VOLUME XCI NUMBER FOUR

THE NATIONAL GEOGRAPHIC MAGAZINE

APRIL, 1947

PUBLISHED BY THE
NATIONAL GEOGRAPHIC SOCIETY
WASHINGTON, D.C.

$5.00 A YEAR 50c THE COPY

VOL. XCI, No. 4 WASHINGTON APRIL, 1947

THE NATIONAL GEOGRAPHIC MAGAZINE

Steel: Master of Them All

BY ALBERT W. ATWOOD

With Illustrations by Staff Photographer Willard R. Culver

IN PEACE and war alike, modern civilization rests upon iron and steel. It is the master substance by which man conquers both Nature and his fellows. As Kipling's verse has it:

> "Gold is for the mistress—silver for the maid—
> Copper for the craftsman cunning at his trade."
> "Good!" cried the Baron, sitting in his hall,
> "But Iron—Cold Iron—is master of them all."

Today man has learned once again, in the awful tragedy of a global war, that military mastery and world supremacy rest upon steel, the modern form of iron.*

Any beach on earth can be taken, at a price, provided trained men are prepared to spend enough steel.

Nearly two thousand years ago Pliny described it as "the most useful and most fatal instrument in the hand of man."

While World War II was still under way, Maj. Gen. G. M. Barnes, then chief of Research and Development Service, Ordnance Department, of the U. S. Army, said, "In the final analysis, fire power is steel and still more steel."

But, almost beyond measure, steel makes the products of peace as well as the weapons of war.

Every Tool a "New Hand"

Everything man creates is made by his hand, directed by his brain, or by a tool which is merely an attachable and detachable hand. Each time a man lays down one tool and picks up another he gets a new hand.

As Thomas Carlyle said, "Man is a tool-using animal . . . Without tools he is nothing, with tools he is all."

Machines in turn are nothing but complex tools, and man's progress can be measured largely by his ability to build such tools.

Once his tools were made of bone or wood or stone. Today tools and machines alike are made overwhelmingly of steel, and with their coming civilization swept forward like a mighty flood.

Steel, of course, is not the only metal of preeminent value to man. But other metals and materials cannot be used unless steel comes into play at one or more stages in their mining, transportation, refining, and machining.

But steel is not only the tool of modern civilization; it is also largely the material which has built our way of life. It provides the structural basis, the backbone, and, to a vast extent, the actual sinews as well.

When the defense program was getting under way late in 1941, William S. Knudsen said that steel was the "material to start practically everything going."

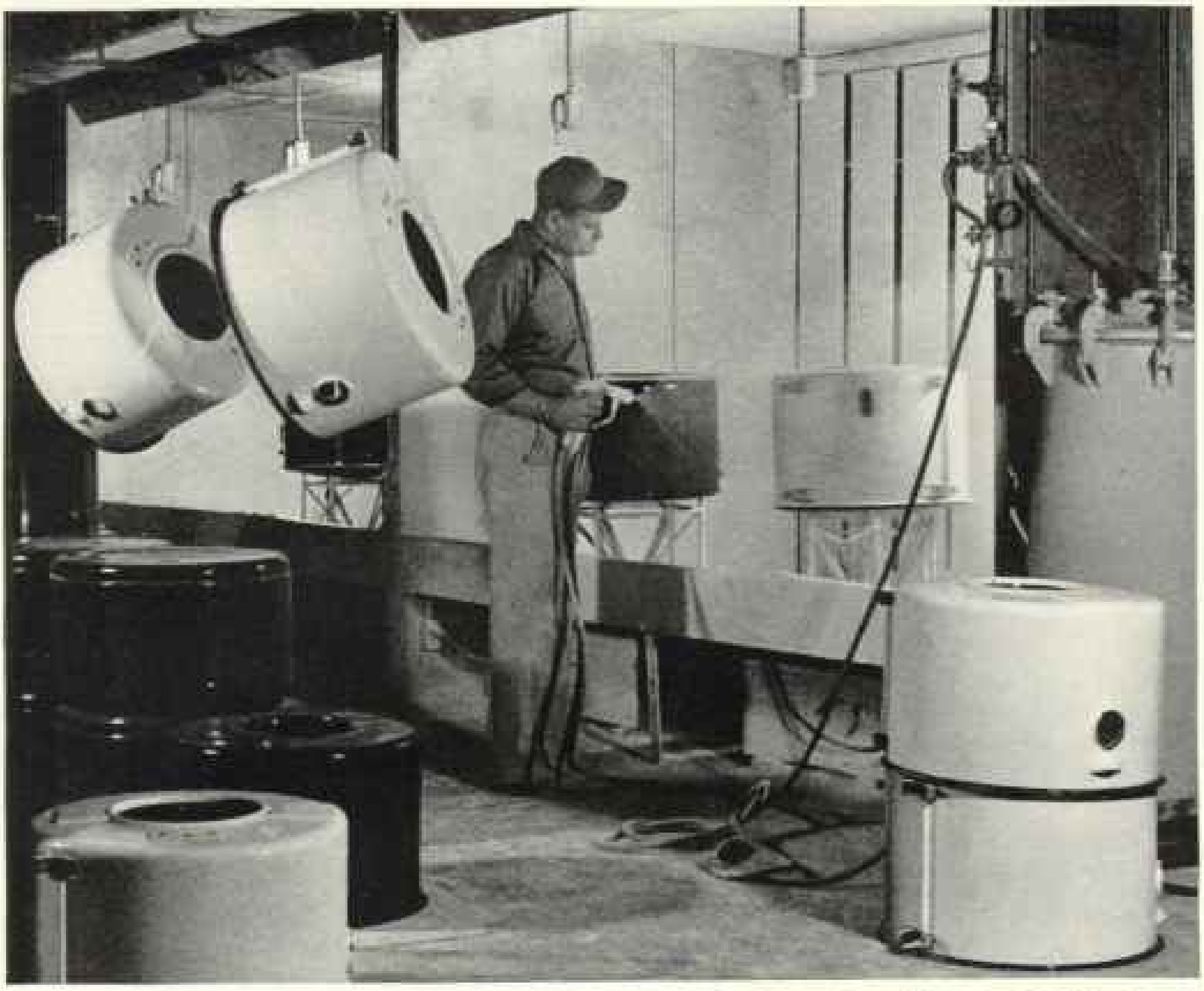
It is so common, useful, and essential that we take it for granted. It is so intimately a part of our daily lives that we pass it by unnoticed.

But there is hardly a human need, even for water, food, and clothing, in the supplying of which steel does not play a vital part.

If all the iron and steel in use in this country were divided up equally among the inhabitants, each man, woman, and child would have more than 17,000 pounds.

Each American soldier, sailor, and Marine fought with the aid of about 1,500 more

* See "Metal Sinews of Strength," by Frederick G. Vosburgh, NATIONAL GEOGRAPHIC MAGAZINE, April, 1942.



What the Housewife Wants to Know: When Do I Get a New Washing Machine?

Washers must compete with automobiles and refrigerators for steel's cold-rolled sheets, which take a fine finish. As the supply is temporarily limited, manufacturers can get only their allocations. Here a Clyde (Ohio) Porcelain Steel worker sprays white enamel on steel tubs. A belt overhead conveys them to fusing ovens. The average small American home contains 8,000 pounds of steel and iron (page 418).

pounds of steel in World War II than in World War I.

It is estimated that more than 40 percent of all the factory workers in the country earn their living by making steel into various products.

For all practical purposes, steel is everywhere and is used by everybody. We are rarely more than a few feet away from it.

A Versatile Metal

I mail my letters in front of the Norwegian Embassy in Washington, D. C. On the opposite corner is the Romanlike palace of the Apostolic Delegation, and across Massachusetts Avenue are the grounds of the Naval Observatory.

The letter box itself is made of iron or steel; so is the traffic-control box next to it, the lamppost a few feet away, the local street sign on the lamppost, the U. S. route (240) number sign, the manhole covers on sidewalk and pavement, the No Parking signs in front of the embassies, the grillwork and lamp fixtures on the front of the buildings, the fence around the Observatory grounds, the gates at the front entrance, and the bus-stop signs on both sides of the avenue.

But these are only trifling and superficial evidences that steel is everywhere. It is in homes, kitchens, farm buildings, garages, offices, stores, hotels, and factories. It is in airplanes, automobiles, railway trains, streetcars, and ships. It is in the air, on and under the ocean, and on and under the ground.

Steel takes the form of a tiny pin, but San Francisco's Golden Gate Bridge is also made of it (page 417).

The dome of the Capitol in Washington happens to have an iron cap which weighs 8,909,200 pounds, and in the shoes of the man who walks underneath it there are on the

Gabriel Moulin from Redwood Empire Association

Steel Leaps San Francisco's Golden Gate in Three Spans; Only Steel Could Do It

Compare steel's airy cobweb, which carries some 18,000 vehicles a day, with stone's massive arches bearing a trickle of traffic. Into this 9,266-foot bridge (including approaches) went 108,000 tons of steel, enough to load 30 miles of freight cars end to end. Twin towers rise as high as 63-story buildings. Bethlehem Steel built it.

Steel, Sharp, Durable, but Cheap, Serves Our Food

These knives and forks began as blanks cut from metal strips. For smoothness, they were rolled, tumbled, and buffed. Stamping dies formed tines and handles. At R. Wallace & Sons, Wallingford, Connecticut, the raw cutlery is racked for a dip in an electrolytic bath. It will emerge with a coating of nickel.

average 62 pieces of steel, including 38 lasting nails and tacks, 20 eyelets, and sometimes 4 lace tips.

But the home is where we should really look for steel. Even the average small house has 4,000 pounds, and, if iron be included, 8,000 pounds. This does not include the family automobile, which is found in front or in back of almost every house. Automobiles contain 125 different kinds of steel, the average passenger car requiring 3,400 pounds, or more.

We don't see steel as such in a house. What we see is a furnace, a kitchen range, a sink, a refrigerator, radiators, hot-water heater, washing machines, and bathtubs. Much of it is hidden from view—the nails and screws which hold the house together, and the pipes which carry in water, gas, and electricity and carry off waste (pages 416, 421).

Oil wells, cities, industries, airplanes, automobiles, and locomotives—all use steel tubing, or pipes, for absolutely essential functions. A steam railroad locomotive has about one mile of boiler tubing (page 432).

Pipe in the Home

But it is in the ordinary home that pipe is peculiarly necessary, for it forms the basis of cleanliness, sanitation, convenience, comfort, and health.

Even the small house has 1,000 feet of iron or steel pipe, the larger modern dwelling as much as two miles, and a big office structure like the Empire State Building as much as 150 miles.

The average family owns far more than 8,000 pounds of iron and steel. Even the most primitive hillbilly has a knife, an ax, and perhaps a gun. In the average household there are many other tools and implements.

When iron manufacture first got successfully under way in the Colonies in 1644, the metal was cast into pots, kettles, and tools.

Today we spend at least a third of our lives on steel wire, for not only bed mattresses but some pieces of stuffed furniture contain 1,200 springs made from wire (page 452).

From the same material come the ordinary nail, watch springs, piano wire, coat hangers, picture wire, bird cages, bobby pins, hairpins, paper clips, and knitting needles (pages 419 and 434 and Plates IV and VIII).

In fact, one estimate is that 150,000 different uses have been recorded for steel wire. There are almost 500 possible combinations that go into hairpins and bobby pins alone, 2

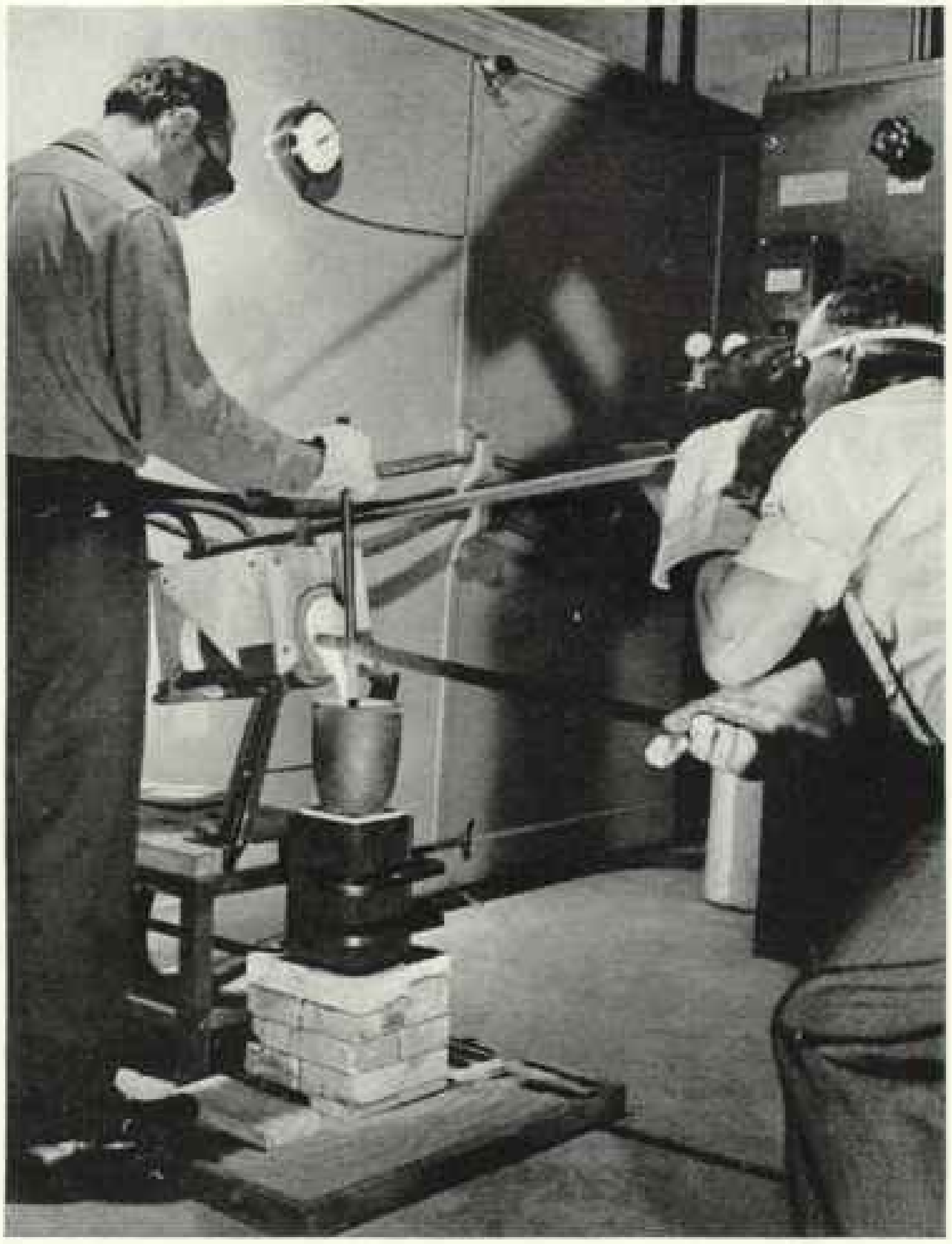
shapes, 8 thicknesses, 7 widths, and 4 finishes.

One of the smallest steel products, coil springs, are made from wire and weigh only 12 millionths of a pound each. They are used by jewelers in necklace clasps.

All springs are made from wire or bars of one size or another, there being enough steel in a railway-car spring to make 4,000,000 necklace and watch-chain clasps.

In colonial days whole families spent evenings and long winter days making a few nails by hand. Now a single machine in a single plant of a single steel company makes 600 nails a minute.

But the basic principle of drawing wire through successively smaller holes, or dies, is at least 1,000 years old, although of course many refinements and improvements of process and material have been made. It has been said that the "master workman, the spider, has been outdone by man," who by repeated reductions can draw wire until it is five times finer than some of the hairs on one's head (Plate XIX).



Men Pour the Molten Brains of 20,000 Watches

In a miniature mill at Lancaster, Pennsylvania, Hamilton Watch Company metallurgists mold 7½ pounds of nickel steel. From the ingot other men will draw 20,000 dainty hairsprings, which regulate the balance wheels of watches. If valued at $1.75 a spring, the steel ingot is worth $35,000, or nine times its weight in gold (Plates IV and VIII).

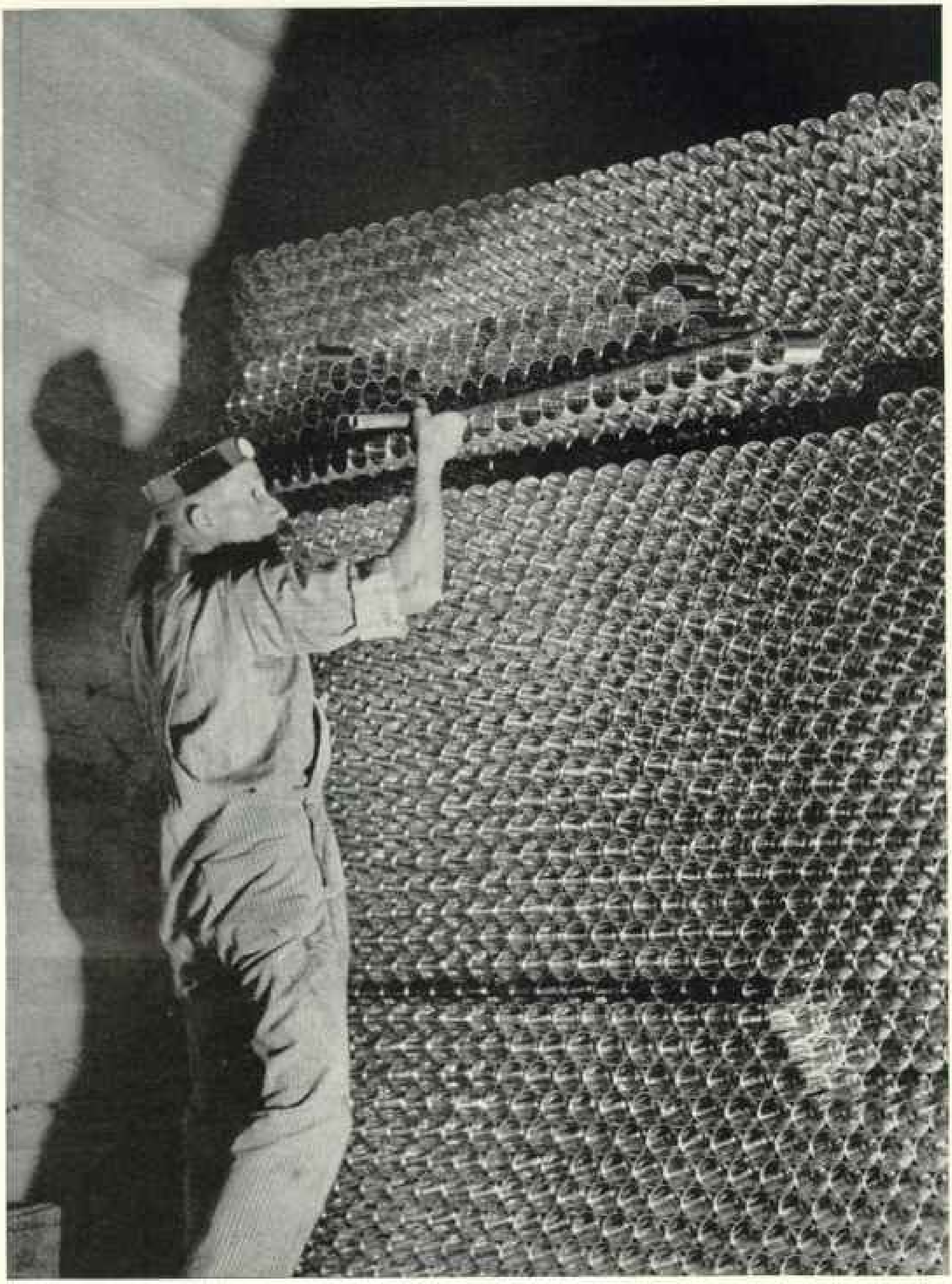
Barbed wire has been responsible, as much as anything, for turning our treeless, stoneless western plains into farms and ranches, fencing in stock, ptotecting crops, and making for variety of production. In fact, a typical 150-acre grain and dairy farm has up to 40,000 pounds of iron and steel, in addition to that in the dwelling and farm buildings.

Besides the barbed-wire fence and poultry netting, there are milk pails, cans, and strainers, and, to the city dweller, a bewildering variety of tools and so-called farm machinery, all the way from a sickle, prototypes of which were made several thousand years before Christ, to the most complicated modern combine.

Much of the food grown on farms reaches the housewife in "tin" cans, which are not made of tin at all but of sheets of steel, with a tin coating to prevent rust and other kinds of corrosion. This coating today is only about 1½ percent of the total weight of the can (Plate VI and page 420).

20 Billions of Tin Cans

No one knows how many tin cans are made each year in this country, but a reliable estimate is 20 billions. A typical tin can costs about two cents.



"Tin" Can, Preserver of the Nation's Foods, Is 98½ Percent Steel

Only the rust-resisting surface is tin. An economical new electroplating process has replaced in part the old hot dip (page 419). Cans have been scarce, owing to metal shortages. In many instances, glass, fibers, and plastics have substituted. With a rakelike bar, this California cannery worker moves dozens of empty tins.

Stainless-steel Cooking Vessels Withstand Attack by Fluids and Flames

Barely 35 years old, stainless steel has grown to an annual production of more than 300,000 tons. Cooking vessels alone take about 14,000 tons. For diffusion of heat over the flame, these pots have copper bottoms. At Rome, New York, a press (left) stamps the trademark of Revere Copper and Brass, Inc.

Japanese capture of the Malay tin mines early in the war forced a rapid development of the electrolytic process of coating steel sheets with tin, since in this way 60 percent or more of the valuable tin is saved, as compared with the old hot-dip method.* An electric current evenly distributes particles from 90-pound anodes of pure tin on a strip of steel moving forward continuously at the rate of 1,000 feet a minute.

Enormous Wartime Production Dramatized Steel

World War II dramatized steel and drove home the fact that it is everywhere and that it is used by everybody.

During the war this country produced twice as much as the three Axis powers combined. In 1940 and 1941 we increased our capacity by an amount almost equal to Japan's entire production in 1940.

The armed forces had to have steel for barrack units, portable bridges and landing fields, docks, helmets, bayonets, trucks, jeeps, tanks, LST's, bombs, shells, guns, and ships.

A battleship such as the *Missouri* calls for as many tons of steel ingots and castings as some 71,000 automobiles, and just the alloy-steel transmission of a medium tank weighs as much as three automobiles.

Although aluminum and other metals figure largely in airplane construction, alloy steel plays vital roles.

A number of new steel alloys were developed during the war for use in gas-turbine engines for aircraft. Some can withstand great extremes of heat and cold, ranging from temperatures of approximately 1,200° F. down to an arctic 65° below zero at 35,000 feet.

Jet propulsion presented new problems, because of the high temperatures at which the

* See "Tin, the Cinderella Metal," by Alicia O'Reardon Overheck, NATIONAL GEOGRAPHIC MAGAZINE, November, 1940.

engines operate. But research on steel alloys and nonsteel alloys made it possible to go approximately 500 degrees higher than had been possible in the past (page 451).

A four-engine bomber has 1,000 steel springs in its fuselage, engines, and armament, the nose guns being almost literally chains of steel springs. In fact, almost no weapon, from mammoth projectile to small pistol, can operate without springs, which do not generate energy but control it by absorbing, storing, and releasing it.

All over the world our Army and Navy planes landed on mats which were made of steel sections.

Tens of thousands of steel huts became the inevitable landmark wherever American fighting men were quartered. They were flown to places inaccessible by rail or ship.

One of the largest orders for steel ever placed with a single company was for tubing for the 1,340-mile-long wartime "Big Inch."

Fortunately, our country had a large reserve steel capacity when war came. Moreover, steel-mill products are much the same whether the final use is for war or peace. But even with these advantages the industry's capacity was nothing like enough for the rapacious appetite of war, and to increase it meant overcoming a peculiar, an extraordinary difficulty.

Increasing Steel Mills' Capacity

The difficulty was that new steel mills themselves require enormous amounts of steel. Early in 1941 it was estimated that to increase steel capacity 10,000,000 tons in the following two or three years would "abstract" from the supply of steel more than 4,000,000 tons.

In other words, the tools and buildings to make the steel to make the weapons of war had to be made of steel themselves.

This problem was solved, as Secretary of the Navy James V. Forrestal expressed it, "by the resourcefulness and adaptability of American industry and the will of a free people."

It was done by what is known as the "scrambled" rather than by the "grass root" method; that is, instead of building entirely new plants from the ground up, increased steel capacity was obtained mainly by adding to, rounding out, and balancing existing plants. This saved both time and critical materials, 10,000,000 ingot tons' capacity being added at the cost of only 800,000 tons of steel instead of more than 4,000,000.

This method had the advantage of using existing experienced management and all the collateral service facilities, such as water, steam, gas, and electricity in a going plant.

Some secondhand equipment was moved from place to place to round out productive capacity. In one instance, a whole abandoned plate mill was moved from Youngstown, Ohio, to Houston, Texas. Except for the electric transformers, an entire alloy steel plant was built of used materials, assembled from different places.

The largest single war need for steel was for plate—plate for the two-ocean Navy, merchant marine, tanks, heavy trucks, locomotives, machinery, and endless other war uses.

Since there was no time or materials to build additional plate mills, more than 5,000,000 additional tons of plate had to be made each year in the continuous-strip mills, which had been built at an average cost of $15,000,000 to $30,000,000 each to roll out light, ribbonlike sheets for automobile bodies, refrigerators, and tin cans.

Sheet and strip steel is thin, and the mills were equipped to coil up 1,000-foot lengths on big spindles as they came off the rollers. But plates for shipbuilding are too thick to be coiled; they have to lie flat.

In no way stumped, the steel industry fastened to the ends of continuous-strip mills the frames of old, unused buildings to provide more space in which to lay the plates flat. Heavier shears to cut it, and heavier cranes, conveyor tables, cooling beds, and handling equipment were added.

More than 3,000 separate projects to enlarge steel capacity in the interest of national defense and war were undertaken.

They ranged in cost from a few thousand dollars to many millions. An addition to the famous Homestead, Pennsylvania, works required the removal of 1,500 buildings and 2,700 families.

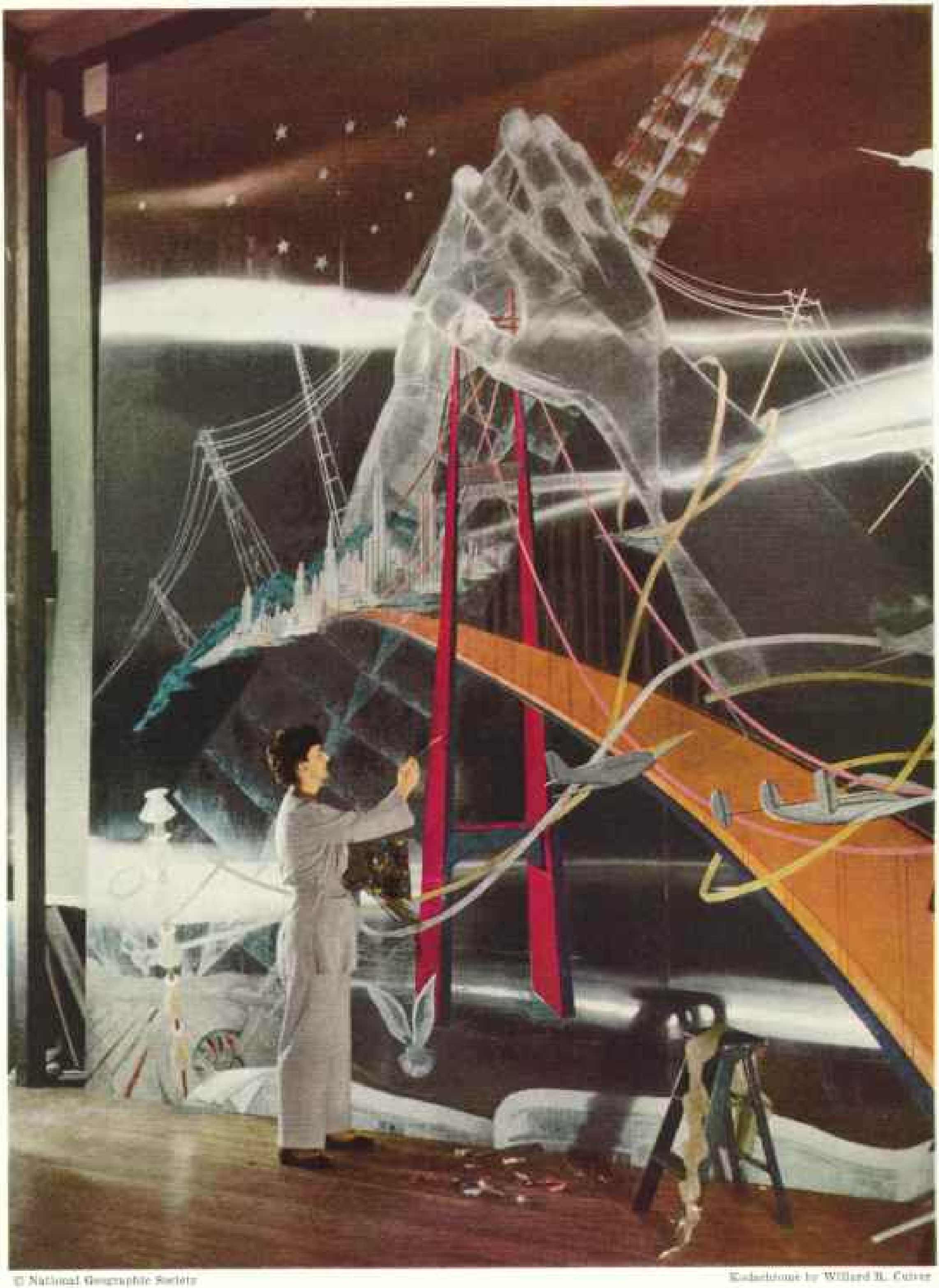
But mechanical ingenuity, typical as it is of our American way of life, does not explain the miracle, the wonder of steel.

Why is steel found practically everywhere? How can it be produced in such prodigious quantities? Why is it the raw material for "fabrication," or conversion into an almost infinite variety of durable goods?

The answer is that steel is not a single commodity but a wide variety of distinct materials and commodities, collectively known as "steel."

There is no concise, satisfactory, or comprehensive definition of steel. The word is merely a general term; the name is not used to denote a definite product. It is a class name, not a specific one.

Before 1938, until work on the atomic bomb



 Kodachrome by Willard R. Culver

Using Stainless Steel for a Canvas, an Artist Paints the World's Communications Story

In her New York studio Miss Buell Mullen completes a mural for Brazil's Ministry of Communications. The giant hands represent the touch of fingertips, man's first message. A beam from heaven conveys spiritual understanding. The press (lower left) spreads intelligence. Eighteen feet high, the polished sheet weighs 1,400 pounds.

 Reclamation by Willard R. Culver

Today's Blacksmith Deserts the Spreading Chestnut Tree and Takes to the Open Road with Forge and Bellows

By appointment, this traveling horseshoer does a custom job on a grand champion Belgian stallion in Ohio. More than 1,500 mobile smithies now serve American horse and mule owners. Each year some 25,000 tons of steel are made into shoes of 300 sizes and shapes.

Kodachrome by Willard R. Culver

In a Glass Penthouse, Passengers Watch Scenery Flash Past Their Stainless-steel Streamliner

Twenty-four persons riding "upstairs" get an unobstructed view. General Motors designed the safety-glass Vista Dome. Burlington Lines run this experimental model between Chicago and San Francisco. Later, domes will be teardrop-shaped. New dining cars will be roof gardens on wheels.

 Kodachrome by Willard R. Culver

Her Handful of Cobweb Steel Will Make Hairsprings for 4,800 Watches

At left is an ingot of elinvar, a nickel-steel alloy which resists magnetization, temperature changes, and rust. Scoops hold materials used to produce elinvar. Forging transforms the ingot into a bar (foreground), from which spring wire is drawn. Hairspring wire for small watches is one-fifth the thickness of a human hair (Plate VIII).

Interchangeable Parts Teach the Young Engineer to Build His Own Steel Empire

An electric motor powers this miniature crane, made from an Erector set's stamped-steel beams, girders, and plates. During the war the famed Bailey bridge was developed with the aid of two Erector kits flown to England.

Kodachrome by Willard R. Culver

For Lack of the Lowly Nail, America Faced a Crisis

Factories even bent old nails and re-used them. A veteran said: "I have all it takes to build a home but a keg of nails." Once made by hand, nails now are turned out by machines faster than the eye can follow.

Steel's Dainty Dentist Checks a Saw's 64 "Cavities"

Teeth of tough steel will be inserted in these notches, as in the saw in the foreground. The cutting surfaces may be removed for sharpening or replacement when worn. Designed to rip through big logs, this 60-inch blade is made of high-carbon alloy steel at the Disston plant in Philadelphia.

Kodachrome by Willard R. Culver

Coils of Tin Plate Unwind into 2-mile Ribbons

Each weighs about 15,000 pounds. Tin-coated plate is machine-polished and then cut in rectangles to make cans like those held by the girl at Bethlehem Steel's Sparrows Point plant. War shortages sped development of electroplating processes, reducing the amount of tin used.

Kodachrome by Willard R. Culver

Fifty-two Steel Rollers, Each Weighing 17 Pounds, Fit into a Giant Bearing to Carry Industry's Load

Workmen at SKF Industries, Inc., Philadelphia, assemble a 3,800-pound spherical roller for heavy duty in a steel rolling mill. At left is a finished bearing of the same size. In background are smaller bearing rings.

Rugged Car Spring and Delicate Watch Springs Cushion and Time Trains with Steel

If made of proper alloy, a 22½-pound car spring, valued at $1.38, would produce 225,000 hairsprings worth $400,000. Drawing to fine gauge would stretch it to 43 miles. This Hamilton Watch employee sorts 517 hairsprings.

 Kodachromes by Willard R. Culver

Steel Spheres Eliminate Friction Drag from Industry's Wheels

Ball bearings replace wearing drag with sliding smoothness in almost everything that revolves. The balls are finished to tolerances as fine as twelve-millionths of an inch. The girl measures a batch for accuracy at SKF Industries.

disclosed several new additions, there were 92 recorded chemical elements that constituted the known physical matter of the universe. Of these no fewer than 26 are used in various proportions and combinations to make steel.

The steel industry is no assembly-line proposition where parts are put together into a finished product, as in an automobile plant. Rather, it creates from the very elements of the physical universe material that did not exist before.

There are two indispensable steps in steelmaking. First, iron ore is turned into iron; second, iron is turned into steel.

Earth's Surface Abounds in Iron

Fortunately, one-twentieth of the earth's surface consists of iron, and workable deposits of iron ore are found in many places.

By far the largest part used in this country comes from the Lake Superior district, where it is found mainly in six long, narrow ranges. Chief of these is the Mesabi, 90 miles long and 2 to 10 miles wide, the word "Mesabi" being Chippewa Indian for "giant."

The accessibility of this ore is one of the chief reasons for the extensive use of steel in America, particularly in wartime.

Being close to the surface, most of the Mesabi ore is dug from open pits by power shovels and removed by trucks or trains of cars. As many as 15 terraces are dug into the sides of a pit so that shovels, trucks, and trains can operate. Some ore is mined underground (Plates IX, X, and page 437).

Specialized railroad equipment carries the ore downgrade the short distance to Lake Superior, where it is transported in huge ore boats to the lower ports on Lakes Michigan and Erie, from Chicago on the west to Buffalo on the east (Plate XIV).

These ore boats make a practically continuous shuttle or endless chain of voyages during the navigation season from about May 1 to December 1, each boat covering some 40,000 miles during the period and staying in port only a few hours.

During the five winter months ice and storms make shipping hazardous. In addition, the ore freezes like concrete and will not flow from the "hopper bottom" railroad cars into the pockets of the loading docks and thence into the holds of the ships.

Lake Superior ore proved to be a gigantic stock pile for war purposes. This was because one ton of ore is normally "developed" for each ton mined. This means that the overburden is removed and the ore got ready for mining, even though it is not taken out.

Thus production can be stepped up very quickly, or slowed down, with low maintenance costs and little adverse effect. In the single year 1942 more than 92,000,000 tons came down the Lakes from U. S. and Canadian ports, or nearly eight and a half times what Germany produced in prewar years.

Iron exists in the sun, stars, nearly all hard rocks, the sea, mineral waters, plants, animals, and in practically all soils. But, unlike some of the other common metals, it is not found in Nature in a free, or metallic, state except in meteorites which have fallen from the sky and in some unusual lavas in Greenland.

The ore from Mesabi and many other places is really a form of rust, soft, rich, powdery, and commonly brick red in color. By putting it through the blast furnace, this rustlike material is restored, or smelted back into metallic form.

To turn out iron, blast furnaces must be fed huge quantities of coke and limestone, as well as ore.*

Ordinarily, more than a fifth of all railroad freight consists of materials going to and from steel mills.

In 1943 the railroads moved to steel plants about six and a quarter million carloads of such materials as ore, coal, limestone, scrap, manganese, chromite, and other special ores. Two million cars were provided to haul the finished steel away.

Thus the cost of handling and transporting raw materials is of major importance to the steel industry.

Naturally, most blast furnaces and steel mills are located where the costs of assembling these materials and of shipping finished products to large markets are economical.

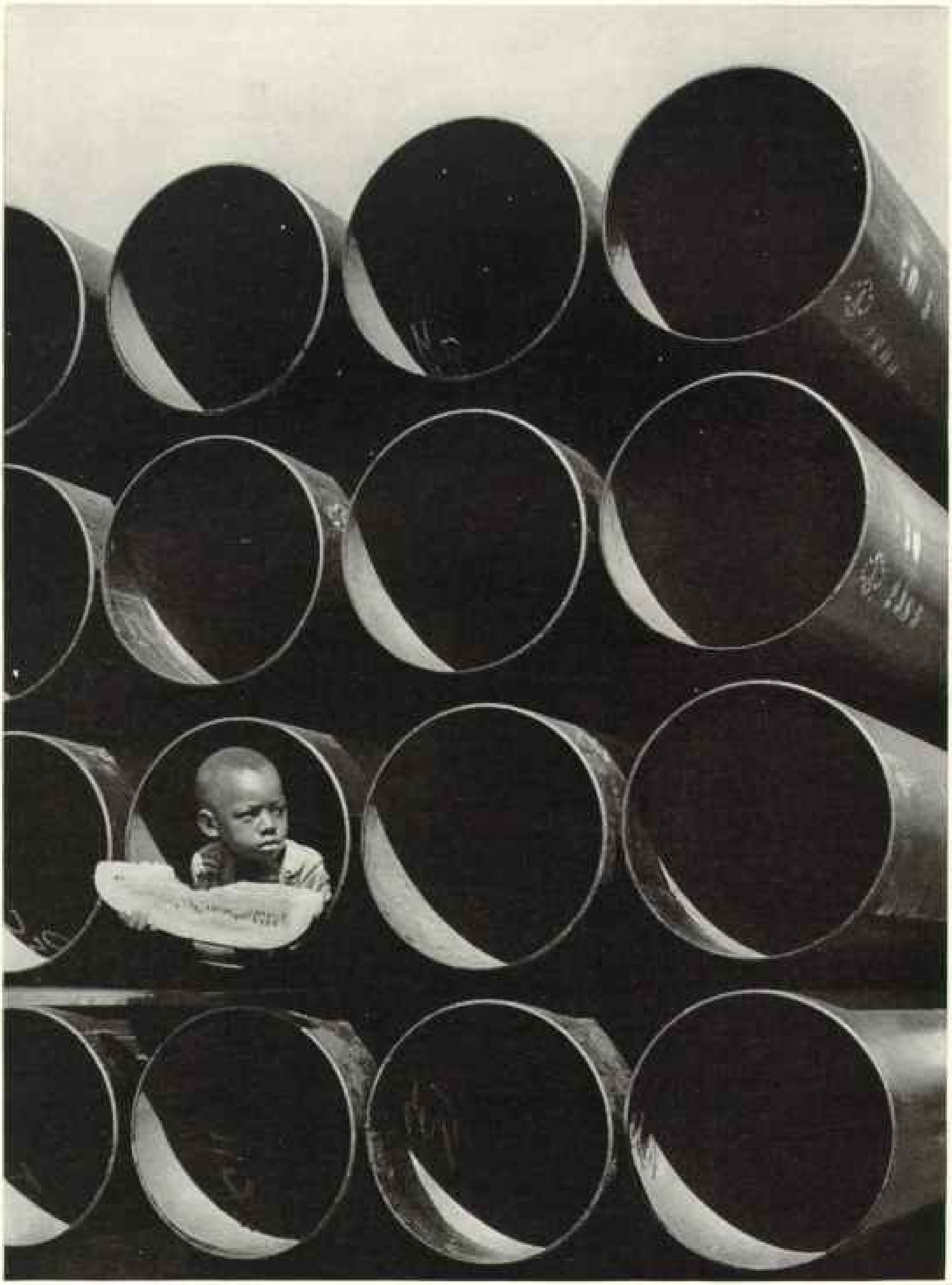
They are usually located on the shores of lakes or rivers, not only because of cheap transportation but because the industry itself, when working at capacity, uses four to five times daily as much water as all five boroughs of New York City, or more than 3,000,000 gallons a minute.

A single plant, that of the Bethlehem Steel Company, at Sparrows Point, Baltimore, averages daily more water than the city of Baltimore. The Lackawanna plant of the same company at Buffalo uses daily more water than the city of Buffalo.

As a rule, ore moves to coal rather than the other way around. Coal is bulkier and deteriorates more rapidly. Extra handling breaks the lumps of coke and makes them unsuitable from the viewpoint of size.

As a result of these and other natural forces,

* See "Coal, Prodigious Worker for Man," by Albert W. Atwood, NATIONAL GEOGRAPHIC MAGAZINE, May, 1944.



Twenty-inch Guns, Built to Shoot Water, Oil, or Gas, Fire a Watermelon Salvo

These pipes have been welded electrically. Seamless pipe, drawn out of a round billet, costs slightly more. Steel moves so rapidly from mill to consumer that Youngstown Sheet and Tube Company stacked this pile especially for its photograph. The 20-inch diameter is that of the Little Inch pipe line.

steel production is highly concentrated in such places as Pittsburgh, Pennsylvania; Gary, Indiana; South Chicago, Illinois; the Lake Erie ports; the valleys between Lake Erie and Pittsburgh; Birmingham, Alabama; and eastern Pennsylvania and Maryland, with such steel centers as Bethlehem and Sparrows Point.

Appalachian Coal Meets Chile's Ore

At Sparrows Point coal from the Appalachians meets cheaply water-borne ore from Chile.

Despite the wartime erection of steel plants in Utah and California, the greatest tonnage increase in production was in the Pittsburgh district itself, which includes a number of industrial satellites in the surrounding areas of Pennsylvania, Ohio, and West Virginia. Pittsburgh is still far and away the outstanding symbol of the Steel Age.

I stood outside the giant blast furnace No. 2 at the Edgar Thomson Works of the Carnegie-Illinois Steel Corporation at Braddock, Pennsylvania, looking at miniature near-by mountains of ore stored against the coming winter.

Not far beyond these stock piles were the hills where General Braddock and his army, including the youthful George Washington, were so disastrously defeated by the French and Indians in 1755. The ground where we stood had felt the tread of Braddock's troops as they marched from the Monongahela River to the ill-fated battlefield.

Today the main line of the Baltimore & Ohio Railroad runs directly through the Edgar Thomson Works, and the Pennsylvania skirts along the edge.

Not long before my visit, No. 2 had hung up a world's record for turning out 1,975 tons of iron in a single day.

Here and there in various parts of the country are the ruins of more than 1,000 early blast furnaces. How much smaller they were than those of today is shown by the fact that fewer than a third of this number were enough to supply the entire country with iron during World War II.

A modern blast furnace is a huge brick-lined steel stove, about the height of a 10-story building. Into it ore, coke, and limestone are "charged," or dumped, in proportions of 12, 6, and 3; that is, 2 tons of ore, 1 of coke, and ½ of limestone (Plates XII and XIII).

A blast furnace is practically in continuous operation, running for months or even years; it stops only when repairs become necessary.

Tornadic blasts of air, heated to 1,000° F., are blown into the furnace to promote the smelting process. At least four tons of air blast are needed for each ton of iron produced.

Coke and limestone release the iron from its chemical prison. Without coke it would be necessary to use charcoal, as men did for many centuries, and without limestone it might be necessary to use oystershells, as the New England colonists did.

In early times England was threatened with denudation of her forests to obtain enough charcoal to make the limited amount of iron required in those days. To get enough charcoal to make the iron and steel needed now is unthinkable.

Limestone converts the nonmetallic materials in the ore into slag, or cinder, which rises to the top of the metal bath and is released every few hours from the higher of two tapping holes, while the molten iron pours out of the lower hole.

I noticed that a 1,000-watt floodlight in the wall paled into utter insignificance as the molten iron and slag, in all their fiery splendor, came roaring from the furnace.

Although slag has many uses, such as railroad ballast, cement ingredient, and highway and roofing material, so much is produced that only a small part of it can be utilized.

A modern blast furnace is a very costly, mechanized, largely automatic chemist's shop, highly efficient, and gigantic beyond the layman's mind to grasp, a gargantuan Buck Rogers' dream.

In the bowels of the earth far below the furnace itself I watched materials continuously come and go, with no workmen in sight.

While I turned my head for a few seconds, an automatic train had come, almost silently, dumped 7,500 pounds of material within a few feet of me, and had gone without my even seeing it.

True, on one train that slid past sat a workman, and reassuringly on the seat beside him was a newspaper opened to the sports page.

How Pig Iron Got Its Name

The iron which comes from the blast furnace is known as pig iron, because in earlier days it was cast in sand molds, from a main runway to smaller runways or depressions on one or both sides, and these runways had a fancied resemblance to a sow with a litter of suckling pigs.

Invention of a casting machine changed all this. In any case, most of the metal is no longer cast and cooled into pigs, but goes on in a continuous process in molten condition until it ends up as steel rails, structural shapes, bars, tubes, and sheets.

Although steel can no more be made with-

Vibrant Steel, Strung in Harps, Hums Musically

Harps antedate written records. The first one may have been suggested by a bow's taut string. The Bible mentions harps; David played one. Others are painted on Egyptian tombs. This craftsman at Lyon & Healy, Inc., Chicago, attaches steel strings to steel tuning pins. Eleven heavy bass strings are covered with silk thread and spirals of fine wire.

out iron than bread can be made without flour, the blast furnace is only the kindergarten stage. To become steel, pig iron must go through one or more of three other types of furnaces—Bessemer, open hearth, or electric.

The continuous process, or "preserving the heat," not only saves fuel to reheat but permits the use of gravity to move vast masses of material.

Every source of heat is used, principally coal and coke, but also gas, oil, tar, pitch, and electricity. In 1943 the steel industry used enough coal to heat 12,896,000 houses, enough natural gas to heat 14,470,000 houses, and enough electricity to supply 17,178,000 families.

One of the strangest compensations in industry is that the surplus gas produced in the blast furnace should, when enriched, furnish both heat and power to convert pig iron into steel.

High temperatures are so essential to steelmaking that the glow of hot metal has become the symbol of the industry in the public mind. Steel begins to glow at a temperature of 1,000° F. In the open hearth 3,000° is the rule, and as high as 6,100° may be reached in the arc of the electric furnace.

Although heat is an absolute essential, it must be controlled or it will destroy the furnace. Thus steel men change the layman's "It is not the heat but the humidity" to read, "It is not the heat but the refractory," the refractory being firebrick and other heat-resisting lining material.

The economy of conserving heat and power, of "preserving the heat," naturally involves a continuous process, and this in turn makes for "integration," or great size.

It is not unusual for a steel plant to cost $100,000,000. More than 300 electric overhead travel cranes are used in operating a single large plant. In a normal year one company spends $1,250,000 merely to maintain telephone and telegraph contact between its plants and offices.

From Iron Age to Steel Age

It was not until an Englishman, Sir Henry Bessemer, in 1856 announced his discovery of a way to "manufacture iron without fuel" in a "converter," following experiments to improve the quality of cannon for the Crimean War, that enough steel could be produced for the uses of modern civilization.

An American, William Kelly, discovered

the same method of making steel at practically the same time, when he tried to produce malleable iron by blowing air through a bath of molten blast furnace iron.

Kelly's family thought him insane and forced him to go to the local doctor, who fortunately was so well educated in science that he realized that the oxygen in the air was in itself all the fuel that was needed.

Steel had been made in small quantities and by laborious processes for many centuries, for use as cutlery, edged tools, and weapons, such as the swords and daggers of ancient Japan, India, Damascus, and Toledo, and for medieval armor.

But the Bessemer converter, coming at the same time that coal and coke replaced charcoal as an industrial fuel, first made steel available in the commercial quantities needed in modern life.

The Bessemer process, together with the even more productive open-hearth process, which came after the Civil War, ended the Iron Age and ushered in the Steel Age, thus making possible the internal development of America.

A Bessemer converter is a pear-shaped, tilting vessel, holding from 15 to 35 tons of molten pig iron, into which 20,000 cubic feet of air are blown per minute. It takes only 15 to 20 minutes to make Bessemer steel, whereas the open-hearth furnace, although holding a much larger charge, takes 10 to 12 hours.

A Bessemer converter puts on one of the greatest shows on earth. It is sometimes called the "flame thrower of the steel front."

Millions of railroad passengers en route to Pittsburgh, Cleveland, Detroit, and Chicago have been thrilled, especially at night, by the colors of a Bessemer in action. The flames reach high in the heavens and range from ruddy red through burnt orange and pale yellow to blinding white (Plates XV and XVII).

As the Pittsburgh district mills are nearly all on river banks, the scene at night is doubled by reflection in the dark waters.

Open-hearth furnaces normally produce more than 90 percent of all steel made in the United States. They are large brick rooms with basin-shaped floors; the name "open hearth" comes from the fact that the floor is exposed to the sweep of the flames.

The open-hearth furnace has come to have a peculiar significance and value in our modern economy because it uses about 50 percent or even more of scrap—that is, of used steel. Thus it saves an enormous quantity of ore, as well as fuel and limestone, which would otherwise be used to make pig iron.

In this way steel can serve man indefinitely and can be used over and over again. It is lost only by rust, to a slight extent by abrasion, or such rubbing away as takes place, and by being lost at sea.

It is not yet determined whether ships lost at sea in World War II and steel scrap left on the battlefield can be economically salvaged, but the amount of course is considerable. No doubt many surplus ships will be broken up for scrap. The ill-fated *Normandie* is estimated to contain about 53,000 tons of usable steel scrap.

Unfortunately, for some time before the war we sold a considerable proportion of our scrap to Japan. In the five or six years before Pearl Harbor we sent that country more than 7,000,000 tons.

The Uses of Scrap

Steel mills buy huge quantities of scrap, sometimes 50,000 carloads a month, or more. One Ohio mill bought 80 carloads of unused military landing mats a few months after V-J Day (Plate XI and page 451).

But half or more of the scrap used is produced by the mills themselves. This is possible because, in the course of producing steel products, there are constant discards from trimming or cropping, boring, etc.

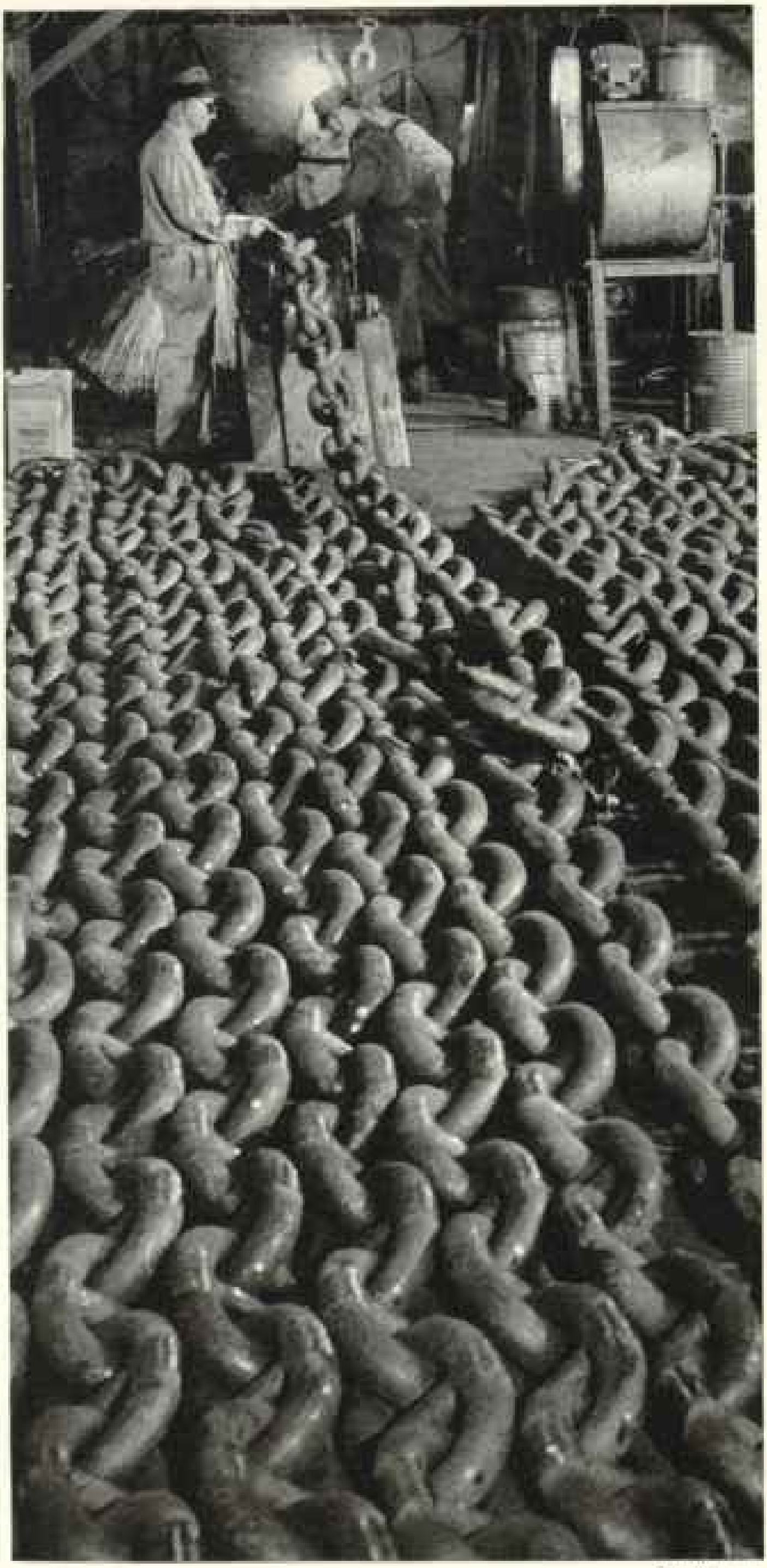
A good illustration is the cylinder of a military airplane engine, which is only 10 percent as large as the original block of steel from which it is made.

This kind of scrap is known as "home" or "run-around" scrap, and naturally it is in continuous circulation.

The open-hearth furnace is charged with molten pig iron, scrap, ferroalloys containing manganese, limestone, and various so-called alloys, as required. Only the alloys are put in by hand (page 451).

Practically the only food which the electric furnace consumes is scrap, although some molten iron may be used. On the other hand, steel may be "duplexed" by being put through the open hearth after it has been made in the Bessemer, or even "triplexed" through all three furnaces.

In the electric arc furnace, large sticks of carbon, called electrodes, extend down through the roof to within a few inches of the metal bath, with electric arcs to furnish the heat. High temperatures are reached very rapidly in this way and are subject to exact control. Although the process is more expensive than the Bessemer and open-hearth, and production much smaller than either, some of the finest-grade steels are frequently made in the electric



Ray Atkeson

Anchor Chain Flows from Machines Like Sausage Links

Virtually every steel record was bettered in World War II. Ship chain was an outstanding example. Formerly every link, hammered tight, cost five minutes. Now the job is done in 30 seconds. Bars of steel are cut, heated, bent into links, and welded by a process called molten flux. For warships, one link is fastened with a removable pin so that the anchor may be slipped in a hurry. This crew polishes welds at Pacific Chain Manufacturing Company, Portland, Oregon.

furnace, especially high-alloy, stainless, and tool steels.

From each of the three types of furnace the liquid steel is poured by machinery first into ladles and then into ingot molds (Plate XVII). When the molds are lifted, there stands a row of ingots, the first solid form which steel takes.

Ingot Is Measure of Production

All processes of steelmaking converge in the ingot, and it in turn is the common denominator of the industry, the standard by which production is measured.

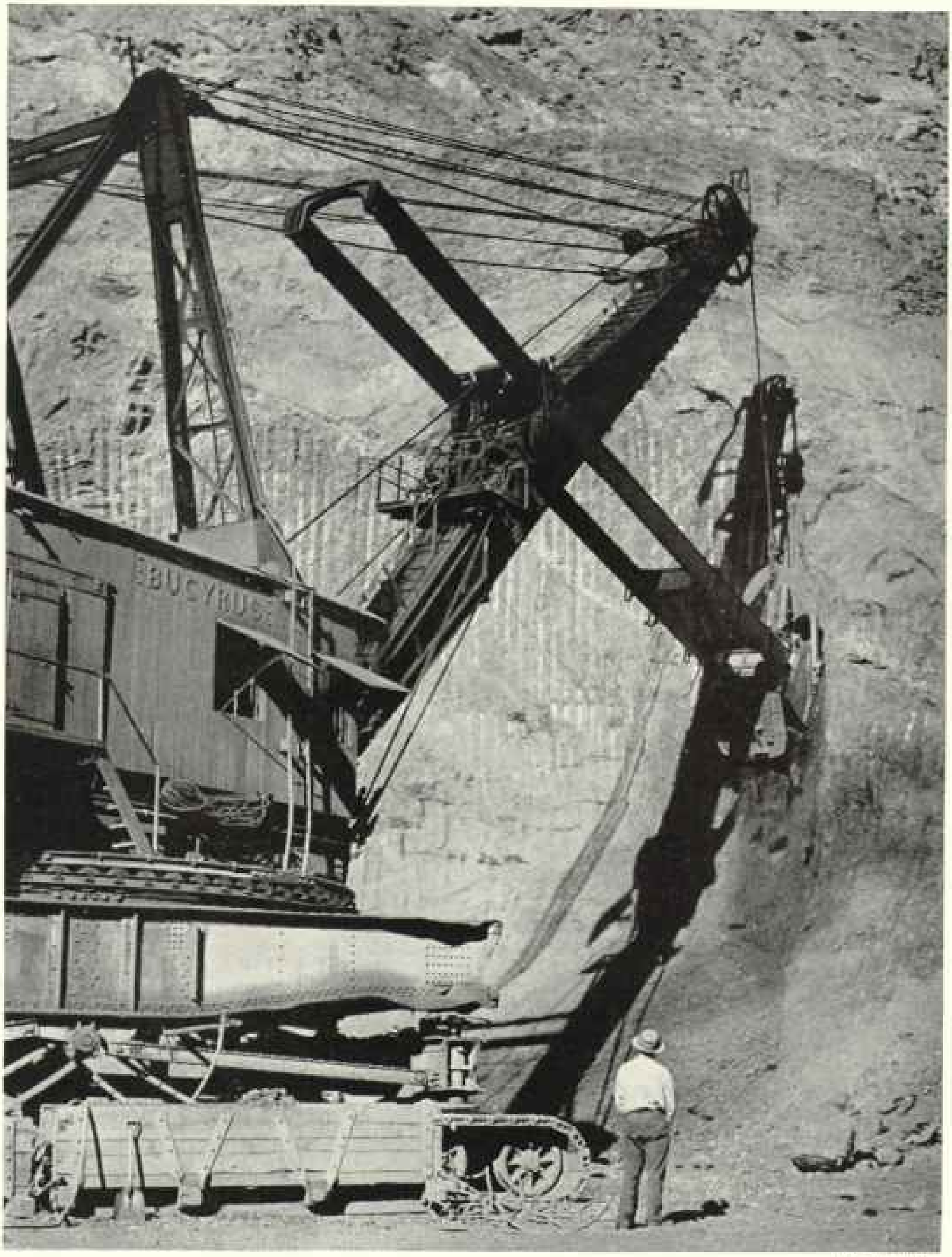
Once the molten metal is poured into the ingot molds, the basic business of steelmaking is ended, but the ingot itself is the beginning of everything made from steel, from a pin to the Golden Gate Bridge.

