

VOL. 117, NO. 3

MARCH, 1960

NATIONAL GEOGRAPHIC



Volcano and Earthquake Show Nature's Awesome Power

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◀ COVER: Ringed by forest fire and gushing lava, a photographer defies a Hawaiian volcano (page 303).



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Here the Maharaja shows Mrs. Schreider some of his rare books while her husband takes photographs. Open on Sir Yadavindra's desk lies a 17th-century volume containing works of the celebrated Persian poet Sa'di. The closed volume, its binding studded with diamonds and rubies, is one of two known hand-lettered copies of a work by Thomas Moore. The volumes are valued at more than \$15,000 each.

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that we practice the brotherhood we preach."

plus au monde que nous pratiquons la fraternité que nous prêchons."

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research in bone growth and bone disease; *Republic*

Congo belge: recherches sur la croissance et les maladies des os;

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République de Corée: études sur les mutations génétiques des plantes;

Brazil: training of engineers; Republic of Vietnam:

Brazil: formation d'ingénieurs; République du Vietnam: supériorité sur

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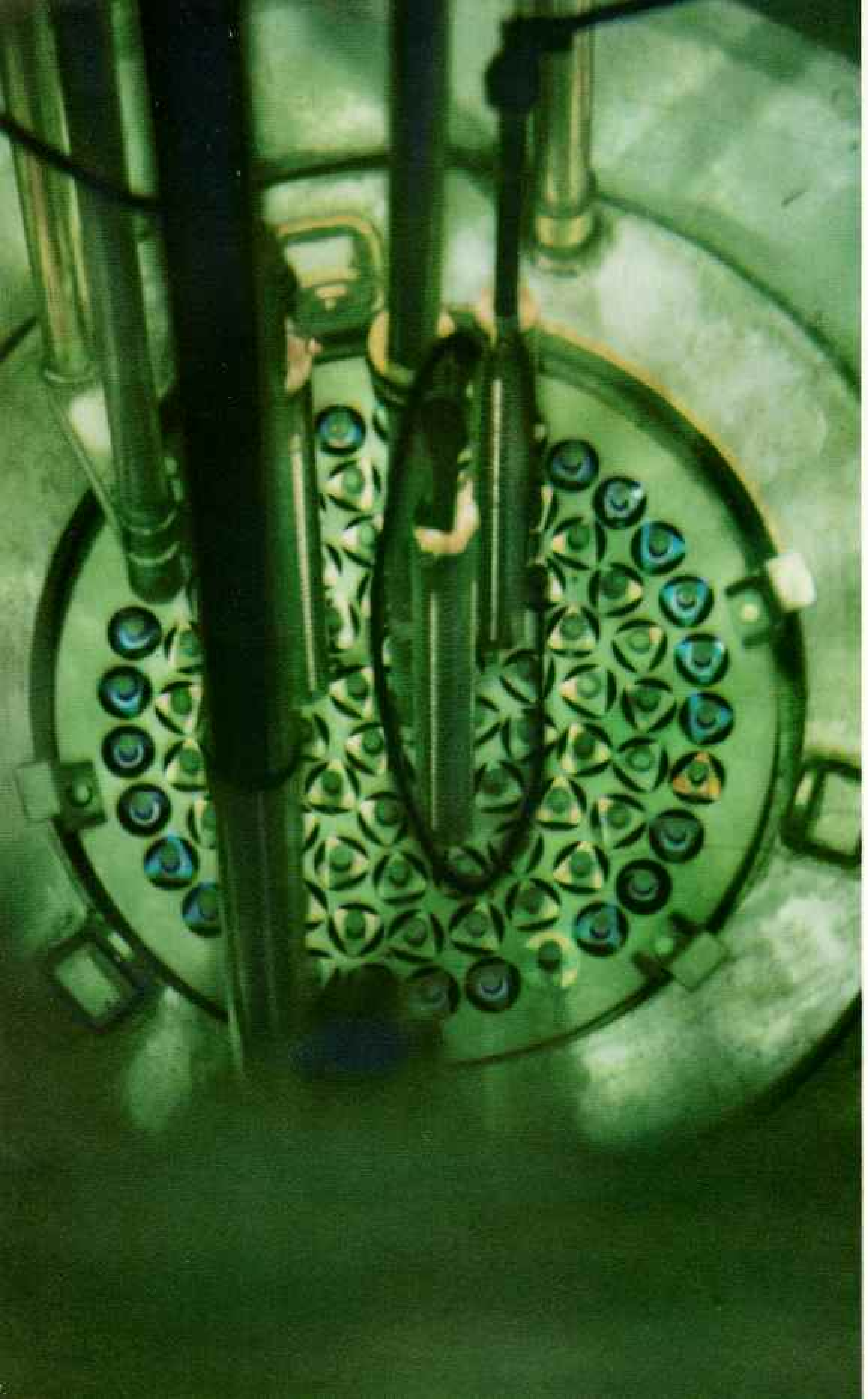
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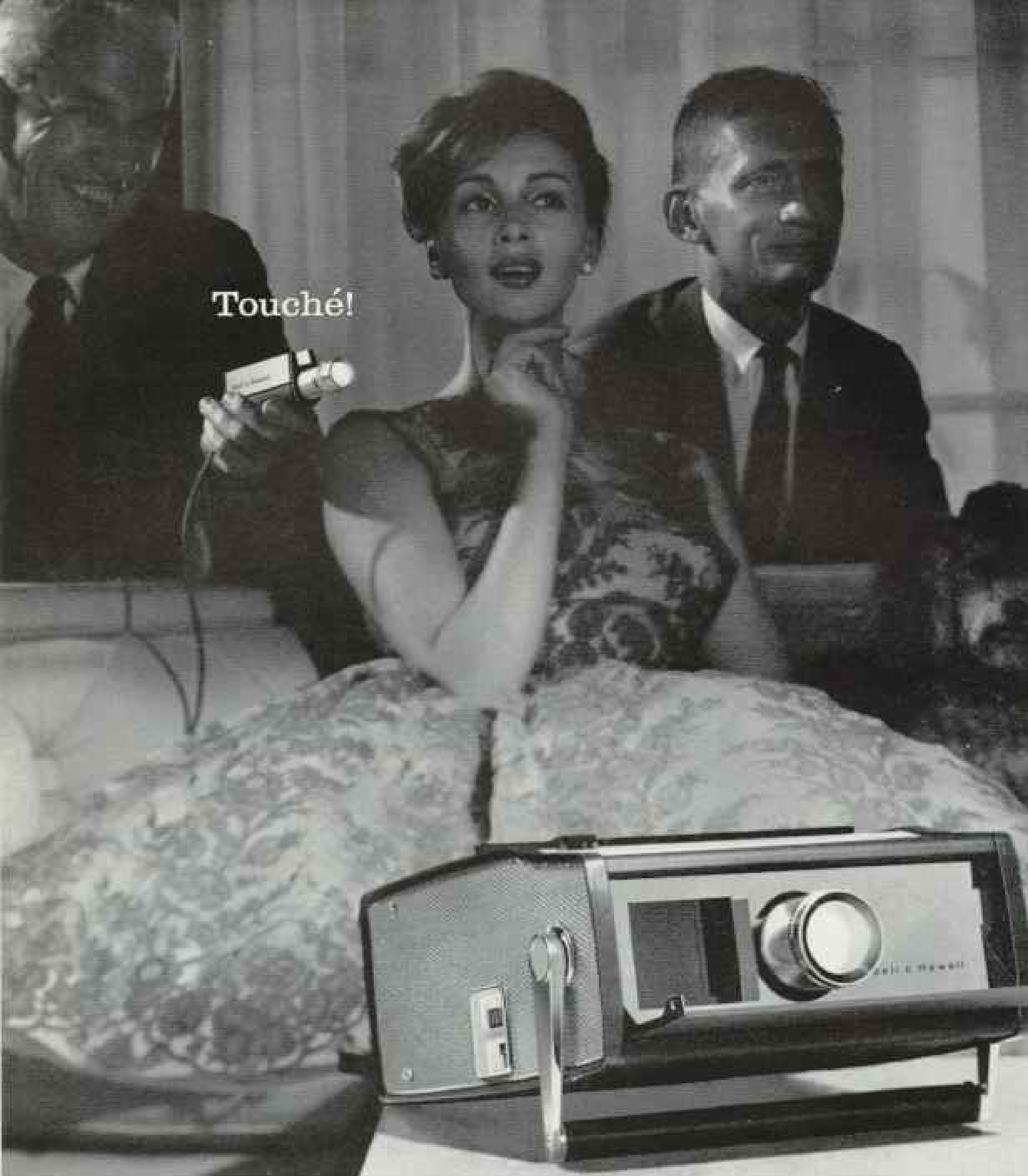



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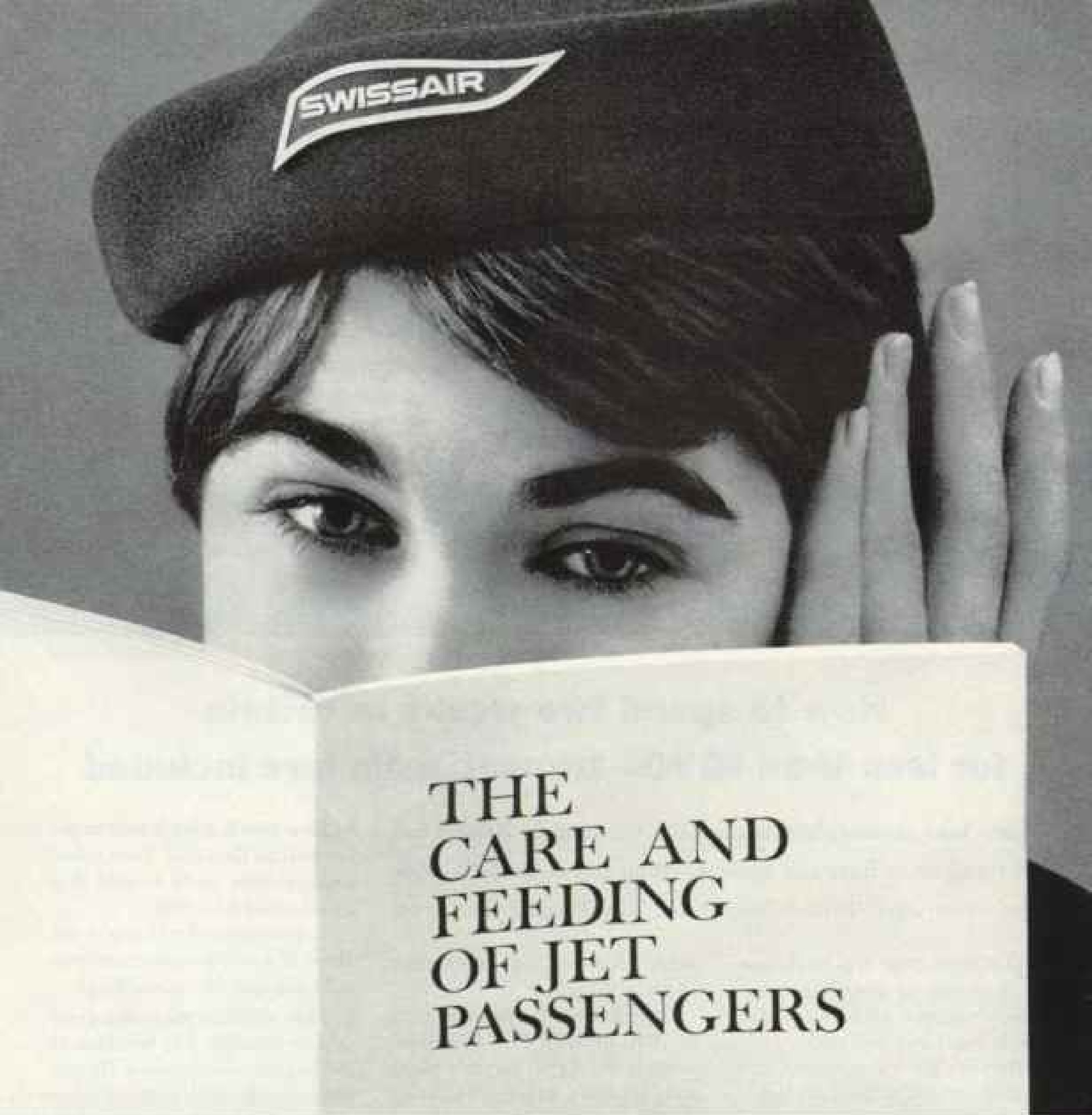
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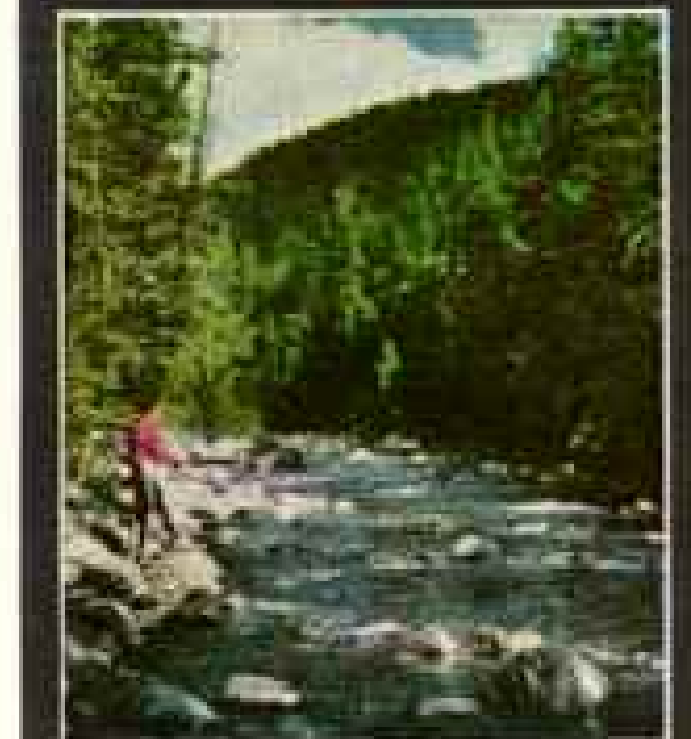
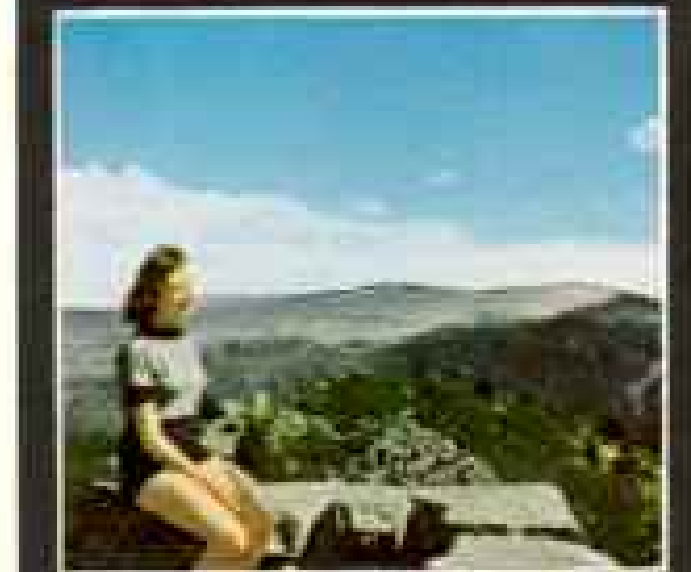
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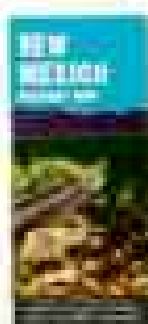
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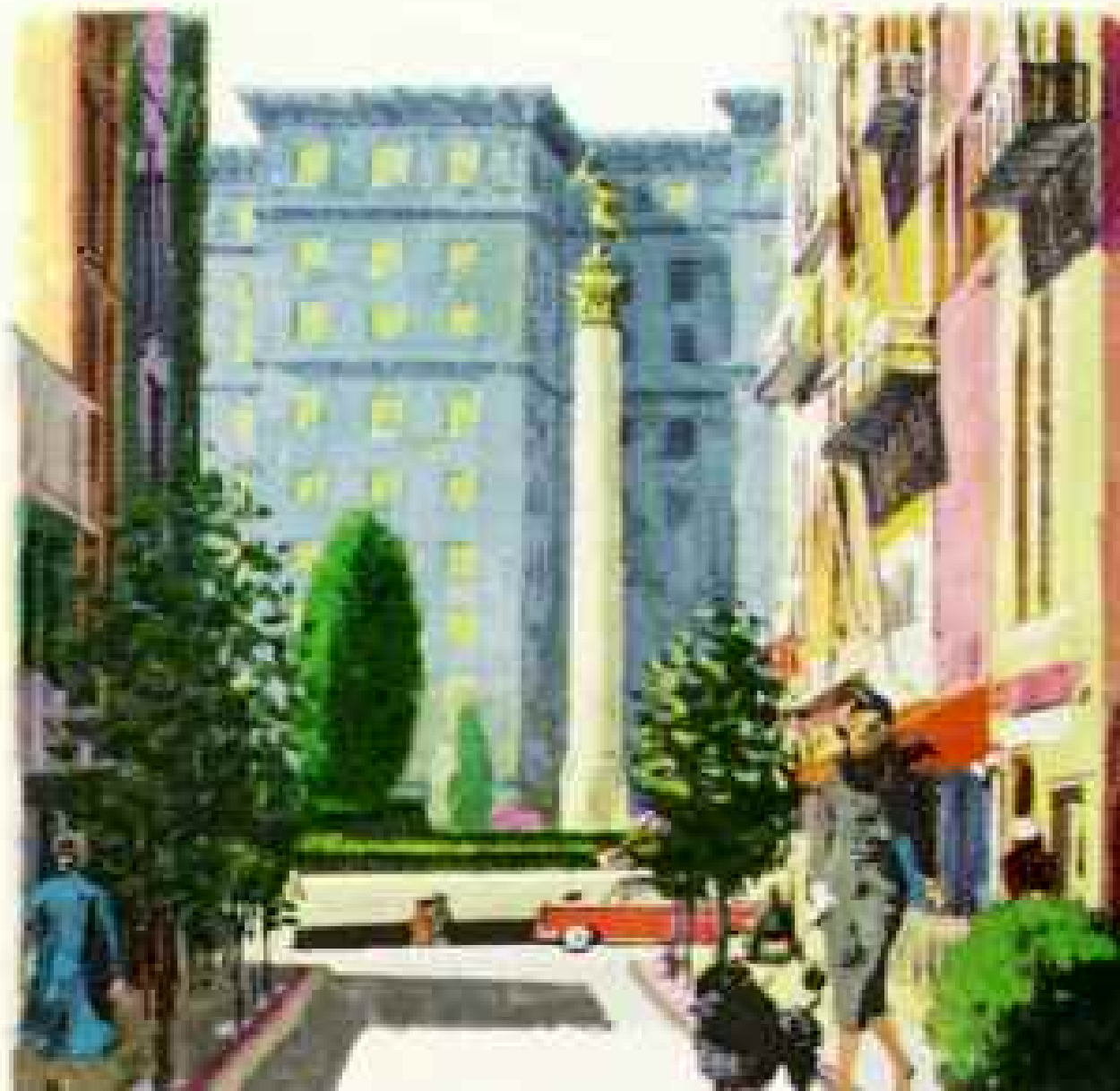
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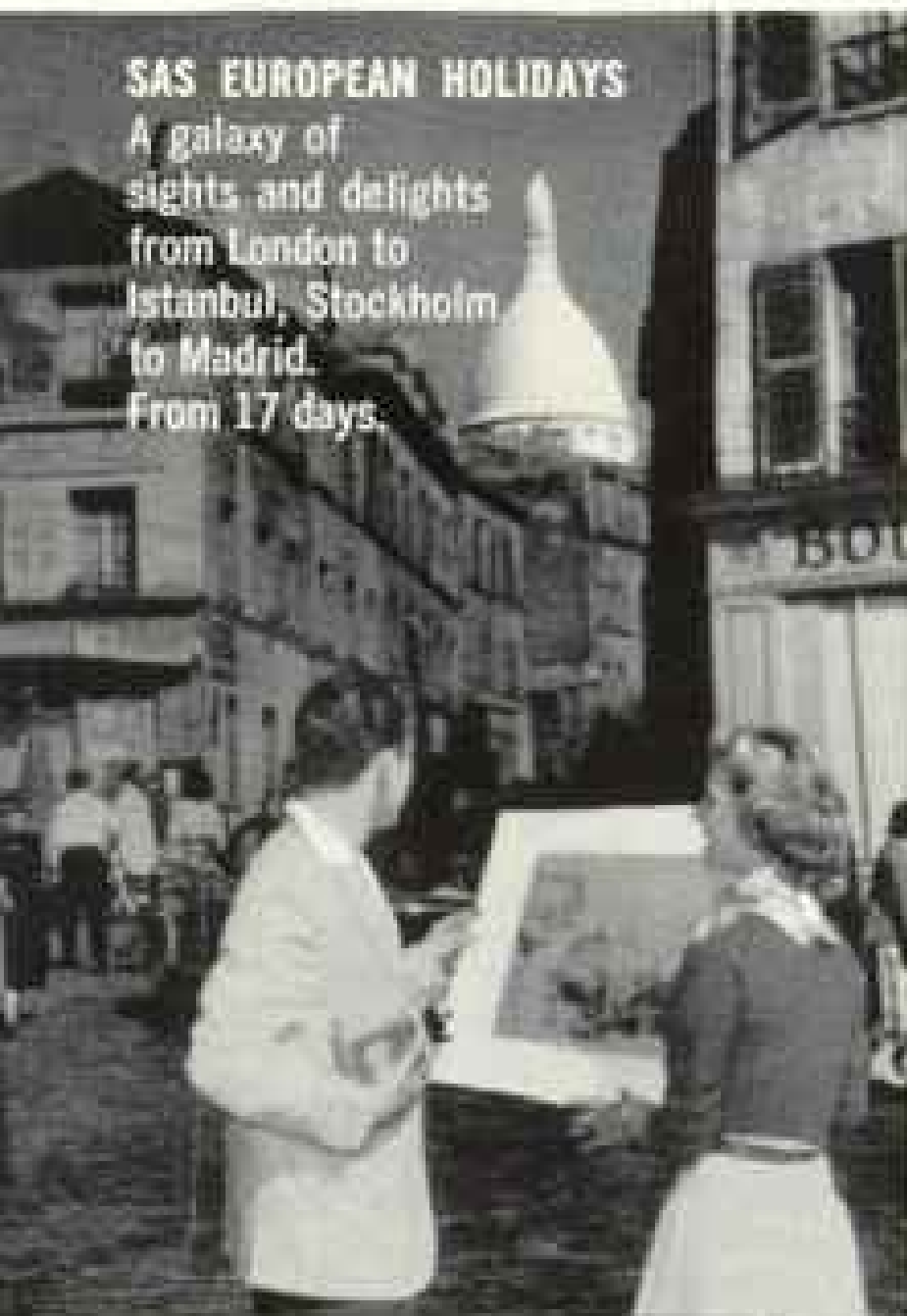
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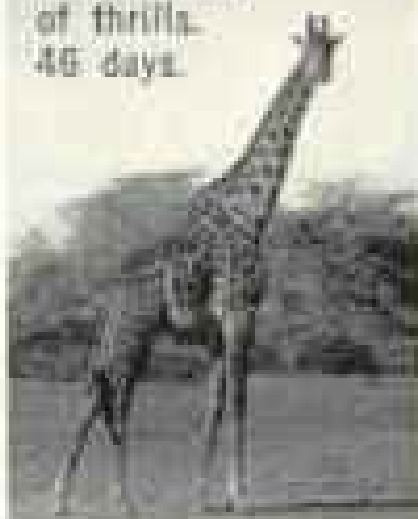
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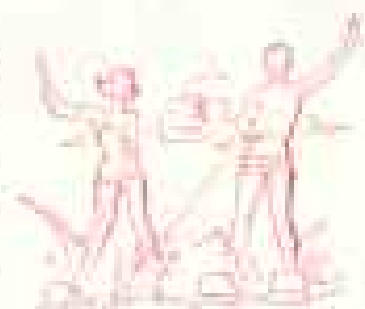


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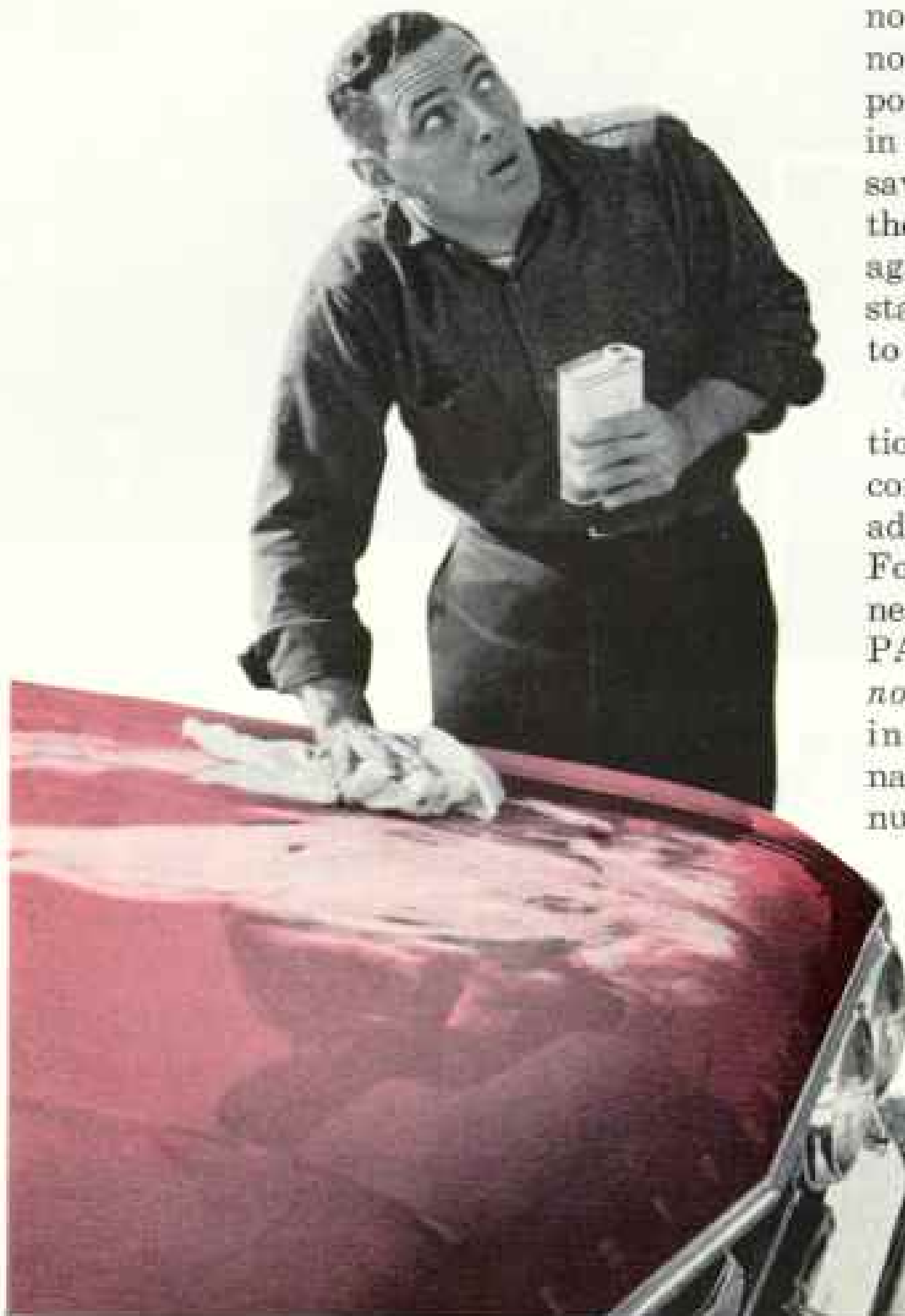
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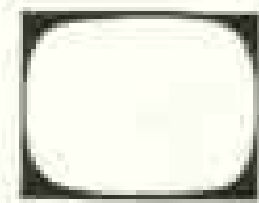
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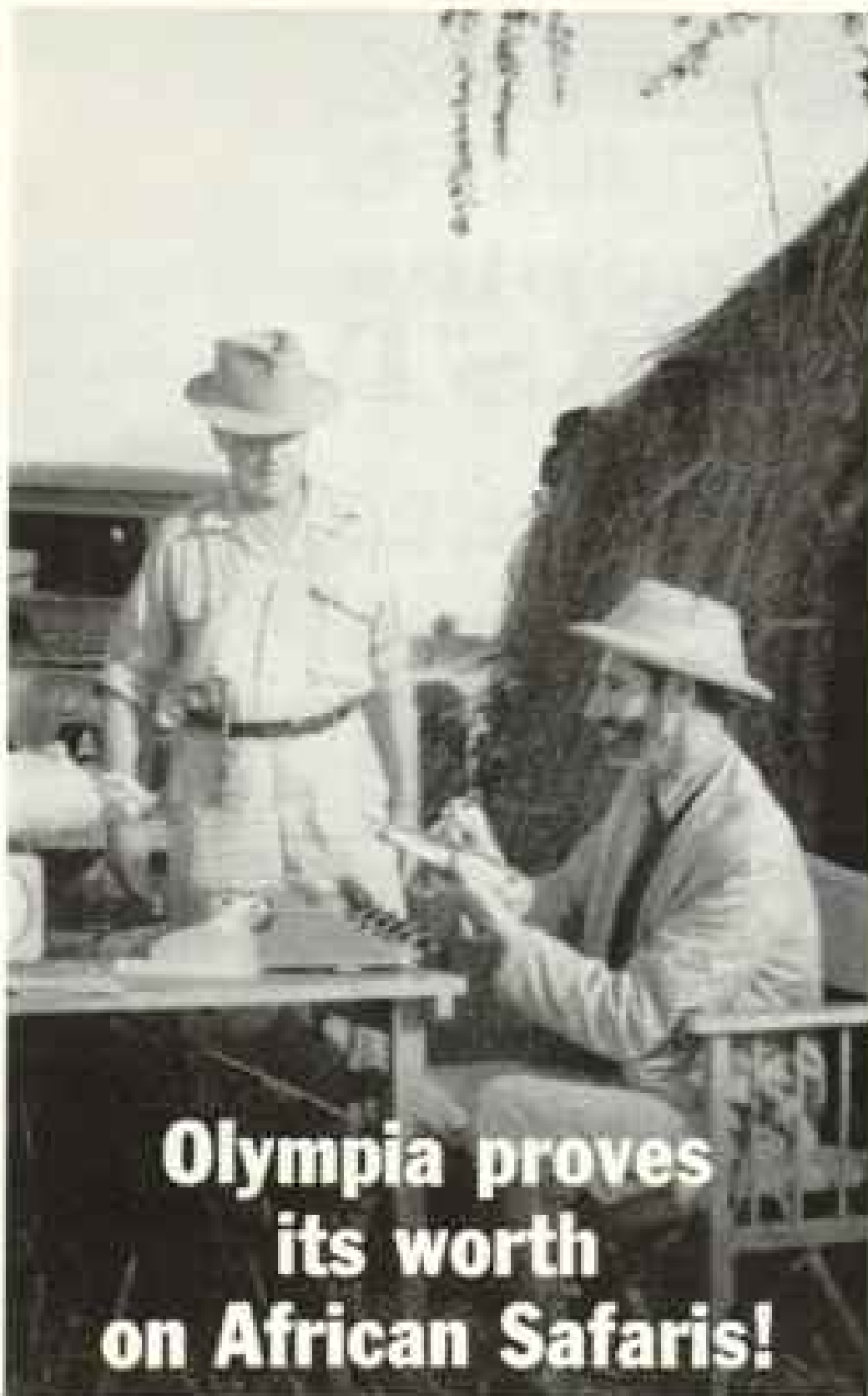
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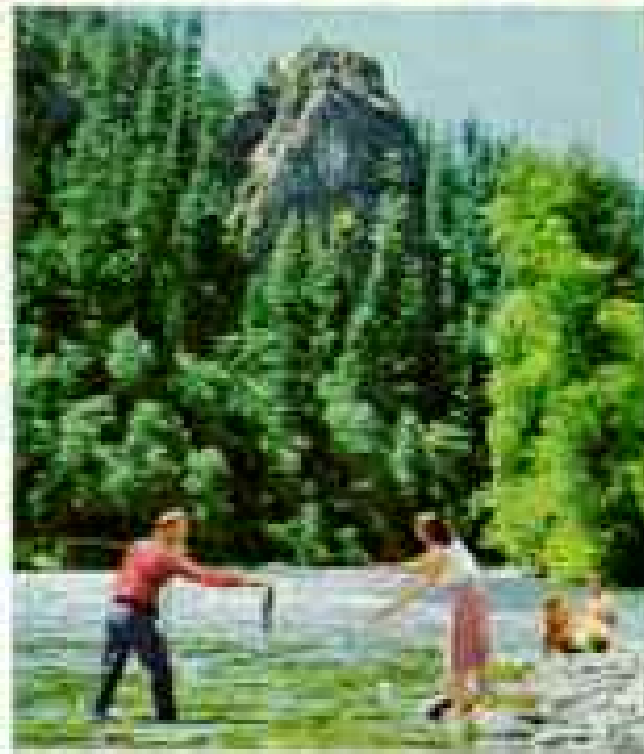
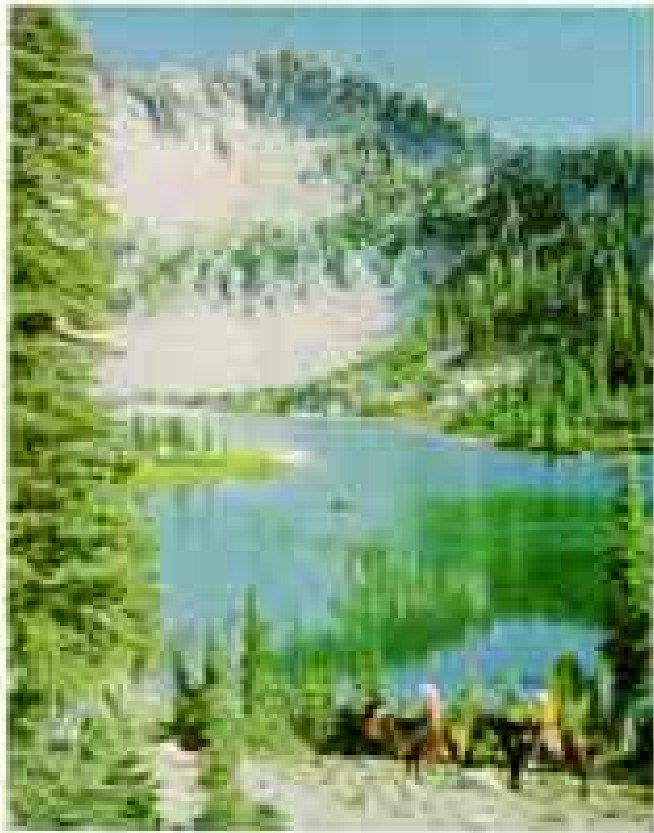
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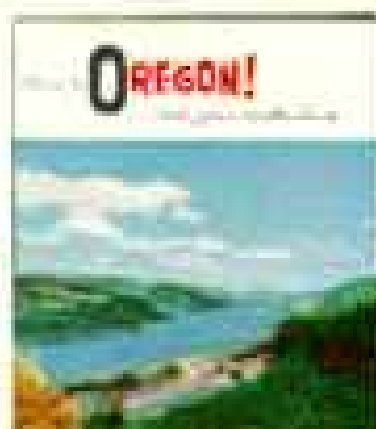
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Oregon abounds in spectacularly beautiful mountain lakes. This one, Bear Lake (left), nestles jewel-like in the rugged Willamette Mountains of Northeastern Oregon.

