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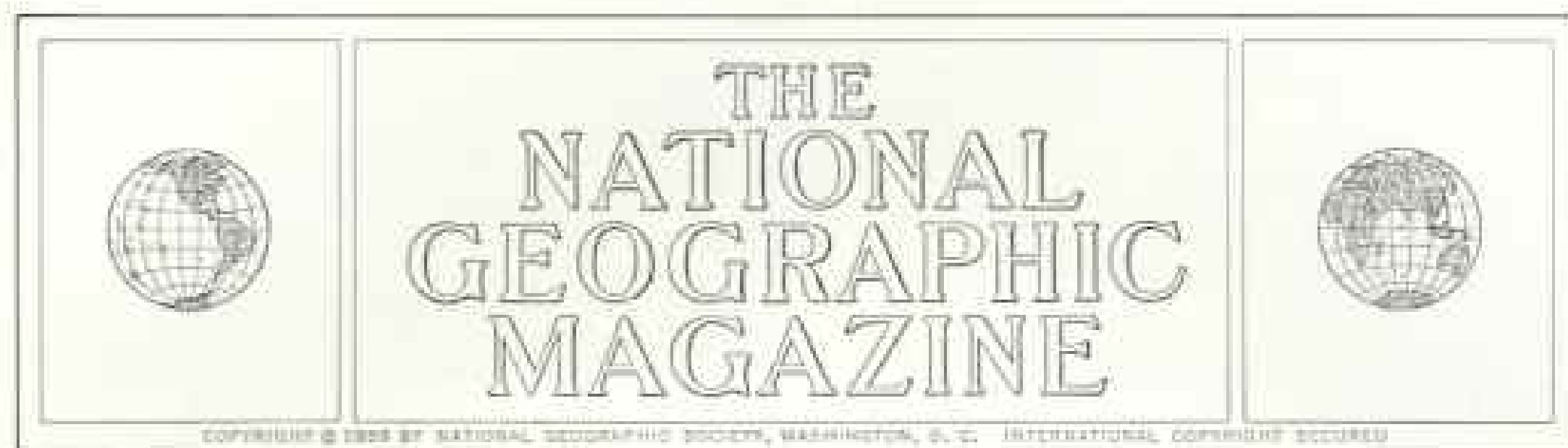
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War tore down its treasured towns and ravaged its land, but France's province of plenty springs up from the ruins.

Normandy Blossoms Anew

By HOWELL WALKER, National Geographic Foreign Editorial Staff

With photographs by the author

ANYONE WHO sees it must ask the same question: How in the world did troops under fire invade this cliff-walled shore of Normandy?

For an on-the-spot answer I turned to the American sergeant beside me; he had found out the hardest way.

We were standing at the brink of a high bluff. Just below us spread Omaha Beach, an empty tidal flat on the Channel coast of France. Here the sergeant and thousands of other Americans stormed ashore that violent D-day morning of June 6, 1944 (page 595).

I waited and waited for the sergeant to tell about the landing. Finally he said, more to himself than to me, "The cliff seemed a lot steeper the first time I saw it." Then he changed the subject.

The sergeant had not returned to refight the Normandy invasion this fresh spring morning. He had come with his wife and two small sons to lay a wreath at the modest monument the 1st Infantry Division erected near the United States cemetery that hallows the battleground of Omaha Beach.* If his family wished to see where he got his feet wet, all right, but he didn't want to talk about it. For him, that was better left as history.

Not for Normandy, though. Cities like Caen, in the wake of war, cannot easily forget the fight that left long-revered buildings and

history-filled streets nothing but tangled rubble. Neither proud Rouen nor the ghost of Saint Lô, nor any one of a hundred towns as old as Normandy itself, will ever look the same again.

The farmlands that were battlefields have naturally led Normandy back to normal. For this is a fat province of lush pastures kept fresh with dependable rain, a paradise for cows and horses, a green terrain of gentle slopes and pleasant valleys.

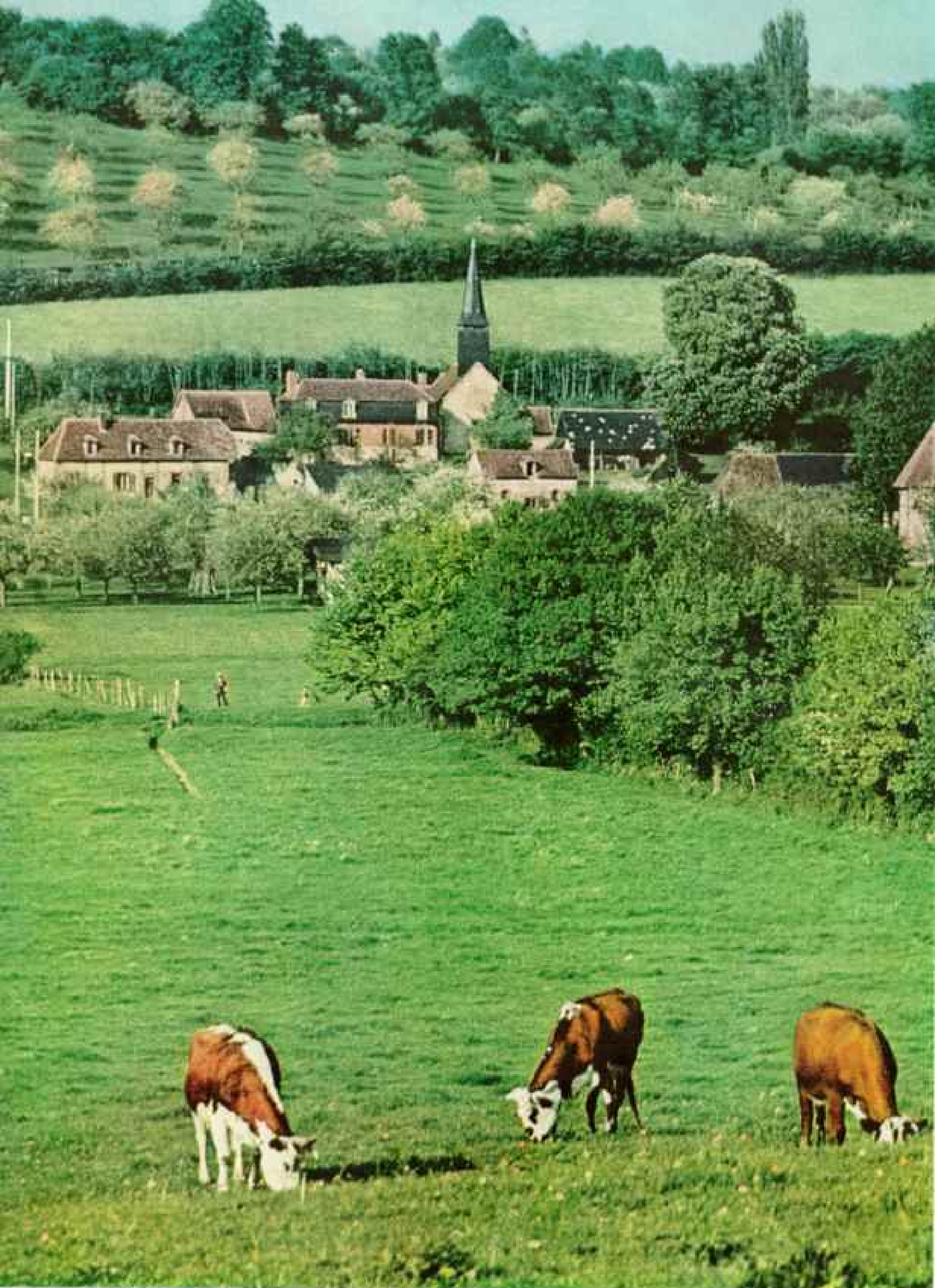
Reborn as France's Horn of Plenty

Everywhere lie patterned orchards fenced with hawthorn hedges. In the pastoral picture of France, Normandy is the horn of plenty—plenty of milk, butter, cheeses, and beef; apples, cider, and its distillate, Calvados.

Such abundance surprised Allied forces coming from lands long accustomed to rationing. Though the Normans lacked some comforts of peace, their larders never felt the pinch that tightened millions of belts around the rest of Europe.

My wife Sheila and I wanted to see what I remembered from a prewar visit as the true and timeless Normandy; so we drove straight

* See, in the NATIONAL GEOGRAPHIC: "Our War Memorials Abroad: A Faith Kept," by Gen. George C. Marshall; and "Here Rest in Honored Glory," by Howell Walker, both June, 1957.





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blossoms. Hedgerows through which armies slashed a passage divide lush pastures. Birds wing across a sky once coursed by bombers. Yes-

terday's village deathtraps are today's homes and churches. Here, near Lisieux, a farmwife milks her cows in the meadow.

into the heart of the butter-fat, cheese-making, apple-growing Pays d'Auge. This regional name, meaning "trough country," comes from the many well-watered valleys in the green, rolling center of Normandy. As Guy de Maupassant wrote, "... everywhere there were slender streams gliding by the poplars' feet and under the tenuous veils of the willows, rivulets that glittered in the grass and bathed all the land with a quickening freshness."

Our destination was the small town of Vimoutiers where, I promised my wife, she would find an old-fashioned community as honest and mellow as the finest Calvados. I also promised myself the sentimental pleasure of walking again along the narrow streets, through the cool butter market, and into the warm homes of good friends. We approached Vimoutiers filled with anticipation.

Only the Church Remained Intact

Incredulously I steered into the town and stopped at an unfamiliar market place. Could this be Vimoutiers? Across the square I saw a *Hôtel du Soleil d'Or*, but not the hotel of the same name I knew in 1939. And where was the statue of Marie Harel, honored as the inventor of Camembert cheese? It used to stand near the butter market. Where was the butter market? All the buildings appeared entirely new and strange to me.

A shopkeeper assured us we were in Vimoutiers. He said the war had destroyed everything except the church. I thought I recognized its twin spires (page 614).

Could he tell me of my friends, the family of Dr. Jean Boullard, for example? Yes, they still lived in the same place, though bombs had mutilated it. And bombs had beheaded Marie Harel's statue, now standing among other debris on the edge of town.

We found the Boullard home repaired, but the once-lovely garden resembled a plowed field. I knocked at the front door and waited.

Madame Boullard remembered me. She invited us into her living room, apologizing that her husband was busy with a patient. To me

the room seemed much as I had remembered it over the years. Madame Boullard told how neighbors had rushed tables, chairs, pictures, and carpets from the house during one fiery air raid. When safe to do so, they brought it all back intact.

Save for graying hair and a not unattractive sadness about the eyes, Madame Boullard had changed little since we last sat together in this room. She was one of the reassuring features of my return to Normandy.

"But Vimoutiers," I said, "it's now so different, so *triste*. Why, I expected...."

"Not at all," Madame Boullard interrupted hastily. "If you had returned a few years earlier, you would then have had reason to complain. But now, *regardez*. This is the year of our renaissance. We're proud of our new town."

Dr. Boullard entered, looking like the genial country physician he is. We began to reminisce.

"Remember the day I tried to drive those stubborn ducks into a picture you wanted to make at the Ribard farm?" he asked.

I had long forgotten the occasion, but not the Ribards, and inquired about them.

"Much the same," he said. "Had lunch with them yesterday. You wouldn't recognize the twins, though."

Geographic Preserves Prewar Scenes

He reached for a well-worn copy of the February, 1940, NATIONAL GEOGRAPHIC, and opened to a color photograph of 10-year-old twins (page 616). Two of Dr. Boullard's own daughters appeared in a companion picture.

"Now there's something the bombs missed," he said, referring to the children and to the Magazine.

Later, Dr. Boullard's mother walked with us through Vimoutiers' church, which the bombs only slightly damaged. She had been in this building during an air raid. When the planes had passed, she opened the big door and faced a crackling hell of flames, smoke, dust—all that was left of the town.

But that was in 1944. Now Madame

An American Soldier Shows His Family Where He Landed on D-day

On June 6, 1944, the Allies launched history's mightiest amphibious assault. Here, in the American Memorial near Omaha Beach, a map fashioned of stone shows the embattled shore. Before dawn three airborne divisions dropped behind the beaches; at daybreak thousands of troops poured in from the sea. Arrows at lower left show British and Canadian landings; two at right point to American targets. Inland, Britons and Canadians later pinned down the Germans entrenched at Caen (left), allowing the Yanks to sweep around the right.

THE LANDINGS ON THE NORMANDY BEACHES & THE DEVELOPMENT OF THE BEACHHEAD



Château Gaillard, Grim Seine-side Ruin, Recalls Scenes of Heroism and Horror

Richard Coeur de Lion reared the fortress in 1196 to protect the southern approaches to his Anglo-Norman fiefs. Set atop sheer rock, the castle seemed impregnable. For months in 1204 its English garrison resisted a French siege. Finally a few enemy soldiers slipped into an unguarded window and lowered the drawbridge. After fierce hand-to-hand fighting, the castle fell. Thereafter it served often as a prison. One inmate, Queen Margaret of Burgundy, died of strangulation ordered by her husband Louis X.

Behind the chateau the town of Les Andelys faces lush pastures on the river's far bank.

Boullard proudly pointed to new windows in the church, and I saw that one of them was given by the Pilot Club of Chicago, Illinois.

"You know," she said, "the Americans helped to destroy our town, but their generosity helped to rebuild it."

Sheila and I took a picnic lunch to the valley hamlet of Les Champeaux, a few miles from Vimoutiers. On a grassy hill in the sun we ate bread baked that morning and a round of Camembert at its creamy best.

Below us a church spire rose above a comfortable clutch of half-timbered houses. Around us tumbled the loveliest part of the Pays d'Auge. The air was softly fragrant and pleasantly warm for Normandy. A bell rang out at noon, mingling its music with school children's laughter. Bees hummed over the food before us. Cuckoos called from trees feathery with young leaves. War had not changed Les Champeaux.

Normandy a Land of Varied Skills

Normandy is not a geographical entity. Men and history, not nature, have fixed its boundaries. It occupies an area about the size of Maryland and Delaware combined, lying between Brittany and Picardy. The English Channel washes its coast from Mont St. Michel in the extreme southwest to Le Tréport at the extreme northeast (map, page 600).

Normandy is not merely a land of cows, apple trees, farmers, and lawyers. In Alençon, for instance, I looked at locally made lace so exquisite and delicate that, according to a museum guide, it has to be protected from moonlight. I wove through the textile town of Elbeuf, photographed the hand-worked copperware of Villedieu les Poêles, and marveled at the magic potters' wheels of Noron la Poterie and ropemaking in St. Côme de Fresné.



At Fécamp I visited an elaborate distillery bottling for all the world the famed liqueur called Benedictine because it was originally concocted of humble herbs by a Benedictine monk in 1510; talked with fishermen at such salty little ports as Honfleur and Port en Bessin; and spent a morning in the stud stables of Le Haras du Pin to learn about Norman horses, particularly the powerful Percherons that pull the plows of France.

We toured the whole province from the edge of Picardy's plains to the Brittany border.



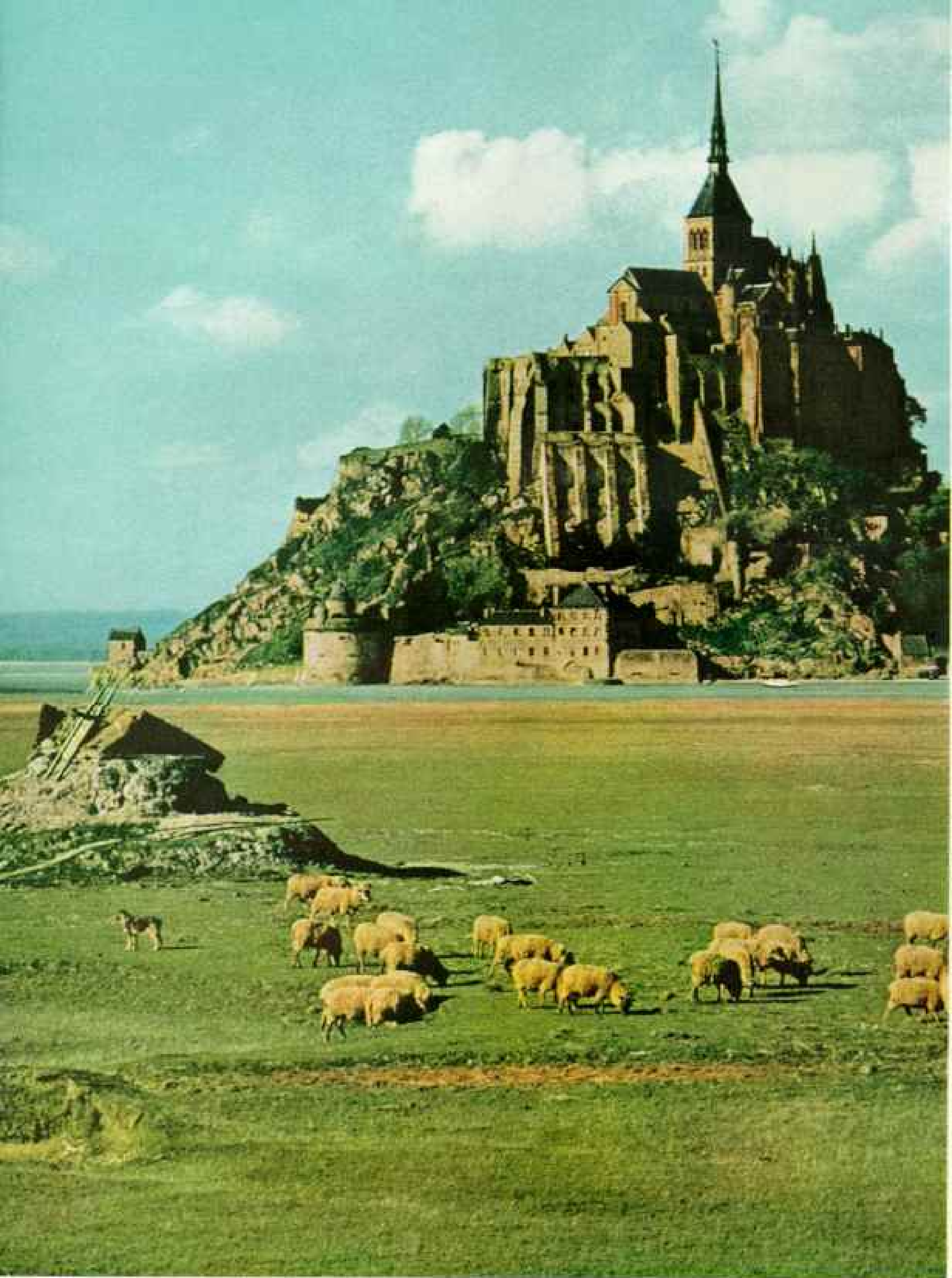
Everything we saw delighted us: the high two-wheeled, horse-drawn carts carrying whole families to church or market; pink-checked nuns gathering spring herbs in a convent garden; housewives scrubbing clothes in chilly rivulets; children playing games with imaginary toys; nonchalant mongrels lying in sunny village streets or waiting outside butcher shops brightened by bowls of camellias, tulips, or lilacs.

If we had charted our haphazard travels, they would have crisscrossed like the strings

of a cat's cradle. A more systematic itinerary seemed unnecessary and much less fun. When we stopped for our habitual midday picnic, I studied the map like a carefree man trying to make up his mind where to spend the best possible vacation.

One day we sat beside a stream that flows past Le Brévedent, just another of Normandy's numerous little hidden villages. We lunched on anchovies, olives, bread, cheese, and the good red wine of Bordeaux. Sunlight played

(Continued on page 663)



Sun-gilded Mont St. Michel Springs
out of the Sea Like a Fairy-tale Castle

Legend says ancient Druid priests made bloody
sacrifice on the pinnacle. A vision of St. Michael
inspired the first Christian chapel. In the 11th

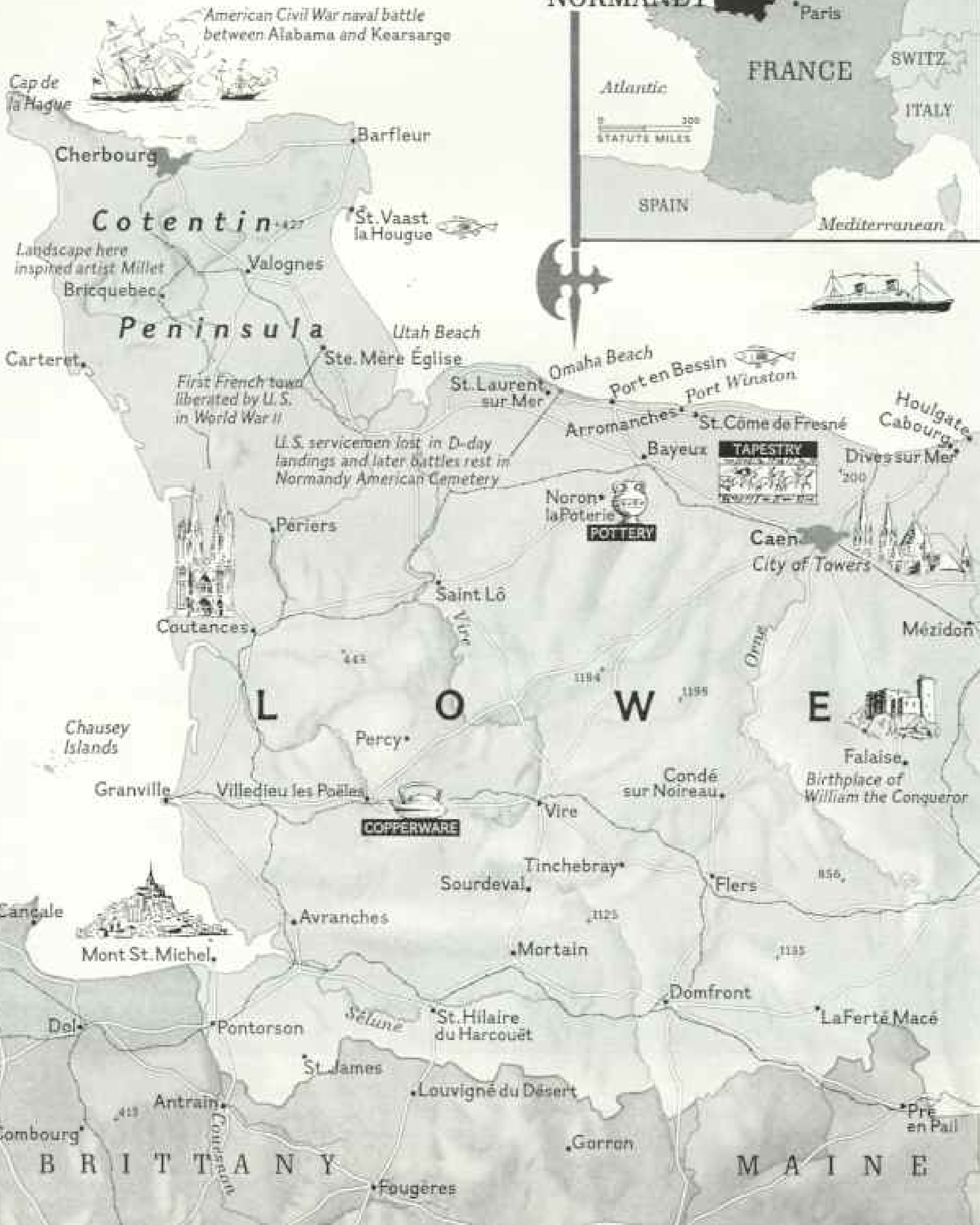


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century Benedictine monks laid the stones of their summit-crowning abbey, a "gigantic granite jewel... as light in its effect as a bit of lace,"

to quote Guy de Maupassant. Here sheep graze salt grasses, a diet that seasons their flesh. Quicksands and tides surround the mount.

NORMANDY



FRANCE'S PROVINCE OF PLENTY



PICARDY

U P P E R

ÎLE DE FRANCE

P E R C H E

A Benedictine monk in 1510 first distilled the liqueur that took the name of his order

Joan of Arc burned at stake, 1431

Le Haras du Pin, famous stud farm for Percherons

LACE

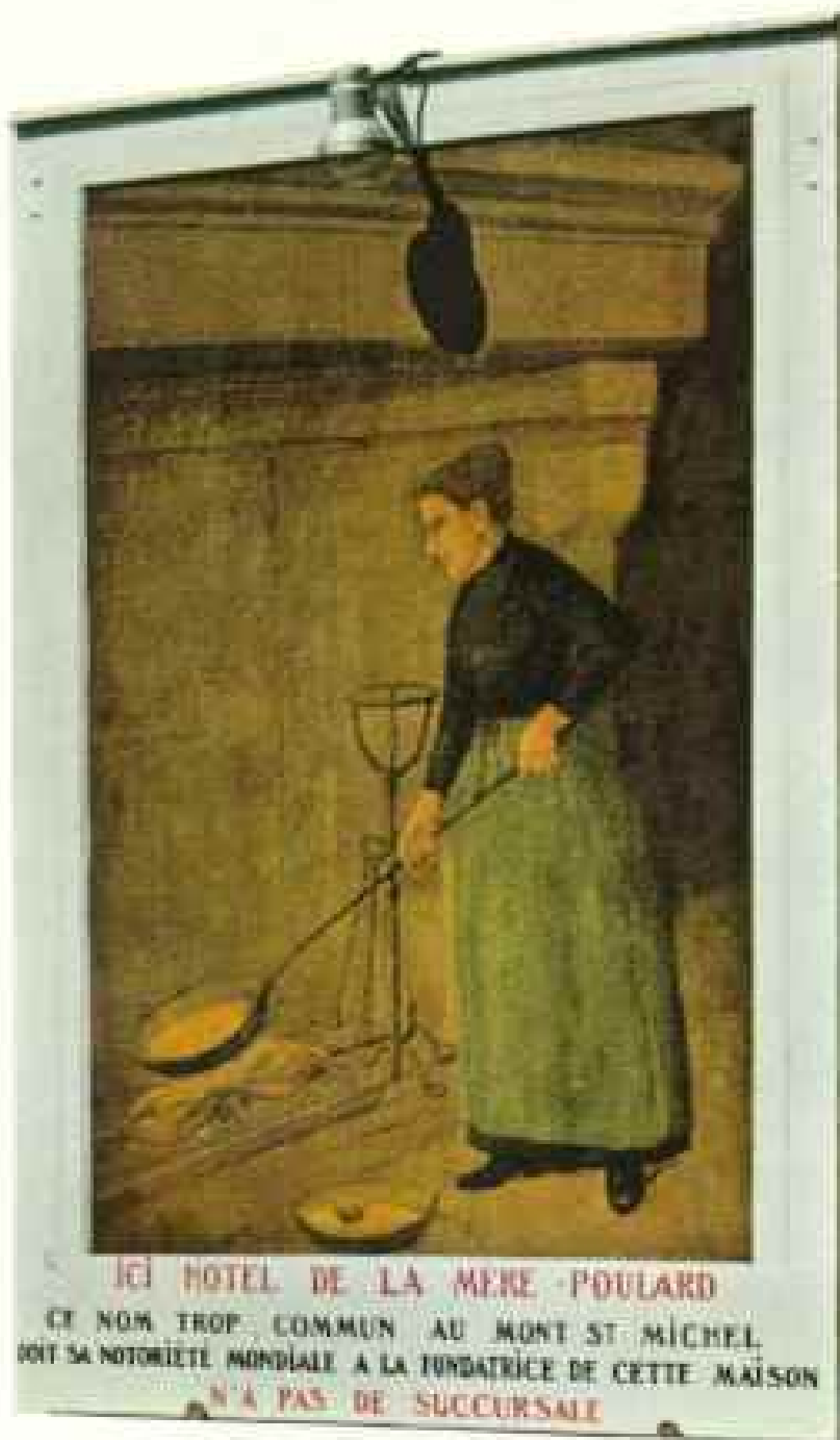
STATUTE MILES

Elevations are in feet

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A Golden Fluff of Eggs and Butter Slips to a Platter at Mont St. Michel

Late in the 19th century Madame Poulard began making omelets in a hotel on the rock. Soon the fame of her concoction swept the world. What was her secret? Anna Bowman Dodd in her book *In and Out of Three Normandy Inns* wrote:

"The head-cook was beating the eggs in a great yellow bowl. Madame had already taken her stand at the yawning Louis XV fireplace; she was beginning, gently, to balance the huge *causerole* over the glowing logs. And all the pilgrims were standing about, watching the process... the pan was kept gently turning and the eggs were poured in at just the right moment. . . .

"Behold, the eggs were now cooked to a turn; the long-handled pan was being lifted with the effortless skill of long practice, the omelette was rolled out at just the right instant of consistency . . . melting, juicy, golden, luscious, and above all *hot!*" Today La Mère Poulard is gone, but her culinary masterpiece is continually re-created at the inn bearing her name and picture.

on the primrose bank; then clouds swirled across the unpredictable Norman sky, leaving us in cool shadow. Through trees not yet fully in leaf, I could see an old stone church too out of the way for a guidebook.

On the grass I spread a detailed Michelin map. For me every route shown, main or unpaved, led to adventure; it did not matter which I followed. City or hamlet, orchard or pasture, it was all Normandy, however varied. And the faintly pink-and-white apple blossoms would look as lovely here as there.

Something—maybe sentiment—drew us to the region south of Vimoutiers. We jolted over an obscure road into a small farming settlement not on the map, but locally known as Malvoue. At one of the few houses we met gentle Madame Touraine, who let us ramble through her flowering apple orchard. Cows under the trees lifted their heads to look at us, then returned to their grazing.

Norman cows, by the way, are different. Square and sturdy, these brown-and-white animals appear to wear thick-rimmed spectacles. The cattle provide generous quantities of beef and milk. They pasture outside all year.

From the milk of Norman cows come wonderful butter and still more wonderful cheese. Besides Camembert, other cheeses have brought renown to the region. Livarot and Pont l'Évêque were both born in or near those towns of the Pays d'Auge. Our picnic lunches always included one, and we never tired of them.

Though cider is the drink of grapeless Normandy, Bordeaux or Burgundy better complements such rich cheese. When thirsty, however, you can't beat a cool draught of the apple straight from a Norman cask.

Time Out for a Cider Break

Near Madame Touraine's house in Malvoue stood the brick home of farmer Duhamel. He invited us to come in for the customary mid-morning break, which rural French folk observe with a little food and drink. We followed him to the kitchen, the most lived-in room of an average Norman dwelling, and met Madame Duhamel and a small son. They pulled chairs up to an oval table spread with a long loaf of freshly baked bread, Camembert, and a carafe of cider.

Norman Farm Folk Bend to Their Toil in Millet's "The Gleaners"

The original painting by this native son of Normandy hangs in the Louvre at Paris (page 617).

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ARCHIVAL PHOTOGRAPHS—PARIS





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Fingers and Bobbins Fly at Bayeux's Lace School

In centuries past the exquisite silk and Chantilly-type laces of Bayeux have dressed queens and enriched palaces. To ensure the future of lacemaking arts, the town supports the school.

Mme. Charlotte Friteau supervises as her pupils manipulate thread-wrapped bobbins across a pattern pricked on cardboard or parchment. After lines from each pair of bobbins twist and cross in the required way, pins go down to hold the design in place. A proficient student can make an inch-long strip in two hours.

Youngest member of the school, six-year-old Martine sees her lace strip grow. To attain the necessary skill, she must work hard until graduation at 16.



Stacked flax spikes a field at St. Samson la Poterie. Workers turn the hollow cones inside out so that all the stalks get sunlight needed for drying.



Thinking the scene would make a good picture, I asked if I might photograph the family gathering. Madame Duhamel pointed out that she was not exactly dressed for the camera.

"All the better," I said. "It will be more natural to have you in everyday dress."

"*Alors,*" said Monsieur Duhamel. "If you want us to be natural, I must be reading my paper."

He picked up the local journal and fished in his pocket for his spectacles. Grasping the paper with one hand, he let the other feel over the table for the cider carafe. He had gone through these motions so often, day after day, that he did not have to look at what he was doing. With consummate skill he filled his glass, all the while keeping his eyes glued to the front-page story he read aloud (opposite).

Madame Prefers an Apple

Madame Duhamel ate no bread and cheese. Instead, she carefully peeled an apple.

"Much better for the *foie* [liver]," she explained, holding up the fruit.

At eleven o'clock I realized that I was detaining the family from its usual schedule. Duhamel had work to do. His wife must start dinner. And the boy, though on school vacation, would have such chores as shifting the cows to another part of the pasture.

Normandy consists of two main areas: upper and lower. The first includes the broad Seine Valley and the region to the north; the second lies to the south and west. In keeping with that age-old law of maximum perversity, upper Normandy—as altitudes go—is lower than lower Normandy.

When we traveled into upper Normandy, we felt as if we had entered quite another province. It was the difference between cheese and chalk. Wind-whipped fields in extensive sweeps replaced intimate little valleys in hill-wrinkled districts; bluebell-carpeted beech forests, unlike any we had seen elsewhere, dwarfed the groves to the south.

Both areas, however, show the effects of

World War II. Upper Normandy's capital city of Rouen, for instance, received a terrible blasting. As an industrial center and strategic seaport 75 winding miles up the Seine but only 40 by air, Rouen offered a fat target for heavy bombers. The cathedral dating from 1201, the late-Gothic palace of justice, museum buildings, and time-tilted, half-timbered dwellings, as well as the river bridges, felt the devastation of aerial warfare. All in all, nothing so tragic had happened at Rouen since Joan of Arc was burned at the stake in the old market place.

Today ocean-going vessels under diverse flags crowd quays flanked by railways and rebuilt industries: textile mills, tanneries, foundries, briquette factories, and oil refineries. We saw ships abuilding, ships refitting, ships in the stream. From one of the yet unfinished steel bridges we watched the endless fleets of barges bound for Paris or Le Havre.

In the ruptured heart of the city the cathedral rang with the reassuring noises of stone-cutters, carpenters, and ironmongers putting it together again (page 619). Miraculously, the richly chiseled west façade with the flamboyant tower that Norman butter built escaped serious damage; money for this "Tour de Beurre" came from the sale of Lenten indulgences to butter-lovers of long ago.

Clock Marks Time for 400 Years

Sheila and I strolled about Rouen where some medieval houses, like precious reliquaries, nestle amid much new construction. Passing under the great 16th-century clock, Le Gros Horloge, that bridges one of the principal streets, we stepped back through the centuries (page 621). We saw the hoary tower where Joan of Arc appeared before her judges, and we came to her statue in the market place. Hard by, the celebrated dramatist and poet Corneille was born.

Then there was La Salle, a Rouennais, who explored the Mississippi River and claimed Louisiana for France. Seeing the house, now

(Continued on page 615)

Normandy's Specialties Refresh a Farm Family at a Midmorning Snack

Madame Duhamel peels a home-grown apple; her husband pours home-brewed cider; their son munches bread spread with Camembert, a creamy cheese named for a near-by village. One tradition says that Marie Harel invented the cheese with the help of a priest whom she harbored in the French Revolution. A more probable story credits her with bringing the cheese to notice by presenting a sample to Emperor Napoleon III.

Dark and fair, Normandy's daughters reflect a heritage from Latin and Nordic peoples.







An Endless Parade of Barges Sweeps the Seine, Main Street of Normandy

Navigable from sea to capital and beyond, the river ranks today as the nation's chief route of trade. Along its banks villages grow to towns and towns to cities; Medieval churches, ruined castles, and imposing chateaux bespeak history; new factories, improved docks, and well-tended farms signal prosperity. Here, at Poses, sylvan islands divide the stream.



Le Havre Rises New Born out of the Rubble of War

At fighting's end sunken ships clogged the harbor, and tangled steel and concrete covered the dock area. Only a flattened wasteland marked the business and civic center. In this view from Fort de Ste. Adresse, new towers of the City Hall (left) and St. Joseph's Church (right) overlook modern buildings.



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Beauty with a smile welcomes the author to Orbec. Such festival encounters taught him the truth of a French writer's words: "The costume of the Norman women is varied to the infinite, but all... have the... science of *coquetterie*." This young greeter's bonnet retains the horn of the medieval style. The handmade lace flowing from its apex would once have revealed the wearer's skill and prosperity.

Dancers await their cue before the Town Hall. Men copy the fashion of the early 1800's; their partners wear caps of organdy and straw,

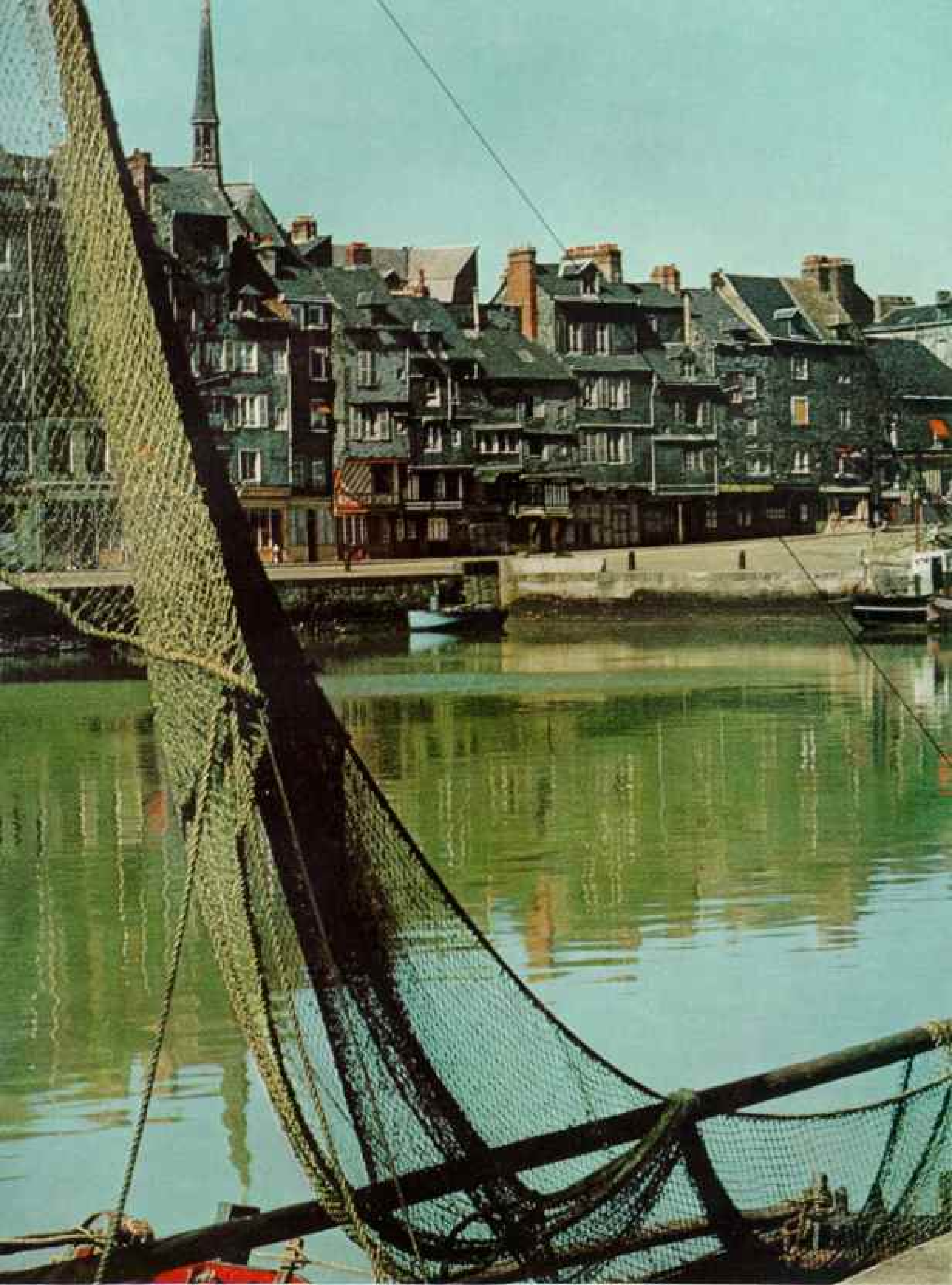
Skirts and Coattails Fly as Dancers in Orbec Romp Through a Country Round

To commemorate Canada's part in the liberation of Normandy, Orbec gave a two-day party during apple-blossom time. The festival got under way with an automobile competition in which drivers tested their skills over a difficult course. Later a procession wound its way across town to the Church of Notre Dame, where a special Mass was said. A service at Orbec's World War II memorial honored Canadian soldiers who fought and died in and around the town.

These Canadian guests and citizens of Orbec watch the folk dancing that climaxed the fete. The honorary Duchess of Normandy, in regional dress, presides from a ringside seat (third from left).







Old World Charm Pervades Honfleur;
Jump-off Port of New World Explorers

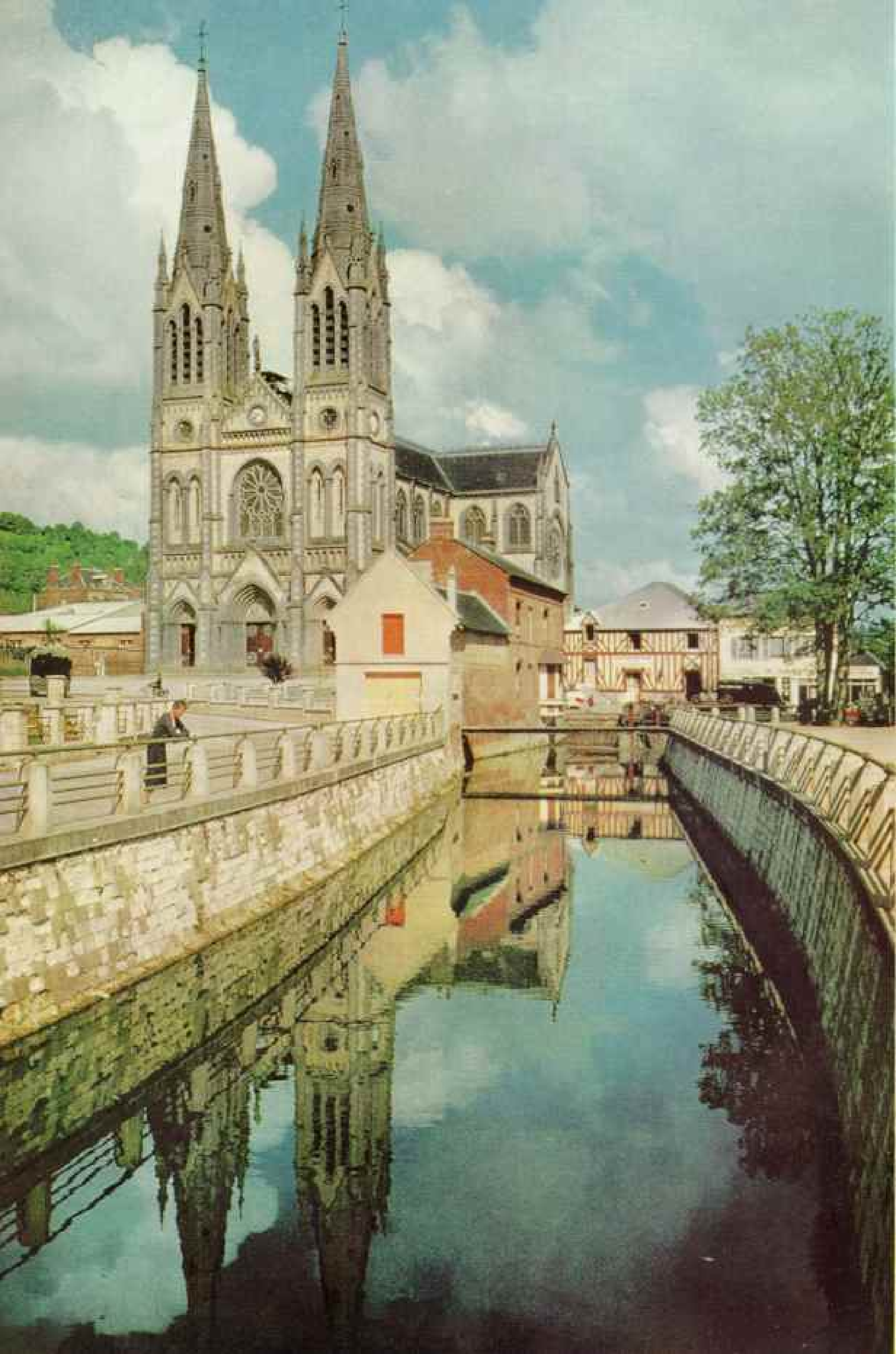
Sailing for Canada, Champlain bade farewell to the same tall, slate-shingled homes and castlelike Lieutenance (center right) where the king's



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representative lived. Although eclipsed by Le Havre, the little port still trades in Scandinavian timber. It escaped World War II bombs but not

the undercover fight. "I was with the Maquis," white-bearded François Rouly (right) told the author, and pulled out a knife to prove it.



a museum, where novelist Gustave Flaubert was born reminded me to read his *Madame Bovary*, whose fictional setting was modeled on near-by Ry.

Normandy began with Rouen in the 9th and 10th centuries when piratical Northmen (hence Normans) from Scandinavia sailed their beaked barks up the Seine. They liked the setting and climate of the old Roman river camp. So Rollo, the Norse chieftain, made Rouen the seat of his duchy in 911. From him descended France's Norman dukes and Crusaders, and, through William the Conqueror, English kings.

England Conquered by Norman Duke

Normandy originated at a time when France was becoming a loose collection of feudal principalities. By the 11th century the Norsemen had firmly established their province as a powerful duchy. In fact, in 1066 Duke William of Normandy was strong enough to cross the Channel and conquer England.

For the next 138 years Normandy remained for the most part united with the English crown, under Norman kings and their descendants. But in 1204 King John, the great-great-grandson of the Conqueror, lost Normandy to the French forces of King Philip Augustus. Thus tumultuous Normandy became reunited with the rest of France, except for a brief period in the Hundred Years' War, which ended in 1453. From then on the province lived in relative peace, until World War II wrought its widespread destruction.

