VOLUME LXVI NUMBER TWO

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AUGUST, 1934

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THE NATIONAL GEOGRAPHIC MAGAZINE

MANLESS ALPINE CLIMBING

The First Woman to Scale the Grépon, the Matterhorn, and Other Famous Peaks Without Masculine Support Relates Her Adventures

BY MIRIAM O'BRIEN UNDERHILL

ALTHOUGH climbing the big rock and ice peaks of the Alps is a sport that gains immeasurably in interest, fun, and excitement from "doing it on your own," only recently has this been considered at all proper, even for men. For women to climb not only without guides, but without men companions, is still unusual. With a few exceptions,* women have never climbed alone.

The essence of guideless climbing consists in taking, oneself, the entire responsibility for carrying the climb through to a successful finish. This is a lot of fun, and I saw no reason why this pleasure should be closed to women, although some of my friends among the French men mountaineers tried patiently to explain to me why it was theoretically impossible for a woman to lead a mountain climb, taking the entire responsibility herself without at least masculine "moral support."

THE GRÉPON THREATENS AND ALLURES

I was unconvinced, however, and I persisted, albeit very privately, in my determination to do a big climb *sans hommes*.

Furthermore, I vowed it should be the traverse of nothing less than the most famous of the Chamonix Aiguilles, the Grépon itself! We should see whether women could climb on their own!

Of course, the Grépon—I barely acknowledged this ambition even to myself—was not to be thought of as a first manless climb. Though I had led it the year before (to "lead" being to go up first on the rope), I had taken with me a professional porter, a man capable of assuming the entire responsibility and doubtless certain in his own mind that he had done so.

Far more difficult than anything attempted before by women alone, though not to be compared with some recent climbs, the Grépon had counted for years as one of the hardest rock climbs in the Alps—one that even some of the licensed Chamonix guides cannot lead. It needed working up to.

The Peigne (about 10,500 feet), another one of the Chamonix peaks, seemed suitable for a beginning, since, while lower and less difficult, it is in many ways like the Grépon, with bold, sweeping, vertical lines and sheer granite walls. Women had climbed it with men, but never alone.

Fortunately, I had right at hand a friend, Miss Winifred E. Marples, of London, who felt as I did about manless climbing, and with her I set out. In the evening of August 13, 1929, we arrived at the little chalet of Plan de l'Aiguille, some 4,000 feet above Chamonix and just under the Peigne.

* The baronesses Rolanda and Ilona Eötvös, of Budapest, did several Dolomite climbs shortly before the war, and three English women, Miss Bray, Miss Dorothy Pilley (now Mrs. Armstrong Richards), and Miss Wells (now Mrs. Hurst), did some climbs in the Saas-Fee region in 1920.

Photograph by Miriam O'Brien Underhill

JUST LEAN BACK AND RUN DOWN

"Roping off" is a device for descending vertical pitches or others not easy to negotiate, but it cannot be recommended to the inexperienced or to those subject to dizziness.

We might have reached the same starting point by leaving Chamonix the next morning, in the first swinging basket on the Aiguille du Midi aërial railway, but we wished to get an earlier start, and thus avoid guided parties and escape the suspicion of benefiting by the experience of a good guide without paying for his services. Since this was our first manless climb, we purposed to do it absolutely unconducted.

ADVENTURE BEGINS WITH THE PEIGNE

Our landlord woke us for breakfast tea about 4 o'clock the morning of our climb, and we started off in high spirits, with our little candle lantern casting its beams feebly into the darkness. Having scouted a bit before going to bed, we knew the way over the grassy alplands to the rocky moraine along the right bank of the Glacier des Pèlerins. Our precaution insured us against the humiliation of getting lost in the pastures before daybreak and wasting valuable time.

It was not quite light when we reached the foot of the steep, snow-covered fan—the "cone of dejection" the French call it—to which the moraine leads; but on the snow we could see well enough to start up. The snow was frozen hard; our nails bit well; and, although the cone was steep, we could walk up it with just a nick from the ice ax now and then for a footstep.

We knew well enough that we ought to delay then and there to cut a good line of steps for use in descending that afternoon, when the snow would be softer and our nails would not hold. It is easier to cut steps going up, on the hard morning snow, than to lean far out from a precarious foothold on a steep slope and hack them going down, in the afternoon, while pieces of ice and rocks loosened by the sun come crashing down from the *couloirs*, or gullies, that drain the mountain walls.

Nevertheless, we neglected step-cutting and walked on up the fan toward the couloir that comes down from the Col du Peigne, thinking of the guided parties that would be right on our heels as soon as the first basket train came up from Chamonix. Let the guides cut their inevitable elephant-size steps to walk down in! We might as well keep our lead.

Crossing fairly easily the *bergschrund*, that large crevasse that almost always splits open where the lower-lying glacier separates from the main rock or snow mass

of the mountain, we reached the rocks at the side of the couloir. From there on it was just sheer fun, rock climbing on good firm Chamonix granite.

Finding the route was easy enough. We knew from the guidebook that it followed first the right and then the left bank* of the couloir from the Col du Peigne, a steep, narrow cleft rising nearly 1,400 feet above, between the walls of the Aiguille du Peigne and the Aiguille des Pélerins. For the details of the course, we followed in general the most likely looking line over slabs and up little cracks and chimneys, and we were gratified to find that the nail scratches on the granite rocks usually went the same way.

THE LAST FEW FEET THE HARDEST

Soon we were at the level of the Col du Peigne and facing the final wall of our peak. Here came the most difficult rock climbing of the day—a long, steep chimney, with good but sometimes smallish holds.

The guidebook had made me a little wary of this chimney by warning that it increased in difficulty as one ascended, and that the last 30 feet became especially delicate because of the rarity of holds. I therefore brought up my "second man" at fairly short and frequent intervals, employing that favorite dodge of the leader who is not quite sure of what is coming next.

In rock climbing that is at all difficult, only one person moves at a time, the others being in secure positions and always ready, should anything happen, to hold the rope. If the second or third man should fall, those above could usually check him almost instantly. If, on the other hand, the leader should fall, he would probably have to drop twice the length of the rope before the second man, below, could hold him.

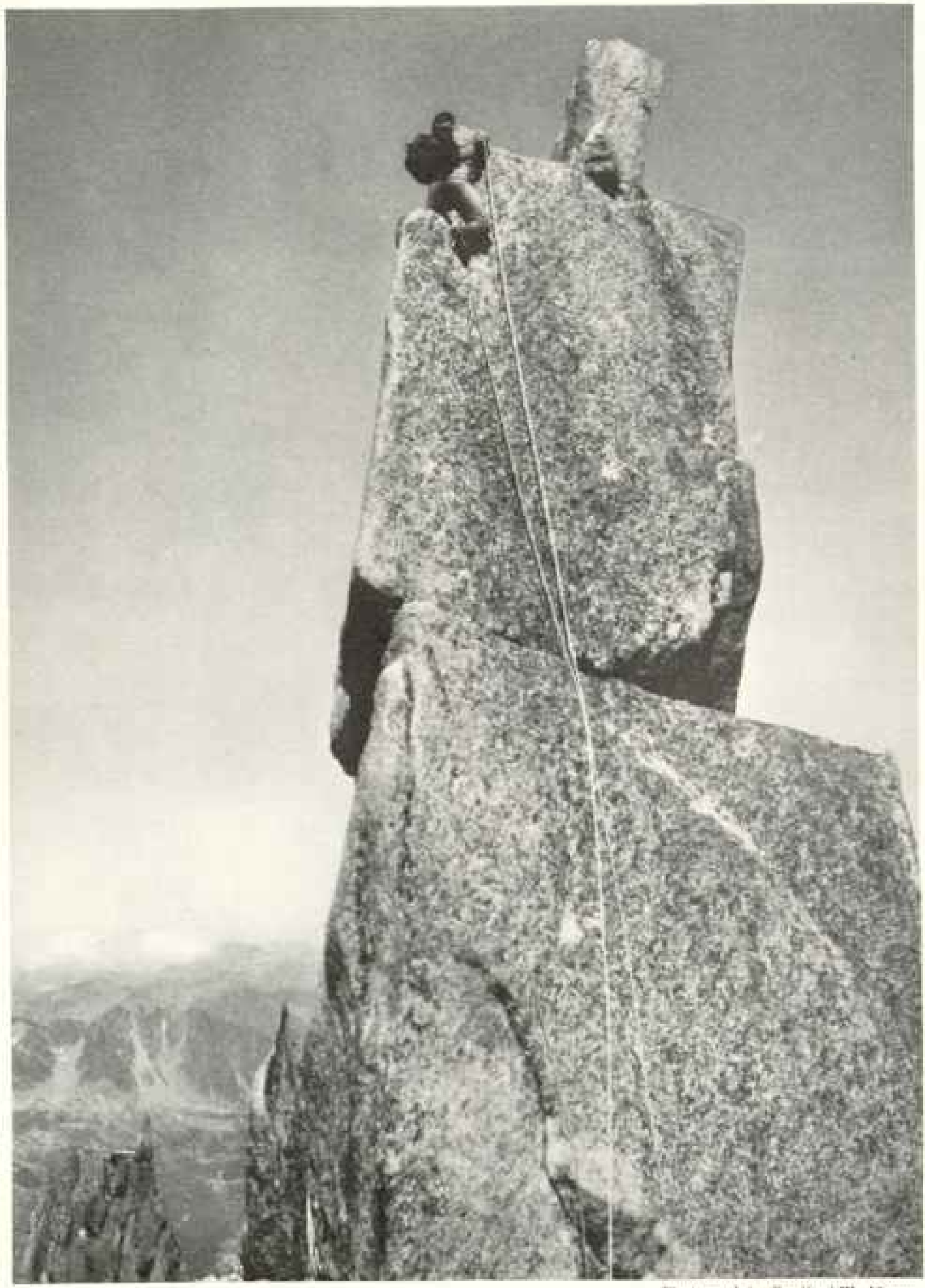
Nothing happened, however, and soon we were on the summit ridge, a narrow crest of huge, upstanding granite blocks. We scrambled joyfully along these and passed a pleasant half hour on the summit eating a mid-morning lunch and admiring the magnificent precipices of the aiguilles around us. Then we came down from the

* Right and left, as applied to couloirs—or glaciers, rivers, ice falls, etc.—are always taken from the point of view of the couloir. For instance, the right bank of a couloir running downhill toward the south would be on the west. As you go up the couloir, however, its right bank is to your left.

Photograph by Mrs. Dean Peabody

NO MORE HANDHOLDS!

To reach the top of this little spire in the Chamonix Aiguilles, the author climbed the ridge seen running up its center, clasping the camera in her teeth.



Photograph by Bradford Washburn

SOME FINESSE IS REQUIRED TO BACK OFF THIS BLOCK

Hanging the rope by its midpoint over the upper corner of the Grand Gendarme of the Grépon, the alpinist slides down astride the edge with one leg and arm on each side and holding one strand in each hand. If he falls to the left, he lands 3,000 feet below; if to the right, 5,000 feet. Good climbers are careful to hold on to both ends of the line!

farther end of the summit ridge, "roping off" a time or two (see illustration, page 132), and rejoined our route of ascent in the couloir.

When we reached the top of the snow fan, at the gully base, we suddenly realized that there had been no other people, guided or otherwise, on the mountain all day, and that we had no steps cut for the descent!

I was all in favor of taking the whole cone in a standing glissade, which is the same motion as skiing, only without skis. Miss Marples, however, objected on account of the piles of jagged rock at the bottom of the snow slope. She had slid into them once.

Retreating in the face of bad weather, on a previous attempt at the Peigne, she had been jerked out of balance on this snow slope by a gentleman, one who has since done, in the Himalayas, one of the biggest climbs that has ever been accomplished by man (even the gods slip up sometimes), and both of them had rolled into the rocks and got scratched up a bit.

We compromised, cutting down the upper half of the cone and glissading the lower.

"AN EASY DAY FOR A LADY"?

The Peigne having gone off well, in good time, and without any of the catastrophes that had been prophesied, I felt much reassured, even a little elated, and ready to take on the Grépon itself without further delay. Three days later, therefore, Madame Alice Damesme, of Fontainebleau, and I did the first manless traverse of the Grépon.

Mummery, the great English climber, who, in 1881, was the first to reach the summit of this peak, says: "It has frequently been noticed that all mountains appear doomed to pass through the three stages: an inaccessible peak, the most difficult ascent in the Alps, an easy day for a lady."

I must confess that the Grépon has not yet reached Mummery's final stage, and that the heading, "An Easy Day for a Lady," which the London *Times* put over the paragraph describing our climb of the peak, is not an altogether accurate description of the affair.

The summit ridge of the Grépon, approximately horizontal, resembles a crenelated wall with five or six spires or pinnacles. The sport consists in reaching this ridge at its north end and traversing over and around the pinnacles to the south, where one descends to the Col des Nantillons. On the west side the sheer granite wall drops in one sweep 3,000 feet to the Glacier des Nantillons, and on the east 5,000 feet to the Mer de Glace.

Mummery and his guides, Burgener and Venetz, had reached the summit of the Grépon from the north by essentially the same route as that used to-day. Four years later, in 1885, M. Dunod and his guides reached the summit of the Grépon by its southern ridge.

The first complete traverse of the peak (and the fourth ascent)—up the north side, over the summit ridge, and down the south—was accomplished in 1892 by Mummery himself with three friends, guideless, and in 1893 Mummery led a party over the Grépon that included the first lady, Miss Bristow, "who had ever stood on this grim tower."

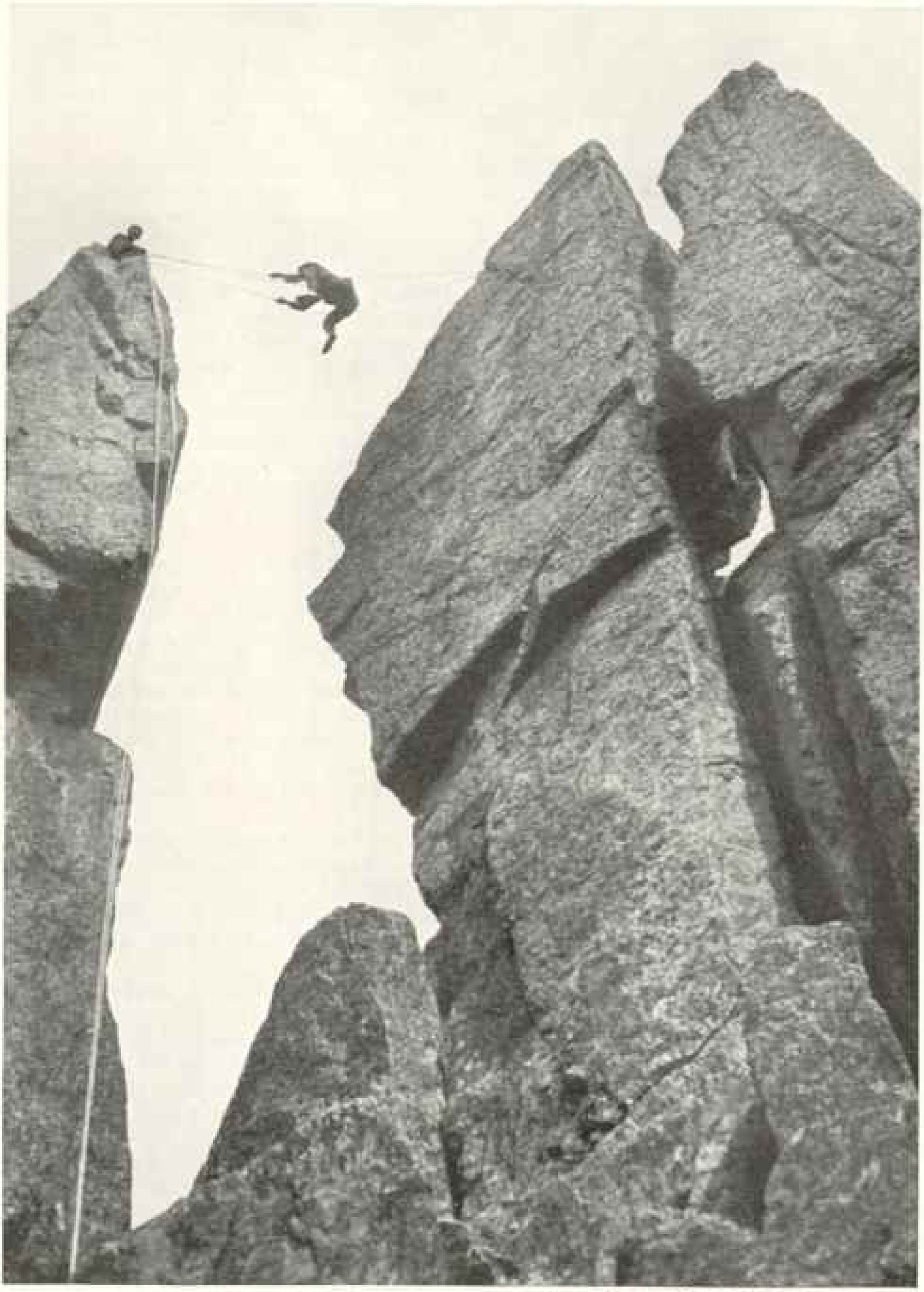
Alice and I left the Montenvers Hotel at 2:35 on the morning of August 17. At 5:40 we had reached the "breakfast place," the Rognon des Nantillons, a rocky promontory emerging from the lower end of the Glacier des Nantillons (see illustration, page 142). Several "caravans" were breakfasting together there; for as far as that point the routes to three aiguilles—the Charmoz, Grépon, and Blaitière—are the same.

Upon learning what Alice and I intended to do, all asked incredulously, "*Vous deux seules?*" and courteously attempted to conceal their smiles when we replied that indeed "we two alone" were essaying the Grépon.

They were good sports, however. As we left the Rognon they politely held back and allowed us to lead the way up the Glacier des Nantillons and on up the rocks—relatively easy except for one or two pitches—to the Charmoz-Grépon Col, the depression between the Charmoz and the Grépon where the serious climbing begins.

The wall of the Grépon rising above the Col looks unclimbable. It is unbroken except for a narrow crack between the main wall of granite and a half-detached slab that lies against it. This is the famous Mummery Crack, 60 feet high, and the only way from here up to the ridge (see illustrations, pages 156-7).

In 1892 Mummery, guideless, made his second ascent by this route, leading the crack himself. He wrote of it, "It is the



Photograph by Miriam O'Brien Underhill

IT WOULD BE "ONLY A COUPLE OF JUMPS," ANYWAY

The method demonstrated in this traverse between two of the Clochetons de Planpraz, above Chamonix, permits the conquest of an unclimbable tower. The alpinist lassoes the summit from an accessible eyrie and goes across on the rope. The start is the hardest, for he must force apart the two lines under his knees to keep from swinging around underneath. The improvised trolley sags when weight is put on it, making the take-off alarmingly downhill.

toughest bit of rock climbing I have ever attempted."

LADIES FIRST UP MUMMERY CRACK

At the Col we found two climbers who had come over the Aiguille des Charmoz—Armand Charlet, Chamonix's best guide, and Mr. Guido Alberto Rivetti, of Biella, Italy. This party should naturally have preceded us up the crack; but, knowing well that we would like to go ahead, Armand announced that they were stopping at the Col for a lunch.

A few of the younger and better guides take a most sportsmanlike attitude toward the "sans-guides." Keen climbers themselves, they appreciate the spirit that makes people wish to do climbs on their own. I do not believe they feel seriously worried that women, at any rate, will take many of their jobs away from them!

Since I had led the whole climb, with a porter behind me, the summer before and Alice had never led it, we readily agreed that she should have the privilege of going ahead. She (in 1929) and I (in 1928) are the only women who have led the Mummery Crack.

The crack is climbed by jamming in the right hand and the right foot and alternately raising them, first supporting the weight on the foot and working the hand higher; then holding everything on the jammed fist and lifting and again wedging the foot. The left hand feels over the outside of the slab, clinging, as Mummery says of another of his climbs, to slight "discolorations in the rock." The left foot, useless, swings in the air.

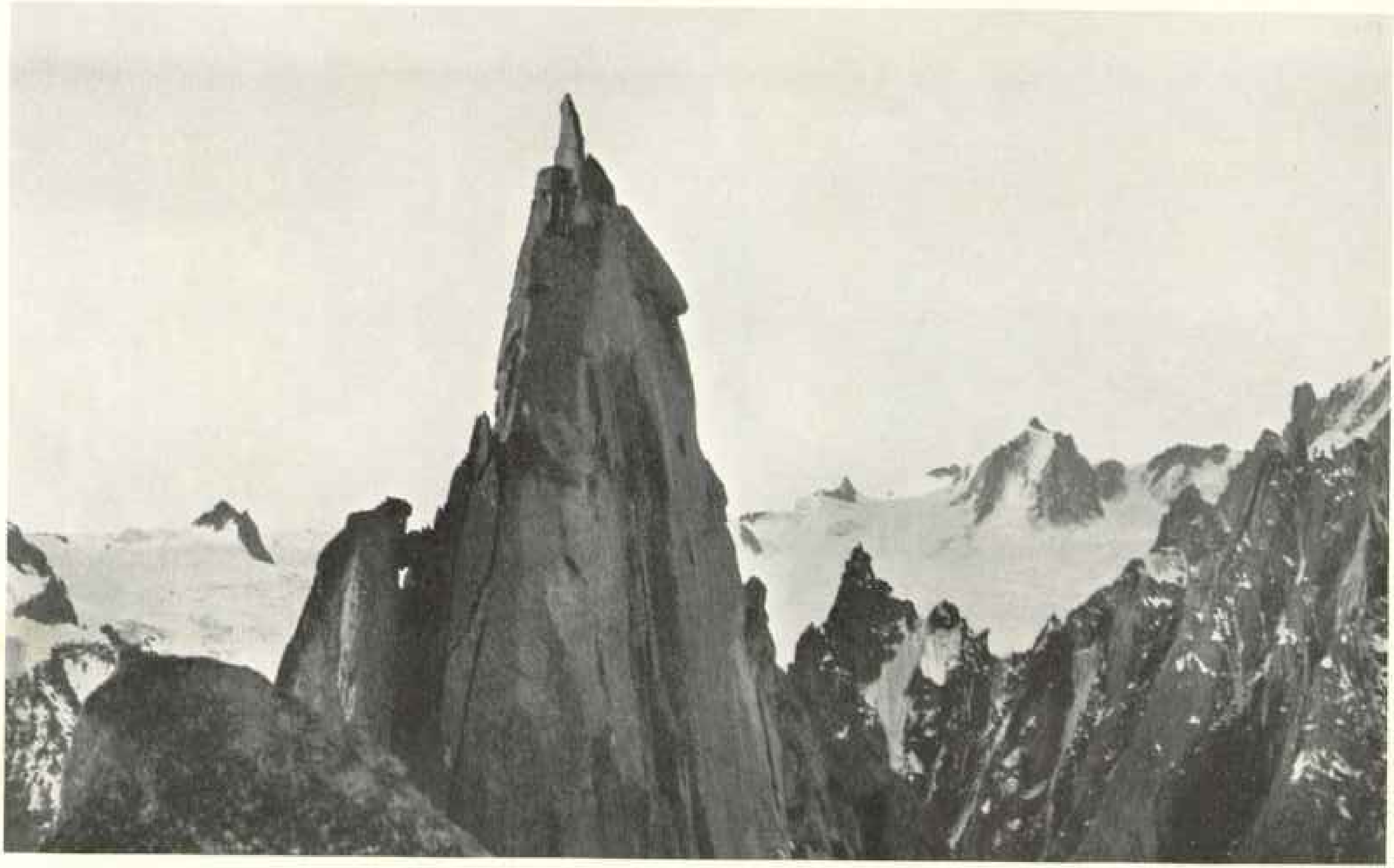
Photograph by Robert L. M. Underhill

NO TRUE MOUNTAINEER LEAVES THESE BEHIND

Modern ice axes are about the height of a comfortable cane, considerably shorter than those formerly used. A large rucksack, partly filled, "rides" better than a smaller one, stuffed. For coolness, the rope is often worn between the bag and the climber's back, or, as here, tied on the outside. There is never room for it inside.

It is hard, strenuous work, particularly at the bottom, where the crack overhangs slightly, so that the climber is leaning backward as he works his way painfully up. After about 30 feet, there is a platform, a small outward-sloping shelf, where he can rest. Above that the crack becomes wider and not quite so difficult, although still very fatiguing.

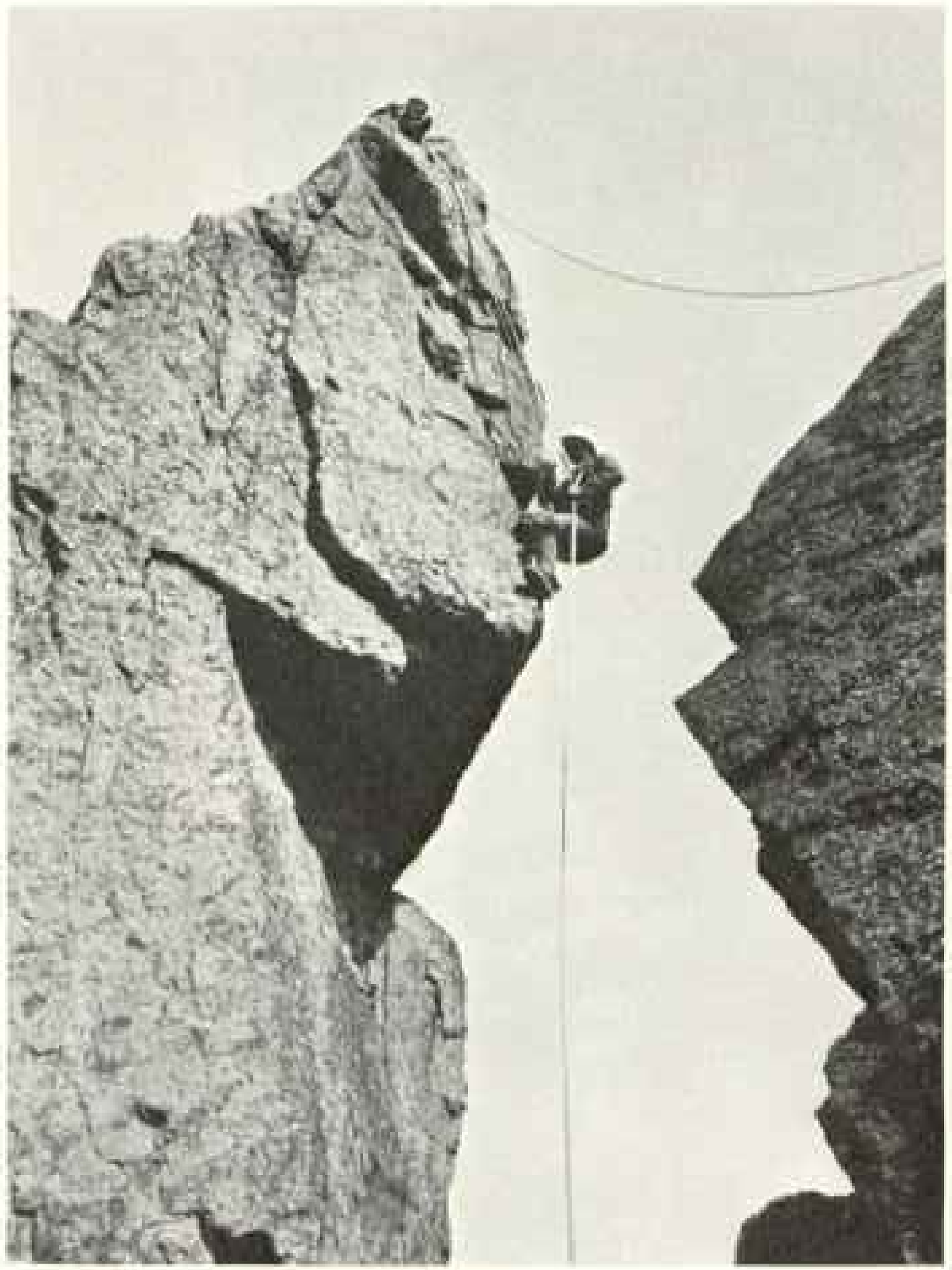
Non-climbers often ask me how a woman can be strong enough for exertion that would tax an "athletic young man." Strange as it may seem, physical strength is a relatively unimportant part of the equipment



Photograph by Capt. Albert H. MacCarthy

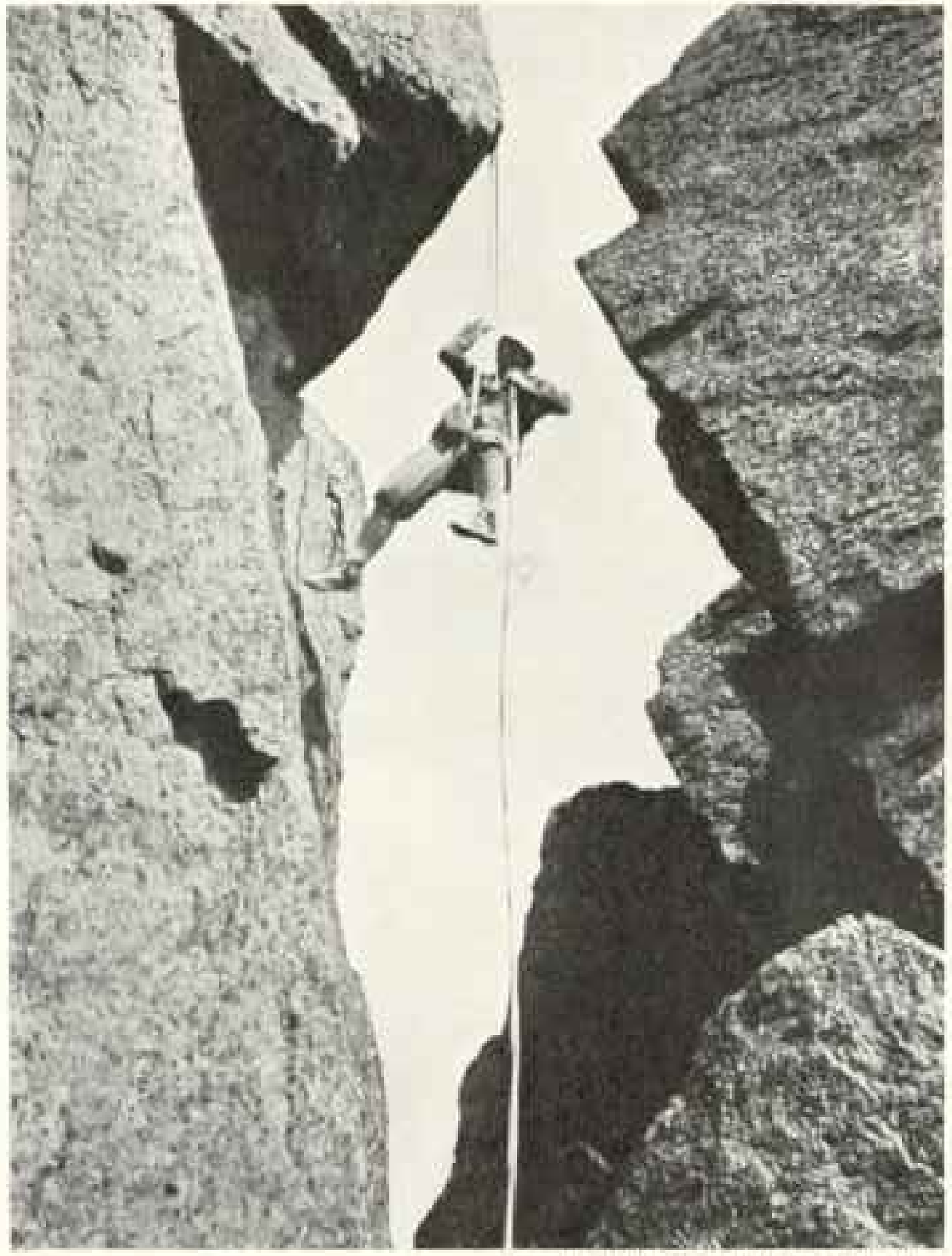
THE GRÉPON THRUSTS UP LIKE A JAGGED SPEAR HURLED BY A TITAN

It defied all attempts to climb it until 1881, when it was finally conquered by the British mountaineer, A. F. Mummery. The author's party have been the only women thus far to make the ascent without masculine aid or accompaniment. On the left ridge is seen the "Cannon Hole," through which one passes shortly after negotiating the Mummery Crack (see pages 156, 157). On the right is the sheer west face that drops 3,000 feet to the Glacier des Nantillons.



THE NEXT FIVE FEET ARE THE MOST NERVE-RACKING

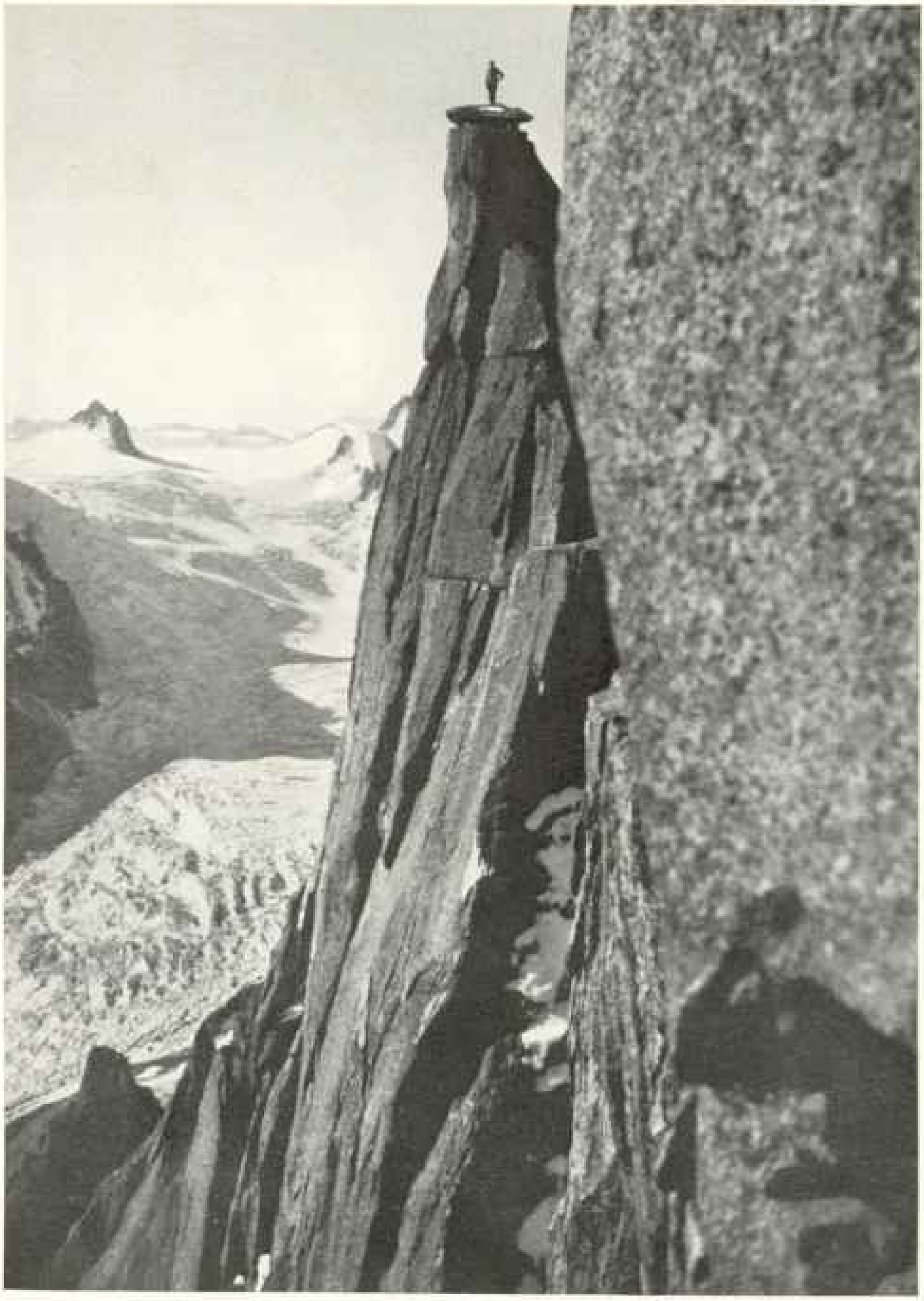
Roping down one of the Clochetons de Planpraz, above Chamonix, Florence Peabody is sliding with her feet against the rock, but after she passes the overhang there will be no wall within reach.



Photograph by Miriam O'Brien Underhill

WITH THE ROCK OUT OF REACH, ONE SHOULD GO DOWN FAST

The twist of the rope usually causes the climber to spin when roping down in the open. Therefore, after passing the overhang, she hurries to reach the bottom before becoming dizzy (see page 136).



Photograph by Bradford Washburn

THE GRÉPON PROVIDES A LUNCHEON TABLE FOR ITS CONQUERORS

The triumphant mountaineer is standing on the summit, a large flat rock, which he has reached by climbing up a crack. Five thousand feet below, to the left, is the crevassed Glacier du Géant, and in the background the Col du Géant, on the Italian frontier. After the author and companion had accomplished the ascent of this needle, a famous man mountaineer announced sadly that the Grépon had "disappeared" (see text, page 146).

necessary to lead the Mummery Crack or most other Alpine climbs, for that matter. A certain muscular vigor is indispensable, of course, as indispensable as having a right arm and a right leg and just as elementary; but technique, knowing how to use strength to the best advantage, is more important. The greater the technique, the less the power required. Of the many "athletic young men" in the valley of Chamonix, few lead the Mummery Crack.

No one who goes up first without the security of a rope from above can make the slightest slip, the slightest miscalculation, in climbing at least the upper part of the Mummery Crack, and live through it. The climber knows this well, as he clings there, looking down at his friends 60 feet below and then at the jagged precipices hundreds of feet beneath them.

NERVE CONTROL INDISPENSABLE

He cannot get panicky. He cannot allow his muscles to become tense and thus needlessly use up energy. Because there is real danger of becoming stuck, he cannot jam himself too far inside the crack in the almost instinctive effort to "get in out of the view," but must keep well outside, where progress is easier. He cannot hurry; he must be just as calm and cool and unflustered as if nothing whatever depended on his getting up.

Alice was perfect. She climbed that crack with the poise and assurance of a lady crossing her drawing-room floor, and we all cheered when she reached the top!

The person who climbs the Mummery Crack with a guide, professional or amateur, knows nothing of all this. Held by a reliable rope from above so that the penalty for failure is reduced from everything to nothing, he struggles merely with the physical difficulties—and loses, in my opinion, a major part of the fun of the climb.

After the Mummery Crack we had a delightful series of rock problems, as we climbed up and down over the different towers—overhangs, narrow tunnels, small ledges, smooth blocks, and all the rest. Each problem called for its own technique and all of them used many muscles.

One of the towers, the Grand Gendarme, is a huge squarish block resting on another smaller block, and the distance down to the gap on the farther side is some 50 feet. The descent is made by "roping down"—that is, by hanging the rope by its midpoint over the top of one of the vertical edges of the upper block and sliding down this edge with one leg on each side, holding one strand of the rope on the left wall and one on the right (see illustration, page 134).

The start is sensational, a backing off into space with a drop below of half a mile! I have seen climbers hesitate for a long time before managing to do this, even when they were held firmly on a second rope by a guide above.

Neither Alice nor I had any anchoring rope when we backed off here. We had not wished to carry two ropes, and our climbing rope of 150 feet was needed for the rope-off.

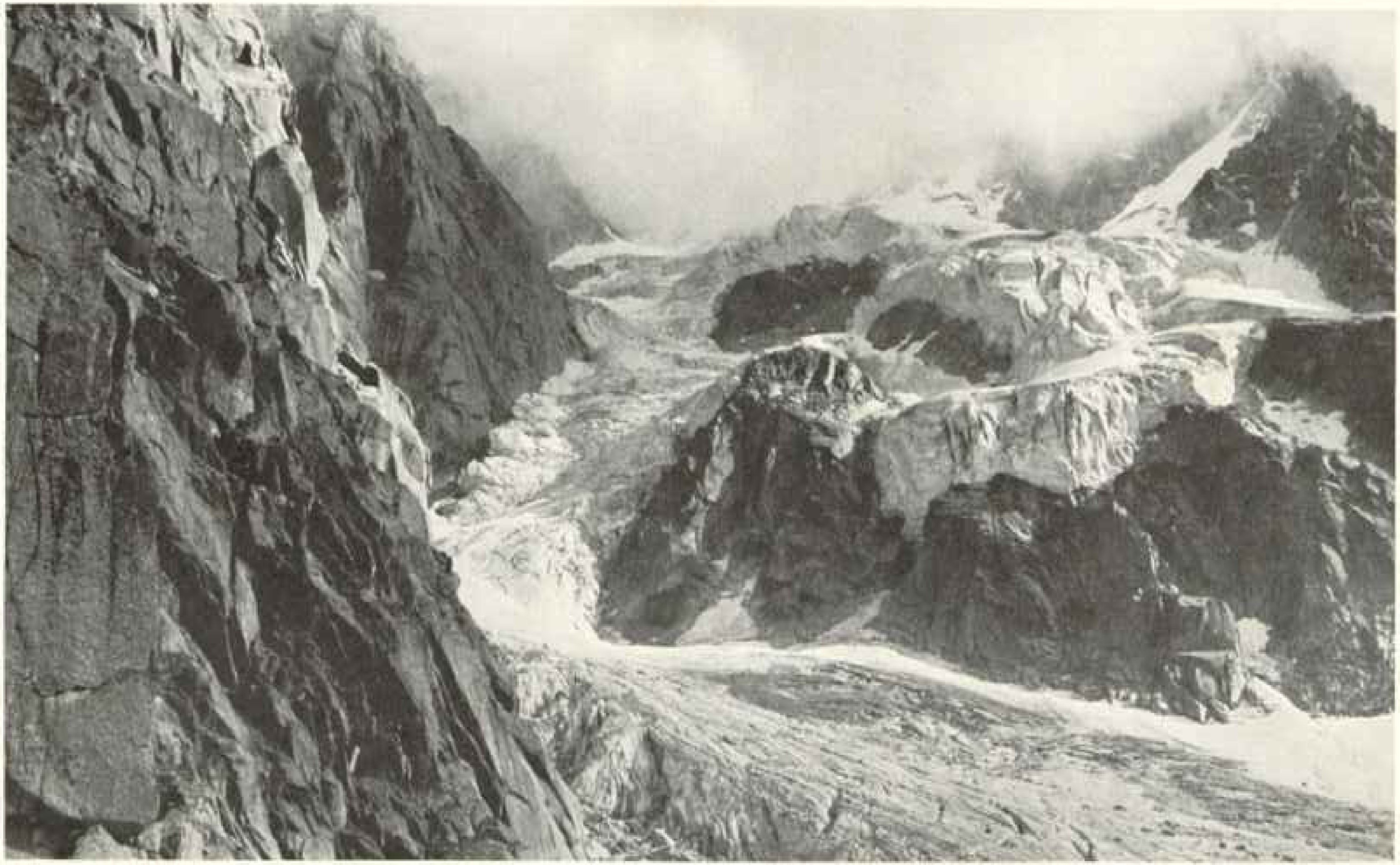
The actual summit of the Grépon is a large flat rock (see illustration, opposite page). Here we all had lunch together—Mr. Rivetti, Armand, Alice, and I—while my mother and Alice's small daughter watched us through telescopes from Chamonix (see illustration, page 170). Lunch was made entertaining by the facetious Mr. Rivetti, who delivered an impassioned oration on the humiliation suffered by a man, and a man who had always considered himself a good climber, at being escorted over the Grépon by a guide on such a day as this.

Leaving the summit at half past 10, we roped off again, on the Mer de Glace side, where the drop to the glacier is a vertical mile. For roping off there are different methods of arranging the rope around the body to give varying degrees of friction, but in any case one should lean well back, keep the hands up and the feet slightly apart for better balance, and then run lightly down (see pages 132 and 144).

LETTING GO OVER A MILE DROP

At this particular place it is necessary to go down over rather a large overhang, and as the feet step over the overhang, and the body naturally swings in toward the rock, there is danger of scratching the hands against the edge of the rock (see illustration, page 165). The way to avoid this is to let go of the rope just above the edge of rock and quickly grab it again underneath.

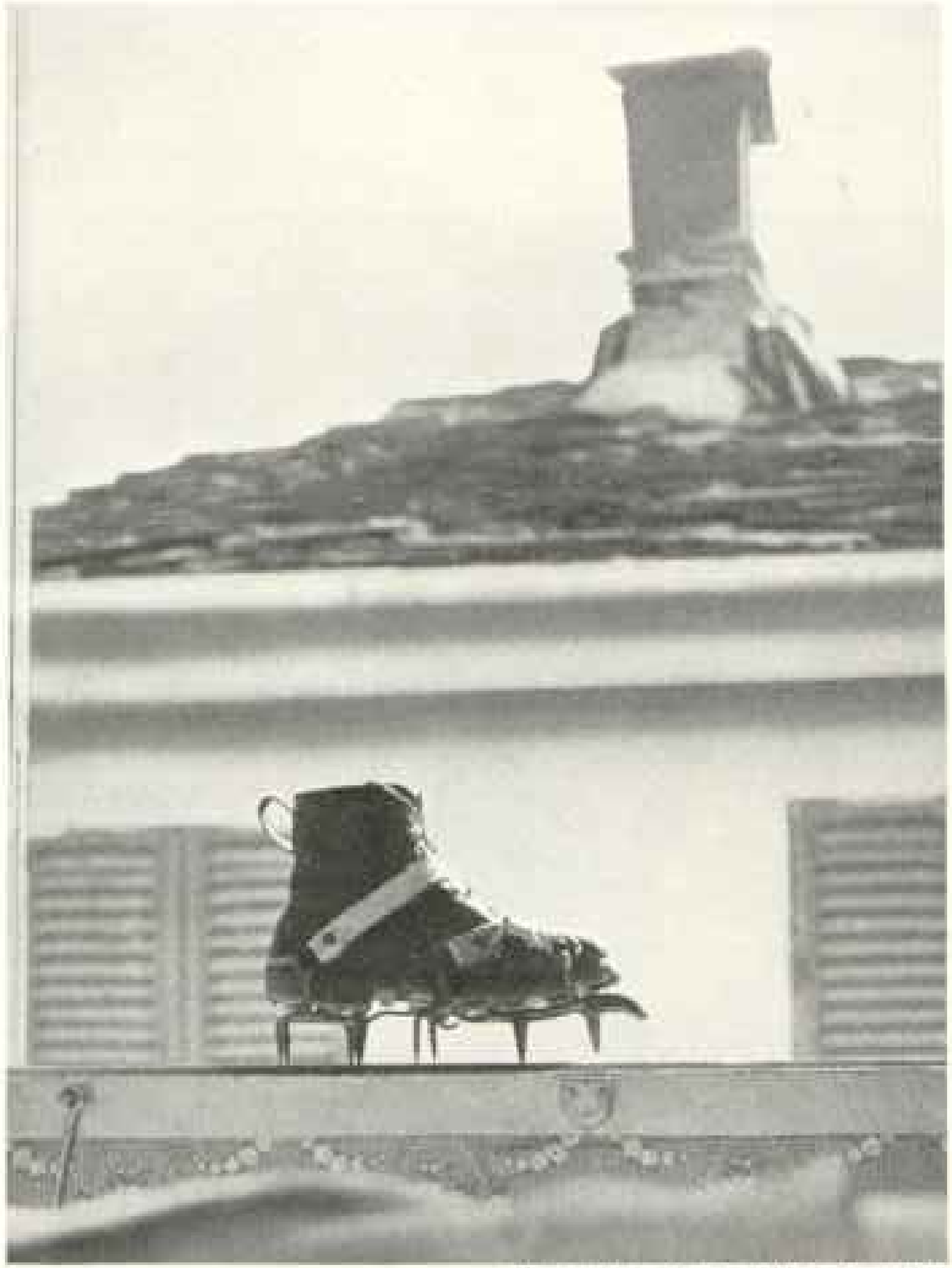
Once at the Col des Nantillons, the rock climbing is over, and from there down to the Rognon one follows the rather steep Glacier des Nantillons, crossing a few crevasses on the way (see illustration, page 145). At one point it is necessary to pass



Photograph by Miriam O'Brien Underhill

CLIMBERS HURRY A LITTLE BENEATH A HANGING GLACIER

Before the ascent of the Grépon (partly hidden by clouds in the left background) begins, there are several hours of laborious walking up the Glacier des Nantillons, the stream of ice and rock flowing down this valley. Parties usually pause for breakfast on top of the rocky promontory in the center. From here they pass the base of dark cliffs, over which hangs a jagged glacier (upper center). Masses of ice break off from time to time and are considered dangerous to climbers (see pages 141 and 143).



