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THE NATIONAL GEOGRAPHIC MAGAZINE

Exploring the Mid-Atlantic Ridge

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Photographs from the Staff of Woods Hole Oceanographic Institution

"WE'RE over the Ridge!"

All hands were tense as the word spread through the little research vessel *Atlantis*, for it meant we had reached our goal. A mile or so beneath our keel stretched the gloom-shrouded peaks, valleys, and ridges of the longest mountain system on earth—the mysterious Mid-Atlantic Ridge, which we had come to explore.

From 300 to 600 miles wide, this mighty submarine mountain range extends nearly 10,000 miles from Iceland almost to the Antarctic Circle. It separates the Atlantic Ocean into eastern and western basins roughly three miles deep (pages 280, 281, and 283).

The range is probably continuous except for a narrow break at the Equator called the Romanche Trench.

From its base on the ocean floor, at a depth of about three miles, the Ridge rears its rugged crest to an average height of 10,000 feet, or a mile below the surface. A few of its peaks actually emerge as the islands of the Azores, St. Paul Rocks (Rochedos São Paulo), Ascension, Tristan da Cunha, Gough, and Bouvet.*

Ever since its discovery 75 years ago, this ocean-covered mountain range of continental size has stirred the imagination of men in many lands. Romanticists inevitably connect the Ridge with the legend of the lost Atlantis, the mythical Atlantic continent which Plato related sank beneath the waves "in a single day and one fatal night."

Though our ship was named *Atlantis*, we had no illusions of solving that age-old mystery story.

In an expedition sponsored jointly by the National Geographic Society, the Woods Hole (Massachusetts) Oceanographic Institution, and Columbia University, we hoped to pierce the veil of hundreds of fathoms of water with our deep-sea camera, probe this dark undersea world with new instruments, map its hidden geography, and bring up rocks and sediments eloquent of its structure and age.

Ridge a Center of Earthquakes

Almost the only earthquakes in the Atlantic Ocean occur along the entire length of the Ridge. The crust of the earth is being deformed and broken on this line of submarine mountains, while the rest of the ocean basin remains undisturbed.

This is perhaps the most definite information we have about the Ridge. It comes from observations made on land thousands of miles away by the world-wide system of seismograph stations, developed during the last 40 years, which continually records and locates all the major earthquakes of the world.

Except for the soundings which have outlined its extent, the Ridge itself is unexplored territory in comparison with mountains on the continents, as is most of the ocean floor.

* See "Our Global Ocean—Last and Vast Frontier," by F. Barrows Colton, NATIONAL GEOGRAPHIC MAGAZINE, January, 1945.

National Geographic Photographer Robert F. Sisson

Atlantis Sets Sail from Woods Hole to Explore the World Beneath the Sea

In the hold of the veteran research vessel, a steel-hulled auxiliary ketch, rests a great winch wound with six miles of ½-inch steel cable; with this she sends to the bottom her deep-sea trawl, rock dredge, and corers for obtaining cross sections of the sea floor (pages 282, 287, and 288). With the same cable, led over the frame on the prow, *Atlantis* has anchored many times in three miles of water. A smaller winch on deck, carrying six miles of 3/16-inch cable, lowers the lighter instruments, including a deep-sea camera (page 293).

This Jules Verne world under the sea forms one of the last great challenging frontiers of geography.

With all these facts in mind, the National Geographic Society had contributed the funds and counsel that made our expedition possible.

Like Flying above an Unknown Planet

As we sailed above the Ridge, I had the strange feeling of being an aviator flying high over an unknown planet tantalizingly hidden from view but outlined on his radar screen. Its peaks and valleys were revealed to us by our deep-sea recording Fathometer. This instrument measures the depth of the water by the time required for the echo of a sound signal—a "ping" like the high-pitched note of a horn—to return from the ocean floor.

By drawing a continuous profile of the bottom at even the greatest depths on our course, our new and improved deep-water Fathometer gave us a great advantage over past oceanographic expeditions (page 290).

It was thrilling to watch the moving strip of recording paper as the level floor of the three-mile-deep ocean basin gave way to saw-

toothed peaks—like climbing into the Rockies from the Great Plains of Kansas.

What did these hidden mountains look like? Of what kinds of rocks were they made? What sediments covered them?

To answer such questions, our expedition had set sail in *Atlantis* on July 16, 1947.

Atlantis is the veteran research vessel of the Woods Hole Oceanographic Institution (page 276). On this ship I had gained most of my experience in scientific work at sea, on a dozen cruises made between 1935 and 1945.

She is a 146-foot steel-hulled ketch, built in Copenhagen in 1930-31 especially for oceanographic work. Diesel engine and 7,200 square feet of canvas give her a cruising range out of all proportion to her size. Her speed, however, is limited to about ten knots.

More Crowded than a Submarine

Two good-sized laboratories occupy the choicest space on the ship, for science comes first and comfort second. Living space, further restricted by the big winch in the hold and the smaller winch on deck, was even more crowded than that on a submarine. We carried a crew of 18 headed by Capt. A. K. Lane, late of the U. S. Coast Guard, and 10 assorted scientists, some of whom slept on deck in good weather to relieve the congestion below.

After two days of sun and bright blue sea, the little ship hit heavy weather. When she struck a big sea at just the wrong angle, she seemed to stop dead.

Soon, however, the skies cleared, an occasional silvery flying fish landed on deck, and between oceanographic duties some of the men took a dip over the side in 80° water, keeping a wary watch for sharks and the big poisonous jellyfish called Portuguese man-of-war. We were in the Gulf Stream.

Dr. Lyman J. Briggs, Chairman of the Research Committee of the National Geographic Society and former Director of the National Bureau of Standards, accompanied us as far as Bermuda. He was an inspiring shipmate.

On our second day out we made our first water temperature and salinity measurements, the 3,603d such Hydrographic Station made from *Atlantis* during her 17 years of oceanographic work.

Each is insignificant in itself, like individual weather-station observations, but all form part of a great picture which gives man better understanding of the waters, winds, and weather of his globe.

Bottles for collecting water samples for chemical analysis were fastened at intervals to a wire and lowered over the side. When the bottles were at the desired depths, a small weight called a messenger was sent sliding down the wire, causing all the bottles to close.

Deep-sea thermometers attached to each bottle were inverted at the same time, breaking the mercury thread in such a way that the water temperature could be read upon return to the surface (page 292).

A dozen or so bottles are usually lowered at a time to learn how cold and salt is the water at as many different depths.

Creatures of Darkness Sink by Day

At the same time we generally made net tows to learn the concentration, at various depths, of the tiny plants and animals called plankton.

Some of these organisms spend their life in perpetual twilight, going down by day to avoid the light and coming up near the surface at night. We towed our silken nets for them every night at 2 a.m.

So incredibly numerous are such sea creatures that this layer of ocean life actually returns an echo of the sound sent down by the Fathometer. The echo from this so-called "scattering layer" is sometimes so strong that it causes navigators to think they are sailing over a shoal (page 290).

Five days after we left Woods Hole, *Atlantis* tied up to a mooring in St. George's Harbour, Bermuda, being denied the privilege of docking because of the ton of TNT we carried for scientific use. When this was removed to a storage magazine next day, *Atlantis* was welcomed into polite society.

Our approach to Bermuda and our departure were depicted strikingly on the trace of the recording Fathometer. It revealed the island as a great submarine mountain rising abruptly from the depths of the ocean. This majestic topography showed itself as clearly as if we had been flying over it on a day of good visibility.

Sea Mount Tells Surprising Story

Northeast of Bermuda, on our way to the Ridge, we investigated a sea mount found in 1945 by the U. S. Navy destroyer escort *Muir* while making a transatlantic passage to drop bombs to be heard by our Navy's SOFAR station in the Bahamas.*

* SOFAR (Sound Fixing and Ranging) was invented by Dr. Ewing during World War II while working at the Woods Hole Oceanographic Institution under a contract with the Bureau of Ships, Navy Department. It is based on the fact that a small bomb fired at the right depth (2,000–4,000 feet) may be heard by hydrophones, also at the right depth, even across the entire width of an ocean. By triangulation, the spot at which the bomb is exploded can be determined within about a mile. One of the practical uses of SOFAR is location of aviators forced down at sea.

Don Fax

Boom! A White Geyser Shoots Up as a Towed TNT Bomb Probes the Ocean Floor

Down goes the sound, through miles of water. Quickly the man casts off slack on the line towing the hydrophones, so these sensitive "ears" will be quiet in the water when the echo returns from the bottom in six to ten seconds (next page). Such tests were made hourly during much of the voyage.

From the ocean floor three miles below the surface, this flat-topped mountain rose gradually and then more steeply to a height of about two miles (map, pages 280-281). At a point near its center we decided to try to get a sample of the bottom (pages 288-9). The depth was 841 fathoms, or about a mile.

Using our big winch and cable, we lowered a coring tube. This steel pipe, 2½ inches in diameter and about 10 feet long, brings up samples of the ocean floor just as a housewife cores an apple. A hardened-steel cutting edge was screwed on the bottom of the tube and about 1,000 pounds of lead weights were attached to the top to drive it into the bottom.

To penetrate far, this tube must fall freely during the last part of its descent. Accordingly, a trigger hangs several feet below the end of the tube. When the trigger touches bottom, it releases a clamp holding the coring tube to the wire and permits a free fall.

Core Spans Millions of Years

To our astonishment, when we examined this core later in our laboratory at Columbia University it was found to have spanned millions of years. It contained two distinct layers.

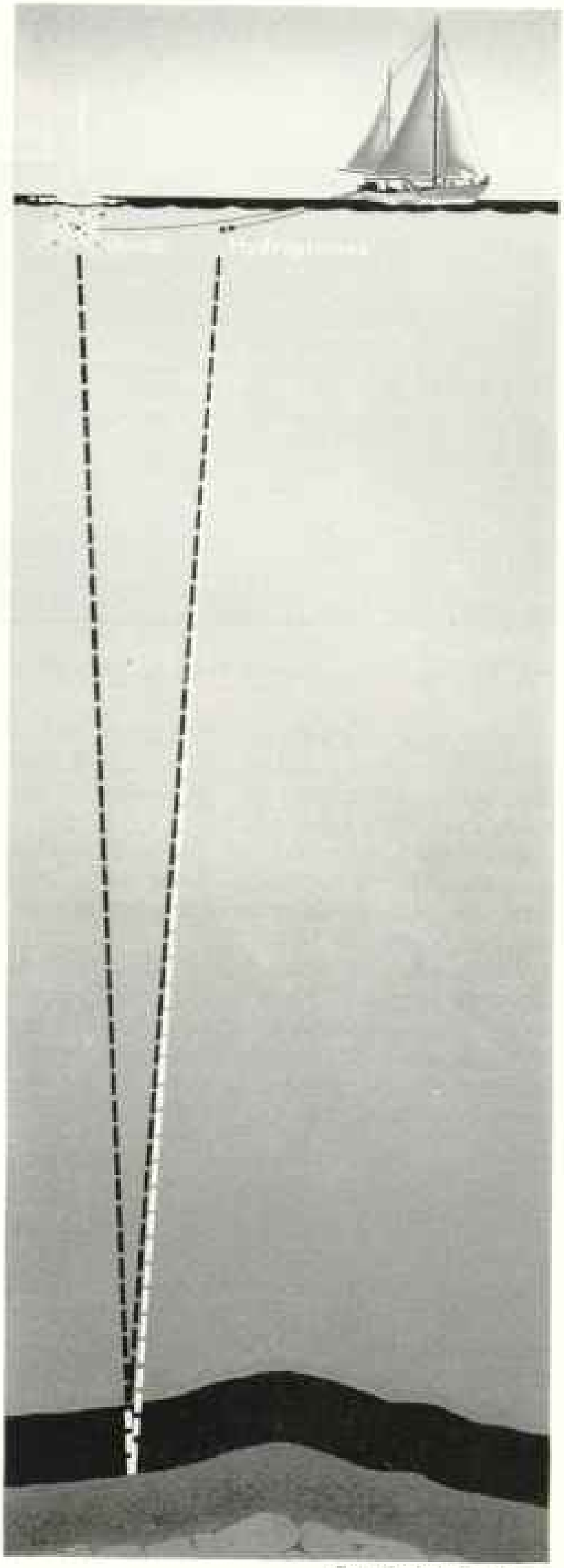
The top eight inches proved to be a recent deep-sea sediment typical of all the ocean bottom far from land where the depth is less than 2,500 fathoms (nearly three miles). This sediment, called globigerina ooze, was dark cream-color and coarse grained, being rich in shells of the one-celled marine organisms called foraminifera.

The remainder of the core was white and much finer-grained. Study showed it to be a fine-grained chalk containing foraminifera of Eocene age.

This meant that an interval of 60 million years had gone by between the deposition of the chalk in the bottom of the core and the top eight inches of ooze and added greatly to the mystery of the origin and history of the sea mount.

So far as I know, this is *the first time that sediments older than a few thousand years have been recovered from considerable depths in any ocean basin.*

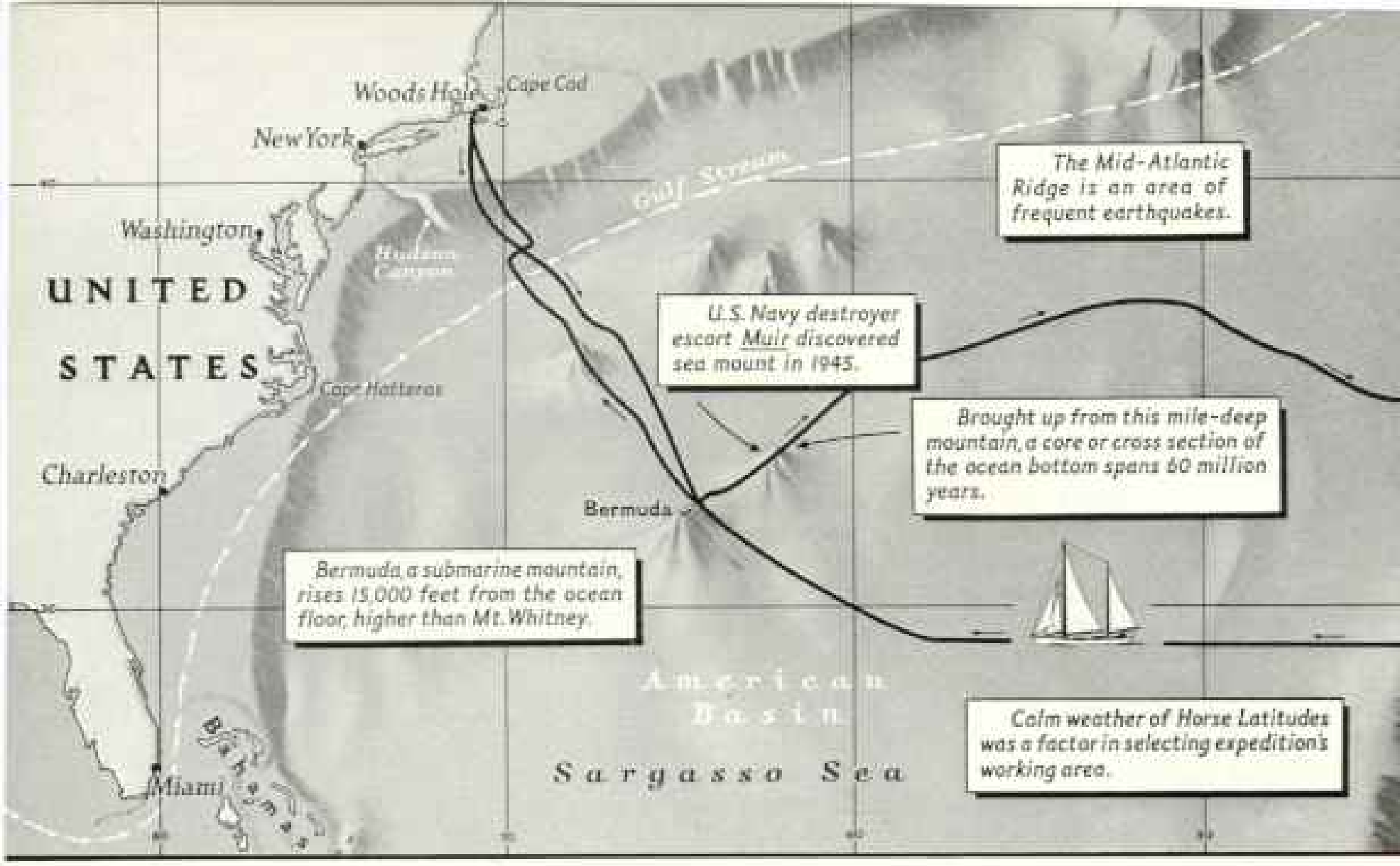
Our discovery of open-ocean sediments of Eocene age on a sea mount near Bermuda, far to the west of the Mid-Atlantic Ridge, is hard to reconcile with the Wegener theory of the formation of the Atlantic Ocean. According to that theory, advanced by the late German scientist Alfred Wegener, the Atlantic Basin was formed by the "drifting apart" of the continents upon the molten interior of the earth, and the Atlantic Ocean in



Drawn by Irvin R. Abelman

Back from Bottom Comes an Eloquent Echo

A sediment layer more than 500 feet thick gives a "double echo." The difference in time between the two echoes indicates its thickness (page 280). To show to scale this depth of 2¾ miles, the page would have to be 7 feet long.



The National Geographic Society Helped Explore 10,000 Square Miles of Ocean Bottom

Eocene times was only a very narrow rift in the vicinity of the Ridge. Our core showed that this western part of the Atlantic was ocean even that long ago.

The *Muir's* discovery of this and another sea mount north-northeast of Bermuda suggests that perhaps many more mountains exist along a general trend.

The gentle rise which led us to the mount extended out some 20 miles. Thus it should not be necessary to pass directly over the top of a mountain to find it. Its presence can be detected and the direction to the summit learned within a radius of 20 miles.

"Great Plain" Crossed for 2½ Days

About midnight on July 27 we entered a great plain at 2,900 fathoms, and this we crossed for the next two and a half days. Here we received another surprise as we fired TNT bombs to test the thickness of bottom sediments (pages 278-9).

Incidentally, the hydrophones that catch and record the echo from the bottom are so sensitive that the sound of rushing water from being towed or a fish biting the towing cable will ruin the test. Several times, after such a failure, I have found a fish's tooth imbedded in the cable and the insulation ruined.

If the topmost layer of sediment is thicker than 500 feet, hydrophones record two distinct echoes—one from the top of the sediment layer and the other from the rock or hard clay beneath it. If the sediment is thinner than 500 feet, these echoes reach the hydrophones too close together to be distinguishable.

From a point about 385 nautical miles northeast of Bermuda to a point about 945 miles west of the Azores, our tests showed no double echo. These results, which we carefully checked, meant that for at least 320 miles the sediments on the deep ocean floor must be less than 500 feet thick.

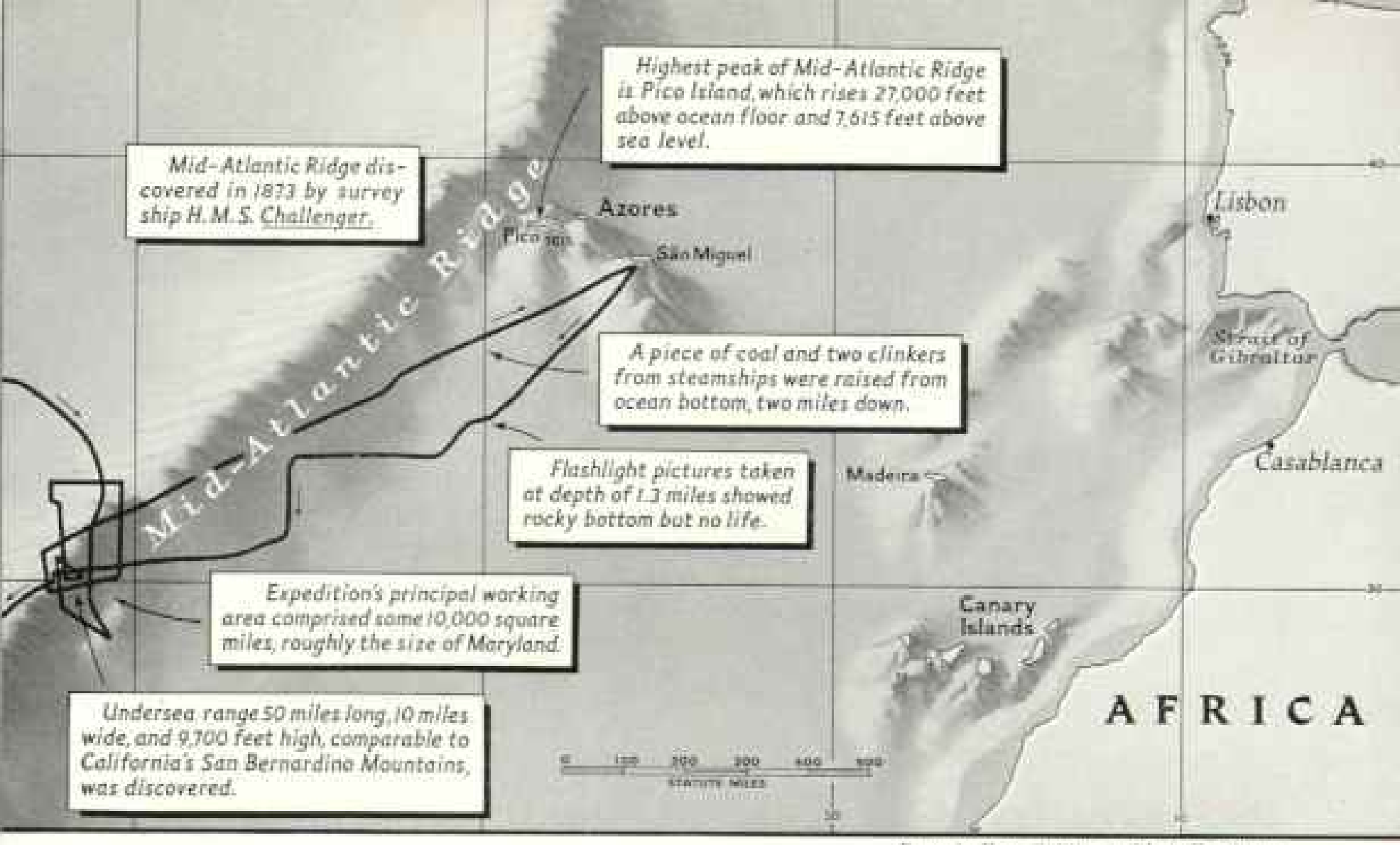
This discovery was surprising, because the bottom of the deep ocean is thought by most geologists to be covered with a great and uniform thickness of sediment—thousands of feet—which has accumulated upon it like a steady undrifted snowfall since its formation and which remains forever undisturbed.

At about 2:30 p.m. on July 30 the great flat plain at 2,900 fathoms showed its first interruption, a rise of 100 fathoms, but the depth dropped back to 2,900 in 20 minutes. At 4:30 another little hill appeared, and after that no hint of the plain recurred. Instead we crossed rugged topography gradually rising toward the Ridge. Here our bombs produced a double echo for the first time in more than 300 miles, indicating thick sediment again.

On the Ridge and Cleared for Action

When at last we reached our working area over the Central Highland of the Ridge we were almost exactly in mid-ocean, 1,650 nautical miles east-southeast of New York City and 1,680 miles west of Casablanca, on the Moroccan coast.

We had chosen this area because charts showed the bottom to be about as rough as any on the Ridge and because it lies in the



Drawn by Harry S. Oliver and Irvin E. Allaman

New-found Undersea Mountains Yielded Telltale Rocks and Sediments

calm of the Horse Latitudes where good working conditions could be expected.

To get acquainted with the mysterious world of mountains beneath these waters, we first made a series of runs back and forth across the Ridge with our Fathometer probing its hidden contours.

Would the Ridge be just a chaos of peaks or would it follow some understandable pattern? Upon the answer to this question much of the success of our expedition would depend.

At first the topography seemed the wildest confusion, but as we studied more and more profiles a definite pattern began to emerge. We found that we were able to predict when certain types of bottom would be encountered. For instance, on the flanks of the Ridge strangely flat terraces were often followed by abrupt upward slopes.

A steep slope, where sediments could not accumulate, seemed the most promising place to get rocks.

For the first attempt I chose the slope of a steep hill which rose more than half a mile from a depth of 1,900 fathoms, or about two miles.

Decks had been cleared for action by throwing overboard the cramping deckload of now empty oil drums, and we unlimbered our "big gun," the deep-sea rock dredge (page 282).

Groping for rocks in deep water with a metal bag on the end of two or three miles of wire stands out as one of the hardest tasks of the submarine geologist, even when he attempts only to hit bottom at random.

Because of winds and currents affecting the ship, the wire does not go down vertically. Hence, a length of wire considerably greater than the depth of water must be used. How much is needed can only be estimated. There is urgent need, which we hope to meet, for a dredge and trawl cable containing an electrical conductor such as is used in "logging" oil wells. This would enable the dredge or trawl to send up automatic signals telling how deep it is and when it hits bottom.

If too much wire is put out or if the right amount is put out too quickly, the slack on the bottom may cause kinking, breaking the wire and losing the instrument. If too little wire is put out, the dredge fails to reach bottom and all the time—at least three or four hours—is wasted.

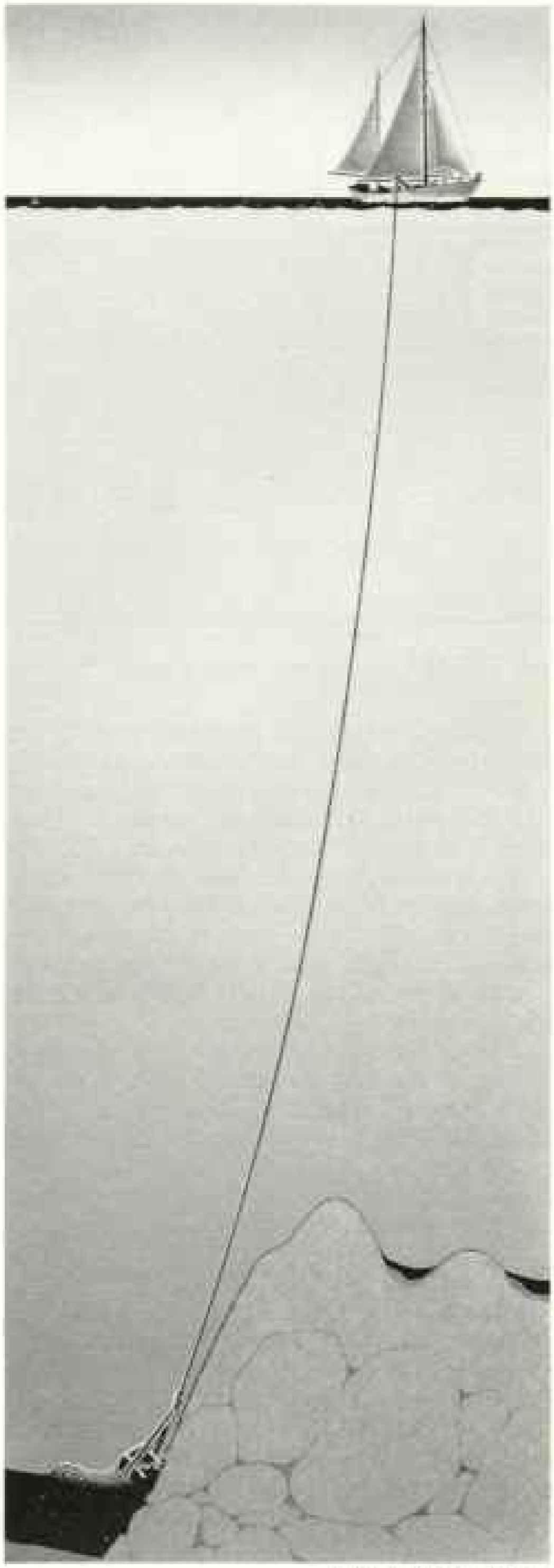
"Pinpoint" Dredging Two Miles Down

Attempting to hit a target with the dredge greatly increases the difficulties, since the ship must remain stationary despite the currents and winds of the open sea.

The stories the rocks can tell are hidden unless we know the places and elevations from which they come. Accordingly, I decided to take what military men call a calculated risk and try "pinpoint" dredging.

Well I knew that an error or wedging of the dredge in some rocky crevice below could mean loss of the equipment and a serious setback to the expedition. I felt a bit tense as I gave the order to lower away.

Lowering or raising the deep-sea instruments is a noisy as well as exciting process.



Drawn by Irvin E. Albosan

Steep Slopes Gave Best Hauls of Rocks

Rocks from the Ridge shed light on its origin—just as a geologist in the Rockies can study a bit of rock and say it was once below sea level because it contains shells, or that another bit once flowed as lava from the depths of the earth (page 285).

The big winch makes a mighty rumbling, and the heavy cable snaps into hollows on the drum with loud reports that seem to shake the whole ship.

Although a gauge indicates the strain on the cable, the dredge's weight is so slight compared with that of two or three miles of wire that the gauge gives no clue as to when the dredge strikes bottom. The curving wire, miles long, strung out astern acts like a spring, and the jerks when the dredge hits bottom cannot be transmitted up it. One can only make an "educated guess" in the light of Fathometer readings and previous experience.

In this case, when we raised the dredge it showed no sign of having touched bottom. All it contained was a doubtless surprised resident of the sea—one large red tunicate with an array of short rubbery tentacles. This seemed a rather slim reward for 4 hours and 17 minutes of effort!

Swallowing our disappointment, we went through the whole process again, except that this time we lowered a coring tube instead of the dredge, first on the top of the hill and then on the plain from which it rose. Both times the corer brought up only the soft cream-colored globigerina ooze.

A good breeze now came up, and for the next two days we saved precious oil by traveling under sail as our Fathometer constantly revealed new mountain profiles.

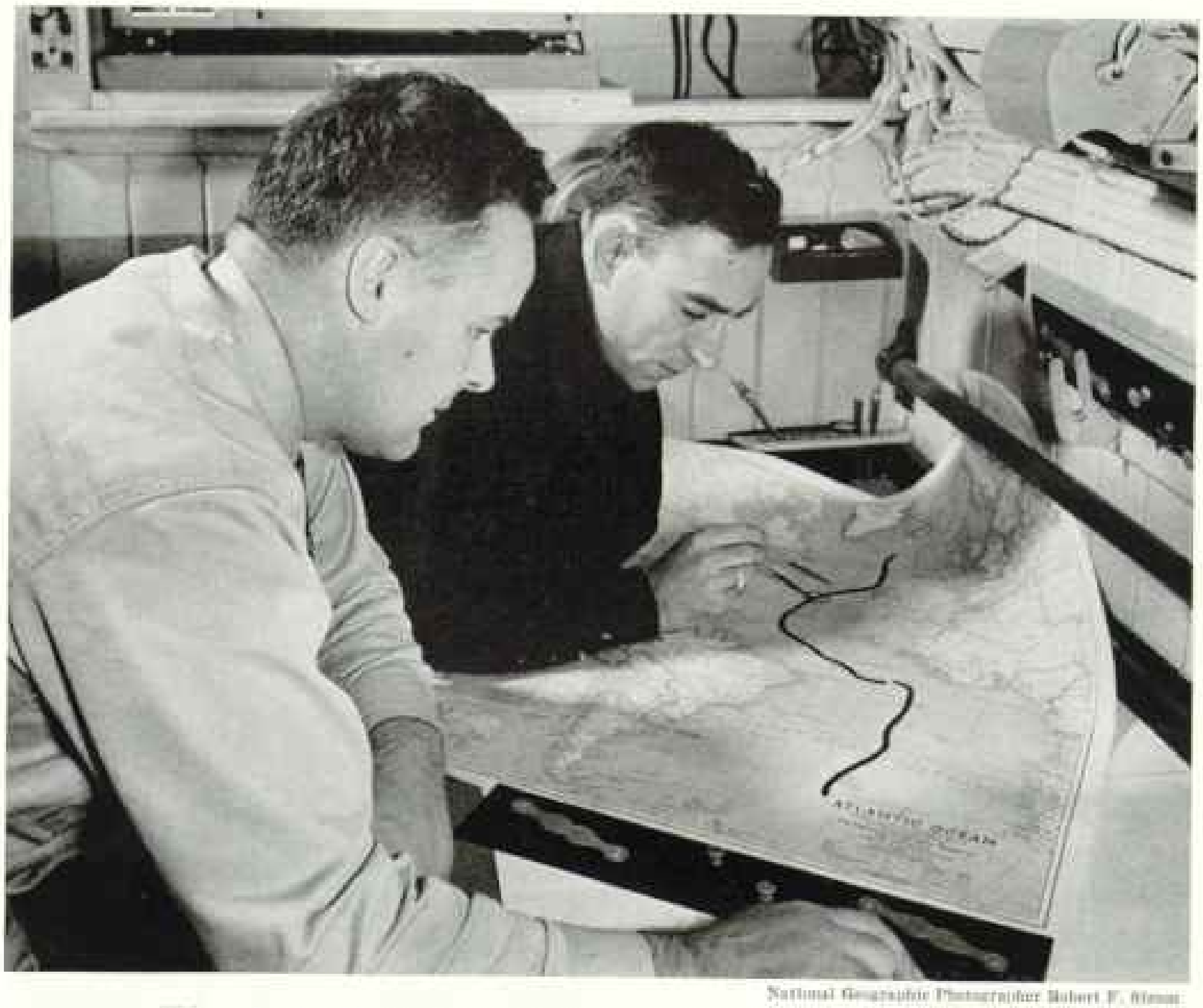
Like a Sledge Hammer Hitting the Hull

To take full advantage of the fuel saving, we made our TNT bomb tests of the bottom sediments without stopping the ship. This was successful, though hard on the muscles of the men who had the job of hauling the hydrophones back aboard against the drag of the wake.

"Seismic stations now take only ten minutes," wrote Assistant Henry McKean in his diary, "but they have now taken to exploding the TNT nearer the ship and it sounds as if someone had hit the hull with a sledge hammer."

During this run I had my first accident with explosives in the 20 years I have been constantly using them in geophysical research. On one of the night seismic shots the one-pound TNT charge was loaded and thrown over the side. Although given the prescribed 300 feet of slack, it fouled and remained only two feet below the rail of the ship where I was standing.

Without knowing this, I fired the charge; but my habit of putting my ear to the opposite rail to hear the echoes return from the bottom kept me out of harm's way. The



National Geographic Photographer Robert F. Sisson

"Here in the Horse Latitudes We Ought to Have Good Weather"

In the chartroom of *Atlantis*, Capt. Adrian K. Lane (right), her skipper, and Oceanographic Technician Carl Hayes look over a National Geographic Society map of the Atlantic Ocean on which the Mid-Atlantic Ridge has been roughly drawn in black ink. The circle shows the expedition's approximate working area in the region of calms and variable breezes called the Horse Latitudes.

explosion broke glass and waked all sleepers, but the only other damage was a slight dent in the hull.

Deep Trench and Lofty Mountain

As we crossed and recrossed the Ridge, our Fathometer outlined many a spectacular mountain and valley, but on August 7 it outdid itself (page 290). It showed that below us lay a sharp-bottomed valley about ten miles wide and an average of more than 2,350 fathoms deep, immediately followed by a mountain whose crest rose to 740 fathoms.

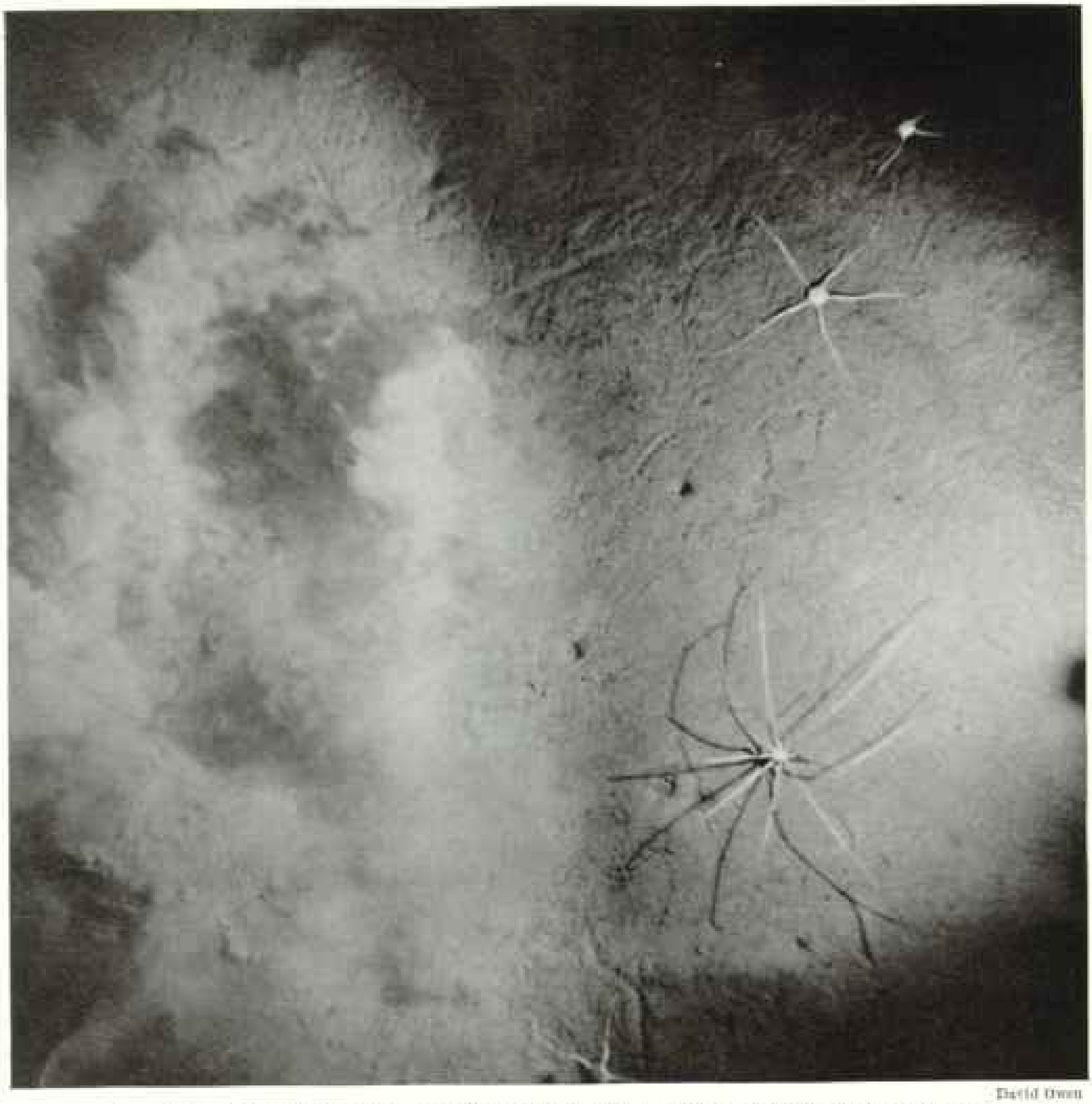
Thus the mountain rises some 9,700 feet from the trench at its foot to its crown, or higher than the mighty Matterhorn above Zermatt, Switzerland. Its slope had a gradient of roughly 1 in 6. Realizing that this was an extraordinary feature, we took a position above the valley at the foot of the slope where the depth was 2,600 fathoms, or almost three miles, and went to work.

First we sent down the Hough coring apparatus, but a heavy swell from a storm to the northward made it hard to judge when the corer hit bottom, and it came up empty. Later we sent down the heavier Stetson corer, but it, too, returned to the surface without having hit.

Darkness had fallen, but we still worked on. Away out here in the middle of the Atlantic it seemed strange to see a little Leach's petrel which fluttered about aloft in the shadows cast by our working lights. This petrel generally shows little interest in ships.

At 2 a.m. we sent down the Stetson corer again, for we were determined to get results from this interesting spot on which we had already spent seven hours with no results.

This time the corer struck bottom. Though badly damaged from striking rock, it had not come back empty.



David Owen

Sea Stars Crawl the Ocean Floor More than a Mile Beneath the Waves

Where no living man has ever gone, the deep-sea flashlight camera reveals the life of inky, ooze-floored depths. Previous information about the *Pycnogonid*, or sea spider (lower right), came only from dredged specimens, and drawings have shown the creature with its feet all bunched under it instead of spread, as here. Above it are brittle stars. The swirl of mud is caused by the trigger of the camera hitting the bottom. A hook and line were attached in hope of catching deep-sea fish. This picture was taken in 3,850 feet at the bottom of the Continental Slope about one-third of the way from Cape Cod to Bermuda.

Under a core of only a few inches of sediment was a freshly broken bit of rock about one inch in diameter. This rock was plainly igneous—crystallized from a molten condition, like granite and many other familiar rocks. Geologists call this rock olivine gabbro.

The core above the rock was not the usual deep-sea sediment, but material resulting from chemical and mechanical breakdown of the gabbroic rocks.

The outside of the tube was deeply scarred along its lower four inches, and it had required great force to pull it clear of bottom. This probably means it had entered a crevice between boulders.

Greenish Rocks from Submarine Peak

Now, having probed the deep abyss, we wanted a core from the top of the mountain which towered so high above it. Moving to a point above the summit, we sent down the Hough corer in some 800 fathoms. It came up empty and completely wrecked, apparently by striking rock. We decided to try the rock dredge.

Don Fay

"Look! Shrimp, Fish with Long Feelers, Shells, Sponges"—and a Lump of Coal!

As the deep-sea trawl is emptied, expedition members crowd around for a view of what one of them called "a fascinating load of everything you could imagine." The man at left holds a piece of pumice. Sponges, starfish, brittle stars, and gorgonians are being transferred from net to tray. This rich haul came from about two miles deep on the Mid-Atlantic Ridge near the Azores. Surprisingly, it included clinkers besides the piece of coal. Were these from some "Pittsburgh" of the lost Atlantis? No, just a steamship—perhaps one that sank.

Three hours of effort were rewarded by complete success. The dredge brought up from 850 fathoms about 100 pounds of greenish rocks which likewise had crystallized from a molten state. Prof. S. J. Shand, of Columbia University, has identified the rocks from various hauls as crushed anorthosite gabbro, with also much serpentine and basalt.

For comparison with the mountaintop rocks we next tried for some from the bottom of the abyss, sending down the dredge this time in 2,340 fathoms. It brought up 400 pounds of basalt rocks, many of which show glassy surface and the typical "pillow" structure resulting from quick cooling of lava under water. This is one of the deepest hauls of such a size ever made (page 282).

Having been continuously on station for 24 hours, we decided to run north a day and then back to the trench, studying topography and giving our men a chance to rest. Before midnight, however, we made a TNT seismic test, which showed no sedimentary layer thick enough to be measured by that method.

The indicated absence of thick deposits here checked with results of our coring and dredging and gave us considerable satisfaction.

Don Ewing

An Extraordinary Discovery—Eocene Rock 60 Million Years Old

Dr. Ewing examines a black-and-white rock from the foot of a cliff on the flank of the Mid-Atlantic Ridge. The chalky rock itself is white, but much of it is covered by a black manganese deposit. Unlike most of the rocks from the Ridge, born amid great heat and pressure, this one was formed by slow deposition of shells from tiny creatures of the sea. Geologists know at what periods various types of these creatures lived and can thus determine the geological era in which the deposit was formed.

Apparently the steepest slopes along the rugged spine of the Ridge were almost if not entirely free of sediment. Their rocks lay virtually bare for us to hit, fish up, and study.

Before our expedition, this had not been known, and the possibility had existed that the whole Ridge might be so deeply "snowed under" with sediment that its rocks could not be reached and raised to tell their story.

The more we explored this mountain and trench the more their magnitude impressed us. The mountain measures 50 miles long, 10 miles from side to side, and nearly 2 miles high. Thus it is roughly comparable to the San Bernardino Mountains in southern California.

The combination of steep slope and deep ditch suggests that the feature may be a fault scarp and rift valley—a zone of slippage between earth masses—and that earthquakes may have occurred there in historic times.

Swimmers Keep Close Watch for Sharks

The bottom on August 9 showed several flat stretches which we found typical of the flanks of the Ridge. These terraces were some 15 miles across and 2,000 fathoms (about 2¾ miles) deep, with higher rugged ground between rising to some 1,300 fathoms, or about a mile and a half.

In midafternoon we passed over a little hill rising to 1,400 fathoms and falling abruptly to 2,100 fathoms. Its steep slope was so tempting that, despite our exhaustion, we decided to dredge it.

During the lowering some of the men had a swim. The water was very clear, but cooler than that of Bermuda—76° compared to 84. We let only one man in at a time, so he could get out quickly if sharks appeared.

These ugly customers were frequently in evidence. Shortly after the last swimmer emerged one of the men lost a sneaker overboard. It was promptly rushed at by a large hammerhead shark, just as a man was getting ready to dive in after it.

As Henry McKean observed in his diary: "The dredge made a great fuss coming up, bumping along the bottom and swinging the ship completely around several times. The strain on the wire went up by jerks as great as 1,000 pounds."

Don Eno

"Lower Away!" The Trawl Descends to Bring Up Life from Lightless Depths

Lowering and raising the big metal-mouthed net for some of the deepest fishing on record required three or four hours. Often it contained weird, snaky-bodied predators. Richest haul of the expedition was made in 1,770 fathoms (about two miles) on the Azores side of the Mid-Atlantic Ridge (pages 285 and 289).

Don Pitt

To Cap a Core He Climbs the Cabin Top

Henry McKean, assistant, seals a ten-foot plastic tube full of sea-floor sediment. This was the liner of a coring tube lowered by *Atlantis* and rammed into the ocean bottom by heavy weights (next page).

The load consisted of several hundred pounds of rock, all heavily coated with the black manganese deposit frequently found in the deep sea, in striking contrast with the rocks of previous hauls, which had been perfectly clean.

Beachlike Terraces Two Miles Deep

A rather wild idea had led us to devote four hours to this particular rock dredging. Our hypothesis was that the long, level terraces, with sediments ranging up to 3,000 feet in depth, were submerged shore lines. If so, the steep cliffs rising from them should have boulders at their bases as do wave-cut cliffs on our shore lines today.

It is, of course, extremely radical speculation to identify these level stretches more than two miles below the sea surface as former beaches. Such a theory would require the obvious but almost incredible conclusion that the land here has subsided two miles or else the sea has risen by that amount.

Much work will have to be done before this startling theory can be proved or disproved. In any case, we were encouraged to find that at the bases of cliffs above such terraces rocks could readily be obtained.

A spotlight that evening showed that the water near the surface teemed with life. Jellyfish abounded, and in the clear water many small fish with red and green jeweled eyes were darting about, chased by a few small squid and one large one.

On one haul we found in the dredge a wicked-looking deep-sea fish. Huge mouth and snaky body made this predator of the inky depths seem like a creature out of a nightmare.*

Days were never dull. Once we sighted a waterspout, like a dark, ominous finger whirling over the sea. A large piece of blubber from a dead whale came floating by, and we saw that it was bobbing up and down from the ferocity of the fish feeding on it. Sunsets were frequently beautiful, with great sweeps of red cloud.

Trawl Yields 200 Species—and Coal!

Our fuel was now running low, and instead of returning to Bermuda for more we decided to head for the Azores, examining the Ridge all the way.

When we sent the Blake trawl to the bottom in 1,770 fathoms (about 2 miles), it brought

* See, by William Beebe, in the National Geographic Magazine: "Half Mile Down," December, 1934; "Depths of the Sea," January, 1932; "Wonderer Under Sea," December, 1932; and "Round Trip to Davy Jones's Locker," June, 1931.

National Geographic Photographer Robert F. Sisson

In Their Woods Hole Laboratory Scientists Study a Core, or Cross Section, of Sea Floor

On the table lies a plastic liner split open to expose the core for examination. "A core that appears to be nothing but 'sandy' mud to the naked eye is material of the greatest beauty when seen under a microscope," observes David Ericson, here describing some of his findings to an assistant. "The sand turns out to be composed of the shells of foraminifera of many different forms. Some are like little rosettes; others are clusters of spheres." Such creatures reveal changes in the sea in ages past (pages 279 and 294).

up a large and varied haul comprising some 200 species of deep-sea creatures. McKean aptly called it "a fascinating load of everything you could imagine—shrimp, fish with long feelers, shells, sponges, and what not."

Dr. Louis W. Hutchins, of the Woods Hole Oceanographic Institution, says this haul affords "one of the most striking examples of the diversity of living organisms that can be found, at least on occasions, at moderately great depths." He adds that "the richness of the haul is probably ascribed to a lucky sampling of one of those exceptionally productive spots which apparently are scattered over the ocean bottom" (pages 285, 287).

Although the net contained a few deep-sea fish, most of the larger bottom forms were siliceous and horny sponges. Mixed with them were many rounded pieces of the light volcanic glass called pumice, often used for smoothing and polishing.

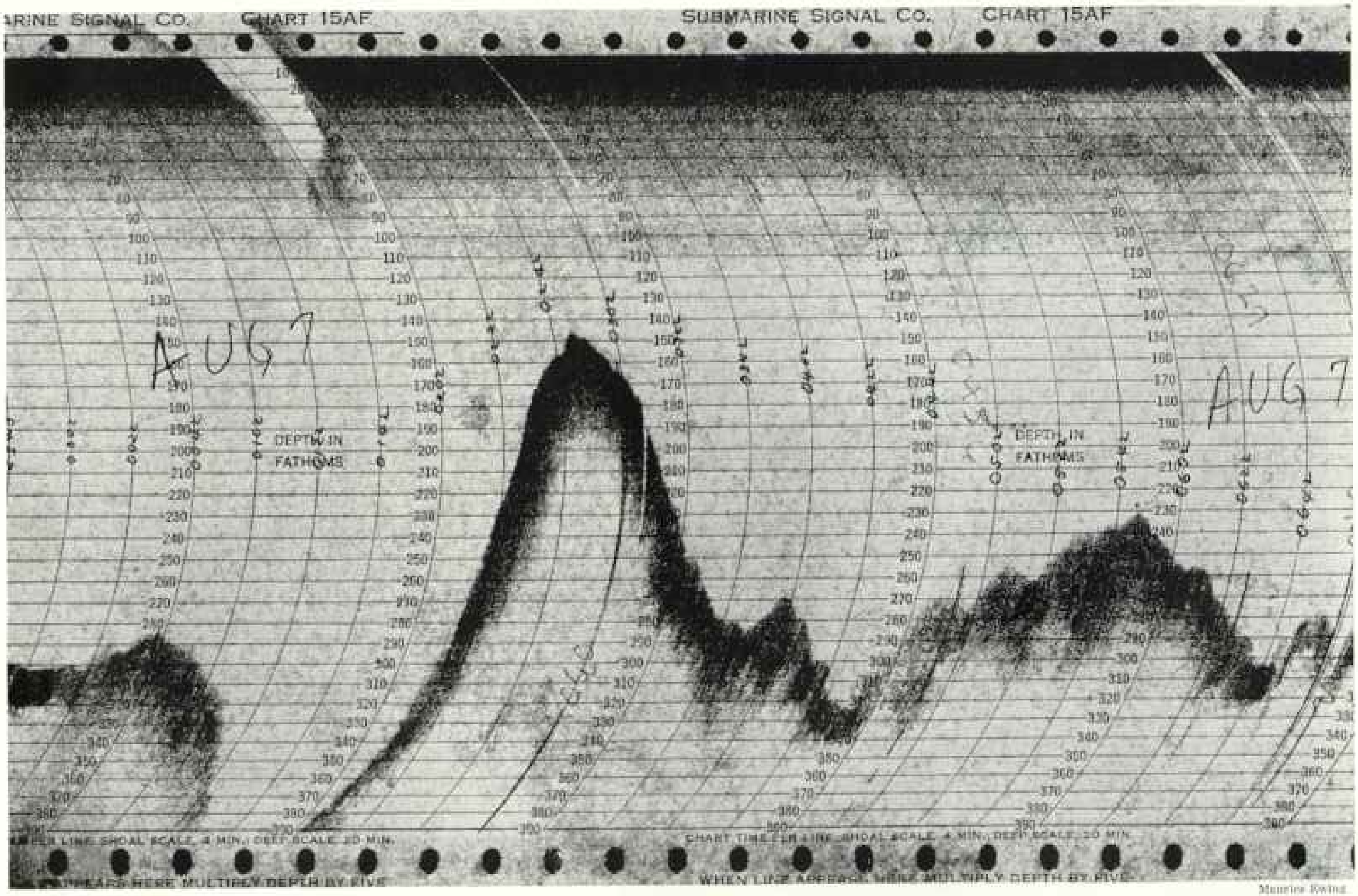
When the net was emptied, out fell a chunk of a black, familiar-looking substance.

