VOLUME XCVI NUMBER ONE

THE NATIONAL GEOGRAPHIC MAGAZINE

JULY, 1949

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

$5.00 A YEAR 50c THE COPY

VOL. XCVI, No. 1 WASHINGTON JULY, 1949

THE NATIONAL GEOGRAPHIC MAGAZINE

Appalachian Valley Pilgrimage

BY CATHERINE BELL PALMER

Illustrations by National Geographic Photographer Justin Locke

LIKE a gigantic furrow, the Great Appalachian Valley plows deep into the face of the United States, creating a continuous corridor from New York to Alabama. Between Carlisle, Pennsylvania, and Natural Bridge, Virginia, lie three sections of this Nature-chiseled pathway—the Cumberland, Hagerstown, and Shenandoah Valleys.

The day I entered the Valley, a brisk autumn breeze was wafting the cidery tang of apples. Nature blended flaming red-gold, deep purple, and brilliant yellow upon the Valley canvas. The green countryside was touched with reddish-yellow of ripening peaches and apples hanging heavy on bending branches. It was a land of beauty and of peace.

Less than a century ago the quiet of this scene was shattered by cannons' roar and shrieking shells as armies of the Blue and Gray locked in struggle.

There is much more in the Valley now than apples, pastoral scenes, and Civil War battlefield sites. From its factories, airplanes and air-conditioning units, plastics and pipe organs, rayon and rubber heels, bricks, furniture, and textiles carry this area's industrial stamp over land and sea.

A Land of Native Americans

Throughout its mountain-bordered length of some 250 miles this Valley area contains more than 600 diversified industrial plants. Scarcely larger in area than Connecticut, its 13 counties shelter nearly half a million people, of whom 92 percent are native Americans.

Early settlers in the Valley wilderness built homes first, churches and schools second, and roads third. Where east-west and north-south roads came together, towns sprang up; today they are found every few miles along the famous Valley Pike (U. S. 11).

But Valley people think counties rather than towns, with the local pride found in English counties.

In Cumberland Valley three towns on the Pike are spaced 10 miles apart, Shippensburg, Chambersburg, and Greencastle. I asked a local historian why.

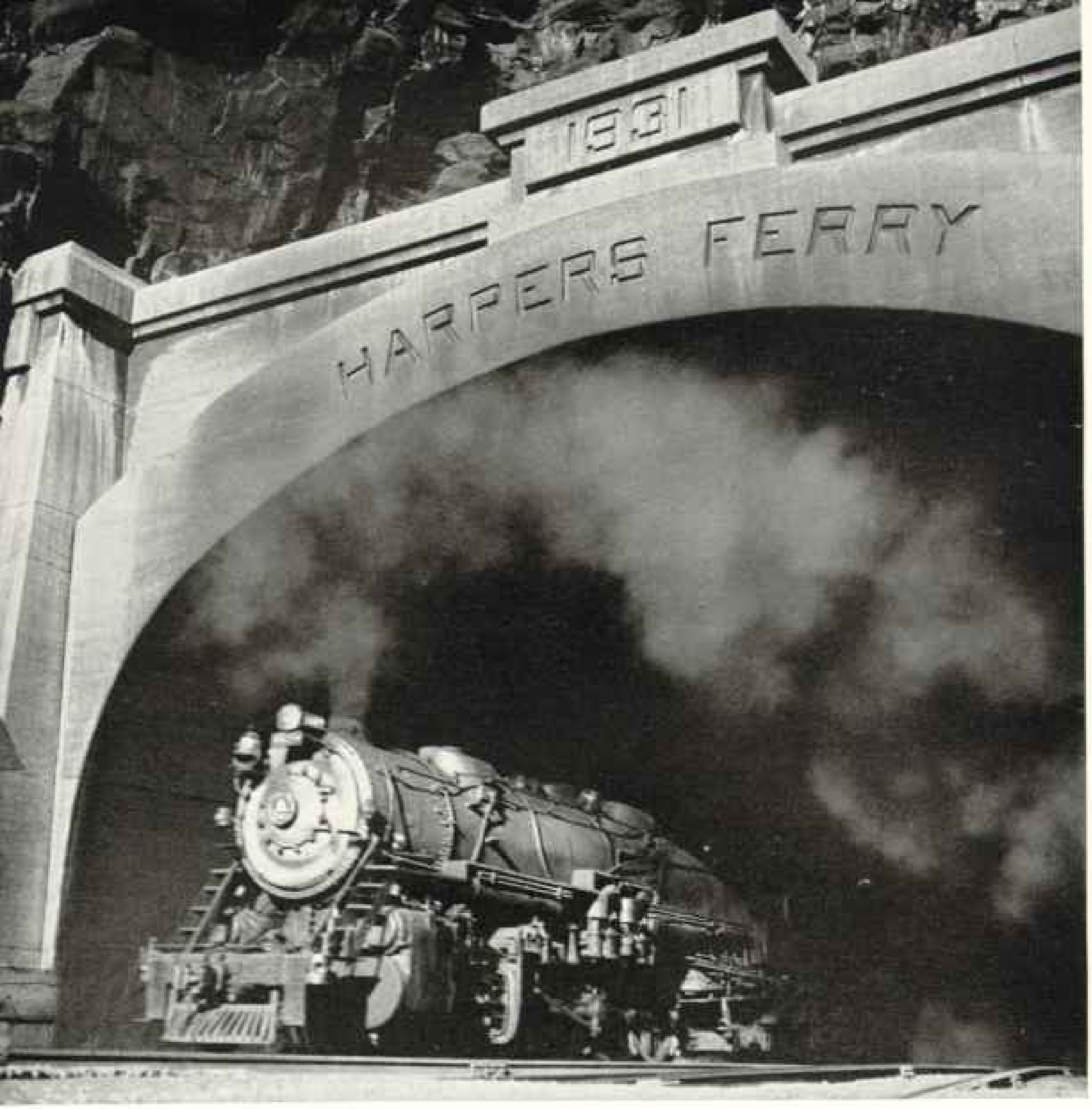
"Churchgoing Scotch-Irish settlers spaced them that way so that folks living between the towns could get to church on time," he told me. "Travel was so slow in those days a man couldn't get to a morning service if he had to go more than five miles."

Today you can hop in your car after breakfast at Carlisle and be in Pittsburgh for lunch. The 160-mile Pennsylvania Turnpike brings industrial Pittsburgh within four driving hours of the State capital, Harrisburg.

Most Cumberland Valley towns have a public square. Wide, shady streets radiate four ways from the square in Carlisle, seat of Cumberland County. Today a traffic light regulates automobiles and pedestrians crossing the square where, in the autumn of 1753, feather-crested Indians talked over peace terms with Benjamin Franklin.

On the northwest corner stands the First Presbyterian Church. Here, in 1774, indignant citizens met to protest the closing of the Port of Boston. George Washington, who was in Carlisle to quell the Whisky Insurrection of 1794, worshiped in this church.

At the Battle of Monmouth, New Jersey, Carlisle's Mary Hays carried water in a



A Baltimore & Ohio Train Puffs Through Elk Ridge Toward Harpers Ferry

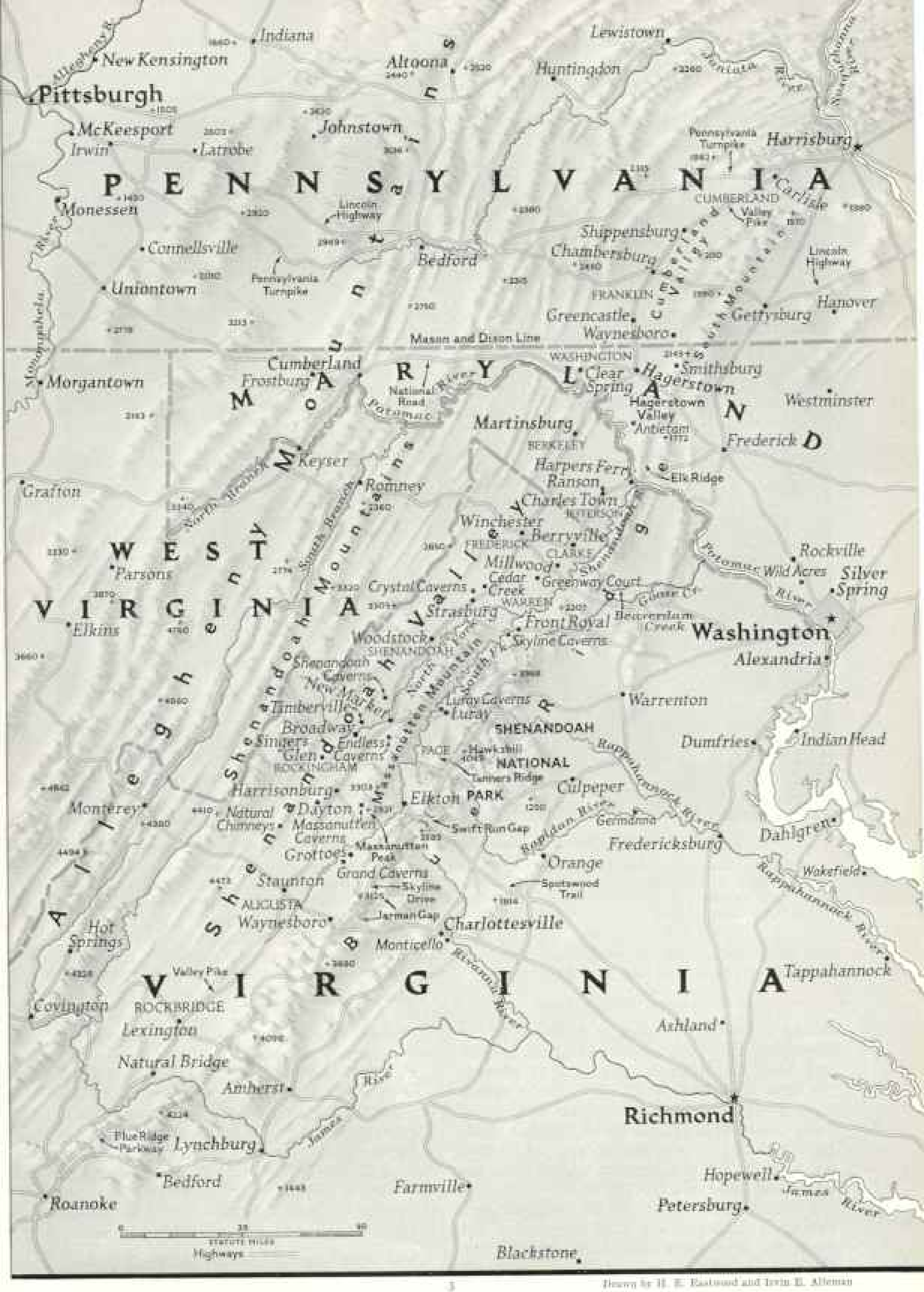
For years the Chesapeake and Ohio Canal Company fought the B & O in the courts for the right of way to Harpers Ferry. When a compromise was reached, both squeezed around the narrow strip of land between the base of the mountain and the Potomac River. Explosives powerful enough to blast the hard rock were not available until 1894, when the railroad tunneled through the ridge. The inscription, "1931," marks the date the railroad widened the west end of the tunnel.

pitcher to wounded soldiers. "Molly Pitcher," they called her, and by that nickname she is known in American history. A few blocks from the Molly Pitcher Hotel a life-size statue marks her grave in the old cemetery.

As a builder of famous athletes, the Indian School at Carlisle Barracks brought fame to the town; such names as Coach Glenn "Pop" Warner and Jim Thorpe became tradition.

Until 1936, tracks of the Cumberland Valley Railroad, now part of the Pennsylvania, ran through the center of town. The first "sleeping car" rolled over the tracks of this railroad in the winter of 1837-38. Crude predecessor of present-day luxurious sleepers, the car was a remodeled day coach, divided into four compartments with three-layer bunks.

Pushing westward from Lancaster and York came the Valley's first white settlers, German and Scotch-Irish, the name America gave to the Scots and English who emigrated to Ulster in the 17th century. Mennonites, Dunkards, Lutherans, and Presbyterians, persecuted in their mother countries, came armed with plow, rifle, and Bible, asking only for land to grow their crops and freedom to worship. Between



Drawn by H. C. Eastwood and Irvin E. Alleman

Mountain Ridges Shelter Great Appalachian Valley, Pioneer Trail to the West

"What Am I Bid?" Asks Curbstone Auctioneer, Selling Land at Greencastle

Saturday sidewalk sales of estates and stock certificates take place in several Cumberland Valley, Pennsylvania, towns. As the chanting auctioneer walks up and down the street, small children follow in his wake as at a circus parade, and indignant elderly ladies sometimes dispute his right of way. Here an attorney (gray suit, left) is selling four estates totaling 485 acres.

the mountain ramparts they found the land rich enough and spacious enough for all.*

Here Erosion Was a Boon

The Valley is a product of erosion. In the Paleozoic era waters from the Gulf of Mexico and from the Atlantic surged in to blanket the land from New York to Alabama with a huge mountain-locked sea. Some deep-down force caused upheavals in earth's surface, folding rocks back upon one another as if they were dough and sluicing the waters from the upheaving land toward the sea.

Streams which rose in the northwestern mountain ranges flowed southeastward. But when the limestones and shales beneath the Valley floor eroded faster than the resistant sandstone and quartzite rocks of the Blue Ridge, the weaker streams couldn't make the grade of the steep mountain wall. Stronger streams, cutting through the soft Valley limestone more rapidly than smaller streams, diverted them from their southeastward course and became swift rivers.

Chambersburg is the seat of Franklin County. At Memorial Square the Valley Pike crosses the Lincoln Highway, natural route for westward migration of frontier settlers.

On the northern outskirts the smell of apples led me to the H. J. Heinz Company factory. Canning applesauce for babies, first food-processing industry to provide all-year-round employment to the town, was started by Heinz

* See "Penn's Land of Modern Miracles," by John Oliver La Gorce, National Geographic Magazine, July, 1935.

A Cabinetmaker Creates a Chippendale Reproduction at Harrisonburg, Virginia

Wakefield, George Washington's reconstructed birthplace, is partly furnished with Virginia Craftsmen's reproductions of antiques. The business, started in 1927, employs about 40 men. James Metts, who sands the chair, has worked here 19 years.

in 1944. I watched machines core apples, strip off their red and yellow coats, and pass them on to be cooked and strained. The whole process from apples to applesauce takes six minutes!

"On a peak day," a company official said, "we convert some 4,000 bushels of apples into strained applesauce for babies."

Driving along King Street, I paused opposite an innocent-looking little gray frame house. Here abolitionist John Brown and his men met before the raid on Harpers Ferry.

Stocks Sold on the Street

Mountain-girt Waynesboro, Pennsylvania, has a fresh-scrubbed, clean-swept look about it. Driving down its incredibly wide Main Street, I noticed that even the parking meters lining the wide sidewalks sparkled under the shining sun.

A visitor to the town may be startled to hear the chant of an auctioneer and see a crowd around him on the sidewalk. No ordinary auction, this is Waynesboro's custom of making literal use of the term "curb exchange," by selling stocks in its industries and banks at public auction on the street.

South of Waynesboro, where Charles Mason and Jeremiah Dixon drew the line between Pennsylvania and Maryland, the Great Valley takes its local name from the city of Hagerstown, seat of Washington County.

Third largest city in Maryland, according to the Census Bureau, Hagerstown lies at the crossroads of the north-south Valley Pike and the old National Road (U. S. 40) linking east and west.*

* See "A Maryland Pilgrimage," by Gilbert Grosvenor, NATIONAL GEOGRAPHIC, February, 1927.

VMI Cadets Meet Their Dates Beneath a Statue to Stonewall Jackson: Lexington, Virginia

Virginia Military Institute graduates may be commissioned directly into the Army. They have fought in every conflict since the Mexican War. More than 4,000 served in World War II. General of the Army George C. Marshall took his degree here. General Jackson was the Institute's philosophy professor and artillery instructor. Freshmen generally salute as they pass his statue (page 24).

The afternoon I arrived, Hagerstown was busy dressing itself for the first Mummers' Parade since World War II. Bordering the public square, business buildings of 19th-century design, mingling with modern chrome-trimmed shops, were bunting-bedecked. Narrow side streets, with stocky stone houses built by early German inhabitants, were roped off.

Geography of Pipe Organs

Hagerstown's trademark, Gruber's *Almanack*, now 152 years old, forecast for October 31 "fair and pleasant."

Hagerstown's industries, many locally owned, are widely diversified—from dust-control equipment to pipe organs.

The M. P. Möller pipe organ factory has produced more than 8,000 organs. The hand-carved grilles and exterior woodwork of pipe organs are fashioned in Möller's cabinet shops from Appalachian maple and walnut, West Virginia spruce, California pine, Gulf coast cypress, Canadian birch, Honduras mahogany. The many valves admitting air to pipes are made from lambskins imported from England; shellac used on wind chests is supplied by gum from India; manual keys are of African ivory and South American ebony.

National Geographic Photographer J. Baylor Roberts

Technicians Test Streptomycin's Strength and Sterility at Elkton, Virginia

A new antibiotic, streptomycin combats infections such as tularemia, septicemia, and certain types of tuberculosis. In 1946 it cost about $25 a gram. Now the wholesale price is down to 64 cents. At Merck & Company's plant, an operator (right) pipettes culture medium into dishes. Her companion makes sure it is distributed evenly.

Beloved by all Hagerstown residents is "Little Heiskell," the Hessian soldier weather vane atop the City Hall. Fashioned from wrought iron with hammer and chisel by a Hessian tinsmith, Little Heiskell stood guard over the city from 1769 until a Civil War bullet found its way to his heart. Today he has a place of honor in the City Hall's museum, and astride the steeple of the new City Hall is a replica.

Southward through Maryland, Hagerstown Valley is guarded on the east by South Mountain, long linked with legends of mountain folk, descendants of German settlers. Now the older generation of mountaineers has died and younger people for the most part have not retained the folklore and magic cures.

South Mountain's magic cure for dropsy: take three pints of vinegar, one ounce juniper berries, one ounce squills, one gill mustard seed, one handful parsley root, two handfuls horse-radish root. Mix together and boil in an iron pot. Take a wineglassful three times a day before each meal.

Shenandoah, Ancient River Pirate

Eons ago the Shenandoah sector of the Valley was a limestone plateau level with the Blue Ridge. Streams rising in the Alleghenies flowed southeastward across the Valley to Chesapeake Bay. When the soft limestone bed eroded more rapidly than the hard rocks of the Blue Ridge, the buccaneer Shenandoah River seized the chance to "pirate" the waters of Beaverdam and Goose Creeks, and of Rappahannock, Rapidan, and Rivanna Rivers. And today "wind gaps" through the Blue Ridge are monuments to the Shenandoah's piracy.*

Harpers Ferry starts at the top of a mountain, coasts down the steep side of it, and stops abruptly where the Shenandoah River meets the Potomac. I climbed the mountain for a look at the view that Thomas Jefferson said was worth a voyage across the Atlantic. Below, the buccaneer Shenandoah poured its liquid wealth into the rushing, roaring Potomac.† Stronger than other ancient transverse Valley rivers, the Potomac cuts a deep gorge into the Blue Ridge.

When I was a child my parents took me to Harpers Ferry (page 2). There a guide had told me that I was standing in two States with my hand on a third. I think, now, he must have been pulling my leg—it would have had to be longer than it was to stretch across the Shenandoah! But it is true that West Virginia, at Harpers Ferry, does stick out its tongue at Maryland and Virginia.

Sandwiched between the Virginia and Maryland State lines, the West Virginia counties of Jefferson and Berkeley are separated from the rest of the State by the Allegheny Mountains. Now a part of the Eastern Panhandle section of West Virginia, these counties formerly belonged to Virginia.

At Charles Town, seat of Jefferson County, the courthouse where John Brown was tried and convicted for treason is still in use.‡

Somnolent Charles Town wakes up twice a year when horse-racing fans pour in to visit the race track, overflow tree-shaded streets, and clamor for rooms in the hotel.

Washington Family Estates Restored

George Washington's brothers and their descendants once owned much of the countryside surrounding Ranson, West Virginia. Today, 25 miles of whitewashed fences enclose the Washington estates, restored by a West Virginia industrialist, R. J. Funkhouser. His O'Sullivan Farms (named for the rubber corporation), including 16 historic homes and farms, cover more than 6,000 acres.

Built by two of Washington's grandnephews, restored 34-room Claymont Court and smaller Blakeley are seats of O'Sullivan Farms' cattle- and horse-breeding activities. Reminiscent of colonial plantation days, the Farms form a community which is practically self-sustaining. When I visited Claymont Court, Mr. Funkhouser's home, the frozen-food unit was well stocked with meat, chickens, and fresh vegetables, all products of the farm. Milk and butter were supplied by O'Sullivan cows.

Mr. Funkhouser also bought and restored Happy Retreat, home of Charles Washington. Though within the Charles Town limits, it is included in the Farms.

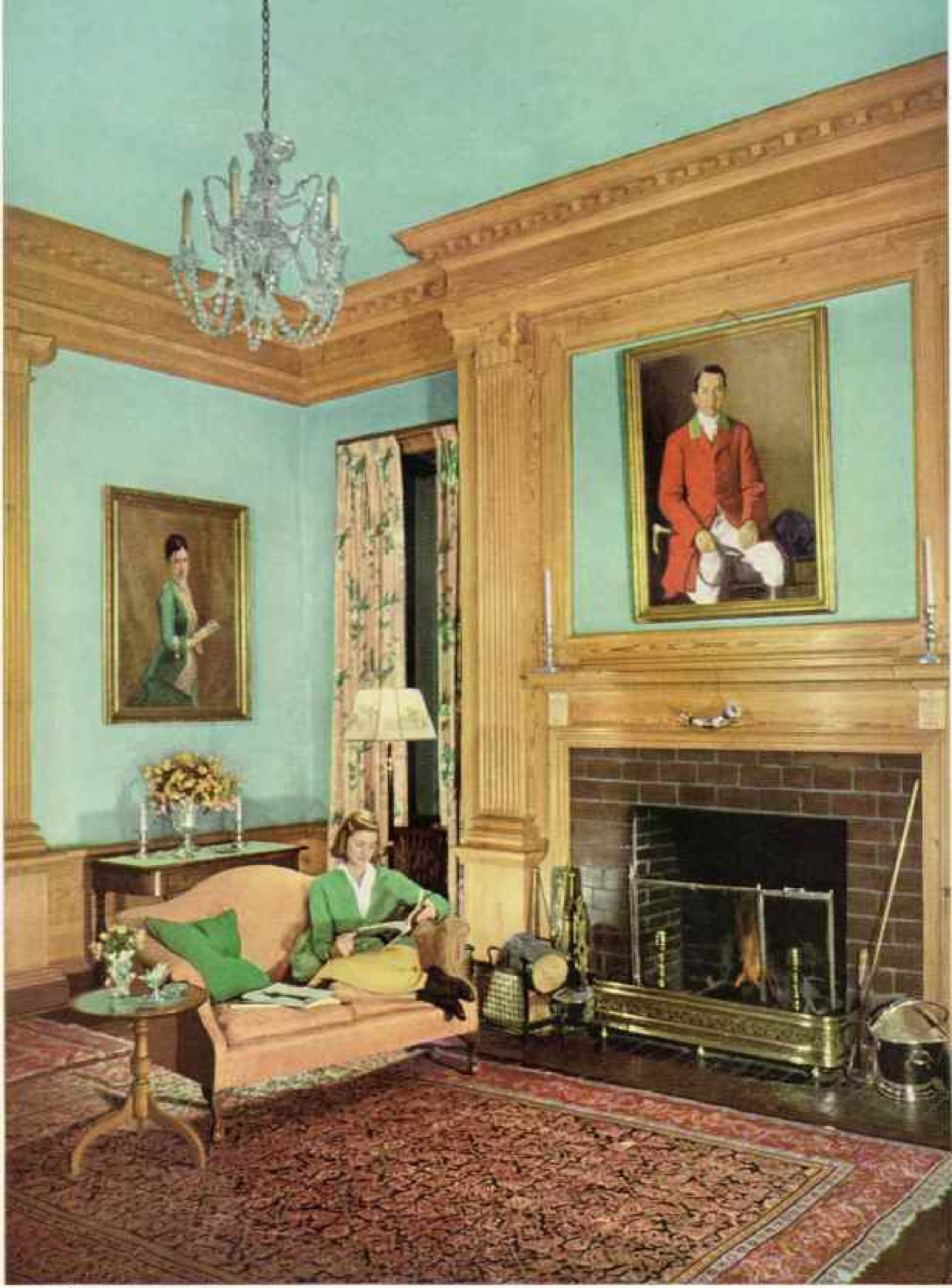
Berkeley County's seat, Martinsburg, works hard. Smoke belching from factories and freight-yard trains pervades the bustling streets of the business section. One factory produces more than 18,000,000 bricks annually, enough to build 1,800 six-room brick-faced bungalows.

Large mills of the Interwoven Stocking Company, makers of men's socks, turn out almost 25,000,000 pairs a year, enough to meet the needs of about a third the male population of the United States (page 29).

* See "Pirate Rivers and Their Prizes," by John Oliver La Gorce, National Geographic Magazine, July, 1926.

† See, in the National Geographic Magazine: "Potomac, River of Destiny," by Albert W. Atwood, July, 1945; and "Down the Potomac by Canoe," by Ralph Gray, August, 1948.

‡ See "West Virginia: Treasure Chest of Industry," by Enrique C. Canova, National Geographic Magazine, August, 1940.



Ektachrome by Justin Locke

Tradition Says Hessian Prisoners Carved Annfield's Woodwork after the Revolutionary War

Matthew Page built this home near Berryville, Virginia, and named it for his wife, Ann. A portrait of the owner, William Bell Watkins, hangs above the mantelpiece. His daughter, Virginia, is reading.

A Glorious Autumn Day Calls Hunters and Hounds to the Chase. Blue Ridge Hunt Leaves the Grounds of Carter Hall, Millwood, Virginia

Pastoral Peace Belies This 117-year-old Bridge's Past. Civil War Troops Tramped over It to Antietam Battlefield

Kodachrome by J. Baylor Roberts

A Veritable Palace for the Dairy Herd Is This King-size Barn near Clear Spring, Maryland

Fruit by the Acre Becomes Apple Butter, Applesauce, and Apple Juice at a Timberville, Virginia, Cannery

A Man of God Talks to Blue Ridge Mountain Children about Nature's Wonders on Tanners Ridge, Overlooking the Shenandoah Valley

Each Sunday the Reverend Ernest Phillips of Luray, Virginia, conducts services at an Episcopal mission here. Janet Walton, at his right, is the teacher.

Summer and the Shenandoah Captivate Bathers at a Sparkling Cascade near Woodstock, Virginia

Illustrations by J. Baylor Roberts

Nature, Using Water as a Chisel, Sculptures Masterpieces Beneath the Shenandoah Valley

Grand Caverns, near Grottoes, Virginia, was discovered in 1804 by a hunter. It is one of three in Cave Hill. Here a visitor to the "Persian Palace" points to an eons-old stalactite "shield."

Clarke and Frederick Counties mark the beginning of Virginia in the Valley. The former, smallest of the 13 counties, yields apples and thoroughbred horses. This is the land to which English settlers came from Tidewater Virginia. Thomas Lord Fairfax, English nobleman, settled at Greenway Court and gave young George Washington the job of surveying the more than 5,000,000-acre proprietary of the Northern Neck of Virginia.* Tradition says that a disappointment in love made Fairfax a misogynist and that no woman was allowed on his estate.

Through a grant by Lord Fairfax, Matthew Page inherited land in Clarke County on which he built Annfield (page 9). Present owners now use the original spelling, although for many years the estate was known as Annefield. The Custis family Bible says Mrs. Robert E. Lee was born here.

From Clarke County's seat, Berryville, to Winchester, seat of Frederick County, the winding road passes through the vast apple orchards of United States Senator Harry Flood Byrd (page 25).

From wind-swept summits of the Appalachians the Valley is a patchwork quilt of green, brown, and golden fields through which the Shenandoah weaves a curving silver thread. It's like looking through the large end of a telescope and seeing far below tiny towns with dollhouses. But these "tiny" towns, Winchester, Staunton, and Waynesboro, are industrial cities, each with populations of more than 10,000 persons.

Winchester, Old in Years, Modern in Ways

Oldest Virginia city west of the Blue Ridge, Winchester was founded in 1744 by Col. James Wood. In 1752 it was named for his birthplace, Winchester, England. In its older section houses built flush with shaded streets hide their gardens in the rear; newer homes proudly display their flower beds in front.

Largest industrial plant in Winchester is the O'Sullivan Rubber Corporation, originators of rubber heels for shoes. This plant turns out 150,000 pairs of rubber heels and soles a day (page 29).

Symbol of Winchester is the apple. I visited one of the town's big cold-storage apple plants and saw room after room filled with apples, in crates and bushel baskets. One room was so chock-full of loose apples that walls had disappeared from view and only a portion of the ceiling was visible.

Of the average 2,500,000 bushels of apples from Frederick County's 700,000 trees, this one plant can hold a million and a half.

From all parts of the country thousands come each year to see the Apple Blossom Festival, held on the campus of privately endowed Handley Public High School.

Wandering along Winchester's streets, whose names reveal the nationality of her founders, visitors linger to see historic shrines. Within one block on Peyton Street are the site of Fort Loudoun, built by George Washington for defense against French and Indians, and the house where Stonewall Jackson had his headquarters during Civil War days.

On Amherst Street is the house where Daniel Morgan, Revolutionary hero of Saratoga and Cowpens, died.

From the present Elks Club building on Piccadilly Street Philip Sheridan began his famous ride to Cedar Creek.

During the Civil War the Shenandoah Valley was called the "granary of the Confederacy." Winchester, northern gateway to the Confederacy, changed hands more than 70 times. Both Federal and Confederate troops marched up and down the Valley Pike so many times that it was known as "the soldiers' racecourse."

Between Front Royal and Strasburg looms rugged Massanutten Mountain, the range which cuts the Valley in two for about 50 miles. Here the Shenandoah divides into two branches, the North Fork draining the wider western valley, the South Fork meandering through the narrow eastern valley.

Explorer John Lederer, reputed to have been the first white man to see Shenandoah Valley, may have come through a gap near Front Royal in 1670. Looking down at the curling white smoke rising from Front Royal's factories, I wondered what he would think if he could see it now.

Front Royal, seat of Warren County, is the northern gateway to Shenandoah National Park. Today the town is dominated by a large viscose rayon plant, which employs 3,000 people. When I first visited the sleepy rural village in 1940, it was beginning to recover from the sudden influx of tourists streaming southward to the park. Homes had hung out neon signs to attract them; restaurants, gas stations, and "ye olde gifte shoppes" had mushroomed up and down the main street.

Shenandoah National Park, extending 65 miles along the crest of the Blue Ridge from Front Royal to the vicinity of Waynesboro, Virginia, has about 194,000 acres. Altitudes vary from 600 feet above sea level at the northern entrance to 4,049 at the summit of Hawksbill Mountain.

* See "The Travels of George Washington," by William Joseph Showalter, NATIONAL GEOGRAPHIC MAGAZINE, January, 1932.

Turkey or Oysters Any Time of the Year!

Frozen-food locker plants are sweeping the country, having increased from 2,000 in 1940 to 11,000 in 1949. Some 22 million Americans store 1¼ billion pounds of food annually in individual lockers. Most lockers hold meat, fish, poultry, vegetables, fruit, and ice cream; some contain rabbit, buffalo, and even possum (page 23). Average locker, renting for $12 a year, holds about 200 pounds. This is the Mutual Cold Storage plant at Broadway, Virginia.

Soon after the park was authorized by act of Congress in 1926, the National Geographic Society purchased 1,000 acres and presented them to the park.

In 1948 nearly a million people visited the park, coming from every State in the Union, the District of Columbia, Canada, and foreign countries. To the botanist and the ornithologist the park is a paradise. More than 700 species of trees, shrubs, plants, and vines, and 130 species of birds have been identified.

The 96-mile scenic Skyline Drive runs the entire length of the park along the backbone of the Blue Ridge from Front Royal to Jarman Gap, where it connects with the Blue Ridge Parkway, now under construction. When completed, the parkway will link the Shenandoah and Great Smoky Mountains National Parks. Paralleling Skyline Drive through the park is the Appalachian Trail for hikers.

According to popular legend, *Shenandoah* was Indian for "Daughter of the Stars." One starlit night I stood on a high, wind-swept cliff of the drive and looked down into the Valley. The twinkling lights far below, sparkling jewels against black velvet, seemed to be reflections of the stars above.

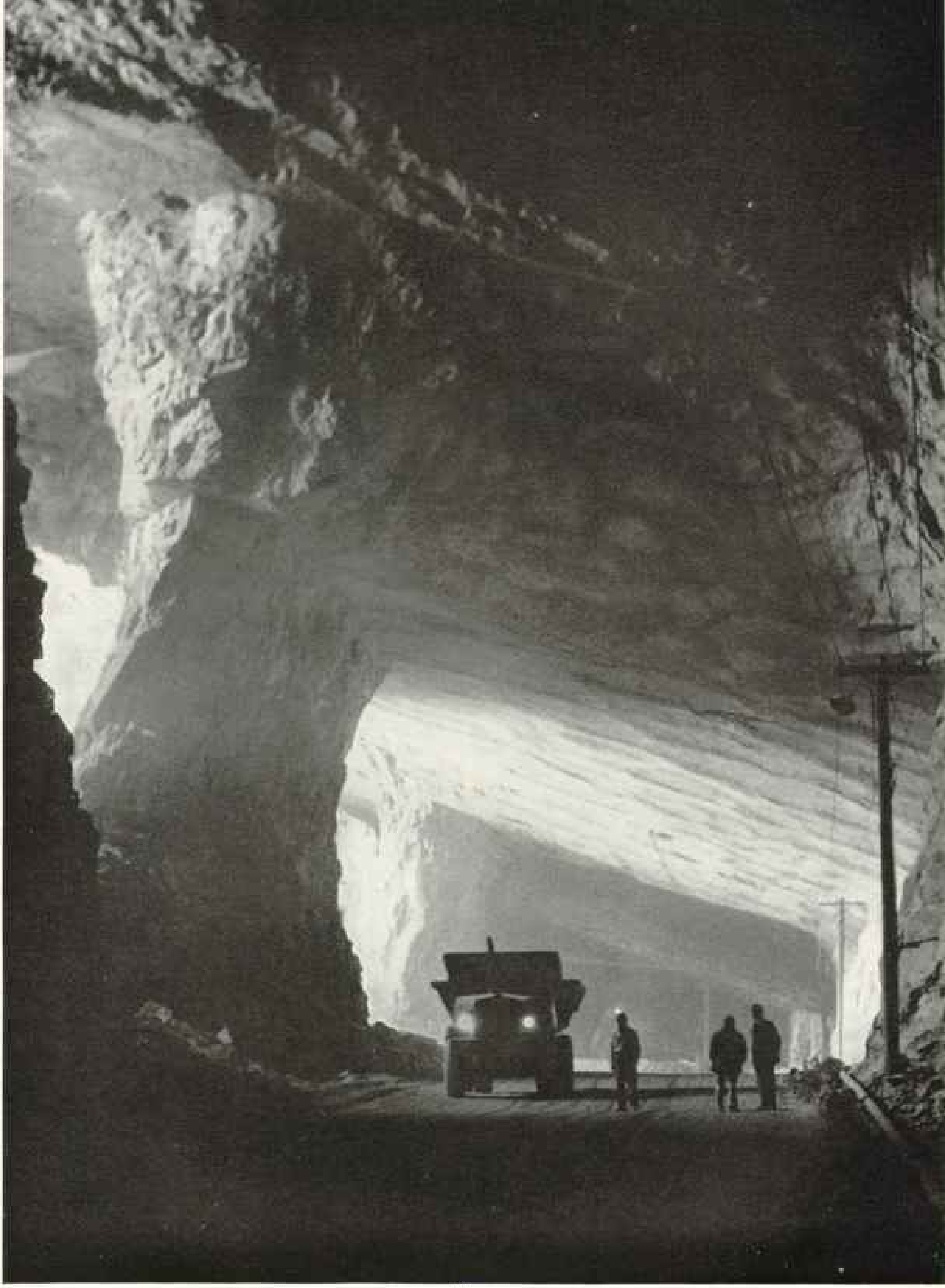
When Shenandoah National Park was created, families who had lived in the hills and hollows of the Blue Ridge for generations had to be moved. Some were able to purchase homes elsewhere; others, aided by Government loans, were relocated in homestead communities; still others became State charges.

These people, isolated from the outside world, retained for generations some of the Elizabethan words, Old World ballads, and superstitions of their ancestors. Modern times have changed their lives (pages 14, 31, 32).

Within the mountains are several missions. My guide during my visit was the Reverend Dennis Whittle, an Episcopal clergyman who had worked among the people for years.

"These people are of good stock," he told me. "You'll find them cordial and hospitable. I think they are the salt of the earth. Many writers have played up the illiteracy and the moonshining found in some parts of the mountains, but this is not a true picture."

With almost no exception, each home we



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Sunlight, Headlights, and Miner's Lamp Pierce the Gloom of a West Virginia Limestone Mine

Shenandoah limestone is used in the manufacture of paper, glass, paint, leather, and synthetic rubber. In blast furnaces the crushed stone purifies molten iron. Trucks here rumble through miles of underground highways.

visited had a picture of Christ on the wall and a Bible on the table. And in almost every house, simple homespun prayers were offered for the minister and sometimes for me, too, with a sincerity that touched the heart.

Our first stop was in the Mill Creek section near Luray, seat of Page County, where we visited Bob Lam and his wife, Lessie. Bob, who had formerly lived in the park area, had been able to buy his farm when he moved, partly with money earned by raising ginseng, an herb exported largely to China.

Quaint Speech and Archaic English

"Do stay for lunch," Mrs. Lam said. "But I'm a warnin' yer, a short horse don't need no curryin'."

"What does that mean?" I asked.

"Means I don't have much to offer yer, so it won't take long to fix it."

When we sat down to a table loaded with roast pork tenderloin, string beans, hot biscuits, scalloped potatoes, hot applesauce, cake, and steaming coffee, I wondered what a "long" horse would have provided. Except for the coffee, all the food was raised on their farm.

The Blue Ridge is composed of a number of ranges with hollows, or small valleys, between them. A small cabin in a hollow high up in the mountains outside the park was our second stop. I met a widow whose husband had died before she had to move out of the park.

"Who built your house for you?" I asked.

"The men from hyarabouts give what time they could and built it fer me. They sure holped me aplenty."

The use of the archaic word "holped," for "helped," was the only time I heard old English spoken when I was in the mountains.

Torrential downpours made hard driving up steep, slippery clay roads. In search of a singer of Old World ballads, I tried one day to drive the Geographic car up one of these slick roads, with no luck. We took to the foot trail and, after climbing a mile through oozing mud, came to a clearing high on a windy hill. There, snuggling down into the ground as if to protect itself against the weather, was a rough-hewn log cabin.

Through the window I heard the strains of a hillbilly song, the only one I heard while in the mountains. On the front porch a young girl was beating a rag rug in time to the music, broadcast from a local radio station!

The little old lady who had once sung ballads couldn't, or perhaps was too shy, to remember any of the words or the tunes.

But the wet climb up the mountain was worth while when, slowly shaking her head, she said, "We don't get together no more to sing. Seems like thar's so much ahustlin' and abustlin' in the world nowadays, folks don't have time for them kinda things no more. But I do listen to the radio."

Her few words told the story of how modern civilization has brought a different way of life to the mountain people.

In a crowded one-room school some of the children grouped themselves around the center stove and sang the ballad of *Little Doris Dean* for me. Written by one of the mountain folk in 1944, the ballad tells of a four-year-old girl who wandered away from her mountain home in the Blue Ridge. It begins:

> At the foot of the Blue Ridge Mountain,
> By the rest of the world unseen,
> Stands a little mountain cabin,
> The home of Doris Dean.
> The first four little summers
> She played around its door,
> And then it seemed that Doris thought
> There wasn't room no more.

Later I talked with one of the searchers, a God-fearing mountain man. "We found her with rattlesnakes all around her," he told me. "But them snakes didn't tech her. Yer know why, ma'am? 'Twas cus the hand of the Lord was on little Doris Dean."

Valley-bisecting Massanutten separates the counties of Page and Warren from Shenandoah County. Connecting link is the curving Luray-New Market road (U. S. 211), which follows an old Indian trail up the mountain.

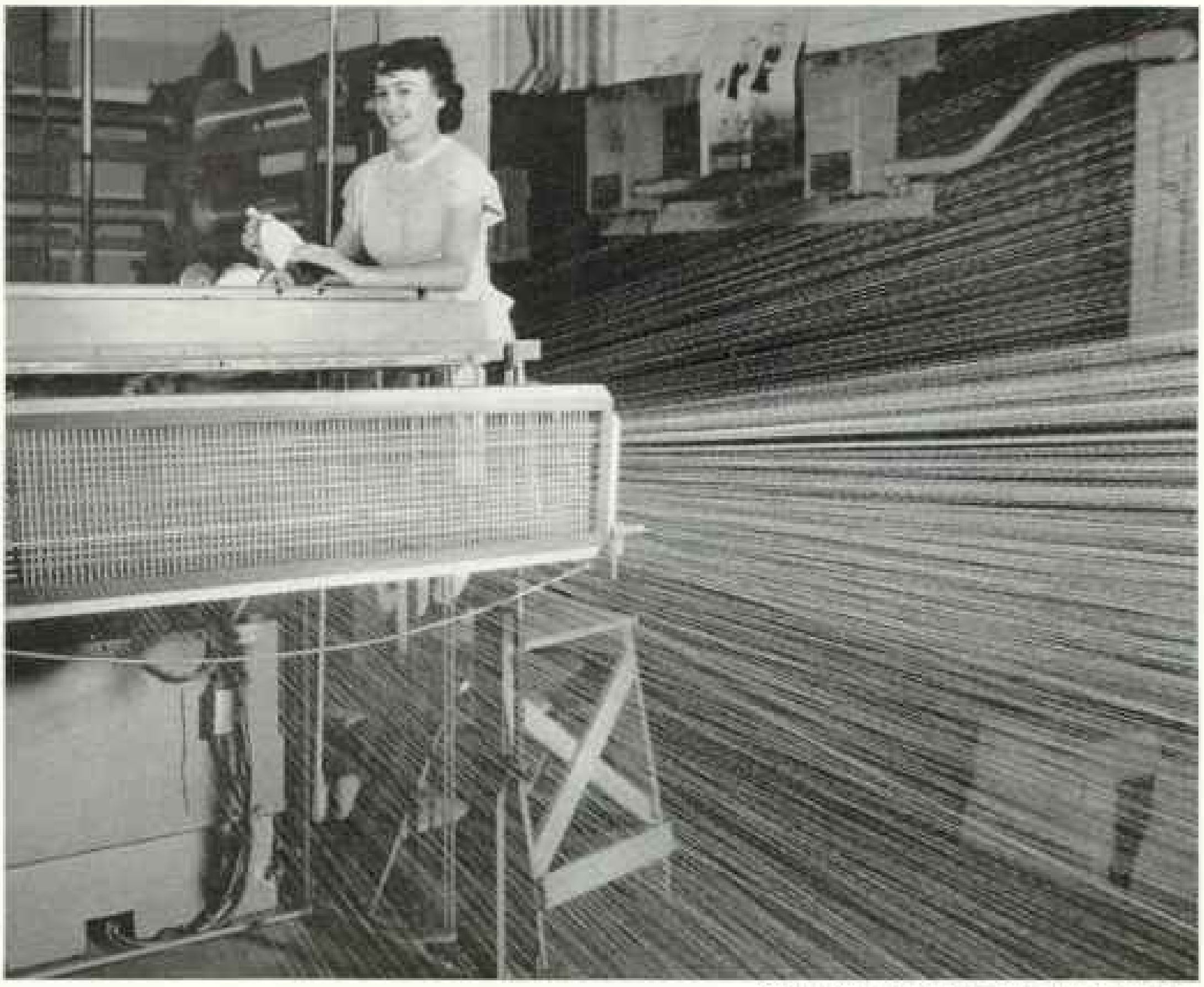
Shenandoah County, named for the river which winds slowly through the land, was settled by German farmers attracted to its alluvial soil. Road mileage between Strasburg and Woodstock, the county seat, is only 12 miles, but between the two towns the broad silver ribbon of the North Fork of the Shenandoah River loops back on itself several times, making the river distance 30 miles.