Photograph by Miriam O'Brien Underhill

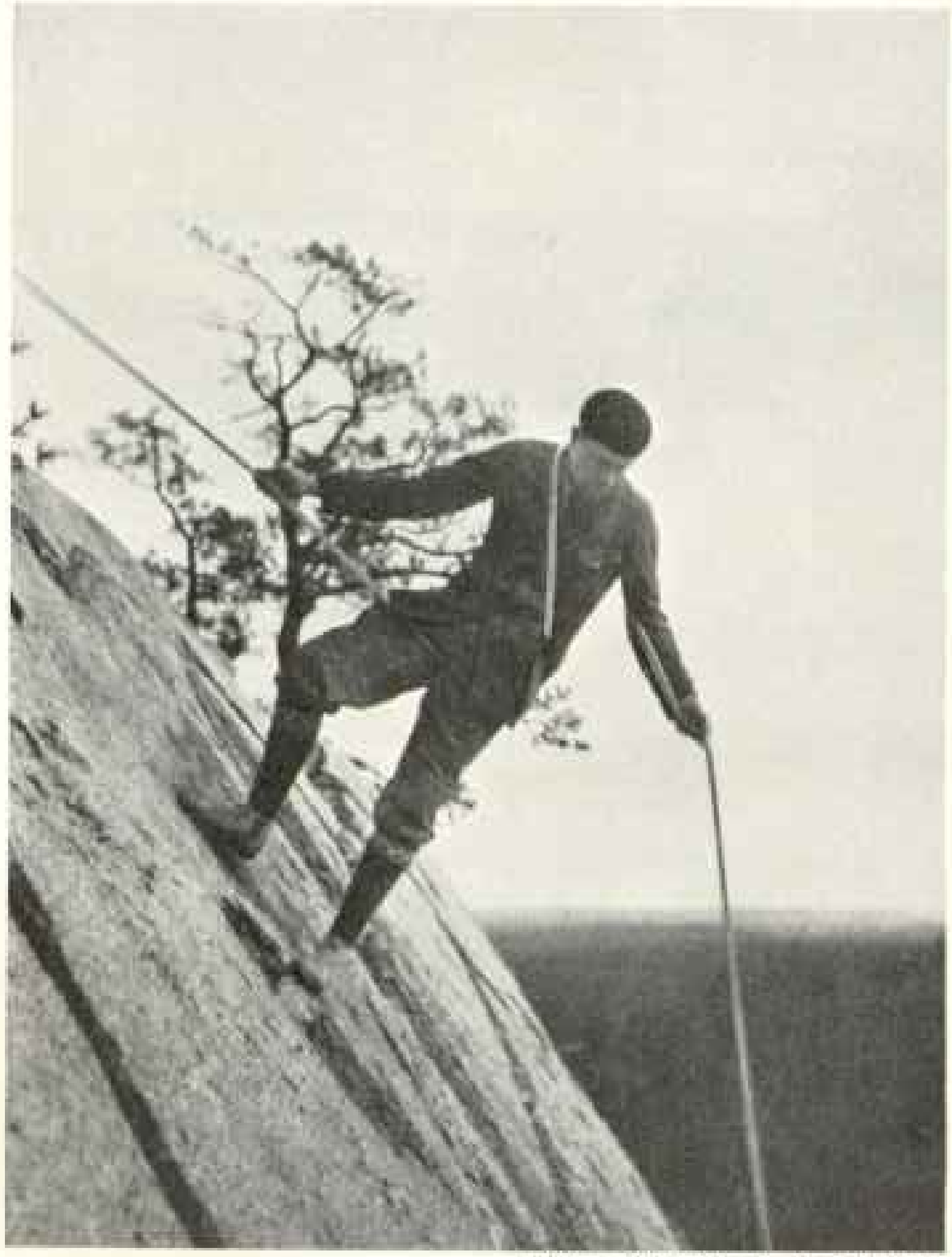
LADY CLIMBERS HAIL THIS AS FASHIONABLE WEAR

The heavy 12-point crampon designed by Grivel, of Courmayeur, Italy, lessens slipping on steep ice climbs. Iron spikes on a steel framework are hand-forged to fit the boot, and the device is fastened on by webbing or leather straps. Because her companion forgot her crampons, the author's climb on the Mönch was difficult (see page 155). On ascents over mixed ice and rock, a model without the two front prongs must be used.

© Donald McLeish

SWISS ALPINE CLUB HUTS ARE CLEAN AND COMFORTABLE

Built high on the mountain sides, they enable climbers to make ascents and get back without sleeping in the open; but quarters may be crowded. Jessie Whitehead loved to shock her friends by telling them she slept in a tiny Alpine hut next to a young man who kicked her all night. The braided rope hanging from the rafters is not considered good equipment nowadays and the ice ax is too long.



Photograph by Robert L. M. Underhill

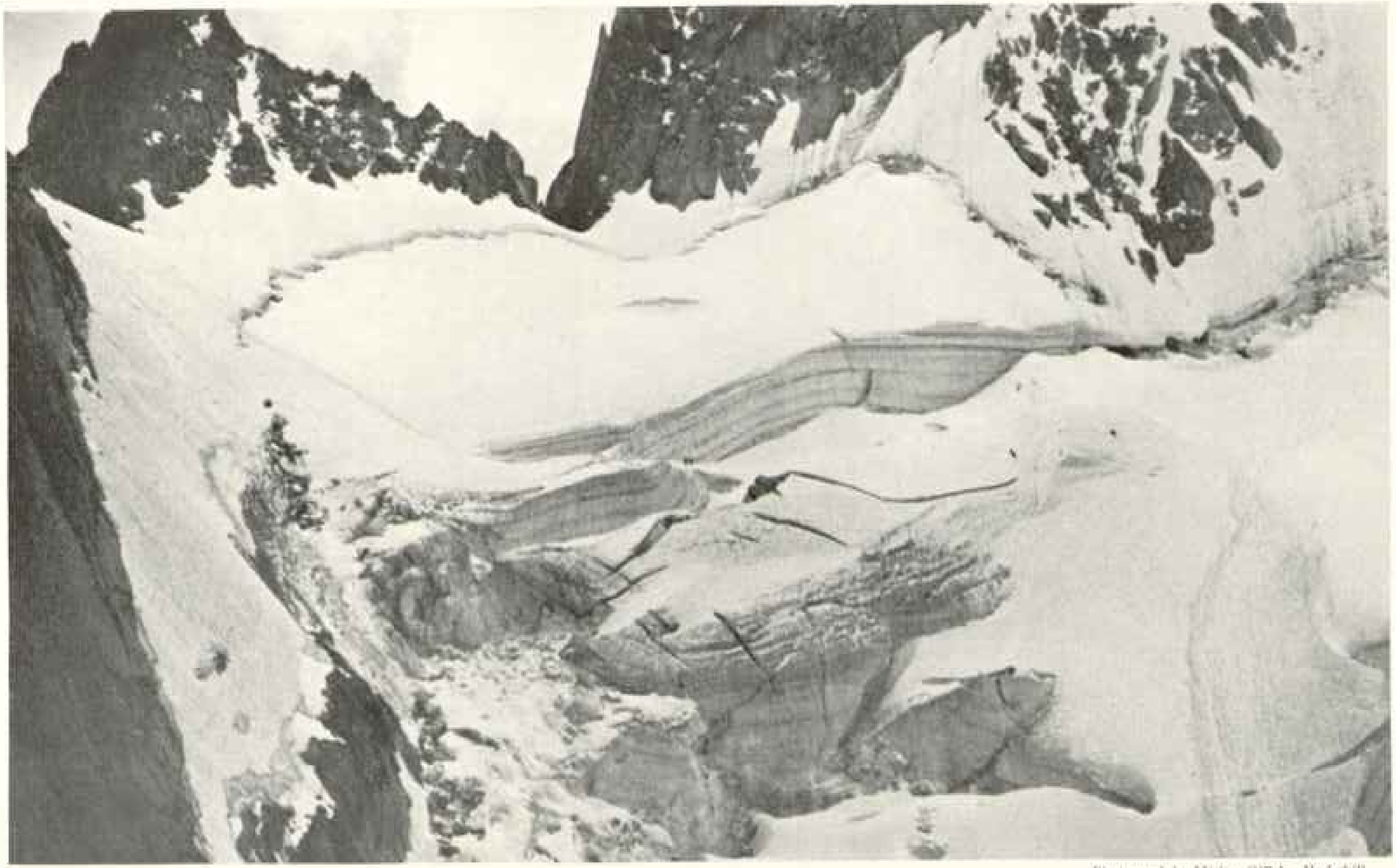
"ROPING OFF" THUS, ONE MAY GET HOT UNDER THE COLLAR

As the man runs down, the rope sliding around his body affords so much friction that little weight is carried on the hands, but the neck must be kept covered. To go faster, he pulls up the free lower end.

Photograph by Micheline Morin

A LADDER MADE EASY THE WORST JUNGFRAU CREVASSE

Though the guides had removed most of the hazard, there was still a bulge of ice on the upper lip. The author had to cut a few holds to climb out over this.



Photograph by Miriam O'Brien Underhill

CLIMBERS MUST TEST EACH FOOTSTEP AMONG THE CREVASSES

When crossing a crack by a bridge of snow, they constantly feel out the firmness of the footing by thrusting ahead with the ice ax (see text, pages 141 and 160). Two persons are seen here crossing such a precarious span on the Glacier des Nantillons, approximately in the middle of the picture.

along the base of some cliffs with a hanging glacier projecting over them, from which huge blocks of ice break off from time to time (see illustration, page 142). One's pace usually quickens a bit here.

We reached the Rognon again at five minutes after 1, and there waited for Maurice Damesme (Alice's husband), Winifred Marples, and René Picard, who had done the traverse of the Grands Charmoz that day. That morning Alice and I had left our crampons rather too high up on the glacier, at the foot of the rocks below the Charmoz-Grépon Col, and we should have been obliged to climb up again a considerable distance to fetch them, had these others not brought them down to us. It is rather convenient, I have noticed, when doing this manless climbing, to have a husband or two around to gather up the loose ends!

That evening some friends arrived in Chamonix and asked for the latest news. "The Grépon," replied Etienne Bruhl, "has disappeared." To their astonished protests he explained that, while there might still be some rocks standing where the Grépon used to be, the climb no longer existed; for no self-respecting man could undertake it, now that it had been done by women alone.

The next season I was able to do only one manless climb, the Torre Grande, in the Dolomites, one of the towers of the Cinque Torri group near Cortina d'Ampezzo. Miss Marjorie Hurd, of Cambridge, Massachusetts, was my companion on this adventure.

I should like to do more manless climbing in the Dolomites, since it has long been one of my favorite regions in the Alps. Dolomite climbing is rock climbing *par excellence*. The rock is a magnesian limestone, very firm and solid, often almost vertical in its forms, but so broken up into little projections and hollows, resembling in texture a solidified sponge, that steeper and more startling routes are possible on it than in most mountain regions.

KING ALBERT'S FAVORITE CLIMBS

For these reasons, no doubt, the Dolomites were long a favorite climbing ground of the late King Albert of the Belgians, an excellent mountaineer and a particularly brilliant rock climber. Of course, he visited other climbing regions as well—Courmayeur, Chamonix, the Engelhörner—but almost every September he was back at Tre Croci, just above Cortina, for a round of his favorite sport. Queen Elizabeth occasionally did some of the easier climbs, but not in the last year or two.

The King was once climbing in the French Alps when I was there with French friends, and extended an invitation to some of the best climbers among the Frenchmen to get up a guideless expedition. The climb did not come off because of unfavorable weather, but the chosen ones were primed as to the proper etiquette. Formality, it seemed, diminished with altitude; so that when one got to a mountain hut it was necessary to use only ordinary courtesy in passing His Majesty the omelet, while out on the climb itself all restrictions were thrown aside and one could "swear at him as if he were one's most intimate friend." The true sporting attitude!

I never saw King Albert in the Dolomites, partly because he went there in September and I preferred my Dolomites in the spring. It is just as well, perhaps, that we were not there at the same time, because we should both have wanted the same guide, Angelo Dimai, the best rock climber I have ever seen. I did a great many of the climbs enjoyed by the King.

Once when Angelo and I were making the first descent of the Spigolo (ridge) of Punta di Fiammes, a route which we had already ascended some years previously, I saw a *piton** firmly driven into the rock at a traverse where a slip would have entailed an awkward pendulum. I remarked that this safety device had not been there when I had last seen the place.

Angelo replied that he had put the piton in when he had taken the King of the Belgians up this route, because—very gravely and seriously—"when I am climbing with the King of the Belgians I don't want to have any accident. Of course," he added quickly, with a twinkle, "when it's only you, I don't care."

The closest I ever came to the King of the Belgians was in Angelo's guide's book, where for several years our signatures followed each other on alternate pages: "Albert, roi des Belges . . . Miriam E. O'Brien . . . Albert, roi des Belges . . . Miriam E. O'Brien."

Every Dolomite guide, like those in many other Alpine regions, has an official notebook containing his guide's license, printed

* A piton is an iron spike with an eye through which the rope can be assured by means of a snap-ring.

 Natural Color Photograph by Hans Hildenbrand

OLD FRIBOURG, LOOPED BY THE SARINE RIVER, SEEMS A MOATED CASTLE

The weathered buildings of this stream-guarded city cling to steep hillsides, many of the lower windows overlooking the valley, being below the level of the narrow, crooked streets. Dominating the scene rises the 13th-century Gothic cathedral, St. Nicholas, which houses a remarkably pure-toned organ of 7,800 pipes.

Natural Color Photograph by Hans Hildenbrand

FIVE CENTURIES AGO A HEROIC LITTLE BAND SAVED WERDENBERG CASTLE FROM AN INVADING HOST

To-day, descendants of the warriors live in the old gabled houses of the village, cultivate their vineyards and orchards, and make the fine lace and embroidery for which Switzerland is famous.

Natural Color Photographs by Hans Hildenbrand

IN SWITZERLAND 24 DISTINCT TYPES OF COSTUMES ARE PRESERVED FOR FETE DAYS

Each of the 22 cantons, of which two are partitioned into independent halves, has its peculiar style of dress for both sexes, as well as separate parliament, local government, and officials. The girls on the left smilingly present the garb of the Inner-Rhoden division of Appenzell. Costly chains of chased silver or gold, attached to the guimpe, flash against tight velvet bodices. On the right, a daughter of Samaden in Upper Engadine displays her frock of warm cloth suitable to the rigorous climate (compare Color Plate VI).

THE NEW ROYAL HUT STANDS ON AN ISLAND IN A RIVER OF ICE

Climbing enthusiasts who prefer exploits not too dangerous find delight in the trip up the crevassed Pers Glacier in Upper Engadine. They can rest in comfortable quarters of the shelter before essaying the final drive to the summit.

 Natural Color Photographs by Hans Hildenbrand

GIRLS DRESSED LIKE THESE SAT ON THE SAME BALCONY CENTURIES AGO

Exquisite wood carving, such as that on the arches supporting this roof, distinguishes many ancient homes in Schuls, Lower Engadine. The young ladies' costumes probably are new, but they follow faithfully the old style peculiar to inhabitants of the half-canton (see Color Plate III).

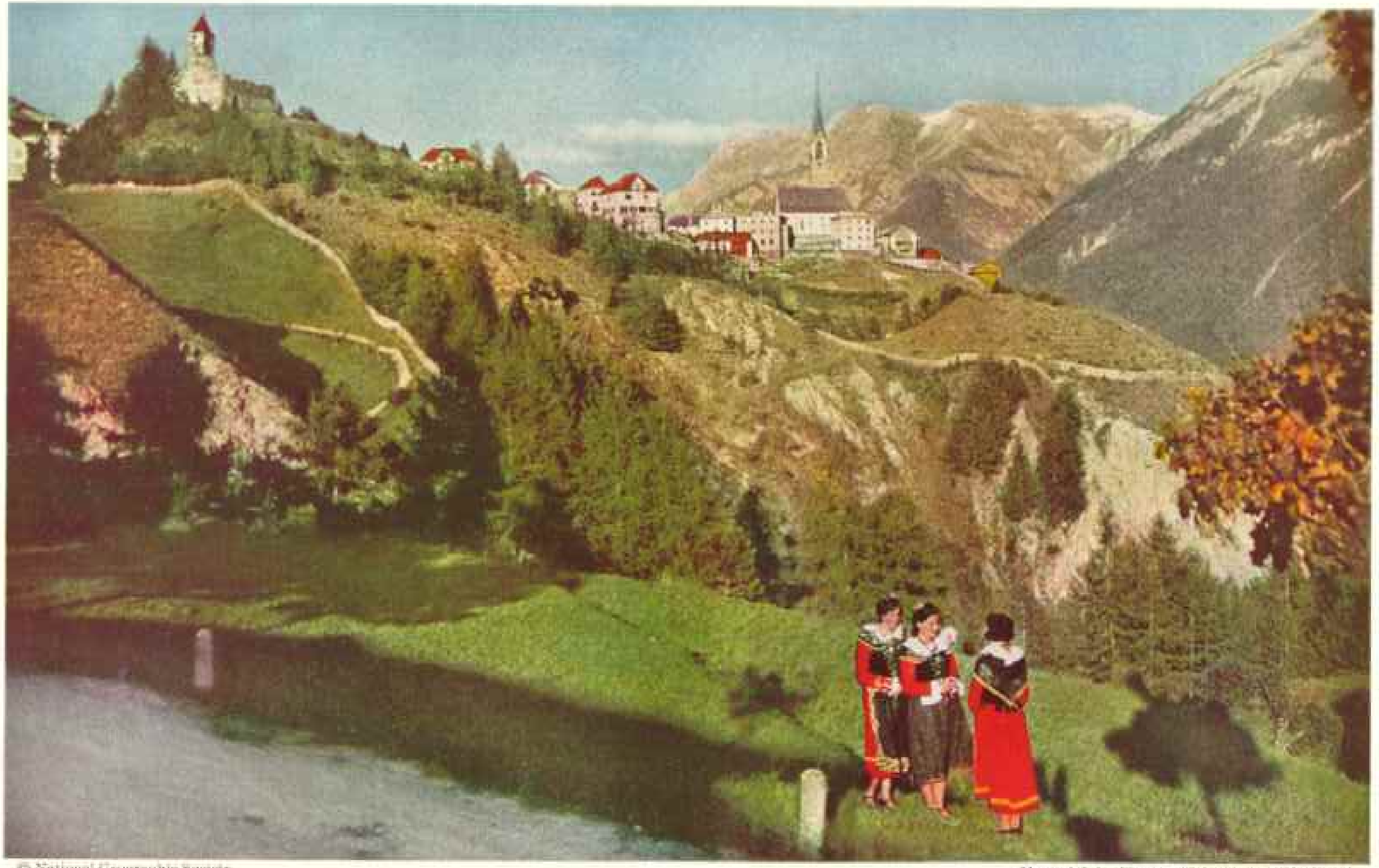
SUNSET ON LAKE GENEVA MAKES ÎLE DE SALAGNON A FAIRY PALACE

For years the French artist Chartran lived in the chalet on this islet. Rousseau also contributed to the fame of the neighborhood, and Byron immortalized the Castle of Chillon not far away with his poem about Bonivard, who for six years was imprisoned in the dungeon there.

 Natural Color Photographs by Hans Hildenbrand

ONCE A MONTH DÜDINGEN GIRLS PUT ON THE OLD COSTUMES

The crowns, decorations for bridal and christening ceremonies, and the "millstone" collars are features of the attire which the village church preserves for processions in the Canton of Fribourg, one of the earliest to be organized in Switzerland.



National Color Photograph by Hans Hildenbrand

PEAKS CHALLENGING CLIMBERS TOWER ABOUT "THE NEATEST VILLAGE IN THE LOWER ENGADINE"

Destroyed by fire in 1921, Sent was rebuilt in the traditional manner, with frescoed houses. Costumes worn by the girls of the town differ from those of Upper Engadine (compare Plate III, right), where a more rigorous climate requires warmer clothing. A Swiss society for the preservation of the disappearing folk garb was organized a few years ago, and to-day needles fly, making new dresses in the old-fashioned styles for holiday use.

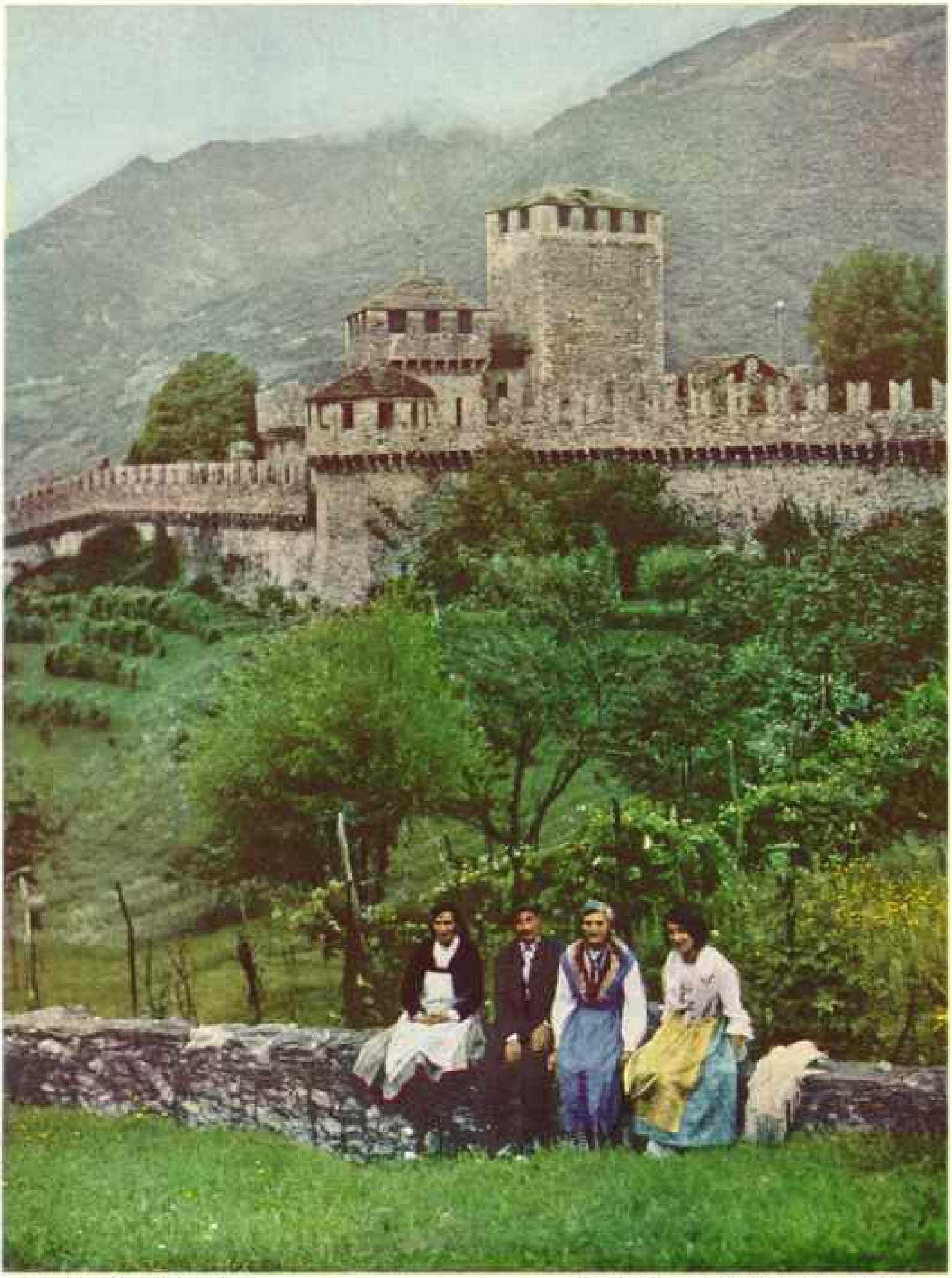
THE ALPHORN CAN SET WILD ECHOES FLYING

Formerly these mighty trumpets, usually fashioned from the curved root of the forest pine or Alpine fir tree, were blown on the heights to warn distant friends of the approach of foes. Later they became musical instruments with a scale similar to that of the B flat French horn.

Natural Color Photographs by Hans Hildenbrand

A THOUSAND YEARS HAVE LEFT STEIN AM RHEIN UNCHANGED

Conscious of the charm of antiquity, the inhabitants of this village have preserved its quaint dwellings, keeping fresh the rich paintings that adorn the fronts of the oldest houses, and treasuring the fountains and the ruins of a Roman camp.



 Natural Color Photograph by Hans Hildenbrand

GRIM GUARDIAN OF THREE FAMOUS PASSES

Built by the Duke of Milan in 1445, Castello di Montebello with its two sister strongholds at Bellinzona, Ticino, defied assault for more than half a century. The Swiss broke Italian shackles when they stormed it. The castle blocked the way between Italy and Germany, being the key to the St. Gotthard, Lukmanier, and San Bernardino Passes. To-day it is used as a museum, and a railway tunnel passes under it. Fine fruit is grown by the peasants of the town.

regulations for the control of the guiding profession, and numbered blank pages for his clients to record the climbs done with him, and a few words of appreciation of him as a guide. The aim of some guides is to have as many entries as possible, to show what fine fellows and popular guides they are. Others consider that it lends more "tone" to this volume to omit the more banal climbs.

I have never known one who pared his list so closely as Angelo. Personally I have always suspected that this may well have been a device on his part to fool the tax collector, since a guide's income taxes are based on the number of entries in his book.

PREPARING FOR THE MATTERHORN

In the season of 1931 my heart was set on climbing the Matterhorn manless. Though far less difficult technically than the Grépon, this famous peak is big and striking, with a formidable history and reputation. The climb presents no individual pitches of great difficulty, but it is tiringly long and higher than the Grépon by 3,000 feet.

To climb the Matterhorn, Miss Jessie Whitehead, of Cambridge (it may be either England or Massachusetts), Alice Damesme, and I were to meet in Zermatt on August 2. I hoped to get in training early in July by doing a few manless climbs in the Oberland with Mademoiselle Micheline Morin, of Paris. Up to date all our manless climbs had been primarily rock climbs, and we chose the Oberland region this year because there the climbs are mostly snow and ice.

The Jungfrau itself, most beautiful of the Oberland peaks, seemed a bit too easy by its regular route. We thought that its neighbor, the Mönch, separated from it by the Jungfraujoch, might be more interesting and still not too ambitious for a manless caravan on their first climb of the season.

Micheline and I arrived at the Jungfraujoch about 8:30 a. m., July 11, engaged our room at the excellent hotel which has been carved out of the rock and ice, left our toothbrushes, and started at once for the Mönch. In doing climbs from the Jungfraujoch, one has the advantage of being 11,400 feet up at the beginning and thus saving much exertion.

The ordinary route up the Mönch crosses the upper snowfield of the Jungfraufirn to the Obermönchjoch and then ascends the southeast ridge. It is throughout a snow-and-ice climb, and while the ridge is fairly steep in places, there is no great difficulty. We planned to use this route for the descent, and to go up by the southwest ridge, a more interesting climb, with some easy rock work as well as snow and ice.

Since the latter ridge runs directly up from the Jungfraujoch, we had only to walk around the little Sphinx and go up a steep but short slope of hard snow, crossing a small *bergschrund* on the way, to get upon the ridge itself. For most of the time we stayed on the crest of the ridge, finding it more amusing to climb over the gendarmes, or rock towers, than to go round them (see illustration, page 159).

There is only one little rock pitch of any difficulty, a slab where the holds, although good, are somewhat small for the big, heavily nailed boots that even a lady wears on the peaks of the Oberland. About halfway up, the rock climbing came to an end and the rest of the ridge was snow. Here we stopped for a little lunch and decided to put on our crampons (see illustration, page 143), for on the ridge ahead the snow was very hard and icy.

FORGOTTEN CRAMPONS MEAN TROUBLE

It then developed that Micheline's crampons were not in her rucksack; they subsequently turned up on the floor of our bedroom at the Jungfraujoch. This was something of a catastrophe, since there were no tracks of any previous party, and without crampons we should have to cut steps. Worse still, I should have to cut them all; the person who has crampons is the one to go ahead.

For my own well-shod feet I did not need steps and I did not purpose to waste any effort unnecessarily. I regulated the size of my steps, therefore, according to Micheline's protests. If she insisted that she absolutely could not advance in such small, sketchy steps, I would reluctantly cut them a little bigger; but if, on the other hand, she came along relatively easily, I knew that the steps were larger than necessary and accordingly reduced their size.

It took us a long time to reach the summit. All the way, there was very hard snow, almost ice—an unusual condition on this ridge. It was the first big climb of the year for both of us; we were not yet accustomed to the altitude; and steady step cutting at 13,000 feet takes one's breath. In

Photograph by John Holden

OH, TO BE ON THE SHELF!

Halfway up the Mummery Crack, the most laborious bit of rock climbing on the Grépon (see text, pages 135, 137), there is a small outward-sloping platform where one can take a breath before continuing the struggle.

the early afternoon we ate a second lunch on the top, in the midst of gorgeous Oberland views.

On our descent over the ordinary route we suffered another mishap. I heard a tinkling noise, and there was Micheline's ice ax sliding down into the bottom of some crevasse below!

It is not easy to walk down a narrow and steep snow ridge without either crampons or an ice ax, even when a big line of steps has been cut by other parties (see page 158). We adopted, therefore, the most elaborate system of precautions: Micheline would go down first the full length of the rope, while I, having a good stance because of my iron spikes, would drive my ice ax in up to the hilt, belay her rope around it, and let the line out as she advanced.

She was thus perfectly assured. When she reached the end of the rope, she would stand still while I came down. She, of course, could do nothing to assure me; but it was not necessary, with my crampons and ice ax, as long as I was not pulled off by some one else. I doubt that any party ever before came down the Mönch so carefully. The method was desperately slow, but safe. It was nearly 5 o'clock before we got down off the ridge onto the glacier, a half hour's walk from the Jungfraujoch.

THE ALPHUBEL—LURE OF THE UNKNOWN

On August 2, Jessie, Alice, and I met in Zermatt, as by our agreement of several months' standing; but the weather was in no way suitable for climbing the Matterhorn, and Alice, with an injured knee, did not feel that she was yet up to it. Jessie and I, therefore, did the Alphubel by the Rotengrat.

The Alphubel, 13,803 feet, is one of the summits in the Mischabel group that lies along the east side of the Zermatt Valley. Its ordinary route is entirely a snow or ice climb, but its west ridge, or Rotengrat, affords a more interesting climb of mixed snow and rock work.

This climb appealed to us particularly because neither of us had ever been on the Alphubel. To take a route up an unfamiliar peak with no tracks to follow or traces of other parties is thrilling adventure.

We started early, at 3:10, from the little chalet of Täschalp, where one spends the night, because from there to the summit of the Alphubel is a rise of 6,536 feet. After

hours of stumbling in the dark among loose rocks, a stretch of easy rock climbing, and a final thousand feet of ice-covered rocks, we reached the summit in good order. It was the descent, the ordinary route down the southeast ridge to the Alphubeljoch and down the Wandgletscher, that gave us trouble.

The snow was not in good condition and on the steeper parts we moved one at a time. Jessie would go down first, drive in her ax, and belay my rope around it, taking the rope in while I came to her, and then letting it out again as I went below. Then I would do the same for her. Each one of us moved two rope's-lengths at a time.

We had not carried crampons because they are heavy and it did not seem worth while, considering that the climb as a whole was so long and the part of it where we would have needed the crampons was relatively so short. They would, however, have saved us many minutes coming down this ridge.

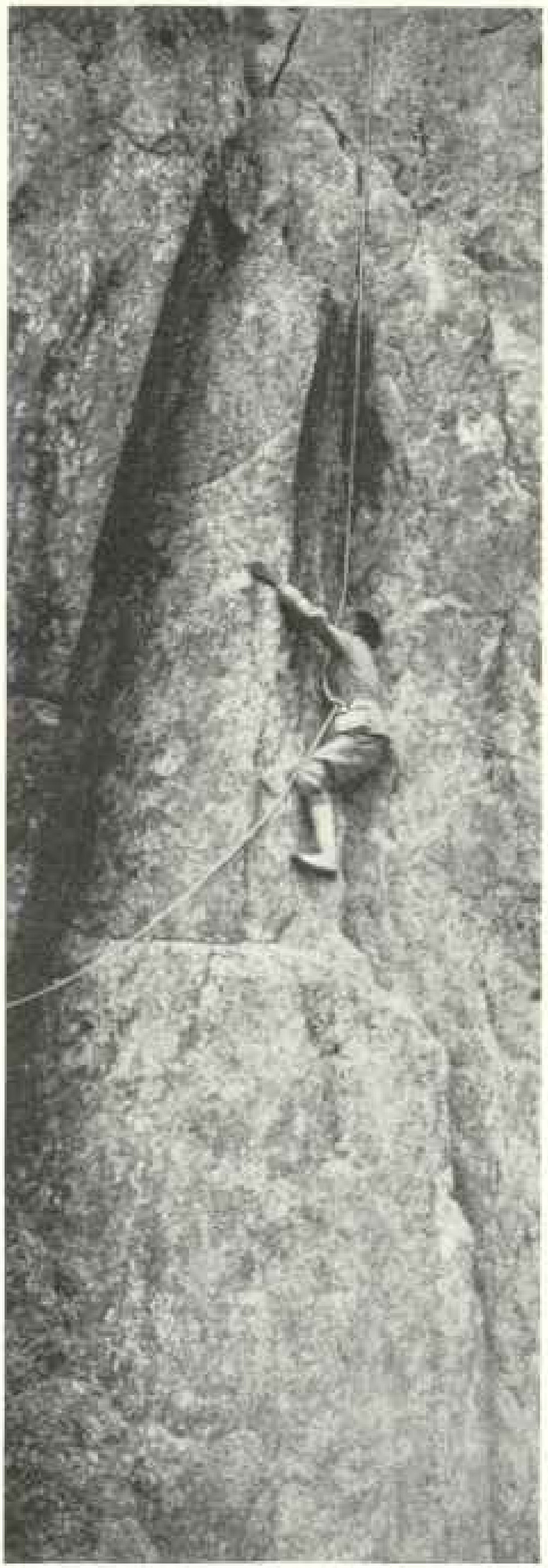
When we got to the worst part of all, a large ice bulge that must be descended, I fortunately happened to be ahead. The footing underneath was rotten. I could chop away as much ice slush on the almost vertical wall as I liked and I never got to anything solid underneath. Finally, with Jessie holding me firmly, I managed to get down.

It was not so simple for her, however, with no rope from above. Far below, I buried myself firmly to the waist in a small crevasse and invited Jessie to come along—to slide, if necessary, and I would field her in.

The only drawback to this plan was the presence of some sharp and hard-looking rocks not very far below me, much nearer me than the length of the rope between Jessie and me. Unfortunately, Jessie noticed these rocks, too, and she was, therefore, not any too keen on the sliding idea. She finally got down, however, quite properly, with not a slip.

REAL PERIL IN THICK MIST

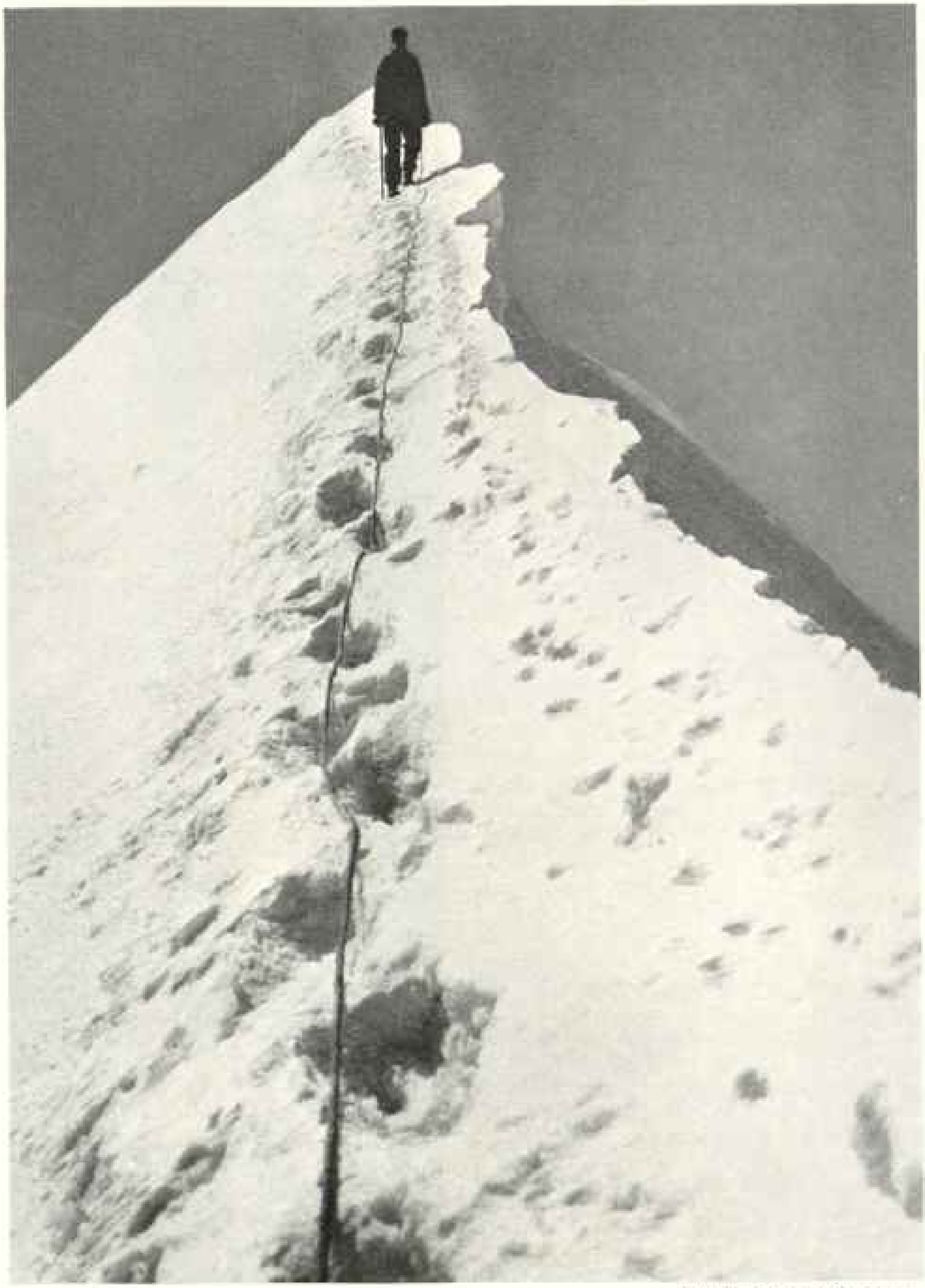
When we reached the Alphubeljoch our troubles began in earnest. The clouds had been low all day and we were now surrounded by thick mist, with not a track or a trace to be seen anywhere, nothing but just whiteness.



Photograph by Georges Tairraz

ONE APES THE CATERPILLAR ON THE MUMMERY CRACK

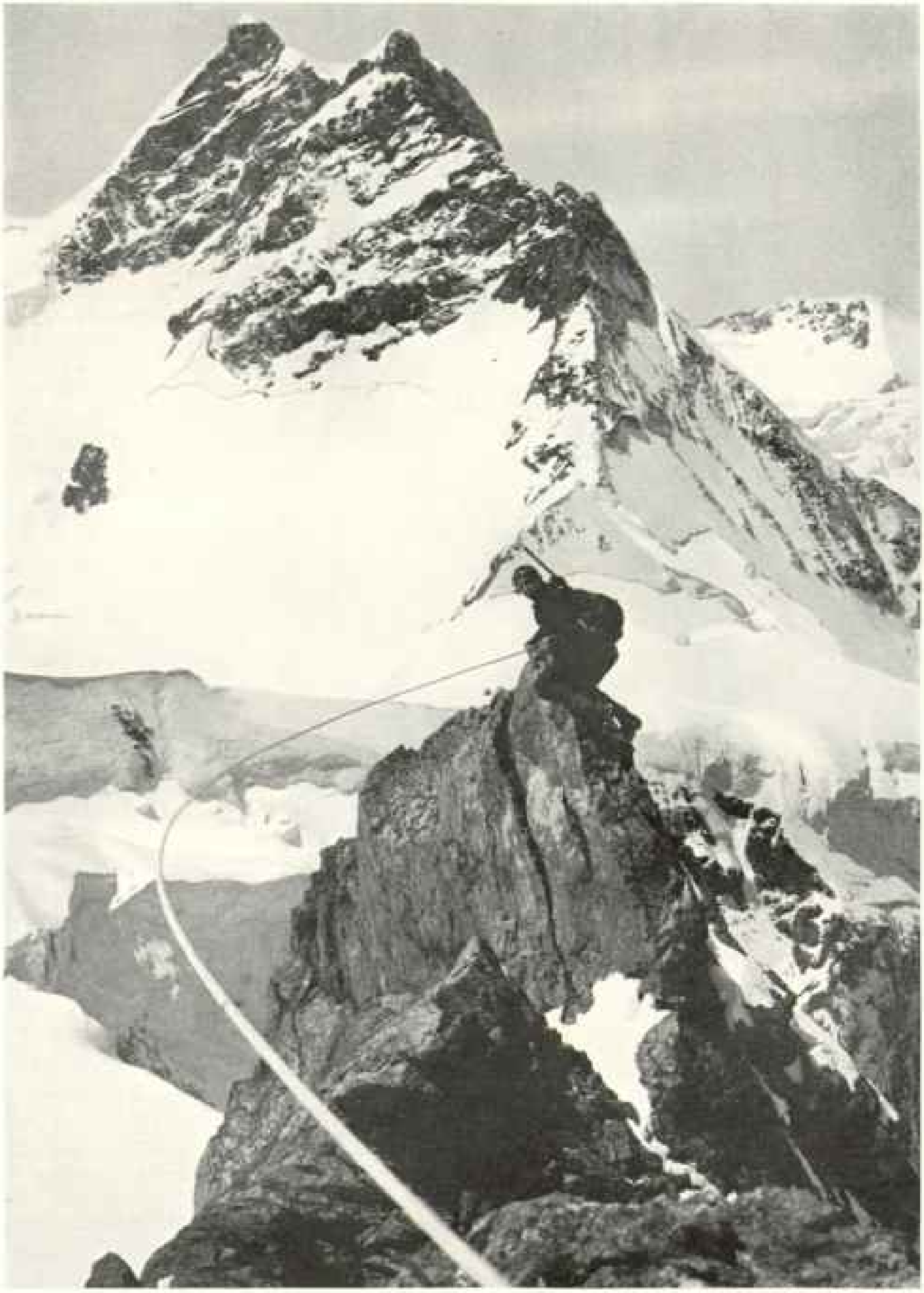
The right hand and foot, jammed into the crevice, are raised alternately, while the left hand "clings to slight discolorations in the rock" and the left foot dangles uselessly in space.



Photograph by Micheline Morin

BLEST BE THE GUIDES THAT CUT SUCH BUCKETLIKE STEPS!

As the author comes down the steep southeast ridge of the Mönch, she is spared the labor of cutting her own path, a difficult and tiring task if one has to lean over from above to chop the snow (see text, pages 155-6). Magnificent views of the snowy peaks, green hills, and silvery lakes of the Oberland nestling far below reward the climber who masters this glistening monster.



Photograph by Miriam O'Brien Underhill

A STRONG WIND BOTHERS A LADY, THOUGH SHE HAS NO SKIRT TO WORRY ABOUT

Micheline Morin had trouble keeping her balance, as a near gale blew out her rope in a wide arc on the narrow southwest ridge of the Mönch. For convenience in roping down, a band marks the midpoint of the rope, 50 feet from the climber. The Jungfrau thrusts a massive head among its fellow giants in the background.

Photograph by Miriam O'Brien Underhill

FRESH SNOW AND ICE MADE THE MATTERHORN TREACHEROUS

Where the rocks are usually bare and dry, they were drift-covered and slippery, as Jessie Whitehead and Alice Damesme made their precarious way up the ridge.

We knew that some boys had come up to the Alphubeljoch that morning, but the snow had been hard then and the faint boot scratches, all the tracks they left, had long since been obliterated by the noonday melting.

Occasionally, on the way down, I thought I could distinguish a line of tiny holes, where the point of somebody's ice ax had been stuck into the snow at regular intervals. But that was all, and very vague it was at best.

Of course, we had a map and a guidebook and a couple of compasses; and we laid out our course by them, the second person holding the compass and seeing that the direction of the rope was kept approximately correct. We walked with almost the full length of the rope between us, theoretically the proper thing to do to prevent both climbers going into the same crevasse at once.

Jessie, behind, held a very taut rope on me every minute, while I, faced by a blank wall of white, tried to find the way down; but the Wandgletscher is a large glacier in a fog, with a lot of crevasses, and the diffused lighting of the mist made snow and sky, level and up and down, all look exactly alike. Not a step did I take without testing the snow in front of me before putting my foot on it.

"I'm trying to figure out the basis of your decisions," remarked Jessie, who was naturally watching with interest. "You plunge your ax into the snow; it goes in all the way easily, and you step forward with confidence. You plunge it in again; it goes in all the way easily, and you draw back in alarm."

The two situations did seem much alike, even to me. All the snow was suffused with water, soft and yielding; but if the texture of the snow seemed to become slightly firmer as the ax went down, I assumed solid glacier; and if the texture was less firm, or seemed like just air, I assumed a crevasse and tried somewhere else.

How tired I got of reaching forward and poking that ax into the snow! But it was not safe to take a single step without doing so. We found a lot of crevasses in our way, both open and snow-covered, some of which we could cross, while others we had to walk around.

Photograph by Miriam O'Brien Underhill

ONE MUST NEEDS APPROACH THIS CROSS HUMBLY

It stands on the Italian summit of the Matterhorn. As the two French climbers toil up the final slope, the effort demands a prayerful attitude.

Although the time and the distance seemed interminable, it was actually only an hour and twenty-five minutes until, trying to follow the ice-ax holes through a maze of crevasses where all the snow bridges were disintegrating, we made out a faint line of rocks on the right. An alternate route, I knew, ran down a rock rib in the middle of the glacier. Were these the right rocks?

They were, and we knew it when, on reaching them, we found a small pile of broken glass — the breakfast place. Never before has the sight of broken bottles given me such keen pleasure.

It was 8 o'clock before we were back at the Täschalp, where we ordered and consumed a Gargantuan dinner. We could, of course, have spent the night there, but we did not think our climb justified two nights out. After dinner we lighted our little candle lantern for the second time that day and started down to Zermatt. When we reached the main Täsch-Zermatt road the candle gave out—it is asking a good deal to expect a candle to work both ends of the day—and we finished our trip in complete darkness.

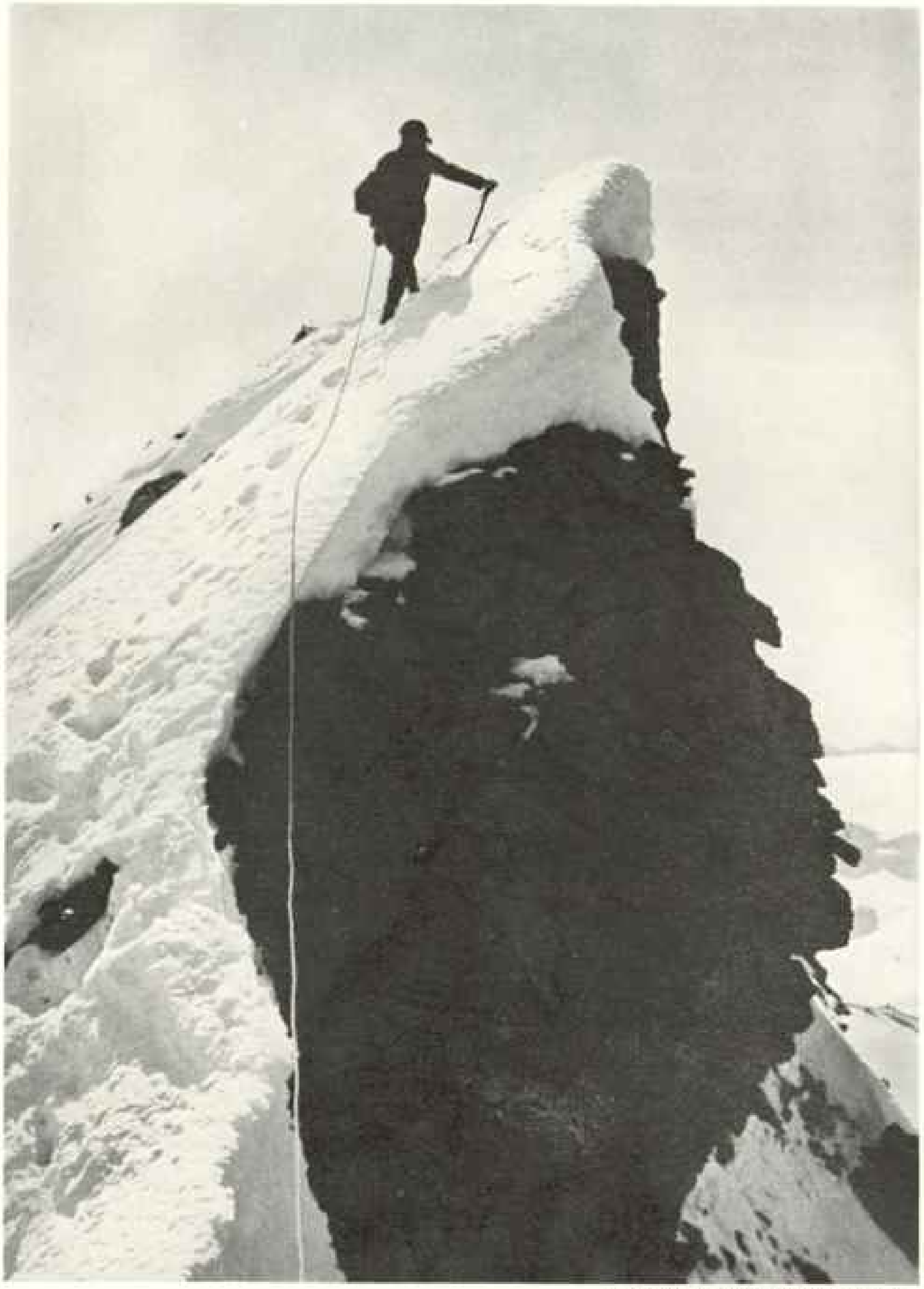
We walked into Zermatt at 11 o'clock, rounding out a good twenty hours of hard work. Of course, if one *had* to work as hard as that for twenty hours . . .!

THE MATTERHORN COYLY ELUSIVE

We passed the rest of the summer trying to get up the Matterhorn. All through August the weather was bad, and we never succeeded. Jessie feels that our attempts provided the comic relief in an otherwise deplorable season at Zermatt, and that the guides, in the long winter evenings ahead, could amuse themselves by thinking of those girls who tried so hard to get up the Matterhorn.

On August 6, Jessie, Alice, and I rode mules up to the Matterhorn Hut of the Swiss Alpine Club, at 10,000 feet, where one may spend the night before climbing the mountain. When we arrived we discussed sleeping places and other arrangements with the hutkeeper in German, with three nice Italian boys in Italian, with Alice in French, and with a stray American in English.

Jessie, feeling that there was not sufficient linguistic confusion, ventured a few



Photograph by Miriam O'Brien Underhill

TRIUMPH! ALICE DAMESME STROLLS ALONG THE CREST OF THE MATTERHORN

Her lofty promenade is on a narrow ridge, approximately 200 feet long. The Swiss summit, at the east, is—as determined by Swiss engineers—43 inches higher than the Italian summit, at the west (see text, page 170), but the spectacular view from either offers rich reward to the victor. On all sides lie magnificent mountain ranges—the snow-crowned giants of the Oberland to the north; the lofty snow dome of Mont Blanc to the west; and the Italian Alps and the rolling plains of Lombardy to the south.