"Why, it looks like coal!" someone exclaimed.

It *was* coal—from two miles down in the ocean! But its presence there was not so surprising as it might seem at first. We were now on the steamship lanes fanning out from the Azores. It must have come from a vessel. Two large clinkers found in the net confirmed this prosaic explanation.

It seemed strange, after days of studying the Ridge at depths of one or two miles and more, to stand on one of its highest peaks, the island of São Miguel, largest of the Azores.* Its volcanic nature was plain, and its rocks were akin to those our dredge had

* See, in the National Geographic Magazine, "American Airmen in the Azores" (10 illustrations from photographs in color), February, 1946; and "European Outpost: The Azores," by Harriet Chalmers Adams, January, 1935.



Maurice Ewing

A Two-mile-high Undersea Mountain Looms above a Deep Trench in a Dramatic Profile Drawn by the Echo-sounding Fathometer (P. 283)

The mountain is 30 miles long, 10 miles wide, and nearly 2 miles above base of trench at left, bottom of which is shown by white area at top because of change in Fathometer scale. This trace exaggerates steepness. Note dark areas near surface—strongest at night—caused by echoes from a dense layer of darkness-loving creatures (page 277).

raised from its sister hills deep in the sea.

Diesel oil for our thirsty engines was unavailable. When we sailed on August 20, *Atlantis* was burning bunker oil and smoking like a coalburner. Everything and everybody soon became grimy. Our new white sails began to look like waste from the engine room.

Poor oil and head winds slowed us down and limited our time on the Ridge, but we wanted another chance or two at the big mountain and valley which stood out as the expedition's chief discoveries. As we steamed above them, the Fathometer again drew their huge and familiar features.

Rock dredging on the north slope of the gorge in 1,700 fathoms (about 2 miles) produced a wonderful haul—some 400 pounds of rock and clay. The clay was not a typical ocean-bottom deposit but contained many angular fragments, probably pulverized material resulting from the slipping of great rock masses along a fault, or crack, in the earth's crust.

These fragments tended to confirm our theory that this was a fault area, a center of earthquakes. The rocks—basalt, serpentine, and diabase—were all igneous and metamorphic (altered by heat, pressure, and water).

Following the deep gorge westward, we dredged again, this time in 2,300 fathoms (about 2⅔ miles). The haul was mostly serpentine, but it included a strange specimen, a mass of tremolite asbestos with strands six inches long.

This kind of asbestos is of different composition from the asbestos of commerce, which is mostly a fibrous form of serpentine. The fibers of tremolite asbestos are usually too short and weak to permit spinning or weaving for the manufacture of fabrics and packing. It is used, however, in molds or blocks, chiefly in the building trade. Such rock is generally considered typical of continents and not of ocean basins.

Four Kinds of Undersea Geography

Our allotted time on the Ridge was now gone, and on August 30 we headed for Bermuda and home. In general, luck had been with us. Every "tool" we had tried had worked.

In a total of 25 days on the Ridge we had cruised over approximately 10,000 square miles of these mid-Atlantic mountains, an area roughly equivalent to that of the State of Maryland.

We had found four distinct types of submarine geography in the part of the Ridge explored. These may now be summarized for the first time.

On the western side of the Ridge stretches the great plain of the American Basin. It is very level and 2,900 fathoms (about 3½ miles) deep. Here no sedimentary layer could be detected by our bomb-and-echo tests.

The American Approach to the Ridge is rough, with gradual change in depth from 2,900 to 2,200 fathoms. Bomb tests showed a thick sediment layer—1,000 to 2,000 feet—in about three-fourths of the cases; none in the others.

On the American (western) Flanks of the Ridge lie level stretches, 2 to 20 miles broad, like terraces or beaches. We found these at six different levels, from 2,200 to 1,800 fathoms. Our bomb tests over such stretches always showed thick sediments, ranging up to 3,000 feet. Rough higher ground often separates successive terraces, and occasional isolated peaks punctuate this part of the Ridge.

The Central Highland of the Ridge ranges in depth from 1,800 to 700 fathoms (about two miles to four-fifths of a mile). Its topography is always rugged with never a flat stretch. Here, as on the great plain, no sedimentary layer was detected by bomb tests.

First Big Haul of Rocks from Ridge

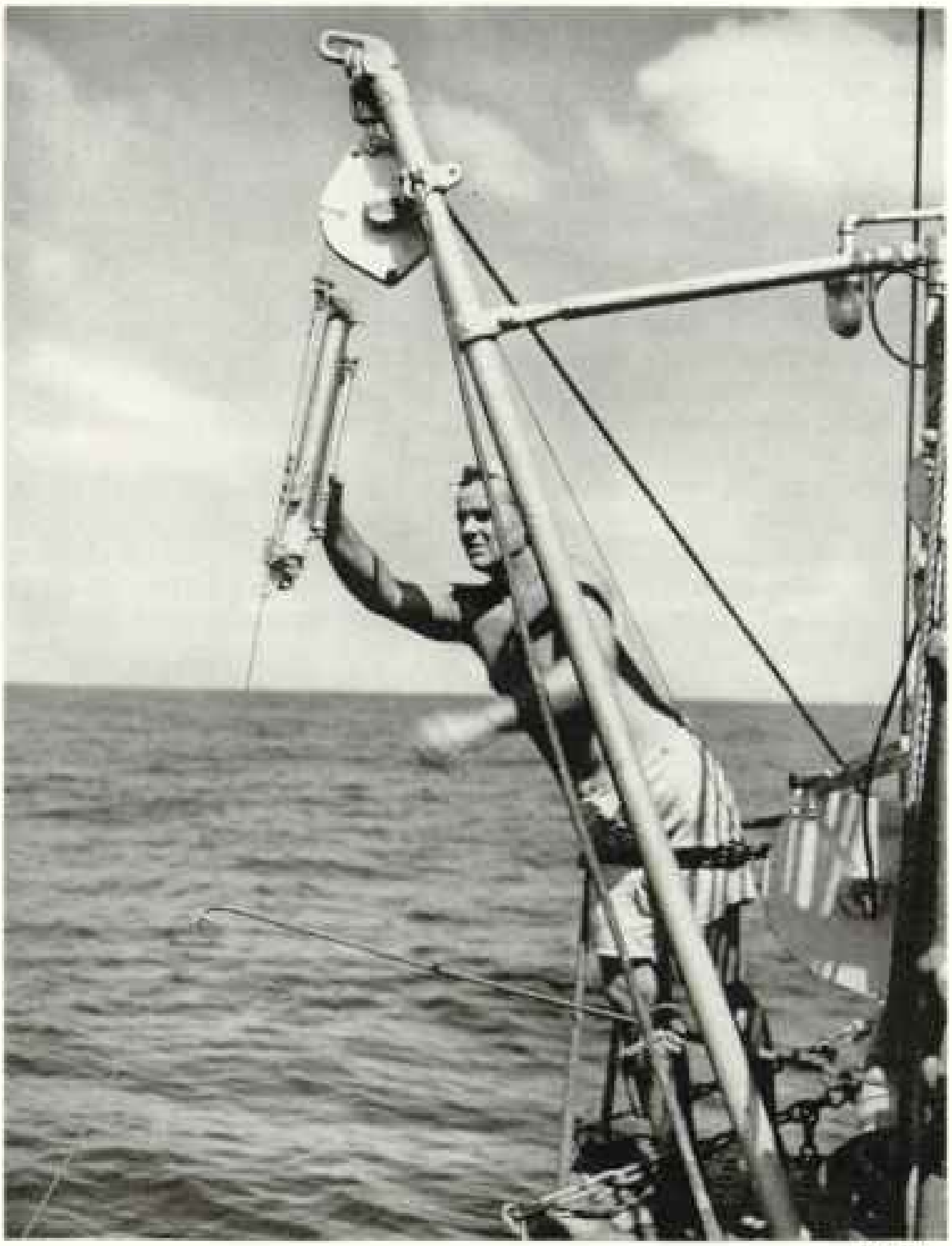
Most encouraging for the future was the fact that the Ridge had proved vulnerable to attack; it could be made to yield information. The deep-water rock dredge, for instance, had brought up about a ton of rocks from the Ridge, which previously had yielded no more than a pebble or two at the end of a sounding lead.

These telltale rocks told a story of formation of the Ridge by great heat and pressure. Once-molten rocks from the interior of the earth were seen to be overlain in some places by limestone formed from dead sea creatures.

On the way home we tested the one tool which we had had no chance to use in our limited time on the Ridge. Its purpose is to show the nature of the rock layer under the sea-bottom sediments by making the sound of an explosion travel horizontally through it and measuring the speed with which it does so.

Called seismic refraction, this test differs from the seismic reflection shot (pages 278-9) in that a larger bomb is used and the hydrophone which receives the sound must be several miles away.

Putting a crew into a whaleboat, we steamed off at different distances while the men in the tossing boat shot 50-pound TNT



Don Fay

To Take the Ocean's Temperature, He Lowers a Thermometer

Attached to the wire is a metal flask open at both ends for collecting water samples and, by the man's thumb, a deep-sea thermometer. Such instruments are placed at intervals along the wire. When they have reached the desired depth, a "messenger" is sent sliding down the cable to close the bottles and invert the thermometers, thus breaking the mercury thread so that water temperatures at various depths can later be read (page 277).

bombs. Each explosion raised a dirty-looking mushroom of foam and water behind the whaleboat, dwarfing the little craft.

Down went the sound of the explosion, through the water and bottom sediment, then laterally through the underlying rock and back up to the receiving hydrophone. This experiment, in which I had been interested for about eight years, proved conclusively that we can learn the nature of the rocks in the ocean basins or on the Ridge with shot and hydrophone both near the surface.

For deep-sea shots of this kind a second ship is almost essential, since the use of a small boat in the open sea is difficult and hazardous.

While the experiment was going on 1,100 miles southeast of Cape Hatteras, a black-and-white warbler paid us a visit. After resting briefly on the deck gear, the little wayfarer flew on again southward.

Sea Mount Predicted —and Found

About halfway between New York and Bermuda, in 2,600 fathoms, we brought up one of our most remarkable cores. It included sand like that found on beaches.

How did beach sand get here, 300 miles from any shallow water? I decided that it must have come from a mountain now beneath the surface of the sea, and predicted that such a sea mount would be found near by. Months later, in April, 1948, a mountain as forecast was discovered by the Woods Hole Oceanographic Institution vessel *Caryn*.

At least a mile high, the mountain lies at approximately 36° 42′ N. and 67° 57′ W. Unfortunately, its exact dimensions could not be obtained by the *Caryn*, since her Fathometer reaches only to 200 fathoms.

If the peak is the source of the sand, it must once have stood at or above the level of the sea, since sand is formed by weathering and wave action. This indication that the sea bottom has subsided or the sea itself has risen coincides with some scientists' interpretation of the submarine canyons off many coasts, including the deep gorge off the mouth of the present Hudson River.*

The same core told us a further story of

* See "The Mighty Hudson," by Albert W. Atwood, National Geographic Magazine, July, 1948.

Don Fay

To "See" Where Human Eyes Cannot Go, the Expedition Used This Deep-sea Camera

Devised by the author and J. L. Worzel, one of his graduate students at Columbia, this camera has made successful pictures at depths of more than a mile (page 284). Here it is being brought aboard. From top to bottom on pole appear camera, batteries in containers, and No. 5 photo-flash lamps; the trigger wire is fouled.

Maurice Ewing

Down in Davy Jones's Locker, Fish Swim Through Portholes of a Tanker

Sunk by a German submarine off the Atlantic coast in World War II, the *E. M. Clark* was photographed by an under-water camera lowered by Dr. Ewing to a depth of 222 feet on July 20, 1945. Cooperating with the Navy, he made pictures of about 100 wrecks to learn their identity, cause and extent of damage, and possibility of salvage. Since that time he and his colleagues have made many pictures at far greater depths for scientific purposes (pages 284 and 293). This photograph was taken with a double camera, used to double the area pictured or to give a stereoscopic view.

changes in the sea in ages past. The sand contains the remains of bottom-dwelling creatures living today in present oceans but confined to much shallower and colder water. The upper part of the core consists of a brownish silty mud containing quantities of the tiny shells of the warm-water-loving creatures which flourish today in the Gulf Stream, and similar warm-water forms appear in layers of silty mud below the sand.

"With this evidence," reports David Ericson, who had charge of analysis of bottom samples, "we can be quite sure that the sand layer was deposited during the Pleistocene (most recent) Ice Age when tremendous masses of ice largely covered Canada and the northern parts of the United States, Europe, and Asia."

Two Expeditions in One

Our cores from the Mid-Atlantic Ridge, much farther from land, indicate that in the past, probably during the Ice Age, the water there was less warm than at present, but only slightly so.

Our oceanographic work kept us busy until we sighted the Massachusetts coast. The expedition was really two separate undertakings, for work done during 5,000 miles of travel to and from the selected area is as important as that done on the Ridge itself. This doubling of our accomplishments was made possible by the broad view of the expedition's objectives which was taken by the Board of Trustees and the Research Committee of the National Geographic Society.

By budgeting about four extra days for travel, we were able to make water temperature and salinity measurements, plankton tows, deep-sea sediment cores, seismic reflection and refraction measurements, as well as valuable depth soundings and topographic studies, along a 5,000-mile track across a relatively unexplored part of the Atlantic Ocean.

As we landed at last at Woods Hole, after 60 days on the Atlantic or its island mountain peaks, we were already talking of a new expedition to probe more of the secrets hidden in the dark world beneath its waters.

The three institutions which sponsored our 1947 explorations are continuing their support.

When the members of the National Geographic Society, whose membership fees made possible this important Atlantic research, receive this number of their Magazine, we will be again exploring the Mid-Atlantic Ridge under their patronage.

American Masters in the National Gallery

By John Walker

Chief Curator, National Gallery of Art

THE American School of painting is scarcely 200 years old, but those 200 years have been extremely productive. Few countries in a similar period have ever produced per capita as many canvases covered with oil paint as has the United States.

In 1829 an early American art critic, John Neal, wrote: "You can hardly open the door of a best-room anywhere without surprising, or being surprised by, the picture of somebody, plastered to the wall and staring at you with both eyes and a bunch of flowers."

True, these staring effigies with their perennial bouquets were banished by changes of fashion to the attics of mansions and farmhouses; but recently many have descended from their garrets to enter public galleries. With them have also come a swarm of works of forgotten painters of the American scene, obscure designers for Currier & Ives, dim illustrators of *Harper's Weekly*, forlorn Romantics of the Hudson River Valley.

In such pictures we have caught a glimpse of our past so seductive and so enthralling that we have forgiven their frequent artistic shortcomings in our love of their subject-matter.

This has caused a confusion of values which is unfortunately wearing away a belief in the basic standards by which a good painting is distinguished from the bad and the mediocre. Yet by these standards some Americans rank among the great painters of the last 200 years.

Here is the challenge to the collector of the art of this country: to show these masters in their full splendor; to prune away the undergrowth of average production until their loftier achievements can be properly seen. This has been the difficult goal we have sought to attain at the National Gallery of Art.*

230 American Paintings in Gallery

In the seven years the National Gallery has been in existence, the collection of American paintings has grown from a token representation of eleven 18th-century canvases until today it includes more than 230 portraits, landscapes, and figure compositions. Of these pictures only one has been purchased: the rest have been either selected from offers of gift or acquired by friends at the request of the Gallery.

The collection as a whole falls into two categories: those paintings which are in themselves esthetically satisfactory and those which are of interest as historical documents. Pictures in the first category are exhibited permanently; those in the second, once a year.

The reason for this double standard is that the National Gallery is the custodian of a number of canvases intended eventually for a National Portrait Gallery. Plans have been laid to establish in Washington an institution modeled on the National Portrait Gallery in London.

When these plans have been carried out, which I hope will be within the next few years, the new gallery will be hung with paintings portraying those who have affected the history of the United States.

Founding Fathers of Our Complex World

Such a painting is "Men of Progress" by Christian Schussele (pages 309 and 324). Now on loan to the White House from the National Gallery of Art, it hangs in the lobby of the Executive Office wing.

The painting shows 19 men whose inventive genius helped to change a world of the handicrafts into a world of the machine. They pioneered such complex inventions as the sewing machine, the electric motor, the telegraph, and the reaper; such domestic conveniences as a pair of rubbers, the base-burning coal stove, and carpeted floors; and such characteristic features of our modern world as the skyscraper, the revolver, and the battleship.

Whether the future blesses or curses these self-confident inventors—a question which never would have occurred to them or to their patron saint, Benjamin Franklin, dimly seen in the background—their portraits painted from life are of great historic interest.

Our generation is often hazy about the appearance of the men who have guided the growth of this country, and it is important to assemble as soon as possible their accurate likenesses.

Among such men George Washington is preeminent. The National Gallery now owns seven contemporary portraits of our first President, some of which will be placed on permanent loan in the National Portrait Gallery. Two of these canvases are by Gilbert Stuart, who was a vigorous delineator of character, both with brush and with pen.

"There were features in his face," Stuart

* See, in the National Geographic Magazine, "Old Masters in a New National Gallery," by Ruth O. McBride, July, 1940.

wrote a friend after first seeing the President, "totally different from what I had observed in any other human being. The sockets of the eyes, for instance, were larger than what I ever met with before, and the upper part of the nose broader. All his features were indicative of the strongest passions; yet like Socrates his judgment and self-command made him appear a man of different cast in the eyes of the world."

In some respects, the portrait of Washington by Rembrandt Peale, a younger contemporary of Gilbert Stuart, comes closer to this verbal description than Stuart's own pictures.

Peale was once known as the last surviving artist who had painted Washington from life; but the likeness reproduced (page 299) was an ideal conception in which he apparently tried to combine the best features of his first portrait, of several portraits painted by his father, Charles Willson Peale, of some by John Trumbull, and of the study for the statue by Jean Antoine Houdon.

"Porthole Portrait" in President's Study

This picture from the National Gallery, one of 79 replicas painted by the artist, now hangs in the President's study at the White House.

When John Marshall saw a replica of the picture the Chief Justice exclaimed, "It seems as if I were looking at the living man! It is more like Washington than anything I have ever seen."

Yet the contrast between Peale's composite and somewhat idealized image of the first President and the realistic, matter-of-fact interpretation by another contemporary, Edward Savage (page 305), is striking. Here Washington, painted from life, is shown at Mount Vernon, leaning his right arm on his adopted son, George Washington Parke Custis, child of Mrs. Washington's son by her first marriage.

On the table at which the President is seated lies a map showing the location of the proposed Capital. Mrs. Washington sits opposite and points with her fan to the chart. By her side is Eleanor Parke Custis, sister of George, and behind stands their Negro servant, Billy Lee.

The engraving after the painting was so successful that Savage wrote Washington in 1798: "As soon as I got one of the prints ready to be seen, I advertised in two of the papers that a subscription would be opened for about twenty days. Within that time there was 331 subscribers to the print and about 100 had subscribed previously, all of them the most respectable people in the city [Philadelphia]. . . . . There is every probability at present of its producing me at least $10,000 in one twelve-month."

In view of the purchasing power of the dollar in the 18th century, this would seem to be the highest income ever realized by an American artist from a single picture.

Mature John Randolph Seems a Boy

Meanwhile, Gilbert Stuart was busily painting not only Washington but the other heroes of the young Republic. Many of these portraits are in the National Gallery's collection, and it is hard to decide in some cases whether their esthetic or historic interest is greater, whether they belong in an art gallery or in a portrait gallery.

Among the Gilbert Stuart paintings, one of the most baffling and difficult to place is that of John Randolph (page 303). As a work of art the picture is superb; as an historic document, fascinating, for never did Stuart paint with more verve or achieve a more urbane characterization.

But whom was the artist actually painting? Was it the sitter he saw before him, who was then aged 32, or was it a schoolboy of 16? Did Randolph's vanity impose itself on the artist's vision, or did this extraordinary Virginian possess the secret of eternal youth?

Henry Adams said that Stuart's portrait "interprets the mystery of the affection and faith he [Randolph] inspired in his friends."

Since the picture hung for many years at Roanoke, Randolph's country house, presumably none of these friends found it startlingly unlike its subject. Could Randolph's adolescent appearance be in part, then, due to his Indian blood, to his descent from Pocahontas? We know that, like an Indian, he remained almost beardless.

Stuart Painted Subjects as He Saw Them

The accuracy of Stuart's portrait seems likely, for on the whole he was disinclined to flatter his sitters. Commodore Thomas Macdonough (page 302), for example, looks like a ruddy-complexioned, vigorous, but not particularly handsome naval officer in his early forties, and this would have been his age at the time he sat for his portrait, shortly after the close of the War of 1812. It was during that war that Macdonough gained a decisive victory on Lake Champlain over the British under Commodore George Downie.

Nor can it be said that Stuart has made Matilda Cruger (page 307) into an exceptional beauty. Instead, how subtly has the artist suggested in the roundness under her chin the young woman who has to watch her figure,

who feels the bodice of her dress grow tighter and tighter!

No, Stuart was a realistic portrait painter, and one is forced to conclude that John Randolph, though he had reached his early thirties when he sat for this picture, continued, for some glandular or other reason, to look like a boy.

"Copley's Canvas, Just and True"

John Singleton Copley, the other great American artist of the 18th century, while painting in his native Boston, was just as unflattering in his portrayals. He did not, however, remain in New England for long.

His wife's father, Richard Clark, was a consignee of the shipment of tea from England, sent contrary to the wishes of the colonists, that was thrown into the harbor in the Boston Tea Party. Consequently this Tory merchant left the Colonies in high dudgeon, though in low repute.

Copley, who had been studying abroad, soon after joined his father-in-law in London, where he remained the rest of his life. Shortly after his arrival he painted the group portrait which is reproduced (page 304).

Mrs. Copley and her father sit in the foreground, surrounded by the little Copleys, while the artist looks out pensively from behind and clutches all that remained of his New England prosperity, a few sheets of drawings.

In London Copley had to learn to flatter, had to master the "grand manner" of portraitists like Gainsborough and Reynolds. This he did with remarkable skill, as can be seen from the painting entitled "The Red Cross Knight" (page 301), a portrait of three of the Copley children now grown up and acting out a passage in Spenser's *Faerie Queene*. So quickly forgotten was the bitterness of the Revolution that the future President of the United States, John Quincy Adams, honored the painting in a poem beginning:

> On Copley's canvas, just and true,
> Our Spenser's happy thought is given.

This literary effort is more commendable for its conciliatory spirit than for its poetic beauty.

Copley and Stuart are the twin pillars of any collection of American paintings. Not until the last quarter of the 19th century did the American school again reach so high a level.

Sully's Full-length Portraits Greatly Valued

Just below these two artists ranks a third and somewhat younger portraitist, Thomas Sully, who was born in England and came to America as a child. The brightness of Sully's fame has been tarnished by potboiling, but the four canvases reproduced show him at his best. All were painted before his portraiture became anemic, before lassitude overcame his men and languor his women.

The portrait of Joseph Dugan (page 306) has an engaging informality and liveliness of expression which recall the best work by Raeburn and prove that Sully at 27 was already capable of competing with the leading British painters.

To the collector of American painting, however, rarer and still more desirable are Sully's full-length portraits. During his life these fetched the best prices. To paint one, the artist asked from $300 to $500, less than a fiftieth of its present value.

Thus, if one's ancestor had been shrewd enough to commission such a portrait, his descendants during the last century would have earned the equivalent of 100 percent on the original investment every two years. Obviously, it paid, and still pays, to pick the right portraitist.

The Ridgelys of Baltimore, with keen perception, selected Sully and had a promising beauty, Eliza Ridgely, pose for him with her harp (page 311).

Author's Call at Hampton Yields Three Prizes for Nation

Some years ago when preparing a book, which was really an illustrated list of the types of pictures wanted for the National Gallery, we made the "Lady with a Harp" our first choice among Sully portraits. To see the painting in its original setting, my collaborator and I, with the Director of the National Gallery, made a pilgrimage to Hampton, the Ridgely country house, north of Baltimore.

The consequences of our journey were unexpectedly rewarding. A donor acquired the "Lady with a Harp" for the Gallery; its owner, in turn, gave us a second portrait by Sully; and a charitable foundation, as a result of our trip, acquired Hampton, the house itself, now designated a National Historic Site by the National Park Service.

This is the only time in our search for American paintings that we have, so to speak, killed three birds with one stone, acquiring two paintings and the house in which they hung, all at one time.

One full-length deserves another. Collecting for a museum is at times like running a marriage bureau. Matchmaking seems unavoidable, since somewhere, one knows, there is to be found a vitally important mate; and how one longs to bring together these handsome couples, these perfect pairs, somewhat

larger than adjacent pictures, which will keep the wall from monotony or "hold down" the end of a gallery!

It was some time before we found a mate for the "Lady with a Harp," but eventually a full-length of superb quality by Sully turned up, representing Capt. Charles Stewart, nicknamed "Old Ironsides" because of his command of the *Constitution* in the War of 1812 (page 310).

Again the same donor proved a friend of the Gallery and made the marriage possible. I wish I could round off this account by saying that the Siccard David children (page 308) were in some way the offspring of the match, but they entered the collection much earlier.

Sully's life covered an enormous span in the history of our art. He studied with Stuart in Boston and lived to see the rise of Eakins and Winslow Homer; thus, he was active from the beginning of the 19th century till some years after the Civil War.

This was an age in America when literature waxed and painting waned; but, even so, a few distinguished canvases by artists other than Sully are to be found.

The aggressive self-assurance that marked the young Republic during these years is summed up in the confident elegance of the wealthy manufacturer and philanthropist, Amos Lawrence, as he appears in the full-length painting which Chester Harding considered to be his masterpiece of portraiture (page 315).

Young Nation's Folklore Portrayed

Such Americans as Lawrence encouraged a spirit of cultural independence, and this in turn stimulated the growth of a native mythology.

The writings of Washington Irving helped to satisfy this interest, and folklore, which in Europe had taken centuries to develop, grew up in this country overnight. But the artists to illustrate these somewhat synthetic myths were few and poorly trained.

John Quidor was better than the average, showing in canvases like "The Return of Rip Van Winkle" (page 300) a fluency of brushwork and an adequacy of draftsmanship almost unique among American illustrators of his generation.

Quidor's work, it is true, shows irritating mannerisms—the trite gestures of a provincial stock company, broad grimaces, popping eyes, all the tricks of the tired hacks who toured the local theaters of the New World—but his pictures are dramatic and his subject matter usually American, and on these two counts much can be forgiven.

Just as the change in American literature from Washington Irving to Mark Twain marks the emergence of a realistic, colloquial approach to the American scene, so in painting at about the same time a new school of regional artists came into being.

The period's three major painters of everyday American life—William Sidney Mount, George Caleb Bingham, and Eastman Johnson—are still inadequately represented in the National Gallery of Art's collection. However, the world of Tom Sawyer and Huckleberry Finn has never received a more idyllic interpretation than in the landscape of George Inness showing the Lackawanna Valley at Scranton, Pennsylvania (page 316).

When Inness's painting came on the market, it was obviously the canvas to help fill a serious gap in the collection, and we started out at once to find a donor. Every effort failed, though the picture was borrowed and for months hung over my desk.

One day, just before the painting was to be returned, I happened to be telling a caller its story. I observed that it was commissioned by the Delaware, Lackawanna and Western Railroad as an advertisement, and I described how as a young man Inness had traveled to Scranton by stagecoach, had lost his baggage, and had had to wire his wife for funds.

When he arrived, he found the railroad intended to pay him only $75, a sum for which he was required to depict the newly constructed roundhouse, to show the four trains and the four tracks the line operated, and to place the initials D. L. & W. conspicuously on the tender of the first locomotive.

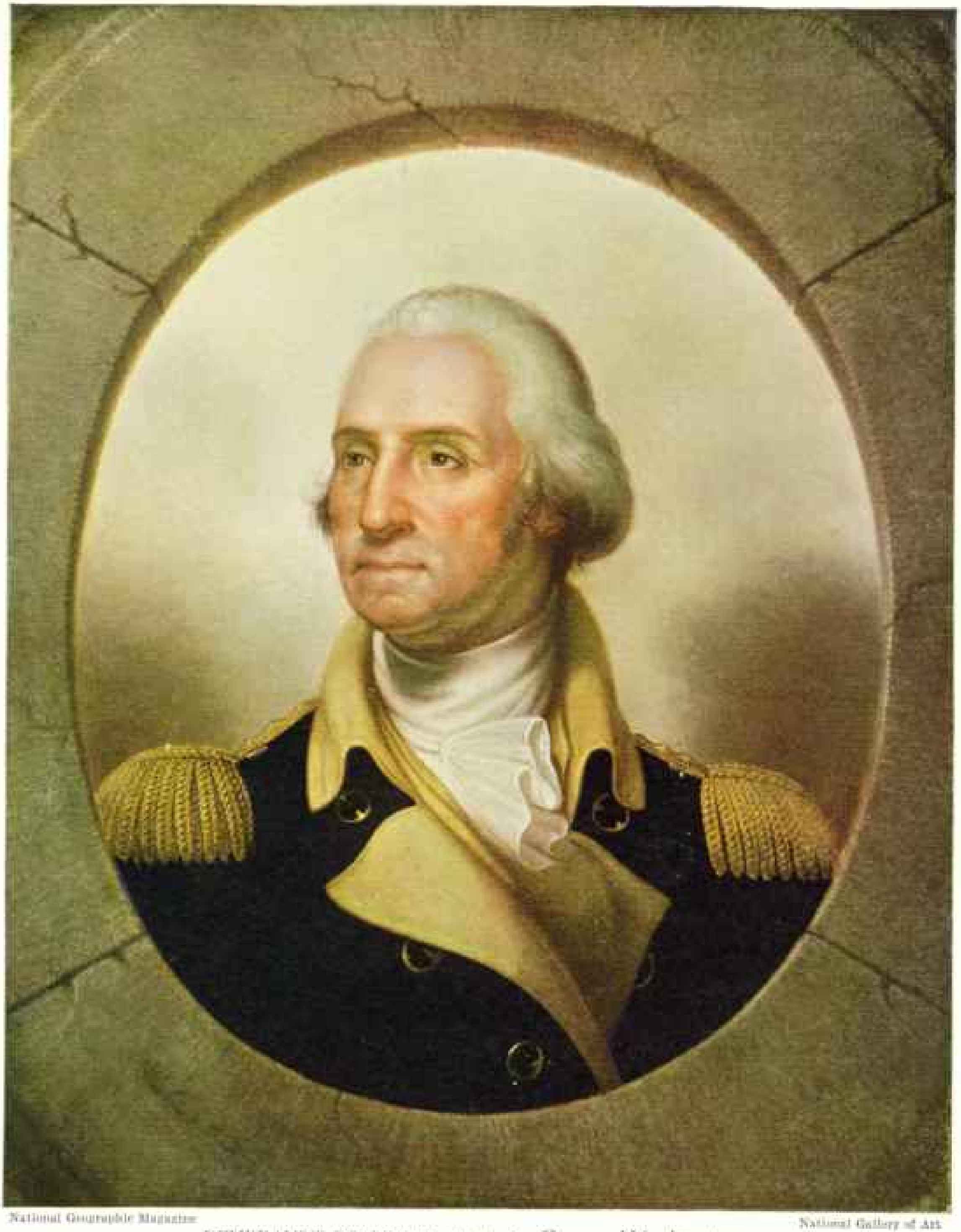
On his second attempt Inness achieved a miracle, for he painted a beautiful landscape and at the same time satisfied the president of the railroad. However, the value of his painting as an advertisement was fleeting, and it was sold or thrown away.

By an incredible coincidence, Inness as an old man rediscovered the picture in a junk shop in Mexico City and bought it back, considering it one of the finest examples of his early work.

To my great surprise my visitor, having heard the story, asked me if we wanted the picture for the Gallery and offered to buy it then and there.

Eakins Masterpiece Discovered by Luck

Alas, such rewards in the professional mendicancy of museum collecting are extremely rare. They are made still rarer by the National Gallery's reputation for immense wealth. Unfortunately, this reputation is undeserved; lack of funds for purchase has been a handicap.



National Geographic Magazine

National Gallery of Art

REMBRANDT PEALE (1778-1860) • *George Washington*

With this portrait from the collection of Mr. and Mrs. George W. Davison, the NATIONAL GEOGRAPHIC MAGAZINE introduces a series of 24 American paintings from the National Gallery of Art, Washington, D. C.

A quarter-century after the first President's death, Rembrandt Peale painted this idealization because the Washington family "grieved that there was no portrait of him which conveyed an adequate idea of his mild, thoughtful, and dignified, yet firm and energetic countenance . . . I determined in 1823 to make a last effort." The first version hangs in the United States Capitol. It is known as the Porthole Washington because of the circular frame. This is one of 79 replicas by Peale.

That the artist bore the name Rembrandt was more than coincidence. His father, Charles Willson Peale, himself a distinguished portraitist of George Washington, named other sons Titian, Rubens, and Raphaelle. At a 1793 sitting, Charles Willson, Rembrandt, Raphaelle, and their uncle James Peale all grouped themselves around Washington. "I will be well pealed today," their subject was quoted.

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JOHN QUIDOR (1801-81) • *The Return of Rip Van Winkle (Mellon Collection)*

With his dramatization of Washington Irving's *Rip Van Winkle* (1829) Quidor was one of the first to make the American scene important in painting.

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JOHN SINGLETON COPLEY (1738-1815). • The Red Cross Knight (Gift of Mrs. Gordon Dexter)

John, Jr., Elizabeth and Mary Copley (page 304) re-enact a scene from Edmund Spenser's *The Faerie Queene*. Painted about 1789.

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GILBERT STUART (1755-1828) • *Commodore Thomas Macdonough (Mellon Collection)*

Young Stuart left the Colonies at 19 to seek his fortune in London. There he acquired art training under extreme privations, but won fashion's favor, competing against such masters as Romney, Reynolds, and Gainsborough. Stuart painted George III, George IV (as Prince of Wales), Louis XVI, and, returning to the United States, portrayed six American Presidents. He felt himself awed by none of his eminent sitters save George Washington.

Benjamin West, his teacher and benefactor, was quoted as having said that Stuart "nails the face to the canvas." Again: "It is of no use to steal Stuart's colors; if you want to paint as he does, you must steal his eyes."

As a young naval officer, Macdonough took part in the bombardment of Tripoli and the burning of the *Philadelphia* (1804). In 1814 his victory on Lake Champlain over a superior British fleet turned back an invasion from Canada.

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GILBERT STUART • John Randolph (Mellon Collection)

Virginia's Randolph of Roanoke, who numbered Pocahontas among his ancestors, was only 26 when elected in 1799 to Congress. There for the next 30 years he made himself loved and hated for his agile wit and biting sarcasm. "Anti" every administration from Jefferson's to Jackson's, Randolph "came near to shaking this Union and desolating this fair land," in the words of Henry Clay. He once described himself as "an aristocrat: I love liberty, I hate equality." He opposed Federal interference in slavery, yet freed his own slaves at his death.

In his late teens a mysterious malady left Randolph beardless and square-voiced. To one who taunted him for lack of virility, he replied: "You pride yourself on an animal faculty (in which) the jackass is infinitely your superior." Yet Randolph was man enough to fight two duels, one with Henry Clay, and to ride horses like a desperado.

For years the Gilbert Stuart painting hung at Roanoke, the Randolph country home. It depicts a statesman of 32 years as a schoolboy of 16. That the artist flattered his subject appears less likely than that he told the truth.

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JOHN SINGLETON COPLEY • The Copley Family (Copley Amory Collection, Loan)

The artist portrays himself, father-in-law Richard Clarke, Jonathan, Elizabeth, John, Jr., Mrs. Copley and Mary in England after the Boston Tea Party.

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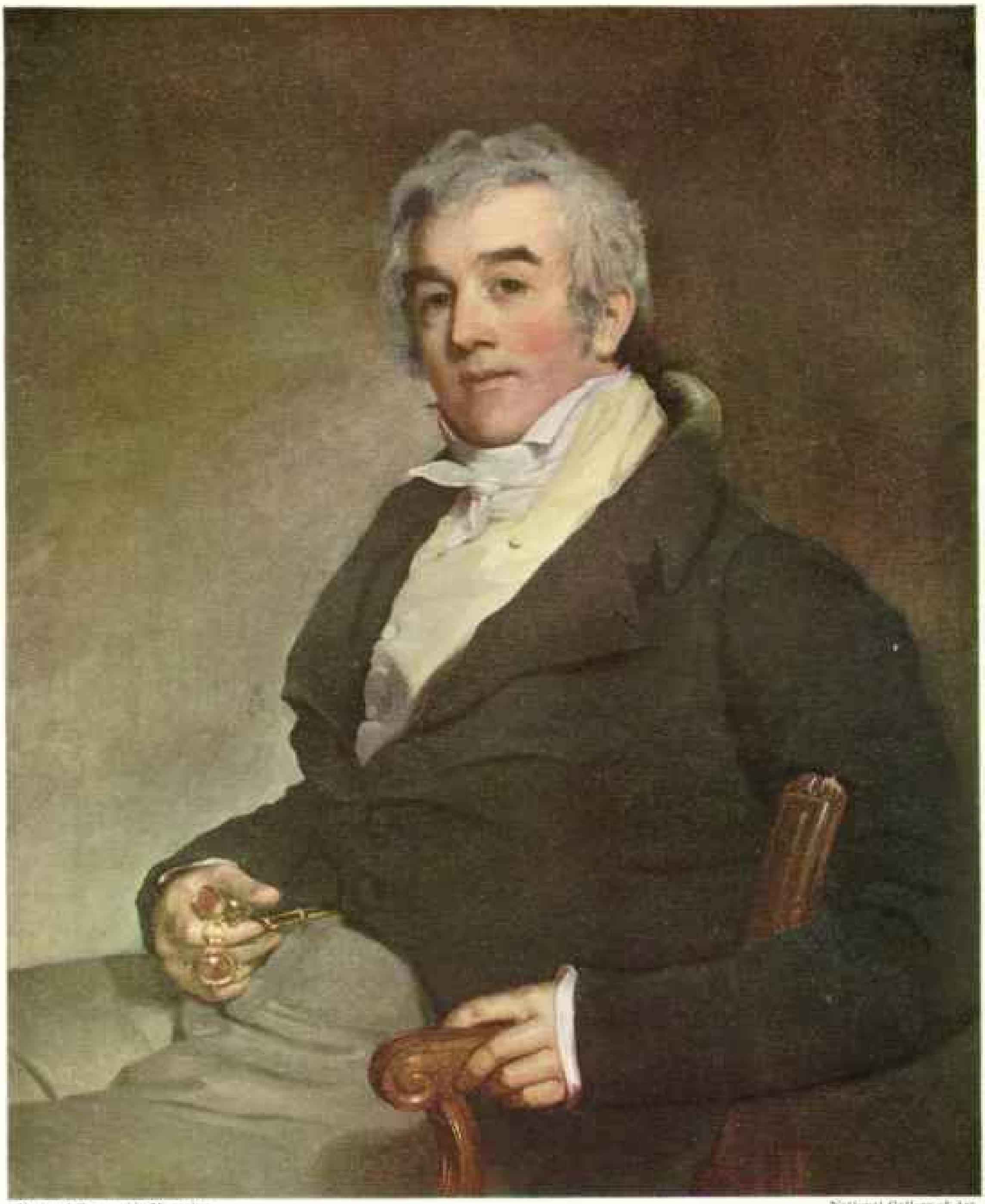
EDWARD SAVAGE (1761-1817) • *The Washington Family (Mellon Collection)*

At Mount Vernon (Potomac in background), General and Mrs. Washington and their adopted children study plans for the Federal City. Painted about 1796.



National Geographic Magazine — National Gallery of Art

THOMAS SULLY (1783-1872) • Joseph Dugan (Gift of Herbert L. Pratt)

Reversing Copley, the American painter who went into English exile, the English-born Sully became an American. With his immigrant actor-parents he arrived at the age of nine. As a boy, he studied under his brother and French brother-in-law. In Boston he received guidance from Stuart and, in London, from West and Lawrence.

During his long career Sully completed some 2,500 pictures. He enriched his country with a notable series of portraits of its most eminent sons, including four Presidents. For the North Carolina Legislature he painted "Washington's Passage of the Delaware," but the canvas was rejected as too large to fit the space assigned, and Sully sold it for $500 to a frame maker. He reached the pinnacle of his fame when he returned to London in 1837 to paint the young Queen Victoria.

In Philadelphia, where he lived, Sully portrayed Joseph Dugan, shipping merchant, philanthropist, and art patron. He was only 27 when he completed this portrait in 1810. Even in his eighties he was in demand as a portraitist.

National Geographic Magazine — National Gallery of Art

GILBERT STUART • Matilda Caroline Cruger (Mellon Collection)

When Stuart returned to New York in 1793, after 18 years of voluntary exile abroad, he painted six portraits of the Yates family. These established Stuart's American reputation, and all hung in the National Gallery.

Miss Cruger's father was Henry Cruger, a member of Parliament, who supported Edmund Burke in advocating American independence. She married Lawrence Reid Yates in 1793, two years after this portrait was painted. Mr. Yates died a year later, and in 1800 his widow married her cousin, Judge Henry Walton.

The author of the accompanying article cites Miss Cruger's portrait as proof of Stuart's unwillingness to flatter his subjects.

"Nor can it be said," Mr. Walker writes, "that Stuart has made Matilda Cruger into an exceptional beauty. Instead, how subtly has the artist suggested in the roundness under her chin the young woman who has to watch her figure, who feels the bodice of her dress grow tighter and tighter!"

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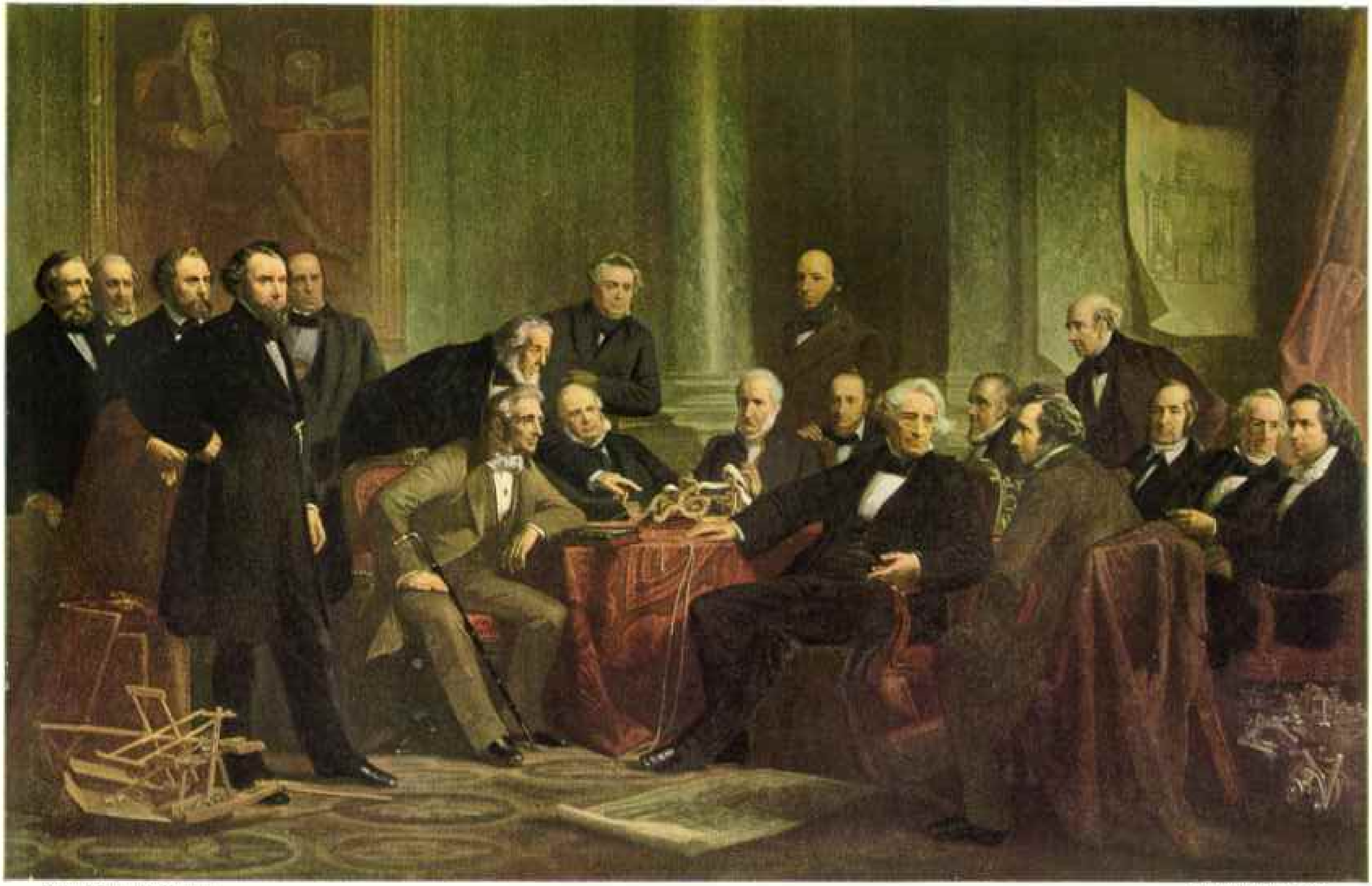
THOMAS SULLY • The Sicard David Children (Chester Dale Collection)

In the background is one of Sully's rare interiors in the Dutch manner. Also unusual for him is this composition of more than one person. Painted 1825.



National Geographic Magazine

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CHRISTIAN SCHUSSELE (1826-79) • *Men of Progress (Mellon Collection)*

Inventors and industrialists of the early Machine Age discuss a model of Samuel F. B. Morse's telegraph (on table behind his hand). Painted 1857-62. (For names see page 324.)

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THOMAS SULLY • Captain Charles Stewart (Gift of Maude Monell Vetlesen)

From cabin boy to rear admiral, Charles Stewart served the sea nearly all his 91 years, 64 of them with the United States Navy. He fought privateers, Tripolitan pirates, and the proudest vessels in the British Navy. During the War of 1812 he brilliantly commanded *Argus*, *Hornet*, *Constellation*, and *Constitution*. From the last-named he won his own nickname, "Old Ironsides." Ovation, sword, and gold medal were showered upon him by a grateful people, legislature, and Congress.

In 1811-12 Sully painted the hero in uniform for $500.

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THOMAS SULLY • Lady with a Harp; Eliza Ridgely

Sully painted Elizabeth Ridgely in 1818 before she was wed to her distant cousin, John Ridgely, son of a Maryland governor. Handed down to her son, grandson, and great-grandson, all Ridgelys, the portrait hung in Hampton, Maryland, the Ridgely country home, until recently.

Officers of the National Gallery made a pilgrimage to see "Eliza." As a result, the gallery was given not one but two Sully portraits, and the house itself has become a National Historic Site. "Eliza" and "Captain Stewart" (opposite) became public treasures through the generosity of Mrs. Maude Monell Vetlesen.

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GEORGE BELLOWS (1882-1925) • *Both Members of This Club (Gift of Chester Dale)*

In 1900, to legalize this New York prize fight, the boxers were made members of Sharkey's Athletic Club for the duration of the bout.

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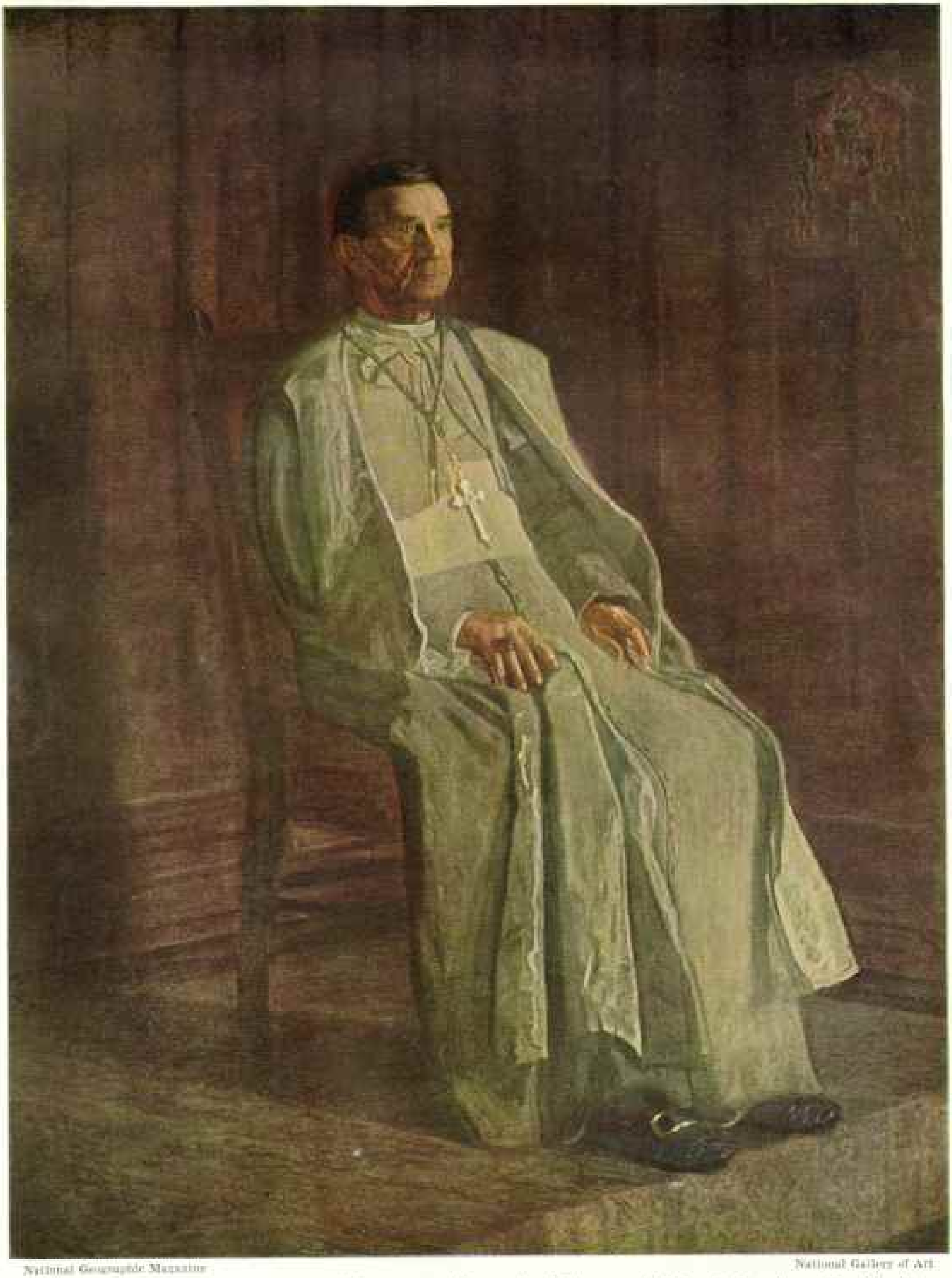
WINSLOW HOMER (1836-1910) • *Hound and Hunter (Gift of Stephen C. Clark)*

Homer's art is wholly American; foreign influence he rejected. Largely self-taught, he began his career as a lithographer's apprentice. Later he was a Civil War artist and magazine illustrator. Many of his pictures tell a story of drama and suspense shown against a background of awesome beauty. Before the close of his 74 years he received virtually every honor an artist could command. Museums outbid themselves for his works. Homer was particularly proud of "Hound and Hunter." Pointing to the model's varying degrees of sunburn, he said: "I spent more than a week painting those hands."