South of New Market a roadside marker designates the southwestern boundary of Lord Fairfax's land grant.

Near by, the Greer-Hale Chinchilla Ranch specializes in the breeding of these little rodents. In one house, air-conditioned in summer and heated in winter, each pair of chinchillas has its own apartment and nursery.

The Shenandoah Valley is visited by thousands each year. Recently your Society received a letter from a member in Bombay, India, who plans a trip to the United States and yearns "to travel down the east coast, paying particular attention to the Shenandoah Valley."

Fair are her meadows, fairer still her misty mountains; but under the Valley's floor Nature has carved masterpieces, the famous



National Geographic Photographer J. Baylor Roberts

These Thousands of Rayon Threads May Become Your Lingerie or Blouse

In 1948 the United States produced more than one billion pounds of rayon. Here at Waynesboro, Virginia, E. I. du Pont de Nemours & Company has been making the synthetic fiber since 1929. No cloth is manufactured, but yarn is wound on spools for weavers. Shown is the last step in the creation of acetate rayon. The manifold ends of fine-denier yarn are being spooled to form the warp for delicate fabrics.

caverns. These water-carved wonderlands, Endless, Luray, Grand, Massanutten, Crystal, Shenandoah, Skyline, and others are now a leading Valley industry (page 16).

Roads cross the Valley where wind gaps pierce mountain ranges. Through these former water gaps rivers flowed ages ago.

At Swift Run Gap stands a pyramidal monument to the Knights of the Golden Horseshoe, early society of explorers led by Governor Alexander Spotswood of Virginia.

Amid blaring of trumpets the Governor, in green velvet riding habit, boots, and plumed hat, started with his little band of men from Germanna on the Rapidan. Unlike most early explorations in America, this expedition was a gala affair, with the fiesta quality of a New Orleans Mardi Gras.

Well provisioned with liquid refreshment, these convivial geographers reached the summit one September afternoon in 1716 and recorded: "We had a good dinner, and after it we got the men together and loaded all their arms; and we drank the King's Health in Champagne, and fired a volley; and the Princess's in Burgundy, and fired a volley; and all the rest of the Royal Family in claret, and fired a volley."

From Swift Run Gap I followed the Spotswood Trail down the mountain into Rockingham County. I must have parked the car on the same spot where Spotswood reined in his horse and exclaimed, "This is the Garden of Eden!" The lush woodlands were touched with fiery fingers of sumac, and Virginia's crimson creeper held tall green pines and broad yellow oaks in its embrace. Cotton-white clouds scudding across the blue sky cast dark shadows on the sun-kissed soil. Against the blue background of Massanutten Mountain lay the broad, verdant Valley.

Many tales are told about the origin of

No Ice Cubes Are Needed to Chill the Water in This Springhouse: Singers Glen, Virginia

Springhouses, the predecessors of electric refrigerators, were used in pioneer days to cool dairy products. Some, built over brook or spring, served as basements, as in this home. Others, made of stone, clay, or logs, were combination smokehouses and springhouses. Like deep, dark wine cellars, springhouses are cool retreats.

Massanutten's name. One version I heard concerned a Valley explorer who encountered a colored man.

"Is there gold in those mountains?" he asked him.

"Massa, no," was the reply.

"Is there coal?"

"Massa, no."

"Well, then, what *is* in those mountains?"

"Massa, nuttin'!"

In rolling Rockingham County, settled by German farmers, the Valley widens so that sometimes only one of its protecting walls can be seen at a time. Southeast of the county seat, Harrisonburg, Massanutten Peak, southern end of Massanutten Mountain, slopes down into the wide Valley (page 30).

Experiments in Cooperatives

South from Winchester toward Rockingham rode General Phil Sheridan in 1864, burning the Valley so completely that a "crow flying over it would have to carry its own provisions."

When war was done, Rockingham farmers gazed silently at the charred remains of their barns and established a cooperative, the Mutual Fire Insurance Company.

Today, milk, poultry, meat packing, cold storage, and electric cooperative associations are mutually owned and operated.

Rockingham calls itself the "turkey capital of the East." Last year the county produced 500,000 turkeys, almost half of the State's entire crop. It takes seven months to produce one 20-pound turkey. But at Broadway, Virginia, a processing plant can dress 5,000 Thanksgiving birds a day.

Farmers are not one- or two-crop men. On individual farms turkey raising is worked in with crop rotation. Blood-tested poultry is nursed in the midst of an apple orchard: or milk cows and beef cattle graze on one hill while sheep jump lightly over rocks in the adjoining field.

Practically every sizable town has a co-operative cold-storage locker plant for freezing and storing foods (page 18). Farmers slaughter their cattle and hogs and store their meat in rented individual lockers.

Vitamins and Antibiotics from Elkton

Near Elkton, onetime camping ground for Stonewall Jackson's army, Merck & Co., Inc., manufacturing chemists, supplied our armed forces during World War II with tons of anti-malarial atabrine. Today the plant helps supply vitamin-conscious Americans with thiamine and riboflavin and produces the new antibiotics, streptomycin, dihydrostreptomycin, and penicillin (page 7).

At Harrisonburg, the Bible School of co-educational Eastern Mennonite College trains students to serve in the Mennonite Church. It was the afternoon recreation period when I arrived. Wearing white caps so tiny that they looked like baby bonnets and armed with tennis rackets, girls poured out of the buildings. Reaching almost to the tops of their ankle-laced tennis shoes, their gay print dresses were a contrast to black cotton stockings.

When I mentioned the color and length of the dresses to a school official, she replied, "I believe you have in mind the Amish Mennonites. We are more liberal. As to length, we do not prohibit the girls from wearing shorter dresses. We leave that to the dictates of each girl's conscience."

Coming out of the building, I heard that American two-toned "wolf whistle," with the accent on the last tone. Written, it might look something like "Whew—*where!*" I couldn't repress a smile when, looking in the direction from which the whistle came, I saw two teen-aged Mennonite boys waving to me.

Today in the Shenandoah Valley rural singers use some of the same syllables employed in medieval times. Because they sing fa, sol, la, fa, sol, la, and mi, instead of do, re, mi, fa, sol, la, and ti, they are called "fasola" singers.

In a Blue Ridge mountain cabin I heard one of the mountain people sing from a "shape note" hymnal. Starting on absolute pitch, without the aid of even a tuning fork, he sang in a high falsetto, using the syllables, fa, sol, la, rather than the words. He told me his singing-master father taught him to "hear" the musical sound of each note by its shape.

At a farm near Harrisonburg, German Mennonite Joseph Funk printed his shape-note hymnals more than a century ago. Today in the tiny village of Dayton, Virginia, his descendants still print shape-note music.

Stepping off the street into the little publishing house, I closed the door on a modern world to spend a delightful half-hour in an Old World atmosphere. At his roll-top desk, littered with letters, ledger books, and sheet music, sat Funk's great-grandson, Will H. Ruebush, puffing on his corn cob pipe.

"So you want to know something about shape notes, do you?" he asked, pushing back his green eyeshade and fumbling through the mass of material on the desk for a blank sheet of paper. "Can't ever find anything. Got hundreds of letters to answer from all parts of the country. Answer them myself. Our books go to every State in the Union."

In a fine Spencerian hand he wrote down the seven notes and their shapes for me: do, ◿; re, ▭; mi, ◆; fa, ◺; sol, ⬭; la, ▭; and ti, ▽.

Augusta County, Rockingham's southern neighbor, clings to old customs. Every year a modified jousting tournament is held at the base of Natural Chimneys, the seven Cyclopean towers of rock which rise more than 100 feet above a level plain.

It all started, I was told, when a local belle, courted in the summer of 1821 by two swains, was unable to choose between them. Someone suggested she "bestow her favor" upon the winner of a modified jousting test. The event was such a success that Valley families have held a tournament every year.

Folklore of Mountain People

Some of the people living in the Allegheny Mountains have retained the folklore of their Scotch-Irish, English, and German ancestors.

At a guest lodge in the Alleghenies the owner asked me if I had ever heard of the custom of "bellsniggling."

About a week before Christmas the men, wearing women's clothes, and the women, dressed in men's clothes, all wearing home-made masks, come to her door, she told me.

"I'm supposed to guess who they are."

The custom is similar to beggars' night, before Halloween, because handouts are expected.

Later I found the word is derived from German Palatinate dialect, *Belshnickle*, or *Belsh Nichel*, meaning Santa Claus.

These people have words of their own. Diapers are "hippons" and a chipmunk is a "faerydiddle."

When a child doesn't grow, in these mountains, you measure him with a string, then put the string in a rut in the road. When a car runs over the string the evil spell will be broken and the child will start growing.

Staunton: Roller-coaster Town

Staunton, like Rome, is built on seven hills. Legend has it that present steep streets followed Indian trails. On one hill is the gleaming white-brick house in which President Woodrow Wilson was born.

This roller-coaster town pioneered the council-manager plan of government in 1908. By the close of 1948, more than 800 cities, towns, and counties in the United States had adopted this form of government.

Staunton's identifying landmark is the twin peaks, Betsey Bell and Mary Gray.

In old Trinity Church the Virginia Assembly took refuge during the Revolution. Riding back roads, John Jouett, Paul Revere's Virginia counterpart, warned the Virginia Assembly at Charlottesville and Thomas Jefferson at Monticello that the British were coming.

At Waynesboro, Virginia, is Fairfax Hall Junior College, girls' school, named ironically for the woman-hating Lord Fairfax (page 17).

In the 1920's the village awoke one morning, rubbed its sleepy eyes, and found Industry sitting on its doorstep (page 21). Today, with a population of 10,000, the town retains the charm and leisurely appearance of a rural Southern village. Outstanding visual fingerprint of industry is the bald scar in the mountainside above the town, caused by steam shovels digging gravel for Chesapeake and Ohio Railway roadbeds.

On the Valley Pike between Staunton and Lexington roadside markers point the way to the birthplace of Sam Houston, winner of Texas independence, and to the little blacksmith shop where Cyrus McCormick perfected the reaper.

At Lexington, seat of Rockbridge County, two Confederate generals, Robert E. Lee and Stonewall Jackson, are buried.

The mellow colonial buildings of Washington and Lee University stand beside the castellated barracks of Virginia Military Institute. I stopped outside VMI barracks to watch gray-clad cadets salute the statue of Jackson, which stands guard over the parade ground (page 6).

On this field once drilled the former Secretary of State, George C. Marshall.

Within these barracks once taught Matthew Fontaine Maury, oceanographer, whose wind and current chart of the North Atlantic revolutionized the science of navigation. Today, every pilot chart issued by the Hydrographic Office of the United States Navy carries a note that it is founded upon Maury's researches.

Another man who became a VMI professor, John Mercer Brooke, invented a deep-sea sounding apparatus. He and Maury, working together in earlier years at the U. S. Naval Observatory in Washington, D. C., made practicable the laying of the first Atlantic cable.

Rockbridge, southernmost of our counties, was named for the Natural Bridge of Virginia, water-carved limestone block which arches 90 feet across a gorge. Everywhere I had traveled in the Valley it seemed that George Washington had been there before me. Natural Bridge of Virginia was no exception. The initials "G.W." on the southeast wall are supposed to have been carved by Washington when he surveyed the bridge.

Thomas Jefferson paid George III of England 20 shillings for the bridge and 157 acres of land less than a year before the first shots were exchanged between Americans and British in the Revolution.

From a sound-reproducing device at the top of the bridge a musical program is presented each night. Strolling toward the bridge, I heard the glorious opening notes of the Pilgrims' Chorus from *Tannhäuser*. The rich, swelling tones of a mighty organ, caught under the arch of the bridge, echoed throughout the glen until the whole night was filled with music. It seemed a fitting climax to my journey. I imagined I could hear the marching feet of those who had been there before me—Washington, Jefferson, and all the countless others who, from the Valley's mountainsides, let freedom ring.

The next day, leaving the Valley, I stopped for gasoline at a small combination country store and gas station. Out hobbled a little old man, his face lined with wrinkles.

"See you been a lot of places in this hyar country," he said, looking at the sticker-covered bumpers. "Whatcher think of it?"

"I like this part of the country so much I'm going to write a story about it," I replied.

He winked. "Oh, sure, ma'am. So am I—some day!"

Perhaps he'll believe me now.

Kodachrome by Justin Locke

Sulphur Spray Protects Apple Trees from Scab at Senator Harry Byrd's Berryville Orchard

More than 10 million gallons of spray materials are used each season in this 1,000-acre Virginia grove. From its 45,000 trees, some 300,000 bushels of apples were harvested in 1948.

Kodachrome by Justin Locke

Built to Withstand Weather's Ravages, the Covered Bridge Is a Charming Relic of Rural America: Near Broadway, Virginia

Young Riders from Massanutten Military Academy's Summer Camp Cross a Shenandoah Bridge near Woodstock

This span is built low so that flood waters may flow over the arches, saving the piers from collapse.

Ektachrome by J. Baylor Roberts

The Camera Looks into a Mirror and Pictures the Chinese Culture Class at Mary Baldwin College, Staunton, Virginia

Dr. Helen Djang, visiting professor from Ginling College, Nanking, illustrates her lecture with prints brought from her native China.

Well-rounded Heels—350 Pairs an Hour!

O'Sullivan's Winchester, Virginia, plant makes heels and soles in 1,600 different sizes and colors. This girl trims overflow left by vulcanizing molds.

Not Sewing Socks, but Clipping Threads

It takes 20 operations to make one pair of socks at Interwoven Stocking Company, Martinsburg, West Virginia. Here vacuum clippers cut loose ends.

Photograph by J. Baylor Roberts

Kodachrome by Justin Locke

When the Fodder's in the Shock, It's Cornhusking Time in Rockingham County, Virginia

Farmer W. O. Lam and his boys work at the southern foot of Massanutten, a range which divides Shenandoah Valley for 50 miles.

"Lost" Arts Live; Virginians Still Weave Baskets and Rag Rugs

Basketry is one of the oldest crafts known to man; he may have woven baskets before he fashioned clay into pottery.

In their years of isolation, the southern mountaineers learned to weave strips of wood into containers they could not buy at stores.

Basketmakers know just how long the sap must rise before they cut strips from saplings.

After the bark is removed, pliable strips are dried and their rough sides smoothed with a knife.

Finished baskets go on sale at roadside stands on major routes throughout the Shenandoah Valley.

Sam Price (left) sells his baskets at his son's stand on U. S. Route 211, the Luray-New Market road.

The "lost" art of rug weaving is being revived among Blue Ridge folk (right).

Near Harrisonburg, Mrs. Nellie McDorman weaves on her old-time hand loom. She has four other looms, all varying in size.

Kodachrome and Ektachrome by Justin Locke

Photograph by Justin Locke

Sunbonnet, Wood Range, and Cats Remind Us All of Grandma's Kitchen on the Farm

In a gap west of Harrisonburg, Virginia, some 25 Allegheny Mountain families live much as their pioneer forefathers did a hundred years ago. Wells provide water; oil lamps, light. Sunbonnet and house dress are woman's uniform. In such isolated hollows, the only daily link with the world is a battery-operated radio. Most families own a cow and a horse; some have chickens and pigs. The few automobiles are usually owned jointly by several families. Descendants of Scotch-Irish and German settlers, these folk make some living from the land. Men supplement the family income by picking fruit in orchards. During vacations, older children work in stores and camps.

Shells Take You Over World Horizons

By Rutherford Platt

SHELLS "have everything." Some stay-at-homes collect them as they would stamps or coins, by ordering from a catalogue. Others go exploring down to the sea or up to the hills, to pick up their specimens. Shells can be traded with correspondents in all parts of the world. Once you have a tidy collection, the fun begins.

I dislike the phrase "shell collecting." It seems to narrow the subject to accumulating or cataloguing. One may enjoy shells as exquisite jewels. Their beauty is an inspiration. They have a lore and a language. Is not a pearl the product of a shell? A pair of amber-colored marginellas make exquisite little earrings.

Many people enjoy them as they delight in flowers for colorful arrangements on kitchen window sills, living-room tables, mantels, or bookshelves. Glance through the color pages in this issue of the National Geographic Magazine, with an eye to the decorative values of these radiant tones and patterns, and imagine their possibilities (pages 36 and 84).

Shells Have *Arabian Nights* Stories

Then too, you can tell your friends their stories, such as the miracle of the octopus in the argonaut; the incredible speed by which a broad, round moon shell dives into firm beach sand to eat a clam; or the strange way a mussel, apparently fixed with tough bonds to a rock, moves about.*

You can travel with shells, if not personally, at least in books and research, to the "steaming stillness of an orchid-scented glade" where brilliant land snails are discovered along the jungle trails of Cuba or Luzon. For the tree-climbing *Liguus* run your eye and hand along the branches of gumbo limbo and Jamaica dogwood on the Florida Keys.

You may know the fresh sting of salt sea spray and the fragrance of seaweed where the mollusks of the Maine coast hide in the tide pools and crevices of that wonderland of rocks (page 41).

You can explore along the broad curving beach at Indian Rocks, Florida, in pursuit of the coquinas that hastily burrow into the sand after each retreating wave. If you are agile, you will catch them by the score and admire the variety of lovely sunsets painted in their porcelain in imitation of the sunsets that illuminate the Gulf horizon between the casuarina trees (page 48).

In Miami, Florida, a hundred collectors specialize in tree snails from the Keys and Everglades (page 76). They like to go forth to do their own exploring with binoculars over their shoulders and armed with collecting box and a sandwich.

Another person may choose to specialize in scallops (*Pecten* is the scientific name). They are a royal, highly distinctive genus with world-wide range (page 49). A big yellow scallop comes from the sea near Bar Harbor, Maine; a pink scallop from deep water near Puget Sound; and the South Pacific abounds in scallops ranging from dazzling brilliance to the most delicate tints.

There are many kinds of shells, any one group of which has enough alluring material for a lifelong study: chitons, murex, olives, cones, snails, clams, tree climbers, limpets, rock dwellers—take your choice.

On the other hand, your special interest may be a geographical location: the west coast of Florida, the New England shore, the Mediterranean, Mauritius, New Caledonia, the Philippines, the Indian Ocean, the Michigan lake region, or the hills of Hocking County, Ohio.

Collectors also specialize in certain sizes. For example, an astonishing number of shells are between ⅛ inch and ½ inch across (page 72). Most of the 100,000 species already known and named are less than half an inch and range down to microscopic. In the largest bracket, a collection is not complete until it has a giant clam (*Tridacna gigas*), which may weigh 500 pounds (page 82).

An entirely different appeal can be found in the biology of shells. The science of the shell alone is called conchology. But a detached shell is a by-product of an immense animal phylum called Mollusca. Shells are not like crystals, rocks, and ores, formed by elemental forces of earth and sky; nor are they stamped out instantaneously like coins.

Shells are the products of a group of animals so old that its fossils are found from the Paleozoic era more than 300 million years ago, the earliest time from which any kind of animal remains are known. Dr. Paul Bartsch of the U. S. National Museum in Washington, D. C., says that those fossil shells "bear evidence that these earliest known animals were already so highly specialized as to force us to the conclusion that their ancestors arose far back beyond Paleozoic times."

* See in the National Geographic Magazine: "Sea Creatures of Our Atlantic Shores," August, 1936; and "Denizens of Our Warm Atlantic Waters," February, 1937, both by Roy Waldo Miner.

National Geographic Photographer Willard R. Culver

"Ooh! Lookie What I Found, Grandma, All by Myself!"

The young, sunbonneted conchologist triumphantly holds up a valve of the Calico Scallop, *Pecten gibbus* (page 46, No. 5) she has picked up on a Sanibel Island, Florida, beach. Overflowing the basket is a chain of egg cases of the Left-handed Whelk, or Conch, of which a specimen is at the right (page 45, No. 7). A giant Band Shell, or Horse Conch, thrusts out its white spire at the left, and under the further end of the handle is a Tulip Band Shell.

National Geographic Photographer J. Baylor Roberts

Baby Sister Listens to the Sound of the Sea in a Big Shell

Common on the keys of Florida, the Bahamas, and the West Indies is the Giant Conch, *Strombus gigas* (page 80). These youngsters are the children of Capt. A. B. Banister, U.S.N., Commander of Submarine Squadron Four, based at Key West. Conchs are prized not only for their beautifully colored shells, popular as souvenirs, but for their delicious flesh, which makes a tasty chowder.

This group of animals is so vast that the Mollusca are exceeded in number in the animal kingdom only by the joint-footed animals (Arthropoda), which include the insects. This mighty horde of mollusks inhabits the sea, the fresh waters of lake and stream, the land, including deserts, the spears of grasses and sedges, the twigs of shrubs, and the high branches of trees.

The warmer waters breed the largest numbers of species as well as the most colorful. But the icy brine of the Maine coast abounds with these animals. Alaska and Patagonia produce mollusks of marked distinction. The fresh-water streams of British Columbia and Labrador have their pearly-blue mussels.

The Shell Is the Skeleton of an Animal

To biologists a shell is a skeleton, carried on the outside of an animal without a backbone. The animals whose skeletons delight us are themselves without eye appeal or harmonious form, mere blobs of low animal life, often without heads or commonly recognized organs.

This animal is not even spirally curved. It is the shell which curves the animal, and not vice versa. A slug—that is, a snail without

National Geographic Photographer Willard R. Culver

Shells as a Decorative Motif for the Home

Between two rooms of her Miami Beach winter residence Mrs. John Oliver La Gorce, wife of the Associate Editor of the National Geographic Magazine, has fitted glass shelves for her collection. A polished Chambered Nautilus (page 65) is at the center near her right shoulder. At the top to the right of the coral are: a Partridge Tun Shell, a Measled Cowry (page 45, No. 6), and a *Trochus niloticus* (page 68, No. 15). Two Helmet Shells are to the left of the starfish above her head, and to the right are the Fighting Conch (page 45, No. 9) and the Triton's Trumpet (pages 67, 68, and 80). Below her right hand, to the left, are two Left-handed Whelks (page 45, No. 7). On the bottom shelf two Queen Conchs flank the fan corals.

a visible shell—is typical of the humble aspect of mollusks. Nevertheless, to the person with a biological turn of mind this is one of the most thrilling divisions of animal life.

The mollusks are a clear-cut classification and not to be confused with shellfish generally. For example, the sea urchin (phylum Echinodermata) has a shell with a wonderful pattern. But the urchin, like its near relative the starfish, is built with radial symmetry. Its structure radiates like the spokes of a wheel, while the mollusk animal has bilateral symmetry; that is to say, he tends to be long and two-sided like a worm.

The shell of a sea urchin is a single layer, growing all over its body all at once. You can see at a glance that this shell is an entirely different texture from that of the mollusk. The crab, lobster, and shrimp (Crustacea) also have conspicuous shells. This group is distinguished by its jointed limbs and segmented antennae and other parts, while the poor little mollusk is just a soft unsegmented creature.

The shell of the crab also is a single layer, growing only in thickness. That of the mollusk is usually three layers, built by being added to gradually at one end. Moreover, the crab shell is cast off and renewed periodically, while the mollusk shell is a permanent covering.

The difference in texture between a crab or lobster shell and that of a snail or oyster is easy to see. The crab shell contains about 15 percent phosphate of lime mixed with the basic carbonate of lime. The mollusk shell, however, has only a trace of the former. It is the carbonate of lime which produces porcelainlike shells with enameled surfaces, as in the aristocratic cones, volutes, and cowries, or layers of mother-of-pearl that glow on the inner sides of the mussel, abalone, and oyster.

Ernest Kleinberg

Fleet Admiral Nimitz's Daughter Is a Shell Enthusiast

With the help of her father, Mary Manson Nimitz has collected 3,000 specimens, 850 varieties, in the last five years. Trays across the lower right corner contain several kinds of cowries, in the foreground Tiger Cowries. Above these are some valves of the Pearl Oyster, *Pinctada margaritifera*, and in the middle of the left side is a Queen Conch. The largest of the Auger Shells, lower left, is a *Terebra maculata* (page 52, No. 21). Just to the right of these is a Scorpion Shell, *Lambis rugosa* (page 68, No. 1). A Chambered Nautilus lies below the box touching Miss Nimitz's knee (page 65).

In their habitats mollusks are frequently on the move (page 40). The squid is one of the fastest swimmers in the sea. It shoots through the water like an arrow. The scallop is a swimming clam. The snail walks with surprising alacrity, considering the clumsy and relatively enormous shell it carries. Chitons creep slowly like lumbering beetles. The clam is a quick, efficient burrower. Even the mussel may put out tough cords like hawsers to pull itself along.

Some of these mollusks go after food like other animals. Others, when well located, wait for the food to be washed into their stomachs. The point is that they are designed by Nature to lead animal lives, and the shell collector must either catch them like any other hunter or dig them out of their hiding places; or else pick up empty shells left by departed animals.

The Univalves Far Outnumber the Bivalves

Of the two chief categories of shells, the larger is that of the single-shelled, the univalves. You will find twice as many kinds of these along the seashore as you will of the

Renata Holl-Studinek

Enhancing Her Charms Are Chaplet and Belt of Cowries

Mayomi, a famous Libian dancer, wears a "dowry" of the shells used for money, *Cypraea moneta*, in a performance which tells the story of a girl's wooing of the man she loves.

two-shelled. This big category of univalves includes the snails and their great variety of spiraling relatives, plus slugs and limpets. The univalve is a marine, fresh-water, land, and tree inhabitant.

This snail type is the higher form of mollusk in that it has evolved a body better equipped for living. The univalve has a head with mouth, tentacles, and eyes. It may have also a tongue like a file that can extend twice the length of the animal for sawing into food. The teeth on this tongue may be counted in thousands, and new teeth grow when old ones are worn out.

The scientific name for this magnificent division of shells is Gastropoda, which, translated from the Latin, means "stomach foot."

The first part out of the shell when the animal is going places, and the last part withdrawn, is the foot. This is a squashing sac-like appendage with a rippling muscle that enables the animal to creep around. You might say that the gastropod appears to be walking on its stomach (page 61).

Attached to the side of the foot of many species is a tough disc that exactly fits the opening of the shell. When the animal withdraws to the safety of its limestone fortress, this disc, called operculum, seals the doorway.

The operculum, meaning "lid," is frequently to be found with the shell, provided that the shell still contains its animal, either dead or alive. It is perfectly designed for its purpose.

If you look closely, you will see that the operculum is constructed on a spiral pattern, exactly like many shells. The spiral of the operculum is on a flat surface, or plane, while that of shells is normally pulled out to make the turbinate form. The collector is often glad to find the operculum that fits his shell. Since it is tough and durable, it does not disintegrate and can be mounted and kept in place in its univalve, making the shell more complete.

Most Bivalves Live in the Sea

The other big category is that of the two-shelled, the bivalves. These are mostly marine, although there are many fresh-water clams and mussels. No land or tree mollusks are bivalves.

Here again science has seen fit to name the division after the foot, Pelecypoda, translated "hatchet foot." The foot is a wedge-shaped organ for digging. It can work so fast that

some types of clams may disappear into the sand before you can stoop and pick them up. Most clams are diggers.

All mollusks bear a remarkable organ called a mantle. This may be a mere pad or fold, or it may cover the animal more completely. You may think of it as a bit of animated skin. This mantle secretes the shell. As a result of its wonderful property we have shell collections and the colorful beauty of the illustrations in this NATIONAL GEOGRAPHIC.

It may seem unique that the skin of a squashy animal can create such wonderful porcelain, but the phenomenon is no more remarkable than other accomplishments of Nature. The rocky mountain goat has superbly curved horns; we have teeth.

Shell material is secreted as a limestone substance, shaped by the instincts of the animal into the forms characteristic of its kind, and painted with pigments synthesized by this lowly creature from chemicals in its environment. Momentarily this material is soft, but it quickly hardens, whether under the water or in the air, to become one of the most time-resistant materials in our world, as witness the fossil shells that predate man's presence on earth.

In museums the walls of some of the largest display halls are lined and their floors crowded with cabinets loaded with multitudes of these animal porcelains. The American Museum of Natural History in New York City has an enormous central hall with panoramas of shells, and countless more in storage. The National Museum in Washington, D. C., has tiers of cabinets with five million shells classified and in order.

Yet, even after the museums have taken their great collections, and the private collectors have accumulated their treasures, whose total staggers the imagination, the supply is practically inexhaustible. If we go to the beaches of Maine, Florida, or California, or wherever else tides deliver shells, we can pick up equally beautiful and startling specimens newly arrived after the last storm (pages 34 and 58).

The Shell Is a Work of Art

The scene is a curving beach set between a sweep of *Uniola*, "sea oats," shimmering with high lights, and the smooth aquamarine of the sea. Is it mere fantasy to say that this beach line, with its band of dune grass impinging on one edge and the curves of white foam from broken waves following its other edge, forms the same curve that you find in the cockle, coquina, clam, nautilus, and abalone?

Look at a wave as it advances into shallow water. It is pushed up, growing higher and steeper from the opposition of a spent wave

© Mori La Vey

Through Shell Eyes the War Canoe "Sees"

New Georgia, Solomon Islands, natives decorate the prows of their seagoing craft with handsome specimens of Egg Shells, *Ovula ovum*, to help them find their way. Related to the cowries, which are used as money, these are cherished as potent charms. They are gastropods, and, when alive, move by means of a muscular foot protruding from the shell.

W. C. Ramsbey

Scarlet Tentacles Fringe the Moving Valves of the *Lima lima*

Propelling itself by opening and closing its shell, this mollusk develops good speed through the waters of Australia's Great Barrier Reef. It and the pecten, or scallop, are the only bivalves capable of swimming during their adult stage. The tentacles cannot be drawn inside when the shell is closed.

flowing back toward the deep, until finally the oncoming wave has no reserves left for increasing its magnitude and must topple.

But it does not crash formlessly. At that moment, when it is undermined by the increasing force of the undertow, the wave bends forward. In cross section it forms momentarily the pattern of a logarithmic spiral, with the crest curving in and under to place its apex at the center of gravity. This figure perpetually repeated by waves as they mount the beach forms the identical curve that you find in the cone, conch, cowry, snail, and nautilus shells.

Here we are confronted not with an imaginative idea but with a thrilling fact of life: that the dynamic spiral is a fundamental pattern of growth.

To produce a spiral, three conditions must exist. First, growth must pursue a continuous course and not be erratic or backtrack. Second, growth must proceed freely and without outside interference. Third, it must operate as a sequence with a growing tip or growing lip, or at least produce new growth following *after* older parts.

The growth of shells clearly pursues a continuous course. Their lines are not zigzag or jagged. They often have spines, knobs, and ridges, but these are protuberances on the basic spiral. Finally, each shell has a lip that generates the shell so that it is built with a sequence of increments, those near the lip being younger than those near the apex.

Because they possess this inherent spiraling ability, combined with the permanence of their structure when built, shells are the most vivid examples in all Nature of this principle of growth.

The stirring quality of the design lies in its action. It is not inert. Even though the spiral of a shell is physically stationary, it has a point of origin, called a nucleus or protoconch, from which it springs whirling toward an infinitely greater magnitude.

Snail and Scallop Inspire Architects

That this pattern of action can be impressed in hard material so as to endow what is fixed and immovable with a quality of movement is one of the characteristics of the spiral. You may say that architects and sculptors borrow from the snail and the scallop their dynamic curves to animate intractable marble with fluidity and living beauty.

A Shell Collector Finds Treasure-trove in a Tide Pool at Ogunquit, Maine

When the water recedes, leaving shallow pools among the rocks and along the beaches, a wonderland of mollusk life is uncovered—single-shell univalves (much the more numerous), and bivalves, like the mussels and oysters.

In these 32 color pages the reader explores for shells around the world. Specimens gathered from near and far, from lakes, rivers, and oceans, from swamps and deserts, from trees and grasses, are reproduced in their natural hues and named so that the collector may readily identify them. Inset Kodachromes show: (1) a group of Marble Snails, *Thais lapillus;* (2) Mandarin Hat and Periwinkle, *Acmaea testudinalis* and *Littorina littorea;* (3) Mussel, *Mytilus edulis;* (4) Moon Shell, *Polinices heros;* (5) Sea Urchin, *Arbacia punctulata* (an echinoderm).

Kodachrome by Rutherford Platt

New England's "Stern and Rockbound Coast" Teems with Mollusk Shells of Many Kinds

When the cold tides, which rise and fall 10 feet and more, draw back from narrow beaches, they expose these treasures of the sea. The Thais (1) in upper corners is a sharp-pointed snail with marblelike texture. Below are familiar periwinkles (3), which cover rocks and seaweed in droves and make excellent bait for small fish caught with hook and line. The larger round specimens (5) are Moon Shells, famous for their filelike tongues with which they saw into clams and mussels. (1) *Thais lapillus;* (2) *Littorina obtusata;* (3) Periwinkles, *Littorina littorea;* (4) Jingle Shell, *Anomia simplex;* (5) *Polinices heros;* (6) Limpets, *Acmaea testudinalis;* (7) Mussels, *Mytilus edulis,* (8) *Mytilus edulis,* and (9) *Volsella modiolus;* (10) Clam, *Venus mercenaria.*

Some of the Rarest Shells on Earth Are These from Florida

Lion's Paw (7) is one of the world's finest and most showy. Exclusive to Florida is this Junonia (11). Most of these are in the collection of the late Dr. R. R. Bales of Circleville, Ohio. They are: (1) *Chlamys mildredae;* (2) *Chlamys imbricatus;* (3) *Murex cabritii;* (4) *Tellina magna;* (5) *Terebra flammea;* (6) Golden Panama, *Oliva sayana citrina;* (7) Lion's Paw, *Chlamys nodosus;* (8) *Conus regius;* (9) *Conus tottoni;* (10) Carrier Shell, *Xenophora conchyliophora;* (11) *Scaphella junonia.* Such treasures await the explorer along 700 miles of the west coast, curving from Pensacola southward by sandy beaches around the shores of Sanibel and the Ten Thousand Islands and through the mangrove swamps and white muddy edges of the Keys.

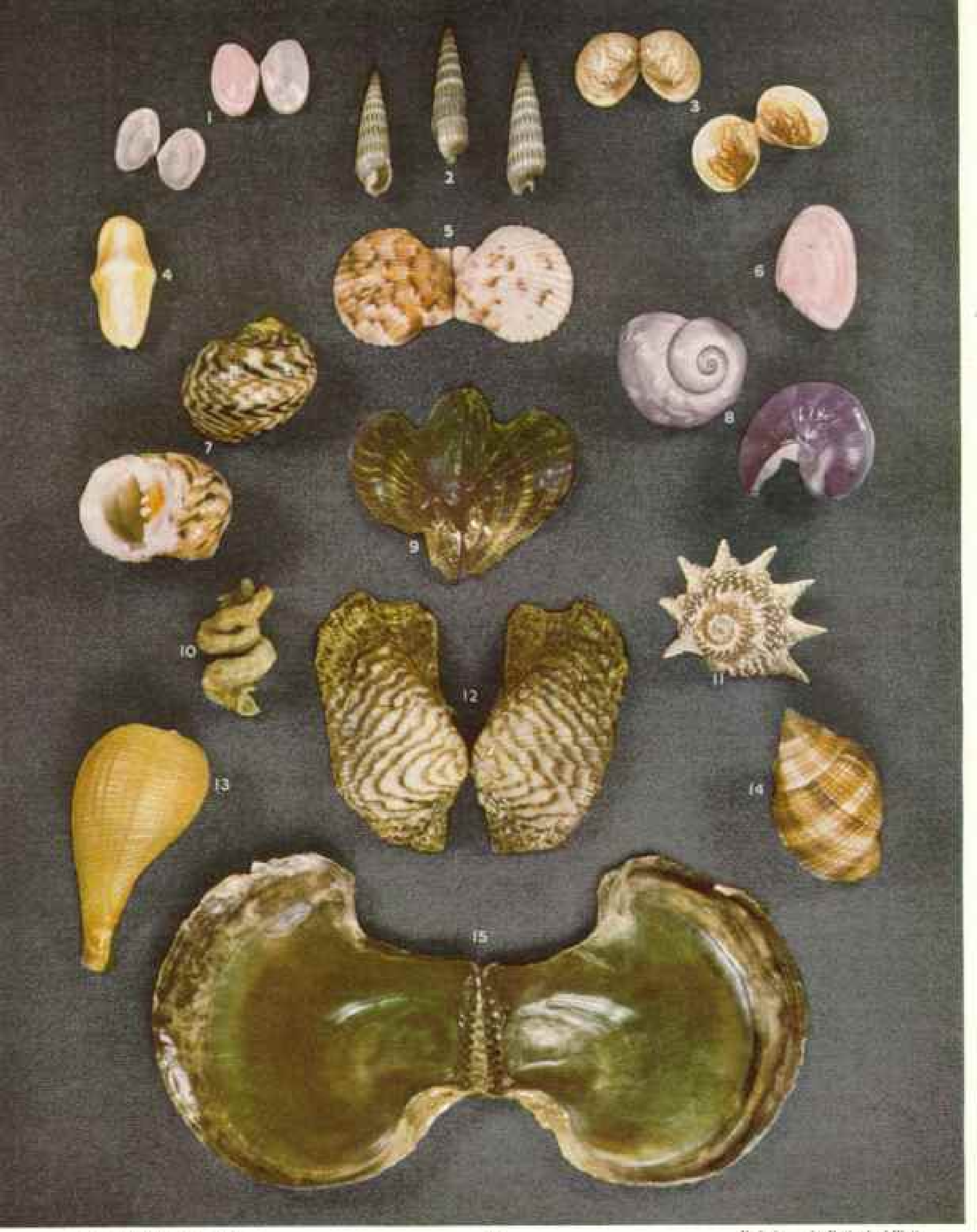
Kodachrome by Rutherford Platt

Amateur Collectors Have Given These Florida Shells Fanciful but Apt Names

As known to imaginative beach visitors and to scientists, the specimens are: (1) Sundial, *Architectonica granulata;* (2) Checkerboard, *Macrocallista maculata;* (3) Star Shell, *Astraea longispina;* (4) Lady's Ear, *Sinum perspectivum;* (5) Cameo Shell, *Crepidula fornicata;* (6) Rose Petal, *Tellina lineata;* (7) Shark's Eye, *Polinices duplicata;* (8) Mandarin Hat, *Arcnaea pustulata;* (9) Buttercup, *Loripinus chrysostoma;* (10) Wing Shell, *Pteria colymbus;* (11) Chinese Alphabet, *Conus spurius atlanticus;* (12) Bleeding Tooth, *Nerita peloronta;* (13) File Shell, *Lima scabra;* (14) Scotch Bonnet, *Semicassis gibba.*

Only Among Florida Univalves Is a Left-handed Whelk Common

Three-quarters of the world's mollusks have a covering consisting of one solid piece. The spiral in virtually all curves clockwise, but in No. 7 it is reversed. (1) Tulip Shell, *Fasciolaria tulipa;* (2) Lace Murex, *Murex florifer;* (3) Banded Tulip Shell, *Fasciolaria distans;* (4) Panama Shell, *Oliva sayana;* (5) Spotted Bull's Eye, *Natica canrena;* (6) Measled Cowry or Micronac, *Cypraea zebra;* (7) Left-handed Whelk, *Busycon contrarium;* (8) Apple Star Shell, *Astraea tuber;* (9) Fighting Conch, *Strombus pugilis;* (10) Crown Conch, *Melongena corona;* (11) Horse Conch, *Fasciolaria gigantea* (now *papillosa*).



