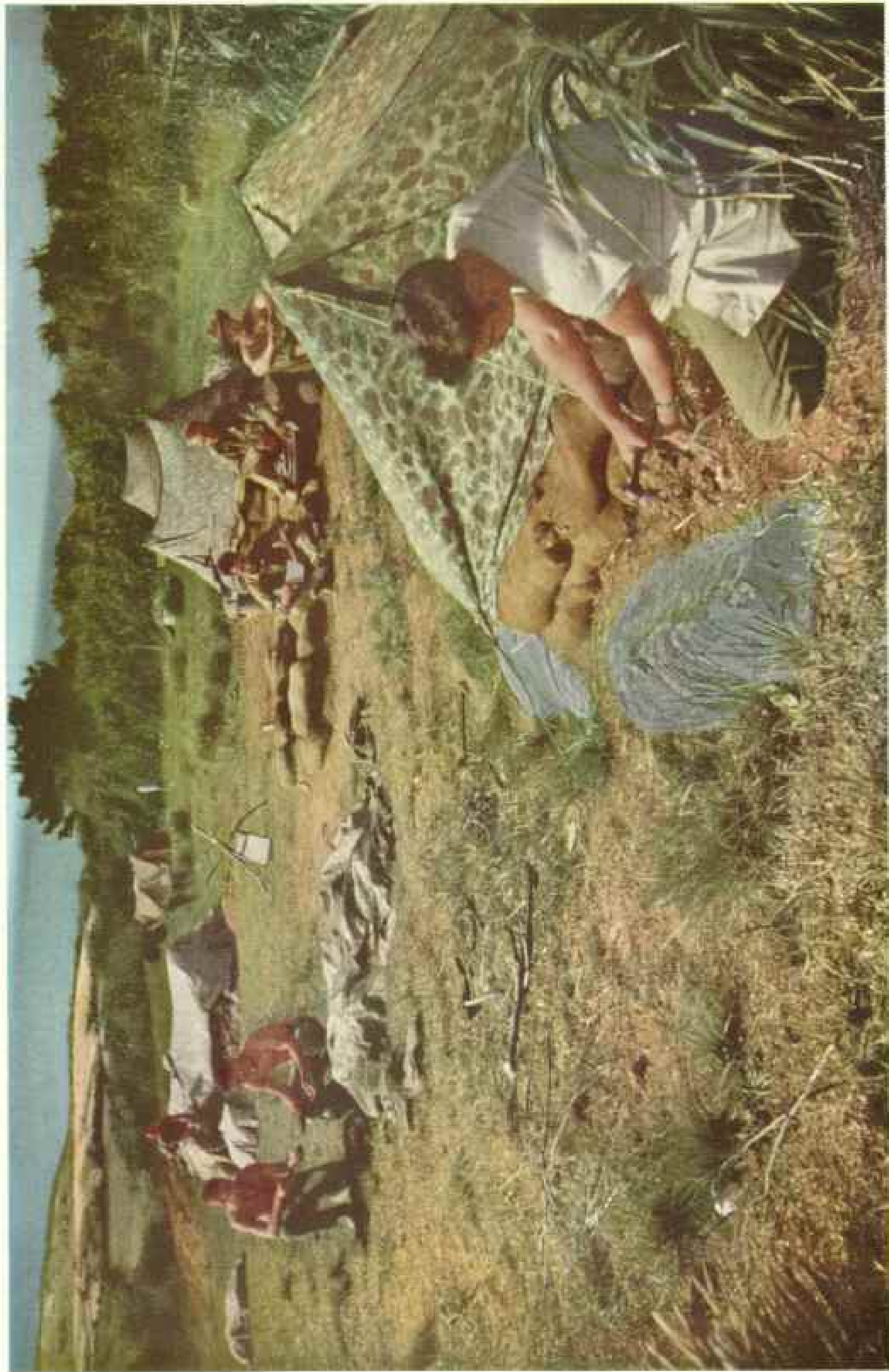


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Richardson L. A. Marine Corps, Okinawa, by Lt. David D. Higgins

Busy as the Boston Post Road Is the Main North-south Highway on Okinawa, Here Crossing the Bisha River

Scabers and Army. Engineers widen and grade the four-lane artery. So quickly did our forces secure the beachhead that Japs had no time to destroy the stone bridge. North-bound traffic uses a new engineers' bridge. The river was the dividing line between Marine (right) and Army units. It served as a jeep "laundry." Caves in the cliff were undefended. Jap-built Yontan Airfield lies on the plateau in the far distance (Plate VII).



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Kodachrome U. S. Marine Corps, offset, by Lt. David D. Thuman

On the High Meadows and Farm Lands of Hedo Zaki, Overlooking the East China Sea, Marines Build a Tent City

On May 6, 1945, this outpost was our closest to Kyushu, only 320 miles away. While one Marine plays a captured Jap phonograph, others listen, read a letter, fill sandbags, and erect shelter halves. They sleep below ground in two-man foxholes under the tents. Pandanus serves as windbreak for fields of wheat and oats.



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Kochikunio (2-4) Marika Kuro, Oshima, Ry. I., South Okinawa

Carrying Everything They Own, Okinawans Trudge Through Grainfields to Their Refugee Camp on Katsuren Peninsula

In the Ryukyū home man is king, the woman his servant. Besides caring for the children, women work in the fields, carry water, and cook. Shuffling along at a fast clip, they carry prodigious loads on heads or slung from poles. Red sack contains a hundred pounds of rice; round woven sitting mats, in foreground.



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Key to an "Okie's" Heart Is a Cigarette

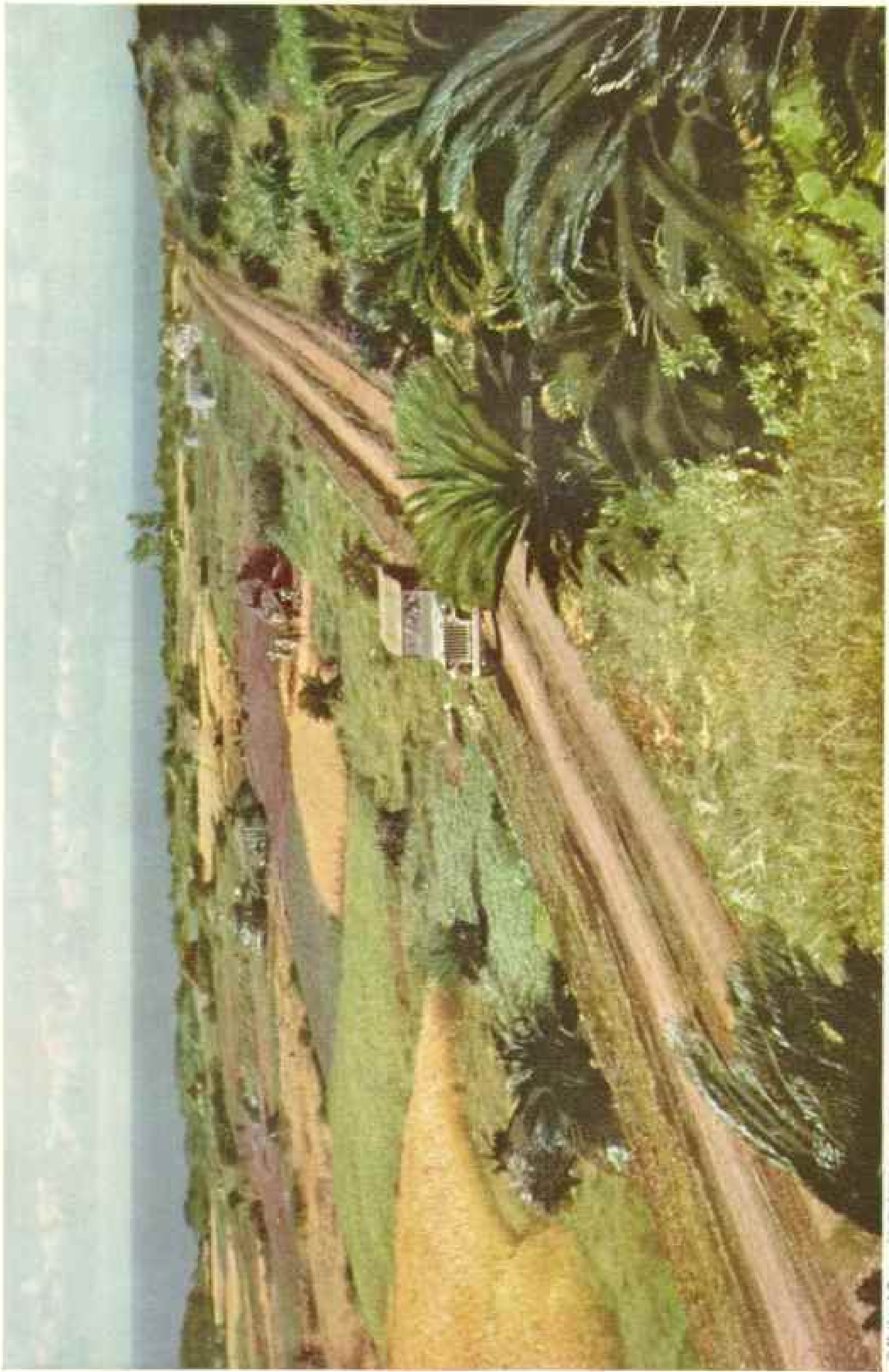
Since he had no connection with the Japs, this fisherman is free to ply his trade. But he must fish from the shore, because use of boats is prohibited by the military government.



Kobayashi U. H. Marine Corps (MIA), Lt. Joseph D. Duman

Grandpa Farmer Typifies the Men of Okinawa

Mostly old people and children were left. Japs impressed the others as labor battalions or to do chores. Okinawans are growing most of their food—rice, wheat, soybeans, cabbages, and sweet potatoes.



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Kodachrome U. S. Marine Corps, official. Lt. Payton D. Palmer

Past Camouflaged Tanks, Trucks, and Foxholes, a Marine Jeep Roars Off on Sniper Patrol to Keep the Road Open

"High, cool, wind-blown, very quiet and beautiful," the author writes of these backyard-size farm lands in Helo Zaki. Here he would build a home overlooking the East China Sea, in background, and the Pacific Ocean, on the other side. Fields of wheat, barley, and oats were ready to harvest when our troops landed.



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Kochunime U. K. Navy, Official

Across a Patchwork of Farms, Amphibious Tanks Waddle, Wiping out Japs in Horseshoe Tombs, Plane Revetments, and Foxholes

Behind them flylike Marine infantrymen in extended order follow closely. Jap planes with "red balls" on wings still nest behind embankments on Okinawa D. Day, April 1, 1945. Taxdways lead to Yontan's main airstrips. This scene has since disappeared; American runways and taxiways cover the area.



Kodachrome E. S. Marine Corps, Official, by Lt. DAVID D. DUMAS

Marines Seek Jap Name Plates and Scrap for Bracelets from Yontan's Wrecked Planes.



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Kodachrome by Richard H. Stewart

Submarine *Barb's* Battle Flag Joins Historic Collection at Annapolis, Maryland

Comdr. E. B. Fluckey, USN, the skipper, lent it to the Naval Academy Museum. Emblems represent: white field, red ball—23 Jap merchantmen sunk; white field, white center—8 merchantmen damaged; red ball with sunburst—aircraft carrier and "Q" ship sunk; white center with red sunburst—aircraft carrier damaged; Nazi swastika—German tanker sunk; tiny flags—7 Jap small craft sunk by gunfire; white field with red crosses—14 Allied prisoners rescued from torpedoed Jap prison ship. Insignia for crew awards: Medal of Honor (center), 13 Silver Stars, 2 Presidential Unit Citations, 3 Navy Crosses, and 16 Bronze Stars.

Okinawa, Threshold to Japan



One Marine Oils His Carbine; the Other Washes in His Helmet on Hedo Zaki



© National Geographic Society

Kobuchimaru U. S. Marine Corps, Official. by Lt. David D. Dunham

Okinawa Secured, Officers Examine the Surf-eroded, Needle-sharp Rocks of Hedo Zaki

Wearing Inseball-type sun hats, the Marines explore the jagged shore where landing craft would have met disaster had they attempted to land. Here the water drops off steeply. Soundings of 1,000-feet are recorded close to shore. The northern half of Okinawa was occupied comparatively easily and quickly, but in the southern section the Japanese, holed out in caves, fought fiercely for 82 days. Long after organized resistance ceased on June 21, 1945, small bands of Jap soldiers still were popping out of mountain fastnesses. Our men mopped them up. Often the guerrillas terrorized native villages, trying to keep them from cooperating with the Americans.



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Daughter of a Fisherman, Tomboy of Her Village

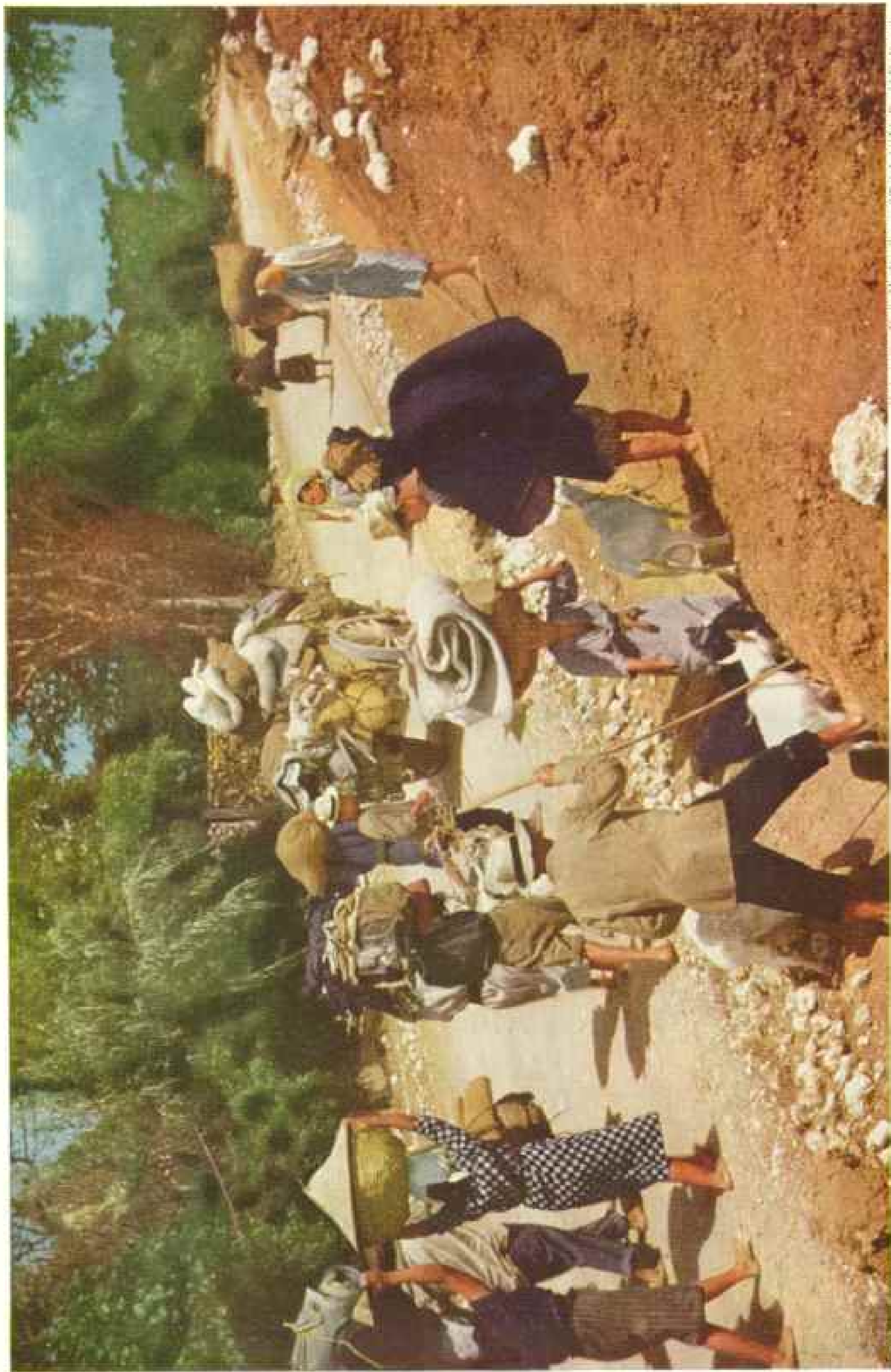
Like other Okinawans caught by our invasion, Hana-ko (Little Flower) had lost everything except the ragged clothes she had on. In spite of this, she was cheerful and loved to romp with her playmates.



Keichirokuwa F. S. Marine Corps, official by Lt. David D. Dunham

All Men Gone, She Pulls Her Farm Cart Alone

"The cart was loaded and very heavy—I helped pull it across a field," the author writes. "Most northern Okinawans were neat, their hair brushed and faces scrubbed bright and clean. Surely this reflects their true character."



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Rudolf H. S. Martin Curves, Offset, by Lt. David D. Duncan

An Entire Village near Ishikawa Heads for the Refugee Area, Bringing Milk, Goats, a Bull, and Personal Belongings

These people were more fortunate than many others who saw their homes destroyed in bombardment or battle. Okinawans were bystanders in the war. Few tried to run away; there was no place to go. In refugee centers, their own representatives handled their affairs and doled out food from the common pool.



Sly but Friendly, Okinawa Farm Women Smile for Their First American Portrait

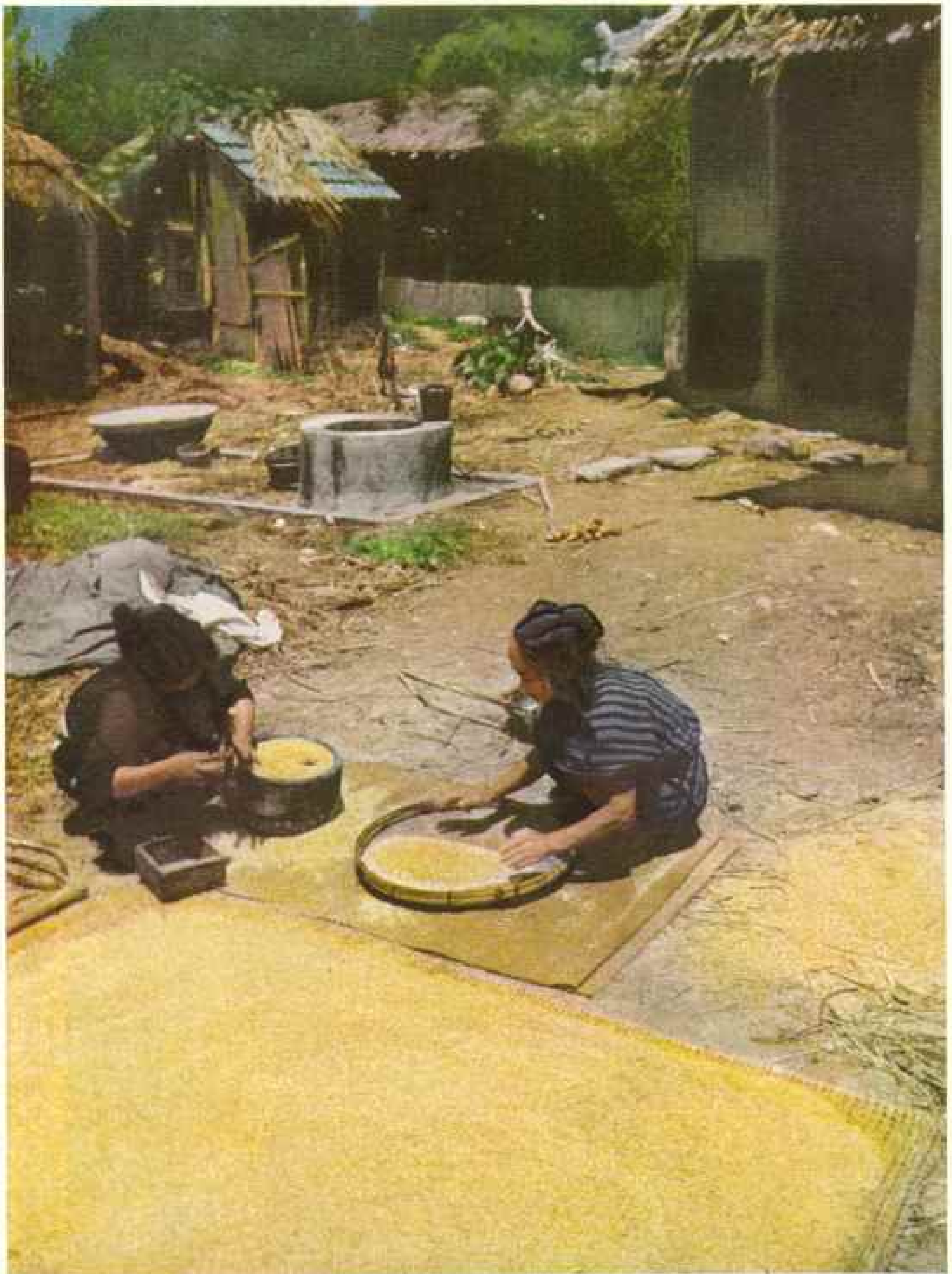
The one at right spoke Spanish, learned during many years' residence in Chile. Her friends were reluctant to smile openly because gold dental work might show! They often wrap cloth around their heads, turbanlike.



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Kobuchizawa U. S. Marine Corps, Official for Lt. David D. Brown

Taro, the Goatherd, Has His Hair Cropped Short Like Other Little Okinawa Boys
Goats browse everywhere on the island. Goatlike taste of the milk, as well as fear of disease, discouraged our men from drinking it.

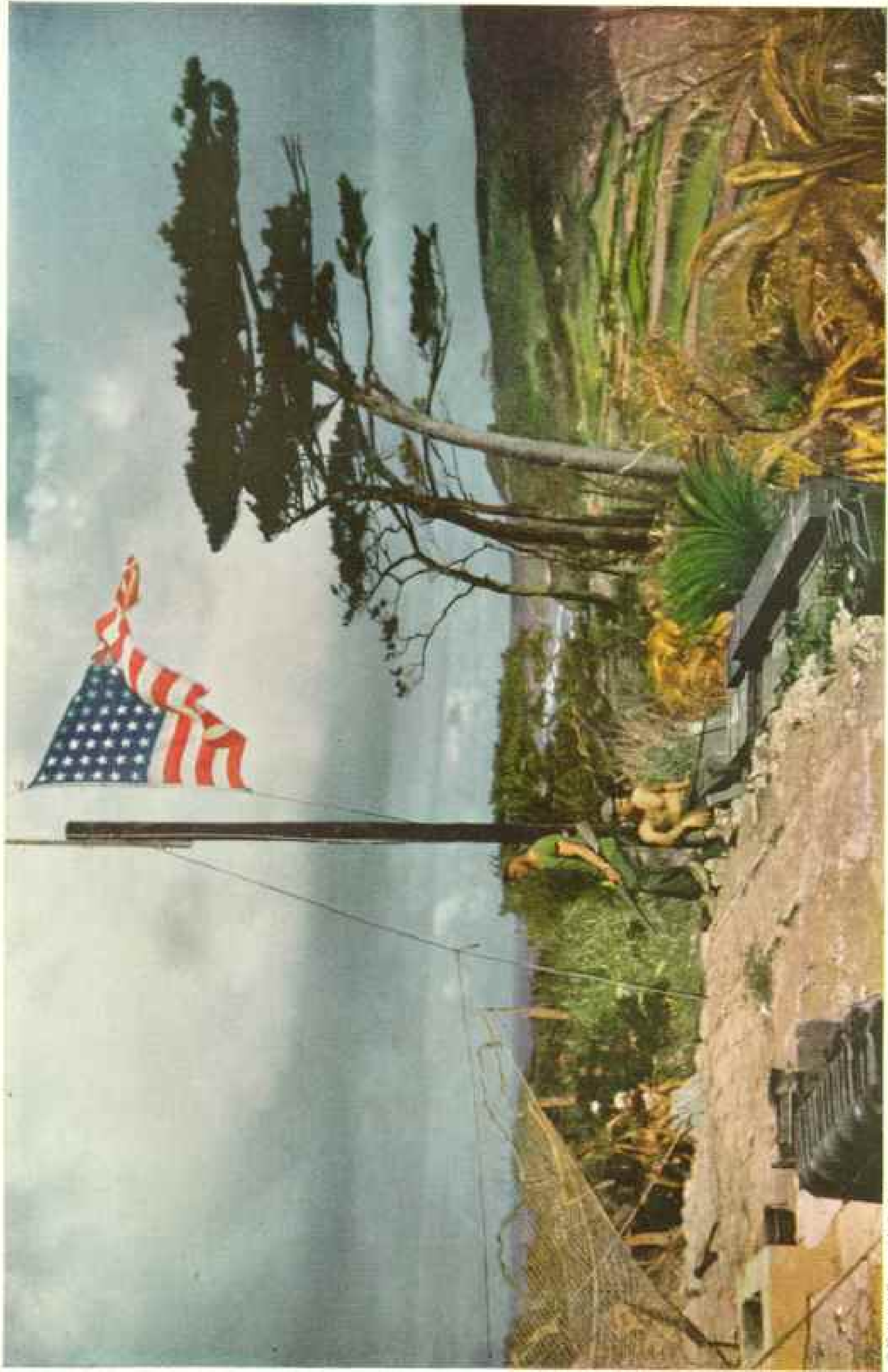


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Koikichiro U. S. Marine Corps, Official, by Lt. David D. Duncan

In the Patio of Their Humble Home Farm Women Sift Wheat

They were allowed to return because their village was outside the military zone. Houses are of flimsy construction with sliding paper and lattice doors. The better the tile roof, the wealthier the owner. Leaves spread on the roofs keep the houses cooler. Mats serve all purposes—sitting, eating, sleeping, and here working.

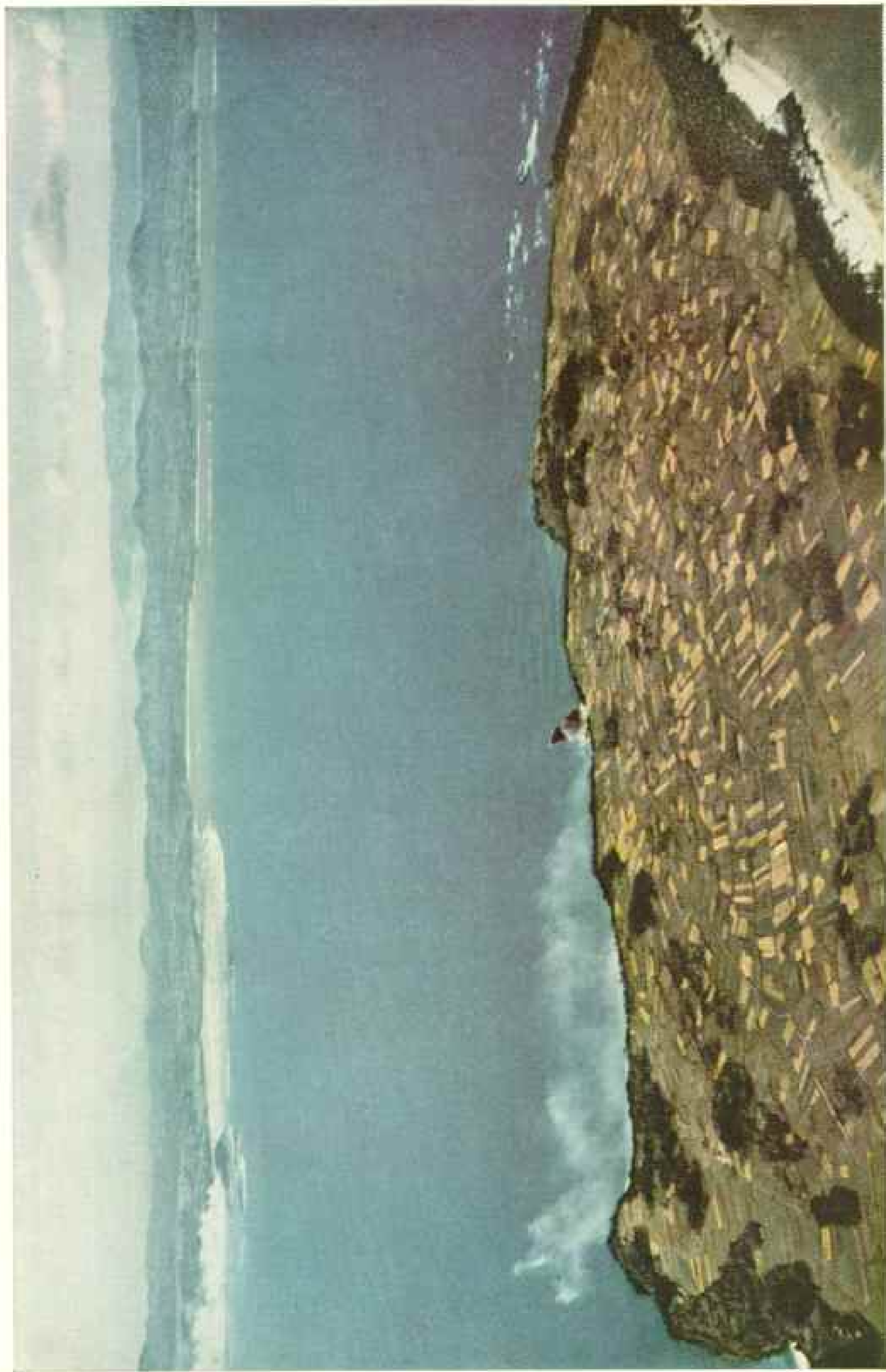


Photograph by Lt. Marine Corps, Official, by Lt. David D. Dupont

At Half-staff for President Roosevelt, the Stars and Stripes Fly over a Land Base Then Closer to Japan Than Any Other

Marines guard this camouflaged outpost from prowling Japs who might infiltrate from hide-outs in the mountains of Hedo Zaki. Dwarf, flat-crowned pines are scattered over Okinawa. Water in wells and streams was abundant. After it was tented and chemically treated, it was stored in cans (left).

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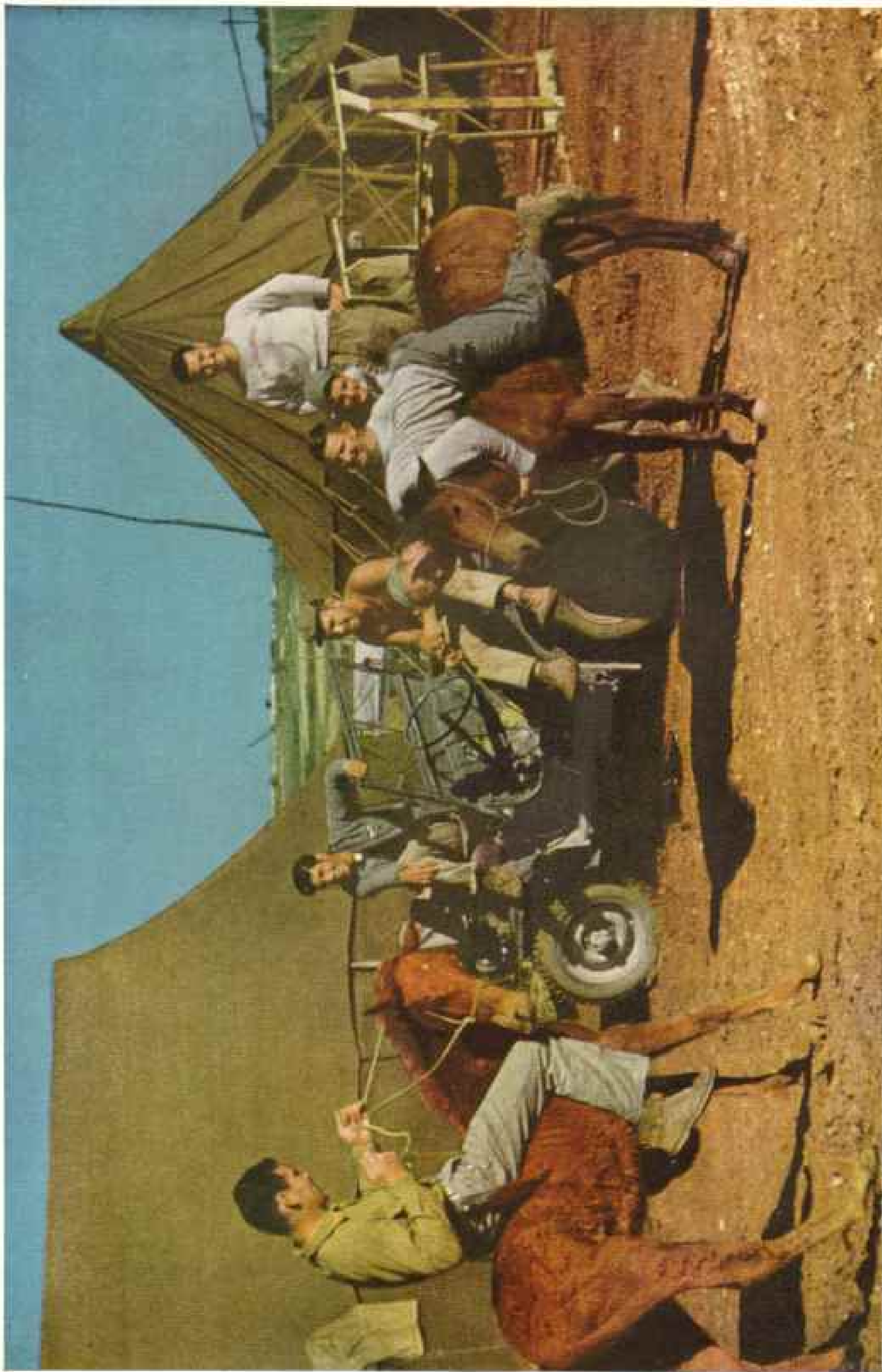


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Kodakrome U. S. Navy Official

Shells and Bombs Devastate the Beaches and Islands of Okinawa Group on D Day, April 1, 1945

Though the landings were on the other side of the island, strong points on Ichi Hanate (island in foreground) and Cape Kinmu (background) were set on fire. Japs held out in the south in just such rugged country as background. Hills were honeycombed with caves, each supporting the other with tunnels and trenches.



© National Geographic Society

Kochetnikov, V. S., Marine Corps, Officer, by Lt. David H. Dunham

Okinawa Leathernecks Skylark as Horse Marines—with Upsetting Results!

Right after this shot was made, the pony on the right took off and the gay caballero landed on his head. Their men of an aviation unit have built a washstand at the right. Water from the canvas bucket is poured into tin bats which serve as basins; mirrors are hung from the crossbar.

Jap Rule in the Hermit Nation

BY WILLARD PRICE

WE CAN learn about our recent enemies, the Japanese, from Korea. She knows them well.

The millions in Asia who dreamed of a gallant Japan coming to their rescue and establishing an "Asia for the Asiatics" might have known, if they had looked at Korea, just what to expect from Nippon.

The people of Asia are growing wary of the Japanese, who have tried to teach them to fear the white man.

Beside the white man's history in Asia should be placed a picture of the accomplishments of the Japanese in a country where they have had full opportunity to establish their "Co-Prosperity Sphere"—Korea.

If all Asiatics could visit Korea, we should have more millions of staunch allies there.

Jailed for "Dangerous Thoughts"

A veil of Japanese secrecy has covered Korea. Close censorship has prevented many unfavorable stories from leaving the country. Nor have Koreans been free to cross the border, particularly when suspected of "dangerous thoughts." Instead, they have been jailed. A few, a very few, have escaped to tell Korea's story.

Foreign visitors to Japan before the war were not urged by the Japan Tourist Bureau to include Korea in their itineraries. If they insisted upon going, they were escorted and guided.

Landing at Fusan, they stepped into a superb train and were whisked to the capital city, Seoul (the Japanese have called it Keijo), where a taxicab took them to the luxurious Chosen Hotel (pages 430, 434).

As their feet sank into its deep rugs and their wondering gaze took in the pink and gold décor, rich furnishings, flowers, fountains, piano, and murals of idyllic Korean scenes done by a Japanese educated in Paris, they began to like Korea.

They saw the reading room supplied with magazines and papers from all the world—except Korea. In the finely appointed bar they liked Korea better and better.

And when the elevator shot them up to a charming bedroom with bath and a fine plate-glass view of Japanese government buildings, banks, department stores, and schools, they could not fail to be impressed by the achievements of modern progressive Japan in the backward Hermit Nation.

The tourist could be excused for enjoying himself. That is why a tourist tours. The

serious investigator rarely went to Korea, because there were more important countries to investigate. The newspaper correspondent did not go there because there was no news there. At least, no news on the surface.

Outwardly the country was still true to its ancient name, Land of the Morning Calm.

But in the light of present events, in her role of object lesson for all Asia, Korea becomes news of the first importance.

This peninsular nose of Asia projects toward Japan. Its tip is only 110 miles distant from the main Japanese islands (map, page 433). Korea is but half as large again as another more familiar peninsula, Florida. But when Ponce de León discovered Florida in 1513 during his search for the Fountain of Youth, Korea had been drinking from that fountain for more than 3,000 years.

Unlike Florida, Korea is mountainous. "Iron it flat," some geographer has remarked, "and Korea would cover the earth."

A Storehouse of Minerals

These mountains are rich in wealth and beauty. Between their ribs is gold in abundance. Sandstones are found; also rock crystal, coal (much of it anthracite), iron, silver, copper, and lead. Korea produces some minerals which Japan itself lacks or mines in small quantities. Zinc, tungsten, graphite, barites, nickel, fluor spar, magnesite, mica, molybdenum, and talc are present, as well as alunite, from which aluminum is obtained.

The soil which covers these mineral treasures is deep and fertile. Grains and vegetables flourish. American pears, grapes, and apples have been introduced and thrive. Japanese agriculturists use scientific methods and wring the highest yield possible from the willing soil. Yet, in the midst of this plenty, many Koreans starve.

The climate is close to perfection. Nearly every morning seems like a perfect Sunday morning, strangely bright and pure, "clear as the tones of a chapel bell." The air throughout the day is electric. If rains come, they are usually brief and closely flanked on both sides with sunshine. Persistent rains fall only during the summer.

It is a high testimonial to Korea that the birds like it. The more spectacular and interesting birds are the large black eagles, the peregrines (which hunters tame and use as winged hounds to capture game), gorgeous pheasants, stately swans, teal wearing spectacles, statuesque pink ibis, cranes and storks,

Frederick L. Hamilton from *Three Lines*

Seoul's Young Fashion Plates Wouldn't Be Seen in Grandfathers' "Bird-cage" Hats

A few of these men are Japanese. One (center) wears the Japanese civilian officials' uniform, decreed as an economy measure. Beside him a girl, in contrast to her sisters in white, has a serge jumper and bobby socks. Years ago an American built Korea's first trolley line, and ricksha boys were put out of business. Mobs stoned the cars.

friendly doves, highly talented pigeons, coloratura soprano orioles and larks.

Wild animals enjoy the mountain fastnesses. Mountain villages must be wary of the Korean tiger, larger, stronger, and more beautiful than his tropical counterpart. He has even been known to enter the capital city itself and carry off human prey. Leopards, too, have been shot within the walls of Seoul.

Wild Life in the "Ever Whites"

Along the northern border in the "Ever White Mountains" (Chang Pai Shan), which, although not exactly ever-white, are covered with snow ten months out of twelve, the huge Korean bear sleeps a good part of the year.

The always active wild boar is considered even more dangerous than the tiger. There are at least five species of deer and a bewildering assortment of otters, beavers, martens, sables, tiger cats, badgers, wolves, and foxes.

Possibly the man who knew Korean animals best was the famous Russian hunter, George

M. Yankovsky (page 436). His story is a thriller.

A nobleman of the old regime, he organized a force of White Russians to fight the Bolsheviks, lost, was driven from his two-million-dollar deer farm near Vladivostok, escaped in a sort of Noah's Ark with his family of 25, his 40 officers, and the best of his deer, cows, and horses to northern Korea.

There he built a unique lodge in the side of a cliff near a brawling mountain stream in the dense forest and began to make a living by hunting.

When I stumbled upon his retreat a few years ago, a beautiful snarling lynx, big as a wolf, met me at the door.

Yankovsky hastened to reassure me.

"He won't hurt you. He's just a pet. I had a leopard, but he got too wild. I had to let him go."

The lodge was a wildwood Palace of Monte Cristo. Its back wall was a precipice into which a huge fireplace and inglenooks had



Frederick L. Hamilton from *Three Lions*

Two Seoul Gentlemen, Pausing for a Chat, Unconsciously Pose for a Style Show

Both wear the old fashion's white gown over baggy pants tied above the ankles. The leisured nobleman is Old Korea from horsehair hat to slippers. His percale socks are padded. The business man wears American-style straw hat, socks, shoes, and glasses, all made in Japan. Nippon's Rising Sun flies over the Bank of Chosen (Korea).

been carved so that one might actually sit inside the cliff. Hugged by mother earth, the house was warmer in winter and cooler in summer than if it had been fully exposed. The other side looked out upon a boiling cataract over which a precarious rope bridge was slung.

Great larches stood so near that some of them thrust their branches into the house through holes in the unpainted larch-board walls and out again through the white-birch roof. Trophies lined the walls—bearskins, boars' tusks, stuffed herons, live-looking leopards. Outside, 14 hunting dogs roamed the grounds.

Yankovsky disdained trapping. He said that any animal that he and his dogs could not track down deserved to live.

He did a large business in furs. He caught live tigers for zoos. He mounted rare specimens for museums.

A Hunter Chases Butterflies

Aided by his brother, he even chased butterflies, to such good effect that 20 species bear his name. He sold \$500 worth of butterflies a year. That is a lot of butterflies.

Collectors and museums the world around watched for his new finds. The man who has a street named after him could be no prouder than was this Russian exile of his *Saturnia jankowskii*, *Marumba jankowskii*, *Actias jankowskii*, and so on, to the number of twenty. Also, his discoveries included a formerly unknown swan, *Cygnus jankowskii*, and a beetle, *Captolabrus jankowskii*.

He ranged far, over the border into Manchuria and even into Soviet territory. But there he was cautious, for there was a price on his head.

As we ate leopard steak (flavorful but a bit tough), he told me how he had killed the leopard.

"I'd rather take a chance with a tiger," he said. "A tiger is conspicuous. But a leopard is very skillful about hiding himself. A tiger meets you on the ground, but a leopard hides in a tree. This one was on a branch just over the trail.

"My horse—he was an Arabian pony—suddenly stiffened and stopped. The presence of a tiger or leopard often has a sort of hypnotic effect upon a horse. I looked around and above, but could see nothing. I dismounted and finally located the leopard and shot him. He fell from the branch, and his thrashing about brought him almost under the nose of the pony, which still did not move a muscle.

"After the leopard was dead and we were on the way home, the horse became so nervous

that it was almost impossible to control him."

Stories of the big Korean bear followed.