Ingots can be of many sizes and shapes, but generally they are large, tapering, rectangular blocks, or chunks, weighing about 5 tons for the open-hearth product. They are handled, of course, by machinery, as it would take 150 men to move a single ingot.

When an ingot has been stripped of its mold, some 45 to 60 minutes after the liquid steel has been poured, it stands glowing on its car, a hot dull-red block of steel with a smooth cherry-red surface.

Brought to uniform white heat again in a soaking pit (Plate XX), the ingot goes to a rolling mill, which is like a giant washing-machine wringer, where the process of shaping into useful form begins. There the ingot is rolled much as piecrust or cookie dough, both to improve its quality and to give it shape. The grain structure of the steel is improved by rolling, and the ingot is usually made narrower and flatter.

From this process emerge smaller and "semifinished" pieces of steel, known variously as blooms, slabs, and billets (Plate XVI).



Alfred T. Palmer

To Make New Tools for Man, a Steel Monster Gulps Six Cubic Yards of Iron Ore

Loading an ore car with four dipperfuls, the steam shovel cleans up track terraces left in an exhausted open pit at Wakefield, Michigan. This pit lies in the 80-mile-long Gogebic Range, one of the Lake Superior district's six main belts of iron ore (page 431). Superior's rich mines account for four-fifths of our iron. They were our reservoir of victory in the War of Steel, in which American mills outproduced the combined Axis powers (page 421).

These in turn go through further rolling, and finally we have the "finished" products —rails, tubes, plates or sheets, bars, and structural shapes.

It is a fascinating sight to stand by the roller, who controls the operation from his platform, or "pulpit," and watch an ingot, or bloom, or slab, lumber steadily and sedately along toward its destiny. Somehow, steel seems to be making itself.

But of course it does not make itself. For a product which is so common and which costs about 3 cents a pound for the ordinary grades, an amazing amount of care is taken in its production.

Samples are tested constantly, all the way from the carloads of ore leaving the Mesabi to the finished product. Some 37 analyses are made of an 180-ton open-hearth "heat." During a few minutes in which I watched an open-hearth furnace, several samples were taken out and sent to the laboratory.

One company alone has more than 170 different laboratory organizations. Another company has 1,500 metallurgists, chemists, and laboratory assistants, not only in its laboratories but in its mines and mills.

Yet much discretion must be left to the workmen themselves. Steelmaking is highly mechanized, but since many of the operations are not routine or repetitive, they require decision and judgment on the job.

The Human Touch in Steelmaking

Steelmaking is an art as well as a science. Despite all the assistance which the technical men can give, despite all the chemistry and physics at their disposal, only the melter or assistant melter in charge of the furnace can decide whether the time has come to tap or not to tap. He must look at the fiery mass, through his colored glasses, and he must draw out a sample to see if it has become steel, just as the housewife must draw out a little quantity of chocolate syrup to see if it has become fudge.

The steel industry is nearly devoid of trade secrets. Small technical improvements are made by individual melters or other men in the mills, and for a time these may prove to be of benefit.

But major developments, such as the electrolytic tin-plating process, are usually patentable and are licensed to other companies. As soon as something new comes along, competing companies either take out a license or develop a similar process or product, possibly by a different route. It is a common saying among the metallurgists that as soon as a sample can be had, one company has a lead of only six weeks over its competitors.

In the complicated industrial world of today steel must be made to do a particular job.

The automobile, airplane, petroleum, electrical, and chemical industries, to name only a few, demand that special steels be made for special purposes. This can be done because steel is not a single thing; it is almost anything, and it can be given almost any mechanical property.

A single practical illustration is the fact that the maximum depth of many producing oil wells has been increased from 3,000 to more than 13,500 feet by providing steel adapted to oil-well drill pipe. In a few other instances, test wells have been drilled to more than 16,000 feet.

A more bizarre illustration is the fact that a ⅜-inch steel plate can be pierced by a spike made from the same plate, if the spike is properly heat-treated.

True, we usually think of steel as strong. Comparing it with other materials we say, "This is stronger or weaker, harder or softer than steel." Chaucer and Shakespeare used the phrase as "true as steel," and Milton said that a woman who has chastity "is clad in complete steel." The word itself apparently comes from the Teutonic *stahal* or *stag*, meaning "firm" or "rigid."

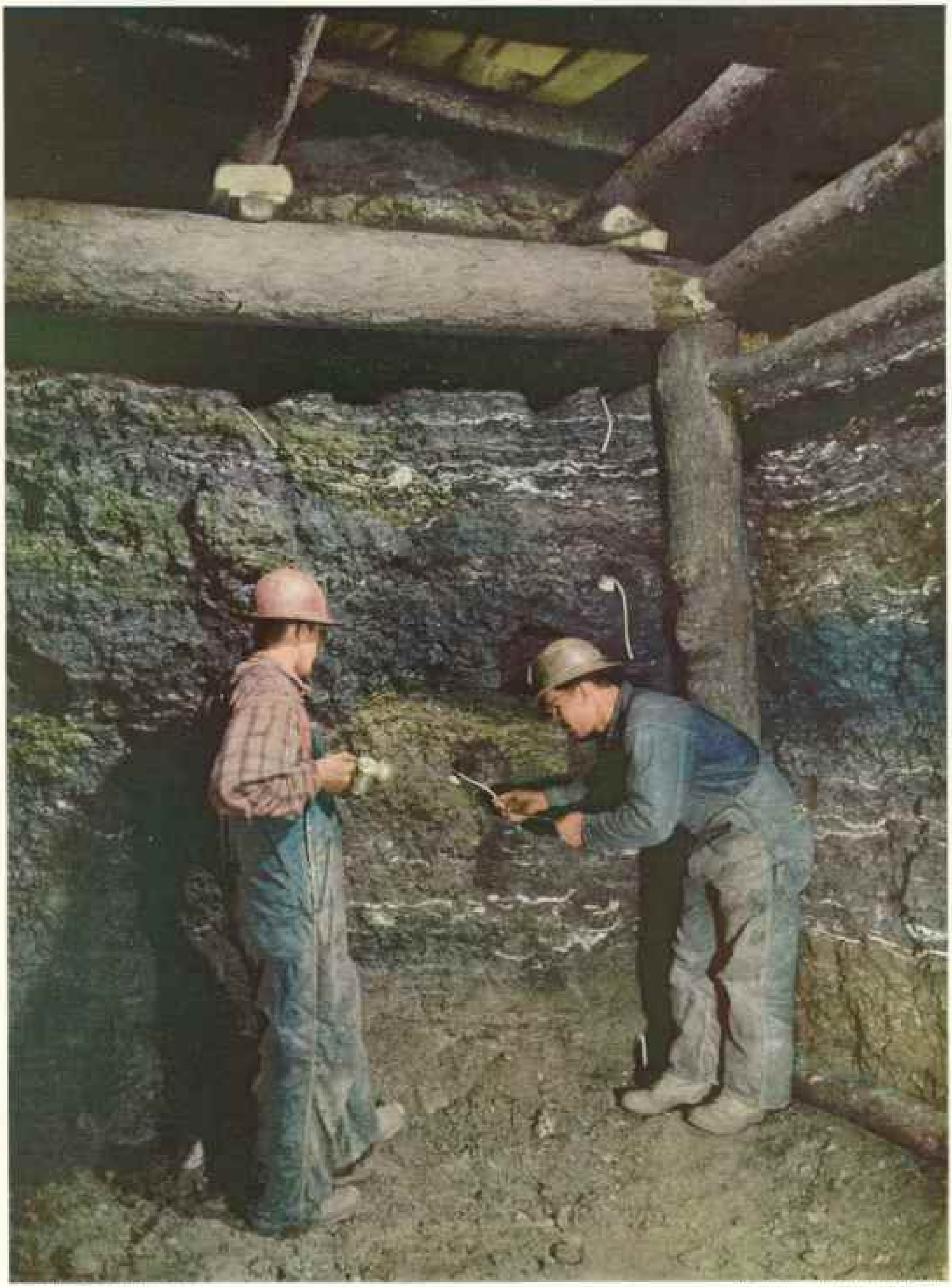
But sensible men do not use stronger materials than are needed for their purpose. It is an incredibly foolish waste to use the same kind of steel in an awning fixture or barn-door hinge that is used in an airplane engine.

The steel that goes into a soldier's helmet must have enough give not to crack when stamped out. But it must be hard and tough enough to resist bullets and shell fragments.

A block-buster bomb requires glasslike hardness on the outside plus toughness on the inside. A plowshare should be soft inside to prevent breakage and hard outside to prevent abrasion. Razor blades must be strong, but they can be made cheaper if brittle, because it is easier to grind and hone brittle steel.

Exhaust valves must not warp or burn. A bridge must withstand stresses and strains. An oil-well drill that goes through thousands of feet of earth and rock must keep its keen cutting edge. An airplane crankshaft must have strength, plus ability to withstand vibrations. An automobile fender requires ductility and smooth finish; above all, it must bend.

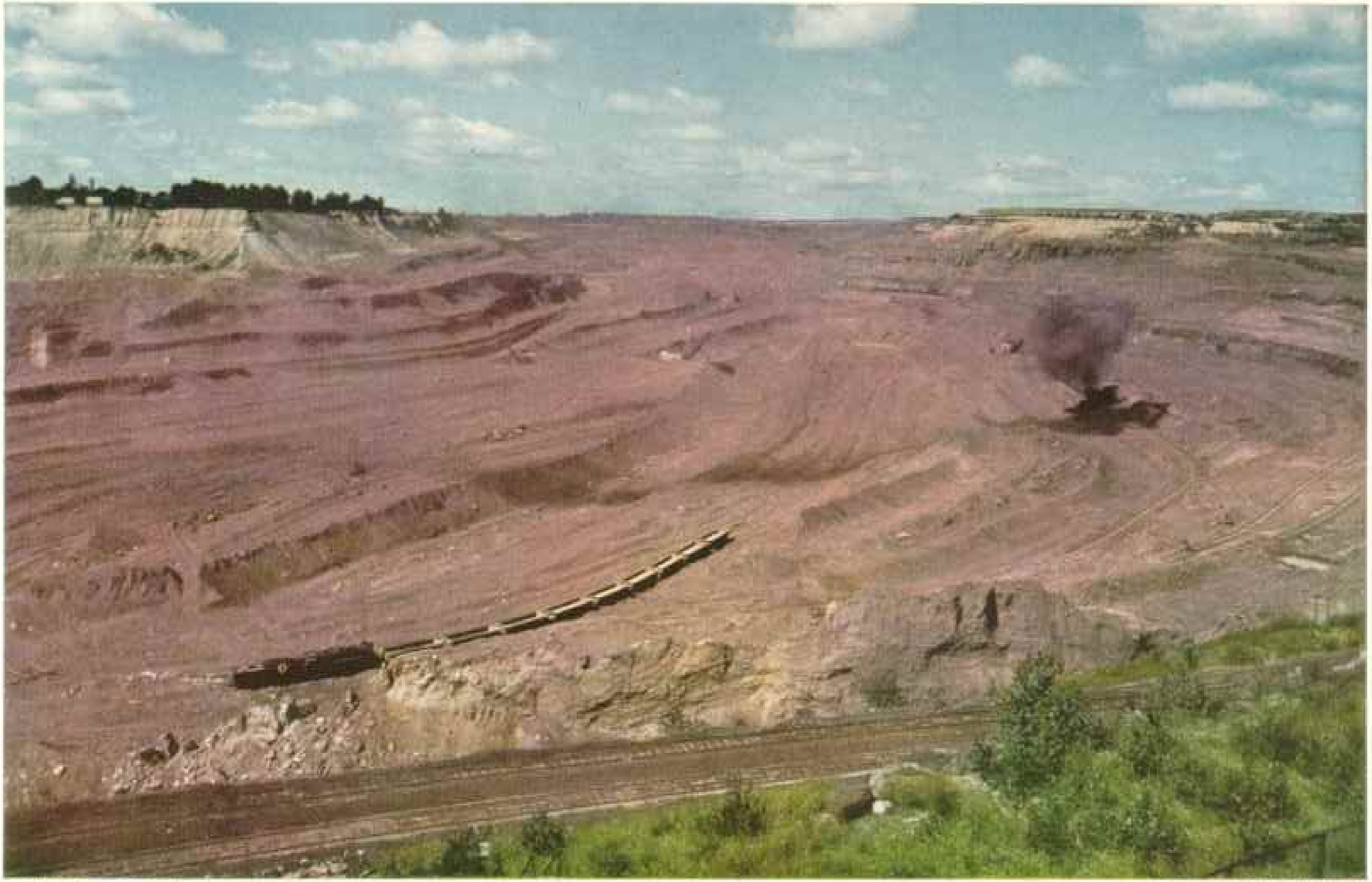
In the offices of the American Iron and Steel Institute in the Empire State Building



 Kodachrome by Willard R. Culver

Dynamite Tears Iron Ore, Mother of Steel, from the Mesabi Range's Embrace

Deep in a Minnesota mine, these men insert explosive charges in the rock wall. Wires connect the fuses to a battery-box detonator placed at a safe distance. Automatic conveyors will load ore into rail cars for the trip to the shaft's mouth. Mesabi ore is mined both underground and on the surface (Plate X).



Kodachrome by Willard R. Culver

Minnesota's Grand Canyon, the Hull-Rust Open Pit Ore Mine Sprawls over 1,100 Acres

Here power shovels load 75-ton railway cars in 7 to 10 scoops of their big dippers. Hull-Rust, opened at Hibbing in 1892, has yielded more than two hundred million tons of the red mineral. Some experts believe it and other Mesabi mines will produce iron ore on a large scale for another hundred years.

Kodachrome by Willard R. Culver

Electromagnetic Cranes, Loading Five Tons in One Grab, Toil in Steel's Graveyard, Resurrecting Scrap

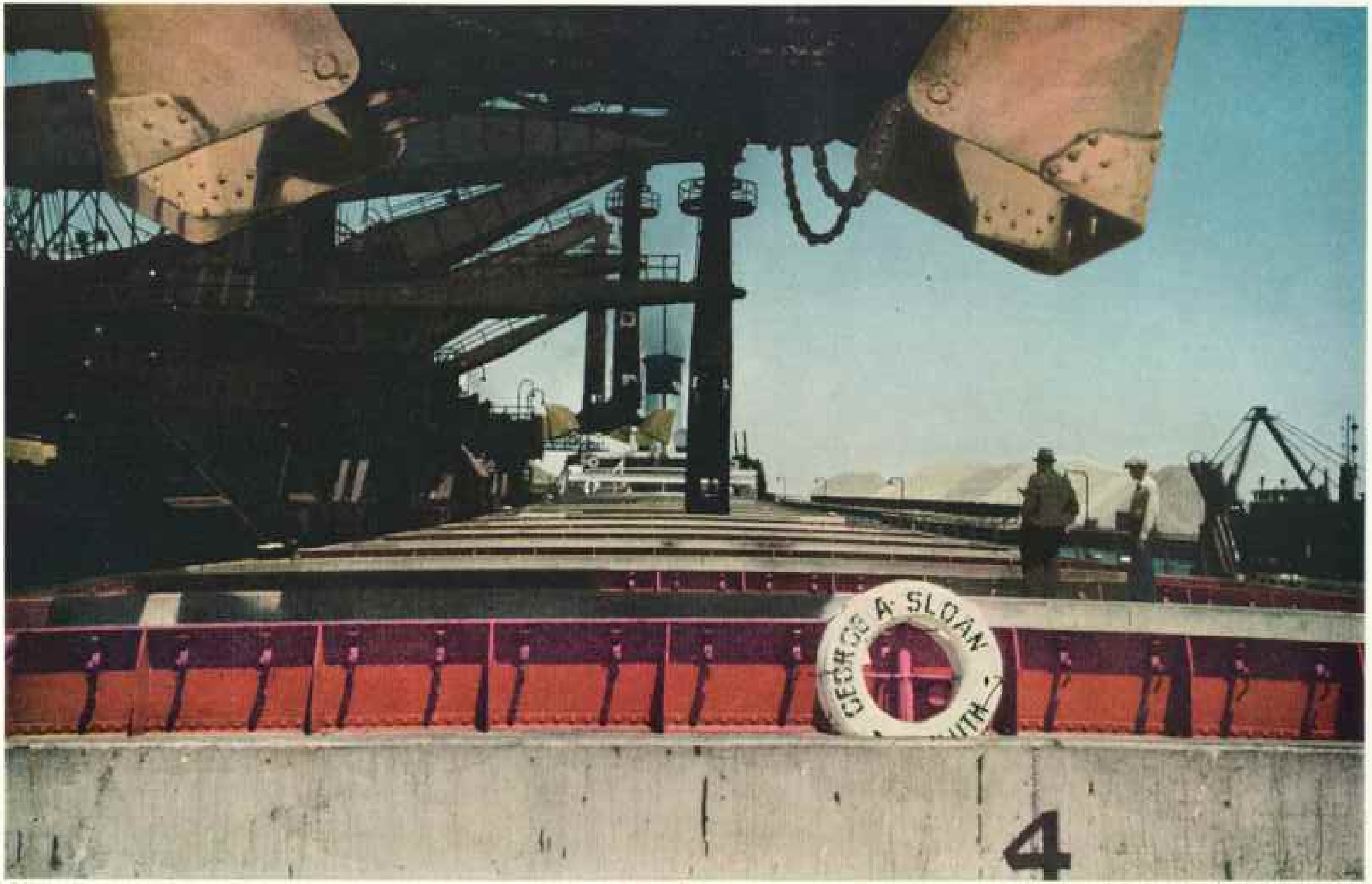
Rusty rails, boilers, fences, old guns, and tanks move to open hearths at Sparrows Point, Maryland, for regeneration as steel for ships and automobiles. Blast furnaces, smelting iron ore, produce only half of the metal required for our steel needs. Scrap makes up the other half. Collections have dropped since the war.

© National Geographic Society

Gary's Roaring Blast Furnaces Smelt Ore, Coke, and Limestone into Iron

Kodachrome by Willard R. Culver

Giant Thermos Bottles on Wheels Haul "Soup," Molten Iron, to Converters to Make Steel



Kodachrome by Willard R. Culver

Electric Cranes, Seizing 17 Tons at a Stroke, Unload a 13,000-ton Lake Ore Carrier in Four Hours

Each unloader is operated by a man in the base of the bucket leg (center). Like pistons the shovels plunge into the ship's many holds and lift steel's raw material to dockside cars. Great Lakes ore vessels ply continuously between mines and mills during the seven or eight ice-free months.

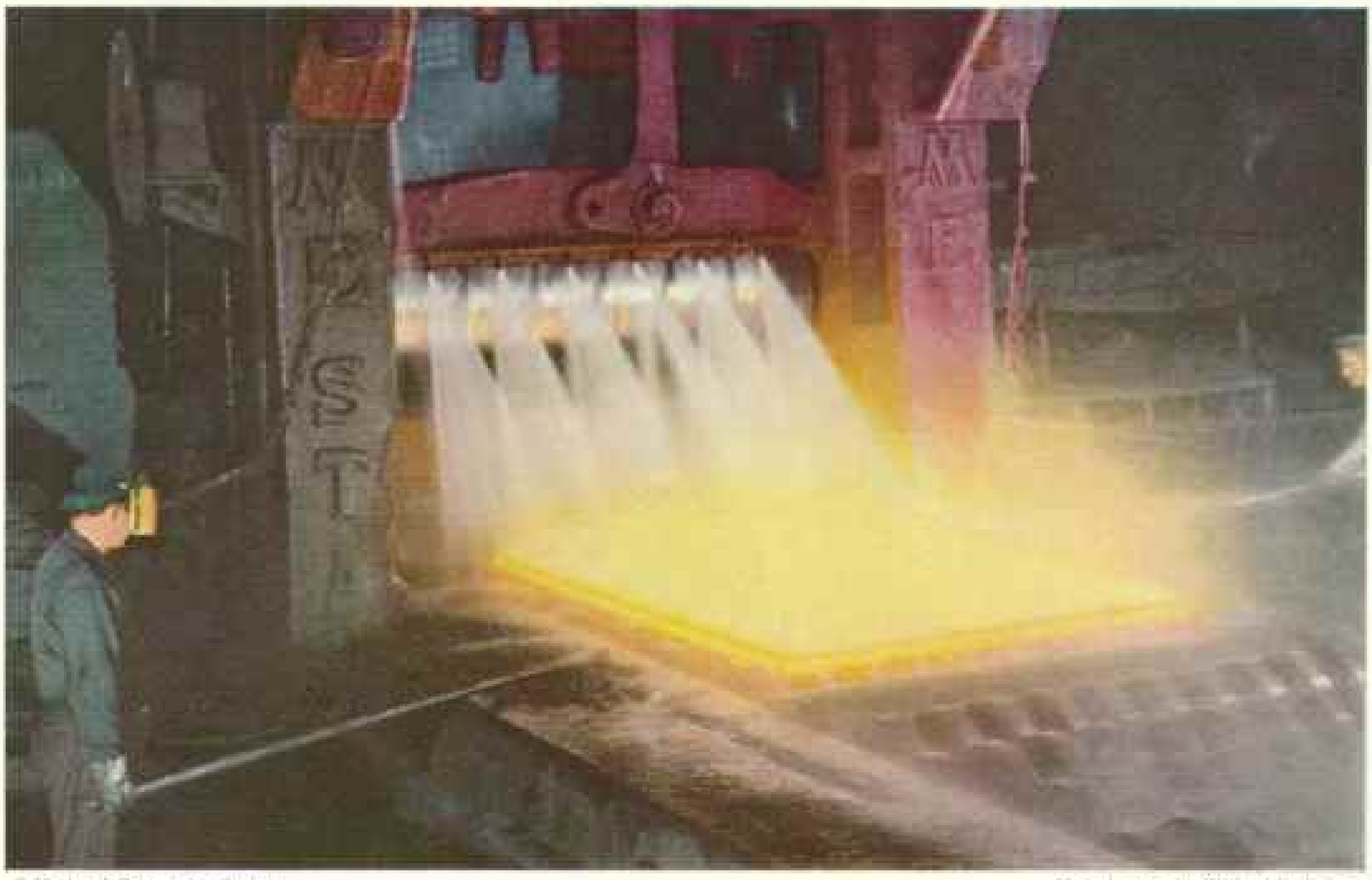
Kodachrome by Willard R. Culver

Where Bessemer Converters Spout Their Fiery Spray, It's the Fourth of July All Year Round

Batteries of these converters redden the night sky over Sparrows Point, Maryland. Air blown through molten iron causes a shower of sparks and vapors to spout from the Bessemer's mouth. Liquid impurities form slag. After 15 or 20 minutes of blowing, the converter tips and pours steel into ingot molds (Plate XVII).

Automatic Fingers Curl Flat Steel into Pipe and Weld the Edges Without Pause

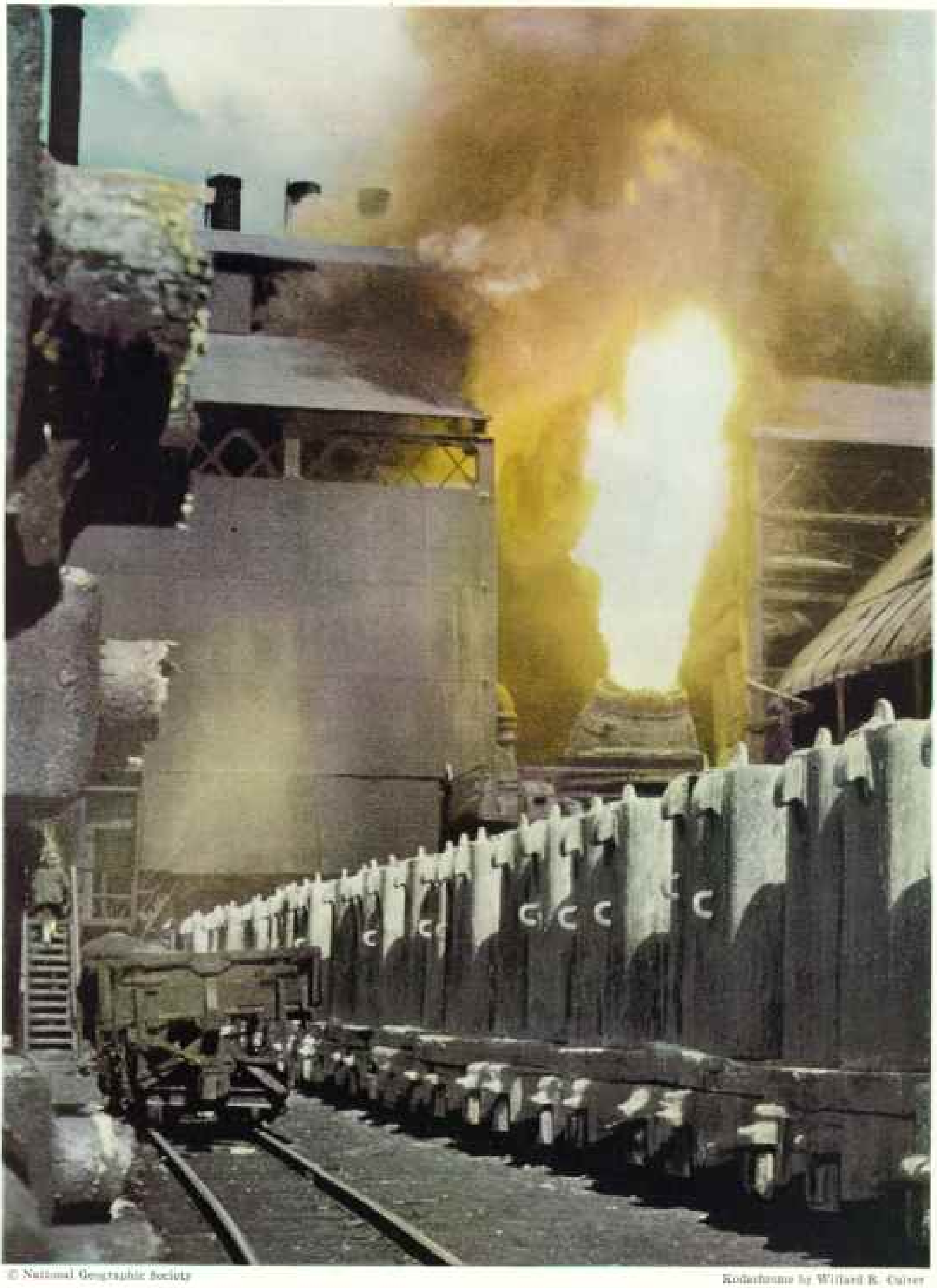
Vertical and horizontal butt-welding rolls (center and left) draw skelp, the continuous flat plate, from a furnace of the Youngstown Sheet and Tube Company. Water removes scale that forms on hot steel in the air.



 Kodachromes by Willard R. Culver

Passing Back and Forth Between Giant Rollers, an Ingot Is Flattened into a Slab

Here the glowing steel thunders through a rolling stand in the plate mill at Sparrows Point. Streams of water wash away scale. Slabs are sheared, then stored for further rolling into plate or sheet steel.



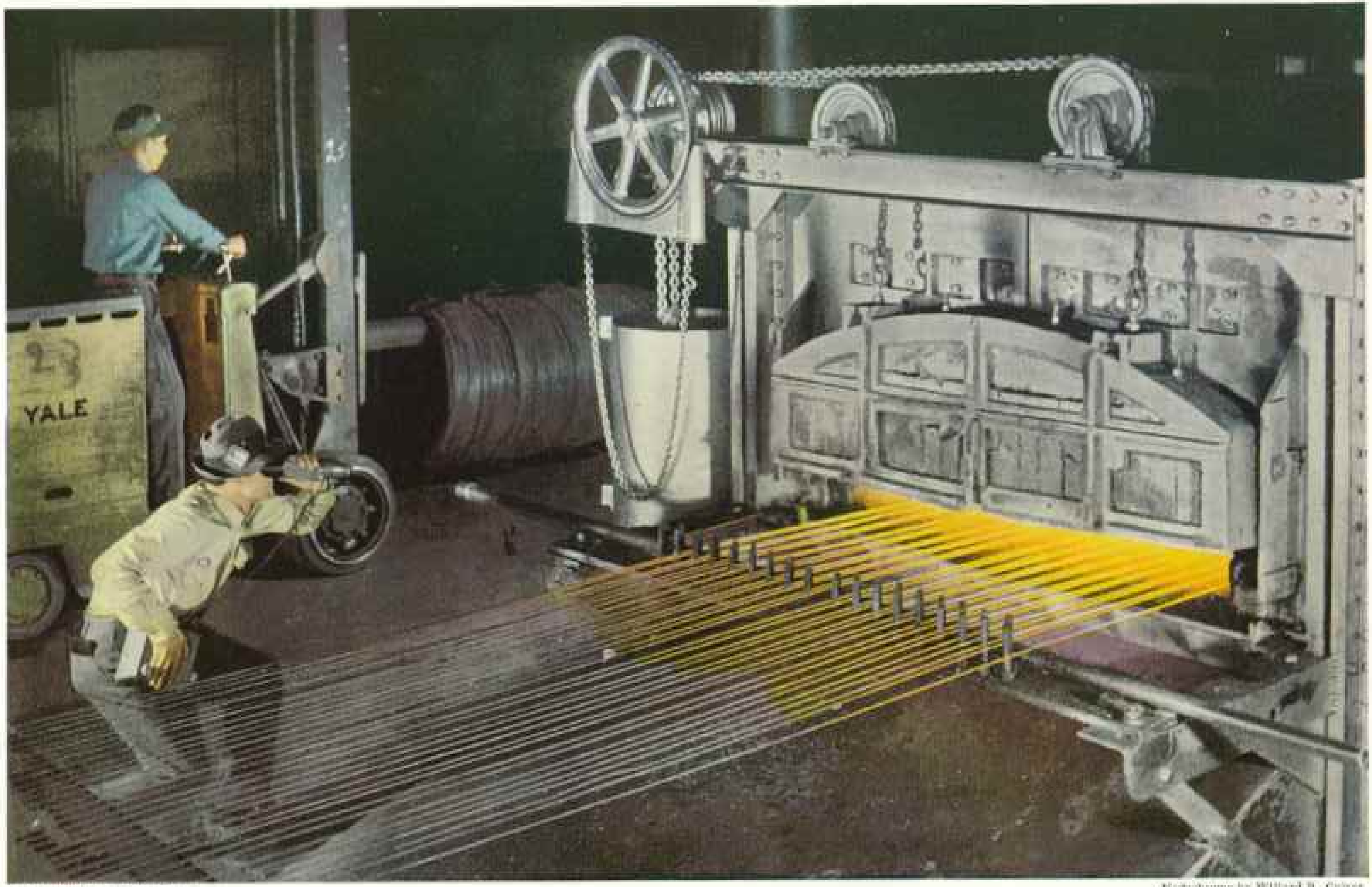
Kodachrome by Willard R. Culver

Ingot Molds Line Up to Receive Sputtering, White-hot Steel from a Spouting Bessemer

After cooling and solidifying in the yards at Youngstown, ingots go to the stripper. There cranes with special tongs engage the lugs on the molds and lift them from the ingots. Then the blocks "soak" in gas-fired furnaces until they are of rolling temperature. Ingots produced by this Bessemer converter weigh 9,000 to 18,000 pounds each.

Railroad Car Wheels, Forged under 20,000,000 Pounds of Pressure, Are Toughened in a Bath of Oil

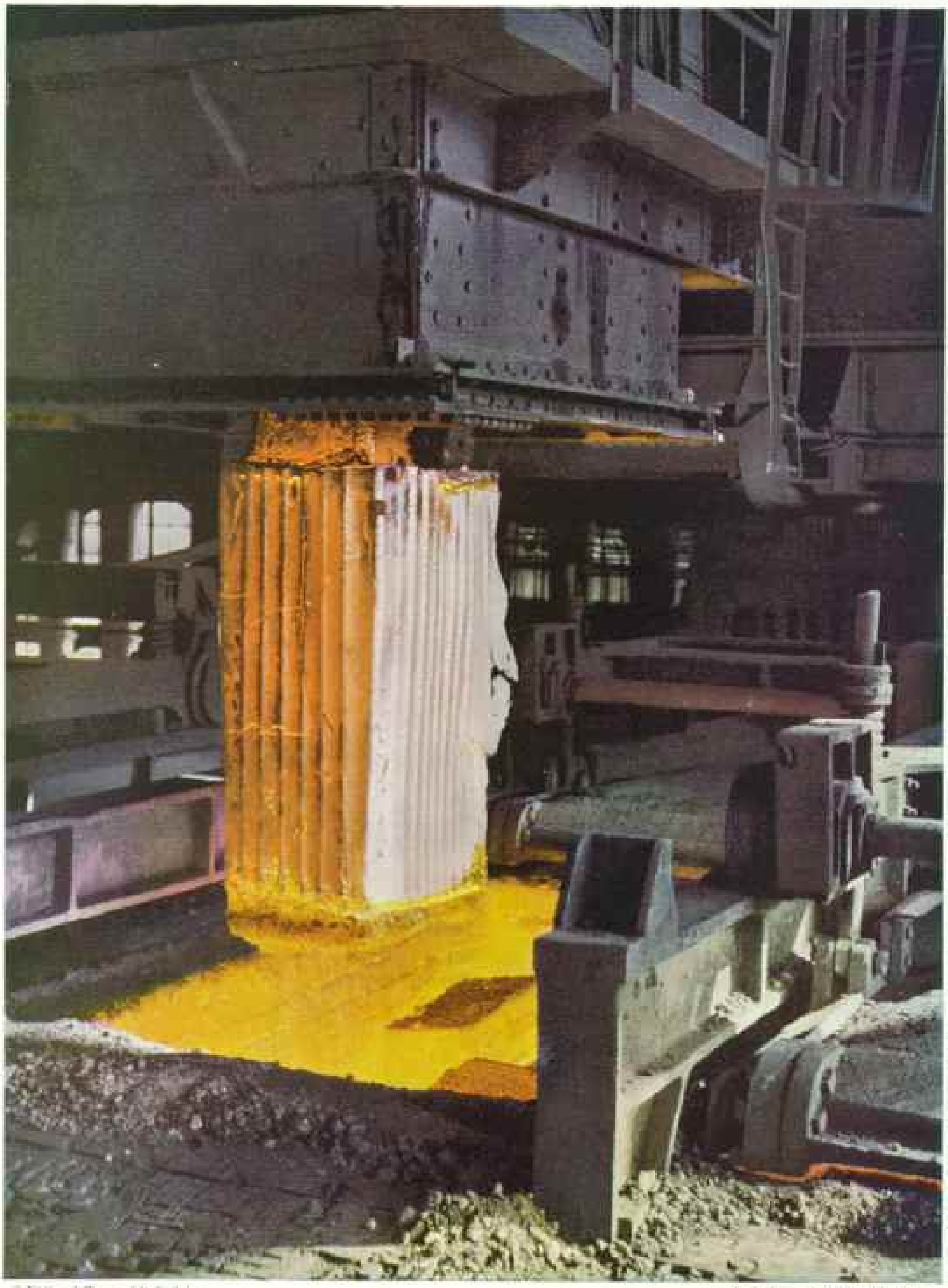
In the Baldwin Locomotive Works at Burnham, Pennsylvania, thick glass protects the operator (upper left) from 1,550° F. heat. Then the wheels go to a tempering furnace to eliminate quench strains. The finished product must bear the pounding punishment of thousands of miles of travel.



Kodachrome by Willard R. Culver

Heated to a Bright Orange, Steel Rods and Wire Have Their Temperatures Checked as They Leave the Patenting Furnace

The inspector at Sparrows Point looks through an optical pyrometer containing a lamp filament which he adjusts to match the light from the rods. Wires of various thicknesses are made by drawing rods through dies of alloy steels, tungsten carbide, or even diamonds.



 Reduction by Willard R. Culver

"Soaking" in 2,200° Heat Prepares a Steel Ingot for the Rolling Mill's Torture

An electric crane lifts the glowing ingot from a soaking pit at Sparrows Point, Maryland. Next it goes to a giant rolling mill where it is formed into blooms or slabs (Plate XVII). Corrugations on the ingot's sides improve its physical quality.

in New York I held in my hand four small pieces of steel, all cut from the same sheet but each hardened by a different treatment.

The first could not be bent at all without breaking; the second took a right-angle bend safely; the third could be bent nearly back on itself without a fracture; and the fourth, not only back on itself but also lengthwise.

A Strip Thinner than Paper

I also held, carefully so as not to cut my fingers, a piece of strip steel thinner than the paper on which I made my notes; it was .0015 inch thick. It would have been instructive to place this tiny ribbon beside one of the main girders that support the Empire State Building!

Let us bear in mind that in America the more modern aspects of the science of metallography, which has to do with the internal structure of metals, go back only to about the beginning of the 20th century. Today an entirely new grain structure can be created by controlling and manipulating the heating and cooling cycles in steelmaking.

What this has meant in the manufacture of bayonets and helmets, to mention only two out of scores of thousands of products, needs no elaboration.

But just as fundamental is the fact that steel can be given a wide range of physical properties by adding to the molten mass certain regulated proportions of one or more other metals, known for this purpose as alloying elements.

All steel is alloy steel in the sense that it is composed of two or more elements. But, as commonly used, the phrase applies to steel in which such elements as manganese, nickel, chromium, molybdenum, cobalt, tungsten, and vanadium—the seven principal alloying elements—are added.

Some alloy steels may be two or three times as strong as simple carbon steel for equivalent sections.

In some cases they are made to resist rust and in general to meet the demands of industry for high-strength products, notably in the ever-increasing speeds and stresses of modern transportation. Jet propulsion made further demands (page 421).

While the uses of alloy steel run up in the thousands, the first great demand came from the automobile industry. In fact, if the automobile had come into use much earlier its development would have been very slow, because alloy steel was not yet available.

Of the many families of alloy steels the public is most familiar with the stainless varieties, because they are used on the outside surfaces of railroad trains and for kitchen equipment.

Weight reduction has been a popular slogan, especially since the war. We hear much of lighter-weight trains and automobiles. "Lighter" materials are all the rage.

But there is no such thing as "light" or "heavy" steel. All steel weighs practically the same, except for insignificant differences due to different alloys used.

What is meant by lightweight steel is usually some form of alloy steel which, because of its superior strength or toughness or hardness or rust resistance, does the same work with the use of less material. In other words, more work is done by a section of the same size, or the same work is done by a section of smaller size.

Most of the elements used in steel alloys normally come from strange and remote parts of the earth made better known to us in the recent swirling fortunes of war.

Nickel came mostly from Canada, but also from Norway and New Caledonia. Manganese came from Russia, the Gold Coast, Brazil, and India; chromium from Southern Rhodesia, Union of South Africa, Greece, Cuba, New Caledonia, Turkey, and the Philippines.*

Alloy Steels in the War

The war was largely a war of alloy steels. Not only the weapons but the tools and machines that made the weapons had to have alloy steel. In wartime the greater costs of the electric furnace did not so much matter (page 435), although alloy steels were and are made in the open hearth as well.

Despite the shutdown in importation of many alloys because of submarine warfare, it was possible to get by.

One reason lay in the recovery of alloys from scrap piles. Many thousands of tons of nickel, chrome, and molybdenum were obtained each year through the use of scrap material. In fact, as much as 95 percent of the nickel used to toughen certain steels was obtained from scrap.

The best-known way in which the critical supply of alloy elements was stretched was by creating the National Emergency, or NE steels. These were "lean" alloy steels that proved just as effective as the "rich" ones.

*See, in the National Geographic Magazine, "Treasure Islands of Australasia," by Douglas L. Oliver, June, 1942; "War Awakened New Caledonia," by Enzo de Chetelat, July, 1942; "Brazil's Potent Weapons," by W. Robert Moore, January, 1944; "The Society's New Map of Soviet Russia," December, 1944; and "India's Treasures Helped the Allies," by John Fischer, April, 1946.

Hard Steel Makes Soft Beds; a Third of Our Lives Is Spent on Wire Springs

Steel, a synonym for inflexibility, acquires springiness from the addition of carbon, heat treatment, and coiling. In wire springs the bounce is intensified by cold working. These Simmons Company employees sew felt borders to an inner-spring mattress at Kenosha, Wisconsin (page 418).

It required no laboratory work to project the NE steels—merely a few days around a conference table of the American Iron and Steel Institute on the part of metallurgists from different companies.

This was because research had several years before propounded a multiple-alloy theory—namely, that small amounts of a larger number of different alloying elements would prove just as effective as larger amounts of fewer alloys.

It was fortunate that the theory worked out in practice. First, there wasn't enough alloy material to provide the rich mixtures. Second, the Russians in their long and costly but successful defense of Stalingrad needed certain types of steel. Their demand on the USA was immediate and urgent; it could not wait for years of laboratory development. They needed our superior alloy steel at once, and they got it.*

In peacetime steel will naturally feel competition from other materials—from the "light" metals, such as aluminum and magnesium; and from plastics and plywood. In fact, the competition among different substances never ceases, whether in peace or war.

But competition works both ways; the light metals may feel the competition of stainless steel.

Of great importance is the fact that most materials supplement or coordinate with steel. Often the best results are obtained where there is a union of two groups of materials, such as steel and aluminum, steel and magnesium, etc.

This is likely to be the case in the construction of airplanes, automobiles, trucks, and buses, as well as in the interior and exterior of modern trains.

The union does not necessarily consist of metals alone. There are products where steel and plastics are used together to great advantage. Even under the forced stimulus of war, such materials as copper, lead, zinc, aluminum, magnesium, and plastics, vitally important as they are, have never been produced in quantities sufficient to provide for more than a fraction of the needs of this modern world.

Steel accounts for more than 90 percent of the production of all metals combined. No wonder it is the master of them all!

* See "Lend-Lease and the Russian Victory," by Harvey Klemmer, NATIONAL GEOGRAPHIC MAGAZINE, October, 1945.

Finding the Tomb of a Warrior-God

By William Duncan Strong

Loubat Professor of American Archeology, Columbia University, and Chairman, Institute of Andean Research, 1946

With Illustrations from Photographs by Clifford Evans, Jr., Research Assistant, Columbia University

IN THE Virú Valley of Peru some ten centuries ago dwelt a living god, a warrior-priest venerated by the Mochica people who developed a brilliant civilization on the northern coast when Europe was deep in the Dark Ages. Last June, on the final day of our field work, we were fortunate enough to discover his tomb.

This editorial "we" represents the 1946 Columbia University Archeological Expedition to Peru, including the writer, his wife, and his assistant, Clifford Evans, Jr., who as a bombardier officer had been blown out of his plane 25,600 feet over Hamburg and less than a year before had been released from a prison camp in Germany.

Now back in our own chosen study—the history of man through the millennia—we were finding a lot to learn and much to unlearn in Peru.

New light was being shed upon the life of the vanished Mochica, who, our explorations now proved, flourished much later than had been thought. We knew at last that the period of their ascendency marked not the beginning of native civilization on the north coast of Peru, but rather its apparently brief but very brilliant flowering in the period between the Gallinazo culture, which has left us ruins of great adobe castles, and the rise of the Tiahuanaco and Chimu civilizations.*

Preserved in the dry soil we found intact not only examples of the splendid art work of the Mochica but some of the actual food they ate and pottery representations of their deer hunting, drinking bouts, warriors, and gods. The climax was the resurrection of old Ai apaec† himself, one of the last of the Mochica warrior-priests, who had represented in his person the great-fanged feline deity of ancient Peru and was buried with the body of a sacrificed boy beside him (Plate I).

Dead City Covers 11 Square Miles

After the downfall of the Mochica there arose the Tiahuanaco civilization and the coastal empire of the Chimu kings, who, in the middle of the 15th century, dominated the northern coast of Peru from the towering Andes to the blue Pacific Ocean.

The capital of this coastal empire was the city of Chan-Chan in the Moche Valley. The ruins of that great dead city cover 11 square miles, and the many carefully planned high-walled compounds, the reservoirs, the intricate irrigation patterns, and the temple mounds, even in their present ruinous state, bespeak a very highly organized and esthetically advanced government (page 462).

After flourishing for several centuries, however, the Chimu Empire and its capital were conquered by an even greater native American empire, that of the Incas. But in turn the Incas themselves were caught in the intricate web of history, and their dominance was as brief as it was brilliant.‡

In 1532 a small but intrepid army of Spaniards under Francisco Pizarro landed on the northwestern tip of Peru, and within two years the empire of the Incas followed that of the Chimu, and the still earlier kingdom of the Mochica, into oblivion.

Each of these great pre-Columbian empires and kingdoms left far more than their extensive ruins, for many of the people of each survived and blended, and today their descendants form the larger part of the population of modern Peru.

Six Expeditions Focus on One Valley

It was this continuity of very ancient and modern civilizations that led to the selection of the Virú Valley as the scene of a unique program in 1946.

The Virú Valley Project of that year was organized by the Institute of Andean Research, made up of North American and Peruvian scholars representing numerous universities, museums, and similar scientific

* See "Air Adventures in Peru," by Robert Shippee, National Geographic Magazine, January, 1933, and "Heart of Aymará Land (Tiahuanaco)," by Stewart E. McMillin, February, 1927.

† Pronounced "Eye a peak."

‡ See, in the National Geographic Magazine, "Incas: Empire Builders of the Andes," by Philip Ainsworth Means, February, 1938; "Story of Machu Picchu: The Peruvian Expeditions of the National Geographic Society and Yale University," February, 1915, and "Further Explorations in the Land of the Incas," May 1916, both by Hiram Bingham; and "Pith of Peru," by Henry Albert Phillips, August, 1942.

Columbia University Expedition, 1946

War or Archeology—It's All the Same to a Jeep

Inside and on the "observation platform" this one carried the entire personnel of the Columbia University Archeological Expedition to Peru and all its equipment. In addition to Dr. Strong (right) and the three Peruvian diggers, there were three other members—one taking the photograph and two already inside the jeep. Two legacies of war—jeeps and photographic air maps—greatly expedited the work of the scientists studying past and present civilizations in coastal Peru.

organizations interested in the modern peoples and ancient civilizations of the vast Andean region.

In 1941-1942 the Institute of Andean Research had sponsored a far-flung and successful program under which some ten expeditions carried on successful archeological work in little-known areas from northern Mexico to Chile. In 1945 it was decided that a comparable program should be launched, but that in this case all participating institutions should work in one area, the Virú Valley, each concentrating upon a different aspect of the valley's total cultural history.

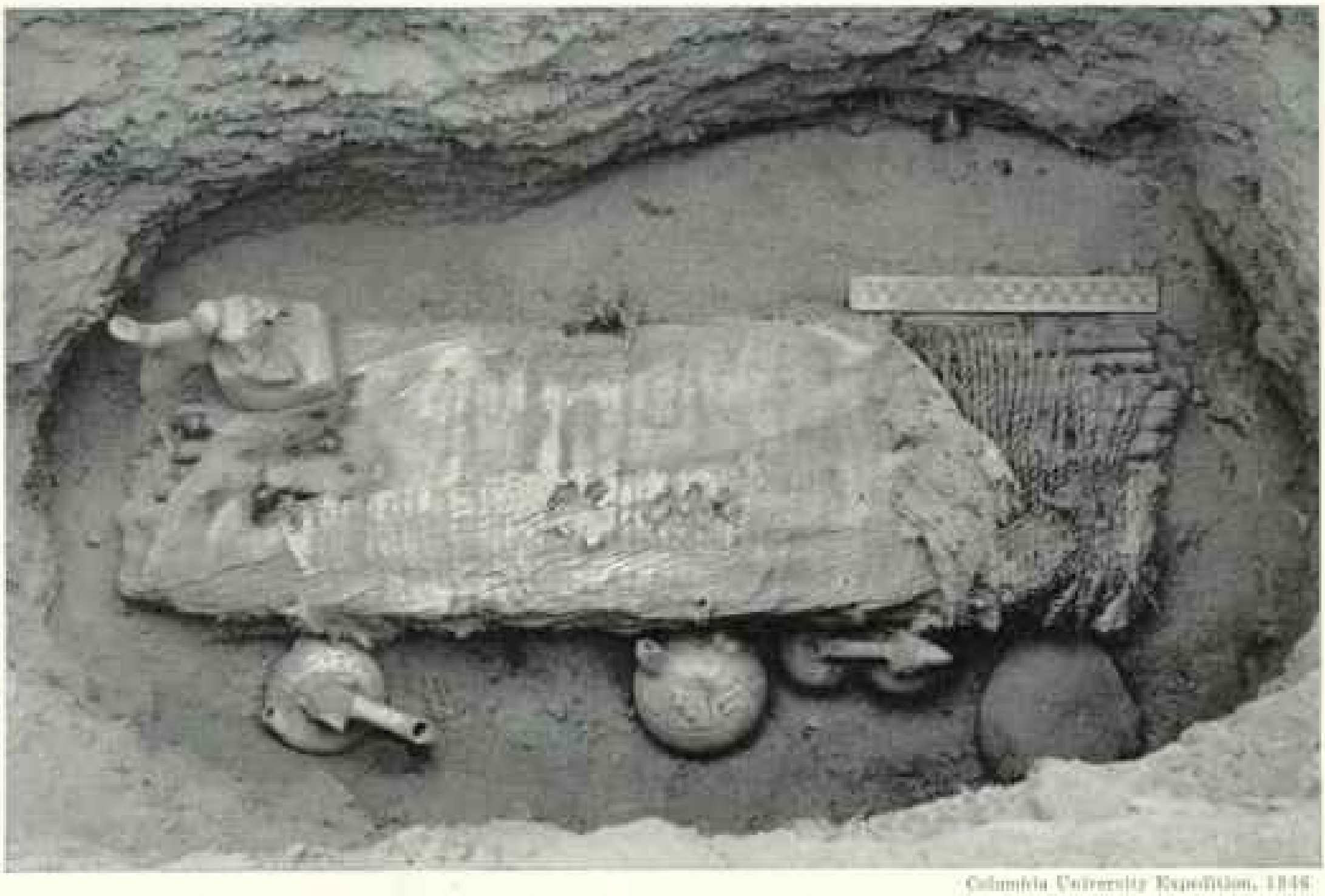
The working plan included human geography, modern sociology, historical and archeological research. Participating in various phases of the coordinated research program were the American Museum of Natural History, the Chicago Natural History Museum, Columbia and Yale Universities, the Smithsonian Institution, and both the Instituto de Estudios Etnológicos and the Museo Nacional de Antropología y Arqueología del Perú.

The small Virú Valley, about 25 miles south of the modern city of Trujillo and the ancient sites of Chan-Chan and Moche, was selected largely because it is one of the smallest valleys in the very important archeological area of north coastal Peru. This may sound like a haphazard method of choice, but a limited area permits greater concentration of effort.

The men who chose the site had all worked in coastal Peru, and they knew how incredibly rich in archeological remains is this entire area. Further, the Virú Valley had in part been archeologically explored by Señor Rafael Larco Hoyle, Director of the Museo Arqueológico "Rafael Larco Herrera" at Chiclin, in the Chicama Valley, and by Dr. Wendell C. Bennett of Yale University. This work had shown that there was a long and important human record here.

Miniature Valleys of the Nile

It was the purpose of the Virú Valley Project not merely to explore but to bring together a coordinated geographical, archeological, and socioeconomic study of culture change, through time and space, in one isolated Peruvian valley, from the earliest-known human occupation to the present day.



Columbia University Expedition, 1948

Here Lies a Mochica Child, Wrapped and Buried with Loving Care

A high child-mortality rate at Huaca de la Cruz in late Mochica times was indicated by the relative number of such graves (page 475). Around the small body are twilled cloth, cordage, and finally a layer of canes. Gourds and pots buried with the dead were intended to provide them with food and drink. Near the spout of some pots is a built-in whistle (Plate VII). An apocryphal story has it that since water was scarce in Peru the whistle was intended to give the alarm if anyone stole a drink!

Peru is perfect for such a study because each of its coastal valleys, large or small, is like a little Valley of the Nile, being similarly isolated from its neighbors by great stretches of utterly barren desert and mountains.

In the past, as in the present, there was contact between all parts of Peru, but there was then no Pan American Highway and each valley has its own peculiar history on which the larger Pan-Peruvian and Pan-American movements have left their respective marks.

Where each small river comes down from the high sierras, as far as the water can be extended the desert blooms like a garden (map, page 457, and page 460). Such valleys have been ideal for human habitation for thousands of years. The near-equatorial climate is cooled by the Humboldt, or Peruvian, Current from the Antarctic. The sun shines nearly every day, with heavy rains only at intervals of many years.

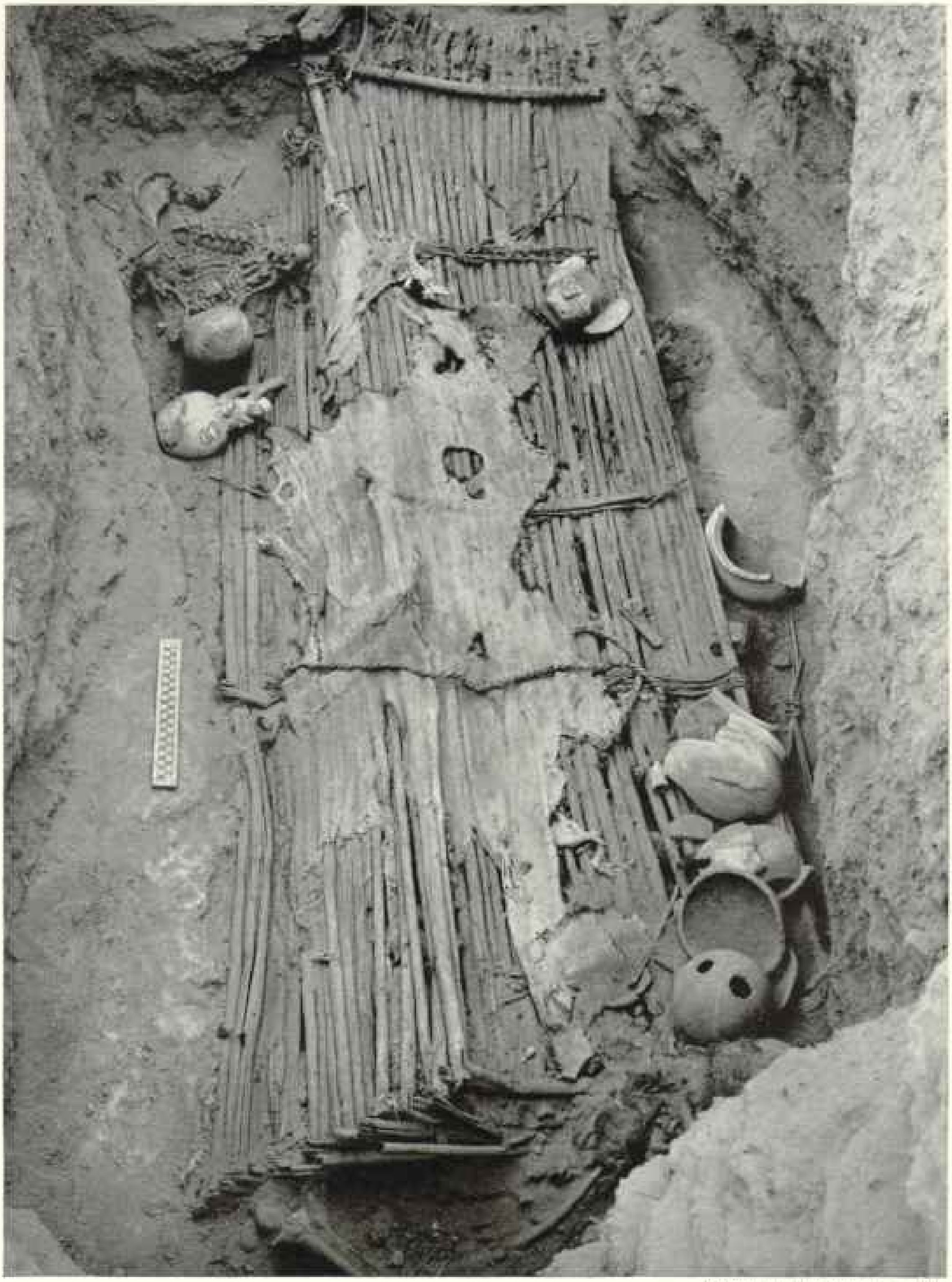
Thus the prehistoric record of coastal Peru is amazingly rich, and the small Virú Valley will still have many secrets to reveal long after the explorations of the six expeditions, and many others, have been completed.

In the present article it is possible to describe in detail only one of the striking discoveries made by the Columbia University unit of the larger Virú Valley Project. Equally important results were achieved by all other cooperating expeditions, but these will be presented in the reports of those who did the work.

The major work of even the Columbia University Unit, some four months of intensive stratigraphic excavation, can only be sketched here. The unit had one main job—to work out as complete a stratigraphic sequence as time and funds permitted. This was accomplished by numerous and very meticulous excavations in deep refuse heaps, level by level, at various key sites in the valley.

Of all the products of the human hand and brain, pottery comes nearest to writing, for its painted, modeled, or incised decoration changes in style with every generation or even more often. For this reason it is an invaluable index of the changing stages of prehistoric development.

Whenever possible, we excavated also a few



Columbia University Expedition, 1934

Two Women Accompanied the Warrior-Priest-God on His Final Journey—Death

At the head and foot of the 9-foot cane tomb are two female skeletons (upper left and bottom). Their crumpled condition indicates that the women were sacrificial victims. Under the canes was a third—a boy (page 479). On top of the main sarcophagus reposed the tomb of a powerful man with knees and ankles tied.