It left us heartsick to find only traces of early Normandy in its towns of old: Saint Lô seemed no more than an epitaph; at best, Coutances kept its cathedral; Vire all but disappeared. Mortain rose from ghostly war ruins, gray, granitic, and grim; and Avranches was largely a memory.

Though not nearly so picturesque as before, urban Normandy rises anew along eminently practical lines. The automobile has dictated wider streets and the allocation of large areas to what the French call "parkings."

Whatever else time and wars have done to Normandy, Mont-St. Michel remains today its abiding symbol and invincible monument (page 598). There it stands like an island pyramid. Forest surrounded this rocky out-

crop when Jesus was a child, legend says, but a rising of the sea drowned the trees and inundated the hinterland. It left the rock in dramatic isolation among the terrible swift tides that sweep the coast where Normandy and Brittany come together.

The Couesnon River, forming the boundary between these two provinces, debouches just west of the mount. Thus, by fluvial chance, geography gives one of earth's wonders to Normandy. Envious, if not indignant, Bretons therefore say:

*Le Couesnon dans sa folie
A mis le Mont en Normandie.
(The Couesnon in its folly
Has put the Mount in Normandy.)*

To which the Normans justly reply:

*Si bonne n'était la Normandie
Saint-Michel n'y serait mis.
(Were Normandy not with goodness graced
St. Michael would not here be placed.)*

Since recorded time the mount has been beset in turn by Druids, Romans, Celts, and Norsemen; anchorites, Christian monks, dukes, knights, pilgrims, and kings; warriors, artists, and everyday tourists. By some extraordinary favor of fate, Mont St. Michel came through World War II unscathed.

Fairy Castle Hovers Seven Miles Away

It all started with a saintly dream. In 708 Bishop Aubert of Avranches had a vision. The Archangel Michael appeared and commanded him to build a chapel on the rock. The bishop did.

Aubert experienced this vision where many a traveler catches his first breath-taking glimpse of Mont St. Michel. For if you go, as we did, to the gardens on Avranches' heights, you can see the airy isle seven hazy miles away. It may hover as a mirage above shimmering desert; or, looking like some fairy castle, suddenly emerge from nowhere to float upon the boundless bay. At a distance the mount can only be described as fantastic.

Yet, once you are down on the mile-long causeway linking the rock and mainland, fantasy turns to granite fact. Mont St. Michel looms larger, bolder, more marvelous; it dominates the sea, the sand, even the sky. You

Spires and Transept at Vimoutiers Shimmer in the Vie River

When battle smoke cleared in the town, the Gothic-style church alone remained in place.



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17 Years and a War Separate Two Pictures of the Ribard Twins

On a 1939 survey of Normandy, the author visited the 16th-century manor of La Cauvinière, near Orbec, and photographed the owner's two sons as altar boys. Returning in 1956, Mr. Walker found Navier and Guy grown to manhood. Here they stand against the same brick-tile and half-timbered wall, holding a copy of their picture in the February, 1940, NATIONAL GEOGRAPHIC.

The twins' "pink" coats reveal their hobby: riding and jumping in horse shows.

feel, on drawing nearer, that you have seen at last a dream come true—as true and tangible as the mount's rocky foundation.

We left our car at the base of the lofty ramparts and walked through the only entrance. Under the musty walls we followed our noses to La Mère Poulard, a restaurant renowned for its omelet.

There are two marvels of the mount: how medieval Benedictines could possibly have built the abbey on the summit; and how eggs and butter cooked over an open wood fire make the best omelet on earth.

Eggs, Butter, and Kitchen Magic

You can stand right there in the Poulard kitchen while the whole brown-and-yellow bundle is born before your eyes (page 602). First, a youth at a deep copper bowl whips the eggs so rhythmically you want to jig. Next, a girl offers him a long-handled skillet sizzling with melted butter into which he pours the golden mass. She returns to the chimneyplace, holding the pan over a low fire. You watch her every slightest flick, seeking to spot a subtle clue; but it all seems so elementary until—*voilà!* Your omelet, it is ready.

Swept along in the usual flood of visitors, we moved up Mont St. Michel's Grande Rue, the one and only street. It squeezed and twisted between centuries-old souvenir shops banked with trivial knickknackery. We passed hotel porters and restaurant waitresses pleading the pleasures of their palaces. Then steps, steep steps, still more steps—662 in all.

Our reward was the crowning glory of the pinnacle: an architectural miracle of time and space.* The abbey appears to grow from the rock as naturally as a tree on a hill. Its slender spire dwindles into the sword of St. Michael, whose winged statue soars 500 feet above the tidal flat.

To build the abbey, monks brought granite from the outlying Chausey Islands across voracious quicksands and through fearsome tides. They lifted the blocks by brute force to the top of the rock and put them in place by hand. Moreover, they chose to lay a foundation on the summit's narrow ridge—something like constructing a chapel upon the peak of the Washington Monument.

Sheila and I looked dizzily down upon the antlike activity at the base of the mount. Fast-traveling clouds gave us the feeling of flying over a world of sand and sea.

We rambled through the abbey, learning

that one night in 1103 as monks filed out from prayers the north side of the nave collapsed in a thunderous avalanche. The solidity of the present wall comforted us. But suddenly a roar began to reverberate with increasing intensity among the Norman arches.

Our minds flashed back eight centuries. What we heard, though, was no echo of history. A rapid glance at each other, and we dashed for the nearest door. Outside we looked into the distended nostrils of two jet fighters. The planes zoomed so close it seemed possible to hit one with our guidebook.

Driving away from the mount, I could not resist the urge to gaze back and back again at the acute accent it made on the flat expanse of sand and sea. We had to stop for a last long look. Then I felt that Normandy's marvel, in any phase of sun or moon, rivals India's Taj Mahal by moonlight or Egypt's pyramids at sunset.

Medieval Church Surveys a Postwar Town

The saving grace of heavily bombed Normandy is that many of its churches survived. The Cathedral of Coutances, for example, came through the war with all buttresses flying, and as prickly as ever with pinnacles. Yet, from its central tower we looked down upon a postwar town.

North of Coutances the Cotentin Peninsula thrusts a stubby finger into the English Channel. Sandy beaches sweep much of the western shore, but near Cap de la Hague the coast becomes a rocky waste pounded by ever-restless waves. Sea winds lash this austere corner with grim persistence. Here few others than fishermen, coast-guard crew, and a lighthouse family dare to live in an isolated stony huddle. After the gently congenial aspect of the rest of the province, gaunt, gnarled, gray La Hague seems the end of the world.

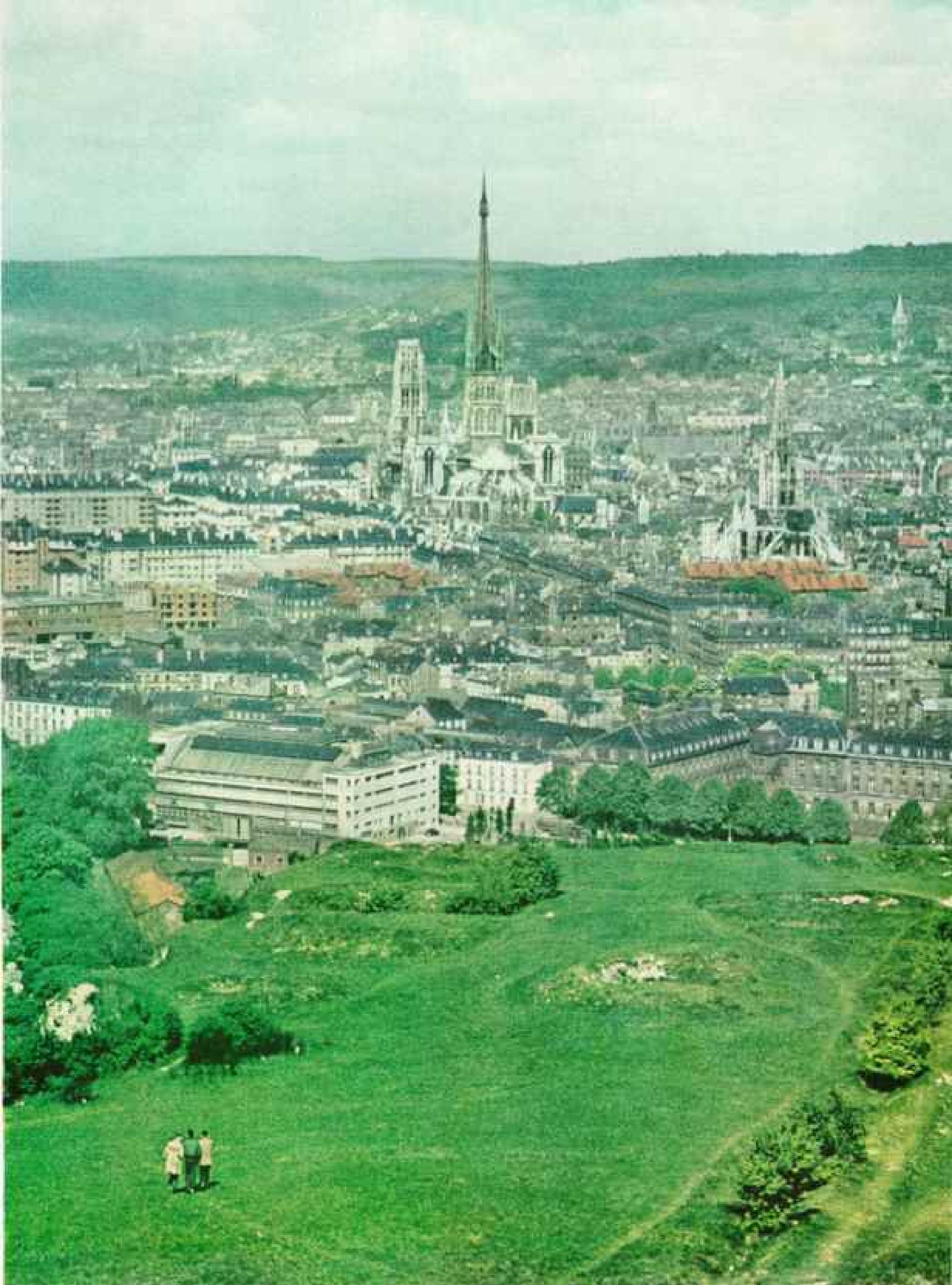
The rural landscape and farming folk of his native Cotentin inspired peasant-born Jean François Millet. In the humblest thatched homes I have seen copies of the paintings that reflect so faithfully Millet's feeling for French soil and the toil-bent souls close to it. Besides the well-known "Angelus," this farmer-artist painted "Man with the Hoe," "The Sower," "The Gleaners" (page 603), "Harvesters Resting," and other earthy vignettes. Millet laid down his hoe for the brush, receiving his first art lessons in Cherbourg.

* See "Mont St. Michel," 22 illustrations in duplicate, NATIONAL GEOGRAPHIC, May, 1936.



***Ships of the World Sail the Seine
to Rouen, Capital of Normandy***

Though modern buildings streak the city's medieval face and industries spray out to the suburbs, the heart of Rouen still fits Guy de Maupassant's description: "Down yonder lies Rouen... with



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its blue roofs massing under pointed Gothic towers... dominated by the spire of the cathedral, full of bells which sound through the blue air on fine mornings, sending their sweet and dis-

tant iron clang to me...". Here in 1431 smoke billowed from the market place where Joan of Arc, tied to a stake, met death by fire. France now reveres her as a patron saint.

We found postwar Cherbourg solidly back on both feet and newly shod. From a hotel so recently completed our guidebook didn't list it, we looked along a waterfront of rebuilt quays. Cranes and waiting boat trains noisily told that the port was in business again. And the *Queen Mary*, majestic Cunarder, announced her arrival with a roar that split the dawn wide open.

French Cheered a Civil War Battle

Countless Americans traveling to and from France have used the Paris-Cherbourg railway. But how many know that on June 19, 1864, a special "train of pleasure" from Paris brought 1,500 persons who watched a Civil War naval battle? The *Alabama* and the *Kearsarge* clashed off Cherbourg within sight of enthusiastic thousands. The hills around the harbor formed a natural grandstand.

Though supposedly neutral, most of the French cheered for the Confederate raider. Alas! In vain. The armored Yankee sank the Southerner, and vanquished Capt. Raphael Semmes threw his sword into the sea. Reluctantly, local authorities allowed the *Kearsarge* to refit in the "neutral" port.

Our road wound inland through Ste. Mère Église, the first town in France liberated by Americans. Several miles away U. S. amphibious forces, led by such officers as Brig. Gen. Theodore Roosevelt, Jr., stormed onto Utah Beach.

The war left medieval Bayeux alone to its quiet religious routine, entirely undamaged. For this unsuspected exemption (the town lies only five miles from the invasion beaches) the residents could thank a quick-thinking monk. He bicycled forth in his Benedictine habit to advise the Allies that only a token enemy force remained in Bayeux. British troops immediately advanced on the town. The Germans fled without fighting. Faith had spared one of our favorite places in Normandy.

We liked the tranquillity of the gray little town. We liked its sounds. The cathedral chimes tried all day and night to make a melody, but never quite did. Yet these "sweet bells jangled, out of tune" were never harsh.

Their unfinished music tempted us to linger in Bayeux until some odd resolve might let them ring true.

With honest street noises of pick and shovel this community of Gaulish origin was installing drains beneath time-worn cobbles. Laborers, up to their necks in ditches, uncovered traces of earlier civilization: shards of pottery they carefully laid aside. Now and then a thirsty workman paused to swig cider from a modern jug cooling in the upturned earth of the past.

To the past Bayeux belongs and apparently would like to cling. In the past it gently lives under the gray cathedral partly built by a half brother of William the Conqueror. It persists in teaching its children such handicrafts as lacemaking (page 604). And close to its heart the town keeps that remarkable "tapestry" some believe the work of William's wife Matilda, aided by her ladies in waiting.

Whoever the author of this late 11th-century masterpiece, the Bayeux Tapestry remains one of the prime documents of the Norman conquest of England. The tapestry—really an embroidery of colored wool on a linen band 20 inches wide—extends 231 amazing feet around the walls of a gallery built for it. The coherent succession of exquisite detail depicts better than any other known medieval work of art the warfare, ships, and male costumes of the epoch.

History Unreels Like Color Film

Look at it as a giant strip of color film and see the logical sequence of history unfold. Latin titles above more than 70 lively scenes explain the action, but anyone can follow the graphic course of events.

The epic begins probably in 1064 when England's Edward the Confessor sends his brother-in-law Harold on an unspecified mission to France across the Channel. It ends with Harold's death and the defeat of the English at the Battle of Hastings in 1066.

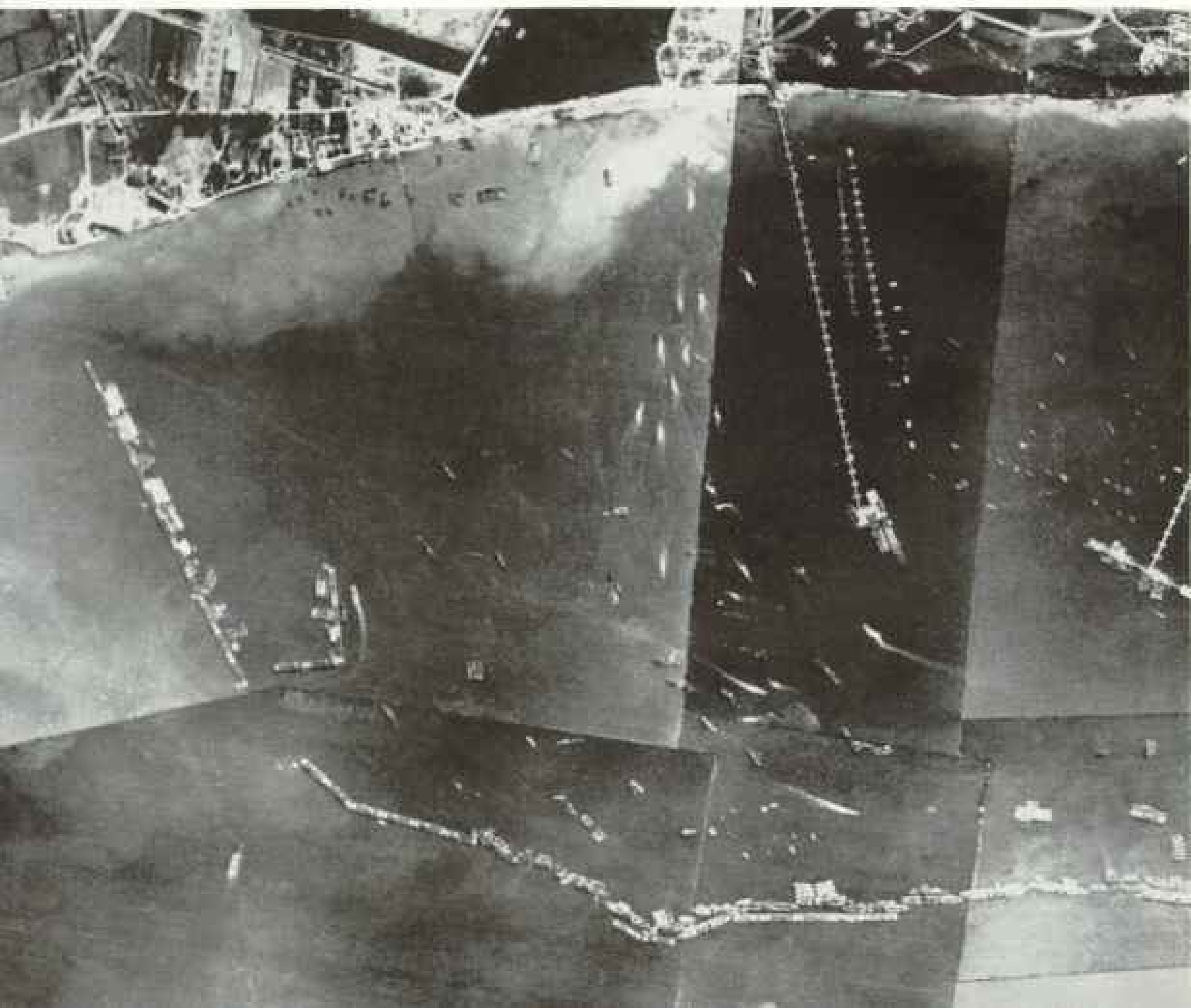
Between these dates appear significant incidents preceding, and resulting from, William's determination to gain the English throne in conflict with Harold's ambitions.

One sees steeds bounding in the quick-

Rouen's Great Clock Ticks Off the March of Centuries

Joan of Arc passed near by moments before her execution; a Gothic tower adjoining the clock stood witness to her last journey. Built in 1527, the Renaissance-style Gros Horloge moves an hour hand only. The spire atop Rouen's 15th-century cathedral rises at the end of this narrow street, which rarely sees an automobile.







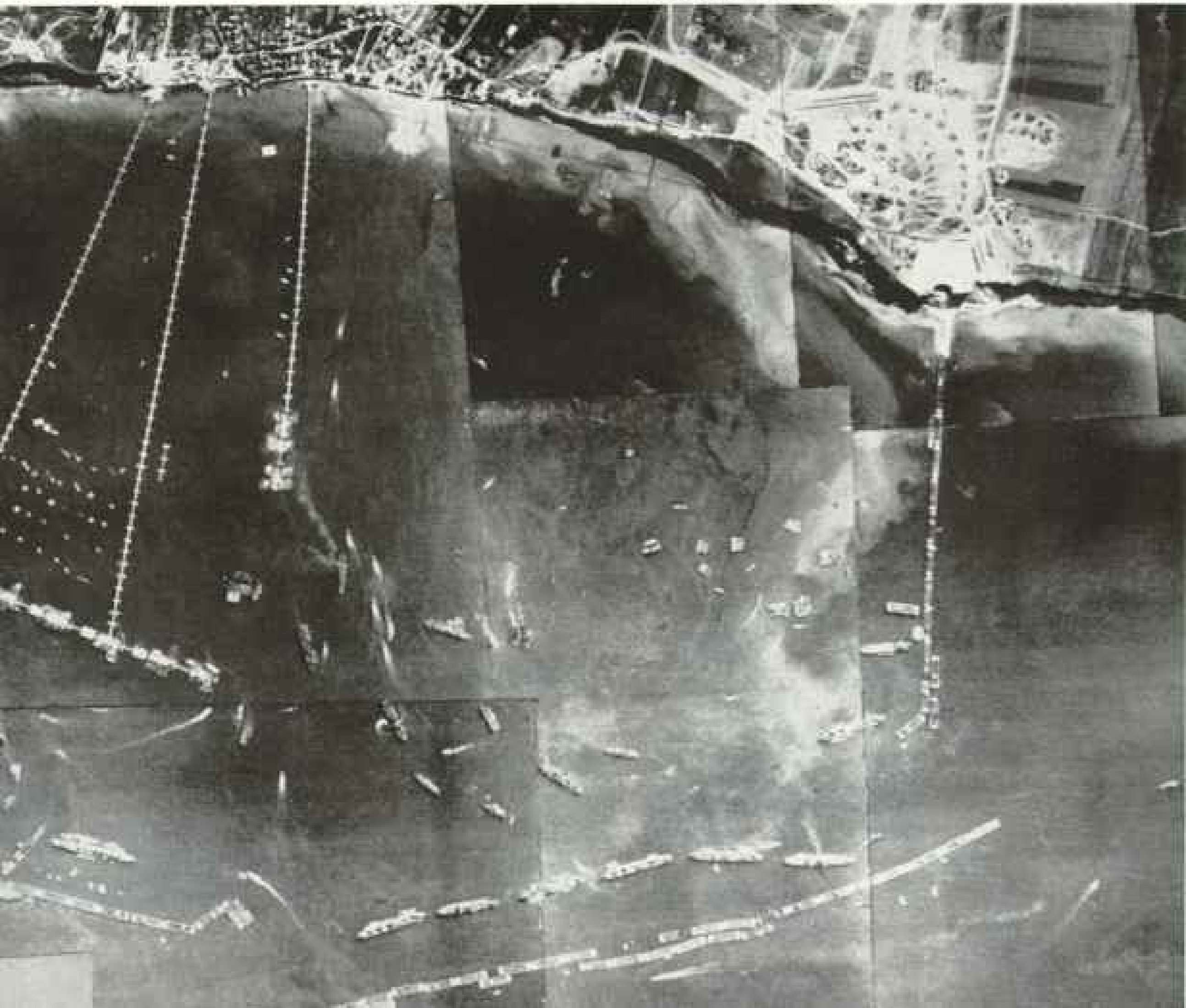
An Invasion Armada Rings Omaha Beach; LST's Disgorge Trucks and Supplies

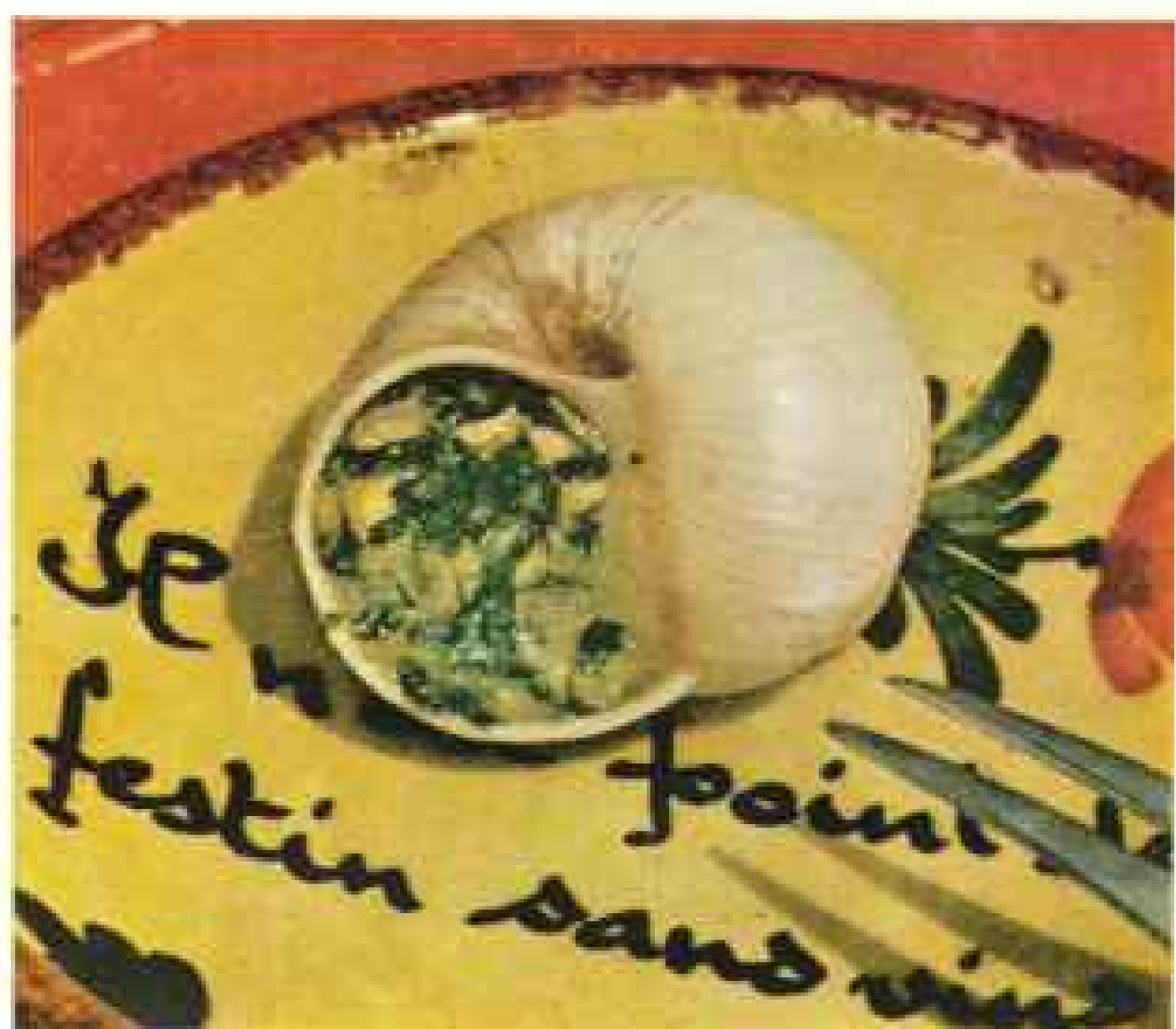
"June 1944 saw the highest winds and roughest seas experienced in the English Channel in June for 20 years," wrote Supreme Commander Eisenhower. After continued delays, a brief respite in the weather was forecast, and the Channel crossing was launched. On D-day Allied troops crawled through barbed wire and land mines. Fire from German artillery pinned them to the beach through long hours. Here, several days later, barrage balloons fly above supply ships.

British Mulberry turns Gold Beach into the busiest port in France. Prefabricated secretly in England and towed to Normandy in sections, the portable harbor opened the door to Fortress Europe. This mosaic of aerial photographs shows the breakwater of concrete caissons and scuttled ships shielding an area a mile wide and three miles long. Floating piers and causeways rising and falling with the tides funnel traffic into Arromanches. A storm wrecked a similar Mulberry (a code name) for Americans at Omaha (above).

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sands near Mont St. Michel; feasts, councils, and intrigues; Harold's alleged oath over sacred relics to support Duke William; his return to England and meeting with King Edward; Harold's coronation after Edward's death; then the exciting and vengeful invasion of Britain by William, his impressive fleet heavy with horses, soldiers, and—true to French character—casks of wine.

Time Turns the Tide of Invasion

Nine centuries later another history-making invasion fleet sailed the other way, from England to Normandy. This time it brought Britons, Canadians, and their American cousins, together with French and Polish divisions, to liberate France.

At the small summer resort of Arromanches, near the principal British and Canadian beachheads, Sheila and I marveled at what remained of the Mulberry. This 24,000-foot-long breakwater of concrete caissons and sunken ships formed a broken ellipse extending a mile offshore. Once it sheltered steel pontoons serving as jetty heads, linked with the land by floating causeways. Across these piers rising and falling with the tides, men, vehicles, and all the stuff of war rolled to the battlefields of Normandy (pages 622-3).

As an English officer said of the Normandy coast, "If we can't capture a port, we must take one with us." Accordingly, in May, 1942, Winston Churchill sent a directive to his generals, regarding "Piers For Use On Beaches: They must float up and down with the tide. The anchor problem *must* be mastered. . . . Let me have the best solution worked out. Don't argue the matter. The difficulties will argue for themselves. WC."

The bulk of the artificial port, prefabricated in England, was tediously towed in sections across the Channel and set in place under the guns of the enemy.* During the first critical months following the invasion, the Mulberry transformed a little fishing village into the most important seaport in the world. The French gratefully renamed Arromanches' harbor Port Winston.

As we drove through the peaceful farm-

ing country behind Arromanches, we could scarcely believe that war had passed this way. Then suddenly we were at the gates of Caen, capital of lower Normandy and an industrial port nine miles up the Orne River.

World War II wiped out three-fourths of Caen, taking the lives of at least 2,000 Caennais. But the survivors are replacing their churches, homes, university, and industries. From age-old quarries they cut the white stone of which Caen, and even English cathedrals like Canterbury, were constructed.

A castle begun by William the Conqueror, a dozen or more churches, and one of France's earliest universities long ago earned for Caen the titles "City of Towers," "City of Wisdom," and "Athens of Normandy." For Madame de Sévigné, 17th-century lady of letters, it was "the source of all our most beautiful intellects."

At the head of her list must have stood poet François de Malherbe. He, despite his noxious name—Evilweed in English—did more than anyone else to purify the French language. In fact, on his deathbed he awoke from a coma to reprove his nurse for using bad grammar.

Sounds of Rebuilding Ring Loud

We rolled into the basement garage of a hotel fairly named Moderne. Our room looked out on a battered square where men were clearing debris left by bombs and shells. On every side the clamor of reconstruction hammered away, until reset church bells sounded vespers.

While twilight settled over Caen, Sheila and I explored its streets. Dog-tired laborers pushed past in a bicycle cavalcade; pedestrians hurried homeward or to their favorite cafes; shops shut up for the night; and the stillness of evening came to Caen as it comes to most French provincial towns.

In the quiet of spring's dilatory dusk we stopped before the shell of a bombed-out church. Among the stone lace of its crumbling

* See "Normandy's Made-in-England Harbors," 16 illustrations with full legends, NATIONAL GEOGRAPHIC, May, 1945.

An Innkeeper's Wife Converts Snails into a Gourmet's Delight

Preparation of this dish, known since Roman times, consumes half a day. Dug out of the ground in winter, a snail is first washed several times, then boiled, and parted from its shell (lower left). Thereafter the cooked meat returns to a cleaned shell along with a dressing of butter, garlic paste, chopped shallots, and parsley (upper). Finally, a hot oven makes it ready for the fork (lower right).



Dieppe Walls a Haven for Ships Crossing the English Channel

A port since Roman times, Dieppe has survived frequent attacks. In August, 1942, heroic Canadians and Britons raided the German-fortified city. Though repulsed with heavy losses, the assault proved valuable as a rehearsal for D-day.

Dieppe fishmonger sells *langoustines* (left), shrimp, snails, spider crabs, scallops, squid, and mussels.

Janet hauls youngsters along Dieppe's waterfront. The resort became fashionable in the early 1800's when the Duchess of Berry introduced sea bathing, scandalizing society and alarming the medical profession.



Gothic windows a bird sang with all its heart. For me this singing in the ruins epitomized the spirit of Caen.

When but a village, Caen became the favorite residence of William of Normandy. Today the Conqueror pervades the city as inexorably as he altered the course of Norman and English history. He fortified the place and, with his wife Matilda, founded its two most notable churches. They are the Abbaye aux Hommes and the Abbaye aux Dames, both still in use.

Abbeys Restore Conqueror to Grace

These two abbeys resulted from the Conqueror's desire to regain religious grace. Because he married his cousin, the Church excommunicated the ducal couple. So, before they could be readmitted to the Church, each erected an abbey as an act of penance: his for men, hers for women.

Nearly 900 years later thousands of Caennais used the Abbaye aux Hommes as an air raid shelter, trusting the Allies to spare this historic link with Britain. They did not misplace their faith; they and their beloved building survived.

Although the 15th-century university disappeared in World War II, academic Caen replaced it with another. Metallurgic Caen has gone back to work with new blast furnaces and foundries. Civic Caen has laid out boulevards and parks, cleaned up the canal, and refurbished the quays of its resurgent port.

Eastward along the embattled shore we again crossed the inescapable wake of William the Conqueror, this time at Dives sur Mer, a geographical misnomer since the Middle Ages. Long ago the sea abandoned Dives to a landlocked fate not unlike that of Bruges in Belgium.* But here, while it was still a port, the Conqueror assembled his fleet, 50,000 men-at-arms and 200,000 varlets, and embarked to invade England.

Cabourg, Houlgate, Villers, Deauville, and Trouville color the Côte Fleurie, the Flowery Coast, like seasonal blooms. Through these holiday beach towns sweep tides of weekend-ing Parisians. The resorts have little in common with the real Normandy.

No doubt about Honfleur's Norman pedigree, though (page 612). The half-timbered hotel on the market square stands close to a 500-year-old church, with twin naves built entirely of wood by local shipwrights. In fact, the ceiling appears as two upturned hulls, its rafters bent like vessels' ribs, its ridgepieces the keels.

Our first morning in Honfleur I did not leave my bed with the usual deliberation; I sprang up like one stung. The church's detached belfry, directly opposite our window, boomed unmercifully at 7 a.m.; we could even hear the ropes chafing wooden beams.

The young sunlight exaggerated shadows of persons in the street and set the old cobbles in irregular relief. I saw a priest on the way to devotions; a housewife in carpet slippers, sweeping her sidewalk; a boy with a big loaf of bread strapped to the back of his bicycle; an aged woman under a black shawl, shuffling along with a milk pail. Fishermen in wooden shoes clopped down to the waterfront.

Honfleur Sent French Tide to Canada

Honfleur has always loved the sea by which it gains fame and a salty living. From this fishing port in 1603 Samuel de Champlain sailed on a mission to explore the vast unknown territory called Canada. He made several voyages, carrying pioneers to the New World, and in 1608 founded Quebec. Thus Honfleur began the emigration that put some of Normandy in North America.

Soldiers accompanied the farming, trapping, and fishing families to the strange, savage land. According to a state decree, those of the colonial guard who wished to marry must do so in Canada. Fair enough, except not girls enough. So France sent out shiploads of female volunteers.

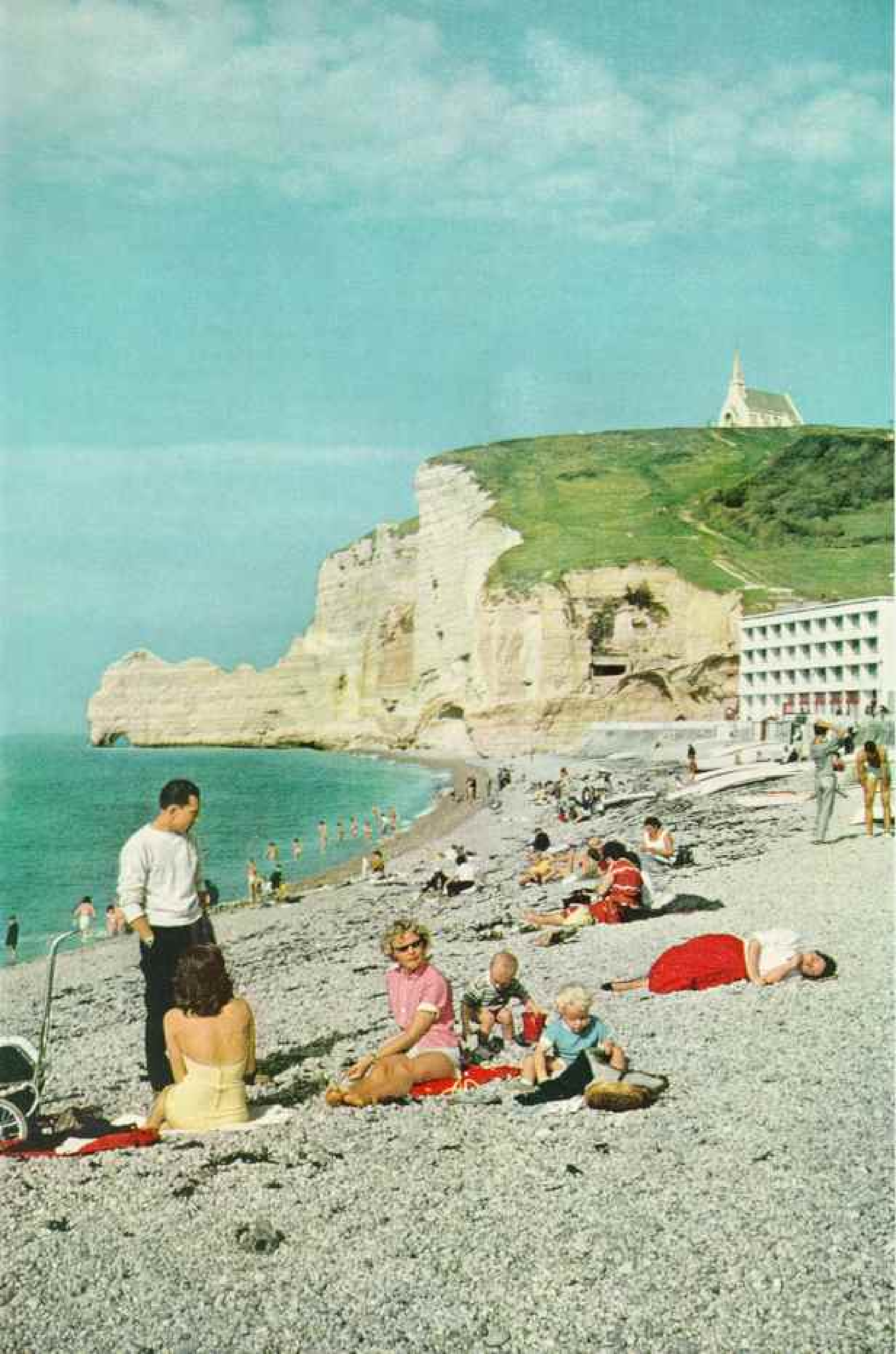
The story goes that when hardy troopers, rarely known to quail in the face of the Iroquois, saw these matrimonial recruits, they recoiled in fright. Heroism had its limits!

At one point Jean Baptiste Colbert, a sympathetic minister for the French colonies, appealed to the Archbishop of Rouen, to whose

* See "Bruges, the City the Sea Forgot," by Luis Marden, NATIONAL GEOGRAPHIC, May, 1955.

Sun and Sea Bathers at Étretat Bask in the Lee of Lofty Chalk Walls

A seafarers' chapel, Notre Dame de la Garde crowns the 300-foot Cliff of Amont. German soldiers destroyed a near-by monument to aviators Nungesser and Coli, lost in 1927 on the first attempt at nonstop flight from France to the United States.



diocese Canada belonged. Would he please send over some pretty village maidens, *really* pretty? Yes, indeed. In fact, the generous celibate delivered far more lovely ladies of Normandy than the soldiers could monogamously marry. *Vive l'archevêque de Rouen!*

Roughly midway between Honfleur and Rouen we stopped in Caudebec en Caux where, if one is lucky, he may see the famous tidal bore roar up the Seine. Together with other upper Normandy market towns, picturesque old Caudebec suffered terrible destruction in the war. But, as in the more fortunate, its church was spared serious damage.

Fishing Ports Sigh for Past

Even harder hit than inland towns of upper Normandy were coastal communities between Le Havre and Le Tréport. The majority have rebuilt and continue to live as valuable fishing ports and commercial harbors. Still, in a few we sensed a postwar melancholy which seemed to sigh: "Ah yes, we have repaired the damage, but we've seen happier days."

Dieppe, on the other hand, has recovered its municipal health, wealth, and gaiety. In fact, it is difficult to tell which the city enjoys more: working or playing. It does both with remarkable zest.

Dieppe's seafront, smashed in war, now takes the form of a mile-long recreation area between beach and blocks of recently completed hotels and restaurants. Into the old port behind this façade, cross-Channel ships pour tourists from Britain. Trains of pleasure and business arrive from Paris. Freighters unload tons of bananas from the Antilles or Canaries, and varied cargoes from the rest of the world. Chunky fishing boats, draped with nets, moor along the stone quays (page 626).

At the waterfront buxom women sell all kinds of fish netted by their menfolk. The near-by central market is redolent with cheeses and vegetables, fruits and flowers. Here you can buy almost anything from underwear to ironware, from birds to goldfish.

At Dieppe the Allies staged a daring amphibious raid on the French coast one August dawn in 1942.* Costly though it proved, this attack amounted to a priceless dress re-

hearsal for the massive Normandy invasion that came later. The operation revealed the problems of trying to establish beachheads near useful Channel ports. Why? Because the Germans assumed Allied invasion forces would pick the ports as landing places, and therefore fortified them heavily. It told the Allies, too, how vast a force would be needed to gain a foothold anywhere along that coast.

We saw grim reminders of the enemy's powerful defenses as we moved along the precipitous shore in the direction of Le Havre. But the concrete blockhouses and big gun pits could not compete with the grandeur of the sheer chalk cliffs that dramatize upper Normandy's coastline. Rearing more than 300 feet straight up from the sea, these natural battlements attain their most fantastic proportions at Étretat.

The great white cliffs of Normandy, greater even than their cross-Channel counterparts, extend to the very suburbs of Le Havre. Where they fall away, this postwar city again stands as France's foremost transatlantic haven. In 1945 it won, quays down, the unenviable epithet of France's most gravely damaged port.

Harbor Busier Than Before War

Today the harbor, wholly restored, handles even more traffic than before the war. Here passenger ships like the French Line's *Liberté* turn around with impressive ease, while miscellaneous cargo vessels, tankers, barges, and husky tugs make a moving picture of *Lloyd's Register*.

In the over-all picture of postwar Normandy, Le Havre stands out boldly. But in all fairness I could say the same of any other Norman city, town, or village that has had to rebuild from the ruins up.

The province-wide task of restoration continues as naturally as plowing or milking. As Normans themselves would say, "*C'est normal.*" And indeed it is normal that Normandy should blossom again—normal as the springtime flowering of its apple trees.

* See, in the NATIONAL GEOGRAPHIC: "Rehearsal at Dieppe," October, 1942; and "Coasts of Normandy and Brittany," August, 1943, both by W. Robert Moore.

New City Hall Stands Squarely in the Reborn Heart of Le Havre

Bombs and shells wiped out some 12,000 buildings, damaged 5,000 others, and left 40,000 persons homeless. The 17-story skyscraper reflects the recovery of France's most devastated city. From the roof, Le Havre and its harbor look brand new.



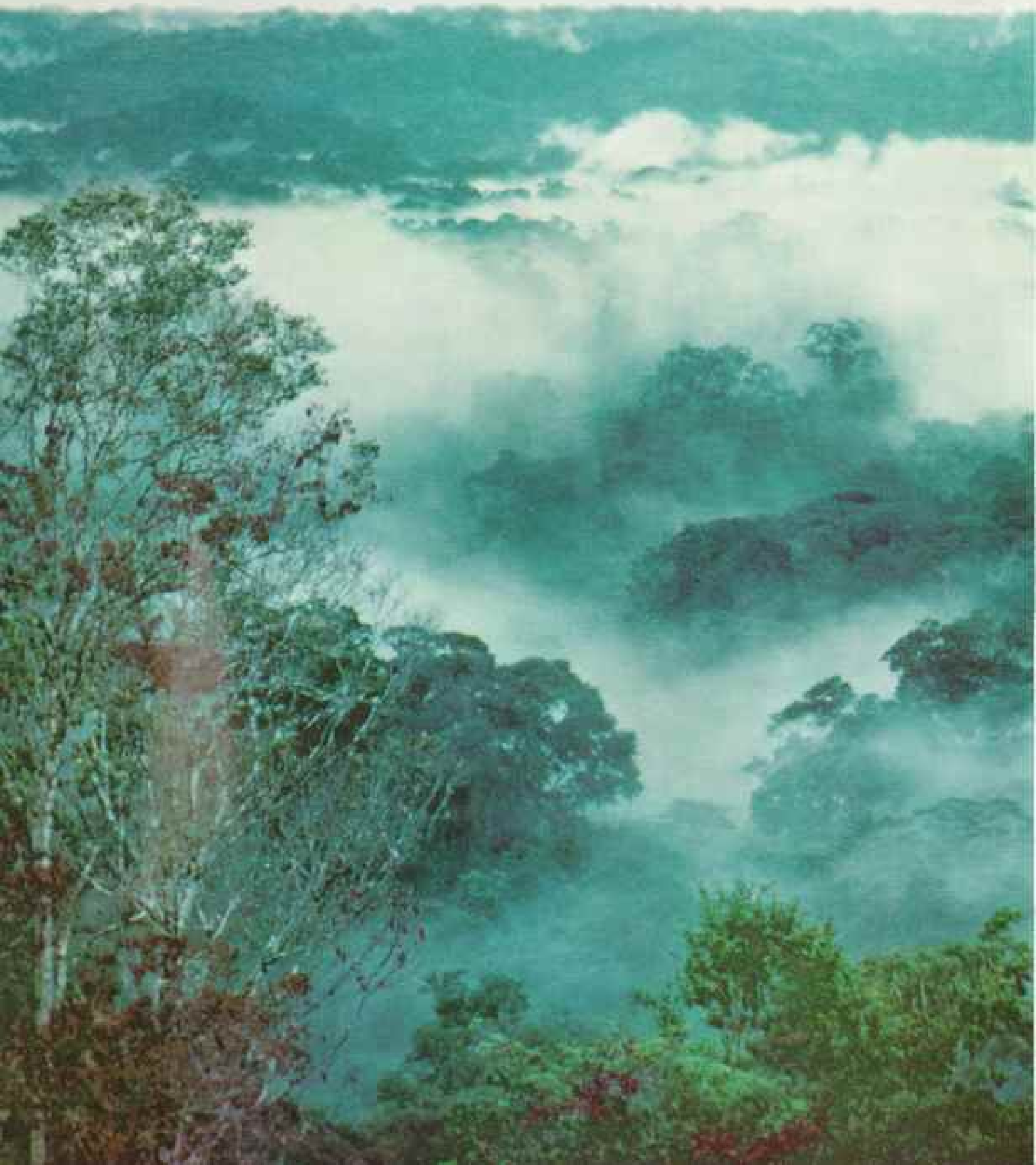
Ferocious ants and beetles big as bats confront a National Geographic naturalist in the steaming jungles of Brazil

Giant Insects OF THE Amazon

By PAUL A. ZAHL, Ph.D.

