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NATIONAL GEOGRAPHIC

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FOR FIVE YEARS NOW we have dug and studied. In one of the most thorough explorations of the past ever undertaken in this country, we have peered through the lenses of some 28 different sciences to learn the ways of the prehistoric cliff dwellers of Mesa Verde, Colorado.

By studying fecal matter 700 years old, we have learned a great deal about their diet, nutrition, and parasitic diseases.

Tree rings in the beams of their cliff-hanging homes not only enable us to date the ruins, but by comparison with growth rings in trees of today we can get a good idea of their weather.

From centuries-old pollen we have found what plants grew here in those days—and gained evidence pointing to hitherto-unknown crops in the ancient Indian economy.

Cores that give us cross sections of soil combine with the pollen studies to tell a sad story of changing conditions—of growing erosion, ruined farmland, possibly a prehistoric dust bowl.

We can even ache with these vanished people, for their bones show ravages of arthritis as well as decayed and throbbing teeth.

Yet the story ends on a happier note, for among the Indians of today in the sunny pueblos far to the south, almost identical artifacts show that many of the ways, if not the blood, of the cliff dwellers survive to this day.

Broad-scale Project Begins in 1958

Our opportunity came in 1958, when the National Park Service decided to excavate the pueblos of Wetherill Mesa, a section of Mesa Verde National Park in southwest Colorado. If we could get enough support—both in money and in brains—we could not only dig out and preserve a priceless archeological treasure, but contribute deeply to unraveling mysteries of prehistoric life in America.

But the National Park Service has trouble getting funds appropriated for research, and we asked the National Geographic Society for help. It promptly came forward with generous grants of research funds for a major five-year effort. Thus we were able to bring to bear many varied fields of study—from dendrochronology (tree-ring dating) and endoparasitology (study of internal parasites) to archeo-entomology (study of ancient insects)—and make this a project of unequalled scope, an archeological model.

The cliff dwellings of Mesa Verde are, of course, widely known. In fact, they are so popular that they are in danger of being worn



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*Silent cities clinging to sandstone
cliffs yield their secrets to a
major five-year archeological effort
by a National Park Service–National
Geographic Society scientific team*

Solving the Riddles of Wetherill Mesa

By DOUGLAS OSBORNE, Ph.D.

Supervisory Archeologist
National Park Service–National Geographic Society
Wetherill Mesa Archeological Project

Paintings by PETER V. BIANCHI
National Geographic artist

out by the traffic of visitors. During 1963 a record number of people, more than 320,000, drove up the northern escarpment of the mesa from Colorado's flat Mancos Valley—up into the scrub woods which gave the plateau the name Mesa Verde, Spanish for "green table" (maps, pages 164-5).

The visitors flocked onto Chapin Mesa, site of the most famous pueblos: Cliff Palace, the

largest and most imposing, where in the 13th century at least 400 Indians lived in a complex of 200 rooms; Spruce Tree House and Balcony House, at once apartments, citadels, and cathedrals of stone and mortar.

In time these relatively fragile ruins could be eroded away by the ever-increasing throngs of admirers. But fortunately there were more cliff houses—silent, remote, seldom visited,



BOUQUINORRE BY STAFF PHOTOGRAPHER ALBERT WELLSKY

Treasure from the past emerges into the bright sun of Wetherill Mesa. A bowl goes up through the rebuilt door of a kiva.

Life in the Kiva Seven Centuries Ago: Painting Depicts a Busy Work Day

Wetherill Mesa dwellers vanished mysteriously but left many clues. National Geographic Society grants to the National Park Service backed a thorough scientific study.

Indians used the underground kiva as both ceremonial chamber and workshop. Weaver at left looms cotton, spun by man beside ladder. Youth above emerges from a tunnel. Man in center creates a blanket by twining yucca cords wrapped in turkey feathers. Indian at right chips an arrowhead; woman on ladder brings in corn gruel. Hole in the floor is the *sipapu*, gateway to the spirit world. Archeologists guided artist Peter V. Bianchi to ensure accuracy in recreating the life of pre-Columbian pueblos.



much as the passage of 700 years had left them—on Wetherill Mesa, three miles to the west. If these could be excavated and restored, they could ease the pressure on Chapin Mesa and afford another look into America's past. So we set to work.*

"How do you know where to dig? What do you look for?" We archeologists are constantly asked the same questions.

A short visit with our survey crew will tell you quickly how we know "where to dig."

We stand on the mesatop, in a gnarled, stunted forest of juniper and piñon trees. The sun beats through the thin foliage. Occasionally a cool breeze touches our cheeks. Beneath our feet is red, dusty soil, sparsely grassed.

*See "Searching for Cliff Dwellers' Secrets," by Carroll A. Burroughs, NATIONAL GEOGRAPHIC, Nov., 1959.

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PAINTING BY NATIONAL GEOGRAPHIC SOCIETY



CITY IN A CAVE prepares for winter. An autumn day about 1250 finds residents hard at work in Cliff Palace, largest of the Mesa Verde cave pueblos. Masons patch a crumbled corner; others hoist building materials atop a towerlike dwelling. Ears of corn are spread on rooftops, and squashes, cut in coils, hang on sticks to dry (right). Some 400 Indians lived in Cliff Palace.

PAINTING BY NATIONAL GEOGRAPHIC ARTIST PETER F. BIANCHI © N.G.S.





EMMETH



Sounds move toward us—voices, the crackling of dead brush underfoot. A line of men comes through the woods. They are about 50 feet apart, their eyes sweeping back and forth, each man to his allotted section.

A call comes from the end of the line: "Here are sherds, several of them."

"What are they?"

"Black on white; others corrugated. Looks like float [sherds exposed by erosion] in this little gully."

"Good—we'll move ahead and follow it up. If you lose contact, call me; we'll stop."

A moment later: "More sherds, getting thicker as I go uphill."

"Fine, hold to the gully."

"It's float, all right. Bet there's a site on the ridge above us."

"Lots of 'em now."

"Here's the site; *here it is!*"

It is a low, formless mound, thick with gray-green sagebrush. To the left was the trash dump—see the broken pottery? Look, there's a metate, a corn-grinding stone; here's a chipped tool, a couple of arrow points.

That low mound, with a few building stones sticking up helter-skelter: that was a line of dwelling rooms. That faint depression, easy to overlook but eloquent to practiced eyes, was a kiva—a circular underground religious chamber. A thousand years ago people worked and played and prayed here. Here some of them still sleep.

This will be a big job. The whole crew is called in to map, photograph, collect sherds,

number and flag the site. Then the line reforms and moves on. All in a day's work.

Before our survey was finished, we had learned not only more about the ancients, but more about our own profession. We perfected a new technique of fixing our position in the dense growth on the mesatop. Archeologist Carroll A. Burroughs, a boat lover stranded on dry land, proposed using a radio-direction finder similar to those carried by small boats in coastal waters.

It worked wonderfully. We set up two small battery-powered transmitters on mapped points a good distance apart. Then, when we found a ruin but could see only 50 yards or so through the woods, we plotted our position by taking a fix on each transmitter and drawing corresponding lines on a map. The lines crossed wherever we were standing. Cal's method saved many a weary day and many an archeological dollar.

Diggers Discover a Prehistoric Tragedy

In our five years of labor, there were days that stand out in memory. One day, in Room 28 of the cliff village we call Long House, a digger cleared away two feet of dry soil and a fallen roof and wall. He glimpsed a bit of fabric. Dropping his shovel, he gently revealed more with a trowel. He straightened up. "This is a mummy! Call Art!"

In North American archeology, a mummy is the rarest of finds, the most telling of clues, a scientific treasure. Archeologist Arthur H. Rohn hurried to the room and took charge.

In a sea of pottery, Dr. Douglas Osborne, chief archeologist of the Wetherill project, studies a classic Mesa Verde black-on-white bowl. This array of pots, mugs, bowls, and dippers includes about a third of the pottery found. Stone axheads (lower right), digging sticks (left center), and baskets (above sticks) complete the display. Fires blackened pots at the top of the picture.

Careful hands of Mrs. Sue Waite glue sherds together to reconstruct a cooking pot. Archeologists rebuilt some pots from as many as 200 fragments.



ALBERT ROZDOLNY (STILLER) AND KODACHROME BY WILLIAM ZUCKERMAN, JR. © 1952

His trained hands removed the soil placed there so long ago, and a small bundle came to light. It was a baby girl; with her lay a mummified turkey (page 172).

Some 700 years ago the baby died. Her mother tenderly wrapped her in a feather blanket that had taken many hours of work. Gently she buried her in the dirt floor of a back room and placed the turkey beside her, perhaps as food for the journey into the hereafter. Then the mother returned, mourning, to the incessant toil of life.

Centuries passed; forces of nature beyond her comprehension drove the woman's people from their dwellings in the cliffs.

Where the baby lay it was dry; perhaps a little drifting snow reached in, a sprinkle of hard-driven rain, nothing more. The small brown body dried out. In time a wall crumbled and the roof fell.

For hundreds of years the silence of the abandoned building was broken only by the raven's hoarse call, the coyote's song. Then came a new race of men to dig among the long-forgotten ruins.

Clues Reveal Life of the "Old Ones"

Many such eloquent clues to a life long gone have confronted us as we surveyed, dug, sifted, and restored the fascinating ruins of Wetherill Mesa. Today, our digging completed, we know much about the vanished people of Mesa Verde. And what we don't know about them we hope to find in the great mass of still-uncorrelated data that we have gathered. Such finds as the infant and the turkey have helped us along the way.

The child's blanket, for example, shows us how the Indians made their textiles. The tiny body shows the burial position, flexed as in the womb, the same as that used by other early peoples of the Southwest. The turkey testifies to hopes and beliefs as well as to animal husbandry.

So we learn of the Anasazi, the "Old Ones," as our Navajo workers call the mesa dwellers. Each clue we have unearthed leads toward the solution of the final mystery, a mystery that permeates Mesa Verde's stunted forest, the rough canyons that gouge it, and above all, the wonderfully preserved dwellings in the great overhangs of sandstone.

Why did the Anasazi abandon these awesome towns in the cliffs?

Shortly after the baby died, by the year 1300 or thereabouts, these great pueblos were deserted. Juniper smoke hung no more in the valleys in the cool mornings; men went

no more to the fields; the turkeys ran wild. No longer did the chants of the people, the shaking rattles and stamping feet implore the gods for rain. After a thousand years of developing culture, it was all over. Why?

Earliest Anasazi Lived by Hunting

Let us review briefly what we already know of these people. First, they were American Indians; their descendants must still live in New Mexico and Arizona, their past enveloped in the haze of time.*

Our Mesa Verdeans reached this region only a couple of centuries after Christ. At first, they must have lived by hunting and gathering wild food. We call them Basket Makers, for their skill in fashioning basketry. Their homes were half-underground pit houses.

By A.D. 500 or 600 they had begun building larger pit homes, and corn, beans, and squash were firmly established as the great triad of Indian agriculture. They had learned to make primitive pottery; sherds of it litter the old dwelling sites on the mesatop.

By 700 to 800, the Anasazi had stopped living in pit houses. Instead they built above-ground homes of stone and adobe, with wood beams. These they often constructed side by side, in curving lines, rather like the row houses of cities today.

Another few centuries rolled by. In Europe, William of Normandy sailed the Channel to conquer England. Leif Ericson's longships touched North America. To the south, the great Maya empire waxed—and began to wane. Art and philosophy burgeoned in Asia.

On the mesa, men did as their fathers did—or as they thought they did. Few indeed must have recognized change. But it was there: Agriculture, building methods, and pottery all changed—sometimes for the better, sometimes not—or so it seems to us today.

Mesa Dwellers Retreat to the Cliffs

So we come to the 1100's and the 1200's. The mesa culture had steadily advanced. Stone-and-adobe masonry was finely constructed, with blocks shaped to corners and curved walls. Handsome pottery, painted black on a white ground, had evolved. The turkey was domesticated. Even soil-conservation practices were in use.

The mesatop was heavily populated (pages 192-3). Then, for some reason, the people re-

* See in NATIONAL GEOGRAPHIC "Ancient Cliff Dwellers of Mesa Verde," by Don Watson, September, 1948; and "Indian Tribes of Pueblo Land," by Matthew W. Stirling, November, 1940.



REARRANGED BY NATIONAL GEOGRAPHIC PHOTOGRAPHER KLEET HOLBYER (LEFT) AND WILLIAM BELKAMP, JR. © N.G.S.

Climbing into cliff-dweller haunts, National Geographic Society and National Park Service officials inspect a restored kiva at Long House in 1961, near the project's mid-point. Park Service funds paid for pick-and-shovel work, but none were available for scientific studies aimed at solving the mysteries of the vanished Mesa Verdeans. The Society, through its Committee for Research and Exploration, authorized grants totaling \$320,000 for a five-year project.

Standing on the kiva roof, the inspection group gains entry, as the ancients did, by the square roof hole through which juniper smoke once swirled. Before Long House is opened to the public in a few years, the ladder will be replaced by one of sticks such as the Indians used.

Research Committee members in this group include Trustee Conrad L. Wirth, then Director of the National Park Service (descending ladder into kiva); Matthew W. Stirling, Smithsonian Institution (second from left); and Trustee Leo Otis Colbert (center with cap). Beside him (left to right) are archeologist Douglas Osborne, the author; Committee Chairman Leonard Carmichael, then Secretary of the Smithsonian; Melvin M. Payne, Executive Vice President of the Society, and (far right) Melville Bell Grosvenor, President and Editor.

Sandstone whets a stone ax dulled by hacking firewood. Indians used the slab so long they wore a deep groove.



treated—or they may have thought it an advance—into the caves below the sandstone rim.

Why? Was it an invasion by an enemy tribe? The Utes? Surely the cliff dwellings are in commanding positions and are, indeed, fairly good fortresses. Could there have been internecine strife, civil wars? Such might well have caused the withdrawal from the open mesatops.

Yet I doubt that defense was the primary reason. So far we have found no direct evidence of any invasion, any warfare that might have driven the peaceful farmers of the mesas to build their last strongholds in the shelter of the cliffs.

For now we can only say that there is abundant evidence that many people moved, and sometimes moved their building timbers and the very stones of their masonry, into the cave pueblos. Rooms and kivas were crammed into the limited space, in prodigies of architecture.

Drought Strikes the Mesas

One wonders if those who took to the great caves or alcoves in the cliffs were leaders, the religious or secular elite. In any event, the last period of pueblo-dwelling Indian occupation of Mesa Verde, the 1200's, saw intensified use of the huge rock shelters.

Times were hard indeed, but the Indians clung to the old gods and the old crafts. Finally, in the late 1200's, came prolonged drought that must have made existence grim.

A strange life it must have been in the cliffs, the people crowded together, sheltered under the great sandstone ribs of the earth, yet in surroundings of tremendous beauty.

These people must have been both agile and hardy. Rock climbers today, with modern equipment, find entrance to some of the ancient dwellings difficult. Yet among the skeletons we have found, none showed evidence of a fall—no broken arms or legs, for example.

The Anasazi knew their land and how to live on it in an intimate way few of us can comprehend. Every feature, every rocky point and cliff

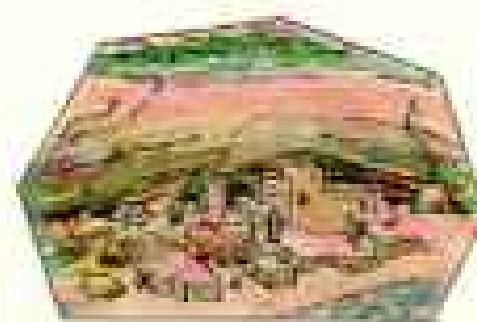


MAPS DRAWN BY JOHN W. COYNE, COMPILED BY EUGENE W. SCHMIDT. © NATIONAL GEOGRAPHIC SOCIETY. RECONSTRUCTIONS OF WEATHERILL MESA SITES BY PROJECT ARCHITECT, GEORGE S. KING.

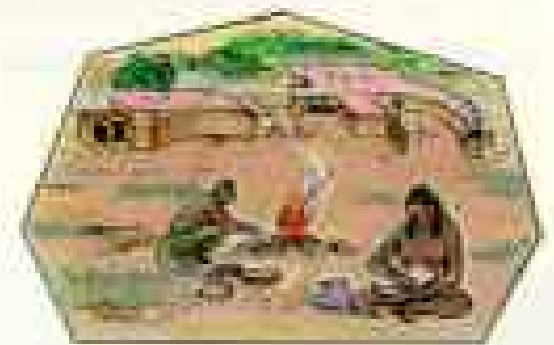




Mug House, one of the larger cliff dwellings on the mesa, was inhabited in the 11th century, abandoned, and reoccupied in the 1200's. The Wetherill brothers, nearby ranchers, named it for the many drinking mugs they found there in the 1890's.



Step House, a small cliff ruin, takes its name from stone steps that descend to the dwelling from the overhanging mesa. First occupied in the seventh century, it was deserted, resettled in the 1100's, and finally abandoned. Another find by the Wetherill brothers.



Big Juniper House, a mesatop ruin, was occupied from A.D. 900 to 1150, when it was abandoned for the cliff dwellings. The site was discovered in 1960 by the National Park Service-National Geographic Society Wetherill Mesa Archeological Project.



Two Raven House, a surface ruin, was a living pueblo during the 11th and 12th centuries. Remnants of a wood stockade around the eastern side of the site were discovered by project archeologists in 1962.



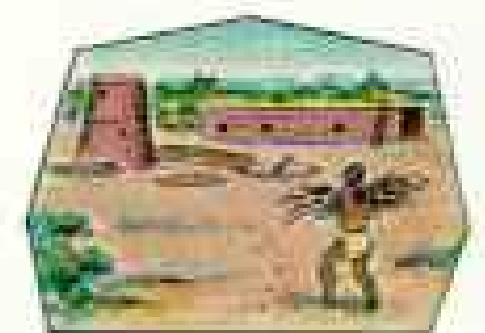
Long House, Wetherill Mesa's largest cliff dwelling, appears to have been a religious center. Built in the early 1200's, it was abandoned later in the century. The Wetherills discovered it in 1890.



Site 1676, largest of the excavated mesatop sites, housed Indian families during the eighth and ninth centuries. Discovered by the project in 1960.



Basket Maker pit houses date back to the seventh century. Builders lacked the skill to create the splendid cliff dwellings of a later era.



Badger House, a mesatop tower and dwelling, carried on its daily life from the ninth to the mid-thirteenth century. As the older structures crumbled, fresh ones were built atop the ruins. The archeological project made the discovery in 1959.

Home of the vanished Anasazi, or "Old Ones," Wetherill Mesa stands in Mesa Verde National Park near Four Corners, where Colorado, New Mexico, Arizona, and Utah touch (opposite). Here in the 1200's Pueblo culture reached a climax just before the Indians abandoned the area. Mesa Verdeans are believed to have trekked hundreds of miles to settle among the pueblos of Arizona and New Mexico.

Mesatop ruins at Wetherill include pit houses from the Basket Maker era, about A.D. 600, discovered by the Wetherill Mesa Archeological Project. Indians dug these dwellings three feet into the ground, then topped them with slanting walls and log-and-mud roofs. Later dwellings, such as Big Juniper House and Two Raven House, show Indian stone-and-mortar architecture evolving toward the magnificent cliff dwellings of the 1200's exemplified by Long House and Mug House.

Huddled in a Sheltering Cave, Long House Emerges From the Rubble of the Past

Paired photographs at right were taken by the Editor from the same spot, at the same time of day, four years apart. They show Long House in 1958 before digging began and (below) after 700 tons of rock and dirt had been removed and work nearly finished.

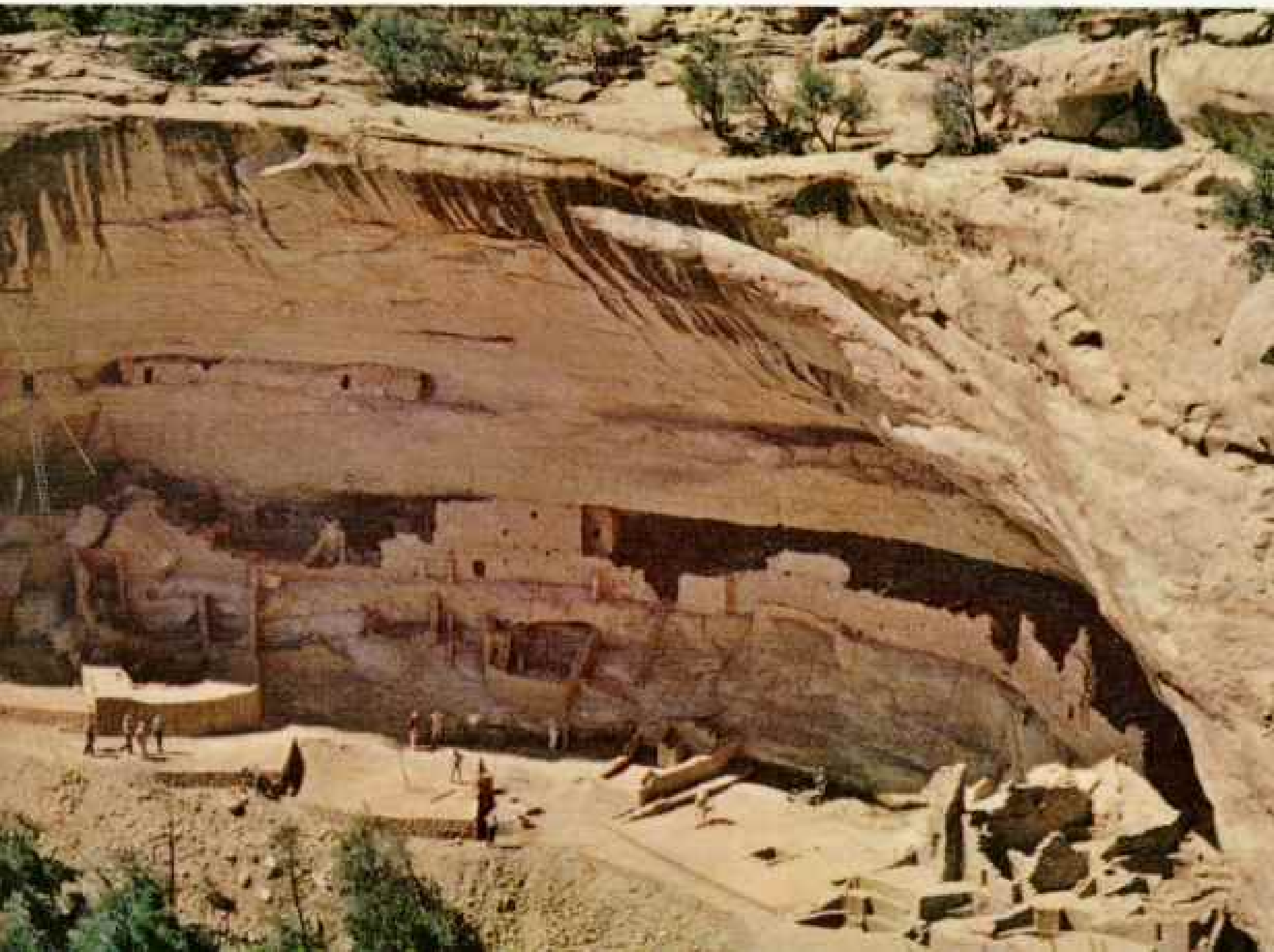
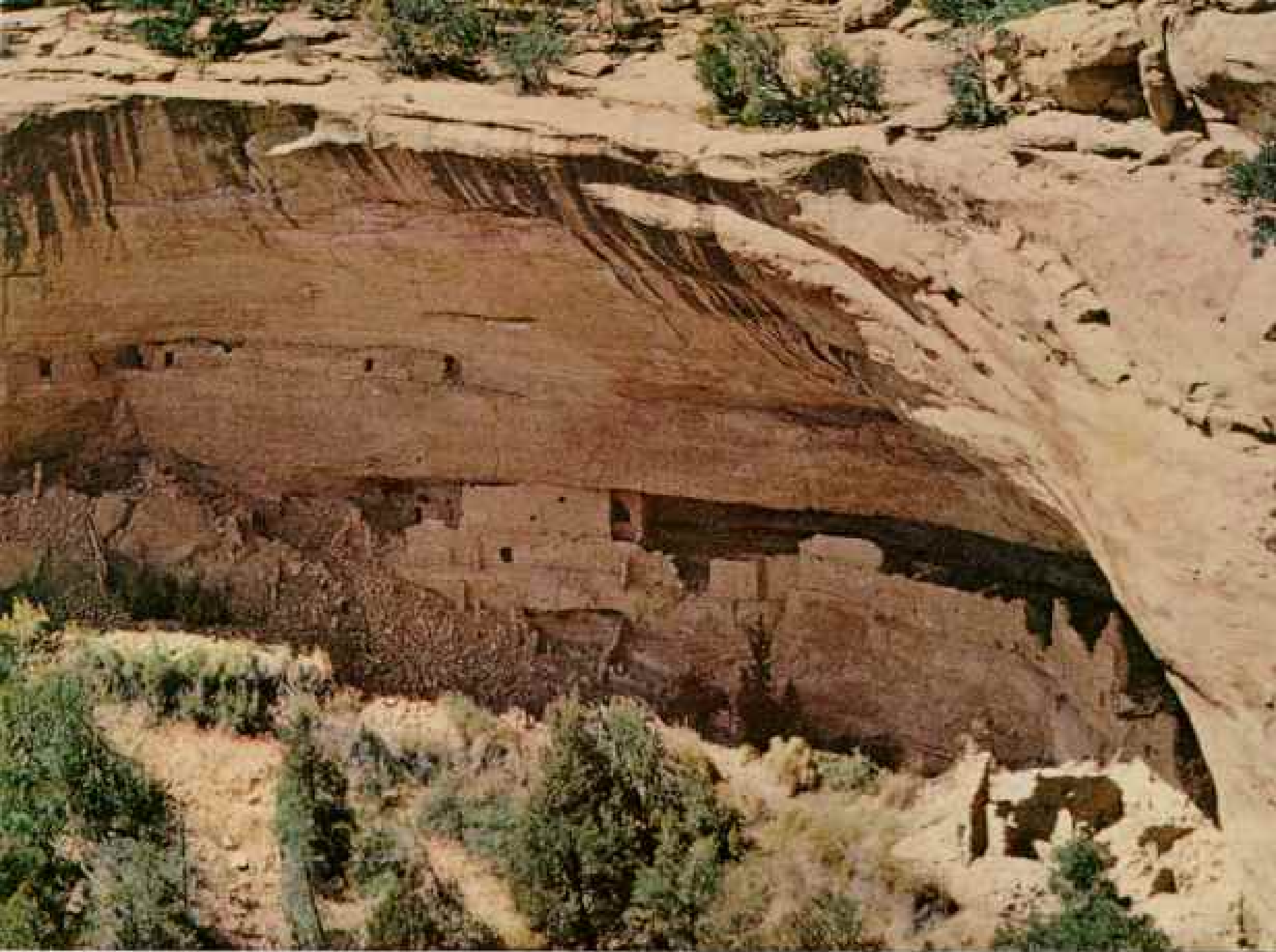
Below the ruin stretches a trash slope where 40 Indians were buried. Galleries above the main ruin were used primarily for storage, but one had 21 slots so placed that a single Bowman could command the pueblo from an impregnable position.

PHOTOGRAPHS BY MELVILLE BELL BRIDGEMAN
AND WILLIAM BILLYARD, JR. (BELOW) © N.A.S.



Excavation begins, not with a shovel, but a map. Archeologists George S. Cattanaach (left), Arthur H. Rohn, and Dr. Osborne make the preliminary ground plan of Long House. Excavators later recorded the position of every artifact they found.







face must have had its name and story. Even the abandoned dwellings on the mesatop must have been well known in oft-told legend. Evidence exists that they may have been revisited, probably for religious reasons.

Then, about the year A.D. 1300, our Anasazi simply vanished.

Let me tell you some of the things we have

done here to fill in details and to understand the disappearance of the Anasazi, and where they went. We archeologists can find out *what* was here. But we have to range into other fields to find out *why* it was here—and then why, suddenly, it was not. To discover the past, we start with the present.

What varieties of natural life grow in this



PHOTOGRAPHS BY WILLIAM BELLEAF, JR. © N.S.P.

Fire-gutted kiva emerges at Long House. Charred beams from its roof are cleaned, mapped, and photographed to determine how they fitted. Box holds sherds of pottery.

Indian basket, centuries old, gets a shampoo with liquid castile soap.



Southwestern horned toad—a true lizard—was painted and flame-fired on this bowl some seven hundred years ago.



PHOTOGRAPHS BY JEROME WENNER

Paint brush flicks the dust of centuries from a storage jar set in the dirt floor of a cliff dwelling in Wetherill Mesa.





STEREOPHOTOS BY WILLIAM SELBY, JR. © N.S.

high, dry tableland today? If we know what exists now, we can better recognize and understand the traces of prehistoric plants and animals we find in the ruins.

Plant ecologist James A. Erdman has made an intensive survey of vegetation on Mesa Verde, its patterns, adaptations, and relationships. Already he and botanist Stanley L. Welsh have found nearly 100 species of plants unknown here earlier.

Charles L. Douglas, animal ecologist, has so far found 10 animal species never before recorded on the mesa. They include snakes, bats, a wood rat, a pocket mouse.

Our ancient materials—bones and feathers, seeds and pollen—indicate that in general the fauna and flora of Mesa Verde in the Anasazi's time were similar to those of today: bighorn sheep, deer, and cottontail rabbits; juniper and piñon trees and sagebrush.

There was, however, one thing conspic-

uously absent from the ancient material: We found no trace of cotton plants. Yet the Anasazi did leave behind cotton textiles. This can only mean that trade existed between the Mesa Verdeans and peoples to the south. And this supports our best guess to date that when the Anasazi left the mesa, they went south.

Evidence Found of Vanished Crops

In contrast to the total absence of cotton plants, in ancient times as now, our scientists discovered the seed of several food plants no longer found on the mesa—including miners' lettuce, an edible portulaca, which grows today only in high altitudes. Apparently our Anasazi, like peoples today, had plant explorers who ranged afar for wild foods and brought home promising new crops (page 173).

Our researches into pollen turned up another plant the Anasazi perhaps encouraged to grow on the mesa. The beeweed (genus



Telltale tree rings reveal the age of roof beams to an archeologist's magnifying lens.

How old is it? Jerry Melbye (far left), drills into a beam of a Long House kiva. Matched to a master calendar (right), the sample dates the log at A.D. 1257. Pencil-thin core from a living tree (left) shows annual growth rings and dark bark at bottom.

Fragile charcoal specimens, kept intact by cord wrappings, get a preservative bath in paraffin and gasoline. Charcoal often shows growth rings more clearly than wood.



EDERCHOWEE © NATIONAL GEOGRAPHIC SOCIETY

Dating a specimen, archeologist Robert Nichols works with a tapelike chart of Wetherill Mesa tree rings running from A.D. 500 to the present.

Cleome), a common weed in the Southwest, must have flourished in Anasazi times; its pollen is found throughout the ruins. It would have been most useful. The young sprouts are an acceptable potherb; turkeys could feed on it (we found beeweed parts in turkey feces); and finally, when boiled down, its stems give the black substance that the Anasazi used to paint pottery.

When the last Anasazi left the mesa, so did the beeweed. Perhaps the forest, slowly reclaiming the farmlands, simply shaded it out; perhaps it couldn't get along without Anasazi help.

"If we find that the Anasazi did cultivate beeweed—a plant related to the caper—it could affect our picture not only of the Anasazi but of other prehistoric Indians in the



PAINTING BY NATIONAL GEOGRAPHIC ARTIST PETER H. BIANCHI © N.G.S.

Potters, always women, aimed at beauty as well as utility. Here a mother keeps an eye on her baby as she applies a white undercoat to a bowl. Sister (right) mixes white clay with water. In the background, grandmother oversees the firing of finished pots, while brother fetches firewood.

Mummified infant came from such a family. Shrouded in a feather blanket, she was buried with the turkey below, perhaps food for her journey. Over the centuries, insects stripped blanket and turkey of feathers.

PHOTOGRAPHS BY WILLIAM BURFORD, JR.



Southwest," reports Dr. Paul S. Martin of the University of Arizona. "Up to now we have known only three food crops cultivated at that period: corn, beans, and squash."

Orville A. Parsons of the Soil Conservation Service spent months studying present soil patterns. Then he bored down with a hollow probe driven by a powerful hydraulic cylinder mounted on a pickup truck. He brought up the underlying ancient soils and analyzed their differences from present soils. He has already discovered evidence of severe water (and possibly wind) erosion that might have made life hopeless for an Indian farmer in the 1200's. Here may have occurred a disaster somewhat comparable to that of our own Dust Bowl of the 1930's.

Parsons also made an interesting find having to do with the Anasazi's building methods. Examining soils at one of the cliff dwellings, he uncovered a pile of hardened clay patties.

"It took us some time to figure out what they were," Orville says. "Now we feel sure that the cliff dwellers made them for use as mortar in building their mud-and-stone walls. The interesting thing is that the clay obviously came from some distance away from the walls themselves. It means the Anasazi builders prepared batches of the clay patties ahead of time and stockpiled them—probably covered somehow to keep them moist—where they were working on a wall. And we think we invented prefabrication!"

Tree Rings Reveal Age and Weather

On certain piñon trees on the mesa, we placed complex little machines, called dendrographs, that measure otherwise imperceptible growth in a tree's diameter. This growth, which produces the tree's annual rings, is a cornerstone of Southwest archeology, enabling us to date the pueblos with great exactness by a method developed by University of Arizona-National Geographic Society expeditions during the 1920's.*

The width of each ring varies with the amount of growth of the tree in any given year. Hundreds of overlapping patterns of tree rings form a chart that reaches back to before the time of Christ. We can match the ring patterns of ancient building timbers to this chart, and thus determine just about when the pueblos were built (pages 170-71). Our dates ranged from 750 for several mesa-top ruins to 1278 for the latest timber found in Long House.

We set our dendrographs near several of our automatic weather stations. Knowing the



FROM ANCIENT SEEDS AND POLLEN, scientists deduce the Anasazi may have cultivated the edible bee-weed (*Cleome serrulata*) above, as well as miners' or Indian lettuce (*Montia perfoliata*) below. Neither plant grows on these mesas today.



present tree growth and the present weather, we can figure out past weather on the basis of past tree growth. This is not easy; it involves a mile-long statistical process. We shall need the help of computers before it is finished.

Even chemistry helps fill in the story of the Anasazi. Analyzing ancient fecal matter, Dr. Bruno E. Sabels, then of the University of Nevada, found decreasing levels of phosphorus and manganese over the years. Oddly, just the reverse was found in turkey droppings. He concludes that the Indians may have had less and less to eat, as food crops grew leaner in a changing climate, while turkeys thrived on wild plants, seeds, and insects.

We find traces of fecal matter everywhere among the ruins, but concentrations occur mainly in a few chambers. Our theory is that as the Anasazi built additional rooms in the cliff dwellings, they occasionally converted an older chamber into a latrine.

Dr. Welsh, at Brigham Young University in Utah, has run detailed analyses of fecal samples from Wetherill.