Photograph by Mrs. Robert Lincoln O'Brien

MULES CARRY THE CLIMBERS TO THE MATTERHORN HUT

So frequently did the author and her companions make this trip over the dusty path from Zermatt that they felt personally acquainted with every saddle animal in service (see text, page 169). The riders, left to right, are Alice Damesme, Jessie Whitehead, and the author.

remarks in Latin. Sure enough, two of the Italian boys responded at once, and Jessie and they carried on a conversation that impressed us as having every appearance of a fluent discussion of the day's events, until we listened carefully and discovered that they were considering such burning questions as the division into three parts of all Gaul!

The Italian boys soon noticed that my Italian Alpine Club badge was not of the most recent model, with the Fascist symbol on it, and one of them insisted on exchanging it for his own. Then, on learning that Alice and I were indeed the girls who had done the Grépon manless, a second boy presented her with his badge.

Alice demurred a bit, pointing out that she had no "right" to wear it. They insisted vehemently that it was no question of right, that it was an honor to the Italian Alpine Club.

Poor Jessie was left out, with a courteous, but very brief, "We regret, Mademoiselle, that we haven't another one for you," a remark that was not strictly true, since they obviously still had the one that had originally been mine.

Jessie was furious, and rightly so, and insisted that Alice's flashing black eyes had a lot more to do with the question than climbing the Grépon. From then on her main purpose in life was to acquire an Italian Alpine Club badge. But the weather was so bad that no more Italians crossed the Matterhorn into Zermatt, and she was finally compelled to take extreme measures and join the club.

CLIMBERS SLEEP EN MASSE

In these little Alpine Club huts the climbers sleep in low-walled box stalls for six to ten people, with straw mattresses underneath, and usually in the Swiss huts there is at least one blanket apiece. (I'll never forget my first night in a French hut some years ago. "Here is a blanket, Mademoiselle," said the hutkeeper, doling them out. "Share it with the gentleman next to you.") The hut, as is usual for the Matterhorn Hut, was crowded, and Jessie later took great pleasure in telling some of her more conventional friends in the valley that she slept next to a young man who kicked her all night long.

Photograph by Miriam O'Brien Underhill

SLIDING SAVES TIME

To hang the rope around a projection and rope down is quicker and often safer than making the descent by foot and hand. Then the rope is brought down by pulling one end.

Before going to bed we scouted out the route for the next morning; but we were not called at half past 2, or at any of the other hoped-for hours. Jessie was disturbed enough to crawl out of her blanket and walk over all her sleeping companions to look out the window and find out why.

"It's snowing," she reported.

The next thing I knew she was shaking me and telling me the weather was fine. "It's 7 o'clock," she said, "but Bernhard Biner is starting up now and why can't we?"

We could. I sat up at once and dressed; dressing in a hut means pulling on your boots and lacing them up. At 7:25 we started. At 9:15 we caught up to Biner. At 10 we reached the Solvay Hut, a small refuge shelter slightly more than halfway up the Matterhorn ridge.

The weather meantime had been getting progressively worse. Jessie's clearing at 7 was just temporary. We stayed in the Solvay Hut for nearly an hour and a half, chatting with Bernhard Biner, one of the Zermatt guides, and his tourist, Yvonne Jérôme-Lévy, a friend of ours. Finally, in fine snow, we climbed down again and walked back to Zermatt.

The next day it cleared a little, and in the afternoon we again rode mules up to the Matterhorn Hut. The following morning, again, we were not called. At daylight we opened our eyes to a Christmas morning scene.

To wake on Christmas morning and see the window panes half covered with little drifts of fine, dry snow seems pleasant and suitable, but to open eyes to a similar sight on August 9, with the Matterhorn climb anticipated, brings no cheer to the heart. A real snowstorm not only interferes with climbing for the duration of the storm, but it plasters the mountains white with treacherous sheets of snow and ice that effectively prevent climbing for many days afterward.

Glissading the scree slopes above Staffel Alp on our way down to Zermatt in this pretty snowstorm, Alice hurt her knee again and was not able to do any further climbing that year. Jessie and I left that afternoon for the Oberland and, for a change of scene, passed the next few days watching the Oberland snowflakes fall.

On the evening of August 12 we received from my brother, who had remained in Zer-

matt, a telegram that the barometer was going slowly up and a clearing north wind was blowing. We rushed back to Zermatt and the next night slept again at the Matterhorn Hut.

HOPE SPRINGS ETERNAL

The hutkeeper, Kronig, was by this time a great friend of ours and sincerely in sympathy with our aspirations. He knew that we desired, as usual, to start ahead of the guided parties, and his method of arranging this for us, though indirect, lacked nothing in effectiveness.

The duties of the hutkeeper include serving tea in the morning, or at least being in charge of the stove and providing the climbers with hot water. He first served a pot of tea to Jessie and me, just enough for the two of us. No one, of course, took exception to this priority, since we were the only party of ladies.

Then it developed that there was no more hot water! The other parties had to wait, fuming with impatience, while the hutkeeper cut a little wood, stirred up the stove, and heated water for the rest of them.

Jessie and I got away at 3:10, with a good fifteen minutes' start. We put our rope on in the hut, for in five minutes we should be at the beginning of the rock climbing. The first pitch, since it is usually done in darkness, is moderately difficult.

Not only for that pitch, but for most of the climbing on the Matterhorn, the climber has to have the use of both hands; it is out of the question to give up one of them just to hold a lantern. Whatever illumination is provided, therefore, must be carried in the mouth.

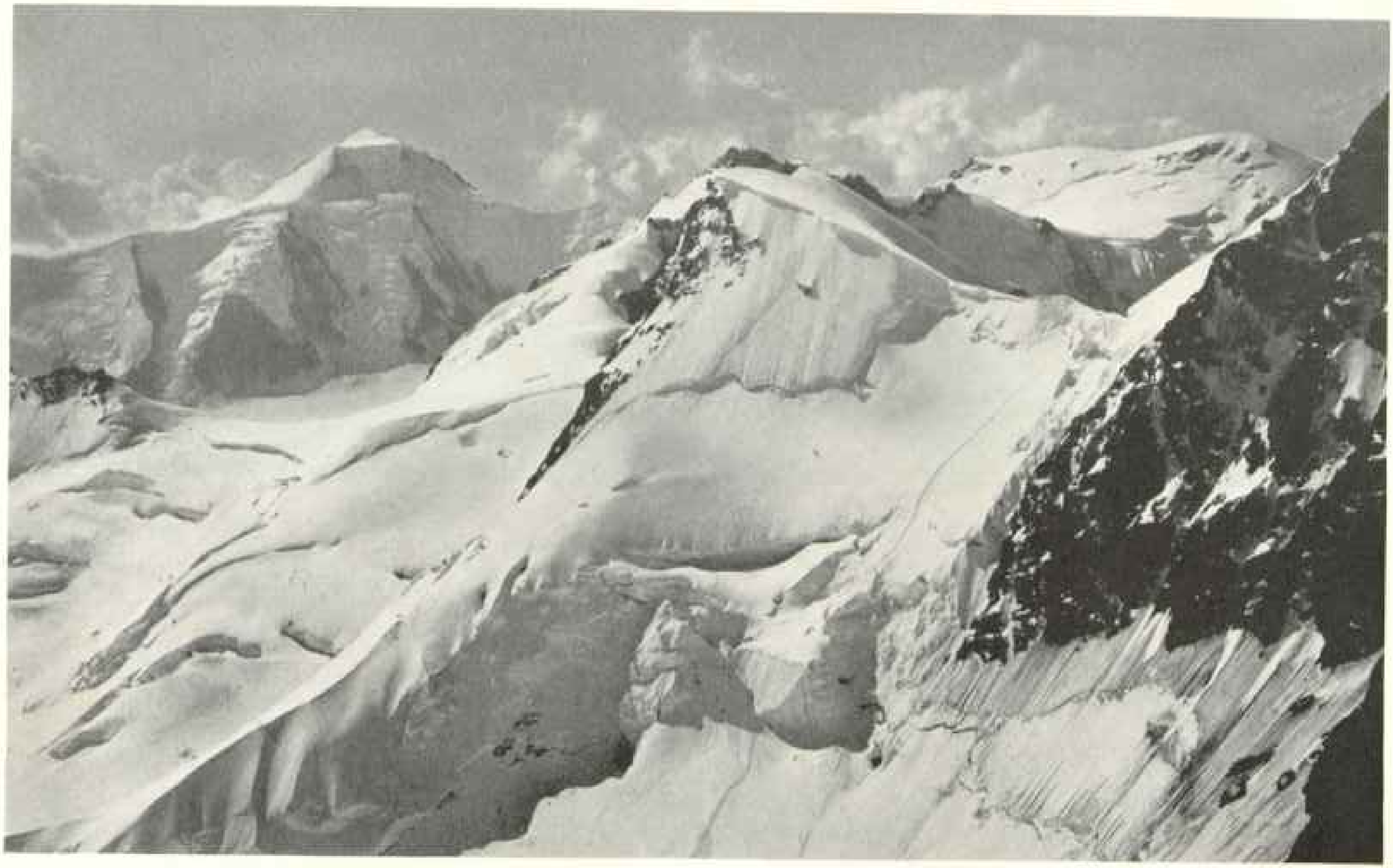
The old school climbs its rocks, as well as walks along its paths, with a candle lantern: the new school uses an electric flashlight. There are disadvantages to both. The candle lantern burns nose and chin alternately, and the cooler flashlight, an awkward thing to hold in the teeth for two hours, interferes somewhat with conversation. Nevertheless, I held a flashlight in my mouth until dawn.

Although we climbed as hard as we could, our progress was slow because of the large quantities of fresh snow and ice still remaining on the rocks. We reached the Solvay Hut at 7 and waited for an hour there.

Photograph by Miriam O'Brien Underhill

HE MUST LET GO AT THE NEXT STEP!

As the climber slides down the rope on the Grépon, his body swings in toward the wall. Lest his hands strike painfully against the overhang, he must cast loose all holds and grab the line again.



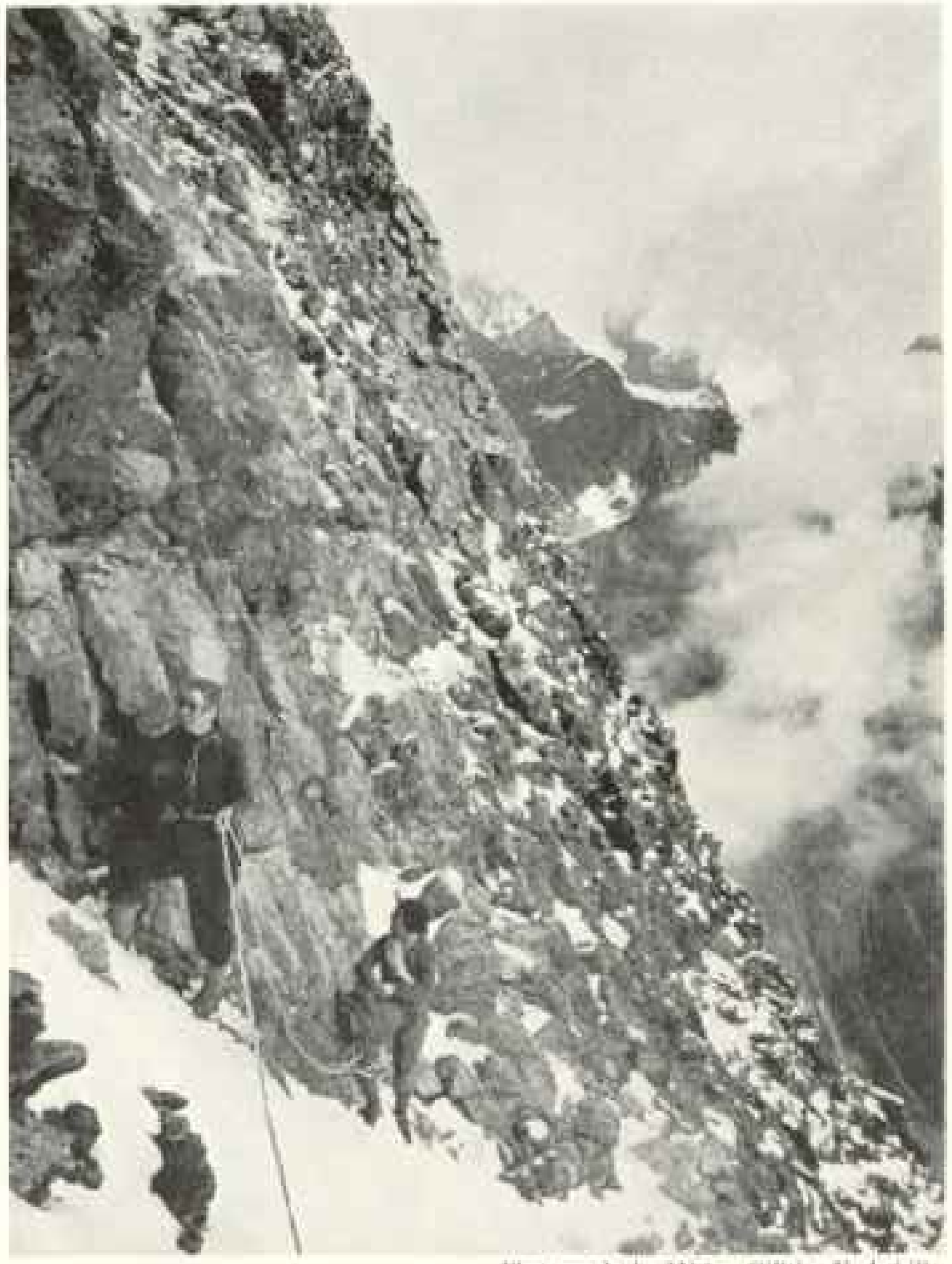
Photograph by Miriam O'Brien Underhill

THE ORDINARY ROUTE UP THE JUNGFRAU IS JUST A WALK UP STEEP SNOW AND ICE!

Starting from the middle of the bottom edge of the picture, the line of footsteps can be plainly seen running diagonally upward to the Rottalsattel, a saddle between the Jungfrau (right) and the Rottalhorn (center). From there the route scales the final slope of the Jungfrau. The black specks in the center and on the track (about an inch and a half from the bottom) are four climbers. The Aletschhorn looms on the far left.

MATTERHORN DEVOTEES DO THIS IN THE DARK

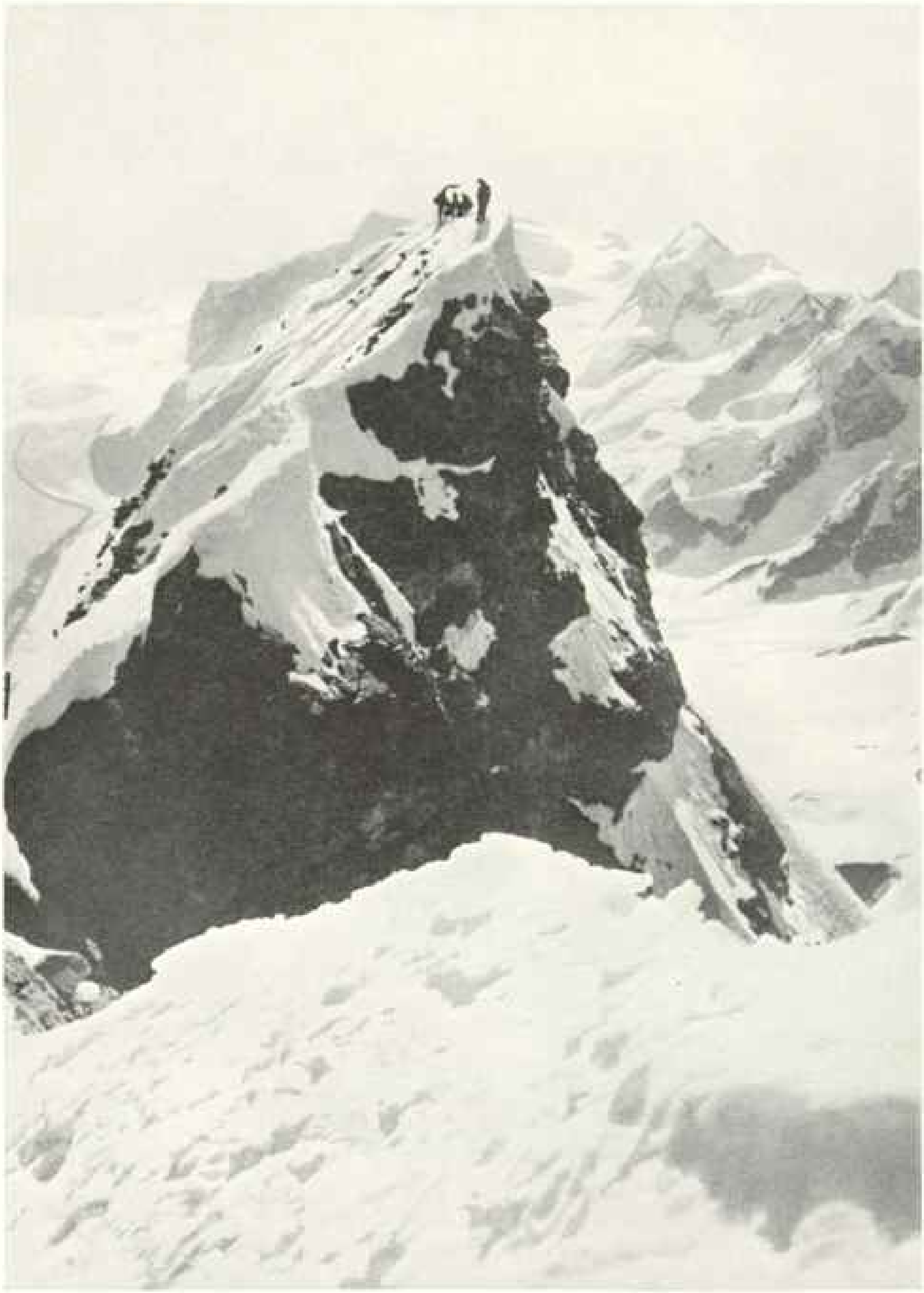
About 15 minutes above the Matterhorn Hut, the rock climbing begins. The author's party passed this spot at 3 a. m. the day of their successful attempt (see text, page 169). Here Jessie Whitehead clings like a fly to a ledge one morning when snow foiled the party.



Photographs by Miriam O'Brien Underhill

FRESH SNOW AND LOOSE ROCKS MAKE TRICKY FOOTING

As Jessie Whitehead and Alice Damesme pick their way up the ascent just above the Matterhorn Hut, they must be careful lest they dislodge blocks upon the heads of those following. The white drifts, unusually deep, conceal bad surfaces and occasion extra caution.



Photograph by Miriam O'Brien Underhill

TO ENJOY QUIET AT LUNCHEON, TRY THE MATTERHORN

After conquering the steep snow slope on the left, the climbers pause on the Swiss summit, and the photographer snaps them from the Italian. At least 39 alpinists have lost their lives assaulting this dangerous giant. On the fateful first ascent by E. Whymper, July 14, 1865, four men of his party of seven were killed. Descending after their victory, one man slipped, dragging three of his companions over the brink. When the rope linking them to the others broke, they crashed 4,000 feet to a glacier below.

The weather was definitely turning bad. We had had ample experience in recognizing the signs of approaching bad weather and they were all there. We felt, however, that the storm might, perhaps, hold off for just a little while, and we would attempt a quick dash toward the summit, now not so very far away.

SO NEAR AND YET—LIGHTNING!

We climbed for about an hour longer and reached the Shoulder, that snow-covered projection just below the final rise to the summit. Here at last there was no escaping from the bad-weather portents. Great black clouds were rolling up out of Italy before us, and if we looked the other way we could not avoid seeing a snowstorm raging on the Weisshorn.

Obviously we ought to turn down; an exposed ridge at 14,000 feet is no place in which to be caught by a thunderstorm. To stay on the crest of the ridge itself would be to run a very real risk of being struck by lightning; to drop down on the wall below the ridge would be to get in the path of falling rocks.

Still, there were all those other people keeping on, twenty-four of them, strung out all along the ridge. We were not the only ones who had been waiting for weeks for good weather to climb the Matterhorn. Not a single party had turned back!

Since the others, guides and amateurs alike, obviously thought it proper to continue, who were we to set our judgment above theirs?

However, the presence of other people on a mountain does not keep lightning away; and I, for one, am timid in the face of objective danger. Though it took great independence and courage, we felt, thus to oppose public opinion, we turned back.

Promptly three-quarters of the others turned around, too! Our error dawned on us. We had misinterpreted the continued upward climbing of the other parties. They had kept on not because they considered it the proper thing to do, but because, being men, they could not admit defeat until we, the two girls, did!

How tiresome was the climb down in mist and cloud and driving snow! The rocks were wet and cold and our hands, too, were wet and cold. It was hard to see the route, and the tracks we had made coming up in the morning were covered by the falling snow. Furthermore, when ropes get wet they stiffen and twist and become unmanageable. And I am afraid we were a little discouraged! It was getting near the end of the season, and Jessie had only a few more days before sailing home.

Five days we waited in Zermatt, and on August 19 we made our fourth trip to the Matterhorn Hut. Jessie says there is not a mule in Zermatt that does not recognize her.

Kronig had reserved the best mattresses for us by placing our crampons, points up, in the middle of them, as we had directed him to do on the first good day. I am afraid there is no "news value" in saying that the next morning it was snowing.

Admitting then that the season was over, we departed, taking all our equipment down with us. We made arrangements with Kronig, however, to spend the entire summer of 1932, *en pension*, paying our board by the month, in his hut, until we should climb the mountain. Kronig considered this rare humor.

THE MATTERHORN AT LAST!

In 1932 things did not start in any better. July was bad in the Alps. It was well into August, I think, before any party managed to get up the Matterhorn or almost any of the other big peaks of the Valais.

Alice Damesme and I (Jessie could not get across that year) waited around Chamonix for days, at the end of July and the first part of August, hoping to do a training climb or two before going to Zermatt. But it rained and snowed, and we finally went away for some manless climbing in the Dauphiné Alps: the Pic des Pavéoux and the Tour Carrée de Roche Méane.

The day after accomplishing the Tour Carrée, Alice and I started for Zermatt. The Matterhorn, by this time, we felt, must be in good condition. We passed the night of August 12 at the Matterhorn Hut—it has been suggested that I write a book on my 1,001 nights in the Matterhorn Hut—and the next day climbed the mountain.

Although there was a great deal of snow and ice on the rocks, especially above the Shoulder, and a crowd of people showering down clouds of snow on one another, we found no insurmountable difficulties, and we reached the summit at half past 8. It

Photograph by Lincoln O'Brien

THE AUTHOR'S MOTHER WATCHED HER CLIMB THE MATTERHORN

Herself a mountaineer, Mrs. Robert Lincoln O'Brien took keen interest in following the progress of her daughter. Almost the whole route is visible from the village of Zermatt. The guide, Bernhard Biner, is here explaining that an apparently bad storm is just a "local disturbance."

was a beautiful day, warm and sunny, but with a few little clouds that suggested that the weather might not stay that way forever.

The Matterhorn has two summits—the Swiss, 14,692 feet high, and the Italian, some forty-three inches lower (as determined by Swiss engineers!). These two are connected by a narrow ridge about 260 feet long, and one should visit both, if only for the stupendous views down the Italian side, at the time of our ascent deeply snowed under. Alice and I tarried for two hours on these two summits before starting down (see page 162).

The descent was slightly more difficult, because, of course, the snow had become softer with the action of the sun and much of it showed a tendency to slide away, leaving bare ice underneath. We put on our crampons, therefore, and wore them down to the Solvay Hut, treating this part as an ice climb instead of a rock climb.

The signs of bad weather increased, and the last hour down the rocks a little flurry of snow overtook us. We were well used to that, however. Never in three experiences have I come down that lower part of the Matterhorn *except* in a snowstorm!

I should have gone back to Chamonix with Alice, where our friends among the French climbers had prepared an elaborate reception at the railroad station, with enormous bunches of flowers, a "band," and "orations," in honor of the first women to climb the Matterhorn alone, but instead I drove over to do some guideless climbing—not manless—in the Eastern Alps. As a result, this story was temporarily interrupted.

STALKING ANTS, SAVAGE AND CIVILIZED

A Naturalist Braves Bites and Stings in Many Lands to Learn the Story of an Insect Whose Ways Often Parallel Those of Man

By W. M. Mann

Director, National Zoological Park, Washington, D. C.

TO WRITE the word "ant" in Japanese, you take the character for "insect" (to the left, below) and add to it "unselfishness, justice, and courtesy" (center). Then you have the character (on the right) which means "ant" and also shows the flattering Japanese opinion of it.

虫義蟻

This delightful compliment is most interesting and many species undoubtedly deserve it; yet there are ants as savage and ruthless as the ancient Huns or Mongols—ants that devote their lives to foraging in vast armies, destroying the nests of others, and killing all insects and animals in their way (see Color Plate VIII). There are queen ants that enter a foreign colony, ingratiate themselves with the citizens, foully murder the true queen, and usurp her place. There are ants that raid the nests of their neighbors and kidnap their young as slaves (see Color Plate I).

GROW GARDENS AND KEEP "COWS"

Some, high in the scale of ant civilization, make their own gardens and grow their own special food. There are ants that keep "cows"; others that gather and store honey in barrels made from living nest-mates; * still others that use their own young as spools of silken thread in making nests (see Color Plate IV).

In sheer numbers, too, the ants challenge imagination. Their legions outnumber those of every other land creature in the world, except possibly some minute forms of life. So far, some 8,000 species, subspecies, and varieties have been collected and painstakingly classified—a different kind of ant for about every word of this article.

The immense amount of work devoted to studying ants in all regions of the world bears witness to their magnetic appeal to the interest of man.

Thus there have been published monographs on the ants of Madagascar and of New Caledonia; catalogues of the species which inhabit Brazil, Chile, Switzerland, Connecticut, and the peninsula of Baja California. One huge volume concerned with the ants of the Belgian Congo alone contains 1,139 pages.

Even the ants that crawled on the earth three million years ago live again in the pages of voluminous books, because their bodies happened to be entombed and preserved in the flowing resin of prehistoric pines, now known to science as the "Baltic amber."

LIKE SHIP LIFE AND HEATED HOUSES

Of these incredibly numerous and interesting creatures there are certain to be colonies on your lawns; there may be a nest or two in the rafters of your home and almost certainly some in the vicinity of the kitchen. Each colony of a species contains from a few to many thousands, even hundreds of thousands, of individuals.

The common little yellow house ant, *Monomorium pharaonis*, takes readily to life on shipboard, and so has traveled to all parts of the world (see Color Plate II). It takes kindly, also, to heated houses, and so, although a tropical ant, it thrives in northern countries and has become a pest everywhere.

One of our lawn ants, *Lasius niger*, in its several varieties spreads itself throughout the entire Northern Hemisphere, where it damages the golf greens of Washington, D. C., as impartially as it does the temple gardens of Japan. It is one of the most abundant single species of insect (see Color Plate II).

Some warm day, preferably after a shower, find a nice, flat stone on a sunny

* See "Living Casks of Honey," in this issue of the National Geographic Magazine.

hillside and turn it over. There probably will be an ant nest beneath it—a series of channels leading from one cavity to another (see illustration, page 190). Worker ants rush about, excited at the sudden uncovering of their home. One, very much larger than the others, is the queen, or there may be several of them if the colony is a large one. If there are males, and they are present only during the mating season, they are usually much smaller than the rest, generally dark in color and wearing large wings.

Piles of larvae and pupae, a few of them unusually big and destined to become females, will be whisked below out of sight while you are watching. If you look closely, you may see the eggs, little clusters of tiny white specks adhering together. The "ant eggs" of commerce are not eggs at all, but pupae of the large red ant. The cocoons, from which adult ants soon would emerge, are gathered in large quantities in Europe and dried and exported, to be used as food for goldfish and captive soft-billed birds. At the Zoo we sometimes put a few of them in the custard fed to the anteaters.

HONEYDEW ON ANTS' MENU

In our nest under the stone there may be one or more reddish beetles stalking slowly about among the ants. These are guests or parasites. Often they have a strange hold upon the affections of their hosts. They beg liquid food regurgitated from the communal crop, or storage stomach, of the ants, which sometimes so neglect their own young to pamper these insidious spongers that the colony becomes debilitated and dies out.

On the roots of plants in the passages there may be plant lice, or aphids and coccids, the "cows" of the ants (see illustration, page 197). As the weather gets warmer, the lice will be taken out and "pastured" on the roots of other plants, sometimes on Indian corn, where they do much damage to the farmers' crops. In this case, ants are an accessory to the fact. It is the aphid that does the harm, but the damage is greatly exaggerated by the ants' tender care.

By a stroking process similar to milking, the ants obtain from the plant lice a highly valued food substance, honeydew. This is the sweet sap of plants after it has been sucked out and passed through the bodies of the tiny insects, most of which take more than they can absorb.

As this forms the chief food of many ants, they tend and protect their cows as conscientiously as do any pastoral people. Sometimes they even build sheds of carton, a papery substance, on the trunks of trees to shelter them. At the approach of cold weather the ants sometimes gather them into their nests on plant roots, taking them out to pasture again when the danger of frost is over and their proper food plants are growing. A common sight about Washington in the spring is a troop of ants tending aphids that are feeding on the stalks of our common roadside weeds.

Examine carefully the nest under the stone on the hillside and you may find the home of another ant there, an almost microscopic yellow species (*Solenopsis molesta*), sometimes called the thief ant.

Making a nest adjoining that of a larger species, it tunnels into the larder of its neighbor and aggravatingly helps itself. The passages are so small that the big ants have no more chance of chasing their tiny tormentors than a man would have of pursuing a marauding rat into its hole. Uncovering two such nests sometimes precipitates a battle in which the larger ants get their long-sought revenge. The thieves can only cling annoyingly to their big opponents, which they do until bitten to death.

Break open a rotten log and a colony of a different kind may be revealed, with workers less excitable (see Color Plate II). Slowly and methodically they move their young away from the disturbance.

MARVELOUS RESOURCES OF THE QUEEN

Under a deeply imbedded rock you will perhaps discover a small family of the Troglodyte ants, blind dwellers in the dark, remaining motionless to avoid detection.

All ant colonies have one point in common. The members, excepting, of course, guests, parasites, and other intruders, are all children of a widow queen who has left the home nest on her nuptial flight. After mating high in the air, the male always dies, as he falls to earth far from the home nest and is helpless without workers to care for and feed him. The female, however, has marvelous resources within herself, and all alone she establishes a home and a family of her own.

After fertilization the queen creeps into some cranny beneath bark or under a stone;

Photograph from Topical Press

A GOOD TEE-SHOT FROM ATOP A GIANT TERMITE HILL

Scores of natural hazards have been erected by the insects on this strange nine-hole golf course at Elisabethville, in the copper-mining region of the Belgian Congo (see illustration, page 175).

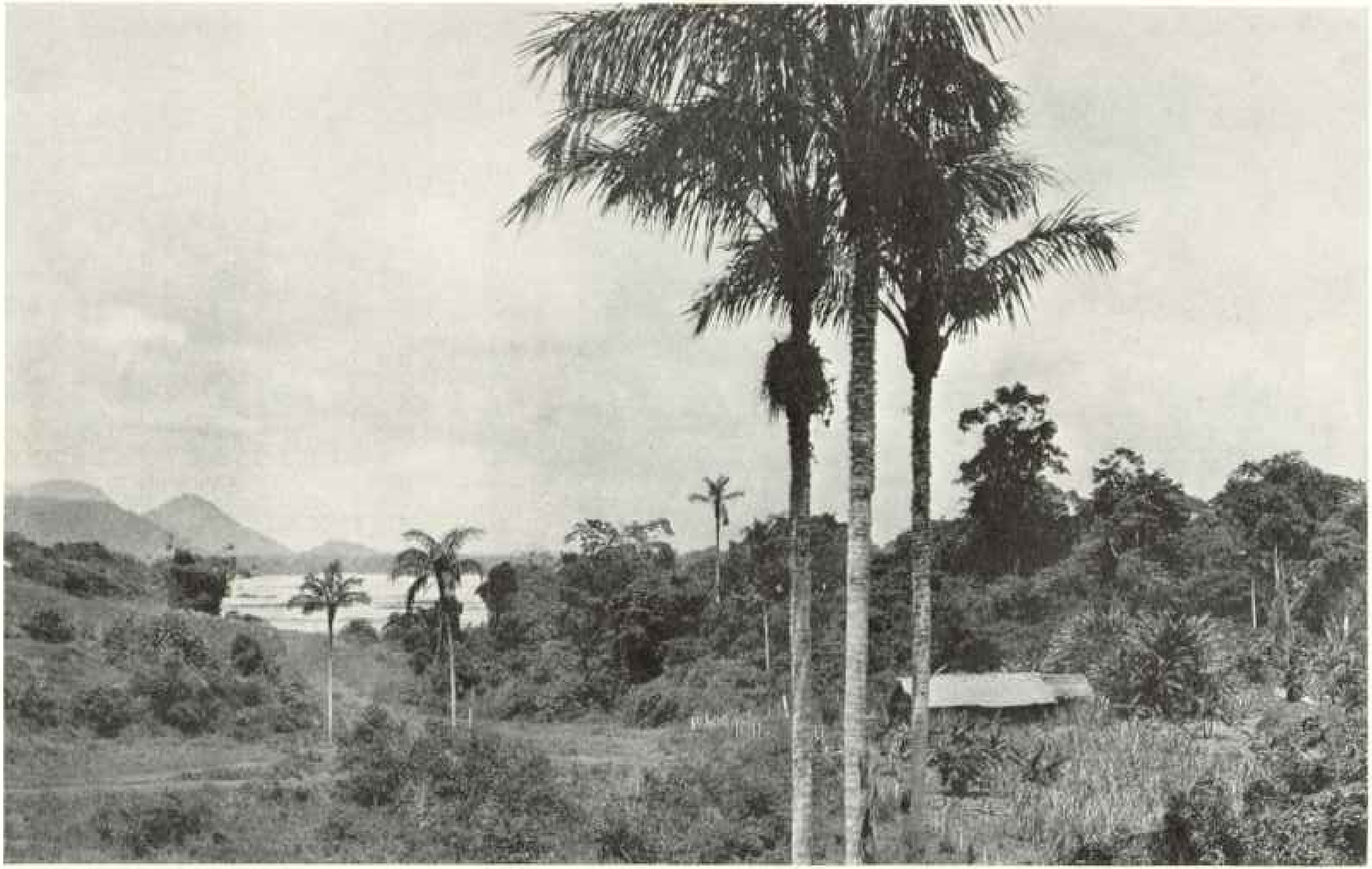
sometimes she constructs a small shelter of crude paper made by chewing bark from a tree. Now she lays her first eggs. During the time when she was a larva and a newly hatched female in her home nest she had been constantly cared for and even pampered by the workers of the parent colony. Special foods were given her, and she was able to lay up in her body a considerable surplus. Her wing muscles were enormously developed for just this one flight. Fat was stored in her abdomen.

From now on there is no further use for wings, so she scrapes or bites them off. The wing muscles disintegrate and add to the stored-up food which she is able to feed her first babies by regurgitation. The first hatched are runts and weaklings, but ants, nevertheless. Their instinct is fully developed and they go to work collecting food for their mother and for their new and constantly appearing sisters.

An ant colony has been created. The queen, her troubles over, becomes a mere egg-laying machine, carefully fed and protected by her children.

Mating flights of ants are common in the spring and midsummer, when hosts of males and females swarm into the air. Crowds of them are seen emerging from cracks in cement walks, on lawns and in gardens, and at this time of year the entomologist receives many letters asking about these "flying ants" and usually enclosing a specimen, folded and badly crushed, in the envelope.

Although practically all ant colonies are founded by a lone female, there are some



Photograph by Ernest G. Holt

TERRIBLE SCOURGES OF LEAF-CUTTING ANTS DESTROY THE LIFE-GIVING CROPS OF SÃO GABRIEL

The legions of Brazil's insatiable saubas have raided the gardens of this lonely village on the Rio Negro so often that the natives must depend upon a few banana plants, a patch of sugar cane, and a little cassava. But for the bounty of forest and river, the inhabitants would starve. The leaves are not eaten by the ants, but are used in growing their "mushroom" food (see Color Plate V and text, page 192).

Photograph from Topical Press

A GOLFER'S NIGHTMARE IS THE "ANT HILL" COURSE IN CENTRAL AFRICA

Natural bunkers as big as houses rise on every hand. They are termite nests—120 of them—guarding the fairway like mountains in miniature. Some are even used as tees, although it takes considerable climbing ability to get to the top. The man at the right, with two black caddies near him, has sliced into one of the insect-erected hazards. American greenskeepers, bothered by the castings and sand cones of common ants (see Color Plate II), may consider such trials as these and take heart.

extraordinary exceptions. One is Carebara, an ant of Asia and North Africa, noted for being a great enemy of the "white ants," or termites, on which it feeds (see Color Plate VI).

A RETINUE FOR HER HONEYMOON

When the mother-to-be Carebara goes on her honeymoon, a number of the almost microscopic workers attach themselves to her legs by their jaws, and in this way are with her to be of help when she starts the new colony.

Extraordinary and somewhat piratical methods of establishing colonies are followed by the females of some ants, usually species not physically capable of caring for their own first brood. One kind steals into the nest of a related species, hurriedly seizes and makes a pile of the pupae already there, and fiercely defends them from their rightful owners. When adult ants emerge from these pupae they are loyal to their kidnapper mother and, antlike, commence to care for her eggs and for the young hatched from them. This results in a mixed colony of two species.

A few species of Western ants of the genus *Formica* have very small females, thickly covered with soft yellow hair. Entering a colony of another, though closely related, species, they so ingratiate themselves with the workers that they are adopted and the rightful queen is murdered by her own progeny, who devote the rest of their lives to the new queen and her young. The original inhabitants eventually die off, leaving their native nest entirely in the possession of the usurper and her brood.

THE QUEEN IS MURDERED!

In North Africa a fertile queen of the "decapitating ant" (*Bothriomyrmex decapitans*) will fly to a nest of Tapinoma, a much larger ant, and loiter around the entrance until Tapinoma workers seize her. They take her into the nest, but for some reason do not eat her; whereupon she climbs onto the back of the rightful queen and saws at her neck until the head falls off. Then the Tapinoma workers adopt her and care for her eggs and young until the nest is populated only by the offspring of the regicide.

More males and females are produced; queens fly away, find another nest of Tapinoma, and repeat the process. One wonders how the host species has persisted so long, but it may be that it will eventually be exterminated by the decapitators; then the latter must disappear also, for such a parasite cannot exist without its host.

Certain ants have gone so far in parasitic development that the worker caste has entirely disappeared, leaving only males and females incapable of caring for themselves and entirely dependent on their ability to find nests of suitable host ants. Some fifteen genera of these have been discovered.

When the Amazon queen goes out to found a colony or "queendom," she enters a nest of the common Formica and immediately pierces the head of their queen with her long, curved, and sharp-pointed jaws. She is then adopted by the Formica workers, who devote the rest of their lives to caring for her progeny.

The Amazon, with its lethal mandibles, made only for fighting, is incapable of feeding itself or performing the ordinary home duties of an ant, so the supply of slaves has to be replenished from time to time by raids on neighboring Formica nests (see Color Plate I).

The hard-working defenders, with their short, triangular mandibles, are no match for their well-armed foes and the battle is always one-sided. It is interesting to see the Amazons, sometimes in more or less regular file, bearing home the captured pupae from which new slave ants will emerge. Later the captives occasionally help raid their old nests and enslave their own sisters.

The Amazons occur throughout the temperate regions of the Northern Hemisphere, rather rarely in eastern United States, but commonly in parts of the West. I have found them only twice in the vicinity of Washington, D. C., on the edge of Soldiers' Home Park and on Bull Run Battlefield, curiously enough.

THE "FORGOTTEN ANTS"

One feels sorry for some of the industrious species of Formica, solid citizens, but really the "forgotten ants," because they seem to be preyed upon by every sort of warrior ant and their nests are nearly always shared with various guests and parasites.

Two kinds of ants, very different from each other, sometimes live together amica-

Photograph by Jacob Gayer

BRAZILIANS FIGHT ANT ENEMIES WITH SMOKE

In Belém (Pará) leaf-cutting pests are killed by pumping sulphur fumes into the nests (see Color Plate V and illustration, page 174). The can at the left contains a charcoal fire. It is placed over the entrances and the pump at the right does the rest.

bly, each occupying a separate part of the same nest and contributing to the general welfare.

The little shampoo ant (*Leptothorax emersoni*), discovered by Dr. William Morton Wheeler, of Harvard,* in the peat bogs of Connecticut, lives in the nests of *Myrmica canadensis*, a much larger species. When the Leptothorax worker needs food, it approaches the Myrmica worker and proceeds to shampoo and lick it. The Myrmica obviously enjoys this, for it regurgitates food to the Leptothorax.

One day in Brazil I was investigating an ant nest consisting of a mass of earth six inches in diameter in a fork of a tree.

I tapped this nest gently with my forceps and the surface was immediately covered with small, reddish-brown ants of the genus *Dolichoderus*. When I gouged into the nest to find the various forms, a swarm of Odontomachus rushed out and one of them stung me. Odontomachus was a dozen times as big as the Dolichoderus and provided with strong biting jaws and a red-hot sting.

Undoubtedly the little Dolichoderus had built the nest and the Odontomachus had taken up their abode there also. Evidently a small insect alighting on such a nest would attract only the smaller inhabitants, but a severe jolt would bring out the shock troops in defense. Both of these ants were new to science and never have been found again.

THE THRILLS OF AN ANT HUNT

Often I have gotten as big a thrill from a successful hunt for a rare ant as I have from the capture of giraffes or wart hogs. There is about as much physical exertion involved, too, turning over thousands of stones and logs, digging into the earth, chopping hard wood, and peeling bark from innumerable dead trees.

Luck frequently plays an important part.

In 1901 Father Schmitt, a Jesuit missionary, sent to the great myrmecologist, Forel, of Switzerland, a single specimen of a new and extraordinary ant from Haiti. Forel described it and named the genus

* See "Notes About Ants and Their Resemblance to Man," by William Morton Wheeler, in the National Geographic Magazine, August, 1912.

after his good friend, Carol Emery, of Bologna, and the species after the Jesuit (*Emeryella schmitti*). This lone specimen was long the only representative of its kind in collections, and the species was something I especially wanted to find while in Haiti (see Color Plate VI).

At the end of a month's work I had found one solitary worker along a roadside. I had no fine-tooth comb with me, but for two months I tried every other method I knew of to discover the nest or more of the workers. Finally I reported to my teacher in zoölogy that, as far as I could make out, the species was now extinct and I had captured the last survivor on the island.

Then one evening I went for a stroll just before dinner and noticed on the path a millipede, or thousand-legger, moving in an unnatural way. Bending over, I saw that the millipede was dead and was being carried by an ant. The ant was *Emeryella!*

It took all of my strength of character to keep from seizing both ant and prey at once, but I smoked my pipe as calmly as I could and watched the ant till it leisurely entered a small hole at one side of a flat stone.

When the stone was turned over, there was an entire colony of some sixty workers. Later, in the same locality, I found a similar colony, and specimens of these have now been distributed to all the important ant collections in museums all over the world.

There were no females in either nest; so it is not improbable that this species lacks a special female, and that one of the workers functions as an egg-layer. At night there came to lights in my quarters a reddish ant, which from its general character we assume to be the male of the species and have so described it.

I had talked about *Emeryella schmitti* so much that it became well known to the scant white population of the island under the name of "Mary Ella Schmitt," and when I finally reported its discovery there was a great celebration among my fellow Americans, railroad men vacationing at Port-au-Prince.

Another missionary priest, Père Sallé, had sent to the Museum in Paris from Haiti a curious nest of vegetable fiber, not unlike a wasp's nest.

Forel, while rummaging about among the specimens, found it and tapped it on a piece of white paper. Several dead and dried ants dropped out. They belonged to the genus *Macromischa*, the most exquisitely formed of the ants and with beautiful metallic coloration—purples, greens, and reds (see Color Plate III). The genus is interesting, too, because it alone of the ants of the West Indies has developed into numerous species. About thirty are known from Cuba alone.

I remember one Christmas Day at the Mina Carlota, in the Sierra de Trinidad of Cuba. When I attempted to turn over a large rock to see what was living underneath, the rock split in the middle, and there, in the very center, was a half teaspoonful of brilliant green metallic ants glistening in the sunshine. They proved to be an unknown species of this genus.

FINDING A "LONG LOST"

One of the "long losts" was *Macromischa sallei*, in Haiti, and my heart was set on finding it again. Coming into Furcy one afternoon, mounted on a diminutive Haitian horse, I saw an ant walking across the road. It was *M. sallei*. I collected it and put it carefully into a vial of alcohol.

Père Plombé, most genial of hosts, greeted me and announced that dinner was nearly ready. On the little ridge where the church and priest's house stood were low bushes belonging to the genus *Baccharis*. While waiting for dinner I strolled among them and noticed an oval object on one of the bushes. I tapped it with my forceps and the next moment the thing was literally covered with ants. They were *M. sallei* swarming out to defend their home.

Other bushes contained other nests, and I shall not forget the thrill I had when I told Père Plombé, on my return to his home ten minutes later, that I had rediscovered this species and had enough specimens for all the museums in the world.

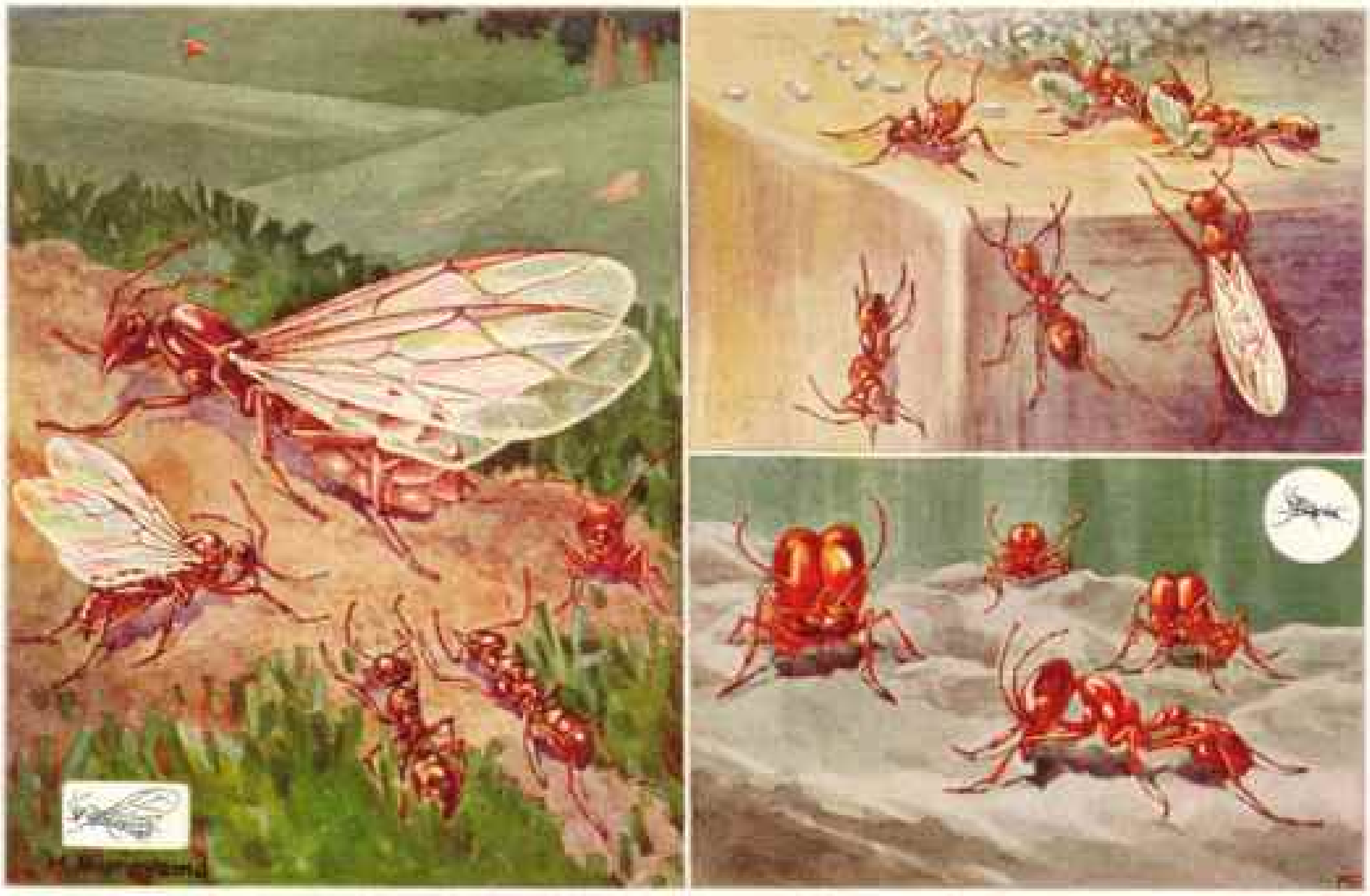
Père Plombé in his profession meets all sorts of people with all sorts of enthusiasms, but my elation over this find puzzled him a little. He gazed at me, then at the vials densely packed with ants, shook his head, and murmured to himself, "C'est curieux!"