Drawn by Theodora Price

Where Water Makes the Desert Bloom, Man Has Lived for Thousands of Years

To unravel the absorbing life story of the Virú Valley in Peru, six expeditions concentrated upon it in an all-out scientific attack. Trujillo served as headquarters. Among the many sites explored were Castillo de Tomaval, Gallinazo, Guañape, Huaca Negra, and Huaca de la Cruz, where the Columbia University expedition found the thousand-year-old tomb of a Mochica warrior-priest-god. The dark tint indicates the nondesert area, irrigated by the Virú River.

burials of the various cultures so that the complete pottery lots from the graves could be compared with the broken pottery fragments from the respective levels of the rubbish heaps.

Thus, in a sense, the discovery of the tomb of the Mochica warrior-priest-god with which this article is primarily concerned was merely a fortunate by-product of our major task.

Jeeps Aid the Modern Archeologist

Thanks to the generosity of the Viking Fund of New York, all the Institute of Andean Research expeditions shared a hotel rooftop laboratory in the modern city of Trujillo, in the Moche Valley just north of the Virú Valley (Plate VI).

From this vantage point of four stories we could look west toward the Pacific and see the great dead Chimu capital city of Chan-Chan. Looking southeastward toward the Andes, we could see the famous Mochica ruins, the Temples of the Sun and Moon, at Moche (pages 458 and 461).

In addition to the laboratory, the same central service fund also provided all of us with two war-developed techniques which proved invaluable. These were three United States Army surplus jeeps, a half-ton trailer, and two complete sets of photographic air maps of the Virú Valley, purchased from the National Aerophotographic Service of Peru.

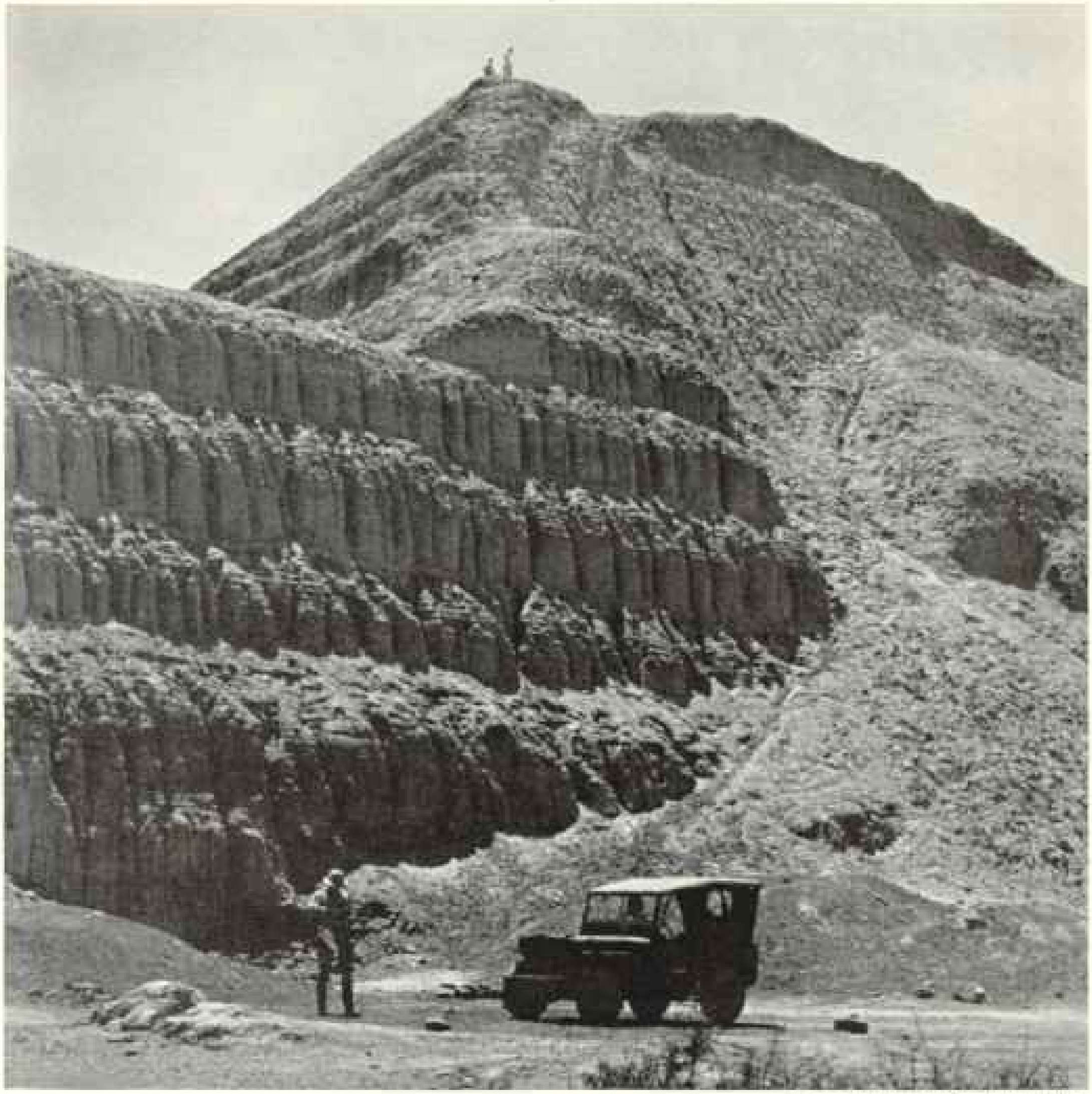
These maps, with the jeeps to take us to the sites they so clearly indicated, sped up all aspects of our combined work to an amazing degree (page 454).

When the Columbia University stratigraphic unit began work in the Virú Valley, we believed, in common with the majority of archeologists, that the four great hilltop temple fortresses guarding the central Virú Valley had been built by the Mochica, as were Moche's Temples of the Sun and Moon. Hence we started work at the imposing Castillo de Tomaval to see what lay below (Plate IV).

To our amazement, work on the side and top of this dominating fortress soon showed that it had actually been built by an earlier people, a local Virú Valley formative civilization which at present bears the unalluring name of Gallinazo, or "buzzard," from a type site in the lower valley.

Spurred on by this discovery, we dug several big trenches reaching some 25 feet in depth (Plate II). They indicated that all the underlying deposits here consisted of cane-marked adobes, unlike the plain adobes at known Mochica sites. These lower horizons were further characterized by unique, negative-painted, and vivid but crudely modeled pottery types which are characteristic of the Gallinazo culture.

Apparently there was something wrong with the generally accepted Peruvian culture sequence (see diagram, page 464), for below this Gallinazo horizon we found an old white-on-red pottery horizon, known as the Salinar culture, whereas the reputedly ancient Mo-



Columbia University Expedition, 1940

Time Has Furrowed the Ancient Face of the Great Mochica Temple of the Sun

Largest man-made structure known in South America, it probably represents the Mochica period at the time of its highest development a millennium ago. Antlike armies of workers must have labored upon it, for the temple is entirely handmade—a mass of millions of adobe blocks. It measures 750 by 450 feet and the figures at the top look down from a height of 135 feet (page 461).

chica pottery and cultural remains appeared only on the surface at the Castillo de Tomaval.

Mummy in a Chicha Pot

An interesting find in this uppermost and latest Mochica town level was a *chicheria*, or tavern, of Mochica times where *chicha*, or corn beer, was probably dispensed. This prehistoric tavern room contained four large and several smaller pottery vessels of types very similar to those used by the modern Indians to brew their chicha (Plate III).

When we found that the largest pot contained the mummified body of an old woman, we could only speculate whether she might have been the proprietress and, if so, how she came to be occupying her rather unusual burial receptacle.

Our workmen showed no superstitious fears, and as soon as we had measured and photographed the big chicha jars they pre-empted them for their own home use for the same purpose for which they were made perhaps a thousand years ago. The past and the present are closely linked in Peru!

If the great adobe structures, or *castillos* (literally "castles"), of the central valley were earlier than the advent of the Mochica in

Virú, it was obviously important that we find out whether this was also true of the lower valley where the great site, or sites, of Gallinazo dominated the scene.

Once the center of a rich and abundant life, this region is now desolate as a result of modern charcoal burning and flooding. It is deserted save for a few wandering burros and scattered flocks of goats and kids which browse amid the terrible thorns of the algarroba thickets. The flocks are guarded by smart little black dogs, which by day keep an eye out for swooping condors and at evening drive their charges home to their odoriferous but safe thorn-brush pens.

Hoping to encourage more *monte*, or brush, for both browsing and soil cover, the local people had flooded much of the area with the overabundant water resulting from unusually heavy rains in the highlands. Lagoons thus formed had attracted roseate flamingos, white herons, and breeding tree ducks which seemed strange and brilliant companions in the midst of this recently man-made desolation.

The Gallinazo area actually includes six major groups of ruins which stand above the plain in lonely grandeur.

Unlike the great castillos of the middle valley, these lower ruins are subjected day in and day out to the sweep of the prevailing southwest winds from the sea, and these have rounded every contour of what once were angular buildings and pyramids.

Indeed, as we found later, these ever-present winds are constantly removing layers of the old deposits, and it is an impressive indication of their original size that the highest of these mounds still looms some 75 feet above the level of the surrounding plain. Neither time nor the Conquistadores and their successors, who have ceaselessly dug in these structures for treasure, can obliterate the grandeur and signs of abundant life that once existed here.

Our one very deep stratigraphic pit here, as well as Dr. Bennett's detailed architectural studies for Yale University, indicate that the Gallinazo ruins, one town over another, extend to a depth of almost 30 feet. Here again we found that all the major structures belonged to the Gallinazo culture and the lowest levels to the Salinar culture, with its white-on-red pottery. The only Mochica remains were on the very surface!

Lucky Accident Leads to Discoveries

Thanks to a lucky but at the time unpleasant accident due to flood waters from the highlands, which blocked the roads to Gallinazo, we were forced to explore for new roads and thereby found clear evidence of still earlier civilizations in the lower Virú Valley.

At the little town of Guañape, in colonial times the metropolis and seaport of the valley but now a small fishing village cut off by the Pan American Highway, we made some of our most important scientific discoveries.

Here we found a burial ground of the Salinar culture which yielded complete pottery of the type we had found only in fragments in the lowest levels of our deep trenches at Castillo de Tomaval and at Gallinazo. This is an important early pottery horizon.

Then in the desolate but large black mound at Huaca Negra, previously unknown to science, we found Coastal Chavin, the earliest pottery culture of the north coast. The finding of a crude rock temple, with sacrificed llamas, gave more detail to this earliest pottery-making, corn-raising civilization of the Peruvian coast.

Primitive Guañape People Grew Cotton

Most important of all, we discovered here a pre-pottery civilization of long standing in which the people grew cotton, and raised squash, lucuma, and other vegetables and fruits to supplement their fishing diet, but did not grow corn or know any type of true weaving, though they twined cotton into cloth in the manner of basketmaking.

All this, however, is another story. Junius Bird, of the American Museum of Natural History, arrived just after our discovery and, since his part of the Virú Valley Project was concerned with the pre-pottery cultures, we gladly turned over this aspect of the work into his very able hands (pages 463 and 476).

Working in both the Virú and the Chicama Valleys, Mr. Bird has not only secured many data on this new and exciting pre-ceramic horizon but has also discovered a possibly still earlier stone-using and hunting culture in the upper valleys of the coast (Plate VIII).

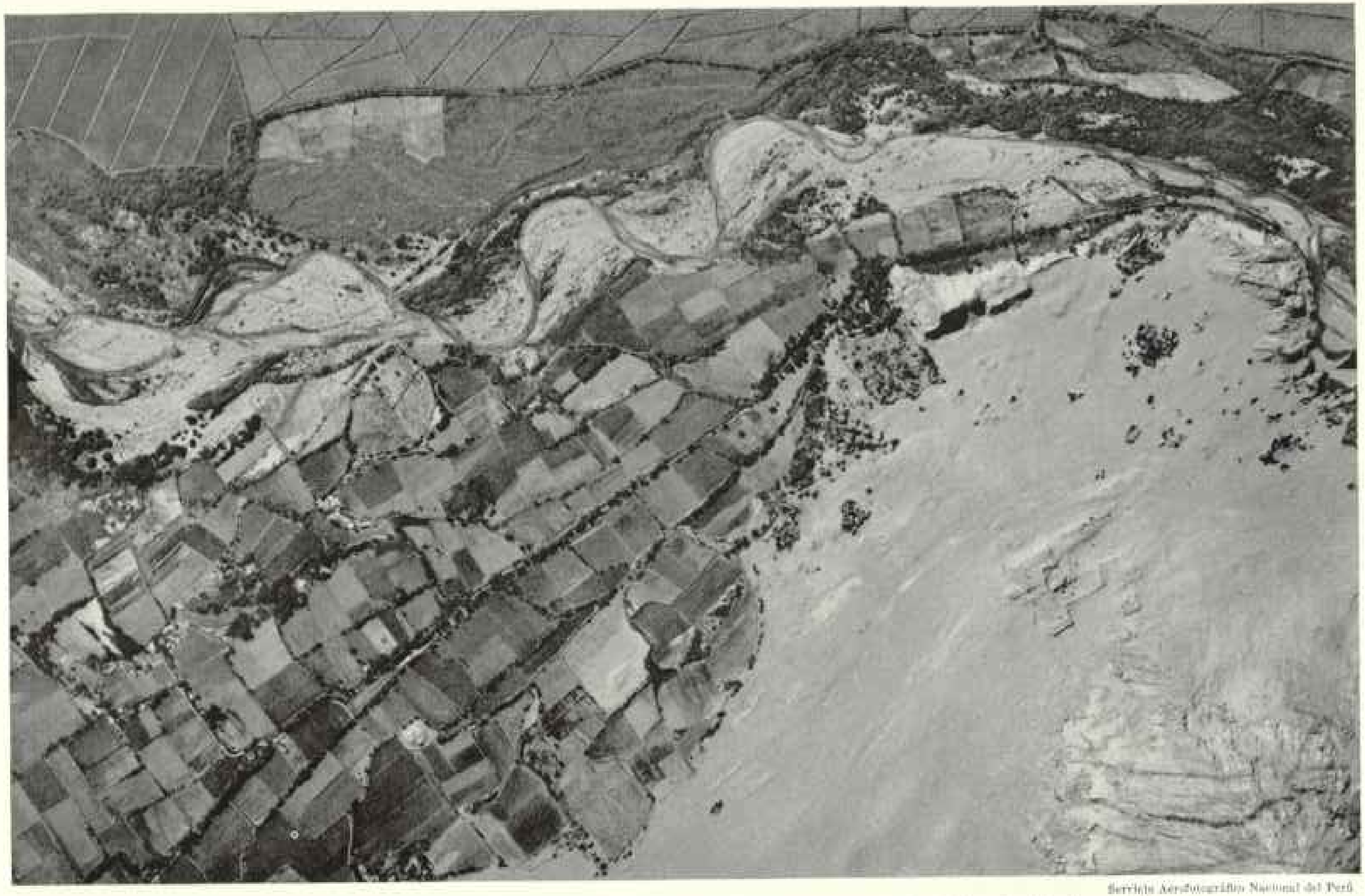
We were free now to concentrate on the actual place of the brilliant Mochica civilization in the cultural sequence of the Virú Valley. As a result of our work thus far, we knew that the former story of culture growth in north coastal Peru was incomplete and, in places, incorrect. A revised picture was taking shape.

First were the hunters, represented by chipped-stone-using peoples in the upper valleys, and fishermen-farmers, without pottery, on the coast. Then came the first pottery makers and corn growers, the Coastal Chavin, or, as they are known locally, the Cupisnique peoples. Developing from these were the Salinar peoples, who made the white-on-red pottery, and, after these, the Gallinazo people who

Corporación Nacional de Turismo

Civilizations Have Risen and Fallen in This Miniature Valley of the Nile in Peru

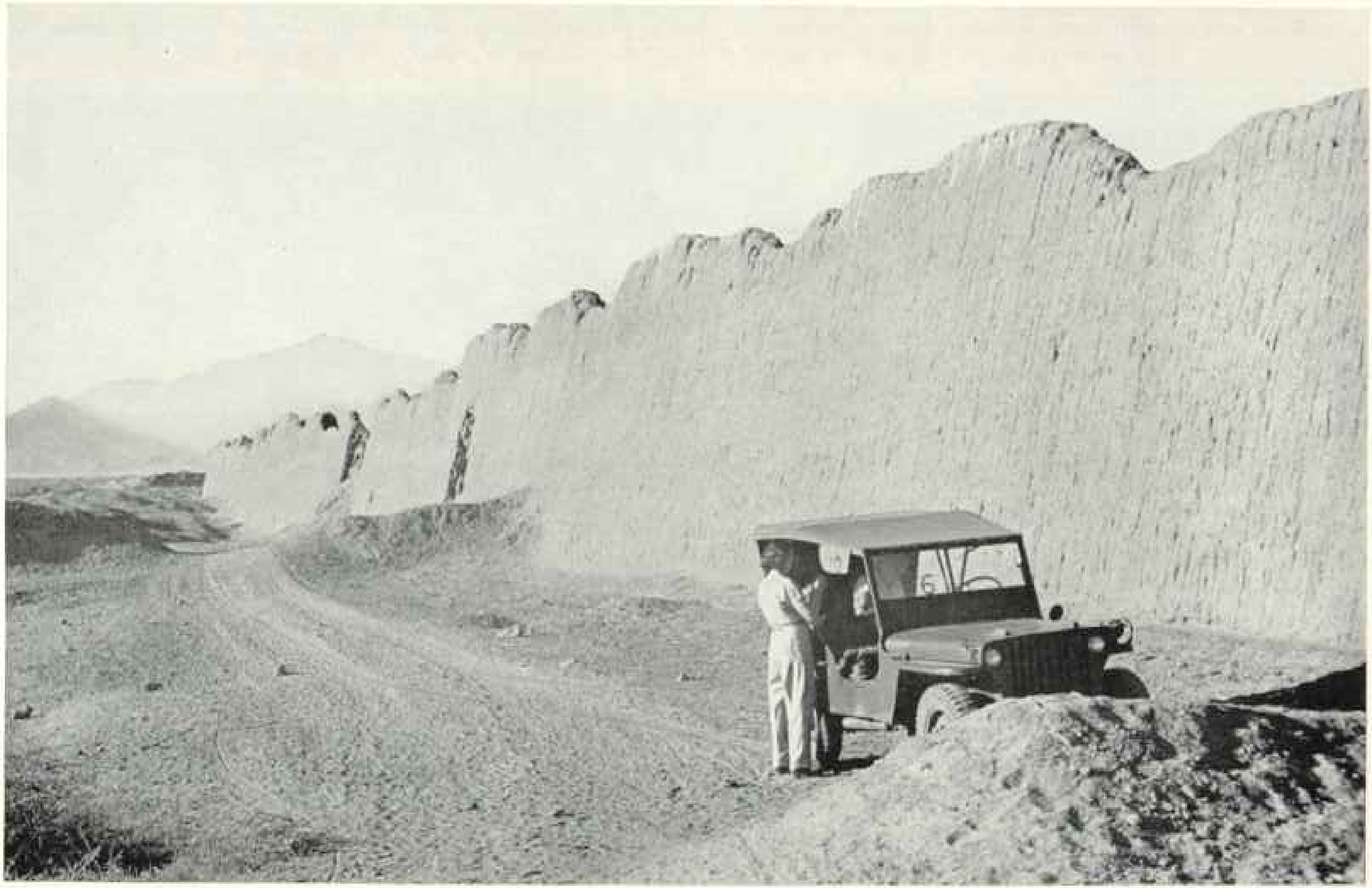
As sharply defined as an ocean shore is the line between desert (top) and green fields of the Virú Valley, checkerboarded with hedgerows of trees along irrigation ditches. Here the Virú Valley Project expeditions unearthed a rich record of vanished peoples. In the present-day town of Virú, life centers about the plaza.



Servicio Aerofotográfico Nacional del Perú

To the Airman the Temples of the Sun and Moon at Moche Seem Drifted by the Sands of Time

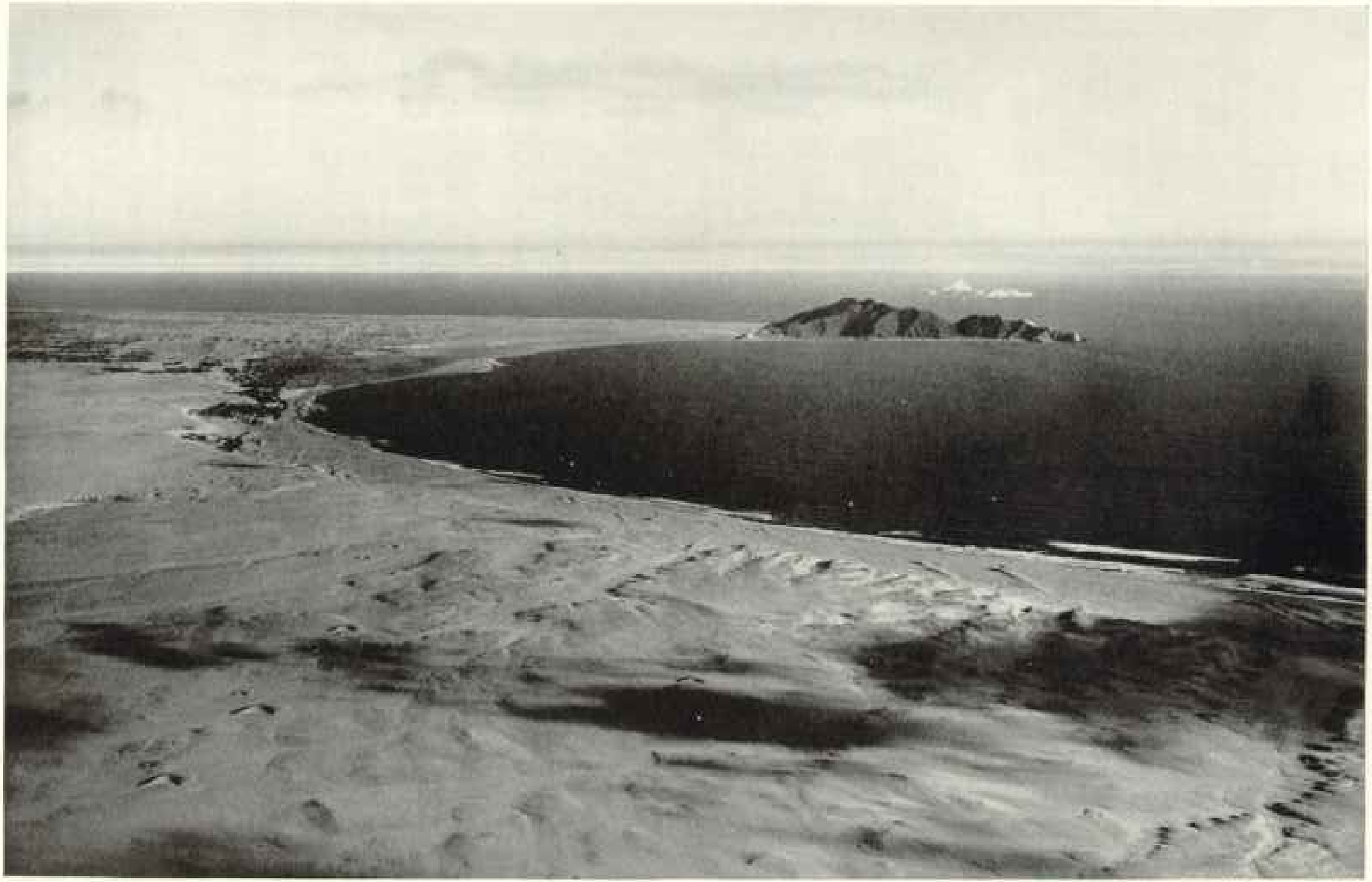
In the midst of the desert expanse at right sprawls the Mochica Temple of the Moon. Above it, on the border of the green valley, stands the huge Temple of the Sun (page 458), which has been partly cut away by the meandering Moche River. Air photographs help the modern archeologist find ruins.



Columbia University Expedition, 1941

Over Once-mighty Chan-Chan, in the Moche Valley, Hangs the Silence of Death and Desolation

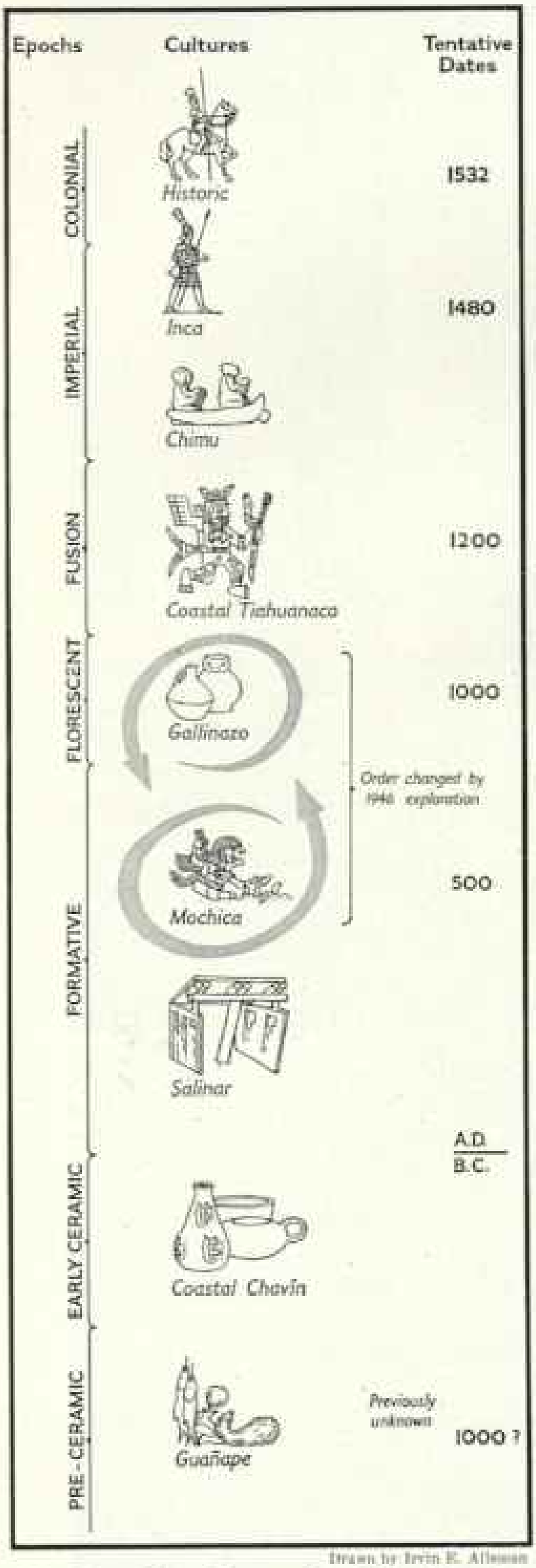
This ghost city, covering 11 square miles, once teemed with colorful life. It flourished as capital of the Chimu Empire which arose after Mochica times. But it fell to the conquering Incas—themselves doomed in turn. The adobe walls towering above the jeep form one of the city's many great compounds (page 453).



Servicio Aerofotográfico Nacional del Perú

Here on the Brink of the Broad Pacific, Primitive Americans Grew Cotton and Squash Before the Time of Christ

At the deepest indentation of the bay lies the important site of Guañape where the Columbia University Expedition found relics of a people hitherto unknown (p. 459). The bold landmark is Cerro Prieto (Blackish Rock) de Guañape, lonely abode of sea lions and condors. Beyond lie guano islands, white as icebergs.



Drawn by Irvin E. Allenson

Mochicas Lived Later than Was Thought

This chart shows how last year's work revised the chronology of peoples in Peru's Virú Valley. Newly added are the fishing and farming Guañape folk.

composed the long, local, formative epoch of civilization on the north coast.

We felt sure now that the Gallinazo era was followed by the brilliant Mochica period, with its florescent art styles, but we had not yet proved it by direct stratification. Therefore, Evans and I left the remote past and concentrated on the problem of stratigraphically placing the Mochica culture in relation to the presumably earlier Gallinazo culture and the later Tiahuanaco, Chimu, and Inca civilizations in the Virú Valley. The exact stratigraphic sequence of these post-Mochica cultures was subsequently brilliantly demonstrated by Mr. Donald Collier of the Chicago Natural History Museum.

We had planned to carry on our work at the great temple site of Huancaco, under the hills on the south side of the Virú Valley. Surveys by James A. Ford, of the Guggenheim Foundation, and Dr. Gordon R. Willey, of the Smithsonian Institution, had indicated that this huge, lonely, and impressive structure, built entirely of adobe bricks without cane-mold marks, was actually of Mochica origin. However, the same survey also indicated that Mochica refuse deposits at this site were only three and a half feet thick and that below this depth the soil was sterile of human refuse.

Graves Looted by Treasure Hunters

Mochica remains had also been reported from the site of Huaca de la Cruz, almost in the center of the valley, and we decided to try for stratigraphy here, despite the fact that this entire site had apparently been turned over by treasure hunters in both the recent and the remote past.

The site at Huaca de la Cruz (Ruin of the Cross) covers approximately 10 acres and receives its modern name from a small wooden cross on the top of the 30-foot-high mound which is covered by turned-over ancient graves and occupational debris (Plate V). Many of the ancient ruins in Peru are topped by Christian shrines and crosses, for the ancient cults and the later religion have often been blended in the ideology of the local people.

Unlike the sites of Gallinazo and Guañape, Huaca de la Cruz is in the valley's fertile heart, adjacent to the Pan American Highway, and its brown, seemingly bomb-torn desolation is surrounded by rich green cornfields.

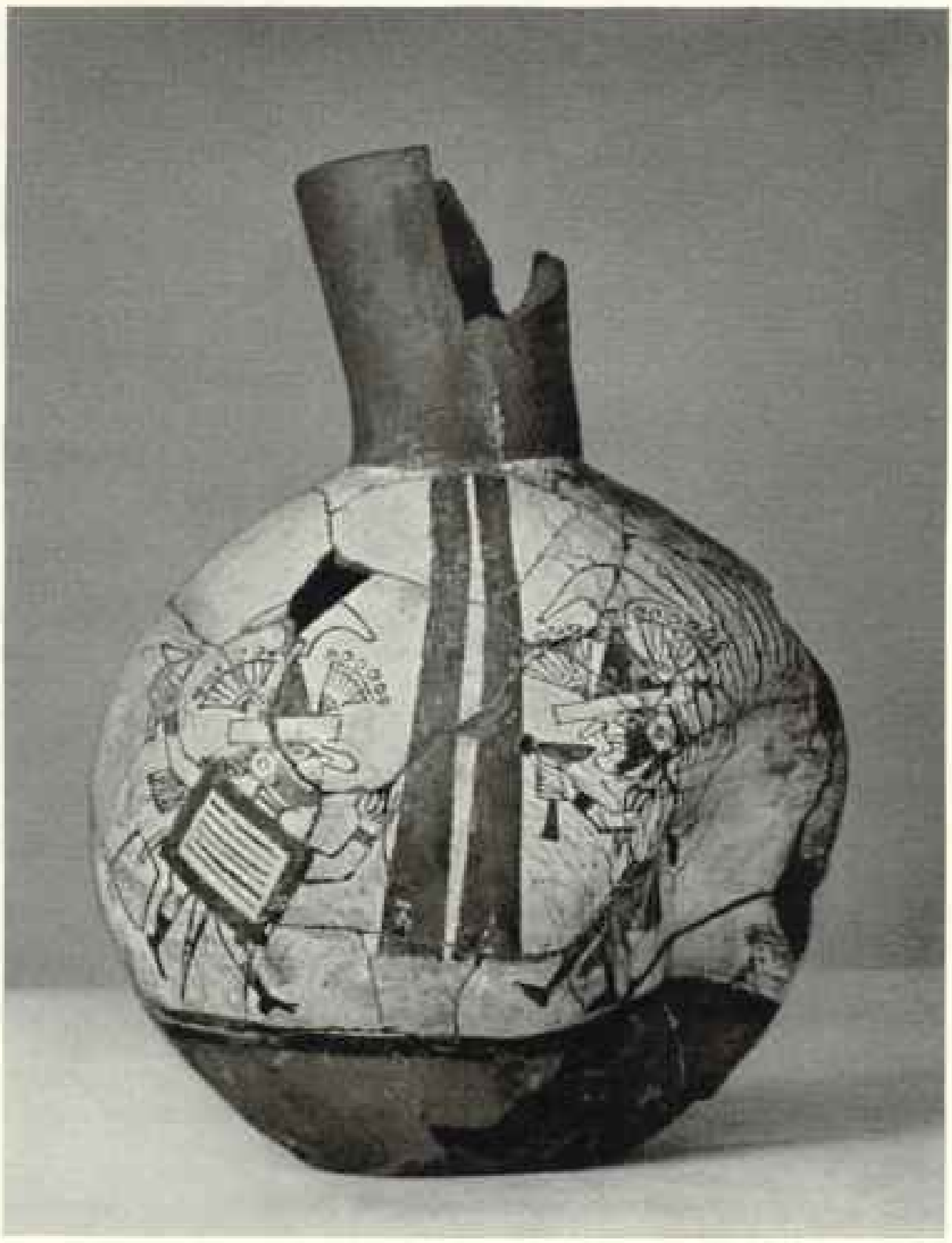
The core of the site is a small natural sand dune whose central area has been covered to a depth of many yards by ancient occupational and burial detritus. So dry and so thick are these upper refuse materials that one large area has been completely burned to a depth of two yards.

On the surface, amid the ancient looted graves, we found fragments of pottery ranging from European porcelains of colonial times to the very early white-on-red ware of the Salinar peoples (Plate VII). Most abundant, however, were evidences of the Mochica and the Tiahuanaco and Chimu civilizations, the last of which just preceded the Inca conquest.

Very little Gallinazo cultural material showed up on the surface. This fact was discouraging, since it was the exact relationship between this demonstrably old horizon and the still unplaced Mochica civilization that we were trying to determine.

Aided by Dr. Bennett, who had excavated here in 1936, we selected an area several yards square on a ridge where the *huaqueros*, or treasure hunters, had not dug so extensively.

This is usually a good sign that occupation materials, not graves, occur, for huaqueros are interested only in the richer graves. These they skillfully locate and even appraise underground by touch with a long steel probe called *baqueta*, the Spanish word for ramrod. Since looting started with the Spanish Conquest and has continued ever since, it is probable that the art of the baqueta goes back to the soldiers of Pizarro.



Columbia University Expedition, 1940

Warriors Tipple in What Might Be a Prehistoric Officers' Club

In the painting on this large jug the Mochica fighting man at right has doffed his battle gear and is drinking heartily from a goblet; on his right arm he holds a *chicha* (corn beer) jar. At left a second warrior rushes up in full battle equipment, waving an empty goblet as if about to die of thirst. The jug, warped and broken because fired at too high a temperature, was found in the grave of a young woman, perhaps a camp follower. Also buried with her was a goblet like those in the painting—complete with rattles for attracting the attention of the Mochica equivalent of a bartender (page 476).

Having carefully cleared the surface of all mixed materials, we dug down by 12-inch levels, saving every fragment of pottery and other material by level. It was soon clear that we were in Mochica house structures, for the rectangular adobes were not cane-marked and the refuse was full of fragments of beautifully painted and modeled, as well as plain or household, Mochica pottery.

More surprising, there were abundant remains of corncobs, beans, squash rinds, peanuts, cloth, and other perishable materials which were not generally believed by archeologists to have survived from Mochica times. However, this abundant Mochica cultural material and distinctive architecture terminated abruptly at a depth of six feet. At this point we encountered the remains of older structures made of cane-marked adobe bricks.

The refuse within these earlier rooms was

characterized solely by negative-painted and other pottery styles pertaining to the Gallinazo culture. Moreover, the perishable materials characteristic of the upper, or Mochica, levels became scarce and then disappeared in the lower and older Gallinazo levels.

The cane-marked adobe structures and refuse of the Gallinazo, or Formative, civilization continued unmixed down to a depth of more than 12 feet, where we encountered the natural sand of the original dune.

To check this seemingly positive evidence of direct superimposition, we made a second stratigraphic cut of the same size in another portion of the site. It confirmed the above sequence in full detail.

At long last we had settled the question as to where the Mochica belonged in the Virú Valley sequence. Here, after four months' search, was clear proof that the bearers of the great Mochica civilization had come into the valley at the time when the Gallinazo culture was in full flower and at Huaca de la Cruz had erected their town on the ruins of a town of that earlier valley people.

We had only a week of field work remaining, for it would then be necessary to return to our hotel rooftop laboratory in Trujillo to study, repair, and photograph our collections. However, other direct and surprising evidence still awaited us beneath the torn-up surface of Huaca de la Cruz.

Having trailed the Mochica this far, we decided to devote the last week to what appeared to be a rather forlorn hope—the search for undisturbed Mochica burials which might shed more light upon their culture. Since Huaca de la Cruz has been torn up for centuries by treasure hunters digging for tombs, we were not optimistic.

After Three Days, a Tomb—Empty!

The first three days we concentrated work on what our men believed to be a deep Mochica tomb. As we dug, we were disturbed to find large fragments of fine Mochica vessels in the grave shaft; but the men said that these must have fallen in from above and that they thought the main grave was intact, for there was a hollow cane leading down and they believed the fill was undisturbed.

Such hollow canes, sometimes solid poles, often mark Mochica graves, terminating just back of the head of the grave's occupant. It is possible that offerings of chicha were poured down them and that they also were thought to permit the dead to breathe.

At the end of the third day, and at a depth of 20 feet, we found the tomb—empty. It had been looted many, many years before, possibly in colonial times, by tunneling in from the side. This is a most dangerous technique, especially at such a great depth, but one that is still common practice among huaqueros. It was this sidewise approach that had fooled us.

We were all the more disappointed because the tomb was of a Chicama Valley type, being made of adobe blocks with side niches for offerings and having wooden roof beams. The pottery, carelessly broken and thrown aside by the treasure hunters, was of a fine white and red type, more characteristic of earlier Mochica sites in the Chicama Valley than of the later Virú Valley Mochica.

Undisturbed Graves of Unusual Type

With half our time almost gone, we extended our test pitting and found several other previously looted Mochica graves. These, however, were shallow, six to nine feet in depth, and the tombs were of tied canes instead of adobe.

Unlike the conventional Mochica graves of the earlier period, these did not extend down through all earlier rubbish into unmixed sand, but terminated long before that in the midst of the underlying Gallinazo rubbish.

Then at last we began to encounter undisturbed graves, all of this rather unusual late Mochica type.

The technique of working out these burials had already been well established. Our workmen, "el Professor," "el Perrito," and others, had adapted their own local techniques to ours, and no time or scientific opportunities were wasted. The workmen would dig their test pits and then, if they thought the spot promising, they would call Evans or me. If it looked productive to us, we had the men dig down to the top of the grave proper and call us when the upper portion of the grave offerings became visible.

The clearing and recording of a single grave are slow and painstaking operations. The soil or sand must be removed with trowels and brushes, and every object and bone recorded as to its exact location. This was done by Evans, Mrs. Strong, and the writer.

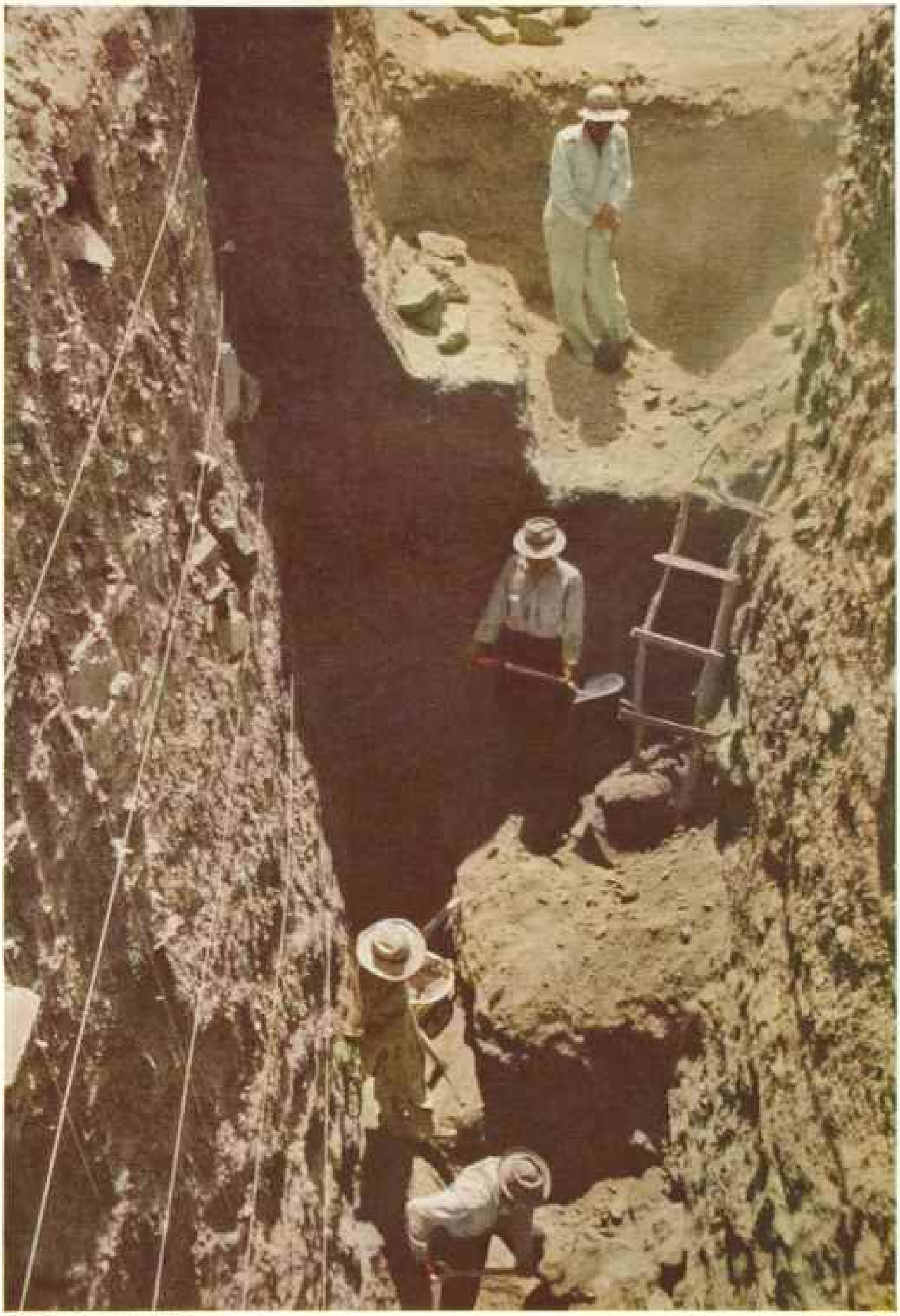
When all the dirt was removed, photographs had to be taken and diagrams made. Then the gourds or other coverings were removed and the process repeated, until finally only the skeleton remained.

Rojas Ponce's painting (Plate I, opposite page) of the long-tusked image unearthed at Huaca de la Cruz, Peru, by the Columbia University Expedition, was presented to Dr. Strong by Dr. Julio C. Tello, Inspector General of Archeological Monuments and Director of the Museo Nacional de Antropología y Arqueología, Magdalena Vieja, Lima, Peru, where all the finds described in this article were deposited.

 Painting by Rojas Pinto

Beneath a Jaguar Headdress Glares the Mochica God of Fertility

This remarkable hardwood image with red eyes and long white tusks of shell was found in the grave of the warrior-priest-god, regarded as the earthly incarnation of the deity. Buried with him was a boy, like the lad here sowing turquoise "seeds" in furrows formed by Ai apaec's digging stick. At lower right is a serpent.



 Kodachrome by Clifford Evans, Jr.

Digging Trenches 25 Feet Deep, They Learn Castillo de Tonaval's Ancient Secret

Cross sections of history show the fortress was built by a people who lived about the time Rome fell.

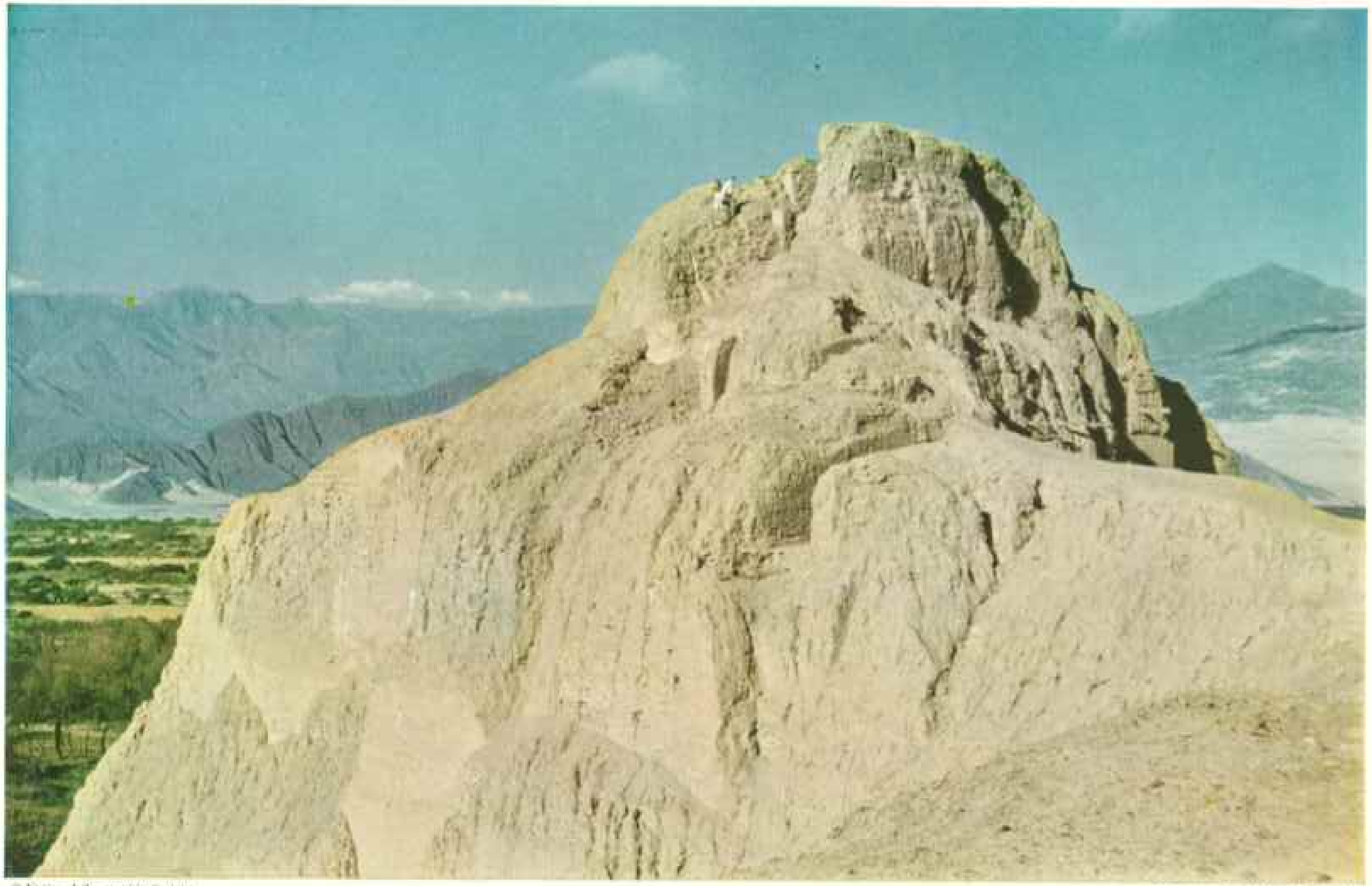
Carved Wooden Maces and Digging Sticks Represent War, Agriculture, Wisdom

All were in the warrior-priest-god's tomb. At left, Mrs. Junius Bird inspects the war mace, held by Dr. Strong. Mrs. Strong looks at the agricultural deity (Plate I). Clifford Evans, Jr., holds an owl baton.

Kodachromes by Clifford Evans, Jr.

Dust Fills the Air as They Excavate a Mochica *Chicheria*, or Tavern

Dr. Strong examines a *chicha* (corn beer) jar while "el Profesor," one of his best diggers, plies the shovel in the uppermost levels at Castillo de Tomaval. One chicha jar contained an old woman's body.



Kodachrome by Clifford Evans, Jr.

Men Are Dwarfed to Insect Size on the Great Castillo de Tomaval's Summit

This was one of the four lofty fortress-temples which overlooked the central Virú Valley and afforded complete control. The prehistoric monuments of awe-inspiring height were built of adobe by the people of the Formative Epoch, about A. D. 500.

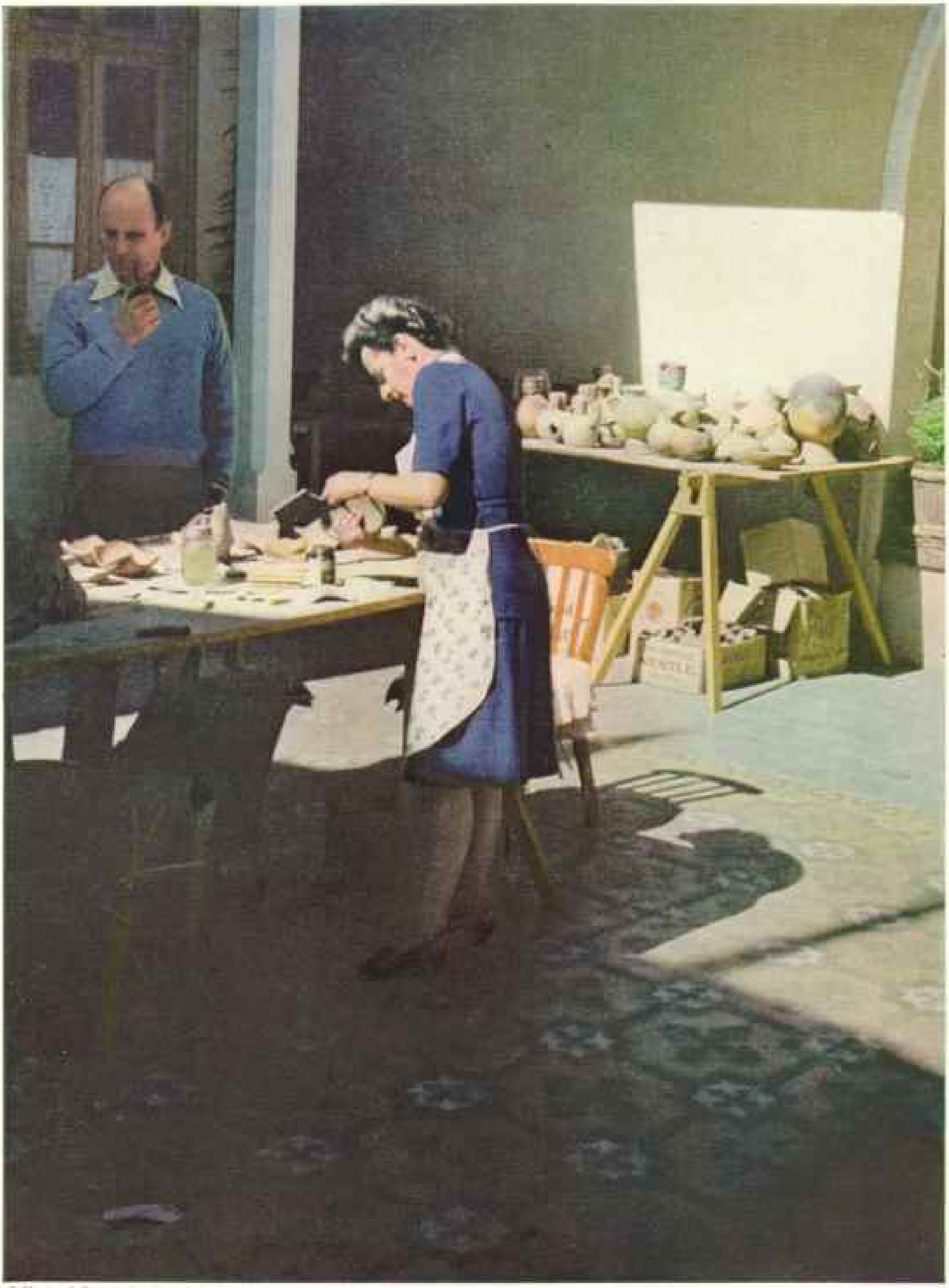
Clouds of Dust of the Centuries Roll from Screening Operations at the Virú Valley's Earliest Pottery-making Site, Guañape

Under 12 feet of deposit of the Chavín people, first pottery makers in the valley, the expedition found relics of a pre-ceramic folk who farmed and fished.

Kodachromes by Clifford Evans, Jr.

A Christian Cross Stands on the Old Pagan Site of Huaca de la Cruz (Ruin of the Cross); to the Eastward Loom the Andes

The site in the central Virú Valley gains its name from the lonely wooden cross, replaced many times. Here dwelt and died the Mochica warrior-priest-god unearthed by this expedition. The seemingly bomb-pocked desolation of the site is the result of centuries of digging by treasure hunters.



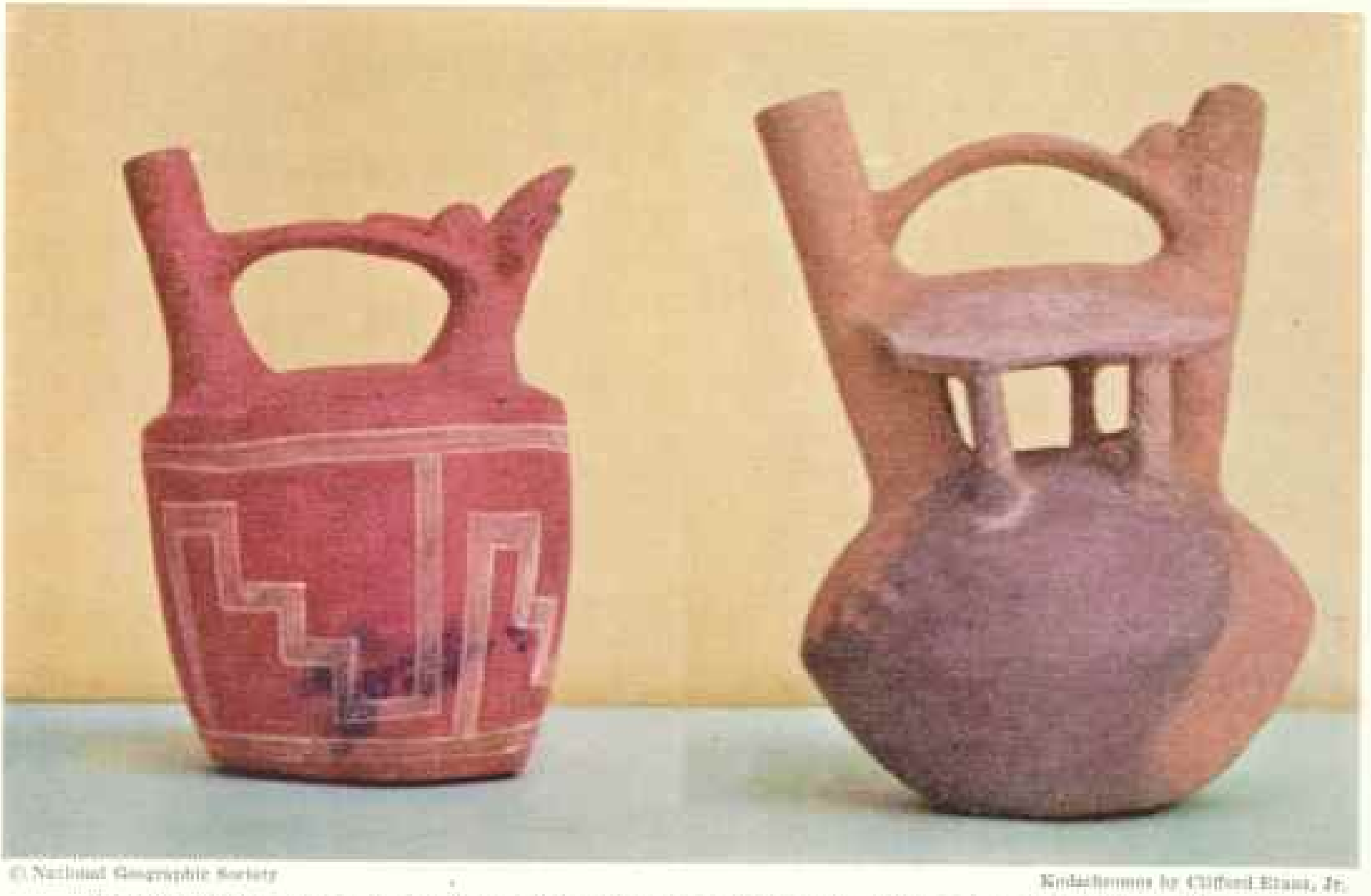
 Kodachrome by Clifford Evans, Jr.

Distant Past and Present Meet in a Rooftop Laboratory

Atop a four-story hotel in the modern city of Trujillo, the wives of expedition members worked with their Peruvian associates to prepare the Virú Valley Project specimens for further study and description. The task required months of work in this laboratory where Mrs. Strong is mending a broken pot.

Stirrup-spout Pot and Portrait Vase Show Painted Face and Falcon Headdress

Both were found in Mochica graves at Huaca de la Cruz. The late-Mochica white, red, and black one at left was buried with the warrior-priest-god, the other with a young woman.



Kodachromes by Clifford Evans, Jr.

Pre-Mochica Pots of Salinar Times Bear a Hummingbird and a Wall-less House

The *casita* (little house) pot shows the Salinar had plenty of ventilation. The other illustrates their white-on-red painting and incising of pottery. Both vessels whistle when partly filled and tipped from side to side.

Kodachrome by Clifford Evans, Jr.

Close to the Blue Pacific the American Museum of Natural History Expedition Pitched Its Tents and Parked Its Jeep

The picture is taken from a refuse heap left by the pre-pottery, but agricultural, people of the Peruvian coast at El Brujo, in the Chicama Valley. This was the camp of Junius Bird, his wife, and three small sons, who had several six-foot boa constrictors as pets.

The skeletons at Huaca de la Cruz were usually in an extremely fragmentary state and, when notes and photographs had been completed, they often crumbled to dust at touch. However, in some cases, particularly when the bones had been in contact with copper objects, they could be preserved and were carefully saved for further study.

After the third day we found several burials of Mochica children. These were usually wrapped in twilled cloth, a unique type of Mochica textile that is very rare in museum collections. Some were also wrapped in cordage and covered by canes (page 455).

Only a few fragments of bone remained in these graves, despite the fact that the cloth, cordage, and covering calabashes or gourds were often well preserved.