  Kodachrome by Rutherford Platt

Any Amateur Beach Searcher Can Find These Easily in Florida

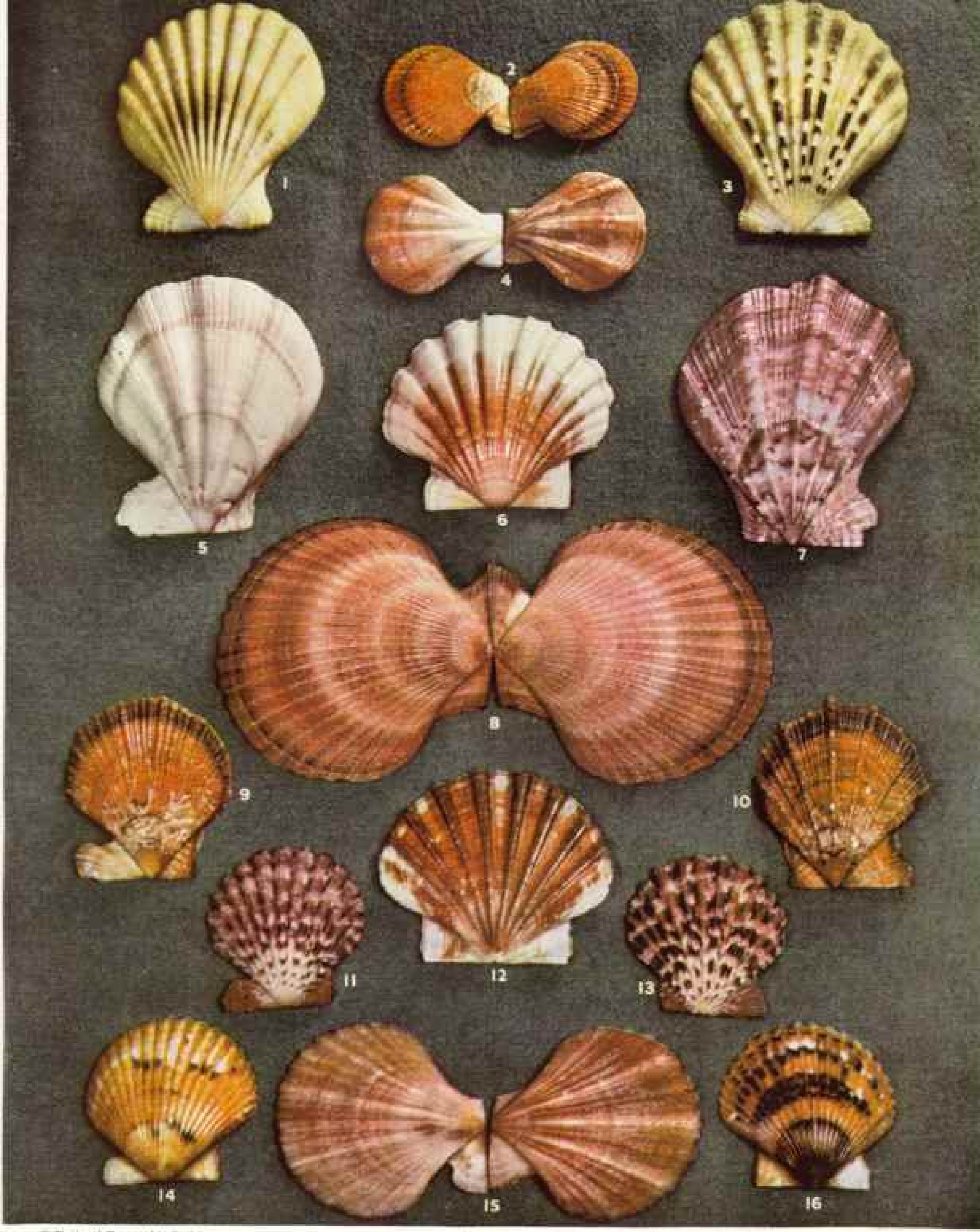
Because they are common and their popular names describe them, no skill is required in collecting. (1) Candy Stick, *Tellina similis;* (2) Screw Shell, *Terebra dislocata;* (3) Fried Egg Shell, *Laevicardium mortoni;* (4) Flamingo Tongue, *Cyphoma gibbosa;* (5) Calico Scallop, *Pecten gibbus;* (6) Rose Petal, *Tellina lineata;* (7) Bleeding Tooth, *Nerita peloronta;* (8) Violet Sea Snail, *Janthina janthina;* (9) Wing Shell, *Pteria colymbus;* (10) Worm Shell, *Vermicularia spirata;* (11) Star Shell, *Astraea longispina;* (12) Turkey Wing, *Arca zebra;* (13) Paper Fig Shell, *Ficus papyratia;* (14) Nutmeg Shell, *Cancellaria reticulata;* (15) Purse Shell, *Isognomon alatum.*

Laved by Tropic Waters, Florida Is the American Paradise for Shell Collectors

Delicate tints characterize these common shells found on beaches. Shaped like a volcano and distinguished by the hole at the apex, (1) Keyhole Limpet, *Diadora alternata*, is unique in that it is a gastropod, a single shell, although not coiled like a snail. (2) Rose Cockle Shell, *Trachycardium isocardia;* (3) Striped Venus Shell, *Anomalocardia brasiliana;* (4) Little Pink Murex, *Murex recurvirostris rubidus;* (5) Sunrise Shell, *Tellina radiata;* (6) Flesh Marginella, *Marginella carnea;* (7) Florida Cone Shell, *Conus floridanus;* (8) Banded Thais, *Thais deltoidea;* (9) Sunray Shell, *Macrocallista nimbosa;* (10) Periwinkle, *Littorina angulifera.*

The Walrus and the Carpenter Would Find Coquinas a Treat to Both Eye and Palate

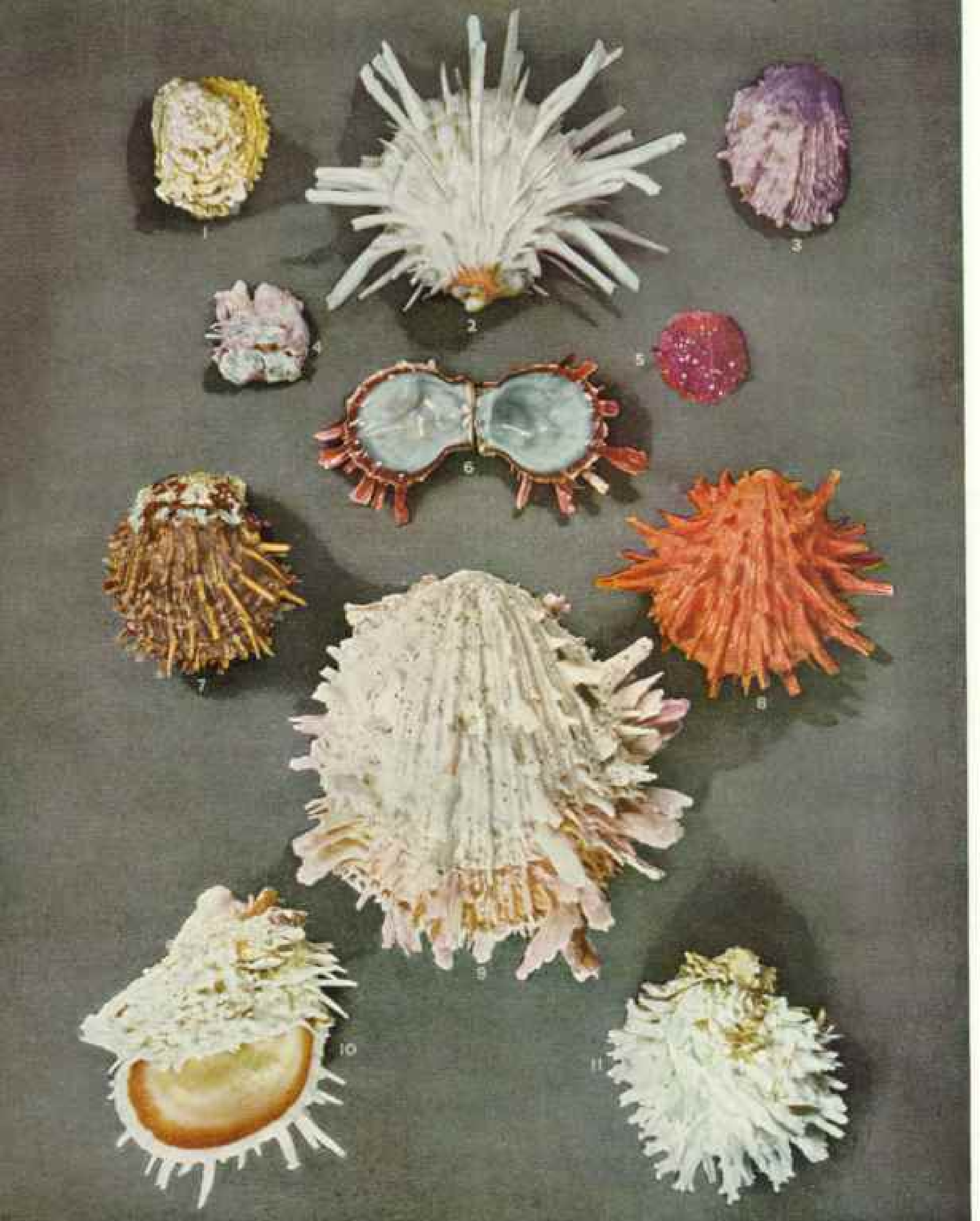
Belonging to a big group known as the Wedge Shells, these are sometimes called Butterfly Shells. Florida has a wealth of them, particularly on the west coast, and a few are found in California, the Philippines, and Ceylon. They ride up on waves and then suddenly and with amazing speed dig into the soft, wet sand. Gourmets collect them by the bucketful and boil them for a delicious broth, but even people who come to eat often stay to search for specimens marked with the brightest sunrays or the most colorful bands. Their scientific name is *Donax variabilis*. These are the common species easiest for beginners to find.



Kodachrome by Rutherford Platt

Models of Classic Architecture, Pectens Are Nature's Examples of Jet Propulsion

With the scallop of gourmet's delight as their power muscle, they swim by opening and closing their shells in the motion of an oar, ejecting water to drive them on a zigzag course. (1, 3) *radula* (Philippines); (2) *xentis* (Miami, Florida); (4) *pictus* (Japan); (5, 7) *swifti* (Japan); (6, 12) *luquearus* (Japan); (8) *gloriosus* (Australia); (9, 10) *lactus* (Japan); (11, 13) *pallium* (Philippines); (14) *circularis* (Mission Beach, California); (15) *hericeus* (Puget Sound, Washington); (16) *circularis* (Mission Beach, California). Note how the two valves of the same shell are usually of different shades of color.



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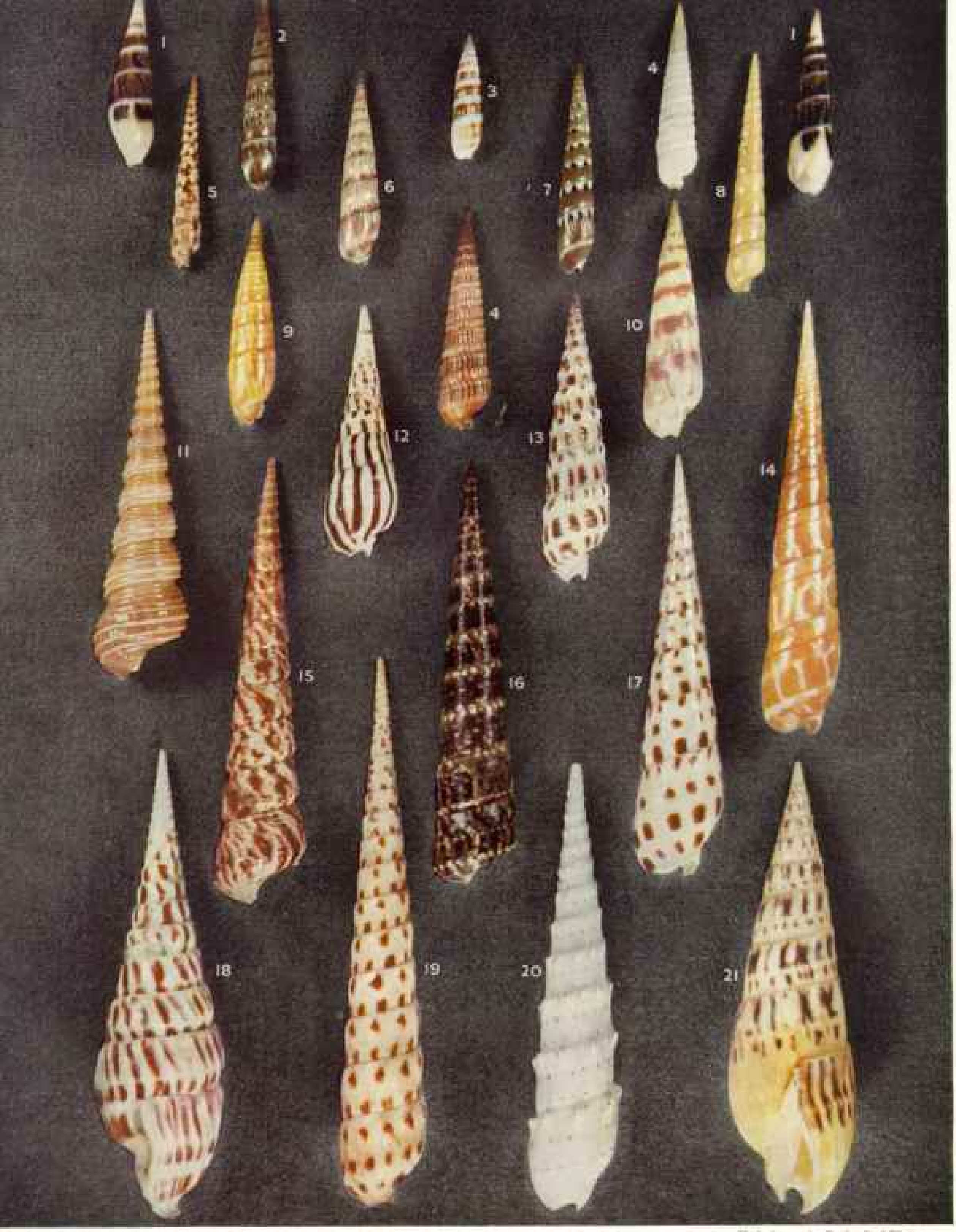
Unlike Its Swimmer Cousin, the Peeten, the Thorny Oyster Lives Cemented to Coral Rock

There are 85 known species but comparatively few types in this bivalve family. Strangely, the smaller specimens have longer spines than the larger. The average size is four to eight inches across. Holding the valves together and acting as a hinge, each has two interlocking teeth. Pictured here are two *Chama*, (1) *congregata* and (11) *lazarus;* and nine *Spondylus:* (2) *ducalis* (Philippines); (3, 4, 5) *dominicensis* (Key West); (6) *japonicus* (Japan); (7) *princeps* (Mazatlán, Mexico); (8) *aurantium* (Philippines); (9) *dominicensis* (Tarpon Springs, Florida); (10) *aciculáris* (Philippines).

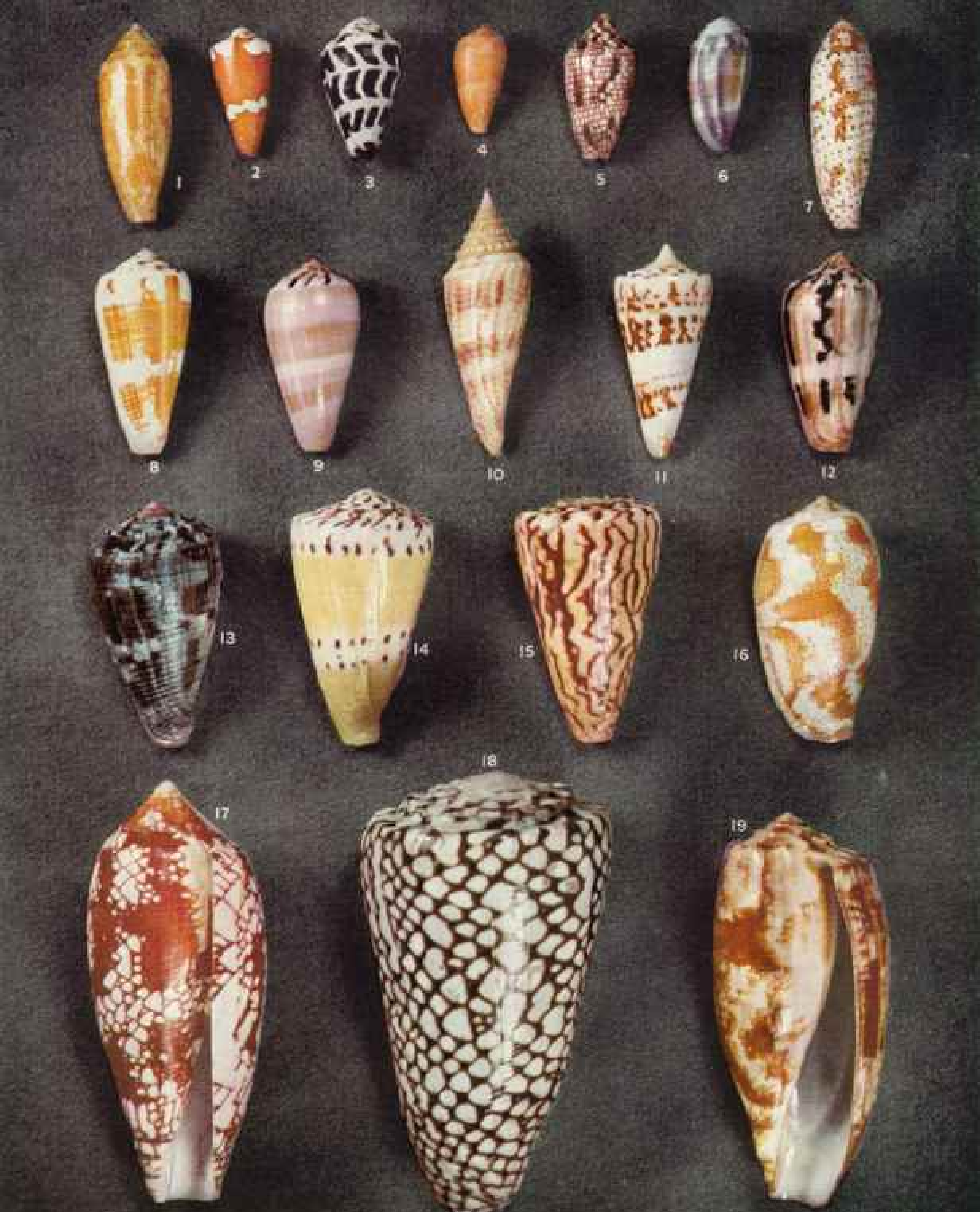
To Find These Volutes at Home, a Collector Must Travel Around the World

Save the Junonia of Florida, page 43, few of these aristocrats exist in continental United States. Here are: (1, 5) *piperita* (Solomon Islands); (2) *pulchra* (Australia); (3, 18, 23) *dumoni* (Australia); (4) *ponsonbyi* (South Africa); (6) *rosiniana* (New Caledonia); (7) *thatcheri* (New Caledonia); (8) *ericsea* (Australia); (9) *humillei* (Japan); (10) *imperialis* (Sulu Sea); (11) *gatliffi* (Australia); (12) *elliotti* (Australia); (13) *ponsonbyi* (Natal, South Africa); (14) *vexillum* (Ceylon); (15) *costata* (Mauritius); (16, 17) *delicata* (Japan); (19) *reticulata* (Australia); (20) *hirasei* (Japan); (21) *davicxi* (Japan); (22) *prevostiana* (Japan).



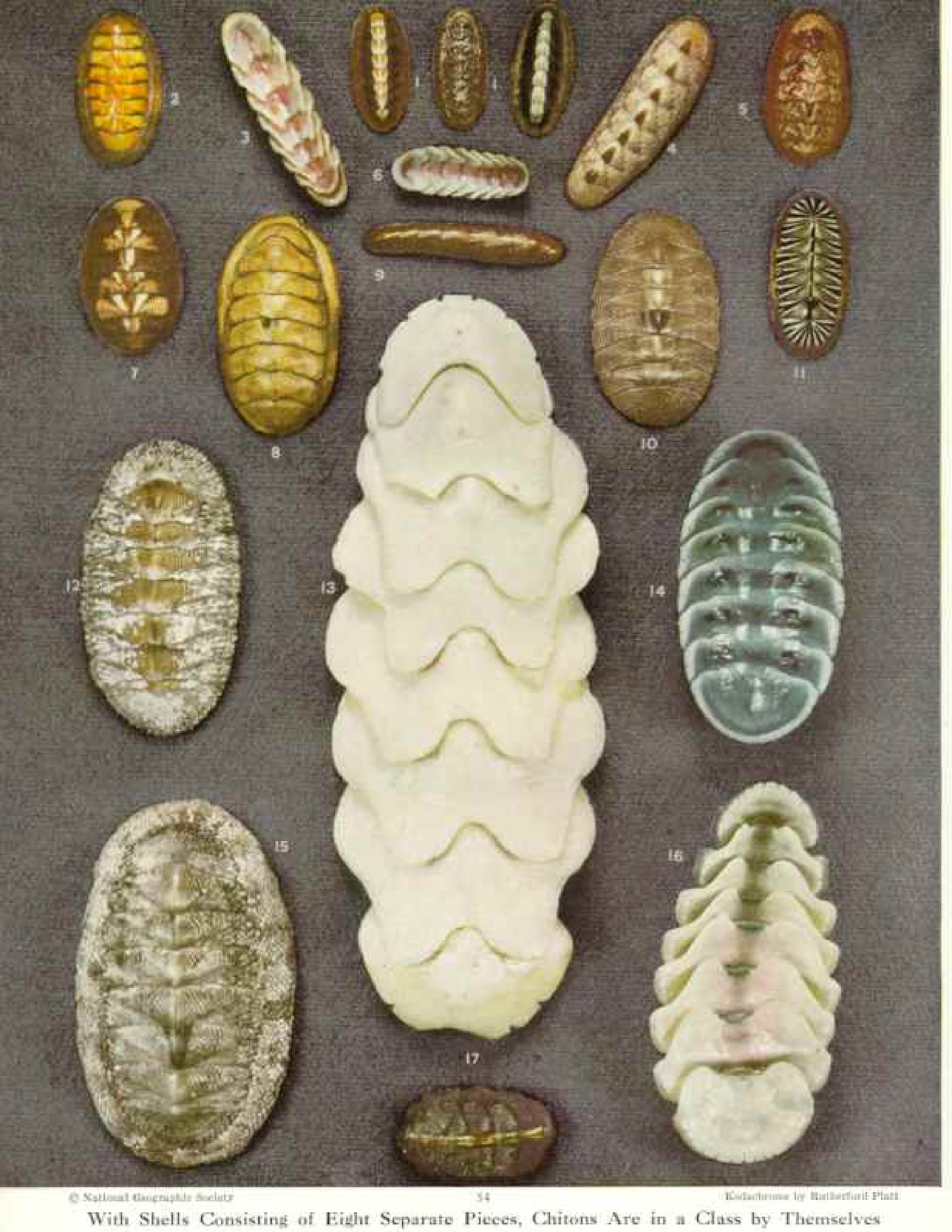
Terebra and Turritella Shells Resemble Augers and Screws or the Twist of a Tornado

Common on both shores of Florida, they are world-wide. The tiny snails look funny lumbering along with their steeples. Here are 18 *Terebra* specimens: (1) *caerulescens* (Tahiti); (2) *cinerea* (Florida); (3) *hastata* (Florida); (4) *dislocata* (Florida); (5) *subulata consobrina* (Indian Ocean); (6) *affinis* (Red Sea); (7) *strigata* (Philippines); (8) *cingulifera* (Philippines); (9) *cerithina* (Philippines); (10) *chordata* (Midway Islands); (12) *strigata* (Canal Zone); (13) *variegata* (Mexico); (14) *dimidiata* (Australia); (17) *ocdata* (Philippines); (18) *robusta* (Panama); (19) *subulata* (Philippines); (20) *crenulata* (Ceylon); (21) *maculata* (Ceylon); and three of the *Turritella* family: (11) *terebra* (Philippines); (15) *tigrina* (Mexico); (16) *gonlostoma* (Mexico).



Collecting Cones Is Dangerous, for Some When Alive Give Poisonous Stings

For tracing the habitats of these, a world atlas is needed. All should be handled with care. While living, (17) *Conus aulicus* (Philippines) and (19) *Conus geographus* (Moluccas) can inject a poison that causes great pain or even death. Others of the Conus group are: (1) *aureus* (Philippines); (2) *lithographus* (Ceylon); (3) *hebraeus* (Hawaii); (4) *rosaceus* (South Africa); (5) *luidus* (Manta, Ecuador); (6) *glans* (Philippines); (7) *mussatella* (Red Sea); (8) *consul* (Singapore); (9) *fulmen* (Japan); (10) *d'Orbignyi* (Japan); (11) *monile* (Indo-Pacific); (12) *achatinus* (Japan); (13) *purpurascens* (Acapulco, Mexico); (14) *mustelinus* (East Indies); (15) *princeps* (Acapulco, Mexico); (16) *tulipa* (Moluccas); (18) *marmoratus* (Philippines).

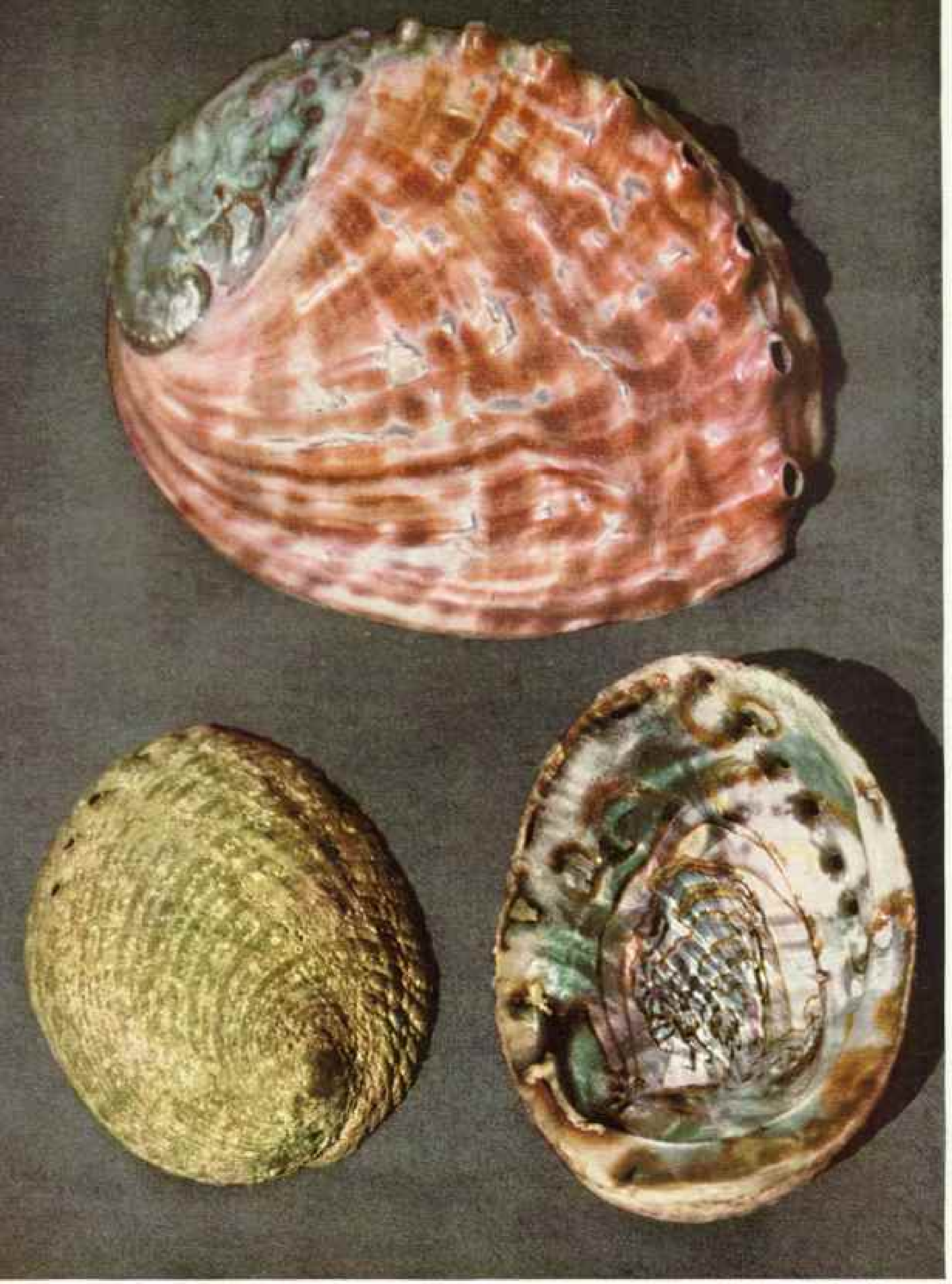


With Shells Consisting of Eight Separate Pieces, Chitons Are in a Class by Themselves

These conservative mollusks cling to stones by a broad muscular foot. (1) *Ischnochiton elongatus* (New South Wales); (2) *Rhyssoplax distolor* (New Caledonia); (3, 4) *Ischnochiton floridana* (Vaca Key, Florida); (5) *Tonicia forbesii* (Acapulco, Mexico); (6) *Ischnochiton limaciformis* (Acapulco, Mexico); (7) *Lepidochiton lineata* (British Columbia); (8) *Tonicia elegans* (Chile); (9) *Stenochiton longicymba* (South Australia); (10) *Chiton cumingi* (Chile); (11) *Chiton albolineatus* (Acapulco, Mexico); (12) *Chiton tuberculatus* (Bahamas); (13) *Cryptochiton stelleri* (Puget Sound); (14) *Chiton laevigatus* (Acapulco, Mexico); (15) *Chiton tuberculatus* (Bahamas); (16) *Ischnochiton conspicuus* (Laguna Beach, California); (17) *Mopalia muscosa* (San Pedro, California).

Mediterranean Mollusks Made Ancient Dyes; Artists Glorified the Shells

From a kind of Murex came Tyrian purple, and in Botticelli's "Birth of Venus" the goddess is standing on the opened valve of a Pecten, the bivalve whose power muscle is the edible scallop (page 49). (8) *Haliotis tuberculata* is closely related to the abalone of California (page 56). This mollusk lives in abundance in the cool Mediterranean, but is never found on the Atlantic coast of the United States. The four Patellas at the upper left should be compared to the limpets of the New England coast (page 42), to which they are related. (1) *Patella pectinata;* (2) *Fusinus syracusanus;* (3) *Patella vulgata;* (4) *Halia prismatica;* (5) *Patella lusitanica;* (6) *Natica millepunctata maculata;* (7) *Patella ferruginea;* (9) *Ranella gigantea;* (10, 11) *Semicassis undulata.*



Kodachrome by Rutherford Platt

Found in America Only on the Pacific Coast Is the Ear Shell Called Abalone in California

The red inner layer is revvaled at top, after the outer covering at left has been removed. Holes are for breathing. Mother-of-pearl lining is pictured at right. Monterey Bay produced in one year 5,000,000 pounds of abalone.

The chimney of the Château of Blois is wreathed with scallops. The volute or scroll was used by the Greeks in their Corinthian and Ionic capitals. Famous at Blois is the double winding staircase, which reproduces with mathematical precision the double curves in the columella of certain turbinate shells.

While the artist finds in shells rousing examples of the dynamic spiral, it would be shortsighted to assert that shells are the only source and origin of this spiral. You can see the same curves, with the identical proportions, in the florets of a sunflower, in the scales of a pine cone, in the leaves of an artichoke, in the horns of the Rocky Mountain goat, in the cyme of forget-me-nots, in fern croziers, and in elephants' tusks.

The lowly mollusk simply uses a fundamental law of growth, together with economy of structure, for building a strong house. The architect builds spiral staircases and columns, using a fundamental law of beauty and an economy of structure that are synonymous with the mollusk's law of growth.

The curve of the shell is one of the simplest of all known curves. Its proportions may be defined by a mathematical formula. Its discipline is rigid. The diameter of the coiled tube will grow in exact proportion to its length.

You can see a beautiful diagram of this fact when you refer to the picture of the chambered nautilus (page 65). The control of its proportions is so perfect that each new coil is exactly three times the width of the coil preceding it.

Shell Growth Mathematically Exact

Another type of shell may increase at a much slower rate. For example, one terebra may increase the diameter of its coil at the rate of one and one-quarter times at each complete turn. At the other extreme, the abalone (page 56) multiplies its coil diameter by ten at each complete revolution. This is purely a mathematical proportion, because the abalone curve widens so fast that the shell never gets around itself. It is merely a short segment of a wide spiral.

This type of spiral has a remarkable property. It can increase by growing at one end only and always retain without change the form of the entire figure. A little shell grows into a big one and both look the same. This is a marvelous fact, because the shell grows only at one terminal end.

Compare this with most growth. When a boy grows into a man, he grows proportionately all over. How could a shell grow all over? The animal builds a house of which each increment is forever dead, rigid material. Yet this structure, added to at one end only, continues to grow as if by magic, appearing to become larger all over!*

The diversity, which is so bewildering as we look over a collection of shells, is due to the endless combinations of this dynamic spiral. For instance, the growing edge, or aperture, of the shell may be round, triangular, oval, wide or narrow ellipses, or countless other shapes. The shape of this growing edge will vary the form of the completed shell.

An additional variation is seen in the way this aperture—that is, the cross section of the shell tube—is set at various angles in relation to the axis of the shell. One angle will cause it to go round and round, approximating a coiled rope. Another will pull out the coil into a long, steep corkscrew.

Still another influence comes from the various velocities of growth in relation to angle of rotation. These factors of the figure of the growing lip, its angle, rate of growth in relation to twist, and so on, may be likened to the few notes of music by combinations of which all the countless varieties of tunes are produced. Thus the tens of thousands of shell forms are rooted in the simplicity of a curve with a simple formula governing its proportions.

* For a fuller description of this spiral see *On Growth and Form*, by D'Arcy W. Thompson.

Exploring in Our Color Plates

THE 32 PAGES of color illustrations in this issue take the reader on a world-wide hunt for shells, from the cold shores of New England to the humid beaches of the Tropics.

Color Page 41

The rock-bound coast of New England, with its intervening beaches, teems with mollusks offering an opportunity for many thousands of summer visitors to become acquainted with the beauty of shells.

In this region the tides have a great rise and fall, sometimes 10 feet or more. When the Atlantic breakers draw back they uncover jungles of seaweed and limpid pools among the rocks.

Color Page 42

All the shells on page 42 are from the collection of the Boston Museum of Science. The Thais in the upper corners is a sharp-pointed snail with colorful stripes and a marblelike texture. Just below these is the familiar Periwinkle, one of the commonest shells on the New England coast. The larger round snails are Moon Shells.

National Geographic Photographer Willard R. Culver

Churned Up from Undersurface by a Storm, Pen Shells Lie Dying on a Sanibel Beach

These mollusks, *Atrina rigida*, live almost completely buried in the sand, and only extremely heavy waves can dislodge them. The collector has stumbled upon a scene of devastation.

Florida is the American paradise for shell collectors. The east coast is a catchall of the vast wealth of shells borne from the Tropics by storm and current.

Here the Violet Snail comes riding on his bubble raft; the Cockles and other Pectens are thrust up from their deep-water haunts. The translucent, delicate Paper Argonaut may ride ashore on the breakers after a trip of unknown distance from the clutching tentacles of the mother octopus—lucky the person who finds this fragile piece of art unbroken!

Because the beaches of Florida's east coast are steeper, and deep water comes nearer to the shore, certain shells are found there which rarely appear on the west coast.

To the west coast, however, the shell enthusiast goes first. There the beaches shelve gradually under the Gulf of Mexico, and the most brilliant and varied wealth of shells to be found on any United States coast is tossed up by the storms from the coral reefs, sponge beds, and tropical waters.

Sanibel Island, near Fort Myers, is a particularly fruitful spot for collectors.

Color Page 43

You see here some of the rarest and most prized shells of the Florida collector. They are shown through the courtesy of the late Dr. B. R. Hales of Circleville, Ohio, whose collection includes most of them. The delicately tinted *Terebra flammea* is from the Museum of Comparative Zoology, Harvard University, and the *Conus rozoni* from the McGinty collection in Florida.

The Lion's Paw is one of the world's finest and most showy Pectens. The Junonia shown is exclusive to Florida. The Carrier Shells in the lower corners are curiosities; this species collects other mollusks and cements them to itself. The Golden Panama is highly prized by collectors.

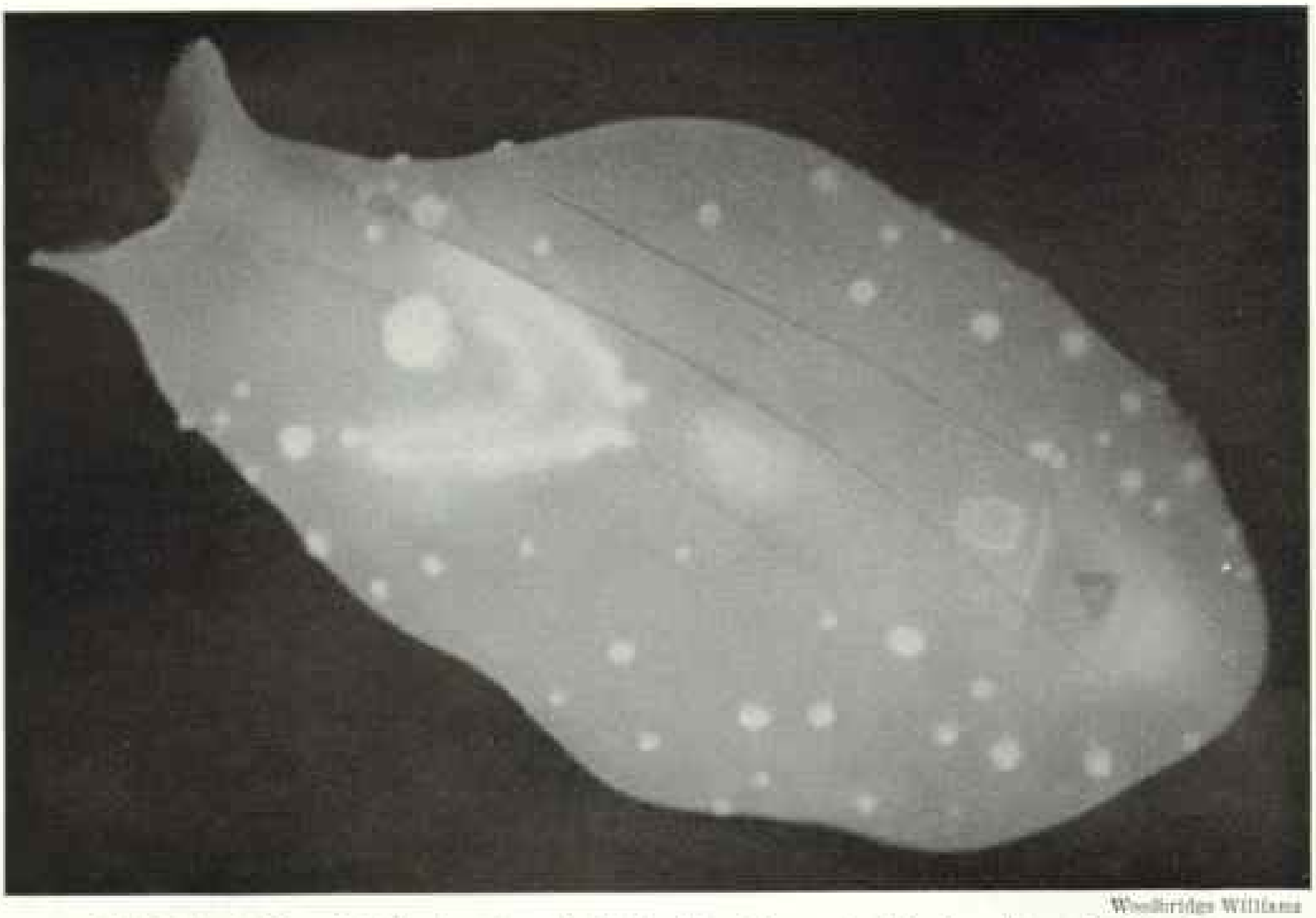
Color Pages 44 and 45

Because amateur collectors come to Florida, many shells of this region are given picturesque names, as illustrated on these pages. You will note how appropriate these names are. What could be more vivid than the Lady's Ear, or the Bleeding Tooth, or the File Shell? The Shark's Eye is one of the aggressive Moon Shells found from Labrador to Florida. It is carnivorous, with a powerful

David F. Martin

Shinto Priests of Kyoto, Japan, Sound the Call to Worship with Conchs

By blowing into these Triton's Trumpets (page 80, No. 1; 67, 11; 68, 4), they produce a low, far-reaching monotone not unlike the weird sound of a foghorn. Shells play a part in many religious services in the Orient. In parts of India left-handed spirals (page 69, No. 3) are considered sacred, and among many island tribes the Golden Cowry is the symbol of chieftainship (page 66, No. 6; 67, 10).



Woodbridge Williams

A "Naked Clam," Wearing Its Shell Inside, Lives in Mission Bay, California

This queer mollusk, although it closely resembles the gastropods such as small cowries, is a bivalve called *Chlamydoconcha orcutti*. Buried as if swallowed in the top layer of tissue known as the mantle is an internal rudimentary shell. The creature, an inch and a half long and an inch wide, moves by means of a hatchet-shaped foot which protrudes from a slit in the body. At the base of this organ is a large gland capable of spinning a tuft of fine, tough filaments used for anchoring. Photograph first published in *Pacific Discovery*, March-April, 1949.

tongue to puncture and eat mussels and clams. Shell experts call them by their scientific names for accurate identification. But when you find Turkey Wings, Nutmegs, Rose Petals, Angel's Wings, and Chinese Alphabets lurking among the sands and driftwood you may remember more easily.

Color Page 46

Here you see examples of the different shapes and the range of brilliant colors easily found by the amateur collector. Note the different tones of the two valves of the Calico Scallop. The right-hand valve is the lower one, and in this species it is usually much lighter, almost white.

Here is the Violet Snail. It averages one inch across. In contrast to common snails, it has a thin shell so fragile that it would be quickly broken except for this creature's peculiar way of life. The Violet Snail floats upside down suspended from a gelatinous cushion, filled with air bubbles for buoyancy, that is part of its body. One observer says that he saw millions of these snails coloring the sea violet.

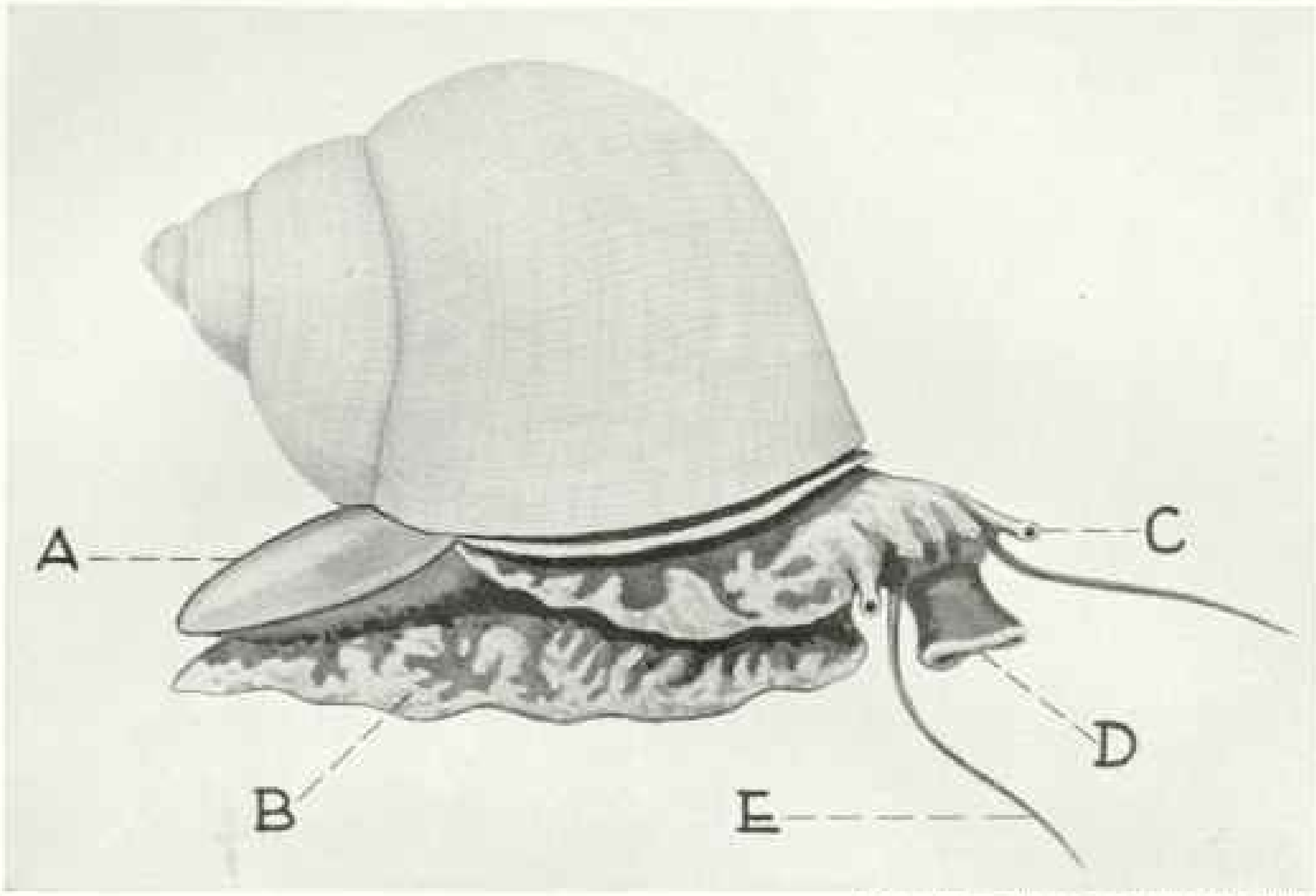
The Wing Shell is characterized by unequal valves and a straight hinge line. This is the same family as the pearl-bearing oyster. (There are no true pearl-bearing oysters around Florida.) The Wing Shell has an inner coating of beautiful, iridescent mother-of-pearl.

Color Page 47

These are selected to reveal a variety of delicate tints. In the upper left-hand corner you see the famous Keyhole Limpet. The limpet is unique in that it is a gastropod, a single shell, although not coiled like a snail. This one is distinguished from the regular limpets by the hole at the apex. It is most common in the Bahama Islands, but many are found on the Florida coast.

The Rose Cockle is one of the joys of the amateur collector. Note that it makes a heart-shaped outline. The Flesh Marginella is like an agate with beautifully polished enamel. This is sometimes called the Ruddy Rim Shell, or the Gem Shell. For those who search only in the daytime it is hard to find. Dr. Bales said that he found many more of these choice Marginellas when he went after them at night with a gasoline lantern that shed a bright white light.