"But our prize animal is the boar," Yankovsky continued. "He is the largest wild boar in the world. He may weigh 400 pounds or more. He's very common here. Every year two or three hundred people are killed in this section by boars. When one is wounded he is more dangerous than the tiger or leopard or bear. There's quite a bit of excitement in hunting him. Would you like to try it?"

I replied that I'd like to be a spectator while someone else did the hunting.

As it turned out, I was something more than a spectator—almost a victim. At dusk we prowled through a thicket of oak trees where the boars were in the habit of coming for acorns.

"Remember," said Yankovsky, "that a boar runs in a straight line. If he rushes you, stand where you are until he is five or six yards away, then move to one side."

It sounded as simple as stepping out of a plane, counting ten, and then pulling the cord.

A black shadow came out from behind a tree trunk. Its size was amazing. It was twice as big as a man. "Shoot!" shouted Yankovsky. I followed his suggestion. The bullet's chief effect was to bring the wounded boar toward us like a midnight express. His knifelike tusks gleamed white.

I found it possible to stand still, but doubt that I could have followed the second part of my friend's advice, for, like the Arabian pony, I was glued to the spot.

Fortunately I did not need to move. Yankovsky's shot felled the boar, and we had delicious fresh ham the next day for dinner.

Thrills of Whale Hunting

There are more thrills to be had hunting whales along Korea's east coast. The whaling industry, with Japanese capital and Korean labor, sold millions of dollars' worth of whale products every year in peacetime.

It was here that the "lost" California gray whale was rediscovered by an American. This whale, once common along our west coast, was so relentlessly hunted that it all but disap-

Korea: Japan's First Foothold on the Continent of Asia (Map at Right)

Half a century ago the peninsula was the "dagger pointing at Japan," only 110 miles to the southeast. To make it her base, Japan fought China in 1894 and Russia in 1904-5. In 1910 she annexed Korea, changing its name to *Chosen*. By the Cairo declaration of 1943, the United States, Great Britain, and China promised Korea eventual independence. In August, 1945, Russia invaded it. The country contains 24 million people, including 650,000 Japanese.



U.S.S.R.
Vladivostok

KOREA



Railroads ——— Highways ———

EQUIVALENT TERMS

Gunto	Archipelago
Kaikyo	Channel, Strait
Kan	Cape, Point
Ka	Harbor, River, Point
Retto	Chain of Islands
Saki	Cape, Point
Shan	Mountain
Shima	Island
Sudo	Channel, Strait
Tan	Cape, Point
To	Island
Wan	Bay, Gulf

SEA

Utsuryo To
Dodo

Take Shima
(Liancourt Rocks)

JAPAN

YELLOW
SEA

STRAIT

HONSHU

Hiroshima
Kure

Inland
Sea

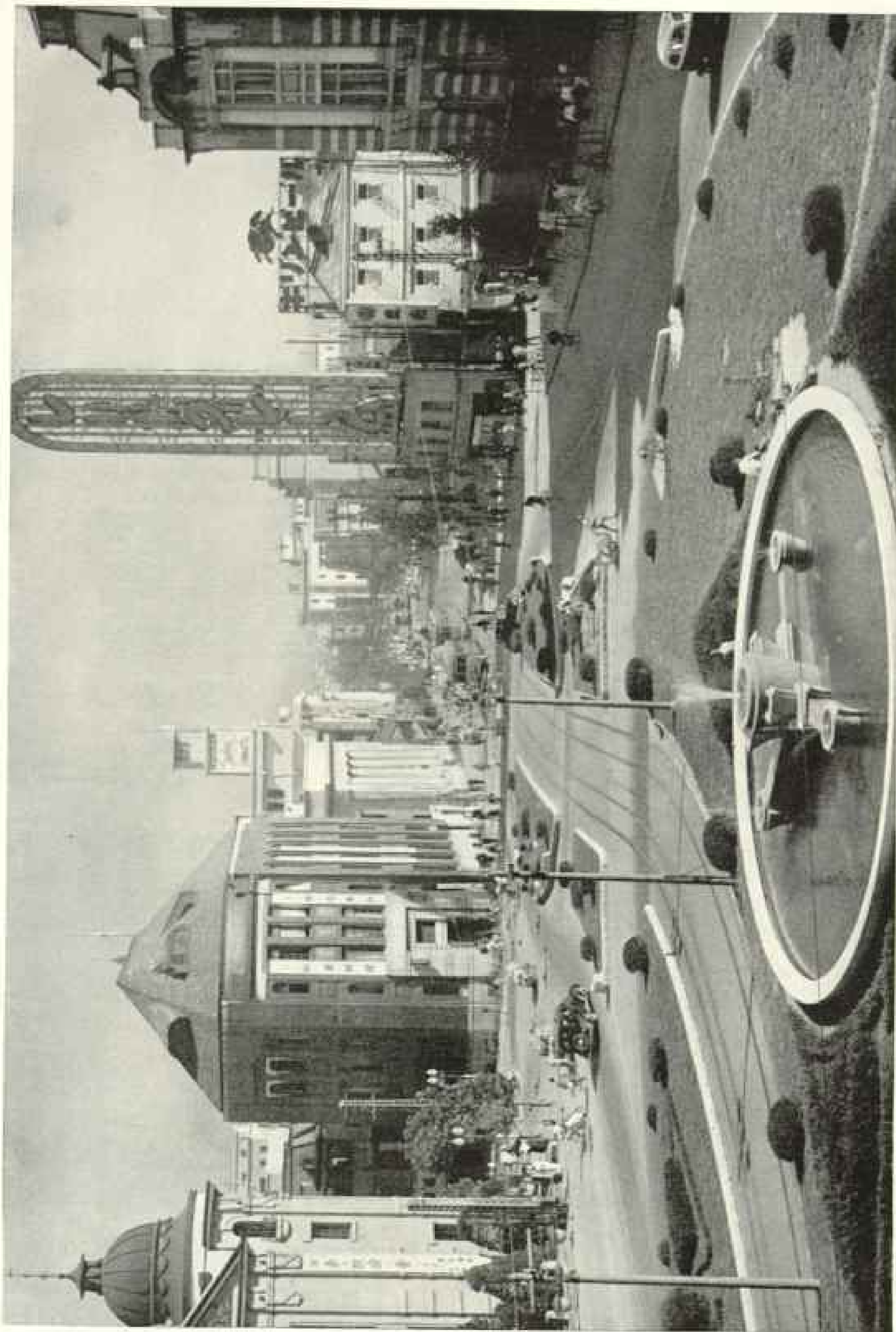
KYUSHU

EAST CHINA SEA

KOREA

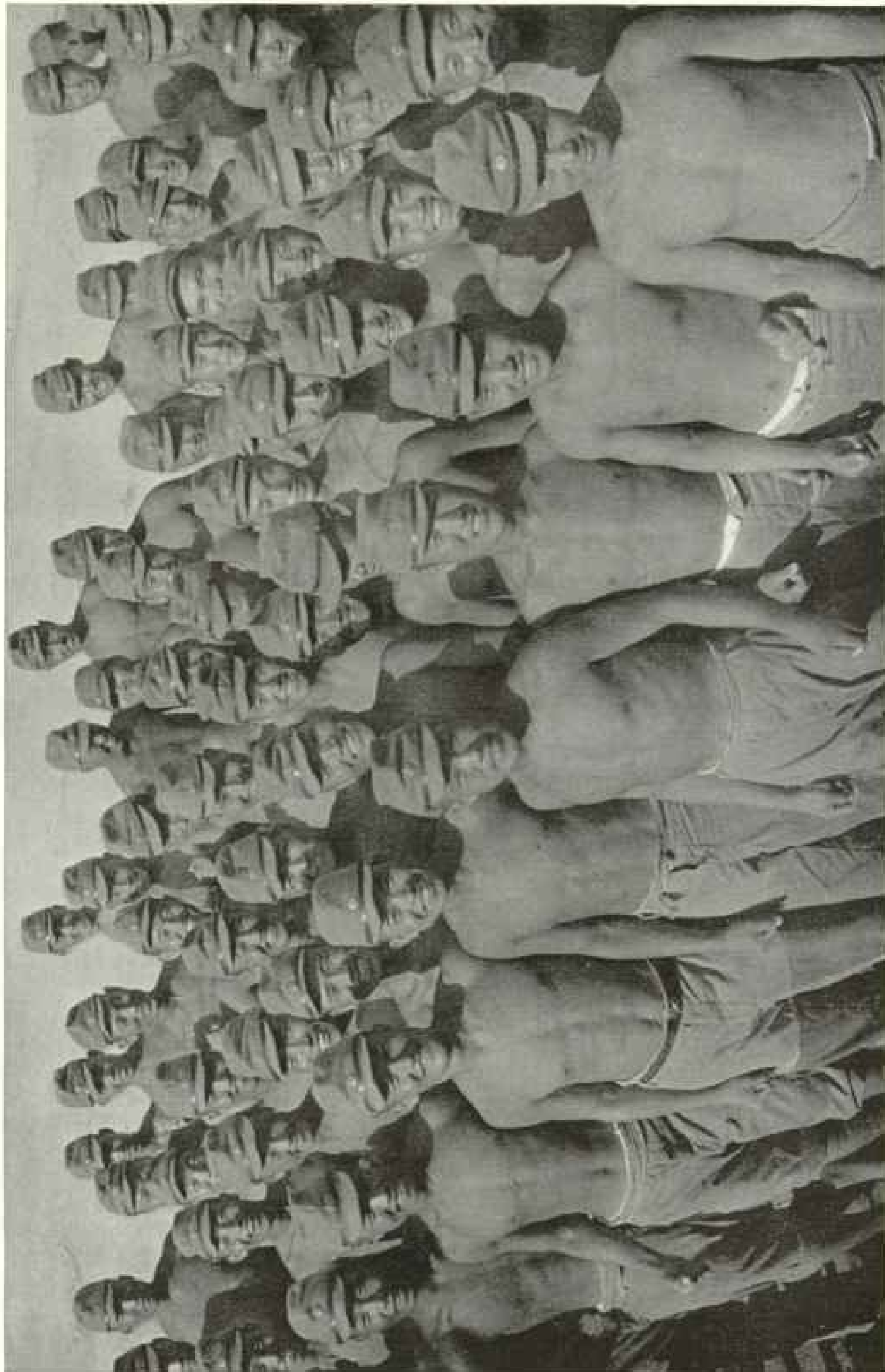
Nagasaki

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Frederick L. Hamilton from "Three Lions"

On Seoul's Main Street Japan Advertises to Visitors the "Progress" She Has Brought to Korea



Frederick L. Hamilton from "Flare Japan"

Japan Enlisted These Korean "Volunteers," but Knew Better Than to Trust Them. Their Smiles Don't Mean What They Say

In the Pacific, Korean labor battalions surrendered readily to Americans. In China, Koreans fought in the open. At home, their close resemblance to Japanese made them effective spies and saboteurs. When Tokyo talked of "100 million Japanese," it included 24 million Koreans, but its army was slow in drafting them.



Willard Price

Korea's Famous Hunter Was Proud of His Curious Coat of Arms.

With George Yankovsky, an exile from Siberia, the author went on a bear hunt. "Twice as big as a man," a wounded bear charged "like a midnight express." Price, "glued to the spot," was saved by his host's shot (page 430). Yankovsky was a collector of butterflies; 20 species have been named for him.

peared. It was supposed to have become extinct.

However, the Asiatic stocks of this whale had managed to survive in Korean waters, and there it was identified by Roy Chapman Andrews, explorer of Gobi fame.*

Andrews did his stint behind the harpoon gun, his oilskins frozen stiff by the bitter cold and sleet, and was rewarded by the opportunity to examine in six weeks more than 40 gray whales.

This mammal is so primitive as to be, in Dr. Andrews's words, "almost a living fossil." To examine it was like having a chance to step back into the dim past and study living specimens of the period.

But it is now being so vigorously pursued that it is likely once again to disappear, this time for good and all.

The poverty-stricken inhabitants of this land of plenty are an attractive people. Americans find them "so much like us."

Their racial origins are unknown, except that they are largely Mongolian. But the Korean is taller, stronger, and better-looking than the average Mongol. His skin is lighter and his features are more regular. Korean girls seem prettier to us than Chinese or Japanese girls; Korean features are closer to the standard we associate with beauty.

American missionaries and business men who have worked among Asiatic peoples say that his way of thinking is more like our own.

I found that in a few weeks I forgot that my Korean friends were of a different race. But five years of residence in Japan only confirmed the contrasts between the Japanese mind and the Western.

The Japanese may wear coat and pants, collar and tie, but he remains a son of Heaven. The Korean we promptly recognize as being of the same clay as the rest of us, despite one of the most fantastic and individual costumes in the world.

Fantastic Costume Has a "Bible Pocket"

He wears a long white robe over a short white jacket and ballooning white trousers tied at the ankle with a blue ribbon (page 431). Another ribbon, blue or white, girdles

* See "Shore-Whaling: A World Industry," by Roy Chapman Andrews, NATIONAL GEOGRAPHIC MAGAZINE, May, 1911, and "Whales, Giants of the Sea," by Remington Kellogg, January, 1940.

his waist. No buttons are used. There were formerly no pockets, but when many Koreans became Christian and needed to carry a Bible to church, a pocket was introduced. It is still called the "Bible pocket."

The national costume is white because white is the mourning color of Korea. Whenever a member of royalty died, the entire population had to wear white for three years (page 444).

During one period of Korean history royalty died off so fast that the people were continually in white and became used to it.

Topping the tall, saintlike figure of the man in white is a plug hat of horsehair (not so commonly worn now). It is so loosely woven that one may look inside it and see the matrimonial topknot (page 451).

The unmarried man, in some localities, wears his hair down. Even though he may be 80 years old, he is considered a boy and his opinion is not taken seriously. When he is married, up goes his hair and he is consulted on village affairs. The topknot is the index of wisdom.

These customs still prevail in the villages. In the cities many young Koreans wear Western clothes and some of the men and boys cut their hair.

The woman's costume is less spectacular. A full skirt hangs from the waist and almost sweeps the ground. The village maiden takes care not to show her well-turned ankle. But she considers it perfectly proper to reveal her breasts, which her jacket is too short to cover.

The girl marries young and makes a good wife. She spends a large part of her married life beating the dirt out of white clothing with a stick and "ironing" it by roundly pounding



Frederick L. Hamilton from *Three Lions*

Though Tongues Clack and Heads Wag, Bundles Stay Balanced

One of these gossiping women on a Seoul street carries an umbrella atop her laundry. Occasionally an umbrella and nothing else is head-borne. Five-gallon water jars are the opposite extreme (page 444). Korean children ride on mothers' backs or hips.

it over a flat rock or wooden roller with two ironing clubs. These, if deftly handled, bring out a fine gloss that could not be produced by an iron (page 438).

Life in a Korean Home

Korean home life can best be understood by living in a Korean home. So come with me to the house of Hyun, a young man who has seen the life of the city but is not ashamed of the mud-and-thatch dwelling of his parents in a mountain village back of Seoul.

We passed through a yard filled with big jars, any one of them large enough to contain a man. Instead, they contain the winter's store of *kimchi*, composed mainly of Chinese



Staff Photographer W. Robert Moore

Gold Wood Serves Like Hot Steel as Ironers Bat Wrinkles out of White Garments

Tap, tap! Tap, tap! Often at night the sound of Korean wives clubbing ironing stones may be heard outside their homes. Other clothes are smoothed on a wooden roller. Both methods impart a fine sheen. At each laundering, winter's padded garments must be ripped apart and restitched (page 437).

cabbage and garnished with fish, onions, garlic, and red pepper. It is a favorite dish of the Korean, but guaranteed to lift the top of the head off any foreigner.

"Here we are," said Hyun happily and opened a low, handsomely carved door. "Step over the threshold, please."

I carefully stepped over the doorsill and then looked at Hyun inquiringly.

"It's a superstition," he explained. "Every house is supposed to have its own particular household god. The doorsill is the god's neck and must not be stepped upon or the god will become angry and bring misfortune upon the house." He laughed. "It's just an old idea. But we respect old ideas."

He introduced me to his white-clad father and mother and his pretty sister. Then he invited me to take a seat. There was no chair. We sat on the floor.

The autumn air had been chilly outside, but now a delightful warmth began to pass up through me. It seemed to be coming from the floor (pages 439-40).

And then I became acquainted with one of the cleverest inventions of man since the age of fire began. It is the heated floor. America and Europe, for all their ingenuity, know it

not. The Chinese have something like it—the *kang*, a heated brick divan. By living on top of the kang and stepping down upon the cold floor as rarely as possible, one may keep reasonably warm.

But the Korean invention has gone the Chinese idea one better. The entire floor becomes a kang.

Who has not suffered with cold feet and hot head in an unevenly heated room? Since cold air falls and forces up warm air, it would seem elementary that the heat should come from the floor, and from all parts of the floor, not just from a register in one corner.

This very obvious fact seems to have struck the Korean and no one else. And he has very simply solved the problem by running the hot smoke from his kitchen stove under the floors of the other rooms to the far side of the house where at last, its heat exhausted, it is allowed to escape.

By using what we throw away he keeps his house warm.

The floor is raised from the ground a foot or two and is made of stone slabs cemented together so that no smoke can rise into the room. The stones absorb heat easily and hold it well.



Willard Prim

Korean Fire Does Double Duty, Cooking Meals and Warming Homes

At this end of the house the clay stove holds a built-in soup pot. At the other side smoke escapes after heating a series of rooms (pages 438, 440). Firewood is scarce; the Korean does not waste it. For fuel, his ancestors denuded the forests.

For comfort's sake, the entire floor is covered with resilient oiled paper almost as thick as a thin carpet and much easier to keep clean. On this spotless silklike surface cushions are placed for sitting, or beds spread at night.

Cooking the usual two or three meals will furnish enough heat to keep the floor warm all day, and a blaze of pine needles at retiring will store enough heat in the stone floor to last till morning.

The walls of the room in which I sat were bare except for a hanging scroll on which was inscribed in Chinese characters a gem from the classics. The windows were of oiled paper, translucent but not transparent.

Beer-bottle Glass Highly Prized

Glass is still almost unknown in the country. But in the center of one pane of oiled paper was a small piece of glass, green and curved, giving a curiously distorted and jaundiced glimpse of the street.

"A piece of a beer bottle," said Hyun. "Bottles are rare and much prized because they can be broken and the bits inserted in windows. Then we can see out without poking a hole in the paper."

The women were busy in the kitchen. Pres-

ently they brought in three small low tables and set one before each of the men. We removed the chopsticks from their paper cases and set to work. I was much relieved to see that the gastronomic dynamite, kimchi, had not been served (pages 437-8).

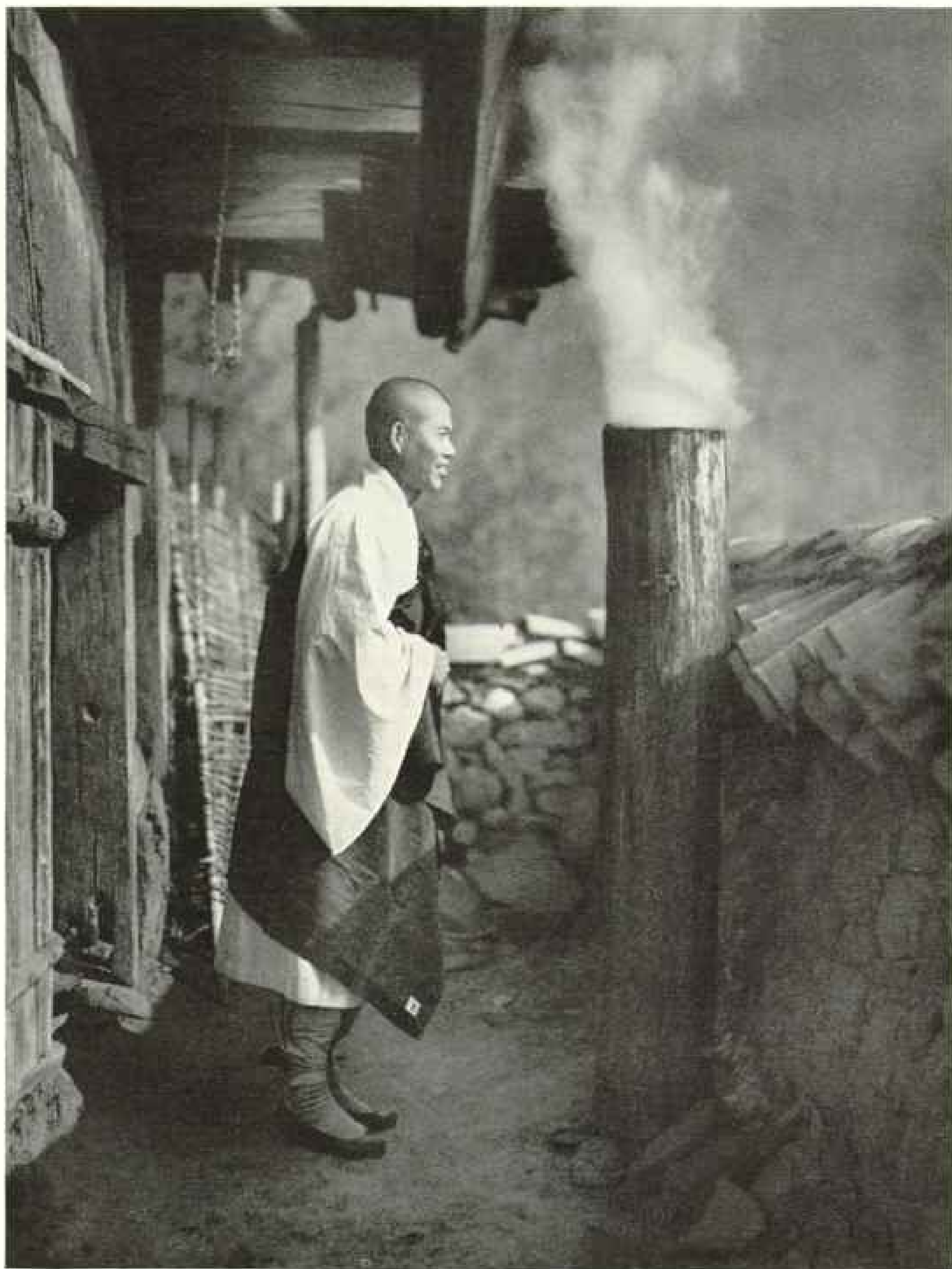
Before me was a big bowl of rice surrounded by a perfect ring of small bowls. Each small bowl contained a pickle. The result was entirely satisfactory. A mouthful of rice was followed by a bit of pickle.

By going right around the circle, selecting a new pickle each time, a delightful sense of variety was achieved, for the bowls offered this gamut of flavorful delights: pickled cabbage, pickled pine nuts, pickled turnips, pickled maple leaves, pickled beans sprinkled with millet seeds, pickled mushrooms, and pickled seaweed.

The whole was washed down with a tangy tea made of dried ginseng and ginger.

At bedtime an enormous thick rug made of tiger skins was spread for me and on it were laid wadded comfortables, beautifully designed, evidently the pride of the house. Korean women are excellent seamstresses.

Hyun offered me a cushion as a pillow; but when I saw that he and his father were using



Willard Price

A Buddhist Priest Beams on Korea's Unique Hot-air Furnace

Long before Americans knew central heating, Koreans had their own system, simple but efficient. This smoke is generated by a cooking stove (page 439). Conducted through flues under the house, it warms stone floors so effectively that sleepers sometimes are blistered. Here, sparks and heat spent, the fumes escape without burning the wooden chimney. Black gown and shaven head mark the priest.

blocks of wood, I insisted upon having one, too. I regretted my decision before morning.

The traditional Korean wooden pillow is made of smooth soft pine, but wood at its softest is hard to the pampered skull of the foreigner (page 442).

Hyun's house was better than the average. Life in a Korean village is frugal and severe. The fruits of labor of the little farms go to Japanese overlords. Korea has only memories—memories of those great days when Korea held a torch of progress and learning.

Korea Once Was Japan's Teacher

Japan owes a great deal of her civilization to the Hermit Nation. Korea was a teacher of Japan.

Because Korea was the closest foreign nation to Japan, her influence was felt even before that of China. Korea had learned much from China. She passed it and her own learning on to Japan. She had a long head start on Japan.

While Japanese history fades into legend when we try to go back more than 1,500 years, Korean civilization is at least 3,000 years old, and some scholars trace it back nearly a thousand years farther.

Korean knowledge flourished for more than two millenniums before Japan learned to read and write.

Early Japan scorned intellectual pursuits. The man of learning was at a discount. The soldier ranked first, as he still does.

Even after the importation of the art of writing from Korea, the early samurai was ashamed to be caught with a writing brush in his hand. It was unmanly.

History records that in the 12th century, when an imperial mandate was sent to a certain troop of 5,000 soldiers, only one man in the 5,000 could read it. His ability disgraced him in the eyes of his fellows.

Samurai were unable to count, or pretended they could not if they could. To go into a store, buy something, and get the right change was considered commercial and beneath the dignity of a military man. The only arts and sciences honored were those of war.

In Korea war was considered an evil, if sometimes a necessary one. It interfered with the true purpose of man, the advance of civilization.

Learning, far from being scorned, was the badge of honor. To win a government post the candidate had to pass a literary examination.

So greatly was education respected that the title of address such as our "Mr." was *So-bang*, meaning "Writing Place" or, by in-

ference, "Schoolman." As an expression of courtesy, even Kim who dug ditches and never saw the inside of a school is ordinarily addressed as "Schoolman Kim."

Koreans Devised an Alphabet

Korea had learned writing from China, but only a scholar had the time to master the involved Chinese ideographs. The common people wanted to read and write. The king heard their clamor and commanded his scholars to devise a simple alphabet.

The scholars showed a creative ability amounting to genius when they invented an alphabet so simple that Homer B. Hulbert, one of the early American teachers in Korea and personal adviser to the king, said of it:

"I can give evidence from my personal knowledge that any Korean of average ability can take up his alphabet and in two weeks read any book you lay before him."

This was the first simplified alphabetical script to be invented in the Far East. Korea had gone her teacher China one better. The script was so easy, in fact, that scholars soon scorned it. They called it *Ommun*, "the vulgar language."

But "the vulgar language" was a godsend to the people. Reading became widespread. When American missionaries arrived, they at once saw the value of the easy alphabet and used it in printing the Bible.

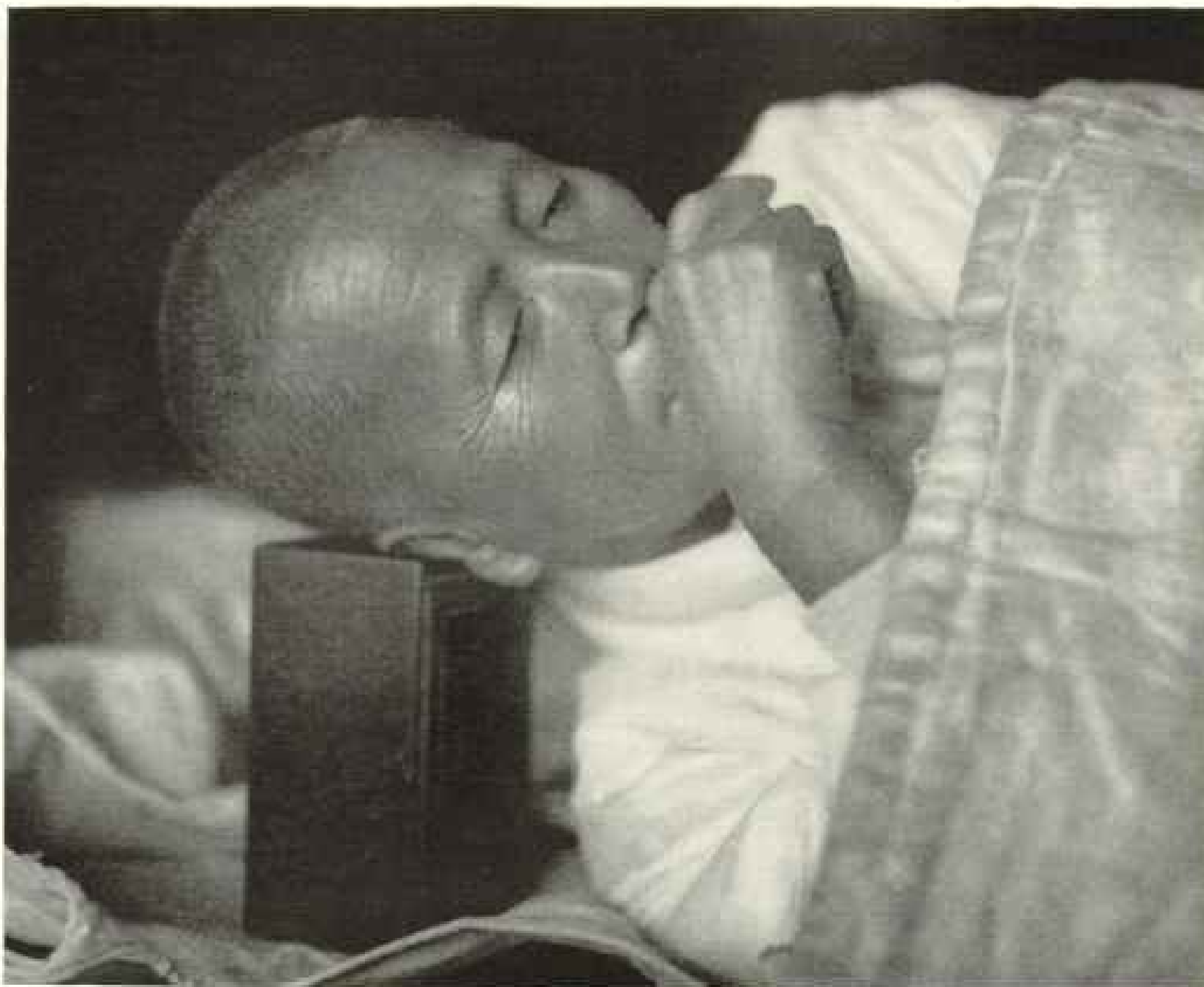
Development of Movable Metal Type

The Koreans were responsible for another great intellectual achievement, movable *metal* types.

Movable type is the very foundation of modern printing (page 447). Imagine the labor if every word in this magazine had to be carved out by hand on blocks of wood, one block for each page. That was the ancient system, in Europe as well as in Asia. Once the page was printed, the block was of no further use, since the letters or characters were not movable.

A Chinese genius conceived the idea of making a separate block for each character. Then, after a page had been printed, the characters could be taken up, reassembled to form new sentences, and used to print another page. Without movable types the rapid production of books and periodicals at low prices would have been impossible.

The Chinese used movable type of baked clay or wood, and experimented with tin. But the use of metal type was perfected by the Koreans. They cast it of bronze, from molds, and encouraged its use to such an extent that for a while Korea led the world in printing.



WILLIAM PRYOR

Soft as Eider Down to Him Is His Wooden Pillow

Of soft pine is the block, but to a Westerner it is as hard as iron. The author tried one, and the memory is with him yet (page 441). Korea's pioneer steel rails made tempting pillows for natives who wished to save hotel charges. A few lost their heads when an occasional night train failed to stop in time!

Specimens of early Korean metal type may be seen in the American Museum of Natural History, in New York. The development dates back possibly to 1232, certainly to 1392, when a type foundry was built. By 1406 metal type was in general use in Korea.

It was not until half a century later that Gutenberg perfected a similar system for use in Europe.

Some Korean "Firsts"

Korea has other "firsts" or "near firsts" to her credit.

A Korean engineer built what is believed to have been the world's first real suspension bridge only a hundred years after Columbus discovered America. With the first ironclad ships, Korea defeated Japan more than two and a half centuries before the *Monitor* and *Merrimac* (page 445).

In the town of Kyongju (Keishu) you may still see an astronomical observatory built by a Korean queen some 1,500 years ago. So far

as I know, it is the oldest existing observatory in the Far East. But it was preceded by another from whose tower astronomers studied the stars and kept records of comets, sunspots, meteors, and the movement of the planets during the first century before Christ.

They even calculated in advance eclipses of the sun and moon.

Korea led Japan out of the Dark Ages. Much of the culture which Korea gave Nippon was Chinese.

To go back further still, it was the hand of India that reached through China and Korea and lifted Japan. Indian Buddhism, enriched in China and Korea, carried civilization with it.

The Buddhist priests had time to study and to teach. Just as the Church was for centuries responsible for education in Europe, so the Buddhist monastery was the school, the art gallery, the science laboratory, and the seat of culture and learning in Asia.



Willard Price

Unlike Their White-clad Parents, Korea's Chubby Children Wear Colored Garments

Lacking a pocket, this boy ties a packet of papers in his kimono strings. He eats first with the men; his sister dines with mother on what's left. If they went to school, they were instructed in Japanese. Korean was taught only as a literary language.

Buddhist missionaries were the teachers of Japan. They were sent by a Korean king in the sixth century to work among the island barbarians. As the new teachers were accepted, others followed, and temples and monasteries were built. The entire nation from the Emperor down adopted the new religion (pages 440, 448).

Japan's Debt to Buddhist Priests

But Buddhism was more than a religion—it was a complete system of enlightenment. Korean Buddhist priests taught the Japanese reading and writing, medicine, astronomy, architecture, music, painting, wood carving, bronze work, literature, philosophy, political and social administration—everything except the art of cleanliness which the Japanese, though barbarians, knew better than their teachers.

The esthetic qualities of Japan so widely acclaimed came almost bodily from the con-

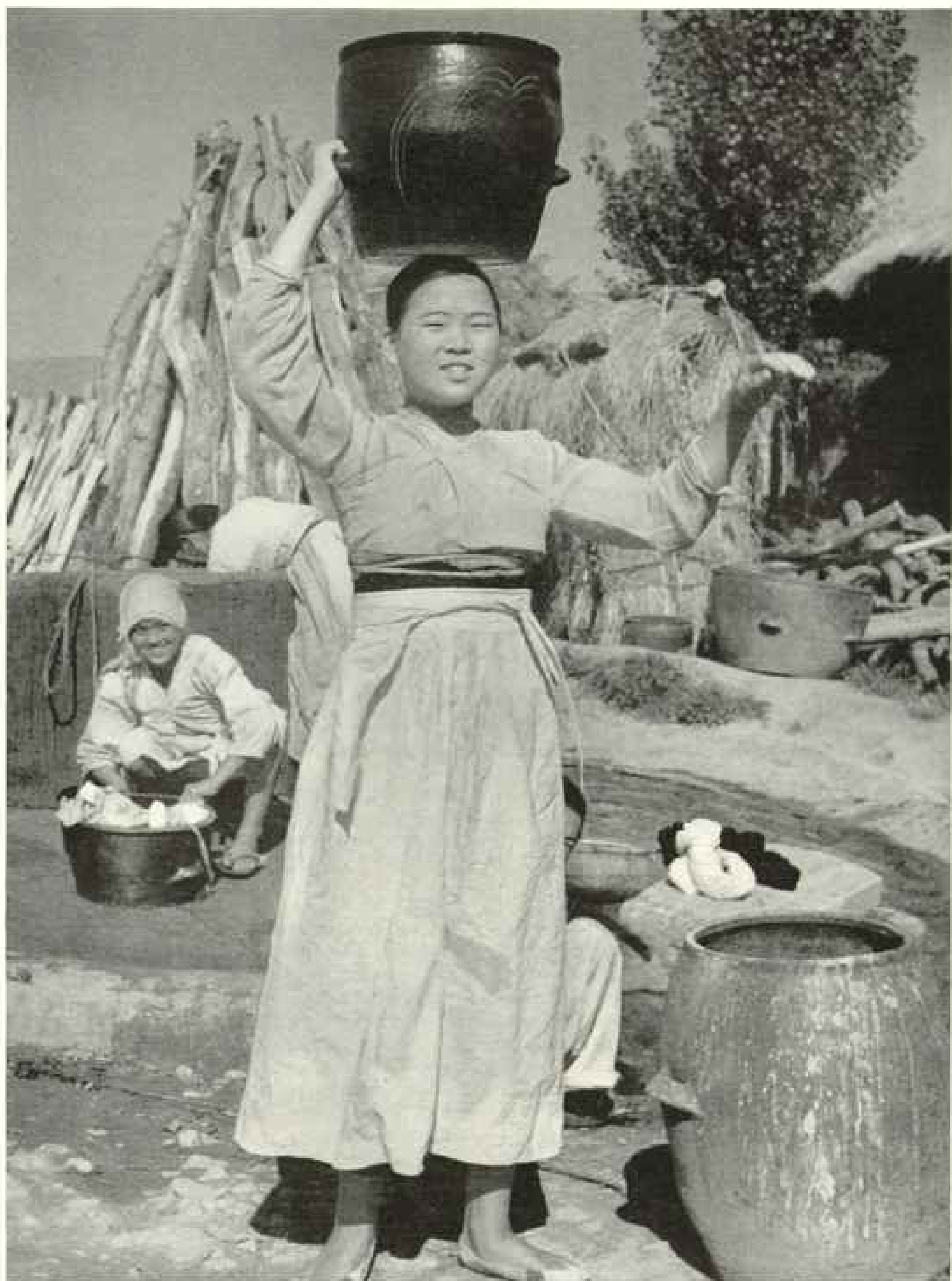
tinents; the love of poetry, of gardens and flowers; skill with lacquer and silk; the courtesies of daily life.

It must be granted that the Japanese were receptive students. Even in barbarism they were possessed of great pride, and they did not rest until they had mastered all the knowledge of their teachers.

They always resented the fact that they must learn from others and instinctively plotted revenge.

They ached to show the superior Koreans and Chinese that they, the Japanese, were, after all, better men, just as in a later century they could not rest until they had flung down the gauntlet to another of their teachers, the West.

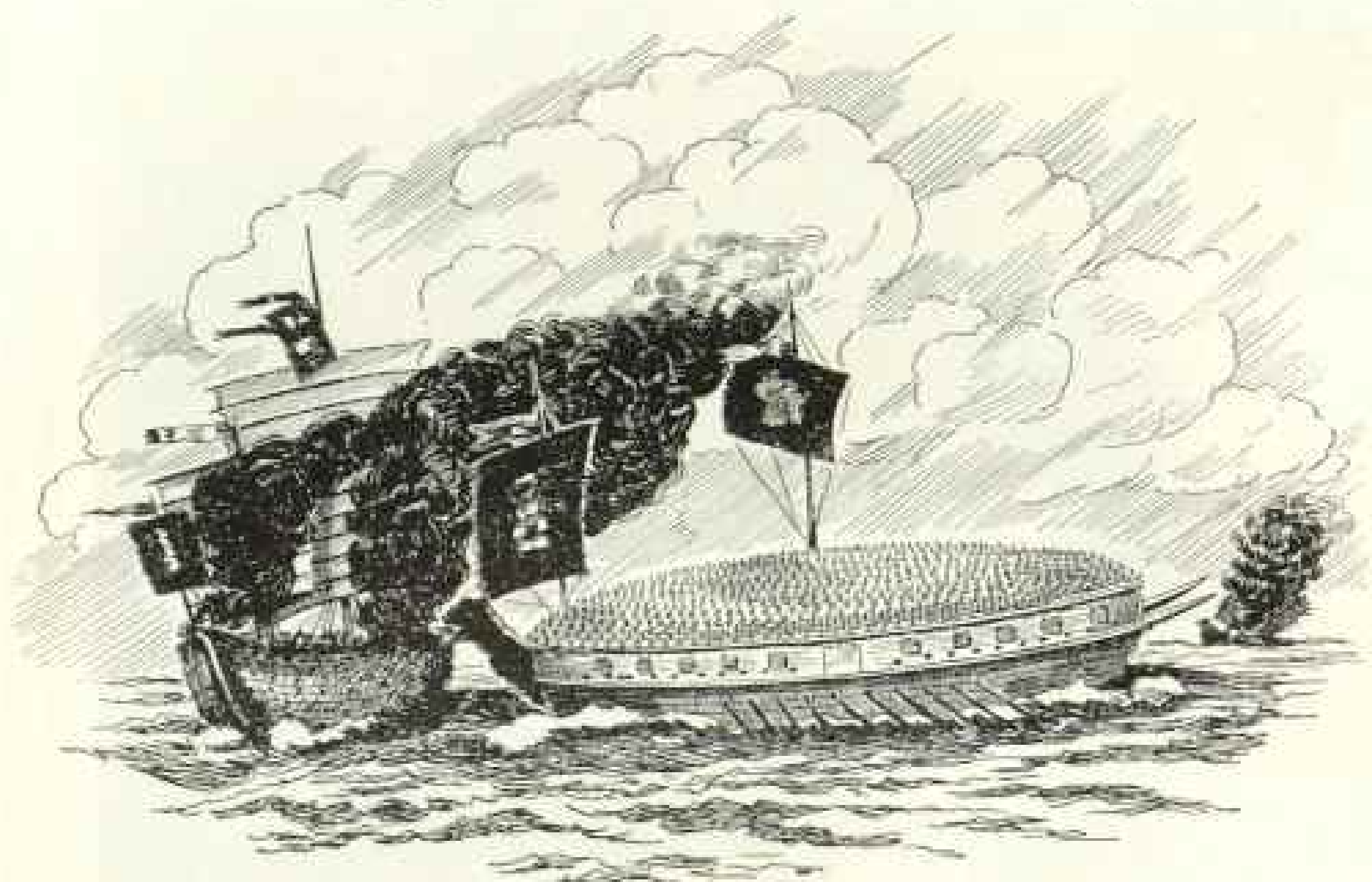
The swashbuckling general, Toyotomi Hideyoshi, in 1592 resolved to punish Asia for her superiority. Japan's benefactors had been Korea, China, and India. Hideyoshi set out to conquer them.



Frederick L. Hamilton from *Three Days*

Koreans Dress in White; Their Wives Pay Toll with Long Hours in the Laundry

Once so many royalty died in quick succession that white, the color of mourning, became the fixed fashion (page 437). A statistician figured Korean women spent three billion hours a year washing, ironing, and sewing. To get more work, Japanese ordered Koreans to be practical and wear darker clothes, but they refused.



From Korean Affairs Institute

With the First Ironclads, Koreans Rammed and Burned Jap Warships 3½ Centuries Ago

Iron plates shielded the sides, and spikes repelled boarders. The turtle's-beak prow rammed ships and shot fire arrows. Propulsion was by oars and sails. Korea's Admiral Yi Sun-sin not only invented "turtle boats"; he led them. Twice he sank Japanese fleets in two campaigns.

"I shall do it," he bragged, "as easily as a man rolls up a mat and puts it under his arm." He believed that destiny was his, for a soothsayer had told him, "Wherever the sun shines, all places shall be subject to you."

When warned that he should take along a Chinese interpreter, he retorted, "We shall teach these Chinese to use *our* literature."

He announced that he would fill the sky of Asia with the hoarfrost from his sword.

He would clean up Korea first. In 1592 he dispatched an army of some 250,000 men to Korea, and later another 100,000.