National Geographic Senior Editorial Staff (Natural Sciences)

With photographs by the author



ONE OF the Amazon's first visitors, the Spanish conquistador Orellana, claimed he was set upon by fierce fighting women as he journeyed down Brazil's largest river in 1541. Since then, South America's fresh-water colossus has been known as the Amazon, after the female warriors notorious in ancient Greek mythology.

Some four hundred years later I, too, encountered fierce fighting females in Brazil's jungles, and they proved no less ferocious than Orellana's.

The time was early October; the locale, some miles east of the busy port city of Belém on the southeastern flank of the Amazon Delta. Jauntily mounted on bicycles, my Brazilian helper José Lameira and I were proceeding along a roadway bordered on both sides by lush greenery.

Bulging from each bike were digging implements, machetes, raincoats, and a hodgepodge of containers and screened boxes. Laborers in a clearing we passed looked up and must have wondered. Amazon explorers



on bicycles? Orellana would have turned in his grave at the sight.

After half an hour or so of pedal pushing, we jumped down and hurried toward a ruined edifice half hidden in burgeoning jungle. The sky had suddenly clouded over; perhaps within those crumbling walls we could find shelter. But the ruin, an abandoned chapel, had long since lost its roof. As the downpour began, we stayed close to the decaying masonry and prayed for a quick return of blue sky.

The rain was lessening when I saw something moving on the dank floor a yard or two away. A black creature with stiltlike legs and a pair of huge mandibles was approaching a small hole in the earth; it disappeared, followed within seconds by another of its kind, and then another.

Lair of the World's Largest Ant

I felt a twinge of excitement. The size, the color, the form of the creatures, all were telltale. Here, in this ruin, we had come upon a lair of the world's largest ant, *Dinoponera gigantea*, whose wickedly stinging females are at once the rulers, warriors, reproducers, and huntresses of their jungle kingdom.

To locate the nests and to observe the habits of these little-known insect behemoths was high on my list of reasons for coming to Brazil. They are found only in South America. Eighteen years earlier I had visited the Amazon Delta to observe its giant ants. Now, for the National Geographic Society, I had returned for a more careful study.

As raindrops spattered from a million moisture-laden leaves, we continued to watch the hole and the comings and goings of its inhabitants. Those glistening black bodies were well in excess of an inch long, but in motion their total length, including legs and feelers, seemed closer to two inches (page 637).

During previous searches we had encountered many single specimens of *Dinoponera* stalking about the floor of the jungle forest, the *mata*. But all attempts to follow them to their nests had failed because of the tangle of fallen logs and undergrowth into which they

had invariably led us. Here the entrance to a colony lay in the open!

Now the sun beat down and the jungle steamed. We quickly unpacked our gear. Then, armed with long chrome tweezers, I cautiously approached the fist-sized ant hole (page 640).

Running through my mind was a comment of the late Prof. William M. Wheeler of Harvard, who in years past had sparked my interest in natural history. About giant ants he had written: "...they bite and sting with such ferocity that few observers have cared to study them at close quarters."

Our plan was to seize every returning forager, as well as any individual setting out from the hole. Thus we hoped to remove from circulation a large part of the colony before we dug to see what lay below. José stood back a bit from the hole to act as lookout; he would be on the alert for any ants evading me.

Unlike most other ant species, *Dinoponera gigantea* colonies seem to have no queen, no special soldier or worker castes, no fungus gardens, no complex tunnels and galleries. Great black females dominate each colony, capturing all food and doing all work. How reproductive duties are divided among the seemingly identical ladies is still a mystery.

"On guard, *senhor*, one approaches!" cried José in Portuguese. I turned to see a heavily laden giantess bound for the hole. Securely between her jaws was a beetle, its legs still thrashing; this huntress was bringing her catch home alive. Then the chrome fingers of my 12-inch-long tweezers grasped the ant's hard thorax.

Immediately the lady dropped her load and attacked the metal with vicious mandibles. Her legs braced and strained, and her abdomen contorted as she strove to escape; at the same time a hypodermic sting at the tip of her abdomen sought to pierce anything it might contact. I drew the captive close and watched droplets of venom swell from the stinger's sharp tip each time it struck metal.

There was another "On guard!" from José; I dropped my catch into a jar and quickly

Mist rises above virgin forest in the Territory of Amapá, about 100 miles north of the Equator. Said the author: "In early morning, or after a shower, the Brazilian jungle resembles a vast industrial area of smoking stacks." Most of the giant beetles collected on this National Geographic Society expedition came from the Amapá region.

Nutcracker Jaws of a Giant Ant Clutch a Golden Beetle in a Death Grip

The world's largest ant, *Dinoponera gigantea*, dwells in the Brazilian rain forest. Stinging females dominate the smaller, weaker males and fight the colony's battles. *Dinoponera*'s glistening black body, magnified 18 times, measures more than an inch. Her prey, a chrysomelid beetle, still lives; its brilliance will fade shortly after death.





dived for number two—then three and four. By midafternoon the container held dozens of struggling furies.

Most of the incoming huntresses carried fresh meat—small spiders, beetles, and larvae—for giant ants are primarily carnivorous, although now and then one bore a seed or a small nut kernel. Individuals setting out empty mouthed from the nest seemed more alert and wary than the incomers. Several times, sensing danger, one would pivot and hurry back into the hole. I believe they retreated not in fear of their own lives but to guard the eggs and young down in the nest.

Eventually the number of returning foragers tapered off; so we assumed that a substantial proportion of the colony's inhabitants had been taken.

Natives Warn of Danger from Big Ants

Almost unnoticed by us, two jungle woodcutters had appeared and were watching intently. Following our every move, the older man finally warned gravely: "*Tocandira!* Be very careful with those ants, senhor! The sting of one will cause fever. If several bite you, the result can be serious."

I accepted his advice with gratitude. *Tocandira* is the Brazilian Indian name

used in some districts for both *Dinoponera* and another slightly smaller black ant species, *Paraponera clavata*. Both also bear such local synonyms as "fever ant" and "four-sting ant," the latter carrying the perhaps exaggerated implication that to be stung four times at once is fatal.

With pick and shovel, José and I started digging. Almost immediately we lost track of the nest's entrance corridor as its walls collapsed, and we had to excavate about a square yard around the original hole. We found the moist floor undermined by a snarl of roots, and our axes saw as much use as our picks and shovels.

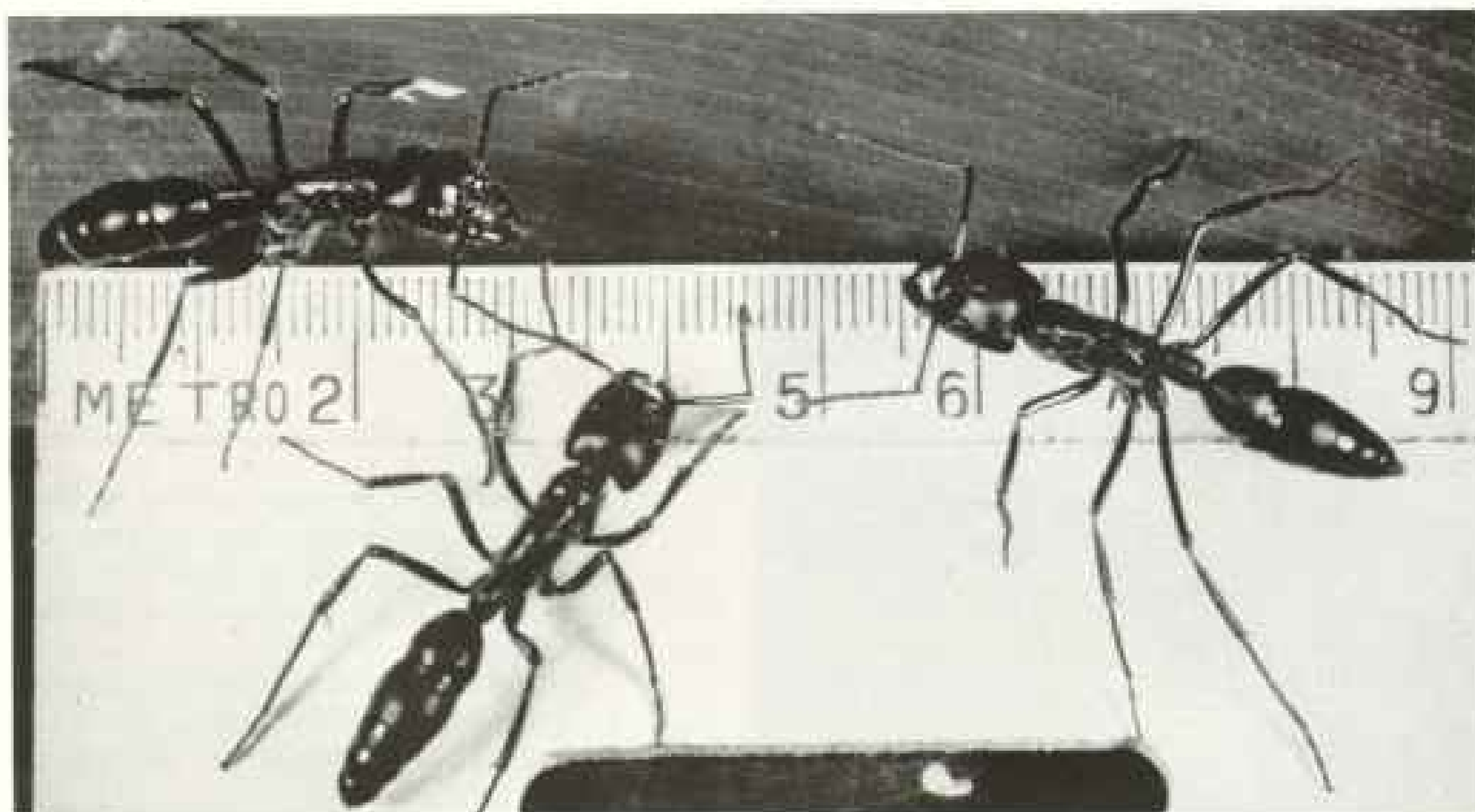
The tree mainly responsible for these roots was conspicuous—an enormous strangler fig growing from the top of one of the chapel's decaying walls. Its aerial roots hung down like the tentacles of a great terrestrial octopus (opposite page).

We had dug about 14 inches down when we came to a halt, abruptly throwing down implements and grabbing forceps and bottles. A shovel had exposed a cluster of some twenty highly agitated *Dinoponera* females violently thrashing their way up through the disturbed soil. That we had struck the nest's primary chamber was instantly revealed by 30 to 40

Ant Hunters Uncover a Nest in a Jungle-strangled Chapel Near Belém

Ruins that sheltered Dr. Zahl from rain also yielded a rare colony of giant ants. While his helper loosens soil, the author captures fighting females with tweezers and puts them in the screened box. Roots of a strangler fig grip the decaying walls.

Parading across a metric ruler, ants reveal a length of thirty-four millimeters, about 1½ inches.



Winged Male Ant Clumbers over Cocoons; a Female Guards the White Larvae

Poking deep into the nest, Dr. Zahl bared the primary chamber 14 inches below the jungle floor. His invasion panicked the colony. Brick-red males with fragile legs and translucent wings thrashed helplessly. Coal-black females seized their mates and tried to carry them to safety.

Less than half the size of its sisters, the male (enlarged five times) resembles a wasp. Many experts believe these ants evolved from wasplike ancestors. Cocoons are about an inch in length. Squirming white larvae will later assume the cocoon covering.



Scooping up several eggs in her jaws, a female flees her crumbling nest. The glistening capsules, about $\frac{1}{8}$ inch long and no thicker than a pin, are enlarged nine times.

Frantic female struggles to lift a cocoon. Sealed in a smooth, silky covering, the immature ant remains self-sufficient. When the cocoon is chewed open, a complete adult emerges.

Unlike most ants, these giants appear to have neither specialized queen nor worker castes. Females share the breeding and feeding of the young.



cocoons shaped like miniature Idaho potatoes, each about an inch long (page 639).

Uproar among the females was total now as each seized a cocoon in her jaws and tried desperately to carry it away. Safety, however, was nowhere to be found, for I had already set to with eager forceps. Soon all these faithful females, together with their cocoons, were part of my harem.

Females Carry Helpless Males

With a stick I gently shoved aside more soil and uncovered yet another section of the shattered chamber, containing scores of squirming white ant larvae. Some were nearly the size of the cocoons; others graded down to mere pinheads.

The rarest sight of all, however, came a moment later as we uncovered two brick-red winged males (page 638). Arranged in a triangle on each tiny forehead were three minute crystalline lenses, the so-called accessory eyes, found in many insects, but rarely so conspicuous.

Less than half the size of their coal-black sisters, these males resembled small wasps. In an emergency such as this, they seemed as helpless as the legless and wingless larvae. Now each of the males was lifted in the jaws of a *Dinoponera* female and hurried off the battlefield. Just as quickly, my forceps seized the would-be rescuers, and, with their frail masculine loads, they were summarily dropped into my containers.

Finally, in the crude nest's farthest recesses, we found *Dinoponera* eggs—each a smooth, rounded cylinder about an eighth of an inch long and no thicker than a pin. Several females had scooped up clusters of these and were scuttling off, only to be stopped in their tracks by my tweezers.

Eventually we were satisfied that we held in custody all the living denizens of the nest. Our collection included every stage of the giant ants' life cycle.

Exuberant over the rare haul, José and I packed our prizes and pedaled back to Belém, Capital of the Brazilian State of Pará,

Scurrying on stiltlike legs, an ant huntress (enlarged two diameters) sets out from her jungle burrow in quest of spiders, beetles, or larvae. Seconds later the author captured her with forceps, which she viciously attacked with gnashing mandibles.





Search for giant insects led the author through jungle and savanna from the port of Belém, in the Amazon Delta, to Manaus, onetime rubber center of the world. Another quest took him to the Territory of Amapá, near the French Guiana border.

Belém is a city of more than 200,000, which since the rubber boom of the late 1800's has been regarded as the gateway to the mighty Amazon. Eighteen years before, I had found it a quiet river port. Today, reflecting a profound resurgence in the whole Amazon Valley, Belém is no longer provincial. New buildings tower; aircraft and ships come in from all parts of the world; commerce flourishes; institutions of learning and research thrive.

I made my field headquarters at the Agronomical Institute of the North, dedicated to the development of the Amazon's vast agricultural and forest potential. Dr. Elias Sefer, chief entomologist for the institute, was deeply interested in my program. "Any research relating to Amazon biology interests us, too."

That night I got down to the business of sorting and observing my catch. A shrill chorus of cicadas in a near-by rubber grove supplied appropriate background music.

First, my total catch of some 90 female *Dinoponera* was equally divided and consigned to two large screened cages I had brought from the States. Each had a floor of damp soil three inches deep. Would the captives tunnel a new nest?

By midnight the prisoners were still pacing their cells or climbing the screened sides.

Then into one cage I placed most of the day's cocoons and larvae. Each female hurriedly seized one and sought exit from her prison. The effort seemed as disorganized as the escape reactions we had witnessed in the field.

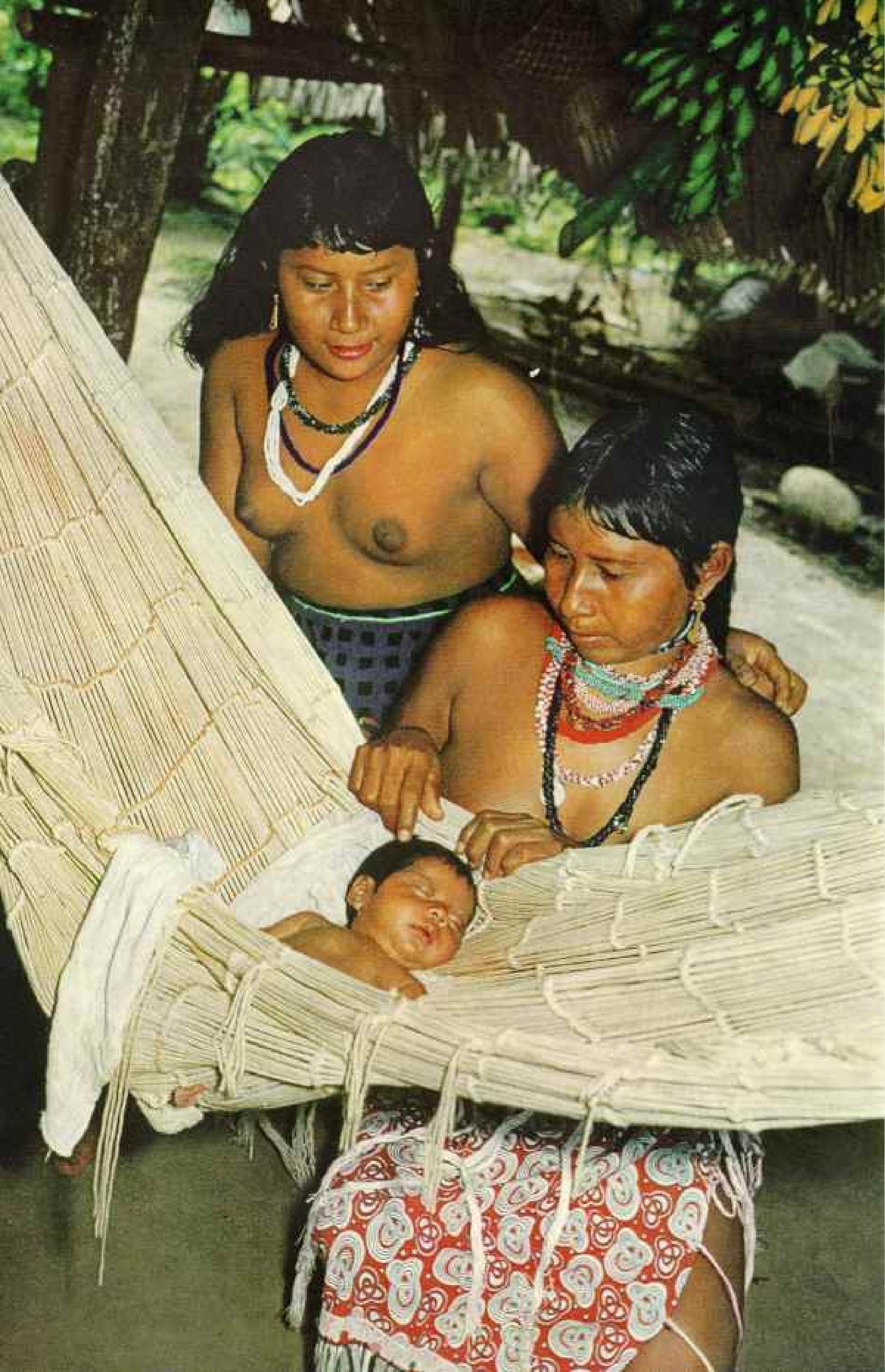
Eventually some of the ants put down their loads and started gently to lick the soft skins of the larvae, perhaps to cleanse, perhaps to secure tasty exudates produced by the larvae skin. Had I supplied food, some of the females no doubt would have carried it to their charges' tiny mouths, for ant larvae are helpless and must depend on their grown sisters for nutrition.

A pupa, in contrast, obviously cannot feed or be fed, for it is sealed in its silky covering. There it remains, living on its own store of nutrition. Finally the female chews the cocoon open and the new adult emerges.

New Life for a Disrupted Colony

Every half hour or so I turned to the cage into which I had placed the other group of females. After midnight I witnessed a change there. A number of the ants had arranged themselves in a circle, with heads inward, like kittens around a bowl of milk.

I had added no cocoons, larvae, or eggs to that cage. Curious as to what was the object 641



of all the attention, I opened the cage door and with forceps gently pushed the "kittens" aside. There, stacked like cordwood in the center of the circle, lay about 25 tiny glistening eggs.

It was apparent that one or more of the females had just laid these eggs. The sisters were gathering around to honor the event, perhaps to act as midwives, certainly to serve as nurses to this brand-new ant life. Whether the eggs were fertile, I had no way of knowing. Doubtless, however, I was witnessing an effort to produce new citizens for a disrupted jungle empire.

One can only surmise how many *Dinoponera* females are capable of egg laying. Perhaps all are. Their apparent lack of a specialized queen is in sharp contrast to most ant species, whose queens differ markedly in appearance and function from workers and who live only for reproduction and colony formation.

By now it was nearly five o'clock in the morning. I was constrained to rub the ants out of my eyes and get some sleep.

Back at the chapel ruins next day, José and I found three lonely females in the rubble of the former ant city. If one could read human emotion into their mien, I should say that these Amazons were reflecting sorrow and frustration. The chain of their biological sequence had been broken, and they knew not how to repair it. They paced aimlessly, making no attempt to dig. One still held in its jaws a small golden, helmet-shaped beetle captured on the last foraging trip (page 635).

Morphos Drawn to Mango Banquet

To determine whether the three stragglers would find a way to resolve their dilemma, I decided to wait awhile. José and I strolled down a path to a jungle stream. On its mud bank stood a mango tree with a scattering of fallen fruit underneath.

Here, in gorgeous contrast to the forbidding blackness of giant ants, were some ten huge Morpho butterflies quietly sipping juices from the rotting mangoes. At our approach they sailed into the air, with iridescent wings flashing the most brilliant of all blues (page 649).*

When we returned to our ant excavation, the three lost sisters were still pacing there. I

decided against taking them; perhaps nature would use them as the nucleus for a new colony.

For several more weeks I combed the jungle around Belém, finding other colonies of giant ants, securing the first photographic record of these astonishing creatures, and collecting hundreds for laboratory study. Then I flew to the very heart of the Amazon Valley—Manaus, on the great tributary Rio Negro, nearly 1,000 miles upstream from Belém (map, page 641).

Museum's Elephants Outnumber Titanus

I was in pursuit of another six-legged savage, of which Dr. C. H. Curran, Curator of Insects and Spiders at the American Museum of Natural History in New York, writes: "...our own museum [contains] more specimens of elephants than all the museums of the world do of this beetle." As *Dinoponera gigantea* is the behemoth among ants, so is *Titanus giganteus* one of the world's largest beetles.

"It will certainly be exciting if you bag some," said John C. Pallister, distinguished coleopterist at the American Museum, "but don't get your hopes up."

Pallister was well aware that, although the huge beetles have been known to science for many years, fewer than a score of specimens had been recorded. Nothing was known of the beetle's habits or life cycle, other than that it belonged to the family of long-horned beetles, the Cerambycidae, whose larvae are wood eaters. *Titanus* had been found in a jungle zone which encompasses Manaus, capital of the Brazilian State of Amazonas, and in other areas of northern Brazil and the Guianas.

The porter put my bags in an air-conditioned room on a high floor of the handsome Hotel Amazonas. From my balconied window I could see the harbor, alive with every kind of craft from dugout canoe to ocean liner. My wonder increased when an hour later a sumptuous dinner was served me on the veranda of the hotel's dining room.

Giant beetles? A pest-ridden bush? This sort of expedition would please the most luxury-loving traveler.

* See "Keeping House for Tropical Butterflies," by Jocelyn Crane, NATIONAL GEOGRAPHIC, August, 1957.

Brazil's Galibi Indians Aided the Author's Quest for Giant Insects

A gentle, friendly people, the Galibi dwell on the banks of the Oiapoque River. On rare canoe trips to the French Guiana town of St. Georges, they exchange produce and bows and arrows for beads, cloth, and axheads. Baby sleeps in a cotton hammock.





Oarsman Follows a River Choked with Hyacinths

Savannas and matted wilderness fill Brazil's Territory of Amapá, just north of the Amazon's mouth. In vast stretches, rivers provide the only roads.

For years Amapá's enormous potential lay untapped, but within the past 15 years the region has made a century of progress. The boom began when a prospector discovered rich manganese deposits in a territory which also contains tin, iron ore, gold, quartz, mica, and feldspar.

Amapá became a bonanza. Macapá, its capital, grew a thousand percent between 1940 and 1950.

A Galibi family heads riverward for a day of fishing. Ankle-deep in silt, father launches the dugout.

"Have you seen beetles like these?" Dr. Zahi asks Galibi villagers. Indian fingers touch the hard wing covers of *Titanus giganteus*, one of the world's largest beetles, and the smaller *Megasona actaeon*. The head of the house reclines in a cloth hammock.

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My life of ease turned out to be a short one.

"It happens," said Dr. Raul A. Antony, M. I. T.-educated Director of the National Institute for Amazonian Research in Manaus, "that Claudionor Elias, a member of our staff, sets out tomorrow for work in the bush. I am sure he would be glad for your company. If you wish, I will arrange to have his jeep call for you at the hotel in the morning."

So it was that I abruptly exchanged a bed with fine linen for a cotton-mesh hammock slung in primeval jungle. Our camp stood in a clearing not far from a slow-moving, amber-colored stream, the Igarapé do Passarinho, about 15 miles west of the city.

Wasp Brandishes Half-inch Stinger

Wildlife was rarely in evidence here, although now and then we might see a monkey silhouetted in treetop galleries, or hear a band of howlers in the distance warning of the approach of rain, or have our eardrums split by the screech of invisible macaws. Actually, insects—butterflies, ants, beetles, and a legion of others—were the chief residents of these parts. This was all to the good, so far as I was concerned.

One afternoon as Claud was hacking a path with his machete through a minor thicket, he suddenly froze, his eyes on a log about ten feet ahead. Cautiously and quietly he handed me his gun and, borrowing my insect net, began a tiptoeing advance. I waited, still unaware of the object of his attention, but ready with the shotgun. I knew that peccaries, bushmasters, jaguars, and boas lurked here in the bush.

There was a lightning swish of the net, followed by a cry of triumph from Claud. Within the net was an incredibly large wasp, perhaps two and a half inches long, its wingspread at least four inches.

Claud had captured a *Pepis atrata*, or giant spider wasp (page 654).

In dramatic contrast to a massive blue-black body, the wasp's frantically buzzing wings were blood red. A hypodermic stinger three times the length of *Dinoponera's* was stabbing in and out from the tip of the abdomen through the meshes of the net. A few squirts of chloroform put a quick end to

all movement. Here was a species I had not expected to find, but one fully as spectacular as giant ants or the sought-after *Titanus*.

On another occasion we were accompanied by a muscular *caboclo*, a Brazilian laborer, armed with an ax. Near the edge of a clearing the axman stopped and pointed out a half-dead tree of moderate size. A *matamata* tree, he said. It seemed a likely hiding place for giant beetles and their like.

For 10 minutes the jungle echoed with the sound of the ax biting into the *matamata*. Then there was a crash, and the tree lay prone. The woodchopper split the lower trunk lengthwise, revealing the chewed-up center filled with what resembled coarse red sawdust. I prodded this moist material with the end of a stick.

There was a sudden upheaving movement within the sawdust. Claud cried: "*Cobra! Beware!*" *Cobra*, in Portuguese, is the general term for snake.

All three of us leaped back, then watched guardedly. Nothing appeared. Continuing my probings, but now with my stick held at maximum length, I uncovered a half-buried cluster of enormous blue-white grubs. They were wholly harmless, though looking most sinister in their squirmings and contortions (page 664).

As I gathered these thumb-sized grubs in a collecting bottle, their anatomy identified them as the young of a scarab beetle, probably *Megasoma actaeon*, a species I had not previously encountered in these parts. Later I was to find these elephant scarabs in abundance.

Green Parade of the Leaf Cutters

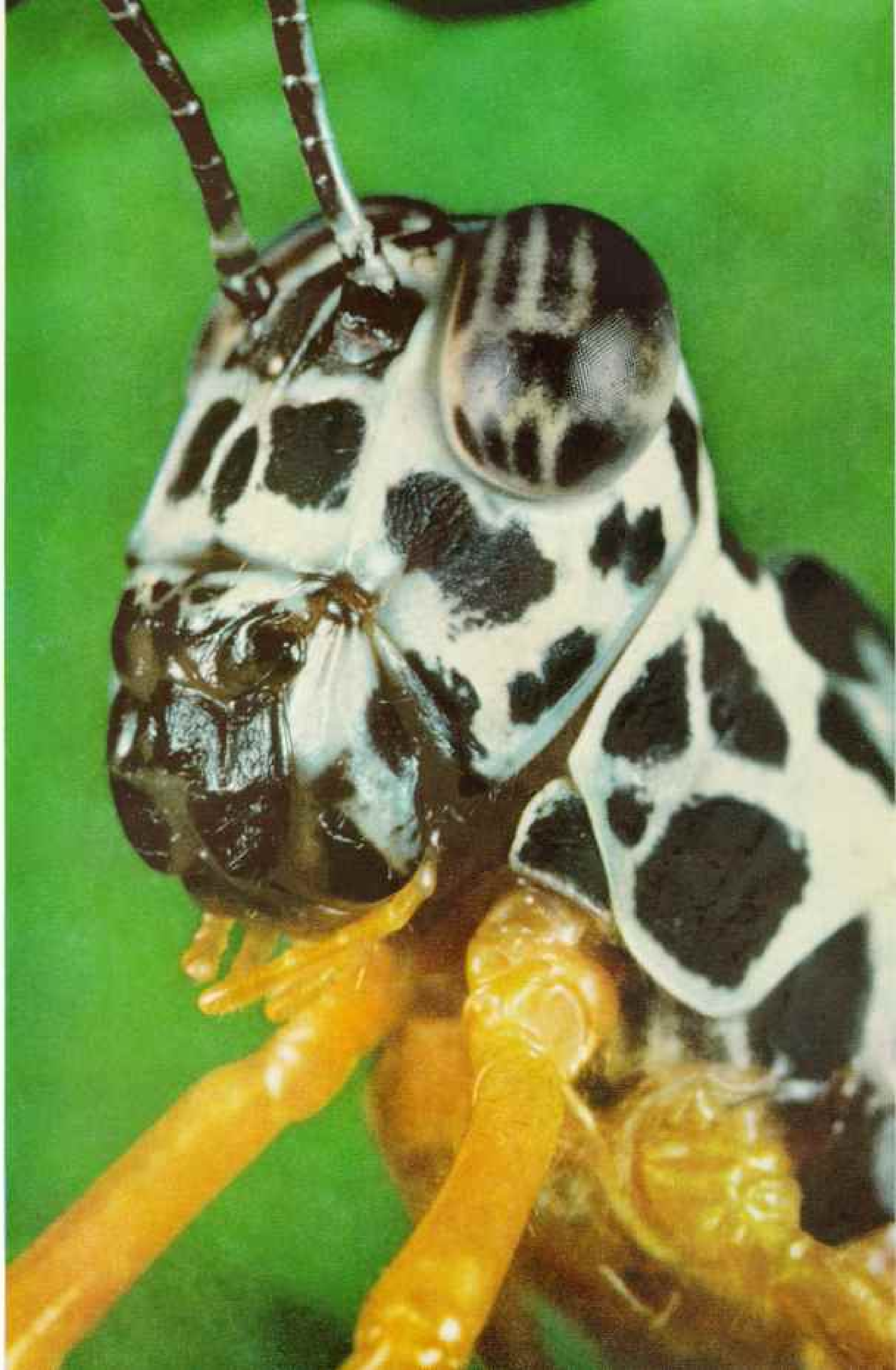
A day or two later, wandering through the bush near camp, I came upon a parade of *saúva*, or leaf-cutting ants, hurrying along their own well-worn trail.

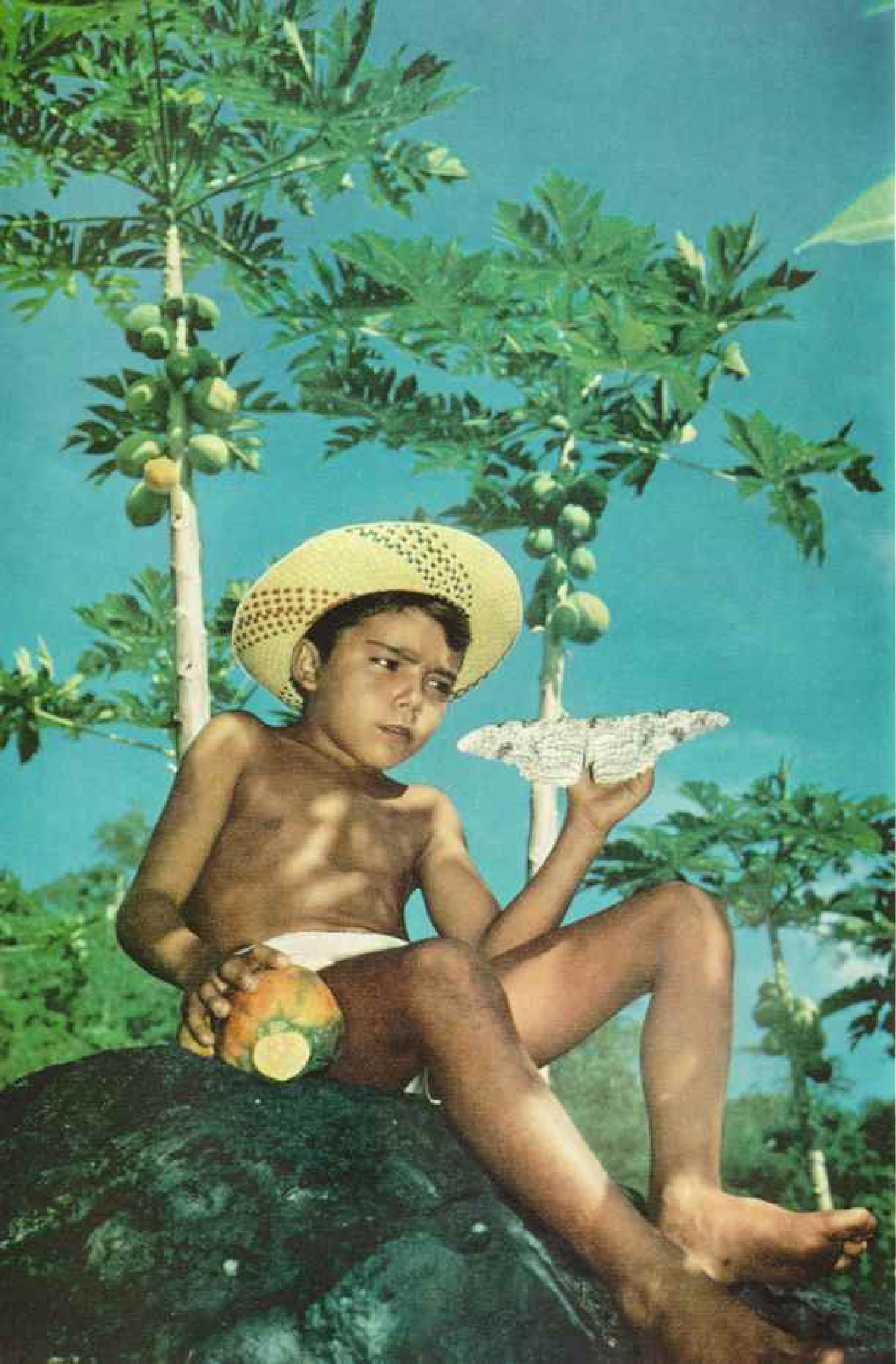
On first sight they suggested a stream of liquid chlorophyll. Those moving in one direction clasped in their jaws leaf fragments larger than their bodies; those traveling against the tide were empty mouthed. These odd creatures are found everywhere in the American tropics, but this particular display

(Continued on page 655)

Head-on Look at a Jungle Monster: a Grasshopper Magnified Ten Times

Lancelike antennae, bulbous eyes, leopard spots, and golden underbody distinguish this acridian. Appendages about the mouth serve as feeding organs. Antennae bear various sensory organs, including that of smell. People of many lands eat the insects.







Morpho butterfly was sipping overripe mangoes beside a jungle stream when the author's net enclosed it.

The Morphos rank with the most brilliantly colored of tropical insects. This specimen is striped with blue; some species have entire wings of iridescent sapphire.

So popular did the Morpho once become for the making of jewelry, trays, and framed pictures that some Latin American governments prohibited its capture and export lest it become extinct.

Wings of a Jungle Moth Spread Nearly a Foot

Floodlights at an Amapá manganese mine brought *Thysania agrippina* within range of the author's net on one of his midnight prowls. Antônio, 10-year-old son of a mine employee, accompanied Dr. Zahl on many field sorties (page 663). Ripening papayas load the trees.

Bold black stripes on a delicately colored Automolis moth, magnified five times, give the impression of crayon marks.





Judge on the bench. A judicial grasshopper, shown eight times life size, peers with gleaming eyes halfway up an ice-cream-cone head. Dagger-blade antennae explore for food amid a blossom cluster.

Windowpane wings adorn a butterfly visiting a hairy melastomad plant. Color-bearing scales are reduced to fine hairs, making the wings transparent except for four eyelike dots.

Callitaera is shown eight times life size.







Grab eyes, shell, and legs—but pentatomid is an insect (six times life size). Commonly called a stinkbug, it repels predators by emitting a vile secretion. Feeding on sap, the bug transmits diseases from plant to plant.

Pale cerise wing covers of a cerambycid, or wood-boring beetle, contrast with blue legs and body. Enormous eyes wrap around the front of the head. Slender antennae, springing from knobs, stretch as long as the insect itself (enlarged seven times).



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Spent tips arm the shield of a membracid, or tree hopper, enlarged four times. Some 2,500 varieties of these sapsuckers display bizarre armature and ornamentation that includes sails, thorns, leaves, crescents, and balls.

**Palm-leaf Hat Protects Manuel,
the Net Boy, from Rain and Sun**

Camped in the delta near Belém and later in the Amazon Valley near Manaus, members of the Zahi party explored deep jungle. Their machetes hacked a path through brush harboring peccaries, jaguars, bushmasters, and boas.

Collecting trips yielded a galaxy of insects, including giant spider wasps (page 654), harlequin beetles, alligator bugs, mantids, butterflies, and moths. Young Manuel, born in the Belém region, proved a nimble and resourceful guide.

Bright belt of red and yellow seems to split an ebony erotylid beetle in half. Thick, rigid outer wings, functioning like armor plate, cover and protect the fragile wings used for flying.

Beetle species number more than 270,000; they form the largest single order in the animal kingdom.





Gargantuan Spider Wasp Demands Careful Handling

The blue-black body of *Pepsis atrata*, giant of the pompilids, measures 2½ inches; its wing-spread, 4 inches. Nicknamed tarantula hawk, the insect is one of the world's largest wasps.

Claudionor Elias, a naturalist with the National Institute for Amazonian Research, who accompanied the author in the field, caught this specimen and dosed it with chloroform.

Blood-red wings buzzed frantically as the wasp's stinger (opposite page) sought the captor's flesh through the mesh. Any error might have netted Senhor Elias a large and painful dose of venom.

Vivid coloring shows to advantage in this magnified close-up of *Pepsis*. Compare its size with the 10-cent piece.

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of two-way traffic seemed denser and more vigorous than any I had ever seen (following pages).

Leaf-cutting ants of the genus *Atta* have colonies running into the tens of thousands, with special worker castes equipped with scissorlike jaws. Accompanied by equally grotesque soldiers, the swarming workers locate a suitable tree or bush, and proceed to cut its foliage into dime-sized or smaller fragments. These are triumphantly borne, sail-like, back to colony headquarters. There, well underground, the fresh green fragments serve as a compost for the colony's food-supplying fungus gardens.

On that particular excursion I carried photo-flash-strobe lights, for no sunlight penetrated here. One of my purposes in the Amazon was to photograph not only the region's insect giants but some of its lesser dwellers as well.

The principal difficulty now, however, lay in the nearly 100-percent relative humidity along that ant boulevard. As I worked, perspiration drenched me. Repeatedly, as I prepared to snap the shutter, either the lens would fog or the strobe unit would short-circuit and flash of its own accord. I took perhaps 100 pictures before feeling even remotely confident that one or two might be of value. And a good thing, too, for next day the ant trail was empty; that particular raiding party had finished its job.

Bush routine involved not only daytime sorties. Long after dusk we would set forth down a jungle path, armed with machetes, flashlights, and a gasoline lantern, casting beams this way and that in search of insects. Eventually we would stop and suspend our lamp, sometimes with a white sheet hung behind it, then wait hopefully for insect night flyers to be attracted.

Every now and then we would hear a thump

near the lantern or on the sheet, and a beetle of some non-Titanus sort would fall to the ground, back down and legs squirming. Or a large moth would alight on the white surface, wholly unaware that forceps, fingers, and cyanide bottles were close by.

Finally it occurred to me that our lights might be too small to attract beetles of the rare Titanus clan. Suppose there were only one or two or even a dozen individuals in the jungle hereabouts. What chance would a feeble gasoline lantern have? We needed a light of enormously greater power.

Refinery Floodlights Lure Insect Giants

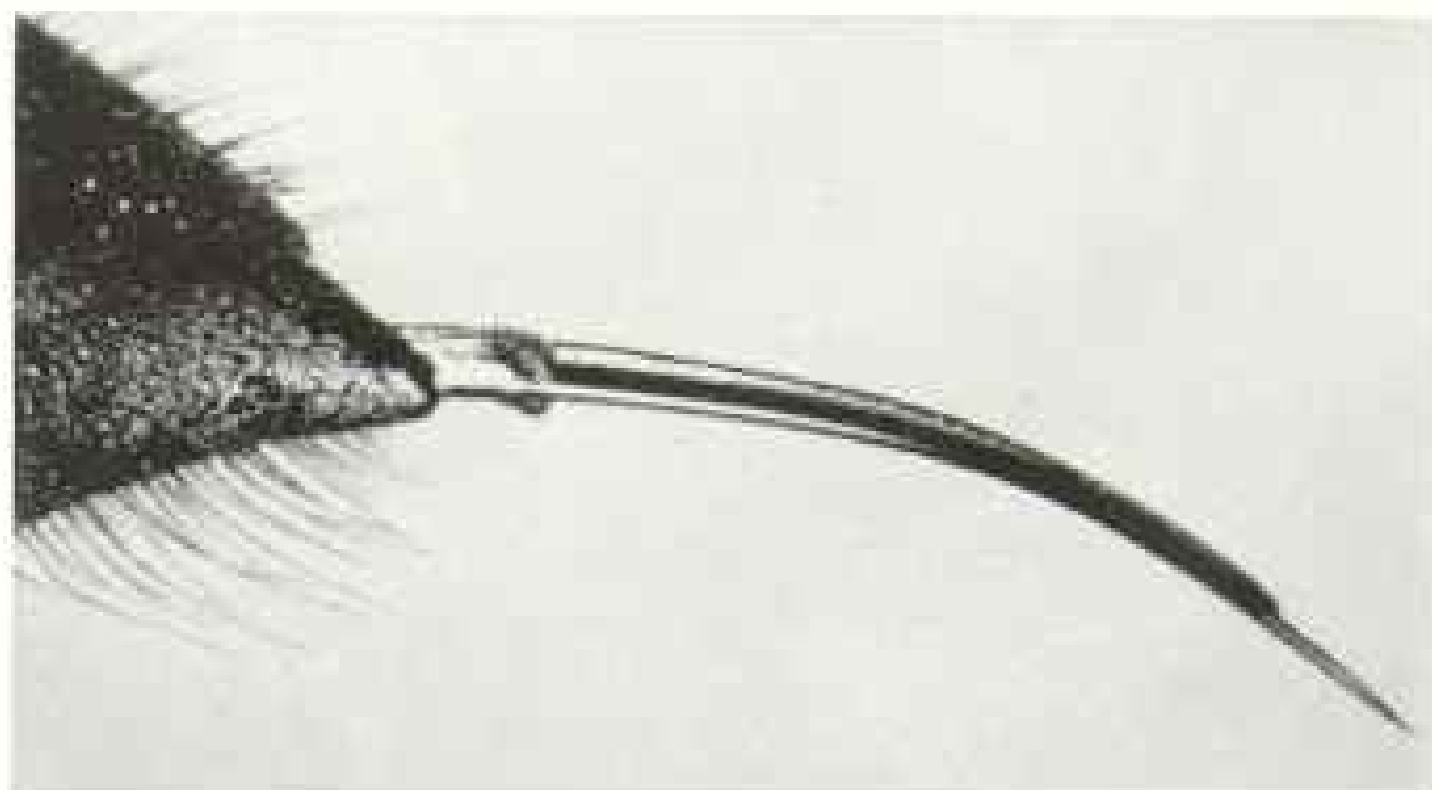
On a bluff rising out of the Rio Negro's waters, about 10 miles downriver from Manaus, stands the oil refinery of the Companhia de Petróleo da Amazônia. During the night shift powerful floodlights on the refinery's towers cast their come-hither signals far out over the river's jungled banks.

Wearing a refinery worker's metal helmet and armed with nets, jars, bottles, and pincers, I took station late one night under one of these glowing lights. Around it a thousand insect satellites orbited. Now and then a dark, nonreflecting body would hurl itself through the illumined space, then vanish into the black void beyond—an insect-hunting bat, here for essentially the same reason as I.

Minutes passed into hours. Scores of victims, singed by the light's heat or knocked half-conscious by a collision with the tower, dropped to earth—moths, katydids, beetles. But none even vaguely resembled Titanus.