*See "Secrets of the Southwest Solved by Talkative Tree Rings," by Andrew E. Douglass, NATIONAL GEOGRAPHIC, December, 1929.



PHOTOGRAPH BY WILLIAM DELANEY, JR., (TIME EXPOSURE: 4000)

Point Lookout, a massive butte, rises 2,000 feet above the Mancos Valley. Car lights paint

"Your Anasazi," he has reported, "was like all other Indians of the Southwest in at least one respect—he ate everything that could conceivably be called food. The fecal samples include remains of everything from choke-cherry seeds to yucca fibers—we even found cactus spines three-quarters of an inch long! Presumably the Indians boiled the cactus before they ate it, so that the spines would be thoroughly softened."

Other scientists have been at work on our specimens. Dr. Robert Samuels, a microbiologist at the University of Colorado Medical Center, found that the Anasazi harbored parasites inside their bodies. These microscopic roundworms, or pinworms, whose eggs are seen in the feces, were not debilitating.

"You could live quite happily with them without even knowing they were there," Dr. Samuels says. "In fact, I wouldn't be surprised if we are doing just that."

Familiar Ailments Plagued Anasazi

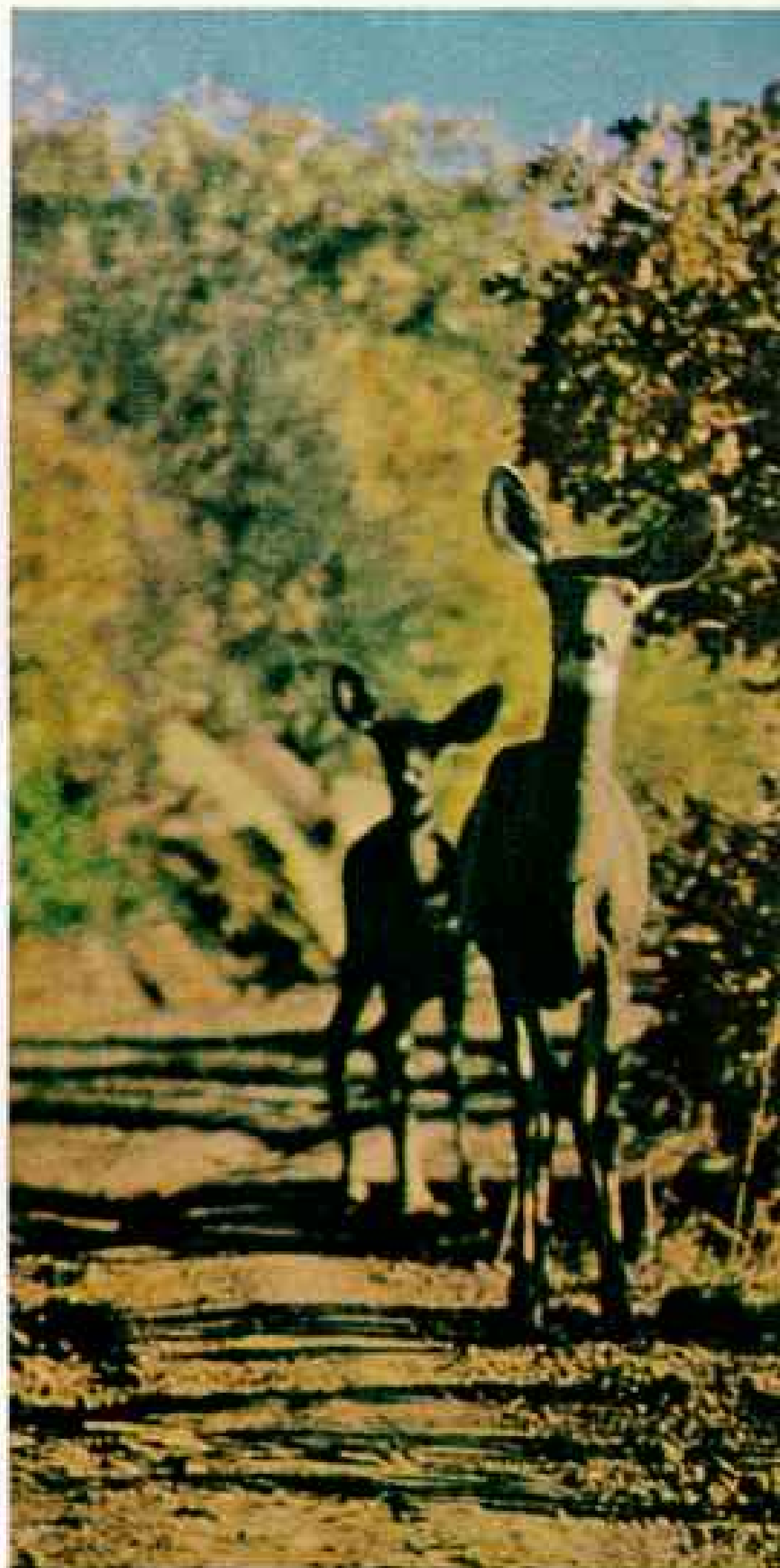
From the bones of the Old Ones themselves, we have determined that they were closely related to present-day Indians, and we have diagnosed several of their ills: They suffered greatly from poor teeth and bone diseases such as rheumatism and arthritis.

Finally, we are investigating the people living in pueblos in Arizona and New Mexico today. They may prove to be descendants of the Mesa Verdeans. Their architecture is similar; many use tools that can hardly be



AND NATIONAL GEOGRAPHIC PHOTOGRAPHER ALBERT HELLVIG © N.G.S.

the sinuous road in Mesa Verde National Park.



Doe and fawn freeze on a mesa road.

distinguished from artifacts we have dug up at Wetherill Mesa. Perhaps these people will be our Rosetta Stone, giving us a key to the past (see "20th-century Indians Preserve Customs of the Cliff Dwellers," page 196).

One of our researchers, Dr. Florence E. Ellis of the University of New Mexico, has been working in the Rio Grande region, where we think some Anasazi went. She has found migration myths in several pueblos there.

So goes the absorbing task of reforming the past, painstakingly looking for clues. Clue joins clue, and more of the story takes shape.

For example, we found pieces of a canelike grass that had been neatly trimmed at one end and burned on the other. What were they?

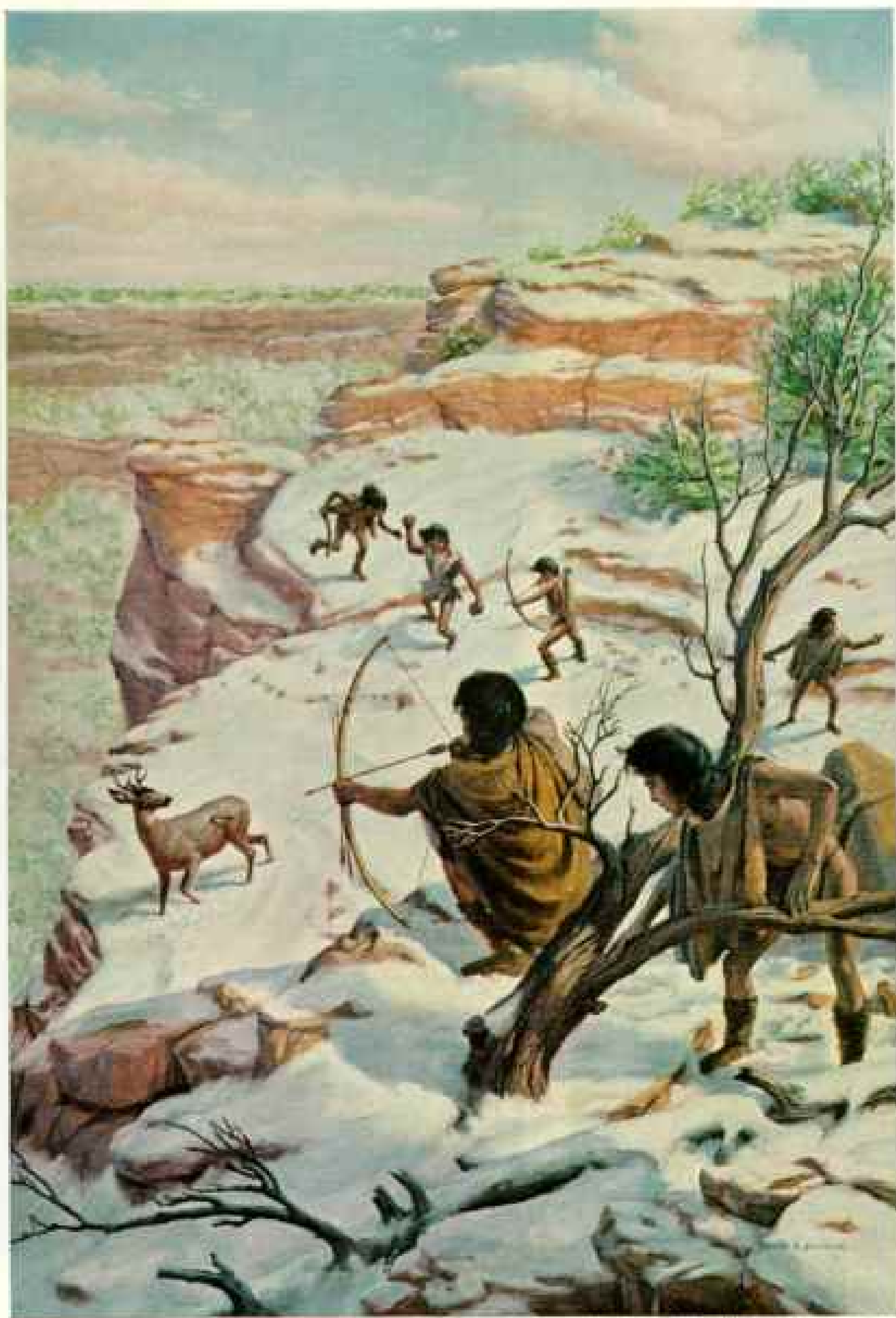
Dr. Ellis brought some of her Indian friends

to Wetherill Mesa to inspect the ruins. They looked at the cane pieces.

"Those are ends of cane cigarettes," said one. "We still use them. Put tobacco inside and smoke them in the kiva." The others nodded agreement. So even a cigarette butt can be a link to the past.

All these researches, and the final putting together of the pieces, the presenting of proof or disproof to the scientific world, will take time. But we are on a warm trail that is getting hot. Most signs so far point to a people forced slowly from their land by drought and soil loss, moving in small groups to the south and disappearing by assimilation into other tribes situated on better land.

Before our survey, Wetherill Mesa was vir-



PAINTING © NATIONAL GEOGRAPHIC SOCIETY

Trapped between hunters and rim, a deer appears doomed. Mesa Verdeans rush to the kill with arrows and rocks. Their bows are hardwood. Sinew bowstrings propel cane arrows with wooden foreshafts and stone points. Hunters wear skins of deer or bighorn sheep and socks of turkey-feather fabric.

Lofty Land of the Wetherill Cliff Dwellers Gleams Gold in the Afternoon Sun

Piñon and juniper forest now blankets the tableland, once the site of Indian cornfields, early pit houses, and pueblos. The saw-tooth cliffs of Wetherill Mesa jut into Rock Canyon, some 600 feet deep. In the sheltering arches, the Anasazi built their fortresslike pueblos, such as Mug House at lower left. In forest and cliffside, archeologists have found 806 prehistoric dwelling sites.

ILLUSTRATION BY W. C. HANRETT, NATIONAL GEOGRAPHIC STAFF





tually untrodden. It is still pretty wild. Fortunately, it is a bit high and dry to be good rattlesnake pasture, but I have killed one or two rattlers each year, and the men who camped there found more.

Mesa Verde's ruins were discovered in 1888 and worked over in the 1890's by local people and the archeologists of the day, who avidly collected artifacts for museums in this country and abroad. Some were only grasping pot hunters; others became sincerely interested in local archeology and gave it their best.

Wetherill Mesa, found in 1890, is named for the pioneer family that fathered Mesa Verde archeology (page 180). The early explorers and archeologists they guided combed the area, and of course entered and stripped most of the cliff dwellings of any artifacts left above ground. But they did not find all the caches that were made and forgotten a thousand years ago.

Our painstaking survey located many untouched ruins and caches. Archeologist Alden C. Hayes, working alone, found the first of them. He entered a small ruin in upper Rock Canyon by climbing a log propped against the cliff.

After recording the site, he started down, hesitated a moment, went back and peered into a crevice at the back of the cave. He found a bundle of digging sticks—sharpened hardwood staffs used to till the soil—and a large black-on-white painted olla, a jar used to store precious water from spring rains for the dry days of summer.

Al still does not know why he went back to stare into that particular crack. He couldn't get the pot out alone, so he returned the next day, Saturday, his day off, with his son Eric. He *had* to get that pot out intact—and he did. It had been there, unharmed, for 700 years!

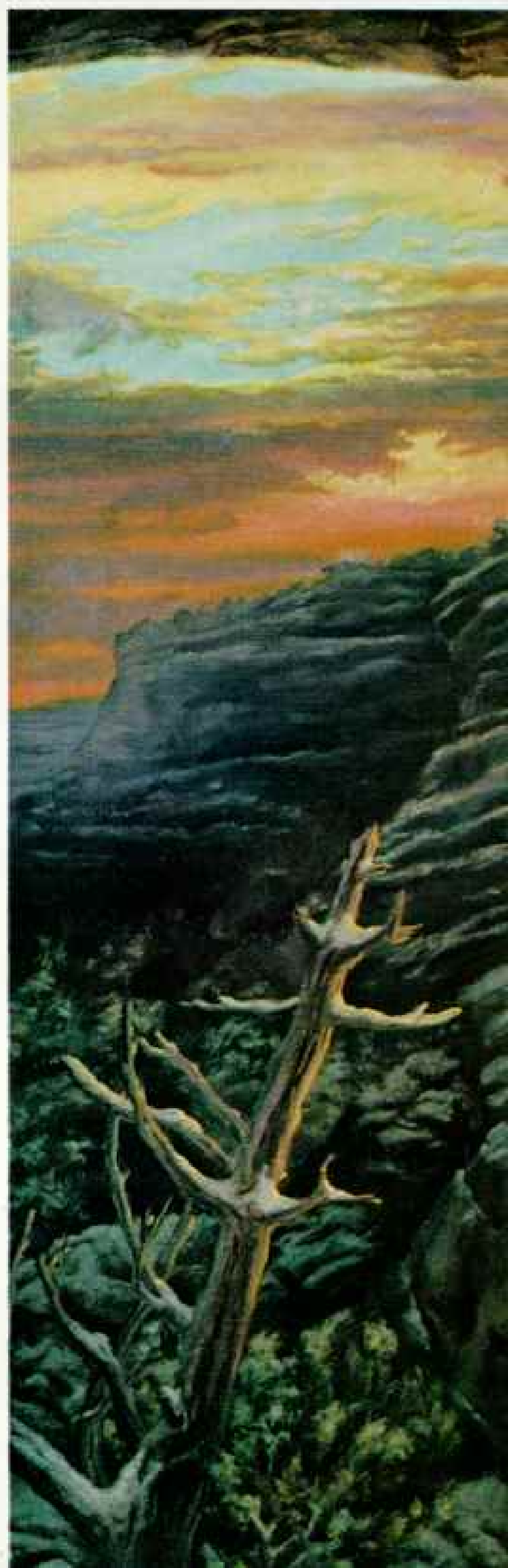
Climber's Hat Forestalls a Mishap

One of the most exciting climbs turned out to be among the most valuable. Between Long and Bobcat Canyons stands an isolated butte, only 400 feet long by 25 to 30 feet wide, but with sheer walls rising 100 feet high. It tantalized the survey crew; through glasses they could see ruins on the top (Site 1368 on map, page 164).

Al Hayes and Curt Schaafsma circled the stone mass carefully, the way boxers measure opponents. They found a crack and started up. Curt took a rope and climbed Al's back and shoulders to reach a foothold. With his heels in a niche, he lowered the rope to Al, who climbed the rope, then climbed Curt, and reached a place above where he could return the favor.

Two-thirds of the way up, Curt suddenly shouted, "Loose rock. I'm afraid it's coming off!" And at that moment it did. Al couldn't dodge without losing his balance and tumbling 60 feet.

Triumphant hunter brings home a kill, a fat deer. Members of a small cliff village look up from the evening meal to greet the provider; his partner follows with the bows. Dinner has con-



sisted of a thin corn gruel cooked in the pot on the fire and drunk from decorated mugs. Grandmother, in warm feather blanket, huddles close to the fire. Smoke stains the sandstone roof. With snow on

the ground, the Indians must watch their food stores carefully; they will waste little of the deer. Its skin will provide clothing; its bones, tools; and its sinews, bowstrings and sewing thread.

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Ranchers and Indian traders, the Wetherill brothers pose stiffly for a 19th-century portrait. Discoverers of many cliff dwellings, they took careful notes, giving their collections a genuine scientific value. "Richard Wetherill was as good an archeologist as any of that day," says Dr. Osborne. Left to right: Al, Winn, Richard, Clayton, and John.

Charcoal inscription in Long House reads: "John & Clate Wetherill, 3rd 9 1891."

COLLECTOR: WILLIAM BELLEFANT, JR. © U.S.P.



The resilient crown of Al's Stetson absorbed most of the impact of the football-size stone.

"That saved me," he said later. "I had my head pulled down so far my hat brim was resting on my collarbones!"

The trip was worth the strain. The Anasazi had built 15 rooms on the butte. Three jars, a ladle, and an ax had been left behind. These added to the story of Wetherill Mesa. A dwelling site—what a site!—a kind of pottery, and a kind of ax all tell us something of how these people lived, how far their ceramic work and stone shaping had progressed.

Our preliminary survey of Wetherill Mesa was completed in August of 1960; no fewer than 806 sites were found.

Grandest of all is Long House, second largest cliff dwelling in the park (after Cliff Palace on Chapin Mesa). Long House grips you. I have heard many a man gasp as I led him to the cliff edge above the ruin (pages 166-8).

George S. Cattanach and Art Rohn started digging in Long House in the spring of 1959—the first time a full-scale dig had been attempted there. Just clearing away the rubble was a tremendous job.

Our next move was to search and excavate the talus slope—an incline of soil and rock debris—that stretched away below the dwelling. Here we found garbage, sweepings, discarded building material, potsherds—all the trash that might be thrown away by aboriginal villagers, turned into compact earth by the centuries. Here, too, were skeletons.

I doubt if the Anasazi had any particular reason for burying some of their dead in, so to speak, the village dump. The skeletons from the Long House trash slope were as carefully buried and had as many objects with them as did burials in rooms or rock crannies—perhaps even more. The ancient Mesa Verdean did not mind having his dead close by; maybe he preferred it that way.

We found some 40 burials below Long House; in fact these were the most exciting and important of our discoveries there.

Step with me out of the shadow of the cave-like alcove, skirting the walls and rooms, and walk down the trash slope.

Ignore those protesting ravens croaking at us. They think they own Long House because they nest in the cliff.

Watch your step here; it is steep and the footing is loose. We walk down to a pair of men troweling the earth beside a sandstone block. One rises from his knees to say, "Bur-

ial 16 is ready for photographing and drawing." He wipes sweat from his sun-bronzed face while we look at the skeleton, still lying in its 700-year-old bed. It is on its side, knees drawn up, arms folded.

Worn Teeth Provide Clue to Diet

You may be impressed with the size of the bones and teeth and wonder whether it was a man or woman. I show you the characteristics of the skull and pelvis that tell us this was a man who died in his mid-forties.

See how worn the teeth are, how smooth the grinding surfaces? These people ground their corn on sandstone slabs; grit was present in every meal.

You think this person was a large man? Not at all. The right thigh bone, matched against my own upper leg, is at least an inch and a half shorter. The other bones are all smaller than mine. I am 6 feet tall; this man could not have been taller than 5 feet 5 or 6 inches.

Picture a small, dark man, strongly yet lightly muscled, lithe. His face is weather-beaten, his hands gnarled from hard work. He was laid to rest with tools and pots of food; his people believed in an afterlife, and probably expected to meet him again. There were no signs of violence on the skeleton. He died naturally. Probably 40-odd years of life in the canyons and fields were enough for any man. He needed rest.

Trash Dump Traces Unwritten History

The trash slope also yielded several interesting sequences of pottery types. If an Indian woman broke a pot, swept it up swearing under her breath, and threw the pieces in a depression where erosion would not move them, she had started what we call a stratigraphic column. More breaking and sweeping, and more debris piled on as decades passed—eventually several feet of material, largely returned to the soil from which it came.

Ninety-nine times out of a hundred, the sherds at the bottom of the column will be different from those on top. Pottery fashions and techniques change, slowly but inexorably, and furnish major clues toward the prehistory we are trying to write.

Probing into the series of ruins, both cliff dwellings and those of the mesatop, we could watch, in effect, the Indian women perfect their ceramic art. We found a growing sophistication, both in the decorations and in the shape of the pots themselves.

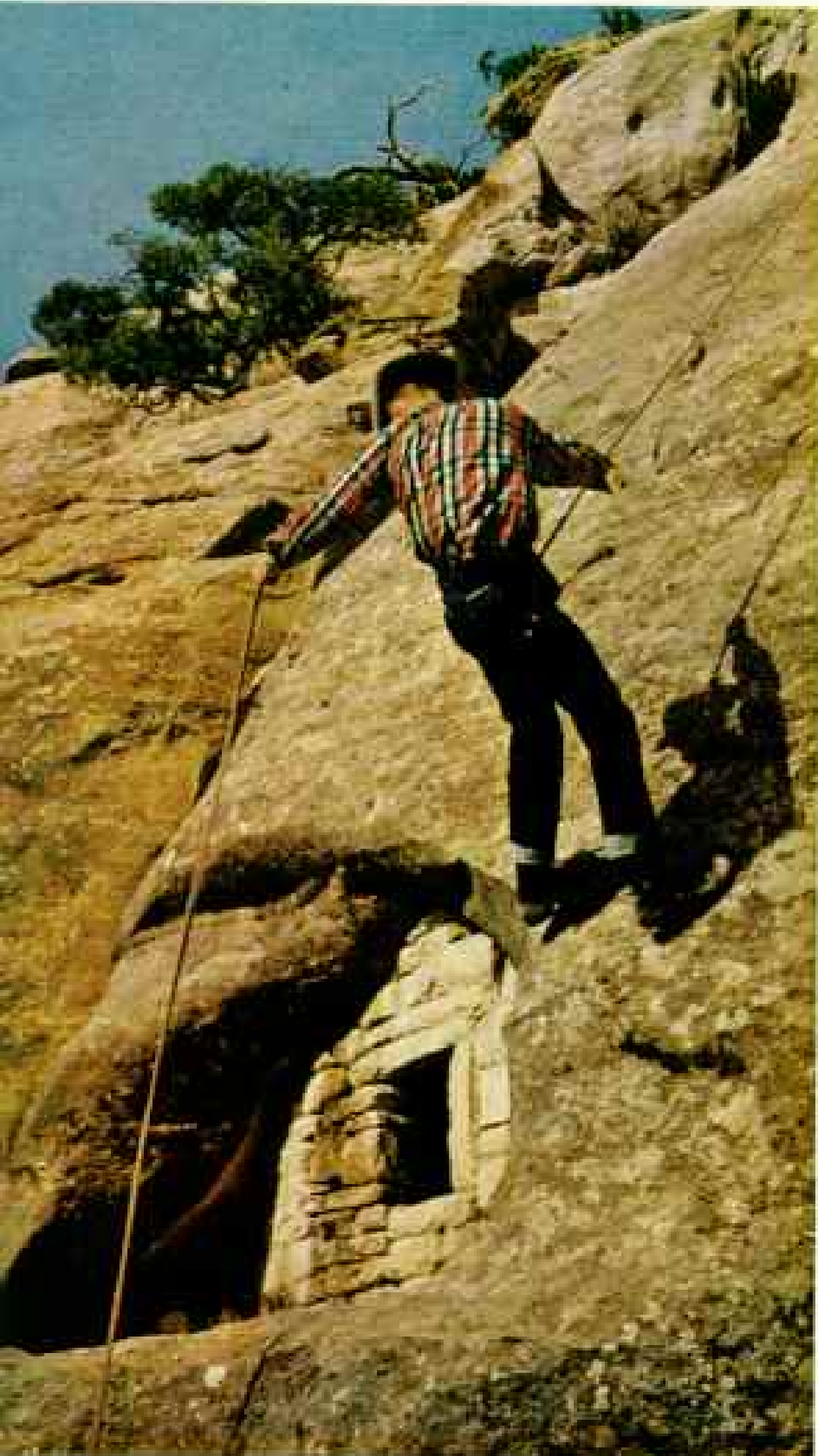
And we noted a gradual change in materials. First, the Indians used sand, or sometimes crushed rock, as "temper," material added to the raw clay for strength. Later, by the 10th century, ground-up pottery was used. Doubtless, it was far easier to get.

Anyone can find similar cultural change in his own city dump, if he is stout-stomached enough to dig into it. The lower layers of a long-established dump might show no tin cans, for example. Later, hand-soldered ones appear. Then machine-sealed cans appear suddenly and grow exceedingly common. But

in the layers laid down during World War II, cans are rare—we were carefully saving them to be melted down. (That layer may drive archeologists to distraction some day!) Post-war, the dump would reveal the emergence of new containers, such as plastic.

Under five rooms and a kiva of Long House, we found the remains of a large pit house, some 16 feet in diameter. It was a happy home about 650, during the depths of Europe's Dark Ages.

Six centuries later, the descendants of the pit-house dwellers lived out the last decades



PHOTOGRAPHS BY WILLIAM BELKNAP, JR., U.S.G.P.

Rappelling down a cliff, Jerry Melbye stops at a small, isolated chamber, possibly a grain bin.

Double House, largest of Wetherill's "inaccessible" ruins, requires real rock-climbing skill for entry. Some 25 families occupied its several shelves.



of pueblo existence on Mesa Verde in the same cave, a few feet above the floor of the pit house. Such was the amazing continuity of life in ancient America.

One aspect of Long House offers a problem of magnitude. If we could answer it, I feel, we would be very close indeed to some of the answers to the key mysteries of Mesa Verde.

The question: Why is the ratio of kivas to rooms so great? Kivas were used as we use our churches, as religious and social centers. Long House had 22 kivas, plus a great kiva, to some 150 rooms—one kiva to seven rooms. This

is almost double the ratio in most other cliff dwellings.

This situation suggests that the people from several of the smaller surface houses crowded into the great cliff dwelling. Each incoming group or religious society had to have its own kiva (pages 188-9).

Does this mean that those who lived in Long House were priest-ridden and spent an uneconomic amount of time in religious activity? Perhaps. Does it mean that there was an increasing tension as people in cramped quarters eyed the space taken up by the numerous







kivas? Maybe. Perhaps the people were turning, ever hopefully, finally frantically, to their gods as they battled whatever it was that was driving them from their homes.

One mile north of Long House along the canyon rim, another cliff dwelling clings to the sandstone like a swallow's nest (page 177). This is Mug House—smaller, less overwhelming, but fascinating. Visitors seem to understand it better and be more at home there than at Long House.

Roof Fell In on Mug House

It is doubtful, however, whether the Indians felt at home or secure during their last years there. Mug House offers evidence that it was abandoned more abruptly than Long House. Far more artifacts—stone, bone, and pottery—came from this site than from the larger ruin.

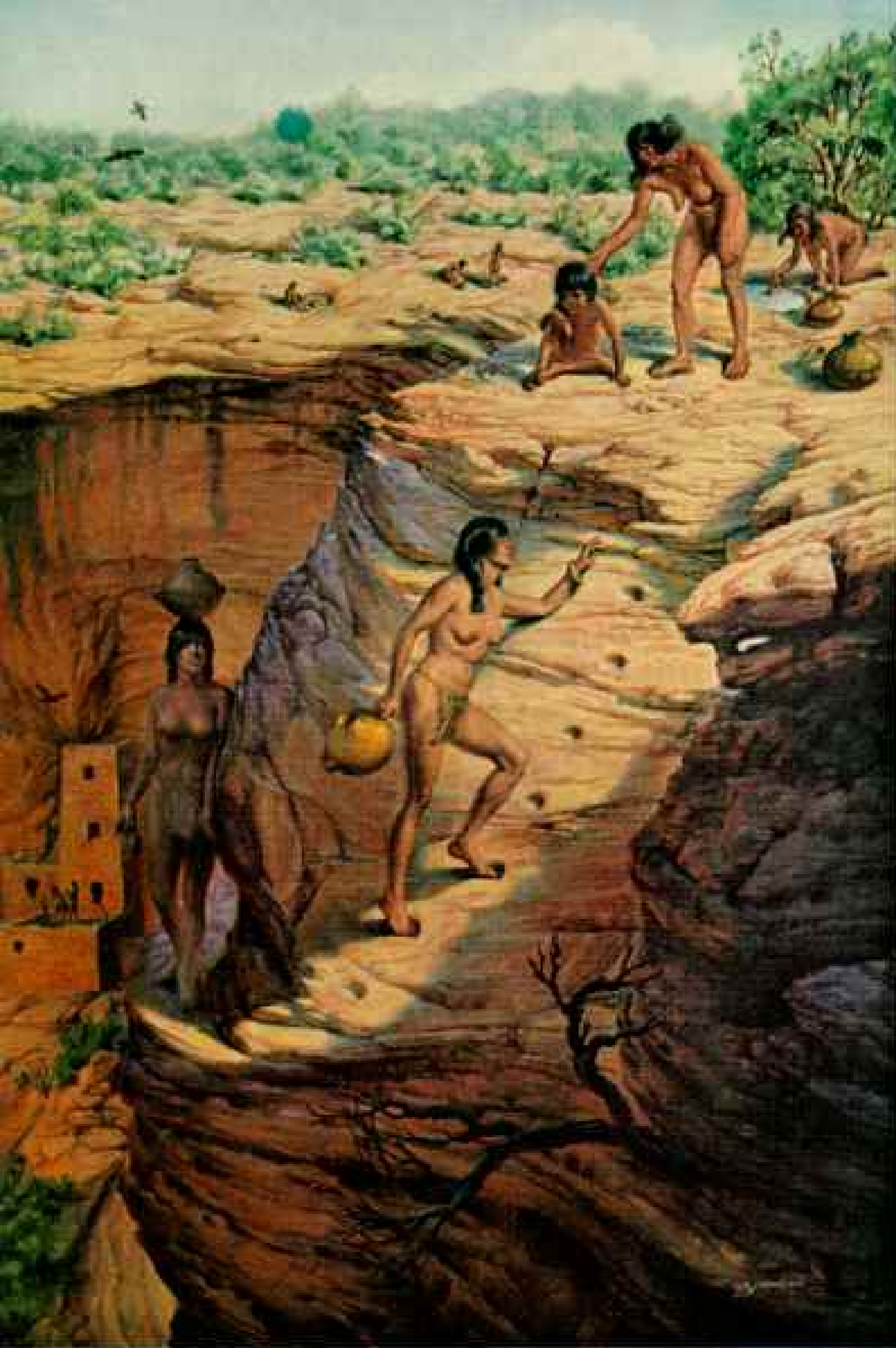
Some 430 pots, bowls, and jars, relatively whole or easily restorable, were found in Mug House. It would appear that the ancients did not have a chance to remove all their possessions during the last days or years of village life. Perhaps they did not dare re-enter their dwellings, for fear of the ceiling falling.

Sometime after they left, one or several falls of rock from the arched roof of the cave smothered most of the lower ruin in great jagged blocks of sandstone. We had to call in a hard-rock miner to remove a huge scale of rock above the walls of the upper level. We feared for ourselves—and later visitors.



Decorated mug, a fine example of Pueblo ware, came from the ruin at left. The Wetherills found so many here they named the place Mug House.

Present-day pueblo dweller, Joe Chino of Acoma Pueblo, New Mexico, visits a house that may have been built by his distant ancestors. Mug House, like Long House and Step House, is scheduled to be opened to the public by 1968.



PAINTING BY NATIONAL GEOGRAPHIC ARTIST PETER H. BLANCHE © N.G.S.

Ancient climbers, drawn by rainwater trapped in mesatop potholes, mount precarious footholds from Square Tower House.

Modern climber, archeologist Alden C. Hayes, descends a cable ladder to Kodak House, so named from early photographic work in the vicinity. Scientists left this ruin undisturbed save for the concrete they applied to shore up its crumbling walls.

PHOTOGRAPH BY WILLIAM FELANAP, JR.

led one small room where he found 13 whole stone axheads, a pottery canteen—and a mug. He was finally satisfied.

It was not all easy digging and exciting finds. For weeks, the stone walls of the huge cave echoed as men with sledge hammers broke up the great masses of fallen rock. Then they had to lift the rock fragments out of the deep kivas and wheelbarrow the heavy loads to the dump.

Archeology requires biceps as well as brains. Sometimes I think the former are more important.

Brains are useful, though. One of the graves near Mug House contained a broken bowl that dated the burial a couple of centuries earlier than the ruin itself. Could

Mug House gets its name from one of the forms of pottery common in Mesa Verde, a heavy-handled mug apparently used for drinking soups or corn gruel (preceding page). Numbers of them were found by early visitors to Mug House. The Wetherills named the ruin for them.

Mug Hunt Finally Succeeds

From the beginning, Les Goff, one of our diggers, was determined to find a mug in Mug House. He talked mugs and thought mugs.