Early Bombs and Ironclads

For six years Japanese armies ravaged Korea. In the end they were beaten. Korea thus stands out as the only nation in the world that has ever whipped Japan. She had the help of friendly Chinese.

But the chief achievement was her own in devising weapons that broke the morale of the Japanese.

One of these weapons was a bomb. One day a great iron ball came hurtling into the courtyard of a castle held by the Japanese. The samurai gathered to look at it. Suddenly it exploded, killing thirty men.

Gunpowder had of course long been known and used. But the exploding shell was new

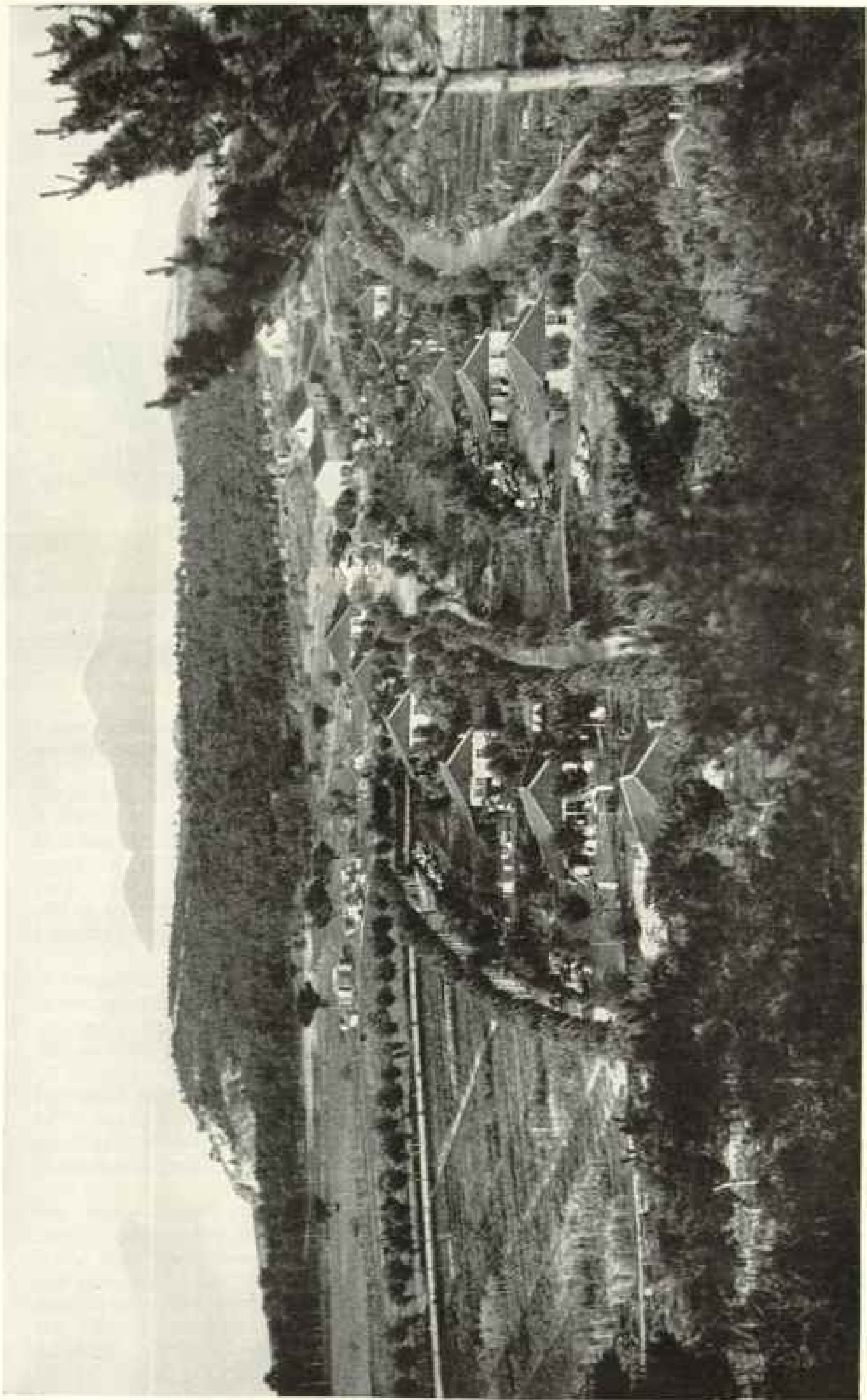
in this part of the world. Its inventor was a Korean, Yi Jang-son, and he appropriately named it the "flying thunderbolt."

It came into general use on the part of the Koreans and their Chinese allies, but there is no record that the Japanese, skillful imitators that they were, succeeded in copying it. Japanese soldiers were inclined to regard it as supernatural, and it had a great effect in disorganizing and demoralizing Nippon's arrogant armies.

When a large Japanese fleet attempted to go to the relief of the troops, it encountered a new horror—nothing less than a gigantic tortoise, large as a ship, which came swiftly toward them over the water.

It had a dragon's head fitted with horns and from the mouth came blasts of flame. The terrified sailors could not know that the flame came from a bronze rocket gun, prototype of the modern flame thrower.

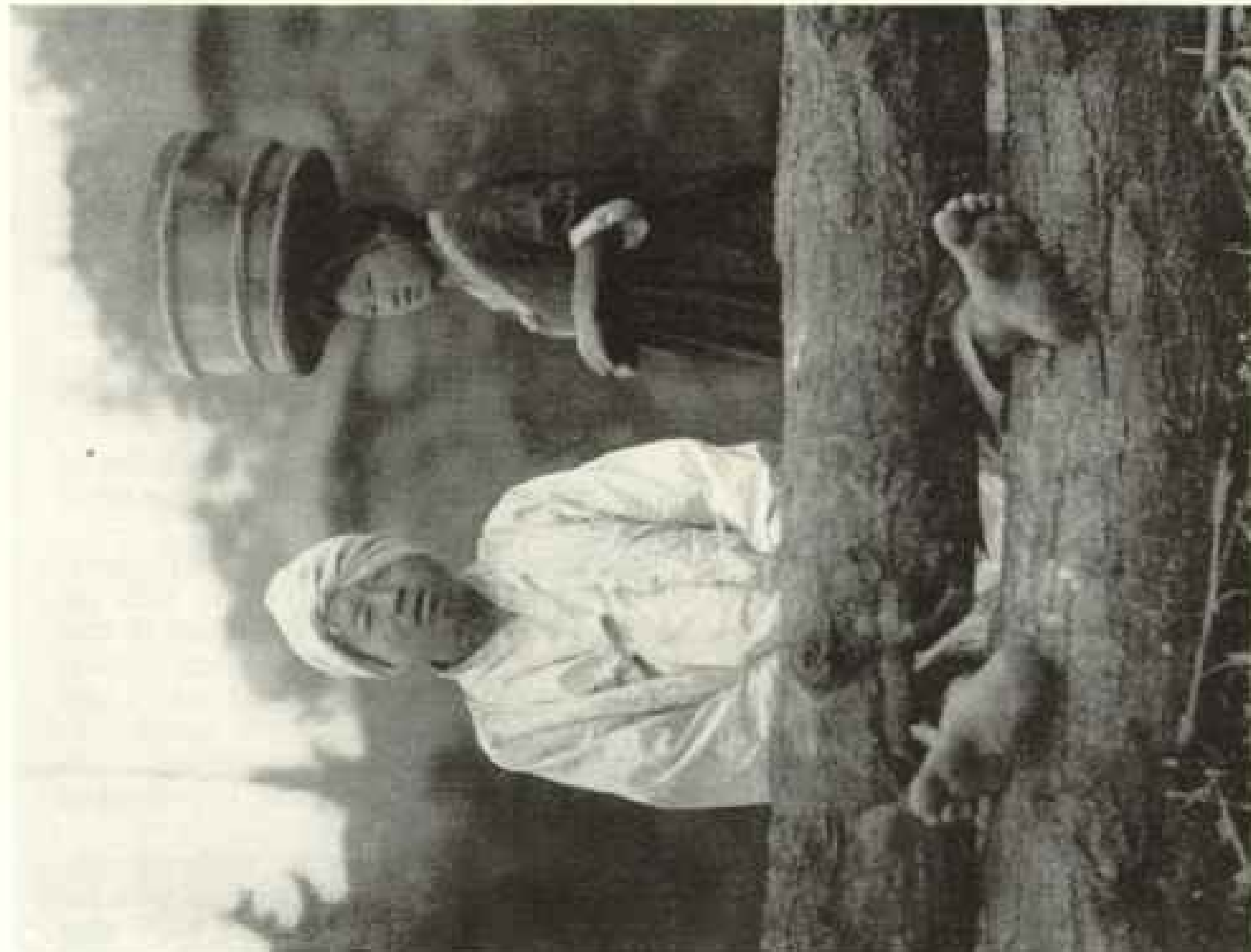
Long oars projected through ports and propelled the craft swiftly over the surface. Above the oar ports were others from which cannon were fired. The top of the ship was curved like a turtle's back and covered with metal plates, as were the sides, for this was probably history's first ironclad. Japanese balls bounced harmlessly from the copper and iron shell.



Willard Price

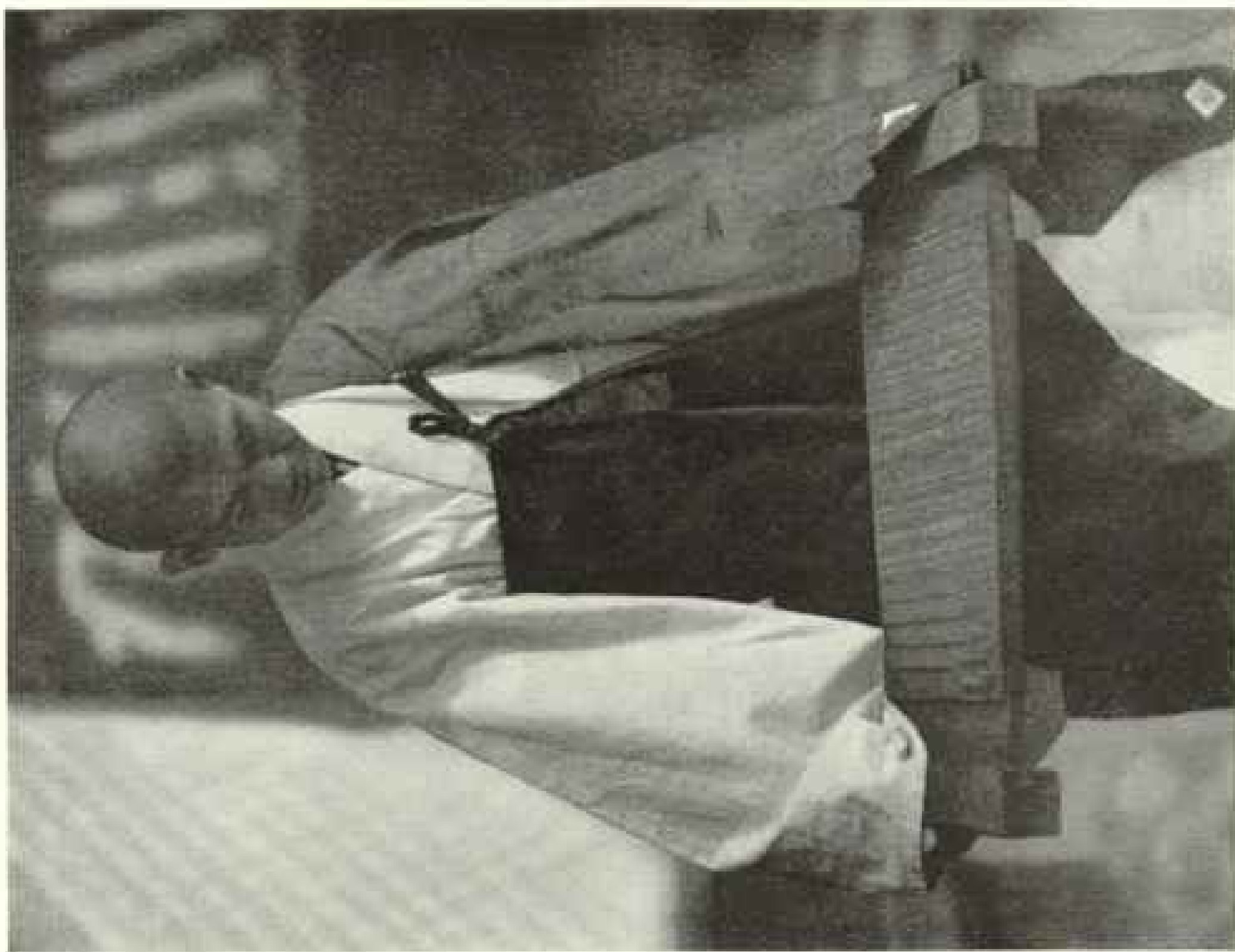
At This Inviting Seaside Colony American Medical Missionaries Cared for 800 Outcasts, Victims of Leprosy

Formerly Korean lepers roamed the countryside; a few still do. Some practiced cannibalism in hope that human flesh would cure them. Near Junien (Suncheon) the Southern Presbyterian Church operated these rest homes and a hospital. Lepers grew their own food, caught fish, and made handicrafts. Japanese, acknowledging the leprossarium's value, made contributions. However, they jailed its native pastor for rejecting Shinto shrines and emperor worship. Now its missionaries, like some 600 others in Korea, have gone home. Some were imprisoned and tortured.



Locked in Stocks: His Treatment for Insanity

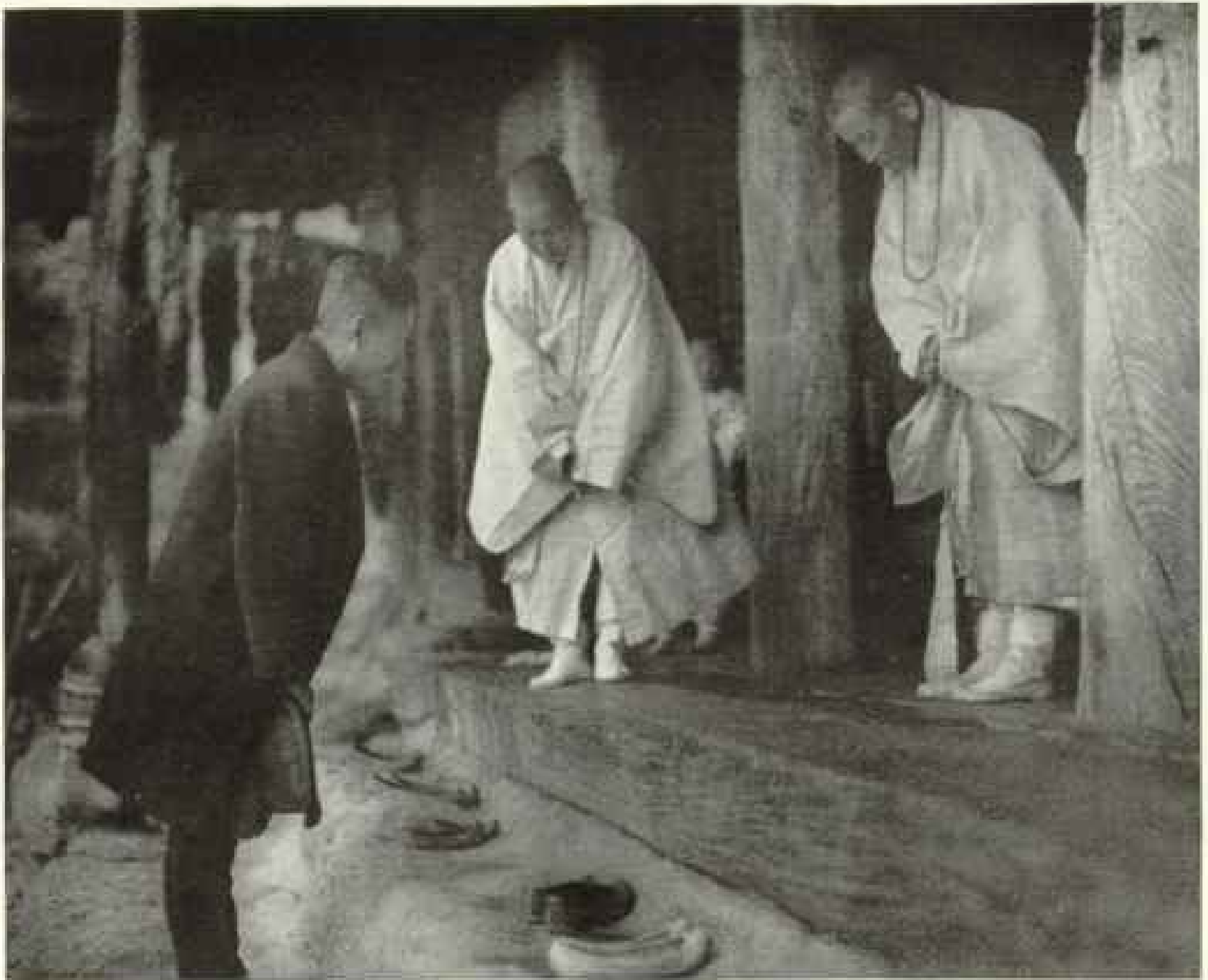
Japan did nothing about Korea's insane. Some were chained. This man has been violent. His family locked him up, trusting the "evil spirit" would tire of confinement and leave the body. When gangrene threatened, the patient was taken to an American doctor. He poses in reconstructed stocks.



Willard Peyer

Korea's Prides: Alphabet and Movable Metal Type

That his people might learn to read, one of the early kings directed the creation of a phonetic alphabet. The king, too, ordered movable metal type faces, anticipating Gutenberg's invention by half a century (page 441). Japan suppressed both accomplishments. She foisted her own language on Koreans.



Willard Prier

Buddhist Nuns in Stocking Feet Bow to a Japanese Visiting Their Mountain Temple

Centuries ago Koreans took Buddhist civilization to Japan (page 442). Later the Korean government discredited the faith, and monks and nuns retired like hermits to the Diamond Mountains. Wartime Japan, to undermine Christianity, sent her own Buddhist missionaries to Korea and restored temples. Also Japan compelled Korean school children to revere Shinto's Sun Goddess. Here rubber slippers, Japan's export, are left outside the temple door.

This *ku-sun*, or "tortoise boat," had been invented by the Korean Admiral Yi Sun-sin. Numbers of them appeared before the war was over.

Humility finally overtook Hideyoshi on his deathbed in 1598.

"Alas!" he murmured. "Like the falling and vanishing dew am I."

He recalled the warning of the Korean king that an attempt to conquer Asia was like trying to bail out the ocean with a cockleshell. He had stubbornly forced his discouraged troops to fight on in Korea. Now he turned to his aide.

"Let them come home," he said, and died.

40,000 Ears and Noses of Enemies Were Trophies of War

The troops gladly came home. They brought with them the ears and noses of 40,000 of their victims. These were placed in a

mound near the statue of Buddha at Kyoto. The "Ear Mound" still stands, and teachers bring their children to it that they may have clear evidence that Japan was really victorious over Korea.

For it is a jealously guarded tradition of Japan that she has never been and can never be defeated.

In a sense, Japan did defeat Korea utterly. Hideyoshi had indeed filled Korea with the hoarfrost from his sword. The blight of that terrible frost remains today. Korean civilization was almost completely wiped out. Cities were ruined, monasteries were burned, libraries destroyed, scholars put to death. Six years of rapine and slaughter impoverished the people.

Now the bitter struggle for existence consumed every moment; there was no time for the arts and refinements of life. From that holocaust Korea never recovered.

The old skills were dead. But they lived on in Japan. A single example is pottery. The Japanese officers recognized the glory of Korean pottery, and when they retreated to Japan they took with them the only remaining Korean potters they could lay their hands on.

These were settled in a colony in the old province of Satsuma and were set to work. That was the beginning of the famous and beautiful Satsuma faience that makes tourists marvel at Japanese artistry.

But with the skilled workmen, the skill vanished from Korea.

This was not the first Japanese invasion of Korea nor was it the last. Repeated attacks upon the weakened nation culminated in annexation in 1910.

Japan, finally master of the long-coveted peninsula, began to work miracles. Roads and railroads were built, mines dug, new land put under cultivation, natural resources of all kinds developed.

Barren hills were reforested, harbors were deepened, fisheries were financed. Plumbing made cities safe for the incoming Japanese. Money was sound, a competent police force ensured order, new factories offered employment.

It looked like a new day and a better day for Korea. And it was, for Korea, but not for the Korean.

That distinction may seem subtle, but it is important. While his country has gone upward, the Korean has gone downward. Goldsmith would recognize Korea as a land "where wealth accumulates and men decay."

Korea Produced—for the Japs

Korea produced. Trade grew by leaps and bounds. But it was trade by Japanese with Japanese for Japanese. The Korean had no part in it, except as a serf. The 650,000 Japanese of Korea used 24,000,000 Koreans as their tools in the exploitation of this rich land.

The menial tasks fell to the Korean. He could hold few important positions. Such a job would ordinarily be occupied by a Japanese even if the Korean were better trained, and so often he was not trained. Seldom was he allowed to go beyond grammar school. There is only one small university and it was mainly for Japanese.

The Korean was not even sure of grammar-school education. Schools were provided for only 1,200,000 children; two million go without. And the curriculum of these inadequate schools was very limited.

On my last visit to Korea I saw how re-

lentlessly Japan had pursued the policy explained to me by Governor General Masakata Terauchi on my first trip there.

"You Americans make a mistake in the Philippines," he had said. "You give the same education as in America. Here we shall not train the Korean for work that he will never need to do. His education will be agricultural and industrial. With the trained hands of the Korean and the trained brains of the Japanese, the destiny of Chosen will be fulfilled."

It has been fulfilled, to the satisfaction of the Japanese. Koreans performed the manual labor under the direction of competent Japanese executives and engineers.

Work Is Compulsory

Rarely were Japanese coolies employed along with Koreans. If so, they were paid twice or three times as much. On road construction sometimes Koreans received no payment.

If you were Japanese, you might order any Korean to work for you and punish him if he did not comply. If he took the case to court, he would almost certainly be turned away without a hearing.

Japanese foremen, without vestige of government authority, have compelled villagers at the point of the revolver to work on the railroads at one-third of the standard wage. If, because of other duties or inability, they could not go to work on the tracks, they were required to pay for each day off twice what they would have received in wages.

This blackmail in one town amounted to \$20,000. In order to pay, people were forced to borrow a part of it from Japanese usurers at 12 percent a month interest.

The effort of a Korean to "better himself" was quickly checked. If a Korean storekeeper began to have a little success, a Japanese store opened near by and, with Government support, pegged prices so low that they could not be met. Consignments to the Korean store were mysteriously broken or lost in transit. Things went from bad to worse.

One day a Japanese would drop in and buy the store, at his own price.

Fate of the Korean Farmer

But the saddest tragedy of Korea is the fate of the farmer. More than three-quarters of the people depend upon farming for their living. So systematically have their farms been taken from them on one pretext or another that more than 50 percent of the farmers were full tenants under Japanese landlords, and another 30 percent were part tenants.



W. O. Dyer

For Milking, an Ingenious Platform Raises the Goat, and Hay Keeps Her Quiet

Not boiled snakes, superstition's remedy, but fresh milk was served to tuberculosis patients in the Methodist sanitarium at Kaishu. Since 1937, the Japanese oppressed Christians in Korea. They searched missionaries' homes, packed church assemblies with soldiers, and persecuted Koreans for even talking to Americans. Most mission church schools closed rather than teach emperor worship, as required.

Half of the year's produce had to be delivered to the landlord. Much of the remaining half went in taxes and other exactions. The farmer came out with about 17 percent of the total yield of his farm. This did not feed his family until the next crop could be harvested.

During the spring, when the storage jars are empty, many families must live on bark, grass roots, rice hulls, and weeds.

The Koreans have a name for this unhappy annual experience. It is "the spring suffering."

And this in a land where it was formerly much easier to make a living than in Japan or China, since the ratio of arable land to population was greater than in those countries. The rice yield of Korea was so bountiful that frequently rice had to be thrown out of the storehouses to make room for the next crop.

From an annual rice consumption of 220 pounds per person in 1912, the amount dwindle

dled to 133 pounds in 1933. It is now from 10 to 20 percent less, because of the exportation of rice to Japan.

The Korean standard of living has been reduced by at least half during the Japanese regime.

There is not space for me to set down one in a hundred of the details accumulated on four visits to Korea concerning life under alien rule.

Hardships of Alien Rule

Some of the most memorable to me were the strict suppression of free speech, the burning of Korean books, the destruction of ancient culture, the jailing of Korean editors, the banning of the Korean language in the schools, arrest without warrant and frequently prison without trial, tortures reminiscent of the most ingenious inventions of the Inquisition, the massacres of 1919, 1923, and



Willard Prior

A Modern Doctor Interviews Two Old-timers in Presbyterian Hospital, Taikyu

Some 500 like him have been graduated at Seoul by Severance Union Medical College, a joint enterprise of several Protestant denominations. They are the hope of their superstition-ridden country. Some are sons of old-time practitioners. Japanese tolerated medical education for colonials, as their own doctors did not care to treat Koreans. Left: a transparent horsehair hat, worn indoors and out, reveals the topknot, old Korea's badge of marriage (page 457). Center: the amber-bead chin strap denotes a man of standing.

1942, and, above all, the unflagging determination of the Korean people to regain, some day, their independence.

Japan blames America for much of Korea's recalcitrance. And it is true that American missionaries have been great "troublemakers." Not that they set out to make trouble. But the teaching of Christian democratic principles in the mission schools has stiffened the Korean demand for self-rule.

"Americans Are Our Best Friends"

"Americans are our best friends," many Koreans told me.

American doctors introduced modern medical science to displace belief in a tourniquet of woman's hair to cure snakebite, the stocks as treatment for the insane (page 447), the puncturing of the body with needles to let out evil spirits.

Woodrow Wilson's Fourteen Points and his doctrine of self-determination raised high hopes in Korea. Those hopes were revived by the late President Roosevelt's promise of the Four Freedoms.

The Koreans will be our staunch allies if the time comes to make use of this stepping-stone at the very threshold of Japan.

In the meantime, their story offers the most solemn warning to those Indians, Burmese, Malays, Filipinos, and Chinese who may, in moments of despair, be tempted to trade their hope of ultimate freedom for "co-prosperity" under Nippon.*

* For additional articles on Korea in the NATIONAL GEOGRAPHIC MAGAZINE, see: "Chosen—Land of Morning Calm," by Mabel Craft Deering, October, 1933; "In the Diamond Mountains," by Marquess Curzon of Kedleston, October, 1924; "Exploring the Unknown Corners of the 'Hermit Kingdom,'" by Roy Chapman Andrews, July, 1919.

Flaming Cliffs of Monument Valley

BY LT. JACK BREED, USNR

ON A MAP of the United States find the only spot where four States meet—Utah, Arizona, Colorado, and New Mexico. There, just west of “four corners,” sprawls mile-high Monument Valley, spectacular desert land of red stone skyscrapers.

I first heard of Monument Valley while traveling through the Southwest in 1935. Fantastic stories about its huge buttes, astride the Arizona-Utah border, inspired me to see them.

With a companion to help with the “pushing,” we drove up U S 89 from Flagstaff to Tuba City, both in Arizona, and thence by the Rainbow Trail through the heart of the Navajo country to Monument Valley. Since that first trip we have made eight more.

Our goal was the trading post operated by Harry and “Mike” Goulding, often called the “King and Queen of Monument Valley.” They have been the Valley’s sole year-round white residents for two decades.

Skyscraper City of Red Sandstone

One crystal-clear July day in 1922, Goulding, a young shepherd, was riding the range in the “four-corners country,” searching for stray sheep. The land was new to him.

Suddenly, at Comb Ridge, the view to the west took his breath away (Plate II). Far across the hot plains spread a skyscraper city. Flaming Woolworth Towers and Flatiron Buildings—huge buttes of red sandstone—rose from the desert. Some mighty blocks even had gigantic “windows”—natural bridges (Plate VIII).

This was fabulous Monument Valley.

Later, Goulding returned with his wife and set up permanent “diggings” in the Valley.

At first they lived in a simple shepherd’s tent. But soon they won the friendship of the Navajo, and their shepherding became a trading business. A two-story stone trading post was built for them by the Indians. Now this sandstone house, perched on a natural step near Old Baldy Mesa, serves as headquarters for many visitors.

The post has the conveniences of a city home—electric lights, refrigerator, gas stove, bathroom with tub and shower, fine Navajo rugs on the polished floors, even a piano.

Downstairs is a combination pawnshop and general store. Every item a Navajo could wish, mostly from a mail-order-house catalogue, is on display.

The Goulding place is 100 miles from the nearest railroad. There are no towns in the Valley, no telephones, no street lamps, no

hard-surfaced roads. To get mail we had to drive 27 miles to the village of Kayenta, Arizona. To shop Saturday nights we motored 175 miles to Flagstaff.

Across the Gouldings’ “front yard” marches a parade of monuments rising a thousand feet above the plain. They look only a stone’s throw away, yet they are over eight miles distant. The clear, dry air at mile-high altitude makes distances deceiving.

Valley Has an Airport

Goulding has constructed a hard-packed airfield snuggled beneath two lofty mesas. Three-thousand-foot runways crisscross the desert. Citizens in Albuquerque, New Mexico, or Cortez, Colorado, fly visitors to the Valley airport.

The Valley is a geologist’s paradise. Originally it was level with the tops of its tall monuments, roughly a thousand feet higher than the floor today. A huge body of water covered the area. In succeeding ages extensive uplifts occurred and the sea drained off into the stream beds which now are the Colorado and San Juan Rivers.

Gradually the rivers cut the land away, carrying off enormous quantities of the softer sands and shales. Isolated mesas and buttes of more resistant material were left standing above the plain.

Canyon walls were undercut and giant caves formed. Sometimes thick chunks of the roofs fell in, leaving jagged holes. Running water and wind-blasted sand grains gradually smoothed out the edges, forming natural bridges.*

With only about eight inches of rain each year now, Monument Valley is not eroding very fast. Even in a thousand years, little change in its profile will be noticeable.

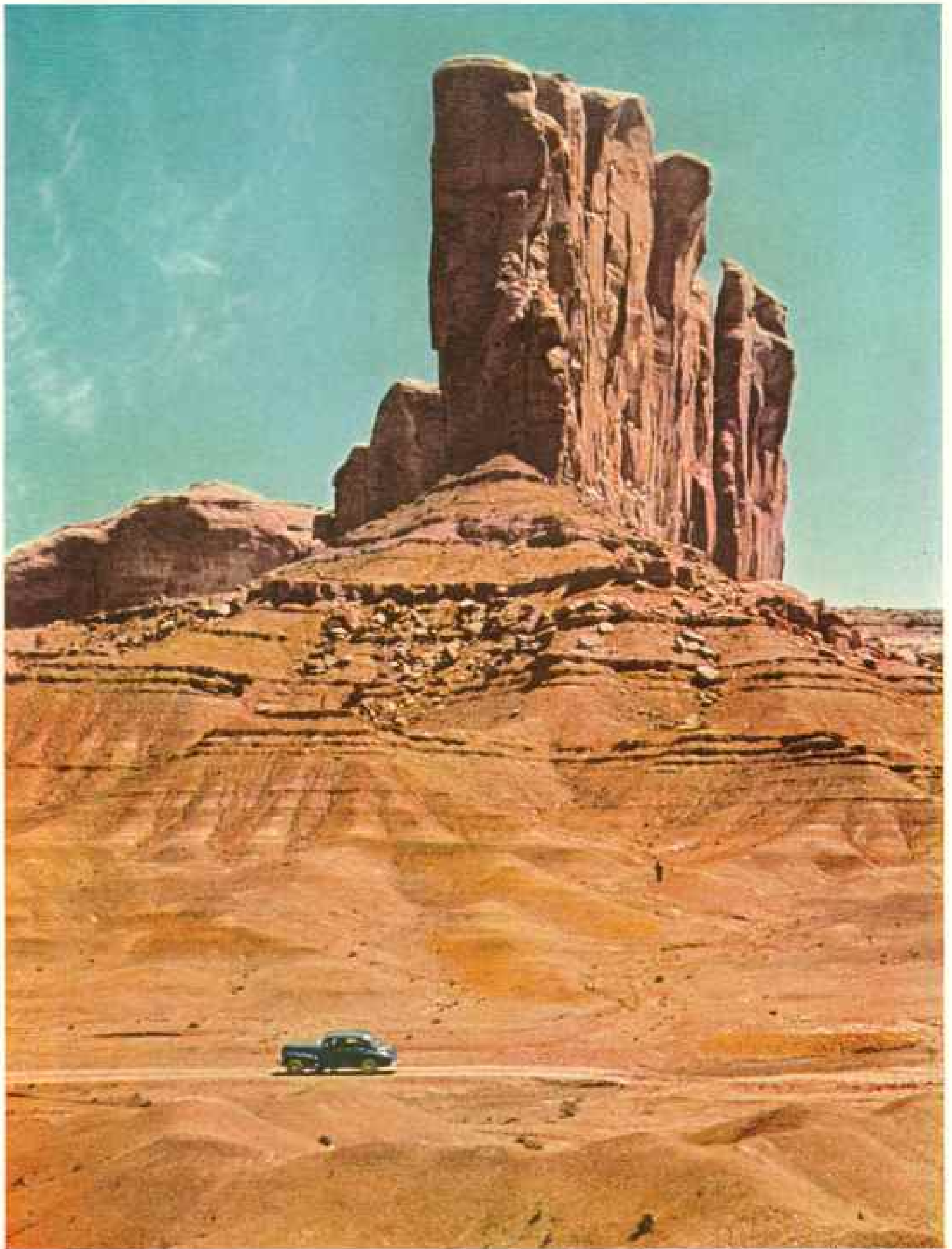
The first white people to view Monument Valley are not known. Spanish friars from Coronado’s expedition in the middle 1500’s may have passed close by, but probably they did not cross the nearly waterless Valley. About 300 years later, in 1864, some of Kit Carson’s men pursued the Navajo in Canyon del Muerto,† 70 miles southeast of the Valley.

Explorers and scientists penetrated the region, to study its prehistoric Indian cultures or to prospect for precious minerals. But not until the early 1900’s, when John Wetherill

* See “Great Rainbow Natural Bridge of Southern Utah,” by Joseph E. Pogue, in the NATIONAL GEOGRAPHIC MAGAZINE, November, 1911.

† See “Exploring in the Canyon of Death,” by Earl H. Morris, in the NATIONAL GEOGRAPHIC MAGAZINE, September, 1925.

Flaming Cliffs of Monument Valley



© National Geographic Society

Kodachrome by Warren T. Miloff

Heat and Cold, Moisture and Drought Sculptured This Memorial to a Navajo

Cly Butte was named for an old Indian saddle maker who lived near by and was buried at its base. In accordance with Navajo ritual, his horse and some sheep and cattle were killed to accompany him to the happy hunting grounds. Many such red sandstone towers rise from mile-high Monument Valley, lying astride the Utah-Arizona border in Navajo Indian Reservation. Flocks are the livelihood for 300 Indians living in the valley.



© National Geographic Society

Kilburne to Jack Boveri

Clear as Crystal Is the Hot, Dry, Air of Monument Valley; Mitten Buttes (Left) Are Actually Three and Six Miles Away

Merrick Butte (right), named for a prospector who was murdered at its base by Indians, is four miles beyond the two Navajo horsemen and Harry Gaulting, Monument Valley guide. The pillars average close to 1,000 feet in height above the desertlike floor. Comb Ridge in the distance is 25-30 miles away.



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Pity the Papoose Strapped Tightly to a Cradleboard

Before their brush-covered summer hogan, a young Navajo mother poses her infant for his first portrait. Heat and flies must be unbearable for baby. The mother wears traditional dress—a velvet-lined jacket and large pleated skirt.



Illustrations by Jack Broad

Little Gambler, One of the Oldest and Best-loved Navajos

Ada-Ki-Yaah, medicine man of Monument Valley, is expert at making Indian mud paintings, part of the curing ceremony for sick people. He wears his favorite red shirt, spát-bottom trousers, moccasins, and a turquoise necklace.



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Redrawn by Jack Breen

Beneath the "Three Sisters" a Young Navajo Shepherdder Waters His Flock in a Monument Valley Mudhole

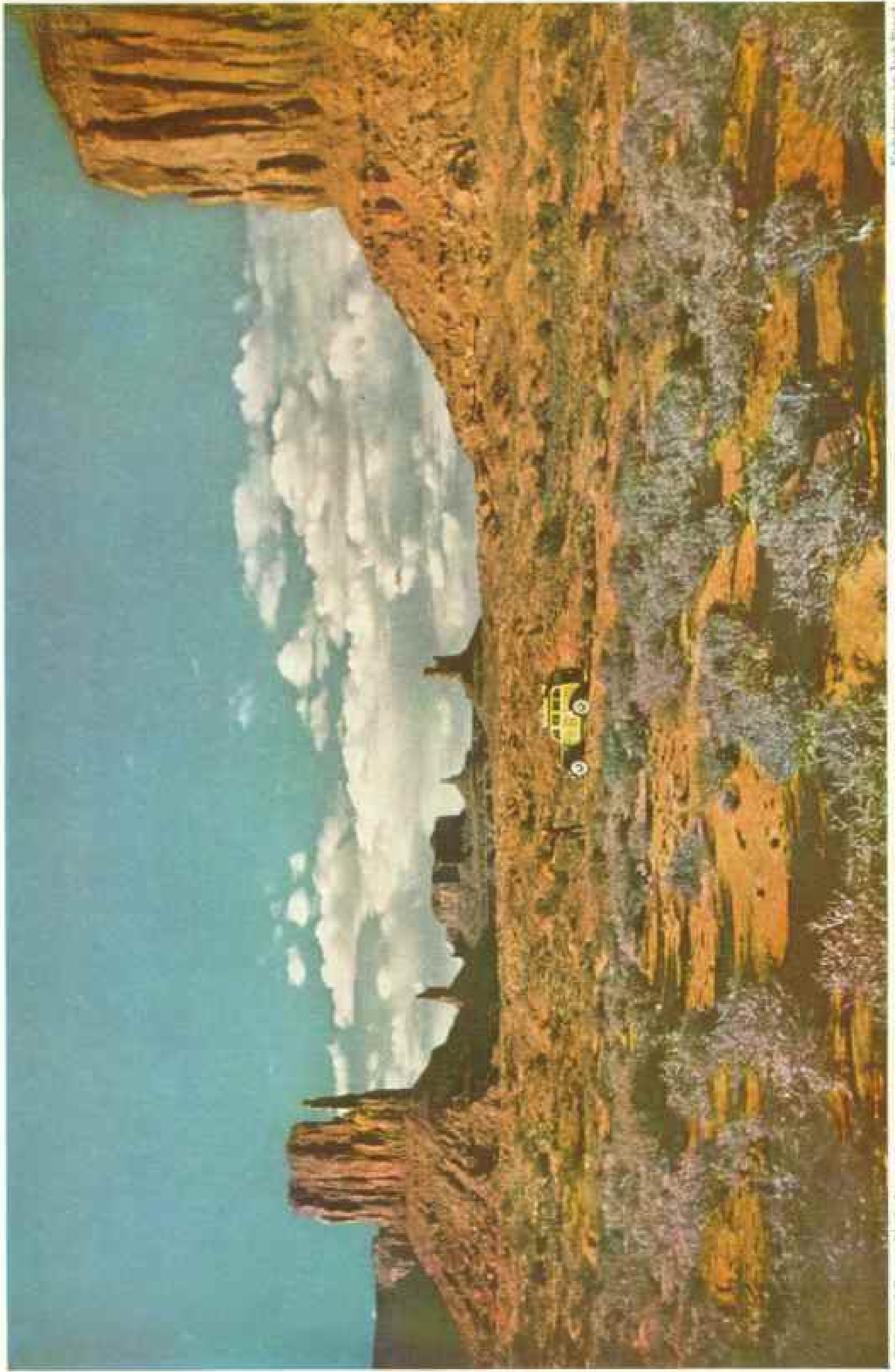


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Photomontage by Arca-Fronte

In Stately Procession the "Three Sisters" March to the Red Rock "Cathedral" in Monument Valley

The "Pillboxes," bringing up the rear, seems to have her hands folded sedately; even her features can be made out. Snow sometimes tells the figures towering some 800 feet above the valley floor. Brief cloudbursts have washed away the mud covering from this deserted winter hogan, leaving exposed its skeleton of logs and sticks.

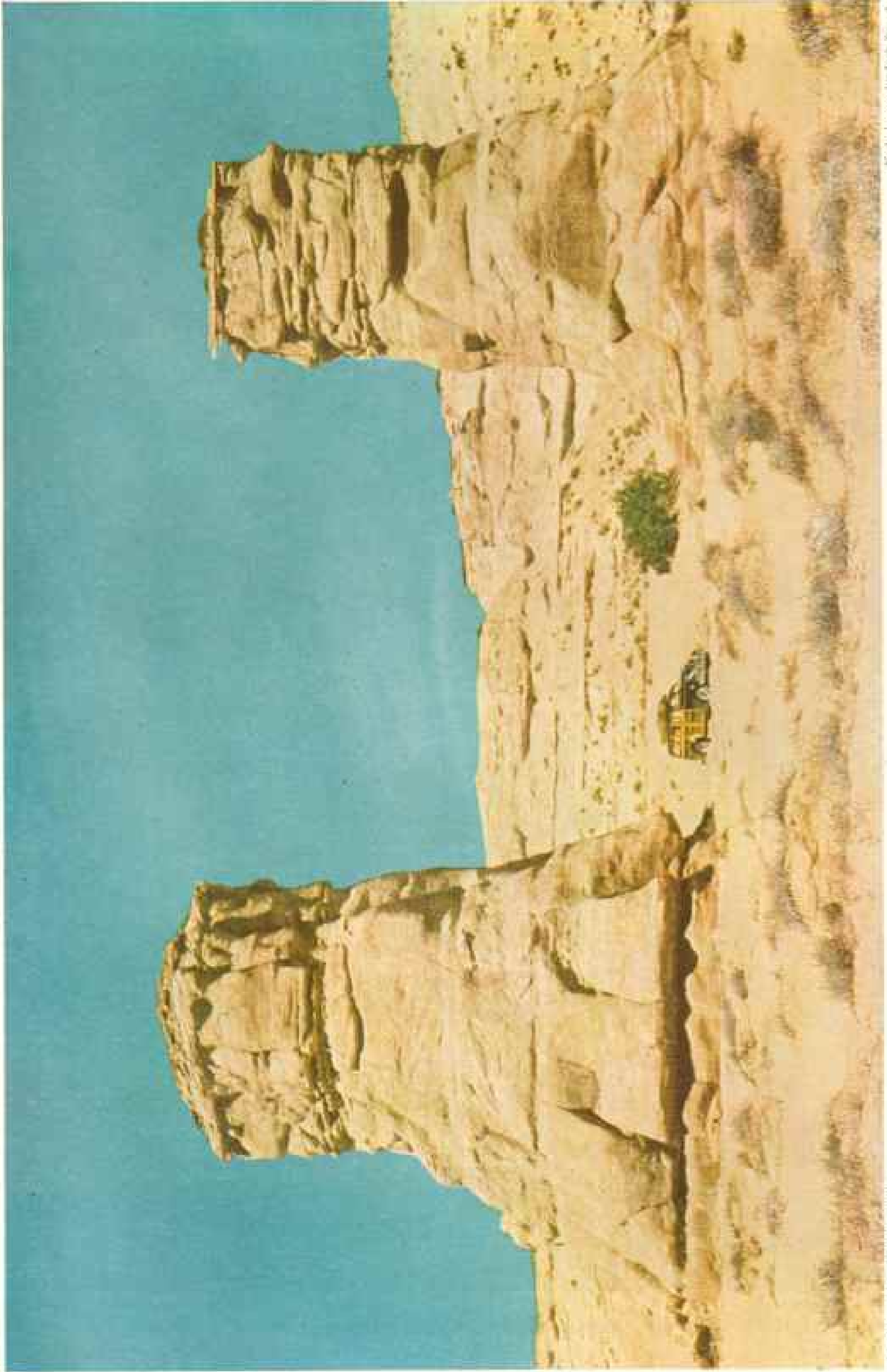


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"A Yellow-and-purple Corrugated World of Distance," Zane Grey Described Monument Valley

Flat tops of the brilliant turrets mark the level of a vast plateau through which water carved its way ages ago. Wind, sand, rain, and frost chiseled the buttes into odd shapes. To the left is Mitten Butte, over the car appears Castle Rock, and to right, Merrick Butte (Plate II). Late evening shadows creep out for miles.