National Geographic Magazine

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THOMAS EAKINS (1844-1916) • *Monsignor Diomede Falconio (Gift of Stephen C. Clark)*

Eakins's studies of Spanish realism and the structure of the body made profound impressions on his works. As an overtaxed art student resting in Spain, he fell under the spell of Velázquez, Goya, Ribera, and Herrera. Returning to Philadelphia, he mastered anatomy. He expressed not only personality but racial type. His Americans were homespun.

Monsignor Falconio was a native Italian. He was portrayed in 1905 as the Vatican's Apostolic Delegate to the United States. Later he became a Cardinal.

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CHESTER HARDING (1792-1866) • Amos Lawrence (Gift Rt. Rev. Wm. Lawrence's Children)

Son of a perpetual-motion "inventor" who neglected his family, young Harding had little schooling. During the War of 1812 sickness almost finished his career before it began. An unpaid debt led to his arrest on his wedding day. Harding attempted his wife's portrait; the resemblance made him "frantic with delight."

Success transformed this simple rustic into a social lion. Boston caught the "Harding fever."

The artist considered "Amos Lawrence," a Boston textile merchant, the "best thing I have ever done."

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GEORGE INNESS (1825-94) • *The Lackawanna Valley (Gift of Mrs. Huttleston Rogers)*

This view, near Scranton, Pa., of the Delaware, Lackawanna and Western Railroad's new roundhouse, was painted as an advertisement. It brought young Inness $75.

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WINSLOW HOMER • Breezing Up (Gift of W. L. and May T. Mellon Foundation)

In marine art, no American excelled Homer, creator of a stirring series of deep-sea classics. The beauty and fury of water fascinated him. From English shipwrecks to Caribbean derelicts, he depicted the perils of sailing folk. Maine's rugged coast he sketched from the shelter of a small portable studio. "Breezing Up," originally entitled "A Fair Wind," was painted in Gloucester in 1873-76.

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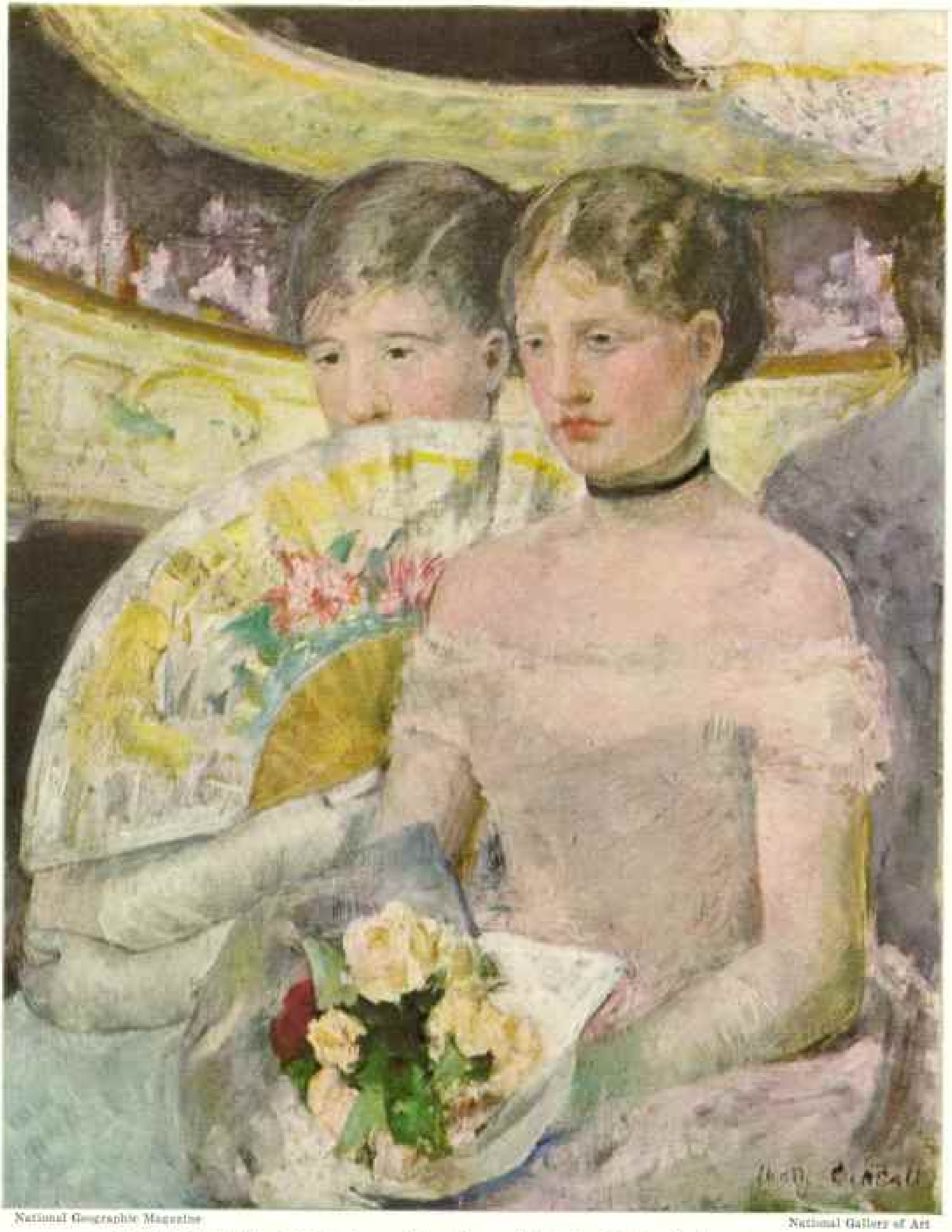
JAMES ABBOTT McNEILL WHISTLER (1834-1903) • *The White Girl*

In his third year at West Point, Whistler flunked chemistry. Going into a Bohemian existence abroad, he never came home. This triumph in tones of white was a sensation of the Paris Salon des Refusés in 1863. (Harris Whittemore Collection.)



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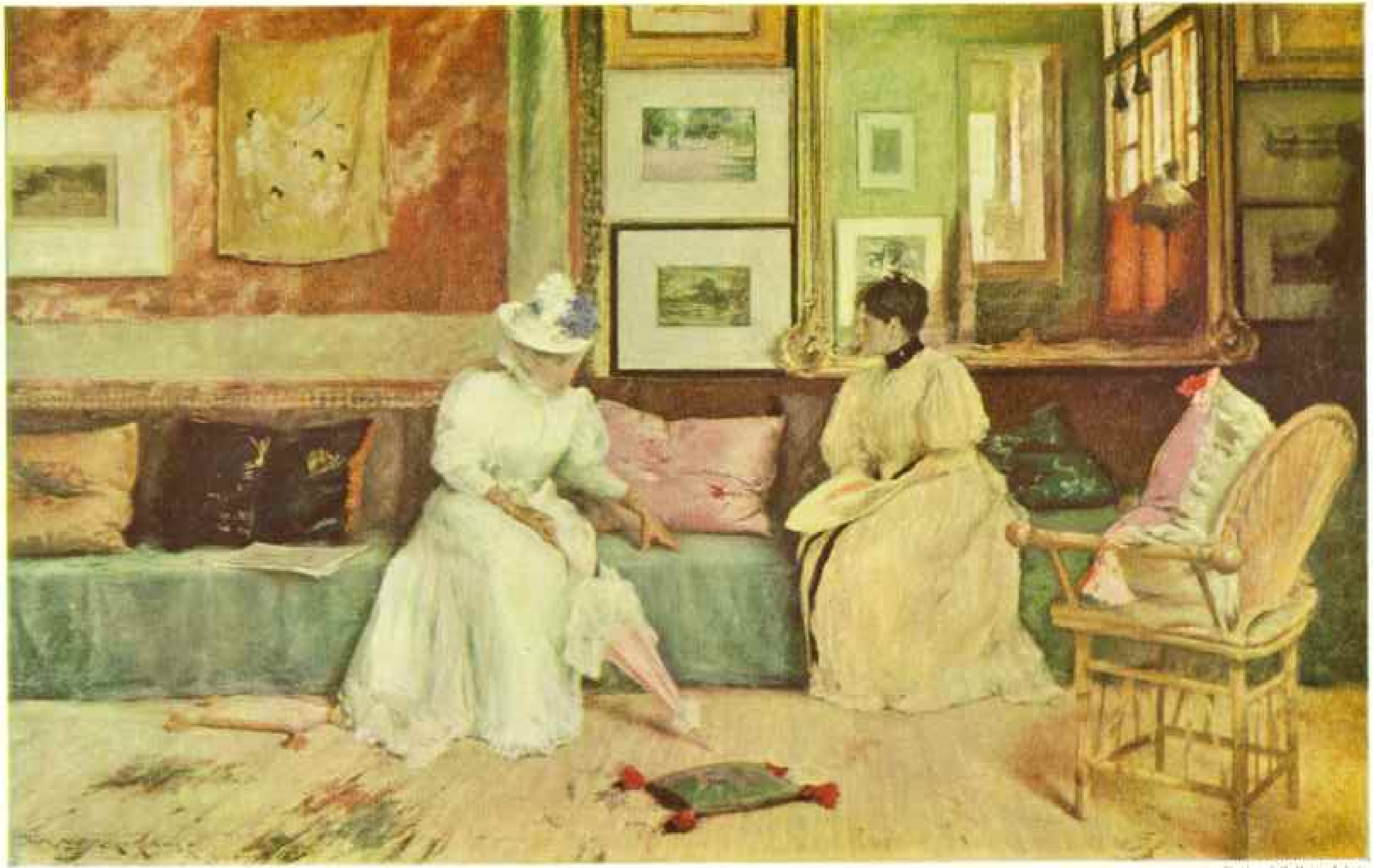
MARY CASSATT (1845-1926) • The Loge (Chester Dale Collection, Loan)

Born in Allegheny City, now part of Pittsburgh, Miss Cassatt, a wealthy banker's daughter, rebelled against the role of an American society leader; likewise she kicked over the traditions of conventional art. Later, she chose to reside in France, the country of her distant ancestors. When Paris art jurors rejected her work she "accepted with delight" the invitation of her friend and fellow artist, Edgar Degas, to join the new Impressionist School.

Thereafter Miss Cassatt painted as she chose, ignoring academic traditions that she might emphasize her own interpretations. Motherhood, painted without sentimentality, was her favorite theme (page 321). Said Degas, admiring one of her pictures: "I will not admit that a woman can draw like that." Whistler, her fellow expatriate, became her close friend. Next to him, she has been judged the most accomplished American etcher.

Invalided and almost blind, but rich in honors, Miss Cassatt died in France. Today her works hang in the most important galleries in Europe and America.



National Geographic Magazine

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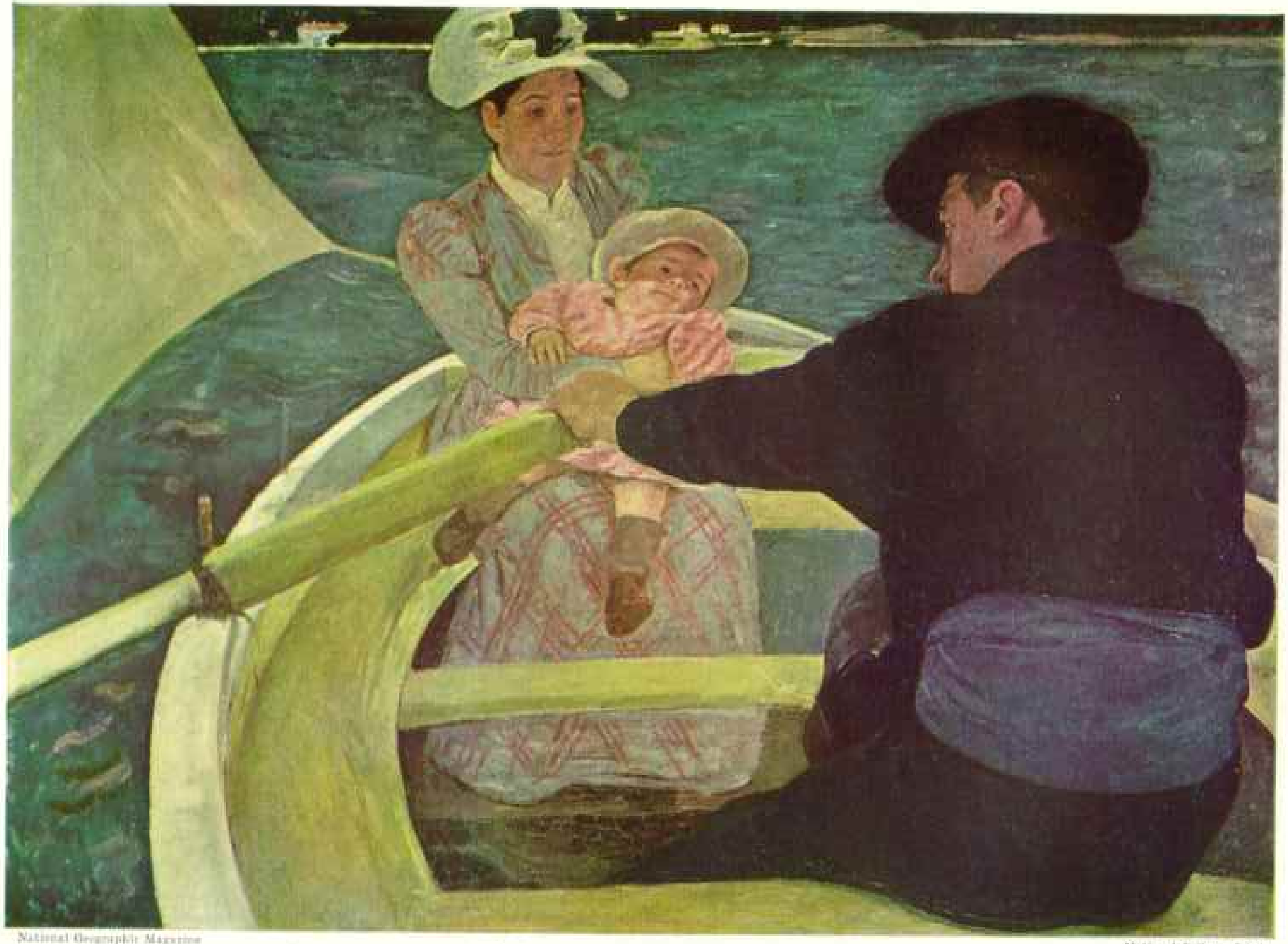
WILLIAM MERRITT CHASE (1849-1916) • *A Friendly Call (Gift of Chester Dale)*

Chase's talent became apparent during his Indiana childhood, when he copied woodcuts. Following study abroad, he settled down in Manhattan. There his Tenth Street studio became famous as the gathering place of artists and students. Possibly no other American artist taught so many pupils. For a dozen years Chase conducted a students' summer tour through the galleries and studios of Europe.



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MARY CASSATT • The Boating Party (Chester Dale Collection, Loan)

Popular subject for Impressionists, it was painted in Antibes, France (1893-94). A similar one, by Manet, now in Metropolitan Museum, New York, was its inspiration.

National Geographic Magazine — National Gallery of Art

CHILDE HASSAM (1859-1935) • *Allies Day, May, 1917 (Gift of Miss Ethlyn McKinney)*

Born in Dorchester, Massachusetts, Hassam studied in Paris. There, like Mary Cassatt, he fell under the influence of the Impressionists, painting in a style of his own. Unlike Miss Cassatt and Whistler, however, Hassam returned to his native land.

As an evangelist of the new style, he became a member of the Ten, a group organized in 1898 to preach Impressionism in America. He died not without honor; medals, awards, and gallery recognition were his.

Although "Allies Day" is a valued possession of the National Gallery, it is not yet entitled to a place in the permanent collection. Not until 1973, twentieth anniversary of the artist's death, will it have that privilege, according to the rules.

Fond of colorful street scenes, Hassam shows New York's Fifth Avenue draped with British, French, and United States flags shortly after America's entry into World War I.

For six years, from the time of the opening of the Gallery, we tried, for instance, to acquire an important canvas by Thomas Eakins, the most intellectual and penetrating portraitist America has produced. However, almost all of Eakins's work is in museums, concentrated especially in the museum of his native city, Philadelphia. It seemed for a time as if the National Gallery of this country might always lack an adequate painting by one of our greatest masters of 19th-century realism.

One day I was asked to look at a picture, supposedly by Sully, in the United States Army Medical Library, almost next door to the Gallery. The picture proved to be of no importance, but as I was leaving the building, depressed at having wasted my time, I happened to glance up. There, almost invisible under its dirty, discolored varnish, was what I had looked for everywhere, a magnificent full-length portrait by Thomas Eakins.

The subject of the painting was Dr. John H. Brinton, first curator of the Army Medical Museum. Permission was readily granted the National Gallery to clean the picture and, as compensation, to exhibit it on loan.

Shortly after this painting was hung, we were offered, to our great delight, a second and even finer work by Eakins, a portrait of Monsignor Diomede Falconio (page 314).

This picture was painted at the end of the artist's life, when, like Rembrandt's vision in his last years, Eakins's insight into human personality had deepened.

Particularly beautiful are the face with its lines of tired sadness and the hands with their knobby, sensitive fingers. Eakins once said, "A hand takes as long to paint as a head nearly, and a man's hand no more looks like another man's hand than his head like another's."

Though the National Gallery still seeks a landscape by Eakins, these two portraits have helped immensely to round out the collection.

Homer and Bellows Full of Rugged Vitality

In the case of another great master of American realism, Winslow Homer, scarcity and demand have combined until today his paintings are more costly than those of any other American artist.

Collectors have recognized that Homer has to a pre-eminent degree a quality that is at the heart of the American style in painting, a certain hard, brusque actuality. This objective recording appears in his work from his early canvases like "Breezing Up" (page 317) to his last style, typified by "Hound and Hunter" (page 313). With lucid detachment he depicts the pleasures, the dangers, and the tragedies of men who live out of doors.

Winslow Homer was also preoccupied with the changing beauty of water, and in the National Gallery one can see how varied was his interpretation. His scenes range from the sparkling choppy waves of Gloucester Harbor to the vast breakers that gnaw at the cliffs of Maine, or from the stillness of Adirondack lakes reflecting the autumnal color of the shore to the monotonous swells of the Grand Banks, gray-green under leaden skies.

George Bellows brings the same realistic vision close to our own time. "Both Members of This Club" (page 312), showing a boxing bout at Sharkey's Athletic Club between a Negro and a white man, has a corrosive realism, a savage energy typical of one aspect, perhaps the most significant, of American art.

This painting was acquired for the Gallery exactly 20 years after Bellows died. Thus Bellows became a part of the permanent collection at the earliest possible moment, for the policy of the Board of Trustees requires that an artist's reputation be established for at least 20 years following his death before his work can be exhibited continuously and with the main section of the collection.

Paintings by more recently deceased artists can be accepted, however, for occasional exhibit. "Allies Day" by Childe Hassam, who died in 1935 (page 322), falls into this classification.

Though not yet qualified for continuous exhibition with the permanent collection, this painting was gladly accepted by the Gallery to be shown for a period of time each year as a distinguished example of an American adaptation of French Impressionism.

The style of the picture and its subject matter, incidentally, are curiously united, for both express, the one technically and the other symbolically, the commingling of America and Europe, a cosmopolitanism of style and spirit which represents an important phase of American art.

Two Traditions in American Painting

There have always been, in fact, two traditions in American painting. Eakins, Homer, and Bellows express one: a rugged native vitality. Whistler, Mary Cassatt, Chase, and Hassam illustrate the second: a genteel, Europeanized urbanity.

The reputations of our cosmopolitan painters have suffered from a wave of nationalism, which will probably pass. Though James McNeill Whistler's fame, for example, is brighter in Europe than in America, his sophisticated selection of what seems best

wherever found is of the greatest significance to this country, for it marks the coming of age of American painting. "The White Girl" (page 318), especially, is a landmark in the history of the American School.

"The White Girl" was shown in 1863 at the Salon des Refusés with what we now consider to be many of the greatest French paintings of the second half of the 19th century. It proved to be the sensation of that exhibition, the most revolutionary held in France in a hundred years.

True, the public was hostile, and Zola has reported how people nudged one another and became almost hysterical with indignation in front of the painting. But the wisest connoisseurs and critics were enthusiastic, and with "The White Girl" Whistler became the first American painter since the 18th century to attain renown and leadership among European artists.

Mary Cassatt is another American who achieved success abroad. Today her work hangs in the National Gallery of Art with that of the French Impressionists, who were her friends.

The six paintings from the Chester Dale Collection, ranging from "The Loge" (page 319), with its fragile, feminine beauty and its impressionistic technique, to "The Boating Party" (page 321), with its more solid painting and its anticipation of the bolder designs of the Post Impressionists, are among Miss Cassatt's most brilliant achievements. At her best she was probably the greatest woman painter of the 19th century.

Many Mansions in House of Art

But should Whistler and Mary Cassatt, who spent most of their lives abroad, form part of a collection of American art?

Citizenship in art is always hard to define, and particularly difficult in the case of the United States. For two centuries America has been a cultural adjunct of Europe, separated geographically, yet closely joined by blood, by tradition, and by travel.

Americans, because of their wealth, their migratory instincts, and their mixed ancestry, have formed the core of international society. Authors like Henry James and Edith Wharton have devoted much of their work to the analysis of American expatriation. What they have written is as significant and as valid as the writings of their colleagues at the opposite pole, novelists like Theodore Dreiser and Sherwood Anderson, who have focused attention on the American scene.

This contrast, so evident in our literature, is just as apparent in our painting. "A Friendly Call," for example, by William Merritt Chase (page 320), could serve as an illustration to Edith Wharton, whereas "Both Members of This Club" by George Bellows (page 312) would do equally well in a novel by Theodore Dreiser.

Both aspects of society, the local and the cosmopolitan, are important; both are significant to the artist.

In forming the collection of the National Gallery, we have tried to bear in mind that in the House of Art there are many mansions, and we have tried to show every important phase of American painting, to represent the work of the artists who have lived abroad and of those who have stayed at home, and to discern quality in both groups.

By our selection we have sought to prove that galleries hung with the greatest of American paintings can hold their own with galleries filled with the best European work of the same periods. The accompanying reproductions will help the reader to decide whether we have succeeded.

Names of the inventors and industrialists appearing in Christian Schussele's painting on page 309 are as follows, left to right: William Thomas Green Morton, dentist, physician, first to give a public demonstration of ether as an anesthetic; James Bogardus, machinery, used cast iron in building construction, making possible the modern skyscraper; Samuel Colt, the revolver; Cyrus Hall McCormick, the reaper; Joseph Saxton, fountain pen; Charles Goodyear (seated, arm on table), first to vulcanize rubber; Peter Cooper (behind Goodyear), industrialist, built *Tom Thumb*, first railway locomotive in America, financial backer of transatlantic cable; Jordan Lawrence Mott, anthracite stove; Joseph Henry (standing, left of column), physicist, organizer of Smithsonian Institution (page 327); Eliphalet Nott, educator, heating; John Ericsson (standing, right of column), developer of the screw propeller, designer U.S.S. *Monitor*; Frederick Ellsworth Sickels, steam engines; Samuel F. B. Morse, telegraph; Henry Burden, machinery; Robert Hoe, printing equipment; Erastus Brigham Bigelow, power loom for carpet manufacture; Isaiah Jennings, dentistry tools; Thomas Blanchard, machine tools for making tacks, turning gunstocks; and Elias Howe, the sewing machine.

Notice of change of address for your NATIONAL GEOGRAPHIC MAGAZINE *should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your November number, The Society should be notified of your new address not later than October first. Be sure to include your postal-zone number.*

The Smithsonian Institution

By Thomas R. Henry

THE Smithsonian Institution began its second century in 1947.

Its first hundred years encompass the major part of that systematic exploration of Nature which has brought man from the 10-mile-an-hour stagecoach to the jet plane, and which has nearly doubled the average span of human life. For much of this progress, the Institution in Washington, housed in three monumental buildings midway between the White House and the Capitol, has been a pioneer and torchbearer in North America.

The Smithsonian is one of the oldest of the privately financed American scientific foundations whose investigational work has been perhaps the most significant factor in making the present age possible. It has served more or less as a model for all the others.

When he died in 1829 an English scientist named James Smithson willed his fortune of approximately $500,000 to the United States of America to set up in Washington an establishment "for the increase and diffusion of knowledge among men." He made no further definition of his desires. It was an ideal form of bequest for any institution, allowing almost unrestricted latitude for research and educational activities.

Compared with endowments of science in more recent years, this was a trifling sum; but it was such an enormous amount at the time that Members of Congress wondered how it could possibly be spent for the purpose specified. Few at that time had any conception of science for its own sake as a worthwhile pursuit.

"High Adventure" of Science

A brave, defiant little man, lashed all his life by devils, was this James Smithson—illegitimate son of a Duke of Northumberland, in whose veins ran the blood of England's kings; gentleman devotee of chemistry and mineralogy; rich, sick, soul-tortured exile. He was born to frustration.

In snug England of the Georges his birth barred him effectively from those respectable professions in which gentlemen with stirrings of ambition could justify their lives, such as the Army or Navy, the Church, or diplomacy. Fate seemed to have doomed him to obscurity and intolerable boredom. James Smithson escaped by crossing the borders of a realm of high adventure—natural science.

This field was then a hobby rather than a vocation. James Smithson busied himself with test tubes and collections of rocks. At 22 he became a member of the Royal Society. He made some notable contributions to chemistry and mineralogy. But he apparently had a vision of the future such as was shared by few men of his generation.

To his pain-filled loneliness came dim glimmerings of "the wonder that would be" through the systematic pursuit of science. It was a promise he would not live to see fulfilled. The shadows gathered about the wanderer. With one last blow he struck back at fate and defeated oblivion.

One can appreciate all the bitterness of sixty years of frustration in Smithson's heart as he willed his fortune—part of it obtained, some say, at the gaming table and by betting on horse races according to mathematical systems he himself devised—to a country which had eschewed noble blood and coronets.

Then the frustrated man died secure, as he wrote, in the faith that "my name shall live in the memory of man when the titles of the Northumberlands and the Percys are extinct and forgotten." His entombed remains now rest in the great Institution he founded, near the entrance. Thousands have paused reverently to give him a moment's homage.

Vision of a Practical Legislator

When one considers the low estate of scientific appreciation among many legislators and their constituents in those days, it seems almost a miracle that James Smithson's money was not wasted.

Hurdles of ignorance and indifference were surmounted, largely because of the intelligent vision of former President John Quincy Adams, then a Member of the House of Representatives, and the Smithsonian Institution was set up on the general plan it has followed since.

The time could hardly have been better chosen. It was almost at the beginning of one of those great intellectual surges—perhaps the greatest of all—by which the tide of civilization has advanced through the ages.

Progress of science the world over before 1846 had been spasmodic and unorganized. Practical men had solved brilliantly a few mechanical and medical problems. "Impractical" men—James Smithson may have been one of them—collected plants and butterflies as children collect sea shells.

The whole realm of science before Smithson's time might be compared to the continent of North America through most of the 17th

National Geographic Photographer R. Anthony Stewart

Bronze *Freedom* on United States Capitol Dome Was Cast from Model Now in Smithsonian

Thomas Crawford (1814–57) designed the figure, 19 feet 6 inches high, clad in draperies. Her right hand holds a sheathed sword, her left a shield. On her head is a helmet encircled by stars, and a feather headdress.

century, a vast, almost unexplored wilderness. Here and there a few pioneers had begun to penetrate, but their findings were not coordinated or assembled for the common benefit.

The establishment of the Smithsonian was like the opening of the first bank at the edge of the forests. It was a place where the garnerings of many men along the advancing frontier could be stored to constitute community wealth.

This has remained the most significant function of the Institution for a century. It has been a place where science "banks" men's skulls and butterflies, fossil dinosaurs, and Indian dolls.

From the first the Smithsonian took all knowledge as its province. Its interests have ranged from the crawling life of Cambrian beaches to the tools of the village blacksmith.

Through the years it naturally has accumulated a great store of curiosities, but its real treasure is in its vaults—fishes and reptiles in tanks of alcohol, insects, fossils, bird skins, dried leaves and flowers in long rows of storage cases. The bulk of this material is seldom seen by the general public. It is, for the most part, unspectacular, except to the specialist.

Since the Smithsonian's founding, ten Government agencies dealing with art, science, and related activities have been placed under its direction and are essentially a part of it. They are supported in whole or in part by Congressional appropriations, which today greatly exceed the Institution's income from the Smithson bequest.

Pioneer in Electricity

Fortunately for the realization of James Smithson's wishes, the man chosen to organize and direct the new Institution in 1846 was one of the most broad-minded and intelligent men of the day.

He was America's best-known physicist of his time—Joseph Henry. He had discovered the basic principle of the telegraph, but left the harvest of profit and fame to be garnered by others. He made an electromagnetic engine, and his great work on electromagnetism was one of the bases for all electric motor and generator development. (See Schussele's painting, pages 309, 324.)

"My ambition," Henry said, "is to add to the total sum of human knowledge by discovering new truths. Their practical application I leave to others."

During the Civil War, Henry's genius was employed in defense of the Union. He was frequently called to the White House by President Lincoln for advice on scientific problems arising out of the war.

Henry laid down the basic pattern of the Smithsonian, but he had little personal interest in the great field of biology to which the Institution was destined to make some of its greatest contributions.

When he died in 1878, knowledge of the teeming plant and animal life of the North American Continent was scanty, patchy, and largely unsystematized. It became the job of his assistant, and, later, successor, Spencer Fullerton Baird, to carry out the development of the great collections which are today one of the two or three most important reservoirs of biological material on earth. Here are to be found study specimens of almost all living things from jellyfishes to gorillas.

Life in Myriad Forms

Altogether, the U. S. National Museum, a branch of the Institution, has more than 15,000,000 biological specimens.

There are approximately 280,000 species of plants, including fungi, now known in the world. About a third of these are included in the 2,300,000 specimens in the Smithsonian.

Reptilian forms number only about 10,000. Nearly 50 percent of them are represented in the 133,000 preserved at the Museum.

The collections include 254,000 mammals. The latest estimate is that there may be as many as 14,000 species and geographical races extant.

One of the Government-supported branches of the Smithsonian is the National Zoological Park, where live mammals, reptiles, and birds are kept both for the education of the public and for scientific study (page 332).

The most abundant and varied form of life is that of the insect kingdom. A rough estimate of the number of species identified all over the world up to the present is 800,000. Several thousand hitherto unknown species are described each year. All the major genera are represented in the 6,000,000 specimens in the Smithsonian cases.

The collections are most nearly complete in respect to bird life. There are about 8,500 species of birds known in the world. Subspecies, or geographic variations in different areas, increase the number to about 30,000. Of these, 65 percent are represented among the 330,000 specimens in the National Museum.

Ornithology is the specialty of Dr. Alexander Wetmore, the present Secretary, from whose own explorations in North, Central, and South America several thousand items have been added to the collections (page 344).

Dr. Wetmore has devoted much research to extinct birds (page 340). This is a particularly difficult field because of the fragility of

National Geographic Photographer R. Anthony Stewart

Gowns of Presidents' Wives Draw Most Attention from Smithsonian's Female Visitors

Dolly Madison's dress is arranged for a photograph while Martha Washington's figure sits by. Included in the collection are garments of relatives or friends who served as hostesses for Presidents whose wives were dead or ill, and for the only bachelor, James Buchanan. Only a shawl of Martha Randolph, Jefferson's daughter, is available, since her dresses were cut up for reuse during the Civil War. A cloak is worn by the figure of Martha Patterson, Andrew Johnson's daughter, since no other garment of hers could be found. Faces are not likenesses, but hair arrangements are authentic.

the light bones of feathered creatures. Fossils usually are very fragmentary. Dr. Wetmore's systematic classification of all birds, extinct and extant, which was based largely on his studies of the Museum collections, is now the accepted authority the world over.*

Known fishes number about 40,000 species and subspecies, with 1,400,000 specimens in the National Museum, representing about 60 percent of the known forms (page 347).

During its history the Institution has sent out approximately 1,500 exploring and collecting expeditions. Nearly half have been for the purpose of enriching the plant and animal collections.

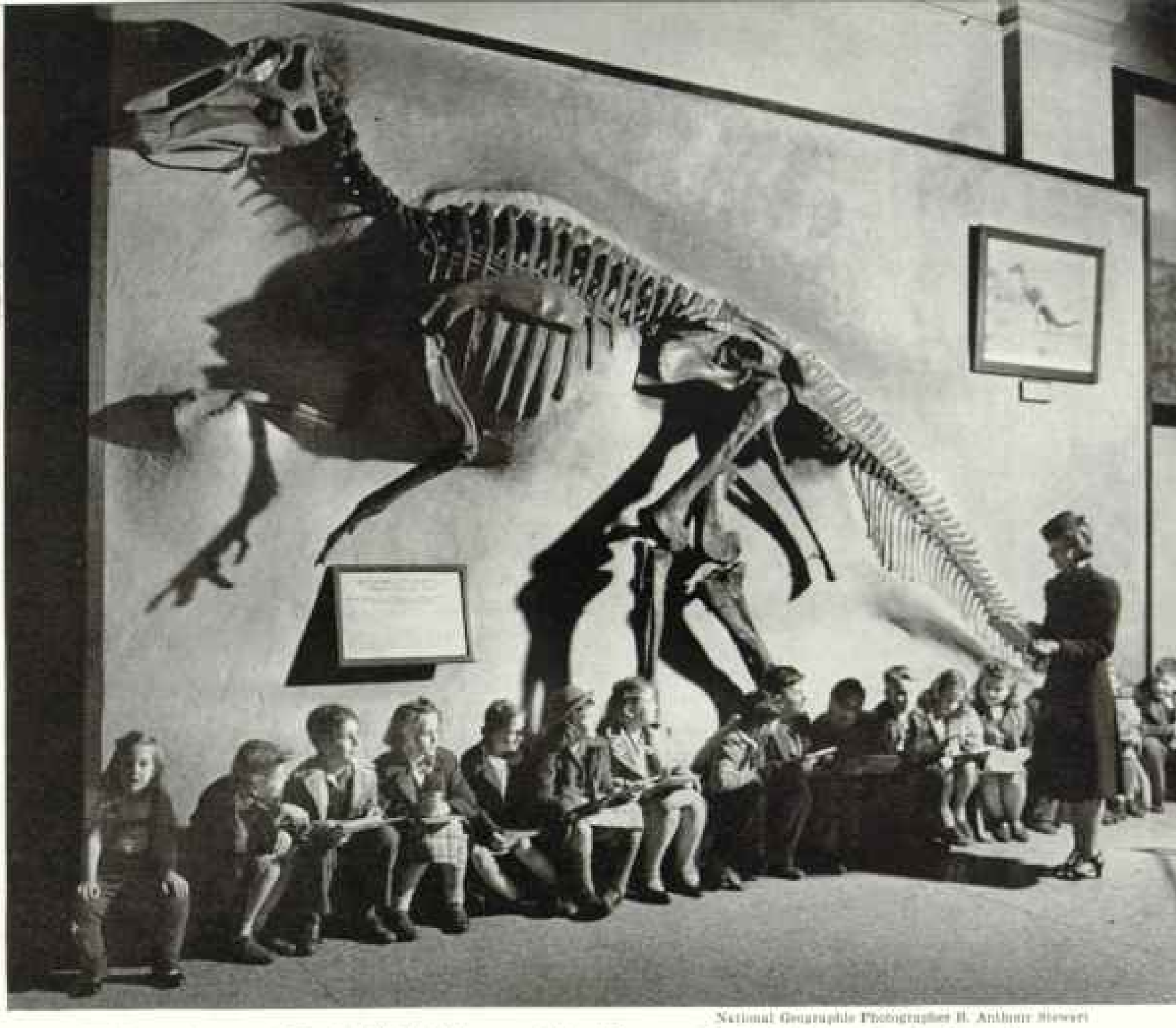
Relatively little of this biological material is of much interest to the lay public. Only a few of the more spectacular specimens are on display. Its value, however, is enormous, both economically and from the standpoint of pure science. It has been described as an enormous "dictionary of Life," containing and defining the symbols in which the story of organic evolution from algae to man has been written.

Man Aspires to Wings

The Smithsonian was one of aviation's first workshops. Today it is a pantheon of that epic development of the past 45 years which has made it possible to span the United States from ocean to ocean in little more than four hours. Here flight was pioneered in a series of successes which, however, culminated abruptly like the final scene of a Greek tragedy, with the frustrated closing of a scholar's dream.

The third Secretary of the Institution was

* See *The Book of Birds* (2 volumes), edited by Gilbert Grosvenor and Alexander Wetmore, with 950 color portraits by Maj. Allan Brooks, published by the National Geographic Society. At present out of print.



National Geographic Photographer B. Anthony Stewart

Children Learn of Duck-billed Dinosaur That Ran on Its Hind Legs in Ancient Swamps

Twenty-six feet long and eight feet high at the hips, this reptile lived about 80 million years ago in what is now Wyoming. Others have been found in midwestern, eastern, and southern States. Its diet of water plants was chewed with 1,100 teeth. Dinosaurs in the Smithsonian range from Diplodocus, 70 feet long, to small ones the size of a turkey, constituting one of the world's most complete collections (page 330).

Dr. Samuel Pierpont Langley. He was one of the foremost physicists and astronomers of his generation. The Smithsonian had swung back to the tradition of Joseph Henry. Langley came to Washington with a dream of giving man the wings of an eagle.

The prospect had intrigued Professor Langley since boyhood. His unique contribution after he came to the Smithsonian was to explore the possibilities systematically with trial-and-error tests, according to established scientific procedure. He accepted nothing, assumed nothing, but worked out the basic principles on which any heavier-than-air flight must depend.

Langley was ever on the alert for a clue which would aid in solving the problem of flight. Crossing a bridge over the Potomac on a windy winter evening, he watched the buzzards and meditated on their remarkable ability to remain in the air almost without effort.

After several years of experimenting a light steam engine was developed. On May 6, 1896, a steam-powered model with a 13-foot wingspread was catapulted successfully from a houseboat in the Potomac. It flew more than half a mile unmanned but inherently stable, and landed gently and unharmed on the water.

He then turned his attention to a man-carrying flying machine. In the fall of 1903 this was completed, and on October 7 an attempt was made to launch it from a houseboat anchored in the river about 40 miles below Washington.

It never got into the air properly. The front king post did not detach from the launching mechanism, and the guy wires were forced backward to a fatal extent.

The "aerodrome" was repaired, but a second attempt also failed in the launching.

This was on December 8, 1903. Nine days later the first human flight in a heavier-than-

air machine was achieved by Wilbur and Orville Wright at Kitty Hawk, North Carolina, in a biplane constructed by them after independent scientific investigation.

Wright Plane Coming to Smithsonian

Langley never begrudged the glory of the Wrights, and the plane they flew at Kitty Hawk soon will be enshrined in the Smithsonian in accordance with the wishes of Orville, who died January 30, 1948. It will be the crowning addition to the Smithsonian's new National Air Museum, in which will be displayed historic aircraft that have marked the successive forward steps of aviation in America (page 345).*

These planes—the most celebrated is the *Spirit of St. Louis* in which Col. Charles A. Lindbergh first flew solo from New York to Paris—constitute probably the Smithsonian's greatest popular attraction, especially for the air-minded schoolboys of this age of flight.

Langley helped push ajar the gates of the winged future. It remained for his successor to make long voyages through the nightmarish past to the earliest days of life on earth. Dr. Charles D. Walcott was one of the foremost paleontologists of the century. He explored the infinities of dead time as astronomers explore the infinities of space.

Death has been Life's biographer for half a billion years, since the first cryptic notes on the great struggle for survival were written on soft, flat seashores of the Cambrian geological period.

A drowsy summer afternoon of the ages was this Cambrian time. Warm tides washed gently over low beaches of undulating continents with red and purple hills. Rivers flowed lazily into sleepy seas. Great shallow arms of the Arctic Ocean cut far southward into the continents of North America and Eurasia.

About 50,000,000 years elapsed. During this time span Life's first records were written in the ocean-bottom ooze which, in succeeding ages, was hardened into rocks from which mountains were built.

Vast hordes of little animals swarmed in the shallow inshore waters. They had hard shells which were preserved in the mud. They were, of course, far from Life's beginning. Their simpler predecessors must have been soft-bodied animals not preservable as fossils.

The Smithsonian has made peculiarly its own this first recorded chapter of Life's story, a chapter based largely on the enormous impetus given the collection and interpretation of Cambrian fossils by Dr. Walcott. The dominant animals in the warm Cambrian seas were the trilobites—vaguely similar to present-day crabs and scorpions, although not in any direct ancestral line (page 341).

Most spectacular from the viewpoint of the average visitor to the Smithsonian exhibition halls are the fossil skeletons of the monster dinosaurs. Compared with the trilobite, of course, they were creatures of yesterday—enormous reptiles which began to appear on earth not much more than 150,000,000 years ago.†

North America was particularly rich in dinosaur fossils, and Smithsonian scientists such as the late Charles W. Gilmore were unusually successful in locating them.

Dominating the Institution's collection of dinosaurs stands Diplodocus. It was one of the largest animals ever to live on land. The creature was more than 70 feet in length from the front of its head to the tip of its tail, and stood nearly 15 feet high. As nearly as can be estimated from the bones, Diplodocus weighed from 20 to 30 tons. A large elephant may weigh four or five tons.

The dinosaur may have eaten about a quarter of a ton of water weeds a day. Judging from the size of the monster's brain, it could have had little more than a vague awareness that it was alive.

The dinosaurs—reptiles with bills like ducks and feet like turkeys, horned monsters, waders, flesh eaters, plant eaters, creatures ranging in size from a small rabbit to Diplodocus—are represented in all their weird diversity in the Smithsonian collections (page 329).

Remnants of Earth's Dawn Age

The long era of the dinosaurs gradually merged into the age of singing birds, blooming plants, and the warm-blooded life which now proceeded for about 50,000,000 years toward its noontime. The Smithsonian collections are particularly rich in fossils of this Eocene, or "dawn" age.

Very early—in the so-called Paleocene time which came just before the dawn—there appeared in North America the extremely primitive precursors of the line of mammals which eventually was to lead to the great apes and man. The fossils representing these creatures are only tiny fragments. They lack any elements of the picturesque and are filed away for the use of experts.

Among them are fossil bones of an order of mammals altogether different from anything

* For list of numerous articles on stages of aviation development, see headings "Aeronautics" and "Aviation" in "National Geographic Magazine Cumulative Index, 1899 to 1947."

† See "Parade of Life Through the Ages," by Charles R. Knight, National Geographic Magazine, February, 1942.

Ektachrome by Justin N. Locke

The Army Map Service Re-creates the Earth's Surface in Tough, Spongy Rubber

Relief-map experts put finishing touches on a large-scale model of the Philippine Islands. Made of foam rubber with a strong latex "skin," the map withstands rough treatment and rolls up for carrying. Wartime models blueprinted island-hopping campaigns in the Pacific and the invasions of Europe.

Washington, D. C., political heart of the United States, is also in many ways the Nation's science center. These color photographs show glimpses of a few of its varied scientific activities. Best known of the Capital's scientific establishments is the venerable Smithsonian Institution, subject of the accompanying article. Founded with the fortune of James Smithson, an English scientist, it began its second century last year.

Kodachrome by Justin N. Locke

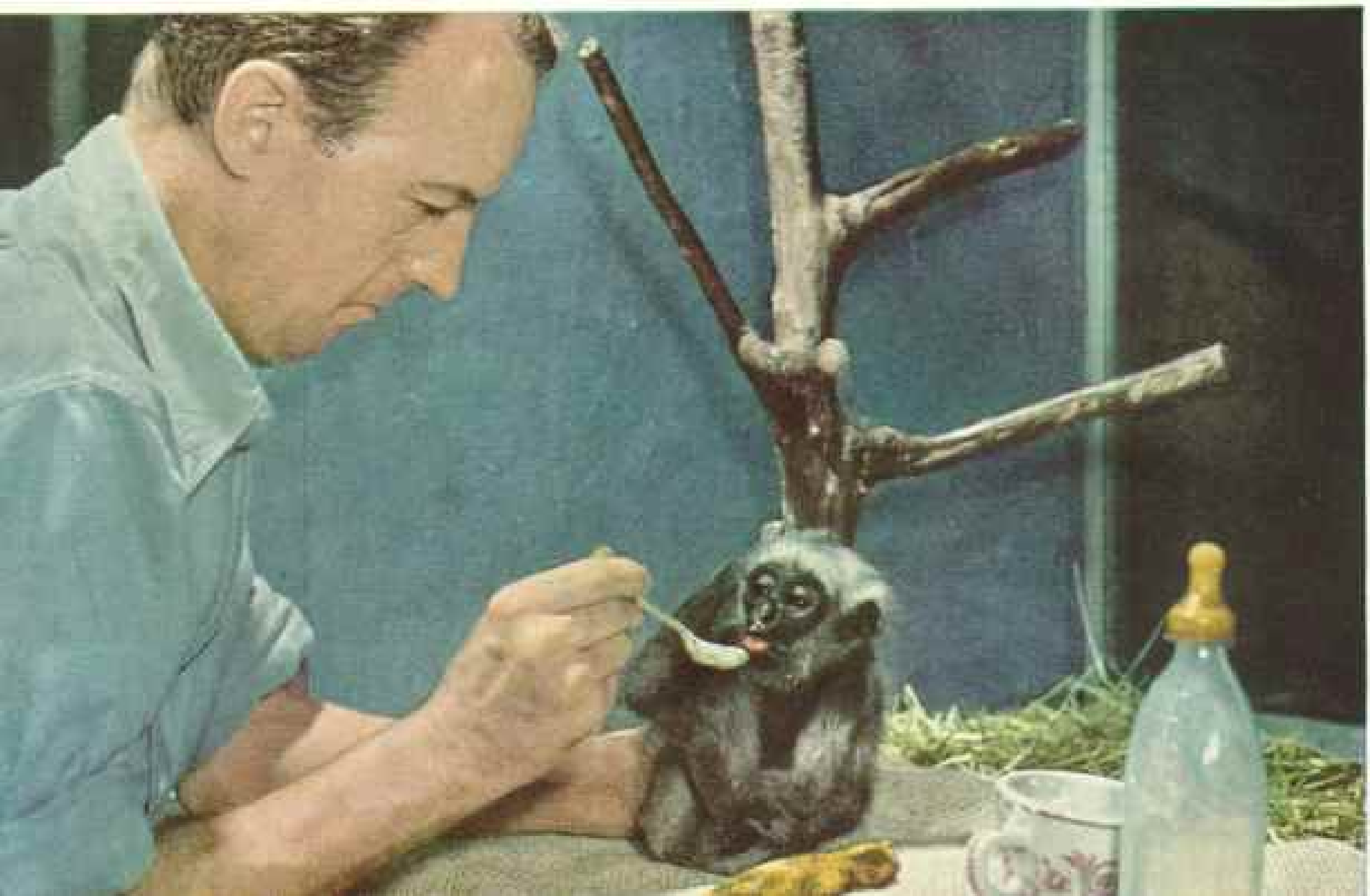
Birdhouse Attendants in the Washington Zoo Cater to Fussy Appetites

From a bird "chuck wagon" they prepare special dishes to suit the varied tastes of a world-wide collection. At left is Jacob, pet cockatoo from the East Indies. The Zoo is part of the Smithsonian Institution.

When an Excited Mother Gibbon Won't Feed Her Baby the Keeper Takes Over

Hand-raised at the Zoo on infant foods and a bottle, Barbara is now a healthy four-year-old—the first hybrid gibbon ever raised in captivity. As a baby she sucked her thumb and played with a rattle.

Kodachrome by R. Anthony Stewart



Illustrations by Justin N. Locke

↑ For Its 1,800,000 Members the National Geographic Society Maps the Capital

The Society's chief cartographer watches the cutting out of street and building areas from a red transparency overlaying the current map of Washington, D. C. The red, covering parks, appears green on the finished map.

↓ At the Botanic Garden, in the Shadow of the Capitol Dome, Orchids Bloom Every Day

On display are more than 8,000 plants of some 650 varieties from all over the tropic and subtropic world. Here an orchidologist cross-pollinates a moth orchid, native of the Philippine Islands.

← Captured German Models Give Navy Experts Data on Supersonic Missiles

Milton "Buck" Rogers, aeronautical engineer at the Naval Ordnance Laboratory, studies a modified version of the powerful V-2 rocket. Others stand on his desk. Model at left with swept-back wings is, unlike the V-2, a controlled missile; war's end prevented its use.

Kodachrome by Justin N. Locke

A Former Smithsonian → Institution Secretary Harnesses the Sun's Vast Power

Dr. Charles G. Abbot, noted astrophysicist, adjusts a working model of his latest invention, a solar-powered steam engine. The reflector focuses the sun's rays on the boiler tube, generating steam which drives the tiny engine at left. The clockwork at right turns the reflector to follow the sun.

Kodachrome by Justin N. Locke

In a Kindergarten Setting, George Washington University's New Eye Clinic Leads Youngsters Back to Normal Sight

Some children lose their ability to fuse into a single picture what their two eyes view. To prevent seeing double, Nature suppresses one eye's sight. By covering the good eye, the orthoptic clinic strengthens the poor one; then it restores the brain's fusion power. Here the supervisor checks a child's progress.

© National Geographic Society

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Ektachrome by Justin N. Locke

↑ Cheek-tinting Rouge Puts a Gleam in the "Eyes" of a New Aerial Camera

A final polishing with the powder, dissolved in water, gives brilliance to these lenses, designed and built by the National Bureau of Standards. The technician puts a polishing cap, lined with rouge-tinted pitch, over a lens.

↑ The Flame in a Supersonic Ram-jet Engine Has Its Picture Taken for Research

Propane gas, injected into an air stream, shoots out in a tongue of blue flame. This is part of a Navy guided-missiles study at the Johns Hopkins University Applied Physics Laboratory, near Washington, D. C.

Ektachrome by Justin N. Locke

 337 Kodachrome by B. Anthony Stewart

To Protect Your Health, a Government Chemist Tests Canned Shrimp

He works in the Washington laboratories of the Food and Drug Administration. The depth of color in the stoppered glass cylinders in the foreground indicates the condition of the pack.

Kodachromes by B. Anthony Stewart

A Fortuneteller's Dream—the Largest Perfect Crystal Ball in the World

A flawless sphere nearly 13 inches across, it is part of the Smithsonian Institution's mineral collection, the world's most complete. The crystal inverts the image of a girl seated behind it.

An Army Technician Inoculates Embryos in Eggs with Japanese Sleeping Sickness

The virus grows in the unborn chicks. At the end of ten days they are made into vaccine. Planes fly it, frozen and packed in dry ice, to U. S. forces in Japan, Okinawa, and Guam.

known on earth today, or for the past 50,000,000 years.

These were the multituberculates, the dominant order of mammals at the end of the age of dinosaurs. They were small rodentlike creatures, the largest about the size of a woodchuck. Presumably they were either egg layers or marsupials like the present-day pouched animals of Australia. They were one of Nature's discarded experiments on the way to elephants and dogs and men.

For nearly a decade of summers Smithsonian paleontologists hunted fossil horselike mammals in the Rocky Mountains of Wyoming and Montana. These expeditions have given the horse an almost complete family tree. There are few missing links between the earliest of the line—creatures no larger than bird dogs with toes which had not merged into hoofs—and the Arabians and Percherons of the present.