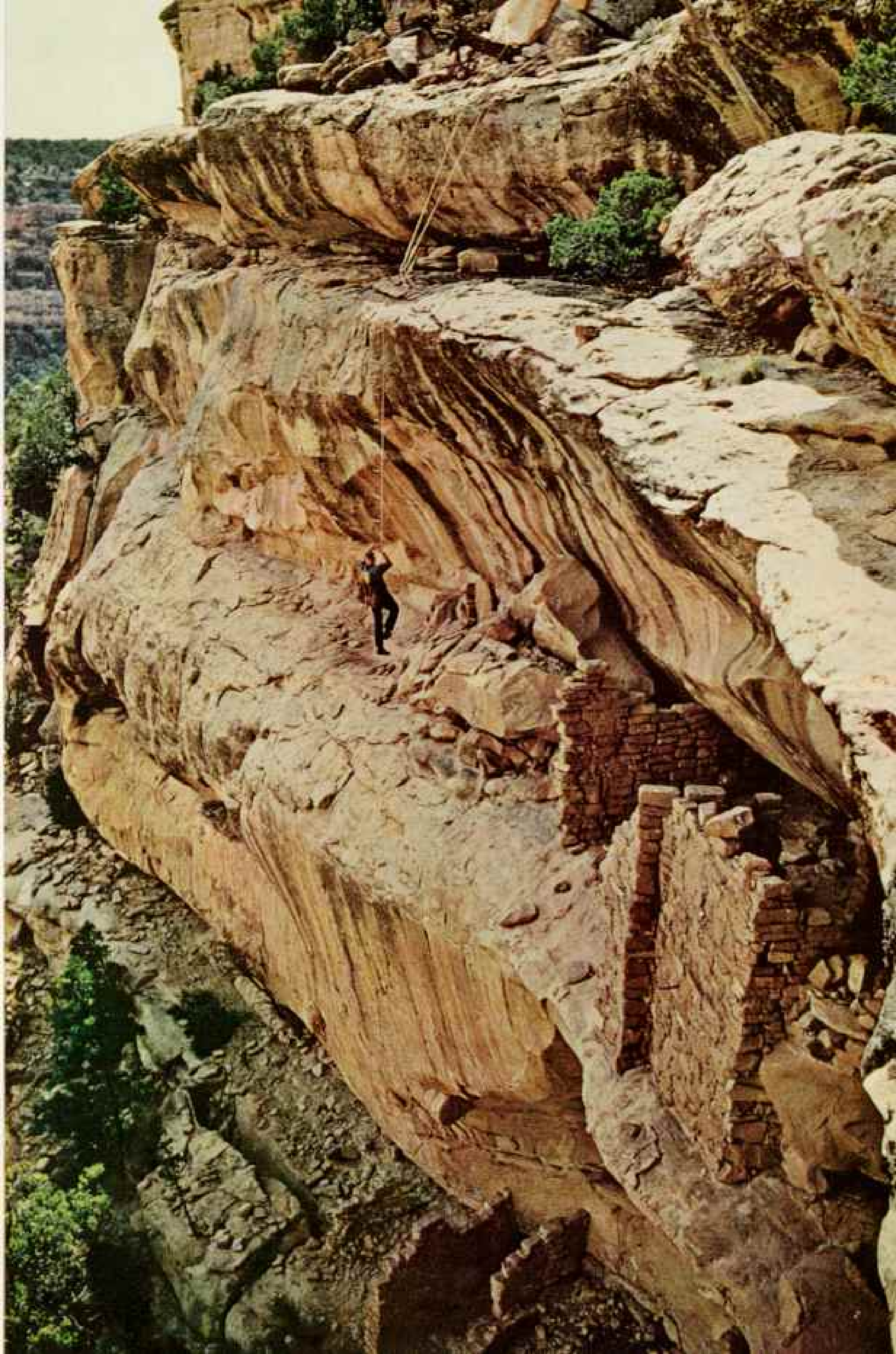
On his first day on the site, he found a pottery dipper, a bone flesher, a bone awl—but no mugs. His second day: five restorable pots and many stone tools—no mugs. The third day: seven pots and many small objects—no mugs. After weeks of mugless labor, he tack-

this have been a Mug House burial?

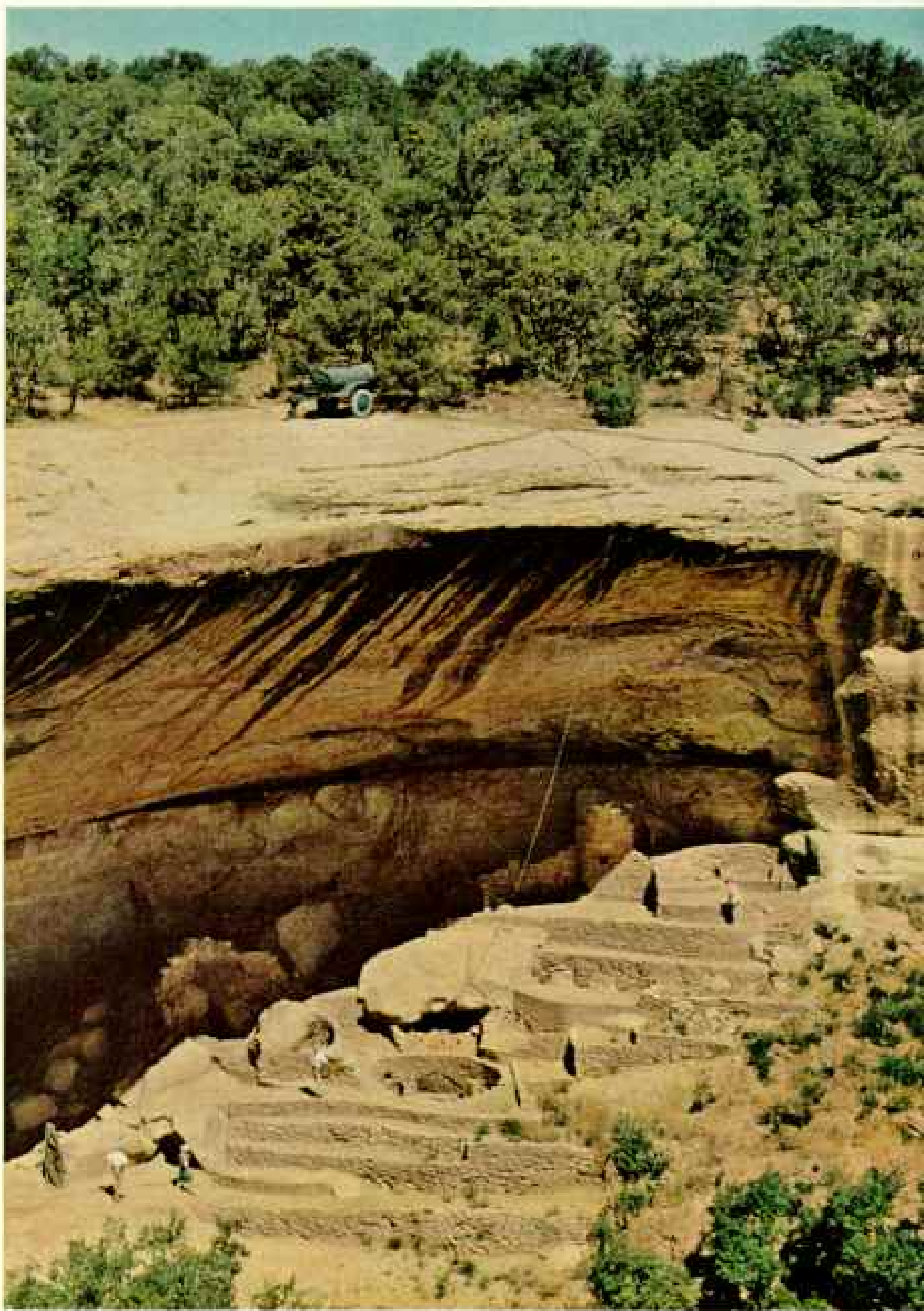
We found a deposit of early sherds on the slope below the ruin. In the laboratory, one of these thousands of fragments—our total now exceeds 750,000—was recognized as having the same design as the bowl from the burial. Holding his breath, Art Rohn took the bowl from its shelf—and the sherd fitted the gaping hole perfectly. The burial had indeed come from Mug House; this site had therefore been occupied much earlier than the surviving ruins.

A miracle of memory and recognition? Not exactly; patient study played a part. A similar thing happened in the laboratory as the Long House pottery was sorted and classified. The first burial we found on the talus slope yielded a fine late-classic painted bowl. Several pieces

(Continued on page 194)







PHOTOGRAPHS BY ROBERT F. WICKS (OPPOSITE, UPPER) AND RICHARD W. STEWART, NATIONAL GEOGRAPHIC STAFF © W.G.P.

ONE THING that definitely links the Mesa Verdeans to their presumed successors is the underground kiva, an outgrowth of the primitive pit house. Kivas, serving as ritual centers, men's clubs, and workrooms, still flourish in pueblos of the Southwest. These photographs illustrate the excavation of Kiva C, the circular

Ruined kiva comes to light

depression in Step House below its overhanging cliff (above). A triumph of prehistoric construction, the 11-foot-wide chamber varies less than two inches from a perfect circle. Close-ups at left picture the room as excavated (upper) and as stabilized. Six columns of masonry supported the vanished roof beams. A central fireplace warmed the pit. Smoke escaped through a hole in the roof, fresh air flowed down a vent and swirled around a deflector. Dr. Osborne (lower) points to the stone baffle. A feature of every kiva is the *sipapu* (not visible here), a small hole in the floor, symbolic entryway for the spirits, both good and evil, that dwell in the earth. Such a *sipapu* appears in the painting on page 157.



PHOTOGRAPHS BY ELLIOTT BELMONT, JR. © NATIONAL GEOGRAPHIC SOCIETY

Pottery washers clean the grime of centuries from Wetherill Mesa sherds. Altogether, three-quarters of a million fragments were processed. All were bathed in suds and water while being kept in strict order according to the spot and the depth where they were found. Some had a coating of lime that was removed with acid. Dorothy Ann Riggan scours broken cooking pots. David and Jean Lee, a Navajo brother-and-sister team, work beside her.

Jigsaw Puzzle of Pottery Sherds Is Pieced Together; Out Steps Kokopelli, a Mythical Flute Player

Indians regarded backward-footed Kokopelli as a jovial demigod. Like the Greek Pan, he is thought to have cast a roving eye on the daughters of men. Fragments of flutes like Kokopelli's have been found at Wetherill Mesa, but no complete instruments. Numbered sherd indicates its catalogue entry (17,821) and tells that it came from Mug House (1229) in the summer of 1960 (703).





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Pre-Columbian Water System Catches Rain and Brings It to Pueblos and Fields

A thousand years ago Indians on Chapin Mesa banded together and built this extensive network.

A fan of ditches (top), discovered in 1962, collected sparse rains falling on the hillside. A master canal carried water to Mummy Lake (at fork), so named because only its dry basin survives. The reservoir could store half a million gallons. Main canal con-



PAINTING BY NATIONAL GEOGRAPHIC ARTIST PETER S. BIRNCHIE © 1981

tinued past Far View and Pipe Shrine Houses (near bend at right) and flowed on at least four miles toward Spruce Tree House and Cliff Palace (out of sight). Delivering drinking water, it must have saved housewives many a weary step. Diversion

canal at left took water to irrigate terraced fields of corn, beans, and squash. Youths scare ravens from the crops, as hunters (left) carry home their prey. After 200 to 300 years, a long drought set in. The system dried up, and the Indians moved away.

were missing. All but two finally were located in a collection made by an archeologist who was there in the 1920's. We found one in Long House itself; one is still missing. We may get it yet!

One of the driest caves on the mesa holds Step House, last of our cliff dwellings to be excavated. Here we found our greatest quantity of perishable material, including yucca sandals, corn husks, and the only actual leaves of tobacco we uncovered. In the dry atmosphere of the cave they had endured seven centuries.

Although it was built in the same style as the other pueblos, Step House frustrated our tree-ring experts by being almost totally devoid of wooden beams. Only one datable specimen was found, which read A.D. 1229. All the other beams had been wrenched from their places long ago.

Robert F. Nichols, archeologist in charge of the Step House dig, believes the building was abandoned earlier than others on Wetherill Mesa, and nearby groups pillaged the pueblo for whatever was left. Or perhaps the departing Anasazi, like many other primitive peoples, left behind any tribesmen unable to contribute to their journey. In that case, the old and the crippled may have lived on in Step House, knowing they were doomed, keeping warm as long as they could by tearing up their homes for fuel.

Indians Built Intricate Water System

While we were at work on Wetherill Mesa, our colleagues of the National Park Service made a significant discovery on neighboring Chapin Mesa that shed additional light on the Anasazi. Ever since 1935, archeologist James A. Lancaster had harbored a suspicion. He had noticed long depressions, some 18 inches deep by six feet wide, on the mesatop.

"I thought they might be parts of a water-supply ditch, and if they were, there should be some sort of collection system at the uphill end of it, but I never seemed to find time to look into it properly," Al Lancaster told me.

But when the park planned a new campground for that area in 1962, Al acted quickly. "I took a crew right up there and ran a few trenches," he said.

What he uncovered turned out to be a massive water-collection system built nearly a thousand years before (preceding pages). One day Park Superintendent Chester A. Thomas guided me to it.

"South of Navajo Hill there," Mr. Thomas said, "we found that the Indians dug a fan of ditches, one half a mile long, to catch the runoff from 25 acres of hillside. Right here they had a storage tank big enough to hold half a million gallons. We call it Mummy Lake, because it has dried up [map, page 164]. By clever sluice work they allowed only clear water to enter the lake—the silt settled in the bend of a feeder trench, where it could be easily dredged out."

A ditch from Mummy Lake ran far down the mesatop to supply water to Spruce Tree House, four miles away, and possibly to Cliff Palace, one and a half miles farther.

The water system was so big that only several pueblos working in partnership could have built it. Cooperative ventures of this kind are often found among ancient Indians of the Southwest. The Anasazi obviously knew the value of working together.

The waterworks had a long-delayed effect. To avoid destroying it, 20th-century national park planners had to choose a different site for the new campground.

Ruins Given New Lease on Life

We did far more than dig on Wetherill Mesa; we preserved. These ruins are fragile and their numbers limited. If Mesa Verde was to continue to be one of the great outdoor museums of the world, we had to prepare these remnants of the past to survive long into the future.

So we strengthened the ancient structures, shoring up and bracing the enfeebled walls, providing firm foundations and protection from the elements. We did not attempt to rebuild; that would have been false. Instead, we treated the ruins as a restorer would an old painting, carefully giving them a new lease on life.

Someday a few years from now Wetherill Mesa will have good roads and trails. A museum will be built to house and preserve the clues we found. Then you will be able to come into this splendid frame of cliff and canyon, and see the mysterious past with your own eyes.

Your first impression, as mine has often been on first entering these dwellings of a forgotten people, may be: "This is impossible. These walls, these pots, these discarded corn husks, and roofs still blackened by cooking fires—these things cannot be 700 years old."

But they can be. They are. THE END

Tall tripod gives Douglas Scovill a perpendicular shot into a pit house. Shortly after, as National Geographic photographer Albert Moldvay leaned out from the tower, it twisted and dumped him to the ground.

Burial chamber holds three intact skeletons. Apparently built as living quarters two feet below the mesatop, the room was converted into a tomb about A.D. 800 by removing the roof beams and letting the mud ceiling fall in. Richard Lee dusts one skull with a paint brush; its jaws tell of tooth troubles, which plagued the Anasazi. Alden C. Hayes records other finds. A metate, or corn-grinding stone, lies at right.

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ILLUSTRATION BY JERRY D. SMITH, JR., LARSEN AND FRED S. WANG, JR. © N.G.S.





THE KETCHUMBY (ARROYO) AND KODACHROMES © N.S.S.

WHEN DROUGHT STRUCK in the 13th century and the Mesa Verdeans vanished from their Colorado cliff homes, where did they go? Each year brings new evidence that they moved south into certain regions of New Mexico and Arizona. Key clues lie in the simple housekeeping routines of today's Pueblo people. Their tools and products bear striking similarity to those uncovered in the ruins of Wetherill Mesa.

Before a crackling fire in her adobe home at Santa Ana Pueblo, New Mexico, potter Dora Montoya white-coats a jar before decorating it. She follows the ceramic techniques of the prehistoric Mesa Verde people.

Bearing an olla, or water jar, from Wetherill Mesa, Mrs. Montoya shows the Indian woman's age-old way of balancing awkward burdens.

Other prizes of the National Park Service—National Geographic Society Wetherill Mesa Project include (below) a food bowl and pitcher, plus corrugated jar and black-on-white water jug with yucca-leaf harness for carrying or hanging. All were shaped and fired in Colorado at least 700 years ago by methods still used in Jemez Pueblo, New Mexico (pages 204-5).

20th-century Indians Preserve Customs of the Cliff Dwellers

Photographs by WILLIAM BELKNAP, JR.





HL. ENTACHIRONE (ABOVE) AND KIBACHIRIKKA © NATIONAL GEOGRAPHIC SOCIETY





WOLFFHARDT JAROSZ





AND HIS RETRIBUTION © NATIONAL GEOGRAPHIC SOCIETY

Peeling "paper" bread from her fireplace griddle, Dora Montoya folds it in the shape of a newspaper ready for home delivery. "To the uninitiated," says photographer Belknap, "it tastes much like well-dried newsprint." But in the pueblos, paper bread is a treat usually reserved for festive occasions.

To make the Indian delicacy, Mrs. Montoya spreads with her hand a thin batter of blue-corn meal on the smoking-hot griddle, allows it to bake a few seconds, then lifts it off. Years of practice are needed to smear batter without burning the fingers.

The stone griddle, one of a Pueblo woman's most treasured possessions, is handed down from generation to generation.

It was snowing when Mr. Belknap made this photograph in Santa Ana Pueblo. Picture-taking completed, Mrs. Montoya's husband climbed to the roof and covered the chimney openings lest the flakes fall on her precious cooking stone.

Grinding bins at Mug House saw Wetherill Mesa women bent over from dawn to dark, making corn meal by rubbing dry corn between handstones and slanted slabs, or metates. Differing textures of stone produced various degrees of fineness. A visitor examines an ancient mano, or handstone.

Present-day bin in Santa Ana Pueblo is identical to the one at Mug House except that wood has replaced stone in the partitions. Dora Montoya, using a Mexican-style mano, grinds blue corn for the paper-thin bread she makes at right.





Dignified grandmother, Mrs. Swynnee Sanchez of Acoma Pueblo uses a twilled pot rest to support a boldly patterned clay jar. Fashioned from yucca leaf, the cushion is a virtual twin to the one below, found at Mesa Verde 75 years ago and now in the Colorado State Museum at Denver. Hollow and elastic, the support also keeps round-bottomed jars from tipping when placed on the floor. Old-time Indians, says tribal legend, always finished weaving such rings behind their backs because anyone who knowingly completed a circle violated a taboo.

Acoma, known as the City in the Sky, sits atop a 357-foot-high butte 60 miles west of Albuquerque, New Mexico. Occupied since the 1200's, it is one of the oldest continuously inhabited towns in the United States.

Last maker of coiled baskets in New Mexican pueblos, Alcario Gachupin of Jemez fashions a circular base. Core rods and wrapping material come from the same plant, a three-leaf sumac. Mr. Gachupin scraped the bark off the rods; then he split other twigs and smoothed them flat. Working in spare moments, he will finish the basket in about two weeks and sell it for \$15. For the designs, he usually uses synthetic dyes instead of the old vegetable stains, which take too long to prepare. Otherwise his product is remarkably similar to the Mesa Verde basket base at lower right.



ACOMA (HOMER GILLOW) AND GILETTE (HOMER GILLOW) © R. S. A.





Finishing a woven basket, Mrs. Alice Kabotie, a Hopi of Oraibi, Arizona, works with finely split yucca leaves. She holds one leaf in her teeth as she loops another around the rim. Fresh green leaves provide the design against a background of sun-bleached white ones. Mrs. Kabotie's diamond-patterned creation required two hours to make.

Centuries-old basket (below, left), retrieved from the cliff ruins, looks amazingly new.

Bright-eyed Acoma baby is strapped to a hard-back cradle-board such as Indians have used for more than 12 centuries. Mothers at work in the pueblo can prop their infants against a wall or rock, where they can look around while awake.

Because the board serves as a bed where baby spends the night and most of the day, the head becomes permanently flattened.

Adult skull from Adobe Cave, near Mug House, shows the flattening produced by such cradle-boards as the 700-year-old Mesa Verde ones below.







Pottery makers fire wares in a corral at Jemez Pueblo

MESA VERDEANS used wood to fire their pots and fix the designs. Most Pueblo Indians today burn slabs of dried dung. But the Panana family in Jemez still relies on the old ways and uses wood, believing that it makes the vessels harder.

In red apron, Louisa Panana and her daughter Annie place vessels upside down in a crude metal bed resting on old cans. Earlier, Mrs. Panana molded the clay pots and polished them with a slick pebble. Annie painted designs with a yucca brush.

Pieces of discarded metal cover the pots.

Fire is applied to wood around the bed.

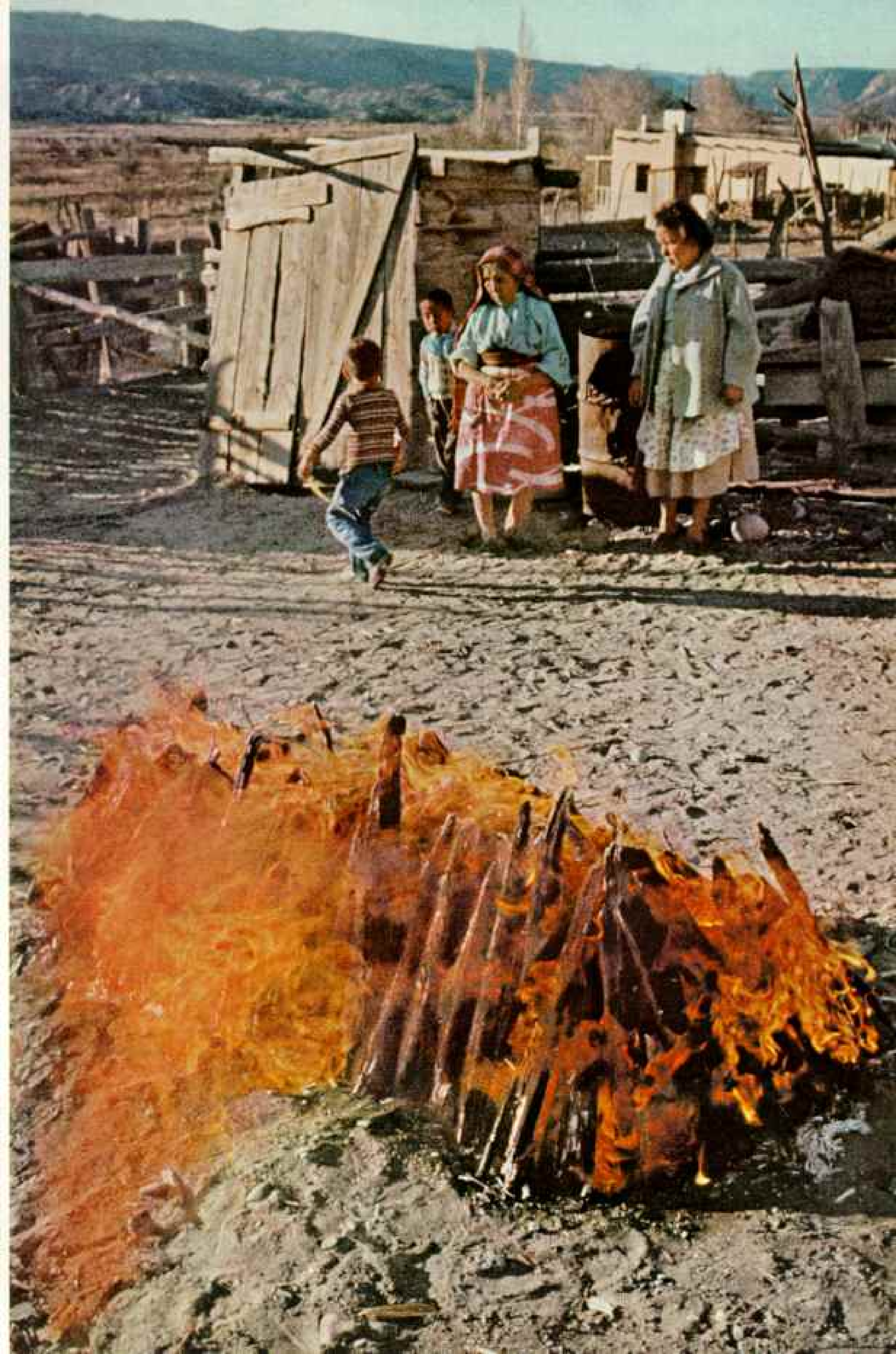
Mother and daughter wait for the fire to die. They will lift out the vessels with long sticks and let them cool.



REDWOODS (LEFT)
AND HE ESTADONIA © N.S.S.

Handsome kiva jar from Long House at Wetherill Mesa, fired at least seven centuries ago, clearly retains its distinctive markings.

This is one of the treasures of the National Park Service—National Geographic Society archeological project. It will go on view in a new visitor center planned for 1968.





HE LAYACOMBE BRADY AND FORD/OWENS © NATIONAL GEOGRAPHIC SOCIETY



Luxurious rabbit-fur blanket woven from long strips of cottontail pelt serves as play mat for a Hopi child. Once common in Indian homes, the rugs are now scarce and expensive. Only one man in the Hopi pueblo of Hotevilla, Arizona, makes them.

Woven rabbit-fur robe more than 1,300 years old served Basket Makers, ancestors of the cliff dwellers, as overcoat, bedding, or burial shroud. Cord of yucca fiber provided the foundation for hundreds of furry strips.

Making heeshee—necklaces of shell or of turquoise or other stone—is an Indian art passed down from cliff-dweller times. Then shells such as olivellas (upper) from the Gulf of California were traded from tribe to tribe; now they are purchased. Bead makers cut shells into small squares and drill holes through the centers. After stringing fragments (middle), they wet-grind strands on stones (lower) to make them smooth and uniform. Santo Domingo Pueblo in New Mexico produces superb heeshee, eagerly sought by Indians and visitors. Strands sell for \$4 to \$18.



Junior bead maker of Santo Domingo bores shells with a hand drill whirled by thongs.

Mesa Verde necklaces of shell and black shale rival the best modern Indian creations.





MURAHOME (LEFT) AND
HE EYALAHORE © N.C.C.



With sheaf of straw, Dora Montoya brushes the hair of her husband Porfirio after shampooing it with yucca-root suds. Then she pulls it back and ties it in the traditional *chongo*, a bundle at the nape of the neck.

Most young Pueblo men now cut their hair short, but many as they grow older revert to the old style, or "become long hair again."

Mr. Montoya, a former governor of the Santa Ana tribe, has been a National Geographic member for seven years.

Brush of dry grass at lower left is one of many dug up at Mesa Verde. Short, tight end was used to brush hair; the longer, looser end swept floors and corn bins.

Belt-weaver Lorenzo Medina sets up the warp on five pegs in his adobe home at Zia Pueblo, New Mexico. Drying chillis hang from the ceiling. Moccasins swing out of reach of gnawing mice.

Weaving begins when the warp is transferred to a belt loom (lower right). Mr. Medina maintains tension with a leather strap that circles his waist. His wooden batten tightens weft threads; the roller separates warp threads.

Almost identical weaving batten and roller were unearthed at Mesa Verde.



NO ENLARGEMENT (ABOVE AND BELOW) AND REDUCTIONS © N.G.S.



BATTEN, ROLLER, AND BRUSH (OPPOSITE) FROM COLORADO STATE MUSEUM





T-shaped doorway separates upstairs storerooms in the Acoma home of Swymee Sanchez, a retired railroad worker. Cooking fires have blackened the ceiling. Dried Indian corn hangs on the wall. In no other modern pueblo do entryways bear so close a resemblance to those at Wetherill (left).

Stooping to enter, Mardy Erdman, wife of a Wetherill project ecologist, squeezes through an opening in Mug House. Sooty wooden lintel remains in place. Dotted line on wall marks the level of fill prior to digging.

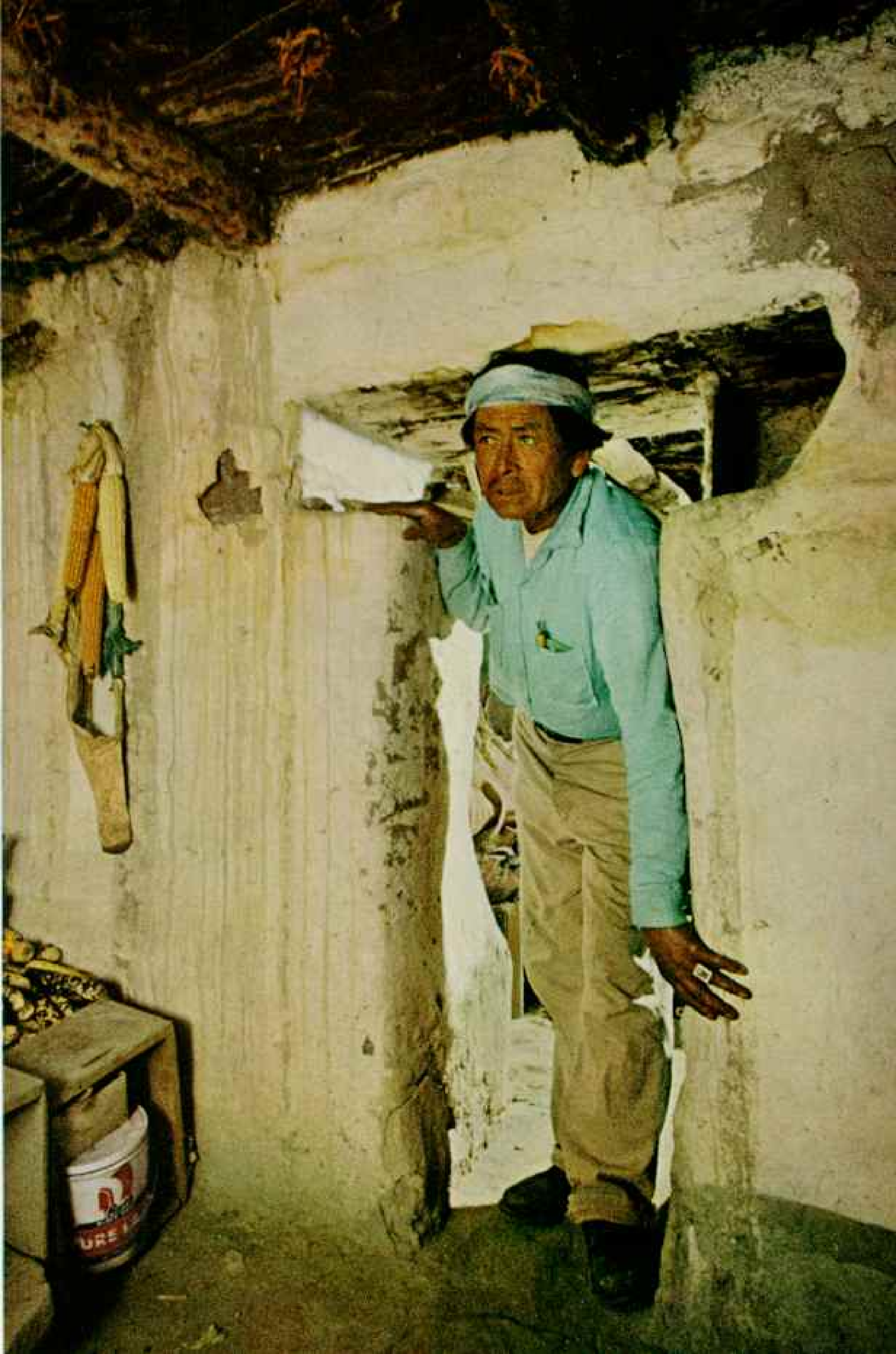
Scientists speculate that the odd shape enabled cliff dwellers to enter more easily with burdens on backs; niches at hand level eased the strain of loads. The doorways would also force invaders to enter bending over and in single file.

What is it? Pueblo Indians visiting the Wetherill laboratory with archeologist Arthur Rohn, Jr. (left), and Dr. Osborne (center) study artifacts uncovered in the ruins. Here Porfirio Montoya of Santa Ana, Joe Chino of Acoma, and Lorenzo Medina of Zia discuss the making of a hafted ax. THE END

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EDUCATIONAL LABORERS AND THE EXTRAORDINARY © W.S.P.









SAD EYES reflect the hard life of Peru's highland Indians. This mother with piggyback child raises potatoes near Huancayo.

STRECHER © N.G.S.

The Five Worlds of PERU

By KENNETH F. WEAVER

*Photographs by
BATES LITTLEHALES*

Both National Geographic Staff

FIVE HUNDRED YEARS AGO the Incas of Peru divided their far-flung empire into four regions and gave it the melodious name Tahuantinsuyu. It meant "Land of the Four Quarters."

Today in this strikingly diverse land of the Incas, I too found four regions, with contrasts as sharp as can be seen in any nation on earth.

There's a mountain world, with peaks so high they bow only to

the Himalayas and a few other crests in the Andes; a desert world, lifeless as the moon, yet rich in relics of ancient civilizations; a world of cold seas boiling with multitudes of tiny fish; and finally a green world of jungle, where Indians crowned in toucan feathers hunt with blowguns and poison darts.

To these I would add a fifth: Lima, City of Kings, a cosmopolitan world that did not yet exist when the Incas held sway. For although these regions are radically different and isolated by natural barriers, Lima, Peru's capital, is the force that pulls them together and makes of them one land. And Lima is the focus and symbol of the progress being made by a new generation of Peruvians.

Capital Remembers Its Conquistador Founder

When I arrived in Lima, the dependable sunshine of summer had faded and the coastal winter was setting in. A gray blanket hung above the city, muffling the sun. At intervals a heavy mist, the *garúa*, moistened my face. But no rain; Limeños never carry umbrellas.

Only 12 degrees south of the Equator, Lima would have a tropical climate but for the influence of the coastal Peru Current. (See the Atlas Map, *Northwestern South America*, distributed with this issue.) Carrying upwellings of cool water, this stream holds Lima's temperature average to 75° F. What little moisture the winds bring landward turns to fog. Despite this lack of rainfall, Lima's roses bloom year round, watered by the Rimac River, which rises in snow-capped mountains to the east and flows through the city.

On the outskirts of Lima, I saw a huge advertisement proclaiming that "*Llantas Goodrich valen un Perú.*" Literally translated, it meant "Goodrich tires are worth a Peru." The expression goes back four centuries and more to a time when the extraordinary flow of Inca gold and silver was filling the coffers of Spain. The word Peru became a synonym for riches, and it was common to say that something was worth "a Peru."

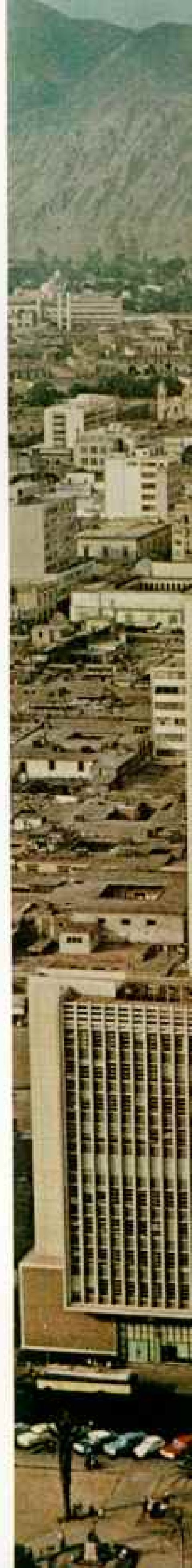
Apart from a few pre-Columbian burial mounds, I discovered nothing Inca in Lima except Inca Cigarettes, Inca Kola, and the Incas Country Club. But I found many memories of Francisco Pizarro, the Spanish conquistador who destroyed the Inca Empire: his statue beside the Plaza de Armas, where he founded the city in 1535; a fig tree, still blooming, that he planted nearby; and, in the cathedral, the remains of the soldier-adventurer himself.

For three centuries after Pizarro, Lima was queen of South Ameri-

Bustling Lima Crowds the Barren Andean Foothills

Peru's 429-year-old capital city draws together a land divided by geographic extremes: the separate worlds of cold sea and desert wilderness, snow-crowned mountain and riverine jungle.

Here the glass-faced Ministry of Education (left) adorns the 10-lane Avenida Abancay, which passes the Ministry of Finance (right) and ends at the Plaza de Acho, Lima's famous bull ring. A *barriada*, or squatters' settlement, covers lower slopes of the distant foothills.







