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THE NATIONAL GEOGRAPHIC MAGAZINE

Dixie Spins the Wheel of Industry

By WILLIAM H. NICHOLAS

Illustrations by National Geographic Photographer J. Baylor Roberts

ROCK HILL, South Carolina, will never be the same again.

The 1940 census put the population of this tranquil York County town at 15,009. Mainstays in its comfortable economic life were a textile finishing mill, some cotton mills, a rug mill, a hosiery mill, and Winthrop College, which is the South Carolina State college for women.

Then one day an engineer for Celanese Corporation of America came to town, met Charles L. Cobb, president of the Peoples National Bank, and revealed that he was looking for a site for a new plant. Things began to happen.

Last summer I saw the towers of a $40,000,000 plant of Celanese Corporation rising in the middle of a 1,100-acre tract along the Catawba River, a few minutes' drive from town (page 289). Here the plant can get the water it needs—100,000,000 gallons a day. Late last year it started to produce the synthetic textile yarn, Celanese, in enormous quantities.

Workers Ride 30 Miles to Jobs

Most of the 5,000 workers will live within a radius of 30 miles from the new plant. Hundreds now ride to their jobs in their cars. Others come in special buses. Many more live in new homes in a real-estate development between the plant site and Rock Hill. And the town itself supplies its share of the employees.

Rock Hill floated a $3,000,000 bond issue to widen streets and extend water, sewer, and power lines. Businessmen enlarged and spruced up their stores. Mr. Cobb transformed his old, conservative banking house into a gleaming combination of tile flooring and brass tellers' cages, and installed an air-conditioning system.

Rock Hill was definitely on the map of Southern industrial progress.

New Factories Blanket Dixie

Establishment of this big plant in a small South Carolina community is not an isolated instance. In a trip through the Carolinas, Georgia, Alabama, Tennessee, Mississippi, and the port of New Orleans, I found on all sides similar examples of the amazing industrial development of the South.*

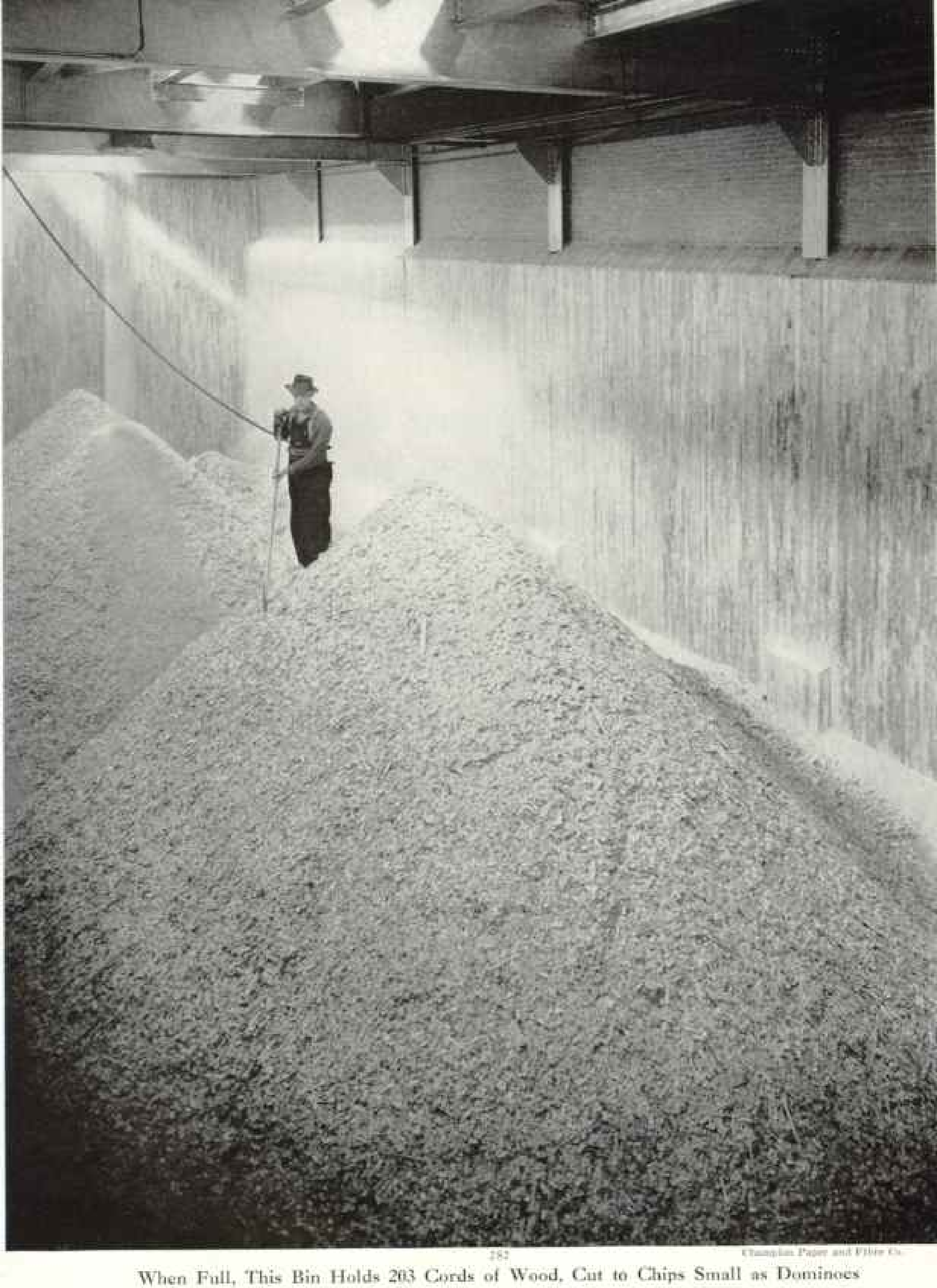
To cover a cross section of Dixie, I followed for the most part the 8,000-mile network of the Southern Railway System, which serves the South from Mason and Dixon's line to the Gulf and from the Atlantic Ocean to the Mississippi River.†

In the last three years more than 1,000 new factories, 100 large warehouses, and 300 substantial additions to existing plants have sprung up alongside its tracks.

Magnolia and moonlight still supply the motive for the Southern symphony, but it is played today to an ever-increasing accompaniment of humming spindles, throbbing paper

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Louisiana Trades with the World," by Frederick Simpich, December, 1947; "Machines Come to Mississippi," by J. R. Hildebrand, September, 1937; "Highlights of the Volunteer State," May, 1939, and "Tarheelia on Parade," August, 1941, both by Leonard C. Roy; and "Charleston, Where Mellow Past and Present Meet," by DuBose Heyward, March, 1939.

† See National Geographic Society's Map of Southeastern United States, special supplement to the February, 1947, issue of the NATIONAL GEOGRAPHIC.



Champion Paper and Fibre Co.

When Full, This Bin Holds 203 Cords of Wood, Cut to Chips Small as Dominoes

Every day the Champion Paper and Fibre Company mill at Canton, North Carolina, receives some 85 carloads of pine and hardwoods to be turned into paper. The logs are cut up by chippers, a series of knives set in slots in rotating disks. From the storage bin the chips go to a "digester" to cook in a caustic liquor.

Pajama-clad Businessmen of Royston, Georgia, Hail a Local Industry

The marchers' attire is the product of Textron South, Inc. An enterprising Citizens' Commercial Committee erected a building to house this newest Royston enterprise, one of four Textron textile plants in Dixie. The parade was the highlight of a community "Progress Day" celebration.

mills, clanging forges, and whining generators.

"The South's phenomenal industrial growth is the brightest spot on the whole horizon," Ernest E. Norris, president of the Southern Railway System, told me. "Along our lines new plants have averaged one a day for the last three years, and the trend is continuing. It sometimes seems that all the factories have adopted 'I Wish I Was in Dixie' as their theme song."

Robert Gregg, president of Birmingham's big Tennessee Coal, Iron and Railroad Company, takes exception to saying "postwar" in connection with the industrial development of the South.

"As a matter of fact," he told me, "World War II actually interrupted it. The South got comparatively few war plants. Its industrial growth started long before World War II and was increasing steadily at the time of Pearl Harbor. Our company launched a big expansion program in the late 1930's. We were expanding for peace, not for war. The same was true of many other Southern industries. It was fortunate for the war effort that such expansion had taken place, but the war did not cause it."

Textiles South's Top Industry

Giant of Southern manufacturing is the textile industry, which centers in the Carolina Piedmont, extends deep into Georgia and Alabama, and stretches over into Tennessee and Mississippi. Today the South makes about 75 percent of the Nation's textiles. Only bigger operation in Dixie is food production.

There were a few cotton mills in the South in the 1790's and early 1800's, but the first of importance was the Graniteville Mill in Horse Creek Valley, South Carolina. It was established in 1845 by William Gregg, "father of Southern cotton manufacture." Today, bigger than ever, the Graniteville Company

Southern Railway System

"The Little Southerner" Makes Its Debut in Birmingham's "Kiddie Land Park"

"Engineer" Ernest E. Norris, president of the Southern Railway System, and as many of Birmingham's little folk as could climb aboard, made the inaugural trip on June 5, 1948. The miniature System is complete with modern Diesel locomotive, six passenger cars, a station, tracks, tunnel, and roadside signals.

turns out in a year 56,000 miles of drills, twills, jeans, poplins, flannel, duck, and similar woven goods.

The Elkin Cotton Mill, which started operations in 1845 on Elkin River, North Carolina, didn't survive, but it laid the foundations for a huge textile plant. After the Civil War its operators turned it into a gristmill.

Its mountaineer customers raised sheep as well as grain, so a carding machine was installed to card fleeces for them. By 1890 a small woolen mill was set up to make cloth, yarn, and blankets—and the town of Elkin grew up near by.

From this modest beginning evolved the Chatham Manufacturing Company, which made more than 10,000,000 blankets for Uncle Sam during World War II and was the first textile plant to gain the Army-Navy "E" award (page 316).

Today Chatham imports fleeces from Scotland, Australia, Argentina, South Africa, New Zealand, and Uruguay. Seventeen million pounds of raw wool were processed to make Chatham blankets in 1947. Thurmond Chatham, third generation of his family in the business, is chairman of the board. His son is a vice president of the company.

Sons Expand Fathers' Mills

Sons are expanding mills their fathers established at the close of the Reconstruction period.

In 1888 a cotton factory began operations at Fort Mill, South Carolina. Trained weavers from Pennsylvania were imported, but they couldn't get along with the "unreconstructed" Fort Mill boys. A strike and a riot were followed by the departure of the Yankees.

Soon the Fort Mill plant became one of the Springs Cotton Mills, built up by Col. Leroy Springs and expanded now to huge proportions by his son, Col. Elliott W. Springs, World War I flying ace. Today seven Springs mills produce six million yards of cotton fabrics a week. The Lancaster, South Carolina, mill is the largest in the world under one roof, with 7,000 looms. Colonel Springs last year added to it a $15,000,000 bleaching and finishing plant and foundry.

Moses and Caesar Cone, natives of Tennessee, launched their first cotton mill in 1895

in the then small village of Greensboro, North Carolina. They named it Proximity because "there was nothing to begin with but proximity to the cotton fields." Today the Cone family operates 18 mills. They are the largest weavers of denim cloth in the world. I saw 3,000 looms weaving yarn into cloth in a five-acre room in their White Oak Mill, which consumes about 325 bales of cotton a day.

Robert Lee Stowe and Samuel Pinckney Stowe in 1901 gave up management of their small general store at Belmont, North Carolina, then a water stop on the old Atlanta & Charlotte Air Line Railway, to build a cotton mill. Farmers, a rival storekeeper, traveling salesmen, and others subscribed enough stock to enable the brothers to put up a little mill with 5,000 spindles on which to spin yarn. Its pay roll was $115 a month.

Now Belmont has 15 yarn-spinning mills with 240,000 spindles, also a finishing plant, a dye plant, five hosiery mills, and many small related firms. Employees number 5,000, and the annual pay roll is $12,000,000. Although a younger generation is connected with the business, the Stowe brothers, who built up nearly all these enterprises with the aid of the late A. C. Lineberger, still have their hands at the helm. Both past 80, they plan with youthful zest for further expansion.

Lindale Made Sailors' Shirts

The old Massachusetts Cotton Mills of Lowell, Massachusetts, built a factory at Lindale, near Rome, Georgia, in 1895. It was taken over by the Pepperell Manufacturing Company, of Boston, in 1926, when Pepperell absorbed the older company. Expansion through the years has been such that in World War II the Lindale mill was able to turn out enough chambray to make nine shirts for every sailor in the United States Navy.

In the 1920's the South emerged as the leading cotton-textile producing section of the Nation. Northern companies began to build mills below Mason and Dixon's line in ever-increasing numbers.

Now synthetic fibers have made a definite place for themselves in the industry. In 1947 the United States produced 950 million pounds of rayon yarn and staple—6½ pounds for every person. Three-fourths of this was manufactured by Southern mills.

E. I. du Pont de Nemours & Company of Wilmington, Delaware, is ready to build a multimillion-dollar plant at Camden, South Carolina, for the manufacture of a new synthetic fiber known as "Orlon." Thus far Orlon has been made only in a laboratory-scale pilot plant. It originated in the research section of the company's rayon department. The new fiber strongly resists deterioration by sunlight.

Burlington Mills Corporation, of Greensboro, North Carolina, is still a first-generation company, founded 25 years ago in Burlington, North Carolina, by J. Spencer Love. Mr. Love, who came out of World War I as a major at the age of 22 with a citation from General Pershing, had saved up $3,000. With this he started a small cotton mill. But a year later, in 1924, he hitched his wagon to the dawning star of rayon.

Burlington Mills' Growth Spectacular

Burlington Mills has ridden its star from one small factory to 82 plants in 56 communities in North Carolina, Virginia, West Virginia, Tennessee, Alabama, Pennsylvania, and New Jersey; Australia, Canada, Cuba, Mexico, England, and South America. Net sales exceed $275,000,000 annually.

Now one of the largest weavers of rayon in the world, Burlington also is a big producer of nylon hosiery, and its ribbon division turns out more than 300,000 miles of satin, grosgrain, and moire ribbon every year.

As chairman of the board, Mr. Love keeps in touch with his far-flung empire by air. The firm owns three twin-engine planes.

"It's a rather awe-inspiring thing to have your boss talk to you from an airplane while you are sitting in your office," a Burlington executive told me. "Makes you think of the 'man from Mars.'"

At the Dunean Mill of J. P. Stevens & Co., Inc., in Greenville, South Carolina, I saw 2,000 looms weaving cloth made of various types and combinations of synthetic fiber. The company operates cotton, rayon, and woolen mills in the Carolinas and Georgia, and also acts as sales representatives for other mills. Site of its newest mill, which will weave woolens, is at Dublin, Georgia.

In the last two years Deering, Milliken & Company, Inc., has built four new mills at Clemson, McCormick, Johnston, and Pendleton, South Carolina. Old-time mill operators still are talking about them. Each is windowless, scientifically illuminated with fluorescent lighting, and equipped with the most modern textile machinery. Since 1940, Deering-Milliken has spent more than $50,000,000 for new equipment in the South to weave cotton, woolen, and rayon cloth in 20 mills.

To supply rayon weavers with enough fiber to feed their looms keeps Southern raw-material manufacturers running full blast.

The Southern Chemical Cotton Company

With the Dawn the Chant of the Tobacco Auctioneer Will Ring in This Winston-Salem Warehouse

Early-rising farmers stack their shallow trays, or baskets, with "hands" of tobacco. The baskets will be weighed and placed in long rows. Then buyers, moving at a shuffling pace in time to the auctioneer's singsong recital, will pass down the rows, swiftly making bids. In a five-hour sales day 350,000 pounds of tobacco may be sold (page 306).

in Chattanooga, for example, buys cotton linters from cottonseed-oil manufacturers by the solid trainload, processes the linters into pure cellulose, and sells that to rayon-yarn makers. Rayon is made from cellulose obtained from cotton linters or wood pulp, or from a combination of both.

The company's cellulose also goes to manufacturers of fine paper. Fifty percent of every dollar bill Uncle Sam makes is composed of cotton.

Rayon Yarn from "Soup"

At the rayon plant of the American Enka Corporation, near Asheville, North Carolina, I saw liquefied cellulose, or chemical "soup," forced through tiny apertures in hundreds of nozzles. Each nozzle was immersed in a bath of dilute sulphuric acid and salts.

When the "soup" comes in contact with the acid bath, it coagulates at the tip of each nozzle. To start the spinning process, an operator runs his finger across the tip of a nozzle. The coagulated "soup" adheres to it in the form of a thread. He draws the strand up out of the bath, over a series of guides and rollers, and starts it winding on a rapidly revolving spool.

All about him hundreds of these spools are spinning, drawing seemingly never-ending threads up from immersed nozzles.

A large share of Enka's production goes to automobile tire cord manufacturers (page 317). Nearly every big tire company has one or more weaving plants in the South.

Nylon yarn is made by Du Pont, whose newest plant near Chattanooga, Tennessee, started production last July (page 317).

Nylon—Textiles' Glamour Girl

Glamour girl of the textile industry is nylon full-fashioned hosiery. In the plant of the Melrose Hosiery Mills at High Point, North Carolina, I saw how carefully the stockings were handled to keep them from developing runs, snags, and other defects during manufacture.

With all precautions, which include daily manicures for feminine workers and nylon-lined baskets or other special carriers to take the finished product to the packing rooms, a manufacturer is happy if 70 percent of his sheer quality output turns out to be first grade.

"I'm glad women like sheer hosiery," one maker told me. "It helps business, because the stockings don't last. Heavier nylons wear much longer."

Sheer nylons in largest demand today are twice as sheer as the finest prewar silk and much more transparent.

The P. H. Hanes Knitting Company in Winston-Salem has grown into one of the Nation's leading manufacturers of knit underwear (page 301). Here I was amazed at the efficiency acquired by girl operators. Some of the complicated sewing machines stitch as many as nine threads at one time in making seams for heavy underwear.

Largest manufacturer of work clothes in the world is Blue Bell, Inc., of Greensboro, North Carolina. The original Blue Bell sewing shop was set up in Jellico, Tennessee, in 1906, with a dozen machines. After World War I a series of mergers expanded Blue Bell to 21 plants, mostly in Mississippi, Louisiana, Tennessee, North Carolina, Virginia, Georgia, and Alabama.

The big Avondale Mills, with general offices at Sylacauga, Alabama, which uses 180,000 bales of cotton a year, has been a leader in seeking means to utilize low-grade cotton—always a problem in the industry, since it comprises more than 15 percent of the crop.

One answer has been Avondale's production, as a side line to its quality products, of a nonwoven fabric of low-grade cotton fibers bonded with a synthetic resin. Since the resin is pliable, transparent, and strong, the fabric can be dry-cleaned and ironed. It is formed in a special carding operation, without spinning or weaving. A team of five men can produce 25,000 yards in a day.

Soiled Napkin? Throw It Away!

Avondale also makes napkins, tablecloths, and draperies out of this fabric. They are so inexpensive they can be thrown away when they become soiled.

Wages of textile-mill workers in the South have increased 165 to 200 percent since 1939. This vastly expanded purchasing power has stimulated a remarkable growth in retailing.

A purely Southern institution, Belk Brothers Company, of Charlotte, North Carolina, affords an example. Back in 1888, W. H. and J. M. Belk opened a small general store at near-by Monroe. From that modest start the Belk Brothers group of department stores has grown to 276, operating in every Southern State. Of these, 100 are in North Carolina. In the last decade Belk Brothers has opened 100 new stores.

Since the war, Sears, Roebuck and Company has built retail stores in Durham, Asheville, Greensboro, Winston-Salem, Fayetteville, and Charlotte, North Carolina; Florence and Greenville, South Carolina; Gadsden, Alabama; Jackson and Greenville, Mississippi; Macon, Georgia; and Knoxville, Tennessee.

The J. C. Penney Company's new single-

floor warehouse sprawls over eight acres just outside Statesville, North Carolina. From a double-track Southern Railway siding 18 boxcars can be unloaded at once. Merchandise of Southern manufacture is redistributed to Penney stores from there.

Forests Spell Wealth in Dixie

Forests represent one of Dixie's basic resources. On more than half the land of this region, trees are the logical crop. Trees blanket two-thirds of Georgia. And most Southern trees grow faster than northern.

In years past many Southern groves grew wild on thousands of acres of abandoned farm land. But the rapid rise of Dixie's pulp and paper industry, in which a billion dollars now is invested, makes it imperative that an enormous supply of pulpwood be available.

Southern pine trees, among the fastest growing of all pulp timber, attain a diameter of from 8 to 10 inches, suitable for pulpwood, in about twelve years. Thus Southern pine forests, under scientific care, can replenish themselves indefinitely.

State governments and paper mills have united to fight forest enemies. Fire is enemy number one. Fires alone destroy enough wood to support another Southern paper industry nearly two-thirds as large as the one now in operation.

Systematic protection pays dividends. Within five years, fire watching in South Carolina's Piedmont region reduced the extent of forest fires by 74 percent.

Tree growers have learned, among other things, to keep pigs out of their young groves. Some years ago a Mississippi forester followed a little wild pig around a forest for seven hours and watched it uproot 407 young pine trees.

Twelve years ago Claude E. Bullard, Hampton County, South Carolina, farmer, set aside some of his submarginal land to provide a future income for his infant son.

The first season he planted five acres in pine seedlings. By 1945, Mr. Bullard had 37,500 trees growing on 60 acres of land unsuitable for farming.

Through scientific cutting he already has sold $2,740.70 in pulpwood, for a net profit of $1,438.77, which has been credited to his son's education fund. Now Claude, Jr., and the oldest stand of trees are twelve years old. As they increase in stature, so will Claude's annual income.

For a quarter of a century the Southern Railway System has operated a 14,000-acre tract known as Lincoln Green Demonstration Forest, at Dorchester, South Carolina, to show how pine trees may be grown for a profit. More than 22 million board feet have been produced there; yet the volume of merchantable timber is increasing rapidly through the employment of scientific forestry methods.

"Profitable forestry begins with the ax," they tell you at Lincoln Green. "First step in improving a previously mismanaged woodland is careful thinning. If the stand is predominantly pine, first trees to be felled are those suitable for poles and saw timber. Then undesirables are cut, leaving a forest of select trees, chosen for straight, tall growth."

State-owned nurseries in Georgia last year distributed 18,000,000 seedlings to land owners for reforestation. Alabama distributed six million and set out 18 million more for the 1948-49 season.

Kraft Paper from Southern Pine

In 1884 a German discovered that a heavy, strong, brownish paper could be made cheaply by treating and refining wood chips in a "cooking liquor" in which salt cake had been substituted for the customary, but more expensive, soda ash. He called it "kraft" paper. "Kraft" in both German and Swedish means "strength." Southern pine proved an ideal raw material.

The International Paper Company mill at Georgetown, South Carolina, largest in the kraft industry, can turn out 1,350 tons of container board a day.

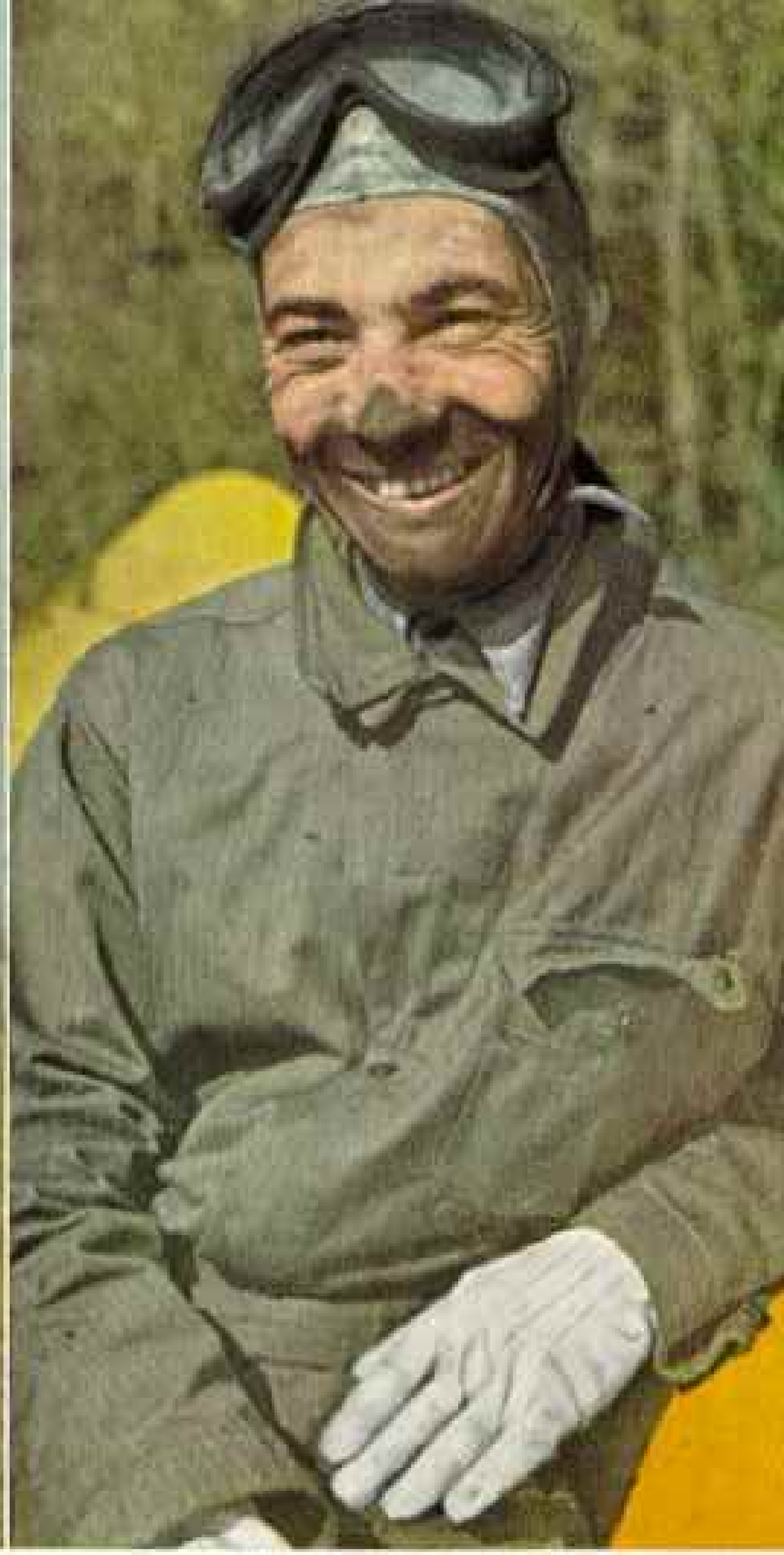
The Union Bag & Paper Corporation of Savannah, Georgia, world's largest integrated kraft container plant, has, as a result of many expansion projects, increased production steadily. The plant produces 1,100 tons of kraft paper and kraft board every day, and its largest converting unit, the bag division, makes bags at the rate of 30 million a day, with an annual output of 7½ billion bags! (Page 323.)

At Port Wentworth, Savannah suburb, the new plant of the Southern Paperboard Corporation began last year to make kraft container board at the rate of 450 tons per day. At Macon, Georgia, I saw the new mill of the Macon Kraft Company turning out a freight carload of container board an hour.

Four-block-long Fourdrinier paper-forming machines, on which the "slurry" of refined pulp and water is transformed into a continuous sheet of paper through the removal of the water, are expensive gadgets. The West Virginia Pulp and Paper Company recently added a new Fourdrinier to the battery at its big Charleston, South Carolina, plant at a cost of $6,500,000, including installation. These machines, named for their inventors, English brothers, make continuous sheets of paper ranging up to 21 feet in width.

Another New Giant Plant in South Carolina Spurs Dixie's Industrial Growth

Harmon Howarth, plant manager, shows to Charles Cobb, Rock Hill banker, blueprints for the $40,000,000 Celanese Corporation of America factory rising along the Catawba River near Rock Hill. Here the synthetic yarn, Celanese, is made. Principal raw materials are cellulose, in the form of wood pulp or cotton linters, and acetic acid. The chemical processes call for use of 100,000,000 gallons of water a day.



Kodachromes by J. Baylor Roberts

Cotton Plant Leaves Die Under Cyanamid Aerial Attack, Exposing Bolls for Mechanical Pickers—But It's a Dusty Job!

Flying six feet above ground, the plane dusts up to 100 acres in one trip. The effect of the chemical is similar to that of a frost. Leaves drop off in from 5 to 7 days. Thus there is less trash for the picker to gobble up with the cotton. Rubber gloves, goggles, helmet, and face cream protect the pilot from skin irritation.

Across a Mississippi Delta Cotton Field Parades a Mechanical Picker, Pausing Only to Tip Its Hopper-load into a Truck

In one and one-half hours it can pick a bale of cotton. Hand picking requires about 75 man-hours to do the same job, although the old process is cleaner and thus produces a higher grade. Mechanical pickers are in demand mostly in the Mississippi Delta, in Texas, and in California (page 319).

Kodachromes by J. Baylor Roberts

Kodachrome by J. Baylor Roberts

TCI Blast Furnaces Light the Night in Ensley, Suburb of Birmingham, Steel Center of the South

Biggest producer of iron and steel in Dixie, the Tennessee Coal, Iron and Railroad Company makes rails, billets, slabs, ingots, and pig iron in this huge mill. The Birmingham area is the only spot in America where the steelmaker's three basic requirements—iron ore, coal, and limestone—are found together in commercial quantities.

Liquid Metal Poured into a Whirling Mold Spins into a Length of Cast-iron Pipe

Here in the American Cast Iron Pipe Company plant at Birmingham, pipes from 3 to 48 inches in diameter are fashioned.

The molten metal, tipped from the ladle at left, flows into a trough from which it is conducted to a sand-lined flask, or mold, here obscured by the flames.

The flask, resting horizontally in a casting machine, is spun at high speed as the metal enters. Centrifugal force distributes the molten metal on the wall of the mold, producing a pipe in which all parts are formed at the same time on the wall of sand.

The spinning liquid solidifies in a few minutes. Within 30 minutes to an hour the pipe can be removed.

Thickness of the pipe is determined precisely by the quantity of molten metal poured into the mold. All of the pipes are cast in 16-foot lengths.

Kodachrome by J. Baylor Roberts

Kodachrome by J. Baylor Roberts

Southern Railway Workmen at Spartanburg's Hayne Shops Turn Old Passenger Cars into Ultramodern Reclining-seat Coaches

They have stripped side walls and interior furnishings from the antiquated model at left. Shop visitors see finishing touches applied to a rebuilt car at right, which is complete with new sides and roof, modern seats, and luxurious interior appointments.

Southern Railway Engineers Study Diesel Operation in a Training Car

The locomotive engineer at right sits before a full-scale model throttle. The instructor, pointing to a throttle diagram, discusses speed pickup technique.

Every part of the model Diesel at left is true to scale. This miniature locomotive can be raised for close inspection of wheel and truck construction and other features.

Southern Railway maintains two Diesel instruction cars. They travel from point to point on the System as fully equipped Diesel "schools on wheels."

Southern Railway now has 521 Diesel units in service or on order.

Kodachrome by J. Baylor Roberts

Kodachrome by J. Baylor Roberts

Belgian Goods Tempt Buyers at New Orleans's New International Trade Mart

First foreign exhibit of merchandise at the new "global" selling center features ceramics, tapestry, lace, needlepoint, and furniture. Many United States manufacturers have set up exhibits in the building.

Kodachromes by J. Baylor Roberts

▲ Even a Machine Can Err—Every Package Must Hold 16 Ounces

In steady procession empty cartons march under the hooded hopper in the packaging room of the Savannah Sugar Refining Corporation. There exactly a pound of sugar is poured into each box. To be sure none is short weight, the girl checks the filling machine.

▼ Whirling Drums Sugar-coat Jelly Beans and Polish Them

The confections start out as gum-drop centers here at the Century Company in Chattanooga. As the drums whirl, the attendant adds sugar, and syrup for flavoring and coloring, at frequent intervals. They adhere as a firm coating.

Kodachrome by J. Baylor Roberts

Gainesville, Georgia, Center of a $45,000,000 Poultry Industry, Honors the Chicken with a Labor Day Parade Float

One Honey-colored Blob at Left Will Print Blue, the Other Red, on That Chemically Treated Yellow Cloth

Here this dye-coupling process is used by the Southern Bleachery and Print Works, Inc., of Taylors, South Carolina. At right, in the dyehouse of the North Georgia Processing Company, Inc., at Toccoa, Georgia, a machine colors twelve pounds of thread at a time on each of its ten rollers.

Kodachromes by J. Baylor Roberts

Decorators Select New Fabric Designs in a Tomlinson, Inc., Furniture Studio

Gainsborough Portrait chairs, created by this High Point, North Carolina, factory, stand about the shop. Designing a new piece of furniture calls for close collaboration among stylists, decorators, and production engineers.

High Point is the center of a vast Southern furniture industry. Within a radius of 125 miles are made 38 percent of the Nation's bedroom furniture and 40 percent of its dining room suites.

Kodachrome by J. Baylor Roberts

A Milling Machine Veins Rubber Floor Covering Like Marble

Strips of white rubber, not mixed in thoroughly, produce the effect. This American Rubber Corporation mill was a Huntsville, Alabama, war plant.

Striped Sportswear Cloth "Flows" from a Big Knitting Machine

This electrically driven knitter in the P. H. Hanes Knitting Company plant at Winston-Salem, North Carolina, plies some 1,700 needles.

Kodachromes by J. Baylor Roberts

Kodachrome by J. Baylor Roberts

While Mothers Work, Children Play in the Day Nursery of the Matthews Mill, Greenwood, South Carolina

3,000 Pounds of Margarine Shimmer in a Blending Vat

Cottonseed oil, cultured milk, coloring, salt, and vitamin A go into the batch at Southern Margarine Company, Inc., Greenville, South Carolina.

Memphis Shops by Electronics in a "Keydoozle" Grocery Store

Press a button for each selection. "Keydoozle" punches holes in your tape. An electronic selecting device deciphers the tape and picks out your order.

Kodachromes by J. Baylor Roberts

"Maid of Cotton" Queens Turn Feed Sacks into Becoming Frocks

Three of the models in this feature of the 1948 Mid-South Fair and Livestock Show pose for the television camera in Memphis, with their "raw material" background. Brand names are on removable paper bands around the sacks.

Tennessee Girls Man a Line Assembling Radio Sets

This Greeneville plant originally was set up by the Magnavox Company, of Fort Wayne, Indiana, as a cabinet shop and shipping point. Radio set building followed. This year the factory will be expanded to produce television sets.

On August 3, 1937, the first press run of a roll of newsprint made in the South from Southern pine took place. In front of me, as these words are written, lies a page of that special edition of the *Savannah Evening Press*, testimony 12 years later to the excellence of the paper's surface and printing quality.

Months before, the late Dr. Charles Holmes Herty, in his Savannah laboratory, had been experimenting with Southern pine in making newsprint.

His success is an old story now. Several years ago the Southland Paper Mills, Inc., at Lufkin, Texas, began to make newsprint commercially from Southern pine.

Soon Alabama is to have the South's second newsprint mill. During World War II the Federal Government built the huge Alabama Ordnance Works along the Coosa River in Talladega County. Now many of its facilities have been acquired by the Coosa River Newsprint Company, and a $30,000,000 mill is being built.

Newspaper publishers, mostly Southern, own $10,000,000 of the stock and expect to buy 100,000 tons of newsprint each year. Kimberly-Clark Corporation, one of the country's largest paper and pulp and cellulose manufacturers, will operate the mill.

Kimberly-Clark also expects to take thousands of tons of sulphate pulp annually from the plant for use in its first all-South manufacturing venture at Memphis, Tennessee.

The company bought the 17-acre Memphis plant in which the Fisher Aircraft Division of General Motors Corporation had built thousands of warplanes. Strolling through the big factory recently, I had difficulty in believing that it had ever made aircraft.

Making Kleenex by the Mile

There I saw creped wadding turned out at incredible speed. Two large machines were producing a mile of Kleenex, 13 feet wide, every three minutes.

An experiment a quarter-century ago by William H. Mason, long an associate of Thomas A. Edison, to produce wood fiber by mechanical, instead of chemical, means accidentally gave birth to a new Southern industry.

Mr. Mason subjected wood chips to high-pressure steam until they were thoroughly penetrated by heat and moisture, then suddenly lessened the pressure. The resulting explosion reduced the chips to fiber.

From the fiber he made paper, but it was stiff and brittle because lignin, the natural bonding agent of wood, had not been expelled. The product did, however, make good insulation board.

One day in his modest laboratory he placed a piece of half-finished insulation board, or lap, in a steam-heated screw press to force out the water. He applied pressure, turned off the steam, and went home to lunch.

In his absence the steam valve sprang a leak and when he returned he found his piece of board smoking. Taking it from the press, he discovered that he held in his hand a piece of hard, dense, perfectly dry fiber hardboard. That was the beginning of the Masonite Corporation, manufacturer of high-density pressed woods.

Masonite hardboard now is made in Canada, Italy, Sweden, New South Wales, and the Union of South Africa. But the largest hardboard plant in the world is the parent plant at Laurel, Mississippi. Masonite net sales in the fiscal year ending August 31, 1948, totaled $36,472,950.

Cigarette Paper from Flax

In a Pisgah Forest valley not far from Asheville, North Carolina, most of the world's cigarette paper is made in the mill of the Ecusta Paper Corporation. Ecusta cigarette paper is made from fibers of the seed flax plant.

Until World War II cigarette manufacturers in the United States bought nearly all their paper from European makers, whose raw material was old linen rags. One of the largest of these was a French concern with which Harry H. Straus was affiliated.

Mr. Straus became worried about the unsettled state of political affairs in Europe. He also looked with distaste upon the fact that cigarette paper makers were dependent upon the ragpickers of central Europe and the Balkans for their paper supply.

By 1937 Mr. Straus perfected a method of utilizing the fiber of the seed flax plant. An American banking syndicate, headed by the Wachovia Bank and Trust Company, of which Robert M. Hanes is chairman of the board, and cigarette manufacturers helped him build his modern 85-acre plant. It is located on the Davidson River, where a never-failing supply of pure mountain water flows from Pisgah National Forest.

On September 2, 1939, as the Nazis rolled into Poland to precipitate the war in Europe, the big mill went into operation. That is why smokers in the United States and in the American armies did not have to go without cigarettes when Hitler's invasion of western Europe cut off our foreign cigarette paper supply.

Ecusta buys its flax principally in California and Minnesota. I saw nearly 40,000 tons —a 12-month supply—stored in its ware-

From This Kaolin Pit Comes Clay to Coat the Pages of the NATIONAL GEOGRAPHIC

Here Southern Clays, Inc., strip-mines the clay in a basin a mile in diameter at Gordon, Georgia. Processed and then mixed with English clay from Cornwall, and with casein, it is applied to the paper at the Champion-International mill in Lawrence, Massachusetts. This smooth, uniform coating permits faithful reproduction of the fine engravings made from National Geographic Society photographs (page 312).

houses. In previous years all of this material would have been burned as waste, for only the flaxseed was salable.

The cigarette paper goes to manufacturers in rolls called bobbins, as wide as the circumference of a cigarette and three and three-quarter miles long (page 309).

An Industry That Goes Up in Smoke

In 1940, half a million acres in North Carolina were planted in tobacco. By 1946 this acreage had grown to more than 800,000. And prices skyrocketed. The 1940 crop was worth 91 million dollars; the 1946 crop, 457 millions. South Carolina, Georgia, and Tennessee tobacco raisers took an additional 192 million dollars for their share.

In Bowen's Big Brick Warehouse at Lake City, South Carolina, I heard the mystic chant of the tobacco auctioneer as he passed down the narrow aisles between stacks of bright-leaf, flue-cured tobacco. Unintelligible to me, his singsong recital was serious business.

In front, behind, and in an adjoining aisle, buyers for the big tobacco companies and exporting houses shuffled along with him, in a curious, rhythmic lock step, their pace speeded by the tempo of his chant. With a friend I trailed the procession.

"Why, that's just the way it sounds over the radio," was my none-too-bright comment.

"How did you expect it to sound?" my companion asked sourly. "And keep your hands in your pockets. If you absent-mindedly wiggle a finger in the direction of the auctioneer, you might discover you've bought 500 pounds of tobacco."

Buyers made their bids by quick signs or by crisp intonations as mysterious to me as the chant itself.

Four hundred stacks an hour was the goal of the warehouseman, who paid his auctioneer $100 a day to keep selling going at a fast pace. In a five-hour sales day between 325 and 350

thousand pounds of tobacco can be disposed of (page 286).

To find out what happens to tobacco after the farmer sells it, I visited the R. J. Reynolds Tobacco Company at Winston-Salem, North Carolina. Nearly all the big tobacco firms have plants in that State, which makes 60 percent of the Nation's tobacco products.

"I have smoked Camel cigarettes for 32 years," I told James A. Gray, chairman of the company's executive committee.

"Well," he replied, "I can almost match that. I have been reading the NATIONAL GEOGRAPHIC MAGAZINE for about 25 years."

Back in 1875, Richard Reynolds began to make chewing tobacco in Winston. The original little red factory and its machinery cost less than $2,500. It made chewing tobacco exclusively.

Now R. J. Reynolds Tobacco Company needs more than 140 large factory units and storage warehouses to age the leaf, prepare the tobacco, and make Camel cigarettes and pipe and chewing tobacco.

In one building I saw a battery of intricate machines turning out cigarettes so fast my eyes had difficulty following the process. A single machine can make more than 1,000 cigarettes a minute.

R. J. Reynolds is one of two wholly Southern manufacturing enterprises which, from humble beginnings, have developed international distribution on a huge scale for their products.

Coca-Cola, an International Institution

The other is the Coca-Cola Company, of Atlanta, Georgia. The fantastic story of Coca-Cola starts back in the administration of Grover Cleveland, when John S. Pemberton worked out a formula for a new soft drink in his Atlanta home. For his new beverage a business associate produced a trademark in flowing script—Coca-Cola. Today it is one of the best-known trademarks in the world.

To the soda fountain of Dr. Joseph Jacobs' Drug Store at historic Five Points in front of Atlanta's old town well, Pemberton carried a jug of the syrup one May day in 1886. Soda fountains, rare in those days, operated only in summer months. The public response to Coca-Cola that first summer was unimpressive. Pemberton sold only 25 gallons of syrup.

Two years later, when Mr. Pemberton died, all the property of the infant company could be—and was—carried in a one-horse wagon. But Asa G. Candler, a wholesale druggist, liked Coca-Cola and had bought a one-third interest in the business before Pemberton's death. A few years later he became the sole owner of the formula, trademark, and equipment.

Candler began to build up sales. By 1895 the beverage had entered every State in the Union, and Indian Territory, too.

While Coca-Cola had been sold locally in bottles as far back as 1894 by Joseph A. Biedenharn at Vicksburg, Mississippi, it remained primarily a soda-fountain drink until late in 1899, when two Chattanooga lawyers convinced Mr. Candler it should be bottled. There the groundwork was laid for the Coca-Cola bottling plants which have sprung up all over the United States. Most of them are owned and run by citizens of the communities in which they operate.

Another outgrowth of the lawyers' visit was the Chattanooga Glass Company, whose principal business is the manufacture of Coca-Cola bottles. Its annual capacity is 1,200,000 gross, which represents somewhat less than half the bottled Coca-Cola sold last year in the United States.

In 1919 Mr. Candler retired. Since then the company has been owned by thousands of stockholders, who live in all parts of the United States. Robert W. Woodruff, a native Georgian, is chairman of the executive committee; Harrison Jones, a Virginian by birth, is chairman of the board of directors; and William J. Hobbs, a North Carolinian, is president of the company.

Before World War II Coca-Cola was sold in some 70 foreign countries. Today more than 6,000 persons, nationals of nearly all countries, are employed in producing and selling Coca-Cola outside the United States.

The formula for Coca-Cola is one of the world's top commercial mysteries. In the long history of the business, only seven men have known the secret. Today two of the company's oldest chemists know it. Should both die suddenly, the only existing written copy of the formula would have to be taken from a bank vault and consulted before production of syrup could continue.

Southern Furniture Making Centers in High Point

Toward the close of the War Between the States, Capt. W. H. Snow, a Vermont Yankee, trudged along with other Union troops through the forests of North Carolina's Piedmont. The climate and the fine stands of hardwood on all sides made such deep impressions upon him that when the war ended he came back to High Point to live.

Captain Snow first made hardwood spokes and handles. Then he sold New England textile manufacturers bobbins and shuttle blocks

Stronger than Steel or Bamboo Is a Glass Fishing Rod

It is also lighter in weight and is impervious to water or weather. These casting rods are made of resinated fiber glass in the Columbia, South Carolina, plant of the Shakespeare Company, Kalamazoo, Michigan, manufacturers of fishing tackle.

from North Carolina persimmon and dogwood.

Captain Snow has gone down in history as the father of High Point's furniture industry. Today about 90 factories, large and small, operate there (page 300).

I wandered over the big Southern Furniture Exposition building in High Point, where some 5,000 buyers come each July to see the exhibits of the country's leading furniture makers, most of them Southern. The 14-story building has a quarter-million feet of floor space.

North Carolina's furniture industry has branched out in all directions. Thirty-eight percent of the Nation's bedroom furniture and 40 percent of its dining-room suites now are made within a radius of 125 miles of High Point.

The South's industrial growth can be measured by the expansion of private power companies.*

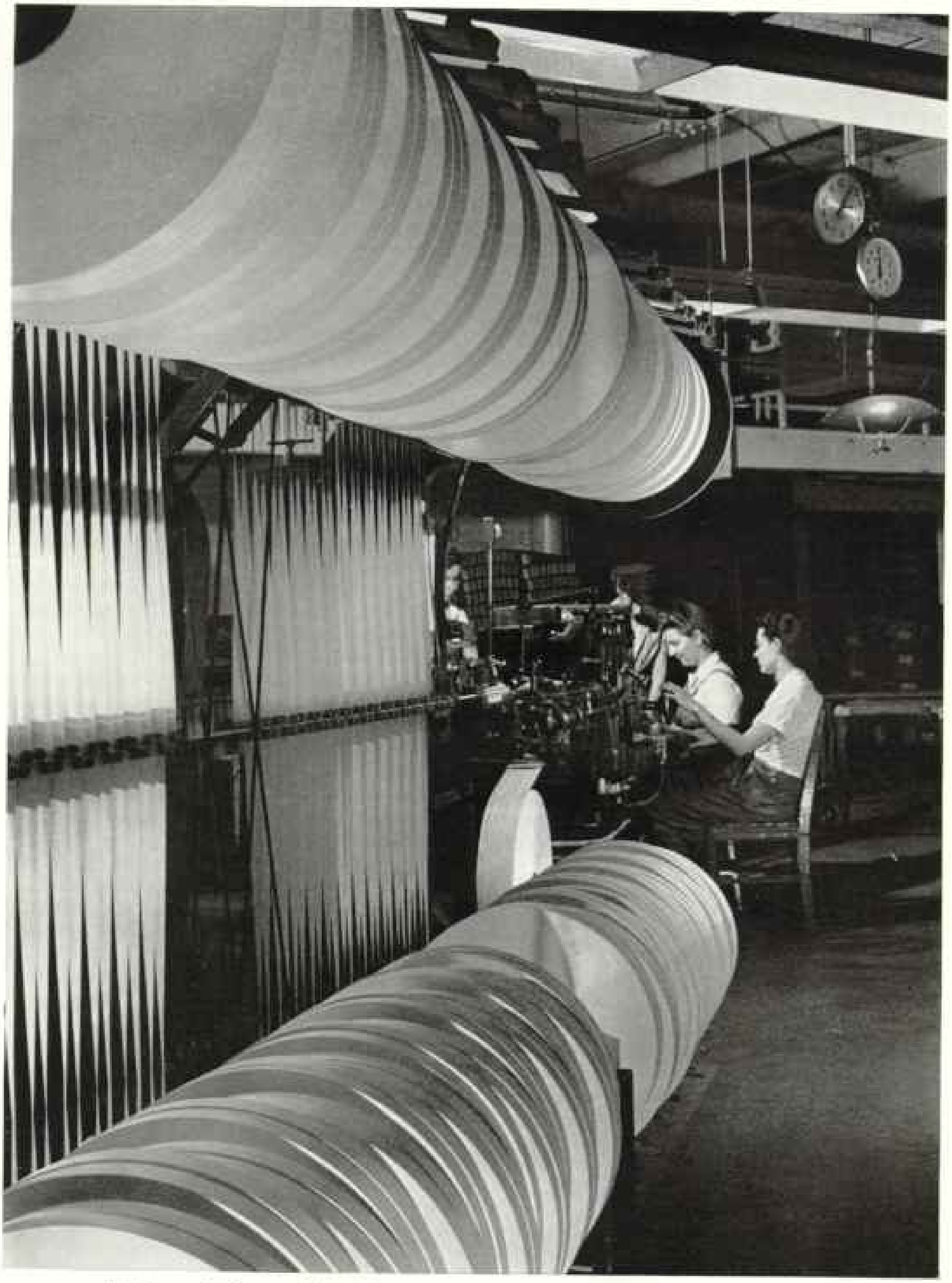
The late James B. Duke built a small hydroelectric plant in North Carolina in 1904. By the eve of World War I, Duke Power Company production had grown to 325 million kilowatt-hours annually.

But by 1945 the company was selling four *billion* kilowatt-hours. Its transmission lines covered the Piedmont from Durham, North Carolina, across South Carolina, to the Georgia border. In 1947 sales jumped to five billion kilowatt-hours, and in the first seven months of last year a further increase had been recorded.

Today the Georgia Power Company is selling almost twice as much electricity as it did in 1940. In five years, 542 new factories were added to its list of customers.

The Alabama Power Company, working closely with the Rural Electrification Administration, has added some 40,000 new farm cus-

* See "The Fire of Heaven—Electricity," by Albert W. Atwood, NATIONAL GEOGRAPHIC MAGAZINE, November, 1948.



High-speed Cutters Slice Paper for "Roll Your Own" Cigarette Smokers

Each filled bobbin holds a strip of cigarette paper 3¼ miles long. Here in the plant of the Ecusta Paper Corporation near Asheville, North Carolina, the rolls feed into a machine which cuts and wraps individual sheets in packs of from 12 to 150 (page 305).

tomers since World War II, bringing its total rural accounts to more than 81,000.

With Thomas W. Martin, president of Alabama Power, I motored to Gorgas, site of the company's two Warrior River plants, 55 miles northwest of Birmingham.

Burning Coal Underground

Here I saw preliminary work for a gasification project to be conducted in the area adjoining the company's steam plant. This experiment, conducted by the United States Bureau of Mines in cooperation with the power company, is the first of its kind in the United States to burn coal underground and to utilize the gases thus produced.