Monument by Jack Breen

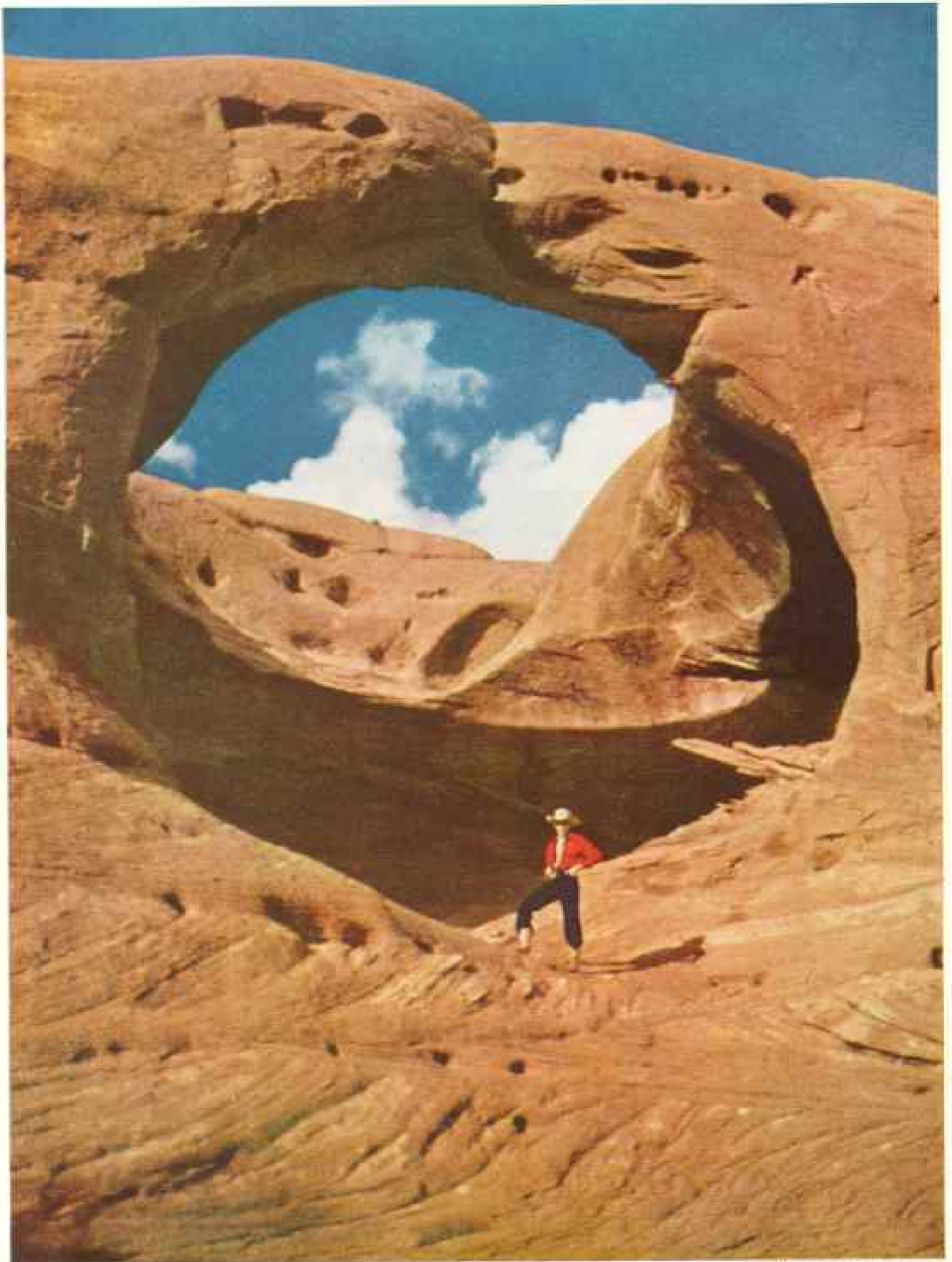


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Elephants Feet Buttes Stalk Across the Desert Like Prehistoric Giants

At Tontula, on the rough sandy road leading into Monument Valley from Cameron, Arizona, the motorist sees these fantastic sandstone towers. Hard caps on top served as roofs protecting the monoliths from weathering. During the war, Navajos have mined much rich vanadium ore from such cap rocks in the valley.

Woolwicher by Jack Reed



© National Geographic Society

Photograph by Jack Birell

Holes in the Rock, Indians Call Such Red Sandstone Natural Bridges

Monument Valley has many stone arches gouged out by water and carved and smoothed by wind-driven grains of sand. West of Monument Valley in Utah lies Rainbow Bridge National Monument, famous for its huge arch that rises 300 feet above a small clear stream. Ruin is scarce; only eight inches falls annually.

explored the mesa country, did the real wonders of the Valley become known.*

Cliff dweller pueblos are found in larger caves of the Valley. Usually ruins are small one-family clusters, but some cave villages contain 200 rooms, thus rivaling the more famous Mesa Verde in neighboring Colorado. Navajos say there are many fine pueblos still undiscovered in distant canyons.

To visit these red pillars, natural bridges, and pueblo ruins in isolated reaches of the Valley, Harry Goulding took me for a trip in his sand-duning vehicle. Behind a tractor with deflated balloon tires, his homemade trailer bounced along. Dry arroyos became our highways, sand dunes our short cuts. Our Indian guide took us to many new canyons probably not seen by white men before.

We saw Navajos in their family wagons creaking across the Valley to the nearest water hole, sometimes more than 20 miles from their earth-covered homes (Plate V). At one stop a Navajo girl had her papoose out for an airing. We wondered how the baby, strapped so tightly to its cradleboard, could survive the heat, dust, and flies (Plate III).

Goulding is the Indians' best customer. Goats and sheep, he explained, provide the fine wool from which the women weave their blankets and rugs. These are traded at the post for flour, sugar, coffee, bright-colored shirts for the menfolk (Plate III), and even sunglasses! Wool not used for weaving is traded in its raw state for household articles that catch the Indian's eye. Goulding in turn ships the handiwork to Gallup and Shiprock, New Mexico, or to Holbrook, Arizona.

Navajo Men Make Jewelry

In their spare time the Navajo men make jewelry, such as handsome bracelets and necklaces, concha buttons and buckles, all hand-fashioned from silver and adorned with bits of turquoise. The shiny trinkets are traded at the post.

Bouncing over the purple sage, we passed two huge blocks rising like giant red tombstones—and tombstones they really are. Mitchell Butte and its neighbor Merrick are named for two unwelcome prospectors who sought secret silver mines in the 1880's. They tried to worm the location from Navajo chiefs. Younger braves became suspicious. One night they crept up to the prospectors' campfire and murdered the plotting Mitchell near the base of the butte that bears his name.

Merrick escaped and hid among the tumbled rocks at the base of another monolith (Plates II, VI). Forced out by thirst and starvation a few days later, he was killed by the Indians.

Many other buttes earned their names from their resemblance to various objects, such as Rooster Rock, the Old Indian, Elephants Feet (Plate VII), and others. Meridian Butte is located on the 110th meridian.

Our Indian guide led us to Echo Cave, a huge cavern gouged from a sandstone cliff. In answer to our single shout, 16 distinct "hal-loos" came bounding back.

One late afternoon the Navajo took us hunting for rabbits. The rabbit fry that night under the moonlight was delicious. But we found nothing else to hunt. The arid Valley supports little natural life. The only wild creatures seen, besides the few rabbits scampering about the sagebrush, were a horned "toad" (really a lizard) and a collared lizard sunning itself on a warm stone. Rarely, among the rocks, we found small Arizona prairie rattlesnakes. Bird life was at a minimum, though we saw a cliff swallow now and then and occasionally a circling hawk.

The soil of the Valley is fertile—if you can water it. Our Indian guide took us to see the Navajo's attempt at irrigation. There we examined his corn crops and his melons. Some enterprising individuals had even grown potatoes, beans, and tomatoes!

Natural vegetation in Monument Valley is mainly sagebrush, scrub juniper and piñon, and a few small cacti.

Nevertheless, in springtime, after a light rain or perhaps even a snow storm (Plate V), the Valley suddenly becomes a garden of gorgeous wild flowers. Mile after mile of blue lupine, brilliant red pincushion and beavertail cactus blossoms, and the yellow and pink of the yucca brightens the drab desert. Thousand-foot waterfalls cascade down mesa sides as the snow melts. Such phenomena last only a few hours.

With the advent of the war, a new industry came to Monument Valley. Deposits of valuable vanadium ore were found in the cap rocks atop some monoliths. Navajos have been mining this essential commodity and starting it on its way to the steel mills. Their product improves the "shootin' irons" of Navajo braves fighting the Japs overseas.

Monument Valley is not a national park or a national monument. As a part of Navajoland, it is still remote and unspoiled. The Indians want it to remain that way; it is their last frontier.†

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Beyond the Clay Hills," by Neil M. Judd, March, 1924; and "Encircling Navajo Mountain with a Pack-Train," by Charles L. Bernheimer, February, 1923.

† See "Indian Tribes of Pueblo Land," by Matthew W. Stirling, NATIONAL GEOGRAPHIC MAGAZINE, November, 1940.



U. S. Army Signal Corps, Official

Over Coffee, Al Saud Meets Mr. Roosevelt on an American Cruiser in the Suez Canal.

Lamed by nine old battle wounds, the King admired and accepted the late President's spare wheel chair. In return he distributed flowing Arab robes. Invited by telegram, he made an 800-mile voyage from Jidda aboard an American destroyer. His tents were pitched and his sheep were slaughtered on the destroyer's deck. His ceremonial coffee maker was dissuaded from lighting a charcoal brazier in an ammunition room he chose as a galley.

Guest in Saudi Arabia

BY MAYNARD OWEN WILLIAMS

With Illustrations from Photographs by the Author

CIRCLING Jidda, Red Sea port for holy Mecca, our swift plane touched the soil of Saudi Arabia, where erstwhile camel drivers handle mighty machines and whose absolute ruler, His Majesty Abdul Aziz al Saud, bows to the will of Allah.

Not even Ellis Island, that other gateway to Paradise, is more yearned for than this tall, walled city, between blue water and yellow sand (pages 464, 466, and 470).

Here, in crowded *dhow*s, Mohammedan pilgrims come ashore robed in snowy bath towels and proceed to Mecca, toward which they have directed their prayers five times a day for a lifetime.

Except to such faithful *hadjis*, united by the democratic brotherhood of Moslem pilgrimage, Arabia only yesterday was an isolated land.* Today it is pumping crude oil through a submarine pipeline to the refinery on Bahrein Island and shaping high-priority equipment into a great new refinery at Ras at Tannura.

With side trips totaling nearly a thousand miles, I recently crossed Saudi Arabia in less than three weeks (map, page 469).

Terrors of Thirst and Sand

In a land where trails are dotted with the skeletons of fallen camels, where thirst is an ever-present terror, and men are still lost in swirling sands, a camera-toting war correspondent would not get far without friends.

Thanks to His Majesty, to Col. William A. Eddy, to Karl S. Twitchell, and to others, what had seemed a formidable undertaking proved to be a delightful and revealing trip.

Travel in this forbidding land is quite safe, and as sure as tired motors and worn tires can make it. Saudi Arabia is made hospitable by princely people, but one must be a guest to travel there at all. So I "hopped in" when invited to share the joy of the open road.

First-aid kit, halazone tablets, and insect powder were not necessary. The head shawl of the Arab proved better protection than my favorite sun helmet. My nose did not peel, nor did my lips crack, as on former desert trips in Sinai and the Gobi. Sunglasses protected my eyes.

The emergency camera I had bought in Cairo—for heat, humidity, and wind-tossed sand are enemies of good photography—was never out of its case. But a guest of the King must take no chances.

Saudi Arabia will never be the same again. Such wealth as the frugal Arab never dreamed of now wells up from the sterile sands.

Wise strategist that he is, the Arabian monarch finds his kingdom, which holds the holy cities of Medina and Mecca, caught in a cross fire of importunate demands.

"Oil!" pleads a mechanized world.

"Water!" cries thirsty Arabia, parched by the sun.

"Bread!" beg cameleers supplanted by 6-wheel trucks.

A Desert Is Vanishing

If Arab workmen can perform the miracle of turning oil into water (page 481), parts of the great Arabian desert may vanish as did the Great American Desert.

But material progress is subject to the unwritten law of Islam—"If Allah wills it so."

To one who has enjoyed, as I have, the fellowship of Moslems from Afghanistan to Algiers, and from Sumatra to Samarkand, the Saudi Arab is a living reminder of the days when earlier Moslems swept into Spain and India, leaving Alhambra and the Taj Mahal as incomparable souvenirs.

Before leaving Washington, I conferred with Lt. Col. Harold B. Hoskins, son of Dr. Franklin E. Hoskins, distinguished missionary-geographer of Beirut (Beyrouth).†

On the blinding airfield at the edge of the desert I was met by the American Minister, Col. William A. Eddy, a Distinguished Service Cross leatherneck of World War I, whose son had just led his Marines with distinction at Saipan, Tinian, and Iwo Jima (page 472).

A few weeks before, when rich Oriental rugs and an Arab tent went to sea on an American destroyer, Colonel Eddy had translated at the conference on February 14 between the first King of Saudi Arabia and the fourth-term President of the United States (page 462).

I had expected blistering heat at Jidda, but Legation attachés stood bareheaded in the sun or wore brimless skullcaps as foundations for head shawls or turbans.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "An Unbeliever Joins the Hadj," by Owen Tweedy, June, 1934, and "Pilgrims' Progress to Mecca," 22 ill. in duotone, November, 1937.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Rock City of Petra," May, 1907, and "Route Over Which Moses Led the Children of Israel Out of Egypt," December, 1909, both by Franklin E. Hoskins.



Each Sale Is a Noisy Argument, Each Argument a Scramble, in a Jidda Bazaar

Balconies appear too flimsy to support even a child. Arcade roofs are littered with debris as from a carpenter's unfinished work. Pilgrims, led by guides often walking backward, love to explore Jidda's narrow alleys and hole-in-the-wall shops.

North of the town, above the city's flooded littoral, stands a mansion built by a rich Syrian merchant. On its breezy roof Tuesday movies bring Jidda's congenial foreign colony together. Arabia's far-famed hospitality began for me at this residence of the American Minister and his charming wife (page 467).

Photogenic Jidda, with its arched bazaars, white-candle minarets, and jigsaw balconies stuck like birds' nests to tall, white walls, is a challenge to the photographer. But within 24 hours of my sunrise flight from Cairo to Jidda we were leaving for Taif, again at dawn. In the desert, dawn rivals afternoon twilight as the witching hour.

Saudi Arabia is among those nations entitled to Lend-Lease. Although the warlike temperament of the Arabs is proverbial, it seemed futile for them to receive surveying instruments, radio transmitters, walkie-talkies, Browning automatic rifles, and the ubiquitous jeep without being taught how to use them.

At Taif nearly 300 young Arab officers had three months of intensive training. Colonel Eddy, invited to the graduation exercises, asked me to join his friends in a command car and a jeep for maneuvers in the hills.

Beside the paved road a sign reads "To Mecca," but the holy city is forbidden to unbelievers.



Saudi Arabia's King and America's Oil Partner: Al Saud (Second from Right)

Though born into royalty, he is a self-made monarch. From impoverished exile, he conquered most of Arabia. He is not above trouncing mischievous young princes with his cane. His six feet four inches are crowned with gold-wrapped camel's-hair head ropes. Paid a royalty on each barrel of oil, he regards United States business men as his benevolent associates. With his courtiers, he stands in his palace in Riyadh (page 477). His Majesty's full ceremonial name is Abdul Aziz ibn Abdul Rahman al Faisal al Saud. On gifts and documents he shortens this to Abdul Aziz al Saud. His family name is Al Saud (not Ibn Saud).

Leaving the pavement, we set off up the Wadi Fatima. Oases of this fertile valley are picnic retreats from Jidda's humid heat.

Fatal Floods of the Desert

At Bahra long-necked camels filled their multiple stomach cavities. Bedouin women hovered in a shadow whose sharp edges seemed cut out with scissors. This quiet oasis just over the tawny hills from Mecca was the essence of the "Araby" of the poets.

Men drown in the desert, for when torrential rains hiss on arid rocks, wide wadies

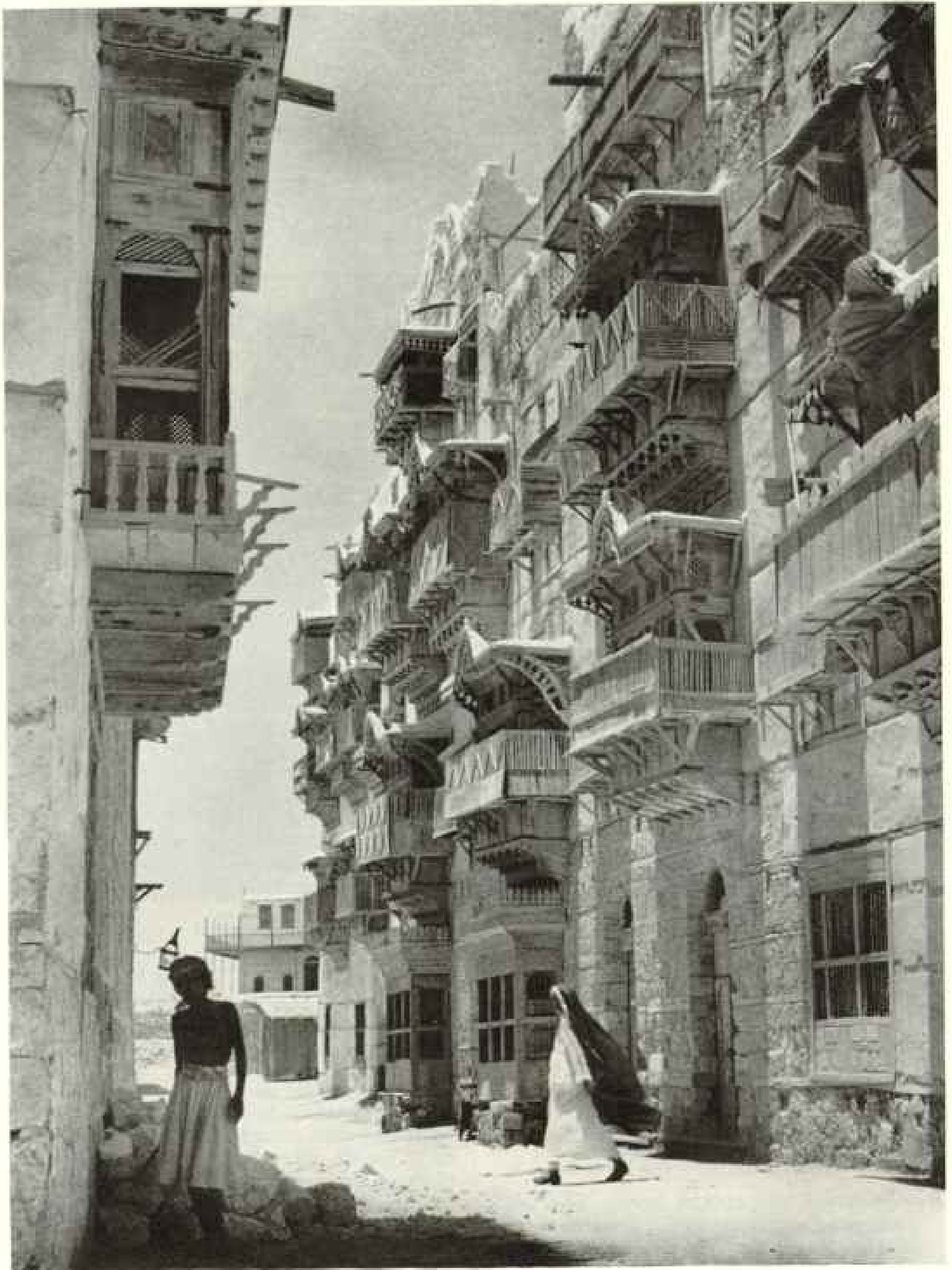
swirl with deadly floods.

For generations Arabs have sought to divert water into their gardens without burying them under sterile silt. Against the stealthy advance of dunes, rude retaining walls are built.

At Jumum our cars stood a full story above gardens set like square-cut emeralds in the pale gold sands.

There we found a happy Arab squatting beside a clear spring, his sleeves rolled back as he scooped cool water into the goatskin which is his perpetual companion and lifeguard.

Not far away some plump lambs, amazingly



Latticed, Weather-beaten Balconies Perch Precariously on White Coral Walls in Jidda

During the pilgrim season the galleries provide box seats for veiled women watching the Moslem world on parade. Sailing from Asia and Africa, more than 100,000 pilgrims a year normally enter this port city, whose permanent population is about 30,000. Their goal is Mecca, two hours away by bus, two days by camel,



Contrast to Jidda's Oriental Architecture Is the American Minister's Home

On the roof, where the American flag flies, motion pictures entertain the foreign colony once a week. Here the author and 31 fellow Americans celebrated V-E Day. Rooms are air-conditioned (page 464).

white, nosed one another's tails. Agile kids perched on the rocks and studied the world.

At a certain well we stopped for lunch at a guest tent. I noticed that the custodian's daughter had heightened her charms with *kohl*, widely used as eye shadow in the East. And this coy miss was all of three!

To our cold lunch the King's deputy added steaming coffee, strained through a wad of palm fiber that clogged the nose of a brass pot.

Unsweetened coffee, flavored with cardamom, is refreshing but bitter. A guest is entitled to three thimbles. When he has had enough, he wiggles the tiny bowl between the fingers of his right hand. After coffee comes sweet tea in narrow-waisted glasses.

The well is one of the few from which the King will drink (page 477). Lest goats and camels pollute the water, a cement cover was built. Pumps, too, were installed.

But when I was there, strong-armed Bedouin girls were hauling up dripping goatskins. Heavy coins, which must burn the skin at times, outlined the veils which these women of the desert were wearing.

When the snowy sheep had drunk their fill and when by some magic one jet-black flock had been separated from another, the girls and their charges were off across the sands.

As we waved goodbye, the dark-eyed little daughter of the desert could not wave back. Her hands were full of Nabiscos.

Rich Rugs and Gilt Chairs in a Tent

On the camp site at Taif a huge green-lined tent had been decorated with rich Oriental rugs and gilt chairs, some of which were taken when His Majesty met President Roosevelt at Great Bitter Lake. One thronelike seat was reserved for Amir Mansur ibn Abdul Aziz, sixth son of the King and Minister of Defense, who presided at the graduation exercises (page 472).

Overhead floated the green flag of Saudi Arabia, bearing the inscription, "There is no god but Allah; and Mohammed is his Prophet." In memory of the late President Roosevelt, the Stars and Stripes fluttered at half-staff. The battle-green head shawls of the officers and the flowing headdresses of the onlookers formed a bright fringe along the skyline of rusty red hills.

The huge tent, with one side raised as a canopy, could contain only a fraction of those who came to see the student officers get their gilt-lettered blue diplomas. Men in brocaded gowns and well-cartridged bandoleers strolled back and forth or formed informal groups.

After lunch there were marksmanship exhibitions with pistol, carbine, rifle, light machine gun, and Browning automatic rifle. Behind the main target, 450 yards away, each bullet spattered the rock or tossed up sand for all to see.

When the Minister of Defense lay behind an automatic rifle, every Arab eye was on the target. As one shot after another pierced the bull's-eye, there was spontaneous applause from the watching thousands.

Then, under a barrage of live ammunition, the student officers closed in on an enemy position while a loud-speaker boomed a running comment on the mock battle. When the youngsters thought the show was over, they raced onto the field to pick up the empty shells.

Before leaving, Prince Mansur visited the various instruction tents, squinted through transits, listened in over a walkie-talkie, and showed his appreciation of the way the graduation exercises had gone off.

Hands Anointed with Orange Oil

At his palace we drank coffee, tea, a long cool sherbet, and a final coffee before a servant anointed our hands with orange oil.

This was not a mere perfunctory ceremony, but a cordial party with an atmosphere of sincere good will.

Near at hand was an autographed photograph of Franklin Delano Roosevelt, whose untimely death had affected the Near East even more profoundly than did V-E Day nearly a month later.

Back at Jidda, I profited from preliminary tours with Karl Twitchell and Mrs. Eddy. In an Oriental city, where the grapevine is amazingly efficient, to be well introduced is to be well received. This meant much in a Moslem land where photography is a privilege rather than a right.

One warm day Twitchell and I visited the Middle East Locust Mission. A score of heavy trucks were lined up at this desert camp, which is cooler at night and less humid than Jidda, 12 miles away.

Tarpaulins covered vast piles of canned food for the workers and poisoned mash for the locusts. At a safe distance was ranged a veritable wall of barreled gasoline.

Such all-out war against grasshoppers seems a bit like using a 50-ton trip hammer to kill flies. But it works.

Soft-spoken British Maj. M. C. Leney showed us his large-scale "war map," indicating the strength and positions held by the swiftly moving enemy and the stores and rolling equipment of man's defense (page 474).

Since some Arabs are as fond of eating locusts as was John the Baptist, wholesale poisoning of the voracious pests is not popular.

Normally, Arabia imports from two-thirds to four-fifths of its food. But with Allied shipping busy elsewhere, ample stocks could not be delivered here. Delicacy or not, the hungering hordes of locusts must be thoroughly eradicated.

The desert locust, which has been the scourge of agriculturists from early times, eats its way over an area stretching from India to the west coast of Africa and from Russian Middle Asia to below the Equator in eastern Africa. These pests may invade Arabia from east or west or may breed here.

Young locusts grow so fast that their path is littered with castoff skins. How these plaguy pests find enough succulent food in the Arabian wastes to split their belts, only a locust knows. But when the devastating horde has passed, the land is as bare as Mother Hubbard's cupboard.

In swiftly advancing divisions, each covering perhaps a hundred square miles, billions of devouring locusts move inexorably ahead. Since the young "hoppers" (wingless stage) eat their own kind, a bran mash containing sodium arsenite may poison at second or third hand. If the proportion of poison is correct and the mash is scattered thinly, goats and camels cannot eat enough to hurt themselves.

In eastern Africa the British have recently started experiments with another chemical which may replace sodium arsenite, since it is not dangerous to animals.

If an egg-laying area can be spotted and poisoned, fine! Otherwise the war must be waged on the wing or the jump. Trucks and radio help in the battle, and roving Arabs are encouraged to spy on the enemy's movements.

Locust Control an International Problem

Major Leney believes that locust control pays for itself even when crops in only the immediate area are considered. But to end this plague, which afflicted Pharaoh in the time of Moses, international bodies such as the Middle East Locust Mission are essential.

Some days later, as I left Al Kharj, one of my friends said, "You won't die of hunger, at least!" Into the toolbox of the big Diamond T truck the driver was stuffing a crunchy sack of dried locusts—very precious to those who like them.

From springs in the hills, water is conducted through underground tunnels to Jidda's Mecca Gate. Karl Twitchell, Ray Walters, and I rode out to see an American windmill helping to assuage thirst.



Drawn by Robert E. Eastwood and Jervis E. Alliman

Saudi Arabia, Largely a Desert, Sits above a Pool of American-owned Petroleum

Ras at Tannura refines oil piped from wells at Dhahran (inset). Mecca and Medina, holy to pilgrims, are, respectively, Mohammed's birthplace and tomb. Riyadh and Mecca are twin capitals. Its four divisions describe the country: Nejd ("high country"), the Hejaz ("boundary"), Asir ("difficult"), and Hasa ("stony").

In the guestchamber was an old man whose wrinkled face was a pictorial diary of an unselfish life. He and Twitchell immediately began to talk like old cronies. They were. They had worked together to bring water to Jidda.

About twenty years ago an American admirer of the Arabs, who had traveled widely in Moslem lands, offered to pay the salary and expenses of a consulting engineer to assist Al Saud in the development of his kingdom.

The philanthropist was the late Charles R. Crane; the consulting engineer, Karl S. Twitchell. From that friendly gesture developed much of the cordial relationship which was evidenced in February of this year when "two strong men stood face to face" on an American warship in the Suez Canal (p. 462).

When Twitchell began his survey, the amazing extent of Arabia's oil reserves had not been realized, nor had modern machinery begun to make a profit out of what ancient miners had thrown away.

Ancient Gold Mine Nets a Profit

After studying various old documents dating as far back as the second chapter of the Book of Genesis, Twitchell decided to develop the ancient workings at Mahd Dhahab, "the Cradle of Gold." In a region of 110,000 square miles, once rumored so auriferous that gold was worth only half its weight in iron or a tenth its weight in silver, this is one property which is paying off.

At the mine I held mineralized samples in my hand—dull black dust with less glint in



Profile in Jidda—Fancy Work by a Muleteer-Barber

His master not only clips, but lavishes a salty vocabulary on this beast. The fluent Arab will curse a donkey's ancestors and its impossible progeny.

it than a dead man's eye. Deep in the desert, 248 miles northeast of the port of Jidda, I saw a 14-ton cylinder head, part of one of two 750-horsepower Nordberg Diesel engines made in Milwaukee.

This far-flung fragment of Wisconsin industry determined the size of the Saudi Arabian Mining Syndicate's trucks and the minimum curve of road that must carry it from Jidda to Mahd Dhahab.

Mining Tiny Particles with Titan Tools

It gives one a healthy respect for science and industry when men can make a business of mining for precious particles too small for the eye to see with tools so big that no Titan could lift one.

The rock hill seems split by great fissures,

visible a mile away. These superficial cracks show where miners centuries ago probed deep into this geological safety-deposit box to get at the treasure. But their equipment was too puny, their methods too wasteful.

Recently a whole elaborate setup of Diesels and compressors, generators and settling tanks, blueprints and crucibles, strong-jawed rock crushers and supersensitive laboratory scales made a profit out of the "tailings" those less efficient miners cast aside.

Now the mining has been carried underground, and compressed air rips the rock so that samples can be secured for assay. An almost invisible wire, playing teeterboard on delicate balances, weighs a mountain's worth.

On a blueprint I noted how poor were some samples, while others close by assayed many times as much. The richer ore might have showed a profit when ground in the an-

cient basalt hand mills. But it takes tons of equipment today, much of it from America, to release most of the gold from its ore.

In the process, Arab workmen become skilled technicians. Toiling side by side with their American colleagues, Arab engineers, technical men, and workmen are just getting the hang of things (opposite page).

Into the gray soup of suspended ore I saw them toss what looked like overgrown moth balls. Should one of the workers lick his fingers after handling these pretty pellets, there might be a funeral. Those harmless-looking balls are sodium cyanide, potent enough to kill the strongest man.

War's end in Europe released a lot of helmets that might save many an underground worker a cracked skull. But no one would

dare enforce such a safety measure. Wearing a battle helmet, a Moslem could not touch his forehead to the ground in prayer.

Not "safety first" but "Allah first" is the rule in Arabia.

As we crossed a grazing area, an Arab came running, his skirt in his teeth. Of course we stopped. We imagined that he was begging for a drink. Not so. He was thinking of his camels.

A Royal Pilgrim from Baghdad

He wanted to know whether we had found water in one of the string of cisterns we had just passed. These cisterns date from about A. D. 800 and are reputed to have been built for Queen Zobeidah, wife of Baghdad's most famous caliph, Harun al Rashid. The queen, who made several pilgrimages to Mecca, also had watering places built at intervals along her route.

We had to report that the reservoir bottom was dry. Back trudged the camel herdsman, pondering some other solution to his eternal problem of keeping his camels' emergency tanks full.

Soon after, we were stopped by the drivers of a big truck, 150 miles from its destination and out of gas.

Said wavy-haired Walters, newly arrived from Iraq, "These fellows put too much trust in Allah, who gave Arabia whole subterranean seas of oil but no filling stations."

Our own gas ration did not provide for stranded trucks, but Twitchell gave the drivers enough gas to get them to Birka, where some other good Samaritan was almost sure to pass. He could carry their plea to Mecca or Jidda, and in a day, or a week, enough gas might arrive to get them home.



An Arab Smile Creases a Swarthy Countenance

At Mahd Dhahab (Cradle of Gold) he is a foreman for the Saudi Arabian Mining Syndicate. There he and his men reworked waste material discarded by miners in Bible times. Now they drive new workings underground with American machinery (page 469).

On our last night at Mahd Dhahab, storm clouds hung black over the white-walled cabins. There was danger that we might be bogged down in the desert—in May! We did do some jeep-like puddle jumping amid the grass clumps. But we got safely back over the road which Twitchell had laid out with a pocket transit made in Denver.

Trucks Arrive, but Camels Slog On

As yet, this is the best road for its length in all Arabia. But with ample supplies of road-binding by-products available, Hofuf, Al Kharj, and Riyadh may soon be as well connected with Ras at Tannura as Mecca is with Jidda.



Prince Mansur Talks to U. S. Minister Eddy at a Lend-Lease Demonstration

At Taif they watched a mock battle by 300 Arab officers trained with American weapons. Mansur, his royal father's Minister of Defense, excelled at target practice with the Browning automatic rifle. Surrounded by officers, he occupies a thronelike chair beneath a tent. Rich rugs are spread on the desert sands (page 467).

When that is done, motors will speed where now the camel slogs along. Despite terrific costs for upkeep and tires, the truck has already proved its superiority over the ship of the desert. But motor vs. camel is not wholly a question of cost per ton-mile.

Strangely enough, it was the Ford agent, Ahmed Ali Reza, who stood up for his plodding competitor.

"Thousands of Arabs make their living not only from breeding camels or using them for transport, but from building camel saddles, weaving bright trappings, dealing in hides or hair, or twisting hay into loose ropes of camel fodder.

"Much-needed modern roads will cross the land. But that won't wipe out nomadism, for the Arab, his camel, and the desert are a 'natural.'

"The hardy Arab, who can weather a hot day of the Ramadan fast without drinking water or swallowing his own dusty spittle,

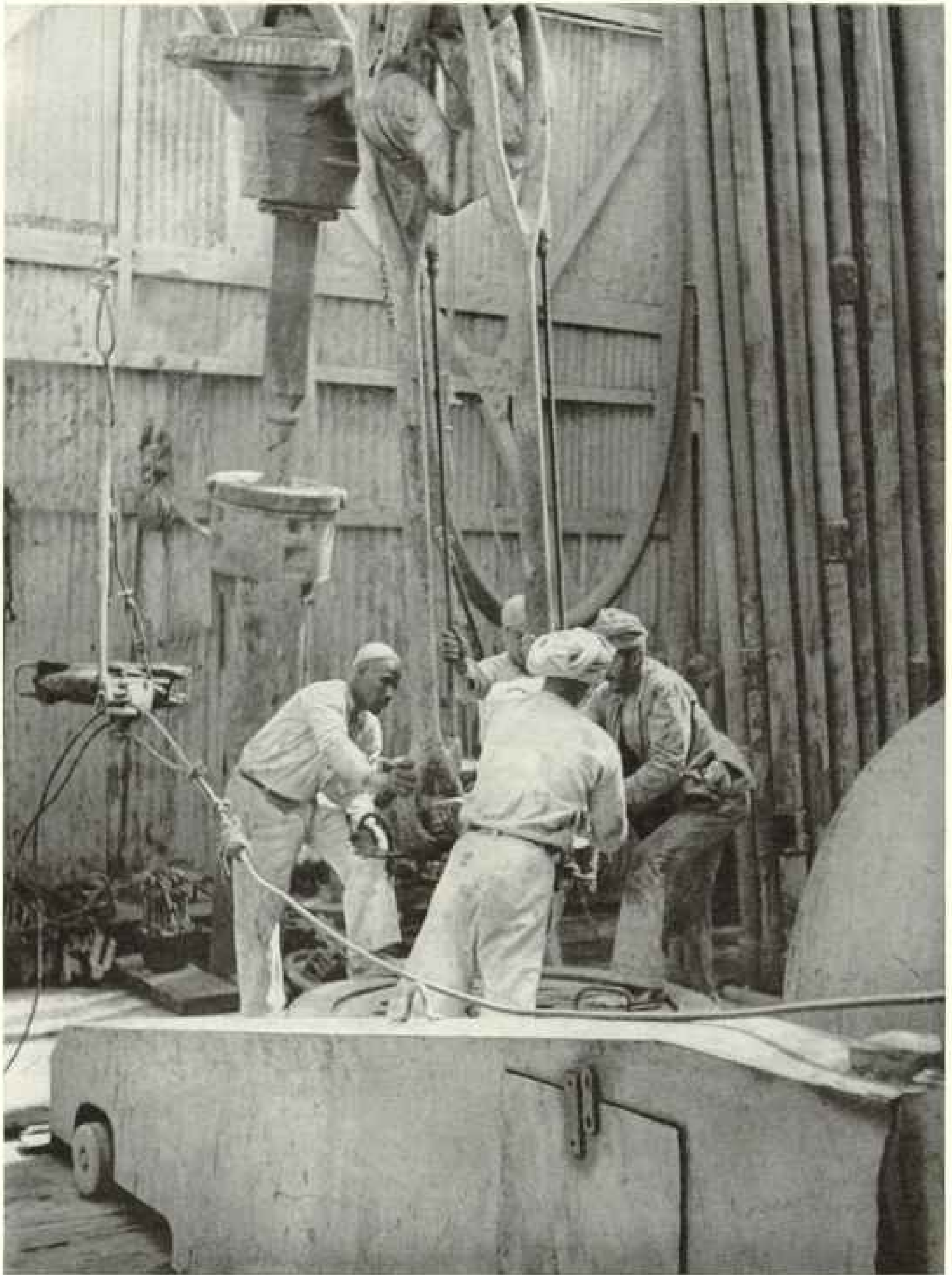
will continue to count on his gawky partner, who groans and bubbles and roars but somehow survives in the desert wastes.

"Mile for mile, the plane and the truck can go much farther between drinks than camels can. But it will be a long time before this ancient beast, whose ugly shape adds beauty to the desert scene, disappears entirely. He's no streamliner, but as a feeder for through traffic he's here; he fits the country and he lives off the land. You haven't seen the last of the camel yet."

V-E Day Comes to Jidda

Coming out from a luncheon with the Palestine-born Minister of Roads and Mines, we discovered that the Netherlands Legation, where NATIONAL GEOGRAPHIC contributor Van der Meulen* is Minister, was bowered in

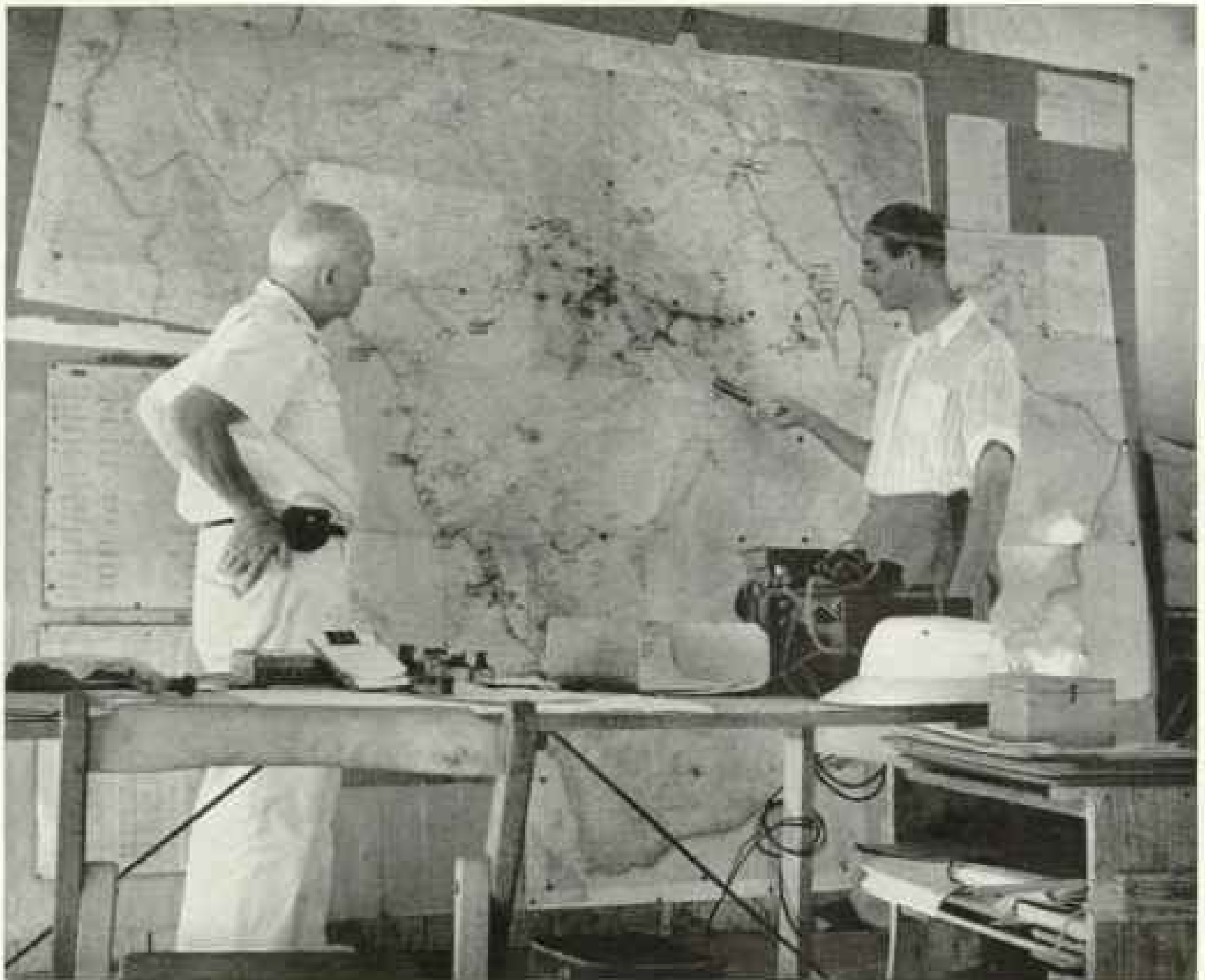
* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Into Burning Hadhramaut (Arabia)," by D. Van der Meulen, October, 1932.



