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AN AUGUST FIRST IN GRUYÈRES

By Melville Bell Grosvenor

Author of "Color Camera's First Aerial Success," in the National Geographic Magazine

WE ARRIVED in Gruyères at dusk. It was August the First—the Swiss Fourth of July!

Bells began pealing joyously as we climbed the steep path to the town. Something was in the air.

As we listened to the melodious tones we considered how much these bells mean in the lives of the people. They toll for funerals and national tragedies, clang out the time, summon to church, proudly ring out the glad tidings of victory, political or military, and sing hymns and old airs at the whim of the carillonneur. Each call has a distinctive tone. Bells have spoken thus for centuries.

But this excited pean could mean only that some great event was about to take place. It inspired in us, as we hurried along with the stream of laughing, singing country folk, that same expectant thrill that I had felt as a boy when I chased the whining calliope of the circus parade.

A FIT SETTING FOR AN OPERA

We crowded through the narrow arch of the ancient tower, a frowning pile, gray and forbidding, which once barred the way to the invader (Color Plate I). Now it serves the peaceful purpose of framing the old gate and supporting the arms of Gruyères—a silver crane on a gules shield, surmounted by a crown and held by two semi-naked savages, clubs in hand (page 140).

What a scene burst upon us as we passed out of the entranceway and walked into the town's cobbled court! Throngs of people, dressed in gorgeous Gruyérien costumes, were gathered in a medieval setting. All seemed exalted, as were we, by the constant dingdong of the scores of bells, some loud and clear, others fainter and farther away, perhaps miles down the valley (Plates VI and XII).

The scene was like an animated amphitheater, in which the central floor formed the arena, and the high gabled houses, with lace-capped heads craning from each Gothic window, made the tiers.

The backdrop was a veritable rainbow of color. Every sill flaunted a box of brilliant geraniums and nasturtiums, making a kaleidoscope of the pastel houses. White-crossed, blood-red flags of Switzerland stretched between the houses and fluttered from poles. Above most doors waved the scarlet flag of Gruyères, with a white crane strutting across its center. Nature, not to be outdone by the efforts of man, tinted the billowing clouds with the rosy glow of an Alpine sunset.

Gradually, we worked our way up the arena, past the central fountain with its washtubs and wooden boards worn smooth with much scrubbing, to the court's upper end. Like a stage before curtain raising, it was the focal point of all eyes.

The peal of the bells ceased, the echoes dying away in the mountains. From afar the faint notes of an approaching band came through the hush. The music was that stirring song, "Le Ranz des Vaches."

Tradition says King Louis XIV forbade his bands to play it, for the lilting tune made his Swiss mercenaries so homesick that they would weep and desert the colors when they heard it. Even today, when a Swiss is far from home, the refrain brings

Photograph by Melville Bell Grosvenor

CLIMB TO THIS LOFTY TERRACE AND ENJOY THE VIEW OF CHÂTEAU, CHURCH, AND MOUNTAINS

From here on the night of August 1 the surrounding hills sparkle with bonfires lit by herders (page 141). Covered with ivy is the Château's "Tower of Torture," now an arms museum, where tattered flags captured by the Gruyèriens at the Battle of Morat are preserved. Strangely, the name of this dairying district in Fribourg Canton is spelled Gruyère, while its ancient capital adds an "s," making Gruyères.

tears to his eyes. It produces that same tingling along the spine that a United States Naval Academy man feels when "Anchors Aweigh" is played.

PARADE OF THE COSTUMED DOLLS

Soon we saw emerging from beneath the arch a file of tots, gay in Gruyèrien costumes. At once a chatter began in the audience, as mothers and fathers recognized their offspring. A vivacious little bride and handsome young bridegroom led the parade. So small and neat did they seem that they might have been animated dolls paddling along—a Swiss edition of the Chauve Souris (page 142).

Each "doll" looked searchingly at the spectators. Every now and then one broke into a blushing smile and shyly turned away; perhaps a parent had been glimpsed in the throng.

The happy children passed on, the eldest and tallest bringing up the rear. Arranged in steps, they resembled a bright-hued escalator moving down the path.

The men of the village and near-by dairy farms, young blades and gray-bearded sires, followed the children, solemn and in step, mindful, perhaps, of their many months of military service. They wore traditional dark-blue jackets with short, puffed-out sleeves, white shirts clean as new snow, and tiny skullcaps like those of college freshmen, only made of straw (Plates I and IV).

Some of these men had come down from the high pastures to attend the fete. Each had his inevitable pipe, huge and cumbersome, with a lid to keep the sparks from flying on a windy day.

Behind their lords cheerfully marched the maids and matrons, full-scale models of the infants. Broad-brimmed hats with black velvet streamers set off the good looks of these blond Swiss demoiselles and their brilliant dresses.

I turned to my Swiss cousin, who had brought us here to his favorite village and knows his native land like a book. "Lilo, I always understood that costumes were

Photograph by Melville Bell Grosvenor

AS THE SUN SETS, A BOY AND HIS SAINT BERNARD TROT WITH THE MILK TO THE CHEESE FACTORY

Chief traffic hazard on many of Switzerland's excellent highways are dog-drawn carts, used mainly for hauling dairy products (Plate X). This magnificent animal pulls his cart so fast that the boy seems to be holding back, rather than assisting. Paced by the author's automobile on a level stretch, the team jogged along steadily at about five or six miles an hour (page 155).

never worn any more in Switzerland. You see them only in picture postcards—models dressed up in museum clothes and posing for the photographers!"

"Oh, no," he said, "the people of Gruyère take pride in their costumes and cling to them. Once the garments were practically abandoned, but patriotic societies for preserving costumes delved into records and drawings of early days and these are the treasure-trove. *They are* Gruyère.

"Women don the bright dresses only on fete days, but the men wear theirs daily, even when herding cattle in the high pastures or making that famous cheese—which we really came here to see, you know."

EVEN FIREWORKS!

The joyous parade meanwhile circled the fountain and came back up the street, children toddling, their fathers and brothers still stern and solemn in military formation.

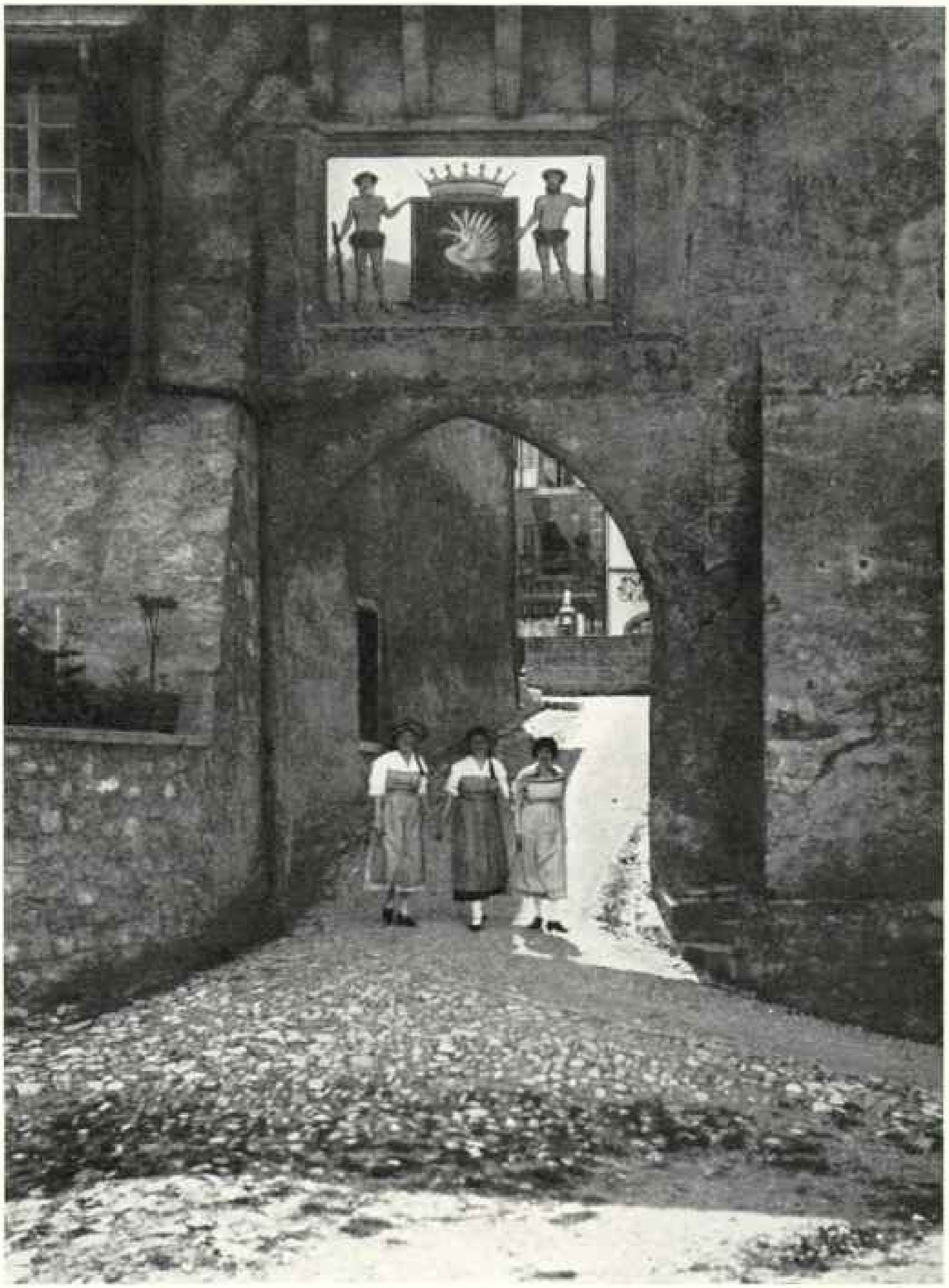
It was to the village shrine beneath an overhanging eave that the procession wound. Here they gathered, young and old, in a circle and sang the chorals and rollicking folk ballads, as their forefathers had before them (Color Plate III).

Suddenly, as the last note of the last song died away, a terrific bang was heard far down the court. All eyes turned, to see a rocket bursting in the air, the sparks falling into the gay crowd. This was the signal the youngsters had been awaiting. Forgetting their lace and silk costumes, they rushed pell-mell toward the man with the fireworks.

Soon all were swinging sparklers, Roman candles, and red flares to make a fantastic sight in that ancient courtyard. Arched windows, gilded coats of arms hanging from house fronts, and bright flags stood out brilliantly in the glaring light.

If some old man-at-arms had come to life and poked his head out of a window, the ghostly scene and popping din might have made him think the Count's army was defending the town from a night attack.

Was this Switzerland? That staid land of snow-capped mountains and winter



Photograph by Melville Bell Grosvenor

TWO SEMI-NAKED BARBARIANS, CLUBS IN HAND, NOW ARE THE ONLY SENTRIES AT GRUYÈRES' ANCIENT GATEWAY

Once the arched portal was heavily fortified. It fronts on a terrace to which two sloping paths lead up from the valley (Color Plate XV). Twin towers, pepperbox style, guard the corners. Beyond the arch is the central court upon which the houses face.

Photograph by Melville Bell Grosvenor

NO CHANCE OF BEING GIVEN SHORT MEASURE HERE

Wheat was poured into the basins of various sizes carved out of the stone block. When full, they were emptied by pulling plugs from holes in the far side. Now the measure is preserved as a curiosity. Children use it as a play-place, the tiniest curling up in its largest openings in the game of hide-and-seek.

sports, where folk never wear costumes or perform the old dances? Even Lilo was spellbound. He had never before been in Gruyères on the night of August the First!

A whirling cartwheel, on a post above the fountain, was the mad climax to the fireworks spectacle. While a sea of shouting, happy youngsters watched, a daredevil climbed up gingerly and stole the still red-hot frame as a souvenir.

We went into the hostelry for dinner. Entering, we passed the large kitchen with cooks and kitchen maids scurrying around with their array of shining copper pots and pans. The delicious aromas that came from that spotless kitchen were a tantalizing appetizer.

Our charming hostess, matronly in her colorful costume with a dainty Swiss lace shawl thrown over her shoulders, insisted that we come out on her terrace for a moment. We went rather reluctantly, for it was nine o'clock and we were hungry.

We were astounded by the view, as we stepped out onto the gravelly balcony, perched on the brink of a precipice. A ring of jeweled lights, sparkling from the mountains, encircled us (page 138).

ALPINE BONFIRES RIVAL THE STARS

"What are they?" we asked our hostess.

"Huge bonfires built by the herdsmen to celebrate August the First."

"You mean all of those twinkling lights, some down low in the valley and others high on the mountains, are specially built fires? What for?"

"Originally the Swiss used bonfires as a sort of medieval wireless to pass news of a victory quickly from one village to the next. Now they celebrate great events in their history, especially battles and alliances, by building the fires on anniversary days," Mademoiselle Ruffieu explained.

"On August 1, 1291, three communities of Uri, Schwyz, and Unterwalden formed a

Photograph by Morel

ALL DRESSED UP AND READY FOR THE PARADE

These youngsters led the August 1 procession of costumed villagers and herders (page 138). The girl, wearing a broad-brimmed hat with black velvet streamers, is a miniature of her elder sisters and mother. A gray top hat supplants the usual straw skullcap for the boy, but he carries a herder's cane.

perpetual alliance to protect themselves against bullying neighbors. That was the beginning of the Swiss Confederation, our 'Declaration of Independence.' Now each year we keep alive the memory of that great day by a fete, the ringing of bells and the crackling of bonfires.

"You see that tiny light up there? It's not a star. Some alpinist has climbed the rocky crest of Dent de Broc, 6,010 feet, and lit that fire (Plate XV). He had to carry every bit of wood up from the timber line. Climbing down in the dark will be no joke, either, if he wishes to descend before dawn."

When we had fully viewed this dazzling sight, she guided us back to her cozy dining room. "Do you mind eating at this little table in the corner, messieurs et mesdames? The Choral Society is to meet here tonight and I have reserved these big tables for them."

"No, indeed, mademoiselle. All we want is dinner. We are hungry!" A banquet was put before us, but the steaming vegetable soup was enjoyed most. Lilo was looking forward impatiently to the last course, because instead of a "sweet," native cheese—Gruyère — was to be served, and it was a favorite with him.

While I was enjoying a savory bit of chicken, I heard a familiar song in the distance. Turning to my wife, I said, "Did you hear that?"

"Yes, it's 'Frère Jacques.'"

We peered out of the window. Leaning far out over the geranium box, we saw below us a ring of dancing, singing children (Color Plate VI).

"Frère Jacques! Frère Jacques!
Dormez-vous? Dormez-vous?
Sonnez les matinés! Sonnez les matinés!
Dig, ding, don! Dig, ding, don!"

Over and over they sang it, whirling and skipping the while. So, we thought, even the youngsters are conscious of the rôle the silver-toned bells play in their lives.

The song happens to be a favorite with our children, who learned it in French class at school. All last winter they sang it repeatedly until we forbade the song in the house! It was thrilling to hear it sung by these French-Swiss youngsters in that

Photograph by Melville Bell Grosvenor

WHEN VILLAGERS DON THEIR COSTUMES AND FEAST AND SING ON AUGUST THE FIRST, GRUYÈRES RECAPTURES ITS LONG PAST GLORY

Bright Swiss flags, blood red with white crosses, and scarlet banners flaunting rampant silver cranes fly from every house front on this important day. When the weather is fair, guests of the pleasant Hotel Fleur de Lys eat their meals at the white tables (background) or on the terrace in the rear of the buildings, overlooking the valleys and the mountains that surround the hilltop town.

paved street, lit by the fitful light of open doors and windows.

We listened and watched for a quarter of an hour, while our chicken grew cold on the table, to this and many other native refrains and dances. Finally, to our delight and the surprise of my cousin, the childlike voices broke into "Auld Lang Syne." Soon thereafter the youngsters scurried to their beds and the audience of parents and villagers dispersed. The court was empty in a few minutes, and only the sound of singing in various taverns broke the peace.

CHORAL SOCIETY PROVIDES DINNER MUSIC

As we ate the tasty cheese—it seemed more delicious here in its native haunt than anywhere else—groups of young women and men began filing in with their songbooks. The room filled rapidly.

Some of the girls soon grew weary of their tight black-lace caps or wide-brimmed bonnets and took them off. Luckily, the end of our table became the depository for these bonnets. Each girl, as she laid hers down, gave us a smile.

Then, under the leadership of a vivacious matron, they sang together, full-throatedly, their old ballads (Plate V).

When the singing was over and the young people had gone to their homes, the landlady escorted us to our rooms. We were disappointed, for they faced the court, and we could not see from aerie windows the mountains and the still-glowing bonfires.

The good lady was surprised, for not often does she have such requests for outside rooms. Most guests prefer the ringside seats which court windows provide, as we soon found out.

Our low-ceilinged chamber was a delight. It was large, and, of course, as neat as a pin. In one corner stood a blue, glazed-tiled stove which, in the cold winter days, served to warm the room (Plate XIII). White beds, placed close to the heater, suggested puppies snuggling up to their mother on a frosty night.

On each bed lay a mountainous white quilt, fully 15 inches thick. While this covering looked heavy, actually it was light and fluffy, for it was stuffed with duck or goose feathers and down.

Furniture was plain, but comfortable, and the wide white boards of the floor creaked as we walked across the room.

Shortly after we had climbed into our feather beds, the boys in the tavern next door became boisterous. From snatches of the gay speeches and songs, we learned that some of the party were Gruyèriens who had come all the way from Spain to be home on the day and night of August the First! (Plate IV).

They sang the songs of their boyhood, but repeatedly broke in with "Le Ranz des Vaches." Over and over again they sang this haunting refrain. Here truly was a 20th-century example of the magnetic power of the old piece. The singing of the song in far-off Granada may have drawn these native sons home again.

Far into the wee hours, until three a.m., the revelers sang. Then they poured out into the court, laughing, talking, and shaking hands in adieu.

A TOUCHING FAREWELL

"One last song," they shouted to two handsome young herders, who, wearing traditional dark-blue costumes, stood together, arm in arm, and sang the eerie "Au Clair de la Lune" (In the Moonlight). Around the court, heads poked out of windows to watch this farewell, but no one complained of the noise!

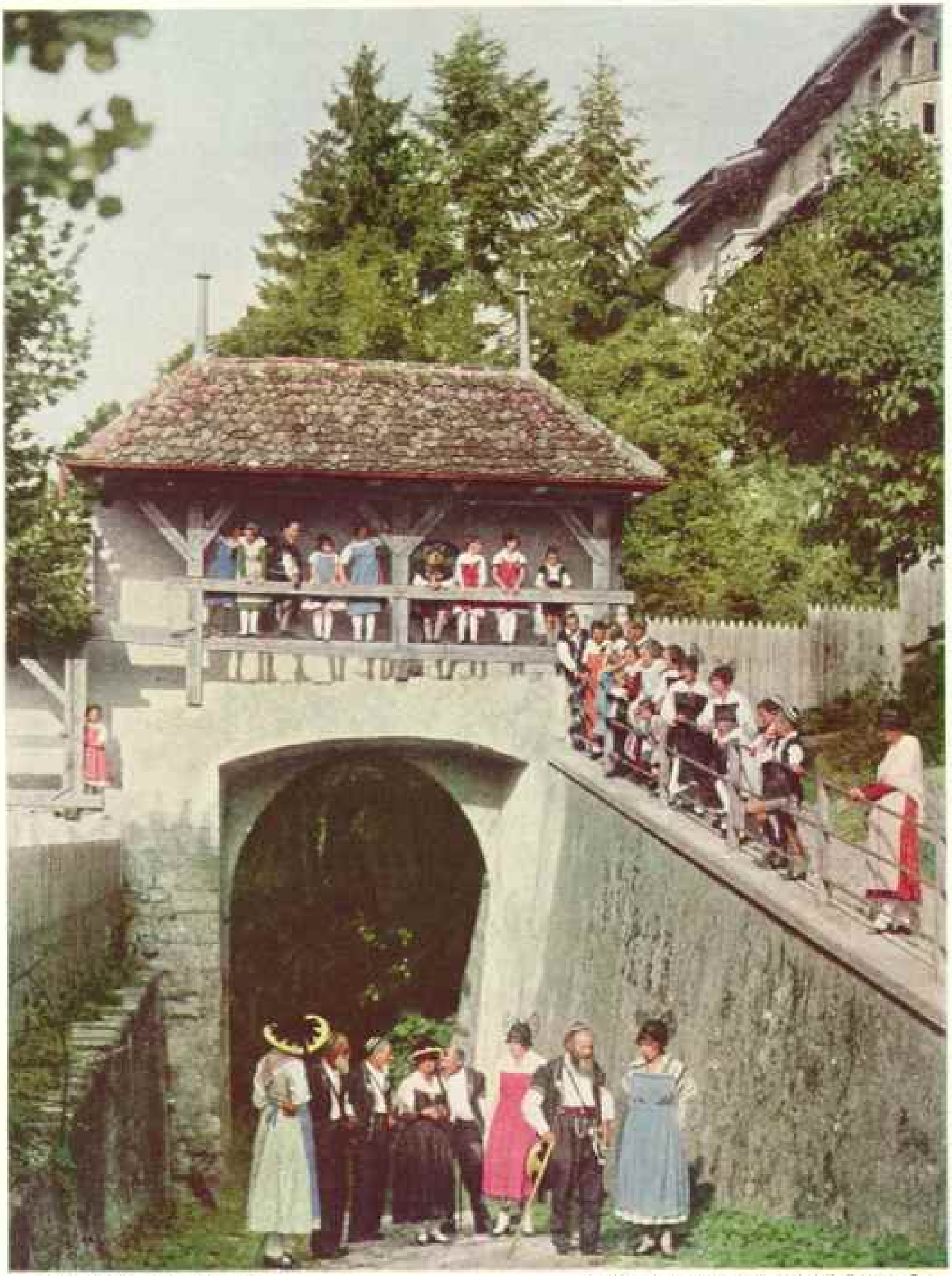
As the song ended, the group began "Le Ranz des Vaches" again and the automobile pulled away with the harmony in full sway. We could hear the voices growing fainter as the car passed out of range down the hill. The stay-at-homes in the court finished the ballad alone, and then turned on their heels and were gone.

In the morning we wandered up the court toward the Château. Girls and women were already scrubbing clothes at the fountain and in the covered washing place set aside for the purpose.

Three boys were rambling over the stone grain measures at the side of the street (page 141). They took delight in casting pebbles into the holes on top, where the wheat used to be poured in, and watching them come tumbling out the exit holes at the side. Stoppers still dangled by rusty chains from some of the spouts.

We wandered through the old Château, turreted and forlorn, which crowns the high side of the town's lofty perch (Color Plate IX). Here the Counts of Gruyère held sway over the fertile Sarine Valley for nearly five hundred years.

In the middle of the 16th century, the last Count became involved financially,



 Finlay Photograph by Bernard F. Rogers, Jr.

GRUYÉRIENS, OLD AND YOUNG, GATHER BY THE ENTRANCE FOR THE AUGUST 1 FÊTE

Each summer they celebrate the founding of the Swiss Confederation, when three communities united more than six centuries ago. In the old hill town of Gruyères, set apart from the busy life of today, the happy herdsmen and their costumed families meet in a medieval setting. All men, from boy to grandfather, wear the round straw caps, like freshmen's hats. Now only foot visitors climb this steep path, because wheeled traffic uses the new road cut through on the other side of the town. Above tower the tall houses which in olden times served as protecting walls as well as domiciles.

Finlay Photograph by Bernard F. Rogers, Jr.

FROM THE CHÂTEAU ARCHERS COULD COMMAND THE VILLAGE'S ONLY STREET AND THE FERTILE VALLEY LYING BELOW

Small vineyards and gardens now cover the slopes where the knights used to joust and practice at war. In the right center, between the houses, is the courtyard, center of life in Gruyères, where the festival is held. Chalets of herders dot the surrounding hillsides.

Finlay Photograph by Bernard F. Rogers, Jr.

CLIMAX OF THE AUGUST FETE IS THE SINGING OF CAROLS AND OLD-TIME BALLADS AROUND THE VILLAGE SHRINE

While the festival usually is held at dusk, last year the Choral Society courteously met on another day so that these natural-color photographs could be made in brilliant sunlight. Every housewife takes pride in the flower boxes which brighten her home. A covered water trough behind the spectators (left) provides the tubs for the town's "hand laundry" and the road passing it leads to the Château whence the procession started.

"GOOD LUCK BE YOURS, RICH CHEESE AND BREAD—HAI HAI LIOBA"

So sing and shout the herders in their French dialect. In medieval days, when Swiss serving in foreign armies heard this ballad, "Le Ranz des Vaches," they became homesick and sometimes deserted. Many versions of the song to the cows have been handed down through the generations.

 Finlay Photographs by Bernard F. Rogers, Jr.

IN THE BANQUET HALL THE COUNT OF GRUYÈRE DINED HIS GAY COURT

Painted on the walls are scenes famous in Swiss history. In the central panel a feast is being held in this room in the Château, with the fireplace and coat of arms depicted as they still appear (right).

WHILE THE HERDERS SING IN TAVERNS, THE CHORAL SOCIETY CHANTS IN THE HOTEL

Dressed in the silks and satins of the Gruyère costume, these French Swiss keep alive the traditional songs of their forbears of love, war, and the lowing herds. To enter this dining room of the Fleur de Lys, one must pass by the kitchen, and the pleasant aromas from steaming pots serve as appetizers.

Finlay Photographs by Bernard F. Rogers, Jr.

KNIGHTS OF OLD WERE FEASTED FROM SUCH FIREPLACES

Now no longer in use, this kitchen in an annex of the Fleur de Lys Hotel serves as a museum. The proprietress lights a fire beneath the soup kettle, and the cat, its bed too warm, jumps down.

Finlay Photograph by Bernard F. Rogers, Jr.

TODAY CHILDREN DANCE AND SING IN THE OLD COURTYARD TO ENTERTAIN PARENTS; NOT, AS FORMERLY, TO CELEBRATE A BATTLE

Gruyériens have always loved to feast and dance. In the days of chivalry it was to welcome home the knights of the castle when a victory had been won. The town is a center for a dairying district and the herders, who still cling to their traditional costume, frequent the one street, which is this court. Old French songs are favorites with the youngsters.

"NOW I LAY ME DOWN TO SLEEP" IN A FEATHER BED

This youngster climbs under one of the thick comforters found in the bedrooms of the older houses. Often the fluffy coverings seem mountain high, but they are light and warm.

Finlay Photographs by Bernard F. Rogers, Jr.

HERDERS OF TOMORROW STOP FOR A DRINK

Water, fed from a spring, spouts into the trough hewn from a log, like an Indian dugout canoe. Cheese is stored in the cool, dark basement at the left, while the family lives above.

Finlay Photograph by Bernard F. Rogers, Jr.

HERE LIVED CHALAMALA, FAMOUS JESTER TO THE COURT OF GRUYÈRE

This kitchen, completely furnished with copper pots and pans, now serves as a museum of home life during the MiddleAges. Chalamala had a ready wit and his advice on state affairs was always sought.

 Autochrome Lumière by Bernard F. Rogers, Jr.

THEIR FORBEARS FOUGHT VALIANTLY IN THE CRUSADES

Gruyèriens are as proud today of their independence as they formerly were loyal to the Counts. Hanging in the window are wooden spoons with which one partakes of Gruyère's famous thick cream.

with the result that Fribourg swallowed part of his lands and Bern took the rest. Gruyère is still an integral part of the Canton of Fribourg, but bustling Bulle near by is now the capital of the district, politically and commercially.

We left Gruyères in the forenoon, planning to visit some of the famous "two-family" homes and villages around Romont and Fribourg.

Driving along the fine roads of Gruyère, smooth as a billiard table, we passed many little hamlets of several farmhouses grouped together.

It was quite evident that we had come in the midst of the manuring season, that time of the year when rich fertilizer is spread over the fields. In the front yard of nearly every house there was a pile of fine brown compost, stacked in neat square heaps.

As we passed one particularly large, rectangular mound, Lilo shouted from the rumble seat, "That farmer is wealthy."

"How's that?"

"Well, he has a huge pile of manure, larger than any of his neighbors, and, you know, in these parts that is a sign of wealth. The larger the pile, the bigger the herd of cattle, and, of course, the more cheese from the milk, the richer you are!"

Some of the homes of the dairymen serve a double purpose. One half or end is devoted to livestock and the equipment pertaining to the animals, while the other houses the owner and his family. Huge overhanging eaves, sometimes projecting as much as 10 or 15 feet from the walls, protect the homes from driving rain and the heavy snowfalls and drifts of winter.

FAMILY AND CATTLE SHARE SAME ROOF

The family's end of the house is so charming that it seems to offset the unsightliness of the "built-in" barn.

A well-kept garden, bright with nodding hollyhocks, nasturtiums, geraniums, and other familiar flowers, smiles behind the neat fence. Each window of the three- or four-storied house is framed by a box of geraniums, with scarlet and orange blossoms, and bright-green shutters which set off the white front. Everything appears orderly and clean—a Swiss characteristic.

Let the eye wander slightly to the right or left of the home, and behold the barn, all under the same roof. A horse or ox is tethered at the corner, a big two-wheeled cart leans against the wall, and chickens are always clucking and scurrying in and out of the door.

Looking through the large opening, one sees the barn yawning like a huge cavern. High up is the hayloft, as in most other barns the world over. To the right or left of the entrance are the covered stalls, which, though empty now, house in winter the owner's income producer, the dairy herd.

Some chalets have as many as four or five floors, but these are mostly country inns found in the higher villages. Styles in architecture vary widely, but the "two-family" type seemed to be the popular farmhouse in this vicinity.

Floors of the home are made of boards as wide as 18 or 20 inches, worn creamy white from constant scrubbing. Ceilings are low and, of course, partitions are natural wood, unvarnished and unpainted. In the better-class homes, the walls are richly paneled.

We drew up in front of one attractive chalet. The housewife was standing in the doorway holding a pink-cheeked cherub. My cousin, knowing that I had been longing to inspect such a home, ventured up to the lady, and in a few minutes we had a smiling invitation to enter.

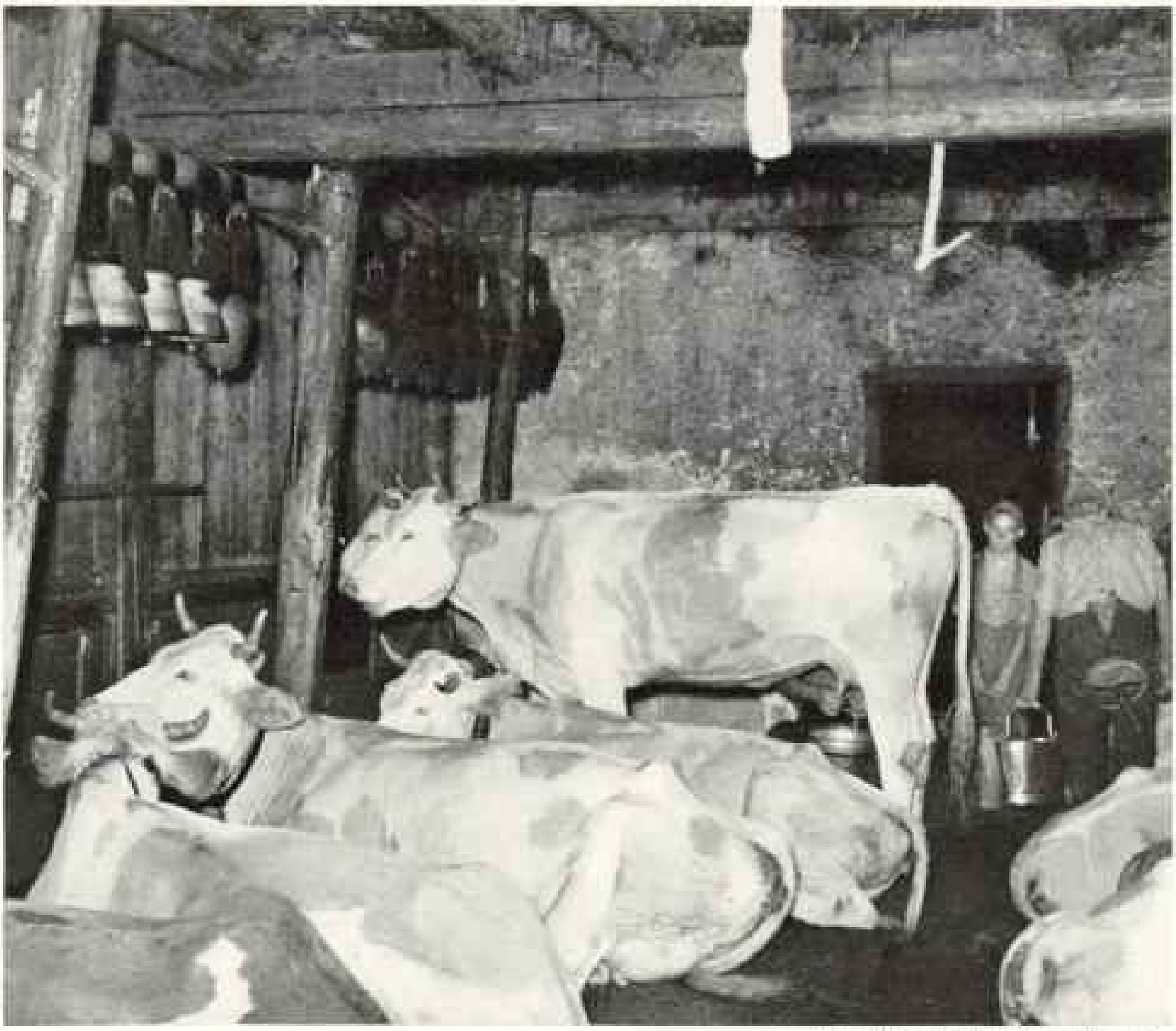
THE KITCHEN SERVES FOR MANY PURPOSES

Opening the gate, we crossed the garden and walked through the door. To our surprise, we entered the kitchen, or rather the dining room, kitchen, and living room combined in one.

Our hostess pointed out the objects so familiar to her. On the right as we entered was the simple long table with narrow benches drawn up on each side. Of course, a tiny bunch of flowers from the garden graced the center, giving a touch of color to the bare room.

Continuing around the kitchen, she showed us the huge copper cheese boiler, hanging from a hook over the hearth, and the wide chimney at the top which draws off the smoke when fires are lit beneath the kettle. Other pots and pans for cooking were placed neatly on hooks.

On the other side of the room was a cupboard where were kept wooden milk buckets and other dairy implements. We were impressed particularly by the clean-



Photograph by Bernard F. Rogers, Jr.

MILKING TIME IN A COW SHED HIGH IN THE JURA MOUNTAINS

A herder, with a single-legged milking stool fastened to him, carries a full bucket into the adjoining cheese room, while another milks. All cows wear bells which acquaint the keeper with their location and perhaps direct the strays to rejoin the grazing herd. "Queens," or herd leaders, are cows which have a knack for leading the other animals back to the milking spot or guiding them to the foraging grounds. They carry the largest bells, sometimes two or three hundred years old and quite musical in tone. Several hang on the wall.

liness of this room, about which the daily life of the family revolves.

A door led off to a large bedroom with big wooden beds against the wall and under the windows. Next to this was a smaller one, reserved for the owner and his wife.

A BALCONY FOR A BREAKFAST NOOK

In a corner of the larger room was a masonry stove, resembling the one in our inn at Gruyères. It was fired from the other side of the wall in the kitchen. On cold days in winter the children sometimes hide away on top of the stove or behind it to keep warm (Color Plate XIII).

We climbed the narrow stairway from the kitchen to the second floor bedrooms.

Our hostess led us out onto her wide balcony overlooking the garden. Outside the rail a flower box was aflame with bright blossoms. "On warm days we dine out here," she told us.

"Your balcony must be cozy in all weather," my cousin suggested, noting the overhanging roof.

"Yes, monsieur, in summer the gable acts as an awning to ward off the hot sun or driving rain. In winter it is a double blessing, for it permits the low, slanting sun's rays to peep in our windows and warm our rooms, yet protects us from the heavy snows."

How we would like to take this balcony home for a breakfast alcove, we thought, with its pleasant view of the green mountains and garden.

On our return drive through the rolling hills, cupped in the Sarine Valley between gaunt mountains, we came across many men and children carrying large flat cans strapped on their backs. We stopped and had a look into the can of one jolly dairyman. It was chock-full of rich, creamy milk, still warm and bubbly from the milking.

PICKABACK MILK DELIVERY

The man told us he was taking it to the community dairy where it would be made into cheese. We asked if he would be paid. "Oh, no," he said, "we shall be credited at the dairy with the amount of milk brought in and later paid in cheese."

Driving on farther, we came upon a tiny cart loaded with two huge milk cans and pulled by a powerful Saint Bernard and a youngster no older than ten.

The boy gladly posed and smiled for us as we snapped his picture. His beaming face and that beautiful brown and white dog straining at the harness, evidently striving to take the load off his young master's shoulders, live in my memory (page 139).

We passed many another dogcart that evening, but none seemed so fine as the first. Sometimes we saw young girls and boys carrying the containers on their backs. Pleasant work, maybe, in summer, but no easy task on icy and snow-choked roads in the dead of winter.

As we approached the upper end of the valley, we could see afar off the turrets, conical roofs, and gray walls of Gruyères, poised on its forested hill like a ship breasting the crest of some green tidal wave. Yet the huge "ship" was dwarfed by the forested and pasture-clad peaks that towered above it (Color Plate XV).

The Counts of Gruyère chose well, when they selected this idyllic spot for their stronghold. Impregnable, it was the key to upper Gruyère, or upper Sarine Valley, which, in the clutch of the mountains beyond the town, forms one route, though roundabout, to the Rhône Valley and Lake Geneva.

HOW GRUYÈRE IS MADE

Before climbing to the village for the night, we stopped in at the *laiterie*, or white creamery building at its foot.

"Good evening, mesdames and messieurs," greeted the buxom cheesemaker as we entered. "Would you like to see how we make Gruyère?"

"Of course." So the good lady escorted us into the clean cheese-room.

"In these two large boilers is heated and mixed the creamy paste that later becomes cheese," she explained. The copper pots, at least seven feet across and about three feet deep, were polished until they shone like the binnacle of a smart ship.

"Milk, often still warm from the cows, is poured in, and rennet added," she said. "The mixture is heated and stirred with a special fork, or 'harp,' until it curdles and thickens. Next, helpers ladle out the paste and pour it into a burlap sack placed inside one of those round molds or hoops over on the bench.

CURING ROOM IS CALLED THE "LIBRARY"

"When the sack is full, the cloth is drawn across the top and the cover put on. The lever above is then pressed down and clamped. The cheese remains in the press overnight, while the excess liquid drains off. Next day, when the curd has congealed sufficiently, the cloth is removed and men carry the new cheeses down into the 'library,' or curing cellar" (page 159).

We descended to the dungeonlike room, and when our eyes had become accustomed to the dim light we saw rows and rows of closely stacked cheeses. Round, thick, and yellowish colored, they suggested grindstones piled one on top of the other.

Strangely, the air in this storage room was not bad, though, of course, we recognized Gruyère instantly! Ventilation was good, for there were small windows near the ceiling, and basement doors were open.

At one stack a man was busy washing the cheeses with a thick brine. He told us that one day he coats the cheeses with the liquid and the next wipes off that which has not soaked in. This procedure he repeats alternately for about four or five days. After some two weeks tiny gas holes, or "eyes," form inside the cheeses, and then they are stored for several months in a cooler room to age and season.

The disks, when ripe, are taken to the central cheese depot at Bulle, later to be distributed to waiting markets.

We considered buying a cheese to take home, but were surprised to find each round disk weighed about 80 pounds and cost $30! Transportation problems would be difficult, not to mention the "bouquet."

That evening, after we had dined sumptuously in mademoiselle's pleasant inn

Photograph by S. Glanzman

DESCENDING FROM ALPINE PASTURES, HERDERS ARE WELCOMED WITH A THREE-DAY FEAST

This man, coming to town with two cheeses strapped to the back of his donkey, is husky and sunburned from his summer in the mountains. Perhaps his pay will be in cheese, because it forms a big part of the menu of these pastoral people. Wherever Swiss settled in American farming areas cheese industries grew up, and now large quantities are produced in these localities in Wisconsin, New York, and other States.

in old Gruyères, she asked us about our trip. Though our tales must have been familiar to her, she listened politely. Finally she said, "Today you visited the winter homes of our pastoral people. Why don't you go up tomorrow and see some of these happy herdsmen in their summer chalets?"

"Fine," we said, "but is it possible to go up in one day?"

"Of course. But why not visit a chalet on your way back to Geneva? If you follow the Sarine Valley and cross Les Mosses, surely you will be within sight of many high pastures. Stop your car there and climb up and visit one of those chalets."

COLOR IS THE KEY TO A CHALET'S AGE

Following her advice, we started off next morning. At first the road was a gentle incline crawling up the lower, grassy slopes. Then it entered a steep, rocky gorge and snaked along a narrow ledge high above the foaming white torrent. Green forested cliffs rose sheer above us. Climbing ever, it finally swung around a bad turn and came out in a green valley.

"Lilo," I remarked, "those little chalets over there with the slate roofs must be old as the hills!"

"Oh no, they aren't more than 20 or 30 years old," he said.

"How do you know?"

"You can always approximate the age of a chalet by its weathering. When new, they are creamy yellow, the color of new lumber. Exposed to a few winters' snows and rains, the walls become a golden brown. Then, as successive generations live in them and pass on, the houses become a darker brown. Hoary old-time chalets are almost black. Those over there are merely brownish!"

By this time we had crossed the meadow and found ourselves approaching a steep, forested hillside dead ahead. Where could the road lead? A dead end?

Suddenly we found out. A sharp turn and up we started. Soon the car slowed

Photograph by Melville Bell Grosvenor

DEER HEADS, GARGOYLES, AND TWIN WINDOWS DECORATE CHALAMALA'S MEDIEVAL HOME

Geranium boxes; brightly painted armorial windows, arranged in pairs; and a carmine arch framing the door make this house of the court jester a focal point for visitors. The old woman on the bench, busily making lace, remains bent over her work for hours at a time, never looking up to view passers-by. Her cat basks in the sun on the wall, and firewood is stacked ready for winter. Chalamala's prophecy that "the Bern bear will some day eat the grue (crane of Gruyère) in the caldron of Fribourg" was fulfilled when the Count's feudal domain was sold to those two cities many years later (Plates VIII and IX).

Photograph by Monti

"COME! COME! LARGE AND SMALL, THE BLACK, THE WHITE, THE SHORT, THE TALL—UNDER THE OAK TREE COME, HA! HA! LIOBA!"

On still evenings the hills reverberate with such verses of "Le Ranz des Vaches" as herders sing while driving in their cows (page 137). When several herds are mingled, the animals often recognize their owners' voices, separate, and file back to the milking ground.

Photograph by Perrochet-Matile

UNDER THE WATCHFUL EYE OF THE MASTER HERDER YOUNG MEN MAKE THE FAMOUS GRUYÈRE CHEESE

One stirs the curds with a "Swiss harp," while the "cabin boy" builds a fire beneath the copper caldron (Plate XIV and page 160). At left are the cheese presses and above is a frame for carrying the disks to market. Herders wear blue costumes and straw caps and suck big curved pipes.

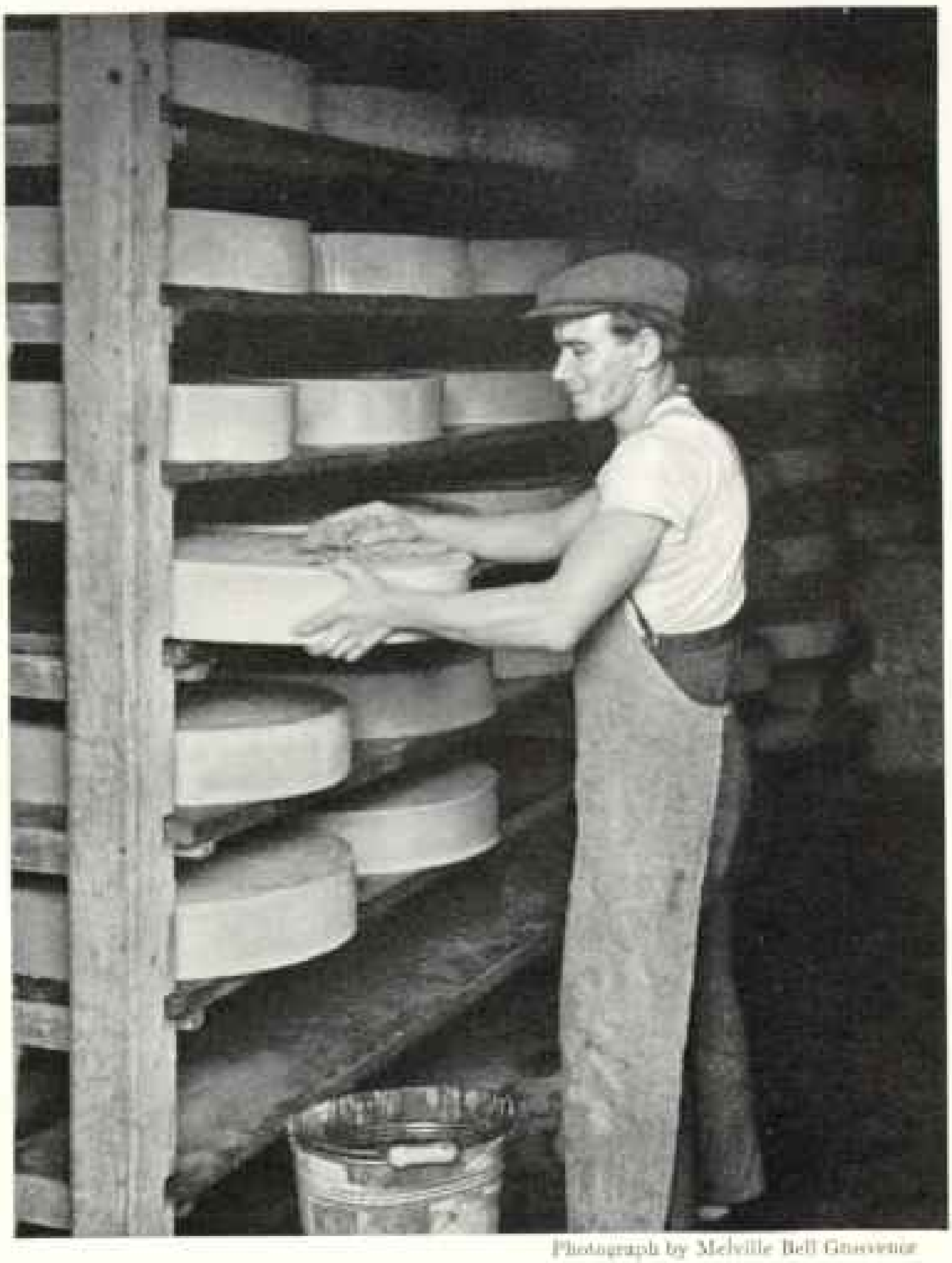
from the steepness of the grade, and we slipped into second. Ultimately we were thankful for the push of low gear.