The children's burials were usually accompanied by several pottery vessels of late Mochica type. These had been made in molds and were elaborately painted with white, red, and black designs. The vessels included human figurines, women beating drums, and whistling jugs with characteristic stirrup-shaped spouts.

Although the jars were elaborately decorated, they were somewhat crude and slapdash in execution. This fact, like the presence of the black paint, indicates that they represented a very late stage in Mochica culture.

Evidence of High Child Mortality

From the relative number of young children buried, with and without their mothers, one would judge that child mortality ran high during late Mochica times at Huaca de la Cruz.

We also encountered several burials of adult women in those last few days. Two of these were particularly striking. One seemed to have been a much-honored older woman of high rank and the other an equally honored young woman of about 20, who, from the peculiar content of her grave offerings, may have been either the cherished wife of a military commander or perhaps a member of a Mochica women's army auxiliary.

The older woman was completely enclosed in a wrapping of heavy canes which were tied together at both ends and the middle with fiber ropes and then covered with a layer of thick twilled cloth. The grave was shallow, less than a yard in depth, but there was every evidence of painstaking care about the burial. Outside the cane cover, at her right shoulder, was a woven basket containing spindles for making thread; also needles and a gourd spoon. By her feet was a large calabash containing unspun cotton.

At the woman's left shoulder were three fine pottery vessels, one shaped like a flower pot, or *florero*, one with a spout and handle, and the third with a stirrup spout. The last is particularly interesting because it bears a strange figure called "cat of the moon," since this mythical creature is usually associated with the moon in Mochica art.

When the cane cover was lifted, the body was found to be wrapped in a finely woven white garment decorated with brown designs. The body was fully extended, as are most Mochica burials, with the arms at the sides, the knees drawn together, and the legs, feet, and hands all fully extended.

"Charon's Obol" of Ancient Peru

The head rested on one calabash and was covered with another. Around the neck was a shell necklace. In the mouth, wrapped in cotton, was a copper plate, and each hand held a similar object, like the copper coin which the ancient Greeks put in the mouth of their dead to pay the ferryman for their passage across the river Styx. This "Charon's obol" in the mouth is characteristic of both Mochica and later Chimu burials.

But the most remarkable relic with this highly honored weaver of late Mochica times was a unique wooden, copper-tipped object, probably a ceremonial distaff, about three feet long and carved from very hard algarroba wood. The upper, four-pronged end rises above the seated figure of an elderly and dignified Mochica matron, who is faced by her two little page boys. The lower end of the distaff has a socketed copper point (page 477).

Since the wide range of Mochica art rarely shows women in any other than menial and often undignified attitudes, this strong carving with its great dignity and reserve holds a unique and special importance.

The grave of the younger woman lacks the impressive unity of offerings that accompanied her older compatriot in a near-by grave. However, she too was evidently much beloved and buried with great care and impressive offerings.

Her grave was also very shallow and in the corner of a previously abandoned Mochica room. A hollow cane tube extended from the surface down to the back of her head. The grave covering was of lashed canes and by her right side were two weaving baskets with decaying cotton and wooden spindles. Under the cane cover the body was wrapped in fiber matting and under this was a simple cotton cloth.

The position of the body was the same as that of the other, but here the upper part of

Columbia University Expedition, 1940

Blackface Marks Him a True "Dirt" Archeologist

After a day's work at Huaca Negra (Black Ruin), in the Chicama Valley, Mr. Junius Bird, of the American Museum of Natural History, reveals a two-tone complexion as he doffs his cap and prepares for supper with his wife. The black dust resembles soot. The Virú Valley, too, has a Huaca Negra (page 459).

the head was covered by a calabash and the lower face by a slightly modeled copper mask. The latter had preserved the skull and jaw and thus made sex and age determination easier.

In the girl's mouth was a copper tube; around her wrists were copper pendants; and her extended feet rested upon copper sandals. Her hair was combed into two large braids, one on either side of her face, extending well below the shoulders and each wrapped with cotton string. A necklace around her neck was made up of 12 strands of brown stone and one strand of shell beads.

The offerings with this burial were surprisingly varied. They included the bones of two llamas, one of which had apparently been decapitated, since no skull was found. The other offerings consisted of 16 highly variegated painted and modeled pots.

All of these are interesting, but several are outstanding. The finest, which was broken by earth pressure but proved restorable, shows a strikingly modeled face of a warrior or nobleman with a pierced nose, earplugs, and an elaborate headdress. The latter is modeled and painted to represent two very lifelike falcons which peer over the rim (Plate VII, upper right). Other pots with this identical face and headdress have been found in the Chicama Valley, possibly having been made in the same mold, and there is no doubt that a definite and renowned individual is here represented.

Less realistic is a strange apelike face with protruding lips and a bestial expression.

The most convivial of all the vessels is a large jug which had been fired at such a high temperature that it had exploded and is warped badly out of shape. On its surface is a clearly painted design showing a warrior in full battle equipment waving an empty goblet and running toward a similar male. The second figure, though, has apparently doffed his battle gear and holds a chicha jar on one arm while he drinks heartily out of a goblet with the other hand (page 465).

What sort of Valhalla or Officers' Club is represented here one can only guess; but when we found in the same young woman's grave a pottery drinking goblet identical with the two figured on the jug, we felt that there must be more than a chance connection. This goblet, which has a hollow conical base containing

rattles that still make a loud noise, had undoubtedly served well to attract the attention of prehistoric chicha dispensers.

Why such specialized drinking equipment should be concentrated in the grave of a young woman we hesitate to guess.

In several of the graves in this immediate vicinity we found pottery representations of the great-fanged jaguar god of the Mochica, whose name, some authorities say, was Ai apaec. The jaguar-god concept is very old in Peru, being known as far back as Chavín times and extending through all intervening periods into the Inca religion, where he is named Viracocha. Strikingly similar tusked feline gods are also found among other native American agriculturists as far north as Mexico.*

We were interested in the disproportionate number of representations of Ai apaec in this small group of apparently related burials, but were hardly prepared for the startling revelation of the Ai apaec cult which met our eyes in the next and last tomb we unearthed at Huaca de la Cruz.

Columbia University Expedition, 1941

Across a Thousand Years a Modern Woman Studies an Ancient One

Amid orderly piles of excavated materials, the author's wife examines a ceremonial distaff from the grave of a much-honored Mochica woman. This implement, carved from extremely hard wood, is noteworthy for its dignified portrayal of an elderly seated matron, faced by two page boys (page 475).

The actual shaft of this tomb had no unusual features and was sunk through Mochica rubbish on down into the older Gallinazo refuse below. A large, erect algarroba wood post marked the head of the main burial, which occurred at a depth of about 14 feet. However, our wonder grew long before we had reached this depth.

The first object of interest encountered was one of the actual algarroba digging sticks with which the shaft had been dug. It had been lost or abandoned at a depth of about four feet in filling in the grave. Since it was in perfect condition, with a sharp blade, it adds a bit of evidence to the theory that this burial had been made and filled up with unusual haste.

Legs Bound, Face Painted Red

The next feature, encountered at a depth of nine feet, was a coffin of tied canes containing the extended skeleton of a powerfully built middle-aged man whose body was wrapped first in matting and then in fine cloth. A strange feature here was the fact

* See articles on National Geographic Society-Smithsonian Institution expeditions to Mexico, by Matthew W. Stirling, in the National Geographic Magazine for February, 1947, September, 1943, November, 1942, September, 1941, September, 1940, August, 1939.

Columbia University Expedition, 1918

Round and Round the War-club Head Mochicas Chase the Foe

Carving on the butt of the warrior-priest-god's fighting mace shows a Mochica warrior (left) thrusting with his mace toward the fleeing enemy (right), who is pictured as slightly smaller. The complete scene includes another Mochica and two more enemy warriors. Hummingbirds take part in the action. Below is depicted a council of chiefs and around the neck of the club head hang three trussed-up dead warriors. The mace shows marks of battle and the eagle, or falcon, which surmounted its head has been partly broken off. The weapon has a sharp copper point and was used as spear or club (page 480).

that both his knees and his ankles were tightly tied together, although his hands were free.

Over and under his face were gourds. In his mouth was a piece of copper wrapped in cotton and by each wrist was another piece of copper. Red pigment had been placed on his forehead and cheeks and by his side were eight gourd bowls filled with corn or beans and one containing cotton bolls. His cane coffin contained only one pot, a striking mold-made vessel depicting a cat's face with extended pink tongue. On the bottom of the pot was an X, apparently the maker's mark.

Since an identical twin to this pot was found outside the coffin, just below the head of the grave, it is probable that a number of other near-by pots pertained to the tied man's burial offerings. However, the clearing and removal of this burial revealed that we had reached only Chapter One in a very rich and complex story.

It was soon obvious that the tied man's coffin rested upon a much larger and more elaborate burial. From here on, for an entire day, from dawn to dusk, Evans and I did most of the digging as well as all the photographing and recording while our men either watched with mild interest or slept in the warm sun. It was a busy and exciting finale.

When the uppermost coffin had been fully recorded and removed, it was then possible to work with the larger and more elaborate cane sarcophagus below, upon and around which were other offerings and burials.

The major tomb was about 9 feet long, 3½ feet wide, and 2½ feet high. It was composed of heavy canes reinforced at both ends and the middle and tied with cordage. The outer wrapping, only partially preserved, was of the rare Mochica twilled cloth. Although the sarcophagus had slumped somewhat at the western or head end, it was in good structural condition.

There was a great temptation to remove the lid and see what it contained, but much recording had to be done first.

On the top of the main sarcophagus and under the wrappings of the tied man were the remains of a sacrificed llama with no head as well as several elaborate pots, some of which

probably belonged to the upper burial. Another sacrificial llama lay to the right of the foot of the major sarcophagus.*

Signs of Human Sacrifice

However, the most startling evidence of sacrifice were the distorted skeletons of two middle-aged women. One of them, with associated offerings of pottery, was crowded in at the foot of the main tomb outside the large cane box. The other lay to the right and near the head of the sarcophagus (page 456).

This last body had been crammed in between the large cane tomb and an ancient adobe house wall of Gallinazo times which had been encountered at this level by the Mochica grave diggers. The torsion of this skeleton was even more extreme than that of the bundled female skeleton at the foot of the grave.

Considering the general practice of the Mochica to extend the bodies of their dead, it is hard to see the role of these two women as other than that of sacrificial victims who, by force or otherwise, had accompanied their very old and great priest-god into the afterworld. This may be speculation, but, in the light of further evidence inside the sarcophagus, it seems the most reasonable deduction. There was more than chance in this association.

It was noon by the time we had fully recorded the story to this point and, despite our burning curiosity to see what the main sarcophagus contained, we stopped for lunch. Evans's long legs were able to extend from one side of the tomb to the other as the seemingly endless photography and recording went on, but I knew my shorter ones were aching and weary.

The workmen were used to our slow and apparently interminable approach to burials which they had uncovered for us, but this was not true of the only other witness of our resurrection of the Mochica god Ai apaec. This worthy, attached to a near-by hacienda, was an ancient range rider on a flea-bitten gray horse. For four months he had despaired of our sanity as he came upon us time and again while we were digging through refuse heap after refuse heap and gloating over pieces of broken pots.

All the time the cynical one had been convinced that really what we must be looking for was treasure. This time he had caught us flat-footed in what might well be a rich tomb and, absurdity upon absurdity, what did we do when at last we had the sarcophagus bare of earth but still covered from the human eye? We sat down and ate lunch!

* See "Camels of the Clouds," by W. H. Hodge, National Geographic Magazine, May, 1946.

Columbia University Expedition, 1946

Offerings Included a Sacrificed Boy

In center at left are the ribs of the lad buried with the great man, just as a boy accompanies the deity Ai apaec in the carving near the top (Plate 1).

It wasn't a long lunch. Archeologists are human beings, too. Within half an hour, Evans was down in the pit, carefully removing the cloth and well-lashed cane cover of the main sarcophagus. As he lifted the cover it was immediately apparent that here, in the upper section of the main depository, were the rich offerings to the most important person in this complex tomb.

I had just time to grab the range rider by his belt and hold him out of the grave, for his impatience had gone beyond bounds. He was thinking of gold and treasure.

Even a quick glance at this strange assemblage of offerings showed that there were treasures here, but they were art treasures, not gold or silver.

One's first glance lingered on numerous painted and modeled Mochica pots and on brightly colored green, yellow, and blue feather headdresses. But the eye soon stopped on something else—two great carved algarroba wood batons and a fighting mace that extended the length of the tomb, their elaborately carved heads resting above the breast of their former owner (page 479).

We have spoken of the Mochica as artists in pottery, but here were suddenly revealed the finest examples of wood carving yet found in any Mochica site.

Key to Tomb Is Long-fanged God

It took several hours of clearing and recording before we were able to remove these three important objects, one of which, particularly, furnishes the key to the arrangement of the entire tomb.

The most eloquent ceremonial object is the 6-foot copper-shod digging stick with the figure of the god Ai apaec on the top. The solid shaft of this remarkable specimen is surmounted by an 8-inch figure of the tusked god himself, with the entire body beautifully carved in the round and inlaid with bright-colored shells set in asphalt (Plates I and III and page 481).

In his hands the miniature god holds a jaguar-headed digging stick with which he is making furrows in the ground. The pupils of his eyes gleam red with white irises and his great fangs of white shell glisten. On his head is a crouched jaguar forming part of a crescentic headdress with a large indented knob behind.

Down the middle of his back extend the head and neck of a serpent, forming the tail of the jaguar headdress, and from the god's waistband two other serpents extend to the ground to form his forked tail.

The serpent, in many times and places, has been symbolic of fertility and life-giving water. That is probably the case here, for on the right-hand side of the god stands a little boy who, from a broken basket at his side, is throwing turquoise, the symbolic corn seeds, into the furrows made by the digging stick of the god.

Here is the great agricultural god-ruler opening the planting season for his irrigating and agricultural people. In the same manner, many years later, the sacred Inca in Cuzco performed the first planting of the highland maize crop.

Likewise, very close parallels exist among much earlier Old World empires where the carefully controlled life-giving waters were also basic to the very existence of the people. The pharaohs of Egypt and the ancient emperors of China, who performed almost identical rites, are striking examples of similar conditions leading to similar ceremonies.

Thus the attributes suggested by this first carving would seem to indicate that its owner was a priest, or even a god, of agriculture.

The second long ceremonial digging stick, which long ago had lost its copper chisel point, is far less flamboyant than the first, but it has a special dignity. It is surmounted by the figure of an owl carved in the round, with deep scroll designs on the shaft below.

This owl figure represents the very familiar *lechuza*, or burrowing owl of the Peruvian desert. One associates this staff with wise council and, perhaps, with one of the actual feathered headdresses from the tomb, since this bit of headgear bears two artificial birds which peered over the wearer's forehead.

The owl baton, then, suggests that a second attribute of the old priest whom the late Mochica buried here may have been that of councilor.

War Mace Bears a Battle Scene

However, it was the battered war mace which immediately caught my eye. This is a much-used, beautifully carved, and very deadly weapon. It is balanced like a rapier, or a perfect bayonet if such ever existed, and is made for fighting either with point or butt. It has been battered around the upper end in battle, and the crowning eagle, or falcon, with spread wings is broken.

Nevertheless, the encircling design showing two large Mochica warriors pursuing three smaller, possibly Gallinazo culture, warriors is clear. So are the hummingbirds participating in this spirited action; the council of chiefs below; and, around the neck of the club head, the three lashed-up dead warriors staring at the sky (page 478).

Columbia University Expedition, 1946

Symbols of Earthly Glory Lie above the Body of the Fighting Priest

On the baton in the center is carved the god of fertility, Ai apaec, whom he personified in life (Plate I). Success in war and in council is represented by the fighting mace and the baton bearing a solemn owl. Across the god baton rests a plume of tropical bird feathers. This close-up of the offertory compartment (page 479) also shows, at upper left, a headdress decoration comprising the jaw of a long-fanged animal representing the great feline god of the Mochica people (page 482).

The square, spear-shaped, socketed copper point is heavy and deadly sharp. One felt on handling this weapon that one might still remain an objective scientist and imagine that the owner of this war mace was also one of the high command who had led the brief Mochica invasion into the Virú Valley!

If the mace belonged to the old man who was buried in this tomb, he was not only the personification of an agricultural god and a wise councilor; he was also a warrior in the higher brackets.

Thus we return to the cane sarcophagus with its dead human occupants. Why do we conclude that this old mortal had once assumed the role of the great Mochica tusked god Ai apaec? Once we had had a chance to study the effigy on the wooden copper-tipped digging stick, such a conclusion was hard to escape.

First, over the old man's body, which lay below another layer of bound canes, were extended the two great wooden staves and the battle mace which had once constituted his authority as an agricultural god, a councilor, and a veteran war leader.

Second, by his right side, exactly as on the Ai apaec mace, and with the other offerings, was extended the actual skeleton of a boy of 10 or 12 years of age. At the hand of the boy were the remains of one or more elaborate wickerwork baskets such as that from which the miniature boy on the digging stick was throwing the turquoise maize kernels (page

479). Further, there was a mass of tiny turquoise beads by the old man's neck.

Collapsed beside the head of the warrior-priest-god were the remains of a headdress, originally very similar to the one worn by the effigy of Ai apaec. Time and the crushed condition of this corner of the sarcophagus had broken it, but here were the remains of a fiber, cotton, and feather headdress frame with three metal paws of gilded copper and two gilded copper covers with danglers for an animal's jaw, all of which had once formed the tusked animal on the front of this elaborate headdress.

Finally, we found here an ancient animal's jaw which had the actual great overlapping canine teeth that archeologists know so well from carvings in the ancient cultures of Peru, Colombia, Honduras, and Mexico (page 481).

This peculiar animal jaw was an old specimen, like so many pieces in the tomb. It was mended with thread and asphalt, but there is no doubt as to its authenticity. Zoologists at the American Museum of Natural History say it is the jaw of a dog fox (*Dusicyon culpaeus*), a creature about the size of a large coyote, which is still extant in the highlands of Ecuador and Peru.

Captives Thrown into the Sea

In addition to all these factors suggesting an identity between the god concept and the dead man, other contents of the tomb furthered this probability.

There were 16 pottery vessels in the sarcophagus, all of late Mochica white, red, and black type. Of these, three show the god Ai apaec. On one he is leaning over the mountains and fishing in the sea where he has caught a shark. The little dog with the long teeth, so often associated with Ai apaec, is lustily swimming after the big shark!

A second pot shows Ai apaec taking what appears to be a fish away from some manlike demon, and the third shows him sitting on his throne at the base of the mountains while prisoners of war are being thrown from the mountain peaks into the sea. This, too, is a common theme, and here Ai apaec has a lizard for a companion or servant.

The other pots in the grave are highly varied: a skull pot (apparently hastily made for the occasion); a weird potato-face pot with many eyes and a made-up pink mouth; a "corn popper" with a handle; several portrait vessels showing elaborately costumed men; and one vessel with a vivid hunting scene, with the hunters throwing their spears from spear throwers and the struck deer stretching his head back to lick the wound.

Very fragmentary remains of a third headdress were found, besides the jaguar and bird-head examples, but the featherwork was in poor condition. The tropical bird feathers in various plumes and fans probably came from the eastern side of the Andes.

At Last, Old Ai apaec Himself

It was late in the day, the shadows were drifting across the face of the Andes at our backs, and down in the grave shaft it was cold when, after recording and removing the offerings, we raised the last carefully lashed layer of canes and finally saw the body of the man who impersonated Ai apaec.

The body was lying fully extended with its head to the west. It was wrapped in matting, with fine but badly decayed cloth under this covering. The lower face was hidden by a simple copper mask, below which was a remarkable mouth mask of copper with gilding on the outer surface. This had originally fitted, one must imagine painfully, over the septum of the nose, with the two conventional birds' heads flaring out on the sides, while the circular stone center, with its turquoise border, rested over the mouth.

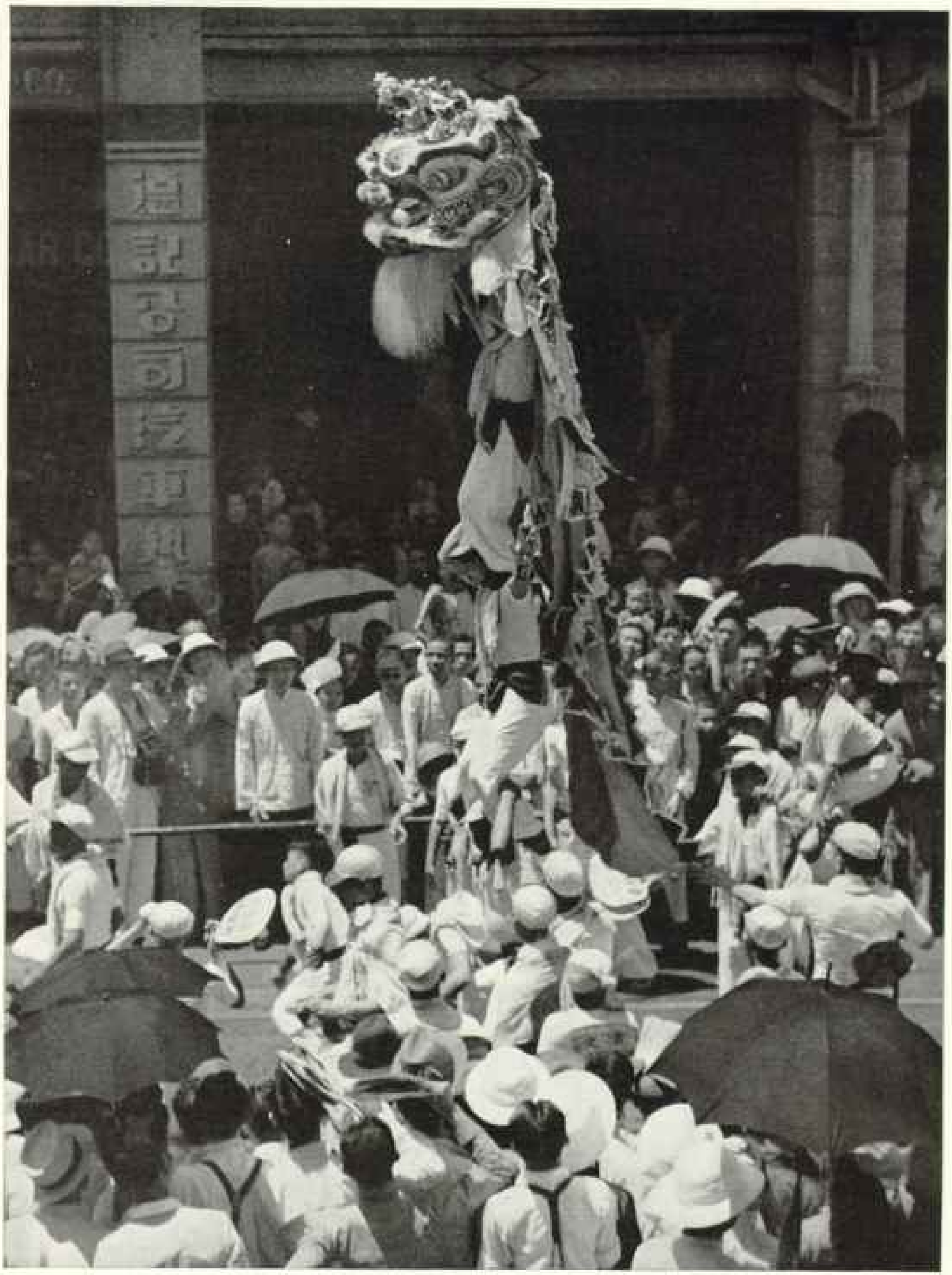
Such mouth masks are very rare and are believed to be the symbol of a god. They probably have some relationship to the feline deity, since they occur on cat gods in the colorful Nazca pottery to the south.

The skull itself was badly broken, but, thanks to the preservative quality of the copper mask, the lower jaw was intact. It was the jaw of an old, old man, so old that not one tooth was left. Even the sockets of all but two teeth had been absorbed.

When we uncovered the body we received another surprise. Under the layers of matting and cloth the extended body was covered with bleached white skin. Apparently he was so old that the skin had dried like brittle parchment. The old man's knees and his ankles were tied together with cloth sashes—he and the "tied man" had been treated in the same fashion.

The entire body lay on a black mass of rotting cotton, and behind the warrior-priest-god's head was a great pillow or indented button of cotton, like that behind the headdress on the carving of Ai apaec (Plate I). Below the floor of the cane sarcophagus was the refuse of the older Gallinazo culture.

When we tried to remove the bones they crumbled to powder, for this was an old, old man who had died and been buried with all the honors of a god a thousand years ago. But before he found his destiny of dust to dust, he had given us a priceless glimpse into the life of the past.



Mee Cheung

A Bearded Lion, Three Men High, Stalks a Hong Kong Holiday Crowd

In the century after it became a British crown colony in 1841, this island near the mouth of China's Canton River grew into one of the world's largest ports. Japanese held it from Christmas, 1941, to September 16, 1945 (pages 486-8). Now Hong Kong is regaining its prewar trade.

South China Morning Post

Fishing Boats Jam the Natural Harbor of Cheung Chau, Called "Dumbbell Island" Because of Its Shape

Fishermen live on the narrow neck of land which connects two hilly knobs. This community lies west of Hong Kong Island, but is part of the colony. For nearly two centuries before China ceded Hong Kong, pirates used the region as a base to harass English merchant ships.

Three Lions

"One Cent for 13 Volumes," Reads the Sign on This Sidewalk Lending Library in Hong Kong

The "volumes" are thin booklets of novelettes and folk stories, with gaily lithographed covers. Customers read them on the spot, becoming engrossed despite street noises.

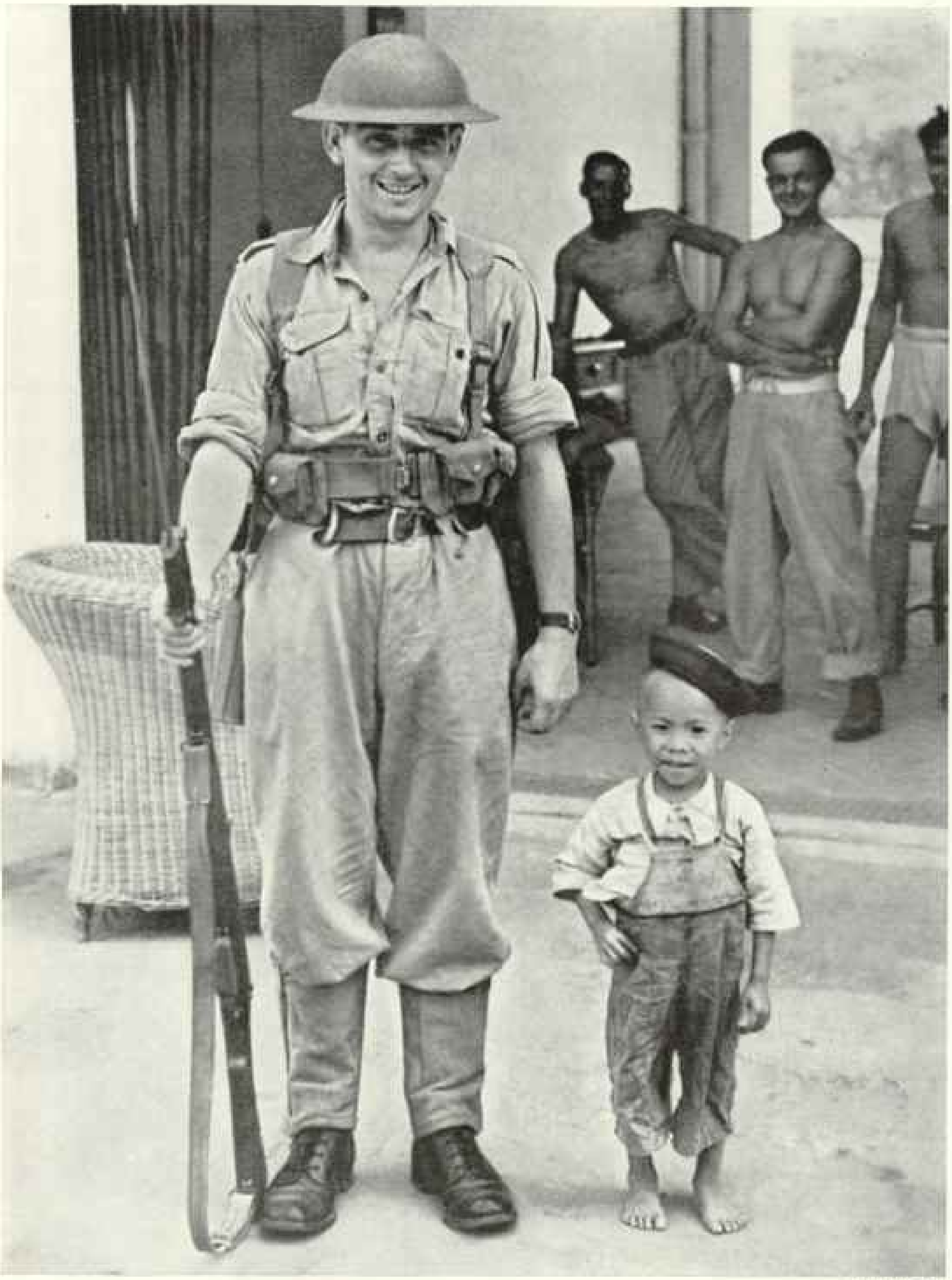
Freed from Japanese Internment, a Hong Kong Official Greets His Liberator

A smile creases the gaunt face of Sir Grenville Alabaster (center), former Attorney General of the colony, as he talks with Rear Admiral C. H. J. Harcourt (left), who accepted the Japanese surrender.

British Official

British Sailors Distribute Food after the Japanese Laid Down Their Arms

A Chinese girl beams her thanks for cans of rice, which at first were carefully rationed. Hong Kong's normal population of more than a million had been nearly doubled by refugees from China.



British Official

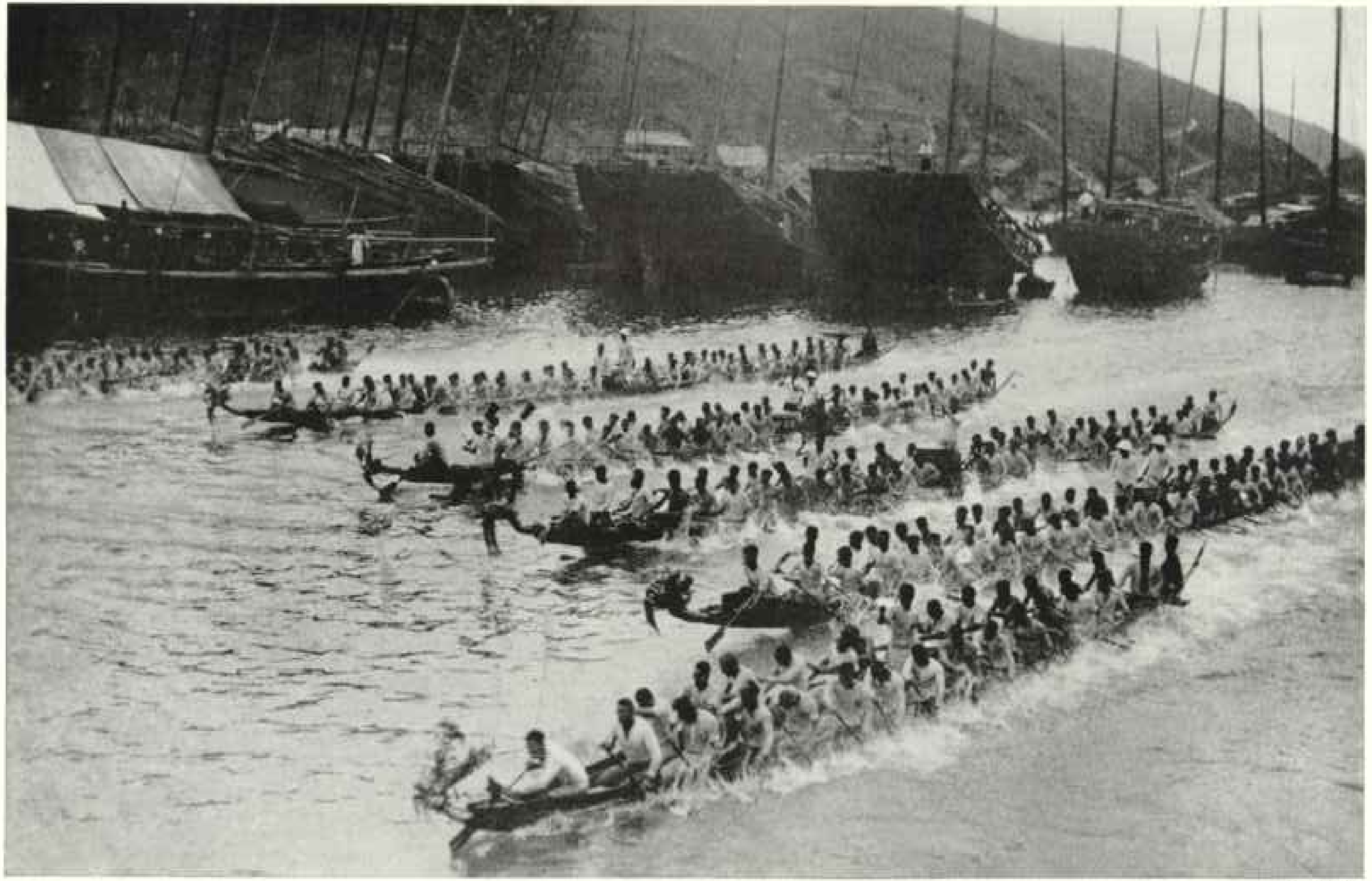
The Long and Short of It: a Chinese Boy Joins a British Sentry on Patrol

Warships led by the new 35,000-ton British battleship *Anson* relieved Hong Kong. Prisoners of war and internees, including jubilant Canadian troops, rejoiced over the end of suffering. Japanese officers, replacing them in prison, were released to sign the surrender document while 21-gun salutes blazed and fireworks crackled.

British Official

A Boatload of Grinning Jack-tars Heads for Shore to Replace Defeated Japanese Guards in Hong Kong—H.M.S. *Indomitable* in Background

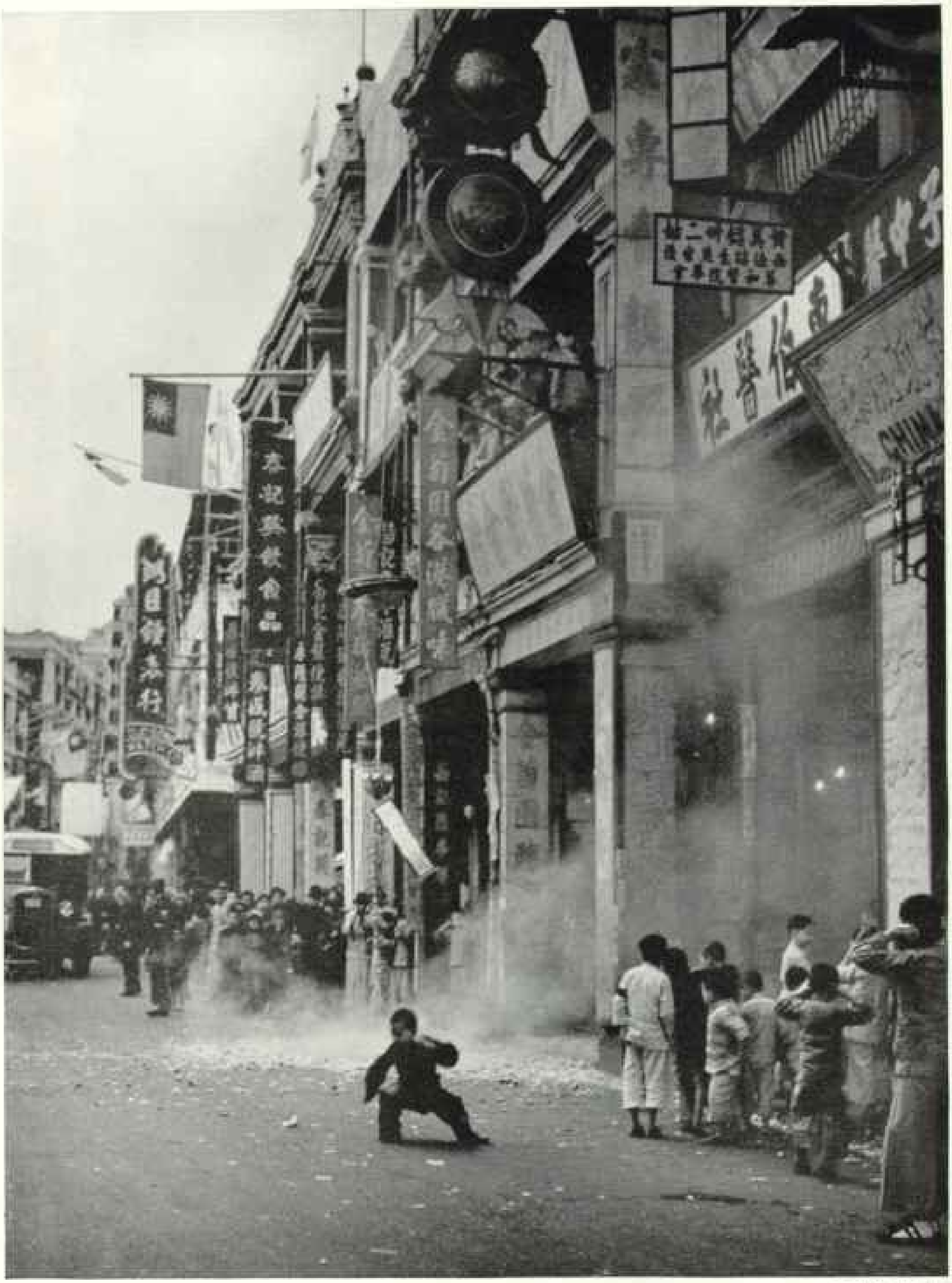
Despite their victory smiles, the sailors have their rifles ready. Snipers inside the dockyard had to be silenced. Escaping Japanese suicide boats were bombed.



Mee Cheong

Straining at the Paddles, a Dragon Boat Crew Spurts Ahead of Rival Craft in a Noisy Race

Annual regattas throughout China commemorate the legendary search for the body of a drowned official. Leaders exhort their oarsmen with loud shouts. Drummers standing amidships beat furiously to frighten evil spirits. In the excitement novice crews sometimes swamp their boats, ornamented with dragon heads.



J. Baylor Roberts

Forty Feet of Firecrackers Snap and Sputter in a New Year's Greeting

To prolong the noise during celebration of the Chinese New Year, firecrackers are strung together and explode one after another. A small boy gingerly approaches a string of them dangling here from the third floor of a building. As the chain is gradually lowered, the crackers pop for half an hour.

Backwoods Japan During American Occupation

By M. A. Huberman

TO BUILD their wood and paper houses; to cook their food and to keep themselves warm over their braziers; to ensure water for irrigating the valley rice fields; to hold the mountain slopes from sliding down over the food-producing farms; to make the boats for bringing in the fish; to supply the sleepers for railroad tracks and poles for their telephone, telegraph, and power lines—for all these necessities the Japanese depend amazingly on their forests. The forests cover 60 to 65 percent of the country.

Knowing this, General MacArthur and his staff in October, 1945, established a Forestry Division to advise them on forest resources and forest products.*

First, we had to determine the location, the quantity, and the quality of the timber resources. We had to find out how much was being produced of each kind of product and how to get the Japs to produce more.

This survey gave us a chance to travel through the backwoods of Japan (map, page 497). We saw logging operations, sawmills, veneer plants, pulp and paper mills, charcoal kilns, and camphor stills.

Through our Nisei interpreters (page 516) we spoke to sawmill owners and laborers, lumberjacks, log rafters, charcoal burners, farmers, fishermen, and shopkeepers.

We met governors, mayors, chiefs of police, village headmen, presidents of forestry cooperatives and community forests, and officials of Government-monopoly control associations and control companies.

We flew and rode in courier planes, trains, jeeps, trucks, limousines, tugboats, fishing vessels, bateaus, and logging cars, and walked to remote valleys and towns in interior Japan.

When we rode in a prefectural governor's long, black limousine, driven by a Japanese chauffeur, the physical comfort of the deep cushions was often more than offset by our mental discomfort.

The chauffeur seemed to use only horn and accelerator. He seldom applied the brake, perhaps because it would have meant taking his foot off his beloved accelerator. I doubt that he ever needed to have his brakes relined.

The pedestrians in the village streets had to jump out of his way. Many times the crowds would part before him, as the waters of the Red Sea must have parted for the Hebrews fleeing from Pharaoh.

It was nerve-wracking to see how narrowly he often missed hitting children absorbed in playing in the road.

We finally had to tell him, through our Nisei sergeant, to slow down. Accustomed to driving for the governor, he found it difficult to comprehend our concern for the people in the streets. Traffic moves on the left in Japan, so that our car always seemed, to us, to be in the wrong lane. We never hit anyone, but I can't understand why.

In traveling away from the densely populated, heavily bomb-damaged centers such as Tokyo, Yokohama, Osaka, and Nagoya there always was the danger of forgetting that the people we saw in the villages and in the hills were also warmaking Japs. We had to remind ourselves that the majority of Jap military men and munitions plant workers were recruited from these rural families, who were so hospitable and courteous. Their manner seemed somewhat less unctuous than that of the Tokyo Government officials.

Factory Owners in "Full Dress"

Owners of sawmills and small wood-products plants which turned out *geta*, or wooden clogs, farm-tool handles, pails and buckets, and prefabricated houses were anxious to take us through their establishments. Almost always they greeted us in their best clothes, not infrequently with wing collars. One owner wore a sugar-scoop coat, striped trousers, and white piping on his vest.

No plant visit was complete without at least one cup of sugarless tea in a handleless cup.

After such a tea party the host, with much bowing, would motion us to lead the way, and after him would follow his assistants, in order of rank. He would proudly point out pieces of machinery, often copies of American machines, and especially the electric motor as he recited the horsepower and production figures of his plant.

Over 80 percent of the 7,500 sawmills in operable condition after the cessation of hostilities were electrically operated. In contrast to their pride in describing the physical aspects of their plants, most owners were reluctant to give information about costs, prices, and wages.

Much cross-questioning was necessary to obtain such data, and often we had to ask the same question of foremen and individual work-

* The staff of this Division consisted of three civilian scientific consultants, detailed from the U. S. Forest Service, and ten junior officers and enlisted men, who were forestry graduates before entering the Army. Later three Australian foresters, officers in the Australian Army, became part of the staff.

Germaine Kellerman

In June, Rice-transplanting Time, Backs Are Rarely Straight, Feet Seldom Dry

Upland rice, grown like wheat, involves comparatively little labor, but lowland rice keeps everyone, from grandfather to baby, all summer long in mud, pulling weeds and applying fertilizer. Every task proceeds by backbreaking labor. In places, water is pumped by treadmill. Poorer Japanese families cannot afford the rice they grow. Cheaper barley, wheat, and millet form their fare (pages 495, 506, 507, 509).

men, after having one of our party lead the owner to another part of the plant.

Such separate questioning almost invariably produced divergent answers.

With regard to wages this was not at all surprising, because, in addition to base pay, Japanese employers provided certain perquisites, such as food and clothing rations; and to complicate the picture further, they often gave to their most obedient employees a year-end bonus which might equal or exceed the entire annual base pay.

A time-consuming habit of the Japanese reminded us of a radio comedian's gag. I would direct a question to the owner of the plant or local government official.

Our Nisei sergeant would repeat the question in Japanese to the "number one" man. Not knowing the answer, he in turn would repeat the question to his first assistant. When this man did not know the answer, he would repeat the question to the next man down the line, and this continued until one of the underlings in the parade replied.

If none knew the answer, one would be ordered to dash off to the office or some other place to bring back the information. The answer, if brought in, could not, of course, be

Army

Something New in Japan: Fluorescent Light Lures Insects to a Kerosene Trap

Observe the power line's tower. Japan does not lack electricity; even the most medieval farm home has its one modern convenience, a 10-watt bulb hanging on a bare cord. Ample rain and mountainous terrain encourage hydroelectric projects. Since water reservoirs are small, drought sometimes reduces output. Last January some theaters in Tokyo had to close for lack of power.

given direct to the number-one man. It had to follow the chain of command up the line, just as the question had trickled down the line, until finally the top man repeated the answer to our interpreter, who translated it into English. It was difficult for us to keep our faces straight during such proceedings, but the Japs never seemed to think it funny.

Our efforts to save time by directing questions to the most likely-looking man, in the presence of the higher officials, almost always met with defeat, because the individual we singled out would have to wait until the question was repeated to the number-one man and sent down the ladder. Sometimes the answer would be modified in transmittal from bottom to top, especially if policy was involved.

In such cases the Nisei interpreter was especially valuable because he was able to obtain not only the official, sometimes evasive, answer, but the real answer as well.

The Japs never seemed to realize that our Nisei sergeant listened not only to the official number-one man's answer, but understood also what each employee said.

Much of the information we sought would be checked by additional factors and cross references. When we pointed out various

Gretchen Kellerman

Into the Fishing Village of Tomo Glide Two Sailing Vessels Which Have Worked Their Nets as a Team

Japan's prewar fishery held first rank. The average citizen ate 95 pounds of fish a year, and produced a large surplus for export. War cost fishermen their rights in foreign waters. To meet Japan's food needs, General MacArthur allotted oil for fishing vessels. Tomo residents terrace the mountain slope.

Lowell S. Wilgert

Where Land Is Scarce and Labor Cheap, 30 Rice Growers Share 40 Muddy Acres of Tired Soil

Wet plowing is under way on a terraced mountain near Osaka. One lucky farmer has a plow ox (right). Others hoe flooded paddies (left). In the center, topsoil is piled in four rows. Later the dry clods, mixed with fertilizer, will be pulverized by the hands of the entire squatting family.

Acme

Bucket after Bucket, Saltmakers Tediously Scoop the Sea onto Their Shoulders

On the shores of Honshu Island, pumps are as scarce as salt mines, but labor is as abundant as ocean water. From the brine these men extract an unappetizing gray seasoning. This they are required to sell to the Government's salt monopoly at a fraction of its retail price (pages 498 and 499).

inconsistencies, the Japs were always hissingly sorry, and would explain that they had misunderstood the question. After several such checkups, there seemed to be fewer inconsistencies in their replies.

Conferences with various prefectural governors usually began with a polite little speech of welcome and ended with an apology for having to be elsewhere just as we would begin asking specific questions about methods and quantities of forest production. We decided that their apparent concern for avoiding our "catechism" was due to lack of interest or lack of knowledge, or both, especially when we learned that they were not elected by the people in the prefectures. Governors were appointed by the Tokyo office of the Ministry for Home Affairs. Frequently they were transferred from one prefecture to another.

In one prefecture where special efforts had been put forth to increase production of charcoal and the shipment of saw logs, I complimented the governor on his having organized such a worth-while activity. He was profuse in his thanks, but hastened to explain that he had arrived at his new post just two weeks before our visit and therefore did not deserve the credit. His predecessor had been governor there for only about two months.

Pooh-Bahs of the Villages

We soon found that in many cases the governors were better acquainted with the facilities at the various hot-spring hotels than

with the problems affecting the welfare of the people.

Mayors and village headmen, on the other hand, were usually local men and as a rule were well informed about the problems of their communities.

Often they took an active part in the economic life of the town or village. In some instances such individuals had a virtual monopoly of the business activity in their bailiwicks.

We were comically reminded of Gilbert and Sullivan's *The Mikado* by one mayor who was president of the local forestry association, which owned or controlled a large share of the timbered mountain slopes in the vicinity. He was also president of the local lumber company, which was the war-created Government monopoly controlling the sawmills producing the lumber.

As mayor, he decided that lumber was needed for repair and reconstruction. As president of the association, he decided to have some trees cut and to sell the logs to himself as president of the local lumber company. In this capacity he determined which of his sawmills should cut the logs into lumber and which consumers should purchase the finished boards.

Four Main Islands Are All That Is Left of Japan's Empire

Most people think of dollhouse Japan, home of 70 millions, as cultivated down to the very last inch. Actually, forests cover 60 to 65 percent of the country. To help take a census of the Empire's forest resources for General MacArthur, the author toured the little-known "backwoods."

As mayor, he decided that lumber was needed for repair and reconstruction. As president of the association, he decided to have some trees cut and to sell the logs to himself as president of the local lumber company. In this capacity he determined which of his sawmills should cut the logs into lumber and which consumers should purchase the finished boards.

The fees to be received for each service were set at a conference between the mayor, the president of the forestry association, and the president of the local lumber company. He laughingly explained that he thought this was a most efficient arrangement because there was seldom any difference of opinion at such conferences.

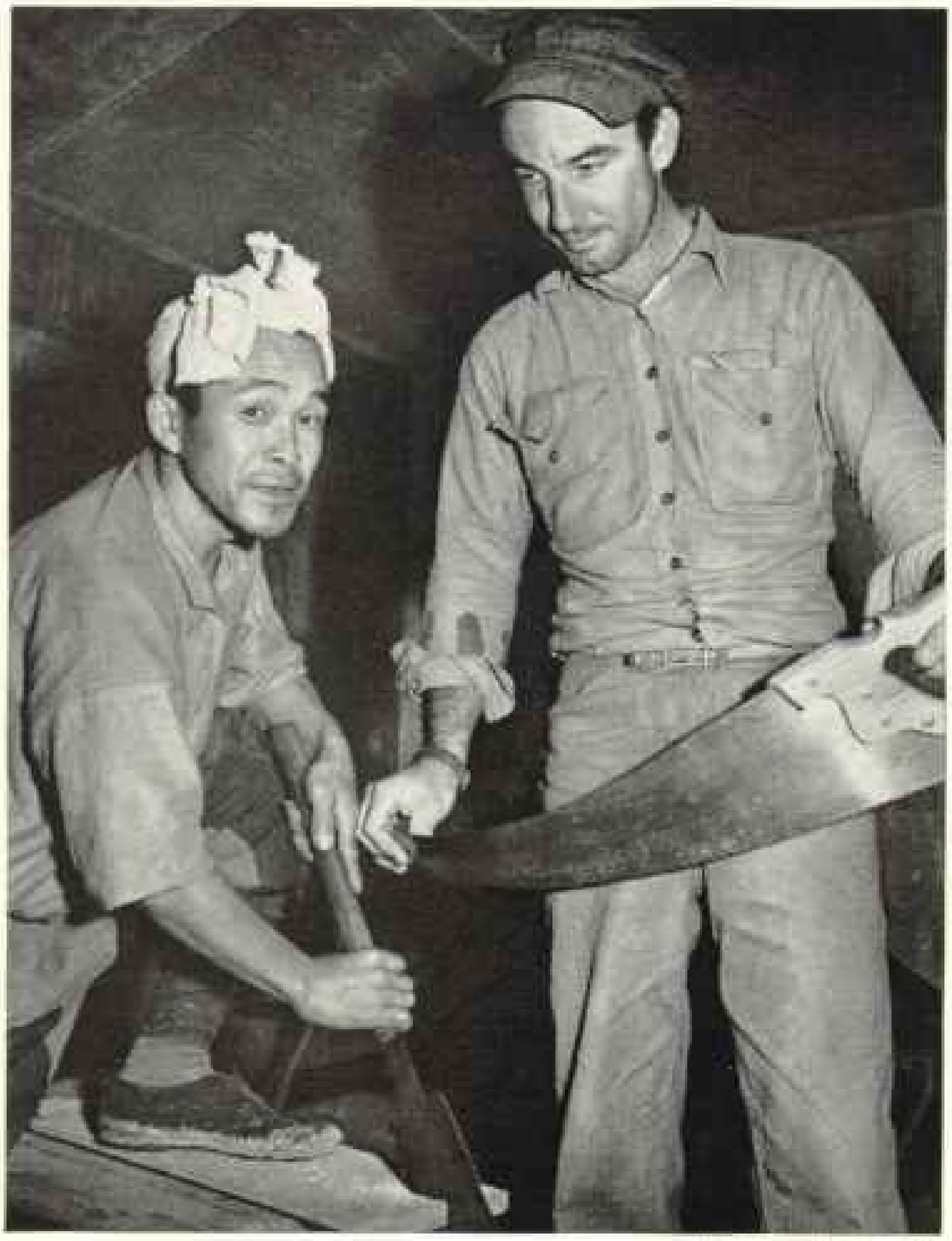
In each small village the chief of police, in black uniform with gold buttons and small sword as his badge of authority, looked and acted, almost without exception, like an imitation of a Hollywood version of a Jap. He answered not to the headman but to the Ministry for Home Affairs through the prefectural governor. Everything that happened in the village seemed to be his concern.

It appeared to be impossible to hold a conference in a village without the presence of the chief of police or one of his representatives.

The reluctance on the part of minor officials and ordinary people to provide us with information in the presence of these policemen was almost unbelievable.

Fish and Salt Towns

In several seacoast villages set on bays or inlets where forested slopes came down to the



U. S. Marine Corps, Official

By Their Saws You May Tell Yank and Japanese

Slow and clumsy is the double-edged saw, but it does extremely smooth work and wastes little sawdust. Teeth, which are set by eye, cut on the pull rather than the push. The awkward, tiring grip has no guard. As it requires both hands, a foot is used as a brace. "Very interesting," the Marine might say, "but I haven't got all day to saw a board. A toothed bread knife would be just as fast."

narrow beach, we watched the small fishing boats come in, each propelled by an oarsman in the stern who worked a long-handled sweep with a rolling motion.

From more than idle curiosity the womenfolk with their babies on their backs would come down to the beach to see what luck their husbands had had. As soon as they could get to the side of the boat, on the sand, they lifted the covers of the shallow holds to look at the cuttlefish, sardines, herring, bream, or mackerel which made up such an important part of their food supply (page 494).

In many places groups of fishing boats worked fish nets together. When they brought in the catch, the families of the fishermen would gather around on the sand as the fish were divided equally into piles or shares, even to the point of cutting slices of larger fish to equalize the shares.

In such villages fish were dried for later use by stringing them up on the sides of the houses. Fish are an important source of protein in the Japanese diet.

Family of Saltmakers

Many of these seacoast towns make salt. The saltmakers evaporate the sea water in flat trays in the sun or in shallow pans over wood fires in small straw shelters (pages 496 and 499).

In one small straw hut in southern Kyushu a saltmaker, begrimed by the smoke from the wood fire under the evaporating pan, explained how he, his 14-year-old son, and his wife, with a besmudged baby on her back, made salt.

They carried pails of ocean water up the beach to the 6-inch-deep sheet-metal pans set on a stone fire pit. They chopped down the pine trees on the hills back from the beach for the wood to keep the fire going.

With a wooden paddle they shoveled the salt into a woven-grass inverted cone funnel hanging from an upright pole in order to drain off excess water and dry the salt. Then they placed the dried, dirty gray salt into woven straw bags for delivery to the Government-monopoly salt-control association.

They listened uncomprehendingly to tales of salt mines in the United States, and were even more impressed with a brown-paper

packet of pure white salt from an Army 10-in-1 ration.

One day, while walking through some cut-over hillsides, we came upon a charcoal burner and his wife about lunchtime, just as they had finished filling the straw bales with newly made charcoal.

The kiln was already smoking with another charge of charcoal. The man and his wife bowed low as our Japanese forester guide explained that we were foresters from General MacArthur's headquarters.

Eating Canned Beans with Chopsticks

The man seemed to growl to his wife, and she disappeared into a weathered wooden house.

She soon reappeared with some cups and a small teakettle which she placed over a glowing charcoal fire on the ground near the kiln. The man had in the meantime arranged several blocks of wood for us to sit on.

As the wife poured out the tea for us, we took out our C and K rations and offered some C's to the couple. The woman giggled and looked at her husband, who told her to go into the house again. He would not accept the rations until our guide told him to do so.

Although it was not easy to identify the feelings of the Japs by their facial expressions, there seemed to be no doubt about the enjoyment this one felt at using his freshly cut chopsticks on a can of beans and sausage.

As we ate, he told us how he and his wife cut the oak and other hardwood trees on the slopes around his house, brought in the trunks and branches on their backs, and stacked the wood carefully inside the clay kiln with proper openings to the drafts in the top and sides of the kiln (page 503).

Army

Tin Can on a Stick Ladles a Brine Sample

By evaporating sea water, peacetime Japan produced a third of its salt requirements. Defeat aggravated the shortage; much salt fled to the black market. American exports helped relieve the scarcity. This woman's larger can contains sand for filtering (pages 496 and 498).

It took four or five days to complete the charring and another two to let the kiln cool. The charcoal was then placed in straw bales of about 33 or 66 pounds each. He pointed out that he cut the trees so that they would sprout from the remaining stumps and in five to six years provide another cut for charcoal.

Bales of Charcoal Carried on Backs

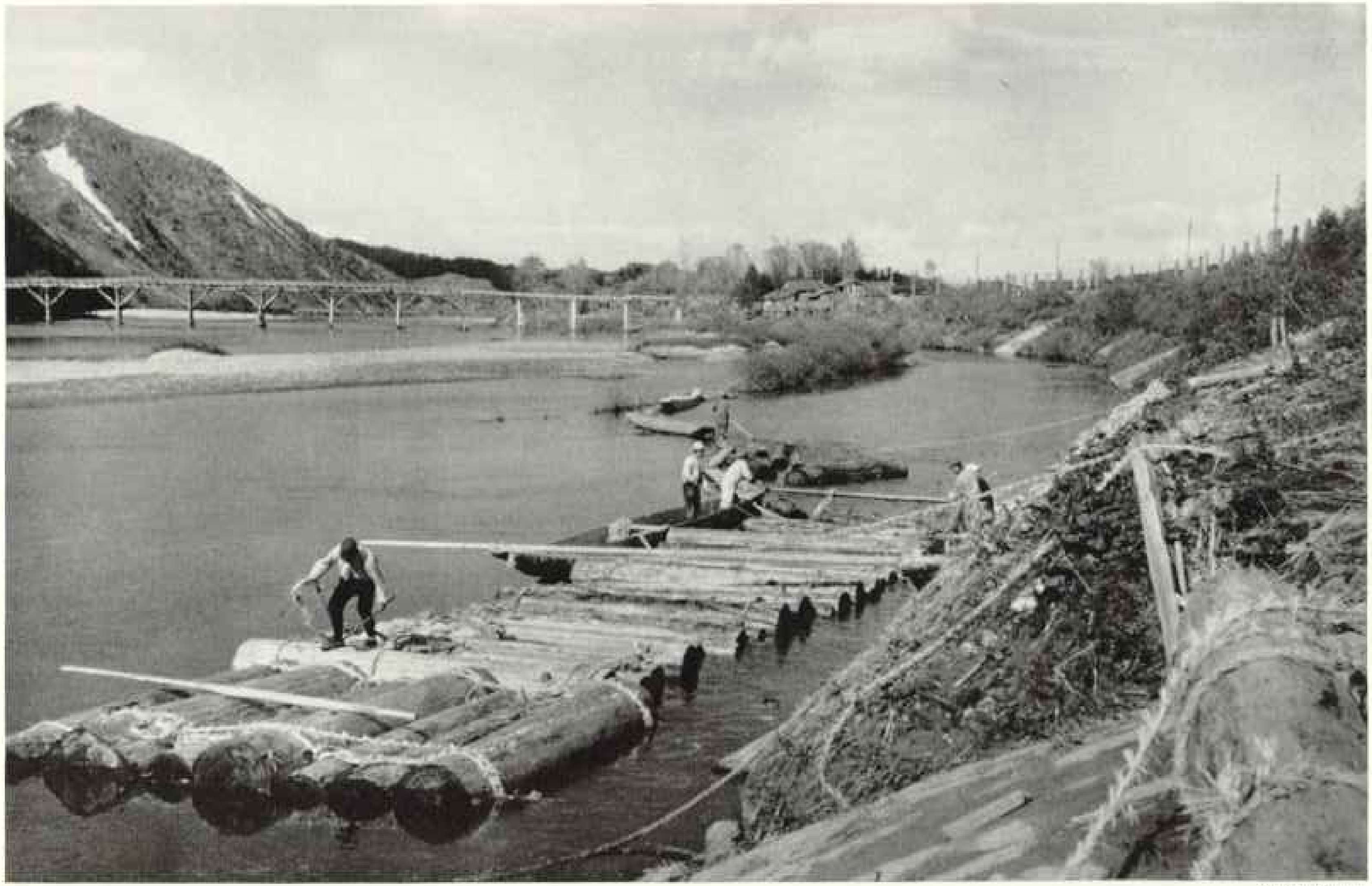
He and his wife carried the bales of charcoal on their backs to the logging station of the national forest, some three or four miles away, and at such times saw other people.