The Marginellas are abundant on the beaches of South Africa. There is a record of 79 different species picked up on one beach at Port Alfred. In the lower left-hand corner you see the Banded Thais. This is the Florida type of the Thais, so common on the Maine coast.



National Geographic Staff Artist Walter A. Weber

Thus Moves a Living Tapestry Snail, Carrying His Pearl-lined House

The hard, shiny operculum, or door (A) of *Turbo petholatus's* dwelling (page 68, No. 3), which resembles the brilliant green cat's-eye, is prized as a jewel. B is the foot, C the eye, D the probescis, and E the tentacles. The mouth, which is underneath, does not show in the drawing. Appearing as a light strip under the edge is the mantle, which produces the shell material. In the drawing the shell is indicated lighter.

Color Page 48

Coquinas are sometimes called Butterfly Shells. They belong to a big group known as the Wedge Shells. Florida has a wealth of these shells, averaging about an inch long. A few are found in California, the Philippines, and Ceylon. This is the elementary shell for beginners.

Many visitors to Florida who have not thought of shell collecting are first attracted by the countless numbers of coquinas washed up by the small waves from the Gulf onto the beaches of the west coast.

Coquinas play where the waves wash up and recede, riding up and then suddenly digging into the soft wet sand. They dig so fast that they disappear in a few seconds. Gourmets collect the coquinas by the bucketful and boil them up for delicious broth.

Color Page 49

The Pecten has world-wide distribution and a glorious variety of colors. More than any other shell form, the Pecten is a classic symbol, and its radiating symmetry, like the fingers of our hands, is frequently incorporated in architecture. One of the finest examples is the Château of Blois, France, where Pectens ornament chimneys and friezes.

On this page note that the two valves of the same animal are usually produced in different shades of color. A good example is seen in the two upper corners, which are opposite valves of the same animal. Note also how those shells with heavy ridges resemble the Thorny Oyster (page 50), except that Pectens do not have spines.

Color Page 50

The Thorny Oysters resemble Pectens, but the two valves produce fantastic spines. These spines may be tiny scales, or pin points, or heavy spikes. Many of these shells are white, but those that are colored are brilliant flaming red, rose, deep purple, salmon. They are found around the entire Florida coast, in Baja California, the Philippines, Mauritius, and along the coast of China. When torn away by a storm, the Thorny Oyster is thrown up on the beach where collectors usually find it broken by the surf. To find these grotesque shells with both valves and the spines unbroken is an event.

Color Page 51

The Volutes are sometimes referred to as the aristocrats of shells. They are cherished by collectors for their handsome spirals and variety of colors and markings. Note the depth and character of the aperture with the finely drawn curve forming its outer edge.

Pierre Verger from Black Star

In the Dance of the Skeletons French Sudan Natives Wear Their Wealth

Ornamental bands, producing the effect of bare bones, are strings of Cowry Shells, used as money among many African tribes and related to the Golden Cowry (page 66, No. 6; 67, 10). To propitiate the spirits of the dead and to attract rain for crops, the performers, garbed in their finest, prance with traditional steps. Each participant represents a creature from the spirit world. The feathers are symbols of dignity. Incongruous are the tennis shoes and pipe.

See how some of these Volutes have a rounded apex. This little knob is known as the protoconch. It is the nucleus from which the rest of the shell has grown.

Color Page 52

Terebras are known as the Auger Shells. Their distinction is revealed in the long tapering cone that, for regularity and elegance, is unequaled among shells. This is the spire of church and temple. The Turritella, or Screw Shell, is similar, so that three of them are included in our plate. If you look closely at the bottom of each shell you will see that the Turritella has a smooth, abrupt lip, while that of the Terebra has a fancy little protuberance or fold. The tip is so slender that sometimes the animal fills it with nacre (mother-of-pearl); some species break off the tip, making the shell blunter but easier to carry around. They present an amusing appearance, lumbering along under their steeples.

Terebra is common on both shores of Florida. Every amateur collector ought to have one. You can collect them alive, buried shallowly in a horizontal position in wet sand at the water's edge or in shallow water. This marvelous shell is also world wide. Tahiti, the Philippines, Ceylon, and the Red Sea are represented in our plate.

Color Page 53

The collector of Cones needs a world atlas for reference. The specimens selected for our page illustrate their universal distribution. Here are cones from Hawaii, South Africa, Ecuador, Singapore, the Red Sea, Mexico, and other places in the Pacific. Compared to other shell families, the Cones have remarkable regularity; all are trim and distinctive. A typical cone is about two inches long with a flat apex and a broad top, its straight sides forming a triangle. The chief variations are in the markings and color, which offer a wealth of enchanting ideas for the decorator.

The big one in the lower right-hand corner is the Geographic Cone. It averages four to five inches and has a wide aperture, giving it an outline more curved than triangular. The two Cones in the lower corners, *Conus aulicus* and *Conus geographus* are dangerous to the collector. Their inhabitants have a sting that injects a painful poison which may prove fatal. In fact, all Cones should be handled with care when alive.

Color Page 54

Chitons are the most individual of the mollusks and the most ancient and conservative family. They belong in a class by themselves. Unlike other mollusks, they have shells consisting of eight separate pieces. These pieces are formed simultaneously and do not have a spiral curve.

Science believes that the original primitive mollusk must have resembled the Chiton more than any other. In this sense it is an antique. The Chiton clings to a small rock at the water line by means of a vacuum cup the length of his foot. He is stuck so tightly that to dislodge him the collector needs to thrust a flat knife quickly underneath him.

Most of these shells are collected in living condition with the eight separate pieces held together by a surrounding girdle. Some of those on our page show this girdle, especially the large one in the upper center. When cleaning and preparing shells for collection, some collectors remove the girdle; then the pieces must be stuck together with glue to hold their form.

Color Page 55

We recall that the ancients were a maritime people, that they made dyes from mollusks. Later, artists of the Renaissance, whose world lay close to the Mediterranean shores, immortalized shells. Yet the Mediterranean cannot compare with other regions, such as the South Seas or Florida, in the richness of color and variety of its shells.

In the center of page 55 is a Haliotis, a species closely related to the Abalone of California (page 36). In the upper left-hand part of the page you will see four Patellas whose special charm is the inner lining of mother-of-pearl. Compare these with the limpets of the New England coast, page 42, to which they are related. At the bottom you have two views of the handsome Helmet Shell. One species of this, called the Cameo Shell, appears often in Italian curio shops. Many American families have these shells, carved with exquisite little cameos, as souvenirs.

Color Page 56

The Ear Shell, called Abalone in California, is the most distinctive shell of our Pacific coast. It is remarkable both for the play of iridescent colors through its incomparable mother-of-pearl and for the food value of its animal.

The Abalone is never found on Atlantic beaches; yet many Florida shell types are found in Baja California. Geologists say this proves that the Atlantic and Pacific Oceans were connected during a late period in the earth's history.

The shells on this plate are from the collection of the Berkshire Museum, Pittsfield, Mass.

Color Page 65

The Chambered Nautilus is in a class by itself, not only for the beauty of its dynamic symmetry but also biologically. It belongs to the most highly organized group of mollusks—the nautiluses, cuttlefishes, squids, and octopuses. These animals, in contrast to other mollusks, have large bodies, well-developed eyes, and a circle of arms (tentacles), often with sucker discs, arising from their heads.

You might say that the shell on this page is the home of a member of the octopus family. It is found most commonly in the deep waters of the Pacific. The Nautilus is an animal with an ancient lineage revealed by 2,000 fossil species; yet today only three living species survive.

The Nautilus animal occupies only the largest outer chamber of its shell. It protrudes from this to swim about and to catch crabs and other animals with its tentacles. For protection it withdraws completely within its shell.

The wirelike tube running through the middle, all the way from the apex to the last chamber, is called a siphuncle. As the baby Nautilus grows, it builds its spiral with mathematical precision and, as it moves outward, leaves vacant chambers sealed with watertight partitions. According to one theory, the siphuncle enables the animal to control the gas pressure of these empty chambers and thus give its shell buoyancy to become a vehicle of transportation.

The age of this shell is unknown. The chambers do not bear any relationship to the years. One of the largest perfect specimens of the Chambered Nautilus ever found measures about 11 inches across.

Color Page 66

Some South Pacific regions have been less disturbed through the ages than other parts of the world. Here the mollusk fauna, like the flora of certain South Pacific islands, is most primitive and ancient. Because of the relatively stable temperatures of the sea-water currents that flow between the islands, shell forms have achieved richer colors and more imaginative patterns here than in any other shell region in the world.

In this plate the coral orange Tridacna valves at

top center show the heavy sculpturing of the giant clam. This is a medium-sized species, but some achieve three or four feet across; they are found in six to ten feet of water in channels between the islands.

The smooth oval shell just above the center is the Golden Cowry. This is greatly prized by shell collectors and must be obtained via the underground, so to speak, because its export from Fiji is sternly prohibited. The Golden Cowry is worn only by a chief, as a symbol of his sovereignty, like a crown. In South Sea islands, as elsewhere in the Tropics, cowry shells are used as money and a man's wealth may be estimated by the number he wears as ornaments (page 62).

Color Page 67

Among these Philippine specimens you will see one of the most distinctive and beautiful shells of the Far Eastern waters, *Lambis willepeda*. This is closely related to the Scorpion Shell, but the experienced observer will distinguish it by the two prominent notches at the top forming the letter W and the stubby notches along the side.

In the lower center our plate shows the Golden Cowry. This is the most highly prized shell on the page. To the right of the Golden Cowry you see the famous Triton Shell (page 59), which is the prototype of Triton's trumpet used in mythological pictures.

This page is noteworthy also for the slender, curved, green Tooth Shell in the upper right-hand corner. Its scientific name, *Dentalium elephantinum*, means Elephant's Tooth. A small white variety of these shells was strung by American Indians to make necklaces, and for use as wampum. The shape of this shell, which appears to have neither the spiral of the univalves nor the clam-like couplets of the bivalve, betrays that it is in a class by itself.

Color Page 68

Early in the war, New Caledonia, in the South Pacific directly east of Australia, one of the world's important outposts for shell collectors, became a base for military operations. As a result, in May, 1943, the National Geographic Society received from Lt. Gen. Alexander Patch, since deceased, one of the finest shell collections sent back to the United States from the South Pacific. You see here some of the notable specimens of this collection, which has been turned over to the U. S. National Museum in Washington.

Compare the Trochus in the lower right-hand corner with the rare and highly prized Pleurotomaria on page 71. They are closely related, as you can see from the shape, but quite different in detail. In the upper left corner you see the famous Scorpion Shell. This should be compared with the Lambis on page 67. The Scorpion Shell is common in the South Seas, but highly distinctive and easily identified by its six hooks. At the bottom of the page you will find three Cowries. Although not so rare as the Golden Cowry of page 67, this shell is cherished for ornamental value in the South Seas.

Color Page 69

In our shell tour, page 69 carries us south of the Philippines to the Equator and the heart of the East Indies. Here, around the Moluccas, is found a baffling profusion of the world's most brilliant shells.

On our page the most arresting item from the viewpoint of the expert shell collector is the large Melo in the upper right-hand corner. Study it carefully. You will realize that it has a left-handed spiral. The genus shown is right-handed, so that we have here a rare and unusual specimen. Most all other shells through these pages are right-handed. The only exception is the left-handed whelk on page 45. This whelk species is always left-handed and is distinguished for that reason, but individual specimens are not rare. Our left-handed twist, shown here from the beaches of the East Indies, would create a sensation in the temples of old India where left-handed shells are sacred objects.

Color Page 70

A few especially peculiar shapes are gathered on this page; but you will also find many imaginative designs scattered through other pages in this series. The terraced shell in the upper left-hand corner should be compared with the small *Cancellaria trigonostoma* in the upper left-hand corner of page 71. In the center at the top we see two incredibly slender Terebras. Compare these with the spires related to them (page 52).

At the bottom you see the beautiful Venus Comb, characterized by its curving spines. This extraordinary shell is fairly common, but hard to find with the long brittle spines unbroken. This belongs to the *Murex* group, which produces more capricious spines and ridges than any other type of shell. Five other specimens of the fantastic Murex can be counted on this page.

At the bottom, to the right of the Venus Comb, we see a striking example of the Carrier Shell. This is a univalve, with a flat spiral, that collects smaller shells, bits of stone, coral, or refuse, cementing them on for a perfect camouflage. It resembles so exactly the bottom where it lives that it is virtually impossible to pick up casually.

Color Page 71

You see here a page of shells pronounced by the U. S. National Museum, Washington, D. C., as among the rarest in the world. To be rated rare, from a collector's standpoint, a shell should be scarce. It should be a distinctive species or type, of which possibly only one or two have ever been picked up. The discovery of rare shells is the ambition of the most expert collectors, and may be the high point of a career.

Form and color are not criteria of rareness; the rare shell may be unattractive to the eye. For this reason it usually takes an expert to detect them. The thousands of amateurs who seek shells are more apt to look for perfection and beauty, and doubtless have cast aside many rare discoveries without a thought.

A sport or a freak of a species may be a rare

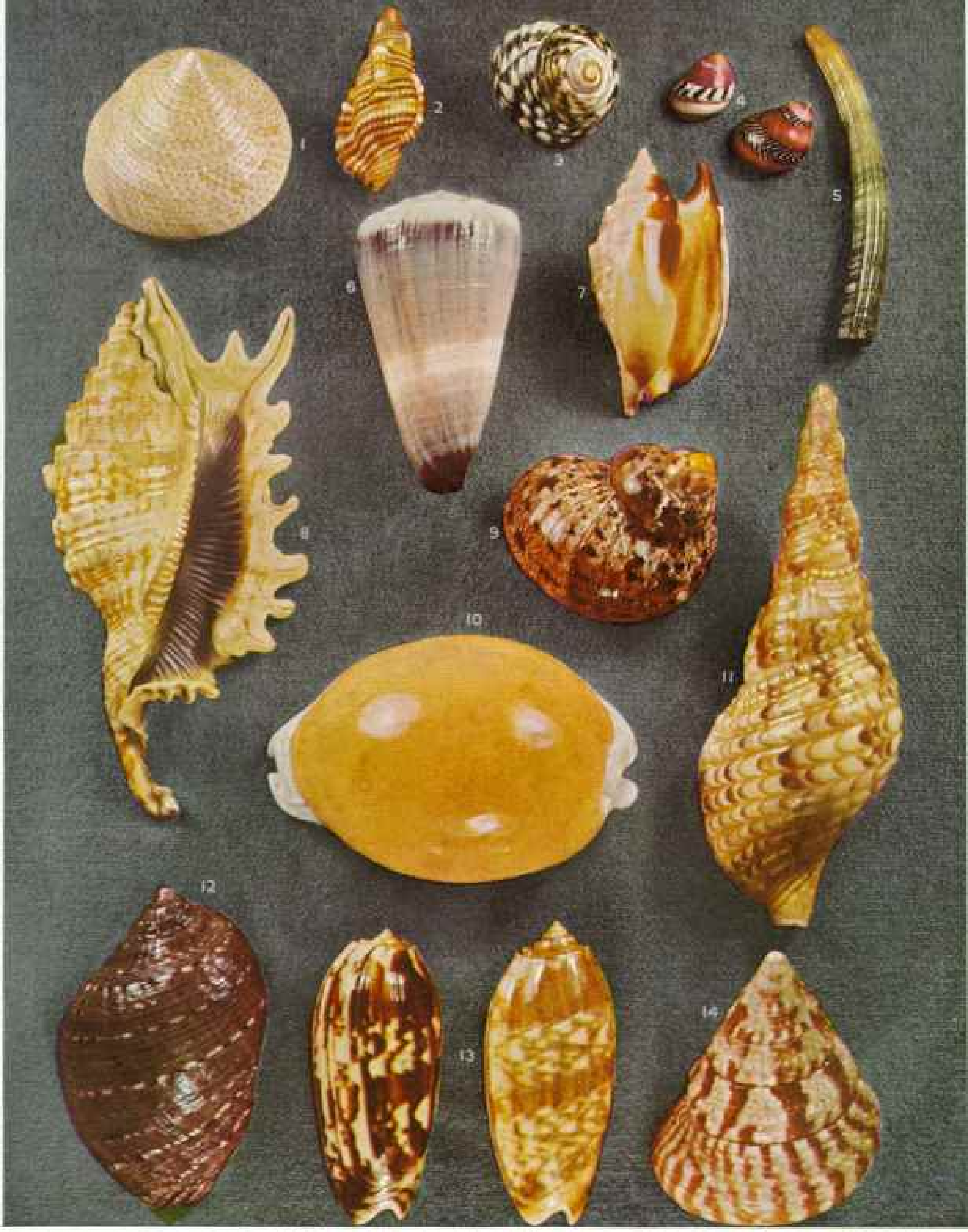
The Chambered Nautilus, as It Grows, Makes Each New Room Larger than the Last

As Oliver Wendell Holmes said in his famous poem, it seals each cell when abandoned for a new room. Cross section comes from Mrs. Fiske Warren of Boston, exterior from the American Museum of Natural History, New York.

Kodachrome by Rutherford Platt

Most Precious of These South Pacific Shells of Ancient Lineage Is the Golden Cowry (6)

To obtain the prize, the collector often goes to underground dealers, for it is worn by a chief as a symbol of sovereignty, and its export from Fiji is sternly prohibited. Its official name is *Cypraea aurantium* (Fiji). The shells on this plate are: (1) *Bathybembix argentea* (Japan); (2) *Tridacna noae* (East Indies); (3) *Turritella terebra* (Philippines); (4) *Papuina pulcherrima* (Admiralty Islands); (5) *Cantharidus opalus* (New Zealand); (6) *Cypraea aurantium* (Fiji); (7) *Oliva tigrina* (Western Pacific); (8) *Chlamys senatorius nobilis* (Philippines); (9) *Chlamys senatorius nobilis* (Philippines); (10) *Astraea heliotropium* (New Zealand).

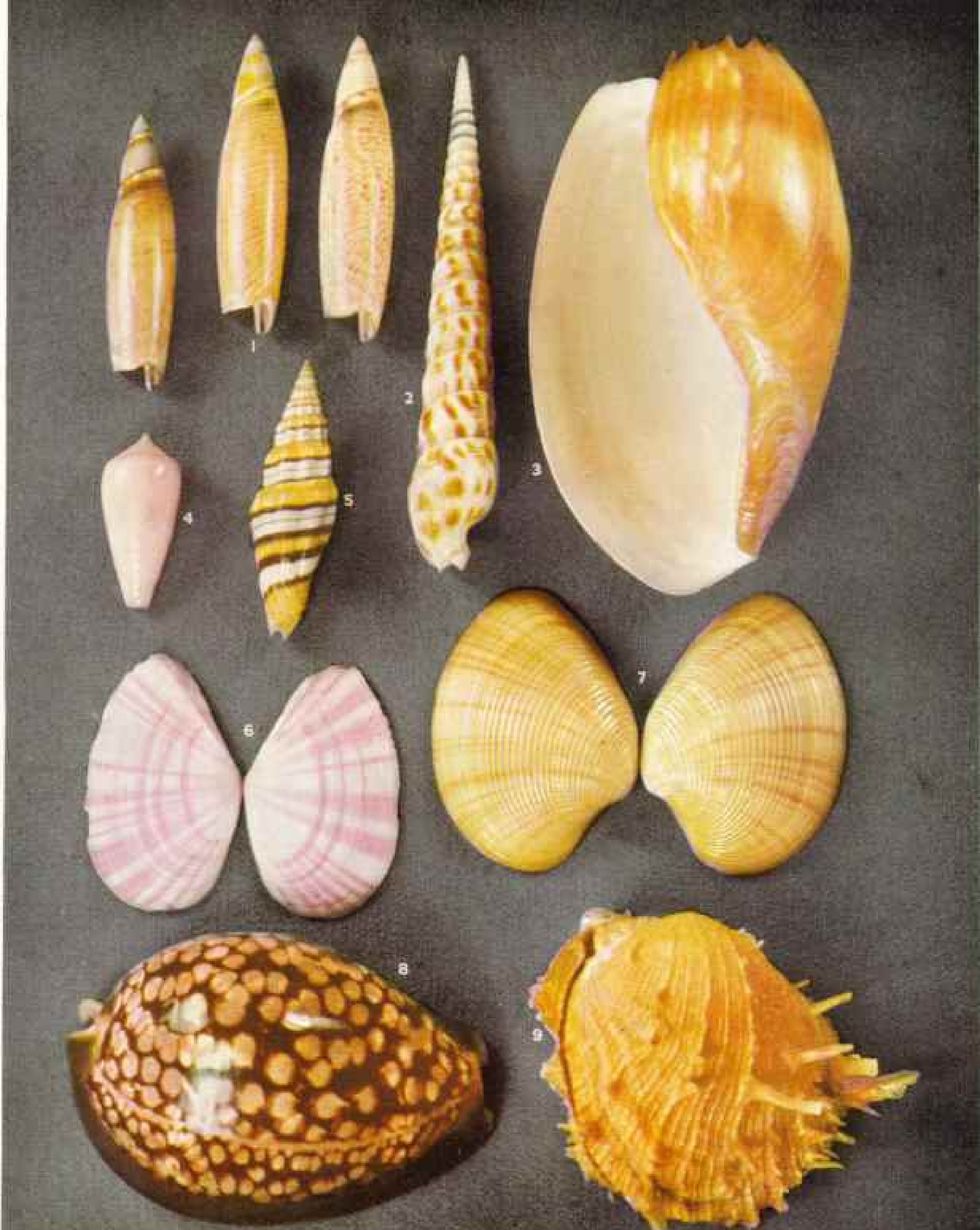


To the Collector the Philippines Offer the World's Greatest Source of Wonder Shells

The islands, extending 1,150 miles south from near Formosa to about five degrees north of the Equator, have many shores as yet unexplored. Of countless striking species, only a few are pictured here: (1) *Calliostoma cunninghami;* (2) *Cymatium rubecula;* (3) *Turbo undulatus;* (4) *Neritina communis;* (5) Elephant's Tooth, *Dentalium elephantinum;* (6) *Conus lividus;* (7) *Strombus auris-dianae auratum;* (8) *Lambis millepeda;* (9) *Turbo petholatus;* (10) Golden Cowry, *Cypraea aurantium;* (11) Triton's Trumpet, *Charonia tritonis;* (12) *Purpura persica;* (13) *Oliva sericea miniacea;* (14) *Trochus acutangulus.*

General Patch Brought the National Geographic Wonder Shells from New Caledonia

These few from the huge collection are: (1) Scorpion Shell, *Lambis rugosa*; (2) *Natica vitellus*; (3) *Turbo petholatus*; (4) *Charonia tritonis*; (5) *Turbo marmoratus*; (6) *Architectonica perspectiva*; (7) *Mitra episcopalis*; (8) *Cellana testudinaria*; (9) *Cerithium nodulosum*; (10) *Amusium pleuronectes*; (11) *Nautilus macromphalus* (young); (12) *Cypraea tigris*; (13) *Cypraea talpa*; (14) *Cypraea vitellus*; (15) *Trochus niloticus*. The priceless gift was placed in the U. S. National Museum by the donor (since deceased) and Trustees of The Society in May, 1943.



Kodachromes by Rutherford Platt

From the Moluccas, East Indies, Comes a Baffling Profusion of Brilliant Shells

The world produces nowhere else such numbers of striking specimens as are found here and in the Philippines. Of the few pictured, the large Melo, (3), *Cymbium aethiopica*, is exceedingly rare and unusual because of the left-handed spiral which makes it a freak of its family. Reverse-twist shells are sacred in India. Other Moluccas specimens on the page are: (1) *Terebellum terebellum;* (2) *Terebra flammea* (Florida); (4) *Conus cinereus;* (5) *Mitra vittata;* (6) *Tellina virgata;* (7) *Callista lilacina;* (8) *Cypraea mauritiana;* (9) *Spondylus crocens.*

Some Shells, Like the Giraffe, Are So Fantastic as To Be Unbelievable Until Seen

In capricious mood Nature has created these odd shapes: (1) *Aneistrolepis hirasei* (Japan); (2) *Murex pele* (Hawaiian Islands); (3) *Terebra triserrata* (Japan); (4) *Latiaxis deburghiae* (Japan); (5) Bubble Shell, *Hydatina albocincta* (Canton, China); (6) *Trisidos tortuosum* (China); (7) *Malleus albus*; (8) *Trophon triangulatus* (California); (9) *Murex brandaris* (Port Darwin, Australia); (10) *Brechites radix* (Torres Strait); (11) *Murex tenuispina* (Ryukyu Islands); (12) *Xenophora pallidula* (Japan); (13) Spindle Shell, *Tibia fusus* (off San Fernando Point, Luzon, Philippines).

Kodachrome by Rutherford Platt

Among the Rarest Shells in the World Are These from the U. S. National Museum

Specimen No. 3, long believed to be unique, was found by John B. Henderson, Jr., on an expedition to Barbados. The large shell, No. 7, is unusual in that numerous fossil forms of it have been discovered, but only a few live specimens have been found. (1) *Cancellaria trigonostoma*; (2) *Fenimorea jametae* (Puerto Rico); (3) *Sthenorytis pernobilis* (Barbados); (4) *Eldridgea johnsoni* (Puerto Rico); (5) *Basilissa babelica* (Japan); (6) *Calliotoma haliarchus* (Japan); (7) *Pleurotomaria salmiana* (Japan); (8) *Rehderia schmitti* (Florida); (9) *Murex beaui* (Cuba); (10) *Tibia martinii* (Philippines); (11) *Lima dalli* (Philippines).

Tiny Shells Range in Size from a Half Inch to a Barely Visible Speck

Of all kinds known, about 90 percent are little, although the larger species usually make up the bulk of collections. The ones on this page (there are thousands much smaller) are: (1) *Tricolia tessellata* (Curaçao); (2) *Umbonium vestiarium* (Indian Ocean); (3) *Tricolia affinis* (Martinique, West Indies); (4) *Columbella gardalina* (Philippines); (5) *Cantharidus iridodontes* (Australia); (6) *Bankivia fasciata* (Australia); (7) *Columbella fulgurans* (Philippines); (8) *Columbella mercatoria* (Bermuda); (9) *Neritina communis* (Philippines). The two rows at the bottom, handsomest of sea snails, are marked like tooled leather.

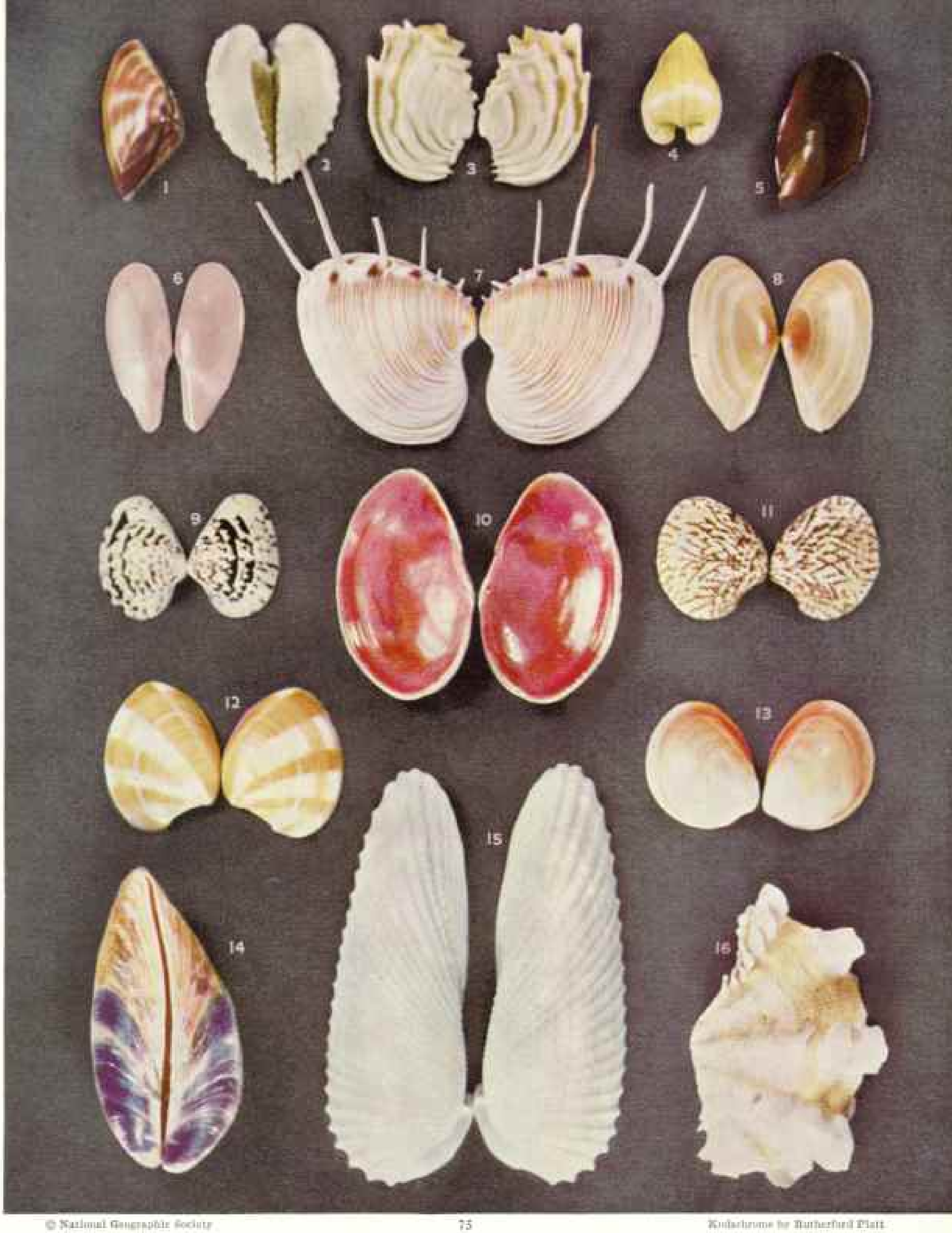
  Kodachrome by Rutherford Platt

These Are Highlights from the Late Frederick A. Constable's Collection of 50,000

As others might choose rare books or paintings, he selected shells (mostly marine) from all over the world. The entire treasure is now a gift to the American Museum of Natural History, New York. Bivalves are: (1) *Mactra violacea* (China); (2) *Corculum cardissa* (Philippines). Univalves are: (3) *Conus victoriae* (Australia); (4) *Guildfordia triumphans* (Hong Kong); (5) *Conus rhododendron* (Australia); (6) *Conus geographicus mappa* (Pacific islands); (7) *Ranella pustulosa;* (8) *Voluta lyraeformis;* (9) *Fasinus nitidulus* (West Indies); (10) *Cypraecassis testiculus* (West Indies); (11) *Voluta sclateri* (Tasmania).

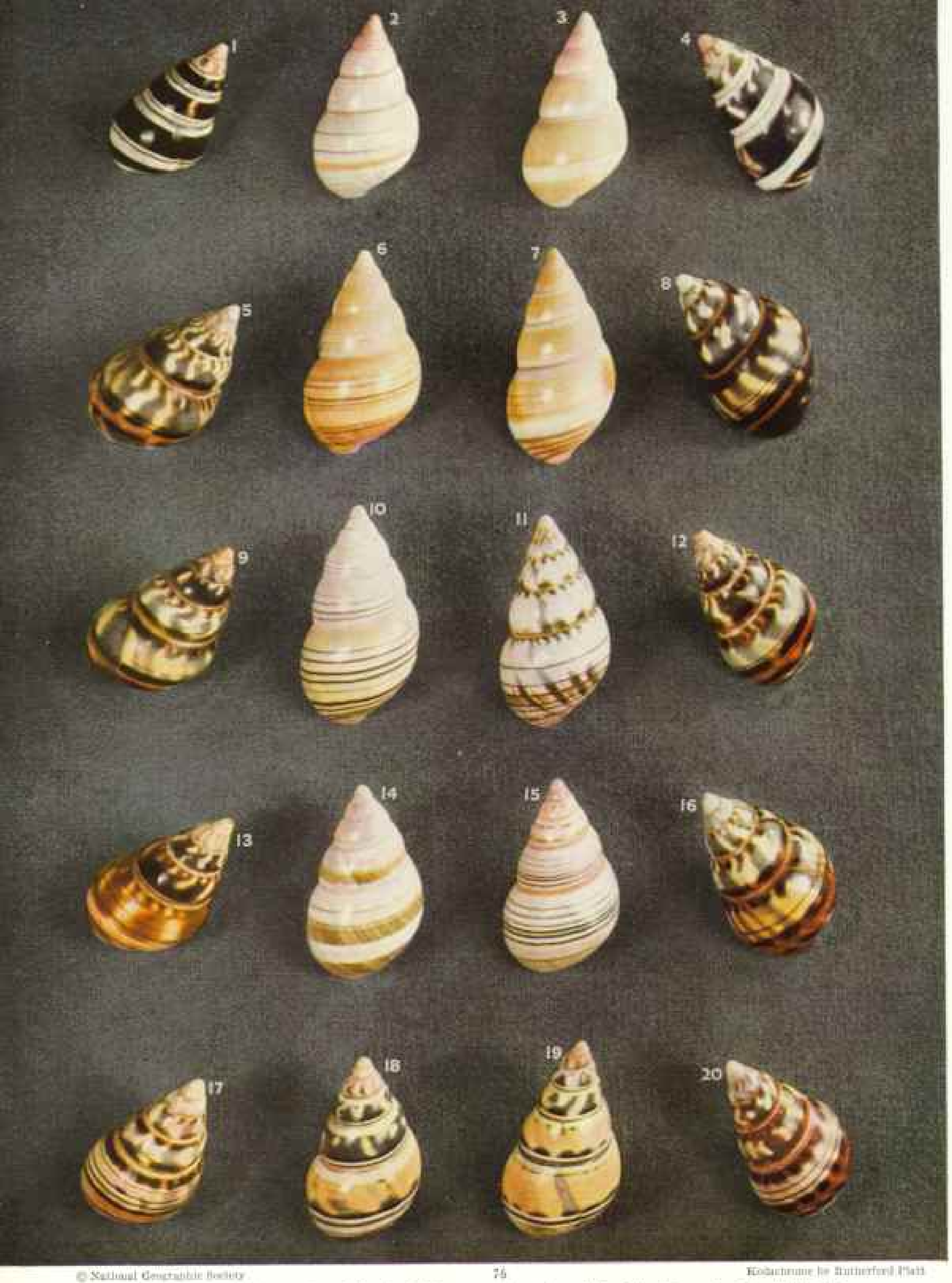
Univalves Do Not Fade; from One of Them Was Made the Famous Tyrian Purple

The dye resulted from chemical changes in an extract from glands of a Murex which was gathered in ancient times from the shores of the Mediterranean Sea. From the Pacific come: (1) *Umbonium giganteum* (Japan); (2) *Epitonium pretiosum* (China); (3) *Ancilla rubiginosa* (China); (4) *Pyramidella maculosa;* (5) *Trochus maculatus* (Oceania); (6) *Cancellaria nodulifera* (Japan); (7) *Phasianella australis* (Australia); (8) Sundial Shell, *Architectonica maximum* (China); (9) *Babylonia japonica* (Japan); (10) *Voluta fulgetrum* (Australia); (11) *Murex bicolor* (Gulf of California); (12) *Oliva irisans* (Japan).



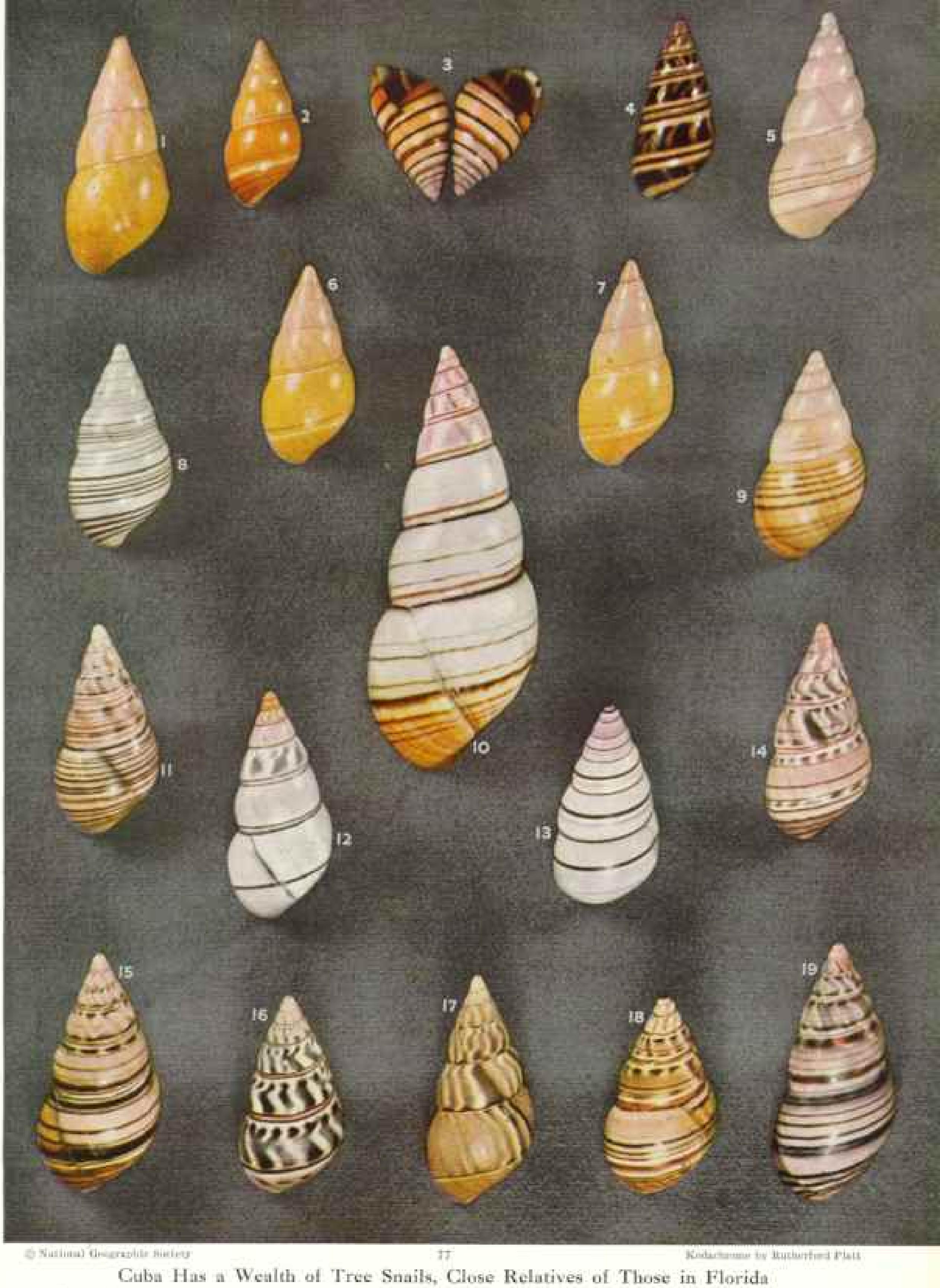
Bivalves—Clams, Oysters, Mussels—Open and Close Hinged Shells Like Doors

For building the valves they have two mantles, one on each side of the body. (1) *Donax carinatus* (Mexico); (2) *Corculum cardissa* (Philippines); (3) *Bassina dejecta* (Australia); (4) *Isocardia lamarcki* (China); (5) *Mytilus achatinus* (Brazil); (6) *Tellina volsella* (Japan); (7) *Pitar lupanaria* (Mexico); (8) *Tellina albinella* (Australia); (9) *Lioconcha tigrina* (Japan); (10) *Sanguinolaria tellinoides* (Mexico); (11) *Chione undatella* (Mexico); (12) *Chione pachyphylla* (Australia); (13) *Laevicardium laevigatum* (Florida Keys); (14) *Volsella capax* (California); (15) Angel's Wings, *Barnea costata* (Florida); (16) *Tridacna noae* (Philippines).



If Shifted from One Kind of Tree to Another, Florida Tree Snails Will Die

These specimens of *Liguus* from the collection of Archie Jones of Miami are: (1) *fasciatus castanezonatus;* (2) *f. lineolatus;* (3) *solidus dryas;* (4) *f. castaneozonatus;* (5) *crenatus marmoratus;* (6) *c. lossmanicus;* (7) *f. roseatus;* (8) *c. marmoratus;* (9) *f. versicolor;* (10) *c. mosieri;* (11) *s. pseudopictus;* (12) *f. versicolor;* (13) *f. castaneus;* (14) *c. vacaensis;* (15) *f. lineolatus;* (16) *c. marmoratus;* (17) *c. floridanus;* (18) *f. castaneozonatus;* (19) *s. graphicus;* (20) *c. nebulosus.*



Cuba Has a Wealth of Tree Snails, Close Relatives of Those in Florida

Strangely, one kind, *poeyanus* (3), of this *Liguus* collection is about half left-handed, half right. (1) *flammellus bermudezi*; (2) *fasciatus mcgintyi*; (4) *blainianus*; (5) *fasciatus helianthus*; (6) *flammellus cubensis*; (7) *fasciatus helianthus*; (8) *crenatus*; (9) *crenatus caroli*; (10) *achatinus*; (11) *fasciatus fasciatus*; (12) *fasciatus pallidus*; (13) *virgineus*; (14) *fasciatus viridis*; (15) *fasciatus laurani*; (16) *fasciatus torrei*; (17) *flammellus flammellus*; (18) *fasciatus aguayoi*; (19) *fasciatus vignalensis*.

Probably the Most Brilliantly Colored Land Snails in the World Are Found in Cuba

All have the same architecture, yet no two look alike. From every angle they are colorful and distinctive. They exemplify in a remarkable way the Greek paradox of "diversity with uniformity." Artists and designers study them for the inspiration of color combinations and originality of blends and tints. The Province of Oriente, on the east end of the island, is the only place in the world where these particular snails are found. Here are presented handsome members of the *Polymita* genus: (1, 5, 7) *muscarum*; (2, 3) *picta*; (4) *venusta*; (6) *versicolor*; (8) *flammulata*; (9) *picta* (with subspecies).

Philippine Land and Tree Snails Closely Resemble Their Cousins in Cuba, 10,000 Miles Away

Here are 27 of 1,000 Philippine species. Most are tree dwellers; a few live on the ground. Though all require moisture, they drown easily. No. 6 is *Chlorasa sirena*. All others are *Helicostyla*, *helico* being Greek for "spiral." (1) *annulata*; (2) *psittacina*; (3) *reginae*; (4) *tricolor*; (5) *jonasi*; (7) *stabilis*; (8, 9) *iloconensis*; (10) *orbitula*; (11) *leucophthalma*; (12) *filaris*; (13, 14) *intorta*; (15) *magtanensis*; (16) *effusa fasciata*; (17) *fulgens*; (18) *circe*; (19) *florida*; (20) *marinduquensis*; (21) *semperi*; (22) *limasauensis*; (23) *mirabilis*; (24) *festiva*; (25) *polillensis portei*; (26) *guimarasensis*; (27, 30) *polychroa*; (28) *woodiana*; (29) *metaformis*.

Cutting Cross Sections of Pearly Shells Harder than Glass Is Delicate Work

Here are four superb examples made for Mrs. Fiske Warren of Boston. The triton, *Charonia tritonis* (1), is used in Peru as a musical instrument in religious services. The central columella, or axis, shown in (2), *Xancus angulatus* (Bahamas and Florida), is strikingly like the famous double staircase of the Château of Blois, France. Nos. 3 and 4 show different ways of cutting the common Giant Conch, *Strombus gigas*, of the Florida Keys.

shell, provided its condition is natural growth and not merely a distortion. For example, on page 69, upper right-hand corner, you can see a left-handed Melo. This could qualify for a place among the world's rarest, because the other shells of the same species are right-handed. This sport is probably the only left-handed Melo ever found.