Below—Ecola State Park, just off U.S. 101 near Cannon Beach, presents the famed varied beauty of Oregon's ruggedly picturesque Pacific Ocean coast. Rocky headlands, golden-sunny beaches, wildflower-carpeted hillsides and interesting rock formations alternate along the 400-mile coastline.



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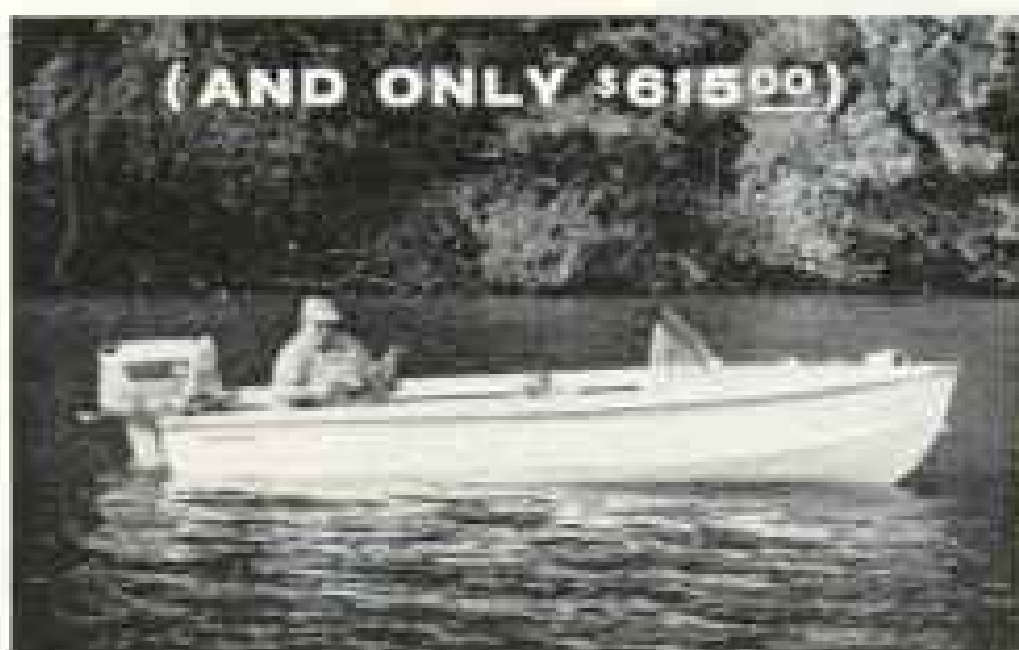
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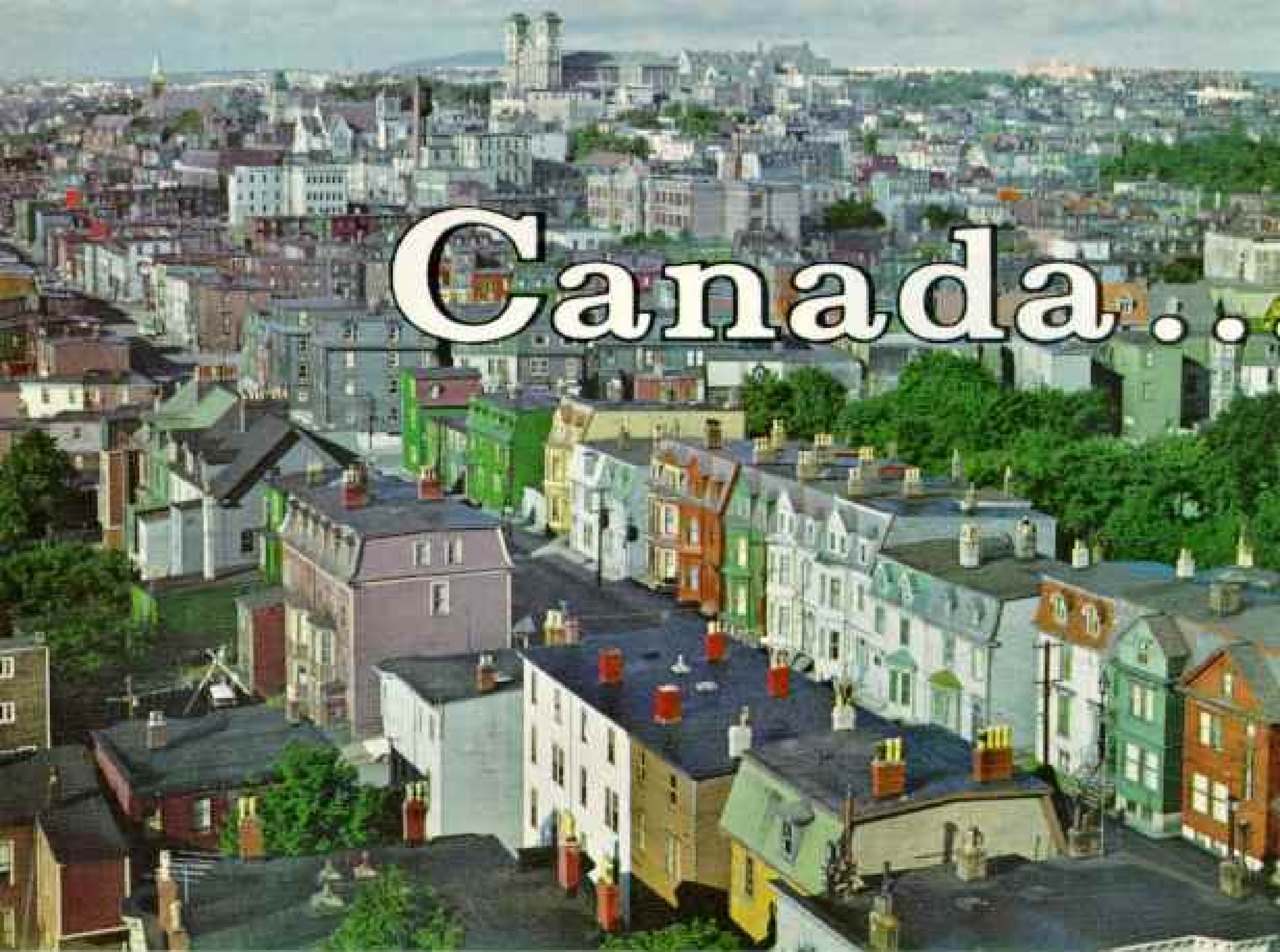
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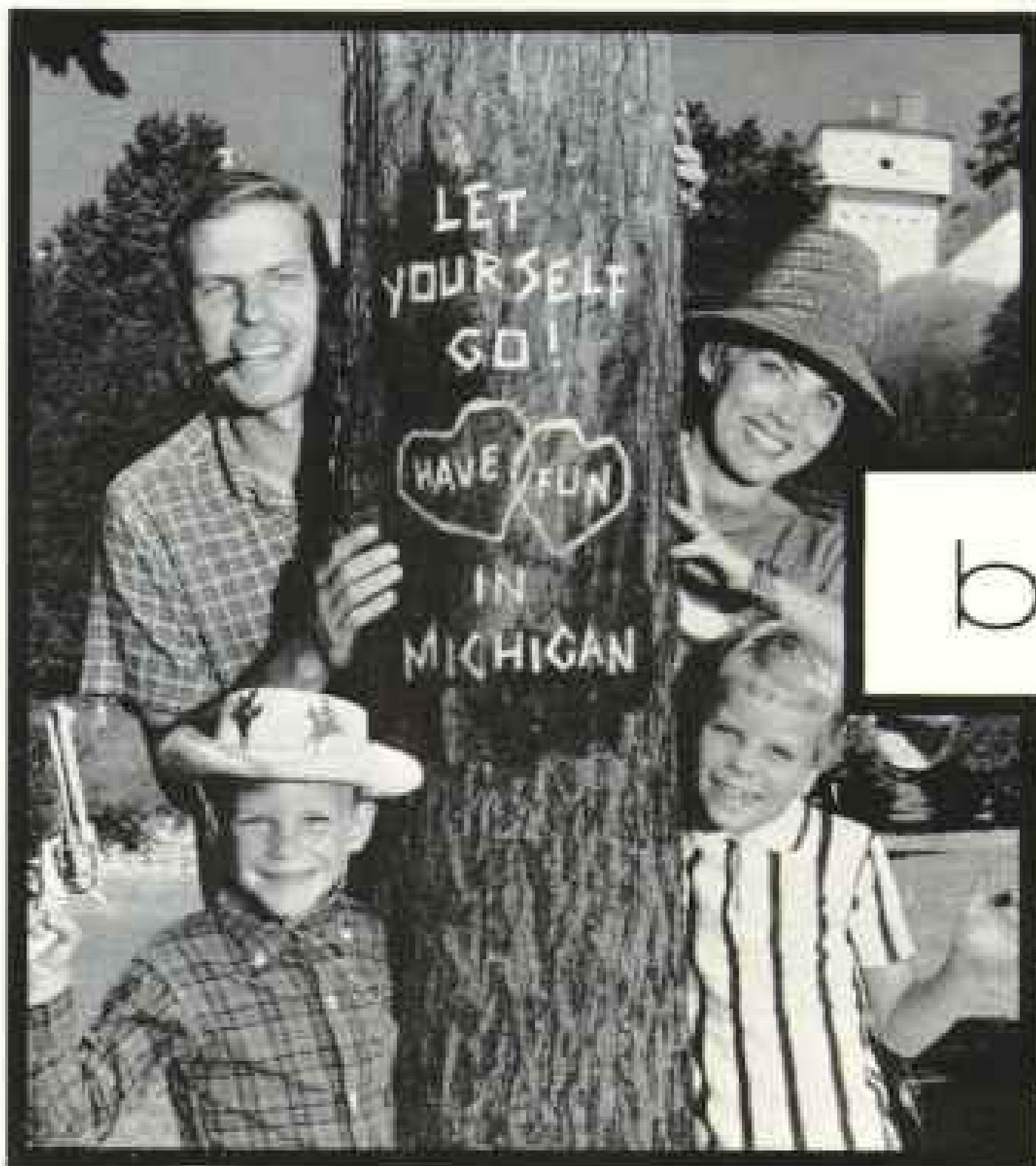


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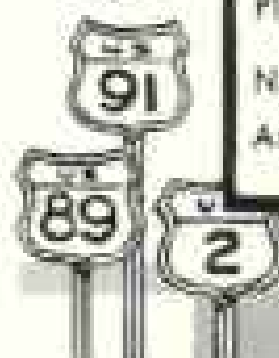


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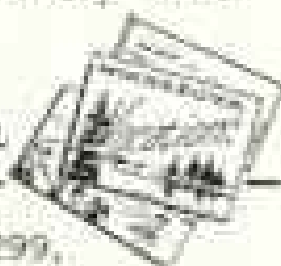
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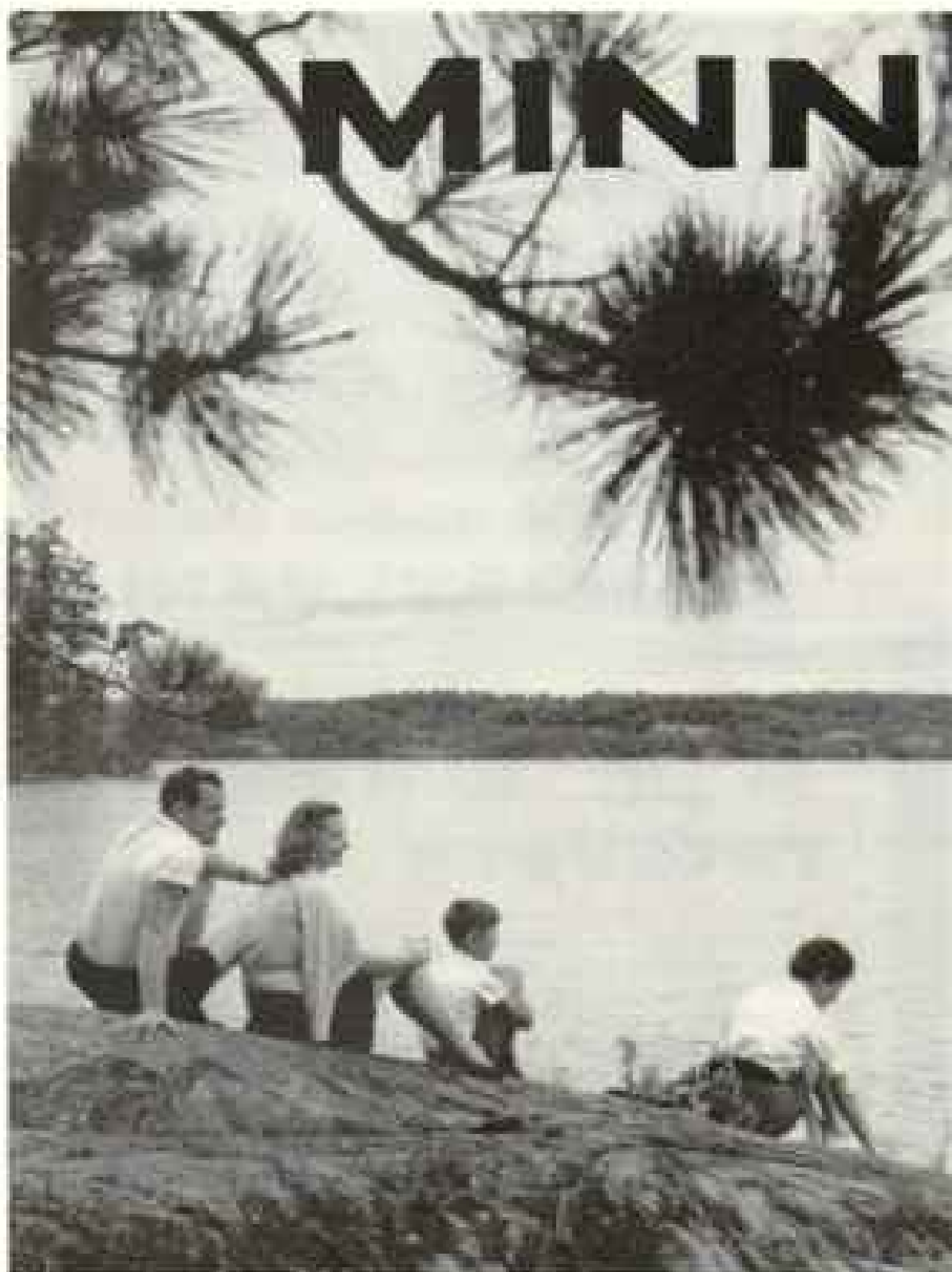
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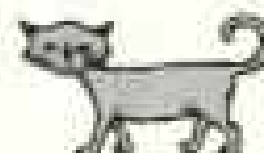
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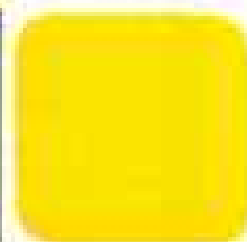
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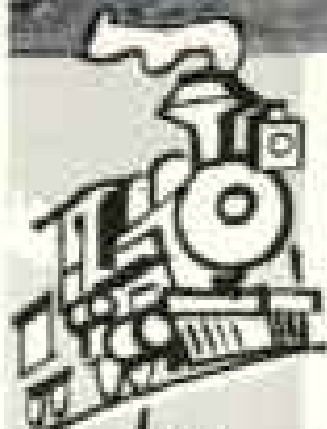
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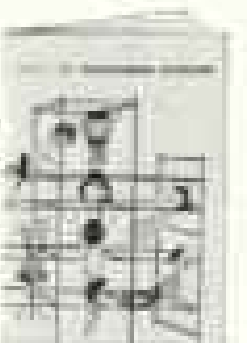
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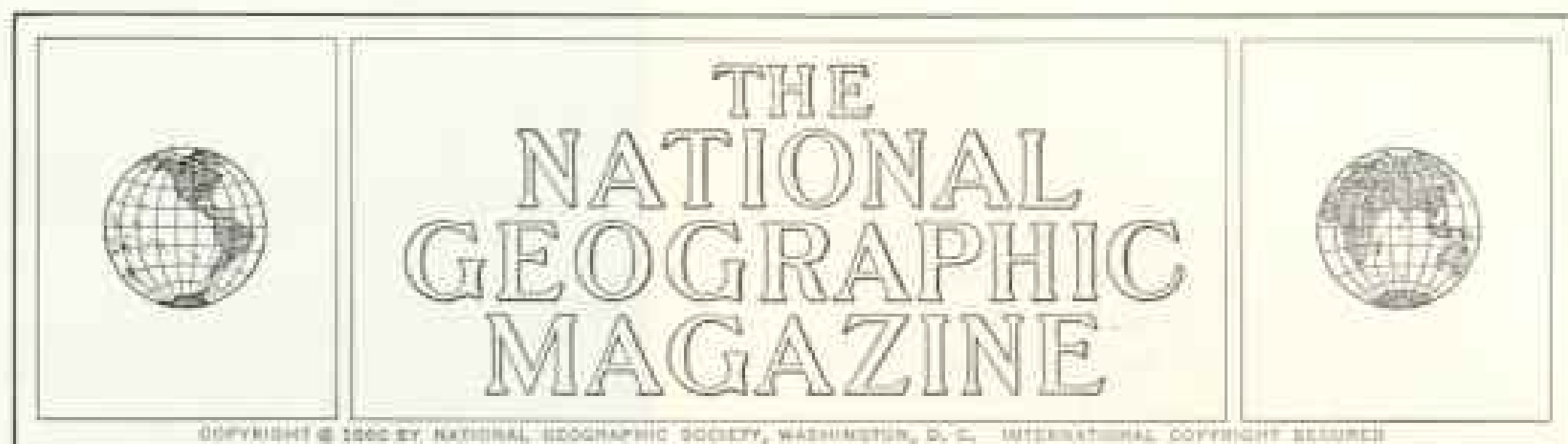
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Folklore has forever fed upon the earth's great fevers and agues. When the land trembled, ancient Peruvians assumed their creator had returned for an inspection. Each answered the fearful summons by shouting, "Here I am!" The modern scientist gives a similar answer. At the first hint of action, he hurries to an erupting volcano, and each year he dutifully logs a hundred thousand earthquakes.

In recent months, geologists and photographers have had unparalleled opportunity to study two of earth's mightiest convulsions: a volcano in Hawaii that spewed molten lava higher than any other on record, and an earthquake of top rank that rocked Montana and Yellowstone. Never have such elemental displays been better covered by color photography than in the articles that lead this issue.—The Editor.

Fountain of Fire in Hawaii

By FREDERICK SIMPICH, JR.

*High Speed Ektachromes by
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IN ONE FASHION or another we all sensed it was coming, this most spectacular of Hawaiian eruptions.

Scientists read it in their instruments. There were more than 2,000 separate quakes under Kilauea Crater on "the big island" of Hawaii in a single day just before it came.

Two hundred miles away on another island, my wife and I were awakened several mornings before by the unusual call of a pheasant from the meadow below our home. In a moment there followed the sharp rap of an earthshock—as if the bird had sensed its coming. During the next few days Honolulu, where we live, lay in an unnatural calm, un-

touched by the usual trades and bathed in a blue-gray mist—what old Hawaiians call "volcano weather."

Acting on these coincidental and less-than-scientific signs, I confirmed a long-standing reservation for accommodations in the event of an eruption.

The word came on Saturday night, November 14: "Kilauea is erupting again!" In a 4 a.m. phone call from Washington, my standing assignment to cover any major eruption for NATIONAL GEOGRAPHIC was confirmed, and we took off on the first Sunday flight.

In the next two weeks we were to see a 1,700-foot lava fountain, then the highest in

the history of recorded Hawaiian eruptions, perhaps the highest in the memory of man. We were to feel our feet grow hot from stepping on encrusted lava. We were to face heat so great—2,000° F. at the source—that it was like standing before the door of an open-hearth furnace, and our faces were to redden as if they had been exposed to the summer sun. The lava pool that remains may take a century to cool.

But volcanologists and the photographers who made the remarkable pictures in this issue were well ahead of us in reaching the scene.

On that fateful Saturday evening, Jack Murata, scientist in charge of the U. S. Geo-

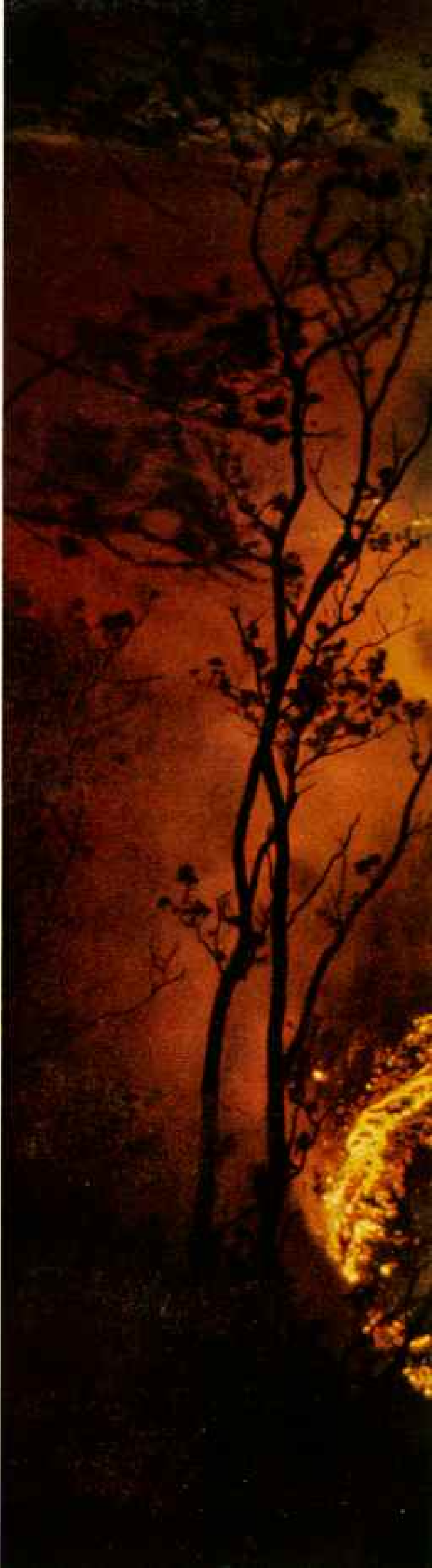
EDITORIAL © NATIONAL GEOGRAPHIC SOCIETY



Devil's Caldron of Liquid Fire Baptizes a Volcano Reborn

At 8:09 p.m. on November 14, 1959, Kilauea Volcano in Hawaii National Park broke the silence of four slumbering years. The long-dormant crater of Kilauea Iki (Little Kilauea) belched steam and incandescent lava from a dozen fountains and turned the somber pit into an inferno.

Among the early arrivals was author Frederick Simpich, Jr., a dedicated volcano watcher, Honolulu businessman, and son of a former NATIONAL GEOGRAPHIC assistant editor.





logical Survey study of Hawaiian volcanoes, watched with members of his 12-man team in the Hawaiian Volcano Observatory overlooking Kilauea Crater. Closely they checked the seismograph needle as it flickered with the vast movements of magma in the earth beneath them. Outside, a party of wives and friends had gathered, for in Hawaii people run to, not from, an eruption.*

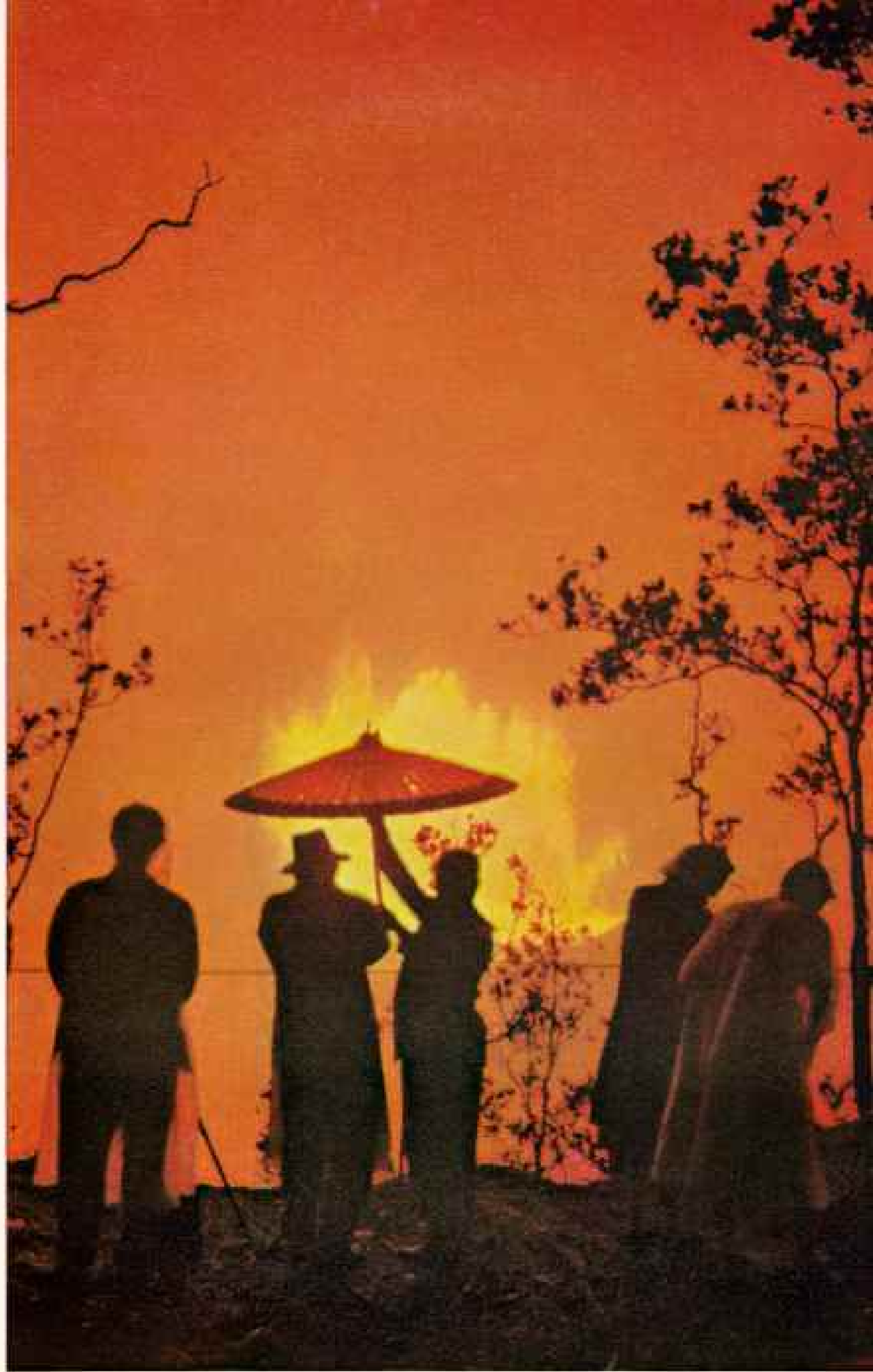
The oval crater below them stretched for two and a half black and forbidding miles. The eruption was expected in the fire pit of Halemaumau, a 430-foot-deep crater-within-a-crater. From the lookout in front of the observatory, all eyes were trained on that

spot. At 8:09 p.m. the sky turned red, on beyond Kilauea's rim. This was it—but in an unexpected quarter. The activity came from Kilauea Iki, a subsidiary crater on Kilauea's 4,090-foot crest (map, pages 322-3). There had been no activity there for 91 years.