At an outcropping of a horizontal seam of coal I saw the opening of a tunnel which has been pushed into a hill, through the seam, for a distance of 1,500 feet. Later, atop the hill, I saw holes, 18 inches in diameter, drilled down to the tunnel. Some were more than 200 feet deep. The holes were spaced at intervals of 300 feet.

A huge air compressor will pump air into one of these holes, and when the face of the coal has been ignited, the gas will be forced from an adjoining hole. If gas of suitable quantity and quality can be made, it will be utilized to operate a gas turbine, which in turn will drive a compressor. Later it is planned, if the flow is constant, to pipe the gas to one of the boilers at the power company's steam plant.

No one knows how great an expanse of coal will burn, what the action of the overlying strata will be, or how much air pressure will be necessary to keep the coal burning and produce a satisfactory gas.

Mississippi Power Needs Grow

Not until 1923, when the Mississippi Power & Light Company was organized, did western Mississippi receive dependable electric power. Just a few months ago the company's new $9,500,000 steam electric generating station was put into operation a few miles north of Jackson. Its huge high-pressure boiler, heated by natural gas, stands eight stories high.

Amazing industrial growth in Jackson, Natchez, and half a dozen other communities, along with increased rural electrification, made such a plant necessary.

The Mississippi Power Company began to serve some 5,500 customers along the Gulf coast and in southeastern Mississippi on January 1, 1925. Some of the small plants it took over had supplied homeowners with electricity only at night. 'There were no' industries to speak of. Residential rates were as high as 25 cents a kilowatt-hour, compared with less than 3½ cents today.

New factories in Gulfport, Biloxi, Pascagoula, Hattiesburg, Laurel, and Meridian demand more and more electric energy. The company's generating plant near Hattiesburg was scarcely completed in 1945 before work was begun on a second unit to double its output. Now a third unit is under construction.

Northern Alabama and northeastern Mississippi are served by the Tennessee Valley Authority (TVA).*

Vulcan Guards Birmingham

Atop Red Mountain, overlooking Birmingham, stands a giant statue of Vulcan, god of the forge, gazing upon a city whose chief source of wealth is iron and steel. From deep within Red Mountain comes 90 percent of the iron ore for Birmingham's mills.

Near by, within a radius of eight miles, lie coal and limestone deposits in superlative abundance. Nowhere else in America are these three requisites for steelmaking found together in commercial quantities.†

Largest of Birmingham's many makers and fabricators of iron and steel is the Tennessee Coal, Iron and Railroad Company.

Before the War Between the States it began business in Tennessee as a coal-mining company. By 1886 it had expanded into the iron business in Birmingham; by the time it became a part of the United States Steel Corporation in 1907 most of its operations were in Alabama. Now all are in Alabama. But it has ever clung tenaciously to the "Tennessee" in its name.

TCI has grown up with the South. Yet with 32,000 men on its pay roll and all its mills humming, it is hard put to fill its orders, so heavy is Dixie's demand for steel (pages 292, 293, 314).

Last July the Republic Steel Corporation's new plant at Gadsden, Alabama, began to make steel pipe.

The R. D. Cole Manufacturing Company, of Newnan, Georgia, founded 95 years ago by R. D. Cole, Sr., survived a boycott by citizens of the town in its early days. The company was engaged chiefly in woodworking. One of its products was caskets.

When someone died, the custom was for a relative to go to the woodworking plant and order a casket built at once.

If a citizen died on a Saturday night or

* See "Around the 'Great Lakes of the South,'" by Frederick Simpich, National Geographic Magazine, April, 1948.

† See "Coal: Prodigious Worker for Man," by Albert W. Atwood, National Geographic Magazine, May, 1944.

Body Meets Chassis in Assembly Line at the New Ford Plant near Atlanta

Here, near the end of the line, the chassis is completed; the body is trimmed but has no seats. In the final 400 feet of the journey the car will be finished, its fuel tank filled, and then it will be driven off for steering, wheel alignment, and roadability tests. At peak production 350 passenger cars and trucks are assembled here in one day (page 312).

Sunday, Mr. Cole had to call in his workmen to do the job in off hours. He decided to fly in the face of convention and build up a stock of caskets.

Some of the citizens charged that Mr. Cole wanted people to die so he could make a profit on his caskets. But he stuck to his guns, the boycott died a natural death, and the company went on to become one of the Nation's leading builders of elevated steel water tanks. I saw one Cole tank in Spartanburg, South Carolina, with a capacity of 1,500,000 gallons.

A good customer for Southern steel is the Bessemer, Alabama, plant of the Pullman-Standard Car Manufacturing Company, world's largest builder of railroad freight cars. Every year it spends about $14,000,000 to buy steel, axles, car wheels, rivets, and bolts in Birmingham; journal bearings in Atlanta; brake shoes in Chattanooga; and huge quantities of lumber from Alabama forests. The Bessemer plant turns out a new freight car every ten minutes of each working day.

The Southern Railway is one of Dixie's best customers. From 1940 to 1948 it plowed back $100,000,000 of its earnings into capital investment, and the South got a big share of that spending. In 1947 Southern bought 116 new units of Diesel power, 1,000 automobile boxcars, 500 standard boxcars, 600 gondola cars, and 250 ballast cars. Orders for 1948 delivery were on a similar scale.

Southern Goes "Diesel"

Last year seven percent of Southern's freight locomotives, 16 percent of its passenger locomotives, and 25 percent of its switching locomotives were Diesels. Southern is adding new Diesels as fast as they are available and now has 521 units in service and on order (pages 294, 295).

Calumet & Hecla Consolidated Copper Company, Inc., built a $10,000,000 factory at Decatur, Alabama, last year for its Wol-

verine Tube Division. Last autumn it shipped out the first seamless, nonferrous copper tubing ever made in Dixie.

In the giant North Plant of the Aluminum Company of America at Alcoa, Tennessee, I saw "rivers" of shimmering silver-colored metal passing at incredible speed along run-out tables in the world's largest aluminum rolling mill. Here thick plates of aluminum alloy pass through a series of five sets of rollers, emerging finally in block-long strips about ⅛ of an inch thick, at such speed that they seem to flow.

Alcoa ships bring crushed, washed bauxite from Surinam to Mobile, where the powdery alumina is extracted. This is shipped in hopper cars to the mills. Four pounds of bauxite yield two pounds of alumina, which, in turn, yield one pound of aluminum.

At Listerhill, near Florence, Alabama, the Reynolds Metals Company has been making aluminum from Arkansas bauxite since 1941.

Atlanta has three of the biggest automobile-assembly plants in the United States. Oldest is Chevrolet, now somewhat overshadowed by two new giant installations. One of these, the General Motors Corporation plant at near-by Doraville, turns out Buicks, Oldsmobiles, and Pontiacs. Automobile parts, shipped from Michigan, arrive by rail and go direct to the assembly lines.

The other plant, at Hapeville, a suburb, was opened by the Ford Motor Company on December 10, 1947. At peak production it can assemble 350 Ford passenger cars and trucks in one day (page 311).

Georgia Clays Have Many Uses

Around Macon and Augusta, Georgia, a principal industrial operation is mining of clay. Here large coverings of vegetation and earth have been stripped away, revealing thick deposits varied in their composition. Each type has a different use.

"God made man out of clay," a Georgia kaolin man told me, "and clays have as many differing characteristics as man."

Pages of the National Geographic Magazine are coated with a white clay combined with casein to give them their smooth, glossy finish and enable them to reproduce with utmost fidelity the fine engravings made from National Geographic Society photographs. Slightly more than half of this clay is mined and processed by Southern Clays, Inc., at Gordon, Georgia, and by Edgar Bros., at near-by McIntyre. The remainder is Cornwall clay from Great Britain (page 306).

Oak Ridge, Tennessee, has settled down to peacetime pursuits. Population of the city of Oak Ridge has dropped from its 75,000 wartime peak to a stable 35,000. Gone are most of the trailers, huts, and temporary barracks of the hectic war days.

Carbide & Carbon Chemicals Corporation operates the three main units for the Atomic Energy Commission—the gaseous diffusion plant for production of U-235; the electromagnetic isotope separation plant; and the Oak Ridge National Laboratory, a nuclear research center (page 320).

I drove over the 60,000-acre area and saw, from the outside, the gaseous diffusion plant and a steam turbo-generating plant which has twice the capacity of Norris Dam of TVA.

J. A. Jones, head of the construction company which built these two huge installations, started his business career in 1887 in Charlotte, North Carolina, as a bricklayer's apprentice at 25 cents a day and board.

At age 24 he started his own contracting business and today he still is active in the affairs of the J. A. Jones Construction Company, which operates both in the United States and abroad.

Southern Shipping Increases

Shipping keeps pace with industrial growth in the South. In New Orleans I saw ships from all over the world on my short trip around the docks.

At the Chalmette pier of Southern Railway hustling stevedores were unloading 36,000 bags of sugar from a Lykes Bros. ship for the Colonial Sugar Company. Next to it 6,800 tons of Philippine copra were being sucked from the hold of another Lykes ship and blown into a huge hopper from which boxcars, destined for Procter & Gamble, in Cincinnati, were being loaded.

From one end of the port to the other, similar scenes of loading and unloading were being enacted.

In the heart of the city I visited International House, where buyers from abroad are accorded Southern hospitality, with all the facilities of a club at their convenience. I walked through the new International Trade Mart, where United States manufacturers and exporters display samples of their varied lines for these foreign businessmen (page 296).

Lykes Bros. Steamship Co., Inc., of New Orleans, owns a fleet of 50 C-type vessels and charters scores of others from the United States Maritime Commission.

It operates on seven established trade routes from United States Gulf ports to Great Britain, Ireland, the Mediterranean, and Black Sea areas, the west coast of South America, and the West Indies and Caribbean area.

© National Geographic Society 313 Katherine G. J. Baylor Roberts

Lumite Fly Screening, One-third as Heavy as Metal, Holds Her Weight Safely

Screening, automobile upholstery, and acid-resistant filter cloth are made by the Lumite Division of the Chicopee Manufacturing Corporation at Cornelia, Georgia. The yarn is Saran, a Dow Chemical Company synthetic.

Heat Tops 4,000° F. in Ares of Electric Furnaces to Make Ferrochromium

Chromite, only commercial chromium ore, is imported from Turkey, Rhodesia, India, Cuba, and the Philippines to Charleston, South Carolina, where it is reduced to ferrochromium here in the plant of the Pittsburgh Metallurgical Company, Inc.

Because chromite is highly refractory, an ordinary blast furnace cannot reduce it.

In the electric-arc furnace, large sticks of carbon, called electrodes, conduct electricity into the furnace as a source of heat. Coke is used as a chemical reducing agent.

Chromium, converted into ferrochromium, is shipped from Charleston to steel manufacturers, who add it to molten steel to make stainless steel and other alloy steels.

It imparts an extra toughness, hardness, and resistance to abrasion and corrosion.

The plant also refines ferrosilicon and ferromanganese by a similar process. These alloys are deoxidizing and heating agents in making special alloy steels.

Kodachrome by J. Baylor Roberts

Jaws of a Track-mounted Loading Machine Scoop Up Coal on a Conveyor Belt in a Modern Tennessee Mine

The coal previously had been blasted, then undercut by a cutting machine here in the Royal Blue Mine of the Blue Diamond Coal Company, in Campbell County. The conveyor loads the coal into the waiting cars, which are brought out of the mine in trains of 35 cars each.

Kodachrome by J. Baylor Roberts

Tightly Woven Woolen Blanketing Piles Up, Yard on Yard, for Inspection

The material will go through napping machines here at Chatham Manufacturing Company, Elkin, North Carolina, to take on a fleecy texture. Chatham made more than 10,000,000 military blankets in World War II.

↑ Nylon Yarn Runs a Gamut of Inspection Before It Goes to Hosiery Makers

The girl makes one of the 24 visual checks each shiny bobbin receives before it leaves the new nylon plant of the E. I. du Pont de Nemours & Company in Chattanooga, Tennessee. Women today wear nylon hosiery twice as sheer as prewar silk stockings.

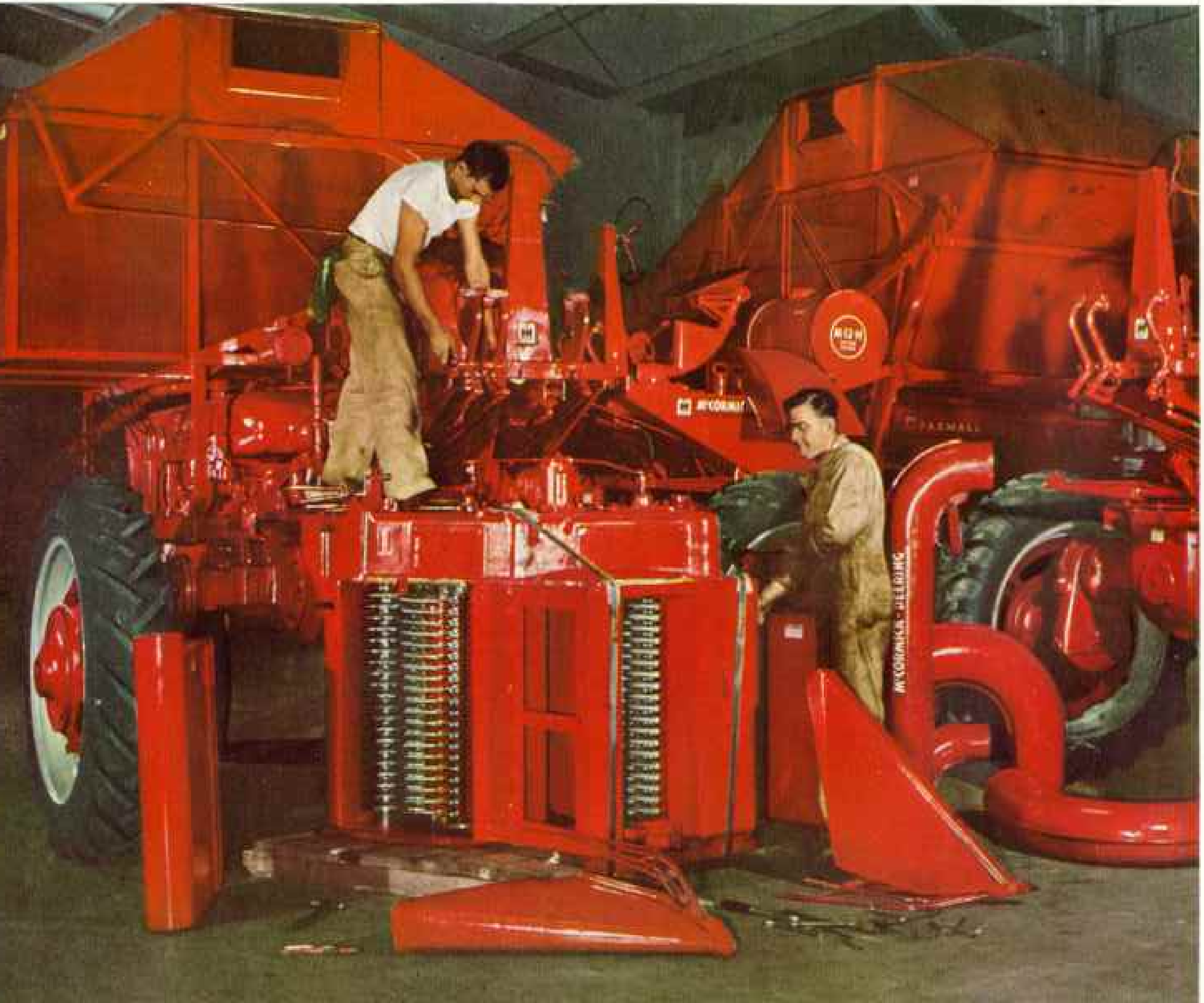
↓ Finished Rayon Yarn, Wound on Cones, Is Ready for Textile Mill Use

Fugitive dye colors in this yarn identify gauge and twist of each consignment and are washed out easily at the mills. Shoulder patch of this attendant at the American Enka Corporation, near Asheville, North Carolina, shows she is a machine operator, first class.

Kodachrome by J. Baylor Roberts

Final Coat of Gleaming Paint Goes on a Giant Earthmover, Capable of Picking Up 16 Tons of Dirt in One Gulp

The new model, built in the Toccoa, Georgia, plant of R. G. LeTourneau, Inc., is Diesel-powered. The operator loads, hauls, spreads, and turns by touching finger-tip switches which control powerful electric motors. The steering gear has two speeds.



Key to Cotton Picking by Machine Lies in Revolving Spindles Set in Picker Head

Here in the new International Harvester Company plant at Memphis a picking unit is attached to the front of the tractor. Two revolving drums on each side of the unit are equipped with 15 vertical picker bars, each containing 20 horizontal chromium-plated spindles. Each spindle has numerous small projecting barbs.

As the picker passes down a row of cotton, the plants are guided into the head by triangular gathering shields (here lying unattached in front of the unit).

The plant is thoroughly picked on both sides by the rapidly revolving barbed spindles, which seize the lint from the open bolls.

The cotton passes by suction into the hopper above the rear of the tractor (page 291).

Kodachrome by J. Baylor Roberts

↑ High School Students Learn About Atomic Energy at Oak Ridge, Tennessee

The exhibit illustrates the gaseous diffusion process for separating U-238 and U-235, principal isotopes of uranium. The device shows separation of simulated uranium hexafluoride molecules across a barrier.

↓ Burns Brick Company's Office Interiors in Macon, Georgia, Are Built of Brick

Instrument panel in rear shows operating conditions in the plant, whose two machines punch out 30,000 bricks an hour—enough in 30 minutes for a six-story house. Annual output is 60 million bricks.

The company was founded by seven Southern brothers.

The Delta Line, operated by the Mississippi Shipping Company, Inc., is known as the "coffee fleet." Delta ships, in 1947, carried 2,700,590 bags of coffee from Brazil to New Orleans, 94 percent of that port's total.

The 55 ships owned by the Waterman Steamship Corporation, of Mobile, weave a network of world-wide transport service to European ports, to the Far East, to Puerto Rico, and to North Atlantic and west-coast ports of the United States.

At Mobile the Alabama State Docks provide one of the Nation's most modern seaport terminals. On the east coast, the rival ports of Charleston and Savannah both are expanding their shipping.

Machinery Streamlines King Cotton

Farm mechanization has radically altered King Cotton and his realm.

Cotton acreage dwindled from 42 million to about 21 million in the last 25 years. Some 1,600,000 workers, mostly agricultural, moved out of the South between 1940 and 1945. Other thousands are at work in the new factories. Yet 1948 saw the harvesting of a bumper cotton crop.

The heaviest crops in the area I visited now come from the rich Mississippi Delta, a 50-mile-wide strip which stretches along the east bank of the river from Memphis to Vicksburg and from fertile soil in the Carolinas, Georgia, and Alabama.

For generations the Southern planter depended on the cotton hand and his mule to prepare the ground, plant the crop, and cultivate. But between 1940 and 1947, tractors on Southern farms increased 155 percent—from 229,000 to 585,000.

Allis-Chalmers Manufacturing Company sensed this big demand when it occupied a huge former war plant at Gadsden, Alabama, and began to build thousands of tractors.

Ten Minutes to Plant an Acre of Cotton

The old laborious process of "chopping," or weeding and thinning, young cotton with a hoe, is being supplanted by the flame cultivator, adapted from the military flame thrower by Col. Price McLemore, cotton grower of Waugh, Alabama. Flame may be safely used on cotton plants which are seven inches high. The cultivator throws a blast of flame at the base of the plants, killing weed and grass growth.

Colonel McLemore found that he could plant an acre of cotton in 10 minutes with mechanical equipment, as against 7½ hours with man-mule labor. A flame cultivator in 15 minutes duplicated a hand-hoeing job of 13 hours 20 minutes. At a time when per-cost acre of hand weeding was $5 a day in the Mississippi Delta, flame cultivation cost 50 cents an acre.

Colonel McLemore found that to pick a bale of cotton by hand required at least 75 man-hours. With the mechanical cotton picker he accomplished this tedious task in 1½ hours (page 291).

I walked through the $30,000,000 plant of the International Harvester Company at Memphis, built to manufacture mechanical pickers (page 319).

Opened early in 1948, its first year's output was more than 1,100. These machines were sold principally in the Mississippi Delta, in Texas, and in California.

For every 100 pounds of cotton fiber, the cotton plant yields about 180 pounds of cottonseed. Not more than one-tenth of this is needed to plant the next year's crop. Research has found many uses for the left-over 162 pounds.

Out of each 2,000 pounds of cottonseed bought by the Southern Cotton Oil Company, of New Orleans, 313 pounds go into cottonseed oil; 822 pounds into meal for animal feed; 550 pounds, in hulls, are sold to feed dealers and dairymen; 170 pounds of linters go to mattress makers for stuffing or to rayon producers for cellulose; and only the remaining 145 pounds, mostly sand and trash, is waste.

The cottonseed oil goes into margarine and shortenings or is sold to bakers, hotels, restaurants, potato chippers, and grocery stores. To housewives, best-known Southern Cotton Oil Company brand names are Wesson Oil and Snowdrift.

The Buckeye Cotton Oil Company, a subsidiary of Procter & Gamble, soap manufacturers, similarly processes cottonseed on a big scale.

Buckeye's most familiar cottonseed oil product is Crisco. In refining the oil, soap stocks are recovered as a by-product.

Field Peas Restore Poor Soil

I went to Blue Springs Farms, 75 miles south of Atlanta and 15 miles from Warm Springs, Georgia, to see an outstanding effort to restore some of the South's worn-out soil.

Here, in 1932, Cason J. Callaway, textile operator, began to buy up small farms. He eventually acquired 30,000 acres, including some mountainous timberland, and turned his entire attention to farming.

First he cleared pine trees and other growth

from a field, then leveled off the land, and in the spring planted a cover crop of field peas. In the fall he plowed them under, to give humus to the soil, and planted a winter cover crop of vetch. The second year he repeated the process. By the third spring the soil had improved notably. Today he has 3,000 acres under cultivation.

One-third of the cleared land is in kudzu, the Asiatic weed popular with Southern road builders, who plant it along embankments where its roots penetrate deeply and prevent erosion.

Mr. Callaway harvests his stubborn crop with heavy equipment and dehydrates it in his own plant. Then he sells it as meal for three cents a pound to poultry-feed manufacturers, who value it for its high protein content.

Blue Springs boasts the largest commercial mallard duckling flock in the country. There I saw about 6,000 ducklings, all that remained from a flock of 20,000. The others had been killed, table-dressed, and quick-frozen for sale at Thanksgiving and Christmas.

10,000 Cows for North Carolina

George S. Coble, former farm boy, in cooperation with North Carolina State, is engaged in a program to bring 10,000 Holstein, Guernsey, and Jersey cows into his native State from Minnesota to help boost milk production. He sells the cows to farmers at cost and contracts for the milk.

Coble bought a bankrupt dairy in Lexington, North Carolina, in 1934 with a down payment of $75. On the first day he stocked up with 11 gallons of milk, and his retail sales totaled $2.78.

Now he is president of Coble Dairy Products, Inc., which has five processing plants, 20 receiving stations, 900 employees, and handles up to one million pounds of milk a day.

For the last three years South Carolina has produced more peaches than Georgia. More than half its crop comes from Spartanburg County.

The boll weevil's ravages in the cotton fields a quarter century ago drove Spartanburg to peaches. Four Spartanburg farmers went to Georgia in 1923 to look into peach growing. When they returned, each planted five acres. That year Georgia shipped 8,701 carloads of peaches; all of South Carolina, 16.

Now over Spartanburg County's 832 square miles extend peach orchards with more than 3,250,000 trees. In 1947 rail shipments of Spartanburg peaches totaled 7,265 cars, at 400 bushels to the car. The 1948 crop, hit by frost, was somewhat smaller.

The major share of Spartanburg peaches—some 5,000 carloads—is moved by the Southern Railway in a hectic three-week operation in July. Some 600 employees from other parts of the System come to Spartanburg to help. Fresh peaches must be shipped quickly so they will not spoil.

A preparatory step is to haul in 500 carloads of baskets, crates, pads, and lids for packing. As shipping deadline nears, 600 carloads of ice must be moved in to supplement the 17,500 tons of ice in storage in and around Spartanburg.

Shippers load their peaches at six main yards, capable of handling 857 cars at one time. The main icing station at Hayne Yard, on the outskirts of Spartanburg, can ice 40 refrigerator cars at a time. A car, requiring 4½ tons of ice and salt, can be iced in two minutes.

The peach-laden cars, in solid trains, then move northward, consigned to Potomac Yards, Alexandria, Virginia, or westward, consigned to Cincinnati or Louisville yards. Shippers do not know their ultimate destinations. Their contents are sold while the cars are en route, and ultimate point of delivery depends on where the shipper has found the best market for his peaches. By telegraph, the yards are advised of the changed destination.

"By the time the last car has moved," a Southern Railway man told me, "both our clothes and our brains are peach-fuzzy."

Gainesville Thrives on Chickens

Spartanburg turned to peaches; Gainesville later turned to chickens. That Georgia town was in the doldrums in 1935. In nine Georgia counties centering on Gainesville, soil was farmed out. Chicken population was less than half a million.

A few men became interested in poultry, almost in a spirit of desperation. They prospered. By 1943 the chicken population within a radius of 50 miles had gone up to about 11 million. The Army placed big orders. By the time the war ended, Gainesville was marketing 35 million chickens a year.

Peacetime demand is even bigger. Today between 40 and 45 million chickens are being raised, and the poultry, poultry-feed, and poultry-dressing businesses in Gainesville and its hinterland have grown into a $45,000,000-a-year industry (page 298).

In the large dressing plant of Jesse Jewell, one of Gainesville's pioneer chicken men, I saw live chickens come into the plant at one end and go out at the other, dressed, quick-frozen, and packaged, at the rate of 1,800 an hour.

Giant Machines Will Turn This Kraft Paper, Roll by Roll, into Sturdy Bags

Kraft, in German and Swedish, means "strength." Here in the storage well of the Union Bag & Paper Corporation, at Savannah, Georgia, is the raw material for some of the 30,000,000 multiwall specialty and standard grocery bags produced daily (page 288). Annual output of this huge plant exceeds 7½ billion bags a year!

Cash a Check Without Leaving Your Car? You Can Do It in Mobile

These young women drove their automobile straight to the "Drive Up Teller," transacted their banking business, and now are ready to depart. Their parking problem was solved.

Nuts from tung trees in China entered the United States in 1904. Some found their way into the hands of Dr. David Fairchild, for many years agricultural explorer for the United States Department of Agriculture, and a member of the Board of Trustees of the National Geographic Society. He later planted tung seeds in an experimental plot at Chico, California, and thereby laid the foundation for the American tung oil industry, which in 1947 produced some 10,454,000 pounds of oil.

Driving through southern Mississippi, in the vicinity of Poplarville, I saw acre after acre of the low-branched, silvery-barked trees with their heavy, heart-shaped foliage. Today the nuts from America's tung trees, in Alabama, Georgia, Louisiana, Florida, Mississippi, and Texas, are gathered by about 5,000 growers, for a cash income of some $5,000,000.

Fast- and hard-drying tung oil is a valuable ingredient in waterproof paints and varnishes, linoleum and artificial leather, and specialty printing inks.

More and more, Dixie is converting its own raw materials into manufactured goods instead of shipping them north and buying them back as finished products. More and more, Southern factories are selling their output in other sections of the United States and abroad.

These giant strides of the South in balancing its economy spell increased prosperity everywhere below Mason and Dixon's Line.

Operation Eclipse: 1948

By William A. Kinney

THE National Geographic Society, long a patron of astronomical research, went eclipse hunting on an unprecedented scale in 1948, tracking the always spectacular blackout of the sun across one-fifth of the earth.

This "Operation Eclipse" set a new high in coordinated scientific endeavor. Never before had a single organization undertaken such an ambitious and complicated venture to study solar phenomena.

The project called for multiple expeditions posted along a far-flung arc stretching northeastward from Burma to the Aleutians. The latest scientific equipment, modern aircraft, and the old reliable native bearers all have a place in the story.

In its essence, the eclipse operation of May 8 and 9 was a calculated scientific gamble on 149 seconds spun out along a 5,320-mile path from monsoon-drenched jungles to the snow and fog of the sub-Arctic.

The eclipse would take five hours to traverse that path. But the seconds that counted most were 35 seconds in Burma, 32 in Siam, six in China, a single second in Korea, two in Japan, 22 and 27 for the most likely pair of outposts in the western Aleutians, and finally 24 seconds for the aircraft operating aloft in Aleutian skies.

A "Calculated Risk"

This calculated risk was decided upon 11 months before the 149 seconds came due, and many more months may elapse before the ultimate results of the expeditions are known.

The entire operation demanded imagination, meticulous planning, and long weeks of study and preparation. But even planning can have its bold moments, and a historic one came with the decision to utilize the eclipse for testing a trail-blazing aerial technique for astronomical research.

Careful as the planners were, they could not anticipate everything, and the unexpected contributed surprises. No one, for example, foresaw that the arrival of one eclipse party in south Korea would influence postponement of the United Nations plebiscite there.

Or that the advance work of the expedition to Japan would call international attention to the discovery that Tokyo was out of place on all existing maps.

Many other unlooked-for footnotes were to accumulate in the eclipse log.

The inception of Operation Eclipse actually dates back to June, 1947. The previous month an expedition under the National Geographic Society's auspices had studied the solar eclipse in Brazil, with notable results, casting new light on Einstein's theory of relativity.*

An Eclipse Made to Order

The question logically arose, What about 1948's eclipses? One would begin deep in the Indian Ocean, move in a sweeping global curve across southern Burma, Siam, China, Korea, northern Japan, and then over the top of the Pacific into the Aleutians (map, pages 328-9).

Another eclipse would not track that identical path for 972 years.

For astronomers, this eclipse of May 8 and 9, 1948, had made-to-order features. First, it would afford an opportunity to advance mankind's knowledge of the size and shape of the earth.

Many believe that scientists long have known everything about this subject. Not so. They have been gathering data on it since the 6th century B. C. and the days of the Greek philosopher, Pythagoras. Yet, after many centuries of observation and research, the best information existing still might lead to errors of a mile or more in plotting the relative locations of many points on the globe.

The prime target of a 1948 eclipse project was to procure data that eventually would enable relative locations on the earth's surface to be determined more accurately.

A second, though incidental, opportunity also was apparent. Observations might enable us to link some of the existing geodetic surveys on two great land masses, for the sweep of the eclipse would traverse parts of Asia and North America.

Such an accomplishment would be of great value to astronomers and mathematicians in their unceasing efforts to come closer to perfection in computations dealing with the curving surfaces of the earth and their relation to the nearer celestial bodies.

Ultimately the gain might well be reflected in everyday life, giving man a basis for more accurate interpretation of maps, and advancing modern navigational techniques for peaceful commerce between nations.

The possibilities of the May eclipse known, there remained the big question mark of the weather prospects for that time of year.

Meteorological records indicated less than

*See "Eclipse Hunting in Brazil's Ranchland," by F. Barrows Colton, National Geographic Magazine, September, 1947.

National Geographic Photographer W. Robert Moore

Distinguished Visitors Drop In on the Camp of the Siamese Expedition

Edwin F. Stanton, United States Ambassador to Siam, Mrs. Stanton, and H. H. Prince Dhani Nivat, a member of the Siam Privy Council, stand in front of the converted milk bar housing the expedition's equipment. Prince Dhani wrote "Pageantry of the Siamese Stage" for the February, 1947, NATIONAL GEOGRAPHIC MAGAZINE.

a 50-50 chance for favorable conditions. The record showed, for example, that the western Aleutians averaged only one completely sunny day in 90 at the eclipse time of year. Northern Japan could expect three clear days a month. The rain-laden monsoons would be over Burma and Siam. Observation stations in China and Korea might hope for somewhat better weather, but here again seasonal averages were unfavorable.

A Master Plan Evolves

Two decisions now confronted Dr. Gilbert Grosvenor, President of the National Geographic Society, and Dr. Lyman J. Briggs, Chairman of The Society's Committee on Research. Should the odds against favorable weather be considered prohibitive in the light of existing knowledge? If not, how could the eclipse best be studied with the highest expectation of success?

With the eclipse weather still some 11 months in the future, there was no saying what it might be, so Dr. Grosvenor and Dr. Briggs determined to take a chance on it. They also were convinced that, for maximum results, the eclipse should be covered, not by one or two scientific parties, but on an unprecedented multi-expedition scale.

The plan was this:

Observation teams were to be sent to lower Burma, Siam, China, southern Korea, northern Japan, and the western Aleutians. Teams in the Aleutians, where weather would be the most treacherous, were to be backed up by aircraft using a yet unproved aerial technique.

Cooperation of Government agencies was enlisted—the Departments of State and Commerce and the National Military Establishment.

Specific acknowledgment is due for the generous assistance provided by the following agencies of the Departments of National Defense and Commerce:

The Military Air Transport Service, which supplied air transportation for the ground teams to their destinations.

The Strategic Air Command of the U. S. Air Force, which furnished the two B-29's for the pioneering operation on top of the stormy weather "roof" of the Aleutians.

The Far East Command and the Alaskan Command, which handled ground transportation, supplies, and assistance for the expedition stations.

The Signal Corps, which contributed special cameras and radio technicians.

The Naval Photographic Center, which also made valuable photographic equipment available and later processed the eclipse films.

The Naval Observatory, which rated the chronometers so essential to the project, and loaned equipment.

The Army Map Service, which provided maps, technical assistance and personnel, and coordinated other military support.

The U. S. Coast and Geodetic Survey, long concerned with chart and map making.

And the National Bureau of Standards.

Cooperation was quickly forthcoming from scientific institutions in Burma, Siam, Japan, China, and other countries. A conspicuous contribution came from Finland's Geodetic Institute which loaned two extremely rare Bonsdorff sono-cameras for observation use.

Japanese participation was particularly noteworthy for it heralded the rebirth of scientific collaboration with America after the void of World War II.

Why 149 Seconds Counted

The eclipse on which all efforts now were concentrated was of the annular variety. The name comes from the Latin word, *annulus*, which means "ring." In an eclipse of this kind, when moon and sun are centered, a thin circlet of golden light is visible around the dark edges of the moon. This distinguishes it from the total eclipse which sees the moon completely blacking out the sun.

Careful computations established that only 149 seconds would matter—but matter vitally—in the five-hour, 5,000-mile progress of the eclipse from Burma to the Aleutians.

If enough of these important seconds of the eclipse could be trapped on film, there might well be rejoicing.

To put it another way, an annular eclipse has, in astronomers' eyes, four critical contacts.

The first is the sliver of a second when the moon makes contact with the rim of the sun.

The second is the moment when the moon has come completely within the sun's disk and the edges of the two appear to be touching. This is forerunner of the central, or annular, phase in which the moon and sun make concentric circles.

The third contact is the reverse of the second—moon and sun edges merging inside the sun disk, just as the moon's shadow is about to start moving off the sun's face.

And the fourth, or final, contact occurs when that moving-off process is almost complete, and the rims of the heavenly bodies are about to part, ending the eclipse.

The job was to "measure" those four contacts. Measure them both in terms of the precise split-second times and of the geographical locations at which they occurred. In effect, the aim was to employ the eclipse as an enormous measuring instrument to produce more nearly accurate information on the size and shape of the earth.

A Job for the Sound Camera

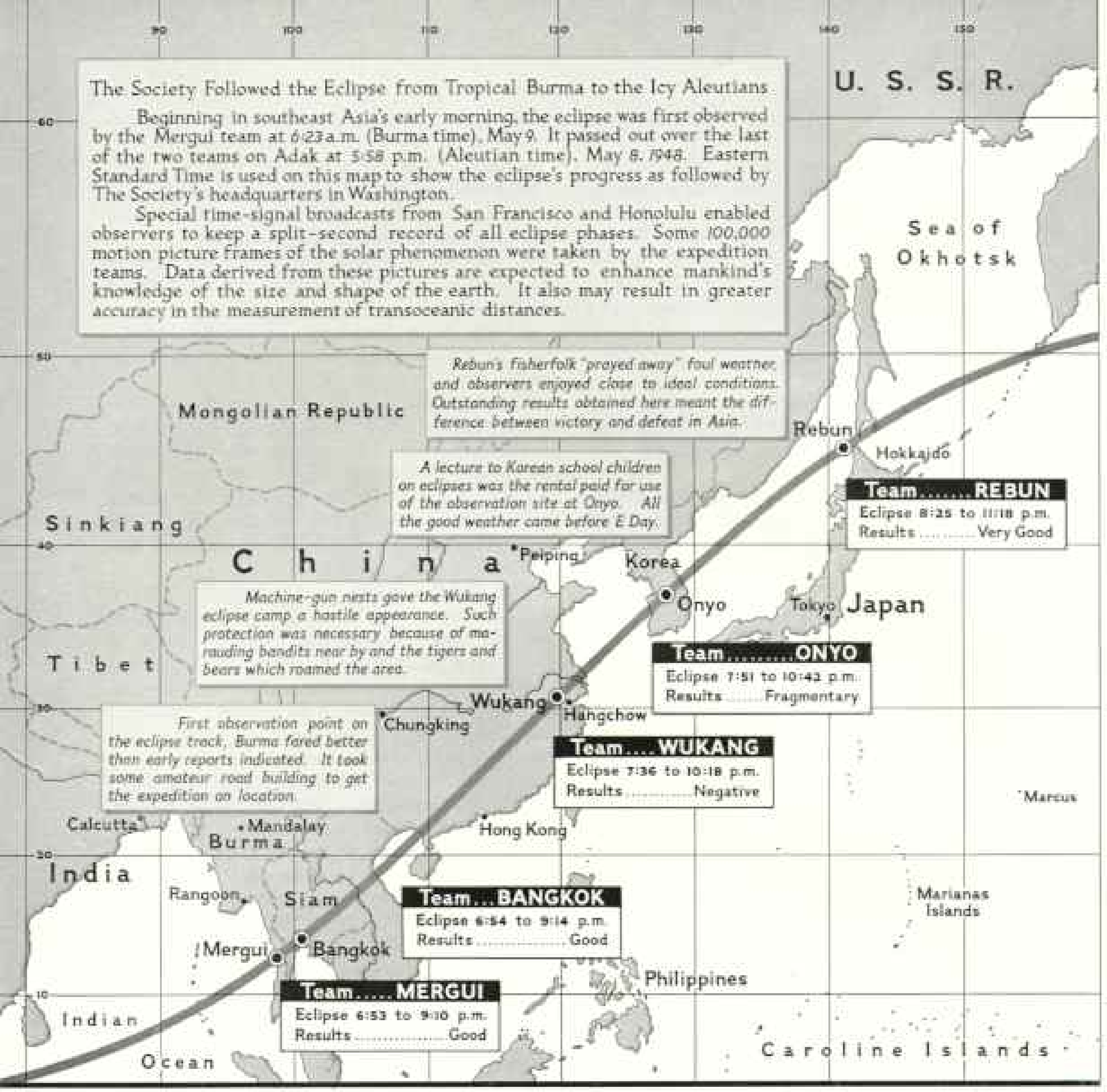
For the layman, the method to be employed may sound deceptively simple. It was to photograph the eclipse on 35-mm. motion picture film, with the film's sound track recording the one-per-second ticks of chronometers checked for accuracy by radio time signals.

Actually, the procedure was much more complicated. For the ground parties, photographic observation sites had to be spotted on or near the eclipse path, with meticulous precision as to latitude and longitude.

Instruments had to have a stable platform and be guarded against vibration, or their records would be valueless. Radio time signals were another consideration. And last, the projected use of the B-29's raised its own host of troublesome problems.

On the human side, expedition requirements were no less exacting than on the mechanical side, and the National Geographic Society selected its men with characteristic care.

To E. A. Halbach, past President and Director of the Milwaukee, Wisconsin, Astronomical Society, was entrusted the lead-off



observation post on the eclipse track—a site near the little fishing town of Mergui on the western coast of lower Burma.

The second expedition, to operate on the outskirts of Bangkok, Siam, was placed in charge of Prof. Charles H. Smiley, Director of Ladd Observatory at Brown University, Providence, Rhode Island.

Heading the third was the Reverend Francis J. Heyden, S. J., Director of Georgetown College Astronomical Observatory, Washington, D. C., who was assigned to operate in China in the Wukang-Hangchow area.

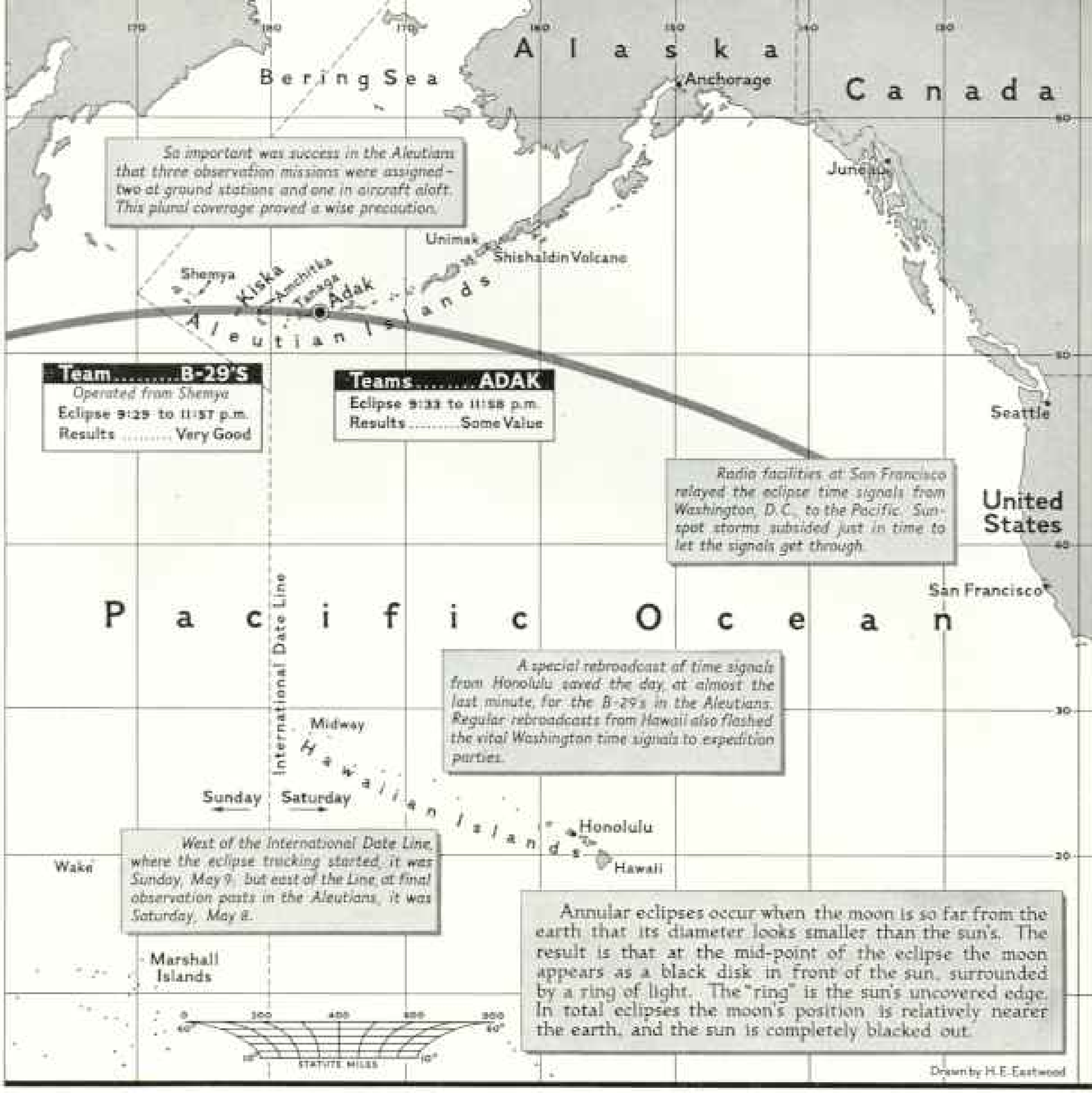
A Gesture to Reviving Japan

For the fourth, Dr. Briggs picked a grand old man of American astronomy, Dr. George Van Biesbroeck, of Yerkes Observatory, Williams Bay, Wisconsin, and gave him the observation post near Onyo, southern Korea.

The selections for the final Asiatic location, on the island of Rebun in northern Japan, represented a sincere gesture of postwar scientific amity. Dr. Briggs named Dr. Yusuke Hagihara, Director of the Tokyo Astronomical Observatory, and Dr. J. A. O'Keefe, of the U. S. Army Map Service, as expedition co-leaders.

To expedite the work and preparations of all the teams in Asia, J. P. M. Johnston of the National Geographic Society's staff was assigned to Tokyo as coordinator.

Across the Pacific in the Aleutians, the ground observation responsibilities went to two experts borrowed from the U. S. Coast and Geodetic Survey—Lt. Comdr. George R. Shelton and his brother, Clarence A. Shelton. The latter was assigned to the island of Adak. Commander Shelton was given Kiska—and this bleak isle of wartime fame was destined



to produce more than its share of suspense and frustration before E-Day.

But the Kiska story takes telling elsewhere.

To complete the clockwise roster of expedition leaders, there was Maj. George H. Wyman, Project Officer in charge of the two specially equipped B-29's from the Strategic Air Command of the U. S. Air Force.

As organization of the teams went forward, the undramatic business of planning and preparation moved on apace. Myriad details of supply, transport, and equipment demanded attention.

In all this essential preliminary work, Dr. Briggs had the able and enthusiastic assistance of Dr. O'Keefe, of Army Map Service. A scientist of marked talent and background, Dr. O'Keefe brought to the task a thorough understanding of the numerous astronomical problems involved.

From the date the coming expeditions were officially announced, the project aroused widespread popular interest. One aspect, in particular, seemed to pique attention. This was that the eclipse actually would "end" the day before it "started."

The apparent contradiction arose from the fact the eclipse would cross the International Date Line in the northern Pacific toward the close of its journey, thereby "losing" a day.

Thus, for the official record, expedition observations would begin early Sunday morning, May 9, in Burma and conclude in the Aleutians on the afternoon of the previous day, May 8.

Off to the Orient

By late January the tempo of preparations quickened. One team after another reported to Washington for technical discussions, then

Rev. Francis J. Heyden, S.J.

No Place for Faltering Legs Was China's "Camp One Long Climb," a Hilltop Observatory

Father Francis J. Heyden (left), the expedition's leader, appears unclerical in his GI garb as he watches technician J. P. Gray check the eclipse movie camera. Lt. N. J. Fay (center) stands by with extra drums of film. The Wukang camp, nicknamed One Long Climb, was hacked out on the crest of a bamboo-wooded hill (page 346). Frequent drills kept its observers letter-perfect.

for test trials with equipment amid wintry surroundings at the National Bureau of Standards.

Soon the first teams were on their way, fanning out by air to the northern and southern reaches of Asia. The journeys were uneventful. Dr. Van Biesbroeck noted the only unusual feature of his party's trip was an "oxygen supper" at 14,000 feet over the snowy Rockies—the plane's passengers alternating between a bite of food and a whiff from oxygen containers.

Despite all the care of advance planning, getting established on location was something else again.

The Siam party fared best. The Government of Siam placed an ideal observation site at its disposal on the grounds of the 400-acre Agricultural University experimental station at Bang Khen, nine miles north of Bangkok. The University's Rector, Luang Suwan, donated the institution's milk bar for use as an instrument house (page 342). As an added touch, he had the little wooden structure freshly painted for the occasion.

The observation site at Bang Khen would have delighted a research farmer. It was surrounded by experimental plots of sugar cane, tobacco, soybeans, cotton, and vegetables, with an encircling moat abloom with water lilies and lotus flowers. The milk-bar instrument shack was only 120 feet from the center of the eclipse path, and the expedition had the advantage of accessible accommodations in near-by Bangkok's modern hotels.

No "Plush" in China

There was nothing so plush in China. Father Heyden found his station situated atop a bamboo-thicketed hill, some 10 miles southwest of Wukang. The hill rose from a Chinese village so small that it was nameless on available maps.

Actually the hamlet's name was Sze Pi Tsung, but from the start the expedition called it "Four Corners," and dubbed the hilltop observation site "Camp One Long Climb," in apt tribute to its steep slopes (page 346).

From the beginning, Camp One Long Climb left next to everything to be desired. Camp was pitched in a pouring rain, and foul weather persisted. Temperatures varied so sharply that Father Heyden was forced to bury his chronometers to protect them against

National Geographic Photographer Maynard Owen Williams

Rifleman in His Foxhole Gives the Chinese Eclipse Camp a Front-line Touch

This soldier and his buddies protected the Wukang camp against bandits. Astronomers recall no other time that rifle pits and machine-gun nests were fixtures of an eclipse project (page 353).

the excessive changes. There were bandits in the area, and wild beasts on the prowl.

The Burma team ran into varied troubles. These started during the stopover at Bangkok, when the complete shipment of camp gear failed to arrive from the Philippines. Energetic scrounging in the local marts was necessary to assemble enough supplies and equipment with which to proceed.

Part of the missing shipment, incidentally, never did show up. However, thanks to strenuous work by W. Robert Moore, of the National Geographic Society staff, the team was kept supplied, in the main, by a special airlift from Bangkok.

Once in Burma, the party found no complaint with the gracious hospitality or the living accommodations near Mergui (pages 337, 338, and 340). Unhappily the center of the eclipse path did not pass over Mergui. The observation site had to be located 15 airline miles out in the jungle, and the trip there took from three to nine hours. The villains of the piece were two rivers to be crossed, the Tamok, beset by 20-foot tides, and the mile-wide Kyaukpya.

The task of getting organized at the observation site put the Halbach party on its mettle at the very outset.

The location was on an 800-foot hill, only half a mile from the main highway (Mergui's "Road to Mandalay"), but the countryside was thickly overgrown with bamboo and elephant grass, with no trails except those left by wild boars. A "jeep-able" roadway, however primitive, had to be constructed to make the observation site accessible.

A native contractor was approached. He estimated he could build the road in three weeks. That was too much time. Halbach and his second-in-command, Rex E. Henderson, recruited a crew of Burmese workers and went into the construction business, undismayed by their own amateur status as road builders.

Instead of taking three weeks, they had their road in three days. The result probably would make engineers wince, for it coiled, twisted, and turned like a tortured snake. But it served. And it was ceremoniously designated the Halbach-Henderson Turnpike, with the accent definitely on the "turn."

The rough road in, Burmese workers cleared the observation knoll and threw up an observation shack of bamboo and thatched palm leaves, complete with wide panels in the side to open on the eastern sky where the eclipse trail would start. Both in shack and road

National Geographic Photographer Justin N. Locke

In Washington, Dr. Lyman J. Briggs, Director of Operation Eclipse, Studies Radiograms from Star-marked Pacific Eclipse Bases

The first field dispatches told of adverse weather. Then the outlook changed abruptly; belated radiograms signaled success. The map shows the eclipse path.