Perhaps the rarest on page 71 is the small white shell in the center of the top line. This was found by the late John B. Henderson, Jr., of the U. S. National Museum, when he was on an expedition to Barbados. The large cone, top-center, is the famous *Pleurotomaria adansiana*. There are a large number of fossil forms of this shell, but only a few live specimens have ever been found. These have been dredged up off the coast of Japan in 600 fathoms of water by trawlers looking for big crabs.

Formerly, when a Pleurotomaria was discovered it became the possession of the Japanese Emperor. A few specimens in this country were smuggled out at a great risk.

Color Page 72

These platoons of little shells, measuring about half an inch or less, give you a glimpse behind the scenes of the vast world of tiny shells. About 90 percent of all shells are small, although the larger types usually make up the bulk of collections. Some full-grown shells are barely visible, like a speck of dust. The very tiny types, smaller in size than those shown on this page, do not have much color. Most of them are white or translucent, like a bit of mica.

The two bottom rows are Neritinas, handsomest of sea snails. The lower right-hand group, just above the Neritinas, are Mottled Dove Shells.

Color Page 73

Here you see high spots from the famous private collection of Frederick A. Constable. It consists mostly of marine shells, selected for their excellent quality, and totals about 50,000 species.

Shortly before his death, Mr. Constable donated 15,000 selected items to the American Museum of Natural History in New York. In recent years, after a study of the collection by Dr. Roy W. Miner, the balance was bequeathed to the Museum by Mrs. Constable, now deceased.

The sources of the specimens shown in our plate reveal the global origins of an assemblage such as this: Indian Ocean, China, Philippines, Tasmania, West Indies, Australia, Africa, and Hawaii.

Color Page 74

For some mysterious reason, almost all of the spirals of univalves are right-handed. That is, they curve clockwise as the animal puts out his head. This is the same direction of twist as the thread of a screw. Whether this right-handed curve is a coincidence, or whether it is due to a law of physics or biology as yet undiscovered, is not known. Rarely, one of these right-handed shells is found curving to the left. This is a sport or a freak and as such it has special value for the collector.

The fine specimen of Murex on page 74 is a member of a large and very ancient family of shells found in all the seas. They develop fantastic spines, knobs, horns, and fins as projections from an otherwise normal turbinate shell. The Murex has a rough appearance, and it is a tough actor. It is a menace to oyster beds; it bores holes through the hardest shells and feasts on the occupant.

Classical history has many references to the Murex. This type of shell collected in Mediterranean waters was the source of the famous Tyrian purple. This mollusk dye came in deep red, blue, violet, black, and green, but its most historic color was purple. The royal houses of Persia, Babylon, and Syria all wore Tyrian purple. The wealth of Phoenician merchants was derived from Murex dyes.

Color Page 75

About one-fifth of the species of mollusks in the world are bivalves (Pelecypoda, "hatchet foot"). These are the clams, oysters, mussels, and their variations. They have two mantles for producing their shells, one on each side of the animal. These mantles build the shells (called valves) with almost perfect synchronization. Each valve has an apex, or umbo, from which spiral lines of growth are pushed out in ever-increasing magnitude. Each increment of growth is usually marked by little ridges. These are not like the annual rings of trees. No one can tell the age of a bivalve by counting these growth lines. The size of bivalves runs from tiny ones like a pinhead to the giant Tridacna which may measure four feet across.

Most bivalves are slow movers. They either attach themselves to hard surfaces, like the oysters, or burrow in the sand where they hide lazily. However, as we have seen elsewhere, the coquinas are very active in the shallow surf.

In the lower right-hand corner you will see a small species of the mighty Tridacna. Although this one is only about three inches across, others will grow to three or four feet and may weigh 500 pounds. It is said that pearl divers have been drowned when the mighty valves closed tight on their arms, trapping them underwater.

Because these mammoths of the mollusk world have been in great demand—they are often used as basins for holy water in churches—they are scarce. Collectors report that it takes six men to dislodge them from reefs 60 feet under the water.

Color Page 76

The marine mollusks are so celebrated that one instinctively belittles the land snails. Yet these last make a varied and world-wide fauna. If the sea had never cast up a shell, mollusks would still be famous for their dynamic spirals and the brilliance of their colors because of those which inhabit the land.

The land snail likes moisture. He is found in damp spots under rocks or on the shady side of

Joint Army-Navy Task Force 1

This Giant Clam Was Dug Out of Coral at Bikini

Dr. A. D. Welander, of the University of Washington School of Fisheries, displays a 100-pound *Tridacna gigas* he brought up from its hard bed 10 feet below the surface of the water. When the big mollusk is lying in its natural surroundings, the edges of the fleshy mantle, appearing between the gaping valves, resemble a round serpentine worm, brilliantly colored in shades of red, blue, and green. Unproved fantastic stories are told of native swimmers getting caught by the foot by these creatures and drowned.

plants. But the amount of moisture needed for his pleasure is relative—our Southwest desert and the Sahara also have their snails. They lurk under rocks and dig several inches into the sand, coming out at night.

Except for the tree snails of southernmost Florida, most of the 1,275 kinds of land snails across the United States crawl along the ground, through the grassy jungles, and mount only a few inches on small plants. In addition, there are many kinds of fresh-water mollusks, so that the population of both land and fresh water in the United States is around 3,000 species.

When the trees of the Florida Keys were flattened by the hurricane of 1937, which was followed a few years later by increased tourist trade through the opening of the automobile road to Key West, the *Liguus* became scarce and some of the species are considered to be extinct. It is possible, however, that the reduction of automobile travel during the war has permitted tree-snail colonies to flourish again.

They like certain trees—chiefly the Jamaica dogwood and gumbo limbo. If you take a snail off his tree and plant him on another kind of tree, he languishes and dies, Dr. Bales reported.

Sometimes they are found in groups, because a snail will spread a slimy film where he plans to walk, and other snails finding such a "board-walk" already spread on the bark will go that way. Often they are found underneath a tree from which they have been shaken by the wind, lumbering patiently back to climb their tree again.

The food of these tree snails consists of tiny plant life that grows along bark—lichens and algae. They are not long-lived; the average age of the *Liguus* is three years.

Color Page 77

Our plate shows the beautiful Tree Snails of Cuba. Note how similar these are to those of Florida. Notice particularly the two small ones at the top—both the same kind, yet one is right-handed, the other left-handed. This is a unique characteristic of this species; about half grow in one direction and half in the other. Some tropical islands are rich with land snails, whereas others have comparatively few. For example, Cuba has 10 times as many species as Java.

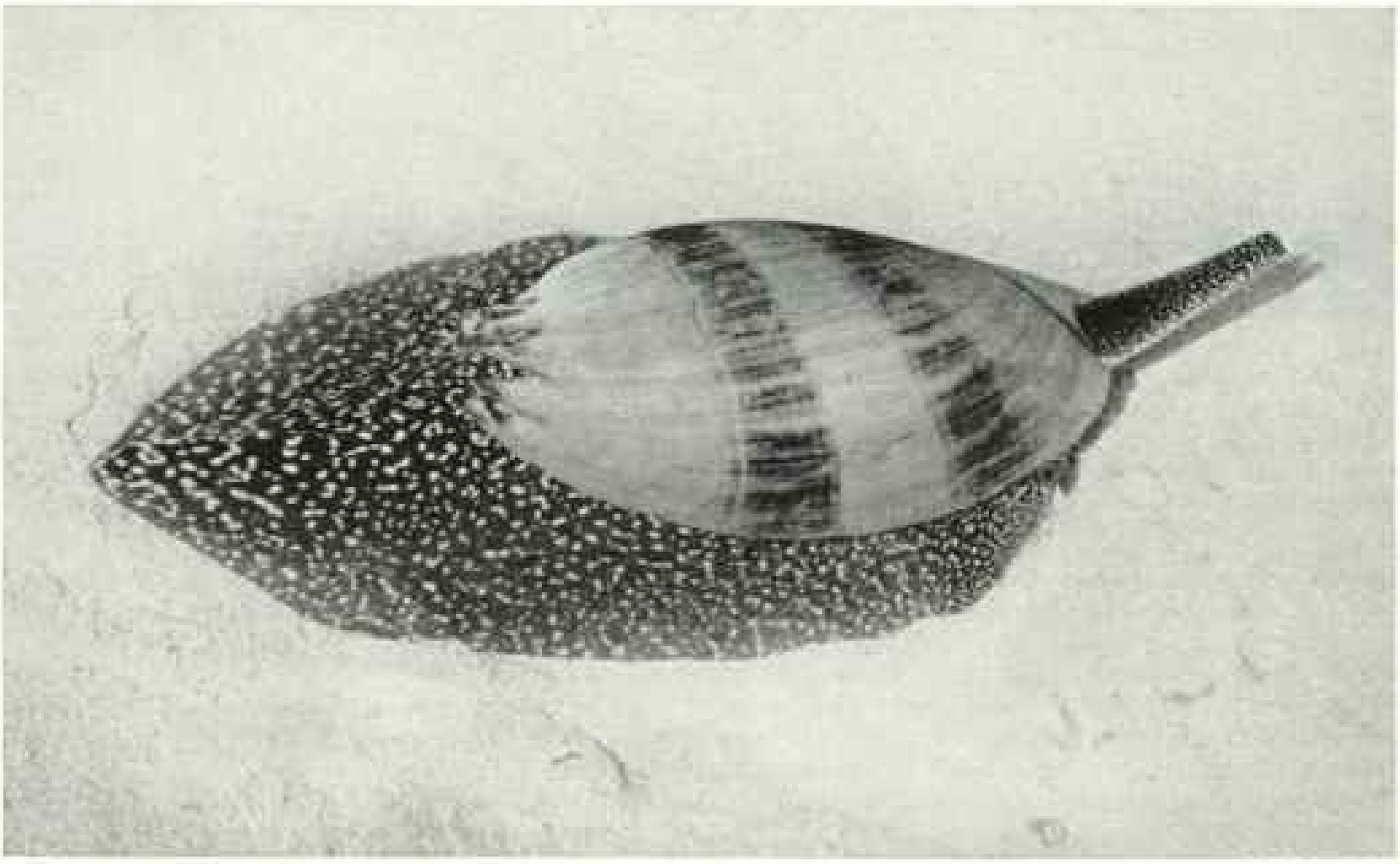
Color Page 78

The Cuban Land Snails are a remarkable group, probably the most brilliantly colored of all the land snails of the world. When you look at this page, you will see how well it illustrates what

National Geographic Photographer Justin Locke

Big Enough for a Child's Bathtub Is Half a Giant Clam Shell

The little visitor to the Smithsonian Institution is sitting in a 150-pound valve of *Tridacna gigas* from the coral reefs of the South Pacific (opposite page).



T. C. Boutilier

Shell of the Bailer Shellfish Is Big as a Football, Its Muscular Foot Even Larger

Common on the Great Barrier Reef, *Cymbium diadema* resembles a watermelon in shape and pattern. The shell is cream or ochreous yellow outside, rich apricot inside. Often as long as 16 inches, it is invaluable to the natives as basket, saucepan, drinking vessel, and canoe bailer. The muscular foot, too big to draw inside, may double the creature's length when fully extended, and weigh several pounds.

National Geographic Photographers B. Anthony Stewart and John E. Fletcher

Set in Soft Velvet and Covered with Glass, Shells Make a Novel Card-table Top

Mrs. Roy Halverson and her daughter, of Duluth, Minnesota, find a novel use for souvenirs of a Florida vacation. On the left side are several rows of scallops (*Pecten gibbus*, page 46, No. 5), and lower right Tellen Shells. The bottom shelf in the background holds specimens of the King Helmet and Frog Conch (*Strombus raninus*).

Greek architects called "diversity with uniformity." Each snail has the same architecture—a small round typical shell. Most of them have the same lineal markings. But what a wonderful range of tints and tones. From every angle they are colorful and distinctive. Artists and designers should study Cuban Land Snails for the inspiration of their color combinations and the originality of blends and tints.

Color Page 79

This plate shows a few typical specimens from the vast tree and land fauna that inhabits the Philippines. This architecture is so similar to the land and tree snails of Cuba that one marvels at the world-wide distribution of these creatures whose habitats are separated by vast seas.

Color Page 80

To cut shells calls for a special skill and special tools. The pearly substance is much harder than glass.

The two lower panels offer a vivid comparison in the spiral designs that result from two different ways of cutting the same shell. This is the common Giant Conch that may be found lying on the beaches of the Florida Keys—a veritable art gem rolled up by the waves unappreciated, unless somebody picks it up and explores its marvelous construction.

Skyway Below the Clouds

By Carl R. Markwith

Illustrations by National Geographic Photographer Ernest J. Cottrell

THE DEDICATION of Skyway 1 as the Wright Way, in honor of the Wright brothers, opened a door long closed to the average amateur flyer. Planned especially for the use of private planes, the new route, when completed, will so simplify navigation that any careful amateur can fly it with safety.

As one of those amateur flyers, I saw in the Wright Way a chance to use my GI flight training. Six weeks after its dedication I started a round-trip flight over the route in a personal plane.

With me went National Geographic Society staff photographer Ernest J. Cottrell, who was even more of an amateur than I. I had a Private Pilot Certificate and had flown 175 hours in small airplanes. Ernie got his Student Pilot Certificate a few days before we took off, and did not fly solo until after we returned.

Some of our flying friends implied that we were not amateurs but professionals—professional dodos. We couldn't blame them, for our transcontinental flight took off on a train to Wichita, Kansas.

In Wichita I began to believe that I should have stayed a dodo, and at home. The man-sized wind blowing down the runway at Cessna Aircraft Field was more than I had bargained for. The company pilots laughed about my eastern caution and insisted that in Kansas they just ignored it.

Regional sales manager "Dutch" Dutton introduced me to Cessna 41692, the four-place airplane loaned by Cessna Aircraft Company for the trip.

The 692 was a perfect lady. She forgave my clumsy efforts to take off and land, and in the air was a far better flyer than I. She and Dutch soon taught me to handle her and the wind safely, if not always gracefully.

Stowing Baggage a Problem

Stowing our 300 pounds of baggage looked like an easy job. Weight had to be distributed to keep the ship in trim in the air; but there was plenty of room and spare load capacity. Parachutes, cameras, film, emergency kit, brief case, and personal gear all had to be stowed to be available when needed.

By the time they were all in place, Ernie was wondering aloud if I really had to have 13 pounds of maps; and I was sure he had at least twice as much film as he could use. We were still rearranging the load when we returned to Wichita seven weeks later.

The airways weather forecaster assured us that the weather was VFR (visual flight rules, as distinguished from IFR, or instrument flight rules), and provided wind directions and velocities above the surface. We selected a cruising altitude where there would be a helping wind and took off for Tulsa, Oklahoma. At that point we should come onto Skyway 1-N, the northern section of the Wright Way.

No Route Signs Aloft

The moment we cleared Wichita we were out on an unmarked highway. It was like driving a car on a secondary highway having no route, direction, or distance signs. The third dimension of altitude, changeable wind drift, and the lack of cloud-borne filling stations complicated matters.

I'd allowed for altitude and wind drift in the flight plan and had studied the course laid out on my chart. Stopping for directions was out of the question; so every 10 minutes or so I had to identify on the ground a check point previously selected on the chart.

Miss more than one of those check points and we'd be lost. If weather turned bad ahead and we wanted to land, we'd suddenly realize that we had no idea of the location of the nearest airport. Turning back would be equally hopeless; for unless we knew where we were, "back" could be anywhere.

The squared-off section lines of the Kansas plains gave the country a checkerboard appearance, beautiful to look at but confusing to navigation. Until I learned to use the section lines on a diagonal course, I depended for check points on towns, rivers, and railroads.

Suddenly the checkerboard orderliness ended, and we knew we had crossed the State line into Oklahoma.* When Tulsa appeared on the horizon, we neglected the charts and compass to enjoy the scenery.

The tower operator at Tulsa Municipal Airport didn't know it, but he started an argument when he reported a ground wind of 45 miles an hour, several miles faster than our

* See, in the National Geographic Magazine: "Speaking of Kansas," August, 1937, and "So Oklahoma Grew Up," March, 1941, both by Frederick Simpich.

In a Pilots' Lounge in Atlanta the Author Plots a Course to Mount Oglethorpe

Mr. Markwith uses a combination parallel rule and protractor on a sectional aeronautical chart. From the chart and the latest weather report he will compile a detailed flight plan. This hop was a side trip to see the monument atop the Georgia mountain, southern anchor of the Appalachian Trail.

landing speed. I knew that wind was going to make it difficult to keep 692 on the ground, even if I made a successful landing. Ernie didn't, and he was hungry. We argued—he for lunch and I for going on.

Ernie and lunch won out and we landed—three times in quick succession. Each time I got the ship down, a gust of wind would lift her off and I'd have it all to do over again.

In the parking area I held the ship against the wind with power and brakes while Ernie chocked the wheels. He then held the tail down while I tied it and the wings to mooring rings and secured the controls.

In the Weather Bureau after luncheon I met the pilot of an airliner which had landed behind us. While he was helping me interpret the weather maps, he said, "I thought they were going to have to shoot you down!"

By early afternoon we were over the man-made Lake O' The Cherokees, in northeastern Oklahoma. Ernie was busy for more than an hour photographing the tall white dam, the beautiful coves, and the bridges crossing the lake. Sail and speedboats crossing the sun blaze on the surface of the water looked to us like toys.

Landing on Monkey Island

This time there was no argument about landing, on Monkey Island Airport, in the center of the lake.

The field was the gateway to a vacation paradise—without a vacant hotel room. Our disappointment must have been obvious, for field owner Merrell Andrews offered the use of bunks aboard his cabin cruiser. The landing float was only 100 yards from the hangar, and the water off the stern of the boat looked so inviting we let the baggage go until after a swim.

At bedtime we discovered that there were no screens on our floating hotel room and went looking for some mosquito netting.

Despite the Sign, He Greased the Tail Wheel and Forgot the Windshield!

When the flyers pointed to the bug-spotted screen, Johnnie Cleveland (page 99), manager of the East Jackson, Mississippi, Airport, instantly offered a refund. He laughed when they admitted that they had bought no gas, and insisted upon having the tanks "topped off" without charge.

Mr. Andrews laughed and asked how many bites we had had during the evening. Astonished, we realized that neither of us had felt a mosquito. The entire lake area is free of the pests, Mr. Andrews explained, because of control measures used by the Grand River Dam Authority, which built and operates the dam.

We were awakened early Saturday morning by a plane arriving at the field. It was the first of several that arrived before noon, bringing Tulsa and Oklahoma City businessmen pilots to join their families for the week end. More were coming in as we took off and headed back to the East again.

A series of newly installed air markings provided such positive check points that we were able to relax and enjoy the scenery as we flew over the Ozarks in Missouri.*

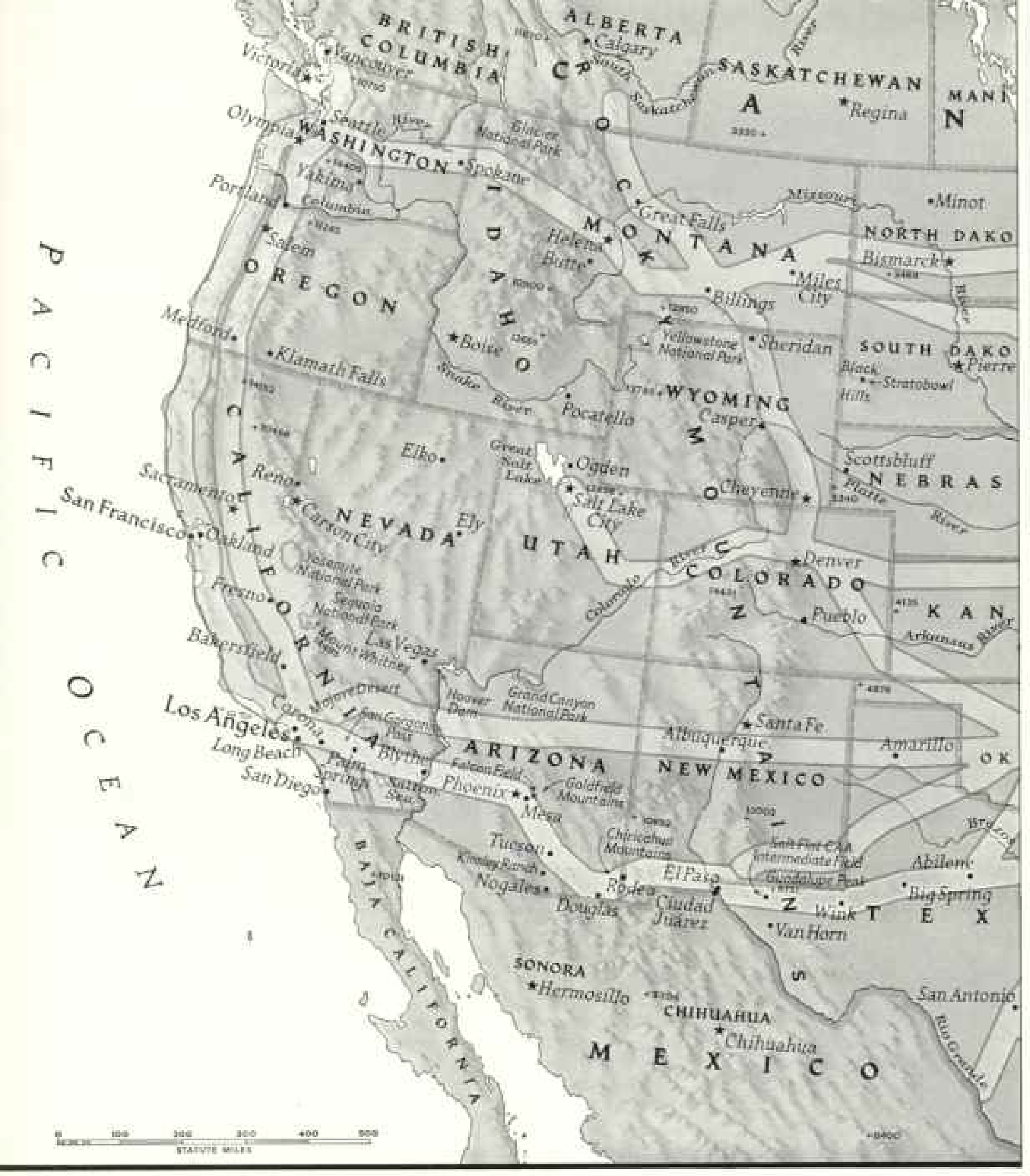
The steady dah-dit of the radio beam coming over the cabin loud-speaker was suddenly interrupted by a series of sharp dits, which indicated a special broadcast. Switching over to earphones, we heard Springfield Radio report a big thunderstorm east of the city, moving westward toward us.

We reached Springfield ahead of the storm, and I went to the Weather Bureau to check on the chances of proceeding. The forecaster did everything she could, but it was hopeless, and we headed for town after getting 692 into a hangar.

Late on a "Breakfast Flight"

During the height of the storm, Dr. Robert Smith, head of a group of local flyers, telephoned to invite us to join the club on a "breakfast flight" the next morning. We accepted when he assured us that he had made special arrangements with the Weather Bureau for good flying weather.

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Land of a Million Smiles," May, 1943, and "Arkansas Rolls Up Its Sleeves," September, 1946, both by Frederick Simpich.

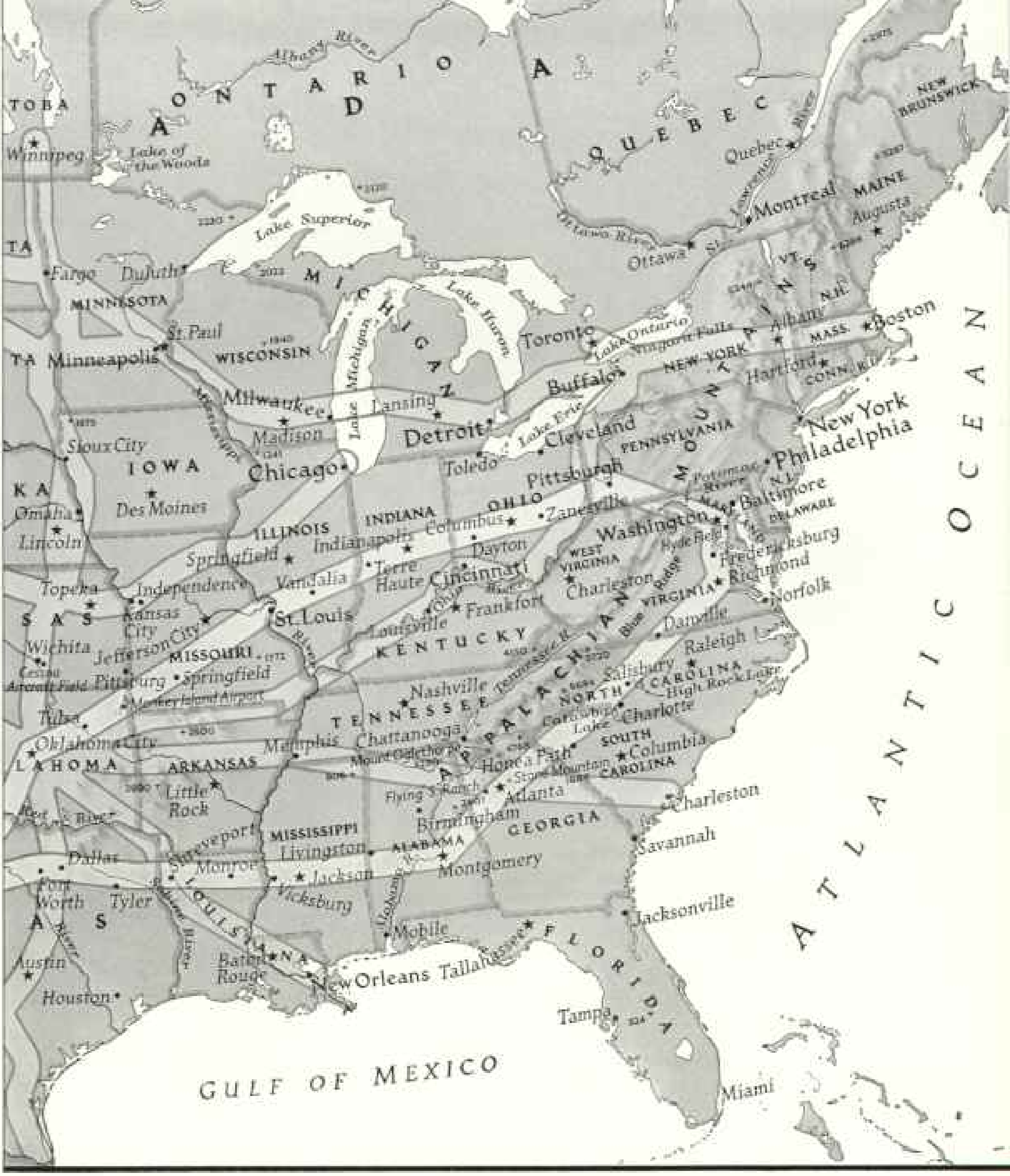


Wright Way (White) Is to Flyers What the Lincoln Highway Is to Motorists

Breakfast was scheduled for 9 o'clock at Pittsburg, Kansas, 75 miles away, and 8 o'clock found a dozen ships in the air carrying nearly 30 lusty appetites. The others were on time, but I got off course and we were late.

Over bacon, eggs, and coffee I took a ribbing from other members of the group with less experience who had made it on time in slower ships. We met several families with small children, two flying farmers, and two men who had been personal pilots for more than 20 years.

Just before we left Springfield for St. Louis, the Weather Bureau reported scattered lower clouds at 4,500 feet and a 30-mph head wind below them. Flying in the turbulent air below the clouds would reduce our normal air speed of 125 mph to a ground speed of 95 mph, and we would require more than two hours for the 200-mile flight.



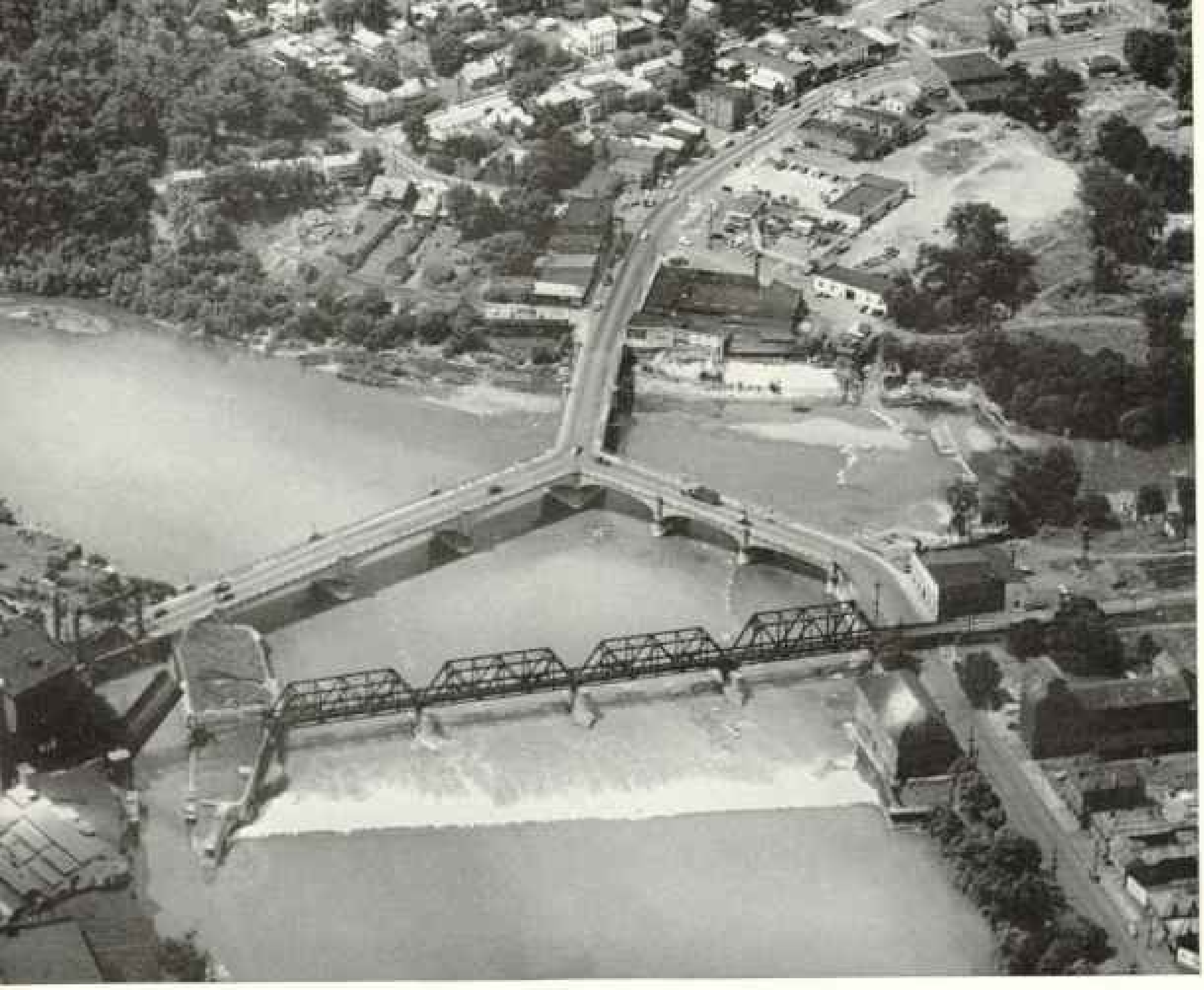
Nine Other Skyways Weave a Network of "Highways" Below the Clouds

I decided to take advantage of a 35-mph tail wind reported to be blowing at 6,500 feet, just above the clouds, and fly a dead-reckoning course with the radio beams for guidance.

With the help of that tail wind we would have a ground speed of 160 mph and be in St. Louis in an hour and a quarter, provided my navigation was as good as I thought. Actual ground-to-ground time from Springfield to Parks Metropolitan Airport at East St. Louis, Illinois, proved to be 70 minutes, for a ground speed of more than 170 mph.

We were never out of sight of the ground for more than a few seconds, and the radio range stations kept us informed of weather conditions ahead at 30-minute intervals. Special broadcasts would have warned us of any sudden change for the worse.

This was making flying pay off in a big way, and we were becoming more and more



Zanesville Needs No Aerial Marker; Its Famous "Y" Bridge Is Unmistakable

Even pioneers on the old National Road knew this Ohio town, where Muskingum and Licking Rivers meet, by its "Y" bridge, then a covered wooden span built in 1814. Such odd landmarks are often a private flyer's best guideposts. Where none exist, an aerial marker with a town's name may save a lost flyer. Motorists asking directions here are amazed when told to "go to the center of the bridge and turn left."

delighted with it. We had burned just a little under 10 gallons of gasoline, which, at 25 cents a gallon, cost less than the cab fare between field and hotel in St. Louis.

Next day we headed for Indianapolis, Indiana, by way of Vandalia, Illinois, and Terre Haute. The weatherman reported numerous local thunder showers en route, and again he was right. We had to go around three of them, and arrived just outside Indianapolis to find three more holding a convention right over the city.

Fearing one of the earlier ones might sneak in behind us, we turned back and landed to wait it out, and were more than an hour late landing at Indianapolis. This was the other side of flying, and we were no longer so certain it was the only way to travel.

A Veteran Air-mail Pilot's Memories

While Ernie made pictures, I got acquainted with airport owner Bob Shank, who was a pilot on the first established air-mail route, from Washington to New York.* At that time there was no proved method of aerial navigation, and Mr. Shank told me, from his rich experience, how painted markings would have helped.

He recalled that the magnetic compass was the only navigation instrument then available to the cross-country flyer, and that many planes lacked even that. When he confessed to having been lost even with modern instruments and radio, I felt much better about my own wanderings.

Leaving Indianapolis, we flew over what was probably the country's first marked air route. Early pilots had found navigation so difficult with the sketchy maps available that they had spent their own time and money to paint signs on the roofs of buildings between Indianapolis

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "On the Trail of the Air Mail," by J. Parker Van Zandt, January, 1926.

and Dayton, Ohio. As we looked down upon the busy countryside below, we wondered how much it had changed since then. Certainly there are now plenty of check points.

Our course paralleled U. S. Route 40, one of the network of transcontinental highways which developed in the wake of the Lincoln Highway. When it was completed, in 1925, the Lincoln Highway became the first marked and mapped road extending from coast to coast. Like the Wright Way, it was planned and developed by an organization of private individuals, using their own time and funds. It did for the private motorist of the day what the Wright Way is designed to do for today's and the future's personal flyers.

Over the Home of the Wright Brothers

Within an hour we were over Dayton, Ohio, home of the Wright brothers and of famous Wright Field, which we could see off to our right as we continued east toward Pittsburgh, still following U. S. 40 and the Pennsylvania Railroad.

Near Pittsburgh the confusion of highways, railroads, and small towns increased to such an extent that contact navigation in the hazy weather became very difficult.

Thanks to a vigorous air-marking program carried out since the war by the Pennsylvania Aeronautics Commission, we found all of the larger towns marked and had no trouble staying on course, even with haze and smoke thick enough to limit visibility to three miles. Towns neither of us had ever heard of will be long remembered for their big yellow air markers.

Pittsburgh was first recognizable as a large area of brown haze, much denser than the blue atmospheric haze to which we had become accustomed. Penetrating that haze to come in over the Golden Triangle was well worth while. Here was one of the sources of America's might (page 117). Spread out over the hills and in the valleys of three great rivers lay the homes, offices, and mills of the people who make the steel for which the city is famous.* Our interest was quickened by the knowledge that some of that steel had gone into our sturdy ship.

Southeast of Pittsburgh, en route to Washington, D. C., we found the Pennsylvania Turnpike climbing into the Appalachian Mountains below us, and took pleasure in our ability to ignore its turns and tunnels and thereby more than double the speed of the racing vehicles on its surface. Itself a chapter in the saga of speed, the highway's broad surface forms a guidepost for the flyer.

The great green mountains unrolled below, and soon we found the Potomac River, with a railroad on each bank.† On one shore was the abandoned channel of the Chesapeake and Ohio Canal and a modern highway.

From the flyer's vantage point we were looking down on the history of transportation in the New World—trail, river, canal, railroad, and auto highway. The river, which had opened a pass for the older forms of transportation, now also serves as a guide for the airplane, the newest.

Before we were clear of the Blue Ridge the tall finger of the Washington Monument appeared on the horizon, and we knew that we should find the city free of its heat haze. Ernie's cameras clicked busily as we crossed over the Pentagon, National Airport, and Alexandria, into Maryland to our home base at Hyde Field near Clinton.

As we settled in for the landing, I caught a glimpse of field manager Chris Martin standing near the landing area, arms akimbo and head to one side. He had a vital interest in that landing, for it was his final approval as flight instructor that had let me make the trip. Chris had further backed his belief in my flying judgment by arranging, through field owner Arthur Hyde, for the loan of Cessna 692.

Chris and ground school instructor Austin Howard had spent many extra hours working out the trip with me (page 97). Thanks to those briefings, many potentially troublesome situations never developed.

A Panorama of History

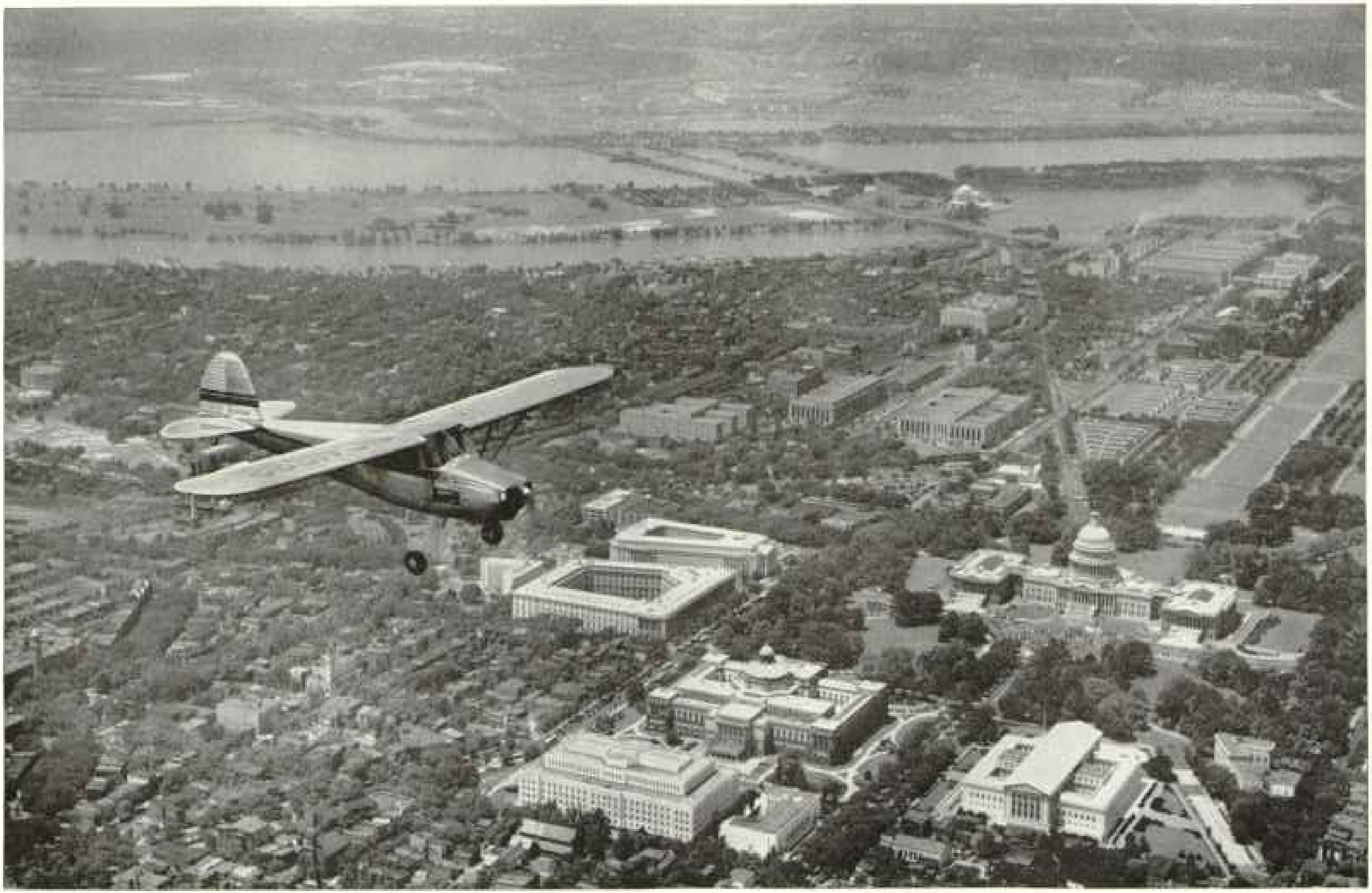
The southern and western sections of the Wright Way still lay ahead; we were soon in the air again, headed southwest (page 92). The Potomac River was once more our guide, and in 15 minutes' flying over its channel we crossed a whole series of historical landmarks.

On our left, the Maryland shore held Fort Washington and Marshall Hall. The colonial seaport of Alexandria, and Mount Vernon, home of George Washington, lay on the Virginia side.‡

* See, in the National Geographic Magazine: "Penn's Land of Modern Miracles," by John Oliver La Gorce, July, 1935; and "Steel: Master of Them All," by Albert W. Atwood, April, 1947.

† See, in the National Geographic Magazine: "Potomac, River of Destiny," by Albert W. Atwood, July, 1945; and "Down the Potomac by Canoe," by Ralph Gray, August, 1948.

‡ See, in the National Geographic Magazine: "Washington: Home of the Nation's Great," by Albert W. Atwood; and "The Washington National Monument Society," by Charles Warren, both for June, 1947; and "Home of the First Farmer of America," by Worth E. Sboults, May, 1928.