Story of the American Indian

The Europeans who followed Columbus to the Americas found dark woodlands peopled sparsely by "savages" with bronze-hued skins, straight black hair, and sometimes with grotesquely painted faces. These "savages" spoke several hundred apparently unrelated languages, and their cultures ranged from some of the lowest levels known to the human race to the astronomy of the Maya and the political organization of the Iroquois.

Whence came these "red men"? For more than three centuries few cared. The interests of the white man in the Indian were, paradoxically, twofold—to exploit and dispossess him and to save his soul.

The European's world was egocentric. But the newcomer absorbed much. From the Indian he learned about many new plants unknown in Europe—maize, potatoes, and tobacco are outstanding examples.

From Iroquois and Delaware the white man also learned military tactics which were to confound European armies and to which scalplocked, face-painted American paratroopers reverted in World War II.

Study of Indian origins and culture has been a major Smithsonian activity from the beginning; since 1879 this work has been under its Bureau of American Ethnology. From these studies have come many of the best and most detailed data the world possesses, both on the Indians themselves and on the basic factors in the development of human culture everywhere.*

Inextricably interwoven with the cultural studies of the Indian have been archeological researches to uncover the origins of the New World aborigines and the ebbs and surges of culture through the long centuries before the white man came. It was quickly obvious to the scientists that the Indians were not entirely a race apart. In features and anatomical characteristics they were Mongoloids, somewhat divergent members of the group which peopled eastern Asia.

This led naturally to the hypothesis that their ancestors must have come to the Americas from Asia at some remote time—probably quite remote indeed to account for the enormous diversification of languages and folkways that had taken place in the two continents.

Whence Came the Indians?

Since the most reasonable hypothesis was that the road of the red man in North America started somewhere around Bering Strait, this whole area was explored intensively for human remains by Smithsonian expeditions through many summers. The general concept which has developed from all these studies is that the ancestors of the aborigines came from Asia in scattered, entirely unorganized migrations which may have started as early as 20,000 years ago and ended in the relatively recent past.

When the first groups came, this was a dismal land gripped in one of the winters of the ages, with thick ice sheets covering much of the northern half of the continent. The woolly mammoth, Pleistocene camel, and giant sloth still were extant, and great herds of native horses browsed on the cold wet plains of Arizona.

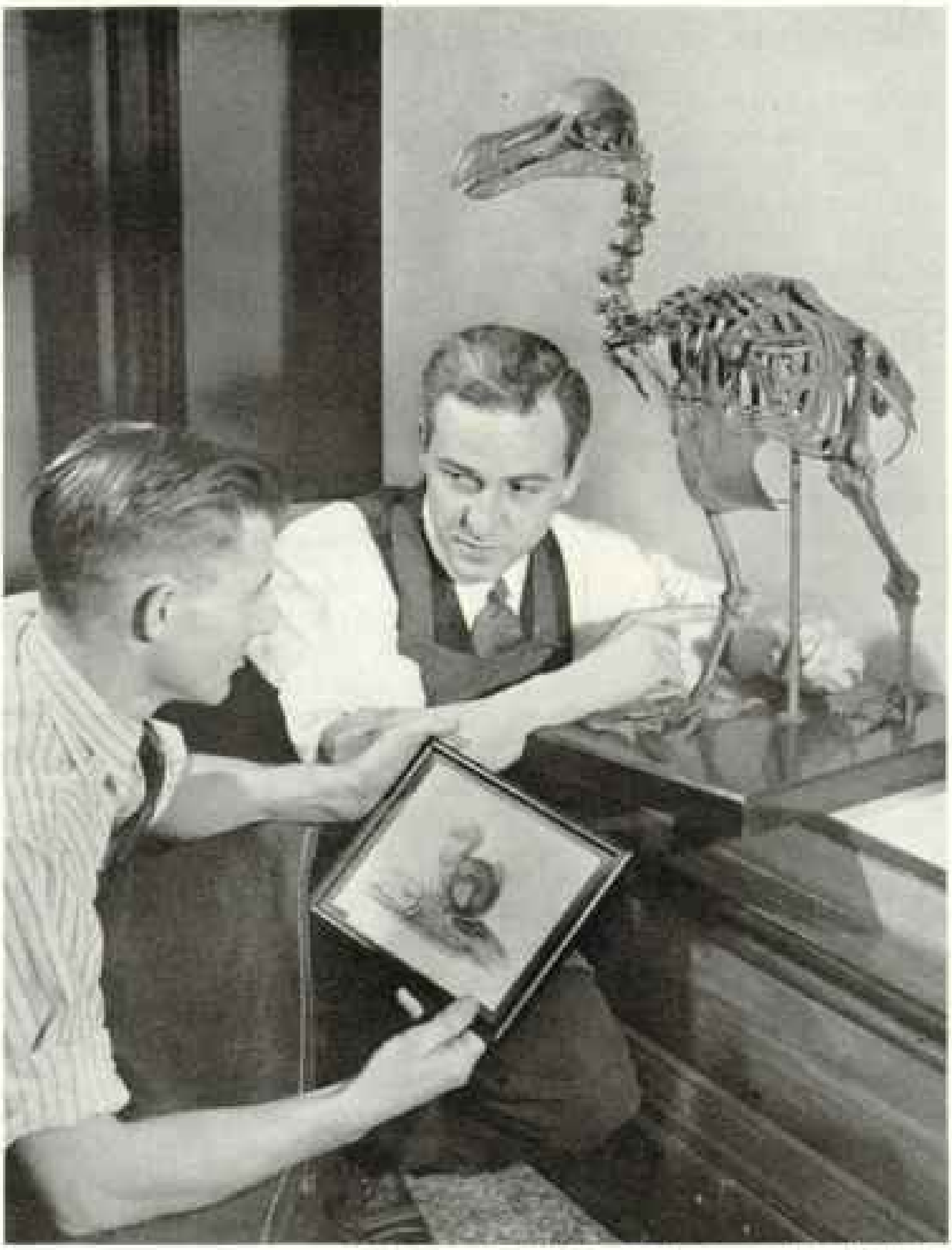
The last migration, which brought the progenitors of the present-day Athabascan tribes, of whom the Navajos of New Mexico and Arizona are the best known, may have taken place not many hundreds of years before the first voyage of Columbus.

Actually, there has been migration in both directions. One of the most significant of these Bering Sea expeditions was a joint enterprise of the Institution and the National Geographic Society carried out in 1936 by Dr. Henry B. Collins, Jr., of the Smithsonian staff.†

His discoveries, together with earlier Smithsonian excavations which had proved that the Eskimos came originally from Asia, showed that man had migrated both eastward and

* See, in the NATIONAL GEOGRAPHIC MAGAZINE, the many articles on the American Indian by Dr. Matthew W. Stirling, illustrated with paintings by W. Langdon Kihn.

† See "Exploring Frozen Fragments of American History," by Henry B. Collins, Jr., NATIONAL GEOGRAPHIC MAGAZINE, May, 1939.



National Geographic Photographer John E. Fletcher

Only Bones Remain of the Dodo, Extinct for 250 Years

Smithsonian's skeleton of this famous flightless bird is one of the most complete. Settlers on the island of Mauritius, in the Indian Ocean, hunted it for food, while their rats, dogs, and swine destroyed the eggs and young. Its extinction was complete by 1693. The man on the left holds a picture of a live specimen brought to Europe in the 17th century.

westward in Arctic North America, and that some aborigines may even have returned to Asia.

One of the major excavations of the Institution during the past decade was that of a summer bivouac of ancient camel and bison hunters who apparently followed the animals feeding in lush meadows left in the wake of melting glaciers during the closing days of the last ice age.

This place—the Lindenmeier site—in northern Colorado is one of the oldest-known habitats of human beings on the continent. Its people presumably antedated the bow and arrow, for Smithsonian expeditions led by Dr. Frank H. H. Roberts, Jr., have found there hundreds of distinctively designed flint spearheads in association with bones of long-extinct mammals.

Unfortunately, the earliest Americans left no bones of their own from which could be obtained some idea of what type of men they were. Thus this so-called Folsom man remains a wraithlike figure who apparently spread over most of the present area of the United States.

The Colorado site has been dated by geologists as not less than 10,000 nor more than 25,000 years old. Thus the Smithsonian has a record of a race of men in a discrete setting for at least a hundred centuries.

A Pre-Columbian Apartment

North of Mexico Indian material culture reached its highest development among the corn-raising farmers of the present southwestern United States. They lived in great "apartment houses" which contained their homes, storage rooms, and temples.*

One of the largest and most elaborate of their buildings in North America was Pueblo Bonito, in the Chaco Canyon of New Mexico. The ruin was approximately 1,000 years old. It had consisted of about 600 rooms in four terraced stories, covered more than three acres, and had housed at one time between 800 and 1,000 people. In 1920 when Neil M. Judd, the Smithsonian's curator of archeology, made his preliminary survey, the tumbled ruin was buried in debris and wind-blown sand.

For the next seven summers Judd, heading a cooperative project of the Smithsonian and

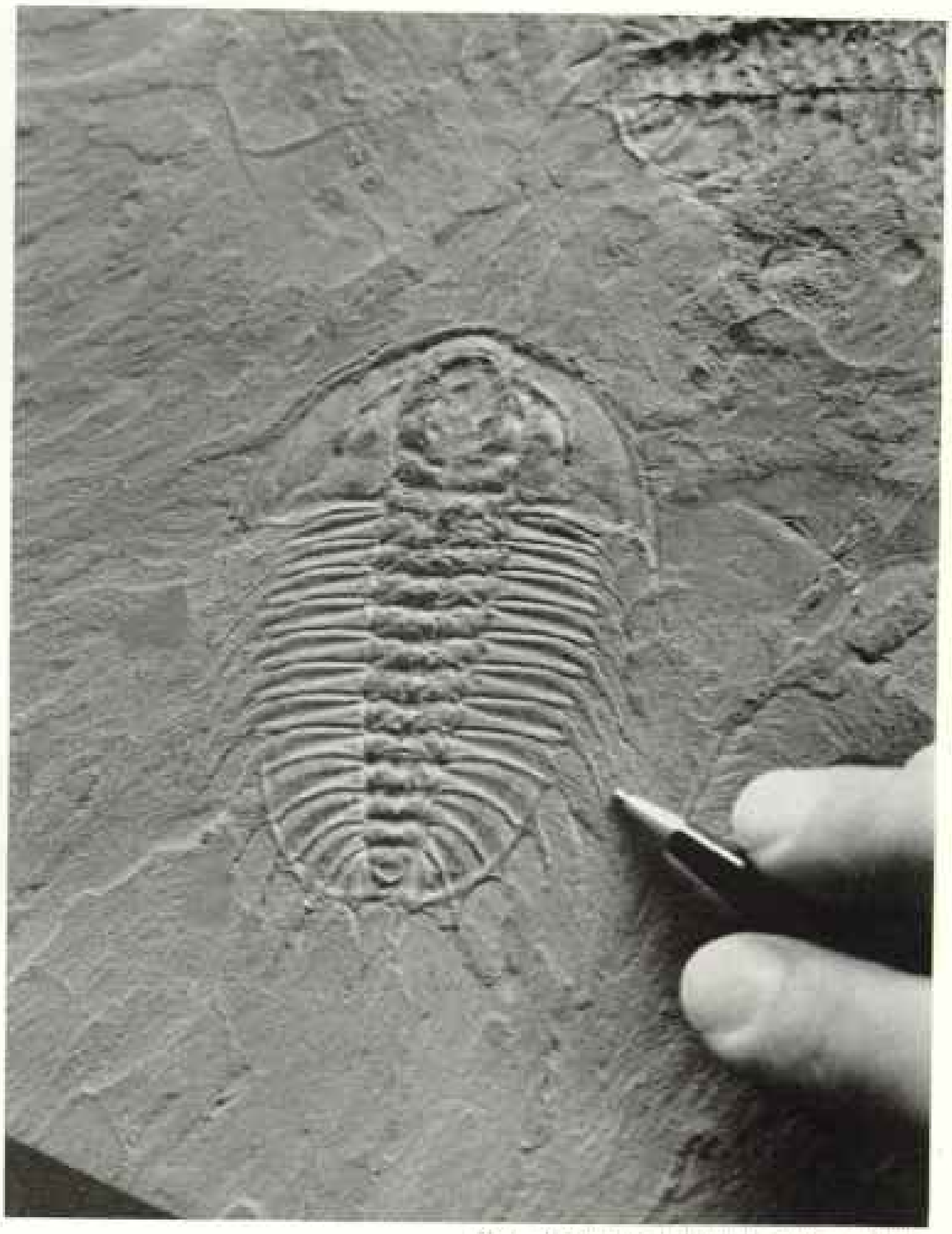
* See "Ancient Cliff Dwellers of Mesa Verde," by Don Watson, page 349 in this issue.

the National Geographic Society, worked on the site to uncover and preserve for the American people the most famous ruin in this country.*

The culture of the red men reached its greatest heights among the Maya Indians of Yucatán and Guatemala. In a land now covered by almost impenetrable jungle was evolved one of the three "high civilizations" of antiquity—a corn civilization not unfavorably comparable to the wheat civilization of the Mediterranean Basin or the rice civilization of China.

Whence was derived this civilization of cities and temples, astronomy and mathematics, which was far in decline when the first Spaniards came with their halberds and crucifixes? This was one problem which Dr. Matthew W. Stirling, Chief of the Smithsonian's Bureau of American Ethnology, attacked nine years ago in a joint undertaking of the Institution and the National Geographic Society.†

Scattered through the Mexican States of Veracruz and Tabasco were sites occupied by an ancient people, the Olmecs, beginning about 200 years before Christ. Here was found the earliest-dated stone in the New World. From the bar and dot numerical symbols carved on it, later used by the Maya, this stone could be ascribed definitely to the year 31 B. C., according to the most commonly accepted correlation of Mayan and Christian calendars. By means of pottery fragments it was possible to trace the development of these people and their contacts throughout southern Mexico.



National Geographic Photographer John E. Fletcher

500 Million Years Ago This Trilobite Lived in Ancient Seas

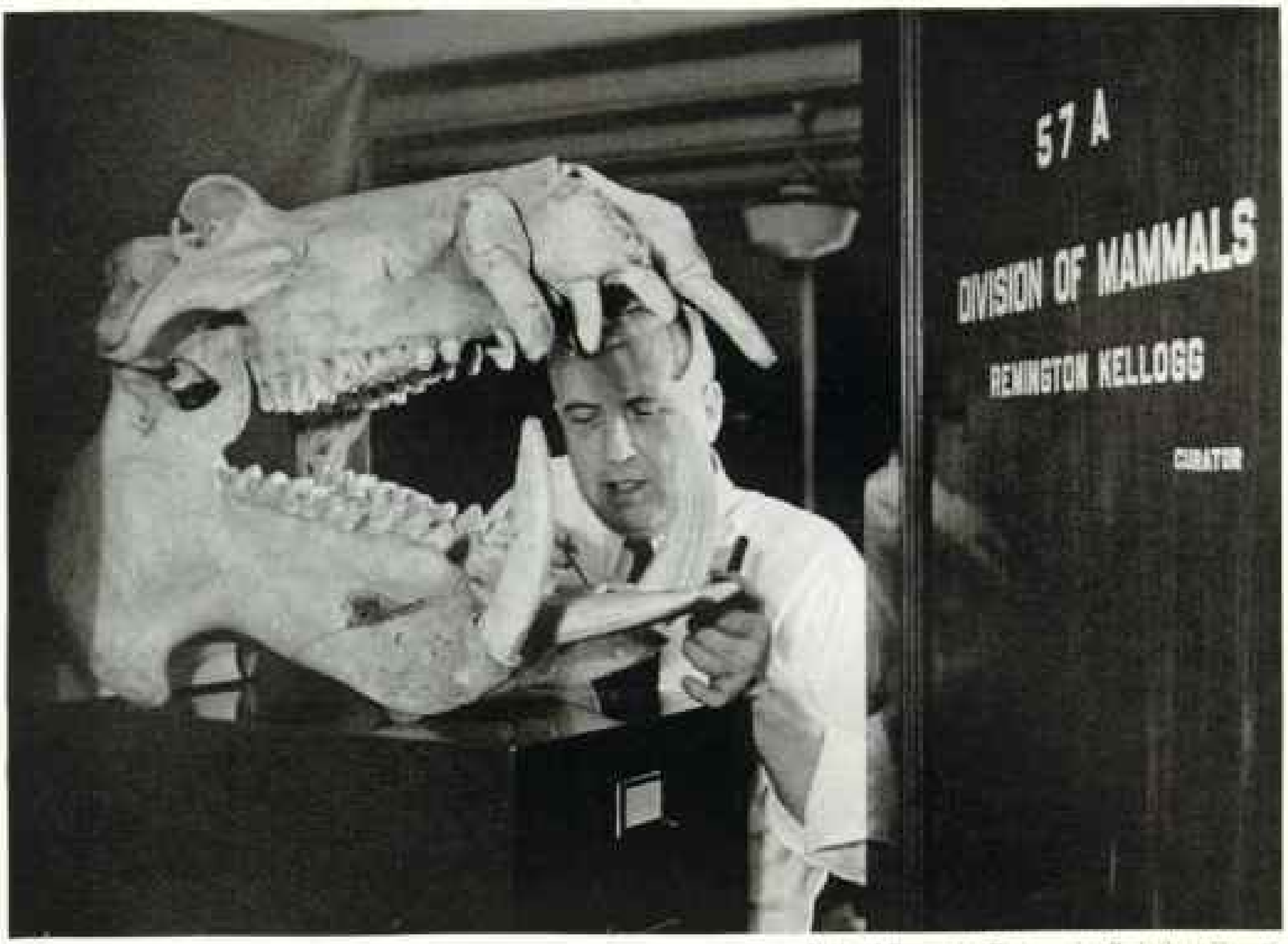
One of the earliest forms of animal life, the creatures had jointed or articulated shells and crablike legs. Long extinct, they are preserved as fossils in rocks deposited as far back as the Cambrian period, the oldest that can be approximately dated. Trilobites varied from a fraction of an inch to over a foot in length and were distant relatives of present-day crustaceans (page 330).

A Reference Library of Human Skulls

Among the treasures of the Institution are approximately 17,000 human skulls. In the language of skulls dead men tell strange tales of dead times. By means of them anthropologists trace migrations of peoples, mixtures of racial stocks, the ebbings and surgings of the human ocean. The skull is the one part of

* See, in the National Geographic Magazine, "Beyond the Clay Hills," March, 1924; "Everyday Life in Pueblo Bonito," September, 1925; "Pueblo Bonito, the Ancient," July, 1923; and "Pueblo Bonito Expedition of the National Geographic Society," March, 1922, all by Neil M. Judd.

† See, in the National Geographic Magazine, "On the Trail of La Venta Man," February, 1947, and "La Venta's Green Stone Tigers," September, 1943; and many other articles by Matthew W. Stirling.



National Geographic Photographer B. Anthony Stewart

Best Time to Put Your Head in a Hippo's Mouth Is after He Gets into a Museum

Dr. Remington Kellogg, mammalogist and new Director of the National Museum, examines the structure of a hippopotamus skull. With all its array of teeth, the animal eats only vegetable foods. The large tusks, including those extending horizontally from the lower jaw, probably are used to dig up plants from river bottoms. The Smithsonian has one of the largest collections of hippo skeletons.

man's anatomy which is most distinctly human and, fortunately for science, it is the part best preserved through the ages (page 348).

These crania have been gathered from all over the world. They have been studied and classified until they constitute a skull dictionary. By referring to them it is possible, within limits, to tell the race, age, sex, period in history, and something of the mental condition of the owner of almost any skull found anywhere. They have helped solve murder mysteries. They have been used to identify distinguished dead men after a couple of centuries.

Human intelligence varies roughly, providing there are no pathological conditions, with the size of the brain and with the development of certain of its areas. This is a very general rule, of course, to which there are notable exceptions. There are historic cases of brilliant intellects in quite small heads.

It is noteworthy that the Smithsonian collection contains one of the smallest skulls and the second-largest skull known in the world.

The small skull was that of a prehistoric Peruvian. Its capacity is only 910 cubic centimeters. This is about halfway across the gulf which separates the human brain from the largest infrahuman.

The big skull, with a capacity of 2,005 cubic centimeters, belonged to a Virginia Indian of the tribe of Powhatan. It is a trifle smaller than the largest human skull ever known, that of the Russian novelist and poet, Ivan Turgenev. There are several other Indian skulls of almost the same size, all dating from about the 16th century.

From the culture of the Indian it is only a little jump to the culture of the white man, which is also, from the point of view of a scientific institution, an ethnological phenomenon.

Within about the lifetime of the Smithsonian Institution have come the locomotive, the telegraph, the automobile, the typewriter, the telephone, the airplane, the radio, the X-ray, the ocean liner, the electric refrigerator, the washing machine, all the incredible developments of electronics, safety razors, ready-made clothes, breakfast foods, plastics,

National Geographic Photographer B. Anthony Stewart

Norsemen Reached Minnesota 130 Years Before 1492, This Inscription Says

Neil M. Judd, curator of archeology, examines the "Kensington stone," found in 1898 and first believed to be a hoax. Later studies indicate that it was carved by white men who had traveled far into North America long before Columbus's first voyage. The runic carving states that a party of Swedes and Norwegians, exploring westward from Vinland, reached this point in 1362. Ten of them had been killed, presumably by Indians, and the survivors feared for their own lives.

streetcars, weather predictions, and dentistry.

In the Smithsonian are preserved the clumsy beginnings of locomotive and radio; of textile, mining, and agricultural machinery; and of most of the other marvels of the mechanical age. They constitute the most distinctive feature of American culture. An old threshing machine saved from the junk pile may be as much of a shrine of the Republic's history as a battlefield or the birthplace of a President.

The buggy of our grandfathers may have been as significant in the development of America as the railroad. It remains to this day, Smithsonian experts say, the one indisputable contribution of this country to transportation. The covered wagon of the forty-niners really was European. The automobile was basically European. Americans adapted it to their peculiar needs only around the turn of the last century.

Within the memory of men now living, many American institutions have vanished.

Gone, for example, is the village blacksmith's shop. Within a very few years there may be nobody left alive who will ever have seen the brawny smith shaping red-hot horseshoes on his anvil. When the Smithsonian tried to acquire all the paraphernalia of such a shop recently the job proved quite difficult.

The Sun—Mother of Us All

A few years ago the Smithsonian received a somewhat cryptically worded bequest for study of "the mother stuff of the universe." There was little question in the mind of Dr. Charles G. Abbot, the fifth Secretary, that this could be applied to scientific researches related to "sunshine," which had become a major activity during his administration, but more directly to the structure of the atom, now in the forefront of scientific progress (page 334).

The sun is the great mother. All life on earth might be considered as transient materialization of the exhaustless floods of radiance which she pours on the planet's surface. This enables green plants to synthesize sugars and starches from water in the soil and from

National Geographic Photographer Richard H. Stewart

Dr. Alexander Wetmore, Smithsonian Secretary, Finds New Bird Types in Mexico

On a National Geographic-Smithsonian expedition to the State of Veracruz he prepares bird skins while a small boy tries to sell him a parrot. Sixth of the line of distinguished scientists who have headed the Institution, he is a noted ornithologist and finds time every year to collect birds in the field, many of them previously unknown to science. As a life trustee and vice-chairman of the Research Committee of the National Geographic Society, Dr. Wetmore is a valued adviser on its scientific activities.

carbon-dioxide gas in the atmosphere, thus making possible all other forms of life on earth by producing the essential foods. We eat sunshine in sugar, bread, and meat, burn sunshine of millions of years ago in coal and oil, wear sunshine in wool and cotton. Sunshine makes the winds and the rain, the summers and winters of years and of ages.

Inextricably interwoven are the threads of Life and light. It has been the job of Dr. Abbot and his associates of the Institution's Astrophysical Observatory to untangle a few of them.

The sun floods space around it for hundreds of millions of miles with energy waves. Some, moving in long undulations through the ether, are radio waves. Some, with etheric undulations measurable in tenths of billionths of centimeters, are the extremely short X-rays.

Between these lies the relatively narrow band of "sunshine," the elixir of life. This band comprises those solar radiations which are experienced on earth as heat, visible light, and the invisible ultraviolet which burns the skin and kills germs.

Within this range of sunlight are millions of separate wave lengths, and small groups of them have specific effects on such things as plant growth, which have been studied by the Division of Radiation and Organisms.

Plants tend to bend toward a source of light —a curious and complicated phenomenon known as phototropism. It was found, for example, that with certain bands of blue light this effect was magnified ten thousand times over that experienced with yellow light.

All weather depends ultimately on the heat of the sun, and there are periodic fluctuations in this heat for which there can be approximate predictions. The fluctuations, however, are relatively small, and solar-heat radiation must cross almost a hundred million miles of space before it falls on the surface of this planet.

Many things can happen to it, especially after it reaches the upper layers of the earth's atmosphere. A major job of the Institution while directed by Dr. Abbot was to discover what does happen and what are the effects of these fluctuations on weather. Eventually, it

National Geographic Photographer Justin N. Locke

Two Men Ballooned to the World Record Height of 13.71 Miles in This 9-foot Metal Ball

Inside the magnesium-alloy gondola, Capt. Albert W. Stevens and Capt. Orvil A. Anderson piloted the 3,700,000-cubic-foot balloon *Explorer II* to a height of 72,395 feet, November 11, 1935. The stratosphere flight was sponsored by the National Geographic Society and the U. S. Army Air Corps. Smithsonian also has Lindbergh's *Spirit of St. Louis* and soon will have the Wright brothers' Kitty Hawk plane (page 330).

National Geographic Photographer Willard R. Culver

Lifelike Figures Portray the Hopi Snake Dance, a Prayer to the Gods for Rain

A tribal priest, at right, carries a rattlesnake in his mouth while another diverts the snake's attention with a feather wand. A third priest stoops to pick up snakes previously carried and dropped. At the left a maiden scatters corn meal as an offering to the snakes and gods. This exhibit is one of a series in the Smithsonian showing the everyday life of American Indian tribes.

is hoped, these studies may provide a reliable basis for long-range weather forecasts.

The Smithsonian's Astrophysical Observatory workers must make exact determinations of solar heat, not as it reaches the earth's surface—this would be relatively easy with nicely calibrated thermometers—but as it reaches the outer edge of the atmosphere. Such measurements are made daily on three isolated mountaintops in California, New Mexico, and the Atacama Desert in Chile.

In 1925 Dr. Abbot, in cooperation with the National Geographic Society, searched the Eastern Hemisphere for the most cloudless high spot in the world where an observatory could be set up and selected the summit of Mount Brukkaros, on the Hottentot Reservation in Southwest Africa.*

At this site it was possible to detect variations of less than one percent in the amount of radiation reaching the outer limit of the atmosphere. This station was abandoned, largely because of accumulations of dust at great heights, in favor of the summit of Mount St. Katharine in the Sinai Peninsula, near the traditional site of Mount Sinai, where Moses received the Tablets of the Law.

From Arms to Costumes

The Smithsonian is the great depository of Americana maintained by the Federal Government. Its collections in this field range from the dolls with which little American girls have played, from the days of the log cabin to those of the apartment house, to the various forms of primitive "money" with

* See, in the National Geographic Magazine, "Measuring the Sun's Heat and Forecasting the Weather," January, 1926, and "Hunting an Observatory," October, 1926, both by Dr. C. G. Abbot; and "Keeping House for the 'Shepherds of the Sun,'" by Mrs. William H. Hoover, April, 1930.

National Geographic Photographer B. Anthony Stewart

Fish from Bikini Atoll Are Checked for Effects of Atom-bomb Explosions

Dr. Leonard P. Schultz, curator of fishes, makes precision measurements of a parrotfish. Jars contain some of the 70,000 specimens collected before and after the Navy's experimental blasts. Fish that survived showed no anatomical changes, but continuing radiation from the lagoon bottom may cause sterility, destruction of red blood cells, and abnormal growths in some fish. Eventually, however, with the passage of time, new life will come in from outside and Bikini's fish population will return to normal.

which Americans have traded, from counterfeit wampum to fox pelts.

Here are the sword and uniform of General Washington; the desk on which Thomas Jefferson drafted the Declaration of Independence; the original Star-Spangled Banner; the medals and decorations of Admiral Robert E. Peary, who discovered the North Pole in 1909, including the Special Medal of the National Geographic Society; a portion of the linen towel which was General Lee's flag of truce at Appomattox.

Dresses of the Presidents' Wives

One of the most popular collections with visitors to Washington is that of the dresses of the wives of American Presidents from Martha Washington to Mrs. Franklin D. Roosevelt, illustrating the changes of feminine attire through 150 years. The collection includes also dresses of the ladies who acted as hostesses of the White House during those periods when the Executive Mansion was occupied by a bachelor or when the First Lady was unable to act as hostess (page 328).

The Institution has specialized in collecting gems around the nucleus of three large private collections. Here may be seen the largest perfect crystal ball, nearly 13 inches in diameter; a grass-green chrysoberyl gem of 65 carats; and specimens of nearly all the minerals known on earth (page 338).

Associated with the terrestrial minerals are those of celestial origin—those of which meteorites are constituted. There is an exceptionally rich collection of these. One weighs 2,570 pounds, but most of those which hit the earth weigh only a few ounces.

Each is analyzed by expert mineralogists when it is received. The minerals found are

National Geographic Photographer R. Anthony Stewart

Indian Skulls Yield Clues to the Red Man's Descent from Asiatic Peoples

Dr. T. Dale Stewart, curator of physical anthropology, uses a stereograph to help draw an exact horizontal cross section of a skull. All these are Sioux skulls, collected by Army medical officers in the Indian wars. The bust is of Sitting Bull, whose warriors destroyed Custer's cavalry at the battle of the Little Big Horn, Montana, in 1876. In the background stands an Indian skeleton. Smithsonian collections contain approximately 17,000 skulls (pages 341 and 342).

about the same as those known on earth, but with slightly different structures. They give few clues to the place of origin of the "shooting stars" which constantly bombard the earth, the majority of which are burned to ashes in the upper levels of the atmosphere.*

From the first it has been recognized that, in accordance with the will of its founder, a primary function of the Institution is the "diffusion" of knowledge. This has been accomplished by a long series of publications which would occupy more than 100 feet of shelf space. Each volume has been distributed gratis to 1,500 libraries and scientific institutions in nearly all countries.

The Institution is the custodian of some of the world's most valuable art collections, notably those of the late Andrew W. Mellon and Charles L. Freer, which are housed in separate buildings, the National and Freer Galleries of Art (page 295).

All these vast collections have been brought together with a single object—the "increase and diffusion of knowledge among men," as desired by the Institution's founder.

Perhaps in no other place on earth has so much been accomplished in gathering the scattered fragments of the pattern of one brief interlude—the episode of the earth and the strange ferment called "life" which evolved upon it—in the majestic progress of Eternity.

* See, in the National Geographic Magazine, by F. Barrows Colton, "News of the Universe," July, 1939, and "New Frontier in the Sky," September, 1946.

Ancient Cliff Dwellers of Mesa Verde

By Don Watson

Park Naturalist, Mesa Verde National Park, Colorado

Illustrations by National Geographic *Photographer Willard R. Culver*

ON A SNOWY day in December, 1888, two cowboys rode across a vast snow-covered mesa in the far southwestern corner of Colorado. On all sides lay a wilderness of jumbled canyons and flat-topped hills, mostly unexplored by white men.

This was of little importance to the cowboys: they were searching for cattle. Friendly Ute Indians allowed them to winter their herds in the great Mancos Canyon to the south, and the cattle sometimes scattered across the mesa tops. Recovering them was no easy task. The cattle soon became as wild as deer, and sometimes their owners were forced to shoot them and pack them out to avoid a total loss.

As the men searched for cattle, they also searched for something else—something they felt sure did not exist.

It seemed impossible that here in this trackless wilderness was a large town—built in a cave! But Acowitz, a neighborly Ute, had insisted that somewhere to the north, in one of the numerous canyons, was the "biggest of all" cliff villages. His description sounded utterly fantastic; the men knew he was merely spinning a yarn for their benefit. Still, as they rode along the canyons they always watched the cliffs "just in case."

True, houses were to be found in the caves. The cowboys had seen a number of them. In the small stone rooms, built under overhanging cliffs, the men had come upon bits of pottery, corncobs, and a few stone tools. It was evident that at some time Indians had lived there. But Acowitz's story of a great cave containing a large town seemed unbelievable.

Silently the two men rode across the mesa, forcing their way through the thick snow-covered forest. The cow tracks they followed led them always to the north. At last the trees thinned out and rock ledges began to click under their horses' feet as they emerged on a barren rocky point at the edge of a canyon.

A Silent City of Stone

Suddenly Richard Wetherill, who was leading, jerked his horse to a stop.

"Charlie, look at that!" he cried, pointing across the canyon.

As Charles Mason joined his companion his eyes, too, went wide with amazement. There across the canyon was the "biggest of all"—a silent stone city almost completely sheltered by an enormous cave (pages 374-5).

From end to end the cave was filled with stone houses. Some were piled story upon story, rising even to the arched cave roof. More than anything else, it reminded them of a palace or castle built in a cave, and it was this impression that caused them later to name it Cliff Palace (pages 355, 357).

Acowitz was right. More than half a century of search has proved that Cliff Palace is the biggest of all cliff dwellings in the Mesa Verde.

As Wetherill and Mason sat staring there on their horses, the swirling snowflakes hid some of the ruins; rubble and bushes concealed others. One large ruin on the opposite canyon rim was completely covered with a high mound of earth. But, in all, ten ruins lay cold and silent within range of vision.

Cliff Palace Housed 400 Indians

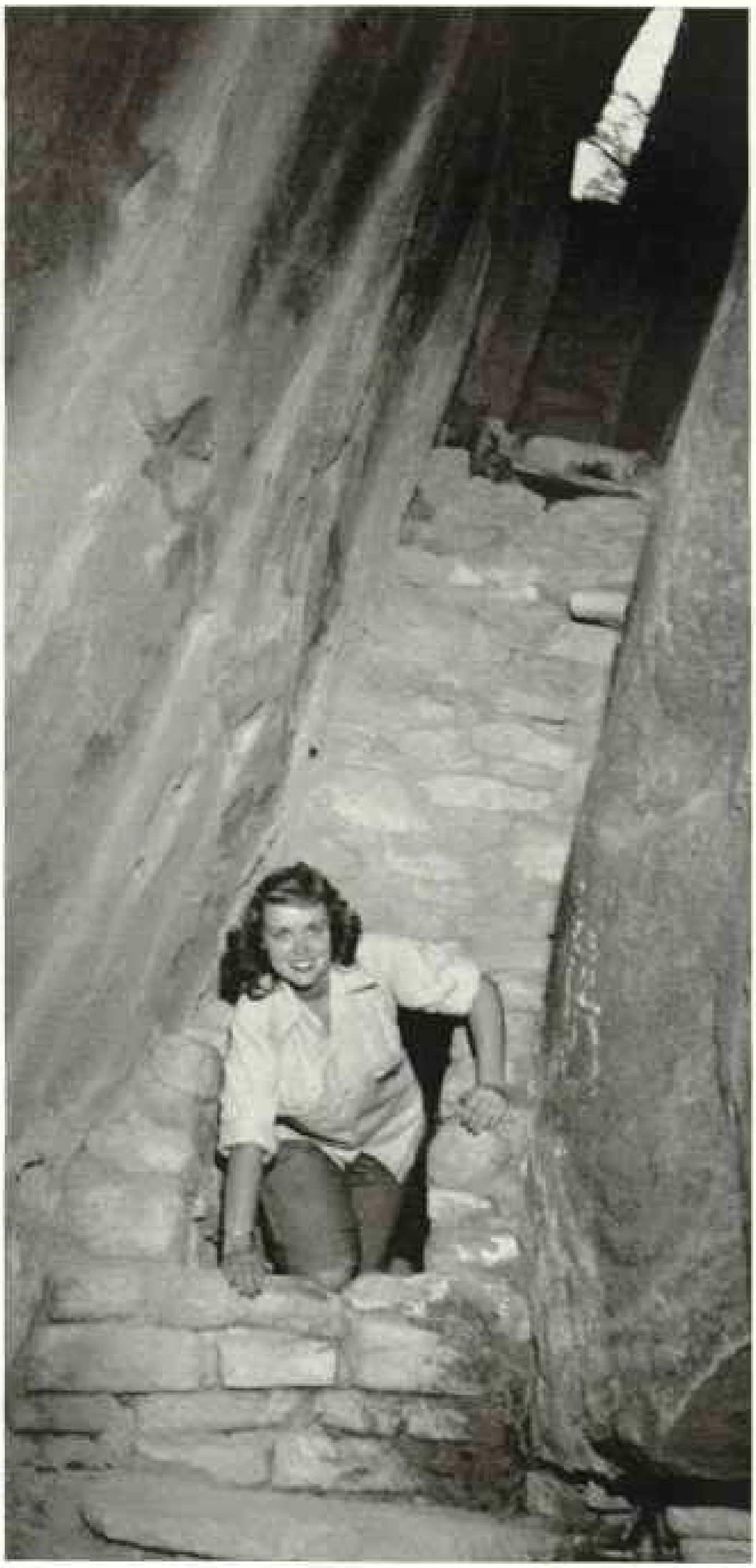
If the two cowboys could have stood in the same spot some two and half centuries before Columbus discovered America, they would have seen a vastly different panorama. Then each village was alive. Each hummed with activity as its brown-skinned occupants went about their daily tasks.

In Cliff Palace at least four hundred Indians made their homes. The other near-by villages were smaller, but probably seven or eight hundred Indians lived in the vicinity.

Their high cave homes protected them from their enemies and the elements. Crops from their mesa-top fields filled their bins with corn, beans, and squash that carried them safely through the long winter months.

In the courts and on the terraced housetops the women bent over their cooking fires. Wisps of smoke drifted up the cliff faces and disappeared into the flake-filled sky. Pots of broth and stew bubbled over the coals, and bread baked on flat stone griddles. Aged men and women toasted their arthritic bones around the fires and talked of bygone days when "things were better."

In the mealing rooms the young women and girls plied their grinding stones, reducing the brightly colored corn to precious meal. The constant rasping of the stones was made bearable only by the melodious notes of the grinding songs (page 376).



To Visit Balcony House, She Wriggles Through a Narrow Cleft

This rock crevice was the only entrance to a village poised 700 feet above the canyon floor. Cliff Dwellers narrowed the opening by building thick stone walls. From the wooden platform above the girl's head, a few archers could keep out any number of men similarly armed. Because of a curve in the cliff, invaders could not shoot arrows into the tunnel (page 371).

Children and dogs scrambled about the terraced villages. Their noise, added to the gobbling of the turkeys they disturbed, created a din that echoed through the canyons. Low chanting voices of the priests, as they carried on their ceremonies in the underground ceremonial rooms, added a deep undertone.

Each village was a terraced apartment house built in a cave. Each was a simple farming community.

Despite strange customs and unusual surroundings, life in general was much like that in many of our own small, back-country farming communities of the 19th century.

Many Ruins Still Unexplored

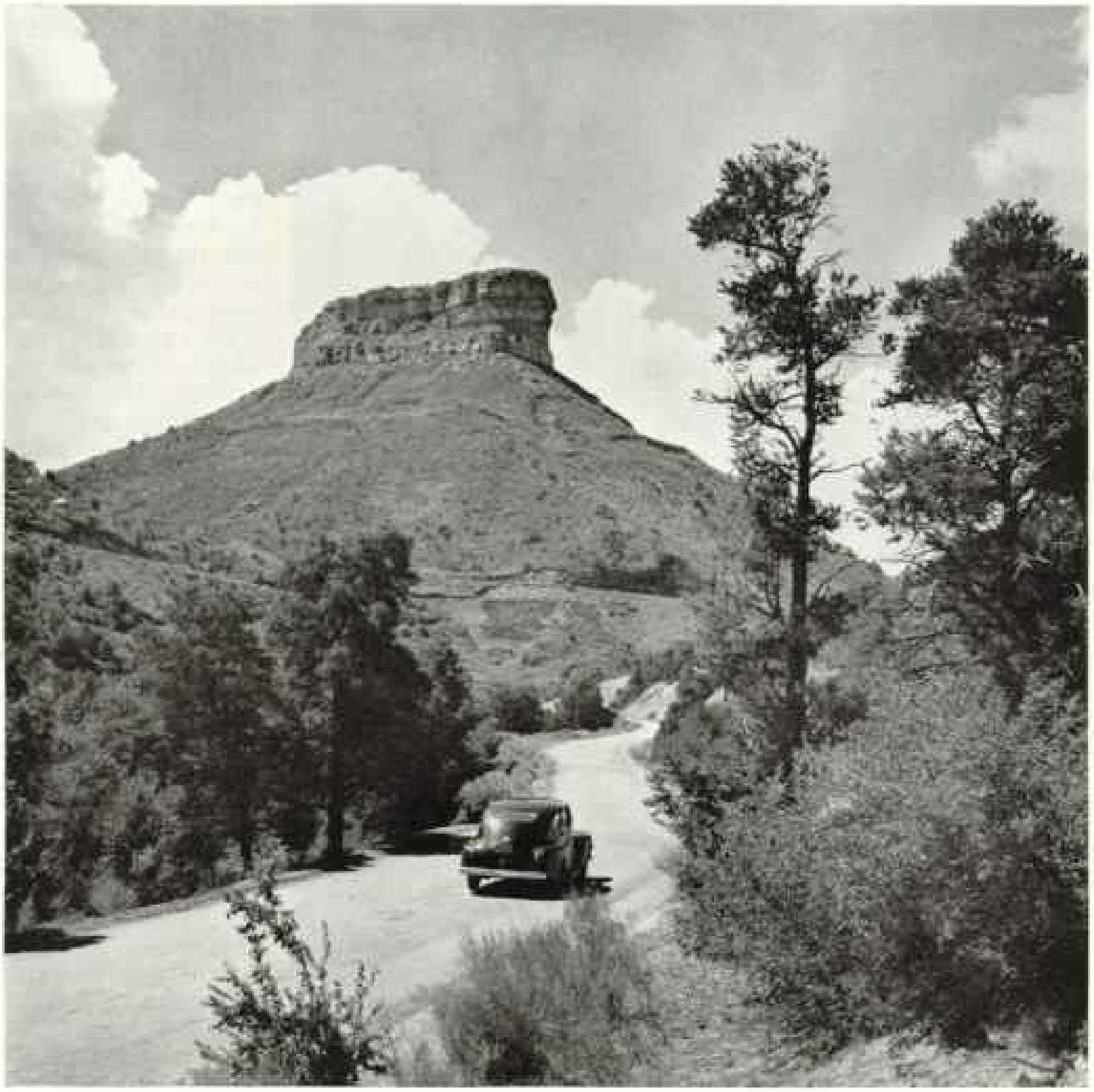
In the years that followed discovery of Cliff Palace, hundreds of additional ruins were found. Even today the total number is not known, for no complete archeological survey has been made of this area in which the ancient farmers lived for more than a thousand years.

Not all of the ruins are in the caves; even more are on the open mesa tops.

The cliff dwellings, some 300 or 400, are the most spectacular because of their unusual location in the faces of the cliffs. They are also better preserved because the sheltering caves have protected them from the elements.

Artifacts left behind by the Cliff Dwellers are also well protected. The cowboy discoverers found that a wealth of such material could be obtained with small effort. Pottery, baskets, fabrics, stone and bone tools, turquoise and shell jewelry, burials and mummies were found in a marvelous state of preservation.

For nearly 20 years after the discovery of the great cliff dwellings they stood unprotected, and large collections of artifacts were taken from them to various parts of the world.



Craggy Point Lookout Towers Boldly above the Mesa Verde Park Entrance

Ruins of an ancient structure, where Indians kept watch for approaching enemies, crown this lofty promontory. High cliffs surround Colorado's "green table" on all sides. The mesa itself, named by Friar Escalante in 1776, is about 20 miles long and 15 miles wide.

But by 1906 steps were taken to conserve the archeological wealth of the great mesa. In that year Congress set part of the area aside as Mesa Verde National Park, the only national park created to preserve the works of ancient man.

Thousands of years ago prehistoric Indians migrated to America from their Asiatic homeland. In the Mesa Verde region they developed one of the most amazing cultures of pre-Columbian America.

As the name implies, Mesa Verde (Spanish for "green table") is a flat, forest-covered tableland or plateau. On all sides it rises from 1,000 to 2,000 feet above the surrounding country. About 20 miles long and 15 wide, the mesa top is seamed with a score of deep canyons, all running to the south. Each of these large canyons has countless smaller side canyons. In the sheer walls of this labyrinthine system the forces of Nature cut the caverns in which the spectacular cliff dwellings are found.

The park occupies only the northern half of the mesa; the southern half is still a part of the Southern Ute Indian Reservation.

In the 42 years since the Mesa Verde became a national park surprising changes have been made and it has become one of the outstanding travel spots of America.

"Will I Look as Well 1,500 Years from Now?"

A Mesa Verde visitor calls on "Esther," one of the best preserved mummies ever found in the dry Southwest. Her skin is unbroken except for a small patch just below each knee. It is light brown in color with a warm reddish tone that could have been the young lady's actual complexion in life. The mummy weighs 16 pounds, which represents Esther without her original moisture (page 372).

Excellent highways lead to the park. But the tortuous trails the cowboys built are still there; Ute and Navajo Indians often use them. Some of the more venturesome visitors also traverse these old trails into the back country.

Most of the park visitors prefer to spend their time in the areas that can be reached by automobile. Within a few days a vacationist can revert to the prehistoric times of 1,000 years ago.

In his own car the visitor drives to the rim of the canyon above one of the cliff dwellings. The moment he turns his back on this fleet, rubber-tired symbol of civilization he slips back through the ages. Under the guidance of a ranger-naturalist provided by the National Park Service, he climbs down the cliff and steps into the cave that shelters one of the magnificent ruins.

For a restful hour the visitor lives with the ancients. The stories of the ranger bring the venerable village to life, and Stone Age America lives again to remind the listener of man's humble beginnings.

Visit to an Ancient Village

Of all the cliff dwellings, Balcony House seems to be the favorite, with a sensational location on the face of the cliff. Its walls are unusually well built and many original roofs are still in place. In the rear of the cave is a bountiful spring of clear, cold water, always welcome on a summer afternoon (page 373).

Guided by a ranger-naturalist, a party of uninitiated visitors sets out for the ruin. The ranger is probably a college student who is studying archeology. He spends only the summer months in the Mesa Verde, where he finds both summer employment and a chance to study archeology at first hand.

The walk to Balcony House proves easy, and the party is soon below the ruin. Above it is the overhanging canyon rim; below is the sheer cliff face. Nature provided the high cave, and the Cliff Dwellers gladly accepted this defensive location.

The entrance to Balcony House for visitors at this point is by a modern 30-foot ladder (page 362). The Indians had no such entrance from below, for they had no long ladder. Here the fun begins for the ranger,

for it is his duty to bring these people "back alive." By this time he knows every person in the party and has singled out those who need help. In one party the youngest member was a girl of three; the oldest a veteran of 88. Neither of these needed help; they climbed the ladder with perfect ease.

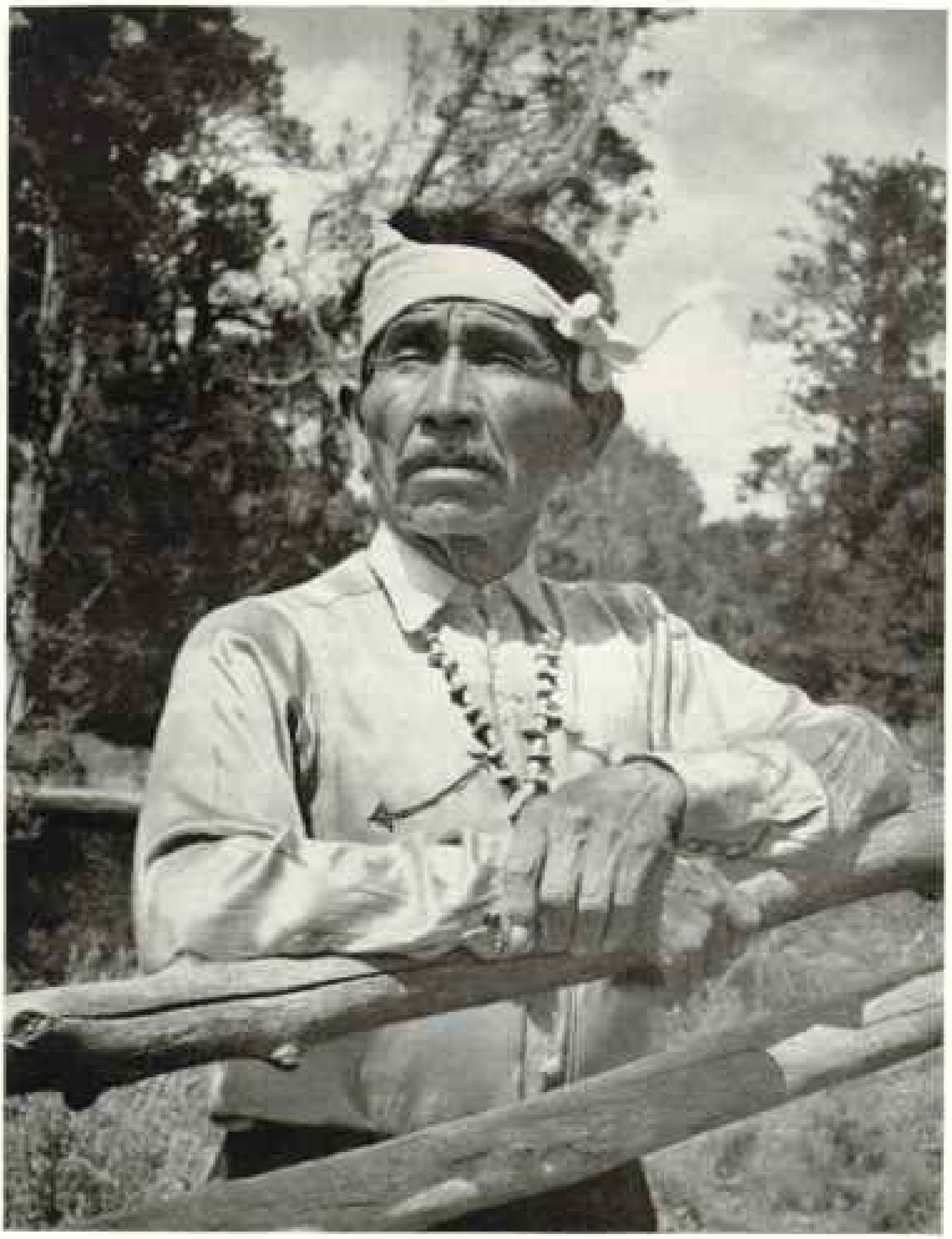
When the visitor steps off the ladder, he is in one end of the cave, but his view of the ruin is cut off by a high wall. He follows the ranger through a dark passage along the rear wall of the cave and suddenly steps into the ruin.

It is a breath-taking moment. Here is a large open adobe-paved court with the vaulted cave roof hanging far out over it.

On three sides of the court are beautifully built two-story houses. Along the fourth side is the sheer cliff. The cliff holds no terror for the visitor now; the Cliff Dwellers built a low sturdy wall along the edge to keep their children from falling into the abyss (p. 363).

Practically every visitor steps to this wall and, leaning on it chin in hands, gazes silently into the canyon.

It is a thrilling view. Seven hundred feet below is the tiny arroyo at the bottom of the canyon. Beyond it rises the opposite wall, and in the sheer cliffs sharp eyes can discern more caves and cliff dwellings.



Indian Folklore Is Sandoval Begay's Specialty

This patriarch leads a group of Navajos in singing and dancing around a nightly campfire in Mesa Verde National Park. He also tends a cornfield on the mesa top near Cliff Palace and helps maintain the park grounds. Son of a famous old Navajo judge, Sandoval wears a bright gold shirt, yellow headband, and turquoise necklace and earrings.