Up and up we mounted, twisting and turning, over a highway so crooked, Lilo said, "it would break a snake's back!"

The road was wide enough for only one car. My wife, at the wheel, kept sounding the horn at every bend until the noise became unbearable.

But, actually, how thankful we were for that same horn! It was to us what the foghorn is to the mariner. When strong blasts echoed faintly above us, we knew another car was approaching. Whichever machine happened to come first to one of those wide places in the road —"switches" we called them— provided at convenient spots, the driver would stop and await the other car.

Often there were only inches to spare between the outer wheels and the sheer face of the mountain. Lilo called it "alpine climbing in an automobile."



Photograph by Melville Bell Grosvenor

NOT GRINDSTONES STORED IN A SHOP, BUT FAT DISKS OF GRUYÈRE!

In the cellar, or "library," of this coöperative cheese factory an attendant washes the "wheels" with a brine solution which aids fermenting or "ripening" (page 155). Soft and rubbery, these are only about two weeks old. Most Switzerland cheese imported by the United States comes from the Emmen Tal, in Bern Canton. Native Gruyère is nearly all consumed locally.

CHALETS CLING TO STEEP HILLSIDES

Gradually, the fir trees thinned and we came to a lush meadow near the top. High above us rose a steep, grassy slope. It was peppered with isolated chalets joined by a cobweb of paths.

"This is the place," we all agreed, and, piling out, started up.

While from the car the huts had seemed close, we found the climb more than we had bargained for. That heights are deceptive, we were soon reminded. But we kept on, guided by Lilo, who we knew had summered in such a chalet as a boy.

Puffing from the effort, we approached a chalet. It was a very dark-brown one, roofed with thick slate held down by stones.

"I believe it's a herder's hut, all right,"

called Lilo. "See, it is low and one-storied. The herders live in that half of the house, and the cattle are milked in the other when the weather is bad."

Out of the door popped a stern, bearded man, evidently surprised to hear a foreign tongue. Pipe in hand, he watched us solemnly.

Lilo addressed the old man. His face wreathed in smiles, and he invited us in, with apologies for the bareness of his quarters.

THE CHIEF HERDER INSISTS ON STRICT DISCIPLINE

They were in the midst of cheese making. Our friend, who it soon appeared was master herder, conducted us around. He was as much the master of his little world as the "skipper" on the bridge of a ship. Full responsibility for the herds, the cheese making, and the men was in his hands—and he felt it.

The room was large and quite plain. A strapping assistant herder, not deigning to remove his pipe, kept on stirring the new cheese in a huge copper kettle. Another lad was busy keeping the fire going on the hearth beneath the pot, the smoke drawing swiftly up a cone-shaped chimney above (page 158).

This lad is the "cabin boy" for the herders. His duties are analogous with those of his seagoing counterpart, with a few "lubberly" jobs thrown in, such as carrying in the milk and guarding the goats.

INVITED TO "ALPINE TEA"

In the corner we saw the cupboard for the wooden milk buckets, and on a bench against the wall the cheese press, now becoming familiar to us. Hanging near by was a strange-looking wooden saddle or frame. Our host called it an "oiseau." Daily a robust herder, he said, carries this "bird," with a heavy flat cheese perched on it, down to the village (Color Plate XVI and page 158).

"Would you like some Gruyère cream?" the master herder asked. Gladly we accepted, for we had been hoping all along for an invitation to "Alpine tea."

For seats our host showed our party plain benches, but I preferred to balance myself on a one-legged milking stool.

A large bucket filled with thick cream was put before us. Handing each a large wooden spoon, the herder invited us to help ourselves from the common bowl. The cream, though somewhat cloying, was delicious.

"It is too bad you cannot come to Gruyère in May or June," he said, as we partook of his simple hospitality. "It is then that we leave the village in a grand procession and come up to these summer lands.

"You would often see whole families moving with all their belongings. The herds go first, led by the queen or strongest cow, her huge bell jangling. Next come the goats and then the wagons laden with caldrons, pots, cheese press, and clothes.

"All summer we remain in the mountains, caring for the cows, milking, and making cheese. When the first snow falls, we start for home and revel in the grand feast that lasts for three days and nights.

"If our herds have increased, the market is good at Bulle, and, above all, if our cheese is well flavored, then we consider the season a good one and everybody is pleased."

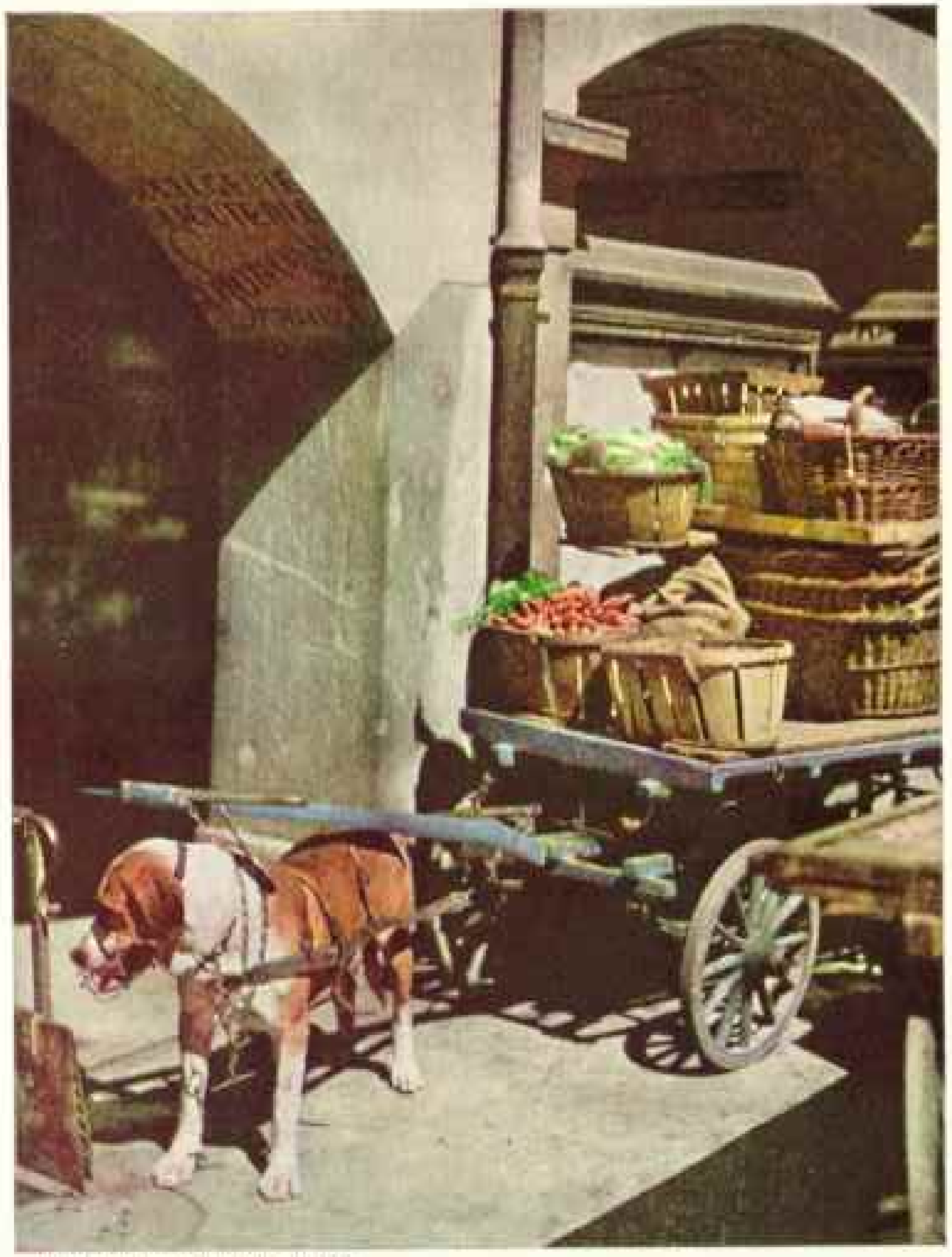
Saying good-by to the "skipper" of this mountain cheese factory, we flung ourselves down the hill and climbed into the car, again bound for Montreux.

From time to time as we drove over the pass, there were breaks in the trees, and we could catch glimpses far below of the green fields we had crossed only shortly before. The chalets dotting the valley and the cows grazing seemed tiny toys. Would that we could bring these "toys" home to our children, but they are safely tucked away among our memories of happy Gruyère.

 Finlay Photograph by Bernard F. Rogers, Jr.

FOR NEARLY FIVE CENTURIES GRUYÈRE COUNTS HELD SWAY IN THIS TURRETED CASTLE, OFTEN RESTORED

Valiantly they defended their stronghold. The last of the line, Michael I, became indebted to Fribourg and Bern, so that those two cantons swallowed up his little feudal state in 1555. In the last century, the Château was put up for sale and an artist bought it for its junk value. He repaired the building, and many of his friends, including Corot, painted panels on its walls. Beyond the Castle, Dent de Broc is veiled in mist.



© National Geographic Society

"MAN'S BEST FRIEND" IS ALSO HIS HELPER IN BERN

At the hospice on the Great St. Bernard Pass, huge animals, specially trained, locate and succor snow-bound travelers. In the valleys, dogs haul carts for grocer, dairyman, or children.

Finlay Photographs by Bernard F. Rogers, Jr.

EVERY VISITOR TO GRUYÈRES BUYS A DOLL

Many of the figures are made by the townsfolk, but all are not garbed Gruyérien style. The young lady keeps hers in an old-fashioned cradle. Swiss treasure their costumes, but wear them only on holidays.

Finlay Photograph by Bernard F. Rogers, Jr.

FARM HOMES AND BARNS PEPPER THE GREEN MEADOWS IN THE VALLEY AROUND GRUYÈRES

During spring and autumn herds graze in the fields, but in summer the cows are on high pastures. When deep snow blankets the ground the animals remain indoors. Some of these houses are of the "two-family" variety, the owner living in one half and the cattle in the other. In the far-distant left is Bulle. Once, according to Gruyèrien legend, when Bernese invaders threatened, every man turned out to stop them. Housewives and children tied torches to the goats and drove them at night across the slopes below the town. The enemy, seeing this "army," turned and fled.

 Finlay Photograph by Bernard P. Rogers, Jr.

GRUYÈRES' HOMES CLING AROUND THE COURTYARD, LIKE OLD WOMEN HUDDLED IN A CIRCLE OVER THEIR KNITTING

Flower-boxed windows make balcony seats for the villagers when Gruyèriens celebrate the August 1 fete in the town's one and only street (Plate III).

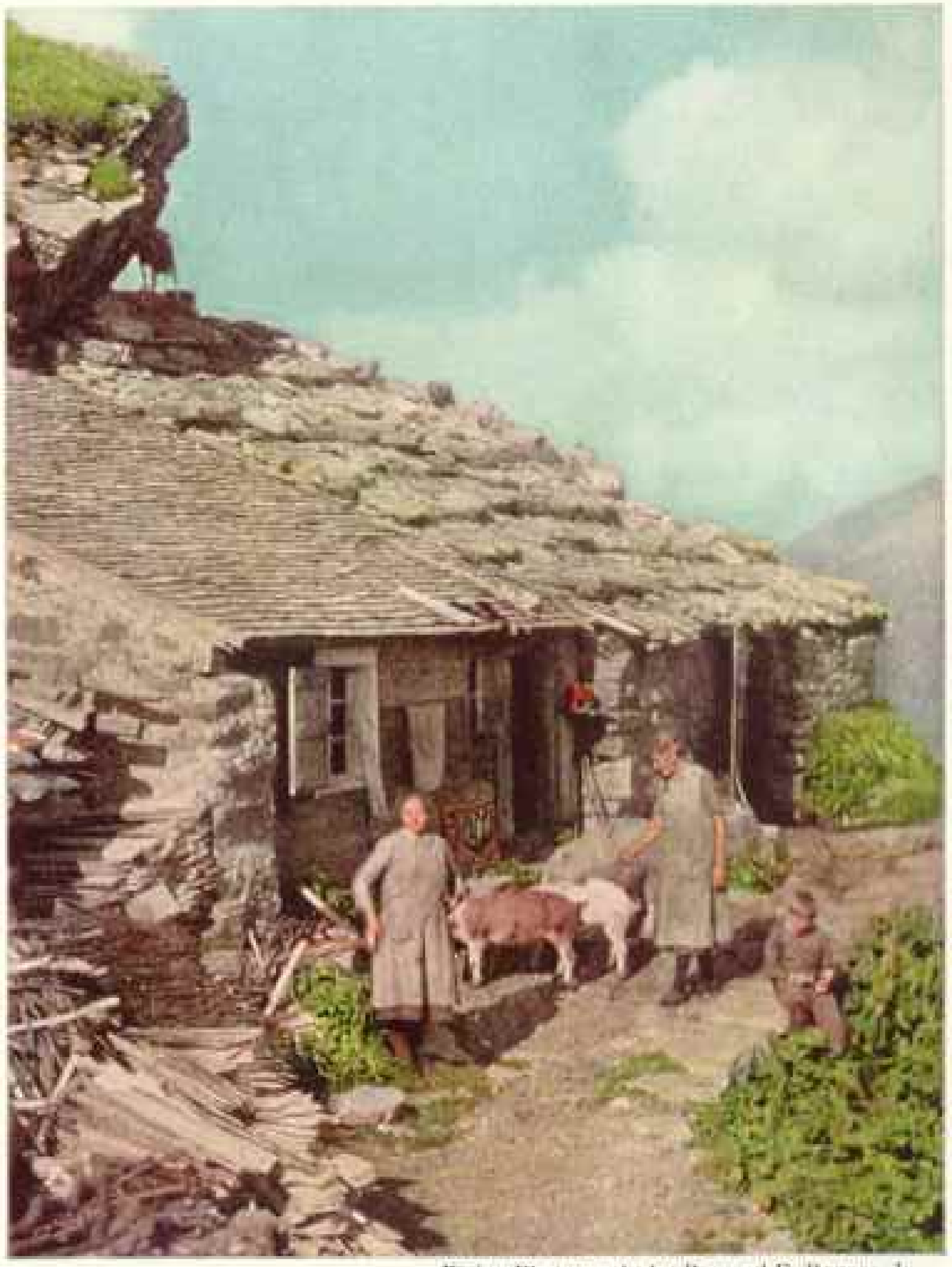
NOT FORGOTTEN IS THE ART OF KNITTING STRAW

The old lady says she is the only person in Gruyères who still makes mats, baskets, and hats by this old-fashioned method. On warm days she often sits on her doorstep in the court making lace.

Finlay Photographs by Bernard F. Rogers, Jr.

"RADIATORS" IN GRUYÈRES ARE ALSO DECORATIVE

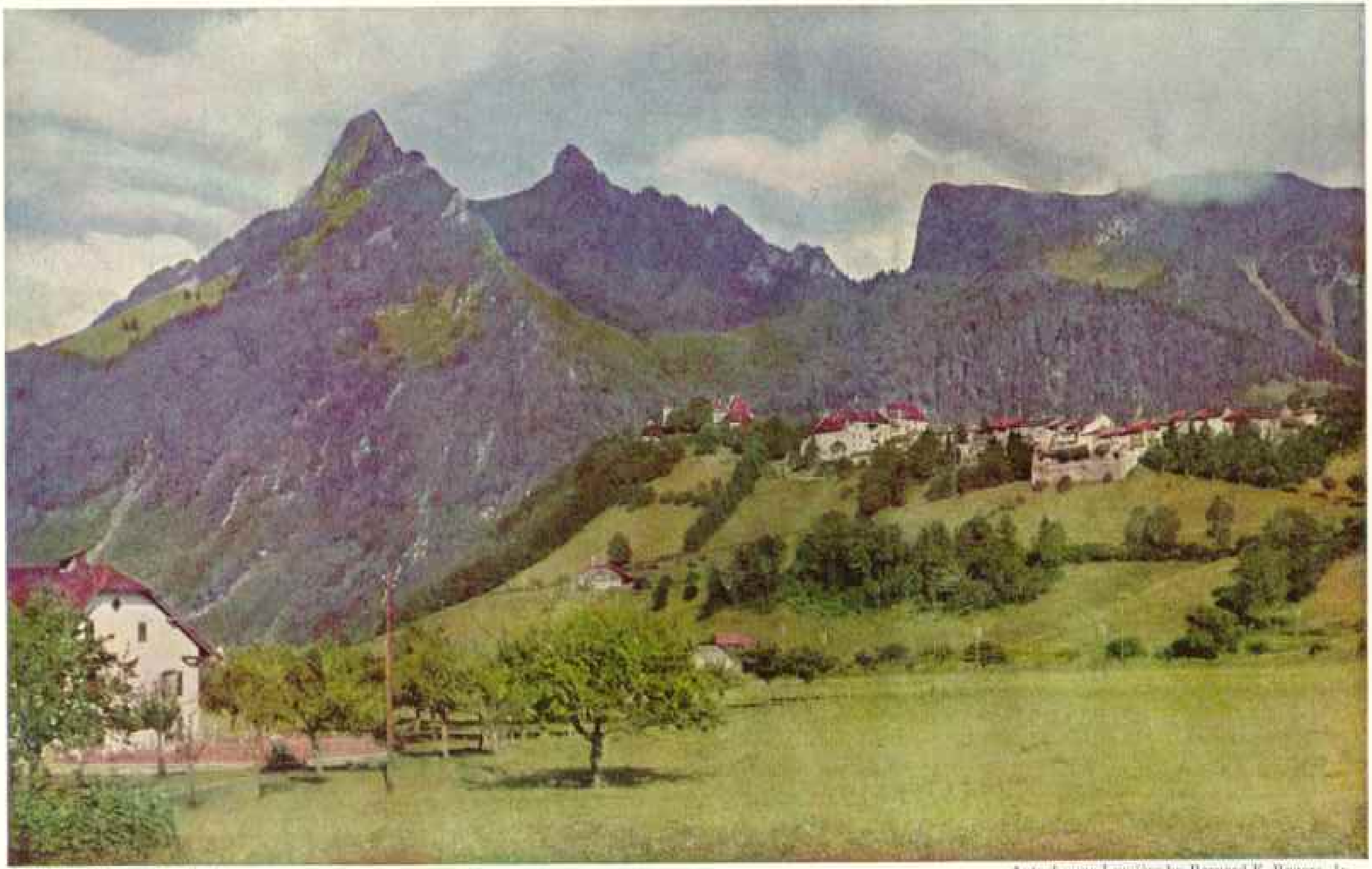
Every home has such a wood-burning stove, but not all are surfaced with attractive glazed tiles. Three "steps" provide seats for those who wish to warm themselves.



Finlay Photographs by Bernard F. Rogers, Jr.

HERDERS AND THEIR FAMILIES LIVE IN SUCH CRUDE HUTS WHEN THE COWS GRAZE ON HIGH PASTURES

Cheese makers on the Furka Pass discuss the quality of their product and wonder whether the patches of snow on the peaks above indicate an early autumn (left). One man holds a "Swiss harp" for stirring the curds in the caldron, while the other has under his arm a small cheese ready for market. Callers on the housewife (right) would expect "Alpine tea"—clotted cream or curds. Pigs, goats, and cows occupy the "addition" under the stone slab roof, while the family lives in the left half of this home on Klausen Pass. A goat rests in the shade on top.



Autochrome Lumière by Bernard F. Rogers, Jr.

GRUYÈRES RIDES ITS HILL LIKE A PHANTOM SHIP BREASTING A GREAT GREEN WAVE

High mountains that nearly surround the little town served as a barrier to invaders and now isolate the district, preserving traditions, customs, and the French dialect. Overhanging balconies and galleries of the houses served for defense and as lookout posts, rather than as vantage points to view the lovely valley below. Pathways leading up, from the center of the picture and from the right edge, meet at the walled entrance. Three of the tall peaks, or "teeth," that tower above Gruyères show here—Dent de Broc (left), Dent du Chamois (center), and flat-topped Dent du Bourgoz (right).

 Finlay Photograph by Bernard F. Rogers, Jr.

IN AN "OISEAU," OR "BIRD," A HERDER BRINGS HOME A FAT CHEESE FROM THE SUMMER CHALET

Carrying the disk in this strange wooden frame, he has trudged down miles of mountain paths. "Eyes," or gas holes, in genuine Gruyère are sparsely distributed, and its taste, when fully cured, is rather sharp and not so mild as that of other Swiss varieties. It is not colored artificially, and when ripe is of about the same shade as fresh butter.

NEW SAFEGUARDS FOR SHIPS IN FOG AND STORM

By George R. Putnam

Commissioner of Lighthouses, Retired

THE most magnificent of all lighthouses was built before the dawn of New Testament history, but the most remarkable of navigational safeguards has come only in the past few years.

Day and night a monotonous drone of dots and dashes goes out over the sea, penetrating the thickest rain and fog, to help bring the voyager safely home.

Today radiobeacons are essential equipment on our most important lightships and lighthouses, and apparatus for receiving radiobeacon signals is carried on all modern passenger liners and many other vessels.

Thus, after more than 2,200 years, we approach the solution of one of mankind's oldest problems. The lofty Pharos of Alexandria, erected by the Ptolemies near the mouth of the Nile, has never been surpassed by any other lighthouse in height or in fame (page 174). Its name became the word for lighthouse in the Romance languages; the French use it in *radiophare* (radiobeacon).

But the signal which this magnificent tower gave to mariners was the light and the smoke from an open fire. No progress was made in marine signal lights for many centuries. Only a hundred and twenty-five years ago tallow candles burned in the famous Eddystone Lighthouse near the English coast, and until 1816 the May Island Light, off Scotland, still used a blazing coal fire to guide ships.

Nearly all the major advances in lights and fog signals—the electric lamp, the incandescent oil-vapor light, the Fresnel lens focusing the beam in the horizon of the mariner, the fast-revolving light making it possible still further to gather the rays into powerful beams, and the fog bells, followed by the whistle, siren, and diaphone—have been developed within a little more than a century.

Only in the last 30 years has so necessary an aid been employed as the lighted buoy, boon to the navigator who must bring his vessel into port at night through treacherous shoals and narrow channels.

The most notable advance was made 15 years ago, when radiobeacons were placed by the U. S. Lighthouse Service on Ambrose Channel Lightship and two other stations in the approaches to New York. Thus was solved an age-old problem. Only the radio signal penetrates fog and rain that blot out the most brilliant light.* It can carry its message of safety through storms that drown the most powerful whistle.

Above the pilothouse of a modern liner you will see a small rotating coil antenna mounted on a metal frame. This coil receives radiobeacon signals now sent out from important lighthouses and lightships —more than 120 of them on the coasts of this country.

THE RADIOBEACON AT WORK

In approaching the coast, the navigator of a ship with this coil picks up a radiobeacon signal—perhaps the four dashes from Nantucket Shoals Lightship, or the single dots from Ambrose. By rotating his radiocompass coil until the signal fades away ("taking the minimum" it is called), he determines the direction from which the signal comes, even from distances of more than a hundred miles (page 170).

Anyone who has stood on the deck of a liner in a dripping fog, and has wondered at the courage of the navigators going ahead toward the unseeable, must realize what a blessing this is to tense nerves—how valuable is this gift of science to better navigation and to safety at sea.

Radiobeacon systems now are being extended throughout the world, and radio direction-finders are being placed on more and more vessels, recently even on fishing craft. There also are direction-finding stations on shore which give radio bearings to ships asking for them.

These radiobeacons have added some 1,300,000 square miles of water to the area served by United States aids to navigation. In fact, their signals may carry far beyond this area. While off Nova Scotia, for example, the *Bremen* once took bearings on the radiobeacon at Colón, Panama, more than 2,000 miles away.

* Other Government agencies have done pioneer work and have cooperated in the development of radio navigational aids, including the Navy, the Army, and the Department of Commerce, especially the National Bureau of Standards and the Bureau of Air Commerce.

Photograph by U. S. Lighthouse Service

"TAKING THE MINIMUM" ABOARD SHIP

All modern liners, and even some fishing vessels, are equipped with this important direction-finding device. With it a bearing may be taken on a radiobeacon station by rotating the coil until the signals "fade out." This is known in the pilothouse as "taking the minimum." The pointer then indicates on the magnetic compass below the direction from which signals come (page 169).

A simple arrangement for distance finding is now in use at a number of stations, especially on the Great Lakes. The radio signal and the sound signal are synchronized to be sent at the same instant, and the difference in the transmission time, as measured by a stop watch, gives the approximate distance of the vessel from the station. This is easily computed when it is remembered that sound in air travels approximately a mile in five seconds. The distance, therefore, is roughly the "time lag" divided by five.

A comparison of the number of Great Lakes ships which stranded during the four years preceding the use of radiobeacons, with the number for the four years following, indicates a 50 percent reduction; also the saving of time by vessels taking radio bearings is a large factor in economical navigation.

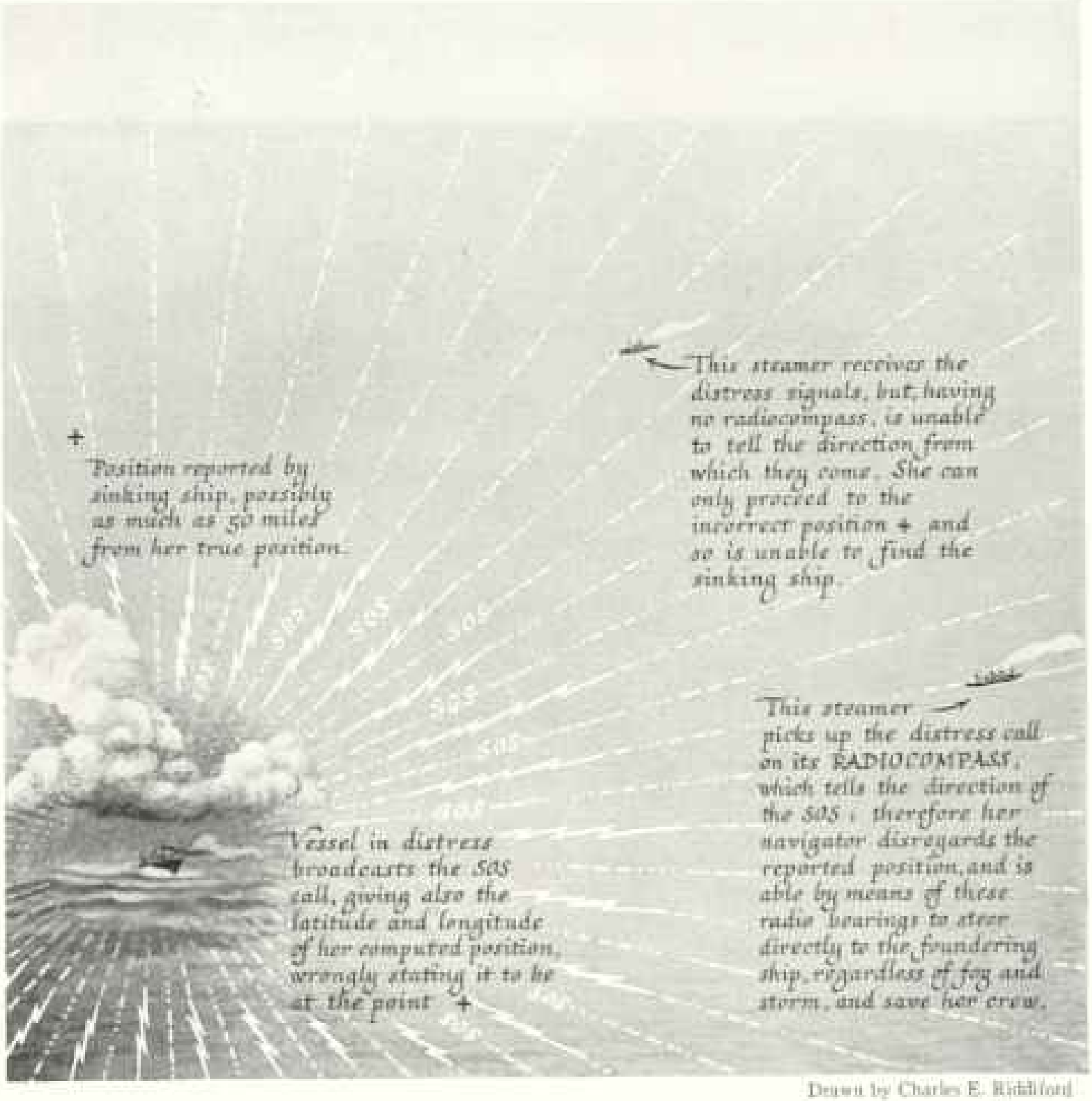
The dramatic use of SOS calls in dangers and tragedies of the sea is familiar enough.* Radiograms to and from friends on shipboard are commonplace. Radio also serves navigation in transmitting the correct time, a service of prime importance in determination of longitude at sea.

TAKING RADIO BEARINGS ON A SHIP IN DISTRESS

When wrecks obstruct channels, or when storms drag buoys from their normal locations, radio affords a valuable means of broadcasting such urgent information. Radio also transmits reports from mariners who observe defects in navigational aids.

A vessel equipped with a radiocompass can take a bearing on another ship sending radio signals, and thus determine its direction at sea by the same method it would use with a radiobeacon on shore. This taking of bearings between ship and ship diminishes the risk of collision in fog, and it also helps one ship to find another which may be in distress. The rescue of the crew

* SOS, since 1912, has been the international radio distress signal. The letters have no verbal significance, but were adopted because they are easily sent and readily understood. In code, SOS consists of three dots, three dashes, and three dots.



Drawn by Charles E. Riddiford

A RESCUING VESSEL LOCATES A SHIP THAT GAVE THE WRONG "ADDRESS"

When a steamer in distress in fog or storm reports an incorrect position, it now can be reached by ships equipped with radio direction-finders. So that the directional apparatus may pick up the faint signals, the wireless operator of the sinking vessel must stick to his post, flashing out SOS or other messages as long as he can.

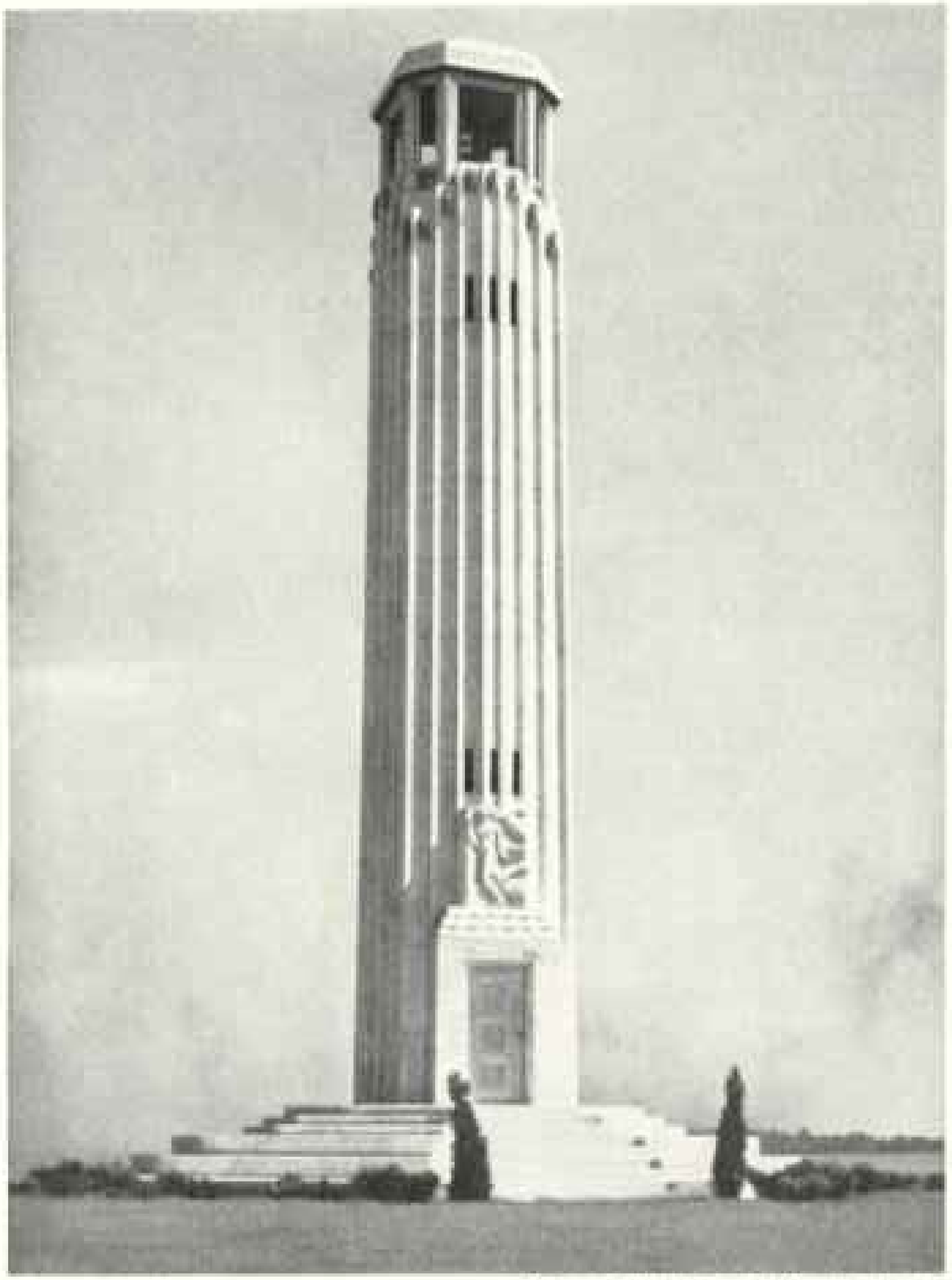
of the British freighter *Antinoe* by the United States ship *President Roosevelt* in mid-Atlantic in January, 1926, is a notable example of this use of radio bearings.

Capt. George Fried, then master of the *Roosevelt*, immediately changed his course on receiving the SOS, and radio bearings on the *Antinoe* were taken every 15 minutes. He found the *Antinoe's* position as given was some 50 miles in error; but, steering by the radio bearings, he reached the *Antinoe* in about six hours. After three and a half days' heroic struggle, the 25 men of the sinking *Antinoe* were rescued.

Tragic loss of 42 lives, through lack of equipment for taking radio bearings, is shown in the wreck of the *Alaska*, which sank the very year that radiobeacons came into use.

One August day in 1921, the *Wakkeena*, in a dense fog off Cape Mendocino, California, picked up an SOS call from the *Alaska*. Having then no device for telling from which direction came the call for help, the *Wakkeena* cruised for ten hours before she could find the sinking *Alaska*.

The picture which sticks in his mind, says the radio operator saved from the doomed ship, was that of the *Wakkeena* only 12 or 13 miles away, "trying, all night,



Photograph by U. S. Lighthouse Service

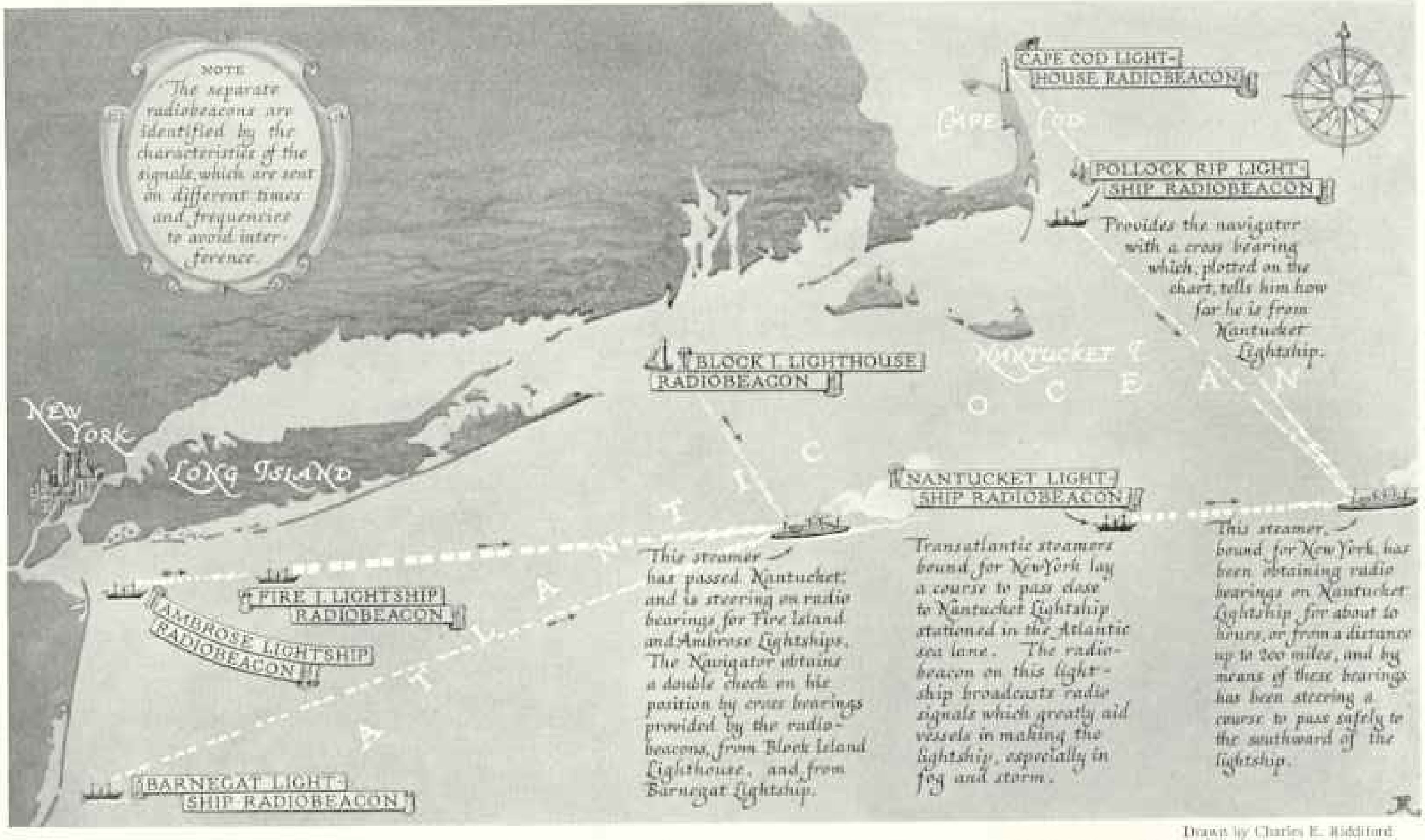
A MEMORIAL AND LIGHTHOUSE COMBINED

The beautiful marble William Livingstone Memorial Lighthouse at Detroit, built on Belle Isle by private subscription, provides a navigation mark for all vessels bound down the St. Clair and Detroit Rivers. The light is maintained by the Government. The architect was Albert Kahn, of Detroit.

Photograph by Edwin L. Wisherd

THIS IS THE GRANDDAD OF AMERICAN LIGHTS

Sandy Hook Lighthouse, New Jersey, at the entrance to New York Bay, built of stone by the Colony of New York in 1764, is the oldest standing lighthouse still in service in this country. The walls, seven feet thick at the base, are lined on the inside with brick.



Drawn by Charles E. Riddiford

FRIENDLY DOTS AND DASHES ENABLE A LINER'S SKIPPER TO "SEE THROUGH" FOG OR SNOW AND BRING HIS SHIP SAFELY INTO PORT

Each radiobeacon has a different signal, indicated by white dots and dashes on the drawing. They have proved highly important aids to navigation because they enable ships to steer a proper course in foul weather or fair.

Drawn by Hashime Murayama, courtesy Illustrated London News

LARGEST AND TALLEST BEACON EVER BUILT WAS THE PHAROS OF ALEXANDRIA, ONE OF THE SEVEN WONDERS OF THE ANCIENT WORLD

It was completed about 280 B. C., under Ptolemy II, and the tower was approximately 400 feet high. For more than a thousand years an open fire in the lantern guided Mediterranean galleys and early sailing ships to the chief port of Egypt. Its fate is a mystery, but its tumbled ruins were said to be visible until about 1350. The drawing above is based upon recent historical research.

Photograph by Fairchild Aerial Surveys

FRANCE'S GIFT TO AMERICA JOINS IN THE WELCOME TO THE "QUEEN MARY"

The torch held aloft by the Statue of Liberty is now only decorative. Hospitable New York greets Great Britain's "ocean queen" with crowded excursion steamers and tugs, yachts, airplanes, and a chorus of raucous whistles. Ellis Island appears at the right. The British have contributed enormously toward improved navigation throughout the world by charting remote coasts, even those outside British territory, and encouraging other nations to improve their lights and buoys.

Photograph by Dr. H. S. Palmer

"HE FLOATS THROUGH THE AIR—!"

When a supply ship arrives at Kaula Rock Station, Hawaiian Islands, men must be swung to the end of the narrow trail cut into the side of the rock. The same rope is used to hoist supplies (page 182).

to locate us while many unfortunate human beings were clinging to floating wreckage and succumbing slowly to exposure."

Pioneer use of radio in the Lighthouse Service began in 1901, when an experimental radio set was installed on the Nantucket Shoals Lightship. About four years later, during a severe gale, the lightship sprang a leak and her operator kept spelling out the word "help," as no SOS or other distress call had then been adopted. Coming to the lightship's rescue, the tender *Azalea* got a hawser to the sinking ship and started towing her to New Bedford. Though she sank on the way, her crew of 13 men was saved.

Today, of course, all outside tenders and lightships use radio, and a number of isolated light stations and some tenders are equipped with radiotelephones, which greatly facilitate reports and orders in emergencies.

At remote stations, the lightkeeper's life long has been a symbol of loneliness. Before the days of radio, all the keepers heard was wind and waves, sea birds, or the foghorns of passing ships. During a period of bad weather in 1912, no tender could reach the lighthouse on Tillamook Rock, Oregon, for seven weeks (p. 187). The station on Cape Sarichef, at the entrance to Bering Sea, went for ten months without any mail or news—August, 1912, to June, 1913!

Radio changed all that.

"Before we got our radio," wrote one keeper, "a new President might have been elected a month before we knew about it. . . . This time, we heard it as soon as anybody. The last two big prize fights, when it was announced who was champion, we heard it. . . . We listen also to ministers preaching, and there is singing. It is almost the same as being in church. . . . When storms blow, our sets keep us posted; we can take all necessary precautions and follow the progress of the hurricane."

THE LIGHTSHIP, OUTMOST SENTRY OF SAFETY

Look over the rail as your liner sweeps by Nantucket Lightship. If it be a misty evening, you will see a small red vessel, only 149 feet long, rolling in the sea, and you will note the quick flash of its brilliant electric light and hear the tireless blasts of its fog signal. This is the new *No. 112*, which recently replaced the relief lightship, *No. 106*. *No. 106* was rushed to the Nantucket station within 24 hours after the

regular station ship was sunk by the liner *Olympic* in May, 1934 (page 182).

Anchored in deep water and close to steamer lanes, a lightship is a valuable aid, because vessels may pass it on either side.

These are by far the most costly aids to navigation, and their use must be limited to positions where the value of the service to shipping justifies the expense. The eighteen outside lightships off the Atlantic coast and the five off the Pacific coast are the outmost sentries off our shores.

Lightships have repeatedly given refuge to the shipwrecked.

A German submarine raider visited Newport in 1916, before we entered the World War. Later, it went out and made its lair near Nantucket Lightship, where, until the alarm spread, vessels were constantly passing. The submarine sank a number of unarmed merchant ships, the crews of which took refuge on the lightship. At one time there were 115 shipwrecked men aboard the lightship, and 19 ships' boats were trailing on a line astern.

Photograph from Keystone

GUARDIAN OF THE TURKEY POINT LIGHT

Mrs. Fannie M. Salter is the only official woman lighthouse keeper in the United States. At her Maryland station near the head of Chesapeake Bay she cleans and fills the old-fashioned oil lamp used at night, and tolls the lighthouse bell to guide ships during heavy fog and rain.

As bad weather ensued shortly, and the locality is 47 miles from the nearest land, it is certain that many of these seamen would have lost their lives had it not been for the haven provided by the lightship.