Suddenly there was a thud heavier than any so far. On the ground under the light, a second or two later, stalked a tawny brown monster whose size, by comparison, made giant ants and wasps seem puny. It was a good four inches long, with a pair of probing

Poison-laden, a hypodermic needle nearly half an inch long emerges from the tip of the wasp's abdomen. Though feeding mostly on nectar, the female *Pepsis* hunts tarantulas. After paralyzing a victim with her stinger, she carries it to her burrow and deposits an egg on the spider's stomach. Upon hatching, the larva feeds on its living but helpless host.





Ants with Green Parasols Parade the Jungle Floor

Leaf-cutting *Atta* ants, scourge of Brazilian planters, can strip a tree of its foliage in a night.

Swarming up trunk and branches, these workers (shown life size) cut the leaves into neat fragments, then carry them to their nests underground. There the fermented leaves form a compost heap for gardens of fungus, the *Atta*'s sole food.

Swollen, heart-shaped head and scissorlike jaws distinguish the *Atta* (enlarged 10 times).

Sail-like segment of leaf burdens an *Atta* heading nestward. An empty-mouthed worker emerges for another load.



antennae adding another four inches. From the head extended a short pair of thick pincers which could have slashed a human finger to the bone.

I plunged my net violently down to earth over the creature and held it there firmly. But the beetle's six taloned feet immediately began ripping the cheesecloth. Fortunately, among my containers was an empty one-gallon paint can, whose mouth I cautiously maneuvered under the net. Soon my prize was in the can, scratching and snapping futilely.

A Good Find, but Not Titanus

Can and beetle spent the rest of the night under a heavy footstool in my hotel room. It was midday before I awoke. Excitedly I pried the lid off the paint can to see what the monster would look like in daylight. He was still there, much alive and eager. But he was not Titanus.

The thorax, the antennae, the legs, the color . . . all marked him as one of the giant cerambycids. But this fellow was *Callipogon armilatus*, only a near cousin to Titanus.

I was still trying to down my disappointment when a knock came at the door. A boy handed me an envelope marked: "Very Urgent! Deliver Immediately!"

I tore it open and read the handwritten message, in effect:

"We have a six-legged beast out here . . . found crawling around the grounds this morning. The boys are afraid of it. Can you hurry before someone gets hurt?"

The note was signed by Bob Hlavin, an American engineer at the refinery. Minutes later I was in an office where five Brazilian engineers and technicians were rattling away in Portuguese, half in excited apprehension, half in side-splitting amusement.

"He's under there," said Bob, pointing to a large inverted metal wastepaper basket on which one of the engineers was sitting, as if he were keeping in check the very fires of hell.

"Take care . . . Watch it . . . Look out for those teeth . . ." The warnings flew in Por-

tuguese, as I asked the engineer to get off the basket and allow me to look underneath. This time I had come equipped with a heavy nylon net strong enough to resist any insect claws or talons. I kicked over the basket, and in an instant had the creature securely ensnared.

I studied the features of the struggling captive, nearly five inches long. Here, finally, was a true *Titanus giganteus*.

Though for a fortnight I made many another sortie into the bush and under various industrial lights around Manaus, not another Titanus did I encounter. Yet I was certainly not dissatisfied when my strange assortment of baggage went aboard the passenger ship *Lauro Sodré*, bound back downstream for Belém. With one living Titanus, several living Callipogon, and three preserved Pepsis, I had achieved far more than my minimum objectives.

Boxes Hold Rich Insect Trove

Furthermore, securely packed and preserved in naphthalene was a galaxy of other insects, less spectacular in size than my giants, but many of them more weirdly shaped or beautifully colored. In boxes piled to one side of the cabin were several dozen *Euchroma* beetles, whose iridescent bronze-green elytra, or hard front wings, are used in necklaces and ceremonial pieces by aboriginal Indians throughout the Amazon Valley; half a dozen of the so-called harlequin beetles, *Acrocinus*, their wing covers colorfully mottled in abstract patterns, forelegs preposterously long; numerous jacare, or alligator bugs, with hollow peanut-shaped heads; and thousands of more common varieties—butterflies, moths, mantids, stick insects, cicadas, grasshoppers.

Next morning found me in my stateroom, the door and windows locked, and Titanus loose and stalking about. I had learned to handle him, having noted with profound respect the ease with which his powerful jaw pincers could crack through a proffered match stick (page 666).

The head of Titanus is more or less fixed in a forward position, rendering him unable

Huge Titanus Beetle and Eight-inch Larva Blanket a Magazine

Because *Titanus giganteus* inhabits only a few jungle zones in northern Brazil and the Guianas, its habits and life cycle have long been a mystery. Fewer than 20 specimens had been recorded prior to the author's 1957 expedition, which yielded another 15, including four measuring more than six inches. Dr. Zahl took the photograph in his Belém hotel room. He has evidence, but not positive proof, that the wormlike larva is the immature Titanus. If so, it may be the first of its kind ever collected.

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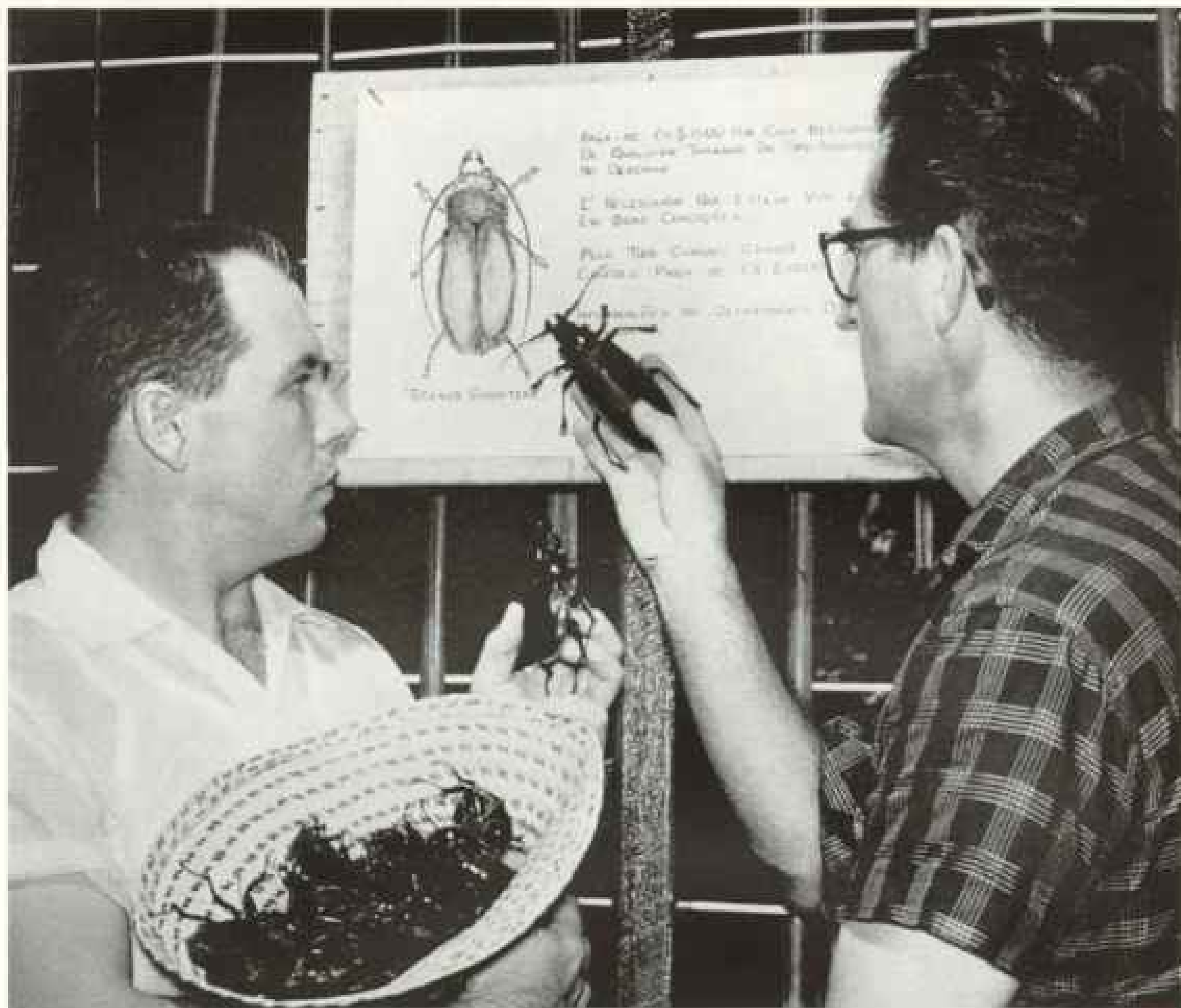
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Wanted! Titanus Beetles—Alive and in Good Condition. Reward!

Signs posted throughout a mining camp in Amapá offered employees ten cents apiece for *Titanus* and less for *Megasoma* specimens. The posters paid dividends; workers brought in dozens. Here Dr. Zahl compares a preserved *Titanus* with the identification sketch. Chief mining engineer Howard G. Fleshman holds a hatful of *Megasomas*.

to turn and bite the hand that feeds him. Accordingly, if I approached from behind and quickly and very firmly closed thumb and forefinger over the midriff, being careful at the same time to avoid underside thrashings of the six taloned feet, the creature could not harm me. Sometimes I even tied a string around my pet's thorax and led him about like a poodle on a leash.

By precise measurement, this specimen was four and three-fourths inches long from jaw to abdomen tip, and one and three-fourths across at mid-body.

Next to his armament of jaws and talons, the most impressive features of my brown-bodied titan were his huge eyes curving around the base of each antenna and shimmering with countless tiny hexagonal facets. Eyes

of this sort—the so-called compound eyes possessed by most insects—are presumed to give their possessors extremely wide-angle vision and unique perception of pattern and detail.*

Close to the end of each of the jointed legs were three flat pads, velvet to the touch, terminating in a double-pronged hook. Thus "snowshoed" for soft jungle moss and hooked for tree climbing, *Titanus* is admirably fitted for forest life.

The creature displayed no desire to fly, although folded under each of the two long, leathery elytra were yellowish wings, tissue-thin and veined, and clearly functional. Nor would it accept any food I offered—meat, fruit, pastry, even woody materials.

* See "Nature's Alert Eyes," by Constance P. Warner, NATIONAL GEOGRAPHIC, April, 1959.

Most amazing was the beast's vitality and aggressiveness. Any interference would result immediately in an irritated snapping of the jaws and an agitated sweeping of the antennae. Embedded in the surface of insects' antennae are minute sense organs which presumably tell the owners something about their surroundings—perhaps even to odor and humidity.

Eggs Hatch in Woody Nests

Beetles of the Cerambycidae family (*Titanus* is but one of many thousands of diverse species throughout the world) spend the early phases of their lives almost exclusively in the stems or roots of plants. Eggs laid in wood crevices or gnawed excavations produce tunneling grubs which thrive on a woody diet for from a few months to several years.

Then comes a period of quiescence and non-feeding, during which radical tissue changes slowly mold the adult form. Upon emergence from this pupal state, the now-adult beetle gnaws its way to freedom. Some cerambycids take no further food; their sole reason for attaining adulthood seems to be the finding of a mate and its consequence of fertilization and egg laying. Death soon follows reproduction, for nature has by then accomplished a complete cycle.

When the *Lauro Sodré* docked in Belém, I must confess that I knew more of beetle behavior than of Amazonian scenery. My preoccupation had been with *Titanus*.

In this one-track state of mind I tarried in Belém only a few days before setting out on my last foray—this time, to Brazil's Territory of Amapá, where savannas and vast jungle tracts fill the map from the north flank of the Amazon Delta all the way to French Guiana. During the previous January, Brazilian entomologists had found two *Titanus* specimens there; eight of the British Museum's nine specimens bear French Guiana labels. In this region, where some of South America's most superb rain forests tower, I would chance a final hunt.

Accordingly, I flew 200 miles across the delta to the territorial capital of Macapá, then continued northwest via railway to the end-of-the-line settlement of Serra do Navio. Beyond this outpost lay jungle as dense and uncharted as any in the world.

"You've certainly come to the right place," mine superintendent Gilbert Whitehead said. "Just now," he continued, "you don't see many insects because of the dry weather. But the

raains could start any day. And then they will be plentiful."

From weather data for these parts, I had timed my visit to coincide with the transition from dry to wet season. There is evidence to indicate that only when the jungle is newly drenched do the giant cerambycid beetles emerge from under bark and logs for their nocturnal mating flights.

Mr. Whitehead led me to an aluminum-roofed dormitory-bungalow. A verandalike porch hanging over the steep bank of the Amapari River provided a magnificent view not only of the water but also of the tropical forest all around. From the near-by clearing protruded enormous half-buried knobs of coal-black rock.

"That's why you're here," said Mr. Whitehead, indicating the solid wall of jungle. "And that's why we're here," he added, nodding toward the black rock masses that seemed more like meteor fragments than ore. "Our mine is one of the most prominent producers of commercial-grade manganese ore."

Only a few years earlier this area had been unmapped, virtually untrodden. Today, under a Brazilian-American company known as ICOMI, there are modern bungalows and dispensaries, with iceboxes and bathtubs, not to mention the technological wherewithal for mining and handling a vast tonnage of manganese ore—ore critically important to the Western World's metal industry.

Oasis Deep in a Wilderness

A week earlier at ICOMI's main offices at Porto Macapá, 100 miles to the southeast, I had talked with Dr. Robert D. Butler, a geologist and the company's general manager.

"We've created an oasis in the Serra do Navio wilds," he said. "Changed everything," he added, "that is, everything except the bugs. I'm sure you'll find plenty of them."

But luck seemed to have forsaken me. Day after day I waited and wished for storm clouds. But no rain came—only a monotony of perfect weather. This *would* be the unusual year!

Nevertheless, seeking specimens with willing helpers recruited at Serra do Navio, I probed jungle trails, clambered up dry creek beds, turned over logs, stripped off bark, killed an occasional snake, dug into humus mounds, prowled long night hours under floodlights. We found many fascinating insects, but none were of the genus *Titanus*.

"What more do you seek, senhor?" asked



Tenacious *Megasoma* Lifts a Two-pound Log

The *Megasoma* is a scarab beetle, one of the world's largest, and possibly the heaviest still in existence.

Ancient Egyptians regarded a related but smaller species as sacred, a symbol of eternal life. They used carved images of the black beetles as charms, ornaments, and gifts. Often they buried half a dozen with a mummy and painted a scarab's likeness on the tomb.

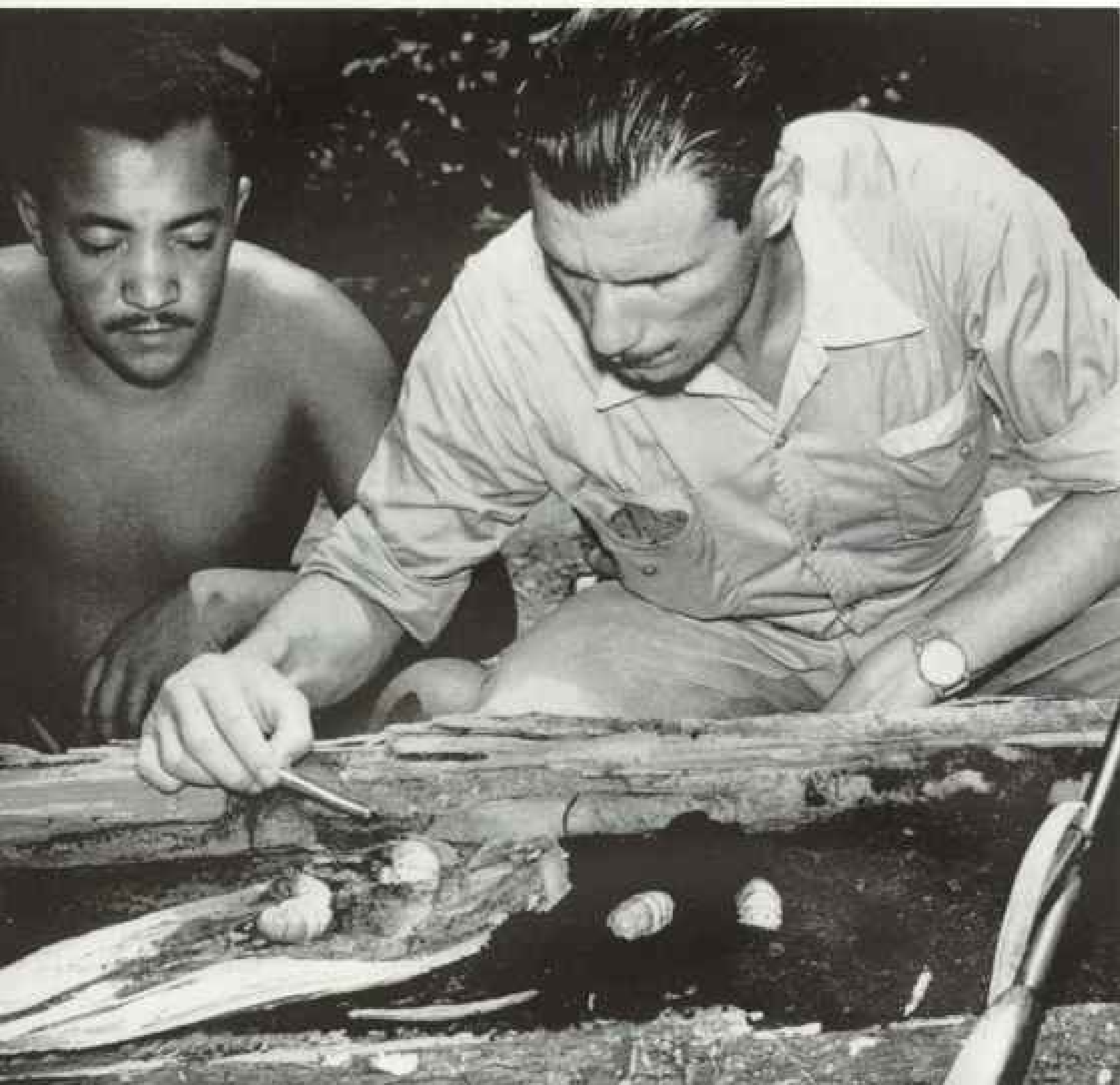
Here Mr. Freshman demonstrates the *Megasoma*'s powerful grip. A ribbon-tied male, its taloned feet clawing the soft wood, refuses to let go.

A male *Megasoma* crawls into camera range on a fallen tree in the Brazilian jungle outside Serra do Navio.

Ivory-hard horns of male *Megasomas* make a distinctive charm bracelet. Some Indian tribes believe the pendants increase the wearer's potency.







Voracious *Megasoma* Grubs Chew a Hardwood's Heart to Sawdust

Matamata trees in the Brazilian rain forest harbor the enormous blue-white grubs. Tunneling through the trunk, the immature beetles thrive on the woody diet for several months. Senhor Elias collects specimens in a tree felled by the woodcutter at left.

10-year-old Antônio, son of a Brazilian mine employee, as he saw me gazing wistfully up at the sky. This handsome barefoot lad had accompanied me as net carrier on a number of my wanderings around Serra do Navio (pages 648 and 663).

To my reply of "Rain and big *besouros* [beetles]," Antônio looked only puzzled. Why did this *norte americano* wish to change so happy a condition as clear, dry weather and bug-free evenings?

Yet Antônio was truly delighted with the elephant beetles we found here and there. These bulky black specimens of *Megasoma octacon*—adults of blue-white scarab grubs

such as I had found near Manaus—were a bit more than four inches long, with the male possessing a grotesque horn, hard as ivory, curving frontwards and upwards from the forehead (page 662).

Another consolation prize was a preserved 5-inch-long *Titanus* caught the year before and kindly presented to me by Antônio Moraes, a company employee. I accepted it gratefully, but it was clear that my hopes for living *Titanus* had been rudely upset by failure of the rains to arrive on schedule. That this was big-beetle country there could be no question. But when would the wet season begin, so that they would start flying?

While waiting, I decided to make a side excursion northward to the Brazil-French Guiana border to visit some Indian tribes inhabiting that area. For years I had read of South American aboriginals eating the grubs of giant insects. Could these have been *Titanus giganteus*?

Water Nymph Dives into a Stream

Arthur F. Beynon, the mine's assistant superintendent, accepted an invitation to go along. Before we left, chief mining engineer Howard G. Fleshman promised that everyone at Serra do Navio would be on the lookout for beetles, should the heavy rains begin before our return. He prepared signs bearing a sketch of *Titanus*, which we posted, together with a reward offer, at strategic points in the camp (page 660).

Not long after a *Cruzeiro do Sul* plane set us down at the border town of Oiapoque, Art Beynon and I found ourselves in a place just about as remote from the modern world as one can find anywhere on this planet.

Together with Senhor Roque Pennafort, Prefect of Oiapoque, and several Brazilian helpers, we teetered our way on foot over water-smoothed logs that lay end-to-end across a margin of mud which separated our canoe from the jungle shore. In a clearing several hundred yards inland from the Oiapoque River we could see the peaks of thatched roofs and rising wisps of pale-blue smoke.

While the party went on toward the village, I lingered near the river to take some pictures. Suddenly a half-naked, exquisitely proportioned Indian girl of about 17, with a wealth of ebony hair cascading around her shoulders, appeared from over the embankment. Like a happy fugitive from Herman Melville's *Typee*, she brushed past me and in an instant was racing down the logway. At the other end, where our canoe lay tethered,

she threw off her sarong and dived gracefully into the river.

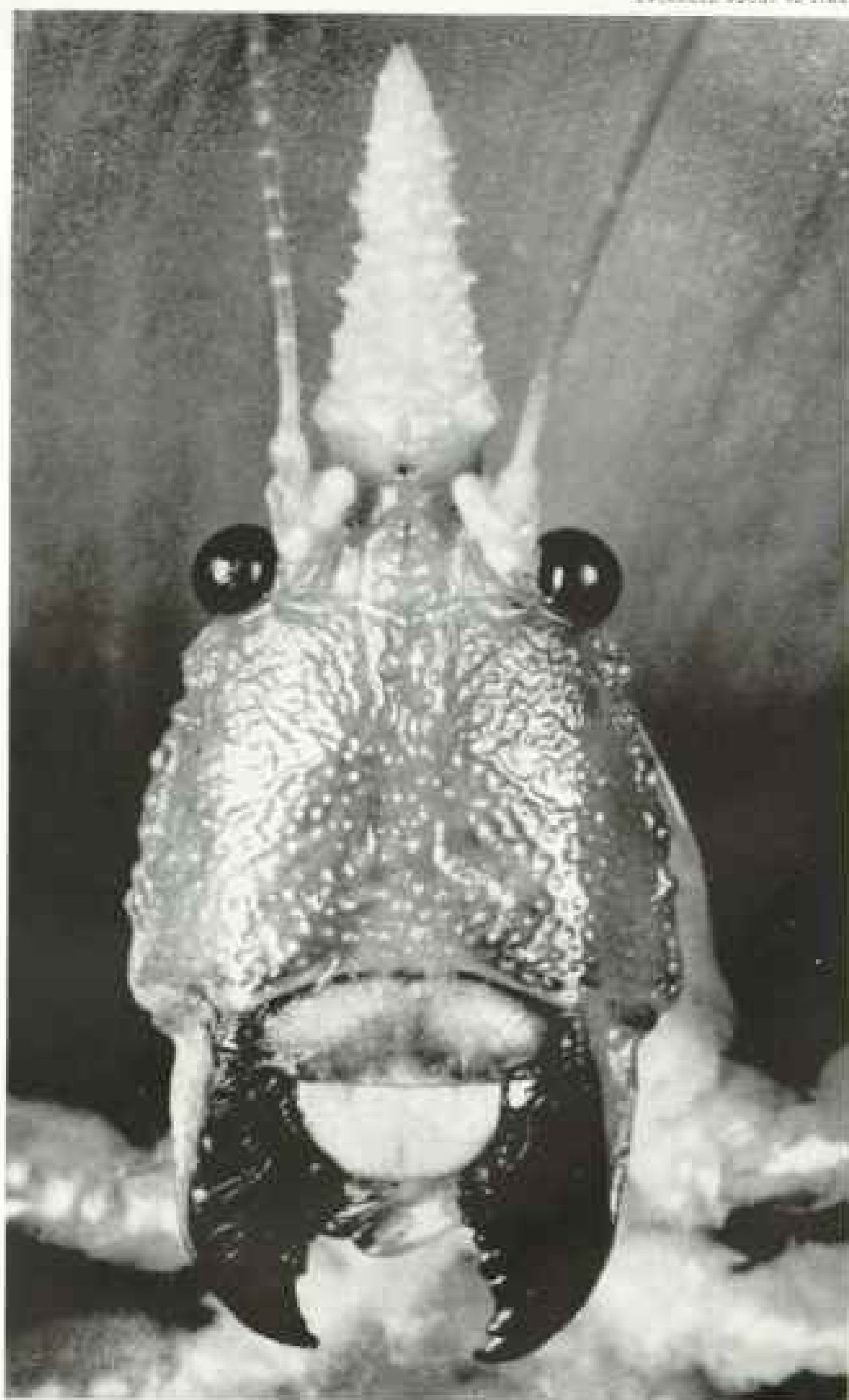
A little later, as we sat in the open-sided hut of one of the village elders, the water nymph reappeared, bathed now and somewhat clothed, her hips bound in a brightly colored fabric and her neck and bosom draped with necklaces of glass beads and crocodile teeth.

I opened a box I had brought along containing two items—the *Titanus* specimen received from Senhor Moraes, and an elephant scarab.

Through an interpreter, I explained that I had come to northern Brazil in search of ants,

Cone-headed katydid, a bizarre member of the long-horned grasshopper family, chirps by rubbing front wings together. A North American cousin sings "Katy did, Katy didn't!"

ENLARGED ABOUT 40 TIMES





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Titan's Pincers Snap a Match; They Could Slash a Finger to the Bone

Boarding an Amazon River vessel, the author locked his stateroom and let Titanus stalk across bed, rugs, and this striped traveling bag. Powerful jaws cracked the match with one twist. Shape of the many-faceted eyes permits extreme wide-angle vision.

beetles, and the like. "This one," I said, showing the brown monster, "is one of the biggest beetles in the world. Have your people, in chopping down trees and making jungle clearings, ever seen the likes of it?"

All eyes were on the insect. Indian fingers pushed forward curiously to touch its hard wing coverings and its feelers and feet.

The Indian girl boldly held out both her hands to me. I placed the brown giant into one, the black *Megasoma* into the other. The whole assemblage broke out in laughter, and the girl too went into paroxysms.

Our copper-skinned host, reclining in a cloth hammock (page 645), quieted the laughter by commenting: "Yes, the black one in our Galibi tongue is known as *unacailiacai*; we see it often. But the brown insect is unfamiliar, unless it be the rare *tukxin*."

Insect Diet a Thing of the Past

I pressed another aspect of the matter: "It is said that some jungle Indians eat such beetles or their grubs. Is this correct?"

The elder thought for a time, then replied: "In times when game was scarce, our ancestors may have eaten insects. Today we have no need for such food. We raise chickens, and the river provides plenty of fish. Our clearings of manioc and maize and bananas keep us well fed." He laughed at the thought of anyone eating insects.

Previous to this visit we had taken our canoe up and down various other jungle waterways of the area, stopping wherever we found natives to inquire into their knowledge of insects, especially of the two giants I carried as samples. The Curipis, Paricuras, and Galibis all delightedly examined my specimens (following pages). But none could say where we might find more; nor did they seem to have any specific information as to *Titanus* natural history.

When Art and I arrived back at Serra do Navio, our first stop was at the Fleshman bungalow. Howard was not yet in from the mine, but his wife, Ruth, greeted me.

"Thank heaven, you're back!" she said. "The freezing compartment of my icebox is full of beetles. Howard won't give me a bit of space for food."

A little later the accused appeared. He took me into the kitchen, opened the refrigerator, and showed me the bulging compartment. "We've had some rain," explained Howard, "but not the real thing yet. I've kept scores

of elephant beetles for you, but I haven't seen anything yet that looks like a *Titanus*."

Well, I philosophized sadly, that's the way it goes. I could wait no longer for the rains to come.

A month later, back in my New York apartment, I was sitting on the floor of the living room, sorting, classifying, pinning, and labeling my Amazonian insects, when the buzzer sounded and I went to the door. It was a special-delivery letter from Howard Fleshman, still in his jungle outpost. He had promised to carry on the hunt for giant beetles when the rains finally came.

I quickly scanned past the letter's amenities, then came to the following paragraphs:

"Two days after you left, we got our first *Titanus*. A real beauty, perfect, and six inches long. They started coming in 'in force,' and for two weeks we got several bugs a day. They were all frozen (you should hear Ruth) in the freezing compartment of our little refrigerator. I believe there are 15 *Titanus*.

"I took all comers. Several are minus a leg, antennae, or one thing or another. However, every person who brought in a mutilated one said they found it that way. They chewed the office pencils up. The *Titanus* can actually cut a standard drafting pencil in two. Also they are fighters. I made the mistake of placing two together, and one cut the other's antennae.

"I am packing all that I have to date in order that Art can post them in Belém on or about the 20th."

Family Unpacks a Beetle Bonanza

This momentous news was followed within a few days by a large wooden box labeled: "Preserved Biological Specimens. For Scientific Use Only."

My wife and two children gathered around, nearly as breathless as I. The smell of naphthalene filled the room as I detached the lid and carefully pulled away pad after pad of packing tissue.

Finally, there they were—15 enormous, shiny specimens of *Titanus giganteus*—to me the most beautiful sight in all the world.

"These big ones could turn out to be record-breakers," I exclaimed to Eda and the children, "and now our collection of *Titanus* may well rank as the largest in the world!"

"We could start a museum," suggested my young son Paul.

So we could, I had to agree.

Sample Beetles Fascinate the Paricura Indians

"Don't be discouraged," an entomologist cautioned the author on the eve of his trip, "if you don't find *Titanus*. Remember, it is extremely rare."

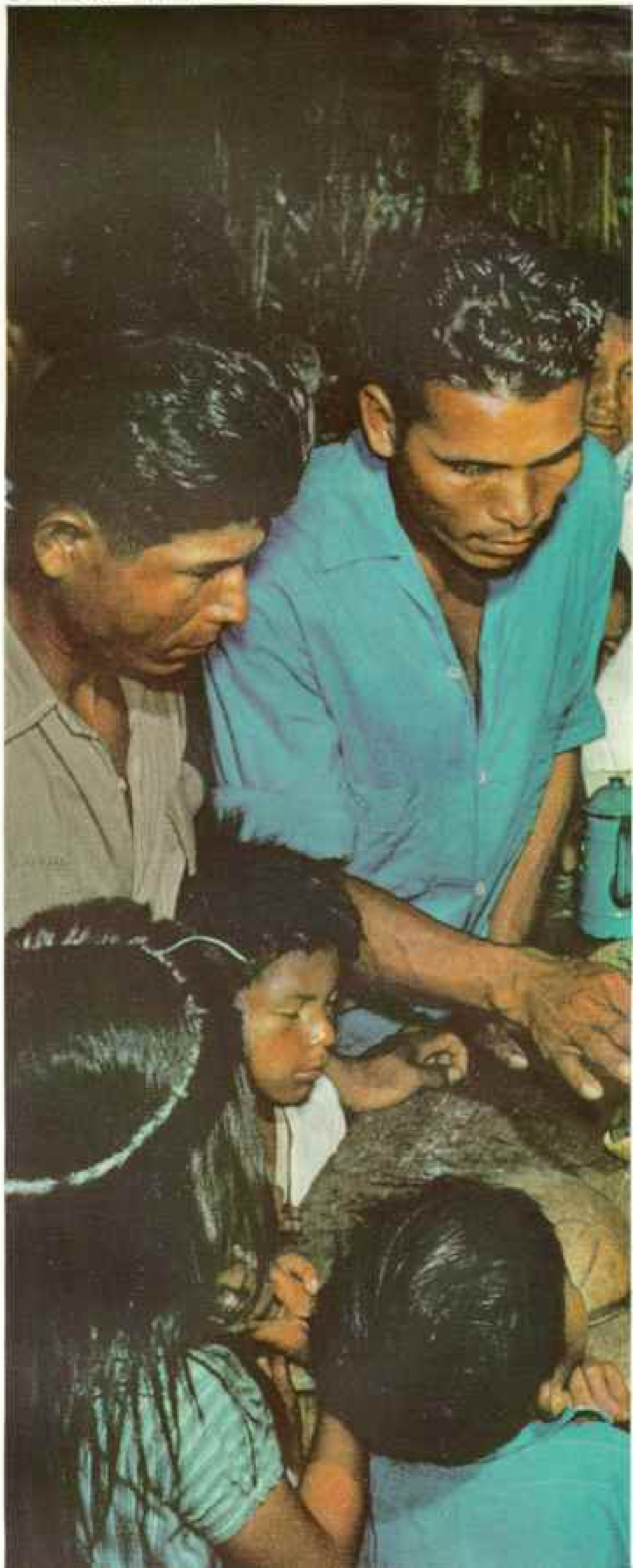
Canoeing the jungle waterways of northern Brazil, Dr. Zahl showed specimens of *Titanus* and *Megasoma* to a number of Indian tribes. Many, like these Paricuras, had never seen the scarce giants.

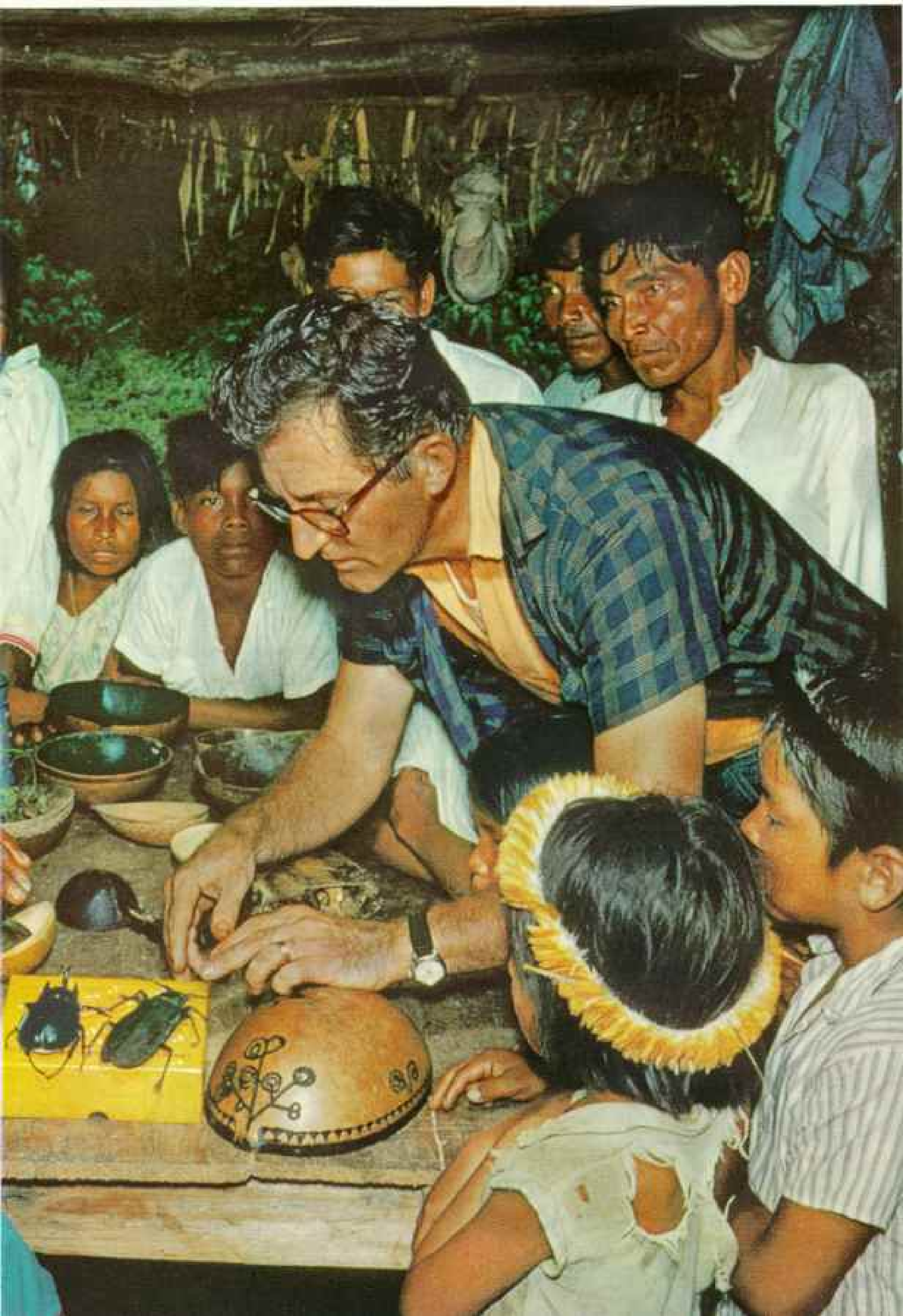
"A group of people viewing the beetles in Times Square couldn't have expressed more amazement and curiosity," reports the author.

The Paricuras, he points out, dressed in deference to his visit. Ordinarily they wear fewer clothes.

Calabash cup on table demonstrates the tribe's art.

Big beetle, big smile. A Paricura girl, wearing a hair band of feathers, displays teeth filed for beauty. A gift of lipstick delighted her; she immediately streaked nose and cheeks a vivid red.





Natural-color photographs reveal the spectacular beauty of distant nebulae and galaxies

First Color Portraits of the Heavens

By WILLIAM C. MILLER

Research Photographer, Mount Wilson and Palomar Observatories

With illustrations by the author

WHEN A STARGAZER turns his eye heavenward, he sees only a black vault spangled with silver. He catches the merest hint—the sapphire glint of Sirius or the warm glow of Mars—that the heavens blaze with colors his eye cannot discern.

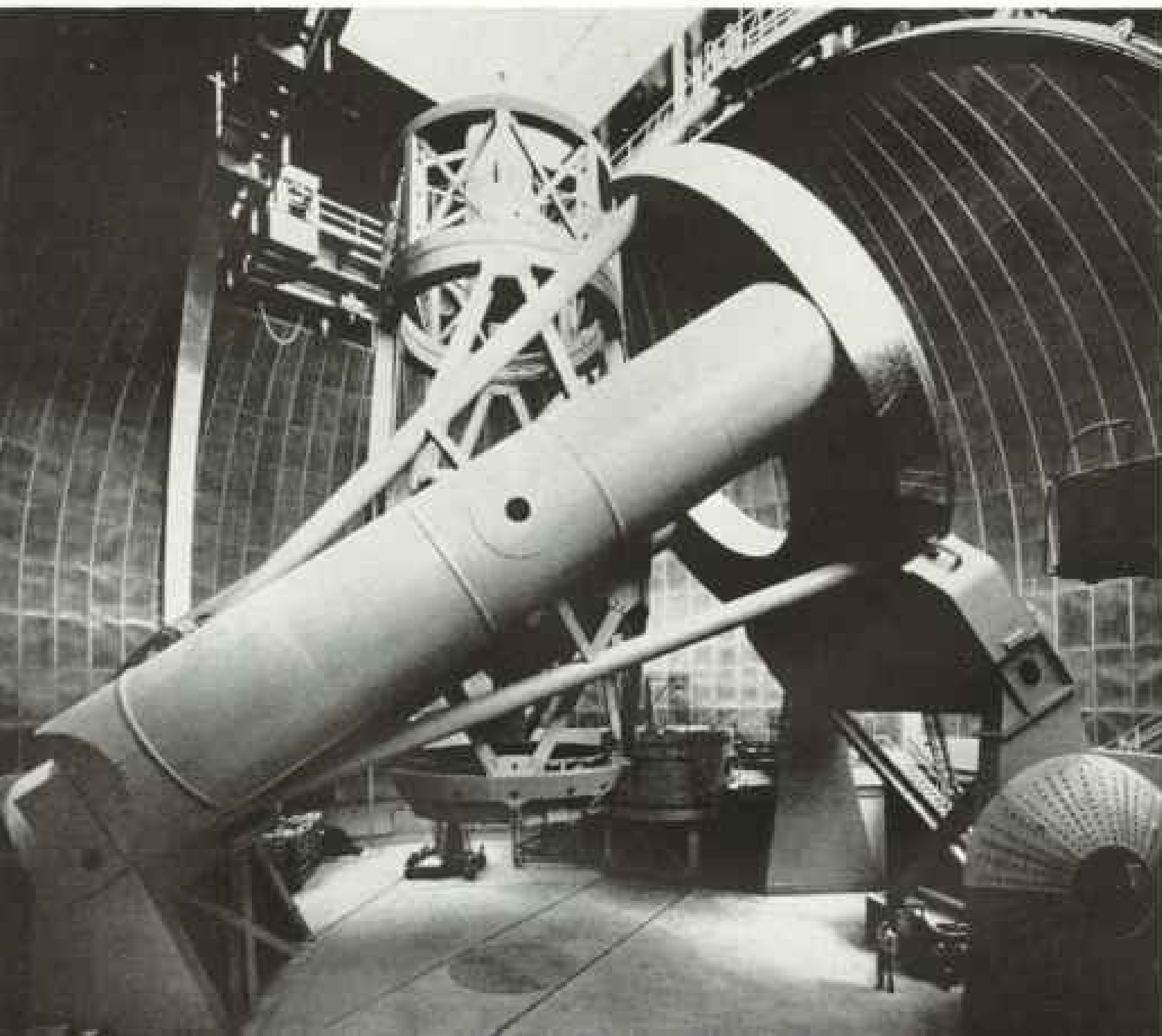
The colors are there, nonetheless, and astronomers constantly study them. Now for the first time we have reasonably accurate color photographs of some of the most impressive wonders of space. They are far more spectacular than color pictures of the planets, which show only pallid hues.

Astronomers talk about blue stars and orange stars and yellow stars; about red giants and white dwarfs. Through telescope and spectrograph we seek constantly to determine star colors, for these studies tell much about temperature and chemical composition.

Yet even our most powerful instruments do not reveal the full glory of the most dramatic celestial displays—the clouds of gas and dust called nebulae. These interstellar clouds, extremely common, fill enormous regions of space. Some are veils of darkness, blotting

(Continued on page 679)

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ALL STARS AND NEBULAE FROM WUBST WILSON AND PALOMAR OBSERVATORIES © NATIONAL GEOGRAPHIC SOCIETY

Crab Nebula, Remnant of an Exploding Star, Glows Like Veined Marble

Chinese astronomers in 1054 recorded the appearance of a star so bright that it shone by day. It blazed for a few months, then disappeared. What the Chinese saw was nature's rarest and most awesome fireworks, a supernova. Erupting with the brightness of a hundred million suns, the star ejected this cloud of gas, which ever since has been expanding 70 million miles a day. High-speed electrons, still gyrating violently after 900 years, illumine the nebula's interior. Racing electrons in the Crab's tentacles collide with nitrogen and hydrogen atoms, causing them to glow cherry red.

Invisible to the eye, the radiant colors on these pages are accurately presented for the first time with the use of newly developed supersensitive film.

Andromeda's Whirling Blue Pinwheel Combines the Fires of Billions of Suns

This magnificent hub of incandescence is barely visible on a clear night as a hazy wisp in the constellation Andromeda. Until a few decades ago astronomers still believed it to be a nebula—a luminous cloud of gas.

But in the 1920's Edwin P. Hubble, working with the new 100-inch telescope on Mount Wilson, proved that the misty patch was not a nebula at all but a system of separate stars, the first that man had ever discovered outside his own galaxy.

Gradually other galaxies came to light; the National Geographic Society-Palomar Observatory Sky Survey has shown their number to be legion. With few exceptions, each of these millions of galaxies is populated by billions of suns. They lie so incredibly far away that their stars seem to melt together into luminescent blurs.

Andromeda is the most distant object visible to the naked eye. Its light, traveling 186,000 miles a second, requires about two million years to reach earth. Its diameter measures 100,000 light years.

An observer far out in space would see Andromeda and our own Milky Way as sisters—two similar pinwheels.

All the 18,000-odd stars visible in this photograph belong to our galaxy. Andromeda's giant blue stars, young and superhot, merge into a shimmering blue halo among the galaxy's spiraling arms. Temperatures of these atomic furnaces range as high as 80,000° F. Ancient red giants, cooler than our own sun's 11,000° F., give a yellowish cast to the center.

Two small galaxies near Andromeda appear to revolve about it like satellites around a planet. They are known only by catalog numbers: NGC 205 (left) and NGC 221.

In the arms of Andromeda's Great Galaxy shine many gaseous nebulae like those of our own system pictured in these pages. They are too small and faint, however, to show in the photograph.

PHOTOGRAPHS WITH THE EXHIBIT © NATIONAL GEOGRAPHIC SOCIETY





Cosmic Smoke Ring Encircles a Hot Star

The Ring Nebula in Lyra, a familiar sight to amateur astronomers, appears relatively colorless through the telescope because the eye cannot detect colors at low light intensities. But high-speed color film, which accumulates light in a way the eye cannot, reveals this astronomical gem in all its prismatic beauty.

Although nebular gases appear dense, they are incredibly rarefied. This ring, with only a thousand atoms of gas per cubic centimeter, far surpasses most vacuums attainable on earth.

A very hot blue star centered in the ring bombards the gases with invisible ultraviolet rays. Fluorescing gases convert the energy to visible light. Colors vary according to their distance

The turbulent Great Nebula in Orion suggests an inferno such as Dante had in mind. But no fires light this frightful scene. Celestial "flames" are gases fluorescing under the stimulus of hot stars near by.

Blue reveals a high proportion of oxygen; red indicates a predominance of hydrogen, the pri-



mordial building block of the universe. The light area would show the same fiery colors had not excess light overexposed the film.

This vast and magnificent cloud of glowing gas appears to the naked eye as the middle star in the sword of Orion, one of the most conspicuous constellations in the winter sky. Distant from earth

by 1,500 light years, the nebula measures 15 light years across. Despite the extreme thinness of its gases, the cloud contains 10 times as much matter as our sun.

A tremendous curtain of fine interstellar dust at the lower right corner blots out most of the light from the region beyond.