National Geographic Photographer Maynard Owen Williams

Dr. Van Biesbroeck Pays His Expedition's Rent by Lecturing on the Eclipse to Korean School Children

When the observation site was located near Onyo, the owner proved to be the school superintendent. Asked his terms for a lease, he demanded in payment only a lecture explaining the solar blackout to his pupils. The camera catches the astronomer paying the bill. An interpreter at his side translates (page 335).

John P. St. Clair

"Tell You What We're Going to Do," Says Charlie Pak, Korean Translator

Looking like a carnival magician about to demonstrate a trick, Charlie explains the workings of a light meter to his intent little audience at Onyo camp. Words and gestures availed little; the Koreans remained baffled.

construction, their work was not made easier by the large red ants and the leeches abounding in the vicinity.

An Election Bows to the Eclipse

The pattern in Korea had its own distinctive notes.

After Dr. Van Biesbroeck deplaned there, he and Dr. Maynard O. Williams, Chief of The Society's Foreign Staff, proceeded to pay their respects to Lt. Gen. John R. Hodge, U. S. military commander for southern Korea.*

It was a pleasant visit with genial conversation. As the three talked, Dr. Van Biesbroeck mentioned that the date of the scheduled United Nations plebiscite for southern Korea coincided with eclipse day. The veteran astronomer indulged in some idle speculation as to whether the coincidence might lead some superstitious Koreans to regard plebiscite day as one of ill omen.

The effect of the offhand remarks on General Hodge was immediate.

As Dr. Van Biesbroeck relates it: "The General at once decided to have the elections postponed one day to avoid the influence of any local superstition about the occasion of the eclipse." So it happened that the United Nations plebiscite, instead of being held on E-Day as scheduled, was postponed 24 hours.

The Korean observation site proved hard to spot. Dr. Van Biesbroeck and his party searched the countryside two days, trying to locate the geodetic survey marker that would enable them to fix the precise location of their camp. Their hunt was futile until they encountered a kindly farmer. As soon as he understood the problem, the old native led the party without delay to the marker, which had been hidden by overgrowing vegetation.

Locating the site was not enough. There were the arrangements for use of the land. The rent the owner stipulated may serve as a

* See "With the U. S. Army in Korea," by Lt. Gen. John R. Hodge, NATIONAL GEOGRAPHIC MAGAZINE, June, 1947.

John P. St. Clair

Baby's Picture Proves a Powerful Persuader; Everybody Wants One Like It

When the National Geographic Society's expedition arrived at Onyo, no Korean mother wanted the camera anywhere near her baby. Finally the photographer snapped a Korean carpenter's baby. That did it! Pleased relatives spread the word. Doting mothers flocked to have their babies photographed.

model: It was that Dr. Van Biesbroeck deliver a lecture on the coming eclipse in nonscientific language to the assembled school children of the area! (Page 333.)

With the assistance of an interpreter, Dr. Van Biesbroeck handsomely paid his rent in advance with a talk that made a profound impression on a wide-eyed youthful audience in gay dress. The talk effectively squelched all stirring of eclipse day superstitions.

Dr. Van Biesbroeck named his camp *Hai-Tal*, Hai being the Korean word for sun, and Tal for the moon (page 354). It was situated in paddy country, which made for trouble. The only access was across a one-foot-wide dike between flooded rice fields. Everything that came in had to be brought across this narrow footwalk in Korean back baskets.

Sturdy Korean bearers brought in all the essentials—instruments; sand, gravel, and cement for foundations; radio equipment; coils of barbed wire; iron pipe; and food.

Rebun was something else again. That beautiful mountainous island, populated largely by fisherfolk, still had plenty of snow when the vanguard of the expedition arrived.

Herring Raises Its Head

And snow was not the only problem. Traditionally, as soon as the snow went out, the natives employed large areas of the island for drying their spring herring catch. But this practice held the threat of interference with free access to the observation location.

Definitely a delicate question of what to do, but one which the diplomacy of Japanese authorities and fortuitous circumstances settled nicely.

When the expedition first established its Rebun beachhead, it was regarded by the people with mistrust and perhaps resentment. A poor herring season was indicated, and the fishermen feared it would be even poorer with

big boats churning up the waters around the island (page 350).

For weeks this apprehension about the catch appeared to be justified, but then came a series of record hauls prior to the eclipse. Families worked around the clock and the catch gave the island one of its most prosperous years in history. Long before E-Day, the eclipse expedition was being hailed as a harbinger of good fortune.

For expedition members, the association with the fishing industry was not considered entirely a blessing. They worked in a redolent atmosphere. There was no escaping the inevitable fish scales. Fishwives were endlessly busy cleaning the catch, and fish were drying in the slow spring sun everywhere. But the genuine good will of Rebun's people more than compensated for the fishy atmosphere.

Headache on Kiska

In the Aleutians,* trouble was spelled with a capital "K"—for Kiska. The Adak team met no special difficulties, but Commander Shelton found Kiska a headache from the start.

His preselected observation site was on the slopes of Kiska volcano, the snowy cone at the north end of the island, which U. S. Air Force pilots used for a "fix" before making their bombing runs on Japanese installations.

Commander Shelton soon learned, however, that the volcano slopes were still deadly with booby traps and land mines. Time was lacking for a complete demining job. Anything less thorough would be foolhardy; in the fogs, mists, and sudden snow squalls expedition members might blunder off a narrow cleared lane into dangerous areas. The hazard was too great.

Commander Shelton's report that Kiska volcano could not be used caused disappointment at National Geographic Society headquarters in Washington and to Rear Admiral L. O. Colbert, Director of the Coast and Geodetic Survey. The site selected was nearly ideal for observations.

Instructions went back to Commander Shelton to plan a new location along the northeast coast of the island.

Air reconnaissance in a Navy PBY made Commander Shelton very doubtful that this alternate site could be reached overland from Kiska Harbor, but he made a try.

The try deserves a story in itself. With a small party that included J. Baylor Roberts, photographer of the National Geographic Society's staff, he set out in two "weasel" tractors from Kiska Harbor. The start was made in drizzling rain. The rain changed to snow. The snow became a blizzard.

Thrown in was an Aleutian williwaw—technically on the mild side, with the wind only 60 miles an hour; but a man still could lean against it (page 370).

Battling the weather, the task force struggled on until it encountered terrain which no weasel could negotiate. In many hours of effort, Commander Shelton had been able to cover less than half of the 15 miles that separated the proposed observation site from Kiska Harbor. It was obvious that transport and supply could not be maintained for such a location.

With regret, Dr. Briggs and Admiral Colbert wrote off Kiska and reluctantly decided all the ground expedition eggs must be put into one Aleutian basket, with both teams concentrating on Adak.

The decision was not welcome, for high hope had been staked on the original plan of spacing the two teams on islands 250 miles apart. Now both would be on Adak, with less than eight miles between them, a small gap for bad weather. The original Adak team was getting set up on 2,072-foot Mount Adagdak. The thwarted Kiska party prepared to make its stand on 3,900-foot Mount Moffett to the westward (page 368).

While the Aleutian complications were unfolding, things were far from humdrum elsewhere along the eclipse arc.

In China, Father Heyden had good cause for regret that his expedition did not include a financial expert. Dizzy was a mild word for the currency inflation he found. Two dollars in U. S. money then meant nearly $1,000,000 in Chinese. Even today Father Heyden is incredulous when he recalls the astronomical sums he disbursed.

Laborers: $240,000 a Day

Workmen who cleared the observation site each received $240,000 (Chinese) per day. A shoeshine in Wukang cost at least $40,000 and a roadside beggar would be insulted with a handout of less than $20,000. Eggs brough $8,000 apiece at Four Corners.

To his surprise, Father Heyden also found himself cast in the fabulous role of paymaster to a private "army" (page 331).

Advance plans of the expedition had not anticipated need for troops, but reports of marauding outlaw bands in the neighborhood

* See, in the National Geographic Magazine, "Bizarre Battleground—the Lonely Aleutians," by Lonnelle Davison, September, 1942; "Riddle of the Aleutians," by Isobel Wylie Hutchison, December, 1942; "Exploring Aleutian Volcanoes," by G. D. Robinson, October, 1948.

Kodachrome by W. Robert Moore

Mythical Beasts, with Red Jaws Agape, Guard the Approach to Mergui's Glittering Pagoda

The elaborate, gem-studded *hti*, or umbrella, crowning the golden spire is illuminated at night by electric lights. The path of the annular eclipse of the sun, first touching the mainland only 15 miles north of this small tropical Burman port, swept northeastward to the cold, foggy Aleutians. Along its 5,320-mile path National Geographic Society parties set up seven observation sites.

Kodachrome by W. Robert Moore

Humpbacked Zebus Still Furnish Motive Power for Carting Goods in Mergui, Burma

Workmen, most of them Indian, load sacks of grain in an open area near the docks. Some residents own motorcars; others ride two-wheeled pony carts or rickshas. Two carts stand in the background (right). Government offices crown the hill beside the pagoda.

New Look Skirts Are Traditional Dress for Slender Burmese Women

A goat peacefully chews its cud in the main street of Kyaukpya, as girls and matrons go to and from the village well where they take their afternoon baths. Kyaukpya is a fishing village on the banks of the wide tidal river by the same name, 10 miles northeast of Mergui. At right "Miss Mergui" (with light parasol) stands beside her nearest rival in an athletic competition which included bicycle riding and shot-putting. Miss Mergui, like many in this coastal town, is of mixed parentage —part Burmese, part Chinese.

Kodachromes by W. Robert Moore

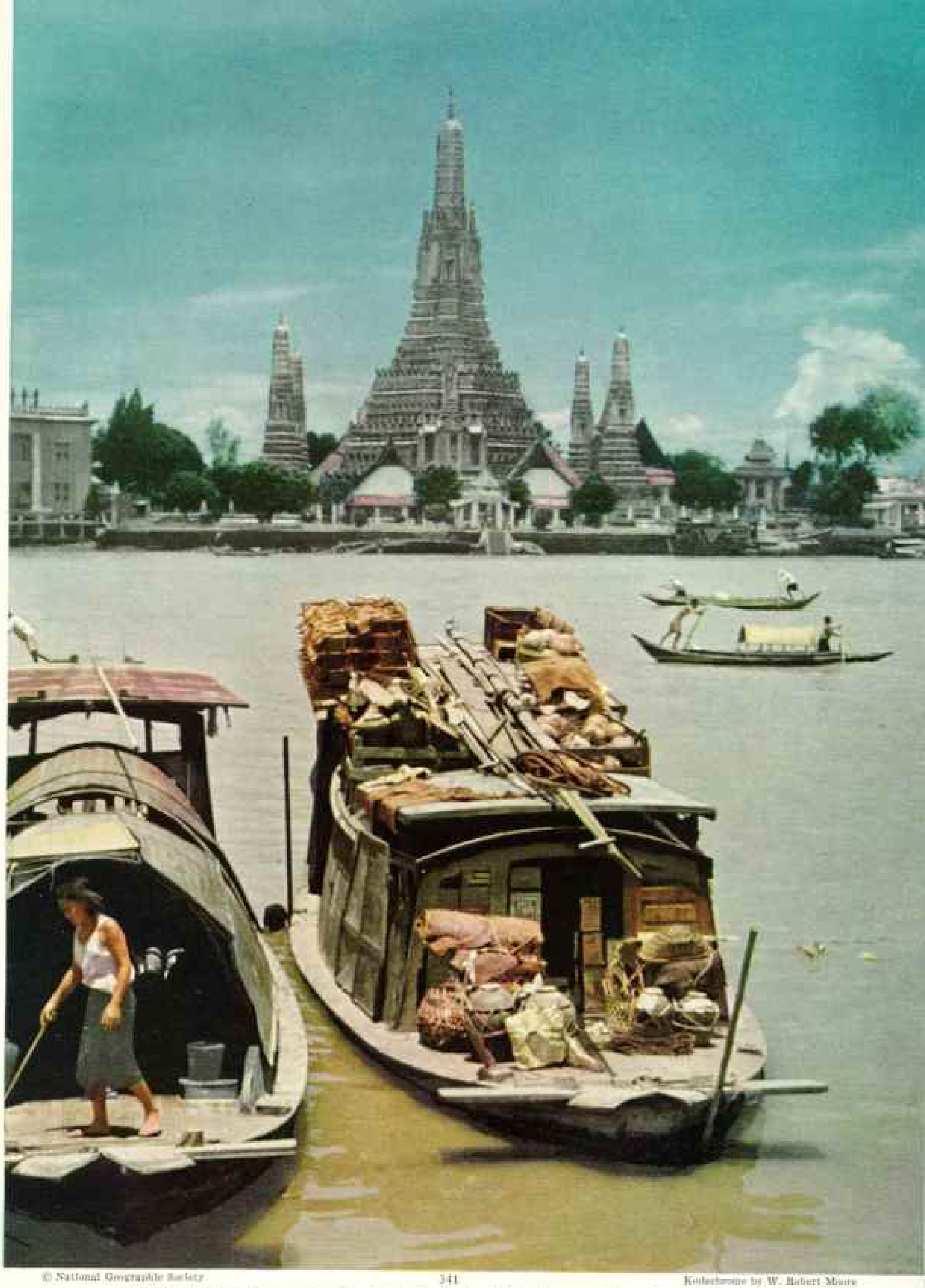
Kodachromes by W. Robert Moore

▲ **Rangoon Scientists Fly to Mergui to Join the National Geographic Eclipse Party**

Left to right are Dr. U. Hla, Assistant Director of the Meteorology Department, and University of Rangoon professors Dr. Hla Kyaw, biology; Dr. Tha Hla, geology and geography; Dr. Maung Maung Kha, physics; and Dr. Frederick Dickason, botany.

▼ **Morning Shopping Ended, Mergui Women Cart Away Unsold Fruits**

Two women load durian into the cart beside a basket of pineapples. The durian, though highly odoriferous, has a rich nutlike flavor. At eclipse time the streets were lined with stalls selling durian. One woman (left) lifts jackfruit into baskets.



Kodachrome by W. Robert Moore

Majestic Landmark in Bangkok Is Lofty Wat Arun, "Temple of Dawn"

This porcelain-encrusted spire is more than 240 feet high. Small passenger sampans skim across the muddy Chao Phraya River. Light cargo craft, the dwelling places of their operators, anchor along the shore.

Kodachromes by W. Robert Moore

Guest Day at the Bangkok Eclipse Site—Expedition Members Explain Operation of Equipment to the Siam Society

The small building, serving as a milk bar at the Agricultural University experiment station at Bang Khen, nine miles north of the capital, was vacated to house the expedition's radio, chronograph, and other equipment. The eclipse motion-picture camera is mounted on a pier at right.

Green-faced Phra Rahu Takes a Bite from the Sun

Siamese and other oriental legends credit this celestial demon with causing eclipses of both sun and moon. One version relates that at the dawn of time Phra Rahu outraged the gods by slaking his thirst at a sacred reservoir of nectar. A deity slashed Rahu's body in two for this sacrilege, but the drink had made the monster immortal.

Now he roves the sky in his bisected fashion, ever seeking revenge against the sun and moon. When he catches up with one, he tries to gulp it, causing the eclipse.

Whenever such sky conflicts occur, many Siamese and Chinese beat gongs, drums, and other noise instruments to frighten Phra Rahu away.

This painting was one of several made by a Bangkok artist and presented to members of the eclipse expedition.

Kodachromes by W. Robert Moore

Monks in Yellow Robes and Musicians in Antique Dress Gather for the Cremation of a Buddhist Abbot

Thousands arrive to attend the last rites at the funeral pyre, as the deceased was head of one of Bangkok's large temples. The flageolet player and several green-clad drummers furnish the plaintive oriental dirge. In Buddhist Siam most males don the humble robes of priesthood for a period during their lives. Some remain a few months; others may spend a lifetime in monastic life.

While Waiting for Cremation Rites to Begin, Priests Seek Friendly Shade from the Glaring Sun

Kodachromes by Maynard Owen Williams

In the Hills Some 25 Miles Northwest of Hangchow the China Eclipse Party Set Up Its Camp Site

At tiny Sze Pi Tsung, 10 miles southwest of Wukang, where the expedition left the motor road to climb to the hilltop site, an army tent marks "bottomside" camp. At left, two Chinese army engineers accurately establish the position of "topside" camp on a hill 900 feet above the rice plain. Clouds prevented eclipse observations at this site.

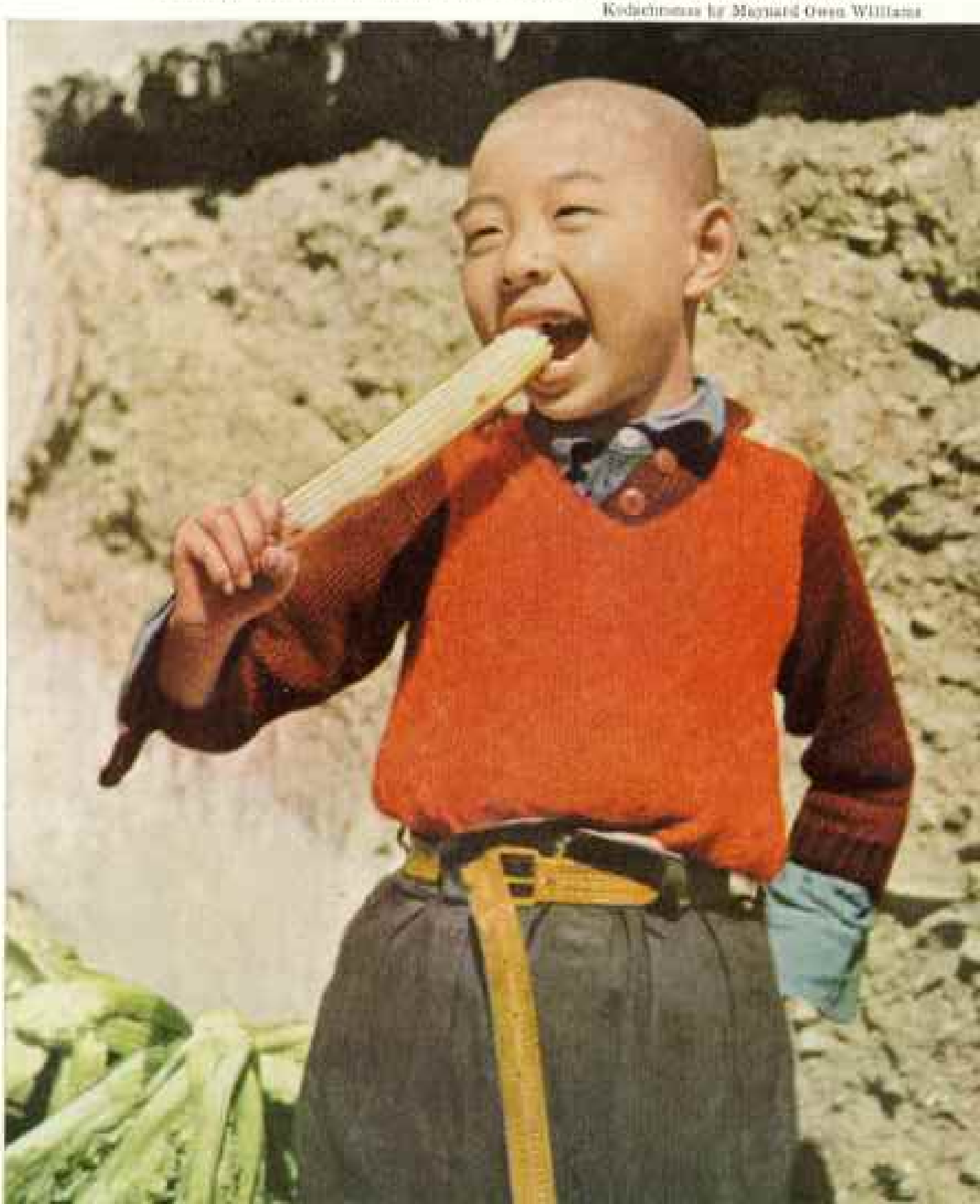
Age Caters to Youth—If It's the Favorite Grandson!

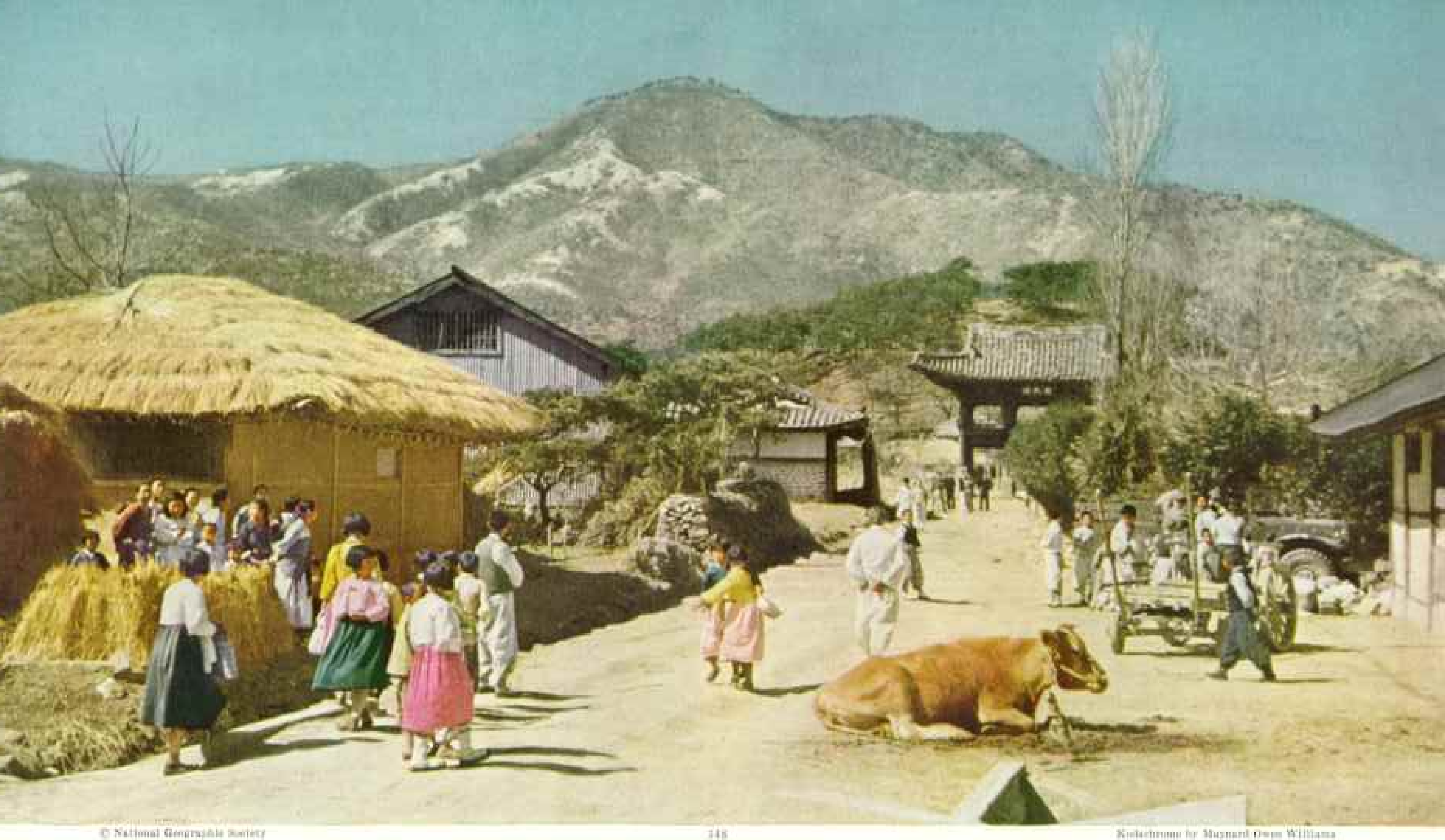
The white-bearded headman of the tiny village of Sze Pi Tsung became a cordial host to the expedition members when they established camp near by.

Juicy Sugar Cane Satisfies Young China's Sweet Tooth

This shaven-polled Son of Han will have to eat much to fill the belt he wears! Several sweaters are needed for warmth in early China springtime.

Kodachromes by Maynard Owen Williams



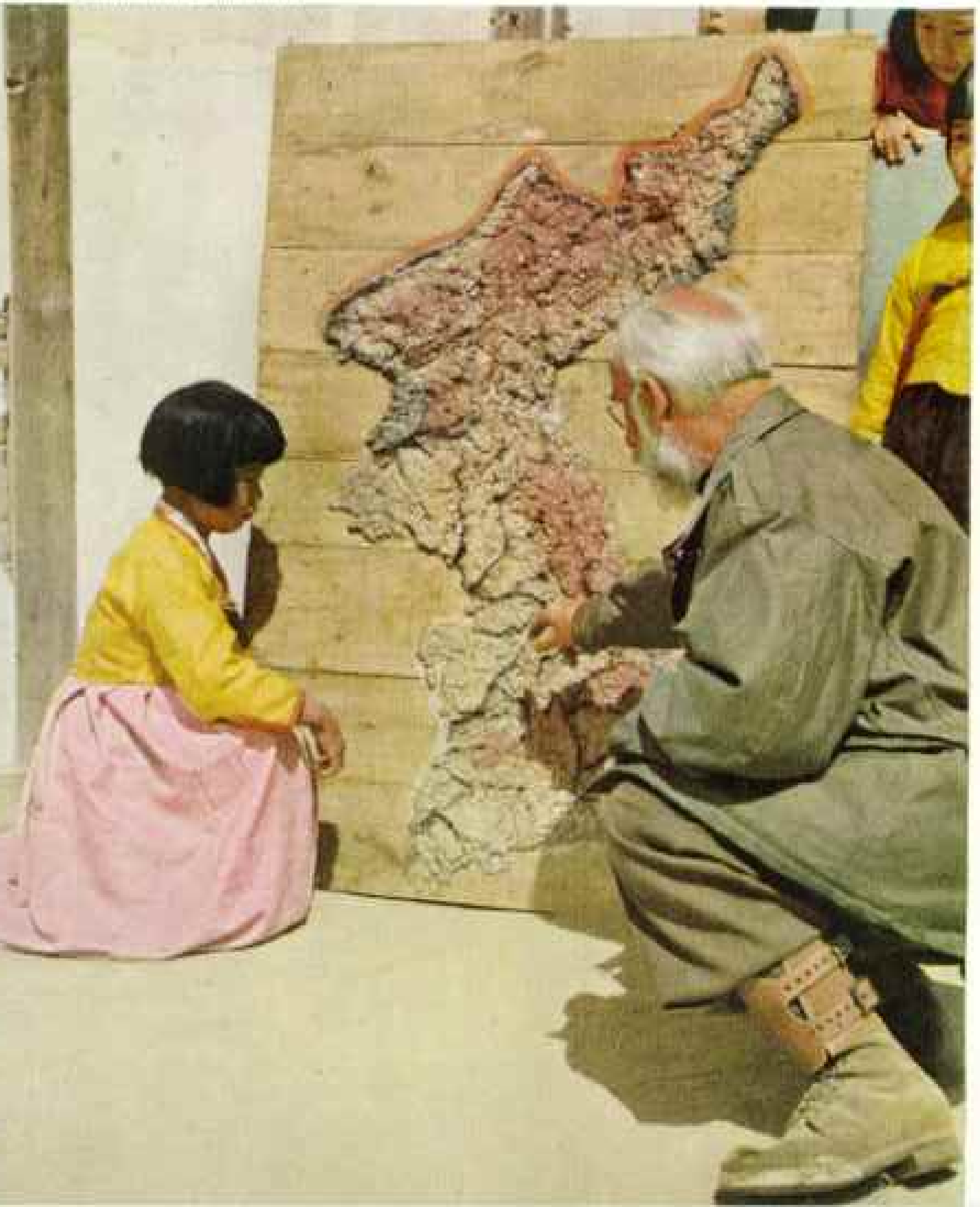


The Korea Eclipse Party, Searching for Geodetic Markers, Passed Through This Hamlet near Onyo

School youngsters in bright costumes, grownups, and a contented cow fill the village street that leads through a historic gateway. Expedition members stayed in a hot springs hotel, taken over by the U. S. Army, in Onyo, but set up their equipment three miles distant.

A Demonstration of Astronomy, Geography, and Friendly Relations

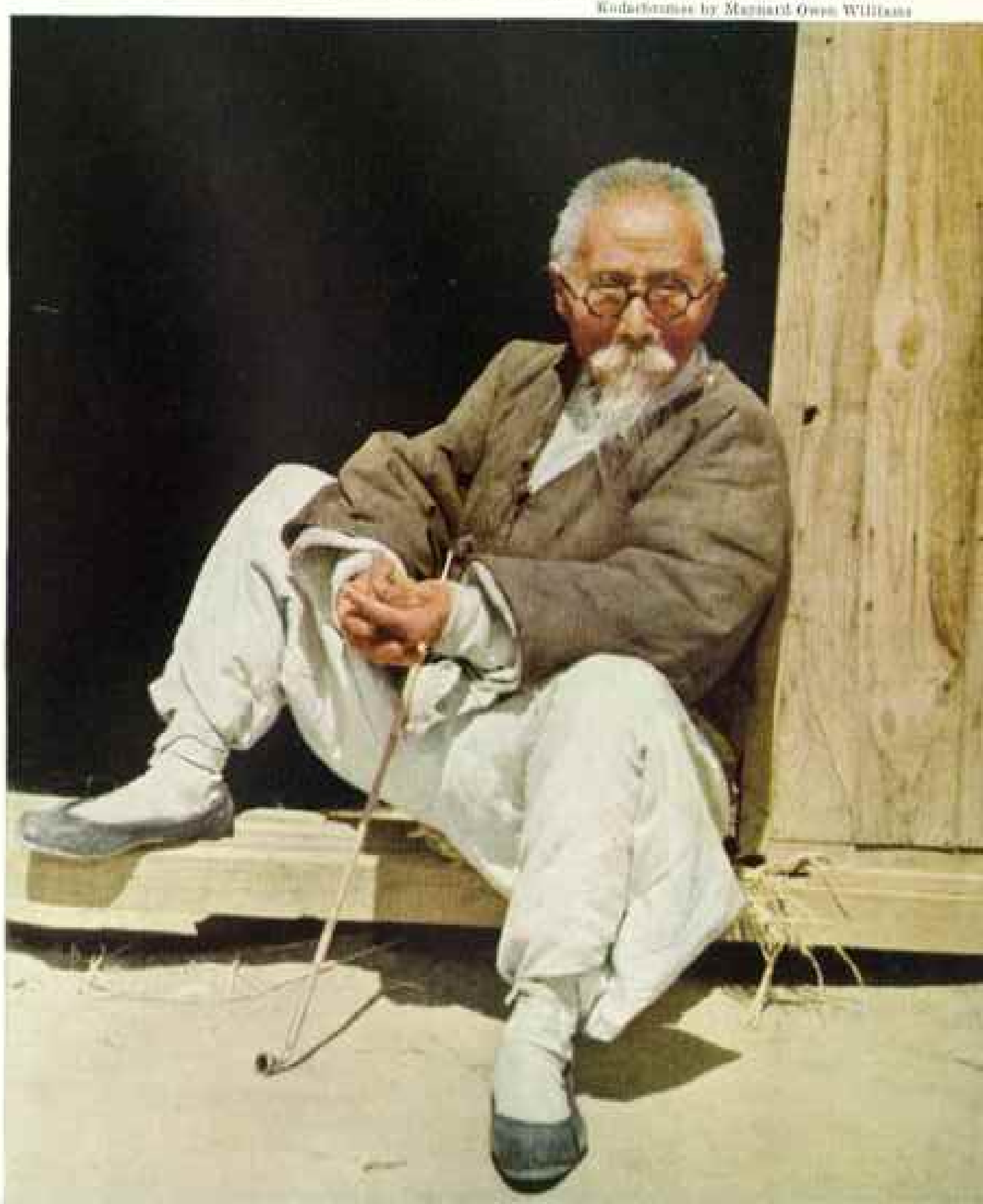
Dr. George Van Biesbroeck, expedition leader to Korea, points out the eclipse site on a relief map made by schoolmates and teachers of this Onyo pupil.



An Onyo Villager Takes a Short Rest and a Long Smoke

Shell-rimmed spectacles are this veteran's concession to the modern. His cloth shoes, ankle-bound trousers, and several coats are traditional Korean attire.

Kodachromes by Maynard Owen Williams



Kodachrome by Maynard Owen Williams

Arriving at Rebun Island, the Eclipse Party Found Fishing Crews in the Midst of a Record Herring Harvest

The eclipse path missed Japan proper, but passed over this rocky dot west of the northern tip of Hokkaido. Japanese and American scientists watched the distant cloud-covered volcano on Rishiri Island as their weathermaker. Drying fish and odors covered Rebun Island.

Eclipse or No Eclipse, Rebun Fishermen Must Repair Their Gear and Cure Their Catches

At left, workers bind glass globe floats to their fishing nets. Ocean currents often carry the floats to American shores. A fisherman (right), working against a backdrop of drying fish, baits his lines for another night journey at sea. Although trolling is done for cod and other large fish, biggest harvest is the herring catch of early spring.

Kodachromes by Maynard Owen Williams

Kodachromes by Maynard Owen Williams

↑ In Unclouded Skies Rebun Crowds Watch the Sun Pass into Eclipse

Massed just outside the camp barrier, they squint through photographic film or smoked glass. The moon, too far from the earth to cover the sun completely, leaves a ring of light, an effect of the annular eclipse.

↑ The Long-awaited Moment Approaches—15 Seconds to Annularity!

The air gets chilly as the sky darkens. Ernest Rubin warms hands in pockets as he watches one coelostat reflecting the sun's image into a camera lens. Saburo Nakano, a Tokyo astronomer, oversees another.

suggested the wisdom of military protection for the eclipse camp.

All cooperation, local authorities promptly produced a guard detail, but the 17 young soldiers in it were so dispirited upon arrival that their protection value seemed dubious, to say the least.

It did not take long to learn why. Their pay was only $5,000 a day, despite the high cost of living. With a Midaslike gesture, Father Heyden remedied matters. He gave all the soldiers a lavish 900 percent raise, which brought their daily earnings to a mere $50,000. Morale and efficiency skyrocketed.

The armed guards remained a source of uneasiness throughout the pre-eclipse period, however. The young troops all seemed to have itchy trigger fingers, and the casual way they handled hand grenades would try strong nerves. Petty larceny also could not be overlooked, particularly with so much valuable scientific equipment about.

Nevertheless, the guards may have their own special niche in astronomical history, for this is believed the first time that protective machine-gun nests and rifle emplacements were features of an eclipse expedition camp.

Attention, GI's!

Japan, too, came up with its own parcel of diverting news. Tokyo was out of place. The Tokyo-Yokohama, Japan, edition of the Pacific *Stars and Stripes* headlined the tidings for occupation GI's with: "Do you know you aren't here? Attention: Tokyo is not where you think!"

The location error came to light during exploratory discussions between scientists of the expedition and Japanese astronomers. From these it developed that the accepted position of Tokyo, starting point for all geodetic surveys of Japan and Korea, was, in fact, some 1,600 feet southeast of its true position.

This revelation was of prime importance. Use of the incorrect Tokyo position, in the advance projection of the central eclipse line across Korea and Japan, would have led to grave miscalculations. Since exact computation of this central line is essential for precise observations, catching the error saved the Onyo and Rebun expeditions from being located far "off base" on E-Day.

The scientific explanation for Tokyo's mislocation is lengthy. Briefly, the mountains and other irregular land masses near the Japanese capital combine to pull the plumb line out of its truly vertical position. This introduces an error in the latitude and longitude readings obtained by observing the stars.

In the steady flow of other progress reports to Washington, items kept cropping up that were neither scientific nor relevant.

Lost: 638 Years

From Burma came one dispatch announcing the expedition had just lost 638 years and was soaking wet. This unusual intelligence was elaborated by the explanation that the Burmese New Year of 1310 had just arrived, ushering in the traditional Water Festival.

During the celebration, Burmese douse one another with water, much in the same gala spirit that Westerners fling confetti and streamers on New Year's Eve or at carnival time. The individual who fails to get at least a little moist during the festivities hasn't a friend in the country.

The three-day celebration was a signal for the Burmese workers at the expedition camp to quit work, and all the labor performed during the interval was by members of the party. Mr. Halbach and his assistants were drenched repeatedly by their holiday-making workers and other good-natured Burmese as they traveled to or from the observation site.

The Siam party also was treated to a festival, though on a more formal, less damp side. It was "on location" in time for the colorful kite-flying season, and its members jumped at the chance to build kites of their own and join in the sport. Their most ambitious entry was a model rarely seen in Bangkok skies—a large box kite, bearing the legend "NGS."

The box kite, however, did not remain long in the control of its creators. Once they had it aloft, the razor-equipped pirate kite of some Siamese sawed through its line and it soared off free. Expedition members saw it again in the skies on subsequent days, but definitely operating under new management.

Astronomers Lose Face—and Heads

For the classic nonessential footnote in this series, perhaps the prize should go to the China party for resurrecting one of astronomy's forgotten legends.

The One Long Climb observation site was located in the same area where the first recorded eclipse in world history was noted around the middle of the 22nd century B. C. And on that eclipse hangs the story.

According to ancient Chinese annals, the royal astronomers at the time were a pair named Hsi and Ho. Their duties were to divine the approach of an eclipse and then, when it was at hand, to sound the alarm so that gongs could be beaten to frighten off the heavenly dragon which, so it was believed, was trying to swallow the sun (page 343).

Richard C. Ferguson from Amos

Dr. George Van Biesbroeck Takes His Sights Beneath Three Flags

Old Glory and the flags of Korea and the National Geographic Society whip in the breeze above the "prefab" observatory at Camp Hal-Tal (Korean for Sun-Moon). The theodolite was used in a series of double-checks to confirm the exact location.

Hsi and Ho, the chronicles indicate, proved efficient royal servants in determining the approximate time of the eclipse's arrival, but then they started a mutual round of congratulations on their superior skill and knowledge. There were many toasts. The beginning of the eclipse found them, the old chronicle sorrowfully relates, "sunk in wine and excess."

As a result of their dereliction, warning gongs were not beaten, the traditional din was not prepared, and great confusion swept the superstitious populace. The Emperor of China was so angry he took drastic action—he had both Hsi and Ho beheaded. (Astronomers, it is understood, have been most discreet ever since.)

B-29's Get on Location

It is indeed a far (41-century) cry from Hsi and Ho to the two B-29's of the Strategic Air Command, but these modern aerial eclipse hunters took off for the Aleutians from a Florida base just about the time the resurrected Chinese legend was causing chuckles.

Arriving on the island of Shemya a little more than two weeks before the eclipse, the B-29 mission members found no cause for merriment. Rugged was the word for their situation.

The routine work of aircraft maintenance came close to being a nightmare. Most maintenance had to be done out in the open by crew members, with a 50-mile wind blowing across the Shemya plateau.

A supply of spare parts never arrived, so the crews were forced to prodigies of improvisation, fabricating the needed replacement items out of discarded metal equipment they ferreted out around the Shemya base. A special electronics shop was set up from scratch, and an extra supply of power was conjured up somehow. The work got done.

As the B-29's took over on Shemya, the ground Shoran crews which accompanied them set up stations on the islands of Amchitka (page 364) and Tanaga. Shoran (or short-

range navigation) is the system whereby radar signals are exchanged between aircraft and ground stations, making possible accurate determination of the plane's distance from the ground transmitter.

Getting the mission shaken down took less time than its difficulties would indicate, and the Superforts embarked on a series of test flights, crisscrossing the 180th meridian to check Shoran's behavior. The equipment functioned with fidelity and the airborne positions of the planes could be plotted with satisfactory accuracy on the earth's surface below.

On one of the test flights an engine on one B-29 caught fire, but the blaze was extinguished and the pilot brought his ship in without further trouble.

Meanwhile, for all hands from Burma to Alaska, the time was drawing closer.

E-Week—and Trouble

E-Week finally arrived. There was much scanning of long-range weather forecasts. Along the multi-thousand-mile eclipse path teams went through a final series of rehearsals. Instruments and equipment were checked for the hundredth time. One after another, ground party leaders radioed National Geographic Society headquarters that everything was in readiness—and fingers duly crossed.

Then trouble began to hatch with a vengeance. To Dr. Briggs came an urgent message from Major Wyman reporting that heavy interference was blanketing all radio channels assigned for B-29 use, making it impossible for the planes to receive the all-important time signals. Wyman said that unless a new continuous time-signal broadcast could be arranged on a different frequency, the airborne eclipse mission should be abandoned.

That was Wednesday. The eclipse was due the following Saturday. For the moment it looked as if the trail-blazing B-29 experiment was doomed. Arranging for the special facilities Wyman needed was a tall order on only 72 hours' notice.

But in two days of intensive activity mountains of red tape were moved, technical difficulties overcome, administrative short cuts created. By sundown Thursday, thanks to cooperation extended by Secretary of State George C. Marshall, the State Department's powerful station in Hawaii had started to transmit continuous time signals on the requested new channel; the B-29's were receiving them successfully and rated the Superfort time check now accurate down to a split second.

But the elation at National Geographic Society headquarters was short-lived. A new and far greater threat to any successful observations had arisen. The sun suddenly erupted with a severe outburst of sunspot activity. Heavy radio storms resulted, playing havoc with wireless communications. The big question now became whether any observation team could receive the vital time-signal broadcasts through this tempest of static.

Sunspot experts at the National Bureau of Standards were not optimistic. All signs seemed to indicate that the radio storms would grow more intense as eclipse time approached. The outlook was considered particularly poor for the Aleutian area.

By eclipse eve the forecasters' pessimism appeared more than justified. Washington time signals were not even getting through to the Federal Communications Commission's station at Grand Island, Nebraska.

E-Day dawned a clear and sunny Saturday in Washington—and battered hopes revived slightly. The Bureau of Standards reported slackening sunspot activity and an easing of severe radio storms. Time signals were given a "good" chance of getting through, although experts warned that a renewal of violent disturbances remained a definite hazard.

Final advance weather forecasts began to trickle in from the observation sites. Though not ideal, they were far from discouraging.

Stand By for the Flashes

These reports in, there was nothing to do but wait. Wait on what the threatening sunspots might do. Wait on the uncertain vagaries of the weather at the observation points. Wait, finally, for the flash reports of results from the field.

The role of Dr. Briggs in the over-all project might be compared with that of a chief of staff in a military undertaking. All the planning and preparations were complete. Operation Eclipse was now in progress. The anxious hours had come. Time, as the GI's used to say, to "sweat it out."

This was to be a long-drawn-out process. The first eclipse contact at Mergui came at 6:53 p. m. (Eastern Standard Time), the last in the Aleutians five hours later. But the evening wore on. No news. Midnight passed. Still no word. Then, shortly after midnight, the first break in the silence and suspense, Bangkok reporting:

DESPITE MASSING MONSOON CLOUDS FIRST CONTACT RECORDED SUCCESSFULLY THROUGH THIN CIRRUS CLOUDS STOP AFTER FIRST CONTACT SECOND CONTACT AND MOST ANNULARITY RECORDED BUT THIRD CONTACT PROBLEMATICAL STOP TIME SIGNALS RECORDED STOP PARTY JUBILANT.

Richard C. Ferguson from Arrow

East and West Get Together for Shop Talk Before Eclipse Day

Prof. Kwon Nyung Dai, of Korea's National University, listens as Dr. Van Biesbroeck refers to a chart timing the eclipse phases (Korean local time). Two tiny arrows pointing to the sun indicate the beginning of the first and last contacts of the eclipse.

These were heartening tidings. But what of the other stations? The small hours of Sunday morning plodded on to dawn. Nothing further. The clock was edging toward noon.

At long last, the story began to unfold with a rush, and the first installments made unwelcome reading.

From Korea:

CLOUDS NO RECORD STOP

Dr. Briggs smiled wryly at that radiogram and commented that he certainly could not accuse Dr. Van Biesbroeck of wasting words.

From Wukang:

SOLID CLOUD COVER STOP BETTER LUCK NEXT TIME

From the Aleutians:

ADAGDAK ZERO STOP MOFFETT POSSIBILITY OF CONTACT FIRST PHASE THOUGH SUN PARTIALLY CLOUD COVERED DURING PERIOD STOP CENTRAL PHASE SHOT IN DRIVING SNOWSTORM RESULTS DOUBTFUL STOP FINAL PHASE OVERCAST STOP ALL PARTY DISAPPOINTED

So the score stood: one; one; three. Promising results at one station. Very dubious results at a second. Negative results at the other three.

Disappointment lined Dr. Briggs's face (page 332). "It looks as if we are going to lose out this time," he said regretfully. The next message virtually persuaded him he was right. It was the first in a much delayed series of radiograms from Rebun and it deepened the general gloom with the news:

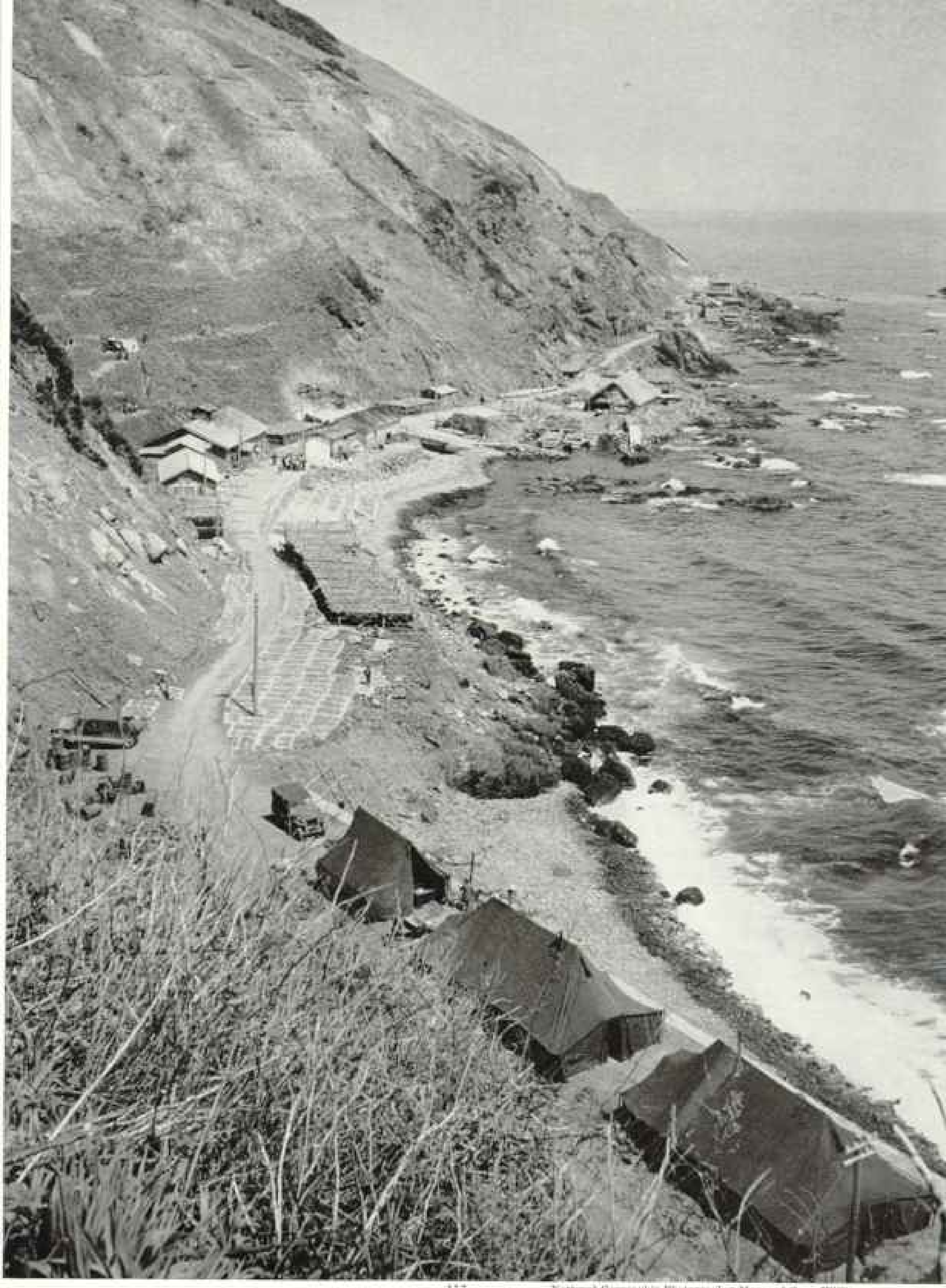
TWO HOURS BEFORE ECLIPSE WEATHER FOUL NO SUN IMAGE

Ill Fortune Relents

But swiftly on the heels of this dispatch came a rush of others. The weather at Rebun had started to break up. Skies clearing. Then the bell-ringing news:

CONTACTS ONE COMMA TWO COMMA THREE PERFECT WEATHER STOP MINOR CLOUD INTERFERENCE FOURTH CONTACT STOP SCIENTISTS WELL SATISFIED.

Operation Eclipse was not a failure, after all! Success at Rebun and at Bangkok encouraged the hope that scientists could link surveys of southeast Asia with those of Japan and probably Korea. There was a possibility, too, of salvaging something from the photo-



157 National Geographic Photographer Maynard Owen Williams

Roaring Surf Beats Against Camp Reban's Pacific Doorstep

The tented camp, pitched on the island's handkerchief-sized beach, never lacked the music of the sea. Tidy homes of Japanese fisherfolk hug the narrow road between ocean and mountain.

graphic record made from Mount Moffett in the Aleutians. Burma and the B-29's were yet to be heard from.

The Burma report eventually came through after many hours' delay in transit. At the time it gave no cause for elation with its terse:

RESULTS DOUBTFUL SOME CLOUDS

That left only the B-29 mission. The story of the Superforts was destined to remain unknown for days, wrapped in a baffling blanket of silence.

Communication difficulties, due to radio storms, thwarted repeated efforts to contact the mission at its Aleutian airbase. And when communications were restored, the big planes had already departed for their home station in Florida. Dr. Briggs was nettled by the suspense.

The Unknown Story

Masterminding the work of multiple eclipse expeditions by remote control from the National Geographic Society's headquarters, thousands of miles away, was an exasperating business. Even the most encouraging radiograms left much to be desired.

Had global television been available, there was an intensely varied pictorial narrative that might have been transmitted.

At Mergui, Mr. Halbach and his assistants were up hours before dawn to find the skies thickly banked with forbidding monsoon clouds, and the threat of rain in the air. The trip to the bamboo-and-palm observation shack was made through brooding tropical darkness.

With dawn the two large panels in the eastern wall of the shack were swung open to give the camera a clear range of the morning sky, and the party was cheered by the appearance of a few rifts in the heavy canopy of clouds.

It was through one of these opportune rifts that the first contact of sun and moon was caught. Seconds later, however, the rains descended in earnest, sluicing down on the remote jungle outpost. Prospects for any further observations looked bleak and damp.

But Halbach had the equivalent of a rabbit's foot in his pocket. Just as the time neared for the important second and third contacts, the rain ceased momentarily and another fleeting but providentially timed break opened the thick clouds.