We asked what he would do when his children would be big enough to go to school. He answered that he did not know.

M. A. Huberman

So that Bombed Cities May Rise Anew, a 50-year-old Stand of Japan Cedars Falls into a Jackstraw Chaos

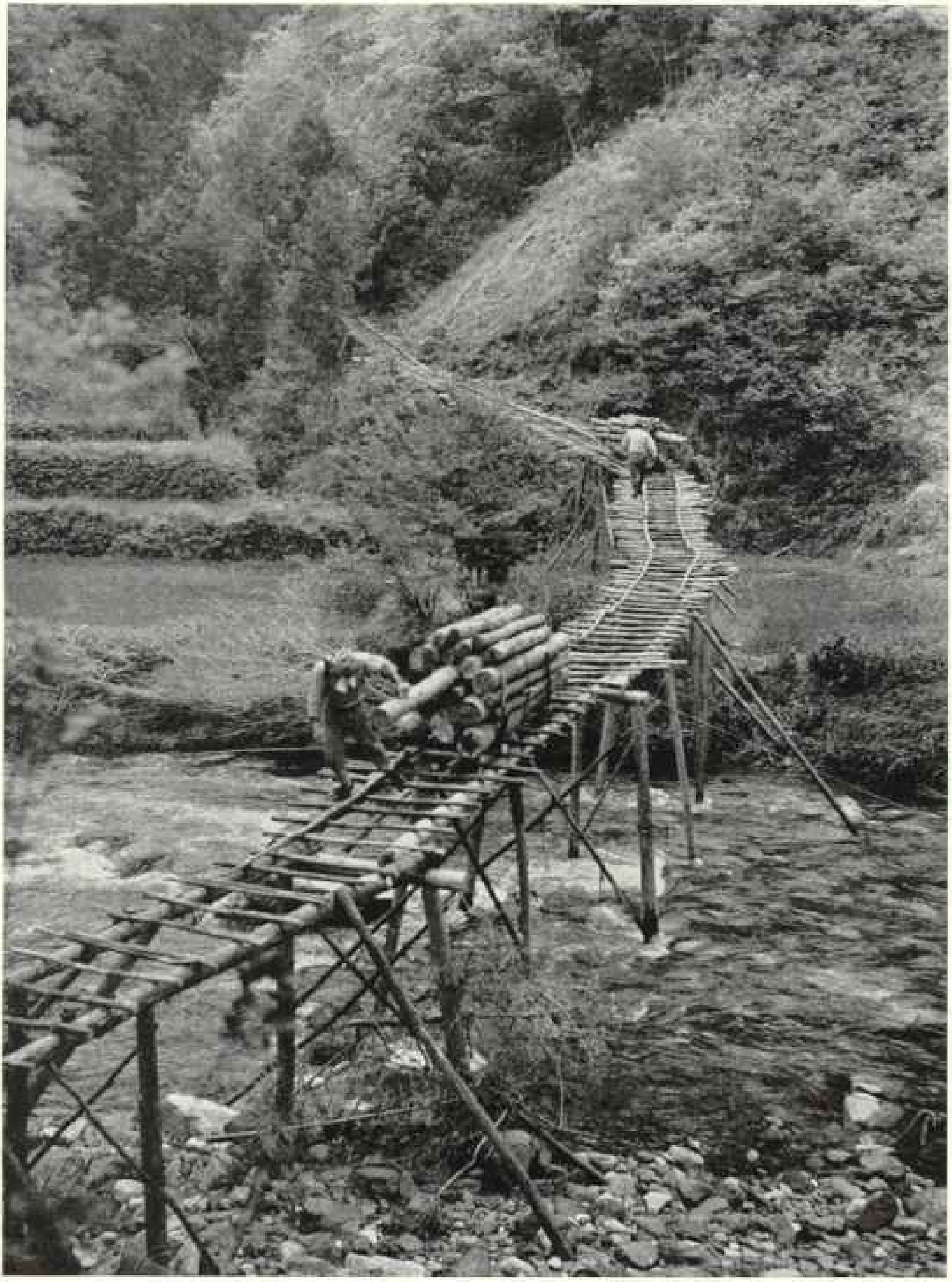
These *Cryptomeria* have been cut by one-man saws so close that stumps barely show. Each is peeled to facilitate skidding and to save bark for shingles (page 506). Lacking steam draglines, men will remove the logs. Soon the ravine will be planted with seedlings. In peacetime, Japanese reforestation is virtually 100 percent.



M. A. Huberman

Rubber-shod Boatmen Tie a Raft with Grass Ropes. American Lumberjacks Look in Vain for Calked Boots, Wire Cables, and Pike Poles

Logs roll down concrete aprons into the Yoneshiro River. Two men, one at a pole, the other at a sweep, will steer the raft to a sawmill downstream. Rafting is rare in Japan; mountain streams are too rough. Grass ropes, tough enough to be used several times, surprised United States foresters (page 509).



Lowell R. Hilbert

Roller-coaster, Lumberjack, Gambling with Death, Steers Logs down a Greased Trestle

A Honshu Island logger drags or brakes his sled half a mile down the mountain (page 506). To tread the ties surefootedly, he wears mittenlike rubber-soled shoes. The load delivered, he pulls his light sled up the skidway or carries it on his back. His womenfolk describe his daily stint as "life or death."

M. A. Haberman

Between Crops, Impoverished Farmers Burn Charcoal to Eke Out a Living

Charcoal, for heating homes, cooking food, and running automobiles, ranks as Japan's most valuable forest product. Nevertheless, it wastes the country's resources, for the primitive kilns dissipate chemicals such as alcohol. Lumber firms generally sell waste products to charcoal burners. Other producers strip scrub forests. Terraced fields surround this kiln and storage shed (page 499).

He changed the subject by pointing to rows of *sugi* stumps (page 500)* between which he and his wife had planted wheat and sugi seedlings. He said that after cutting of mature sugi it was possible to harvest three or four crops of wheat before the newly planted seedlings shaded the ground.

Along the bank of the Gokase River in central Kyushu we saw women making balls of mud and charcoal particles which were too fine to transport in straw bales and to burn in domestic braziers. Such charcoal balls are much in demand for restaurants and geisha houses.

We visited lumberjacks in Kyushu, and in Nagano, Akita, and Aomori Prefectures in Honshu. In some permanent logging stations in the national forests the lumberjacks lived with their families in small bark-roofed wood-and-paper houses.

These were similar to the "cottages" in which we stayed many times. The exterior walls were sliding panels which were moved aside in the morning on clear days to reveal a narrow passageway on at least two sides and sometimes all four sides of the house.

Houses with Convertible Rooms

The inner wall of this passageway consisted of sliding latticework wooden panels, with the openings in the lattice covered with translucent handmade paper.

Inside these latticed walls were the rooms, which extended the width of the house from passageway to passageway. The panels between rooms could be pushed back or removed to combine two or three rooms into one.

Usually the room at one end of the house opened into the kitchen, which was often in a

* Japan cedar, or *Cryptomeria japonica*. This conifer resembles California redwood but is not so large.

M. A. Huberman

U. S. Foresters Get a Circus Thrill Riding Hand-braked Logging Cars down a Mountain

In central Kyushu the author rode one of these gravity-borne cars. Down 15-degree grades he sped at 20 miles an hour. Flying leaps over high trestles took his breath away. Each hairpin turn threatened a derailment. At the end of this ride, Japanese apply brakes. They slow some cars by jamming sticks against wheels. A tiny charcoal engine hauls back the cars (page 506).

lean-to with an earthen floor. The room at the opposite end of the house had a non-sliding wall, and the *tokonoma*, or altar alcove, was recessed in this wall. In the tokonoma were placed odd pieces of gnarled trunks or tree roots; small tables or pedestals supporting the ever-present flower arrangement of sprigs of foliage or flowers, with a backdrop of a *kakemono*, a long, painted silk or paper scroll depicting a landscape.

No other wall decorations appeared in the house, except occasional carvings in the walls above the sliding panels.

Except for the houses farthest back in the hills, there was almost always one electric-light bulb, usually in the room with the tokonoma.

The floors were covered with woven straw mats three feet by six feet, fitted together to form a square. There was no furniture in these rooms except for the crockery or metal-lined wooden *hibachi*, or charcoal braziers.

The family sat on the floor, ate off trays on the floor, and slept on a *futon*, or quilts placed on the floor. Closets of shelves held these quilts during the day.

Off one corner of the kitchen was the bath, made of lumber (page 515). Hot water from the kitchen was carried in wooden pails by the women of the house.

After we grew accustomed to the blisteringly hot baths, we found it a really relaxing pleasure to bathe before supper each night after a tiring day in the hills.

Fire Hazard in Barracks

The unmarried lumberjacks or those working during the logging season away from their families did not fare so well. Their quarters consisted of a long, low shingled or bark-roofed, wooden-walled building about 30 feet wide and 50 feet long.

As with many buildings in the mountainous areas and in the northern part of Japan, heavy stones were placed on the roof to prevent the shingles or sheets of bark from being blown away.

The building had two rooms. One was an earthen-floored kitchen, and the other was a wooden-floored eating and sleeping low-raftered room with a shallow dirt or stone-bottomed pit in the center.

In this pit wood or sometimes charcoal was burned for heating and for drying clothes. The

M. A. Tilleman

A Still in the Kyushu Backwoods Cooks, Not Sour Corn Mash, but Fragrant Camphor

Years ago Japan cornered the camphor market. For their old-time celluloid collars, Americans paid as high as $3.75 a pound for camphor. Synthetic camphor and new plastics broke prices. Japan's loss of Formosa, leading camphor producer, hurt still more. This tub boils camphorwood chips. When the oil is extracted, the chips become fuel (page 509).

rafters and walls were grimy with soot and condensed creosote.

The men slept side by side on their not-so-clean quilts, with their feet almost in the heating pit. During the day the quilts were aired outdoors or stored on shelves in a recess along the outside walls. How these buildings were kept from burning down was a mystery.

In some parts of Japan, as in Hokkaido, wood-burning stoves have been substituted for the open pit.

Rolling Logs down the Mountain

The lumberjacks we saw in the Kiso Imperial Forest, in Nagano Prefecture in Honshu, were husky, rugged-looking fellows who had been brought south from Hokkaido.

In March, when the snow was two and three feet deep and the weather just above freezing, these men from the north were found to be more suitable than local laborers for the hard work of getting out the logs which had been cut in late fall and early winter.

They brought them down the mountains in a variety of ways in the Kiso. The most spectacular method was that of loading two or three large logs with their 15- to 25-inch butt ends on a small sled consisting of a crosspiece mounted on two skilike runners. The logs were dogged together and lashed to the sled with light cable or rope.

Two lumberjacks would start this log sled by pushing, and one would jump on the front end and ride it, one foot on each ski, like a Lake Placid bobsled, down a steep, winding snow trail, showering snow as he hit each banked turn in the trail. He steered by applying pressure with his feet on the skis.

To slow down the sled, he held a light cable attached to a wire ring, which he could pull back under the right ski. As the sled slowed down, he brought it to a halt at the log deck at the foot of the slope by jumping off in front of the sled and bracing his feet in the snow and his back against the logs.

A slight miscalculation could have resulted in his being run over by his load, but this did not happen very often, according to the forest supervisor.

Another method was to build a series of log deflectors in a zigzag arrangement down the slope.

When the snow was deep enough, the

Aeme

Electric Motor, Vanity of a Rural Household, Threshes the Rice Crop

Nearly all Japanese farm work is accomplished with hand tools. Only Hokkaido, the northern island, where farms are relatively large, can afford a few American-type implements. Most threshing is done with treadles, some with old-style flails. Last October Japan produced a good rice harvest, easing the food crisis.

lumberjacks started the logs down the steep slope toward the first deflector. It bounced them off at an angle so that they headed down to the next deflector, and so on down the mountain to the log deck, where they were loaded on cars.

These log cars were brought up the mountain on a narrow-gauge railroad built on high timber trestles forming an intricate network up and down the slopes. The empty cars were hauled up by a charcoal-burning locomotive. The loaded cars were taken down by gravity in strings of six or eight cars, with lumberjacks controlling their speed by hand brakes on the rear end of each car. We were left breathless as we watched the cars make their way down around hairpin turns without jumping the track (page 504).

Less risky was the use of steam- or Diesel-powered donkey engines with winches and cables and high-lines copied from some of our Rocky Mountain and West Coast logging shows by visiting Japanese logging engineers. They were especially proud in showing us an engine with a Waukesha, Wisconsin, name plate on it, as well as a plate of the Osaka Iron Works.

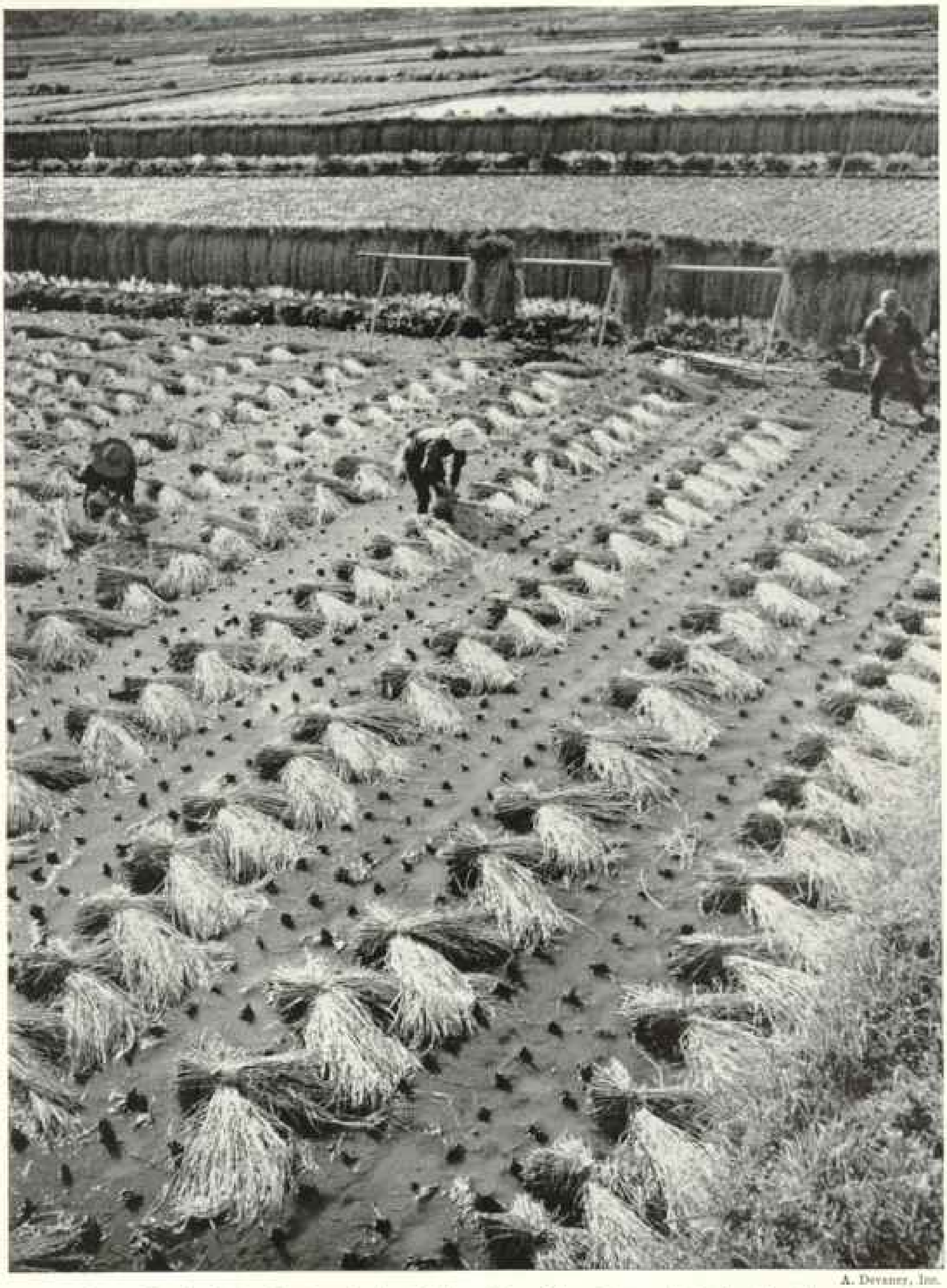
As in our own high-line logging, chokers and loops were placed on the logs, from one to three to a load, suspended on a cable, and by trolley ridden down the sky-line to the log deck at the donkey engine, where they were then loaded on the cars.

In the absence of snow, as in Kyushu and in southern Honshu, as well as in spring and summer logging in northern Honshu, most skidding of logs was done by manpower. Wooden sleds, pulled by men or women over greased crossties placed in dirt trails, were one common method (page 502). Oxen were used in Kyushu and horses in Hokkaido to skid logs.

Logs Peeled for Bark

In many places logs were peeled in the woods, chiefly medium-sized *Cryptomeria*, to obtain bark for roofing or for walls. We saw them being pushed down steep chutes by men in woven-straw rain capes one rainy day when the slippery trunks slid easily over one another (page 500). Animals or machinery were less frequent than manpower and womanpower.

Although women often worked alongside the men in the woods, they were more commonly seen in the log yards, where the logs were accumulated before being transported to the



A. Devaney, Inc.

On a Drained Paddy October's Golden Rice Lies Fettered in Double Sheaves

In Japan, reaping has not changed in the last 1,000 years. These farmers, still treading mud, clip every stalk with sickles. They saddle twin bundles across a pole (background) for carrying to the threshing floor. Windbreaks appear to be of rice straw. Other straw will be stamped back into the soil as mulch.

International

No Volcano Can Bluff the Woman Who Hoes Her Crop 50 Feet from Steaming Lava

In a land of death-dealing earthquakes, typhoons, and volcanoes, few Japanese feel secure for long. Not until Sakura Jima engulfed her farm two days after the picture was taken did this cultivator leave.

various sawmills by rail, raft, or boat.*

The mountain roads leading back into these logging operations were really something to write home about. We rode up such a narrow, tortuous, slippery road one cold, wet day in a Jap car.

Our driver was an unsmiling Jap who seemed more interested in looking at the misty scenery several hundred feet below us than in safely hugging the steep rock wall on the other side of the road. The car slithered into and out of the muddy ruts which still had ice and snow in spots.

As we slid and jerked close to the edge, I could not keep my mind on the forest for which we were headed. I could think only of *kamikaze* pilots. Surely this Jap wouldn't try deliberately to take several Americans with him to meet his ancestors by rolling the car over the brink!

I didn't convince myself, however, until we arrived at our destination at the top of the mountain. For the return trip down the mountain, however, I suddenly remembered that I had to talk over several things with the American GI driver of our jeep. It was colder in the open jeep than in the Jap car, but I didn't sweat as much under the collar on the descent.

Women Work in Tree Nurseries

In many of the tree nurseries in Japan, women perform most of the labor of cultivating the soil, making up the seedbeds, sowing, weeding, transplanting, and digging, as well as the planting of the seedlings on the cutover slopes.

In one log yard in Akita Prefecture, in northern Honshu, most of the work of loading logs on handcars, pushing the cars to concrete aprons, and rolling the logs into the water for making up rafts, was done by women, except for the foremen and a few men.

* See "Women's Work in Japan," by Mary A. Nourse, NATIONAL GEOGRAPHIC MAGAZINE, January, 1938.

The making of these rafts on the Yoneshiro, a clear, smooth-flowing stream, was one step in transporting logs from the log yards to the sawmills at the important lumber-producing center of Noshirominato.

During a period when rail transportation was difficult because of a coal shortage, this river rafting was highly important. Not many rivers in Japan were suitable for this type of log movement. The upper reaches of most rivers in the mountainous areas where trees were cut and logs could be accumulated were too narrow, rough, or fast-flowing to make rafting practicable.

In a wide curve of the river the logs were rolled down concrete aprons into the shallow water, where three men bound them together with grass ropes into rafts about 20 feet wide and 60 to 80 feet long (page 501). The completed rafts were tied up alongshore until 18 or 20 were ready to leave.

Two men on each raft cast off early in the morning and by long poles guided the rafts into the current. Six or eight hours brought them ashore at Noshirominato, about 30 miles downstream.

Here the rafts were broken up and the logs were stored until needed at near-by sawmills, or until a log train was made up for shipment to Tokyo and Yokohama mills.

In the Camphor Forests

In the camphor-forest region of southern Kyushu we observed the process of making camphor (page 505).

At a small house by the foot of the mountain a camphor still was steaming and giving off fragrant fumes, in delightful contrast to the odors from near-by fields. Alongside the house was a heap of bolts of camphorwood (*Cinnamomum camphora*).*

As we approached, a wrinkled old man took off his cap, bowed, hissed, grinned, and went about his work of holding the bolts against a turning knife-ridged wheel to make small chips.

These chips were shoveled into a big container which looked like a large inverted bucket, smaller at top than at bottom. Water was boiling under it, and steam rose through the chips, dissolving the camphor into vapor.

This vapor was led through a bamboo pipe into a smaller inverted bucket of water with a pan of cold water on the top to condense the camphor oil. As it condensed, the oil floated to the top of the bucket and was led off through another bamboo pipe into another container, where it settled out into solid camphor. This was then taken out, dried, and crushed.

It had to be sold to the Camphor Control Company, a Government monopoly, which refined the material for use in drugs and perfumes and, during the war, in explosives.

Farming provides a livelihood for 40 percent of the families of Japan, although only one-sixth of the land area is suitable for cultivation. Since two-thirds of Japanese farms are less than 2½ acres in size, it may be more accurate to refer to them as large gardens rather than as small farms.

We saw laborious, backbreaking methods used throughout Japan. In the northern parts horses and occasionally oxen were used for plowing; elsewhere men or women with babies on their backs did the hoeing, turning over the soil with short-handled, long-bladed hoes. In the early spring men broke up the clods with a small, hand-operated spike-tooth harrow.

After the plants sprouted, the famous "Nipper with the dipper" would make his appearance. From his wooden pail he would take the ripe night soil, dipperful by dipperful, and carefully dole it out to the growing crops.

Not a drop was wasted, because fertilizer is the key to productivity of the overworked soil.

Most of the chemical-fertilizer factories had been converted for the manufacture of explosives during the war and were, therefore, highly strategic bombing targets. Consequently, chemical fertilizer was not abundant, and night soil, more technically referred to as "indigenous organic material," always important in Japan, was now more vital than ever.

The chemical fertilizer available was placed carefully between the drills or rows of sprouting plants almost grain by grain or crystal by crystal.

Rice Planting Muddy Work

At rice-planting time men and women worked knee-deep in mud, turning over the flooded soil and renewing, strengthening, and patting down the raised edge of the rice seedbed. The grains were broadcast by hand on the almost drained surface.

Grass ropes, with bits of red and white paper tied at intervals, were supported on bamboo sticks around the edge of the fields (pages 492, 495, 506, 507).

The ropes and paper swaying in the breeze were to scare away the crows, and also were of some religious significance. As the bright yellow-green sprouts appeared, water was kept on the seedbeds until it was time to transplant the

* See also "Formosa the Beautiful," by Alice Ballantine Kirjassoff, NATIONAL GEOGRAPHIC MAGAZINE, March, 1920.

M. A. Huberman

Like a Snail Building Its Limestone House, a Barrelmaker Erects a Lofty Shell of Wood

Barrels and casks, not steel drums and pails, carry most of Japan's liquid burdens. Resembling a farmer on a haystack, this Honshu islander stacks heading, the strips used to seal barrelheads. Scaffold-borne, he now ties the top boards for stability. To escape, he has left a door, as in the two stacks at the right.

Harold Lindner

In Thrifty Honshu, Cows Not Only Give Milk but Haul It to Market

Cow's milk is a rarity even to Japanese babies. Only wealthy city people use dairy products. Beef cattle are scarce. Men do most of the work of draft animals because human beings require less land for food.

M. A. Huberman

Baby-toting Women Cart Their Meager Wood Ration in Tosu, Kyushu

Japan's wood-and-paper homes, heated by charcoal braziers, seemed cold to Americans even in peacetime. Postwar Tosu had little or no charcoal to ration, the author found (page 514). Here a male Japanese typically accepts the softer job, steering the cart.

Ytaka Tanaka Does Some Serious Reading Aloud for His Emperor

Two years ago the boy trembled at sight of his Emperor's picture unveiled at school in Gifu. Now Hirohito, having resigned his divinity, visits his countrymen in person, like a candidate for office.

seedlings to rows in the prepared and flooded paddy fields.

This was done by the whole family—father, mother, grandfather, grandmother, and the children—in the night-soil-saturated mud. Little wonder they have to bathe frequently!

Fuel and Flowers

Often we saw women and children from the valley farms on their way to the mountains or loaded down with fuel wood or branches for heating the bath water and for cooking.

Heavily laden though they were, the women almost always carried in their hands a sprig of attractive foliage or blossoms of the season, such as azalea or *sakura*, the well-known cherry, for use in a flower arrangement on the tokonoma (page 504).

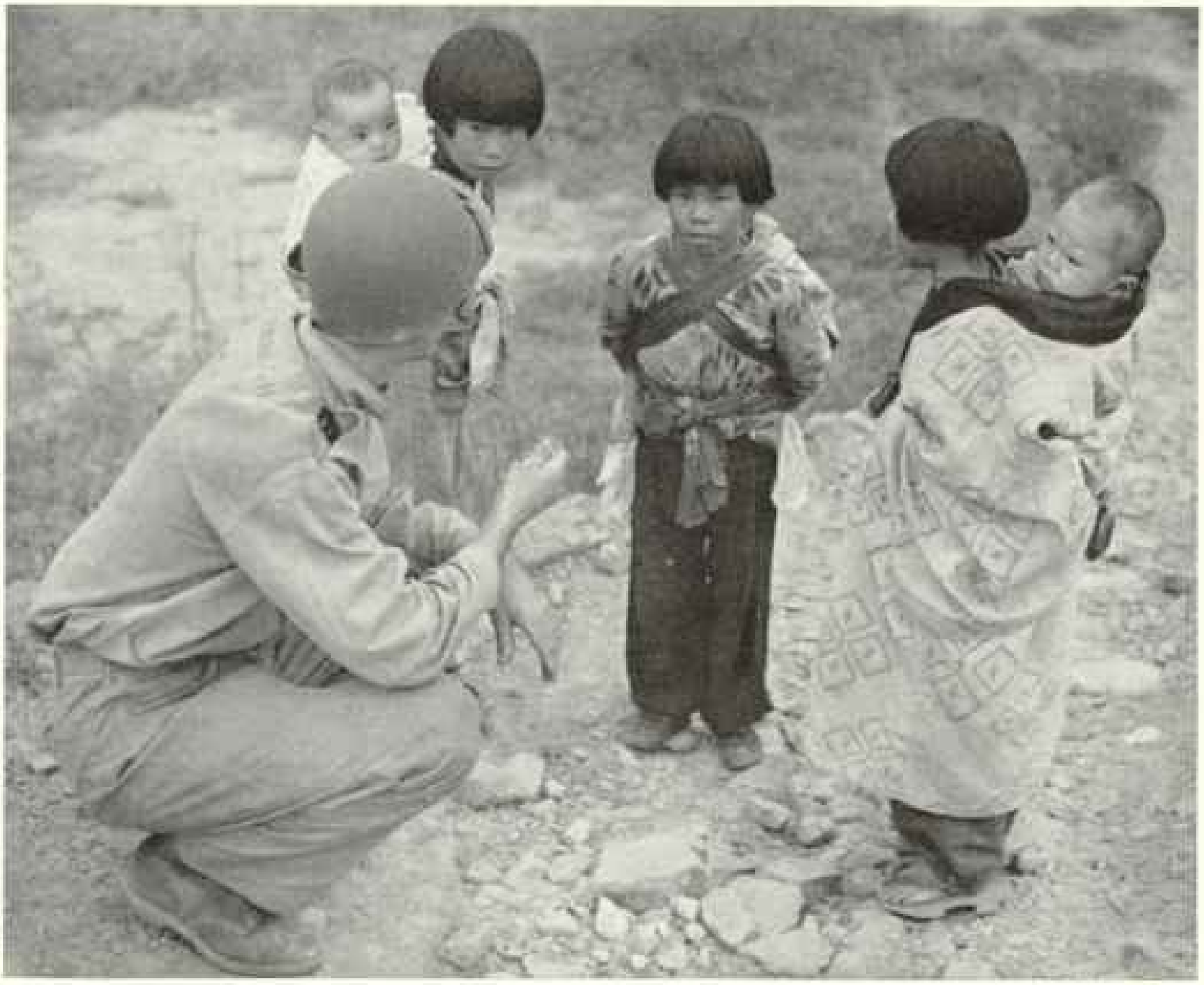
Almost every farmhouse had flowering trees or shrubs with attractive foliage near the building. The yellow-green rice seedlings, the weathered brown-and-gray-thatched roofs of the houses, and the white- or pink-blossomed trees, with a background of a dark-green *Cryptomeria* plantation on the hillside, was a color harmony marred only by the bucolic odors.

There were evidences on every hand of religious feeling in the rural areas, entirely aside from the popular pilgrimages to the famous shrines or temples of Ise (at Ujiyamada), Nikko, and Kyoto. Torii, the gates to Shinto shrines, were in every nook and cranny of the country—along the roads, on tops of mountains, and of course in every town of any size.

Hung across them were specially woven rice-straw ropes, with pieces of paper folded into zigzag patterns.

Small wooden shrines were found in sawmills, quarries, and other places of employment. Twigs of *sakaki* (an evergreen bush), dishes of food, or cups of *sake* (rice wine) were often seen in such small shrines.

Boys and girls, and grown Japs as well, never passed these shrines without stopping to pay homage. After removing his hat, and



U. S. Marine Corps

With Candy and Gum, Sentimental Yanks React to Sight of Children Carrying Babies

One childish trick, quickly learned, is to shoulder baby sister and stretch out both pleading hands to a Yank. Boys are not immune from carrying. Men and women too old to do anything else tote grandchildren. Very little girls shoulder dolls in imitation of older sisters (pages 514 and 517).

with feet together and arms hanging down at the sides, each Jap would bow stiffly and slowly from the hips before continuing.

We were told that this was done in reverence for Emperor Hirohito, despite the fact that in answer to General MacArthur's directive to separate the government from Shintoism, the Emperor had issued an Imperial Rescript declaring himself divested of his divinity and ordering his people not to revere him as a deity.

Horses for Spirits to Ride

In one small town in northern Honshu we noticed stone statues of horses before a Shinto shrine. A number of them wore woven straw shoes over their upraised feet.

We were told that these horses were placed there for the divine spirits to ride in their leisure hours. In the wintertime such straw shoes keep the horses from slipping and falling on the icy roads.

Some poor men in the community, unable to contribute money to the shrine, had woven these straw shoes and placed them on the stone statues every winter. As far as is known, none of the divine spirits has been injured while riding these stone horses in winter, since this devoted worshiper has been keeping the animals so well shod.

Many of the larger shrines had forest groves, most frequently of planted sugi (page 503), to supply timber for construction and repair of shrine buildings. Upon visiting one shrine forest, the priest invited us to see the shrine itself. Many gold and lacquer items, meticulously done, had been donated to the shrine by pious worshipers.

The priest and his woman helper served us tea in beautiful china cups, dried persimmons, and roasted peanuts. This priest's flock must have been well-to-do.

We were told that some shrines helped support themselves by admission fees from ath-

letic matches, such as *sumo* (wrestling) exhibitions. Financial support from the Government was ordered stopped, to help separate the State from Shintoism.

We later saw an exhibition at the Yasukuni shrine in Tokyo where a silk-brocaded priest refereed the bouts.

The bulbous 200- or 300-pound wrestlers go through a tedious ceremony of alternately squatting on their haunches, rising to stretch one hamlike leg, then the other, bowing, scattering salt on the floor of the ring (to purify the arena), and squatting and bowing again. Finally the refereeing priest brings them together.

They grasp each other about the shoulders and try to shove each other out of the ring. The one whose foot first touches the outside edge is the loser.

With so little excitement provided by such contests, it seemed to me to be a waste of good food to fatten up these mastodons for such exhibitions.

Three Wise Men on Teacups

At every opportunity our Japanese guides would point out to us evidences of Christian missionary activity.

In one conference room was a wall decoration of the Three Wise Men and the Star of Bethlehem, hung conspicuously so to be seen by the American officers. At one place we were served tea in cups decorated with the same motif.

The guides also pointed out to us young women wearing crucifixes, presumably former students at a mission school. These various evidences of Christianity were to be seen more in the towns of medium size than in the very small villages or on the farms.

Wherever we traveled, we were impressed by the large quantities of logs, charcoal, and fuel wood awaiting transportation. Many railroad platforms were loaded with such material. That these products were badly needed was proved clearly in the little town of Tosu in northern Kyushu, where a train of boxcars filled with bundled fuel wood had just arrived.

Almost half the town, mostly women, were at the depot with all manner of carts and wagons to help unload the wood and take it to the ration station (page 511). In view of the shortage of charcoal, the rationing officials were substituting fuel wood at the rate of five bundles per family per month in lieu of one bale of charcoal.

In a number of small towns where war industries had been bombed so thoroughly that adjacent residential areas had also been hit, considerable rebuilding was beginning to take place. Most of the reconstruction was with lumber produced by local sawmills from logs hauled from neighboring mountains by wagons or charcoal-burning trucks.

There was more progress visible in such towns and villages than in those less fortunate localities which had to depend on lumber or logs being shipped in by rail. This was especially true of the larger cities, where not only was the damage more extensive but the transportation problem was also more acute.

"Gummu" and "Chocolettu" in Demand

The sound of an approaching American vehicle, especially the "jeep-u," even on rainy days, would bring the runny-nosed, bright-eyed children out of the closely packed unpainted houses along the village streets. They would wave and shout "Hallow-goodaby," or "Gummu," or "Chocolettu." We had to drive carefully over the rough dirt streets to avoid injuring them.

In the more remote sections little girls on their way to or from school would stop and bow to the passing vehicle. We found out that during the war all school children had been taught to show proper respect to Japanese military personnel.

The chubby-cheeked rural school children were a strong contrast to the less colorful and less chubby city-school pupils in Tokyo and Osaka.

Whenever a jeep stopped, crowds of children would quickly gather in hopes of getting a caramel or lemon drop from the GIs. The soldiers seemed to be especially partial to the youngsters who were carrying baby brothers or sisters on their backs, and it did not take the children long to catch on to this. As a result, the older ones would quickly pick up a smaller child, and they would both hold out their hands for a piece of candy or gum.

Mothers with children on their backs, though shy at first, soon overcame their shyness, in response to the contagious grin of the big Americans who learned to say "*Konichiwa*" (good day), and smilingly allowed their babies to have the sweets.

Soldiers attached to Military Government or tactical units in the small towns made friends easily with the children. Some little Japanese boys diving for abalone along the rocky shore of the Pacific proudly displayed their catch, diving masks, and knives to the American soldiers who were interested, in hopes of getting "cigarettos."

It was a common sight to see a GI teaching the children American words for ordinary objects at hand, and the children in turn would repeat the Japanese words for the same objects

as they chewed American gum provided by the teacher. The mothers seemed to appreciate this friendliness, but the fathers or menfolk generally showed no sign of approval on their expressionless faces (pages 513, 517).

The ordinary people of Japan seemed to be learning that the GI, far from being the barbaric monster they had been taught to expect, was a friendly gentleman.

Local shopkeepers in the villages were usually glad to welcome Americans, not only for the obvious reason of doing a profitable business, but also because they had learned to expect courteous dealing without looting or rough treatment.

One instance will illustrate the kind of Occupation our men were carrying out.

On a narrow road near the edge of a small town in southern Honshu a jeep came to a bridge blocked by a tired horse trying to pull a wagonload of used lumber. The bridge had sagged somewhat and there was a 6- or 8-inch rise from the bridge floor to the road proper.

Natori from Black Star

Japan's Pride, the Wooden Tub, Gets a Rubdown

Soaping and rinsing are done on the platform; the tub is for relaxing. Father, son, mother, and daughter use the same water in that order. American soldiers have yelled on feeling the scalding temperatures. But now both soap and hot water are hard to get (page 504).

The front wheels of the wagon were resting against this rise, and the Jap driver was pushing on one wheel while the horse strained to budge the load.

As the jeep came to a stop, the ragged Jap removed his hat, bowed low, and helplessly repeated, "I am so sorry." The GIs backed the jeep out of the way and the four of them got out. Two of them each pushed on a wheel while the others pushed from the rear. The Jap urged the horse to strain once more, and the wagon moved up the rise and off the bridge, to clear the road.

The GIs gave the Jap a cigarette and climbed back into their jeep as the driver bowed many times, repeating, "Thank you, thank you, thank you."

American Health Program Impresses the Japanese

The Japs cannot help but be favorably impressed by such treatment, and by the conscientious and effective job our men are doing.

The work on health and sanitation, such as DDT dusting, inoculations, and purifying water supplies is also bound to make an impression which should be long remembered, even if such measures are chiefly a protection for our Occupation personnel.

Another amazing thing to the Japanese is

Carl Bakal

On Her Frame a Silk Weaver Creates an Embroidery Effect in Seven Dazzling Colors

Automatic machinery cannot duplicate *tsuzure* tapestry, product of a painstaking Kyoto industry. A day's work is measured in inches; a sash, or *obi*, takes months. This operator duplicates a pattern placed below the fabric. Used like a loom's reed, her right hand's notched fingernails (opposite page) tuck tight the freshly woven weft (transverse threads). In and out of the warp (longitudinal threads) the left hand guides the shuttle, which weaves small motifs as it follows the pattern. Yarn of a single color flows from the shuttle's bobbin, or spool. Since colors change frequently, so must shuttles. Six spares are at hand. Hundreds of hues may be woven in.

the Nisei soldier. As interpreter, of course, the Nisei makes possible communication between our occupiers and the occupied. Without this the task would be exceedingly difficult, if not impossible. But, beyond this, the Nisei are actual examples of American democracy at work, since all who are born in America, regardless of race, color, or national origin, are Americans.

GIs Climb Fuji

A Nisei GI in Japan does much to counteract the exaggerated stories of mistreatment in U. S. relocation centers and of mob violence against these Americans over here which the Japs heard luridly described on their radios during the war.

The Nisei are living proof to the Japanese that American democracy is not necessarily the decadent system depicted in their war propaganda.

Fuji, much photographed, much painted, and well known, is unaffected by the American Occupation, except for the fact that thousands of GIs have made the ascent by now. Scenic shrines and other oft-visited spots such as Ise, Kyoto, Nikko, and Shuzenji are undamaged.

Many peaks, less famous than Fuji, have been even less affected by the Occupation forces. Aso and Kirishima are two of the active volcanoes on Kyushu which we visited. We did not get to the recently erupting volcano near Kagoshima.

Aso, more than 5,000 feet high, is reputed to have the largest crater of any terrestrial volcano in the world. The crater basin is about 12 miles across. The hills surrounding

U. S. Army Signal Corps, Official

Baby Talk in English Fails to Allay the Tears of a Nipper Lost in Sasebo

Americans gave their hearts to the former enemy's children. They found them well behaved. Candy and gum promptly spoiled a few. Mothers appreciated GI interest in their babies, but most fathers remained poker-faced (page 514).

Carl Rakal

For Gripping Silk Threads, a Finger-tip Weaver Files Her Nails Like Saw Teeth

No matter how vexed, she cannot afford to bite her nails, the built-in tools of her trade (opposite page).

the volcano were bare of trees except for recent plantings on the lower slopes.

Fumes and gases of eruptions several hundred years ago had killed all the vegetation, and now only coarse grass grows on the slopes. The Japanese Army had used these grassy slopes for maneuvers and training.

We drove over winding cinder roads, past a U. S. Marine radio and meteorology station, to a Shinto shrine and a Jap weather and volcano laboratory at the end of the road, about a mile from the crater's edge.

Clouds of steam were boiling up from the top of the steep, cindery slope. Since the wind was blowing from us to the crater, we were spared the discomfort of inhaling the sulphurous fumes.

We made many detours to avoid soft-bottomed gullies varying from 2 to 20 feet in depth.

Finally we stood at the edge of the crater and looked down into boiling clouds of vapor rolling out of the tremendous gaping hole and pouring from myriad small openings in the inside wall.

The combination of overcast sky, dark, cindery cone, gray clouds of steam, and strong sulphur odor was climaxed by the sight of a solitary figure of a man in a dark kimono.

He was silhouetted against the sky on the opposite edge of the crater, now visible, now blotted out by clouds of steam, and now visible again.

We learned that he was the priest who tended the shrine at the foot of Aso. Any wavering worshiper could be given a ready glimpse of the Inferno in the priest's backyard.

Kirishima is a long ridge with a pointed conical peak at its eastern end. On this smoking peak, according to Japanese belief, the grandson of Amaterasu, the sun goddess, descended from heaven.

From this august grandson was descended the first Japanese Emperor, Jimmu Tenno; hence the reference to the Emperor as the Son of Heaven.

Remnants of War and Typhoon

The steep eastern shore of southern Kyushu along the Pacific Ocean presents many fine views of fishing villages in little bays and of vertically dipping rock outcrops instead of sandy beach in places.

In this area, as well as on most of Kyushu, can be seen excavations in the hillsides and especially along road embankments. These were dug during the war for gun emplacements, for road blocks, and for shelters and storage places.

Also in this region were many spectacular evidences of damage from the 1945 typhoon. The heavy rain caused a number of landslides, and in many places the washed-out roads were just being repaired. The strong winds had blown down many stands of pine and sugi timber and had destroyed a sizable portion of the season's rice crop.

The much-indented shore of the Inland Sea and its many small tree-covered islands are beautiful to see. The group of islands in the Pacific off Matsushima (Pine Islands) is a national beauty spot.

These islands are small bits of sandstone crowned with the typically Japanese, grotesquely shaped red pine and black pine, *Pinus densiflora* and *Pinus thunbergii*.

Among the "Japanese Alps"

Central Japan, along the Kiso Valley, source of much hydroelectric power, and west to the Sea of Japan has many rugged ridges, the so-called Japanese Alps, which retain their snow late into the summer. Ontake and Komaga Take, at about 10,000 feet, dominate the scenery of the famous Kiso Imperial Forest.

Aside from the mountains, volcanoes, coastal villages, and ocean islands, some of the most scenic aspects of the country are the people themselves at their work, the fishermen in their small boats, the loggers and charcoal burners back in the hills, and the farmers on the terraced hillside patches or muddy valley-floor paddy fields.

The development of a tourist trade which would take Americans and other Allied nationals into backwoods Japan could serve several useful purposes.

The scenic beauty would provide real enjoyment to the tourists; the money spent would give the Japanese badly needed foreign exchange to permit them to buy our products; and exposing the people to foreign peaceful ideas and customs would help promote international understanding.

Such understanding would undoubtedly contribute to the realization of the newly drafted Japanese Constitution's renouncement of war as an instrument of international relations.*

* For full list of articles on Japan and the Japanese Empire in THE GEOGRAPHIC, see "Cumulative Index to the National Geographic Magazine," 1899-1946, especially the following: "Japan and the Pacific," by Joseph C. Grew, April, 1944; "Face of Japan," by W. Robert Moore, December, 1945; "Behind the Mask of Modern Japan," November, 1945, and "Unknown Japan," August, 1942, both by Willard Price; "Geography of Japan," by Walter Weston, July, 1921; and "Japan, Child of the World's Old Age," by William Elliot Griffis, March, 1933.

 Kodachrome by Joint Task Force I

Bikini's First Atomic Bomb Rides at 30,000 Feet in *Dave's Dream*, a B-29

Kodachrome by Joint Task Force 1

11 A Poison Pillar Erupts Within a Doughnut-shaped Cloud Formed by the Condensation Following the Bomb's Blast

III Uranium Explodes with the Power That Lights the Stars. Swift and Silent, Its Mushroom Cloud Rises from Bikini Lagoon

Fleecy Vapor Covers Over-water Bomb's Blinding Fire Ball

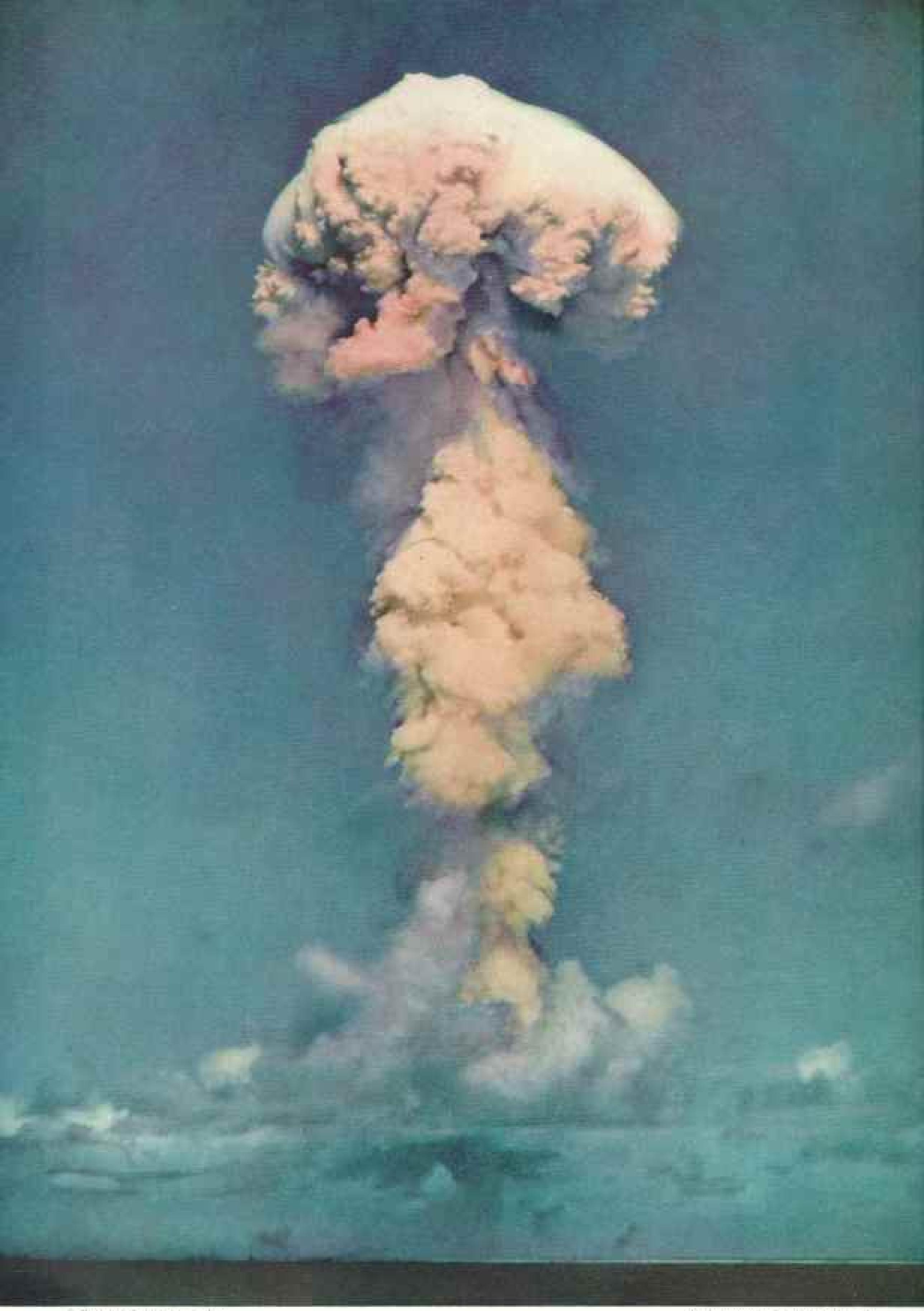
Seen from a pilotless Army plane, the burst of July 1, 1946, is two to three seconds old. Already its hemisphere of fog, genesis of the subsequent doughnut ring (Plate II), is two miles in diameter. Engulfed in mist, a target ship (left) feels the blast of the bomb, which fell 1,500 feet off its aiming point.

So far the natural clouds are untouched by the explosion. Its effect is carried by the air-pressure wave, shown by the opaque circle on the sea, which advances with a velocity greater than that of sound. Outside this circle the sea is calm, its striated surface reflecting only the wind.

A second ago the temperature at the center was in the millions of degrees—comparable to that in the sun's interior, which is around 20,000,000° centigrade. Winds of super-hurricane speed were pushed out by enormous pressures. Radiation equal to that of hundreds of tons of radium spread a slow poison capable of killing the men in a fleet or a city. Distance was the only known safeguard.

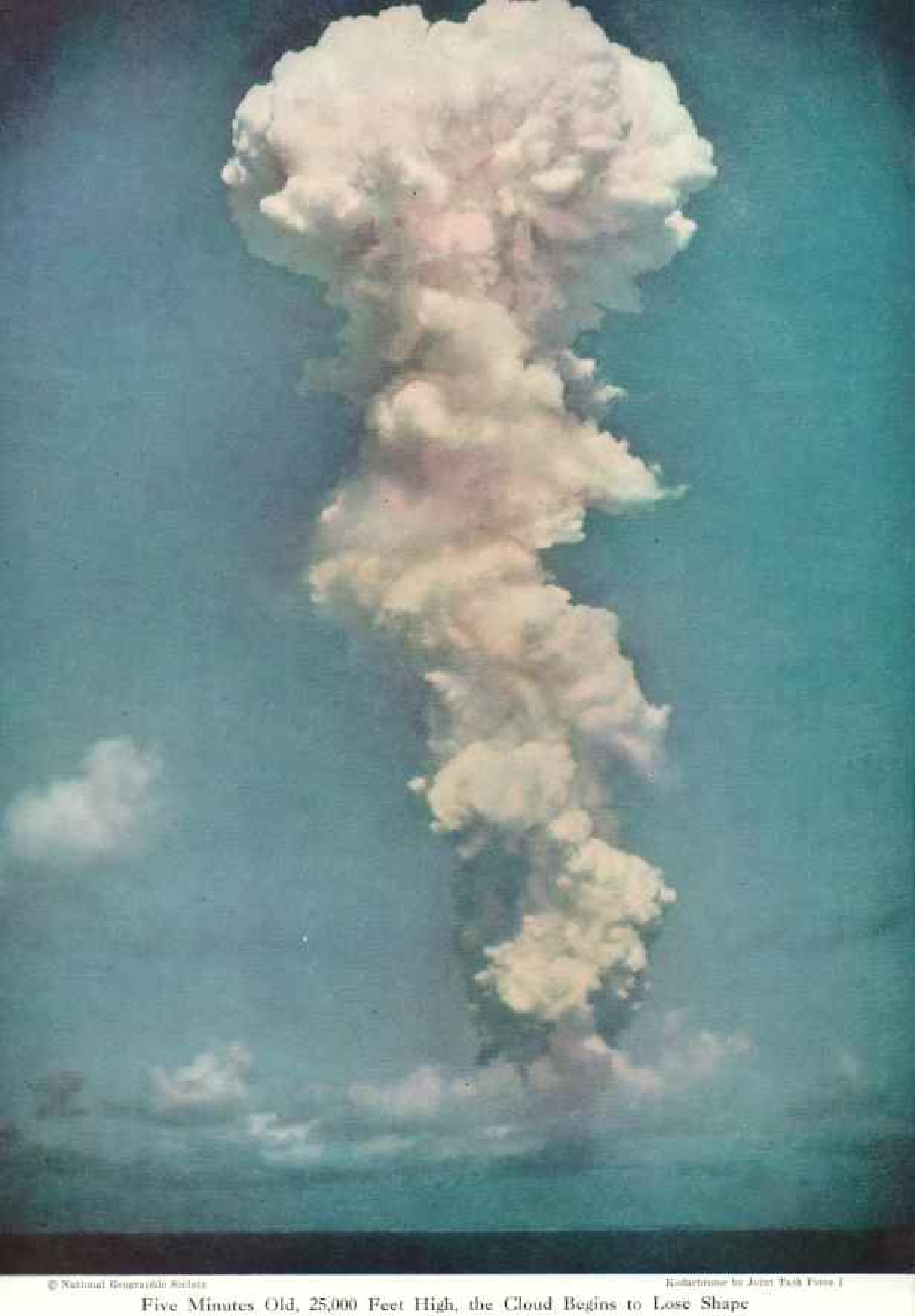
All this potential havoc was accomplished by the splitting of atoms, formerly regarded as the indivisible core of matter. In comparison, the old-fashioned chemical explosion, caused by the splitting of molecules, a conglomeration of atoms, is a gentle puff. If only one pound of uranium derivative had been used in the bomb, it would have had the explosive force of 8,000 tons of TNT. At that, only a thousandth part of the energy latent in every atom was released.

Atom bursting, called fission, is the reverse of fusion, the process going on in the sun, whose powerhouse releases energy by building four hydrogen atoms into one helium atom.



Kodachrome by Joint Task Force 1

Hot, Moist Gases, Cooling at 18,000 Feet, Form an Icy White Cape, as on a Cloud



Kodachrome by Joint Task Force 1

Five Minutes Old, 25,000 Feet High, the Cloud Begins to Lose Shape

© National Geographic Society

Painting by Charles Bittinger, Joint Task Force I

Nitric Oxide Creates Apricot Hues, Ice Cap Reflects the Sky's Blue: an Artist's View

Kodachrome by Joint Task Force I

One Second Old, the Underwater Blast Sends Up a Geyser Weighing 10 Million Tons

Foam Falls in Purple Stalactites Bigger than Battleships

This is Operation Crossroads. It was so named by Vice Admiral W. H. P. Blandy, commander of Joint Task Force I, because, he said, "it was apparent that warfare, perhaps civilization itself, had been brought to a turning point by this revolutionary weapon."

Here on July 25, 1946, the atom's first underwater explosion, as portrayed by the task force artist, an eyewitness, is 45 seconds old. Gravity has taken control of the 4,000-foot column of aerated water. Its high white collar, composed of fog, is so light that it did not even buoy the target ships, but it spread so much contaminated water that they could not be inspected for days. Rear Admiral W. S. Parsons, a deputy task force commander, called the foggy outsurge "a wet caress, a kiss of death."

As a test of radiation's probable effect on crews, some of the 84 target ships are "manned" by a few animals. Distance protects the task force's 42,000 men; not one suffered.

In its downward thrust, the blast pulverized Bikini Lagoon's hard coral bottom; divers later sank to their armpits in ooze.

Drone planes, testing the sky, collected lighter elements resulting from the fission of heavy uranium. Thus they verified the dream of the Dark Ages' gold-hunting alchemists who, using chemical processes, vainly tried to transmute the elements.

How much uranium derivative was exploded remains a secret. However, the fission of only one pound is enough to release 29 thousand billion foot-pounds of energy. This represents the work of ten million husky men climbing Pike's Peak. It is sufficient to hurl a 600-ton projectile to the moon.

Painting by Charles Bittinger, Joint Task Force I

Kodachrome by John Turk Force I

XII An Atomic Volcano Sprays the Target Fleet with Invisible Poison and Sinks Three Capital Ships in One Blow

The Flying Telegraph

By Joseph F. Spears

Lieutenant Colonel, Signal Corps Reserve, U. S. Army

With Illustrations from Official U. S. Army Signal Corps Photographs

IN THIS DAY of such developments as radar contact with the moon and radio guidance of rockets and airplanes, it may surprise many to learn of the high place still held by one of the oldest forms of military communication—the homing pigeon. These silent messengers played their part in many campaigns of World War II.

One such bird was Jungle Joe, a four-month-old pigeon dropped in a parachute container with an American airborne patrol far beyond the Japanese lines in Burma. In the jump the radio operator was lost, and the unit was thus deprived of radio contact with headquarters.

Jungle Joe spent seven days in a small bamboo container while the patrol collected valuable information on Japanese positions and troop movements. Then he was liberated with an urgent and secret message. Flying 225 miles through hawk-infested country and over lofty mountains, he delivered the fateful bit of paper which led to capture of a large section of Burma by Allied troops (page 534).

At another time, an Allied unit operating on the border of Burma and Siam was attacked by overwhelming Japanese forces. All radio codes were destroyed to prevent capture, and the Allied commander in the area lost contact with the retreating unit.

A Mitchell bomber was dispatched with Burma Queen, a five-month-old blue-checked hen, and she was successfully parachuted to the open arms of the troops below. Released with a message at 6 a.m., the bird traveled 320 miles across the Burma mountains, arriving at her loft at 3 p.m. the same day (p. 535).

Burma Queen proved a credit to the Signal Corps by accomplishing her mission despite the fact that she had had only 11 weeks of training and was released 120 miles off the course she had been trained to fly.

GI Joe Saved a Thousand Lives

Another pigeon, GI Joe, is officially credited with saving a thousand Allied soldiers' lives in Italy.

The British 56th Infantry Division had requested air support to aid in breaking the German defense line at the heavily fortified village of Colvi Vecchia on the morning of October 18, 1943. As Allied planes were about to take off on a mission that would have bombed the town off the map, GI Joe arrived with a message stating that the village had been captured by a British infantry brigade. The attack was canceled just in time.

The time on the message revealed that GI Joe had covered the 20-odd miles in as many minutes. Now in retirement at Fort Monmouth, New Jersey, he recently was taken to England to receive the Dickin Medal from the Lord Mayor of London. He was the first non-British bird or animal to win the award, equal to a Victoria Cross for humans.