Two-story Houses Have Balconies

No need to explain why the Cliff Dwellers chose the high caves for their homes. Their security is obvious. Rain, snow, and wind could not come in; no human enemy could invade. The villages were as secure as any swallow's nest hanging on the face of a cliff.

Balcony House has three types of structures: houses, storage rooms, and kivas, or ceremonial rooms.

The houses are simple, rectangular rooms, seldom larger than 8 by 10 feet. Very few have window openings, and the doors are small, averaging about 16 by 24 inches. Every doorsill is two or three feet above the floor. Some of the walls are plain, some are plastered; a few bear paintings in red and white. The roofs of poles and adobe are low, often too low to clear the head of a standing person.

Each room was once the home of a family. It served principally as a sleeping room and in it were stored the family possessions.

The business of living was carried on in the open courts.

Most of the structures in the ruin are two stories high. Under the upper doors are narrow walks, or balconies, that lead from one room to the next. One well-preserved balcony caused the cowboys to give the ruin its name, Balcony House (page 363).

Some of the stonework is amazingly good. Seven hundred years have not produced even a tiny crack.

The storage rooms are small structures, often merely bins, that were built in odd nooks and crannies. Here were stored the corn, beans, and squash each harvest produced.

The structures that perplex visitors are the kivas. The modern Hopi Indians call their underground ceremonial rooms "kivas," and the name has been borrowed for these rooms, which served a similar purpose.

There are two of these circular, subterranean rooms in Balcony House. Now they stand open, but formerly they were roofed over. A small hatchway in the open court was the only indication of the room beneath.

Each kiva served as a ceremonial room, clubroom, and workshop for the men of one religious society. Evidently there were at least two societies in Balcony House (page 357).

This is the setting for a typical village of the New Stone Age in the Mesa Verde—a high cave containing some 35 houses, two ceremonial rooms, adequate storage space, and a spring of clear water bubbling from the rocks.

Throughout the world practically all civilized people have passed through the New Stone Age. It was the time when man took his greatest stride away from savagery. During this period several extremely important things developed: agriculture, domestication of animals, houses, pottery, polished stone tools, and the bow and arrow.

Crops Grew on Mesa Tops

The Cliff Dwellers had all of these things, but they had no knowledge of metal. They were truly a New Stone Age people.

Balcony House, seven or eight centuries ago, was a simple farming village. Sixty or eighty people lived in this one cave.

Out on the mesa tops were the fields. During the growing season the men trotted up the toe holds they had cut in the face of the cliff and cared for their crops (page 361). Rainfall in the Mesa Verde averages over 18 inches a year, enough for dry farming.

The villagers were short, heavy-set Indians. Their Asiatic origin was clearly evident in their brown skins, straight black hair, prominent cheekbones, and so-called "slant eyes."

Present-day Pueblo Indians are of the same type, and it is from these modern descendants of the ancient people that we gain our ideas of their religious and social life.*

Women's Rights in Cliff-dwelling Society

Women occupied an important position. The social system was matrilineal, with descent of lineage and property following the female line. When a boy married he went to live with his wife in her house.

Although the women helped to build the houses, theirs was the light work of plastering and painting. The men did the heavy work, with a large group of relatives assisting.

In the present-day Hopi village the young groom may live in the house of his mother-in-law for several months after the wedding. When it is evident that the two young people are going to make a success of their marriage, the relatives get together and build them a house of their own.

Just as the Mesa Verde house belonged to the women, the children belonged to the mother's social clan. The father was somewhat of an outsider. His social relationships were with his mother's people and he spent much of his time in his old home. If you ask a modern Hopi where he lives, he will tell you his wife's house. Ask him where his home is, and he will often mention his mother's house.

Cliff Dweller men spent a great deal of time with their ceremonies. Throughout the year there was a definite succession of such events as the priests followed their ceremonial calendar. Most important were prayers for the ever-vital rain.

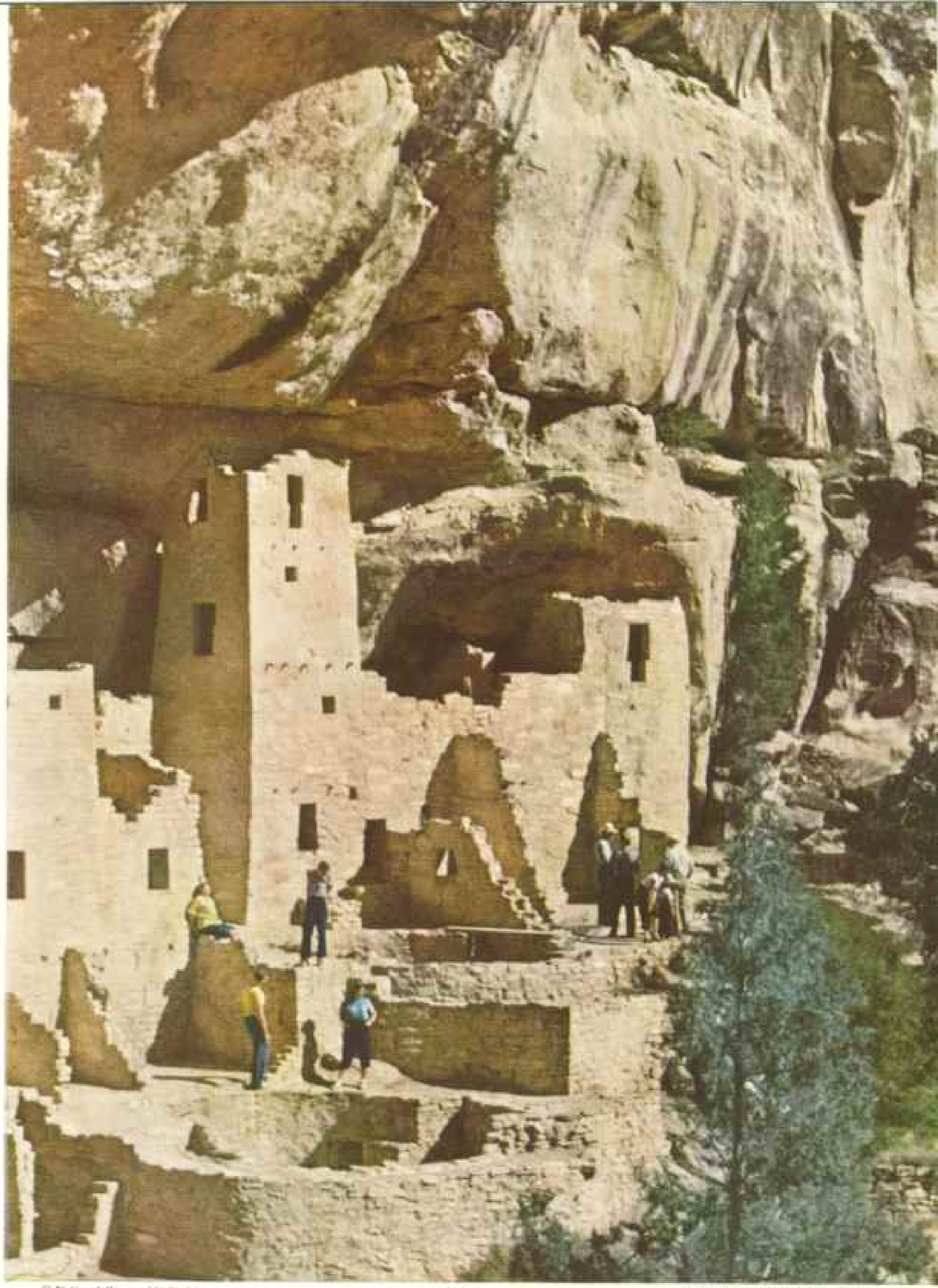
The spectacular present-day Hopi Snake Dance and the impressive Corn Dance of Santo Domingo pueblo are modern equivalents of the rain dances of the Cliff Dwellers.

Fertility rites were also important, as were the ceremonies that assured success in the hunt. Belief in witches and malevolent spirits was strong, and ceremonies were thought necessary to counteract their evil deeds. Countless ceremonies were held for the treatment of various ills.

Arts and crafts occupied much of the time of the people of the little village. Everything they used was the result of their own labors. Since they were without metal tools, production was rather slow.

Cliff Dweller women made beautiful black-on-white pottery. From the crude clay they shaped the vessels with their hands. (No potter's wheel was known in prehistoric

* See "Indian Tribes of Pueblo Land," by Matthew W. Stirling, NATIONAL GEOGRAPHIC MAGAZINE, November, 1940.



Kodachrome by Willard R. Culver

Cliff Palace, a Vast Cave Village, Once Sheltered Hundreds of Indians

In this tenement in Mesa Verde National Park, Colorado, aborigines lived on eight floors beneath a rock roof. Even after seven centuries, the masonry walls of its 200 living rooms, 23 kivas, and storage bins are well preserved.

Kodachrome by Willard R. Culver

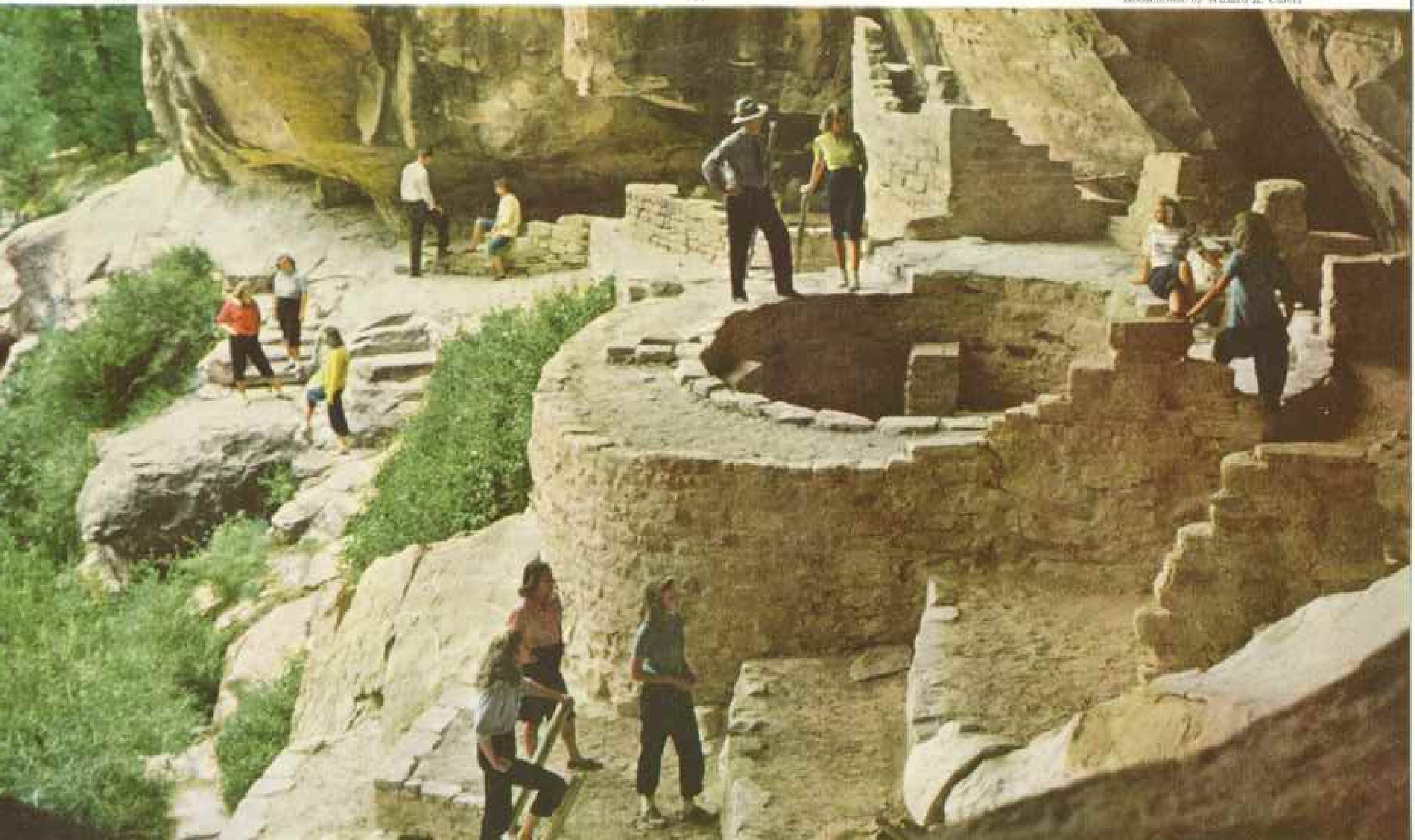
Gazing from Lofty Mesa Top, Modern Man May Turn the Clock Back to Stone Age America

Below the rock platform lies Navajo Canyon, one of many that seam Colorado's "green table," or *mesa verde* in Spanish. From this point, near the edge of the Consolidated Ute Indian Reservation, many cave villages can be seen. Cliff Dwellers climbed to the flat top of the mesa to till their fields and hunt game.

For "Stag" Gatherings, Heads of Cliff Dweller Families Went Underground to Their Circular Clubrooms

Women seldom were admitted to kivas, such as this at Cliff Palace. Formerly kivas were roofed over, with the entrance through a hatchway.

Kodachrome by Willard R. Culver



Kodachrome by Willard R. Culver

Between Mesa Verde Summit and Park Entrance a 10-mile Highway Spirals Downward from an Altitude of 8,572 Feet

The Knife Edge, a rock bulwark formed by erosion, overlooks fertile Montezuma Valley (left). Autumn-blooming rabbit brush brightens the roadside.

Explorers of Kivas and Apartments Clamber over Stone Worn Smooth by Prehistoric Feet

A ranger explains Spruce Tree House, one of Mesa Verde's largest dwellings. The girl at right emerges from the hatchway of a kiva like the roofless one in foreground.

Kodachrome by Willard R. Culver

Parts of Four States Unfold in Verdant Panorama below Mesa Verde's Precipitous North Face

Colorado, Utah, New Mexico, and Arizona meet a few miles from this spot. The road leading from the cliff ruins curves around the Knife Edge (upper right, page 358). Wild flowers are never picked except, as here, by naturalists for the park museum.

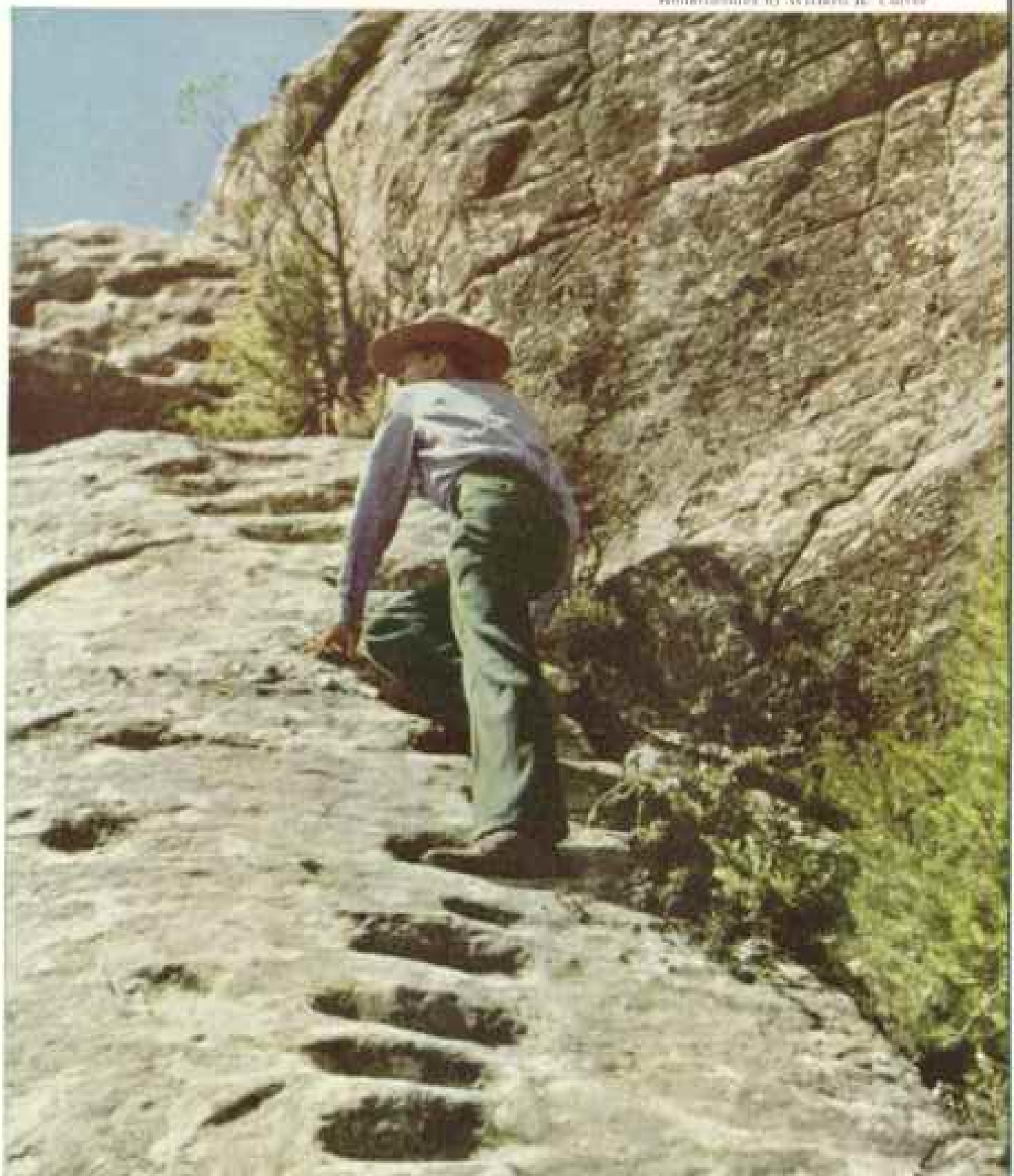
She Admires a Bowl Shaped by a Cave Woman's Hands

Paint from native plants and minerals colors this vessel, found in a Mesa Verde kiva. Archeologists studying tree rings of roof beams learned that the cliff villages were built during the 12th and 13th centuries.

Still in Use Are Steps Cut More than 700 Years Ago

The author climbs a toe-hold trail made by Cliff Dwellers to reach their farms and hunting grounds on the mesa top. Indian women once trotted up and down, balancing water jars on their heads.

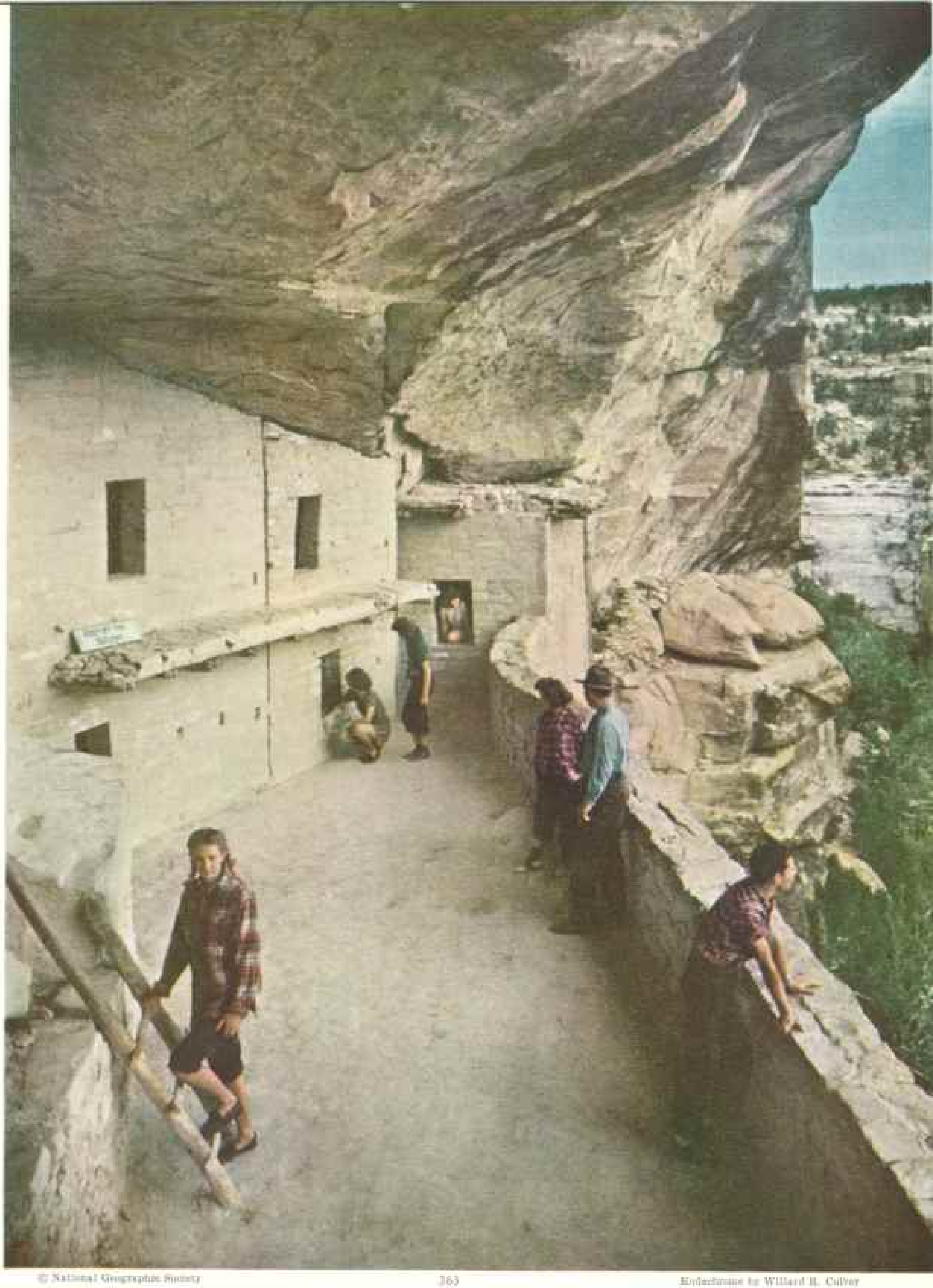
Kodachromes by William R. Culver



Kodachrome by Willard R. Culver

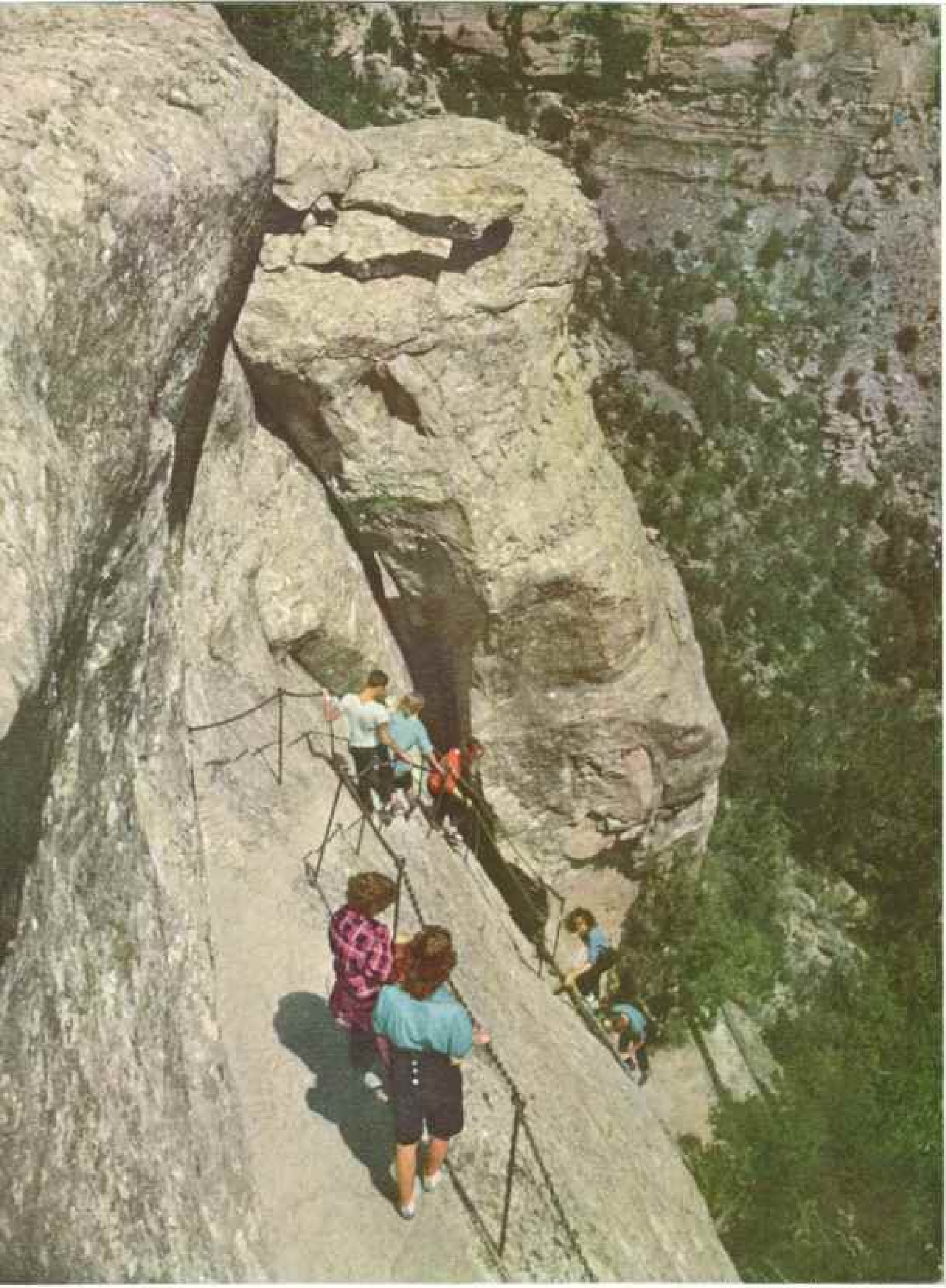
Balcony House, Clinging to Its Cliff Like a Swallow's Nest, Was an Impregnable Fortress

Its only approach for the Indians was along a narrow ledge and through a cleverly fortified tunnel. Today's visitors must climb this 30-foot ladder to enter. A spring in the cave gives good water.



Parapets Kept Balcony House Youngsters from Tumbling Out of Their Homes

Canyon floor lies 700 feet below the wall. The cave's overhanging roof shelters an open court where cooking, eating, work, and play took place. A balcony enabled a woman to visit her neighbor without using ladders.



Kodachrome by Willard R. Culver

Dizzy Trails along Almost Vertical Cliffs Provide Extra Thrills for Mesa Verde Visitors

Prehistoric Cliff Dwellers reached the mesa top by paths like these, but without chain handrails. Broken bones found among their remains indicate that they sometimes fell. Between the cliff wall and the leaning boulder (center) passes a ledge that formerly was the only approach to Balcony House (pages 362 and 363).

Kodachromes by Willard R. Culver

It's Hands Across the Centuries for a Student of Cliff Dweller Art

Meanings of these petroglyphs carved on a sandstone canyon wall are lost in antiquity. Recognizable are human figures, hands, birds, mammals, and "doodles." Mesa Verde's Cliff Dwellers had no written language.

Sturdy Walls Remain as Monuments to Indian Skill

Years of experimentation made the Cliff Dwellers expert masons. Earlier structures were of poles, adobe wickerwork, and stone slabs. Then they learned to fit sandstone in mortar, with small wedges to tighten joints.

Navajo Canyon's Overhanging Rim Forms a Massive Canopy for Square Tower House

At least 125 Cliff Dwellers lived in this cave village of 60 rooms and eight kivas. On flat roofs, now missing, women ground corn and bent over cooking fires. Square Tower was built between 1204 and 1246 of our era.

Kodachrome by Willard R. Culver

Here a Peace-loving People Lived Before White Men Came to America

Archeologists still probe such ruins as these, seeking to reconstruct the life of the prehistoric Southwest. Cliff villages were abandoned in the 13th century, when a 24-year drought struck mesa-top farms.

Kodachrome by Willard R. Culver

Riding Out on This Canyon Rim, in 1888, Two Cowboys Discovered the Rocky Chasm with Its Empty Cliff Dwellings

Visitors to Sun Temple atop Mesa Verde Gaze into Rooms Where Indian Farmers Once Prayed to Their Gods

Since no artifacts were found in it, archeologists believe it was used for special ceremonies rather than as a dwelling. Its round and rectangular rooms were roofless.

Kodachrome by Willard R. Culver

From Primitive Navajo Looms Come Bright-hued Blankets for Mesa Verde Visitors

In a brush shelter before Spruce Tree Lodge, mother weaves while her daughters card and spin wool. Navajos are not related to the departed Cliff Dwellers. They come to Mesa Verde each summer from their reservation.

America.) From native plants and minerals they concocted their paints (page 361).

When the firing process was over, only a heap of ashes stood there on the ground, but from within those ashes came pottery of superlative beauty. It was gracefully shaped and artistically decorated. Mugs, pitchers, ladles, canteens, jars, and bowls were produced. They served the same purposes as the pots and pans of any modern kitchen.

The men produced cotton cloth, bows, arrows, stone axes and hammers, bone awls and scrapers, stone knives, ropes, jewelry, feather blankets, and the all-important ceremonial objects. Each man could make any of these, but he preferred to specialize.

Here lived a flint chipper; there was a rope maker; across the court was a man who wove fine cotton cloth. So it was throughout the village. Exchange of goods was by barter and often by gambling. In the cliff dwellings are found painted sticks like those with which the Navajos and Pueblos of today play gambling games.

A Day with the Cliff Dwellers

At any time of the day a group of men were engaged in some game of chance. Arrowheads against sandals; stone axes against cotton cloth; a feather blanket against a necklace—anything that had value served as stakes. Jewelry was the most valuable possession. An inch of beads would buy a bow; a foot of beads almost anything a man needed.

To visualize the daily life of the Cliff Dwellers one need only think of one of our small frontier towns of a few decades ago.

Early in the morning the sun came over the opposite canyon rim and awakened the people. After a simple breakfast of corn bread and meat they went to their tasks.

The women changed the juniper-bark diapers of the babies, bound the happy infants to their cradleboards, and hung them on the ends of roof poles to swing in the breeze. It was those long days on the pillowless cradleboard that caused every Cliff Dweller's skull to be perfectly flat in the back. The strange deformity lasted through life.

Some of the women cooked; some made pottery; some worked at the grinding stones. A few climbed to the mesa top to gather roots and berries in the forest.

The turkeys were driven out of the cave to feed along the slopes. Children and dogs swarmed over the canyon walls, making life miserable for the squirrels, chipmunks, and other small animals they hunted.

When the sun grew too warm, the men returned from the fields and dozed the warm hours away or worked at their various crafts. Later in the day the hunters returned with deer and mountain sheep over their shoulders.

The evening meal was more elaborate than breakfast had been. Corn bread was inevitable, in one of several versions. A thick stew, perhaps, or green corn, or a pot of green beans might be on the menu. Deer meat roasted over the coals was a delicacy. Sometimes a fat prairie dog or a grouse brought happy exclamations from the hungry men.

The food was placed on the floor in the pots in which it had been cooked. Each family gathered around in a tight little circle. Fingers were the only tools and the single rule of etiquette was "first come, first served." The food was boiling hot, but fingers long accustomed to this type of eating dipped into the pots recklessly.

It was a noisy meal—the better the food the more finger-sucking and lip-smacking. After it was over, a deep, rumbling belch was the highest compliment for the cook. It indicated happy, overfed contentment.

When at last the great full moon soared up out of the eastern horizon, Balcony House was a quiet, happy village. Women and children were already dozing on their pallets of mountain sheepskins. From the kivas came chanting of the priests and the voices of men who were telling endless stories to the boys.

An old man snored; a restless baby whimpered; up on the mesa top a coyote howled at the moon. Balcony House was wrapped in the night.

"Needle's Eye" Entrance Lent Security

After giving his party this glimpse of Balcony House as it was when occupied 700 years ago, the ranger leads his visitors from the ruin. To get out, each must pass through the "Needle's Eye," the Indians' only entrance to Balcony House cave (page 350). The Cliff Dwellers came in from the south on a high, narrow ledge that ran about 400 feet along the face of the cliff.

Just before it reached the cave, the ledge passed behind a huge boulder that leaned against the cliff. The only way of entering the cave was by going through the crack behind the boulder—a crack three feet wide and 25 feet long.

In the eyes of the Cliff Dwellers the passage was too wide. Two stone walls were built in the crevice; through each was left a tunnel so small that a man could just squeeze through on his hands and knees.

The tunnels are quite a test for some of the members of our party. Wide hips and bay windows do not pass through easily and

slender visitors are soon in hysterics as heavier members wriggle through.

Startled gasps are heard as the visitors emerge from the tunnel and look up. Ahead is the most difficult climb of all! (Page 364.) Up the almost vertical cliff is a zigzag line of toe holds with only slender chains for the hands. It is too late to turn back; so, summoning their courage, they scramble up the cliff and are at last on the comforting flat mesa top.

Visitors often ask their ranger guides odd questions.

One evening Dr. J. Walter Fewkes, the famous archeologist, gathered his visitors around the campfire and told them of the people who lived in the Mesa Verde so long ago.

"Are there any questions?" he asked.

From the flickering campfire shadows came the serious voice of a young woman.

"Why in the world did the Cliff Dwellers build their homes so far from the railroads?"

15,000 Years in 30 Feet

The first goal of the visitor is the Mesa Verde museum, in the headquarters area, 20 miles from the park entrance.

The exhibits show graphically the life of the ancient Indians. Outstanding are the five dioramas that enable the visitor to cover a period of 15,000 years by walking 30 feet! Executed in miniature, these dioramas cover five ancient cultures.

The human figures are four inches high and all objects are designed on the same scale. Every detail is true to life.

The dioramas show vividly the startling progress made by the American Indians after they came from Asia to the New World.

In the first one are shown the ancient hunters of the Southwest of perhaps 15,000 years ago who are referred to as Folsom man. Their culture was exceedingly primitive: they were nomads who depended upon each day's kill of game.

The second diorama shows a radical change. Agriculture had developed, and in the Mesa Verde the Indians of 1,800 years ago were raising corn and squash. The culture was still fairly simple, but the greatest step toward high cultural development had been taken.

In the third diorama amazing progress is evident. Houses were being built, pottery and the bow were in use, and the turkey had been domesticated. In the next one the stone wall was perfected and the large pueblo structures resulted. Cotton cloth was being woven and arts and crafts developed rapidly.

The last diorama is the climax of the whole story. It is a reproduction of one great cliff dwelling, Spruce Tree House (page 359), and shows the Indians of the Mesa Verde at their cultural peak. This, the Great Pueblo period, lasted for 300 years. It was the climax in the development of the people and ended only when a meteorological catastrophe—a great drought—drove them from the Mesa Verde.

One exhibit that attracts especial attention shows the diseases from which the Cliff Dwellers suffered. Firmly implanted is the belief that Indians were exceptionally healthy. The bones of the Cliff Dwellers are mute evidence to the contrary. Abnormal bone growths show the effects of rheumatism and arthritis as well as such strange diseases as periostitis, Perthes disease, and osteomyelitis.

The teeth of the Indians were in shocking condition. Common ailments were attrition, caries, abscesses, pyorrhea, impactions, benign growths, and loss of teeth. The skull of one old man shows that he had lost 21 teeth.

The collection of mummies, gruesome reminder of the ancient people, strangely fascinates visitors.

Centuries ago the Indians buried some of their dead far back in the caves behind the houses. The bodies were covered with dust, dirt, ashes, and trash. These dry materials gradually drew the moisture from the flesh. Slowly it dried out until every trace of moisture was gone. The process was entirely a matter of natural dehydration.

There is no similarity between the Mesa Verde mummies and those of Egypt. In the latter the remarkable preservation was due to deliberate embalming with chemicals. In the Mesa Verde it was due to the dry condition of the caves. Just as a juicy plum dries and shrivels to become a hard, wrinkled prune, so does the human body dry and shrivel. A "human prune" is the result!

"Esther," Glamour Girl of Long Ago

The most famous mummy in the museum is "Esther" (page 352). Seventeen centuries ago Esther was a young woman of 19 or 20. When her untimely death occurred, her sorrowing relatives placed her body in a crevice in the rear of a cave. Eighteen other bodies were placed in the same crevice. Through all those centuries Esther and her companions sat there, waiting.

Finally an amateur archeologist found the burial crevice and the bodies came to light. Best preserved of all was this body of a young woman, and to it the finder gave the name "Esther." As Esther this mummy has acquired a definite personality; people seldom refer to her as a mummy.

Esther's manners are not above reproach

A Spring Once Used by Cliff Dwellers Still Bubbles from the Floor of Balcony House

Thick layers of porous sandstone cap the Mesa Verde and act as reservoirs for rain and melted snow. Water filtering through the stone carried the Indians through dry spells. Balcony House inhabitants, with their water supply, stores of food, and clever defenses, could have withstood a long siege.

—she is definitely making faces at onlookers. Her tongue is extended and clenched between the teeth, the left side of her mouth is drawn up, and her left eye is squinted. Mothers often point her out as a horrible example.

Background of the Cliff Dwellers

The first Indians to practice agriculture in the Mesa Verde region are now known as the Basket Makers. The name was given to the culture because of the superb baskets and woven bags that are found in the caves they occupied about the beginning of the Christian Era.

The Basket Maker culture was simple. Somewhere in their rovings they had acquired corn and squash and the idea of farming.

Instead of the bow they used the *atlatl*, or spear thrower—a short stick with which they threw a dart.

About A.D. 400 the Basket Makers acquired important things they had lacked. They began to build houses and make pottery, and a little later to use the bow and arrow.

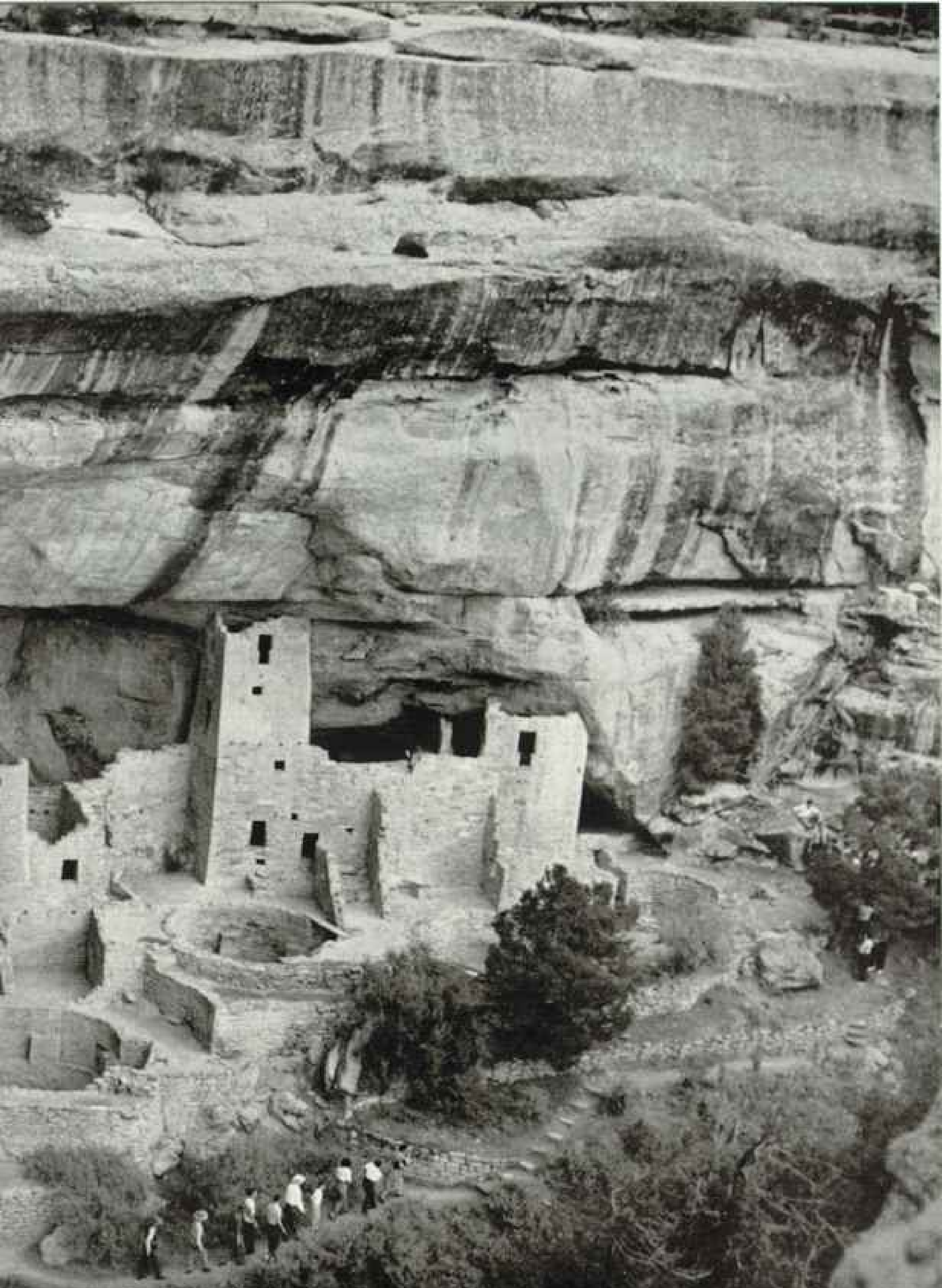
The early part of the eighth century began what archeologists call the Developmental Pueblo period. It lasted for about 300 years.

Houses were built in compact villages, with all rooms adjoining. This was the origin of the pueblo (Spanish for "village") type of architecture that dominated the Southwest until the Spaniards arrived.

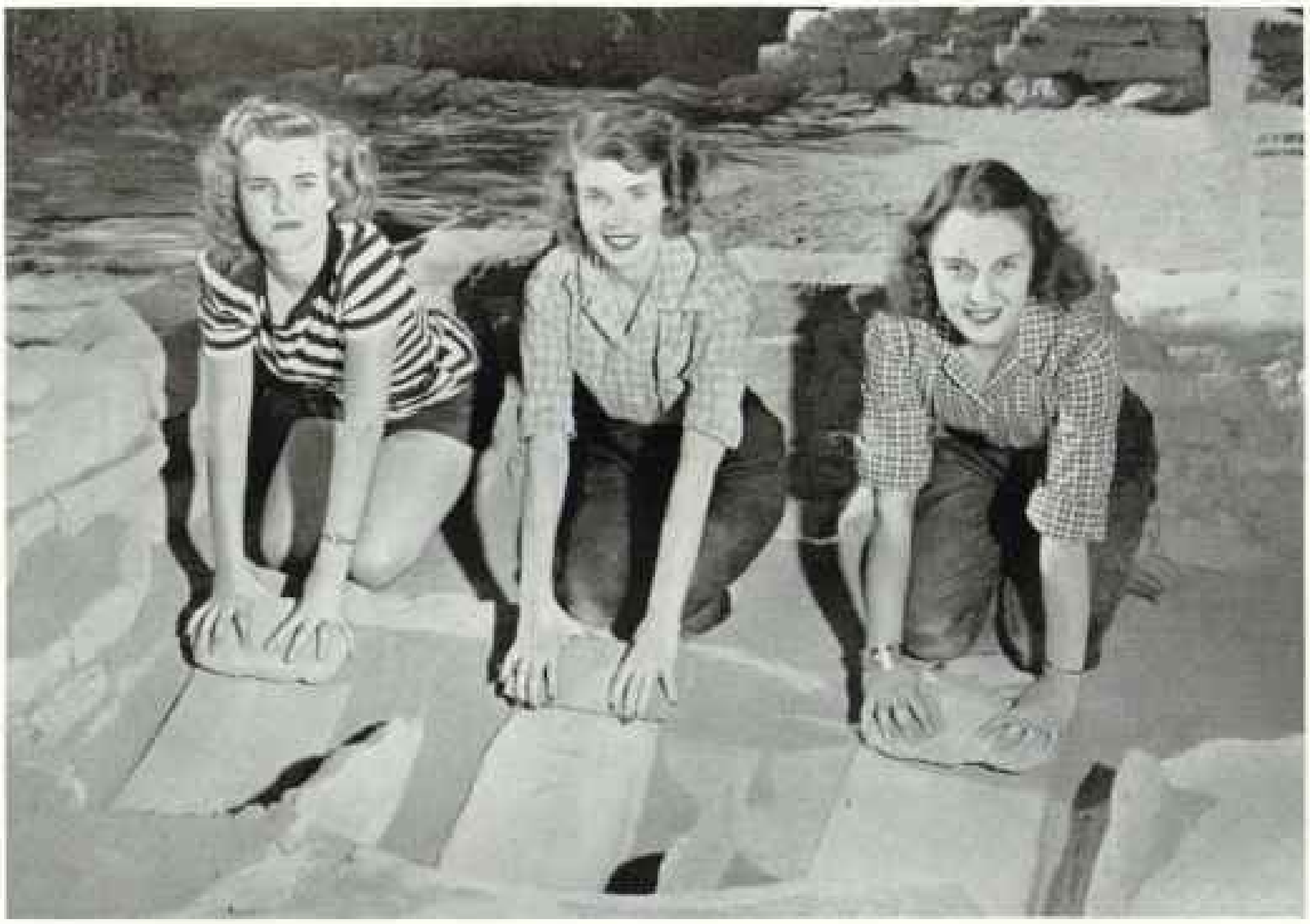
Until recently, it was believed that the Basket Makers, mostly longheaded, were supplanted by broadheaded newcomers about A.D. 700. New studies indicate that this idea is erroneous.

The Basket Maker cradle, made of reeds, contained a soft pad on which the baby's head rested, permitting its soft skull to develop normally. The Pueblo cradle, which the Basket Makers adopted, was rigid, often just a thin board, and on it the baby's head rested without a pillow. This caused the soft skull

A Frowning Brow of Rock Shelters Cliff Palace, Largest Mesa Verde Village



Centuries Have Caused Surprisingly Little Decay in These Marvels of Masonry



Thus Did Cliff Dweller Maids Grind Corn for Indian Braves

Each girl rubs a *mano*, or small stone, back and forth over the large stone, *metate*, to pulverize the grain. The teeth in Indian skulls are badly worn, probably from sandstone grit in the corn meal. Metates were usually placed in groups so that the women could sing or gossip as they did their backbreaking grinding.

to flatten. Thus the hard cradle was one important factor in gradually changing the shapes of Basket Makers' skulls.

During the 11th, 12th, and 13th centuries the Pueblo Indians built the huge pueblos that characterize the Great Pueblo period.

During this period the Indians reached the peak of their development. For almost 1,000 years their culture had been rising. Now for 300 years the people enjoyed the results of their efforts for cultural progress.

The Great Drought—Mesa Verde Deserted

Then, just before the end of the 13th century Nature turned against the Indians of the Mesa Verde, and within a short time the great green mesa was a veritable no man's land. Every pueblo, every cliff dwelling was silent and empty. Only the eerie wail of the coyote and the mournful call of the owl echoed through the canyons.

In the year 1276 drought settled down on the Southwest. That drought lasted 24 years.

The record of the great drought comes to us through the trees that grew during the dry period. In the thick and thin rings is revealed the weather of those ancient times.*

Year after year the crops failed and the springs dwindled. Turning their backs on their homes, the Indians drifted away, hoping to find better conditions elsewhere.

Before the drought was over, all of the inhabitants of the Mesa Verde had gone, never to return.

There is ample evidence that many of the Mesa Verde Indians survived the drought. They drifted off to the southeast, south, and southwest, and mingled with other Pueblo Indians.

Gradually they lost their Mesa Verde identity, and today it is impossible to say that any certain people came directly from the Mesa Verde.

As a result of the long occupation of the Mesa Verde by large numbers of Indians, it is a paradise for the archeologist.

The total number of pit houses, pueblos, and cliff dwellings may run into the thousands. Of all these fewer than two dozen have been excavated! The rest stand as a challenge to the archeologists of the future.

* See "Secret of the Southwest Solved by Talkative Tree Rings," by Andrew Ellicott Douglass, National Geographic Magazine, December, 1929.

Easter Egg Chickens

By Frederick G. Vosburgh

Illustrations by National Geographic Photographer B. Anthony Stewart

ONE DAY 21 years ago, young Ward Brower, Jr., son of a prominent New York attorney, saw in the National Geographic Magazine a picture which fired his imagination. It was a painting of the Araucana chicken of Chile, the only domestic chicken that lays a blue-shelled egg.*

Now, after more than 20 years of effort, he has developed a flock of "Easter egg chickens" that lay eggs of delicate pastel shades—not only blue ones but green ones, pink ones, and, most recently, an egg of a rich olive-drab color that looks as if it had been produced especially for the United States Army.

Chickens with "Whiskers"

The Araucana chicken that caught Brower's eye was a strange-looking bird without a tail and with a round tuft of feathers like whiskers on each side of the neck at the juncture with the head (Plate VIII).

Most intriguing of all to the youthful Brower, raising chickens near Monroe, Orange County, New York, was the sky-blue color of the Araucana egg. Blue is his favorite color. Why, he reflected, should eggs be merely a monotonous white or brown? Maybe some of that Araucana blood would make it possible to produce blue eggs.

Bostonians, Brower knew, like brown eggs, while white eggs sell best in New York City. Perhaps some other cities, he mused, might show a preference for blue eggs. Anyway, his eggs would have a built-in trade-mark, created by the mysterious chemistry within the bodies of his hens.

Stronger, however, than hope of gain were love of Nature, the desire to accomplish something unusual, and the challenge presented by the difficulties involved in perpetuating this rare breed.

Correspondence with the Department of Agriculture showed that, as far as it could learn, not a single living Araucana then existed in the United States. Two breeders were known to have owned them, but the birds had died.

Brower thereupon determined to get some Araucanas from Chile. But from whom? He combed the poultry publications and finally, in an incubator catalogue, he found a testimonial letter from a chicken breeder in Santiago, Chile, one Juan Sierra Z. He wrote him—and nothing happened.

At last, after a year and a half, he had an answer to his letter. The pure Araucana, it said, was exceedingly rare, if not extinct, and months of fruitless search had been the cause of the delay; even the Araucanian Indians had interbred their namesake strain with commoner kinds of chickens. However, Señor Sierra had hopes of obtaining satisfactory birds from a friend.

Six months later came word of success:

"Your letter," wrote the obliging Chilean, "has remained unanswered for the reason that Mr. Haverbeck's fowls had all become diseased with Diphtheria and I was compelled to wait until they had recovered, but it happened that all the birds died with the exception of one hen and one male bird, so that I had to give up the idea of obtaining the birds from that source. I was, therefore, compelled to obtain these from other sources, and have now been able to secure 2 Hens and 1 Malebird which I propose to send you with the next boat sailing . . .

"The 3 birds are all different in colour, as it is impossible to secure birds alike as no one in the country breeds them pure, and these are best can be obtaining."

Three Dismal Immigrants from Chile

Shipping costs consumed most of Brower's modest capital, as he was not long out of college and was determined to be independent. But the sacrifice seemed well worth while when finally he saw the crate unloaded and congratulated himself upon owning Araucanas at last.

Carefully he opened the crate—and beheld three of the saddest-looking chickens he had ever seen. His heart sank as he saw that the trip had left them more dead than alive.

Could these really be Araucanas? The rooster obviously had Dominique blood. One hen was part Rhode Island Red and the other's family tree had contained both Rhode Island Red and Barred Plymouth Rock ancestors. But the little red hen had the odd "rumpless," or tailless, silhouette and all three had feather "whiskers"—trade-marks of the exotic Araucana breed.

It was the autumn of 1930. The birds had just gone through a winter in the Southern Hemisphere and now they faced another. The

* See "The Races of Domestic Fowl," by M. A. Jull, National Geographic Magazine, April, 1927.

red hen wintered worst, but when spring came she laid six eggs. All were depressingly brownish-white—just like any other hen's eggs—instead of the heavenly blue.

Undiscouraged, Brower went 11 miles to borrow a good brooding hen, but despite her best efforts none of the eggs hatched.