While it lasted, the expedition was able to catch the vital interval of the two central contacts. This sent spirits soaring.

As if on a timetable, the monsoon rains promptly resumed. Across the countryside during the hour-long final phase of the eclipse, Burmese natives continued to bêlabor the trunks of food trees with stout cudgels in accordance with the timeworn tradition that a tree beaten during the darkening of the sun will have a more bountiful yield.

This quaint custom contrasted with the alert scientific interest of the five faculty members from the University of Rangoon who clustered about the equipment in the observation shack.

There was no lucky break on the fourth and final contact. When that moment arrived, torrential rain completely obscured the sun. For the Mergui team, Operation Eclipse was over.

Had the exact extent of Halbach's success been known then in Washington, it would have been cause for jubilation, instead of having somewhat the opposite effect. The reason for the strange understatement of the flash report was explained weeks later.

To expedite the dispatch of the report, Halbach had prepared in advance three "canned" messages to cover major contingencies. One was for complete success, one for complete failure, and the third for uncertain results due to the probability of cloud trouble.

When the fourth contact ended, there was no time to draft a more complete report, so Halbach immediately sent a fleet Burmese runner back the 18 miles of the road to Mergui with instructions to the telegraph operator there to get the inadequate message No. 3 speeding out on the wires.

Again, Fickle Weather

Like Burma, the Bangkok story proved one of fickle weather. Forsaking the comforts of their metropolitan hotel, the members of the party camped out overnight at the site to make sure all would be on hand, without fail, well in advance of eclipse time.

"We awoke to find it raining," Professor Smiley relates, "but it began to clear about 6:30 a. m., half an hour before first contact time. Just as the eclipse was about to start, a huge cumulus cloud moved to one side and we were able to photograph the first contact through a thin cirrus veil.

"Then another large cumulus cloud moved in front of the sun, and it was nip and tuck whether it would be out of the way in time for the important second and third contacts.

"It was a tense moment, but the sun was again in the clear when it was time to start the camera to record the minute before annularity, the 32 seconds of annularity, and the minute after. Another large cumulus cloud

Wide World

Rain Puddles on Tokyo Streets Serve as Mirrors for the Solar Show

These Japanese discovered a way to do without the time-honored piece of smoked glass. Popular interest in the eclipse ran so high that baseball games were interrupted and traffic was stalled.

was moving in at the end of the annular phase, but only its thin edge was between us and the sun when the third contact occurred.

"The fourth contact was recorded through thin cirrus only."

There was much rejoicing outside the trim milk-bar building on the grounds of Siam's Agricultural University. It might have been somewhat dampened had expedition members known that the "thin edge" of cumulus cloud at the end of the annular phase was really the villain of the act. The developed films later showed that it had succeeded in robbing the expedition of the third contact.

The Gremlins Show No Mercy

In sharp contrast to the jubilation at Bang Khen, the scene at Wukang was one of gloom and frustration. Father Heyden stood beside the instruments atop his bamboo-thicketed hill and stared helplessly at the lowering heavens (page 330). As far as eye could see across the rough countryside, the drab gray ceiling of cloud stretched unbroken.

The day darkened as the eclipse progressed on the other side of the curtain, but the sun never appeared.

Having ruined the eclipse for the expedition, the gremlins of the Dirty Tricks Department refused to bow out without a final mean turn. Some weeks earlier, Lt. Nelson J. Fay, who helped set up the camp, had secured a bottle of champagne (shades of Hsi and Ho!) in anticipation of toasting the expedition's success after the eclipse. The bottle had been buried in the damp earth near the observation site. Now Fay exhumed it, hoping to solace the disappointed ones. Came the last straw. The champagne was flat!

The gremlins also had the weather situation well in hand over Korea, much to Dr. Van Biesbroeck's regret.

"There were many clear mornings during March and April," he recalls ruefully, "but on eclipse day several layers of clouds prevented virtually all recording of the phenomenon.

"It was tantalizing to be able to distinguish

faintly the narrowing crescent of the sun when the clouds were a little less heavy.

"Many people crowded around our wire fence with great interest, but they respected our request for silence at the central phase. All seemed impressed by the eerie darkness which crept over the land, and they marveled at the precision of our advance predictions as to the exact times of the eclipse (page 356).

"When all was done, it was plain that this throng of Korean friends was sharing our disappointment."

Despite the unfavorable weather conditions, Dr. Van Biesbroeck did manage to get a short run of film during a partial phase, and, in the over-all undertaking, every such bit helped.

Rebun "Prays Away" the Weather

At Rebun, the weather tables finally turned in favor of the scientists, although not until after many anxious hours.

All during eclipse week the fisherfolk of the rugged yet scenic island had been offering prayers for fair weather and the success of the expedition's observations. On the eve of E-Day all work was halted on Rebun for a time while its people offered up a final special prayer for this intention (opposite).

Even the most devout, however, may have felt grave doubt about the efficacy of this mass prayer when the E-Day weather did arrive. It stormed all night, whipping up heavy seas which pounded Rebun's rocky shoreline. Dawn found the weather still foul. Skies were gray and leaden. A cold drizzling rain sifted down cheerlessly. Two hours before first contact time there was not the vaguest hint of a sun in the heavens.

The stage seemed set for a crushing anticlimax. Rebun's hamlets had been bedecked with gay posters to hail the eclipse occasion. A special postal cancellation stamp had been authorized to commemorate the event. In addition to the National Geographic Society's expedition, there were representatives of some 17 Japanese scientific associations intent on studying various aspects of the solar phenomenon.

Elaborate press coverage arrangements had been made, and special communication facilities set up. There were so many correspondents, American and Japanese, on the scene, that it had been necessary to restrict to 22 the number permitted in the observation area during the eclipse. One Japanese vernacular paper alone had 25 reporters and photographers on hand to cover the story, and wired picture equipment was installed to whisk photos to Tokyo in six minutes (page 371).

Even the police of crimeless Rebun were anticipating a memorable day. Roads in the vicinity of the observation area had been closed off. Special regulations had been issued for handling the unprecedented influx of visitors and spectators.

All these preparations—and now abominable weather.

Nor did the weather show any signs of breaking. Offshore the Japan Travel Bureau ship, *Hakuun Maru*, with its load of Japanese eclipse seekers, pitched and tossed forlornly in the turbulent seas. When the U. S. destroyer *Orleck* arrived with a final contingent of newspapermen and photographers from Tokyo, the seas were so rough that there was doubt personnel could be landed.

Then, capriciously, it happened. The wind suddenly began to freshen. It picked up until it was blowing about 30 knots. It became so strong that it blew completely out of the water a six-place rubber landing boat which was moored to the *Orleck's* boom. And the wind was blowing aloft, too.

Breaks started to appear in the cloud ceiling. Patches of blue sky showed through, and glimpses of the sun. The rifts widened. Soon the heavens were clear, except for a few small errant clouds. Across the wide channel from Rebun, Riishiri emerged from the mists, its mile-high snow-clad cone a spectacle of beautiful symmetry.

Clear Skies on Schedule

If the weather shift had been ordered by the scientists on Rebun, they could not have timed it with greater nicety.

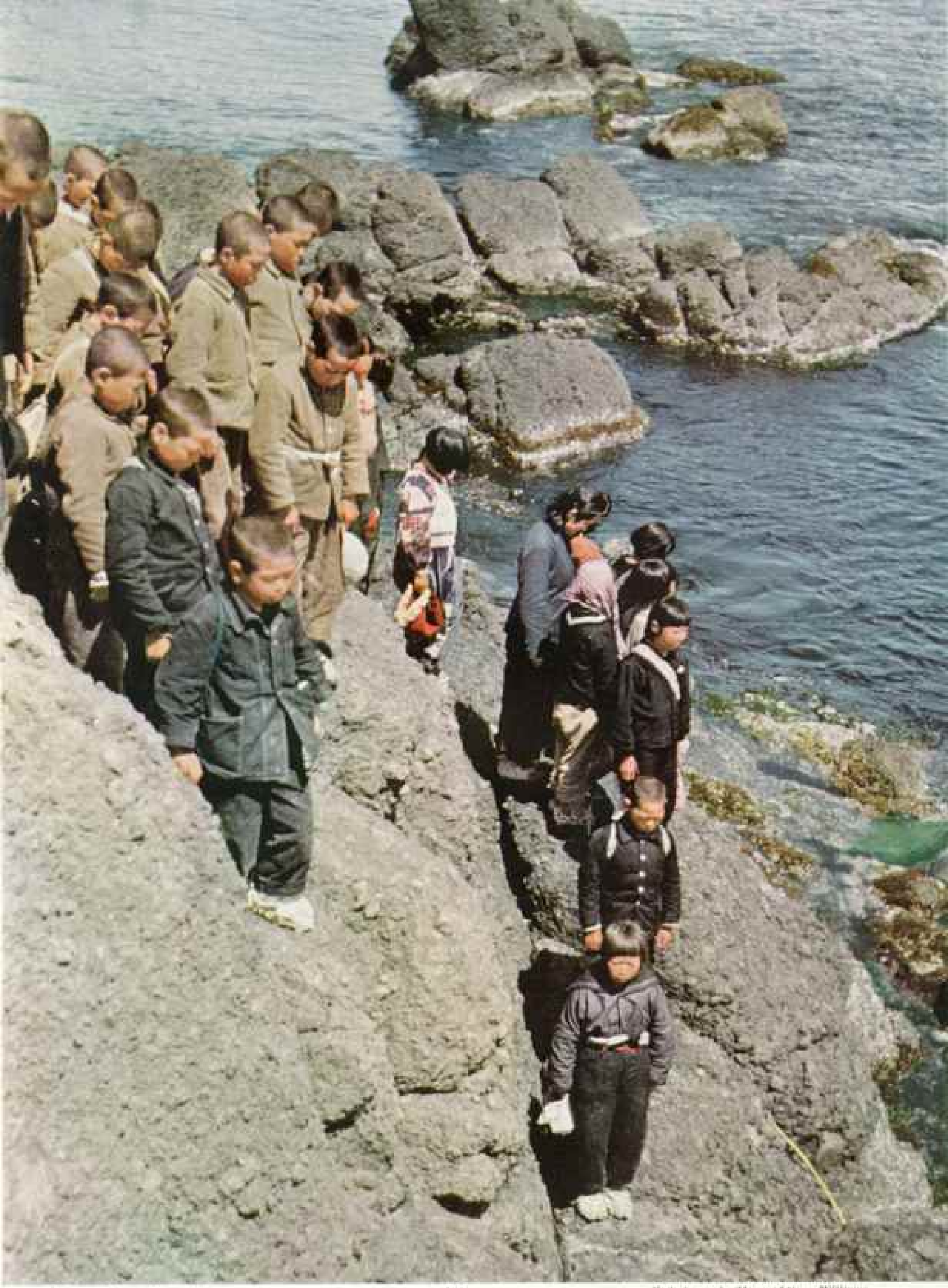
As the eclipse began, the rocky hillside sloping down to the shore-front observation area was crowded with an intent gallery of spectators—solemn-faced youngsters from the island, their equally interested elders, the inevitable battery of amateur photographers snapping away with their cameras, students with notebooks or sketch pads in their hands—and, of course, a few of Rebun's "finest," on hand to preserve law and order.

The sky was almost cloudless for the first three contacts.

Although a few clouds approached the sun when the fourth contact neared, the camera was able to catch that final phase at intervals between the clouds (page 352).

Members of the expedition clapped one another on the back. There was much shaking of hands and exchange of congratulations.

Beaming widely, Japanese scientists and technicians bowed to each other in triumph and saluted Dr. O'Keefe. For Rebun this, indeed, was "it."



Kodachrome by Maynard Owen Williams

School Youngsters and Teacher Bow in a Seaside Prayer for the Expedition's Success

This group was but one of many all over Rebun that paused to offer supplication for clear skies. On eclipse morning clouds covered the sky, but vanished in time to permit almost perfect observation.

Baby Rides atop Bundles of Twigs Gleaned by Mother

It was fun—until the toddler discovered the photographer's attentions; then she began to cry. But the proud Japanese mother insisted the picture be made, tears or no tears.

The slender twigs, carefully raked up and tied into bundles, will be used as firewood. The rake atop the bulky load has long bamboo tines.

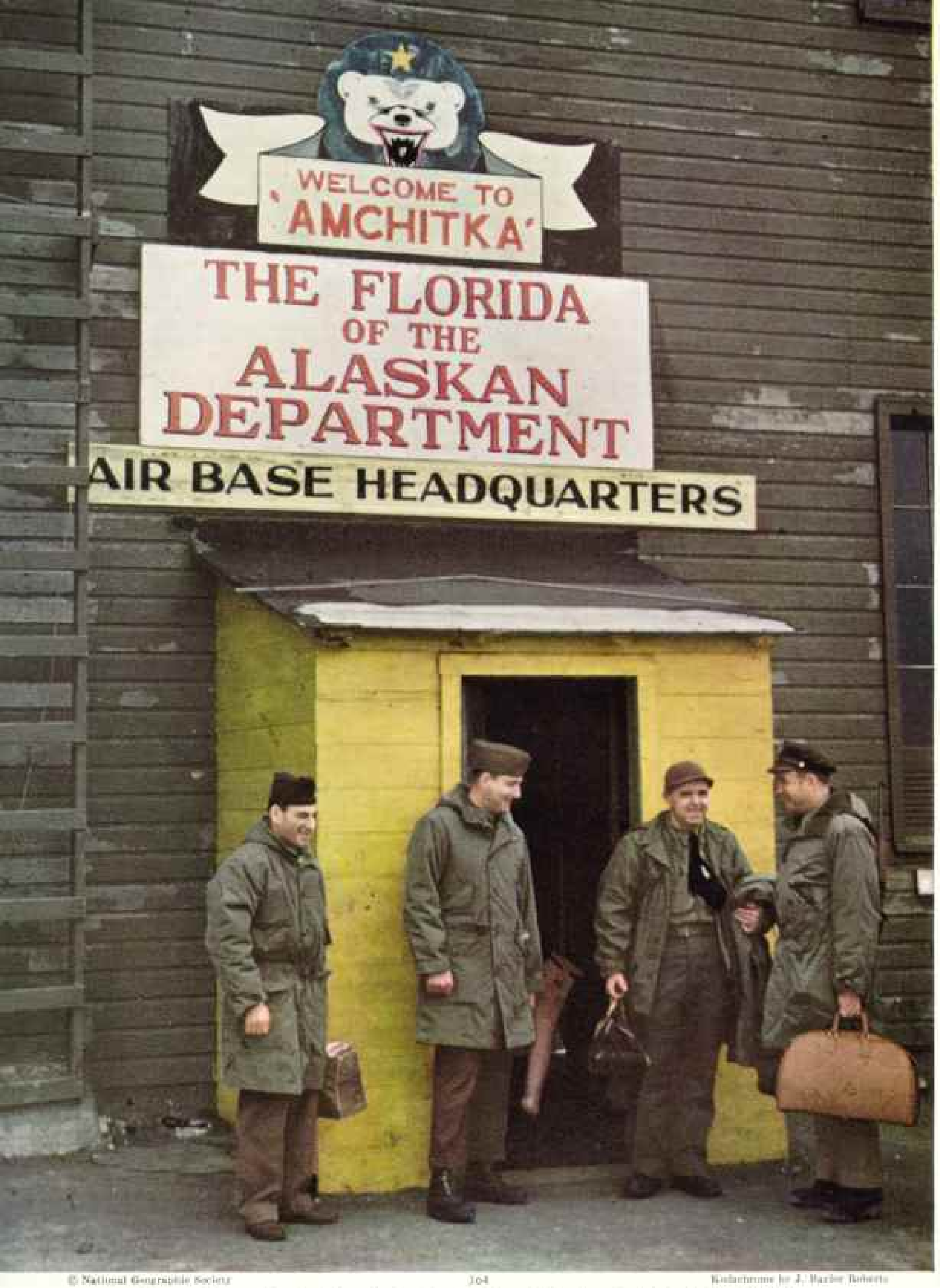
Like many of her rural sisters, the woman still wears the baggy, trousered costume adopted during the war to replace the kimono. In the larger cities most women again dress in kimonos or in Western clothes.

Kodachromes by Maynard Owen Williams

These Alert, Well-dressed Youngsters Reflect None of Rebun's Isolation

The island's 5,000 inhabitants are relatively wealthy because of their rich fishing industry. No bubble gum for the youngster at left; she plays with a fish's air bladder which can be inflated like a small balloon. The schoolgirls attend a sketching class on a hillside. Their trousered costumes make them look like skiers.

Kodachromes by Maynard Owen Williams



Heavy Coats Emphasize the Lack of Balmy Weather in This "Florida" Base

Amchitka gains its nickname from its position as one of the southernmost of the Aleutians. The Kiska eclipse team, just arriving here, found Kiska volcano impossible as a base because of old Japanese booby traps.

▲ Highest Peak in the Aleutian Chain Is Steaming, Snow-robed Shishaldin

This cone, as perfect as that of Mayon in the Philippines or Fuji in Japan, towers to 9,978 feet. It dominates Unimak Island, separated from the Alaska Peninsula only by a narrow strait.

▼ Coast and Geodetic Survey Men Locate the Adak Eclipse Sites

They take bearings from a geodetic marker to establish the position. While Burma and Siam teams sweated in tropic heat, Aleutian observers shivered in heavy coats. Snow marred the view of the eclipse here.

Kodachrome by J. Baylor Roberts

Clouds Blanket the Aleutians, but This B-29 Observatory Flies in Full View of the Sun

Cruising at 27,000 feet, the crew made eclipse photographs through specially built optical-glass turrets, seen as the black object behind the nose. Position was determined by Shoran (short-range navigation) signals from ground stations.

Sunset Stains the Clouds Hanging Above Snow-capped Great Sitkin Island in the Middle Aleutians

The rugged mountains in this 11-mile-long island culminate in a volcano which thrusts its 5,740-foot peak into the lowering clouds. It lies some 20 miles distant from Adak, upon which National Geographic photographer Roberts was stationed with the Aleutian eclipse teams.

Kodachrome by J. Baylor Roberts

Kodachrome by J. Baylor Roberts

Camera Trials Run Smoothly—"Ready," Says the Team on Mount Adagdak

When Kiska proved unsuitable, that team went to Adak and set up equipment on Mount Moffett. Equipment and men rode in U. S. Army "weasels," one of which stands in front of the hut.

Two hard-working members of the National Geographic Society's field staff were on hand to participate in the moment of triumph. Mr. Johnston, coordinator at Tokyo for all the Asiatic expeditions, arrived a few hours before the eclipse after a very stormy voyage. Waiting to greet him he found Dr. Williams, who had previously spent considerable time in Korea and China, assisting with the preparations of the eclipse teams at those locations.

Weather Gods Frown Again

A few hours after the eclipse passed Rebun, it was the Aleutians' turn, and the ill fortune which had dogged the ground parties there did its best again to spoil the occasion. The scheduled celebration in the officers' club on Adak after the eclipse turned out to be closer to a wake.

The treacherous Aleutian weather acted up as eclipse time approached. Located in a more westerly position, Commander Shelton's group had the first opportunity to "shoot" the phenomenon and got some usable film footage at the first contact. Then a driving snowstorm whipped down suddenly out of the clouding sky and raged throughout the central phase and after.

It was a weird spectacle, for the darkened sun could be seen intermittently through the whirling snowflakes and shredded clouds. The camera kept grinding all during annularity, but heavy clouds obscured the sun at the critical moments. Matters improved momentarily at the fourth contact, but after a few more feet of film had been exposed, the sun was blotted out completely.

Clarence Shelton's party on Mount Adagdak, 7¼ miles to the east-northeast, fared even worse. Their location was weathered in solidly, and they got not a glimpse of the eclipse.

The big question on Adak that night was how had the B-29's made out. Army and Navy pilots who had been in the air during part of the eclipse reported overhearing snatches of "intercom" talk between the two Superforts which indicated that things were going well; but no official report ever came through to Brig. Gen. Frederick Kimble, Air Force Commander in the Aleutians, from Major Wyman after the big planes had landed on Amchitka, an alternate base.

Both Amchitka and Shemya, the original base of the B-29's, were peppered with urgent messages. They came from General Kimble, from The Society, from Major Wyman's immediate superior in Washington.

No replies came back from Amchitka or Shemya, until a final message elicited the information that the B-29's had already departed for home base in Florida.

It developed later that Major Wyman had filed his routine official reports and a long eclipse dispatch to The Society immediately upon landing, but the sunspot storms had obliterated them in transmission and they never reached their destinations. The same freakish disturbances had kept the urgent inquiries from getting through to Major Wyman while he was on Amchitka. The experts at the Bureau of Standards had been all too correct in their warnings that radio storms would be bad in the Aleutian area.

For four days the outcome of the B-29 mission remained an exasperating mystery.

Then all the confusion about the vanished reports and unreceived messages suddenly cleared up. Major Wyman returned to Washington and sat down with Dr. Briggs and a group of geodetic and map experts to tell the B-29 story.

The Big Story Gets Told

And the B-29 story proved to be the most stirring and dramatic account to come out of Operation Eclipse. It made a fitting climax to a great venture.

The flight plan worked out in advance for the Superforts called for them to do their eclipse work at between 8,000 and 10,000 feet.

"This," explained Major Wyman, "is the maximum altitude required 360 days in the year to get on top of the Aleutian weather—but on the other five days you have to go higher, sometimes much higher.

"E-Day, we found, was one of those five. Maybe I should say six, since this is leap year."

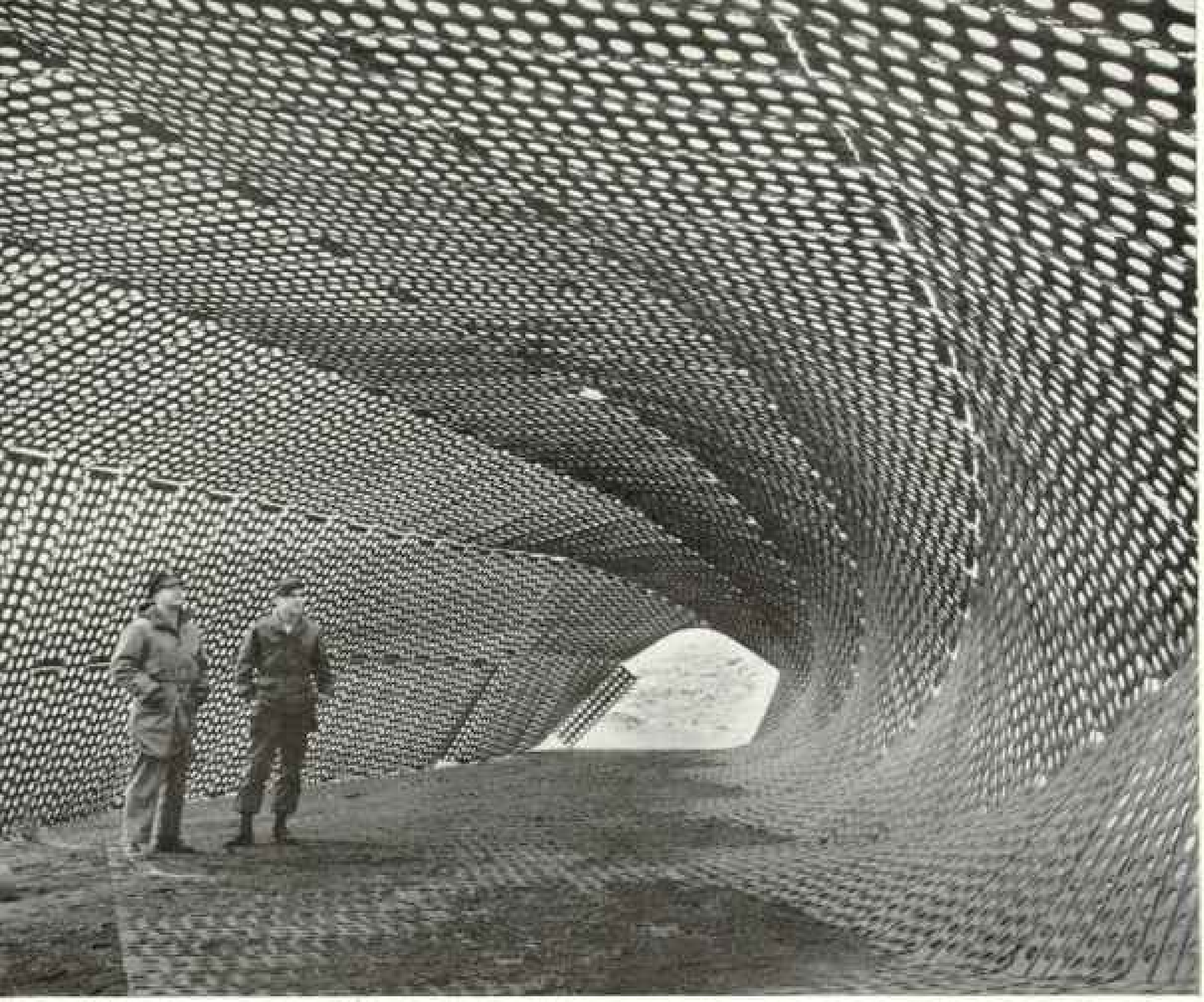
When the B-29's came out on top of the regular overcast at about 10,000 feet, they did not meet clear weather with unlimited visibility, but a seemingly endless layer of haze.

They groped higher. Three miles. Four. Five. Still the "soup" persisted.

Finally they broke into the clear, but still kept climbing to put a good margin between themselves and the weather "roof" beneath them. Altimeters showed 29,000 feet.

Then a bad moment came. In the rarefied atmosphere of the great height an engine conked out on one of the B-29's. The big ship was forced to drop down 2,000 feet before the balky motor picked up again. Fortunately, it gave no further trouble.

The mission was carried out at those altitudes, one plane flying at 29,000 feet about ten miles ahead and 2,000 feet above the



National Geographic Photographer J. Baylor Roberts

This Curled-up Landing Strip Is the Artistic Work of an Aleutian Williwaw

Williwaws, fierce windstorms unexpectedly sweeping down from the mountains, posed an extra hazard for eclipse hunters in the Aleutians. At speeds up to 100 miles an hour they played havoc with installations such as this steel matting.

second. Both flew an identical course, tight-rope-walking the center line of the eclipse path.

At the final operating levels the weather was very clear and cold, with the outside thermometers registering 50 degrees below zero centigrade at 29,000 feet, and 43 below at 27,000 feet. And crewmen commented on the strange brightness of the atmosphere.

Despite the planes' heating systems, the subzero temperatures outside had a decided effect on the delicate mechanism of the eclipse cameras mounted in the specially improvised blisters atop the Superforts (page 366). The cameras proved extremely cold and stiff and had to be warmed up for a while before it was thought wise to load them with film. Major Wyman remarked that he wished he had had a couple of electric blankets along to bundle around the photographic equipment.

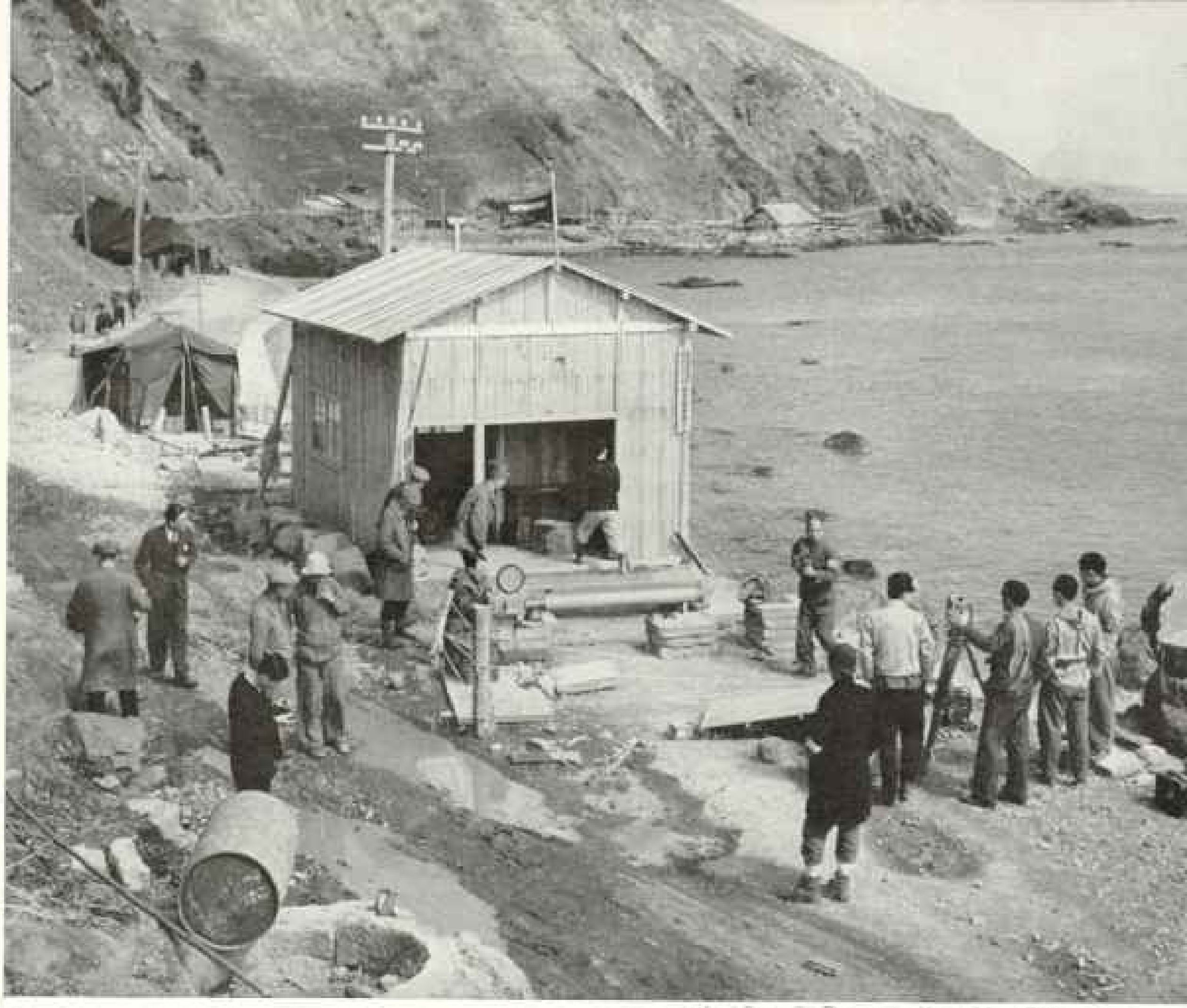
The cameras were not the only pre-eclipse run problem. Pilots had to worry about contrails—the long, vapory wakes which aircraft produce under certain conditions. There was concern lest the contrails of the lead plane might, at a critical moment, interfere with the camera in the B-29 that followed.

"This Is It"

Zero hour. It was shortly before 5 p. m. The run was on, and still the extraordinary brightness pervaded the great empty void of the upper world when the moon started to bite into the edge of the resplendent sun.

But things changed rapidly. Brightness gave way to an eerie twilight, then darkness so complete that the B-29's had to switch on their electric-lighting systems so that the all-important men in the cockpits could see their instruments.

The men in the cockpits had a ticklish, nerve-racking job. If a wingtip dipped ever so little during the course of the eclipse, it would be enough to throw cameras off the



National Geographic Photographer Maynard Owen Williams

Japanese Newsreel Men on Rebun Shoot a Rehearsal of the Eclipse

Dominating the observation enclosure, the long tube of the eclipse camera is mounted on concrete piers and trained on the coelostat (right), which mirrors the sun's image. Tents of the expedition darken the winding shoreline.

eclipse image and perhaps ruin chances for the mission's complete success. It had to be a steady course, and true.

As the cameras ground in the gathering darkness, a new danger arose, due to the thin upper atmosphere. With explosive reports, ribs began to crack in the special optical-glass domes housing the eclipse cameras. Three ribs buckled in the dome on one of the ships, and one on the other.

Those were tense seconds. The photographers were lashed in their positions, but there was no predicting what might happen should a dome blister give way and create a terrific pressure change inside the aircraft. Similar accidents in the past have sucked men and equipment out of pressurized planes to certain destruction.

Happily, while the dome ribs cracked and groaned, they held. Shoran and time-signal equipment functioned smoothly. The sheen of brightness crept back into the upper skies. Then, abruptly, the eclipse run was over, and the B-29's, with their triumphant crews, swooped down almost six miles to land on Amchitka and dispatch the "Mission Accomplished" reports which were never received.

Operation Eclipse Estimates Revised

The B-29 story, plus the subsequent receipt of more detailed information on the Mergui observations, gave Dr. Briggs and his scientific associates most welcome ground for revising their initial long-range estimates on the results of the eclipse expeditions.

Understandably enough, the original estimates had been much on the conservative side.

On the basis of first reports, the most Dr. Briggs hoped for was that the triangulation networks of Siam and Japan could be tied in to further knowledge of the size and shape of the earth.

A major accomplishment, this, and one that any single eclipse expedition might well regard

as a gratifying success. But it was still somewhat on the disappointing side for the ambitious multiple enterprise that had been at work so long.

Subsequent reports enhanced prospects substantially. It was no longer a question of a single linkup. Burma promised a double check on the tie from southeast Asia to Japan, possibly to Korea. The success at Rebun seemed to ensure such a result.

The exciting development, of course, was the outcome in the Aleutians, for on that hinged the slender hope of obtaining new data on intercontinental distances between North America and Asia.

The Long Job Ahead

Making scientifically sure of results is something far different from giving tentative estimates of spot reports.

The work of evaluating and correlating scientific information produced by the several expeditions will require many months before any final report can be drafted. There are some 100,000 separate pictures of various eclipse phases to be studied and compared. Atmospheric conditions, slight variations in time signals, and other factors all must be taken into careful account.

The bare preliminary preparation of the B-29 eclipse film, alone, took more than seven months of the most painstaking work.

A cautious, if terse, progress report to Dr. Briggs gives grounds for more than restrained optimism on the ultimate verdict. It states: "Results better than meteorological predictions would have led us to believe. Most of the stations had some measure of success, and five of them produced results of *great* value, namely, Mergui, Bangkok, Rebun, and the two B-29's."

Whether the ultimate results turn out to be on the minimum or maximum side, two things seem plain:

Mankind's knowledge of the size and shape of the earth stands to be bettered. And in the size and shape of the earth is the footrule, so to speak, by which man measures the universe wherein he lives.

A revolutionary new technique in precise astronomical observations has been introduced by the use of aircraft, and this should facilitate the future work of scientists intent on advancing the cause of more accurate geography.

Aircraft have been used in the past for observing and photographing eclipses, but the data obtained lacked precise value because the plane's constantly changing position in the sky could not be plotted continuously in terms of equivalent positions on the surface of the earth below.

The success of the airborne operation hence takes on notable significance, for it promises to provide scientists with "eclipse insurance" for the expeditions that will be studying solar blackouts in years to come.

In the past, astronomers have been tied to the ground because a stationary platform for instruments was believed necessary to obtain reliable data. And they have always been completely at the mercy of the weather —a few minutes of clouds and rain have defeated countless expeditions, organized at great expense and effort.

Now that the new aerial technique has demonstrated marked effectiveness, scientists can plan on using the moving platform of the airplane to supplement the observations made from stationary platforms on the ground. Moreover, the airplane gives them a veto over bad weather, because, except for rare cases, aircraft can climb out on top of the storms and clouds that would thwart ground observers.

Taking advantage of the new technique presents no insurmountable obstacles. Modern commercial transport planes are readily available for charter. They could be fitted out privately with the necessary additional navigational and electronic equipment. Installation of scientific instruments and cameras would be a comparatively simple task.

Perhaps the day may come when major scientific organizations, or groups of them, will maintain their own specially equipped aircraft for various phases of celestial research and other projects of exploration, just as some industrial firms and large newspapers do today for their special purposes.

"Calculated Risk" Justified

For the National Geographic Society and its 1,800,000 member-families, the 1948 eclipse thus may well be regarded as a memorable one. The Society sent out the largest coordinated team of expeditions yet to take the field for a blackout of the sun. It pioneered again in sponsoring the use of high-altitude aircraft in a new approach to the problem of eclipse hunting. And this unprecedented ground-air combination obtained important scientific results.

The scientific gamble risked back in June, 1947, and supported by The Society's membership, would appear to have been well calculated and more than justified in its returns.

Exploring the Past in Panama

By Matthew W. Stirling

Leader of the National Geographic Society-Smithsonian Institution Archeological Expedition to Western Panama

Illustrations by National Geographic Photographer Richard H. Stewart

IT WAS COLD in New York that December afternoon, and it was cold on the deck of the S. S. *Ancon* as she slowly eased down the East River. Snow covered the city.

Wearing light coats, since this was the only day we expected to need them, we shivered a while on deck, viewing the somber but beautiful sight, before descending to the grateful warmth of our staterooms.

Like migrating birds, Gordon Willey, Richard H. Stewart, (Mrs.) Marion Stirling, and I were again heading south on our annual National Geographic Society-Smithsonian Institution archeological expedition, this time to western Panama.*

Our final destination was to be the Azuero Peninsula on the Pacific side, 160 road miles southwest of the Canal Zone (map, page 377).

From Snow to Tropic Sun

Two days later we were lounging on deck chairs as we sailed through sunny seas, thoroughly enjoying the climatic contrast and the brief rest before plunging into the strenuous work ahead.

At Colón, to our surprise and pleasure, we were met by a compatriot, Karl Curtis, voluntary aide, guide, and mentor of practically every scientific expedition that has visited Panama in the past 25 years (page 375). In his car we rode across the Isthmus to our hotel in Ancon.

On the pleasant two-hour drive from the Atlantic to the Pacific we were again impressed by contrast: this time, the ease of modern travel as compared to the crossing by rugged trail through fever-laden jungle.

One of the first mainland points to be touched by the Spaniards, the Isthmus of Panama played from the start a leading part in the opening of the New World.†

Here on the wasp waist of the Americas was the obvious point of access to the shores of the great Pacific, first seen by Balboa from his "peak in Darién." Here, Columbus stated, Spaniards saw more signs of gold in two days than they had observed in four years of exploration in the West Indies.

Soon after the Spaniards had looted fabulous riches in gold from the native chiefs of Panama, the treasures of Peru were discovered. For years the wealth of the stricken country of the Incas poured across the Isthmus over the gold road from Old Panama (Panamá Vieja) to Portobelo on its way to Spain.

Then came the period of the Buccaneers, of Henry Morgan and his "terrible men." The sack of Portobelo and of Old Panama was a blow from which the Spanish Empire never recovered.

In the middle of the 19th century this shortest coast-to-coast route revived, and again the magic word "gold" was the cause. California mines started a new stream of treasure seekers across the fever-stricken Isthmus. In 1855 the trans-Isthmian railroad was finished and the trip became easy.

An epic story in itself is the construction and final completion of the Panama Canal. During this period Panama became the foremost focus of research in tropical medicine, and continues to contribute much in this field today.

Gold Doomed Rich Native Culture

Almost lost in this romantic background is the fact that at the time of the Conquest there flourished in Panama one of the richest and most colorful aboriginal civilizations in America. As happened in many other places, the very richness of the natives brought about their early doom.

Tantalizing but inadequate descriptions of these people have been left us by Gonzalo de Badajoz and Gaspar de Espinosa, who, between 1515 and 1525, led looting expeditions into the region for which we were bound.

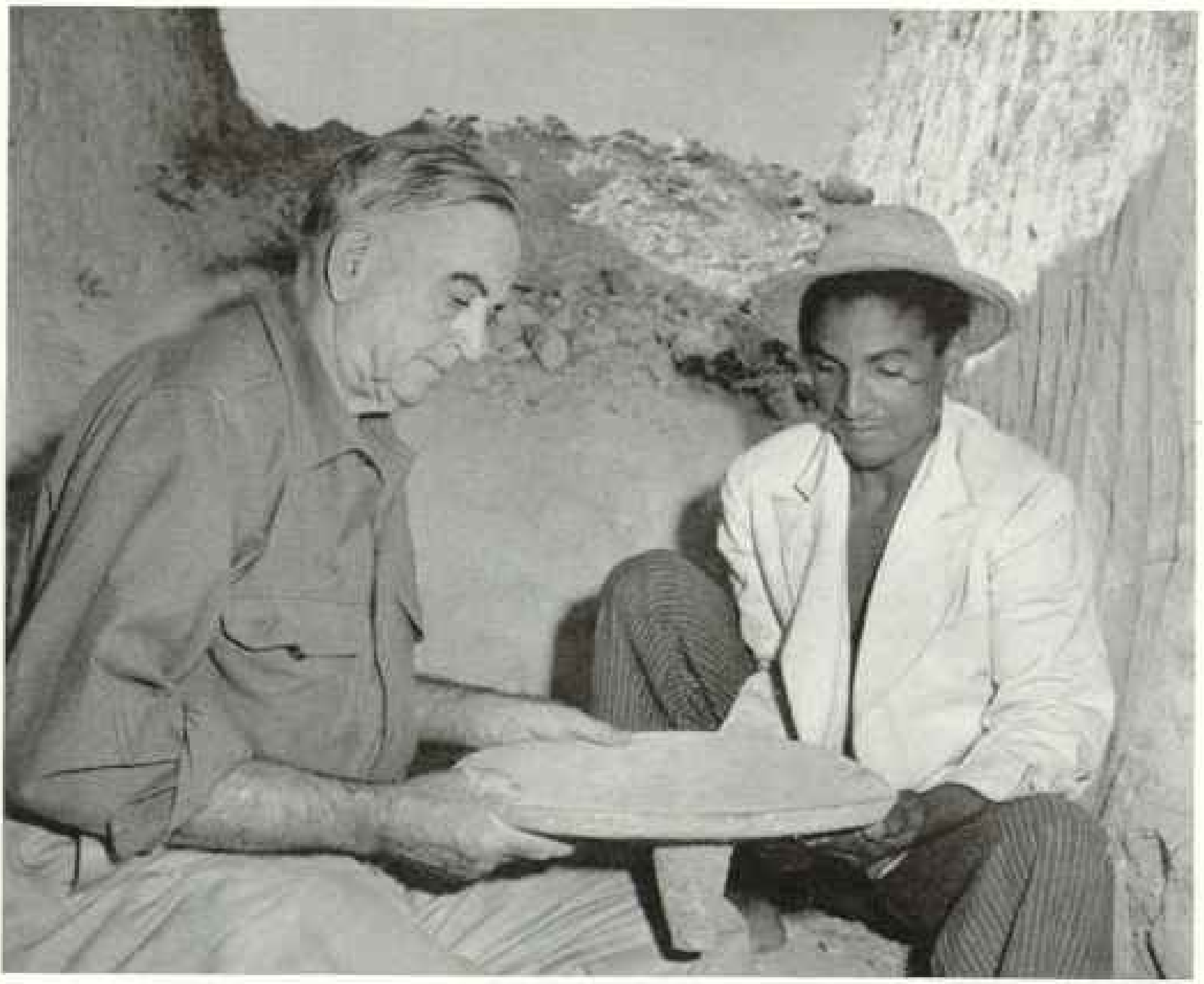
Center of greatest population and highest culture of Panama in pre-Columbian times, this area consists of the narrow, semiarid Pacific coastal strip lying west of the Canal

* For accounts of previous National Geographic-Smithsonian expeditions, see the following National Geographic Magazine articles by Dr. Stirling, who is Chief of the Bureau of American Ethnology, Smithsonian Institution: "On the Trail of La Venta Man," February, 1947; "La Venta's Green Stone Tigers," September, 1943; "Finding Jewels of Jade in a Mexican Swamp" (La Venta), November, 1942; "Expedition Unearths Buried Masterpieces of Carved Jade" (Cerro de las Mesas, Mexico), September, 1941; "Great Stone Faces of the Mexican Jungle," September, 1940; "Discovering the New World's Oldest Dated Work of Man," August, 1939.

† See "Panama, Bridge of the World," by Luis Marden, National Geographic Magazine, November, 1941.

After Nine Years with the Stirlings, Your Society's Flag Shows Wear and Tear

Here the blue, brown, and green banner adorns Parita headquarters of the 1948 expedition. "Most luxurious quarters we ever had," Dr. and Mrs. Stirling called their adobe house. On previous trips the flag waved over jungle camps. The Stirlings are now in Panama on a new search for knowledge of early America.



Out of a Tomb Dug Centuries Ago Comes an Indian Grinding Stone

Examining the three-legged *metate* are Karl Curtis, expedition guide, and a Panamanian worker. Archeologists burrowed through three feet of village refuse and eight feet of soft granite to break into an earth-filled chamber which contained two human skeletons. Buried with the bodies were the grinding stone, pottery vessels, stone axes, and a copper chisel (page 394).

Zone (map, page 377). To this day most of the population of Panama—outside of the cities of Panamá and Colón at the ends of the canal and the railroad—is concentrated here.

Paradoxically, this coast region is referred to as the "Interior." From the middle of the area juts the Azuero Peninsula, one of the largest peninsulas on the Pacific Coast south of Baja California.

The "Plains" of Panama

The visitor who receives his impression of Panama from passing through the jungle-clad Canal Zone is due for a change of viewpoint on traveling through the Interior. Along the base of the Azuero Peninsula he might fancy himself on the plains of South Dakota rather than in the American Tropics.

At present the principal industry of the Interior is cattle raising. The rich agricultural potentialities are only partially developed, chiefly because of lack of a suitable market. Considerable excellent coffee is raised near the Costa Rican border, however, on the shoulders of the Chiriqui volcano.

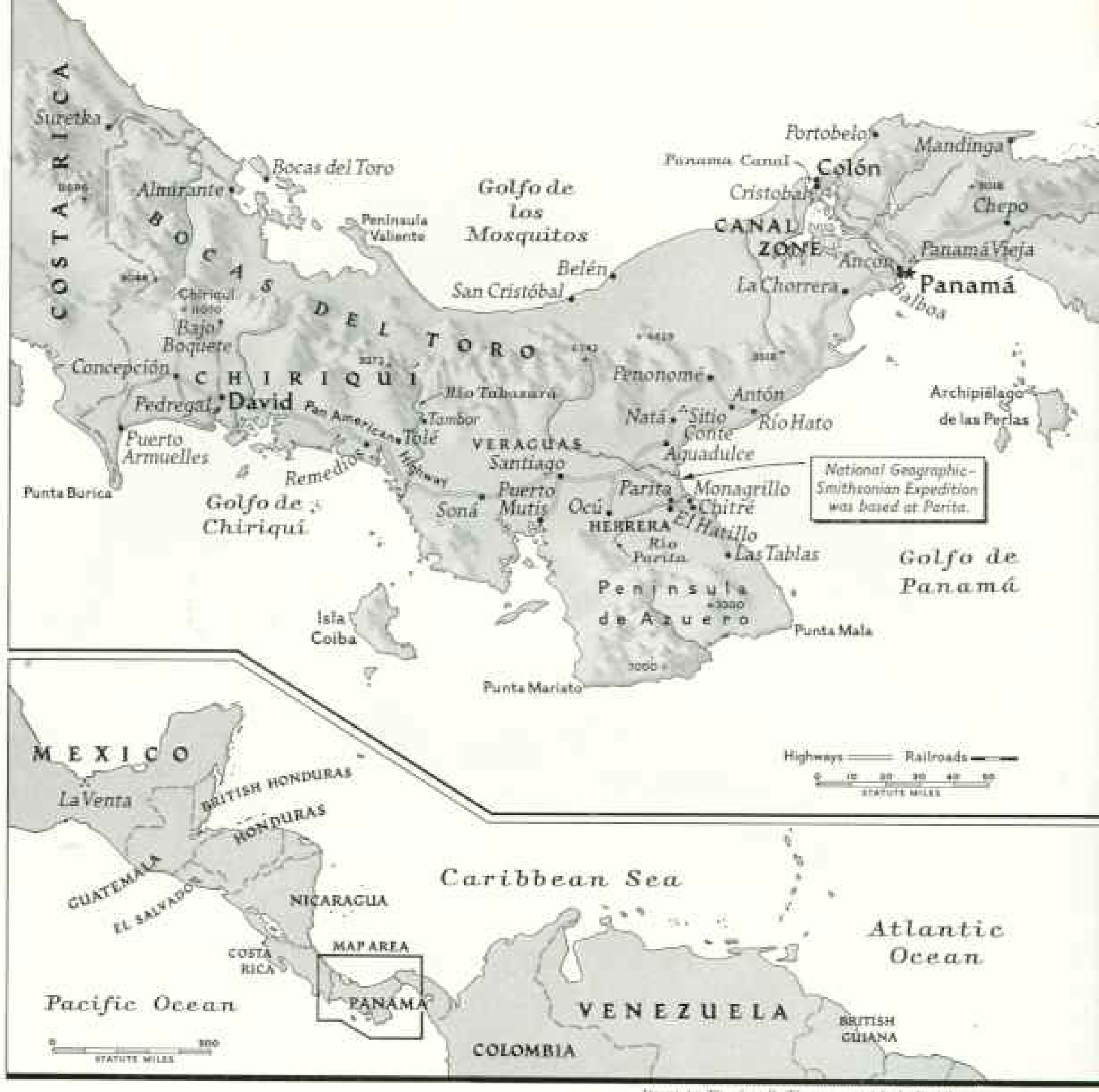
At the beginning of the 16th century, the Azuero Peninsula and the adjacent mainland were under the control of a powerful chief named Parita. The region to the west was dominated by another strong chief, Urraca. These two rulers were probably of the Guaymi tribe.

Both men fiercely resisted the invasion of the Spaniards under Badajoz and Espinosa, and were never fully conquered. They could not, however, prevent the Spaniards from obtaining a foothold at Natá and taking more than $100,000 worth of gold.

A few years later Espinosa led another raid into the Azuero Peninsula and found to his surprise that Parita had recently died.

Fanciful Bird and Reptile Designs, in Bright Colors, Adorn Panama's Ancient Pottery

A pedestal-base bowl (top, left) represents a king vulture with two heads side by side. Colors are red and black on buff. Its dark red companion piece has vulture heads at either side. Crocodile-design cups (second row) are red, black, and purple on white. Missing head prevented identification of a bottleneck vessel (lower left). Whippoorwills, doves, and ducks, as well as vultures were used. The plate bears a humanized turtle. Beside it is a conventionalized king vulture.



Drawn by Theodora P. Thompson and Irvin E. Allen

On Panama's Pacific Coast, National Geographic Society-Smithsonian Archeologists Unearth Evidence of Rich Indian Civilization

Near Parita, named for a powerful chief who ruled the Azuero Peninsula before the Spanish conquest, the Panama Expedition made important finds. Monagrillo's shell mounds, near the mouth of the Parita River, revealed the oldest village site yet found in Panama. From Parita the scientists journeyed westward to Ocú, Tolé, and the Tambor region to visit the Guaymí and other tribes in their isolated mountain homes.

Breaking into the house where his body lay in state, the Spaniards obtained one of the richest hauls of loot ever recovered. Among the elaborate burial wrappings they found 355 pounds of gold ornaments.