The fire ant (*Solenopsis geminata*) is such a good traveler that one variety or another is found throughout the warmer parts of the earth (see Color Plate II). It gets its name from the painful, burning sting it can inflict. A colony contains

(Inset, natural size)

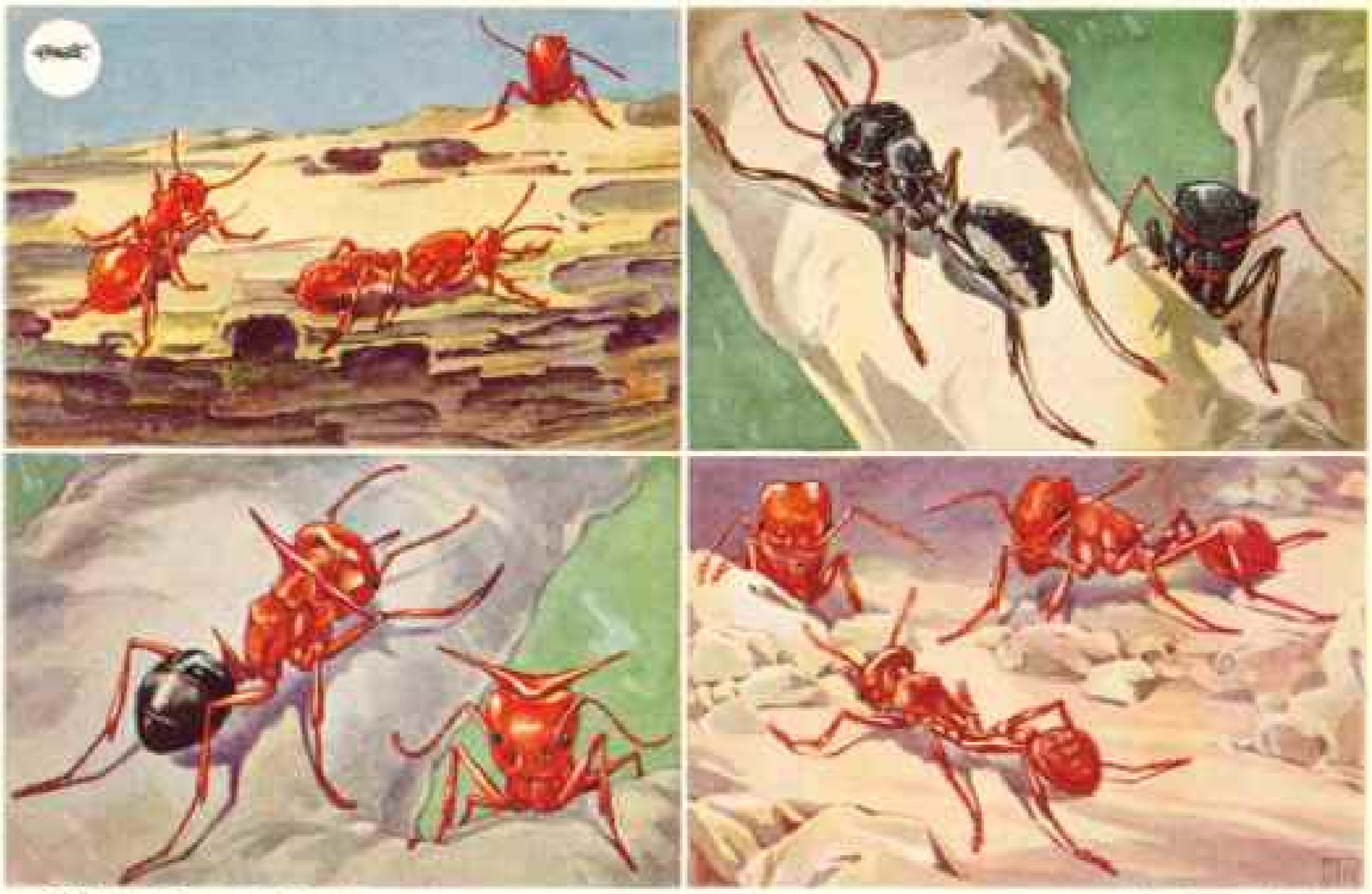
RED AMAZONS WITH ICE-TONG JAWS DEAL DEATH IN A KIDNAPPING RAID

One drives the twin prongs through her black foeman's head. Others grapple or poise for the kill. With duller jaws, the desperate blacks (*Formica*) gnaw their enemies' legs, but some of the reds dart into the nest and bear off the booty—fat pupae from which black ants will emerge to become their slaves. Without them these Amazon ants (*Polyergus*) of the United States, Europe, and Japan would die, as their weapons are so long and sharp they can neither feed themselves nor care for their young. The Geographic's staff artist peered through microscopes for months to make these remarkable action paintings.



"PUBLIC ENEMIES" SPOIL PUTTS, LOOT PANTRIES, STING LIKE HOT NEEDLES

Among the world's most abundant insect species are the lawn ant, bane of golf courses (left, *Lasius niger americanus*), and the tiny, yellow house ant (*Monomorium pharaonis*, upper right, stealing sugar). The southern and tropical fire ant (lower right, *Solenopsis geminata*) carries a burning sting.



(Insects, natural size)

A PRIMITIVE UNITED STATES ANT "PLAYS POSSUM" WHEN ATTACKED

This sluggish dweller in rotten wood is *Proceratium croceum* (upper left). On the tomb of Haiti's black king, Christophe, Dr. Mann discovered *Camponotus cristophei* (upper right), hence its name. South America's rare *Dolichoderus spinicollis* (lower left) has horns, and the Texas harvesting ant (*Pogonomyrmex desertorum*, lower right) wears a beard in which it carries sand in nest-digging.

THESE SLENDER BEAUTIES OFTEN WALK WITH THEIR HINDQUARTERS REVERSED

Delicate in sculpture and striking in hue is *Macromischa purpurata*, found by Dr. Mann in the West Indies. It feeds on small insects or plant nectar, nests in hollow twigs, and works without the energetic haste often associated with ants. The legs are long but the pace is slow.

(Insets, natural size)

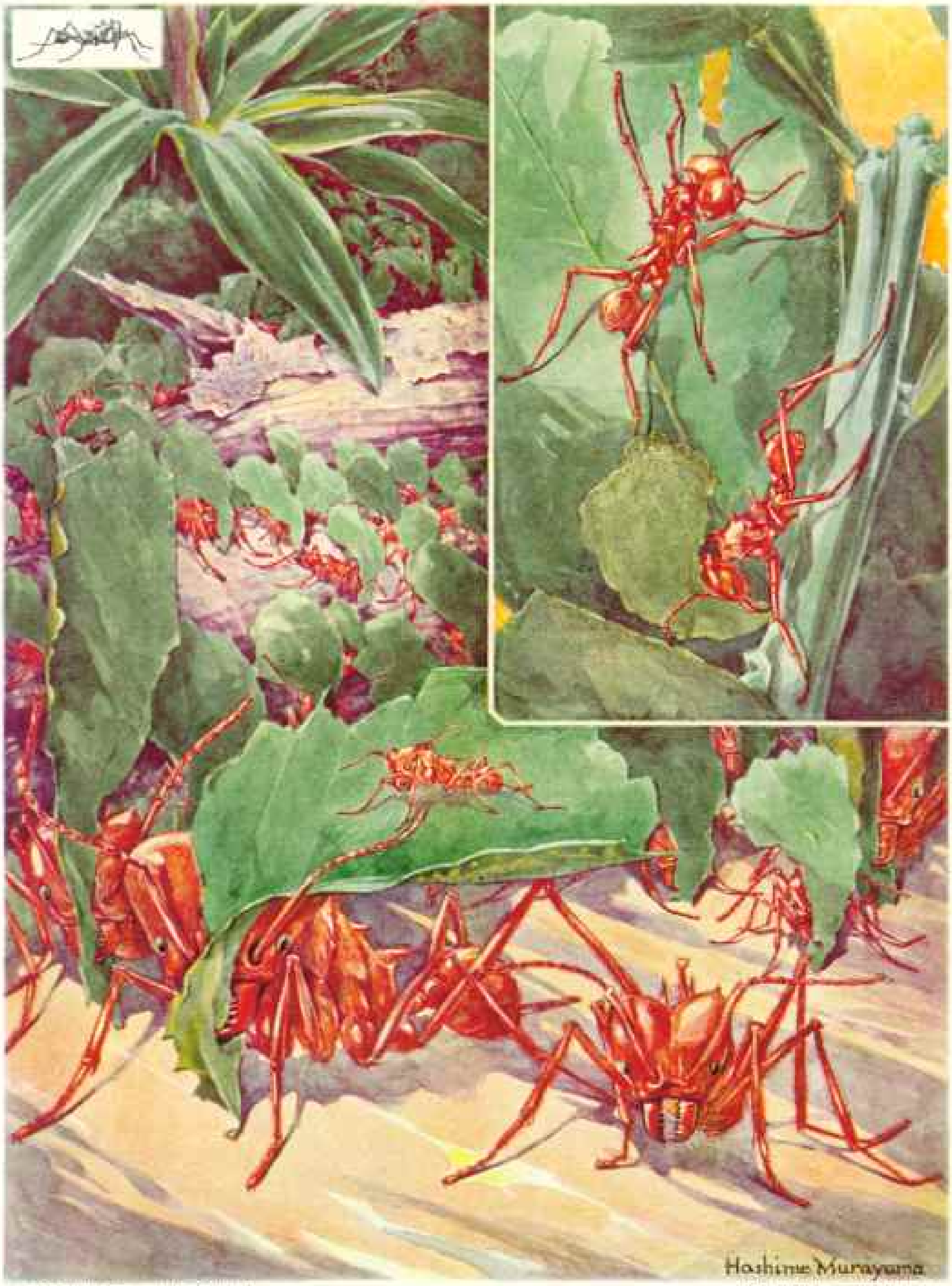
A BIG, HOMELY FACE MAKES A LIVING DOOR

The soldiers of *Camponotus* (*Colobopsis*), left, living throughout the world, have oversized, curiously indented heads. With these they block the round entrances to their nests in the hollow stems of sedges, as one is doing here, and open only at the proper "password"—a series of antennae strokes. A blind, primeval Australian ant is *Eusphinctus sternelli* (right).

 (Inset, natural size)

TAILOR ANTS, LIKE MEN, HAVE MASTERED THE USE OF TOOLS

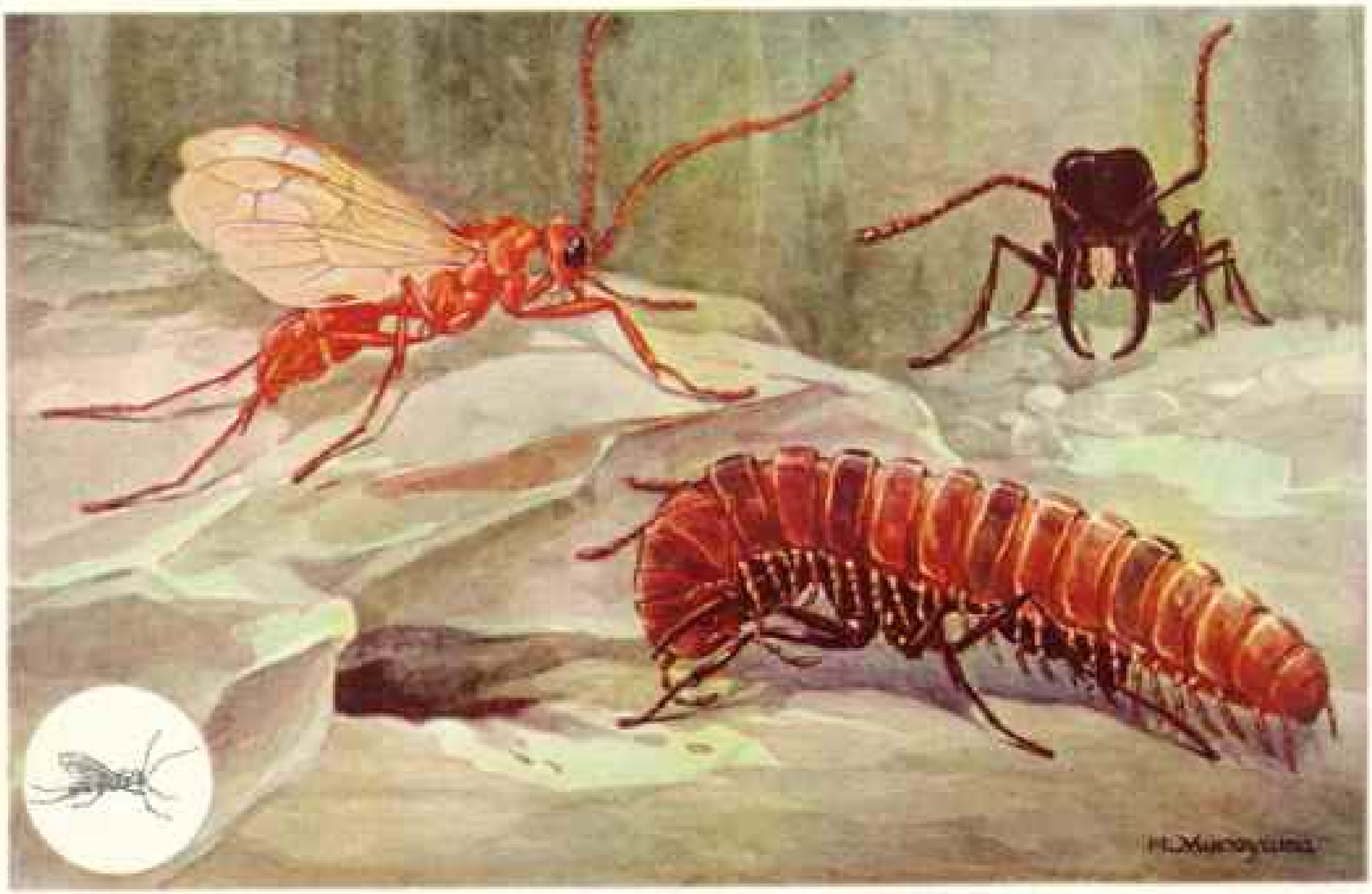
Their own young are used as spinning machines in nest-building. While some of the long, vicious, red workers (*Oecophylla smaragdina* of the Old World Tropics) yank the edges of growing leaves together with their tusks, others pick up half-grown larvae with well-developed silk glands for spinning cocoons. Stimulating the grub with its antennae, the tailor makes it produce a silken thread which sticks to the leaves and binds them together. These ants bite so ferociously that they often leave their heads in the wound when brushed off. In India, men pound the ants to a paste which is eaten with curry. Wearing the wings of their marriage flight are the queen and the smaller male.



(Small inset, natural size)

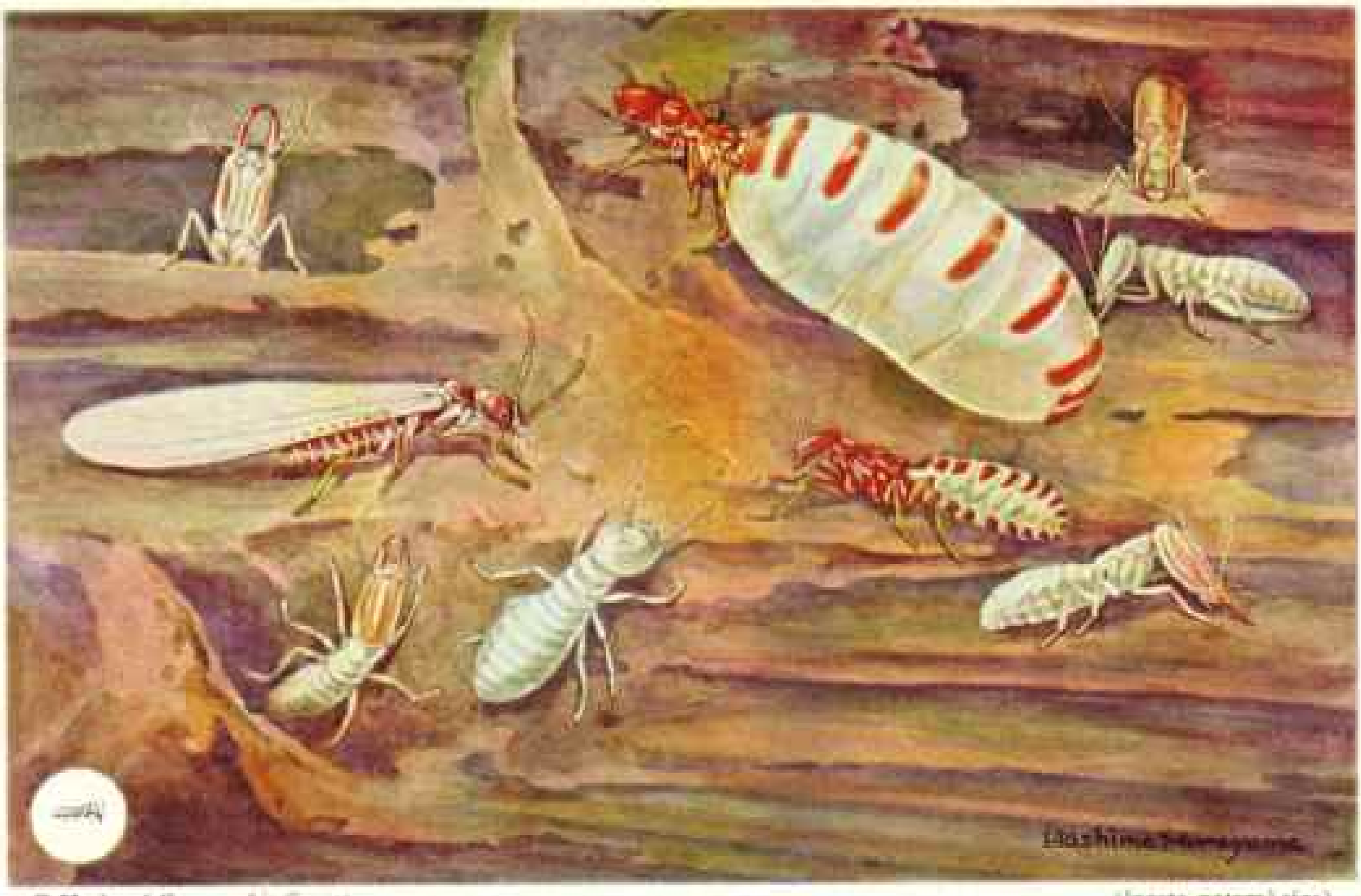
AT NIGHT OR ON CLOUDY DAYS, SWARMS OF LEAF-CUTTING ANTS STRIP WHOLE TREES

Pieces of leaves are sheared off with their saw-edged jaws (inset, upper right) and carried home like waving banners by workers marching in wide columns and beating regular paths. Then the leaves are chewed to a paste, on which later grow the "mushrooms" that form the only food of these ants (*Atta cephalotes*, of tropical America). They do immense damage to orange groves. Large and medium ants serve as leaf gatherers or soldiers. The smallest, riding on the leaf in the center like a mahout on an elephant, acts as gardener for the fungus, or works in the nursery. Known as sauba ants in Brazil, they are fried and eaten by Indians.



A HUNTER RETURNS, ALL BUT HIDDEN BY ITS PREY

To the home nest under a stone, a worker of *Eurycella*, of Haiti, brings one of the millipedes which form its chief food. A comrade displays the powerful jaws with which it seizes its quarry. The actual execution has been done by rapier thrusts with a sting. A winged male sits on the stone.



(Insects, natural size)

THE "WHITE ANT" WHICH RIDDLES WOODWORK IS NOT AN ANT AT ALL

Instead it is a termite (*Reticulitermes flavipes*), related to the cockroaches. Perpetrators of great damage in tropical countries, these wood-eaters have recently become a menace to buildings in many United States cities. Here in the royal chamber sprawls the egg-laden queen. Beneath her is a young female facing a winged male. The others are workers and big-jawed soldiers.

FAR FIERCER THAN ITS NAMESAKE IS AUSTRALIA'S BULLDOG ANT

Routing many a picnicker and scientist, it grabs with strong, saw-toothed jaws, then drives in a sting a quarter of an inch long, partly visible at the rear of the nearer one. These well-armed fighters —*Myrmecia formosa* and (inset, upper right) *Myrmecia nigriventris*—are among the largest of ants.

(Small insets, natural size)

THE CARPENTER ANT WEAKENS HOUSES, BRIDGES, AND TREES

Like the termites (see Color Plate opposite), it bores elaborate tunnels which sometimes cause beams and rafters to collapse without warning. The thick-jawed wreckers (*Camponotus herculeanus pennsylvanicus ferrugineus*) have been found frequently in the eastern United States. On a log crawl a winged male, workers, and soldiers with large heads.

(Inset, natural size)

AGAINST THE HUNLIKE HORDES OF ARMY ANTS NO LIVING THING CAN STAND

Even men flee as the mighty column writhes through the jungle, wiping out all insect and animal life in its path. Like generals, colonels, and captains at intervals in this line of destroyers (*Eciton hamatum*) march the biggest ants with such long, sharp-pointed hooks for jaws that they have to hold their heads up. With the army come camp followers—guests and parasites superficially resembling ants. Just this side of the twig that serves as a bridge is a beetle. Nearer, in line with the head of the caterpillar, which has been bitten and stung to death, creeps a masquerading wasp. The hovering fly is believed to lay eggs and larvae on the heads of ants, the grubs then killing the hosts.

vast numbers of workers. They have recently been reported as doing great damage to young quail in the Southeastern States. The birds, incapable of defending themselves, are stung to death.

Fire ants nest in almost any kind of locality and are extremely prolific. Even floods cannot daunt the fire ant, for it has been reported in Brazil that when the water rises and washes out a colony, the ants form a ball, queen and brood in the middle, and this living ball floats away to a tree or to higher ground, where the ants recommence housekeeping.

THE TAILOR ANTS USE LIVING TOOLS

The tailor ant (*Oecophylla smaragdina*) and a few other ants (*Polyrhachis*) are unique among all the earth's creatures, so far as we know, in that they use their young as tools in nest construction (see Color Plate IV).

Few adult insects spin silk, but the larvae of many have this ability to enclose themselves in silken cocoons, from which they will later emerge as fully formed adults. Oecophylla utilizes this accomplishment of its young in making its nests.

I have often torn one of the leaves that formed its box-shaped nest and then watched the proceedings.

At first there is a wild sortie on the part of the ants, all in fighting mood. They cannot sting, but they bite annoyingly.

After they have given up trying to find and destroy the intruder, worker ants seize larvae in their mandibles and bring them to the damaged portions. Other workers seize the edges of the leaves and pull them together, while those with the larvae pass them back and forth, stimulating the grub to exude silk, which sticks and holds the pieces of the leaves together.

After their silk has been used for the common good, the luckless larvae have to sleep naked!

The tailor ant lives throughout the Old World Tropics and is one of the few ants that are greenish in color, though some of its varieties are red, and one, in West Africa, is brown almost to black.

COLLECTING FROM TREE TOPS

In the Solomon Islands this pugnacious Oecophylla abounds. On the island of Malaupaina I had for two weeks the unusual and delightful good fortune for a naturalist of being able to collect among the tops of high trees. A plantation company was felling the original forest, clearing the land for coconuts. One enormous tree after another was felled, and as soon as it came down I would go among the upper branches and collect.

Oecophylla was abundant, and I can safely say that there was scarcely a moment of daylight during those two weeks when an ant was not biting me on the neck. I would instinctively reach up, seize the little creature, break its neck between my thumb and forefinger, and go on collecting.

But once, as I crushed one of them, I noticed that it was unusually hard. It was another ant, a Podomyrma, rare and desirable. After that it was necessary for me to seize each attacking ant and carefully examine it before destroying it, so as not to crush a valuable specimen by mistake.

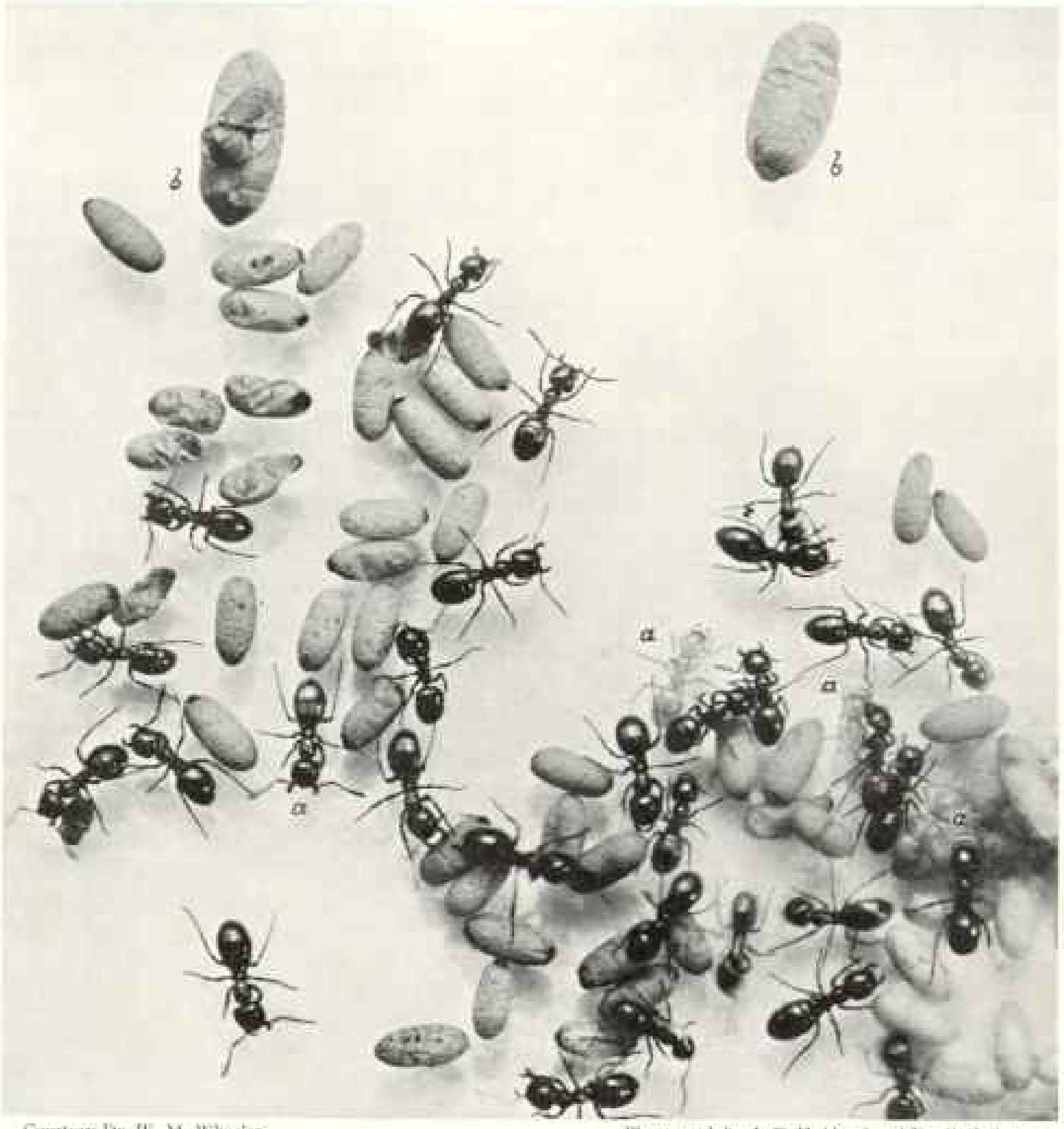
Eight thousand different kinds of ants are a large order, but students have simplified their study by a classification which is one of the finest that has been done for any insect group. They have been arranged into different families, and the first and most primitive of these are the Ponerines, the ant savages. Like cavemen, they live solely by hunting. Big, strong jaws run in the family and at the other end they carry a poisonous sting. Their headquarters are the Tropics, but a few forms extend into the colder climates also. Some are minute in size, but others, the largest of the ants, attain a length of more than an inch and have antagonistic dispositions more than worthy of their bulk.

In Bolivia we found that one kind, nearly an inch long, locally called "buni," but classified as *Paraponera clavata*, would sometimes actually drive the bare-footed natives from their own corn patches.

PROMENADING IN THE FOREST

A still larger species, the "great, terrible ant" (*Dinoponera grandis*), the "tucandero" of the Brazilians, also inhabits tropical South America. At Belém (Pará) every day we could see individuals an inch in length, black and shining, walking unconcernedly along the path in the forest.

One primitive group includes the bulldog ant of Australia, which gets its name from its powerful biting jaws; also it has a sting so efficient that it inspires respect (see Color Plate VII). There are many species, and they range from a third of an inch to more than an inch in length. Some live



Courtesy Dr. W. M. Wheeler Photograph by J. G. Hubbard and Dr. O. S. Strong

EXCITED ANTS DASH ABOUT AT A COMING-OUT PARTY

A new generation is making its début. Pale, callow workers (*a*) have just emerged. In the two large cocoons (*b*) are future queens. The smaller casings will yield workers. These common ants of the Northern States, *Lasius* (*Acanthomyops*) *claviger*, keep herds of plant lice (see illustration, page 197).

beneath stones; others make mound nests, and they forage all over the place.

The Australians are very fond of picnicking. I remember on my first visit there, when we would go out for a day our place for luncheon was carefully selected, usually in the center of a broad sheet of Hawkesbury sandstone, not because this rock was particularly soft, but because of its vantage as a lookout for bulldog ants.

The Ponerines usually hunt singly, but with their formidable armament they are able to subdue insects much larger than themselves. A few hunt in groups and raid nests of other ants or of termites.

In Africa I have seen such raids made by a black hunter, *Paltothyreus tarsatus*. The workers are about three-quarters of an inch long. Marching in an orderly, though hurried, column some twenty feet in length, they enter a termite nest. From the surface there is no evidence of a struggle, but after several minutes the column streams out of the ground, each worker holding a dead termite in its jaws.

Termites (see Color Plate VI) form the chief food of many of these Ponerines. Sometimes they establish their colonies in the termite nest itself, somewhat apart from the rightful owners, but still near the source of their living food supply.

In Bolivia I found in a decayed log a populous nest of termites and in the same log was a colony of red hunter ants (*Centromyrmex*). In the chambers of the ants' home I noticed on the top of each larva the body of a decapitated termite. Near by were little piles of dead termites to provide a second helping.

ARMY ANTS ARE LIKE MONGOL HORDES

If these Ponerines, living in small colonies and subsisting by hunting, may be compared to such primitive peoples as the Australian aborigines, the Ituri pygmies, or the Carapuna Indians, then the next group, the Dorylines, or army ants, may be likened to the Mongols of Genghis Khan, traveling in countless hordes (see Color Plate VIII).

Blind workers of different sizes, marching in efficient, ruthless military formation, they leave a wake of death behind them. Nothing in their path is safe. Holes in the ground are entered, tall trees are climbed, and even human dwellings invaded in search of insect prey.

Some raid only the nests of other ants for the larvae and pupae on which they live; some seem especially fond of cockroaches; and I was once driven out of my forest hut by a swarm of these ants pouring up over the door-sill log like a black Niagara flowing the wrong way. I sat outside for hours, until the invaders eventually left, carrying with them what looked like pounds of dismembered cockroaches, spiders, and other late but not lamented fellow housemates of mine.

Different species of these driver, or legionary ants, inhabit all of the continents, but they are most abundant and the armies are largest in the Tropics. Our North American species, some of which range as far north as North Carolina, are small and often subterranean in habit.

EVEN THE ELEPHANTS MAKE WAY

In Africa and in South America roam the mightiest legions. It is said that even the elephant will get out of their line of march, and that the anteater itself might find them too much of a good thing. Certainly, any living creature that becomes covered with these biting, stinging demons is in a pathetic plight. As they are blind, the size of their quarry means nothing whatsoever to them.

Once, in Africa, I leaped into a stream after carelessly stepping into a file of ants. A dozen or so of the vanguard had already clamped onto my leg and kept stinging me, even under water, until I plucked them off.

The number of individuals in a big horde of these marauders cannot be estimated. The column may be an ant or two wide, or it may be over a foot or a yard wide. One army stayed in the vicinity of our camp in Bolivia for weeks, so that I came to feel well acquainted with it as a whole, though not individually.

For hours I sat alongside and watched the column flowing along, waiting for the curious parasitic beetles that live with the ants and accompany them on their march. The beetles so closely resemble the ants that it required experience to single them out in the rapidly moving procession.

When one came along at last—one that I saw—I would grab at it with my forceps. Then a terrific commotion would result. Flanking columns hurried out to find who was molesting them, so I would retreat ingloriously and wait until the column of blind investigators had reorganized itself before resuming my watch.

FORMING A LIVING BRIDGE

Several times I have seen the army form a bridge across a rivulet. In doing this, numbers gather in a mass on the edge and cling together; others venture out; still others closely intertwine their legs till an elongated mass of living ants is extended across; then the army passes over, using this bridge.

I could not find out how the bridge was broken up, because night would come with the file still crossing. Neither could I locate the other end of this file, and I still think of it as marching endlessly and eternally through the Bolivian forest.

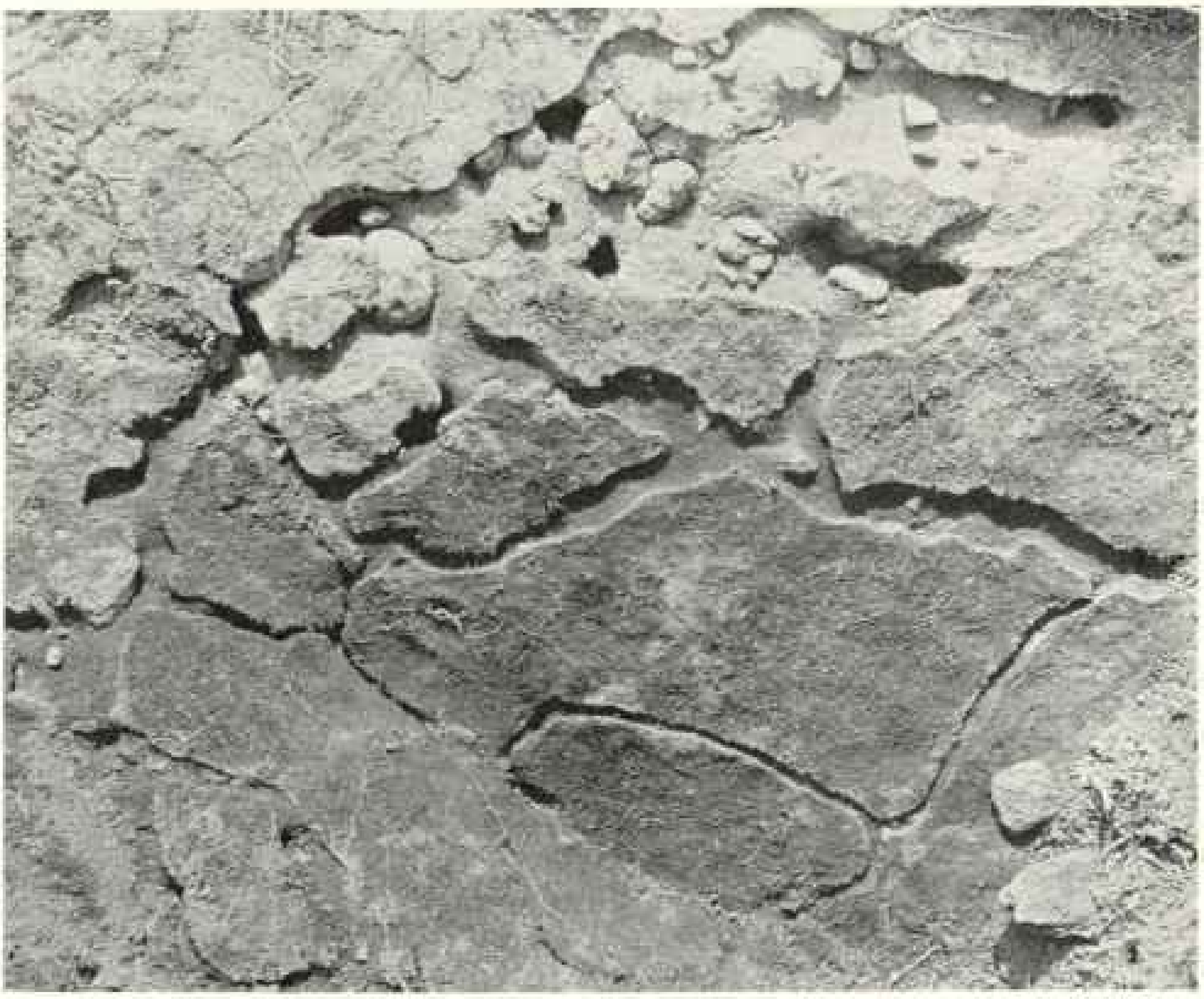
In the American Tropics legionary ants are encountered on every walk in the woods, yet the discovery of one of their queens is an entomological event. The female is wingless, an ungainly creature, blind like the workers, her abdomen greatly enlarged.

There is no permanent nest, though some species make temporary ones in the ground and remain there till the hunters have

Drawing by Hashime Murayama

THE THRIFTY ANT OF THE BIBLE STILL LABORS NEAR JERUSALEM

Thousands of years ago an ant, probably of this species (*Messor barbarus*), caught the attention of King Solomon and inspired his immortal advice: "Go to the ant, thou sluggard; consider her ways, and be wise." Here she "gathereth her food in the harvest" by carrying to her nest a grain of millet locked in her jaws.



Photograph courtesy Dr. W. M. Wheeler

THE STREETS OF AN ANT CITY ARE KEPT SCRUPULOUSLY CLEAN

A flat stone has been removed and the well-ordered nest of a very common ant, *Lasius (Acanthomyops) latipes*, stands revealed. In the interest of sanitation and unimpeded traffic, all food refuse, empty cocoons, dead ants, and débris are carried off to veritable kitchen middens some distance from the living apartments.

thinned out the near-by fauna, reminding us of the yearly hunts of the ancient Mongols. Then the whole colony migrates, taking with them the larvae and the queen.

Sometimes, during the heat of the day, they cluster in a hollow tree or some other depression, a huge swarm of ants, sometimes a bushel of them in one close mass, with brood and female in the center for protection.

With them may also be found the parasites, usually beetles or wasps that superficially resemble the ants. In watching the file one may see one of these inquilines every several minutes, or one may not notice one for an hour. The capture of a swarm, with dozens or hundreds of them at the same time, is to the collector nothing less than a gold mine. He is certain to get badly bitten and stung, as he breaks up the mass and searches for the prizes, but it is worth it.

LONG LIVES THE QUEEN!

The one duty of the queen is to lay eggs, and this she does almost continually, the colony increasing in number and in strength. She may have a long life, for there is one record of a queen confined in a glass observation nest who had survived for 17 years, and I once saw a 14-year-old queen who had spent her life in the collection of a friend of mine in England.

The tasks of housekeeping, nursing the babies, and gathering food are left to the worker, the undeveloped female. Contrary to general opinion, only a small percentage of workers are actually out of the nest at any one time. At home they spend much of their time in grooming themselves and each other.

Most ants subsist entirely on liquid food. Even the pieces of insects which they eat are taken into the mouth cavity and the liquid pressed out and swallowed. The dry pellets are spat out. These hard pellets, by the way, sometimes are used as food by other insects which share the nest with the ants.

ANTS HAVE MILLERS TO GRIND GRAIN

Naturally, in a colony of many thousand individuals a large amount of food is consumed. It has been estimated that a single nest of the large mound-building ants of Europe, practically the same as those we find throughout our Far West, collects each day insects to the number of several hundred thousand.

The harvesting ants, most of them inhabitants of deserts, have developed millers, with heads enormously enlarged to contain the muscles of the jaws.

The ordinary worker goes out day after day and brings in seeds of plants. These the millers laboriously grind into a sort of flour, which is stored in the nest.

Once in Arizona, while collecting ants, I noticed a small turret entrance to a nest. Around this were a number of mammoth ant heads. Later I found that these were the heads of the millers. The harvesting season was over. The millers had done their duty in grinding the grain; whereupon the workers, provident always, had sawn their heads off. It was more economical from the standpoint of the colony to raise a new brood of millers next year than to carry these over during the times of depression.

From the train window the traveler in the Southwest sees large ant hills dotted over the desert. These are usually nests of the bearded agricultural ants, Pogonomyrmex (see Color Plate II). They live on the seeds of grasses which they gather and store in their nests. There is usually a large area kept carefully cleared about the nest, which makes the mound stand out prominently. Sometimes surrounding these cleared areas is a fringe of the grass that supplies the food of the ants.

From this, some observers have thought that the ants intentionally plant their own food. This is probably not so. Refuse from the nest is carried out and deposited at the edge of the clearing, and with this refuse may be some of the seeds which germinate there. It is thus by accident that a source of food supply appears adjacent to the nest.

These desert harvesters are fierce in the defense of their home, and it is said that small children have been stung to death while playing on the nest. I have been stung a number of times while collecting Pogonomyrmex and can testify that the sting leaves a dull pain which lasts for some time.

Honey ants are another example of those that look ahead to the days of famine, piling up quantities of honeydew in living containers (see text, page 193, and illustrations, pages 194 and 195).

The fungus-growing ants, chiefly inhabiting tropical America, but also extending into the Temperate Zone as far north as New Jersey, actually plant and cultivate their food. They belong to a distinct group, called the Attinae, and all they ever eat is a little mushroom which they themselves grow.

Any evening, on a walk in southern Texas or in practically any part of tropical or subtropical America, one will see files of these ants, each ant bearing a bit of leaf. For this they have been called "parasol ants" and "leaf-cutting ants" (see Color Plate V and illustration, page 174).

One species is a terrible pest to citrus planters in the Tropics. The colonies are enormous. Sometimes an orange tree will be stripped of leaves in a single night.

The ants carry these leaves into their nests along well-beaten trails. There they are chewed into a paste by the smaller workers. This paste is used as a stratum on which to grow the minute mushrooms on which the ants live. The smallest members of the colony serve as gardeners as well as nurses and take care of the crop. For fertilizer most of them use leaves, but some use bits of straw, and others caterpillar droppings, on which to raise the fungus.

The queen ant, before she leaves her parent nest, takes into her mouth some spores of this fungus. When she lays her first eggs she crushes them and deposits these spores upon them. The fungus starts and maintains itself there until her second crop of eggs develops into young ants, who go out at once to obtain new food for the home garden.

TERMITE IS KIN TO COCKROACHES

There is an old saying that termites are called "white ants" because they are not white and because they are not ants. A true ant is a relative of the bees and wasps; the termite is kin to the cockroaches. But these two groups, so widely different in origin, have developed somewhat similar ways of living. In termites we have the differentiation into soldiers and workers, and we have the sexual forms, males and females (see Color Plate VI).

The latter, however, pair for life; so, instead of the widowed queen that we have in the ant nest, we find in the termites a king and a queen. Their method of establishing the colony is essentially the same. There are flights when the air is filled with flying white ants, their wings dropping off much more easily than do those of the true ants.

I remember one occasion in the Solomon Islands when such a flight occurred while we were at dinner, and we hastily withdrew from the vicinity of the lights in order to keep our soup from being entirely wings. These, however, are not mating flights, as in the ants, but are distributional flights. Pairs go out, find a suitable place, and commence housekeeping together.

Like the ants, termites build various forms of houses, mounds, and tree nests, but often live in the heart of the tree itself. Their food consists almost entirely of wood, which they chew up and swallow, but some of them raise fungus, reminding one of the fungus-growing ants.

With one or two exceptions, they are denizens of the dark. Exposure to heat causes the death of most species immediately.

They are much more injurious than ants. In certain tropical countries the termites' habit of destroying books makes it difficult to maintain libraries. Even as far north as Washington, D. C., it has been necessary to replace floors in the National Museum and other public buildings on account of the depredations these insects have committed.

Ants, like man, live in complicated societies. They recognize fellow citizens only by their odor, and any that do not smell the same are enemies.

Ants have an intense patriotism, evinced by their willingness to fight and die for the home nest; and a touching devotion to their mother and to the babies in the nest. They are, for the most part, hard workers, and each individual does its utmost to contribute to the general welfare. They build complicated homes, and they show a wise providence in the storage and preservation of food.

The joker may say, also, that the ant has attained complete perfection in one field: the women do all the work.

On the other hand, there are among ants morons, paupers, and other parasites: thieves, ingrates, murderers, and kidnappers.

So, in reply to a question which has been asked me in all seriousness:

"Which is the more intelligent, man or the ant?" I feel inclined to reply:

"It depends on the man—and the ant!"

LIVING CASKS OF HONEY

By Jennie E. Harris

EACH year thousands of people visit the Garden of the Gods, in Colorado. They stand in awe before fiery-red pinnacles etched against blue sky. They marvel at those fantastic rock formations—the gods of mythology, with their human shapes, some of their hats, most of their spears, and a few of their cathedral spires, towering about them in red sandstone; and they are unaware, these interested sight-seers, of an ancient, dramatic "*civilization*" living under their feet.

Yet here, in the sandstone ridges, dwell creatures who might themselves have stepped from living myths—creatures with yellow heads and large, inflated, translucent bodies—who are, perhaps, the most self-sacrificing beings known.

In fairy tales boys and girls are fattened by witches, so that they may later be eaten with gusto. In this race, dwelling in darkness in the Garden of the Gods, children are fed enormously, so that a few may become overcapacious and hang in underground cellars for months, for years, as living casks of honey.

This would be terrifying were these creatures human. Instead, they are honey ants.

Honey ants are unhuman and unlike any other insect in their translation of themselves into honeypots.

They gather a honey not unlike that of bees and store it in round, thin casks that let the beautiful amber of honey shine through. But the casks possess living trunks, living heads, living legs. They hang by living claws to the cellar roof, and open a living spigot when an imbiber comes to drink (see illustrations, pages 194 and 195). For this, children are fed to enormous size and chambered in eternal darkness.

TINY BEINGS DO PRODIGIOUS EXCAVATING

Here and there, across the tufts of grama grass and wild sunflower heads, gleam little mounds of red sandstone and bright-colored quartz—craters cut into rock. The red, loose stones roll out on all sides to a diameter of about thirty inches, with each mound rising to three or four inches, pierced by a large central entrance hole.

Outside, all looks simple; but inside, a descending shaft runs vertically for a while before carrying off sharply to a long gallery and other shafts, forming galleries under galleries, all running in the same direction. Then, seldom far from the surface, usually up or down a few steps from a main gallery, single or in suites, are the wine cellars, the honey chambers, the forever-homes of the swollen members of the race.

It would take a Gustave Doré to portray adequately the drama of honey ants.

The honey chambers where they hang are virtually death chambers, except that life flows from them freely. The severed casks of honey in the burial grounds form a nightmare thing, cask rolled beside cask. But beauty exists in the ants' refusal to touch a honey cask after its owner has died. The little crammed honeypots stand idle and untouched, once they are rolled into the cemeteries.

VISITING THE ANTS' HOME

Be an Alice in Wonderland in such a home, if you will. Come down that wide central stair, having ducked into the rabbit hole, passed sentinels at the gate, and given the essential salute. All is dusky dim; only that glimmering round of daylight above. You turn left down a long, narrow passage, which leads into deeper and deeper darkness; but the floor glints up with a firm polish—the floor deliberately made smooth, not merely worn smooth by the passing of innumerable feet. And the walls are smooth and straight, a sort of guide in the dark.

Little feet rustle by—ants laden with earth, excavating a new room far at the end of the passage. All that mound above was formed by similar excavations; each pebble, each shining bit of quartz, was carried along galleries up the main stairs and out.

"Um-m-m!" An ant licks her mandibles, giving off a vague sweet scent. Honey! Somewhere near is a honey cellar. The ant has paused in working to take a good stiff drink. A shaft descends darkly to the left; cautiously down, down, to a great vaulted, globe-lighted room.

The vaulted roof is clustered with enormous hanging lamps. No, not lamps; pale amber spheres, hanging about midway into the room, occupying half the cellar space. The globes glow with the light that lives in honey; their pale-gold color is the richness

Drawing by Maruyama, after H. C. McCook

THE PASSWORD GIVEN, A HONEY CASK OPENS THE FAUCET

Hungry workers flock around their balloonlike sister and swallow the sweet liquid regurgitated from her huge community stomach. By this unique storage system the honey ants (*Myrmecocystus horsideorum*) of Colorado's Garden of the Gods tide over the season when food is scarce (see illustration, opposite page).

of honey; that scent rising from them is the warm flavor of honey. Each globe is a living jewel, nothing more nor less than the distended body of a living ant, filled almost to bursting with limpid honey, clutched to the roof by its claws.

They crowd the arched ceiling; stir restlessly; twist their yellow heads, squirm their shoulders, but do not loosen hold. Below them the clean walls slope to the level floor, which is swept, polished, made smooth. But the roof is gritty, purposely left rough, for the claws to maintain perch.

The roof arches half again the height of the walls; a cellar made deliberately for honey casks, to allow free passage beneath, space for keeping the honey casks clean and the cellar free from mold.

There are little soft sounds, as the great globes stir, shift an arm or foot, sway a little nearer to a neighbor. "Careful! Don't dare lean. You might break me!" And one turns a pointed yellow head toward another's. The globes are not all clear amber. Queer dark planes streak them. Their translucent part is inner skin stretched to balloon proportions, pushing apart the dark planes of the outer body, forming islands on a globe map of strange world seas.

SPIGOT MOUTHS OF LIVING HONEYPOTS

Suddenly an ant enters to drink. She looks like these hanging ants, yellow-headed, yellow-waisted, but she wears no inflated balloon. Her antennae lift inquisitively. Already the foretaste of honey is in her mouth. She stands almost erect, climbs to the hanging ant, leans to its little closed mouth. "Open, please." Obediently its mouth opens. Up comes a clear drop of honey, pushed up by some inner movement, to hang a moment, glistening, on the cask's lower mandible, before dropping into the waiting ant's mouth.

She takes one, two, even three, drops. "Thank you; you may close." She climbs down, and the little spigot mouth closes. Before the ant leaves she daintily wipes her mouth against the back of her hand, smooths down her back hair, then trots off, groomed, well fed.

Another ant enters; another, another. Each climbs to a chosen sphere; says, "Open, please," with that leaning of mouth

Drawing by Murayama, after H. C. McCook

HONEY-FILLED "REPLETES" MAY CLING TO THE CEILING FOR THEIR LIFETIME

Equipped with commodious, elastic crops, the ants that are to become honey casks crawl to the vaulted roof of the storage cellar, get a good grip, and let the workers fill them almost to bursting with the sweet discharge from oak galls or living aphids (see page 199). Then they function as living food reservoirs, yielding drops to hungry workers on demand.

to mouth, and at once the mouth opens and up comes the honey drop.

But suppose they enter to deposit honey rather than receive it. What then? Painfully, slowly this time, because so laden they are almost honey casks themselves, the ants climb to the hanging casks, place mouth to mouth. "Open, please," and, with antennae held back out of the way, let drops of honey form on their mandibles to enter the obedient casks.

This new honey is almost white in its freshness. As long as drops are there to fall in, the little spigot mouth holds open. Then the emptied ant, relieved, turns away; and the globe, clinging to the roof, gleams larger, more bulbous still, with the added contents. It scarcely dares draw a full breath, move an arm, or shift a leg for fear this new weight and fullness will make it burst or fall.