Meanwhile, Little Red had laid four more. They too failed to hatch.

Little Red laid three more eggs—and died. These were placed under the brooding hen for a third attempt. Two failed to hatch, but the barnyard biddy ended her nine-week marathon in triumph by hatching out the other.

All Hopes Bound Up in One Chick

The next day the rooster died. Brower's breeding stock now consisted of one hen that produced no eggs and one day-old chick.

"You've heard of a hen with one chick," says Brower, his mild blue eyes twinkling. "You should have seen that hen. After all that work she was taking no chances. She watched over that chick as if it were made of gold. It was the apple of her eye—and mine.

"The lone chick turned out to be a fine, healthy rooster, styled after his father. There were grasshoppers in abundance in the fall, and the young chick practically grew up on them. By spring he was bigger than his father had been and far more vigorous."

With the coming of this second spring the other imported hen was bred to the new rooster and started to lay—creamy-white eggs without a bit of Araucana blue. Five of the eggs hatched, yielding three young roosters and two pullets. With these and the other rooster Brower began to develop his strain.

Above all, he bred for blueness of egg color, but he also sought to retain the breed's distinctive "whiskers" and so-called rumplessness. About 25 percent of his birds had the ear tufts, but all had lost their rumpless quality. In Brower's 18 years of breeding, only one rumpless chicken has appeared, and that one, a rooster, was killed by a car in 1945 before it could be bred.

Throughout most of the first year, all the eggs were ordinary white or brown. Then one day, while candling the eggs, Brower noticed one which contained a faint haze of blue in its shell. By careful breeding, year in, year out, he intensified the color.

Hundreds, even thousands, of white-egg-laying, whiskerless chickens were sold for the pot, while the blue-egg and whiskered stock was kept. More and more often, eggs of a delicate pastel blue or of a greenish tint appeared.

Experimenting, Brower developed two distinct lines of birds.

One is pure Araucana—or as pure as the mixed nature of his original Chilean birds would permit.

The other is about seven-eighths this strain and one-eighth a mixture of other breeds from various parts of the world—the vigorous and colorful Red Cuban Game and Silver Duckwing Game, the big, hardy Brahma and the prolific Barred Plymouth Rock (both of which lay brownish or pinkish eggs), Rhode Island Red, Cornish Game, and a dash of Silver Spangled Hamburg, ornamental, good-laying Ancona, and White and Brown Leghorn.

The latter mixture is the strain Brower calls the Easter egg chicken because, strangely, it produces a higher percentage of colored eggs than the one with more Araucana blood and the colors are more varied, often including pinkish eggs as well as blue or green ones.

Convincing the Skeptical

When colored eggs began to appear with considerable regularity, Brower ventured to mention the matter to a woman reporter for a local newspaper. The conversation went somewhat like this:

Brower: "Good morning. Say, we've got chickens up at our place that lay blue eggs."

Reporter: "Good morning, Ward. How's your family?"

Brower: "Oh, they're fine. . . . But I say, we've got some chickens that lay blue eggs."

Reporter: "It's certainly been a hard winter, hasn't it?"

Brower: "Yes, it has. But I wanted to tell you about my chickens that lay blue eggs."

Reporter: "Oh, yes—blue with the cold, blue with the cold."

And she went off down the street.

Later Brower encountered the reporter on the street with a local doctor and again mentioned his blue eggs. The doctor peered at him with professional interest.

"You don't believe me, either one of you," Brower said.

"Oh, yes," said the doctor soothingly. "Of course we believe you, Ward. Blue eggs. Of course. Certainly." But his manner said, "Poor fellow! It's been a hard winter. He's harmless, but we'd better not cross him."

Eventually, however, the eggs themselves convinced the most skeptical.

"Is it something you feed them?" many ask. But as poultrymen know, the color of the eggshell cannot be influenced by special feeding, though certain substances, if fed to chickens, produce eggs with yolks bright red, for instance. Shell color, however, is determined by the chemistry of the hen, which in turn results from her inheritance of genes.

"Why All This Interest in My Work?" the Brooding Biddy Seems to Say

On the "Easter egg chicken" farm of Ward Brower, Jr., near Monroe, New York, she hatches a setting of naturally colored eggs. When they were exposed for the photographer, the would-be mother kept trying to pull them back under her with her bill. Though part Araucana—the blue-egg-laying chicken from Chile—she lacks the "whiskers" that are one characteristic of the breed (Plates IV, V, and VIII).

Kodachrome by R. Anthony Stewart

In a Hand Eloquent of a Farmer's Life Repose Three Drowsy "Easter Egg Chicks"

Pastel Shades Predominate in a Nestful of Brower Easter Eggs; the Olive-drab Ones Are Rare

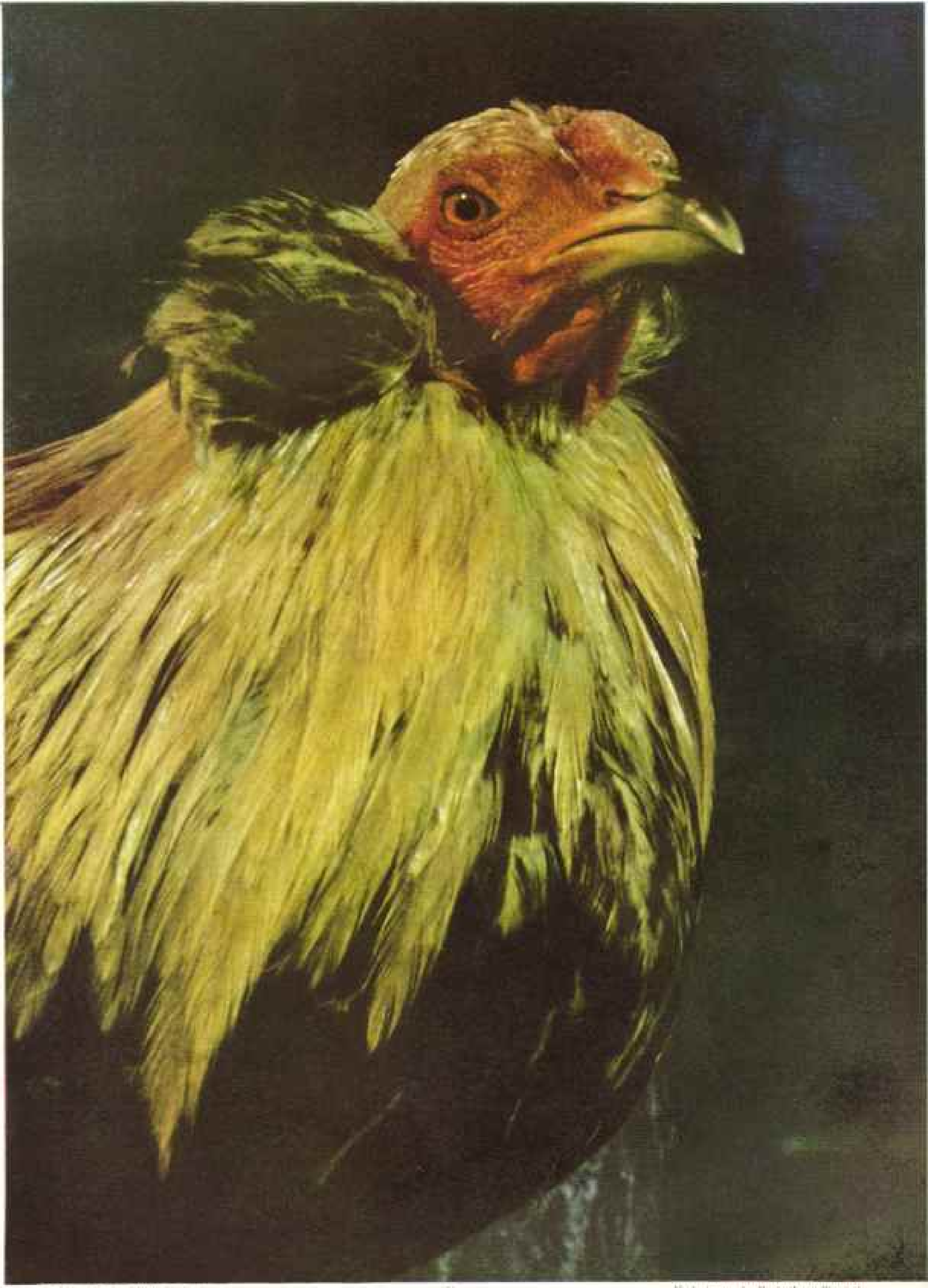
III

Photograph by Newton V. Blakeslee

Kodachrome by B. Anthony Stewart

Part Game Fowl, This Easter Egg Hen Ably Defends Her Whiskers

Ear tufts are inherited from Araucanas imported from South America. As if jealous, whiskerless hens try to pull out the feathers. But Scrappy Sue here usually glares them down or wins the fight for her finery.



V

Kodachrome by B. Anthony Stewart

Colorful Cape and Full Set of Whiskers Stamp Him a Rooster of Distinction

But Little Joe cuts no swath in barnyard social life. His Araucana "blue blood" fails to make up for lack of size and strength. Other roosters pick on him and barnyard belles ignore him.

Boss of the Barnyard Is Araucana Bill, with His Battle-scarred Beak

"This," says Ward Brower, Jr., displaying him proudly, "is the principal breeding rooster of my Easter egg chicken flock."

A few months before, Bill went AWOL in the woods and returned with half his bill torn off, apparently by some predatory animal. He readily survived, however, thanks to his sturdy constitution and probably his fighting ability, and now his beak is growing a new horny covering on the upper half. Besides Araucana, his ancestry includes tough gamecock strains.

Kodachrome by B. Anthony Stewart

Three of the Five Brower Children and Their Mother Pamper an "Easter-bonnet Duck," One of a Flock with Big Topknots

Kodachrome by B. Anthony Stewart

Kodachrome by B. Anthony Stewart

♠ Strange-looking Chickens from Chile Form the Basis of the Easter Egg Breed

This painting of the rumpless, whiskered, blue-egg-laying Araucanas caught Mr. Brower's eye in the April, 1927, National Geographic Magazine. As stated then, the true colors are not known, since the original bird has been much interbred.

♀Dr. M. A. Jull Notes that "Easter Egg" Shells Have Color Even on the Inside

Now head of the Department of Poultry Husbandry at the University of Maryland, Dr. Jull wrote the National Geographic article, "The Races of Domestic Fowl," which started Mr. Brower on his breeding experiments 21 years ago.

Except for the shells, the Brower Easter eggs are undistinguishable from other eggs. To me and to Tony Stewart, NATIONAL GEOGRAPHIC photographer, they tasted exactly like the colorless fruit of less talented hens.

In an incubator we saw baby chicks emerging from eggs of blue, green, and pink. The chicks were three different colors—white, black, and brownish striped with dark brown and black (Plate II). There is no relationship between color of egg and color of chick. A pink egg, for instance, may produce a chicken that will grow up to lay green eggs.

No single hen, of course, lays eggs of varied Easter hues. Every hen is a specialist and lays an egg of the same color every time. But Brower's Easter egg chicken flock contains specialists in many different shades.

Blue Plus Brown Yields Olive-drab

One week before we arrived a new egg made its appearance in the Brower hencoop. It was a definite olive green. Only one hen was laying this "new look" egg, the shell of which is so heavily pigmented as to be entirely opaque.

At Cornell University, where poultry scientists have made a careful study of this unusual breed, the investigators crossed blue-egg stock with a brown-shell stock and produced eggs with olive-colored shells. Such a cross is doubtless the explanation of Mr. Brower's "olive-drab" egg. Eggs of a lighter green are apparently a result of similar admixture.

Walter Landauer, Professor of Genetics at the University of Connecticut, is studying inheritance of ear tufts of Araucanas at the Storrs (Connecticut) Agricultural Experiment Station and would like to study inheritance of rumplessness, if rumpless birds can be found.

When I showed an assortment of Brower "Easter eggs" to Dr. M. A. Jull, Head of the Department of Poultry Husbandry at the University of Maryland and author of the 1927 NATIONAL GEOGRAPHIC MAGAZINE article that launched these experiments, he noted that the shell of a blue, green, or olive egg has color all the way through (Pl. VIII).

At the Agricultural Research Center of the Department of Agriculture at Beltsville, Maryland, Drs. C. W. Knox and M. W. Olsen of the poultry section of the Bureau of Animal Industry showed equal interest and accepted some eggs from the Brower flock for experimental incubation there.

Dr. Alexander Wetmore, Secretary of the Smithsonian Institution and Vice-Chairman of the National Geographic Society's Research Committee, remarked that the collections of the National Museum include shells of similar eggs from South American chickens. He recalled that the National Zoological Park at Washington has exhibited specimens of the breed, billed as "Easter egg chickens."

"In early February, 1928," Dr. Wetmore said, "I received a hen of this variety and several eggs from a friend in Valparaiso, Chile. A rooster and hen from the same source came to me the following July. Here the three lived for a time and the hens produced blue-shelled eggs in abundance.

"Bluish eggs are common on the west coast of South America. You find them in markets from Valparaiso north to Callao, Peru. They are reported even to Panamá.

"The Araucana in typical form has been lost through crossbreeding with other strains, and the blue-shelled eggs now are produced by hens varying widely in appearance."

The origin of the blue-egg-laying characteristic is unknown. One story is that chickens which landed from a wrecked vessel crossed with the tinamou, a small South American member of the ostrich tribe, which is virtually tailless and lays colored eggs.

However, Dr. Wetmore, distinguished ornithologist, told me that he believed this would be biologically impossible. He is convinced that the Araucana, like all other American breeds, is derived from chickens imported to the New World from the Old.

Effort to Standardize Breed Begun

Although it had been previously reported that the Araucana was unknown to science until about 1914, Dr. Wetmore pointed out that hens laying blue eggs were mentioned as long ago as 1880 in reports on the Indians of southern Chile. Since that time they have spread widely in western South America. A few have reached Europe, as well as the United States.

In this country there are now several breeders of Araucanas, and an Araucana Club has been formed. It is headed by Ivan N. Cuthbert, of East Ann Arbor, Michigan, who is attempting to standardize the breed. He and Brower have exchanged some Araucana stock, and his chickens lay colored eggs.

"The credit for my Easter egg chickens," says Ward Brower, Jr., "belongs to my uncle, John Brower, an architect and man of wide interests, who showed me that NATIONAL GEOGRAPHIC article more than 20 years ago."

Brower also raises ducks with "Easter bonnets"—topknots nearly as big as their heads (Plate VII). But the brood of which he and his young wife are proudest consists of their five children under the age of five, whom they plan to bring up with an equal interest in the world of Nature around them.

International

"Popeye" the Tarsier: Philippine Natives Call Him "Old Man of the Mountains"

Huge eyes are useful in nocturnal prowls on Mindanao; here, in strong light, the pupils are greatly contracted. Long, bony fingers with tiny nails have soft pads at the tips for clinging to smooth surfaces (page 397). The ears are movable and can be furled down like a sail; note creases. Tarsiers are only four inches high sitting down.

Seeking Mindanao's Strangest Creatures

By Charles Heizer Wharton

TO CAPTURE wild jungle animals was a dream I had carried through two years of Army service in the Pacific. Then, discharged in Manila in the fall of 1946, I got my chance to "go south."

John N. Hamlet, biologist on leave from the United States Fish and Wildlife Service, was in the city, preparing to depart for the southern Philippine Islands for special zoological research.

"Come along and help me on this problem," Hamlet suggested. I eagerly accepted the opportunity.

A few months in Davao, Mindanao, convinced me that I was in the midst of animals and birds so little known as to be zoological rarities, mostly unseen in American zoos. Pop-eyed tarsiers; hairy-tailed tree shrews; flying lemurs, Nature's most efficient gliders; huge monkey-eating eagles—a multitude of peculiar and rare forms of life existed practically under my nose.

Fascinated, I resolved to bring some back to America alive.

Home of Curious Animals

Geologically, Mindanao is an interesting island.* Some geologists think land bridges once connected it with Borneo and Celebes (map, page 393). At one time it was probably five islands instead of one.

Through the centuries, geological changes here and in other parts of the Philippines allowed certain curious forms of life to develop independently. Some of the strangest live on Mindanao, especially on Mount Apo, highest mountain in the Philippines.

Many zoologists have traveled the Pacific islands without once having glimpsed such curious animals as tarsiers and flying lemurs.

Often it was pure luck which led me to locate certain animals and birds. Some, like the spectacular monkey-eating eagle, were really rare; others, like the tarsier, were common, once their home had been located.

My first job was to acquire initial specimens of these and other supposedly rare animals and to determine their natural foods. I could then learn to feed and cage other specimens in some central, sheltered location. The next step would be to find substitute foods and to develop feeding methods which would be successful in the United States.

Only in the case of the flying lemur did my system ultimately fail, and, except for my unfortunate arrival in Oakland, California, on the Fourth of July, with all stores closed, even this strange animal might have survived to delight scientists and zoo-goers.

The commanding officer of the only United States Army unit in the Davao area helped me set up headquarters in a deserted warehouse. This provided adequate light, yet protected the cages from pouring rainstorms and the inborn curiosity of the Filipino.

The only, and often unreliable, way to get into the wilder areas was by small motor launch. The most cooperative, but not the smoothest riding, of these was the *Columbian*, a converted naval boat belonging to the Columbian Rope Company, which was engaged in transporting abaca fiber (Manila hemp) and copra along the rugged coast.

Friendly Christian Filipinos on this "hemp run" would battle any surf to get their cargo through. Sometimes I carried my animals to Davao on this trim little launch, though often I was marooned for a week or so and kept busy cramming food down voracious throats while waiting for the boat to appear. Occasionally I went through sieges of fever, during which I regretted my isolation in the impenetrable mountain wilderness.

For months after, in nightmarish dreams, I would see again a seminaked nut-brown cargo boy, waist-deep in foaming surf. On his head he precariously balanced a fragile cage full of tarsiers while waiting for a lull in the pounding waves to dash to the surf boat and deposit his precious load.

Large Staring Eyes in Tiny Face

The tarsier (*Tarsius carbonarius*) was my chief quarry. Only two, so far as I know, had been seen alive in the United States. The animal is a small, primitive primate, exceedingly specialized. It developed from the same stock that has given rise to the monkeys and higher primates.†

This is one of the very early types of mammals which have come down to us relatively unchanged. Bones of tarsiers have been found in southern California rocks of the Eocene period of some 50 million years ago, and also in Wyoming. Today, on Mindanao, tarsiers appear to thrive best in second- or third-growth thickets along the coast and in valleys.

* See "Mindanao, on the Road to Tokyo," by Frederick Simpich, National Geographic Magazine, November, 1944.

† See, in the National Geographic Magazine, by William M. Mann: "Monkey Folk," May, 1938, and "Man's Closest Counterparts," August, 1940.

Charles H. Wharton

In a Mad Chase after a Tarsier, This Little Fellow Barked His Leg

He was all smiles, however, for hunting was good and each tarsier meant the equivalent of two or three weeks' pay (page 393). Natives brought in the creatures in every conceivable container, including carrying cases made of rattan, bamboo, abacá, and other fibers. Their favorite way of restraining a tarsier was to tie a vine about its waist and the other end to a stick.

Most of the tarsier's modest length is tail. A large tarsier measures some 5 inches from the nose to the base of the tail, which is about 10 inches long.

The tarsier has odd, leathery ears that can be folded to prevent injury, but even more remarkable features are the large staring eyes. They are very efficient orbs of astonishing size for so small an animal. Since they can be moved only slightly in their sockets, the tarsier must pivot its head about, even to inspect something a few inches to its right or left.

Puzzling, too, are the tarsier's toes. The second and third toes of each foot bear long sharp claws, at right angles to the toe, while other digits have small, flat nails (page 388).

To observe the many curious yet practical peculiarities with which the tarsier is endowed, it is best to picture it in its native haunts. Here, in a thicket of small trees, it clings tightly to an upright limb, aided by long fingers equipped with little round tenacious pads on the ends. Its small soft-furred body is grayish, tinged with buff and reddish brown.

Tail Serves as Prop

The tarsier props itself on the limb by its ratlike tail, the basal section of which, for about two inches, is stiff; the remainder is normally flexible.

Now it is night, and the animal leaves its vine-tangled hide-out in the top of a small tree in a series of long, rapid hops from branch to branch. It propels its 3-ounce body across 6-foot gaps between trees in leaps made possible by an elongation of the heel bones. In the air it sails along, ears extended, hands and feet drawn up, and tail trailing behind. An instant before landing, the tail swings upward, and the long hind legs come forward to touch first and break the impact (pages 396-7).

Charles H. Wharton

Collector Wharton's Expedition Bought Pythons "by the Yard"

Prices quoted in Filipino money range from the equivalent of about $1.50 (U. S.) for a four-foot *sawa*, or python, to $37.50 for a 28-foot specimen. Mr. Wharton's able Filipino assistants hold a regal, or reticulated, python and a crested serpent eagle, which eats small snakes. Signs advertise $50 for a monkey-eating eagle, $3 to $5 for a *cagwang*, or flying lemur, $1.50 to $2.50 for a civet *(milo)*, and 2½ cents apiece for geckos, the lizards which natives welcome in their houses to eat insects. About 4,000 geckos were fed to the tarsiers.

It is spring and the tarsier is uttering a series of locustlike chirps. But now its long, delicate ears have caught the faint sounds of a large beetle crawling on a branch a few feet behind. Slowly the head rotates, owl-like, until the animal looks directly to the rear. In the darkness the large, wide eyes open to the utmost. Enormous pupils almost completely obliterate the chestnut-colored iris.

Waving ears move forward and backward and rapidly locate the insect. The eyes detect a slight movement of the prey. This is all the dinner invitation the tarsier needs. With a scarcely perceptible shift, it flashes across the intervening space faster than the eye can follow and lands on a small branch.

Thumbless hands snatch the luckless beetle and bring it to the teeth, where needle-sharp incisors shear through the hard shell in a series of crunching bites. The beetle rapidly disappears, head first, and is but the first of many to form the nightly repast. The wonderful eyes, during this operation, are mere furry slits, completely covered by the russet eyelids.

I had built an elaborate cage for my first tarsier. I thought I should be lucky to get just one during the entire trip, and because I had heard many tales of their delicate nature, I prepared for the worst.

One day I received word that my Moro animal catcher at Madaum, on the head of Davao Gulf, had a tarsier on the plantation of the International Harvester Company. Borrowing a rickety jeep, I drove over 40 miles of rough road at a furious rate, ferrying two rivers and scattering numerous carabao out of the road in my haste to reach the animal before it expired.

Tall, stately trees bordered the right-of-

Charles H. Wharton

No Sobersides Is the Tarsier, with Its Look of Impish Glee

Actually the "grin" is deceiving, for the creature is far from happy at being caught. Bitten fingers account for the pained expression of the Manobo guide. Natives who captured adult male tarsiers invariably bore the marks of sharp little teeth. When not frightened, however, the tarsier is gentle and inoffensive.

way; the roadside itself was garbed in the gleaming red of calla lilies, like red flags along the way. But I had no time to enjoy this beauty.

"Delicate" Tarsiers Can Take It

On arriving, I was taken aback to learn that my supposedly fragile animal had spent the night battering and thumping against the wire screen on the plantation manager's front porch. So great, however, was my belief in the delicate nature of my charge that I did not drive over ten miles an hour all the way back to Davao for fear that the jar at higher speeds would fatally upset him.

Since this episode, tarsiers have been shaken out of trees, have been accidentally knocked off high porches, have survived storms at sea which laid me prostrate with misery, have lived on starvation diets, endured days of travel by airplane, truck, and automobile, lived through a world of popping flash bulbs and eager, curious spectators, and yet have come through alive, still retaining a characteristic wistful and angelic expression on their savage little faces.

The first trip into the wilderness of the Sarangani Peninsula caught me entirely unprepared for the number of tarsiers which I found. Harry Hoogstraal, Assistant Curator of Insects of the Chicago Natural History Museum, was also in the area, leading an expedition, and we agreed to visit this locality together, he to prepare skins from dead specimens and I to secure live animals and birds.

We landed through a heavy surf and the boat departed. While Hoogstraal and I were establishing camp near the beach, we attracted a group of curious Manobo tribesmen who had been chopping a clearing in a second-growth thicket near by. We told them what we wanted.

Imagine our surprise when three natives ran up about two hours later, each bearing a tarsier in his hands! The creatures regarded the scene through their incredible eyes, the pupils now reduced to tiny horizontal slits by the bright sunlight.

A six-month catch in two hours! It was unbelievable. The animals had been frightened from their hiding places by the falling trees, and had been run down and captured by the bolo-wielding laborers (page 399).

This was only the start. Interesting and

amusing as the tarsiers were, I had little time to observe them thoroughly, for I began the never-ending job of feeding this gluttonous company, which rapidly grew in numbers day by day.

We had offered the unheard-of sum of $5 American for each tarsier. Since natives ordinarily worked several weeks for that much money, tarsier hunting became the order of the day. My funds were soon gone and we went through Hoogstraal's about as fast, meanwhile trying desperately to find an excuse to cut the price.

At first, I accused my companion of having a bad effect on the animals, as well as making me nervous. He sat in front of my cages with his row of preserving jars ready and a gleam in his eye, just waiting, I thought, for something to die.

Many tarsiers did die from injuries received in the wild scrambles attending their capture at the hands of some native who didn't want his two weeks' salary hopping off through the trees. Hoogstraal, whose jars were already brimful of snakes and frogs, began to cast anxious eyes at every tin can and bottle in the area. Meanwhile, my troubles had just begun.

Drawn by H. E. Eastwood and Irvin E. Allaman

Curious Animals Survive on Mindanao in the Philippines

Most fruitful collecting areas for the author were the north end of Davao Gulf, Sarangani Peninsula, and the region of 9,690-foot Mount Apo, the Philippines' highest peak. The inset shows Mindanao's relationship to Borneo and Celebes, to which some geologists believe it was once connected (page 389).

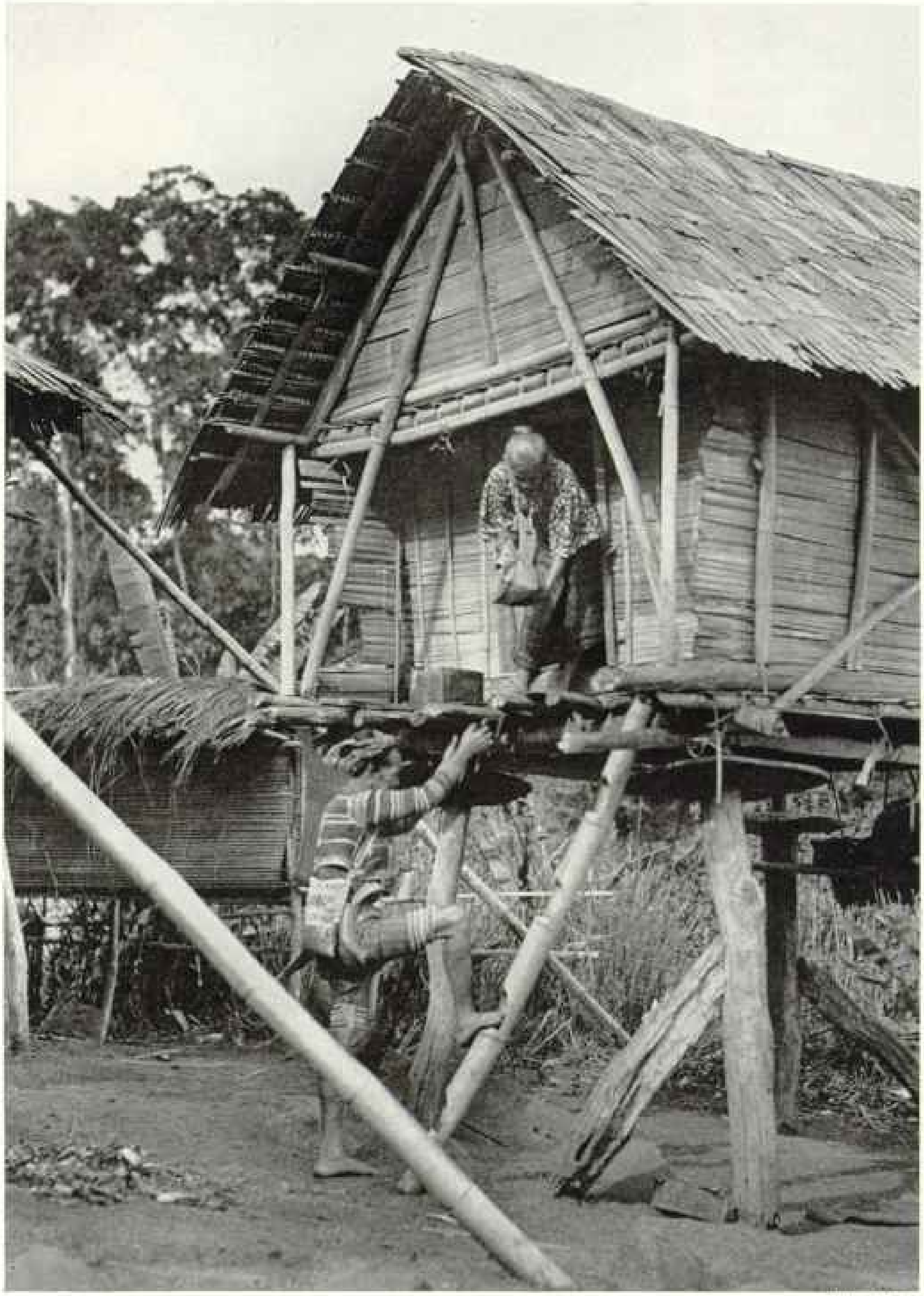
When several cages were filled with tarsiers, the housing situation became acute. We had neither nails nor lumber. Soon I was faced with the formidable task of caging, as well as feeding, fifty or more animals that not only ate a tremendous quantity but required items like grasshoppers and lizards, which are not the easiest things to catch.

Tackling the housing shortage first, I bound strips of bamboo together to form new cages, but these airy affairs allowed grasshoppers and geckos, placed inside as food, to escape through the plentiful openings. I solved this exasperating problem by stringing the live food items on a small wire suspended down the center of the cage. This enabled the animals to reach up and pull off a morsel.

Twenty Pairs of Goggle Eyes

As my housing problem grew to appalling proportions, in desperation I sacrificed my mosquito bar and draped it around a pole frame to form a rectangular structure holding 20 tarsiers. This makeshift affair surprised me by not collapsing until several days later.

To look into one of those cages and see 20 tarsiers lined up on a branch inside, all watching you with their big brown eyes,



Willard Price

Up a Notched Bamboo Pole a Bagobo Climbs to an Airy House on Stilts

Such four-legged huts are common on Mindanao, even where there is no danger of flood. They are cool and safe from intrusion by strangers, dogs, chickens, and rats. Note the circular rat guards on the props of this house, which is used for storage of grain and other foods and made chiefly of split bamboo.

was a thrill I never expected as an amateur naturalist.

Local grasshoppers and lizards played out quickly. Since each tarsier could consume about ten hoppers or five lizards a day, there seemed to be no solution to the food problem. I sent natives out to get ant eggs, at which the animals promptly turned up their pug noses. Each day seemed longer and longer as I looked in vain for the small boat to nose into the green waters of the bay.

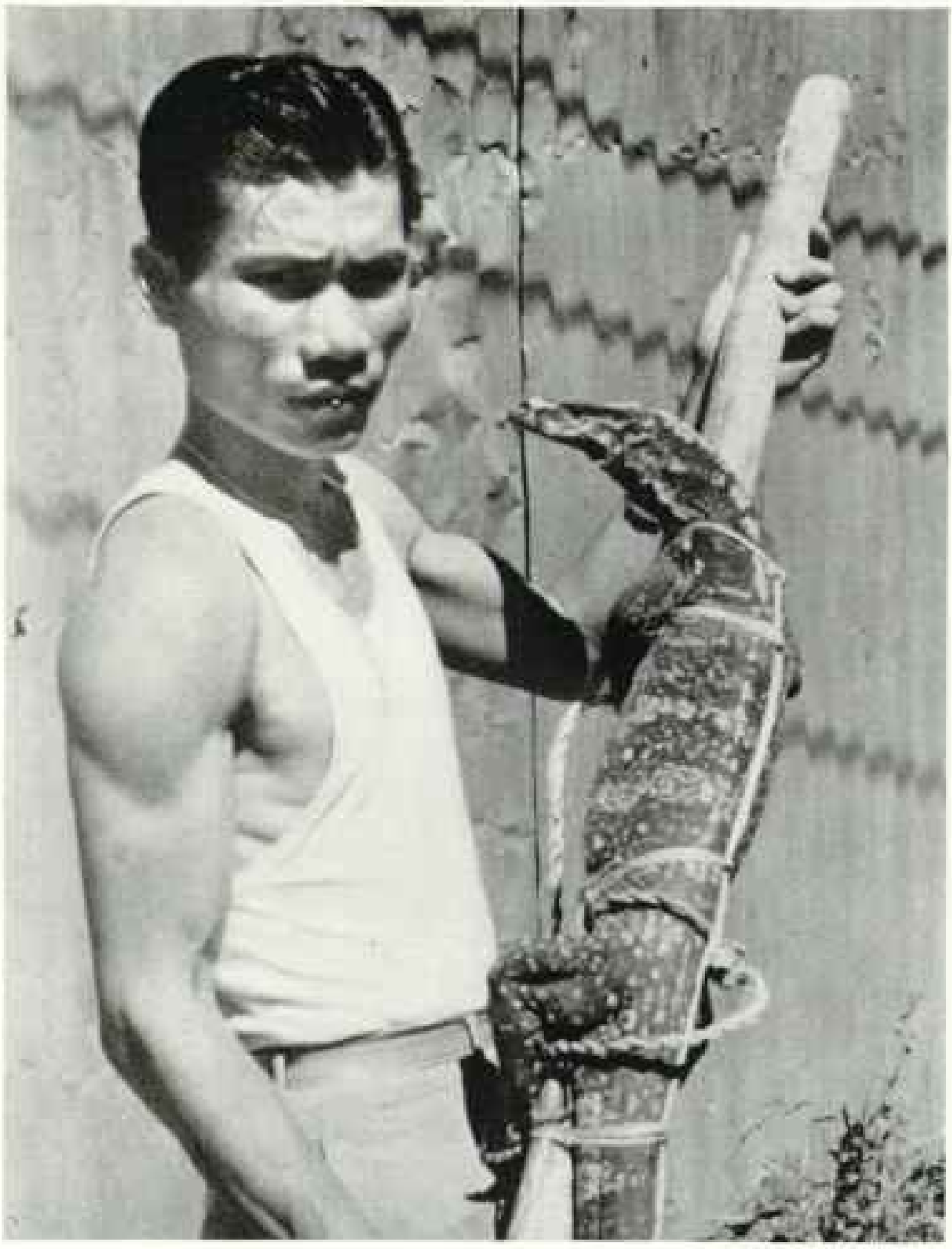
On a later trip to the same area, after experiments in Davao had revealed the fact that tarsiers could be induced to eat raw meat, the matter of food supply in the field was considerably simplified. Crows and coucals (birds of the cuckoo family) abounded near our camp, and the warm breast meat was eagerly accepted as food.

But on my first trip I was soon confronted by 100 hungry tarsiers and I had not learned of such easy escape from the food problem. In despair one day I hiked to a local creek and caught a handful of small crabs. These, it occurred to me, resembled insects in a general way and might fool the little animals. To my relief these small crustaceans were pounced on as eagerly as a juicy grasshopper.

The nightly noises made by many small mouths cracking and chewing insects, now augmented by crabs whose shells crunched with a particularly loud sound, disturbed my companion's sleep. But I got great satisfaction out of knowing the animals had something to chew on and thereby might survive.

Other animals and reptiles which the natives brought in from time to time made my own sleep fitful. One night a 12-foot reticulated python continually writhed and thumped about on the floor at the foot of my cot in a sack of dubious strength, while at the head of my bed a flying lemur tried to claw his way out of a weak bamboo cage. It was an easy matter to imagine that one or the other was loose. Each new sound drew me upright.

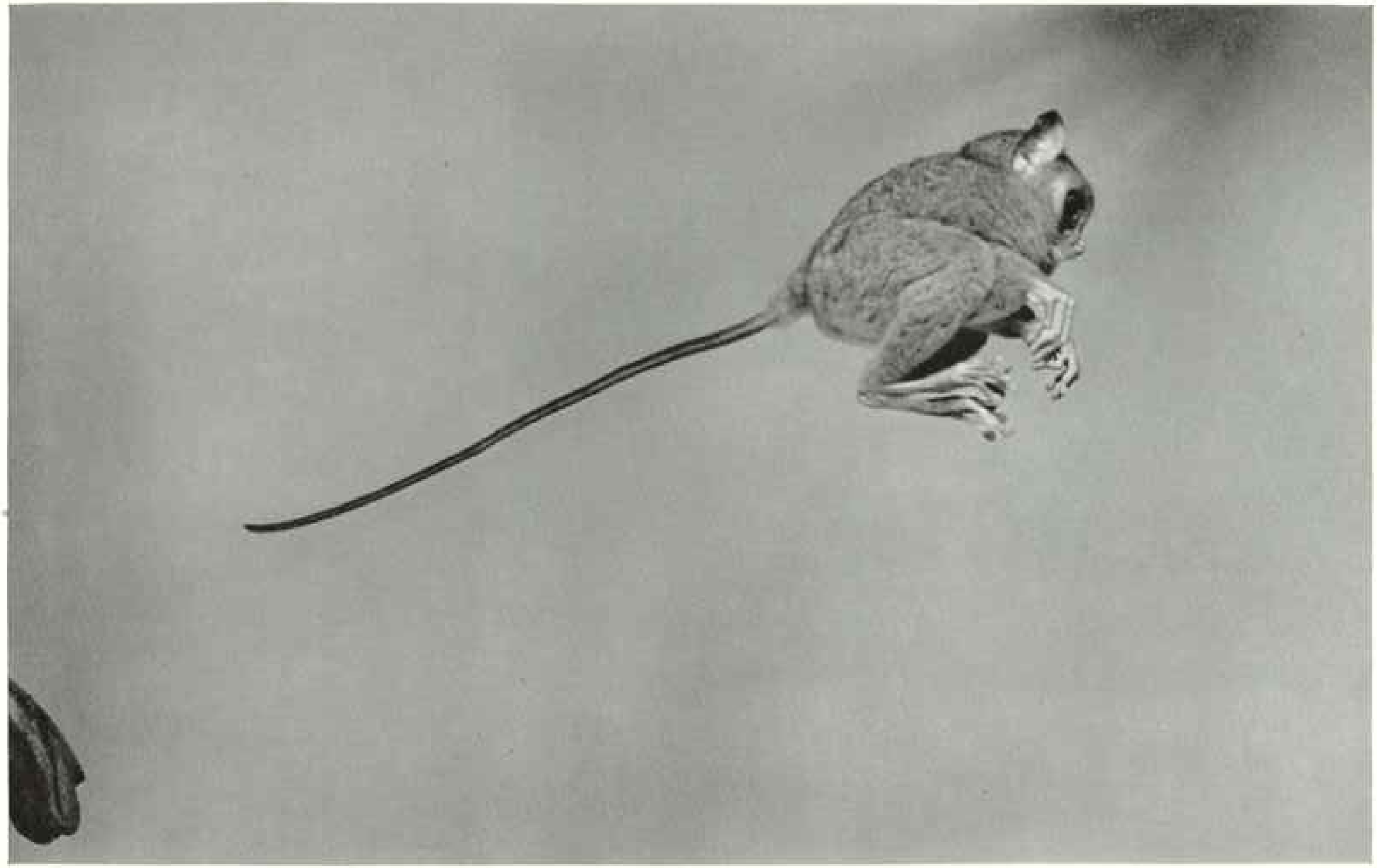
Most of my tarsiers were caught by natives. Sometimes a whole family of Manobos would troop in with two or three tarsiers they had surprised while clearing the family garden. Usually they tied the little fellows around the waist in the manner in which monkeys are often tied, or they carried them in some cleverly made container (page 390).



Charles H. Wharton

Monitor Lizards Eat Rats, Chickens, Even Stray Cats

This black-and-yellow lizard—some are much larger—was noosed by the native and lashed to a pole. "Many of these powerful creatures escaped by forcing the wire front of their cages," says the author. "This became irritating, since I was forced to pay twice for the capture of the same lizard." He brought nine to the United States.



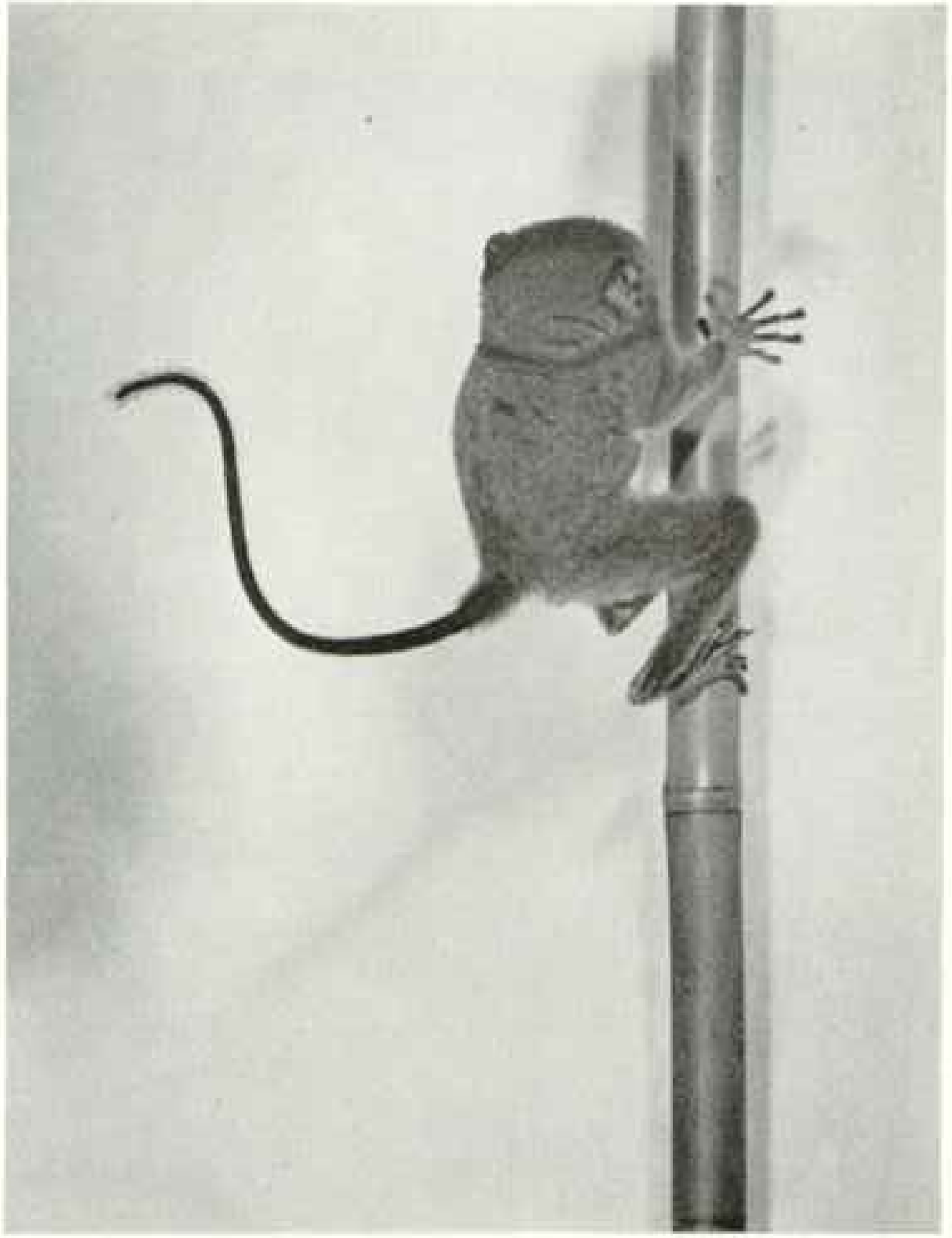
Ernest P. Walker

A Tarsier's Take-off—He Travels in a High Trajectory, Rising about Two Feet in a Six-foot Standing Broad Jump

This unique series of photographs was made by the Assistant Director of the National Zoological Park, Washington, D. C., using a high-speed flash at 1/5000 of a second. The tarsier leaped from the author's hand. Accustomed to photographing flying squirrels, which launch themselves horizontally, Mr. Walker at first caught only the tarsier's feet or tail because of the high trajectory (see "'Flying' Squirrels, Nature's Gliders," by Ernest P. Walker, NATIONAL GEOGRAPHIC MAGAZINE, May, 1947).

"Popeye" Comes In for a Four-point Landing

High-speed photography showed that the tail whipped upward near the end of the jump and that the tarsier employed good broad-jumping form, extending its legs far forward. Wonderfully strong little hands and feet are about to clutch and cling to a drapery.



Ernest P. Walker

This Time the Tarsier's Leap Ends on a Vertical Pole

Soft pads on the tips of fingers and toes give traction—like an underinflated tire in sand—and enable it to cling to the smooth bamboo with remarkable tenacity. This ability is valuable in the tarsier's native thickets on Mindanao where branches are often slippery with rain.

Charles H. Wharton

Wiry, Tireless Bagobos Pack Rare Animals Out to Civilization

They carry specially made cages containing tree shrews caught in the wilds of lofty Mount Apo. The cages are covered to keep the animals quiet. "Coming down the mountain," Mr. Wharton reports, "we waded this crystal-clear river, the Sibulan, for three hours. I was greatly afraid the barefoot natives would slip and drown my precious cargo, but I was the one who fell in instead!"

Of more than a hundred recorded captives, at least half were caught clinging to small trees near the ground, in a crotch, or when otherwise in plain view during the day.

One morning I decided to organize my own hunt in the hope of obtaining some pictures of tarsiers in natural surroundings. The region to be searched lay between the base of a mountain and a large cleared area.

I chose a portion of the thicket on level ground where several of the animals had been heard at night, "whispering and talking," as the natives put it. Three boys spread out through the growth to examine closely each possible hiding place and to shake likely-looking trees. Within 30 minutes one of the crew yelled, and I rushed over to find a tarsier sitting in a bunch of vines, peering down at his would-be captors.

I snapped a few pictures as the animal leaped with speedy hops from tree to tree, always near the top and almost faster than we could run through the underbrush. When everyone was exhausted, including the tarsier, the little animal was shaken out and grabbed on the ground. At this indignity the tarsier swiveled his head about and sank his teeth into his captor's hand, bringing forth a piercing yell and no little blood.

Tarsiers Gather Round a Campfire

Fires, and lamps blinked by hand, hold a powerful attraction for the tarsier. I was told that in the higher mountains on a cold night during the rainy season, the natives often build a fire and then withdraw several yards. The *amas*, as the Manobos call them, then gather around the fire. Sometimes there will be three or four, hopping about like miniature kangaroos and warming themselves before the blaze.

Natives spot the location of a tarsier by

Oldham Natural History Museum

Native Hunters Search the Brush for Tiny Imps with Big Staring Eyes

Spurred on by the fabulous offer of $5 apiece for tarsiers, men and boys dropped everything to pursue the weird little creatures (pages 388, 392, and 396-7). Many were found by bolo-wielding tribesmen cutting this thicket for planting coconut trees. From a tarsier's viewpoint the spot is ideal, affording plenty of insect life, closely spaced trees with many small upright limbs, and numerous vine tangles for daytime protection.

its strong, heavy odor, which seems to hang on the moist air. Several times I have detected this rather disagreeable scent while walking down a trail, and once the smell was accompanied by a loud shrewlike alarm call. This sound is in sharp contrast to the beautiful birdlike trill or twittering of the tarsiers when everything is quiet and peaceful.

Natives call the tarsier "Old Man of the Mountains." It is curious how these little animals like to sit and hold each other for hours. Folklore has it that a tarsier will clasp the neck of a dead companion for half a day before releasing it.

A belief prevalent among the Manobos is that papa tarsier gives medicine to the mother before childbirth and actually aids in the labor by holding his mate's stomach during the critical moments.

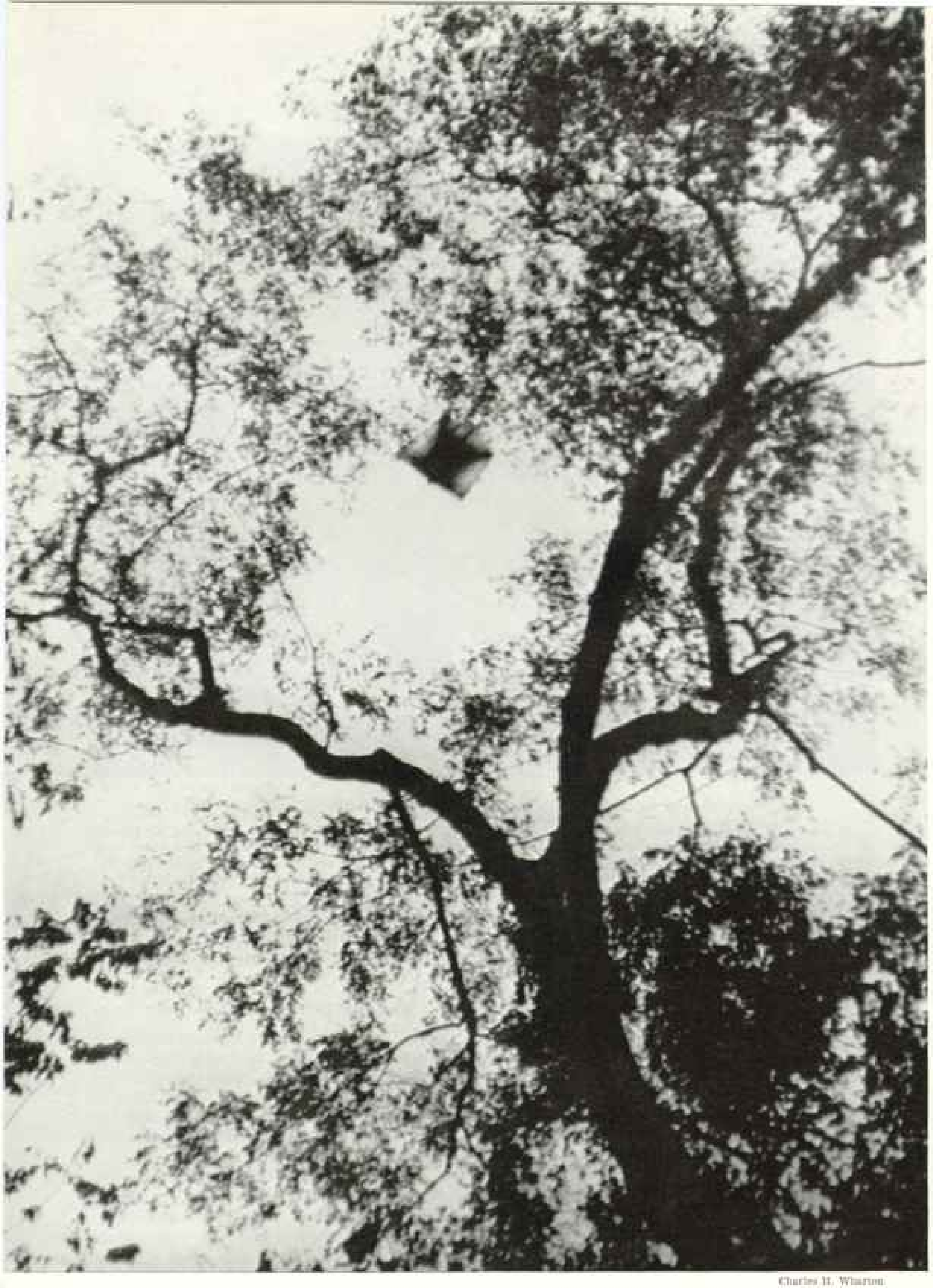
Although males fight savagely among themselves if penned together, tarsiers are frequently found in the wilds in pairs, or a mother may carry a young one at her breast with last year's young tagging along as a companion.