Dark cloud of hair framing her beauty, Luz Maria "Mimina" Grau talks of her great-grandfather, Peru's beloved admiral Miguel Grau. He died in 1879 fighting against Chile in the War of the Pacific.

ca, the center of Spanish power. She gave the continent its first university (page 221), its first printing press, its first theatrical company. The elegance of her society and architecture approached that of the Old World.

The very progress that makes Lima a modern city of a million and a half has inevitably destroyed or obscured much of her colorful colonial legacy. Grandees' palaces, with cobbled entrances, iron grilles, and graceful pati-

os, yield to glass-and-concrete skyscrapers.

During colonial days, Limenian women watched the world go by from behind shuttered balconies overhanging the street (page 223). Those lovely carved balconies, the most obvious legacy of Lima's golden age, are disappearing fast. Fewer than 200 remain. If many are preserved, it will be because of a one-man war by Dr. Bruno Roselli, professor of art at the University of San Marcos. They call him the Don Quixote of the Balconies.

"This beautiful lady, Lima, is conceding her favors unwisely," Dr. Roselli told me, his flowing mustache quivering and his eyes burning with indignation. "I am 76, but I teach from 7 in the morning until 9 o'clock at night in order to buy more balconies and fight these giants who would tear them down!"

Sturdy Old Balconies Resist the Wrecker

Seizing his cane and his Homburg hat, he hobbled with me to the Plaza de Armas. "There, look at that! Two hundred and fifty years old! It's seen everything!

"And this one! It's unique!" Now we stood across from the Ministry of Education, where a house was being demolished. "Already they are chopping away at it. You should see how difficult it is to take down. It takes eight men an entire day. The beams go clear through the house. The owner and all his family—20 or 30 people—could stand there safely to watch the procession of Corpus Christi.

"Like butterflies when they are dead, they are nothing after they are taken down," he added sadly.

For seven years Dr. Roselli watched over the Lima of Pizarro, exhausting his slim purse to buy as many balconies as possible for future study and exhibition. Last year he saw his tireless labors go up in smoke as fire destroyed the entire collection.

With Miguel Pons, a young law student in training for the diplomatic service, Bates and I sought other evidences of Lima's golden age. We dined in high-ceilinged splendor at Las Trece Monedas, an exquisite colonial mansion turned restaurant. We visited the Torre Tagle Palace, whose Moorish galleries now surround the Ministry of Foreign Affairs, and whose balcony is the finest in the city. And at the pink rococo palace Quinta de

Champion of champions in Lima's 1963 horse show, Caramelo displays the soft, easy-in-the-saddle gait of the Peruvian pacer, the *caballo peruano de paso*. Cross between Arab and Andalusian breeds, the pacer moves both right legs together, then both left legs. Sr. Alfredo Elias from Hacienda Los Tranquitos near Ica rides his prizewinner.





Presa, now a museum, we examined the portrait, marble bathtub, and other personal possessions of the most famous woman in Lima's history—the actress La Perricholi.

"Her real name was Micaela Villegas," said Miguel as we looked at the impudent face in the painting. "She was mistress of the Viceroy Amat in the 1760's and '70's. She delighted half of Lima with her mischievous wit, but her unconventional conduct and scorn for society scandalized her enemies; they called her *la perra chola*, 'the half-caste bitch.' Amat just laughed and adopted the nickname, mispronouncing it La Perricholi."

The actress's portrait does not bear out the legend of her beauty. But her obvious charm

stirred a generation of Limeños, whose city, as one Frenchman remarked, was "a heaven for lovers and a hell for husbands." And this uncrowned queen of Peru inspired an opera, Offenbach's *La Périchole*, and half a dozen literary works, including Thornton Wilder's *The Bridge of San Luis Rey*.

If Lima is no longer the city of colonial times, it has in modern dress a personality all its own, summed up in the word *criollo*. The word once meant a Spaniard born in Peru, but it now refers to a way of life uniquely Peruvian. It is the vigorous throbbing of guitars, and couples flirting in the dance called *la marinera*; the delightful aroma of *anticuchos*, kebabs of beef heart roasting over euca-



ARRANGED BY BATES LITTLEFAIR (D. N. S. P.)

Political banners vie with advertising signs in Lima's heart, the Plaza San Martín. The equestrian statue honors the Argentine patriot José de San Martín, who led an expedition of 4,000 men to free Peru from Spanish domination. On July 28, 1821, Peru's independence day, San Martín formally declared the country's freedom in the nearby Plaza de Armas (below).

Foreground banner and distant rooftop sign urge election of presidential candidates: Víctor Raúl Haya de la Torre and Manuel A. Odría, both of whom lost to Fernando Belaúnde Terry.

Gran Hotel Bolívar, from which this photograph was made, used to draw crowds for afternoon tea; the custom waned with the increase of parking problems.

Changing of the guard before Lima's Palace of Government displays glittering helmets, jack boots, and uniforms inspired by Napoleon's army elite. Troops' parade ground faces the Plaza de Armas, a square laid out in 1535 by Francisco Pizarro.



lyptus embers in streetside braziers; the fiery bite of *ají*, the hot orange pepper of Peruvian food; the beat of the *cajón*, a box drum on which the drummer sits.

Behind Lima's modern façade, life proceeds at a leisurely pace. If someone says, "Meet me at 5 o'clock," make sure whether he means "Lima time" or "gringo time." Lima time can mean anything up to an hour late.

In the magnificent suburbs of San Isidro and Miraflores, bright with flowers and elegant homes, life is not only leisurely but formal and sophisticated. The high-born Peruvian is one of the world's most cultivated citizens, fluent in a variety of languages, at home in the capitals of Europe. His women

wear the fashions of Paris. He is proud of his fine collections of art, including the *arte popular* of today's Indians and the incomparable funerary textiles and pottery of pre-Columbian cultures (pages 230-31 and 244).

At the other end of the scale (and there is a small but growing middle class in between) are the people of the *barriadas*, or shanty towns. Their shacks of cane and mud and tin ring the Peruvian capital. These sections have mushroomed since World War II as the sierra people have fled the hard life of the highlands, seeking jobs in the city. Lima has not been able to assimilate them, for her population has almost quadrupled in 20 years.

Poverty Fails to Crush the Soul

In the *barriada* of Pampa de Comas, on the barren slopes of Lima's foothills, I found a hundred thousand people in mud shacks without water or sewage disposal. They have squatted on unused public land, resisting efforts to eject them. They are laying out streets, setting up schools, and organizing community government.

There Señora Inez Cruz López taught me the difference between poverty and misery. Her blue dress was not of the cleanest, and her pink apron needed mending, but her spirit was unquenchable.

"Are you proud to be an 'invader'?" I asked.

Her eyes blazed. "*Claro que sí!* [You bet!] With my forehead high and with my own sweat, I came here and built my own house."

"Any trouble with the police?"

She grinned. "*Muchas veces.* [Often.] They even tried to put me in jail. But as long as I can talk, I can defend myself with words and no one can defeat me."

She was 53. Her three children were married, her husband gone. She had formerly lived in one of the alley dwellings, the *callejones*, of Lima, but there she had to rent. Here she could own. She lived by knitting and by selling cookies and fruit.

"What of the future?"

"*Espero lo que Dios me dé.*" Whatever God may give me.

As I took my leave of Señora Cruz López, she called to me, "*Vaya con Dios!* [Go with

God!] May He guide you and may you always remember us, the poor!"

For Easter, photographer Bates Littlehales and I went to Ayacucho in the central highlands, thus entering Peru's mountain world.

Bates went ahead by car with two Americans, Lyndon "Rusty" Bell and his wife Elsie, and with a daughter of the Peruvian aristocracy, Doña Elena Gaffron. This charming and intelligent woman, who knows virtually everyone of importance in her country, helped open many doors for us throughout Peru.

I followed several days later in a small unheated, unpressurized plane—and I was lucky to get aboard even that, because so many people had reservations to go to Ayacucho to see the magnificent Holy Week ceremonies.

The air turned frigid soon after take-off, and I shivered repeatedly. My lungs seemed strangely tight, and I couldn't breathe fast enough. I felt lightheaded. The lack of oxygen was taking its toll at 20,000 feet.

Across the aisle, an eight-year-old Peruvian girl on her first plane ride was whimpering. As I looked out the window, I could understand her apprehension. Jagged peaks of the Andean cordilleras clutched icily at us on every side, turning our flight into a lofty obstacle course.

Temperature in Plane Drops to Freezing

The stewardess, a capable girl with black hair and high cheek bones, attached a rubber oxygen hose to a nozzle behind my seat and handed me the wooden mouthpiece.

"How cold is it?" I chattered.

"It's down to freezing. Don't worry, señor, we'll soon be there."

I sucked greedily on the mouthpiece. The invisible flow of oxygen did wonders. I could breathe easily again, and my brain cleared. The glittering snow crests of the Andes suddenly appeared less a threat and more a spectacle of rare beauty.

As I talked to Aurora Carrillo, the stewardess, she took only an occasional whiff of oxygen and she seemed oblivious to the cold, although she wore a short-sleeved blouse. Only 23, she told me she was the first air hostess to parachute in Peru. Could it be

Aspiring Lawyers Await Classes at South America's Oldest University

Charles V of Spain signed the decree establishing San Marcos in Lima in 1551. Today 13,500 students jam its colonial courtyards and galleried halls and spill over into a new suburban campus. A fifth of the students are women.



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Rented bridal gown and installment-plan television set proclaim the emergence of a middle class in Lima, where society has long been divided between poles of great wealth and dire poverty. Here the bride gets last-minute counsel from her grandmother as neighborhood girls admire her lacy finery.



Coquettish eye peers from a *tapada*, the fitted shawl affected by 18th-century belles of Lima. Statue adorns a monument to Peru's noted writer, Ricardo Palma, whose *Tradiciones Peruanas* contains these lines of appreciation for such a woman: "The girl was one of those beauties Lima is famous for who could have charmed the devil himself and made him cross himself and turn somersaults. She had a pair of black eyes that were like two charges of dynamite. . . ."

Lattice-windowed balcony on the Torre Tagle Palace suggests the elegance of Lima's colonial days. Such balconies are rapidly disappearing, but a San Marcos professor, Dr. Bruno Roselli, wages a one-man war to preserve them (page 216). Built in 1735, the Moorish palace houses Peru's Ministry of Foreign Affairs.





PHOTOGRAPHS BY NATIONAL GEOGRAPHIC SOCIETY

Image of Christ on a burro moves through Ayacucho as Holy Week ceremonies begin with reenactment of His triumphant entry into Jerusalem. Burning incense fills the air with smoke.

Palm fronds wave as faces grave with reverence watch the Palm Sunday procession in Ayacucho. Many in the throng walked from miles away to celebrate Holy Week.

that lady parachutists are hardier than the rest of us?

She had a simpler explanation: "I grew up in the mountains and I'm used to thin air. You're not, and you must take it easy. Don't run. Don't carry anything. Rest a lot. Otherwise you'll get *soroche*—mountain sickness."

I had heard of *soroche*, and I had no desire to experience its headache, nausea, and general misery.

With that warning we landed on Ayacucho's earthen strip—8,500 feet above sea level. Thus was I introduced to the high sierra, the heartland of Peru, where 60 percent of her people make their homes. The Indians of the sierra, the *serranos*, live on feudal estates, till the soil with foot plows, dance the monotonous *huayno*, and mix Inca tradition with Catholic practices much as they have done since the Spanish Conquest in 1533.





Ayacucho, a corner of 16th-century Spain, is filled with colonial patios and colonial memories. Near here, in 1824, the Battle of Ayacucho finally broke the power of Spain and drove her from the New World. In its many churches, the town retains a strong religious heritage from the conquistadors. And here the colorful Holy Week ceremonies rival those of Seville. Palm Sunday sees a spectacle of waving yellow palm fronds in a brilliant procession (pages 224-5).

At the cathedral I found Bates and Doña Elena. She took us inside to watch the Indians build the *andas*, or litter, on which they would carry the figure of Christ during the Easter procession. Men lashed long poles into a sturdy framework and tied to it hundreds of intricate candles in the form of flowers and ears of corn. Some men wore the *chullo*, a knitted cap with ear flaps. Often a felt hat rested atop the *chullo*.

In a corner of the cathedral, sad-faced women gently cleaned the face of the image of Christ. None lacked the hat of felt or straw which sierra women seem never to remove. Their bright skirts and mantles contrasted sharply with the dark shadows in the church.

Outside, politics competed vigorously for attention. Presidential candidate Victor Raúl Haya de la Torre was in town, and loudspeakers blared political speeches across the plaza. But the hundreds of Indians, many of whom had walked long distances for this week's events, seemed more interested in sitting in the sunshine of this cool April day, chewing a quid of coca, the narcotic leaf that banishes hunger, thirst, and fatigue. Or eating tripe stew from one of the steaming caldrons around the square. Or enjoying the delights of *chicha*, the popular home-made beer that is considered especially delicious because women have chewed the corn before it is fermented. Just *how* tasty it is I never found out.

That afternoon we crowded around a corral for the provincial bullfight—an affair that turned out to be more comic than serious. One happy animal might have been the inspiration for Ferdinand, the storybook bull who would rather smell flowers than fight. The torero, angered when his adversary would not charge, yanked the complacent bull's tail. The impatient spectators screamed

"*Michi, michi!*" as they would call a pussycat.

At quarter to four the next morning, church bells announced the Easter ceremonies. I mingled with the crowds in the plaza; the Southern Cross still hovered in the sky.

Presently boys lit the candles. The *andas* became a thing of shimmering beauty as light glistened from thousands of waxy facets. Thirty men lifted it onto their shoulders to lead the procession. Skyrockets shrieked upward, then exploded in bursts.

Bonfires of *retama*, the shrub we know as Scotch broom, lit the square. Church bells tolled wildly; a brass band shrilled; whirling pinwheels screamed. The sharp smell of smoke hung on the chill morning air.

The glittering *andas* and its sacred image became a phantasm, seeming to float over the throngs as it slowly traversed the plaza and made its way back to the cathedral.

The eastern sky was beginning to lighten as the ceremonies ended. Devotees gathered firebrands from the smoldering bonfires as tokens of good fortune. The country people began to pack up blankets, cooking pots, and babies for the long trek home.

Inca Road Thwarts Two-way Traffic

The mountain highway north and south of Ayacucho follows roughly the old Inca imperial road from Quito to Cuzco. It is so narrow in places that traffic goes one way on Monday, the other on Tuesday. So it was Tuesday before our party could set out in the Bells' station wagon to traverse the interlocking valleys and ridges and high plateaus of the sierra that lay between us and the coast. In our luggage we carried a bottle of oxygen in case of altitude sickness.

Our way was bright with yellow blossoms of *retama*, as glowing as the bonfires the night before. Sunlight shimmered on eucalyptus trees, which came, Peruvians assured me, from Australia by way of California.

"Those blue flowers in the meadow are *chamicos*—if a gringo drinks a love potion made from them, he will never leave Peru," Elena told us with a mischievous smile.

Agricultural terraces built by Inca engineers climbed some of the valley walls. In other places, farms clung to impossible slopes. On one hillside we watched a farmer tilling

Flavor of Spain lingers in tile-roofed Izcuchaca, nestled in an Andean valley. Llamas in a pack train cross the Mantaro River. Tier upon tier of terraces climb the distant hills, as in Inca times. The potato, native to Peru, thrives in these highlands.





FORBACHOWE © NATIONAL GEOGRAPHIC SOCIETY

Morochuco mothers wear the felt hats and bright homespun of the Indian, but a tendency to fair skin and blue eyes among them betrays their descent from Spanish conquistadors who settled in the highlands. Not uncommonly, mountain women—both Morochuco and Indian—wear a new fedora atop the old. They seldom remove their hats except to sleep. These women's skirts are wet from walking in high, rain-damp grass.

Little known, the Morochucos live by breeding horses, sheep, and dairy cattle in the mountainous Ayacucho area. They come to town only for fiestas or fairs.

Hard-riding horsewomen show Morochuco familiarity with the saddle as they race into the home-stretch at Ayacucho.

Unshod Morochuco ponies are especially sure-footed, placing their feet like goats with an unusual vertical step. Centuries of breeding have adapted the hardy animals to Peru's high altitudes.

an incredibly steep potato patch. We measured it: only 35 degrees from vertical.

Why were his rows up and down? I wondered about this as I saw vertical rows all over Peru. An agricultural expert finally explained that as the Indians chop or hoe, they can back down the hill more easily than they can move sideways. Most of them know little about erosion and contour planting.

Llamas Limit Loads to 100 Pounds

Flocks of goats and sheep occasionally blocked our road; or arrogant llamas with little red tassels in their ears and sacks of potatoes carried like saddlebags.

"The llama is stubborn," Elena remarked. "He will carry no more than a hundred pounds, and if you load on more he will lie down."

Serrano women hurried along the road in a shuffling little trot, invariably bent beneath a load. Mantas, or shawls, slung over the back served as cradles and carryalls. Spindles twirled ceaselessly at their sides as the women spun the wool of alpaca and sheep. Some of the girls wore flowers in their hats—a sign meaning "Husband wanted!"

And such colors! The sierra woman prides herself on bright-hued homespun skirts flaring like square-dance dresses.

In the isolated colonial town of Huancavelica, by contrast, a few women wore solid black. Elena explained that here Inca tradition remains strong; these women still mourn the last Inca emperor, who died more than four centuries ago.

By following the stewardess's advice on mountain sickness, I was able to avoid symptoms until we climbed to 14,000 feet to visit the Santa Bárbara mercury mine near Huancavelica. There we all found ourselves sleepy and lethargic. Even taking out my notebook to scratch a few notes was an effort; my pen moved with annoying slowness.

"That's all right," the mine manager said with a grin. "It takes me five days to recuperate when I come up from sea level."

Santa Bárbara was prized by the Spanish kings of the 17th century because its mercury was useful to amalgamate, or "pick up," silver and gold from ore. Today this mine is the largest producer of mercury in South America.

We watched hard-hatted miners in an open pit digging out lumps of reddish ore. Workmen wearing masks against poisonous fumes heated the ore in furnaces to vaporize the mercury, then condensed it to the familiar silvery liquid. I undertook to lift a gallon-and-a-half bucket of the stuff. It didn't look

like much, but the bucket felt bolted down. I checked the scales—77 kilograms, or 169 pounds. Exactly my own weight.

Santa Bárbara is but a drop in Peru's vast mineral riches. The gold that the conquistadors sought so greedily has been superseded by copper, silver, iron ore, lead, and zinc. Peru, in fact, produces nearly all the major metals. Her enormous new pits at Toquepala in the far south tap one of the world's largest deposits of copper.

Still climbing beyond Huancavelica, with our ears popping, we left soft green valleys behind and passed for miles through treeless plateau country known as *puna*, reaching a height of 16,000 feet. Nowhere in the United States does a road go above 14,500.

Llamas grazed by the thousands on pastures of bunch grass called *ichu*, watered

by melt streams from snowfields. An Andean goose flew over, white with black wings. Flamingos waded in a little lake. They are called *peruanos*, Doña Elena told us, because the red wings and white chest suggest the Peruvian flag (page 246).

Alpaca's Weak Spot: Tender Ears

Within an easy climb of the snowline, we came across men shearing alpacas in a stone corral. The alpacas—shaggy cousins of the llama—squealed viciously and spat at the shepherds as they were lassoed. But as soon as one of the women seized their tender ears, they lay quiet. The shearers hacked away the fleece with broad-bladed knives. All the while a murmur of unrest, almost a moan, swept over the flock of 150 beasts.

Dropping toward the coast, we skirted prec- 229

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY





FOLK ARTIST FASHIONS a clay church like the one below. Indians believe it brings blessings to any house whose roof it adorns.



TEXTILE MASTERPIECES of exquisite color and design, rivaling the best on earth, came from looms of ancient Peruvians. Using cotton as well as wool from llamas and alpacas, craftsmen as early as 2500 B.C. developed techniques that produced almost every kind of known fabric, including tapestry, embroidery, and lace-like gauze.

Peruvian tern above swishes a golden tail on a fragment of wool-embroidered cotton from Chancay; its maker lived some 800 years ago. Sea god (opposite), embroidered on the border of a mantle, came from a 2,000-year-old grave at Paracas. Even today the old techniques survive. The weaver below uses her ancestors' methods to create a belt.







ipices hundreds of feet above rushing mountain streams. At one curve, a truck coming from the opposite direction failed to honk, and we skidded to a dusty halt hardly a bumper's width apart. Slowly we scraped by each other, with our outside wheels crumbling away the very lip of the cliff.

Peruvians give their trucks fancy names. This one—"The Friend of Death"—did no good for my peace of mind.

A day later we encountered the terror of the Peruvian highlands—a landslide. Near Castrovirreyña we rounded a curve to find our narrow ledge above the Sinto River blocked for a hundred yards where the side of a hill, lubricated by the seasonal rains, had come crashing down. Buses and trucks waited on both sides as a bulldozer and a score of workmen strained to clear the way.

After a cold night in a miners' rest house, we returned to watch under a sun that burned with special ferocity through the thin air. Boulders were sent flying into the ravine, but new cracks kept appearing in the slope, and rivulets of sand slithered down beside us.

Women from the puna came down to sell food: a dish of sheep liver, onions, and rice for three soles; three small potatoes for a sol (about four cents). The potatoes had purple flesh. They were one of a hundred or more varieties grown in this land where the "Irish" potato originated.

Finally, near sundown on the third day, a one-way passage was cleared. A countryman in a brown poncho, with a sack of rockets for a fiesta, came leaping across like a frightened deer. "*Dios es grande!* [God is great!]" he gasped as he reached safety.

Ranrahirca Still Lies Buried

Later we visited the site of Peru's most destructive recent landslide, at Ranrahirca, in the Callejón de Huaylas north of Lima.*

Above us loomed the incredible white bulk of Nevado Huascarán, at 22,205 feet Peru's highest peak. At the edge of the boulder-strewn avalanche path, the remnants of Ran-

*In the June, 1962, *Geographic*, writer Bart McDowell and photographer John E. Fletcher described the avalanche that wiped out 3,500 Peruvians in seven minutes.



Snake dancing through Chaucayán, villagers re-enact the pageantry of Inca times. Bearing a staff, a herald leads the way for the Inca emperor, who wears a white ruff, balloon sleeves, and jingling coins sewn on his knees. Virgins of the Sun and men playing the Peruvian harp, flute, and violins follow.

Author and photographer happened on this echo of Inca times far back in the hills.

Mock battle rages at a fiesta in nearby Cajacay as men re-fight the Spanish Conquest. The straw-hatted Inca (left) struggles with a sword-wielding conquistador after pulling him from his horse. An Indian woman reveals her sympathies by restraining the "Spaniard." Firecrackers and the stamping of high-spirited horses provide excitement for this saint's day.

rahirca's population live in a few red-tiled mud houses. But they have not rebuilt their village. Nor are they likely to, for high on Huascarán poise other glaciers that at any moment could break loose and trigger another devastating onslaught.

Little Fish Make Large Fortunes

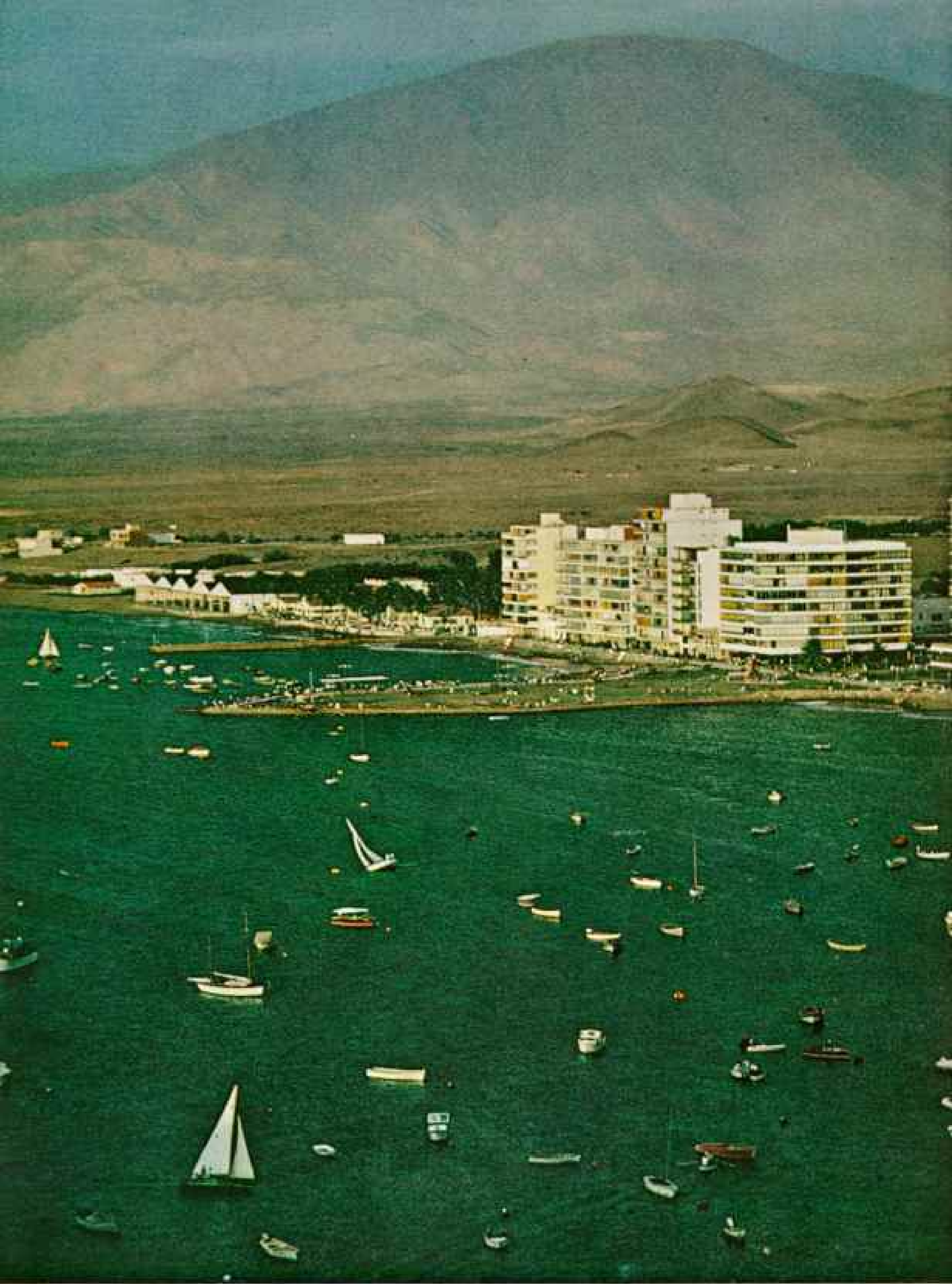
Back on the coast, we explored Peru's teeming world of the sea (pages 238-9). We smelled it first, for when the wind was from the ocean, the odor of fish pervaded all Lima. If we breathed deeply, we sampled the aroma of the fish-meal plants at Callao, Peru's chief port, eight miles from the capital.

Everything in Callao speaks of fishing. Boats by the score are under construction—in shipyards, in empty lots, in the streets. They are destined for the rapidly growing fleets that ply the waters of the coastal Peru Current, wondrously rich in both plankton and the fish that feed on it.

In the harbor, swarms of *bolicheras*, or fishing boats, ride at anchor, packed like cars in a parking lot, their superstructures a wilderness of masts and spars. Seamen load nets 1,500 feet long that can haul in fish 100 tons at a time.

Manuel Elguera, one of the leaders in the industry, told us that nylon has revolutionized Peruvian fishing in the past seven or eight years. Cotton nets rot out in a few weeks, he said, but nylon lasts much longer. So fishing and fish-meal production





Shining Towers of Glass Rim the Sea at Ancón, a Desertside Bathing Resort

Mining rainless flats and hills beyond the town, archeologists have uncovered the debris of cultures that flourished as long ago as 3,000 years



PHOTOGRAPH BY NATIONAL GEOGRAPHIC PHOTOGRAPHER GATES LITTLEHALES © N.G.P.

before Christ. Graves have yielded hundreds of mummies buried with fishing nets, baskets, textiles, and pottery. A onetime fishing village, Ancón

thrives today as an oasis for families on summer vacation from Lima, 70 miles away. Many office workers flock to the beach over weekends.

have become the largest industry in Peru.

Señor Elguera reeled off the figures: More than 1,000 vessels brought in 6,000,000 tons of the sardine-like anchovetas in 1962—not bad for a business begun as recently as 1950. Processing plants, including those under construction, total some 130. A fishing boat captain can make more than \$800 a month, a fantastic wage by Peruvian standards.

On Callao's piers we saw food fish in glistening piles: corvina, bonito, cockfish, guitar fish—and eels, some still wriggling.

But the little anchovetas, three or four inches long, go directly to the fish-meal plants. Giant suction hoses reach into ships' holds, like elephants' trunks. Bright streams of fish roar through the hoses to be belched into waiting trucks.

Fish Meal Feeds Chickens and Pigs

We followed one truck to its destination, a place of stench and steam and roaring flame. Dumped into a deep well, the little fish slithered down in a vortex, like water flowing out of a tub, as an auger screw at the bottom emptied the well. On an endless belt the anchovetas passed into a cooker, then through a sieve, into a press to give up water and oil, to a rotating oven, finally to a grinder.

Dried and pulverized, the light-gray fish meal passed through overhead tubes to be sacked. Mountains of meal in burlap bags waited for shipment to Germany, England, the Netherlands, and the United States to be used for poultry and pig feed.

As the bolicheras fill their holds and the

fish-meal industry prospers, an older industry—guano—declines. Anchoveta fishermen are cutting into the food supply of an estimated 30 million guano birds—cormorants and boobies—whose mineral-rich droppings were used as fertilizer even by the Incas.

One chilly dawn Bates and I took a launch from Pisco, south of Lima, to visit the guano island of Central Chincha.* A century ago this island was covered with a fabulously valuable deposit of guano 130 feet thick. In 1864, incidentally, Spain occupied the island in an abortive attempt to reconquer Peru.

Pelicans skimmed low beside us, their wingtips all but touching the glassy water. Sea nettles like striped umbrellas floated near the surface; the Peruvians call them *malaguas*, "bad water." We passed an island that appeared to be covered with soot, so dense was its population of black guano birds.

The acrid odor of a thousand chicken coops assailed us as we climbed the heights of Central Chincha. Long lines of barefoot "miners," working with trowels, scrapers, and brushes, scratched among the rocks to pile up little brown mounds, dusty and evil-smelling and feather-speckled (page 239). In the two years since the last harvest, several inches had accumulated. The guano birds, temporarily displaced, had retreated to the tip of the island. They kept up a bedlam of clucking in mass disapproval of man's intrusion.

After fish-filled seas, there could hardly be more of a contrast than Peru's fourth world,

* See "Peru Profits From Sea Fowl," by Robert Cushman Murphy, NATIONAL GEOGRAPHIC, March, 1959.



Riding his *caballito*—little horse—a Huanchaco boy learns to maneuver a surfboardlike boat of *totora* reeds. Eventually, atop a larger version, he will venture several miles off shore to fish with net or line.



Surge of Pacific surf gives sportsmen an express-fast shove to shore at Miraflores, a suburb of Lima. These riders are members of the Club Waikiki, appropriately named for the Hawaiian beach that popularized surfboarding.

Mosaics in wavy design, reminiscent of Brazil's Rio de Janeiro, pave a promenade beside new hotels and apartments in Ancón. Although summer days are warm, bathing waters run cool because of the nearby Peru Current.

RODARONHOFF © NATIONAL GEOGRAPHIC SOCIETY





its desert. When rain clouds move west from the Amazon basin, they strike the steep Andean cordilleras and dump their moisture. Thus the mountains and jungle are well watered. But Peru's narrow coastal fringe, spanning 1,475 miles between Ecuador and Chile and ranging from almost nothing to 120 miles wide, is virtually devoid of rain. One isolated spot near Tacna is so dry that wagon tracks and footprints made years ago remain undisturbed. Coastal graves preserve in near-perfect condition fine textiles and wood objects that were buried many centuries earlier.

Yet this barren region yields much of the nation's wealth—minerals, including oil; and, surprisingly, agriculture. Farming flourishes in oases created by short rivers that plunge down from the snowfields of the sierra (page 242). Along the northern coast, we saw irrigated stands of sugar cane higher than our heads. Smoke rose in black columns from fields fired to burn off dry leaves. Later, giant

cranes clawed up the cane, loading it on flatcars for the mills. Hawaii alone produces more sugar per acre than Peru.

On haciendas to the south, vineyards and fields of fine long-staple cotton, a major export, replace sugar cane. With Doña Elena, Bates and I drove south along the coastal road to visit such an hacienda, owned by her nephew, Ismael Benavides.

Political Slogans Deface Inca Ruins

The garúa misted our windshield as we left Lima, and fog played hide and seek with us for miles. We passed steep slopes crisscrossed with tracks where avid skiers pursue their sport on sand instead of snow. Political signs were scrawled on every conceivable surface, even on the Inca and pre-Inca pyramid temples at Pachacamac.

Some of these slogans were international in flavor: "*Castro al paredón!*" (Castro to the wall!); "*Muera el comunismo!*" (Death to



IDEASPHOTOS © W.C.C.

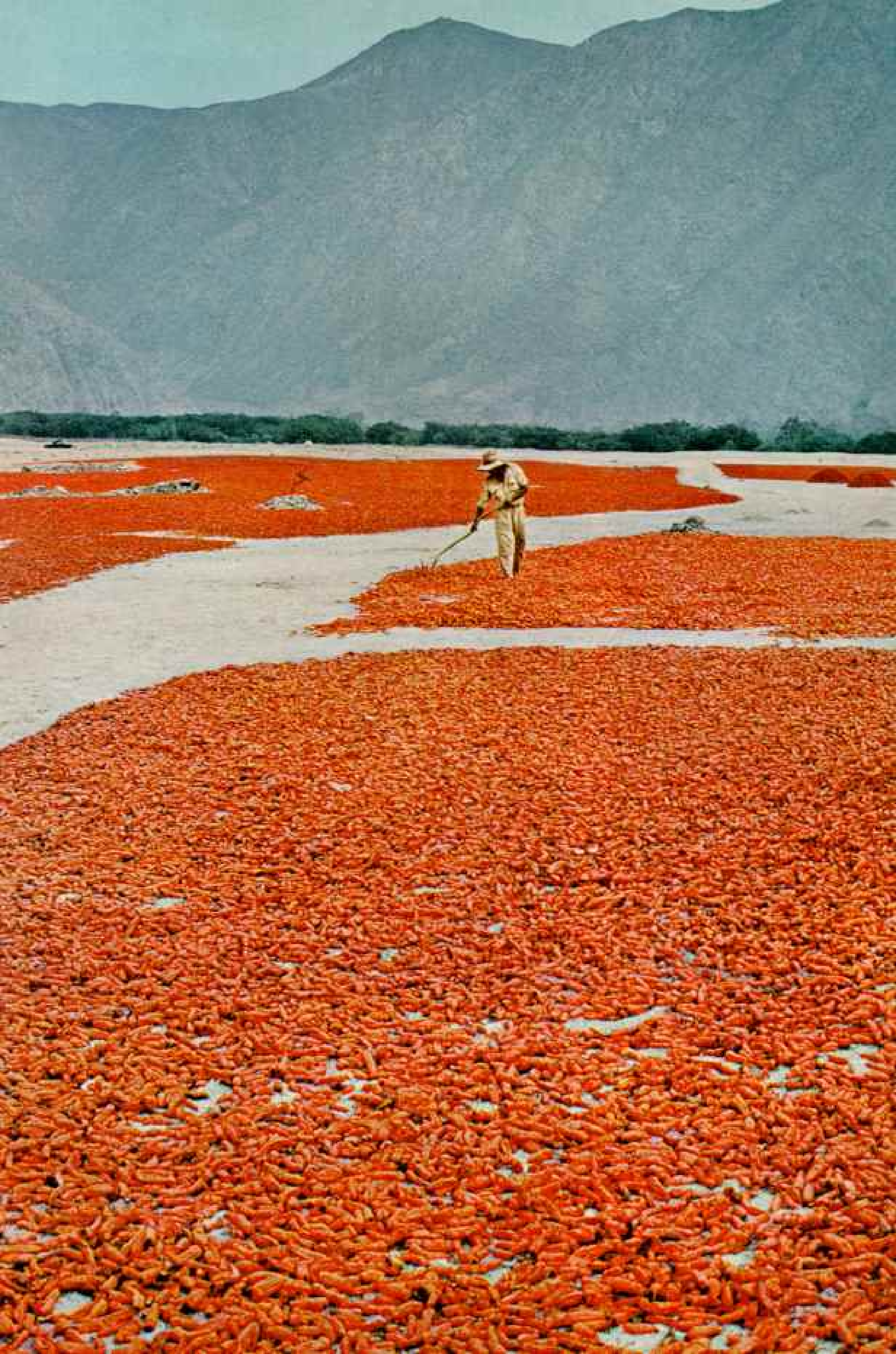
Gold, misty waters off Peru swarm with small fishing boats—and feathered fishermen. Ring of pelicans, waiting for a fish dinner, bobs atop a nylon net that has trapped tons of sardinelike *anchovetas* near Chimbote.