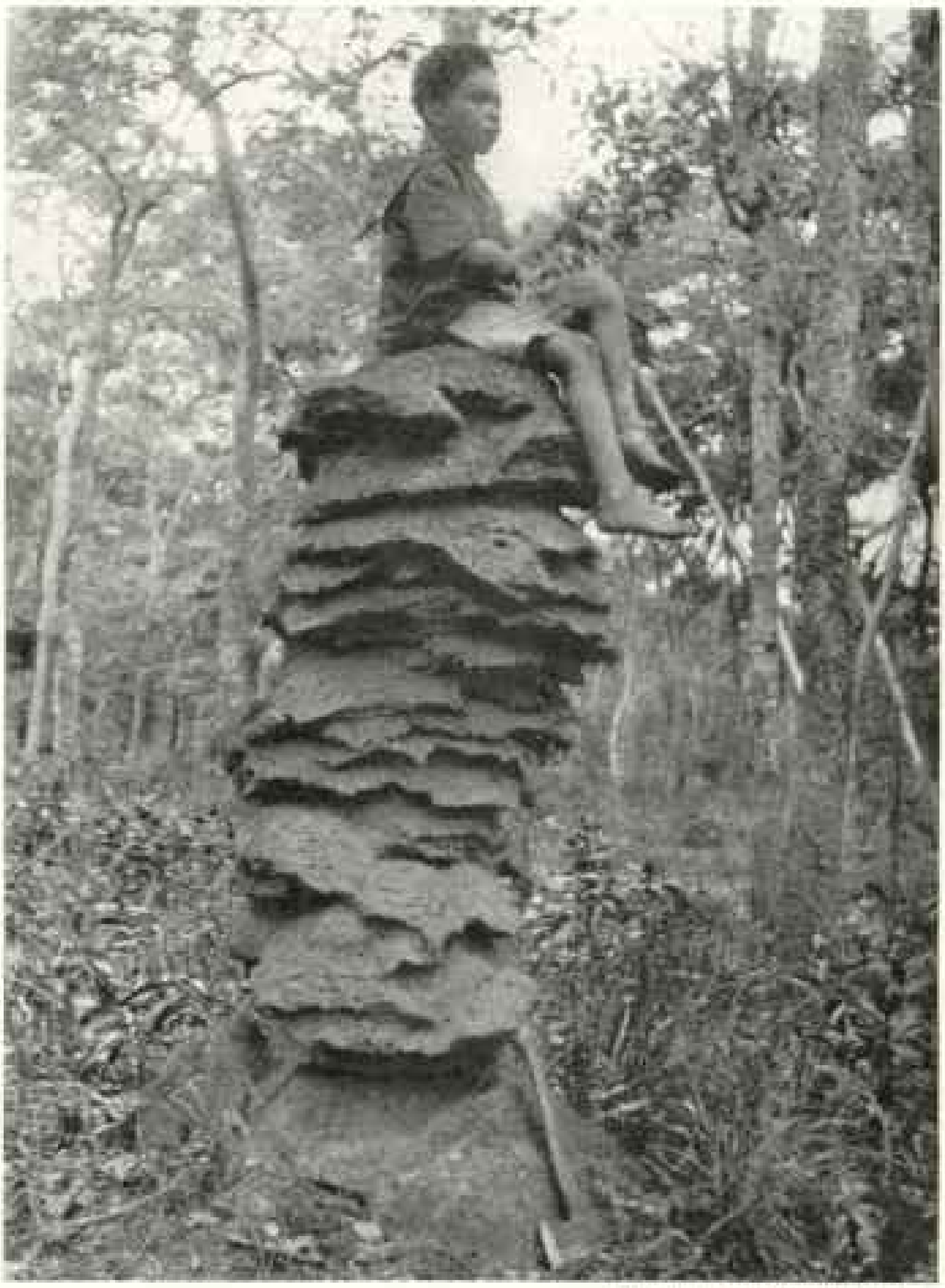
Poor little doomed creatures! What determined such a fate? When young, they resembled other ants. They had the same two stomachs—one private, the other for communal use. Much that entered their mouths they never tasted, for it passed at once to the communal crop, to be fed later to the queen (whose duties are like those of a queen bee); to males (resembling drones in a hive); to workers, or to baby ants. But some showed an enormous capacity for food. How they begged, their pale mouths open all the time! Now these are honey casks.

Late dusk in the Garden of the Gods. The sandstone gods are cold and dark. They have had their play of light all day, while the red mounds of the ants stayed quiet, with gates closed. Seemingly all inside were asleep: yet few ants slept, being busy, most of them, with underground tasks.

Now ants push out of that round tubular hole so fast they cover the mound. If this were daylight, no red rock would shine. Yellow ants are everywhere, by hundreds, by thousands.

A NIGHT SORTIE IN QUEST OF HONEY

A ring of sentinels begins pacing the outer edges of the mound. Others guard the gate, their heads thrusting up, like sol-



Photograph by Will F. Taylor

HOW MANY STORIES IN THIS TERMITE SKYSCRAPER?

The photographer made it twenty-two, but the number varies, depending on the view. Not all "white ants" are wreckers of houses (see Color Plate VI). These in Angola, Africa, are master masons, working in clay, which becomes so hard that the youngster could break it only with an ax. In other regions their architecture runs to spires, monoliths, or huge mounds (see illustration, page 175).

diers with bayonets. Still others move about the narrow platform surrounding the gate, while one ant, then twenty, then a whole column of ants, move off over the ridge, preparing for a march. In the vales between the ridges, far, far away, low scrub oaks, in the light of the moon, thrust up their dark thick leaves. The ants know these dwarf oaks.

They move through straggly bunches of grass on a familiar path, with scant deviation, reaching the oak copse in fifteen minutes. Moonlight pierces the leaves sharply, revealing the ants straddling up the stems, clambering out over leaves, searching endlessly, sometimes fruitlessly, for new oak galls, with their tiny flashes of shining sweet.

A curious insect makes an oak gall and stimulates that flow of oak dew. The tiny creature develops in an inner cell in the gall. When he is extremely young, the gall he lies in is bright, almost scarlet or vivid blue. When he has crawled outside his nursery and lies in the outer sphere, the gall is bright green, soft, about the size of a pea, and bits of sweet stand up about it in tiny flashing dew.

Old red galls, with holes where gallflies have escaped, the ants pass by; but the new pale-green galls, glistening with honeydew, they sniff at, lap the honeydew with delight; then move off to other fresh galls. But after a while they come back to the first gall; after another period, come back again, for new galls exude usually three series of drops in a single night.

The ants started forth at dusk. From midnight till daylight they straggle home. Some are so loaded they can scarcely waddle; others only a little filled; still others empty and unsuccessful.

All night, while they were away, sentinels paced the outer walks. Hungry now, surely; yet surprisingly few sentinels request honey from the filled ants. They only challenge them and cross antennae with antennae in salute. Inside, workers crowd the entrance stairs, begging, relieving the bearers of weighty drops. Honeydew passes from mouth to mouth.

Some workers, amazingly huge, hitch

themselves sidewise to move at all; yet they come up for more and more, clowns skirted with enormous balloons. And the honey-gatherers give to them willingly, knowing here are sisters fast turning into honey casks of their own sweet will.

Babies, too, some of them, keep their little mouths open. Their communal crops, soft and elastic, easily become habitually swollen. Then the surplus honeydew, if any remains, is carried to the dark cellars and dumped into the living honey casks.

WILLING SACRIFICES AS HONEY VATS

When a bee flounders home from pillaging a fresh flower, she pours the bead of nectar into a honey vat near the entrance of the hive, where it is fanned, cooled, its water evaporated, and then stored as honey in a pale waxen cell. But honey ants, laden with a similar beneficial dew, have no power to breathe out wax from their own small bodies; cannot knead wax into cells. So they use certain members of their family as honey vats.

Photograph by Paul Griswold Howes

AN ANT CARRIES ITS "COWS" TO PASTURE

In the herder's jaws and protruding above its head is one of the tiny plant lice, or aphids, which the ants "milk" of their honeydew and move from one plant to another (see text, page 172). On the stalk feeds the rest of the teeming drove. The caretaker in this greatly enlarged photograph is a carpenter ant, often found in the beams of houses (see Color Plate VII).

For months, years, their whole remaining lives, honey casks cling to the vaulted roof of the dark cellar, their bodies dilated to eight or ten times normal size, all that weight of honey suspended by the frailty of tiny claws. Thirty or more honey casks, usually, to a honey cellar; about ten honey cellars to a sizable ant home.

The little swollen things move a little, but seem to lose desire for motion. Once in a great while, one becomes sufficiently empty to be able to unhook itself from the roof, climb down, and even look out the cellar door. In the main they stay filled. If they ever feed themselves, they must open a little inner spigot to let a drop of honey pass into their personal stomach. But they are frugal in the extreme; or else, hanging there so long, so still, they seldom require food. No noticeable portion of the honey they carry is ever self-consumed. In the swelling, the small stomach is pushed far down to the base of the bubble, so that it is doubtful if a honey cask ever eats or drinks.

The power of work has been taken from

them. A few clean themselves, gripping the roof by their hind legs, washing with their middle legs or arms. But a regular delegation of ants comes in to keep them clean, sweep the floor, scrub the walls, and see that the globes stay dry and sweet and sanitary.

The seasons speed; years go by. The only knowledge of time to these little swollen creatures must be that oak galls are fresh outside, for they are given honey today. Or oak galls are old, winter is on them; they must yield honey now.

WHEN DEATH COMES TO A HONEY CASK

Even honey casks cannot live forever. A slender arm becomes paralyzed through that long, tight clutching to the gritty roof. It loses hold; the whole cask falls and strikes that hard, strange floor. It lies with its body projected up by that great ball of itself, its feet and arms waving, its head nodding from side to side. But efforts do no good. It is powerless to rise.

If it falls on something large, it may be able to assist itself back to the roof by scant inches; but usually there it lies. Ants coming in to clean or drink could easily hoist and hoist the honey cask until it could clutch the roof once more. It is in the way; ants must go around it; but they seem not to notice those frantically waving arms, that desperately bobbing head, though the honey cask would grasp gladly, even at a straw. It may lie there for two or three months and be solicitously cleaned and caressed. Its new position is a relief to strained muscles, perhaps, though decidedly uncomfortable. Finally something in its plight shortens its life.

Or, losing hold, falling, the thin cask breaks and the honey spills. There lies Humpty Dumpty, sure enough, feeling all its contents trickle out. Not all the king's horses can restore that honey to the cask. Ants hear the crash, sniff spilled honey, rush in, lap up the oozing sweet in a frenzy of delight. But they disgorge most of the honey into the hanging casks, or rush out with filled crops to feed others.

Sometimes a broken cask will grow together, mending itself, and be hoisted to the roof and filled as before.

At last, after years of holding honey, a honey cask dies. It still hangs to the roof for a day or more, the ants unaware of its death. They clean this cask and others; drink from other casks. Then one climbs to the little closed mouth. "Open, please!" It does not open. What does this mean? Disobedience, unwillingness, in a community where such things are unknown?

Several in turn climb to the tight little mouth. "Open, please!" It never opens; it stays pressed tight. Yet the honey crop is full; its body is a bright amber sphere. They can see the rich honey inside. But at last they realize. The little honey cask is dead.

It takes several ants to handle the corpse. First, the cask part must be severed from the rest of the body. The separation is easy—just a biting through that one narrow connection. Then the cask is rolled through long, dim galleries to the burial ground these ants possess. The claws are unhooked gently from the roof, and the top part of the body is lifted down and carried through the same winding passages in a silent little procession to the same cemetery.

CASKS OF THE DEAD NEVER DESECRATED

And in that gloom of the dead, under the Garden of the Gods, strange gods keep watch. These gods are round, silent casks of honey. Life still lives in them, sustenance is there, food for numerous babies, workers, males, queens. The honey is still sweet and pure. But the ants never desecrate the cask of the dead. It is as if they realize it belongs no more to themselves, but to the darkness and the stillness. In that quiet cemetery, several spheres lie side by side, glowing more and more golden as the honey within them mellows with age.

This honey is almost a pure solution of grape sugar, but it never crystallizes. Its flavor is slightly aromatic, extremely sweet. The honey is limpid, like bees' honey before thickened in the hive. It can be made to evaporate to a gummy mass, but when left in the open it absorbs moisture from the air and becomes liquid honey again.

We owe much that we know about honey ants to Dr. Henry C. McCook. He and his men spent days with chisel and hammer opening a single home, coming carefully upon the used galleries and occupied rooms, taking measurements, making sketches and plaster casts. At one time he found a queen in her room, more than 28 inches below the surface of the hill, over 72 inches from the central stair. She may have dwelt in

that room habitually, or else her attendants, frightened at the strange chiseling, had carried her through hall after hall, as the sounds came nearer, till they reached this far-off circular chamber, where naked babies and some of the workers and honey-bearers had also gathered in their fear.

The gallery leading to this chamber went on sloping for ten inches, ending in a bay-room and a small upcurving hall, the lowest room in the home, almost seven feet out from the main stair, more than three feet below gate level. What depth of architecture for those tiny diggers!

At Dr. McCook's excavating, ants rushed into the cellars, helped the casks down from the roofs, pushed and tugged them to safe places, solicitous about that enormous storage of honey. A large worker would take a portion of that tightly stretched skin into her mandibles and tug and tug, backing out from the cellar into the unbroken hall, and perhaps a small worker stood on the globe and pushed vehemently, though surely she was doing little more than stealing a ride.

Honey ants that were kept in a large glass bottle died in less than three minutes, killed by the sun. Perhaps they are necessarily nocturnal, never daring to venture into daylight. They like sugar, these honey-lovers; but, surprisingly enough, care little for bee honey. At present, honey ants are found in Colorado, New Mexico, and Old Mexico.

Mexicans press out honey casks as one would grapes, and ferment the honey into an alcoholic drink. The swollen casks are really not unlike grapes, their bodies being enlarged from tiny beads to full grape size, to hang like grapes in clusters to the cellar roof.

Commercializing such honey scarcely seems possible. A thousand honey casks filled to the limit would yield barely a pound of honey.

Except for that strange honey-cask custom of theirs, honey ants are rather like other ants. The queen is surrounded by attendants, who groom, caress, and feed her. They form a circle about her as she lays her eggs, then rush these carefully to the incubating rooms, to lick them and keep them warm. Other nurses care for the little things who hatch forth, touching mouth to mouth in feeding. To bathe a baby, a nurse takes it carefully into her arms, turns it slowly while passing her mouth over it. Nurses handle the infants a great deal, turning them frequently, making sure they are warm and well.

The babies are helped in shaping the cradles they spin; are watched over while they sleep in these, to awake as ants and to be cleaned, bathed, and fed until large enough to take care of smaller babies. It is not known what determines which babies shall be princesses (who are bright yellow), which drones (also bright), which workers (pale yellow); but it seems that any worker honey ants who make up their minds can become honey casks.

HONEY ANTS MILK APHID "COWS"

One intelligent custom of honey ants is shared by other ants. They milk aphids for some of their honeydew.

When fresh wild roses scent the Garden of the Gods, honey ants trail toward these instead of toward oak galls. Aphids, those green, translucent-legged creatures who thrust their sucking beaks into roses and thrive on that inner rose dew, draw forth more sweet than they need, the surplus passing out of their backs.

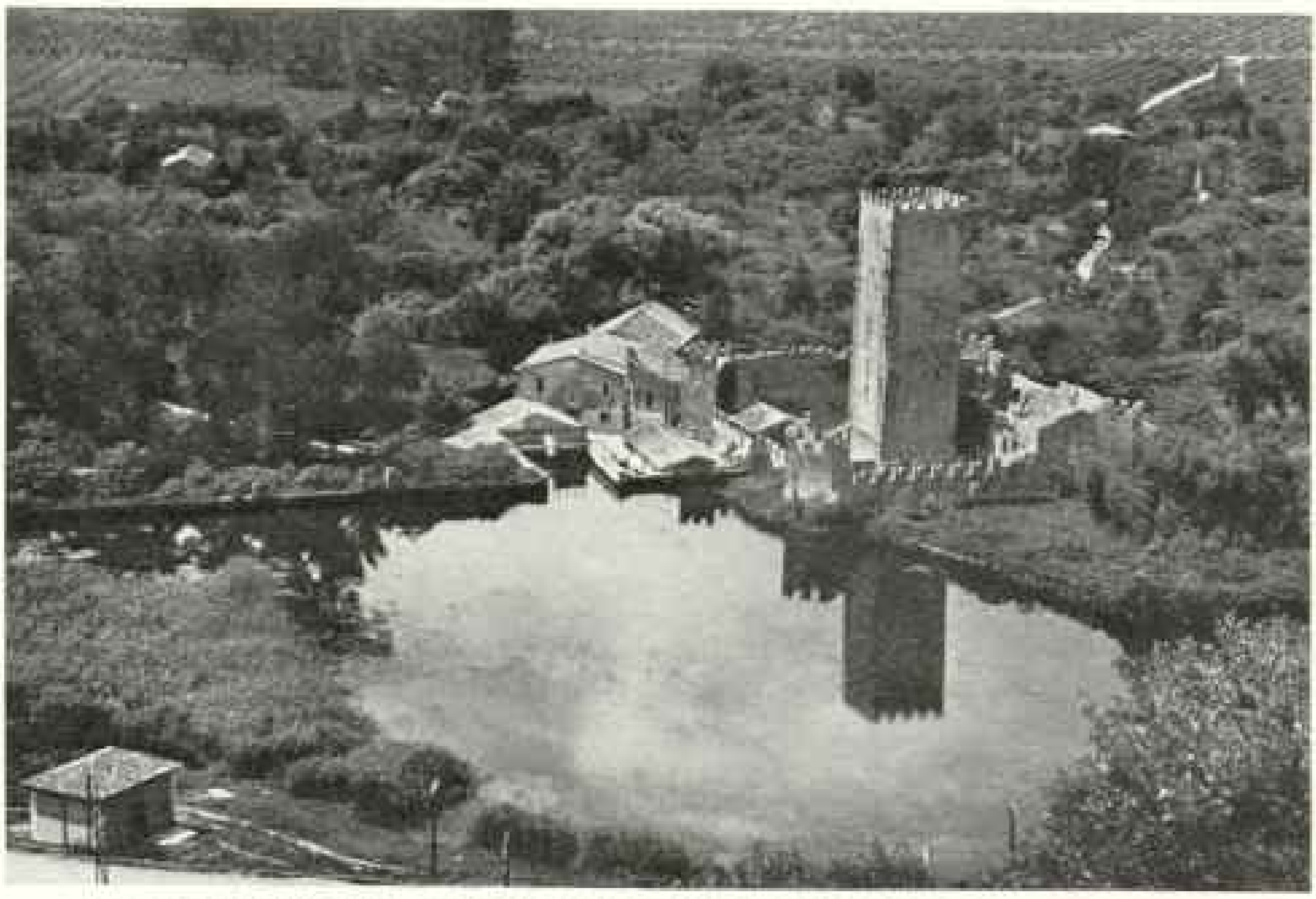
Ants have found this out. Usually among several aphids lies a clever ant. She crawls behind the aphid, gently strokes her sides with first one antenna, then the other, a sort of seesaw motion much like our milking a cow, to which the aphid gratefully submits. And either the aphid's pleasure or else the quiet massaging itself causes honeydew to appear faster and faster on the aphid's rear. The ant laps the honeydew with delight and deposits it in her little inner bucket.

The aphid's body, filled with rose dew, slumps as the ant's body swells. The little green cow even lifts her back to make the milking easy and grazes farther along the rose for more honeydew for the next milker who comes along. Several ants in turn may milk the same aphid. But once in a while a stubborn aphid kicks out her leg and spurts honeydew far beyond reach of an ant's mouth; whereupon the ant probably moves to a more docile cow.

They gain from thirty to forty drops from the same aphid in an hour, go home to empty their little buckets, and then return for further milking. The ants nurse the aphid's young as carefully as their own, and in the spring lead them out to known pastures.

HOME, SWEET HOME, REWARDS EQUALLY PEASANT AND LANDOWNER

From miasmatic, fever-ridden swamp the Pontine Marsh project has created fields amazingly fertile (see page 217) and has equipped the farms with fine buildings, where dwell happiness and health. Vergil would have delighted to sing of the shrewd husbandry of the settlers of to-day.



AMID NEW WONDERS, THE CAETANI TOWER RECALLS THE WONDERS OF OLD

The marshes were partly drained when Rome was at its heyday, and the charming town of Ninfa was known as a center of agriculture. While negligence and the forces of unbridled Nature undid the work of the early reclamation engineers, the buildings fell to ruin. Legend says the lovely maid for whom the place was named took her own life by leaping from the parapet into the lake (see opposite page) and her wraith became the spirit of malaria. These venerable walls, built in the first era of prosperity, have stood through centuries of gloom to welcome a modern transformation.

REDEMPTION OF THE PONTINE MARSHES

By Draining the Malarial Wastes Around Rome, Italy Has Created a Promised Land

By Gelasio Caetani

Senator of the Kingdom of Italy

With Illustrations from Photographs from the Author

THE story runs that a foreigner, traveling through the Pontine Marshes,* asked a shepherd sitting by the wayside: "How do you live here?" and got the reply: "One does not live, one dies."

Two years ago Premier Benito Mussolini gave orders that by October 28, 1935, all the stagnant waters of this region should be drained off to the sea, malaria should be eradicated, 4,000 farmhouses built and populated with as many peasant families drawn from the crowded agricultural provinces of the north, and that three cities should rise in the deserted land: Littoria, Sabaudia, and Pontinia. The waste and flooded plain at the doors of Rome was to become a garden and supply the needs of the capital.

The order is being carried out on schedule time and the project is in first-class shape.

WILD BOARS ROAMED A NEW CITY SITE

Where two years ago wild boars roamed in the broom thickets, you can see to-day the neat city of Littoria, so called to perpetuate this achievement. All the surrounding land is dotted by hundreds of bright, healthful farmhouses, whereas two years ago peasants lived in primitive huts.

Twenty miles to the south, near the sea, Sabaudia, named in honor of the House of Savoy, to which Italy owes its political unity, is growing like a mushroom in the midst of a vast forest that will be its natural park. And at the foot of the mountains Pontinia will rise in 1935, recalling the Etruscan population that, 2,500 years ago, first settled and cultivated this land. This city has not yet been staked out, but the date for the inauguration has been settled.

This astounding transformation could not have been possible had there not been a silent preparatory engineering work. Since 1926 a consortium, with Senator Natale Prampolini, a very capable engineer, at the head, has been working steadily and without beating the big drum. One hundred and sixty miles of road have been constructed, 300 miles of canals excavated, five villages built in the marshy desert, and 270 millions of lire (more than $23,000,000) already spent.

A huge canal, 85 feet wide, gathers the torrential waters at the foot of the hills and, skirting the lowland, leads them to the sea, 24 miles away.

Fourteen thousand men are at work to-day in the region. The hydraulic engineering work has been the indispensable premise to the colonization, an enterprise that has been entrusted to the great war-veteran organization, the Opera Nazionale Combattenti, and to those landowners who have the necessary grit and faith to follow the lead. The veterans will build about 3,000 farmhouses and the landowners about 250.

THE GEOGRAPHY OF THE MARSHES

We must go back in history a little to grasp the general picture. The Pontine Marshes are a rectangular plain, about 175,000 acres in extent, which is hemmed in on two sides by the Lepine Mountains and on the other two by the sea. But along the sea runs a dune three miles wide that prevents the waters from flowing to the sea. The region, therefore, is like a large shallow basin in which the water collects and cannot drain. Between the great dune and the sea lies a series of lagoons.

The old Romans partly solved the problem by digging through the dune a gigantic canal called the Rio Martino.

The pretty legend attached to this name has been told: the legend of King Martino, who, for love of beautiful Ninfa, dug out this kind of Culebra Cut, but was defeated by the magic of the wicked King Moor. The unhappy young lady threw herself from

* See "The Story and the Legends of the Pontine Marshes," by Don Gelasio Caetani, in the National Geographic Magazine, April, 1924.

Drawn by A. E. Holdstock

A SPIDER'S WEB OF CANALS IS THE PONTINE MARSHES' NEW DEAL

Bisected by ancient Rome's "Queen of Roads," the Appian Way, this reclaimed land lies in a hollow depression caught between the Apennines and the sand hills along the Tyrrhenian Sea. Early canals built in Roman times have recently been recut and new ones dug to drain the excess water collected during the rainy season and from springs.

the tower of Ninfa into the adjoining lake and became the evil spirit of malaria (200).

The fact is, that some unknown Roman gentleman called Martinus did the work and succeeded in getting the bulk of the waters to flow out of the lowland to the sea.

However, as the Roman Empire declined and the barbarians invaded Italy, civilization fell to such a low ebb that the noblest knights no longer knew how to scribble their names. So small was the production of writing material that Roman classics were erased from precious vellum sheets to indite the contracts for the sale of pieces of land.

During that period public works were abandoned and the swamps reconquered their kingdom. Pirates roamed freely over the seas and the Pontine coast had to be guarded by strong towers to prevent the

 Natural Color Photograph by Luigi Pellerano

GENZANO LAYS A FRAGRANT CARPET OF FLOWERS TO CELEBRATE CORPUS CHRISTI

Skillful artists first trace the designs with lime water on the pavement. Then, in the afternoon, women bring huge baskets of blossoms and spread the brilliant petals. In the foreground is a religious emblem framed with yellow broom and contrasting red poppies. Next comes the Royal Italian coat of arms, white cross on a red shield, surmounted by a golden crown. Above it, floral artists are completing a picture of an ox and plowman beneath the word "Produrre" (to produce), an invitation to farmers to cultivate the land. As a climax to the festival, a religious procession advances down the avenue of flowers.

Natural Color Photograph by Hans Hildenbrand

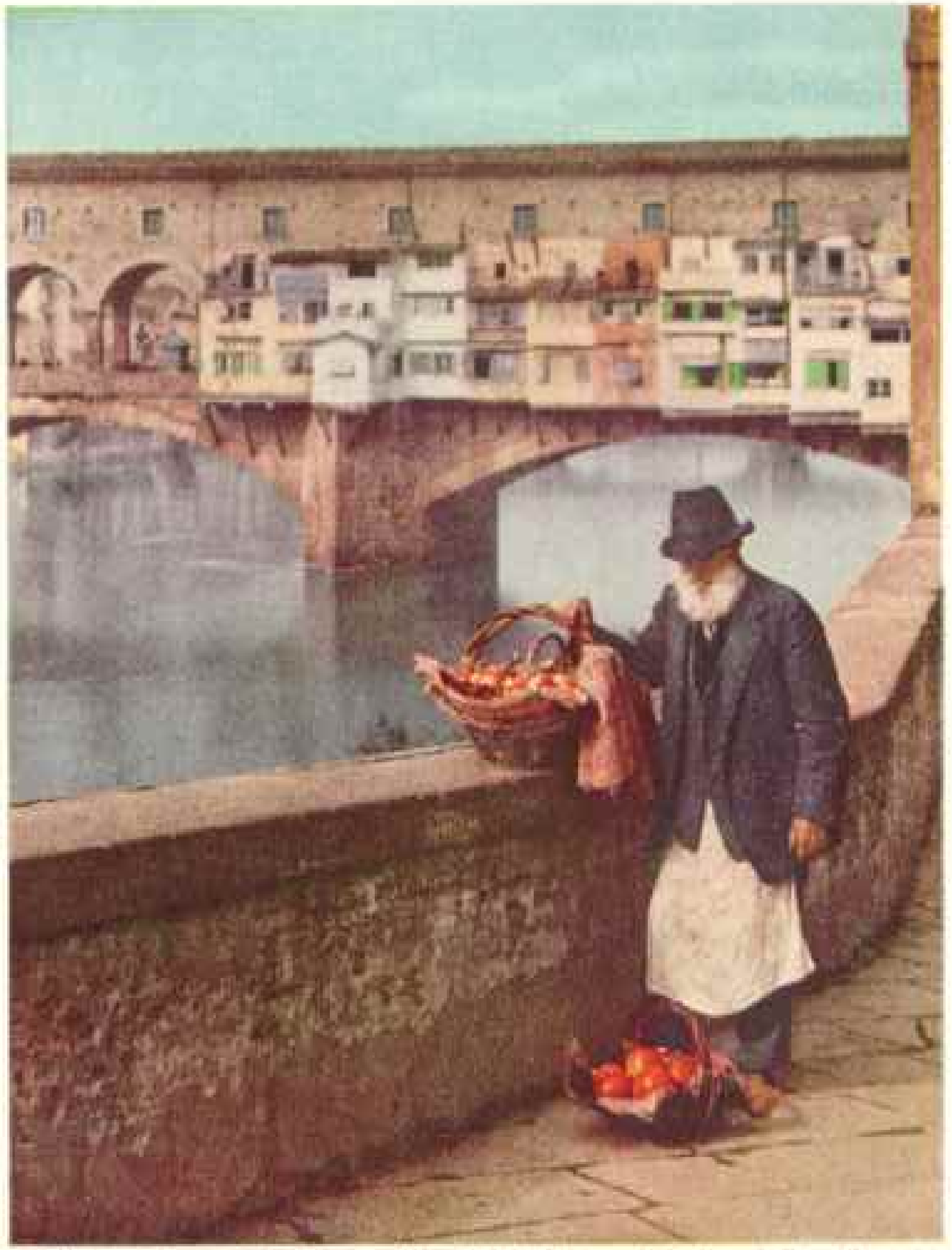
BROODING VESUVIUS WATCHES OVER THE INDIGO MOODS OF THE BAY OF NAPLES

Nearly every visitor to Naples climbs to the gardens of Camaldoli Monastery to glimpse this magnificent sunset scene. Gleaming in rainbow colors, the city lies far below, encircled by sweeping hills which rise like the tiers of a gigantic amphitheater.

© National Geographic Society Natural Color Photograph by Luigi Pellerano

A BANNER-PENNON IS THE PALIO WINNER'S PRIZE

Around Siena's crowded public square, each August, 10 rival horses race and clatter, the jockeys belaboring each other with whips. On the banner appear the image of Santa Maria Assunta, the black and white shield of Siena, and, below the Roman wolf, a panorama of the medieval city.



© National Geographic Society Natural Color Photograph by Gervais Courtellemont

POMEGRANATES FOR SALE ALONG THE ARNO

Crossing the river in giant strides in the background is the historic Ponte Vecchio, the covered upper gallery of which links Florence's renowned storehouses of art, the Pitti and Uffizi Palaces. Goldsmith and jewelry shops project on stilts from the sides of the 600-year-old bridge.

THE STORY OF CASTEL SANT' ANGELO IS THAT OF ROME IN THE MIDDLE AGES

Overlooking the Tiber, the round structure, only a skeleton of its former grandeur, was a tomb for some of Rome's most august emperors, a garrison for her defenders against the Goths, and a former stronghold of the Popes. The huge dome of St. Peter's looms against the sky.

 Natural Color Photographs by Hans Hildenbrand

ROME'S LEGIONS TRAMPED BY SUCH FLOWERED GATEWAYS

For the first 65 miles, the Appian Way, built of lava slabs more than 20 centuries ago, runs straight as a taut string. To-day, crumbling tombs of famous heroes and old aqueducts stand in vivid contrast to modern farmhouses. The road originally connected Rome with Capua, but later was extended to Brindisi.

LAKE BOLSENA'S EELS WERE MENTIONED IN DANTE'S "DIVINE COMEDY"

To-day, men and boys in strange, triangular boats angle in the blue waters of this circular lake, cupped in an extinct crater—all that's left of a volcanic giant that eons ago blew off its head. Rising above the deep pool are the weathered walls and towers of medieval Bolsena.

 Natural Color Photographs by Hans Hildenbrand

A VEST-POCKET HARBOR OF CAPRI

Not far from this stony inlet at Marina Piccola rear the fabled rocks from which the Sirens saw "The Winged Galley" bear Ulysses safely by. The island, once a favored retreat of Roman emperors, recently was made a bird sanctuary. Above this tiny harbor a steep, zigzag road leads to the town of Capri.

Natural Color Photograph by Hans Hildenbrand

THE VILLAS AND HOTELS OF SORRENTO CLING TO HIGH CLIFFS ABOVE AN AZURE SEA

From the balconies of their eyrie rooms, visitors scan the Isle of Capri, looming mistily from the bay of Naples, and watch the busy life of the colorful fisher-folk and bathers on the narrow beach far below. This city also is the rendezvous for those who wish to take the winding and spectacular drive to Amalfi, or glide in boats to the Blue Grotto. In courtyard gardens, beneath the lemon trees and vine-clad trellises, costumed dancers entertain and would-be Carusos sing lustily.

Natural Color Photograph by Hans Hildenbrand

TIVOLI'S WATERFALLS ROAR ON SUNDAYS AND HOLIDAYS ONLY

The cataract of the Aniene is considerably reduced on week days, when its waters are depleted to generate electric power for lighting Rome and driving street cars. Near Tivoli, summer playground for Roman emperors, Hadrian erected his sumptuous villa.

 Natural Color Photograph by Hans Hildenbrand

THE LEANING TOWER WAS ERECTED ASLANT!

Although Pisa's far-famed campanile was intended to be straight, one side began to sag when the masonry walls were only partly finished. The builders altered the plans accordingly, and finished it out of plumb. The inclination increased about one foot during the last century, until now it is about 16½ feet.

 Natural Color Photograph by Opera Nazionale Dopolavoro

UNDER THIS EMBLEM PISANS OF OLD FOUGHT AND DIED

Trumpeters and pages costumed in the period of the 14th century recall the stirring conquests of this once-powerful commercial and seafaring city. A rival of Florence and Genoa, Pisa sent its fleets foraging throughout the Mediterranean, and took a bold part in the Crusades.

men of Barbary from landing and putting the villages to sack and ruin.

To make things worse, Nature also took a hand in the game. With that great pressure which causes the mountains to rise, the broad sand dune that runs along the sea was buckled and the bottom of the Rio Martino canal was raised a few feet toward the center of its course. The outlet of the waters was thereby closed off.

After the fall of the Western Roman Empire, the Pontine region that once had been well cultivated and livened with villas and cities again became a swampy and desolate waste.

THE STRATEGY OF A MEDICI

Several attempts to redeem the land are recorded; kings and popes tried and failed. But the first with a modern turn of mind to accomplish something effective was Leo X.

That great Pope (1513-1521) declared the draining of the region was a work of public utility and therefore expropriation was a justified procedure. He granted the enterprise to his nephew, Giuliano dei Medici, who made a good business of it.

Giuliano would invite the owners of the land, private persons or communities, to go into partnership with him in the enterprise. The owners, fearing large expenses, would refuse; whereupon Giuliano would expropriate for a song.

The worst case befell the indolent community of Terracina. Following its refusal, Giuliano, at a relatively small expense, dug a short canal to the sea. The accumulated water that for centuries had remained dammed up behind the town ran off gaily and, in a very short time, Giuliano became the lucky owner of vast tracts of wonderfully fertile land on the outskirts of the town. The citizens of Terracina lived for years in lamentation! By this clever work Giuliano grew quite rich.

Two further attempts are worthy of record. One was that of Sixtus V, who, in 1586-1589, had the old water channel, the Flumen Antiquum, enlarged into a broad canal that in his honor was renamed Sisto. Two centuries later Pius VI called the hydraulic engineer, Gaetano Rappini, to avail himself of the modern technique for definitely resolving the problem. The old Appian Way, submerged for a thousand years, was given back to traffic, and along it a great canal was excavated that took the name of Linea Pia.

The Pope, naturally much pleased with his accomplishment, had a tiny obelisk erected near Torre Tre Ponti, on which are engraved the words: "OLIM PONTINA PALUS—NUNC AGER PONTINUS" (Once the Pontine Marshes—Now the Pontine Fields).

Not many years later an earthquake gave a bad twist to the obelisk, and malaria drove away the people who had attempted to settle on the land; also, the Benedictine monks, for whom the Pope had built a nice convent at Torre Tre Ponti, had to leave or died. The traveler could drive along the restored Appian Way, but in winter, on both sides of the road, large sheets of water extended for miles. This was the paradise of sea gulls, ducks, and geese, and of the Roman hunters who stalked the wild fowl while wading behind innocent-looking old horses.

Now an end has been put to all this. When the landowners were called by the Government to unite in a consortium for planning and carrying out the final hydraulic drainage of the region, the Government agreed to contribute to the huge expense the large share of 87½ per cent.

The actual work of road building and canal digging began in 1926 under Senator Prampolini's direction.

THE FIGHT AGAINST MALARIA

In the meanwhile, an effective organization was created, with the assistance of the Rockefeller Foundation, to fight the malaria, because, unless this enemy had been destroyed, it would not have been possible to conquer the land.

The first and most important experimental center was created in the old Caetani castle of Sermoneta. When the work was started, statistics showed that 95 per cent of the population were infected with the disease and that virtually no infant reached its first year without an attack of fever. Yellow little faces and sunken eyes stared at you in the medieval streets. Now new infections are practically unknown and pink and white little cherubs greet you.

After driving away the water and the malaria the next step was to populate and transform the land. The Government issued orders that by the year 1935, for the anniversary of the March on Rome, every acre of arable land, excepting woods, lakes, and certain tracts of lowland awaiting special work, should be colonized.

RADIANT AND CONFIDENT, COLONISTS' CHILDREN PASS IN REVIEW IN THE CITY THAT WAS WRESTED FROM A SWAMP

No trappings of war, but the habiliments of health and happiness, appear as the "Young Italians" parade before the Premier (on stand at left, arm raised in Fascist salute) in the main street of Littoria.

TWO YEARS AGO WILD BOARS ROAMED THE BROOM THICKETS WHERE LITTORIA NOW STANDS

Like a lost Atlantis conjured back from the sea by magic, the bright new city recalls the glory that was Rome (see text, page 201), as it smiles a welcome to peasant families coming to town from the neat farmhouses on the pleasant surrounding fields. Only yesterday malaria mosquitoes swarmed over the stagnating waters of the Pontine Marshes.

RUDDY-CHEEKED CHILDREN ATTEND THE NEW VILLAGES' FINE SCHOOLS

For the success of the Pontine Marsh project, the people must have every comfort and advantage. Prospective settlers ask especially about educational facilities (see text, page 217).

"LITTORIA, SABAUDIA—THIS IS THE WAR WE PREFER"

Veterans and their families work with a will on the reclaimed land (see text, page 201). The harvests are remarkably heavy, for the soil is of incredible richness.

NO MORE WILL WINTER TURN THE LAND INTO A WATERY WASTE

Before canals drained the Pontine Marshes, the wet season was a time of extreme hardship. Now the farmer reaps doubly from the soil enriched through centuries of floods.

CHILDREN, PIGS, AND CHICKENS SHARED THE MISERY OF THE OLD MARSH HUTS

For a graphic illustration of "before and after," compare this scene with the lower picture opposite. When Vergil wrote his "Georgics" the Pontine Marshes were fertile fields.

BEETS LARGE AS BABIES MAKE A DOUBLE ARMFUL FOR YOLANDA

Happy and healthy, this sturdy child of Todi feels just pride in the products of the farm she and her family till. She is one of the colonists who have settled on the author's land.

The Government has offered financial assistance to the landowners in building, on every 30 acres of land, a house with stables, pig and chicken pens, and a baking oven. Money is loaned at 2½ per cent interest. If the owner refuses, his land is expropriated and the war veterans' organization undertakes the work (see page 201).

Personally, I have obeyed, and I must say that, though the work has been hard and the financial strain great, I feel satisfied in seeing on my 2,500 acres of land so many happy and prosperous families that a year ago were living in poverty.

These families are called from the overpopulated central and northern provinces of Italy, where the institution of the *mezzadria* is more than a thousand years old.

The mezzadria is a partnership contract, of a patriarchal nature, between the landowner and the head of the peasant family. The landowner gives the land, pays the taxes, supplies the machinery, and anticipates the capital expense for the cattle. The peasant, with the whole of his family, supplies all the labor, the cart, the plow, and the small working tools.

In Italy these people are called *famiglie coloniche* to distinguish them from the *contadino*, who is a day laborer or works his own little piece of land. Whereas the farmer *(affittuario)* pays rent, the *colono* is not paid and does not pay anything, living almost exclusively from the products of the soil.

Very often the coloni, who are handy at all trades, make their own shoes, and from the wool of their sheep make their own clothes. They build their carts, weave baskets, and every housewife bakes her own bread from the wheat grown on the land. They are self-sufficient; they may be poor, but are never in misery.

According to the mezzadria contract, everything that goes in and everything that comes out is on a fifty-fifty basis. The sacks of wheat gathered from the harvest are divided in two; the fat pig, when sacrificed at New Year, is split neatly in half, and one round cake of fresh cheese

goes to the peasant for every one that goes to the landowner; the proceeds from the sale of a calf are divided, and likewise the losses when a cow dies.

The owner guides the peasant family economically; he should also do so morally. Officially, he deals with only one responsible member of the family, the father, or, if the father is too old, with the eldest son. Accounts are noted day by day in special registers called colonial booklets, of which one copy is in the hands of the head of the family and one copy is held by the landowner. The latter, in a way, is the banker of his peasants, trying to save the money from being squandered in years of prosperity and financing the family through hard times. Men are not always perfect, but the system generally works very well.

EVERY HOUSEHOLD MEMBER HAS HIS TASK

Everybody works; even little children eight years old, when free from school, watch the sheep graze along the ditches. The babies and the farmyard industry—pigs, chickens, geese—are the exclusive domain of the womenfolk. The land gives back tenfold what is put into it.

At harvest time everybody helps. The women are in the turmoil of straw, dust, and milling machinery, and, with a red bandanna handkerchief tied around their perspiring brows, they handle the sheaves. And they sing—sing with the full joy of life. The Duce shares in this festivity, for the harvest is the great festival of agricultural life. Last year for two hours he took a hand in the game, feeding the sheaves into the threshing machine, after which he smilingly cashed his pay of 4.50 lire (about 38 cents) for the work he had done.

When the wheat has been sacked and the sacks have been divided, the housewife spreads a white cloth on a table under a shady tree and serves the traditional roast lamb, home-made bread, and *fiaschi*, the sweet local wine. Everybody who has taken part in the work, neighbor helping neighbor, landowner included, partakes of the feast.

Such is the association between peasant and landowner on the mezzadria contract. The contract has the duration of only one year, but it is always renewed unless something very serious has happened. Peasant families remain on the same tract for generations; some claim to have lived there for hundreds of years.

The ground is cultivated in a five-year rotation. Wheat, barley, alfalfa, beets, etc., are planted in succession, so that every year each part of the land has a different crop. At the end of the fifth year the cycle begins again. The stables are the index of the farmer's qualities, and the curing of the manure is brought up to a fine art.

Usually these peasants are excellent people, docile and hard-working, the backbone of the country. They care more for their fields and their cows than for politics; they go to bed early, get up at sunrise, are sober, and procreate an amazing number of healthy children. These have plenty of fresh air and simple but wholesome food, which gives white teeth.

The State takes care of their education. Each child that grows up is an additional worker for the family. When the hive gets full, the swarming takes place, and that is the reason so many families are willing to come from Venice or Siena or Perugia to settle on the Pontine land.

The mezzadria is something of a life in common. It is well to find out who are the persons that are going to live on your land. For this reason I always go to pick out in their homes the peasants I need.

Upon my arrival the whole family is mustered: the men are called back from the fields, where the oxen remain waiting with the yoke on their necks; the smaller children are gathered from under the tablecloth.

"How much land do you give us?" they ask. "Does the wheat grow well there and is there a vineyard already? How far is the church, and where are the schools? Is there nothing to fear any more from malaria?"

These are the questions. But the peasants generally know pretty well already, because they have a wireless communication among themselves. Friends write to friends, and those who go back to the old home on a visit speak in glowing terms of the promised land.

MAIN ENTRANCE TO THE PARK OF OLDEST LIVING TREES

Towering veterans, nearly 2,000 years old when Christ was born, stand hale and hearty in this tree sanctuary in California. Here, beside blue lupines, a uniformed park ranger points out to visitors snow-veiled Alta Peak.

Photographs by Clifton Adams

FROM WARM CITIES OF LOWLAND CALIFORNIA, WINTER VISITORS MAY REACH PARK SNOWS IN A FEW HOURS

Sport lovers eagerly await news of the season's first deep snowfall. Then, with skis, staffs, and toboggans tied on their motorcars, they dash for the park, where rangers have prepared the slides and lodges are warmed and ready with hot food for the hungry horde.

AMONG THE BIG TREES OF CALIFORNIA

By John R. White

Superintendent of Sequoia National Park

THINK of an ant crawling on the ground through a vast cornfield, looking up at the tall stalks.

To the ant the cornstalks are as high as these California Big Trees are to a man gazing up at their distant tops.

But it is their astounding age, as well as their size and beauty, which fills the soul of puny man with awe and reverence for the Creator.

Big Trees, stout and healthy to-day, were centuries old when Christ was born. Men call them "the oldest living things." So nearly indestructible are they that some naked, fire-scorched trunks still stand, though dead before America was discovered; others, which fell centuries ago, remain sound and solid inside. Such vitality has the sequoia that when felled its branches do not wither for years. One giant crashed in 1926 when I was near. I saw it again, in 1931; its foliage was still fresh and green.

They link us with the past. Their sequoia forbears grew here when the world was younger, when reptiles likewise grew to enormous size. Such mammoths as the dinosaur, unable to adjust themselves to climatic and other changes, faded from the earth; but the sequoia family endured and saw the rise of the mammals. Yet to-day, when you walk beneath these towering tree giants, you feel that the deer and the squirrel hardly fit into a scene set for the brontosaurus and the pterodactyl.

SEQUOIAS GREW MILLIONS OF YEARS AGO

Time was when the *Sequoia* genus was spread over four continents. At least twelve fossil species are known, scattered from Greenland and across Europe to Asia. Fossilized trunks as much as 10 feet in diameter and nearly 30 feet high still stand in Miocene deposits in Yellowstone National Park. The wood of these petrified trunks under the microscope looks very much like that of the trees alive to-day.

These ancestors of our present sequoias formed much of forests which in ancient days clothed polar regions now barren or locked in ice. Only two species survived the Glacial Epoch, and these are now practically limited to California.

Some people confuse California's Redwoods with its so-called "Big Trees." Both are "big" and both are of the genus *Sequoia;* both have pink or red wood and both are trees of the largest size. But they are two species, distinct in habitat, in bark, foliage, and in reproduction.

The Coast Redwood, or *Sequoia sempervirens,* is found only near the coast or within the belt of sea fogs, and extends from southern Oregon down to Monterey County, in California.

The larger species, the California Big Tree, or *Sequoia gigantea,* is confined to the western slopes of the Sierra Nevada, between 4,000 and 8,500 feet elevation, from Placer County, in the north, to Tulare County, in the south, and is much more abundant in the south than in the north.

The Coast Redwood forms an almost continuous forest in which it is the dominant stand; the Big Trees grow in scattered groves, 71 in all, interspersed among the heavier stands of white fir, sugar pine, and other trees.

Though smaller in diameter and bulk, the Coast Redwood is taller than its cousin, the Big Tree. The former attains a maximum height of 363 feet and a maximum base diameter of about 25 feet; the latter has a maximum height of about 300 feet and a base diameter of about 35 feet.

When the Coast Redwood is cut down, it "stump-sprouts," as foresters say. A ring of young trees springs up around the stump of the slaughtered *sempervirens;* hence its Latin name, the "Ever-living Sequoia."

But the Big Tree reproduces only from seed; and, since its seeds require specially favorable conditions to root, there was real danger of the extinction of the species until national and State parks were created.

The bark of the Coast Redwood is brown and gray; that of a mature Big Tree has warm hues, from maroon to several shades of red, which at sunset often shine with strange brilliancy. Big Tree forests are open, sunny, and full of color. The Coast Redwood forests are by contrast damp and somber.

The foliage of the Coast Redwood somewhat resembles that of the fir or hemlock, but the slender, prickly foliage of the Big

Photograph by Lindley Eddy

HERE WILD ANIMALS WALK IN PEACE WITH MAN—USUALLY!

Now and then, however, as when famished after hibernation, a bear turns outlaw, breaking into vacant cabins or even smashing parked automobile windows in quest of food. Then he is trapped in a "bear patrol," a wire cage mounted on a truck, squirted with red paint to "mark" him, and deported to a remote region of the park.

Tree has no counterpart in America. The only tree which at first glance might be confused with the Big Tree is the cryptomeria of Japan.

ICE AND FIRE WERE FIRST FOES OF THE BIG TREES

Ages before man came to chop these trees for his use, ice and fire were their fierce foes. Again and again moving glaciers mowed them down—glaciers whose icy fingers stretched down mountain canyons to freeze all animal and plant life. Whether in warm and sheltered spots a few trees remained, or whether only seeds survived, can probably never be known; but slowly the cold hands relaxed and the forests returned. The fact that the Big Trees are more abundant and larger in the southern part of their range indicates that there the effects of the glaciers were less severe.

With the passing of the Age of Ice, the struggles of the sequoias had only begun. Fires followed the ordeal of ice. The abundant rains ceased, and long, dry summers rendered the forests tinderlike, ready to be ignited by lightning or by brands tossed by Indians to drive out game or clear land for forage.

There is scarcely a mature sequoia that does not show the effects of at least one fire. Every 20 or 30 years flames swept through

Photograph courtesy National Park Service

INTO FORESTS PRIMEVAL TRAIL THE GUESTS OF UNCLE SAM

But let them not confuse Big Trees with the Redwoods. Although both are members of the famous *Sequoia* genus, the two groups of forest monarchs reside in separate parts of California. These Big Trees, the larger of the two, are found on the western slopes of the Sierra Nevada, while Redwoods, which are taller, thrive along the rugged coastline from Monterey County northward to Oregon (see text, page 219).

the forest, sometimes licking hungrily, but with little effect, at the thick, asbestoslike bark; again, where a litter of boughs and fallen logs was piled up against a Big Tree, the fire burned fiercely enough to penetrate the outer cover and into the heart. That is why the great black caverns in the living sequoias are almost always found on the upper side of those standing on a slope.

THE SEQUOIAS HEAL THEIR OWN WOUNDS

Careful inspection of a Big Tree, even one with an unbroken front of new bark, usually shows traces of many fires. Often an arrow-shaped scar runs from the base a hundred feet or more toward the crown. Such blemishes, covered by new bark, were caused by fires long before the discovery of America. For centuries the tree grew new bark, at the rate of half an inch or less a year, until finally the wound was healed.

Tree torches burning in the Sierra Nevada might have signalized every event in recorded human history, from the building of the Pyramids to our own Civil War.