Mice on Tarsier's Bill of Fare

In captivity I found the tarsiers would eat —in addition to their previously mentioned bill of fare—beef, liver, meal worms, and small mammals such as mice. Experiments show that three adult fence lizards and ten June beetles provide a good daily repast for these voracious little creatures.

In the wild state tarsiers subsist on insects, lizards, and probably mice, thus ranking among the most carnivorous of the primates.

The Manobos insist that the tarsier eats charcoal. So persistent is this belief that the specific name of the Mindanao tarsier is *carbonarius*. The fact that it is often found in burned-over areas may have something to



Charles H. Wharton

Photograph of a Lifetime—a Flying Lemur in Gliding Flight in Its Jungle Home

Galloping to the top of a tree, this remarkable creature spreads its membranes and launches into space like a living magic carpet. By a hundred-yard dash on his fifteenth attempt, the author caught this eerie silhouette.

Charles H. Wharton

A Baby Flying Lemur Rests in a Furry Hammock Formed by Its Mother

When the mother is hanging upside down from a branch, the youngster has a perfect cradle. But when she glides from tree to tree, it has to cling for dear life. "How the lemur lands on a tree without smashing the little one is yet a mystery," says the author. "It makes no perceptible effort to land easily. . . . In captivity little ones used to get wet inside the mother's membranes and she would leave them hanging on a limb to dry, then come back later and pick them up."

do with this legend. Although I placed charcoal in every cage for weeks, I never saw any indication of a liking for this material.

Since I could not supply the tarsiers with everything they would ordinarily eat in the wild, I had the problem of supplementing their food with extra vitamins and minerals. I soon hit upon the idea of injecting egg yolk into the abdomen of lizards and grasshoppers with a hypodermic needle.

A Living Magic Carpet

Meanwhile, other strange creatures were meeting my astonished eyes.

Words can scarcely describe that jungle oddity, the flying lemur (*Cynocephalus volans*). Some zoologists assume it to be in a transitional stage between the tree mammals and the free-flying bats.

Imagine, if you can, a cat-sized animal hanging slothlike from the limb of some jungle tree, resembling a giant tropical fruit but covered with silky, soft brown fur splotched here and there with yellowish white.

Suddenly it unfolds hidden membranes until it looks like a man struggling into a bathrobe six sizes too large. With amazing speed it dashes along the underside of the limb, springs onto the main trunk, and leaps upward in a galloping motion with almost the agility of a squirrel.

At this point the now incredulous watcher sees a blurred leap, and out on the still jungle air floats the most perfect gliding machine Nature ever developed, looking for all the world like a small carpet with pointed ends, sailing through space (opposite page).

Since the flying lemur is unique, scientists class it alone in a separate order, the Dermoptera. The membranes which give this creature its remarkable power to glide and turn in the air from tree to tree extend from the underside of the flat jaw and continue to the very tip of the foot-long tail. They even join the toes, which look like those of some web-footed aquatic creature.

Flying Lemurs Use Teeth for Comb

Adaptation to a particular existence has reached a peak in the flying lemur, with its distinctive mode of travel and food habits. It feeds on nothing but green leaves, buds,

Charles H. Wharton

Down from the Hills Came This Wild Manobo, Bearing a Bird for Sale

His offering was a pet tarictic, a small hornbill. "The bird squawked so persistently for its papaya fruit and other food," says the author, "that I had to get rid of it." In some species of hornbill the male has the habit of walling the female into the nest with mud during the brooding period, leaving only a small hole through which he gives her food.

and young seed pods. These it shears with molars surprisingly like the triangular teeth of sharks. Its fine fur and the need to keep itself scrupulously clean have led to the use of the lower front teeth as a comb.

Young flying lemurs cling across their mother's breast during flight. When she is at rest, they fight their way out of their mother's bassinet to perform their little toilets while hanging over the edge, so to speak. Holding on with the front feet, they turn their "bathrobe" wrongside out in evacuation.

The slightest tap on the den tree, usually some venerable giant set on a forested hillside, may send four or five lemurs lunging out of the slitlike entrance. Filipinos who know the animal's ways stand poised with bow and arrow or set a snare in its absence, for the meat of the lemur is much sought.

In areas where lemurs are plentiful the tribesman waits until dusk in a coconut grove through which the animals pass on the way to their regularly visited food trees. He then clubs the slow-witted gliders as they hit the palms near the ground at the end of a glide.

A Flying Lemur at Home

In the face of this continual persecution, the difficulty of finding these animals at home, in order to scare them forth for pictures in flight, may well be imagined. I set up my cameras without reward at no fewer than 20 den trees after having painstakingly cleared the surrounding jungle so that the animal would be silhouetted against the sky.

I found one at home, strangely enough, not 50 yards from the headquarters of the municipality of Caburan. From this palm-thatched hut a large area of almost virgin territory was governed by one man and a handful of native police.

The slit was some 50 feet above the ground

in a huge buttress-based balete tree (a strangling fig of the genus *Ficus*, supposed to house gnomes and spirits) which had surrounded and strangled some other forest giant, long rotted away, leaving a multitude of passages and holes.

As a vine was rattled on the side, a large grayish female (males are mostly chocolate brown) paused for a moment in the opening and launched out into space. After dropping 10 feet or so to gain speed, it drifted across to a near-by mamakau tree (*Dracontomelum dao*) and hitched upward out of sight.

One flying lemur shot from this same tree by members of the Chicago Museum's Philippine Zoological Expedition measured 31 inches across the spread of its front legs.

Flying lemurs make fine pets from the start, for the majority make no attempt to bite. When the soft fur is stroked as the creature hangs upside down at rest, one notices its sweet, agreeable odor.

The animal may show resentment at such familiarities by harsh squeals, which seem to be as loud on the intake of breath as on the discharge. This produces a continuous, nerve-wracking noise that sounds like a pig in mortal terror.

Black Imp Saves Lemurs' Food

On Bohol, one of the southern islands, the flying lemur has survived in a comparatively deforested area under the most curious circumstances. On this island the lemur feeds on the leaves of the *nangka*, or jackfruit, tree.

The islanders believe that a small black imp called *agta* dwells in this tree and that anyone harming the tree incurs the wrath of this spirit, bringing all manner of evil to the household. The agta may show his displeasure by inexplicable pranks, such as putting pull-over garments on a post supporting the house, a thing that no human could do.

Although the cutting of trees on Bohol has reduced the once-luxuriant forests, the flying lemur has been assured of a steady food supply in the jackfruit tree, untouched by the bolo because it is guarded by the agta.

Five flying lemurs started their trip to the United States, including one of the rare red phases. All expired en route but one, which survived until I reached New York. There it refused all offerings of food and died, to the despair of many distinguished zoologists who came to have a glimpse of the first, but we hope not the last, of these peculiar creatures to reach the United States alive.

The tree shrew of the Philippines (*Urogale everetti*) is as much of a surprise to the average man as it is of value to the scientist. For in this foot-long package of energy, which looks like a cross between an anteater and a squirrel, some zoologists see the dim beginnings of primate ancestry (page 406).

The Philippine tree shrew differs greatly from North American shrews. Among the differences are its large size, red-brown fur, hairy tail, and its surprising ability to climb trees and feed partly on fruit.

Few animals can exhibit the ceaseless movement and speed of these long-snouted creatures with ears that would look more at home on a monkey. To fuel the coil-spring muscles of this animal requires an enormous amount of fruit, insects, lizards, and, in the zoo, raw meat and vegetables as well.

Up Mount Apo for Tree Shrews

I brought back almost a dozen of these insectivores, previously unknown in captivity, so far as I know, after a journey up the flank of Mount Apo, a volcano of intermittent mild activity and magnificent grandeur.

Mount Apo can be seen, when its 9,690-foot peak is not shrouded in clouds, from Davao city. This is one of the principal ports and a leading town of Mindanao, situated in an area which produces more abacá fiber (for ropes, twine, nets, etc.) than any other spot in the world.

Apo appears close by; yet its summit is four days from the nearest road over the most rugged trails imaginable. It was over one of these precipitous paths up the Sibulan River that I traveled to get to the village of Todaya and the home of the Philippine tree shrew (page 398).

The ability of all members of the shrew family to escape from containers is well known. I therefore took the precaution of sending ahead native porters loaded with sturdy cages to hold my intended captives.

On my arrival I was welcomed by the chief. As I swung my jungle hammock from the hewn rafters of my host's surprisingly clean hut, I could hear on every side the shattering explosions of green bamboo.

When the natives burn an area for a clearing called a *caingin*, where they plant their sweet potatoes and corn, the stems of the bamboo shatter with terrific force. When I first came within earshot of this fusillade on my way to the village, my first thought was that a company of Japs had somehow gotten together enough arms to raid a village.

The first shrew, with a fiber noose about its stout little waist, was brought to me by an exhausted but grinning tribesman. The tree shrew, feeding in the morning hours, regularly visits certain fruit-bearing trees growing

Willard Price

A Mindanao Tribesman Loads His Silent Blowgun "Artillery"

The tuft of cotton fills the bore snugly and a puff from powerful lungs propels the light dart. Blowguns now are rarely used by the Bagobos. The ivory disk in the man's ear has an inner flange an inch and a half in diameter, requiring a hole of that size in his stretched ear lobe. From his belt projects the hilt of his long utility knife. Such tribesmen of Mindanao helped in the quest for rare and curious animal life.

on steep, moist hillsides along the river gorges. A snare set in the animals' runways proved the most effective means of catching them. I caught them also in a crude box trap made from bamboo strips, just to show the natives it could be done.

The Bagobos in Todaya are rarely visited by white men, but have had some contact with Christian missionaries in the past. In their nightly gatherings for prayer and songs, an inspiring ceremony, I was able to transmit my requests for shrews, or *tarra-bahbooey*, to the people. Later, in their long daily prayers, I heard frequent reference to "tarra-bahbooey" and "Americano," the only words I could catch.

The tree shrew lives in holes in the ground or under rock cliffs and bears about five young in a leaf-lined nest, according to a native account. It is strictly a day-lover and sleeps during the night curled into a tight ball. The shrews are so fast and strong that twice they escaped their cages in Davao despite all precautions and had to be retrapped, much to the amusement of the townspeople.

During our early work on Mindanao my friend Hamlet remarked that if I even saw the rare monkey-eating eagle (*Pithecophaga jefferyi*) in the wild I would be one of the few white men to have glimpsed this magnificent bird.

Monkey-eater Sighted at Last

It was a rainy, misty day deep in the mountains of the Sarangani Peninsula when I actually did see my first eagle in its jungle home. I was stumbling down a slippery trail, my hands bleeding from the razor edges of the stout grass that was my only help over the rough places.

I had a bait monkey on my shoulder, and the little creature was huddled there as cold and miserable as I was, when I met my Manobo guide coming breathlessly up the path with the news that an eagle was sitting just across the valley.

Squinting with rain-blurred eyes across the deep gorge, I saw the gleam of a snow-white breast standing out against the green verdure of the hillside. Even at that distance the bird appeared tremendous, and the sight filled me with such joy that I momentarily forgot my sodden plight and hastened down the mountain to set another trap.

N. Y. Zoological Society

Slender-tailed, or Pallid, Cloud Rats Emit Terrific Growling Sounds

Though the author worked chiefly on Mindanao, his collection included two kinds of cloud rats from the high mountains of Luzon. Captive specimens of this one, the larger variety, show a liking for meat. Seizing a piece of beef or a mouse in one "hand," they shear the flesh away with beaverlike incisors. When an Igorot gets a stomach-ache he steeps some of the animal's hair in water and drinks the broth!

I had already spent half the day hunched in a blind high on the mountain, my pull net baited and ready, but I set another in the drizzling rainfall in a cleared camote patch so steep that I could hardly stand.

For four long wet hours I watched the great bird as it surveyed its domain, probably digesting some monkey or lemur it had caught that morning. Just before dusk it left its perch with a series of rapid wing beats, flying low over the trees. With its long tail and its blunt, wide wings it resembled a gigantic goshawk.

Eagles Raid Farmyards

This monkey-eating eagle is found only in the Philippine Islands and is one of the most desirable eagles in the world from the viewpoint of a zoological park. Many people have lived for years in what would seem to be ideal haunts for the bird without seeing it. Tribesmen trap and eat it, using a white dog as bait.

In June and July, when the parent birds are feeding their young, they become bold enough to take dogs, cats, and pigs from the yard of a native dwelling.

The Manobo family with whom I visited in the eagle country had twice been raided in this manner. Often the eagles, three or four strong, had been seen to cavort and play in the air above the tiny cabin, which is perched on a steep mountainside.

The monkey-eating eagle feeds on almost all native mammals and some reptiles. It often catches the flying lemur. The Manobos claim that the eagle has learned to catch the lemur by taking advantage of the latter's habit of darting forth from its den at the slightest tap on the tree trunk. The eagle, so the story goes, flies down and alights near the hole. It then taps the tree with its wings and grabs the lemur as it scurries out.

The eagle's large feet, equaled only by those of the harpy eagle of the American Tropics, leave little doubt as to their power. They appear almost twice as large as the feet of the golden eagle of North America. The rear talon measures over three inches along the curve.

One of the three eagles which I was able to obtain and bring alive to the United States was captured by a group of tribesmen after it had attacked a large monkey. Somehow the prey got a firm hold on the bird's leg in

Charles R. Wharton

"Here's a Tarra-bahbooey for the Americano"

The Bagobo lad holds a freshly snared tree shrew (page 403). Dangling below is the noose of abaca fiber (Manila hemp) which tightened about the animal's waist as it scurried through one of its runways on the slopes of Mount Apo, Mindanao. Eleven of the long-snouted little creatures—foot-long packets of energy—reached the United States alive.

the soft part. Both fell struggling to the ground, the fall apparently breaking the eagle's leg. A group of tribesmen, within sight of the battle, rushed up and secured both participants. The valiant monkey was promptly eaten, but the eagle was brought to me.

Warlike Crest Heightens Fierce Mien

Only one eagle of this kind had ever been on public exhibition in the United States. It lived for nearly a year at the San Diego Zoo, and then was presented to the University of California at Los Angeles. Such eagles are good show specimens because of their size, their wild appearance, and the tremendous laterally compressed beak, the depth of which is probably greater than that of any other bird of prey (pages 407 and 408).

The nostrils have been reduced to vertical slits and the pale eyes give the head a fierce look, heightened in effect by a full crest of long, fingerlike feathers that can be raised to form a halo about the head. Though I have associated closely with them for months, I have never lost admiration for these powerful wild eagles with the cold gray eyes.

The Manobos in the engle country are primitive but industrious, weaving beautiful cloth from the native abacá fiber. Though less warlike than the near-by Bilaans, they still carry spears, bows, and arrows. Brass gongs are used as a medium of exchange. Five large ones are equal in value to one horse. Wives, as well as horses, can be purchased with gongs.

Horses, chiefly stallions, are prized possessions. As far as I could determine, the main use of the latter is in horse fighting. The stallions are carefully groomed for these weekly bouts, which are held at some common meeting place. Natives gather from as far as ten miles away to witness this odd sport. There they make bets, whoop and shout, and in general have a rousing good time.

The animals are fought in a large cleared area. The clash is initiated by a brood mare which remains on the scene. Each stallion is angered by the other's presence, and the ensuing melee is one of pawing hoofs, rearing and biting, neighing and kicking, with the din heightened by shouts from the crowd, particularly when one lands a telling blow.

Even the bloodiest cockfights pale in comparison with this event, which provides a great deal more action for the spectators, especially when one of the fighting stallions tears out in a mad circuit of the area, forcing everyone to sprint for the nearest fence.

But stallion fighting was a side issue with me. I had to get home with my collection.

I decided to fly the animals home rather than attempt the trip by ship, since many food and temperature problems were involved in handling the comparatively delicate cargo.

One-eyed Tarsier on Trial Flight

One of the experiments by way of preparing for the flight consisted of sending a tarsier by plane to Baguio, in northern Luzon, where the cold nights and high altitude would test its ability to survive under those conditions. For this I chose a tarsier with only one eye but otherwise in robust health.

He was the most vigorous and voracious tarsier I have ever seen. I saw him kill and devour a large 8-inch skink lizard in slightly more than four hours. I suspected strongly that if I kept him he would be the *only* one to survive and he was naturally not desirable for exhibition purposes. He lived in Baguio long enough to convince me that air transport at reasonable altitudes was the answer.

An official of the Philippine Air Lines solved the fresh-meat problem when he suggested I keep the meat in dry ice, which the company provided on the entire trip.

The animals had a special compartment, and temperatures inside the plane were kept as high and as steady as possible. I spent many anxious hours hoping that the plane would not be forced to rise over some thunderstorm. Such a climb would have resulted in a fatal drop in temperature. Once the automatic heat regulator failed, but fortunately the ship carried a spare.

Charles H. Wharton

This Monkey-eating Eagle Ate Two Pounds of Beef a Day

At the price of meat in the Philippines, feeding three of these eagles threatened to bankrupt the expedition. Holding the powerful bird is the author, former first lieutenant in the U. S. Army's Medical Administration Corps. Despite heavy leather belts strapped around their legs and attached to a strong swivel and dog chain, the eagles repeatedly broke their leashes, so powerful and persistent were their lunges for freedom. At the National Zoological Park in Washington, Mr. Wharton's collection was hailed as a "zoological triumph."

Strange Aerial Immigrants

When the plane hit the runway at Oakland, California, it carried alive 31 tarsiers, 11 tree shrews, 14 cloud rats of two kinds (from Luzon Island), one flying lemur, and three

John N. Hamlet

Woe to the Luckless Monkey Caught by This Flying Ogre of the Philippines

Cold gray eyes, flaring erectile feathers, and powerful, highly arched beak like that of some gigantic parrot make the monkey-eating eagle a picture of predatory ferocity. Sometimes such aerial raiders snatch dogs, cats, or pigs to feed their voracious young (page 403).

monkey-eating eagles, as well as civets, pythons, green tree snakes, and gaudy black-and-yellow monitor lizards (page 395).

Through the courtesy of the air line, a heated room for the animals awaited me in Oakland, but when the thermometer dropped that night I could find no car with a heater to transport the cages from the room to the next plane bound for the east coast. Finally I warmed a panel delivery truck with an electric heater, quickly loaded the vehicle before it cooled off, and raced to the plane.

Further unforeseen difficulties came when all of my food supply was confiscated. This, I found, was a regular procedure for foreign

fruits and vegetables. So I went shopping on the Fourth of July for things like bananas and okra. I found enough fruit to last out the trip, but the shortage hastened the death of the flying lemur.

Arrival at Washington, D. C., a few days later completed the longest flight which a large collection of live animals had endured—11,400 miles from Davao, Mindanao, to Washington. Here, with the exception of specimens delivered en route to Chicago's Brookfield Zoo and New York's Bronx Zoo, all were placed in the National Zoological Park, there to get their first good look at the great American public.

The Society's New Map of Washington

WHEN the NATIONAL GEOGRAPHIC MAGAZINE's cartographers set out to compile a new Pocket Map of Central Washington, with a companion Map of Suburban Washington, they discovered that there was no complete, detailed, up-to-date chart of the Nation's Capital in existence.

Washington's phenomenal wartime and postwar growth had been too fast. Whole suburbs, new Army and Navy installations, new public buildings, new arterial highways, and scores of new streets were unmapped.

First step in making the new double chart, which comes to the 1,800,000 member-families of the National Geographic Society as a supplement to this issue of their Magazine,* was to conduct a complete aerial photographic survey of the entire metropolitan area. A survey plane shuttled back and forth, taking 361 aerial photographs which became the starting point for compilation.

The pictures revealed many improved areas and developments hitherto unrecorded. To check all these changes, plot them accurately in detail, and fit them into a new cartographic picture of Washington required a tremendous amount of original research, so radically had the face of the Capital been transformed.

The 1940 census listed the population of the District of Columbia at 663,091. Latest estimates place it at more than 900,000. The 1940 census put the population of the metropolitan area (District of Columbia and adjoining Maryland and Virginia suburbs) at 907,816; latest estimates show an increase of some 300,000 to a total of 1,205,000.

Map Outdistances Plat Books

County real-estate plat books are far behind your Society's new map in recording important boundary changes in housing projects, country-club areas, and similar new developments.

The new chart is the first postwar map to locate virtually everything of public interest in the Washington area.

The project of mapping metropolitan Washington in detail was undertaken in response to hundreds of requests by Government workers, visitors, and others who wanted an up-to-date map of the Capital and its environs.

The maps are printed on either side of a sheet 31¾ inches by 24¾ inches. The Pocket Map of Central Washington is drawn on a scale of four inches to a mile; the Pocket Map of Suburban Washington, on a scale of one inch to a mile.

The Pocket Map of Central Washington extends from American University on the northwest to the Franciscan Monastery on the northeast; and from Arlington Village on the southwest, across Washington National Airport, to Fort Stanton Park on the southeast.

Downtown blocks in which buildings are solidly packed are indicated with solid tint. A fringe of tint in residential sections marks houses fronting on the streets, with grounds untinted in the rear. In sparsely settled outlying areas individual buildings are shown.

Washington is famous for its trees. Although it was not feasible to show tree-lined streets, the new map indicates important groups of trees, and distinctive patterns indicate whether they are evergreen or deciduous. The famous Oriental flowering cherry trees around the Tidal Basin are clearly located.

The aerial photographs showed that the heavy woodland surrounding St. Vincent's Home and School, fronting on Edgewood Avenue, Northeast, extended eastward beyond the Home's property to the Baltimore & Ohio Railroad tracks. The trees were correctly indicated on the map.

A few days later, a keen-eyed National Geographic cartographer, passing the area on his way home, noticed bulldozers at work on the land between St. Vincent's and the railroad. All the trees on the tract—more than 500—were being cut down to make room for a new warehouse. Off the map they came and now the tract is shown denuded of trees!

Schools, public parks, police precincts, streetcar lines, bus routes, theaters, churches, monuments, and statues are located and named. Street classifications show at a glance arterial streets, secondary streets, private roads and driveways.

The Capitol, White House, Federal Triangle buildings, and other landmarks are outlined as they appear from the air.

Of interest to motorists is the accurate drawing of the Pentagon Building, with its labyrinth of surrounding highways. To the southwest three of these highways cross, each on a different level.

All units of the Washington Cathedral Close, drawn to their actual plans, are shown clustering around the huge cathedral. College buildings of Catholic University are mapped in accurate detail and location. Important buildings of George Washington University,

* Members may obtain additional copies of the new double map, "Pocket Map of Central Washington" and "Pocket Map of Suburban Washington" (and of all standard maps published by The Society), by writing to the National Geographic Society, Washington 6, D. C. Prices, in United States and Possessions, 50¢ each on paper; $1 on linen. Outside United States and Possessions, 75¢ on paper; $1.25 on linen. All remittances payable in U. S. funds. Postage prepaid.

Georgetown University, and American University are designated.

From Lion House to American Waterfowl Pond, the units of the National Zoological Park are outlined.

Railroad Network Mapped

Look north from the White House up Sixteenth Street to find the spacious headquarters of the National Geographic Society at M Street. A large L indicates the new wing, now building, necessitated by The Society's rapid expansion in the last decade.

The new map locates construction work on the new dual highway bridge across the Potomac, which will replace the old bridge at the foot of Fourteenth Street and expedite traffic between the Capital City and the Washington National Airport, the Pentagon, and Mount Vernon, and along the Jefferson Davis Highway southward.

Also designated is construction work on the K Street Elevated highway which will relieve traffic congestion between downtown Washington and suburban Arlington County, Virginia, by way of Georgetown.

Construction work is noted on the Dupont Circle underpass at the intersection of Connecticut, Massachusetts, and New Hampshire Avenues, and Nineteenth and P Streets—long one of the Capital's biggest traffic bottlenecks. When it is completed, streetcars and motor traffic on Connecticut Avenue will tunnel under the Circle. No longer will the bewildered out-of-town motorist drive into Dupont Circle to find a streetcar bearing down upon him in the wrong direction, clanging its way uptown through a swarm of autos, buses, and trucks going downtown!

The new Dupont Plaza, giant apartment hotel, on the northern side of Dupont Circle, and the new Congressional Hotel, on New Jersey Avenue south of the House Office Building, are designated, along with two new hospitals, the Georgetown University Hospital at Reservoir Road and 39th Street, and George Washington University Hospital on Washington Circle.

As the new map was about to go to press, boys playing with matches in the abandoned Gales Public School, near Union Station, set the building afire and it was destroyed. Off the map it came.

After the map had been delivered to the engraver, St. Agnes Episcopal Church on Q Street, Northwest, merged with the Church of the Ascension and abandoned its edifice. A correction was made in the plates.

The Pocket Map of Suburban Washington encompasses the Great Falls of the Potomac, scene of George Washington's canal project, on the northwest; the Patuxent Wildlife Refuge in Maryland, on the northeast; Alexandria, Virginia, on the southwest, and the Andrews Air Force Base in Maryland, on the southeast. An inset maps Mount Vernon, south of Alexandria.

Only thorough firsthand cartographic surveys made it possible to name and map in detail all the new suburban communities and subdivisions.

Investigators in automobiles checked developers' sketches, often inaccurate, and other maps of new subdivisions. They also investigated uncharted thoroughfares and groups of houses revealed only by the aerial photographic survey.

One cartographer, checking a chart of the Beltsville, Maryland, area, followed a road plainly marked on a sketch map. The road became nonexistent after a few blocks and left the National Geographic Society automobile stuck in the mud up to the hubcaps.

The new map shows the huge wartime housing projects of Parkfairfax, in Alexandria, Virginia, and Fairlington, nine-tenths of which lies in adjoining Arlington County, Virginia, with the remainder in Fairfax County.

Montgomery County's Growth

The map also shows new housing projects dotting Montgomery County, Maryland, in which lie the Washington suburbs of Bethesda and Silver Spring.

The huge Department of Agriculture Research Center at Beltsville, Maryland, is drawn in detail, with subcenters of research clearly marked.

The vast new building now under construction at the National Institute of Health will house the National Institute of Mental Health, and provide 500-bed hospital facilities for the National Cancer Institute, the National Heart Institute, and the National Institute for Dental Research.

The map shows the 2,775-foot tank of the David W. Taylor Model Basin at Carderock, Maryland, where the United States Navy tests exact models of all types of hulls.

White Oak, Maryland, is the home of the new Naval Ordnance Laboratory. Closely associated with it is the Johns Hopkins Applied Physics Laboratory at Silver Spring, Maryland, chief wartime center for the development of the proximity fuse.

The new map, compiled for general use, has been designed to answer any question about Washington or its environs. An index on each side identifies more than 500 important locations.

NATIONAL GEOGRAPHIC SOCIETY

GEOGRAPHIC ADMINISTRATION BUILDING
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ORGANIZED FOR "THE INCREASE AND DIFFUSION OF GEOGRAPHIC KNOWLEDGE"

To carry out the purposes for which it was founded sixty 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 The Magazine uses, generous remuneration is made.

In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus crossed the Atlantic. By dating the ruins of the vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for three hundred years.

In Mexico, The Society and the Smithsonian Institution, January 16, 1930, discovered the oldest work of man in the Americas for which we have a date. This slab of stone is engraved in Mayan characters with a date which means November 4, 291 B. C. (Spinden Correlation). It antedates by 200 years anything heretofore dated in America, and reveals a great center of early American culture, previously unknown.

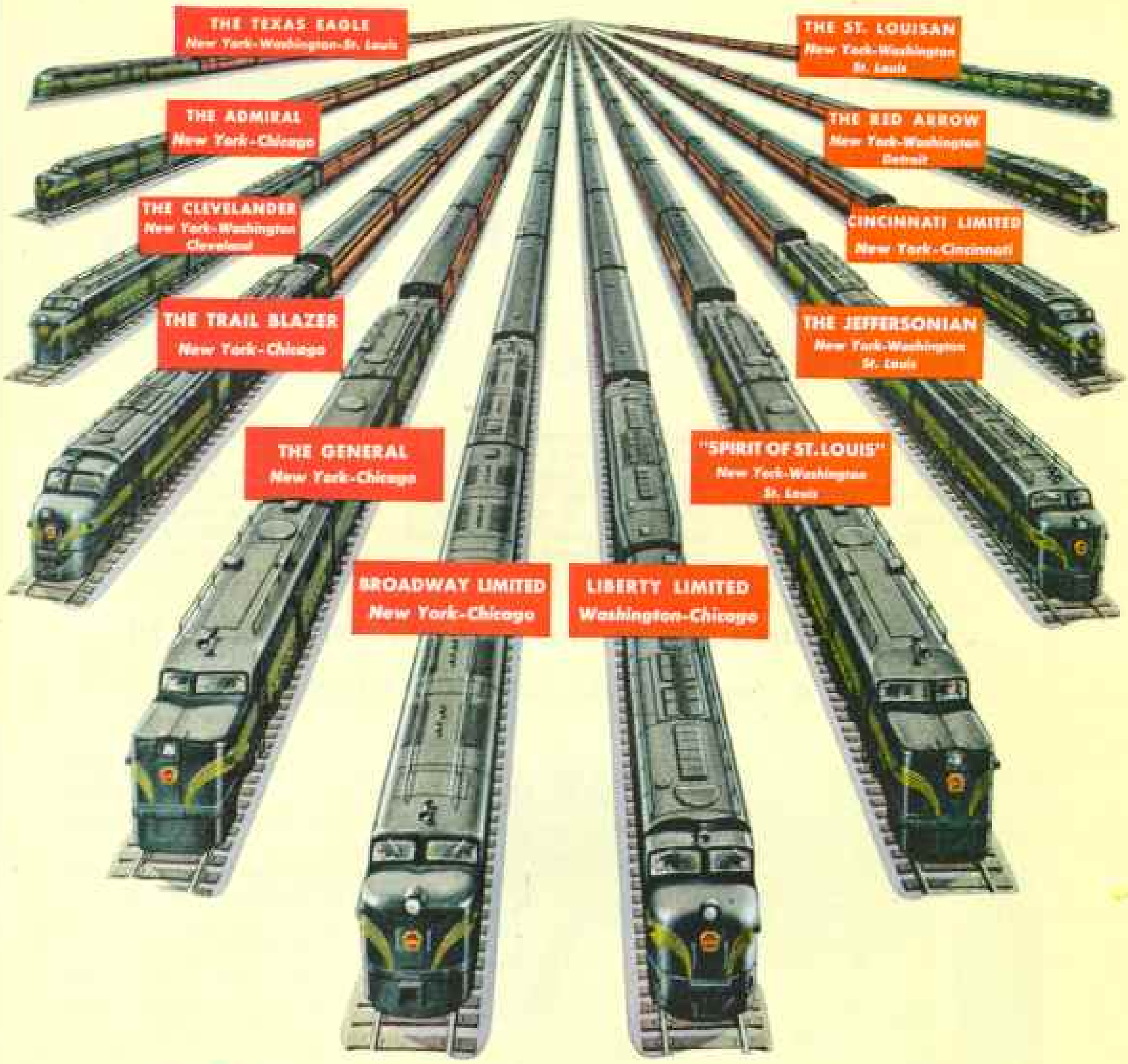
On November 11, 1935, in a flight sponsored jointly by the National Geographic Society and the U. S. Army Air Corps, the world's largest balloon, *Explorer II*, ascended to the world altitude record of 72,395 feet. Capt. Albert W. Stevens and Capt. Orvil A. Anderson took aloft in the gondola nearly a ton of scientific instruments, and obtained results of extraordinary value.

The National Geographic Society-U. S. Army Air Forces Expedition, from a camp in southern Brazil, photographed and observed the solar eclipse of 1947. This was the seventh expedition of The Society to observe a total eclipse of the sun.

The Society cooperated with Dr. William Beebe in deep-sea explorations off Bermuda, during which a world record depth of 3,028 feet was attained.

The Society granted $25,000, and in addition $75,000 was given by individual members, to the Government when the congressional appropriation for the purpose was insufficient, and the finest of the giant sequoia trees in the Giant Forest of Sequoia National Park of California were thereby saved for the American people.

One of the world's largest icefields and glacial systems outside the polar regions was discovered in Alaska and Yukon by Bradford Washburn while exploring for The Society and the Harvard Institute of Exploration, 1938.



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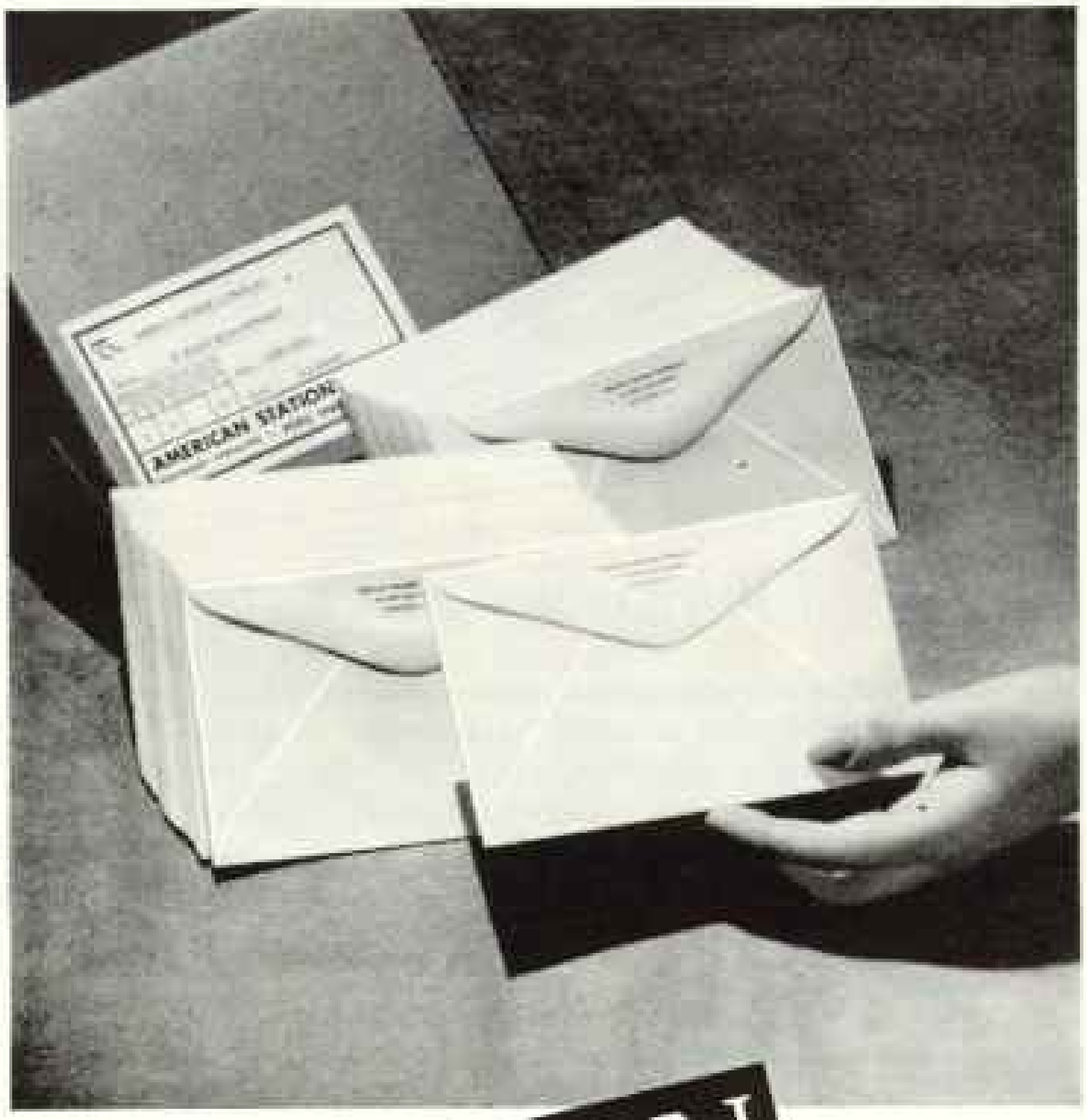

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Whose eyes are better?

Neither. American eyes are no better than others. But we Americans see better because the professional and technical services of modern eye care are so widely available — and within the reach of all. It is part of the American way of life constantly to improve our standards of living — and our standards of seeing.

We all need "seeing ability" to meet the visual requirements of our modern living, but many of us cannot achieve this unaided. The only way to make sure that your seeing ability meets your seeing needs is to seek professional advice.

Glasses alone won't correct faulty vision. They are important, but their aid to your visual comfort and efficiency depends upon the professional and technical services of Optometrists, Ophthalmologists, Ophthalmic Dispensers (Opticians).

We Americans owe our high standards of vision to their professional and technical services, some of which are illustrated below. Services like these are essential to your seeing ability — your eye comfort, your visual efficiency. It is these services which have helped Americans see better. It is for these services — not for glasses alone — that you pay a fee.

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Seats are chair-height—so a man can sit up like a man. And you literally ride on air when you ride on Airfoam Seat Cushions, available on Special De Luxe Plymouths at moderate additional cost. Millions of tiny air pillows give to your slightest body pressure, mold themselves to you for restful support.

You ride *between* the axles, not over them. That's a difference, a comfort difference. Bigger, fatter Super-Cushion Tires, standard equipment on Plymouth, soak up road shocks from sides and below. The longest wheelbase in its price field makes for a still more level ride.

And these are only a few of the dozen and more major Plymouth features that speak up for a great ride—and a great car. There is a difference in low-priced cars, and Plymouth makes the difference!

PLYMOUTH BUILDS GREAT CARS

PLYMOUTH is still the low-priced car most like high-priced cars

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PLYMOUTH BUILDS GREAT CARS . . . GOOD SERVICE KEEPS THEM GREAT. *Your nearby Plymouth dealer will provide the service and factory-engineered parts to keep your present car in good condition while you're waiting for your new Plymouth.* PLYMOUTH Division of CHRYSLER CORPORATION, Detroit 31, Mich.

● *General Electric Automatic Dishwasher saves hours of kitchen drudgery! Washes dishes sparkling clean. They dry in their own heat!*

1. A day's dishes done like magic! The G-E Dishwasher will wash a whole day's dishes at one time for a family of four. Convenient racks hold china, glassware, silver safely. Dishwasher cleans pots and pans, too!

2. No more rough, red hands! You never touch dishwater. Just turn the switch and the Dishwasher takes over —*automatically* washing and rinsing dishes in water hotter than hands can stand.

3. Gives you new hours of freedom! You're no longer a slave to a dishpan. The Dishwasher thoroughly cleans and rinses each piece *cleaner than by hand*. Safely, too—only the water moves.

4. No dishes to wipe—ever again! After dishes are washed and rinsed, the cover opens automatically, and both dishes and Dishwasher dry in their own heat. Gleaming, sparkling clean dishes are ready to be put away.

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NOTE: The Dishwasher is available either in a complete sink, or as a separate individual appliance for installation in your new or present kitchen. General Electric Company, Bridgeport 2, Conn.

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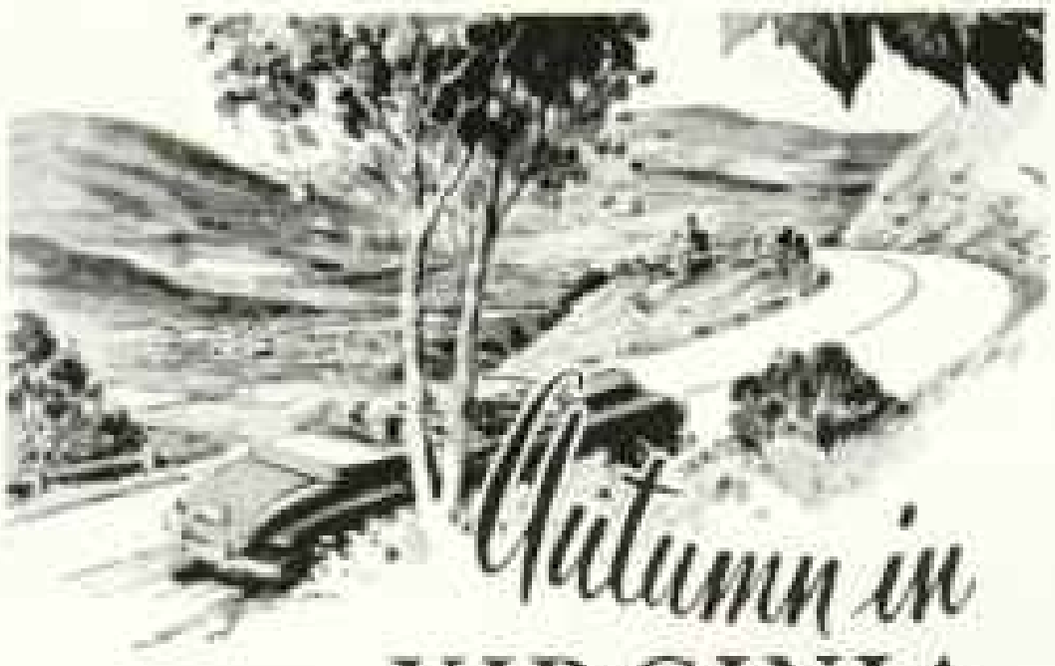

Autumn in VIRGINIA

Virginia in September, October and early November is a vast panorama of magnificent color . . . a coronation of Nature in her most wondrous guise. From the warm, blue Atlantic in the east to the peaks of the Blue Ridge in the west, *all* Virginia in Autumn is a scenic miracle visited and revisited by thousands each year. For a glorious last-minute vacation you'll long remember, come to romantic Virginia . . . in the Autumn . . .

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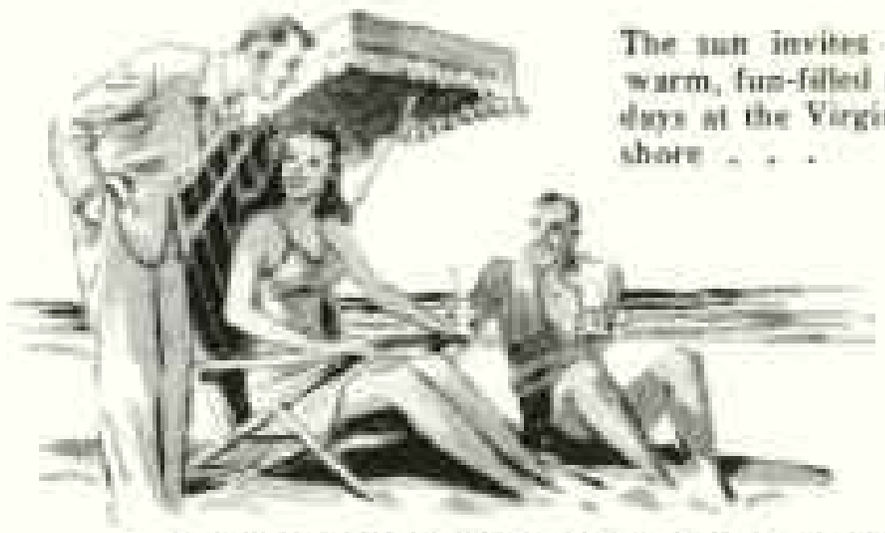

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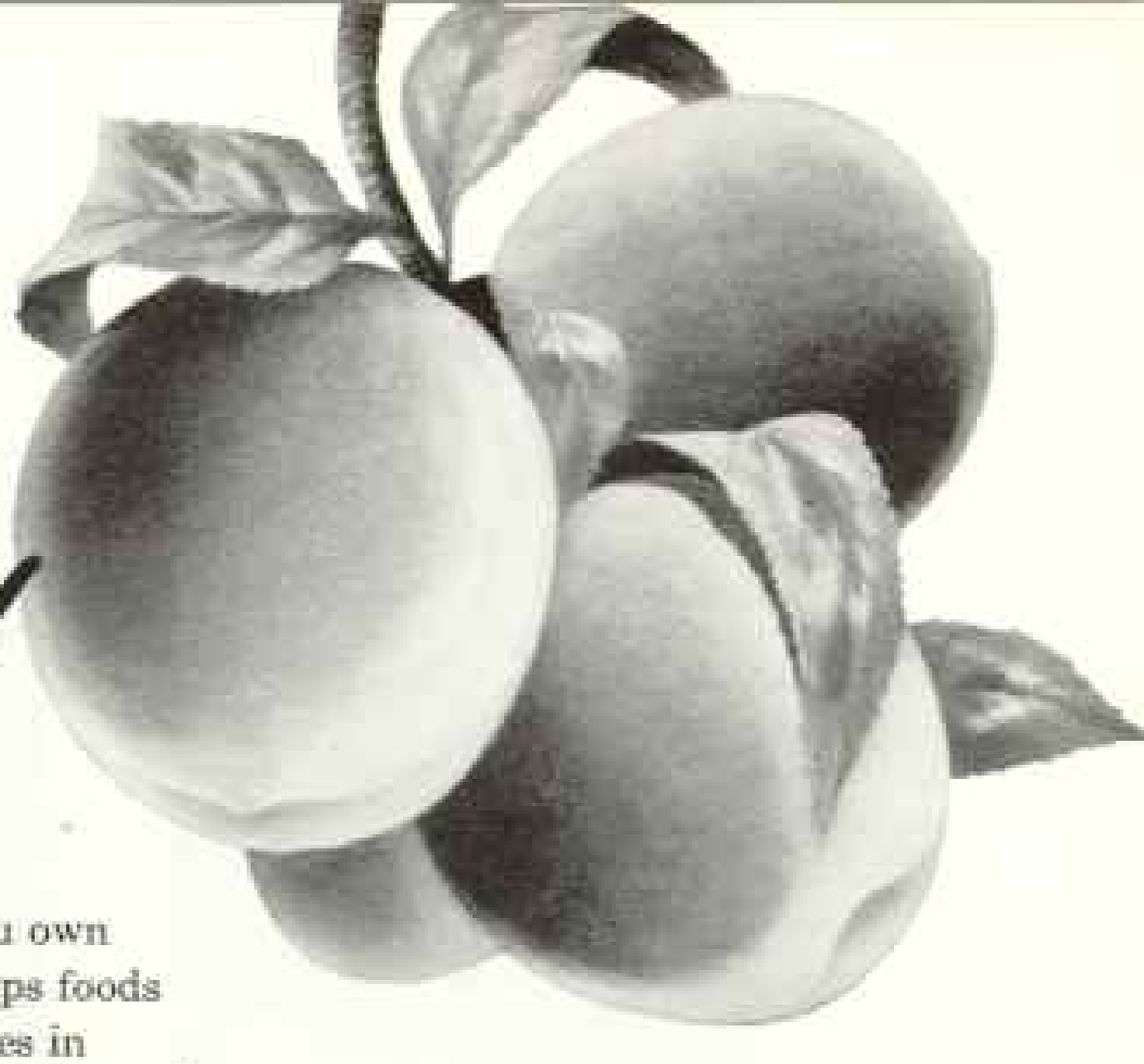

THE calendar has less meaning when you own a Philco Freezer. Below-zero storage keeps foods *freezer-fresh* the year around. Strawberries in January . . . red-ripe and luscious. Corn-on-the-cob at Christmas . . . tender and thrilling to Winter's jaded tastes. Fresh-tasting peaches in February . . . orchard-ripe and delicious. The joy of a well-filled larder, no matter what the emergency of weather or pop-in guests. Get the story from your Philco dealer.

Keep foods FREEZER-FRESH*

*Fresh as the day they were picked, caught, or bought.

Says Mrs. Frank Allisan of Dallas, Texas

"I find so many uses for our Philco Freezer, I'd hardly know where to start telling you about them. The freezer idea sort of grows on you the longer you have one."

PHILCO MODEL AV-75. Deluxe Upright; large 7½ cu. ft. capacity holds up to 300 lbs. of frozen foods. 3 compartments, one for sharp freezing. Patented sloping shelves and 2 position drop doors conserve cold. Temperatures as low as 15° below zero. Built-in Thermometer, Outer Door Lock and Temperature Control. Battery-operated Guardian Bell. Hermetically Sealed Power System. Philco quality throughout.

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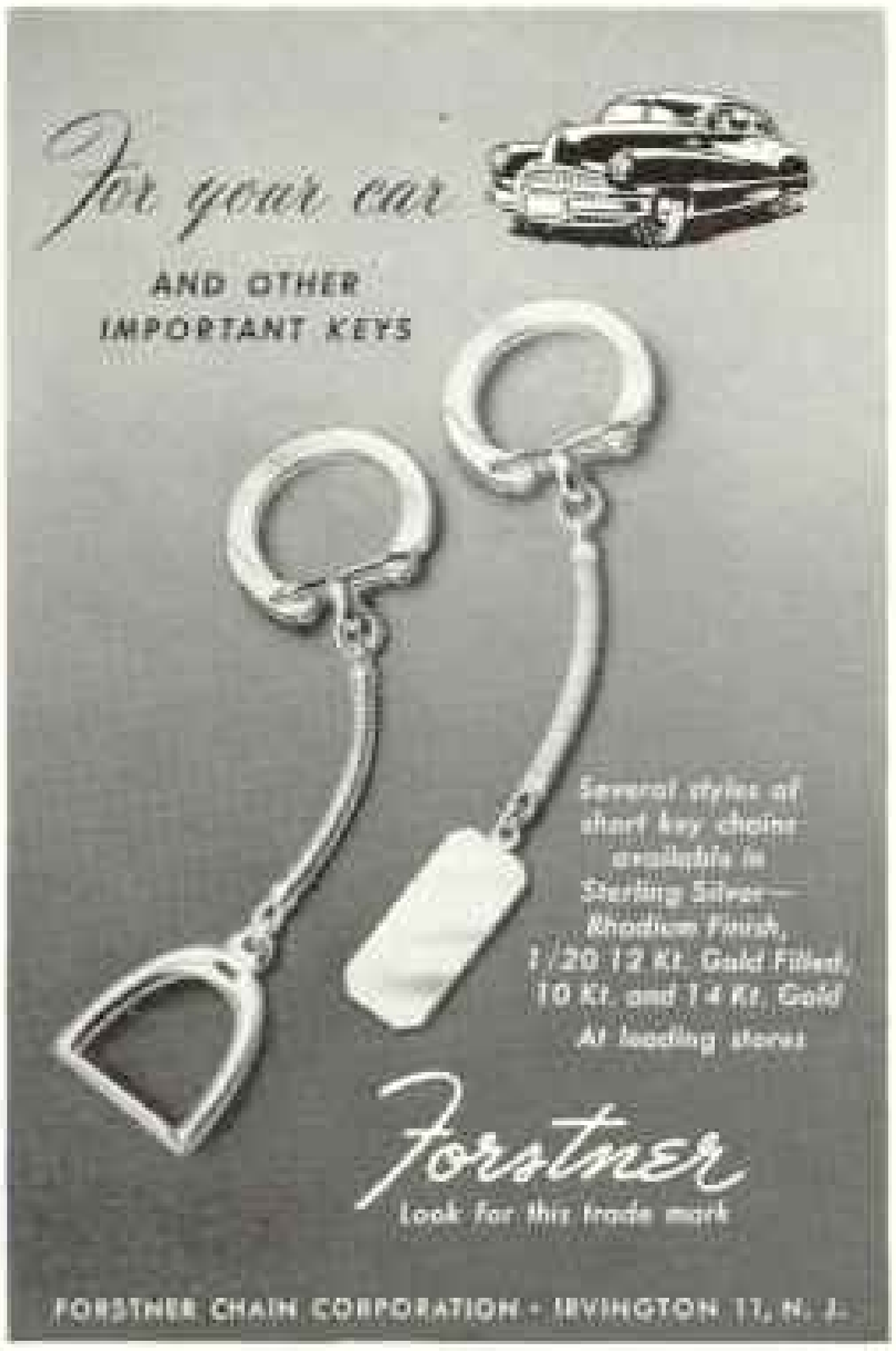

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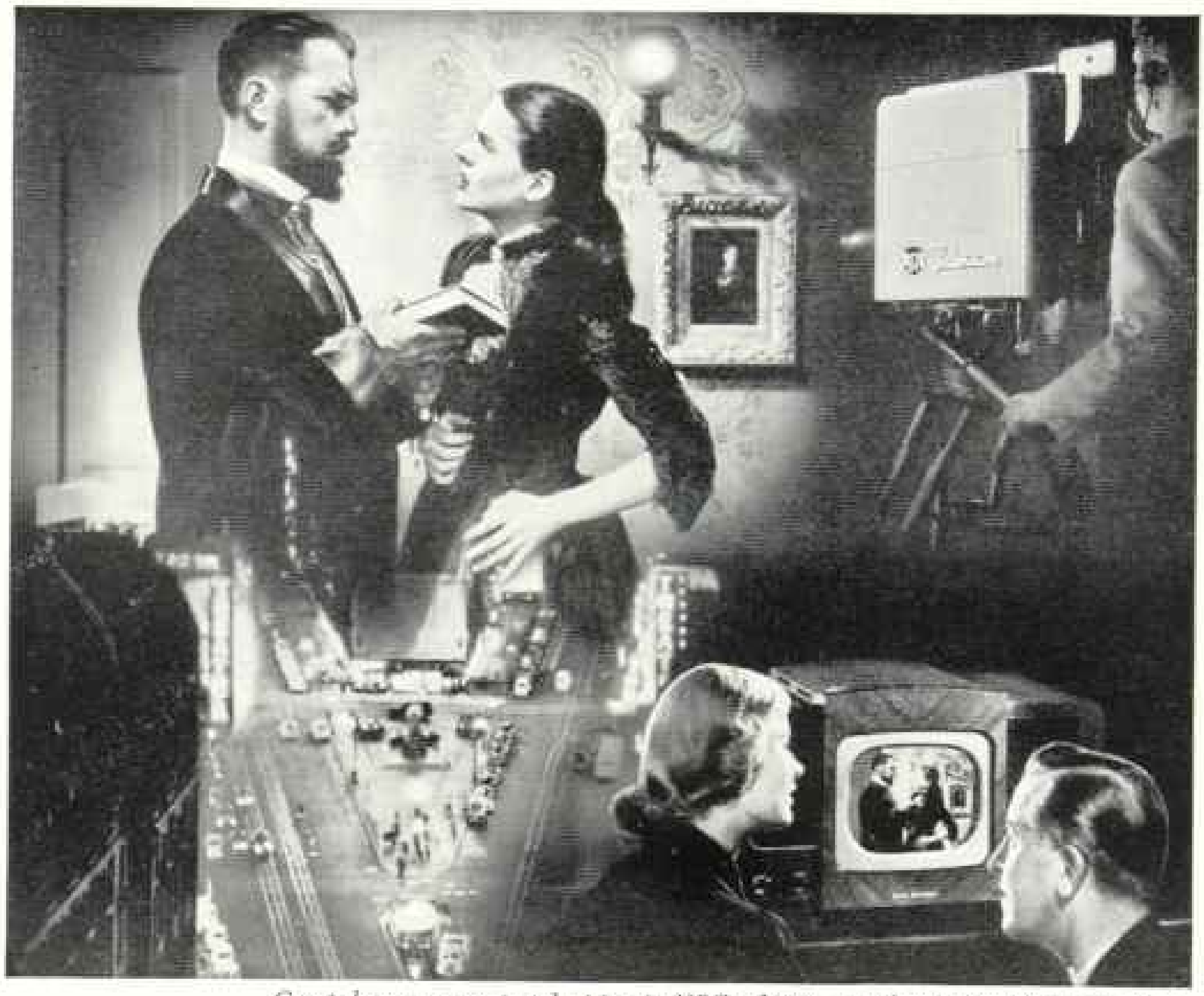

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That television can make so important a contribution to American entertainment is in good part the result of pioneering and research at RCA Laboratories. Such research enters every instrument bearing the name RCA or RCA Victor.