Arabian American Oil Co.

In a Parched Wasteland Four Arabs Dig a 5,000-foot Well—but Not for Water!

Their quest is for oil, whose royalties and taxes enable their barren country to import food. They drive in fresh drill pipe (stacked, right) or draw it out as need arises. Motive power, a rotary chain drive, is housed by the large wheeled guard. In Arabia the corrugated-iron windbreak is especially useful for repelling air-borne sand.



Arabia's War Map Shows Positions Held by Man and His Enemy, the Devouring Locust

At Middle East Locust Station near Jidda, poison bait is prepared. Not all Arabs approve the anti-locust campaign; some are fond of eating locusts. One migratory swarm crossing the Red Sea covered an estimated 2,000 square miles; others have been seen 1,300 miles from land. Karl Twitchell (left), an American engineer, visits Maj. M. C. Loney, a Briton (page 468).

flags and streamers. Some anniversary of the House of Orange, no doubt.

Then we saw the offices of a shipping company decked out like regatta day at a yacht club and we realized that it must be true—V-E Day had come to Jidda!

At the British Legation a crowd of Arabs was looking at war posters arranged in a triumphant V for victory—come at last!

Seeing us, they came running. "Germany is finished!" they gloated. And then they asked, "When will victory come over Japan?"

Shrugging my shoulders and pivoting my outstretched hand, I gestured, "Who knows?"

Then it occurred to me that such an act, before Allah, showed neither gratitude nor faith. So I quickly added, "Soon—if Allah wills!"

"If Allah wills!" echoed the crowd, awed by a faraway event which had become a part of their lives.

Thirty-two Americans attended the Victory Day celebration at the Eddys'. The still night air was sticky and hot. But the whole city breathed more easily. It seemed a cleaner world.

Early this spring the United States presented a silvery plane, complete with luxurious seats and a full-length bed, to Saudi Arabia's progressive but cautious King.

On the morning after V-E Day, Colonel Eddy led a group of his friends on a flight from Jidda to Riyadh, where the King was born in 1880. In 1901 the young warrior, returning from exile, seized his ancestral capital. Today the wise ruler uses it as his capital, deep in the heart of the Nejd.

With the King's bright plane as a landmark, our pilot hoped to be able to distinguish the royal landing field from a few thousand miles of territory which looks much like it.

No plane—not even the King's—is allowed



Through His Radio Stations, Al Saud Gets Reports on His Subjects

To install wireless, the King convinced Wahabi holy men, to whom even hymns are sacrilegious, that it did not carry Satan's words; this he accomplished by broadcasting Koranic texts. Now he follows the war, even the safety of his desert-going guests, by radio. A few of the royal family's automobiles are garaged here. Arabian American Oil Company shops obligingly make repairs.

to look down on Mecca, Medina, or Riyadh; so the airport was nearly 40 miles away from the town, the palaces, and the gardens of the capital. The new airport is nearer Riyadh.

Searching for the Royal Airport

Over desert and lava flow we flew, until the palms of the Riyadh oasis lay like a dark cloud in the south. Then the search for the airport began.

In the area indicated there was plenty of room to land, but no wind sock, no welcoming tent, no silvery flying fish to mark the spot.

For an hour the plane cruised over the area. Then our pilot decided to set his course for Dhahran.

While His Majesty waited at Riyadh, we completed a nonstop flight from the Red Sea to the Persian Gulf. When the plane fueled at Bahrein, geologist Tom C. Barger pointed out the site of the elusive airport on an Arabian

American Oil Company map. Between cliff and dune, how could one miss it?

We didn't. We hit the royal landing field right on the nose—but gently—and the King's plane, which had been "upstairs" looking for us, sat down beside ours.

On the 90-minute drive to the Badia Palace of the Crown Prince, Viceroy of Nejd (page 476), I chatted with two former students of the American University of Beirut,* one in the King's service, one in our own.

Our drivers had turned the wide desert into a racecourse, and at the bottlenecks between open spaces there were thrills, if not spills.

"We Arabs are trying to adopt the best from all civilizations," laughed my seat mate, bounding away.

After dinner in the palace—with knives and

* See "American Alma Maters in the Near East," by Maynard Owen Williams, NATIONAL GEOGRAPHIC MAGAZINE, August, 1945.



It is Houseboys' Hour Off at the Brick-and-plaster Palace of the Crown Prince

Dark recesses, built around an airy courtyard, shut out heat and make desert life endurable. Here at Riyadh the author, a guest of the royal family, slept on the roof beneath the stars.

forks belying the tradition of whole sheep torn apart by bare brown hands—we sat under the stars. A sound like that of a Santa Fe *Super Chief* whistle split the quiet air.

Some declare that the camels and donkeys who toil at the water hoists work better when squeaky axles set the pace. Others say that the absent overseer, listening to the axle's groan, knows that cool water is gushing forth to irrigate the palms.

In any case, the chief musician in this oasis capital is the man who drives wedges into bulky wooden axles to make them squeak, tuning praises to Allah for the gift of water.

Beds were brought up to the cool roof, and we drifted off to sleep.

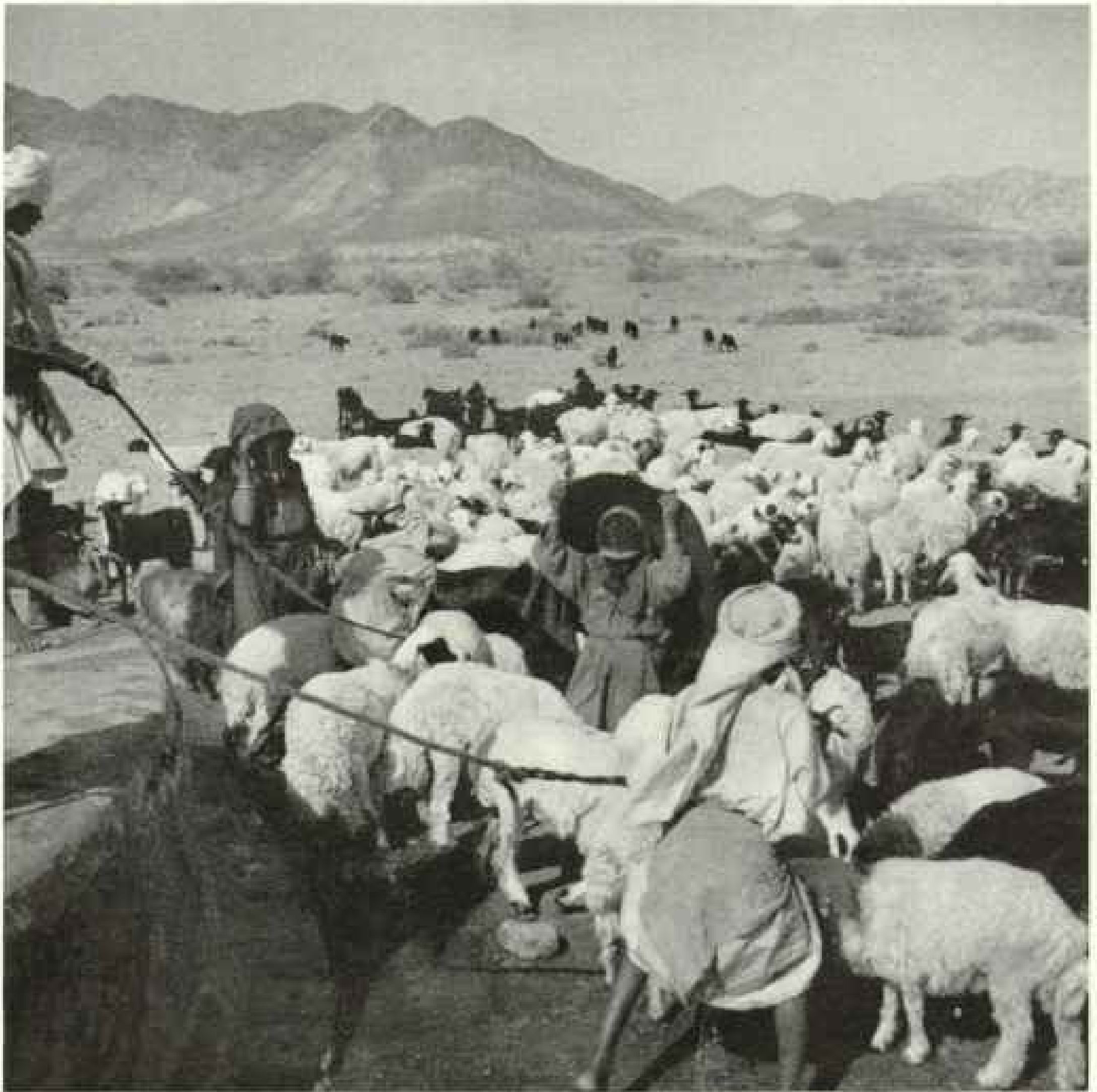
In the back country of Arabia there are wild men who love liberty more than life. To them a roof is a prison; a motorcar, a menace.

Given one wife, or possibly two, to draw water and prepare white cheeses in the taut goat's-hair tent; given camel's milk to drink and spitted mutton and a handful of dates for a holiday treat, such men feel at rest in their nomadism.

In Arabia, Dress as the Arabs Do

But a man in foreign dress, symbol of what they neither know nor like, fills their hearts with a vague distrust.

In the plane we had dressed ourselves in fine raiment, presented by the King in a



Nomads at a Desert Well Water Their Meat, Wool, Milk, and Butter on the Hoof

Sheep, drinking from goatskin pouches tied to well ropes, are of the Hadjazi breed. Their "buldi" heads lack fleece as well as horns. Storing energy for famine, thick tails are laden with fat; Near East butchers sell it in small bits with the mutton. Black, horned stragglers are goats. This well is cemented, because it is a favorite of the King (page 467).

friendly gesture like the note "White Tie" on an engraved invitation (page 481).

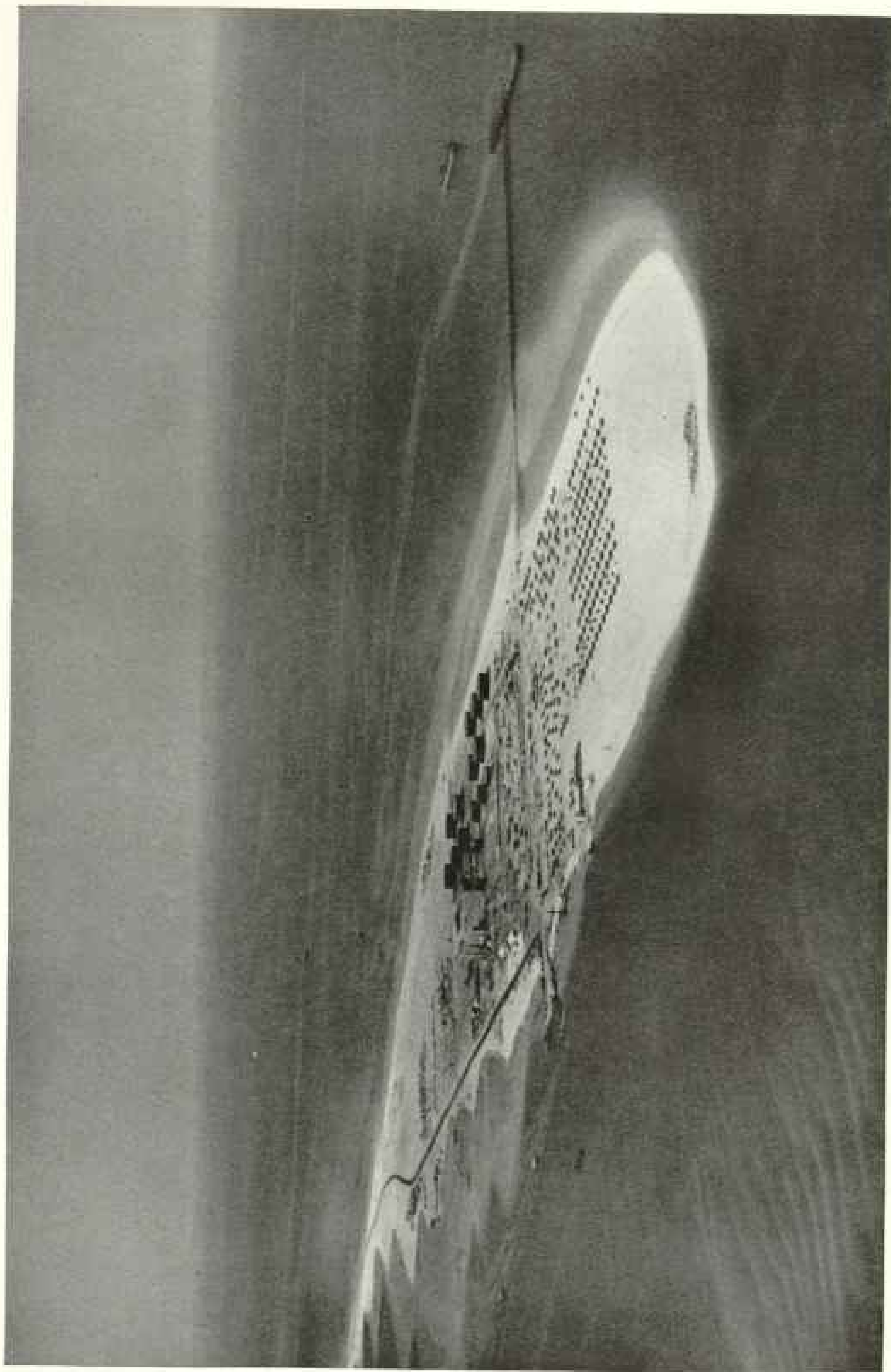
At that very moment Prince Faisal, the King's second son and Foreign Minister, and his Saudi Arabian colleagues in their flowing garments were stealing the show at San Francisco. We, in Riyadh, were draping ourselves in the same picturesque but unaccustomed costume so that we would *not* look different.

This was no Hollywood stunt, but sound practice of the principle that when you visit the King of Saudi Arabia you do as the Arabs do.

Our audience with His Majesty was impressive but not formal. It was immediately apparent that the King and Colonel Eddy were trusted friends (page 465).

Behind the pale, narrowed eyes of this desert warrior there glowed a lively interest, complete frankness, and cordiality. If he has a poker face, he wasn't using it. Broad of shoulder, manly in bearing, and full of good humor, His Majesty Abdul Aziz al Saud dominated the vast reception room without a trace of posing or striving for effect.

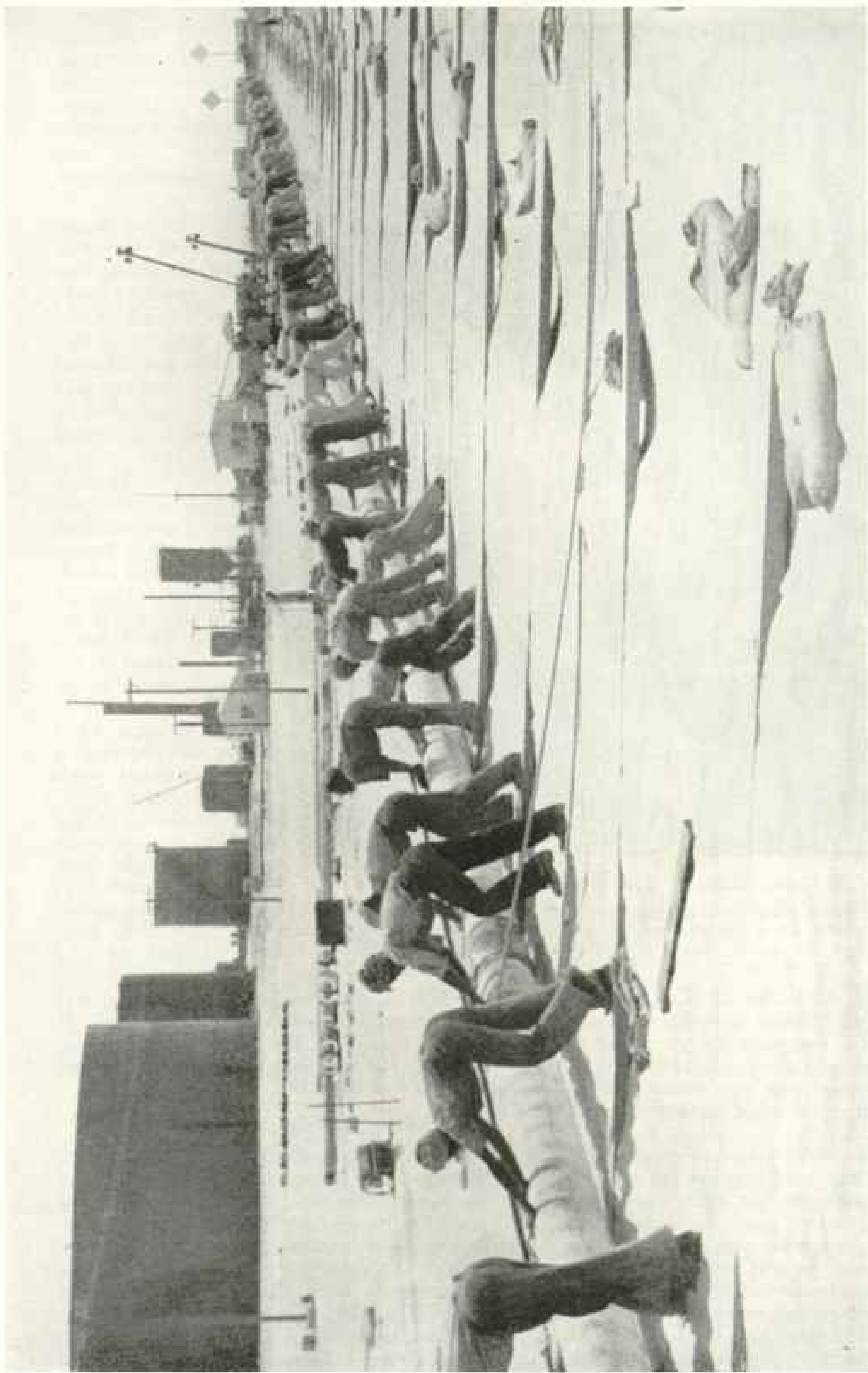
The King is noted for his love of fun and practical jokes. When our former Minister



Drifted Kuwait company LIFE

To Ras at Tammura, a Sandspit Glistening in the Persian Gulf, Saudi Arabia's Oil Is Piped for Tanker and Refinery (page 485)

Deep water for the pier (right) led to the selection of this spot by the Arabian American Oil Company. A dozen tanks store oil. Near them, chimneys mark a 3,000-barrel-a-day refinery serving Arabia's needs. Left: the site of a new refinery which will serve the world. Much oil is piped to near-by Bahrain Island (map, page 469).



Arabian American Oil Co.

Stretching Almost Out of Sight, a 20-inch Pipe Rolls Across Ras at Tannura's Sands in Front of Crouching Arabs

The Arabian American Oil Company, builder of this tank farm, controls a Texas-size concession in Saudi Arabia. Beneath its sandy wastes lies one of the world's largest oil reserves. The discovery well was brought in in 1938. A United States Government-financed pipeline to pump oil from the Persian Gulf to the Mediterranean was abandoned in the planning stage. Private capital holds the project in reserve.



In Come Steins of Tea as a Chaser for Coffee

Among Arabs, whose word *qahwah* gave us *coffee*, the brew is the ritualistic national drink. Black and unsweetened, but spiced, it is served usually in a thimble-sized cup, and a guest is entitled to three helpings (page 467).

to Egypt, Alexander C. Kirk, who was also serving as Minister to Saudi Arabia, visited Al Saud a few years ago, he asked his host about his early adventures as a warrior.

"Is it true that you always rode a pure-white camel? I am a great admirer of white camels."

Realizing how broad a hint he had made, our Minister tried to squirm out of it. But the next morning he was invited to a parade of several hundred gaily decorated camels, including some white ones.

Not until he was safely away—without a white camel—did our Minister breathe easily.

During my visit another story was going the rounds. It seems that the King and his ministers were discussing connubial bliss, when a

confirmed monogamist entered the room. Continuing his banter, His Majesty said, "Here's a young man with only one wife. We'll have to do something about that."

For days the happy husband of one wife went about fearing that some lovely lady, chosen by his King, might drop in his lap.

During our informal meeting two casual remarks revealed a good deal about Saudi Arabia—1945.

"Has Your Majesty seen the motion pictures of the meeting with President Roosevelt?" someone asked.

"Not yet. The vice of the cinema has entered my blood, but I have to control it, for there is much to be done."

The King's next statement showed a closer contact with worldly affairs.

"The victory in Europe has brought much joy to my people. You will be interested to know that yesterday, just after V-E Day, prices fell in the Riyadh bazaar."

We later discovered that the news had sent the cost of some items diving 50 percent in 24 hours. The next day prices shot up again. Riyadh may be a remote oasis, but it is not isolated economically.

Author Doubles for Court Jester

Since a photograph is not a graven image, forbidden by Islam, but a combination of lights and shadows, the King readily consented to let me take his portrait.

I had been warned not to ask His Majesty to pose in the fierce sun. What a gargantuan laugh would have shaken his six-foot-four frame if he had heard that!

When he arrived I regretted my timidity. I had chosen a shady corner, and a cloud of

courtiers cut down the light.

But that was the least of my troubles. Just then my head shawl got in the way of my sweaty glasses, and I tramped on the corner of my robe. My gold-wound crown slipped over my eyes at a bacchanalian angle. Even my Contax slumped forward on its tiny tripod in an unscheduled curtsy.

Was this impromptu comedy a howling success? Far from it. Thanks to Arab self-control, the whole affair passed off as though the sound track had gone dead.

Abandoning the idea of color after two cramped exposures, I grabbed my Rolleiflex, shot quickly from several angles, and called it a day—more to the relief of the King's advisers than of the smiling giant himself. Once the tension was over, he seemed to be having a good time.

Within three hours I was off for Al Kharj with David Rogers, chief of the United States Agricultural Mission. On a 2,000-acre tract this small group of farmers is attempting the experiment of turning oil, of which Arabia has more than anyone knows, into water, of which it has never had enough.

Abundant water means a stable society and good crops, for the virgin soil here is fertile. Our farm experts find the situation here somewhat similar to that in their native Arizona. They are fighting for the future of an empire so vast that it outreaches the Texas yardstick.

In the first months of wholehearted struggle, these pioneer sons of pioneers had their ups and downs. Splendid stands of vegetables were gobbled up by locusts. Film on which their triumphs were to be recorded did not fit their cameras. Motocars for which they had

waited months were hurt by the sea water.

But, on the whole, things were going well. Four Diesel-motored Caterpillars, hooked up to Pomono pumps, were pouring water through the main irrigation canal, which had been built by the oilmen, and the pumps installed, before the agriculturists arrived.

Young palms, their tender stalks bandaged in gunny and ranged with mathematical precision, were taking root. A second crop of vegetables was flourishing. Wheat, saved from the locusts, was being stacked near the dormitory where twenty hand-picked trainees are to live and learn.

In a region where grown men, within sight of a king's palace, winnow grain by letting



The Author Wears the King's Gift Raiment

In robe and head shawl, Dr. Williams awaits Al Saud in the King's palace at Riyadh. This costume, designed to protect him against suspicious nomads, proved his undoing. As he photographed the King, he tripped over the hem of his gown and his "crown" slipped over his eyes (page 476).



Indian Pin Boys Set 'Em Up for American Bowlers in Ras at Tannura Recreation Hall

Sports and air-conditioning help lonely oilmen, working on long-term contracts, to forget that home is halfway around the world. Swimming pool, golf course, tennis court, and clubhouse are theirs. On the coast they enjoy fishing and swimming; in the desert, gazelle shooting and falconry.

trodden straw slip through their fingers, a new threshing machine stood ready.

At Al Kharj the water comes from three great natural cisterns, two of which are about 420 feet in depth and 300 in diameter. After a sweaty day of visiting the farm and rubbing the soft muzzles of some of the royal herd of Arabian brood mares, I swam in the clear, dark water below a hill crest pimpled with prehistoric grave mounds.

A 2,000-acre plot, set in the immensity of a land with a trying climate and a scanty rainfall, is only an experimental farm. But if good engineering and good will can solve the problem, our agricultural missionaries are off to a good start.

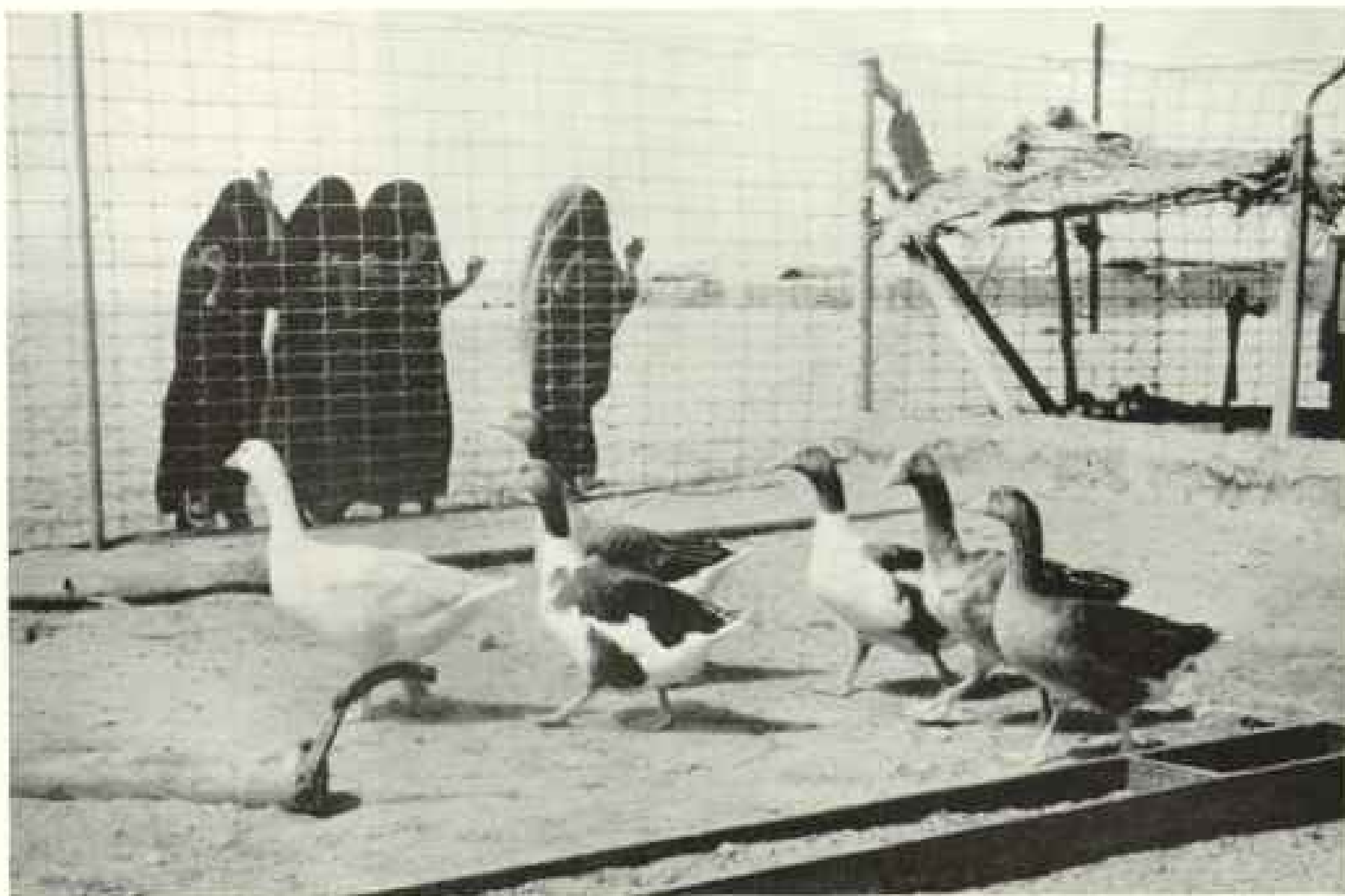
Yesterday Saudi Arabia offered plenty of work but little food to its nomads, variously

estimated at from one to several million. Today oil royalties are pouring in, palaces are being built, and wages are being paid to a new class of laborers. Tomorrow—what?

Desert Cars Sport Hoop Skirts

Between Al Kharj and Dhahran we crossed from the realm of water into the realm of oil in a Diamond T 6-wheeler piled high with 39 empty oil drums. No mat provided insulation between the grilling cab floor and our feet. The radiator's water went up to 210°.

Between the flat plain of Al Kharj and the blue Gulf near Dhahran there extends a long red tongue of shifting sand, the Dahana. A few years ago it would have been sheerest folly to attempt that bone-strewn journey in a car.



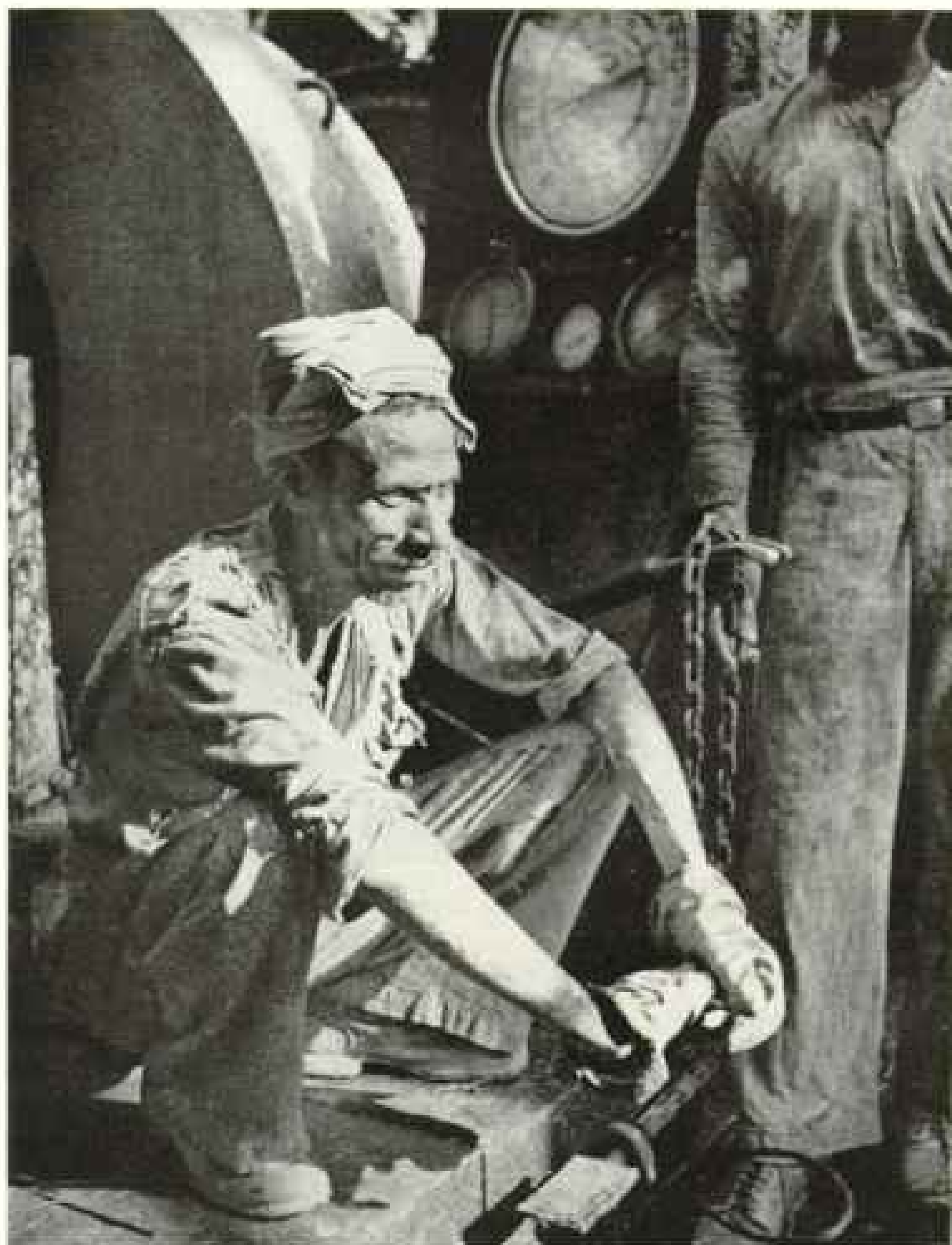
"What Strange Food Americans Eat!"—Hissing Geese Fascinate Four Wives from a Harem

At this experimental farm near Al Khobar, winter-grown tomatoes climb high on trellises. They vary the canned goods imported for 1,300 American oilmen. In all the Middle East, few men eat better than they.



Native Muscle and American Steam Run a Laundry at Ras at Tammura

Each time the author leveled his camera to snap this scene, a skullcapped head bobbed into view. He found he was disturbing another laundry worker's prayers (page 487).



A Follower of the Prophet Helps the American Oil Driller

Between Ras at Tannura and Dhahran, he works with tools and gauges he never saw until a few months or years ago. He learns *how* quickly, but *why* still eludes him. Ten thousand like him work for an American oil company.

But Aramco (Arabian American Oil Company) geologists do things with a car that a Spanish riding academy would hardly do to a horse.

Doughnut-shaped sand tires were designed (page 487). Conventional car fenders gave way to jutting hoop skirts. Even in the dune country, where tall camel and kneeling Arab are trademarks, the modern car has come to stay.

When a man sets out in his car on this grueling trail, his friends radio ahead that he is on his way, attach a canvas water bag where the hot wind will cool it, and strap a "Jerrican" of drinking water where it can't fall off.

That supercontainer has been widely used for gasoline during the war. With the aid of

it, Rommel almost took Alexandria, but it later helped power the Allied drive on Berlin. Another German chicken came home to roost.

We carried one—just in case—and rustling in the toolbox was that week's supply of dried locusts (page 468).

I was setting out across an area where many of the inhabitants had never seen a camera, setting out to picture the dread Dahana, where vultures gather whenever a camel founders on a sandbank.

My two Arab companions looked more like Stone Age nomads than skilled truck drivers. But when the going got tough, the way they shifted into 6-wheel drive and squjged solidly ahead on their pudgy tires inspired confidence.

Actually, Dahana is not synonymous with danger, for surrounding the wagging red tongue of sand are miles of herbage which turns green after a rain. To the Arab, who considers his country a paradise, it is the "Land of Milk and Honey."

At the southwest edge of the Dahana was a cluster of tents; piles of merchandise were awaiting transfer from car to camel. In a combination of sign language, Arabic, and English, the dark-skinned driver said, "Don't stop here, or the police will make us carry a lot of hitchhikers to Dhahran."

Hitchhikers indeed! What was I?

We had no intention of stopping at the water well and fuel tank of Al Hani. The day was still hot; with the dunes behind us, there was nothing to see until the morrow's long shadows should set off the lovely curves on the 19-mile belt of dunes between Abqaiq and Dhahran. But Al Hani was out of gas; so there we waited until a tanker could waddle down to help us.

I was given a royal welcome by Bob Lang, who controls traffic on this unbelievable highway and uses his radio to keep from forgetting English entirely.

So hot had been the air blown through his dripping "desert cooler" that it seemed preferable to stop the fan. Nightfall brought a stiff wind that plastered flowing gowns to the erect, sculptural forms of the desert women.

In this modernized Basque sheep wagon, equipped with radio transmitter and power fan, neither of us expected to get much sleep. But "the sands of the desert grow cold." Only habit woke us before the flaming sun disk heralded another desert day.

At garden-set Hofuf a small boy indicated some Bedouin women as models—to show that he knew what a camera was. Women here are still invisible to the gentlemanly eye, but, since they had signaled for the attention, I let my lens have just a little look.

In the three months that I had been away from Dhahran the cooling system should have begun operation, but the administrative center had grown so fast that no power could be spared to air-condition the tastefully decorated homes. But there was plenty of Coca-Cola and all the pie à la mode one could eat. And this was Araby!

Oil workers have a strenuous life, far from home. But Aramco gives their stomachs no cause for complaint. No use trying to do high-priority work on a low-priority diet.

I swam in the clear, cold swimming pool, which had looked like a shimmering aquamarine from the plane; visited the "farm," whose cows, geese, goats, and rabbits helped feed the workers when Axis bombs cut down



A Road Worker, Resting on a Scraper, Plays a Primitive Lyre

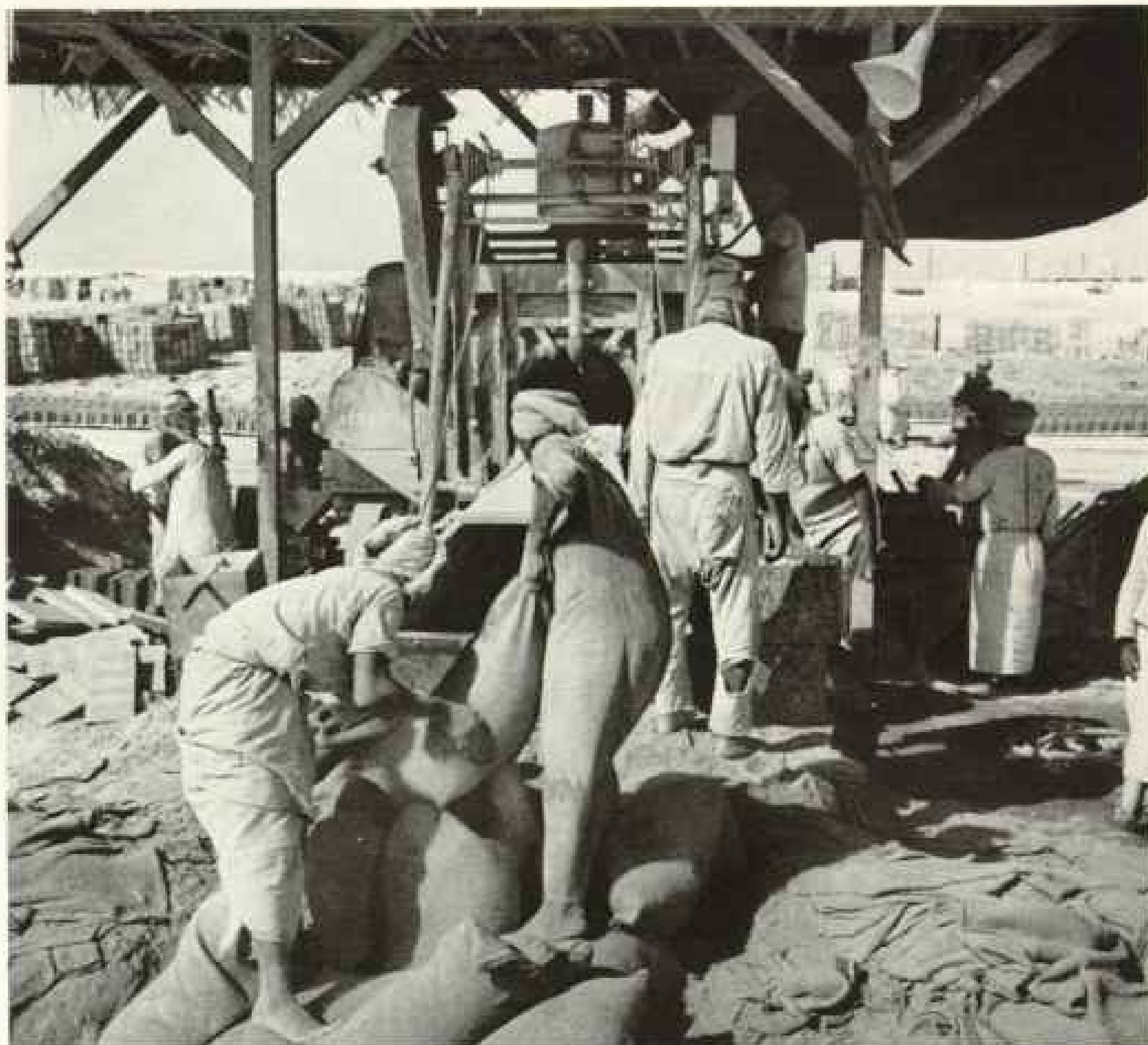
While improving the highway between Jidda and Mahil Dhahab, this daring Arab defies a taboo of the Wahabis, Islam's puritan sect. Rulers of Saudi Arabia, they condemn music, tobacco, and liquor. Of modern roads, the kingdom has 45 asphalted miles between Jidda and Mecca.

the shipping; saw shale ground up to make light-weight bricks that may solve the acute housing problem.

As I watched a speedy softball game being played under brilliant floodlights in the soft, balmy May night and heard the good old "raspberry" and pitcher baiting, I realized that Dhahran is something to see—and hear! But the next day at dawn we were off for Ras at Tannura.

A Modern City Rises in the Sand

Ras at Tannura is a name to remember. How extensive are the Arabian oil reserves, operated jointly by the Standard Oil Company of California and the Texas Company, not



Arabs, Feeding a Concrete Mixer, Build an American Oil City on the Persian Gulf

"As far as the eye can see (at Ras at Tannura), a mighty community is taking shape," writes the author. Proving his words, boxes of building materials cover acres in the background.

even the Aramco geologists know. Anything you have read about Arabian oil is probably obsolete (pages 473, 478, 479).

At Ras at Tannura will soon rise an ultra-modern American city with no slums, close to a beautiful stretch of sandy beach.

A few months ago that shining sandspit was as clean as an 18th-century heroine's lily-white hand. Now look at it!

Helmeted welders have set up a tank farm close to powerhouse and pipeline. All the elaborate equipment through which crude oil is taught its tricks is reaching for the sky. It looks like a Rube Goldberg setup!

Like tireless squirrels, workers roll tight cylinders of structural steel wire on which reinforced-concrete piping is to take shape.

Wahabi tribesmen with braided hair drive huge tractors which do anything they command, except kneel. Behind them are cabin-

sized scrapers, transporting enough sand to lift this great industrial community six feet in the air, making it one of the world's largest "fills."

Canals are being dug, along which cool sea water will flow to condensers. Above the Meccano maze, which may change the destiny of nations, is a concrete mixer. From it, as far as the eye can see, a mighty community is taking shape, its colossal power punch to be divided among millions of motors around the world.