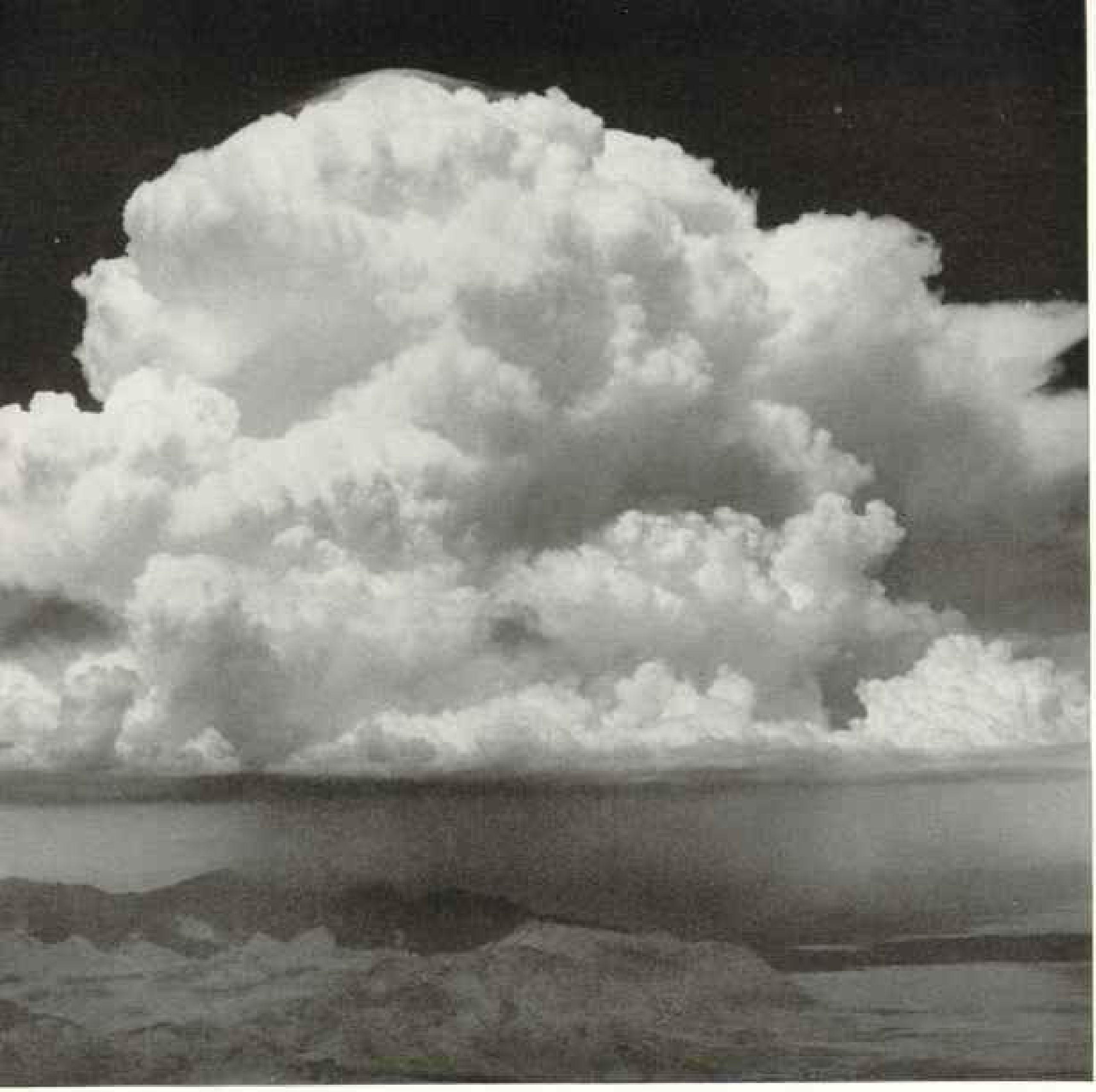


Wearing the National Geographic Flag, 692 Wings over Washington Bound South and West for California

The pilot-author skirts the National Capital's center, forbidden to all planes. Clockwise around the domed Capitol are the Supreme Court (lower right), Library of Congress and its modern annex, and House Office Buildings. In the distance are the Jefferson Memorial and the Pentagon, and National Airport at extreme left.

Skyway Pilots Flying Through Georgia Spot-check Their Position by the Bald Pate of Stone Mountain

Wright Way crosses the granite outcropping, two miles long and seven in circumference, some 15 miles from Atlanta. Visible on its sheer front is the colossal Confederate Memorial, with its unfinished figures of Robert E. Lee, Jefferson Davis, and Stonewall Jackson, begun by Gutzon Borglum.



Ice-capped Thunderhead and Gray Rain Shroud Are a Pilot's Nightmare

Nature in a savage mood looms over the Chiricahua Mountains in southeastern Arizona. Visibility in the dense rain ahead is nearly zero. Lightning, hail, and violent winds within the cloud can destroy even the largest transport. The silken-icecap atop the cloud warns of dangerous icing conditions. No small plane can get above such a storm; it must land or scurry around it. If it can, the plane will veer to the right to take advantage of tail winds generated by the storm's counter-clockwise motion. Plane 692 gave this one a wide berth. In 53 days spent on their survey of the Wright Way, the flyers were grounded by weather only five. They met only three storms too large to circumvent. Regular and special weather broadcasts of the airway radio stations give flyers advance notice of weather conditions and warn of the presence of storms. Actual flying time for 692 on its trip, which spanned the continent twice, was 46 hours. Some 40 additional hours were spent on aerial photography and exploratory flights.

Swinging wide to avoid the Marine Corps Air Station at Quantico, we followed U. S. Highway 1 into Fredericksburg, Virginia, and then found below us another area where air markers would have been helpful.

From Fredericksburg to Danville, wide highways, railroads, and large towns were few, and navigation had to be pin-point sharp if we were to stay on course. However, I'd flown the route before and, with the good visibility, I was able to identify such hamlets as Bumpass and Cuckoo, and even saw the home of my brother at Apple Grove.

When we crossed from Virginia into North Carolina, air markers became more frequent as we flew over numerous industrial towns with their tall chimneys and water towers.

High Rock Lake, near Salisbury, demon-

strated in full color what happens when water is allowed to get out of control. The water behind the dam was a rich chocolate brown from the silt washed down from farms in the hills to the north and west. We could tell which section had had no rain, for some of the creeks draining into the dam were clear, while others were even darker than the reservoir itself.

Lost on an Unmarked Highway

Five minutes after leaving Charlotte (page 103), we crossed Catawba Lake into South Carolina and were once more dependent upon compass and map alone.

There was a big summer thunderstorm building up on our left, and both of us became so interested in watching it that we neglected navigation. Suddenly I realized that we were away off course.

I was the pilot on an unmarked highway, and I was lost. I'd been lost in the air before, but this was different; I was now responsible for Ernie, who had had nothing to do with it. It was just as well that he hadn't checked out as a mind reader.

Telling myself that I still had gas in the tanks for more than three hours' flying, that visibility was more than 10 miles, and that the ceiling was unlimited didn't relieve that sinking sensation under my safety belt.

Remembering the rules, I continued on the old heading until a fair-sized town showed up below, and then circled it trying to tie it to the chart.

Neither of us could be certain about that one; but there was another a few miles away, so we flew over to try there. Almost immediately we identified Honea Path by its airport, a railroad, a main highway intersection, and large mill buildings on the north side of town, all indicated on the chart.

Getting back on course was a simple matter of working out a new compass heading and flying that to our destination. The thoroughness of Chris Martin and Al Howard had paid off again, but an air marker would have saved us 20 uncomfortable minutes and several gallons of gasoline.

At Villa Rica, a few minutes' flight west of Atlanta, Georgia, Mr. and Mrs. A. H. Stockmar are turning their ancestral home into a personal flyer's paradise. When completed, Flying "S" Ranch will be a worthy rival of any western dude ranch. The main house is built over a partly worked-out gold mine.

Mrs. Stockmar met us with a jeep when we landed and insisted that we stay for a potluck dinner in the kitchen. What a meal! Cold sliced country ham, fried chicken, hot corn bread, green beans, corn on the cob, sweet potatoes, bowls of fresh butter, pickles, relishes, iced tea, and pie!

After such a meal I'd have preferred a hammock under a tree, but instead we toured the mine, the hangars, partly completed tourist-style quarters, and the dam being built to provide a lake for seaplane landings and fishing for guests.

Mr. Stockmar offered me the use of his pet Tennessee walking horse. Flattered, I made the mistake of accepting. That horse was a born Rebel and showed her disdain of a Dan-yankee flyer by refusing to use any gait but a stiff-legged trot. The others were polite enough to laugh only when they thought I was too busy to notice—which was most of the time.

West of Montgomery, Alabama, we ran into a local thundershower that had grown up to be a full-sized storm, and had to turn off course for a landing at Livingston. The field was small and appeared to be deserted. I dragged over it slowly at 100 feet to check before landing.

As we came around again for the landing, a car turned in off the highway and the driver got out to signal us into the parking area. He was the field manager, who had seen us letting down over town and had left his seat at a Fourth of July baseball game to meet us and offer any help needed. At our insistence he returned to his ball game, after rigging a window so we could use his phone to check weather before proceeding.

At Hawkins Field, Jackson, Mississippi, I had the thrill of flying a plane equipped with the new Goodyear crosswind landing gear. Landing safely with the conventional landing gear requires extremely careful handling, unless the wind is blowing straight down the runway. A moment's carelessness can result in expensive damage and even serious injury.

Using the crosswind gear, I headed the ship off center of the runway to correct for the wind drift, and a casterlike device inside the wheels brought them automatically into line with the runway when they touched the ground. The new gear requires no extra controls and is so simple that I could use it successfully after a couple of tries.

By reducing the number of runways required, this new gear may make possible safer, less expensive airports in many places where there is now no room for them.

A Versatile Airport

Three miles outside Jackson, John Cleveland runs the three-ring-circus he calls East Jackson Airport (pages 87 and 99). Johnny's

"Union Jack" Airfield, Tucked in a Loop of the Wide-swinging Red River, Identifies Bustling Shreveport

Near here 602 developed the only engine trouble of its long trip and landed for repairs (page 98). Louisiana's second largest city, Shreveport grew from tepees to skyscrapers in a century, mostly on cotton and oil. The river, carrying a heavy load of silt, is a deep terra cotta color.

Veteran Pilots Huddle with the Author in Last-minute Briefing

At his home field near Clinton, Maryland, Mr. Markwith is about to take off on the westward leg of his aerial adventure. Chris Martin, left, and Al Howard, right, taught him to fly. Martin, a former Navy pilot and manager of Hyde Field, began to fly when he was 15 and has logged more than 8,000 hours.

To Strain Out Water, a Sonoran Refuels 692 Through a Chamois

When gasoline supplies become low, water often condenses in underground storage tanks. If it gets into a plane's fuel, it causes engine failure, possibly a crash landing. The Hermosillo, Mexico, runway is packed adobe, hard and smooth as concrete.

motto is "Service," and he provides it in the form of a good coffee shop and tourist cabins right on the field. If you prefer to stay in town, his service car takes you there without charge.

To add to the fun—and the income—the field has a dirt track for midget auto racing, and there was an auto auction in the main hangar once a week. One of the field's small training planes was equipped with loudspeakers and flown over the city to send down music and advertising patter. The morning we were there it was being used to boost a local political candidate.

Both of us became so intrigued with picturemaking at Vicksburg and along the Mississippi River* that our flight plan had to be amended to include an extra fuel stop at Monroe, Louisiana. It was the only time on the trip that we failed to reach our scheduled destination for lack of fuel. We always planned our flights to allow an hour of fuel reserve.

Some minutes west of Monroe, Ernie pointed to the fuel-pressure gauge, which was jittering badly. I'd noticed it earlier and, assuming the worst, a fuel pump failure, had already decided on a landing at the nearest airport. The last check point marked on my running flight log quickly indicated that the closest field was at Shreveport, 15 minutes ahead (page 96).

Cessna had thoughtfully provided an automatic, gravity fuel system which would keep gas flowing to the engine even if the pump failed completely. But this knowledge didn't prevent us from keeping a nervous eye on that gauge until we had cut the switches in the parking area of Shreveport Municipal Airport.

Next morning I watched while a CAA licensed mechanic blew out of the fuel gauge line a big gas bubble, caused by the high temperatures of the day before. When a test run of the engine on the ground showed that there was still some trouble, we overhauled and cleaned the entire fuel system. It was a wise decision, for there was a tiny crack in a fuel pump part which later might have caused a complete failure.

"Posing" Landscapes for Pictures

When it came to pictures, Ernie was in command, and it was my job to put the ship where he wanted her, within the limits of safety and Civil Air Regulations. Usually he wanted her lower, slower, and closer, but the summer clouds west of Shreveport grew so fast he kept calling for more altitude and more distance to get them in his camera field.

The distance wasn't hard, but no small ship could have got above those clouds. We were more than two and a half miles high and shaking with cold when he gave up. The thermometer was down to 35° F., and we'd been too busy to think of the cabin heaters. Neither of us realized at the time that we were feeling the prolonged lack of oxygen, but the scrawly characters on my flight log indicate that I was.

Since our leaving Washington, weather reports and the weather had been almost monotonous—high overcast, scattered lower clouds, visibility 10 miles with haze, winds west, 10 to 15 mph. As we crossed east Texas, a change became apparent. Visibility and wind velocities increased; haze and thunderstorms decreased. We saw our last thunderstorm at Tyler.

West of Dallas and Fort Worth, the fertile blacklands began to disappear as the ground steadily rose to the high, dry plains of the cattle country.†

Ranch Houses Serve as Check Points

At Abilene the desert areas began to appear, and good check points came at wider intervals. They were, however, easier to see and identify. In some sections an isolated ranch house was important enough to be marked on the charts.

Tank farms, oil well derricks, and the huge gas flares of the refineries dotted the landscape. Small airplanes flew along below us, checking the pipe lines which cross the desert in all directions.

Darkness brought us down on the Wink Municipal Airport, in the heart of the natural gas fields. Here we found the field manager, Wesley L. Stoddard, using a National Geographic map of the United States as an aid to students planning cross-country flights.

We had a graphic demonstration of the clarity of desert air when the Sacramento Mountains appeared on the horizon more than 80 miles away. When we reached them, 40 minutes later, the weather station near Guadalupe Peak, highest point in Texas, was reporting visibility at more than 150 miles. Flying at 10,000 feet, 5,000 feet above the floor of the pass, we were in smooth, sparkling-clear air.

Minutes later, as we descended to land at Salt Flat CAA Intermediate Field, the desert-heated air was so rough that our vertical

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Down Mark Twain's River on a Raft," by Rex E. Hieronymus, April, 1948; and "Machines Come to Mississippi," by J. R. Hildebrand, September, 1937.

† See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Yield of Texas," by Frederick Simpich, February, 1945.

Like a Motorist at a Motel, the Author Parks 692 Beside His Cabin in a Mississippi "Skytel"

Overnight guests at East Jackson Airport sleep in comfortable air-tourist cabins beside the flying field. This skytel also provides a coffee shop, free transportation to town, midget auto races, and weekly car auctions (page 95). Here Johnnie Cleveland, owner and operator (right), helps Mr. Markwith plan his next hop.

From 1,500 Feet, Southern California's "Circle City" Looks Like a Plane Geometry Problem

R. B. Taylor, who founded Corona, ringed his new town with a three-mile boulevard, an idea he picked up in Omaha. After 63 years the city covers 16 square miles; Grand Boulevard encircles business and older residential sections. From 1913 to 1916 auto races, attracting national attention, were held on the circle.

After San Gorgonio Pass, Skyway Flyers "Hit" This Target on the Way to Los Angeles

Cross and circle make a distinctive check point. Citrus groves, lower left and right, make other symmetrical patterns. Corona, which calls itself "the lemon capital of the citrus belt," thrives on some 6,000 acres of lemon and orange trees. It ships 3,000 carloads of the fruit a year.

speed varied from 1,500 feet a minute up to the same amount down a second later. On the ground, at 3,700 feet above sea level, the thermometer shot up above 130° F. in the sun—there was no shade. The mountains all around the field seemed to dance behind the curtain of heat waves.

About a dozen Department of Commerce employees and their families live on and operate this lighthouse and harbor in the desert. Diesel-driven generators supply power for the marker beacon, field lights, radio instruments, and lighting. A windmill pumps water, and the homes and work spaces are made livable by small evaporation-type air-conditioning units.

A small restaurant caters to tourists on near-by Route 62, but there is no school and until recently the post office was at Van Horn, 70 road miles away. We were the first aerial visitors in more than two weeks.

El Paso, Texas, is a busy modern city, spiced with the speech, dress, and confidence of the Texans. The early Spanish explorers called it El Paso del Norte, "Pass of the North." Modern-day tourists have made it a "Pass of the South," for it is a port of entry into Mexico. Just across the block-long International Bridge is Ciudad Juárez, in the State of Chihuahua. It, too, is a busy modern city, but as different from El Paso as if it were in another hemisphere.

We stepped off the bridge to Avenida Juárez into a mixture of Atlantic City Boardwalk and Coney Island Midway, seasoned with chili pepper and Spanish architecture. It is a paradise for souvenir hunters, art collectors, and shoppers, and business is conducted in English or Spanish, dollars or pesos. The rule is, Buy if you like—but bargain you must. It is unthinkable to pay the asking price; doing that would break up the game.

Mexican Lunch "of Heroic Size"

Restaurants, juke joints, and plush-lined floor-show clubs provide either Mexican or American food and drinks at prices that make bargaining unnecessary. I had a cocktail and a Mexican lunch of heroic size for less than $2.

On the Calle 16 de Septiembre, in the center of the business district, are the 17th-century Mission Nuestra Señora Guadalupe and the futuristic façade of a luxurious motion-picture theater. Back of the mission are modern steel-and-stone government buildings and an up-to-date market. An occasional burro cart slows the heavy stream of autos, trucks, and buses.

Except in the residential districts with their Spanish-style homes, contrasts are the rule. Juárez and its people are undoubtedly Mexican, but not the Mexican of song and legend. They work and play as hard as any Yankee, and seem to enjoy it more.

Returning to El Paso was as easy as leaving it—for Ernie. Each time he just walked through customs, while I had to stop and prove my citizenship. The fourth time I was annoyed enough to ask why I was always *it*.

"Don't blame me, mister," said the customs inspector. "I'm just doing my job. You're sunburned the same copper color as some of these Indians, and a lot of them have blue eyes and blond hair, too. You just don't look like an American to me."

The sparsely populated border country of New Mexico and Arizona, from El Paso west to Tucson, is the driest and most mountainous section of the Wright Way. A forced landing there could be serious. Chances of trouble in the air were slim, but I followed the advice of seasoned desert pilots and filed a detailed flight plan with the Air Traffic Control Center at El Paso.

I prepared the plan for this run exactly as I had all the others, and then reduced it to the standard sequence required for filing by radio after take-off. When I had established contact with El Paso Radio Range Station and told what I wanted, my earphones said, "Cessna six-nine-two, this is El Paso Radio. Proceed with your plan. Over."

I answered: "El Paso Radio, this is Cessna six-nine-two. Here is my VFR (visual flight rules) flight plan. NC four one six nine two, Cessna one seven zero, Markwith, Anderson Field, 10,000 Green 5 Tucson, one two five, three one zero five, oh nine twenty, eleven forty-five, four point five. This is Cessna six-nine-two. Over."

After repeating back to me, the communicator told me he would accept and file the plan. He then relayed it to Air Route Traffic Control Center, where a dispatcher put the exact sequence on the teletype circuits to Tucson and all the radio range stations between.

Translated, that sequence meant that NC 41692, a Cessna Model 170 plane, piloted by Markwith, would leave Anderson Field, El Paso, to fly at 10,000 feet, along Civil Airway Green 5 to Tucson, Arizona. The plane would fly at 125 mph, transmit on a radio frequency of 3,105 kilocycles, depart at 9:20 a.m., arrive at 11:45 a.m., and carry enough fuel for four and a half hours of flight.

If we failed to terminate that plan before 2 p.m., when our fuel would be gone, all the organized machinery of search and rescue would automatically go into action to find us.

No Place for a Back-seat Flyer! 692 "Slides Downhill" to Land at Charlotte, N. C.

The plane is gliding down a 600-foot "hill" of air at 115 mph and will reach the airstrip in 90 seconds, instruments in the top row indicate. Non-flyers find airplane panels confusing; actually, five of these instruments are identical with those in cars. The law requires only six for private flying; others are used mainly in bad weather. Here the plane's nose has been pulled down and to the right in a "forward slip" for the cameraman's benefit.

Without the flight plan, we might not be missed for days, and even then no one would know where to begin the search.

Clouds Cause Detour

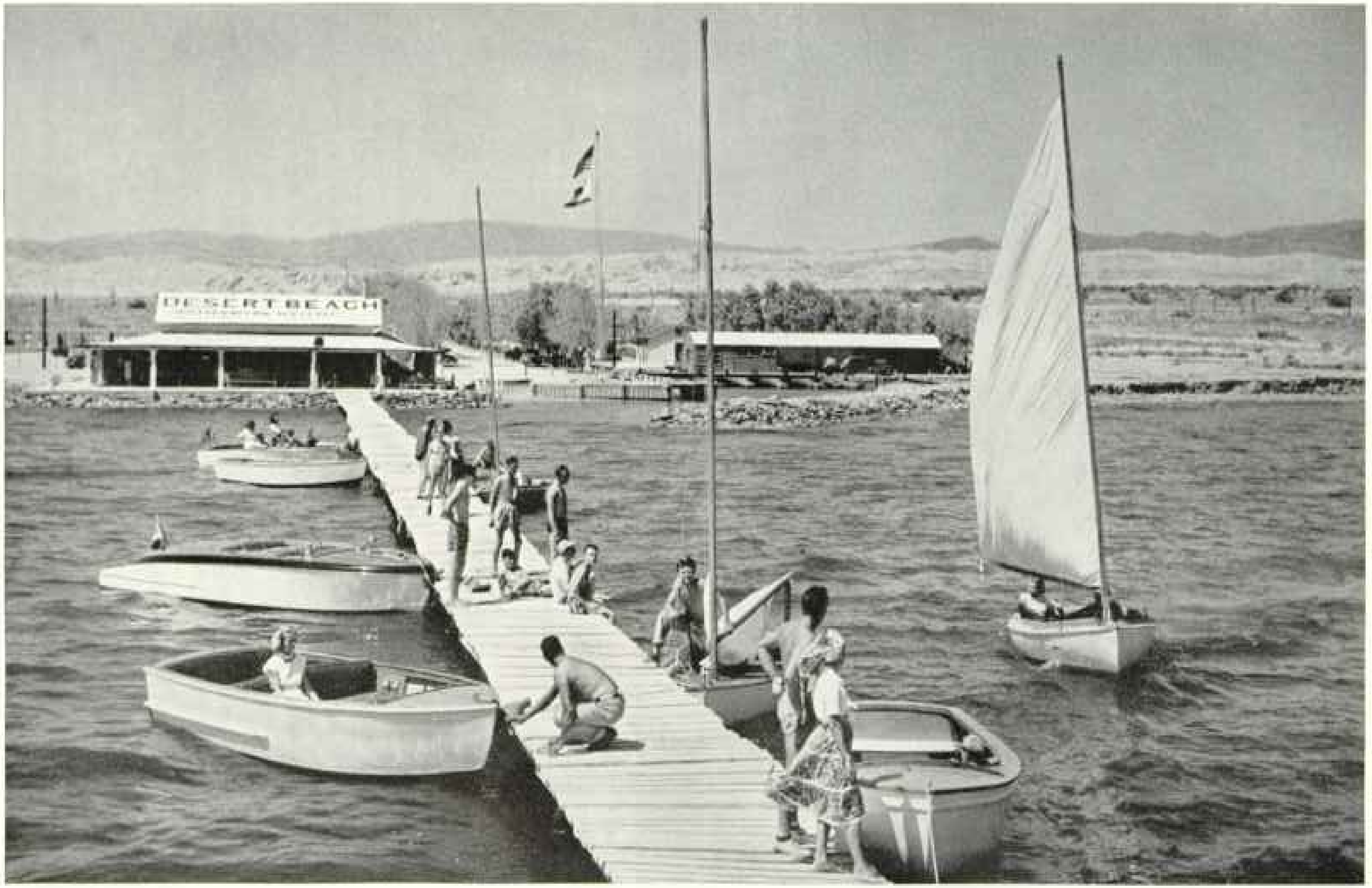
At Rodeo, New Mexico, the Wright Way swings southwest to Douglas, Arizona, to avoid the Chiricahua Mountains (map, pages 88-89). The Civil Airway takes a more direct route over the mountains to Tucson, and I planned to follow it instead of the Wright Way. The ship performed so well at higher altitudes that we would be perfectly safe and save time and fuel.

But when we arrived at Rodeo the mountains were wearing a mantle of clouds which meant just one thing—change course. A short discussion by radio with the Aircraft Communicator at Rodeo CAA Intermediate Field amended the flight plan from Airway to Wright Way, and we headed for Douglas. The communicator forwarded the amended plan to Tucson by teletype.

Though we were half an hour late arriving in Tucson, we had completed in three hours a journey that took days by stagecoach back in the 1850's. A few side trips into the desert by car gave us a solid respect for the people who had made the trip by stage.

Returning from one such trip, we stopped to cool off in the swimming pool on the Kinsley Ranch. Long famous for breeding and supplying stock for the Nation's rodeos, Kinsley Ranch also caters to flying and motoring travelers. Owner Otho Kinsley and his sons have built a better mousetrap.

In the course of developing guest facilities around the main ranch house and airstrip, they built a large lake to store the overflow from the deep well which feeds the swimming pool. As soon as the lake had been stocked for fishing, busy flocks of sea gulls and brown



Skippers Sail Trim Yachts, Not Subs, 40 Fathoms Below the Pacific—on California's Salton Sea

Desert Beach Yacht Club, 241 feet below sea level, welcomed the flyers with burning sands, 95-degree water, and warm hospitality. Member of the American Power Squadron, the Club holds speedboat races each fall. Buoyancy of the salt-packed water makes for record-breaking runs.

Above Santa Monica's Famous Beach the Flyers, Like Balboa "Silent, upon a Peak in Darién," Discovered the Pacific

Private homes and clubs elbow for room between bluff and beach at the California resort. Palm-dotted Palisades Park covers the bluff; busy, beach-level Highway U. S. 101A runs behind the houses. At near-by Los Angeles the Skyway reaches its western end. Santa Monica Mountains tower in the distance (page 106).

pelicans arrived to show the fishermen how it's done. The wheeling flock of sea birds stood out in sharp contrast against the background of desert and mountains, more than 100 miles from salt water.

Ten minutes after the passing of a mountain cloudburst, the road and the desert appeared as dry as ever, but a miracle had been performed. The gray desert now sparkled with green, and the mountains glowed with brilliant colors. The heat was gone, and we drove along under a flaming sunset that lasted nearly an hour. The play of colors changed so rapidly that only a motion-picture camera could have captured them.

Desert Plant Flames into Lighthouse

Some steers outlined against the sky refused to wait for Ernie to make their portraits, so I set out on foot to drive them back into position. They drove easily—anywhere but back. When they were tired of me, they just faded into the brush, leaving me breathless and convinced that cacti should be admired from a safe altitude.

Paul Nichols, Chief Pilot at Falcon Field, was our guide on a trip into the Goldfield Mountains. This was the desert of the tall saguaro* and the wickedly beautiful cholla cacti. Every plant we saw grew thorns of some nature.

Paul cautiously ignited a cholla plant to demonstrate its usefulness as a sort of desert lighthouse. Hunters lost on the desert after nightfall use its brilliant, lasting flame to guide searchers.

Near Mesa, Paul showed us bank-full irrigation ditches which had been built by the predecessors of the Pima Indians.†

The thrifty, industrious Mormons who founded Mesa in 1878 repaired and enlarged the ancient irrigation system to provide water for the rich date-palm and citrus groves which surround the city today. From the air, Mesa appeared as a fairy city in the midst of its man-made oasis.

Smaller oases dotting the area were the sites of the luxurious wintertime guest ranches which surround Mesa and Phoenix.

The large irrigated area along the banks of the Colorado River near Blythe, California, presented another sharp contrast to the barren mountains and scrub-covered desert. The downdraft caused by the cooling effect of the green area gave us a real jounce as we crossed its borders.

As we approached, clouds completely obscured the 10,000-foot-plus peaks guarding each side of the San Gorgonio Pass. After Indio Radio had assured us that the lowest of them were 3,000 feet above the floor of the pass, we entered it and found ourselves flying in a sort of tunnel.

Below was the 2,000-foot-high floor of the pass, on each side the steep, chocolate-colored slopes of the mountains, and, above, the ever-changing clouds for a ceiling. Soon our tunnel widened into a valley, and we were out in clear air north of March Air Force Base.

Ahead a curtain of brown smog hung from the lower peaks right down to the ground. The charts said Los Angeles was under it, and the radio kept insisting that I could see through three miles of it. When a flight of jet planes burst out of that haze ahead, I knew we were going to stay above it as long as possible. Sure enough, the outlines of greater Los Angeles appeared below, and we cautiously glided down to land at Central Airport.‡

Daily plane traffic at Central is heavier than that at Los Angeles Airport. It was the only privately owned field we found using a radio-equipped control tower. The heavy traffic of visiting planes is probably due to the many services available.

In addition to service for the plane, the field provides radio-equipped sleeping quarters, a restaurant, and a cocktail lounge. The office will rent you a car, or have your laundry and dry cleaning done in 24 hours. It will also reserve your hotel room, receive and forward your mail, and furnish you with the latest weather report.

While Ernie was busy with his cameras on the ground, I worried the Weather Bureau and the Chamber of Commerce about weather for aerial photography.

When the go-ahead came, we started at Cahuenga Pass and worked west over Beverly Hills and the Santa Monica Mountains to the coast at Dume Point. Returning, we flew east and south along the coast (page 105) to Palos Verdes Point and then over to Long Beach.

Mountains, Sea, and City

Heading north again, we found the incredible natural setting of the area spread out in all its glory. The contrasts of mountains, sea, and city made it easy to understand the

* See, in the National Geographic Magazine: "Saguaro, Cactus Camel of Arizona," by Forrest Shreve, December, 1945; and "Saguaro Forest," by H. L. Shantz, April, 1937.

† See, in the National Geographic Magazine: "Seeing Our Spanish Southwest," by Frederick Simpich, June, 1940.

‡ See, in the National Geographic Magazine: "Southern California at Work," by Frederick Simpich, November, 1934.

692 Sails Through Customs and Immigration on the Mexican Border—as a "Ship"

Unlike motorcars, planes entering the United States are classed as ships. Therefore, airborne entrants must clear quarantine as well as customs and immigration. Back from a side trip to Mexico, the author checks with the health official at Nogales, Arizona, while an inspector examines his baggage.

pride the natives take in their homeland.

A report of perfect weather in the San Gorgonio Pass caused us to check out of our hotel hastily and head back east. The towering peaks of the San Bernardino and San Jacinto Mountains were so plainly visible that charts and flight plan were quickly discarded in favor of the scenery. Ernie soon had me flying in great circles while he tried to capture as much as possible on film.

The intense heat rising to meet us from Palm Springs Municipal Airport made it easy to understand the success of the famous winter resort—in winter.

The city runs a sort of holding operation during the hot months. Everyone who can leaves for cooler climates; those remaining stay indoors during the middle of the day. Air conditioning is as usual as heat in a Government building, and cleaning and servicing swimming pools is about the most active business in town.

Living-room Swimming Pool

When she learned that the pool at our hotel was closed for repairs, airport owner Mary Nelson offered the use of the now-famous one which forms part of the living room in her home in the desert. We stepped from the rug-covered floor right into the

pool, and if we had climbed out at the other end we should have stepped into the cactus-covered desert. A backdrop of mountains shimmering through the heat completed the wide range of contrast so common in California.

Taking a personal plane into Mexico can involve endless time and red tape, but not at International Airport, Nogales, Arizona (page 107). Here border authorities of both countries cooperate to reduce immigration, customs, and health requirements to a single painless operation. Nogales businessmen credit airport manager Jack Evans with the innovations which have resulted in international visiting at the rate of 2,000 personal planes a year.

Exploring Sonora's Capital

Declaring Ernie's foreign-made cameras and obtaining Mexican flight plan and tourist permits required only a few minutes in a small section of the field office. With my receipted airport statement, which included all border fees, Mr. Evans gave me a list of Americans living in Sonora and a schedule of Mexican hotel, taxi, and gasoline rates. He also provided Mexican currency at the going rate of exchange.

On arrival at Hermosillo, capital city of Sonora, we piled our gear in an air-conditioned hotel room and set out to explore. The city presented many fine examples of the progressive planning and active development for which the whole State has become famous. A large American-designed cement plant has provided the material for an irrigation dam, State University buildings, a museum and library, and many homes and office buildings of ultramodern design.

The strong emphasis placed on education was, I thought, aptly demonstrated by placing the elementary and secondary schools as close as possible to the University campus. Even after learning that English was a required subject, I couldn't get used to having 10-year-olds answer my horrible Spanish in fluent English.

Ernie's Spanish was more than adequate—until he tried to order breakfast eggs "sunny-side-up." Finally he drew a picture while I made motions in favor of scrambling them. It worked so well that we never learned the proper terms.

Diagrams and gestures would not work over the telephone, so the hotel clerk put through my call to Nogales to give American customs the required notice of arrival.

The only other formality required was permission to take off (page 97).

The airport manager instantly granted this and we set out on a speed run for home. A bit of figuring after landing at Big Spring, Texas, that night showed that we had covered 750 miles, over three States and two countries, in less than nine hours. Five hours and 40 minutes was actual transit time. Customs, a leisurely luncheon, and aerial photography accounted for the rest.

Another four flying hours brought us down on Cessna Aircraft Field at Wichita to complete the round trip. In less than 46 flying hours we had safely covered 5,600 miles over mountains, deserts, and farmlands, in 20 States, Mexico, and the District of Columbia.

Weather delays amounted to less than 5 days out of 53. Operating and maintenance costs of $180 were about the same as they would have been for a medium-priced car carrying the same load.

Looking back, we found that, where available, air marking had provided a positive link between ground and chart. In planned sequences it had speeded flight planning and increased ground speed by simplifying navigation. Because they were so hard to find, big-city markings had not been important, but small-town markers had been invaluable. A surprising number of airports had been unmarked.

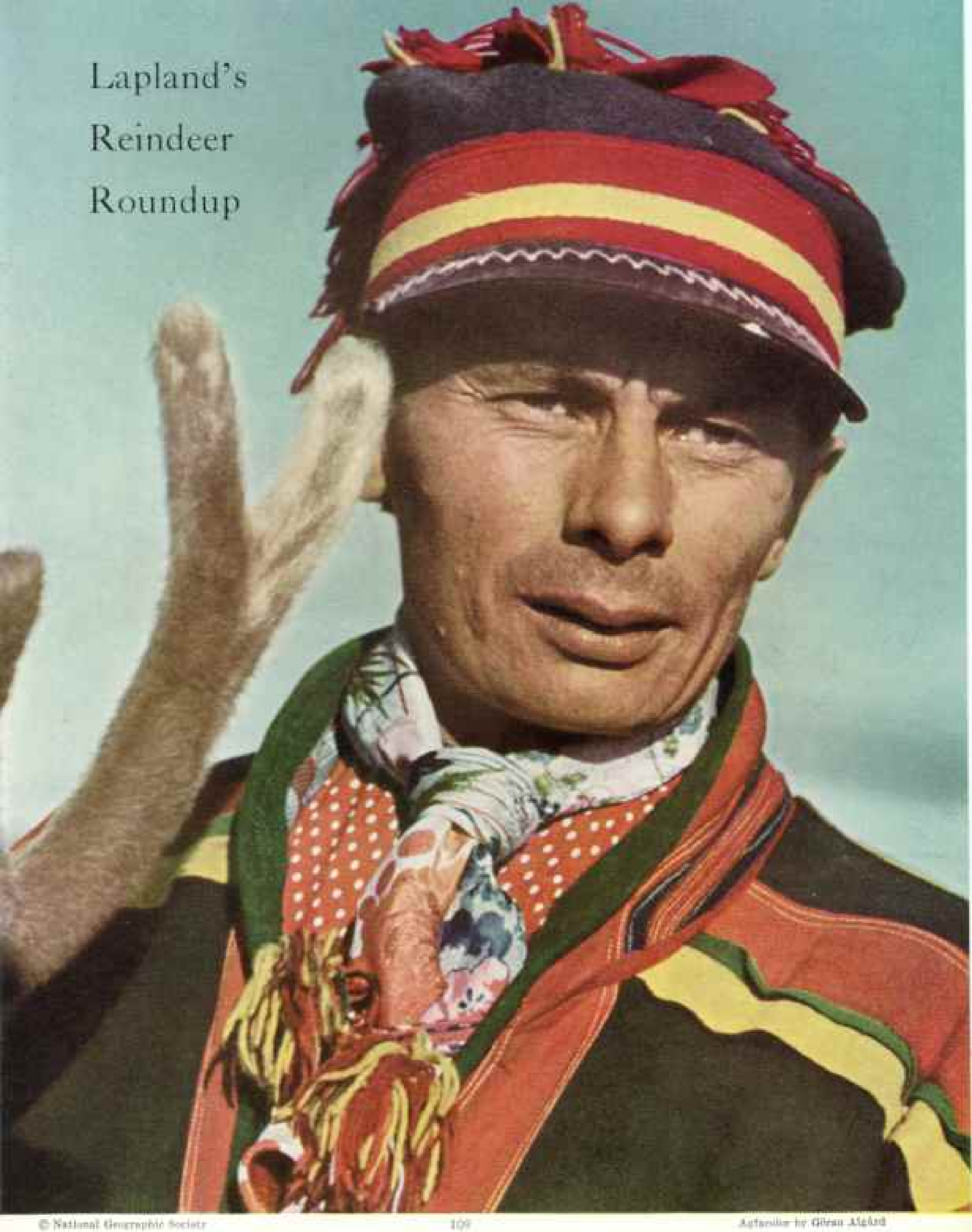
Skyways Make Flying Safer

While much remains to be done, the Wright Way and its sister Skyways mark another long, forward step in the growth of personal air transportation.

With a relatively small amount of training and plenty of respect for the weather, Mr. Average American will be able to navigate his personal plane along the Skyways as easily and safely as he now navigates a well-marked surface highway in his car.

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 September number, The Society should be notified of your new address not later than August first. Be sure to include your postal-zone number.*

Lapland's Reindeer Roundup



Aquarelle by Göran Akfeldt

Stern-faced Lapp or Velvet-antlered Reindeer—Which Is Truly the Master?

The nomadic mountain Lapp may own a thousand deer, yet they rule his life. To follow their search for pasture, he sacrifices fixed abode. Though they plunge into the teeth of a blizzard, he must follow, for the herd represents his meat, milk, furs, and leather. Even reindeer sinews are used as thread, antlers made into knife handles.

The Lapps' ancestral origins presumably lie in Asia, for many bear the Mongoloid stamp. Others, children of intermarriage, are tall and fair. Lapland has no fixed frontier; it extends across Arctic Norway, Sweden, Finland, and Russia. Attention was focused on Lapland recently when a Finnish wolf hunt was described by Moscow as a sinister military maneuver. Wolves are the principal enemies of the Lapps' reindeer herds.

Aquarelle by Göran Algård

Antlers Clash at Fall Roundup, Earth Rumbles Beneath Thudding Hoofs. . . . A Deer Roper Uses His Back as a Hitching Post

Driven from Norwegian peaks in the background, where they nosed through snow for moss, the reindeer wheel within a stockade in Sweden. Young bucks are bewildered; fawns hunt mothers. Now is the time for sorting. This owner, having tossed his lasso with lightning speed, claims a deer of his own. A rakish pompon, part of his tribal regalia, bobs on his visored cap. Gay ribbons are stitched on his woolen tunic.

Lapp Herdsmen, Unlike Cowboys, Work on Foot, Yet They Are Equally Skillful, Rarely Missing a Lasso Cast

Owners brand ears with registered notches (top picture). Unmarked strays are sold to help the aged. The tribe outlaws rustlers.

Woman's Lot in Lapland Is Hard Work; She Hangs Out the Laundry and Milks the Obstinate Reindeer

When the nomad wife needs fresh milk, she calls on her husband to rope a twisting, kicking doe and hold the animal tight until she has finished. The yield is small, but rich in fat. This milkmaid wears an American wrist watch. The Lapp laundress works at a traveler's lodge. She has turned her back on nomad life—a difficult decision for the Lapp—possibly because she has no marriage dowry.

Baby Sitter Minds Brother Beside the Summer Tent . . . Store Shoes and Stockings Create a New Look for Mamma

Ask a Lapp boy his favorite game; he probably will answer, "Reindeer!" He thinks it fun to lasso a playmate and pretend to notch his ear. Little girls weep when the knife draws near. Caring for their homemade dolls, they train to be mothers. Intelligent and eager, girls learn to cook and sew at eight years. Lapp children are seldom scolded or punished. These two accompany the tribal migration.

Kodachrome by William J. Sisto

Aufnahme by Gösta Algård

Aquarelle by Göran Ahlfeld

Fear Gleaming in Her Eye, a Mulish Doe Refuses to Budge. Her Owner Advances Hand over Hand on His Lasso

If necessity compels, this deer can travel 100 miles a day. Waterproof fur gives her a buoyant swim suit; spreading hoofs serve as snowshoes. Unlike other female deer, she has equal right to antlers. North America's untamed caribou are her tall cousins; both are members of the genus *Rangifer*. A sharp-eyed Lapp herdsman can pick out his ear notches 30 feet away in the swirling herd.

Lapps Prosper on Hardship; Fatigue Is Their Medicine

Nomadic grandfather builds no towns, knows few comforts; snowstorms and icy floods have been his lot for three-score winters. Time he tells by the stars, and weather by a glance at the sky. Now that his powers are fading, his people treat him tenderly, though he hinders their strenuous wanderings.

Grandmother wears her tribe's shawl and lace-frill bonnet. A brief, dazzling summer, the midnight sun riding the horizon, rewards her toil over the long winter, part of it entirely dark. Her task at the autumn roundup is to smoke venison and prepare sausage. Skins she scrapes until they are soft enough to be sewn into winter's leggings and furs.

"With us," she might say, "family is everything. When a Lapp woman takes a husband, it is to the end of her days."

Both these Lapps, like some 30,000 of their kindred, are Christians. When they were converted, they gave up their pagan drums, dances, and myths.

Aafaculpt by Glynn Algard

↑ Baby Is Cradled Like a Mummy; Brother Glowers Jealously

This cloth-covered, moss-stuffed cradle has been hollowed, like a canoe, from a log. A curtain shields the child from sun and insects. On treks, mother carries the bundle on her back. At rest, she may suspend it from a bough, as in the nursery rhyme.

↓ Coffee Brewer Puffs Out His Cheeks and Blows the Fire

Once the Lapps drank grated reindeer cheese boiled in water. Then the Swedes introduced coffee. Now the reindeer people refuse to travel without a coffeepot. Many grind the beans in old-fashioned mills. Sugar is placed in the mouth, not in the cup.

Pittsburgh: Workshop of the Titans

By Albert W. Atwood

With Illustrations by National Geographic Photographers B. Anthony Stewart, J. Baylor Roberts, and John E. Fletcher

OF ALL great cities, probably none is so dependent upon natural resources, especially upon mineral resources, as Pittsburgh, world capital of coal and steel.

As the throbbing heart of basic, heavy industry, and the very symbol of America's industrial power, there is something elemental about Pittsburgh. It is direct, natural, vibrant, and virile. It has restless, dynamic drive. It has fundamental strength, like steel, of which it is the world's No. 1 producer (page 123).

To an unparalleled extent, Pittsburgh is a city of producers, and by contrast many other cities seem like mere market places.

Underlying the greatness of Pittsburgh, both literally and figuratively, is the so-called Pittsburgh seam of bituminous coal, found throughout so much of western Pennsylvania and West Virginia. This is one of America's chief sources of energy and is generally considered the world's most valuable single mineral fuel deposit.

Other seams of coal, both in the United States and abroad, are thicker and more extensive; but there are relatively few from which coke for steel manufacturing can be made, and an even more limited number whose location so perfectly fits the needs of industry.*

Set in a Cirelet of Riches

Pittsburgh's location, plus its nearness to coal, has made it a titan of industry. Within a 500-mile radius is more population and probably greater riches than in such a circle drawn around any other metropolis in North America.

Like most big cities, Pittsburgh is located at a natural break or junction in transportation routes. With some cities it is the mouth of a river or the end of a lake; in the case of Pittsburgh it is a junction of river valleys.

Indeed, Pittsburgh exists because two great rivers, the Allegheny and the Monongahela, come together at the "Point," or apex of the city, to form the Ohio.

The result is a marvelous system for the collection and assembly of vast quantities of bulky raw materials, such as iron ore, limestone, coal, and coke to make steel. Transportation is supplied by fleets of barges on three rivers and trunk-line railroads along their banks.

Like New York and San Francisco, Pittsburgh has a spectacular setting, a capacity for being seen with the eye in the large. Its location has great natural beauty as well as colossal utility.

But alas, it is handicapped as well as blessed by topography, for it occupies one of the most irregular and uneven sites of any upon which a great city is built (page 126).