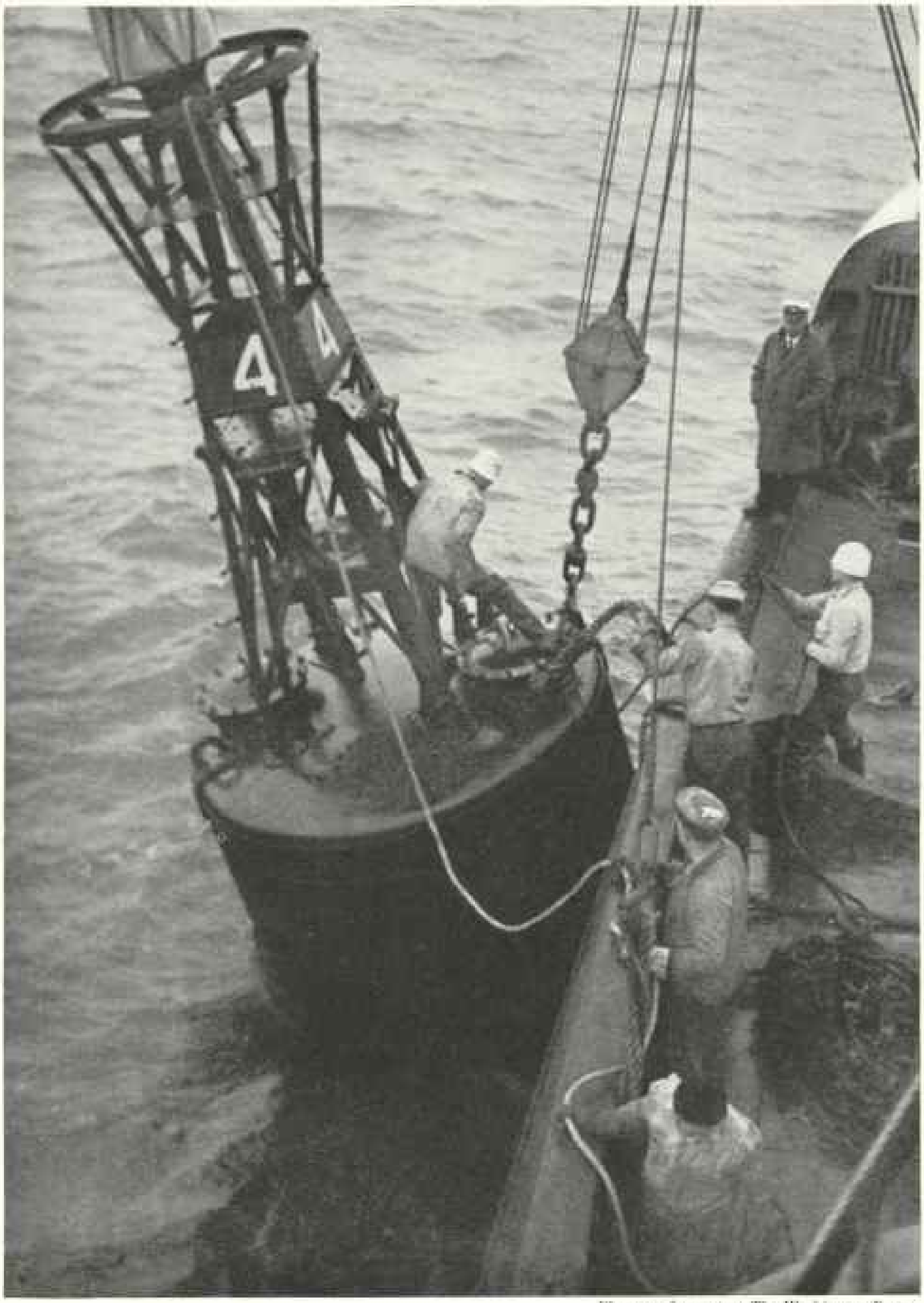
The only navigational aid in this country destroyed by the enemy during the World War was the Diamond Shoal Lightship off Cape Hatteras.

On the afternoon of August 8, 1918, a submarine raider began firing at a merchant ship about a mile and a half away. The lightship broadcast by radio a warning to other vessels in the vicinity, and this was undoubtedly the means of saving many ships. But it resulted in the submarine's firing six shots at the lightship and later returning and sinking it by gunfire.

The crew got away in boats, and, after seeing the ship go to the bottom, they landed safely that evening on Cape Hatteras.

Blunts Reef Lightship marks the outer limit of rocks off Cape Mendocino, a wild and desolate section of the California coast.

At 1:30 on a June morning in 1916, the lookout reported a boat hailing the lightship. On coming alongside, the officer in



Photograph courtesy The Washington Post

SERVICING A HUGE "TRAFFIC LIGHT" OF THE SEA

Only when these floating sentinels are hauled alongside the lighthouse tender may one obtain a true idea of their size and sturdy construction. Here the crew of the tender *Orchid* is unbolting a tank cover on a buoy off the Virginia coast, preparatory to lifting out an acetylene gas tank and replacing it with another cylinder. The buoys are examined and the gas supply is replenished about four times a year. At least once a year the buoy is taken up for cleaning and replaced by another.

charge stated that the steamship *Bear* had stranded between the cape and False Cape Rock. In all, nine lifeboats came alongside, and 155 people from the *Bear*, including many women, were taken aboard the lightship and given hot coffee and warm bedding.

Other lifeboats arrived later with more survivors. Eventually all these people were transferred to land by the steamer *Grace Dollar*.

This all happened during dense fog which had lasted for two days, with the station fog signals sounding regularly. Now a radiobeacon has been placed on Blunts Reef Lightship.

Because they are moored close to steamer lanes lightships are themselves liable to various kinds of catastrophe, chiefly collision, but radio permits the immediate summoning of aid.

In 1916, Fire Island Lightship, in the approach to New York, was rammed by the steamer *Philadelphian*, and her side cut open for four feet below the water line.

The ship was saved from sinking only by the remarkable presence of mind and quick work of her crew, who shifted weights, slung out boats, and filled them with water, so as to list the vessel and bring the damage above the water line.

A LIGHTSHIP THAT SERVED MORE THAN 75 YEARS

Lightship *No. 1* was retired from duty in 1930, after 75 years of service. This vessel was built for the station then known as Nantucket New South Shoals, and remained on this exposed station for 36 years, with only sails for power.

"If this ship could talk, what a story she might unfold!" wrote a Baltimore editor. "She was still in her early youth when the new armor-clad *Merrimac* wrought havoc on wooden vessels in Hampton Roads. She saw the transition from wood to iron and from iron to steel. From her vantage point off Nantucket, what a host of vessels have spoken her! Day after day and year after year, in fair weather and foul, her sturdy ribs of oak have withstood the thrashing of the waves."

In early years it was not easy to maintain lightships on outside stations. The first attempts in this country were made at Sandy Hook, at the entrance to New York Bay, in 1823, and at Diamond Shoal, off Cape Hatteras, in 1824. In the latter case the ship broke from her moorings within a few months, and, after being replaced several times, was wrecked in 1827. It was 70 years before another lightship was placed off Diamond Shoal.

Marked advance has since been made in lightship design. The breaking strength of mooring chains has been doubled; even a West Indies hurricane passing up the coast seldom parts a mooring.

In the gale of September, 1933, Diamond Shoal Lightship dragged her 5,500-pound mushroom anchor five miles, but the mooring chain withstood the tremendous strain.

MANY NEW DEVICES USED

Our coastal lighthouse system was fairly well completed in the last century. Structures which house the great lights of today were for the most part built from 60 to 80 years ago.

Progress in recent years has been more in technical improvements, making use of radio, electricity, new illuminants, and improved fog signals.

Now and then, however, changes must be made in the primary stations themselves; new needs call for new stations, the abandonment of old towers, or the substitution of less expensive automatic lights.

Six light stations of the first rank, recently completed, show the different needs that occasionally arise. At North Manitou, in the northern part of Lake Michigan, a station has been built in 22 feet of water to take the place of a lightship. Two other similar stations have recently been completed in this lake.

At Cape Decision, Alaska, a new light and fog signal station stands in a key position for the navigation of southeast Alaska, situated as it is at an entrance from the outside, and at a turning point for the inside passages.

At the south end of Santa Barbara Channel, off the coast of California, navigation is now safeguarded by the station on Anacapa Island, a guide both to coasting vessels and to those approaching Los Angeles from the open sea.

The sixth of these new primary stations stands at the entrance from Lake Huron to the St. Mary's River, where it was necessary to have a guide close to the channel for the Lake Superior traffic.

The most powerful light in the American lighthouse system shines from a low struc-

Photograph by U. S. Lighthouse Service

SUCH "LOUD-SPEAKERS" MAKE A LIGHTSHIP'S VOICE HOARSE

Automatic apparatus accurately times the compressed air blasts, so that the sending station may be identified. This lightship on Fire Island Station is one of the newest in service, and is equipped with Diesel electric propulsion.

ture atop the Atlantic Highlands at Navesink, New Jersey. Its penetrating beam measures 9,000,000 candlepower.

Progress, as well as nature's assaults, sometimes dooms fine old lighthouses. Often these towers figure prominently in local history and romance. Fortunately, such old towers sometimes can be preserved.

The State of New Jersey has taken over the tall tower of Barnegat Light, which is of diminished importance to navigation. The first Cape Henry tower, in Virginia, has been transferred to a patriotic organization (page 191), and that at Cape Florida is preserved by a private purchaser.

When the sea encroaches, it is often difficult to save an old station. Usually it is less expensive to move it, or to build another lighthouse.

Thus, along the low-lying, sandy south Atlantic States and Gulf coasts, many early masonry towers have succumbed to the sea. Metal structures have been dismantled and moved back to places of safety.

Ten years ago (1926) the historic lighthouse at Cape Henlopen, Delaware, was destroyed by the inroads of the Atlantic. Henlopen was one of the early Colonial lights, completed on a sand dune in 1767, and, for sentimental reasons, efforts were made to protect it. Its value to shipping, however, had been superseded by new lights and lightships.

Only this year it was decided to abandon the 66-year old Cape Hatteras Lighthouse, tallest tower in this service. Its site was originally two miles inland, but it is now within 100 feet of the surf. It has been replaced by a steel tower, set farther back from the sea.

LIGHT KEEPERS STILL ARE NEEDED

Our steady change to modern automatic lights has saved the public much money. But for primary lights the maxim is, "Safety is found only in certainty," and human attention, given by lightkeepers, must be retained. An exception is the lighthouse operated by the U. S. Government on Navassa Island in the West Indies.* Here the

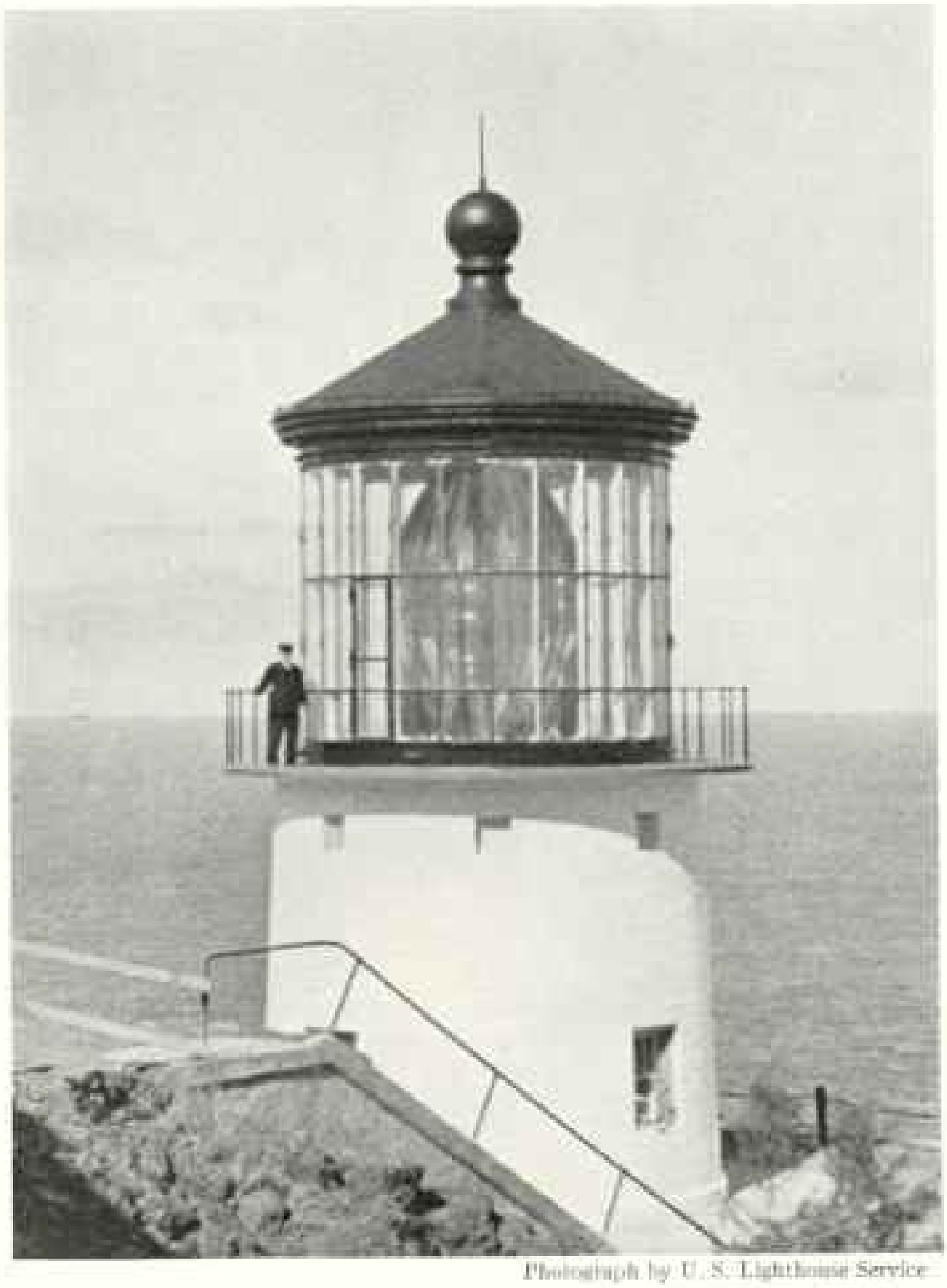
* See "An Important New Guide for Shipping," by George R. Putnam, in the NATIONAL GEOGRAPHIC MAGAZINE for November, 1918.

keepers were removed because of difficulty in maintaining them on this uninhabited and barren island between Jamaica and Hispaniola. This lighthouse now has two automatic flashing lights, one above the other, with independent gas supplies for each, to insure that one light will always show.

Ingenious devices are utilized to save gas or electricity in burning the automatic lights. Sun valves, depending on the rate of expansion of different metals, are used to turn off the acetylene gas lights during the daytime.

Recently the light-sensitive cell has been employed to turn on and off automatic electric lights operated from batteries. This is a metallic disk which turns light energy directly into electric energy. The principle is familiar to the multitudes who have seen it operating the doors to the waiting room of the Pennsylvania Station in New York City.

The unattended flashing light at Molokini, Hawaiian Islands, burned without failure for nearly 20 years, flashing over 200,000,000 times. Two lighted buoys each have a record of burning nearly a year and a half on one charge of acetylene gas.



Photograph by U. S. Lighthouse Service

HAWAII BOASTS THE LARGEST U. S. LIGHTHOUSE LENS

Makapuu Point Light Station, Oahu, is landfall for vessels approaching Hawaii from California. The huge glass, nine feet in diameter, is made up of perfectly cut curved prisms, and is nearly as tall as the tower of the lighthouse itself. The beacon perches atop a rocky headland 642 feet above the Pacific (see page 189).

BREAKING UP THE WRECKING INDUSTRY

The wrecking industry, which long flourished on the Florida reefs, has now vanished—proof that modern lighthouses and navigation methods make shipping far more safe.

Recently the local courts vacated the wrecking and salvage rules, because it was said: "Such a point of efficiency has been reached in placing the many aids to navigation along the Florida reefs that the rules have become practically obsolete."

A hundred years ago a fleet of fifty wreckers was sustained by this industry and salvage profits were huge.

Boldness of the wreckers, and their casual attitude toward buoyage early in the last century, are shown by a remark in the annual report of the superintendent of Cape Fear Lighthouse, in January, 1821: "It may not be amiss to observe that the

Photograph from U. S. Lighthouse Service

OFF FOR AMERICA'S MOST FAMOUS WATCH POST

The new Nantucket Lightship *No. 112* leaves Wilmington, Delaware, to take up its station on the Nantucket Shoals. It replaced a relief ship rushed to this important outpost, 47 miles from the nearest land, when the original lightship was rammed and sunk by the liner *Olympic* during a dense fog in May, 1934. Many vessels have occupied this station since 1854. The new lightship embodies numerous improvements, including double sides, watertight compartments, and a radio antenna raised above the lanterns on the masts. Under the bow is a large mushroom anchor that is lowered when the ship takes its station on the shoals (page 176).

buoy which was placed at the end of Cape Lookout Shoals last summer came ashore in less than a fortnight, and some of the wreckers who live on the banks cut up the buoy and sold the copper and spikes in Beaufort, without asking leave of anybody."

AN UNUSUAL LIGHT IN HAWAII

Kaula, westerly island of the main Hawaiian group, lies 180 miles from Honolulu. A lofty, tablelike rocky islet, with an area of about 100 acres, it is uninhabited and almost barren (page 176). But bird colonies here are so dense that one can scarcely walk over its rounded summit without treading on eggs or nests. When steamers pass for Manila or other oriental ports, they often toot their whistles to arouse the birds, and thus amuse passengers.

To put a needed light on the crest of this islet, 550 feet high, was a task of singular hazard. Bronze handholds had to be grouted into the walls of overhanging cliffs so that workers might follow the only trail, which for some distance was within reach of the waves. A ladder and chain were added to aid the ascent, and a derrick was placed at a higher level for hoisting and lowering into the boat both cargo and workers.

But now the light burns, using acetylene gas, which is piped to the summit from a supply house high above the landing. To guard against failure of the automatic light, the installation is in duplicate and each gas supply will last more than a year.

Kaula lies in favorite fishing waters of the Hawaiian natives. They hold it in awe, for ancient tribal legends cling about it. On the northwest side of the rock is a cave, broad and high enough for a small schooner to enter. The Hawaiians say this cathedral-like cavern was the home of Kuhaimoana, deified king of all the sharks in the Hawaiian Islands.

The old Hawaiian practice is to enter this cave and pray before fishing or

Photograph by Ralph C. Smith

LIKE A GIANT WATER SPIDER, FOWEY ROCKS LIGHT GUARDS THE FLORIDA REEFS

This station, near Miami, is the most northerly of six iron sentinels marking one of the Nation's busiest "water highways." A scale model of this tower, with light flashing, stands in the lobby of the new Department of Commerce Building in Washington, D. C.

Photograph by U. S. Lighthouse Service

PALMETTO PILES POINT THE WAY ON INLAND WATERS

Lighthouse tender *Alibon* and a finger marker on the intracoastal waterway in Florida. The pile, driven into the soft bottom with a strong jet of water boring the hole, indicates by color and number on which side of the channel it stands (page 184).

landing; it is believed that evil will befall one if this is not done.

One Hawaiian member of the crew could not understand why no accidents befell this lighthouse group who had failed to offer their devotions. He finally concluded that the gods were satisfied because of the humanitarian purpose of the work!

RIVERS AND INLAND WATERWAYS ARE ALSO PROTECTED

Most people, thinking of lighthouses as standing by the sea, do not realize to what extent inland waterways are also marked.

The navigable waterways of no other continent can compare in extent and importance with those of North America, which comprise the St. Lawrence and the Great Lakes; the Mississippi River system; the Atlantic and Gulf intracoastal waterways; the Alaska inside channels, and such long river and bay approaches to great seaports as Delaware Bay, Chesapeake Bay, the Mississippi River Passes, and the Columbia. Many of these are marked for seagoing vessels, others for shallow-draft boats.

The Atlantic coast inland waterway, from Cape Cod to Key West, is about 1,900 miles in length, and is marked by 3,200 aids to navigation. The lower portion of this route, south from Norfolk, is a combination of natural channels and artificial cuts, and is a winding, picturesque passage.

The special type of beacon best adapted to the Florida waterway is a simple palmetto pile, sunk by water jet into the mud. The top of the pile carries a finger board pointing toward the channel (page 185).

With many vessels and tows going through the passages, which are often narrow and crooked, it is a busy job for the little lighthouse tender *Althea* to keep these markers in place. This interesting channel lures scores of private yachts to balmier climates in winter, and much commercial traffic moves over some sections of it.

NO LIGHTS IN MARK TWAIN'S TIME

The Mississippi River system includes about 4,500 miles of navigable waterways, and is marked by nearly 5,000 small lights and buoys. Its once heavy traffic developed and reached its zenith before the days of marking the channels. In 1874, when the first navigational lights were placed on the Mississippi, the river already carried 1,100 steamboats, besides other craft.

Mark Twain describes graphically the job of a young pilot "learning the river," and memorizing "the shape of the river in all the different ways that could be thought of."

He refers to piloting on "vast streams like the Mississippi and the Missouri, whose alluvial banks cave and change constantly, whose snags are always hunting up new quarters, whose sand bars are never at rest, whose channels are forever dodging and shirking, and whose obstructions must be confronted in all nights and all weathers without the aid of a single lighthouse or a single buoy, for there is neither light nor buoy to be found anywhere in all these thousands of miles of villainous river."

Years later, but still in the period of numerous steamboats, few lights and no buoys, the writer of this article, with two boy companions, made a canoe trip of 400 miles down the upper Mississippi.

Memory vividly recalls the difficulty steamboats had in some of the shallower crossings, the great spars carried to help hoist themselves over sand bars, and the numerous log and lumber rafts being slowly pushed down the river, each by a small stern-wheeler.

Lights on the lower Mississippi were maintained during the period of the great flood of 1927 under the most trying circumstances.* Near Natchez a keeper was driven from his house, which was flooded to the eaves; yet no matter how high the water got, he kept his light going. As the river rose, the lantern was raised several times by adding to its support. Homes in the vicinity were flooded to their roofs, and it is a mystery where the keepers found shelter.

The keeper of Windy Point Light, on Grand Lake, Louisiana, reported: "I am yet on the job, but the water has run me out of my house. I have the oil on some logs. I will stay out here. All is well."

After landfall is made by means of radio, lightships and lighthouses, buoys and smaller lights guide vessels into port.

When an incoming steamer reaches Ambrose Lightship, picks up the pilot and heads for New York, it soon passes between two large lighted buoys marking the actual entrance to Ambrose Channel. On the right side is a quick-flashing red light

* See "The Great Mississippi Flood of 1927," by Frederick Simpich, in the NATIONAL GEOGRAPHIC MAGAZINE for September, 1927.

Photograph courtesy The Washington Post

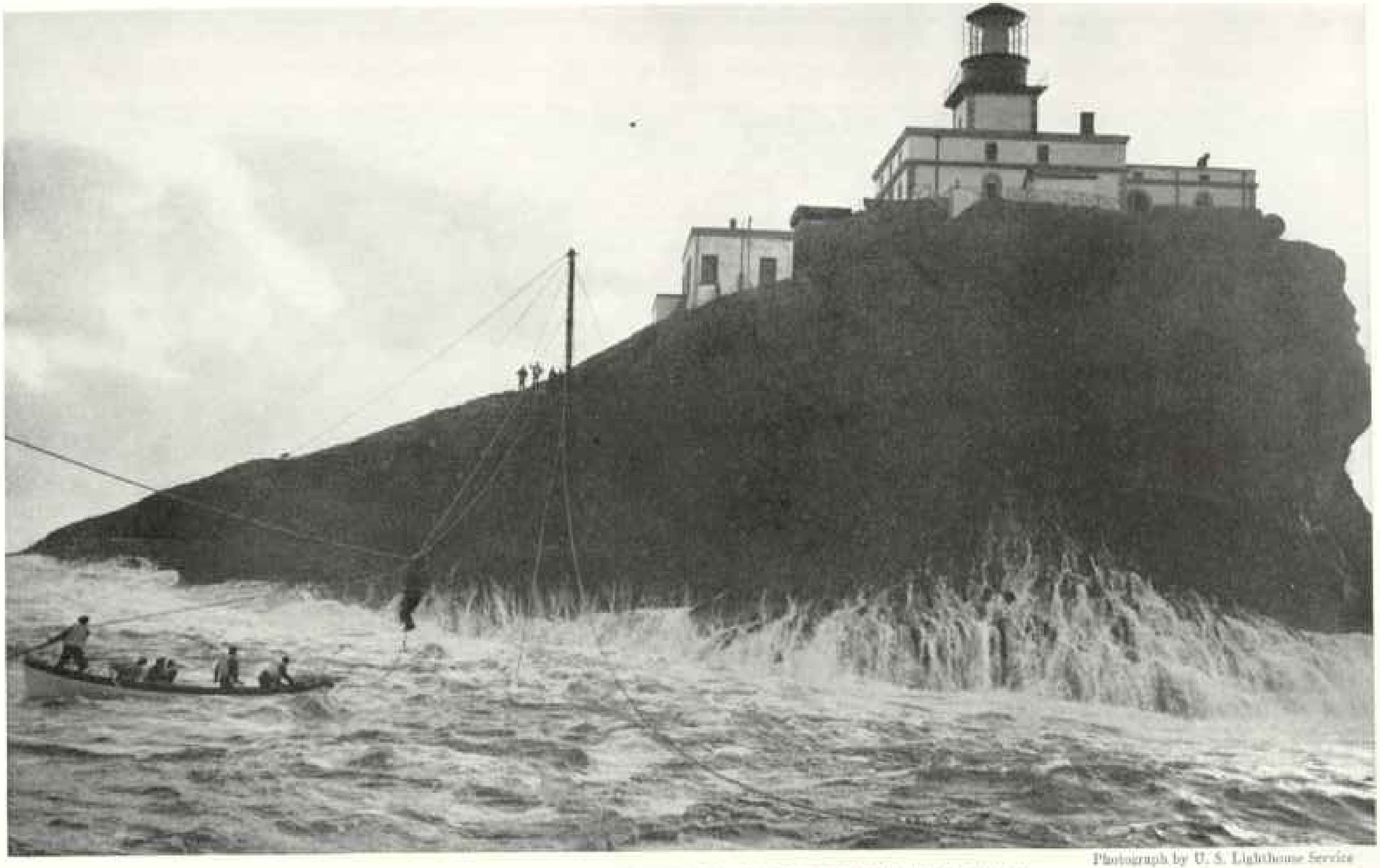
DUSTING IS A DAILY CHORE IN "LIGHTHOUSEKEEPING"

Four small bulbs are the sources of the dazzling shaft of light which the Cape Henry, Virginia, station throws 22 miles out to sea on a clear night to guide shipping into the entrance to Chesapeake Bay. A huge lens concentrates the light from the four lamps into a piercing white beam of some 160,000 candlepower. Cape Henry is one of the 116 primary lights of the U. S. Lighthouse Service (pages 191 and 195).

Photograph by U. S. Lighthouse Service

AS A SEAGULL MIGHT VIEW A NOTED BEACON

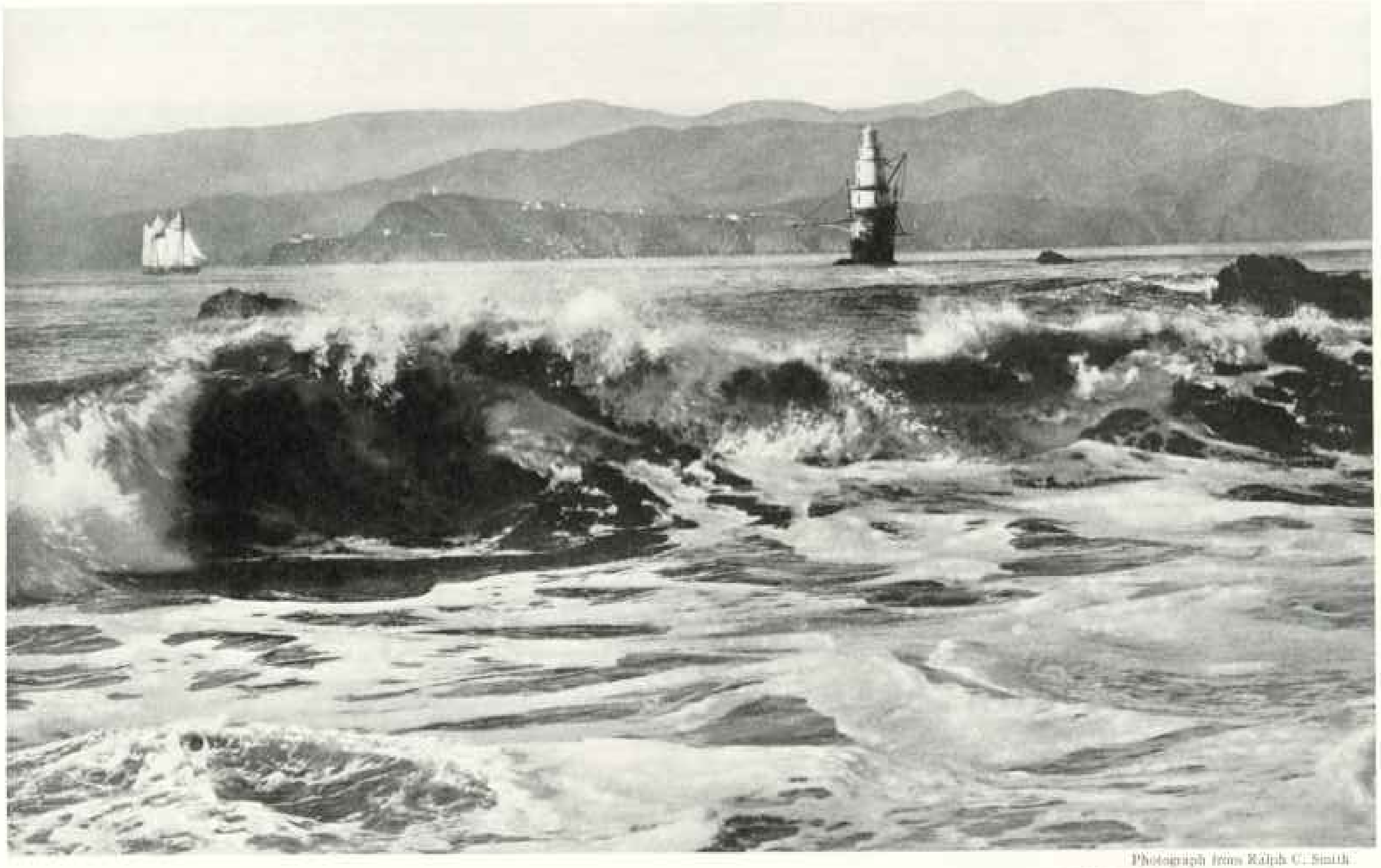
Boiling reefs and sunken ledges surround Minots Ledge Lighthouse, whose fame among mariners is perhaps second only to that of England's Eddystone. This light points the way to Boston Harbor. It must be provisioned and the crew relieved during periods of fair weather, for only then may small boats approach safely. When storm winds blow, mountainous waves from the open Atlantic dash far up its stout masonry sides.



Photograph by U. S. Lighthouse Service

FOR THRILLS APLENTY, GO ASHORE IN AN EMERGENCY AERIAL FERRY

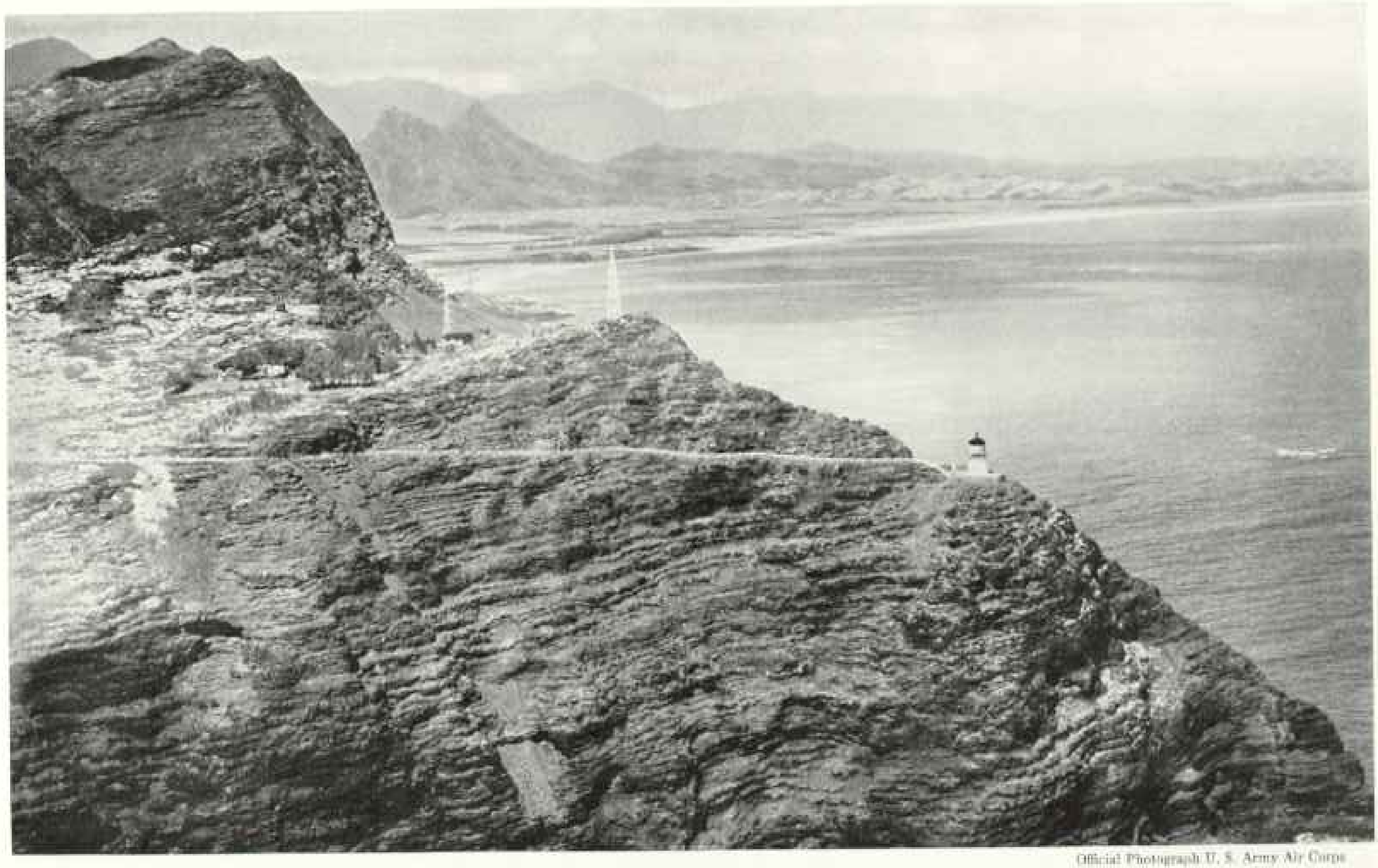
After the disastrous storm of October, 1934, a temporary landing gear and breeches buoy had to be employed to land workmen and relieve the keepers of the Tillamook Rock Lighthouse. This beacon stands on an isolated crag off the Oregon coast, south of the mouth of the Columbia River. During the four-day storm wave-tossed rocks broke sixteen panels of the plate-glass lantern, 133 feet above normal high water (page 198).



Photograph from Ralph C. Smith

CLOSE-HAULED AND BOUND IN, A SCHOONER APPROACHES MILE ROCKS LIGHT, A KEY TO THE GOLDEN GATE

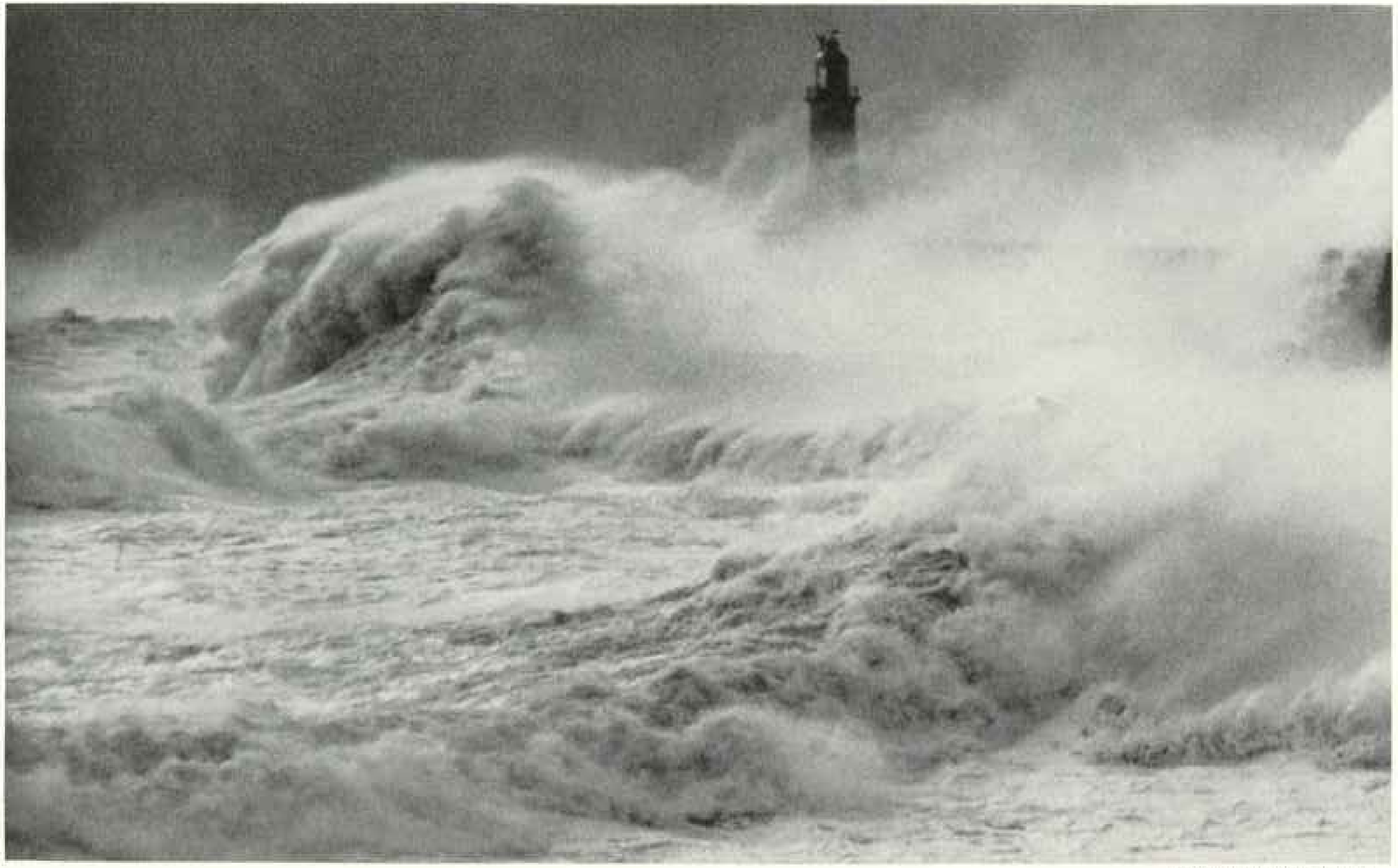
At one of the narrowest points along the cliff-walled passageway between the Pacific Ocean and San Francisco Bay, this tapering shaft warns mariners of jagged black rocks that flank the north face of Point Lobos. Even on fair days this light is difficult of access for the tenders. In 1901 the steamship *Rio de Janeiro* run aground near by in a dense fog and more than 100 lives were lost. In the distance is Point Bonita, with a companion tower.



Official Photograph U. S. Army Air Corps

HAWAII'S "OFFICIAL GREETER" FOR SHIPS AND PLANES IS THIS STUBBY TOWER PERCHED HUNDREDS OF FEET ABOVE THE PACIFIC

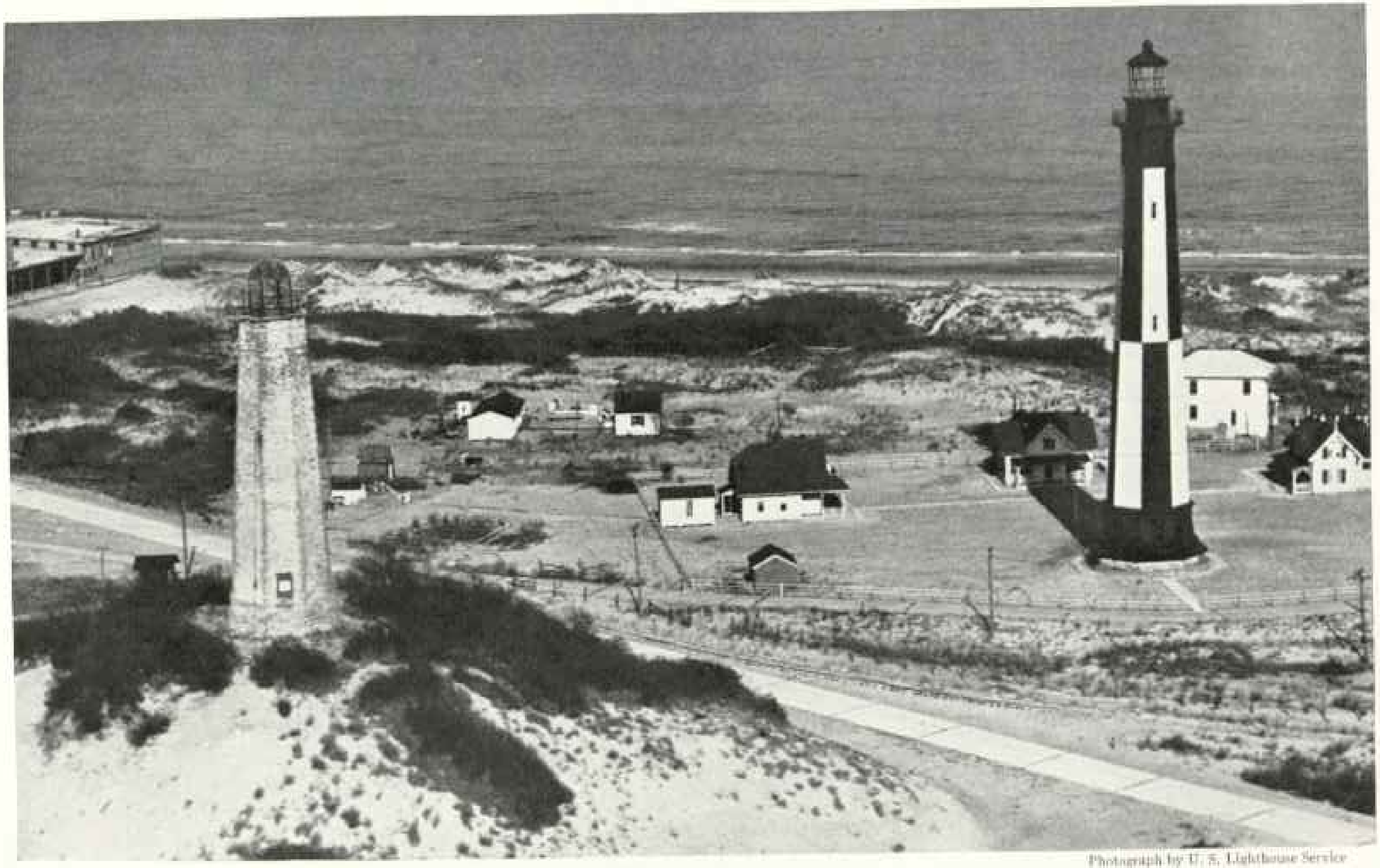
Both sea and air travelers from California on their way to Honolulu watch for the first flash of Makapuu Point Light. Its radiobeacon (towers, left center) has guided in many famous flyers and the Pan American trans-Pacific Clippers (page 181).



Photograph by H. S. Thorne

NEPTUNE'S RAGE—MONSTROUS WAVES THUNDER AND HISS IN THIS SPECTACULAR ASSAULT ON A STURDY ENGLISH LIGHT

In the teeth of a severe northeaster, the North Pier Lighthouse, a half mile offshore, stands its ground against a surf that breaks to heights of 80 to 100 feet. Tynemouth is a seaside resort at the mouth of the River Tyne, near Newcastle.



Photograph by U. S. Lighthouse Service

MANY AN OLD-TIME FRIGATE, BALTIMORE TEA CLIPPER, OR SLEEK OCEAN LINER HAS MADE CHESAPEAKE BAY BY THESE HISTORIC LIGHTS

The masonry tower (left) guarded the southern cape of the entrance to Chesapeake Bay from 1792 to 1884. This was the first lighthouse built by the United States Government, the work being included in the first appropriation made by Congress for lighthouse purposes, on March 26, 1790. After 1884 the cast-iron structure (right) was put into service. The old tower is preserved by a patriotic society and is no longer used as an aid to navigation (pages 180, 185, and 195).

Photograph by Gibson and Sons

THE ONLY WAY ASHORE, FAIR WEATHER OR FOUL

At Bishop Rock Lighthouse, Scilly Islands, England, the ledge is so steep and the sea so turbulent that no boat can approach very close. Both lightkeepers and supplies must be hoisted by a rope suspended from a beam, and then hauled in by the winch on the platform 30 feet above the water. Although this picture was taken on a day when the sea was comparatively calm, ocean swells were breaking over the base rocks, as indicated by the water cascading off.

and bell, on the left a quick-flashing white light and whistle.

The ship then follows six miles of a dredged channel, 2,000 feet wide and 40 feet deep, lighted with frequent buoys on either side and special markings at turns.

Large liners, which formerly waited for the tide, now pass in and out of New York Harbor under all conditions but that of dense fog.

Along other coasts and at harbor entrances, buoys mark the sides of the channels as well as shoals, rocks, or wrecks. Their upkeep is an endless task for the fleet of lighthouse tenders, which constantly pick up and set out the buoys, restore them to their proper stations, bring them in for their annual overhaul, and supply the lighted buoys with tanks of compressed acetylene gas. This country now has over 1,640 lighted buoys, and a total of over 10,900 buoys of all types and sizes, not including the large number of reliefs.

Despite unceasing care, buoys sometimes break away in storms, are torn loose by passing vessels, or sink. Some have had strange adventures and to them poets have often ascribed human attributes. There is Kipling's poem, "The Bell Buoy," and Southey's "Inchcape Rock."

THE ADVENTURE OF A RUNAWAY BUOY

A strange story is that of the Frying-Pan Shoals Buoy 2A FP, which a few years ago broke from its moorings off the North Carolina coast and set out for the open sea. It was 40 feet long, weighed 12 tons, with light and whistle, and cost $8,000.

This runaway buoy drifted over into the Gulf Stream and sailed for Europe. Though sighted and reported many times, no vessel recovered it. Finally a French steamer saw it approaching the Irish coast and lighthouse authorities there were notified.

After 13 months at sea and a voyage of about 4,000 miles, 2A FP (the "FP" stands for "Frying-Pan") was washed ashore off Skibbereen, County Cork. That this buoy was an unusual guest on the Irish coast is quaintly told in the petition for reward made by John O'Sullivan:

"Myself and my assistant salvors seriously endangered our lives in the struggle to tow this buoy into port; hemp and manilla ropes to the value of at least ten Pounds have been destroyed while endeavouring to secure the buoy: for three weeks myself and my assistant salvors had to watch this buoy by day and night, to prevent it from being smashed against the rocks by the storm or again swept out to sea; due to the extraordinary weight and peculiar shape of this buoy, we have had an enormous amount of heavy manual labor in our efforts, as a result of which some of us are now suffering from pains in the back and aching limbs in general; the boots and clothing worn by myself and assistant salvors have been severely damaged by being ground and torn with the jagged rocks which surround the cove where this buoy is now moored."

The Irishmen were duly rewarded, the buoy brought home, and it is now again chained and shackled to its mooring, serving humanity on a station of our Atlantic coast.

Sounding its whistle day and night, another buoy broke away from near Nantucket Shoals Lightship, drifting 3,300 miles in 19 months, circling between Bermuda and the Atlantic coast.