Lashed to the house posts by cords tied around their throats were 20 Indian captives who had been destined to be buried alive with the great chieftain.

The burial rites of these Indians were unusually elaborate. After the death of an important chief, funeral ceremonies lasted for two days. During this period his wives and household attendants were prepared for burial with him.

Wives and Servants Buried Alive

A deep pit was dug, with a bench along the sides at the bottom. During the two-day ceremony, the wives of the chief—sometimes ten or a dozen—sat on the bench in the grave and were plied with chicha, a fermented corn drink, until they were thoroughly intoxicated.

When the body of the chief had been placed in the grave, his servants and captives were put in with the wives, and the grave was filled.

Near Monagrillo, a Shell Mound Marks the Scene of Shore Dinners Eaten 1,000 Years Ago

Dr. Gordon Willey (right), Smithsonian archeologist, and a Panamanian assistant measure a prehistoric refuse pile near the mouth of the Parita River. The area now is a dry salt flat, but findings show that its inhabitants lived on shellfish and crustaceans. Monagrillo is the oldest village site yet found in Panama (p. 395).

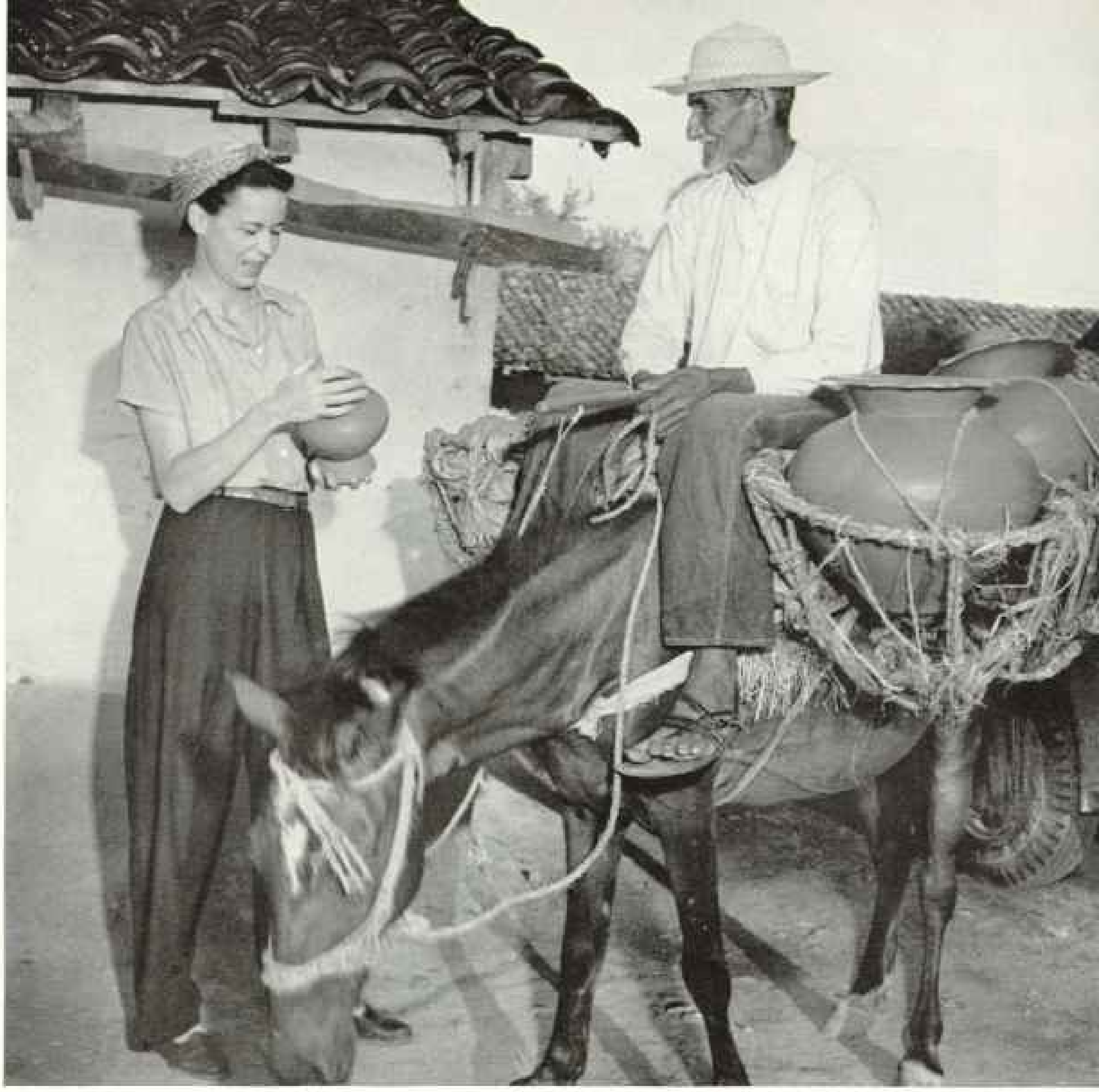
Sometimes as many as 50 individuals and a fortune in personal possessions were thus buried with an important chief.

A Rich Archeological Site

Sitio Conte, a center of Coclé Indian culture near Natá, is probably the richest archeological site ever excavated scientifically in the New World. There the largest number of individuals found buried with a chief was 21. During our excavations this past season we found one tomb site near the town of Parita which contained the remains of 32 persons.

Evidence of the high state of their culture is some of the most beautiful pottery produced in the New World. Graceful bowls on pedestal bases were painted in intricate and ingenious patterns of red, white, purple, and black. Utensils were modeled in myriad forms, often as birds and animals.

These Indians made delicate and beautiful carvings in wood, bone, stone, and ivory. They were among the finest metallurgists of the world in their day, possessing the art of plating other metals with gold and of mixing alloys. They made exquisite gold jewelry in incredible quantities by replacing a wax model with molten gold—the "lost wax" casting process.



When Faucets Fail in Parita, Business Booms for the Water Vendor

Arriving at headquarters, the Panama expedition found the town waterworks out of commission. A mule-back salesman brought some supplies from near-by wells. Here he offers his wares, including a pottery jar, to Mrs. Marion Stirling. Most water was hauled in 50-gallon drums from the Parita River, a mile distant. Native workers preferred the latter, because of its "richer" flavor (page 383).

Gold pendants were set with polished precious and semiprecious stones. Some found at Sitio Conte were mounted with huge emeralds, probably imported from South America.

Looting of Graves Now Outlawed

Important chiefs wore richly embossed helmets of solid gold, had garments covered with golden disks, and wore on their breasts immense embossed disks of gold, or gorgets in the form of birds with outspread wings.

Because of the aboriginal practice of burying a man's possessions with him, there has been a vast amount of grave looting in Panama. This practice has now been outlawed by a progressive Panamanian Government; digging permits are necessary and are issued only to qualified organizations.

Panama is fortunate in having at the head of its National Museum a true scientist and conservationist, Dr. Alejandro Mendez, who is making every effort to halt looting and to encourage true scientific work. His wholehearted cooperation with our expedition was the most pleasant feature of a completely pleasant field season.

After a preliminary survey with Karl Curtis, we decided to spend the season excavating

Teen-age Miss Panama Looks at the World Outside

Attending a fiesta at Ocú, Marion Stirling showed copies of the NATIONAL GEOGRAPHIC MAGAZINE containing pictures of archeological expeditions to Mexico. This girl took time out from dancing to study costumes of a neighbor land.

in the vicinity of Parita. This old town is near the headquarters of the 16th-century chief whose name it bears.

Armed with letters from Dr. Mendez, we introduced ourselves to the mayor, Diógenes Arosamena. He offered full cooperation and took us to the home of his father, Don Leopoldo, who helped us arrange to rent a vacant adobe house next door (page 374).

Housekeeping arrangements being the woman's end of the expedition, Marion went into a huddle with the mayor's mother, Doña Rosa. With her efficient advice we soon found ourselves in possession of a cook, Onarina, and her half-sister Aurora as general housemaid.

Running water and electric lights were lacking, and the house was bare of furniture and shelves. The lack of furniture was remedied from the Army salvage dump near Balboa, and National Geographic photographer Richard H. Stewart, in his customary side role of camp carpenter, soon had the rooms equipped with wooden shelves.

In the rear of the patio we built long tables for washing and drying sherds. For packing and shipping our archeological collections, we acquired 100 army footlockers.

Behind the four-room house, facing the patio, was a two-room annex with kitchen and storeroom.

When Dr. Alexander Wetmore and Watson Perrygo joined us for their ornithological work, they devised a workroom between the kitchen and the house. There townsfolk congregated daily and sat by the hour, watching the fascinating process of skinning birds (page 387).

The river being a mile from town, one of our first acts was to build an outdoor shower bath—an enclosure of poles and palm leaves containing a 50-gallon gasoline drum equipped with a spray. Herminio, Dr. Wetmore's young assistant, kept the drum filled with water.

Dr. Wetmore and Mr. Perrygo washed off innumerable ticks each morning after tramping through fields and mountains, hunting birds. Gordon and I did not collect many ticks, but always returned from the excavations heavily encrusted with dirt from the continuous dust storm produced by the strong trade winds which swept over the area all day along.

Our ex-army chairs and tables were various shades of green and brown. Marion bought a can of paint and painted them all a Chinese red. After that our furniture was gay, if not pretentious.

Our quarters were the most luxurious we have enjoyed in nine years of exploration in the American Tropics. On previous trips we lived in camps in the jungle.

Life in an Old Panamanian Town

In outward appearance Parita today seems a very close replica of a Panamanian colonial town of the 16th or 17th century. The church, built in 1556, is one of the oldest in Panama.

Houses in the center of town have walls of adobe tinted with a slip of white, pink, green, or blue, made from colored clays found near by. Roofs and floors are of tile. There is but one two-storied house in town, and the only glass windows are in the church.

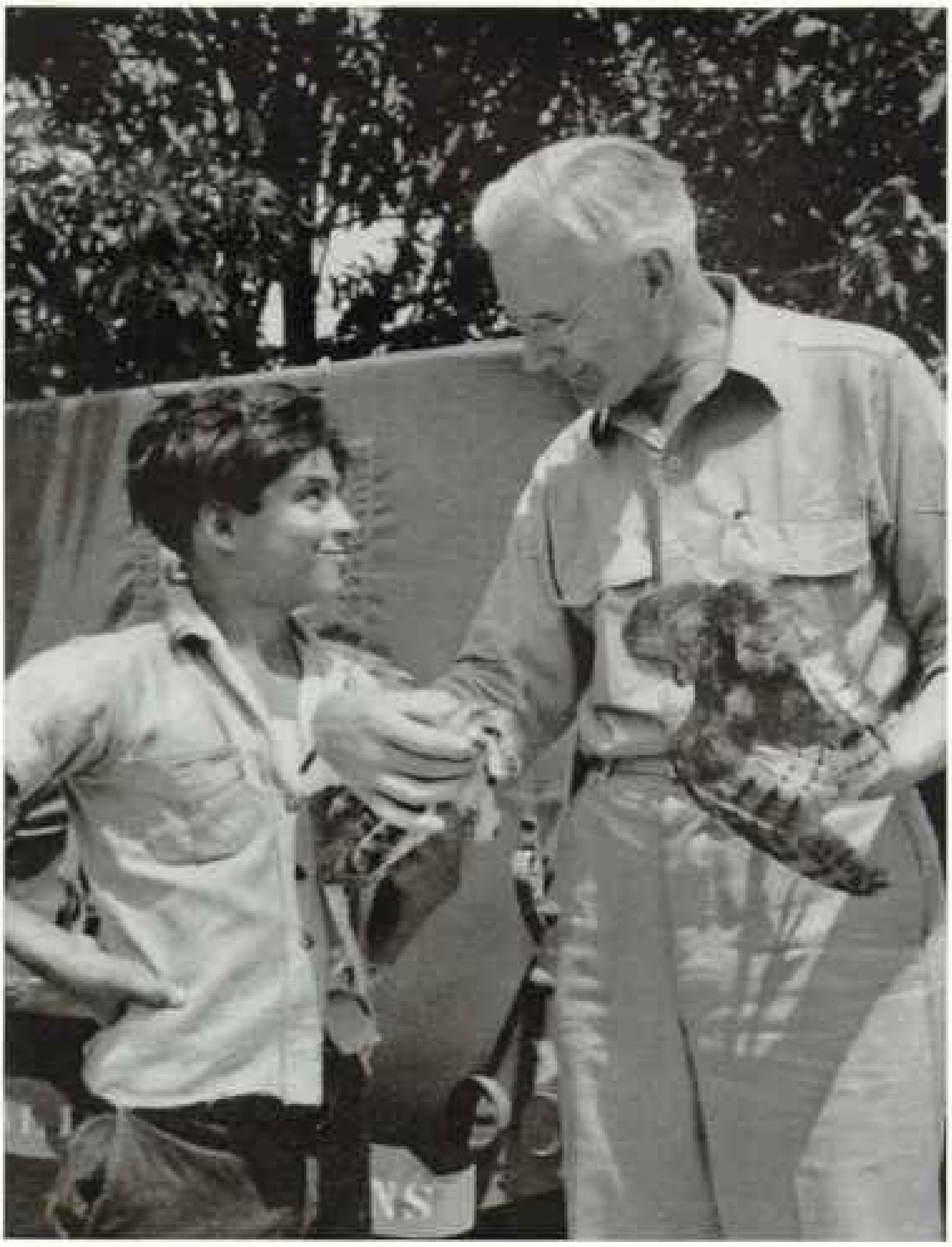
On the fringes of town the houses are of the old aboriginal Indian type—oval-shaped, with thatched roofs of grass, palm, or sugar cane leaves.

Parita is by no means uncivilized.

Movies are shown twice a week in an old schoolhouse. The films are almost all of North American origin, and westerns are heavy favorites.

The municipal electric plant functions from 7 p. m. to 11 p. m., the curfew hour. On Sunday mornings at 11 the plant is operated for a half-hour, so that radios can bring in the national lottery results. All activity stops at this time while the populace gathers around windows and doors of homes that have radios.

Virtually everyone who possesses 50 cents or more holds one or more shares of a lottery ticket. Those who have less than 50 cents generally pool their pittance with others equally broke and share the rewards in case of a win.



"Yes, Pedro, We'll Buy Your Owls"

Word that National Geographic-Smithsonian scientists sought birds as well as ancient tombs spread quickly among the Parita younger set. Boys and girls captured specimens, sold them for a few cents apiece, and remained to watch them being skinned. Here a village youth delivers a pair of young barn owls to Dr. Alexander Wetmore.

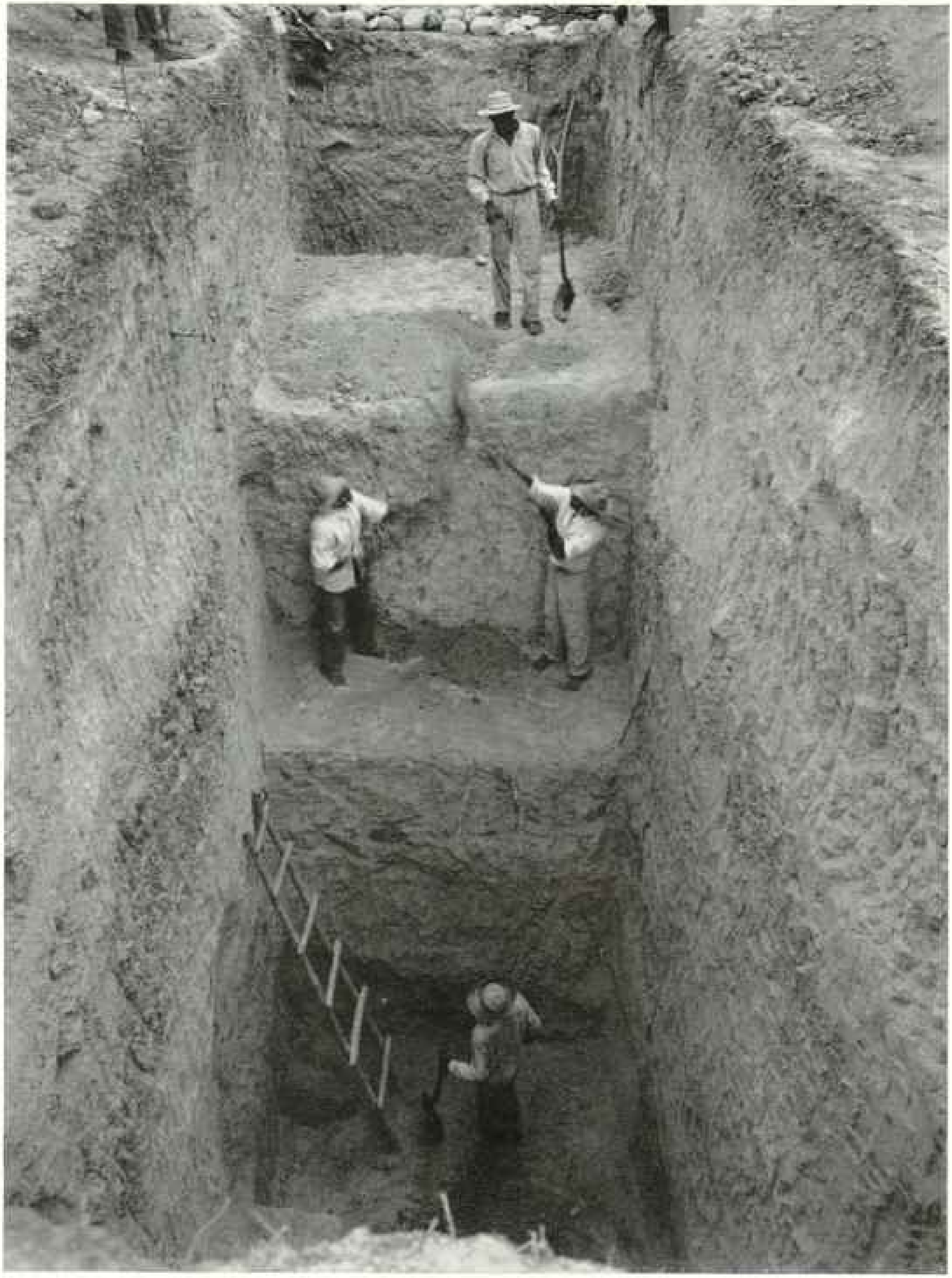
On the day the number of our house "came up," half the townspeople berated themselves for not having thought of such an obvious hunch.

Parita has five schools which reach through the sixth grade. A nurse from Chitré visits the town three times a week to hold a clinic.

Water Hauled from River by Oxcart

Swamps near by are sprayed with DDT in a mosquito control campaign, and outdoor toilets are similarly treated.

Mail arrives and leaves twice a week. In the post office are a telegraph office and a telephone.



Each Shovelful of Earth Brings Science Closer to the Secrets of Aboriginal America

Burial urns and caches of valuables were uncovered at different levels of this 22-foot trench. Here the archeologists dug through 10 mounds grouped crescentlike around a level court. Beautiful pottery was fashioned by Indians who occupied the site before the Spaniards arrived. It was named "El Hatillo" ware, for a near-by ranch.

Huge Painted Urns, Found Deep in Burial Mounds, Reveal Panama's Ancient Funeral Customs

A few miles from Parita the expedition uncovered the first mound-burial site recorded in Panama. To reach the cemetery scientists dug into eight-foot hillocks. There they found dozens of globular bowls containing human bones. Funeral offerings included necklaces of human teeth, pottery in animal shapes, and carved manatee ribs (page 394).

Well water was supposed to be running from a tap at the street corner, but the waterworks had broken down at the time of our arrival; most of the time our water was hauled in drums by oxcart from the river at a cost of 50 cents a barrel (page 379).

Our workmen, incidentally, preferred the richer flavor of the river water and never drank water from the taps if they could help it.

Being accessible by auto, we had many visitors, including Panamanian officials who came to see the archeological finds. Often we did not know whether we were entertaining one of the congressmen of the district or one of our own townspeople until Onarina gave us a biography after the visitor had left.

Any Americans who did not speak Spanish and who passed within 20 miles of Parita were apt to be diverted to us on the assumption that our place must be their objective.

Once, when Marion was working on the never-ending job of cleaning potsherds, a car escorted by a dozen local boys drove into our patio. In it were a bewildered United States Army officer and his wife.

"I haven't the faintest idea why we are here," said the officer. "We came to Parita to see the old church, but it seems as though the whole town insisted on bringing us here—so here we are!"

The situation was soon explained, and we had a most pleasant visit.

Wanted: 30 Pregnant Women

On another occasion we were visited by a group of American doctors from Gorgas Hospital, in Ancon, who were making a series of nutrition studies in the hinterlands of Panama. On leaving us in the evening, they asked if we would kindly round up 25 or 30 pregnant

women and have them on hand the next morning so they could take blood samples.

We thought this seemed a little outside of our archeological program, but we solved the problem by passing it on to our friend the mayor. He immediately sent messengers around with orders. The next morning, when the doctors returned, the 30 women were on hand!

Onarina prepared our meals on the usual *fogón*, a large box partly filled with earth and containing several stones on which the cooking utensils were placed.

Our food was not exotic. Beef was abundant, and hunters brought in venison on the average of once a week. Best were *conejo pintado*, and *paca*, white meat which fried as tender as chicken.

Dr. Wetmore and Mr. Perrygo mystified the townsfolk by never taking along shot heavy enough to kill a deer or conejo. Once in a while they did kill an iguana for their guide. We like iguana well enough when there is no other meat available, but don't consider it a delicacy.

Various boys in town trapped quail and sold them to us for 10 cents each, so we often had quail soup or broiled quail.

White potatoes were expensive. Instead we usually had fried yams.

Only one woman in town could make tortillas. She made them about three-quarters of an inch thick and as heavy as a tire boot, so we were content with rolls.

Oranges, bananas, pineapples, and papayas were plentiful and cheap. We had rice and red beans twice a day. What we didn't eat, Aurora, our handy girl, took home to her three children.

We ate on oilcloth. Marion says she will never again live in a town without having a tablecloth; it adds to prestige.

Marion glued together many of the fine pots that were found in the excavations. In a sand box she let the pieces dry in the proper position. Doña Rosario, a neighbor, remarked that Marion didn't sew or weave—playing with pottery was her work! Sometimes play was the word for it, when the pieces were warped and the pot did not come out even.

Carnival Opens with Water Throwing

We had been settled in Parita only a month when carnival time arrived.

Onarina and Aurora had four new dresses, one for each day of the carnival, big social event of the year (page 392). They must have gone to bed in their clothes, for they always came to work in the much-rumpled party dress.

The first day of the carnival was the wetters' day; children or grownups could throw water on anyone they could catch. We stayed in our own patio most of the day, since we did not care to be baptized.

A *tuna* is a group of serenaders. The tuna from the Calle Arriba, or "Upper Street," arrived first, its leader carrying a huge green banner. Next in line came three drummers, a group of women singing, clapping their hands, and dancing, and some 50 or more followers—men, women, and children.

The leader presented the flag to Marion, and all the men in the group threw their hats at her feet. Twenty or more women formed a circle and a couple started to dance. The women sang and took turns dancing, while the men alternately danced and beat the drums.

Cow Dance "Brings Down the House"

Each of us had to take a turn dancing. They tell me I brought down the house with my version of the *vaca*, or cow, dance. All I was trying to do was to keep out of the way of my partner, who suddenly crouched over and started charging and bucking me with her head.

Pariteños are supposed to excel in the purest form of *tamborito*. The best dancers do not move the body above the hips. The women circle about the men and keep time in a rhythmical, restrained fashion. The instrumental music, of African derivation, is produced by three drums, two of which are vertical and played with the hands; the other is horizontal and is beaten on both heads with sticks.

Dick and Marion permitted themselves to be decorated with straight pins holding a tiny piece of green ribbon. When they asked Onarina what the decoration was for, she informed them they were supposed to give a dollar to the donor on the following day. Unfortunately, neither of them had the slightest idea which of the 70 people had honored them.

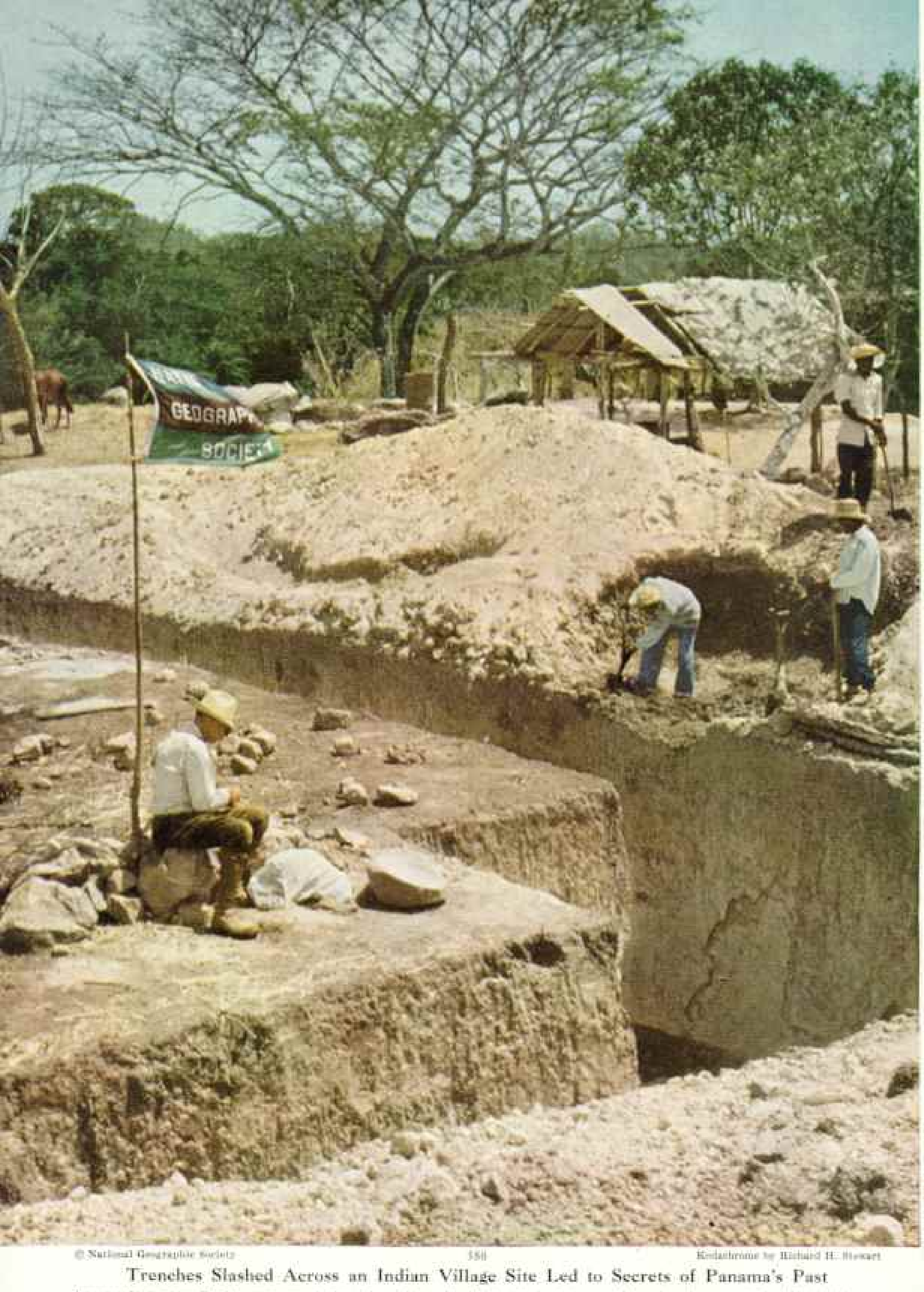
The second day of the carnival we had a visit from the tuna of the Calle Abajo, or "Lower Street," their banner being a bright red flag. On the last day both tunas came by for a final glorious fling. Needless to say, no work was done during the four days the carnival lasted.

The town barber, who lived across the street from us, filled the barber's traditional role as general news source. He rushed over at 7 one morning to tell us we should go to see a wedding party which had just left the church for a bit of breakfast, before starting its long trek homeward.

© National Geographic Society 185 Kodachrome by Richard H. Stewart

Grim Memento of Panama's Savage Days: a Necklace of Human Teeth

Mrs. Matthew W. Stirling, wife of the leader of the National Geographic Society-Smithsonian Institution archeological expedition, displays the 800 teeth, mostly incisors, found buried with a male skeleton.



Trenches Slashed Across an Indian Village Site Led to Secrets of Panama's Past

Excavations near Parita uncovered shoe-shaped tombs 10 to 23 feet deep. One chamber contained 36 skeletons, apparently the remains of Chibchan tribesmen described in Spanish records. Left: Dr. Stirling.

▲ **Ornithologists, Skinning Birds in Camp, Attract a Gallery of Kibitzers**

Dr. Alexander Wetmore (center), Secretary of the Smithsonian Institution, and his assistant, Watson Perrygo, share headquarters with the archeologists. They added 850 birds to the Institution's collection in Washington, D. C.

▼ **Panamanians Wear Real Panama Hats above Embroidered Shirts**

Sombreros de montuno, made of braided palm fibers, adorn these solemn fiesta celebrants at Ocú. Hats commonly known as "panamas" are woven in Ecuador. A full-length portrait would show the man and boys in knee-length shorts.

Kodachrome by Richard H. Stewart

A Cattle Gate Swung Across a Skyline Trail Identifies the Range of Panama's Vanishing Guaymi Indians

Guaymis once inhabited most of Panama west of the Canal Zone; now some 6,000 live in Veraguas, Bocas del Toro, and Chiriqui Provinces. Their gates, straddling ridges, control grazing cattle. Here the author's party is on a six-hour horseback ride to visit the Indians.

Archeologists Burn Brush to Lay Bare an Indian Burial Mound near Parita

On this site Dr. Stirling and his assistants uncovered their first evidence of urn burials in Panama. One urn contained a male skeleton and 800 human teeth (page 385). The teeth may have belonged to the entombed warrior's victims in combat.

Kodachrome by Richard H. Stewart

Kodachrome by Richard H. Stewart

Arms Locked Like Wrestlers', Adobe Builders Work with Feet in Mud

Two villagers knead mud and straw binder until the mass coheres. At intervals they form a large ball and kick it out of the mortar bed. Another worker then carries it to the building site.

↑ Just Married! Beneath Her Satin Gown the Bride Wears Cotton Slacks

After a wedding in the church at Parita, the young woman replaced her veil with a homemade straw hat like the groom's. Then, leading a procession of friends who sang and strummed guitars, the newlyweds rode to their country home.

↓ Panama Styles Range from Town's Lacy Ruffles to Jungle's Jaguar Teeth

A Parita child and her nurse wear the *pollera*, national fiesta costume (page 392). A Guaymi, his face painted for the balsa-throwing contests in Tambor Valley, dresses in quetzal feathers, beaded collar, and hunting-trophy necklace.

Kodachrome by Richard H. Stewart

Happy Smile and Elaborate Costume Proclaim Fiesta Time in Parita

For special occasions this young woman puts on her *pollera*, the costume derived from Spanish colonial gowns. Hair ornaments, quivering on tiny springs, are of fish scales and artificial pearls.

The bride put on a pair of blue cotton slacks so that she could straddle her horse, but left on her white satin gown (page 391). She replaced the long veil with a straw hat. She and the groom led the long procession of relatives and friends who were to ride the 20 miles back into the country, accompanied by guitar music and stopping to have a little wine or chicha with friends along the way.

Dick took pictures of the wedding party, and the grateful groom returned several days later to present him with a fine chicken.

The barber also informed us of our first *junta*, a get-together to build a house. All the men donate their time, and the builder furnishes food and drink. Oxcarts haul water for making adobe.

The men come in spotless clothes, but are soon covered with mud as they mix the clay, straw, and water to the proper consistency with their feet (page 390). Crossing arms over each other's shoulders, they stamp and kick, and finally their busy feet throw up a clod of adobe. This is caught on the fly by a worker, who carries it to the house.

The framework of the dwelling has been prepared by the town carpenter or the owner. Mud is slapped on from inside and outside. More, held together by the straw, is draped over horizontally placed cane or pole supports.

The men grunt a tuneless chant, "Hunh, hunh, ugh, ugh," all the time they are working, and the women keep their spirits well fortified with liquid refreshments.

As usual we went on various side trips to take pictures of fiestas and to see the country. When we showed copies of the NATIONAL GEOGRAPHIC MAGAZINE containing pictures of our Mexican expeditions, one bright-eyed little Indian at Ocú asked if the people in Mexico were as *cariñosa* (lovable) as her people (page 380).

"Yes," we told her, "they too are country people, and are friendly and sincere."

A typical example of the hospitality of the people was our reception in Ocú. We had gone there to take pictures of the fiesta in honor of the town's patron saint (page 387).

Mr. Curtis had told us to be sure to introduce ourselves to Leopoldo Castellera; so we went to his home, which turned out to be three houses. All but two of his 12 children were married, and so many had returned home with their children for the fiesta that there were 40 people for meals. Nevertheless, he and his wife insisted that we join them for lunch and seemed disappointed because we would not stay for supper!

At Ocú we paid a dollar for a ringside seat under the stands to take pictures of the bullfight. In these country bullfights the animal is never killed. Local brave or foolhardy young men play the bull. There were often so many bullfighters in the ring shaking blankets that the poor bull didn't know which way to turn.

Once, at a bullfight in Parita, one of our workmen came over to dedicate his bull to Marion with much formality. All ceremony was quickly forgotten when a brave cow instead of the expected bull entered the ring. Poor Juan was forced to run for his life and climb the fence.

When we broke camp Marion presented Juan with her favorite bright-red Mexican wool blanket, which we hope has brought him luck and has not attracted too many bulls his way.

Shoe-shaped Tomb Deep in Rock

Our archeological work meanwhile was proving extremely productive. During our three months at Parita we excavated four aboriginal sites.

The first of these was about two miles from town. A day's work with our crew of 25 men repaired the oxcart road enough to enable us to reach the spot with our truck. This site, which we designated He-1 (Herrera Province No. 1), held a real surprise in store.

Natives of Parita had led us to the place, a flat elevation high above the river, where the ground was strewn with broken pottery. Not being possessed of X-ray eyes, we decided to dig a long trench (page 386).

Since our main purpose was to determine the period and length of occupation of the site, we dug the trench in one-foot levels, labelling the material from each level separately, according to standard archeological procedure. In this way it is possible to trace changes in artifacts and pottery styles, the most recent material being near the surface and the oldest at the bottom.

We found less than three feet of village refuse on the surface. Underlying this was a solid but soft disintegrating granite base rock.

More to test the nature of the underlying rock than for any other purpose, we continued the trench to a depth of eight feet. Then, surprisingly, the pick of one of the workmen broke through the soft sterile rock into a large pocket of rich brown soil.

This seemingly impossible situation was soon explained when we found we had broken into an earth-filled tomb. Clearing it out, we saw that it had been constructed by digging a circular shaft, about two feet in diameter, through the base rock to a depth of eight feet.

At the base of the shaft a shoe-shaped chamber had been hollowed out. In this had been placed the bodies of two individuals, with offerings consisting of beautifully painted pottery vessels, a large three-legged *metate* (page 375), or grinding stone, several polished stone axes, and a copper chisel.

Continuing to expand and deepen our trench, we encountered many such tombs, all constructed in the same manner. The largest of these reached a depth of 14 feet and contained the bodies of 32 persons.

Most of the pottery vessels and other objects we recovered from He-1 proved to be very similar in type to the pottery and artifacts found at the famous Sitio Conte, type site for the Coclé culture. The tombs at He-1, however, are of a quite different type.

The site was probably occupied only a short time before the arrival of the Spaniards at the beginning of the 16th century. The pottery from this period is some of the most artistic and pleasing that was ever produced by pre-Columbian Indians.

When we felt we had completed a fair sampling of He-1, we moved to a similar site a mile distant. This, we found by excavation, belonged to the same period.

Earth Mound Covers Numerous Tombs

Finally, four or five miles from Parita, we discovered a site with a very different appearance. This site, He-4, was at the base of an isolated hill almost two miles from the present course of the river. It consisted of a group of 10 earth mounds arranged in the form of a crescent around a level court.

This was of great interest to us, since never before had mounds been reported from Panama. It was here that most of our excavations were conducted (page 389).

The first mound into which we dug was a large flat-topped structure about eight feet in height. To our surprise, our trench did not reach base level at eight feet, but continued through a succession of clay floors to a depth of 22 feet. It was a most complicated structure, and beneath the mound proper a number of tombs had been excavated (page 382).

The pottery here was of a different type from the typical Coclé ware. In one large painted bowl we found the remains of a young child with a necklace of hollow gold beads and other beads of greenstone. There were also several animal effigies made from shell.

The next mound was entirely different. Near its center, and not more than two feet below the surface, was a cache of 40 painted pots in the form of bird effigies and a number of long-necked bottles. Just below these were some exquisitely carved batons in the form of stylized alligators made from manatee ribs.

Still lower, at the base of the mound, were many urn burials. The large globular urns were covered by lids with crisscross handles, and each contained the bones of from one to four individuals (page 383).

Necklace of 800 Human Teeth

In one urn, containing the remains of a single adult male, we found a necklace made of approximately 800 perforated human teeth! Most of these were the front incisors. More than 200 individuals must have been required to make up this necklace (page 385).

Still another mound contained only offerings of ceremonial pottery vessels in astonishing quantities. Most of these vessels were mounted on tall pedestal bases and were of two types. One type consisted of a painted globular bowl and the other of a bowl forming the effigy of a brightly painted king vulture with outspread wings.

Other vessel forms, such as frogs, alligators, whippoorwills, and more conventional shapes, such as platters and bowls, were also represented in lesser numbers (page 376).

The pottery from this amazing mound forms the nucleus for a new type of aboriginal ware which we have termed "El Hatillo" ware, after the name of a near-by ranch.

In another mound at this site we found again the practice of excavating tombs beneath and in the mound itself. Here the favorite offering consisted of large quantities, sometimes more than 100, of almost identical red-painted globular jars with short necks.

In this mound, too, we found more of the carved manatee ribs; one burial with a half-dozen gold disks the size of 50-cent pieces; some burials with gold-plated animal and bird effigies; and the most beautiful examples of polychrome El Hatillo ware that we recovered.

By far the largest quantity of material excavated by the expedition came from the El Hatillo site, and because it represents a new culture we are looking forward eagerly to further study of it.

Oldest Panamanian Site Yet Known

The final site which we worked, while not so spectacular, was in many respects the most important of all. This was a shell mound near the mouth of the Parita River, not far from the town of Monagrillo.

Here on a desolate salt flat is a pile of village refuse and shell about 200 yards long and 50 yards wide, marking the site of an ancient group who subsisted principally from the sea. When the site was occupied, what

is now a dry flat most of the year must have been water deep enough to support shellfish and crustaceans (page 378).

On excavation we found that the site had been occupied for a time and then long abandoned; a layer of sand covered the village debris. Then the site was reoccupied for a longer period, and finally abandoned, probably more than a thousand years ago.

The pottery used by these ancient inhabitants bears no resemblance whatever to that from the known mainland sites and is of a primitive type. It is unpainted, and decorated only by simple incisions and punctate designs reminiscent of the earliest pottery types known from other parts of the New World, such as Peru and Mexico. The Monagrillo site represents by far the oldest human occupation yet reported from Panama.

Survivors of Looted Tribes Fear Whites

In the high mountains of the central part of the Isthmus, west of the Azuero Peninsula, live the Southern Guaymi Indians. These are the present-day survivors of the gold-rich tribes who so valiantly resisted the encroachment of the Spaniards in the 16th century. Their justly acquired suspicion toward strangers has not yet disappeared.

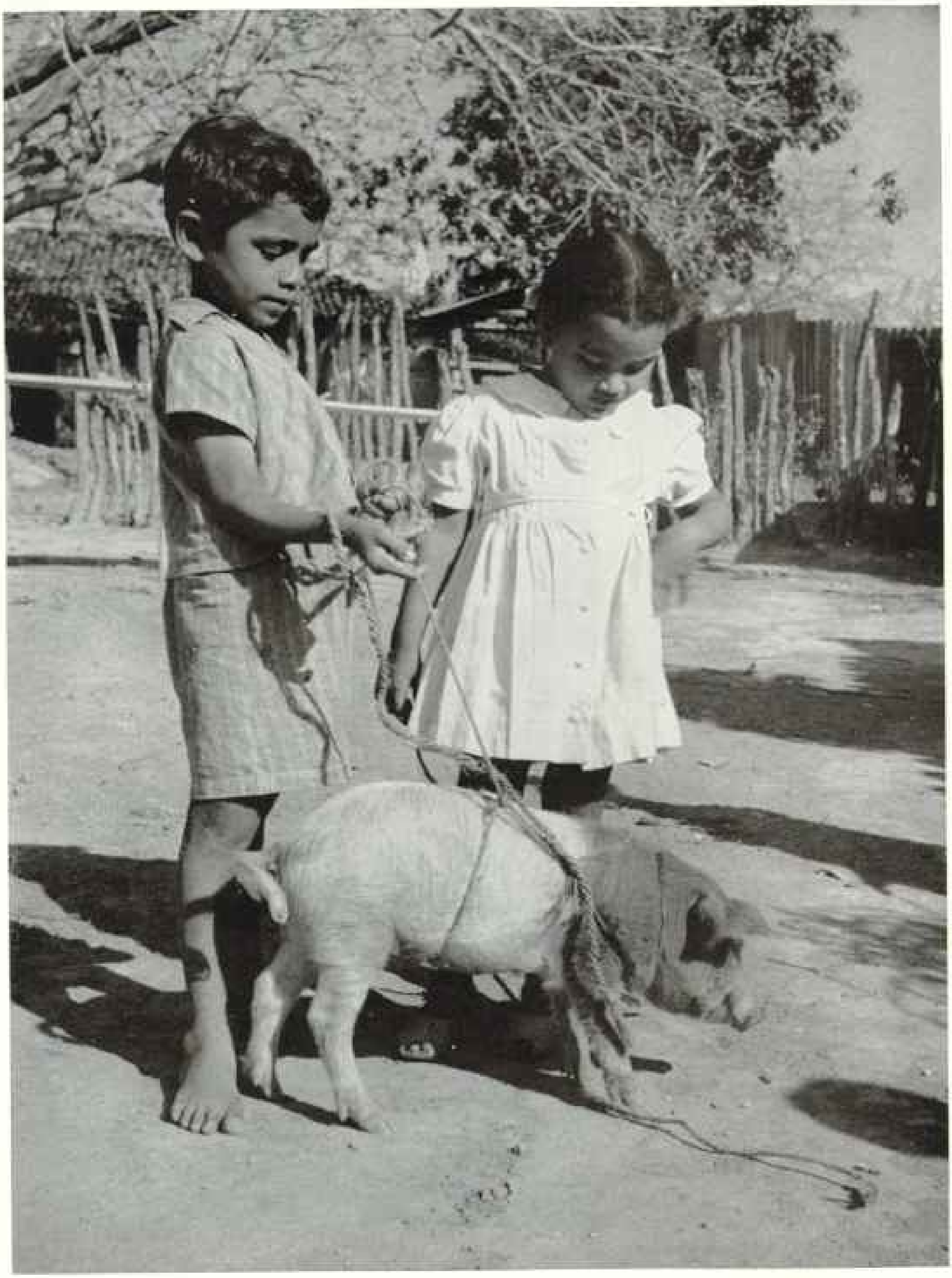
This hostile attitude is not so much due to any dislike of strangers, as such, as it is to a fear that the stranger may be interested in some activity, such as mining or lumbering, that might result in white encroachment on Guaymi territory.

To the present day these Indians sometimes place concealed set weapons—bows and arrows or guns—along the trails where the unwary traveler will step into a string and discharge them.

The ethnology of these Indians is imperfectly known. They are seldom visited, and descriptions by early travelers are brief and inadequate. Only

Dr. Wetmore Studies a Masked Duck's Air Sac

With a blowpipe the Smithsonian Institution ornithologist inflates the throat membranes of *Oxyura dominica*, a species found throughout tropical America. The sac, resembling a blob of bubble gum, is blown up by the bird during courtship. To obtain this specimen for anatomical study, Dr. Wetmore waded hip-deep in a lagoon.



"Who Needs Toys?" A Pet Pig on a Leash Makes a Portrait of Dejection

As the archeologists packed up to leave Parita, townsfolk swarmed to expedition headquarters with their babies. "Take a picture, please," they asked photographer Stewart. But these two youngsters presented their favorite porker, whose woebegone manner seems to reflect the knowledge that soon he will be pork chops.

one modern ethnographer has studied them. They live primarily by hunting and farming, their principal crops at present being corn, beans, manioc, and bananas.

Most of the scattered Guaymí houses are built on a ridge or mountain top commanding a magnificent panorama, even though living on such a site entails the penalty of carrying water up a steep trail from the nearest stream far below.

One Guaymí to whom I mentioned this disadvantage stated that the drawback was more imaginary than real, since the women carried all the water anyway!

This practice of building on mountain tops is probably a survival from earlier and more warlike days, when a good lookout was essential and such a position was favorable for defense.

Each year, usually in March, when the clearing and planting have been completed, the Guaymí hold their principal ceremony, known by the Spanish name of *balseria*. We determined to see one if possible.

Although our archeological camp near the coast was not a great distance from the Guaymí country, we could not find a single person who had witnessed the ceremony.

The difficulties are not confined to reaching the remote locality where the event is held. The location and date of the ceremony are changed every year, and the Indians try to keep this information from outsiders. The day decided upon is made known to the widespread Guaymí groups by means of knots tied in reeds along the trails.

Tolé, a mountain village, is the nearest Panamanian town to the Southern Guaymí territory. Our friend the mayor of Parita communicated with Tolé for us, and finally learned at the last minute that a three-day period in late March had been definitely set for a big balseria.

Accompanied by Mr. Max Arosemena, former Panamanian Minister of Education, and Dr. Alejandro Mendez, who were visiting us at the time, we left Parita in our truck and reached Tolé over a rough road well after dark. Town officials received us with wonderful hospitality, had a fine meal prepared, and permitted us to spread our blankets in the schoolhouse, where we spent the night.

By Horseback into the Guaymí Country

With a guide, Pablo, who spoke the Guaymí language, we left on horseback the next day for a locality known as Tambor, where the balseria was to be held (page 388).

Leaving Tolé, we rode across a plateau and down a steep and narrow trail into a deep canyon. There we crossed a rushing, boulder-strewn river, then climbed an atrociously steep and winding trail onto another plateau.

In places this trail, worn by the hoofs of horses and mules and the downpours of the rainy season, had eroded to a depth of 25 or 30 feet, although not more than three feet wide.

So narrow were some of these slots that we had to readjust our packs to enable our horses to pass through.

After five hours of up and down riding, we came to the edge of a plateau and suddenly our objective lay before us.

In the bottom of a bowl in the mountains, several hundred feet below us, was a partly cleared area within a bend of the Tabasará River.

There the balseria was in full swing. Before starting the steep descent we paused for 10 minutes to drink in this bird's-eye view of the wild scene beneath us.

Like Times Square at New Year's

At this distance the most impressive and surprising feature was the sound. Intermingled with the incessant shouting of some 2,000 Indians were mechanical noises that sounded to us like the blaring of hundreds of automobile horns and discordant musical instruments.

The sun was just setting, and as this incredible medley of sound rose to us on the evening air, Marion said, "Why it's just like Times Square at midnight on New Year's Eve!" And so it was.

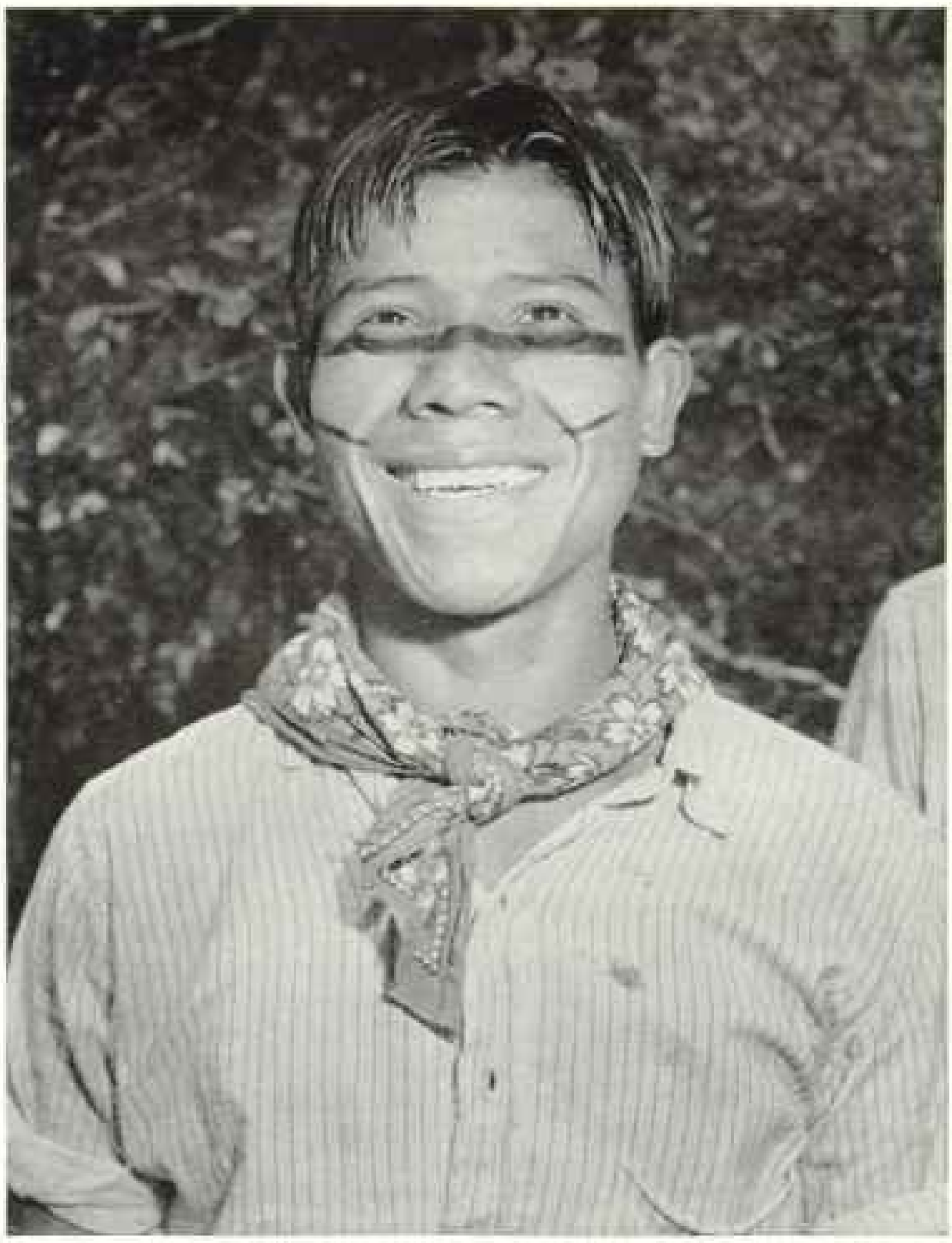
By the time our horses had scrambled to the level of the river, it was dusk.