Here are splendid new hospitals, billiard room, bowling alleys (page 482), dining halls, and a huge commissary that may bring bigger benefits than high wages could.

More than a thousand American oil and construction workers fit this intricate mechanism together. Twelve hundred Italian construction men toil around the clock in shifts.

More significant are the 10,000 more or less Arab workers of Aramco, finding a new



Nonskid Tires Mold a Gigantic American Footprint in the Sands of Araby

This tread was left by a super-balloon, one of 16 bloated tires sharing truck and trailer. Cushioned by such a tire's 10-pound inflation, steel pipe rides as on a pillow. Arabian American Oil Company geologists designed the tire for crossing dunes, and American rubber men built it (page 484). Start of a huge fill, this is the site of a new refinery to be erected at Ras at Tannura (page 485).

way of life here. At their first aptitude tests I saw them fumbling with nuts and bolts while a stop watch timed their clumsy reactions. After brief training I watched them handle a smoothly synchronized mechanical ballet of well-controlled machines (pages 484, 486).

Laundry, an Arab, and a Prayer

Had enough skilled Arabs been available, the *Santa Paula* would not have dumped the Italians on the Ras at Tannura docks. When the construction job is done, they will go, leaving behind a fine record and many Arab successors, now students of their skills.

I wanted to photograph an Arab laborer at his American laundry machine. Between my camera and my subject a skullcapped head kept bobbing up. Another worker had chosen this as his hour of prayer.

I refrained from photographing this privacy, shared by the Moslem and his God.

In cities like Baghdad and Beirut, laundrymen blow on the flames of charcoal-heated irons. In cosmopolitan Cairo, Egyptian pressers, standing on one leg, guide big flatirons with the other.

On this remote sandspit, yesterday's nomads stretch trousers on stainless-steel legs and set the creases with steam (page 483).

"How come?" I asked.

"We haven't men enough or time enough to do it any other way."

Where time is *that* valuable, the time clock is not far away.

Not since Mohammedanism first burst the bonds of its desert birthplace has Arabia meant so much to the world. Saudi Arabia is "going places"—if Allah wills it so.

The Fairy Wrens of Australia

The Little Long-tailed "Blue Birds of Happiness" Rank High Among the Island Continent's Remarkable Birds

BY NEVILLE W. CAYLEY

AUSTRALIA has numerous birds of distinction—the world-famous parrots and cockatoos, the large and colorful families of the honey eaters, the strange and unusual bowerbirds, flycatchers, whistlers, and pardalotes—but for daintiness, grace, and beauty the Fairy Wrens, "the Blue Birds of Happiness," surpass them all.

Nothing in Nature is to me more fascinating than these sprightly little feathered jewels flashing in the sunlight or playing and chattering in a setting bright with sweet-scented flowering plants.

The Fairy Wrens comprise 13 distinct species with numerous races. To see them all, the bird lover would have to circumnavigate Australia and journey far inland.

The first generic name proposed for the group was *Malurus*, from the Greek meaning "soft tail." Nothing could be more appropriate, for the upright tail, light as thistle-down, is a distinctive feature of these tiny creatures, hardly larger than the top of your thumb.

For specific names there are *cyaneus*, meaning "blue," *callainus*, "like a turquoise," *splendens*, "shining," *amabilis*, "lovely," and *pulcherrimus*, "most beautiful"—all bestowed in homage by admiring scientists.

Following the usual way of the wild, only the males sport brilliant colors. Their mates are sober wee things habitually clad in browns and grays.

There is one notable exception—the female Lovely Wren is modishly turned out in bluish-gray upper parts and light buff and white breast and abdomen (Plate V).

Although their garb is modest, the other little ladies all possess charm, and in the spring they flirt their delightful tails in such a bewitching manner that no young Mr. *Malurus* can possibly resist.

A Winged Lord Faunteroy

The name "Blue Bird of Happiness" is usually given to the Blue Fairy Wren because he is the best-known member of the family, but the name could be applied to most of his relatives. He is an elegant little gentleman, with an electric-blue head, blue back, dark-blue tail, iridescent purplish breast, brown wings, and white underparts (Plate I).

Color schemes vary widely among his kins-

men. The Turquoise Wren has lustrous turquoise blue as his main feature (Plate II). The Splendid Wren is a scintillating vision in blues and purples (Plate I). The Blue and White Wren is a deep cobalt blue with white wings, while the Black and White Wren is a shimmering jet and white (Plate III).

Some of the family, however, have developed a red complex. The Variegated Wren has an electric-blue cap and cheeks, blue saddle, black back and chest, brown wings, and chestnut-red scapulars.

The Elegant, Blue-breasted, and Lovely Wrens are similar in coloration, the last-mentioned, with his chromatic spouse, making a lovely couple (Plates IV and V).

The Red-backed Wren is black with brilliant red back (Plate VI). Picture this dapper little dandy flitting down a sunbeam in tropical northern Australia!

Perhaps the Fairy Wrens first originated in the colder northern continents. If so, they must have entered Australia at its most northerly point, Cape York.

At Home in the Cities

For that day in the dim past when the first of the group arrived there is much to be thankful. The bush would be much less pleasant if it lacked the pert happiness of these elegant mites.

Even if the Fairy Wrens did not come from other lands, but are natives, it is almost certain that their first habitat was northern Australia, whence they began a slow migration southward by way of the east and west coasts, respectively.

The Blue Wren must have been one of the first to start on the long southward trail along the eastern edge of the continent, for it is found from southern Queensland down to Tasmania on the extreme south, and also along the Victorian coast well into South Australia.

It must have migrated to Tasmania when that island was still part of the mainland, for such a small bird could not possibly have winged its way across the expanse of ocean that is Bass Strait.

Strangely, the dainty Black and White Wren has been found only on two small islands 350 miles apart—Dirk Hartogs and Barrow—and not on the mainland, although

Pastel Wrens from "Down Under"



© National Geographic Society

Painting by N. W. Collier

Fairy Wrens of Australia Grace Sprays of Native Flowers

Thirteen species of these wrens, with numerous races, are distributed over the island continent. Best known is the pert and friendly Blue Fairy Wren (left, male perched above female on fuchsia heath), which is at home in city parks and gardens in southeastern Australia and Tasmania. The Splendid Fairy Wren (right, male below female on blossoming Leschenaultia) frequents coastal regions of southwestern Australia and arid regions eastward toward the Stirling Range. Those living in the drier sections are much paler in color.



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Illustrated by S. W. Cassin

Dapper Little Busybodies Are Living Exclamation Points

The lovely Black-backed Fairy Wren (pair at right, male above female on Sturt's desert pea, which grows in hot, dry country) is an inland dweller ranging from Queensland through western New South Wales to the brushwood country of South Australia. It closely resembles the Blue Wren in nesting habits. So filled with curiosity is the Turquoise Fairy Wren (left, female over male clinging to kangaroo paw) that it will approach and investigate a bat laid on the ground. This species frequents southern and central Australia.

Pastel Wrens from "Down Under"



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Painting by S. W. Carter

Females of Some Wrens Are More Courageous Than the Males

When a flock of Blue and White Fairy Wrens (left, male lower) is flushed, the soberly dressed females boldly approach an intruder, while brightly clad husbands hop away to a safe distance. Several relatives have the same trait. Yellow blossoms adorn the thorny dead-finish wattle, a favorite nesting site. Only on Barrow and Dirk Hartogs Islands, off Australia's western coast, is the Black and White Fairy Wren (right, male above) found. It evolved from the Blue and White variety; young males may have blue feathering.



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Painting by N. W. Gayney

Gay as Butterflies Are Two Glittering Cousins

More often heard than seen is the shy Variegated Fairy Wren (pair at left, male below, perched on flannelflower), which is widely distributed over the greater part of Australia. Often the young of the first brood help the parents in feeding those of the second. Swampy heath lands of the southwest coastal districts are the favorite haunts of the Elegant Fairy Wren (right, female lower, balancing on brown, or sweet-scented, boronia, which is cultivated for commercial purposes).

Pastel Wrens from "Down Under"



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Painting by S. W. Copley

Saucy Midgets Flash Chestnut Epaulets

Scrub and heath lands across tropical northern Australia are enlivened by pairs or family groups of the quite common Lovely Fairy Wren (left-hand couple, male below). Perched among rosy blossoms of the Geraldton waxflower is a pair of Blue-breasted Fairy Wrens (at right, male above). This striking dweller among thickets of small gum trees in the interior of southwestern Australia is secretive and therefore difficult to observe. One may attract the female by imitating the call of a young bird in distress.



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Painting by N. W. Taylor

Even among Colorful Wild Flowers, Red-backed Wrens Are "Standouts"

Perched on sweet-scented pink, or mountain, boronia, the cheerful Red-backed Fairy Wren (left, male upper) shows off its vivid markings. Toward the end of the breeding season the red of the males may fade to orange through exposure and wear. This wren's range is chiefly coastal in eastern and northern Australia. A closely allied race of Northern Territory is the Crimson-backed Fairy Wren (pair at right, male above), of a deeper red and more compact feathering.

Pastel Wrens from "Down Under"



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Illustration by S. W. Gilmer

Nimble as Acrobats, They Busily Hunt for Insect Food

John Gould, 19th-century English naturalist, gave "the palm for elegance and beauty" among all Australian birds to the Purple-crowned Fairy Wren. Few birds have the lovely lilac tint which encircles the head of only the male. It inhabits a narrow inland belt extending across northern Australia and favors cane-like grasses, which it climbs with agility. Females appear to lead family groups as they move swiftly through tall grasses and pandanus palms along rivers searching for insects and larvae.



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Painting by S. W. Carter

Poor Flyers, Tiny Emu Wrens Run, Mouselike, Through Reeds and Scrub

One of Australia's smallest birds, the wary and retiring Emu Wren (two at left, male lower, swinging on Sydney rose) was named from the resemblance of its fanlike tail feathers to the plumage of the emu, the country's largest native avian resident. The Rufous-crowned Emu Wren (pair at right, male above) lives in stunted shrubland and spinifex grass areas from southern and central Australia to the midwestern coast. Its extremely short, round wings are ill adapted to flight. The birds seldom take wing unless hard driven.

the first is only a mile or so, and the second 35 miles offshore.

Of all the Fairy Wrens, the Blue Wren seems the favorite, because he is abundant in the more populous parts of Australia and is most closely associated with the home life of the country. He is common in gardens, both public and private, in the heart of cities and towns.

Scientists sailing with Capt. James Cook 168 years ago observed the Blue Fairy Wren at Adventure Bay, Tasmania, noting that it had a "pretty long tail" and "part of the head and neck of a most beautiful azure color."

Since the habits of all the members of the family are essentially alike, personal observations of a pair of Blue Wrens for seven years suggest the life history of each species.

My residence at the time had some six acres of grounds, mostly in a wild state. Two pairs of wrens lived in the area, one pair in the gardens close to the house, the other in the far corner of the property among the tangle of low scrub and blackberry vines.

The garden dwellers nested for two seasons in a clump of red-hot poker plants, but the following year, most likely because of my too close attention, they built their home ten feet up in a Japanese screw pine. The other pair nested in the blackberry vines for seven consecutive years and regularly reared two broods of three youngsters each season.

The normal breeding season begins toward the end of July. Then the Blue Wren is at his best. His whirring little song, somewhat like a musical alarm clock going off, bursts forth at break of day and continues at intervals until sunset, often much later.

His attentions toward his mate are persistent, and his pugnacity toward other wrens, especially his offspring of the previous breeding season, is marked.

He woos with blue head thrown back and dark-blue tail erect, blue cap and mantle all fluffed most importantly; with blue patches on his cheeks puffed out as if he were about to burst, he struts and hops. Occasionally he pauses to give a quick series of bows, and he never ceases in his efforts to charm his willing mate.

He assiduously helps with the nest building and later with the brooding.

When not assisting in the latter task, he spends most of his time on guard near the nest. If another bird encroaches on his territory, he is after it like a winged fury, never giving up the attack until it seeks safety in flight.

Thick and thorny vegetation, low bush, hedge, cluster of vines, or thick clumps of tall

grass are usually selected as nesting sites. If the foliage has thorns and clings close to the ground, so much the better. Such sites afford shelter against weather and protection from snakes and other enemies.

The nests are dome-shaped structures with an entrance at the side slightly protected by a hood. They are composed of grasses, pieces of bark fiber, rootlets, cobwebs, and cocoons, and are cosily lined with feathers, fur, hair, wool, or other soft materials.

Three, occasionally four, eggs are laid, the ground color being fleshy or reddish white, minutely dotted, spotted, or blotched with pale red or different shades of reddish brown. These markings are more numerous on the larger end.

The eggs take about 14 days to hatch, and the young when they first appear are naked, ugly mites, seeming all gaping mouths. But soon feathers begin to show, and at three weeks old the young are ready to leave the nest.

Tails of Character

A wren on the wing makes what seamen call "heavy weather." Their long tails seem to be in the way and not to be useful in aiding flight. The tails, usually cocked upright or over the back, are carried straight out behind in flying.

It is wholly different when the birds are on foot, as they usually are. They hop and run along the ground, over or through bushes and grass at a very fast pace.

What a lot of character there is in a wren's tail! Its carriage means everything to its owner's appearance. When it is held in its usual upright position, few birds look more sprightly or fascinating. But what dejected-looking little mites they are when the tail is drooped behind!

Often when one approaches their nests, especially if the nest contains youngsters, the parents adopt the drooped-tail pose and creep about like mice through the bushes and grass, cheeping plaintively the while.

They also use the well-known trick of the broken wing and flop about, seemingly in a helpless manner, trying to attract attention toward themselves and away from their nests and babes.

Bathing in Dewdrops

Like most other small birds, Blue Wrens are fond of bathing. If the bathing pool is shallow, they stand in the water and splash; but if the water is deep, they take their bath on the wing by dropping to the surface of the water and flying up again.



BOY P. COOPER

In His Courting Best, the Cocker Blue Fairy Wren Guards His Thatched Home

Although nests are usually built near the ground, he chose a lofty site beyond the reach of prowling cats and other foes. Nearly naked youngsters soon grow feathers and in three weeks, when they leave the nest, resemble their somber mother (Plate I). Dark-blue tail feathers are the first change in the young man's livery, corresponding to a boy's first long-trousers. Then black and bright-blue feathers appear, and Lord Fauntleroy bursts forth in all his splendor. During molting the birds hide in dense undergrowth.

Their favorite bath, however, is taken among the leaves of trees and grasses when sprinkled with dew or wet from rain or the garden hose. They hop and splash about in the dewdrops until they are thoroughly wet.

I know of no prettier sight than this—to see a party of these dainty little blue and brown birds bathing in dewdrops. If there are flowers on the bathing tree, the sight is even more beautiful.

After this bath, the preening process commences. First, the feathers are thoroughly dried. The usual method is to bask in the sun, with the feathers of the upper parts raised, the breast feathers puffed out, and the tail fully spread. Then, after a vigorous shaking of the body, every feather is carefully lifted, passed through the beak for its entire length, and as carefully replaced.

Food consists entirely of insects and larvae, and one family of wrens will eat hundreds of such pests each day.

It is estimated that a young wren eats more than its own weight in food every 24 hours. This conclusion is the result of carefully kept records of the number of visits

paid by the parents with food for their young in the nest, and of the examination of the stomach contents of birds killed for museum specimens.

4-inch Tail; 2-inch Body

I include the Emu Wrens, quaint shy wrens of the southern Australia heath lands, with the Fairy Wrens in this article because few birds are more elfin in appearance and habits than the two representatives of this remarkable genus (Plate VIII).

Emu Wrens are unusual chiefly because of the reduced number and peculiar structure of their six tail feathers. The central and longest pair are from four to five inches in length, and the feathers on either side decrease successively by about an inch.

These birds received their name from the appearance of the loosely barbed rectrices (quill feathers in the tail), which were believed to resemble the feathers of the emu, Australia's largest bird.

The generic name *Stipiturus*, meaning "stem tail," is well chosen for the tiny birds with the "stick-up" tails.

Lend-Lease and the Russian Victory

BY HARVEY KLEMMER

THE Foreign Economic Administration recently issued a table. It was labeled "Exports to the Union of Soviet Socialist Republics" and it went like this:

Year	Value	Gross long tons
1941	\$545,000	194,000
1942	\$1,351,788,000	2,466,000
1943	\$2,965,928,000	4,794,000
1944	\$3,429,345,000	6,218,000
1945 (Jan-June)	\$1,371,598,000	2,977,000
Total	\$9,119,204,000	16,651,000

Behind these figures lies one of the great stories of World War II. Not all of it can yet be told. What can be told now helps explain the German failure to conquer the Soviet Union, the debacle which befell the Nazis, and the final triumph of the United Nations.

Victory in eastern Europe was preponderantly the result of Soviet manpower, Soviet materials, Soviet weapons, and a Soviet determination to die rather than accept the German yoke. However, there was another factor without which victory would have been delayed and conceivably might have been lost altogether.

That factor was the American program known as Lend-Lease.

It will not minimize the achievements of our Soviet ally to outline the extent of aid supplied by the United States, the uses to which it was put, and the ways this aid contributed to the common victory.

Lend-Lease New in World Warfare

Lend-Lease was a new and important development in the foreign policy of the United States. It was based on the theory that the United Nations, by pooling their resources, could win a speedier and a less expensive victory than if they attempted to operate in watertight compartments. Military cooperation is as old as war itself; the sharing of resources, on a world basis, was achieved for the first time in World War II.

We have made available to 44 countries, under Lend-Lease, goods and services valued at more than 42 billion dollars. Lend-Lease exports—that is, goods actually shipped from the United States—have amounted to more than 31 billion dollars. Of this total, more than 9 billion dollars is (as we have seen above) accounted for by the Soviet Union.

Only Great Britain has received more aid from the United States than the U.S.S.R.

The Soviet program presented peculiar difficulties. Many of the items requested by the

Soviets were already in short supply. Many were needed by other allies and some were required by our own fighting men. The transportation problem was, with the exception of the same problem for China, the most acute with which we had to contend.

The difficulties were overcome. Supplies required by the Russians were, somehow or another, procured, and they were, in one way or another, transported to the Soviet Union. It is a good thing they were.

The European phase of Soviet Lend-Lease—which forms the subject of this article—came to an end with V-E Day. However, Leo T. Crowley, Foreign Economic Administrator, has revealed that shipments were continued to Siberia on the theory that the possibility of the U.S.S.R. coming into the war would act to pin down Japanese troops who otherwise might be used against us. The theory became a reality when the Soviet Union entered the war in the Pacific on August 8.

Assistance rendered by the United States to the Soviet Union has taken many forms. Munitions—planes, tanks, guns, explosives—were obvious "musts." In addition, we have sent prodigious quantities of supplies and equipment required to keep Soviet transportation going, Soviet mouths fed, and Soviet industry in operation.

Communications Take Top Priority

I asked an official of the Foreign Economic Administration what category of supplies he considered most important to the Russians.

"Communications equipment," he replied. Then, noting my surprise, he went on:

"You can't run a modern war without telephonic, telegraphic, and radio equipment. The Soviets lost most of their factories for making this sort of equipment early in the war. It was absolutely necessary that the production of these factories be replaced if the Red Army was to stand up against the German panzers."

"We want 62,000 miles of field-telephone wire a month," the Russians declared.

Our Signal Corps said the request was extreme; that no army in the world could use that much wire; that the Soviets must have overestimated their needs.

The Russians were adamant. They pointed to the length of their front, some 2,000 miles, to the depth of the German penetration, and to the great distances their armies would have to travel to throw the invader out.

They also made a surprising assertion—that,

modern firepower being what it is, the life of field-telephone wire at the front averages just 20 minutes.

The Soviets ultimately got their wire—more than a million miles of it, enough to go around the earth 50 times. However, we were still skeptical. Later on, when we got into the fight ourselves, we discovered that the Russian figures were, if anything, conservative.

The same situation arose with respect to field telephones, of which 420,000 have been shipped.

The next most important items supplied to the U.S.S.R. by the United States, after communications equipment, probably have been airplanes, trucks, and railway equipment.

The first planes went to the Soviet Union in September, 1941, shortly after the Germans launched their attack. Since then, a mighty tide of aircraft has flowed to that country.

Warfare of the Air and Wheels

More planes have been sent to Russia under Lend-Lease than to any other country. They have been of all types—fighters, bombers, trainers, cargo planes, observation planes, flying boats.

Nearly 14,000 aircraft have been delivered into the hands of Soviet pilots, who used them with deadly effect against the common enemy. That was one reason why the Germans were not able to maintain air superiority on the eastern front.

The Nazis also had an unpleasant surprise on the ground. Hitler's panzer divisions had nothing on the Soviets when it came to mobility. The Red Army moved on wheels, and a good share of the wheels, as you might expect, came from the United States.

The 1,400-mile sweep of the Red Army from Stalingrad through Poland to Berlin and Torgau on the Elbe,* where, on April 25, the Soviets joined forces with our First Army, was made possible by the greatest array of mobile equipment ever assembled. We have sent under Lend-Lease more than 400,000 trucks and jeeps, plus many thousands of other military vehicles, such as artillery movers, tank transporters, and scout cars.

At one time more than half the Red Army's supplies on some sectors of the front were moving in Lend-Lease trucks. Without these trucks, the spectacular Soviet advances of 1943, 1944, and 1945 would have been greatly hampered, if not held up altogether.

Many of the trucks sent to the U.S.S.R. have had to be equipped with special treads for mud and snow.

The Soviets are extremely fond of American jeeps. They originally asked for motorcycles

with sidecars; however, when it was pointed out that our Army was using jeeps almost entirely and that sidecars would be difficult to obtain, they agreed to try jeeps.

The sturdy little cars worked so well on Russian roads that the Red Army quickly asked for more. Today the jeep is as well known in Russia as it is in the United States.

An Associated Press correspondent bouncing along with a Red Army driver asked the latter how he liked his jeep. The driver answered with one word:

"Zamechatelno!"

That is the Russian equivalent for "swell."

Trains and Tracks for Russia

Side by side with the provision of trucks has gone the shipment of railway equipment. Railway lines, bridges, and rolling stock were pretty thoroughly destroyed in areas occupied by the enemy. All of this equipment had to be replaced and additional facilities provided to maintain the rapidly lengthening supply lines of Soviet forces as they plunged westward into Germany.

We have sent to Russia under Lend-Lease about 700,000 tons of rails, wheels, axles, and other equipment. We have sent, in addition, the following rolling stock: 1,825 steam locomotives, 10,000 flatcars, 1,000 dump cars, 100 tank cars (page 511).

Steam locomotives are naturally used in areas where coal is available. For other areas, we have supplied 70 Diesel-electric locomotives.

Food has bulked large in the Lend-Lease program. The Soviet Union's need for food has been great. Nearly half of her most fertile cropland, including the Ukraine, was at one time or another under Nazi control. Soviet factories could be moved to new locations behind the Urals; farms couldn't.

Although the U.S.S.R. made remarkable strides in developing new agricultural regions, she could not produce nearly enough food to satisfy her minimum needs.†

The situation became so desperate that, at the time when Stalingrad was fighting for its life, vessels loading on our West Coast carried food in preference to munitions.

More than 4,000,000 tons of foodstuffs have been sent to Russia. This is about a third of

* See "Germany and Its Approaches," map supplement to the NATIONAL GEOGRAPHIC MAGAZINE for July, 1944; and "Union of Soviet Socialist Republics," supplement to the December, 1944, issue.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Magnetic City' (Magnitogorsk), Core of Valiant Russia's Industrial Might," by John Scott, May, 1943; and "Liberated Ukraine," by Eddy Gilmore, May, 1944.



Persian Gulf Command, U. S. Army, Official

The Russian "Firewoman" and the American General Shake Hands on a Job Well Done

Mme. V. Verbanovna's infectious good humor is caught by Maj. Gen. Donald H. Connolly, Commanding General, Persian Gulf Command, and by Maj. Gen. Ivan V. Kargin, Chief, Soviet Transport Department in Iran (white coat). The train in the Tehran Yards behind them carried the 1,500,000th ton of supplies to the U.S.S.R. through Iran. Before it ceased activities on June 1, 1945, after two and a half years of work, the Persian Gulf Command, by rail and highway, had handled three times that tonnage (pages 505 and 509).

all food supplied by the United States under Lend-Lease.

Food shipments have consisted principally of wheat, flour, meats, sugar, fats, and oils.

"Tushonka" Helps Win a War

The meat has been largely canned. The Russians asked for a special product called *tushonka*. This consists of pork packed in tins and covered with lard. As a concession to flavor, each can is topped off with a bay leaf. Tushonka can be eaten hot or cold, so the Russians say, and the lard supplies quick energy. A quarter of a million tons have been shipped. This concoction contributed substantially to the German defeat on the eastern front (page 502).

Sugar has been an important item in Lend-Lease shipments to Russia. Much of this sugar has gone in lumps. Lend-Lease demands and Army demands took lump sugar off the American market early in the war.

This may have bothered some civilians, but it helped United Nations' fighting men, as granulated sugar is difficult to handle in field rations. It is particularly hard to handle in Russia, where the troops are accustomed to march with food around their belts. Citizens of the U.S.S.R., moreover, like to suck their tea through sugar.

Sugar shipments aggregate about 700,000 tons. They have been augmented by some 700 tons of saccharin!

Butter shipments to the Soviet Union, which



Berfoto

American Canned Pork Brings Smiles to Russian Lips

Lend-Lease foods provided midnight snacks for these bomber crewmen. Popular with Russians is *tushonka*, a heavily larded pork concoction which after V-E Day was the only canned meat sent to the U.S.S.R. Ivan eats it hot or cold, likes it flavored with bay leaves. It gives him quick energy (p. 501).

aroused considerable controversy in the United States, have totaled about 65,000 tons. This sounds like a lot of butter, but, in relation to Russian needs and in comparison with American consumption, it is really an extremely moderate program.

Butter was originally requested for the Red Army, particularly for men who had been wounded. Shipments have amounted to a small fraction of American consumption, averaging two-tenths of an ounce per week for each civilian during 1943 and 1944 and falling even lower in 1945.

Margarine has also been supplied, but not without a struggle. The Soviet Government was trying to popularize margarine before

the war and, to convince the people that it was an acceptable substitute for butter, had undertaken an advertising campaign in the Moscow subways. Notwithstanding this official attitude, members of the Soviet Purchasing Commission here were not overly enthusiastic about taking margarine, fearing that it would be wasted on people who had not become accustomed to it.

Lend-Lease officials set up a butter-margarine display at the Department of Agriculture and invited the Russians to distinguish between the various samples. We had no further trouble with margarine; in fact, a special tropical type developed here, which will not melt even in the hottest weather, proved to be exceptionally suitable for transportation via the Persian Gulf and for use in the Crimea* and other hot areas.

Three hundred thousand tons of lard, frequently used in lieu of butter, have been sent to the Soviet Union.

It is estimated that more than half of Russia's requirements for fats and oils during the war have been supplied by the United States.

Various kinds of soups have been tried, including the traditional *borsch*, which is made chiefly from beets, and others derived from potatoes, onions, and carrots. The Russians have taken most of the soups, but one, made of alfalfa on the recommendation of food experts in Australia, they turned down.

Much of the food sent to Russia has gone in concentrated form. The eggs are dried; the milk is condensed or powdered; the vegetables are dehydrated. Some products have also been compressed.

* See "Crimea Reborn," by Eddy Gilmore, NATIONAL GEOGRAPHIC MAGAZINE, April, 1945.

Eggs can be reduced to one-seventh of their volume through dehydration and compression; potatoes to one-tenth. The result is a great saving in shipping space.

Soups are exported in squares about the size of a box of safety matches. The addition of water converts the square into a large bowl of soup.

Keeping Pigs Aboard Ship

Russian sailors have done their share to ease the food shortage by keeping pigs aboard ship. The pigs are fed galley left-overs until ready for slaughter. Meanwhile, they serve as ships' pets and mascots.

The captain of one ship had a brilliant idea. There were more than enough slops to feed one pig. Why not get a sow and raise a family? Accordingly, on his next voyage to the United States he included in his list of supplies the following item: "One she-pig for mating with ship's mascot."

Nearly half of our exports to the U.S.S.R. under Lend-Lease have consisted of munitions. Aircraft have been the biggest item, followed by motor vehicles, ordnance and ammunition, tanks, and water craft.

We have sent more airplanes and trucks to Russia than to any other ally. We have also sent some 7,000 tanks, 344,000 tons of explosives, and tens of thousands of guns of various types.

The Soviets produced in their own plants most of the munitions used by their troops. However, without munitions received from the United States the Red Army's tremendous drive from Stalingrad to Berlin would have been both slower and more costly.

Notwithstanding their own vast reserves, the Russians have been desperately short of petroleum products. Here again Uncle Sam has lent a hand, supplying nearly 2,000,000 tons.

Shipments of chemicals, used principally for making explosives, have amounted to approximately 1,000,000 tons.

In addition to putting the Red Army on wheels, Lend-Lease has also helped to put shoes on Ivan's feet. Some 15,000,000 pairs of army boots have been supplied, plus more than 50,000 tons of leather for use in Soviet factories.

Most of the boots have been of standard type. However, the Soviets asked if we could supply a certain kind of high-top felt-lined footwear designed for use in melting snow and ice. For centuries these boots had been made by hand; it devolved upon the Lend-Lease Administration to find a way of producing them by modern factory methods.

Fortunately, there was a man in the United States who knew all about such boots. He was the former head of the Tsar's boot factory. The American Government asked his help in making boots for the Soviets. He went to work, and a machine process for making the water-resistant boot was perfected.

German troops on the eastern front suffered horribly from frozen and gangrenous feet. Red Army troops, thanks to Lend-Lease and the Tsar's bootmaker, were better shod than they otherwise would have been.

We have also sent a great deal of cloth to Russia for the manufacture of army uniforms. The count on cotton cloth stands at slightly more than 100,000,000 yards, on woolen cloth about 60,000,000 yards. That's a lot of cloth in any language. However, there are a lot of Russian soldiers and they couldn't fight without clothes.

From Ships to Buttons and Bridges

Other items made available to the Soviets include ships (both merchant and combatant), construction machinery, medical supplies, bridges (pontoon and cableway), marine engines and other vessel equipment, paint, plastics, cordage, rubber, paper, photographic materials, asbestos, fish nets, and buttons. This is only a partial list, but it will give an idea of the scope and variety of the mighty exchange which has taken place between the U. S. and the U.S.S.R.

Large quantities of military equipment and other supplies have also been furnished to the Soviets by Great Britain and Canada.

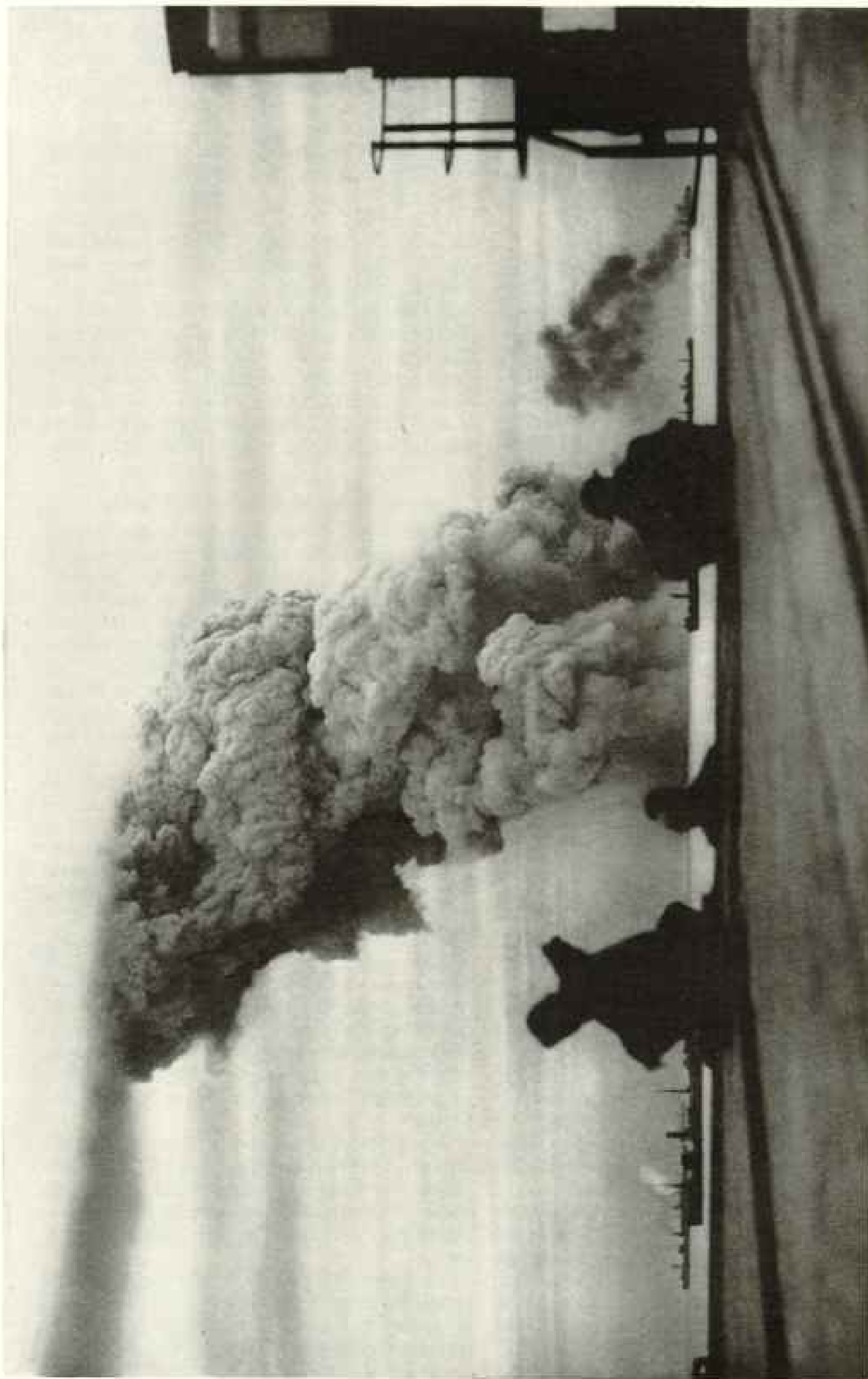
It was a cardinal principle of Lend-Lease to help our Allies so far as possible to help themselves. This was particularly true with regard to the Soviet Union.

The United States could not possibly supply all the needs of her Allies. The best we could hope to do was to fill in the gaps and provide certain equipment and materials that would put other equipment and materials to work. This approach worked very well in Russia, where a vast potential was stymied for want of strategic items available in the United States.

Many Soviet factories were destroyed by the enemy. Others were destroyed by the Soviets themselves to prevent the enemy from using them. It was vital that those factories which remained be utilized to the fullest possible extent.

Vast quantities of raw materials have been supplied under Lend-Lease. We have also sent machines and machine tools required to convert these materials into weapons.

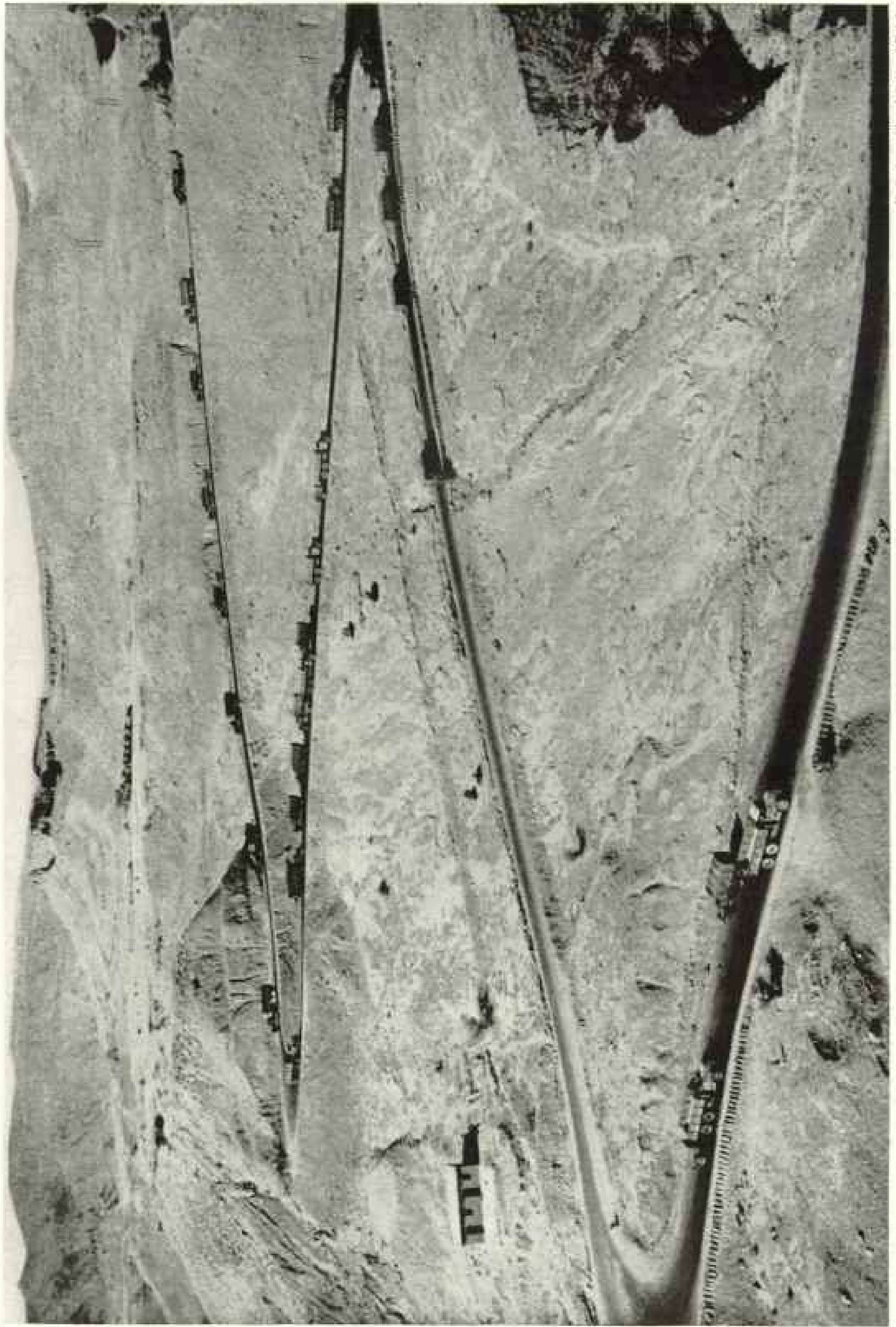
Two and a half million tons of steel, most



BRITISH OVERCAST

Smoke, Billowing from a Bombed Merchantman in a Murmansk Convoy, Disappears Magically into the Low Overcast.

An escort vessel (foreground) stands by. Harassed by the enemy on three levels—air, surface, and underwater—convoys suffered 25 percent losses in the early days on this shortest and most dangerous route to the eastern front. Nazi dive bombers from Norwegian and Finnish bases were often curtailed by the overcast until just above their target (page 568).



U. S. Army Signal Corps, Official

Switchbacking Across Sun-tortured Mountains, Convoys of American Ten-wheelers Meet Near Andimishk on the Iranian Route to Russia

of its special types used for making armor plate, tanks, and guns, have been shipped. We have also sent 400,000 tons of copper products, 250,000 tons of aluminum, and nearly a million tons of blending agents for the production of aviation gasoline.

This procedure of supplying raw materials and manufacturing equipment multiplied the effectiveness of Lend-Lease manyfold.

"It was like spending \$5,000 to put a million dollars to work," explained an official.

Entire Factories Exported

Entire factories have also been exported to the Soviet Union. Among them were a tire plant, an aluminum rolling mill, and two pipe-fabricating mills. Plants have been built or were building for the manufacture of wall-board, nitric acid, and hydrogen gas.

A block-signal system designed to increase the carrying capacity of existing facilities was installed on Soviet railways. Various projects for the provision of electric power were also approved.

As all the world knows, the Soviets crippled their famed Dnieper Dam when they were forced to retreat before the invaders. The Nazis, when it was their turn to retreat, blew up some of the dam. It has been estimated that it will take 10 years to restore the project to service. Meanwhile, adjacent communities and other parts of the country as well had to have electricity in order to keep going.

Under Lend-Lease, General Electric and Westinghouse developed a "power train" which proved to be extremely effective in putting idle plants to work. The power train consists of a complete steam-generating unit mounted on railway flatcars which can be moved from city to city, or from factory to factory, as the need arises. As soon as the local utilities are functioning again, the train moves on to "spark" another area.

Some sixty-odd trains have been supplied, and the Soviets have put them to good use, particularly in the Donets Basin.

The trains were designed to operate on low-grade Soviet coal. To make sure that they would work, it was necessary to locate similar fuel in the United States. A type of coal almost identical with that found in the U.S.S.R. was finally spotted in Arkansas.

Seeds Flown to Siberia

The trains have also presented a serious shipping problem, as each one is the equivalent of seven railway flatcars.

Both factories and power trains fitted into the scheme of helping the Soviets to help themselves.

Just as we sent refining equipment so that the Soviets could produce more of their own aviation gasoline, so we sent seeds to help them increase their production of food.

The first seeds from the United States were flown to Russia by way of Iran in time for the 1942 planting. Since then, we have sent 40,000 tons of seeds for the growing of some 30 staple crops. These seeds have been used to replant devastated areas liberated from the Nazis and to pioneer new agricultural projects on the undeveloped plains of Siberia.

The cold statistics do not give any idea of the travail with which the Lend-Lease program for Russia was accomplished. Many of the products requested were unknown to American producers; they conflicted with the requirements of other countries and of our own armed forces; they had to be produced within time limits and with a degree of precision once thought to be impossible. It took ingenuity and imagination and guts to fulfill the needs of our Soviet ally during those grim days when the future of mankind was at stake.

There were many frustrations and delays and some mishaps. Occasionally we missed the boat, both literally and figuratively, such as the time a shipload of planes was sent to Archangel (Arkhangelsk) while essential parts went to Basra. This error kept dozens of Soviet flyers on the ground for six months.

Fortunately such experiences were rare. Usually we made the boat.

Wanted—Barbed Wire

The Soviets gave us a scare, at the very beginning of the program, when they asked for 4,000 tons of barbed wire. That was about 20 times as much barbed wire as was available at the time; moreover, the Russians wanted it in two weeks. Mr. Edward Stettinius and Mr. William Batt and Mr. Arthur Whiteside worked night and day to get that wire. They got it, but several American industrialists will never be the same!

After Stalingrad the Russians didn't need any more barbed wire. From that time on it was the Germans who needed it. Unfortunately for him, Hitler hadn't planned on that contingency and, since he wasn't eligible for Lend-Lease, his position left much to be desired!

Once, when Soviet stocks were running low, a trainload of aluminum was rushed to the Pacific coast on a nonstop schedule which gave it the right-of-way over everything else on the rails.