The length of time that the black, charred wood, soft as it is, has adhered is equally astonishing. With your thumb nail you can chip off pieces of charcoal formed by fires that burned hundreds of years ago.

Photograph by C. O. Schneider

THE GIANT TREES ARE NAMED FOR SE-QUO-YAH, A CHEROKEE INDIAN SCHOLAR

Soon after the adoption of a phonetic alphabet of 86 symbols, invented by Se-quo-yah (who knew no English), many members of his tribe learned to read and write. With type made of such symbols, the Gospels were printed; also tribal laws and even a newspaper. This group of closely massed giants is Congress Grove, one of 22 areas of Big Trees in the park.

Photograph by Hammond

THIS CAVELIKE SEQUOIA MIGHT SERVE AS A GARAGE FOR TRACTORS

Perhaps an Indian camp, or their fires set in hunting, or lightning, long before Columbus touched American shores, kindled the blaze which first scarred this tree. Succeeding fires enlarged the wound, ate out the heartwood, and left this tough bark cavern of enormous magnitude (see text, page 220).

Photograph by C. O. Schneider

THESE PEOPLE ARE DWARFED TO PYGMY SIZE BESIDE HUGE "GENERAL SHERMAN"

Containing lumber enough to build a good-sized village, it measures 36½ feet in diameter. From the ring count of a core, drilled through the heart of this tree in 1931, Dr. A. E. Douglass estimated its age to be between 3,500 and 4,000 years (see text, page 231).

No doubt the Coast Redwoods were seen by the first Europeans to visit our Pacific coast. Yet for more than two centuries after the visit of Sir Francis Drake, in 1579, white men roamed up and down California apparently without climbing far enough up the high Sierras to find the Big Trees.

The Indians knew them, of course. In summer they camped among them and left potholes in granite rocks where they ground acorn meal.

Even now the identity of the first white men to gaze on the Big Trees of the Sierras is in doubt. It may have been some member of the Joseph R. Walker Expedition of 1833. One Zenas Leonard, clerk of the Walker party, recorded:

"In the last two days' traveling we have found some trees of the Redwood species incredibly large, some of which would measure from 16 to 18 fathoms (96 to 108 feet) around the trunk at the height of a large man's head from the ground."

That group of Big Trees, now known as the Calaveras North Grove, was, however, the first of these sequoias to become well known.

In the spring of 1852 A. T. Dowd, a miner of Murphy's Camp, in the historic Mother Lode district, followed a wounded bear into the sequoias. He came running

back to his companions and excitedly dragged them with him to see "the largest bear in California." What he showed them was a Big Tree—probably the one which afterward was felled and a dance hall built on top of it.

John Bidwell, a member of the first immigrant party to enter California by the overland route, stated that he saw the Calaveras Big Trees in 1841; but Dowd is popularly given credit as the discoverer of the *Sequoia gigantea*. It was the Calaveras Grove which inspired Bret Harte to write his poem, "On a Cone of the Big Trees."

DISCOVERY OF THE GIANT FOREST

In 1857 Galen Clark discovered the Mariposa, or Wawona, Grove in what is now the Yosemite National Park. The following year Hale D. Tharp, a pioneer of Three Rivers, in Tulare County, was led up the Middle Fork of the Kaweah River by Yokut Indians, and on up the grassy slopes beneath Moro Rock to the plateau where grows the noblest forest of the *Sequoia gigantea*, the Giant Forest, in what is now Sequoia National Park.

THE "GENERAL SHERMAN" MAY BE THE WORLD'S LARGEST TREE

Few explorers have left as permanent a record of their discoveries as that made by old Hale Tharp. On a fallen, hollow sequoia log the bold and well-formed characters, "H. D. Tharp, 1858," stand to-day almost as fresh as when he carved them.

Photograph by Lindley Eddy

THE PLAQUE RECORDS THE GIFT BY YOUR SOCIETY OF THESE BIG TREES TO THE NATION

The text reads: "The tract of land on which this tablet has been erected, together with four other tracts of land, all within the heart of the Giant Forest, was purchased from private owners with funds subscribed by the National Geographic Society, together with an appropriation by the Congress of the United States. These areas were deeded to the United States on December 30, 1916, for the benefit of and to serve the people of the Nation." Col. John R. White, Superintendent of Sequoia National Park, and a visitor inspect the marker (see text, page 231).

A glassed frame now protects them from vandalism.

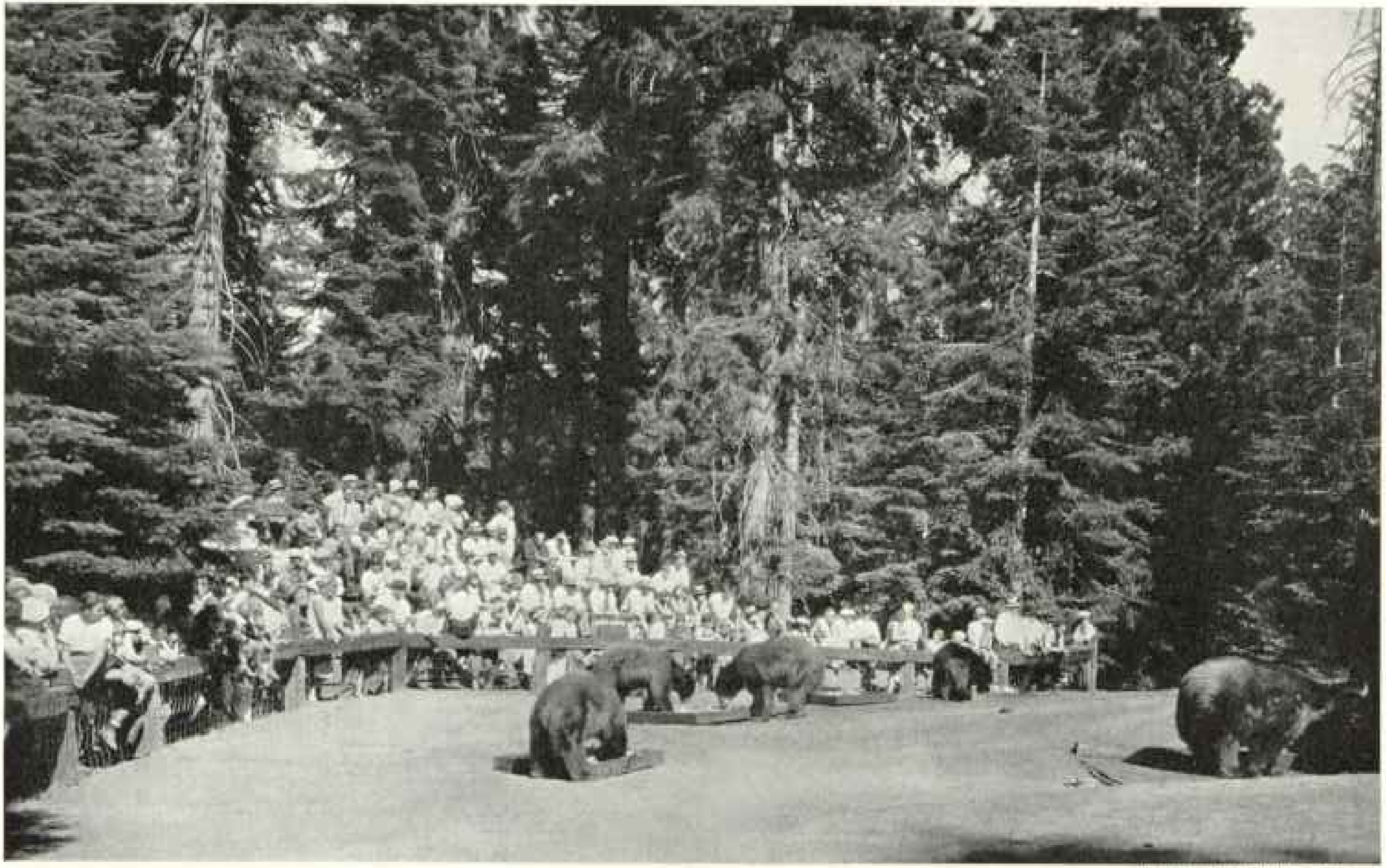
Here, in Sequoia National Park, stands that hoary veteran of all Big Trees, the "General Sherman," found and named by James Wolverton in 1879.* Many other trees, including Redwoods, Douglas firs, and the Australian eucalyptus, are taller;

*See "The Oldest Living Thing," Pictorial Supplement, NATIONAL GEOGRAPHIC MAGAZINE for April, 1916.

Photograph courtesy National Park Service

LODGES, STORES, A POST OFFICE, AND RESTAURANT STAND AT THE ENTRANCE TO THE GIANT FOREST

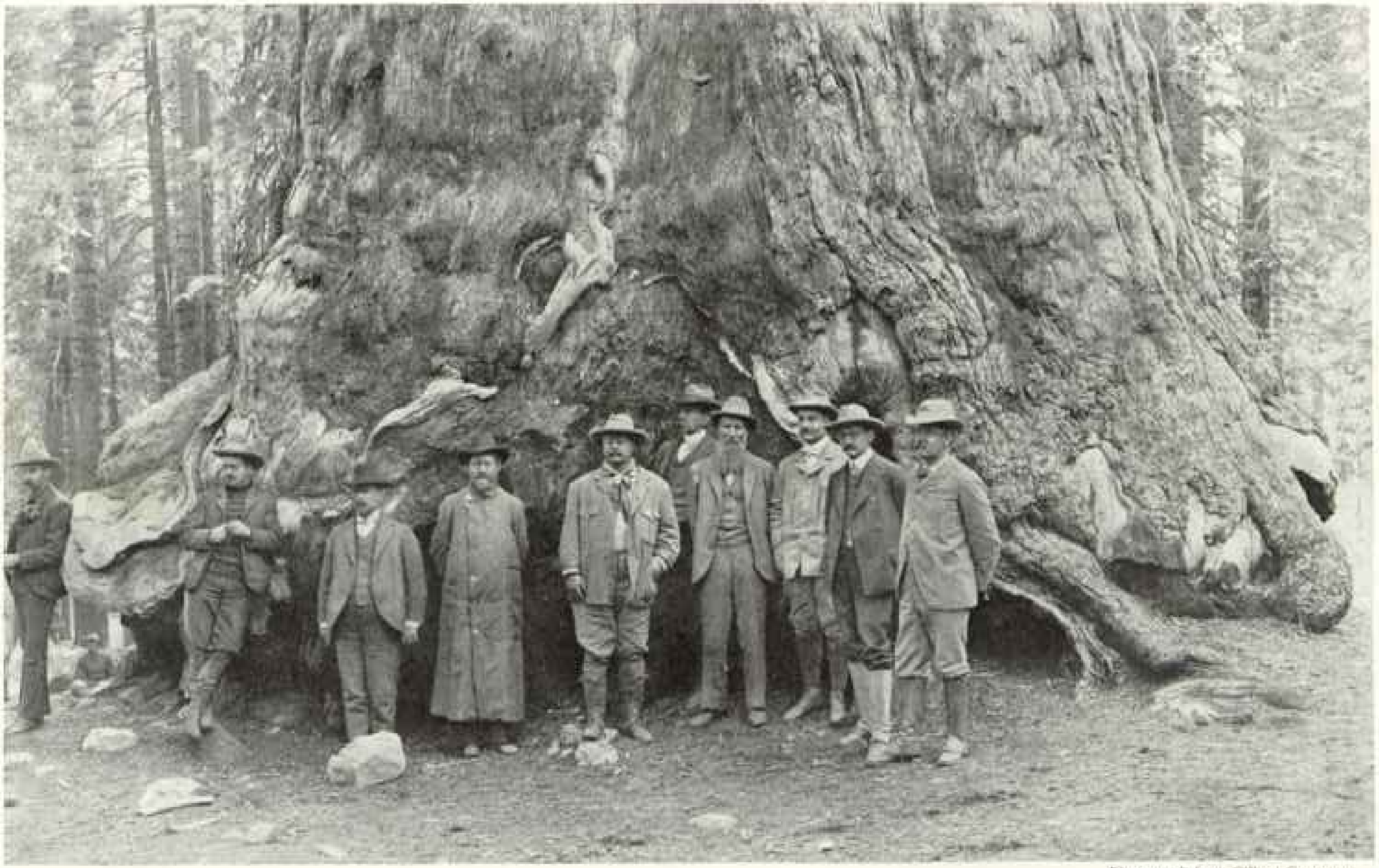
Every effort is made to insure the comfort and enjoyment of the park's guests. To preserve trees and to protect wild life, certain rules as to fires, trash, camps, the use of roads, and fishing privileges are enforced by young rangers, who patrol the forest to aid and advise visitors.



Photograph by Padilla Studios

"LET'S WATCH THEM FEED THE BEARS"

Gorged on rich camp "left overs," these bears get so fat and lazy they no longer forage for themselves. The appalling gluttony of the animals, and their grotesque, flat-on-the-back and feet-up attitudes as they later sprawl about and "sleep it off," amuse the crowd, especially the youngsters.



Photograph from Gilbert Grosvenor

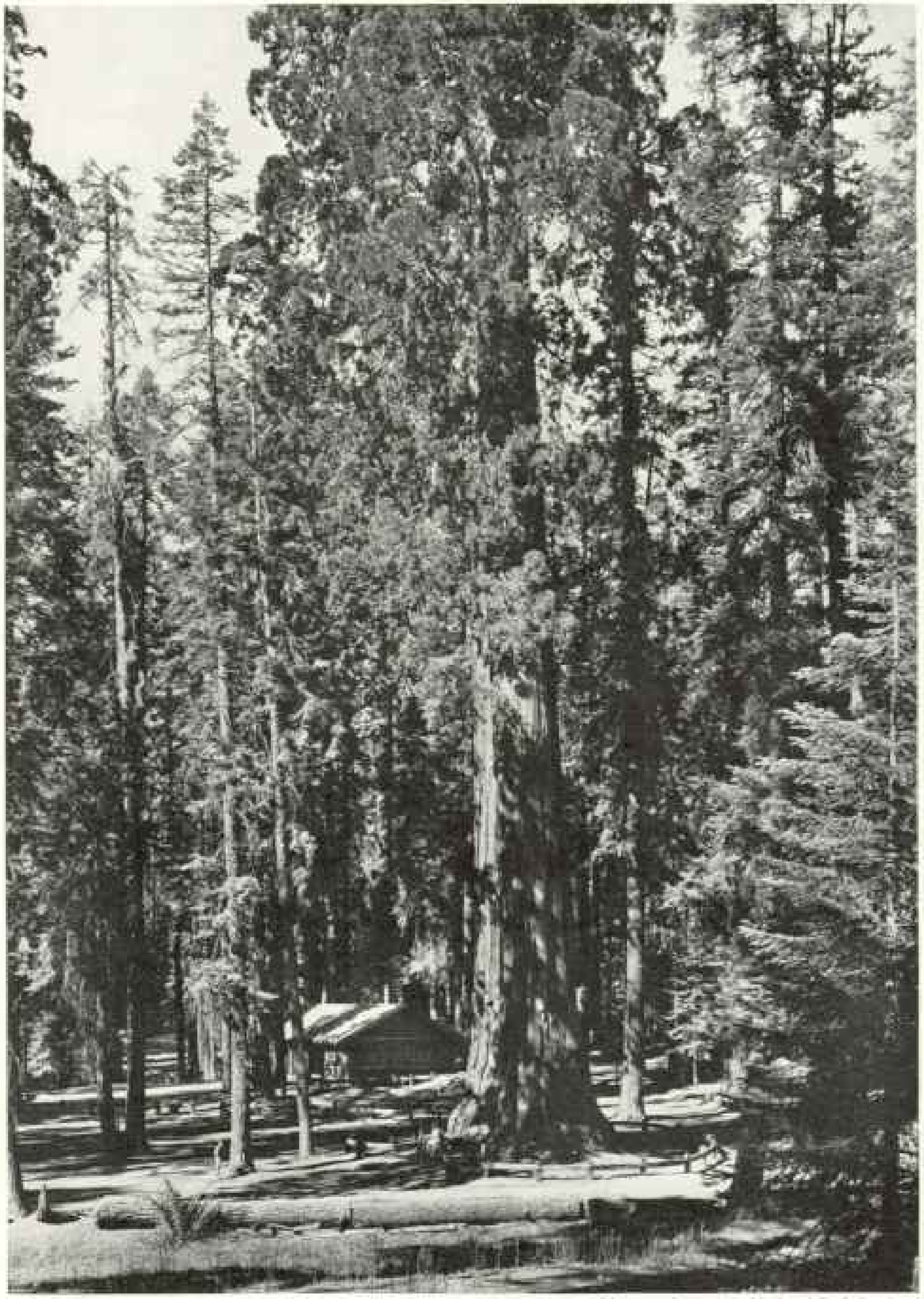
PRESIDENT THEODORE ROOSEVELT ON HIS HISTORIC VISIT TO THE REDWOOD GROVE AT SANTA CRUZ IN MAY, 1903

In a speech here, among the Coast Redwoods (see page 219), Colonel Roosevelt urged the protection of the giant trees, "whose architect has been the ages. . . . The rash creature who wishes to leave his name to mar the beauties of Nature should be sternly discouraged. Keep these trees . . . . unmarred by the vandalism . . . of man." The bearded man on the left of President Roosevelt (center) is the late naturalist and explorer, John Muir, and next to him stands Dr. Nicholas Murray Butler, President of Columbia University.

Photograph by Capt. Albert W. Stevens

FROM ON HIGH, GIANT SEQUOIAS APPEAR AS GREEN TOY TREES SET ON A CHRISTMAS TABLE

Roofs of Park Headquarters' huts, protruding from a 20-foot fall of snow, spoil the illusion and give a true scale. After such deep snows, winter visitors flock in with sleds, skis, and snowshoes (see page 218). Last winter Otto Steiner, famous German alpinist, climbed Mount Whitney and skied down—the first to achieve this feat.



Photograph courtesy National Park Service

BENEATH A BIG TREE, A MAN IS AS PUNY AS AN ANT ON A CORNSTALK!

Up and up—right out of the picture stretches this gnarled member of the royal family of treedom in Giant Forest. Actually it is two trees—twin Big Trees united several feet above ground. To the man standing at the left they appear as a huge natural archway. Housed in the rustic museum beyond are specimens of plant and animal life found in the park and examples of handiwork by the Yokut Indians.

but no other, so far as I know, has its bulk. Its greatest base diameter is 36.5 feet and its trunk contains 600,120 board feet of lumber.

You can imagine its size when told that a train of 30 railway cars would be required to haul its trunk alone. One limb, 130 feet above the ground, is nearly seven feet thick. Sawed into boards, the tree would build about forty 5-room houses!

In New Zealand, kauri pines attain a diameter of 20 feet, and in Tule, Oaxaca, Mexico, a giant cypress, said to be 6,500 years old, measures 58 feet in diameter and 255 feet in height. The reputed age of the latter is, of course, a guess, and the diameter may include a number of stump sprouts around a dead tree, which have coalesced into a solid bole.

So far as is reliably known, the California Big Trees are the oldest and largest living things in the world; but there is an opportunity for some explorer and lover of trees to investigate the arboreal monarchs of the world, to see whether there are any legitimate disputants of "General Sherman's" title to the "oldest and largest living thing."

When a tree is older than the Christian era, there is no need for exaggeration. Yet there has been much confusion about the ages of the Big Trees and the Coast Redwoods. Guesses of 5,000 years and more have been made.

The only way to determine the age of a tree is by counting the rings of annual growth. To get this count, one must either saw down a tree or take core borings.

The oldest Big Tree found by Huntington was 3,150 years old, and he found only three over 3,000 years and 79 over 2,000 years. John Muir states that he counted the rings of one tree in the Converse Basin that showed an age of more than 4,000 years; but diligent search has failed to rediscover that tree.

Dr. A. E. Douglass, of the University of Arizona, a leading authority on the relation between weather cycles and tree rings,* took a boring of "General Sherman" in August, 1931. Results of his experiment indicate that the tree is between 3,500 and 4,000 years old.

* See "Secret of the Southwest Solved by Talkative Tree Rings," by Andrew Ellicott Douglass, in the NATIONAL GEOGRAPHIC MAGAZINE for December, 1929.

Until white men came with ax, saw, and dynamite, the Big Trees' only enemies were ice and fire. Yet in a few short years of logging perhaps as many Big Trees as now remain in the Giant Forest were destroyed.

In one area alone, the Converse Basin, mammoth sequoias by the score were felled and scarcely used. With the passing of their shade, moist, flowery meadows were also turned into dreary sand flats. Here stands what is called the "Chicago Stump," all that is left of a Big Tree felled in 1891, sections of which were shipped to Chicago for exhibition at the World's Fair.

That tree was reported to have been 300 feet high and 26 feet in diameter where cut. A later estimate shows it may have been larger, even larger than the Sherman tree. Two men, using an extra-long saw made by brazing two 12-foot saws together, worked thirteen days to cut down the Chicago tree!

SAVING THESE GLORIOUS TREES FOR MAN'S FUTURE ENJOYMENT

To save some of these trees, the Sequoia National Park was created in 1890, and for years patrolled each summer by United States cavalry.

Private individuals, however, still owned the finest parts of the sequoia forests and had, of course, a perfect right to cut them down for lumber. To avoid this, the late Stephen T. Mather, as Director of the National Park Service, asked Congress for funds with which to buy and save more of the Big Trees. An appropriation was made, but it was insufficient.

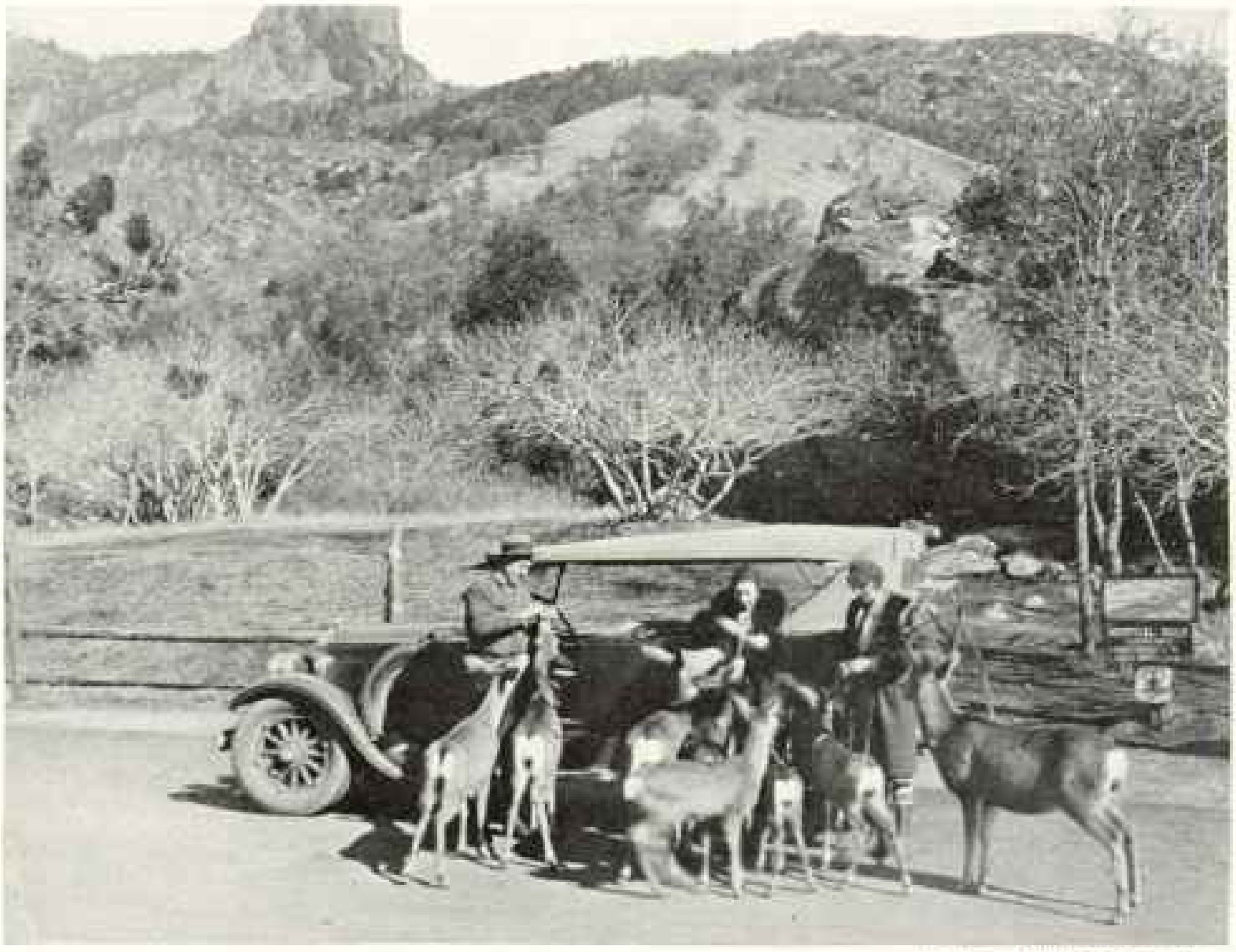
Then aid was asked of the National Geographic Society. Immediately, from its own funds and with voluntary contributions from individual members, it subscribed sufficient to purchase the lands and Big Trees desired (see illustration, page 225).

In all, The Society bought and gave to the United States a total of 1,916 acres at a cost of $96,330.*

In early days of the park, when cavalry rode its trails, visitors were few—not more than 3,000 to 4,000 people a year. Now, with motor roads, hotels, and comfortable Government-owned camp grounds, this season may bring 150,000 visitors.

Stand at the park entrance long enough

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, "Our Big Trees Saved," January, 1917, and "The National Geographic Society Completes Its Gifts of Big Trees," July, 1921.



Photograph by Padilla Studios

THEY LIKE CANDY, CAKE, AND BREAD, BUT APPLES ARE PREFERRED

Thousands of mule deer roam the reservation. Ordinarily among the wildest of animals, they become tame and inquisitive under park protection. Hospital Rock (right background) is the place where Yokut Indian medicine men once chanted incantations over sick tribesmen.

and you may see motorcars from every State in the Union and Canada. Thousands flee the desert and lowlands heat for the cool, pine-scented forest shadows 7,000 feet and more above sea level.

Some are most amused by park bears fussing over the camp garbage (see page 227). Some fish or hike, or want to climb near-by Mount Whitney, 14,496 feet high.

"How high is *this* tree?" some ask; or, "How old is that one?"

Others, in the midst of the Giant Forest itself, will ask, "When do we get to the Big Trees?"

Some read, some sleep, ignoring it all. Some walk off alone, to sit silently a long time, gazing up at the giants.

Although summer visitors are most numerous, increasing numbers now come in winter for the snow sports. California newspapers are quick to report the first falls of snow heavy enough for coasting, and any week-end after snow has fallen girls and boys in bright-colored Alpine costumes, with sleds, skis, and toboggans lashed on their motorcars, come swarming up to the park from Los Angeles and other near-by cities. Park officials and lodge-keepers take especial pains for the comfort and safety of these "snow birds" (see page 218).

Winter or summer, all visitors are the guests of Uncle Sam; for them, for posterity, he saved the Big Trees.

WHEN THE HERRING FLEET COMES TO GREAT YARMOUTH

By W. Robert Moore

Author of "'Land of the Free' in Asia," "The Glory That Was Imperial Peking," "Motor Trails in Japan," etc., in the National Geographic Magazine

With Illustrations from Photographs by the Author

TO DAVID COPPERFIELD, riding into Great Yarmouth with Peggotty on a carrier's cart, "the town and tide seemed too much mixed up, like toast and water." But Peggotty, stirred with civic loyalty, declared with emphasis that, "for her part, she was proud to call herself a Yarmouth bloater."

For many centuries before the strokes of Dickens' pen sent young David through the narrow streets where he "smelt the fish, and pitch, and oakum, and tar, and saw the sailors walking about, and the carts jingling over the stones," Yarmouth was inseparable from the sea—and the herring harvest. To the sand bank that blocked the estuary at the mouths of the rivers Yare, Bure, and Waveney, fishermen long have resorted to land their fish and dry their nets, and on this sand bank Yarmouth has grown, along with the expansion of the herring industry.

A civic symbol, like Boston's cod

Appropriately enough, her ancient civic arms bore three silver herrings against an azure field that might have been a bit of the sunlit North Sea itself. In the war with France during the reign of Edward III, however, because of the able assistance of Yarmouth's fleet, born of her fishing craft, these were dimidiated and had their heads replaced by those of the royal lion (239). By her ancient charter, too, the city sent annually to the English monarch's kitchen "100 herrings baked in 24 pies or pasties."

To-day, as when the shimmer of herrings determined the prosperity and sea power of the Hanseatic merchants, the Dutch, and the English, Yarmouth still looks to the sea. True, the town has seen many changes in recent years, and publicity pamphlets are inclined to emphasize the benefits of the stimulating sea air along the wide promenades and the recreations provided at the piers and boating pools.

However, when *the season* has ended along the beach and the summer pavilions have assumed the appearance of mausoleums, a new *season* begins along the river banks and on the Denes.

Here, from October to December, herring is king. Hundreds of steam drifters clutter the harbor of the world's premier herring port. Tackles rattle; trucks and carts clatter over the stones of the quay and about the curing yards with bulky loads of fish baskets and coal; auctioneers cry for bids from local and foreign buyers; and, as a background to shrieking whistles and sundry other noises, there is the constant ring of laughter and the chatter of the rhythmic Gaelic tongue. Incoming trains debouch into Yarmouth some 3,500 Scottish fisher girls and many hundreds of longshoremen to handle and cure the herring catches.

Here resort also the butchers and bakers and sweetmeat makers, for Scottish palates must be catered to. Churches announce special services, entertainment societies flourish, and shopkeepers display goods to appeal to the fisher folk. Countless window signs urge visitors to "Send a box of famous Yarmouth bloaters to your friends," while candy makers, not to be outdone, advertise "Yarmouth rock, the candy with the fish center." In its favor, however, it should be said the fish center of the candy refers to a colored fish design in the stick rather than to the flavor.

The bustling pageant centers on Yarmouth's water front. Lowestoft, also, a few miles distant down the coast, presents a similar scene of lesser magnitude.

Aboard the "Violet and Rose"

It was one of those dull, gray, fog-laden English mornings in late October when I stepped aboard the *Violet and Rose*, captained by Ronald Balls, as the hundred-odd English drifters began to unloose their moorings and put out to sea from Yarmouth.

It was also Sunday; consequently all the fleet was in, as fishery laws require that every ship return to port on Saturday. The 540 Scottish drifters that lay tied up five deep on either side of harbor, however, would remain idle until the following morning, in accord with the ancient Scottish

AT DAWN THE HERRING FLEET STEAMS OUT TO SEA

With their smoke pluming into the dull, fog-laden sky and gulls screaming overhead, steam drifters file out of Great Yarmouth's harbor and breast the seas to the fishing grounds. All boats return to port each Saturday (see text, page 253).

regulations. "Man works six days and rests one," it has been said; "so, too, let the herring rest one and they will come to the surface better on the others."

Like bats in a belfry tower, the boats milled about in the mile-long river harbor and then strung out in single file to breast the sea that came surging against the entrance piers.

"Are you a good sailor?" questioned one of our crew, as I braced myself against the rail to get a photograph of the ship ahead of us, while she reared and careened on the pitching sea. "It will probably get you, because this isn't exactly an ocean liner," he added, when I indicated that I was enjoying myself at the moment, anyway.

THE RICHEST HERRING FISHING GROUND

For two days fairly high seas had been running, and one of the drifters returning home had crashed into the pier. She lay beached near by and was breaking up under the impact of the heavy surf. Because of its shallowness, the North Sea rises quickly, often causing considerable havoc among the fishing craft.

Navigating an unsteady course over the tilting deck, as the little 90-ton *Violet and Rose* stood first on her nose and then settled back on her haunches, I joined the skipper in the wheelhouse to look at the charts of this richest of all herring fishing grounds.

"Here's where we get our herring runs at this time of the year," he explained, tracing his finger down around Smith's Knoll and several other shallows in its locality, some 25 miles off the coast.

To me it seemed almost incredible that the fishermen should rely so definitely on the belief that the vast herring shoals would be at such a specific location at a certain time. But for centuries the fish have appeared with such unfailing regularity at their annual feeding and spawning grounds that never has a fishing season been without success.

In some seasons, it is true, their appearance has been delayed for a short time by local conditions of the water and unusual currents. Early in the 1933 season unusual conditions did exist to delay the migration. Two large areas of floating organisms (*Phaeocystis* and *Biddulphia sinensis*), often referred to by fishermen as "weedy

HERRING IS KING AT GREAT YARMOUTH

From ship to pier, under the auctioneer's hammer, and into the curing yards, the fish are cared for with surprising dispatch. Yards are cleaned frequently and the water front sluiced daily, so there is little odor of stale fish. Oddly shaped double baskets, called "swills," are used for carting.

water," or "Dutchman's baccy juice" (because of its brownish color), lay directly across their normal path. Its recognized distastefulness to the fish had halted their progress, but by going around or making a hurried dash through the obstacle, the vast shoals eventually returned unerringly to their old haunts.

WHEN HERRING MADE HISTORY

Elsewhere, herring shoals have unexpectedly shifted their migratory courses, and by so doing have shifted the powers of nations. Such was the case when finny hosts failed to return to the Baltic.

The mighty commerce of the Hanseatic League had as one of its substantial foundation stones the Baltic herring trade. In providing fish for its markets, the League had extended its power far and wide to traffic in other goods as well. The Hansa merchants did not go to sea themselves; the Danes did their fishing for them. But when the herring quit the Baltic grounds, economic depression hit the League. The three golden herrings that were emblazoned on Lübeck's coat of arms lost much of their former luster.

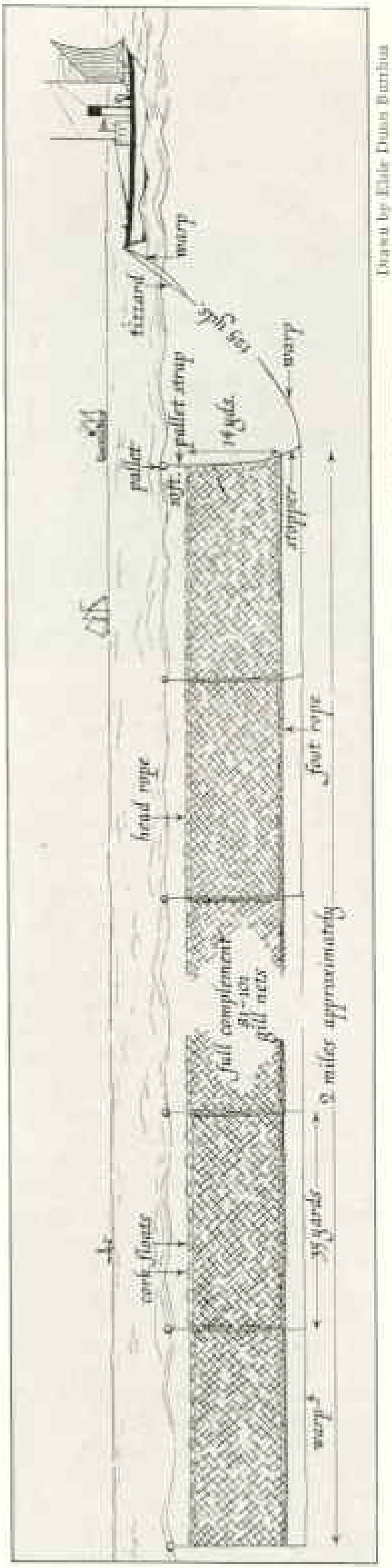
Of course, the whole story of the decline of the Hanseatic League is not as simple as the above statement, because its commerce had many ramifications.

Cruising over these North Sea waters, one ponders on the rivalry that long existed between the Dutch and the English over questions that had their origin in the countless billions of herring that have moved back and forth through these territories.

And how like some of the conversations that must have taken place in centuries gone were the words of the skipper!

"Yes, this boat did patrol work during the war; all of them did, for that matter. There aren't any new ones. The loss of our Russian and other markets during the war has made our fishing a poorly paid industry. Practically all of the steam drifters are mortgaged to the limit, and there seems little prospect of paying them off. Now the Germans and the Scandinavians, on government subsidies, are building new boats, with Diesel engines, that will cut further into our markets, because they are much cheaper to operate."

The talk of slump in markets, falling prices, and gluts of fish was interrupted by



Drawn by Elsie Dunn Burbus

A DRIFTER RIDES THE NORTH SEA WAVES MOORED TO HER TRAIN OF NETS

Strung out in a long line across the tide and buoyed vertically by inflated pallets, these nets ensnare vast shoals of herring as they move across the fishing grounds.

the cook's call to lunch. Together we went astern, lurched into the tiny galley where the broth from the joint was spilling onto the hot stove at every roll of the ship. We crossed in front of the doorway of the engine room, from which issued pungent oily fumes, and then backed down the hatchway ladder to the cabin.

"Still going strong?" asked the member who had referred to seasickness.

"Still going." And I attacked a piece of joint, potatoes, and peas, while holding the plate in my hand.

Instead of sea chanties, the crew were humming the popular jazz tunes that came blaring from the loudspeaker of a radio.

Here, in this small, ill-ventilated cabin and in the bunks, arranged like cupboards along its sides, the ship's crew of ten spend their hours when they are not on deck bending, casting, or drawing their nets. If the catches are heavy, there are precious few hours below deck, even for eating, because of the grueling hours of hauling, quick return to port for unloading, and preparing nets for the next catch.

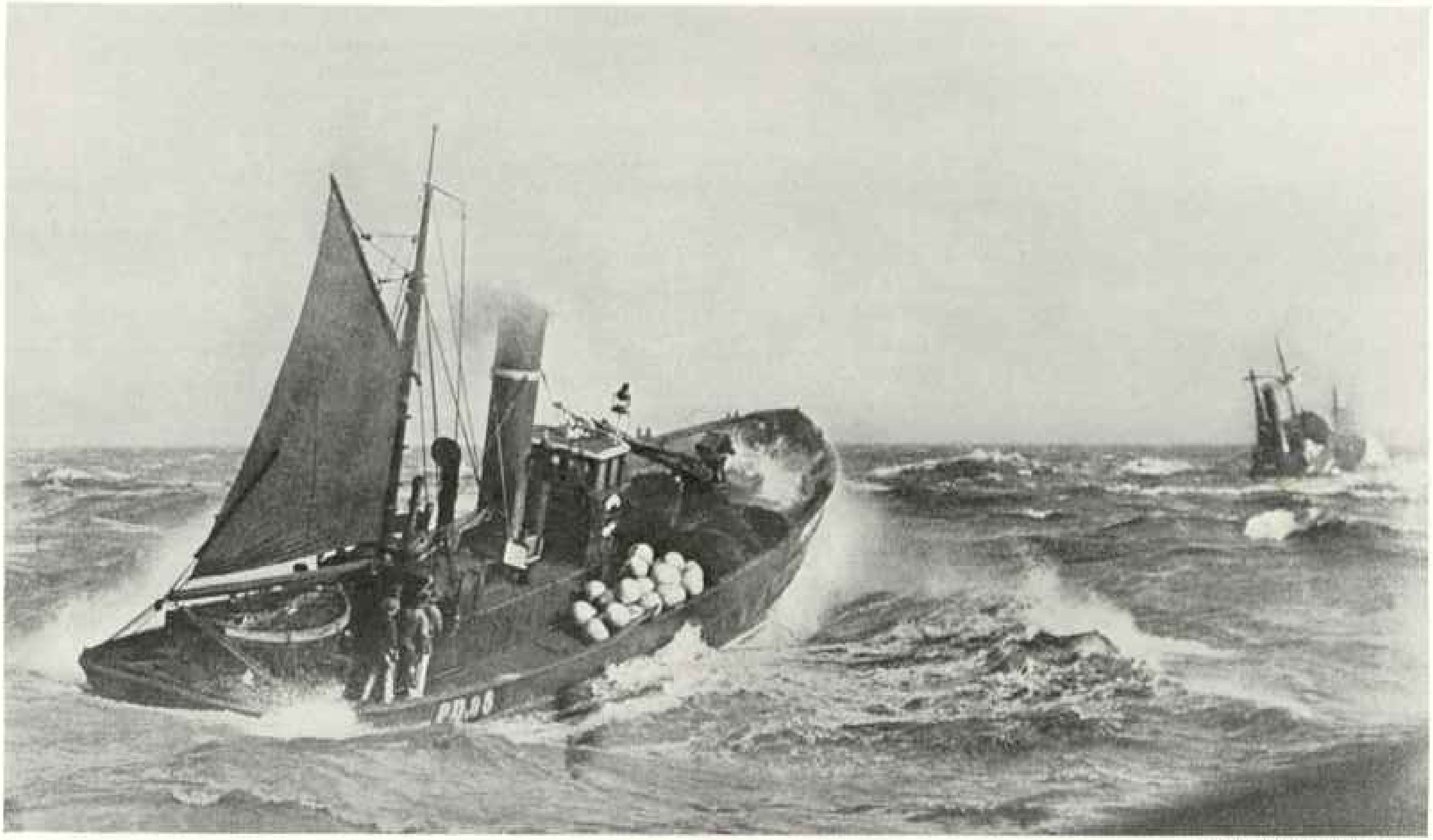
AN ECHO FROM SHOALS OF FISH

By late afternoon we reached a place where the skipper thought the water "looked pretty good." More progressive than the other captains, however, he was also trying to approach the fishing industry from a scientific angle and had equipped his boat with a depth-sounding device. On this we had seen a number of flashes beside the one which indicated the ocean depth, a suggestion that we were perhaps getting a secondary echo from the backs of a shoal of fish. So densely packed are some of these massive shoals that it is quite possible to detect their presence.

"Up with the flag and get ready to shoot," called the skipper. A flag, indicating to other vessels that we were drifting, was raised at the bow, and, with the engines running dead slow, the two miles of nets were "shot" across the tide. Then, mizzen-sail raised to hold the boat into the wind, engines were stopped and we drifted, wallowing in the restless sea. Night lights on the other drifters gave one the impression of being in the center of some vast circular town.

"All shot, well laid, may the Lord send them back well paid," is the herring fisherman's saying and his hope.

The gill nets are about 35 yards long by half that width and are buoyed up to within 10 feet of the surface by inflated



UP AND OVER, BUT IT'S ALL IN THE DAY'S WORK

On the tossing decks are piled inflated canvas pallets, or buoys, which keep afloat the two-mile string of gill nets. Drifters have earned their name by the method of fishing which they employ—idly drifting with the tide and wind until their nets are drawn. A trawler, on the other hand, *drags* a long line of baited hooks or nets.

A SMALL "SHIMMER" OF HERRING ROLLS OVER THE GUNWALES

When the haul is heavy the nets suggest thick silvery blankets, so closely are the fish enmeshed. Last year the herring runs were so large that much expensive gear was torn away because of the colossal burden (see text, page 240). Two inflated canvas pallets, which buoy the nets, bob in the foreground.

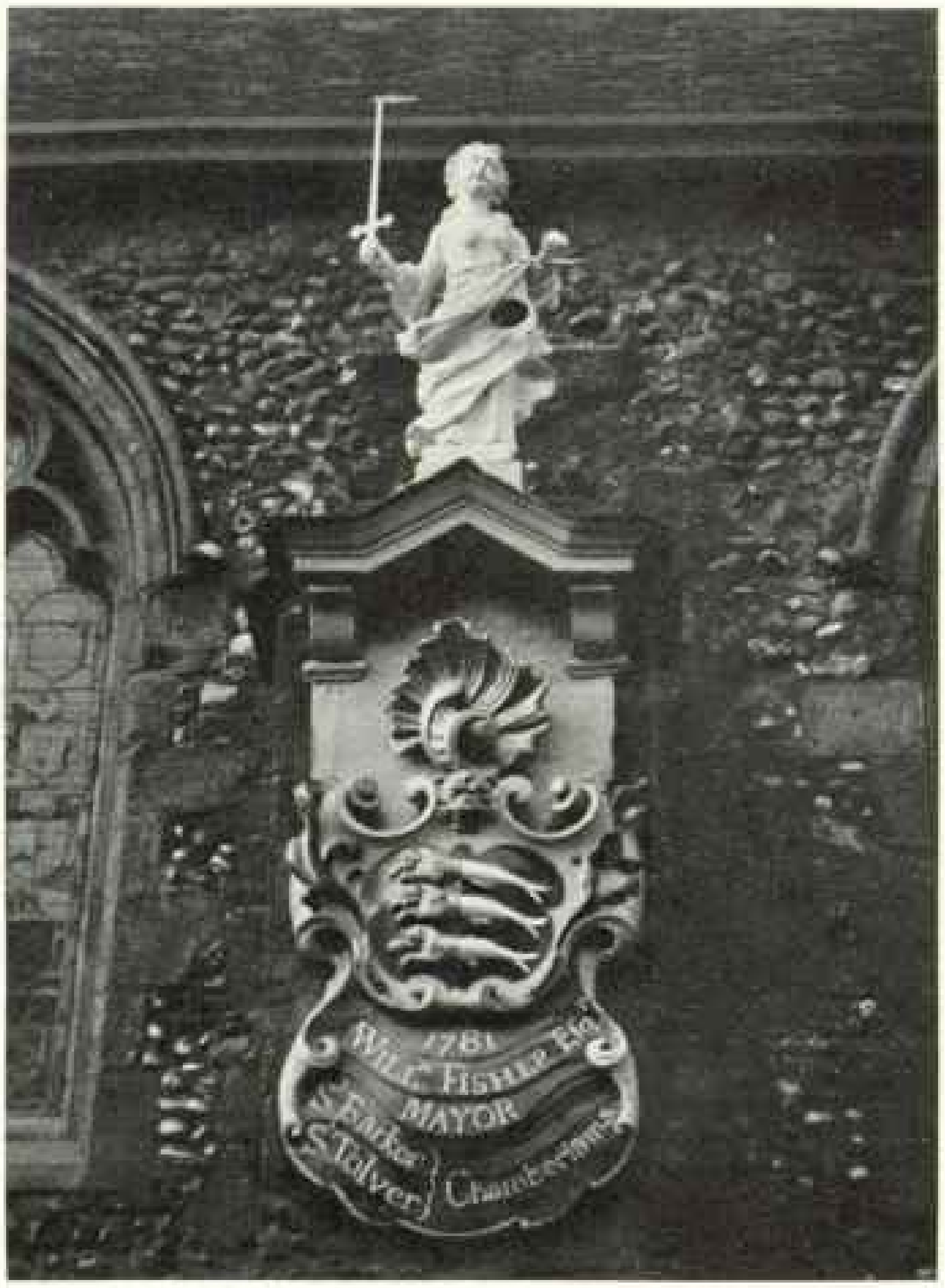
THE "VIOLET AND ROSE" SHOOTS HER NETS

Each steam drifter usually casts about 100 nets, although superstition dictates that it must not be an even number. A pallet is being hurled overboard in this photograph (see diagram, page 236). A Dutch sailing drifter lolls on the horizon.

canvas pallets. Although usually about 100 nets are employed by each drifter, superstition dictates the use of an uneven number.

Many other superstitions prevail among the herring-fishing hands. For some reason salmon are never mentioned by name. If one must talk of them, one calls them "cold iron." Whistle and you are certain to bring a gale. To start on a venture on Friday is to court ill luck.

To meet an old lady with a cast in her eye just before going to sea is a sure sign that poor luck will attend the fishing. This can sometimes be overcome by making an effigy of her and burning her as a witch. Years ago persons in fishing villages were often singled out and accused of working witchcraft on the herring runs and were burned in effigy. Others, less fortunate, were ingloriously ridden out of town in wheelbarrows.



GREAT YARMOUTH HONORS THE HERRING ON HER COAT OF ARMS

After her fleet aided King Edward III in the wars with France, the armorial fish on an azure field were decapitated and the heads replaced by royal lions. This plaque and statue adorn the walls of the 16th-century Tolhouse, now converted into a museum.

Deeply religious as many of the Scottish fishermen are, they never like to see a minister come anywhere near their boats. Herring bones have to be disposed of by other means than burning, as an ancient saying runs: "Catch me, kill me, but don't burn my bones."

DRAWING IN THE NETS

Herring often swim at the "close," shortly after dark, or else move at the change of tide. At 8:30 that evening all hands were called to draw in the first two nets to see what the catch had been. As they came up comparatively empty, they were dropped back again.

At 3:30 o'clock in the morning orders to haul away were again given. Nets came rolling in over the gunwales; herring flashed in silvery iridescence under the glare of acetylene lamps. "Spin up, spin up" (probably a corruption of "swim up"), repeated the skipper in the traditional formula of the sea.

For four hours the men hauled, taking turn about at different positions to relieve the monotonous strain. Herring flew in every direction as they were shaken from the nets; decks were covered with their gleaming bodies, and at frequent intervals the fish had to be shoveled into the hold. Yet it was a poor catch; we had landed only about 10 crans (a cran is 37½ impe-

FOR PROTECTION AGAINST SALT—NOT FIRST AID

Tightly wound bandages serve as gloves. Each season, 5,500 "lassies," varying in age from 16 to 60 years, swarm into Great Yarmouth from distant Scottish ports.

rial gallons, or 1,200 to 1,500 fish); so it was not worth while to return to port.

Throughout the morning we cruised around, as did the other drifters, questioning what luck each had, hoping thereby to learn where the best hauls had been made. The waters in the immediate vicinity of the Smith's Knoll Lightship seemed our most favorable grounds, although the shallows thereabout made shooting nets a fairly tricky business.

A RACE AGAINST THE TIDE

So close to the lightship did we finally shoot the nets that a deeply inset tide during the night bore us down toward it, with the risk of drawing our nets across its bows. For a frantic half hour the crew hauled nets as they had never hauled before; perspiration streamed from their every pore, though the night was cold. Cutting of the nets seemed imminent. The fog signal blared closer every moment.

"Haul faster!" shouted the skipper, with an eye ever on the ominous red light. "Never mind the few fish that stick in the nets, get them out later. Haul faster!" The capstan rattled a higher crescendo.

Signals jingled to the engine room: "Stand by!" For a few moments it seemed that, to avoid a crash of the drifter against the lightship, the nets would have to be sacrificed.

Then the light slowly but surely began to fall astern. "You can take it a bit easier, boys," came the welcome order. The race against the tide was won.

With twisted smile on his face, the captain turned to me and remarked: "Well, I think you can say you've been closer to that lightship than any other American!"