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PHOTOGRAPHER WITH THE HALE © NATIONAL GEOGRAPHIC SOCIETY





Blue and Red Traceries Mark the Veil Nebula in Cygnus, the Swan

Faint brushes of color across an infinity of stars in the Milky Way form an enormous wreath of interstellar gas. Astronomers trace the origin of the nebula—also called the Cygnus Loop—to the explosion of a supernova 50,000 years or more ago. The monstrous blast ejected vast quantities of hydrogen, helium, and other gases at some 5,000 miles a second. As these rushing clouds collide with scattered atoms of interstellar matter, they dislocate electrons, and the ionized atoms glow with light.

Sweeping up cosmic debris, the nebula has increased its mass perhaps 50 times; its speed has dropped to 75 miles a second. Within 25,000 years it will have faded away.





out everything behind them and leaving black voids. Others are highly luminous. Affected by hot stars relatively close by, they fluoresce in reds and blues and greens and violets, not unlike the advertisers' signs on earth.

Unfortunately, these vibrant colors are no more visible than are the colors of flowers by moonlight. In dim light the eye loses its ability to perceive color. Even in the Great Nebula of Orion (page 675), by far the most brilliant of the nebulae, telescopes reveal only faint tints of bluish green and pink.

For years we have had some idea of what the eye has been missing. We have learned much about nebular colors by comparing black-and-white photographs made alternately on red- and blue-sensitive plates—for example, the Sky Survey charts produced recently by the National Geographic Society and Palomar Observatory.* But even with this evidence, astronomers could not agree on how color photographs of the nebulae would look.

The unprecedented pictures reproduced on these pages were not possible before the development of Super Anscochrome, the new film that triples the speed of color photography. Even with this ultrafast film, such finely detailed photographs could not have been taken except with the 200-inch Hale and the 48-inch Schmidt—the unique telescopes on Palomar Mountain operated jointly by the California Institute of Technology and the Carnegie Institution of Washington.

Clockwork Keeps Hale Aimed at Stars

Both these telescopes are in reality cameras. The Hale can gather starlight from more than 6,000 billion billion miles away. It could photograph a candle flame 30,000 miles distant. Some 500 tons of moving parts, controlled by exquisitely fine clockwork, keep the barrel perfectly aimed for exposures that continue for hours (page 670).

Oddly enough, no color photograph as it comes from the camera can show the nebulae faithfully. In the case of the Crab Nebula (page 671), the misty light required nearly

five hours of exposure. In such faint light, photographic film works less efficiently than in bright light, and in color film the red- and green-sensitive layers of the emulsion lose much more sensitivity than the blue layer. To bring the Crab's colors back into balance, a copy had to be made from the original, filtering out two-thirds of the blue and a fifth of the green.

Such intricate color-correction processes, worked out with the cooperation of Ansco engineers during two years of experiments, assure that the pictures you see here are as true as the photographic art now permits.

New Films Aid Star Study

How significant are these photographs? Are they merely dramatic and beautiful showpieces, or are they scientific tools?

No one can yet be sure. But the initial reaction of astronomers has been that of pleased surprise. After seeing the Veil Nebula (pages 676-7), one scientist told me, "I have learned more in ten minutes looking at this photograph than in two years studying black-and-white plates."

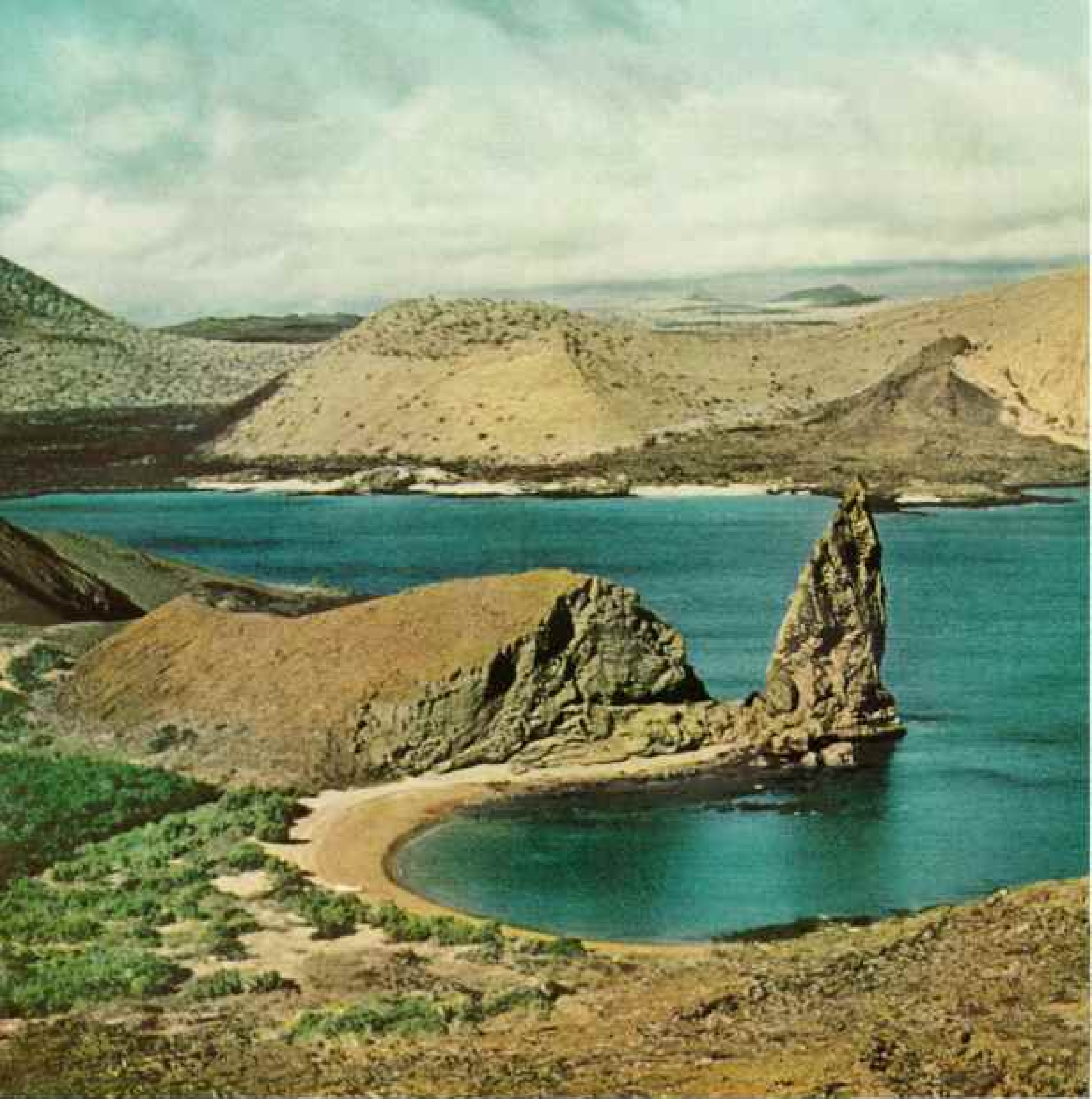
I believe that color photography holds much promise for astronomy, especially as we improve techniques. Color pictures bring together in one view many bits of information that otherwise must be laboriously picked out from several black-and-white negatives. And with color film, an astronomer can quickly select stars and glowing threads of gas whose differing colors offer promise for special study.

For astronomer and layman alike, the beauties of the heavens—already overwhelming in their magnificence—are here revealed in unparalleled splendor. Their subtle details and blending hues are perceived only through the camera's eye, for the human eye will never see them directly, even through the world's most powerful telescopes.

* See, in the NATIONAL GEOGRAPHIC, December, 1956: "Sky Survey Charts the Universe," by Ira Sprague Bowen, and "Exploring the Farthest Reaches of Space," by George O. Abell.

Obscuring Dust and a Pink Nebula Outline a Heavenly North America

High overhead in the summer Milky Way, this extraordinary likeness of the continent rides in the constellation Cygnus. The filtering action of interstellar dust causes its flush, just as particles in earth's atmosphere redden the sunset. Dust clouds shroud the stellar "Gulf of Mexico" and adjoining "oceans." Hot blue stars in the neighborhood provide the energy exciting the gases. Stars in the upper part of the picture number approximately 4,200 to the square inch on the original film. By comparison, 34,000 stars powder the entire sky on pages 676-7.



*Dragonlike iguanas, giant tortoises,
and tree-climbing sea lions greet Yankee's
crew in the "ash-heap" islands*

Yankee, world-traveling brigantine, anchors off Bartholomew Island's spirelike Sentinel Rock. Congealed lava from dead volcanoes spills across a fantastic Galapagos landscape. This view, taken from the lip of a crater, looks across Sullivan Bay to James Island.

Saffron-hued iguana basks in the sun. Members of the *Yankee* crew, dining on iguana tail, described it as a cross between chicken and beef.



ILLUSTRATION BY CHRISTOPHER SHELDON © NATIONAL GEOGRAPHIC SOCIETY

Lost World of the Galapagos

By IRVING AND ELECTA JOHNSON

GENERATIONS of voyagers have recorded the cruel and eerie atmosphere of the Galapagos Islands.

"Nothing but loose Rocks, like Cynders," wrote an 18th-century privateer, "very rotten and heavy, and the Earth so parch'd, that it will not bear a Man, but breaks into Holes under his Feet."

The young Charles Darwin stepped ashore

from the *Beagle* into a scientific wonderland of giant tortoises and yard-long swimming lizards found nowhere else in the world. "Nothing could be less inviting," he noted of their habitat, "a broken field of black basaltic lava, thrown into the most rugged waves, and crossed by great fissures."

And the awe-struck Herman Melville wrote of the Equator-straddling archipelago: "In

no world but a fallen one could such lands exist."

Beating toward the Galapagos from Panama, our brigantine *Fankee*—bound around the world—made her first landfall on Tower Island. The helmsman eyed Tower with dismay. Could this dull, gray, lifeless hump be the gateway to the fabled Enchanted Isles? Like his shipmates, amateurs all when we sailed from Gloucester a month before, he already fancied himself an old salt.

"We won't find any action on that ash heap," he grumbled.

The ship nosed her way between two headlands into the calm circle of Darwin Bay. Walls of this submerged crater rise almost vertically out of the water. Only the seaward entrance—blown open by some long-ago eruption—and a small beach of white sand break the ring. On a shelf four fathoms down, *Fankee's* anchor chain clattered and the hook went solidly home.

Visitors Handle Fearless Birds

Lava cliffs frowned down on us. Beyond, the landscape stretched grim and empty (page 686). Not a blade of grass was visible among the harsh volcanic crags. Still, within minutes after landing on Tower, our helmsman had to dine on his words.

Just a few steps inland, we found birds nesting on a tangle of tough, low, springy growth. We could—and did—walk up to them and pick them up. Big black frigate, or man-of-war, birds with six-foot wingspreads made a flapping armful. Blue-footed boobies watched approvingly as we scooped up their nestlings and fondled them. Mockingbirds ran stiff-legged across the rocks for a closer look at us.

Some of our crew members ranged the shoreline, pursuing shiny red-and-orange crabs that scuttled over the wet rocks.

"Hey, look, dragons!" someone suddenly cried. On a near-by lava shelf black sea

iguanas were sunning themselves by the hundreds (page 694). Exy, my wife, caught one by the tail and held it at arm's length. There it writhed mightily, a fearsome monster with clawing talons, bristling horny spines, and prehistoric aspect—but quite harmless.

"A hideous-looking creature," observed Darwin in his famous chronicle, "of a dirty black colour, stupid and sluggish in its movements. . . . I threw one several times as far as I could, into a deep pool left by the retiring tide; but it invariably returned in a direct line to the spot where I stood. . . . I several times caught this same lizard, by driving it down to a point, and though possessed of such perfect powers of diving and swimming, nothing would induce it to enter the water; and as often as I threw it in, it returned in the manner above described. Perhaps. . . this reptile has no enemy whatever on shore whereas at sea it must often fall prey to the numerous sharks. Hence, probably, urged by a fixed and hereditary instinct that the shore is its place of safety. . . it there takes refuge."

Testing Darwin's theory, Exy tossed her iguana into the water. Sure enough, it beelined back to shore, right at her feet.

Irate Sea Lion Charges Boys

Farther along the shore, three boys—caught up in a frenzy of discovery—had cornered a sea lion. Annoyed, the old bull was anxious to reach the security of the bay. With a gruff roar, he charged; the boys prudently gave way, and he disappeared into the sea with a flash of fur and a loud splash.

In the afternoon the boys went spearfishing. Watching them was like peering into another dimension. In slow motion, their bodies glided through the flickering green of the bay (page 703). Their prey hovered uncertainly, fins rippling in the slight current. A sudden glint of light on a spear, and then a grinning boy broke the surface brandishing a fat

Giant *Galápagos*, Spanish for Tortoise, Gave the Archipelago Its Name

Charles Darwin, visiting the Galapagos in 1835, likened the reptiles to "antediluvian animals." In the early days thousands roamed the islands, reaching weights of 500 pounds and reportedly living as long as five centuries. Whalers and traders all but exterminated the tortoise for food and oil. Ecuador, owner of the archipelago, today protects the species. Ann Woodin photographs this survivor on Indefatigable Island.

Hunters boat a sea turtle off Indefatigable. The reptiles are only distantly related to the dry-land tortoises (above). Islanders gig them with pole and gaff, eat the flesh, and boil the fat for lard. Members of the *Fankee* crew hunted turtles barehanded, diving and forcing them to surface under their own power.



grouper—that night's dinner. The sport lost a good deal of its zest when a school of hammerhead sharks—huge, ugly, and hungry—closed in on us.

A handful of crewmen put out in the dinghy and managed to harpoon one of the intruders. The shark took off in an abrupt, diving rush that almost dragged the boat under. The crew, somewhat daunted by this display of power, breathed easier when the harpoon jerked free.

In spite of Tower's attractions, we sailed the next day to explore the farther reaches of the strange archipelago. These scores of islands and rocks, all of volcanic origin, total 3,000 square miles (map, page 688). Most are uninhabited, some are still unexplored, and a few—like Narborough—have seen recent volcanic activity.

The Peru Current, sweeping northward from the Antarctic, washes their shores. Besides tempering the climate, this cool oceanic stream swarms with plankton and fish. Among the migrants that have followed its rich trove to the Galapagos are such unlikely equatorial residents as fur seals, sea lions, and penguins (pages 696 and 702). For humans the temperature is ideal: warm days and one-blanket nights.

The dry, colorless aspect of the islands is no illusion. Fresh water is a rarity throughout the Galapagos. Many a sailor shipwrecked or becalmed on these shores has died of thirst. The inland heights of the large islands, however, trap passing rain clouds, which condense on the hillsides and support lush, junglelike vegetation. Both crops and livestock also thrive on the misty uplands.

The Galapagos were discovered in 1535 by the Bishop of Panama, Tomás de Berlanga. Sent by Spain to report on conqueror Pizarro's progress, he set sail for Peru. But his becalmed vessel drifted all the way from the coast of South America to the islands. Although history recognizes Berlanga's landing as the first on the Galapagos, evidence of much earlier pre-European visits was found by Thor Heyerdahl, of *Kon Tiki* fame, in 1953.

A gigantic vise, Kicker Rock appears about to crush *Fankee* between 486-foot-high jaws of stone. The ship merely nosed into the 30-foot channel; her yards proved too wide for passage. Crew members swam through accompanied by sea lions (page 696).

Spanish navigators nicknamed the Galapagos *Las Islas Encantadas* (the Enchanted Isles) for capricious currents that seemed alternately to attract and repel ships, as if by magic.



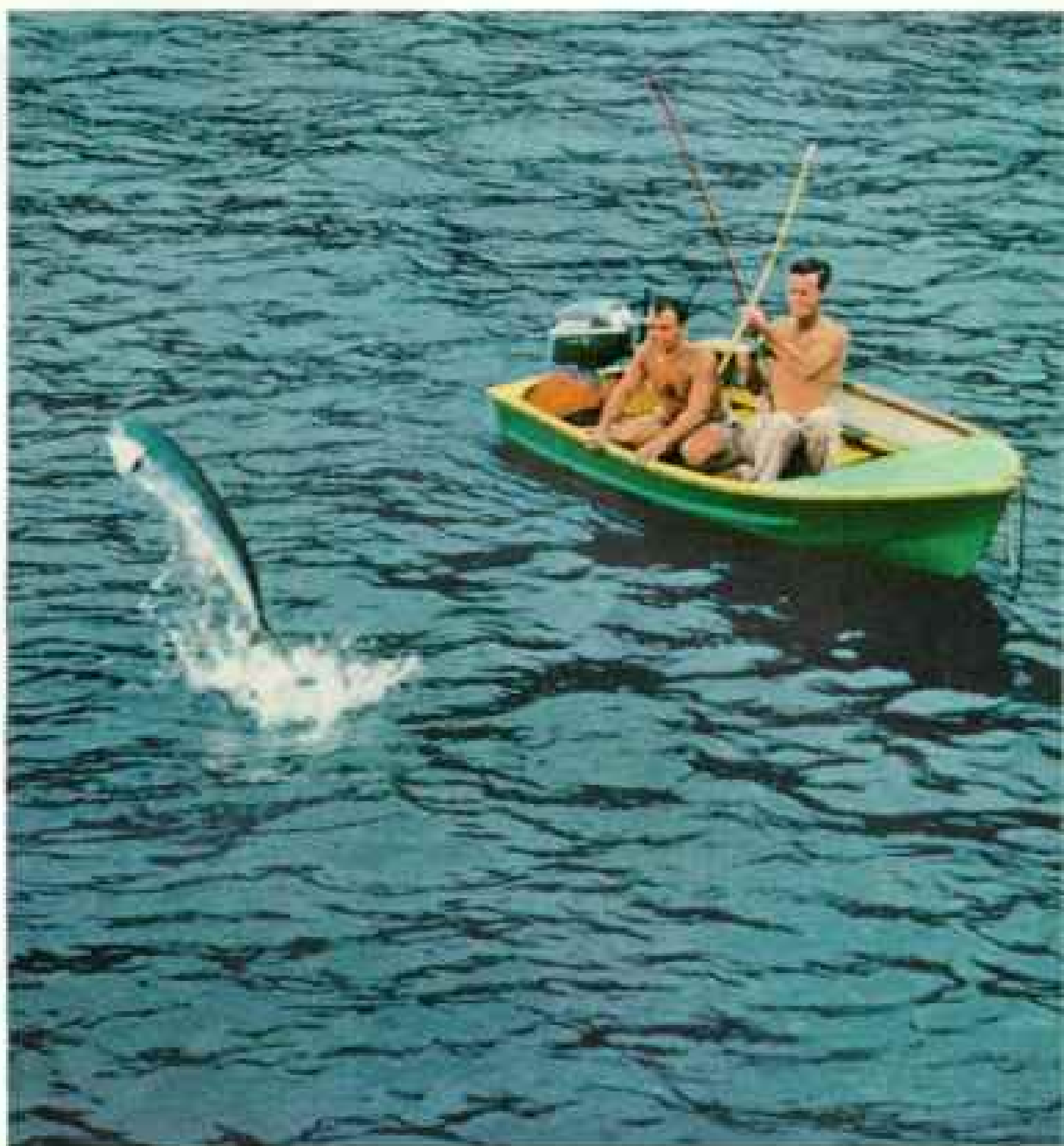




Salt-water Lake on Tower Island Floods a Dormant Crater

There are more volcanoes than people in the Galapagos. Of some 2,000 craters, only a handful are active. Scarcity of fresh water plagues settlers; for rain seldom falls save on mountain slopes. Guano, not sand, rims this brackish lake. Scrub growth and volcanic peaks lend a lifeless aspect. Darwin described the islands' vegetation as "wretched-looking little weeds" which "better become an arctic than an equatorial flora."

Blue-footed booby, fish-eating relative of the pelican, jeers at intruders on Albemarle Island. The clownish birds take their name from the Spanish *bobo* (fool.) "This fellow seemed to laugh at our clumsy efforts to catch fish," the authors wrote.



BYRON BOND BY HOW ALLAN

Hooked dolphin stands on its tail in Tagus Cove, Albemarle Island. Hungry sea birds tormented *Funker's* anglers, diving on lures and swallowing them before the fish could strike.

A collapsed oceanside crater shelters ships at Tagus Cove. Painted rocks on its walls bear the names of vessels that have called. Brackish water fills the smaller crater beyond.

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EDUCATIONS BY ANN S. WOODRIF © NATIONAL GEOGRAPHIC SOCIETY



The islands' name derives from their most striking inhabitant, the giant land tortoise or, in Spanish, *galápagos* (pages 685 and opposite). At one time these behemoths—some weighing as much as 500 pounds—swarmed here by the thousands. Now only a few survive, and even they are edging toward extinction.

The archipelago has also been known as Las Islas Encantadas, the Enchanted Isles; the strong and unpredictable currents in their vicinity so tricked early navigators that the islands seemed to appear and disappear like magic. The Spaniards were the first to confer individual names upon them, but in the late 17th century English pirates named them again—this time for high-placed Britons: Albemarle, Hood, Narborough, Bindloe, and James. Most of the islands still bear both Spanish and English names.

Pirates knew the islands intimately, for the Galapagos provided an ideal base for preying upon Spanish galleons plying between Peru and the Isthmus of Panama. The buccaneers

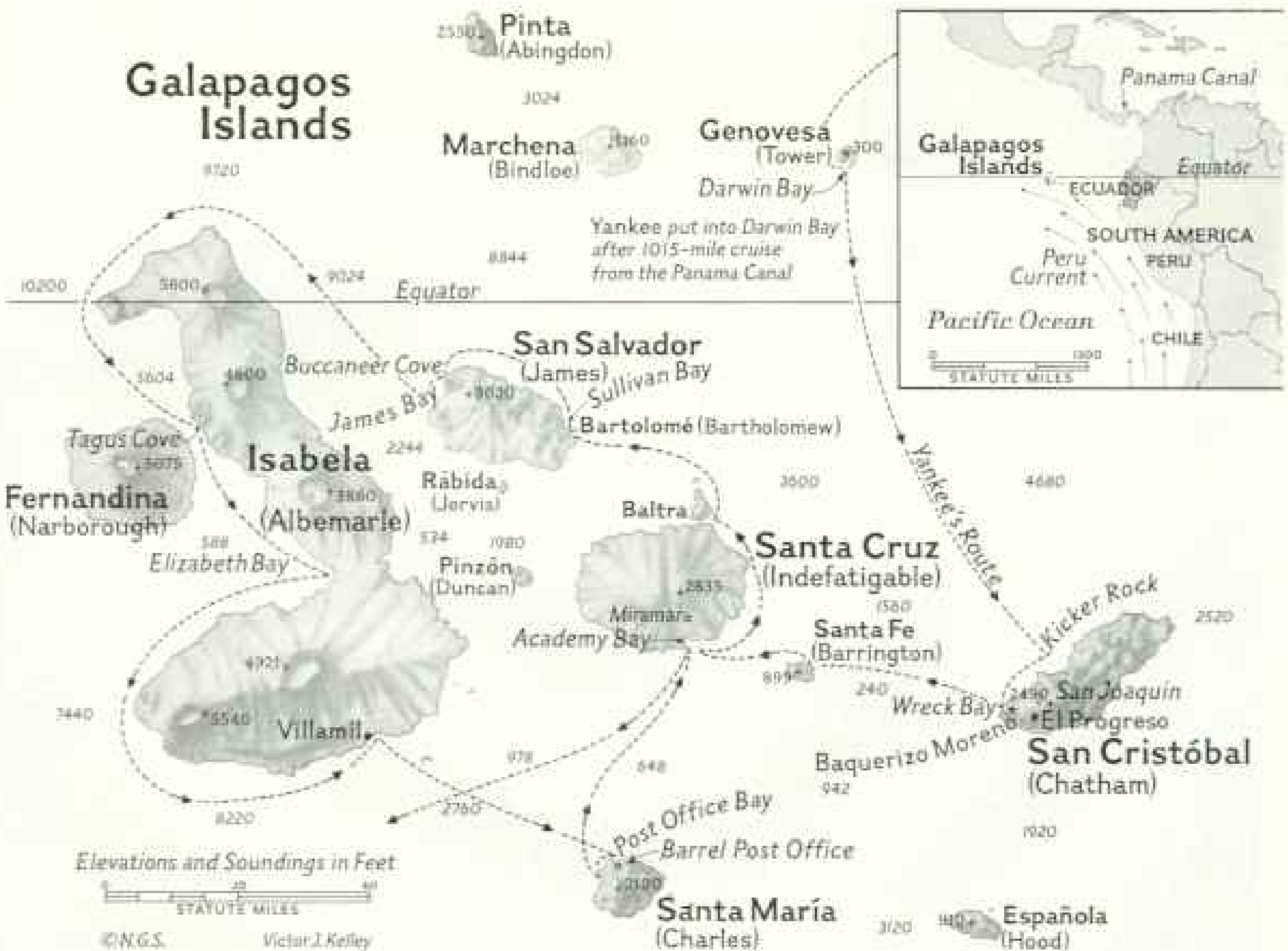
even stocked the islands with goats, pigs, and cattle to provide a steady supply of fresh meat. In the absence of natural enemies, these animals have multiplied incredibly; 75,000 wild cattle roam Albemarle alone.

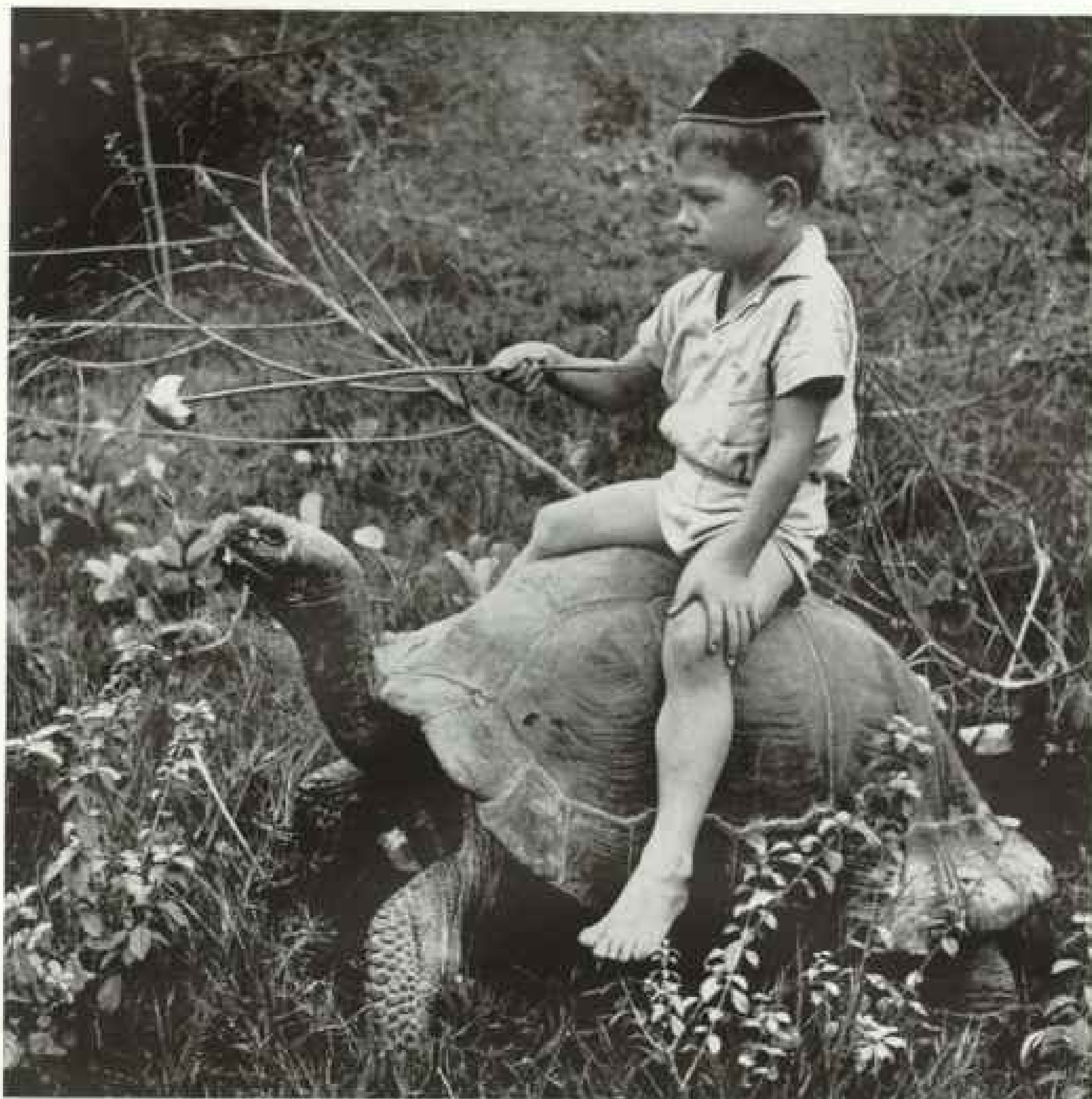
Tortoises Stocked Whalers' Larders

Then, in the 19th century, came the whalers. For the scurvy-threatened crews, the Galapagos were a larder of plenty. The gigantic land tortoises provided fresh, succulent meat; oil from their bodies was as pure and fine as butter. Best of all, the giants would hibernate in a ship's damp hold for a year or more. They required neither food nor water, and their meat remained in prime condition.

Whaling skippers were almost lyrical in their praise of tortoise meat, terming it far more delicious than chicken, pork, or beef. And, of equal importance to thrifty New Englanders, it was free. The whalers were so fond of it that they stowed an estimated 100,000 tortoises from the Galapagos in their holds.

Dormant volcanoes rising from the sea, the 13 major Galapagos Islands lie on the Equator, 600 miles west of Ecuador. Fewer than 2,000 people live in this lost world.





SELF ILLUSTRATION

Tortoise Chases a Banana; Boy Gets a Slow Ride on Indefatigable Island
Charles Darwin estimated the tortoise's speed at four miles a day, "allowing . . . time . . . to eat on the road" (page 683). This rider employs the donkey-and-carrot technique.

Often the crews lost track of exactly how many they had taken aboard. Back in New Bedford at cleanup time many a landlubber must have bolted in terror when he stumbled across a five-foot reptile in the bilges.

The depredations of the whalers decimated the defenseless galapagos. Entire islands were stripped of their last tortoise. To find the beleaguered survivors, one must now press far into the interiors of the more remote islands. But they still exist, and I once saw one with a steeply humped carapace higher than a table.

The tortoises, however, are fighting a losing battle. Although it is illegal, islanders still slaughter them for their oil. Wild dogs, cats, and pigs feed ruthlessly upon the young whose shells have not yet hardened.

The lumbering tortoises differed significantly from island to island, naturalist Charles Darwin reported after visiting the Galapagos on the *Beagle* survey expedition. This observation—together with one involving Galapagan finches—crystallized his theories on the evolution of species.

I would love to have seen the tortoises as Darwin describes them: "Near the springs it was a curious spectacle to behold many of these huge creatures, one set eagerly traveling onwards with outstretched necks, and another returning, after having drunk their fill." Ever the meticulous scientist, he adds: "One large tortoise, which I watched, walked at the rate of 60 yards in ten minutes, that is 360 yards in the hour or four miles a day."



Sober Herons Outstare a Visitor to the Nest

Seldom harassed by humans or predators, Galapagos birds remain unbelievably fearless. Dr. William Beebe, the naturalist, recalls that a wild heron taken aboard his research vessel off the islands pestered the crew and terrorized the ship's pet monkey.

Mother great blue heron and her young on James Island allow this boy to approach within five feet of their nest, a tangle of twigs in a mangrove tree.

Albatross meets mockingbird at her nest on Hood Island. *Fanber* photographers found the songsters so tame they had to shoo them off their cameras.

REPRODUCED BY HOW ILLUS (TOP) AND
FEB 1952 © NATIONAL GEOGRAPHIC SOCIETY

The Galapagos Islands are such uninviting chunks of real estate that no nation bothered to claim them until Ecuador planted its flag there in 1832. Some of the islands then became penal colonies, but not until the 20th century did settlers arrive in any numbers. Thin soil and scarcity of water make farming difficult; variable currents make commercial fishing hazardous, and the great distance from markets makes it unprofitable.

Modern bustle brushed the lonely archipelago briefly during World War II, when the United States established an Army and Navy base on Baltra Island. For a few exciting years planes roared in on a specially built airstrip, bulldozers carved out roads, the latest movies showed at the Rock-Si, and frozen food graced the messhall.

Mrs. FDR a Wartime Caller

Water was brought by tug from the one island where the Americans could build a reservoir (unfortunately not the same one where they could build a runway), and Mrs. Franklin D. Roosevelt even came to visit.

From Tower, I coned *Yankee* on an overnight sail to Wreck Bay and Baquerizo Moreno, the capital of the Galapagos on Chatham Island. The little port had grown to three times the size we had seen three years before. Now it has a civil governor, a naval headquarters, and more than 1,000 Ecuadoran residents. But still it is a village of shacks (page 699).

On Chatham, Exy wanted to call on an old friend. Karin Cobos had come here from Norway in the early 1920's, when a colonization scheme attracted a large number of Norwegians to the Galapagos, described by the promoters as a verdant paradise. When the immigrants arrived, the brutal realities of their situation overwhelmed them. Nonetheless, they set doggedly to work. But the unyielding lava conquered them in the end.

Gradually the colonists drifted back to the old country—sadder, wiser, and poorer. Vestiges of their foredoomed dream still exist on Charles Island, where streets of a projected city are staked out in ghostly precision and two fish canneries crumble quietly into dust.

Karin's parents, however, elected to stay on. Eventually she married an Ecuadoran whose father, the director of the old penal colony on Chatham, had been murdered on his doorstep by the convicts.

It is a rugged five-mile hike inland to call

on Karin in the whimsically named village of El Progreso. In this frontier settlement pigs root in the muddy streets and an aura of poverty clings to the dilapidated dwellings. There is a public school, however, and a crude wattle-and-daub church. The priest was bravely putting up paper Christmas decorations as we plodded past.

Karin greeted us warmly. I was tired after our trek from the coast, and winced as she said, "We're building a house out near the reservoir, and I'd love to show it to you."

"How far is it?" I asked with sinking heart.

"Only another six miles."

My heart plummeted further. "Uphill?"

"All the way."

It struck bottom.

Karin and Exy rode small horses, while the boys and I were left to rely on shanks' mare. Karin was enthusiastic about her plans. "During the old days of the penal colony, hundreds of cattle grazed here on the uplands," she told us. "Why not again?"

She had already taken the first steps toward establishing a dairy herd. "There are only 45 head now, but someday we'll have hundreds. We'll be able to produce milk, cheese, butter, meat, and hides."

When our footsore party finally arrived at the site of Karin's new home, all weariness melted away before the sheer grandeur of the setting. Although the house was built of United States Army boards, it has a Scandinavian air. Its chaletlike rear balcony looks up toward the soaring green mountain where Karin's cattle will graze; springs in this same mountain feed the near-by reservoir. A big front window frames the far-off sea with an island crouched on the horizon.

Wild Horses Roam Heights

To the northeast towers Chatham's highest peak, San Joaquín, 2,490 feet. Wild horses, descended from forebears marooned by sailing vessels, roam its heights. As we watched, a herd, with manes flying, dashed across the face of the mountain.

I looked at the rich green of the landscape and at Karin's shining face. I could not help reflecting that sooner or later she would fulfill the vision that had brought her parents to the Galapagos.

Our next port of call was uninhabited little Barrington Island. We took *Yankee* into a cove by careful soundings and secured her with anchors fore and aft. Then all hands



Grounded flamingo in the arms of Ann Woodin recuperates from its collision with the camera. Unafraid, the bird lay passively in her hands until she released it.



Wings Beating, Legs Flailing, Flamingos Take to the Air

Vankee's photographers surprised this flock in a lagoon on James Island. Startled by the camera's whir, the birds lumbered across the shallows to gather speed for take-off. For an instant they appeared to walk on the water. "They were in such a hurry their heads could hardly wait for their bodies to catch up," the authors report.

One bird (opposite) failed to gain sufficient altitude and crashed into the camera.

Flightless cormorants on Narborough Island fan the air with stubby wings. Lacking the need to fly for food or survival, countless generations of the birds acquired the stunted appendages. Crumbled lava walls the cove.

EDDICHORIE BY JOHN W. BELLON (LEFT);
SEN CLITE (LEFT) AND W. H. WHODIN
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climbed the rigging to admire our surroundings: the turquoise pool of the cove, a jumble of dark lava and cactus on the shore astern, and a small white beach to starboard.

Our day on Barrington offered a typical roster of Galapagos activities. A hunting party shot two wild goats and brought aboard two live land iguanas (page 680 and opposite). Despite their ferocious mien, the fat, brown dragons do nothing worse than hang on like death to anything within reach of their prehensile talons. Dinner that night featured fried iguana tail. One of the girls approached her portion with reservations, but the first bite won her. "Why," she exclaimed, "it tastes like good beef."

Our spear fishermen fattened the larder with several groupers and a handsome yellow snapper. The beachcombers made friends with the local sea lions, and the mother of one 18-inch pup let us take her baby aboard

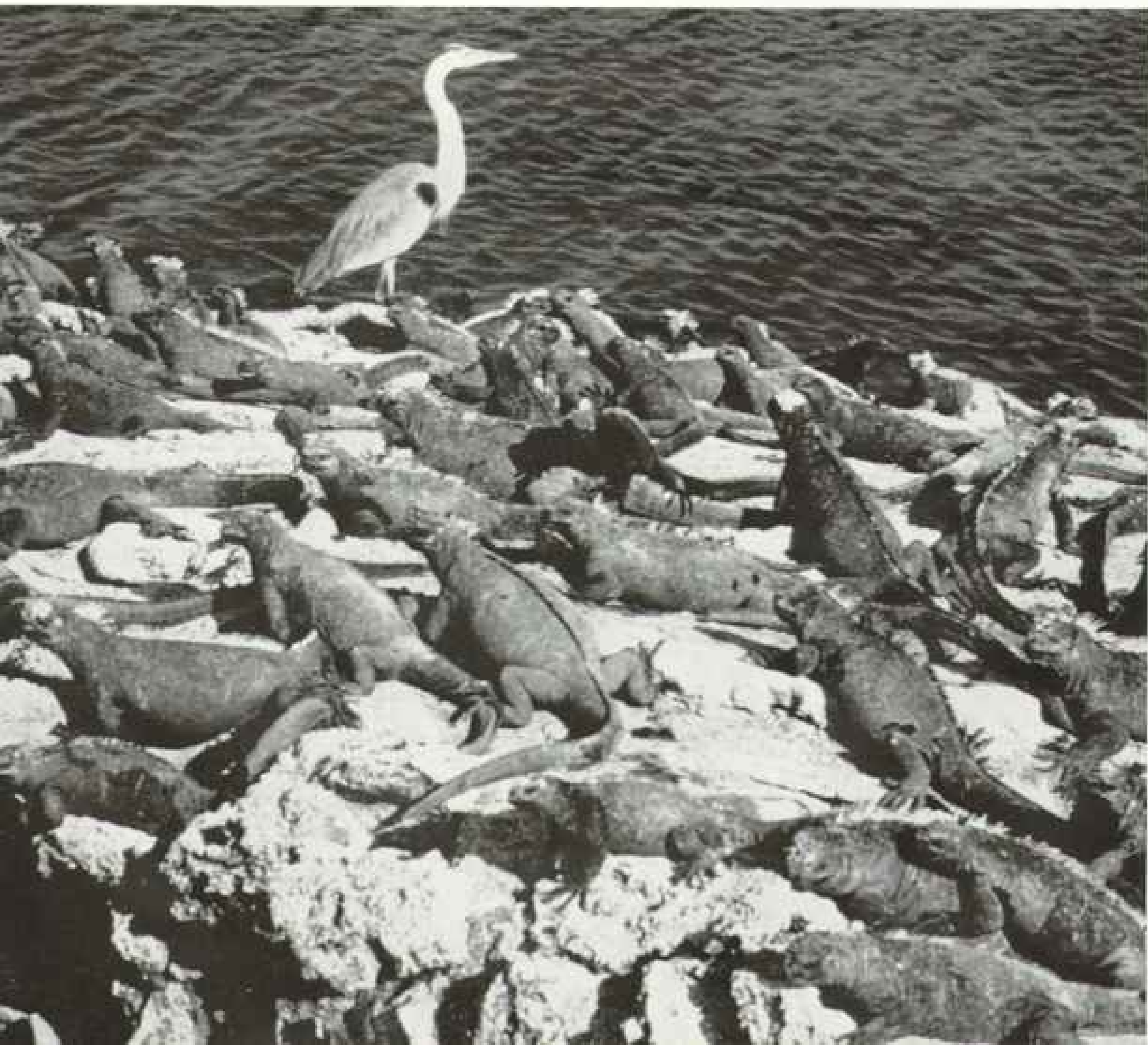
for a few hours. Cuddly and affectionate, it responded to petting by nuzzling up to one's foot and begging for more out of big soft eyes.

That night a flight of owls paid us a visit, swarming into the rigging. With gloved hands—a necessary protection against the vicious claws—I caught an owl and brought him below for a closer look at his fascinating shape, softly shaded brown plumage, and strange round eyes.

Island Boasts International Village

Alternating wildlife with human interest, we next put in to Academy Bay on Indefatigable Island. *Yankee* had brought from the States and from Panama cases and cartons of goods for our other Norwegian friends, the Kastdalen family. Fourteen of us planned to hike inland to their homestead, Miramar.

Ashore, we were greeted by Gus Angermeyer, whose parents had shipped him and



Land Iguana's Hideous Form Conceals a Gentle Nature

For all their dragonlike appearance, the big lizards prefer flight to fight. If cornered, they puff up, hiss, and spit, but the demonstration is nothing more than a bluff. This four-foot-long vegetarian monster pauses beside a cactus, a favorite food.

BOB BLOMBERG

Heron and Marine Iguanas Share a Sun Bath

Herman Melville, surveying the Galapagos reptile colonies, wrote, "The chief sound of life here is a hiss." Cousin of the land variety, the marine iguana occurs nowhere else. A superb swimmer, it feeds on seaweeds that festoon the rocky coast.

CONRAD HALL AND JACK DOOPFFS



his brothers from Germany to the Galapagos just before the storm of World War II broke across Europe. Gus, big and genial, is called "the tractor" because he occasionally drags trees by hand from the island's interior. He is one of some 60 pioneers who form an astonishingly varied group living at Academy Bay; among the nationalities represented are Ecuadoran, German, Swiss, Norwegian, Italian, and Czechoslovakian.

"The mud is terrible, Skipper," Gus told me. "Inland, this has been the worst rainy season in years. Nobody's been up or down for weeks."

Despite misgivings, we were anxious to see the Kastdalens again; so we started up the trail. For the first three miles we strolled easily through dry country with good footing. Colorless at first glance, the vegetation held happy surprises for the keen observer—bright yellow flowers blooming from stems one would think dead, morning-glories, a sudden burst of red hibiscus. A flashing yellow finch darted across our path, and twice we glimpsed brilliant vermilion flycatchers.

Then the mud began. For the last three miles we slipped and slithered and wallowed. After the first good calf-deep dunking, things became easier, because staying dry was no longer a problem. One of the boys lost a sneaker when he sank to his knees. With a sigh of resignation, he sat down and fished for it. All of us were covered with mud, but we kept slogging on and finally reached the Kastdalens' gate. Ten handsome dogs came yelping out to meet us.

The welcome from the family was less noisy



Galapagos Penguins Pay a Formal Call on *Yankee*

Swinging northward from the Antarctic, the Peru Current air-conditions the tropical Galapagos, making the waters habitable for such polar life as penguins and seals.

These birds, shanghaied from Albemarle Island (distance), roamed the ship for several hours, permitting crew members to stroke their stubby feathers. Clumsy on deck, they swam with unbelievable speed when released. Judy Huggins and Captain Johnson make friends with their visitors.

Sea lions bask in a surf-swept cove. *Yankee* crewmen found the bulls hard to approach, but cows and their young romped with swimmers and even served as pillows for a sun bath.

ILLUSTRATIONS BY EDWARD J. PARFEE, JR.
(AROSE) AND JAMES S. MICHAELIS, JR.
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but just as warm as that from the dogs. The Kastdalens guided us through their formal garden, past a well-built house raised above the ground, and presented us with buckets of rain water to wash off our coating of mud.

Weary of Europe and its strife, the Kastdalen family came to the Galapagos 18 years ago in pursuit of tranquillity. While they harbored no illusions about their chosen home, they were unprepared for the incredible hardships of their first year. They lived under a tarpaulin, baking in the summer sun, shuddering through the chill damp of the rainy season. Wild pigs rooted up their crops, and wild bananas were their only food.

Borro's Mishap Ruins Bananas

"It was a seven-hour burro trip to the nearest banana grove and another seven hours back," our hosts ruefully recollected. "Once, after a 14-hour round trip, just as we were nearing home the burro slipped in the mud, rolled over, and crushed every banana. Nothing to do but turn around and go back for more. But sometimes, as we sat down to a three-course meal of fried bananas, mashed bananas, and plain bananas, we would think kindly of that burro."

Slowly the family gained on their surroundings. The first crop—cabbage—brought a welcome change of diet. They became adept hunters, transforming the wild pigs from pests to pork. Eventually they built a house in the solid Scandinavian tradition.

Although we had arrived unannounced, our hosts treated us to a royal feast—homemade bread, wild pig, cottage cheese from a formerly wild cow, chunks of papaya pickled in ginger, and dark, rich Galapagos coffee.

None of the Kastdalen clan has seen the outside world in almost a generation. But none of them wants to. For they have wrested happiness and satisfaction from the unwilling soil of Indefatigable. And there they have found the peace they sought.

The following days saw us sailing among islands large and small, spearfishing and swimming to our heart's content.