"We were set for it," Dr. Wayne U. Ault, geochemist of the observatory, recalled. "We had every available vehicle parked outside and our gear all assembled. We were at the rim

* See, in the NATIONAL GEOGRAPHIC: "Volcanic Fires of the 50th State," by Paul A. Zahl, June, 1959; and "Photographing a Volcano in Action," by Thomas J. Hargrave, October, 1955.





GOODMAN © NATIONAL GEOGRAPHIC SOCIETY

Under a Japanese parasol, spectators become silhouettes in flaming mist. Raindrops diffused the volcano's light, creating the ghostly orange haze. "It was like walking through a cloud of cinnamon," reports photographer Goodman. "Even in dense forest, the rain was my flashlight."

Like an oriental scroll, a golden torrent of lava winds across the crater floor and disappears over a ledge at upper left. Within hours all but one fountain subsided. At peak flow the surviving spout hourly gushed two million tons of liquid rock heated to 2,000° F. Jewel-like dots bordering the flow are brush fires lighted as lava climbed the slopes. Halation, a photographic phenomenon, makes the glowing river appear to flow through the twigs in foreground.



Aircraft Lights in a Jeweled Strand Crown Kilauea Iki's Fiery Tresses

Interisland and transpacific airlines jammed the skies above the blazing crater with sightseeing tours. Pilots flew full circle about the volcano until rocketing pumice cracked a windshield and canceled further downwind sweeps.

Gas and steam produce the wind-swept, mile-high plume, which reflects light from the crater.

This time exposure turns flashing wing lights into glowing beads.

in 15 minutes. Only two fountains were working at first. Then more sprang up."

Meanwhile, photographers Robert Goodman and Robert Wenkam were having troubles. They rushed to the Honolulu airport, only to find the terminal filled with sightseers clamoring for space.

It was as if the airline had staged a great "come-as-you-are" party. Sleepy-eyed men in hurriedly donned shorts and aloha shirts and youngsters still in their sleeping garments mingled with celebrators in dinner dress from Waikiki night spots.



GOODMAN © NATIONAL GEOGRAPHIC SOCIETY

Only one plane was then available, with 10 aspirants for each of its 52 seats. More people came by the minute.

At last a line of lucky passengers began to board, and the two agonized photographers stood by, still without seats. Volcanoes were their business. They felt abused as the count of sightseeing passengers rose from 40 to 45, then 50. Here the count stopped. Somewhere on the way, hopelessly delayed, were two tardy reservation holders. But for this misfortune, Wenkam and Goodman would not have been the first cameramen into the crater.

When they arrived, five of the original dozen fountains were still playing, but some of these soon began to die down. As Goodman said later, "We were afraid the show might be ending. So we decided to go down the trail into the crater a little way.

"Every 50 feet brought us new camera angles. Whenever we stopped to think, we were sure we were too close, but then one of us would say, 'Let's go down a little farther.' The thing was irresistible.

"By fits and starts we worked our way to the rift line. I didn't know we were there



until I realized it had suddenly become much hotter. Then I heard a gurgling below me and looked down into the very throat of a fountain that had been playing lava minutes before.

"I was terrified, but I knew this was a chance that might never come again. And dawn was already breaking.

"Soon we were so close to the main fountain that we couldn't stand the heat for more than seconds. We would dart toward it, make exposures, and run back. Each time our clothes seemed to sear us wherever they touched, and we felt as if we would burst into flames ourselves.

"Finally the sulphur fumes got so bad our throats felt as if we had swallowed gravel. Daylight had come, and we were exhausted. So we worked our way back to the trail, shooting as we retreated. All of a sudden I got really scared. For the first time it occurred to me: Nobody in the world knows we're down here!"

Halfway up the trail they met a Geological Survey team on one of many trips to the crater floor (opposite). Here was new picture material. So back the photographers went, leaving the trail to get to the edge of the lava that had pooled on the floor of the crater during the night. This was a seemingly vertical descent, with crumbled lava providing an uncertain footing and fragile tree fern an unsure handhold. Burdened as they all were with cameras and instruments, it is amazing that no one slipped into the lava below.

Stunned Visitors Look Like Refugees

In midmorning I met the two tired men at the Hilo airport, on their way to Honolulu to process and mail their film. Both wore the drawn, gray look I had last seen on Marines coming out of the line in Korea.

"Did you get it all?" I asked Goodman.

"I got it all. It'll be on the midnight jet to the coast."

The tourist viewpoint of the eruption was on Kilauea Iki's rim, a mile and a half from

Volcano House, which was to be my home at intervals in the weeks ahead. A good road leads from the hotel to the eastern rim of the crater. By the time I arrived on Sunday morning, 16 hours after the eruption broke out, Hawaii National Park employees and servicemen from the near-by Kilauea Military Camp had sightseeing traffic under control. We parked our car half a mile from the rim and hiked the rest of the way (page 312).

We walked through a forest of gaunt, gray-barked ohia rising from an underbrush of ohelo shrub, tree fern, and blackberry brambles. We could hear the roar of the unseen volcano and the crackle of fires as trees along the crater's wall exploded from the heat. These sounds, as of battle, gave me the impression that the crowds of people trudging toward us were evacuees. Parents carried crying children, blankets, and lunch boxes; only cameras and binoculars betrayed them as spectators.

Beauty Masks the Volcano's Danger

Then we came to the eruption. Two fountains thrust torrents of red-hot lava 200 feet into the air, far up toward the crater's rim. Half a mile away, they were like lion cubs, beautiful but potentially dangerous.

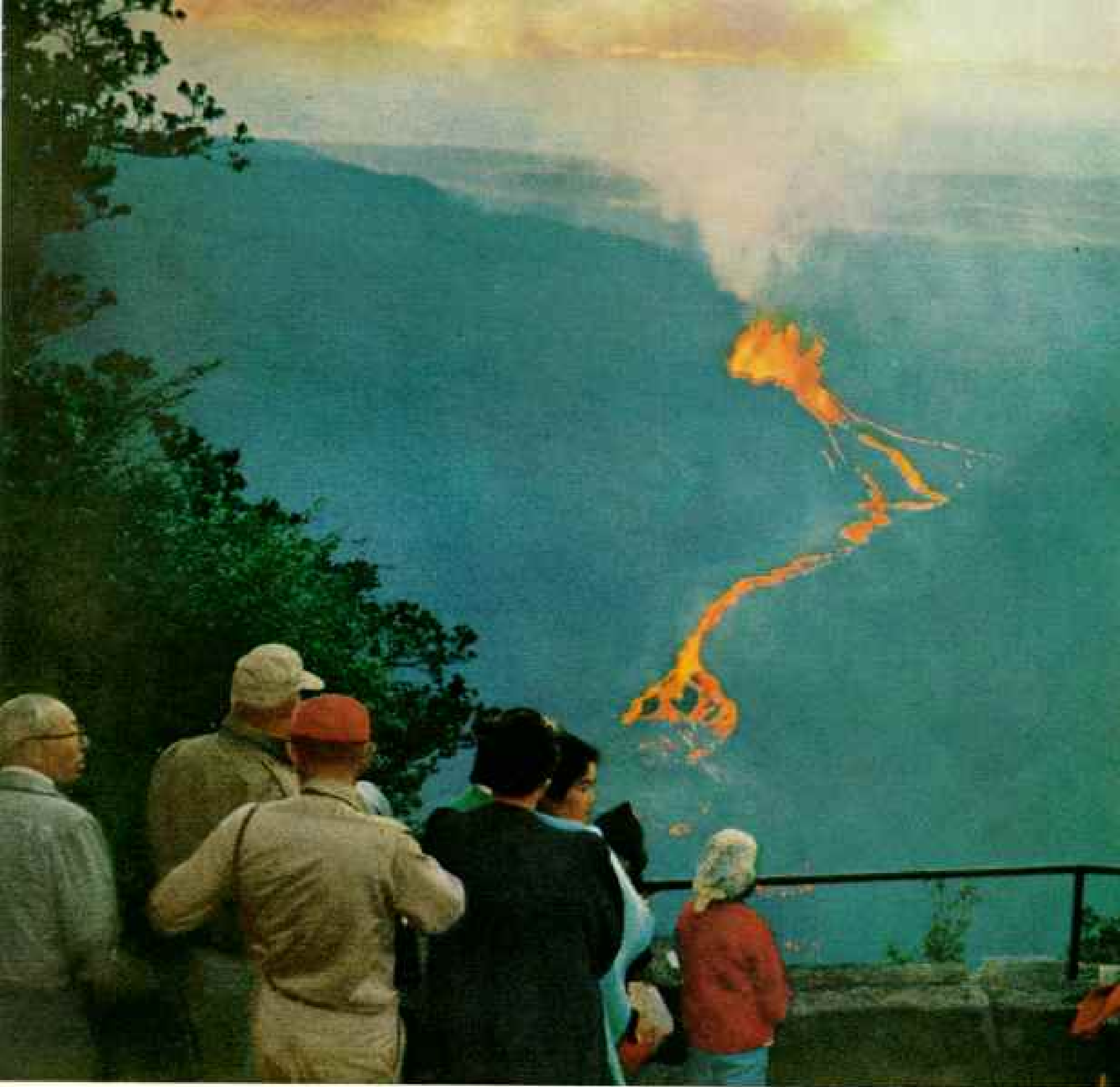
Even as one fountain was dying, the other was growing to magnificence. It seemed to pulse and breathe as it played. The lava it blasted upward streamed down to splatter on a shelf, then merge in a molten cascade to the crater floor, 300 feet below (page 305).

The floor was streaked with red rivalets of running lava, and a fiery pool was turning gray here and there where it was already crusting over. There were puffs of smoke around its banks as ohias caught fire.

Although the cascading lava lighted the whole sky, it was at that point a modest display as such things go. The surviving fountain was blowing out only about 45,000 cubic yards of lava an hour. As recently as 1950, an eruption not far from here—near the summit of 13,680-foot Mauna Loa—flowed 150 times that fast at its maximum.

Volcano Guardians Brave an Inferno to Take Their Patient's Pulse

Scientists of the U. S. Geological Survey's Hawaiian Volcano Observatory ran daily tests on Kilauea Iki's debris, but never approached flowing lava without a clear line of retreat. Only 100 yards from the blistering spray, this party (see text, above) risks painful lava burn or asphyxiation from a shift in the wind. One man described such exposure as "a little like standing behind a jet plane when the pilot lights his burner." A moment after the picture was taken, the volcano spat a stream of lava at the intruders, forcing them to withdraw to higher ground. Massive flows soon to come (page 319) buried this spot under millions of tons of molten rock.



Continued





HERBERT S. WILSON, NATIONAL GEOGRAPHIC STAFF © N.G.S.

A lava lake is born as molten rock streams from the vent and repaves the crater's old floor. Visitors and a park naturalist (right) on the second day of eruption gaze down on lower slopes that are now forever sealed beneath a basalt slab hundreds of feet thick. Viewers stand on Byron Ledge Overlook. Byron Ledge itself, just beyond the fiery fountain, separates Kilauea Iki from Kilauea Crater (map, pages 322-5).

Winds carried wisps of volcanic glass nearly 50 miles from the fountain.

Midnight sun from the eruption's glare bathes a motorcade of sightseers. So large were crowds at early displays that spectators often waited two hours to take their turn for a 10-minute view. Many cars on leaving the "drive-in" crater rejoined the line immediately.

Yet this eruption had a special appeal from the outset. From the sightseers' point of view, it was almost as accessible as if it had burst forth at home plate in Honolulu Stadium.

The scientists were delighted, too. They could get down to the fountain and pools with relative ease, and their laboratory and equipment were close at hand. There was no rain-fall at first to carry radioactive fallout, still lingering in the atmosphere from bomb tests, and spoil their samples. And the crater cupped the lava like a giant beaker, reducing the chance of contamination. Here was an ideal clinic for their fundamental assignment: To learn how and at what rate a flow of magma adds to or alters the land, sea, and air.

The next day brought my first opportunity to see how it is to look up, rather than down, at a volcano. With seismologist Jerry Eaton and geologist Don Richter of the observatory, I went down to the crater floor. The trail started out through a forest of tree fern so verdant that only the roar of the eruption reminded us that this was more than a pleasant downhill hike. Among the tree fern grew little bunches of strawberries bearing a white fruit sweet to the tongue.

Fumes Kill Unsuspecting Birds

Overhead, the red-and-black apapane and the elepaio sang. These birds, native to the Islands, abound in the volcano district. I thought then that they seemed conditioned by the ages of eruptions, and were taking all this as a matter of course. But later I saw several of them plummet into the lava, overcome by gas. Eventually, when the fountain finally reached its full fury, their bodies dotted the road behind the crater.

Our trail proceeded in switchbacks; to descend the 740-foot cliff took us more than a mile. Of that mile, all but the last 50 feet was a delight.

Then the heat of the lava lake made itself really felt. We began to smell the sulphur gases, and puffs of vapor emerged through the rock and fern.

"Those are danger signals," Eaton cautioned. "They show where pressures may be developing or combustible gases accumulating. Explosions often result."

I counted rapidly and saw a score of explosive possibilities ahead. Farther on, burning trees arched the trail as it disappeared into oozing lava, poinsettia red.

The first mission for Richter and Eaton was to set out bench marks so that they might measure the rise of the lava day by

day. They calculated it had already covered the crater bottom to a depth of 15 feet.

Their second job was to walk across the encrusted lava pond toward the fountain to photograph and inspect the cascading lava. To me this was a daring excursion, but Eaton dismissed it lightly. The fact is that although the lava hardened rapidly, its surface temperature was still more than 200° F., and a few feet below the surface it remained molten at more than 1,500° F. The crust formed like ice on a river, constantly cracking and shifting.

Lava Threatens to Cut Off Retreat

As Richter and Eaton prepared to walk the crusted lake, they observed that my tennis shoes—fine for walking over cold lava—would not stand the heat. I was never so grateful for improper attire.

I went up the trail a way, a cautious distance above the puffs of vapor, and sat in shade where I could watch Eaton and Richter pick their way across the lake. As I sat, I wondered what would happen if those early fountains, now directly over my head, were to

come alive. What if the whole thing blew up? I could see that the surface of the lake had risen a foot in the time I had been there. What if it were to rise faster than I could climb the trail?

Still, I could not leave. For one thing, I wanted to wait for a souvenir to cool—a penny Eaton and Richter had encrusted for me in a blob of molten lava. I was held also by the beauty of the fountain and its hints of how the earth was born. Most of all I had to watch those two men as they made their way over a surface where one misstep could plunge them into annihilation.

It was hunger that finally drew me to my feet and the long, hard climb up the trail.

That night the fountain really began to flourish, and Goodman and Wenkam came back for more pictures. This time they were better prepared, with warmer clothing, flashlights, water—and even a tin hat.

Following a back road to avoid traffic and roadblocks, they drove close to the crater's edge and hiked on through the darkness. For minutes they just sat and looked.



Blazing Batter Explodes Above a Doomed Forest

This remarkable view less than 100 yards from the volcano's throat shows molasseslike blobs that explode as their imprisoned gases expand, producing what one witness called "devil's popcorn." High Speed Ektachrome, a sensitive new film, stops the lava in mid-flight and reveals patches of tranquil blue sky.

Intent faces bear the mark of Kilauea Iki's hypnotic spell. Some 170,000 persons visited the volcano during the first two weeks. "They rarely spoke," says photographer Goodman, "and when they did, it was in cathedral tones."

To veteran watchers Kilauea Iki became "our volcano." One man wept when the fountain seemed to die. This crowd watches from Byron Ledge Overlook, half a mile from the vent.





"It held all the satisfaction, magnified an infinite number of times, of watching a camp-fire," Goodman said. "Finally, we realized why we were there, and we began shooting from the rim. But it was too cold. The heat from the fountain warmed us in front, but our backs froze in the wind and drizzle. Finally, we went down into the crater, as much to get warm as to get pictures.

316 "Once in the crater," Goodman continued, "we felt again the lure to get closer. But

this time the fountain was playing twice as high and seemed twice as hot. We had to hide behind trees and dart out for shots. Then the wind shifted. We could hear the cinder marching toward us as it splattered on the leaves of the trees. We moved to a ledge overlooking the mouth of the fountain. I felt a shaking and first thought it was in my knees. At that point we realized the ledge we were standing on was shaking violently. So we got out of there, and rightly, too—that



GOODMAN © NATIONAL GEOGRAPHIC SOCIETY

ledge just isn't there any more.

"Finally we got all the pictures we wanted. Then we found a warm ledge that wasn't shaking and took a nap—our first in 36 hours."

Sole hotel in the eruption area is Volcano House, and here Goodman and Wenkam went to dry out the next morning. The inn maintains a "perpetual fire" in a fireplace to remind tourists of the

possibility of an eruption—but in all the excitement, it had been allowed to go out.

Central character of Volcano House is "Uncle George" Lycurgus, a sturdy centenarian born in Greece. I observed the old gentleman one day during the eruption greeting guests
(Continued on page 322)

Space-suited Lava Hunter Dips a Sample of Fiery Gruel From the Advancing Tide

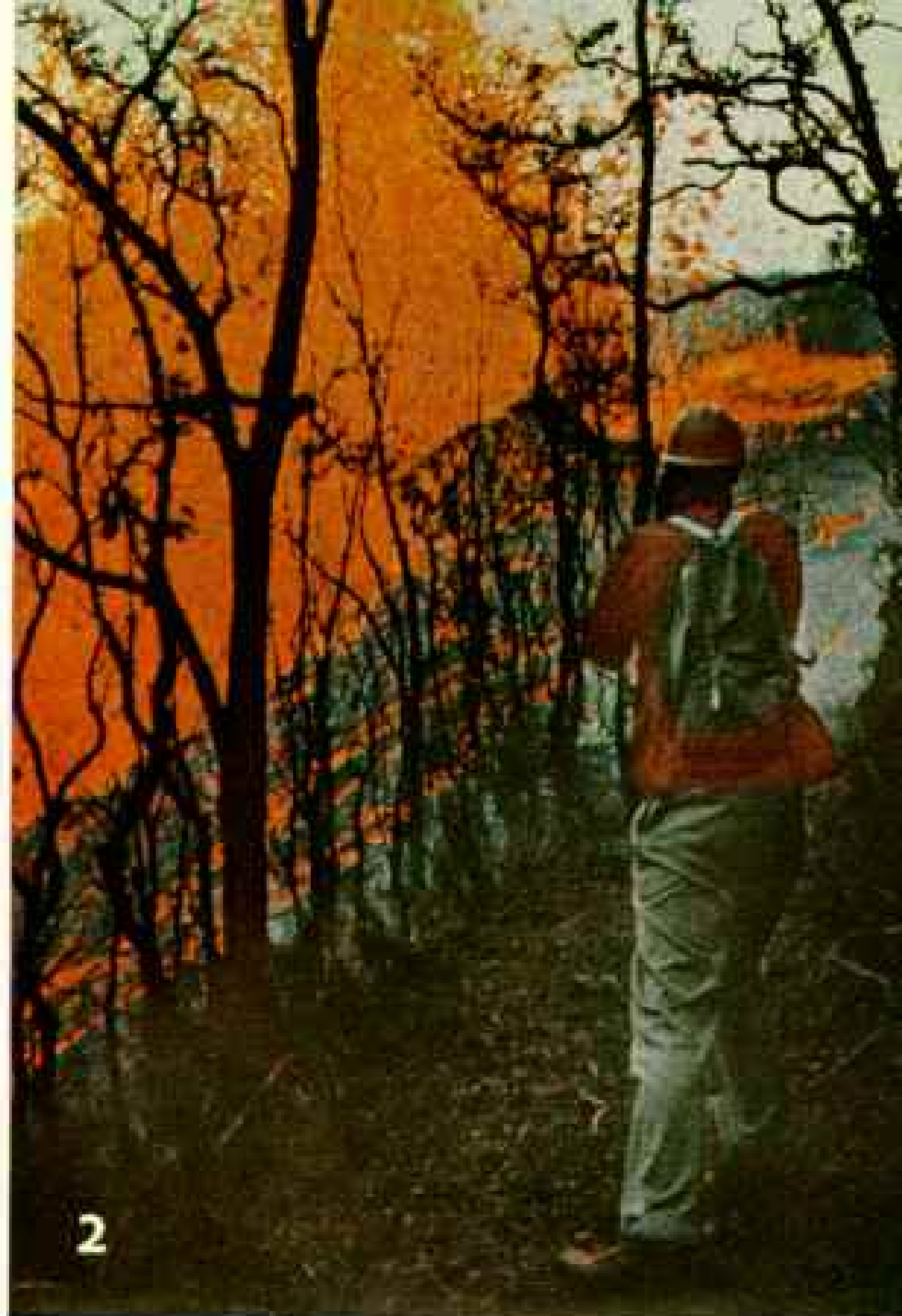
Geochemist Wayne Ault, who tested the aluminum-coated Fiberglas coveralls, found the suit a "portable oven." Its mirrorlike surface effectively reflected heat, but lack of ventilation left him soaked and exhausted within minutes.

Shrubs at right, engulfed by the relentless flow, burst into flame. Far larger trees became charred posts, held upright only by a thin crust of cooled lava. Visitors easily uprooted trunks six inches thick.

Another scientist detaches a still-glowing blob of pahoehoe, a lava that cools with a smooth, porridgelike appearance.

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GUIDERAS (1, 2, AND 3) AND WERRAN (4, 5, AND 6) © NATIONAL GEOGRAPHIC SOCIETY





Life Cycle of a Fire-breathing Giant: From Gurgling Birth to Thundering Prime

Kilauea Iki began its spectacular career at dark as a chain of cataracts (1) spurting from a 2,500-foot-long rift zone in the old volcano wall and tumbling in an incandescent Niagara.

By morning only two fountains remained (2). Photographer Wenkam snapped their portrait at 50 yards. That night one of the vents died.

The survivor (3), flexing its muscles at dawn on the fifth day, climbed to 700 feet.

Celebrating its first week of life (4), the fountain soared to 1,250 feet, shifted direction, and scattered spectators. Then, having raised the crater floor 335 feet, the monster subsided.

On the twelfth day Kilauea Iki roared again (5), blowing a 1,000-foot fountain and loosing waves of glowing surf across the crater floor.

After resting for a day, the jet reappeared (6), registering 1,600 feet on the National Park Service's homemade height gauge.

Next page

Kilauea Iki's Colossal Torch Sears the Sky

With a climactic burst on November 29, the fountain set a new altitude record for Hawaiian volcanoes. At times it reached 1,700 feet, nearly a third of a mile. Later it soared to even greater record-breaking heights, up to 1,900 feet.

On January 13, 1960, Kilauea burst forth near Kapoho, some 25 miles to the east, forcing evacuation of two villages.









World's tallest mountains if measured from base to peak, Mauna Loa and Mauna Kea on the island of Hawaii rise more than 30,000 feet from sea bottom. Volcanoes built them, inch by inch, through the ages.

at 8 a.m. and drowsing before the fire at 3 the following morning.

Slender, thin-faced, and mustachioed, Uncle George has been innkeeper for the volcano for 56 years. His fortunes have varied with its activity. This time he had booked a cattlemen's convention for the weekend the eruption broke out. Their leather jackets, silver belt buckles, and high-heeled boots added color to the generally bizarre costumes of the other visitors.

For no one has yet established the proper costume for volcano watching. I've seen women sloshing through the mud in pastel-colored shoes with spike heels. One couple I know dug out the raccoon coats they had worn to college in the twenties. Blankets

322 found favor at night, often shared, poncho-

like, by two or three chilled sightseers.

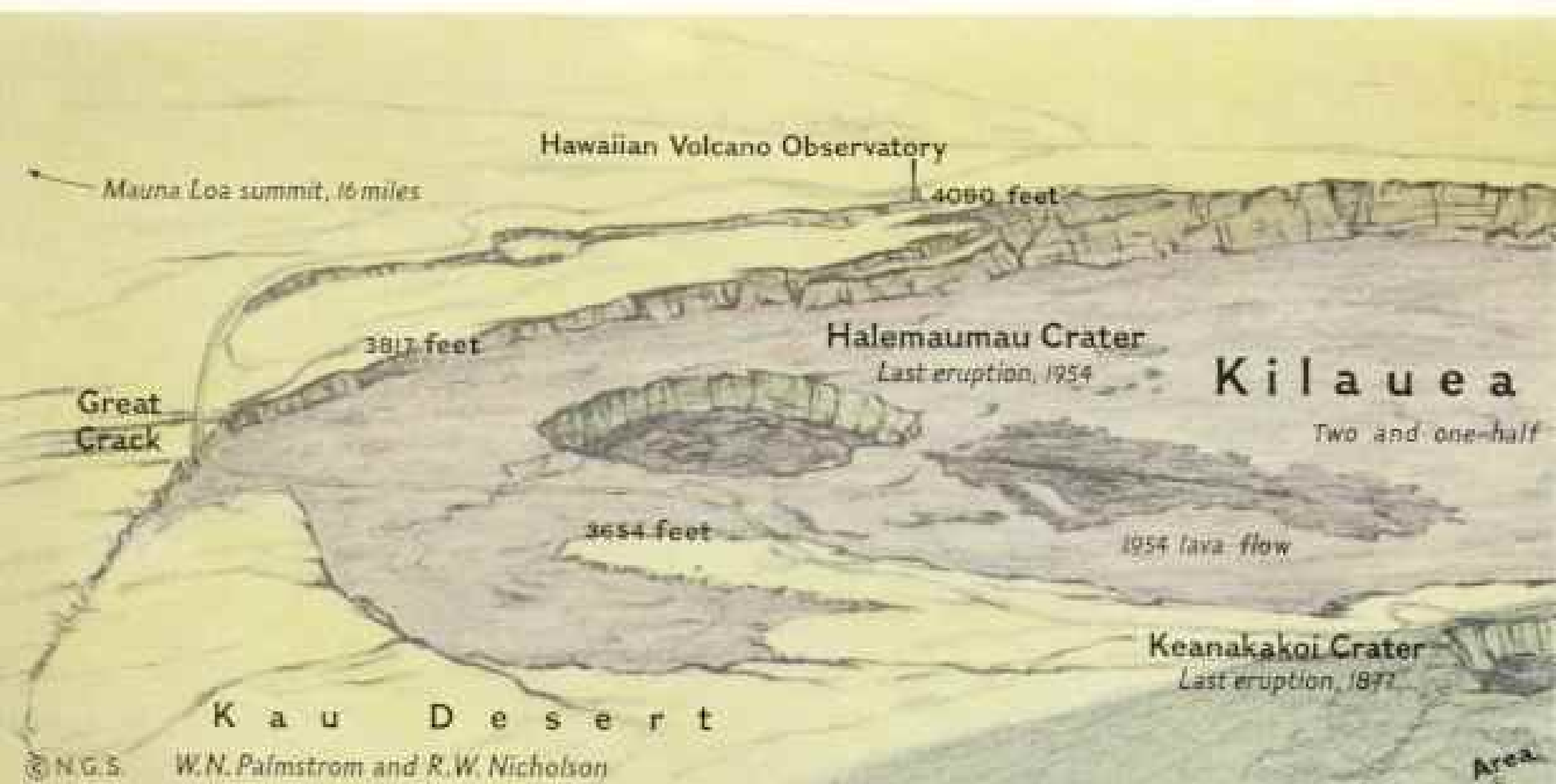
Many craterside scenes remain in my mind: A mother who was trying to teach a little girl to use binoculars and couldn't get her to open her eyes. A ranger, calling stridently through a bull horn, urging the crowd to move because a wind change threatened them with hot cinders. An invalid woman with two canes hobbling in the rain at midnight. And three Hawaiian grandmothers in trailing night-gownlike muumius watching the fountain in awe and whispering about the goddess Pele.

In the mythology of Hawaii, Pele is the volcano goddess. She is believed to have lived at some time in every crater of the Hawaiian chain. Currently, Halemaumau is thought to be her home. Some islanders still believe in her and even toss offerings into the crater. Traditionally a black pig or berries of the ohelo bush served; today Pele's taste runs more to gin, tobacco, or brandy.

The wife of Mori, the Japanese major-domo at Volcano House, believes in Pele. She says the earthquakes that preceded this eruption were not like the rolling shakes of the past. Rather, they were sharp, like knocks on a door. Thus she knew, before it came to pass, that the flow would not be in Halemaumau, for Pele was knocking at the door of a new home.

Hawaii's two airlines did a rich sightseeing business during the eruption. Their planes flew over from Honolulu in an hour, circled the crater for about half that time, and then returned. In a single weekend 171 such flights were scheduled—enough to carry more than 8,000 passengers (page 308).

These trips were homey affairs; the pilots



reporting the latest data on the eruption; the stewardesses passing pineapple juice. The passengers even played a game of musical chairs, changing sides at the pilot's command to share the view.

The volcano pelted some flights with pumice. Capt. Robert S. Barnes, 13-year veteran with Hawaiian Airlines and a World War II pilot, was circling the volcano on Wednesday night following the eruption.

"I felt something like light hail striking the wings," he told me. "I was sure it was pumice, so I widened my flight pattern. On my last time around—several miles downwind from the fountain—it happened. A big chunk shattered the outer pane of the windshield. I couldn't see a thing. Fortunately, the copilot's windshield wasn't affected."

"Were your passengers upset?"

"No. I told them right away that we'd be making a precautionary landing in Hilo," Barnes answered. "I think they were just pleased that it had held off until the last time around, so they had all their pictures."

He added, "You might ask our purchasing people what one of those windshields costs."

I did: \$642.

Scientists Take Volcano's Pulse

But to scientists of the U. S. Geological Survey, the volcano is much more than a spectacle to be seen and photographed when it blows up. It is a marvelous phenomenon to be studied in dormant periods as well.

Taking the pulse of the mountain with the seismograph, scientists record earth tremors that tell dramatically of movements of magma within the chambers of the earth's crust.

Other instruments that measure the tilting of the earth's surface can detect an inclination of one inch over a span of 75 miles. Roughly speaking, such movements reveal the build-up of magma beneath the surface. Before this eruption started, Eaton said, the tilt was so great it was "off the map."

During an eruption, the scientists take samples of the molten lava and gases to analyze them and learn, among other things, the probable depth of their source.