Laden dip net swings aboard as fishermen guide it to the cargo hatch. Converted into meal, anchovetas go abroad as feed for poultry and pigs. World's largest producer of fish meal, Peru hopes to find new uses for the protein-rich product. Lima's Center of Research for Child Nutrition recently reported success substituting fish flour—refined meal—for milk in diets of babies suffering from malnutrition.



Scratching and brushing, workers collect guano from rocky Central Chincha Island. Vast colonies of sea birds nesting on Peruvian islets deposit layers of waste valuable as fertilizer. Today Peru's booming fish-meal industry competes for the birds' food supply.





Flaming carpet of *aji*, a Peruvian pepper, covers rock-hard sands near Paramonga. Spread out for 20 days to cure, the pods turn darker as time passes. Using a tree branch as a rake, this farmer turns a freshly laid bed to ensure even drying. The author, after opening an *aji* pod, felt the burn of its oil when his hands inadvertently touched the tender skin of his face. Peruvians liberally spice many of their dishes with it.

Brown and bare, youngsters on the Casa Grande hacienda near Trujillo turn an irrigation ditch into a splashy race course. Sugar cane, the plantation's money crop, blankets vast fields. Highly mechanized, Casa Grande operates like an industry; it supplies employees with homes, shops, schools, and most of their food.

communism!); and the familiar "Cuba Sí, Yanqui No!" Clearly Peruvians are not of one mind.

At Mala bananas flourished. At Playa de Asia, *caballitos*, narrow reed boats, were stacked on the beach. Fishermen straddling these "little horses" sometimes ride half a dozen miles out to sea to cast their nets or lines, just as their Mochica forebears did 1,500 years ago (page 236).

"Today it is very tranquil, the sea," said Elena. "Generally it is *bravo*."

Arid Land of Strange Beauty

Near Chincha Alta trucks passed us loaded high with baled cotton. At Pisco, palms heavy with ripe dates lent an Andalusian air. Now the clouds lifted to give us glimpses of shadowy mountain ranges rising one upon another to the east. Around Ica we came upon giant sand dunes, bent into sharp-ridged crescents by the prevailing winds.

Between the oases we drove for miles through country that varied from flat to mountainous, but always dry, dry, dry. The very monotony and utter absence of life—not a sprig of green, not a soul—held a beauty at once mysterious and terrifying.

Turning inland from Ica, where jacaranda trees bloomed lavender, we passed through dusty haciendas much like plantations of our own South. Peacocks bent lovely blue necks to drink from irrigation ditches. Our car



EDDACHOWRES © NATIONAL GEOGRAPHIC SOCIETY

shuddered violently when we crossed the boulder beds of old avalanches.

Two tall pines marked the ranch house at Hacienda Huamani, well up in the Ica Valley. Ismael Benavides' soft brown eyes smiled a welcome to us from beneath a huge broad-brimmed straw hat. In excellent English he invited us to watch the making of *pisco*, Peru's famed and fiery grape brandy.

Beneath thatched shades stood rank upon rank of clay fermentation jugs shaped like the amphorae of ancient Greece. From an old English still of thick copper, clear *pisco* flowed into a large vat. Workmen ladled the brandy with metal pitchers and carried it to

(Continued on page 246)

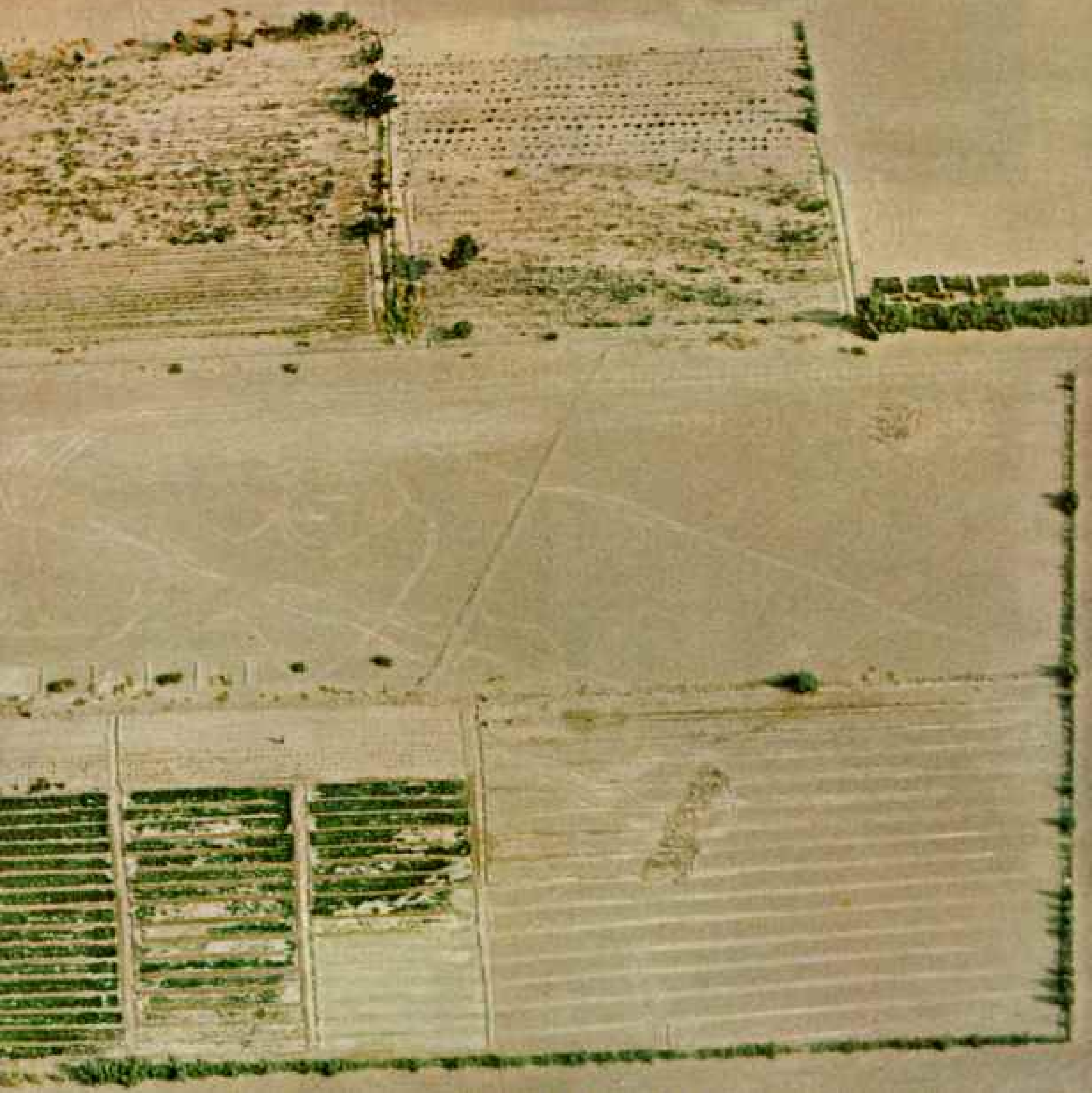
ISLANDS OF GREEN in a sea of sand dramatically show irrigation's power to transform fertile but bone-dry coastal plains near Ica.

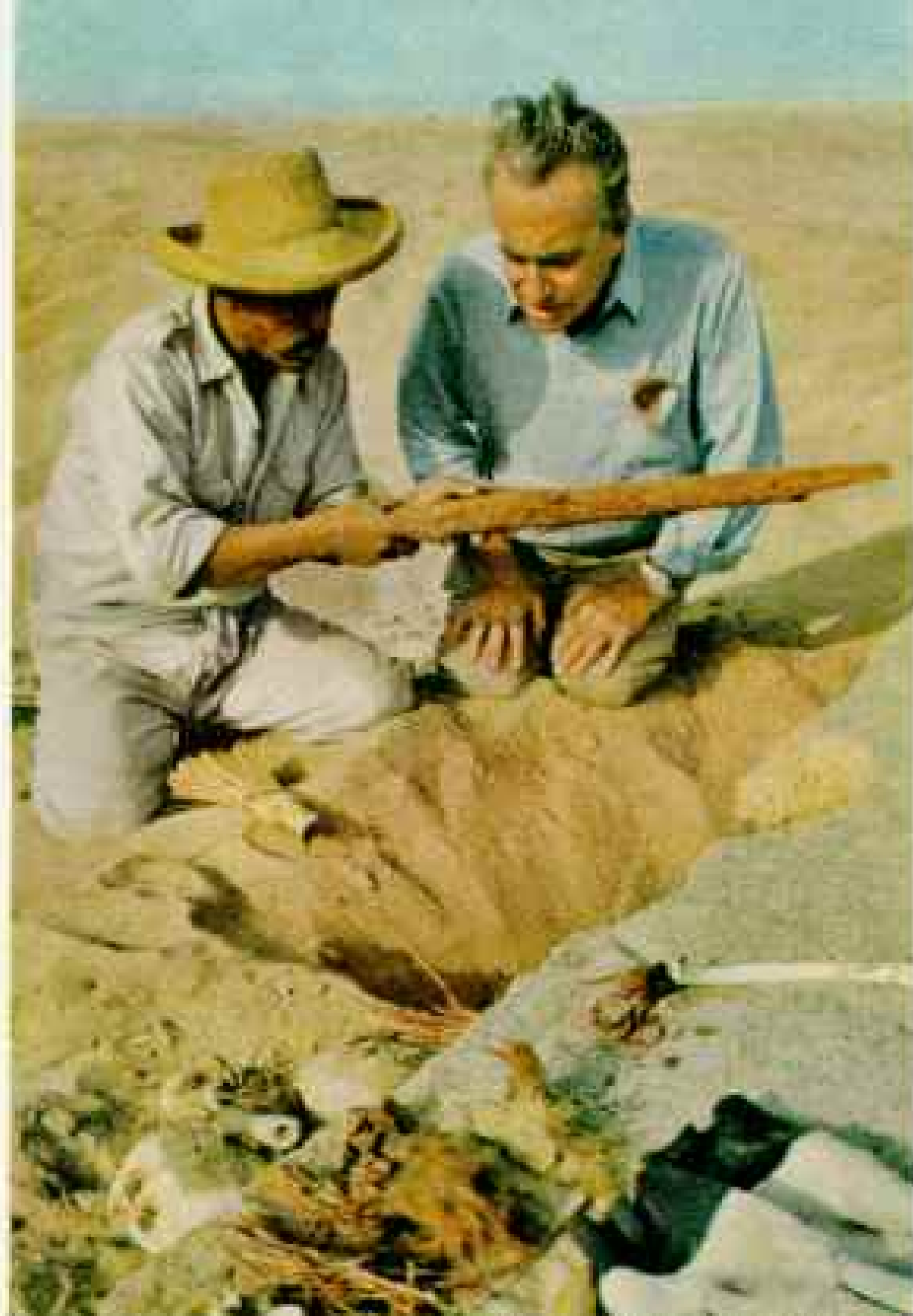
PHOTOGRAPH BY MICHAEL O'NEILL/PHOTOGRAPHY PARTNERS LIMITED U.K.





WORKER CLEARS drifted sand from the Pan American Highway, which threads almost the entire length of Peru's coastal desert.





Entombed for 5,000 years, skulls, bones, and a willow staff come to light before the eyes of archeologist Frédéric Engel (right) and his foreman. Professor Engel spends much of his time digging in the drier-than-dust Paracas area. He has found the oldest burial grounds on the coast of Peru, with remains dated by radiocarbon at 4000 B.C.

Huge bird and monkey on plateaus near Nazca were traced before the time of Christ. The unknown artists also scratched countless straight lines. Some of these may have marked the position of the sun on the horizon at the summer solstice, thus helping farmers time their planting.

Yellow subsoil shows where dark surface stones have been scraped away. Some designs look like ceremonial roads and landing fields; others outline animals, birds, and fish. The monkey (inset) is 262 feet long; a dirt track cuts its coiled tail. Largest Nazca figure measures 787 feet.

SCOTT HUNTER © NATIONAL GEOGRAPHIC SOCIETY

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COLLECTORS (FROM LEFT) OF TOSHITAKE AMANE, RAFAEL LARCO MUSEUM, REGIONAL MUSEUM OF ANCASH, AND YINGO COVER

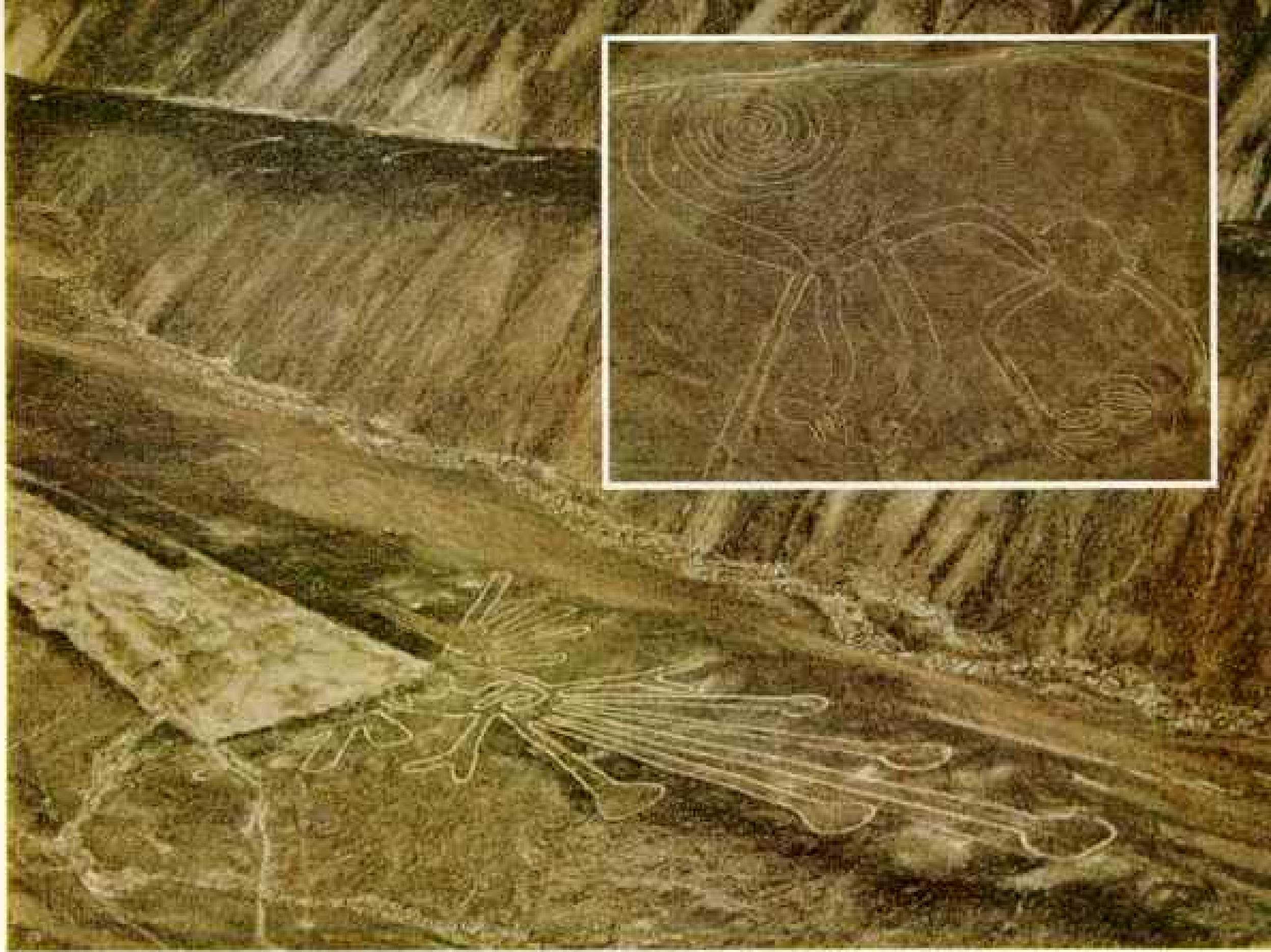
Pre-Columbian treasures suggest 20th-century designs



FANCIFUL SHAPE distinguishes a double-spouted funerary water container of many colors. Found in the Nazca area, it dates from A.D. 500 to 700.



MOTHER NURSING A CHILD forms body of a stirrup-spouted bottle made some 29 centuries ago in the Chicama Valley.



YASACHOWITZ © NATIONAL GEOGRAPHIC SOCIETY

KNEE-HIGH STONE IDOL with snub nose and owl eyes inspired ancient worshipers in the Callejón de Huaylas area.



EERIE FACE STARES from a gold cup wrought in Inca times.

oaken kegs in the *bodega*, or storehouse.

The foreman swirled the pisco in the vat until it made bubbles, then quickly dipped out a glassful for us to see. On the surface was a little flower of bubbles in the center and a little ring of bubbles around the outside.

"The *cordón y rosa*," he said. "The ring and the rose. That's how we tell alcoholic content. It won't form the ring and the rose if the alcohol is too low."

Señor Benavides, sixth generation of his family at Huamani, told us of his plans to diversify the farm, to raise apples, mangoes, pecans, olives. But today his major crop is cotton, and the harvest was in full swing.

"We'll saddle up horses for you to visit the fields," he offered. And so we mounted sleek Peruvian pacers that reminded us of Tennessee walking horses (page 217).

"You see that the hand and foot of the horse go forward on each side at the same time," said Doña Elena, an accomplished horsewoman. "It is a very soft way to walk. A man can ride all day and not be worn out."

She was right. I felt as if I were floating.

Señor Benavides and his wife represent the new generation of Peruvian aristocrats who care deeply about the welfare of their

country and who seek to reduce the gulf between the few who are very rich and the many who are very poor. No absentee landlord, Benavides is an enlightened *patrón* who gives his 150 peons a fair wage, good housing, an adequate diet, and a sense of pride.

"You must understand," he told us, "that here on the coast, haciendas are worked almost like industry. Wages are higher and owners are more progressive. But in the sierra there is still a form of feudalism. Workers on some haciendas or in very remote areas are forced to work without pay, without rights, and often with poor living conditions."

We spoke of the Vicos experiment in the high valley known as the Callejón de Huaylas. Bates and I had visited there when we inspected the avalanche damage at Ranrahirca, and had come away quite excited. We found Benavides also favorably impressed.

Vicos Viewed With Hope and Fear

Vicos is a 35,000-acre cooperative community with 2,150 people. Here, in 1952, came a Cornell University anthropologist, Dr. Allan R. Holmberg, to help the Indians pull out of their centuries-old misery. The Cornell-Peru project, set up by Holmberg and Dr. Carlos Monge, Director of the Peruvian Institute of Indian Affairs, taught them how to double their crops and began educating their children. In time the Peruvian government arranged for them to buy the hacienda from its former owner. The Vicosinos today are prosperous compared to other Indians in the sierra. Above all, they are free men.

Throughout Peru, Vicos is viewed as a sign of the future: with dislike by entrenched landlords, who fear demands for better conditions from their own Indians, and with hope by those who feel that Peru's economic growth depends on improving the life of the Indians.

When we visited Vicos, the Peace Corps had moved in. Eight North Americans, ranging in age from 21 to 68, were treating the physical ills of the Vicosinos and continuing to improve agriculture and living conditions. We were much impressed by the progress these selfless volunteers are making (opposite).

To the south of Señor Benavides' hacienda lies a desert mystery: giant lines and figures traced before the time of Christ. In an amazing variety of shapes they cover the surface of a series of flat-topped mountain spurs near the coastal town of Nazca. They are called the Nazca Lines. Almost unnoticeable from the ground, they were forgotten for centuries

(Continued on page 251)

PERU

CENTER of the fabled Inca Empire of the 15th century, Peru combines enormous mountains, the secret city of Machu Picchu, archeological riches, the highest navigable lake in the world, and more Indians than in any other country on the continent. From their old capital of Cuzco, the Incas once ruled a domain embracing much of western South America with several million subjects.



OFFICIAL NAME: Republic of Peru.
AREA: 496,222 square miles. **POPULATION:**

11,500,000. **LANGUAGE:** Spanish on coast, Quechua and Aymará in the highlands; other Indian languages in jungle. **RELIGION:** Roman Catholic. **ECONOMY:** Agricultural; cotton, sugar cane, and coffee important. Vast deposits of copper, silver, iron ore, lead, zinc, and gold also mined. Fishing and fish-meal production the largest industry. **MAJOR CITIES:** Lima (pop. 1,500,000), capital; Callao, port; Arequipa, trade center. **CLIMATE:** Varies with altitude. Virtually rainless on coast, but Lima area overcast and foggy mid-April to October; rain October to April in Andes and jungle. **INFORMATION:** Embassy of Peru, 1320 16th Street, N. W., Washington, D. C. 20009.



Drop-the-handkerchief game sets laughter bubbling at an Indian school near Vicos, a cooperative community in the Callejón de Huaylas. Peace Corps worker Betty H. Jansen, who teaches in Spanish, organizes play for her Quechua-speaking students.

Visiting 35,000-acre Vicos, Mr. Weaver saw a beneficent revolution in progress. Indians, studying scientific farming under Cornell University anthropologist Allan R. Holmberg, increased income sufficiently to buy the hacienda and now run it almost by themselves.

With gentle hands Dr. Theodor Binder, a naturalized Peruvian, examines a child of the Shipibo tribe at the Albert Schweitzer Hospital near Pucallpa. Her fingers and toes are dyed for beauty. Dr. Binder and his associates raised funds for the 28-bed hospital and research center devoted to helping jungle people. His chief targets are tuberculosis, parasitic diseases, and malnutrition.

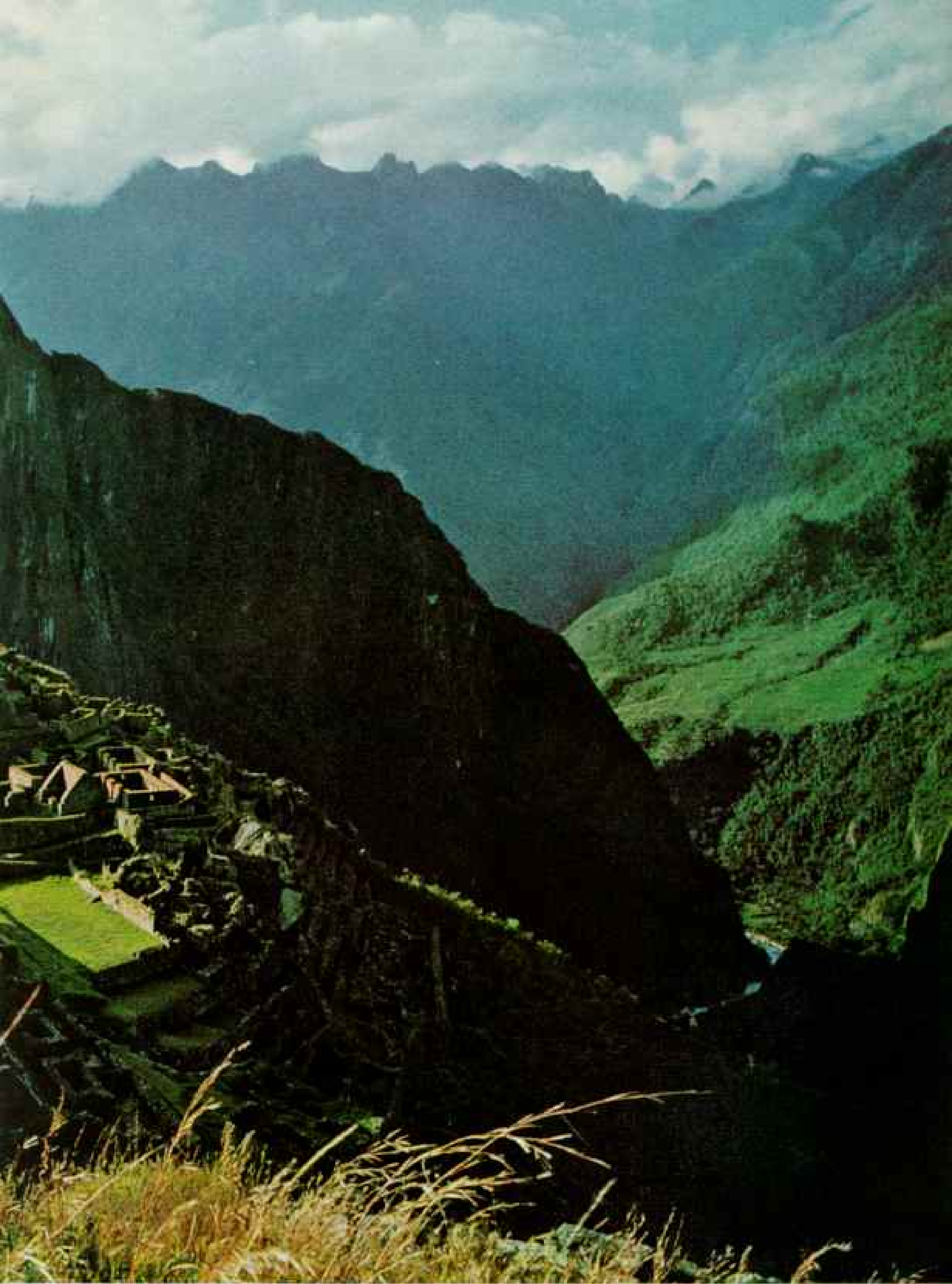


ADAPTED FROM © NATIONAL GEOGRAPHIC SOCIETY



Once a Secret Shangri-La, Machu Picchu
Stands Revealed in Awesome Splendor

Straddling an 8,000-foot mountain saddle between Huayna Picchu (center) and Machu Picchu (camera position), this city may have sheltered Inca refugees after the Spanish invasion in 1533. Hiram



PHOTOGRAPH BY NATIONAL GEOGRAPHIC SOCIETY

Bingham discovered it in 1911 and explored it under National Geographic Society and Yale University grants. Today visitors to the site see roofless houses and garden terraces, central plaza, and

lofty sundial (left) where astronomer-priests once "tied" Inti, the sun, to ensure that the god would continue to shed his blessing on the inhabitants. Terraces and a lookout crown Huayna Picchu.



Beauty of Spanish baroque finds exquisite expression in La Compañía de Jesús, a sanctuary that Jesuit builders dedicated in 1668 on Cuzco's Plaza de Armas. It occupies the site of the palace of Inca Emperor Huayna Capac, known as the Place of Serpents. Remnants of seven other Inca palaces stand in Cuzco. Queue waits for buses in front of the richly carved façade of a cloister now used by the University of Cuzco.

In the cathedral, from which this picture was taken, a sign admonishes Indian worshippers not to light rockets within the temple.

Pint-size passer-by peeks between the massive studded doors of La Compañía,

until rediscovered from the air (page 245).

A Peruvian Air Force C-47 flew us over the lines, with Bates tied in the open hatchway taking photographs. With us rode the leading authority on the prehistoric markings, Miss Maria Reiche. A German mathematician and astronomer, so slender that we wondered how she could withstand the desert winds, Miss Reiche has devoted 15 years of her life to probing these desert riddles.

Curving around a spur, we viewed a veritable zoo: a spider with legs crouched to spring; a bird with elongated beak and another with a zigzag neck; a monkey with coiled tail; a killer whale. The largest figure, a bird, measures 787 feet long; the longest line runs more than five miles. The tracings reminded us of similar giant effigies in California.*

What do they mean? "We think they are astronomical markings," Miss Reiche explained. "Many of the straight lines pointed to certain stars. Others were likely used to mark the summer solstice, a date important to an agricultural people."

Travelers on the Pan American Highway occasionally see Miss Reiche's spare figure and her jeep as she pursues her solitary studies on the mesas. When funds permit, she stays out five days at a time, then goes to Nazca for water and supplies.

"All I want is to walk the pampas the rest of the days of my life," this gray-haired scientist told me wistfully as our plane landed at Pisco Airfield.

For at least 2,000 years before the Incas, other Peruvian cultures—Mochica, Nazca, and Paracas among them—were producing unsurpassed textiles and ceramics. Because the evidences of these cultures are so well preserved in the bone-dry graves of the coast-



EDGARCHORNY BY BATES LITTLEHALL © R.S.S.

al desert, Peru is an archeologist's paradise.

Near Pisco, on the Paracas Peninsula, the desert is giving up some of its secrets to a French archeologist, Frédéric Engel (page 244). Driving us to his excavation, Dr. Engel took us through a setting from a surrealist canvas: a long curving sidewalk, buckled and cracked, lined with street lights, and running through an utterly lifeless desert. Developers had started to lay out a seaside community there, but a tidal wave swamped the area,

*See "Giant Effigies of the Southwest," by General of the Army George C. Marshall, and "Seeking the Secret of the Giants," by Frank M. Setaler, both in NATIONAL GEOGRAPHIC, September, 1952.



Centuries-old echo, the haunting music of a *quena* accompanies a boy on his way to school in Cuzco. His ancestors during the Inca Empire played just such an instrument.



and the project was permanently abandoned.

We found it hard to believe that man could have lived at Paracas; nothing grows there today, not even weeds. But in centuries past fresh water must have been more plentiful. Dr. Engel has found a settlement a mile long, where as many as 3,000 people of the early Nazca culture lived about the time of Christ. They are called *cabezas largas* (long heads) because the skulls were deformed to produce high foreheads.

Dr. Engel scratched in the sand and unearthed ancient snails, seaweed, rock crabs, fishbones, mollusk shells, beans—all evidence of the diet of the long-head people.

Farther down the coast at a cemetery estimated to be 5,000 years old, Engel excavated for us the body of an ancient hunter with a yard-long willow staff and a fragment of a net pouch. With the skeleton also was part of a mantle of guanaco or vicuña. The vicuña, a small wild cousin of the llama, yields the



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finest fleece known to man; vicuña cloth—even in Peru—costs \$88 a yard.

Dr. Engel asked his assistant to dig at random in the sand for a few minutes to show us the incredible quantity of textiles the ancients buried with their dead. He turned up dozens of pieces of cotton fabric in various stages of preservation, some of them several yards long. All had been previously uncovered by grave robbers. But even faded shreds and bits hinted at beautiful color patterns.

Brooding majesty of the Incas' Sacsahuamán fortress testifies to the genius of Indian engineers who, lacking iron or wheels, quarried and transported stone blocks weighing as much as 200 tons to the site near Cuzco. Fitting stones without mortar, they reared a formidable stronghold 1,800 feet long and 60 feet high, which has endured earthquakes that razed Spanish structures.

As in forgotten times, an Indian herds her llamas past Sacsahuamán's massive pile.

In Lima, at the National Museum of Anthropology and Archeology, we saw magnificent specimens of such mantles, excellently preserved. Their lovely colors show in one of the museum's exhibits on page 231.

In a lavish villa in the Pueblo Libre suburb of Lima, a noted scholar and archeologist, Rafael Larco Hoyle, opened a handsomely carved cedar cabinet to show me his rarest textile specimen. Found in the Ica Valley and believed to be 800 years old, it shows five small llamas in red and brown. A uniquely fine tapestry, it has an average count of 398 two-ply weft yarns to the inch. By comparison, ordinary wool serge made today has only 64 to 70! No wonder these ancient weavers are among the finest in history.

Señor Larco owns not only a superb textile collection but also one of the largest private collections of ancient pottery in the world. His museum in Lima, now open to the public, displays nearly 45,000 pots, vases, urns, and jars, all taken from Peruvian graves. The ancient Peruvians, like the Egyptians, equipped their dead with everything they would need in the other world.

Some 500 professional grave robbers called *huaqueros* systematically loot ancient cemeteries to sell to collectors, Señor Larco said. They dig only at night, to elude the police. Highly superstitious, they make heavy use of coca and pisco to keep evil spirits away.

Peru Plays Role in Space Research

Vast amounts of archeological material have been uncovered near the beaches of Ancón, 20 miles north of Lima, where the capital's elite play in the summertime (pages 234-5 and 237). But my interest there lay in something quite different—a NASA tracking station operated by Peruvian and U. S. personnel. Keeping tabs on unmanned satellites, it is part of STADAN, the Satellite Tracking and Data Acquisition Network.

Twenty-four hours a day the station watches for such satellites as Explorer, Vanguard, and the Orbiting Solar Observatory—all of which were on the schedule the day I visited Ancón. It plots their orbits and by telemetry it receives from them information that it relays to the huge Goddard Space Flight Center just outside Washington, D. C.

Messages from Explorer XIV, 36,000 miles away, came into the recording machines while I was there. I watched pens trace their curves on tapes. But I could hear the signal as well. It sounded like a multitude of tiny bells.

Arequipa, Peru's second city, lies deep in

southern Peru, at the gateway between the coast and the sierra. Above it towers the snow cone of 19,098-foot El Misti (page 265), whose volcanic fires still send out occasional wisps of vapor. Fruit and grain grow in abundance in this sunny region, except where water is not available; there the countryside is as barren as any in the land.

We found Arequipa still rebuilding from the severe earthquakes of 1958 and 1960. Colonial churches with elaborately carved façades of a soft white stone of volcanic ash called *sillar* have been especially damaged.

Although all Peru knows the earthquake, Arequipa seems particularly susceptible. We felt a slight tremor during our stay.

From Arequipa we returned once more to the mountain world, climbing by train to Puno on Lake Titicaca, at 12,500 feet the world's highest navigable lake. There, on floating islands of buoyant reeds, live some 200 Urus, who claim their tribe to be even older than the sun. In Inca times they were outcasts, so poor that the emperor disdainfully levied on them a tax of lice.