Late one afternoon we were cruising along the coast of James Island, vast and mysterious in the gathering dusk. As night gained on us and the hills of James turned from brown to black, we pointed the bow into a deep cove with high surrounding walls: Buccaneer Cove. The anchor chain rattled out, echoing through the lonely inlet.

In the year 1684 a merry band of rogues repaired to this very bay in their freebooting vessel *Bachelor's Delight*. Among them were the famous William Dampier, Lionel Wafer, and Ambrose Cowley—all of whom scourged shipping the length of the Spanish Main. These were no ordinary buccaneers, but rather gentlemen with literary pretensions who were not averse to turning a fast doubloon.

Dampier was one of the first gourmets to rhapsodize over the culinary joys of the tortoises. "The Land-turtle are here so numerous," he wrote, "that 5 or 600 Men might subsist on them alone for several Months. . . . They are . . . so sweet, that no Pullet eats more pleasantly."

The following morning, with an eye toward another Galapagos staple, we put some eager goat hunters ashore at Buccaneer Cove. That afternoon, when I picked them up in the dinghy, they excitedly reported the discovery of flamingos in an inland pond (page 692).

All hands promptly debarked from *Yankee*, and we followed the hunters. After scrambling through a matted tangle of growth, we glimpsed the flamingo flock—flecks of rose pink against the deep, shadowed blue of the pond. Moving stealthily, three of us finally succeeded in getting a fine view from a convenient treetop. Barely breathing, we watched the elegant creatures wading with measured bridesmaid steps.

Crew Battles a Sperm Whale

From James we sailed around 85-mile-long Albemarle Island, largest of the Galapagos, to Tagus Cove. Off Albemarle's coast we ran into a school of whales blowing and breaking water. This was a long-awaited moment. The crew scrambled for harpoons, boat hooks, lily irons, and line. The ship herself was right in the midst of the whales; so we decided to launch our first harpoon from the end of the bowsprit. My son Arthur was out there with all the lore he'd ever heard in Mystic, New Bedford, and Nantucket awhirl in his head.

When one whale obligingly crossed right under the bowsprit, Arthur let drive, and the harpoon went home. The whale's enraged rush whipped fathoms of line over the side. "Lower away!" I called. The battle was on.

To our surprise, the whales surrounded the wounded one as if to protect it. Then one of them bit or broke off the harpoon line. But racing after the quarry, the dinghy bounced in among the others until Arthur

Bouquets and Streamers Festoon a Church Bell at Baquerizo Moreno, Galapagos Capital

California tuna fishermen, frequent visitors to Chatham Island, presented the ship's bell to the Roman Catholic church.

Priest and children here conduct the blessing of the bell, given "for the fine friendship with the people... of the Galapagos Islands." Boys and girls, serving as sponsors, symbolically ring the bell with the paper ribbons as the priest moves the clapper.

During World War II the United States built an airstrip on near-by Baltra Island to guard the western approaches to the Panama Canal. Many of Baquerizo Moreno's buildings contain lumber from the dismantled base.

Ecuador maintains a civil governor and naval headquarters on Chatham. Four junior officers administer outlying islands.



Barrel Post Office on Charles Island gets a refurbishing from members of *Yankee's* crew. Whalers more than a century ago established the cache, each ship dropping mail on the outbound run and picking it up on the voyage home. During the War of 1812 Capt. David Porter of the U.S.S. *Essex* intercepted British ships' mail and planted false notes of his own to confuse his opponents.

Yankee's letters, picked up by a cruise ship, arrived in the United States two months later.

Mock turtle race thrills a young jockey at El Progreso, a hill town on Chatham Island. Lack of mounts forces a villager to take the place of the tortoise. Shells reach such size that mothers in the Galapagos convert them to children's bathtubs.



could retrieve the short end of broken line.

Quickly the boys tied on a new line, shut off the outboard and—towed by their wounded leviathan—were off on a "Nantucket sleigh-ride." Eventually they got another harpoon in their prey, and when the occupants of the second dinghy could get close enough, they opened fire with high-powered bullets. Once the whale tried to bite the boat, but it was too big for his mouth. So he thrashed it with his tail till the ribs cracked. Some of the boys abruptly lost all interest in whaling.

Whale Steak Goes into Larder

Three hours, 27 bullets, and several harpoons later, the weary whalers brought their catch alongside *Fankee*. He proved to be a young square-nosed sperm whale with a gray body, gnarled and uneven. His blowhole was well forward, his teeth mere lumps of cartilage. He provided Arthur with a triumph, the rest of us with dinner, and the deep freeze with 25 pounds of steak.

We made a brief side excursion to Narborough Island which, in Melville's words, lies "in the black jaws of Albemarle like a wolf's red tongue in his open mouth." Narborough, least explored of the larger isles, is the sanctuary of the flightless cormorant.

On a rocky ledge overlooking the beach, I found one of these strange, dusky-plumaged sea birds (page 693). As I approached, he extended his stubby, useless wings and croaked a warning. Risking a raking from his beak, I made a grab and scooped him up. He lashed about furiously for a moment, then calmed and regarded me hostilely from clear greenish-blue eyes like two unblinking chips of sapphire.

These unique fish-hunting birds, very near extinction, long ago lost the power of flight. The abundance of sea life on Galapagan coasts made flying unnecessary; a plunge off any rock sufficed to fill their stomachs. As though to compensate for the evolutionary loss of their birthright, nature has made the Galapagos cormorants heavier and larger than others of their kind. And, while awkward and ugly on land, their underwater gymnastics remain dazzling. The life expectancy of any fish shrinks sharply when a cormorant fixes it with a cold eye.

Recrossing to the coast of Albemarle, we dropped anchor in Elizabeth Bay, where we knew we would find penguins and sea turtles. The two dinghies made their way up an inlet to muddy little lagoons. These were the favorite haunts of sea lions which would sometimes scramble up into the mangroves when disturbed. A sea lion up a tree? Only in Galapagos.

We found the turtles in their usual spot, paddling the water like enormous buoyant rocks. Then followed the finest sport Galapagos can offer. As a turtle passed a dinghy, a boy would dive underwater, grab the back of his shell, and aim him toward the surface.

The indefatigable Arthur grabbed the first turtle, wrenched him upward and, with the deft assistance of his shipmates, flipped him into the dinghy. He measured a whopping 34½ inches across the shell.

The penguins inhabit a little hump of an island off the coast of Albemarle. As we hove to, a delegation came alongside like a reception committee, curious, friendly, and fascinating to watch. Sometimes they acted like proper birds, alert and bright-eyed; then they became streamlined fish as they ducked their heads, humped their backs slightly, and knifed under the clear water with a quick motion of their short fin-wings.

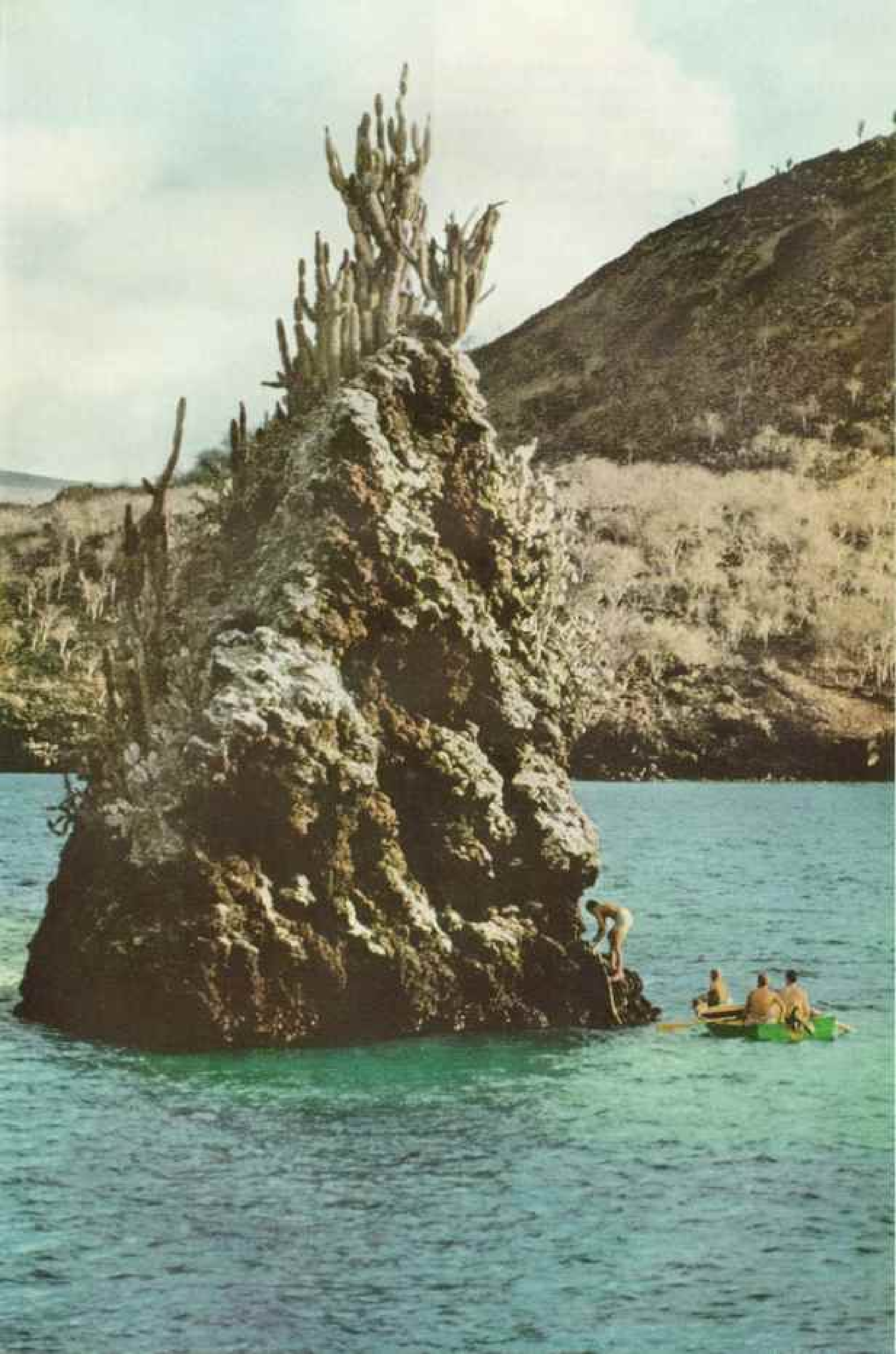
Harpooners Tackle Manta Ray

The following day brought our harpooners another chance to test their iron. As we rounded the Albemarle coast bound for Villamil, we ran into an enormous school of manta rays, big flat fish the size of a barn door. They flailed the water all around the ship with their huge bat wings. In all our years of cruising the world, we had never caught a big ray. Now was the chance!

Over went the dinghy, again with harpoons and line. This time the coxswain drove his boat right up on top of a huge manta, and two boys rammed in the harpoon with all their combined strength. Their victim, a whopper, kept floundering in short circles. At times his long bat wings would slap the boat, or even slap a boy in the boat from both sides at once. He thrashed and flipped dangerously in his attempt to get away.

Cactus Crowns a Volcanic Cone Thrust from the Sea off Charles Island

"Take five-and-twenty heaps of cinders," wrote Herman Melville . . . "imagine some of them magnified into mountains . . . and you will have a fit idea of the . . . Enchanted Isles." These visiting fishermen found fallen cactus spines made climbing dangerous.



Finally, still alive, he gave up and we pulled him alongside. We discovered he was minus his long pointed tail and guessed that perhaps this old injury had taken some of the pep out of him. We didn't try to hoist the huge brute aboard, but towed him in to Villamil at *Yankee's* stern and there dragged him up on the beach. Eighteen feet, four inches he stretched from wing tip to wing tip, and his menacing cavern of a mouth measured three and a half feet across.

Island Acquired an Empress

Charles Island—our next-to-last stop in the Galapagos—has a dark history that even reflects in the local names. One trail, for example, is called *El Camino de la Muerte*, the Road of Death. The island's old reputation for feuds and violence once caused an observer to remark drily: "When a man falls out of a tree, everyone wants to know who pushed him."

Charles gained world-wide notoriety in 1932 when a self-styled Austrian baroness, Eloisa Wagner de Bousquet, arrived from Paris with two male consorts and proclaimed herself empress of the island. Within a year she and one companion abruptly disappeared—murdered, according to local whispers. Shortly thereafter, the other man was found shipwrecked on Bindloe Island, dead of thirst. To this day, the mystery has not been solved.

Anchoring in Post Office Bay, we visited the wooden barrel that has served as a nautical mailbox for more than 100 years. Mariners deposit their letters in the barrel; the next passing vessel picks them up and posts them at the first port.

The famous barrel played an important part in the War of 1812. Capt. David Porter in U.S.S. *Essex* sailed around the Horn in the



EDDY GLENN, BAKER 2228



Cavorting Sea Lion Greet a Diver

Ungainly ashore, sea lions swim with effortless grace. This fellow, flippers outstretched and tail spread wide, flashes past a swimmer equipped with snorkel and spear gun. A cloud of striped wrasses joins the parade.

Soufful eyes appear to reproach the photographer for his intrusion.



winter of 1812 with the intention of raiding British shipping in the Pacific. Obtaining information that British ships were cruising near the Galapagos, he headed for Post Office Bay. There in the barrel—waiting to be picked up by homeward-bound British whalers—he found a virtual roster of English ships and their whereabouts. Merely by lurking in Galapagan waters, Porter soon captured 12 vessels. Eventually he destroyed a million tons of enemy shipping.

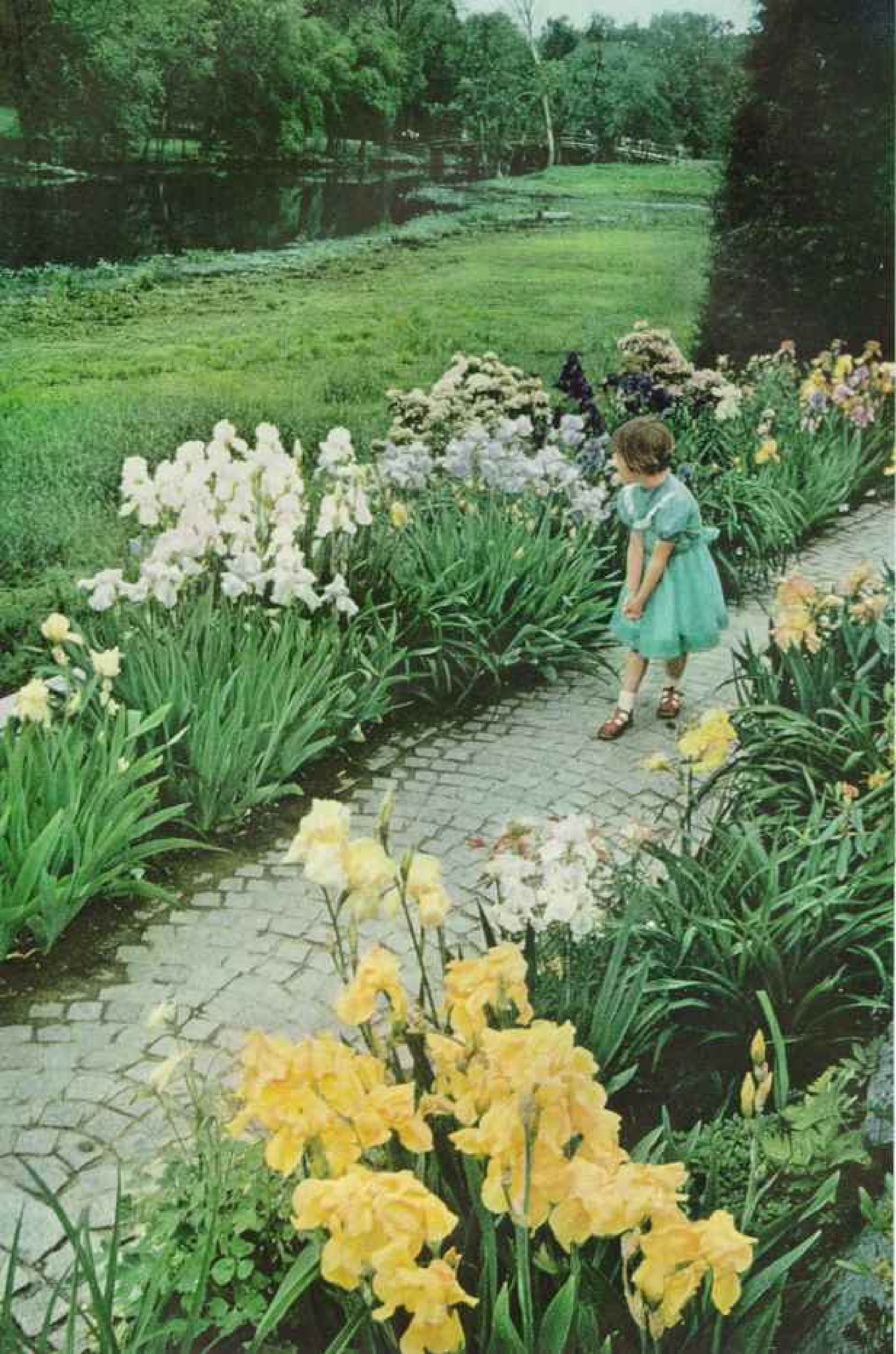
Through the years, grateful sailors have refurbished and renewed the post office whenever necessary. We fulfilled our obligation to tradition by repairing and painting the present barrel (page 698). Then we tucked in our letters and weighed anchor. Two months

later, we subsequently learned, our mail reached its Stateside destinations.

After a brief stop at Indefatigable, *Yankee* sliced out of Academy Bay and caught the first swells of the Pacific. As we headed southwest, impassive iguanas stared at us from the rocks. Somewhere in a hidden fastness a massive tortoise heaved his bulk along at 360 yards an hour, four miles a day.

In all essentials, the Galapagos still stand, defying the centuries, as they have for thousands of years.

Authors Irving and Electa Johnson have described previous *Yankee* cruises in the NATIONAL GEOGRAPHIC: "Yankee Rooms the Orient," March, 1951; "The Yankee's Wander-world," January, 1949; and "Westward Bound in the Yankee," January, 1942.



*A Massachusetts banker grows prize blossoms
where his colonial ancestor fought for freedom*

HISTORY AND BEAUTY BLEND IN A *Concord Iris Garden*

By ROBERT T. COCHRAN, JR., National Geographic Staff

*Illustrations by National Geographic
Photographer M. WOODBRIDGE WILLIAMS*

THE PLANKED BRIDGE beneath my feet and the statue of a minuteman on the riverbank lifted a proud chapter of American history out of the schoolbooks and brought it to life before my eyes. Then a man touched my arm, and history spoke.

"My forebear, Maj. John Buttrick, led the minutemen down that old colonial road across our fields." He pointed to the ghost of a road running through the marshes beyond the Concord River. "British forces falling back toward Concord halted beyond the bridge," he said. "They fired, and my ancestor shouted to the advancing Americans: 'Fire, fellow soldiers, for God's sake, fire!' Then he aimed his own musket and pulled the trigger.

"Historians have never sorted out that morning's confusion, but I believe his was the first shot of the Concord fight."

In the engagement three British and two American soldiers fell mortally wounded.

Stedman Buttrick, my companion on that bright June day, pointed again. "There is our house," he said, "and there, on the hillside, is the garden." I looked to our right and saw his magnificent irises blooming along the river. Flowering shrubs and majestic trees, their peaceful beauty the product of 30 years' planning and hard work, climbed an easy slope between the house and the gently arching bridge where we stood.

Mr. Buttrick lives on familiar terms with Concord and its historic past. His family settled beside the river in 1635. Twenty-eight

years earlier, the first permanent English settlement in North America was founded in Virginia. Fifteen years before, the Pilgrims landed from the *Mayflower* at Cape Cod. Since these early days, Buttricks—ten generations of them—have lived on the same land. Few families in the United States have such enduring roots.

"Our irises bloom at the edge of the battleground," Mr. Buttrick told me. "Only Buttricks have farmed, fought, and gardened on this riverbank."

Irises Crowd History for Attention

When I visited the Buttricks, I saw a steady stream of tourists pour through Concord's historic battleground. They crossed the 20th-century copy of Old North Bridge to admire Daniel Chester French's heroic bronze statue, and paused to read Ralph Waldo Emerson's immortal stanza, carved on its granite base:

*By the rude bridge that arched the
flood,
Their flag to April's breeze unfurled,
Here once the embattled farmers
stood,
And fired the shot heard round the
world.*

Emerson's last line measures the importance of that rattle of gunfire on April 19, 1775. It touched off the American Revolution, which ended six and a half years later at Yorktown.

The Buttrick irises vie with historic land-

"The Shot Heard Round the World" Echoed Along This Quiet Stream

Colonial America's quarrel with George III flared into war on April 19, 1775, when Maj. John Buttrick rallied "embattled farmers" near Concord, Massachusetts, and hurled them against a column of British soldiers at North Bridge. Today Stedman Buttrick raises prize-winning irises above the battleground where his brave ancestor fought. Only Buttricks and Indians have owned this land, the Buttricks since 1635. Susan Murray, the head gardener's daughter, admires irises at the peak of their June magnificence. Distant bridge spanning the Concord River copies the original.



**Spring's Pageant Decks a Hill
That Saw the Minutemen March Past**

When the colonials saw smoke from their military supplies, fired by British troops, they advanced on Concord in step to life and drum playing "The White Cockade." One of the fifers was Major



Buttrick's young son John. Today irises, peonies, and rhododendrons spill across the hillside. Special precautions help delicate plants survive New England winters. Rhododendrons hibernate un-

der sprayed wax. A mulch of wild hay keeps iris beds from heaving during freezes and thaws. In June the garden bursts into spectacular bloom. Rhododendrons and spruce surround the irises.

marks as a Concord attraction. To dedicated enthusiasts a visit to the garden is a ticket to irisdrom's World Series. Years of patient crossbreeding have developed scores of champions. But the garden is more than a busy laboratory, carefully propagating potential iris champions. Azaleas and rhododendrons bloom on the hillsides. Tall shafts of Virginia juniper accent terraced vistas. Peonies and columbine weave patterns through the iris beds (page 716).

Mr. Buttrick commutes from Concord to his investment banking office in near-by Boston. In the spring and summer he hurries home each day, dons shorts, and works in his beloved garden.

Buttrick Blooms Cross the Atlantic

One afternoon he led me between beds filled with 200 varieties of bearded irises, and I admired some of the largest blooms I have ever seen. Many of his white and blue varieties, brought to perfection after years of hopeful breeding, have drawn admiring comment at American and British flower shows (page 718).

New Englanders traditionally love their land, and some have an almost mystical understanding of nature's ways. Henry Murray, the Buttricks' head gardener, might have stepped from the pages of Emerson or Thoreau, who wrote with keen insight about man and his relationship with the elemental forces that surround him.

Often I watched Henry's big hands gently set out new life in the spring garden. Late in June, I followed him beside the flower beds. He picked off a straplike anther from one iris stamen and, holding it carefully with a tiny pair of tweezers, delicately brushed its pollen onto the stigma of another choice hybrid (page 711). This cross-pollination, repeated hundreds of times each year in the Buttrick garden, speeds nature's haphazard way of creating new varieties.

"About 23 years ago Mr. Buttrick started with one yellow iris that cost him \$20 or so," Henry recalled. "The thing died that winter,

and I thought my job with irises was over.

"But Mr. Buttrick asked me to buy more. We started to breed our stock. From 15 seedlings I obtained one cross which we protected with a canvas cover during thunder-showers. We wouldn't give a cent for it now, but in those days we thought it was wonderful."

Irises are hardy, but they need extra protection from New England's severe winters. Henry covers the beds with a layer of hay each November "to put the irises in an icebox for the winter." With two helpers, he cuts wild hay along the Concord River (page 714). If the river floods, they travel to Cape Cod and harvest dune grass.

A mulch spread over the iris beds prevents the soil from buckling after a thaw and damaging the dormant plants.

Also in November Henry sprays a winter coat of protective wax over the evergreen rhododendrons, giving their branches and leaves a milky cast. Summer heat melts the wax when the temperature reaches 80°. The rhododendrons bloomed last June with wax still on their leaves, following an unusually cool spring.

New England Spring Plays Tricks

Some years, despite all precautions, new buds freeze above the snow line. Concord farmers say a hard winter kills off old growth, and they consider it a blessing. For gardener Murray, trying to grow the plants north of their natural range, a hard winter can bring disaster.

Plants often cannot cope with the off-again, on-again vagaries of a New England spring. Sometimes a late freeze wipes out early blooms; another year an unseasonal warm spell forces spring and summer plants into bloom all at once. Early dogwood and daffodils mix their colors with late tulips and irises.

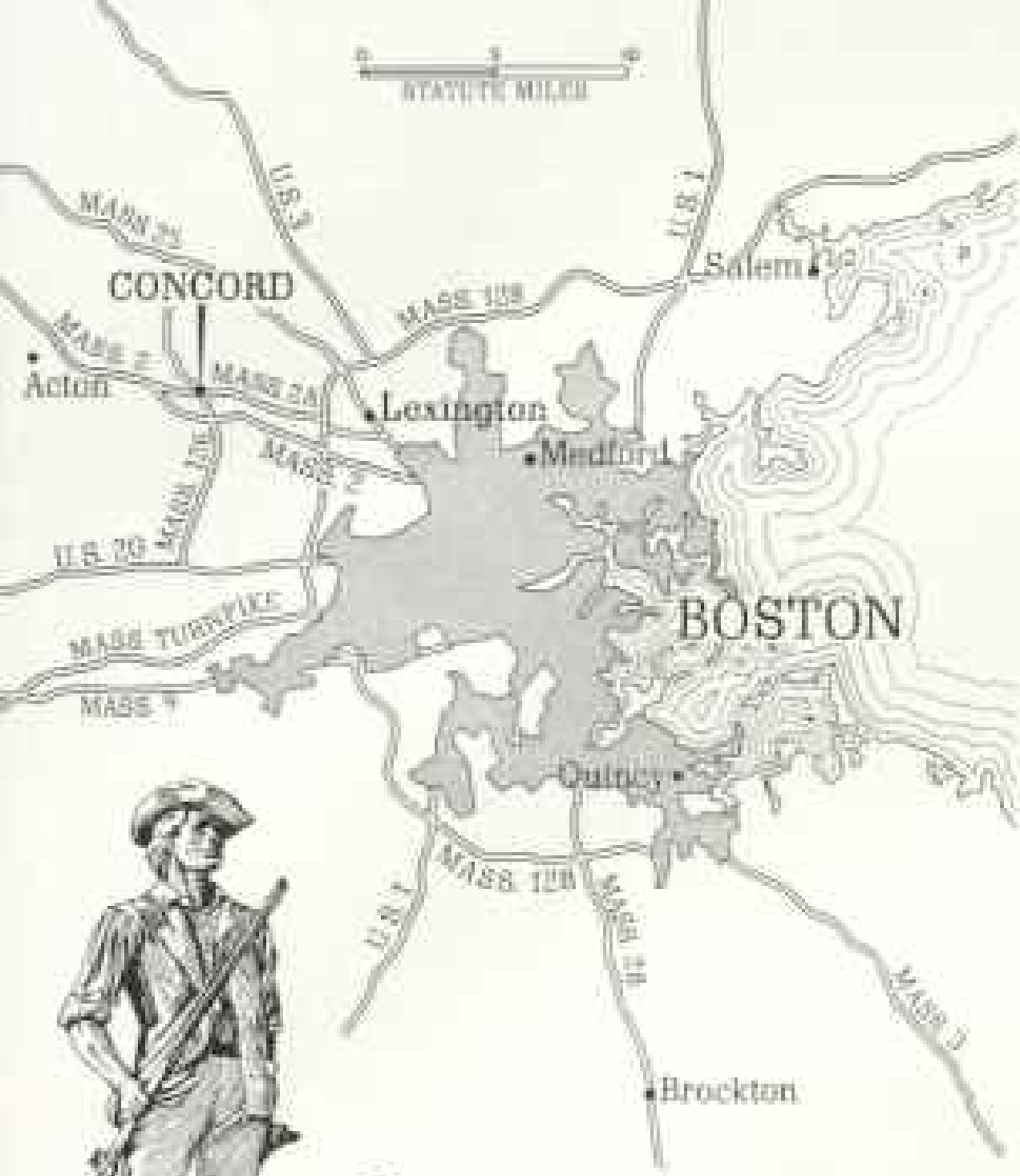
Work for the late spring iris season begins in the Buttrick garden during the preceding summer. While the hot, still days hang heavily over New England, Henry divides two- and three-year-old iris clumps that have

Pale Beauty Rewards Years of Patient Crossbreeding

An impressive string of flower-show awards testifies to the success of Mr. and Mrs. Buttrick. Here they clip armloads of irises for their home overlooking the Concord.

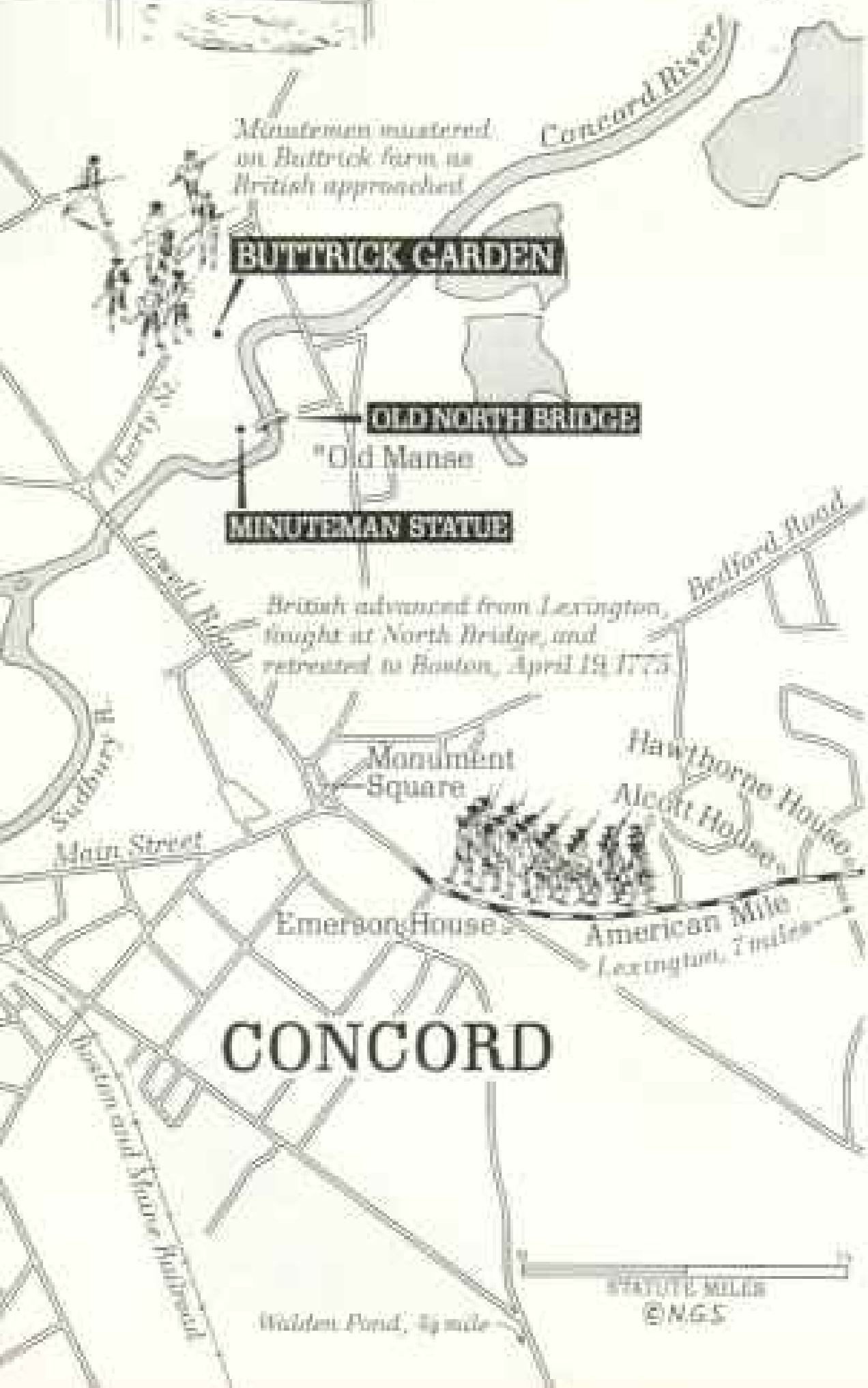
Burrowing turtle plows a path through a bed of seedlings. Young irises must survive winter freezes and snapping turtles. The armored pests outplow moles as they criss-cross beds and dig their nests. Gardeners toss the intruders back into the river, usually before they can lay their eggs.





By the rude bridge that arched the flood,
 Their flag to April's breeze unfurled,
 Here once the embattled farmers stood,
 And fired the shot heard round the world.

R. Waldo Emerson



shed their blooms and resets them in new locations. He splashes next year's color about the garden as an artist might conceive a painting.

Iris rhizomes, the fleshy, underground stems from which roots sprout, barely show above the ground after setting. "You plant iris shallow, like ducks sitting on the water," Henry told me. "In the spring you add a little bone meal to the soil, and lime if it is acid."

The estate uses three tons of fertilizer a year. "Nitrogen for foliage, phosphate for flowers, potash for root growth," Henry explained. Then, in June, this well-fed garden pays off in glorious blooms.

Iris Breeders Face Gamblers' Odds

Beside the formal garden, Mr. Buttrick and Henry cultivate separate plots cut from hay-fields. Here they raise seedlings from iris crossbreeding experiments. Although they can predict, to some extent, what the offspring of a given cross will look like, a great deal still depends on luck.

An infinity of improvements or faults can result from the many possible gene combinations in a single cross. Mr. Buttrick and Henry hope for luck and watch their seedlings come into bloom with the anticipation of gamblers watching a roll of the dice.

Although the genes express themselves in riotous color, the owner and gardener do not like most of what they see. Out of 400 seedlings, only three plants may show improvement—perhaps a bluer blue, a whiter white, or a bigger flower. The rest are destroyed. Gardeners carefully tag and propagate the rhizomes of these choice survivors. When Mr. Buttrick finds a new hybrid he really likes, he lies awake nights trying to think of a good name for it. A new iris's name, like a new novel's title, can help boost the creation's popularity.

Some Buttrick varieties have names indicating their origin—such as "Concord Town" and "Concord River." One of Mr. Buttrick's most successful hybrids is a standard among white varieties, and appropriately bears the name "Wedding Bouquet."

The Buttrick garden lies between Liberty Street, a quiet country lane north of Concord, and the low, marshy flood plain of the Concord River. Today clipped lawns and a trim stone wall cover all traces of an old road that once curved down a gentle slope to North Bridge. Iris seedling beds to the west of the formal garden also stretch across this old route (page 706). A causeway, now crumbled but



PHOTOGRAPHS BY W. WOODBRIDGE WILLIAMS, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Pollen-laden Irises Require a Chaperon Lest the Blooms Cross Haphazardly

Successful iris breeders need canny instinct and much luck. Out of a crop of 400 seedlings, Stedman Buttrick may save only three that show improvement over their ancestors. He cuts the creeping stems, or rhizomes, of these few into small sections. When planted, each section duplicates the original bloom. Harry Crowell (above) prunes the seedlings daily, one of the many chores that keep three gardeners busy during the growing season.

Planned breeding occurs when a gardener rubs a pollen-charged anther against another iris's stigma, first step in producing seed for a new, perhaps improved variety.

Some botanists believe the iris's furry, caterpillarlike beard leads insects to nectar deep inside the bloom.





The Minuteman, immortalized in bronze at Concord Bridge by sculptor Daniel Chester French, inspired Ralph Waldo Emerson's stirring "Concord Hymn." Both Emerson and French lived in Concord. Their combined effort prompted the quip that few towns could afford "a poet, a sculptor, and an occasion."

Young Sightseers Line Concord's "Rude Bridge That Arched the Flood"

Early in 1775 America hovered on the brink of revolution. British forces, bent on capturing colonial military stores, left Boston on the night of April 18 and marched through Lexington to Concord.

Roused by Paul Revere and others who gave the alarm, militia and minutemen turned back the redcoats in a sharp skirmish at Concord's North Bridge.

The bronze Minuteman (background) stands guard near the spot where Maj. John Buttrick shouted, "Fire, fellow soldiers, for God's sake, fire!" The statue stands on land deeded to Concord by the Buttrick family in 1875.

still visible near the river's edge, carried the road across the marsh to the bridge.

On April 19, 1775, between nine and ten o'clock in the morning, Maj. John Buttrick led his column of minutemen and militia down the road and into the pages of history. Redcoats fired across the bridge. Major Buttrick shouted his famous command, and the colonials fired. The "Concord fight" ended two or three minutes later.

"We always call it the 'Concord fight,'" Mr. Buttrick told me. "Some scholars call it a battle, but 'fight' seems a better word. The action was too brief and disorganized to deserve the word 'battle.'"

Briefly, he sketched events leading to the

EDDACH/SHORE BY DAVID E. BOYER, NATIONAL GEOGRAPHIC STAFF © N. G. S.



fight, filling gaps in my recollection of history. A British column, 700 strong, marched out of Boston on the night of April 18. It headed toward Concord, then a center of revolutionary activity. The Provincial Congress, a defiant patriot organization, had met in the village a few days earlier. Much of Massachusetts' small supply of weapons and military stores lay concealed in garrets and barns in the neighborhood.

Lt. Col. Francis Smith and Maj. John Pitcairn, who commanded the British column, were determined to destroy the colonial arsenal. To Major Pitcairn, the idea of an expedition through the Massachusetts countryside was not new. Writing to the Earl of Sandwich

in England about colonial unrest, he had said: "I am satisfied that one active campaign, a smart action, and burning two or three of their towns, will set everything to rights."

Minutemen Slept with Their Muskets

Events proved that Major Pitcairn, although resourceful and courageous, erred in his estimate of American bravery and determination.

Nor was the British march from Boston a surprise to the colonials. For months they had planned how to meet just such a thrust. The countryside stood ready to spring to arms at a moment's notice. Minutemen slept with muskets and powder horns beside their beds.



Three Centuries of Peace and War Scatter
Reminders of Our Heritage Along the River

Concord remembers great men and great deeds.
Minutemen hurried through the April dawn in
1775 to form ranks near the small fenced field be-
yond the house and trees. Ralph Waldo Emerson



and Nathaniel Hawthorne penned classics in historic Old Manse, across the river. Philosopher Henry David Thoreau often paced the Concord's banks in meditation. Louisa May Alcott as a girl

lived in the near-by village. Today speedboats trace patterns below the Buttricks' ivy-clad home. Windrows of fresh-cut hay etch a swirling mosaic beside the formal gardens.

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RENDERING BY W. WOODBRIDGE WILLIAMS, NATIONAL GEOGRAPHIC STAFF © W. B. S.



Visitors Find Irises Worth a Wetting, Though Rain Blurs Their Notes

Iris enthusiasts from many States and countries make pilgrimages to the Buttrick garden. A Cuban determined to grow the flower on his subtropic island told his hosts he had had to create his own winter hibernating season by refrigerating his plants three months each year. Irises refuse to grow near the Equator, but some varieties bloom at the edge of the Arctic.

Budding peonies and columbine accent this bed. Tall juniper in the background fell like a matchstick in the 1938 hurricane. Gardeners tipped it upright; today it appears none the worse for its experience.

Spattered with raindrops, an iris spreads its ruffled glory. This lavender beauty stands out among the current crop of seedlings. As yet, it has no name.

Dismissed by some as a "poor man's orchid," the iris has a proud place in history. Tradition says France's Louis VII took it as his emblem and it became the fleur-de-lis, or flower of Louis.



They carried their weapons in the fields while they plowed, and to church on Sunday.

Intelligence of the British march spread swiftly through Boston and reached the ears of Dr. Joseph Warren. He summoned two patriot couriers, William Dawes and Paul Revere, and told them to prepare to ride. Both waited for assurance that the British were ready to start. Revere then "went to git me a Horse."

Dawes and Revere roused every house between Medford and Lexington. There, Dr. Samuel Prescott of Concord joined them. Soon Dawes was turned back and Revere captured by a British party. Dr. Prescott jumped his



RECREATION BY H. WOODBRIDGE WILLIAMS, NATIONAL GEOGRAPHIC STAFF © N.G.S.

horse over a stone wall and escaped to carry the alarm to Concord.

The British column arrived in Lexington at dawn on the 19th. Capt. John Parker's company of militia formed hurriedly on the town green. Tradition says their commander ordered: "Stand your ground. Don't fire unless fired upon. But if they mean to have a war, let it begin here."

Eyewitness accounts say Parker soon realized the futility of pitting his small band against 700, and told them to disperse. Then a shot rang out. Redcoats swarmed across the green. Their muskets and bayonets made short work of the gallant colonial force. Eight

men of the little force died; ten were wounded.

The grim column marched on to Concord and occupied the town square. Detachments fanned out through the countryside, searching for the supplies they had come to destroy. Three companies stayed behind to guard North Bridge, so that foraging detachments would not be cut off from the village.

Historians Still Argue Over Details

Meanwhile, militia and minutemen, their ranks continually swelled as fresh contingents arrived from neighboring towns, gathered above the bridge on the Buttrick farm. Finally, colonial fire drove the British troops



FOODCAMEL BY W. WOODBRIDGE WILLIAMS, NATIONAL GEOGRAPHIC STAFF © N. G. S.

A True Blue Iris Eludes Breeders; This One Approaches Their Ideal

Iris growers seek pure primary colors. Progressive crossbreeding brings their goal into sight. Except for a slight purple tint, this Buttrick bloom could qualify as true blue.

away from the bridge and back to Concord.

Three British regulars fell at the bridge. Companions carried one back to the village, but the other two were buried where they died. Today, a British delegation decorates their grave each year. A modest stone commemorates these two soldiers who died on a bright spring morning in a strange field far from home.

"The British marched from Boston to Concord and back again in less than 24 hours, but historians still disagree on details of the day's fighting," Mr. Buttrick told me with a smile. "For years, Lexington people argued with Concord people, each side insisting that the Revolution really started in their town. And Acton partisans claimed their men had been slighted in accounts of the engagement."

Areas May Become Historical Park

He spread a map before us. "You remember how colonials, firing from houses, behind trees, and over stone walls along the way, harassed the redcoats as they returned to Boston after the Concord fight," he said. "This map, from a report by the Boston National Historic Sites Commission, shows the route they took. The commission wants to preserve as much as possible of the Concord battleground and the Lexington-Concord battle road. Eventually, these areas may become a national historical park."

As we looked at the map, I noticed a short stretch of road east of Concord identified as the "American Mile." The proposed park bypasses it.

"Concord's history doesn't end with the American Revolution," Mr. Buttrick reminded me. "Nathaniel Hawthorne, Louisa May Alcott, and Ralph Waldo Emerson all lived along that mile of road. You can see their houses as you drive out from Boston. A short distance to the south you'll find Walden Pond, where Henry David Thoreau built his hut and lived in seclusion."

The commission suggests that these literary landmarks deserve a historic district of their own. Concord's contribution to America's 19th-century literature almost overshadows its role in the Revolution.*

"My ancestors were farmers," Mr. Buttrick explained, "and they had very little to do with Concord's great writers. That's to be expected. Emerson never sat on the steps of the general store, discussing philosophy with passers-by, although he took a New England-

er's traditional interest in the affairs of his town. Hawthorne kept mostly to himself when he lived in Concord. Louisa May Alcott's father, Bronson, may have been brilliant, but he seldom held a steady job.

"However, my great-grandfather, an earlier Stedman Buttrick, did know Thoreau, and Thoreau wrote about him in his *Journal*," Mr. Buttrick continued.

"It came about in this way. Although Thoreau seldom bothered with money, occasionally he hired out as a surveyor. In 1857, my great-grandfather differed with a neighbor over the location of a boundary line. Thoreau was called in to survey the line and settle the matter. Here, let me read what Thoreau wrote: 'My assistants and company in surveying on the 9th were, Gordon and Buttrick, the principals in the dispute; Jacob Farmer, the principal witness; George Buttrick, son of Stedman; and French, son-in-law of Gordon . . . Buttrick is a rather large man in more senses than one. His portly body as he stood over the bound was the mark at which I sighted through the woods, rather too wide a one for accuracy.'"

"Great Spirit" Watches Over Town

Today, Boston is spreading over the surrounding Massachusetts countryside. The city's growth has blurred the boundaries of the little New England towns where the Revolution was born. Armies of commuters follow the route the redcoats took in April, 1775, and their houses crowd around historic landmarks. But Concord, despite these pressures, manages to preserve its charm.

"So many nice young people have moved here from Boston," Mrs. Buttrick told me. "I suppose they came here because it is Concord, and they would be the last to want it to change too much."

Fortunately, commuters and parks so far have invaded Concord as friends. Were they unfriendly, they might fall afoul of an ancient Indian prophecy. During King Philip's War of 1675, marauding tribes pillaged near-by settlements. Historians say a war party paused on a hill overlooking Concord, took counsel, and decided to spare the town.

"We shall never prosper if we go there," the hostile Indians said. "The Great Spirit knows that town."

* See "Literary Landmarks of Massachusetts," by William H. Nicholas, NATIONAL GEOGRAPHIC, March, 1950.

A humble little railroad huffs and hoots its winning way through the California forests.

The Friendly Train Called Skunk

By DEAN JENNINGS

*Illustrations by National Geographic
Photographer B. ANTHONY STEWART*

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Sightseers at Fort Bragg happily await the conductor's "All aboard!" that will start



TRAIN NO. 1 of the California Western Railroad slowly twisted through the tall Coast Ranges forest 140 miles northwest of San Francisco one recent fine morning. It was climbing east from the lumber town of Fort Bragg to Willits, just across the divide.