On Guadalcanal a signalman received a message from an officer, folded it, tucked it into a plastic capsule, fastened the capsule to the leg of one Blackie Halligan, homing pigeon, Army of the United States, and released him into a fusillade of Japanese fire.

Fragments of steel tore into the pigeon and knocked him down into the tortuous thorn and scrub land. The message failed to arrive on time; it should have taken twenty minutes. But five hours later, maimed and bloody, split down the middle, Blackie reached his trailer loft, still bearing his message.

In French Morocco a blue-checked pigeon named Lady Astor flew 90 miles to deliver an important tactical message. When she dropped exhausted into a Signal Corps loft she had been shot twice through the crop and once through the wing.

News by "Pigeongram"

Members of the armed forces were not the only ones to recognize these winged couriers. War correspondents frequently used the birds when they lacked other means of communication.

During the war, articles in daily newspapers sometimes bore the statement in the dateline, "via pigeon." Behind this terse notation was often a story as gripping as the news that was printed.

In North Africa, David Brown, war correspondent of the British news agency, Reuters, sent the following pigeongram:

ITALIANS STARTED EVACUATION OF GAFSA ONLY HALF HOUR POST FORMAL ATTACK UNDERWAY TEN O'CLOCK MOVING TOWARDS EL GUETTAR AMERICANS MOVED INTO GAFSA AGAINST ONLY LIGHT REARGUARD RESISTANCE ABOUT ELEVEN O'CLOCK. SIGNED BROWN, REUTERS CORRESPONDENT.

At the Desert Training Center in California a Tank Commander "Single Tosses" a Pigeon

In training, the birds are often released singly, but in combat operations "double tossing" is the rule, one bird carrying the original message and the other a duplicate. Army experience shows that pigeons like company and work best when released in pairs. The homers enable armored spearheads to operate under radio silence.

In bringing this first news of the fall of Gafsa, the pigeon Yank made a 90-mile flight in 110 minutes. Yank further proved his worth by carrying several urgent messages later in the African campaign.

For another war correspondent a blue-checked cock, No. 783, carried the following message forty miles in forty minutes: "Enemy evacuating Tebourba Tunisward." This was the outside world's first word of the fall of the Tunisian town, which climaxed several days of hard fighting and paved the way for Allied capture of Bizerte and Tunis.

These are only a few of the thousands of wartime achievements of homing pigeons. One pigeon company alone delivered six thousand messages in a month.

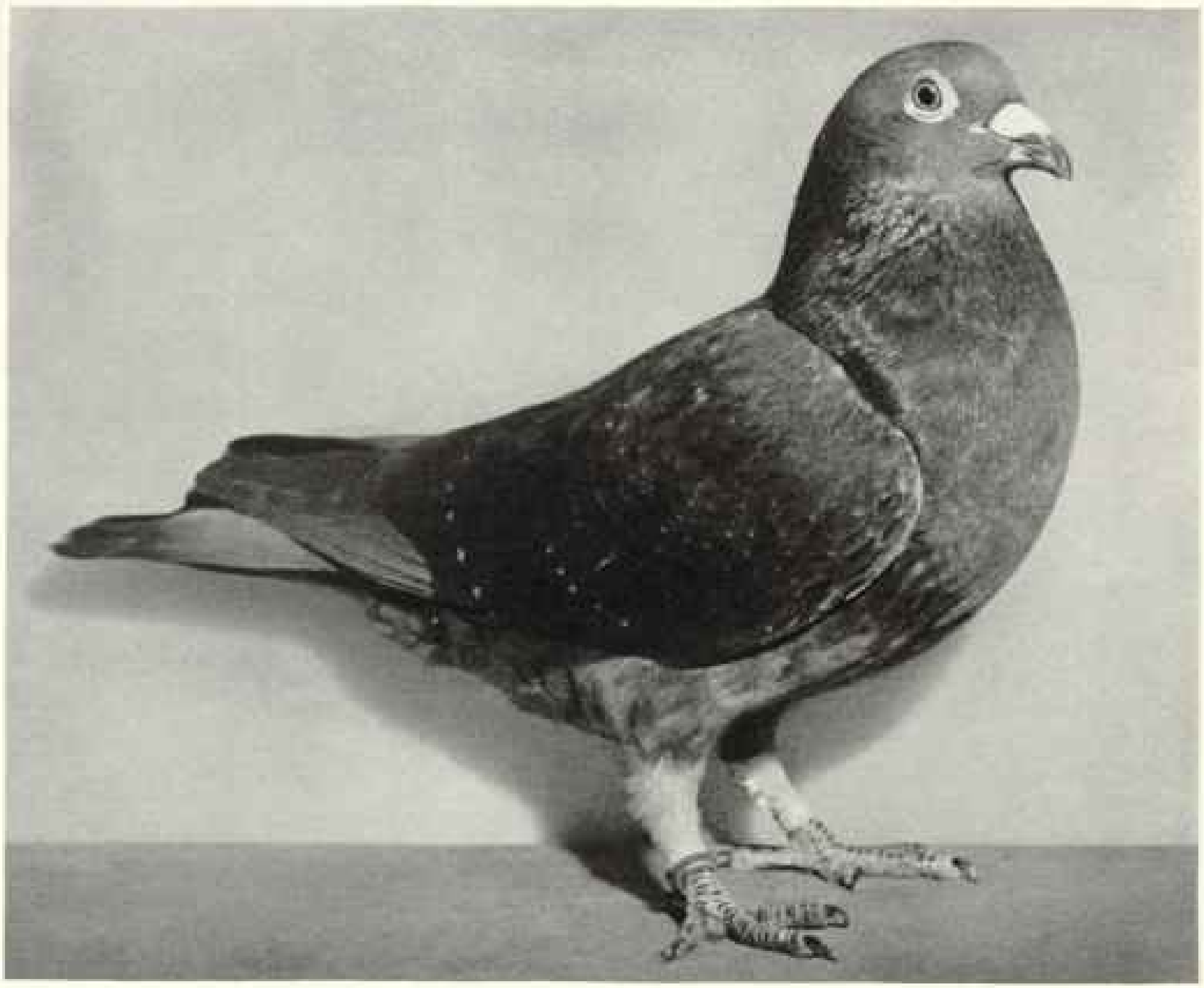
At the close of World War II, the Signal Corps Army Pigeon Service had trained more than 3,000 enlisted men and 150 officers in the technique of schooling and handling the birds. American pigeon companies, platoons, and detachments served in all theaters of operations. Much of their work related to behind-the-lines activities of our Office of Strategic Services.

The pigeon in the Army, like its human civilian counterpart, undergoes an immense change. Its home is changed, its habits are modified, its duties are new and strange. The bird must be especially trained and made to fit a specialized job, depending upon the branch of service to which it is assigned.

As the homing pigeon learns its duty it may ride in a jeep or aboard a ship, fly in an airplane, be carried on a man's back or on a war dog's shoulders, or go on a

Wing Feathers Open and Close at Every Stroke

How each feather plays its part is revealed by the camera's split-second eye. As the pigeon's wings are raised in the upstroke (top picture), feathers open for minimum air resistance (2 and 3), much as an oarsman feathers an oar or an airplane pilot feathers the propeller of a useless engine. In the downstroke (bottom) all wing feathers are closed.



"Private Jungle Joe Reporting, Sir"

When only four months old, this sturdy bird was dropped with an airborne patrol behind the Japanese lines in Burma. Released, he flew 225 miles over some of the country's highest mountains to deliver an urgent and secret message that was responsible for opening a large section of Burma to Allied troops (page 531).

secret mission in a manner which even yet cannot be disclosed. Wherever the Army, the Navy, the Coast Guard, or the Marines go, a pigeon may go also.

70-Mile-an-hour Speeds

During the war the Army Pigeon Service trained 54,000 homers, of which 36,000 were sent abroad for active duty.

Great advances were made in training the birds. Speeds and distances achieved by homers used in our military services have steadily increased. Now flights of 500 miles a day and speeds of more than 70 miles an hour under ideal conditions are not uncommon among the better-trained Army pigeons.

During World War I, the pigeoneer was happy to have 90 percent of his birds return to their home loft. Today the pigeoneer would be greatly disappointed if he did not receive returns of more than 98 percent.

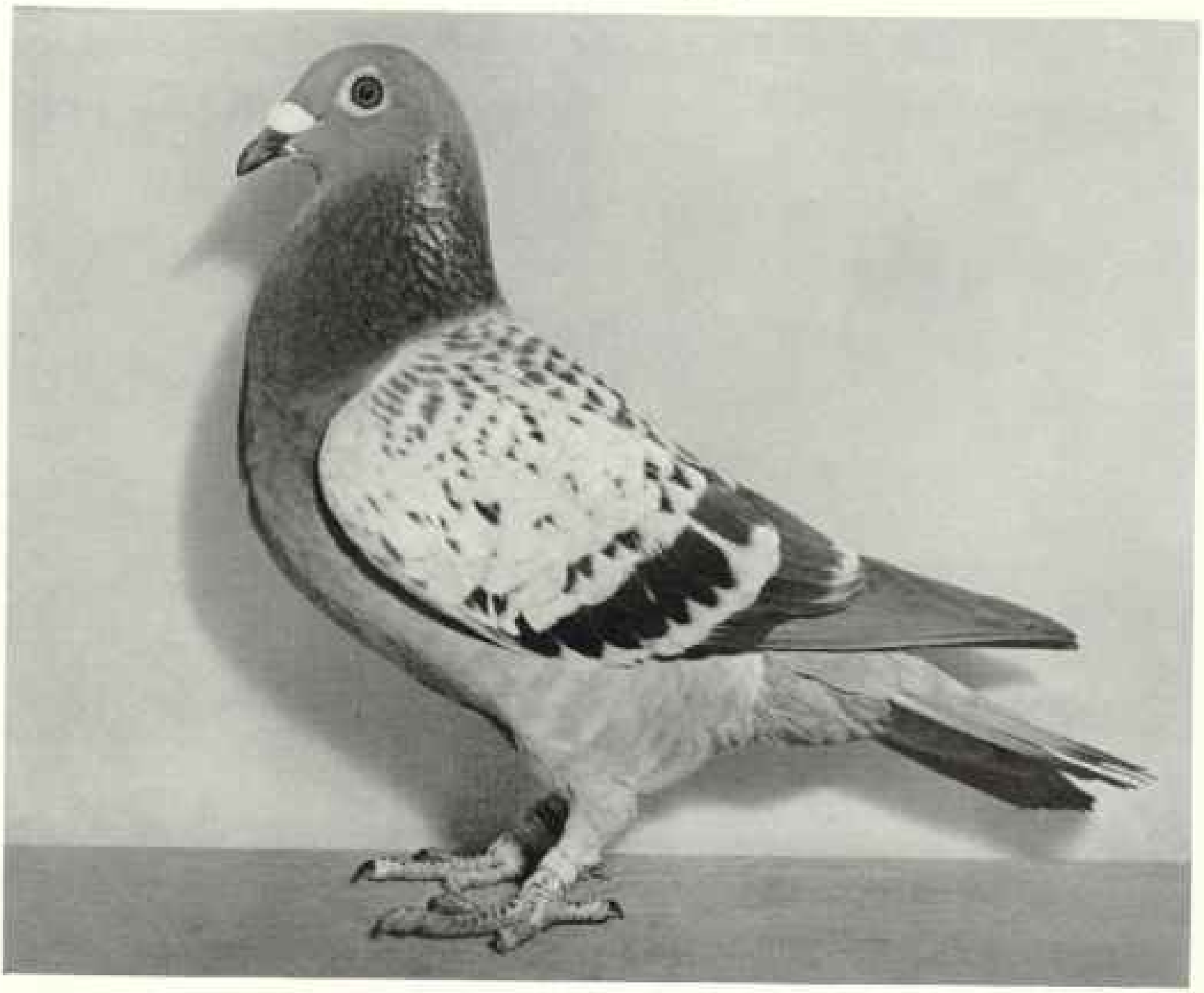
Since Noah sent out the dove which returned to the Ark with an olive leaf the "flying telegraph" has been delivering information.*

The use of pigeons to carry messages is as old as Solomon and the ancient Greeks, who probably learned the art of training pigeons from the Persians. The names of Greek Olympic victors were carried back to their various cities by pigeons with homing instincts.

In the time of the Romans, Pliny writes, immense prices were given for pigeons. "Nay, they are come to this pass, that they can reckon up their pedigree and race."

Documentary evidence of the use of the homing pigeon in war dates from 43 B. C. when Brutus was besieged in Mutina (Modena) by Mark Antony, and the consuls Hirtius and Pansa, with Octavianus, came to raise the siege. The consuls communicated with Brutus

* See "Man's Feathered Friends of Longest Standing," by Elisha Hanson, National Geographic Magazine, January, 1926.



Burma Queen Flew 320 Miles Through Burmese Mountains in Nine Hours

This feathered heroine, a blue-checked hen, brought word of the plight of an Allied unit hard-pressed by Japs in the Burma-Siam border area (page 531). Both sexes make good couriers. Female homers weigh 15 to 16 ounces and males 14 to 17, with a larger head, bill, legs, and feet, broader shoulders, and stronger neck.

by pigeons, which flew over the heads of the besiegers.

An actual pigeon post was established in Baghdad by the Sultan in 1150.

Pigeons were regularly used by the Saracens during the Crusades, and when King Louis IX of France invaded Egypt in 1249, his arrival at Damietta was reported by pigeon to the Sultan at Cairo.

At the siege of Haarlem in 1573, William of Orange sent homing pigeons to encourage the defenders. One fell into the hands of the Spaniards, who thenceforward tried to kill every bird flying near their camp.

During the months of the Siege of Paris in the Franco-Prussian War of 1870-71, some 150,000 official and a million private messages were carried into the city by the winged couriers. Many pigeons were sent out by balloon. By use of microphotography, a single bird could carry films bearing the equivalent of 40,000 messages. Letters and even newspapers thus photographed were enlarged and read by magic lantern.

First Military Pigeon Lofts

This effective use of the homing pigeon brought the bird international note, and Germany became one of the first nations to establish military pigeon lofts.

Pigeons were introduced into the United States Army in 1878 when the Signal Officer purchased some from a Philadelphia fancier for Col. Nelson A. Miles, commanding the 5th Infantry Regiment in the Dakotas. However, inexperience and the prevalence of hawks were almost insurmountable handicaps in the Indian country of the West. Later experiments at Key West, Florida, and along the Mexican border were only partially successful.

Up until World War I, no organized pigeon service existed in our Army. The use of pigeons had been left to individual commanders. In July, 1917, Gen. John J. Per-

Poker-faced, a Pigeon Suffers a Message to Be Affixed

Side openings in this standard Army container enable the pigeoneer to attach the message capsule of light plastic to the messenger's leg before the dowel door is raised. The pigeon is then allowed to leave of its own volition. These containers are made in two-bird and four-bird sizes, each pigeon having its own compartment. Here shown is the larger type.

sling, Commander in Chief of the American Expeditionary Forces, sent a cablegram strongly urging immediate establishment of a pigeon service, and his Chief Signal Officer cited French, British, and German use of pigeons in declaring, "There is no longer any doubt of the immense import of this service."

Pigeons thus became a regular part of our military establishment, and several birds won a place among the immortal heroes of World War I.

Outstanding were Cher Ami, which brought word of the plight of the "Lost Battalion," flying 40 kilometers (25 miles) in 25 minutes with one leg shattered by shrapnel and a hole through his breast; and President Wilson, which also lost a leg in fulfilling his mission. Their bodies were mounted and are on exhibition at the Smithsonian Institution, Washington, D. C.

The Mocker, another war-wounded hero, was awarded the Distinguished Service Cross and the French Croix de Guerre. Though the normal life span of a pigeon is five to eight years, he lived to be 21.

The Kaiser, Pigeon Methuselah

Even more of a Methuselah is the now world-famous bird, The Kaiser. As a youngster this German military pigeon was captured when the Yanks stormed a front-line trench during the Meuse offensive of 1918.

The bird was brought to this country after the war, and today, despite his 30 years—comparable to 135 in a man—he is still fathering some of the Army's finest homing pigeons. The longevity record of the hardy bird has pigeon fanciers stumped.

The Kaiser still wears a seamless aluminum identification band bearing the seal of the German Imperial Crown. He lives apart from the other birds, in a little white loft with his mate, Lady Belle. His home is equipped with an electric heater.

During World War II, a number of German Army birds were captured and are now stationed at Fort Monmouth. But it is reported that The Kaiser has become so indoctrinated with the American way of life that he will have nothing to do with these prisoners of war!

Some months ago The Kaiser became very ill, and it was feared he did not have long to live. Army officials made arrangements with

Dr. Alexander Wetmore, Secretary of the Smithsonian Institution, to have the bird mounted when he passed away. But the expert treatment of one of the Army's best avian pathologists brought him through, and today he is alive and healthy to celebrate his thirtieth birthday.

Homing Ability Improved by Training

In recent years probably no other Army in the world has devoted as much effort and care to the training of homing pigeons as has our own. Similar work is carried on by our Navy, which attained considerable success in experiments with homing pigeons as long ago as 1897.

Men handling the birds are selected for their gentleness and patience. The task of training and caring for our birds in wartime was a seven-day-a-week job, with work starting before sunup and continuing after sundown. The reward of the pigeoneer lay in the hope that some day the results of his long, hard work might save a life or deliver a message of vital importance.

The homing pigeon used by the Army for signal communication is a distinct variety, created through careful crossbreeding aimed at obtaining maximum distance and speed in controlled and direct flight.

A good homing pigeon should have a short, sturdy figure, a broad breast, and light, narrow hind parts. When viewed from above, its outline approximates an equilateral triangle. The legs should be relatively short, the wings well muscled.

Color is of little importance, but rich shades standing out distinct and bright are a good indication that the bird is healthy and in satisfactory condition. I have found it usually wise to avoid white or very light-colored pigeons, since they are more readily seen by birds of prey. A full-grown cock bird should weigh from 14 to 17 ounces, and a hen from 13 to 16 ounces.

Not "Bombs Away" but "Birds Away" Will Be the Cry This Time

Bomb racks find a new use in this bomber over the Burma area. Two crates of pigeons are placed in the racks for parachuting to troops below. Both Jungle Joe and Burma Queen, whose great flights over Burma's jungle and mountains were among the highlights of pigeon performance in World War II, were dropped by parachute (pages 531, 534, 535).

Marital Kiss Seals Union

A cock seeking a mate crows, struts, spreads his tail, and otherwise shows off before the hen he has selected. If the hen accepts him as her mate, a marital kiss ensues. The cock opens his beak, and the hen places her beak in his, thus sealing their union.

Instead of letting Nature take its course,

Young Homers "Pigeonhole" Themselves in a Mobile Army Loft

Each remembers the location of its nest, and pigeoneers say the birds fly better if not changed to another.

Even Though Their Loft Moves Every Day, They Still Find Their Way Home

In the type of training required for the highly mobile operations of World War II, Army trainers released the young birds in late afternoon without their usual feeding. Such flights familiarize them with the vicinity, but since they are hungry and night is near they do not fly far. At first the trailer loft is moved only about a mile a day, but the distance is soon increased (page 543).

most pigeon breeders select mates for their birds, thereby blending the most desirable characteristics of their flock. Pigeons are monogamous and once mated will usually stay paired for life.

Breeders generally allow their pigeons to raise no more than three "rounds" a year. The time varies with climate, but we usually mated our birds in February, March, and April. After mating, nest bowls of earthenware or pressed wood pulp are placed in each compartment, with tobacco stems and other nesting materials such as wood shavings near by.

Parents Have Schedule as "Sitters"

Two eggs form a setting. The first is laid in the afternoon of the seventh to the tenth day after nesting has started; the second about 44 hours later. Danger of one youngster being much larger and killing the other is avoided when the parents do not cover the first egg until the second is laid. Then both may hatch within an hour of each other (page 541). The incubation period is from 17 to 18 days.

Both parents take turns sitting on the eggs. The hen sits from about 4 in the afternoon until 10 the next morning. The male bird sits the remainder of the day. Both parents feed their youngsters by regurgitation of the substance known as pigeon's milk.

When the young are five to six weeks of age they are vaccinated against pigeon pox, one common disease of these birds. This is done by plucking five or six feathers from the breast and brushing the vaccine into the follicles.

All pigeons except those specifically reserved for breeding purposes undergo training from the time they are 28 days old until they are of no further value as message carriers. In the process some are weeded out, for regardless of how good the parent stock is, a proportion

With a Final Stroke of Its Weary Wings a Homing Pigeon Prepares to Alight

Hunger and reproduction are the basic urges that bring the birds home. But how they find their way is still a mystery (p. 550). Pigeons are monogamous, and desire to return to the mate is believed to be often stronger than hunger. Introducing a rival to make the bird return in jealous haste is unnecessary, says the author (p. 545).

Housing Conditions Grow Crowded as Youngsters Eat Almost Their Weight Each Day

Squabs double their weight in the first 48 hours. For two or three days they eat only pigeon's milk, a curdlike substance from the crop of both parents; but soon this soft food is mixed with grain, also from the parents' crops. Feathers appear about the sixth or seventh day, replacing fine, yellow, hairlike down. "Twins" are the rule, often hatched almost simultaneously (page 539). These squabs with their mother at Camp Crowder, Missouri, are 8-day-old homing pigeons.

of the progeny is found unsuitable for messenger service.

The marvelous ability to return home from long distances is an inherited gift of Nature. But to develop it to highest pitch and make it of maximum use to man, constant training is necessary.

Before the youngsters can fly they are allowed access to the settling cage or aviary to acquaint themselves with the surrounding territory. At the age of 28 days they are released for short flights in the vicinity of their loft.

As soon as these young birds are sufficiently strong on the wing, they are placed in a basket and taken to progressively more distant points until they are able to fly 100 miles. The points of release should be in the same general direction from which the birds are expected to fly in line of duty.

Each time the birds approach their loft their trainer coaxes them to land and enter as speedily as possible. This is done by giving a low whistle and rattling a tin can containing feed. As soon as the bird enters the loft he is rewarded with his favorite grain.

When the training of youngsters is started, it must be continued daily, weather permitting. The pigeoneer must take full advantage of favorable weather, since exhaustion from bucking bad weather retards the development and impairs the courage of the growing youngster.

We normally divide the training of homers into two categories—short-distance and long-distance flying. Young birds, or yearlings, are trained to fly up to 100 miles. Exceptionally promising youngsters, however, are sometimes flown to a distance of 500 miles in their first year.

As the bird grows older, the training becomes more strenuous until he is able to fly up to 1,000 miles. Pigeons kept in good condition can usually make long-distance flights until they are five to seven years old.

Mobile War Put Pigeons on Wheels

With the outbreak of World War II, however, it was found that training pigeons to "home" to a permanent stationary loft was not enough. Tactics and techniques of fighting had been drastically changed. In this new warfare major emphasis was placed on rapid mobility.

To keep pace with fast-moving modern war

Eight Pigeons Are About to Take to the Air—but Not to Fly

As the paratroop sergeant tosses out the container, a small parachute will open and carry them to earth. Drops should be made from altitudes of 200 to 1,000 feet and the plane's air speed should not be more than 125 miles an hour; otherwise the birds might be lost by drifting too far or injured by air blast.

Lest Radio Betray Their Position, Paratroops Use the Flying Telegraph

None the worse for their parachute ride to earth, homing pigeons take off with messages reporting the landing of paratroopers in training at Lawson Field, Georgia. Collapsible, cylinder-type parachute equipment is made in two sizes, for four or eight birds, with 6-foot or 9-foot chute.

we started developing mobile lofts, and by early 1942 we had devised a 50-pigeon trailer that could be pulled by a jeep (pages 538, 539, 546).

This was a revolutionary idea in the technique of training birds. Pigeons actually had become tourists, and their home was wherever the trailer and jeep might be parked. Our job now was to train them to return to a home that was frequently on the move. Nobly the pigeons rose to the occasion.

Under the system we developed, mobile training starts as soon as the bird leaves its nest. The pigeoneer spends much time in the loft, feeding and watering the youngsters, to make them as tame as possible.

As soon as the birds are able to try their wings they are released in late afternoon without their customary feeding. Since they are hungry and dark is approaching, the birds do not wander far, but they get a good chance to observe the surrounding territory.

During this training period the mobile loft is never allowed to remain in the same location more than one day, but in the early phases it is moved only short distances—about a mile. As the pigeons become stronger on the wing, these moves are increased up to five miles and care is taken not to move to the same location twice.

This method of training gives a commander pigeon communication on short notice. A mobile loft is moved to the new location and on the first evening the birds are placed in baskets and released from short distances. By the end of the fifth day the pigeoneer can give his commander communications from points 50 to 100 miles away.

Time and again, through the untiring efforts of Signal Corps men, these birds have been trained to home longer distances to new locations in as little as seven or eight days after arrival.

Night Flight

Pigeons have even been trained to carry messages at night. Patience and persistence succeeded in inducing them to reverse their living habits and sleep by day and fly after dark.

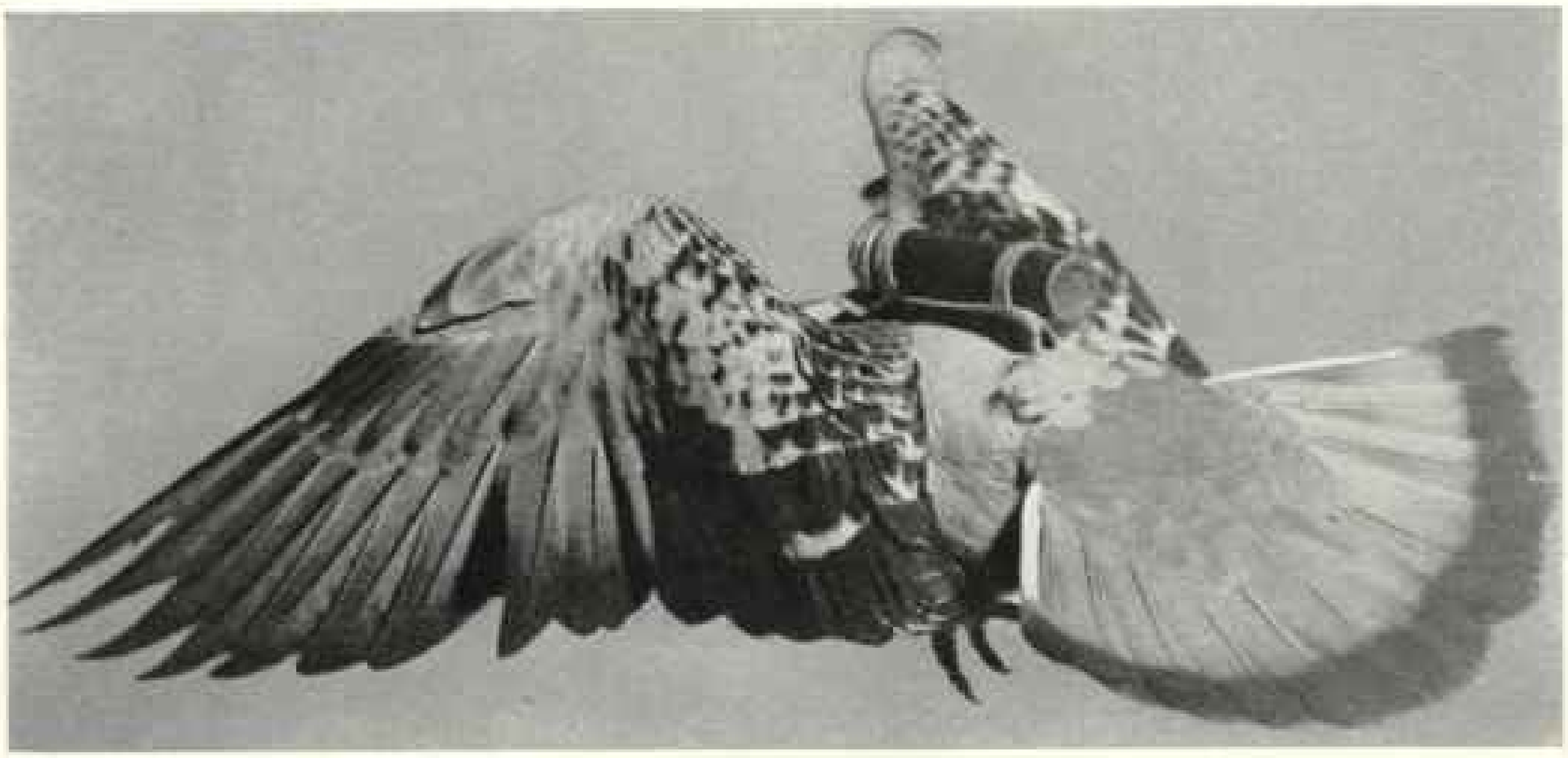
Another achievement of specialized training was the development of two-way pigeons for back-and-forth flights. This was accomplished by allowing pigeons to feed at one point and obtain water and sleep at another.

In our training—at least officially—we did

U. S. Navy, Official.

Firm but Gentle Is the Launching Hold of the Seasoned Pigeoneer

About to release the bird from the rear door of the Navy's nonrigid airship *K-2*, this lad holds it in the approved manner—thumbs over the back and the bird's legs held between the first two fingers of the right hand. Pigeons survive at altitudes where humans would die without supplemental oxygen (pages 551, 553).



For Bulky Loads a Back Saddle Message Holder May Be Used

Far more common, however, is the plastic capsule attached to the leg (page 536). At the high speeds these birds attain, the inanimate rider sets up considerable wind resistance. Note how every feather is doing its job. On a long, hard flight a single feather missing from wings or tail would be a serious handicap.

This Fine Handful of Pigeon Has Been Selected for Breeding

"When the bird's body is drawn through the hand, it should have the feel of satin stretched upon wood," says Wendell M. Levi in his standard work, *The Pigeon*. On the leg of this bird at Camp Crowder, Missouri, is the Army's metal identification band, affixed soon after hatching.

not use the intriguing if fanciful method which some have suggested for inducing return by making use of the power of jealousy—showing the pigeon his mate billing and cooing with a rival before sending him away. The monogamous habits of the pigeon make such measures of doubtful value, and if the bird is well trained an added incentive is unnecessary.

Like race horses, prize fighters, football players, or any other athletic performer requiring physical endurance, homing pigeons must be kept in perfect physical condition. Sanitation is most important to prevent disease and parasites.

A Pigeon Drinks Like a Horse

Plenty of water must be kept in the loft, since pigeons relish a good drink and also like to bathe frequently, particularly in warm weather (page 550).

The pigeon does not drink as most birds do. Instead of dipping its beak and tilting

Many a Homer Fell under the Talons of This Hawk

Two American soldiers in France display a hawk that finally made the mistake of coming too near the loft. Predatory birds give much trouble to pigeoneers. These men carry carbines, but shotguns are provided for loft defense. Bold, hungry raiders sometimes fly against the protective mesh (page 548).

Rudy Arnold

"O.K., Little Fellows, You Tell 'Em Where We Are"

In the basket of a Navy free balloon a crew member prepares to release two of the four birds which form the only link with home. Pigeons, always on the job, sleep little if at all. A noted fancier reports that in more than 40 years of breeding them he has never seen one with its eyes closed unless it was sick or exhausted.

Disinfecting Removes a Pigeon's Nonpaying Passengers

If parasites are not controlled they may impair a bird's health and efficiency. The soldiers are using the dip method, soaking the feathers in a sodium-fluoride solution and even immersing the head for an instant with beak and nostrils held shut. The method is used only on warm, sunny days when the pigeon will dry before night. At other times the louse killer is applied in powder form.

its head back daintily, it thrusts its beak deep into the water and takes long, deep draughts like a horse.

Consequently, a drinking fountain must provide a depth of an inch and a half to two inches of water at all times.

I have heard of pigeons swooping down over a river or lake while in flight and scooping up water in their beaks, after the manner of swallows, but this is unusual.

Overfeeding is a frequent error of the novice and may result in spoiling a good pigeon. Too much food makes the birds listless and sluggish.

During training, pigeons should be fed only twice daily—lightly in the morning and more abundantly after their return in the evening. If more than one training flight is made in a day, birds should be rewarded after each flight with a few grains of their choice feed. The pigeon's diet consists of leguminous seeds, cereal grains, green foods, and grit.

Birds of Prey Often Attack Homers

The principal birds of prey that attack pigeons are falcons, hawks, eagles, and kites. In the falcon the pigeon has one of its most terrible enemies, astute, strong, and ferocious. Generally the pigeon can escape by use of its speed and evasiveness, but frequently one of our birds arrived at the loft torn and bleeding from such an aerial attack.

In areas heavily infested with predators the Army Pigeon Service provides each loft with a shotgun for protection of its flock (page 546).

I have seen the sharp-shinned and Cooper's hawks lie in wait for a flock of birds about to be released, and in several cases, when the hawks were apparently desperate for food, I have seen them even fly into the wire mesh on the aviary in an attempt to secure their meal.

Losses from hawks generally occur when pigeons are in training. The older and better trained the pigeons are, the fewer losses there will be. Well-trained birds are alert and bold. They leave promptly when released, fly fast, and dive or take other evasive action quickly in case of danger.

Probably the question most frequently asked about homing pigeons is, "Why do they always come home?"

Most birds, some mammals, and some insects have an unexplained ability to find their way to distant points. Man has long been awed by the mysterious way in which ducks, geese, terns, and plovers make accurate flights of thousands of miles during the migration season. Some bats have a similar ability.* In the homing pigeon, however, this faculty is developed to the highest degree.

U. S. Navy, Official

Balloon Comes Down, Pigeon Goes Up

Off goes the winged courier with a message reporting the landing of a free balloon from the United States Naval Air Station at Lakehurst, New Jersey. Our Navy, as well as the Army, makes extensive use of homing pigeons. This bird has been tossed by hand instead of being allowed to leave the box of its own accord (page 536).

Pigeons Have Returned Thousands of Miles

Pigeons appear to have a memory that would put the proverbial elephant to shame. Pigeon fanciers frequently sell fine breeding stock to brother fanciers throughout the world, and such birds are usually kept prisoners for life lest they return to their home loft. There are numerous records of birds escaping after eight or ten years and returning hundreds of miles—sometimes over a thousand—to their original home loft.

A pigeon fancier in Elmont, Long Island, New York, sold one of his fine breeders to a ship captain from Caracas, Venezuela. Several months later this bird escaped and returned 3,000 miles to her original owner on Long Island.

Perhaps the most remarkable flight on record is the 7,200-mile journey made by a homing pigeon from Arras, France, to its home in Saigon, Indochina.

To explain such mysteries pigeon fanciers have suggested various theories, including memory, light rays, air currents, magnetic fields, radio waves, and many others, none of which has stood the test of scientific investigation.

Radio Waves Had No Effect

After hearing numerous reports that pigeons become confused when released in the vicinity of radio stations, I conducted several experiments to determine what effect high- and low-frequency radio waves had on the pigeons' homing ability. This was done at Fort Monmouth, New Jersey, home of the Army Pigeon Service, where every conceivable experiment in radio, radar, and other electrical communication devices was being conducted within

* See "Our Greatest Travelers," by Frederick C. Lincoln, in the National Geographic Society's *Book of Birds*, and "Mystery Mammals of the Twilight," by Donald R. Griffin, National Geographic Magazine, July, 1946.

Chickens May Be Satisfied with Dust, but Pigeons Demand Bath Water

Healthy homers delight in a dip; hence, when one declines to bathe, the wise pigeoneer knows it is sick and isolates it for treatment. White scum on the bath water is "milt" washed out of the feathers. This white, chalky powder helps make the feathers rain-resistant and enables the pigeon to fly through any but heavy and prolonged rainstorms (page 551).

a few hundred yards of the pigeon lofts.

Though I maintained a loft and trained pigeons in the immediate vicinity of a most active radio station for several months, not once did we encounter any difficulty in our training program.

On the other hand, I had one experience which still has me mystified. Veteran pigeon fanciers had told me they had found certain locations, which they termed magnetic fields, through which pigeons could not fly and maintain their sense of direction. I dismissed this as just another story until I tried to train birds in Penn State Forest, New Jersey.

In this location the pigeons would fly around crazily and when released at distant points they would sometimes never return to their home loft. Those that did return were hours late. We finally had to move about five miles away before training could be satisfactorily accomplished.

Later a radio team, training for overseas, moved into this same location and experienced difficulty in sending and receiving radio signals.

The Mystery of Homing

Some investigators feel that the answer to the mystery of homing lies in the extremely keen eyesight of this bird. We know that its vision is very acute and plays a large part in its training.

I can well understand how eyesight could be connected with the pigeon's ability to find its way over short distances and over ground it had previously flown. But when a pigeon is placed in a container from which it cannot see, is shipped a thousand miles in a closed express car, and subsequently flies home over territory it has never before seen, or when the bird is released from a ship 300 miles at sea where no landmarks exist, I

Its Home Is Hidden from the Airman's Eye; Yet the Homer Flies Straight to It

A pigeon with a message comes in for a landing at its loft, which is camouflaged with evergreens. Almost immediately the bird will "trap," entering the loft through a one-way door, and the message will be removed. How the bird can return hundreds of miles to its small and obscure home is one of Nature's most challenging mysteries (page 549). To develop the ability to highest pitch, intensive training is necessary.

cannot see how vision can be the answer.

After having most theories disproved, many people fall back on a stock phrase and conclude that the homing pigeon has a "sixth sense" by which the bird simply "knows" the direction to fly.

Out of the confusion appear certain facts: To fly long distances to its home loft successfully, a pigeon must be a progeny of parents of proved homing ability. It must have intelligence. It must be physically fit, and it must be trained.

And if you still ask, "Why does the pigeon always come home?" I can only answer: "That, my friend, is something you will have to ask the pigeon."

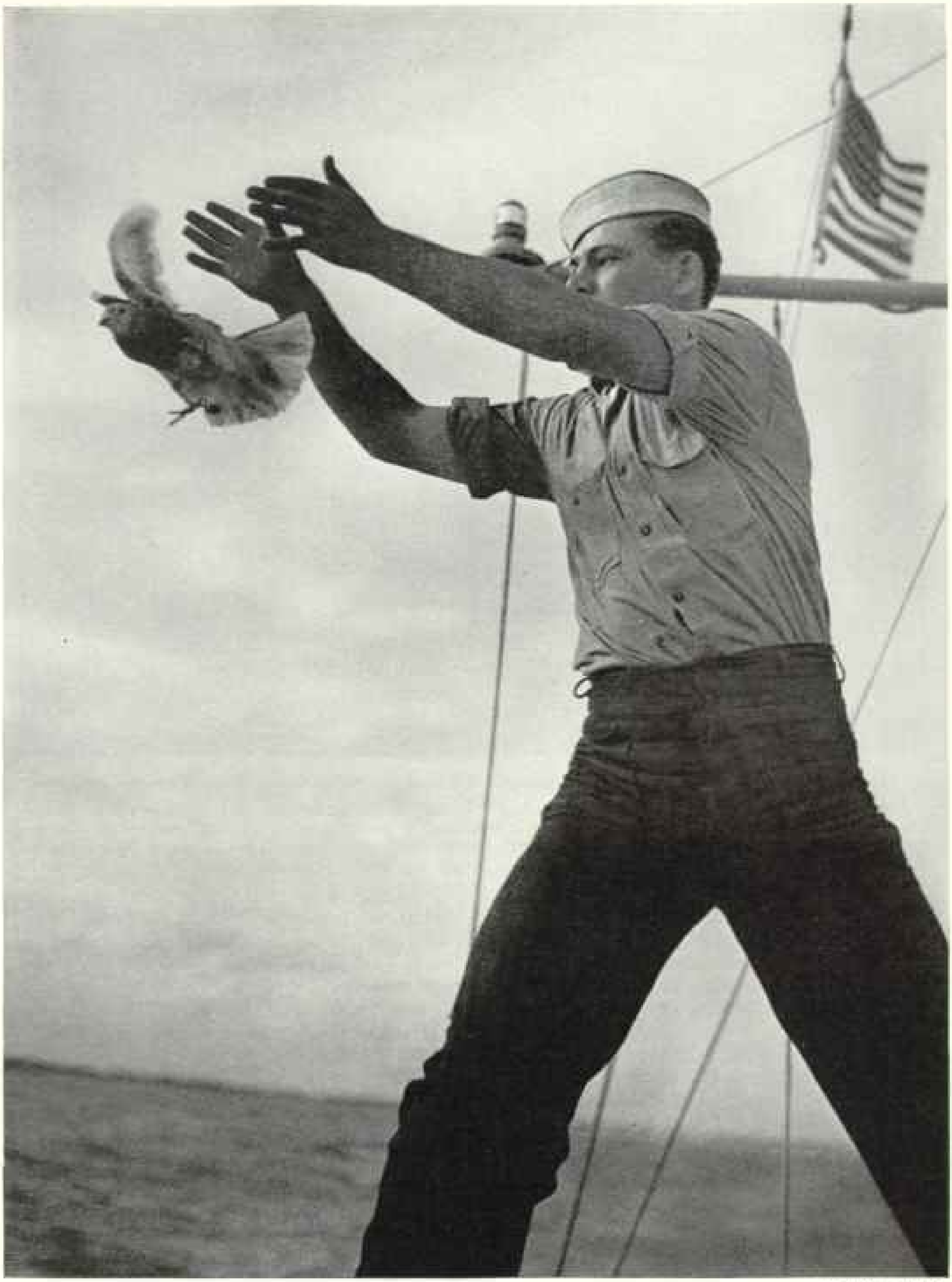
Well Protected Against the Elements

Light showers and misting rains have little effect upon a pigeon's ability to fly, since the feathers are protected by a white coating known as "milt" or "bloom." Heavy and prolonged rains, however, will decrease a pigeon's efficiency and may finally force the bird to land.

Snow, sleet, and hail, too, have an adverse effect, but low temperatures alone are no particular hazard. Since the pigeon's normal body temperature is about 107.2° F., it possesses sufficient warmth and energy to operate under extremely cold conditions.

When head winds are encountered, pigeons, like many other birds, will reduce altitude and fly as near the ground or water as possible. I have watched birds released at sea fly high above the ship and then descend and copy near-by gulls by flying just over the crests of waves, sometimes even going out of sight in the trough of the wave.

Pigeons normally fly at only about 600 feet, but our experiments in conjunction with the Army Air Forces show that the birds can



U. S. Navy, Official

Though a Landlubber, the Pigeon Will Fly over Water if It Must

Training birds for over-water flight for World War II's amphibious fighting, the author found that pigeons made a beeline for home when released at sea. Inducing them to fly from shore to ship or from island to island proved harder (page 554). This bird is being launched from a Navy YP boat, a patrol craft dubbed a "Yippee."

Harold E. Edgerton and Kenneth J. Germeshausen

High-speed Photography "Freezes" a Pigeon at the Moment of Launching

In this photograph, taken at 1/50,000th of a second, the wings are making a fast downward stroke as the bird seeks to gain altitude. Wing feathers are closed tightly against each other to keep the air from slipping through as it does on the upstroke (page 533). Speeds of 70 miles an hour or more are attained by well-trained pigeons under favorable wind and weather conditions (page 534).

withstand tremendously high altitudes without supplemental oxygen.

First we took the pigeons up to 15,000 feet. They suffered no ill effects. The altitude was then increased to 20,000, next to 30,000, and finally to 35,000 feet, with the temperature 45° below zero.

The men were wrapped in heavy fur-lined clothing and were wearing oxygen masks, but our little friends just sat in their boxes with their eyes half closed and their feathers ruffled up for extra protection against the extreme cold. They didn't seem to care how high they went, and the question of oxygen never seemed to enter their heads.

It is not known whether their hollow bones and their ten main air sacs, in addition to their lungs, have any bearing upon their ability to withstand high altitudes.

Sand and dust storms of moderate intensity will not ground a pigeon, since the bird has a third or inner transparent eyelid which slides across the eye like a shutter. This lid can be controlled at will and employed to free the eye of any foreign material.

We found, however, that under desert conditions the use of pigeons was usually limited to 100 miles because of the dryness of the atmosphere and the lack of water. In desert flights of over 100 miles pigeons lost several ounces of weight.

Our best results were obtained by releasing birds before 9 o'clock in the morning. When mountain ranges were present in the desert, the pigeons usually sought the inner connecting valleys. We found many a dead pigeon near pools of oil into which the birds had flown in the belief that it was water. With oil-soaked plumage the bird cannot fly.

Under jungle conditions the greatest handicaps are predatory birds and the dampness, which is dangerous to the pigeon's health.

Most interesting to me was the training of pigeons for use over large bodies of water—ship to shore, shore to ship, and island to island. Normally, a pigeon will not fly voluntarily across large expanses of water, and many a pigeon fancier has lost a race because his birds followed the shore line of a lake or bay instead of taking the shortest distance across it.

But early in 1942 this new type of training was begun as a result of a need for pigeons for amphibious operations. Subsequently I worked off the east coast, near Annapolis, Maryland, and also off Florida in the Gulf of Mexico.

A Natural Fear of Water

I found that it was not necessary to do much training for ship-to-shore communication. Since the bird had a natural fear of water, when he was released from the ship he made a beeline for home. These birds flew almost a true course to their home loft, regardless of the distance they were released at sea.

The pigeons had been placed in crates far below the decks before we sailed, and usually when they were released the ship was out of sight of land. In one case they were released during a fog, but their time of arrival was not affected. Their average speed over water was greater than that over land.

Much harder was the task of training pigeons for flying from shore to ship. To gain success it was necessary to take young birds before they could fly and place them in a loft on board ship.

Each day these seagoing pigeons were allowed to sit in their observation case atop their loft to view their ship and the water about them. Never in their training career were they allowed to fly over land. They were strictly amphibious birds.

Imitating Gulls Almost Proved Fatal

During this entire training period only one bird was lost. He perched atop a smokestack and was suffocated by the fumes. We almost lost another when he joined a flock of gulls and attempted to land on the water the way they did.

With the coming of peace, the Army sold its surplus pigeons to private fanciers, and many are now being used in the sport of pigeon racing.

In the United States, as well as other countries, this sport has many devotees. Nowhere is it more popular than in Belgium, where nearly every village has its *société colombophile*, or pigeon club. There in 1818 the first long-distance pigeon race of over 100 miles was held. In 1820 the birds were raced from Paris to Liége, and three years later the first cross-Channel race, from London to Belgium, took place.

Belgium's annual Concours National, a race of about 500 miles from Toulouse, France, to Brussels, was inaugurated in 1881, and in the same year the first regular races in Great Britain were held, from Exeter, Plymouth, and Penzance to London. The speed attained at that time was about 1,250 yards per minute and was soon to be surpassed. One of the winners in subsequent races of the London Columbarian Society attained 1,836 yards per minute.

Each loft is equipped with a trap which permits the bird to enter but not to leave. In races, specially designed clocks record the time the pigeon "traps."

A Pigeon That Walked Home

Some enthusiastic fanciers will tell you that their birds will come home even if they have to walk—and there are authentic cases of pigeons actually walking home. Clarence did.

Clarence's home loft was at Fort Meade, Maryland. One day, on a routine training flight, he and several other pigeons were released at Odenton, Maryland, a short distance away. At sunset the birds were safely home—all but Clarence; he was A.W.O.L. for reasons then unknown.

The next day one of the soldiers was walking down the road in the direction of Odenton when he sighted Clarence—walking home! Somehow he had fallen into a pool of oil and his feathers were so plastered that flying was impossible. Being a dutiful pigeon, Clarence took his bearings and started "picking 'em up and laying 'em down" in the manner of the infantry soldier, strutting steadily along the road toward Fort Meade and his home loft.

A homer if I ever saw one!

Notice of change of address of your National Geographic Magazine *should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your June issue, The Society should be notified of your new address not later than May first. Be sure to include your postal zone number.*

NATIONAL GEOGRAPHIC SOCIETY

GEOGRAPHIC ADMINISTRATION BUILDING
SIXTEENTH AND M STREETS NORTHWEST, WASHINGTON 6, D. C.

ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded fifty-nine 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, 1939, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (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, 1933, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

The National Geographic Society-U. S. Navy Expedition camped on desert Canton Island in mid-Pacific and successfully photographed and observed the solar eclipse of 1937. The Society has taken part in many projects to increase knowledge of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

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.

Do you recognize your own mother?

She'll bless you on Mother's Day if you remember her with the gift that every woman secretly longs for—a beautiful and faithful Hamilton!

BUSY BUSINESS WOMAN. Has she always been full of energy ever since you can remember? She needs the trustworthy precision of a stunning Hamilton like the FRANCES, below. 17 jewels, 14K natural gold case. **$100**

YOUNGER EVERY DAY. Do people often mistake her for her own daughter? Give her a gift that's as agelessly beautiful as she is—a lovely Hamilton like the LANA, below—17 jewels, 14K natural or white gold case.... **$71.50**

HOMEBODY. Does she bake cakes that make other women jealous? She deserves a watch created by America's most skilled craftsmen. Below: the OLGA —17 jewels, 14K natural or white gold filled case. **$59.50**

COMMUNITY LEADER. Is she the woman other women turn to for advice and help? Show her how proud you are with an accurate Hamilton like the #L-10 (link bracelet) —17 jewels, 14K natural gold case..... **$250**

Father's Day is coming, too! Remember Dad with the ultimate expression of the watchmaker's art—a fine Hamilton. (Left) the BOULTON—19 jewels, gold case, **$86**; (right) the BRUCE—19 jewels, 14K gold case, **$102.**

Every Hamilton is the product of incredible human skills, unbelievably precise machinery, unrelenting inspection and constant research. Hamilton's experience building fine railroad watches and navigational timepieces assures greatest possible accuracy in every grade. At better jewelers everywhere. All prices include Federal Tax. Send for FREE booklet. Hamilton Watch Co., Dept. C-3, Lancaster, Penna.

"Whe-e-e-ew the New Super Chief!"

Just wait, cowboys, till you ride it!
The new Super Chief, all new from head-end to tail sign, will embody up-to-the-minute rail travel features, providing the utmost comfort in smooth-riding speed.
The schedule will be new, too!
The Super Chief will depart from Chicago and Los Angeles every day.
This fine all-first-class streamliner will be one of a whole fleet of new Santa Fe trains soon to be announced.

Santa Fe

SANTA FE SYSTEM LINES.. Serving the West and Southwest

T. B. Gallaher, General Passenger Traffic Manager, Chicago 4

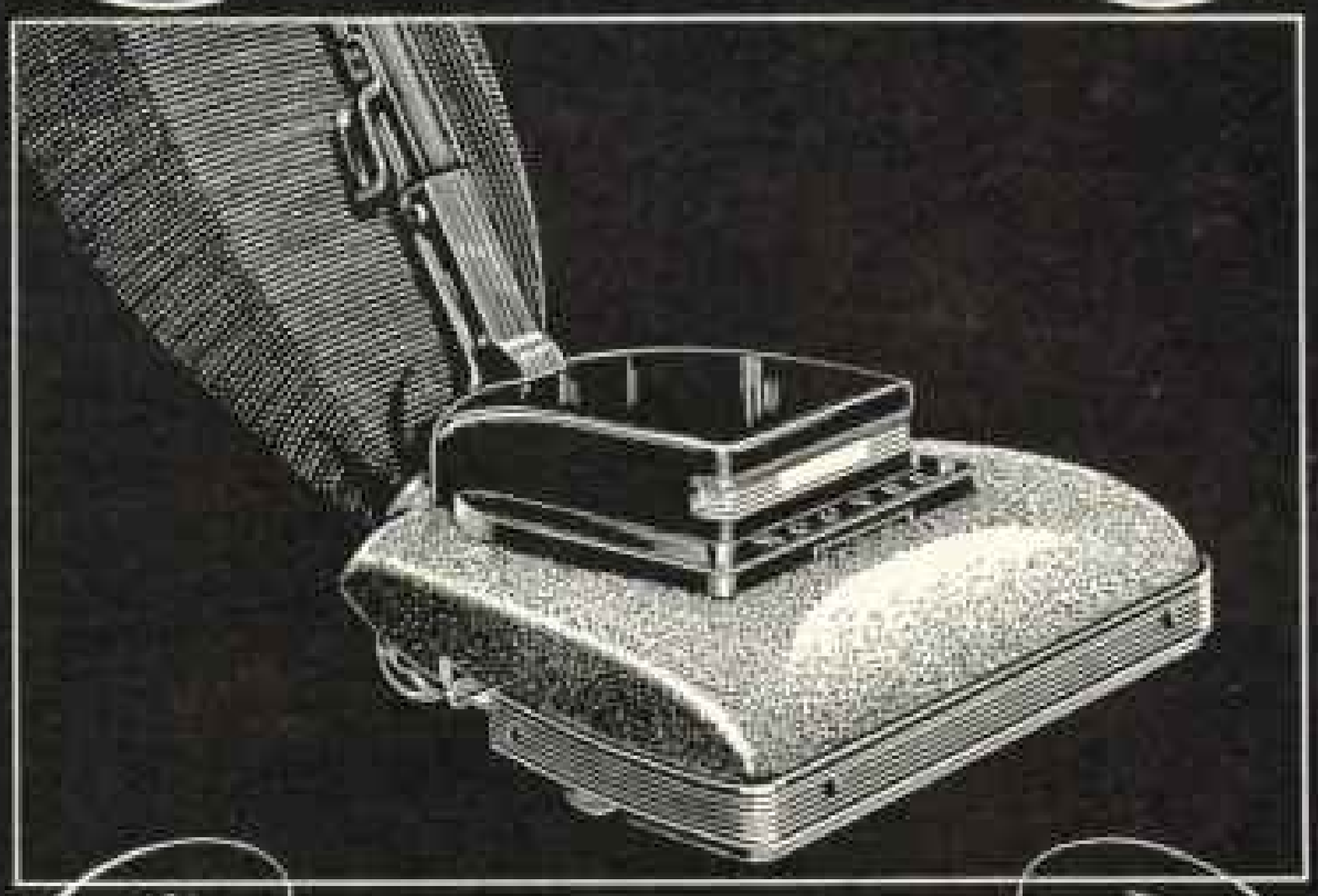
When it rains, it stops! The *quick-stopping* ability of *Action-Traction* on wet pavements is only one outstanding advantage of the General Squeegee Tire. It completes the peace of mind that comes from the blowout protection of extra carcass strength . . . longer, safer mileage from top-quality rubber . . . quieter running from straight, free-rolling ribs. These features make The General Squeegee cost a little more—*but worth much more.* It is truer than ever that *the least of the difference is the difference in price.*

Action-Traction

RUNS LIKE THIS — STOPS LIKE THIS

The GENERAL SQUEEGEE TIRE

It Beats As It Sweeps As It Cleans



The Finest Hoover Cleaner Ever Built

Your Hoover Dealer is now ready to show you the new De luxe Hoover Cleaner, Model 61, complete with cleaning tools (not illustrated).

THE HOOVER COMPANY, North Canton, Ohio; Hamilton, Ontario, Canada

Vacations Unlimited...on Canada's Rail Trail!

You're treated to more than ordinary enjoyment on a Canadian National *Rail Trail* vacation. You ride on famous Canadian National trains. You enjoy unexcelled food and service. You may take your choice of the 4 vacations sketched below—or have your vacation designed to order just for you. Plan your *Rail Trail* vacation now. Write or visit any Canadian National Railways office listed below.

1. JASPER PARK *RAIL TRAIL* VACATION—3 days to 2 weeks in Jasper National Park—the showplace of the Canadian Rockies. Time for trail riding, golf, tennis, canoeing, fishing in snow-capped mountain settings, motor drives through America's largest National Park to the Columbia Icefield—greatest glacial area south of the Arctic Circle.

2. GASPÉ *RAIL TRAIL* VACATION—a 5- to 14-day vacation takes you through a land of quaint old-world charm. See Baie des Chaleurs, Percé Rock, Bonaventure Island Bird Sanctuary, Gulf of St. Lawrence. Watch Gaspesian fishermen and handicraft workers.

3. MARITIME PROVINCES *RAIL TRAIL* VACATION—in Nova Scotia, New Brunswick or Prince Edward Island. Take your choice—or see all three Provinces—two weeks would do it. A glorious seashore holiday. Golf, swimming, fishing. Picturesque villages, beaches, unforgetable forest and ocean scenery.

4. CANADIAN CITIES *RAIL TRAIL* VACATIONS—fascinating days in historic, old-world Quebec (above), gay Montreal, Ottawa, the nation's capital and Toronto, the "Queen City." You can enjoy 4 to 14 days sightseeing and making new friends. Vacations Unlimited also include Maritime, Prairie and Pacific Coast cities.

NO PASSPORT NEEDED — Canadian National Railways Offices in the U. S.: — Boston, Buffalo, Chicago, Cincinnati, Detroit, Duluth, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, Portland, Me., San Francisco, Seattle, St. Louis, Washington, D. C. In Canada, 360 McGill St., Montreal.

CANADIAN NATIONAL

THE RAILWAY TO EVERYWHERE IN CANADA

At Home on the Range...and everywhere else

...THE WORLD'S SMARTEST,
FINEST PERFORMING PORTABLE RADIO!

COPR. 1947, ZENITH RADIO CORP.

No MATTER where—or how—you travel or vacation, your new Zenith Trans-Oceanic Portable will keep you in touch and in tune with the world!

Because no other radio has such features as the "Pop-Up" Waverod and detachable Zenith Wavemagnets for standard *and* short wave (U. S. Patents 2164231... 2200674). No wonder this finest of portables spans continents and oceans . . . works where others won't—in trains, planes, boats, motor cars, remote areas (GI's proved this all over the world).

To tune in the five international short wave bands, you just press a button—and dial them as easily as local stations! In far-away places or in your own living room, this luggage-styled beauty is equally at home. So take it along—and you take a *world* of good times with you. Get a thrilling demonstration at your radio dealer's today!