TUGMEN IRATE AT "PORCUPINES"

In some waters around New York, traffic is rough on buoys. Wooden spar buoys, formerly used, were sometimes cut down more than once in a single day. Now wooden spars have been replaced by light steel buoys, which can better resist collisions and the slashing of ships' propellers.

In areas below The Narrows, where tows of barges pass out to sea, it became necessary to protect the lighted buoys from the towlines by putting teeth or cutting-knives into the upper structure of the buoy. Strong was the language of irate tugmen when they discovered the purpose of this contraption, which one of them termed a "cussed porcupine buoy!" A towing hawser is a costly piece of equipment, and the sawteeth prove an effective cutting device!

All is now serene below The Narrows, and Ambrose Channel buoys are given a wide berth by the tug masters and their tows of scows.

Observe the buoys in a channel as your ship passes between them. You will note their different colors and shapes. On the right, as you come in from the sea, are red, cone-shaped buoys; and on the left are black, cylindrical ones. This uniform system of marking is in use throughout United States waters and in most of the world.

In North American, and some other waters, a red light shines from a red buoy

Photograph courtesy The Washington Post

HOME FROM THE SEA FOR REPAIRS

Periodically the floating light and bell buoys must be brought into the depots for cleaning and overhauling. Mooring chains also are examined carefully. Here about 1¾ miles of heavy chain of various sizes are spread out on the dock of the lighthouse depot at Portsmouth, Virginia, after being cleaned.

and always signifies the starboard side of the channel for the entering ship. The green light means the port side, while a white light may be on either side.

Just now a modification of this system is being introduced in this country, by which the rôle of a buoy is indicated by the character of its flashing light.

A quick flash, 75 flashes per minute, is cautionary, and designates a buoy requiring the particular attention of the navigator—such as a buoy marking an obstruction or danger, a turn in a channel, or a restricted entrance. Slow-flashing buoys (not over 30 flashes a minute) indicate the sides of channels. An interrupted quick flash signifies a wreck, and a short-long flash, a fairway or midchannel buoy.

This is an important advance, and will make buoyage more understandable and helpful to the navigator.

If a wreck occurs in an important waterway, it is extremely important to have it marked immediately, and the tenders make every effort to do this. A notable example was the sinking of the *Fort Victoria* in December, 1929, off the entrance to the New York Harbor channels. As soon as the fog would permit, the wreck was marked with a red bell buoy with red light at one end and a black whistle buoy with green light at the other.

FOG IS THE TERROR OF THE SEA

"Fog is the greatest enemy of navigation." Only recently, as explained on page 169, radio bearings have given the mariner for the first time a means of effective and accurate navigation in fog.

Though menace of collision still remains, the peril must diminish as approaching vessels in open waters make more use of radio bearings of each other, so as to pass clear.

But radio signals do not make it possible to dispense with whistle fog warnings.

Often, however, the whistle signals, as

Photograph by Fred Samuelson

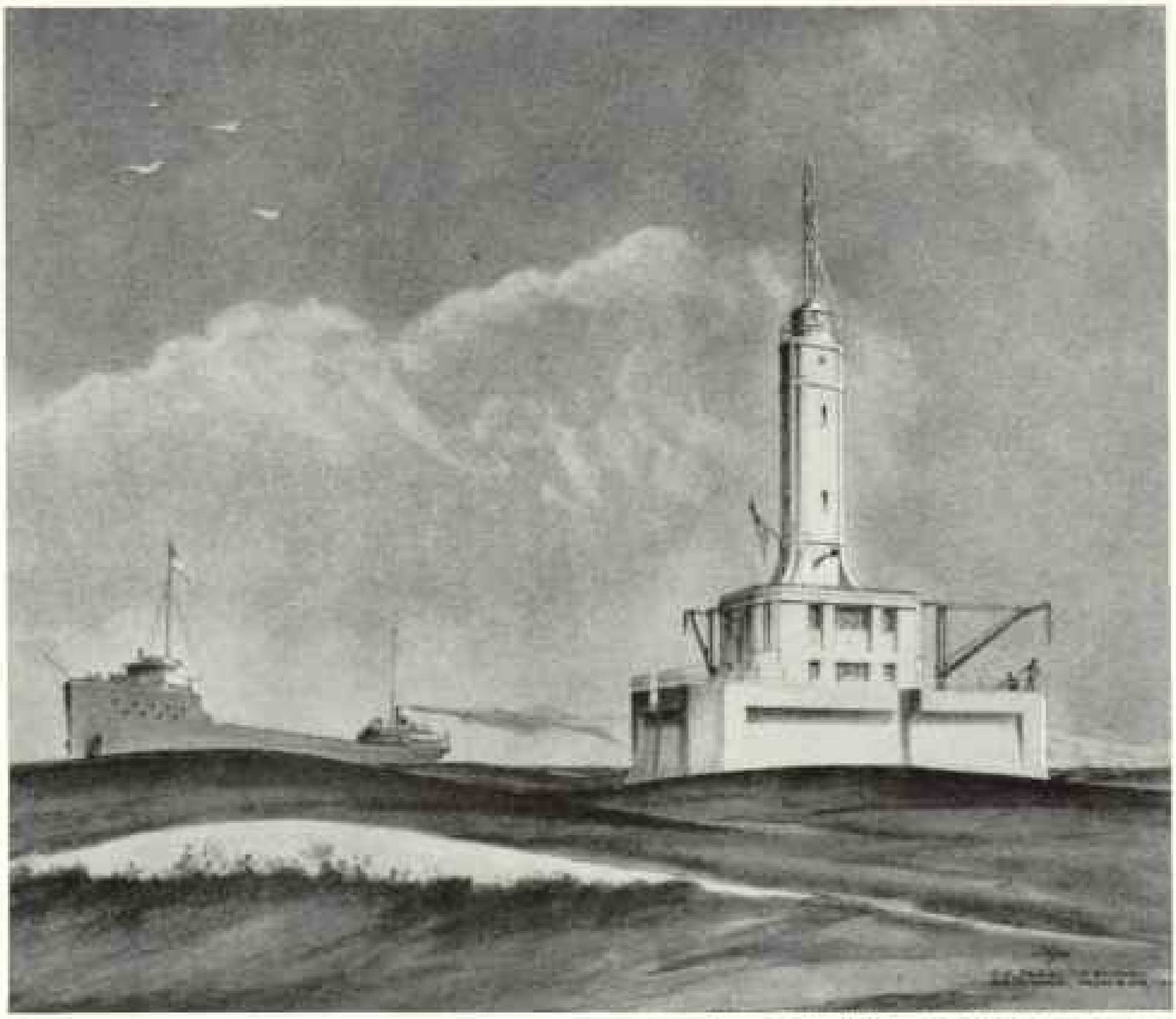
ALL BUT THE LIGHT ENCLOSED IN GLISTENING ICE

During heavy winter weather in 1918 the Ludington North Breakwater Light, marking a car ferry port on the east side of Lake Michigan, was almost put out of commission by frozen spray and ice. This station has a flashing electric light, a diaphone, and a radiobeacon.

Photograph by U. S. Lighthouse Service

A LIGHTHOUSE STAIRCASE, NOT THE INSIDE OF A CONCH SHELL

Lightkeepers get ample exercise in performing their duties. This unusual view, looking straight up the center of the 163-foot shaft of the present Cape Henry Lighthouse, shows the spiral staircase leading to the light and lens on top. Steps and tower are built of cast iron (pages 185, 191).



Drawn by R. E. Yates, U. S. Lighthouse Service

EVEN LIGHTHOUSES HAVE GONE MODERNISTIC

An architect's drawing of the new Grays Reef Lighthouse in Lake Michigan. This tower's diaphone fog signal and radiobeacon are synchronized so that a vessel may determine its distance away by noting the time it takes for the sound signal to travel through the air (page 170). One of six built with PWA funds, this reef station replaces a lightship.

now required, fail to give sufficient warning to prevent collision. A tragic example was the collision off the Massachusetts coast between the passenger steamer *Fairfax* and the oil tanker *Pinthus* in 1930, when 50 lives were lost.

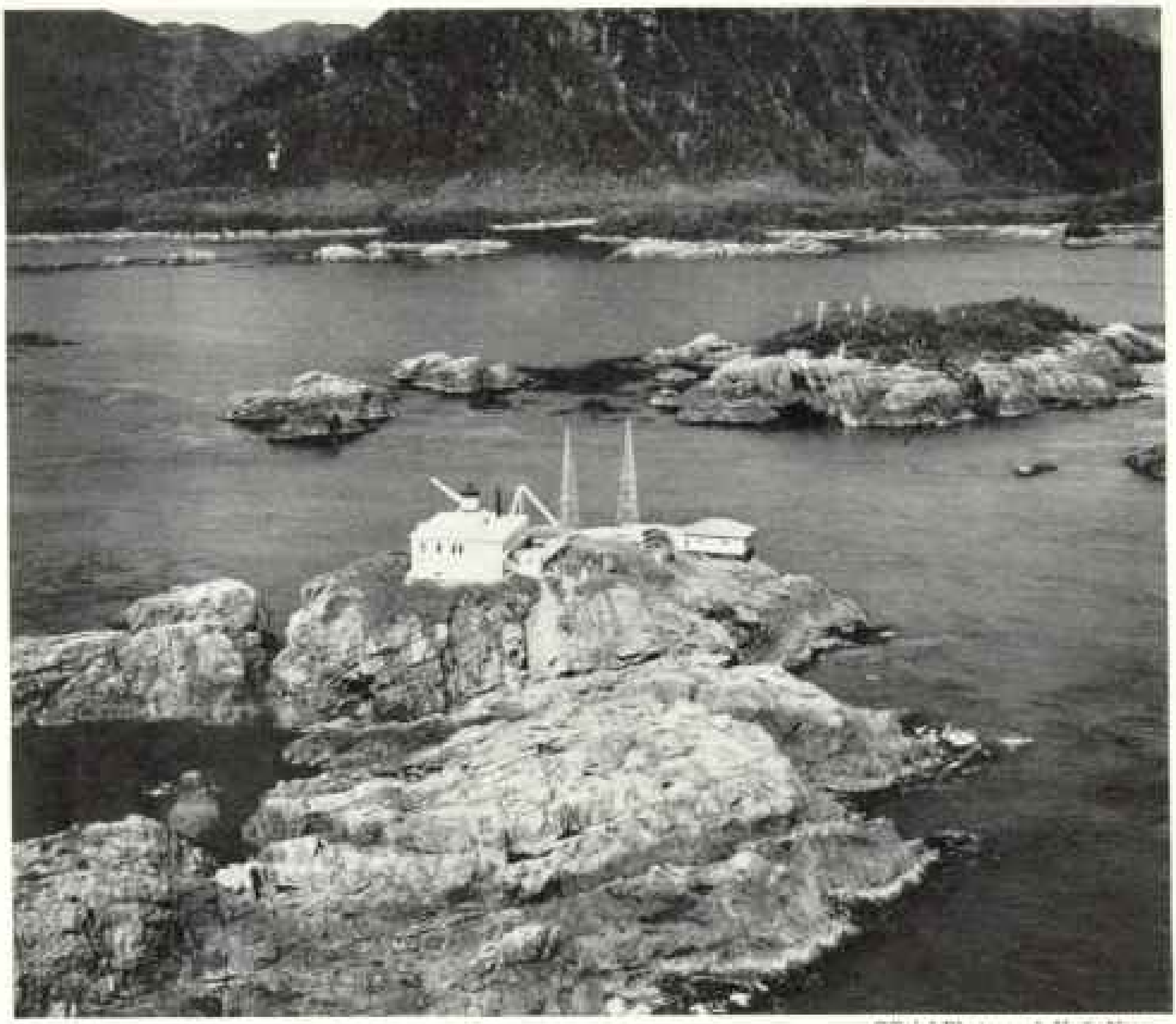
In this disaster the master of the *Fairfax* first heard the fog whistle at the same instant that he saw the bow of the tanker 150 feet away.

NONE SURVIVED TO TELL THE STORY

There was no survivor to report the story of the latter vessel. Surely we need some better means of preventing collision than a steam whistle, which may be drowned out by atmospheric conditions, and whose direction is only to be guessed at.

Here is a report received from the master of car ferry *P. M. 22* on Lake Michigan: "On December 19 when en route to Manitowoc, with strong west winds and winter fog so heavy I could not see the water from the bridge, I picked up the mobile radio signal of *P. M. 21* (a sister ship) nearly ahead. She was coming from Manitowoc. I ported one point. The bearings on our radiocompass constantly changed until I had steamer *21* abreast of me. We probably passed within a mile of each other. We did not see or hear her, but we knew by the bearing that we were going clear, and also when we had passed her. I consider it a perfect demonstration of the value of the mobile radiobeacon."

Low-power, warning radiobeacons have recently been tried out on several stations, in addition to the regular radiobeacons.



Official Photograph U. S. Navy

ITS RADIOBEACON SAFEGUARDS A HAZARDOUS ROUTE

The Cape Spencer Station, on a small, rocky island in the Pacific Ocean off Cape Spencer, and not far from Juneau, marks the principal entrance from the westward into the island-studded Inside Passage of southeastern Alaska. Radiobeacons are especially welcome to mariners sailing treacherous northern waters where fog and rain constantly blot out lights or muffle foghorns.

These warning signals have a distinctive warble note. They are intended to have a range of about 10 miles, and to give a distinct warning to approaching vessels that they are in the vicinity of a lightship or other station. Many reports have come in from navigators, and nearly all are favorable. These warning signals also extend the time for taking bearings.

UNSUNG RÔLE OF LIGHTHOUSE TENDERS

Tenders are used in lighthouse work for the care and supply of buoys, lightships, and lighthouses. A Secretary of Commerce once wrote, "This is a fleet of vessels whose duty it is to go where no other vessels are allowed to go, and who, through storm, darkness, and sunshine, do their work for humanity."

The first steam tenders were side-wheel vessels. The last of these went out of commission only a few years ago, after 50 years of service. This tender, the *Holly*, was a familiar sight in the waters of Chesapeake Bay and about Norfolk, which was her headquarters. President Cleveland sometimes used the *Holly* for short trips away from Washington.

The larger of the present-day tenders are able seagoing vessels, capable of lifting the heaviest sea buoys. Some of the latest ships have Diesel propulsion, and many are equipped for radio communication. These craft are small and of moderate speed. They are sturdily built for difficult work, which at times involves them in marine adventures calling for the highest seamanship and courage.

President Wilson once wrote a letter of commendation to the officers and crew of the tender *Columbine* for their heroic work in a Hawaiian Islands storm. They saved a bark, four times the size of the *Columbine*, disabled in the breakers off the coast of Kauai.

For a similar feat, in which he saved the crew of a patrol boat near San Juan Harbor, Puerto Rico, a gold medal was awarded Captain Manyon, of this same *Columbine*, which had in the meantime been brought around to the Atlantic.

Another time when a President recognized the courage of the officers and crew of a Lighthouse Service vessel was after the hurricane of September, 1933. In this storm the Diamond Shoal Lightship was driven from its station off Cape Hatteras.

The vessel dragged its 2½-ton anchor for five miles until it went into the breakers. Slipping the moorings, the master and crew, by bravery and good seamanship, saved the lightship by maneuvering it out of the breakers. President Roosevelt wrote a special letter of commendation.

STORMS WRECK LIGHTS AND BUOYS

The famous Tillamook Rock Light Station, off the Oregon coast, long battered by the Pacific, was subjected to another severe storm in October, 1934. Tremendous seas swept the rock, repeatedly submerging the entire station, although the light is 133 feet above normal high water. A section of the rock itself was torn away, and large fragments were thrown over the station. Sixteen panels of the heavy plate-glass lantern were shattered, rock fragments sixty pounds in weight being thrown inside (page 187).

The keepers, sometimes submerged to their necks, struggled to erect storm shutters. The storm raged for four days. During this time the keepers could not leave the building, but they managed to display a temporary light after the first night. Since telephone cable connection had been broken, an assistant keeper contrived a short-wave radio set and established contact with amateur radio operators ashore.

Notable work was done later by the master and crew of the lighthouse tender *Rose* in landing construction materials and relieving the men on the rock until repairs could be completed. That job required several months owing to protracted stormy weather.

When the story of the work of the keepers at Tillamook was published, the Chief of the Lighthouse Service of Mexico, Mr. Alberto J. Pawling, had it translated and sent to all the lightkeepers of Mexico as an example of courageous performance of duty.

A Lake Erie storm in January, 1928, so completely covered the Ashtabula, Ohio, Lighthouse with ice that two keepers were imprisoned. Two others, ashore during the storm, on their return found the light station incased in a solid mass of ice. To establish communication, the men inside had to thaw open the door and cut a trench with picks for a distance of nearly forty feet to reach the side of the crib.

Lights and buoys suffered severe damage in the winter storms of 1918. Buoyage in all bays and rivers from Massachusetts to North Carolina was completely disarranged, and inside lightships were repeatedly dragged from their stations by moving fields of ice (page 195).

Ambrose Channel was kept marked only by the continuous and strenuous work of the tenders; some of the buoys were replaced on their stations three times in one day.

Wide-spread destruction was wrought in Chesapeake Bay and the sounds of North Carolina, where upward of 125 lights were battered or destroyed. Practically the entire buoyage of the Hampton Roads and Norfolk areas was swept away. The total damage to aids, caused by this storm, was about $500,000.

Buoys, lightships, and lighthouses on our South Atlantic and Gulf coasts are often exposed to violent assaults when West Indian hurricanes blow. One such storm some years ago moved up the coast and damaged five lightships, three being driven off station. The master of Cape Charles Lightship reported various damage done to the ship, and said there had been 18 inches of water in the hold.

"I respectfully report that all the repairs we will do ourselves," he wrote. "There is nothing needed. The whistle was kept going for 14 hours during the gale."

A lightkeeper in Tampa Bay, reporting the condition of a damaged beacon, cheerfully added, "This structure is standing up from sheer good nature."

ANIMALS ALSO HELP

Like all sailors, men on the lightships and tenders often keep pets. "Sport" was a dog

Photograph by U. S. Lighthouse Service

"TAKING OFF THE KEEPERS" IS OFTEN AN ARDUOUS TASK

At the close of navigation on the Great Lakes, lightkeepers must be removed from offshore stations, and sometimes extreme difficulty is experienced if there is an early freeze. The tender *Marigold* stands by to receive the personnel of Raspberry Island Station in Lake Superior.

on the *Hyacinth*, which looks after Lake Michigan lights and buoys. Rescued from the lake, he spent his remaining twelve years on the tender, becoming "a member of the crew." He swam and played ball with the men. No boat could go ashore without Sport.

Many times he carried a heaving line to shore through the breakers when landing on the beach at some lighthouse. When he died, he was buried with the honors of the sea.

COAST LIGHTS ARE USEFUL TO OVERSEAS AIRCRAFT

On the Charleston Lightship the mascot was a cat, "Tom," of whom the master wrote: "Tom is eight years old. He was born on the old Charleston Lightship and knows no other home except our ship. He's one of our crew, and his regular job is to keep the ship free of rats."

Along the coasts all lights set up to guide vessels on the sea may, of course, be useful to airships, especially those from overseas. But since most air traffic now follows long straight inland routes, these must necessarily be marked by special airways beacons.

Powerful electric light beams, rapidly sweeping the skies like brilliant searchlights, are now familiar sights across the country. When within the range of ships on the sea or lakes, these lights are included in the mariners' list of lights, but this is done more to avoid confusion than because of their value in navigation.

Special radio beams, established for air navigation, are sent out in definite directions to mark definite routes. Marine

Photograph by U. S. Lighthouse Service

MODELMAKING WHILES AWAY LEISURE HOURS

Vessel crews and keepers in the Lighthouse Service find amusement in making miniatures of some of the craft they have seen. The crew of the tender *Iris*, including the cook, display examples of their handicraft, ranging from tugs to full-rigged sailing ships.

radiobeacons, on the other hand, are non-directional—that is, the signal is sent out around the whole horizon.

These marine signals may possibly be of considerable help to airmen in the future, when convenient direction-finders are available for airplanes, a development now being made. Lighter-than-air ships have long been so equipped, as was the *Norge* on her transpolar flight in 1926.

Some of the equipment, particularly the powerful double lens, developed by lighthouse engineers in marking inland commercial airways has been found applicable to certain marine lighting problems.

Twenty-three years ago, THE GEOGRAPHIC published an article by me on our lighthouse system.* Since then the wall of fog — thought impenetrable — has been pierced by radio signals.

Progress in the fields of electricity, optics, acoustics, and mechanics, and especially the radiobeacon and the lighted buoy, have since broadened the efficiency of guiding signals.

The effectiveness of the signal system has been extended to every hour of the year, and its whole frontier has, by radio, been pushed far out over the bordering seas.

* See "Beacons of the Sea: Lighting the Coasts of the United States," by George R. Putnam, in the NATIONAL GEOGRAPHIC MAGAZINE for January, 1913.

INDEX FOR JANUARY-JUNE, 1936, VOLUME READY

Index for Volume LXIX (January-June, 1936) of the National Geographic Magazine will be mailed upon request to members who bind their copies as works of reference.

Photograph by Francis C. Fuerst

UNLADYLIKE SHOES BETRAY A MASKED QUEEN OF THE CARNIVAL

Every third year, just before the beginning of Lent, the residents of Imst, in the mountainous Austrian Tyrol, hold a masquerade fete called the *Schemenlaufen* (Dance of the Phantoms). During this period, Winter and Spring are supposed to fight for the domination of Nature. Only men may act in the traditional festival, which is held to frighten away the accumulated evil spirits of the winter and to promote abundant crops and prosperity during the coming year.

Photographs by Francis C. Fuerst

BEFORE AND AFTER! HAVING EXCHANGED HER BROOM FOR A BURRO, THE WITCH-MOTHER GLOWERS AT ONLOOKERS

In ancient times the people of Imst believed that such grotesque figures caused evil winter weather and controlled the fertility of Nature and Man. Witch masks, carved from wood, are painted as ugly as possible, with goggle eyes, fanglike teeth, and pigs' bristles for beards. By wearing the masks, the participants in the festival are supposed to assume the powers of the demons.

EACH ACTOR TAKES A TRADITIONAL PART

With his syringe, the *Spritzer* (Sprayer), in the center of the trio, keeps back spectators by squirting water on them. His comrades are a witch and a *Sackner* (Sack Holder), with pointed hat, who carries a sack full of corn to throw at the feet of spectators.

Photographs by Francis C. Furrst

A GOOD SPIRIT TAKES OFF HIS "FACE" AND CARRIES IT!

He may use the broom in his left hand to sweep away a devil or two! Above the mask with girlish features is a crown of flowers, which symbolizes the abundance of spring. On the broom handle are large pretzels, popular carnival fare.

FRIGHTSOME MASKS AND JANGLING BELLS PUT EVIL SPIRITS TO FLIGHT

On Gurgl Glacier, not far from Imst, Professor Auguste Piccard landed in his balloon after his first successful ascension in 1931. See "Ballooning in the Stratosphere," in THE GEOGRAPHIC for March, 1933.

Photographs by Francis C. Fuerst

THE LEG OF A ROE WRAPPED IN RUGS IS THE WITCH'S "BABY"

Most maskers dance, sing and shout, but some have special responsibilities. This hideous character throws her baby-in-effigy at favored women and girls, retrieving it with a string. The ceremony is supposed to insure fertility.

NOT DIET, BUT DEVILS, IS THE "REFUSE" THEY SWEEP AWAY

In the Tyrol, broom-riding hags step from the pages of legend to the village streets. These witches' masks are adorned with feathers. The beard of one is the face of an angel whose wings form the sideburns.

Photographs by Francis C. Farrar

A BUXOM HEX IS THE DEVIL'S BRIDE—AND PROUD OF IT!

Grotesque though the masks may be, they usually reflect a spirit of fun and playfulness. Imst is a prosperous town, for neighboring slopes and valleys yield rich harvests and many canaries are raised by the villagers to be sent to England and Turkey.

CARICATURE AND IRONY ADD ZEST TO THE FESTIVAL

Local customs and individuals are often satirized. This get-up is a travesty of a "happy couple."

Photographs by Francis C. Fuerst

IS HE FRIEND OR FOE?

The youngster is puzzled as he views the gaily clad masker, who is carrying his face in the illustration on page 203.

WRINKLES, BROOM, AND STRINGY HAIR—BEWARE THE WITCH!

Evil spirits are most easily repelled by mimicking their appearance! Male impersonators borrow laced bodices and many-plaited skirts from their wives, who may watch the ceremonies but may not participate.

Photographs by Francis C. Farrar

THIS JOVIAL SORCERER MAY BE ADMIRAL OF THE DEVIL'S NAVY

A striped candylike stick serves for his magic sceptre. Perhaps the bird on top indicates that in real life he raises canaries. Known as the "city of the old fountains," Imst nestles in a valley on the southern slopes of the Lechtaler Alps.

Photograph by Francis C. Farrar

RING OUT THE WINTER, ROLL IN THE SPRING

Evil winter spirits must flee from noise. As the dancers eddy through the squares of Imst, they contort their bodies continuously to jangle their bells. Most popular and numerous of the carnival characters are the *Scheller* (Bell Ringers) and the Rollers, who always appear in pairs. They symbolize the battle between the Good and Bad Spirits.

SEA CREATURES OF OUR ATLANTIC SHORES

By Roy Waldo Miner*

Author of "Coral Castle Builders of Tropic Seas," in the National Geographic Magazine

As WE STAND on the seashore at the full of the tide and look out over the swelling floods surging in from the distant horizon, our feet are on the threshold of an enormous empire, so vast in extent and population that the achievements of the haughtiest rulers of mankind are dwarfed by comparison.

Though fleets sail over its depths, they make no significant impression upon this immense realm.

FROM THE SEA CAME ALL LIFE

The subjects of this empire swarm through the waters in myriads totaling far greater numbers than all the life of the continental world. In fact, scientific investigations indicate that the oceans were the original abode of life on the globe, and that the continents were peopled from that inexhaustible reservoir.

Geologists believe that the depressions now occupied by the oceans always have been located in approximately their present positions during the entire history of the earth, and that the foundations of the land masses likewise have been situated nearly as they are at the present time.

But during the great geological periods, the ocean has repeatedly invaded their edges and even their interior basins, sometimes to an enormous extent, forming shallow epicontinental seas.

Thus, all the continents of the world are bordered by a strip of shallow sea, the continental shelf, which slopes gradually from the coast to depths varying from 100 to 1,000 fathoms at its outer edge. Beyond this limit there is usually a more rapid gradient to the main floor of the ocean—the continental slope.

This world-wide shallow strip is of major importance to the life of the seas.

The present article deals especially with the mollusks and other small creatures inhabiting the continental shelf which borders the Atlantic coast of North America from Nova Scotia to New York, and includes the extensive New England fisheries. In a later article a contrast will be drawn between this life of northern waters and that of the warmer seas of the southern Atlantic coast.

A most remarkable stretch of shore this is. Its southern half is of comparatively even contour, but, beginning with the region of Cape Hatteras, the coast to the northward has subsided and is indented with deep bays and irregularities, finally terminating in the long curving and tapering indentation of the Gulf of Maine.

The latter is the most noteworthy feature of the coast, its wide mouth being guarded on either hand by Cape Cod and Cape Sable, and its inner reaches narrowing to a double apex in the Bay of Fundy (map, page 212).

All this northern half of the Atlantic seaboard is a succession of drowned valleys, and its topography and geological history indicate that it has subsided beneath the waves of the sea during relatively recent times. On the other hand, the even outline of the coast from Hatteras south to Florida shows no evidence of such sinking.

The oceanic shelf to the 100-fathom line widens rapidly to the northward, reaching its greatest extent off the Gulf of Maine, where it is approximately 400 miles wide.

The central floor of the Gulf of Maine is an ancient river valley to which the river systems, represented by those now existent, contributed their drainage, to be emptied into the prehistoric sea by a single channel and mouth still traceable on the sea floor at the edge of the continental shelf.

"SHELF" LADEN WITH SEAFOOD

Throughout this extensive and comparatively shallow oceanic margin, well illuminated by the sun's rays, conditions are favorable for an enormous development of the marine plants on which sea animals feed: namely, the microscopic diatoms, one-celled algae, and the larger seaweeds.

Here numerous streams empty their loads of silt, rich in nitrates, phosphates, and other chemicals needed for plant food. The strong tides rushing into the narrowing channel from the open sea keep the water stirred with upwelling currents plentifully supplied with oxygen.

Hordes of small crustaceans, the copepods, feed upon this plant life. At certain

* Curator of Marine Life, American Museum of Natural History.

Photograph by Mary C. Dickerson

MUD SNAILS AND PERIWINKLES LEAVE "FOOTPRINTS ON THE SANDS" AT WOODS HOLE, MASSACHUSETTS

Silt mingles with sand in sheltered coves or behind sand bars, and the mixture contains food for burrowing creatures. Bits of dead matter attract mud snails, here trailing across the sand ripples left by an ebb tide. Periwinkles rest on the rocks in the lower left corner (page 213).

seasons they swarm in these waters in numbers so vast that they give the sea a reddish color for miles.

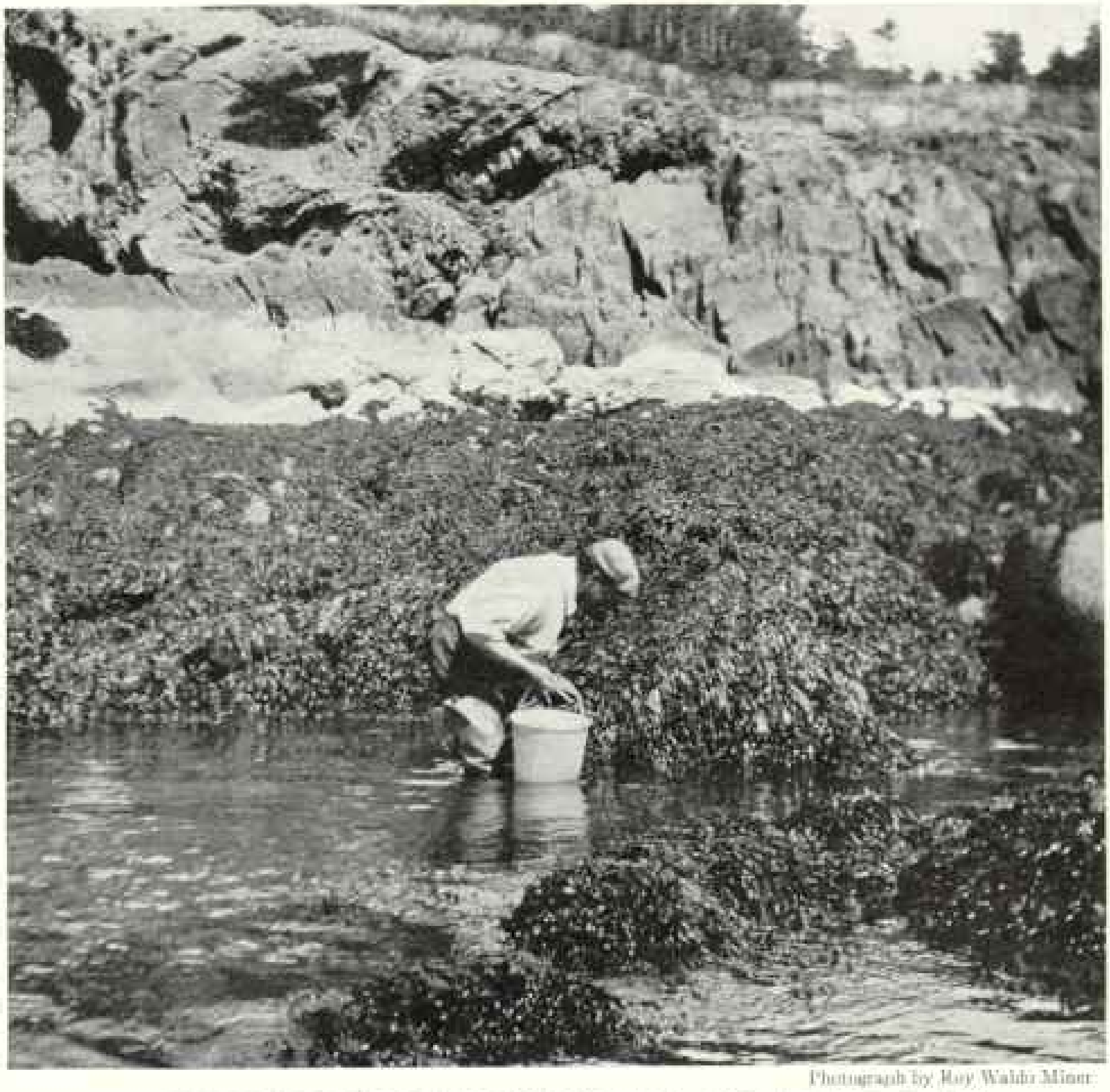
DEVOURING AND DEVOURED IN TURN

These tiny creatures are rich in oils and are greedily devoured by large schools of mackerel, herring, alewives, and shad. Bluefish, cod, hake, and haddock pursue and devour the smaller fishes, and even the huge finback and humpback whales do not disdain to feed upon the herring.

Thus the shallow banks off New England, especially Georges and Browns Banks, at the entrance to the Gulf of Maine, as well as the Grand Banks of Newfoundland, farther away, form a veritable nursery for the important food fishes of our coasts, and thus connect mankind by an interlacing food chain with the microscopic plant life of these shallow waters.

The evolution of the animal world, as we know it, would have been impossible had these primitive plants not come into existence. From such forms, also, all the higher land plants of the world originate.

Countless invertebrates besides the copepods feed upon the microscopic plant life, and in turn fall prey to other larger or more voracious invertebrates, while the latter



Photograph by Roy Waldo Minor

A COLLECTOR SETS TO WORK IN THE TIDAL ZONE AT BLISS ISLAND, PASSAMAQUODDY BAY

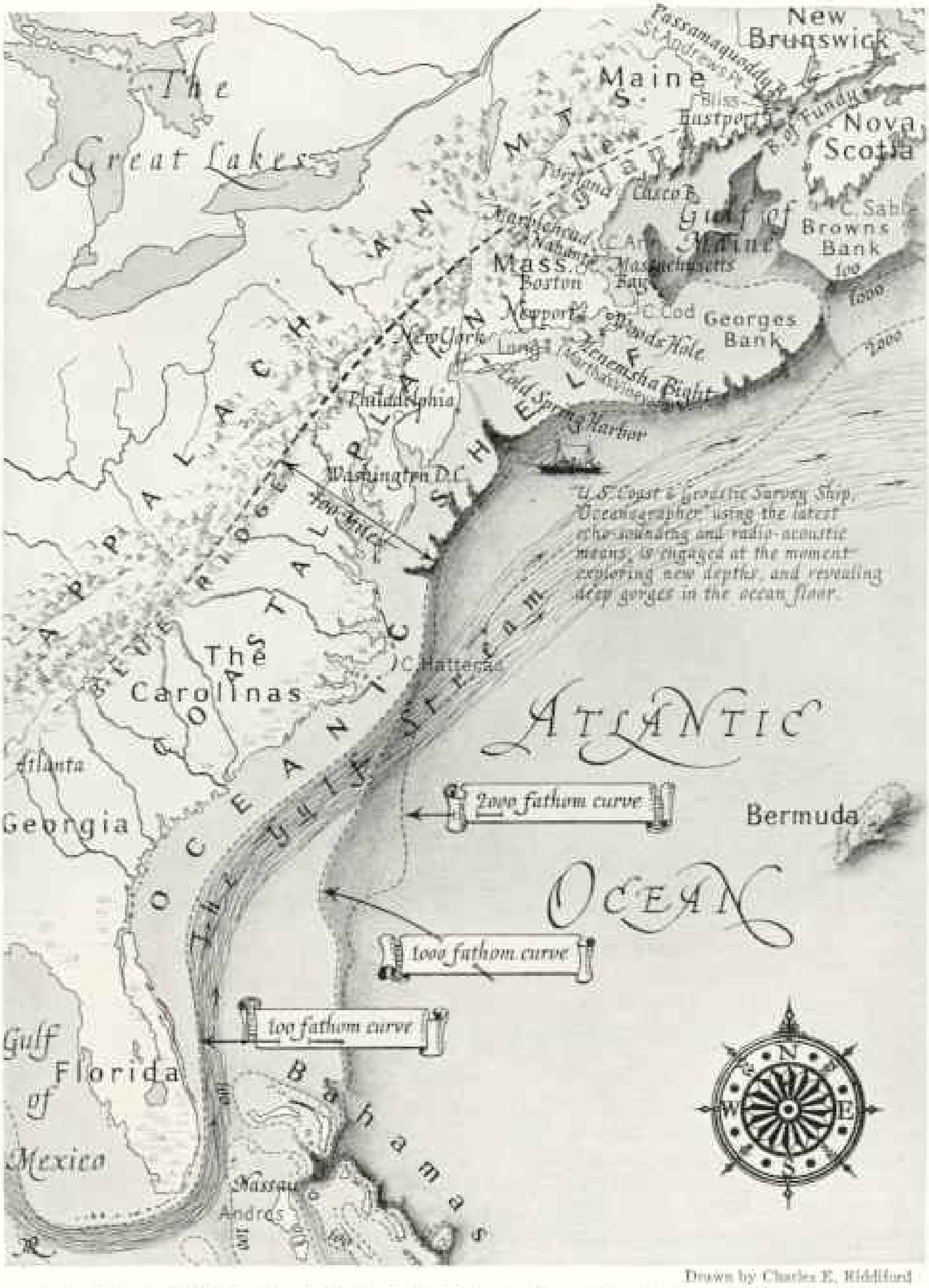
Precipitous shores here have a tidal rise and fall of 22 feet. Sleeves uprolled, the naturalist wades along a submerged ledge at about three-quarters tide. The zonelike arrangement of animal life is clearly shown here. A band of barnacles edges the high-water mark, and thickly matted rockweed covers the cliff below. Underneath the weed many sea animals cling in crevices, kept moist by the over-draping growth.

are hunted by the fishes. Thus a mighty struggle for existence has taken place in these shallow waters over the ages.

Many forms, such as the mollusks, have evolved hard protective shells. Still others hide themselves in submarine burrows, as do the marine worms. Many species, such as the jellyfishes, have become adapted for floating in the open seas and are borne away by ocean currents to less closely contested parts of the waters.

Some bottom creatures have crept down the oceanic slope, apparently crowded from its well-lighted summit by the teeming armies struggling for a place in the sun. Such forms have gradually accustomed themselves to life in dimmer waters, and among them a still lesser number of species have ventured down into the great abysses to live their lives in the Stygian darkness, the perpetual cold, and the enormous pressures of the deeps, miles below the surface.

As the open seas were peopled from the oceanic shelf, so the fresh-water streams and swamps received parts of the overflow. Countless species found food and a measure of safety from enemies by creeping into the area between the tides, where they



Drawn by Charles E. Riddiford

BORDERING THE EAST COAST IS A SHELF OF SHALLOW WATER, HOME OF MANY TINY SEA CREATURES AND SOURCE OF A RICH FISHING INDUSTRY

Strangely, the heavy dotted line (upper left), marking the Appalachian Mountains, and the 100-fathom curve in the ocean run roughly parallel, about 400 miles apart. North and eastward from New York the 100-fathom mark marches far out to sea and the mountain line comes down close to the water's edge in the Bay of Fundy, where rocky cliffs rise from drowned valleys. Southward this undersea plateau is narrow, but the coastal plain is quite broad. Where the shelf is widest, there lie Georges and Browns Banks, fertile fishing grounds for Nova Scotia and New England fleets. Cod, mackerel, shad, haddock, and many other commercial fishes feed on the tiny sea life which thrives there, and lobsters, clams, crabs, and oysters flourish in the coastal waters. Indentations in the 100-fathom line indicate deep gorges in the ocean's bed which are submerged mouths of ancient rivers (page 209).

acquired resistance to exposure to the open air at the intervals of low water. Here a rapid evolution took place, so that the intertidal zone became densely populated with life.

Finally, from fresh-water swamps on the one hand and from the upper parts of the marine tidal zone on the other, first plants and then animals invaded the land itself and produced the highly specialized types that now reign over it.

ANIMALS OF ROCKY SHORES

North of Cape Cod, the coast of New England is predominantly high and rocky. Beginning with the headlands of Nahant, Marblehead, and Cape Ann, north of Boston, the cliffs are at first isolated to local regions, with intervening stretches of sandy beaches and flats. But from Portland, in Casco Bay, northward, the coast is an almost unbroken succession of granite cliffs, sloping rock-ribbed promontories, and reëntrant bays and harbors, with occasional beaches.

The tidal waters flowing from the open sea are gradually confined by the narrowing outline of the Gulf of Maine, which forces them to a progressively increasing height, and reach a climax in the Bay of Fundy. From Massachusetts Bay north to Portland, the tide rises nine feet. It continues to increase northward, until it becomes 18 feet at Eastport and 37 to 48 feet at the ends of the two tapering horns which terminate the Bay of Fundy.

Here, too, there are interpolated stretches of beaches, flat points, and swampy meadows, and these are entirely covered at high tide. Naturally the width of the tidal zone on the side of a vertical cliff is measured exactly by the vertical rise and fall of the water. For example, the cliffs that surround Bliss Island, at the entrance of Passamaquoddy Bay, are exposed for 22 feet from the top of the barnacle frieze that marks the high-tide limit to the water level at low tide.

This region between the tides is teeming with life, both plant and animal, in crowded array. On the vertical granite walls of Bliss Island, the various species are arranged in overlapping zones, with the conspicuous white band of rock barnacles (*Balanus balanoides*) at the top (page 211).

Below this, the rockweeds (*Fucus vesiculosus* and *Ascophyllum nodosum*) hang in thick, gracefully festooned clusters down to the low-water mark and below.

Concealed beneath the rockweed, and succeeding the base of the barnacle zone, the rocks are covered with a dense layer of young black mussels (*Mytilus edulis*).

Among them (Plate II) are closely crowded groups of the common dog whelk (*Thais lapillus*), feeding upon the mussels, and laying their graceful vase-shaped egg cases, tinted rose and yellow, in mosaic-like patches in the crevices.

The latter mollusks secrete a purple dye, formerly used by the Indians for coloring their deerskin garments. They are related to the *Murex* of the Phoenicians, from which that people derived the famous royal purple, later arrogated by the Roman emperors for their personal use.

The dog whelk has a thick shell with a characteristic spindle-shaped opening. It is extremely variable in color, size, and sculpture along the New England shore.

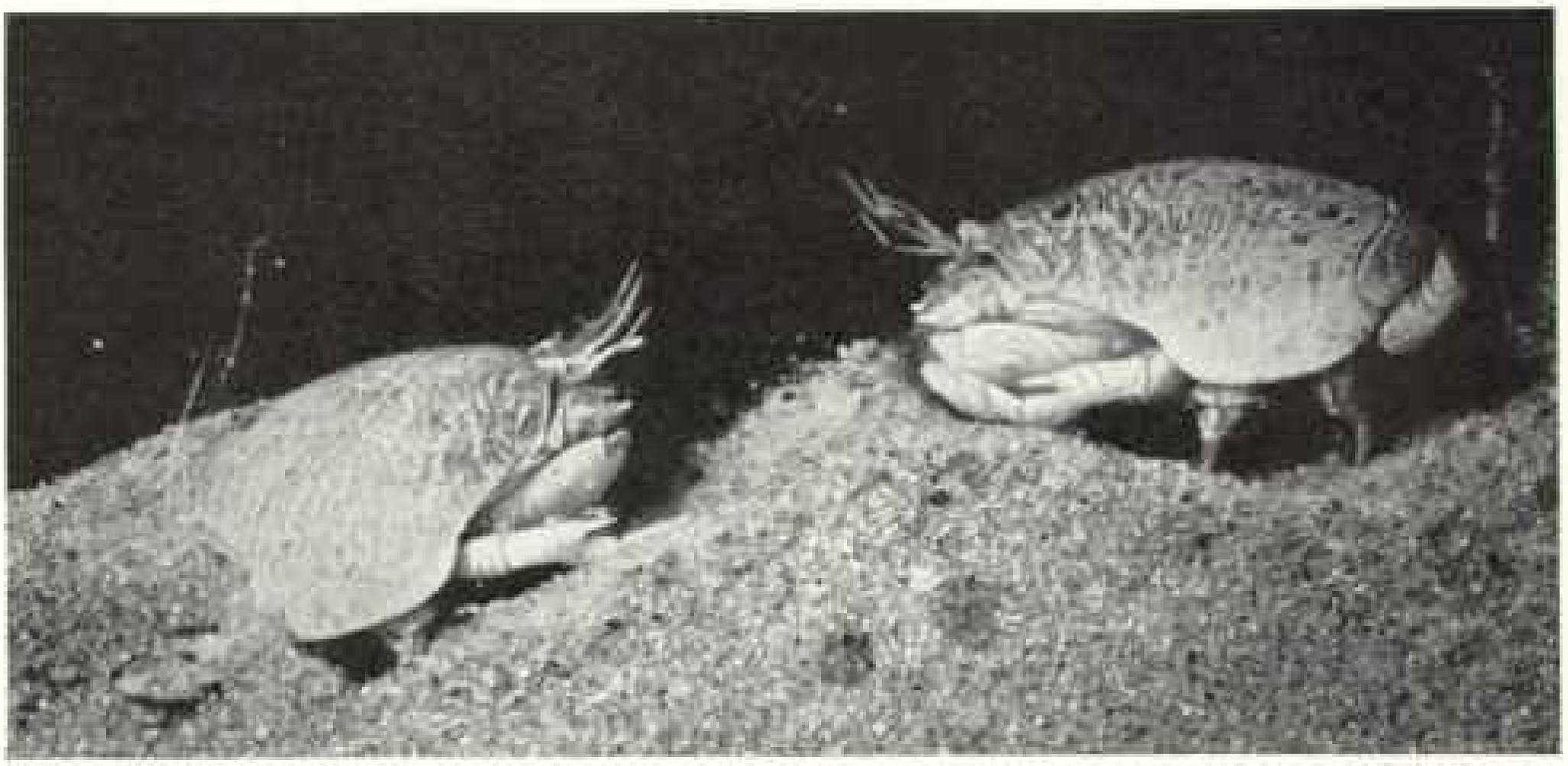
The common periwinkle (*Littorina littorea*) creeps everywhere over the rockweed from the low-water mark to the highest part of the barnacle zone and even upon the bare rocks far above it (page 210). This remarkable sea snail can stand exposure to the open air longer than any other marine creature of the northern coast, except perhaps the closely related black acorn shell (*Littorina rudis*).