In many of the nets there had been a fairly good "shimmer" of herring; so we steamed into port with nearly 40 crans of herring to be unloaded into "swills," or baskets, and then auctioned off (p. 235).

TALL AND TRUE FISH TALES

A few weeks later drifters came to port with real fish stories to tell. There were no wailing complaints of lack of fish; instead, there were dramatic tales of vast shoals moving directly over the grounds where the fleet was fishing, reports of loss of expensive gear, and of such heavy hauls that they could not be stowed away in the

holds! Even the oldest fishermen could not recall when there had been such a run. Masses of herring were literally jumping out of the water.

One Scottish drifter, fishing with more than a hundred nets, came into Yarmouth with 20 crans (between 20,000 and 30,000 fish) taken from one net. It had been the only one that the crew was able to pull aboard; all of the others were so laden with herring that they had been carried away, a loss of some $3,000 in gear alone. Other ships had varying losses, ranging from a few to most of their nets.

When hauled aboard, many of the nets had the appearance of thick silvery blankets, so closely together were the fish massed. Some of the crews, who were fortunate enough to land all or a greater portion of their nets after long hours of fatiguing labor, came into port with shots of from 100,000 to nearly 500,000 herrings. Yarmouth and Lowestoft saw incredible millions of fish for a few days.

"KNIT ONE, PURL ONE" UNTIL ANOTHER BOAT COMES IN!

When a Scottish fisher girl is not busy cleaning and packing herring, she plies her knitting needles on a new scarf for herself or a sweater for brother, husband, or sweetheart in the fleet (see text, page 247).

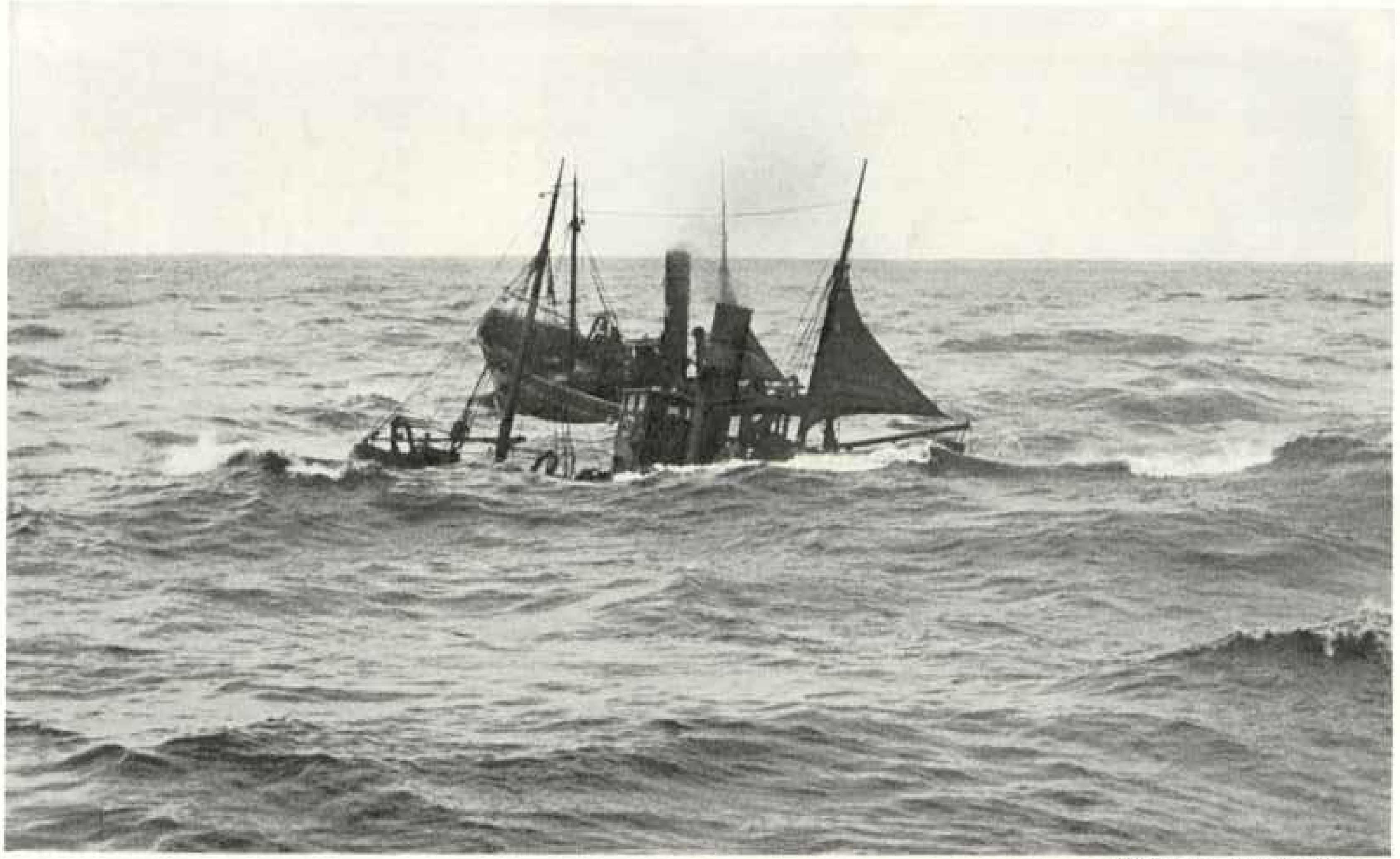
Yet fortune failed to smile on the fishing crews; many of the Scottish drifters were destined to return home burdened with deficits. Great Britain's dwindling export markets could not absorb the heavy glut of fish.

FISHING BY SHARES

On the English drifters a share system prevails. Profits are divided into 16 shares, of which nine go to the owner of the boat and the other seven to the crew. The captain's portion is one and three-fourth shares, the first mate and engineer each receive one and one-fourth, the oarsmen one, and so on down to the cook, who gets three-fourths of a share. On the Scottish boats the crew often own a certain number of nets and their pay is scaled accordingly.

Ashore the catch must be cured, packed, and barreled for shipment.

A comparatively small but increasing portion of the catch is "klondyked"—that is, iced fresh when they are landed—and shipped for immediate consumption. Others are converted into "bloaters," "kippers," and "reds"—all three methods of curing which originated in Yarmouth. Nearly half of all of the landings, however, are pickled for direct export. The Scottish firms are chiefly, though not entirely, concerned with this latter activity, which



Photograph by Topical Press Agency

A WRECK? NO, JUST HEAVY GOING!

In this nautical illusion, a drifter wallows in the trough of a huge wave, while another, cresting a swell, passes close by. Because of its shallowness, the North Sea in a storm piles up quickly into big, choppy waves. Drifters played a heroic rôle in the World War as patrol boats and mine sweepers.

HEAVE HO, WITH A WILL!

A basket of herring comes out of the hold to the quay. Four such baskets make a cran, the customary British measure of fish. In 1913, at Great Yarmouth's all-time peak in the herring trade, more than 824,000 crans, or, roughly, one billion fish, were unloaded at her piers (see text, page 248).

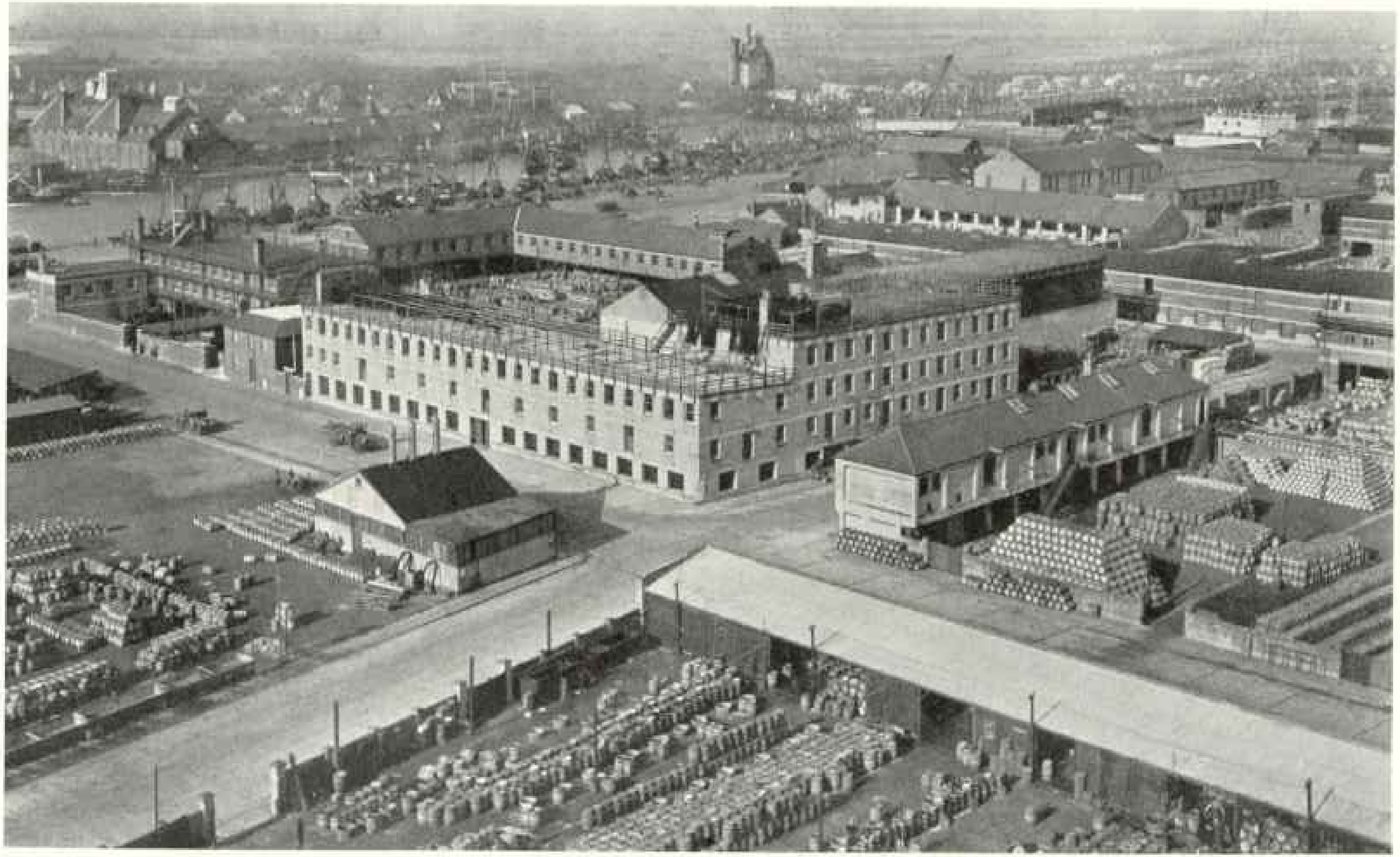
REAPING THE HARVEST OF THE NORTH SEA

Herring fishermen lead strenuous lives. This crew had been hauling nets for more than five hours when the sun peeped above the fog-dimmed horizon. If the catch is large, it often takes twice that time to pull in the heavily laden nets.

© Fox Photos

PACKED CLOSELY TOGETHER, GUNWALE TO GUNWALE, AND IN COLUMN, THE FLEET STREAMS INTO PORT

Nearly 1,000 English and Scottish drifters fish the vast herring shoals which migrate to feeding and spawning grounds in the waters about the British Isles. Curious villagers always watch from the breakwater as the tiny ships, fishing gear stowed on deck and holds full of fish, race for the narrow harbor entrance. In April they operate near Ireland and the west coast of Scotland; May and June find them in the Shetlands and Orkneys, later touching the east coast of Scotland; and then, in October, they are welcomed at Great Yarmouth and near-by Lowestoft (see text, page 250).



THE TOP OF LORD NELSON'S MONUMENT COMMANDS A PANORAMA OF CURING YARDS

A portion of the fishing fleet lies harbored to unload its catch on the ribbon of the River Yare, cutting through Great Yarmouth. Although some fish are iced and shipped fresh, the major portion of the trade is in pickled herring, packed in barrels. When the city sought to honor Nelson, the town clerk, about to administer the oath on the Bible, requested: "Your right hand, my Lord."—"That," said the naval hero, "is at Teneriffe."

PACKING HERRING IS WOMEN'S WORK AT GREAT YARMOUTH

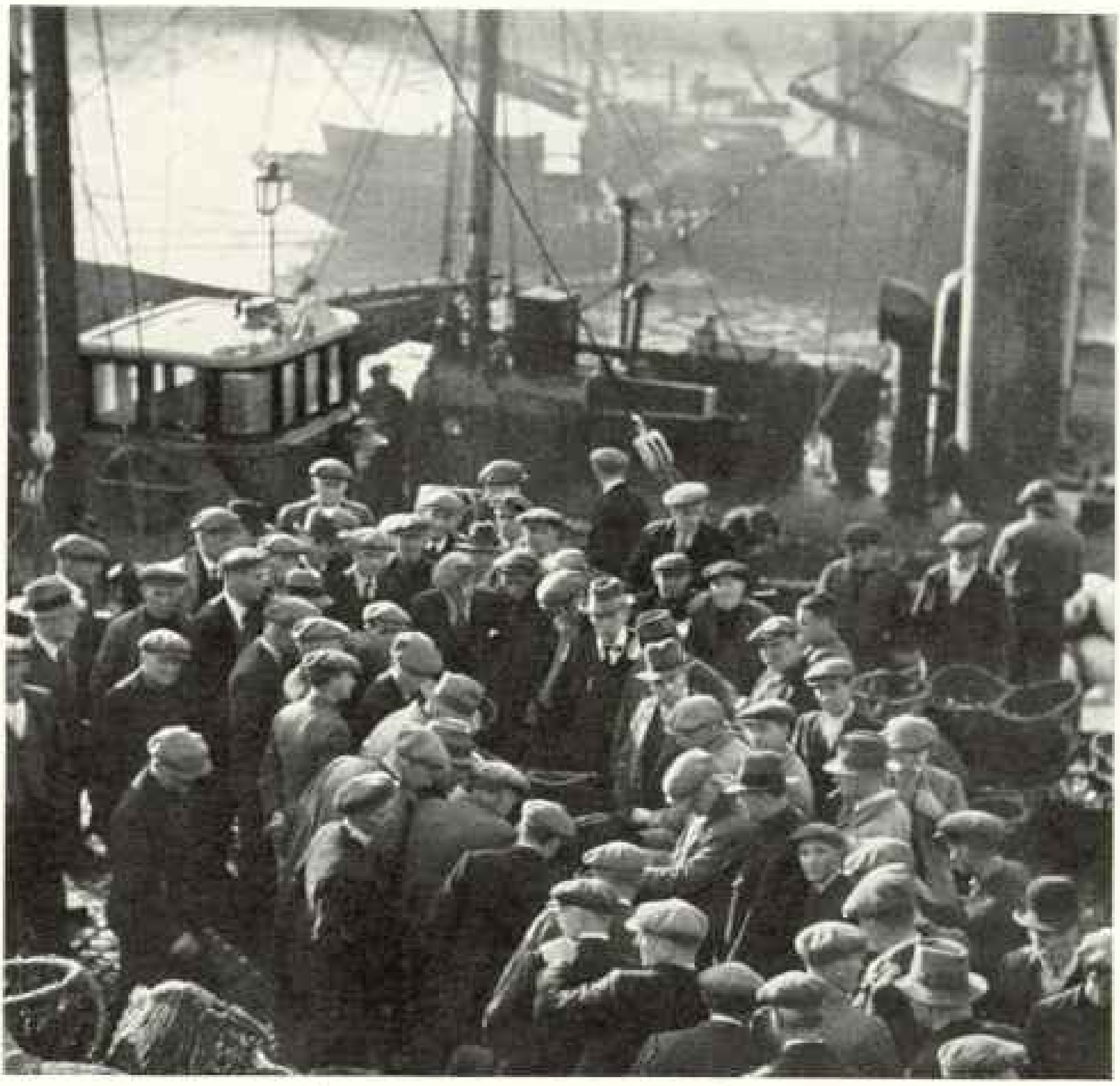
The "gipped," or gutted, fish are graded to size and carefully corded in barrels with liberal sprinklings of salt. As there is some shrinkage after a few days, these lassies are adding another layer of pickled fish to fill the barrels.

accounts in part for the large staff of men and women who come from all over Scotland for the curing season.

The yards in which they work are scattered extensively along the water front and on the Denes, at the lower end of the town. As soon as the lots of herring have fallen under the auctioneer's hammer, carters truck the swills of fish to the yards and dump them into troughs, where they are "gipped," or gutted, and graded by the girls.

Working in teams of three, two for gipping and one for packing, the Scottish lassies dispose of the fish with incredible rapidity. A lightning flash of a knife and the herring is tossed back into one of the three grading tubs. Although a small matie is nine inches in length, a matie nine and one-fourth, a matfull nine and one-half, and a full herring 10 inches, seldom are the girls in error in grading them simply by sight, as they swiftly handle them. Salted first in the gipping troughs and again when they are carefully corded into their proper barrels, the fish make their own brine.

Each team handles about four barrels an hour—slightly more than a herring every second—and a working day is from ten to twelve hours long when catches are sufficiently large to keep the packers busy. Whether they work or not, each girl is paid the equivalent of about $3.50 a week as a living wage; to that is added a commis-



A THOUSAND FISH—"TWENTY-FIVE SHILLINGS, WHO'LL MAKE IT TWENTY-SIX?"

As soon as a herring catch has been landed at Great Yarmouth, it is auctioned off. Price calls are based on the cran (37½ imperial gallons). The herring season attracts English and Scottish buyers, and agents from far-off Greece, Germany, Russia, and other European countries.

sion on each barrel of fish she packs. These commissions are divided equally among the three members of each team.

The kippering rooms present similar scenes of activity, except that in preparing the fish each one is "speeted," or slit through the back, and spread out for a brief salting and smoking. From the brine tubs the speets are put on racks and hung in the smoking rooms on narrow racking partitions, called "louvres." Kippers receive only a brief salting and smoking; "reds" require a longer treatment.

The famous Yarmouth bloater is a lightly salted, briefly smoked, whole herring, prepared for immediate consumption.

When they are not busy with knives in the curing yards, the girls are industriously occupied with their knitting needles. Never have I seen such knitters! As they walk up and down along the water front, sit in knots on the packing barrels, or ride to and from their rooming houses, knitting needles are always active (see page 241).

How many bright-colored jerseys and scarfs they knit to replace the ones that become worn and smeared with fish scales; how many sweaters are knitted for husbands and brothers of the drifters, only an untiring statistician could contemplate. Even in the town social rooms you see the women knitting. Only at night, when the lassies have exchanged their rubber aprons, boots, and bright head scarfs for trim

A CREW UNLOADS A SILVERY CARGO

When herring runs are bountiful, many drifters return to Great Yarmouth with 100,000 to 400,000 fish in their holds. Fast work is made of unloading to permit an early return to the fishing grounds (see text, page 241).

gowns, silk stockings, and high-heeled shoes, to go window shopping in the town or to a dance, do they seem to be able to lay aside their knitting.

One morning I stopped to get a photograph of a group of the girls as they were binding up their fingers with strips of cloth as a protection against the irritating effects of the salt on the fish (see page 240).

"Take a picture of me?" joked one. "Had I known you wanted a picture of me, I'd brought me compact along."

She certainly needed no rouge, for her cheeks were pink from long hours each day in the open air.

"What's the picture for? A paper? And are you going to call us buxom, like the pressmen have?" questioned another.

Perhaps buxom is not the proper word; but, whether 16 or 60 years old, they are the healthiest group I have ever seen. They have to be!

"It's American ye are?" ventured a third, and then movie-born slang descended on me in an avalanche of "Oh, yeah's" and "You're telling me's," amid peals of laughter and cross-conversations of incomprehensible Gaelic.

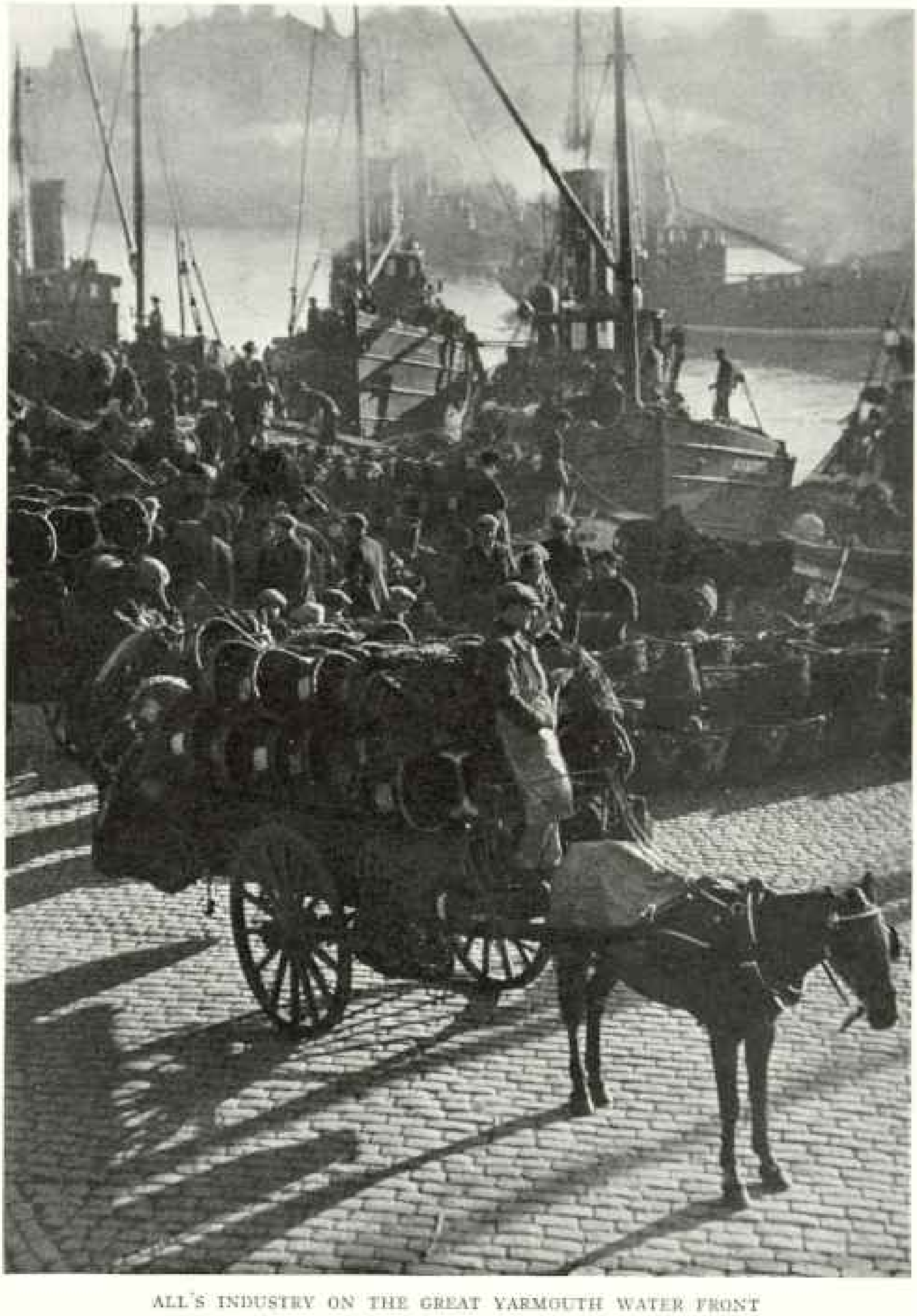
In the net chambers of one of the local firms I found girls busy making and repairing nets, and in other rooms I saw the ransackers overhauling the gear, replacing missing cork floats, and getting the nets ready for sea.

Almost everywhere one turns one sees still other activities linked with the fishing industry. For instance, there is the handling of from 15,000 to 20,000 tons of salt that is imported, unloaded, and distributed to the yards in an ordinary curing season.

In near-by Lowestoft I visited the research laboratories where the scientists of the Ministry of Agriculture and Fisheries are carefully studying the migratory, spawning, and feeding habits of the herring shoals, as well as the influence that harmful organisms may have upon the annual return of the fish to their normal grounds.

A BILLION FISH CATCH

Great Yarmouth's all-time peak in herring fishing came in 1913, when more than 824,000 crans, or somewhere about one billion fish, were unloaded on her piers!



ALL'S INDUSTRY ON THE GREAT YARMOUTH WATER FRONT

Against a background of masts and steaming funnels, longshoremen and crews land the catches, auctioneers cry for bids, and carters bring high-piled loads of "swills." Although somewhat changed to-day, the quay still has the same bustling atmosphere as when David Copperfield watched these two-wheeled carts clatter over the stones (see text, page 233).

THE RAGING NORTH SEA EXACTS ITS TOLL

Returning through high seas to Great Yarmouth with its catch, this Scottish drifter crashed into a pier at the river's mouth and sank. As the ship breaks up under the pounding of the surf, gulls hover above to feast on fish released from the hold. The crew and expensive nets were brought ashore safely.

In 1932 the landings of herring in all of Great Britain's ports came to an aggregate of 1,459,988 crans, valued at about $10,000,000. Add to these already stupendous figures the countless billions caught by Dutch, French, German, and other fleets, not only as full-grown herrings, but as whitebait and sardines, and one asks, "How soon will the herring shoals be depleted?"

For more than a thousand years, however, fishing has gone on over these same grounds without apparent diminution. Although it is estimated that from 8,000 to 10,000 miles of British nets are fishing in the North Sea at one time, yet but a fraction of the fish ever become ensnared.

The spawn of a normal full-grown herring averages from 30,000 to 47,000; so, even though it is probably more extensively preyed upon than any other fish, its progeny will continue to stock the seas abundantly.

During the years of the World War, when practically all the fishing boats were on patrol or mine-trawling duty, the herring shoals had further opportunity to increase. Lack of markets, not lack of fish, will continue to be the chief source of worry of the herring-fishing industry.

So, year after year, despite unstable markets and fluctuating prices, many of the hardy Scottish and English fishermen will go to sea. Now they ship aboard the *Ocean Angler*, *Busy Bee*, *United Friends*, *Braes o'Enzie*, *Ocean Sprite*, *Children's Trust*, *Green Pastures*, *Violet and Rose*, and other steam drifters rapidly becoming obsolete. In the near future, perhaps, they may be hauling their nets over the gunwales of new Diesel-engined ships bearing equally whimsical names.

Every season they will keep the same rendezvous as did their forefathers—April, it will be Ireland and the west coast of Scotland; May and June, it will be the Shetlands and the Orkneys; later, they will touch the east coast of Scotland; then, in October, the cycle will again be completed, when Great Yarmouth and Lowestoft welcome the herring fleet.

"COMPLEAT ANGLER" FISHES FOR FOSSILS

By Imogene Powell

With Illustrations from Photographs by the Author

THERE is one feature of fossil-fishing which sets it apart from all other angling sports—the big ones can't get away!

This fact, and also the minor one that fossil-fishing in this country must be carried on in the remote, not to say obscure, portions of the United States, will probably keep it from assuming the place which it deserves as a major American outdoor sport.

The proper fossil-fishing trip leads you, for example, to Fossil, Wyoming, where you may be the only person getting off there that year!

Now, the *Priscacara pealei* (poor fish to you!) may look tame enough as you pass him by in a museum on your way to the stuffed owls; but that is because these ancient relics of prehistoric days have been carefully caught for you, imprisoned in their stone frames, labeled, and hung where they can excite only the inflammable interest of the paleontologist.

But try fishing some time for those rovers which, only a few million years ago, "when you were a tadpole and I was a fish," swam blithely through that inland ocean where are now the Rocky Mountains.

A WEEK-END FOSSIL "CATCH"

One week-end fishing trip in Wyoming may net you a six-foot palm leaf, three large pickerel, bass, or pike, a prodigious mosquito (just the way you'd like to see a mosquito, transformed into solid rock), sunfish, herring, the thick-scaled gar pike.

Then, you never know when you may come upon an ancient crocodile 13 feet long. One was found near the fossil bed, where you must look if you expect your week's sport to be really exciting.

Fossil, Wyoming, is formed by the accidental meeting of two roads which slipped down from opposite sides of a mountain. There is a pleasing legend that the population of Fossil is 50; but, counting the people you can see and the ones you can imagine, you cannot arrive at a generous estimate of more than 30. There are four regulation buildings, and there is a box-car fitted up with chintz curtains and bespangled with cooking pans. The foreman of a section gang lives there. A sheep herder's summer home, neat barrel staves covered with sheeting, stands at the corner of State and Madison (see page 253).

They will have to stop the train especially for you. They don't like to do it—and, as you look out over the wind-swept, cold, purple dawn on the Rocky Mountains at this particular point, neither do you.

But it's worth it!

ASLEEP IN A DISTANT PAST

A few minutes after you have arrived on a well-conducted fossil-fishing trip, the sun will break over the farthest ridge in a long crescent of fossil mountain which sleeps content in a past which even the most arduous fisherman will never know.

Around you is a shallow sweep of mountain—red, gray, green, blue, and purple—colored with time and embracing earth and sky and air. The sky is a curious translucent blue. You stand as if on the basin of some huge broken piece of pottery. All about you at the broken brim are fossil beds which you may fish to heart's content and whose depth you may never plumb.

Custodian of the fossil beds, amateur sportsman extraordinary, Robert Lee Craig will take you fishing if you have an honest interest. He has been fishing in these hills for 37 years, and he has no patience with people who will not climb with him the 275 feet from his camp to the fossil hill; who will not wait while he lays bare a stratum of fossil rock; who will not, with his own suppressed excitement, cleave those strata again and again, peeling, stripping the layers down as though they were ears of corn. Often the finest specimens of fossilized fish will be hidden just beneath the gray-white surface and would pass notice of all except the most observing (see page 257).

It is best to wait until the heat of the day to raise a ledge, for then the bright rays of sun, striking each layer as it is peeled off with wedge and hammer, often show up the faint tracing of a backbone, the dim outline of a fin.

When this outline is revealed, the fossil fisherman takes the sharp blade of a knife and gently scratches the protecting shale away to make sure of his specimen. Then he hews out a square of rock around the

FOSSIL-FISH STORIES CONCERN AGE RATHER THAN SIZE!

Paleontologists estimate these to be approximately 55,000,000 years old. The long, slender fish has many fossil contemporaries in the dusty mountains of Wyoming, but only one species lives to-day, in the South Pacific. The other is a herring.

fish, and the specimen is ready for cleaning. The cleaning process is done with the fine blade of a knife, great skill being exercised to clear away all trace of rock in which the fish is embedded without destroying the delicate outline of the fish.

CLEANING FOSSIL FISH THE WORK OF AN ARTIST

Through the years Craig has become highly skilled in this art. He waits a certain number of hours after the fish has been raised, so that the slightly damp rock will give properly to the knife blades, and yet so that sufficient air will have struck the specimen to keep it well preserved during the process of cleaning.

To raise the strata, to cleave those gray-stone squares—most often they are about six inches thick, though some are much thicker—requires strength and a certain skill easily acquired by the amateur. But to clean fossilized fish the skill of an artist is required.

This master fisherman skins them in the record time of 20 minutes—can clean them so that the tiniest fin, the most delicate scale, will stand in bas-relief. Sometimes he scrapes away the stone around the fish so that it lies against a frame. Sometimes he cuts an irregular outline about them—each fish to its setting.

If you go to Fossil to fish, you will most certainly not raise a fish the first day. That is contrary to the whole custom of fishing the world over. No, the first day must be one of disappointment—of a long, sharp climb up barren rocks, of sliding on heaps of shale, of digging out mountains of broken rock which nighttime, winds, and a passing sheep herder have shoved down onto a layer which just the day before has been prepared for raising for your special benefit.

These fossil hills are contrary—jealous as deep pools where bass lie hidden from the caster's fly. They slip and slide, they shift and fall, to confound the fisherman and make for him unceasing labor. You must wait and hope, you must listen to stories of other fish, other days; you must eat your noonday sandwich dry and brittle and filled with some dust of shale; you must know the sadness of cleaving a whole sheaf of rock at last—good, firm fossil rock in which whole schools of prehistoric fishes should lie buried—only to find it barren as

a desert trail. No, these fish took one more dive before the cataclysm. They lie to windward or to leeward. And though you are some 25 or 30 feet below the top layer of protecting shale, still you have not fished deep enough.

"FISH" ON DUSTY MOUNTAIN TOPS

If you are a proper fisherman, you will of course spend many lingering moments which might otherwise be tedious in contemplation of the ancient story of how your "catch" came to be cast up, in the very act of living, onto the dry and dusty mountain tops. As a theme for meditation, it far surpasses the habits of the lively pike in his favorite deep-lake retreat. For the how and the why of the northern pike in present-day waters is mysterious enough, but the how and the why of the fossil gar pike is the story of Time itself.

THE COVERED WAGON IS ONE OF FOSSIL'S FEW RESIDENCES

This crossroads settlement in southwestern Wyoming, according to legend, has a population of 50, but the author estimates not more than 30. The "town" has four regulation buildings, a box-car, and a sheep herder's simple summer home on wheels (see text, page 251).

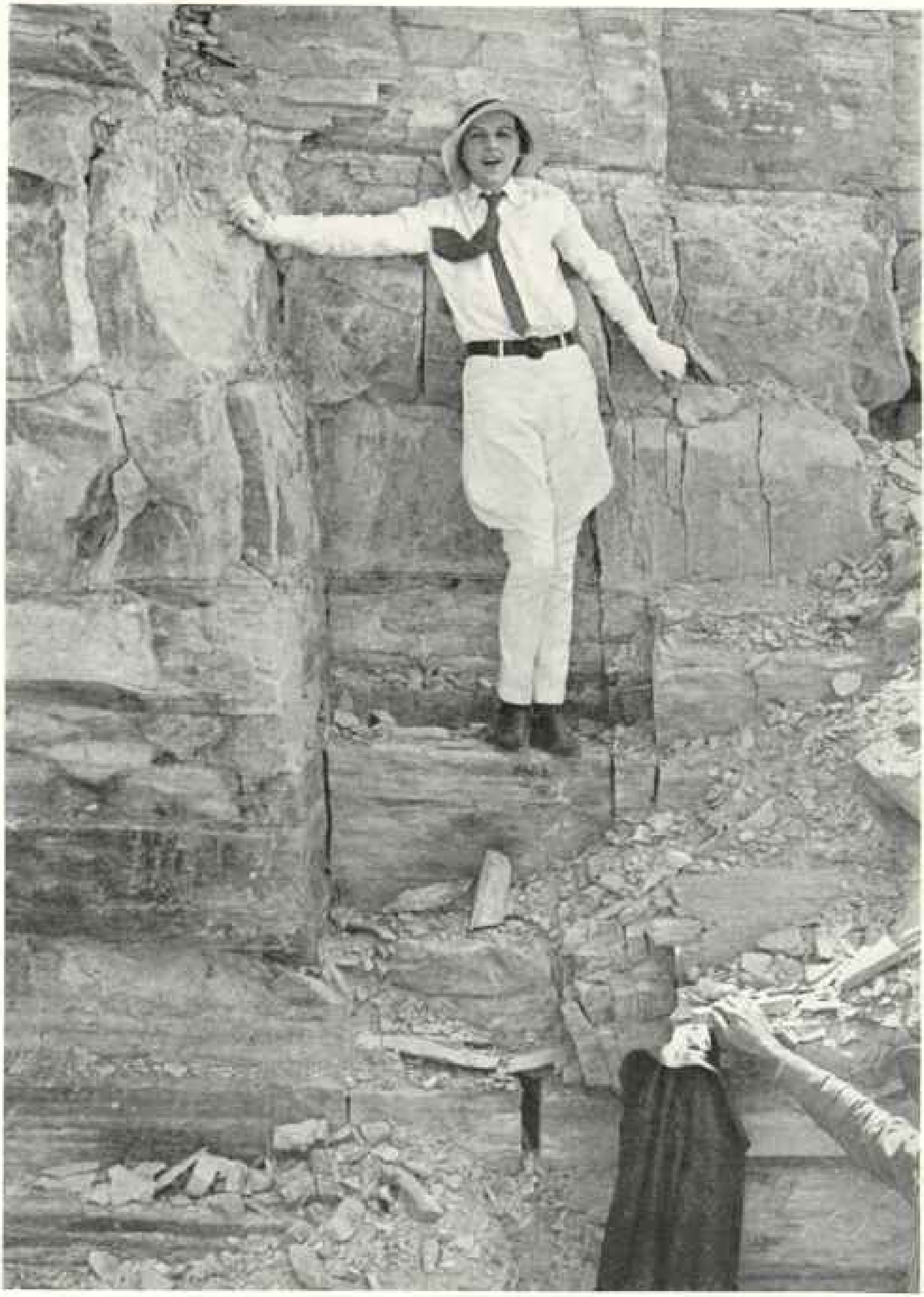
Perhaps the best definition of the fossil fish for the amateur stone fisherman is the simple one given by the late Frederic A. Lucas, formerly a curator of the National Museum, in his book, "Animals of the Past."

"Fossils," he says, "are the remains, or even the indications, of animals and plants that have, through natural agencies, been buried in the earth and preserved for long periods of time." These "indications," which may be footprints, tramped leaves, the almost formless jellyfish, the very ripple on the sands, have been, in many instances, preserved in stone, perfect patterns of the ephemeral life of millions of years ago.

And how did fossil fish come to be imprisoned in their strangely lifelike stony form in the Rocky Mountains of Wyoming? Your mind must go back to lost ages, when an ocean rolled over the wheat fields of Kansas, the prairies of Nebraska, and the site of the Empire State Building alike. These abundant seas were ruled successively by various races of sea creatures, which came, ruled, were conquered by larger and more powerful species, and at last lay scattered at the bottom of the ancient ocean bed.

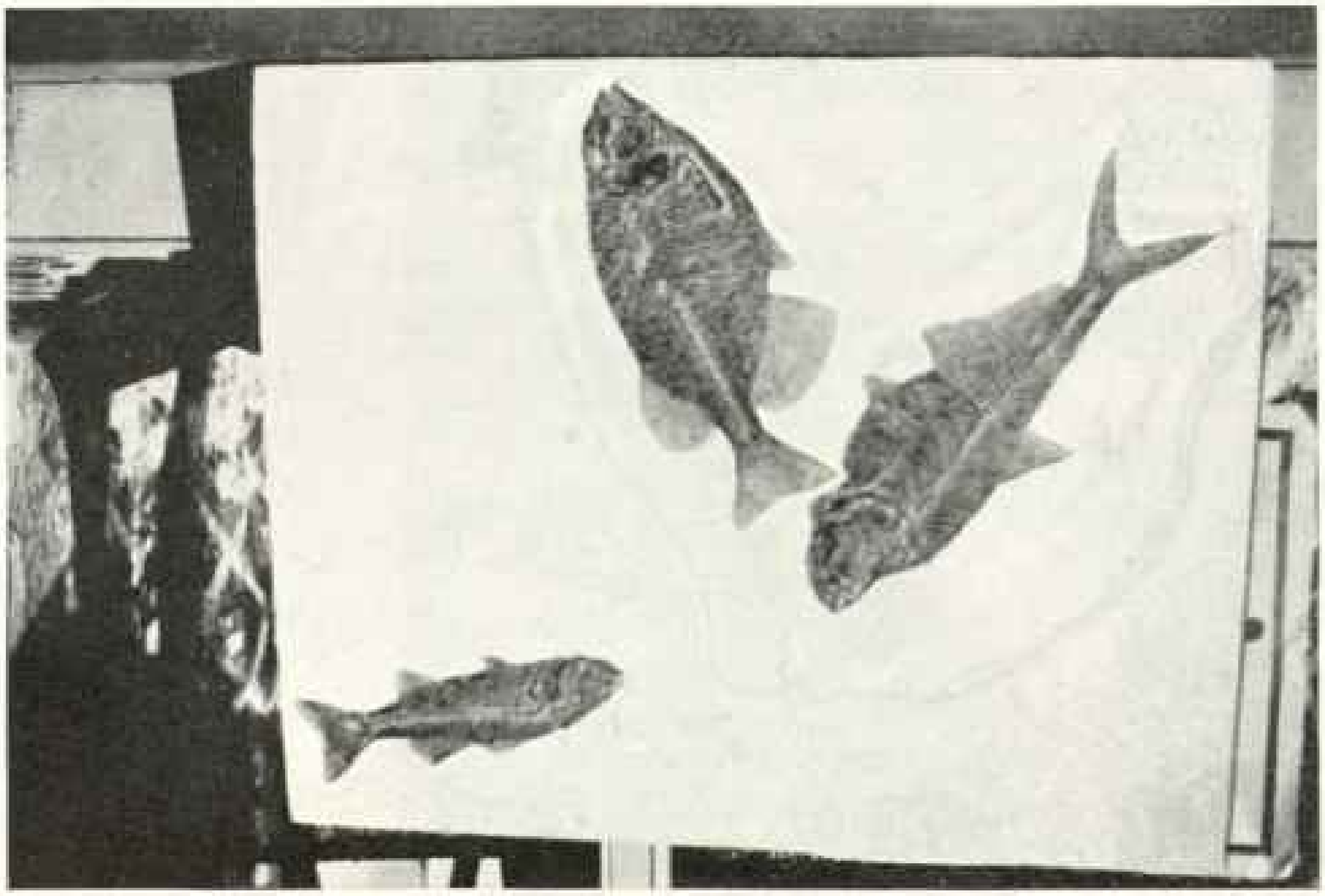
STRANGE OCEAN CREATURES

Among the strange ocean rulers were the armor-clad fish; then, in turn, the fierce, sharp-toothed sharks, the fish lizards, the mysterious ichthyosaurus, the



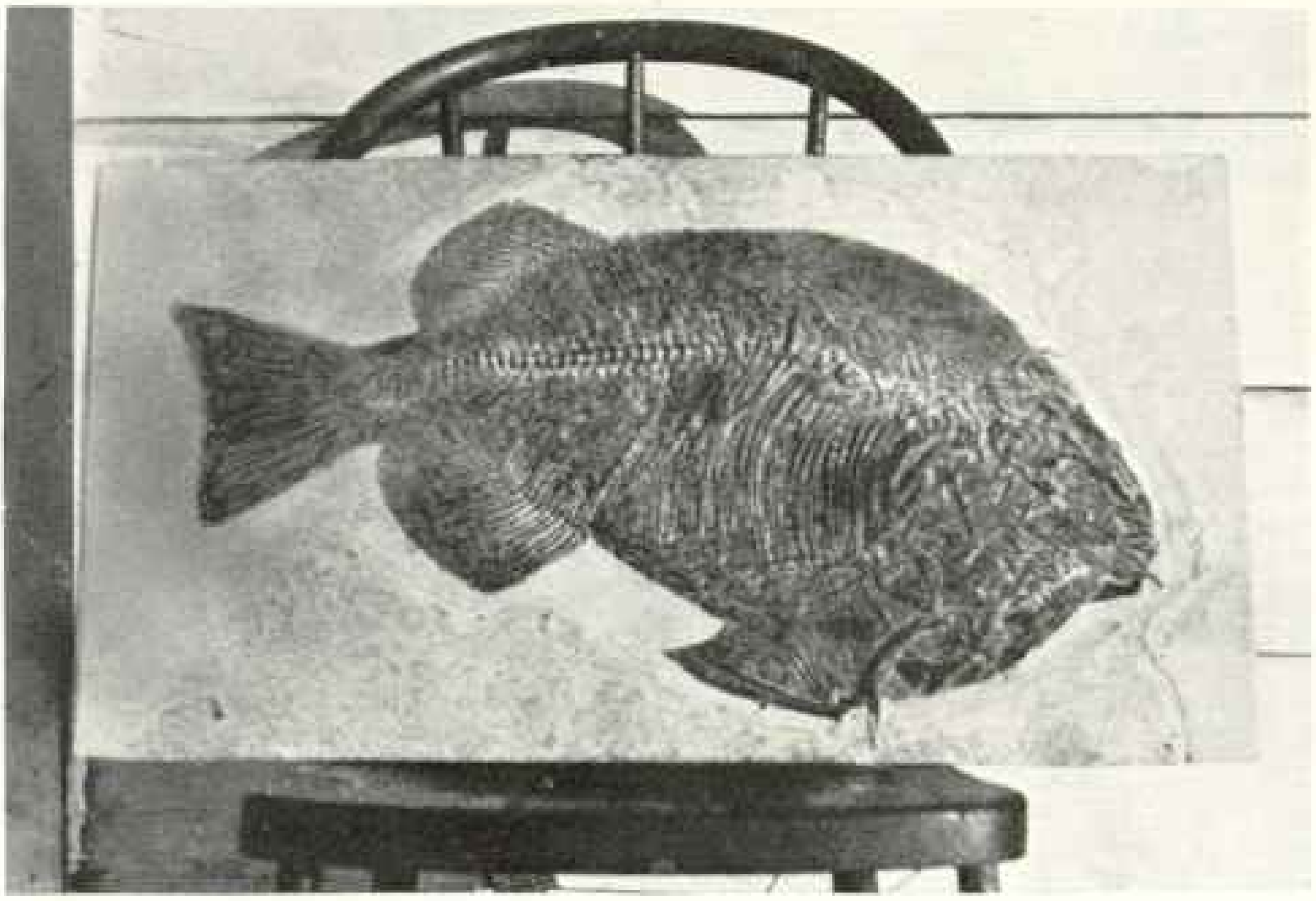
THE AUTHOR EXPLORES THE FOSSIL-FISHING GROUND

Many specimens of plant and animal life that flourished ages ago were buried and perfectly preserved in the ooze of a lake bed which now is this hill of stratified rock. The deposits have escaped destructive land disturbances, and erosion has made easily accessible the richest fossil area in the United States. A week-end "catch" may net a herring, bass, or some other fish, a six-foot palm leaf, a prodigious mosquito, or perhaps even an ancient 15-foot crocodile, all turned to stone (see text, page 251).



ONE "CAST" HOOKS THREE BIG ONES

Not often does the splitting of a single slab of rock so abundantly reward the fossil hunter. Nature has mounted in stone a herring, a *Dapedoglossus*, and a basslike fish. Carbon in the bodies causes them to show up dark against lighter-colored shale.



HIS COUSINS STILL SWIM IN THE RIVERS OF FOUR CONTINENTS

This unusually large *Dapedoglossus* is one of the finest "strikes" that Robert Lee Craig had while quarry fishing. Of the five living species of the family to which this extinct member belongs, one is found in Australia, another in the Malay Archipelago, a third in tropical Africa, and two in the Amazon—one being the pirarucú, the largest fresh-water fish in the world.

"COME ON OVER; WE THINK WE'VE GOT ONE!"

Peeling away the layers of this slab may reveal a rare fossil prize or be as fruitless as whipping a trout stream on an off day. Should the faint tracing of a backbone or a fin appear, the protecting shale is scraped away carefully with a fine knife blade, exposing one of Nature's "reliefs."

plesiosaurus, whose names are only a little less terrifying than the havoc they spread among the fish lizards crawling in the mud of ocean bed. The great marine reptiles called Mosasaurus, geologists believe, ruled the seas from New Zealand to North America at one time. These ancient reptiles, at their most fearsome prime, measured from 25 to 40 feet in length.

The Rocky Mountains—so placid and gray now by daytime—swarmed with heroic battle in the days when they were still ocean bed. Huge turtles, saber-toothed divers, the monstrous fish of legend, all fought for supremacy, and over the waters flew the pterodactyls, dark, menacing shadows, with their powerful wingspread of 20 feet or more.

While the rival fish species spawned, fought, and died, the surface of the North American Continent was gradually taking form. The land which made up the ocean bed was rising with monumental slowness — an inch, perhaps an inch and a half, a century.

At last the "ocean" on the North American Continent was completely enclosed on the west and on the east by elevations of sea bottom, so that it connected with the Atlantic and Pacific Oceans as we now know them only at the Gulf of Mexico and the Arctic Circle. Continued elevations of the eastern and western edges contracted the area of this vast inland ocean, and parts of the ancient sea bottom rose, reached the surface, forming bars and vast fingers of land. Parts of the water area were contracted into inland lakes until, at last, they lost all contact with salt water.

Thus the living creatures—the turtles, the great saber-toothed fish, the gar pike—were imprisoned in fresh-water lakes. The weaker tribes perished slowly, tribe by tribe, lost to their salt-water habitat. With the death of many of the smaller, weaker tribes of fish, the main food supply of some of the larger and more ferocious sea creatures was diminished, and they, too, perished, hapless prisoners in their trap of earth.

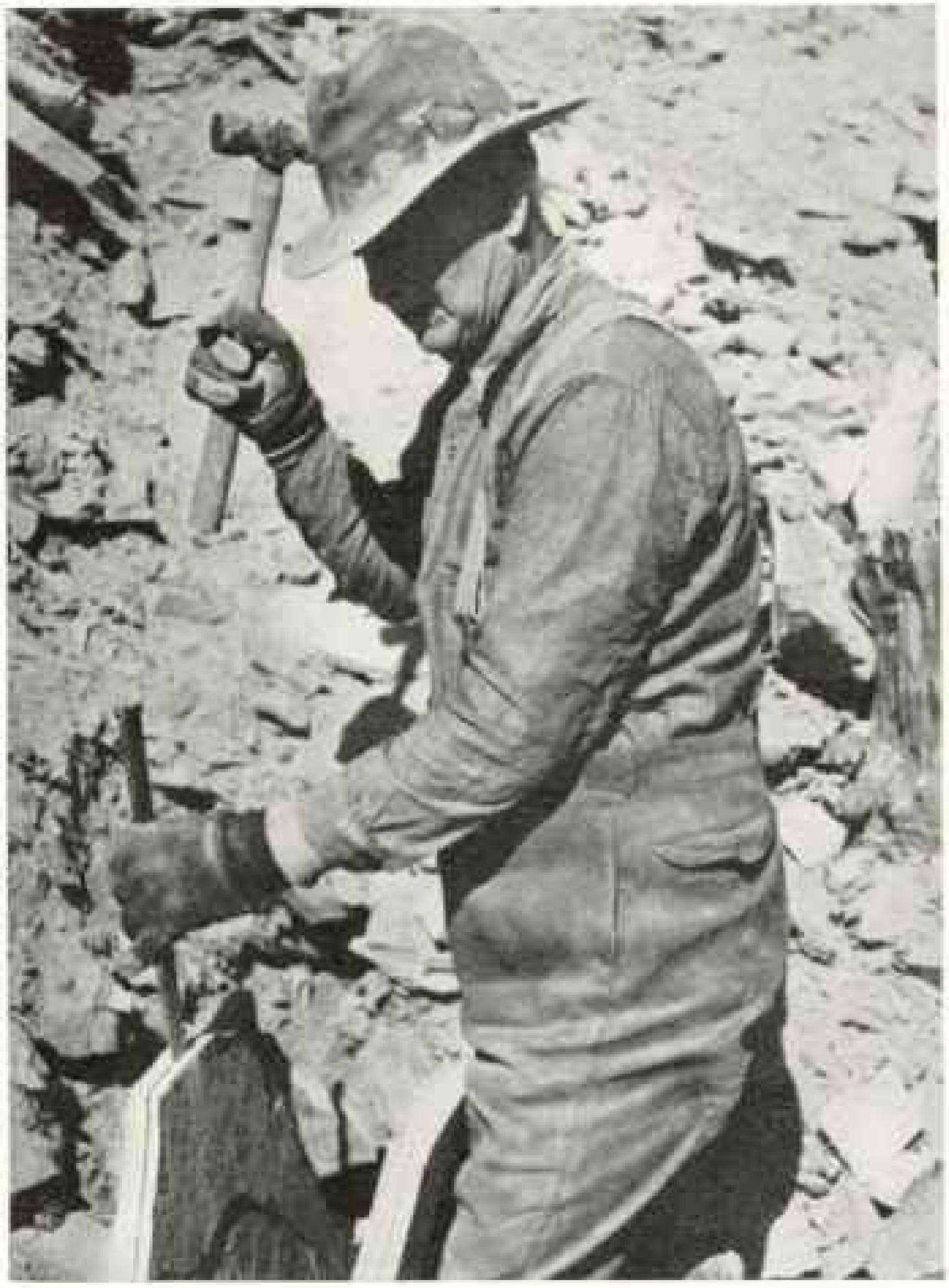
Even though millions of creatures lived and died in the oceans which through the natural geologic change of time became mountains, lakes, and valleys, comparatively few fossils remain to tell the tale. In order to fossilize, objects must first be

protected from the air completely. Nature accomplishes this only by burying them in wet ground.