Urus still live a painfully primitive existence, fishing for the lake's abundant trout, snaring ducks, and building their islands, huts, and boats from the *tatora* reeds that flourish in the shallow fringes of the lake (opposite). In bad weather the islands rock like storm-tossed ships. Strangely, Urus hate the water and fear they will die if they fall in.

Until the 20th century the Urus stayed aloof and seldom married outside the tribe. Now, unhappily, the last tribesman of pure blood is gone; with him, in 1962, died the Uru language.

Puya Traps Sheep for Condors

From Puno to Cuzco, the climax of any trip to Peru, we drove by car through high puna country, a trip memorable for its roughness and for an opportunity to see the rare plant *Puya raimondii*.^{*} Imagine a fat telephone pole 40 feet high, with a bouffant skirt of long barbed spines a few feet from the ground, and you have it. The plant grows nowhere but in the high Andes of Peru and neighboring Bolivia.

The small grove we found had been set afire by sheepherders because the spines snag their animals and hold them prey for condors, the huge black vultures of the Andes.

Cuzco, capital and sacred city of the Incas, is a monument to a brilliant people who had no wheels, no iron, no beasts of burden other

^{*}See "Puya, the Pineapple's Andean Ancestor," by Mulford B. Foster, NATIONAL GEOGRAPHIC, October, 1950.



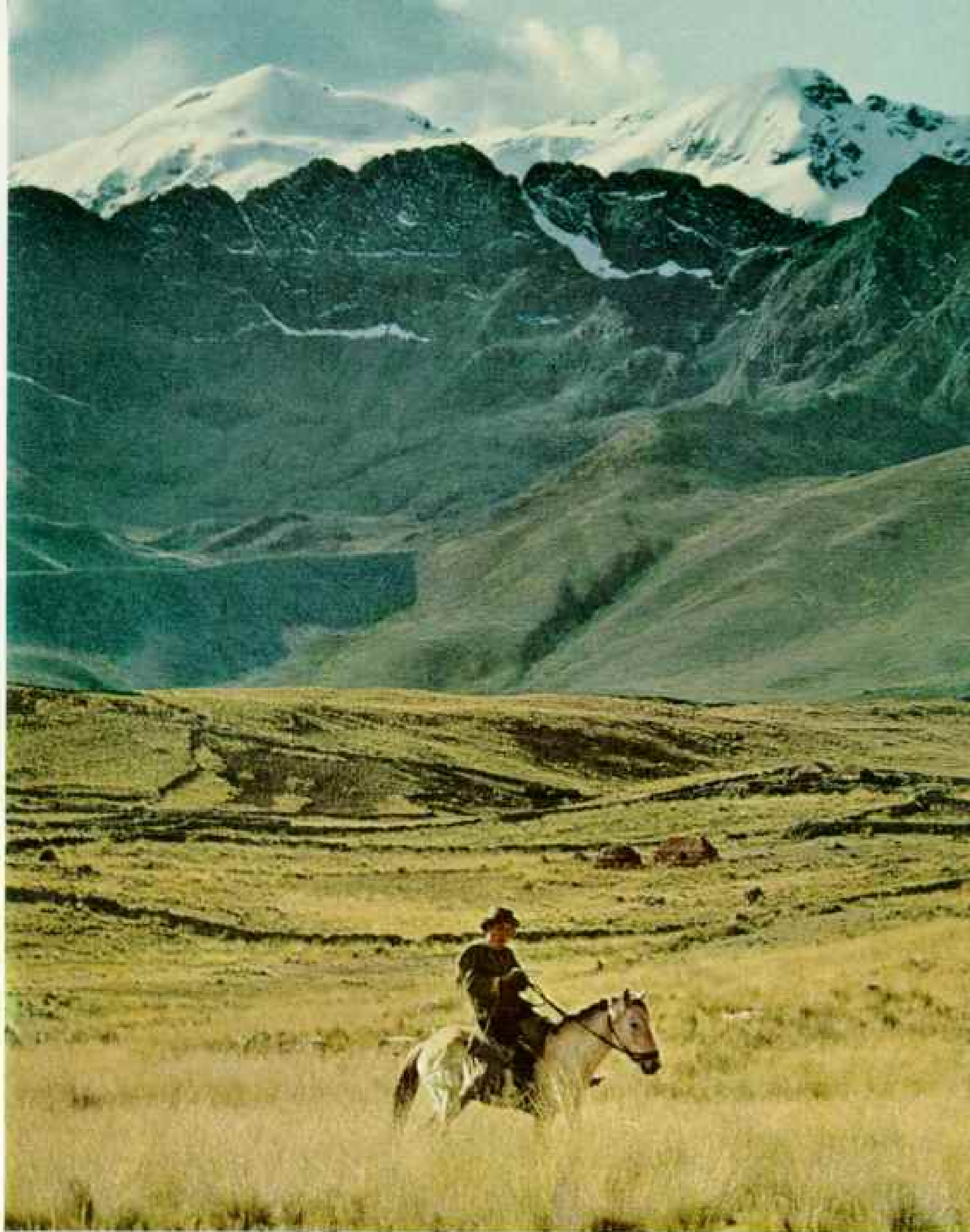
ILLUSTRATION © NATIONAL GEOGRAPHIC SOCIETY

Agile as water bugs, Uru boys on Lake Titicaca pole *balsas*, boats made of totora reeds. Living atop artificial islands of reeds, the youngsters had no chance to go to school until Seventh-Day Adventists recently set up classes in a floating hut.

"Take bread if you want to give the Urus a gift," friends advised the author, who took rolls. "Uru children and adults," Mr. Weaver reports, "came splashing across their boggy islands to greet us, seeking a treat that to them is better than candy."

Building a balsa on the shore of Lake Titicaca, an Aymará binds gunwales with reed rope. Air in the reeds will keep the craft afloat six months. The Indian wears a knitted *chullo* with earflaps beneath his hat as protection against chill winds on the world's highest navigable lake.





than the llama, and no written language, yet who established one of the great civilizations and empires of all time.* Often compared to the Romans, the Incas subjugated numerous tribes in what is now Peru, Ecuador, Bolivia, Colombia, Chile, and Argentina. Their hegemony extended more than 2,500 miles and encompassed 380,000 square miles.

They established a system of social security and abolished both private property and

freedom. They engineered and built 10,000 miles of roads through the Andes, with suspension bridges and tunnels, linking every part of the empire.

Fast relay runners, called *chasquis*, were stationed every one and a half miles; by this system they could cover 150 miles a day, delivering messages in the form of knotted

*See "Peru, Homeland of the Warlike Inca," by Kip Ross, NATIONAL GEOGRAPHIC, October, 1950.



KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

strings, called *quipus*, or bringing fresh fish from the coast for the emperor.

In today's tile-roofed Cuzco, where Indians in knee breeches and herds of llamas pass in the streets, the gold and silver that once adorned temples and palaces are gone, melted and shipped to Spain. But the lower walls of many Inca palaces—built of irregular stone blocks exquisitely fitted without mortar—have survived earthquakes and centuries.

Struggle for life finds mounted Indians herding llamas on the *puna* 14,500 feet above sea level. Stone walls form corrals; thatched homes in bleak isolation dot the plain. Snow-whitened Cunurana Peak dominates the scene.

Afraid of the evil eye, llama herders often hurried to get beyond range of the photographer's camera.

Many new walls, Spanish and modern, have been built atop them.

In Cuzco's cathedral, a painting of the Last Supper by a Cuzqueño artist caught my eye with one incongruous detail: a whole roasted guinea pig on a platter before Christ and the apostles. The detail is not meaningless; for generations the sierra Indians have considered guinea pig a delicacy. We tried it and found it much like rabbit.

Yale Professor Finds Lost Inca City

In 1911 a young Yale professor named Hiram Bingham, who later became Connecticut's governor and a United States senator, was threading the wild, rocky gorge of the Urubamba River. He was searching for the last refuge of the Incas, the lost city to which, legend says, the Virgins of the Sun fled after the Spaniards crushed the Inca Empire.

Through a cold drizzle, Bingham forced his way up the steep side of the gorge, fighting tangled forest vegetation, ever wary of the lethal fer-de-lance that infests the region.

Suddenly, in a narrow saddle between Machu Picchu (Old Peak) and its sister Huayna Picchu (Young Peak), he found himself looking at superlative Inca stonework. Covered with the growth of centuries, here stood the lost city of the Incas, one of the great sights of all the world (pages 248-9).

Supported by the National Geographic Society and Yale University, Bingham made three expeditions in 1912-15 to study and clear the jungle-smothered city. He told the story in the February, 1915, *GEOGRAPHIC*.

We made the 70-mile journey down to the Urubamba Valley from Cuzco by train, and by bus climbed the precipice via a series of 15 dizzy switchbacks.

Man is dwarfed in the Andes, but nowhere does he feel it so much as in the awesome fastness surrounding Machu Picchu. The gorge drops almost sheer for 2,000 feet on two sides. On the third side, Huayna Picchu climbs sharply, then slides off like the body and tail of a crouching lion, nearly surrounded by the roaring curve of the Urubamba.

The only approaches to the ruin for the Incas were pavements from a narrow fortified pass high on Old Peak. Small wonder the Spaniards never found the refuge.

An African grass has been planted in the ruin. It has run wild; now a dozen men labor constantly, tearing it from the walls.

In the still darkness before daybreak I left the hotel, crossed long stone terraces where the Incas raised their food, climbed a series of steps jutting out of a wall, and ascended to Machu Picchu's altar and sundial. Here each year at the winter solstice, the Incas staged a ceremony to "tether the sun," lest it swing even farther north in its daily arc and be lost to them forever.

By 5:30 the eastern sky showed pink above the saw-toothed ridge, but the great curving canyon still lay in deep shadow. Presently the snow crest to the west gleamed in unearthly, almost iridescent glow.

As the sun topped the ridge, laughter from below broke the spell. Four workmen strolled across the central esplanade to begin the day's labor reconstructing part of the ruin.

My body had become chilled from the vigil. Now, as I felt the joyous warmth of the sun, I knew why the Incas, and so many other primitive people, worshiped the sun god.

Special Knife Slashes Adulterer's Scalp

East of the Andes spreads the last of our worlds, the enormous jungle watershed leading into the Amazon near Iquitos, Peru's "Atlantic port." In this green wilderness, which takes up three-fifths of Peru, live an estimated half million Indians separated in some 35 tribes. Many of these primitive people have seen little of civilization except as they have come into contact with rubber hunters, lumber workers, or missionaries. They play virtually no part in the national life.

One major influence—a nondenominational U. S. missionary group known as the Summer Institute of Linguistics—is helping prepare the Indians for the severe adjustment they face as roads and planes threaten their isolation. To see the Summer Institute at work, we flew to the thriving town of Pucallpa, on the Ucayali River 300 miles northeast of Lima (see supplement map).

Robert Russell, one of the missionaries, took us down to the Ucayali to watch the unloading of river boats. Other bystanders—chiefly Shipibo Indians—wore bright-colored clothing with geometric designs.

Crown and ear baubles of toucan feathers mean that this Shapra Indian is a good marriage catch, for he can shoot birds in numbers. Papyo, whose people formerly took heads in revenge killings and chanted to the boa to bring luck, demonstrates another fact of the jungle: A man is no man without his shotgun (right) or blowgun.



One Shipibo attracted my attention because of a curious scar on the back of his head. Russell explained that this scar had been inflicted as punishment for adultery. The guilty man is held by a lock of hair, and the scalp is slashed with a special curved knife. If he resists, he is knocked down by a ceremonial club resembling a thick canoe paddle.

260 Later in the day we visited a Shipibo village half a dozen miles from Pucallpa. As we

entered a thatched hut, I felt a heavy blow on the back of the head. I had accidentally knocked down an "adultery paddle" hanging from a corner post.

"Honest," I cried, "I haven't been out with anyone else's wife!"

When *that* was translated, the Shipibo group howled with laughter.

Near Pucallpa, on a lakelike arm of the Ucayali called Yarinacocha, we visited the



institute's beautiful jungle headquarters. From here missionaries who are also linguistics experts fan out to work with a total of 32 tribes. Their primary purpose is to learn the primitive languages, reduce them to writing, and translate the Bible.

The SIL operates a superb flying service. One of the pilots, Floyd Lyon of Texas, flew us in a pontoon-equipped Cessna-180 to visit the Shapra tribe in Peru's far north, close to

Gray snake on a green path, the Ucayali meanders through jungle. Like most Peruvian rivers, it rises in the Andes close to the Pacific, tumbles east from the Continental Divide, and curls many miles to join the Amazon and eventually the Atlantic. Jungle covers three-fifths of Peru's area but holds only about five percent of her people.

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ILLUSTRATION BY KENNETH F. WEAVER, NATIONAL GEOGRAPHIC STAFF © N.G.S.





Shotguns help balance Shapra warriors as they cross a log bridge on a tour of the jungle with the author. Crack shots, they will bag monkey or bird (right).

Ready-to-cook toucan still wears its beak: Plantains, cultivated by Shapra women in small jungle clearings, flavor the stew.



Convivial bowl of yucca-root beer is downed by chief Tariri. Each evening Shapra men dress in their finest and gather at his hut for hours of drink and talk.





PHOTOGRAPHER BY BATES LITTLEHALL © N.A.S.

Blowgun lifted, Tariri puffs air that sends a palm-leaf dart flying 60 feet to pierce a papaya hanging in a tree. A plug of kapok keeps the dart in place long enough to build up air pressure. Quiver and kapok holder hang from Tariri's belt.

Missionary scholars John Tuggy and his wife take notes with pencil and tape recorder as Tariri explains Candoshi, the Shapra language. The Tuggys hope to use such information to translate the Bible. With four-year-old Joy, and another infant daughter, this dedicated California couple share the Shapra's primitive existence six months each year for the Summer Institute of Linguistics, their sponsor.



Long black hair frames the winsome face of a tribal daughter, here playing with a shotgun. The youngster knows more about the United States than one might suspect; she has heard Tariri talk about the time in 1957 when he traveled to this country to appear on the television show "This Is Your Life," honoring a missionary who had worked with the tribe.



the Ecuadorian border. From a height of 8,000 feet, the cloud-speckled world looked like a green quilt from which a mischievous child had pulled countless tufts of wool.

For four hours we dodged rain squalls, following the serpentine course of rivers, then made a surprisingly soft landing on the Morona River. We taxied into a tributary, the Puchuya, where missionary John Tuggy, alerted by radio, waited in a dugout.

Jungle Chief Becomes a Christian

On the bank, Tariri, the Shapra chief, and his people greeted us with broad smiles and laughing eyes. With their light-brown skins, long black hair cut in bangs, and regular features, they impressed us as an unusually handsome people (pages 262-3).

Despite their good-natured dispositions, the Shapra traditionally have been revenge killers who took their victims' heads. They have carried on vendettas for years because of some slight, fancied or real, by their own people or by the neighboring Huambisa or Aguaruna people.

Chief Tariri, now 44, had long been feared throughout the northern jungle. Today, under the influence of the missionaries, he lives at peace with his neighbors and takes his faith in Christianity very seriously.

We wandered down jungle paths to see the slash-and-burn plots where the Shapra raise tubers, pineapples, and plantains; their thatched houses on stilts, largely without walls; their cooking fires, three logs laid end to end like a star, with monkeys and birds laid on the logs to roast; their fishing spears ("They never miss," John told us); their eight-foot blowguns made of palm.

For a blowgun contest the men jammed a dart in the ground and stuck on it an orange fruit slightly larger than a golf ball. From 20 paces they placed dart after dart through the center of the target.

In the afternoon, all the Shapra washed up, put on their finest decorations of beetle-wing ear baubles and toucan-feather crowns, and gathered at Tariri's house for the daily visit, most important activity in Shapra life.

As each newcomer arrived, the group made a chattering sound like "Chi-chi-chi-chi-chi." I asked John what it meant.

"It's a mildly sarcastic greeting," he explained. "You might translate it, 'Oh, you're all dressed up like a big chief, and I'm afraid of you!'"

In the evening the men gathered again to talk by flickering lamp light while they drank large quantities of yucca beer. One man would take the lead; the rest would repeat to each other what he had said. The staccato hubbub sounded like a bunch of small boys-bragging in a school yard.

One of the men, Papyo, watched me putting anti-mosquito dope on my arms. "If I put that on and wore shoes, I'd have white skin like yours," he joked in the Candoshi tongue.

That night we lay under mosquito nets on the elevated floor of Tariri's house. I listened for the jungle night noises—the expected hoots and grunts and howls. But I heard nothing except the quarreling yap of the dogs and the chirp of crickets.

Next morning, as I climbed into the dugout to return to our plane, Tariri handed me a blowgun to take home with me, and earnestly gave me a last piece of advice:

"Be sure to keep cotton in the ends so wasps don't get in and build their nests!"

Tribute Penned With Condor's Quill

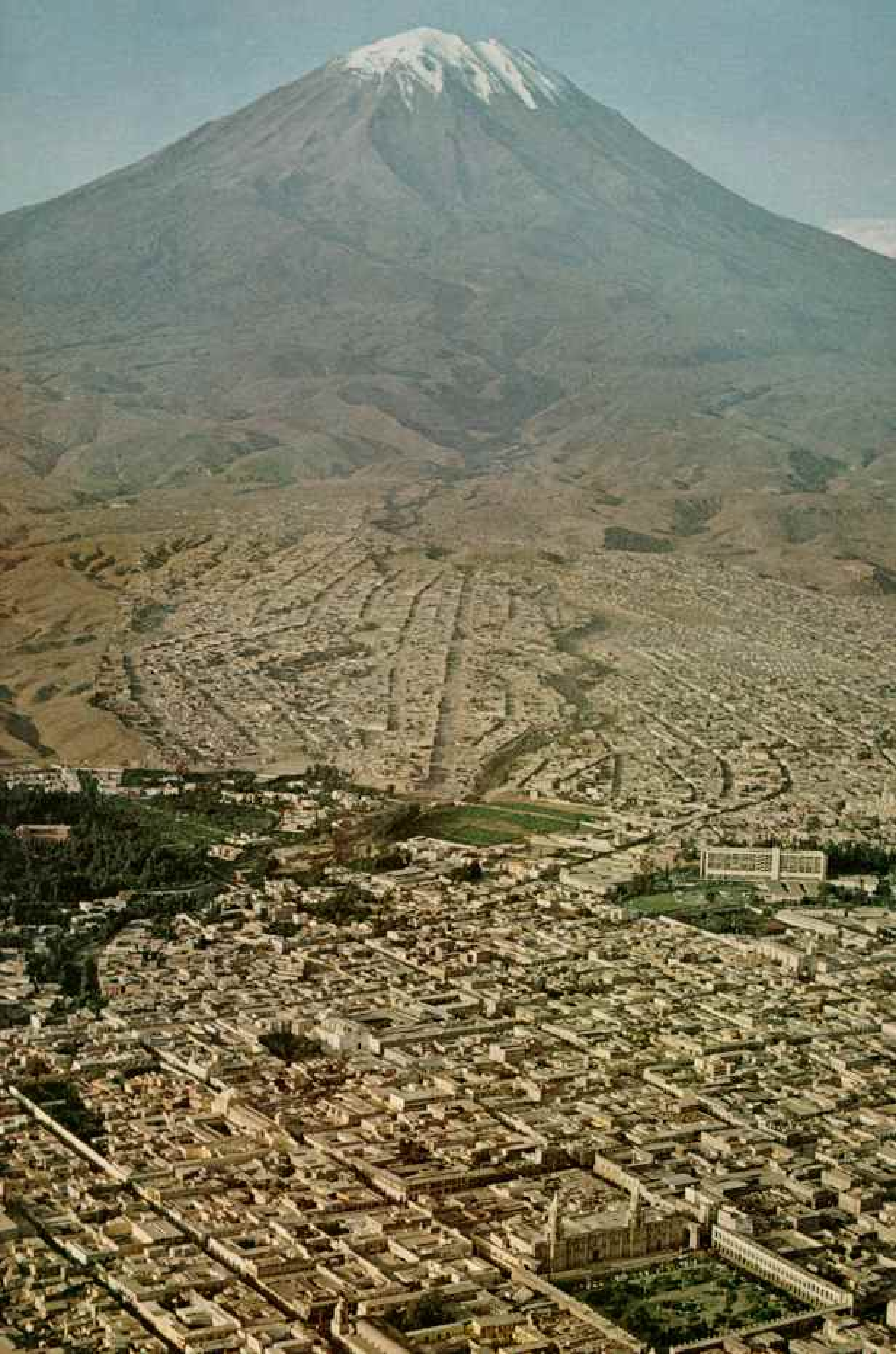
Back in Lima, I sat down one evening to read the chronicle of one of the conquistadors, Pedro de Cieza de León. Writing with a condor's quill, he described his adventures in "that great kingdom of Peru."

He apparently felt a measure of awe at the task, for he wrote: "... who could recount the great and diverse things to be found in it, the lofty mountains, the deep valleys . . . the many and great rivers . . . the variety of provinces, so different in nature; the nations and peoples, each with their own strange customs, rites, and ceremonies, the many birds and animals, trees and fish . . . ?"

I am using a typewriter instead of a condor's quill, and my visit to Peru has come more than four centuries after Cieza de León's, but I find that my reactions are much as were his. With her worlds of mountain and jungle, desert and sea, and with Lima, her incomparable capital, Peru offers in a limited space an astounding variety hard to match anywhere in the world. THE END

Arequipa, White Mosaic Below El Misti's Snow Cone, Dwells in Eternal Spring

Commercial and agricultural hub of southern Peru, the city takes its gleam from volcanic building stone. Daytime temperatures hover in the 60's the year round. Twin towers of the cathedral, completed in 1847, face the Plaza de Armas at lower right.





EXPLORING (ABOVE) BY RICHARD S. JOERNS AND PARACHUTING BY PETER R. GIMBEL © N.G.S.

Daring para-explorers challenge one of earth's last "blank spots"—the high, virtually unknown world of Peru's Cordillera Vilcabamba. G. Brooks Baekeland, Peter R. Gimbel, Jack Joerns, and Peter A. Lake, members of a National Geographic Society–New York Zoological Society party who parachuted into this region, depended on supplies dropped from two Helio Couriers.

Working the steering lines of a special high-altitude parachute, slotted to slow its descent, Joerns practices for his jump into the rugged Vilcabamba.

Northwestern South America Opens New Frontiers

LATIN AMERICA is the fastest growing region in the world, President John F. Kennedy declared in one of his last speeches before an assassin took his life. "Its almost 200 million people will be 400 million by the 1980's," he said in an address stressing the importance of the Alliance for Progress.

This month, a timely portrait of a large part of that swiftly growing region comes to the National Geographic Society's 3,900,000 members—a record increase of 400,000 over last year—as a supplement to their magazine. The area of this up-to-the-minute 11-color map of **Northwestern South America** equals that of the United States. On a generous scale of 105 miles to the inch, it completes the Society's Atlas Series of South America.*

El Dorado Still Beckons

Only 40 years after Columbus reached the New World, armor-clad conquistadors from Spain—lured by tales of gold—were ransacking the land of the Incas in western South America. This was, indeed, one of the first parts of the New World to be explored.

Since then a new El Dorado—of rubber and timber, coffee and oil, copper, tin, and iron—has beckoned. Amazing it is, then, to see how much of the great Andean barrier, and of the untracked, tree-matted jungle beyond it, is only now being explored and mapped.

In Peru, scarcely 250 miles east of Lima, lies an area of the lofty Cordillera Vilcabamba so rugged and inaccessible that it is all but unknown. The map shows no town, no airfield, no road in thousands of square miles of wilderness.

But this high lost world, with peaks above 13,000 feet, now has been breached. In 1963 four members of a National Geographic Society—New York Zoological Society expedition parachuted into the Vilcabamba 15 miles northeast of Luisiana, a frontier farm. Making the first known traverse of the unexplored region, the men struggled for nearly three months to cover 200 miles—on foot, by raft, and by canoe—before they regained civilization at a remote mission station on the Uribamba River.

All along the tropical hump of South America, other frontiers are opening. West

of the Cordillera Vilcabamba, for instance, the map now shows the Mantaro River making an enormous S-curve before entering the Apurimac. These loops drop the river a staggering 6,500 feet, offering a hydroelectric potential of 3,000,000 kilowatts, five times as much as all Peru produces today.

The Mantaro's double curve was drawn even after the map had gone to the printer. Vital new information of this sort comes steadily from the work of such organizations as the Inter-American Geodetic Survey, a postwar U.S.—Latin American effort to survey all South and Central America.

Though airplanes rather than roads serve the area's vast jungle heart, a few lines in red tell of the wheel's ever-growing invasion.

Look at the map's lower right edge, where a red line from Brazil's Cuiabá roughly parallels the Bolivian border northwest to Rio Branco and beyond. Peruvian explorers are seeking a route to connect this new road to their highway system at Pucallpa. Completed, it will link Lima and Rio de Janeiro, 2,350 miles apart at South America's waist.

Names Recall Moments of History

For the history-minded, the map's very names are fraught with meaning: seven Bolívars, plus Bolivia itself, and four San Martins honor the generals who freed the west coast of South America from Spain. Brazil's far-west jungle town of Santos Dumont is named for the national hero who, in 1906, made Europe's first airplane flight.

The visitor to the continent's northwest finds a tremendous contrast between such shining capitals as Caracas, Bogotá, and Lima (spotlighted with insets) and primitive wilderness. This is a region of superlatives: the world's longest mountain chain, the Andes, with snow peaks soaring above 20,000 feet; the headwaters of the world's greatest river system, the Amazon, meandering through the largest of rain forests; the world's highest waterfall, Venezuela's 3,212-foot Angel Falls.

*The companion maps, *Southern South America* and *Eastern South America*—and all other Atlas Series maps published as supplements to NATIONAL GEOGRAPHIC—are obtainable from Society headquarters at 50 cents each and in yearly packets of seven at \$3.00 each, postage prepaid.

UNITED STATES



In mid-November the then Vice President of the United States checked the final proofs of this article describing his trip to Scandinavia and Iceland. Barely a week later Mr. Johnson succeeded President John Fitzgerald Kennedy, whose assassination shocked the world. **THE EDITOR.**

Friendly Flight to Northern Europe

By LYNDON B. JOHNSON

Photographs by VOLKMAR WENTZEL

National Geographic Foreign Staff

ES OF AMERICA



BY ESTHER HINE © NATIONAL GEOGRAPHIC SOCIETY

During a five-nation tour as Vice President, Mr. Johnson greets Finns at Rovaniemi, in Lapland.

THE WORLD'S HIGHEST known clouds sweep across the Arctic. Their altitude is astonishing—50 miles above the earth's surface—and on late summer nights they glow.

Until recently, scientists knew little about these "noctilucent" clouds (page 275). Then Sweden and the United States collaborated on a joint project. U. S. rockets, fired from

northern Sweden, penetrated the clouds. Instead of water vapor, instruments installed in the nose cones trapped bits of meteor dust—particles so large that scientists decided they could not have been carried upward through the atmosphere. Swedes and Americans together had touched the highest clouds—and added to man's knowledge.

Last September, as Vice President, I flew

through these skies on a 15,000-mile tour of northern Europe. Part of my mission was to encourage space projects of this sort. Broadly, I hoped to encourage fruitful collaboration in other fields: mutually profitable trade, the defense of freedom, and the pursuit of peace. I would meet the free and creative people of five nations: two unaligned friends—Sweden and Finland—and three NATO allies—Norway, Denmark, and Iceland.

"No President or Vice President has ever made an official visit to these countries," President Kennedy had pointed out when he asked me to undertake this mission. To both of us, the visit seemed overdue.

These five countries all own land in the strategic Arctic Zone—a distinction shared only with the United States, Canada, and the Soviet Union. And two have common borders with the U.S.S.R. With their shipping fleets, world trade, and high levels of technology, these countries have an importance out of all proportion to their combined population of 21 million.

What I would like to tell you about this trip is neither a diplomatic memorandum nor a geographer's survey. Instead, these are a few personal impressions gathered by an American family. In each country, my wife Lady Bird followed her own keen interests,



seeing farms and exhibits of new home furnishings. Our 16-year-old daughter Lucy Baines stayed home, but 19-year-old Lynda Bird, a sophomore at the University of Texas, came along and met student groups.

Our visit began when our Boeing 707 jet landed at Stockholm's Arlanda Airport in Sweden. After the formal ceremonies of welcome, I asked my wife about her first impressions of Sweden. She summed them up in three words: "Forests, water, and blonds."

A good start. Trees account for much of Sweden's prosperity. Rivers generate electricity, and fine harbors enhance Swedish commerce. And the largely fair-haired Swedes—

more than 7½ million of them—are the skillful developers of these natural resources in this peaceful and democratic kingdom.

The nation's map explains something about the outlook and history of the Swedes: While Danish and Norwegian Vikings looked west toward the wide seas, the Swedes faced a narrow Baltic. Thus their quests lay east and south—and landward. From the ninth to eleventh centuries, Swedish Vikings roamed inland all the way to the Black Sea. And in the 17th century, when Swedish King Gustavus Adolphus invaded Russia and Germany, he frightened Europe with his great land armies rather than with his fleet.



Mosaic splendor of Stockholm's Town Hall surrounds banqueters at a state dinner honoring the distinguished visitor, Sweden and the United States, Mr. Johnson declared here, "stand together in championing the highest goals and greatest values of

SWEDEN

Premier Tage Erlander and a host of other Swedish officials share the speakers' gleaming table (right). On the far wall, the enthroned Queen of Lake Mälaren, symbol of Stockholm, receives homage from nations of the East and West. Nobel Prize winners are acclaimed in this great Golden Hall.

American-born wife of a Swedish businessman, Betty Throne-Holst applauds Mr. Johnson.





**"City Between the Bridges" Lies
at the Heart of Old Stockholm**

Seven centuries ago ruler Birger Jarl raised an island fortress here. Now home to more than a million people, Stockholm spreads across a bridged archipelago. Square tower of the Town Hall (left) rises above Lake Mälaren. Shops, residences, and government offices line the shore. Swedes sun on a terrace overlooking a circular building that houses the harbor authority. Though rain chilled the city, Mr. Johnson received an enthusiastic welcome.

"I haven't clasped one cold hand," he said.

National fortunes turned, but the viewpoint endured. Now, after 150 years of peace, the Swedish affection for the land seems as strong as ever. Swedes are great shipbuilders, for example, ranking fourth, after Japan, Great Britain, and West Germany. "But we are just as ready to sell ships as sail them," one young man told me.

There is much in Sweden to persuade people to stay home. On our helicopter flight into the capital, we could see hay fields gilded by the September sun and well-kept red barns



COURTESY OF NATIONAL GEOGRAPHIC PHOTOGRAPHY WILFELD PARK © N.G.S.

brimming with early harvest. Electrically powered factories stood neat and smokeless. And directly beneath us, the famous motorways were busy with traffic, keeping left in the British manner and traveling at speeds of perhaps 80 miles an hour.

Stockholm today is one of the world's most beautiful cities. In this "northern Venice," stately buildings cast their reflections in the Baltic; the waterfront is remarkably clean.

"It has not always been this way," Prime Minister Tage Erlander told Mrs. Johnson.

"A century ago, Stockholm was one of the dirtiest cities in Europe."

One afternoon my wife and daughter went shopping. Lynda Bird, who plans a wedding in 1964, returned to the hotel with some souvenirs—and great enthusiasm for Sweden's furniture, ceramics, and glass. From the same tour of Stockholm, Mrs. Johnson brought back a new use for an old word: *friendly*.

"If a chair supports your back nicely, Swedes call it a *friendly* chair," she reported. I like that expression: Swedish friendliness



Stockholm's Town Hall, towering 350 feet above Lake Mälaren, looms through a bridge railing.

World's Highest Clouds Billow Fifty Miles Above Stockholm

For centuries silvery blue clouds aglow in the night sky caused wonder among inhabitants of high latitudes. Scientists could only guess their composition. In 1962 U. S. and Swedish scientists fired rockets that trapped microscopic particles of such a cloud above Sweden. They gathered evidence that the clouds are formed of meteor dust—some of it ice-coated. Mr. Johnson, sponsor of the Space Act of 1958 and later Chairman of the National Aeronautics and Space Council, encouraged such joint ventures on his tour.

Gift for a King: a National Geographic Society map case, with indexes. Mr. Johnson, using one of 25 rollout maps, points out his Texas ranch to Sweden's King Gustaf VI Adolf, a member of our Society for 25 years. Queen Louise and Mrs. Johnson admire the case in Sofiero Castle, Hålsingborg.

ENTRAGED BY SOLYMAN BENTZEL, GLENNY BIRD (FRID. HEDG), PHOTOS RESEARCHERS, INC. © N.A.S.





EXCLUSIONS BY SCENE WITH © NATIONAL GEOGRAPHIC SOCIETY

means something more than smiles—it means helpfulness, too.

We began one of our busiest days in Sweden with an early drive through birch-brightened forests to the Tullinge airport. There we saw an extraordinary demonstration by the Royal Swedish Air Force. Four Swedish delta-winged J-35 jet fighters swept out of underground hangars and into the sky. For 20 minutes they moved like a single machine, spilling their thunder over the forested countryside. Neutral Sweden owns not one strategic bomber, but experts evaluate its 1,000-jet air force as one of the world's four or five best. We saw why.

"Accident" Stems From Bad Translation

From Tullinge, we flew to Hälsingborg and Sofiero Castle, the private summer residence of Their Majesties King Gustaf VI Adolf and Queen Louise. For our visit, His Majesty graciously arranged an innovation. No helicopter had ever before landed on the hilltop grounds of Sofiero.

Our pilot was concerned. The day before, when we arrived in Sweden, an error in trans-

lation had resulted in news stories, cabled throughout the world, about an "accident" involving our helicopter. Reports said that a child had been felled by a "blow" from the helicopter blades. Fortunately, the blow referred to wind from the whirling rotors; actually, no one had been hurt.

Now as we noisily settled onto the castle grounds, the pilot took care not to blow too close to the flower beds, for he well knew that the King was an avid gardener. But as we landed, His Majesty allayed all fears. To greet us, he braved the gale of our prop-wash, then jovially brushed off grass clippings that had blown onto his clothes. The grounds, he said, were accustomed to rough-and-tumble.

"This is the place," he confided, "where I played soccer as a child."

For the chiefs of state in each nation I had brought an identical gift. During World War II, I recalled, the National Geographic Society had given President Franklin D. Roosevelt a special case equipped with its excellent maps of the world. The President found them so useful that he ordered a case as a Christmas gift for Prime Minister Churchill. Now



Helsinki's first ticker-tape parade welcomes the author. "I've never seen more friendly faces,"

I had National Geographic map cases for the rulers of each country (page 274).

The Swedish King was greatly pleased. "Marvelous maps," he said. "And I know them well." Then he turned to Queen Louise. "How long have I been a member of the National Geographic Society?" he asked.

"It must be 25 years," the Queen replied.