Before reaching the scene we still had to cross the torrential Tabasará. Our guide selected a wide spot above a rushing white-water rapid, and through the swift current our horses slowly groped their way, more than belly deep, amid the big boulders which formed the stream bed. Zigzagging back and forth, we finally reached the other side.

As we rode up a steep slope to the clearing the wild scene of the balseria met our eyes at close range. The 2,000 participants were so absorbed in their activities that they paid little attention to us.

After Pablo had tied our horses in a patch of woods, he introduced us to the chief of the host tribe. A handsome broad-shouldered man, he greeted us with considerable dignity, even though slightly drunk.

Leading us across the clearing through the milling contestants, the chief introduced us to each of his three principal wives. Each had her own little stockade, and with each we were obliged to drink a large gourd full of chicha.



With Painted Face and Pointed Teeth, He's Ready for an Indian Festival

The author journeyed on horseback into central Panama's mountains, near Tolé, to see isolated Guaymís like this boy, crack each other's shins in a *balseria*, or balsa-throwing contest. Along their trails the Indians sometimes conceal set weapons to be discharged by unwary travelers.

potent variety made from the sap of a tree. It tasted like turpentine and was also used as an embalming fluid!

With social formalities over, we were released to our own devices. It was now night, but the festivities continued in full swing under the bright moon. When we finally made camp by the river, all night long the din of the ceremony rolled down on us from half a mile away.

Sleep and privacy being almost impossible, we were up at daybreak and returned to the clearing, where Dick in particular spent a strenuous day photographing this three-ring circus.

Men, women, and children all had their faces painted with red, white, and black geometric designs.

The women wore large Mother Hubbard dresses, with full skirts hanging loose from a tight yoke at the neck. The men wore tall feather headdresses of iridescent green quetzal tail feathers or the bright red, blue, or yellow feathers of the macaw. In lieu of feathers, some used thick clusters of porcupine quills.

In former times these decorations were worn on a circlet around the head. Now they are attached to the bands of hats woven by the Indians, but patterned after those worn by the people of the coast (page 391).

The chief, although already well supplied, drank heartily with us on each occasion.

Pablo told Marion that this chief had ten wives. She remarked that he must be pretty rich to afford so many women.

"On the contrary, Señora," replied Pablo, "his wives make him rich as they work his fields."

The strongest variety of chicha, and that which is usually drunk at ceremonies, is made of corn masticated by the women and spat into large containers, where it is allowed to ferment for several days. Chicha is also made from various fruits and vegetables. The 16th-century Spaniards described one particularly

Men Wear Stuffed Animal Skins

Many of the men wore the stuffed skins of animals on their backs. These hung with the tail downward, head at the nape of the neck, and paws at the shoulders. Most commonly used were the skins of jaguars, ocelots, pumas, or monkeys. The animal often had a bell

attached to the tip of the tail, and this rang as the wearer leaped about in the antics of the balseria. Many men wore handsome broad collars fashioned from bright-colored glass beads.

The men's blue dungarees were appliquéd down the sides of the legs with colored geometric designs. Pablo pointed out that many new dungarees had big square patches sewed over the knees. This, he explained, was in imitation of similar patches seen on the clothes of poor Panamanians of the coast.

Most of the men had their teeth decorated by chipping. Two styles were in vogue. Sometimes the front teeth were all chipped from the sides so that they came to a sharp point. Others had two deep notches in each tooth, producing a serrated effect with three points on each tooth. This custom was evidently introduced long ago by Negroes from Africa.

The Indians who live on the side of the mountain where the ceremony is held act as hosts to the group which comes from the opposite side. The host group furnishes the necessary food, and unlimited quantities of chicha.

Each family attending the balseria builds fires, around which its members eat and sleep. If there are small children or babies in the family, a small stockade is made of cut branches to keep night prowlers from stepping on the sleeping women and children.

Poles Hurled at Opponents' Shins

The ceremony consists of a series of contests, including innumerable fist fights, and the balsa-throwing game from which the ceremony derives its name. The contestants represent one of two groups, the hosts or the visitors.

The first day is spent in purely social activities, as the Indians gather and set up their little camps. The ceremony itself starts at sunrise next day.

In the clearing a rack is erected and on this are neatly piled 50 or more poles of light balsa wood, six or seven feet long and about four inches in diameter. After appropriate speeches, the poles are distributed and the men divide themselves into opposing teams of three or four men to a side.

From a distance of 10 or 12 feet the leader of one group then throws the pole, end first, as hard as he can at the shins of one of the members of the other group. The defending team retrieves the pole and it is their turn to be the aggressors.

This continues for 24 hours, as many as 20 or 25 teams contesting simultaneously in the midst of a milling crowd of spectators who must be alert to dodge the flying poles.

Most of the spectators, who kept incessantly in motion, carried noise-making devices. Trumpets made from large marine conch shells or from the horns of longhorned cattle produced the effects that from a distance had sounded to us like auto horns. Some celebrants had whistles, flutes, or ocarinas made from pottery, wax, or hollow reeds. Still others had turtle-shell rattles, wooden rasps, or metal bells. To the din thus produced was added the incessant shouting or chanting of all.

Wives at Stake in Bloody Fights

The fist fights, we learned, were usually fought for one another's wives. One man would challenge another of the opposite group and, stripping to the waist, the pair would begin the fight without ceremony, although a crowd would soon collect and form a ring around them. The wives who were the stakes usually abandoned womanly reserve and crowded in closely to watch.

Vicious affairs, the fights continue until one man is beaten helpless. Sportsmanlike rules appear to be observed, only the fists being used for striking. Hair pulling is permitted and the contestants continue fighting on the ground when knocked or pulled off their feet.

Several times we saw a challenge refused when the challenger, made optimistic by chicha, was obviously too drunk to fight effectively.

For trading we had brought some lipsticks, fish hooks, dress material, and pocket mirrors; but cigarettes seemed the only commodity the Indians really wanted.

In this connection I learned an early lesson. As a treat for myself I had brought a few of my favorite cigars. A Guaymi to whom we had just presented a cigarette asked me for a light. I handed him my freshly lighted cigar. The Guaymi promptly pocketed the cigarette, stuck the cigar in his mouth, and went happily on his way.

By early afternoon the effects of the chicha were well advanced. Groups of women gathered here and there in lines, holding hands, swaying on their feet, and wearing the most serious expressions as they went through a measured dance. The friendliness of the men by this time was growing a bit oppressive to us, since we were outnumbered several hundred to one and all seemed bent on showing their regard.

Rounding up our horses, we left the wild scene and took the long but quiet trail back to Tolé.

National Geographic Photographer John E. Fletcher

In a Baltimore Plant, Spices Lend Their Aromatic Flavor to Big Business

Executive offices of McCormick and Company, Inc., world's largest spice and extract house, are a replica of an old English village. Hostesses in Elizabethan costume usher visitors to "Ye Olde McCormick Tea House," where they enjoy refreshments and savor the scent of seasonings wafted from other floors. For blocks around the building on Baltimore's water front the air is redolent of spices (page 406).

Spices, the Essence of Geography

By Stuart E. Jones

LIGHT in weight but heavy with history—these are the spices.

To acquire them today is prosaic. The housewife trundles her wheeled basket through the aisles of her favorite market and selects a package of pepper from India, ginger from Jamaica, or cloves from Zanzibar as casually as she would a bag of flour from Minneapolis.

A few centuries ago, these fragrant, palate-tingling seeds, buds, leaves, roots, berries, and bits of bark lured men into perilous adventures and helped to build empires. Nations and cities blossomed under their influence. Churches and palaces were built, the arts flourished, blood was shed in remote parts of the earth—largely because of spices.

Columbus sought spices, among other things, but discovered the Western Hemisphere instead. After him came Vasco da Gama and a long line of Portuguese, Dutch, and English adventurers whose quests for these precious auxiliary foods opened up the whole world for exploration and trade.

Spiees a Spur to Exploration

Early search for spices was avid because in the days before refrigeration they helped preserve food. Also, they were used to make incense, embalming preparations, perfumes, and ointments long before bathtubs came into vogue.

Our word "spice" comes from the French *épice*, which in turn stems from the Latin *species*, meaning "sort" or "kind." The fact that the French grocer still calls his shop an *épicerie* is not surprising, in view of Gallic reverence for good foods and the part spices play in their preparation.

The word "grocer," too, can be traced to the spice trade. One of the earliest of the city guilds in medieval England was the Pepperers, first heard of in 1180. In 1345 this guild was succeeded by a group which later became the Grocers' Company. The term "grocer" was used to distinguish these men, who bought and sold in "gross" (large) quantities, from those engaged in retail trade.

Over the years since the early voyages of exploration the flow of spices from land of origin to market place increased, so that today, in normal times, they are cheap and plentiful.

Virtually every country contributes some spices; more than half of America's supplies normally come from the East Indies, the Malay Peninsula, China, French Indochina, and Japan. These countries furnish such staples as pepper, cassia or cinnamon, nutmeg, mace, and turmeric.

From Europe and Africa come about 25 percent, including caraway, coriander, cumin, poppy seed, ginger, laurel leaves, sage, and thyme. Other sources are the British West Indies, where nutmeg, mace, ginger, and allspice are grown, and India, which now sends us most of our pepper.

Views of an Expert "Spice Taster"

Very early in my spice assignment I became confused by the overlapping and complicated terminology of the spice trade. Exactly what are spices? How do they differ from herbs?

I took these questions to Crosby Gaige, of New York City, who serves as adviser on flavor to the American Spice Trade Association.

"'Seasoning' is a comprehensive term applied to any ingredient that enhances the flavor of food," Mr. Gaige explained. "In my opinion, the word 'spice' or 'spices' should be limited to aromatic substances, mainly of tropical vegetable origin, that make dumb dishes eloquent.

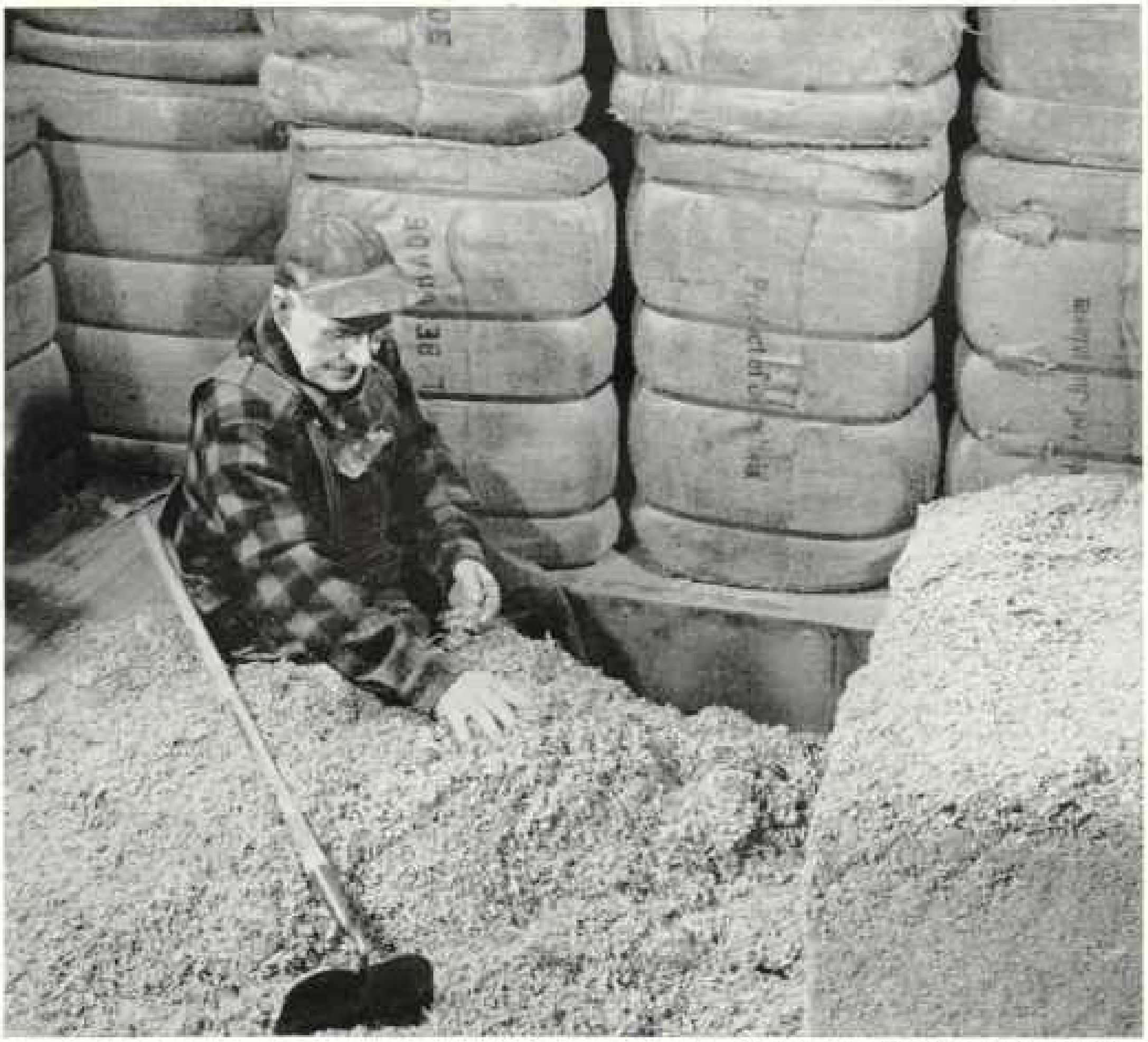
"I would list as spices proper: allspice, cassia, cassia buds, cinnamon, clove, ginger, mace, nutmeg, pepper, and perhaps turmeric. As a subdivision, we may name here derivatives of the *Capsicum* family, the red peppers. These would include cayenne pepper, paprika, and chili pepper" (page 406).

In addition to these true spices, Mr. Gaige continued, there is the category of aromatic seeds. These he listed as anise, cardamom, caraway, celery, cumin, coriander, dill, fennel, fenugreek, mustard, and poppy.

"Under my classification," Mr. Gaige pointed out, "mustard is an aromatic seed, whereas in the spice trade it is generally called a spice.

"And in a bracket by themselves I would put the various flavoring salts—onion, garlic, celery, and a combination generally known as 'seasoning salt,' which is an all-purpose mixture of ground spices, herbs, salt, and hydrolyzed proteins."

Mr. Gaige then turned to the enormous number of culinary herbs. He grows many in the garden of his Westchester County home. Among those in common use are bay leaves, basil, chervil, celery leaves, fennel leaves, horse-radish, oregano, parsley, the mints, marjoram, rosemary, sage, summer savory, winter savory, saffron, sassafras (the dried leaves are called *filé* in Creole cooking), thyme, and tarragon.



National Geographic Photographer John E. Fletcher

Sage Comes from the Dalmatian Coast—Sometimes with Horseshoes or Lead Pipe!

An inspector at the D. & L. Slade Company, Boston, checks a shipment just received from mountain farms along the Adriatic. To avoid ruining machines, grinders screen sage carefully (page 409). Dalmatian coast sage continues to reach United States importers for flavoring meats and drugs.

"A fourth class of flavoring agents may be considered as condiments. 'Condiment,' from the Latin *condire*, to pickle, is a term applied loosely to any kind of seasoning. It would avoid confusion if it became restricted to certain mixtures such as the catsups, chili sauce, curry powder, chili powder, chutney, prepared mustards, tabasco sauce, bottled horse-radish, and such sauces as Worcestershire, A. 1., and Angostura bitters."

Wars Affect World's Spice Shakers

Mr. Gaige paused for breath.

"There is still another member of the vegetable kingdom that is used both as a flavoring agent and as a food, and that is the onion family. This includes chives, shallots, and garlic. This family is essential as a seasoner."

Political and economic upheavals in the growing areas throw the spice industry off balance. World War II had almost catastrophic effects. Even today importers and grinders have not fully recovered.

Almost three-quarters of our tonnage came from enemy-occupied countries or war zones. Fortunately, big stockpiles of spices were on hand. These included enough pepper for three years, cinnamon or cassia for nine months, and a year's supply of other important spices. Just before the conflict the spice market hit a low. Stocks were accumulated in expectation of a price rise, as well as in anticipation of war.

All through the war many people were unaware of spice scarcity. Of pepper, for instance, the average family uses only 7.1 ounces per

National Geographic Photographer B. Anthony Stewart

London Spice Brokers Haggle Amicably Over a Fragrant Bouquet from Tropic Lands

Three men (right) examine cinnamon quills from Ceylon. On the table are similar bundles of cinnamon, Capsicums, mace, cassia, ginger, cloves, nutmegs, and black and white pepper. After 150 years of supremacy, London yielded control of the spice trade to the United States in 1937 (page 410).

Netherlands Indies Information Service

White Pepper Is a Specialty of Bangka Island, in War-torn Indonesia

Into baskets these Chinese workmen pour berries after removal of black outer hulls by soaking and rubbing. Less pungent than black pepper from the same vine, white pepper is used when dark specks are undesirable. Some cooks prefer its mild flavor. Other sources are Sarawak, Siam, and India.

Publicity Associates, Inc.

Cardamom Gives Oriental Pungency to Foods, Perfumes, and Medicines

Here an Indian woman places a tray of green pods on a bleaching-cabin rack to absorb sulphur smoke. Each capsule contains several tiny seeds. Cardamom, used widely in sausage and pickles, is one of the most expensive spices.

National Geographic Photographer John E. Fletcher

In George Washington's Day, Spice Grinding Was a Household Chore

The young lady demonstrates a simple but efficient kitchen mill in Ford Mansion, Morristown, New Jersey, where the General made his headquarters for seven months. Such mills once were found in almost every home.

Rudolph Balogh

From Hungarian Farms Comes Vitamin-rich Paprika to Add Zest and Color to the World's Foods

These women sort dried Capsicum pods, or red peppers, near Szeged. Grinding produces the sweet, mildly pungent spice with numerous uses. Hungarian grades range in flavor from "delicate noble-sweet" to "hot." Spain is another important source. In the United States, where mild types are preferred, paprika output is increasing.

year. Getting along with a fraction of that was a minor wartime annoyance.

There was little need for such spices as cinnamon, cloves, nutmeg, and allspice, since most recipes requiring them also demanded even scarcer sugar and shortening.

Hardest hit when the Japanese overran the Far Eastern spice-growing areas were the meat-packing, baking, and canning industries. Most substitutes fell short of pleasing gourmets.

Synthetic Pepper a Result of War

Normal American consumption of pepper ranges from 30,000,000 to 40,000,000 pounds per year. As soon as the shortage became apparent, the Government froze all stocks and ultimately cut consumption to 25 percent of that amount.

Housewives became familiar, in wartime, with synthetic pepper. This was made from a cereal base with a number of other ingredients, sometimes including a dash of genuine pepper. The imitation lacked the flavor of true pepper and sold for three or four times as much as the real East Indian spice. Also, it was vulnerable to attack by insects, while real pepper is not.

Another source which made up a small part of our pepper deficit was the Malabar Coast of India. Though the Indians themselves consume vast quantities of pepper, the Malabar crop usually is so large that the rest of the world gets some (page 414).

Time must pass before pepper production comes back to normal. In areas occupied by the Japanese, vines were left uncultivated and vanished into tangled jungle undergrowth. Large pepper acreages were plowed up by the Japanese to raise other crops.

Black and White from Same Berry

Salvaging the vines and re-establishing the pepper industry is a slow, painstaking process. Wild pepper vines, when left unattended, grow to some 20 feet; cultivated ones are cut to about half that height, with better yields. Berries turn from green to red. After they are dried by sun or fire, they become black, wrinkled peppercorns, like BB shot. Then they are ready for export and grinding.

Most pepper used in this country is black. White pepper comes from the same berry, but has its outer shell removed before grinding. White pepper, slightly less pungent than black, is used in mayonnaise and other preparations where dark specks are undesirable (page 403).

Red pepper is not a relative of black, or *Piper nigrum*, but is produced by grinding the dried podded fruits of the genus *Capsicum*. This shrub originated in Central and South America, but now grows in virtually all warmer climes. The small, very acrid peppers known as chilies are used whole for pickling purposes or are ground to make cayenne pepper.

The most fiery types of red peppers grow in British Africa and are known as Mombasa, Sierra Leone, or Zanzibar chilies. Most varieties used by the American spice trade are produced in Louisiana, South Carolina, Mississippi, California, Texas, Washington, Florida, and Mexico. A super-hot variety, apt to blister the tongue if used too freely, is the tabasco, from which the famous sauce is made.

A popular product of red pepper is paprika, made from the mildest type of the *Capsicum* family. For some varieties, stems, seeds, and inside veins are removed; for others, the whole pods are ground. The best types come from Hungary and Spain; other producers are Portugal, Bulgaria, Yugoslavia, Chile, and Algeria. Domestic production is increasing, notably in Washington, Louisiana, South Carolina, and Florida.

Besides adding an appetizing red color to foods, paprika imparts a mild, pleasing flavor. Prof. Albert von Szent-Györgyi, of the University of Szeged, Hungary, won the 1937 Nobel prize in medicine for discovering that paprika was rich in vitamin C.

Paprika Turns Canaries Red

Fed to canary birds, paprika turns their plumage red. It improves the coloration of hatchery-reared trout. Paprika is also called "pimiento"—not to be confused with "pimento," another name for allspice (page 420).

One large spice firm, R. T. French Company, of Rochester, New York, is a large supplier of birdseed. Canary fanciers who tire of the standard yellow are urged by French to add a little paprika to the birds' diet. Soon they may be surprised to have red pets!

Spices are again available, though importers worry about the effects of unrest in Indonesia. Daily buying orders flashed by cable or radio from American importers to their agents in trading centers set in motion a complex, far-flung system linking everyone's dinner table with men and women toiling in fields and jungles thousands of miles away.

My exploration of the spice industry began in Baltimore. Hard by the Patapsco River stands the square, many-windowed concrete home of McCormick and Company, the world's largest spice and extract house (page 400). The building's eastern windows look across the cobbled expanse of Light Street and down

Bettmann Archive

To Ward Off Cholera, She Goes Forth All Wrapped Up in Spices

With this fantastic creation an artist lampooned the superstitions which arose during a 19th-century epidemic in Vienna. To chase away evil winds the woman wears a windmill on her hat. Bottles of chloride of lime dangle from her umbrella, and bags of aromatic herbs adorn her skirt. Earring pendants are garlic bulbs. Shoes are of massive size, to prevent infection from the street. Her dog, similarly outfitted, carries a placard with an inscription translated as "Nothing to fear now."

upon the docks of the Chesapeake Bay ferry and steamer lines. Farther east lie historic Fort McHenry and mile after mile of piers where ships unload the exotic grist for McCormick's mills.

McCormick's "flavors" the air with an aroma that has delighted Baltimoreans for years. Since the harbor's waters lap at pilings only a nutmeg toss from the firm's front door, the tantalizing spice smell blends with that of engine-room oil, cordage, tar, and paint. A whiff of this potpourri conjures up visions of Oriental bazaars, swaying palms, steaming jungles, and long voyages.

Offices Under Thatched Roofs

Visitors to the plant are ushered first to the seventh floor, where the executive offices reproduce an English village with half-timbered walls, thatched roofs, and leaded-glass windows. This décor is a reminder that the company imports teas as well as spices.

Charles Allmon

The Aroma of Vanilla Grown on Tahiti Is More Valuable than Its Flavor

Industrious Chinese planters, like this man sorting cigar-shaped pods, raise most vanilla in the Society Islands. Warm Pacific breezes carry the heliotrope scent of drying beans hundreds of yards. Chief use for Tahiti's vanilla is in perfumes. Mexico and Madagascar produce the varieties most highly esteemed for flavoring.

Swift & Co.

To Give the Ball Park "Hot Dog" Its Appetizing Bite, Meat Packers Use Spices by the Ton

In Swift's Chicago plant, high-speed knives chop a sausage mixture in a revolving bowl. Pork (left) is ready to be added. White pepper, coriander, sage, and nutmeg season many sausages. Some packers devise their own secret meat formulas; others retain outside specialists. The meat, canning, and baking industries are the largest consumers of spices (page 414).

Pretty girls in Elizabethan gowns make the stranger comfortable in "Ye Olde McCormick Tea House," where, sipping tea and enjoying the perfume of spices, he awaits his appointment.

My tour of the plant started in a vast loft where spices are stacked high in the burlap sacks and woven bales in which they arrive from far-off lands. First, samples are drawn and sent to the laboratory for analysis. While awaiting the chemists' report, the spices are stored. Some require refrigeration.

If approved by the laboratory, the spices go to the cleaning machinery for removal of the "six little stowaways"—dust, dirt, stones, fiber, strings, and metal. Vacuum cleaning, air blast, screening, sifting, and magnetization all play parts in this process.

"You'd be surprised at what turns up," my guide told me as we watched the cleaning machinery at work. "Take sage, for example. The best comes from the Dalmatian coast, and the growers there sell it by weight. They have been known to slip a big rock or chunk of iron into a bag" (page 402).

Precious Oils Must Be Saved

In the loft, before grinding, each type of spice is fed into large mills, some water-cooled, specially constructed to minimize the loss of flavor-bearing volatile oils. Some spices referred to as "ground" are actually cut into tiny particles by whirling steel blades.

After the first milling process, long chutes funnel the spices to secondary mills on the floor below. There they are pulverized to proper fineness. Silk-mesh sieves, some with as many as 10,000 openings to the square inch, reduce the ground products to a smooth, soft powder which will mix readily with other ingredients.

Spices vary in oil and moisture content, so

National Geographic Photographer John E. Fletcher

Strife in Faraway Lands Affects Trading in New York's Pepper Futures Market

Shouting, gesturing brokers crowd around a brass ring to buy black pepper for later delivery to spice-grinding firms. A clerk in a pulpit (left) records transactions and rings a bell for opening and closing. In the past century prices have ranged from 4 to 80 cents a pound. Early in 1949 buyers hoped for a good Indian crop and awaited the outcome of warfare in Indonesia. Until 1936 London's Mincing Lane was the pepper-trading capital. Then a scandal sent two speculators to jail. A year later the world's largest pepper exchange opened in New York.

they must be milled in different types of machines to attain the desired texture and still retain strength and flavor.

Each cutting, crushing, and grinding machine is equipped with an automatic feeding device. The many wheels and arms spin, thrust, and rock in a slow, stately rhythm.

A third laboratory check follows the grinding and sifting, and then the spices are transferred in large hoppers to the automatic packaging machines on a still lower floor. Here, under supervision of neatly uniformed women, nimble metal fingers tuck the spices into small boxes and cans.

A Final Touch Kills Bacteria

On conveyor belts the containers move in a grave, never-ending procession to a room where they are packed into cartons for shipment. Sterilizers, which kill bacteria, give a final touch.

The McCormick process is duplicated, in its essentials, in dozens of plants throughout the United States. Oldest is the "spice mill on the marsh," a New England landmark since colonial days. Originally a gristmill, this plant was erected in 1734 on Rumney Marsh, near Boston. The colonists threw a dam across Mill Creek and diverted tidal waters into a sluiceway to provide power.

For many years the mill was operated as a community project, grinding the grain brought in from farms. In 1827 Henry Slade acquired a share in the property, and under him the mill began to grind snuff, too.

In those days the mill was a sort of clearinghouse, where the farmer transacted much of his business. When his grain was ground, he paid for the service with the miller's "dole" —a percentage of the meal. The miller often traded tobacco, wool, and other commodities for the farmer's corn.

In 1837 two of Henry Slade's sons, David and Levi, conceived the idea of grinding spices in the mill. Until then spices had been sold to the housewife whole, and each kitchen had its own hand grinder (page 404). Peppercorns were ground on the table in casters with a little crank on the top—a practice followed by many persons even today.

A New Industry Is Born

David and Levi Slade ground up half a barrel of cinnamon, slung it between two poles, and trudged off across the marshes to Boston. There they sold their cinnamon to local grocers, and a new industry—spice grinding—was born.

Thus also was born the D. & L. Slade Company, whose trademark adorns containers of every known spice, condiment, and extract bought today by thousands of New England housewives. David Slade's grandsons carry on the business (page 402).

No longer, however, does the "spice mill on the marsh" depend upon the rise and fall of Mill Creek's tides. Some of the old water-powered machinery is still there, but beside it stands electrically driven equipment.

The charter granting the Slade mill exclusive rights to Mill Creek power provided —and still does—that the mill must at all times be ready to grind grain for any citizen of Chelsea, provided only that the grain was raised in Chelsea.

Carefully preserved is one old grinding wheel, a round stone that weighs 1,800 pounds. No one knows just how old it is. "It has always been there," says Norman S. Dillingham, the Slade grandson who heads the firm.

Another Boston firm, the Stickney & Poor Spice Company, is the oldest importing concern (page 415).

Most spice concerns have important side lines, such as flavoring extracts, which are solutions in alcohol of the aromatic parts of various plants; condiments; and insecticides.

In Dijon, France, the firm of Grey-Poupon has been in business since 1777, and for many of those years it sold only mustard. Now there are other products, and branch factories at Marseille and Paris. Grey-Poupon mustard is sold in small urn-shaped crocks. The recipe is secret, but the makers admit that white wine is an important ingredient.

Biggest consumer of spices is the meat-packing industry. Spice distributors give special attention to seasoning mixtures for such products as sausage and lunch meats, often using formulas supplied by the packers themselves. In Chicago are firms specializing in such service. They also supply special mixtures to canning and baking concerns.

Spice importers and brokers make up a tight little community in a tangle of narrow, teeming streets near the East River docks, in lower Manhattan.

To see a veteran dealer, I climbed to the second floor of a dingy building in Front Street. There, shortly before his death, I found Christopher Clarke behind a venerable rolltop desk. He might have stepped from the pages of Dickens. High starched collar, elastic sleeve garters, and a benign, courtly manner suggested a bygone day when Mr. Clarke might have been perfectly at home in London's Mincing Lane, once the world's spice capital and still an important center.

From his sample room, lined with boxes and bins containing every known spice, issued a heady scent which permeated the entire building. This aroma blended with others wafted from neighboring coffee-roasting houses and Fulton Fish Market.

Cinnamon and Cassia

Ushering me into the sample room, Mr. Clarke reached into a box and drew forth a light-brown stick of bark, curled lengthwise. He broke off a piece.

"Taste this," he said. He popped a piece into his own mouth.

"It tastes like cinnamon," I said.

"That's what it is," Mr. Clarke said. "True cinnamon, from Ceylon" (page 403).

He reached into a second box and snapped off another bit of bark which appeared identical with the first. "Now taste this," he said.

"No difference," I reported. "It's still cinnamon."

"You're wrong," Mr. Clarke said triumphantly. "The second one is cassia, from China and the East Indies. Takes an expert like myself to tell them apart."

Mr. Clarke explained that in normal times American palates seldom knew true cinnamon. It used to be a gourmet's conceit to demand the Ceylonese brand, but most exports in this hemisphere went to Mexico for use in incense burners or for flavoring chocolate. Wartime shifting of trade routes kept cassia off the market, but some true cinnamon trickled through. Both kinds are available now.

Much colorful lore surrounds cinnamon and cassia. Both are the dried bark of evergreen trees of the laurel family. Cinnamon is native to the Malabar Coast of India and Ceylon and is cultivated mainly on the latter island.

The more full-bodied and aromatic cassia, also known as Chinese cinnamon, is used commonly in cooking. Saigon cassia, from

National Geographic Photographer Robert F. Sisson

French Salad Dressings, Almost as Numerous as Frenchmen, All Require Spices

In the kitchen of Washington's Hotel Statler, food supervisor Mary Quinn sifts spices for 14 gallons of dressing, enough for 1,400 individual salads. She follows a recipe devised in the New York research kitchen of the Hotels Statler Company, Inc. Ingredients are white pepper, paprika, salt, olive oil, tarragon and cider vinegar, and eggs. The eight Statler hotels use more than 10,000 pounds of spices annually.

French Indochina, is quoted most often in the importers' price lists. Other grades are grown in southern China. Still another, from the East Indies, is called Batavia cassia.

For some purposes cassia buds are employed. These are the dried immature fruits of the cassia tree, which impart a flavor similar to that of cassia or cinnamon bark. Cassia oil, distilled from bark and leaves, finds its way into medicines, confectionery, perfumes, and toilet preparations.

Early spice traders, bringing their cargoes to Rome and Venice by way of Arabia, gave ingenious reasons for keeping the price of cinnamon high.

Some said the tree grew in the center of a mysterious lake guarded by birds which, from the traders' stories, must have been as large and ferocious as mythical dragons. The birds had to be routed for brief periods, at great personal peril, while the traders waded into the lake, tore off a few branches of the tree, and hurried to safety!

Another story was that nobody had ever seen a cinnamon tree, but that certain eagles were known to build nests of cinnamon branches. The only way to get these branches was to lure the birds with heavy pieces of meat, which they carried back to their nests. The nests broke under the weight, and the cinnamon was scattered for the traders to pick up—or so they told their customers.

Medicines, Perfumes, Ointments

Despite its high prices, cinnamon found a ready market in western Europe. It was used for medicines and for scenting perfumes and ointments long before its flavor value was generally realized.

Like other spices, cinnamon was believed capable of inspiring love; its use as an aphrodisiac is mentioned in *The Arabian Nights*.

National Geographic Photographer Volkmar Wentzel

Purple Saffron Blossoms from Kashmir Yield Yellow Dye and World's Costliest Spice

These sorters near Pampur must hand-pick 75,000 flowers to produce one pound of saffron, worth about $40 wholesale in the United States. For 25 cents the housewife receives a tiny package, but saffron's strong flavor makes a little go a long way in cooking. Each blossom of *Crocus sativus*, a bulb resembling spring crocus, contains three spice-bearing stigmas. Spain, Greece, France, and India are chief producers; most of our imports go into drugs. Hindus mark their foreheads with saffron dye.

In the same work, Sindbad the Sailor tells of voyaging from Basra to an unidentified island where "I took in a great store of pepper and cloves and cinnamon in exchange for coconuts." These spices he sold at a handsome profit in Baghdad.

Cassia is mentioned in early Chinese herbals, and a spice supposed to be cassia was imported into Egypt as early as the 17th century B. C.

A Liquid with Two Purposes

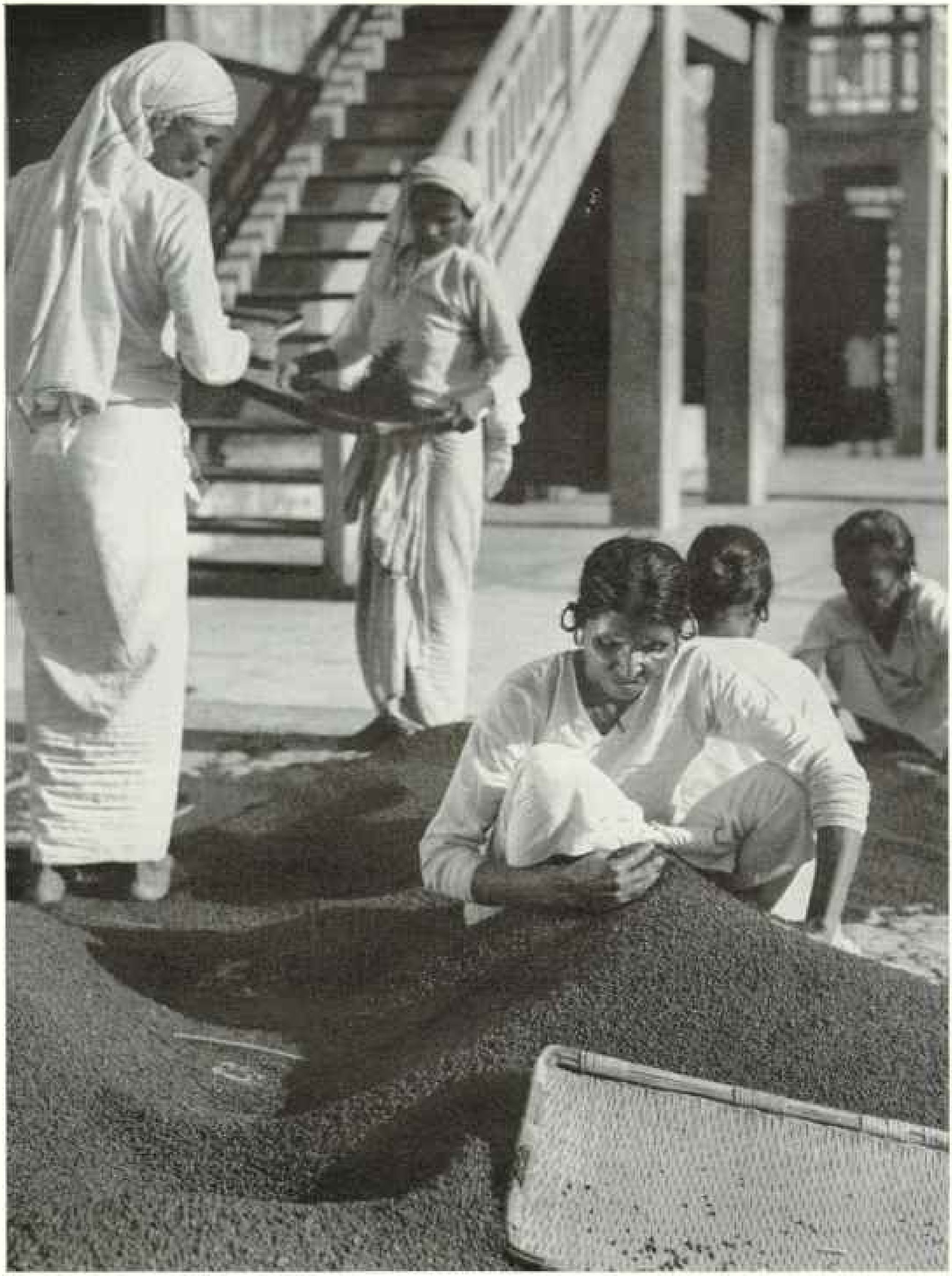
In Chapter 30 of Exodus sweet cinnamon and cassia are listed among the ingredients of the holy oil used for anointing the Tabernacle and its sacred vessels. From the Book of Proverbs, Chapter 7, we learn that a perfume was composed of cinnamon, aloes, and myrrh.

Cinnamon and other spices were constituents of *eau de Carmes*, a preparation invented in the Paris pharmacy of the Carmelite monks in 1611. Used internally as a cordial and externally as a toilet water, it achieved wide popularity.

Along with cloves, garlic, camphor, and other aromatics, cinnamon entered into the composition of a potent brew known as the "vinegar of the four thieves." This was made by four men who used it to ward off infection while looting the homes of the dead and dying during an 18th-century outbreak of the plague in a French city.

Captured and brought to justice, the four thieves were pardoned in return for the recipe of their prophylactic.

In spite of the sharp distinction drawn by the ancients between cassia and cinnamon, most historians agree that their cinnamon was a Chinese product and hence a form of cassia.



National Geographic Photographer Volkmar Wentzel

On Its Long Journey from Vine to Shaker, Pepper Goes Through Many Cleaning Processes

These women of Cochin, on India's Malabar Coast, sift and sort berries from near-by plantations. In burlap bags the peppercorns, like wrinkled BB shot, travel to mills all over the world. The Malabar Coast produces a large percentage of the 30,000,000 to 40,000,000 pounds of pepper consumed annually in the United States.

National Geographic Photographer John E. Fletcher

With a "Thief" He Draws a Sample of Montana Mustard for Laboratory Test

When the workman at the Stickney & Poor Spice Company, Boston, withdraws the pointed tube, he will "rough up" the burlap fibers to close the hole. Mustard, of Asiatic origin, flourishes in many lands; much of the United States supply grows in Montana, California, and Washington. Lincolnshire, England, produces one of the best grades. Most householders know mustard as powder or as the prepared table condiment. Whole seed is used in pickling.

Today, the word "cinnamon" is accepted as covering both spices; only dealers and specialized consumers, such as bakers and confectioners, differentiate between varieties. The fine powder used in cookery may contain the bark of both trees.

The cinnamon tree is ready to give up its bark when about six years old. Branches are cut close to the ground, then taken to a shelter where the bark is removed in long sections. As these dry, they curl and form the familiar cinnamon sticks, or quills. The pruned stumps send up new shoots which are ready for cutting again within a year.

Waste Pieces Are Useful

Cinnamon quills, graded according to size, color, quality, and thickness of bark, reach world markets tied together in bundles. Grinders break them into small pieces before feeding them into their pulverizing machines. Also imported are bags of cinnamon chips, or waste pieces, from which the essential oil, useful as an antiseptic and in dentifrices and perfumes, is extracted by distillation.

Venetian and Genoese sailors, pioneers in the spice trade, met caravans from the Orient and sold their cargoes at exorbitant prices. Wealth accumulated from spices and silks helped build many of Venice's architectural glories in the Middle Ages.

Because of the miraculous improvement they made in foods, spices came to be regarded as a necessity. The rich would pay any price; the poor hoarded the few small grains they could buy. No wonder the trade was profitable!

Various medicinal properties, besides, were rightly or wrongly assigned to spices. Cloves, coriander, nutmeg, cinnamon—these and others were believed capable of curing a long list of ills ranging from leprosy to insomnia.

National Geographic Photographer John E. Fletcher

With a Power Saw He Cuts Chinese Cassia Bark into Short Lengths for Grinding

From this operator in the McCormick plant in Baltimore the sticks go to a cracking machine to be broken into smaller bits. Then final milling and sifting produce the brown, velvety, aromatic powder sold in grocery stores. Cassia reaches the grinders packed tightly in fiber bales. Most people are unable to distinguish between it and its close relative, cinnamon, which grows mainly in Ceylon (page 411).

The Venetian traveler Marco Polo returned from the Orient with tales of seeing cassia and ginger growing in China, cloves in Java, and pepper and cinnamon (cassia) on the Malabar Coast of India.*

Marco Polo's Tales Spur Exploration

Navigators and merchants who read Polo's account began to think that if anyone could find an all-sea route to India and so obviate the difficulties encountered by Polo, he might make a fortune by sailing off to India for a load of spices.

Christopher Columbus, growing up in Genoa with Marco Polo's travels as one inspiration, came to manhood with the idea of sailing westward to reach Asia. He found it difficult to get support. At last the King and Queen of Spain outfitted him with three small vessels and sent him off.

Columbus sailed westward and found land —but it was not the coveted spice lands of Asia.

Eight years before the Great Admiral's death, the Portuguese Vasco da Gama reached India by sailing around Africa. He outmaneuvered the Mohammedan traders, established mercantile relations with the native rulers, and returned with spices and other valuables. At last Portugal had a trade route with the East.†

* See "World's Greatest Overland Explorer (Marco Polo)," National Geographic Magazine, November, 1928.

† See "Pathfinder of the East (Vasco da Gama)," National Geographic Magazine, November, 1927.

By this time, the price of pepper in Europe had risen beyond the reach of anyone but speculators and noblemen. When Da Gama returned, Portugal forthwith set about keeping the price of pepper as near the old caravan figures as possible.

Discovery of the Moluccas

Later, the Portuguese explorers ventured into the waters east of India, went into the Sunda Strait, passed Java, and discovered the Moluccas, the "Spice Islands." *

The Moluccas are a group of half-submerged mountains surrounded by the Philippines on the north, New Guinea on the east, Timor on the south, and Celebes on the west. On the tops of these mountain peaks spice trees flourished. The islands were unimportant for anything but spice, but this alone was sufficient to put the Moluccas on every map of the world.

When the Portuguese, with their right of priority established by Da Gama's discoveries, took up residence in India and elsewhere, other strong countries began laying plans to break Portugal's spice monopoly.

At "Golden Góa," capital of Portugal's Far East empire, the Portuguese East India Company exploited the sale of spices and barred interlopers. During the 16th century, when Portugal was master of the spice trade, some of the finest buildings in the country's history were erected.†

The Dutch first successfully competed for the trade by following the Portuguese around Africa.

Although the Portuguese had opened the way, it was the Dutch who brought to its zenith the highly competitive East India trade.

In 1600 Queen Elizabeth organized the British East India Company to combat Portuguese trade.

At the same time, the Portuguese were finding their hands full with the Dutch, and finally were conquered by them. Then the British came in, but the Dutch successfully resisted them and became the rulers of the East Indies.

Over Portuguese opposition the Dutch seized Amboina, an island in the Banda Sea, and made it a base of operations from which they could obtain the rest of the Moluccas. Amboina contained what was probably the largest clove plantation in all the East Indies; and at that time cloves commanded tremendous prices in Europe. Cloves brought back by one of Magellan's ships were sold for more than the entire cost of the three-year expedition.‡

Amboina also had nutmeg, cinnamon, cassia, and pepper. The spices of Amboina, Ternate, and the Banda Islands would enrich all of the Netherlands. The Dutch thereupon made a spice monopoly their goal.

On other near-by islands there were pepper vines and clove and nutmeg trees. The Dutch invaded them at night and destroyed the trees and vines, so that no one else should profit by the sale of spices.

But Nature, unsympathetic to Dutch ambitions, permitted spices to grow alike on other tropic islands of the French, the English, and the Spanish.

Cinnamon, almost as valuable as cloves and pepper, was most abundant on the island of Ceylon.§ By 1658 the Dutch had driven the Portuguese out of Ceylon. Under their rule the Ceylonese brought the cultivation of cinnamon to its peak, only to see a new master, the British East India Company, take over in 1796. Cinnamon remained a British monopoly until 1833.

Two derivatives are sometimes given for the word "clove"—the French *clou* and the Spanish *clavo*, both meaning "nail." The little "nails" grow on small evergreen trees of the myrtle family. Early mariners reported that under the tropic sun the trees exuded a powerful odor that could be smelled far offshore.

Nutmeg Tree Produces Two Spices

The nutmeg tree is unique in that it produces two spices (page 418). When the outer husk of the peachlike fruit is removed, it reveals a lacy, scarlet membrane. This is mace, carefully removed and dried in the sun. Under the mace is a brown kernel containing the seed, or nutmeg.

The fact that nutmeg trees yielded two spices took some time to register in the minds of Amsterdam spice merchants.

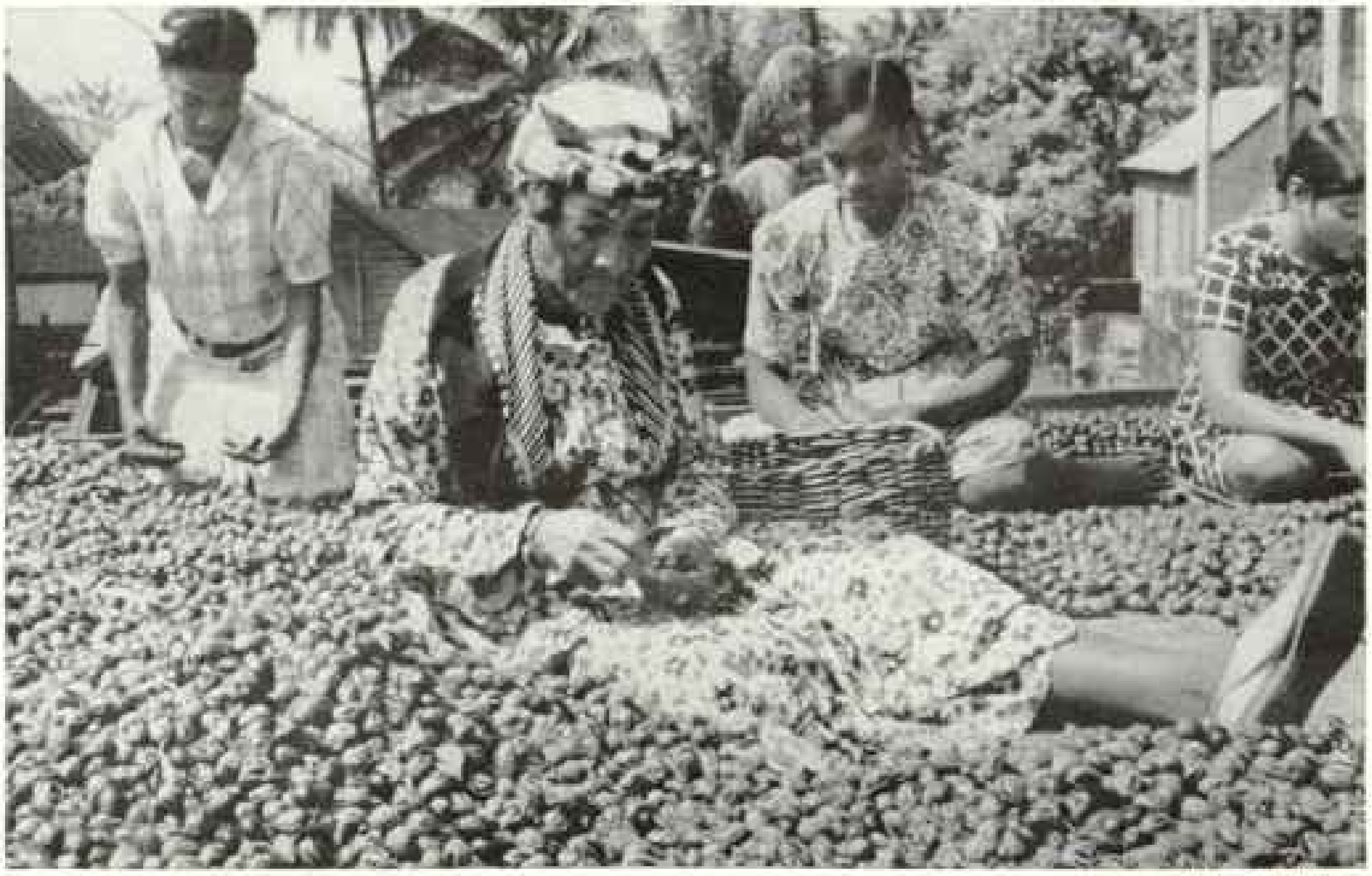
At one time there was more demand for mace than for nutmeg in Europe, and the crusty old traders ordered, "Cut down half

* See "Airplanes Come to the Isles of Spice," by Maynard Owen Williams, NATIONAL GEOGRAPHIC MAGAZINE, May, 1941.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Portugal Is Different," by Clement E. Conger, November, 1948; "Castles and Progress in Portugal," by W. Robert Moore, February, 1938; "Altitudinal Journey Through Portugal," by Harriet Chalmers Adams, November, 1927; "Lisbon, the City of the Friendly Bay," by Clifford Albion Tinker, November, 1922; and "Lisbon—Gateway to Warring Europe," by Harvey Klemmer, August, 1941.

‡ See "Greatest Voyage in the Annals of the Sea (Magellan)," NATIONAL GEOGRAPHIC MAGAZINE, December, 1932.