It was reported early in the war that German steelmakers had developed an I beam 65 feet long for bridging rivers. There was some

skepticism here about the practicability of such a beam, until the Nazis employed it to good effect in their invasion of Russia. Eventually the Russians captured some of the beams and asked us to produce them under Lend-Lease. This we did, although both manufacture and transportation brought many a headache to those in charge of the program.

The beams required two flatcars for the haul to seaboard, and aboard ship they had to be carried in special racks fitted to the deck.

The American copper industry has produced tubing of a thinness never before achieved here in order to meet a Russian requirement. The Russians said that the speed and maneuverability of their planes would be greatly increased if we could give them thinner radiator tubing than that which was then being used. We worked it down to four one-thousandths of an inch.

The dies required to make this tubing were themselves the result of a spectacular production record.

One afternoon in 1942 the Russians reported the destruction of dies which they had been using and made an urgent request for duplicates. It developed that the best time we could give them was 39 days. Speed was essential; 39 days might mean the difference between victory and defeat. What, if anything, could we do?

The problem was turned over to the War Production Board. Michael Schwarz, Director of the Copper Division, located Harry L. Erlicher, Vice President of the General Electric Company, at a reception in Schenectady.

"For heaven's sake," pleaded Schwarz, "get on a plane and go out to Detroit! Check with the Carboloy Company and see what you can do to hurry up those dies they are making for the Russians."

Then, winking at Soviet officials who were listening in on the conversation, he concluded:

"The time limit is three days."

Erlicher went to Detroit. At 7:30 o'clock the next morning he called Schwarz, reported that he and the Carboloy people had worked all night, and that they could produce the dies in five days.

The project was given highest priority. Machines were run 24 hours a day, and each operator was buttressed with a stand-by so that there would be no interruption when he went for a smoke, lunch, or what not. On the fifth day the dies were flown to Waterbury, Connecticut, where the tubing was produced, and within a few hours an initial consignment was on its way to Russia by air.

The Russians later presented Schwarz with a medal contrived of copper tubing and im-

printed with Russian characters symbolic of their appreciation for the job he and his associates had done.

Ten Routes to the U.S.S.R.

The Russian program has involved one of the most complicated shipping problems ever undertaken by any country either in war or in peace. Goods have gone to the U.S.S.R., at one time or another, over ten different routes. Eight of these routes lie over water; two of them lie in the air.

The logical shipping route, via the Baltic, was of course closed to us.

The route across the Pacific from our West Coast to ports of the Soviet Far East suffered from the disadvantage that supplies, after discharge, had to be railed several thousand miles to the front. However, shipments were made this way throughout the war.

The outbreak of war with Japan closed the transpacific route to American vessels. After Pearl Harbor, the run could be made only by Russian ships, which were then neutral so far as the Japanese were concerned.

In addition to maintaining the service to Vladivostok and near-by ports, the Russians have also sent vessels via Bering Strait over the dangerous and little-used passage north of Siberia. This passage, known as the northern sea route, is open only for three months of the year and even then it cannot be traversed without the aid of icebreakers. Each summer for four years a convoy fought its way over the northern sea route to deliver supplies to a once-desolate region now dotted with mines, airports, and weather stations.

At one time it was considered impossible to send ships into this area and then get them out before the ice began to set. The success of the wartime operation resulted from improved icebreakers, the use of airplanes for scouting floes, applied meteorology, and the establishment by the Soviets of a chain of up-to-date weather stations.

The Russians, who are not generally regarded as a maritime people, have shown an unexpected aptitude for the sea. Vessels made available to them under Lend-Lease have been efficiently operated and well kept up, despite a shortage of trained seamen.

Ships "Manned" by Women

Boys of 13 and 14 have been sent to sea, and many vessels have been "manned" with women. One of the Russian ships was skippered by a woman "master," and Pacific coast shipping men stick to their story that another ship was held up two days while the chief engineer had a baby!



Press Syndicate, by Ruth Robertson

American Candy, Tobacco, and Soft Drinks Tempt Soviet Pilots in Fairbanks, Alaska

Of nearly 14,000 Lend-Lease planes delivered to Russia, almost 9,000 were flown from factory door to the front, most of them by way of the Alaska-Siberia "top of the world" route (page 510). Ladd Field at Fairbanks, jointly operated by the United States and the U.S.S.R., was the transfer point. These Russian airmen relax in typical GI surroundings before taking off on the lonely flight to Nome and across Bering Strait to Siberia.

The shortest route to the U.S.S.R. available to us was across the North Atlantic and around the North Cape to Murmansk and Archangel. Unfortunately, this was also the most dangerous route. Vital war supplies required on the eastern front had to move, however, and we had no alternative except to ship what was ready and land what we could.

The British were confronted with the same dilemma, and their decision was the same as ours—to fight it out in the icy waters of the Barents Sea.

The enemy threw everything he had into this battle. Wolf packs of submarines would begin working on the convoys off Iceland. Strong forces of surface raiders, including cruisers and destroyers, would come out as the ships approached the Norwegian coast. Then would come the bombers.

The Germans had built a series of bases

around the top of Norway. To the north, the Arctic ice pack pressed down to within 200 miles of the land; sometimes to within 100 miles. There was no place for our ships to go. They couldn't escape to the north or to the south; they wouldn't go back. They gallantly did what was expected of them—they went ahead and delivered the goods.

The ships would be under fire for four or five days. Enemy planes came out in fleets. Once 350 planes roared down on a single convoy. Forty of the planes were shot down, but they took a terrible toll of our ships before they were driven off.

We fought back as best we could, but the odds were against us. Our warships had their hands full along the eastern seaboard and in the Pacific, so that the bulk of the North-Russian job fell on the British and Canadian Navies. Every available escort vessel was

pressed into service, to the point where some convoys boasted twice as many naval vessels as merchant vessels.

Even so, our losses were frightful. For a while one-quarter of the vessels which sailed for Murmansk failed to reach their destination (page 504).

This was in the summer of 1942. At that time I was writing an article on convoys for the NATIONAL GEOGRAPHIC MAGAZINE and decided to make the trip to Murmansk to get some first-hand information. A friend in the War Shipping Administration to whom I mentioned my plan shook his head.

"How much of a risk are you prepared to take?" he asked.

"Oh, 8 or 10 percent," I replied, remembering that transatlantic losses were running about that high.

My friend then gave it to me straight.

"I don't suppose," he said, "that you would want to take a 66-percent risk."

He picked up a cable on his desk announcing that a convoy of 33 ships had just been torn to pieces and that, so far as the naval authorities could determine, only 11 ships were still afloat.

I didn't go to Murmansk. That is why the convoy article described a trip to Britain instead of a trip to the Soviet Union.*

An 18,000-mile Sea Route

Eventually we licked the Germans off North Cape as elsewhere. Meanwhile, however, a new route to the Soviet Union had been opened up by way of the Persian Gulf.

The Persian Gulf Route was really a combination of four routes. Vessels in the beginning proceeded from our east coast around the Cape of Good Hope and up the east coast of Africa. The voyage took up to 75 days.

When enemy submarines got too active in the South Atlantic, we sent vessels through the Panama Canal, down the west coast of South America, through the Strait of Magellan, and thence around Africa. This was an 18,000-mile voyage, and vessels would be at sea for as long as 110 days.

Still other vessels proceeded by way of the Panama Canal, New Zealand, Australia, and the Indian Ocean—a voyage of 85 days.

Finally, in June, 1943, after the Nazi defeat in North Africa, we were able to send ships via the Mediterranean, the Suez Canal, and the Red Sea. This brought the time down to 48 days.

The Persian Gulf Route, in addition to distance and the ever-present menace of enemy attack, was also beset with political difficulties. Moreover, it involved an enormous program

of port development, road building, and railway improvement. Nevertheless, it turned out to be one of the most successful ventures of the war.

The political climate in Iran was unsuited to our plans. The country was alive with Axis agents. To make sure that the "Persian Corridor" was kept out of Axis hands, British and Soviet troops jointly occupied the country in August, 1941. Reza Shah Pahlavi abdicated in favor of his son, his Nazi advisors were thrown out, and a government sympathetic to the Allied cause took over.

The next thing we had to do was improve the ports at the head of the Persian Gulf. Basra, on the Shatt al 'Arab, was on the wrong side of the river, in Iraq. Khorramshahr, on the Iranian side of the river, could hardly be called a port at all. The same was true of Bandar Shahpur, located farther east on the Persian Gulf.†

The British, who had pioneered the Persian Gulf route, assumed major responsibility for the improvement of Bandar Shahpur; we concentrated most of our efforts on Khorramshahr.

Wharves, piers, and jetties were built. A channel deep enough to handle large freighters was dredged. Cranes for handling heavy equipment were installed. In one of the hottest and most backward areas on earth, modern ports, equipped with the finest of modern facilities, took shape.

A truck-assembly plant was set up at Khorramshahr, another on the road to Tehran. Fighter planes and short-range bombers were unloaded, assembled, tested, and flown straight to the U.S.S.R. from assembly plants at Basra and at Abadan.

Transportation facilities behind the ports also had to be improved.

The railroad which crossed Iran from the Persian Gulf to the Caspian Sea was totally inadequate for the kind of traffic we had in mind. The line was single-tracked most of the way; it was not equipped to handle heavy objects; it was short of rolling stock; it crossed hundreds of bridges and, in one section, traversed tunnels at an average of one every two miles. The service was subject to frequent interruption by landslides.

These things had to be corrected before supplies in any volume could move into the Soviet Union. New track was laid, new bridges were built, and thousands of flatcars, boxcars, and locomotives were shipped in to speed vital

* See "Convoys to Victory," by Harvey Klemmer, NATIONAL GEOGRAPHIC MAGAZINE, February, 1943.

† See "Iran in Wartime," by Brig. Gen. John N. Greely, NATIONAL GEOGRAPHIC MAGAZINE, August, 1943.

supplies to the shore of the Caspian Sea, whence they could be rushed by boat, train, and truck to the various fronts.

Here was an international railroad if there ever was one, operated by British, Russians, and Americans in addition to native Iranians, and equipped with rolling stock from Great Britain, the United States, Canada, Australia, India, and other places as well. Oh, yes, there was also German equipment which the former Shah had bought before the war!

All in all, life on the Trans-Iranian Railway grew a bit complicated at the end (page 501).

New Roads Built to Carry Supplies

There were a few roads running north to Tehran and the Caspian Sea from the Persian Gulf, but they were little better than camel tracks. Here again large-scale improvements had to be made before traffic could begin to roll in the volume required.

An old road from Khorramshahr to Ahwaz (on the Trans-Iranian Railway, about 70 miles away) was taken over by United States Army Engineers. With the help of native gangs, it was made into a first-class highway.

Hundreds of miles of new roads were constructed. Service stations were built, maintenance stations set up, repair shops placed at strategic points.

And then there came to pass a miracle which Hitler could not possibly have foreseen when he decided to attack Russia: thousands upon thousands of trucks, mostly American, winding through the mountains of Iran and laden with bad news for Germany (page 505).

The first ship from the United States to use the Persian Gulf route sailed in November, 1941. The route then had a capacity of 30,000 tons a month. The capacity when we finished was 250,000 tons a month. Khorramshahr and Abadan and Bandar Shahpur and Basra will not soon be forgotten.

The collapse of Axis strength in the Mediterranean gave us a shorter route to southern Russia. Ships which had been making the long voyage around Africa or through the Red Sea could now sail through the Mediterranean and into the Black Sea.

It was an anticlimax to the stirring events of the North Cape and the Persian Gulf. However, the end was in sight, and within three months after the first convoy passed through the Bosphorus, V-E Day had arrived.

The Russian shipping program was slow to start, but when it did get going, goods moved in such volume that the end of the European war found us with half a million tons at sea. Of the 16,651,000 tons which have been moved to the Soviet Union over all routes, about a

third has gone across the Pacific (principally in Russian vessels), a third has gone around the North Cape, and a third has gone by way of the Persian Gulf and the Black Sea.

Three-fourths of all shipments have been carried in American vessels or in vessels made available to the Russians under Lend-Lease. In addition to carrying our own goods, American vessels have also helped to transport materials to the Soviet Union from Britain and Canada.

The overwhelming proportion of Lend-Lease supplies for Russia of course moved by water. However, the airplane played an important part.

Planes Delivered Under Own Power

Of the nearly 14,000 planes turned over to the Soviets, about 9,000 were delivered under their own power.

Many of them, moreover, carried cargoes which, though small in size, were exceedingly important to the Soviet war effort.

The planes were flown over two routes—one via Alaska and Siberia,* the other via Africa and the Middle East.

Adm. William H. Standley, former American Ambassador to the Soviet Union, likes to tell the story of his attempts to sell Stalin on the Alaska-Siberia route.

The Russians didn't seem interested, and it was only after a second appeal had been received from President Roosevelt that Stalin confessed that routes had been laid out, fields built, and gasoline supplies cached.

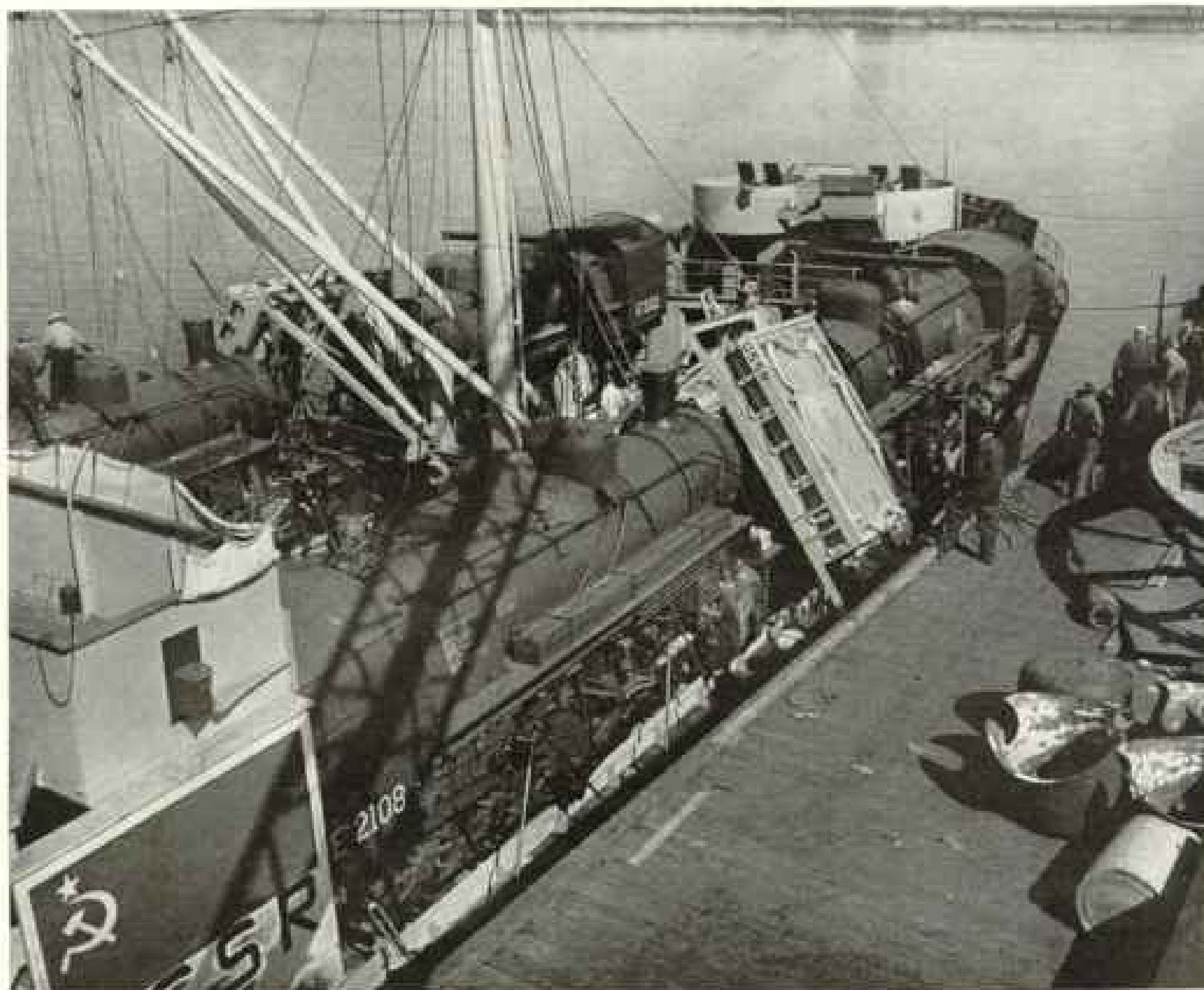
Most of the cargo carried by air went over the Alaska-Siberia route. Supplies were assembled at Great Falls, Montana, and then loaded according to a system of priorities determined by the Russians. Among the items carried were spare parts for planes and tanks, special pieces of machinery, scientific instruments, and medical supplies.

Relief supplies have also been carried, and once 500 hearing aids were rushed through for the use of Soviet officers who had been deafened by the thunderous barrages of the eastern front.

Planes were turned over to the Soviets at Fairbanks, where half of the airport was operated by American personnel, the other half by Russian personnel (page 508). The white star of the United States was replaced by the red star of the U.S.S.R., and another surprise for Hitler was on its way over the steppes of Siberia.

Planes using the African air route went by way of Miami, Cairo, and Basra. The

* See "New Road to Asia," by Owen Lattimore, NATIONAL GEOGRAPHIC MAGAZINE, December, 1944.



U. S. Army Signal Corps, Official

These Locomotives Made Long Hauls Between Far-inland Factories and the Fighting Front

Plying between Portland, Oregon, and Siberian ports, a fleet of specially fitted Soviet vessels carried 18 engines each, 10 below and 8 on deck. Crossings were safe, as Japan and Soviet Russia were not then at war. Locomotives built for Russia's wide gauge did not fit United States rails and had to be shipped to Portland on flatcars (page 500).

service was started with B-25's, but many smaller craft, equipped with special gas tanks for the long ocean hop, were flown to the Soviet Union this way.

Old-timers at Lend-Lease like to reminisce about the early days of this service. The Army had a map on which white buttons were moved about to indicate the progress of Lend-Lease aircraft en route to the Middle East.

Planes which were forced down or lost in transit were designated by black buttons. For a long time there were too many black buttons for comfort. In the end, however, this route, like the others, clicked, and the stuff flowed smoothly and safely to its rendezvous with a fighting man somewhere east of Berlin.

Some persons believe that the Russians didn't appreciate the efforts which we were making to put weapons into their hands. Even Admiral Standley felt that they were inclined to ignore the effects of Lend-Lease.

For some reason or another, possibly because of the enormity of their own sacrifices, the Soviets at first didn't wax especially enthusiastic over the aid which we were sending them. Eventually, however, the Russian newspapers began to print accounts of Lend-Lease shipments, and at Tehran Marshal Stalin gave credit to the part played by American industry in the winning of the war.

Some of our people, chafing under shortages, jumped to the conclusion that these shortages were due to Lend-Lease. Actually, the amount of sugar, meat, butter, and other scarce items sent abroad was small in relation to total United States consumption. Food sent to the U.S.S.R. last year, for example, was only two percent of our domestic supply.

Lend-Lease has cost a lot of money, to be sure. Still, it is but a fraction of our total war costs and, since it helped to shorten the war, saved money as well as lives.

Finally, there is the matter of postwar competition. Britain, the U.S.S.R., and other Lend-Lease beneficiaries will be better off than they would have been without our assistance. But we will be in even better shape. Moreover, American products have been introduced into areas where they were never seen before; it is a foregone conclusion that millions of new customers will demand them after the war.

A Two-way Benefit

The Lend-Lease program is a "two-way street"; it has benefited the United States as well as the countries to which we have sent supplies.* The principal benefit, of course, was victory in Europe. By pooling our resources, we made victory possible. All other considerations fade, compared to this.

We put up men and supplies to the limit of our ability; the Russians put up men and supplies to the limit of their ability. Other countries came in on the same basis. It was an unbeatable combination.

There is one thing which to my knowledge has never been denied—that the Soviets made good use of the equipment which we sent. They hurled our tanks and our aircraft and our shells at the Nazis with a ferocity which made our job much easier when it came time for the all-out assault on Fortress Europe.

The Soviets killed more Germans than all the other United Nations combined. With the help of Lend-Lease weapons and materials, the Red Army destroyed in one year 14,000 Nazi aircraft, 25,000 tanks, and 40,000 guns. Every Nazi weapon destroyed meant one less to be used against us; every Nazi killed or incapacitated saved American lives in the west.

American planes in the hands of Soviet aviators greatly reduced the number of Nazi planes which were able to challenge us over Normandy and Germany. Captain Eddie Rickenbacker reported after his trip to Russia that he met a young fighter who had shot down 27 Nazi planes with an American P-39.

A check made in June, 1944, revealed that 10 Soviet aviators flying Bell Airacobras had each downed 20 or more enemy planes. One flyer had 44 to his credit, while another, Lt. Col. Alexander Pokryshkin, was credited

with 59. Colonel Pokryshkin's score is believed to be the highest hung up by any flyer in the present war. Needless to say, more than one American flyer is alive today as a result of the exploits of this man and his American machine.

There are other benefits which, although less obvious, have been of substantial assistance to the United States.

The Lend-Lease program gave a tremendous spurt to our once-negligible production of weapons. Moreover, many types of items which we manufactured for the Russians were later used by our own troops—the power train and the walkie-talkie, for example.

Planes on Tanker Platforms

The practice of carrying planes on platforms built over the decks of tankers was pioneered on the Persian Gulf run. The Russians helped teach us how to winterize airplanes. Their food program forced us into the dehydration and compression of foods on a large scale.

The Soviets were not in a position to do much in the way of reverse Lend-Lease. They were short of raw materials and we did not have large forces stationed in the U.S.S.R. However, American vessels were repaired in Soviet ports and, when bases for shuttle bombing were established by our Air Forces, the Soviets undertook to furnish most of the supplies and services required to keep these bases in operation.

Next to winning the war, the most important result of the Russian program is the new degree of understanding which has been brought about between the U.S.S.R. and the United States. The Soviet Union and the United States are both necessary to any scheme of collective security that may be established.

The war has brought to each of us a respect for the other's greatness. We found, contrary to much expert military opinion, that Russia could take all the punishment the Germans had to offer. The Soviets discovered, possibly to their surprise, that American capitalism was easily the most productive force on earth.

Above all, we have learned to know each other as individuals. We have found the Russians a brave people, rather like ourselves in fundamentals and not too difficult to deal with. They have found that we try to hold up our end, that we keep our word, and that we are anxious to get along with them.

We have learned how to collaborate in time of war. Is it asking too much to hope that we shall learn how to collaborate in time of peace?

The atomic bomb makes such collaboration absolutely necessary by all of us if civilization is to survive.†

* See "Lend-Lease Is a Two-way Benefit," by Francis Flood, NATIONAL GEOGRAPHIC MAGAZINE, June, 1943.

† Other articles in the NATIONAL GEOGRAPHIC MAGAZINE of especial interest because of the Soviet declaration of war against Japan and the Japs' surrender are: "Japan Faces Russia in Manchuria," by Willard Price, November, 1942; "Byroads and Backwoods of Manchuria," by Owen Lattimore, January, 1932; "Manchuria, Promised Land of Asia," by Frederick Simpich, October, 1929; and "Here in Manchuria," by Lilian Grosvenor Coville, February, 1933.

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ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded fifty-seven years ago, the National Geographic Society publishes this Magazine monthly. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

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

In Mexico, The Society and the Smithsonian Institution, January 16, 1910, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

On November 11, 1931, 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 72,305 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 1927. The Society has taken part in many projects to increase knowledge of the sun.

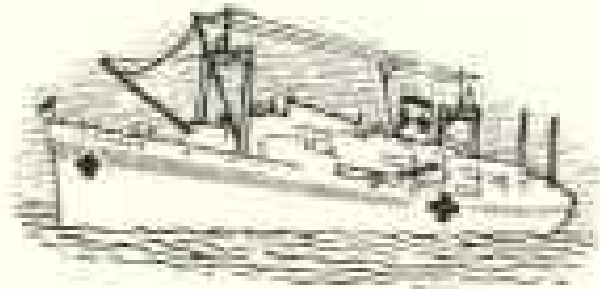
The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,008 feet was attained.

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.

One of the world's largest icefields and glacial systems outside the polar regions was discovered in Alaska and Yukon by Bradford Washburn while exploring for The Society and the Harvard Institute of Exploration, 1938.



Somewhere in the Pacific



Dear Tommy:

So my little brother is 17 - Happy Birthday! I suppose you're shaving twice a week now!

Tommy - just as soon as Hamiltons are on sale again I want you to buy yourself one. I've already mailed you a money order to pay for it. Be sure you wait for a Hamilton. One of the deck officers gave me the attached ad to send you. He says that any Company that can make chronometers like those on our Hospital ship must make about the finest watches money can buy. Yep, they're Hamiltons. Here's that snapshot of me you wanted. We're working pretty hard - but what we're doing is nothing compared to what those poor kids in the wards have been through.

Take good care of Mom and Dad - and a big hug for you. How are all your gal friends?

Sis



NOW . . . THOUSANDS OF HAMILTON CHRONOMETERS SERVE THE NAVY

For three years Hamilton has been manufacturing marine chronometers for the U.S. Navy. Performance tests prove these instruments to be of unsurpassed accuracy. You'll see this wartime precision reflected in your waiting Hamilton. Wait for it!



WAIT FOR HAMILTON

America's Fine Watch

Hamilton Watch Company - makers of "The Watch of Railroad Accuracy" - Lancaster, Pa.

pretty slick, isn't it?

Mr. Moon

191 Palisade Ave.
Englewood,
New York



HAMILTON

The Watch of Railroad Accuracy





Laraine Day
STAR OF RKO'S
"THOSE ENDEARING
YOUNG CHARMS"

I Learned from Experts

HOW TO MAKE HOME MOVIES

... says LARAINÉ DAY, M-G-M Star

Hollywood stars learn in the studios that it takes fine equipment to make fine movies... that Bell & Howell builds the preferred studio equipment.

And they learn that B&H Filmo cameras give professional results with amateur ease. That's why Filmos are favorites among the stars.

Anyone can use a Filmo—you just sight, press a button, and *what you see, you get*... in full natural color or in brilliant black-and-white.

Before you buy, remember... if it's worth the film, it's worth a Filmo!

Take This First Step Now. Send the coupon for information on improved Filmos, available soon. Bell & Howell Company, Chicago; New York; Hollywood; Washington, D. C.; London.



There's a Filmo Camera Exactly Suited to You
Miss Day's camera is a Filmo Auto Load which is loaded (*above left*) simply by sliding in a 16mm. film magazine. *Above right*—the improved Filmo "Sportster," an 8mm. all-purpose home movie camera. Mail the coupon for information.

BELL & HOWELL COMPANY
7194 McCormick Road, Chicago 45

Please send information on Filmo 8mm.
 16mm. Movie Cameras 8mm. Projectors
 16mm. Silent Projectors 16mm. Filmmount Projector.

Name.....

Address.....

City..... State.....

OPTI-ONICS—products combining the sciences of OPTICS • ELECTRONICS • MECHANICS

PRECISION-MADE BY



Bell & Howell

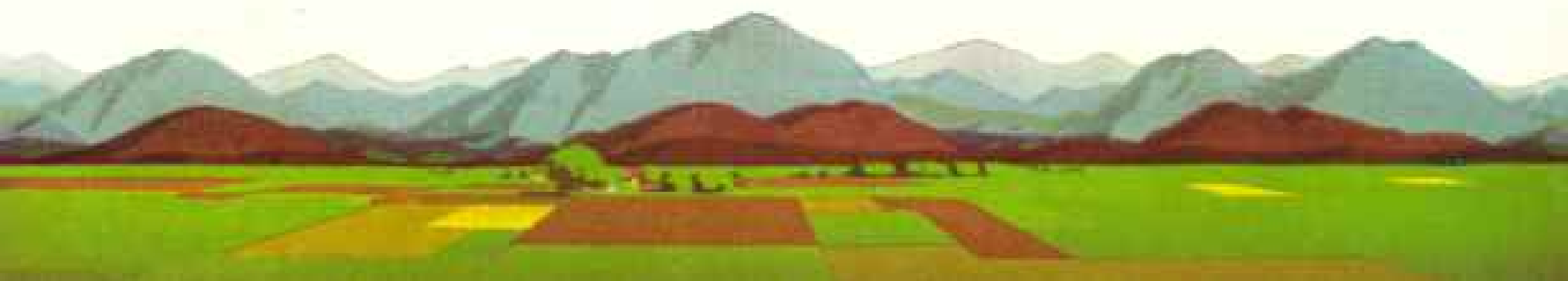
SINCE 1907 THE LARGEST MANUFACTURER OF PRECISION EQUIPMENT FOR MOTION PICTURE STUDIOS OF HOLLYWOOD AND THE WORLD



THERE'S A NEW STANDARD IN AIR TRANSPORTATION!

Lockheed Constellation

Lockheed Aircraft Corporation, Burbank, California  *Years ahead in the science of flight*





AUTOMOTIVE MODELS BY NORMAN BEL GEDDES AND CO.

Control Center

FOR A KEY EXECUTIVE'S POSTWAR PLANNING

Completely relaxed, he settles back, and in a natural conversational voice, talks his plans, ideas, instructions and correspondence to the magic microphone on his desk.

That's Dictaphone Electronic Dictation. The microphone is his Control Center for *action!* It frees him from dependence upon his secretary; frees her to protect him against interruptions. It helps him do the key-thinking that makes him most valuable to his company.

Dictaphone Electronic Dictation is now available for civilian use without priority restrictions. Consult your local phone book or write for our free booklet describing this exciting new business development. DICTAPHONE CORPORATION, 420 Lexington Avenue, New York 17, N. Y. In Canada: Dictaphone Corporation, Ltd. 86 Richmond St. W., Toronto 2, Ont.



DICTAPHONE *Electronic Dictation*

The word DICTAPHONE is the registered trade-mark of Dictaphone Corporation, makers of Acoustic and Electronic dictating machines and other sound recording and reproducing equipment bearing said trade-mark.



Where dependability counts

NOTHING SERVES LIKE COPPER

IN CLEARING HARBORS blocked by the destruction of war, copper and its alloys are essential in opening the way to post-war commerce and reconstruction.

Divers, toiling on the bottom, depend on copper for the helmets that permit them to breathe, for light in the murky depths, for telephone

communication and for the cutting torches that sever the twisted steel of sunken ships.

Because of its workability and immunity to rust, sheet copper is used to form the diver's helmet and breast plate. Bronze, because of its greater strength and ready machinability, is employed in face-plates, air valves and fittings. And copper and brass, because of their conductivity and workability, provide vital parts in

undersea lights and cutting torches.

When copper, most versatile of all commercial metals, becomes freely available for the pursuits of peace, The American Brass Company will be better equipped than at any time in its history to meet the needs of postwar industry.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Co.
In Canada: ANACONDA AMERICAN BRASS
LTD., New Toronto, Ont.

During its 130 years of experience, The American Brass Company has developed a wide variety of copper alloys to meet specific marine requirements. Outstanding are such metals as Tobin Bronze*, Everdur*, Cupro Nickel and Admiralty Alloy. *Reg. U.S. Pat. Off.



Anaconda Copper & Brass

Keep Faith With Your Fighters and Yourself . . . Buy War Bonds!



Argoflex picture
1/10 at f.8.



MODEL E ARGOFLEX



argus
Cameras and Optical Instruments

Precision optical instruments made today for the Armed Forces by Argus . . . foretell the Good Pictures of Tomorrow and we are all looking forward to that.

ARGUS, INCORPORATED . . . ANN ARBOR, MICHIGAN



One of a series of events in the lines of American composers, painted for Magnavox by Saul Tapper

Illustrated at right is the Magnavox Regency Symphony, a reproduction of late 18th century furniture art combined with all the wonders of radio science. The Magnavox Co., Fort Wayne 4, Indiana.

And now

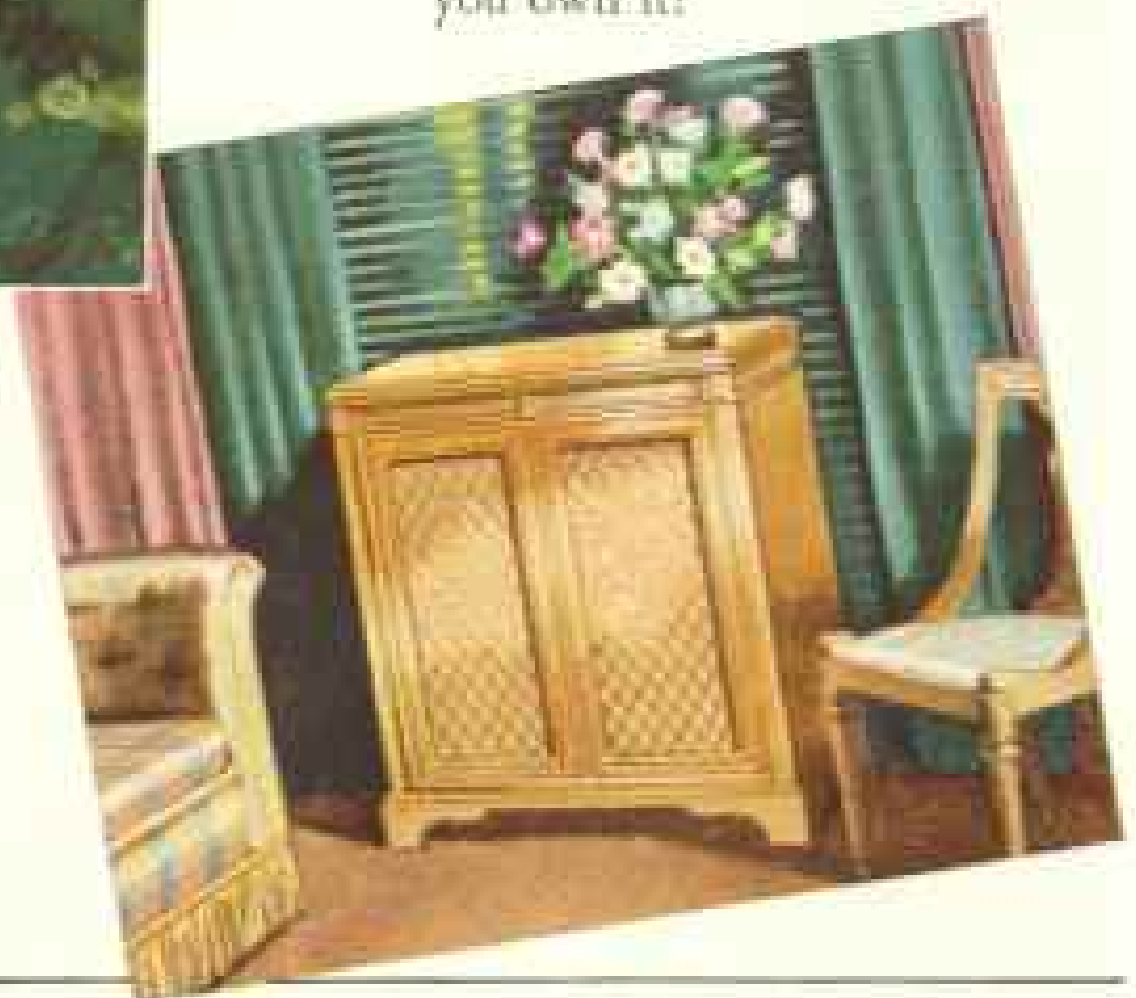
Stardust

floats over a thousand campuses

WITH A SINGLE SONG ...

"Stardust" ... a college prom favorite that floats over a thousand campuses today, Hoagy Carmichael captured America's heart. The young composer went on to write such famous melodies as "Rockin' Chair," "Lazy Bones," "Little Old Lady" and scores of others ... to be ranked by critics with Gerahwin and Berlin.

Hoagy Carmichael's own choice of a Magnavox matches the selection of such great artists as Kreisler, Heifetz, Beecham and others. The Magnavox is so carefully built, so thoughtfully styled, it will bring your family years of pleasure and inspiration. You won't find Magnavox on every corner (naturally, it's sold only through the finest stores) but when you *do* find one, you'll never be content until you own it!



Magnavox • The choice of great artists
RADIO PHONOGRAPH

Why Uncle Sam is ahead more than
6 MILLION DOLLARS
A DAY

BALANCE SHEET

In the other World War

The railroads, in 1918, performed 405 billion ton-miles of freight service.

Railroads performed 42 billion miles of passenger service in 1918.

Freight rates were raised about 25%.

The government took over the operation of the railroads.

Deficits resulting from Federal operation cost the taxpayers 2 million dollars a day.

In this World War

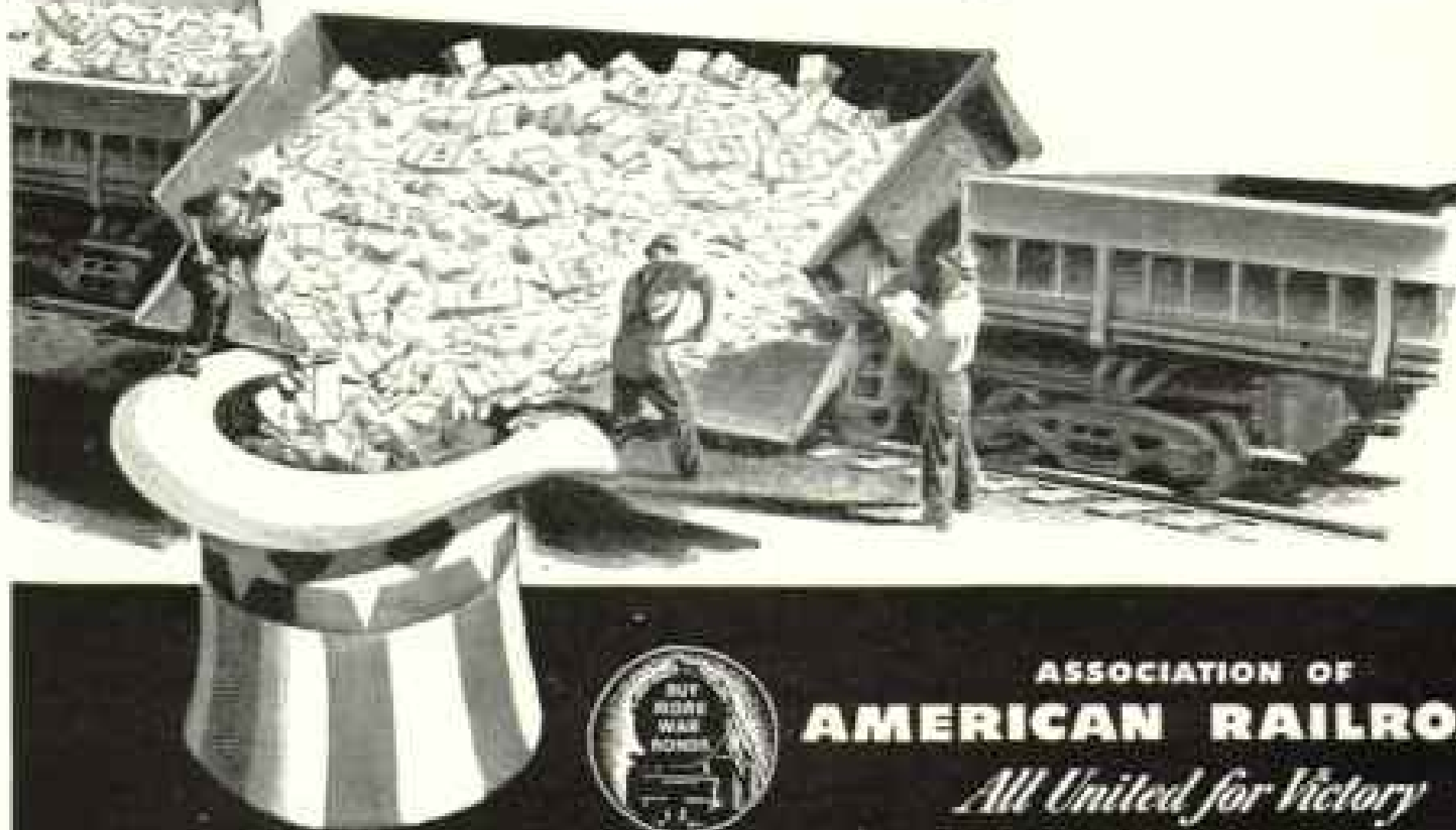
The railroads, in 1943, performed 727 billion ton-miles of freight service, 737 billion in 1944.

Railroads performed 87 billion miles of passenger service in 1943 and 95 billion in 1944.

Freight rates remain substantially the same as they were prior to the war.

The railroads have remained under their own management.

The railroads are paying Federal taxes at the rate of more than 4 million dollars a day—to say nothing of their state and local taxes.



ASSOCIATION OF
AMERICAN RAILROADS

All United for Victory



Famous Ford Firsts

THE UNIQUE PROCESS THAT GAVE THE WORLD
FINE PLATE GLASS AT REASONABLE COST

1st

with a continuous
process of glass making



In 1923, a red hot ribbon of plate glass began to flow from a furnace in the Ford Rouge plant. Year after year, this ribbon poured out . . . rolled into a long cooling oven . . . moved onto the polishing line to be finished and cut into crystal-clear sheets.

This was the first continuous process of glass making . . . capable of producing more than three miles of plate glass every day.

Started in a limited way in 1920, this process was conceived by Henry Ford to make possible the use of finest quality plate

glass in low priced cars. And it hastened another great Ford "first" . . . safety glass as standard equipment "all around."

Following his usual policy, Mr. Ford made the continuous process available to all industry without royalties. Thus, throughout the world, people came to enjoy the beauty and utility of plate glass, not only in their automobiles but in their homes as well.

Ford will produce many more such "firsts" in the future—to the lasting benefit of every owner of Ford-built cars and trucks.

EXPECT THE "FIRSTS" FROM FORD!



THE FLAME THAT CUTS *Through Sea and Steel*

• *The operating subsidiaries of
Air Reduction Company, Inc.,
are:*

AIR REDUCTION SALES COMPANY
MAGNOLIA AIRCO GAS PRODUCTS CO.
Industrial Gases, Welding and
Cutting Equipment

NATIONAL CARBIDE CORPORATION
Calcium Carbide

PURE CARBONIC, INCORPORATED
Carbonic Gas and "Dry-Ice"

THE OHIO CHEMICAL & MFG. CO.
Medical Gases—Anesthesia
Apparatus—Hospital Equipment

WILSON WELDER & METALS CO., INC.
Arc Welding Equipment

AIRCO EXPORT CORPORATION
International Representatives
of the above Companies

Men-of-war that "died" at Pearl Harbor live again to haunt the Sons of Heaven. No small measure of credit for their resurrection belongs to modern techniques of underwater cutting with the oxy-hydrogen flame and underwater welding with the electric arc. These methods are serving the nation's needs in wartime, and are also opening the way to new peacetime accomplishments in submarine salvage and construction.