From Sofiero Castle, we flew across southern Sweden—where 80 percent of the population lives—to the southwestern Swedish port of Göteborg. Through broken clouds we saw rolling farms, meandering streams, and imposing industrial developments, including the Götayerken shipyards, where huge sea-

going vessels are actually assembled indoors on a giant conveyor belt. Some of the other industrial plants here represent part of the \$183-million investment U. S. businesses have made in Sweden.

Rain was peppering down on us when our helicopter landed in Göteborg. But since we come from a region where people often pray for rain, I am always glad to get wet. I was touched to see that despite the bad weather, thousands of citizens had turned out with umbrellas and rubber boots.

I am sure that any American could feel at home here in Sweden's busiest port. The ties are old and strong. It was under President



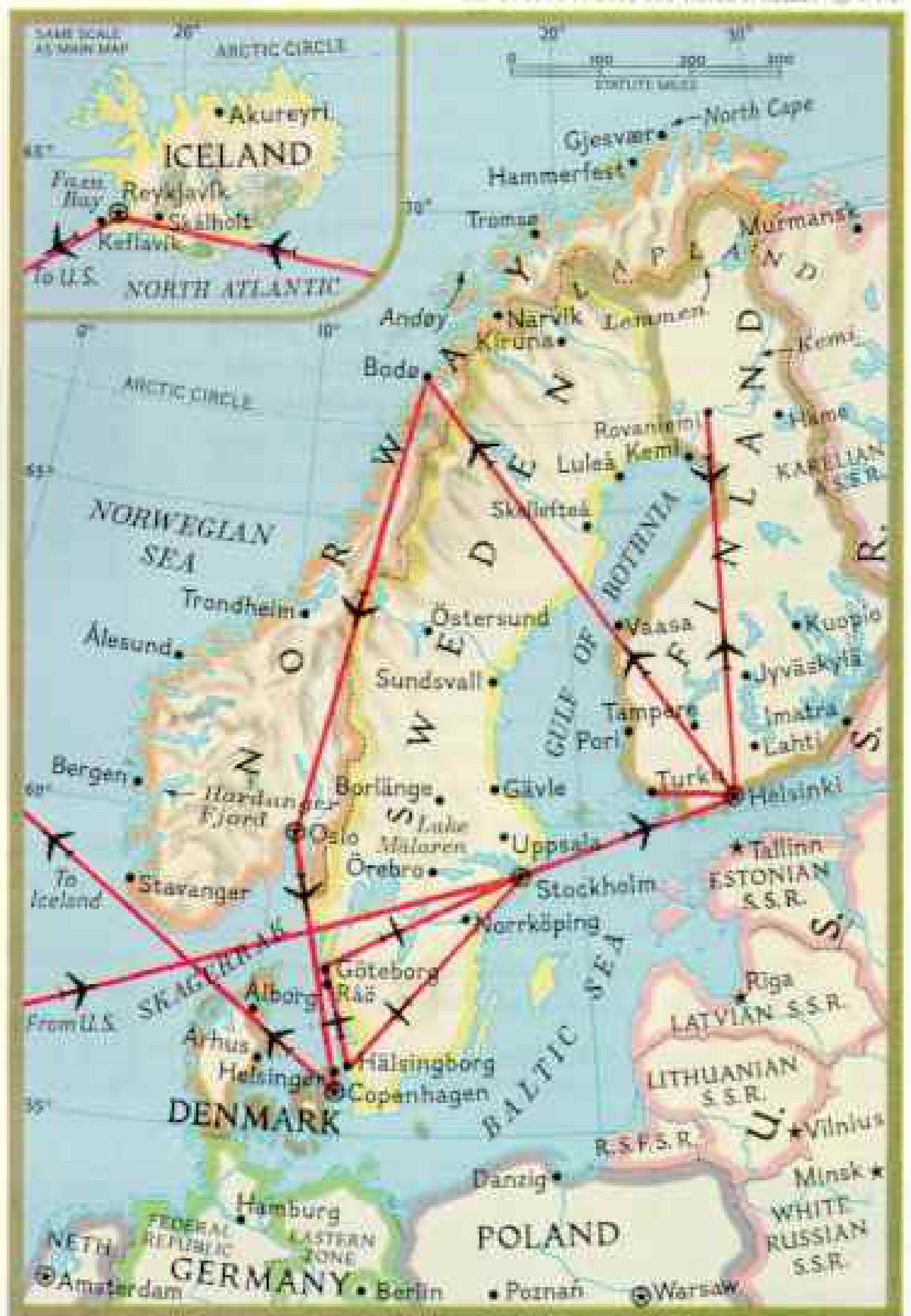
Mr. Johnson said of Finland.

Trails of the Boeing 707 jet used for the 15,000-mile tour crisscross northern Europe. Beginning with Stockholm, Mr. Johnson as Vice President visited the capital cities of five nations: Sweden, Finland, Norway, Denmark, and Iceland.

Cover girl Lady Bird Johnson graces *We Women*, a Finnish food and fashion magazine. A university student stops at a newsstand in Turku to scan the article featuring the visiting Americans.

FINLAND

Finland's highly literate population of four and a half million is served by 225 newspapers. Turku, once the nation's capital, is now its largest shipbuilding center.



HE EXTRACTED BY VOLKMAR WENTZEL © N.S.S.



George Washington that one of our first consular establishments was set up at Göteborg in 1797. And it was through this harbor that thousands of Swedish emigrants left their homeland for new lives in the United States.

I thanked the citizens of Göteborg for this great human legacy: Since they founded New Sweden three and a quarter centuries ago in Delaware, 1.2 million Swedes have settled in the United States. Some brought the material for building towns like Christinahamn, now known as Wilmington. Others brought only their own skills and their character, and they enriched the United States from the Great Lakes to the Rio Grande.

Göteborg No Longer Exports People

In the past century, though, Göteborg has stopped exporting people. Drive past the city's docks—they resemble Seattle's—and you see some of the opportunities that keep Swedes at home.* Sweden is the second largest exporter of iron ore, next to France. The nation's steel production in recent years has grown faster than that of the U.S.S.R. or the European Coal and Steel Community; by next year, production may hit 4.5 million tons. And nearly a fourth of Sweden's steel is of

278 *See "Sweden, Quiet Workshop of the World," by Andrew H. Brown in the April, 1963, *GEOGRAPHIC*.



Father and daughter wait to see the Johnson party at Rovaniemi in Finnish Lapland.

Supplies bundled in deerskin tents ride the sleds of Lapp herders who follow reindeer to summer pastures. Lapland knows no fixed boundaries; it extends across Arctic Sweden, Norway, and Finland into Russia.

REINDEER HERDS BY FREDERICK BELZON; LEVISOUP, ONE OF SEVERAL BY GILBERT BENZEL, U.S.A.C.





Antlers of a reindeer in a Lapp's Arctic stockade win the Johnsons' admiration.

the highest quality—the kind used in the finest cutlery and razor blades.

I had another interest in the Göteborg area. About 25 miles south of here, at the village of Råö on the Onsala peninsula, the Swedes had agreed to locate a large antenna to keep in touch with communications satellites. Jointly financed by Sweden, Norway, and Denmark and with the technical cooperation of the United States, work could begin as soon as the Norwegians and Danes signed the agreement. Since I would be discussing this subject later, I took note of the location, only 52 miles from the Danish coast and 100 miles from Norway—easy distances for the cooperating scientists of the three countries.

With its industrial revolution, Sweden has assumed an increasing share of world responsibility. Swedes contribute money to less industrialized countries; they send their

sons, in U. N. forces, to the Congo and other trouble spots; they produce peacemakers like Count Folke Bernadotte and Dag Hammarskjöld. And to this record they can add their own example of what a free nation can do to lift itself from poverty to plenty.

Finland Stands Where West Begins

To the airborne visitor, Finland presents a rugged face. What the country lacks in mountains, it makes up with harsh rocks, towering trees (forests cover more than two-thirds of Finland), and innumerable lakes. "We have given names to more than 55,000 lakes," a Finnish lady told us. "Those without names we don't even count."

Helsinki impressed us instantly as a modern, vivacious city. Newcomers have swelled the population to 464,000; ringing the city are new buildings of unusual and attractive



Striped Market Hall and Public Buildings Ring South Harbor, Helsinki's Front Door

Ships bringing high-ranking visitors to Finland usually berth at South Harbor. Mr. Johnson upheld the tradition by motoring to the waterfront,

architecture. With its busy stores and streets, Helsinki seems an apt capital for a republic established only in 1917.

If political independence is young, the culture is old. Dynamic President Urho Kekkonen points out that once Finland lay on a line separating the northern outposts of Byzantium and Rome. Thus for a long time Finns have lived on the difficult spot in northern Europe where the West begins.

Descended from Finno-Ugrian tribes (like the Estonians and Hungarians), the Finns were pushed west from the Volga River about the time of Christ. From the 12th to the 20th centuries, they were ruled first by Sweden and then by Russia. But through all their centuries of occupation and war, they preserved their Finnish language, and no one ever made Finnish farmers into serfs.

As I looked at the hundreds of faces greeting us along the streets of Helsinki, I recalled the newspaper headlines of my own young manhood: "Finland Alone Pays War Debts." In 1939 the courageous Finns stood alone again to face invading Russian tanks. Against those tanks they hurled a homemade weapon—a bottle of flaming gasoline known as a "Molotov cocktail."

"Flying Finn" Now Owns a Store

One morning we prowled through vegetable and fish stalls alongside the Helsinki docks, talking to salespeople and shoppers. At one kiosk we drank coffee and ate a *pulla*, a Finnish pastry; the friendly proprietor told us about a relative in New York. We sampled *puolukka*, tasty red lingonberries, and examined a wiggling *rapu*—the Finnish deli-



62 ESTABLISHED © NATIONAL GEOGRAPHIC SOCIETY

though he arrived in the capital by jet. Here he emerges from the Market Hall amid a knot of people. White-columned Presidential Palace, where

cacy that we know as crawfish at home.

Suddenly, out of the crowd stepped a muscular fellow with a familiar face. Unexpectedly, I had met Paavo Nurmi, the great long-distance runner of 40 years ago; the "Flying Finn" was shopping here too. In 1923, a generation before the 4-minute mile, Nurmi ran a mile in 4:10.4, a record that stood until 1931. Today he owns a men's clothing store in Helsinki.

Later in the day, when we passed the docks again, I noticed that other Finns can ring up records for speed. Every sign and scrap of the market had vanished. As our guide explained, "The whole market can be closed and scrubbed down in half an hour."

One-fourth of Finland lies above the Arctic Circle, so we flew north to see a bit of Lapland. Crisp, clear weather permitted us

chief executive Urho Kekkonen received the then Vice President, overlooks the harbor beneath a round advertising sign just left of center.

to look down on rivers clogged with floating logs. Timber is the great industry of this region; the wood beneath us would soon be crushed into newsprint for readers in Helsinki, Paris—or New York.

Northland Resembles Minnesota

Our 707 landed at Rovaniemi (page 268), the first big jet ever to put down in this chief city of Lapland. My Minnesota-raised friend and assistant George Reedy announced, "This looks just like the land around Hibbing." Perhaps he had explained why so many of our half million American-Finns settled around the Great Lakes. But the similarity to Minnesota vanished when we got to town. Rovaniemi has a look all its own.

"We had to rebuild our city after World War II," a Finn explained at a luncheon giv-



Evidence of a shrinking world confronts Lyndon B. Johnson at an Arctic airport in Norway. From Bodo, northernmost point of the tour, a jet could speed him to his LBJ ranch in little more than half a day. School children press about the visitor. An official of the United States Information Service arranged the surprise greeting.

Youngsters shout "Welcome!" outside Bodo's Grand Hotel.



en by city leaders. "Rovaniemi was completely destroyed by the retreating Germans. Only last week we found a buried German grenade."

Starting from the ashes of the old town, architect Alvar Aalto drew up an imaginative city plan: Streets branch off a main stem in the deliberate pattern of a reindeer antler. Homes and buildings are handsomely modern and painted in strong colors.

Our luncheon menu that day included other local color. We had salmon from the chill rivers of Lapland, a roast of young reindeer, and delicious yellow cloudberries gathered wild on the tundra farther north.

That afternoon we drove five miles to a lodge that sits squarely on the Arctic Circle. Here we met some fellow visitors, a Lapp family named Aikio who came from the far-northern Lemmen River area. Finnish Lapps today number fewer than 3,000 people; they rarely venture as far south as the Arctic Circle.* The Aikios had not yet seen Rovaniemi, but they had just been to the airport to look at our jet—"the biggest thing I have ever seen," Mr. Aikio called it.

We reciprocated by inspecting his family's transportation, several sturdy reindeer. Even though Mr. Aikio's livestock looked unlike ours in the U. S. West, his lassoing skill showed a familiar style. Twirling a short rope, he neatly looped it over a deer's head.

As a *Teksasilainen*—Finnish for Texan—I encountered many a refer-

*Jean and Franc Shor told of Finland's Lapps in the August, 1954, NATIONAL GEOGRAPHIC.

Bowsprit of *Fram*, which bore Norwegian explorers toward both Poles, juts above visitors led by Mrs. Johnson and her daughter. During Fridtjof Nansen's polar exploration, 1893-96, *Fram* ventured farther north than any other ship had voyaged. Allowed to freeze fast in pack ice, the craft drifted with crushing floes throughout most of the expedition. In 1910-11 the little vessel carried Roald Amundsen to the Antarctic for his successful assault on the South Pole. Now the ship rides at anchor in its own museum at Bygdøy, near Oslo. Nansen's portrait looks down on stuffed musk ox (foreground), Greenland sled dog, and polar bear.



ence to the U. S. West everywhere we went in Finland. I took a special interest in some remarks by President Kekkonen at our dinner in Helsinki.

"Our national epic '*Kalevala*,'" he said, "tells of a bull with horns a hundred fathoms long and a muzzle half a hundred broad. While switching his tail in southwest Finland, he stooped his head into the Kemi River." The epic animal would have been more than 300 miles long—and that, even a Teksasilainen must concede, is quite a lot of bull.

We spent one sunny day in Turku, until 1812 the capital of Swedish Finland. There is a local saying that "Turku is older than Finland." And so it seems when one visits the nation's first cathedral, its oldest university, and the romantic turrets of its 13th-century castle. But I preferred the description given us by Turku's mayor.

"Ours is a happy city," he said, "still small enough that we know our neighbors."

We met many of those 126,000 neighbors in the city and others beyond it. Among them was Mrs. Irja Puusa, a farmwoman who had lived in the Karelian section of Finland. When Karelia was ceded to Soviet Russia during

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World War II, Mrs. Puusa and her family

had been resettled—like most of the 425,000 other displaced Finns—in this great orchard and truck-farm area beside the Baltic.

In the ceded areas, almost no Finns elected to live under the U.S.S.R. To share in the common costs of freedom, every citizen of Finland was subject to special income and head taxes to pay for resettlement and war reparations imposed by the U.S.S.R.

Today the Puusas' barn door is decorated with medals won for clean milk. They have a sauna, as the Finns call their distinctive steam baths. And, most important, they live on free Finnish soil.

Curiously, just a mile or two from the Puusas' farm, we learned that geology is balancing some historical wrongs. A Finn pointed to a deep meadow that stretched away toward the Baltic shore.

"Old women here can recall when all this was sea," he said. "But the land is rising—about one foot in 50 years. Where the Baltic is shallow, we gain much land."

Thus, though the U.S.S.R. took 12 percent of Finland's prewar territories, Finland still rises—and grows.

The high point of our stay in Finland was the opening of the "American Days" cele-

Mirror-smooth Hardanger Fjord Probes Inland 115 Miles on Norway's West Coast

Ice Age glaciers shaped the spectacular fjords that carry Gulf Stream waters deep into Norway's mountains. From these shores Viking longships



bration, sponsored by the Finnish-American Society, in the capital. "American Days" included everything from exhibits of U. S. books to dances for teenagers. For it, Helsinki broke all precedent and offered us the first ticker-tape parade in the city's history. Our motorcade stretched only a few blocks—yet some 12,000 Finns lined the route, tossing colored streamers, cheering, and showing their warm regard for America. Finns reported that it was the largest welcome anyone could remember in Helsinki (page 276).

I was supposed to make a few remarks, then cut a ribbon to open the celebration. But as the enthusiastic crowd pressed close, I found part of my job done for me; the ceremonial ribbon snapped in the excitement. As good friends, we had all cut it together.

North to Arctic Norway

We entered Norway by a northerly door, flying to the northernmost point in our whole journey, the port of Bodø (map, page 277). Landing at the Arctic airfield there, we got a dramatic view: rainclouds dark as blue northers—as we call our winter storms in Texas—were escaping over the sawtoothed granite peaks that guard some of the world's

sailed to Iceland, Greenland, and North America. In 1963 came proof that Norsemen found the New World 500 years before Columbus. Norwegian

best codfishing waters on the Norwegian Sea.

The town was bustling with construction. Industrious citizens, many of them fishermen, had just celebrated the completion of a railroad linking them with the cities of the south. Bodø, rebuilt from the fires of World War II, was solid and new.

In one new housing project, I met barber Bjarne Skagen and his wife Gunvor.

"A few years ago," he told me, "I took my wife to live in Corpus Christi, Texas." Small world: That was the city to which I had taken my own bride for our first home.

But for Norwegians, the world has always been small. Since Viking days, they have roamed the seas. And today Norway's merchant marine ranks as the world's third largest after the United States and Britain.

"Per capita, our merchant marine is the largest of these three," Norwegians told us proudly. So it is, since the country has more than three tons of shipping-weight for each resident. Their ships make nearly 10,000 calls each year in American ports.

Flying south to Oslo, we saw some of the fjords that Norwegian sailors call home.* The

*See "Norway's Fjords Pit Men Against Mountains," by Andrew H. Brown, *GEOGRAPHIC*, January, 1957.



scenery was striking—as memorable as any we have seen in the world. Fittingly, Oslo itself is located on a magnificent fjord.

Mrs. Johnson and Lynda Bird maintained the seafaring theme during our first morning in the Norwegian capital. They took a harbor launch to Bygdøy to visit the famous exhibit of 1,000-year-old Viking ships.

Out of all the Viking fleets that plied the seas of history, only a few ships have been found and preserved. Mrs. Johnson saw three that were excavated during the past century. They have now been housed in a "spare, strong building like a church," as she described the museum. These were burial ships, dragged ashore as funeral barques for important Vikings, and covered with great hills of preservative mosses, clay, and stone.

The three ships have told the world more about Viking seamanship than any other finds. And since the burial ships were supplied for a voyage to eternity, the cargo reveals much about the daily life of these strong people. The ladies saw Viking armor, bridles, cooking pots, beds, clothes, and sleighs.

In another building not far from the Viking ships, Mrs. Johnson and Lynda Bird saw two other historic craft. One was the

ship, taking an active part in the peaceful movement to win Norwegian independence from Sweden in 1905. But his ship *Fram* led other explorers forward. In 1910 Nansen's fellow Norwegian, Roald Amundsen, sailed the ship to Antarctica on man's first conquest of the South Pole.

Norway is still headed *fram*. When His Majesty King Olav V entertained us at lunch, he said, "You will find that the quality of our people makes up for our lack of quantity."

Space was the subject I discussed most often in Norway. It was the theme of my address at the University of Oslo, and it drew a tremendous crowd. King Olav did us the honor of attending the meeting.

I described the impact that space research was already having on the United States, how 5,000 new companies are today making 3,000 products unknown even five years ago. We are entering a second Industrial Revolution. Bulky natural resources and vast populations matter far less than inventiveness and skill. Thus 3.7 million Norwegians can have an exciting role in space exploration.

The very evening that I spoke, scientists at Andøy, in the Norwegian Arctic, were celebrating a vitally important space probe made



ADDACRONIES BY WILBERT W. GROVEKOR, NATIONAL GEOGRAPHIC STAFF © N.G.S.

Founder of Copenhagen, warrior-bishop Absalon rides a bronze charger above flower sellers' stalls in **DENMARK** Højbro Plads

(opposite). In 1167 the bishop built a fortress where the Danish capital now stands and cleared the Baltic of pirates.

St. Nicholas Church, now a naval museum, towers beyond business houses that fence Højbro Plads. Pleasure boats on Holmens Kanal carry sightseers past the center of Old Copenhagen.

raft *Kon-Tiki*, famous for the trans-Pacific voyage of Thor Heyerdahl. The other was the *Fram*.

Perhaps no ship in history was better named than the *Fram*; in Norwegian, the word means forward. It was designed to withstand the crushing force of ice. Though skeptics predicted failure, the *Fram* proved Fridtjof Nansen right when he took the ship and a 12-man crew into the Arctic seas in 1893-96 and came closer than any predecessor to the North Pole.

Nansen turned his attentions to statesman-

earlier the same day. They had launched a U. S.-made Nike-Apache rocket. Its nose-cone contained radio receivers from Denmark, Norwegian instruments to measure energy particles, and ionospheric monitors furnished by NASA. The cost in time and money had been borne by the three countries.

That evening no one could be sure just how successful the probe had been—and the results are still being analyzed. But we already know that the timing was fortunate. This study of the ionosphere coincided with an eruption on the sun's surface, causing what





Intricate beadwork brightens sealskin costumes of Miss Lynda Bird Johnson (second from left) and serenading Greenlanders at Copenhagen's Royal Hotel. Billed as the Mik Eskimo Dancers, the group from Denmark's island province entertains while attending Danish schools. Taller than most Eskimo girls, Miss Johnson had to squeeze into her costume, a gift from the Greenland Affairs Minister.

Lights by the thousands blossom at Tivoli, 120-year-old amusement park in the center of Copenhagen. Pagoda and minarets of two restaurants, the Chinese Tower and the Nimb, flank the high-columned Concert Hall. Mr. Johnson enjoyed this view from a window of his suite in the Royal Hotel.

scientists call a "polar cap absorption event." To them this meant that our ionosphere was absorbing radio waves rather than reflecting them back to earth.

Our jointly launched rocket from Andøy had soared through a shower of energy particles—probably protons—from the sun. Instruments had measured and sampled this rainstorm of energy. When all the information has been sifted, this basic research may help us solve many problems—ranging from improving the picture on your television screen to ensuring the safety of future astronauts.

The Norwegians had worked with the United States on seven previous launchings, the Danes on three of them. The Swedes had joined us in six such shots.

Since Sweden, Norway, and Denmark had agreed to build and maintain a great antenna near Göteborg, Scandinavian scientists could keep a sharp eye and ear tuned to our communications satellites. It came as no surprise that while I was in Oslo the Norwegian Foreign Minister signed this agreement for his country. And a few days later in Copenhagen, a similar formality brought our four-power agreement into effect. Today, near Göteborg, construction is well along on the 84-foot antenna; the dish will be sweeping the skies this spring.

The Norwegian dramatist Henrik Ibsen once wrote, "I hold that man is in the right who is most closely in league with the future." That agreement brings all of us one more step along the path.

Denmark Spreads Flat and Low

The flight from Oslo to Copenhagen took only an hour, but the geography changed sharply. Steep Norwegian fjords fell away into the Skagerrak, and when Denmark emerged, we saw flat islands—hundreds of them—checkered with farms. The highest point in European Denmark is only 564 feet.



Driving into the city from the handsome Copenhagen airport, we noticed the smokestacks of a large power plant. Lacking convenient waterfalls, the capital supplements its electricity by a five-mile undersea cable from Sweden. This flow is reversed, however, when Sweden cannot meet her home demands.

Greater Copenhagen, with its 1.2 million people, has other kinds of energy. The streets and bridges swarm with shoppers, sightseers, and well-dressed people riding bicycles. Our skyscraper hotel looked down upon the Tivoli amusement park and beyond it, to the towers and canals that inspired the song about "wonderful, wonderful Copenhagen." *

The 300-year-old canals today serve only as reflecting ponds. But other waterways are busy with small-boat commerce.

Mrs. Johnson could not resist exploring the canals, so one morning she took a tour by excursion boat. She started at the 800-year-old fish market, then passed the flag-decked Christianborg Palace and the twisted spire of the old stock exchange. She sailed into the harbor for a look at the gray dockside home of Hans Christian Andersen and the statue of his famous creation, the Little Mermaid, now a symbol of Copenhagen. She returned, ducking under bridges and dodging the houseboats where fisher families live.

"One of the nicest mornings of our trip," Mrs. Johnson called it.

Their Majesties King Frederik IX and Queen Ingrid asked us to luncheon one day

*Stuart F. Jones described Denmark's capital in the January, 1963, NATIONAL GEOGRAPHIC.

NO DETACHMENTS BY VOLKMAR WENTZEL, NATIONAL GEOGRAPHIC STAFF © R. S. L.



at Frederiksborg Castle, an 18th-century royal residence 15 miles northwest of the capital. King Frederik, as befits the monarch of a Viking land, is an accomplished sailor. His sparkling Queen reminded us of her father, King Gustaf VI Adolf of Sweden.

Over a luncheon table that blazed with red flowers, we found that, different as our families may be, we had something in common. They are also about to see a daughter married. Seventeen-year-old Princess Anne-Marie, the youngest of the three pretty Danish princesses, is betrothed to Prince Constantine of Greece.

Driving back to Copenhagen, we enjoyed the Danish countryside. The rural scenery has the beauty of a miniature, with low hills, neatly thatched houses, and small fields. An average farm is only 38 acres, and the soil is not naturally rich. But Danes make their land fertile by their own busy footsteps; farmers produce nearly half the country's exports.

This is a happy countryside. I found it hard to imagine that the original Prince Hamlet could have been so sad in his castle at nearby Helsingør.

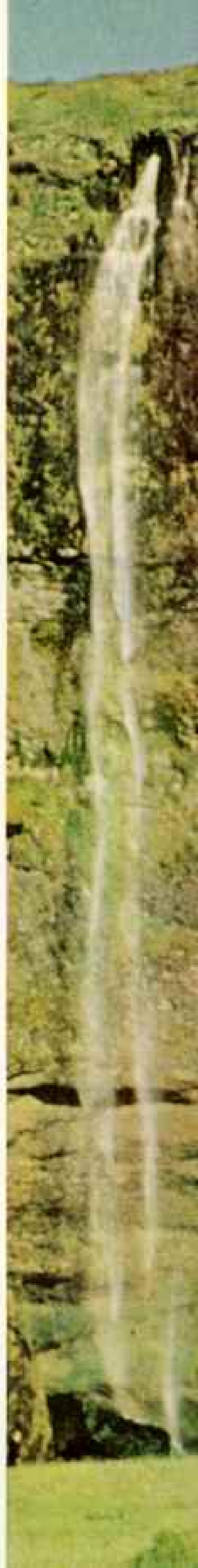
Our schedule for Iceland was condensed into one full day, a "cram course," as my daughter put it. All of us wanted to stay longer to meet more of the 186,000 Icelandic people and see more of their interesting land.

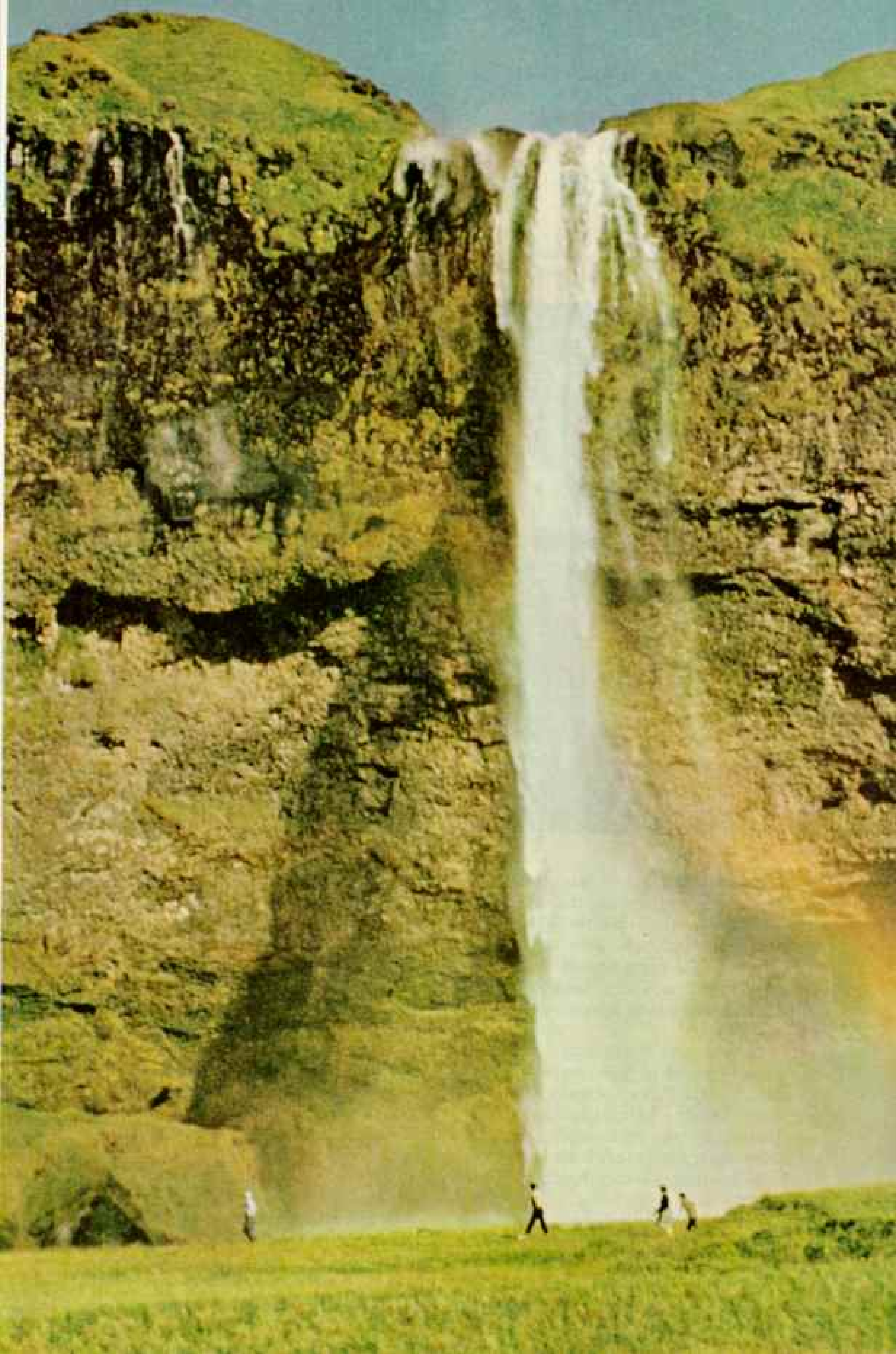
As we approached Keflavik International Airport—where an important NATO base is located—we saw Iceland's surprising summer color scheme:

Rainbow-brushed Seljalandsfoss leaps from the lip of an Icelandic cliff, 75 miles east of Reykjavik. Fed by glaciers, countless icy waterfalls cascade from volcanic mountains and high plateaus.

ICELAND Lofty ice fields cover 13 percent of the island's 40,000 square miles. Most of the people live in the coastal fringe and the wide valleys that spread meadowland far inland. Though its northern tip touches the Arctic Circle, Iceland enjoys a relatively gentle climate, a gift of the Gulf Stream.

Astride Viking horses, Icelanders ride past Skálholt village. Horses, introduced by Norse settlers in the ninth century, carried Iceland on their backs until motors came in. Riderless ponies are spares.





Smogless Reykjavik Rides a Headland Jutting into the Great Bay of Faxa

Subterranean volcanic fires stoke a huge natural furnace for Iceland's almost treeless capital. Piped into homes, the boiling springs provide smokeless warmth. Across an arm of the bay, flat-topped Mount Esja rises 2,982 feet.

The Johnsons deplane at Keflavik International Airport to visit Iceland, final stop on their tour.



black volcanic rocks and treeless green sheep pastures. Dark clouds spotted the sky, for the Gulf Stream that warms this rocky shore also brings a blustering rainy climate—but not as much ice as the name implies.

“Last winter,” a young Icelander complained, “we didn’t even have enough ice for skating.”

On our way into Reykjavik, the capital, we passed immense greenhouses. These “farms under glass” are naturally heated by hot water brought in insulated aqueducts from thermal springs. In the capital the same hot spring water heats many homes as well as handsome apartment houses that stand above the harbor.

In other ways, too, Icelanders make the most of their geography. Fishermen brave North Atlantic storms to bring in their catches of herring and cod. Whalers land 350 to 500 whales each year. (Lynda Bird, tasting one

small portion of this catch, compared whale blubber to “white jello.”)

All these lusty traditions, of course, are true to the island’s Viking past. Norsemen settled Iceland in the ninth century; their sagas are still part of the local culture.

In characteristic fashion, the people of Reykjavik showed me how they feel about our alliance. Outside the University hall where I spoke, a Communist group had assembled to protest Iceland’s NATO ties. About 200 party-liners were carrying signs that said, “We Want a Neutral Iceland” and “Against Foreign Encroachment.” The demonstrators were firmly planted along my path, but I felt nothing could be gained by evasion.

A large and overwhelmingly friendly crowd moved right along with me—straight through the Communists. There were a few scuffles, of course, but I had nothing to worry about with so many Vikings on my side.



REYKJAVIK (AROVE) BY THOMAS HILLYMAN, PHOTO RESEARCHERS, INC., AND HIS ENGRAVING BY VOLMAR BENTZEL © W. W. B.

Free institutions grow naturally in this volcanic soil. In the year 930, Norse chieftains assembled beside a dark cliff 35 miles from Reykjavik, and thus began the nation's parliamentary history. This venerable institution, the Althing, made Icelandic internal laws under the Danish crown.

Iceland Independent Since 1944

When independence came in 1944, the Althing remained the Republic's lawmaking body. From its elected members come the Cabinet and Prime Minister, as named by the President. The Althing proves that freedom needs dedicated men far more than it needs a luxurious climate.

"We are pleased with our neighborhood," said President Asgeir Asgeirsson in his address that day. "The North Atlantic is our common ocean. Along its coasts live the oldest . . . democratic nations. The North Atlantic

is today the Mediterranean of democracy. Our country is located near its center, and we understand what it involves."

Taking my leave of Iceland, I shook more friendly outstretched hands. The strong young men of these northern lands have firm, enthusiastic grips. After greeting hundreds of people each day, my well-practiced right hand had swelled painfully. I could truthfully tell the airport crowd, "We have felt the strength of our allies."

As we returned home through the northern sky, we could also feel a great satisfaction. We had learned much.

And this visit had given our friends a chance to express that friendship—in crowds far greater than we had expected, in public and private statements by government leaders, and in agreements that would improve this world and our knowledge of the space beyond it.

Our Only Native Stork, the Wood Ibis

Once common throughout the southeastern and Gulf states, this spectacular bird now fights a seesaw battle for survival against recurring drought and encroaching civilization.

By ROBERT PORTER ALLEN

Photographs by FREDERICK KENT TRUSLOW

ON WINGS THAT SPANNED a full five feet, the great birds flew in and out of the swamp, just clearing the treetops. Outward bound, they emerged with determined strokes from the gray cypresses, long necks and heavy bills pointing directly toward their goal—a shallow pond a few miles away. Returning, they headed for their bulky nests in the tree crowns 40 and 50 feet above us.

These were wood storks—better known as wood ibises—the only storks native to the United States.