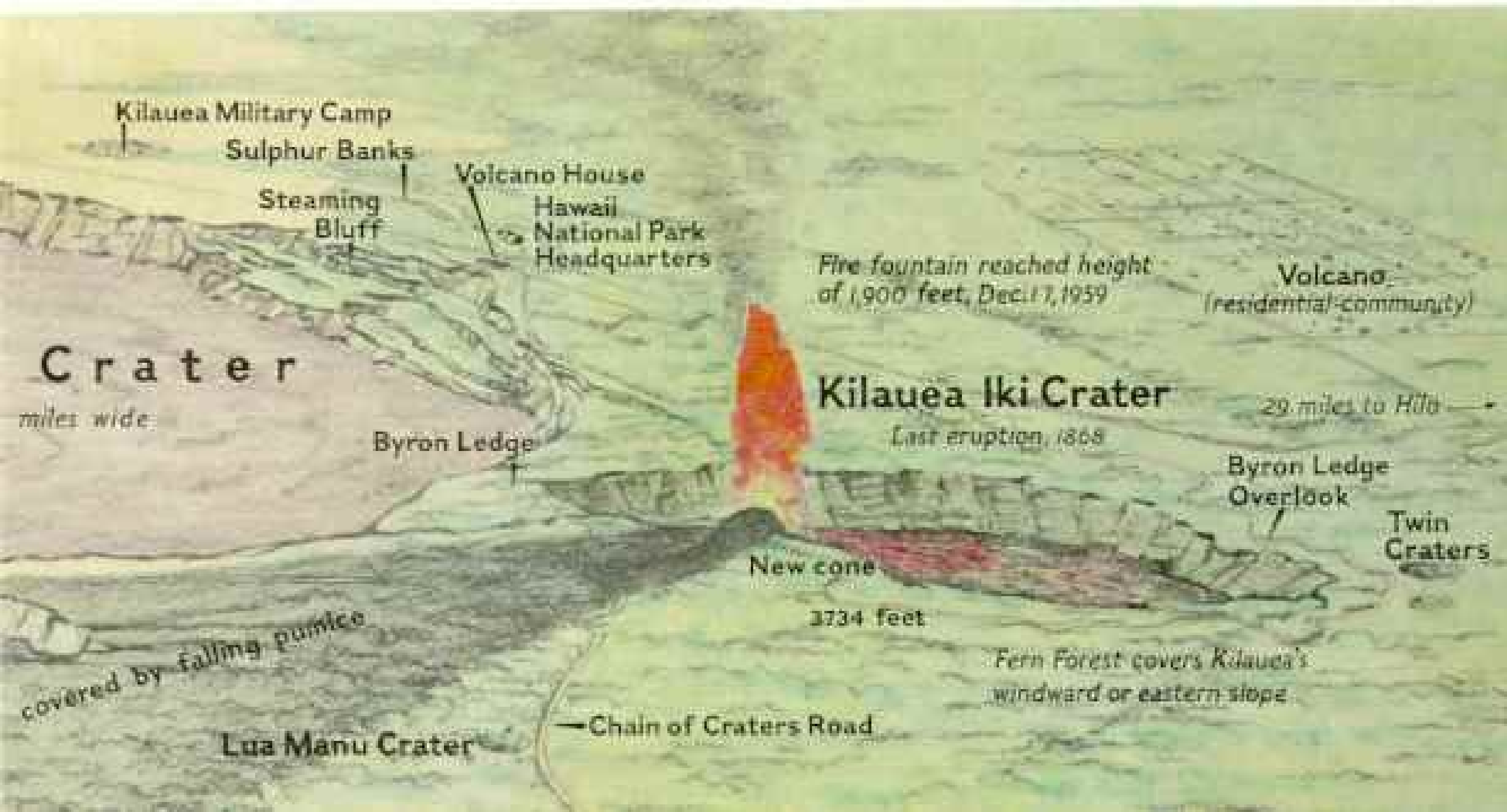
Getting such samples is not as simple as it sounds, and during the first few days Ault and Richter didn't have much luck. Though protected by a Fiberglas-and-aluminum suit that reflected 97 percent of the heat, and working with tubes on the ends of poles, they still got too hot (page 316). When Ault took off the suit after one session, he found he had sweated through his wallet, and the paper money in it was wringing wet.

But a few days later they found what Ault described as "a nice little flow." They devised an effective aluminum shield with slits to see through. And they got the samples they needed.

Twice Ault flew low over the crater in a National Guard plane and captured gas by extending a tube out the window.

"It worked fine," he said, "but the sulphur dioxide made me sick."

Through this first week the fountain was growing—300, then 500, then 800 feet. On Saturday I determined to get as close to the fountain as I could and with my wife drove around behind it. By this time it had built a 200-foot cone of pumice and cinder and had changed from a fountain of cardinal red 323





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Howling Tornado of Brimstone and Fire
Threatens to Atomize a Reckless Invader

With the roar of a thousand express trains, the
hellish storm seems to sweep directly overhead,
its blazing projectiles changing color during flight



ADDACCHIONE BY WENHAM © NATIONAL GEOGRAPHIC SOCIETY

from incandescent red to charred black. Fallout engulfs road and guard rail beneath a mountain of pumice. A telephoto lens pinches the gap—

some 400 feet—between this news-photographer and the impact area. Even at such a distance heat can affect the film in his camera.



EDUCATION BY WIKEMAN © NATIONAL GEOGRAPHIC SOCIETY

Stripped and blasted by semimolten pumice, the limb of an ohia tree reveals devastation half a mile from the vent. Fiery hail flayed the bark and incinerated the side facing the eruption, leaving the lee section intact. "It was as if some gigantic hand had taken sandpaper and a blowtorch to the forest," said the photographer.

to a curtain of gold, showering particles from nearly 1,000 feet above the crater's rim.

As we approached, the road signs beside us shook from the force of winds caused by the eruption, and the rumble and roar were deafening.

I wanted to retrace the trail I had walked with Eaton and Richter earlier in the week. We were scarcely on our way when we met Richter, with a party coming up behind him.

"We're going down to see where you and I went with Eaton last Monday," I explained.

"Last Monday! Why, that's under 300 feet of lava now!" was the answer. "And be careful down there. The fumes are bad, and there are fires all over the place."

We went ahead, I somewhat bemused, recalling where I had sat that afternoon and watched the two men set out across the pond. I thought: That beautiful spot will never feel air or the sun or be seen by man again. We pushed on, but soon the fumes from the pit did become oppressive. And the smell of smoke from smoldering vegetation hung over everything. On the surface of the lake, fumes

rose from a hundred crevasses. There was still green where we stood, but the wall across from the cone had burned a solid gray. I made this note: "Side where sun strikes is dry, burns first, but shaded side is wet, so fire resistant."

Just then I heard a crackling. Fire was breaking out above us in something that was far from fire resistant. We raced to get up the trail before it cut us off.

That night the volcano lost its vigor. First its golden light turned a dirty blood red. Five minutes later it began to sag and lose its height, and in 40 seconds it was out. The crater, now half filled with lava, appeared left for the scientists and the birds again.

But a week later, as I was putting these observations together—thinking I had seen the end of the story—I got a phone call:

"Kilauea Iki has erupted again!"

So I hurried back. When I got there, I thought at first that I had wasted a trip, for the fountain had already fallen back again. But fire still reddened her throat (somehow I think of her as feminine—perhaps because her beauty disguised her danger), and, though I had no way of knowing it, she was about to put on the most fantastic show yet.

Since I was there, I decided I would inspect the aftermath. The crater floor was now so cracked that by day it seemed to hold a hundred burning campfires. At night the red of a thousand rivulets showed through.

Cinder Plows Clear the Road

I visited the familiar trail again, taking along my family.

All was quiet this time. The fires had died down, and the puffs of vapor had thinned to the vanishing point. The lava, now heavily encrusted, had sagged in spots as much as 25 feet because of shrinkage and the backflow into the vent. Near the banks, strange "vegetation" rose where lava had encased trees and then dropped back.

Bulldozers had cleared the road of cinder, pushing it aside like snow. We saw families shoveling it into sacks to use for mulch in Hilo gardens. Tourists strained it through their hands, looking for the black, shiny beads known as Pele's tears, and semiprecious brown-green stones called olivines.

At the cone we watched steam emerge from the 200-foot mass. I found it incredible that this shape, nearly half as tall as the Washington Monument and heaped with the symmetry

of a giant sand pile, had not been here two weeks before.

On our way back, playing a hunch, I detoured by the observatory. Richter was there.

"I've just come from climbing that trail a final time," I said.

"Are you sure it's the final time?" he asked.

So there was something to the hunch. I turned to the seismograph. Its needle wavered grandly.

"Is this normal?" I asked, hopefully. His reply was cautious: "I've never heard of its acting that way when an eruption didn't follow."

Road Buried Beneath 90 Feet of Cinder

That night we saw the greatest display yet. The eruption had been a thing of beauty before; this was anger. The fountain was dark red—the red of beets—and it hurled into the air massive blocks the size of pianos.

I passed through the barricades and drove again around the crater to see how close we could get. A hundred yards from where we parked, cinder rattled on the pavement. After pointing the car toward safety, I advanced along the road a few paces until I could see where we had searched for olivines so peace-

fully earlier in the day. We learned later that 90 feet of cinder had buried this stretch of road.

Next morning the berserk fountain played ever upward, tossing its body in wild patterns with the abandon of a demented being. To 1,500, then 1,600 feet it towered. I was on the rim as it pumped to 1,700 feet, at that time the record for observed Hawaiian fountains and perhaps for the world.

The slightest shift in the wind threatened to submerge us in cinder. There was no certainty what the volcano would do next and no power known to man to contain her.

Later, looking back from miles down the road to Hilo, I could still see her, tossing her red-and-black mantle above the mountain slope like a pagan goddess in a swirling cape.

I didn't know she was to subside that night, only to return again at frequent intervals for weeks, shattering even her own record. But a remark of Eaton's lingered in my mind.

"People always want to know two things about volcanoes," he said. "If one is erupting: how soon will it stop? If it's dormant: when will it erupt?"

"The answer is the same in both cases. We are one day closer to it."

Pumice Obliterates a Road and Enforces a Stop Sign's Command

No tires whine; no engines hum. Only the occasional crunch of a sightseer's shoe on yard-deep cinder breaks the ghostly silence. Scientists and park employees, harried with emergencies during the eruptions, knew quiet spells like this as "peacetime."

WENKAM © NATIONAL GEOGRAPHIC SOCIETY





A Mountain Heaves, Rocks Cascade, and Dust Boils Up: an Earthquake in Action

Seismographs recorded 270 aftershocks in the 24 hours following the disastrous Montana earthquake of August 17, 1959. When one shock



YELLOWSTONE NATIONAL PARK RANGER ELLIOTT

jolted Mount Jackson in near-by Yellowstone Park, nine hours after the first quake, an alert-ranger made this extraordinary color photograph.

Montana's historic 1959 earthquake wrenched the Rockies, created a lake, and touched off new geysers in Yellowstone Park

The Night the Mountains Moved

By SAMUEL W. MATTHEWS
National Geographic Senior Staff

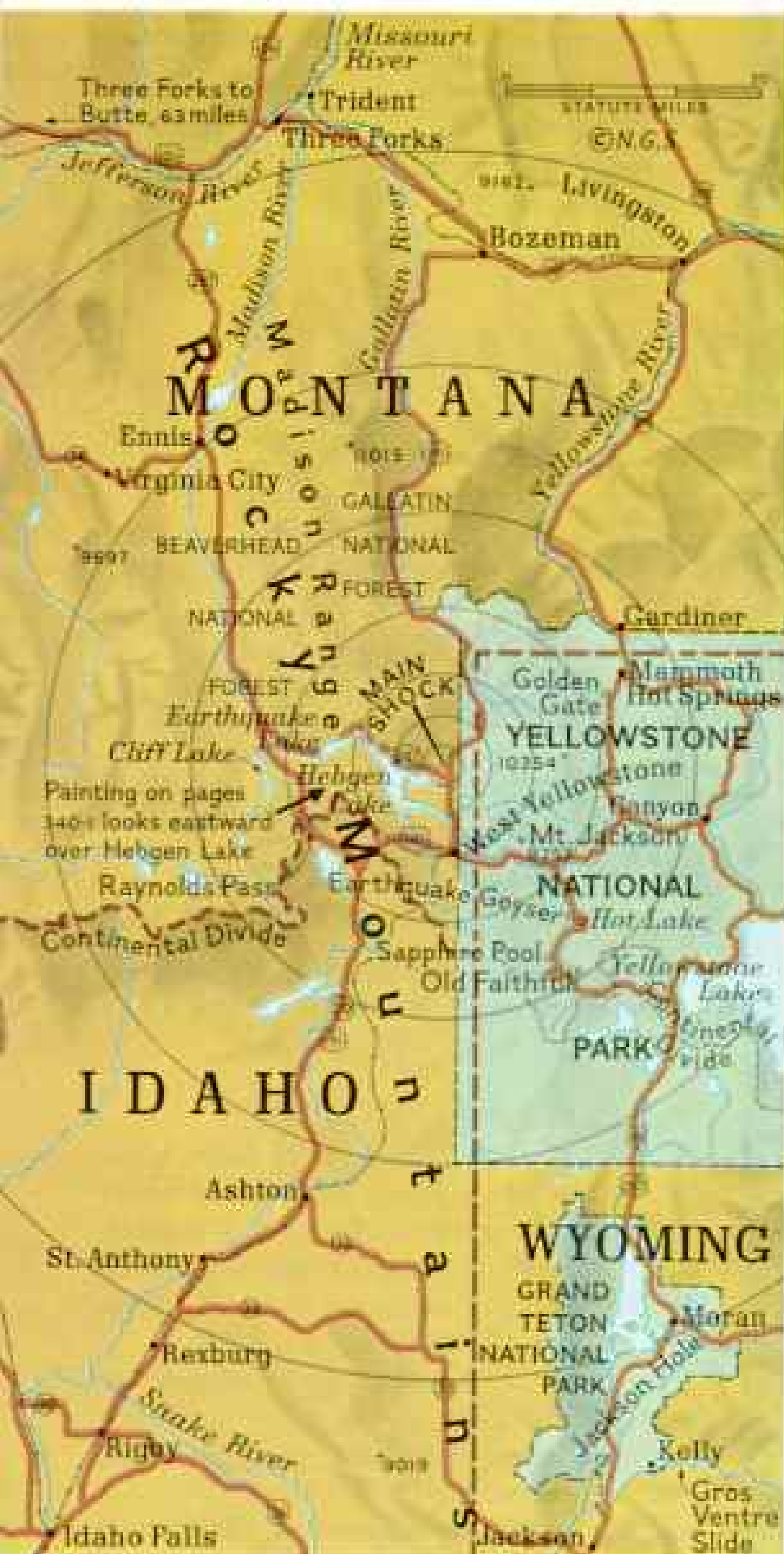
*Kodachromes by National Geographic
Photographer J. BAYLOR ROBERTS*

LATE that clear and gentle night a full moon rode above the tumbled mountainland where Montana, Wyoming, and Idaho meet. Along the mile-high Madison River the air hung cool and still. Monday, August 17, 1959, was nearly over.

Suddenly, 22 minutes and 45 seconds before midnight, an earthquake of historic force wrenched thousands of square miles of the northern Rockies. The earth's crust, warped by unimaginable strain, broke and shifted along several faults, or fractures. A lake in southwestern Montana tilted. Water leaped a dam in racing waves.

Downstream in the Madison's narrow canyon, a mountain face 1,300 feet high and half a mile wide split off and came roaring down on sleeping campers. Eighty million tons of rock and earth smashed into the river and splashed 430 feet high against the facing slope (pages 332-3). Water and terrible blasts of air shot out from under the thundering slide.

In Yellowstone National Park, 20 miles east, the peaks trembled, rockfalls cascaded across roads, and steaming geysers, mud volcanoes, and boiling-hot pools erupted simultaneously in unseen splendor.



Mountain-topping quake pounded Montana, Idaho, and Wyoming. The epicenter, or area on the earth's surface above the earthquake's origin, lay near the eastern end of Hebgen Lake.

Trees teeter along a cliff, or scarp, that suddenly split Cabin Creek Campground in Gallatin National Forest. Exposed soil and gravel trace the Hebgen Fault, a rift in the earth's crust that parallels Hebgen Lake's north shore for eight miles (painting, page 340). A visitor from Salt Lake City, Utah, photographs a fissure that snakes through a shattered fireplace.

Today, months later, earth scientists, naturalists, and engineers are still studying the earthquake region. They have surveyed, plumbed, measured, and mapped. From their work gradually has come a detailed picture of a convulsion of nature that dramatically reshaped an American wonderland.

To report on the earthquake's effects, what caused them, and what they will mean to residents and visitors for years to come, NA-



TIONAL GEOGRAPHIC photographer Joe Roberts and I spent many days exploring the area.

We first saw the Madison Slide on a September day when rain laced with snow slashed through the canyon. Earthquake Lake, the water dammed by the slide, stood 180 feet deep in the gorge, twice the depth of man-made Hebgen Lake six miles upstream.

Water ripped and foamed down the slide's face, into the riverbed below. Bulldozers, half

drowned, labored in the rapids. Joe and I found ourselves atop a wall of shattered rock, hundreds of feet above what once had been a popular camping spot within the Gallatin National Forest in Montana.

Rock Creek Campground had stood beside one of North America's most famous trout-fishing rivers, on the one hand, and a major park-to-park highway, Montana 287, on the other. Now road and river ended abruptly at







this massive barrier, and somewhere beneath rock and water lay the campground (painting, page 340).

That night of August 17, the Bennett family of Coeur d'Alene, Idaho, had been among those camped in the canyon mouth. Eastbound for Yellowstone after a day in the gold-rush atmosphere of Virginia City, Montana, they had decided to sleep under the stars. They pulled their station wagon off the highway into a pleasant turnout beside the river, and settled for the night.

Some 250 other vacationists slept in the canyon that August night. When the earthquake struck, tents, trailers, and cabins lurched and jounced as if shaken by angry bears. Actually, many campers at first thought bears were attacking them.

The Bennetts, oddly, were not greatly alarmed. The four children, in bedrolls on the ground, slept on. In the station wagon their mother and

Where a Mountain Fell: Nature Erects a Dam and Creates a Lake

Jarred loose by the earthquake, 80 million tons of rock slid off a spur of the Madison Range, leaving the naked scar on the left side of the ridge. The avalanche dammed the Madison River and buried Montana State Highway 287 beneath some 400 feet of rubble (center). Water backing up behind the slide formed Earthquake Lake. Bulldozers carved roads and shaped a spillway over the crest of the slide.

The slide threw up a barrier with a base five to eight times thicker than that needed for a man-made rockfill dam of similar height. Its volume, 43.4 million cubic yards, equals a third of the fill required by the Nation's largest earthen structure, the Fort Peck Dam across the Missouri River.

The new lake now stretches five miles upstream and reaches a depth of 130 feet at the toe of the dam.

ILLUSTRATION BY NATIONAL GEOGRAPHIC
PHOTOGRAPHERS J. EATON ROBERTS AND
GUYER GERARD. FILM © N.G.S.

father awoke, but merely wondered "what the loud noise had been."

Some time later, Mrs. Bennett remembers, they heard another great roar. Hastily they went to check on the children. Mrs. Bennett felt a blast of wind and saw her husband grab a small tree for support. She saw him "lift off his feet, hang for a second like a flag, and let go."

She never saw him alive again. One of her children flew by, and a car rolled over and over past her. Then she lost consciousness.

"The first thing I knew I was in water, rolling and banging into things," 16-year-old Philip Bennett told me (opposite).

When he stopped, he knew his left leg was badly broken. He felt no pain, but he was entirely naked and very cold. The earth trembled, and huge shadows rolled in the sky—dust clouds, he realized later. He crawled crablike into a clump of trees and dug into

the mud to keep warm. All night he stayed awake, sure that more water would come rushing down on him, "preparing for it."

At dawn searchers heard Phil and Mrs. Bennett calling for help, and found them in the dry riverbed on the edge of the slide. Later they found the battered, lifeless bodies of Mr. Bennett and his other three children.

Wind Tears Clothes From Campers

Seven families between the Bennetts and Rock Creek Campground were buried alive by the rock, earth, and trees of the landslide. Other people in the campground proper were picked up by water that backwashed 100 feet up the mountainside, and by the hurricane-velocity gusts shot out as the slide displaced air in its path. Several had their clothes literally torn from their bodies.

Nine, in all, could be counted dead. Nineteen more are still missing to this day, pre-

Survivors await rescue on a slope facing the slide-scarred ridge. Fearing a flood if Hebgen Dam gave way, pajama-clad campers leaped out of bed and fled to high ground.

PAUL F. JESSUP AND EBERETT D. HARE





ALBERT WILDEVAY (ABOVE) AND NATIONAL GEOGRAPHIC PHOTOGRAPHER J. EYCOCK ROBERTS (C) W.F.D.

Victims Bed Down on Bales of Hay

Rescued by helicopter, the injured lie beside West Yellowstone airfield awaiting evacuation by ambulance plane to Bozeman, Montana.

Some of the 250 campers trapped by the earthquake in Madison Canyon abandoned their cars and scrambled across the slide. An emergency road let others drive to safety. The quake's toll: nine dead, nineteen missing.

Plucky survivor, 16-year-old Philip Bennett of Coeur d'Alene, Idaho, suffered a mangled leg but remained conscious until rescued. His father, brother, and two sisters perished in the slide. Nurse Mona Reid autographs his cast as he leaves the hospital in Emmis, Montana, after 47 days.





JOHN R. STACEY, U. S. GEOLOGICAL SURVEY (ARROWS) AND WILLIAM B. HALL

Shattered by the Quake, State Highway 287 Disappears Into Hebgen Lake

Its bed warped, the lake today drowns part of the north shore under nine feet of water and exposes its southeast rim. Four big landslips cut the road.

Cadillac plunges off a zigzag crack across U. S. 191. Alarmed by the quake, the driver and his family were fleeing for West Yellowstone when the car turned turtle. The occupants crawled out of the hole where the windshield had been.

sumed lost beneath hundreds of feet of rock.

"That south wall of the canyon must have been on trigger edge for years," Dr. Jarvis E. Hadley of the U. S. Geological Survey told me—"a mountain slide simply waiting for an earthquake to happen."

Dr. Hadley was one of more than 25 geologists, geophysicists, ground-water experts, and other scientists assigned by the Survey to study the earthquake area. He had felt the quake himself; on the night of the slide he was in the town of Ennis, 45 miles downstream.

"Rock layers in the mountain face tilted

steeply toward the river," the geologist explained. "They were weathered and cracked, relatively soft schists and gneiss mixed with slippery mica, with clay in the old clefts and cracks. These greased the skids when the face came down.

"At the base of the ridge ran a buttress of marblelike dolomite. This ledge broke cleanly, probably in the first quake. It had been holding up the mountain."

The layers above snapped, shifted slightly, much as sheets of glass stacked together might move, then hesitated.



Just how long the mountainside hung, a few minutes or as long as three quarters of an hour, neither geologists nor campers themselves can be sure. But as the earth continued to tremble and rock under repeated aftershocks, the slope suddenly began moving.

"When it moved, most of it came down as one mass, 200 to 400 feet thick, and it came fast," Dr. Hadley said. "The main slide was over in less than a minute."

Slide Builds an 80-million-ton Dam

By studying aerial photographs and contour maps of the slide, Army Engineers and geologists calculated the volume of rock and earth that fell: 43.4 million cubic yards, weighing about 80 million tons.

Hoover Dam on the Colorado, highest in the Western Hemisphere, contains only 4.4 million cubic yards of concrete, or one-tenth as much material. Grand Coulee on the Columbia holds only a quarter the slide's volume. Calculated another way, enough material slid into the Madison Canyon to cover Manhattan Island two feet deep.

"For a dam, it fell in the logical spot in the canyon, with the right types of rock pretty much in the right places," Lt. Col. Walter W. Hogrefe of the U. S. Army Corps of Engineers told me.

The slide blocked the Madison River with nearly a mile of rock, 200 to 400 feet deep along its crest. Within a week, Army flood-control technicians, hydrologists, and hard-helmeted construction men were at work cutting and rock-paving an emergency spillway.

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"Did you ever hear of the Gros Ventre Slide?" Colonel Hogrefe asked me. "In 1925, about 100 miles from here east of Jackson Hole, a mountain much like this one came down and blocked the Gros Ventre River.

"Nothing was done to stabilize it, and two years later the crest washed out suddenly. Six people were drowned, and the town of Kelly, Wyoming, was swept away in the flood."

Damage that would be caused by a similar flood in the Madison Valley might exceed \$15,000,000, Colonel Hogrefe estimated.

The Engineers, authorized by law to assist State and local officials in flood fighting and rescue operations, had little time. Winter was coming fast in the high Rockies. And an added menace loomed upstream.

Cracked Dam Holds Back a Flood

Hebgen Dam had been gravely damaged by the earthquake. Its concrete core had cracked, and the earth fill on both sides had slumped. Behind it Hebgen Lake, brimful, held enough water to cover a third of a million acres a foot deep (page 354).

Should Hebgen go out, the wave rushing down the Madison would sweep over the slide and on down the valley. It would flood Ennis and many a ranch and resort, and perhaps not be checked until beyond the point where the river meets the Gallatin and the Jefferson to form the mighty Missouri (page 356).

To repair its 44-year-old dam, the Montana Power Company wanted to draw down Hebgen Lake as soon as possible. But the slide across the river below first had to be stabilized.

For two months the Engineers worked \$3,000,000 worth of roaring rock-moving machines around the clock. They cut a notch more than 50 feet deep to lessen the grade of the rapids and permit an added flow of water without risk of sudden washout.

By November 1 the job was done. But severe blizzards a few days later prevented repairing Hebgen Dam before spring.

Joe Roberts and I climbed the back face of the shattered mountain above the Madison. On the torn and fissured ridge, wind whispered eerily through dry grass. We peered down the dizzying slide face, sheer and bare. Below, Earthquake Lake stretched away through the canyon, blue and placid against its forest-dark walls, five miles long.

Serpentine fence along State 287 illustrates the enormous force that squeezed and sheared the earth. Geologists study such details to assess the quake's effects.



The night of the earthquake, as the Madison Range gave its first massive shudder, strange and sudden things happened along the shores of Hebgen Lake, rimmed by summer homes, fishing resorts, and dude ranches, and on the north shore by Highway 287.

At four different places the road broke away and slid into the heaving water (page 336). The lake bottom itself tilted and folded, draining water in from both ends, then sloshing it northwestward toward the dam in a rushing wave, like a full dishpan rocked back and forth.

Near the Yellowstone Park boundary, east and slightly north of the lake, the ground suddenly broke and dropped. An earth cliff, or scarp, appeared where level ground had been a moment before.

The cliff, in places twice as high as a man's head, cleaved the Y-shaped junction of State 287 and U. S. 191, zigzagged uphill through groves of pine and quaking aspen, and curved north and west along the face of steep canyon ridges above the lake (page 352). The great wound ran nearly 20 miles.

Another jagged scarp, closer to the lake shore, followed the slope above Highway 287 northwest past Hebgen Dam. It sheared straight through Cabin Creek Campground in the upper end of Madison Canyon (page 330).

Geologist Finds a "Pot of Gold"

One man was glad to be caught in the quake: geologist Irving J. Witkind of the Geological Survey. He was fast asleep in his field trailer on a hillside above the northeast arm of Hebgen Lake when the earth heaved.

"I thought my trailer was loose and rolling downhill," he recalls. "I came charging out to stop it, though how I expected to do it I'll never know.

"Then I saw trees swaying, without any wind, and knew it was an earthquake. I thought of the ranch houses below me, and started down in my jeep. I almost drove straight over a 14-foot scarp that wasn't there the day before.

"For a geologist to be sitting on top of a fault when it slips is like falling over a pot of gold," Dr. Witkind said with a grin. "In two summers of mapping that region around Hebgen Lake, I had traced what ap-

(Continued on page 347)

Broken center stripe and rifts in the pavement reflect the earthquake's violence. Motorists bypassed this stretch of U. S. 191 by driving on the shoulder.



Red Canyon Fault Scarp

West Fork Fault Scarp

Hebgen Fault Scarp

Boat Mountain

Parts of lower lake
8 to 10 feet deeper

Hebgen Dam

Cabin Creek
Campground

EARTHQUAKE LAKE

Madison Range

Madison Slide buried Rock Creek Campground
and dammed Madison River, forming Quake Lake

MISSOURI FLATS

Ennis, Montana, 42 miles downstream,
evacuated at 3 a.m. in fear
Hebgen Dam had failed

Montana Highway 287

Madison River

HOW THE EARTHQUAKE SCARRED THE ROCKIES AND FORMED A LAKE

Fault scarps exaggerated for clarity

Main shock began at a point 8 to 10 miles beneath earth's surface

Fault cracked U.S. Highway 191

Montana Highway 287 cut in four places

Upper lake 8 to 10 feet shallower

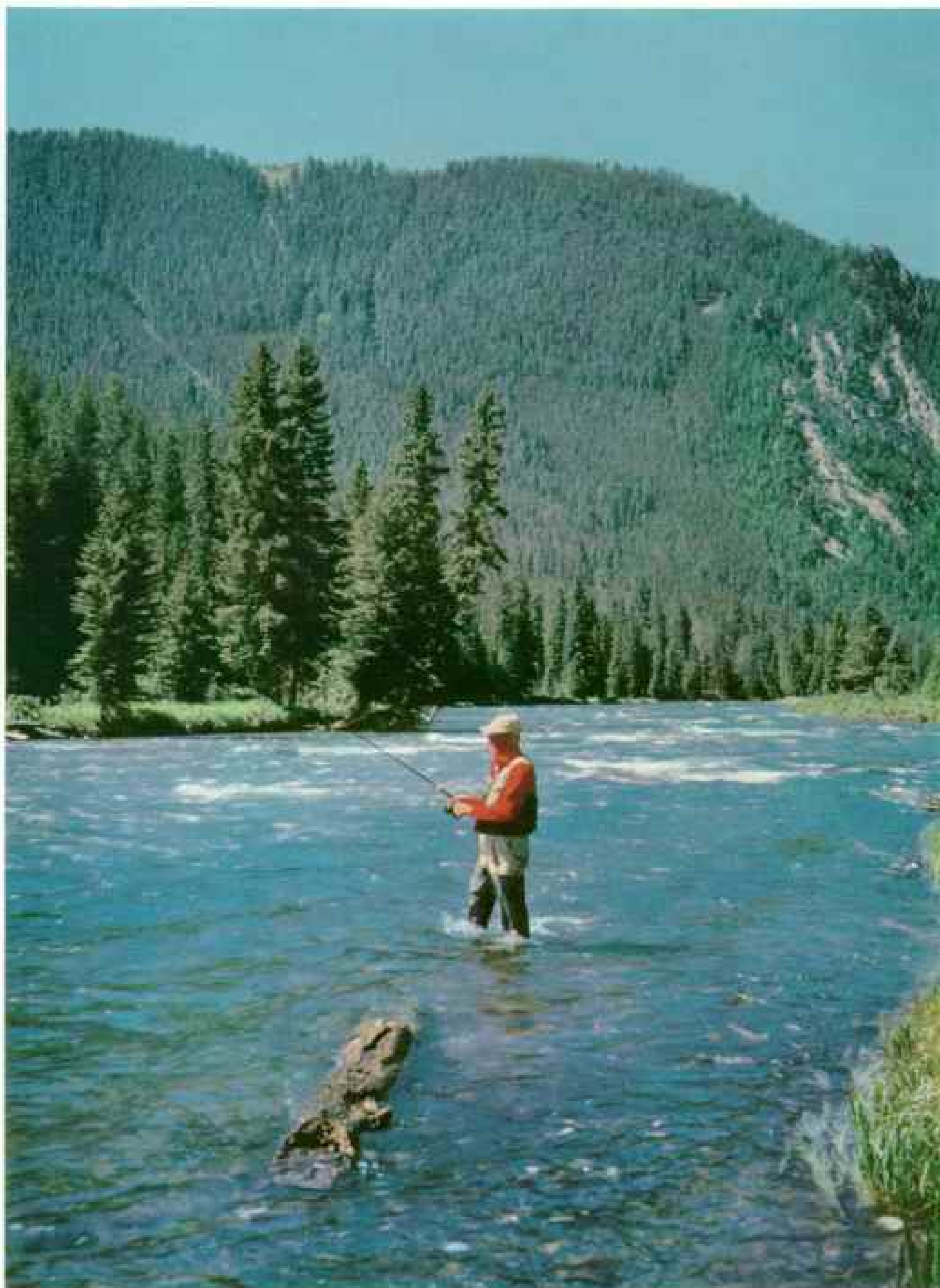
HEBGEN LAKE

10,609 feet

← NORTH

R. V. Nicholson
National Geographic Staff





ERST PETERSON, COURTESY MONTANA POWER COMPANY © NATIONAL GEOGRAPHIC SOCIETY

Before the Slide: A Fisherman Wades the Madison Where a Dam Now Lies

Blanketed by trees, the canyon wall rose to an elevation of 7,600 feet. This entire section thundered down, damming the river and burying part of Rock Creek Campground, on the near side. Herbert Hoover often has fished the Madison, a famous trout stream.