"Pittsburgh is undoubtedly the cockeyedest city in the United States," wrote the late Ernie Pyle. "Physically, it is absolutely irrational. It must have been laid out by a mountain goat."

A Mountain and River Town

Seriously, it is to all intents and purposes a mountain as well as a river town. A local geographer says that 10 percent of its surface is in slopes of 40 percent or more. The lowest elevation, at river level, is above 700 feet, and the hills with which the city abounds rise to more than 1,200 feet, many of them steep, barren, and unfit for habitation.

Because of the mighty force exerted by the three rivers through the ages, the Appalachian plateau at this point is eroded and dissected into a maze of irregular hills and sharp valleys or ravines, some deep and narrow.

One is amazed that human beings should build in such a place. It is a city of isolated settlements and communities, many of whose residents rarely visit other sections, for natural barriers make travel awkward, difficult, and circuitous.

"You may have a friend who lives half a mile away," to quote columnist Ernie Pyle again. "But to get there you circle three miles around a mountain ridge, cross two bridges, go through a tunnel, follow a valley, skirt the edge of a cliff, and wind up at your friend's back door an hour after dark."

However, because of its extraordinary topography, the average visitor to Pittsburgh sees scarcely a dwelling in it, and probably the only steel mills he sees are before he reaches it or after he has left.

The lack of level land has forced a large majority of the basic industries up the Alle-

*See, in the National Geographic Magazine: "Coal: Prodigious Worker for Man," May, 1944; and "Steel: Master of Them All," April, 1947, both by Albert W. Atwood.

Magic Radar Guides Towboats Through Fog and Darkness on Pittsburgh's Rivers

Aboard a Dravo Corporation vessel, the captain shows how he stands beside the radarscope and gives orders to the helmsman. By detecting other boats, riverbanks, and obstructions, such equipment reduces the perils of navigation when "pea soupers" blanket the Allegheny, Monongahela, and Ohio. Through the pilothouse window may be seen the tug's coal-laden barges, called a "tow" though actually they are pushed.

gheny and Monongahela, almost without a break, for distances of 40 and 25 miles, respectively, and down the Ohio for a distance of 30 miles. Pittsburgh is the heart of an industrial empire, but its limbs sprawl along the banks of the rivers into many other communities.

First Settlement at Fort Pitt

Pittsburgh was first settled in the immediate vicinity of Fort Pitt, at the confluence of the two rivers.

As the steel mills spread along the river valleys they pre-empted most of the level space; any undesirable level ground which they did not occupy, together with the steep and precarious building sites on immediately adjacent hills, were taken up by the immigrant hordes who came to work in the mills.

Those who could afford to do so went inland beyond the barrier of hills, in many cases to suburban communities of real charm, both to escape river fogs and steel-mill smoke, and generally to find more attractive surroundings.

The Pittsburgh which the outsider sees is the downtown area, the small apex of the peninsula, shaped like the prow of a ship and known as the Golden Triangle. It is one of the most compact business districts in the world (pages 120 and 121).

Here are the main offices of banks, stockbrokers, hotels, theaters, railroad and bus terminals, newspapers, restaurants, office buildings, headquarters of the great corporations, wholesale houses, and department stores.

On a busy day hundreds of thousands of people enter and leave the small area of the Golden Triangle. For Pittsburgh is a generic term covering all of southwestern Pennsylvania. It is more than the center of a metropolitan area; it is a regional capital.

Allegheny County, of which Pittsburgh is the seat, has 129 cities, boroughs, and townships.

Pittsburgh is one of the few large cities which have not annexed contiguous communities on a large scale, but there are no distinguishable or visible boundary lines; one community melts into another.

Trade in the Golden Triangle

Even the most casual visitor to the Golden Triangle is struck by the size and activity of the department stores (page 139). This is because everybody comes to town to shop.

Her Job Calls for Grit. She Inhales Dust-filled Air to Aid Science

At Pittsburgh's Mellon Institute a researcher prepares to feed contaminated air to an assistant, Nancy Butler, in an iron lung. Plastic bags collect the air mixtures. Results are registered on an ingenious gauge (right). Careful control of the flow protects Miss Butler from danger. Andrew W. Mellon, former Secretary of the Treasury, and his brother, Richard B. Mellon, founded the Institute in 1913 (page 137).

Three Rivers Frame Pittsburgh's Golden Triangle, Seat of American Industrial Might

On the point where the Allegheny (left) and Monongahela merge to form the Ohio, Fort Pitt—forerunner of Pittsburgh—was built in 1758. Through tunnels, across bridges, along cliff-skirting highways, hundreds of thousands swarm daily to work, shop, and play in the Triangle's compact mass of steel and stone. A white limestone pyramid crowns the 42-story Gulf Building, the city's tallest, where executives guide the destinies of a far-flung petroleum empire. Gulf's across-the-street neighbor houses headquarters of the gigantic Koppers Company, Inc., whose interests range from piston rings and plastics to railways and coal mines. In an average month, barges plying the rivers haul more tonnage than passes through the Suez or the Panama Canal.

There are very few branches of the larger stores and relatively few specialty shops as compared with many other cities.

On Monday night, from scores of coal-mining and steel mill towns, the miners and mill-workers themselves, as well as their wives, come in to town. The great stores cater to every economic group and all classes feel at home in them.

Thirty years ago the department stores began to build up departments as if they were specialty shops—junior misses, beauty parlor, gifts, ready-to-wear, and the like.

In no other large city does this type of store do such a large proportion of the total retail business.

But how can such a horde of people be transported in and out of the Triangle in a single day? In addition to those who drive their own automobiles, who use the trunk-line railroads and the more than a dozen independent bus lines, approximately 350,000 are carried by the streetcars of the Pittsburgh Railways Company.

In most cities I have taken streetcars for granted, but not in Pittsburgh! Here 60 separate streetcar routes enter and leave the small Triangle. Outside of it a map of the lines looks like the bad dream of a modernistic artist.

Confused and Complex Street Plan

For one thing, the street plan itself is necessarily confused and complex. Streets come to a dead end in hillsides, and in the different sections of the city they do not run according to the points of the compass, but at right angles or parallel to the three rivers.

Then, too, most of the lines cannot proceed directly through paying territory, but must follow very indirect routes, around, over, or through an unproductive area or barrier of barren hills, to reach spots flat enough for residential settlements.

Once Backwoods Fort Now Rules World of Coal, Steel, Glass, and Aluminum

From these buildings between the Monongahela and Allegheny, men direct the flow of raw materials into furnaces and foundries where they become the tools of modern civilization. George Washington, at the age of 21, was among the first to see the natural advantages of what is now the Golden Triangle. Since 1758, with the development of industry based upon vast coal resources, Pittsburgh has spread its limbs to dozens of other communities along the riverbanks. Science, keeping pace with production, has given the city many firsts. Among these is the pioneer radio station, KDKA, now housed in the 40-story Grant Building (center),

Early one morning I took Route 21 on the North Side (old Allegheny) to Fineview, or Nunnery Hill. We climbed most of the time, almost precipitously, turning and twisting, now on streets, now through fields, now following contours, now over the top of a hill, now into another valley or ravine. Much of the time we were perched precariously on the side of a hill, but always the car seemed able to stop on any kind of grade.

Funiculars Carry Millions

Pittsburgh is one of the few cities in the world in which funicular, or mountain-climbing railways, locally known as inclined planes, or more commonly as inclines, are an ordinary and accepted form of mass transportation. They carried over two million people in 1948.

Fares have been raised recently, but a single fare is still only 5 cents, and I got a big thrill going up and down for the grand total of 10 cents. Six inclines are being operated, most of them on the South Side of the Monongahela River, and several can be reached in a few minutes from the center of the city.

The cars are drawn up the mountain and lowered by cable, one being lowered as the other is raised. They are similar to streetcars but smaller and more boxlike.

Dwellings on some of the steeper hills were erected because of the cheapness of the land, but they cannot be reached by streetcars or even by streets and roads except in the most roundabout way. In lieu of the impossible physical job of street grading, the city provides hundreds of long flights of wooden or concrete steps to reach these houses.

As fast as possible, and at a cost of several million dollars, the city is replacing wood with concrete. Not only were planks torn loose for firewood, but there is the ever-present danger of accidents because of loose planks and consequent suits for damages against the city.

In the office of a division engineer of the Department of Public Works I saw a detailed

In a Midget Laboratory, Lilliputian Experiments Help Control a Gulliver Industry

Beakers, flasks, funnels, and jars are so small they must be handled with tweezers by this microchemistry technician at Pittsburgh's Gulf Research & Development Company (page 135). A plastic mask protects her face. This technique speeds research by allowing use of materials in amounts smaller than milligrams. Minute explosions are managed with ease and safety.

map of the steps, one flight being 1,800 feet long and rising 500 feet from the bottom to the top of the hill. I did not try to climb it!

Pittsburgh and the communities near it could not exist, of course, without hundreds of bridges; it has, perhaps, more bridges than any other city in the world.

A City of Bridges

The county and city together have more than 800 bridges. Not only must the rivers be bridged in many places, but so must many valleys and ravines.

Naturally, when the Triangle empties in the late afternoon the bridges become a serious traffic bottleneck as the suburbanites head for their homes beyond the barrier of hills.

New bridges have far more lanes than the older ones and allow much more space for approaches. The new Dravo Street Bridge is 2,000 feet in length, replacing one of 1,100 feet, the difference in length being due to longer approaches for automobiles.

Descending the Monongahela River in a launch, I was struck by the sheer number of bridges, railroad and industrial as well as highway. Their frequency increased noticeably as we reached the city itself.

A curiosity among them is the "hot metal" bridges, devoted exclusively to the carriage of carloads of molten iron and steel between two plants of the same company.

Most of the basic industries in the Pittsburgh district could not exist on their present scale without the rivers, which supply transportation and essential water for cooling purposes. In fact, the entire flow of the Monongahela is used 19 times for this purpose before it reaches Pittsburgh.

Except during flood stages, the flow of the rivers is regulated, and a constant level maintained the year round, by means of a series

U. S. Steel Corp.

Even a Bessemer Must Learn Steelmaking the Hard Way

English-born Alan (right) is a great-nephew of Sir Henry Bessemer, inventor of the converter that revolutionized steel production. Young Bessemer is shown molten metal flowing from an open-hearth furnace in the Homestead plant of Carnegie-Illinois Steel Corporation, where he worked between college terms. After graduating from Carnegie Tech, he was employed by a Cleveland subsidiary of United States Steel Corporation.

of steps. These are pools or basins, controlled by locks and dams and operated by the Army's Corps of Engineers. For example, the Port of Pittsburgh is on the Emsworth Pool, its water level controlled by the Emsworth Dam.

Serious injury to the lock and dam system might prove a national disaster, for it would close the steel mills by depriving them of water. Early one morning I saw the damage done to one lock by a tow of barges whose pilot, in the dense fog, had mistaken the noise and lights of a near-by railroad and steel mill for his own go-ahead signal.

"The Busiest Little River in the World"

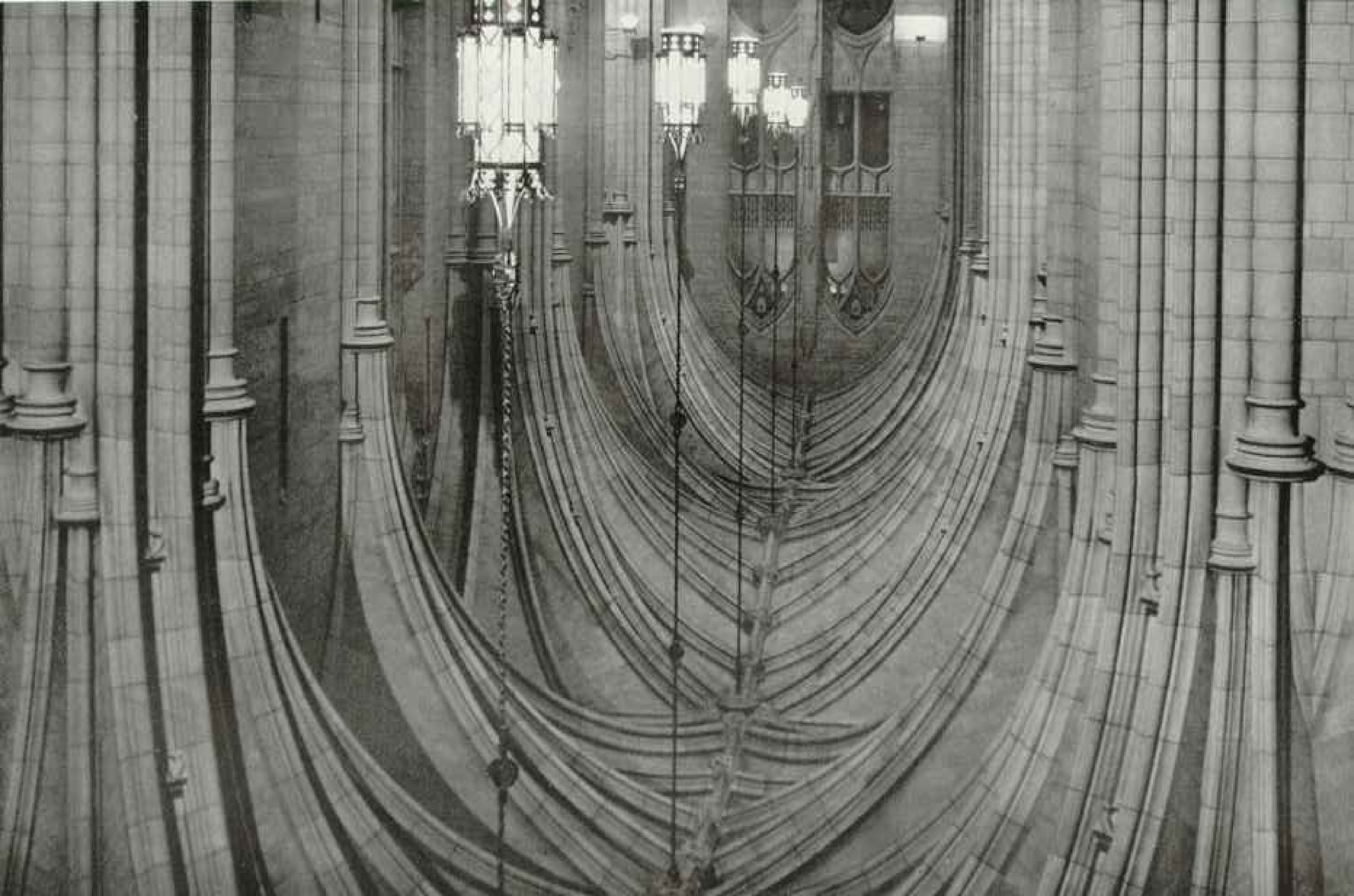
The Monongahela, or "Mon," is perhaps the busiest little river in the world, because more than 27,000,000 tons of coal move upon it each year. A single one of its mills, the Clairton Works of the Carnegie-Illinois Steel Corporation, uses nearly one percent of all the coal mined in the world.

A coal tow usually consists of 12 barges, carrying 900 tons or more each, as compared with 60 tons in a railroad freight car.

Navigation on these rivers is becoming very modern, for radar is being used by many of the boats to find their way in fogs (page 118). The captains and pilots seem like trim young businessmen; many are college graduates. Former State Senator William B. Rodgers told me that he was the third of four generations of licensed river pilots; his grandfather, father, and son were the other three.

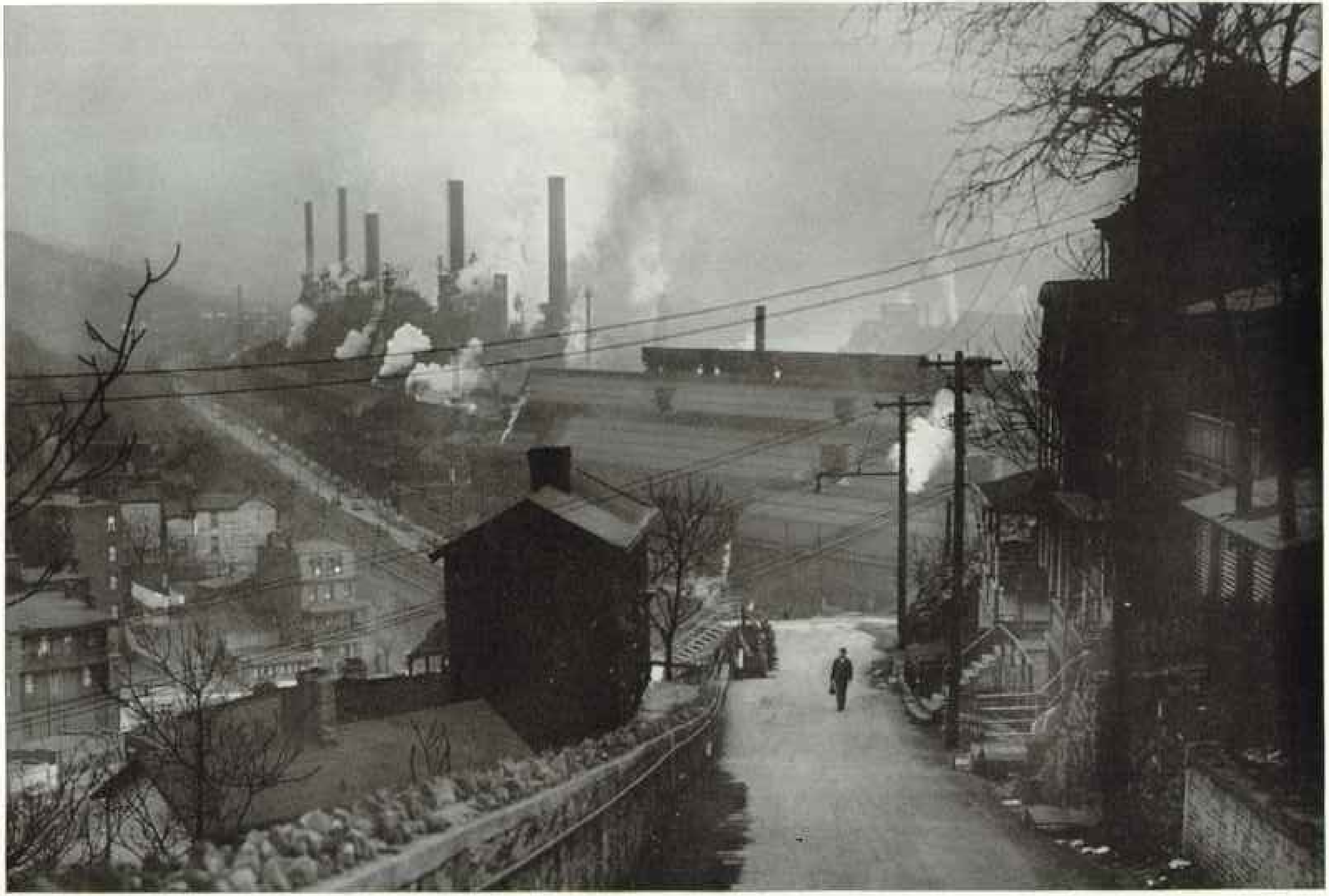
In 1753 the youthful George Washington described the Monongahela as "extremely well designed for water carriage, as it is of a deep, still nature."* Possibly he did not like

* See "Travels of George Washington," by William Joseph Showalter, National Geographic Magazine, January, 1932.



Under Soaring Gothic Arches, University of Pittsburgh Students Work and Relax on Their Half-acre "Indoor Campus"

Daily, at least 10,000 of Pitt's 25,000 students visit the four-story Commons Room to study, read, chat, or listen to organ music between classes (page 138). The room, a gift of Andrew W. Mellon, an alumnus, was dedicated in 1937, at the time of the University's sesquicentennial. Each arch is held in place by a five-ton keystone; no steel was used in construction of the room. Stone piers rise 52 feet to a vaulted ceiling. The Commons Room serves as the base and heart of the Cathedral of Learning, a 42-story skyscraper dominating Pittsburgh's Civic Center. Here are floor after floor of classrooms, faculty and administrative offices, more than 100 laboratories, libraries, and social and assembly rooms. The Cathedral's 9,000,000 cubic feet, if spread out in the usual college buildings, would crowd the 14 acres surrounding the tall structure.



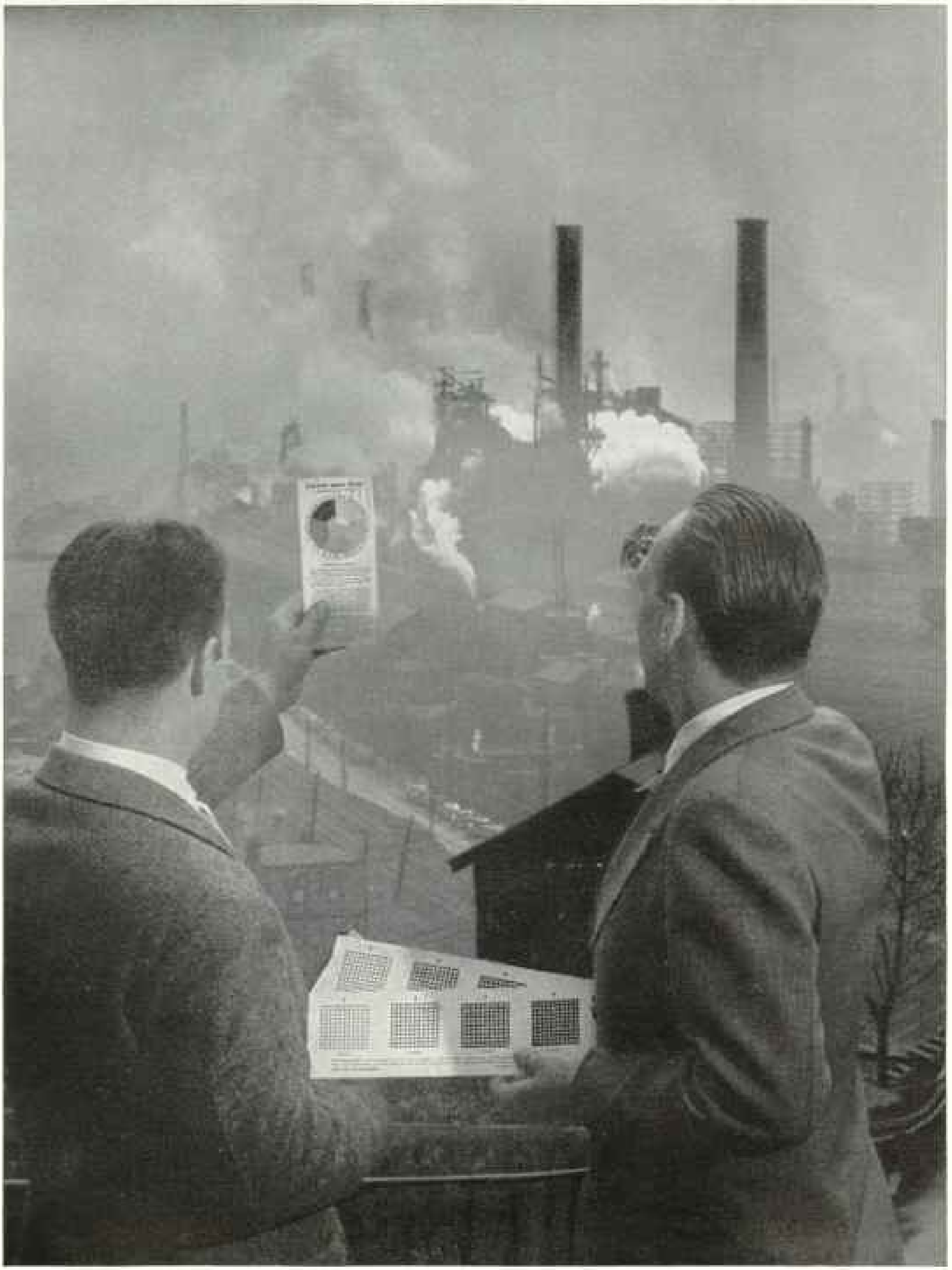
Hillside Houses Stand on One Another's Shoulders, as if Jostling for a View of Pittsburgh's Booming Steel Mills

From Pittsburgh Schools, Carnegie Institute Selects Promising Art Students for Special Training

These teen-agers, busy at easels in the Hall of Architecture, are members of the Carnegie Palettes. Assistant Frank Walchak criticizes the work of two youngsters (left).

They Supervise Pittsburgh's Famous Collection of Prehistoric Animals

Richard K. Mellon (left), chairman of Carnegie Institute's Museum Committee, and Wallace Richards, Museum Director, discuss scale models and sketches of creatures displayed in Dinosaur Hall. A large model (foreground) represents *Diplodocus carnegiei*, named for Andrew Carnegie (portrait on wall).



"Smoke Sleuths" Work Constantly to Combat a Pittsburgh Nuisance

These city inspectors study heavy clouds billowing from a steel mill's chimneys. Smoke is viewed with special glasses (right) and through a hole in a Ringelmann Chart (left). Density is graded by matching it with shades ranging from light gray to black on the card. Violators of smoke-abatement regulations may be fined (page 141).

Pitt University Students Learn How to Arrange a Window Display from Horne's Experts

Pittsburgh department stores provide valuable experience for members of retail sales classes. Here a group studies at close range a window in the Joseph Horne store which presents a conception of how the Golden Triangle may look when the Point project is completed. Compare this exhibit with the photograph of the Triangle on pages 120 and 121. The Horne store celebrates its 100th anniversary this year.

the Allegheny so well, for he was nearly drowned in it when dumped from a hastily constructed raft.

The fully navigable reach of the Monongahela is being improved 23 miles into vast new reserves of metallurgical coal in West Virginia, and an extensive system of dams and reservoirs on upcountry tributaries is expected to reduce future flood damage. In 1936 the water stood 11 feet in Horne's department store in the Golden Triangle.

It is a mistake to think of Pittsburgh only in terms of coal and steel, even though these are the city's underpinnings. Here are the home offices of the world's largest manufacturers of many other important products, including aluminum, certain types of chemicals, plumbing fixtures (page 133), and heating equipment.

One of the largest manufacturers of electrical equipment, one of the largest oil companies, and, curiously enough, one of the largest food manufacturers are located here.

Although bauxite ore from which aluminum is made is not mined in the Pittsburgh district, the Aluminum Company of America, by far the largest unit in the industry, has always had its home office here and one of its largest fabricating plants.

Aluminum's 60th Anniversary

On October 14, 1948, I attended the 60th anniversary of the founding of the aluminum industry, in the industrial section of Pittsburgh. The original building is not standing, but a reproduction of a portion of it had been erected near by.

Arthur Vining Davis, chairman of the board of directors of the company, who is now in his 83d year, re-enacted the scene of 60 years before by pouring an ingot of melted aluminum (page 132).

Although members of the Mellon family have long been large stockholders in this great

Carnegie Tech Teaches Future Printers How to Design Advertising That Sells

Prof. Homer E. Sterling (left), flanked by Munsell color charts on the wall, instructs a class in layout. Carnegie Tech is the country's only college giving a degree of Bachelor of Science in printing administration. Students learn all phases of typography, composition, presswork, and design. Two NATIONAL GEOGRAPHIC MAGAZINE printing specialists are graduates.

corporation, Mr. Davis, who, fresh out of college, became the first employee of the original predecessor company, is still its dominant figure and is known in the industry as "Mr. Aluminum" himself.

But Pittsburgh is the city of glass as well as of steel and aluminum. This is because the sand, of which it is made, and the coal or natural gas, for fuel, have been abundant from the start.* Glass plants, large and small, are scattered up and down the three rivers, but the largest producer is the Pittsburgh Plate Glass Company.

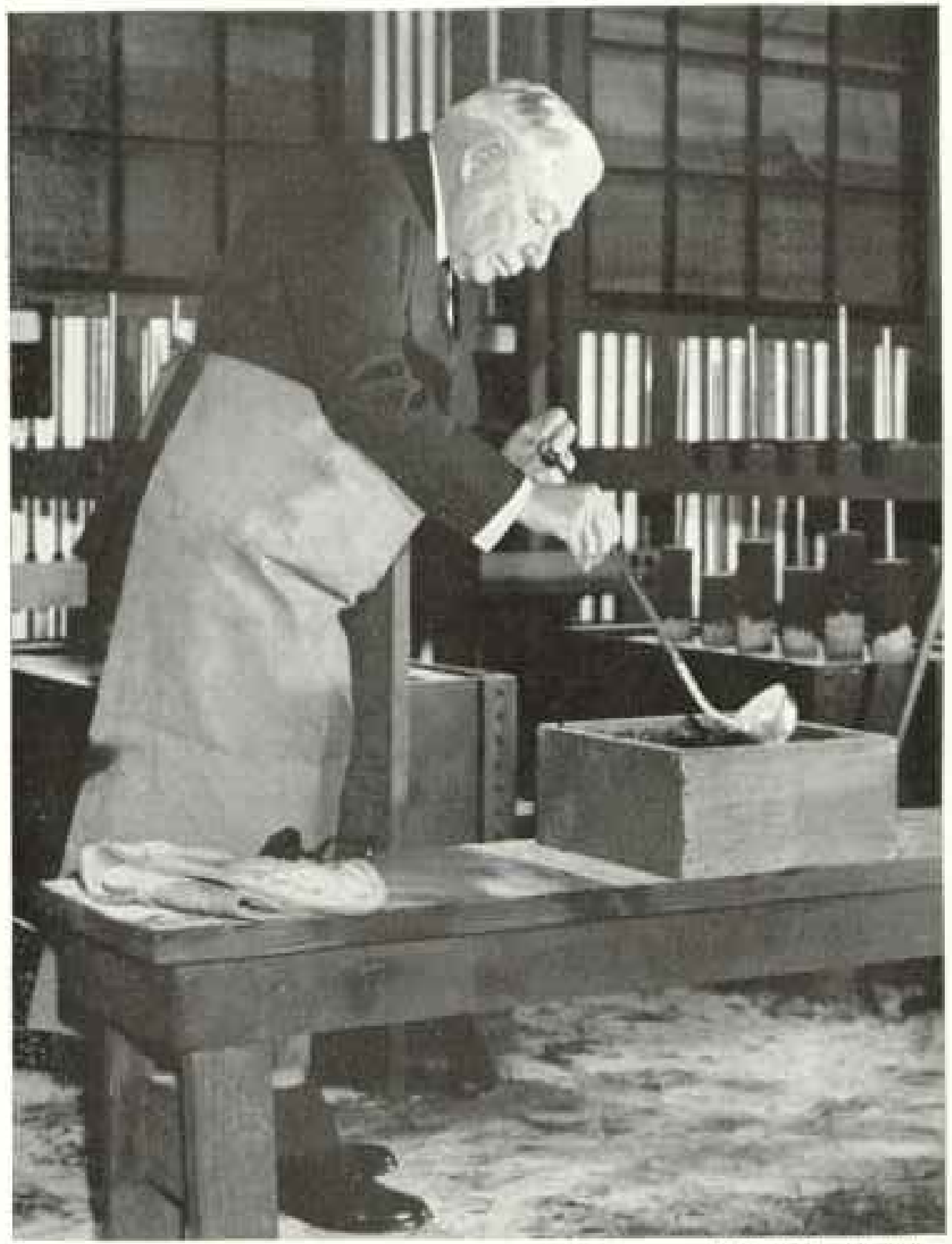
This concern is also a leading paint manufacturer and the largest commercial distributor of chlorine, so extensively used in water supplies to eliminate typhoid. Chlorine is also essential in the making of plastics, synthetic rubbers, vitamins, sulfa drugs, dyes, and many chemicals.

It was in Pittsburgh in the early 1870's and 1880's that George Westinghouse started to manufacture the air brake and railroad signals which he had perfected. Because the signal systems required electrical controls, he soon found himself making electrical equipment; the vast Westinghouse interests have been there ever since.

Family Day at Westinghouse

On October 9, 1948, I attended Family Day at the huge main plant of the Westinghouse Electric Corporation in East Pittsburgh. With operations closed for the day, the more than 20,000 employees were invited to bring their families to see where father works, and apparently all of them came. I was most impressed with the number of workmen who had a small child by the hand.

*See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Glass 'Goes to Town,'" by J. R. Hildebrand, January, 1943; "Industrial Titan of America (Pennsylvania)," May, 1919, and "Penn's Land of Modern Miracles," July, 1935, both by John Oliver La Gorce.



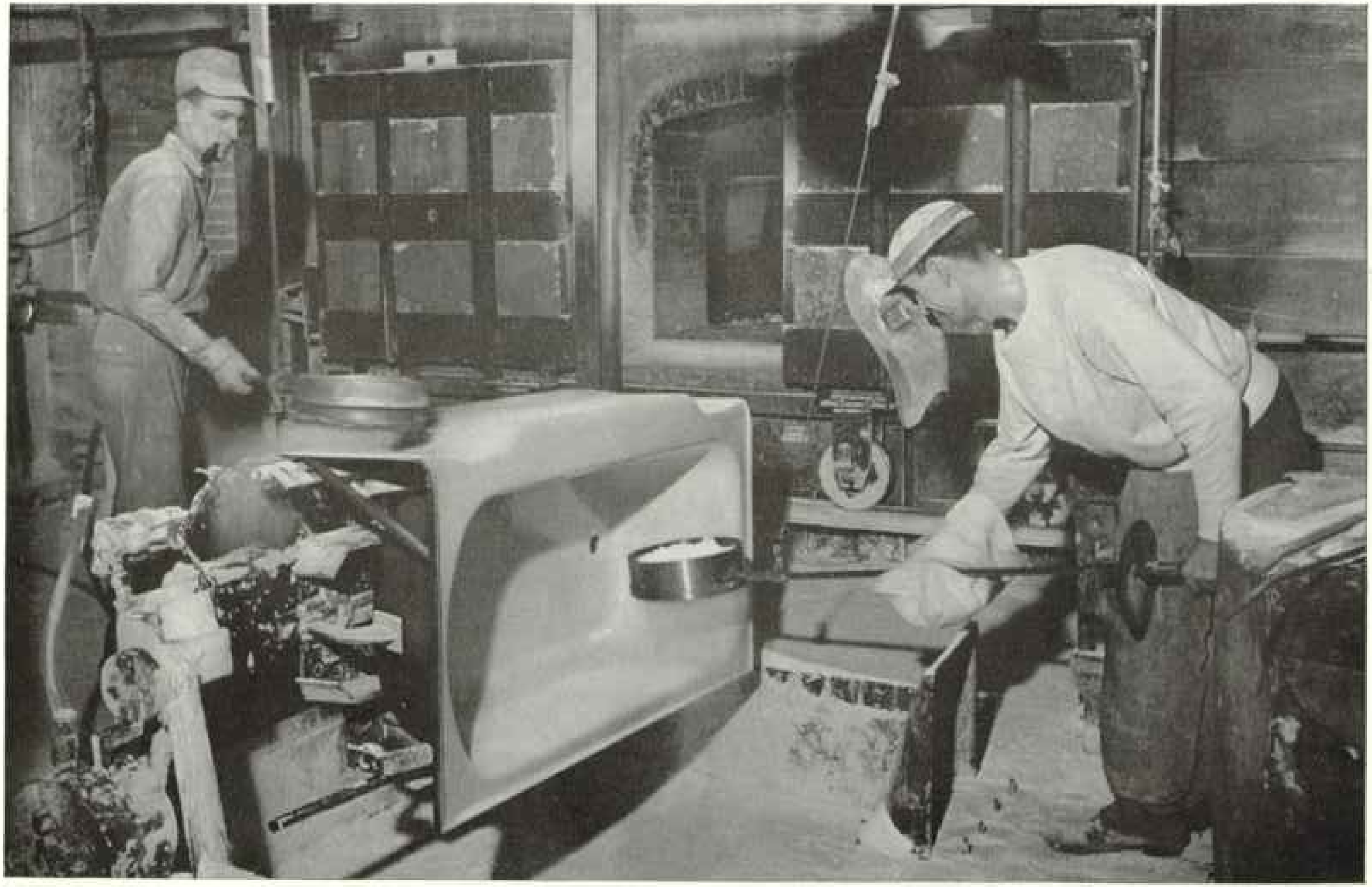
Norman-Schmidt Studios

Pittsburgh's "Mr. Aluminum" Re-enacts a Historic Event

Arthur Vining Davis, board chairman of the Aluminum Company of America, shows 60 years later how he poured the first ingot of aluminum when the industry was founded in 1888 (page 130). Mr. Davis, now in his 83d year, was the first employee of the company, now one of the many Mellon interests.

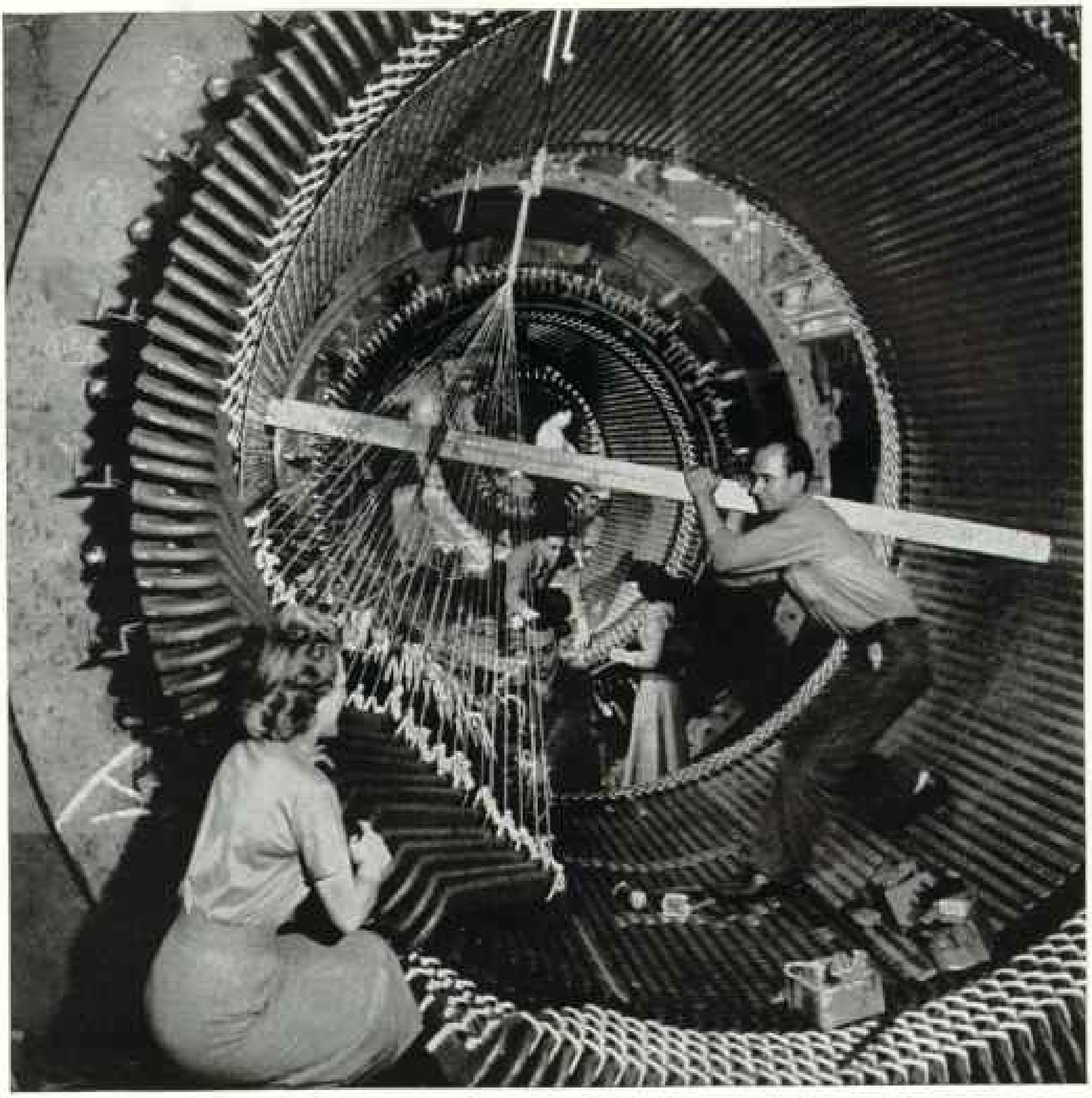
Heinz's "57 Varieties" Are Sold in Several Languages

At Pittsburgh's H. J. Heinz Company, a dietitian displays foods for many lands. Two cans (upper) contain vegetable and chicken soups with Dutch and Spanish labels. Below, beside pears for Spain, are English and Dutch versions of baked beans, Spanish gumbo, and Dutch chicken and green pea soups.



Enamelers, Toiling in Fierce Heat, Give Bathtubs That Satiny Finish

The iron casting comes cherry-red from a furnace at the American Radiator & Standard Sanitary plant. With long-handled sifters, workmen apply enamel powder as the tub turns on a pedal-controlled machine. Heat fuses the porcelain to the metal to form a smooth coating.



Giant Condensers, Custom-built in East Pittsburgh, Help Light the World

In the Westinghouse Electric Corporation plant, workers assemble a 60,000-kilovolt-ampere condenser for a southern power project. When rotor and other parts are added to the stator (foreground), the 295-ton machine will be as big as two 5-room bungalows. By reducing losses, condensers make more power available. Westinghouse's main works ships such equipment to all parts of the globe.

From this vast plant some 18,000 carloads of basic electrical equipment, much of it tailor-made, is shipped each year. Among the products are motors for industrial use and electrical equipment for streetcars, mine cars, and railroad trains.

Most impressive was the long line of generators for the electric-power industry (above). Enormous affairs they are, for Grand Coulee, the TVA, the City of Los Angeles, Brazil, Finland, and Peru, and for many power companies in the United States.

A single piece of such equipment will supply light and power for scores of thousands of homes. The mammoth building where they were being constructed seemed to me one of the most vitally important places in the whole world, so very few are the concerns which make this type of apparatus.

In a tiny makeshift shack on the roof of one of these buildings commercial radio had its beginnings on November 2, 1920, when station KDKA received reports by telephone of the Harding-Cox election from a Pittsburgh newspaper and made the first regularly scheduled broadcast to about 500 listeners, mostly amateur wireless operators.

One of the comparatively few large indus-

tries within the city limits of Pittsburgh itself is the H. J. Heinz Company, so long known for its trademark, "57 Varieties" (page 132).

Its beautifully equipped and attractive buildings, to be greatly expanded this year, are open to visitors; in the summer season a thousand persons a day visit the plant. To me one of the most interesting features was the almost complete mechanization of spaghetti making, formerly a hand operation.

As a young man of 25 in 1869, the first H. J. Heinz grew horse-radish and packaged and distributed it in near-by Sharpsburg; the business has remained in Pittsburgh ever since. The founder was followed by his son Howard, and 32-year-old H. J. Heinz II took over in 1941.

This concern is the largest maker of ketchup in the world, and thus is a very large user of tomatoes. Since tomatoes are vulnerable to blight, Heinz does not rely upon ordinary commercial markets for its supply, as it does with more hardy vegetables, but develops its own strains, supplies seedling plants to thousands of farmers, contracts to buy their entire crop when harvested, and sends out experts during the growing season to help the farmers if blight or other injury is threatened.

Heinz is the second largest maker of canned soups and one of the four largest makers of baby food. Although there literally are from 120 to 127 varieties, not the fabled "57," the chief products, besides ketchup, soup, and baby foods, are baked beans, pickles, spaghetti, and condiments.

A Center of Research

It is unlikely that many people outside of Pittsburgh realize that continuous research as well as production is one of the city's primary functions. Laboratories, no less than mills, line its river valleys, and it has a tremendous concentration of technical societies.

As everyone knows, the electrical industry is based upon research,* and for almost 60 years hundreds of scientific projects in the Westinghouse Research Laboratories in East Pittsburgh have been translated into processes and products that make life pleasanter and easier.