Chest-deep in swamp water, Fred Truslow and I peered up at the impressive birds, admiring their easy flight and filled with a sense of wonder at their obvious dedication and purpose. It was late spring, and the young birds were almost grown here at Bear Island Rookery in the Big Cypress country of southern Florida. Every wood stork in the area, male and female alike, was working at the serious business of feeding its young.

Beside me Fred heaved a sigh.

"I can't take pictures of these storks from down here," he grumbled, shading his eyes with his hands as he peered skyward. "I've got to get up in the air somehow."

I knew he meant what he said, for the indomitable Fred and I had teamed up before—to study and photograph whooping

Flailing wings extended to their full five feet and skinny legs anticipating a rough landing, a wood ibis drops to its nest in the Florida Everglades. As the parent bird joins its two-month-old young, it reveals the delicate pink flush which appears beneath the wings at nesting time. Not an ibis at all but actually a stork, *Mycteria americana* wields a straighter, stouter bill than *Threskiornis aethiopica*, the sacred ibis of the Nile.







Atop an 18-foot tower in a swamp where cottonmouth moccasins and rattlers lurk, photographer Fred Truslow leaves his blind after a stifling 10-hour day of focusing on stork nests in a cypress.



Loafing the noontime away, wood ibises perch in dead mangroves, digesting a fish breakfast caught perhaps 15 miles from the rookery. Dark-



WOOD IBISES © NATIONAL GEOGRAPHIC SOCIETY

Graceful gliders in formation flicker black and white against a cloudless sky. Wingtip feathers spread like fingers. On warm days wood ibises rise almost out of sight, soaring on thermal updrafts; playfully they plunge downward, then rise again. Startled observers have watched birds turn over and glide short distances upside down.



er anhingas, or snakebirds (left), share the trees, which hurricane Donna killed in September, 1960. In December, after the storm, the birds nested as usual.

cranes in Texas and spoonbills in Florida and Texas. This time our objective was another endangered species, one of North America's largest waders.

A striking and conspicuous bird, the wood ibis (*Mycteria americana*) has a scaly, bare-skinned head, stiltlike legs, and brilliant white body plumage set off by greenish-black flight feathers. Its tail feathers are also black, with a purplish sheen; in fact, it is the only North American wader with a black tail. It has an average height of 3½ feet, a foot less than the whooping crane.

The 18th-century naturalist Mark Catesby called the bird a "wood pelican," and "wood ibis" has been the accepted book term for years, though it is really a stork, not an ibis.

Colloquial names—often highly descriptive—include ironhead, flinthead, gourdhead, preacher, and Spanish buzzard. Gannet, which is the correct name of an entirely different bird, is used in the Carolinas.

Storks' Decline Spurs Audubon Study

During the breeding season, usually November through April, the wood storks, as I prefer to call them, converge on certain swampy areas in Florida to lay their eggs and rear their young (map, following page). When the nesting season ends, the concentrations scatter throughout the southern states. Elsewhere these spectacular birds are found only in Mexico and Central and South America, but there are close relatives in Europe, Africa, and Asia.

Our wood storks have had a rough time in recent years. Once, in Florida alone, there were well over 100,000. By 1957 there were no more than 8,000 in the entire country. The wood stork's future looked bleak indeed.

Before that year was out, I had started studies of the species for the National Audubon Society—studies that we hoped would



Southern Florida Marshes Shelter Imperiled Wood Ibises

All U. S. rookeries now in use lie in Florida, and of these, only three are protected against bulldozer, ax, and ditcher. Elsewhere in the Americas, the birds live as far south as Peru and Argentina.

After the winter nesting season, storks spread along the Gulf Coast and the Carolinas. Other groups of undetermined origin wing into California and Arizona.

Fred's blind. Then Peter and another Audubon warden, Hank Bennett, helped us lug it into the swamp.

From our camp we carried the monster three quarters of a mile to the Bear Island Rookery—at times through water that reached our belts—and set it up facing a cypress that held four nests. The platform loomed 14 feet above water level (page 296).

Though the nests were still far above Fred's head, two weeks of work on the shaky tower gave him the nesting pictures we wanted. Since then he has photographed hundreds of other wood storks—from blinds, boats, and airplanes, as well as afoot, if "afoot" is the right term for standing knee-deep or worse in treacherous mud and water.

At the pond where these Bear Island birds were gathering food for their insatiable young, we watched the long-legged fishermen at work. They were so absorbed in catching fish—plus aquatic insects and an occasional small snake or frog—that they paid not the slightest attention to us.

Mickey Reveals an Enormous Appetite

A wood stork needs a lot of food—a fact I came to appreciate after an injured female was found floundering in the mud and water near the Bear Island colony. My family and I fed her for a year and a half before turning her over to a zoo.

We housed her in an unused chicken pen, and named her Mickey—short for *Mycteria*, the generic name. Greek for "snout," it refers to the bird's unique bill—thick and heavy at the base, tapering to a decurved tip.

At first Mickey was so weak and frightened that we had to resort to force feeding. But after a few days of quiet care she began to display an enormous appetite that kept the entire family busy.

In fact, I soon discovered that Mickey's

give us the knowledge to help safeguard this threatened bird. Good photographs would be a valuable part of such a study.

Back at camp, Fred and I talked things over with Peter Isleib, the Audubon warden guarding the rookery. Plainly, the only possible way to photograph these birds was from a tower. But how were we to build one without disturbing them—possibly even causing them to abandon their nests?

"We will have to make the tower here," Fred said, "then *carry* it into the swamp."

And that is just what we did. With lumber and nails from the nearby town of Immokalee we whacked together an 18-foot tower with a three-foot-square platform on top for

The Author: This was one of the last articles completed by Robert Porter Allen, internationally known ornithologist and nature writer, who died suddenly at his home in Tavernier, Florida, last June at 58.

As the far-ranging Research Director of the National Audubon Society, Bob Allen made many intensive field studies, notably of the roseate spoonbill and the whooping crane. His reports, classics in ornithology, helped arouse nationwide interest in their survival. To *NATIONAL GEOGRAPHIC* he contributed memorable articles on both—the spoonbills in February, 1962, and the whoopers in November, 1959.

IN A TREETOP PARADISE of sticks, an ibis family basks in Florida's winter sunshine. One scaly-necked adult, crowded from home by its fish-stuffed offspring, stands on the nest of a neighbor whose fledglings already have flown away. These youngsters will fly soon but return to the nest to be fed. Even scientists cannot tell male from female on sight except by size. The male is slightly larger.

Continued on p. 114





White Puffs of Living Down Frost
a Bookery in an Everglades Lake

Flying so high that not a bird took to the air in alarm, Fred Truslow photographed this colony on an island in Cuthbert Lake. He and the author



RODGERSON © NATIONAL GEOGRAPHIC SOCIETY

estimated that some 800 to 900 pairs of wood ibises, with egrets and anhingas, were nesting there. Many of the birds, now away fishing, will

return in the afternoon, whitening the island even more. Nests top low mangrove trees recovering from a 1935 hurricane.

tastes were too expensive for us. She disdained frozen shrimp, preferring live ones. But even in our area—which is close to the source—we had to pay a dollar for three dozen live shrimp. Mickey would dispose of the 36 in short order, then rummage in the water pan for more. Obviously, this could not continue.

We finally persuaded our voracious guest that we might serve live shrimp as a special treat—say on off Sundays and Izaak Walton's birthday—but that frozen mullet, properly defrosted, would have to do as daily fare.

If the fish were small, Mickey would swallow them whole, headfirst, and a few inches

at a time. But I had to split the large ones into sections. She took these readily enough if I tossed them into a pan of water with a hose running into one end; this stirred things up and simulated the movement of live fish.

Eats Nearly One-third Its Weight a Day

Mickey weighed approximately six pounds, and consumed nearly two pounds of fish daily. A bird in the wild, living a more active life, would require an even larger amount; and a male, slightly bigger than the female, may weigh 8 to 10 pounds or more. Plainly, preservation of large natural feeding areas is vital to the future of the wood stork.

In past years storks were often killed for food, although never enough to reduce their population seriously.

Alexander Sprunt IV, present Research Director for the National Audubon Society, tells a story that shows the high regard in which wood storks are held by the colorful Gullah inhabitants of his native South Carolina. On Wadmalaw Island, 11 miles south of Charleston, an inveterate old hunter named January appeared one day with a rusty shot-



4082CHN01X © NATIONAL GEOGRAPHIC SOCIETY

Fishing bird balances with a black-trimmed wing while it stirs the water with one foot, flushing its prey. When the heavy nine-inch bill feels a minnow, it snaps shut faster than the human eye can blink.

Knobby-necked fisherman makes a catch.





PHOTOGRAPH BY FREDERICK SLYE TRUSLOW © NATIONAL GEOGRAPHIC SOCIETY

Speeding homeward, a wood ibis brings its brooding spouse a gift of greenery to trim the nest. Outstretched neck, legs, and wings form a cross against the blue Florida sky.

gun in one hand and a dead stork in the other.

"January, what in the world have you been doing?" Sprunt asked.

"Got me a gannet, suh," said the old man.

"What you going to do with it?"

"Gonna cawn it an' eat it, suh!"

"Corn it? How do you do that?"

"Well, suh," said January, "yuh clean 'em, pick 'em, rub salt een 'em an' out 'em, wrop 'em een a crocus sack an' bury 'em een de groun'. Dig 'em up 'bout a week fum Sunday, an' 'e better'n a Christmas turkey, suh!"

Storks' Chief Enemies: Man and Drought

Until about ten or twelve years ago there seemed little reason to worry about the future of the wood stork, however edible. It was a common bird, with plenty of feeding grounds, except during drought, and after drought years the birds always seemed to build up their numbers again.

Today the situation is more serious. Droughts still come. In addition, drainage and development projects have destroyed feeding grounds. Breeding sites have been ruined by lumbering and other clearing operations. I know of more than 30 nesting areas

—most of them in Florida—that have been abandoned since 1900.

But we did not begin to feel real concern about the species until the early 1950's, when a widespread drought began. By 1953 it had become severe; in Florida there was no relief until September, 1956.

For the first time in ornithological history, wood storks in large numbers left their usual haunts and wandered across the United States as far north and west as New England and Wyoming, looking for enough water to provide food. Habitat failure was dispossessing the entire stork population. Abnormally low temperatures and winter gales also discouraged the feeble nesting attempts made in a few stork colonies.

As a result, the country's wood stork population sank to a critical low in 1957. Then, just in time, the normal pattern of rainfall began to restore conditions on the feeding grounds. After many lean years, the storks started a definite upswing.

In mid-January, 1959, Fred Truslow and I visited Cuthbert Lake Rookery in Everglades National Park and found that 800 to 900 pairs of storks were well established on the is-



Two weeks after hatching, downy nestlings (left) need safeguarding against gangs of juvenile-delinquent ibises that roam the colony, despoiling nests. At least one adult always stands vigil. These youngsters yammer for food. Old birds disgorge fish on the nest and sprinkle billfuls of water to cool the babies.

At four weeks, rapidly growing young (below) have attained more than half adult size. Able to defend themselves with vicious swipes of sharp beaks, they can now be left unprotected.

At eight weeks (opposite), necks begin to darken, and flight feathers grow out. These birds could fly but hesitate to do so; instead, they jump up and down and exercise their wings.



BOBACH/IBIDEL © NATIONAL GEOGRAPHIC SOCIETY

land in the middle of the lake (pages 300-301).

Here, where the big trees have been swept away by hurricanes, the birds nest in young mangroves only about 10 feet high. All morning, as we inspected and photographed the colony from our boat, adult storks were flying in with nesting material.

The nests were so low we could observe the family life of birds in detail. The newly hatched nestlings are grotesque, naked little creatures with strange dome-shaped skulls and yellow bills.

At hatching the two or three young in each nest have a covering of light-gray down. After ten days this gives way to a white woolly coat. The first signs of flight feathers appear at three weeks, and the chicks hobble around on bent legs, stretching their stubby wings. At two months they are fully grown.

In flight, wood storks are a sight to remember. There is power and dash in the way they take off, and the conspicuous black-and-white pattern is accentuated by the impressive breadth and spread of the wings.

They are also expert gliders. Phil Kahl, one of the Audubon research men, has well described their use of thermal air currents for transportation to and from their distant feeding grounds. The birds spiral slowly upwards in the rising column of warm air. At the "effective top," where the pull of gravity and the push of the rising air on the birds are equal, they may be 1,000 to 2,500 feet above the ground. Here they set their wings for gliding, and off they go, without moving a feather, until they reach feeding ponds as much as 15 or 20 miles away.

In ordinary flapping flight, Phil estimates that wood storks may do close to 35 miles per hour, top speed, which is very good for so heavy a bird.

As we noted at Cuthbert, by 1959 the wood stork rookeries were finally shifting back into full gear, following the lean years of drought and severe winters.

All previous records were broken in 1960, when there were 14 successful breeding colonies—all in Florida. Alexander Sprunt's con-



STOCKBROOK © NATIONAL GEOGRAPHIC SOCIETY

servative figures showed an estimated 8,760 breeding pairs in Florida that year, more than half of them in the Corkscrew Swamp Sanctuary* (map, page 298).

But early in September, 1960, hurricane Donna—one of the worst in a generation—swept through Corkscrew Swamp. Luckily, most of the birds were scattered in small off-season flocks at the time, some of them still loitering as far away as Arkansas and South Carolina. Most of them, we decided, had probably been spared.

Nest Building Hinges on Water Level

Many of Corkscrew's oldest trees, some of which had been growing when Columbus came to America, were uprooted or snapped like matches by winds as high as 160 miles an hour. But enough big trees survived to provide the towering nest sites preferred by the wood stork. As the 1961 nesting season approached, the big question was whether the birds would return and take up normal life in the trees left standing.

Phil Kahl had a theory that the start of nest building is related to water levels on adjacent feeding grounds. Between 9 and 11 inches of water provides a great concentration of fish and also easy wading. At Corkscrew it had been near 11 inches when the birds began nesting in each of the three previous years—twice in November, once in December. But now south Florida was deep under water, with serious flood problems caused by Donna. Would the nesting schedule be further upset by such conditions?

By December 1 the water had lowered. Storks were in the area, but there was no special activity. Two days later, Sprunt and Charles Hutchinson, the sanctuary superintendent, entered the swamp. Reaching the gauge, they found the water level at 11 inches.

"We'd better go in and see what's doing," Sprunt suggested, half jokingly.

They went deeper into the swamp, and be-

*See "Corkscrew Swamp—Florida's Primeval Show Place," by Melville Bell Grosvenor, NATIONAL GEOGRAPHIC, January, 1958.



RODOLPHO © NATIONAL GEOGRAPHIC SOCIETY

Masters of the air, wood storks become clumsy clowns when alighting, sometimes even missing the perch altogether. This bird, coming in for a landing, puts on the brakes with tail between legs and head thrust forward. The species stands slightly taller than the white stork of European rooftops but has a shorter wing span.

fore ten minutes had passed they found storks coming and going in all directions. As Sprunt expressed it, they were "carrying on like crazy!" They were also carrying sticks, the raw material for building nests.

With the rattle of bills sounding in their ears, the two delighted men retreated. The 1961 nesting season was off to a good start.

In March, 1961, three months later, an estimated 6,000 pairs were busy raising a new generation of young at Corkscrew. The banner nesting season of 1960 was already being topped!

But our lordly stork lives in a delicate balance with nature. Our high hopes were dashed again the next year, when extreme drought struck. And, as far as we know, not one wood stork nest was built in Florida in the season of 1961-62.

The drought threatened even the existence of the Corkscrew Sanctuary: Wood fires almost encircled it, and were moving in until a providential rainstorm on June 15, 1962, put them out. With near-normal rainfall thereafter, the birds renested, and by January 16, 1963, the sanctuary held 3,000 nests.

Disaster struck again last February, when a devastating storm killed some 60 percent of the young. But the storks renested and successfully raised at least 2,500 birds. Clearly the wood stork had made another comeback. There are now between 8,000 and 10,000 breeding pairs in Florida.

Three Sanctuaries Hold Species' Future

As far as the United States is concerned, the fate of this magnificent wading bird is tied to Florida. We may never again see the vast assemblages of the past, but the vigor with which these birds have multiplied in recent years demonstrates an encouraging ability to recover. The present problem is to preserve a sufficient number of breeding sites and feeding areas.

Only three of the regularly used breeding sites—Corkscrew Swamp and two nesting colonies in Everglades National Park—are on land protected in permanent sanctuaries. All the others are on private property, and their future is not secure. The preservation of feeding grounds, such as Devil's Garden, Okaloacoochee Slough, and portions of the Fakahatchee Strand, is also vital.

The huge, unspoiled wilderness of the Florida of a century ago is gone forever. Still, many large areas remain reasonably intact. A few of these have already been preserved as monuments to the state's natural beauty and exciting wildlife. The wood stork is a part of this heritage, and it will be well worthwhile to make special arrangements on its behalf. Once you have seen a flock of these great birds soaring against the brilliant blue of the warm winter sky, you will agree that our only stork should not be allowed to pass forever from the American scene.

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◀ COVER: Bright eyes survey the mountain world of the Peruvian Indian (page 212).



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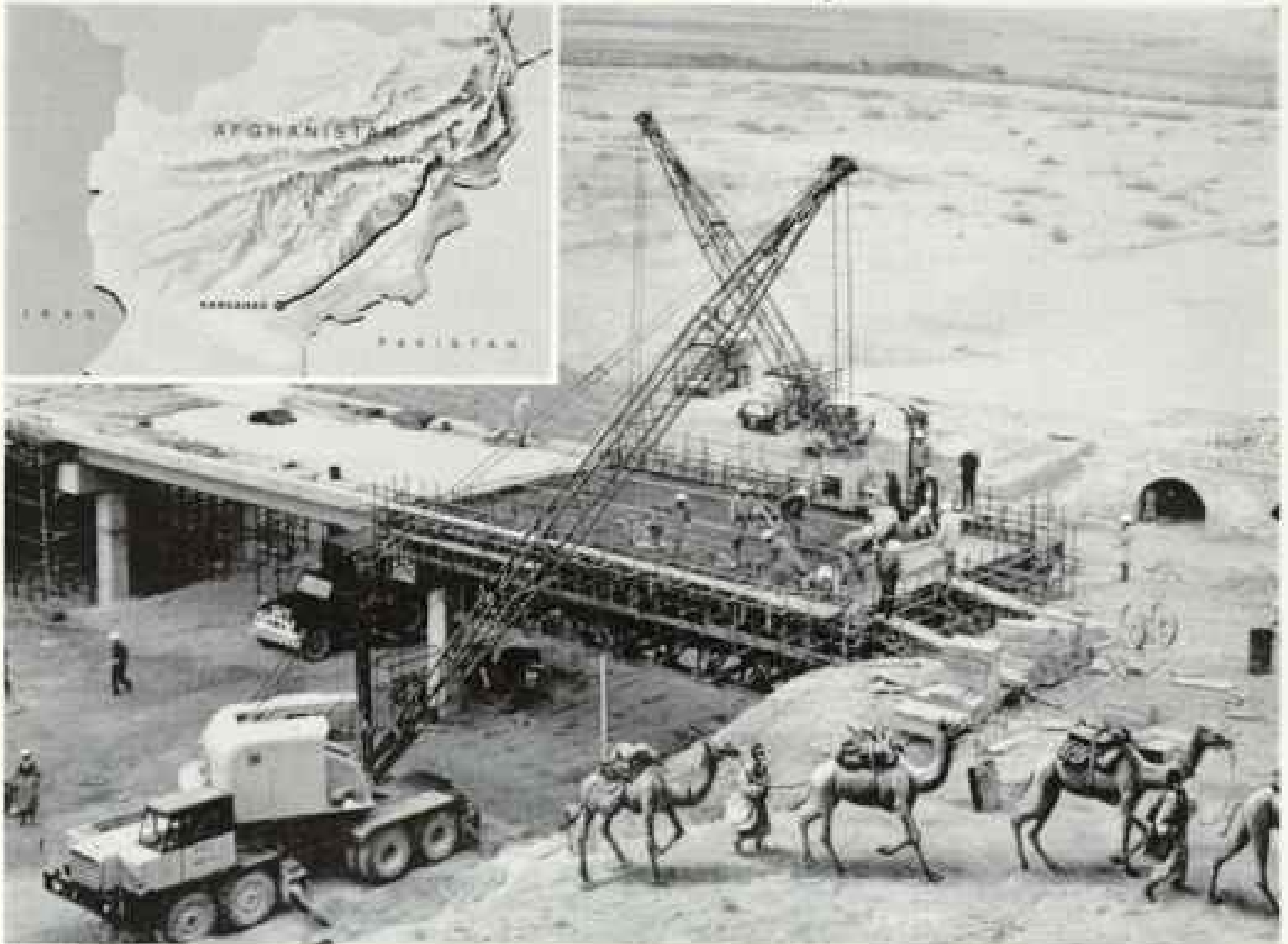
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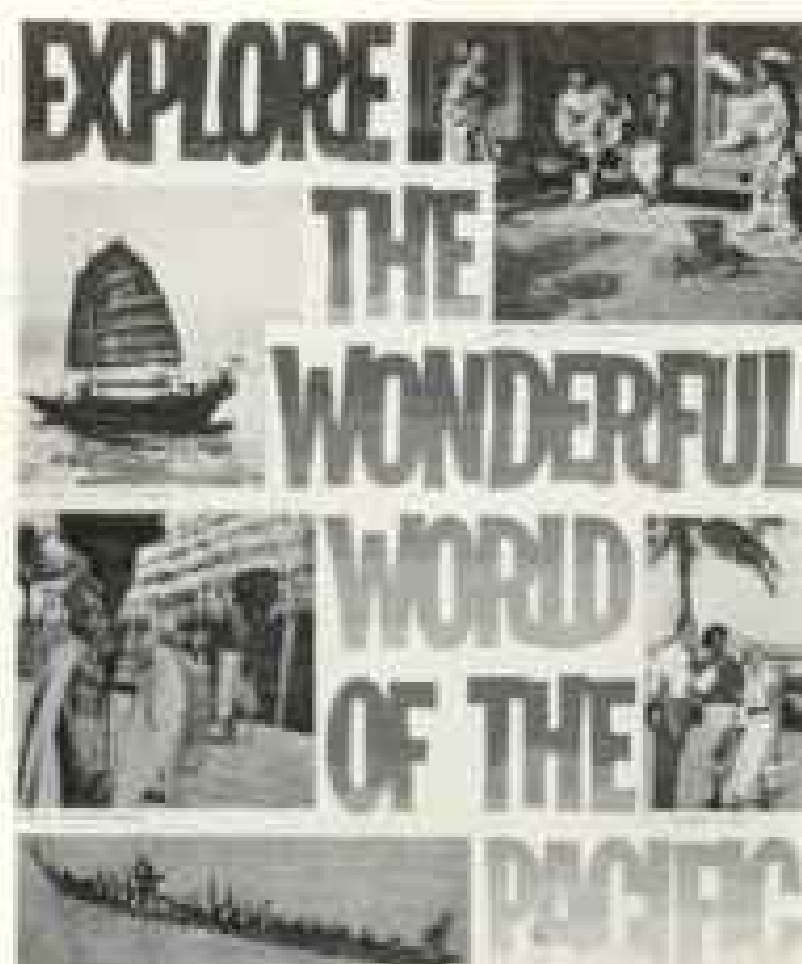
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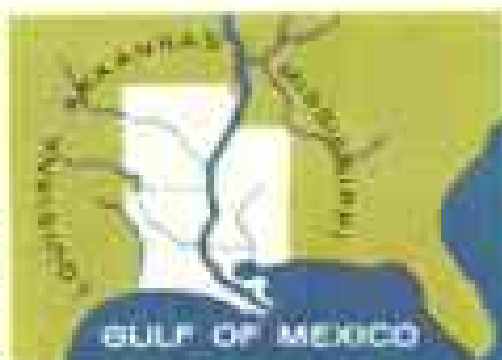
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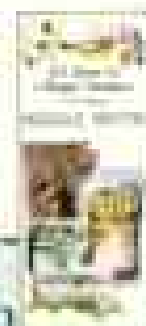
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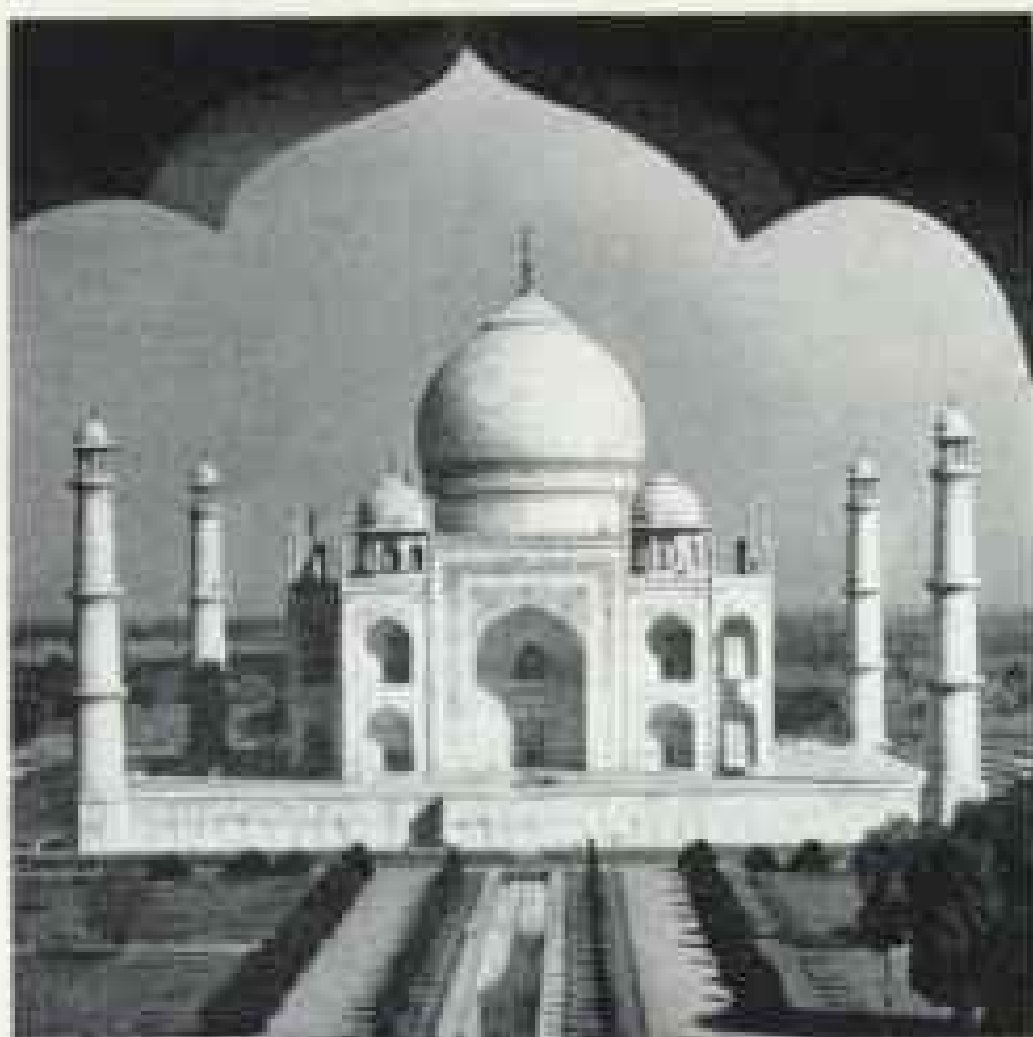
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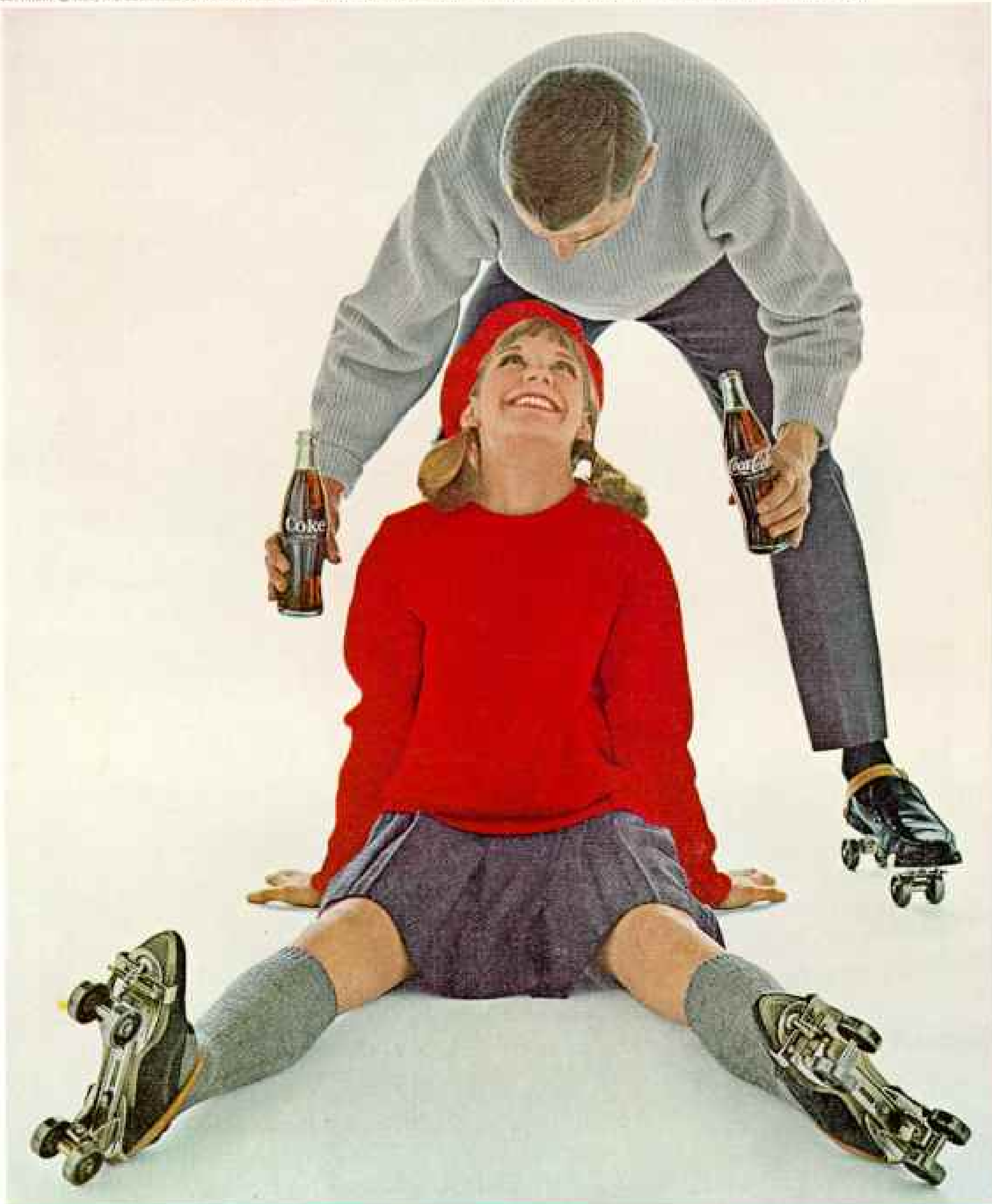
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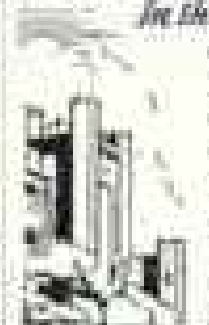


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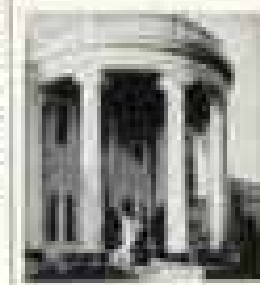
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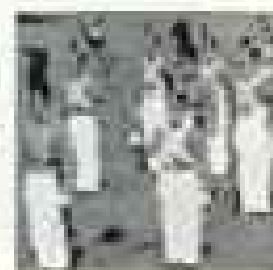
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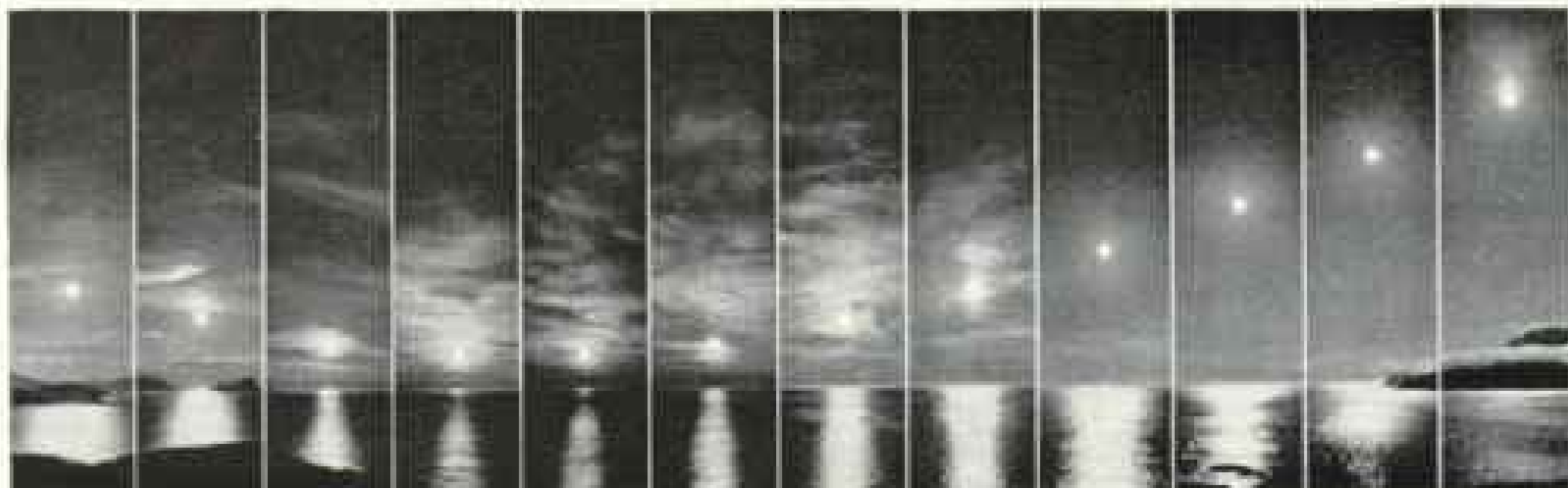
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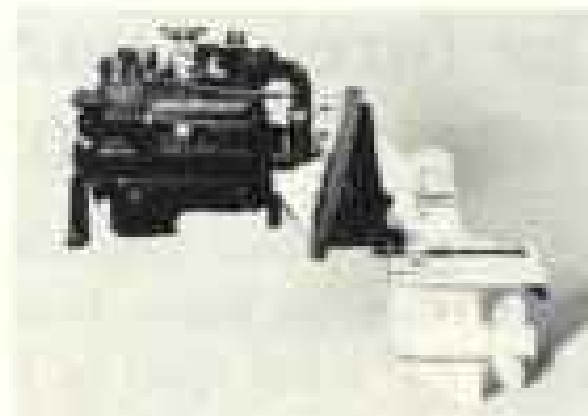
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