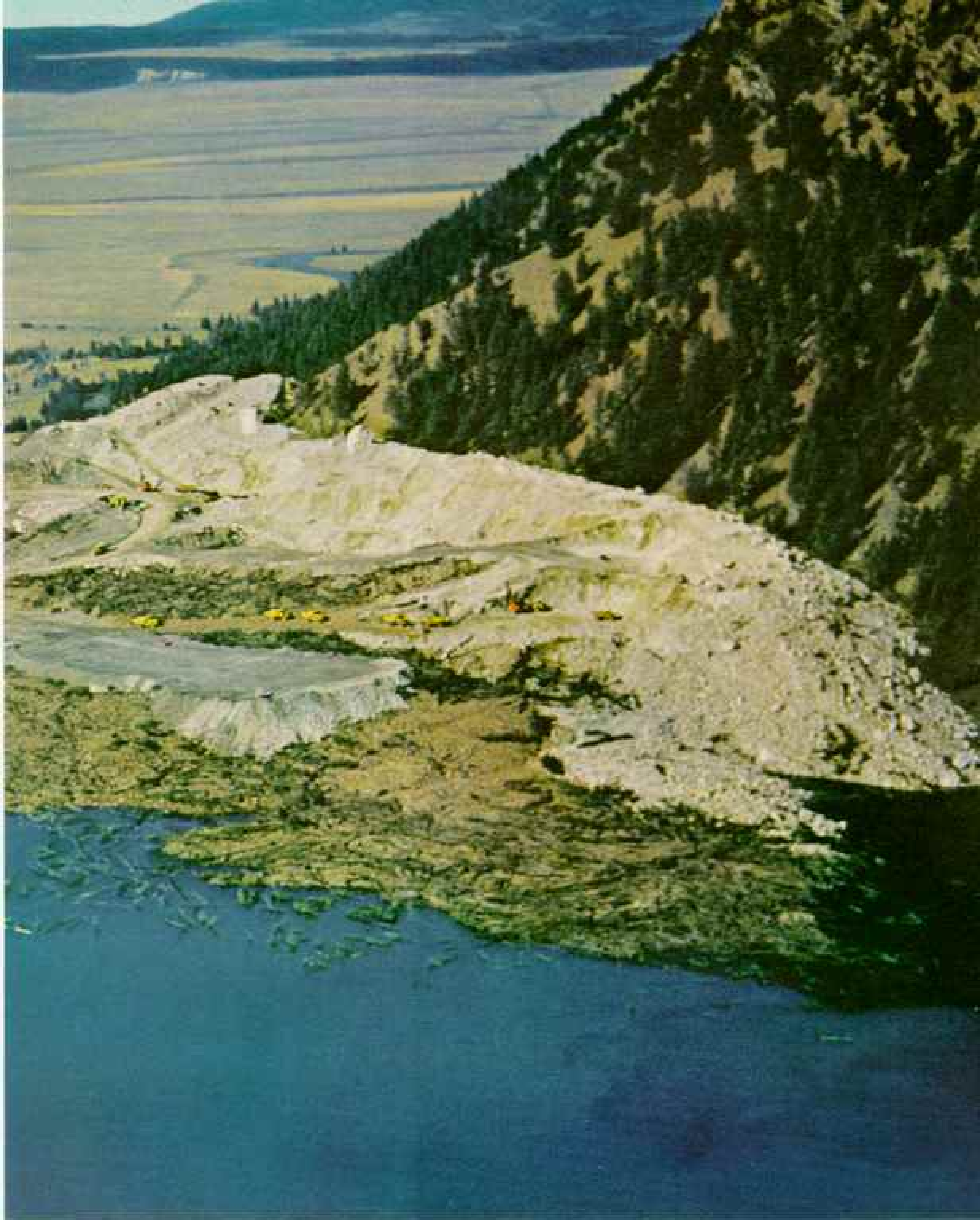
After the Slide: A bulldozer crosses the spillway carved across the barrier's crest, 200 feet above the old riverbed where the fisherman (above) casts for trout. Earth-movers often foundered in the rapids. One truck tumbled down the spillway, but the driver escaped serious injury. Pulverized rock scars the denuded slope.





**Men and Machines Toil Around the Clock
to Shape a Spillway Over the Slide**

Soft rock resting against a wedge of dolomite covered the face of the mountain that fell. When the earthquake snapped the dolomite buttress, a mass of rock up to 400 feet thick plunged down the slope at left and splashed upward against the opposite canyon wall. Water surging from the Madison River flung campers from their beds and



© NATIONAL GEOGRAPHIC SOCIETY

flipped house trailers end over end. Dammed by the slide, the river rose three to six inches an hour. Fearing the overflow would wash out the barrier and send a flash flood coursing downstream, Army Engineers hastily notched the crest to lower the lake, slow the flow of water over the natural dam, and reduce erosion.

Crushed dolomite glistens along the right fringe of the slide. Earthmovers, glinting in the morning sun, crawl over the schist and gneiss that make up the dark bulk of the slide.

Missouri Flats, named for homesteaders from the Midwest, sprawls beyond the canyon mouth. Gallatin National Forest ends below the slide.



peared to be an old fault line. Now I got down on my hands and knees and almost kissed the scarp. It was *mine!*"

Dr. Witkind was indeed on top of the earthquake. Seismic data telegraphed to Washington, D. C., from all across the West fixed the focus of the first great shock eight to ten miles deep in the earth's crust. The epicenter, or surface location directly above the focus, lay just northeast of the geologist's campsite.

For weeks he traced and mapped the jagged breaks through the mountains, on horseback and afoot (page 353). Meanwhile other Survey specialists studied the tilted lake, the broken highways and twisted fences, and the shifted ground.

Quakes Reshape a Land of Wonders

Inside Yellowstone Park, not far to the east, the earthquake struck with a rumble "like a heavy train crossing a trestle," as a Union Pacific man described it. "The ground got right up and shook—like a horse galloping," another visitor said.

Buildings jerked, swayed, and creaked. The

huge log-built Old Faithful Inn echoed with a "Whoom! Whoom!" as if it were a drum.

Rockfalls cascaded through high ravines. Huge boulders bounded and smashed down onto roads, leaving swaths of felled trees in their wake (below).

"We had 18,000 people inside Yellowstone that night," Superintendent Lemuel A. Garrison told me later. "The Lord had His arms around us. Not one person was killed or badly hurt. Think what could have happened if the quake had come during daylight—at Old Faithful Inn, for example, where the chimney fell into the dining room."

Among those in the park was Andrew H. Brown of the NATIONAL GEOGRAPHIC staff, who was gathering material and photographs for a forthcoming article on Yellowstone.

Brought full awake by the "rolling roar" that rocked and bounced his cabin at Canyon, Andy Brown experienced also the aftershocks that jarred the park for days. While roads were still closed and campers trapped between slides were being guided out, he interviewed park officials and saw the many immediate changes in Yellowstone.

Falling Rock Menaces a Road Repair Crew at Yellowstone's Golden Gate

An avalanche spawned by the first quake buried the road, which runs through a notch in northwestern Yellowstone. As men labored to clear the debris early next morning, an aftershock unleashed a second slide. One rock struck the earthmover as the driver backed to safety. The other men fled on foot amid a rain of boulders. Dick Ferguson, a park employee, had his camera ready when the aftershock struck.

Giant boulder blocks the highway a few miles from the park's west entrance. Some rocks bounced all the way to the river. Ranger Bob Perkins surveys shattered trees.



Park Naturalist George D. Marler, who has lived for years with Yellowstone's steaming, spouting thermal features, told him:

"Nature turned a climactic page in her book. It could have taken hundreds of years to bring about what happened here in a few hours."

Shocks Set Off New Geysers

The earthquake unleashed a sudden tremendous surge of thermal energy in the park. Geyser basins exploded into violent activity. Quiet pools and dormant vents erupted with a whishing and a whistling—a weird chorus of sound and fury.

"I only wish I could have seen what happened when the first shock hit," George Marler said wistfully. "Most of the geysers and pools must have erupted simultaneously. The swash marks show how violently they threw water."

Old Faithful seemed just as faithful after the earthquake: its average 61-minute cycle of eruptions slowed only slightly to 65 minutes. But elsewhere Yellowstone both gained and lost a host of geysers and other hot-water features.

Castle, Daisy, and Great Fountain, among many others, speeded

MELVILLE BELL GROSVENOR



Picnic spot on the Madison now lies far under water. Photographed a year before the slide, the scene captures the tumbling river and lofty bluffs that attracted campers to Madison Canyon.

The picnickers, Mr. and Mrs. Sumner Gerard (left) and Mrs. Melville Bell Grosvenor, sit on a bank where fish now feed in Earthquake Lake (above).



NATIONAL GEOGRAPHIC PHOTOGRAPHER J. GARLON ROBERTS © N.G.S.

Cabins float and trees drown as 'Quake Lake creeps up the walls of Madison Canyon

up their performances. Clepsydra, which had erupted only about every four days, went into a continuous "wild phase," pouring out enough steam to drive most of the heat and power plants in the park.

Cascade Geyser, which had not erupted for 40 years, blew its top. Economic Geyser, still for 25 years, began playing 50 feet high every half hour. The Giantess fountained as high as 200 feet for more than four days of uninterrupted glory.

Grand Geyser, one of the highest performers in the park, quit cold. But, as if in repayment, an entirely new "Earthquake Geyser" began playing 75 and 100 feet high at the end of a steam-spouting rift in the Lower Geyser Basin.

Most dramatically, Sapphire Pool in Biscuit Basin changed from a serene, limpid dispenser of silvery gas bubbles to a seething, soaring giant among geysers (page 358).

Not until three weeks after the first earth-

quake did Sapphire blow up. Then it played, regularly and furiously, for eight days. A sharp after-tremor shut it off. Sixteen days later another jolted it to life again.

Since then, constantly on trigger edge, Sapphire has spewed skyward every half hour to two hours. "Yellowstone has seen nothing like it since Excelsior erupted in the 1880's," George Marler said.

All across Yellowstone's superheated wonderland, naturalists spent the fall and early winter measuring depths, taking temperatures, charting the changes the earthquake produced. Their hooded, steam-shrouded figures startled late-season park visitors. Men with long poles fishing in boiling-hot pools? They must be out of their minds!

"The unique underground plumbing system of Yellowstone offers science a chance to learn more of what happens below the surface dur-

ing an earthquake," Superintendent Garrison told me. "The National Park Service has already begun such a study."

"The Yellowstone region of western Montana will continue to feel earth tremors for months, if not for years, as the earth shakes down to a new equilibrium," forecast Prof. Stephen W. Nile of the Montana School of Mines. A physicist, and Collaborator in Seismology for the U.S. Coast and Geodetic Survey, he ranks as chief earthquake recorder and consultant for his State.

Scientist Shaken by His Subject

The night of August 17, Dr. Nile was vacationing at a dude ranch 30 miles north of West Yellowstone, Montana. Without access to his big seismographs bolted to solid concrete at Butte, the excited professor did what he could to time and record intensities of the

Broken Crockery Litters a Kitchen Floor in West Yellowstone

Temblors ruptured gas lines, toppled chimneys, emptied bookcases, tossed television sets to the floor, and sent groceries flying from shelves. Mrs. Elt Davis (below) retrieved only four cups and three dinner plates from a service for 12.



ELT DAVIS



NATIONAL GEOGRAPHIC PHOTOGRAPHER J. BAYLER ROBERTS © N.G.S.

Children play in the rubble-strewn yard of the West Yellowstone school. Blocks jarred from walls and chimney clutter the playground a month after the quake.

tremors. He used a teaspoon on a string as a pendulum, and a glass of water to detect vertical jolts.

Joe Roberts and I later visited Dr. Nile's office at Butte, jammed with books, instruments, and sheafs of seismograms—the "fingerprints of the jittery earth," as he called them. He showed us tracings of aftershocks that still were being recorded, dozens a day, at the Butte seismograph station.

"Montana's earthquakes," Professor Nile told us, "are direct proof that the Rocky Mountains around us are still growing."

The Madison Range began rising from an ancient sea bed about 50 million years ago, geologists say. The tremendous underground forces that folded and uplifted these mountains still press on them, relentlessly bending and distorting their rock layers.

Finally, when the warped layers can bend no more, they snap along a fault, releasing the terrible energy of an earthquake.

"Try pushing your hand down and away from you as hard as you can on the desk," Professor Nile said. "It will jump suddenly rather than slide smoothly. A fault works the same way; it breaks and rebounds with sudden lurches. In fact, modern earthquake theory speaks of 'elastic rebound.'"

Shock waves from a shifting fault travel outward in all directions through the earth. Seismographs register two main types, P and S waves—primary and secondary, or "push" and "shake."

"The P wave is just like sound in air," Dr. Nile said. "The rock moves to and fro in the direction the wave is moving. That's the fastest wave, and it arrives first—right 351



there." He pointed to a sharp jump on a seismogram.

"The other shakes the rock particles from side to side as it passes, like waves in a clothesline when you waggle it. The S wave came along . . . here!" And he pointed to a second and smaller peak.

"The time interval between them tells us how far away the earthquake took place," the seismologist continued. "With three or more records from different points, we can plot the epicenter.

"It took the Hebgen Lake shock 28 seconds to reach Butte. An earthquake in Japan arrives here in 10 to 12 minutes."

From seismograph records the magnitude of a shock can also be calculated, Dr. Nile told us, using logarithmic scales devised by Drs. Charles F. Richter and Beno Gutenberg of the California Institute of Technology.

Few U. S. Earthquakes More Violent

Caltech's measurements gave the Montana earthquake a magnitude of 7.1, ranking it as one of the six strongest recorded shocks ever to jolt the United States, outside of Alaska.

The famous San Francisco earthquake of 1906, which killed 450 and set fires that consumed the city, had a magnitude of 8.3; Kern County, California, suffered a shock of 7.7 in



Red Canyon Fault Draws a Jagged Line Across the Face of a Wooded Ridge

Just as winding stores energy in a watch spring, a strain within the earth's crust slowly builds up energy in the rock. When the strain grows too great, the rock breaks and takes a new position. Such a movement releases explosive energy, triggering an earthquake.

The scarp above Red Canyon Fault cleaves the hills north of Hebgen Lake.

Scarp furrows the earth above Hebgen Fault. Dr. Irving J. Witkind of the United States Geological Survey examines the cleft, which took shape when the lower face fell away. His assistant, William Quinlivan, takes notes.

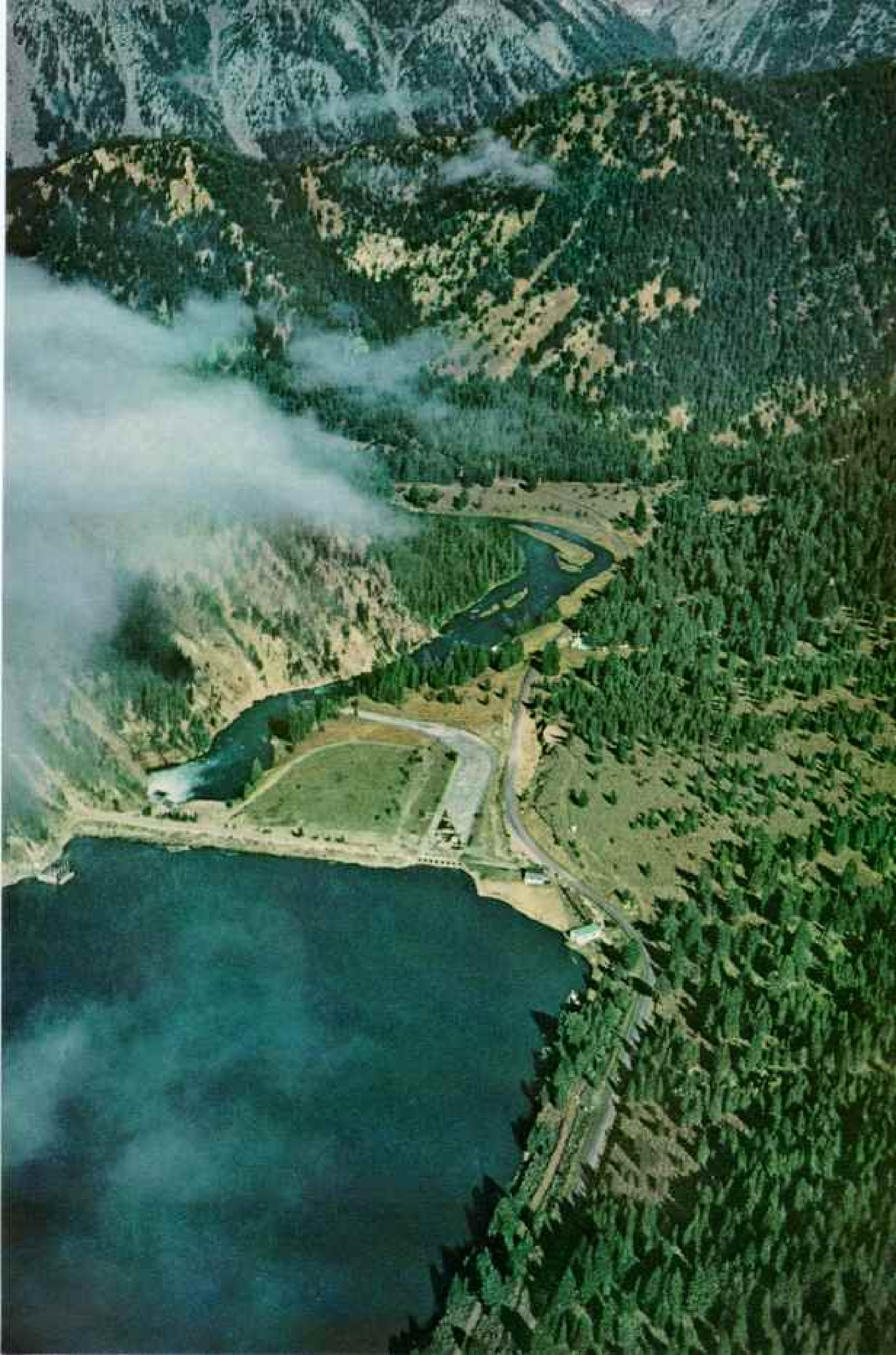


NATIONAL GEOGRAPHIC PHOTOGRAPHER J. BREYER ROBERTS © N.G.S.

1952; and earthquakes in sparsely populated regions of Nevada in 1915, 1932, and 1954 registered 7.6, 7.3, and 7.1 respectively.

Probably the greatest earthquakes ever to hit the United States wrenched the Mississippi Valley in 1811 and 1812, long before modern seismographs. Jarring an enormous area, the shocks wrecked the town of New Madrid, Missouri, and created Reelfoot Lake by dropping the northwest corner of Tennessee.

For sheer horror, none surpasses the Japanese earthquake of 1923, which



caused the death of a quarter of a million people and leveled Tokyo and Yokohama. But the worst earthquake year on record was 1906, when cataclysmic shocks hit not only San Francisco, but Colombia and Ecuador, Chile and New Guinea, Formosa and the Aleutian Islands, Japan and Sinkiang in western China.

Newly revised lists give greatest magnitude, 8.9, to the Colombia-Ecuador quake of January 31, 1906, and to a shock off the Japanese coast in 1933. The great Assam-Tibet earthquake of 1950 and at least five others follow with magnitude 8.7.*

Restless Earth Keeps Trembling

Fortunately, such severe shocks are rare, but our planet's crust is never still. More than a million earthquakes occur each year, seismologists estimate. About 700 detectable tremors strike the United States annually.

"Montanans seem to forget it," Dr. Nile said, "but this State gets a perceptible jolt about every two years, and a real wallop once every decade. Since seismograph records have been kept, truly severe earthquakes have hit Montana in 1925, 1935, 1947, and now 1959."

Most earthquakes fall in a few belts of greatest activity. One rings

the Pacific Ocean. Another runs from Burma to the Mediterranean and on into the Atlantic. In the United States the most active regions lie in Alaska and along the 600-mile San Andreas Fault in California.

The San Andreas Fault shifted 21 feet horizontally in 1906. In last year's Montana shocks the movement was chiefly vertical. Precise measurements by geologists and Coast and Geodetic Survey teams found changes in elevation of as much as 19 feet along the northern shore of Hebgen Lake.

Other, more far-reaching effects may have occurred as well. The entire Yellowstone region may have changed its level above the sea. Whether this is so, only future surveys covering hundreds of miles can tell.

Within two weeks of the August earthquake,

* See "Caught in the Assam-Tibet Earthquake," by F. Kingston-Ward, NATIONAL GEOGRAPHIC, March, 1952.

Damaged but Still Standing, Hebgen Dam Coris a Flood

An earthen structure with a concrete core, the dam regulates the flow to downstream reservoirs. Built half a century ago by the Montana Power Company, it stands 87½ feet high and 718 feet long.

The quake cracked the core and shattered the spillway. During repairs water flows through a diversion tunnel.

If Hebgen Dam had given way, a wall of water would have washed over the slide six miles downstream and flooded the Madison Valley.

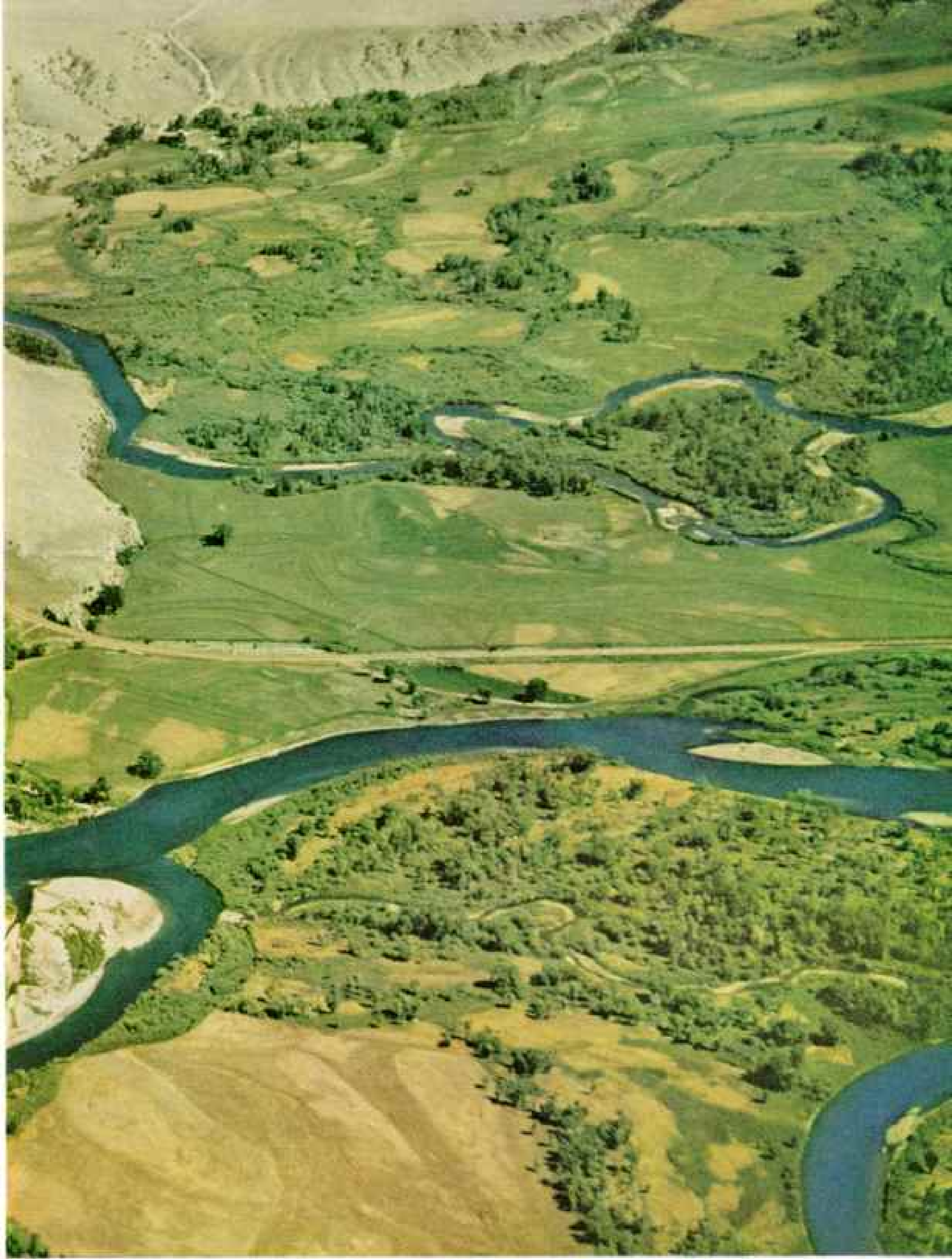
"It was this high." Caretaker George Hungerford describes a wave that swept over the dam. Fresh concrete will be pumped into the crack caused by the quake.





Three Forks of the Missouri Converge
in a Maze of Islets and Twisting Rivers

Lewis and Clark, who camped here in 1805, discovered the parent streams and named them for President Jefferson and two members of his cabinet. The Jefferson (lower left) unites with the Madison (center) and flows between a highway and tracks of the Chicago, Milwaukee, St. Paul



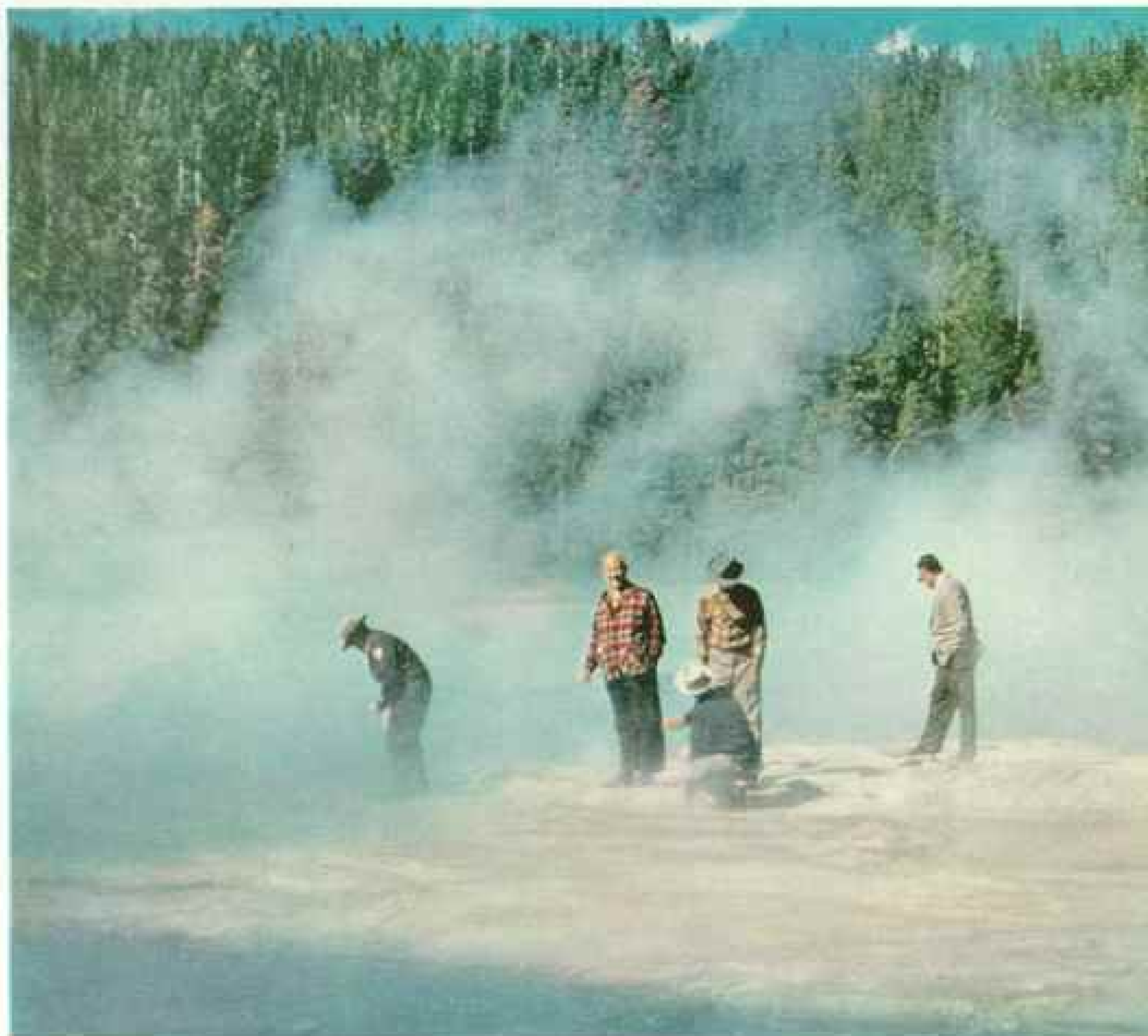
RESEARCHED BY MELVILLE BELL BRIDGEMAN AND DENNIS DENNIS. PHOTO © NATIONAL GEOGRAPHIC SOCIETY

and Pacific. The Gallatin—for Albert Gallatin, Secretary of the Treasury—snakes in at the top, below the Northern Pacific's right of way. Missouri River, highway, and railroads then pass Trident, Montana (upper left), where a plume of dust usually hangs over a cement plant. Dams

along the "Big Muddy's" tributaries curb floods that once plagued the confluence.

Here, 60 miles north of the Madison Slide, abandoned river channels indent farm and forest lands. The town of Three Forks lies between the Madison and Jefferson, just out of the picture.





NATIONAL GEOGRAPHIC PHOTOGRAPHER J. BAILEY ROBERTS (OPPOSITE) AND ELL DAVIS © N.G.S.

Steam from Hot Lake in Yellowstone billows above Steady Geyser's mouth. Conrad L. Wirth (second from left), National Park Service Director, inspects cracks in the rim.

Sapphire Pool, a Mouse That Became a Lion, Scalds the Yellowstone Sky

Earth tremors warped the subterranean plumbing that feeds the park's thermal springs. Old geysers changed schedule, new ones exploded, and bubbling springs burst into violent activity. Last September placid Sapphire Pool suddenly became a geyser, blasting 30 to 50 tons of water a hundred feet or more into the air in frequent eruptions.

the U. S. Forest Service had designated the stricken region along the Madison as a special "geologic area." A task force of highway engineers, geologists, and watershed specialists drew plans for its protection.

"We hope to enable people to see just what nature has done," Regional Forester Charles L. Tebbe told me in his headquarters at Missoula.

Montana's able, plain-spoken Governor J. Hugo Aronson expressed the same hope. "The Madison River has always attracted visitors," he told me. "They will keep coming, and they will want to see the effects of Montana's worst earthquake."