The fossil fish must first have settled to the ocean or inland lake bed. He must have found quiet waters, after his life's struggles, where the wash of waves on the shores would gently wear away the sand or rock. This pulverized rock or sand must then have settled gently over the fish. His bones, little by little, must have been covered by a fine deposit which would embrace every fin and scale, fill every groove so gently as to preserve each delicate outline.

Every schoolboy fisherman, questing with a bent hook in the old mill-pond, has pulled out from the sucking mud some old shoe or tin bucket. The sea creatures of millions of years ago settled first into the mud much as the old boot does — and the first stages of their fossilization had begun.

The crust of the earth was rising and falling, just as it is to-day, and the layers of mud in which the fish were buried became increasingly thick. The lime, or silica, in the water cemented the particles of mud and the grains of sand into a solid mass, a process speeded by the constant slow pressure of the overlying sediment, the heat created by this pressure, and likewise the heat from the earth beneath.



"FISHING" WITH CHISEL AND HAMMER

For 37 years Robert Lee Craig, as amateur sportsman extraordinary, has been angling patiently in the rocks at Fossil, Wyoming, to provide fossilized fish for museums and private collections. Here he cleaves a slab of shale, finding several valuable specimens (see text, page 258).

NATURE "MOUNTS" A FOSSIL

During this process of slow burial, solidification of rock, and pressure from the earth below and above, the animal matter of the creatures embedded disappeared completely. The place of flesh and bone and fin was taken by the lime or silica deposit, and the hardened rock surrounding it formed the layers which millions of years later were to emerge as fossil rock, a perfect protection for the fish buried there. The chemical change which produced this metamorphosis in a fish of flesh and scale is a fit subject for a fisherman's solitary speculation. The exact manner is unknown, even to the geologist, and the transmutations through which the ancient gar pike went before he emerged a perfect fossil specimen could have been achieved only by the patient alchemy of ages.

Worsted in some encounter with a stronger gar pike, he went to the bottom of the sea—a Mr. Hyde of corruptible flesh and fin. He emerges millions of centuries

later—Dr. Jekyll, the image of himself in stone.

Even after mutable Time had caught him unaware, the gar pike, in fossilized form, had still only the remotest chance of coming anywhere near where the zealous fisherman could get at him. After he was transmuted to stone, Nature must still make the contents of the fossil rock accessible by turning the strata on edge. This she did in her own peculiar fashion, by volcanic eruption, by heaving and buckling the fossil strata into cliffs and mountain edges, or by cleaving them into valleys and canyons.

Some fossil strata are lost forever to the prying human eye through too great an upheaval of Nature and the flattening out of other strata on top of them. Sometimes they are cracked by heroic movements of rock, and, if the fossil strata are cracked open and left to the mercies of sun and wind, snow and frost, these, their natural enemies, will quickly obliterate the fossil specimens.

The chances a fish has to attain immortality as a fossil are one in a million. And that is why, when the fossil fisherman is in sight of a "catch," he feels very Eternity tugging at his line.

The sun sends long dun and purple shadows into the hollowed mine where you fish. You could not discern a fishbone, fin or backbone, in the gray rock even if you worked on. A cold and penetrating wind warns you that the day is done. There is the steep path for your tired feet—275 feet straight down, with dizzy depths of shale below you—then a long, winding, two-mile hike to town.

At the general store they ask you, "Any fish to-day?" You shake your head and hurry to the hotel, where supper is waiting and the white-haired lady, who has prepared three hearty meals a day for 30 years against the coming of a crowd of sheep herders, does not even ask you about your luck.

Well—to-morrow, perhaps!

That is the way with fossil fishing. You go back to-morrow. R. Lee Craig has gone back each to-morrow for 37 years, despite the fact that he has just one leg and must climb the sheer mountain sides maintaining an uneven balance with a gnarled wood stick which serves him as a cane.

Fish that were raised from this same hill have gone to museums in all parts of the United States and in foreign lands. Geologists and paleontologists have visited Fossil and are counted among the personal friends of Mr. Craig. He has prepared what is considered the largest collection of fossil fish in the world for a Chicago collector.

HIS "TACKLE" IS PICKS, SHOVELS, AND HAMMERS

Lee Craig has the ideal attributes of an angler. He is patient. He knows his wedges, picks, shovels, knives, hammers, and hack-saws as a sportsman knows his tackle. He handles them unfailingly, wedging into the soft rock with a sure touch, hammering here, cutting there, working with the soft and treacherous stone so as not to harm any specimens which may be hidden in those gray depths.

He has a certain indomitable spirit which has kept him fishing in those mountains all this time. He knows them so well that, walking up his trail and across the shifting edges of the fossil beds, where rock lies piled feet-thick, he can tell whether a stranger has passed that way. He knows by the rocks in the path, he says. "Tenderfoot! Only a stranger would kick shale in his own path!"

Craig discovered his own particular fossil hill and his life's work on his way from Shoshone Falls, Idaho, to Laramie, Wyoming. He had some little previous experience digging fossils with his friend, Fred Brown, leader of expeditions which contributed dinosaurs to the Smithsonian collection. He had helped uncover the bones of that famous brontosaurus, that massive prehistoric creature which in life, it has been estimated, weighed as much as 20 horses. He saw what looked to be a field rich in fossils, and though he'd never seen the town of Fossil before, he asked the conductor to unload him here. And here he has stayed.

INDEX FOR JANUARY–JUNE, 1934, VOLUME READY

Index for Volume LXV (January–June, 1934) of the NATIONAL GEOGRAPHIC MAGAZINE will be mailed upon request to members who preserve their copies and bind them as works of reference.

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-six 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.

AT an expense of over $50,000 The Society sent a notable series of expeditions into Peru to investigate the traces of the Inca race. Their discoveries form a large share of our knowledge of a civilization waning when Pizarro first set foot in Peru.

THE Society also had the honor of subscribing a substantial sum to the expedition of Admiral Peary, who discovered the North Pole, and contributed $55,000 to Admiral Byrd's Antarctic Expedition.

NOT long ago 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 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.

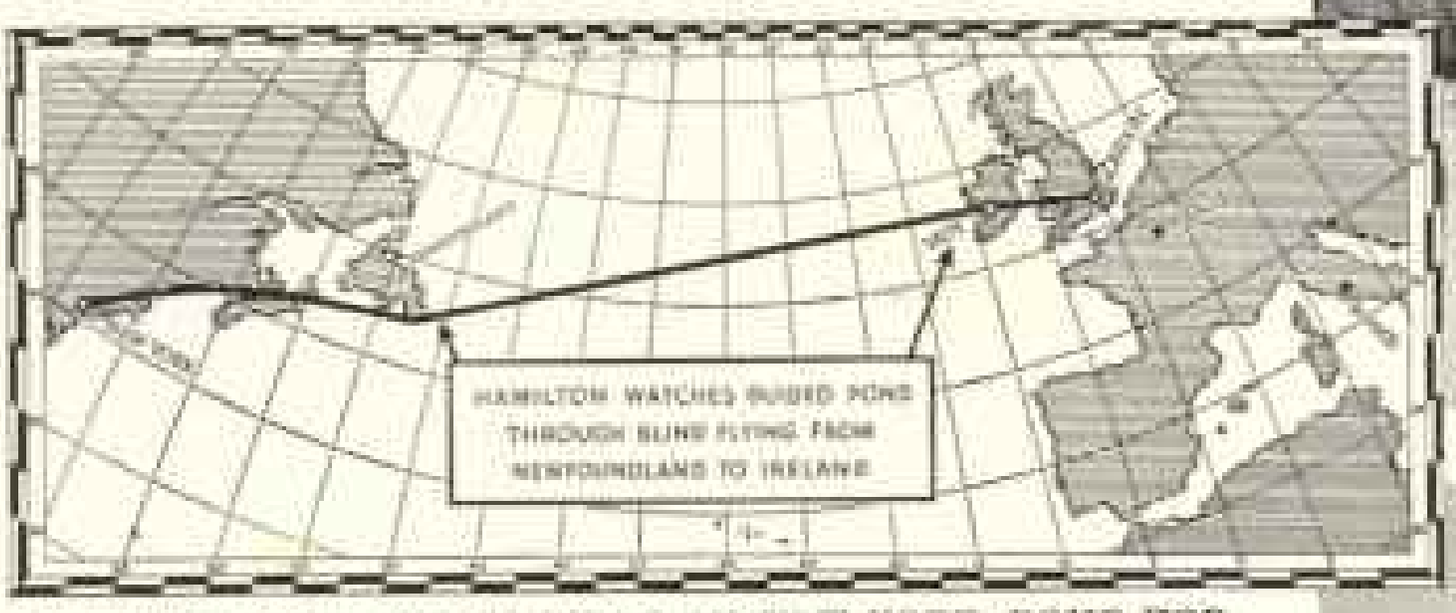
TO further the study of solar radiation in relation to long range weather forecastings, The Society has appropriated $65,000 to enable the Smithsonian Institution to establish a station for six years on Mt. Brukkaros, in South West Africa.

23 HOURS' BLIND FLYING!

HAMILTON WATCHES GUIDED LIEUT.-COM. POND DURING LONG, PERILOUS ATLANTIC CROSSING

ONE of the most perilous flights in aerial history was the first crossing of the Atlantic this season by Lieut.-Com. George R. Pond and his co-pilot in their attempted non-stop hop from New York to Rome. From the time their big orange Bellanca plane, Leonardo Da Vinci, left Newfoundland until it reached Ireland—where the flyers were forced down—Lieut.-Com. Pond flew the plane without visibility. During these 23 hours of blind flying, his only means of measuring distance was the faithful time-keeping of his Hamilton Watches.

Hamilton accuracy and dependability are no new story to Lieut.-Com. Pond. He has carried a Hamilton for 26 years. To insure extreme accuracy, every Hamilton is



ROUTE OF POND AND CO-PILOT ON NEW YORK-ROME HOP

tested by the exclusive Hamilton Time-Microscope. (Reg. U. S. Pat. Off.) See the many new Hamiltons at your dealer's. Write for special folder describing and illustrating the Time-Microscope. Also for illustrated portfolio of Hamilton Watches. Hamilton Watch Company, 882 Columbia Ave., Lancaster, Penna.

Three Smart New Hamiltons. (Top) The WARREN. 17 jewels, 10k filled gold, white or natural yellow, $42.50. 19 jewels, $57.50. (Center) The ASCOTT. New sport model. 17 jewels, 14k filled gold, white or natural yellow. Leather (shown) or silk cord, $62.50. (Bottom) The LEE. 19 jewels, 14k filled gold, white or natural yellow. With raised gold figure dial (shown), $55. With luminous dial, $52.50. Other Hamilton watches for men and women range from $53 to $500.

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the Watch of Railroad Accuracy

MADE IN AMERICA BY AMERICAN WORKMEN

Your own apartment sailing the seas

Live in a palace-of-the-seas next winter . . . for four happy holiday months. Take an apartment on the *Empress of Britain*, sailing on Canadian Pacific's *12th Annual* World Cruise.

You'll enjoy a magnificent home! This *ship of ships* is twice the size of any other world cruise liner. Her apartments are spacious, airy, beautifully appointed. There's the Olympian pool and a deck pool . . . full size tennis and squash courts . . . and a whole deck for talkies, balls, and gay ship parties. The *Empress of Britain* offers the luxury of size, speed, and space.

Go the route of routes. Visit seven Mediterranean cities, Egypt and Palestine at the season's height. Take a special train up through India, in comfortable weather. From Penang, go up to Cambodia and ancient Angkor. Spend two days in Bali, the island paradise. See Japan in cherry blossom time. You'll have *days*, instead of hours, in these glamourous places!

Decide *now* to be among the happy voyagers on the *Empress of Britain* World Cruise. Spend four months roaming the world . . . and bring home a world of memories.

Sail from New York January 10. Fares from $2250. Apartment with bath, from $3800. Both include standard shore programme. 32 ports. 130 days.

• Also, a new cruise . . . Mediterranean-Africa-South America-West Indies. "Five Cruises in One." *Empress of Australia.* 26 ports. 96 days. From New York January 18. Fares from $1350. Room with bath, from $2700. Both include standard shore programme.

A youth of India sings the marriage song to his bride

Empress of Britain

WORLD CRUISE

Canadian Pacific

Information, maps, ship plans from YOUR OWN TRAVEL AGENT *or any Canadian Pacific office . . . consult your telephone directory*

"Building a Canal—or Buying a Car—*Good Engineering* Counts"

★ A CERTIFIED INTERVIEW WITH CONSTRUCTION ENGINEER FRANK VIOLETTE ★

"We punish cars in Panama . . . but let me tell you how my Plymouth takes it"

FRANK VIOLETTE talks little about his supervising millions of dollars' worth of Panama's construction. But ask him about cars . . .

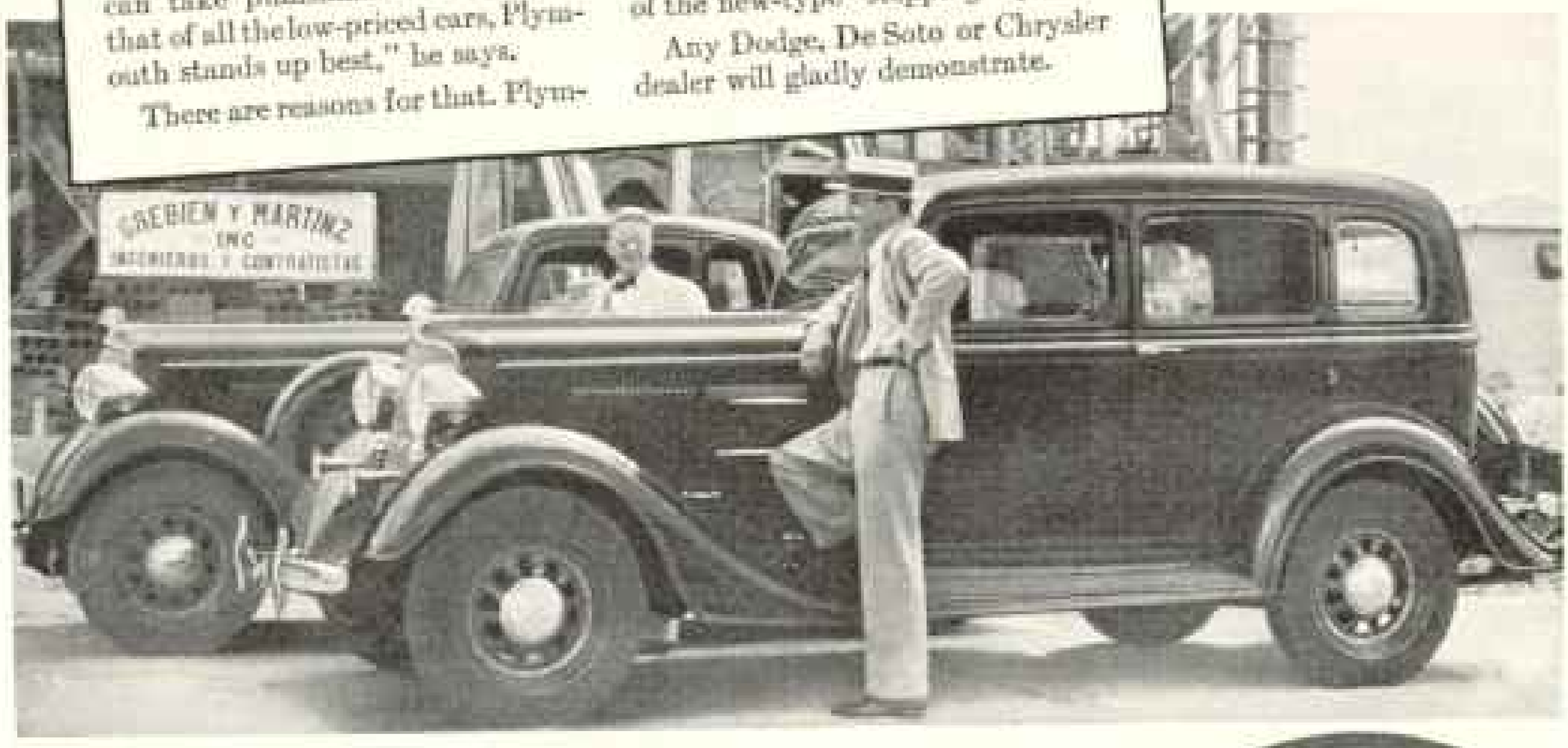
"In the Canal Zone, our everyday driving soon proves how well a car can take punishment. I've found that of all the low-priced cars, Plymouth stands up best," he says.

There are reasons for that. Plymouth has a Safety-Steel Body of steel reinforced with steel. And it also has Hydraulic Brakes . . . the safest, surest brakes on any car.

Then, for *comfort*, it has Floating Power engine mountings and Individual Wheel Springing—strongest of the new-type "stepping" springs.

Any Dodge, De Soto or Chrysler dealer will gladly demonstrate.

1. "The Canal is built of steel. And so is the car I picked. It's a Plymouth with a Safety-Steel Body."



2. Mr. Violette and Mr. Martinz, President of his Company, each with his De Luxe Plymouth. New, reduced prices begin at $485 f. o. b. factory. Time payments to fit your budget. Ask for Official Chrysler Motors Commercial Credit Plan.

PLYMOUTH $485 AND UP AT THE FACTORY DETROIT

IT'S THE BEST ENGINEERED LOW-PRICED CAR

"Few women care to be seen with a man *who needs a shave*"

SAYS GRACE PERKINS, FAMOUS AUTHOR OF "NIGHT NURSE"

Grace Perkins

Who can blame the girl for walking out on the party! Women agree that the humiliation of a half-shaved escort is hard to bear! Few people will deny that stubble is inexcusable — yet many men risk the respect of others by failing to shave well and often.

Let Grace Perkins, the famous author of "Night Nurse," and other best-selling novels, give you the woman's viewpoint. "Few women care to be seen with a man who needs a shave," says Miss Perkins. "If a man hasn't enough respect to shave carefully before he goes out with a girl, he cannot value her friendship very highly. I don't think anyone would blame her for not seeing him again."

With today's Gillette "Blue Blade" there's no excuse for stubble. Here's a razor blade that's made for men with tender skin. It is especially processed to permit clean, close shaving every day — or twice a day, when necessary, with perfect comfort.

Special automatic honing and stropping processes give the "Blue Blade" its marvelous, free stroking edge. No other razor blade is produced by this exclusive method. Only today's Gillette "Blue Blade" can give you the keenness that makes frequent shaving so much easier — so much more pleasant.

If you haven't a Gillette razor, or need a new one, ask your dealer for the "Red and Black" Special — or see coupon below. **Remember — the Gillette Razor with its flexible blade, is adjustable to the special requirements of your beard.** A slight twist of the handle adjusts the blade to the exact shaving edge desired for clean, close shaving. Without this essential feature no razor can be entirely satisfactory.

Gillette

BLUE BLADES

Now 5 FOR 25¢ – 10 FOR 49¢

Gold-Plated Gillette Razor and 5 Gillette "Blue Blades" 49c

• Heavily gold-plated with new-style "husky" handle. Comes in handsome red and black case with 5 Gillette "Blue Blades." If your dealer cannot supply you, send coupon and 49 cents to —

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It takes a Clever Chef to make

CONSOMMÉ THAT JELLS

without adding gelatin

REALLY *good* full-flavored jellied consommé is rare. And for good reasons. Let Heinz soup chefs tell you *why*:

"Clear, full-bodied consommé, as the French enjoy it, requires great patience and skill. But when chilled, *well-made* consommé jells *without* dilution with gelatin. Thus its rich, meaty flavor and seasoning remain unimpoverished."

Heinz concocts and cooks consommé precisely as skilled French chefs do. Selects choice meat stock and rich-marrowed beef bones. Prepares and deftly seasons the soup in small lots. Simmers it very slowly in open kettles, to infuse into the broth every drop of the delectable juices and blend them completely with the seasoning. Skims it amber clear, through fine sieves. Seals it air-tight into stout tins.

That is why Heinz Consommé, like that of master soup chefs, jells with nothing added to it. Merely chill it thoroughly, in the tin, open it, serve it.

Heinz Consommé, like the fifteen other Heinz Home-Recipe Soups, is a *finished* soup. Add *nothing* to it, whether served cold or hot.

HEINZ CONSOMMÉ

Select grocers have it. H. J. Heinz Co., Pittsburgh, U.S.A.; Toronto, Can.; London, Eng.

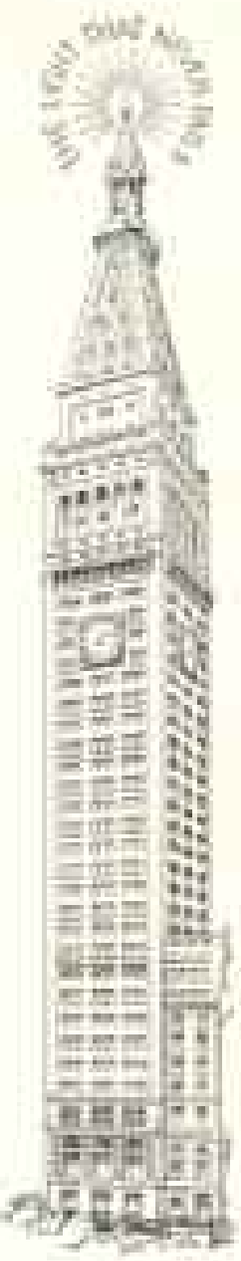
Your Dentist's Detective

"It's a good thing we made these X-ray pictures. Here's a small hidden cavity which I could not discover without my X-ray detective."

POSTPONING a visit to your dentist is not postponing trouble. It is bringing it closer. Time and money will be saved by a visit to your dentist every six months. It is impossible to have good health if the teeth, gums and soft tissues of your mouth are not kept in good condition.

If your dentist advises X-ray pictures of your teeth, take his advice. With the X-ray to inform him, he knows the condition of the deeper structures, the roots and the tooth sockets. In many cases early cavities can be found only by X-rays. If you have pyorrhea he may discover it at a stage in which it can be successfully treated.

Because an aching tooth demands prompt attention it is usually far less dangerous to health than the undiscovered trouble-maker. A tooth may seem to be sound and healthy and yet hidden trouble may be brewing. Infection may exist at the root of a guilty tooth long before it is suspected that anything is wrong. Meanwhile, the surrounding bony structure is being broken down and destroyed, while infection may be absorbed into the system through the blood stream. Such infection may damage the heart and other vital organs, may cause eye, ear, sinus, nerve, joint or digestive trouble.



When a firmly rooted tooth is to be extracted an X-ray picture may be needed to assist the dentist. Sometimes the roots are hooked or teeth may have failed to come through the gums. In such cases damage to the jaw-bone may result from a "blind" extraction.

If you have sound teeth and gums, then a correct diet, including some hard and "crunchy" food, will help to keep them healthy. Teeth, living parts of the body, are built by food. They need the minerals contained in eggs, milk, vegetables, fruits and cereals.

Metropolitan will be glad to send its free booklet, "Good Teeth." Address Booklet Dept. 834-N.

METROPOLITAN LIFE INSURANCE COMPANY

FREDERICK H. ECKER, PRESIDENT — ONE MADISON AVE., NEW YORK, N. Y.

Hitting the Trails OVER HIGH SPEED HIGHWAYS DEMANDS THE GREATER SAFETY OF *"The Blowout-Proof Tire"* *

Even at normal speeds a blowout is a dangerous thing. It can cause serious and often fatal accidents. When a tire blows out it tells its own story. The loud report is nothing more than the explosion of high pressure bursting through a weak spot in the tire. General's patented low pressure construction removes the explosive strain inside the tire that causes blowouts. The new "Blowout-Proof" General has an added feature of safety—the new Silent Safety tread. This revolutionary tread eliminates all smooth parallel ribs. It provides constant, quick contact which means far greater non-skid action and much longer wearing tread. You can purchase "Blowout-Proof" Generals on convenient terms through the General Tire dealer.

THE GENERAL TIRE AND RUBBER COMPANY · AKRON, OHIO
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TUNE IN Jack Benny every Sunday night, 10:30 E.D.S.T. coast-to-coast NBC

NRA USER

The New **GENERAL** *Dual*-BALLOON
WITH THE NEW SILENT SAFETY TREAD

Again this year—approximately one of every three at Chicago's Century of Progress Exposition pause and refresh themselves with ice-cold Coca-Cola. In 1933 more than twenty-two million people attended, and at the soda fountains and refreshment stands within the fair grounds more than six million, five hundred thousand drinks of Coca-Cola were served. Because its life and sparkle go quickly into energy. It keeps you going—feeling fit for what's ahead.

Coca-Cola Bottling Plant in the Food and Agricultural Building at Chicago's 1934 Fair.

"Meet me at Chicago's Fair"

The drink that keeps you feeling fit — everywhere

- You can be sure it is pure and wholesome. Coca-Cola is a pure drink of natural products, with no artificial flavor or coloring. Complying with pure food laws all over the world.

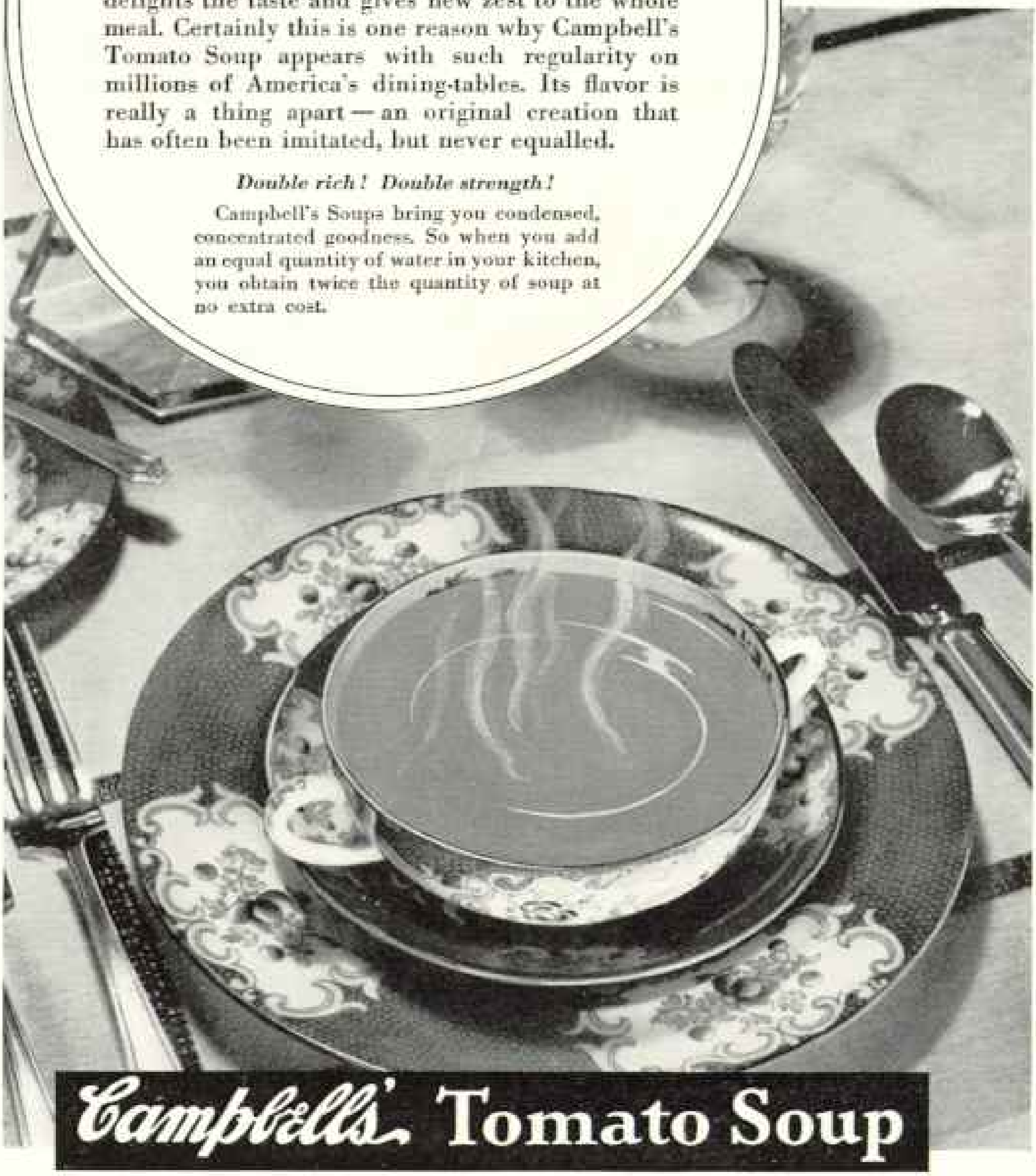
BOUNCE BACK TO NORMAL

You never forget its sparkling flavor!

You know how important it is in every meal to have at least one food with an especially bright and joyous flavor. Something with a tang that instantly delights the taste and gives new zest to the whole meal. Certainly this is one reason why Campbell's Tomato Soup appears with such regularity on millions of America's dining-tables. Its flavor is really a thing apart — an original creation that has often been imitated, but never equalled.

Double rich! Double strength!

Campbell's Soups bring you condensed, concentrated goodness. So when you add an equal quantity of water in your kitchen, you obtain twice the quantity of soup at no extra cost.



Campbells' Tomato Soup

Crisp...Cool

DID you know that crisp, light foods such as Kellogg's Corn Flakes will help you feel cooler, fitter, these hot days?

Kellogg's furnish energy. Yet they're so easy to digest they don't heat you up.

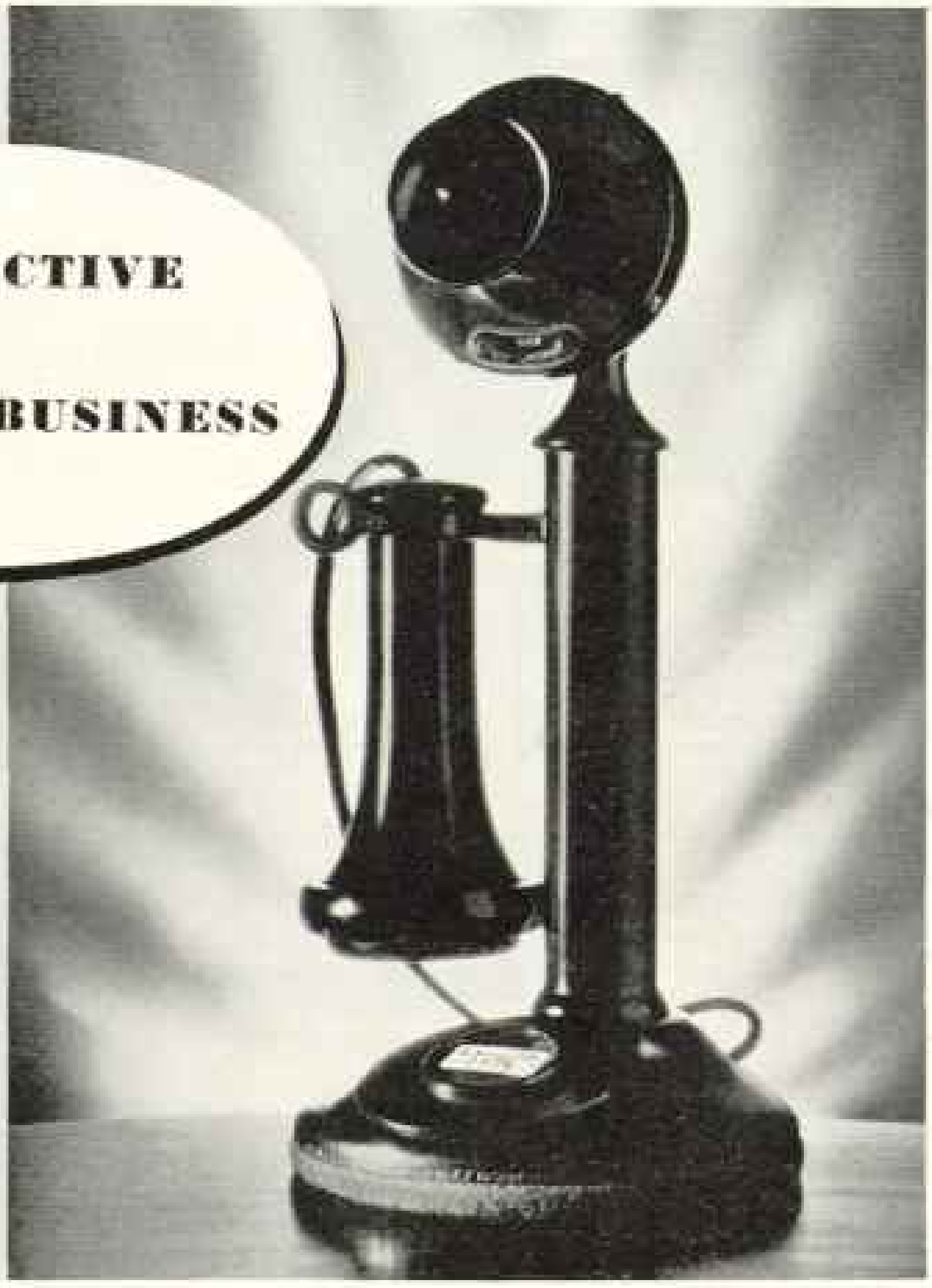
Enjoy a bowl of these crisp, tempting flakes with cool milk or cream . . . sliced peaches . . . berries. Delicious and refreshing for breakfast, luncheon or the children's supper.

Kellogg's Corn Flakes are ready to serve. Less time in the kitchen. More time to rest and keep cool. Convenient. Economical. Made by Kellogg in Battle Creek.

Kellogg's

For Coolness

A DISTINCTIVE AMERICAN BUSINESS



The Bell Telephone System is operated in the interest of the public

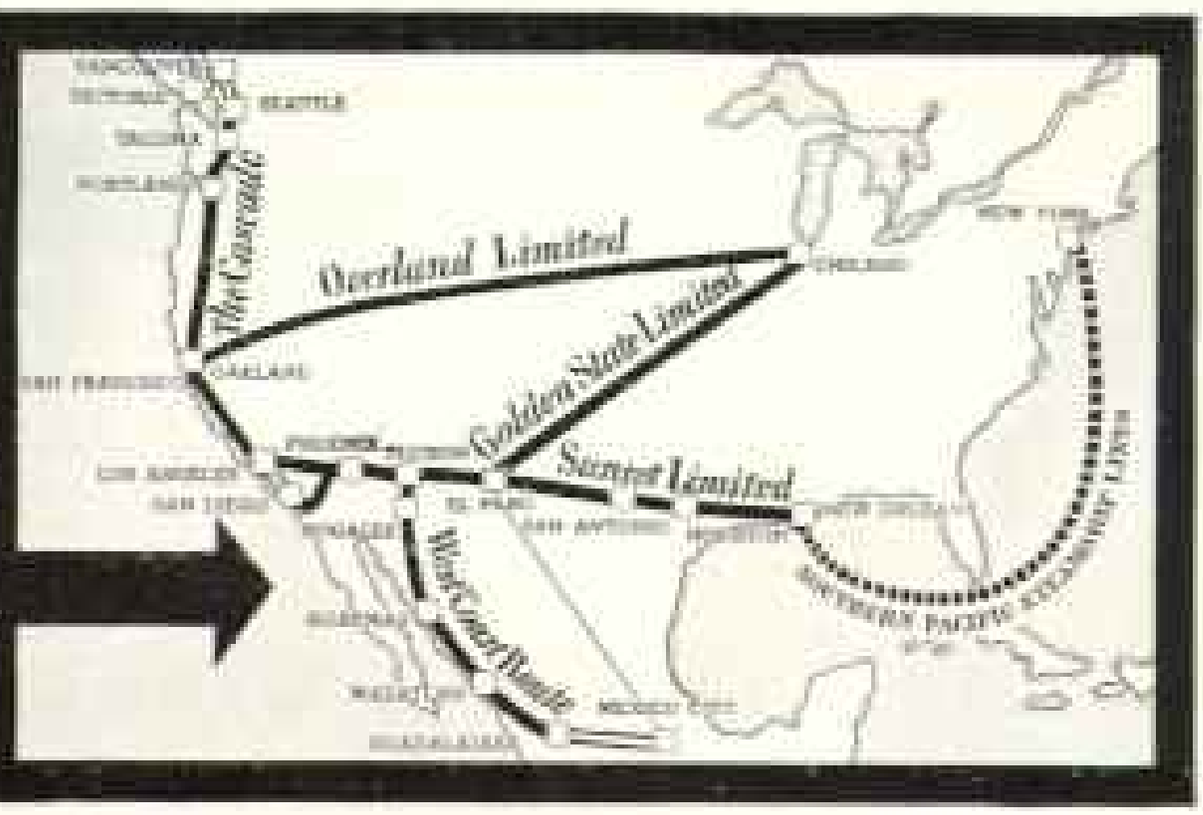
THE Bell System is a widely owned organization operating a public service under federal and state regulation. Its threefold purpose is to give the public the best telephone service at the lowest possible cost, give steady work at fair wages to its hundreds of thousands of employees and pay a reasonable return to the men and women who have invested in it.

The constant endeavor of the management is to deal equitably and honorably with each of these groups. There is no reason to do otherwise. There are 675,000 people who own the stock of the parent company—American Telephone and Telegraph. They are the owners of its nation-wide property. They are your neighbors. They live in every state of the Union and their average holding is 27 shares. No individual or organization owns as much as one per cent of the stock.

In the truest sense, the Bell System is a business democracy — born in America, brought to its present stature by American enterprise, financed and operated by and for the people of America.

BELL TELEPHONE SYSTEM

A new way to MEXICO



Our West Coast Route is the newest rail line to Mexico City. Only in 1927 was the last steel laid through the wild *Barrancas*, joining Tepic with Guadalajara and completing a through rail line from Tucson to Mexico City.

Over this route run trains of modern Pullman cars, through fascinating small towns and part way along the sea. Hermosillo, Navojoa, Mazatlan, Culiacan, Guamuchil, Tepic . . . at every stop great crowds come out to meet the train, selling sarapes, pots, baskets, fruit. To really *see* Mexico, you should use this route at least one way. Summer roundtrip fares, one way via the West Coast Route, are $94.50 from Chicago, $80.30 from New Orleans, $86 from San Francisco, with similar fares from all other cities.

"I've been to Mexico" is an honest, informal account of a trip to Mexico on our West Coast Route. If you would like one of these booklets, write O. P. Bartlett, Dept. C-8, 310 South Michigan Boulevard, Chicago.

Southern Pacific

Iron Fireman cuts fuel costs $464

in the residence of Albert C. Elser, Milwaukee, Wisconsin

Mr. Elser formerly used two kinds of automatic fuel—one for the furnace and another for hot water. Yearly fuel bills averaged $780. . . . Then he installed an Iron Fireman Automatic Coal Burner—replacing the other two automatic burners. Annual fuel cost dropped to $316—a saving of $464 or 59 per cent.

Iron Fireman automatic coal firing actually gives better heating for less money. Ask for a free survey of your present system compared with Iron Fireman firing. The facts may surprise you. Models for homes and for power and heating boilers up to 300 h.p. Quickly installed. Easy terms of payment. Iron Fireman Mfg. Co., Portland, Oregon; Cleveland; Toronto. Dealers everywhere.

See Iron Fireman at Home Planning Hall, Century of Progress, Chicago.

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3125 W. 106th Street, Cleveland, Ohio

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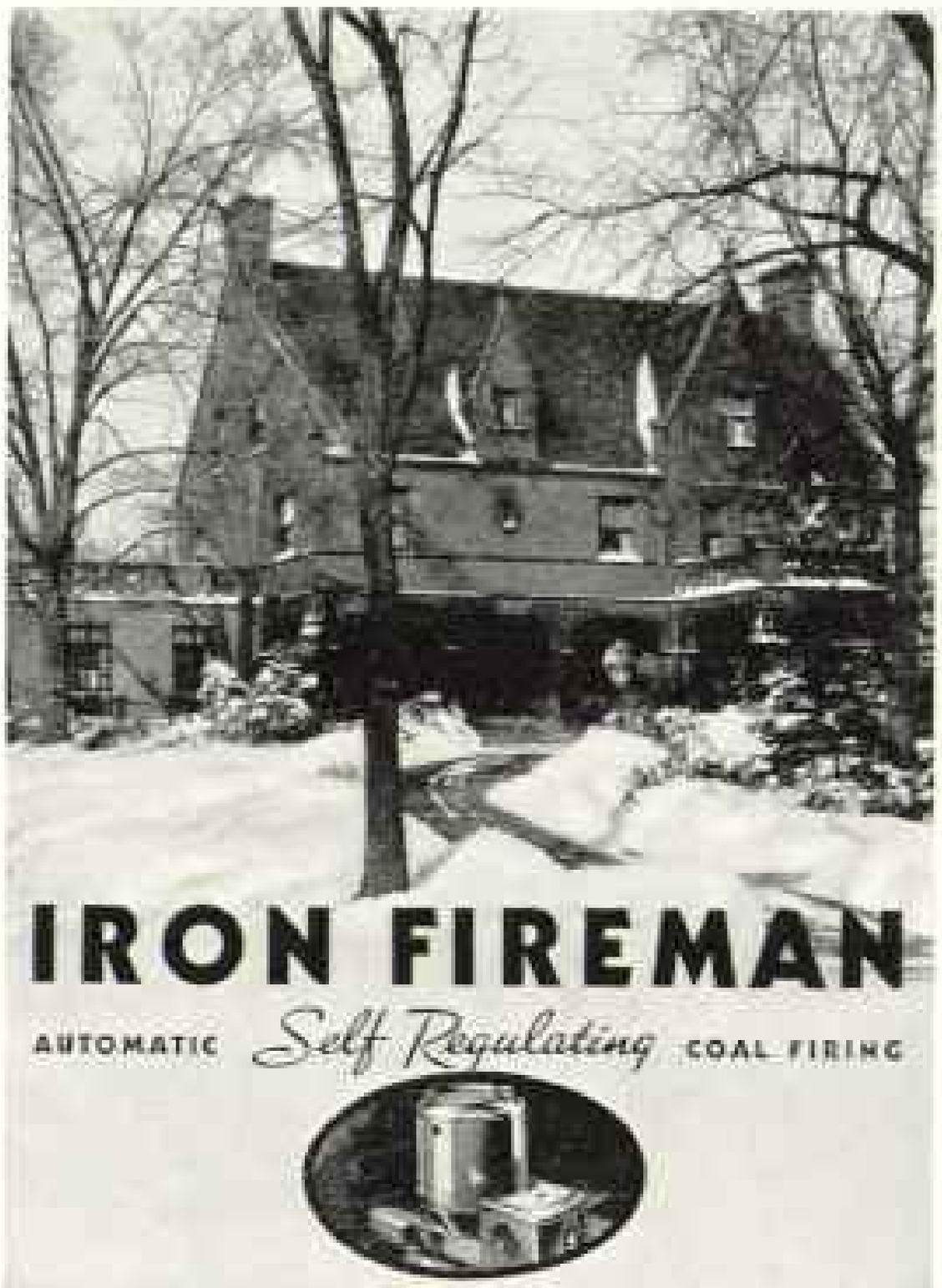

SHARE your sport with those that stay at home. Make *movies*—you'll hardly notice the cost . . .

Ciné-Kodak Eight, Eastman's new-principle movie camera, costs only $34.50, and gives you *finished* movies, ready to show on the screen, for less than 10¢ a "shot." The Eight is sturdy, beautifully made—in every way a full-fledged movie camera. Using it is as easy as taking snapshots. See it at your dealer's—he'll show you sample movies, too.

Stretch the enjoyment of your vacation around the year—with movies. Eastman Kodak Company, Rochester, New York . . . *If it isn't an Eastman, it isn't a Kodak.*

Ciné-Kodak EIGHT

Makes movies for 10¢ a "shot"

In the movie studios of Hollywood, a shot is one continuous scene of a picture story. The Eight makes 20 to 30 such scenes—each as long as those in the average news reel—on a roll of film costing $2.25, finished, ready to show.

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True sportsmen study the habits of game . . . . know where to find them . . . . how to distinguish various species . . . Here are a few companions of field and stream, filled with fascinating tales, authentically presented, wondrously illustrated.

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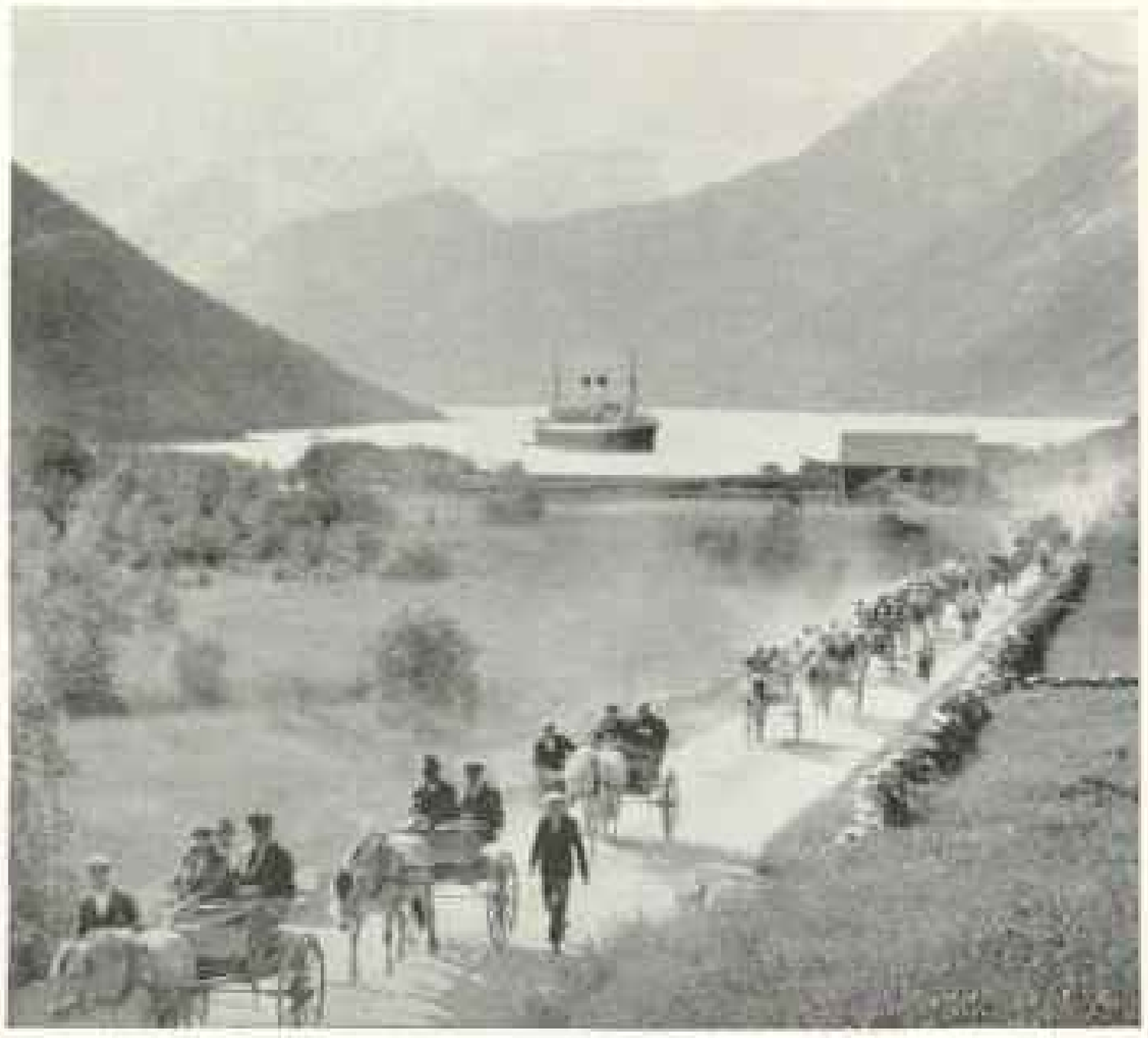

"My vacation trip through New York State was planned from last November's GEOGRAPHIC," writes one member of The Society. Another set off on a cruise to the South Seas after selecting an itinerary from articles in The Magazine. A third member found that the natural history studies of birds, fishes, flowers, and wild animals had increased his capacity to enjoy summer camp life.

To thousands of other members, THE GEOGRAPHIC is an indispensable guide to America's scenic wonderlands, to Nature's amazing animal kingdom, and to the fascination of lands overseas. Perhaps you are one of the many who have used your Magazine in planning vacations at home and abroad.

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