It is in a transitional state of evolution toward terrestrial life, for its gill seems to be on the point of being replaced by a lung. It has a very wide range, being found on both sides of the Atlantic. In England it is the common "winkle" sold in markets.

A zone of kelp occurs at the low-water mark, anchored to the rocks by hold-fasts, the long, slender stems terminating in brown ruffled fronds which float out into the water, sometimes for ten or twenty feet. These are the "devil's apron string" (*Laminaria agardhii*).

SOUPS AND JELLIES FROM THE SEA

Below the kelps, and entirely submerged except at the lowest spring tides, is the zone of red seaweeds, of which the commonest and most conspicuous are the dulse (*Rhodymenia palmata*), consisting of thin, hand-like expansions of a red, rubberlike consistency; and the Irish moss (*Chondrus crispus*), a beautiful, finely divided alga, which shades from green to red in sunny places, or a deep red or chocolate brown, with brilliantly iridescent violet tips, in more shaded localities.



Photograph by Mary C. Dickerson

MOLE SHRIMPS SEEM TO SAY, "LET'S SEE WHO CAN BE FIRST UNDER COVER!"

These little animals burrow in loose beach sand at the surf's edge. Often washed out by storms in countless numbers, they immediately dig in again. Their shells are yellowish, tinged with purple. The creatures, here magnified about one and one-third times, are especially abundant along the south shore of Long Island (page 225).

Dulse is sold in markets for soup stock, and Irish moss is important commercially in the dry state for manufacture of jelly compounds, well known to housewives.

The zonal arrangement of the animal associations continues to the low-water mark. The mussels, overlapped by the seaweeds above mentioned, extend downward until limited by the broad and continuous band of the green sea urchin, which rejoices in the longest scientific name known to zoologists, *Strongylocentrotus drachbachiensis!*

This little animal feeds so voraciously upon the mussels at the lower edge of their distribution that they are abruptly terminated at that level. At about the same region, sea stars of several species are abundant, preying upon the sea urchins and the mussels as well.

Just above low water, the Jonah crab (*Cancer borealis*) abounds. This and the related rock crab (*Cancer irroratus*) are marketed in Boston as "hard-shell crabs" (Plate I).

TIDAL POOLS ARE NEPTUNE'S GARDENS

Here and there, far down the rocks in this intertidal area, are hollows in the ledges, within which water is retained even when the tide has ebbed to its lowest. Elsewhere the creatures of the ocean margin are nicely graded and assorted in orderly frieze-like bands according to the length of time they can endure exposure to the air. But in these tidal pools there is no such selective regimentation, so that the life of all zones is concentrated and intermingled.

Each pool is a veritable sea garden, luxuriant with living things, replete with sea vegetation, and swarming with darting and expanding forms—a riot of rich color.

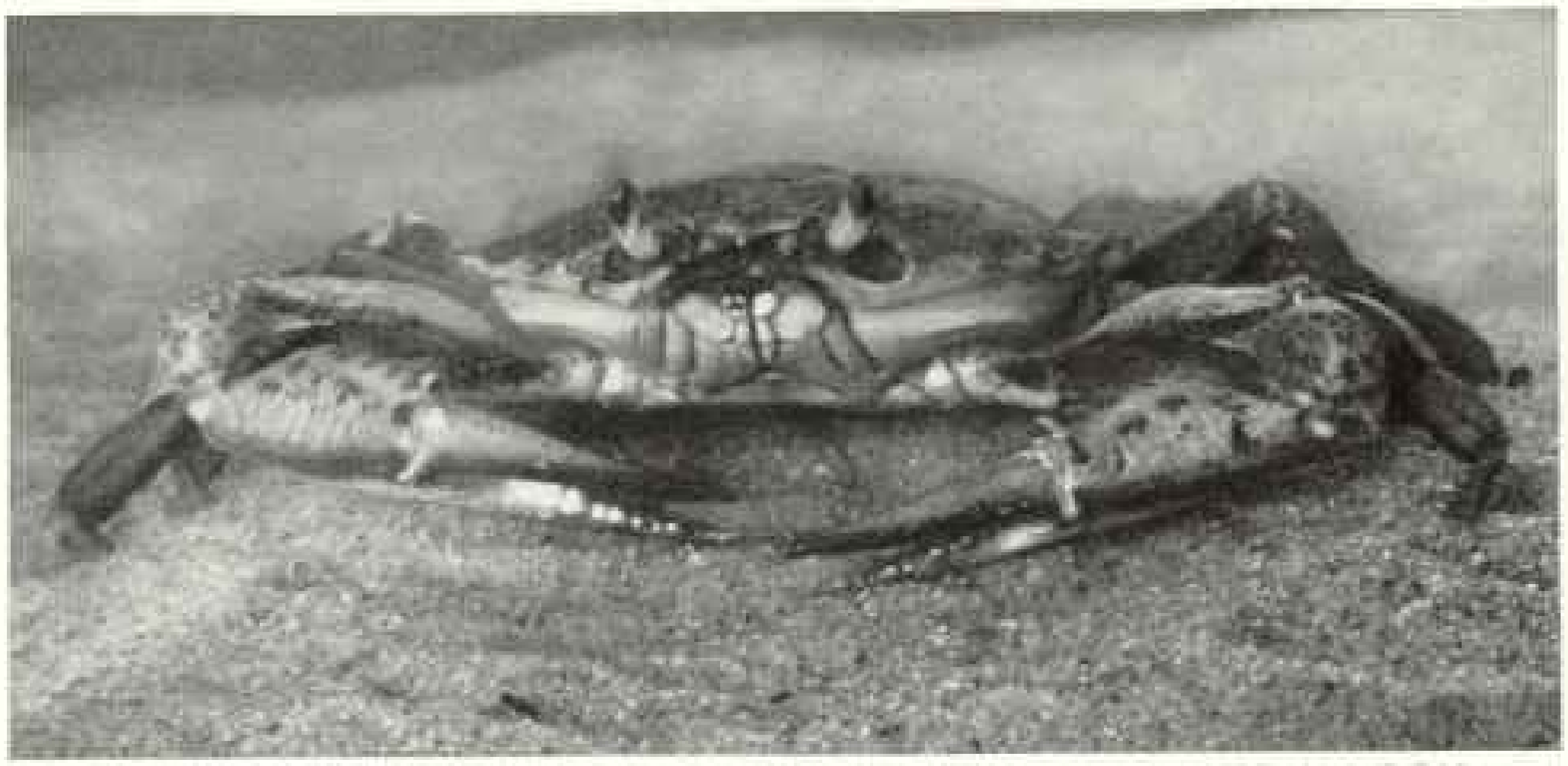
Yet this vital world is plentifully supplied with food and oxygen, for twice a day the life-giving flood of the ocean surges in upon the pool, the turmoil of its white foam dashing over the rocky terraces. Multitudinous planktonic creatures saturate its waters and are eagerly devoured by the sequestered life of the sea garden.

Newly hatched larvae, born in the open sea, either become the prey of the inhabitants or settle down in the crevices to become new members of the colony.

At Nahant, Massachusetts, if we climb down a 60-foot cliff that hems in the shore with its granite ramparts, we suddenly come upon a natural bridge spanning a 20-foot tidal pool, visible only at low water.

The surroundings are wild, almost grotesque. Huge crags of red granite, seamed with white quartz and contrasting dark bands of basalt, stand torn apart from the cliff, as if by some giant hand.

One of these, known locally as Pulpit Rock, tilted toward the sea, towers at a sharp angle just north of the pool. The surf



Photograph by Mary C. Dickerson

A LADY CRAB BURIES "HERSELF" IN THE SAND

When alarmed, it squats down upon the sea floor and works backwards into the sand with paddle-shaped hind legs. Shortly, it is completely concealed, except for protruding eyes and antennae, which, though alert and sensitive, are difficult to detect (page 216).

dashes against its base, which is broadly banded with the conspicuous marking of the nine-foot tidal zone, the white barnacle frieze and festooned rockweed standing out sharply against the colored rock.

If we bend down and peer through the bridge, we may see Pulpit Rock framed in the archway. We stoop nearer to the pool, bracing ourselves against the damp seaweed clothing the sides of the arch. The fronds are dotted with small yellow and brown banded shells of the lesser periwinkle (*Littorina palliata*).

Looking through the transparent water of the pool, shaded from the reflected sunlight by the overhanging rock, we can make out every detail of the basin's bottom, but not an inch of the bare rock is visible.

A ledge to the left gleams with iridescent Irish moss and crimson dulse, relieved by the velvety green of sea lettuce. Rockweed floats about it like soft scalloped draperies, borne upward in the water by multitudinous air floats and adorned with fluffy dark-purple tassels of pompon weed (*Polysiphonia fastigiata*). The overhanging side of the cavern is crowded with black mussels, upon which a bright colony of dog whelks is joyously feasting (Plate II).

ENTER A KNIGHT IN ARMOR

Suddenly the weed at the left is parted and out stalks a large "buckie" (*Buccinum undatum*), or furbelowed whelk, like an armored hero of a play stepping forth from the wings of a theater. In stately fashion it proceeds to the center of the stage. Its head, with tapering tentacles, and the furbelowed border of its undulating foot, patterned conspicuously in black and white, extend from beneath the helmet-shaped shell.

It marches forward and tentatively investigates a clump of horse mussels. These immediately clamp their slightly gaping valves tightly shut to protect the bright orange-colored edge of the soft mantle that just now protruded from their margins. The enemy turns elsewhere.

In a sequestered nook a sea peach (*Cynthia pyriformis*) nestles its smooth, red-cheeked, oval body at the edge of a feathery thicket of purple-pink coralline (*Corallina officinalis*). This creature belongs to the group known as ascidians, or tunicates, of which many species are found along the coast, including the scarlet sea potato. Their rounded oval bodies, often brightly colored, certainly are suggestive of terrestrial fruits and vegetables.

Each ascidian has a pair of projecting siphons, one of which draws the sea water into its body and the other ejects it forcibly after it has been filtered. For this reason they are often known as "sea squirts."

A little farther along in our pool the hard bottom is covered with green encrusting sponges, enameled and overlaid with

patches of magenta lime-secreting algae, and brown, white, and scarlet sea mats, or moss animals, completely concealing what would otherwise be bare rock with a gorgeous irregular mosaic of bright hues.

Over this colorful pavement crawl and sprawl multitudes of sea stars, brittle stars, and sea urchins (Plate III). These echinoderms, or spiny-skinned animals, are abundant in northern seas, and, as we shall see later, have an important effect on the animals of the sea bottom (page 231).

All are characterized by body parts radiating from a common center, on the under side of which is the mouth, also centrally located. Their skins bear multitudes of spines which move upon ball-and-socket joints, and all have "tube feet."

These are small, hollow, cylindrical projections with a pneumatic disk at the end. The creatures move about by stretching out scores of these tube feet, attaching them to the rock, and then pulling the body forward, the spines acting as levers.

In our pool, the conspicuously contrasting and varied color patterns of the sea stars add to the gardenlike beauty of the submarine vista.

Prominent inhabitants of the tide pool are the ubiquitous sea anemones. Their soft, cylindrical bodies may be contracted to velvety mounds, but, if watched, they soon expand to full height, gradually unfolding a fluffy crown of tentacles surrounding a central mouth. These tentacles radiate in all directions like the petals of a flower. One of the most common species is the sea chrysanthemum (*Metridium marginatum*), with which the ledges are crowded close under the water surface (Plate III).

The small white-armed sea anemone (*Sagartia leucolena*) is a slender, translucent species of small size, generally about one-half inch in diameter. It is usually pale blue with delicate whitish arms, and may be seen growing on the rockweed or on shells or stones.

ANIMALS OF THE SAND AND MUD

From Cape Cod southward, the coast of New England is characterized by long stretches of sandy beach where the shore is exposed to the open sea, and, in sheltered places, by mud flats in the bays or in the lagoons behind the outer sand bars.

On the outer face of the bars, where the loose sand is shifted about by the waves and there is no mud mixed with it, shallow-water life is sparse, but, nevertheless, certain animals have become adapted to this strenuous existence.

One of the most interesting is the lady crab (*Ovalipes ocellatus*), a handsome creature with a light-yellow carapace, or shell, covered with purplish rosettelike markings (page 215). The last pair of legs has paddle-shaped terminal joints by means of which the crab is able to swim sidewise through the water with considerable speed. Then, settling down upon the sand, it will suddenly bury itself in it, using its paddles and working itself down backward, until only the stalked eyes are visible above the surface.

THE ELUSIVE RAZOR-SHELL CLAM

Here, also, the razor-shell clam (*Ensis americanus*), so-called from the long, narrow shells, reminding one of an old-fashioned razor, may be seen lying quietly upon the sea bottom. But if you approach, it suddenly pushes a powerful tapering foot from between the ends of its shell and inserts it into the sea bottom. Immediately the shell pops upright and shoots down into the loose sand until the clam is completely hidden. When alarmed, it will dig down faster than it can be pursued with a shovel.

The sand-collar snail (*Lunatia heros*) is one of its chief enemies. This is a mollusk with a rounded shell, about as big as one's fist, sometimes known as the "moon shell." When the creature is alarmed, an enormous body is packed away in this small space, but, if left alone, it will gradually push its immense foot out, fore and aft, and crawl rapidly over the sand, stalking its prey. As it moves, it pushes forward a huge apronlike fold of its foot, above which waves a pair of tapering tentacles having eye spots (page 226).

The egg case of this species is a long, curving, ribbonlike structure of gelatinous substance, which is pushed out from beneath one edge of the apron to form a collar or capelike band, beneath which thousands of transparent beadlike eggs adhere like a mosaic lining. This is shed and left behind on the sea bottom. Often it is cast up on the beach, the sand clinging to its sticky surface. When dry, it is extremely fragile, and, if picked up, crumbles in the fingers.

At the edge of the surf on outlying sandy beaches, especially when the tide is

 Painted by Else Bostelmann under direction Roy W. Miner

CRABS, SCAVENGERS OF THE SEA, ABOUND IN CRACKS AND POOLS

Engaged in a sparring match are GREEN CRABS (foreground) on the rocky coast of Maine. Unlike the ROCK CRAB (upper left), and the JONAH, crouching in a crevice at the right, the green variety is not edible. These two are the "hard-shells" of Boston and Newport markets. Young of the tall SEA POTATO, or "sea squirt" (left), swim about when first hatched like tadpoles. Below is a clump of IRISH MOSS, from which a table jelly is made. Pink-bearted HYDROIDS cluster in the right center.

 Painted by Else Bostelmann under direction Roy W. Miner

MYRIAD SEA PLANTS AND ANIMALS LIVE IN THIS POOL LEFT BY THE RECEDING TIDE

Under a ledge scores of DOG WHELKS feed on BLACK MUSSELS. From the former is produced a purple dye, once used by Indians; egg cases appear at the top. White shells of ROCK BARNACLES grow between and upon the mussels. A flat, oval LIMPET adheres to the ledge (upper right), while to the masses of ROCKWEED below MOSS ANIMALS cling. The fronds also are adorned with branching HYDROIDS and daisylike SEA ANEMONES. Climbing up the KNOTTED ROCKWEED (left) is a LESSER PERIWINKLE and above it is fluffy POMPON WEED. From behind comes a "buckie," or FURBELOWED WHELK, searching for HORSE MUSSELS beneath feathery PINK CORALLINE. The urn-shaped body is a SEA PEACH.

 Painted by Else Bostelmann under direction Roy W. Miner

SEA STARS, LIKE SKY STARS, VARY IN SIZE AND BRILLIANCY IN THE GULF OF MAINE

Most conspicuous is the red and white SUNBURST STAR with arms "radiating." Beyond it is a common SUN STAR with 10 arms. The red PHRYGIAN SEA STAR (lower left) has short, stumpy arms. This and the brown CRISP SEA STAR (left center) are usually found in water of 10 fathoms or more. Most abundant are the COMMON STARFISH and FORBES'S SEA STAR, several of which, varying in color, sprawl to the left. On kelp fronds waving above crawl two small RED STARS. SEA CHRYSANTHEMUMS display petal-like tentacles on the mound (right). Just below are two WHITE-ARMED ANEMONES. Slender arms squirming, a BRITTLE STAR (lower right) crawls to shelter. GREEN SEA URCHINS in the foreground.

Painted by Else Bostelmann under direction Roy W. Miner

SWIMMERS AND BURROWERS LIVE IN SANDY MUD FLATS SOUTH OF CAPE COD

Two pink BEAKTHROWERS, disturbed by a fat, bluish CLAMWORM, dart spiral fashion to safety. One sticks out its club-shaped "tongue" at the intruder. Behind them a FAN WORM suddenly spreads its delicate plumes like a peacock's tail. Peering from chimneys, RED-PLUMED WORMS (center) with lancelike feelers resemble medieval knights. A brown SCALE WORM crawls over rockweed fronds. Just beneath is an ORNATE WORM. Gay-hued SEA WORMS on a pebble in front of the eel grass are magnified in the opposite plate.

Painted by Else Bostelmann under direction Roy W. Miner

UNDER A MAGNIFYING GLASS, A SEA WORM METROPOLIS RISES ON A TINY PEBBLE

Petal-like breathing organs give the SEA DIANTHUS (foreground) the appearance of a spreading flower head. Each plume has tiny eyes so sensitive to light that, when a shadow passes, the "flower" pops into the tube. Crowned with golden "piano keys," SAND BUILDERS (upper and lower left) carefully wall themselves in with sand grains. Grayish tentacles protruding like "whiskers" are covered with a sticky substance that catches bits of food. Shells of thousands of BRYOZOA, or MOSS ANIMALS, and HYDROIDS blanket the background. SWALLOW-TAIL PROTOZOA extend Y-shaped lappets (lower right).

 Painted by Else Bostelmann under direction Roy W. Miner

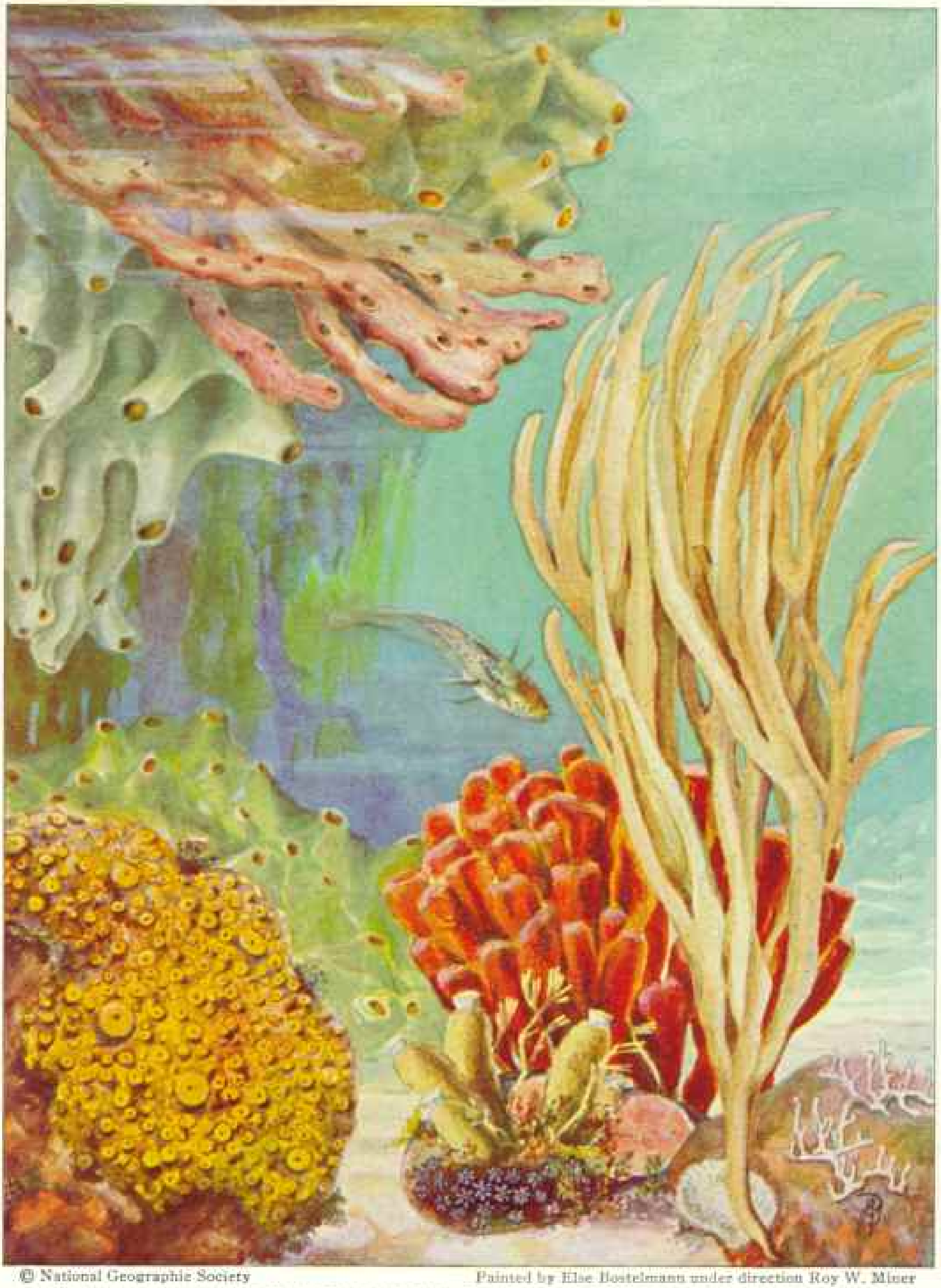
PUT ON A HELMET, GO DOWN AND MARVEL AT THE LIFE ON AN OLD WHARF PILE!

These colorful creatures pump in water, from which they extract food. Yellow SEA GRAPES (top) are related to the backboned animals. A colony of SNOWY TUNICATES is the white patch below, and the rosy mounds (right) are SEA PORK. Near the bottom are large yellow, transparent SEA VASES with long, extended siphons. To seaweed cling green SEA BEADS. Left, working downward, are clusters of HORSE MUSSELS, pink-hearted HYDROIDS, REDBEARD SPONGES, and the SEA DIANTHUS worm (Plate V). In contrast to these stationary creatures are shown SEA ANEMONES, that move slowly, a purple SEA STAR, which crawls, a JELLYFISH, which drifts aimlessly, and the SQUID and CUNNER, which dart swiftly.

Painted by Else Bostelmann under direction Roy W. Moore

LIKE KNIGHTS OF OLD, LOBSTERS, HEAVILY ARMORED, LOVE A FIGHT

The AMERICAN LOBSTER ranges from Nova Scotia to Long Island. Usually one claw is heavier than the other and equipped with knobs for crushing (upper right). The cutting claw has a sharper edge with small teeth. Eyes are mounted on stalks and may be turned in any direction. The first two of its four pairs of walking legs bear small pincers. Underneath the body, forward, are the gills, and, farther back, the tiny, oarlike swimmerets. Most powerful organ is its jointed tail, which, when bent suddenly forward, shoots the lobster backward. When a female carries eggs on her swimmerets, she is "in berry" and illegal for capture. Slender feelers give lobsters a keen sense of smell.



 Painted by Else Bostelmann under direction Roy W. Miner

TROPICAL SPONGES OF BATHROOM USE HAVE RELATIVES IN NORTHERN WATERS

But they have no commercial value. Through pores water is sucked in and food filtered out. Waste water is then ejected through a chimneylike opening, the osculum. Most sponges are made up of many individuals welded together. Common in New England tidal pools is the CRUMB-OF-BREAD SPONGE (upper background). Near it is a pink RED FINGER SPONGE. Waving weirdly below is a pale DEAD-MAN'S-FINGERS SPONGE. Brilliant REDBEARDS frequent the shallows, and yellow SULPHURS (left) cling to stones. Tube-shaped sponges grow on dead mussels (foreground).

coming in, one may often see hundreds of little oval shrimplike creatures, the mole shrimps, or "sand bugs" (*Hippa talpoida*). These peculiar little animals burrow in the loose sand, but are often washed out by the incoming tides, whereupon they immediately dig in again. Sometimes, after heavy storms, they will be found in windrows at the edge of the surf. They have yellowish shells tinged with purple (p. 214).

In the more sheltered bays and harbors in southern New England, the bottoms consist of sand mixed with mud in various proportions. The mud not only gives a more solid bottom to the mixture, but, being derived from silt washed from the land, contains much decaying food material.

In such localities, therefore, a prolific animal and plant population may be supported. Here we find a remarkable concentration of life, not only upon its surface, but also burrowing within the sea bottom itself.

Marine worms are particularly abundant, both in actual numbers and in variety of species. Every square foot of soil is filled with them, as anyone can see by digging with a shovel near the low-tide mark, both above and below the water level.

MARINE WORMS ARE SEA JEWELS

The marine worms include some of the most beautiful and interesting of all sea creatures; so much so that Linnaeus and his successors drew upon Greek mythology for their scientific names, calling them after goddesses and nymphs. Such names as Aphrodite, Clymene, Amphitrite, and Lycidice, were used for their genera, while their specific names are reminiscent of flowers, brilliant colors, and grotesque ornaments (Plate IV).

The clamworm (*Nereis virens*) digs through the sea bottom in search of soft-bodied creatures which it may tear to pieces with its sharp, pincerlike jaws. Ordinarily these are located in its throat, lying within a sac. When in use, this sac is turned inside out, being thrust out and inflated to form a proboscis with the biting jaws at the end.

At times the worm glides out into the open water, swimming with rapid undulations, the waves of which pass quickly from head to tail. The long, tapering body is clad in a many-jointed armor, gleaming with rainbow colors, and is aided in its progress by myriads of oarlike, paired appendages of bright-orange hue, glistening with golden bristles, which sweep the water on both sides in ordered succession.

What appears at first sight to be chance accumulations of shell fragments and bits of dead seaweed resolves itself into tiny chimneys extending from the sandy mud. As we watch, a cluster of tapering, lancelike tentacles is thrust from the opening and spread out symmetrically, followed by a head and shoulders clad in steely-blue plate mail and adorned with waving blood-red plumes. This is the plumed worm (*Diopatra cuprea*).

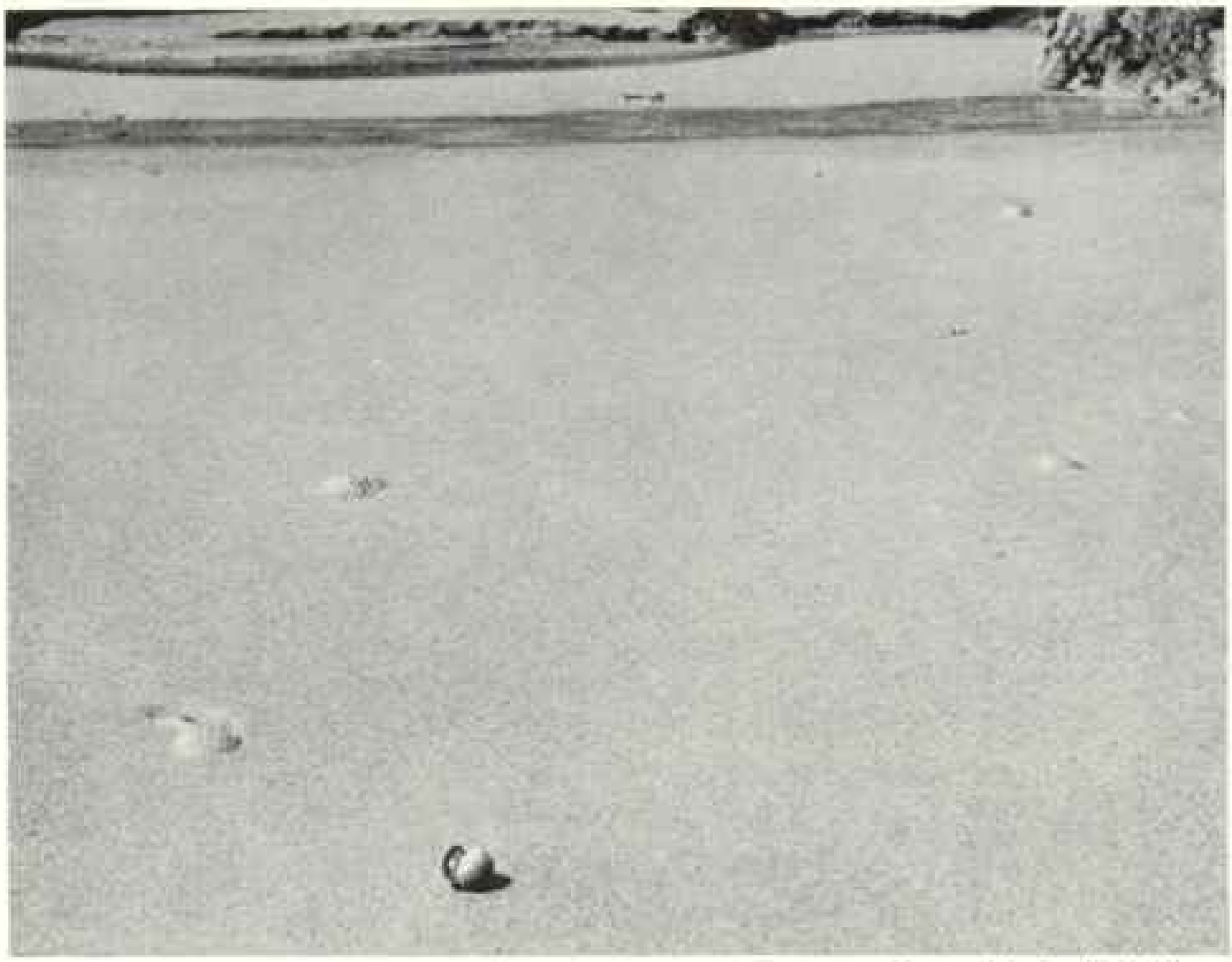
Near by, a cluster of rockweed floats out from the edge of a bowlder half buried in the sand. One of its olive-brown fronds seems to come to life. On closer inspection we find that this is an illusion, for a curious little creature about an inch in length is crawling along the seaweed. Its mottled body blends with the color of the *Fucus* so closely that it is betrayed only by its motion. Its back is covered with a double series of delicately wrought, overlapping scales, while small bunches of golden bristles extend from the sides. This is the scale worm (*Polynoë squamata*).

Beneath the edge of the overhanging rock a wonderful sight now bursts into view. From the mouth of a little mud-colored, leathery tube, two or three delicate, threadlike filaments feel their way out into the water in speculative fashion. Soon others pour out by the score, extending in all directions, undulating in sinuous curves.

Just as we are wondering if the tube is entirely filled with these living threads, they are seen to be merely the fringe of a flesh-colored funnel, the expanding edge of which follows them out of the tube.

Now a rosy-purple, shield-shaped structure erects itself in the midst of the filaments, reminding one of a flower petal. This is followed by three pairs of treelike scarlet plumes, their complex spiral stems surrounded by tufts of branchlets which extend and contract, pulsating rhythmically. A segmented body begins to disclose itself, and we recognize one of the most gorgeous of sea creatures, the ornate worm *Amphitrite ornata*.

A little to the right, at the edge of a tuft of eel grass, a miniature ledge projects from the sand of the sea bottom. Its top is almost completely concealed by an irregular mass of coiled, limy tubes, each with a round opening not more than an



Photograph by Roy Waldo Miner

LIKE A LONE DESERT TRAVELER SEEMS THIS SAND-COLLAR SNAIL ON A BEACH

About the size of a man's fist, the rounded shell contains an enormous body. It feeds upon other mollusks, especially quahogs, the shells of which it pierces with neat holes about a quarter of an inch in diameter (page 216). Its burrows appear behind the snail.

eighth of an inch in diameter (Color Plates IV and V).

These tubes in turn are blanketed with a reddish-brown crust, engraved with fine markings like the engine turnings of a gold watch case. The ends of the limy tubes protrude through this in all directions.

Suddenly, as we watch, a beautiful little flowerlike head emerges from a tube opening and unfolds a circlet of delicate, fern-shaped plumes. Brilliantly banded with purple, brown, and white, these expand on all sides.

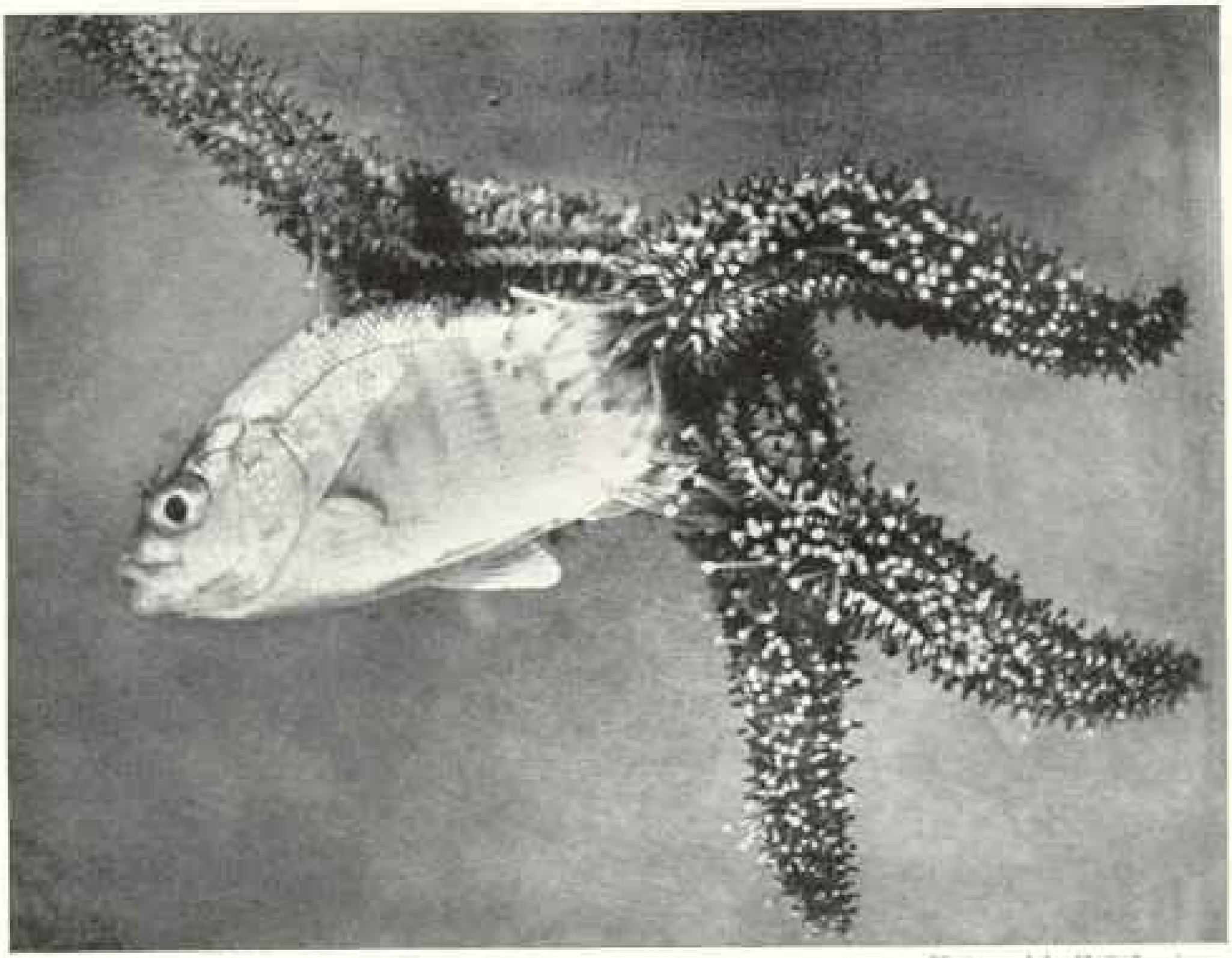
Heads now appear from tube after tube, until the whole surface of the ledge blossoms with animal flowers in every shade of gorgeous color. Some are bright yellow. Others are blue-gray, banded with pink. Still others are patriotically adorned with red, white, and blue stripes.

As the "petals" become fully extended, we see that they are arranged in two fan-like halves. On closer inspection, we perceive a smooth, flexible rod extending from the edge at the end of one row of the plume-like organs. At its free end, it bears a lily-shaped structure with radiating spine tips.

Accidentally, we pass a hand between the ledge and the light, thus casting a shadow over the pulsating garden. Within the twinkling of an eye, every circlet closes and pops back into its tube, the lilylike organ being pulled in last. As it reaches the circular doorway, this structure opens like an umbrella, effectively closing the tube. It functions as a cover.

These colorful animal flowers are really sea worms, the sea dianthus (*Hydroides dianthus*). It is obvious that their fragile beauty is far removed from the unesthetic ugliness of their relative, the earthworm.

But we have not fully appreciated the possibilities of our rock fragment. Let us carefully remove it, encrustations and all, from its submarine bed and submerge it in a dish of sea water. The whole specimen is



Photograph by H. S. Jennings

WOE BETIDE THIS "POOR FISH," CAUGHT IN THE MAW OF A SEA STAR

Struggle though the butterfish may, it cannot dislodge the hundreds of tiny feet equipped with suckers. The starfish will gradually digest its living meal, tail first. Butterfishes sometimes hide beneath jellyfish "umbrellas" to escape their enemies (page 228).

no larger than the palm of our hand. Now place it under a low-power microscope in a good light (Plate V).

A SEA WORM COMMUNITY MAGNIFIED

Let it remain undisturbed for a while, and soon the entire colony of *Hydroides* expands. The plumelike breathing organs, for such is their function, are more clearly seen and their subdivisions show delicate color patterns not before visible.

One of their most interesting features is now prominently displayed. A series of little gleaming lenses forms a row along the main stem of each plume. These are actually eyes which focus the rays of light upon a pigmented surface. Thus we have the secret of their sudden withdrawal when a shadow passes over them.

Let us now look at the reddish-brown crust covering the worm tubes. To our amazement it has become a veritable city of living creatures! The minute markings, when magnified, are resolved into thousands of recumbent vases, set close together, each with a tiny circular opening near one end, equipped with a trapdoor.

As we watch, the trapdoors here and there pop open. Out slip little cylindrical bundles which open up as lily-shaped circlets of transparent golden tentacles surrounding a central mouth. The delicate creature to which they belong lies within the urnlike home, attached to it by a pair of minute muscles. When it is disturbed, these contract, and the animal pops back into its shell.

There are many different species of such little animal communities, growing in matlike encrustations over stones, seaweeds, and dead shells. When fully expanded, they have a fluffy appearance like fine moss, and are therefore known as moss animals, or sea mats, or, scientifically, the Bryozoa. The particular species in our miniature community is the unicorn bryozoan (*Schizoporella unicornis*), so-called from a single minute spine in front of the shell opening.

We must not leave our Lilliputian city on the rock without meeting that redoubtable mason, the sand-building worm (*Sabellaria vulgaris*), which builds a tube of carefully selected sand grains to dwell in (Plate V).

This strange animal is equipped with bunches of gray, hairlike tentacles with which it explores its neighborhood for food particles. These adhere to the tentacles and are transferred to a remarkable series of shining golden plates set close together on either side in two semicircular rows. They move successively like piano keys and manipulate the food material into the mouth cavity in front, where it is sorted by a sensitive conical appendage, or "tongue," the acceptable particles being swallowed and the rest rejected.

ANIMALS OF THE WHARF PILES

Now we leave the sandy flats and, skirting the coast, find our progress interrupted by an old abandoned wharf with rotting piles and sagging timbers.

We borrow a rowboat and scull out along the side of the ancient structure until we come to a gap where a pile is missing. Carefully we push our boat in under the wharf, and, placing a waterglass in position over the gunwale, look down through it along the side of one of the piles (Plate VI).

Below the surface, a marvelous sight bursts upon the view. The whole pile is a gorgeous sea garden, completely covered with gayly colored and luxuriant growths as far down as our vision can penetrate through the dusk of the green sea water.

Huge masses of sea grapes (*Molgula manhattensis*) float in heavy clusters just below the surface. These are ascidians of rounded form, about the size of a hothouse grape, yellow in color, and each one equipped with a pair of protruding siphons.

Below them, sea anemones, brown, white, pink, and yellow, expand their fringed disks among colonies of dead barnacle shells overgrown by a green encrusting sponge. Clusters of horse mussels (*Modiola modiola*), coated with red moss animals, peep out above the fluffy growths of fairy-like, pink-hearted hydroids (*Tubularia crocea*).

Patches of the snowy tunicate (*Leptoclinum albidum*) show conspicuously white among its brightly colored associates. Rounded domes of the pink sea pork (*Amaroucium pellucidum*) cluster thickly in magnificent rosy luxuriance. Sea stars (*Asterias vulgaris*) creep slowly over their neighbors in search of luscious mussels.

Pale-yellow sea vases (*Ciona intestinalis*) show their highly colored orange and scarlet internal structure through their translucent walls, and even our old friends, the sea dianthus (*Hydroides dianthus*), are not missing, for large areas of the wharf pile are blossoming with their multicolored gill circlets.

All these creatures anchor themselves where the tidal currents rhythmically bring a wealth of microscopic animals and plants. All are equipped with internal contrivances to filter out this flood of nutritive material.

In contrast to this stationary habit, other organisms, belonging to the same range of animal subkingdoms, float or swim through the neighboring water. The red-rayed jellyfish (*Dactylometra quinquecirrha*) glides gracefully by, aimlessly contracting and expanding its umbrella disk as it drifts with the currents. Its sting cells give it the power to kill for food many small invertebrates and even young fishes of moderate size.

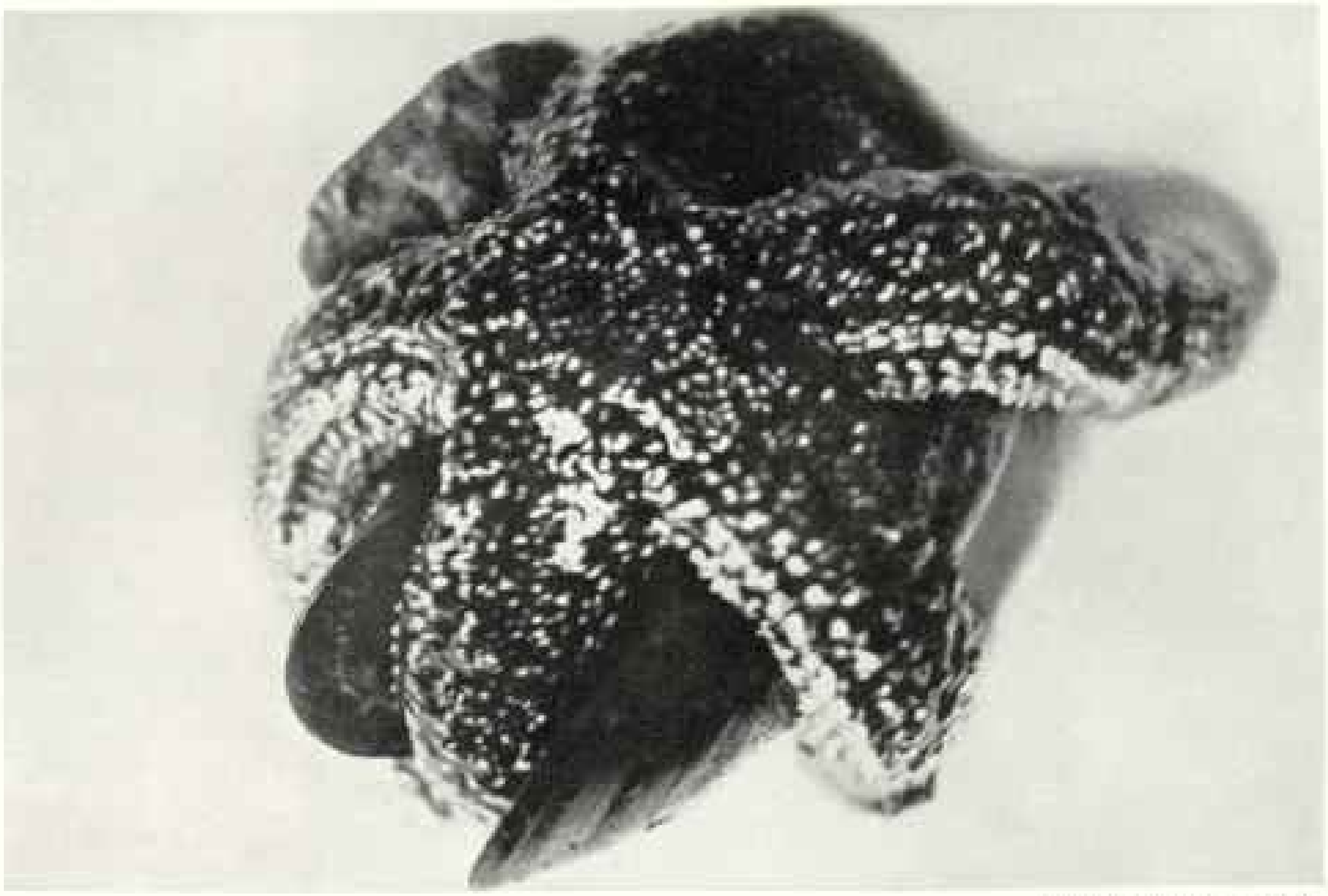
Larger fishes usually keep away, for it can sting their mouths painfully. Yet, strange to relate, half-grown butterfishes (*Poronotus triacanthus*) will take refuge beneath its umbrella and even nibble at its ruffled tentacles and steal copepods and other small food animals from the corners of its mouth.

The butterfishes are protected from their larger enemies and usually are unharmed by the jellyfish, probably because of the thick coating of slippery mucus which covers them and gives them their common name. Now and then, however, a butterfish will fall prey to its protector, but without affecting the persistence of the rest in remaining associated with it.

A squid (*Loligo pealii*) darts past, easily avoiding the sting cells of the jellyfish, for, if taken unawares, it is likely to wind up in the maw of that gracefully casual swimmer.

CREATURES OF THE BAY BOTTOM

Now let us, figuratively, don diving helmets and explore the bottom of the bay. Here huge granite bowlders are imbedded in the sandy mud. Yonder an outcropping ledge, overgrown with seaweed, looms toward the surface with, perhaps, a remnant of a wreck lodged upon its summit.



Photograph by I. A. Field

A STARFISH DEVOURS A MUSSEL BY INSERTING ITS STOMACH WITHIN THE VICTIM'S SHELL

Creeping upon a clump of mussels, the sea star spreads its arms over a tightly closed bivalve. These tentacles, each equipped with hundreds of suckers, pull steadily in opposite directions, gradually opening it. When the victim gapes to aerate its gills, the starfish literally turns its stomach inside out and pushes it in between the shells. Juices pour out, and the mussel is digested within its own home! Starfish destroy countless oysters in a similar way (page 231).