To restore highway travel, State and Forest Service engineers are already planning two new roads. One, an entirely new primary highway linking Montana and Idaho, will cross the Continental Divide over Reynolds Pass, a wide, gentle saddle just south of the Madison Canyon. The other, far more difficult to build, will again thread the canyon, running across the giant landslide and along Earthquake Lake.

Access trails and overlooks will enable vacationists to see the devastation produced in a few awesome moments last August—mute testimony to the terrible power of mountains that moved in the dark of night.





*A Swiss makes history's first
geological survey in a mountainous land
where the wheel has little use*

Afoot in Roadless Nepal

By TONI HAGEN, Ph.D.

Kodachromes by the author

IN THE mid-twentieth century, I never expected to find myself risking a breach of contract with Karkotak, Lord of all the Snakes. But this was Nepal, where the improbable becomes the probable, and my house servants were adamant.

Under no circumstances, they declared, must I kill the six-foot-long snake my four-year-old daughter Kathrin had found peacefully asleep on the stairs of our house in the Nepalese capital.

"Katmandu people have agreement with Karkotak," Aila, my Sherpa major-domo, explained. "They not harm the snakes, the snakes not harm them. Simple, sir."

I have a profound distrust of any snake I can't identify, and so my wife Gertrud and I decided that while we couldn't break Karkotak's pact, our perky brown dachshund Fritz was not a party to the agreement. Brought face to face with the invader, our fearless Fritz set up such a ferocious barking that the snake withdrew, discouraged but unharmed, to seek quieter quarters for its nap. Fritz got an extra helping of dinner that eve-

Silvered by eternal snows, Nepal's mountain crown shimmers beyond a heat-brewed haze. Ten miles ahead of the trail-tudging porter, unconquered, unnamed peaks in the Dhaulagiri chain vault more than 25,000 feet. Working for the United Nations, the author hiked up and down such paths and feasted on such vistas for nearly a decade. He was the first European allowed to roam the kingdom freely.

ning, and I was left to ponder yet another of the frequently baffling aspects of life in this almost unknown Himalayan kingdom.

Nepal, home of the world-famed Gurkha soldier, is emerging like a sleepily blinking child from a slumber of centuries into the bright light of the nuclear era. This is a medieval fastness where the royal palace is so modern that it boasts neon and fluorescent lighting. This is the homeland of the weather-beaten old man with whom I stood and watched a Royal Nepal Airline cargo plane discharge a new jeep at Pokhara airport.

"See," the old fellow explained gravely to his grandchildren, watching open-mouthed, "soon the little one will grow large, it will sprout wings, and then it will fly away, just like its mother."

Nepal Mounts a Stairway to the Summit of the Earth

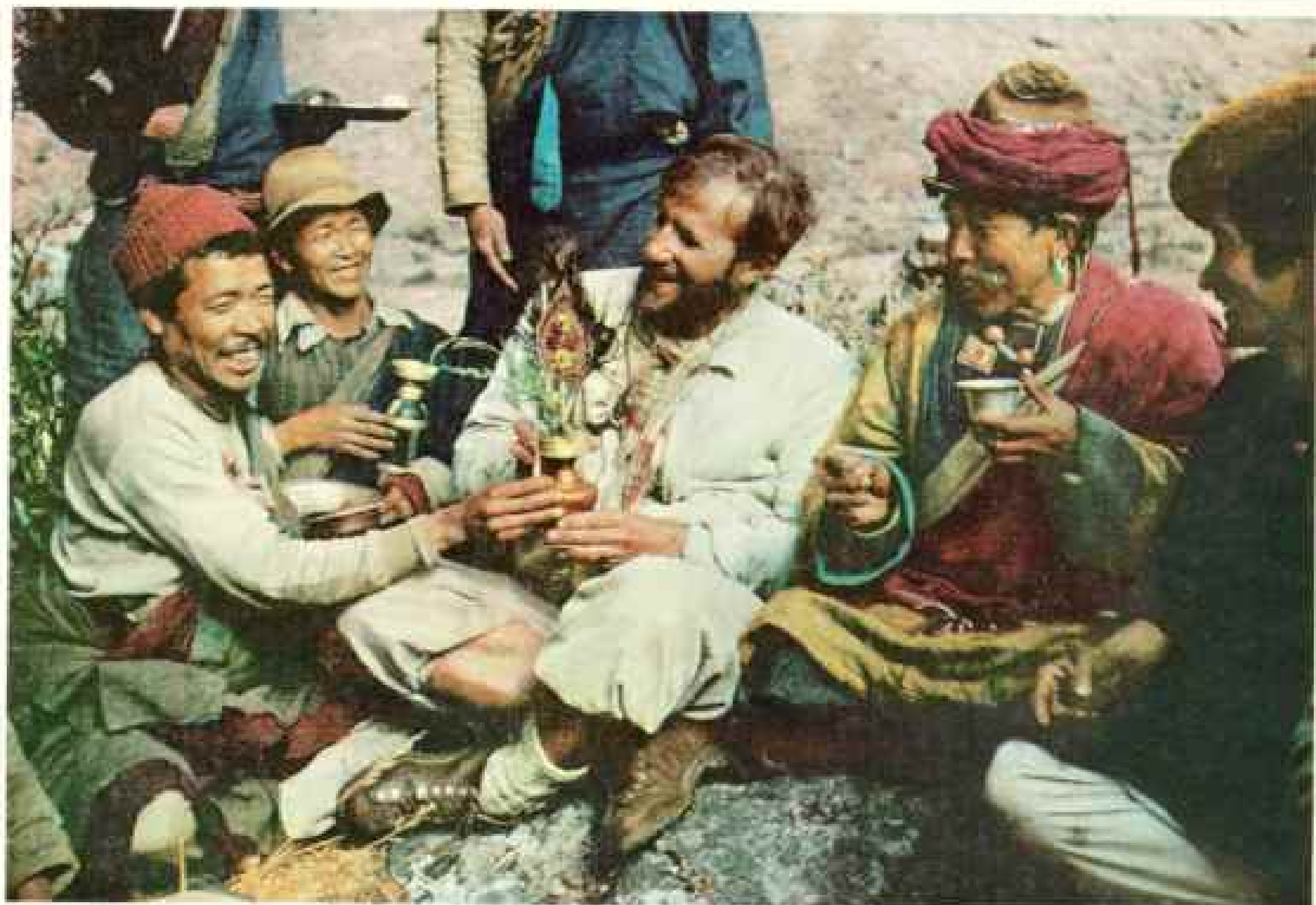
A rectangle 500 miles long and 100 miles wide, Nepal encloses fantastic contrasts. The low-lying Terai steams with jungles, home of tiger and rhinoceros and haunt of deadly fevers. In the midlands rice fields terrace the slopes, and Buddhist and Hindu shrines dot the valleys. At the Tibetan border Himalayan giants bare monstrous fangs of ice, and winds howl in ceaseless anger. Except for the link between Katmandu and the Indian frontier, Nepal is virtually roadless.

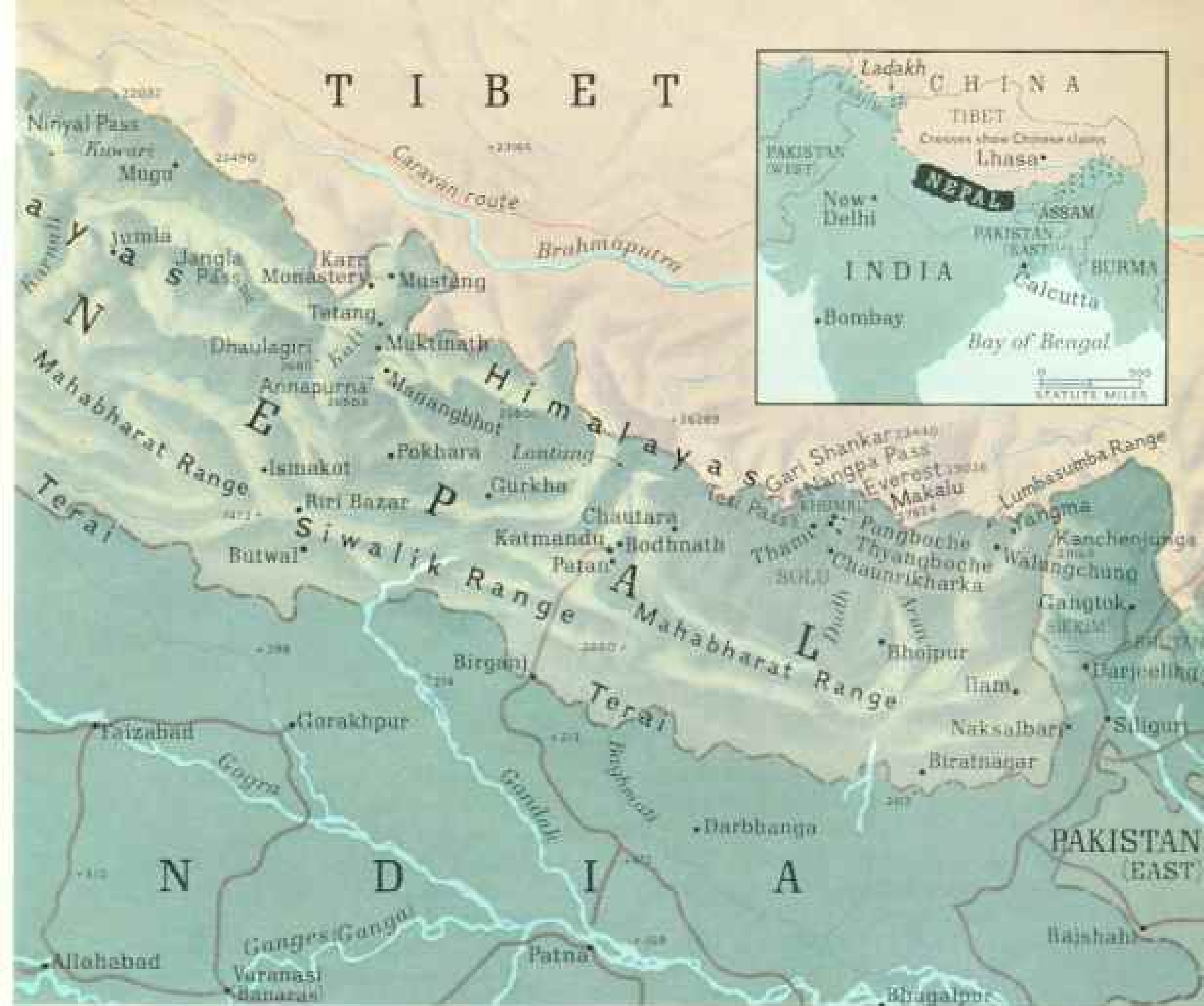
Hatch marks (inset) show areas in Ladakh, Assam, and Bhutan which Chinese Communists have invaded or claimed.

Author and Sherpa Friends Celebrate a Wedding

A peacock-feather emblem in a brass-and-copper jug proclaims friendship for Dr. Hagen (center). Drinking chang, a mild beer, the party waited two days at Chaunikharka, near the foot of Mount Everest, for the bridegroom to appear. He was delayed by celebrating with friends.

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Chances are that the children, like many others in Nepal, were seeing their first airplane before they had seen their first bullock cart. The air age is opening up parts of Nepal where wheeled transport until yesterday remained a mystery. In this mountainous land, roads are nearly nonexistent, and few of its trails will accommodate pack animals, not to speak of a wheeled vehicle. Travel is almost entirely by foot.

For the past decade it has been my great good luck to be a part of Nepal's awakening. In 1950 I undertook the job of completing history's first geological survey of this fascinating country.

Were there, as ancient legend had it, rich treasures of gold and precious stones secreted near the thrones of Nepal's many gods and demons in the Himalayan heights? Were there, as certain perpetually burning natural gas jets hinted, vast reserves of petroleum waiting to be tapped to bring the world's wealth pouring into this predominantly agricultural nation? Did Nepal's known veins

of iron and copper merit greater exploitation?

As if these questions were not challenge enough to fire the imagination of any geologist, I knew that my work would take me into regions never seen by European eyes, into areas unfamiliar even to the Nepalese Government. I would journey into frontier zones which will not be seen again by a foreigner until the tensions of international rivalries ease. I would become the first European ever permitted to roam as I chose through the 500-mile-long, 100-mile-wide rectangle that is Nepal.

Himalayas Create a Giant's Staircase

As Nepal's geography once accounted for her long isolation from the world, so today it is a major factor in her awakening. For centuries the country's protection from pillage—and progress—was her mountains. Along her northern frontier with Tibet marches one-third of the 1,500-mile-long Himalaya Range. To the south are the lower but still formidable Mahabharat and Siwalik Ranges.

A rough cross section of Nepal would look

somewhat like a gigantic staircase leading down from the high Tibetan plateau to the Ganges plain. Before invaders from the plain could begin to ascend this staircase, they first had to cross another protective feature of terrain. This was the Terai, a strip of the Ganges plain 12 to 20 miles wide. Barely above sea level, the Terai is hot, swampy, and thick with jungle. The Terai's chief deterrent to an invader—and to any traveler, for that matter—is the deadly *awal*, a malignant malarial fever, swift striking and often fatal.

India's new independence and Chinese domination of Tibet after World War II thrust Nepal rudely into the arena of global political maneuver. Not even the mighty Himalayas or the feverish Terai were now proof against war from the air, and in this new small world, isolation was impossible. To survive, Nepal must catch up with the calendar: that was her government's decision. I was part of the catching-up process.

"What about it, Hagen?" asked my superiors at the Swiss Federal Institute of Technology, where I was a research assistant. "The Nepalese have asked our government to send a technical assistance mission. Want to go?"

Did I? It was the chance of which I'd been dreaming ever since I was 10 years old, when I attended a lantern-slide lecture about the Himalayas and promptly fell in love with them.

Nepal's Hinterland a Mystery

Nowadays, it is no uncommon thing for a planeload of tourists to fly north from India to visit Katmandu, Nepal's capital, set in the loveliest of the midland valleys. But when my family and I arrived in 1950, we learned that only a few hundred Europeans had ever visited the country. Of these, only a handful had ever been allowed outside Katmandu.*

Indeed, not even officials of the Nepalese Government were permitted to leave the capital without the special permission of the prime minister. This quarantine sprang from the canny theory that subordinates are much better kept under observation in Katmandu. Not surprisingly, most of Nepal beyond the capital's mountain-rimmed valley was almost

as much a mystery to the country's central government as it was to foreigners.

I remember especially what a disappointment I was to my new Nepalese associates. Initially they regarded me as a kind of latter-day forty-niner. I was a geologist, and geologists—or so they theorized—are expected to find gold and jewels, particularly in a country legendarily so well endowed with them.

Notes Alone Fill "Treasure Baskets"

"But where are your treasure baskets?" one official, who has since left the government, asked me in dismay when I returned with nothing but notes from my first short field trips. "Have no fears, Hagen Sahib," he added in a tactful whisper, "that you cannot speak freely to me. Just tell me where you have discovered diamonds and gold, and I shall give you a half share."

Eventually, of course, the Nepalese came to understand the real function of my job, even as I came to learn how it should best be done. There was, for example, the business of my first major field trip.

"I, personally, shall attend to the details," the prime minister told me. "You shall lack nothing."

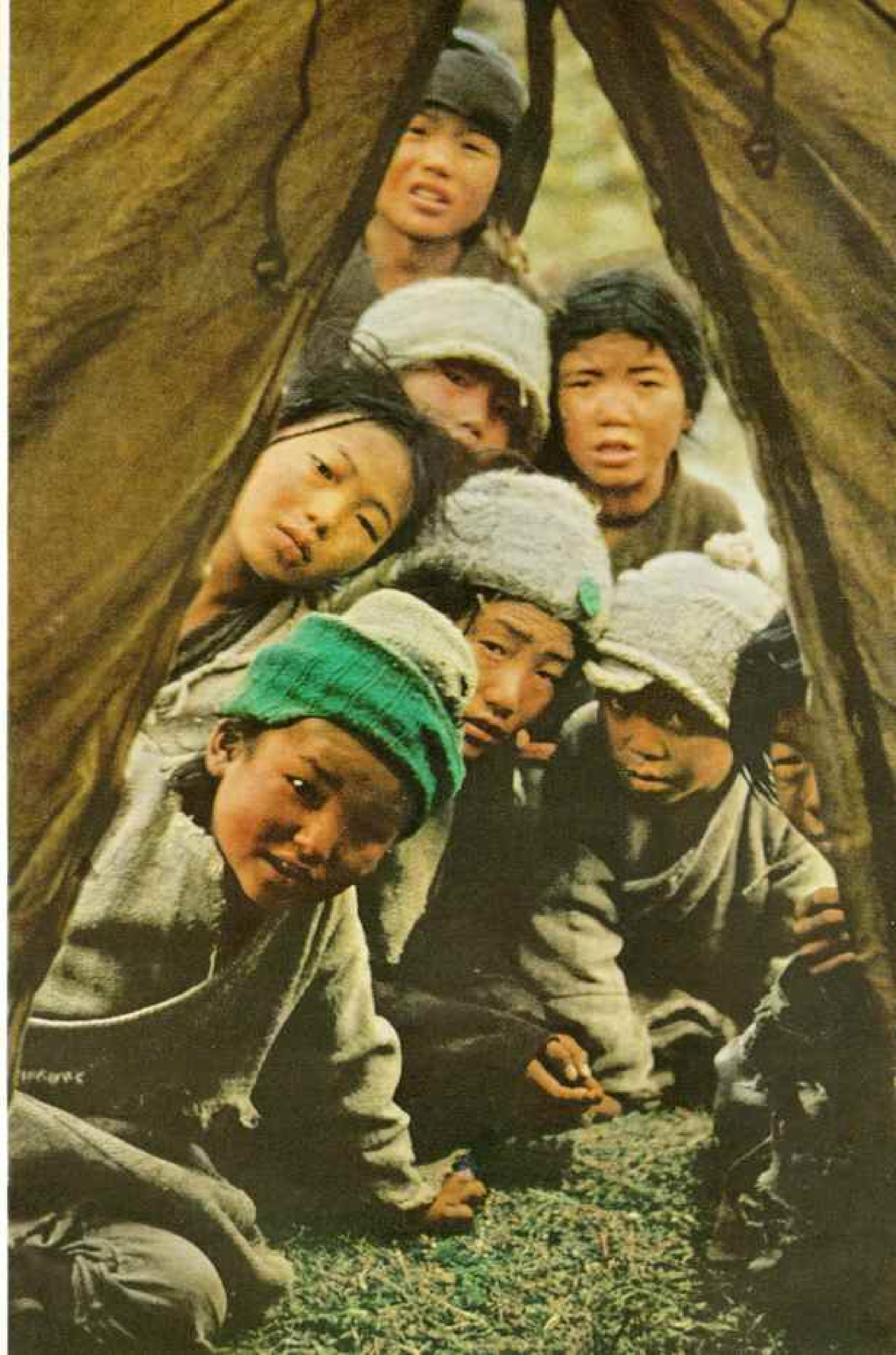
Nor did I, for when I prepared to set out, I found no fewer than 70 porters gathered to accompany me. His Excellency had fitted me out as he was accustomed to equip a royal hunting party, with even a fine china dinner service among the luxuries.

Later on, with the purchase of lightweight mountain equipment in Switzerland and a drastic pruning of nonessentials, my gear needed only a dozen porters. On these subsequent field trips, with my much smaller team of picked men headed by Aila, we were able to move swiftly and efficiently over the worst terrain Nepal has to offer. Each porter became a specialist at his job, and it took us no more than 15 minutes to set up camp, with hot tea ready five minutes later.

* See, in the NATIONAL GEOGRAPHIC: "Coronation in Katmandu," by E. Thomas Gilliard, July, 1957; "Peerless Nepal—a Naturalist's Paradise," by S. Dillon Ripley, January, 1950; and "Nepal, the Sequestered Kingdom," by Penelope Chetwode, March, 1935.

Wonder, Curiosity, and Fear: Children Peep Into the Author's Tent

"A pencil given to these youngsters from Yangma meant wealth and happiness," says Dr. Hagen. "Matches delighted them, since they were accustomed to make fire by striking two stones together. They commented excitedly about my typewriter, but they were upset when they heard their own voices on a wire recorder."





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Chris and Fritz Travel in a Basket

The author's son and dog see Nepal from the back of a porter, the common carrier of the kingdom. Such men consider 80 pounds an average load.

Aila was a Himalayan veteran, one of the two Sherpas who had carried the frostbitten French climber, Maurice Herzog, down from Annapurna. Aila took charge of the house-keeping details, leaving me free to work on my notes and sketches. I never heard him complain, although sometimes, when I walked too fast for the heavily laden porters, he might grin and say gently: "Very long feet today, I think, sir."

During my work in the vicinity of Katmandu, Gertrud and our three children, Christopher, then six, Kathrin, four, and Monika, two, sometimes accompanied me into the field. The children rode in baskets carried by sturdy

porters. We fell in love with this beautiful land, and sometimes Gertrud and the children went off camping by themselves, so safe and secure did we feel among the friendly people.

With the completion of my survey of the midlands, I realized that field trips would take longer as I worked farther into the hinterland. Regretfully, the family went back to Lenzerheide, our home village in Switzerland.

Walks Wear Out 40 Pairs of Boots

As I moved up into the mountains, passes and gorges came to figure large in my planning and daily work.

A glance at the map of Nepal (page 362) will show that the country is naturally divided into four regions by its principal rivers: the Karnali, the Kali, and the Arun. All drain into the Ganges. They break through the main range in mighty gorges, creating natural—though difficult—avenues for trade. Similar, though lesser, gorges crack the Mahabharat and Siwalik Ranges to the south.

Most spectacular of these gorges is surely that of the Kali, which rises some 50 miles north of the Annapurna chain and pierces the main range between the lofty peaks of Annapurna (26,503 feet) and Dhaulagiri (26,811 feet), about 18 miles apart, at a depth of only 3,500 feet above sea level.

In all, I completed 19 field trips and walked roughly—in every sense of the word—9,000 miles, at the cost of 40 pairs of tough Swiss-made mountaineering boots. Our campsite was changed at least 1,200 times.

The day's work began at sunrise with a cup of cold tea. Then we walked three or four hours before stopping for breakfast, followed by an hour's rest. Actually, this first meal was more of a brunch, for the Nepalese eat only twice a day.

By 3 o'clock in the afternoon I began looking for a clean campsite with fuel and water.

Supper eaten, two or three hours were left for recording observations and filing rock and fossil samples at my field desk, aptly nicknamed by my porters "little Singha Durbar," after the main government building in Katmandu. On its battered writing surface I completed 96 geological cross sections of Nepal, from the Ganges plain to the Tibetan border; 2,437 geological sketches filling 20 field notebooks; and the field original of the geological survey map of Nepal on the scale of 1:250,000.

Not infrequently, my office chores were in-

errupted by visits from some of the big game with which Nepal abounds. Most often my visitors were leopards, and because of them I had to discontinue bringing the dachshund Fritz into the field. Absolutely fearless, Fritz barked furiously at any visiting leopard. Luckily, those he threatened so vociferously seemed too astonished to do him harm.

Shouting Chased Leopards From Camp

With Fritz back in Katmandu, we got rid of our uninvited guests by a vigorous yelling from everyone in camp, a noise the leopard invaders apparently disliked intensely.

Not that it was all work and no play. Nothing, I found, exceeds Nepalese hospitality in

the mountains. This openhandedness invariably includes generous helpings of chang—pronounced to rhyme with rung—the native beer, which was sometimes as thick as gruel. Made from rice, millet, or other grain, chang has a flavor that is not notably improved by the lumps of often rancid butter smeared on the rim of the cup for good luck.

I recall leaving one especially jovial village by a trail that led straight out across a flat valley, with Aila and the porters weaving gently behind me, all smiling vacantly and having difficulty with their feet.

"Are you all right, Aila?" I called over my shoulder. Back came an unmistakable hiccough, fortissimo.

Modern Drugs and Ritual Sacrifice Vie in Treating an Injured Bearer

On the trail near Annapurna (background), the prostrate man suffered a heat stroke and tumbled down a slope. Here the author administers a stimulant. Ceremonially stripped and bathed, a Thamanng tribal priest prepares to sacrifice the chicken at right. "One treatment was successful," says Dr. Hagen. "But whose?"

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"Very steep road, sir," was Alla's reply.

We encountered quite a few steep roads in otherwise level valleys, since it would have been considered the height of rudeness to refuse the chang we were so often offered from hand-carved wooden bottles. Indeed, chang figures in many Buddhist religious rites. Among the Sherpas, whose homeland is just to the south of Mount Everest, it is an important feature of any ceremony.

As I had expected, it was impossible to

confine my survey to geology. With absolute freedom of movement guaranteed by the government, mine was a glorious opportunity to study almost every aspect of Nepalese life.

Countrymen Speak Many Dialects

The country's population, I found, consists of about a dozen tribes and castes, with widely varying dialects, religious practices, architecture, and customs.

The small groups fall into three main divi-



sions. The native Tibeto-Burmese-speaking peoples dwell in the midlands and are probably the aboriginal inhabitants. The Tibetan group is largely found on the Tibetan plateau and in the high valleys of the main Himalayas. The Indo-Aryan-speaking peoples, migrants from the south who originally represented the highest Hindu castes—the priestly Brahmans and the warrior Kshatriyas—make up the third group.

The celebrated Gurkhas belong to this last division. Refugees from the Mohammedan conquest of India in the 14th century, they were a small tribe of fighting

Range stand out like islands in a sea of clouds

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A smoke breaks the hardship of crossing 17,000-foot Jangla Pass after a heavy snow. Goggled against glare, the porter puffs his cigarette through a straight Nepalese pipe and a cup of fingers. He wears the long hair and topknot of a priest.

men who set up a pint-sized kingdom at Gurkha, northwest of Katmandu. They were content with this domain until the 18th century, when they united a number of equally small neighboring kingdoms, conquered the largest native kingdom centered on Katmandu, and established what is now known as Nepal.

They also established the country's military traditions, most notable of which is that of mercenary service in the armies of Great Britain and India. Such was their prowess that today all Nepalese soldiers serving in these armies are known as Gurkhas. Their commanders, British and Indian, have described them as among the finest warriors in the world.

The Tibetan group includes the Sherpas, who have won international

fame for their mountaineering skills. They are among the friendliest of the Nepalese people, and their friendship is warmly returned by Europeans whose lives have depended upon steadfast Sherpa courage on some Himalayan peak.*

Tribes Live at Different Altitudes

Perhaps the most astonishing aspect of Nepal's immensely varied population of some eight and a half million is its extraordinary distribution according to altitude. The Indo-Aryan group prefers to live in the valleys, rarely higher than 6,500 feet. The aboriginal Tibeto-Burmese group is found between 4,500 and 8,500 feet, while the Tibetans make their homes above the 8,000-foot level. Thus I could almost always tell from my altimeter, fixed to the top of my ever-present camera case, which group I would next encounter.

One curious consequence of this population distribution is a tolerance and a blending of religious faiths. The shrines of Muktimath, in the great gorge of the Kali, are sacred to both Buddhists and Hindus. Hindus living in the valleys often share a temple with their Buddhist neighbors on the higher slopes.

Climate, too, seems to have a definite effect on the people. In the malarial Terai, fever-menaced natives are less energetic, even apathetic. Their houses are little more than crudely thatched huts, raised on logs above the reach of the prowling game for which the Terai is famed. Their villages are usually carelessly planned and decidedly unsanitary.

In the midlands and the mountains, houses are more solidly built, often of whitewashed brick or stone, and towns are neater. I've seen Nepalese mountain villages that reminded me of picture-postcard views of English hamlets. In the higher regions, people seem more cheerful, and life seems much more worth living. It was in the high valleys and the thundering gorges of the Himalayas that I was happiest. But here, too, I felt the loneliest. Loneliest, that is, for the company of a fellow European.

I remember one night in a high and isolated valley where I had my first encounter with Tsumarr. The almanac would call it an eclipse of the moon, but to the Nepalese mountaineer it is the time when the evil beast, Tsumarr, chases the moon across the sky, clutching at it with huge black claws. As the moon began to fade, moans and prayers of the terror-stricken inhabitants swept across

the dark valley. The eerie keening rose to a prolonged howl of despair.

Finally Aila spoke. Even he, whose home is in modern Darjeeling and whose contacts with the twentieth century have been many, was frightened.

"If once Tsumarr catching earth like that," he muttered, gesturing toward the sky, "then I think all finished, sir."

Possibly the only real risk in working alone was that I might break a bone I couldn't splint or set. Neither Aila nor any of the porters had the faintest notion how to treat a fracture. As it turned out, however, my party suffered only one fracture during eight years, and that one happened just a hundred yards from a missionary hospital!

Easily the most pressing of my extracurricular chores was that of medicine man. Like most Europeans, I held the stereotyped concept of the mountain Nepalese as a sturdy, robust chap, flourishing in the clean Himalayan air. A great many Nepalese are sturdy and robust, but at least a quarter of the people are chronically sick. After seeing the work of the native healers, I wondered that so many survived.

Medicines Win Nepalese Friends

While training to become a ski instructor in Switzerland, I had taken advanced first-aid courses, but that was the extent of my "internship," and I was grimly aware of my limitations. It was impossible, however, to withstand the childlike trust of the Nepalese. I was the "Sahib sent by the King," for many the first white man they had ever seen. My scalpel was a safety-razor blade, my clinic two trunks full of medicines and bandages.

My first major medical project was curing the porters of the habit of indiscriminate spitting. This was simple. Whenever I caught a porter spitting in camp, we moved the camp exactly one mile, no matter how far we had marched that day or how tired we were. After a few such moves, the spitting stopped.

Other problems were not so simple, but modern antibiotics worked miracles. I shall never forget the day a young Hindu father came to me with his daughter in his arms.

(Continued on page 375)

* See, in the NATIONAL GEOGRAPHIC: "Beyond Everest," by Sir Edmund Hillary, K.B.E., November, 1955; "Triumph on Everest: I. Siege and Assault," by Brig. Sir John Hunt, C.B.E., D.S.O.; "II. The Conquest of the Summit," by Sir Edmund Hillary, July, 1954.