Azaleas raised their bright little trumpets along the cool banks of the Noyo River, and the purplish heads of the rosebay nodded on the scarred, logged slopes of the hills. Wild vines threaded a blanket over the gullies, and the sunlight cut through the redwood groves,

slashing the gloom with dusty yellow blades.

Engineer Johnny Galliani, a stout, balding man wrapped in a bright Mackinaw, pulled his striped cap over one eye, peered through gold-rimmed glasses at the roadbed ahead, and told himself he had the happiest railroad job in the land.

At South Fork, 20 minutes out of Fort Bragg, he saw a woman waving an apron to flag him down, and he nudged Tom Golden, the thin, sandy-haired conductor. "What do you make of that, Tom?"

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their ride on California Western's one-coach train, affectionately called the Skunk.



Conductor Golden Lifts Groceries Aboard

Because few roads cross the forest threaded by Skunk, the train crew delivers necessities to isolated families. Tom Golden recalls emergency orders for such oddities as bee-sting ointment and hot-water bottles. Jane Luiz often rides to Willits (map, opposite) to shop during a two-hour lay-over; she carries provisions home in her cart.



Golden squinted up the track. "Don't know," he said. "I've got her milk and paper, but she usually sends her son out for it."

The air brakes hissed, and the train stopped with a metallic screech. "Oh, Tom," the woman said, "I'm in trouble. The phone is out. My husband's sick with a bad cold, and I didn't do any marketing this week. I've got a list. Do you think . . . ?"

"Sure," Tom said. "Give it to me and quit worrying."

He swung aboard the train, gave the bell cord two cheerful yanks, and the train resumed its upgrade journey toward the Willits summit. Some hours later, downbound on the return trip, Johnny stopped the train at the forest ranch, and Tom trudged up the hill to the house to deliver groceries and some medicine. "I phoned the Doc," he reported. "He says to keep Ed in bed for a day or so."

"I sure appreciate it, Tom," the woman said. "I got some new-laid eggs for you. Figured you and Johnny could use 'em at home."

Golden accepted with embarrassed thanks and ambled down the stubbled slope to the train. There he assured half a dozen inquiring passengers that Ed was okay, and that his missus would have him up soon. The train pulled into Fort Bragg a little late, but Tom wasn't asked to explain, and there was no mention of the incident in his regular report. For that neighborly errand, like many others, was routine in the operation of one of the most unusual railroads in the world.

Gas Engine Gave the Line Its Name

"Fact is," the line's long-time General Manager, A. T. Nelson of Fort Bragg, told me before his retirement this year, "you might not call it a railroad at all. It's a family."

Affectionately nicknamed "the Skunk" because the original gas engine used to smell up the countryside, California Western's passenger train is known to railroad men all across the United States.

The entire train consists of one diesel-powered vehicle that looks like an old-time street-car (page 724). It carries everything—passengers, freight, mail, and luggage. Frequently, would-be travelers are left behind because all 40 of the car's seats have been sold. The baggage compartment carries mail sacks, and sometimes a bleating calf, a piano, or even a coffin.

For most of the year the Skunk makes one round trip daily between Fort Bragg, on the foggy Mendocino County coast, and Willits, a connection point for the Northwestern Pa-



Alerting Tardy Riders, the Engineer Yanks the Cord and Toots the Horn. Engineer Johnny Galliani stops the train anywhere he is hailed. He often picks up hikers dropped on an earlier run when they flag him at trackside. Skunk earned its name from an old gasoline unit's smelly exhaust.

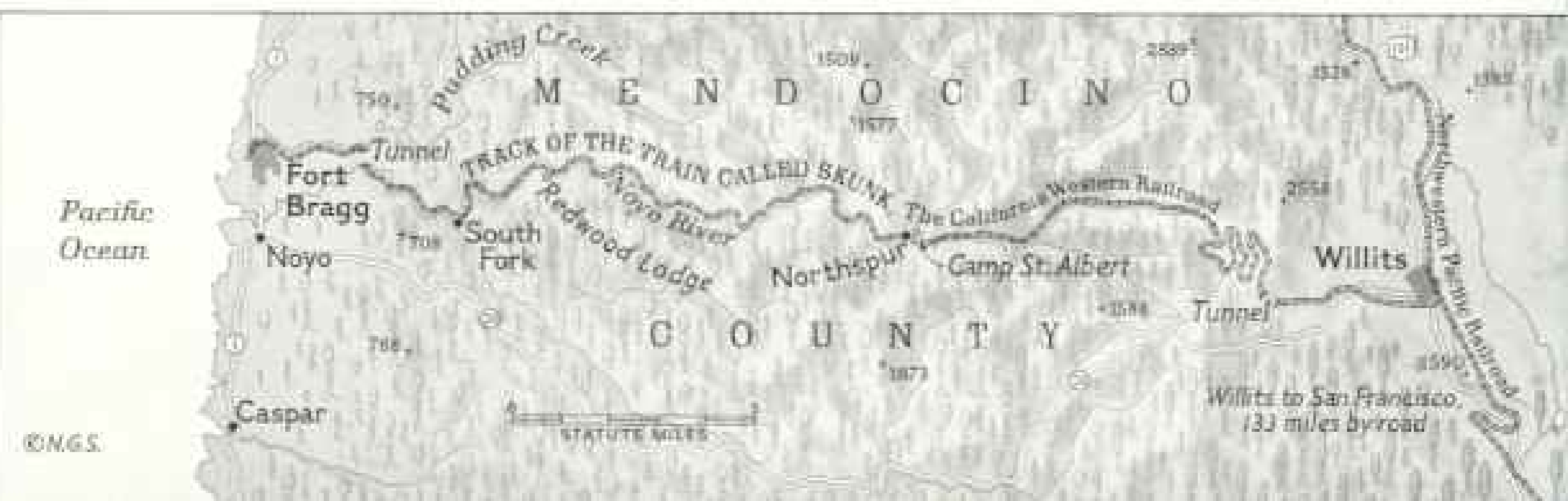
Skunk's Tracks Thrust Inland from the Pacific

The California Western ties coastal Fort Bragg with inland Willits, where it meets the Northwestern Pacific. Between terminals it serves only isolated settlements and homesteads.

Because the California coastal plain rises steeply, so must the railroad. The track unwinds like a kinky string as it seeks toe holds in the forest.

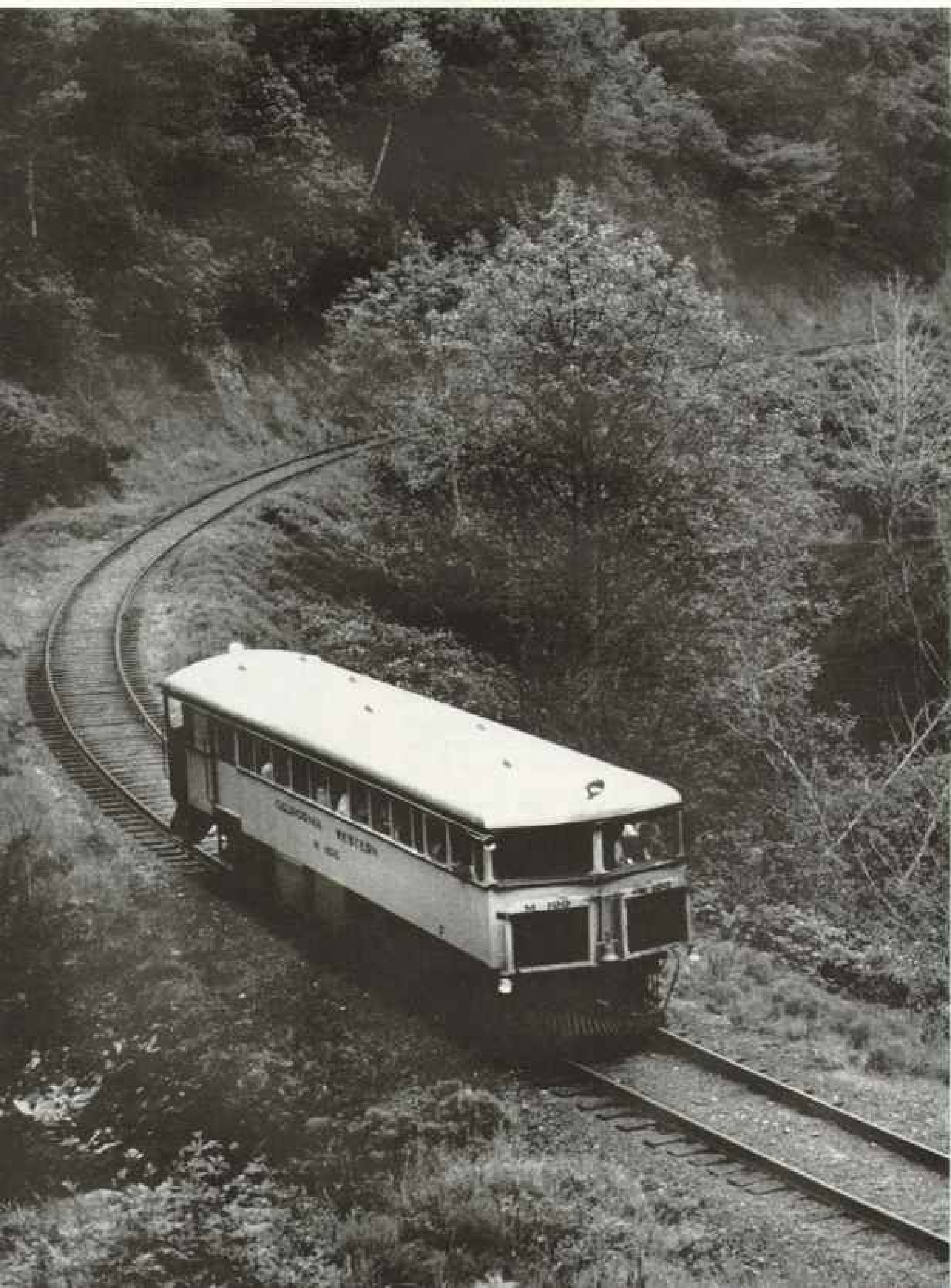
Symbols represent redwoods and Douglas firs, many of which stand in tree farms. New plantings in Mendocino County cover 170,000 acres.

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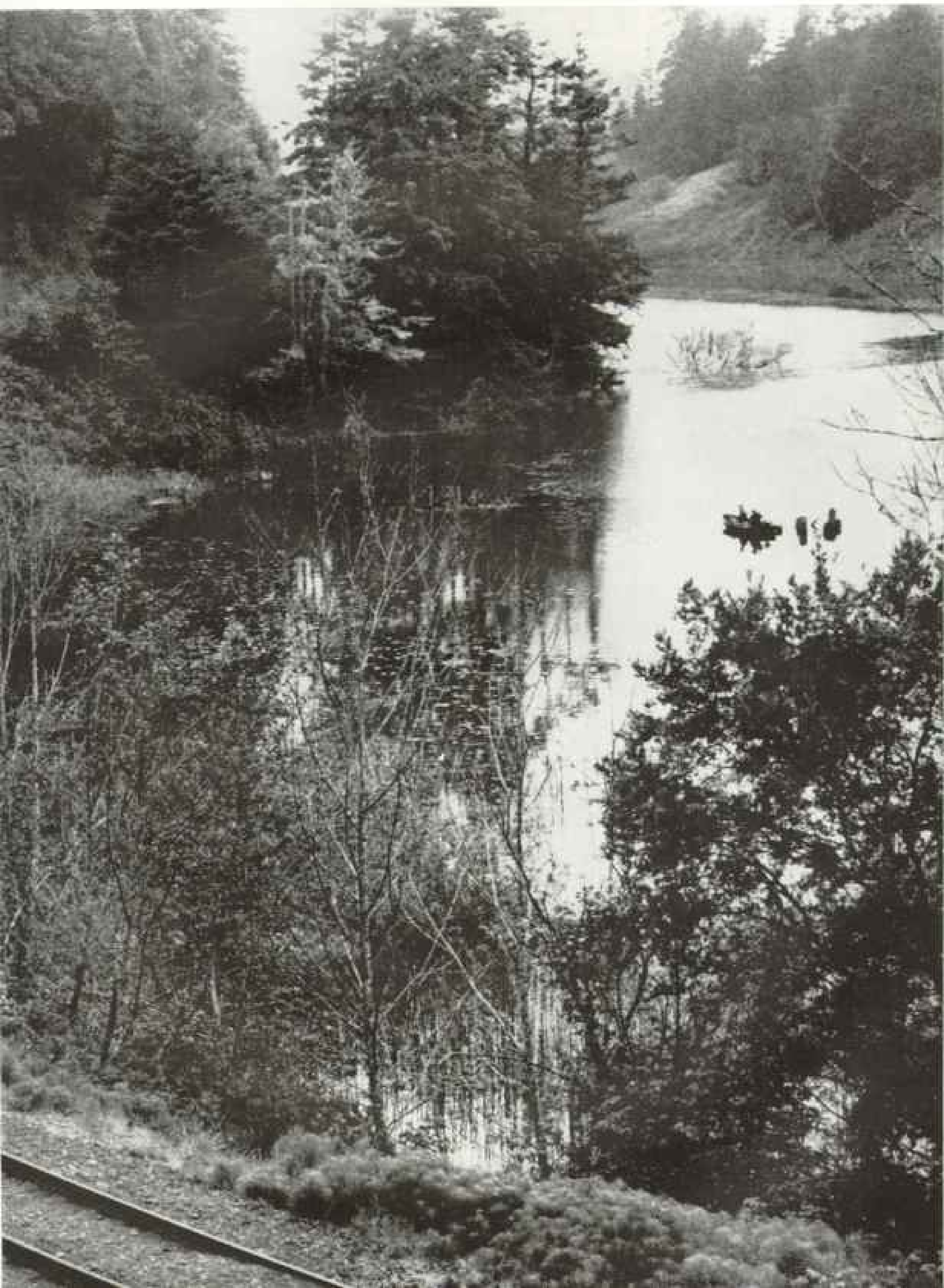
pudding Creek, Near Fort Bragg,
Sends the Line on a Winding Detour

In 40 miles the California Western Railroad
climbs 1,670 feet. Each trip Skunk rumbles across
34 bridges and trestles, swings around 381 curves,



and ducks through two tunnels. Built to haul logs from the redwood and fir forests, the line offers a scenic bonus to passengers as it spirals

through spectacular mountain country. Fishermen in this quiet inlet watch the train as it rounds a sharp curve hugging the shoreline.



When neighbors ride the Skunk to the Dixons' forest cottage, Joe and Louise stoke their ancient wood stove and spread a bountiful lunch on an outdoor table. Joe, a retired lumberman, seldom goes to town except for a haircut. "Wouldn't live anywhere else," he says. Neighbor Jane Luis helps the Dixons at this picnic.

Railroading groceryman Tom Golden swaps news with Louise Dixon when Skunk stops near her home. Mrs. Dixon usually meets him at trackside and collects her provisions.



cific's line into San Francisco (map, page 723). In summer it makes two round trips.

The 40-mile run pierces an area that ranks as a wilderness; highways serving it are inaccessible for much of the year. Three-quarters of a century ago, when the late C. R. Johnson bought up vast redwood stands for his Union Lumber Company, his engineers forced tracks through the deep forest and be-



gan hauling logs into the mill at Fort Bragg. Each succeeding year the loggers penetrated deeper, until in 1911 the track bed was pushed through a tunnel under a 1,740-foot summit and connected to the Northwestern Pacific tracks at Willits.

Now some 6,700 freight cars, mostly hauling lumber, rumble over the Skunk's route in a year's time, but the average visitor is un-

aware of their passage, for they move only at night. Thus the Skunk and its passengers have the tracks to themselves during the day.

A unique trip it is, too. There are 34 bridges and trestles to cross, one every mile or so; 381 curves make the route so crooked that one railroad historian said, "It twists like a snake with green-apple bellyache." The 17 intermediate stations aren't stations at



Skunk Barrels Out of a Leafy Tunnel into the Sun's Spotlight

The lumber boom that built the California Western has largely subsided. Today the area harvests mainly second-growth trees. Some large redwoods and firs still stand. Here, as in other places, branches lace a canopy above the track.

all, but only crude, weathered platforms or hand-scrawled signs that jut from redwood stumps.

The scenery is awesome, and at one point, where a series of compound curves corkscrews some 235 degrees all told, travelers can lean over a cliff and look 105 feet down on the writhing tracks the car has just left.

Forty years ago this section of the ride seemed so risky that now and then a nervous passenger would drop to his knees and pray, or so the newspapers of the period said. The late actor Wallace Beery once made a swash-buckling railroad movie there; after one hair-raising trip to the summit he refused to board the train again, and said he'd rather walk. On the other hand, when Jane Wyman was filming scenes of *Johnny Belinda* near by, she became enchanted with the Skunk, and the crew elected her a sort of unofficial mascot.

The Skunk people are modest and make no flamboyant claims for their run. "We have beautiful scenery, yes," Nelson says. "But we also give personal service, and the Skunk has earned the love of the people it serves."

This sentimental kinship between passengers and crew is kindled the moment Tom and Johnny trundle their yellow car from the railroad yards into the Fort Bragg station to start their daily run. Both men live in Fort Bragg; between them they have been on the California Western payroll for 83 years.

Almost any morning, especially in summer, the waiting room swarms with vacationers or local citizens—women in Bermuda shorts, jeans, or old Army pants; hunters with bright-red caps; fishermen with rods and creels; city folk self-conscious in business suits; booted lumberjacks heading for work in the woods. Children of all ages and dispositions swarm



about carrying pets, swim suits, space guns, and baseball hats to camps along the route.

"Young or old, they're all kids when they ride with us," says engineer Galliani. "Nothing like a ride on this train to take the years off your back and make you young again. I've been sitting in this cab a long time, but I never had a dull ride."

Youngsters Rate a Favored Spot

The trip starts at 9:45 a.m. Sometimes children are allowed to ride on the diesel engine hood inside the cab, where they can watch the engineer at his controls. Only a man with four children of his own, like Johnny Galliani, would have the patience for the job.

"A lot of our friends come here just for this one 80-mile round trip," Nelson says. "They fly in from Salt Lake or Los Angeles or some other distant place, and we don't like to turn them away. So we make up an extra train of flat cars and send them off happy. It may not be modern railroading, but it's a lot of fun."

The trip officially starts when Tom Golden, burdened with milk cartons, mail sacks, news-

Dogs ride free, but at arm's length from the conductor. Though once bitten, Tom Golden holds no grudges against well-behaved pets.

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papers, and other items, climbs aboard and desperately looks for a vacant place to organize himself and his load. He gives the two-bell signal, and the Skunk wheezes, bumps, and rattles out of town.

"We don't have club-car comfort," Johnny Galliani says, "but it's good for the liver."

In a matter of minutes the train is beyond Fort Bragg's gray fog belt and past the city limits. It creeps into the woods at 20 miles an hour, a speed that exasperates an occasional city dweller. "No use rushing through life," Johnny says, "Too much to see."

Wildlife Abounds Along the Route

Any moment, as the car glides around a bend, a doe may spring down from the bank and bound along the ties until, with one frightened leap, she crashes into the sanctuary of the brush. Another time a brown bear may amble along the tracks, or a mountain lion may be seen, stalking a rabbit.

From time to time, as the tracks knife deeper into the forest, Johnny stops the car and beckons to impatient hunters.

"See that hogback up there?" he'll say, "Stand around there for an hour or so, and sooner or later you'll spot some big huck coming out to feed. We'll be back this afternoon and pick you up. And if you're not there," he adds kiddingly, "you'll spend the night with the bobrats."

Fishermen get tips from Johnny, too, for he has fished the trout streams himself. Picnickers are dropped off at inviting spots along the way—a glen canopied by the tall redwoods, or where the Noyo River lies like a mirror in a sun-washed meadow.

Such customers are picked up on the return trip, even if the Skunk has to wait, and often there are forgetful ones who have to be summoned with warning toots of the horn.

But while the Skunk is a delight to tourists and campers, it is also a lifeline to a dozen or so families who have permanent homes in the timberland. Some operate small sheep or cattle ranches; others are retired Union Lumber Company employees or couples from the big cities bent upon living in the woods. They lease an acre or two of land from the company at \$25 a year for five years, and are permitted to renew for indefinite periods if they have cared properly for the land.

To these people, who have no supermarkets, hospitals, or other conveniences, Tom and Johnny are all things—postmen, messengers,

food suppliers, first-aid crew, and personal friends. The grinding sound of the Skunk is music. The cheery blast from Johnny's horn gives its daily summons, and people come running from homes and gardens, from the riverbed and the hillsides (page 726).

Tom delivers their milk and their mail. He brings a case of beer or a bottle of liniment. He has the papers, or a fresh battery for a radio set, or some other item not carried as freight but brought as a neighborly gesture. People tell their troubles and joys to Tom, and even use him as a baby sitter if they have to go to town on the train and take the kids along.

"I bet I've spent more darn lunch hours with kids on my lap than any conductor in the country," Tom says with a grin. "We meet life every day in a lot of ways. And sometimes death," he added soberly.

One day last summer when the Skunk was coming down the mountain into Willits, Johnny saw three small boys hunting with .22-caliber rifles. There was a shot and a sudden pained cry, and Johnny saw one of the boys drop. He stopped the train, hurried to a railroad telephone booth beside the tracks, and in a moment was arranging for help.

Train Serves as Ambulance

A physician was waiting when the train brought the wounded lad to the outskirts of Willits. The boy had a bullet in his lung and would have died, the doctor said, without the prompt help of the train crew.

Because they are so familiar with the habits and needs of their wilderness wards, Tom and Johnny are always ready for emergencies not mentioned in the railroad operations book. They knew, for instance, that one young woman was expecting a baby, and they stayed on call at home for a few nights until, as anticipated, her husband phoned them for help. Johnny and Tom got a speeder, or work car, out of the shed in Fort Bragg, rode into the woods, and brought the woman back to the hospital. There, minutes after their breathless arrival, a new passenger joined the railroad family.

Another time, when a woman rancher was kicked by an ornery mule, Tom saw her limping and gave a helping hand. If one of the woodland dwellers meets the train with a snuffle, Tom will have aspirin and paper handkerchiefs on the return trip. More than once he's brought bee-sting ointment, or a hot-water



Towels and Bedding Hang from a Tree House Built on a Redwood Stump
Forest giants surround Redwood Lodge, a camp 10 miles from Fort Bragg. Given the opportunity, no young visitor ever misses a chance to climb to the snug tree house and spend the night. Ferns sprout around the stump.

bottle to relieve some rancher's aching back.

He's stopped the train often to take aboard a dog that wouldn't be left behind, and he's had arguments with newly born calves that get stuck in the track guardrail and have to be lifted off.

"It's all in the day's work," the conductor shrugs. "I'd hope somebody would do the same for me if I were living out in the middle of nowhere."

Trainmen Know Tragedy and Danger

The Skunk's journeys do not always have a happy ending. Tom and Johnny made one emergency run at night when an old friend phoned that he was having a heart attack, but he was dead by the time they reached his home with a doctor. Another time a war veteran to whom they had waved every day for a year suddenly and inexplicably dived headfirst across the track and was killed under the train wheels. To this day Johnny gets a twinge when he passes the spot, and once in awhile

he murmurs a prayer for his departed friend.

In the winter when the great green arms of the redwoods droop from the weight of snow, and when the wind savagely lashes the river and the forest, the Skunk crawls warily along the route.

Occasionally a tree crashes down across the tracks, and Tom and Johnny can't wait for help. They unpack the saws, chains, and hooks that are standard equipment on the Skunk, cut up the fallen tree, and drag the logs off the tracks.

Their passengers understand these crises, and there are few complaints if the train pulls into Willits or Fort Bragg two hours late. Indeed, at Christmas time both men receive scores of gifts from travelers who, though they may not pass that way again, remember some unselfish deed or a kind word as the Skunk made its humble journey through the woods.

"Our line is primarily a freight line," manager Nelson told me. "Year in, year out, like

Sister herds her flock of boys, who love to gather at the station and watch the train come in. Summer refugees from city streets, the boys enjoy a two-week stay at Roman Catholic Camp St. Albert. Boy Scouts also vacation in the area.





Carrying vacuum bottles and driftwood souvenirs from the Noyo River, Fort Bragg housewives arrive home after a picnic beside the railroad's right of way.

most railroads, we lose money on our passenger traffic. But we feel a community responsibility to the families living out there, and to the thousands of people who visit us, like relatives, again and again.

"There are also three big summer camps for boys and girls along our route, and those hundreds of kids couldn't get to the woods every year without the Skunk (page 731 and opposite).

Friendly Line Has Its Troubles

"The way things are with so many young people in the cities today—you know, gangs and fights and troubles with the police—well, we like to feel we're helping out. That's almost enough reason to keep the train going, profit or no profit."

Nelson said that truck competition and shrinking forest preserves are added threats to the little family railroad, and there are days when he doesn't like to think about the future.

But Tom Golden and Johnny Galliani are confident there will always be a Skunk, and they'll hang on until they're too old to lift a wounded boy, or carry groceries up a steep

hill to a friend's house. Johnny has already been on the job for more than 42 years, and has been rebellious only once.

Johnny was making a special trip one night in a car, since abandoned as obsolete, which combined the baggage compartment and the engineer's cab.

Together with other baggage, a coffin lay in the darkness behind his seat. A shroud of fog hung over the tracks, and Johnny was tolling a warning bell continuously as his headlight probed the gloom.

Just as he entered one of the two tunnels on the line, he heard a muffled grunt. His heart jumped. Then as he rolled around a curve, there came another grunt. Johnny stiffened but dared not look back. Ten minutes later, when he pulled into Fort Bragg, the stifled sounds from the rear had given him the shakes. He jumped out to soothe his nerves under the reassuring light in the station, and told his story to the baggage clerk.

"Hey, Johnny!" the baggageman called out a few minutes later. "I found your ghost."

Johnny returned cautiously, and found himself staring down at a crate containing an



Trainmen Check Watches, Though Time Means Little to Skunk

Tom Golden and Johnny Galliani indulge in the railroad man's time-honored ritual before starting out. Punctuality is striven for, even though Skunk often stops while Tom frees a calf caught in a guardrail or drops off mail to a housewife. The line's two-a-day summer schedule hangs in Fort Bragg's station window.

angry red pig. The pig emitted a spooky grunt, and Johnny forgot his dignity. He heaved the crate to the ground so hard that it broke open, and then, contrite, he spent half an hour chasing the escaped porker.

The experience unstrung Johnny to such an extent—or so they tell in Fort Bragg—that he finally took the general manager's advice to go far away, for a rest and new scenery.

A nice vacation it turned out to be, too.

Johnny spent most of it on a 900-mile round trip aboard the Coast Daylight, the fast Southern Pacific streamliner between San Francisco and Los Angeles. He chatted happily with railroad friends and observed operations with an expert eye.

In the end, however, he was glad to get back to his beloved Skunk.

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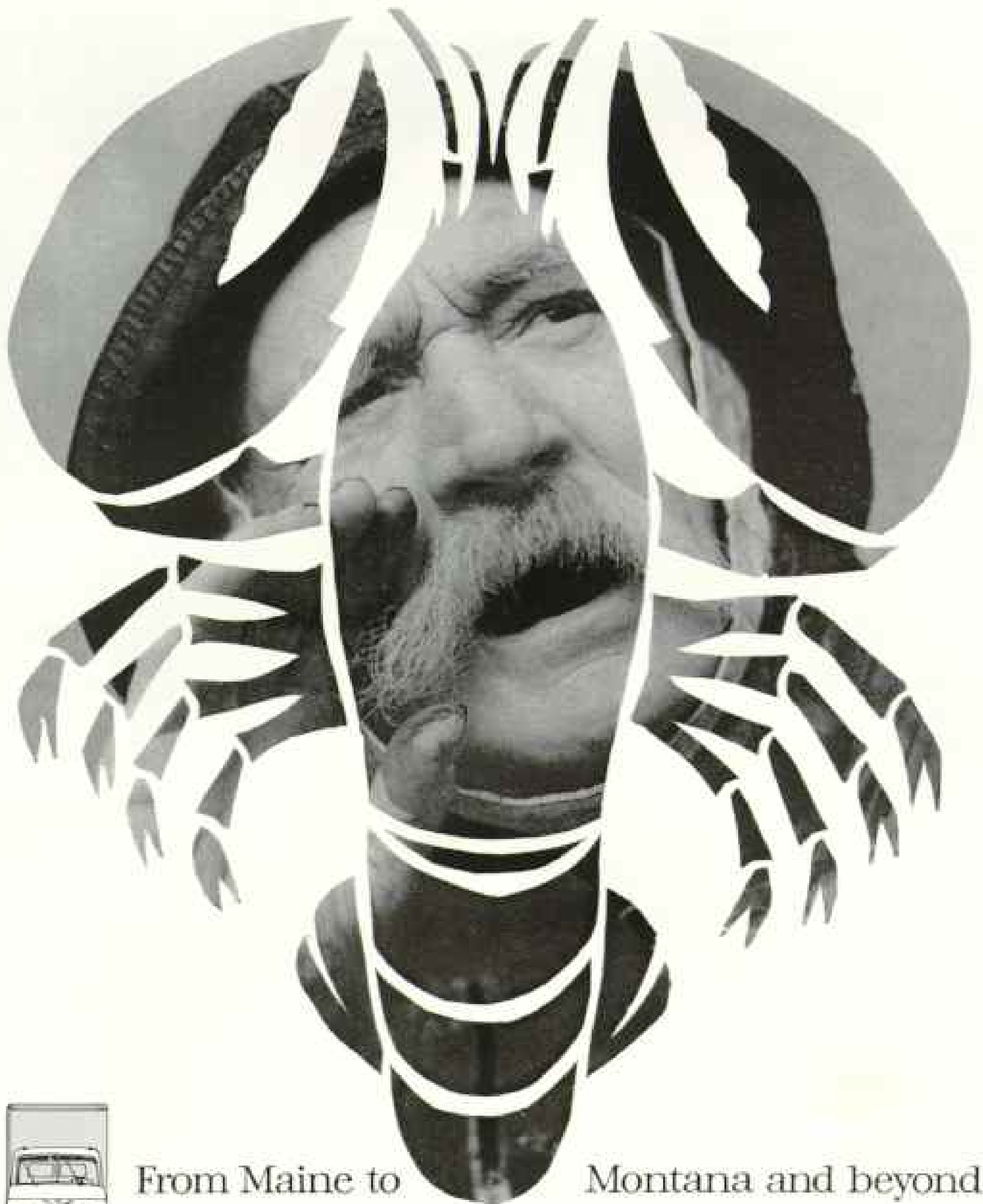
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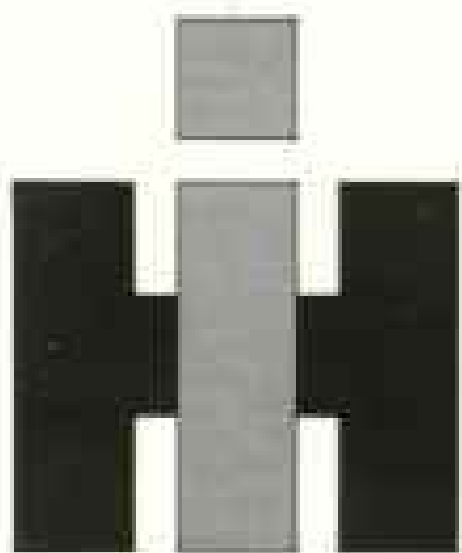
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Color photography was new and film was slow. But young B. Anthony Stewart hefted 100 pounds of camera and glass plates into a Delaware meadow to focus on a restless scene of fox hunters and hounds. His picture, published in the September, 1935, NATIONAL GEOGRAPHIC, made history: one of the first action photographs in color.

Over the years, Tony Stewart's photographic art has shown the whole pioneering sweep of still-color technology. He has illustrated more than 100 NATIONAL GEOGRAPHIC articles. In the remaining months of 1959, members can look forward to three more Stewart photo essays: Sequoia National Park, California's Highway One, and the "Train Called Skunk" (page 720 of this issue).

As The Society's chief photographer, Mr. Stewart heads a corps of cameramen who ranged in one recent week from the ice of Antarctica to the Ruwenzori Mountains of Africa, covering subjects diverse as gorillas, antique dolls, submerging submarines, and outbound rockets.

Only once, Tony insists, did he find his work romantic. On a Maine assignment he asked to photograph the prettiest girl in town, thus met Lillian, his wife and favorite model for 23 years. Here, on a recent trip to Italy, the Stewarts stand atop Rome's Capitoline Hill.