At intervals the weird shapes of king crabs (*Limulus polyphemus*) may be seen investigating the siphons of clams which protrude from the bay bottom, but what immediately draws our attention is the grotesque forms that are industriously at work furrowing up the sandy sea floor with their huge claws and devouring the clams as they are unearthed. We have chanced to peer into a community of lobsters (Plate VII).

These are among the most remarkable of all the sea animals of the present day. Though they are familiar enough in the markets, it is very likely that one acquainted only with their lumbering awkwardness out of water would be greatly surprised at the ease with which they move about on the sea bottom.

HOW A LOBSTER STALKS A CRAB

Some of the lobsters are crouching in their dens under the rocks, where they seem to stand sentinel as if guarding their homes against marauders.

An unwary lady crab works its way out of its burrow in the sand a short distance away. The lobster is all alert and immediately begins to stalk it, moving forward literally on tiptoe, just touching the sea floor with the ends of its walking legs.

Now it stops, poised, with the swimmerets under its tail beating in unison like banked oars. As the crab emerges further, their speed increases.

Too late the crab becomes aware of its enemy and leaps sidewise up into the water, waving its paddle-equipped hind legs frantically back and forth over its carapace.

The swimmerets of the lobster now beat the water at full speed. It darts upward and pounces upon its unhappy victim.

Grasping it and crushing it with its powerful claws, the lobster sinks down to the sea floor, and, pulling the fragile shell of the crab apart, feeds it into the "gastric mill" of its complex mouth.

Just as the meal is about to be finished, another huge lobster near by scents the re-

Photograph by Roy Waldo Miner

SUCH A "TANGLE" DRAGGED ACROSS OYSTER BEDS CAPTURES RAVAGING SEA STARS

Chains with bunches of cotton waste tied to the links are lowered to the oyster beds and dragged back and forth. In this way, at a single haul, hundreds of the invaders are entangled by their rough spines and brought to the surface. When used regularly, the apparatus makes noticeable inroads upon the starfish which at times do much damage to oyster beds (opposite page).

past and dives for his neighbor. The latter, alarmed, puts into action the most effective means of locomotion that he possesses: namely, the powerful tail. This fan-shaped organ is swept vigorously beneath his body, shooting him backward into his den with tremendous speed. Now he crouches at bay, but after a brief sparring match (Plate VII), the assailant withdraws, and retires to his own cavern situated a few feet away in the midst of a luxuriant growth of sponges.

Lobsters have strong proprietary instincts and will defend a chosen location against all comers. But they are also aggressive, often struggling to oust each other from their holdings.

SPONGES OF NORTHERN WATERS

Though none of the sponges of our northern seas is of commercial value, they are very diversified and occur abundantly everywhere, not only attached to ledges on the bay bottoms, but among the submerged rocks and bowlders right up to the water's edge and in the rock pools (Color Plate VIII).

The sulphur sponge (*Cliona sulphurea*) is a bright-yellow species that grows attached to stones, and is of frequent occurrence on dead shells, the limy substance of which it softens and absorbs. Hence it is also known as the "boring sponge."

One may often pick up on the beach dead whelk shells completely permeated with a network of fine canals made by the absorbing fibers of this sponge. Its surface is quite characteristic, being covered with small warts, or papillae.

The crumb-of-bread sponge (*Halichondria panicea*) grows commonly in tide pools and rocky crevices below the water line. It forms encrustations which often

rise as closely crowded conical chimneys, or long cylindrical tubes, where the growth is on a vertical or overhanging rock.

Its color shades from a soft gray-green to yellowish, and the chimneys are lined with bright orange. It is frequently associated with the eyed finger sponge (*Chalina oculata*), a lovely rosy-pink species growing in clusters of flat fingers conspicuously spotted with oval or circular openings, the oscula, scattered over its surface at intervals.

The dead-man's-fingers sponge (*Chalina arbuscula*) is a treelike growth about twelve to eighteen inches in height, light gray or yellowish white in color, made up of long, slender, tapering branches that wave to and fro with the currents. Fancied resemblance to pale spectral hands has given them their gruesome name. The branches are very soft and delicate.

Among the most interesting animal communities of the northern shallow waters are those centering around the oyster and mussel beds. The importance of the common oyster in our markets has made the investigation of the best conditions for growing it, as well as the study of its enemies, of great concern to fisheries experts.

THE OYSTER'S DEADLY ENEMIES

The most destructive of the enemies are the common sea stars belonging to the two species, *Asterias vulgaris* and *forbesi*.

Oysters grow on sandy mud flats on a "cultch" formed by the dead shells of other generations of oysters, or on a rocky or shelly bottom. Slightly opening their shells, they allow a current of water to be passed over the gills to filter out their microscopic food, which consists mostly of diatoms.

Sea stars often invade these beds in great numbers, and, at their approach, the oysters close their shells tightly. The raiders, undismayed, proceed to mount their victims, and, bracing the tips of their arms on surrounding material, take a firm hold on the two shells of the oyster with their countless tube feet and pull steadily in opposite directions (page 229).

Soon the single powerful muscle of the oyster, which keeps the shell closed, begins to weary and yields to the pull.

Then a strange thing happens. The sea star turns its sac-shaped stomach inside out through its mouth, inserts it between the shells of the oyster, pours out digestive fluids, and digests the oyster in its own shell!

The inverted stomach then absorbs the fluid products of digestion through its stomach walls; the sea star withdraws that organ, and, leaving the shells of its victim completely cleaned out, proceeds systematically to the next.

An army of sea stars thus can commit great ravages in a short time.

The oyster drill (*Urosalpinx cinerea*), another important enemy, infests the beds in great numbers. It is a little sea snail with a wavy, spired shell, which bores neat pinholes through the oystershell and sucks out the soft parts. The next time you pick up a dead oystershell from the beach, look and see if it is not perforated by many of these holes.

RELENTLESS STRUGGLE FOR SURVIVAL

The most dramatic phase of the struggle for existence is the slow, relentless, soulless battle that takes place through overcrowding. This is especially well exemplified in the vast mussel beds exposed at low tide on many southern New England sand and mud flats.

At Menemsha Bight on Martha's Vineyard, millions of these black edible mussels (*Mytilus edulis*), literally covering acres, are visible in crowded array. Examining those near by, one may see that the best situated individuals are growing over and crowding down those that chance to be less advantageously placed, until the unlucky ones can no longer open their shells and are smothered. Young individuals, in turn, settle down on the shells of their parents and submerge them completely.

The rapid growth of a mussel colony also causes its margins to overspread and contest the territory of other creatures.

At Cold Spring Harbor, Long Island, an oyster bed was growing in shallow water and was uncovered at low tide. Near by there was a vigorous colony of mussels. Soon this species, being of more rapid growth than the oysters, invaded the latter and completely exterminated them.

But swift justice overtook the conquerors. A colony of rock barnacles (*Balanus balanoides*) occupied a neighboring bowlder-strewn point, and, struggling with the problem of overpopulation, like certain nations of mankind, gradually spread onto the mussel bed and soon completely smothered it!

WHERE BIRDS AND LITTLE ANIMALS FIND HAVEN

By Agnes Akin Atkinson

With Illustrations from Photographs by Spencer R. Atkinson

FROM the most distant places, even from India and Australia, come many visitors to Eaton Canyon Bird and Game Sanctuary to see the birds and little animals which live safeguarded in this refuge near Pasadena, California.

The creatures here first became widely known through an article, "Befriending Nature's Children," which I wrote for the National Geographic Magazine of February, 1932. I described the success which Dr. Atkinson and I had had in winning the confidence of our little wild neighbors and in photographing them.

Now the arroyo is a 200-acre haven where all things wild—trees, flowers, and even rocks—are preserved in their natural state.

The city of Pasadena, petitioned by schools, service clubs, and civic organizations whose interest had been aroused by the article for The Geographic, established this retreat, modeled after State and national parks; and one must hope that many such municipal parks may be created throughout the country, safety zones where the small wild life will learn that it can find care and protection.

MOUNT WILSON TOWERS NEAR BY

The arroyo lies on the floor of Eaton Canyon at the foot of Mount Wilson. Wide and beautiful, it is filled with sycamores, live oaks, greasewood, sage, broom, mountain-holly, and other varieties of native growth. Along the bottom is a dry stream bed over which in our brief rainy season an abundance of water tumbles down from the narrow mountain gorge far above. This arroyo, or canyon, with its widely spreading oaks, brings seclusion and solitude close to civilization.

Soon after our first Geographic article appeared, strangers from New York, Canada, Australia, India, and elsewhere, wishing to become friends of our woodland family, began to arrive at our home on the edge of the arroyo. Letters from all parts of the United States and from many foreign countries filled our mail box.

More than four years have gone by since we first described our hobby, but letters continue to arrive. People still come to our living room and watch with us these animals that have grown so accustomed to us that they no longer object to the lights burning inside the house. We darken the living room now only so that we can see better what is going on outside.

VARIED QUESTIONS ARE ASKED

Strangers ask at our front door if this is the place where wild animals come to dine, if the canyon below us is where the nature park was built. One man inquired whether down in the arroyo we had any lions and bears!

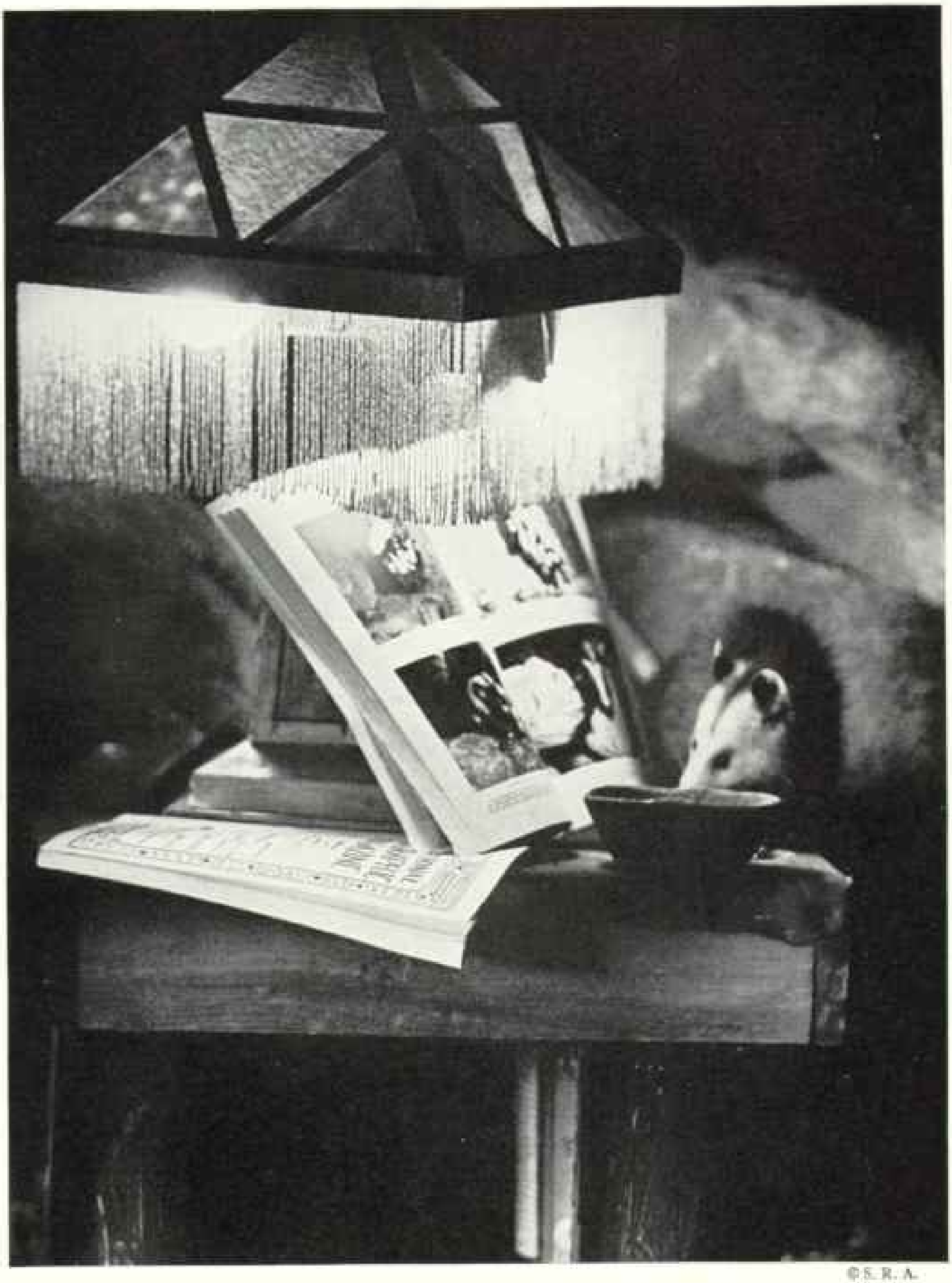
From my study, overlooking this peaceful spot, I can catch glimpses of trails which wind in and out around the rocks and the oaks. An attractive rock bridge spans a small, narrow canyon that joins the arroyo on the east side. Graceful rock steps lead a short distance up the mountain side to a secluded grove of live oaks. Not far away I sometimes see wild deer stop their grazing and look cautiously toward anyone who trespasses on their favorite stamping ground.

From the scenic Foothill Boulevard which adjoins the canyon's edge a few hundred feet beyond our home, a wide, easy trail has been made down into the arroyo. Near the foot of this trail an observatory house—not astronomical, as is the famous observatory above it on the top of Mount Wilson—has been constructed of rocks gathered from the arroyo.

ZOO REVERSED: HUMANS INSIDE, ANIMALS OUT

In one side of this house, facing Mount Wilson, are three large plate-glass windows, through which visitors behold the small wild animals as they come at night to get food which a caretaker places outside on a large flat rock (page 238).

During the day, through these windows one may observe the many varieties of birds which come from all parts of the



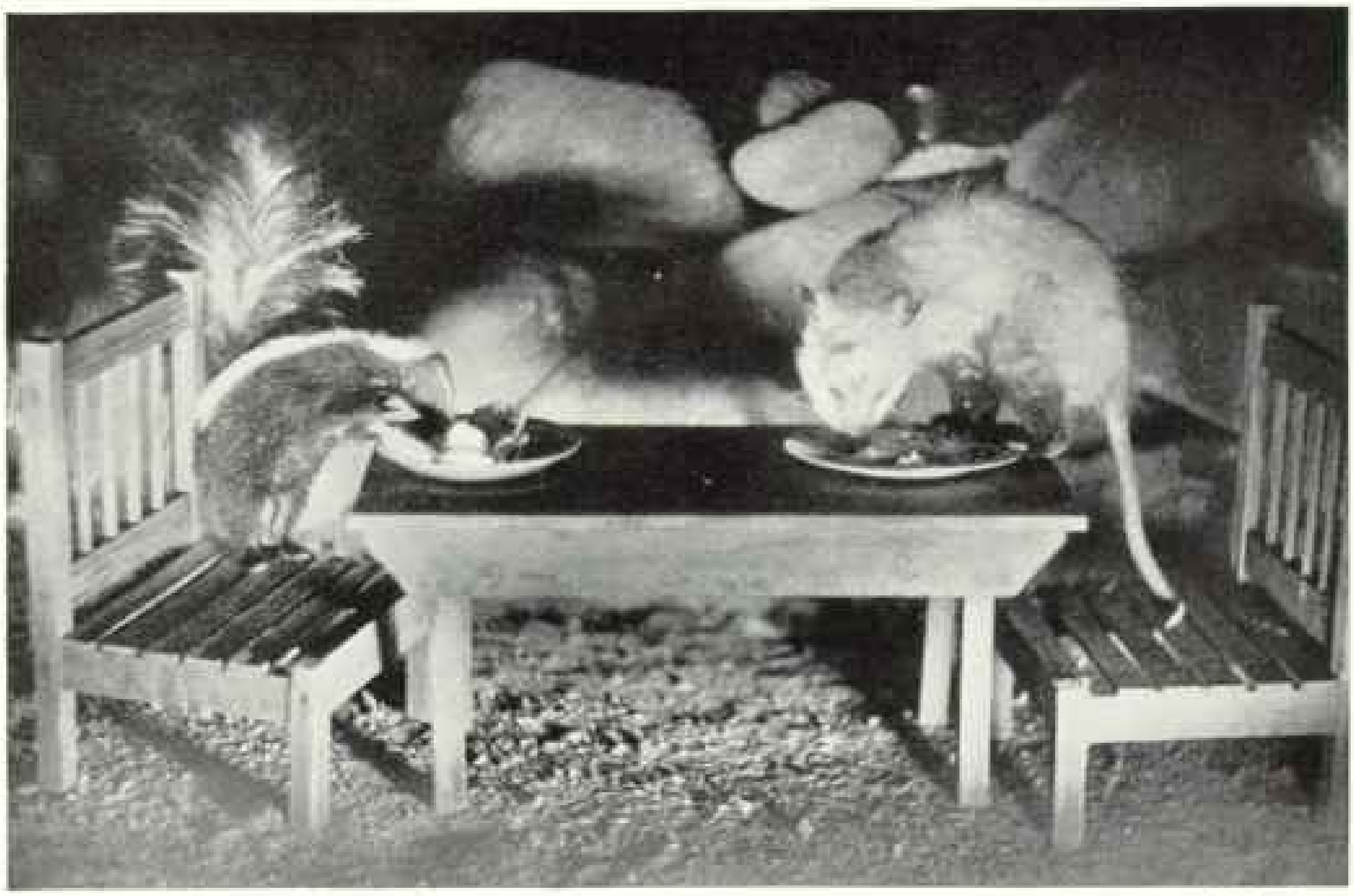
©S. R. A.

BABY OPOSSUM NIBBLES BACON WHILE SITTING FOR A PORTRAIT

This supper guest pays scant attention to pictures of skunks in a copy of the February, 1932, issue of the NATIONAL GEOGRAPHIC MAGAZINE. Before Eaton Canyon Bird and Game Sanctuary was established by the city of Pasadena, California, trappers were active with their steel devices. A mother fox came to the author's animal dining table with two feet cut off; a ring-tailed cat appeared with a lost leg; and several possums had broken and missing feet. Dr. Atkinson took photographs of these injured animals and showed them on the screen to schools and service clubs, thus aiding in the establishment of the municipal park. City officials of Pasadena met one evening in the living room of the Atkinson home and watched the little animals as they came out of the night into the light to feed (p. 238). Later they made the area a sanctuary.

FEAR HALTS A YOUNG RING-TAILED CAT BOUND FOR A BANANA BAIT

A skunk, whose back and tail show in the picture, may or may not be friendly! The cat's family recently moved from the Atkinsons' garage to more comfortable quarters in the house attic.



© N. R. A.

MIXED COMPANY AT THE CANYON CAFETERIA

A skunk and a possum were the first animals of different species to eat peaceably together. Table and chairs have short legs for small guests' convenience.

CALIFORNIA QUAIL SUN THEMSELVES BEFORE DINNER

If they find no cracked grain near the animal table at mealtime, these topknotted guests call and fuss like hungry children. The leader, right, wears an aluminum identification band.

© S. R. A.

WHILE BEING "REFUELED," BABY BROWN TOWHEE TAKES A CHAIR

The mother simply turns her head and body to select food for the robust offspring. These birds feed their young till the latter are practically full-grown.

A GRAY FOX THAT KNOWS NO "STRUGGLE FOR EXISTENCE"

With four brothers and sisters, it was born on the steep slope of Eaton Canyon, where human bounty provides food. Just now a fluttering bird arrests its attention.

© S. R. A.

MAMMA RACCOON INTRODUCES HER CHILDREN TO HUMAN FRIENDS

"Each year," says the author, "she brings a fine new family for our approval. We sit in the living room and feed them bananas and grapes through the window."

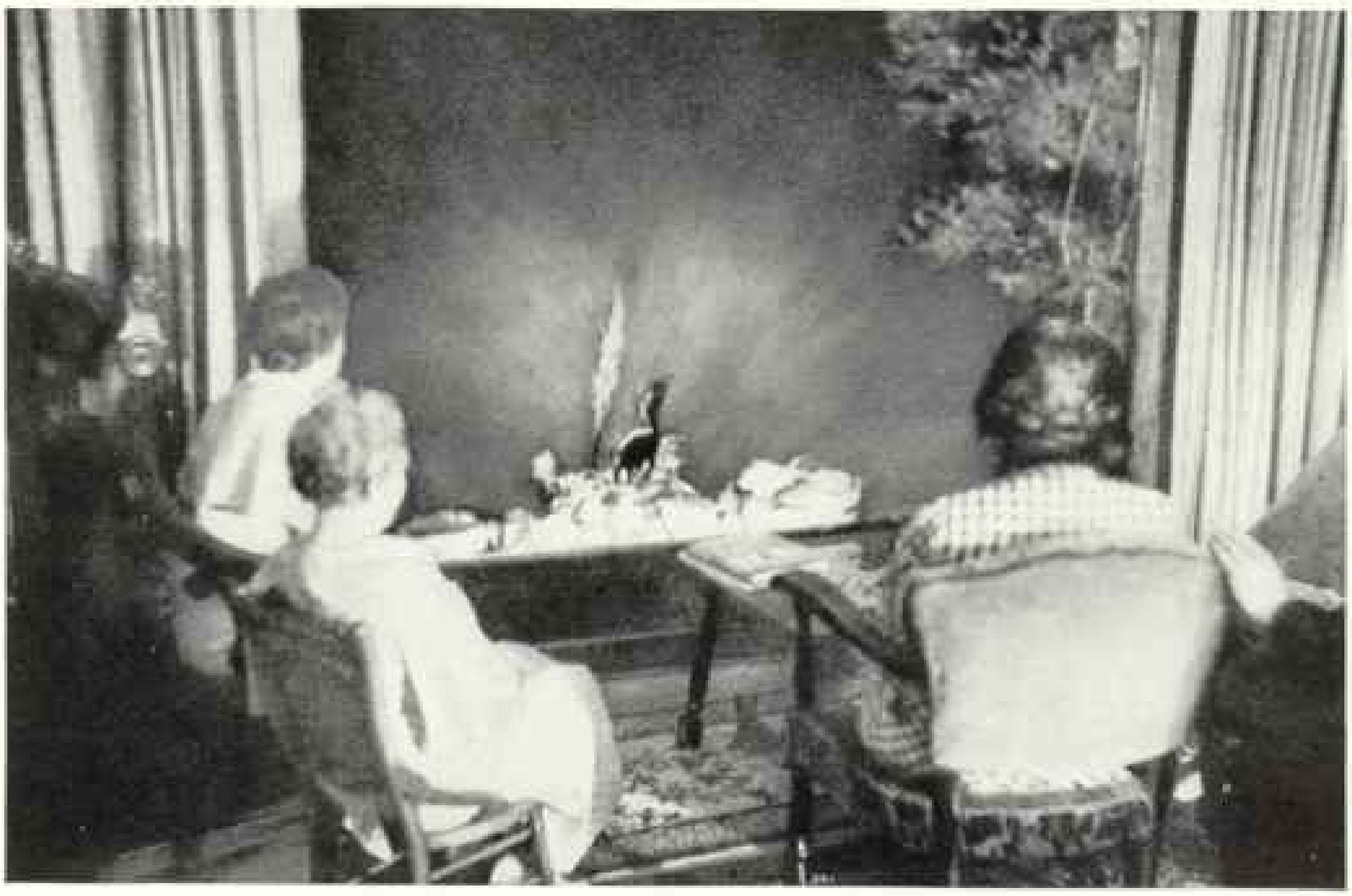
A HAND-OUT SMELLS LIKE FOOD—

Tail upraised, indicating vigilance, a half-grown skunk pauses three feet from an enticing hand. A polecat's hearing and sight are poor, but its keen nose can be trusted.

© S. R. A.

IT IS FOOD!

Meat canned for dogs is a treat for the Canyon skunks. They eat it from hand or pan. The white stripes of this young fellow's fur suggest suspenders.



LOOKING OUT THROUGH THE VIEWING WINDOW

Mrs. Atkinson (left) and friends watch a big skunk at dinner atop the rock feeding wall. Flash bulbs inside and outside the living room gave light for the photograph.

© N. R. A.

LIKE A PUPPY, THIS FRIENDLY SKUNK BEGS FOR BITS OF MEAT

Having nosed ankles to find its mistress, it dines in this fashion or sits up on hind legs and eats chopped bacon from a silver spoon.

FOXES AT LAST DINE WITH A SKUNK

For a long time, the two youngsters were afraid and took their meals alone. Now that the ice is broken, they grow quite accustomed to strange dinner partners. The tin plates are nailed to the table.

© S. R. A.

GOOD TABLE MANNERS DO NOT COME EASILY AT FIRST!

After a few meals, most of the animals learn to sit comfortably or stand on the chairs, forepaws on the table's edge. These gray foxes soon learned the proper etiquette.

© S. R. A.

TAILS FLY HIGH WHEN ANGER FLARES

And what squealing and squirming, what biting and shoving! Yet when these two settled down to eat, they found food enough for both. Skunks seldom fight among themselves except in the mating season; then they go for each other tooth and claw, but without ejecting any scent. If captured young, these animals become as tame and playful as kittens, and the author found them vastly more intelligent and interesting.

arroyo to get food and water from protected feeding stands and bird baths.

No automobiles are allowed in the sanctuary, but adequate parking space has been allotted at the top of the trail. Dogs and cats are barred.

We shall always remember that first night in June, eight years ago, spent in our new home. Weary from moving, we turned out all the lights in the house and quietly sat in the darkened living room behind a big plate-glass window which faced the canyon and gave us an uninterrupted view of Mount Wilson beyond and of the arroyo below.

The full moon cast soft shadows among the friendly shrubbery and rocks. Some of these shadows soon became moving objects. They were the dim forms of two wild gray foxes and a large raccoon stealthily walking about the yard near the big window.

FOOD SCRAPS LEAD TO FRIENDSHIP

The second night, in the hope of making these older inhabitants of the arroyo understand that we were their friends, we placed some table scraps on a large flat stone which extended out from the rock wall.

Night after night, ring-tailed cats, gray foxes, opossums, raccoons, and others climbed the trail to the feeding rock and tested the food. Through the ensuing years these creatures have learned to be friends not only with us, but with one another.

Increasing numbers of these midnight track-makers accept our hospitality. We find ourselves running what one might call an animal cafeteria.

Year by year we watch the strange performances of these fourfoots as they come and eat food from the rock and walk contentedly about our yard. We invite our friends and neighbors to sit with us in darkness behind the big window and witness the unusual and fascinating behavior of the trustful little prowlers that enter the brightness of our outside electric floodlight without the slightest evidence of fear (page 238).

ANIMALS TAUGHT TO USE TABLES AND CHAIRS

This thought came to us: Could we train these animals, without disturbing their liberty, if we made things we wished them to do attractive and desirable?

As an experiment, we fastened a narrow table on top of the rock wall just above the feeding rock. The table was high enough to compel small animals, such as skunks, to exert themselves to reach the top. For their greater convenience, we placed a low chair, without arms, at each end. On the table in front of each chair we nailed a small tin plate and filled it with tidbits of bread, meat, and fruit (pages 234, 235, and 239).

Since there was scarcely room on top of the table for food and animals at the same time, it was easier for the guests to climb into a chair and to eat with their paws on the edge than to stand on top. They soon discovered and adopted this better "sitting" position. Lesson number one!

Next, by placing cakes, candies, and fruits on the inside edges of the tin plates, we induced our pupils to eat the "main course" before indulging in dessert. And that was the second lesson.

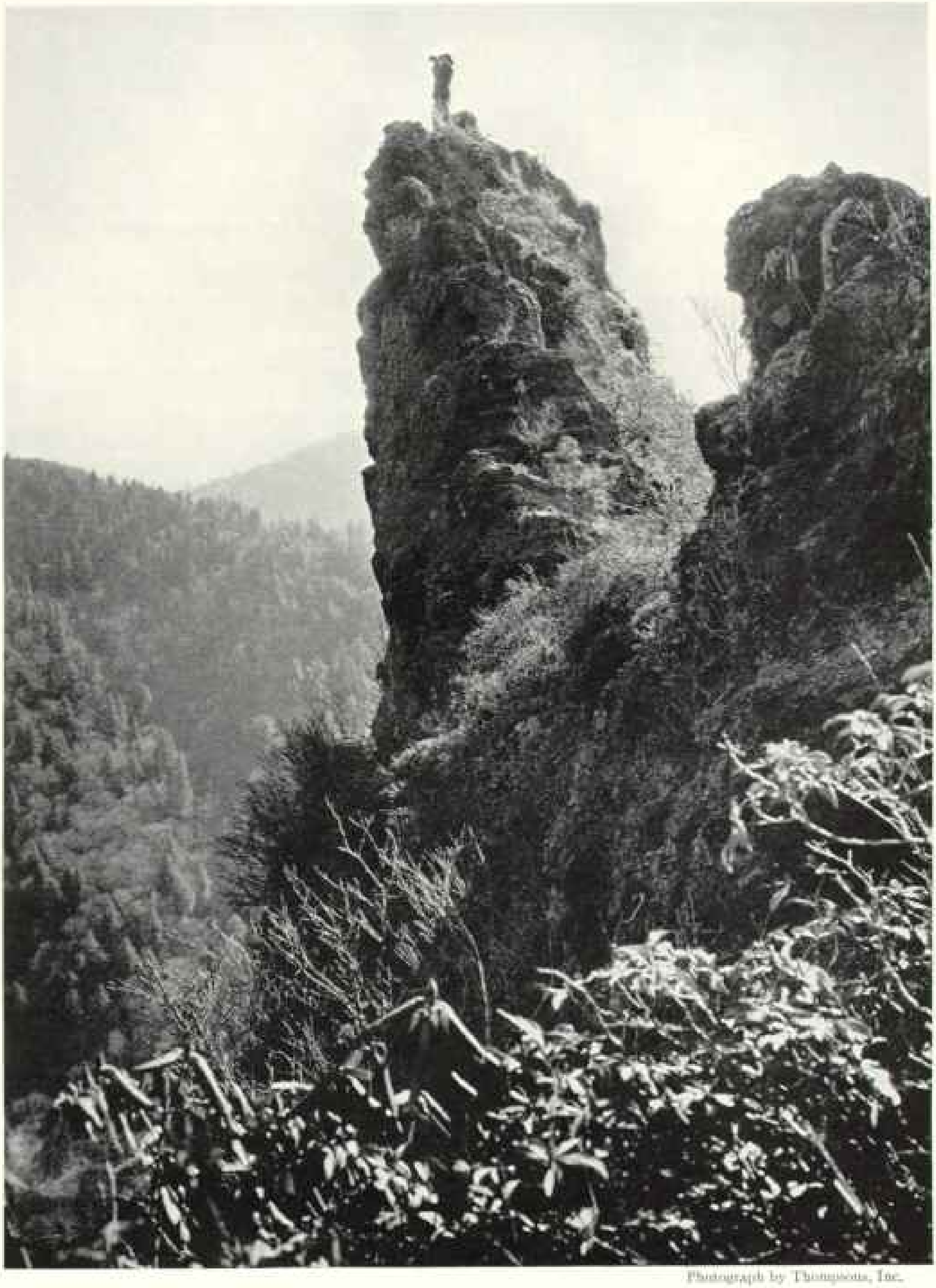
When we used only the flat rock for feeding, no two animals (excepting mothers and their young) would eat together, even with their own kind. After the table and chairs were installed, they gradually relaxed into sociability. General comradeship at the table was first instituted by an opossum and a skunk (page 234).

MOTHERS INTRODUCE THEIR BABIES

Spring and summer months bring to us new adventures. Night after night different mothers introduce their babies to our table. As the babies grow older, they take it for granted that our cafeteria is their natural source of food supply. And they do not always wait until it is dark to come to supper.

Some of the young ones, unafraid of my silent approach, eat from my hand, but baby foxes are an exception. Without much effort I taught one little skunk to sit up on his hind legs like a dog and eat chopped bacon, a skunk's delight, from a silver spoon (page 238).

As the number of young animals has increased, competition has sprung up among them. They vie with one another to see which can be first to arrive at table and get the choicest morsels. This rivalry is so keen that some of them actually wait on the wall as early as three o'clock in the afternoon, their eyes on the kitchen door not far away, an expectant expression on their faces.



Photograph by Thompsons, Inc.

PEREGRINE PEAK EMULATES THE LEANING TOWER OF PISA

Throughout the Great Smoky Mountains National Park there are old trails that test the stamina of even the hardy mountain folk to whose cabins they lead. A pair of duck hawks, the American form of the peregrine falcon, has nested on the overhanging side for many years, giving the pinnacle its name.

RAMBLING AROUND THE ROOF OF EASTERN AMERICA

By Leonard C. Roy

HAZE-SHROUDED, the Great Smoky Mountains dominate the horizon of eastern Tennessee.

"They look like clouds!" exclaimed my companion, who had traveled nearly the length of the Appalachians but had not seen this, the highest mountain mass in the eastern United States.

Visitors often are amazed to find such lofty, wild, and unspoiled mountains straddling the Tennessee-North Carolina State line (map, page 246).

In 1923, when public-spirited men and women of the two States organized to encompass soaring heights and plunging valleys in a national park, even the mountaineers, grandchildren of pioneers who had braved the arrows of cunning Cherokees, had not explored the whole area.

Adventurous hikers who did invade the mountains found the undergrowth so thick in places that they had to chop their way through it with an ax.

A few naturalists and surveyors visited parts of the Smokies. Hunters sought their quarry amid the stately trees and dense cover that sheltered bears, deer, and numerous smaller animals, and here and there a solitary fisherman whipped a woodland stream for trout.

Revenue officers occasionally tried to penetrate the wilderness, and lumbermen, with dynamite, axes, and saws, pushed their roads and railroads only as far as the most recent cutting. There were areas that few white men had seen.

ONCE A BARRIER; NOW A MAGNET

To business men of eastern Tennessee and western North Carolina, the Great Smokies long were a trade barrier. No road leaped the rugged ridge along which the State line rambles for 71 miles. Commerce east and west in this latitude still moves around either end of the mountains, but the "barrier" now is an asset as the Great Smoky Mountains National Park.

A mountain woman told me that a few years ago it took her more than a week to go to Knoxville and return to her cabin in the hills. She was 28 years old when she first visited the city.

In those days there was little reason for the mountaineer to leave the mountains. A few sheep supplied wool for clothing and the mountain woman was an adept spinner and weaver.

When cows and oxen became useless and were dispatched, shoes were made of their hides. Bears, deer, and birds, brought down with five-foot rifles or caught in traps, supplied the family meat platter. "Sweetnin'" was produced from sorghum (p. 244).

A corn patch, clinging to the steep mountain slopes, yielded meal for cornbread and, in many instances, for the powerful, water-white "corn licker" that was sold for cash, or traded for salt, coffee, and other articles.

"NATURE AT HER CHOICEST"

Nearly all the land in the Great Smokies was privately owned when the park movement was initiated. Arrangements had to be made for its purchase before the land could be turned over to the National Park Service for development. An intensive money-raising campaign was planned. Private subscriptions aggregated $1,000,000. Appropriations by the adjoining States brought the fund to $5,000,000.

But this was only one-half of the funds required. The campaigners for many months sought vainly for the other half. Then John D. Rockefeller, Jr., announced that the Laura Spelman Rockefeller Memorial would match dollar for dollar any money raised in the campaign.

In 1926 Congress authorized the establishment of the Great Smoky Mountains National Park on condition that the citizens of Tennessee and North Carolina present 427,000 acres of acceptable land in one solid tract, the acreage to be equally divided between the two States. Officials who had investigated were enthusiastic.

"Nature is at her choicest there," they reported.

Development of the area as a national playground began, and today the thousand resident families have shrunk to about four hundred. Some sold their holdings outright and moved out of the mountains; some sold and took leases for terms of years; some took half the appraised value of their property and were given leases for the remainder of their lives. Only a few landholders have yet to come to an agreement with the Government.

Photograph by Carlos C. Campbell

"GIDDAP" AND "WHOA" HAVE NOT BEEN DISPLACED BY THE PULL OF AN ELECTRIC SWITCH

From dawn till dark dobbin walks round and round, providing the "horsepower" for this sorghum press. Since pioneer days the mountain folk have raised sorghum and squeezed from it in such crude mills a thick, sweet juice used as "sweetnin'." The liquid is boiled down in a near-by open-air vat. Locally called "cane," sorghum is planted and harvested like sugar cane.

Thus, in perhaps two decades, the mountain family may pass from within the Park area. Many mountain folk, however, will live on in the same primitive manner all around the borders of the Park, adding "human interest" to scenic beauty.

For five years now Government agencies under the supervision of the National Park Service have been building roads and trails and restocking forests and streams.

The work is just begun. Only seventy miles of high-standard roads, twenty-five miles of secondary roads, and fewer than 600 miles of trails have been completed. Yet for the last three years this infant of our national park system, not yet dedicated, has been attracting more visitors than any other of our 25 national parks.

SUNRISE IN THE SMOKIES

I had known the Smokies of old, and now, in the summer of 1935, I had come to revisit them.

The mountains rose ever higher against the sunrise as we sped over 38 miles of modern highway from Knoxville, Tennessee's gateway to the Great Smokies, to Gatlinburg, nestling in the foothills.

The village was just awakening. A few hikers and horseback riders emerged from the hotels and roadside cabins for a day's outing on the trails. Men born and reared in the hills, drawn to the village by visitors' dollars, hurried to their filling stations to catch the early morning trade.

Proprietors swung open the doors of their curio and craft shops, displaying stocks of linens, rugs, tapestries, furniture, inlaid and hand-carved trays, jewelry and cigarette boxes and book ends—all made by native craftsmen. No one stirred on the broad acres of the Pi Beta Phi Settlement School which, since 1912, has been teaching handicrafts, agriculture, homemaking, and the three R's to mountain children.

Less than a mile beyond the village a white and green sign announced the boundary of the Great Smoky Mountains National Park.

At the end of a long curve, a short dis-

Photograph by Carlos C. Campbell

A "PARKING LOT" ATOP NEWFOUND GAP PREVENTS TRAFFIC JAMS WHEN MOTORISTS STOP TO SCAN THE VIEW

From this point westward, a splendid highway follows the State line nearly to Clingmans Dome. Reaching an elevation of 6,311 feet, the road is one of the highest in the United States.

tance beyond, the highway forked (map, p. 246). We stopped and peered through the diminishing haze at the steep, tree-blanketed slopes of Mount Le Conte and Sugarland Mountain, whose summits were hidden in low-hanging clouds.

As we gazed up, entranced, at the soaring heights buttressed by sturdy ridges, a mountaineer emerged from a roadside path, a sack of cornmeal straddling his right shoulder.

"Which road leads to Newfound Gap?" I asked.

"Thet un," he said, pointing to the left fork, "and thet un to the gorge."

SPEECH OF PIONEER VINTAGE

The mountaineer's clear-blue eyes stared from a ruddy, bewhiskered face, under a dusty, black felt hat. His overalls were patched and his shoes thick-soled. His language had changed little from the homely speech of his pioneer forbears who migrated to the Great Smokies from North Carolina and southwestern Virginia before the Civil War.

Up ahead, I knew, engineers were widening the road to Newfound Gap and eliminating curves by tunneling through massive ridges.

"How far up the road is the construction work?" I asked the obliging native.

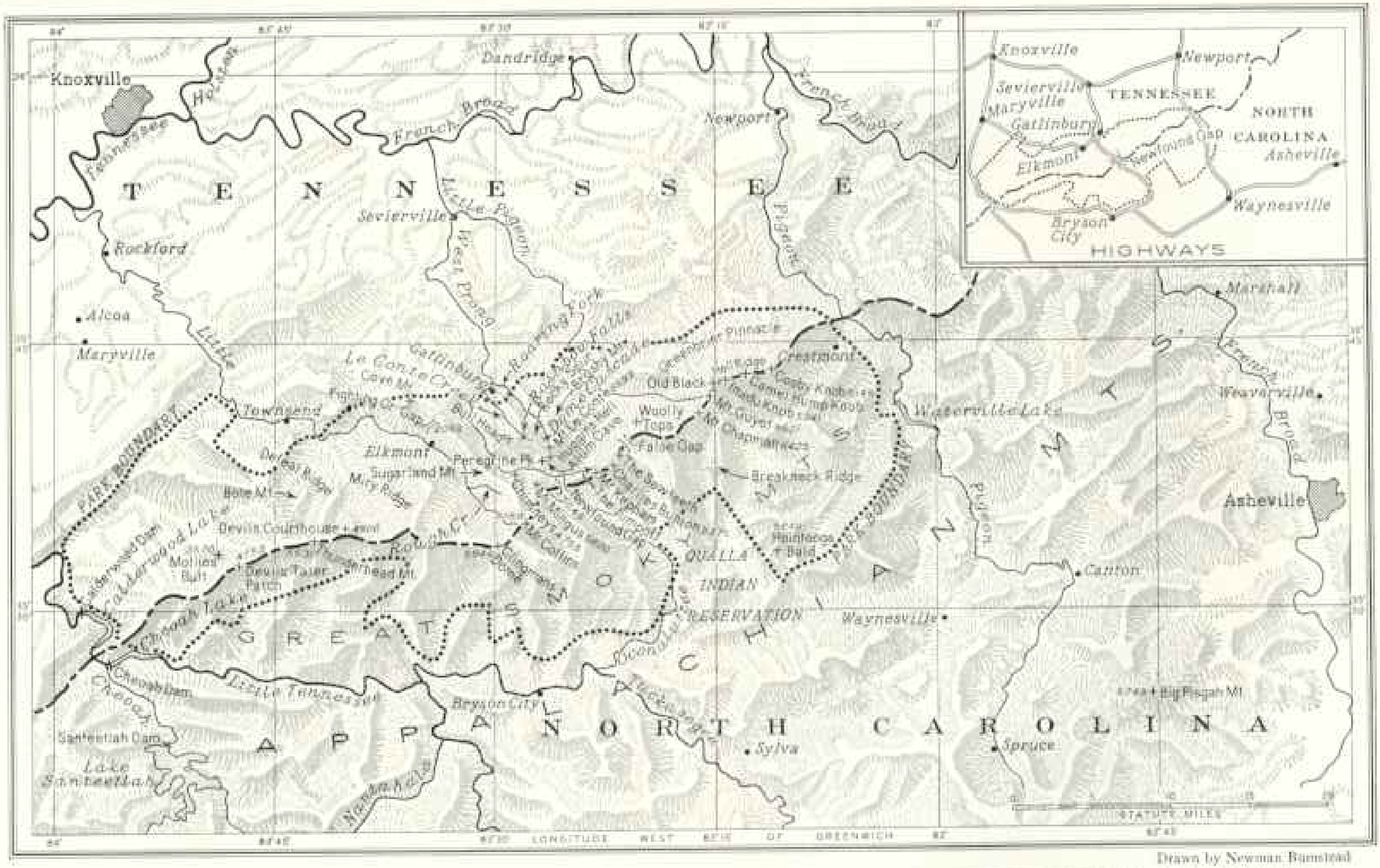
"Hit's a fur piece, stranger. Hit's a leetle rough up thyar whar them men's aworkin', but I reckon hit's safe enough to git past," he drawled.

While talking to the mountaineer, I was inspecting the oil supply of my automobile. He peered over my shoulder as I withdrew the oil gauge, and said:

"Hit ain't hurtin' none for grease."

Along this road, the only modern one over the mountains between Tennessee and North Carolina, we wound through the *scenic valley of the West Prong of Little* Pigeon River, crossing and recrossing the stream to the State line at Newfound Gap.

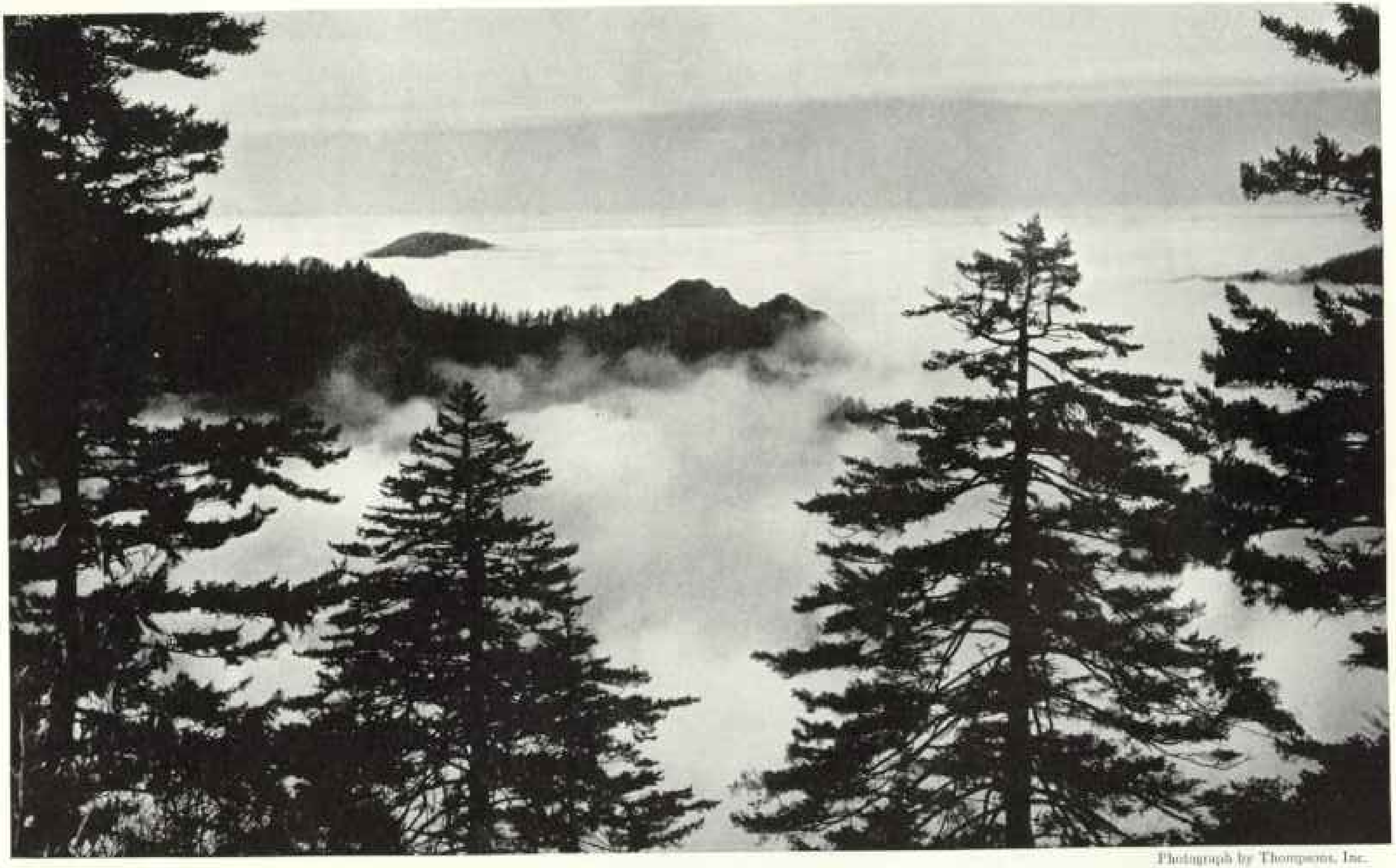
With each well-banked curve a new panorama was spread before us. Seen from one lookout, before the road enters a deep gorge, Mount Le Conte soars above a sweeping valley, a checkerboard of various tints of green; here are the inevitable corn patches of mountain families who have



Drawn by Newman Bumstead

ABOUT EVENLY DIVIDED BETWEEN TENNESSEE AND NORTH CAROLINA, THE GREAT SMOKY MOUNTAINS NATIONAL PARK EMBRACES 427,000 ACRES OF RUGGED HEIGHTS AND DEEP VALLEYS

"Rooftop of Eastern America" the Smokies have been called, because more than a score of peaks rise over a mile above sea level. Clingmans Dome (6,644 feet) is only 40 feet lower than Mount Mitchell in near-by North Carolina, the highest peak east of the Mississippi. The inset shows main roads leading across the Park, which is within twenty-four hours' automobile or train ride of half the population of the United States.