PHOTOGRAPH BY SEYMOUR JONES © NATIONAL GEOGRAPHIC SOCIETY

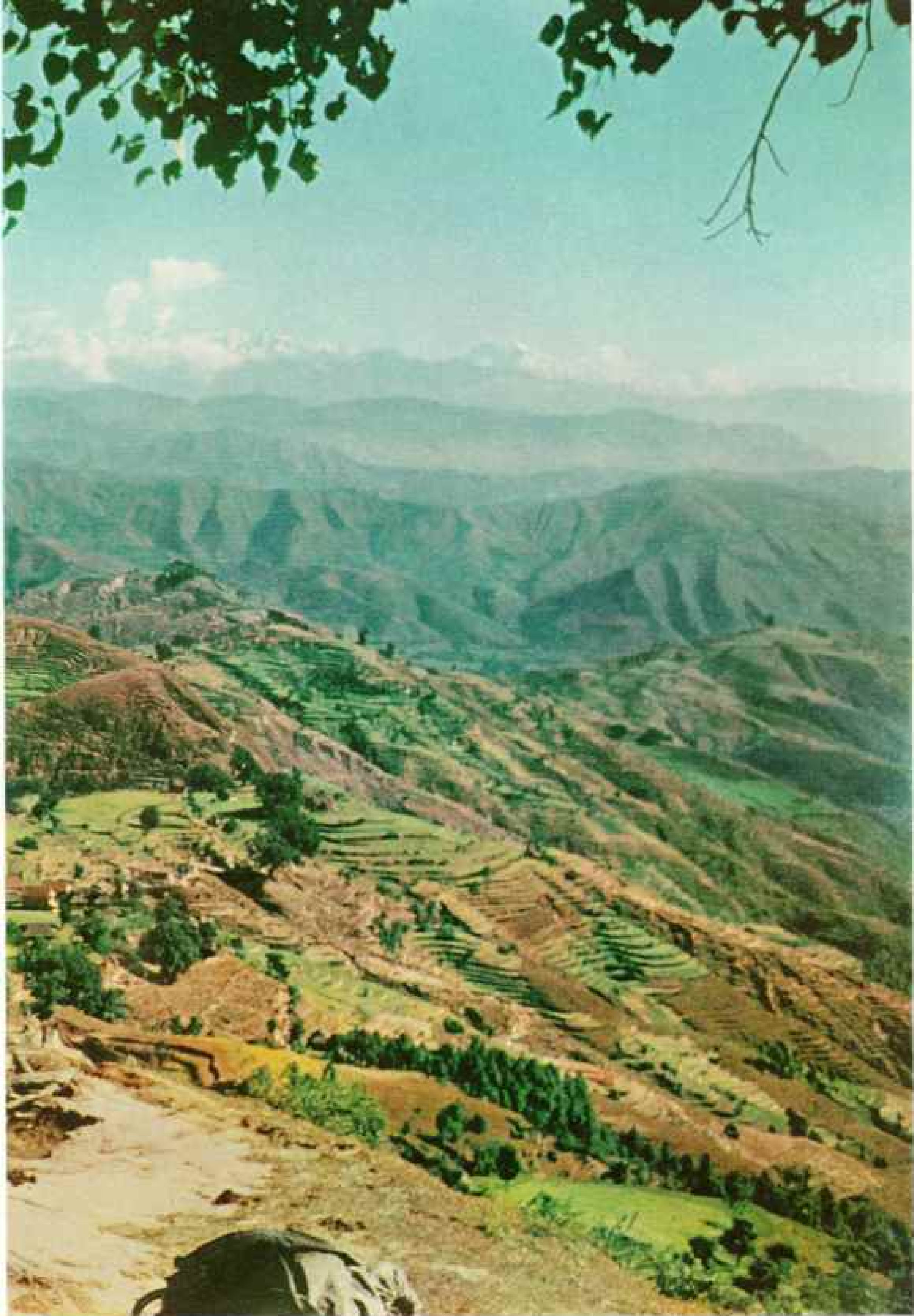
Firewood Travels to Katmandu on the Back of a Sturdy Patriarch

His work began on the evergreen-covered slopes above the Valley of Katmandu. Assisted by his sons, he felled trees and cut them into fireplace-sized sticks. Shouldering two loads, he trotted miles to the city, where he sold the wood for 30 cents.



**Bowed by Baskets of Rice, Farmers Start
a Six-day March to Katmandu Market**

Here where mountains rise like so many huge waves frozen at their crests, planters find the price of life is ceaseless toil. Generations of labor



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carved out these staircase rice terraces in eastern Nepal and walled them with stones. Chautara village clings to a ridge because the monsoon

rains flood the valleys. Last fall a Japanese expedition made reconnaissance for an attempt on 23,440-foot Garl Shankar (right).



"Please, please," he said with broken urgency, "you make well, Sahib."

The child's lovely Indian face contorted with pain as her father showed me her foot. It was hideously infected.

Cow dung—regarded by Hindu villagers as a sovereign remedy because the cow is sacred—had been generously applied to what had been a minor cut. While the girl whimpered softly, I cleaned the wound and used massive applications of penicillin. I had little hope of clearing up the infection.

Imagine the depth of my feeling when, more than a year later, I met the girl walking gaily along at her father's side. Who could ask a greater reward than her happy smile when she recognized me?

All too often my patients disregarded my instructions to keep their injuries clean, and a cut I had swabbed and dusted with sulfa powder one day would return the next day plastered with filth. I soon discovered that the solution was psychological.

By the nature of their religion, Hindu or Buddhist, most Nepalese are fatalists. Death holds no terrors for them, for they often regard it as a release from the world's troubles. But when I said: "If you don't keep your wound clean, you will die in terrible agony," my warnings worked. Physical pain was a far worse prospect than death.

Some sort of peak in my amateur medical career was reached during a visit to Mustang, capital of the province of Mustangbhot, high on the Tibetan border.

Mustangbhot is one of Nepal's forbidden frontier areas, ruled by its own raja and so remote as to be semi-independent. To the best of my knowledge, I was the first European ever to lay eyes on the raja's capital city, in which his mud-walled and glass-windowed four-story palace was the outstanding architectural glory. The last stranger to reach there was an Indian, Hari Ram, of the Survey of India, in 1873.

Chilly Reception in Mustang

Our reception was something less than enthusiastic, but I was hardly prepared to be shown to a shabby stable behind the palace.

Because of the great significance Nepalese attach to military rank, Aila normally introduced me as "Colonel Hagen Sahib" whenever we entered a strange town or village. He was fully equal to this emergency.

"Behold!" he cried, throwing open my field desk to disclose its impressive-looking sheaf of maps and papers to the raja's major-domo. "These are the King's papers. And this is the great and powerful General Hagen Sahib!"

My lightning promotion so impressed the

Improvised Bridge Leaps a Roaring Torrent

Stricken with dysentery at remote Mugu, his money and supplies nearly exhausted, Dr. Hagen began a feverish five-week walk to Pokhara. At the foot of the awesome gorge between the peaks of Dhaulagiri and Annapurna, he found the bridge swept away by monsoon waters. His porters cut trees and stretched a threadlike span across the Kali. Then, nearly fainting from weakness, the author crawled across (page 394).

Carving a wooden pot, workers turn a primitive lathe with a leather belt. Man at left holds the cutting tool, bracing it between his legs.



Belly Deep in Snow, Struggling Yaks Carry Precious Salt Through Ninyal Pass

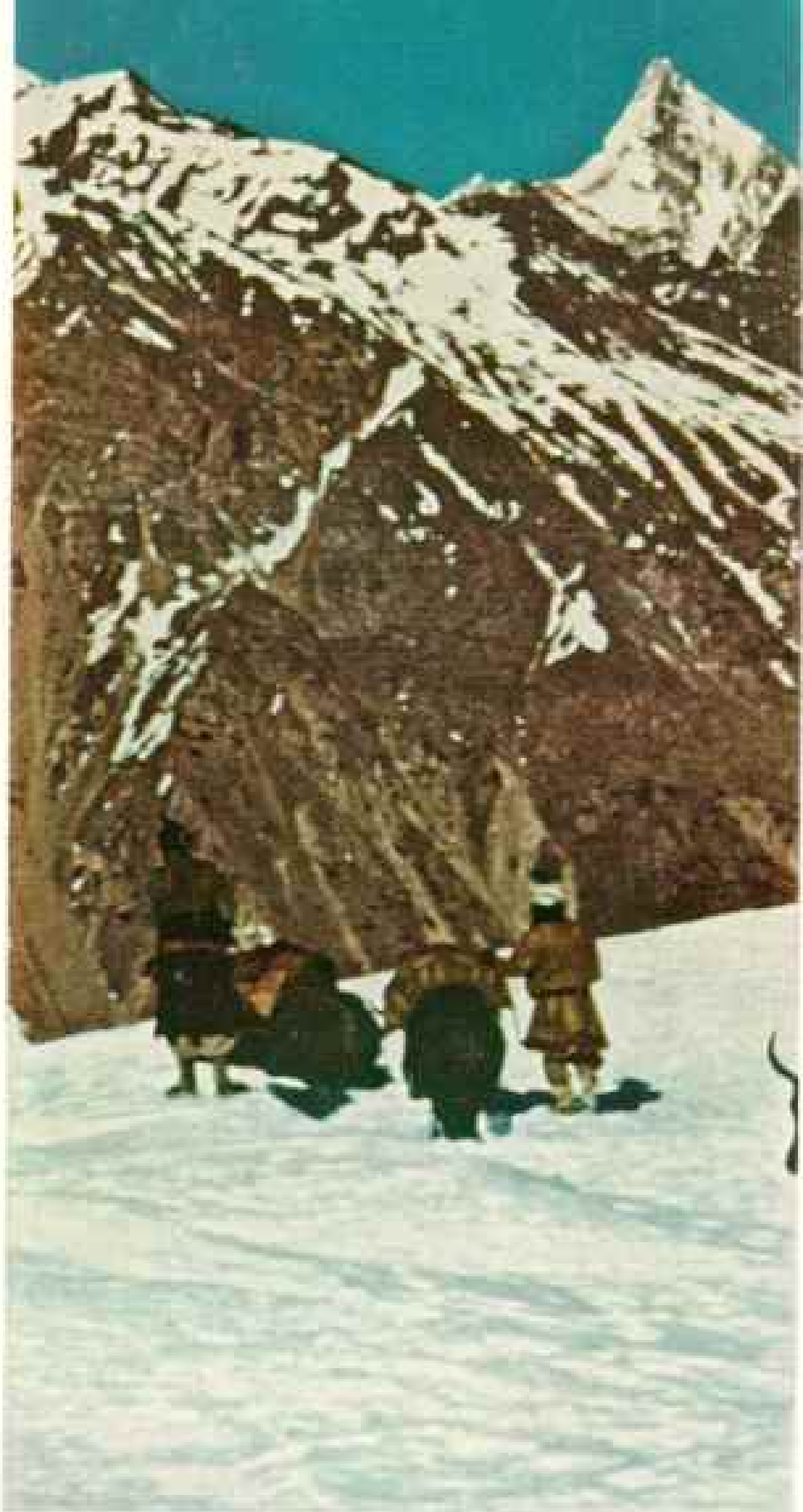
"Holy ones, in Nepal the ground is nothing but rocks, and it is as humpy as the back of a camel." Thus, according to tradition, did Gautama Buddha characterize the land of his birth 25 centuries ago. "Surely," he said to his followers, who were going to Nepal as monks, "you are not going to enjoy your journey."

Now, as in the Buddha's time, few Nepalese travel for pleasure; yet a quarter of the population spends one or two months a year on the trail. Man's need for salt provides the goad.

Nepal must import its salt from India or Tibet, and most families have the responsibility of obtaining their own supply. Tibetan salt depots up the gorges of the Himalayas draw a steady stream of Nepalese, who arrive with rice, wheat, and vegetable oil for barter. Trade has decreased because of the recent Tibetan troubles.

Salt-carrying yak trains thread high passes, cross vast glaciers, and cling to cliffside trails. This Nepalese outfit coming out of Tibet crawls beneath jagged peaks in the Zaskar Range, which dips into northwestern Nepal. Never mapped or named, its crests soar 19,000 to 25,000 feet.

Primarily a beast of burden in high altitudes, the yak yields hair for clothing and blankets, milk for butter and cheese, and meat. After it dies, its tail serves as a fly whisk.



Inflated buffalo skins serve as boats on the streams of western Nepal. These river men steer their rafts with paddles.





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major-domo that he got us slightly better quarters, but the raja declined to grant me an audience.

It was, of course, important to my work that we have his support during our stay in his province. So Aila's one-man propaganda department went to work among the palace servants. Did they not realize that not only was I a mighty General Sahib, but a most learned physician and healer as well? That did the trick.

Skin Lotion for a Rani

Barely was my gear unpacked when the raja's prime minister appeared to tell me that the rani desired my help. She had exhausted her supply of a certain marvelous skin balm and was afraid of losing her complexion. I would therefore and forthwith replenish her supply. To my confusion, the prime minister

handed me an empty jar of a well-known English cold cream. It was clear that my reputation must stand or fall on my ability to supply a substitute.

Because sun glare from glacier ice can cause just as painful a burn as a day at the beach, I always carried a stock of sunburn cream. On the broad theory that it could do no harm, I filled the jar with this ointment. Luckily it had a pleasant aroma, and my stock soared. Soon afterward, diplomatic relations with the raja were firmly cemented over cups of Tibetan tea.

Only recently I saw a newspaper dispatch to the effect that His Highness of Mustang-bhot had secured what he believed to be the skin of a *yeti*, or abominable snowman. Having some knowledge of the raja's sense of humor, I'm inclined to believe that he is having innocent fun at the expense of the

credulous lowlanders, after the fashion of mountaineers the world over.

No one who travels the mountains of Nepal can avoid the yeti legend—and legend I believe it to be, for never did I encounter anyone who had actually seen the beast. Always the yeti had been seen by the great-uncle twice removed who has since moved away, or the brother of a second cousin, the one who died just last year. I have been shown alleged yeti tracks, but these uneven depressions in the snow could have been made by a bear or a strayed yak. The famed Sherpa monastery at Thyangboche, near the foot of Mount Everest, even boasts a portrait of a yeti, but it is admittedly based on legend and looks like the crossing of a wolf, tiger, and bear.

Like most Sherpas, Aila believed implicitly in the yeti. Once, when we were working near the top of a high pass, he suddenly pointed to what were undoubtedly tracks in the snow.

"I think, sir, yeti tracks. Now very good season for seeing yeti, sir. Yeti getting hungry now, eating man."

"But Aila," I said, "how can you be sure those are yeti tracks?"

He waved an arm at the vast, empty expanse of snow, ice, and rock. We might have been on the moon. "Nobody else here, sir," he said simply.

Nepal Reminds Author of His Homeland

It would be pleasant to be able to say that Aila was the only one who shot an occasional glance back over his shoulder the rest of the day. After all, we Swiss have a similar legend. Ancient tomes in the libraries of Lucerne attest the presence of a monstrous dragon on the heights of Mount Pilatus.

Indeed, the many similarities between Nepal and Switzerland were a source of continuing surprise and delight to me. One unex-

Porters Inch Across a Bird's-nest Catwalk. Each Step Gambles With Death

The trails between Nepal and Tibet often fly off into space. Here, high above the Arun River, flimsy forked poles support a teetering roadbed of loose sticks. The author saw many broken bridges; he could only guess how many lives had been lost.

Axmen shape a dugout. Flood in the hills swept the log to their Dudh River home





pected aspect of my work was a brief encounter with that Swiss mainstay, the cheese industry, transplanted to the Himalayas.

Far to the north of Katmandu, I had become entranced with the beautiful Lantang Valley and its wonderfully friendly people. It might easily have been a Swiss valley of five centuries ago. Here stood two-storied wooden chalets, their overhanging roofs held down by rocks against mountain gales. Snowy edelweiss and other Alpine flowers carpeted the valley floor, and often I heard the echo of a yodel. Nepalese mountain herdsmen yodel as do my countrymen—to communicate with one another and to guide their herds. But in

the Lantang Valley the herds were not sleek, fat cows, but great shaggy yaks.

What the camel is to the tribes of the desert, what the buffalo was to the American Indian of the plains, this rugged member of the ox family is to the mountain Nepalese (page 376). It is at once a beast of burden and a magnificent provider of food and textiles. Yak meat, freshly butchered or dried, is considered a delicacy, although this is open to debate. Too valuable for their milk and hair to slaughter for food, the animals are butchered only when they are old and tough.

Yak hair forms the basis for much of the homespun clothing worn in the Himalayas. Yak milk is drunk or churned into butter, which is later clarified into ghee. Ghee figures importantly in Buddhist religious rites, and is in constant demand, especially in Tibet.

Cheese Industry Brings Prosperity

When I learned that the Nepalese Government, with the help of Swiss technicians and the Food and Agriculture Organization of the United Nations, planned to establish the nation's first cheese factory, I suggested the Lantang Valley as an ideal site. I was more than happy when my suggestion was adopted. The little stone factory was a fine success—so much so, in fact, that three more such factories have been started.

For the first time in history, Nepal is exporting cheese to India. Yak milk is far richer in butterfat than the milk of even our finest Swiss cows, and the plump, golden wheels of yak cheese have a delicious flavor. I found the taste equal to the very best grade of Swiss, holes and all.

Through the sale of milk to the cheese fac-

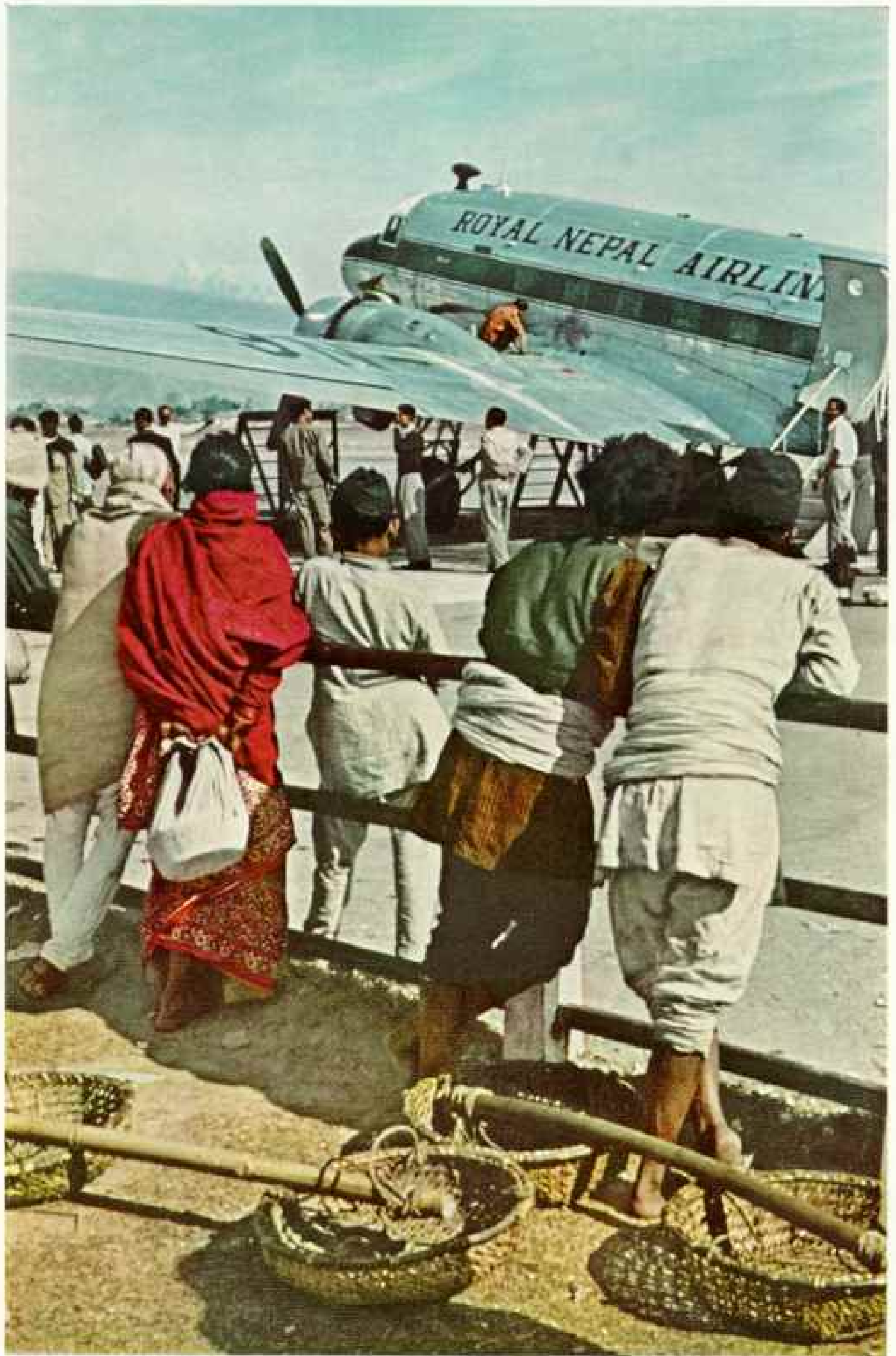
Half a dollar buys this young girl's *Cinnamomum* leaves and rewards her for the seven-day walk from her home in Nepal's midlands to Naksalbari bazaar on the Indian border. The leaves provide an ingredient for the local curry powder.

Katmandu Fruit Vendors Break Winter's Chill With Cotton Quilts

Sidewalk market displays tangerines, guavas, tiny bananas, cashew, papaya (center), peas, and limes. Most of the capital's fruit must be imported from beyond the Katmandu valley.







BOULCHAMPE BY SEMUTLER JONES © NATIONAL GEOGRAPHIC SOCIETY

Royal Nepal Airline Opens Regions That Never Knew the Wheel

Passengers at Katmandu airport board a DC-3 for Pokhara. In 40 minutes they will cover a hundred miles, a journey that would have cost them 10 to 14 days on foot.

tory, the farmers of Lantang Valley were among the first peasants in all Nepal to escape the grip of the money lenders. Throughout the land, many of the countrymen are in the hands of usurers, paying off debts incurred, oftentimes, for the elaborate weddings Nepalese pride and tradition make important. I suspect that the benefits of a project like the Lantang cheese factory, which cost only a few thousand Nepalese rupees, are far more meaningful to the people than many a vastly more expensive long-range scheme.

Significantly, I once met a party of Tibetan traders on a trail more than 400 miles from Lantang. Their first question was for news of the marvelous cheese factory. Would my countrymen come to Tibet to help build a factory there? So swiftly and far does news travel in the Himalayas.

But, as is so often the case, the best devel-

opments are home-grown. One of the most heartening sights of my travels was the spread of education, and for this Nepal must thank the returned Gurkha soldiers. Their military training in the British and Indian armies has made some of them natural leaders in their villages. And their pensions make them gentlemen of independent wealth, able to indulge in small philanthropies.

Warriors Turn to Teaching

Whenever I found an especially well-kept village or a new school, I usually discovered that a pensioned Gurkha mercenary was in part responsible. Often the teachers themselves were Gurkhas, determined that the young should have a better education than they had known (below).

My pedestrian progress up and down Nepal was certainly not of my own choosing. I

School meets in the open air at Bhojpur. The principal, a pensioned Gurkha soldier (left), confers with his three teachers. Salaries run low. "We could get twice as much in India," said one teacher, "but we consider it our duty to our country to work here." The United States helps support a teacher-training program in Nepal.

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Tetang Hides in a Himalayan Cleft;
Beetling Cliffs Dwarf Its Towering Walls

Built like a medieval fortress, Tetang once protected its citizens against raids from near-by Tibet. Today the town lives off the trade between



Nepal and its northern neighbor. Houses rise several stories. Ground floors serve as stables for yaks, sheep, and mules; upper rooms provide

living quarters and storage for trade goods. Irrigated fields of barley stand ready for harvesters; farmers at the far left begin the cutting.





would have been delighted to ride between rock samples. But beyond a few miles of paved highways in Katmandu's valley there are—with one exception—no roads worthy of the name. The single exception is the recently completed motor road from Katmandu to India. During monsoon, even this thin link with the world is frequently blocked by land- and rockslides. The slides often result from severe soil erosion, which in turn is the product of uncontrolled deforestation.

Otherwise, there are only trails, and what trails! Sometimes they are little more than a frighteningly narrow ledge along a cliff half

a thousand feet above a roaring, glacier-fed river. For a roadbed one often trembles across a few worn logs laid on ancient iron spikes driven into the cliff's sheer wall. These are Nepal's superhighways and main trade routes (page 379).

It is hardly astonishing that the Nepalese have not adapted the principle of their prayer wheels to transport, for there are few places where a wheel can roll. As the Nepalese see it, with their simple, direct logic: What's the point of perfecting something for which there is no possible use?

To complicate travel further, there is only



TORI HAGLER

one fairly passable east-west trail through the midlands from one end of Nepal to the other. To save time, we frequently had to go south to India, travel east or west by rail, and then head back north into Nepal.

By way of compensation, walking brought me into far more intimate contact with the people. Often my work in the mountains took me far from any trail, and I could understand the terrible fear the lowland Nepalese feels for the snowy heights where, he believes, only gods and demons live. I could see at close range the patient labor of generations

(Continued on page 392)

Shining Copper Bowls Bespeak a Sherpa Family's Prosperity

Resembling a Swiss chalet, the home boasts a plank floor, wood paneling, and thick walls of stone. However, it lacks a chimney, and smoke festoons everything with soot. The room's Stygian atmosphere rarely affects the good spirits of its occupants.

Here a smiling mother, pleased by the arrival of a guest, roasts potatoes on a stone griddle. Long wooden churn in the wall niche at left holds tea flavored with salt and ghee, or clarified butter.

An outdoor kitchen serves a Katmandu valley housewife. Nepalese eat comparatively little meat; their diet leans heavily to cereals and vegetables. This cook prepares turnips.

SCHOTLER, JUNE © NATIONAL GEOGRAPHIC SOCIETY





Flaming sea of tassels engulfs a farmer in the Kowari Valley;



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the grain, known as amaranth, is popped like corn or ground into flour





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Whirling prayer wheels at Karr Monastery, a Buddhist speeds her petition to the gods. When spun by hand, prayers hammered into the copper cylinders and written on papers stuffed inside go directly to heaven, she believes. Motion blurs the four wheels at right.

Carving a Monument to Faith, Sherpas Write Their Prayers in Granite

Devout workers chisel the face of a cliff overhanging the trail to Thyangboche Monastery, at the foot of Mount Everest. Carving between the letters, they lay bare a white background of unweathered stone. Pilgrims need only to pass by the wall to earn its prayers.

One of the inscriptions is the most famed of Buddhist prayer formulas: *Om mani padme hum*, "O, the jewel in the lotus."

Praying mechanically, a lama from Tibet feels free to laugh and talk during a visit to Thyangboche. On pilgrimage to Nepal's holy places, the priest never ceased to twirl his prayer wheel, the author observed.

Such religious fervor pervades every part of Nepal. Mountain people practice Buddhism; inhabitants of the valleys follow Hinduism. The two faiths live together peacefully; their adherents often share the same temple.



in the neatly stone-walled terraces, rising tier upon fantastic tier up the steep mountainsides (page 372).

Jungle and Glacier Only Hours Apart

Too often, I saw the consequences of this overintensive cultivation of every inch of arable land, coupled with uncontrolled deforestation. Great earth- and rockslides wipe out villages and engulf fields. For the inhabitants, there is the grim choice of abandoning their homes or villages and seeking new land elsewhere, or building all over again.

On foot, too, I could experience more vividly Nepal's wildly varied climate. I have walked shivering from a glacier to stand perspiring, a few hours later and a few thousand feet lower, in a steaming bamboo jungle.

"What I can't understand," I complained to Aila one day after we had managed an especially nasty cliffside path, "is why anybody ever uses these trails. Anybody in his right mind, that is."

"Simple, sir. Salt," was his reply.

So I discovered that the existence of any trails at all is due almost entirely to man's need for salt. Nepal produces little, but both Tibet and India mine deposits. At least a fourth of Nepal's population is on the trail a month or so every year, bent on trading grain or ghee at a salt depot near the Tibetan border or at an Indian bazaar in the south.

Usually the traders from each village travel together, and a picnic atmosphere flavors the expedition. Certainly there seems to be no hurry.

I recall a very narrow trail on which my little party formed only a tiny part of the long file of Nepalese extending far ahead and far behind.

Soliciting alms, a saffron-robed Buddhist carries a lacquered iron bowl. Donors give food and money to support his lamasery at Bodhnath (opposite).

The Lama of Bodhnath Offers 1,000 Gifts to the Buddha

Statues of Buddha mothers adorn the altar above hundreds of pastry cones, cups of clarified butter, and vials of holy water. Presiding from his throne, the ruling lama holds a double drum to attract the deity's attention. In the night-long ceremony held during a full moon, the photographer saw the lighted butter lamps cloud the temple with smoke and heard the eerie music of drum, copper trumpet, and conch shell alternate with chants.

Known as the China Lama after an ancestor who fled to Nepal from China, the prelate speaks several languages, including English.







We had been halted inexplicably, and the delay stretched out endlessly.

"Pass the word," I told Aila. "Find out why we're stopped."

Many minutes later the word came back.

"Fellow ahead having a smoke," Aila explained. "We wait, I think, sir."

The choice being a climb straight up or straight down a cliff, we waited. I heard no outcry against the delay, for the loads my fellow travelers carried were heavy. They were doubtless glad for the rest, leaning their burdens against the T-shaped wooden supports many Nepalese carry on the trail. I was reminded of nothing so much as a group of European race spectators relaxing against their shooting sticks.

If Nepal's trails are bad, her hundreds of bridges are hair-raising. The peasant's idea of bridge building is, to say the least, casual. As with the trails, there was until recently no program for maintenance or new construction. A great many bridges are makeshift structures, built in the sure knowledge that they will be

swept away in the next monsoon's high waters. They are, of course, intended only for the foot traveler, and in many cases a single log, perilously balanced over a roiling, tumbling torrent of glacially cold water, makes up the entire span.

Terror at the Bridge

For sheer horror, one wretched crossing surpasses anything in my memory. Far to the northwest, at Mugu, in the most remote corner of Nepal, I had fallen seriously ill. My supplies were exhausted, and if I was to save my life, I had no choice but to walk back to civilization. It was a dreadful march, an agony of stumbling along between fainting spells.

Finally we reached the Kali River, only to find it roaring in full flood, fed by the heaviest monsoon rains in the memory of the people. The bridge I had hoped to use had long since been swept downstream.

On the other bank, a group of villagers had felled logs to reconstruct the bridge—if I

(Continued on page 399)



Hindus Pray and Feast at an Outdoor Wedding

Here, on a shore of the Kali River, a Brahman priest reads the ritual uniting the couple at center. The bride's father and sister share a straw mat at left. They are descendants of the Kshatriyas, the warrior caste that emigrated from northern India. Remains of the wedding feast—rice, fruits, and water from the holy river—lie on the sand.