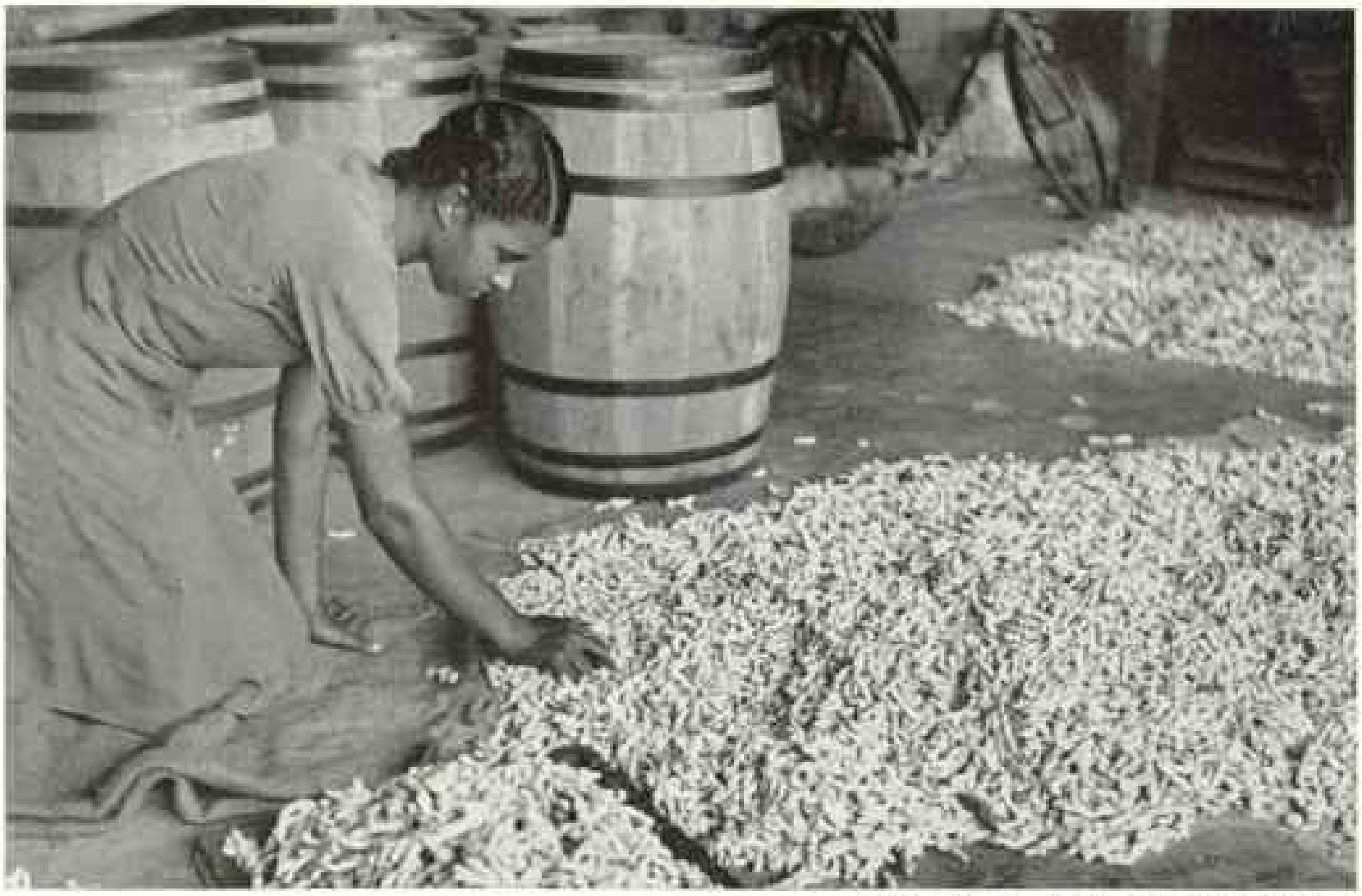
§ See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Ceylon, Island of the 'Lion People,'" by Helen Trybulowski Gilles, July, 1948.



Universal Pictures

Peachlike Fruits of Grenada Nutmeg Trees Yield Two Spices

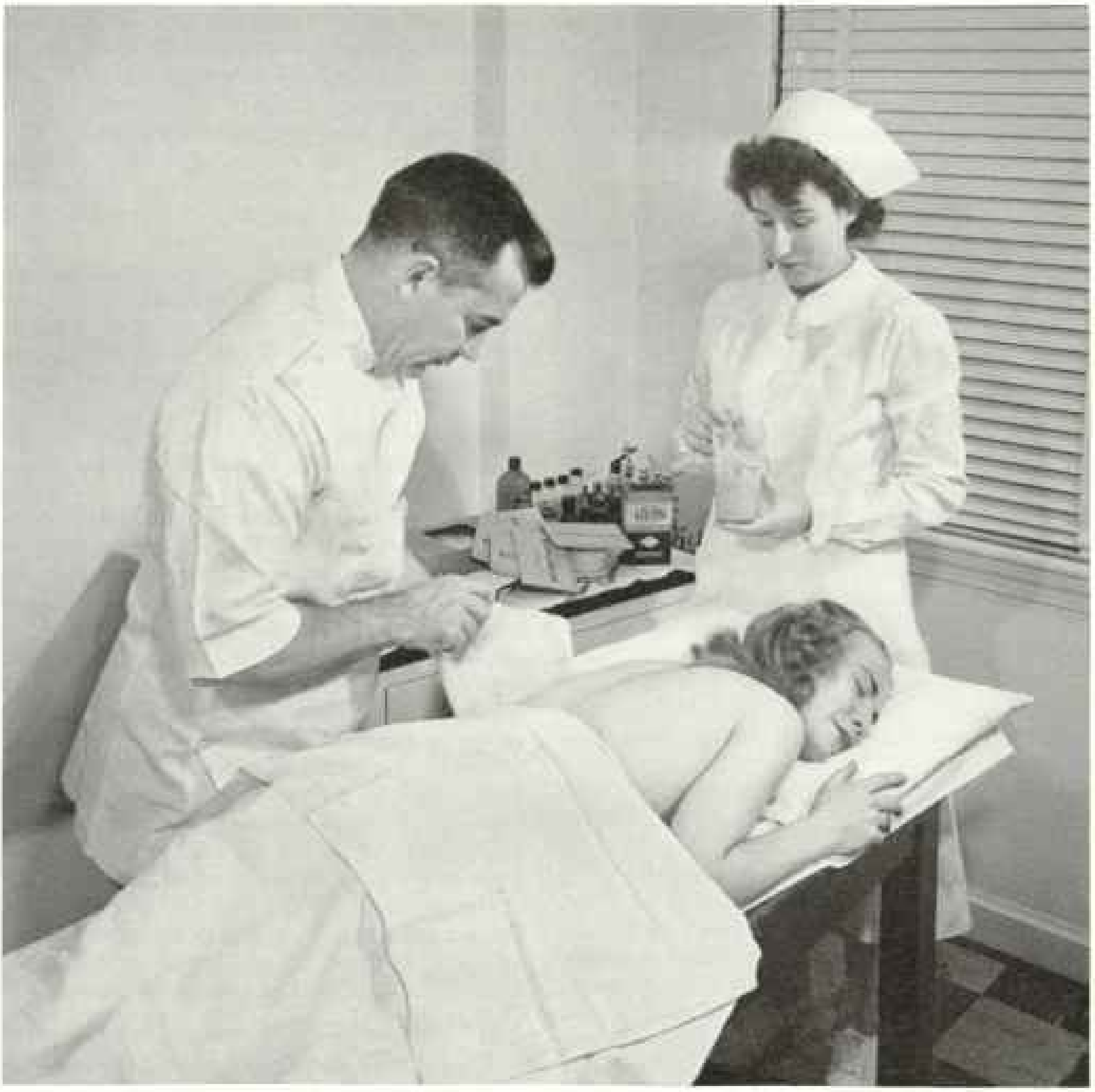
Amsterdam merchants used to believe that nutmeg and mace came from separate trees. Since the latter brought higher prices, they ordered more "mace trees" planted and nutmegs destroyed! Later, they learned that mace is the lacy, scarlet membrane covering the nut that contains the seed, or nutmeg.



National Geographic Photographer W. Robert Moore

Ginger Comes from Many Lands, but Jamaica's Leads in Sharp, Spicy Quality

Spread out on the sorting-room floor of a Kingston warehouse are fingerlike bits of one of the oldest spices. Like turmeric, a member of the same family, ginger grows underground.



National Geographic Photographer John E. Fletcher

Grandma's Remedy, a Piping Hot Mustard Plaster, Holds Its Own in a Day of Miracle Drugs

The nurse stirs a mixture of powdered mustard, flour, and cold water, to be spread on a gauze compress and applied to the patient's back. There it will quickly generate enough heat to increase blood circulation near the skin's surface. Years ago, mustard plasters were used even in pneumonia cases. Many physicians still find them helpful in treating minor colds and congestions.

the nutmeg trees and plant more mace!"

To prevent nutmegs from germinating and thereby from growing elsewhere, the Dutch kept those ready for shipping in a lime bath for three months. All, therefore, bore a white coating of lime water, and even today they are still whitened—some say because of tradition, others because the lime prevents insect infestation.

Malays called the nutmeg the *pala*. One superstition was that it would grow only within the sound of surf.

Some histories record an incident of the 18th century when Pierre Poivre, administrator of Ile de France, now Mauritius, paid a visit to the governor of Amboina.

A Visitor Smuggles Seeds

Poivre is reported to have asked politely to be shown the nutmeg plantations. The governor, yielding to his guest's request, may have driven him around the island to view the trees full of beautiful fruit.

When Poivre left Amboina, he had both nutmeg and clove seeds hidden on his person. He took his trophies to Mauritius, east

of Madagascar, and grew trees from them.

Ginger was planted on the Moluccas from roots brought from China. It is a purple-and-yellow-flowered reedlike plant, whose thick, pungent, and tuberous roots were dug and scraped, and then dried or candied for commerce.

Long before Europeans had become acquainted with it, the East knew and revered ginger, using it for a flavor, as a candy, and also as a medicine. Ginger was not cultivated on a large scale until the Spanish planted it on Jamaica in the West Indies.

Discoveries in the West Indies

While turmoil raged in the East Indies, the Spaniards were making rare discoveries in the West Indies and in Mexico. Among them was a West Indian tree called the pimento.

Its fruit contained a flavor like cloves, nutmeg, and cinnamon combined and was known as allspice. There also were cacao, vanilla, and fiery red peppers.

Spices played a part in the growth of the United States. Soon after the Revolutionary War the American merchant marine came into existence.

With the former colonial trade routes now closed to Americans, they looked far afield for new ports and new trade routes.

A New York ship, the *Empress of China*, opened the China trade with Canton in 1784. Massachusetts shipowners became rich, and with profits from their cargoes of tea, silks, spices, chinaware, and other romantic wares they built many of the white houses that still stand.

Capt. Jonathan Carnes, of Salem, loaded a cargo of pepper in Sumatra in 1791 and sold it back home for a profit of 700 percent. For a time Salem was called the "Pepper Port." In 1805 the United States exported more than 7,500,000 pounds of pepper, much of which had previously been landed in Salem.

Yankee sea captains brought back from the ports of India itself a new flavor in the repertory of American foods. That was curry, a subtle blending of several of those famous spices which have gone into the making of history.

Occidentals know only one curry; in India each kind of fish and fowl has its own blend of curry spice.

Curries in India give zest to commonplace rice. One favorite curry recipe is composed of coriander seed, Madras turmeric, cinnamon, cummin seed, cardamom seed, fenugreek seed, Jamaica ginger, cayenne pepper, pimento, black pepper, long pepper, cloves, and nutmeg.

Men who deal in spices today compete briskly, but their operations are a far cry from the tricks of the trade of a few centuries ago.

McCormick, French, Slade, and dozens of other competitors throughout the United States are united for their common good in the American Spice Trade Association, one of whose principal aims is to educate American cooks in the proper use of spices. Its influence is wide-spread, since the United States is the world's major market for spices today (page 410).

The association maintains a staff of technical experts who are forever on the lookout for new spice sources and ways to use them. For many years practically all mustard seed was grown in Europe, South America, and India; now much of the American supply comes from California, Montana, and Washington. The finest mustard, however, still grows in Lincolnshire, England.

Crosby Gaige's big moment comes once a year when he helps plan the menu for the association's annual dinner, which draws spice merchants, all discriminating trenchermen, from every part of the United States.

He prints the menu on his private press. He always gives it a distinctive touch, such as using, instead of ink, a yellow dye made from saffron, one of his favorite spices.

Shakespeare Wrote of Spices

A recent menu bears a few Shakespearean words on the subject of spices in which Clown, in *The Winter's Tale*, lists his needs for a Bohemian sheepshearing feast: "I must have saffron to colour the warden pies, mace; dates —none, that's out of my note; nutmegs, seven; a race or two of ginger, but that I may beg; four pounds of prunes, and as many of raisins o' th' sun."

Spice men show no alarm at reports that concentrated flavors, made by distilling the essential oils of spices, will someday take the place of whole spices. They feel that man will be eating products of plantation and farm, and not the test tube, for many centuries to come.

"Nothing beats Nature," they say.

Notice of change of address for 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 May number, The Society should be notified of your new address not later than April first. Be sure to include your postal-zone number.*

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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, 1940, 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, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

The National Geographic Society-U. S. Army Air Forces Expedition, from a camp in southern Brazil, photographed and observed the solar eclipse of 1947. This was the seventh expedition of The Society to observe a total eclipse 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.

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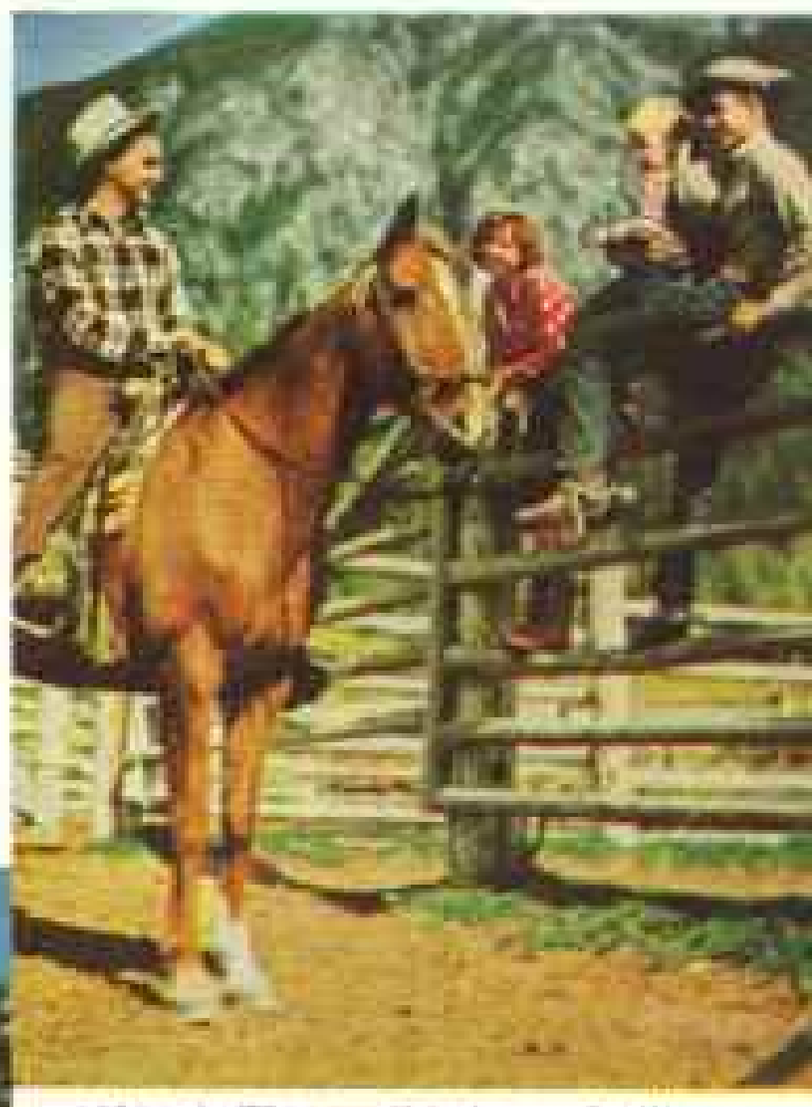

(Above) Western "dude ranches" and skyline trail-riding in Canada's Rockies invite you to a boots-and-saddle vacation

(Left) The old fort at Annapolis Royal, in Nova Scotia's romantic Acadia country

(Below) At cottage colonies and lake resorts the young ones "live on the water"

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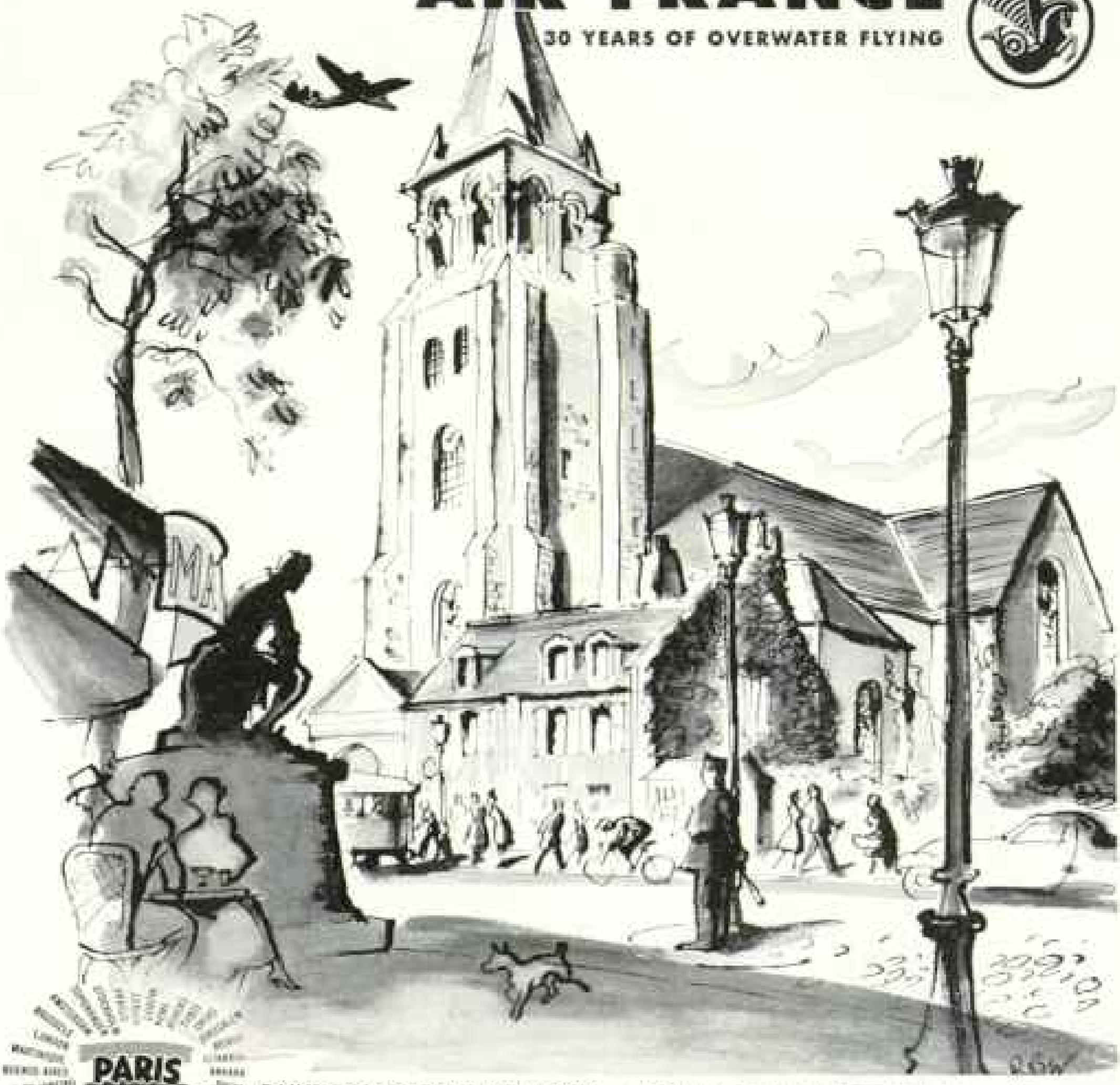

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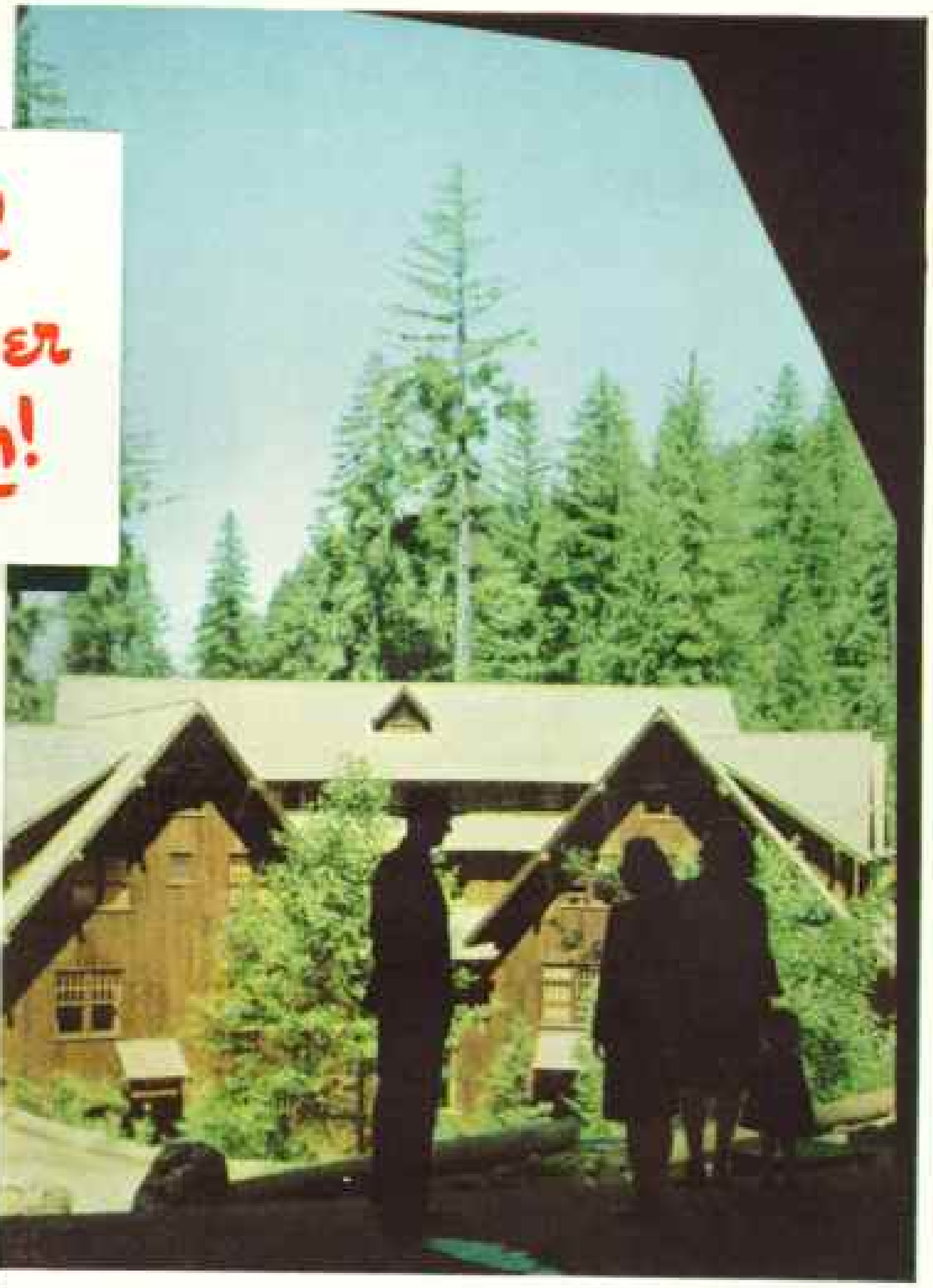

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3. No need to live alone and not like it when you go Pullman. Whether you're thirsty, restless or lonesome you'll find a satisfying answer to all three in the spacious lounge car.

SNOOZER?

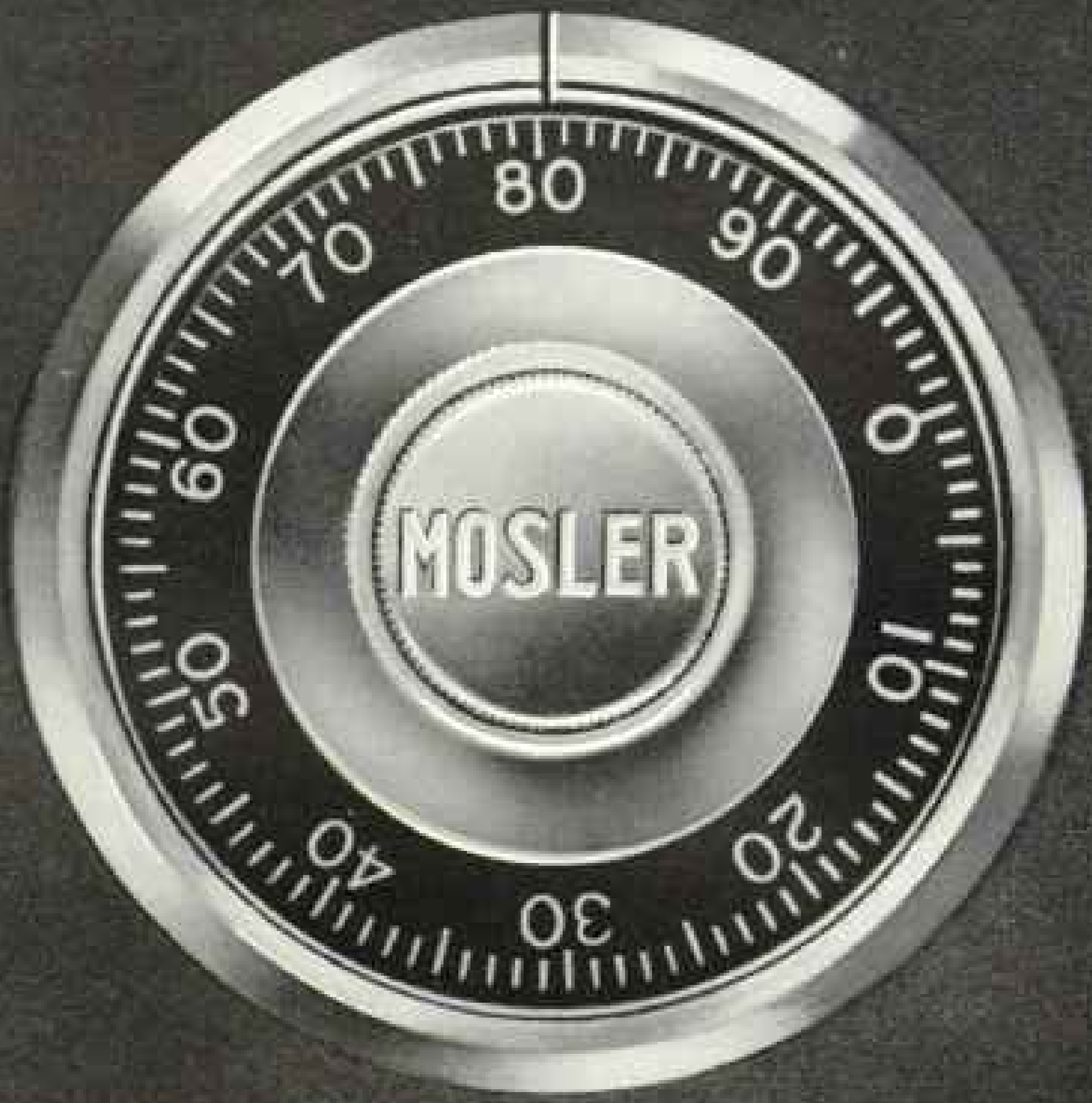
4. You sleep deep and undisturbed in those big, downy-soft Pullman beds. And next morning you're *there* on dependable railroad schedules. You arrive refreshed and relaxed, right in the heart of town, convenient to everything.

There's no question about it: No other form of travel considers your complete comfort as completely as Pullman!

Go Pullman

THE SAFEST, MOST COMFORTABLE WAY TO GET THERE!

What's behind the dial?



Behind the dial is the *heart* of your business—your records! Think—how could you continue after fire destroyed your inventory records, accounts receivable, tax records, deeds and contracts? How could you even establish proof of loss to collect your fire insurance? 4 out of 10 firms never reopen after losing their records! That's why your *safe* is so important!

How You Can Be Sure Of Your Safe

Look for the label of the Underwriters' Laboratories, Inc., on your safe. Don't trust *any* safe that doesn't have it! Modern Mosler safes pass their toughest tests with plenty to spare—you can *depend* on Mosler.

There's a Mosler safe to meet your requirements exactly, at less than you'd expect to pay. Find out about it now, before fire strikes! Fill in the coupon below and mail it *now*.

Mosler "A" Label Safe with burglary resistive chest for dual protection against fire and burglary.

The Mosler Safe Co.

Main Office: 320 Fifth Avenue, New York 1, N. Y.
Dealers in principal cities. Factories: Hamilton, O.
Largest Builders of Safes and Vaults in the World

Builders of the U. S. Gold Storage Vault Doors at Fort Knox, Ky.

The Mosler Safe Co., Dept. 43
320 Fifth Ave., New York 1, N. Y.

Please send me: ☐ The new free booklet "What You Should Know About Safes."

☐ The Name of my nearest Mosler Dealer

Name.....

Firm.....

Address.....

City.....*Zone*.....*State*.....

The Fine Stationery in the Plain Box

American stationery is mailed to you in a plain, stout carton. There are no frills to the package. All the value is in the stationery itself—200 note sheets and 100 envelopes of crisp, white rag content bond paper—all printed with your name and address—for only $1.00! But simple packaging alone does not make this great value possible. It is also the result of specialized manufacture and 33 years of experience in making fine stationery inexpensive...Ideal for informal and household business correspondence. Try it!

Order in quantities as stated. No "split" orders accepted. Maximum printing—4 lines, 30 characters per line. Remit with order. West of Denver, Colo., and in U.S. possessions add 10% to prices. We pay postage. *Satisfaction guaranteed.*

THE AMERICAN STATIONERY COMPANY
300 PARK AVENUE • PERU, INDIANA

DeLuxe Package

For those who prefer *long* style sheets and envelopes in heavier paper, 125 sheets (6¼ x 10½) and 125 envelopes to match. Printed $2.00

Envelope Package

For those who need lots of envelopes for paying by check, etc. 200 envelopes only (envelopes are in Standard Package). Printed . $1.00

Standard Package { 200 Note Sheets, 100 Envelopes *Printed with Your Name and Address* $1.00

AMERICAN STATIONERY

That's my traveling secretary—the new Electronic TIME-MASTER

You can flip open the traveling case—and turn a hotel room into an office. All you have to do is take out the trim, compact, sturdy TIME-MASTER—the revolutionary, new office dictating machine.

With this versatile machine by your side and the small electronic mike in your hand you can dictate "as usual" wherever you go. And you can mail your recordings back to the office at once!

Dictation done? Twelve of these small Memobelts will nest into your billfold. Five of them will tuck into your regular business envelope. And *these* recordings can be mailed in a regulation mail chute.

That's because the electronic TIME-MASTER records on a small, flexible plastic belt—just the right size for your business envelope. Five of these handy Memobelts—an hour and a quarter recording—can be mailed in a standard small-size envelope under a 3¢ stamp!

TIME-MASTER gives better recordings, uniform tonal quality and uniform backspacing—from first word to last!

Your secretary will agree—for all-around convenience—plus perfect voice fidelity—there's no dictating machine to compare with the Dictaphone TIME-MASTER. It's completely new, completely different, completely satisfying!

For a demonstration of the new TIME-MASTER Model, simply call your local Dictaphone representative. For descriptive literature, use this coupon.

Dictaphone Corporation
Department H-29, 420 Lexington Ave., N. Y. C.

☐ Please show me the new TIME-MASTER.
☐ Please send TIME-MASTER literature.

Your Name _____

Company _____

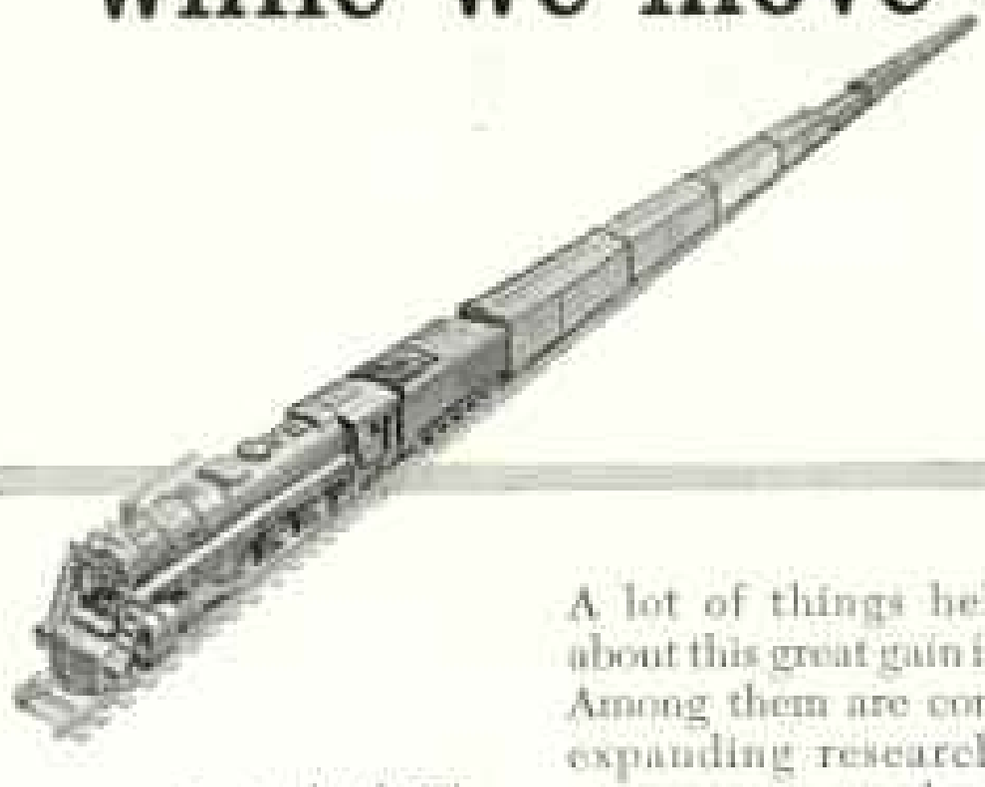
Street Address _____

City & Zone _____ State _____

DICTAPHONE
Electronic Dictation

Only Dictaphone Corporation makes Dictaphone® Machines.
(®Reg. U. S. Pat. Off.)

Just a minute... while we move a mountain!



Yes—we mean just that! The hauling job the railroads are doing these days is equivalent to moving more than a million tons of freight a mile every minute of the day and night.

Moving this mountainous load every minute calls for the most efficient use of cars and locomotives—and the railroads are using them today so efficiently that the average train turns out transportation service equivalent to moving 18,212 tons of freight a mile every hour. That's nearly two and one-half times as much as the average train did just after the first World War.

A lot of things helped bring about this great gain in efficiency. Among them are continued and expanding research in better transportation tools and methods—and huge investment in providing the better facilities necessary to do an ever better job. This investment has averaged, over the past quarter of a century, more than $500,000,000 a year. And in 1948 it was well above one billion dollars.

For the future, the railroads plan to keep on investing in new cars and engines, better shops and signals, better tracks and terminals, and all the other things that mean better service to the public.

The only way railroads can get the money to pay for these improvements is through their earnings. To keep abreast of the needs of the nation they must make earnings which are in line with today's expenses and today's costs. That would be your best insurance that the American people and American business will continue to have the most efficient, most economical, most dependable rail transportation in the world.

ASSOCIATION OF AMERICAN RAILROADS

WASHINGTON 6, D. C.

★ Listen to THE RAILROAD HOUR, presenting the world's great musical shows. Every Monday evening over the ABC Network, 8-8:45 Eastern, Mountain, and Pacific Time; 7-7:45 Central Time. ★

Now! Save on every food dollar

—yet eat like a millionaire!

YOU CAN REALLY buy the food you need week after week for less money . . .

If you'll change your shopping habits just a little bit.

Instead of paying the high retail price for a sliver of steak, or patty of hamburger, you buy a large section of beef on which you receive a "special" price. And you have the butcher cut it into convenient portions for daily servings.

Instead of buying a package or two of frozen food each day, you buy a case. You save money here, too!

You can make savings like these all along the line when you have a General Electric Home Freezer to store the food you buy this way.

Saving money is only part of this new, exciting way of living out of a home freezer!

When you have a food bank right in your home, you need not shop when the weather's bad, or when you just don't feel like it.

You'll feel like a millionaire, too!

You can have fresh corn on the cob, asparagus, nuts, strawberries—most every delicacy you can think of—right on tap the year round.

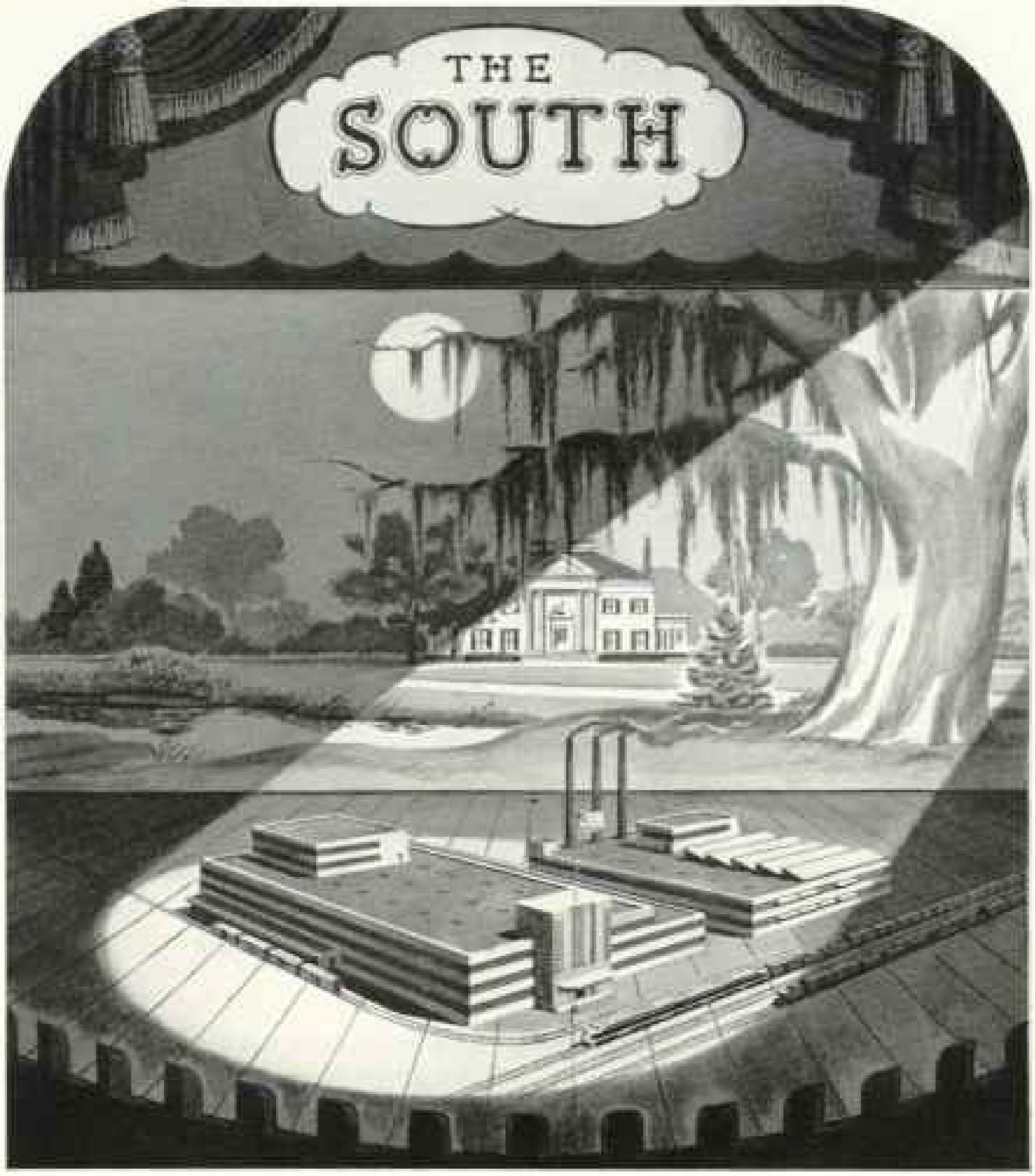
Best of all, these "luxury" foods are *not* luxuries to you, because you buy them in season when prices are low.

Start living this economical and practical way now. See your General Electric retailer.

The General Electric Home Freezer has the same type of sealed-in refrigerating system as that used in G-E Refrigerators. *More than 2 million of these dependable General Electric refrigerating systems have been in service in G-E Refrigerators for 10 years or longer! You can put your confidence in General Electric!*

We sincerely believe no other freezer on the market can compare with the dependable G-E. See it today! General Electric Co., Bridgeport 2, Conn.

GENERAL ELECTRIC



Center of the Stage

One new industry after another takes the spotlight when the inspiring story of the Southland's tremendous industrialization is told.

Against a background of traditional charm and historic beauty . . . supported by a full cast of natural advantages and resources . . . countless factories, new and old, are thriving, growing, and facing the future with confidence . . . all along the 8,000-mile Southern Railway System.

In this great industrial drama there's a vital and rewarding part for your factory.

"Look Ahead—Look South!"

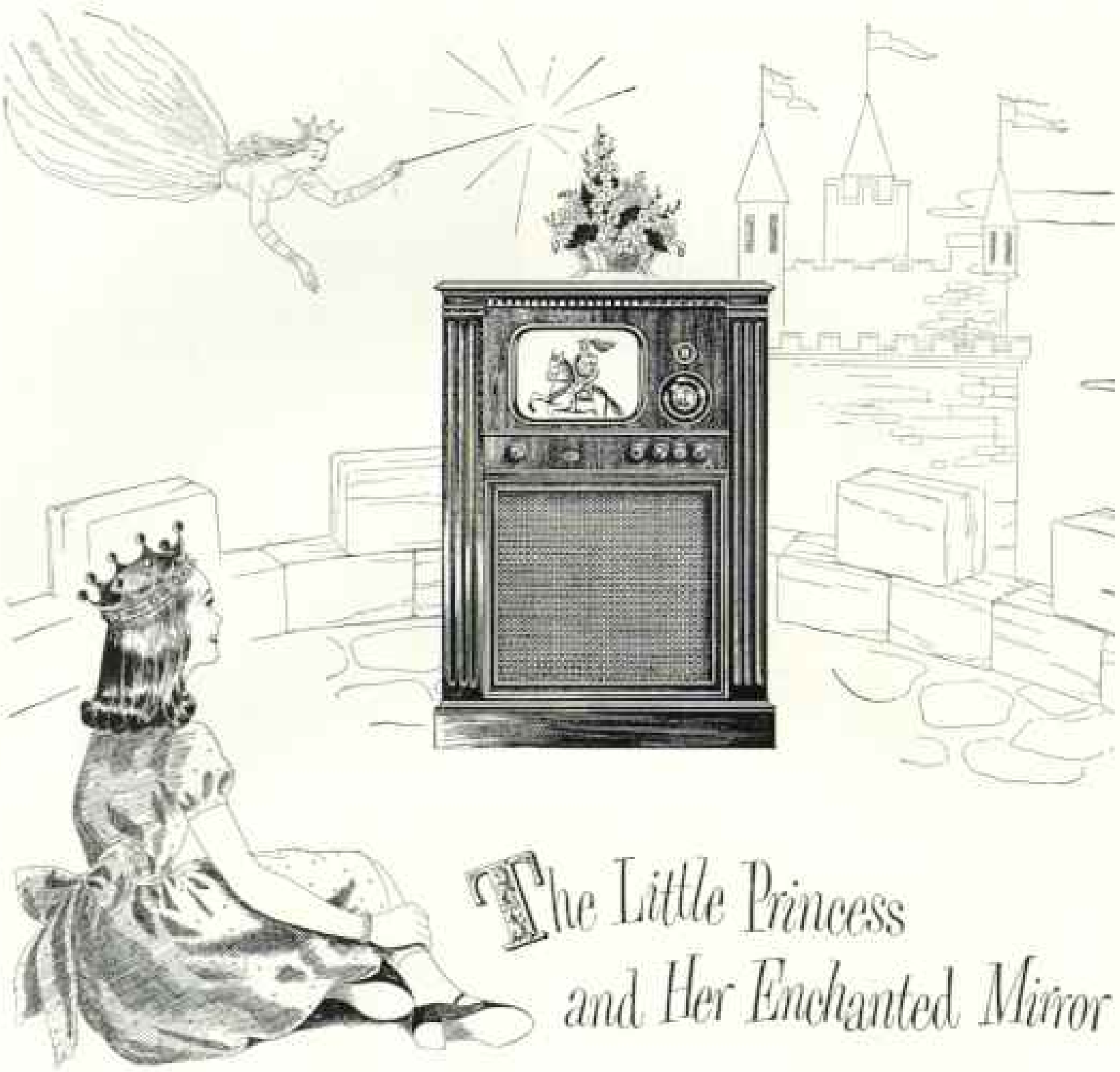
Ernest E. Norris

President

LOOK SOUTH! LOOK AHEAD

SOUTHERN RAILWAY SYSTEM

The Southern Serves the South



The Little Princess and Her Enchanted Mirror

Once upon a time there was a little princess who was very good, and kind to all about her. And because she was so good, her fairy godmother appeared to her one day and said: "I am giving you an Enchanted Mirror. When you look in it you will see and hear things that are far away—even to the farthest corners of the earth. Through it, skilled musicians will play for you and learned men will speak to you. This Enchanted Mirror will bring to you much pleasure and deeper understanding, so that you may live your life in wisdom and happiness. There is no more precious gift that I can give."

Illustrated: THE DUMONT METROPOLITAN—72 square-inch television screen and FM radio in a traditional cabinet of selected mahogany veneers, $525 plus installation

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Wonderful for vacations, sure . . . hub of America's greatest sunshine fun-land. But here's a *better* idea. Abounding opportunities of a young, aggressive metropolis are opening up a brighter, happier way of life for thousands of new *permanent residents.*

So come for a visit . . . *look* for a lifetime!

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CITY HALL, MIAMI, FLORIDA

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FLORIDA HAS THE ANSWERS!

FOR YOUR SPRING OR SUMMER VACATION

More people came to Florida for spring and summer vacations last year than ever before. They found that Florida had the *right* answers to *all* of their vacation questions — and you will, too!

First of all, accommodations are more plentiful, and everyday living expenses compare favorably with those at home. Your vacation dollars go further in *many* ways.

In spring, Florida answers your weather question with bright, sunny days made-to-order for outdoor play. In summer, refreshing Atlantic and Gulf breezes cool Florida from coast to coast. Average summer temperature (July) is 83 degrees in all sections.

Recreation? Florida's reply includes fishing, golf, bathing and a world of other sports. Swimming in crystal-clear springs. Fun on famous beaches. Nighttime fun. Sightseeing. You can fill every day with thrilling things to do and see.

You'll find the right answers to other questions in the booklet "Florida, The Sunshine State." Send for it today. It will help you plan the finest vacation you've ever enjoyed.

LOOK TWICE AT FLORIDA

For years Florida was looked upon merely as a sun-blessed playground. But no longer! Farmers have discovered real opportunities in its soil and sun. Industrialists have found many advantages in a Florida location. And every year, more vacationists become Floridians! So when you come to Florida, see ALL of Florida. You may find a happier future here, too!

COME TO FLORIDA THE SUNSHINE STATE

MAIL THIS COUPON TODAY!

State of Florida, 814 Commission Building
Tallahassee, Florida

Please send me new, free, 48-page, full-color booklet "Florida, The Sunshine State." Print name and address clearly.

Name_____

Street and No._____

City_____ Zone____ State____

Never before a pen so completely satisfying

It's the new Parker "51"

SUCH writing ease, such dependability never before existed in any pen. Only now have new materials made them possible.

14 precision advances mark the new "51". With it, writing is *gliding*. Even filling becomes a pleasure—quick and sure. You *see* the ink level. There's a new guard against leaking—even at the highest flight levels.

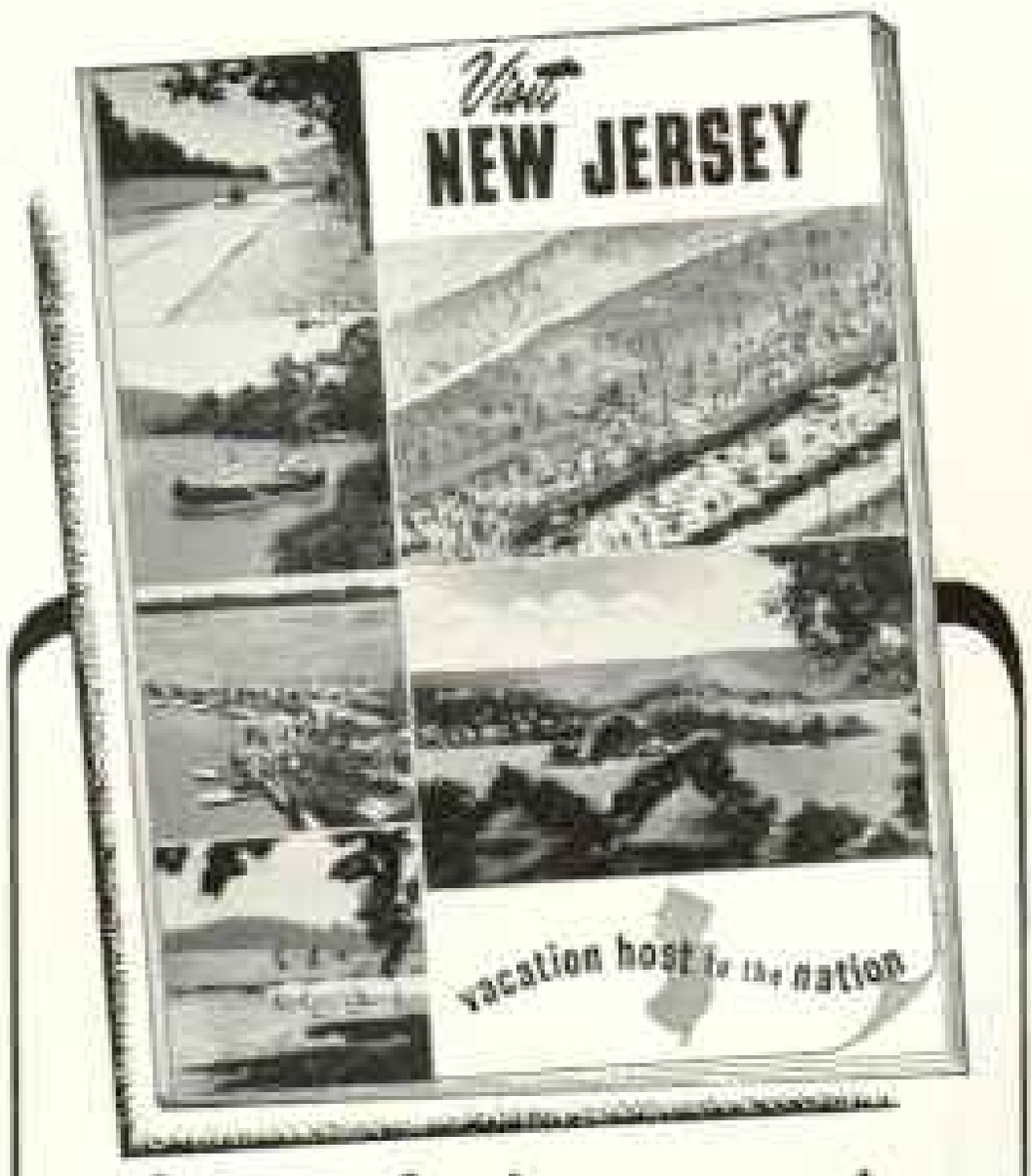
But these are only a few of new 51's advantages. To learn the full story, *try* the new pen now at your Parker dealer's. Choose yours—for keeping or giving—from 7 rich colors and black. Custom points.