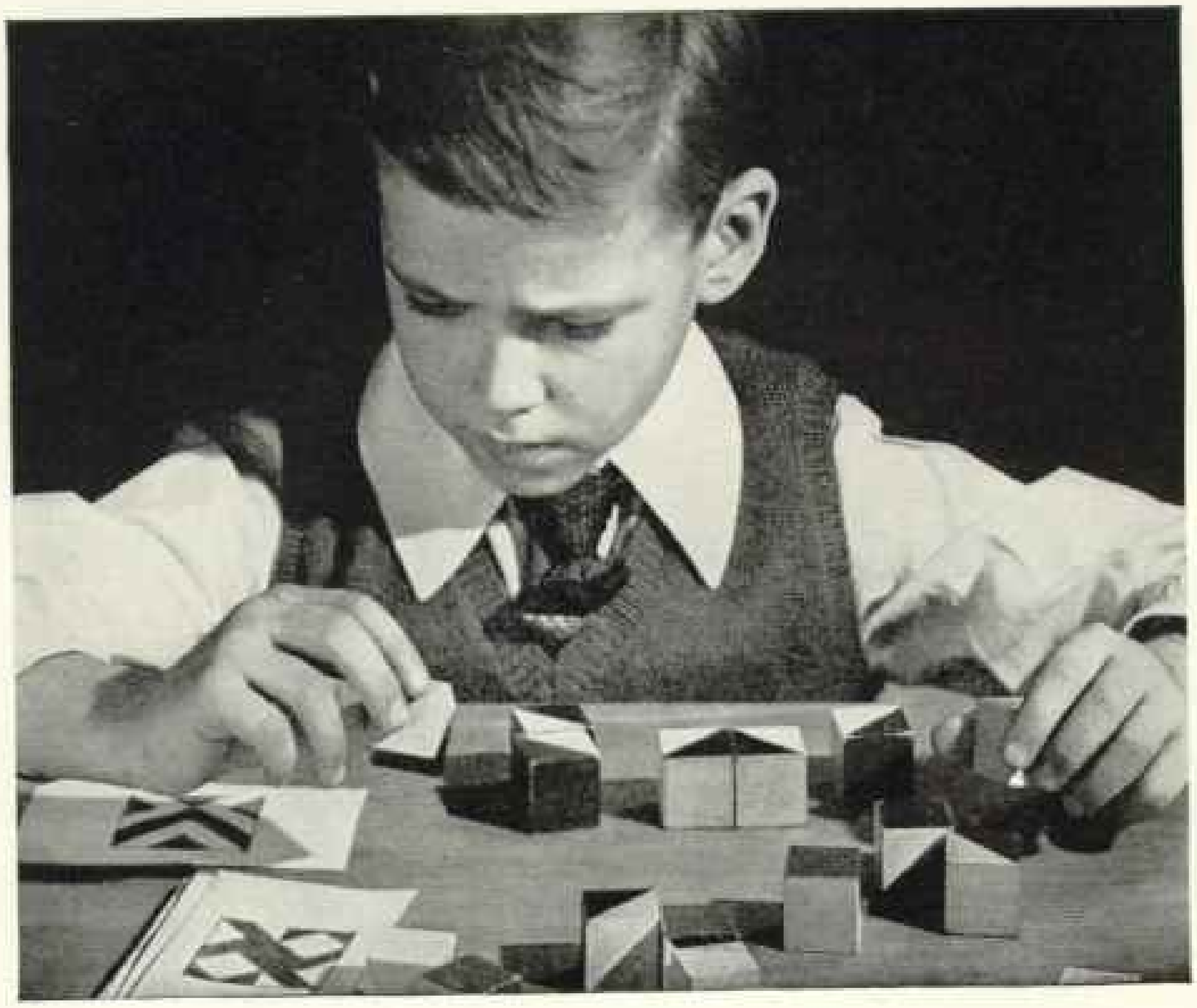
* * *

Operates on long-life battery pack (up to one year normal usage) as well as on AC or DC current. Specially treated for high humidity . . . works on land or sea, in the tropics, where untreated radios fail. Model 8G005Y (7 radio tubes plus power rectifier) $314.40, less battery. Other Zenith Radios from $26.95 to $395 (West Coast prices slightly higher).

NEW ZENITH •LONG DISTANCE• RADIO TRANS-OCEANIC PORTABLE

ALSO MAKERS OF ZENITH RADIONIC HEARING AID

ZENITH RADIO CORPORATION, CHICAGO 39, ILLINOIS • 30 YEARS OF "KNOW-HOW" IN RADIONICS EXCLUSIVELY



Can you spot the stumbling block?

Johnny can't quite get the hang of this elementary I. Q. test. But before you put him down as "dull"—let's inquire into his *diet.*

Were the same inquiry made into the eating habits of *most* American children, the results would be heartening. But there are still too many, like Johnny, who go to school with a watery beverage and a bun in their stomachs. Or—worse—go without any breakfast at all.

Fortunately, more and more parents are learning how to provide better meals. Let's hope that soon the A, B, C's of good nutrition are something *every* parent will know.

We at National Dairy know a lot about food, for we supply many different kinds of it. Especially nature's most nearly *perfect* food—milk. We've gathered together many of the country's top specialists—and pooled their skills—to study milk's properties, its processing, its ever-increasing possibilities as a chemical resource.

This research has helped the whole field of nutrition. But the food needs of a nation like ours don't stand still. We expect to contribute even *more* to America's future health.

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

Times have changed

Old and new rub elbows in the South these days.

Modern factories rise but a stone's throw from scenes of storybook charm and tradition all along the 8,000-mile Southern Railway System.

And there's a reason . . .

Business men who view the future realistically have discovered that the South is an "opportunity-land" beyond belief...with every factor favoring industrial growth and prosperity.

In this fastest-growing industrial area you'll find new opportunity for your business, too . . . in these changing times . . . when you "Look Ahead —Look South."

Ernest E. Norris
President

LOOK SOUTH LOOK AHEAD

SOUTHERN RAILWAY SYSTEM

The Southern Serves the South

For the *Finest* personal movies

Even beginners can make superlatively fine personal movies with a Filmo camera, and enjoy this delightful hobby for years to come. Painstaking engineering and distinguished craftsmanship result in cameras, silent and Filmosound projectors and other equipment which combine rugged simplicity with refinements preferred by the advanced enthusiast. Available for 8mm or 16mm film. Every Filmo is a "bluehlood."

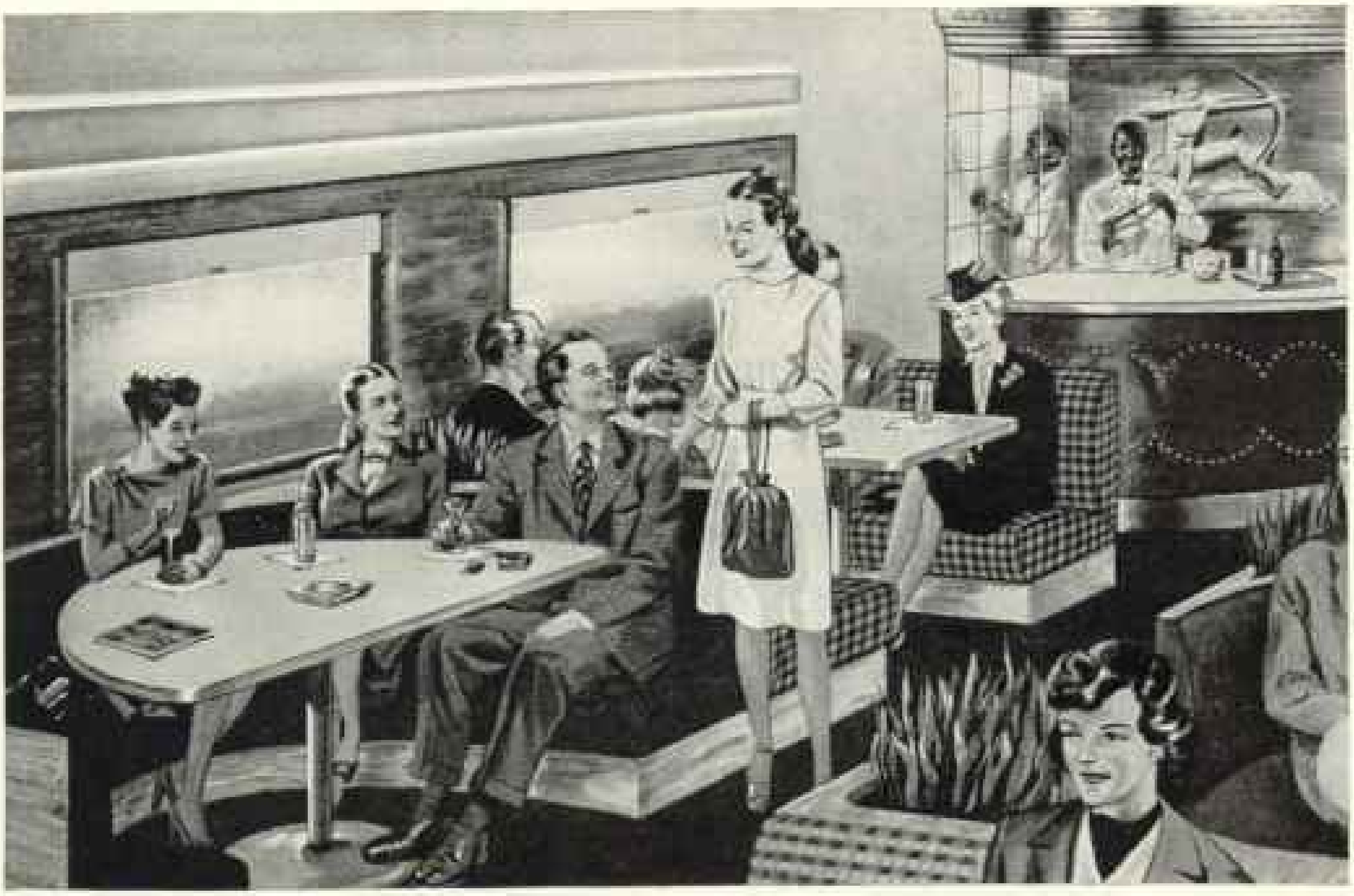
Bell & Howell Company, 7104 McCormick Road, Chicago 45, Ill.

BLUEBLOODS:

Pointers, among the finest of the breed, from a painting by Percival Rousseau, internationally famous American artist, copyright by Ackerman Galleries.

Filmo Auto Loads, the finest 16mm magazine movie camera. Loads in an instant. Makes superb movies in color or black-and-white. At better photographic dealers, now.

FILMO AUTO LOAD
by
Bell & Howell



Timed for your most glorious Vacation . . .

THE MILWAUKEE ROAD'S

Olympian Hiawathas

between Chicago and the Pacific Northwest

TO SERVE summer travel, the OLYMPIAN HIAWATHAS will start operating in advance of receiving their full complement of postwar equipment. Ten of the cars in each twelve-car train will be brand new and brilliantly different. As soon as they are delivered, two distinctive, new, all-room cars will replace the room sleeping cars temporarily in service.

The diesel-powered OLYMPIAN HIAWATHAS will offer many new advantages in luxury, economy, speed and riding ease. You'll enrich your western vacation by taking The Milwaukee Road to Yellowstone; the dude ranch country of Montana and Washington; the Grand Coulee and Spokane lakes area, and the Seattle-Tacoma region with Mt. Rainier, Mt. Baker, the Olympic Peninsula and other Puget Sound attractions.

Free Vacation Information

Write today for literature on vacations in the Northwest Wonderland via the OLYMPIAN HIAWATHAS, newest member of the Speedliner fleet. Address F. N. Hicks, Passenger Traffic Manager, 706 Union Station, Chicago 6, Ill.

CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

Jewelry by Sussman-Scherpa

The Witchery of Music... in all the glory of natural color tone with this superb FM-AM radio-phonograph

Dream, with the composer, the music as he wrote it. Hear, with the artist, the rich harmonies and delicate shadings of his interpretation. Revel in music as you've often wished to hear it—all of it—with the Musaphonic.

Whether you play radio or recordings, it wondrously recreates the natural color tone of every voice and instrument. The very soul of music speaks to you with a clarity and realism you've never known before from radio or phonograph.

Listening to FM programs (on genuine Armstrong FM), you now share in radio's great triumph over static, fading, and station interference. Through the magic of the new G-E Electronic Reproducer you hear all the music on your records. You'll enjoy them in the unmarred perfection of the original performance.

To produce the Musaphonic's magnificent cabinets, the work of Sheraton, Chippendale and the best modern designers inspired cabinets worthy of one of the world's great musical instruments.

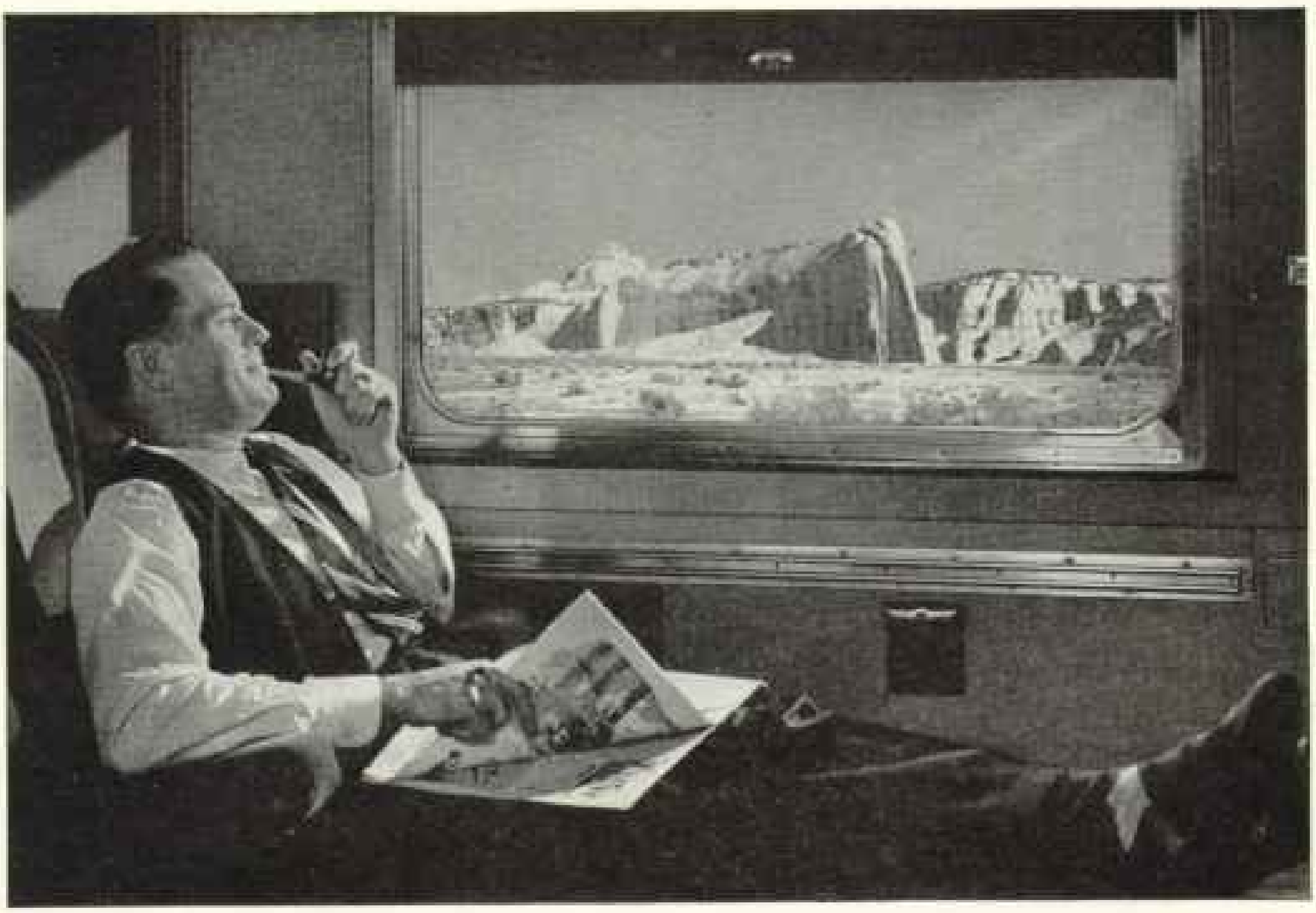
Now, at your Musaphonic dealers, you can see and hear this great electronic instrument, created and built to bring new beauty to the most gracious home.

Yours for the asking—this handsomely illustrated booklet which shows the many beautiful period cabinets of Musaphonic. For a free copy write: Musaphonic 104, General Electric Co., Bridgeport, Connecticut.

GENERAL ELECTRIC

178-72

RADIO-PHONOGRAPHS



Out Where the Rest Begins!

You're out of the city now.

You settle back with a sigh of relief, as the world goes gliding by your Pullman window.

You're out where the *rest* begins . . .

Park your head on the cushion and your cares in the closet. You're serene and secure in your own Pullman room.

Need anything? Just buzz for the porter. Want privacy? Simply close your door. Like to mingle with others? Slip down to the lounge car reserved for you and other Pullman passengers.

Then back to your room for some quiet reading, resting or reflection. Everything you do is *comfortable* on a Pullman!

Feeling drowsy now? Watch that big 6-foot, 5-inch bed slide out of the wall! It's softer than the sheep *you don't have to count* to get to sleep. You ease into those cool, clean sheets and drift off to dreams in one easy operation.

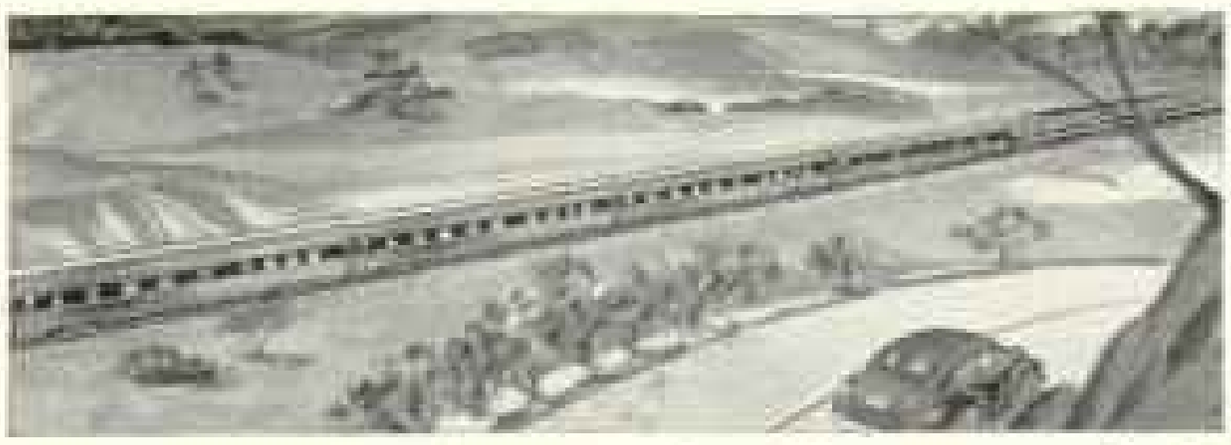
Comes the dawn—you're up with a clear head in your air-conditioned room. Temperature's just right, because you regulated it yourself. Private toilet, wash basin, and towels are there. And lots of light for shaving at that big mirror on the cabinet door.

No wonder you look like you're stepping out of cellophane when you step down from a Pullman car. You *rest* all the way . . . you *get there* on *dependable* railroad schedules . . . and you *get off right* in town, convenient to everything!

So whenever you go . . .
whereever you go . . .

Go Pullman

THE SAFEST, MOST COMFORTABLE
WAY OF GOING PLACES FAST!

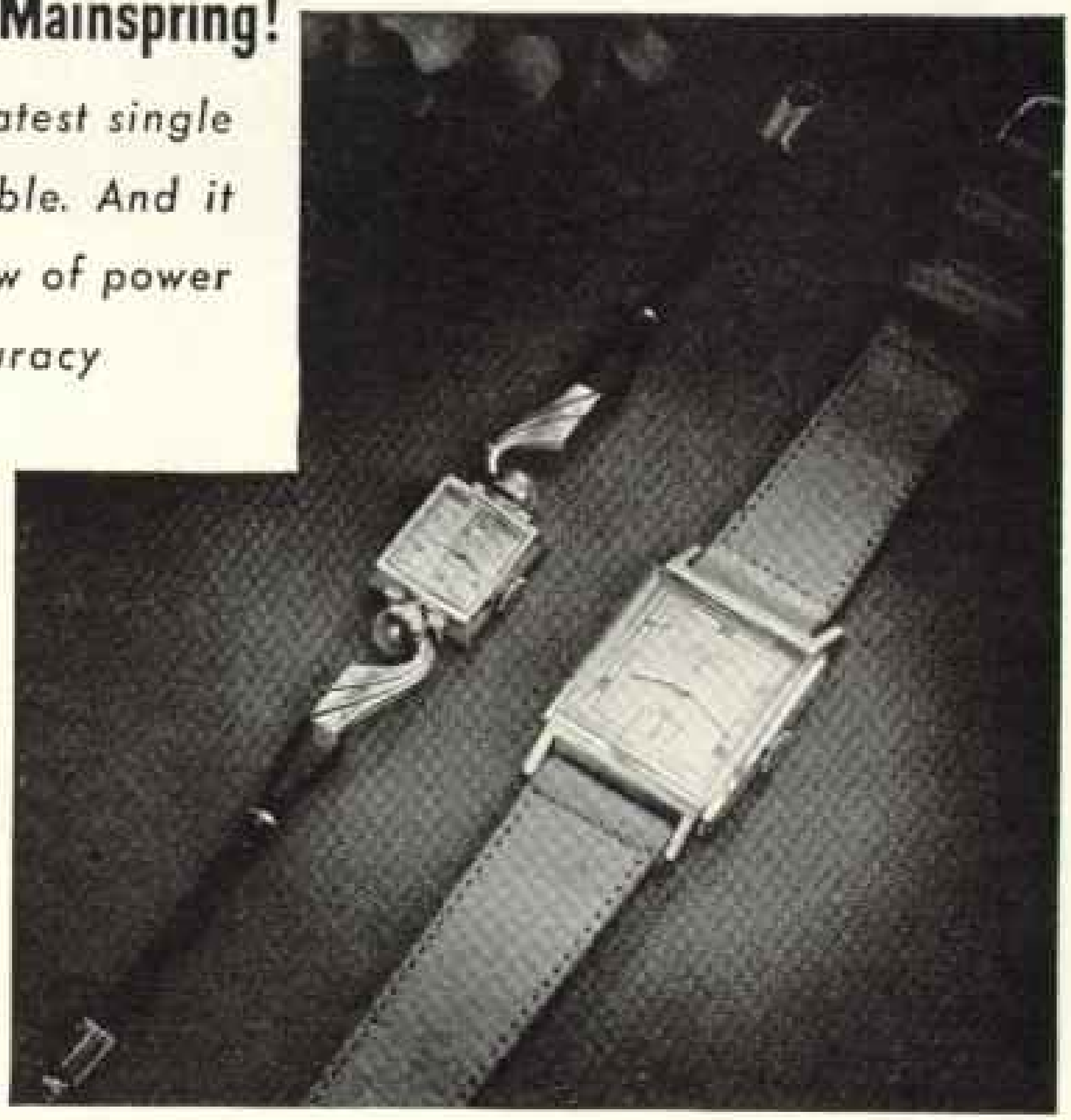


NEW TYPE PULLMAN CARS are now in service on some railroad lines, now being built for others. Spacious drawing rooms, bedrooms with enclosed toilets, duplex roomettes that rival the cost of a lower berth—these are among the accommodations that will give you even *greater* comfort when you "go Pullman."

The most important watchmaking development in over 200 years...!

dp Elgin's DuraPower Mainspring*!

It eliminates the greatest single cause of watch trouble. And it delivers a steady flow of power for greater accuracy



Two Lady Elgin and men's Elgin De Luxe illustrate the beauty of Elgin Watches now arriving at jewelers'. Elgins, with Federal Tax included, are priced from $29.75

When watches stop and can't be wound; when they suddenly start losing or gaining a lot of time, repairmen look first at the *mainspring*. Over half of *all* watch movement repairs are due to mainspring failure.

For, until now, the finest mainsprings have been made of carbon steel. They frequently lose up to 20% of their strength ... watch-running power.

Rust, resulting from moisture formed in the case during humid weather or sudden changes in temperature, weakens or breaks them. Even the transfer of a watch from a warm wrist to a cold surface . . . as when it's placed on a dresser top at night . . . can cause rust that snaps a delicate steel mainspring.

DISCOVERED . . . A NEW ALLOY

Elgin's amazing new DuraPower Mainspring *eliminates* these causes of mainspring failure. It is made from "Elgiloy", a new alloy of metals developed by Elgin after 12 years of intensive research.

A DuraPower Mainspring won't rust. It is non-magnetic. And it is so tough that it cannot be broken by overwinding. It will hold its original "springiness" indefinitely . . . give a steady flow of power for better accuracy day by day and through the years!

PERFORMANCE . . . AS IN NO OTHER WATCH

Not since jewel bearings were introduced in 1704 has there been such an important watchmaking development. Now, to Elgin's famous star-timed accuracy, these DuraPower Mainsprings add a permanency of timekeeping performance and freedom from trouble never before possible in any watch.

All the beautiful new Elgins at your dealer's have DuraPower Mainsprings . . . and the mark dp on their dials.

SEE DEMONSTRATION AT ELGIN DEALER'S

A test of mainspring quality no watch manufacturer in the world but Elgin would dare let you make.

ELGIN NATIONAL WATCH COMPANY, *Elgin, Ill., also Lincoln, Neb., Aurora, Ill.*

ELGIN *Watches*

*Patent pending

MAIL COUPON

for Free Illustrated Literature

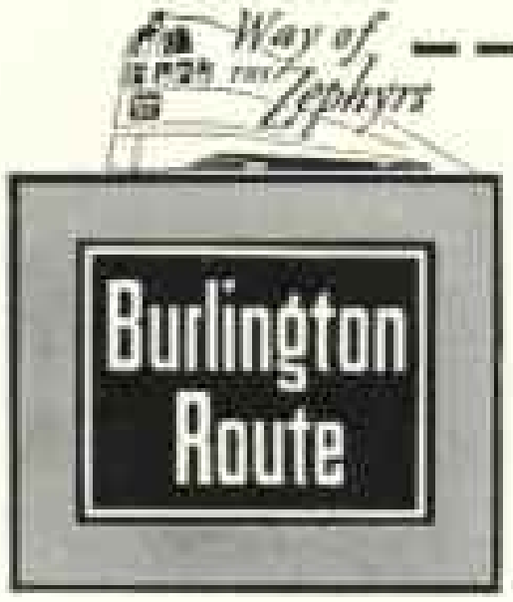
• Travel the world over—in no other single place will you find such a variety of Nature's handiwork. Awe-inspiring canyons! Spectacular waterfalls! Towering mountains and virgin forests! Scores of roaring geysers! Boiling pools and mud volcanoes! Bears, deer, elk, antelope! See them all this summer in America's oldest national park, celebrating its 75th anniversary this year.

Your Choice of 3 Routes When You "GO BURLINGTON"

• The NORTH COAST LIMITED takes you from Chicago direct to Yellowstone. Or, glide along the Black Hills (stop off for an all-expense motor tour, if you like) and through the dude ranch country of the Big Horns. Or, go by way of Colorful Colorado, riding the streamlined DENVER ZEPHYR which speeds you from Chicago to Denver, just overnight. A free side-trip from Denver to Colorado Springs is yours when you "GO BURLINGTON." Go one way—return another.

• You'll enjoy luxurious, air-conditioned travel on any of these routes. And remember, you get a thrilling 80-mile motor trip over the famous Cody Road, at no extra cost, when you "GO BURLINGTON."

• Mail the coupon today for complete information about vacations in Magic Yellowstone. Whether you travel independently or join a congenial escorted tour, you'll enjoy never-to-be-forgotten vacation thrills.



BURLINGTON TRAVEL BUREAU
Dept. 607, 547 W. Jackson Blvd., Chicago 6, Illinois.

I'm interested in a vacation in Magic Yellowstone this summer. Please send me complete information.

Name .....

Address .....

City ..... Zone ..... State .....

FOR A WORLD OF VACATION
FUN AND THRILLS IT'S

Michigan

A STATE OF
HAPPINESS FOR EVERYONE

In a few more weeks your thoughts will turn to summer and vacation time. And Michigan will be thinking right along with you . . . preparing to show you the grandest time ever.

Michigan will be ready with 11,037 lakes filled with fish and fun . . . with miles of bridle paths through pine forests . . . with fairways and greens fashioned for your pleasure . . . with sunny skies and cooling breezes just as always.

So make it a Michigan vacation this year. Write for free folder, choose your spot, and make your reservations early.

MICHIGAN TOURIST COUNCIL
ROOM 11, CAPITOL BUILDING, LANSING 1, MICHIGAN

MICHIGAN TOURIST COUNCIL
ROOM 11, CAPITOL BUILDING
LANSING 1, MICHIGAN

Please send me your free, illustrated folder entitled "Here's Your Michigan!"

NAME _____

STREET _____

CITY _____ STATE _____

61

Do people like to come to your house?..

If you have a home where people like to come . . . you and your husband ought to take a moment to salute each other. You're swell people. And you have things to share that others enjoy. Chances are there's a Stromberg-Carlson for music . . . dancing music . . . listening music. You bought it because you knew that Stromberg-Carlson has built its reputation on tone and quality. You bought it because you wanted flawless complete FM and the latest advances in radio and record reproduction. You bought it because you knew nothing could contribute more towards making your home a place where you like to be, and others like to come.

BELOW YOU SEE "THE AUTOGRAPH," A STROMBERG-CARLSON RADIO PHONOGRAPH of QUALITY and DISTINCTION. Model 1135FL

For the main radio in your home . . .

THERE IS NOTHING FINER THAN A STROMBERG-CARLSON

THE GRACIOUS "GEORGIAN" . . .

THE AMAZING "DYNATOMIC" . . .

THE CHARMING "SALEM CHEST" . . .

These are but a few of the new, exciting Stromberg-Carlsons!
They are available in a broad range of prices, with a distinguished model for every home.

Stromberg-Carlson Company • Radios, Radio-Phonographs, Television • Sound Equipment & Industrial Systems • Telephones, Switchboards & Intercommunication Systems

Another "first" for A.C.F. *... Another "first" for Railway Express Agency*

Weather *changeable* inside this car!

ONE DAY, she'll be carrying fruits and flowers at tropical temperatures through blizzards.

The next, she'll be whisking sea foods and other perishable commodities to market at icebox temperatures.

So smart in appearance that she'll fit gracefully in an up-to-the-minute streamliner, the Controlled Temperature Car, built by A.C.F. for the Railway Express Agency, sets a new pace in express shipping.

And WHAT a pace! For these cars are designed to carry *any* merchandise in express service at a speed of 100 miles an hour! With 500 of them to be added to the cars now operating on 10,000 express trains daily, the Railway Express Agency will offer sensational new service to America's most exacting shippers.

In A.C.F.-built equipment like this, there's advantage all around:

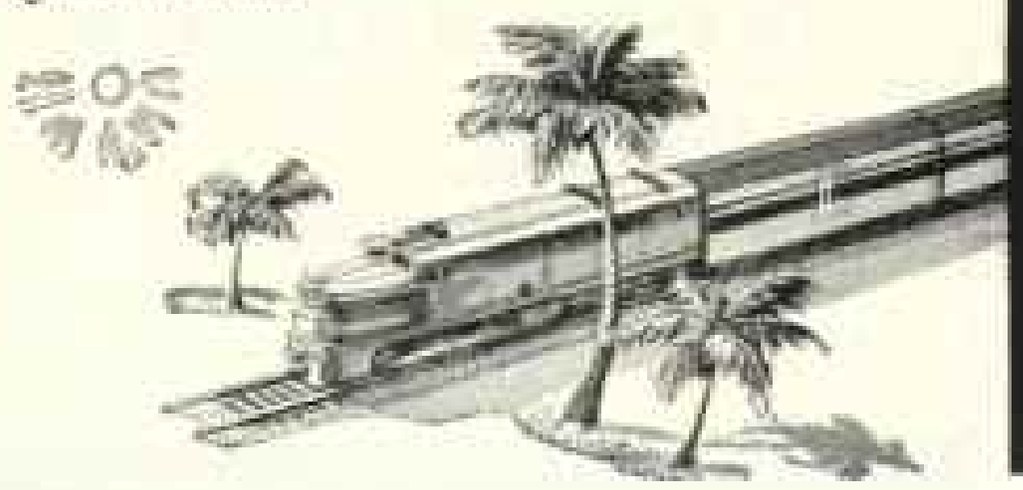
For the consumer, there's fast, sure delivery, in better condition, of his needs.

For the shipper, there's dependability, economy, and the assurance of satisfied customers at the other end.

And for the carrier company itself, there's the efficiency and long life that mean exceptional service at the lowest cost per mile.

AMERICAN CAR AND FOUNDRY COMPANY

New York • Chicago • St. Louis
Cleveland • Washington • Philadelphia
Pittsburgh • San Francisco



American Car and Foundry Co.

"Quality and Vision in Railroad Transportation"

Old crafts, old customs add piquancy to travel in the Eastern provinces.

Sun, swim and sail at one of Canada's away-from-it-all lake colonies.

Canada's coasts and inland waterways invite you to long, lazy hours on deck.

IT CAN STILL BE ALL YOURS THIS YEAR

. . . the "ah"-inspiring scenery, the cool green spaces of Canada's vacation playgrounds . . . the life and colour of her cities and resorts . . . the refreshingly different flavour of this neighbour nation where you're never a stranger—always a guest.

But better hurry and make those reservations. If we can help with information, send the coupon below to Canadian Government Travel Bureau, Department of Trade and Commerce.

Hon. J. A. MacKINNON
Minister

D. LEO DOLAN
Director

NO PASSPORT NEEDED

CANADA

Vacations Unlimited

CANADIAN GOVERNMENT TRAVEL BUREAU
OTTAWA CANADA

Please send me literature on Canada—
Vacations Unlimited. *(Please print.)* Z-473

Name _____

Street & No. _____

Town _____ State _____

Television today is clearer, sharper, and brighter—thanks to the improved kinescope, or picture tube, perfected at RCA Laboratories.

The Picture Tube that brought "life" to television

The screen on your home television table model receiver is the face of a large picture tube. And the skater that you see on the face of the picture tube is the *identical twin* of the skater being televised.

Pioneering and research in RCA Laboratories led to the development of this tube which allows none of the original realism to be "lost in transit." It reproduces everything the television camera sees, shows you every detail, keeps the picture amazingly lifelike and real.

An RCA Victor television receiver brings you all the action, drama and excitement that you'd enjoy if you were at the event in person—and on top of that it's all brought to you in the comfort of your own home . . . you don't have to move from your favorite chair.

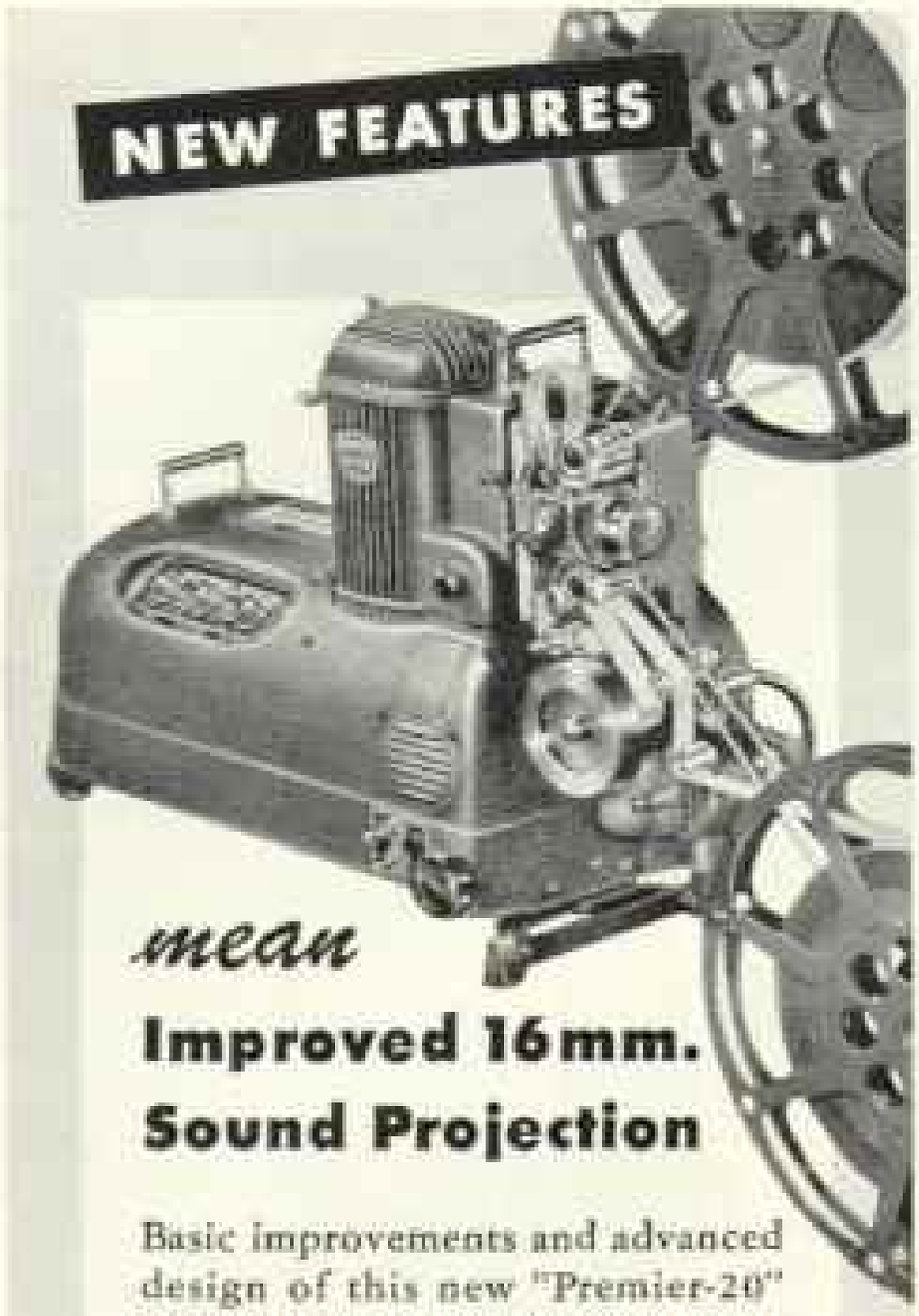
RCA Laboratories has made possible outstanding advances in every phase of television. And for television at its very finest, be sure that you select the receiver bearing the most famous name in television today—RCA Victor.

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 7:00 P.M., Eastern Time, the NBC Network.

Exclusive "Eye-Witness" feature on all RCA Victor home television receivers "locks" the picture in tune with the sending station. It assures you *brighter, clearer, steadier* pictures.

RCA

RADIO CORPORATION of AMERICA



mean

Improved 16mm. Sound Projection

Basic improvements and advanced design of this new "Premier-20" 16mm. Ampro sound projector set new standards of convenience and efficiency of operation. *The new swing-out-gate* permits the inspection and cleaning of aperture plate and pressure shoe . . . without ever disturbing lens focus. *New dynamic speaker* has wide range and adequate power. *Streamlined carrying cases,* richly finished in simulated leather, are scratch resistant . . . offer complete protection for equipment. *Many other* special Ampro features of this "Premier-20" bring new thrills, and enjoyment to all 16mm. sound projection.

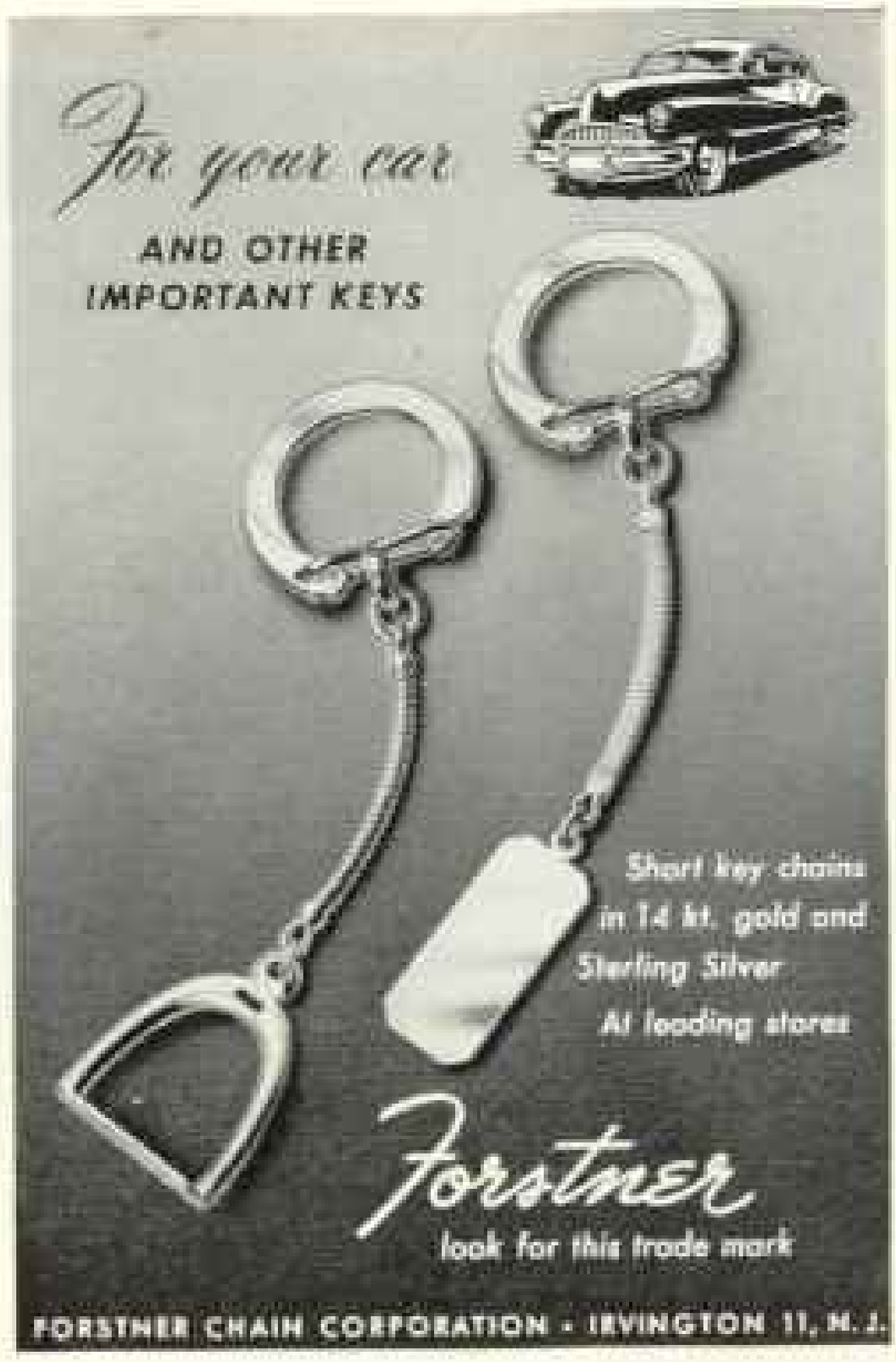
Write today for complete details and prices on the new Ampro "Premier-20"

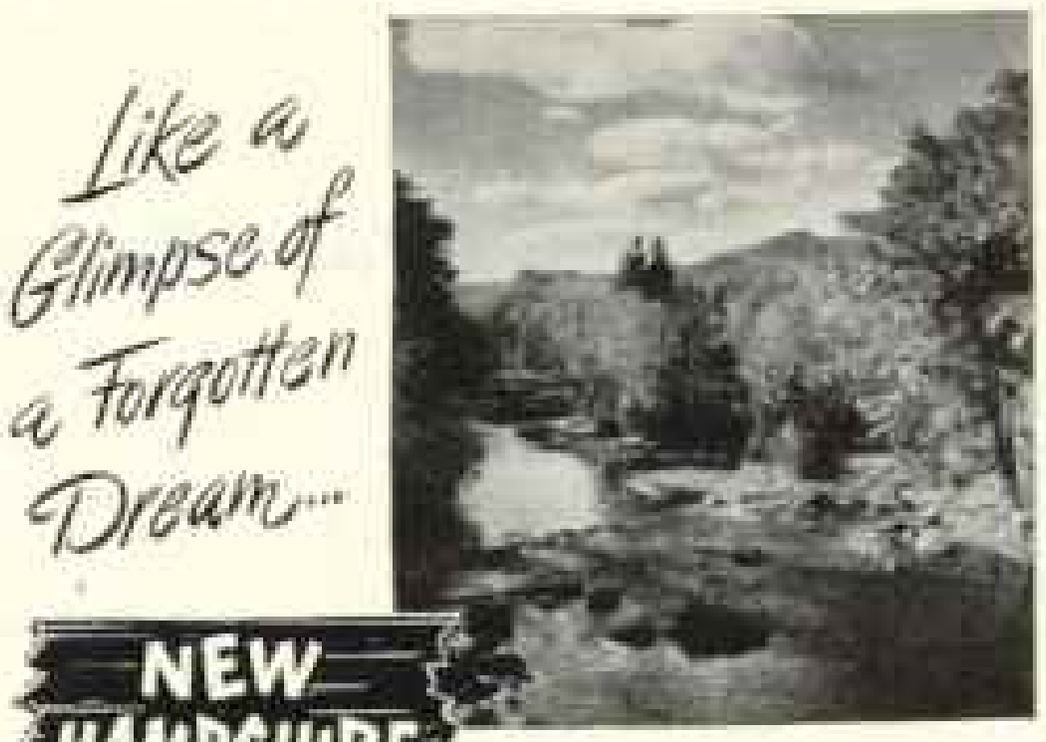
AMPRO CORPORATION
2835 N. Western • Chicago 18, Illinois

AMPRO

8 mm Silent • 16 mm Silent
16 mm Sound-on-Film • Slide Projectors
16 mm Arc Projectors

A General Precision Equipment Subsidiary





New Hampshire's beauty is a friendly, familiar beauty . . . restful and nostalgic. Splashing mountain streams, placid lakes and surf-rimmed shore . . . each to "his own" seems to say "welcome home." That's why each year, vacationists return . . . some to fish, some to golf, others to swim or just relax, but all to enjoy New Hampshire's beauty and hospitality.

In New York visit the N. H. Information Bureau, 10 Rockefeller Plaza.

State Planning and Development Commission
368 Capital Street, Concord, N. H.

Send me FREE the N. H. Vacation Kit, containing illustrated booklets, maps and other valuable information.

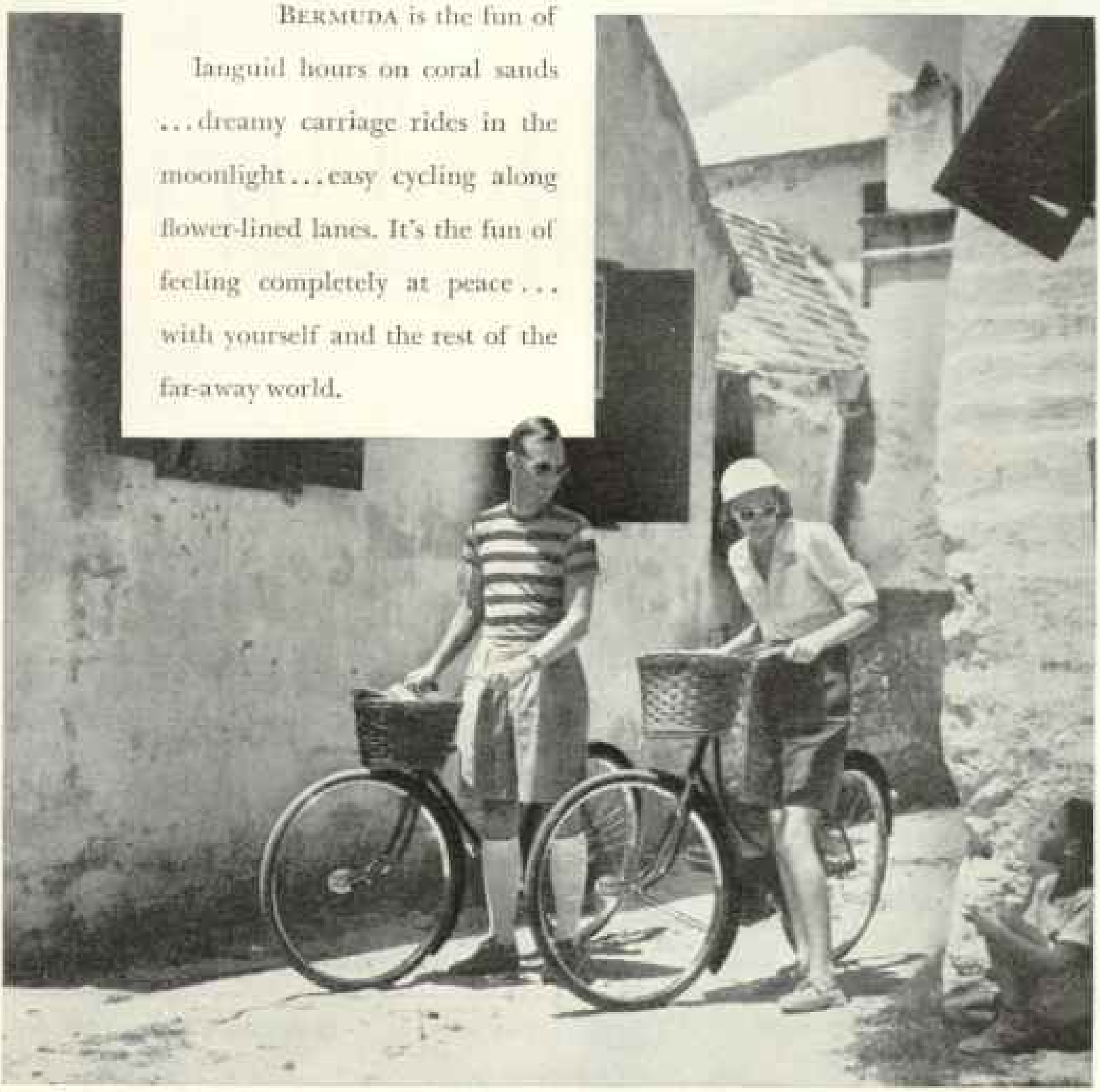
.....

.....

.....

Just for Fun!

BERMUDA is the fun of languid hours on coral sands . . . dreamy carriage rides in the moonlight . . . easy cycling along flower-lined lanes. It's the fun of feeling completely at peace . . . with yourself and the rest of the far-away world.



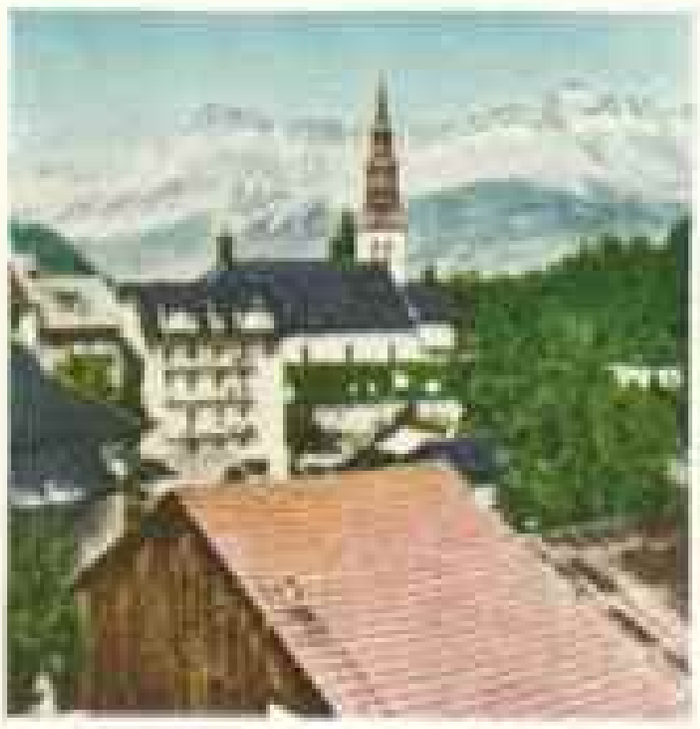
OLD MAID'S LANE, ST. GEORGE

EVERYTHING IS BETTER IN—

Bermuda

Coat of Arms

FOR NEW ILLUSTRATED BOOKLET, *write The Bermuda Trade Development Board, Hamilton, Bermuda or 620 Fifth Avenue, New York 20, N.Y. In planning your trip to Bermuda, your Travel Agent will give you experienced help and complete service—at no cost to you.*



Food is excellent in Switzerland and there are more hotel rooms per capita in that busy little republic than in any country in the world! A short flight by connecting airline from Brussels, Frankfurt, Prague.

You feel like royalty when you step on the blue carpet Pan American rolls out for your take-off.

The White Cliffs of—not Dover here—but Devon! London is now only hours from New York by Clipper . . . But please make hotel reservations in advance! Then see the great city that "could take it!"

CLIPPER FOR EUROPE

TO IRELAND, BRITAIN, BELGIUM, FRANCE, PORTUGAL, MID-EUROPE, TURKEY

Paris—Montmartre! You can make convenient connections to Paris from Pan American airports at Brussels (nearest stop), London or Shannon, Ireland.

Maybe you've done a lot of traveling . . . But don't compare any trip you've ever made with a trip by Clipper! Because here's what will greet you at New York when you fly by Pan American World Airways . . .

Men and women who know their jobs . . . Men and women who belong to the *only airline in the world* which has logged over a half a billion miles of *civilian* overseas flight.

* * *

See your Travel Agent or the nearest Pan American office for rates and reservations to Europe or to Latin America—Africa—the Near East—Alaska—Hawaii—New Zealand—Australia—and the Orient.

PAN AMERICAN WORLD AIRWAYS

The System of the Flying Clippers

WORLD'S MOST EXPERIENCED AIRLINE

Put spring in your car...

with a TEXACO CHECK-UP

WARMER WEATHER COMING! And the open road beckons! For comfort and safety get your car in tip-top shape now. Be an early bird . . . see your Texaco Dealer for a complete spring check-up. You'll get:

1 ***Livelier power*** — by changing now to New and Improved Havoline Motor Oil. Made to a new formula it keeps your motor clean as it lubricates. That means more engine power, more gas-miles, more economy.

2 ***Cushioned riding*** — with longer-lasting Marfak lubrication . . . it stays on the job. Marfak cushions your car against jolts and squeaks for a thousand miles or more . . . protects chassis and wear-points.

3 ***Smooth shifting*** — give costly gears the full protection of the proper seasonal grade of Texaco transmission and differential lubricants. See your Texaco Dealer today.

THE TEXAS COMPANY

TEXACO DEALERS IN ALL 48 STATES

TUNE IN . . . TEXACO STAR THEATRE EVERY SUNDAY NIGHT. See newspaper for time and station.

NEW *Streamliners and Dreamliners...*

Headliners in New York Central's 1947 Luxury Parade!

This is your Travel Year

Miles of new, streamlined coaches are here. And close on their wheels will follow more miles of all-private-room sleeping cars for a new fleet of overnight *Dreamliners*. All part of the $100,000,000 program now spotlighting the *new* in New York Central!

New Days of Delight

Sink back into the depths of a reclining seat aboard one of New York Central's post-war coaches. Enjoy the year round comfort of clean, conditioned air. Watch America roll past your wide-view window at scenic level. Dine in thrifty new coffee-shop cars. Lounge in luxurious new coach observation cars. In short, *fare like a king at low coach fares!*

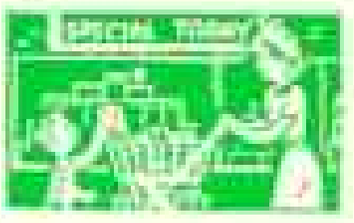
New Dream Trips by Night

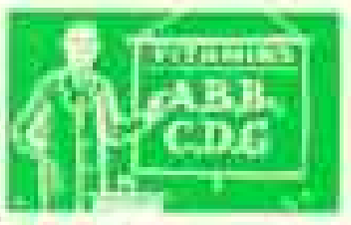
Relax in the privacy of your own completely equipped room. Or enjoy the sociability of Central's smart new club cars. Feast in new dining cars . . . some so spacious they need separate kitchen cars. Later, sleep in a feather-soft bed as your *Dreamliner* speeds in any weather over the smooth *Water Level Route*... And arrive refreshed for the day ahead.

NEW YORK CENTRAL

The Water Level Route—You Can Sleep

NEW YORK CENTRAL SYSTEM

The right foods  can mean better health! But remember, appetite and taste are not always the best guides to a good diet. Neither is cost,  for some families that spend a lot on food are not as well nourished as those who spend less—but choose more wisely. 

Today, medical science  is using food to help in fighting certain physical conditions, such as diabetes, overweight,  and high blood pressure. Eating the *right amount* of the *right foods* every day can mean *better health and a happier life for you!*

Choose foods to meet the body's needs!

Daily needs in nearly every normal diet include milk or cheese, meat, fish or poultry, vegetables, fruits, cereals or breads, fats, and sweets. You should also drink 4 to 8 glasses of water a day.

When and *how* you eat are nearly as important as what you eat. Have your meals at regular times. Eat them slowly and enjoy them—for a happy, peaceful atmosphere is helpful to good digestion.

To help guide your choice of foods for a healthy diet, send for your free copy of Metropolitan's booklet, 47-N, "Three Meals A Day."

Why Chuckwalla wears a slack suit

THE CHUCKWALLA LIZARD, *Sauromalus obesus*, lives among the sun-baked rock ledges of the Southwest deserts.

Chuckwalla is no sleek beauty. His tough, scaly hide sags about his body in loose folds which give him a sluggish ungainly appearance. But while Chuckwalla's draped skin doesn't help his looks, it does aid him in escaping his enemies.

When he is taking a sun bath on a burning-hot rock, and a desert hawk appears in the brassy sky, Chuckwalla scrambles to the nearest ledge crevice and tumbles in. Then his slack hide gives him plenty of room to blow himself up, until his skin scales press against the rock walls. Thus anchored, the strongest claws can't drag Chuckwalla from his refuge.

Many wild things—and the Chuckwalla is a good example—have clever ways of keeping themselves from harm. But man is the only animal who, in addition to figuring out ways to keep out of trouble, goes further and arranges compensation for himself when he is dragged into trouble despite his best precautions.

He does this through insurance—fire, windstorm, burglary, accident, automobile—all forms of insurance.

Right now, your house and its contents—everything you own—is more valuable than ever. And trouble coming your way, like an automobile smashup or an accident that lays you up, stands to cost you more than ever.

So isn't it a good time to check up on your insurance, to make sure you have enough and the right kind?

Your Travelers agent or broker will be glad to help you in this. Call him in today.

MORAL: INSURE IN

The Travelers

ALL FORMS OF INSURANCE AND SURETY BONDS

The Travelers Insurance Company, The Travelers Indemnity Company, The Travelers Fire Insurance Company, The Charter Oak Fire Insurance Company, Hartford, Connecticut.

Office lunch . . . Have a Coke

Folks find there's always a welcome for ice-cold Coca-Cola—at work, at their favorite eating place, shopping or wherever the busy day takes them. So when lunchtime rolls around, it's natural for everyone to say *Let's have a Coke with lunch.* It's easy to relax with *the pause that refreshes* with ice-cold Coca-Cola—a grand way to break the day. It makes lunchtime so refreshing.

Coke = Coca-Cola

"Coca-Cola" and its abbreviation "Coke" are the registered trademarks which distinguish the product of The Coca-Cola Company.

Ideal traveling companion

Everything you need for movie-making in a pocket-size camera with the best memory ever!

Marvelous movies—your first time out

Simply "dial" the exposure . . . aim . . . press the button—and you're making movies. It's as easy as that!

Indoor movies just as easy

In full color, too—with any Ciné-Kodak! Low-cost Photoflood lamps provide plenty of light.

Color—real as life itself

Every Ciné-Kodak makes marvelous full-color movies on Kodachrome Film . . . as easy to use as black-and-white.