Air Reduction has played a leading part in designing and manufacturing equipment for underwater cutting, as part of its program of progress which has given the world many new developments in welding, cutting and other related methods for modern metal-working.



AIR REDUCTION

60 East 42nd Street, New York 17, N. Y.



Main Cabin — Boeing Stratocruiser

Finish the Fight — with War Bonds

Chasing the sun

You left the East Coast at one o'clock after an excellent lunch. Now, stretched out in a big, cushioned easy chair, you watch cloud patterns shift on the green and gold checkerboard of Ohio farmland below.

You're flying high, where the air is smooth, yet the atmosphere in the big Boeing Stratocruiser is held at the same comfortable pressure you'd find at low levels.

You and some seventy other passengers are traveling at 340 miles an hour — yet the sound of four 3500-horsepower engines is only a subdued hum in the insulated cabin.

The twisting ribbon of the Mississippi is beneath you, then the wide prairie. Soon you're looking down on snow-capped mountains. "How about a rubber of bridge, down in the lounge?" your neighbor suggests.

At the foot of a spiral stairway you enter a roomy, comfortably furnished salon, where a congenial group has gathered. When the West Coast comes into view it's still afternoon. You've gained three hours on the sun that hangs high above the Pacific as the great plane lowers smoothly to a landing!

This is no Jules Verne fantasy. It may very well be your own

actual experience after the war is over — and at a fare even lower than present rates.

The aerodynamic advancements built into the Stratocruiser have been thoroughly war-tested in the B-29 Superfortress and are the result of Boeing's long experience in the design and development of other four-engine aircraft.

When victory is won, the same skill in design, engineering and manufacture which have established Boeing leadership in the big bomber field will bring you the Stratocruiser and other advances in air transport. You can be sure . . . if it's "Built by Boeing" it's out in front.

DESIGNERS OF THE B-29 SUPERFORTRESS • THE FLYING FORTRESS • THE NEW STRATOCRUISER
THE KAYDET TRAINER • THE STRATOLINER • PAN AMERICAN CLIPPERS

BOEING

HE DREAMED OF A HOLIDAY
IN A WORLD AT PEACE...



OF ALL the influences upon thought and feeling, there is none more compelling than music...melodies familiar and heart-warming, opening new vistas of memory... experiences yet to be lived...

No matter what kind of music touches your inner self and brings you the deepest personal satisfaction, you will enjoy it most on a Stromberg-Carlson.

In FM, Standard Broadcast, or record reproduction, Stromberg-Carlson makes it possible for you to hear all music as it was meant to be heard—with utmost clarity, with utmost realism in every gradation of tone. And once you have known the fuller, richer quality of a Stromberg-Carlson, you will never be content with a lesser instrument.

For the main radio in your home... there is nothing finer than a

STROMBERG-CARLSON

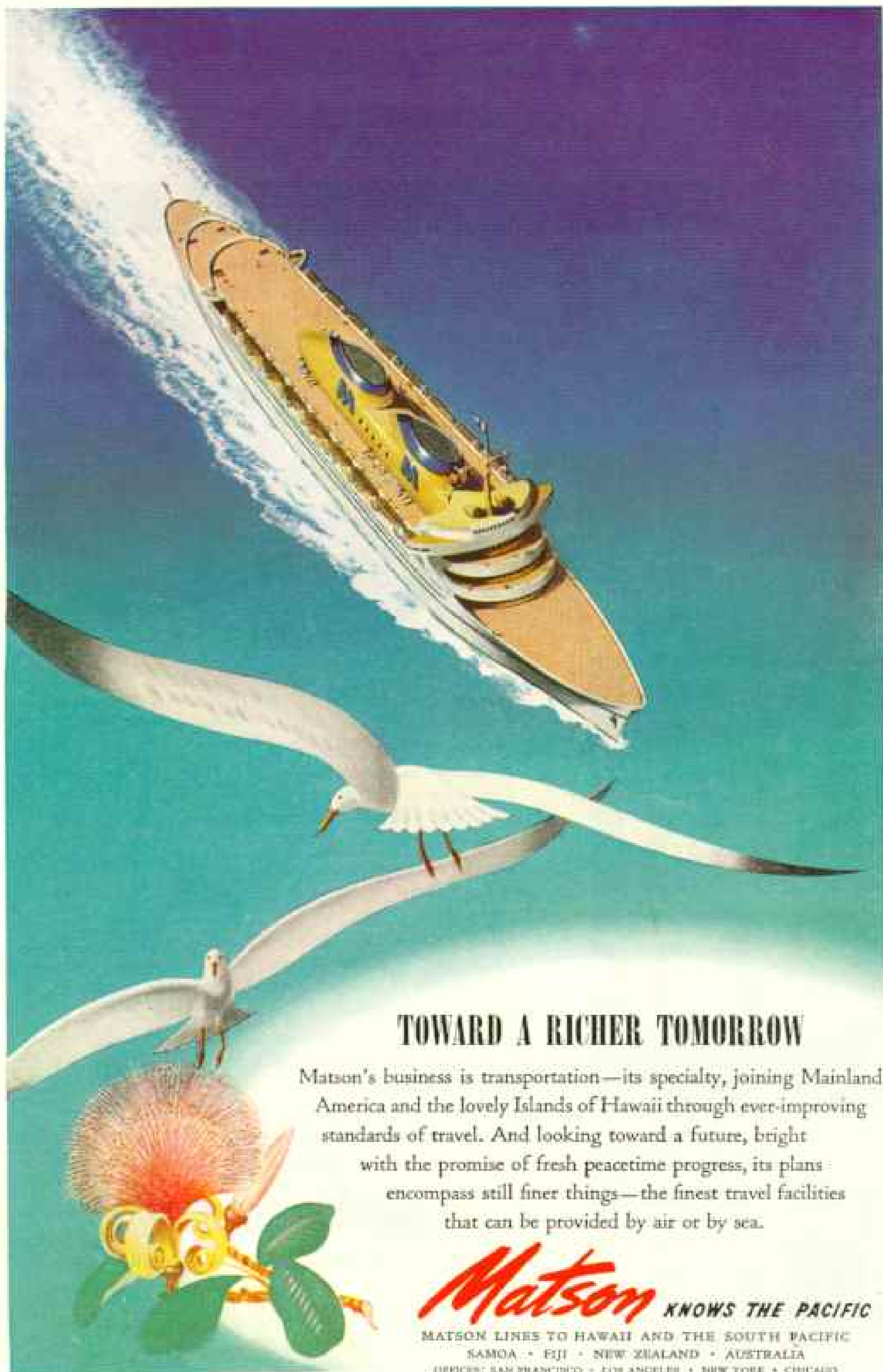
© 1945, STROMBERG-CARLSON COMPANY, ROCHESTER, N. Y.



SHE PLANNED A HOMECOMING...
FOR THEIR SON



IF YOU ARE among those who have promised themselves a Stromberg-Carlson after the war, this is our promise to you: We are now planning the finest FM and Standard Broadcast instruments we have ever made—finest in every detail of radio reception and record reproduction—in cabinetry. You will be able to choose your Stromberg-Carlson from a superb variety in a wide price range.



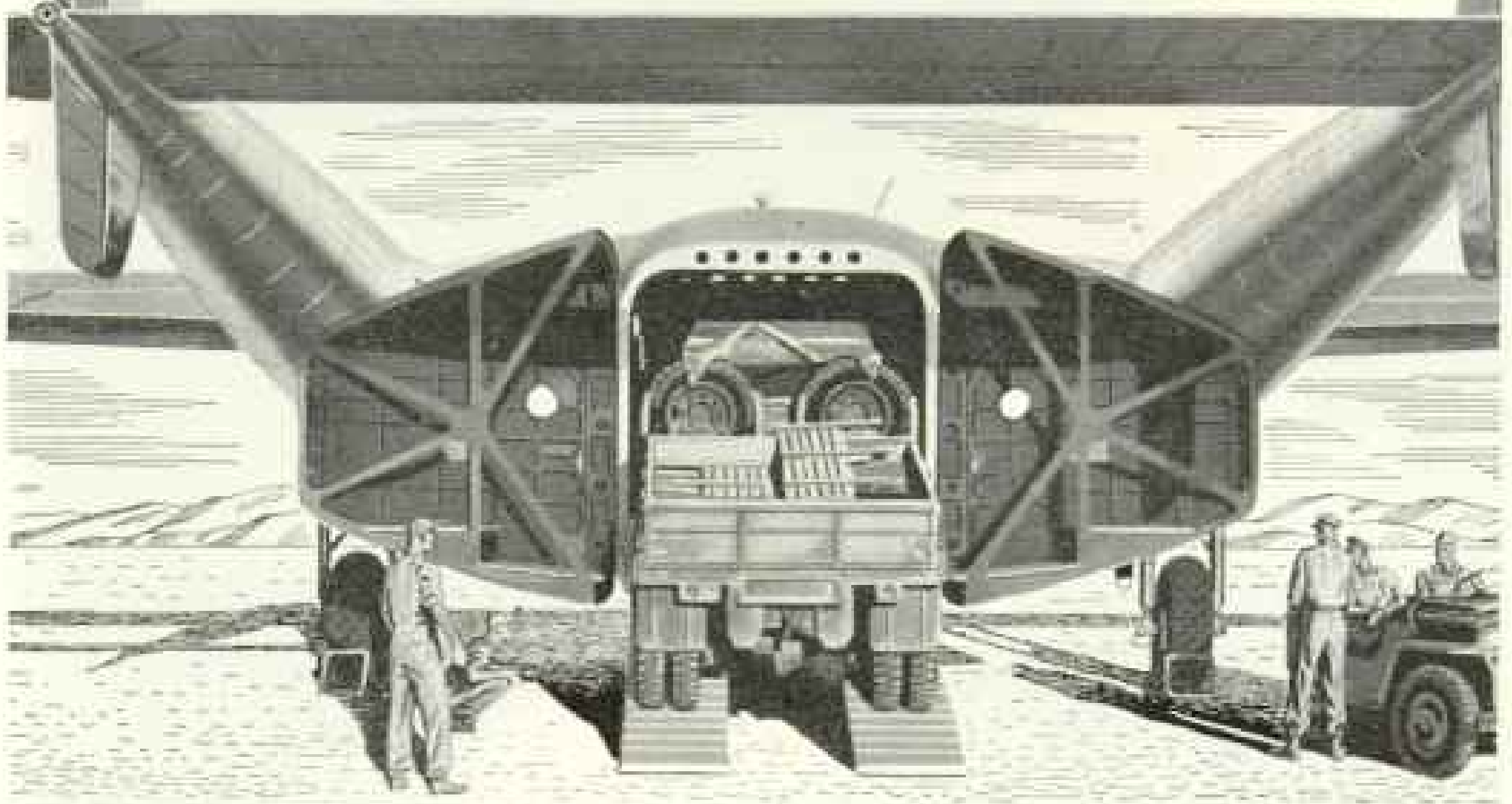
TOWARD A RICHER TOMORROW

Matson's business is transportation—its specialty, joining Mainland America and the lovely Islands of Hawaii through ever-improving standards of travel. And looking toward a future, bright with the promise of fresh peacetime progress, its plans encompass still finer things—the finest travel facilities that can be provided by air or by sea.

Matson KNOWS THE PACIFIC

MATSON LINES TO HAWAII AND THE SOUTH PACIFIC
SAMOA • FIJI • NEW ZEALAND • AUSTRALIA
OFFICES: SAN FRANCISCO • LOS ANGELES • NEW YORK • CHICAGO

IT'S EASY TO LOAD A FLYING BOXCAR



The Army can drive 10-wheeled trucks, tanks, and many other units of heavy military equipment right into the spacious hold of the Fairchild "Packet".

Or bulky cases can be "walked" from a trailer truck directly onto the floor of this "flying boxcar." (Note: Horizontal "Packet" floor is same height as standard truck floor.)

Smaller packages can be loaded through the forward door or through the paratroop doors at the rear when the tail is closed.

Think what this efficient cargo handling will do for the air shippers of tomorrow! Fast flying freight . . . safe, easy loading . . . costs comparable to surface transport at air express speeds.

All Fairchild Aircraft Division's production facilities are now building the "Packet" in quantities exclusively for the Army Air Forces.

For more detailed information about the Flying Box Car, send request on your business stationery, Write Department L.

BUY U. S. WAR BONDS AND STAMPS

 **FAIRCHILD**

ENGINE AND AIRPLANE CORPORATION
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

Engine Aircraft Engines Division, Farmingdale, L. I.

Fairchild Aircraft Division, Hagerstown, Md.

Detroit Division, Detroit, N. Y.

Subsidiary: Air-In Corporation, Jamaica, L. I., N. Y.

Affiliate: Stratco Corporation, Babylon, L. I., N. Y.

Passenger's choice for the

Coach of Tomorrow

How New York Central's
wartime travelers made post-war travel news!

Fighters, service wives, business men...these were some of the wartime passengers New York Central asked to become its post-war plans committee.

And how they responded! Thousands answered questionnaires telling what *they* wanted in future trains . . . choosing from newly developed ideas

and from features now on Central's latest coaches.

The car visualized here reflects their choice. And now this wartime guidance is helping New York Central's designers and engineers plan new trains that will mean more jobs and finer travel in the years of peace ahead.



HERE'S HOW THEY VOTED

RECLINING SEATS . . . The vast majority voted for adjustable coach seats developed from those now on trains like the *Empire State Express*.

WIDE VIEW WINDOWS . . . This was the winning window...extra wide, and non-fogging...ideal for viewing the scenic *Water Level Route*.

BIG DRESSING ROOMS
Large lounge-type dressing rooms were preferred 2-to-1 as against a number of small, individual washrooms.

CONDITIONED AIR . . . Passengers voted 72% about right for winter. But for summer, most felt air conditioning should vary somewhat with temperature outdoors.



THRIFTY DINER . . . Low-cost meals in a separate dining car . . . like the present *Pace-maker* diner . . . won against other plans for eating en route.

"NEWS & VIEWS" . . . 70% favored a Public Address System to announce stations and points of interest.



BUY MORE
WAR BONDS



NEW YORK CENTRAL

THE WATER LEVEL ROUTE



Designed for better living and listening

This is it! The automatic phonograph is a musical instrument that brings the concert hall and the theatre right into your living room. A featherlight touch and out comes Motorola's exclusive ROLL-O-MATIC* record changer. Over half an hour of musical entertainment without annoying interruption for record changing.

The radio is an electronic marvel by the Motorola engineers who originated and developed the battle-famous "Handie Talkie" and "Walkie Talkie." The radio and phonograph control panel is uniquely designed for comfortable TOP-VUE† tuning. For better living and listening there'll be none finer than the new Motorola Radios.

GALVIN MFG. CORPORATION • CHICAGO 51, ILL.

*†Two more exclusive Motorola Radio Firsts!





BUY WAR BONDS AND STAMPS

Favorite subject in 30,000 schools!

The famous "three R's" are "four R's" now. To reading, 'riting and 'rithmetic, modern schools have added *right eating*.

Last year, some 30,000 American schools served nourishing, well-planned mid-day meals. From these lunches, children learn good eating habits. And they gain a respect for food that can be of lasting benefit. War has shown more sharply than ever before how *much* a nation's health depends on diet.

School lunch requirements are flexible so far as most foods are concerned—because of local preferences and facilities. *But there is one food for which there is no alternative—one food that is basic in every lunch for every child—a half-pint of whole milk.*

Milk, of course, is nature's most nearly perfect food. Here at National Dairy we've worked with milk and its many products for many years—making them purer, richer, easier

to serve all the time. Our laboratories have developed milk products in special wartime forms—with promising peacetime uses—all contributing to the health of the nation.

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

SHIP RECOVERY, 1794

A trade mark of Old Spice for Men.



*FOR THAT AMERICAN
FEELING OF WELL-BEING*

For efficiency in shaving, enjoy the tangy scent of Old Spice Shaving Soap in its sturdy, handsome mug, 9 months' supply, \$1.00. Follow with zesty After-Shaving Lotion, \$1.00†. Finish with invisible Talcum, 75¢†.

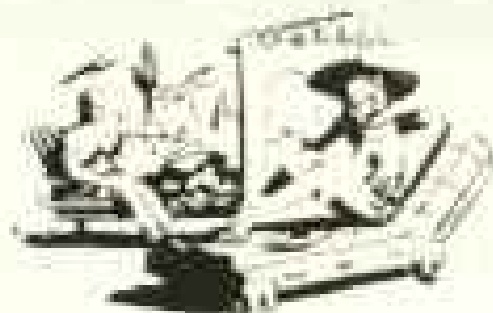
Each a Shulton Original

*Explosion Reduces the Buying Power of Your Money
Help Prevent Inflation, Never Pay More than Ceiling Prices*

*Reg. U.S. Pat. Off. †Plus Tax
SHULTON, INC. • Rockefeller Center • NEW YORK 10, N.Y.



Copyright 1945, Movado Watch Agency, Inc., 610 Fifth Ave., N. Y. 10 Toronto 26, Toronto, Can.



**If you can't travel
... PLAN! Come
when you can -**

Worth remembering

Lazy days. Tranquil nights. Unbelievable sunsets. Ever-changing mountain colors. Guest ranches, fine hotels. Home of University of Arizona.

Unmatched

Nowhere else in U.S. so many days of 100% sunshine. Warm, dry, invigorating! Altitude only 2400 feet. For free booklet, write Tucson Sunshine Climate Club, 4504-A Rialto, Tucson, Ariz.

**UNCHANGED BY WAR
TUCSON'S DESERT
CLIMATE BECKONS**

But please remember -

Do not come without confirmed reservations for living accommodations.



Your place in the sun is TUCSON

"Buy Victory Bonds—They Identify You"

"Writes dry with wet ink!"



Less waiting

THAN YOU THINK MAY BRING YOU A PARKER "51"

EVERYWHERE, Parker 51's are the world's "most wanted" pens. But though today's supply is limited, more 51's *are* coming.

We hope that one day not too far off, a "51" will be yours. Then you will see the magic of its effortless, soundless writing!

And this pen writes dry with wet ink. Only the "51" has the design and construction which permit satisfactory use of the world's fastest drying ink, Parker "51" Ink. It may, of course, be used with any ordinary ink as well.

All 51's are the result of the same patient, precision craftsmanship we apply to rocket fuzes and other war matériel. But, a "51" may be yours with less waiting than you think, if you place a reservation order with your dealer now.

Parker 51's come in four colors: Black, Blue Cedar, Dove Gray, Cordovan Brown. \$12.50; \$15.00. Pencils, \$5.00; \$7.50. Sets, \$17.50 to \$80.00. Vacuumatic Pens, \$8.75. Pencils, \$4.00. The Parker Pen Company, Janesville, Wisconsin.

MAKE YOUR DOLLARS FIGHT—BUY WAR BONDS!

PARKER

"51"

FALSE TEETH WEARERS



Why Risk **DOUBLE DANGER**
by Brushing with
MAKESHIFT CLEANERS?

Take care, Grandpa! Sally seems to be annoyed. Could it be your unpleasant breath due to unclean dentures? Avoid offending in this way. Don't brush your plates with ordinary cleansers that scratch plate material. Such scratches help food particles and film to collect faster, cling tighter, causing unpleasant breath.

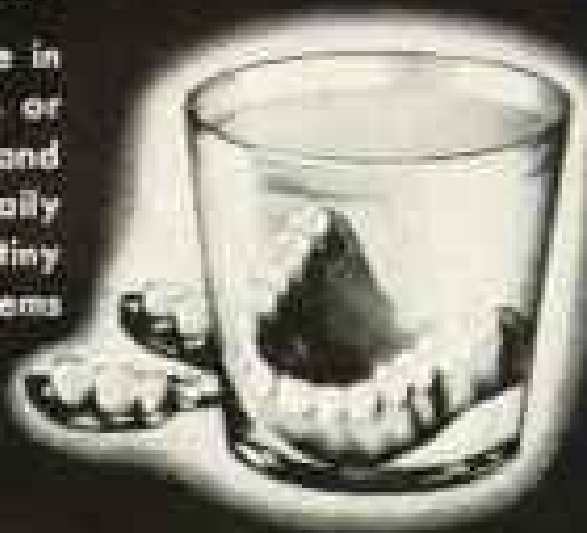
PLAY SAFE—SOAK DENTURES IN POLIDENT DAILY

It's Easy! It's Quick!

Soak your plate or bridge in Polident fifteen minutes or overnight . . . rinse . . . and it's ready to use. A daily Polident bath gets into tiny crevices brushing never seems to reach—keeps your plate sparkling clean and odor-free.



NO BRUSHING



What's more . . . Your plate material is 60 times softer than natural teeth, and brushing with ordinary tooth pastes, tooth powders or soaps, often wears down the delicate fitting ridges on your plate. With worn-down ridges your plate loosens. But, since there is no need for brushing when using Polident—there's no danger.

Later—Now Grandpa doesn't worry about unpleasant breath due to unclean dentures. He's one of the delighted millions who have found Polident the new, easy way to keep dental plates and bridges sparkling clean, odor-free.

If you wear a removable bridge or dental plate . . . *play safe*. Use Polident daily to help maintain the original natural appearance of your denture. Costs less than a penny a day. Get Polident at any drug counter, 30¢ and 60¢ sizes.



NEW!

Another
Polident Product

DENTU-GRIP

Pleasant Powder to
Hold Plates Tight

Use **POLIDENT** Daily TO KEEP PLATES AND BRIDGES
CLEAN . . . AND ODOR-FREE!



One of the great dramatic moments in railroading occurred when the Cotton Belt changed the gauge of its 119 miles of track in a single week end. The scene pictured above is our artist's conception of the closing hours of this successful old-time race against time.

CHANGING THE MEASURE OF RAILROADING

It was September in 1886. All along the Cotton Belt, from Bird's Point, Mo., to Texarkana, old spikes came out. Rails were shifted. New spikes sank home under swinging hammers. The entire railroad was changed from narrow to standard gauge over one week end. The Cotton Belt had stepped along with the times.

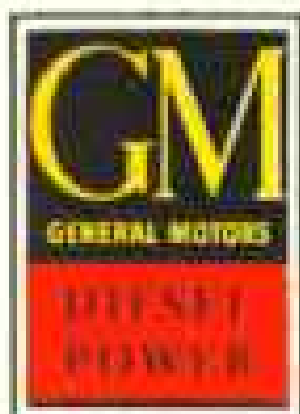
This railroad is still stepping along. It is one of 83 railroads and major industries where General Motors Diesel locomotives are changing the measure of railroading.

Watch what happens when complete lines and systems are GM Dieselized. Far faster freight hauls. Quicker, more comfortable, and more reliable travel for passengers.

And reduced maintenance by sturdiness that goes a million miles or more without major overhaul!

Yes, the measure of railroading is changing—for the better. And GM Diesel locomotives are helping to bring about this new benefit for the railroads, for the country, and for you.

ONE MORE WAR TO WIN
BUY MORE BONDS



LOCOMOTIVES **ELECTRO-MOTIVE DIVISION, La Grange, Ill.**

SINGLE ENGINES Up to 200 H.P. | **DETROIT DIESEL ENGINE DIVISION, Detroit 23, Mich.**
MULTIPLE UNITS Up to 800 H.P.

ENGINES: 150 to 2000 H.P. **CLEVELAND DIESEL ENGINE DIVISION, Cleveland 11, Ohio**



With the new RCA lifeboat radio, shipwrecks need no longer take a terrible toll of lives.

A two-way radiophone — for lifeboats!

Here's when a telephone comes in rather handy . . . when you can "get your party" and hear "We'll pick you up in a couple of hours!"

With the new RCA compact lifeboat radio, that's exactly what happens. A kite, or a balloon, takes the antenna up as high as 300 feet.

Turn the power-generating cranks and out goes an SOS — along with a direction-finder beam so shore stations can figure your exact location.

But even more amazing, shipwrecked mariners can talk with the men on their way to the rescue.

They can "pick up" ships, airplanes, and land — 1000 miles away!

Endless research, such as went into developing this lifeboat radio, goes into all RCA products.

And when you buy an RCA Victor radio, or a television set or a Victrola, you enjoy a unique pride of ownership in knowing that you possess one of the finest instruments of its kind that science has achieved.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to *The RCA Show* Sundays, 4:30 P.M., E.W.T., over the NBC network.



Joseph McDonald and Donald Kolb (holding balloon) are the Radiomarine engineers who developed this lifeboat radio. Here is the balloon that is inflated with helium and carries the antenna 300 feet into the air. At left is your miniature "broadcasting studio" and receiving set.



RADIO CORPORATION of AMERICA

Our Veterans need Your help!

An Important Message from Major General Norman T. Kirk, the Surgeon General, U. S. Army

THE VAST MAJORITY of our Veterans will return from the War physically fit.

Some will not be so fortunate. Some will be disabled . . . physically and mentally scarred.

The Army and Navy provide care for our men in the services; the Veterans Administration for those discharged. In many cases there comes a time when it is best for the Veteran to return to his home environment.

Once at home, it is the family's responsibility to help him with sympathy and patience to get back to normal as fast as possible.

The help which cannot be given in the home becomes the responsibility of *your community*, which should be prepared to offer Veterans such aids as these:

1. *Medical advice, if needed.*
2. *Help in obtaining work which is consistent with impairments.*

For those who return hale and hearty . . . a rapid return to everyday life may be facilitated if the Veteran may obtain:

1. *Help in securing employment through competent vocational counsel.*
2. *Advice on legal, educational, domestic affairs, and other questions.*

If your community does not already offer helpful services to Veterans, you—who belong to business, civic, church, and other community groups



—may take the lead in establishing such assistance.

If your town already supports Veterans Aid bureaus under various auspices, I urge you to help *co-ordinate* their valuable services, so that Veterans will have the *best* your community can give them.

N. T. Kirk
U. S. ARMY

Ask for these free booklets . . . Metropolitan has prepared several containing suggestions for the reception of returning Veterans. Send today for the one you'll need.

For those in the homes of our returning Veterans—

Booklet 105NA—“Coming Home”

For businessmen and community leaders—

Booklet 105NB—“Employment of the Handicapped Veteran”

Booklet 105NC—“Re-employment of the Veteran”

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Metropolitan Life Insurance Company

(A MUTUAL COMPANY)

Frederick H. Ecker,
CHAIRMAN OF THE BOARD

Levy A. Escala,
PRESIDENT

1 MADISON AVENUE, NEW YORK 10, N. Y.





Why the puff adder should be called the “bluff adder”

HETERODON CONTORTRIX is a snake common to the eastern half of this country.

He is often called “hog-nosed snake” because his nose turns up sharply, like a pig’s. He is also called puff adder, because of a trick of his.

Although harmless, he is short, thick, and has markings not unlike some rattlers. He looks poisonous. And if you corner him, he puts up a terrific bluff. He puffs himself up, hisses, coils, and strikes with a fury that’s calculated to scare the daylights out of you.

But, if you don’t scare, he promptly puts on another performance. He writhes in agony, sometimes drawing part of his body through his open jaws. Then he flops on his back and apparently dies. You can pick him up—even hang him on a fence—and he’s as lifeless as a piece of rope.

But if you’ll hide and watch, pretty soon *Heterodon* will roll over, and, seeing no enemy, start to wriggle off as fast as he can.

The puff adder’s antics are an example of the myriad ingenious devices which nature’s crea-

tures use to protect themselves from harm. But these devices are only preventive. To our knowledge, man is the only animal who, in addition to devising preventive measures, has figured out a way to provide some compensation for himself when these preventive measures fail.

If he is hurt, insurance helps meet his expenses until he is well again—and pays his doctor bills besides. If his house burns down, insurance helps him pay for a new one. If thieves make off with his valuables, insurance helps him to replace them. And through insurance, he can do what no other living creature can: protect his family long after he is gone.

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Walk over a carpet of the brilliant gold and crimson of falling leaves. See the panorama of a hundred tints of reds... yellows... and orange against the purple haze of mountain peaks... the cloud-flecked blue sky.

It is like seeing the sunset and the sunrise mingle and come to life. It is a sight that finds its niche forever in your memory.

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Small game season—November 1 to November 30 inclusive. Bear season—November 26 to November 29 inclusive. Deer season—December 1 to December 15 inclusive. For information about your post-war vacation write to the Department of Commerce, Harrisburg, Dept. N-4.

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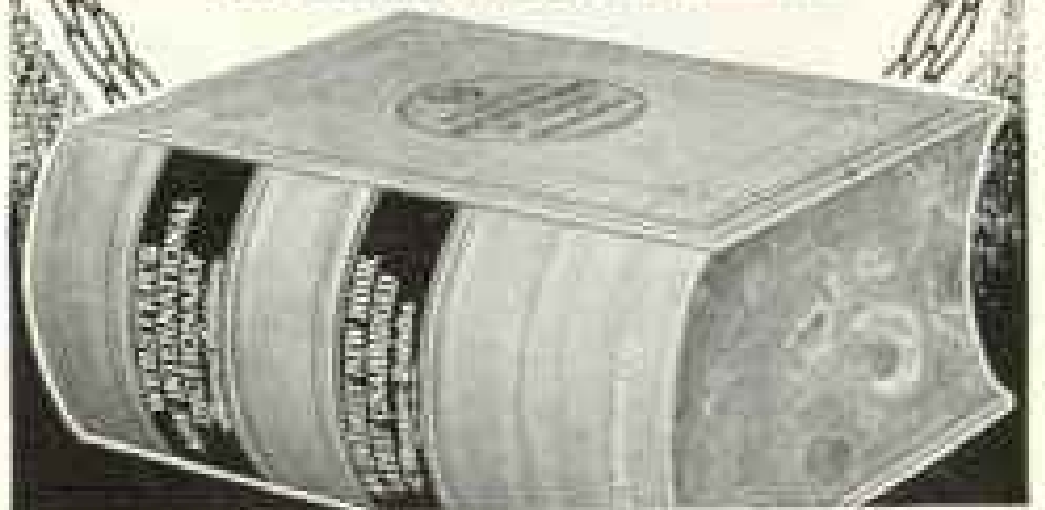
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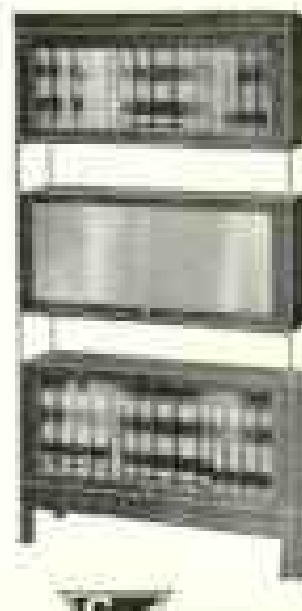
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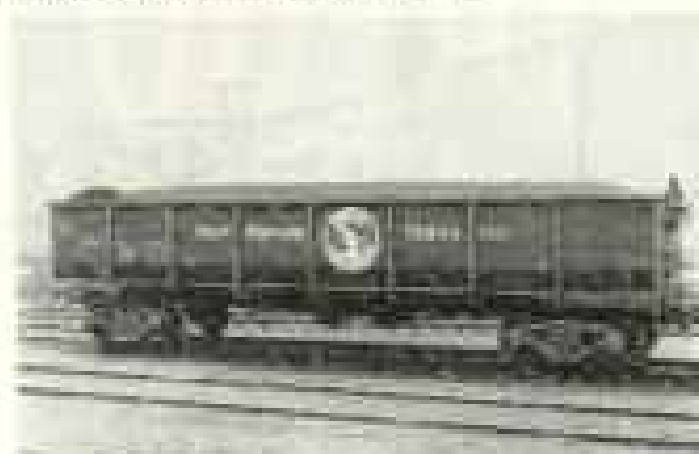
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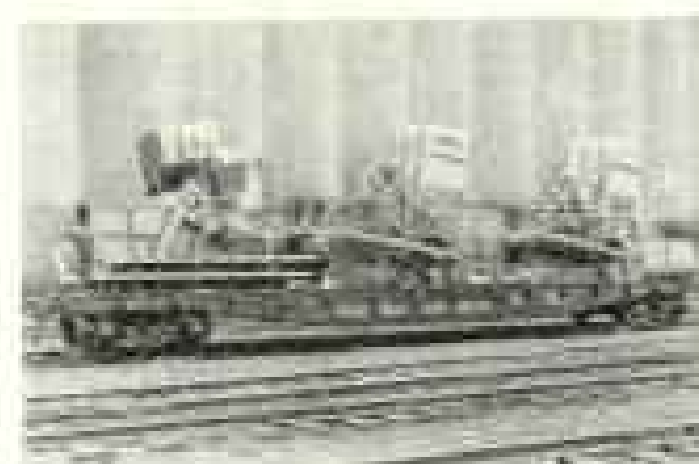
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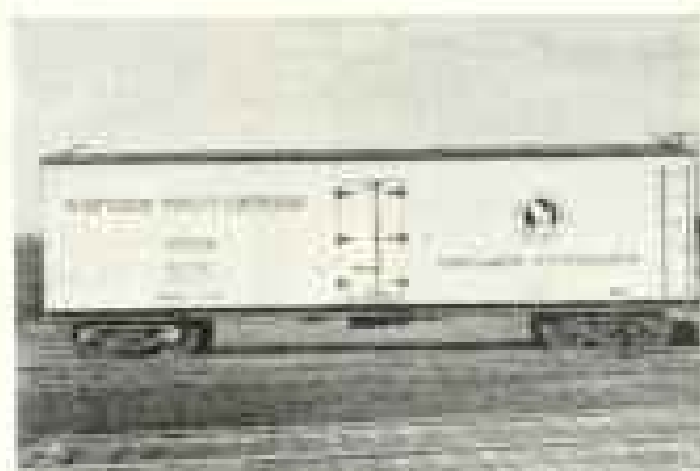
wood-steel construction. Light and rugged, these cars are tip-top for grain, finished lumber, and many other kinds of freight.

Another special "breed" of rolling stock is Great Northern's 75-ton-capacity iron ore car. Thousands of these husky, hopper-type cars are required for the railway's movement of ore from the Minnesota range to Lake Superior vessels.

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Great Northern's freight fleet also includes livestock cars, flat cars, gondolas and hoppers—the right kind of equipment for every kind of transport requirement.

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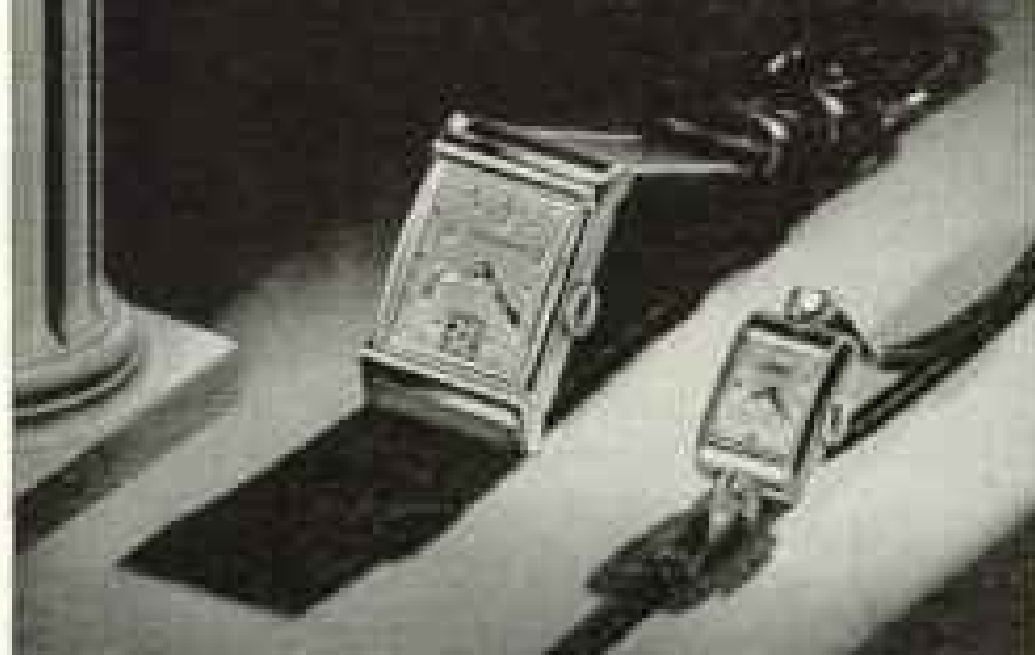
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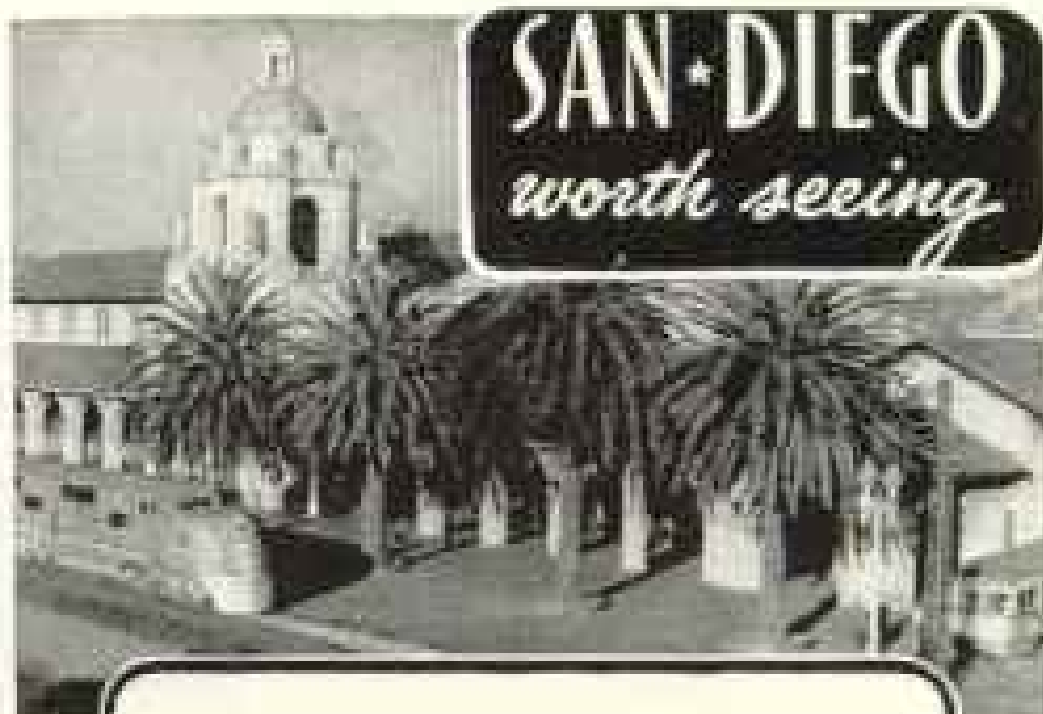
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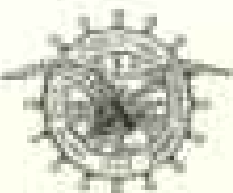


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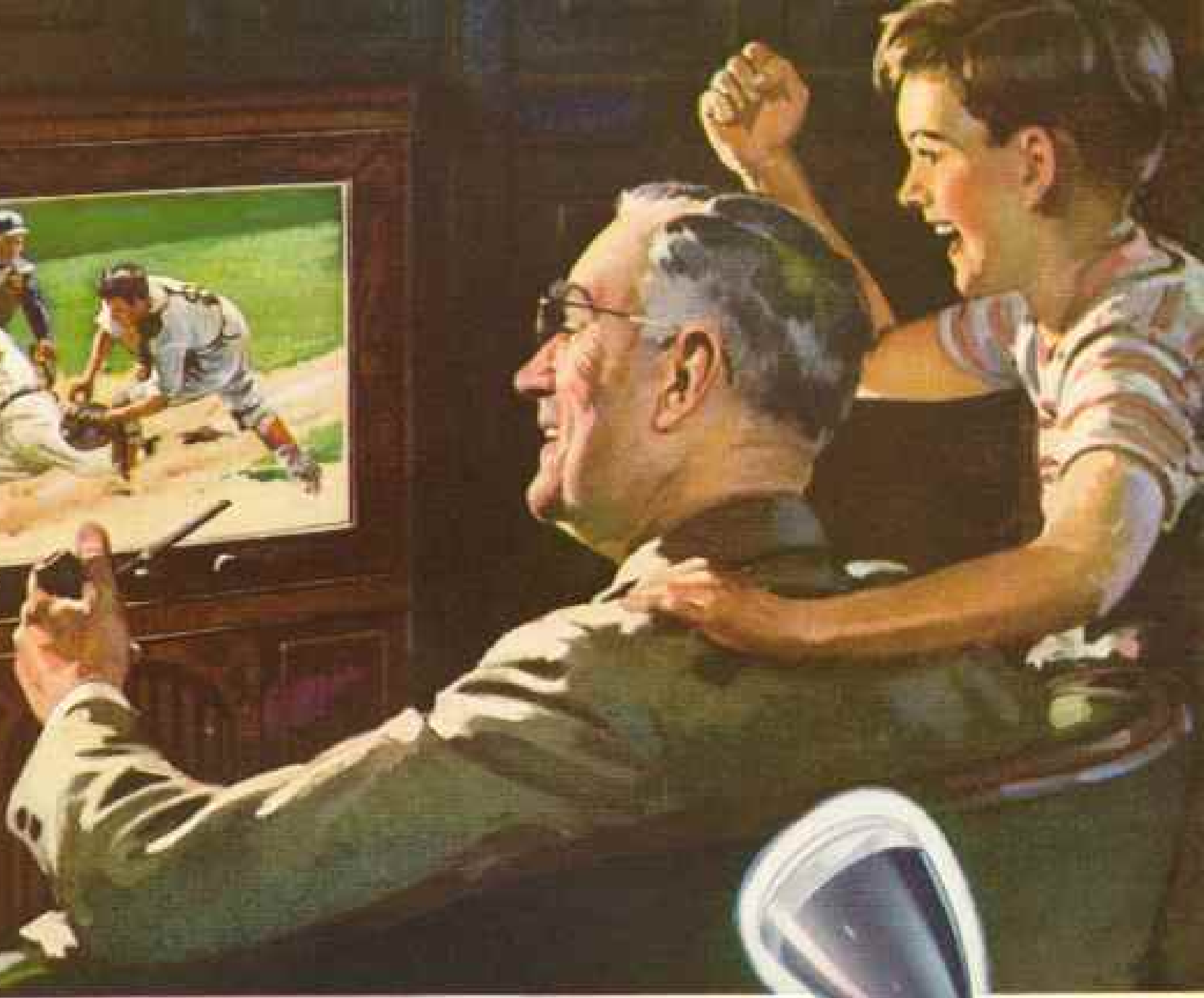
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**Barium has a high affinity for oxygen... and other gases. When the "getter" is flashed in television or radio tubes, molecules of hot metallic vapor combine with... and immobilize... remaining particles of air. The barium, with the "captured" air is deposited as a silvery film inside the tubes.*

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