Pens, $13.50 up. Pencils, $6.75 up. Sets, from $19.75. The Parker Pen Company, Janesville, Wis., U. S. A.; Toronto, Can.

NEW FOTO-FILL FILLER • VISIBLE INK SUPPLY • PLI-GLASS RESERVOIR • EXCLUSIVE INK FLOW GOVERNOR • 5-LAYER INSULATION • HI-FLITE LEAK PREVENTION • GREATER WRITING MILEAGE • PLATHENIUM-TIPPED POINT • "LIVE METAL" CLIP —5 OTHER SIGNIFICANT ADVANCES.

World's most wanted pen...

writes dry with wet ink!



. . for a glorious preview of an exciting 1949 vacation

This guide book is a MUST for planning ahead for a wonderful vacation. Its pages unfold a picture story of gay, romantic seashore resorts . . . 120 miles of superb beaches on the fringe of the Atlantic . . . gem-like lakes nestling among wooded hills . . . deep-sea fishing, surf casting and fresh-water angling . . . sporty golf courses and tennis courts . . . historic shrines and scenic highways. Come to New Jersey where there's a happy holiday to fit every vacation budget. Meanwhile, mail coupon for colorful 32-page booklet.

- SEASHORE RESORTS
- MOUNTAIN RETREATS
- RESTFUL LAKES
- THRILLING FISHING
- GAY BOARDWALKS
- HISTORIC SHRINES

NEW JERSEY

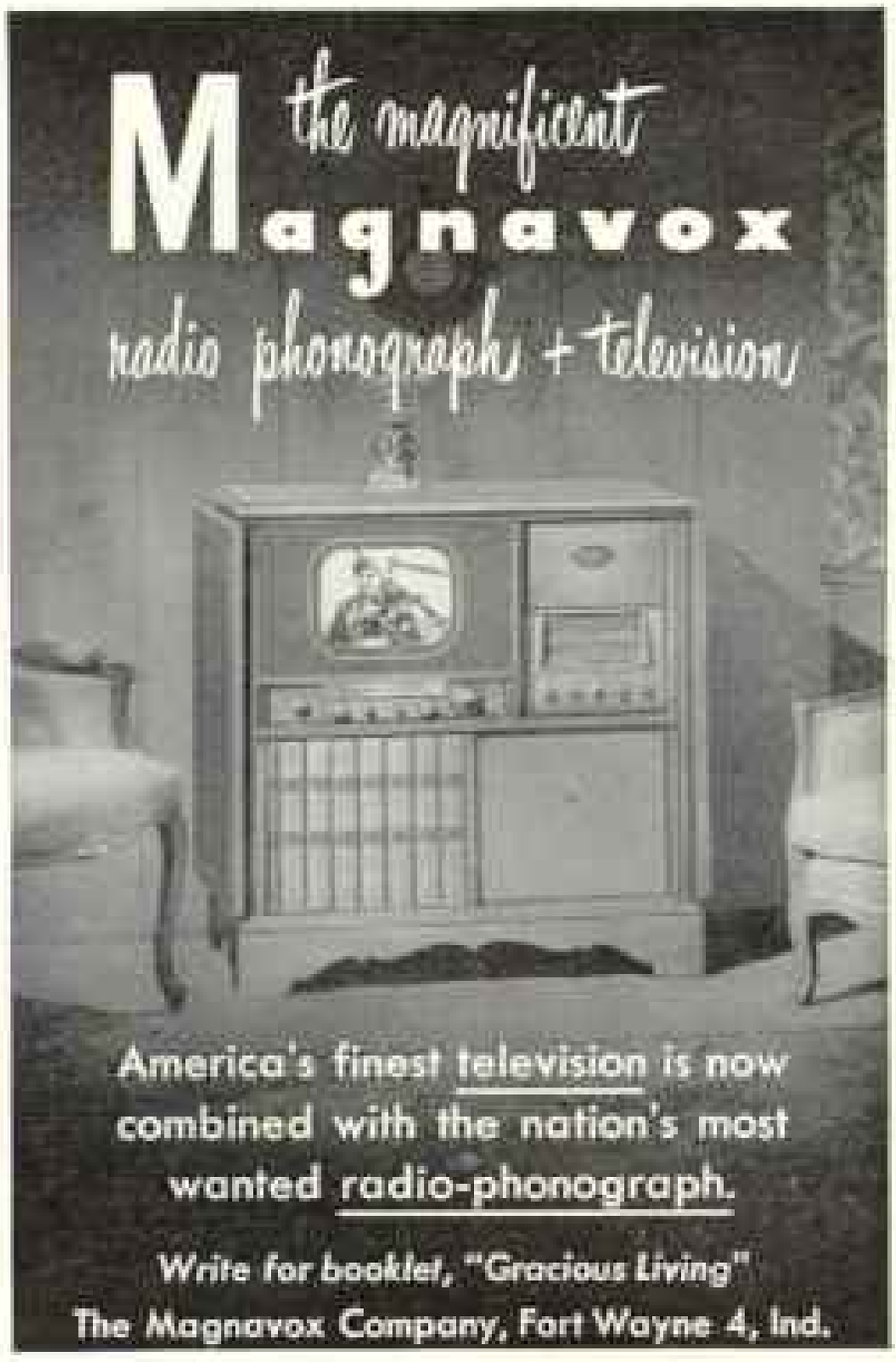
VACATION HOST TO THE NATION

NEW JERSEY COUNCIL,
DEPARTMENT OF CONSERVATION AND
ECONOMIC DEVELOPMENT,
BOX 306, STATE HOUSE,
TRENTON 7, N. J.

NAME .....

ADDRESS .....

CITY ..... STATE .....



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Rare and precious woods from all over the world carefully selected and matched to produce lifelike pictures. Ideal for game room, den, living room, etc. Actual handmade sets, masterpieces in marquetry. Identify type and country of each wood listed on back of ⅝" plywood plaque. 28 subjects to select from, sizes 10" x 14" to 16" x 25". Large size "Royal Bengal Tiger" illustrated $24.75. FREE illustrated brochure. Tower Gift Shop, 4 Tyerhill Street, Dept. 102, Lawrence, Mass.

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Single or selected slides, each 50c

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M. E. DIEMER, Ph.D. STUDIO AND LABORATORY
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one of Canada's 10 most popular VACATIONS

Sightseeing Canada's cities is just *one* of ten top vacations open to your choice through the continent-spanning services of Canadian National Railways. Explore historic Eastern centres, the romantic West. *Above:* In Ottawa, Canada's capital, the stately Chateau Laurier, one of Canadian National's hotels of distinction—centre of the city's social life—stands beside the National War Memorial.

"Choose one of Canada's 10 most popular vacations!"

The Scenic Route across Canada, by Canadian National's *Continental Limited*, is a unique travel experience. Stop over at friendly cities; golf, fish and ride at glorious Jasper Park Lodge in the Canadian Rockies (championship golf course, above); explore the beauties of the rugged West Coast.

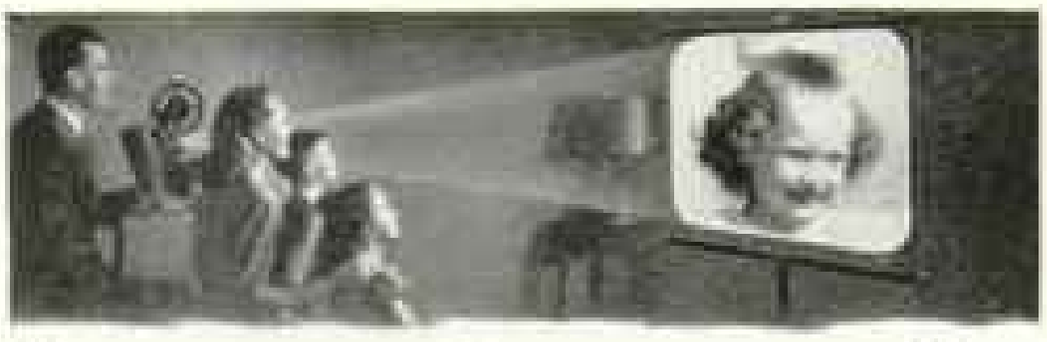
Relax all the way. Your vacation begins the moment you step aboard the *International Limited* (Chicago, Toronto, Montreal), the *Ocean Limited* (Montreal, Halifax), other Canadian National "name" trains. Travel the comfort way—the railway—to everywhere in Canada. To California and anywhere West, to New York and anywhere East, go Canadian National.

Here they are, as revealed in a 1948 survey of U.S. travel preferences: Alaska Cruise • British Columbia • Canadian Rockies • Cross-Canada Rail Tour • Eastern Cities and the Laurentians • Gaspé and the Saguenay • Lake of the Woods • Maritime Provinces • Highlands of Ontario • Winnipeg and Hudson Bay. Make your choice—then have your nearest Canadian National office give you the whole story—itineraries, places to see and stay, costs—everything you need to help you plan exactly the right vacation for *you*. "We'll tell you *where* and *take* you there."

CANADIAN NATIONAL

THE RAILWAY TO EVERYWHERE IN CANADA

Canadian National offices in 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. No passports required of U.S. citizens.



See your 8mm movies at their very best!

with this Ampro super quality 8 mm. projector

If you want to see your 8mm. pictures in a new light—with the best that's in them brought out with brilliant clarity—with colors warm, rich and natural—with quieter, smoother, flickerless operation—then project them on the de luxe quality Ampro "8". For this superb precision unit with its powerful 750 watt lamp illumination has the quality characteristics of a 16mm. projector. It offers many unusual features including: 400 ft. capacity, reverse operation, still pictures, automatic rewind and quick, easy threading. At leading dealers everywhere.

Send for FREE Circular

on Ampro 8mm. projector giving full specifications and prices. If you are interested in sound motion pictures send 10c for 16-page booklet, "The Amazing Story of 16mm. Sound Motion Pictures." It dramatically illustrates the various steps in the recording and reproducing of sound on film.

*Trade Mark Reg. U. S. Pat. Off.

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Send me FREE circular giving full details on the Ampro 8mm. motion picture projector.

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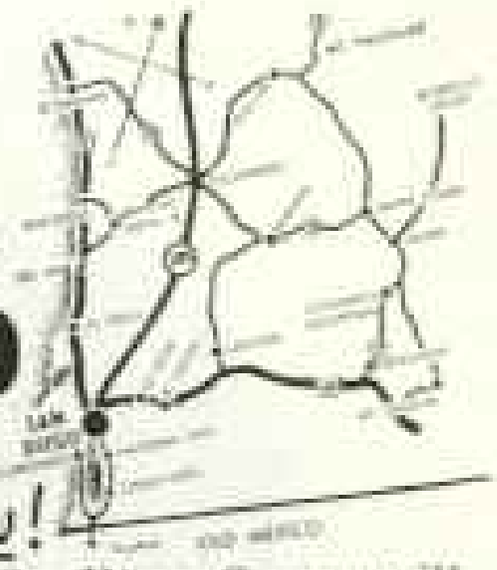
Spring Exploration in SAN DIEGO COUNTY



It's time to come now!

A few days spent now in San Diego County will reawaken your whole interest in life! Travel a hundred miles of Riviera-like scenery, extending into Old Mexico. Motor through quiet inland valleys lush with Spring. Sweep up a mountainside on modern roads and drop into the Borrego desert beyond. Picture panoramas on every hand. A gay city awaits you on San Diego Bay. A foreign land only 30 minutes South. Yes, it's high time you head for San Diego, where there is more of everything the true Southern California offers.

Borrego Desert is in bloom!

Accommodations of all types.
Ask your Travel Agent.

Send now for FREE literature!
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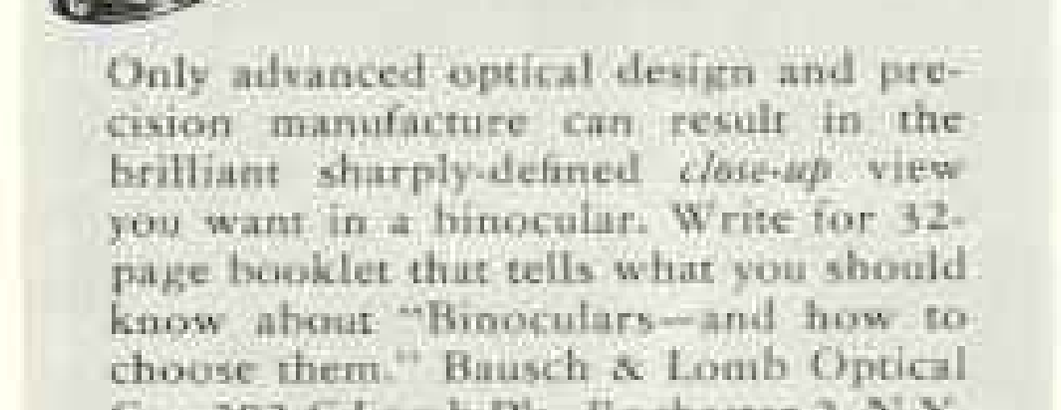
499 W. Broadway, Room 63
San Diego 1, California



for a brilliant close-up view . . . for ease of handling

Only advanced optical design and precision manufacture can result in the brilliant sharply-defined *close-up* view you want in a binocular. Write for 32-page booklet that tells what you should know about "Binoculars—and how to choose them." Bausch & Lomb Optical Co., 282-C Lomb Pk., Rochester 2, N.Y.

BILL STERN, *NBC Sports Editor, says:* "*Unsurpassed for its brilliant view and easy handling . . . My constant companion, indispensable for accurate reporting of all sports events.*" Bill Stern

BAUSCH & LOMB
OPTICAL COMPANY ROCHESTER 2, N.Y.

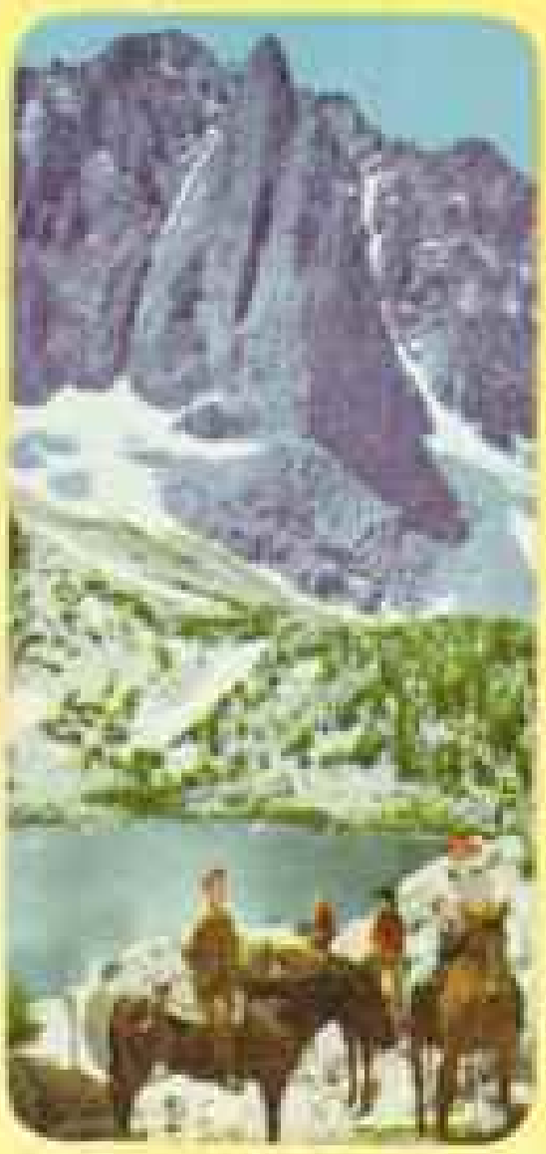
Every season is
vacation season in colorful

Southern California

Southern California has a magic ingredient called DRY SUBTROPICAL CLIMATE that makes one season just as much fun as the next! Weathermen will tell you it's: *Exclusive to Southern California in North America. Occurs only in areas between the humid tropics and the weather to the north, and usually where mountains are close to the sea. Characteristics are: Mild weather year-round; little rain; much sunshine; abundance of fruits and flowers.*

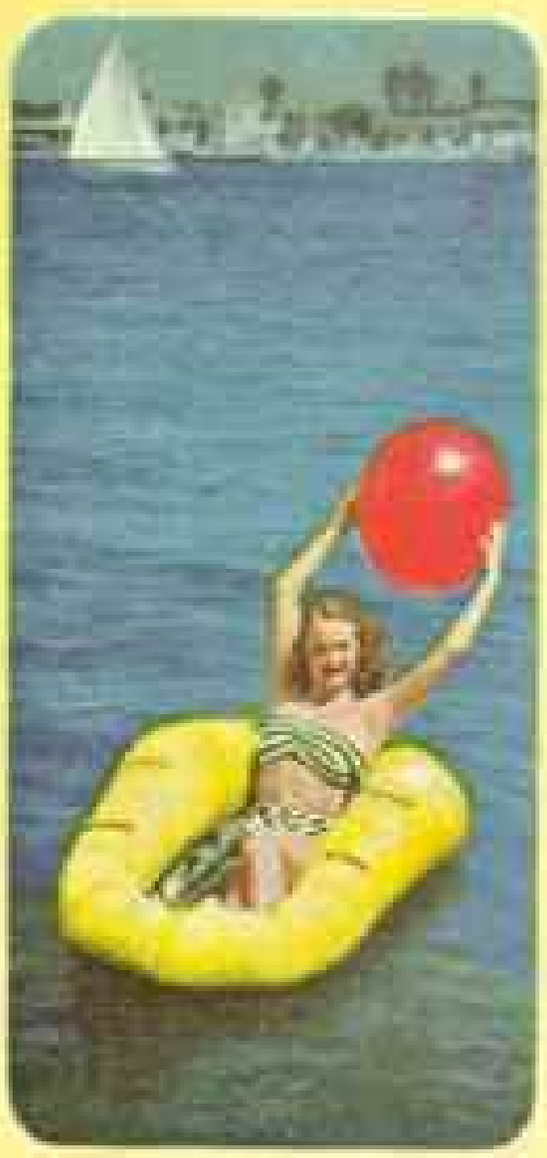
Spring

Spring is three months of air-conditioned warmth. Wildflowers. Orange blossoms. Fun at mountain, desert and seashore resorts.



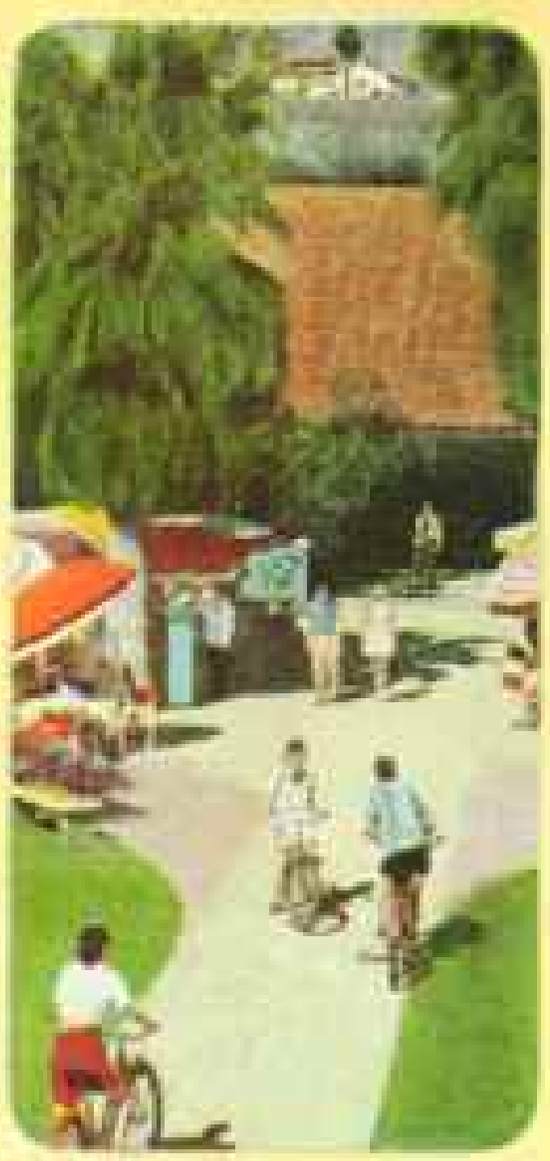
Summer

You'll enjoy sleep-under-blanket nights. Swimming, surfboarding in the Pacific. Mile-high mountain resorts. Open-air concerts.



Fall

Fall is another summer. And there are the desert playgrounds, flower shows, the date harvest in our own little bit of "Arabia".



Winter

Our *warm* winters are just the ticket for those tangled nerves. Bright flowers... green hills. Suntanning by a palm-shaded desert pool.

Visit the old missions, foreign market places, the citrus empire, movie center of the world, world-famous horse-racing tracks *when it's easiest for you to get away!* Mail coupon for free color booklet about Los Angeles County and all Southern California. Visit All-Year Club's Free Visitors' Bureau, 517 W. 6th St., Los Angeles, on arrival.

No one should plan to move now to Southern California to live unless assured in advance of permanent housing.

ALL-YEAR CLUB OF SOUTHERN CALIFORNIA, LTD.

This advertisement sponsored by Los Angeles County Board of Supervisors for citizens of Beverly Hills, Glendale, Hollywood, Long Beach, Los Angeles, Pasadena, Pomona, Santa Monica and 182 other communities. *—a non-profit community organization serving vacationists.*

America's 4-Season Vacationland

— — — — Free Booklet—Mail Coupon Today — — — —

All-Year Club of Southern California, Dept. C-3
620 S. Hill St., Los Angeles 14, California

Please send me your free vacation booklet "WHAT TO DO AND SEE IN SOUTHERN CALIFORNIA."

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Street_____

City_____ Zone_____

State_____

— — — —PLEASE PRINT NAME AND ADDRESS— — — —

MISSOURI *in the Spring...* VACATIONLAND *of* Inspiring BEAUTY!

● Soon Spring will blossom out in Missouri . . . vacationland of inspiring beauty. See the famous dogwood and redbud painting the countryside . . . the fresh air perfumed by apple blossoms. Many resorts now open. Come . . . play and rest.

Send for FREE FOLDER

Just send postcard with your name and address.

MISSOURI DIVISION of
RESOURCES & DEVELOPMENT
Dept. 638, State Office Bldg.
Jefferson City, Missouri

MOVADO

WINNERS OF 165 OBSERVATORY AWARDS

SOLD AND SERVICED BY LEADING JEWELERS ALL OVER THE WORLD

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36 Toronto St., Toronto, Canada

"It's not a green carpet, it IS grass. These people must use an Eclipse."

POWER LAWN MOWERS BY
Eclipse
A COMPLETE LINE OF HAND AND POWER MODELS

FREE BOOKLET

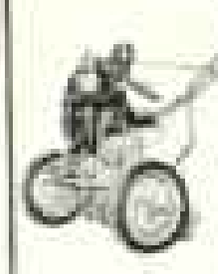
Lists all the features in a power mower. Shows and describes Eclipse models in detail. Write for your copy and name of nearest dealer. The Eclipse Lawn Mower Co., 103 Railroad Street, Prophetstown, Illinois.

THE OUTSTANDING NAME IN POWER LAWN MOWERS

Noted for precision-mowing, handling ease, dependable power and sturdy construction—Eclipse offers power mowers with exclusive features, for every grass-cutting requirement.

ROCKET 20"

Standard on Hi-Cut Models. The leader since 1938 delivers effortless, finger-tip controlled precision power mowing in an economical home-size model.



PARKHOUND 21"

For larger lawns and commercial use, this heavy-duty mower is designed, built and powered to stand up under constant use.

ROLLOWAY 25"

This easy-handling mower performs faultlessly on estates where lawn appearance is primary. Note full-swivel caster wheel.

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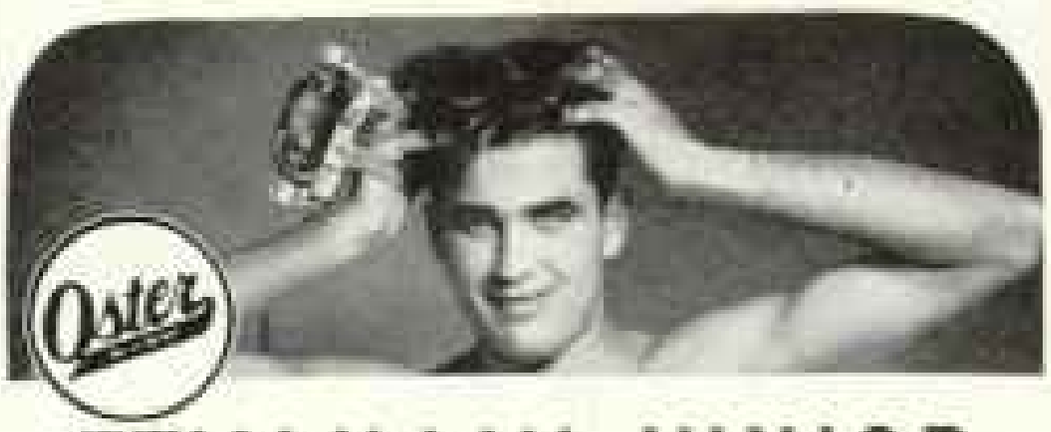
Sulky-equipped for mowing large areas. Speedway cuts a 32" swath at 800 feet per minute.



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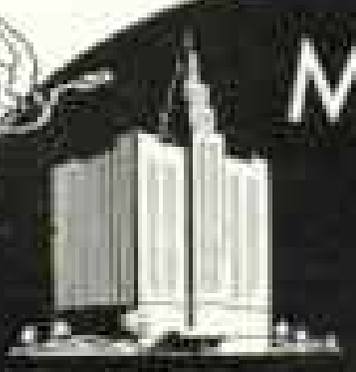

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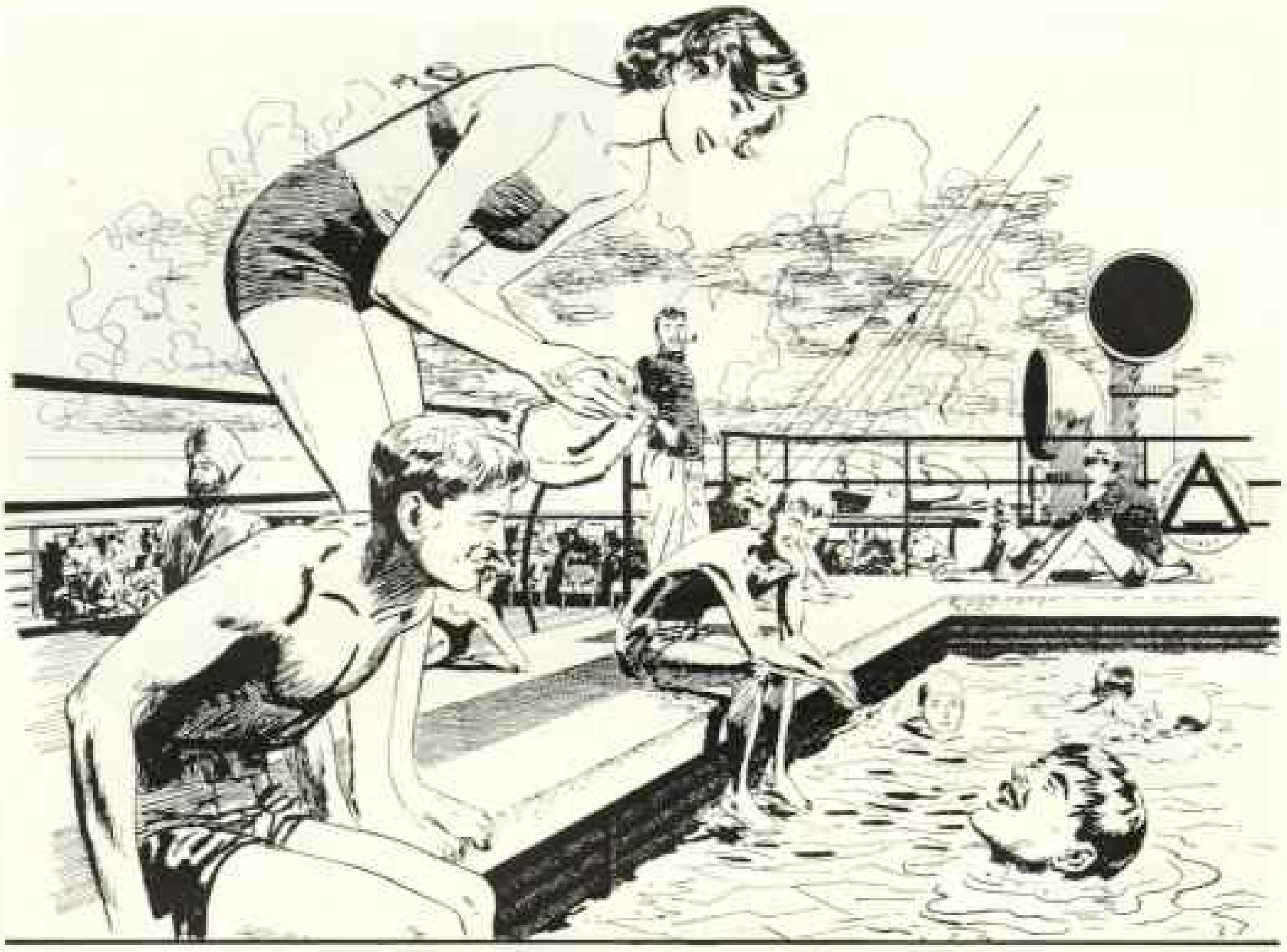

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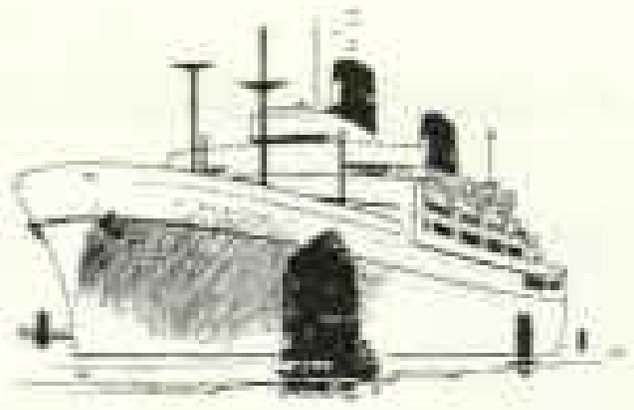

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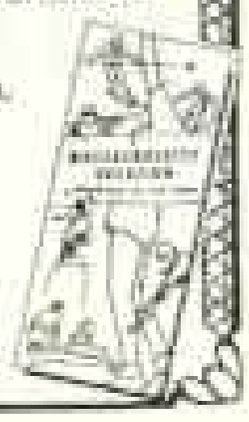

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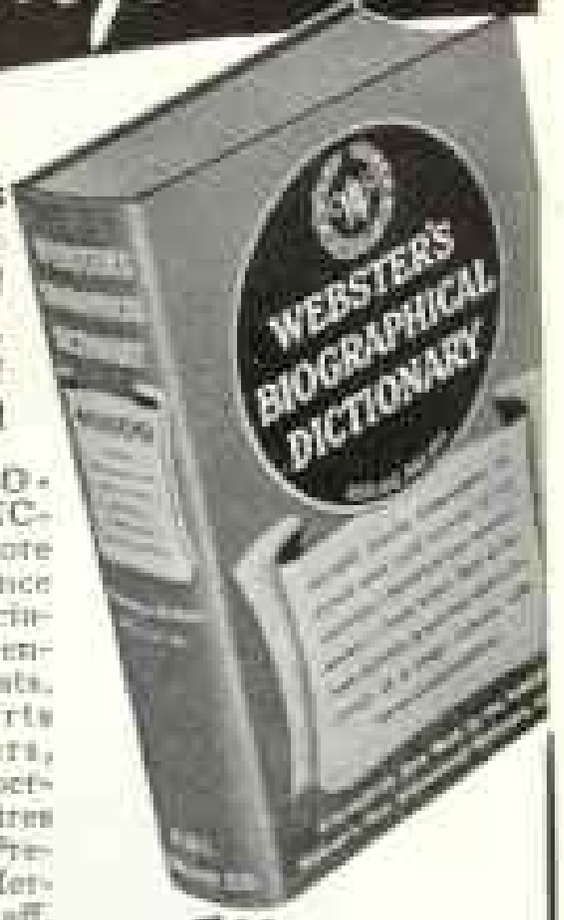

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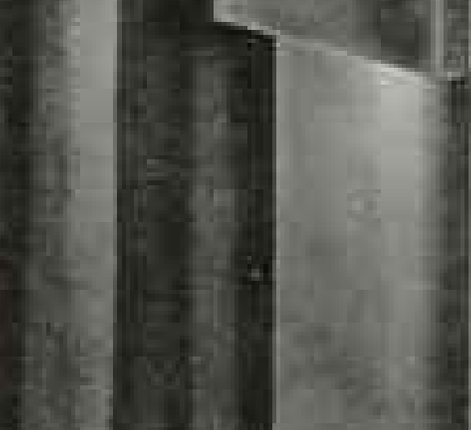

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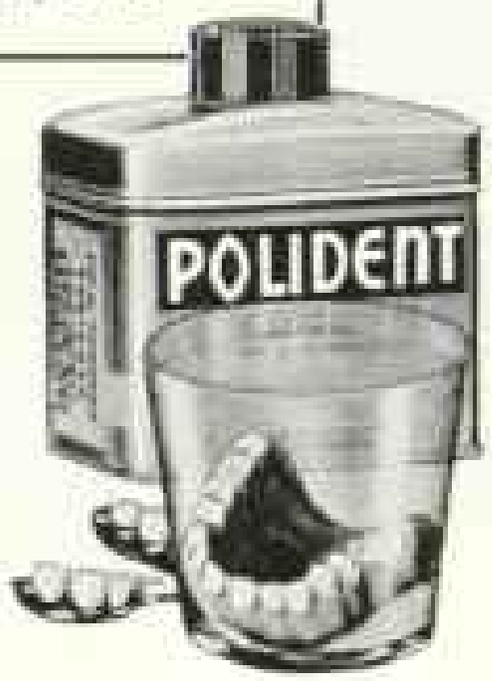

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If he loses those excess pounds—brings his weight down to normal and *keeps it there*—he will look and feel better. Furthermore, *he will probably live longer.* Statistics show that if weight is more than 10 per cent above normal, life expectancy is usually reduced about 20 per cent.

Doctors say one of the reasons overweight tends to shorten life is that it puts an additional burden on the heart and circulatory system. It has been estimated that 10 pounds of extra fat require the development of a half a mile of blood vessels. To maintain this excess body tissue, the heart has to work harder. Fortunately, with good medical care, *overweight can usually be corrected.*

The first step in any weight reducing program is to see the physician, for only he is qualified to determine your *best weight.* A six-foot man weighing 185 pounds may be 20 pounds overweight if he has a slight frame, while if he has a large frame that weight could be considered normal.

Proper diet is essential for controlling weight. Most overweight occurs because the body takes in more food than it can use up as energy, and the excess is stored as fat. The doctor will limit food intake while making sure your diet contains enough essential elements to protect general health.

Some exercise is necessary, but one should not expect to reduce just by exercising. Doctors warn you would have to walk 36 miles to lose one pound. Strenuous exercise may also increase the appetite and make it harder to reduce. So, rely on your physician to recommend the proper exercise.

By faithfully following the program your doctor suggests, it is generally possible to lose weight surely, steadily, *and safely.* For other helpful information on this subject, send for Metropolitan's free booklet, 39-N, "Overweight and Underweight."

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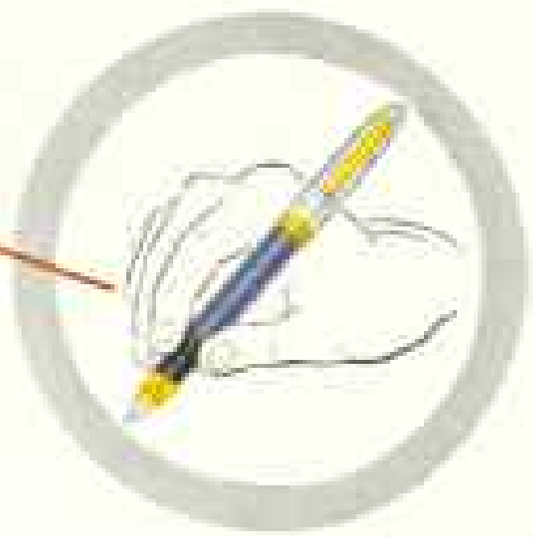

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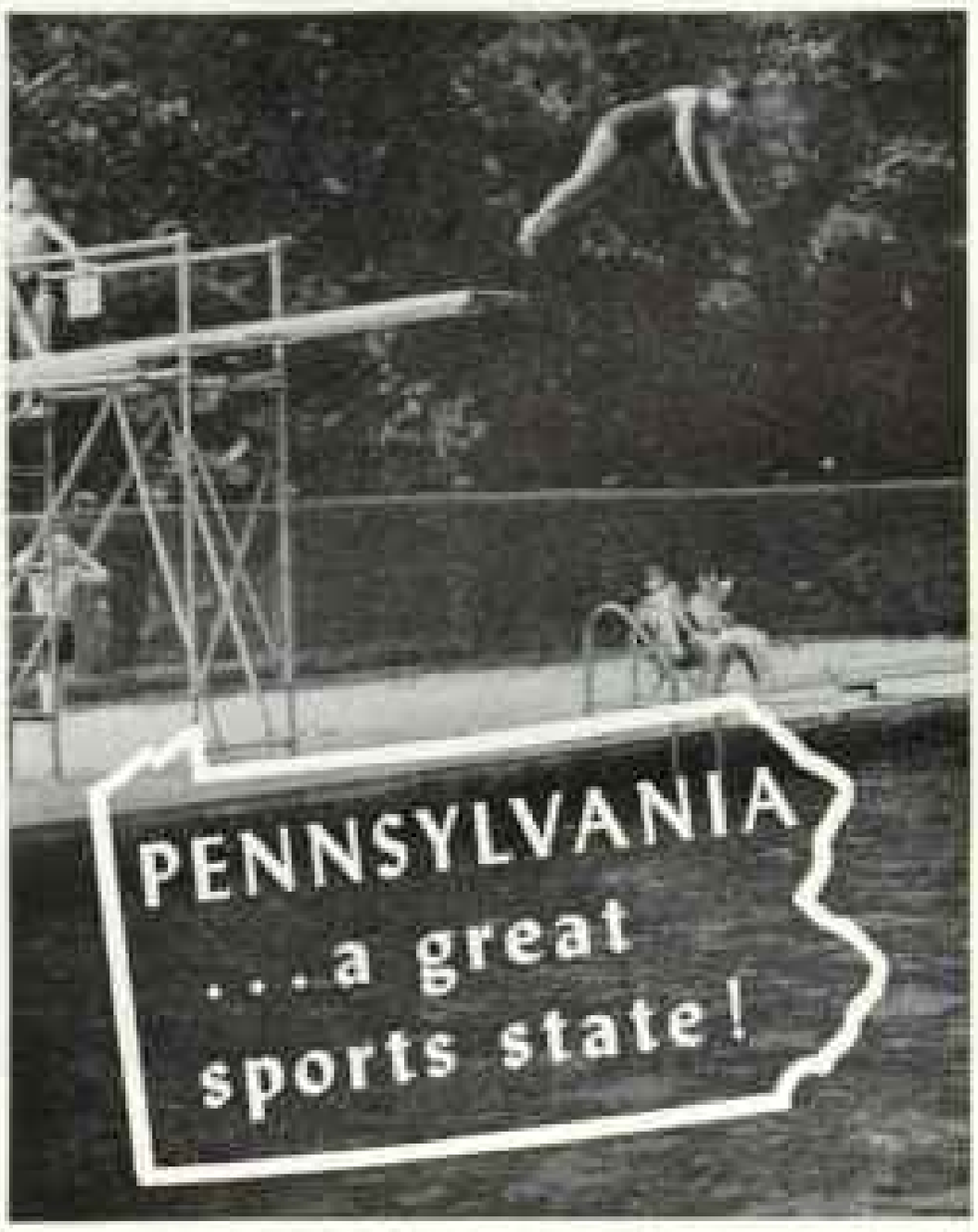

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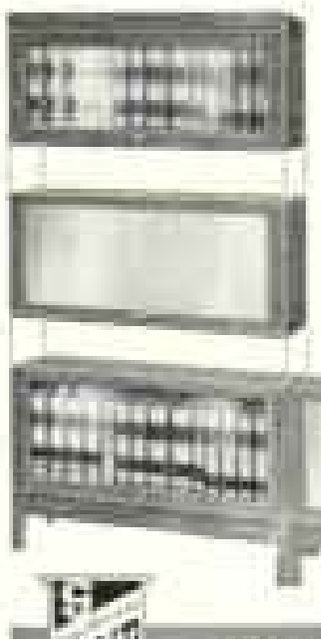

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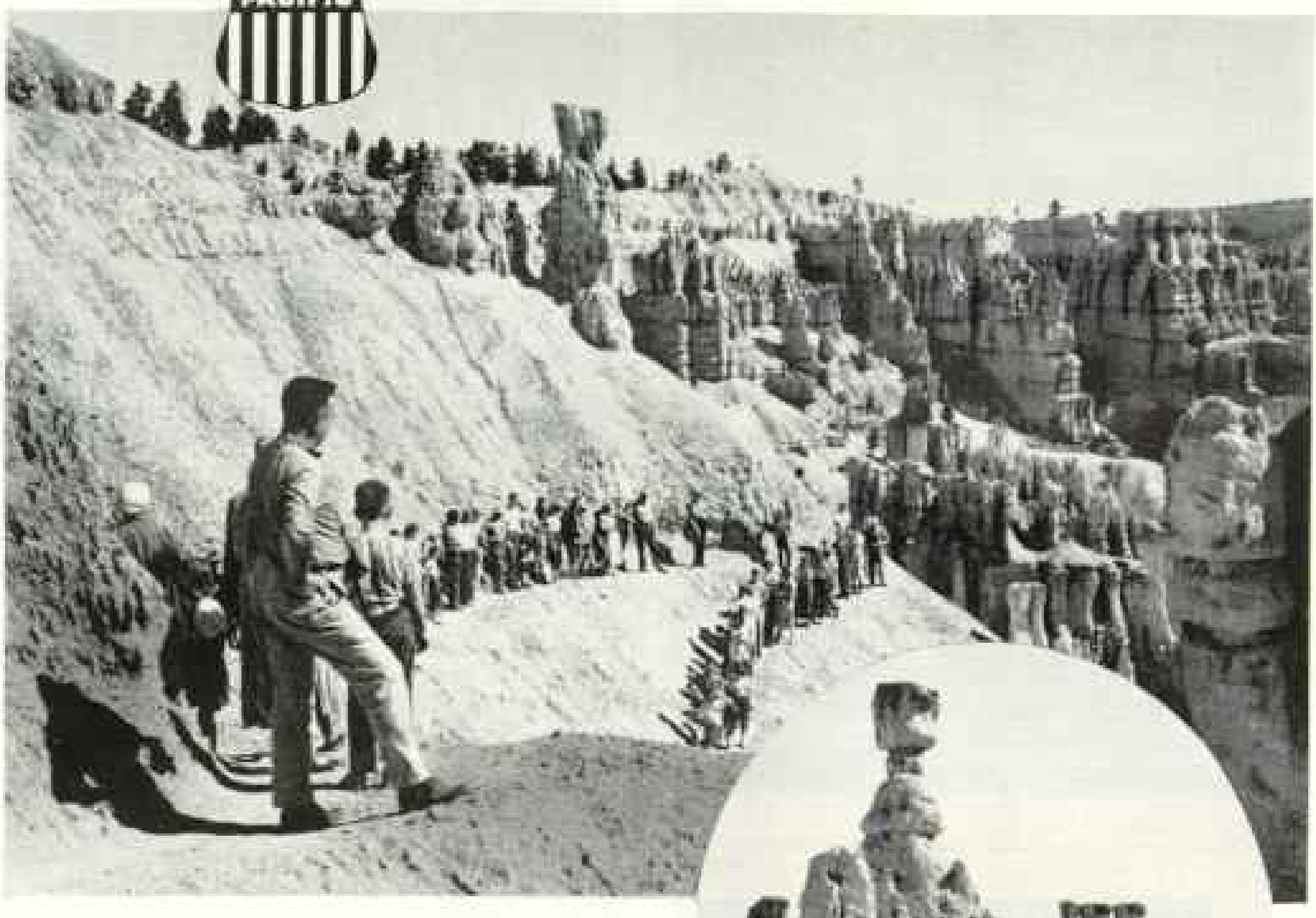

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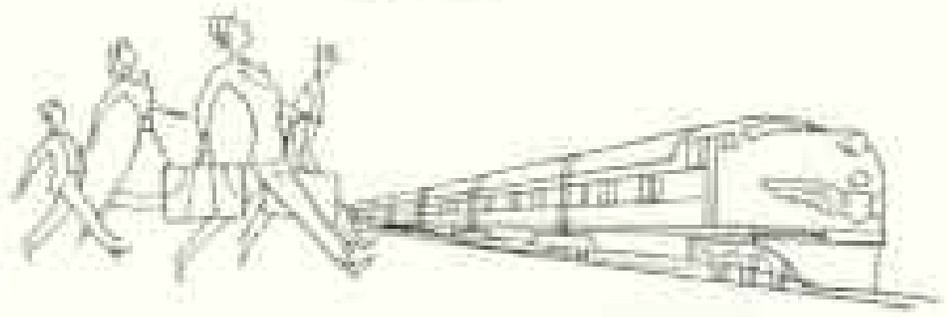

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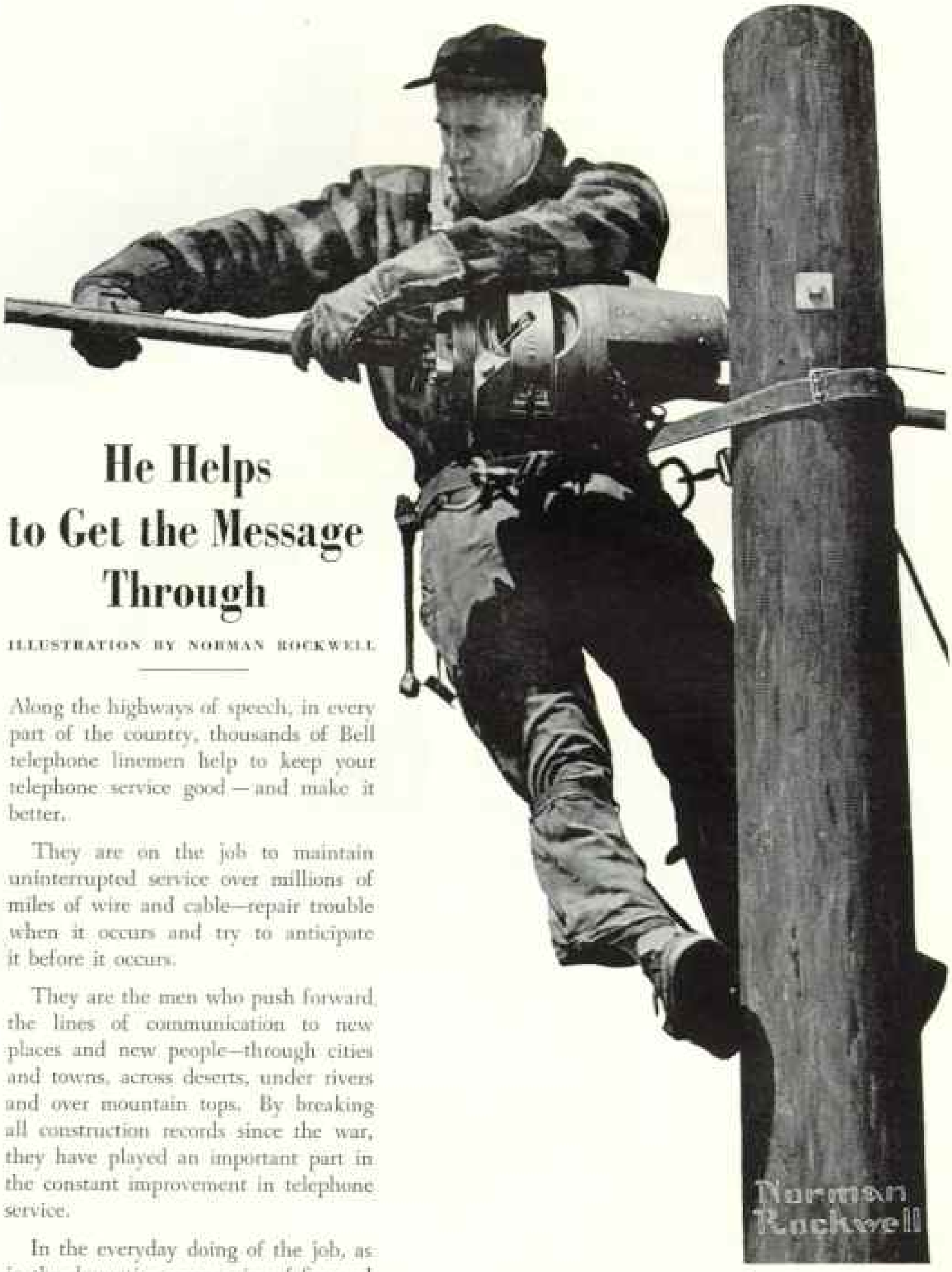

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