Photograph by Thompson, Inc.

WHEN CLOUDS LIE LOW, LOFTY PEAKS BECOME ISLANDS IN A BILLOWY SEA

Although the blue-gray haze, which gave the Great Smokies their name, and clouds often harass photographers, they soften panoramas and make fantastic settings. From the crest of Mount Mingus in Tennessee, the twin peaks of the Chimneys appear in the center (page 248) and the "island" of Sugarland Mountain in the background. A ridge of Mount Le Conte thrusts into the picture at the right.

© Thompsons, Inc.

RAINBOW FALLS BOWS TO JACK FROST

But in the spring this 84-foot cascade leaps from a bower of purple rhododendron. Here ice "stalactite" and "stalagmite," caused by a temperature of 15 degrees below zero high up in the mountains, seek to unite in one vast sheet.

been permitted to remain temporarily in the Park area; there are abandoned farms, grass-grown and studded with young trees that not long hence will return those patches to the forests whence they came.

THE CHIMNEYS ARE THE SENTINELS OF THE HIGHWAY

The Chimneys, rugged twin peaks, thickly forested, stand like sentinels, guarding the bridge which carries the highway across the West Prong (page 247). From the bridge all the way to Newfound Gap we were hemmed in by steep, wooded mountain slopes, unbroken except where a waterfall, too high above us and too far away to be heard, gleamed in the sun like a white silken ribbon as a mountain stream swept over a precipice toward the noisy river cascading below.

At Newfound Gap along the State line the mountain top has been excavated and space provided for parking several hundred automobiles (page 245). Here the arboreal wonderland that is the Great Smokies spread before us in both States.

From this point the highway descends into North Carolina along the Oconaluftee River, through the Qualla Indian Reservation, toward Asheville and Bryson City, North Carolina gateways to the Park.

In the next few weeks our travels carried us across the "waistline" of the vast Park area, completely around its circumference, and deep into the wild interior.

Southwestward from the Gap, the Skyway, one of the highest highways in the country, is taking shape. It has been completed nearly to Clingmans Dome, the loftiest peak in the Great Smokies. Ultimately it will wind forty miles over and around peaks along the State line until it reaches the western end of the Park, affording amazing vistas of jumbled mountains and billowy valleys. Portions of the Skyway are already 6,300 feet above sea level.

The eastern half of the Park will remain a wilderness, except for a minimum of trails and foothill roads for fire protection. A woodland path follows the State line, forming an important link in the 2,000-mile Appalachian Trail from Maine to Georgia.

It is along the trails that the hiker meets isolated mountain families in their cabins, and stumbles upon the remnants of abandoned mills that not long ago ground out the mountaineers' "turn" of cornmeal.

Hiking in the forest near Cove Mountain, far from the main road, I came upon

a lonely cabin. Three sisters were paring apples, gathered from a few scraggly trees that shaded their porch. Their speech was more modern than that of many mountain people who had closer contact with "furriners" (as all outsiders are called), because, unlike some of their neighbors, they attended a log schoolhouse near by.

In other respects, however, they were as independent as any mountain folk I saw. Their cabin was the crude, clay-chinked, log type, with mountain-made furniture and equipment.

"We still weave our winter clothes, but we buy this," one of the sisters said, pinching the blue denim apron that concealed her ankles.

A HOME-MADE MOUNTAIN HOME

Everything I observed in and around that cabin was home-made, except the denim, a bit of frayed newspaper attached to a swinging fly-chasing apparatus over the dining table, a few enamel cooking utensils, a gaudy "ad" for a medicinal cure-all, a mattock, and an ax. Their trundle beds, high-backed chairs, spinning wheel, and loom had been made by their father a quarter-century or more ago.

At another cabin in that neighborhood I found a hoe fashioned from a piece of wagon spring picked up on a mountain road, and a knife that had been hammered out of a saw blade salvaged from the debris of an abandoned lumber camp.

Not far from Gatlinburg one hot afternoon, I explored a narrow lane to a cabin in a grove of trees surrounded by fields of tall corn, sorghum, potatoes, and beans. Under a spreading oak near the cabin a mountaineer was dozing, a smoke-blackened corncob pipe hanging from his lips. A clear mountain brook, a few yards away, sang its perpetual lullaby.

Our host awoke as we approached. His wife, thin and stooped, also with pipe in mouth, emerged from the cabin door and took a seat near us.

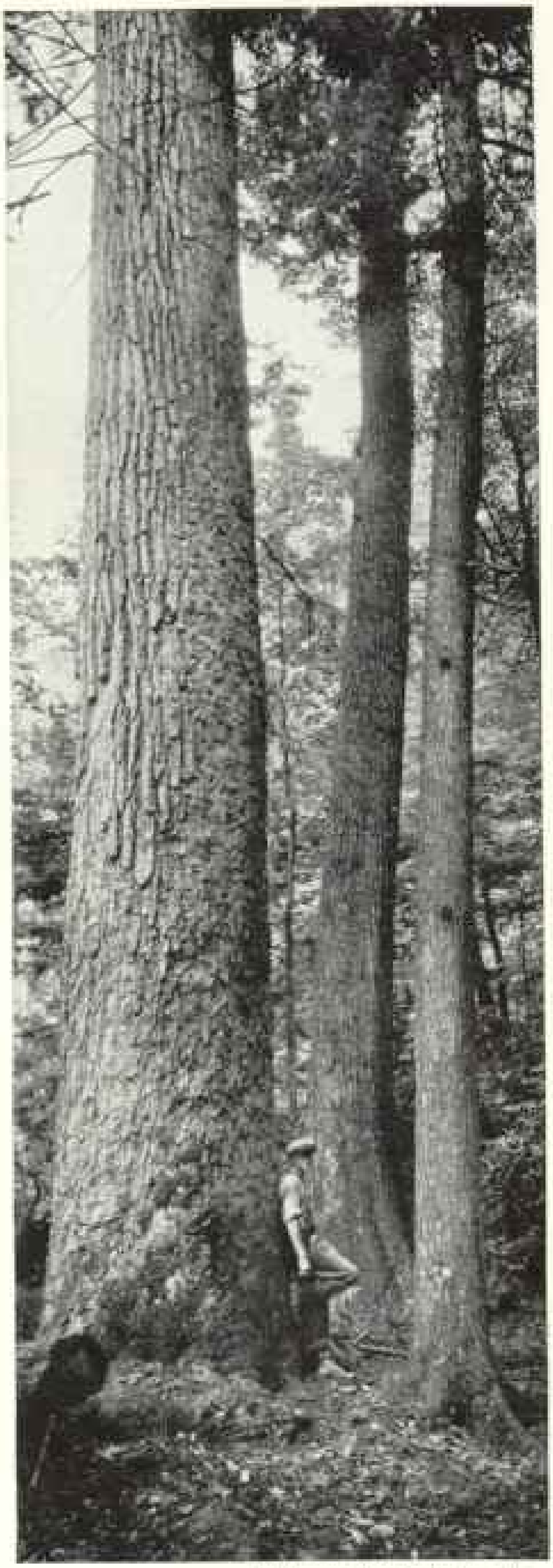
"Is your land in the Park?" I asked the mountaineer.

"The back piece of hit was, but I sold hit to the Gov'mint," he said.

"Did the Government pay a good price?"

"Tolable," he replied.

The mountaineer admitted that the growth of Gatlinburg and the Park visitors had given him a market for all the honey, corn, chickens, and potatoes he could produce, yet he seemed not quite content.



Photograph by Thompsons, Inc.

GIANT OF A FOREST PRIMEVAL

In coves and gorges grow big tulip trees. Some were old when Sir Walter Raleigh set foot in North Carolina. Many trunks measure six to seven feet in diameter, with lowest branches 100 feet above ground. Yellow blossoms resemble tulips.

Photograph by John D. Topping

DEFT FINGERS WEAVE BASKETS FROM RIVER REEDS, CANES, AND WHITE OAK SPLINTS

Thirty-two hundred Cherokees live on the 63,000-acre Qualla Indian Reservation on the southern slopes of the Great Smokies, adjoining the Park. The men cling to native games and the women carry their papooses astride their backs in true Indian fashion (pages 264 and 266).

I suggested that he might be like the Smoky mountaineer who moved when a family settled within ten miles of his cabin because the newcomers were too close. He chuckled, as if in agreement.

"GOOD OLD MOUNTAIN RIFLES"

One morning I visited a summer colonist at Gatlinburg whose hobby was collecting mountain rifles. He was enthusiastically fondling a newly purchased five-foot flintlock when a freckled, red-haired mountain boy approached the cottage and handed him a penciled invitation to a "shoot." The host promised "plenty of mountain music and watermelon." I was invited, too.

I saw mountain boys who had not reached their teens hitting the bull's-eye with hog rifles longer than they were tall, rifles whose leaden bullets were larger than peas (page 265). And mountain men who had passed their threescore and ten seldom missed a target. I was convinced that had the National Park Service not spread its protective net over the mountains, the few remaining wild animals would soon have fallen before the mountaineers' deadly aim.

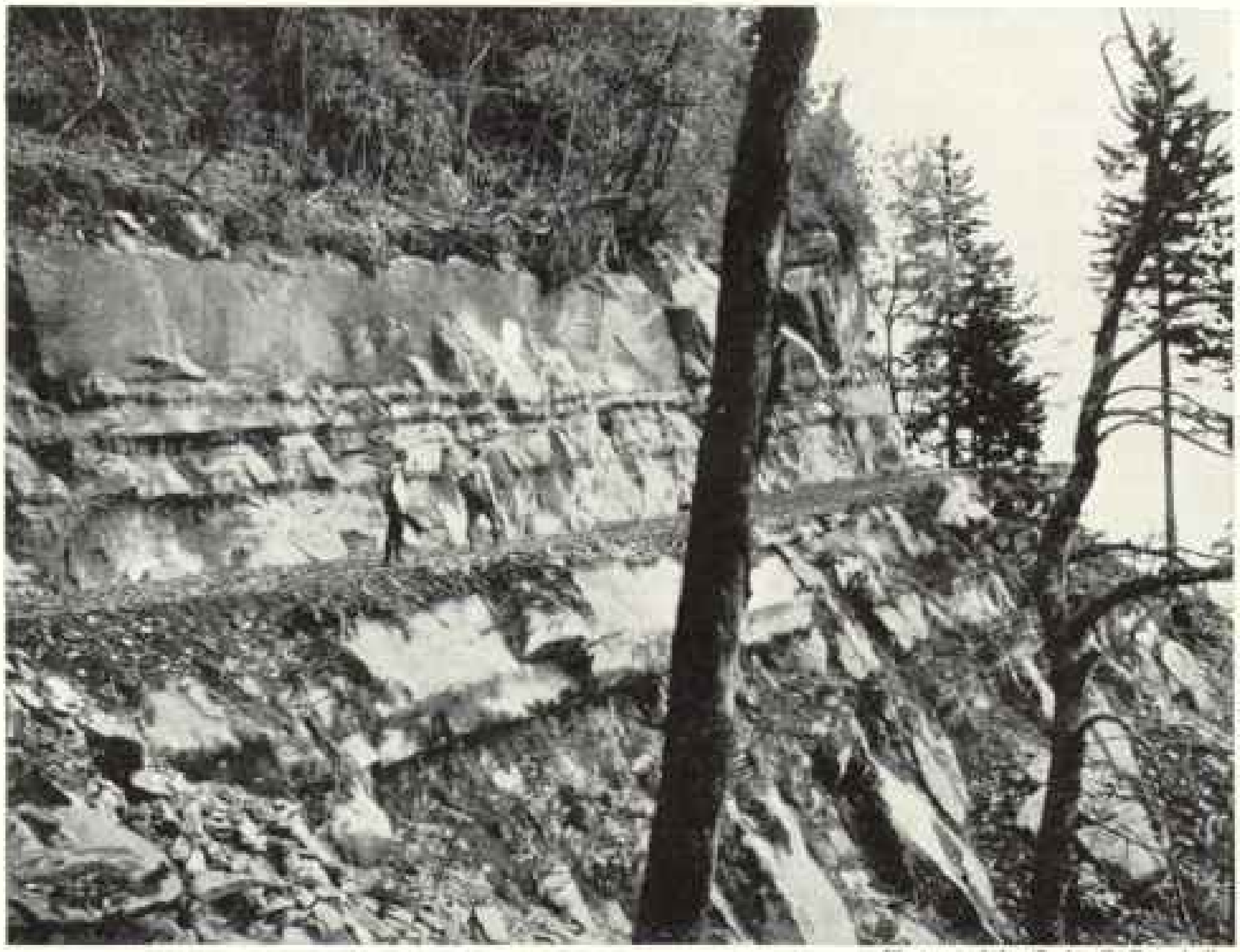
Between shots, mountain music filled the valley. Some of the ballads I had heard; others originally were brought from the Old World by early pioneers and have been handed down to the present generation.

"Lord Thomas and Fair Elender," a folk song of England, traced back to the time of Chaucer, is a favorite. In the mountain cabin or at a "music makin'" in a Great Smoky village you may hear:

"O mother, O mother, come rede me a riddle,
Come riddle it both in one,
Whether I shall marry fair Elender,
Or bring the brown girl home.

"The brown girl, she has house and lands,
Fair Elender, she has none;
Therefore, dear child, under my consent,
Go bring the brown girl home.

"He dressed himself in scarlet red;
His waiters all in green;
And in every town that he rode through
They took him to be a king."



Photograph by Carlos C. Campbell

C.C.C. TRAIL BUILDERS USE ROCK STRATA TO ADVANTAGE

Construction of the well-planned system of trails, that cross and recross streams, skirt scenic spots, and lead to lookouts, often required blasting through solid rock. In addition to the new four-foot trails like this one, there are hundreds of miles of primitive, ungraded paths, known only to mountaineers.

Many other verses describe the associations of Lord Thomas with "fair Elender" and "the brown girl."

"GRANDSTAND OF THE SMOKIES"

Early one morning in late June several years ago a companion and I left Gatlinburg with a capable guide to scale Mount Le Conte. "Grandstand of the Smokies" it is often called, for more people have scanned the surrounding mountains from its summit than from any other peak in the range.

For a mile or more the trail was easy. Then, suddenly, it seemed that it leaped straight skyward. At times we found ourselves reaching for a finger hold in a higher rock as one reaches for the upper rung of a ladder.

No mountaineer would permit his horse to attempt that route. A slip would mean injury or death. Only the glory of the Rainbow Falls, its waters leaping over an 84-foot cliff out of an arbor of purple rhododendron, beds of flame azaleas, phlox, and galax, inspired us to carry on to the summit.

When at last we reached the top, the view amply rewarded us. In the distance rose the rounded, tree-covered crown of Clingmans Dome, which is just 40 feet lower than Mount Mitchell in the Black Mountains of North Carolina, the highest mountain in eastern America.

Fleecy clouds hovered about the upper slopes of Mount Guyot, the Smokies' second highest peak; Mount Kephart, and Mount Chapman, named in honor of Col. David C. Chapman of Knoxville, Tennessee, recognized father of the Great Smoky Mountains National Park.

The blue-gray haze of the Smokies, which gives them their name, swathed the summits of more than a score of peaks that rise over a mile above sea level (pages 246 and 247).

That jagged part of the State line ridge called The Sawteeth resembles a bit of the Rockies in form, but, like all the Great Smoky Mountains, it is covered with the variegated green of trees and shrubs.

Mount Le Conte still is a grandstand, but many other peaks are becoming more and more popular as new trails and highways are completed. The old Mount Le Conte trail is seldom used except by the hardy mountain climber who seeks to test his strength and lungs.

Four graded trails, each four feet wide, now lead to the summit. Engineers saw to it that one of them passed the famous Rainbow Falls and numerous cascades of Le Conte Creek as the route, a few miles longer than the old trail, winds up the slopes.

Climbers usually take two days for the round trip from Gatlinburg to the top of Mount Le Conte, spending the night at the summit in a tiny log village maintained under Park regulations by a concessionaire.

HIGH HEELS ON HIGH CLIMBS

The early riser on Le Conte may see the lifting of the clouds from sweeping, dew-drenched valleys and the gorgeous sunrise whose grandeur observers have proclaimed far and wide. Horses negotiate the new trails, and I even saw two feminine hikers who had climbed to the summit in high-heeled shoes. A single blister was their only casualty.

Mountain climbing in midsummer is hot and strenuous sport, but in the Great Smokies the builders of the new trails have sought easy grades, and thick foliage provides cool shade. In some places the trails have been literally tunneled out of the thicket.

On a hot, humid day my companion and I set out for the summit of Thunderhead, 5,530 feet high. When we alighted from our automobile where the trail began, old Sol dealt us relentless blows. But less than a hundred yards ahead we stepped into a verdure-framed path resembling a narrow gothic passageway in the crypt of an Old World cathedral.

Only the hushed thud of our footsteps on the soft, moist ground, the trickle of numerous springs, the rustle of millions of leaves, and the songs of the mountain birds broke the silence of that forest aisle.

We found the top of Thunderhead a "bald"—an area devoid of trees but supporting a healthy growth of knee-high grass. As we stood on the sun-swept summit, we saw three rainstorms pour their torrents into the mountains of Tennessee to the north, and one into those of North Carolina to the south. Thunder roared all about us, but not a drop of rain fell on Thunderhead.

To see the Great Smokies from Heintooga Bald, in North Carolina, we motored along the bed of an abandoned logging railroad. Heintooga rivals Mount Le Conte in spectacular mountain views, for, as far as we could see, mountains soared and tumbled—mountains in haze, mountains in clouds.

Panoramas of the Great Smoky heights are ever changing. On a trail one afternoon I stopped to rest. Greenbrier Pinnacle, topped by a fire tower, loomed in the distance, shielded only by a slight haze.

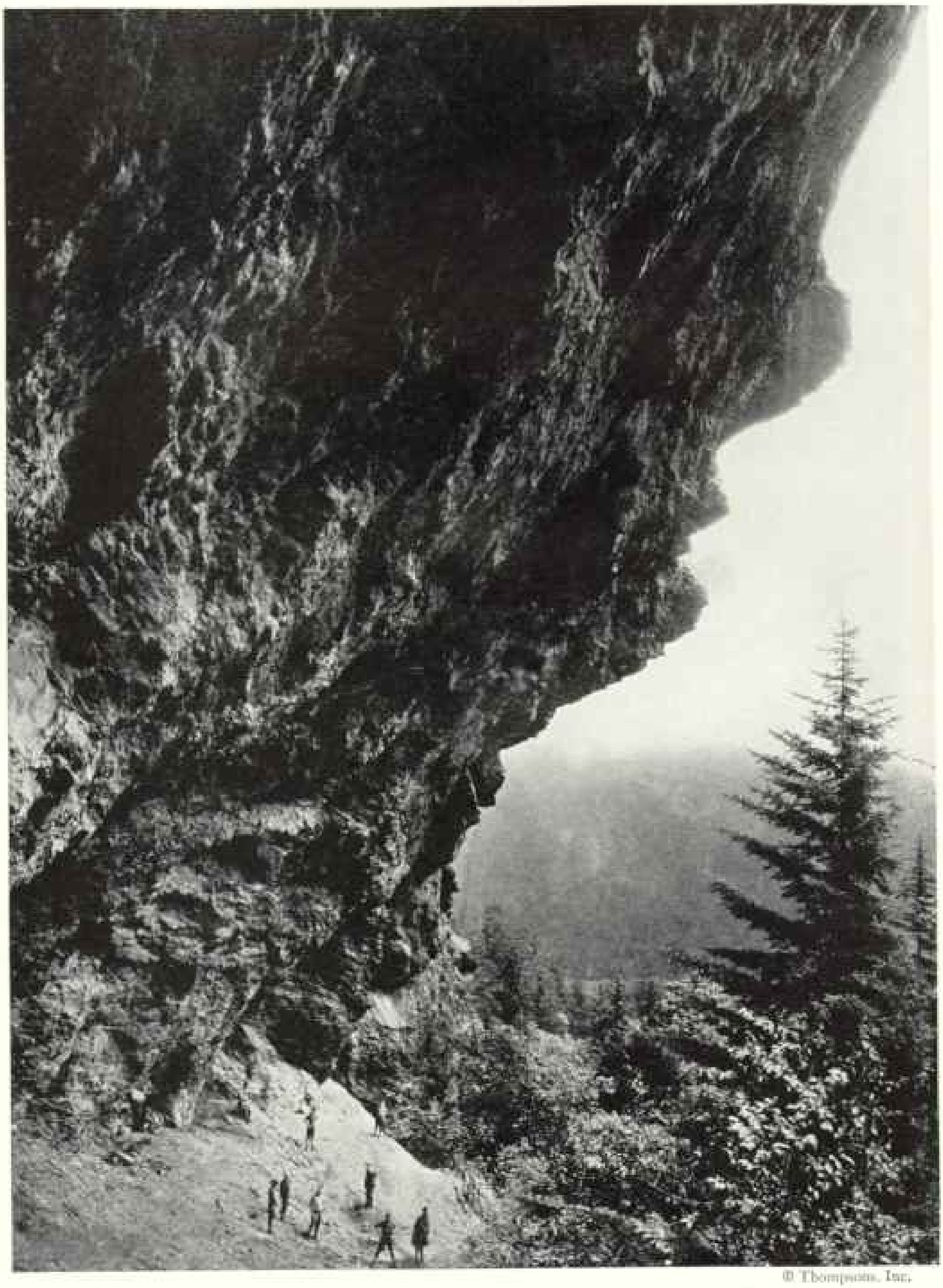
In ten minutes fleecy clouds had hidden its summit, and then lifted to leave the crest again clearly silhouetted against the sky. Spectacular is the view when peaks shade canyonlike valleys and shadows of tiny clouds chase one another on the sweeping slopes above the glens.

One of the first known white men to study the wonders of the Great Smoky Mountains was a botanist, William Bartram, of Philadelphia, who climbed among these heights about the time patriots in Independence Hall signed the Declaration of Independence. After him came other botanists who have found the mountains their paradise; one of the largest and last vestiges of the native forest that swathed the hills and valleys of colonial America.

A CENSUS OF WILD FLOWERS

So diversified are the wild flowers of the Great Smokies that visitors from many sections of the country find species that grow abundantly in their fields and woodlands among others that are rare to them. Twenty-two orchids find a natural habitat in these rugged and well-watered mountains; there are 50 kinds of lilies; 7 of trilliums; 22 of violets, and 5 of magnolias.

The native wild orchids, while not so large as the more familiar cultivated species, have all the exquisite form and dainty coloring of their "civilized" cousins. Like many other plant families in the Smokies, the orchids are found throughout a long blossoming season. Certain species make a bold debut in the very early spring;



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HIKERS PAUSE UNDER THE OVERHANG OF ALUM CAVE BLUFFS

Turned upside down, this photograph more nearly resembles a contour in the Great Smokies! During the Civil War, saltpeter was mined here on a small scale. The bluffs are a favored observation point from which to view autumn coloring. The foot trail from Newfound Gap Highway to the top of Mount Le Conte passes this spectacular spot.

Photograph by Carlos C. Campbell

BRUIN'S SWEET TOOTH LED HIM FROM THE WILDERNESS

This black bear, about eight months old and weighing 100 pounds, was captured by Elkmont C.C.C. boys by smearing honey on a rock. Now and then campers report nocturnal visits, but the bears usually inhabit the forests. Too slow and clumsy to keep out of rifle range, the bears were rapidly becoming extinct when the Park Service stopped hunting in the area.

others appear reluctant to yield sway to chilly autumn.

Ferns range from the most delicate, with lacy fronds, to the most hardy types. There are lush carpets of mosses and lichens of many varieties, and hundreds of mushrooms and other fungus species range from almost microscopic sizes to the large and showy varieties, many of which are prized edibles.

More than 1,500 species of plants, shrubs, and flowering trees blossom before the first day of June. Rarely in my wanderings did I see spots that Nature had not clothed with tree, shrub, grass, or all three. Scars left by man's assaults are soon obliterated by a blanket of verdure.

Here the catawba rhododendron is at its best. In late June and July, its white and purple blossoms cover whole mountain spurs, fleck sweeping slopes, and envelop trails and streams. Mountaineers call rhododendron and laurel thickets "slicks" and "hells." Indeed, the plants grow in such tangled masses in some areas that only wilderness animals can get through them.

Huggins Hell, covering about five hundred acres, is one of the largest rhododendron and laurel thickets. It was named for Irving Huggins, a mountaineer who sought to drive his cattle from one mountain to another. On the way he was trapped in the Huggins Hell area. It took him several days to find his way out. Mountaineers avoid the "slicks," identified by such colorful names as Devils Tater Patch, Devils Courthouse, Woolly Tops, and Breakneck Ridge.

The Brushy Mountain Trail in August revealed to us that the floral display of the Great Smoky Mountains does not reserve all its beauties for spring and fall.

Photograph by H. M. Jennison

WHEN A BOTANIST COMES ACROSS A SHRUB WITH A STEM 8.2 INCHES IN DIAMETER, AND HUNDREDS OF YEARS OLD, THAT'S NEWS!

Favorable weather and soil conditions are conducive to luxuriant vegetation in the Great Smokies. This mountain laurel is an example: its limbs are as large as small trees. A holly with a trunk three feet in diameter and a grapevine with a stem more than five feet in circumference are recorded. Wild cherry trees three and four feet in diameter are so numerous in one region that natives call it "Cherry Orchard" (page 237).

The rhododendron, dogwood, violet, flame azalea, bluet, trailing-arbutus, iris, columbine, wild geranium, and ladyslipper had lost their blossoms, but along the trail we were never more than a few steps away from some blossoming plant.

A FRONTIER OF BOTANY

White and pink phlox and brilliant red cardinal flowers vied with yellow goldenrod, goldenglow, and coneflowers, blue harebells, orange and lemon touch-me-nots, delicate purple, white, and yellow passion flowers, and yellow-fringed orchids.

In the area is the largest and finest stand of virgin hardwood in the United States, as well as the largest virgin stand of red spruce.

Trees and shrubs characteristic of Tennessee, North Carolina, and southern Canada grow here on the slopes of the same mountain, at different altitudes.

One hundred and thirty-two known

Photograph by Carlos C. Campbell

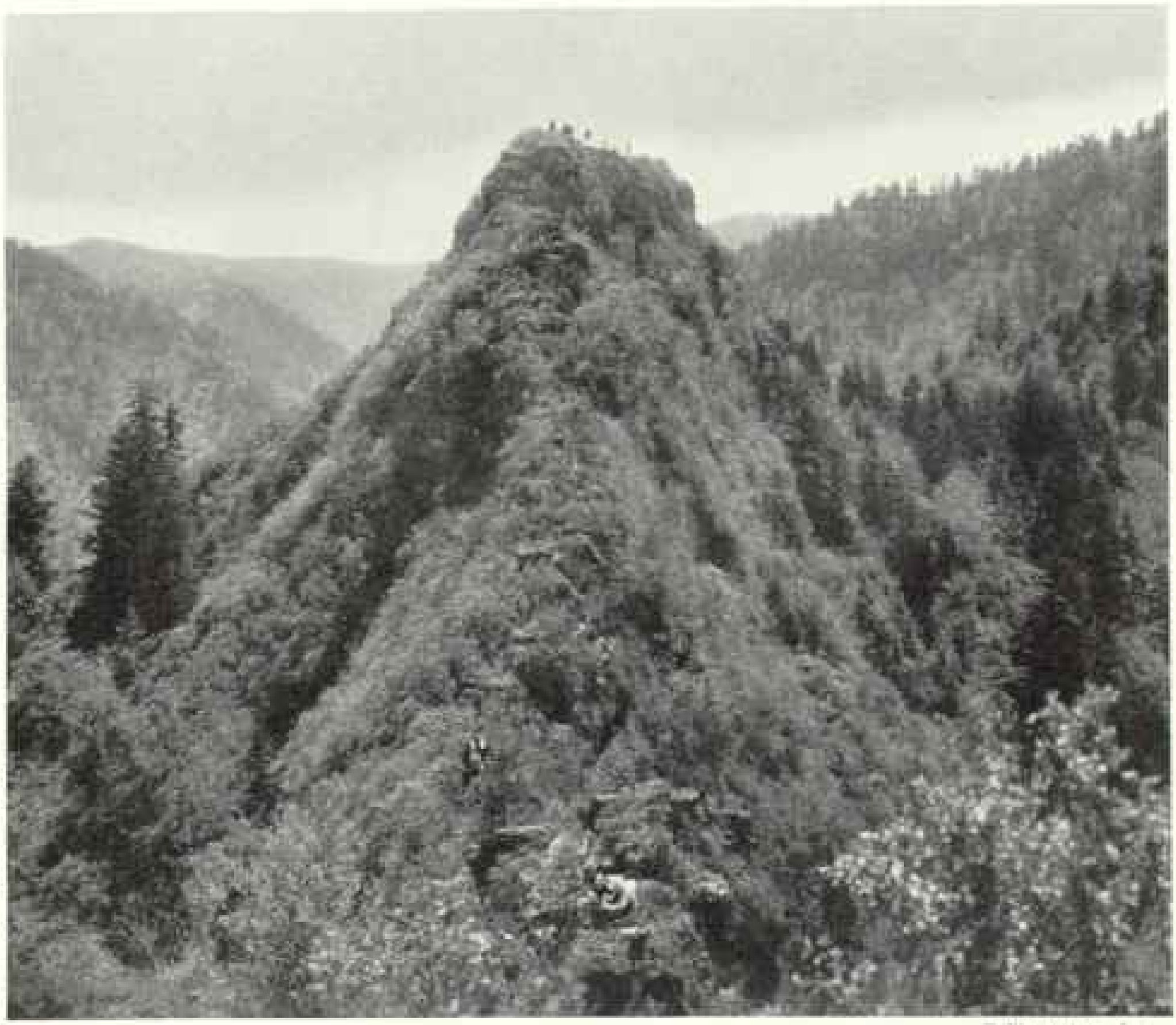
A CARRY-OVER FROM PIONEER DAYS IS THE SLED

Trucks, tractors, and wagons have not yet elbowed from mountain roads such practical conveyances, which slide over rough trails and need no brakes. Wheeled vehicles are still useless in many sections where crops are raised on steep slopes. Ox teams now are rarely seen.

Photograph by Thompson, Inc.

THIS FAT GAMESTER HAS MADE ITS LAST STRIKE IN LITTLE RIVER

Six hundred miles of clear, cool trout streams dash down from the Great Smoky heights. Nearly "fished out" when the Government took possession of the Park, rivers have now been restocked, assuring lively sport and a good catch (page 760).



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THICK FOLIAGE HIDES 75 HIKERS ON THE KNIFELIKE RIDGE OF THE CHIMNEYS

These twin peaks rise near the Newfound Gap Highway, a "crossover" from Tennessee to North Carolina. From here unfolds a magnificent panorama of the wild eastern portion of the Park, which, except for trails, will always remain in its natural state. Beyond the pinnacle is the State line range that forms the backbone of the Park.

species of trees have been identified in the Park area—so I wrote, correctly, after my visit. Later I had news there were 134; two months later there were 136. Now there are 138 on the list. The Park still is a frontier of botanical exploration.

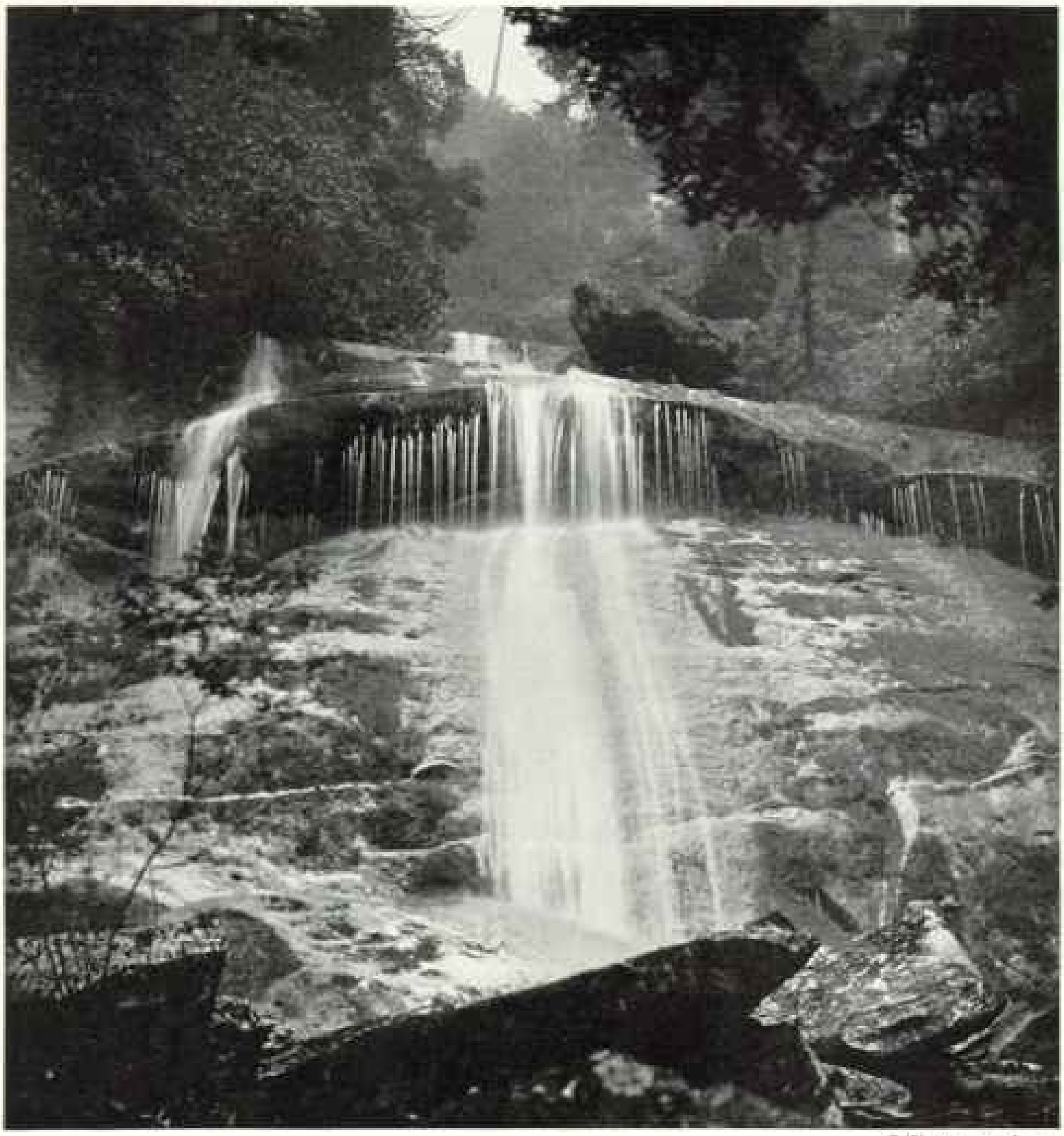
On the lower slopes we passed through forests of sycamore, tulip tree, ash, gum, oak, cherry, elm, basswood, flowering dogwood, and pine. We saw hemlocks that rival in size the famous hemlocks of the western slopes of the Canadian Rockies.

Gaining altitude we were among the beeches, buckeyes, hickories, and birches, and then, near the summit, we stepped into a zone where hardy balsams and red spruce dominate dwarfed species of some of those trees seen below.

Lumbermen had wielded their axes on about half the area before proponents of the Park could stop them. In the uncut half is the forest primeval, where trees of tremendous girth thrust their crowns above shrubs that in some places are as large as trees. Here tulip trees grow six and seven feet in diameter (page 249). Mountain laurels 18 inches thick and as high as a two-story building are not uncommon, and one having a buttress 82 inches in diameter and limbs 12 or more inches through recently was found (page 255).

The main stem of one grapevine in the Park area is more than five feet in circumference.

In autumn the gaudy reds of the maples, sourwoods, black gums; the rich golds of the birches, beeches, tulip poplars, hickories, basswoods, and the few remaining chestnuts; the russets of the oaks; and the varying shades of green contributed by the



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DOME CASCADE IS THE OPENING ROAR IN ROARING FORK

The wind may cease to rustle the leaves and birds may now and then be beyond earshot, but the plash of the mountain stream plays a perpetual symphony in this bowlder-strewn channel on the north slope of Mount Le Conte. The falls are the uppermost of twelve near Gatlinburg, Tennessee. The waters of the Great Smokies flow 1,600 miles, by way of the Tennessee, Ohio, and Mississippi Rivers, before they reach the Gulf of Mexico.

evergreens, suggest that Mother Nature, unable to decide upon a color pattern for this annual spectacle, emptied her paint pots playfully over the mountainsides.

No matter where one goes in the Great Smokies, one is never beyond the murmur of streams, the splash and dash of cascades, or the roar of falls, as the mountain waters flow toward the Tennessee River and thence to the Ohio, the Mississippi, and the Gulf of Mexico.

There are temporary camping grounds on the banks of streams teeming with trout. At one camp site in the gorge of the Little River we spent a pleasant hour in the shade of big trees, chatting with families of the canvas village. Permanent sites will be established for campers with tents, while others will be accommodated in cabin developments. Mosquitoes are conspicuously absent, because there is no standing water.

There are more than six hundred miles of trout streams in the mountains. Some, easy to reach, had been fished out until

Photograph by Carlos C. Campbell

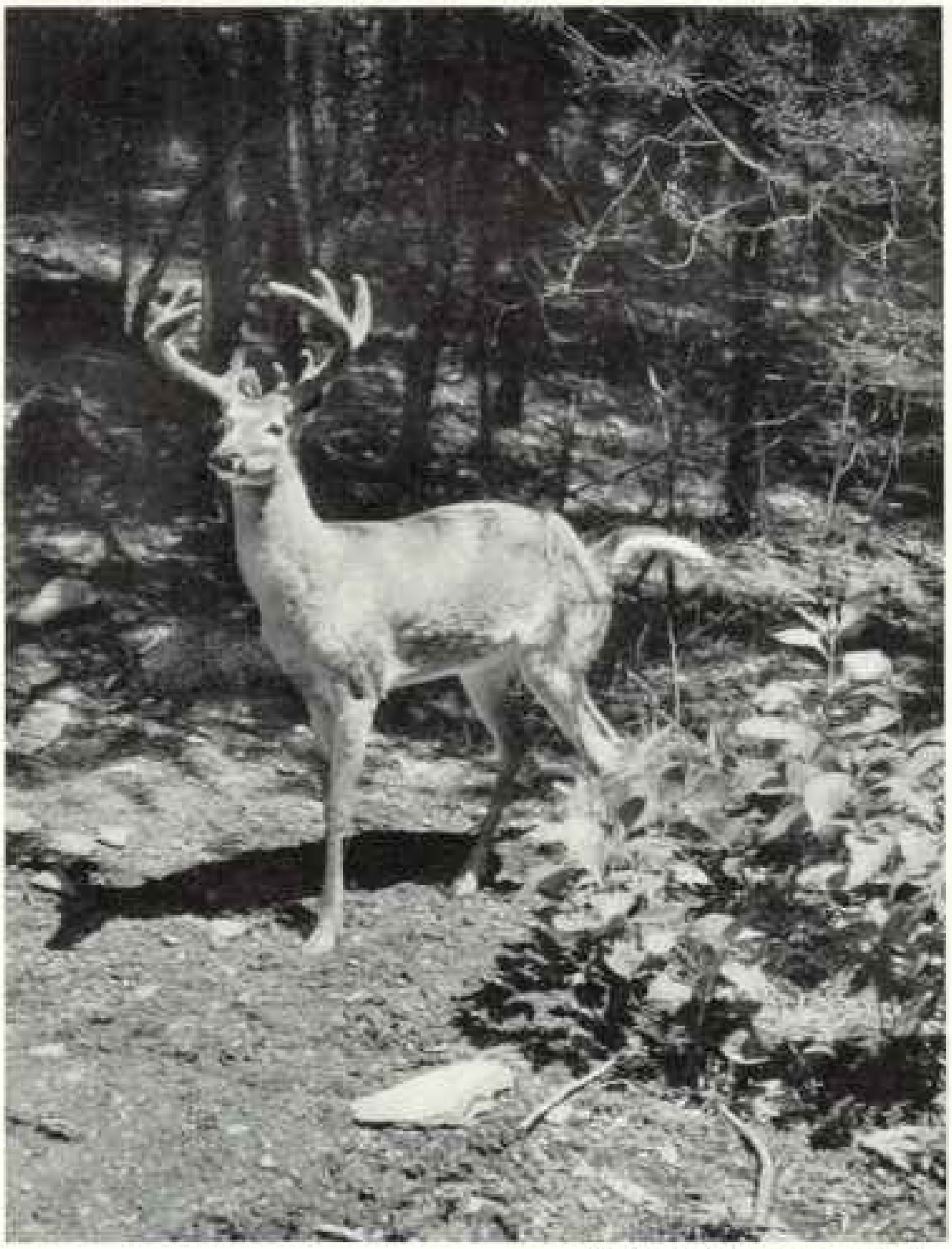
WITH A CYCLOMETER A HIKING CLUB MEMBER MEASURES HELL RIDGE

This bit of trail, thinly covered with snow, earned its name because of the difficulties experienced by hikers who tramped here before the modern path was built. It forms part of the Appalachian Trail, which winds along the main ridge of the Great Smokies for 71 miles.

Photograph by Edwin L. Wisherd

MOUNTAINS IN HAZE AND CLOUDS RISE OUT OF A TANGLED WILDERNESS

Although more than half the population of the United States lives within 600 miles, the Great Smokies contain areas few white men have ever visited. Streams teem with trout.



Photograph by Carlos C. Campbell

HEAD HIGH, TAIL EXTENDED, "PRANCER" POISES FOR FLIGHT

This white-tailed deer, a native of the Great Smokies, is on exhibition in a fenced-in wood near Gatlinburg, Tennessee, local headquarters of the National Park Service. Once deer were plentiful in the region, but hunters and lumbermen have driven the few that remain deep into the wilderness. To bring animal life back to normal, the Park Service plans to restock the area.

recently, when the National Park Service restocked them. We saw a motor truck on one of the mountain roads laden with thousands of tiny fish.

CASTING BREAD UPON TROUT WATERS

We visited fish-rearing ponds of native stone and cement where the little finny fellows are placed until they are old enough to fend for themselves in free streams. Both rainbow and brook trout abound.

A fish hatchery will be built by the Bureau of Fisheries on the Oconaluftee River.

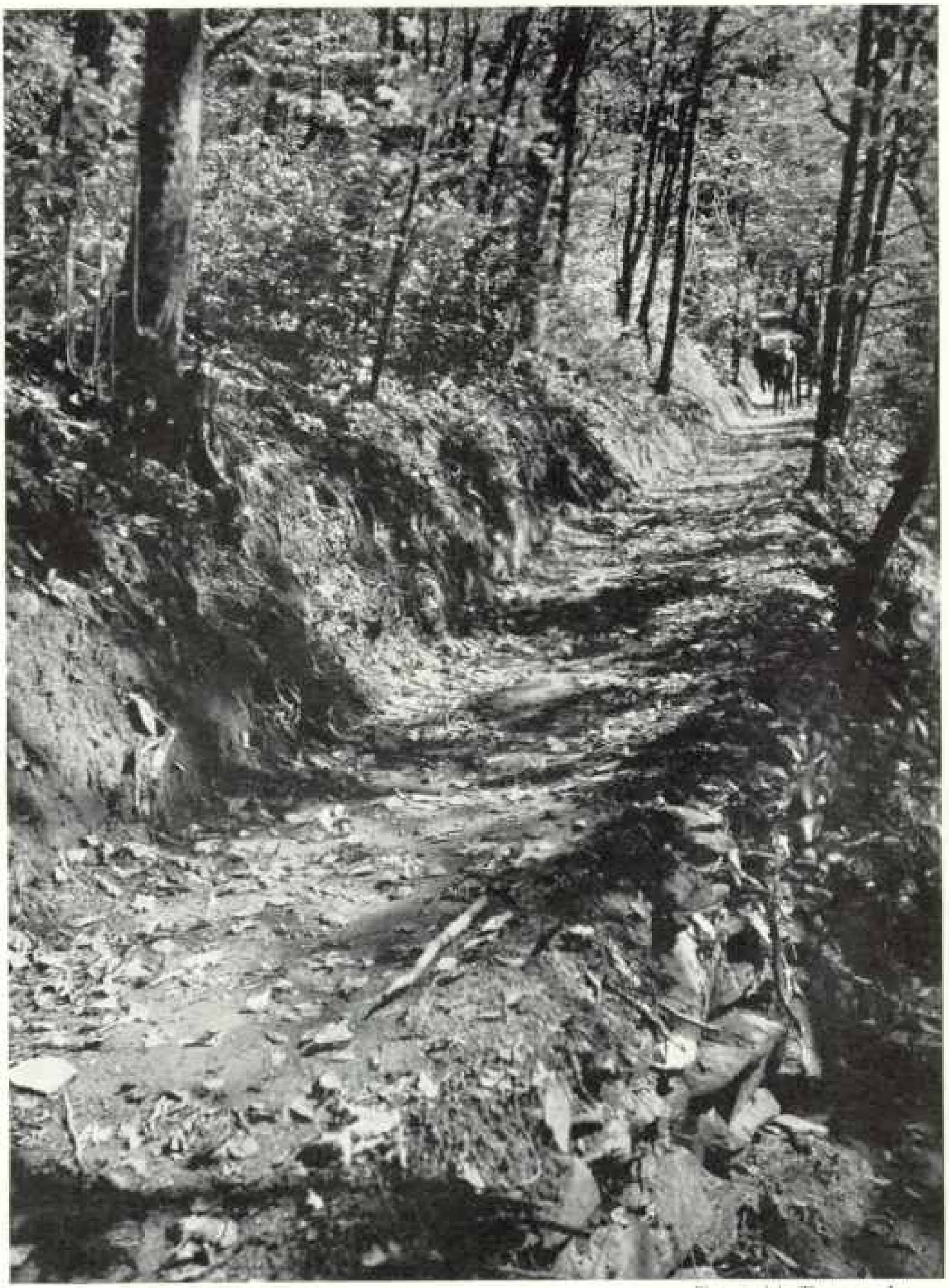
We often peered into the mountain streams but failed to see a trout. Having heard and, perhaps, told fish stories, I rather doubted tales of this region as a fisherman's paradise. So one of my companions purchased a loaf of bread, and led me to the rail of a rustic bridge over one of the streams. There was not a fish to be seen until he cast bits of the bread into the water. In a split second hundreds of rainbow trout appeared, lashing the water as they sought the crumbs.