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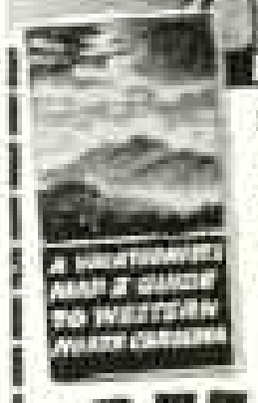

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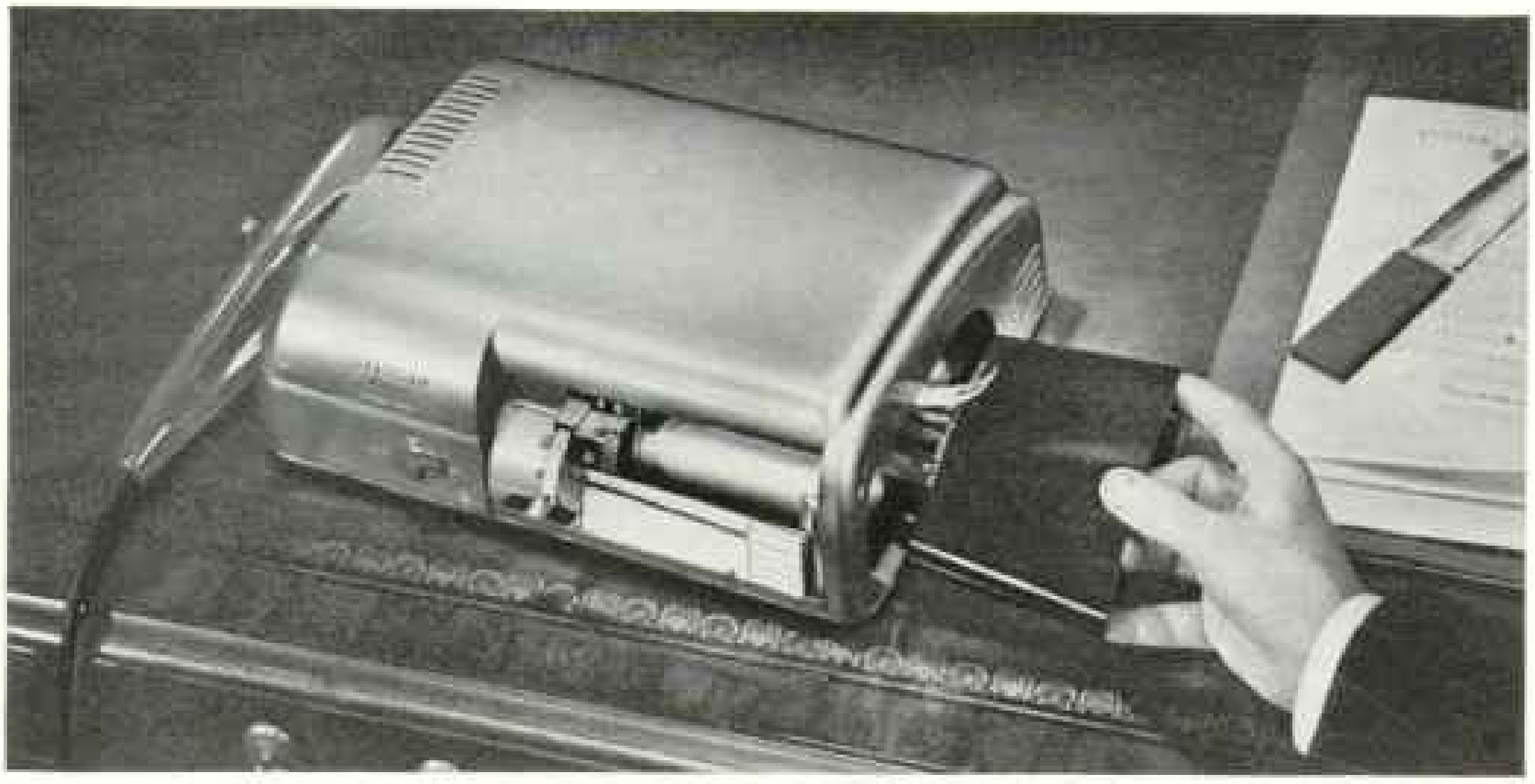

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Amazing new electronic Dictaphone Machine uses revolutionary plastic belt

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Accommodations are uncrowded. You get the kind of service you desire and you meet people with kindred interests. You will enjoy every minute of your stay.

Possibly you sent for your copy of "Tennessee" when advertised in a Spring issue of Geographic. If not, write now. It is quite a book, and it's free.

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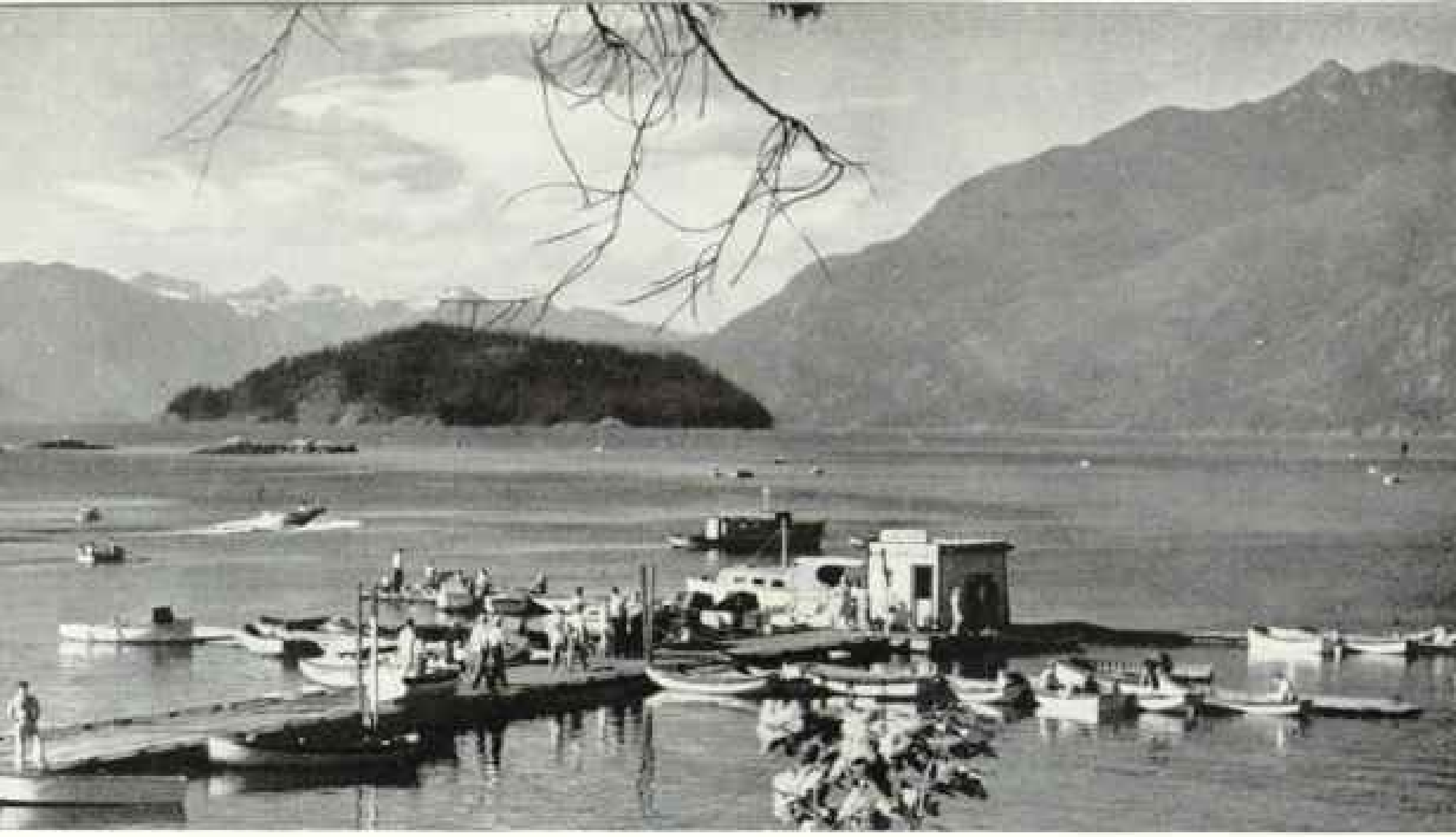
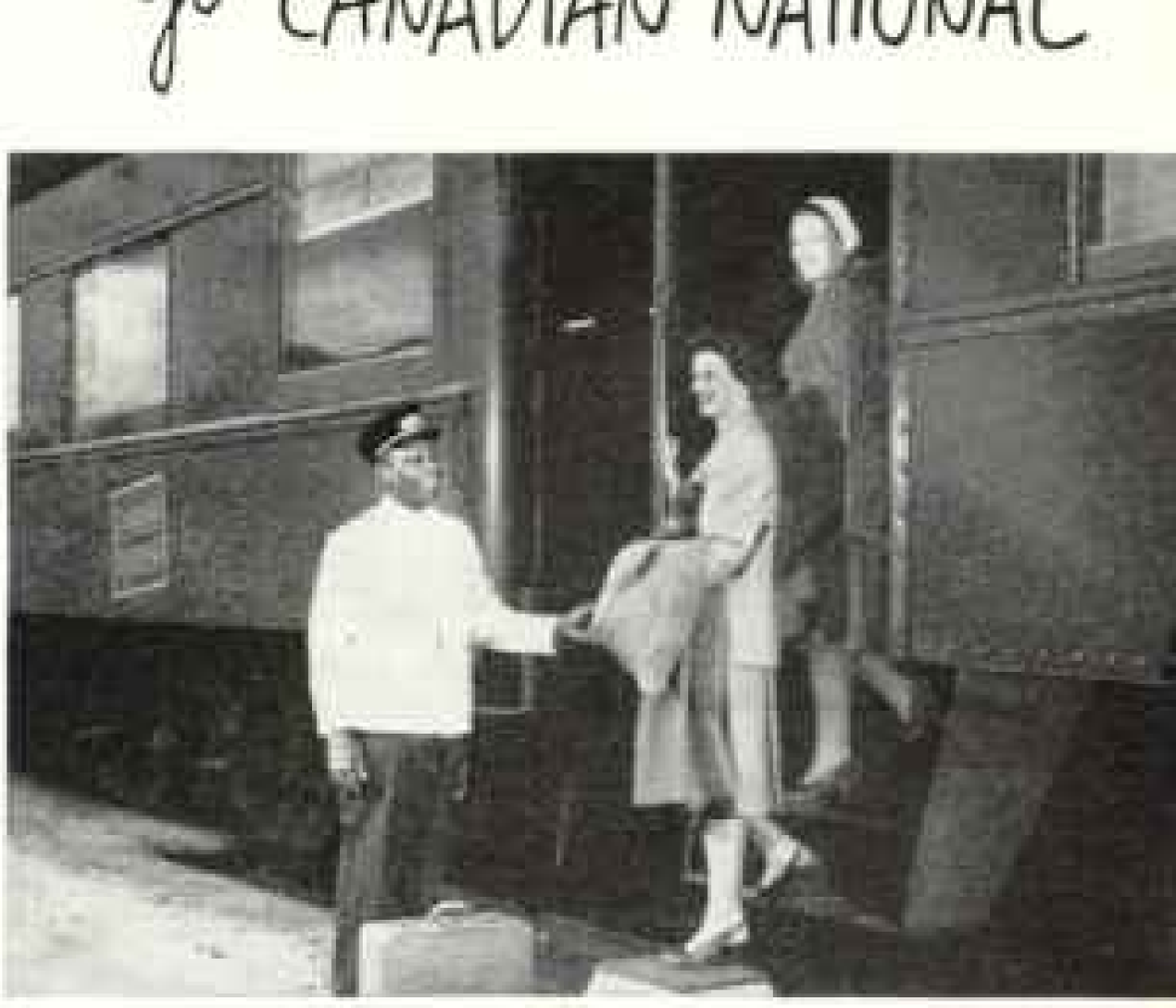


Summer lingers long in British Columbia's mild coastal climate. You can sail, fish, golf right through the fall—enjoy natural beauty spots like this near Vancouver and Victoria, or cruise through the mountain-guarded fjords of British Columbia's famed Inside Passage.

Enjoy Canada in Autumn —go CANADIAN NATIONAL

Fall is ideal for visits to Canada's cities (Canadian National's luxurious Chateau Laurier in Ottawa, above). The International Limited (Chicago, Toronto, Montreal), and the Ocean Limited (Montreal, Halifax) give easy access to Eastern cities; the Continental Limited provides through sleeper service Montreal, Toronto to and from Jasper and Vancouver.



Whenever and wherever you travel in Canada, enjoy guest-of-honor service by the largest transportation system on the continent. Canadian National operates resort and all-year hotels; airlines; steamships to Alaska, Bermuda and the West Indies. To California and anywhere West, to New York and anywhere East, go Canadian National.

See Canada by C.N.R. "We'll tell you where—and take you there."—For particulars, consult your nearest Canadian National Railways office ... Boston, Buffalo, Chicago, Cincinnati, Detroit, Duluth, Kansas City, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh, Portland, Me., San Francisco, Seattle, St. Louis, Washington, D.C.—U.S. citizens need no passport.

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THE RAILWAY TO EVERYWHERE IN CANADA

THRILL TO THE JOYS OF FLAMING FALL IN

Glorious Michigan

There's a scene of autumn pageantry 'round each bend of the road in wonderful Michigan. Winding, lake-trimmed highways cordially welcome you to tour through forests of color-splashed beauty.

And it's not too late for exciting fishing. Flashing Bass, Perch and "Muskie" eagerly await your lure in thousands of Michigan's sparkling, gem-like lakes.

In the Fall, deer herds, duck, geese, pheasant and partridge flushing along woodland trails, promise good hunting. You'll enjoy a hearth-warming vacation or delightful week-end in glorious Michigan.

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I would like to receive free, illustrated literature describing Fall Vacations in Michigan.
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STREET _____
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4408 W. Lake St., Chicago 24, Ill.

The high cost of living has us all in the uneasy seat!

Business dislikes the high cost of living as much as you do. For fewer people buy when prices are too high.

At National Dairy we do everything possible to keep prices *down* and quality *up*. Each month our key men sit down at a "round table" to exchange ideas on how to increase efficiency and improve products. The aim is *top quality at lowest possible price*.

Here are some figures which show how milk prices compare with food prices, from 1939 to 1948:

Increase in cost of food 116%
Increase in cost of fluid milk . . 78%

Notice that milk has not increased nearly so much as the average of other foods. Our profit from all of our milk divisions averaged less than ½ cent per quart sold in 1947—far less than the public thinks business makes—and much less than the average profit in the food industry.

When you buy milk—nature's most nearly perfect food—you get more for your money than in anything else you eat. We guard the quality and flavor of milk and butter, cheese, ice cream and other products made from milk. *And we make them available at the lowest possible prices to the greatest number of people.*

An impartial national survey shows that most Americans consider 10%-15% on sales a fair profit for business. Compared to this, the average profit in the food industry is less than 5%. And National Dairy's profit in its milk divisions in 1947 was less than 2%.

NATIONAL DAIRY
PRODUCTS CORPORATION

Quiet Sunday dinner—100 miles an hour

When a train powered by a General Motors Diesel locomotive glides into — or out of — a station, there's not even a ripple in the glass of water at your elbow.

You travel with a new smoothness — and a new speed, too. Often, on the straightaways, your train may make 100 miles an hour.

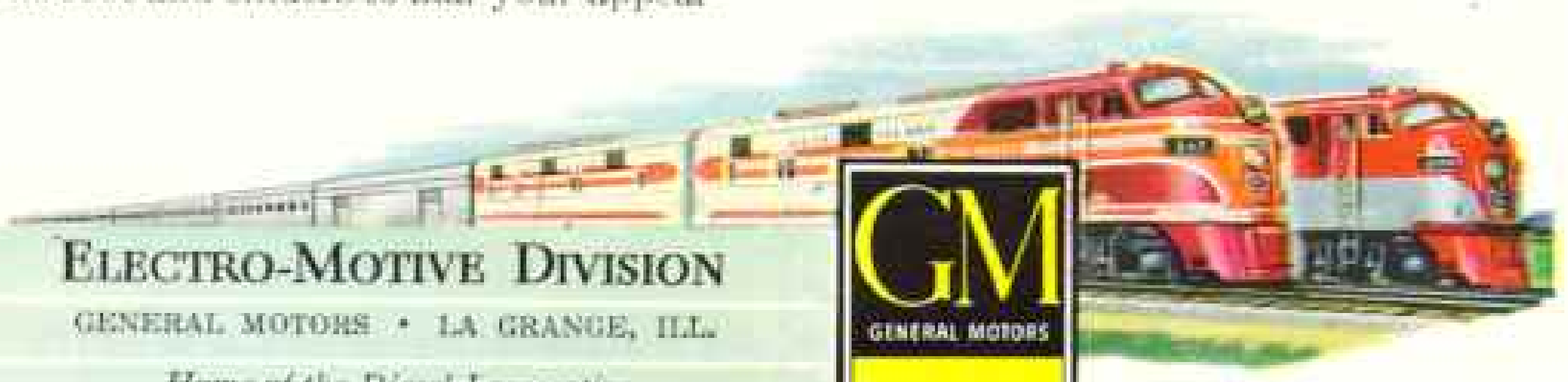
General Motors locomotives have also brought a new cleanliness to travel — no soot and cinders to mar your appearance: no clouds of smoke and steam to mar your view.

They have held, for several years, the records for on-time arrivals.

That's why it is easy to see why 200 of America's finest, fastest name trains are headed by General Motors power.

Easy to understand why better trains follow General Motors locomotives.

See the Electro-Motive Exhibit at the Chicago Railroad Fair.



ELECTRO-MOTIVE DIVISION

GENERAL MOTORS • LA GRANGE, ILL.

Home of the Diesel Locomotive

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GENERAL MOTORS
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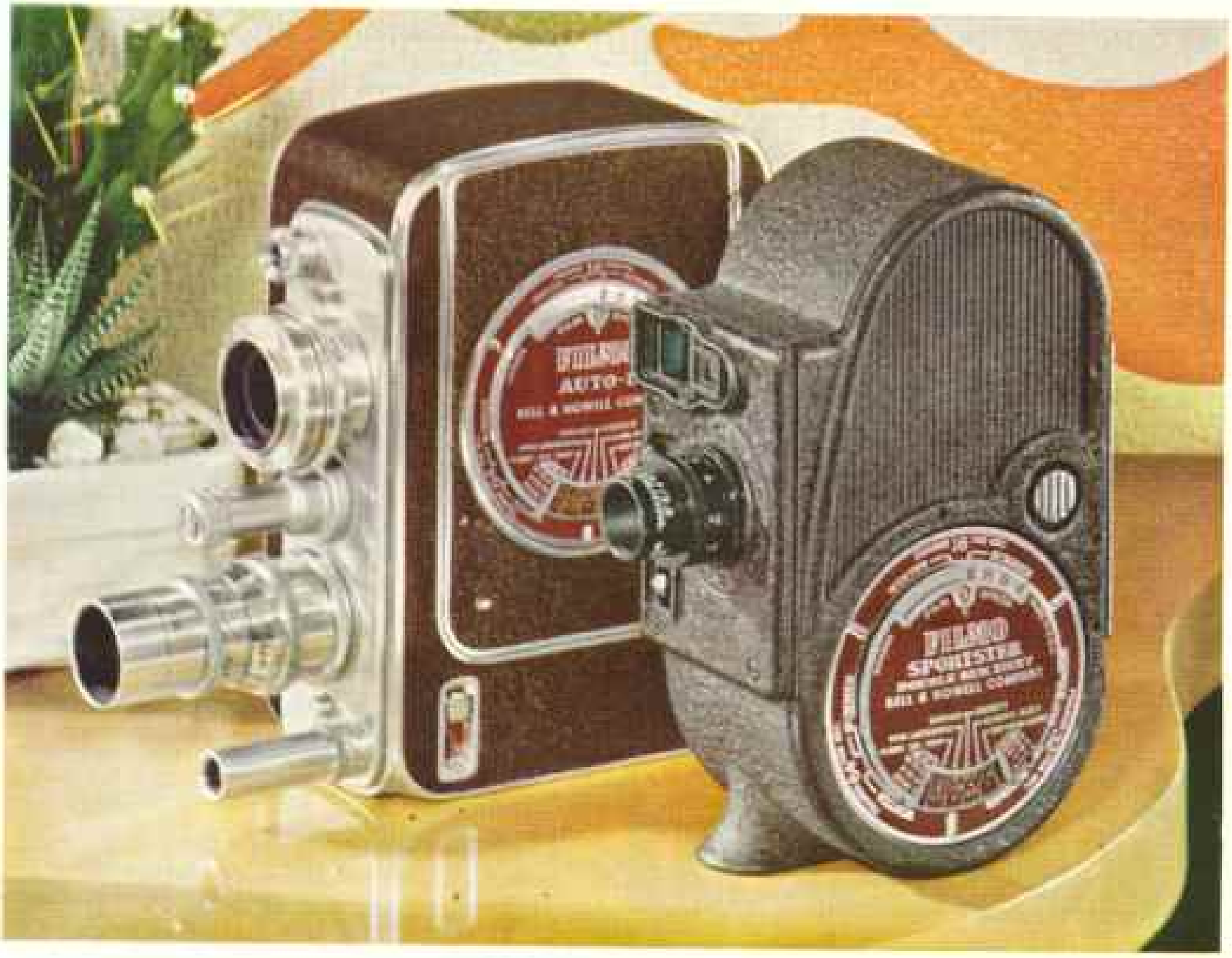

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You raise your movie camera to your eye. The scene in the viewfinder is one you'll want to remember always . . . perhaps one you've traveled days to see.

Will you press the starting button with full assurance of getting a movie so fine you'll cherish it forever? You'll have that assurance if yours is a *Filmo* camera. For all Filmos are built by craftsmen who have met Hollywood's professional equipment needs for 41 years. Only Filmos offer this heritage. With Filmo, *what you see, you get!*

Precision-made Filmos include 8mm and 16mm cameras and projectors, and 16mm sound film projectors. See them in better photo shops now or write Bell & Howell Company, 7104 McCormick Road, Chicago 45.

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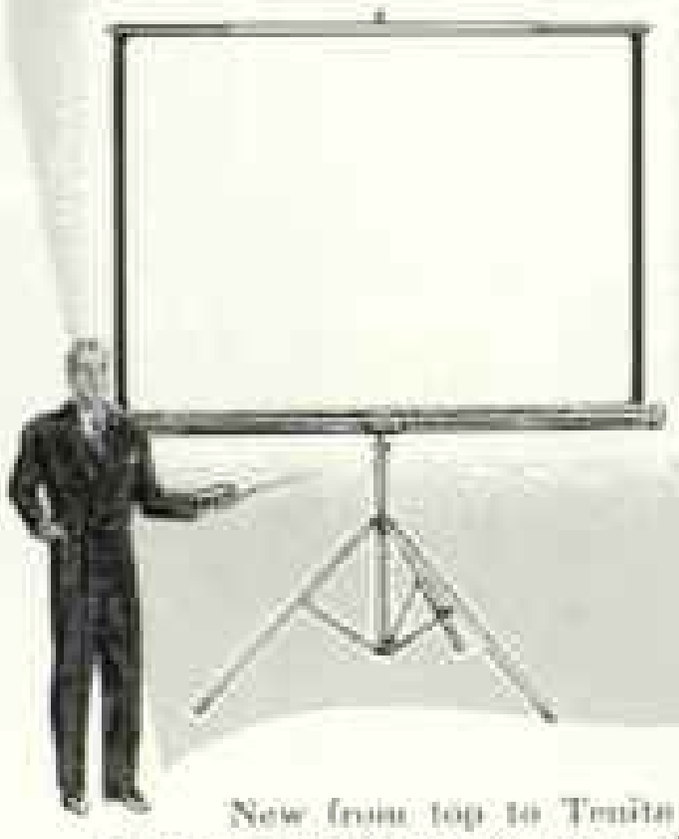

DA-LITE'S 40th Anniversary MODEL AND FINEST PROJECTION SCREEN

Now from top to Tenite feet. The beautiful blue Hammerloid octagon case, gleaming chrome end caps, bright (and light) aluminum alloy tripod and colorful Tenite controls establish a new standard. Da-Lite's wide-angle Crystal-Beaded surface brings new beauty and realism to pictures. Be first to own the best. Available now at your dealer's. Write for free sample of fabric and descriptive circular 96.

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17½ ft. of stately, streamlined Craft, wide beam, large decks, low center of gravity, for steady, sturdy Performance with greatest Safety record. Weighs only 59 lbs., loads 750 lbs. — 2 or 3 persons plus gear and duffle galore, but 1 person easily handles it. Readily packed, stored, fits inside trunk, or rides erected on cartop. Drive or hike it anywhere, for delightful cruising, wonderful hunting, grand fishing, exploring, etc. Excellent in open and stormy seas, surf and rapids, rocky waters, shallows and marshes. Ingenious design, practical construction and very substantial materials make Folbot durable, stronger, smarter, rock-resistant and leak-proof. No upkeep or fees. Folbot is most versatile for independent and expense-free boating. Folbot Corp., L.I.C., N.Y.

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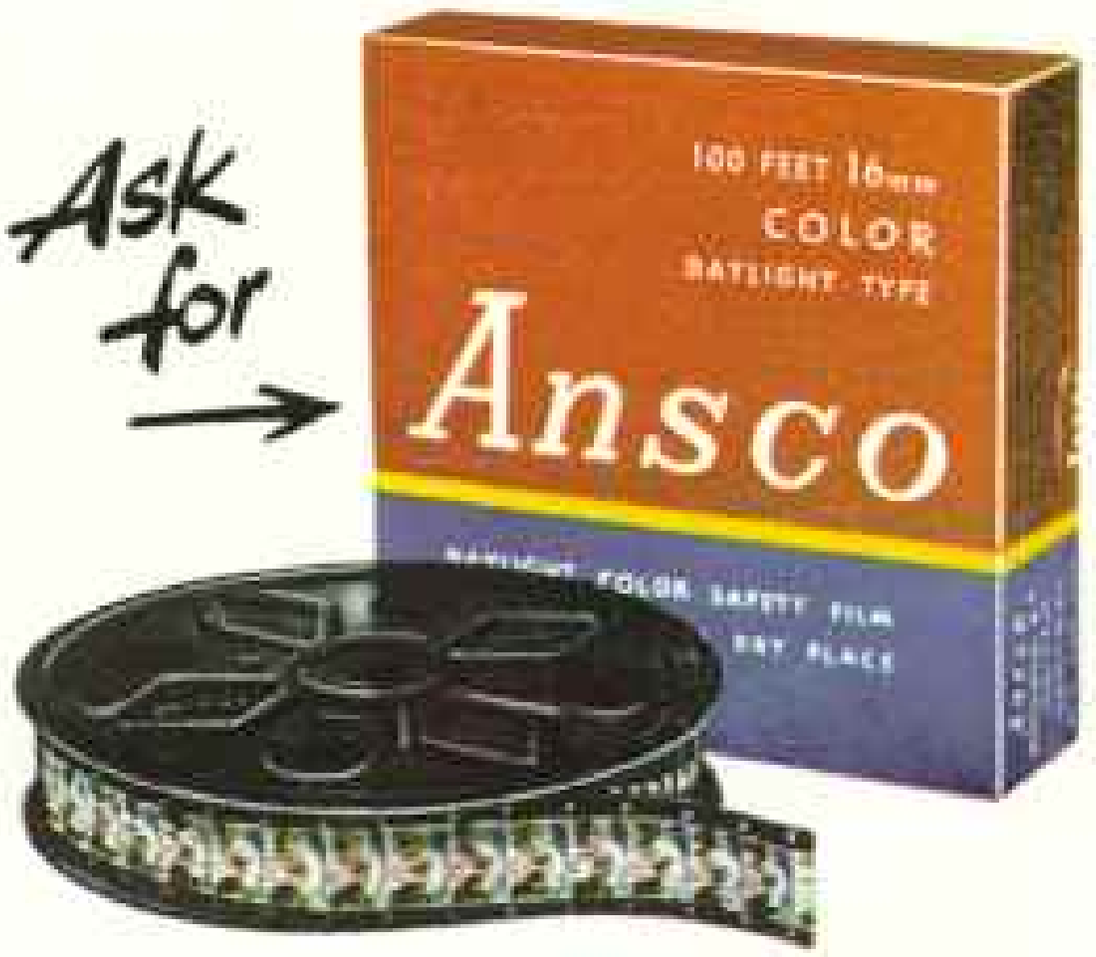
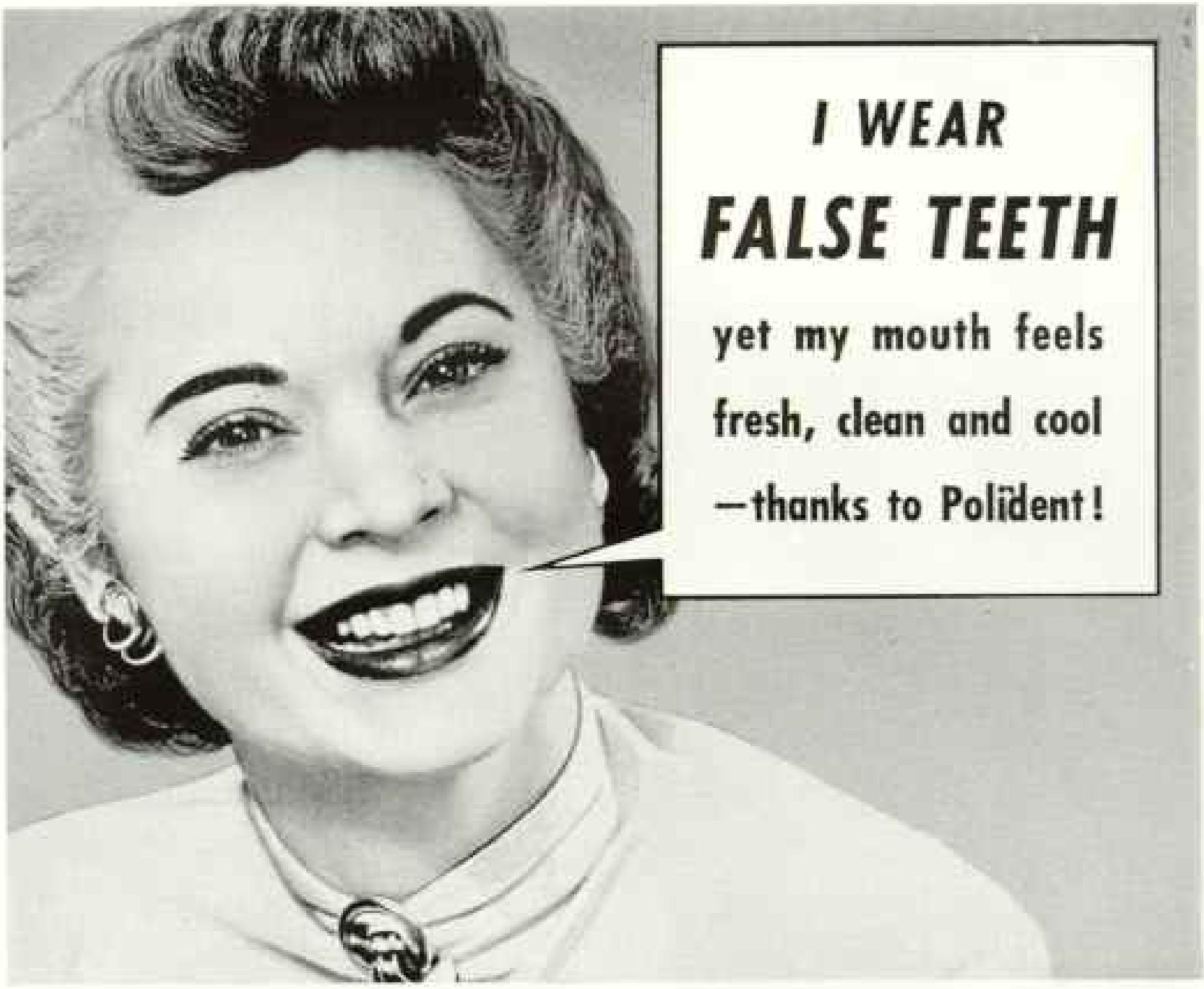
But thousands of others now insist on the living, *true* colors of glorious Ansco Color Film. They say that Ansco's magnificent reproduction of delicate tints and brilliant tones is so faithful that their movies seem to *live!*

We wish you'd shoot your fall movies on this amazing *true-color* film. See why we're so proud of it!

Ask your dealer for 50- or 100-foot 16mm spools of Ansco Color Film. And for "stills" with the same natural color, get 35mm cartridges, 120 or 620 rolls, or sheet sizes. Ansco, Binghamton, N. Y.

A Division of General Aniline & Film Corporation.



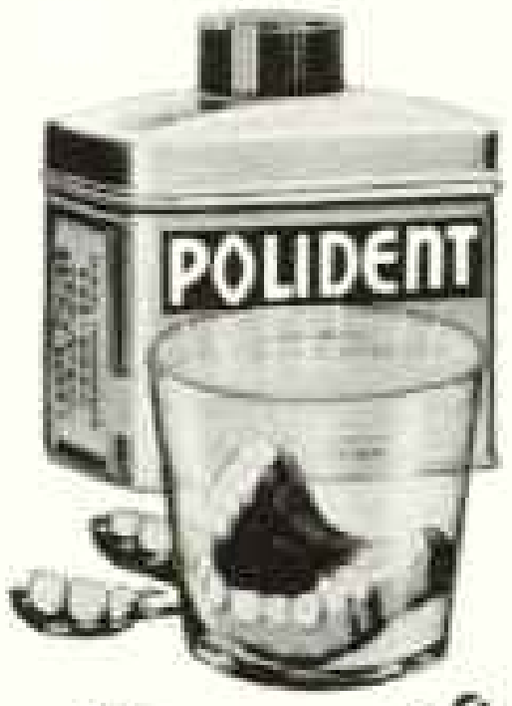


keep your dental plates odor-free by easy daily soaking in Polident

WHEN plates taste bad—feel hot and heavy in your mouth, watch out for "Denture Breath", the oral disturbance that comes from improper cleansing. False teeth need the care of a special denture cleanser—POLIDENT. Safe, easy, quick, Polident leaves your plates clean, cool and fresh. No fear of offensive "Denture Breath".

And remember, Polident keeps your false teeth more natural looking—free from offensive odor, too. For a smile that sparkles, for a mouth that feels cool, clean and fresh—soak your plates in Polident every day.

Polident comes in two sizes—regular and large economy size—available at all drugstores. It costs only about a cent a day to use, so get a can of Polident tomorrow, sure.



Soak plate or bridge daily —fifteen minutes or more— in a fresh, cleansing solution of Polident and water.

Use POLIDENT Daily

RECOMMENDED BY MORE DENTISTS THAN ANY OTHER DENTURE CLEANSER

HOW SAFE ARE YOUR CHILDREN?

In the past 35 years, the death rate from disease among children 1 to 14 years of age has been reduced more than 80%. Today, *accidents* are the leading cause of death in childhood. In addition, thousands of children are temporarily or permanently crippled by accidents each year.

Fortunately, many accidents can be prevented. Parents can do most to guard their children's health and happiness by removing possible causes of accidents, and by establishing rules of safety.

1. Burns cause most fatal home accidents. So it's wise for parents to turn the handles of pots on a stove so they can't be reached, to keep matches in a safe place, and to place a sturdy screen around a fireplace or heater.

2. Falls head the list of serious nonfatal accidents. Parents can help prevent falls by providing a storage place for toys, so that they won't be left on the stairs, or floor. Windows should be guarded, and halls well lighted.

3. Safety in the streets is extremely important. Children should learn to cross only at crossings, to obey traffic lights, to look both ways before stepping into the street, and to face traffic if they have to walk on a road.

4. Drowning accounts for many accidental deaths. That's why a grownup should be present whenever children are playing in or near the water. In winter, parents should check ice conditions where children skate.

Parents can also be helpful in protecting their children by setting a good example and by showing them safe ways to work and play. If your child seems to have more than his share of accidents, it may be a good idea to consult your family doctor.

To learn more about protecting your child, send for Metropolitan's free booklet, 108-N, "Help Your Child to Safety."

Why the Choctaws pampered a stuffed owl

BERNARD ROMANS, who explored the Tombigbee region of Mississippi and Alabama in 1771, visited some seventy Choctaw towns.

On trips between settlements, Romans and his Choctaw guide, Pooskoos Mingo, often met Choctaw war parties. From them the explorer learned that a stuffed owl was an important part of the luggage of the Choctaw on the trail.

The Choctaws took a stuffed owl along as a guiding spirit. They relied on it to watch over the expedition and to keep it from harm.

Along the way, the Indians guarded their stuffed owl as watchfully as they expected it to guard them. They pampered it even to the extent of offering it food. And always they kept the owl facing in the direction of the journey.

As long as their stuffed talisman faced serenely forward, with no feathers ruffled, they figured the path ahead was free of danger.

It undoubtedly would be a fine thing if you could keep trouble out of your way just by carrying a luck piece. But the talisman you'd tote around wouldn't work for you, we suspect, any better than the Choctaw's owl did for them.

So, since you have no sure way to clear your path of accidents that may cost you plenty, shouldn't you take this precaution right now?

Check your accident insurance. Make sure you've got enough to pay the costs of an injury and to protect yourself and your family from financial loss.

It's well to remember that an accident can happen anywhere—at work or at play. But with accident insurance you're protected wherever you are—in your home, your place of business, at some vacation spot, or anywhere on the road.

See your Travelers agent or broker today.

SHEAFFER'S WHITE DOT ○ MARK OF DISTINCTION

Best to give... Best to own!

The satisfaction of ***owning*** the best is only equalled by the satisfaction of ***giving*** the best! . . . That's why so many millions of quality-and value-conscious men and women insist on finding the White Dot when selecting writing instruments. They know it's the ***Mark of Distinction*** found only on Sheaffer's finest products. And they know something else — that Sheaffer's best means the world's best! To reach the same conclusion, you have but to compare Sheaffer's with writing instruments of any other make. W. A. Sheaffer Pen Company, Fort Madison, Iowa—Malton, Ontario, Canada.

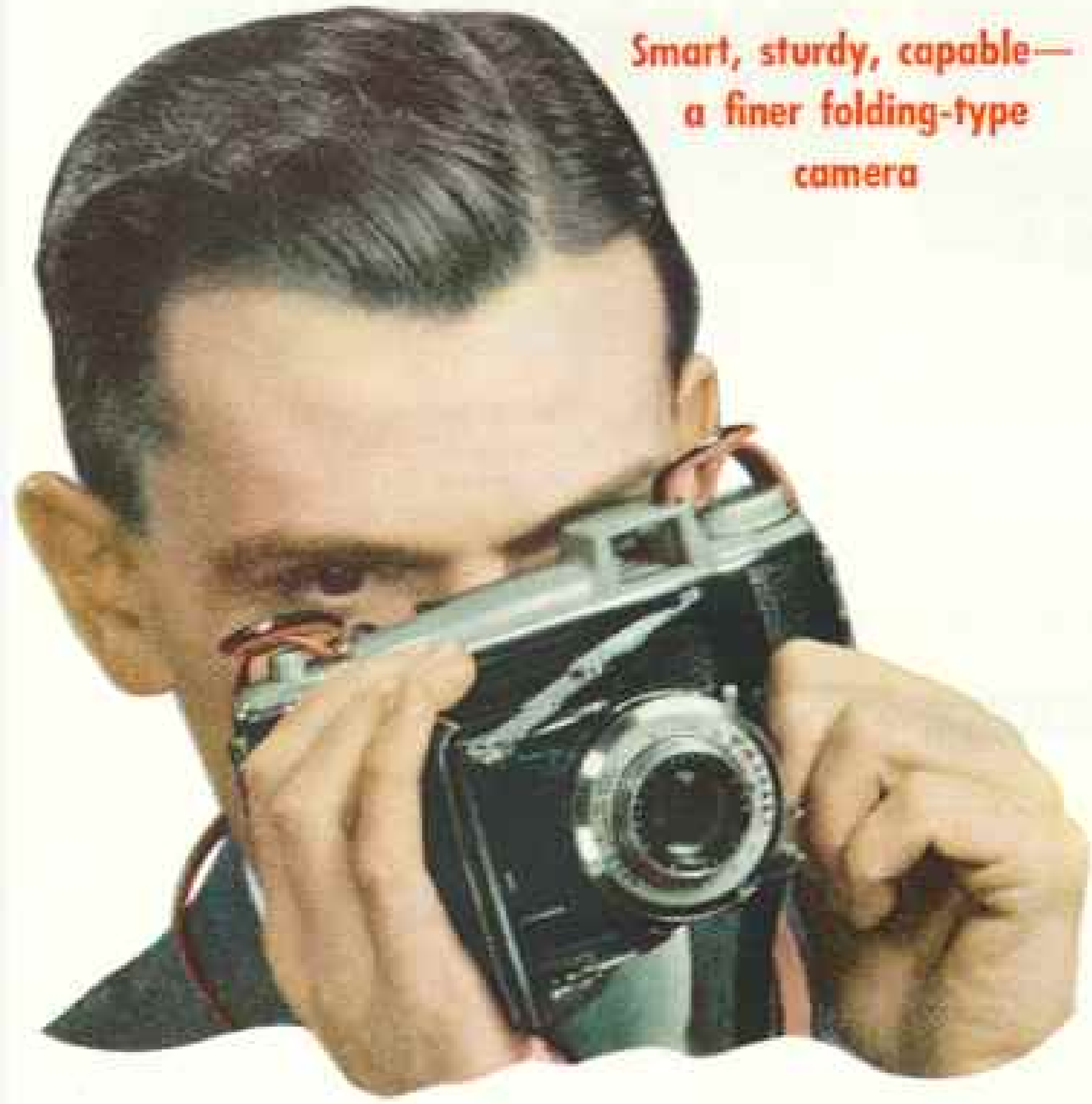
Set illustrated: SENTINEL DELUXE THREESOME—Pen, $15.00—Pencil, $5.00—Stratowriter, $10.00—Complete set, $30.00. No federal tax.

See your Sheaffer dealer. He has Sheaffer pens from $3.50 up; pencils from $1.50 up; desk sets from $10.00 up.

SHEAFFER'S

Announcing the new

Kodak Tourist Camera



Smart, sturdy, capable—a finer folding-type camera

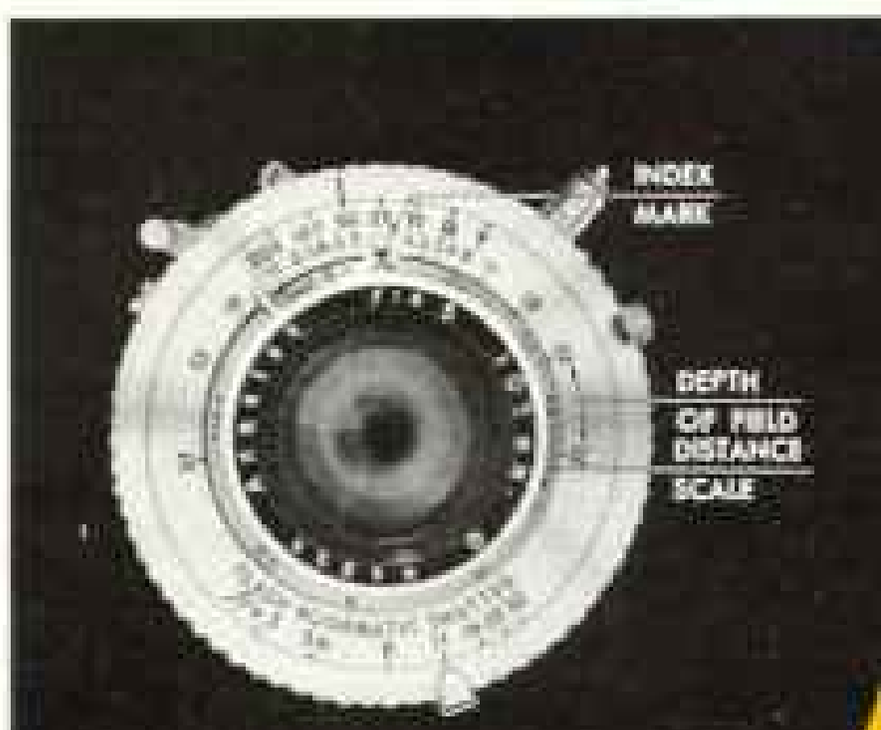
Into the new Kodak Tourist Camera has gone all of Kodak's experience in fifty years of making the folding camera a finer camera. Study it critically—its beautifully balanced design, smart styling, and improved operating controls. You'll agree it's a lot of camera for the money.

Negatives, 2¼ x 3¼. Camera, $61.50 plus tax; Field Case, $10; Kodak Flasholder, $9.50 plus tax . . . At your Kodak dealer's. Eastman Kodak Company, Rochester 4, N. Y. *(Prices subject to change without notice)*

Rugged die-cast aluminum body for maximum strength and rigidity.

For exposures "steady as a rock"—Shutter release is set into edge of bed plate (see arrow).

Quick-set exposure computer right on the camera. Newly engineered film-transport for easy winding.



Lens—Lumenized f/4.5, depth-of-field scale etched on mount. Shutter—1/200 Flash Kodamatic.

Accessory Kodak Flasholder equips camera for sure, simple flash shots.

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New Zenith "Universal"†

Amazing New Pop-Open Portable

Just press the POP-OPEN button, and everything happens at once . . . doors pop open . . . Wavemagnet pops up . . . see begins to play. Detachable Wavemagnet. Zenith DialSpeaker. Lustrous modern finish in two-tone grey-beige. Works on own long-life battery and on AC or DC current.

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The Aristocrat of All Portables

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Exclusive Wavemagnets (U. S. Patents 2164251 . . . 2200674) pull in Standard Broadcast coast to coast, plus Short Wave on any of five separate international bands. Plays where ordinary portables won't play . . . in trains, planes, remote areas. "Tropic-Treated" against radio's greatest enemy —humidity! Plays on AC or DC current and on its own battery.

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"Zenette"† by Zenith

An exquisite, tiny personal radio with powerful volume, rich tone. Lift the new Switch-on Lid—set turns on. Close lid—set turns off. Built-in Wavemagnet. Plays on self-contained battery and AC or DC current. Weighs only 5½ pounds. Makes a smart table model for any room. Your choice of maroon, black or white plastic case.

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**West Coast prices slightly higher. All prices subject to change without notice.*

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Recommendation for Membership

FOR THE YEAR 1949 IN THE

(The list for 1948 is filled)

NATIONAL GEOGRAPHIC SOCIETY

* *The Membership Dues, Which Are for the Calendar Year, Include Subscription to the National Geographic Magazine*

To the Secretary, National Geographic Society,
Sixteenth and M Streets Northwest, Washington 6, D. C.: _____ *1948*

I nominate _____

Occupation _____

(This information is important for the records)

Address _____

_____ *for membership in The Society.*

Name of nominating member _____

Address _____

* DUES: Annual membership in United States, $4.00; Canada, $5.00; abroad, $5.00. Life memberships, $100.00 U. S. funds. Remittances should be payable to National Geographic Society. Remittances from outside of continental United States and Canada should be made by New York draft or international money order. 9-48

Read between the lines, Dad! Your student wants to improve his standing at school this year . . . with both teachers and classmates!

So before September rolls around, get him the "back-to-school" accessory he knows will help most to bring both better grades and the leisure time he needs to develop a well-rounded personality . . . the new two-tone Remington Deluxe Portable!

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So don't delay—those school bells will soon be ringing! See your nearby Remington Rand Dealer today about a new Remington Deluxe Portable for *your* boy or girl!

Sturdy carrying case—at no extra charge—protects your student's Remington Deluxe when not in use.

CRISP, perfectly aligned homework—thanks to my Remington's exclusive Geared Typebar Action!

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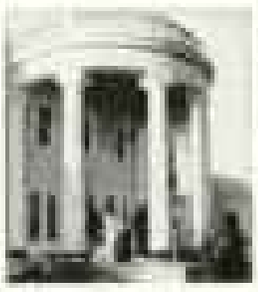

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