In the company's first rented building in Garrison Alley, Pittsburgh, three rooms on the second floor were set aside as an "electrical laboratory." In fact, the company would not have been organized at all if it had not been for William Stanley's research on alternating currents on behalf of George Westinghouse.

For many years the cheapness and abundance of coal discouraged intensive chemical research, but more recently Pittsburgh has become the headquarters for coal research in America. This is being carried on not only by government agencies, universities, and research institutions, but by the joint action of a number of coal and oil companies.

Of particular interest to the general public are the pilot plants for turning coal into gasoline. At present the outcome is still uncertain. But gasoline can be made from coal.

One of the great laboratories which I visited in the Pittsburgh district was that of the Gulf Research & Development Company at Harmarville, on the Allegheny River (page 122). Here more than 1,000 persons are employed and the work of more than an additional 500 in the field is overseen—that is, of exploratory parties in all parts of the world.

Research is especially necessary to oil companies because processes are fast outmoded. Such a company is dependent upon the designers of equipment—that is, of engines. The too sudden replacement of the present type of gasoline automobile engine by another type, such as the turbine, might upset the economics of the oil refinery industry by requiring a different type of fuel.

At the Harmarville laboratories every fuel and lubricant produced from petroleum was being tested, including even the smallest specialties, such as watch oil. Here also I saw experiments in the gasification of coal.

Maps and the Search for Oil

I had not previously thought of such a laboratory as being one of the country's largest and most meticulous map-making centers, but the collection of data concerning the location of oil by means of magnetic, gravitational, and seismological measurements must all be put down on maps, and immediately! Such maps do not take years to make; they are turned out every week (page 143).

The air-borne magnetometer was devised by scientists of this company. The principle was first applied to submarine detection during World War II, and after the conflict it was applied geologically.

It is valuable because a single air-borne crew can map 450 profile miles daily, as compared with 50 miles a day by a surface magnetometer crew in fairly open country. And of course it can readily survey jungle, swamp, desert, and other areas heretofore so inaccessible as to make exploration economically prohibitive.

These measurements of the earth's magnetic

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

Lacquer-and-gold Splendor Surrounds Pittsburgh Students Delving into Oriental Lore

In the University of Pittsburgh's China Memorial Classroom, teaching fellow James T. C. Liu lectures on Far Eastern history. Design of the room was inspired by a hall in a palace of the Forbidden City, Peiping. Other special classrooms are decorated in the styles of 15 foreign lands (page 158).

field from an airplane are only preliminary reconnaissance in finding oil; they must be followed by gravitational measurements, and especially by the use of the seismograph.

One of the most marvelous of scores of gadgets and devices I saw at these laboratories was an electric analog of an oil field. By means of this device actual conditions in a particular oil field can be simulated, and its length of life as well as the best methods of developing it can be ascertained.

But the average layman will probably find the Mellon Institute the most interesting of all research laboratories in the Pittsburgh district (page 119).

This is one of the most important scientific institutions in America, and is housed in an unusual and beautiful building in the Civic Center of Pittsburgh itself.

Three of the nine floors are below ground level, and there are four interior courts for natural lighting. In addition to extensive machine shops and library, office, lecture, and social rooms, there are 370 separate rooms for scientific and investigational work.

"Pillars of Science"

Approximately 80 separate and independent research projects, or "industrial fellowships," were carried on in a recent year by 575 senior and junior scientists. The building has the largest monolithic column installation in the world; each of the 62 columns surrounding the building weighs 60 tons—veritable "pillars of science."

As early as 1909, Andrew W. Mellon, Secretary of the Treasury under three Presidents, and his brother, Richard B. Mellon, became aware of the gap then existing between science and industry in this country, as compared with their profitable partnership in Europe. As a result, they founded the Institute in 1913.

It is the oldest and probably still the largest industrial laboratory in the United States in which joint facilities are used cooperatively to improve existing products and processes and create new ones for a great variety of different industrial companies, large and small; thousands of such companies have been served.

The early idea was to aid small industries, but a number of these have grown into very large ones because of the Institute's work. In fact, it has actually created whole industries, as well as provided presidents, vice presidents, and research directors for others.

One homely illustration is that of the Chicago concern which produces seamless tubing from viscose cellulose to be used for frankfurter casings, "cotton shirts on wieners," the result of ten years of Mellon Institute research.

One of the largest chemical manufacturers in the United States is so engaged largely because of the Institute's contribution.

Among the enormous number and variety of projects on which the Institute has worked are protective coatings for storing hot water, roof ventilators, new methods for measuring stream pollution, production of new food flavors, industrial application of soybeans, chemicals from corn, the behavior and properties of thread, dry-cleaning technology, new fire-fighting agents, new pan coatings for the baking industry to eliminate the greasing of pans, new materials for life preservers, investigation of eye injuries from chemicals, and steel mill and coal mine wastes.

In a recent year, among the new fellowships started were those in candy technology, grinding wheels, and orthopedic appliances. The Institute supports departments of research in pure chemistry and physical chemistry.

Far too many visitors to Pittsburgh see only the Triangle and the industrial districts along the rivers. They do not realize that the Civic Center, of which the Mellon Institute is a part, contains a most striking architectural grouping and is one of the most impressive centers of its kind to be found anywhere.

It is not accurately named, for the county and city buildings are in the Triangle, more than two miles away beyond a barrier of hills. In reality, the Civic Center consists of an unusual concentration of universities, libraries, laboratories, art galleries, music halls, auditoriums, hospitals, memorials, athletic fields, and a natural-history museum.

It is a medical, educational, research, art, musical, and athletic center overlooking Schenley Park.

In Forbes Field more than a million and a half people watch professional football and baseball each year.

A Cathedral of Learning

Dominating the Civic Center, and the chief landmark of the entire area, is a 42-story skyscraper, the Cathedral of Learning of the University of Pittsburgh. This is a building which people cannot avoid looking up to, both literally and figuratively.

It was erected very deliberately, not only to suggest by its height and reach the spiritual values which underlie university education but to give lift to the whole city, to serve as a symbol of the birth of civic spirit.

The building broadens out noticeably toward its base, and most of the hundreds of classrooms are in the first five stories. Above are libraries, and still higher the offices.

Entering from the ground level, you find

Songs of Pittsburgh's Beloved Stephen Foster Still Rise Above the Roar of Industry

In the Stephen Collins Foster Memorial at the University of Pittsburgh, students gather around the composer's piano. Above the keyboard is the original sheet music of *My Old Kentucky Home, Good Night.* Foster scores cover the walls. A native of Pittsburgh, Foster died in New York in 1864, leaving 38 cents and a scrap of paper bearing the words, "Dear Friends and Gentle Hearts."

yourself in a vast Gothic Commons Room (pages 124 and 125). Here thousands of students, of every national and racial origin, gather as in a sort of indoor campus every hour of the day and many in the night, standing, sitting, reading, studying, talking, and resting, on their way to and from classes.

From the corridor surrounding the Commons Room, doors lead to the 16 nationality classrooms, each a gift from a different national group living in the Pittsburgh district and each designed by foreign architects and archeologists. An Early American Room is on the third floor.

These rooms were completed from 1938 to 1945, and two more are in the planning stage. Visitors are welcome and are shown the rooms by student girl guides. Each room expresses in its design, furnishings, and decorations the most precious cultural heritage of a people.

Political differences are never suggested. There are no political symbols in these rooms, not even the portraits of living personalities.

Funds for these rooms were raised in many different ways by large national groups, many of them men and women without formal education. The idea for the rooms was indigenous; it sprang out of the soil.

A study of the nativity of the student body showed that there must be great masses of people in the Pittsburgh district who had not yet become sufficiently a part of America; the challenge was put up to them to produce in the nationality rooms the best of their own culture.

All the University authorities agree that the rooms have made for increased good will, dignity, and tolerance among the student groups of different national origins. Students are not lectured to on the subject, but a Polish boy overhearing a casual visitor exclaim over

Lift the Seat and Presto! Milady's Sofa Becomes a Bathtub

As part of a 100th anniversary celebration, Joseph Horne Co., Pittsburgh department store, displayed this Victorian sofa-tub. The bather filled the zinc-lined bath with a bucket and bailed it out after use. Then the hinged top could be lowered for a nap. The relic is from the bathtub collection of Theodore E. Mueller, president of the American Radiator & Standard Sanitary Corporation.

the beauty of the Polish room is prouder than he was before of his own heritage.

Some of the nationality rooms which I saw had regular classes in session. Not too unsuitably, a professor was lecturing to a large class in medieval history in the Greek room; an Army officer had a small seminar in military strategy in the Chinese room (page 136).

Although this University goes back to the Pittsburgh Academy, chartered in 1787, it was not a very important institution until former Chancellor John G. Bowman began to enlist the interest of large corporations and wealthy individuals in 1921. It is distinctly a local, a city, an urban university.

Not only do most of the students come from the Pittsburgh district, but most of them remain there; in other words, the University supplies the great industries with much of their technical, trained manpower.

During a single semester of the 1947-48 academic year, 2,500 employees of business and industry were enrolled in afternoon, evening, and Saturday classes; the Carnegie-Illinois Steel Corporation alone supplied 200 such students.

One department of the University which does not draw its students from the Pittsburgh district alone, and whose graduates do not necessarily remain there, is the Research Bureau for Retail Training, founded in 1918, the first cooperative college school of retailing in the country. The Pittsburgh department stores have contributed $1,500,000 to its support, and many of its graduates hold executive positions in department stores, both in Pittsburgh and in other cities (page 130).

Memorial to a Song Writer

Near the Cathedral of Learning, and designed to harmonize with it, is a much smaller building, the Stephen Collins Foster Memorial

(page 138). This contains an auditorium in constant use by musical organizations and also the outstanding collection of source material of the famous song writer, whose work is probably the most typically American expression of any composer.

Although Foster began to write songs in earnest in Cincinnati, and there decided to abandon a business career to become a professional composer, he was born in Pittsburgh, lived there most of his life, and wrote most of his great songs there.

Among other treasures in the Memorial is Foster's book of original manuscripts, with more than 200 pages of first drafts of published songs, unpublished verses, inscriptions, and cartoons, all in his handwriting. Here one may see the evolution of his most famous songs, including *Old Folks at Home*.

One of the most pathetic Foster relics to be seen is the pocketbook and its contents which he left at the time of his tragic death in Bellevue Hospital in New York City in 1864. All it contained was 38 cents in money and a small scrap of paper bearing five penciled words. The words were probably to be used as the title or theme of a song which he did not live to write: "Dear Friends and Gentle Hearts."

The erection of the Foster Memorial in 1937 was greatly aided by Josiah Kirby Lilly, an Indianapolis drug manufacturer, to whose activity as a collector of Fosteriana much of the recent revival of interest in Foster is due. Probably one reason Mr. Lilly decided to place his collection in Pittsburgh was that singing has always been an important part of the city's life, especially among the Welsh, German, and Italian elements.

To increase his income as a song writer, Foster wrote for the colored minstrel shows. He was not a southerner, but as a little boy he went to a Negro church with his nurse, and the Pittsburgh river front, where Negroes were a colorful element and where many travelers to and from the South were to be seen, helped give him the flavor for his so-called plantation songs.

Benefactions of Andrew Carnegie

Two other notable groups of buildings in the Civic Center are those founded and endowed by the little Scottish-born iron and steel master, Andrew Carnegie. They are the Carnegie Institute, which combines in a most unusual arrangement a large public library, a museum, an art gallery, and a music hall, all in one building (pages 127 and 128); and in a separate group of buildings the Carnegie Institute of Technology.

As early as 1881 Carnegie offered a library to Pittsburgh; the unique idea of adding a technical school, museum, music hall, and art gallery came later. As a young boy, Carnegie had access to the private library of Col. James Anderson in Allegheny, now the North Side, and his benefactions seem to have been the natural result of his great interest in reading and books.

He may well have looked forward through the dust and smoke of the vast industry which he helped create to see the need of cultural opportunities in the later development of the city.

Beginning in 1896 and continuing, with omissions during World War I and until 1940, when the conditions of World War II made shipments impossible, the Carnegie Institute carried on the famous International Exhibition of Contemporary Paintings. At its peak, as many as 515 paintings were shown, and one exhibition included canvases from 21 nations.

Carnegie Exhibition To Be Resumed

With the aid of a $225,000 Mellon grant, the Exhibition will be resumed in 1950.

At the Carnegie Institute of Technology no fewer than five of the important fine arts, painting, sculpture, architecture, acting, and music, are taught under one roof (pages 131, 142, and opposite).

In addition, there is a women's college and an engineering school. Many engineers and scientists in the industrial laboratories of Pittsburgh take evening courses at "Tech." Some busy students take as long as 10 to 15 years to get a degree.

Tech, however, is not primarily a city university like "Pitt," as it draws students from many parts of the country and from foreign lands rather than almost exclusively from the Pittsburgh district.

The city was settled originally by Scotch-Irish, and their descendants, with their strong leanings toward Presbyterianism, have remained dominant elements in its life. In fact, Pittsburgh is one of the great world centers of the Presbyterian denomination, although in Allegheny County there are 1,273 churches in all, of practically every faith.

In the Triangle there are three historic churches—the First Presbyterian and Trinity Cathedral (Episcopal), which occupy adjoining sites and in whose yards are buried Indians and Revolutionary soldiers, and the near-by German Evangelical Protestant Church. The land for all three congregations was given by the heirs of William Penn.

But it is not until we reach and pass beyond the Civic Center that we really enter the

church belt, so to speak. Of all the church edifices the most notable is the East Liberty Presbyterian Church, built at a cost of nearly $4,000,000 between 1931 and 1935 by Richard B. Mellon and his wife, both of whom are buried in it.

This building occupies an entire block and is the fifth in a series of churches on the site since the congregation was organized in 1819. Except for the spire, as much of the building is underground as aboveground. There are more than 30 Sunday school rooms, and a full-time dietitian and kitchen staff of cooks is employed, with a dining room that seats 500.

Halfway between the great sanctuary and the small chapel, and close to each, is a perfectly equipped brides' room. No minor detail is omitted, including an iron and ironing board that folds into the wall. A two-way communication system between the brides' room and the organist informs the bride when to start on her procession.

Curtain Going Up! She Does Her Share Backstage

Gaye Jordan, student actress, dresses a curly wig for a production at Carnegie Institute of Technology. Tech's drama department offers training in acting, lighting, make-up, and costume and scene design. Equipment includes costumes from the collection of the late Richard Mansfield.

Pittsburgh is indeed fortunate to have the religious, educational, cultural, and recreational facilities described. In addition, there are a very active Playhouse, or community theater, a civic light opera, an arts and crafts center, and many musical and art organizations. To old-timers and newcomers alike, to rich and poor, and to those of every national origin such opportunities are available.

Where so many work with raw materials there must be esthetic values to bring balance into the lives of people. For coal mining and steelmaking do disfigure and leave much that is drab and ugly in their wake.

For a long time Pittsburgh was so busy becoming a mighty production center that it did little about smoke, dirt, and river pollution; or about traffic congestion, inadequate housing, and blight. In other words, it did little to make itself a tolerable place to live.

The Conquest of Smoke and Grime

Inherently conservative, Pittsburghers long accepted smoke and dirt as more or less inevitable. They even defended it as a sign of prosperity.

Or they repeated jokes and jibes at their own expense, such as the remark of the young man who joined the Marines so that he might see the light of day.

But this is no longer the attitude; Pitts-

A Roller Coaster? No, It's a Carnegie Tech Idea for a Better Billboard

Students of industrial design built this model of a three-dimensional roadside sign advertising Swiss watches. Here they use a scale of one inch to the foot to illustrate structural stresses within a 30-foot sign.

burgh is now determined to be a clean city as well as an industrial one. Smoke elimination has become a dramatic symbol of the whole powerful impetus toward civic improvement (page 129).

Being a city of rivers and hills, Pittsburgh will always have fogs, but there has been outstanding accomplishment in making them cleaner. Improvement is due not only to city and county ordinances but to gradual improvement in industrial and residential fuel combustion and to the fact that railroad locomotives and even river boats have largely gone over to Diesel engines.

Pittsburgh has simply had to become a cleaner city, because otherwise it could not secure and retain employees for its vast, growing industries, especially those of the college-trained, technical, engineering type, whose wives objected to dirt and smoke.

Pittsburgh has always had a great philanthropic tradition, partly because of the strong religious leanings of its early settlers. Today there are some 30 foundations and charitable trusts in the city, said to exceed in number those in any city except New York. The largest foundations are those established by the Mellon family, but the Buhl and Falk Foundations are substantial.

Andrew Carnegie gave extensively to Pittsburgh, but he and his wealthy partners, Henry C. Frick, Henry Phipps, and Charles M. Schwab, left the city. Other wealthy families, however, including the Mellons, Lockharts, Harbisons, and Hillmans, have stayed. The "elder" Mellons, Andrew W. and his brother Richard B., gave away large sums but remained in the background so far as personal contact with civic improvements was concerned.

Richard K. Mellon (page 128), R. B.'s son, "head" of the family since his father's death in 1933 and his uncle's death in 1937, is now 50 years old and follows a very different course, as does his sister, Sarah Mellon Scaife, and her husband.

Airplanes Find New Oil Sources; in Pittsburgh, Girls Mark Them on a Huge Field Chart

At Gulf Research & Development Company, these employees record findings of air-borne geological surveyors who map hundreds of miles daily in the search for petroleum (page 135). The young lady, with shoes removed to prevent marring the chart, holds an instrument representing a survey plane. Her co-workers manipulate steel tapes that indicate mileage between the plane and fixed points on the chart.

As a little boy, Dick Mellon walked along Fifth Avenue in New York City with his father and asked who lived in this and that great mansion. "But they all seem to be Pittsburgh people!" he is said to have exclaimed in wonder. His father replied in the affirmative and then added, "Live where you work, son, and work where you live."

The Mellon wealth has been described as "one of the largest working fortunes in the world." Certainly it represents the largest single family stake in many of the great industrial corporations of Pittsburgh. What Dick Mellon has done is to bring these major business interests increasingly into the support of civic ends.

In addition, in the last few years various branches of the Mellon family have made large gifts to local educational institutions, including $13,600,000 to establish a Graduate School of Public Health at Pitt, and $6,000,000 for a Graduate School of Industrial Administration at Tech.

United Action for Civic Improvement

In any case, the city appears to be developing powerful and united group action for community betterment and civic improvement. The various action organizations, whose duty it is to bring about these improvements in detail, are from time to time given blood transfusions, financial and otherwise, by the Allegheny Conference on Community Development, which is a citizens' over-all fact-finding, research, and program organization to unify the new civic spirit.

Thus far, politics appears to have been subordinated, with civic leaders and government authorities of both parties working together harmoniously.

One reason for Pittsburgh's civic spirit is the increased interest and pride which the

city has been taking in its own history, thanks to the Buhl Foundation, the University of Pittsburgh, the Historical Society of Western Pennsylvania, and other organizations.

After all, it was the youthful George Washington who fixed the location of the city by reporting to Governor Dinwiddie of Virginia that the "land in the fork"—that is, the apex of the Triangle—should be fortified. Washington had been sent to warn the French to stay away from this region, and he shared in British defeats which followed, the worst under General Braddock.

But finally on November 25, 1758, the victorious Gen. John Forbes, with Washington as one of his lieutenants, marched into the smoldering ruins of Fort Duquesne, which the French had built on the remains of a former British fort and had now abandoned.

City Named for William Pitt

Forbes wrote, "I have taken the freedom of giving your name to Fort Duquesne," thus naming the future city after England's great statesman, William Pitt. Being a Scotsman, Forbes used the "h," as in Edinburgh. Although there are some 20 Pittsburgs in the United States, there is only one Pittsburgh.

On this site the British built Fort Pitt, a very extensive fortification, the best-designed and the most important frontier fort in the West.

It was never used against the French, because Forbes's victory at Pittsburgh and finally Wolfe's at Quebec the following year ended the imperial designs of France upon the Ohio and Mississippi Valleys.

But Fort Pitt was for a long period a protection to what was perhaps the greatest natural gateway to the West. It fought off Indian attacks and was also an important western outpost during the Revolution.

By 1790 Fort Pitt was no longer needed. It fell into ruins, city streets were extended through it, private owners took up the property, and early houses in Pittsburgh were said to have been built of bricks from the fort.

Though covered up by the city for a century and a half, not all the foundations were destroyed; recent archeological excavations have disclosed extensive remains. In addition, one entire redoubt, that built by Col. Henry Bouquet, has remained intact, the reason being that it was used for many years as a dwelling, and, indeed, had another large house attached to it.

Ultimately this section of the city became a slum and later a forlorn district of railroad sidings and warehouses.

Eventually Mrs. Mary E. Schenley, one of Pittsburgh's first benefactors on the grand scale, inherited the redoubt and in 1894 gave it to the Pittsburgh Chapter of the Daughters of the American Revolution, the first chapter to apply for a charter in that organization.

Block House Reminder of Frontier

At once the attached dwelling and the tumble-down tenements which covered the ground around the redoubt were removed and the name changed from Redoubt to the Block House.

One of the great railroad systems planned to buy and raze the Block House. It was saved only by the spirit and determination of the DAR chapter, especially of one of its members, Mrs. Samuel Ammon, who spent months in Harrisburg fighting the railroad.

Today the Block House is in an isolated spot, almost hidden and surrounded by elevated railroad tracks. Yet many patriotic visitors find their way there.

It is a little building built of brick, five-sided, and with two floors. It has a squared oak log with loopholes for rifle fire on each floor.

It is a simple but authentic and vivid reminder of one of the most important and romantic chapters in colonial history, a chapter of struggles which went far in changing the fate of a continent.

The east- or west-bound motorist sees in Pittsburgh a traffic bottleneck. But this is temporary, because the Penn-Lincoln Parkway is under construction from the terminus of the great Pennsylvania Turnpike at Irwin, Pennsylvania, to the point of the Triangle. It will tunnel through the Pittsburgh hills, drop to the bank of the Monongahela, cross on a new bridge near the Point, and thus start the traveler on his way into West Virginia and Ohio.

Already the State has acquired virtually all of the land to make a 36-acre Point Park (page 130). But no one need wait for these improvements to visit the Block House, the only remaining vestige of frontier Pittsburgh.

NATIONAL GEOGRAPHIC SOCIETY

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Articles and photographs are desired. For material The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1930, 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 $35,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

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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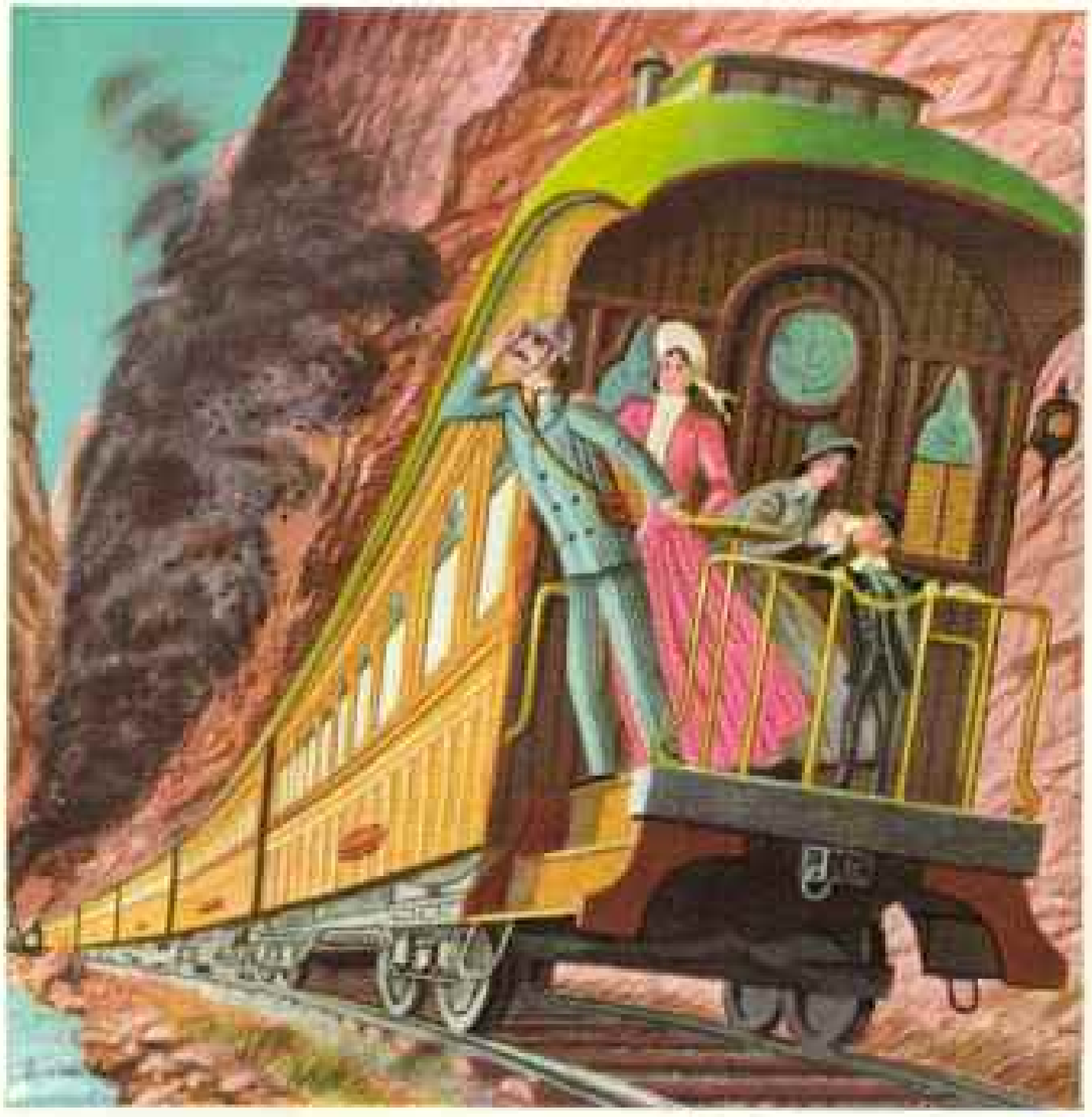

GONE are the "good old days" when a fleeting view of the glories of nature *en route* might be had through clouds of steam and smoke that streamed from the engine up ahead. All accompanied by bone-shaking jerks and jolts at stopping and starting, to say nothing of dirty hands, dirty linen and an occasional cinder in the eye.

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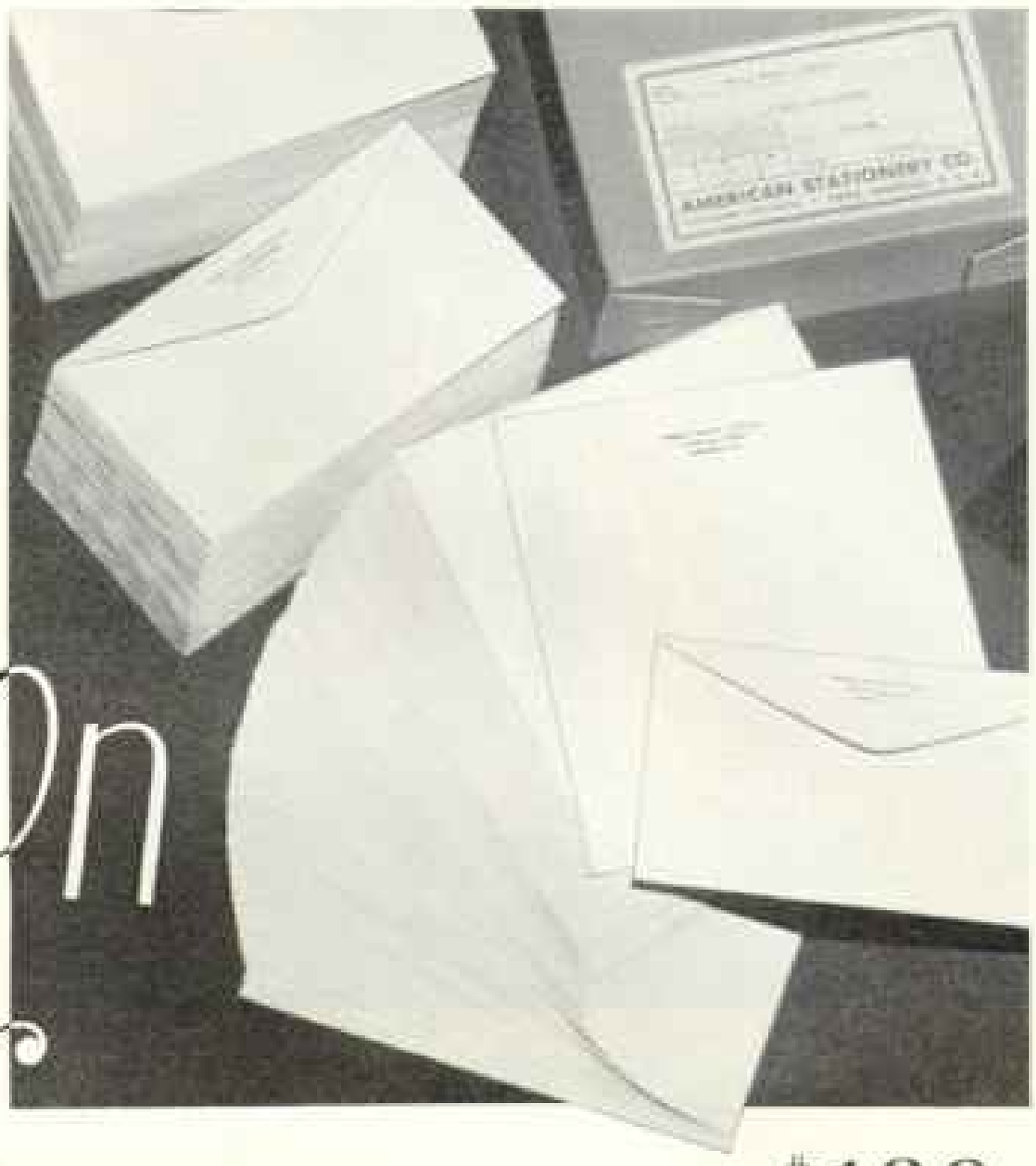

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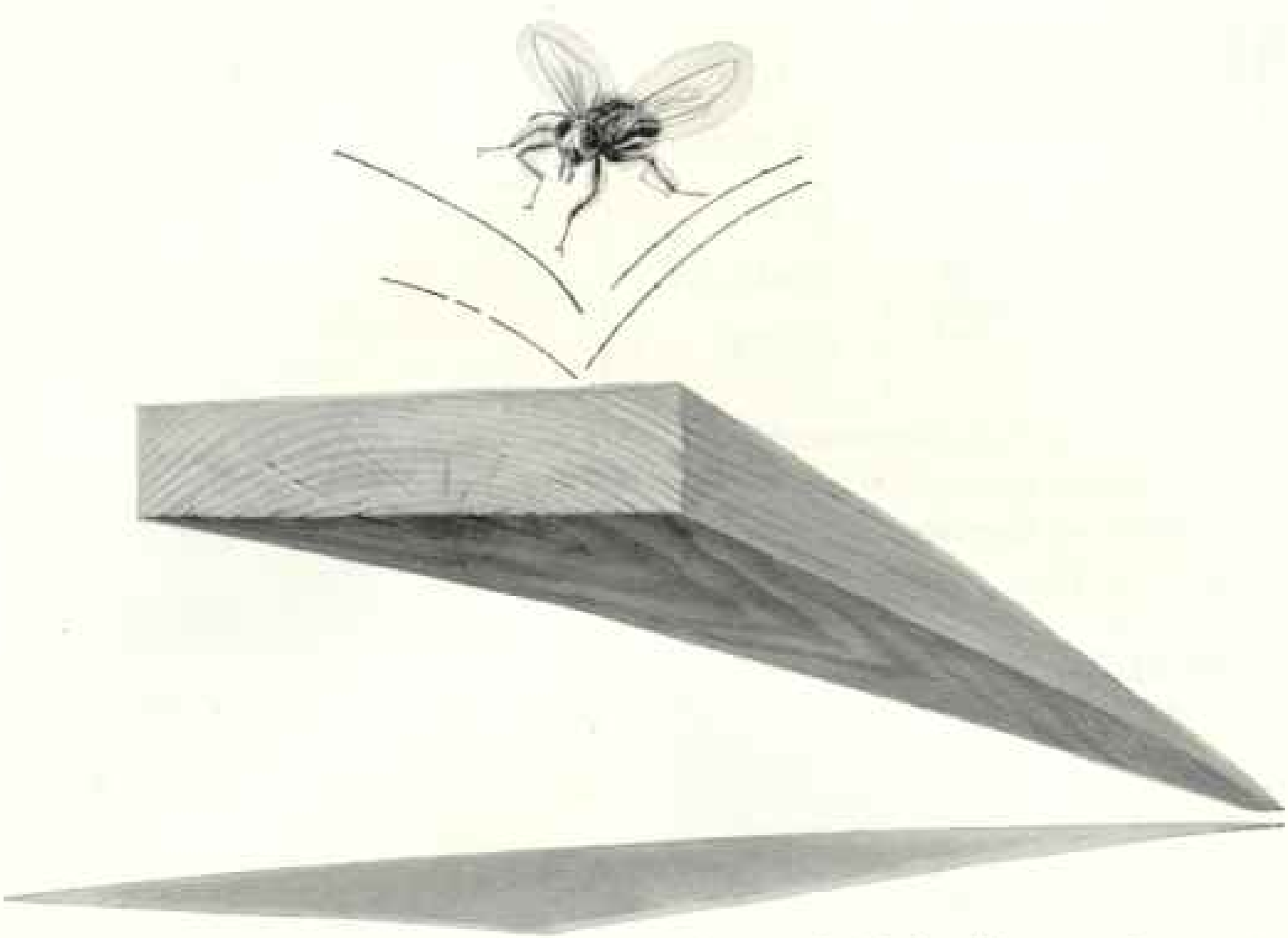

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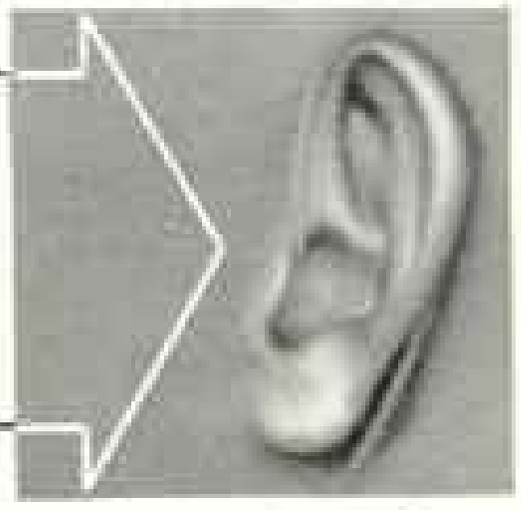

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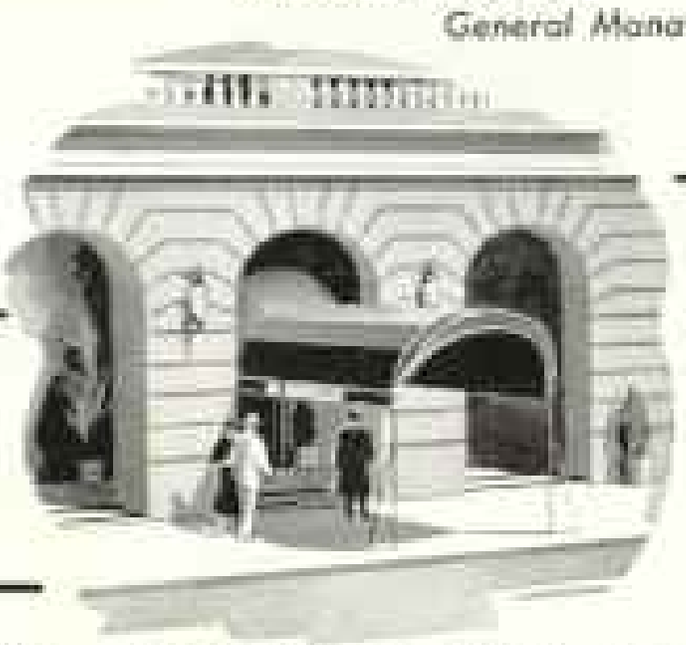

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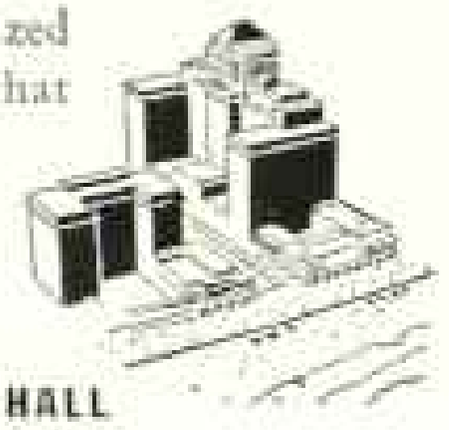

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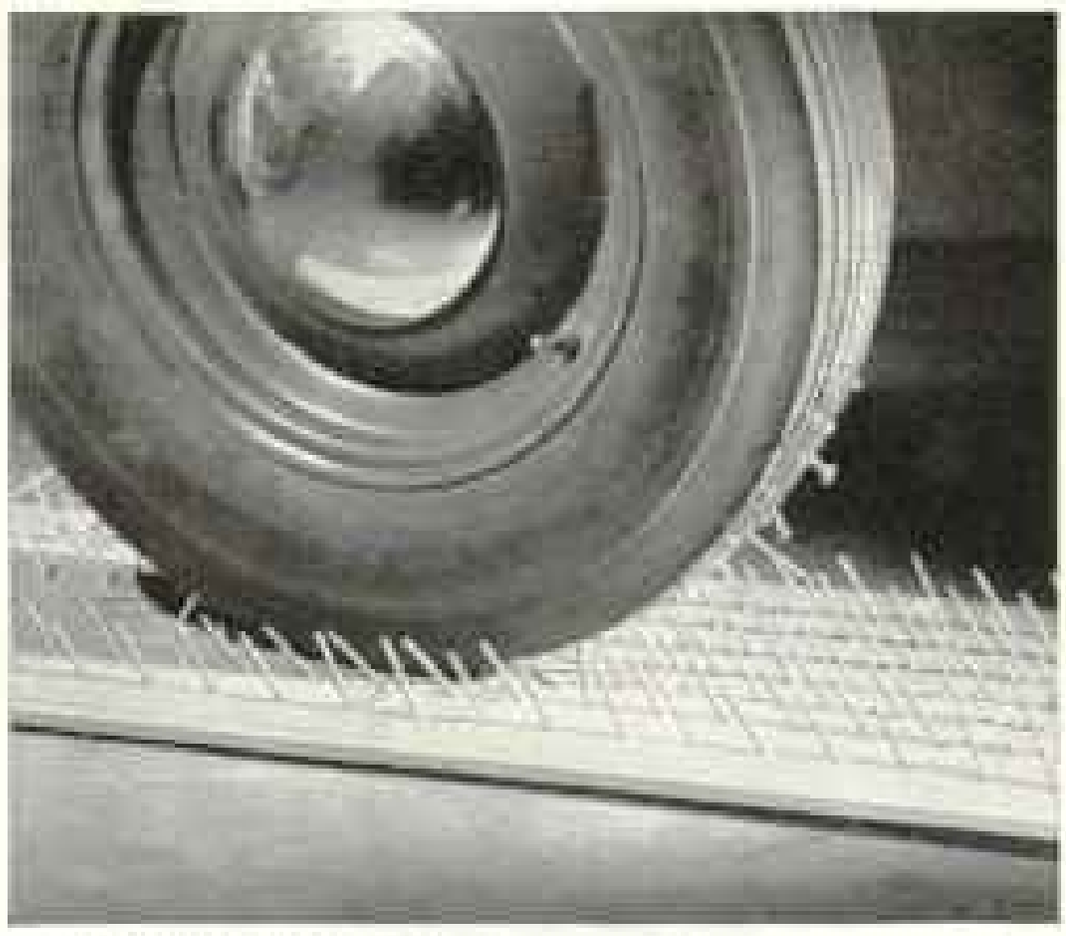

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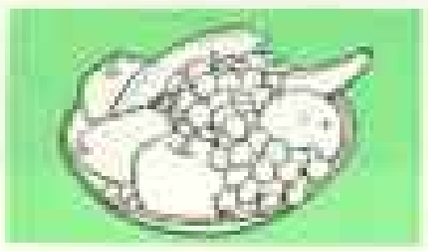
TASTY SUMMER FOODS for GOOD HEALTH

Summer or winter we require a well-balanced diet—one which includes an adequate supply of proteins, carbohydrates, vitamins and minerals. These essentials for sound nutrition may be found in three groups of foods. *Energy foods*, such as cereals and bread, butter and fats, and sweets, provide fuel for daily activities. *Building foods*, including meat, fish, eggs, and milk, help to take care of growth and repair of body tissues. *Protective foods*, like vegetables, whole grain or enriched flour, eggs, and liver, are especially rich in vitamins and minerals and help safeguard health.

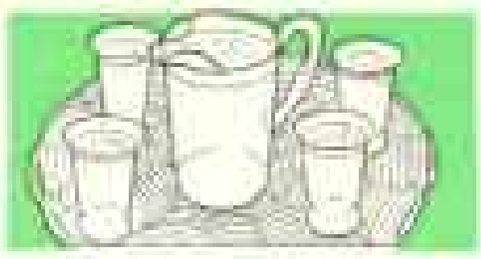
Within each group there is a wide choice of foods which permits the selection of menus suited to the season of the year. Cheese and egg dishes, for example, may be particularly inviting on hot days, while heavy, fatty meats seem more appropriate in the winter. In addition, fresh vegetables and fruits, which are more available in summer, may often be substituted for winter staples.



Digestive upsets are more likely to occur in summer than at other times of the year. A light diet of essential foods, including fruits, will be less apt to overburden the digestive system than a heavy one.

One good hot meal a day in summer is recommended by nutrition experts. During the war, U. S. Army tests in the tropics showed that it was easier for overheated men to digest hot food than cold.

Raw vegetables, served in salads, are often more nutritious than cooked, for the vitamin content of cabbage, carrots and other vegetables is higher when raw. They may also make summer meals more appetizing.



In summer the body may lose more than 1½ quarts of water a day. This liquid must be replaced, for it helps to assimilate food and regulate body temperature. So, one should drink plenty of liquids in warm weather.

Authorities say that eating the right foods in the right amounts usually brings a better level of health at all ages, and may contribute to a longer life. More facts about healthful eating may be found in Metropolitan's booklet, 79N, "Three Meals a Day." Mail the coupon for a free copy.

The fish with an electric fence

THE CHIEF HOME of the electric eel, *Electrophorus electricus*, is in the backwaters of the Amazon, where the vicious piranha and other deadly fish dwell.

So it's a lucky thing for Electrophorus that four-fifths of the length of his stubby body contains electricity-generating tissue, which enables him to send out strong discharges of five hundred volts or more many times each minute.

When a piranha, or other foe of the eel, moves in, Electrophorus builds an electric fence around himself by switching on his generators and charging the water in the vicinity with electricity. With his enemies stunned by the shock, or at least disconcerted, it's an easy matter for the eel to escape —and he doesn't even have to swim fast!

This eel's truly shocking weapon is a good example of the clever devices which nature furnishes to so many animals to help them fend off trouble. But man has improved on nature. He has found many ways to balk trouble. And he's also developed a way to keep trouble from costing him a lot of money and worry when it does strike.

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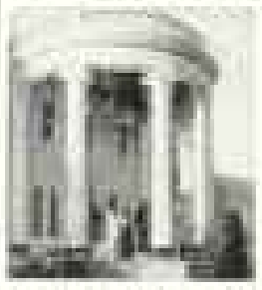

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