Hunting is forbidden in national parks, but the protection given game in the Park area may cause an overflow into surrounding regions where nimrods are not barred.

Deer and other species of wild life that have been nearly exterminated or driven out of the Great Smokies soon will range the mountains under protection.

Hundreds of bears still are in the mountains, and their numbers are increasing rapidly. So far I have not sighted one, although I have seen their tracks.

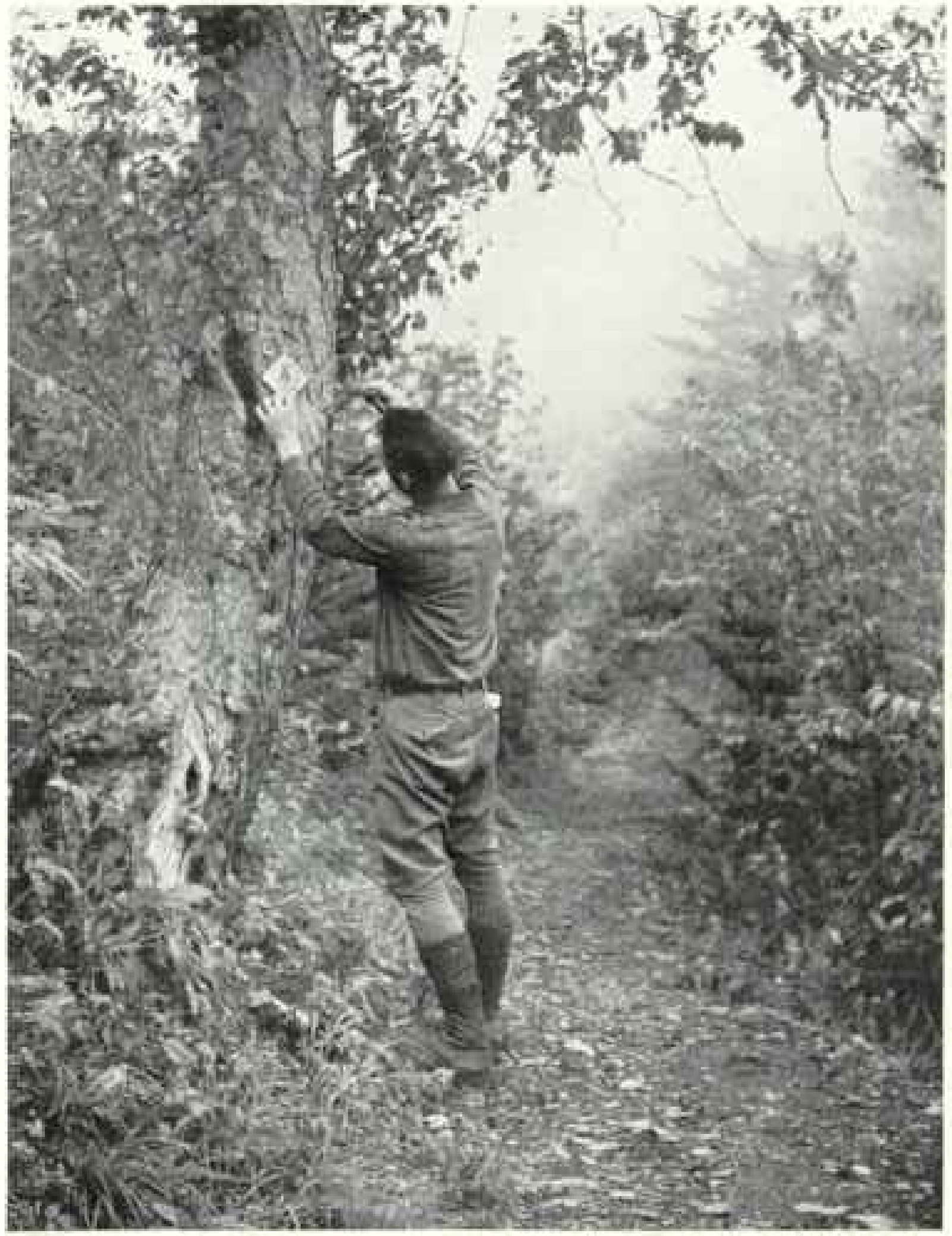
The eastern timber wolf and the eastern mountain lion were known to be in the mountains some 20 years ago, and the eastern otter inhabited one of the valleys until only a few years back. Virginia white-tailed deer, although not extinct, are rarely seen.



Photograph by Thompsons, Inc.

SHADY TRAILS AND EASY GRADES LURE THE HIKER AND HORSEBACK RIDER

Hundreds of miles of fine trails have been built through this silvan region in which botanists have found some 1,500 kinds of plants, shrubs, and flowering trees. Engineers laid out the paths carefully so that they always lead to some spectacular waterfall or vista. This path is near Newfound Gap (page 245).



Photograph by Carlos C. Campbell

NEAR CHARLIES BUNION, A RANGER NAILS AN "A. T." MARKER

Peaks, gaps, and streams in the Great Smokies bear queer names (page 265). Charlies Bunion, a peak, commemorates a guide's sore toe! Fighting Creek Gap recalls an argument over a schoolhouse site. "Hells" are tangled growths, impenetrable without an ax. The sign marks the Appalachian Trail.

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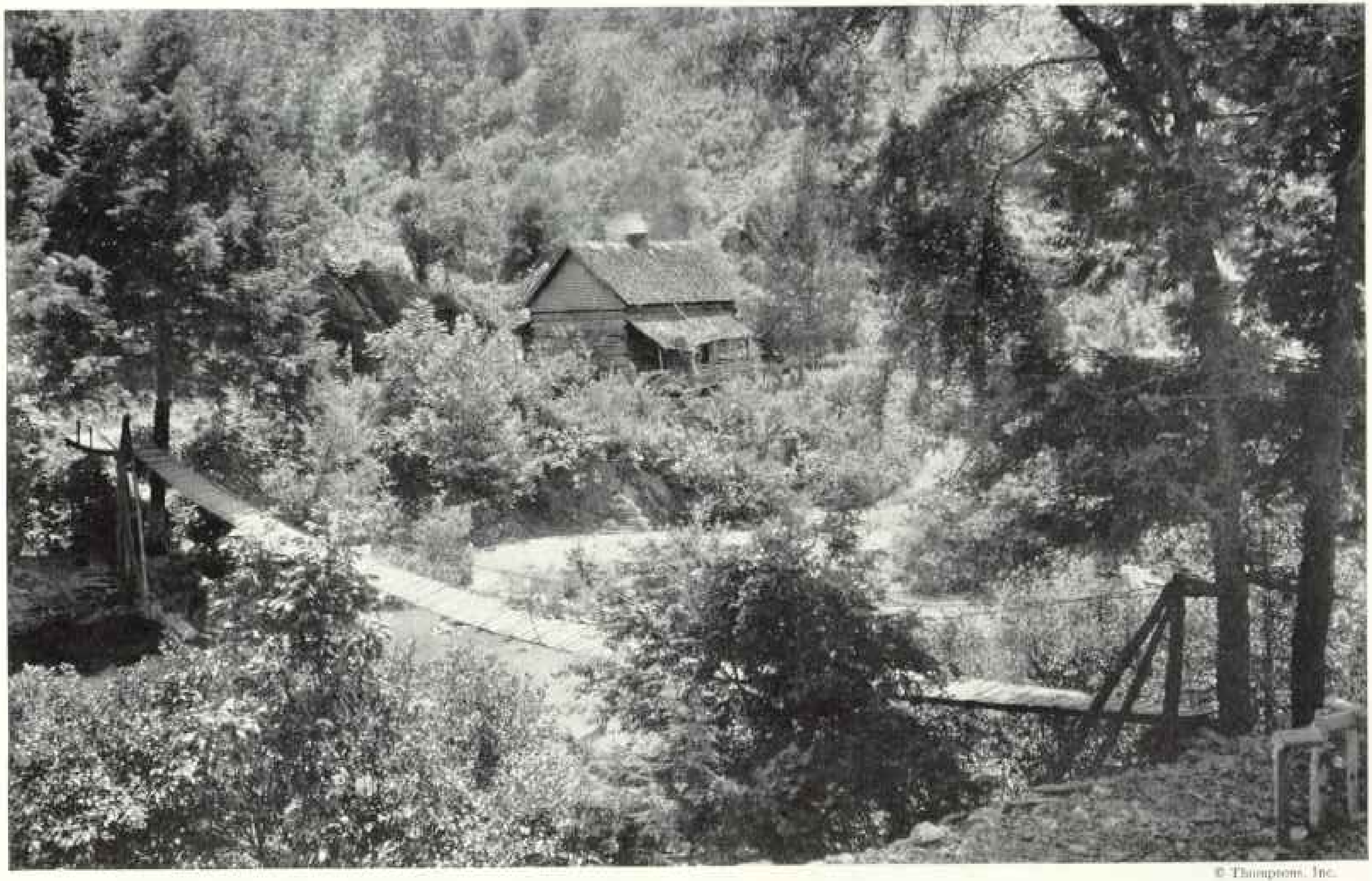
A MOUNTAINEER "TOTES HIS TURN" TO A TUB MILL

Near the door a man waits to grind his corn. A home-made vertical turbine turns the crude grinding stones. Fanlike blades and shaft are carved from a single block of wood. Capacity is small, about a bushel or tubful at a time; hence the name, "tub" mill.



A QUIET VALLEY WITH SWINGING BRIDGE AND CABIN SET AMONG FLOWERING SHRUBS—A FREQUENT SCENE IN THE GREAT SMOKIES

Log cabins usually have one room, combining the living and sleeping quarters, and an enclosed lean-to which serves as kitchen and dining room. Except for a few necessities such as pots and pans, nearly every article, from beds to bureaus, is home-made. Crude suspension bridges are the usual means for crossing streams, but the animals must use fords, or, in case the water is too deep, they are sometimes stabled on the far side.

Photograph courtesy U. S. National Park Service

AUNT SOPHIE'S WELCOME MAT WAS ALWAYS OUT

Thousands of returning visitors to the Great Smokies will miss Mrs. Sophie Campbell, who passed away last January. "Near 'bouts 75," Aunt Sophie, in homespun, enjoyed talking between puffs on her home-made clay pipe about her "gal (daughter) in Alabam'" and her "chap (son) in the gap over yonder." The cabin is of the clay-chinked log type. On the hillside beyond are "bee gums," or home-made beehives, hollowed out of tree trunks, and a corn patch, the source of the mountaineers' staff of life, cornbread.

Photograph by Thompson, Inc.

IN GYM SUITS, CHEROKEES PLAY INDIAN BALL—A HARD, FAST GAME!

Young braves of the Qualla Indian Reservation play their own brand of ball, a combination of football, hockey, basketball, boxing, lacrosse, and tennis. First, the ball is tossed up between two opposing tribesmen, as in basketball. Then it is struck by sticks resembling small tennis rackets. Players may carry the ball in their hands or even in their mouths until the goal is reached. To retrieve the ball, opponents may use any means, even to striking the carrier with fists or sticks.

Photograph by Thompsons, Inc.

NEXT TO HIS FAMILY THE MOUNTAINEER'S GUN IS NEAREST TO HIS HEART

This old muzzle-loader has a hair trigger, and its pea-sized leaden bullets seldom miss their target when the lad's grandfather draws a bead. Since hunting is not allowed in the Park, men now sharpen their vision at "shoots." Made in the mountains with crude tools, many of these guns are valuable museum pieces (page 250).

Wild turkeys occur and ruffed grouse are plentiful.

Naturalists list 50 species of mammals in the Great Smokies, 27 species of reptiles, and 150 species of birds.

BIRDS RANGE FROM EAGLE TO WREN

Bird life here is unexcelled by that of any other inland forest area. On the trail to Thunderhead we saw a golden eagle and heard its shrill call as it soared high above the crest of the mountain. Many of the larger members of the hawk family nest in the Great Smokies. The raven is not uncommon and the red-breasted nuthatch, brown creeper, winter wren, black-capped chickadee, Carolina junco, and pileated woodpecker are often seen and heard in the forest. Bob-whites inhabit the coves and grassy balds.

The evening before we left the mountains we stopped at a roadside inn a few hundred yards from the Park boundary near Gatlinburg. A native of the mountains whom we had met a few days before, asked me where we had been in the hills. I described our wanderings.

"You ain't seen nuthin' yit," he said, and then entered into vivid descriptions of his pet areas in the mountains.

Another native of the hills heard my informant expounding the merits of this and that area and, in a louder tone, outlined the areas he thought I should see. A third entered into the discussion.

QUEER NAMES OF MOUNTAIN PLACES

Huggins Hell, Charlies Bunion, Mollies Butt, The Sawteeth, Fighting Creek Gap, Bull Head, The Jumpoff on Mount Kephart, False Gap, Camel Hump Knob, Old Black, Rocky Spur, Rough Creek, Miry Ridge, and scores of other oddly-named and isolated areas, as well as well-known spots

in the Great Smokies, were mentioned in a half hour of torrid argument.

I learned that some of the queer names in the Great Smokies originated from characteristics of the areas to which they applied; others from chance remarks of natives and visitors.

Bote Mountain was so named because a mountaineer, on entering a meeting called to decide which of two ridges a new mountain road should follow, broke a tie vote by exclaiming, "I bote for yonder ridge." The ridge he "boted" for is Bote Mountain; the one ignored thenceforth was Defeat Ridge.

Fighting Creek Gap got its name as a result of a quarrel over the location of a school.

Charlies Bunion commemorates a Great Smoky guide named Charlie, who, while conducting a party near the peak, compared it with his pedal affliction.

The persistent pull of the verdant beauty, the trout streams, the trails and highways, and the native highlanders have been important factors in the annually increasing guest list of the Great Smokies. Geography also plays its part in the mountains' popularity. Newfound Gap, near the center of the Park, is within 24 hours, by highway or railroad, of more than half the population of the United States.

"AND POINTS NORTH AND WEST!"

Last spring automobiles from every State in the Union, and Alaska, entered the Park area, carrying the bulk of more than 450,000 visitors. Louisville, Cincinnati, Atlanta, Birmingham, and Raleigh all lie within 300 miles' radius of the mountains.

An enthusiastic Park official reeled off the information that within 600 miles are St. Louis, Chicago, Milwaukee, Detroit, Cleveland, Pittsburgh, Philadelphia, Baltimore, Washington, Norfolk, Richmond, Memphis, Buffalo, and New Orleans. And we waited for him to conclude his list, like a train announcer, with the familiar "All aboard!"

The proposed Blue Ridge Parkway, linking the Shenandoah National Park and the Great Smoky Mountains National Park, will be a colorful corridor to the Great Smokies from the north, joining it with such scenic areas in North Carolina as Blowing Rock, Grandfather Mountain, Linville Falls and Gorge, Little Switzerland, Mount Mitchell, Great Craggy Mountains, and Big Pisgah Mountain.

Both Tennessee and North Carolina have provided modern highways, skirting the Park area.

The Nantahala River in North Carolina flows through a gorge famous for its spectacular vistas. Lake Santeetlah, with 83 miles of shore line, winds among the hills close to the southern boundary of the Park. Formed by the impounding of clear mountain waters by the 240-foot Santeetlah Dam, it has the attractiveness of a natural lake.

WHERE THE CHEROKEES ABIDE

Carved out of the North Carolina side of the Great Smoky Mountains, adjoining the Park, is the 63,000-acre Qualla Indian Reservation where nearly 3,200 members of the Eastern Band of the Cherokee Nation of Indians make their homes. Many of the tribesmen live in cabins on the slopes in much the same manner as the white mountaineers in the Park area (pages 250 and 264).

The native Indian costume is seldom seen in the Reservation. We saw two Indian women walking along a Reservation road. Their long, flowing skirts and gay kerchiefs resembled those of gypsies. One squaw had her papoose astride her back, Indian fashion.

In early October the Cherokees hold their harvest festival, when they display products of agriculture, arts and crafts, and perform ceremonial dances and native athletic feats before thousands of visitors, who travel long distances to witness the spectacle. The Indians still are expert with the bow and arrow and the blowgun.

At no season of the year is the Great Smoky Mountains National Park likely to be closed to visitors, said Major J. Ross Eakin, its superintendent.

"This will be an all-year-round park, because," he explained, "we do not anticipate any time during the year when we shall be unable to keep our roads free of snow."

In view of the growing hegira to Florida and other southern States for winter vacations, the Great Smoky Mountains National Park promises to have a visitors' register well filled every month of the year.

NATIONAL GEOGRAPHIC SOCIETY

GEOGRAPHIC ADMINISTRATION BUILDINGS

SIXTEENTH AND M STREETS NORTHWEST, WASHINGTON, D. C.

ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded forty-eight years ago, the National Geographic Society publishes this Magazine monthly. All receipts are invested in The Magazine itself or expended directly to promote geographic knowledge.

Articles and photographs are desired. For material which The Magazine can use, generous remuneration is made. Contributions should be accompanied by addressed return envelope and postage.

Immediately after the terrific eruption of the world's largest crater, Mt. Katmai, in Alaska, a National Geographic Society expedition was sent to make observations of this remarkable phenomenon. Four expeditions have followed and the extraordinary scientific data resulting given to the world. In this vicinity an eighth wonder of the world was discovered and explored—"The Valley of Ten Thousand Smokes," a vast area of steaming, spouting fissures. As a result of The Society's discoveries this area has been created a National Monument by proclamation of the President of the United States.

The Society coöperated with Dr. William Beebe in a deep-sea exploration of underseas life off Bermuda, during which a world record depth of 3,028 feet was attained August 15, 1934, enabling observations of hitherto unknown submarine creatures.

The Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole, and contributed $100,000 to Admiral Byrd's Antarctic Expeditions.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

The Society's notable expeditions to New Mexico have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches have solved secrets that have puzzled historians for three hundred years. The Society is sponsoring an ornithological survey of Venezuela.

On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to an officially recognized altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments which obtained results of extraordinary value.

They scheduled the EARTHQUAKE *for* 10:39

Keeping an eye on split seconds during an actual "March of Time" broadcast

(*Top to Bottom*)
MARTHA. 17 jewels. 14K gold filled, in either white or natural yellow. With silk cord, $47.50. With smart gold filled chain bracelet, $50.

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WHY EVERY SECOND IS NUMBERED WHEN "TIME MARCHES ON"!

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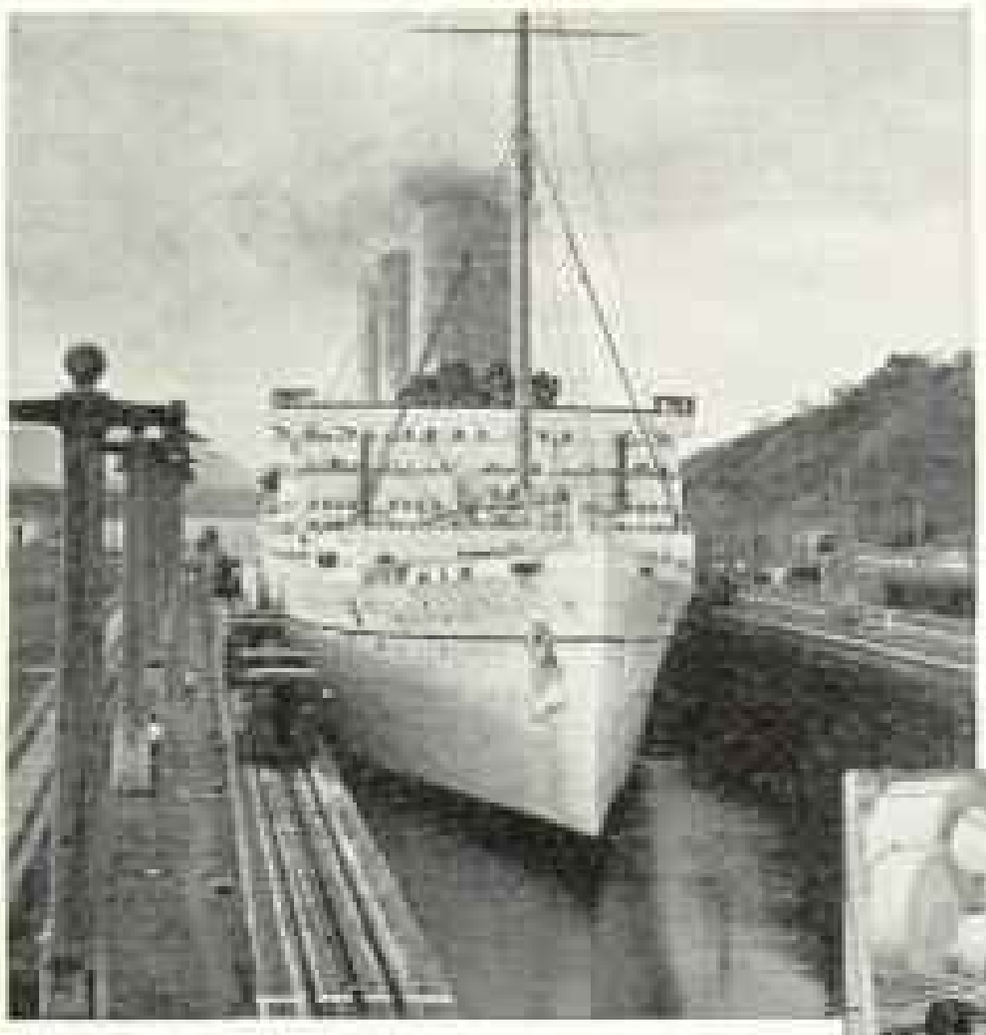

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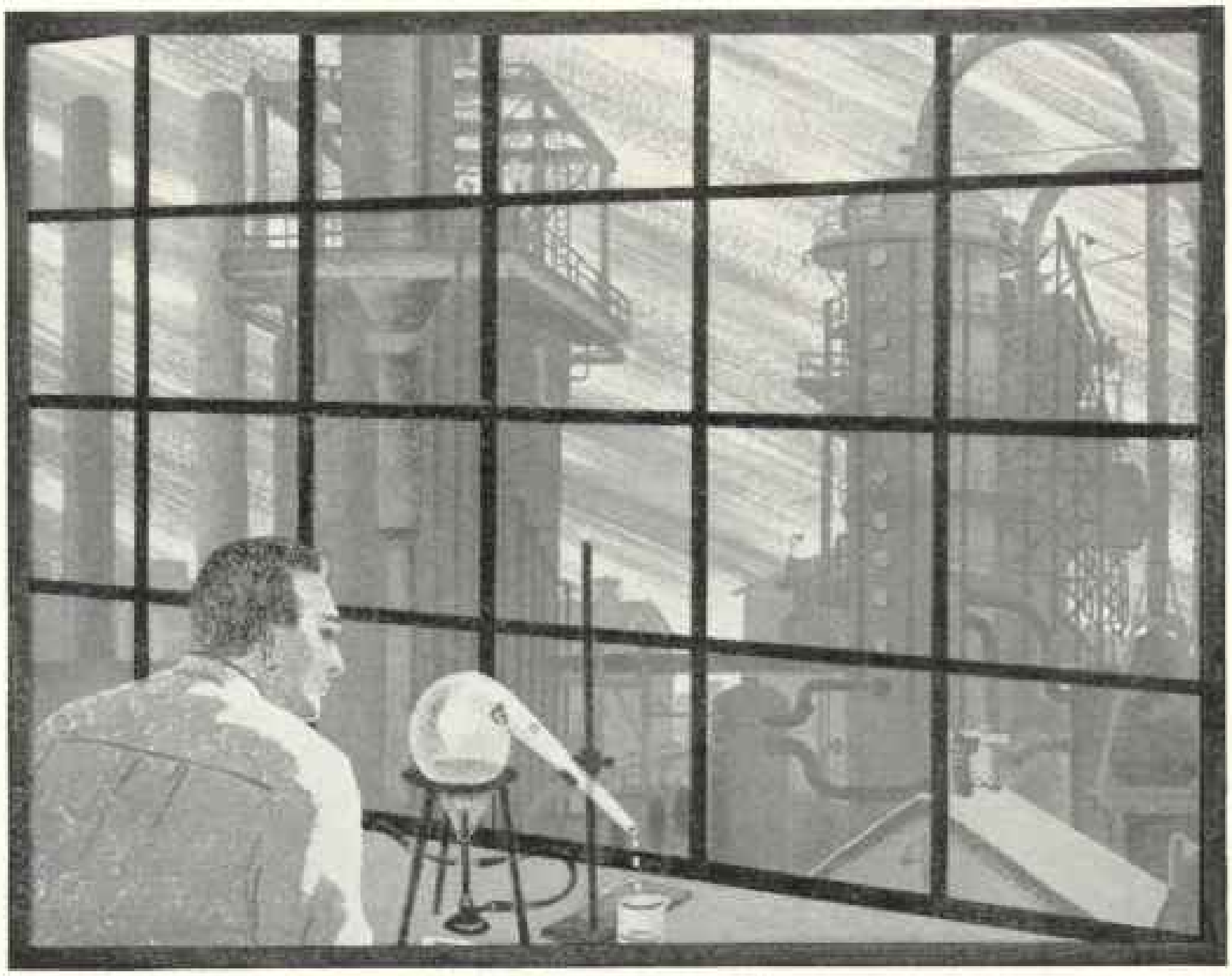

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B Life Guards* take a little longer to inflate because air passes gradually from "inner tire" to outer tube through this VENT HOLE

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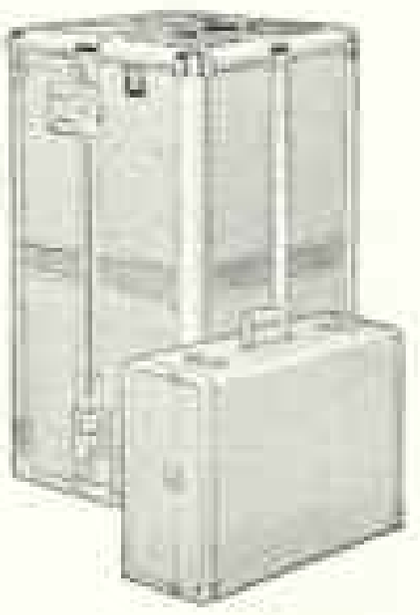

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The Flanders. Directly on boardwalk. American plan. Sea water swimming pools. 250 rooms with baths. June 20 to Sept. 10. J. Howard Sloeum, Mgr.

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All hotels listed on this page will welcome your request for descriptive literature . . . . . Write early, and when writing "Mention THE GEOGRAPHIC—It Identifies You."

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Battery Park Hotel. Five excellent golf courses, many scenic places to visit; entrance to Great Smoky National Park. A Knott Hotel.

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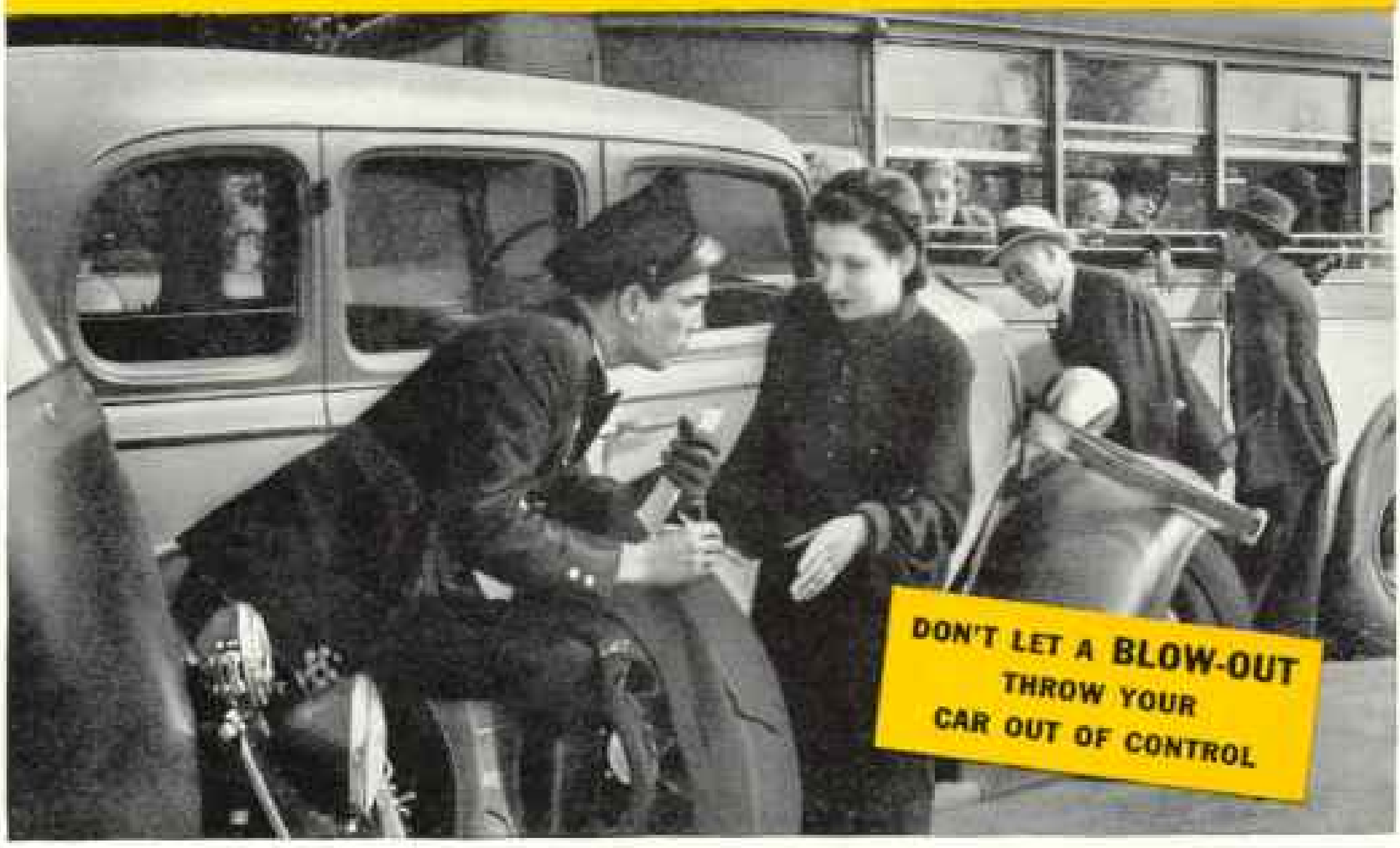

SILVERTOWNS ARE THE ONLY TIRES WITH THE LIFE-SAVER GOLDEN PLY

Woman Driver: "All I remember, Officer, is hearing a BANG! Then the car ran crazy. I guess I'm lucky it wasn't more serious."

Officer: "I'll say you are. Do you know that thousands are killed or injured in blow-out accidents every year?"

* * *

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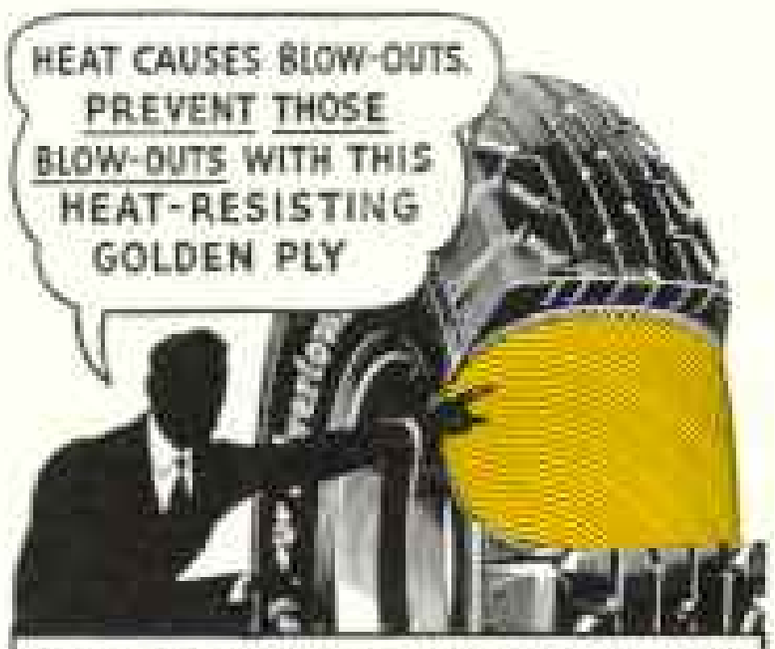

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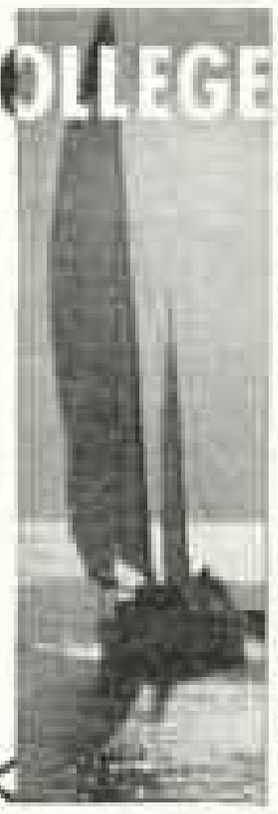

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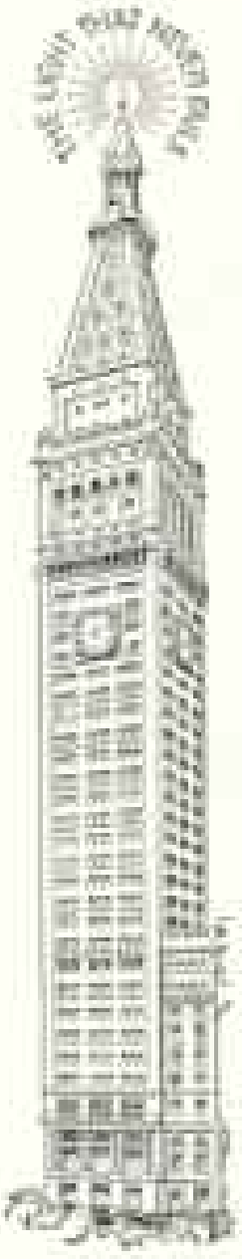

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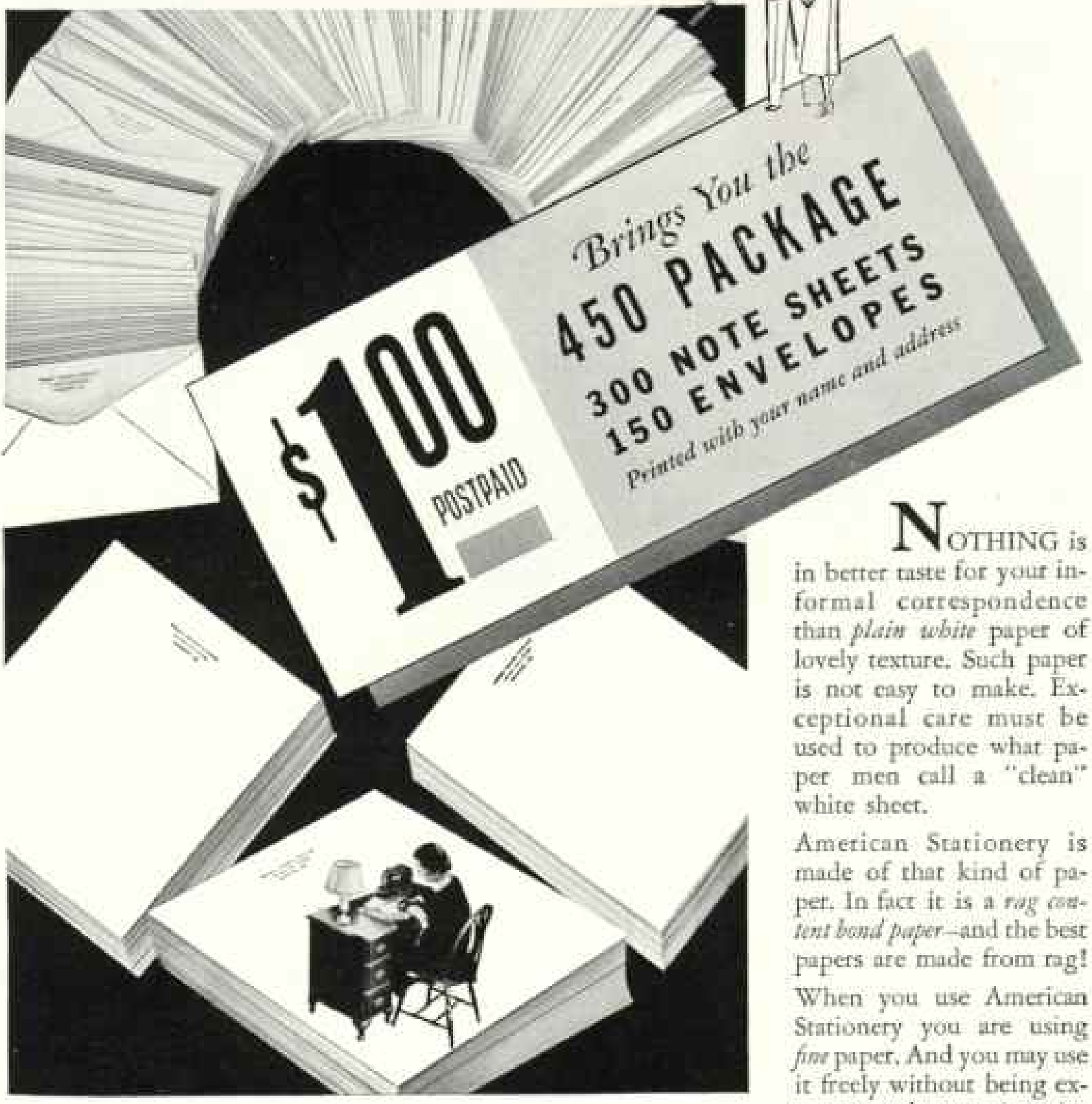

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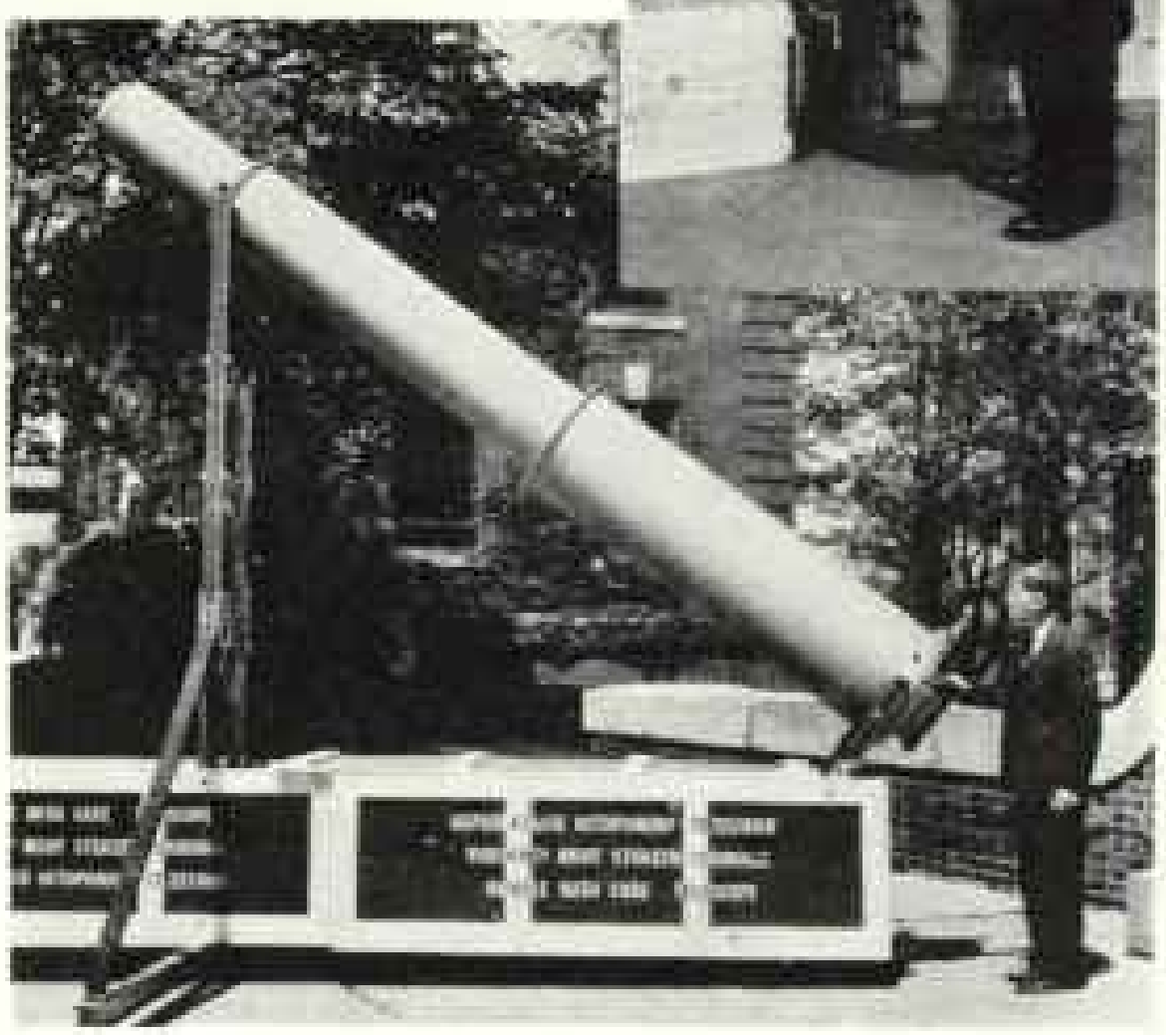
Right: Dr. Paul A. McNally, leader of the National Geographic Society-Georgetown University Expedition to Kustanai, Siberia, shown with telescope, part of 4 tons of astronomical apparatus.

Below: Dr. Irvine C. Gardner, leader of expedition to Ak Bulak, near the Caspian Sea, and a huge, 14-foot telescopic camera used to photograph the 1936 eclipse. This expedition was sponsored by The Society and the National Bureau of Standards.



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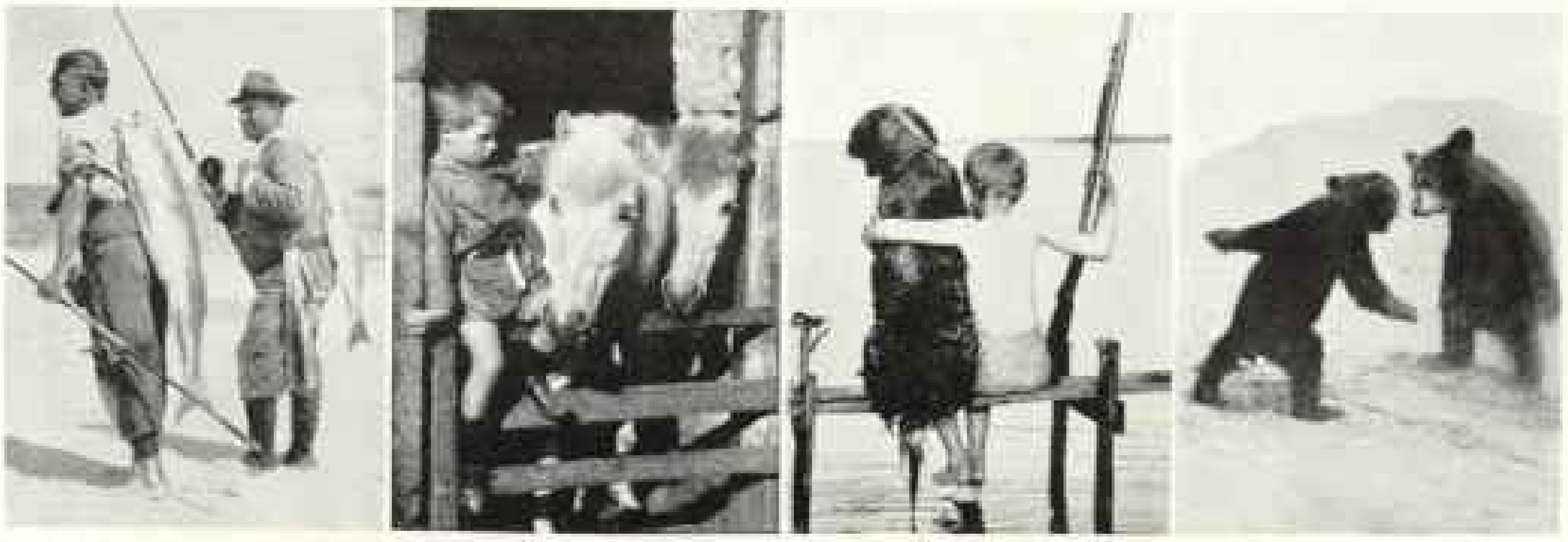

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Close hauled, sails high and full, in the almost imperceptible swell the white winged sloop carries a bone in her teeth.

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