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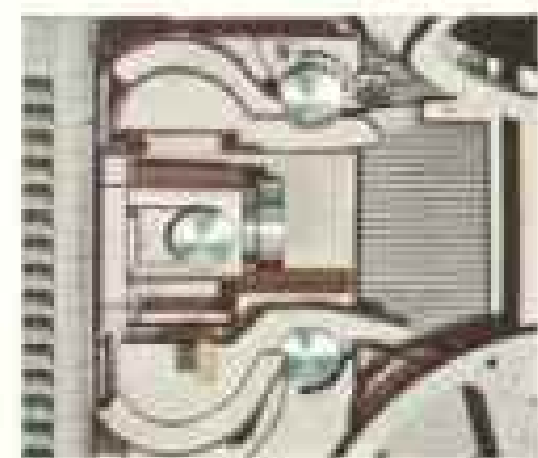
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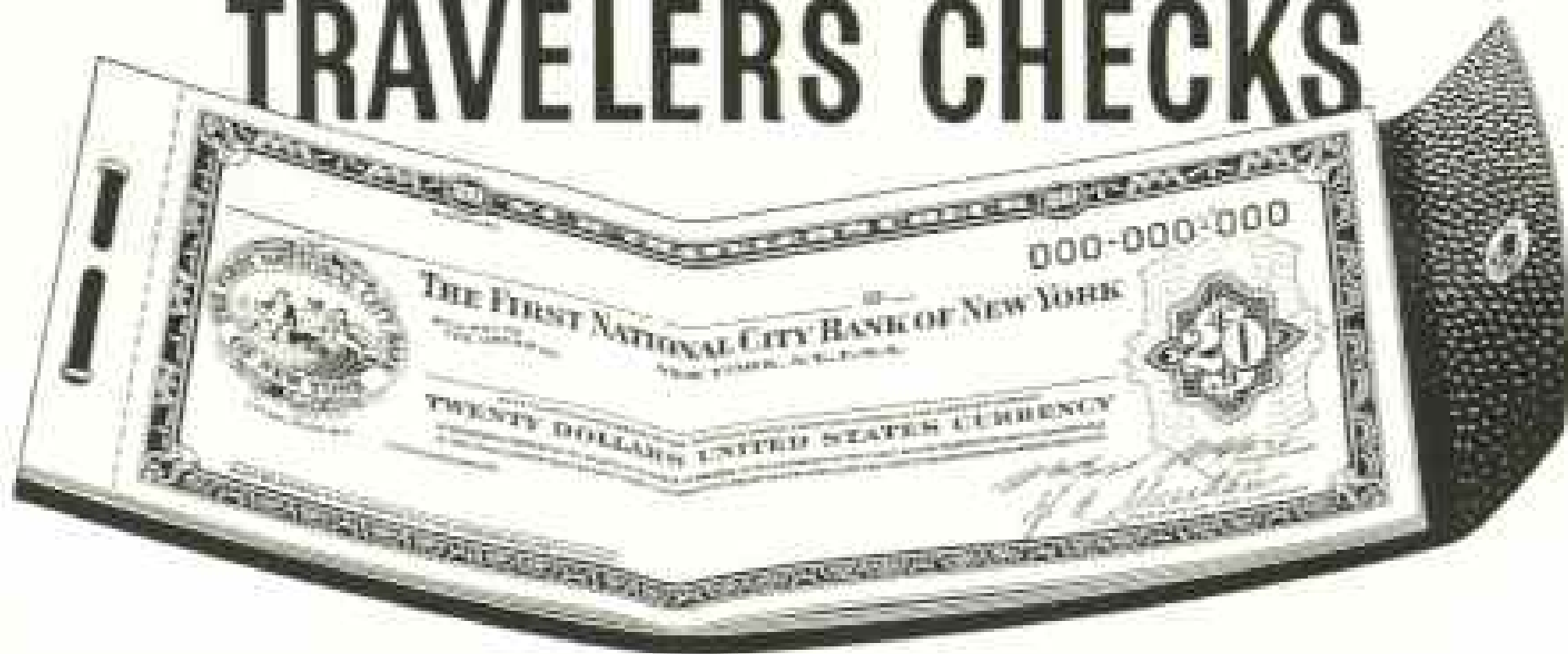
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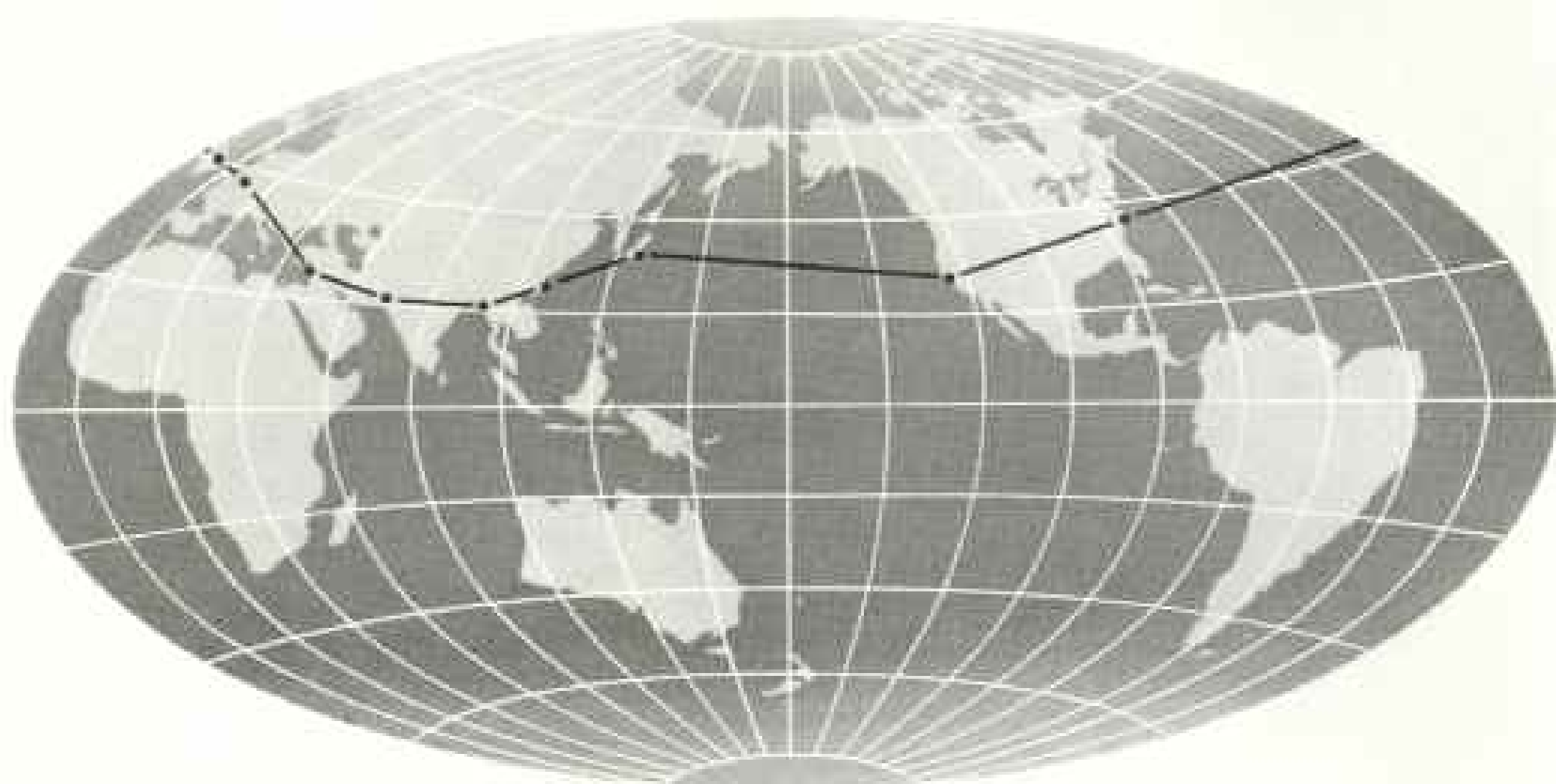
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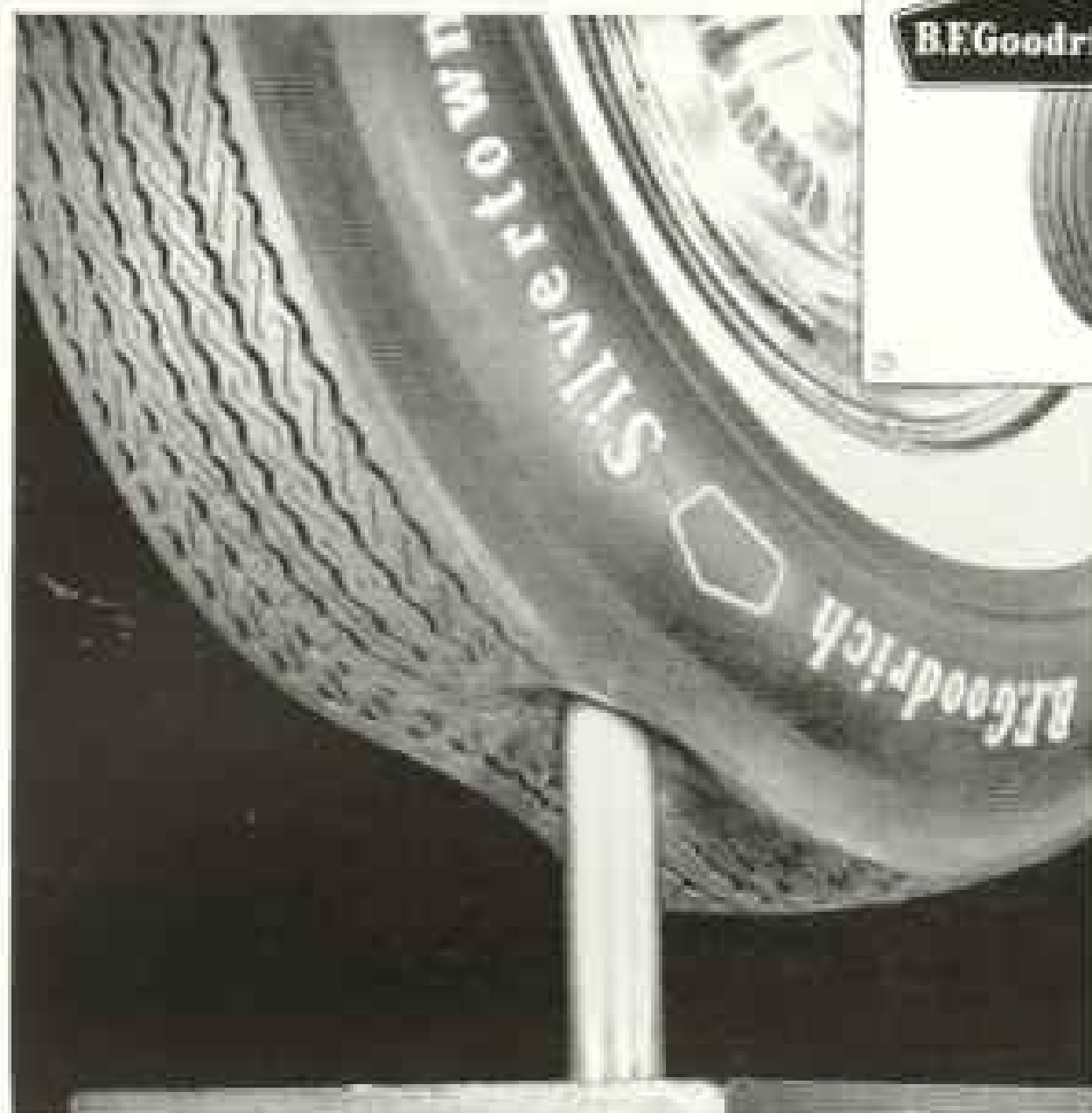
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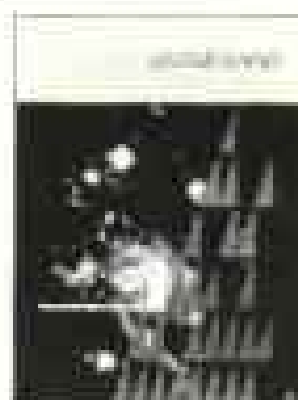
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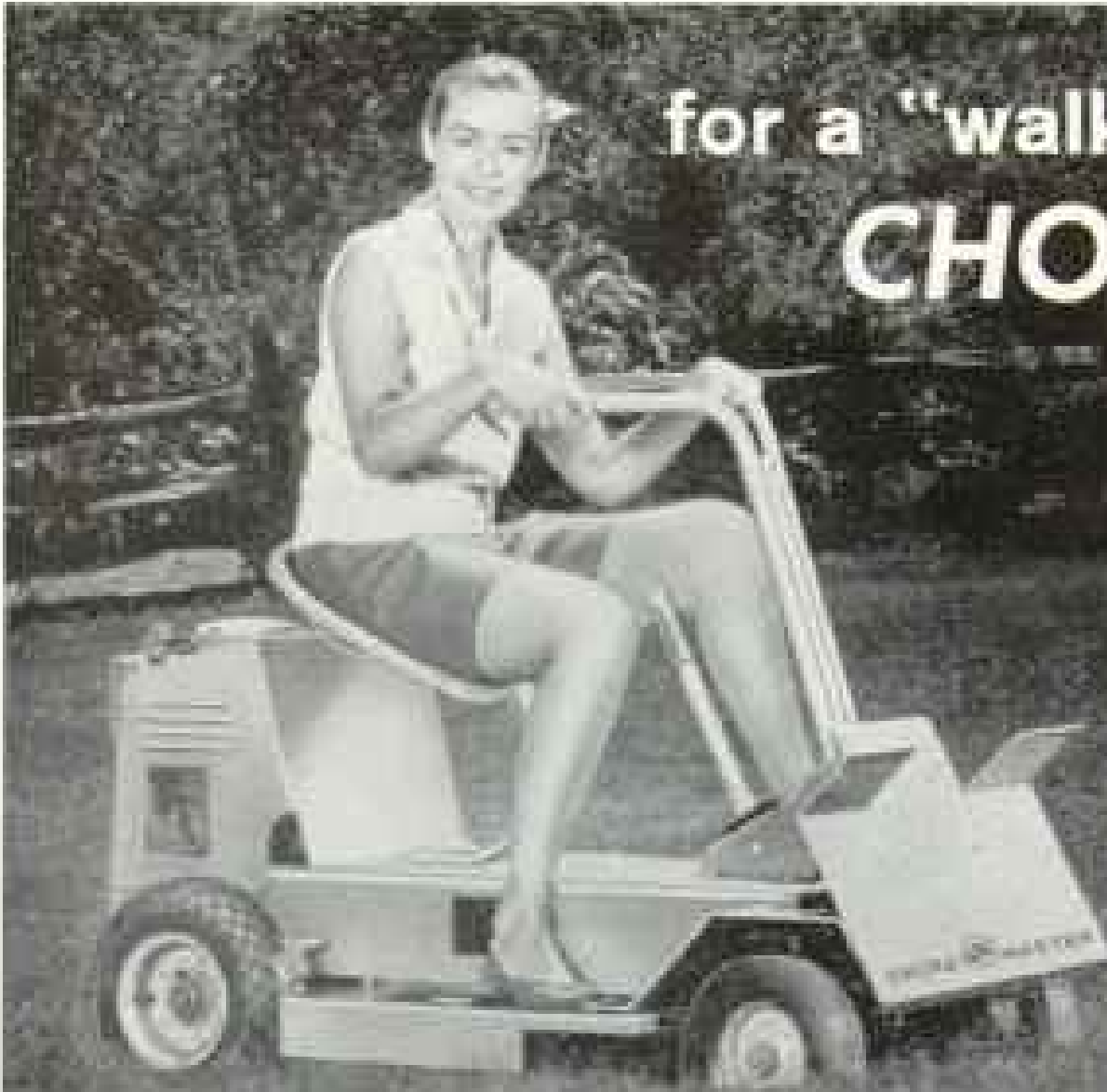
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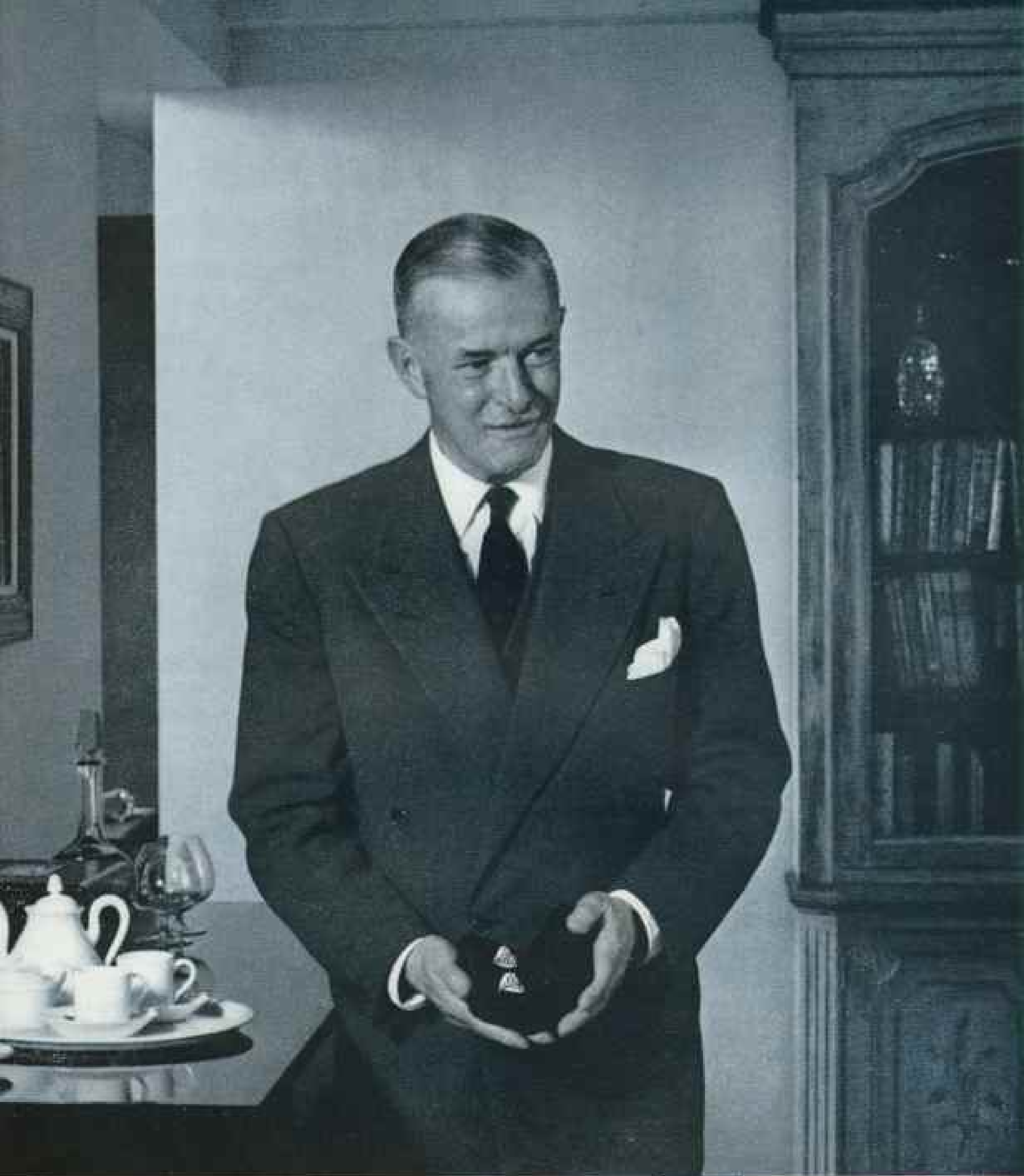
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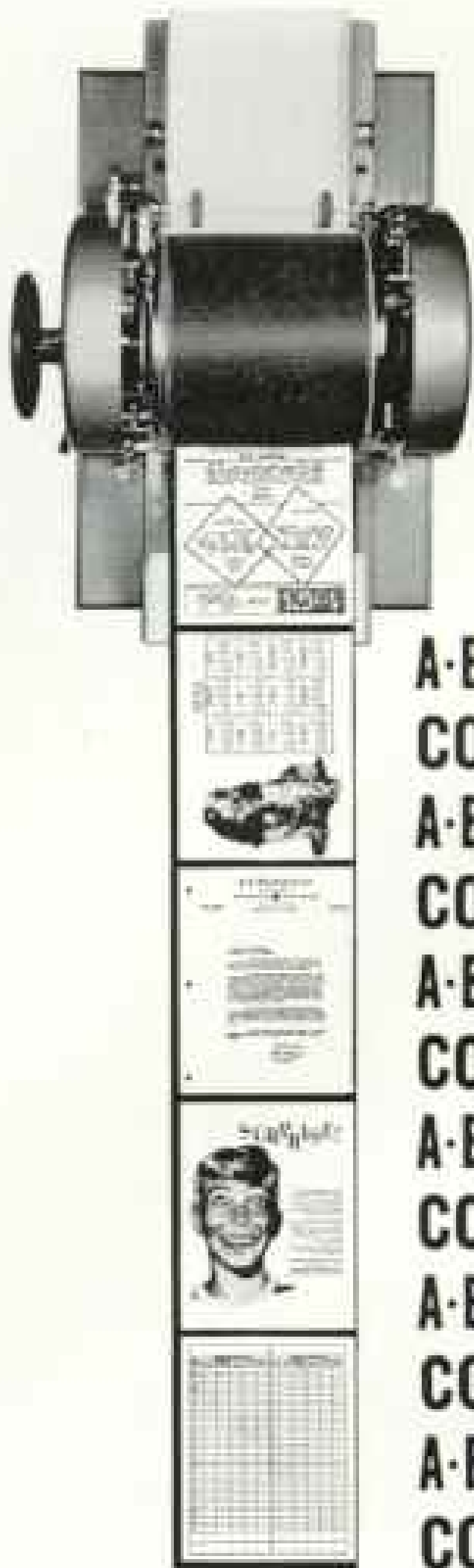
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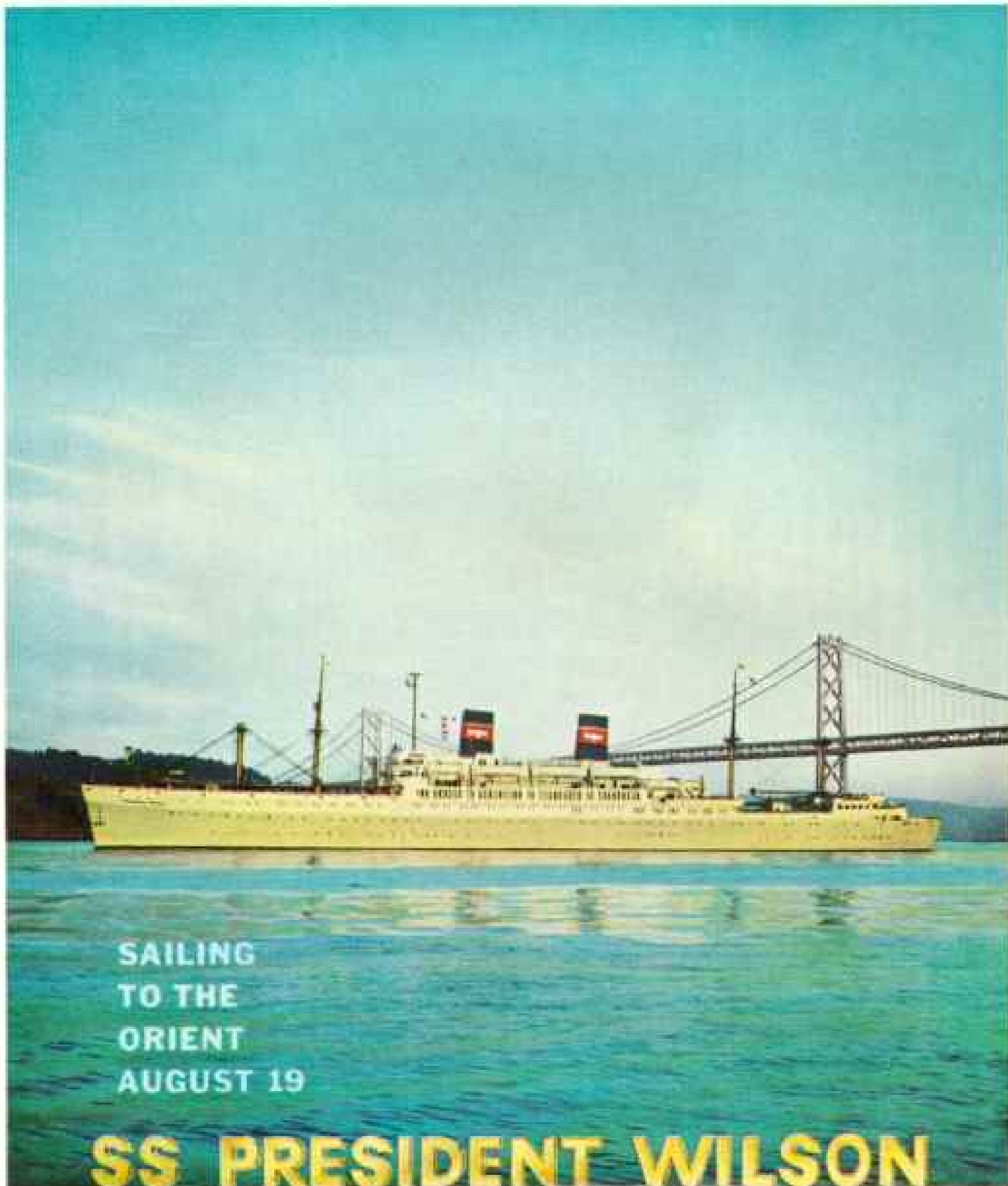
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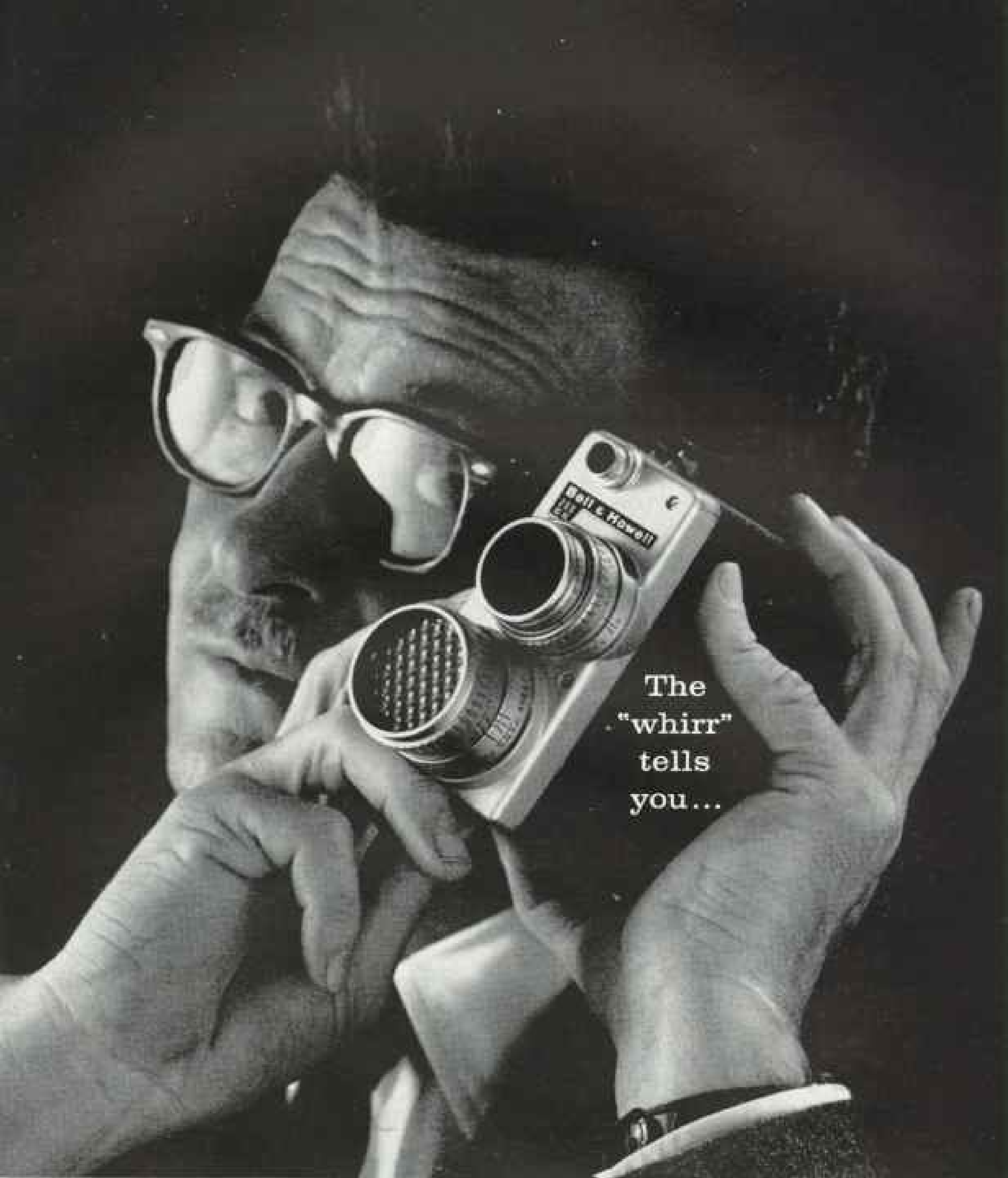
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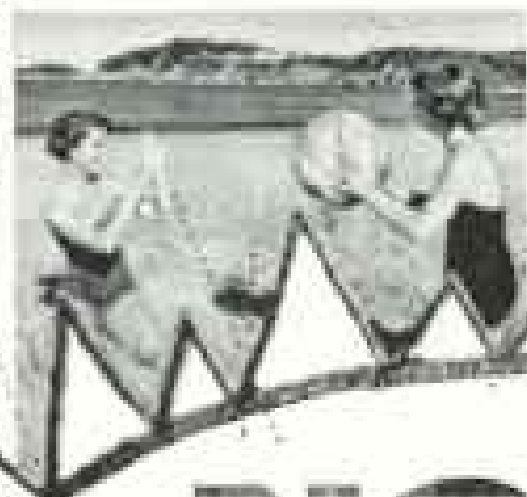
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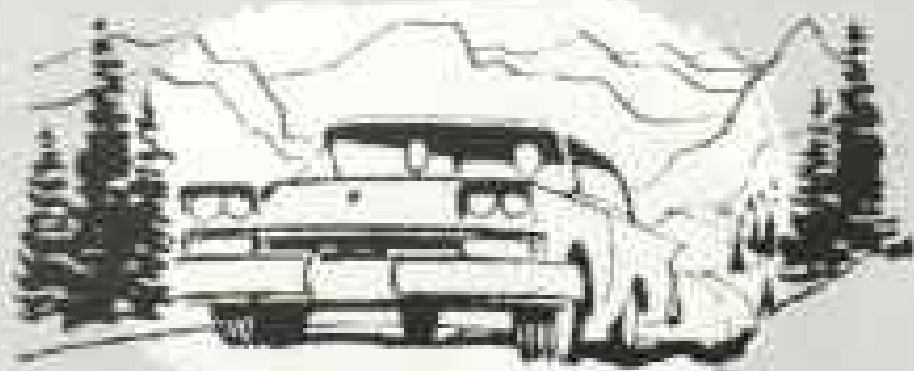
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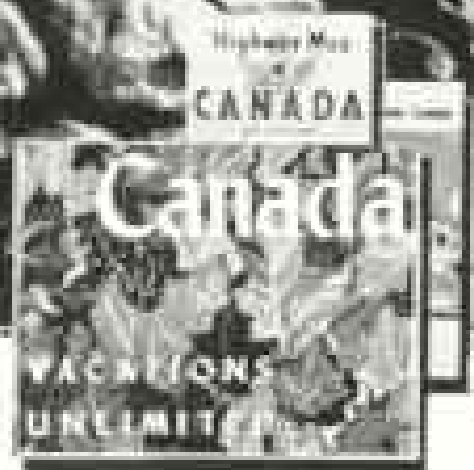
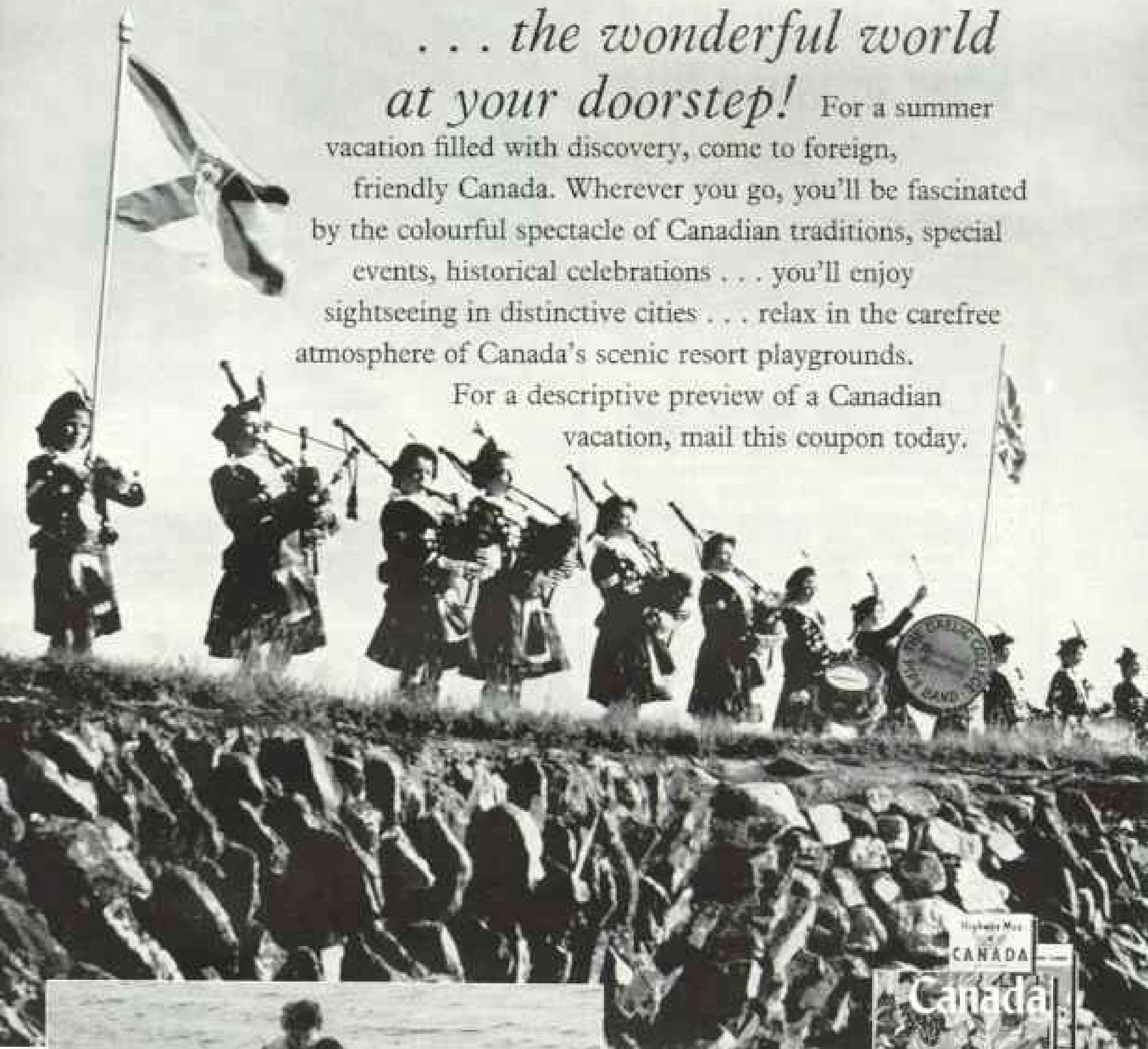
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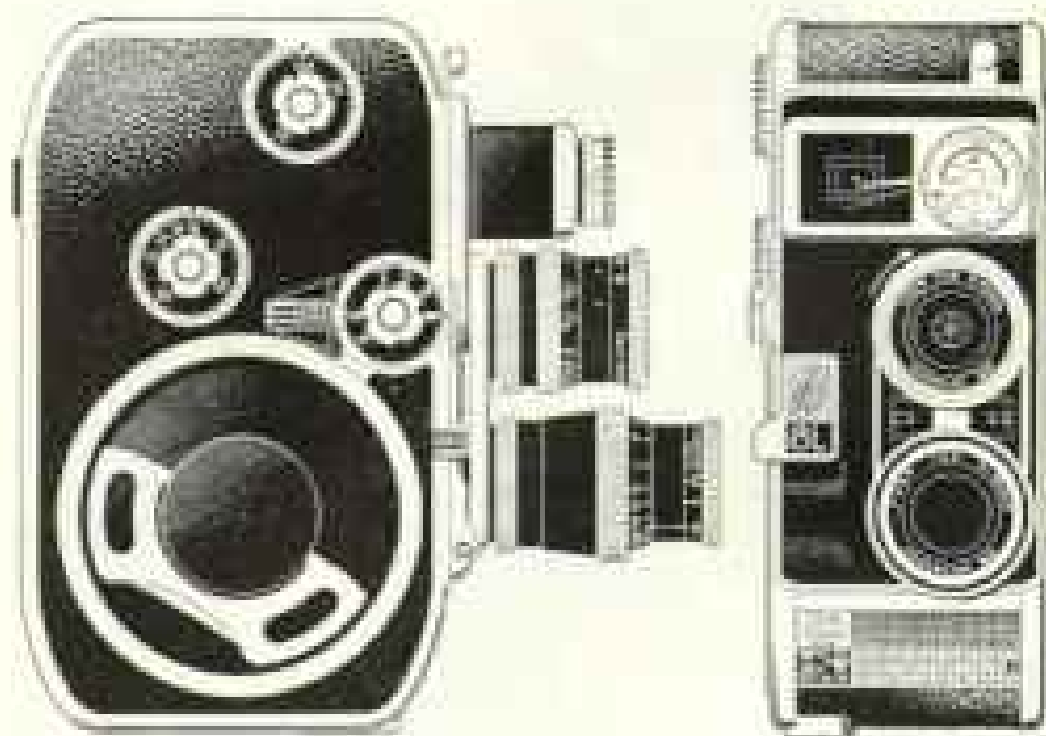
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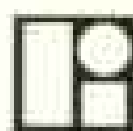
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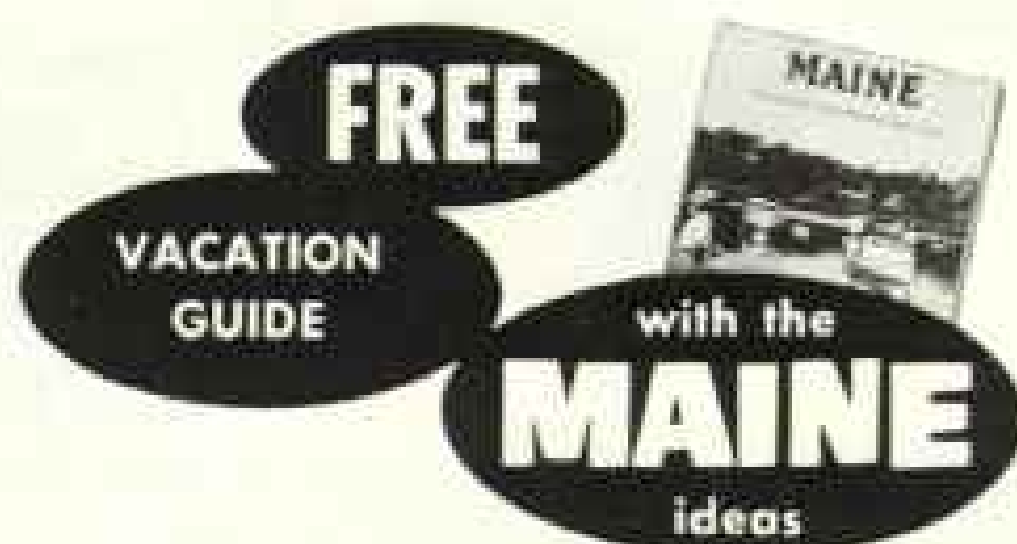


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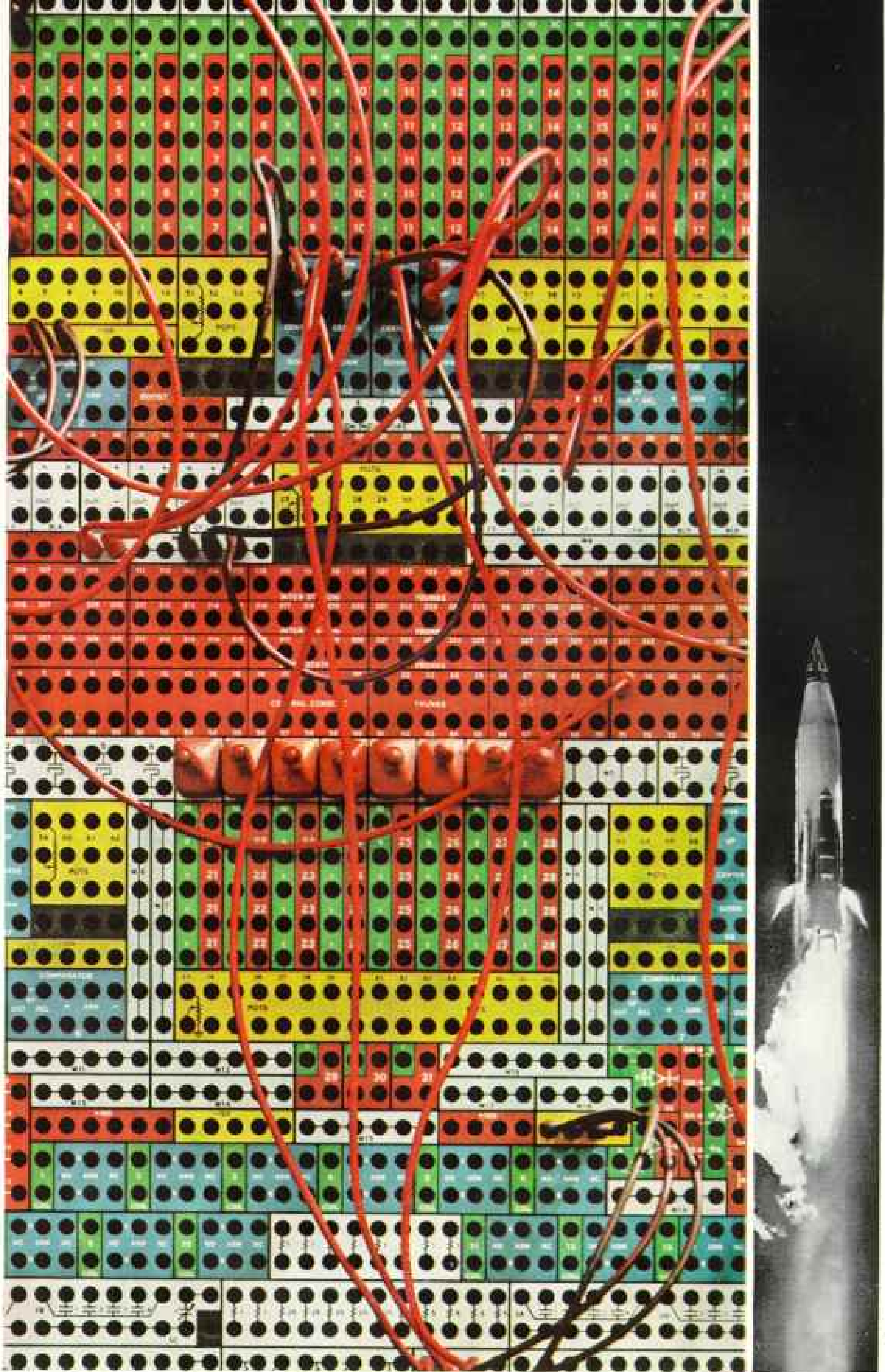
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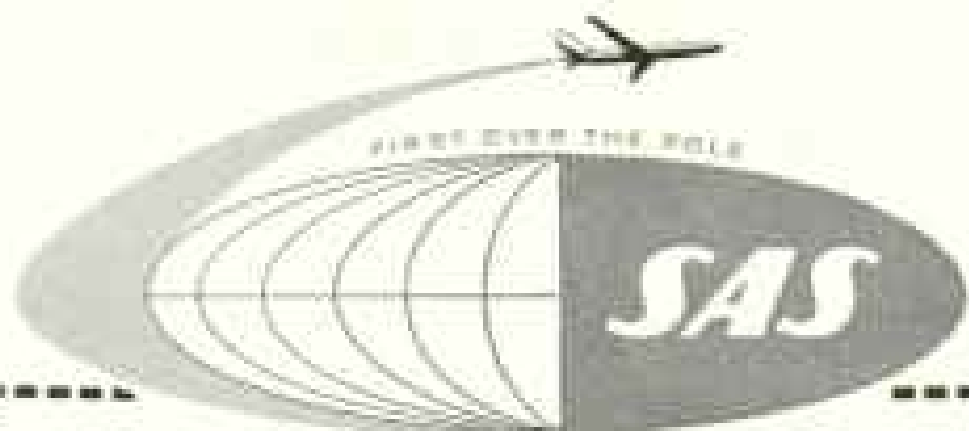
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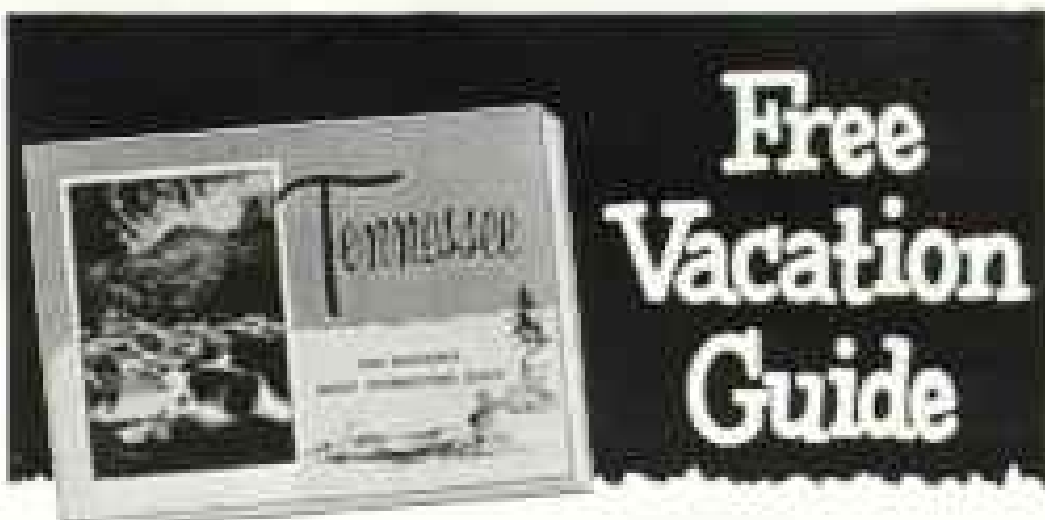


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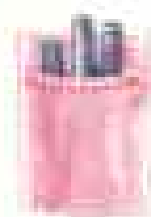
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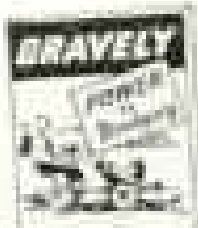
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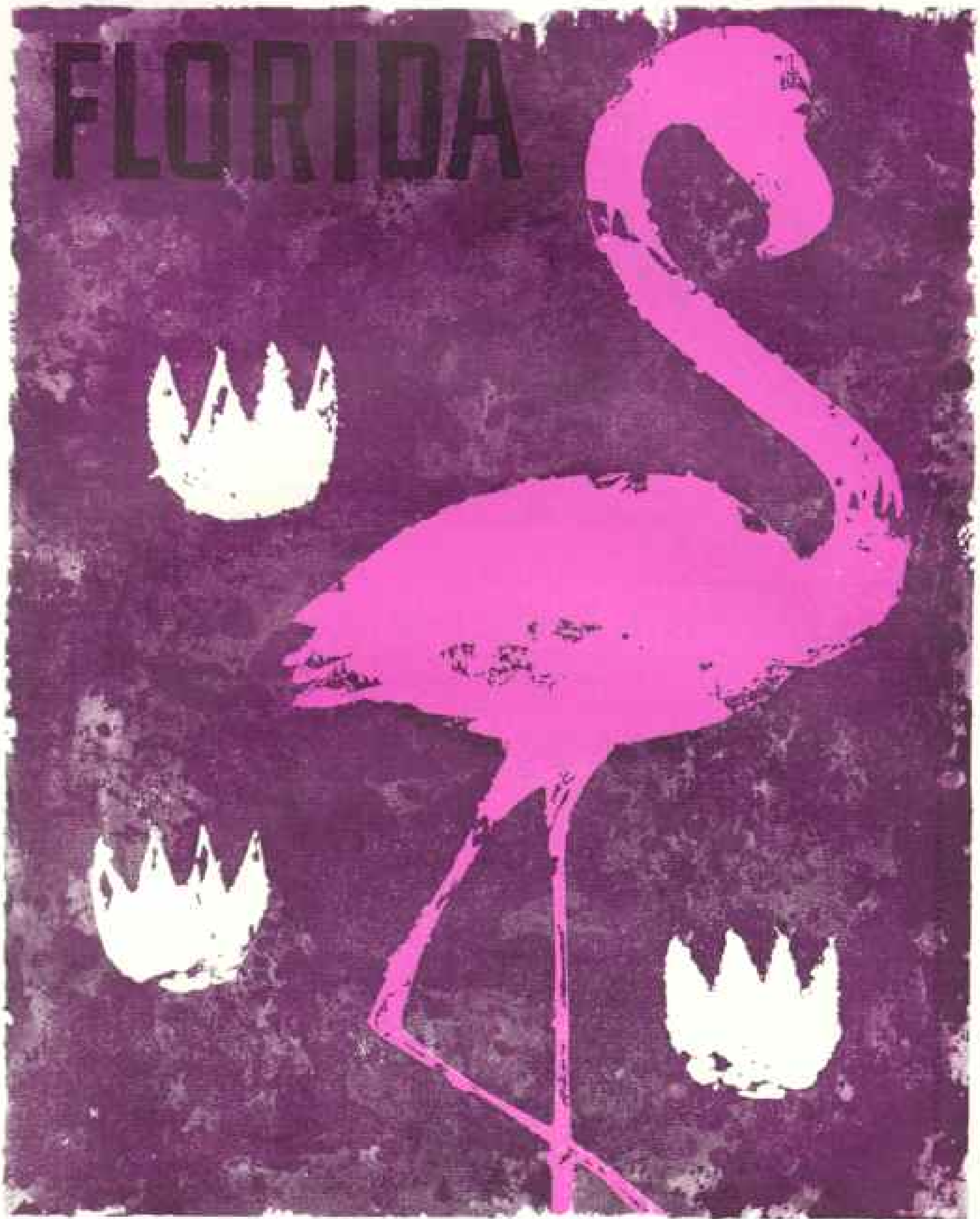
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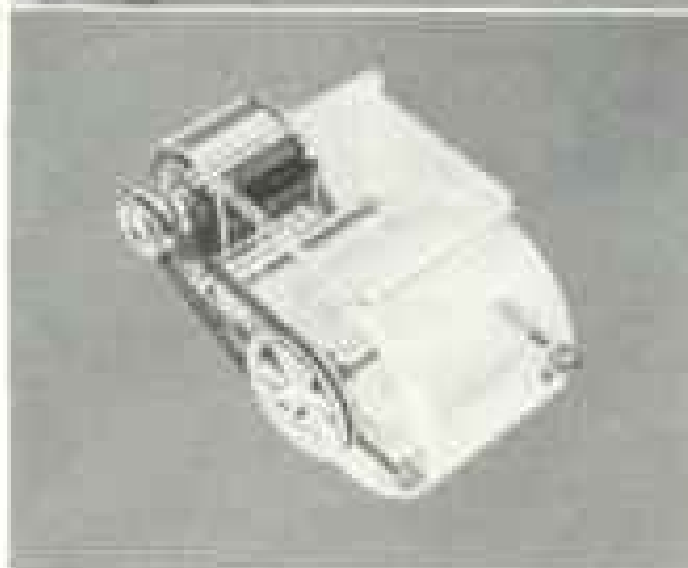
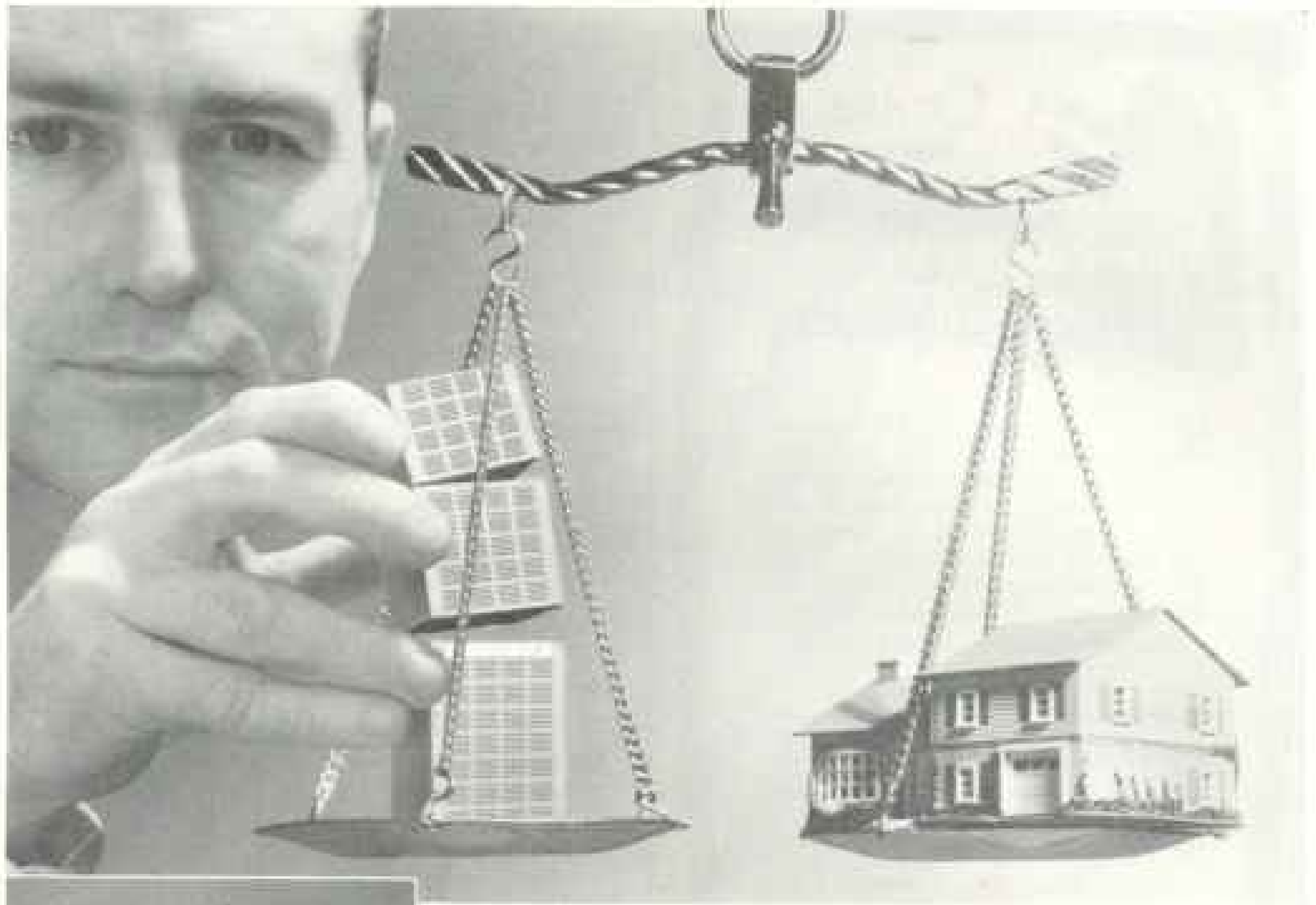
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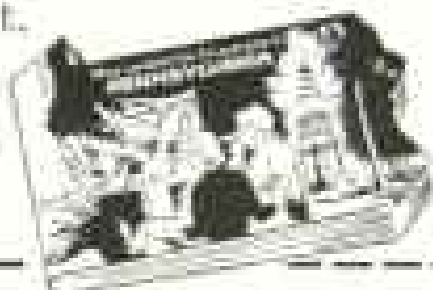
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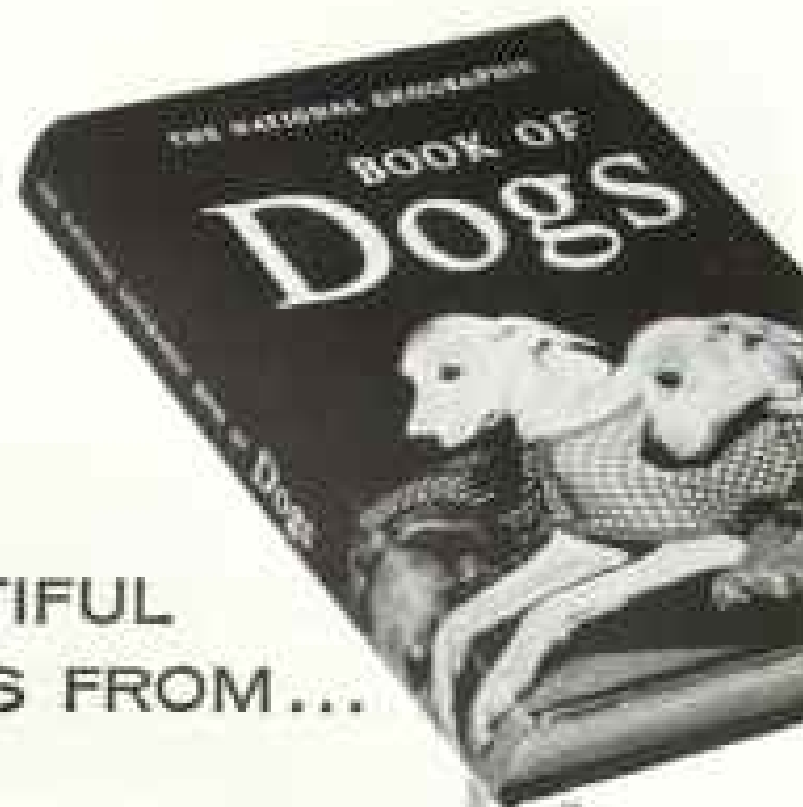
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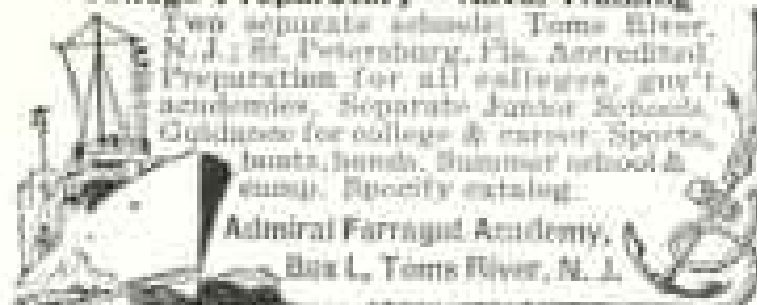


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