Loads in 3 seconds

Open the cover of a Magazine Ciné-Kodak . . . slip in a film . . . close the cover—you're set to shoot!

Snapshot economy

One movie magazine will capture a whole week end. And first price is last price—processing's included!

Ciné-Kodak makes home movies easy as Snapshots!

No wonder Ciné-Kodak is the most widely used personal movie camera. Ciné-Kodak Magazine 8—shown above—has a fast *f*/1.9 *Lumenized* lens that makes wonderful movies, dawn to dusk . . . three operating speeds, including slow motion. Loads in a jiffy with full-color and black-and-white film magazines. Price, $125. Other Ciné-Kodaks from $50. Tax extra. Available in increasing quantities.

KODAK'S COMPLETE MOVIE SERVICE

All Kodak—and all designed to work together: *Ciné-Kodak*, world's most popular home movie camera . . . *Ciné-Kodak Film* . . . and *Kodascope*, the projector that shows your movies simply and brilliantly. See your Kodak dealer . . . or write to EASTMAN KODAK CO., ROCHESTER 4, N. Y.

Kodascope Eight-33—easy to buy; easy to use

Brilliant, sturdy, and inexpensive. Powerful 500-watt lamp and fast, *Lumenized f*/2 lens that gives 30 per cent more light. Simplified threading and operating controls. $70—complete.

Kodak

Union Pacific Presents a 4-Star Feature

TRAIN TRAVEL COMFORT

ZION NATL PARK

BRYCE CANYON NATL PARK

GRAND CANYON NATL PARK

Grand Canyon National Park in Arizona, Bryce Canyon and Zion National Parks in Utah . . . so closely grouped that all three may be visited on one thrilling tour . . . comprise one of the world's greatest scenic attractions.

Magnificent in natural formations, brilliant in color, these regions offer vacationists an unparalleled experience.

As a fourth attraction, there is the enjoyment of traveling in air-conditioned comfort—by Union Pacific. Complete relaxation all the way.

* * *

If desired, the Southern Utah-Arizona National Parks may be visited as a "stop-over" enroute to or from California.

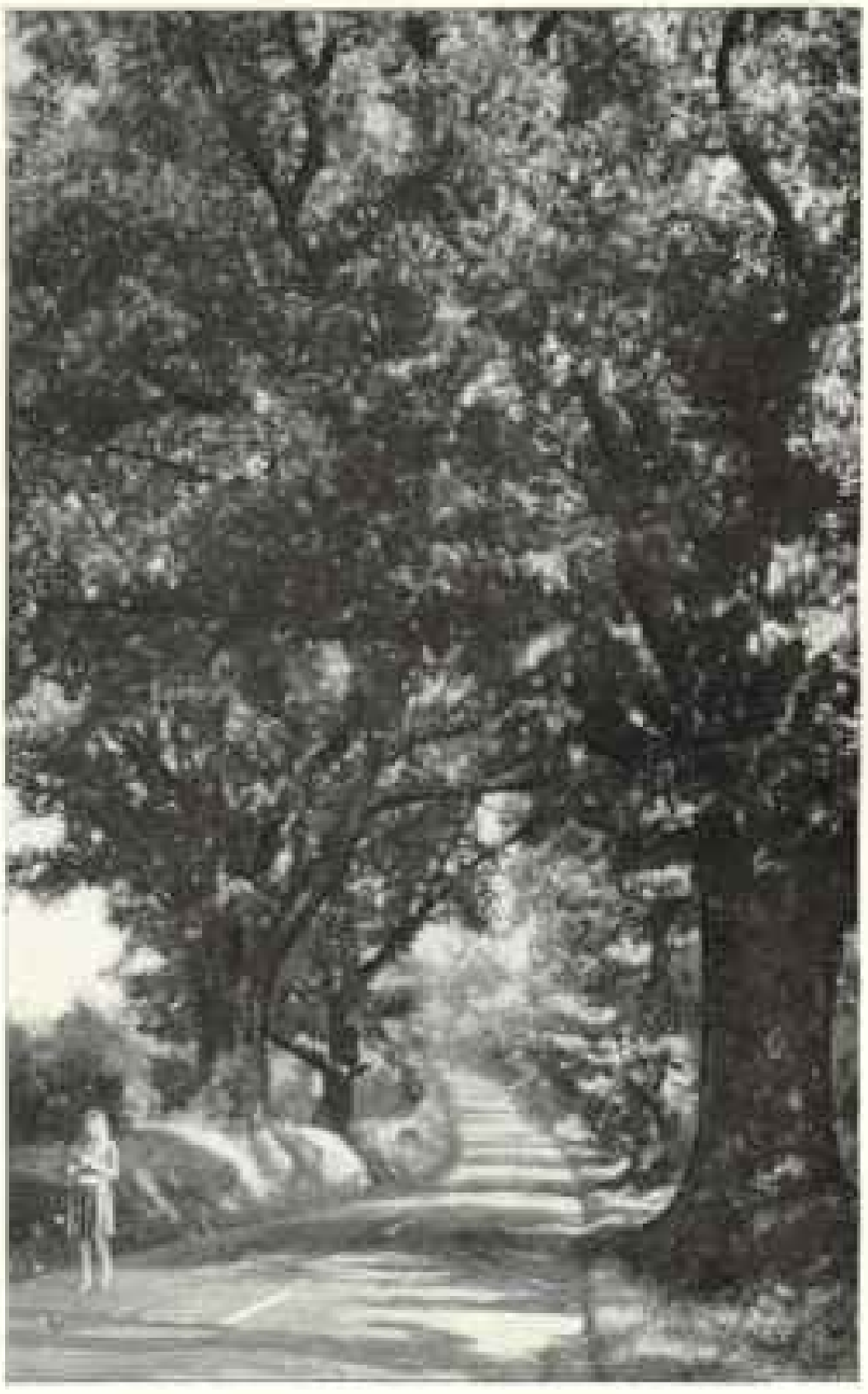
Union Pacific Railroad
Room No. 22, Omaha 2, Neb.

I am planning a train trip to the Southern Utah-Arizona National Parks. Send me information.

Name.....

Street.....

City.....



COME SEE AND FEEL *this wonder . . .*

Steeped in friendliness . . . spiced with Spring . . . there is a quality in the Pennsylvania country that meets your desire for scenes that quicken your heart and renew your spirit.

Pennsylvania has a thousand facets that mirror the varied charm of all her sister states. An industrial giant . . . a cultural leader . . . a historic shrine—Pennsylvania has miles and miles of farm country . . . virginal forests . . . soaring mountain vistas.

Whatever your taste or your purse dictates—Pennsylvania provides. Justly famous resort areas . . . vast State forests and parks . . . lakes and streams and mighty rivers . . . metropolitan cities and quiet hamlets . . . history made and history in the making. And warm hospitality of people who make you feel at home . . . will add the touch of humanity to a majestic natural beauty. You will be glad you came.

Come see and feel this wonder. More than a vacation . . . it is the fine art of living within your reach.

For literature and maps, write to the Department of Commerce, Harrisburg, Dept. N-1

See PENNSYLVANIA

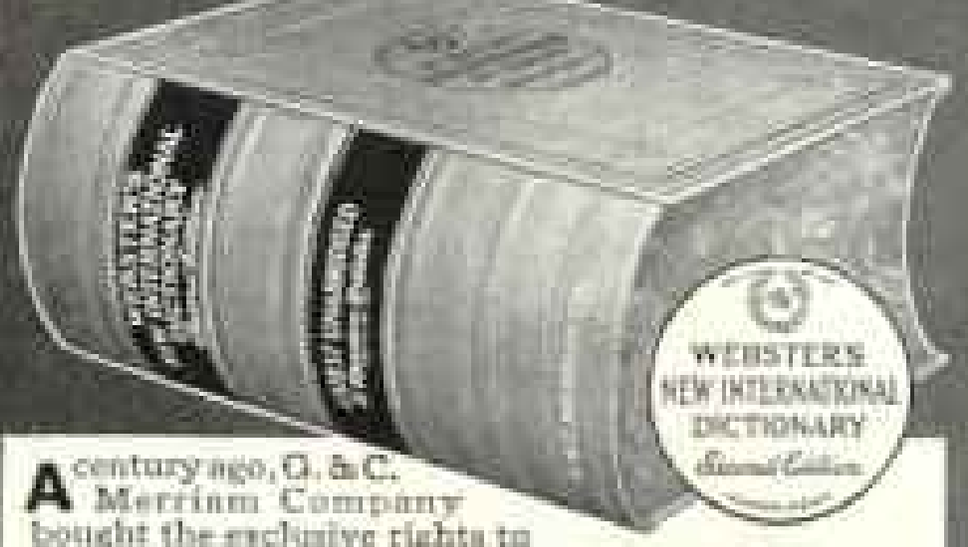
Birth State of The Nation

Keystone of Your Vacation

Pennsylvania Department of Commerce

THE ONLY GENUINE WEBSTER IS THE

Merriam-WEBSTER



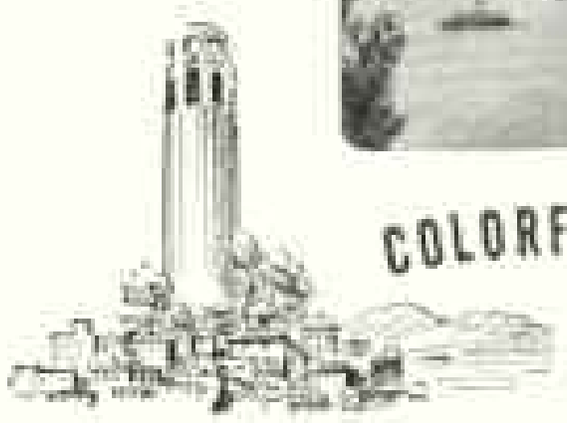
A century ago, G. & C. Merriam Company bought the exclusive rights to publish Webster's Dictionary. Through the years, with each new edition, Merriam has constantly enlarged the scope and usefulness of Noah Webster's original work, until today the names MERRIAM and WEBSTER are equally important in identifying "The Supreme Authority." Ask for WEBSTER'S NEW INTERNATIONAL DICTIONARY, *Second Edition*—the great unabridged Merriam-Webster.

G. & C. MERRIAM CO., Springfield 2, Mass.

1847 A CENTURY OF PUBLISHING MERRIAM-WEBSTERS **1947**

"THE SUPREME AUTHORITY"

Wesco
Kodachrome Slides present



COLORFUL

SAN FRANCISCO

City of poetry and legend, where East meets West. Scenes which delight visitors to the fabulous city by the Golden Gate—now ready for your slide collection in Wesco's new San Francisco series: 12 magnificent color shots in self-viewing panel, $3.85. Individual slides 30c. HUNDREDS OF WESCO SUBJECTS TO CHOOSE FROM—EVERY ONE A PHOTOGRAPHIC GEM.

At better camera stores everywhere

SEND TODAY FOR FREE ILLUSTRATED LIST OF WESCO SUBJECTS

NAME _____

ADDRESS _____

Western Movie Supply Company
203 Rosenstock Bldg., San Francisco 8, Calif.

Wesco *The Most Beautiful Color Slides in the World!*

GET MORE OUT OF LIFE WITH TELEVISION

Illustrated: Sherwood Model—with television, radio, automatic phonograph — Cabinets designed by Herbert Rosengren.

Get the most

*out of television with a Du Mont Teleset**

To convince yourself that Du Mont brings you the finest in television,
you only need to compare it with other sets.
Compare the size, brilliance and clarity of the image. Compare the
quality of sound. Compare the ease and accuracy of tuning.
Compare design and workmanship of the cabinets.
See and hear the new Du Mont Telesets at authorized
Du Mont dealers. See, hear . . . and compare!

First with the DUMONT *finest in Television*

ALLEN B. DU MONT LABORATORIES, INC. • GENERAL TELEVISION SALES OFFICES & STATION WABD, 515 MADISON AVENUE, NEW YORK 22, N. Y. • HOME OFFICES & PLANTS, PASSAIC, N. J.

*Trademark

Used Exclusively By

Claudio Arrau • Leonard Bernstein • Jose Iturbi • Serge Koussevitzky
Gregor Piatigorsky • Lily Pons • Joseph Szigeti • Helen Traubel
and many others

Baldwin THE BALDWIN PIANO COMPANY
CINCINNATI 2, OHIO

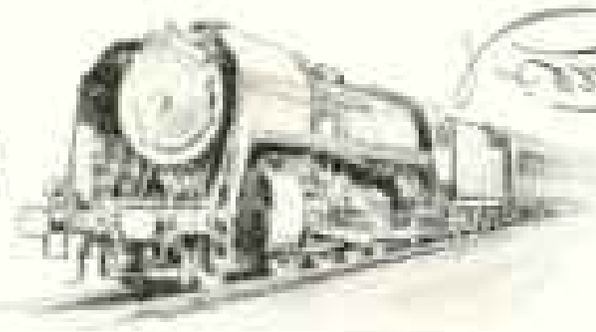
MAKERS OF BALDWIN, ACROSONIC, HAMILTON AND HOWARD PIANOS

Earned Distinction

Public and critical acclaim in concert halls, schools, motion pictures and radio... generations of matchless beauty and performance in homes the world over... superb workmanship made uniform by scientific production control. These are the dominant elements in the Distinction which 85 years of patient endeavor have earned for the Baldwin—Today's Great Piano.

France

HAVE YOUR FAMILY ENJOY FRANCE WHILE YOU SURVEY CONTINENTAL MARKETS



$'S are waiting for the man who is keen enough to recognize opportunities and grasp them on the spot. While the family is preoccupied with sight-seeing, you can combine business with pleasure . . . add buoyancy to your spirit and $ $ to your bank balance. Paris' six great railway terminals are teeming again, serving cities and resorts from Biscay to the Alps, from the Channel to the Riviera. Through railroad tickets from French ports and Paris to all points in France and throughout the Continent now available at regular tariffs.

FRENCH NATIONAL RAILROADS, 610 Fifth Avenue, New York

YOUR TRAVEL AGENCY HAS DETAILED INFORMATION

France

USE **LAVORIS**

For Effective Mouth Cleansing

Mouth care is a habit; Mouth health the result.

YOUR SUMMER VACATION CAN INCLUDE ALL THIS IN

Southern California

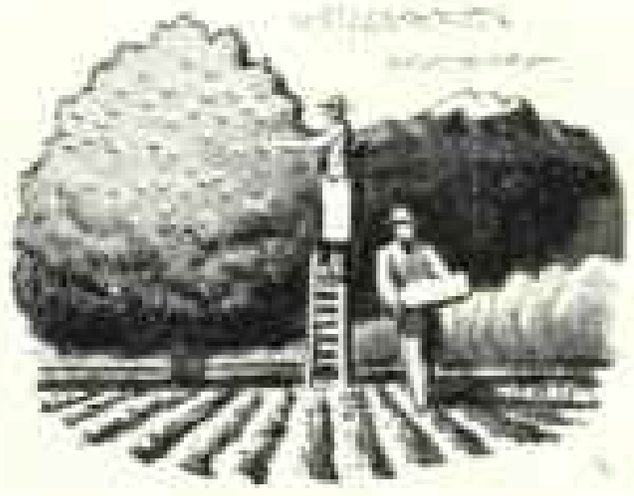
PACIFIC OCEAN—miles of broad beaches . . . great combers to jump in . . . smooth, wide bays for sailing, motorboating.

BRIGHT LIGHTS—Symphonies Under the Stars . . . movieland clubs where you'll dine and dance and see famous people.

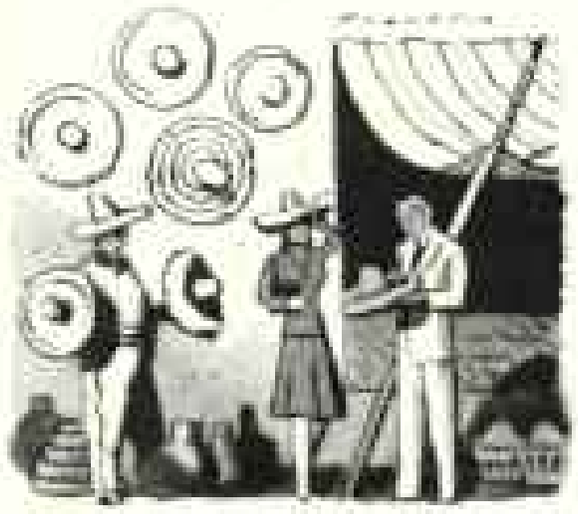
MAJOR SPORTS EVENTS—big-purse races at parklike tracks . . . tournament golf and tennis . . . regattas . . . dozens of others.

FIESTAS—gay and colorful fairs, shows . . . festivals with Spanish caballeros, dancing senoritas . . . parades and fast-paced events.

MOUNTAINS—highest in the U. S. . . . pine-forested slopes . . . cabins by deep glacial lakes . . . streams harboring hungry trout.



ORANGE GROVES—mile on orderly mile of shapely trees . . . waxy blossoms and ripe fruit with a back drop of blue mountains.



FOREIGN QUARTERS—eat with chopsticks in Chinatown . . . watch Spanish dancers, candle makers, glass blowers at the Mexican market place.

YOUR OWN BRAND OF FUN—whatever it is, enjoy it here in a different, more colorful setting where the sun is bright and nights are cool.

SCORES OF OTHER THINGS TO DO AND SEE . . . find out about the hundreds of attractions in Los Angeles County and all Southern California. Send the coupon for a FREE COLOR FOLDER—today!

In Los Angeles, visit our All-Year Club Visitors' Bureau, 517 West 6th Street, for free, friendly vacation service and complete information.

ALL-YEAR CLUB OF
SOUTHERN CALIFORNIA, LTD.

This advertisement sponsored by the Los Angeles County Board of Supervisors for the citizens of Beverly Hills, Glendale, Hollywood, Long Beach, Los Angeles, Pasadena, Pomona, Santa Monica and 182 other communities.

FREE FOLDER—
MAIL COUPON TODAY!

All-Year Club of Southern California, Dept. C-4
629 S. Hill Street, Los Angeles 14, California

Please send me your color folder "WHAT TO DO AND SEE IN SOUTHERN CALIFORNIA" to help me plan my vacation.

Name _____

Street _____

City _____ Zone _____

State _____

(PLEASE PRINT NAME AND ADDRESS)

16 mm Sound Motion Picture Projector

VICTOR

Victor's new "60"—streamlined in design, refined in performance. Truly a triumph in 16 mm sound motion picture equipment—for schools, churches, home and industry.

VICTOR ANIMATOGRAPH CORPORATION

A DIVISION OF CURTISS-WRIGHT CORPORATION

Home Office and Factory: Davenport, Iowa

New York · Chicago

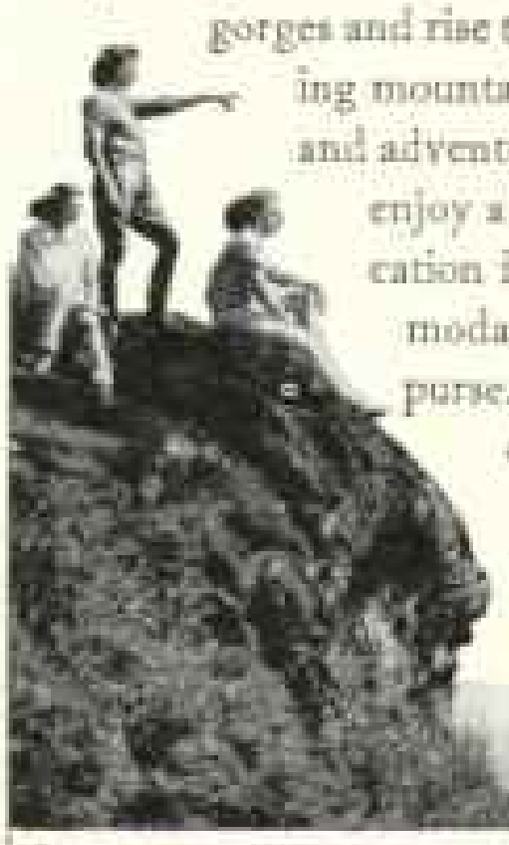
Distributors Throughout the World

MAKERS OF MOVIE EQUIPMENT SINCE 1910

It's Spring Again in North Carolina

LEAVE pneumonia weather behind . . . come where the bluebirds and robins are singing, where daffodils, crocus, redbud and forsythia proclaim the miracle of Spring . . . and bowers of dogwood and wild honeysuckle make every scene a new delight. Soon these ancient mountains will be crowned with all the glory of rhododendron and mountain laurel in bloom.

Days are sun-drenched and pine-scented. Outdoor sport and recreation include golf, tennis, riding, boating, hiking and fishing. Highways wind along purling streams through awe-inspiring mountain gorges and rise to follow the crests of towering mountains . . . with breathless vistas and adventure all the way. Plan now to enjoy a Spring or early Summer vacation in North Carolina. Accommodations are varied to fit every purse. Mail coupon today for new, colorful literature and map.



Free Movie Travelogue in Full Color Available to Clubs and Civic Organizations.

3708 Dept. of Conservation and Development, Raleigh, N.C.

Please send illustrated booklet, "North Carolina Variety Vacationland." I prefer:

Mountains ☐ Seashore ☐

Name _____

Address _____

The National Geographic's TEN-COLOR MAPS

Keep Pace with World Events

ACCURATE, timely maps are essential to well-informed men and women, to students and teachers, and to all others who are eager to understand the geographic factors that influence vital world developments. Because the National Geographic Society's spelling is followed by major press associations, all place names in today's news are easily found on these legible, large-scale, ten-color charts. • MAP INDEXES, available for maps marked with an asterisk (*) in order blank below, make easy the location of names on corresponding maps, and describe areas covered. • In the ten pockets of the 7¾ x 10⅝-inch MAP FILE can be put 20 *folded paper* maps, or 10 *folded paper* maps with indexes.

National Geographic Society
Dept. D-M, Washington 6, D. C. 1947

Please send me items indicated below:

● Standard size maps come on either paper or linen. *Indexes are available for Maps marked with asterisk*. All items are sent postage prepaid.	How Many Copies Desired		
	Paper Maps 50c each in U.S. & Poss. Elsewhere 75c each	Linen Maps $1 each in U.S. & Poss. Elsewhere $1.25 each	Indexes 25c each in U.S. & Poss. Elsewhere 50c each
Africa*			
Arctic Regions			x
Asia and Adjacent Areas*			
Atlantic Ocean			x
Bible Lands*			
British Isles			x
Canada*			
China*			
Classical Lands of Medit.*			
E. & W. Hemispheres			x
Europe & Mediterranean* (Boundaries Jan. 1, 1938.)	x		
Europe and Near East* (Boundaries Sept. 1, 1939.)			
Europe and Near East (Shows partition Poland 1940.)			x
Central Europe & Medit.*			
Theater of War in Europe, Africa & Western Asia*			
Germany & Approaches*			
India & Burma*			
Indian Ocean			x
Japan & Adjacent Regions of Asia & Pacific Ocean*			
Japan & Korea in detail*			
Mex., Cen. Am., & W. I.*			
North America*			
No. & So. Hemispheres*			
Pacific & Bay of Bengal*			
Pacific Ocean* (With 32 Island Insets.)			
Philippines*			
South America*		x	
Southeast Asia*			
The World*			
U.S.S.R. (Russia)*			
United States—1940*			
United States—1940*			
Northeast United States*			
Northwest United States			x
Southeast United States*			
Southwest United States			x

X in columns above indicates item is NOT available. Paper maps are folded for convenient filing. Linen maps come rolled.

Also ..copies of Map File @ $2.50 in U. S. & Poss.; elsewhere, $2.75.

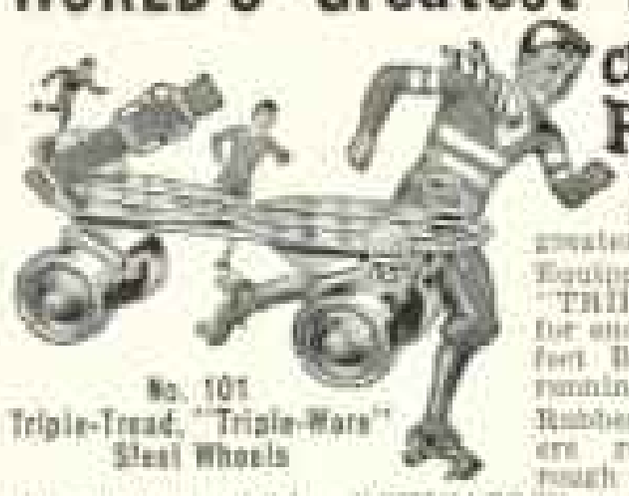
I enclose remittance of $..... payable in U. S. funds.

(WRITE NAME AND ADDRESS IN MARGIN BELOW)

Tennessee offers more opportunities for real enjoyment than any other state. Mountains, rivers, lakes, hills and valleys are all combined into one continuous scenic panorama that extends from the Great Smoky Mountains on the east to the cypress-lined bayous of the Mississippi on the west. Tennessee is Eastern America's Vacation Land, and while no one book can adequately describe it, "Tennessee Highlights" will give you a dramatic preview. Send for your copy now.

DEPARTMENT of CONSERVATION
208 State Office Bldg. Nashville, Tennessee

WORLD'S Greatest Roller Skates



No. 101
Triple-Tread, "Triple-Ware"
Steel Wheels

CHICAGO FLYING SCOUT Roller Skates

For those who want the best, it's "CHICAGO"—the greatest name in Roller Skates. Equipped with TRIPLE-TREAD, "TRIPLE-WARE" Steel Wheels for endurance and long wear. Perfect Ball Bearings assure smooth running with greatest SPEED. Rubber Cushioned Shock Absorbers remove the discomforts of rough spots, making them safe for the youngest child. "CHICAGOS" are the Choice of Champions. If you cannot obtain them now—it will pay you to wait. See your Dealer TODAY!

CHICAGO ROLLER SKATE CO.
World's Greatest Roller Skates for over 45 years
4408 W. Lake St., Chicago 24, Ill.

YOU'LL PRIZE *these genuine leather* BOOKMARKS

Made to fit the corner of a page in any book. Nylon-stitched and handpainted by American artists in bright, lasting colors. Beautiful, practical, and useful—an inexpensive and appropriate gift for any occasion. Set of three, attractively boxed, sent postpaid on receipt of only ONE DOLLAR, check or money order; no COD's. Money cheerfully refunded if you are not satisfied.

FIND OUT WHY THE DEAF CALL IT A MIRACLE

You'd call this new Beltone Mono-Pac Hearing Aid a miracle, too, if you had been wearing a clumsy, annoying, battery pack strapped to your body with entangling wires, and then suddenly found the new Electronic Beltone. It's a single-unit hearing aid—so small you can hide it with the palm of your hand—so light you forget you are wearing it—so thin it is lost from sight—so efficient you bless the day you learned about it.

Those are a few of the reasons why more people are wearing Beltones than all other one-unit hearing aids combined.

GET FREE BOOK ABOUT HEARING PROBLEMS and about the

NEW Beltone MONO-PAC HEARING AID

FREE BOOK—MAIL COUPON

BELTONE HEARING AID CO., Dept. NG-74
1450 West 19th Street, Chicago 8, Illinois

Please send me, without obligation, FREE information concerning the new Beltone with the amazing X-Cell which out-performs units 5 times its size.

Name _____

Address _____

Town _____ *Zone* _____ *State* _____

COLLEGES FOR WOMEN

CHRISTIAN COLLEGE Accredited Junior College and Conservatory (A.A. degree). Terminal, transfer, pre-career courses. Music, Art, Drama, Secretarial, Nursing, Int. Dec., Costume Design, Home Mgmt. All sports, pool. 96th year. *Catalog.* **James C. Miller, Ph.D., Pres., Box D, Columbia, Mo.**

LINDENWOOD COLLEGE A.B., B.S., B.M. degrees. Also 2-yr. Junior College. Prepares for civic and social leadership. Modernized curriculum. Vocational courses. Secretarial. Special work in music, art. Near St. Louis. Sports. Catalog. **President, Box 247, St. Charles, Missouri.**

MARYWOOD COLLEGE Catholic college, conferring A.B., B.S., B.M. degrees. Liberal arts, secretarial, librarianship, child care, nursing, home economics, music. Sports. Accredited by Middle States Association. Catalog. **Marywood College, Box E, Scranton, Pa.**

CO-ED COLLEGES

COE COLLEGE One of the leading medium-sized colleges of the country. A.B., B.M. degrees. Emphasis on liberal arts and music. Located in residence district of charming, small city. Dormitories, ample buildings and campus. Coed. Write **Registrar, Box 147, Cedar Rapids, Iowa.**

GIRLS' SCHOOLS

ASHLEY HALL Accredited college preparatory and general courses in atmosphere of historic Southern culture. Excellent depts. of music and art. Mild climate, year round outdoor sports; riding, pool. Dramatics. Lower school. Write for catalog. **Mary Vardrine McBee, L.H.D., Prin., Box N, Charleston 15, S.C.**

AVERETT Accredited Junior College for girls, emphasizing liberal arts. Music, art, interior decorating, speech and dramatics, secretarial, medical secretarial, physical education, home economics. Modern bldg. 98th year. Endowed. Catalog. **Curtis Bishop, Litt.D., Box N, Danville, Va.**

CHAPEL HILL SCHOOL Girls 10-18. Accredited College Preparation and General Courses. Experienced faculty. Small classes. Art, music, dramatics. Typing. Sports and social activities. Riding. Country life with city advantages, 10 mi. from Boston. **Mrs. Robert C. Rounds, Principal, Waltham, Mass.**

DEAN JUNIOR COLLEGE Liberal arts and semi-professional courses. Home economics, medical assistant, fashion design, sec'l, merchandising. Music, dramatics. Sports. Moderate rate. Placement service. *Catalog.* **W. R. Garner, President, Franklin, Mass.**

EDGEWOOD PARK Accredited College prep. Advanced courses in cultural and practical arts, fine arts, secretarial science, real estate, medical asst., home economics, dramatics. Costume design, interior decoration, merchandising, kindergarten. Sports—riding. **Box N, Briarcliff Manor, N. Y.**

ERSKINE Two-year courses for day and resident girls of college age—liberal arts, social work, radio broadcasting, script writing, secretarial, fine arts, music, drama. Individualized programs. **Miss Anne G. Young, Director. 111 Beacon Street, Boston, Massachusetts.**

FAIRFAX HALL Standard accredited work. 2 years college, 4 years high school. Secretarial, Liberal Arts, Music, Fine Arts. In healthful Shenandoah Valley. Spacious grounds. All sports, stable. Early applications advised. Pools. **Wm. B. Gates, M.A., Pres., Box N-4, Park Station, Waynesboro, Va.**

GREENBRIER COLLEGE For girls. Two years college preparatory and two years standard college work. Founded 1812. Art, Music, Dramatic Art, Secretarial. Exceptional social and recreational advantages. Modern fireproof dormitory. **French W. Thompson, Pres., Dept. N-5, Lewisburg, W. Va.**

GRIER SCHOOL In the Alleghenies. Accredited College Preparation and General Courses. Home atmosphere for girls 12-18. Music, Art, Typing. Exceptional riding. Winter and team sports. 800 acres. Gym, pool. 98th year. Accessible New York, Washington. Catalog. **Thos. C. Grier, Dir., Box 44, Birmingham, Pa.**

KINGSWOOD—CRANBROOK Grades 7-12, post-graduate. College preparatory and general courses. 50 acres on lake near Detroit. Unusual opportunities in arts, handicrafts, sciences. Music, dramatics, sports, typing. **Secretary, 156 Cranbrook Road, Bloomfield Hills, Mich.**

LASELL JUNIOR COLLEGE Young women. 10 mi. from Boston. Academic, Home Ec., Sec'l (gen. or med.), Merchandising, Fashion, Pre-nursing, Pre-med. tech., Pre-occupational therapy, Art, Music. *Catalog.* **Guy M. Winslow, Pres., 123 Woodland Rd., Auburndale, Mass.**

LINDEN HALL Junior College and School for Girls. Cultural and Vocational. Music, Home Economics, Secretarial Studies. Fine and Commercial Art. Dramatic Art. Preparatory and General Courses. Beautiful Campus. All Sports. Riding. Swimming Pool. Moderate Tuition. **F. W. Stengel, D.D., Box 64, Lititz, Pa.**

OAK GROVE

A FRIENDS SCHOOL FOR GIRLS

Emphasizes Preparation for College and Gracious, Purposeful Living. Music, Art, Dramatics. Upper and Lower Schools. Joyous Outdoor Recreation features Winter Sports. Riding included. Beautiful New Fireproof Buildings.

Mr. and Mrs. Robert Owen, Box 140, Vassalboro, Maine

SAINT MARY'S HALL Episcopal. Accredited college prep and general courses for girls. Music, art, crafts, dramatics, secretarial. Spacious campus. Beautiful modern buildings. Sports. 81st year. Catalog. **Margaret Robertson, M.A., Box B, Faribault, Minn.**

SOUTHERN SEMINARY For 80 yrs. one of America's famous schools for girls and young women. Accredited Jr. College and High School. Academic, vocational, cultural courses. Sports. Indoor pool. Riding. *Catalog.* **Robert Lee Durham, Pres., Box 204-N, Buena Vista, Va.**

WALNUT HILL Preparatory and general courses. Superior scholastic training. Music, art. Country life on 55-acre campus 17 miles from Boston. All sports, riding, skiing. Founded 1893. **Hester R. Davies, Principal, 30 Highland Street, Natick, Mass.**

WARRENTON COUNTRY SCHOOL Near Washington. Thorough college preparation. General course. Music, art, sports, riding. Beautiful gardens. Outdoor theatre. Farm owned by school. Grades 7-12. **Miss Lea M. Bouligny, Prin., Box N, Warrenton, Va.**

CO-ED SCHOOLS

DEAN ACADEMY Grades 9 to 12. College preparatory, general courses. Music, dramatics, speech, radio tech., art. Homelike atmosphere. Campus life. Sports. Direct R. R. to Boston, New York City. Moderate rate. 81st year. *Catalog.* **W. R. Garner, Pres., Franklin, Mass.**

HOME STUDY

CALVERT "SCHOOL-AT-HOME"

Kindergarten through 9th grade. Sound schooling for your child wherever you live. No teaching experience required. Transfer to other schools, often with advanced standing. Daily lessons, books, supplies provided. Valuable advisory service. Start any time. Send for Catalog.

CALVERT SCHOOL

34 TUSCANY ROAD, BALTIMORE 10, MD.

CAMPS

ADIRONDACK WOODCRAFT CAMPS Selected boys, 7-17. 3 divisions. On private lake 10 miles north of Utica. Cabins. 20 crafts. Canoe and horse trips. Fee incl. riding, uniforms. Riflery. *Booklet*—**Wm. H. Abbott, Dir., Box 237-N, Fayetteville, N. Y.**

ADMIRAL BILLARD ACADEMY For 11th summer offers eight-week intensive naval program, ages 13-20, with week at sea aboard famous schooner "Yankee." Optional study for H. S. credits. Also naval camp for younger boys 8-13. Write for catalogue. **New London, Conn.**

ADMIRAL FARRAGUT NAVAL CAMP Ahoy mate! Stand by for cruise on 107-ft. "LCI" . . . part of thrilling summer on Toms River for boys 10-17. Navy customs, uniforms, drills. Cutters, sloops. All sports. Academic programs available. *Catalog.* **Registrar, Box 17, Toms River, N. J.**

ADVENTURE TRAILS A Summer to Remember. Thrilling rail-bicycle and rail-motor tours for students to Alaska, the Great West, Canada, Mexico and Europe. Supervised co-ed groups 12-21 years. Write for *Booklet G.* **Adventure Trails, Room 1160, 11 West 42nd St., New York 18, N. Y.**

ARROWHEAD In heart of Indian country on Rehoboth Bay, near ocean. 300-foot beach. Boys 6-14. Cruises, swimming, fishing. Riding. Arts and crafts, woodcraft, nature study. Bungalows. Nurse. 120 acres, pine woods. Salt water pool. Accessible. Inclusive fee. *Booklet.* **Lt. Col. Ralph I. Sasse, Dir., R.F.D., Lewes, Del.**

BROWN LEDGE Mallett's Bay, Vermont. ". . . one of New England's finest camps." Daily riding for all girls included in fee! Aquaplaning, sailing, golf, dramatics. No "extras." Catalog. (Give age.) Also Camp Kiniya Junior Division. **Mr. and Mrs. H. E. Brown, Leicester Jr. Col., Box G, Leicester, Mass.**

CATHOLIC CAMPS Our Lady of Lourdes—Girls. Acadia—Boys. Mile apart. 41st yr. July 1-Aug. 31st. Catskill Mts. Own lakes. Sports, dramatics, crafts. "Not Merely Camping, but a Way of Life." Age 6-18. Doctor, nurses. **Rev. J. H. Mahoney, D.D., Dir., 472 W. 142 St., N.Y.C. 31, Ed.4-5840.**

CULVER SUMMER SCHOOLS on Lake Maxinkuckee. Naval or Cavalry (Boys 14-18). Woodcraft Camp (Boys 10-14). Exceptional housing, dining and health facilities. Regular Academy personnel. All land, water sports. Separate catalogs. **49 Lake Shore Way, Culver, Ind.**

FENIMORE On Otsego Lake, Cooperstown, N. Y. Camp for 50 boys & girls, 4 to 13. 27th Season. Riding (own saddle horses), sailing, swimming, tennis, riflery, shop, metal crafts, weaving, Art & Music. Own farm produce. *Booklet.* **Mrs. C. N. Braider, Fenimore School of Horsemanship, 240 East 20th St., N.Y.C. GR.5-1408.**

HALF MOON Great Barrington, Massachusetts. Boys 6-16. In Berkshires, 120 miles NYC. Special trips by canoe, covered wagon. All sports, riding daily. Canadian fishing trips for older boys. Mature staff. Nurse. 25th year. *Catalog.* **Dr. Edward N. Storey, 330 Carroll Ave., Mamaroneck, N. Y.**

LAKE GREELEY Pocono Mts. in Penna. 27th year. Girls, 6-17. Glorious summer of riding, tennis, dancing, swimming, crafts, trips, etc. Talented staff. Cabins with baths. 3 groups. Altitude 2,000 feet. 500 acres. N. Y. C. 95 mi., Phila. 120 mi. Catalog. **Carl N. Hummel, 403 Charles Lane, Wynnewood, Pa.**

LAKE PEMBINA CAMP St. Donat, Quebec. On Mt. Tremblant Park. 85 miles north of Montreal. Land & water sports, arts & crafts. Boys & Girls 6-14. Recreation hall, 5 cottages, tents. Adult supervision. Friday Eve service. Pamphlet: **Mrs. L. Morgenstern, 4752 Victoria Ave., Montreal 6.**

LEN-A-PE Indian, cowboy, magician, nurse. On natural lake in Poconos near N. Y. C. and Phila. Boys 4-16. Excellent food and care. Riding, sailing, aquaplaning, tennis, swimming, crafts. Adult camp nearby. *Booklet.* **David E. Keiser, 7733 Mill Road, Philadelphia 17, Pennsylvania.** Phone Melrose 1682.

OGONTZ White Mountain Camp for Girls, in New Hampshire. 6-18 in separate groups. 750 acres on mountain lake. Rustic cabins. Swimming, sailing, canoeing, aquaplaning; farm and trail riding; tennis, hockey, golf, art, crafts, music, dramatics. Trips. Tutoring. *Booklet.* **Abby A. Sutherland, Box 600, Ogontz School P. O., Pa.**

CAMP PAGWA 8 Week Adventure for Young Sportsmen 12-16. Trip of 2500 mi. by Trans-Canada airlines and by canoes thru Northern Ontario's wilderness with Indian Guides, Athletic Coaches, Medical Staff. Fishing. No hay fever. **John J. Gleason, Dir., 55 West 95th St., New York 25, N. Y. RI.9-3166.**

PERRY-MANSFIELD CAMPS Steamboat Springs, Colorado. Western camp for girls in three age groups. Junior 8-12, Intermediate 13-14 and Senior 15-20. Horseback riding, pack trips, swimming, tennis, drama, dance. **Portia G. Mansfield, 216 E. 70th St., N.Y. 21, PL9-2820.**

QUANSET Sailing camps, 43rd year. Learn sailing every day on Cape Cod's beautiful, safe Pleasant Bay. Riding, swimming, tennis, crafts, archery, canoeing, sailing trips. 3 age groups, carefully chosen girls, 3 to 18 yrs. Also Adult Sailing School, June and Sept. *Booklet*—Interview. **Mr. and Mrs. F. N. Hammatt, So. Orleans, Mass.**

CAMP ST. JOHN'S ★ ★ ★

A sports and recreational camp for boys 9-18 with one hour daily military training. Large staff mature men, many from **St. John's Military Academy** faculty, others, leading university athletes. Superb equipment, modern sanitation, pure water, splendid meals, physician and trained nurses. Accredited academic work offered. Lake location. One term only, 8 weeks. *Catalog.*

★ ★ ★ **N-134 DeKoven Hall, Delafield, Wis.**

BOSTON UNIV. SARGENT CAMP On a private lake in New Hampshire. Girls, ages 7-20. University supervision. All water sports, riding, tennis, crafts. *Catalog.* **Dean Geo. K. Makechnie, 2 Everett St., Cambridge 38, Mass.**

SUSQUEHANNA Boys 5-16. Mountain camp on private lake. New Milford, Pa. 39th year. 775 acres. Daily riding, complete course in horsemanship. Fine lake swimming. All other sports. Skilled leader for each 4 boys. Personal development our aim. *Booklet.* **Robert Smith, New Milford, Pennsylvania.**

VOCATIONAL

Bryant COLLEGE

EXECUTIVE Secretarial course leads to B.S. degree in only 2 years. Superior technical training, cultural subjects. Also 1-yr. diploma Sec'l, 2-yr. Bus. Admin. and Acc'ting degree courses. Academic standards of a senior college. Dorms on campus. 12 buildings. Coed. 86th year. Providence, New York, Boston placement. Register early. Catalog. **Enrollment Secretary, Providence 6, R. I.**

KATHARINE GIBBS OUTSTANDING secretarial training for high school, private school graduates, college women. Resident facilities. Catalog: **Assistant Dean, 90 Marlborough St., Boston 16; 51 E. Superior St., Chicago 11; 230 Park Ave., New York 17; 155 Angell St., Providence 6.**

WHY DON'T YOU WRITE?

Writing short stories, articles on business, travels, homemaking, hobbies, local and club activities, etc., will enable you to earn extra money. In your own home, on your own time, the New York Copy Desk Method teaches you how to write—the way newspaper men learn, by writing. Our unique "Writing Aptitude Test" tells whether you possess the fundamental qualities essential to successful writing. Write for it, without cost or obligation. *VETERANS: Course approved for Veterans' Trg.*

NEWSPAPER INSTITUTE OF AMERICA
Suite 1106-B, One Park Avenue, New York 16, N. Y.

TRI-STATE COLLEGE B. S. Degree in 27 months in Civil, Electrical, Mechanical, Chemical, Aeronautical, Radio Engineering; Bus. Admin., Asst. and Secretarial Science. School now filled to capacity. No applications can be accepted until further notice. **1447 College Ave., Angola, Indiana.**

BOYS' SCHOOLS

ADMIRAL FARRAGUT

ACCREDITED. Prepares for all colleges, government academies. Naval-military training at Toms River, N. J. (grades 7-12); or naval-military-aviation at St. Petersburg, Fla. (grades 5-12). Sports. Specify catalog. **Box L, Toms River, N. J.**

ARMY AND NAVY ACADEMY

"Where the Campus meets the Surf." A school of distinction, one of the West's oldest. Accredited. Successful guidance program. Year round surf sports. Camp July 5. Fall term Sept. 15. *Catalog.* **Col. W. C. Atkinson, Box N, Carlsbad, Calif.**

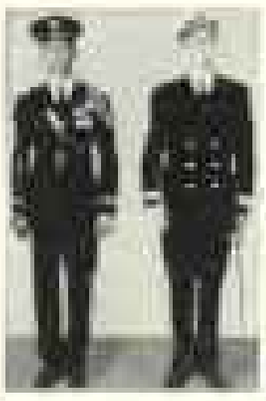
AUGUSTA MILITARY ACADEMY

Country location in famous Shenandoah Valley of Virginia. Prepares for all Universities, West Point and Annapolis. Able faculty of experienced teachers. R. O. T. C. Beautiful gymnasium, indoor swimming pool. All sports. Fully accredited. 83rd session. *Catalog.*

Address all communications to
Major Chas. S. Roller, Jr.,
Box N, Fort Defiance, Va.
Capacity enrollment last year.

BOLLES

On Beautiful St. John's River



ACCREDITED prep for colleges, gov't academies. Grades 8-12. Naval or military training. Highest Navy rating. Small classes. Year-round golf, tennis, flints. Outdoor swimming pool, gym. Catalog. **Director of Admissions, Box 5037-N, Jacksonville, Fla.**

BORDENTOWN MILITARY INSTITUTE FULLY accredited. College preparatory and general courses. R.O.T.C. Vigorous physical training. Boys taught how to study. Homelike atmosphere. Near Trenton. Junior school, 62nd year. Summer session. Catalog. **Registrar, Box 654, Bordentown, New Jersey.**

CASTLE HEIGHTS

(Gen. Bnht. Lea Bullard, Ret. U.S.A., Chairman of Board)

MILITARY Accredited

Preparation for College and Gov't Academies. Jr. College. Jr. School in separate quart. Boys taught to study and inspired to excel. Sr. R. O. T. C. 17 modern buildings. Every boy in athletics every day. Outdoor sports year round. Endowed. Swimming pool, golf, aviation. Summer session: June 15 to August 25. For catalog and "22 Points", address: **Col. H. N. Armstrong, Pres., Lebanon, Tenn.** (Near Nashville)

COLUMBIA MILITARY ACADEMY 12 miles from Nashville. Built by U.S. Gov't. Fully Accred. R.O.T.C. Special Dept. preparing for Gov't Academies. Jr. School. New $90,000 gym. Athletics: swimming, golf, horsemanship. 50 piece band. Summer session. Catalog. **Dept. N, Columbia, Tenn.**

CULVER MILITARY ACADEMY

on Lake Maxinkuckee. Emphasis on physical, intellectual, moral stamina. High scholastic standards. Thorough preparation for college. Three BOTC units—Artillery, Cavalry, Infantry. Band. All sports. Catalog. **49 Pershing Way, Culver, Ind.**

DARLINGTON SCHOOL FOR BOYS FULLY accredited. Individualistic instruction—highest standards. Christian character developed. In foothills, Lookout Mt. range. Sports. Dairy farm. For catalog, address: **C. N. Wilcox, Ph.D., President, Rome, Ga.**

FISHBURNE MILITARY SCHOOL

Accredited college prep emphasizing academic excellence. 69th session. All sports, social programs, individual guidance. War Department. ROTC. Highest gov't rating. Catalog and viewbook. **Col. Morgan H. Hudgins, Box N-7, Waynesboro, Va.**

FLORIDA MILITARY ACADEMY

One of the outstanding schools of the South. Fully accredited. R. O. T. C. Separate Junior School. Recreation center on Gulf of Mexico. All-inclusive rate. Limited enrollment. **Col. Walter B. Mendels, President, Box 1, St. Petersburg, Florida.**

FLORIDA NAVAL ACADEMY

FULLY accredited. On Matanzas Bay. Prepares for college, Government Academies. Junior College. Aviation and flying. Graduates excel in college. Sports. Write for Catalog-Viewbook. **Com'd'r Claude N. Brubeck, St. Augustine, Fla.**

FORK UNION MILITARY ACADEMY

★ Builds character, initiative.

Teaches boys to think and talk in each subject, understand basic principles. Accredited. ROTC. Highest Gov't rating. Athletics, Pool, Bands. Separate Lower School. Housemothers. Catalog. **Dr. J. C. Wicker, Box 304-R, Fork Union, Va.**

GEORGIA MILITARY ACADEMY

3 miles from Atlanta. Winter and Summer School. Prep School—Junior College—Separate Junior School—R. O. T. C.—Aviation. Accredited. Moderate rates. Write for catalog to **Col. W. N. Brewster, Pres., College Park, Ga.**

GREENBRIER MILITARY SCHOOL. Also SUMMER CAMP

135th Year. Fully accredited Lower School, High School, Junior College. Trains for leadership. Remarkable success records at Government Academies and elsewhere. Elevation 2200 feet. Climate and health conditions ideal. Modern fireproof connected buildings. Complete athletic program. R. O. T. C. For catalog, address: **Colonel D. T. Moore, Registrar, Box N, Lewisburg, West Virginia.**

HILL MILITARY ACADEMY R.O.T.C. school, recognized by State and accredited Associations; exceptionally high Academic standards; ample facilities in the mild invigorating climate of the great Northwest. Grades and High School. **Jos. A. Hill, Pres., Dept. NG, Rocky Butte, Portland 16, Ore.**

HOWE MILITARY SCHOOL

TRAINING young Americans for leadership. R.O.T.C. Accredited college preparatory, business courses. Junior school. Sports. Episcopal. Est. 1884. Summer camp. Catalog. **Burrett B. Bouton, M.A., Supt., 947 Academy Place, Howe, Indiana.**

KEMPER MILITARY SCHOOL

HIGH SCHOOL & JUNIOR COLLEGE

100th year. Accredited education with military training to help develop courtesy, self-reliance, leadership. ROTC. Small classes. Varied social, cultural, recreational programs. Sports for all. 2 gymnasiums, 6 diamonds, tennis, golf, flying. Pool. New stadium, gym. Catalog. **Colonel A. M. Hitch, 1047 Third St., Boonville, Missouri.**

KENTUCKY MILITARY INSTITUTE A SCHOOL with a winter home in Florida. Preparation for college under ideal climatic conditions all year. Oldest Private Military School in America. For illustrated catalog, address: **Col. C. B. Richmond, Pres., Box N, Lyndon, Ky.**

LA SALLE MILITARY ACADEMY ACCREDITED college preparation under Brothers of the Christian Schools. 9th grade through High School. Senior ROTC. Flight training. Two regulation rifle ranges. 25-acre playing field. 94th year. Catalogue. **Rev. Brother Brendan, Box G, Oakdale, Long Island, N. Y.**

MANLIUS SCHOOL ACCREDITED college preparatory, 8th grade. Military training develops initiative, character, fitness. R. O. T. C. Sailing. Flight training available. Earliest background for gov't academies. All sports. Register early. Catalog. **Director of Admissions, Box 447, Manlius, N.Y.**

MASSANUTTEN MILITARY ACADEMY Stresses scholarship and leadership. Distinguished record. Also operates Camp Lupton for boys 8 to 12, July and August. For bulletin address: **Box N.G., Woodstock, Virginia.**

MERCERSBURG ACADEMY

Thorough preparation for leading colleges. Grades 9-12. Summer session. Beautiful 300-acre campus, 90 mi. Washington. 17 tennis courts, 5 playing fields, gym, pool. 111th yr. Catalog. **Charles S. Tippetts, Ph.D., Box N, Mercersburg, Pa.**

MILFORD FAMOUS for its teaching for the past 35 years. Personal attention in small classes encourages initiative; leads to full development of each boy's abilities; introduces younger boys to proper habits of study. Full program of extra-curricular activities. Separate lower school. **W. D. Pearsen, Hdmr., Milford, Conn.**

MISSOURI MILITARY ACADEMY AND JUNIOR SCHOOL

82nd yr. Fully accredited. R.O.T.C. Individualized instruction teaches Joy How to Study. Complete guidance program prepares for future. All sports. 5 athletic fields. 200 ac. campus. Riding. Catalog. **Col. C. R. Stribling, 947 Main St., Mexico, Mo.**

MORGAN PARK MILITARY ACADEMY

ACCREDITED college preparation, with close attention to every boy. Thorough academic training. Small classes. Lower School. All sports, gym. Riding. Band. Near Chicago. 75th year. Catalog. **Col. Sandford Sellers, Jr., Box 747, Morgan Park, Ill.**

NEW MEXICO MILITARY INSTITUTE BALANCED program of academic, military, physical training. High School, Junior College. Outdoor life year round; dry climate —3500 ft. alt. All sports. Cavalry R.O.T.C. Catalog. **Col. D. C. Pearson, Supt., Box F, Roswell, N. M.**

NEW YORK MILITARY ACADEMY

THE SCHOOL OF DISTINCTION

★

Renowned for character-building, physical development and high scholastic standing. An institution whose graduates are destined for leadership in all walks of life. *Catalog.* Address 22 Academy Ave., Cornwall-on-Hudson, N. Y.

NORTHWESTERN MILITARY AND NAVAL ACADEMY On beautiful Lake Geneva, 75 mi. from Chicago. College prep. Naval science dept. R.O.T.C. Grades 9 to 12. Sailboats, motorboats, sailors. Wooded campus. 59th year. Catalog. **54 Lake Shore Road, Lake Geneva, Wis.**

OHIO MILITARY INSTITUTE

Harmony at the best in your boy. Large faculty, small classes. Lower School for Younger Boys. 115th year. Certifies to Colleges. High, healthful location. Music, sports, new armory. Write: **Col. A. M. Henshaw, Box NG, College Hill, Cincinnati 24, Ohio.**

ONARGA MILITARY SCHOOL

Supervised College Preparation. Accredited without exams. Business Courses. Teaches How to Study. Character first. Vocational Guidance. Ages 10-18. New gym and pool. 85 miles S. of Chicago. Endowed. Catalog. **Col. L. W. Rittinger, Box W, Onarga, Ill.**

OXFORD ACADEMY SUCCESSFUL college preparation. Our tests enable us to (1) discover causes of difficulties; (2) devise method of education to fit each case; (3) make up quickly lost time; (4) plan individualized programs—each student a class. **Box C-92, Pleasantville, N. J.**

PEDDIE Boys thoroughly prepared for college and for life. Fully accredited. Jr. School. Small classes, individual guidance. Public speaking course required. Sports. Gym, playing fields, golf, pool. 240 acres. Summer session. 40 miles NYC. 82nd year. *Catalog.* **Wilbour E. Saunders, Headmaster, Box 4-N, Hightstown, N. J.**

PEEKSKILL MILITARY ACADEMY ACCREDITED Preparation for college and government academies. All around development of each boy. Business course. Small classes. Sr. and Jr. Schools. Riding. Swimming pool. Catalog. **Col. Thomas R. Fisher, Harvard A.M., Headmaster, Box 16, Peekskill-on-Hudson, N. Y.**

BARRE GUILD

To women past 40 . . .

How can you best be sure that the monument you buy is cut from the finest granite, artistically correct and fully backed by a guarantee that means something?

There is one sure way to identify a monument of superior quality, design and workmanship, and the dealer who sells it: look for the Barre Guild Seal (shown above) etched inconspicuously in the monument itself and on display in your dealer's showroom. Monuments bearing the approval of the Guild are made only of Select Barre Granite, are guaranteed by the Guild's Certificate of Quality—the strongest guarantee in the monument industry.

YOURS FOR THE ASKING

Send today for new booklet, "*Monument Views*"—a handpicked selection of inspiring monument designs. Barre Guild, Desk NG-10, Barre, Vermont.

ENLARGED MAPS

Made available as a service to members by the National Geographic Society. Highly legible and printed in ten colors, they are ideal for wall display in Schools, Libraries, Offices, Homes.

BIBLE LANDS—64½" x 44½"
UNITED STATES—67" x 43½"
THE WORLD—67" x 43½"
NO. & SO. HEMISPHERES—67" x 35½"

National Geographic Society
Dept. D-M, Washington 6, D. C. 1947
Please send me items indicated below:

ENLARGED MAPS On Heavy Chart Paper	How Many Copies Desired	
	Maps $2 each in U. S. & Poss. Elsewhere $2.25	Indexes 25c each in U. S. & Poss. Elsewhere 50c
Bible Lands		
United States		
The World		
No. & So. Hemispheres		

Enlarged maps are mailed rolled to U. S. and Possessions. Postal regulations necessitate folding these maps for mailing to all other places.

I enclose remittance of $..... payable in U. S. funds.

(WRITE NAME AND ADDRESS IN MARGIN BELOW)

in Massachusetts

. . . You'll land at Plymouth with the gallant Pilgrim band . . . ride with Revere . . . stand staunchly with the Minutemen. In your ears will echo the ringing words that started a war at Lexington . . . the roar of Old Ironsides' guns, the rattle of musketry and the shrill cry of painted warriors. If America's history thrills you . . . see it come alive in Massachusetts, where so much of it was lived!

Write for the booklet—"Vacation Variety." Address the Massachusetts Development and Industrial Commission, Dept. A-1, 20 Somerset Street, Boston 8, Massachusetts.

FOR
Sports • Country
Sea Shore • Antiquity
• Scenic Splendor •
History • Famous
Food • Refreshing
Climate • Relaxation

Choose MASSACHUSETTS
the COMPLETE Vacation Land!

NEW ENGLAND VACATIONS

We've added 80,000 telephone girls in the last year

We're working hard to give you more and better telephone service than ever before.

In the last year, we have added 53,000 telephone operators; also 27,000 service representatives, secretaries, clerks, stenographers, typists and manufacturing employees.

These are just the figures for women. We have also increased our employees by 80,000 men—most of them war veterans.

Yet in spite of record figures on employment, manufacturing and installations, we are greatly concerned that there are still more than 2,000,000 people waiting for telephone service and many who are not getting the kind of service they want.

We want you to know that we are doing our level best to catch up with every telephone need of everybody—everywhere.

BELL TELEPHONE SYSTEM

The Philippines are coming closer

To us – to all of us – the Philippines are more than a port of call. More than a group of 7,083 islands anchored to the ocean floor north of Borneo and east of Siam. Their flag is new, their government free, their future their own. They are close now, and coming closer.

THROUGH OUR predecessor companies, we were the first American flag line to visit the Orient and trade there. Today, our interim ships are again providing limited transportation across the Pacific.

And soon you will be able to step aboard one of our fast, new luxury liners—ships that will provide comforts never before offered travelers to the Orient and 'Round-the-World: roomy, shipside apartments, air conditioning, grand food, entertainment, swimming pools. American flag service in every respect.

Normal 'Round-the-World service touches 14 countries and 23 ports of call: New York, Boston, Havana, Cristobal, Balboa, Los Angeles, San Francisco, Honolulu, Yokohama, Kobe, Shanghai, Hong Kong, Manila, Singapore, Penang, Colombo, Bombay, Suez, Port Said, Alexandria, Naples, Genoa, Marseilles, (New York).

Do this: see your travel agent, or write or call on us at 604 Fifth Ave., New York 20; 89 State St., Boston 9; 716 Transportation Bldg., Washington 6, D. C.; Hanna Building, Cleveland 15; 110 South Dearborn St., Chicago 3; 258 Henry Bldg., Seattle 1; 514 W. Sixth St., Los Angeles 14; or 311 California St., San Francisco 4 (Head Office).

Plan ahead for the

ORIENT

the world's supreme travel experience

AMERICAN PRESIDENT LINES

For 76 years America's link with the Orient