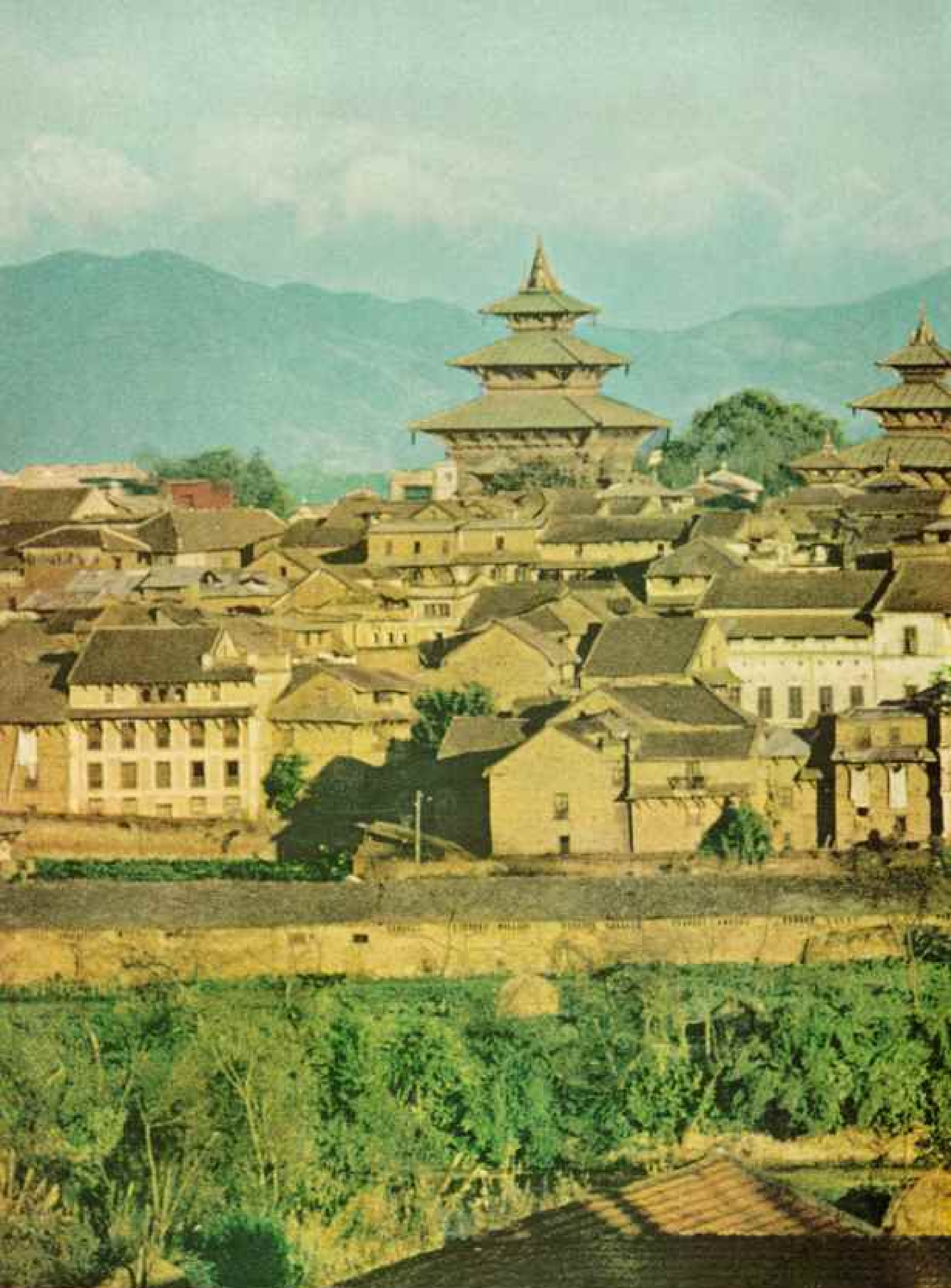
The wedding party paid no heed to another ceremony within view: a cremation with its mourners (below).

Shaved and stripped, members of a bereaved family watch the flames of a funeral pyre on the Kali.

When Nepal's King Tribhuvan died in 1955, many men shaved their heads out of respect.

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Sunset's Gold Burnishes the Pagodas and Homes of Katmandu, Nepal's Capital

The architectural genius of the Newars, early inhabitants of Katmandu valley, enriched the city with spacious squares, skyscraping shrines, and eye-catching stone gods and goddesses. Some

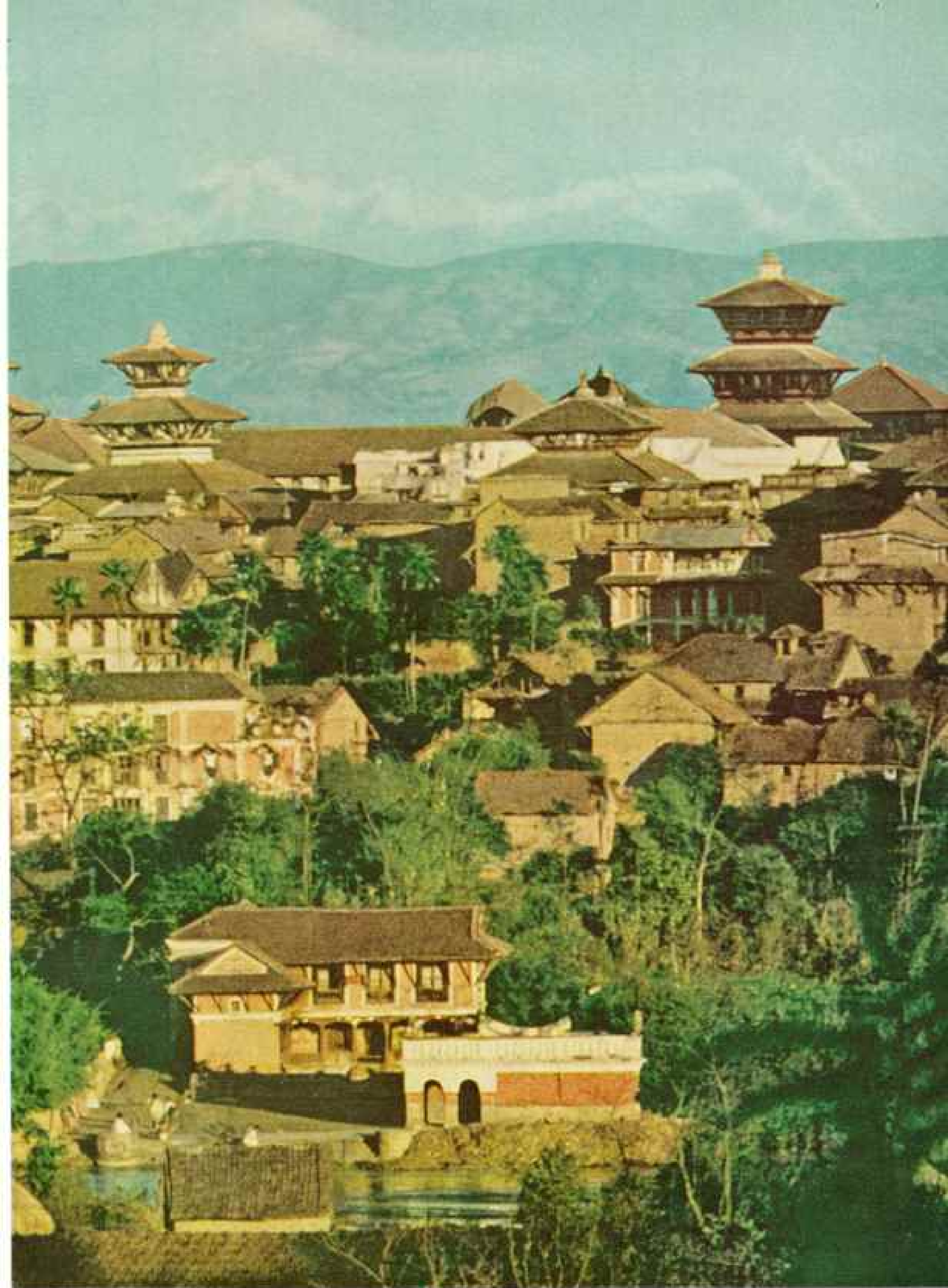
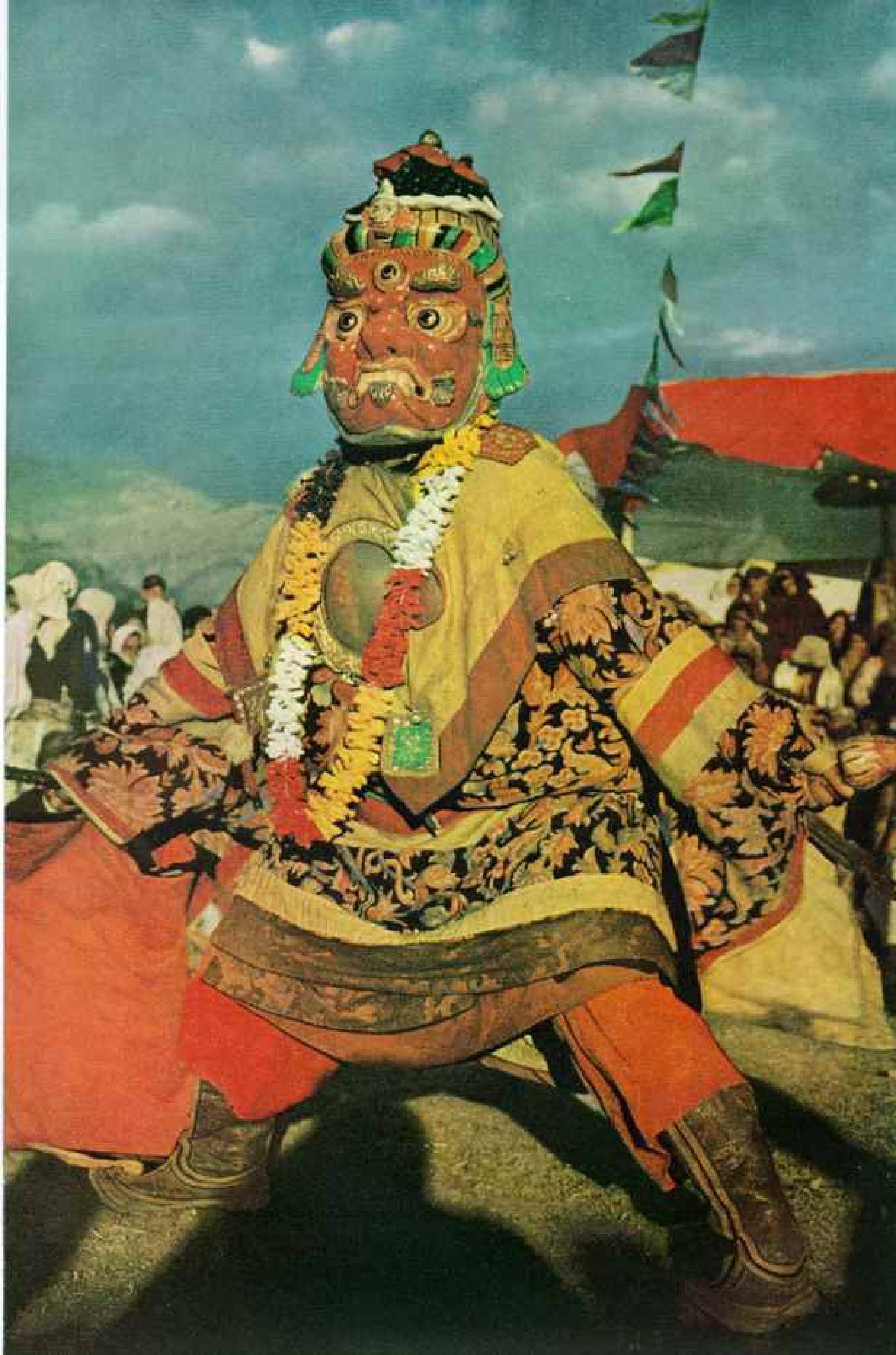


ILLUSTRATION BY ANTHONY JONES © NATIONAL GEOGRAPHIC SOCIETY

scholars believe the Newars originated the pagoda style of the Orient. Long closed to most travelers, Katmandu so impressed the few European visitors of the 1800's that Kipling penned this

summary: "The wildest dreams of Kew [a London suburb] are the facts of Khatmandhu." Women in foreground gather at the Vishnumati River, whose waters, they believe, cleanse the soul.



would pay them to do it. Their price was two rupees. It was impossible to shout over the roar of the waters, and our negotiations were conducted by notes wrapped around rocks and hurled across the flood.

As the Kali rose, so did the price. Encouraged by my prompt agreement to the initial two-rupee fee, the canny farmers kept asking for more. Back and forth sailed the rock-weighted notes, until the price went to ten rupees—and two rupees was all I had.

If the bridge was not built soon, it would be too late. My only hope of reaching Pokhara and medical aid would be gone. By now I had developed a kind of beriberi, my fingernails had dropped out, and I kept myself going only by massive injections of aureomycin and other medicines.

In this extremity, my own porters came through. Somehow, they located trees long enough to span the gap; somehow they managed to extend them across the roaring Kali. And somehow we all managed to get across this matchstick

structure (page 374). It was an experience I have no wish to repeat.

Some of Nepal's more ancient bridges are of the chain-suspension type, the links hand-forged by native smiths from Nepalese iron, but even these give the traveler no great feeling of safety. In former days, I was told, certain bridges were so terrifying that travelers were blindfolded, strapped to boards, and maneuvered across by means of cables slung to the chains.

Where the rivers are broader and the primitive bridges are unable to span them, dugout canoes, manned by a distinct caste of ferry-

REPRODUCED BY SCHULTECH JONES © NATIONAL GEOGRAPHIC SOCIETY



A Demon God Dances With Spear and Lotus Jewel

Last year priests from Himalayan lamaseries made a pilgrimage to Pokhara, where their ceremonies coincided with King Mahendra's visit (following page).

This lama wears the fearsome mask and brocaded dress of a mountain deity. Flaming lotus bud in the left hand symbolizes the riches stored on the god's sacred peaks.

Some awed, some apprehensive, women and children watch the sacred drama. Once the almond-shaped marks on the foreheads of two spectators at center would have identified them as Hindu followers of the god Vishnu; nowadays women wear such marks for beauty only.





men, provide the crossings. If possible, these narrow-beamed, top-heavy craft are more dangerous than the bridges.

Even the normally fearless Aila took a dim view of the dugouts, although, as the property of the Hindu river gods, they were as sacred as temples and could only be entered barefoot. A Buddhist, Aila took no stock in the ability of the river gods to keep a dugout from capsizing.

Icy River Preferable to Canoes

When a canoe looked particularly unsafe, I used a bone-chilling solution. I simply strapped my notebooks and camera on top of my inflated air mattress and swam the river, pushing my mattress raft ahead of me.

In northernmost Nepal, where the influence of Tibetan traders has been strong, trails are better kept and bridges more stoutly built. Thus northern Nepal, because of poor contact with the central government at Katmandu, has been commercially oriented to Tibet. Cultural ties have also been strong because of the influence of religion.

The problem of roads, I firmly believe, is the real drama of Nepal, and upon its outcome will depend the country's future. In my own reports to the Nepal Government, I put the strongest possible emphasis on the immediate need for a comprehensive program of trail improvement and bridge building.

Happily for my hopes, I once had the opportunity to present a slide lecture to His Majesty, King Mahendra Bir Bikram Shaha Deva, and other members of the royal family. I'm afraid they were spared nothing, for I was careful to include photographs of some of the worst trails and bridges I'd ever encountered.

At the end of the lecture, the bespectacled young king looked thoughtful.

"Yes," he said finally. "It is time I saw my country."

Not long afterward His Majesty personally led some 300 government officials, many of whom had never before left the capital, into the field to see at firsthand the country's condition and needs. It must have been a heartening journey, for the loyalty

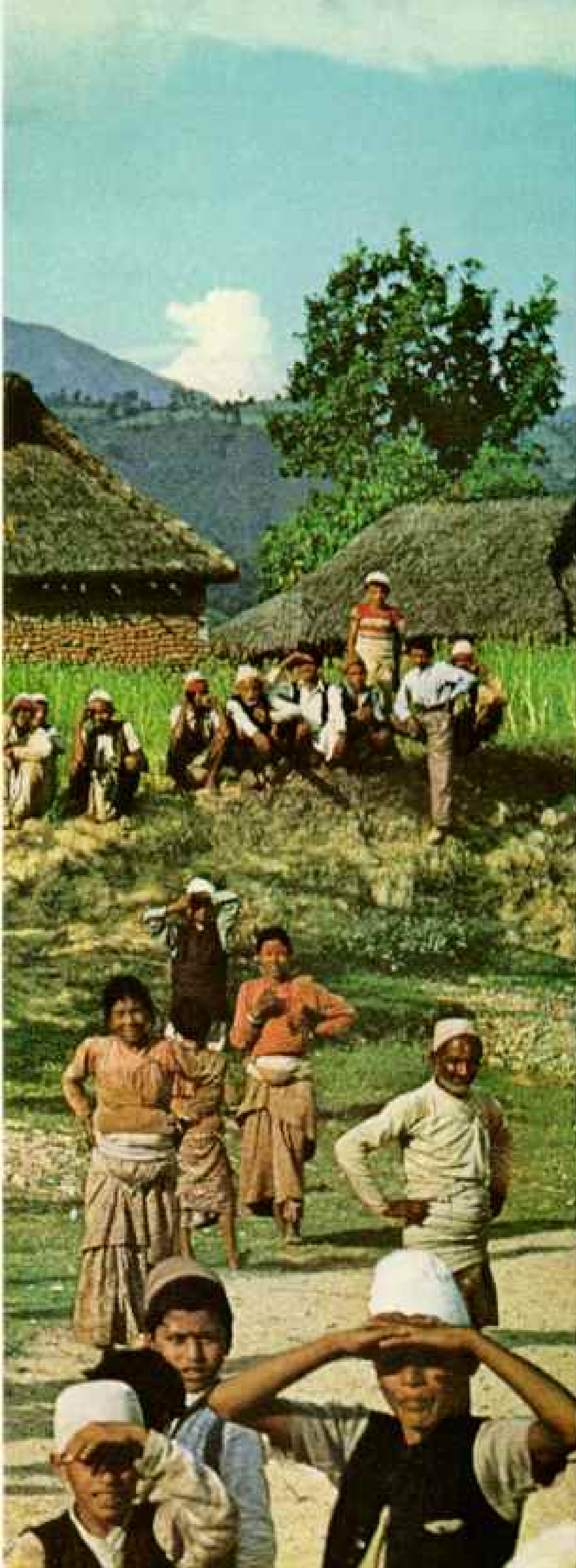
Trumpets and Drums Hail King Mahendra as He Mixes With His People in Pokhara

Once Nepal's rulers never ventured beyond Katmandu. But in 1956 young King Mahendra and 300 officials made a triumphal four-month tour of the country after seeing Nepalese scenes photographed by the author. Here, on a 1959 visit, His Majesty walks a red carpet beneath an umbrella signifying royalty. Officials leading the way hold their hands in gestures of greeting.



Homemade, hand-powered Ferris wheel amuses villagers during the fall festival of the Hindu goddess Durga. Adults find the contraption so

entertaining that children rarely have a chance to ride. Patrons queue up to await their turn. Two men at the wheel's hub turn the spokes.



REARRANGED BY SCOTTLEIGH JONES (LADIES) AND TONY NAGLER © N. S. S.

Gold-embroidered fur hat and heavy necklaces comprise the finery of a Sherpa woman. Her costume is Tibetan.

of the provincial peasants to the monarchy is tremendous. The king's inspection tour lasted four months and was the first such survey ever made.

Water Power—Nepal's Brightest Hope

It is still too early to assess the results of my geological survey, but I can say that Nepal's mineral resources are not on the highest mountains, as its ancient legends claimed. There are a number of extremely primitive iron and copper workings which would probably repay exploiting on a limited scale. Small smithies and factories might profitably produce iron plowshares or bridge chains, but until Nepal improves her transportation, she cannot hope to compete with India in steel or copper.

As for petroleum, there seem to be some possibilities that prospecting might prove worthwhile.

More important for Nepal, it seems to me, are the potentials of her agriculture and forestry. Scientific irrigation would increase farm production in many areas. And the stability of the government since the country's first elections in 1959 seems to assure promising developments in farming and irrigation, as well as in the building of roads and bridges.

Perhaps Nepal's greatest resource is her abundant potential for hydroelectric power, needing in most cases no expensive dams. Her rivers offer many a hairpin curve where



a tunnel from one level of the stream bed to the next would suffice for power production. In time, Nepal might be able to supply power for most of northern India.

Such abundant and cheap electric power, used to extract nitrogen from the air, could also provide nitrogen fertilizer for Nepal and much of Southeast Asia as well.

As for all those diamonds, rubies, emeralds, and other precious stones supposedly abounding among the high thrones of the gods—well, I never did find them. But, faced with the threat of bandits, I did discover a seemingly inexhaustible supply of another kind of Himalayan “jewel.”

Eight Bullets for Eight Bandits

On one of my northern trips, I saw that my route would carry me through Manangbhot, principal town of the region north of Annapurna. As always, my porters were alert to pick up any gossip concerning trail conditions ahead. Now Aila came up to me as we rested after our brunch.

“Porters much frightened, sir,” he told me gravely. “Very bad place ahead, sir. I think many bandits there.”

“But it’s marked on the map as just a tiny village,” I protested. Aila remained firm.

All my experience of Nepal had been that violence and banditry are almost unknown among the fundamentally decent and honest mountain people. I carried a Swiss Army pistol, but normally it rode in the bottom of my luggage. Now, I decided, was the time for a little applied psychology.

Some time before, in what must have been one of the most unfair competitions in history, I had demonstrated my prowess with a pistol by shooting at rock targets against a friendly Tibetan trader. His antique muzzle-loader took him 10 minutes to load and had to be fired from a support. The muzzle-loader boomed like a cannon when he fired it, but at 60 feet its accuracy was no match for my modern pistol. I felt exceedingly unsporting, but the competition had the desired effect of making my porters regard me as a Himalayan Deadeye Dick.

Now I made a great show of unpacking my

pistol and counting my cartridges. I had a dozen rounds of ammunition.

“Just how many bandits are there?” I asked Aila.

“I think, sir, eight bandits.”

“Excellent,” I said briskly. “I shall shoot all eight, and we will still have four cartridges to spare.”

Vastly reassured, my porters cheerfully followed their bold and fearless leader, who was wondering nervously just what he would do if eight bandits actually did turn up. Or what he would have done if Aila had reported 13 bandits.

We met no bandits, but Manangbhot came as a surprise. Much more than a village, it was a large and prosperous town. Many of the townsmen had traveled abroad and were familiar with airplanes, railroads, and even steamships.

Our somewhat cool reception was explained when I found that the residents had mistaken me for a government customs officer, for we had stumbled on a kind of illicit Shangri-La. The city’s principal business was smuggling! And the bandit report we’d heard down trail was a carefully nurtured propaganda effort to keep prying strangers clear.

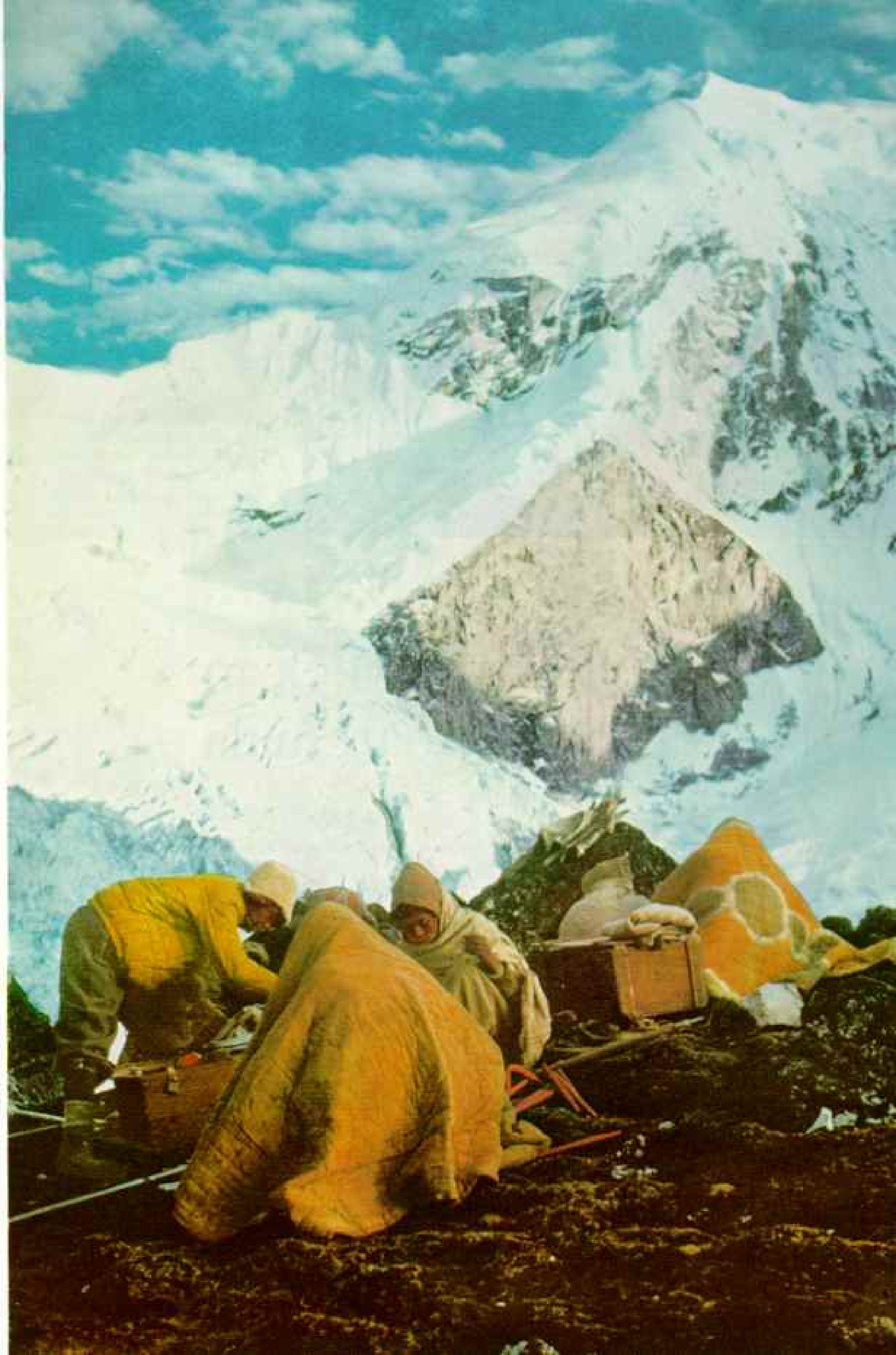
“Gems” From Europe’s Glass Factories

The main commerce was in those legendary “jewels from the thrones of the gods.” “Straight from the Himalayas,” as they unquestionably were, they fetched a handsome price from the unsuspecting but deeply religious peasants of lower Nepal and India. The only trouble was that they had originated not in the Himalayas but in the glass factories of Czechoslovakia.

My work in Nepal is not yet finished, for there remain a number of technical chores to be completed. Perhaps it will be necessary for Aila, “little Singha Durbar,” and me to journey once again to the snowy heights behind Kanchenjunga and Makalu, Annapurna and Dhaulagiri. Once again Aila and I may sit before a yak dung fire and share a cup of chang in some mountaineer’s smoky, cheerful home, while outside the wind howls down from high Tibet.

Blanketed Porters Huddle Under the Frosty Eaves of Mount Everest

At sunset the November temperature stood above freezing. Two hours later the author sat in his tent drinking hot tea; within minutes the liquid froze. Soaring 29,028 feet, Everest lies 28 air miles from this 19,000-foot camp at Tesi Lapcha.





Indian parishioner, his richly illustrated Bible held aloft, recites the Easter story to a Holy Week audience at the church of Santa María de Jesús, near Antigua. In some villages, lay members lead ceremonies and mix Christian and Maya rituals.

Rain-soaked women wearing the distinctive *huipiles* of Santa María wait at dusk to bear lighted candles into the church. Folded cloths on heads often serve as slings for carrying infants.

Easter Week in Indian Guatemala

By JOHN SCOFIELD

Assistant Editor, National Geographic

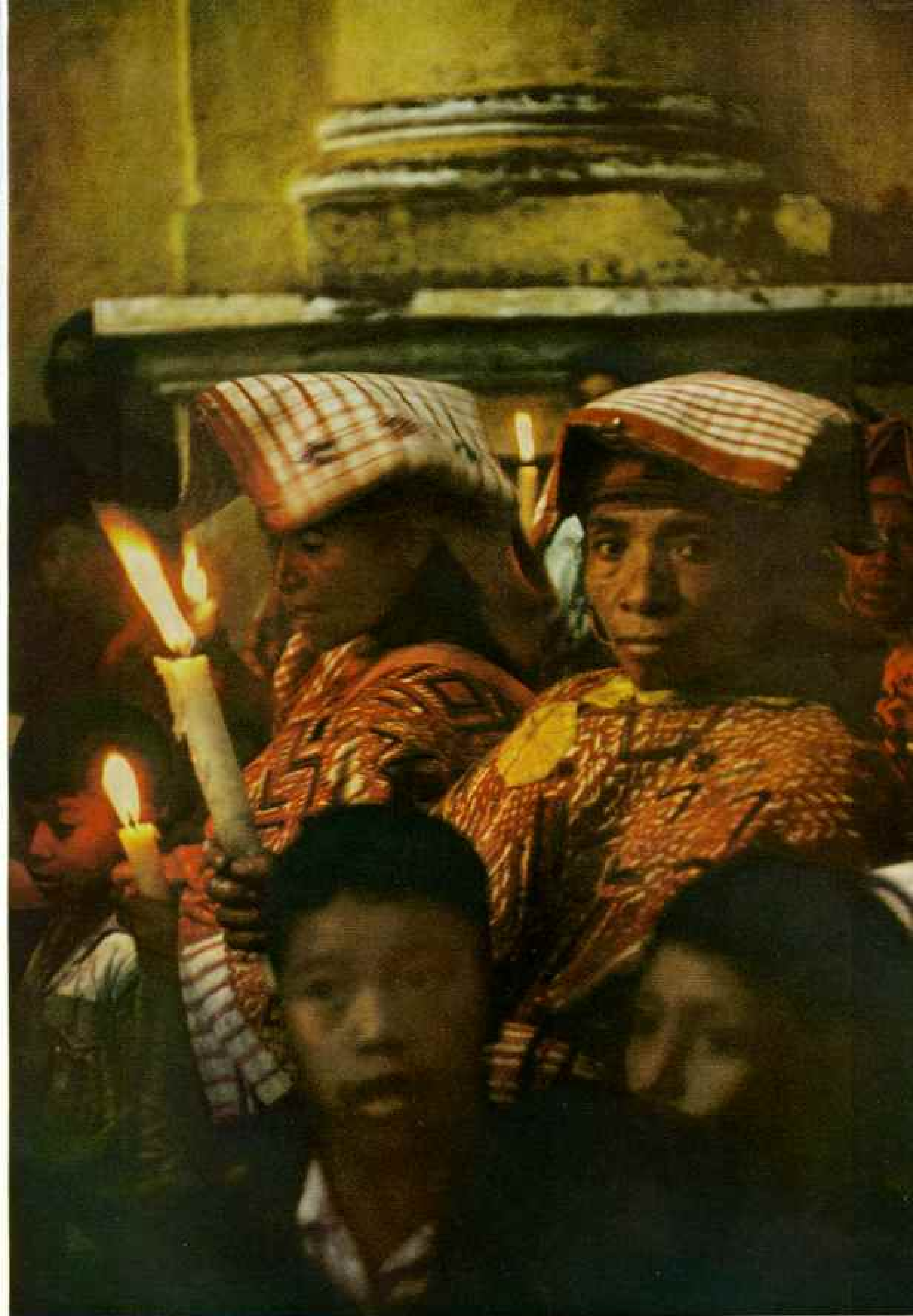
Kodachromes by the author

“GO TO ANTIGUA,” a friend in Guatemala City told me. “There you will find the best processions in the country.”

I had come to this northernmost of Central America’s six colorful republics to see the rites of Easter Week—ceremonies, I had been told, that rival those of Spain in brilliance and fervor. But even this advance notice hardly prepared me for the Good Friday splendor of Guatemala’s onetime colonial capital.

Before the façade of venerable La Merced church, newly painted in lemon and white, stood ranks of Indian and Ladino parishioners robed in vivid purple. Behind them were others, mounted and on foot, armored and helmeted to represent the Roman soldiers of Pontius Pilate. Ringing these costumed ranks, thousands of Antiguans waited in holiday dress for the ceremony to begin.

On La Merced’s roof, shirt-sleeved men cranked a six-foot-high wooden rattle, adding a sense of mounting excitement to the scene. Then, as the sound of the noisemaker rose to a deafening din, a ball of gray smoke puffed from the entrance of the church.





Villagers bear a swaying red-robed Christ past coffee trees to a carpet of flowers



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and dyed sawdust; band and smoking censers herald Antigua's Good Friday procession

A knot of robed figures stood for a moment in the doorway, swinging silver censers in which fragrant incense smoldered. Behind them twin files of men walked slowly into the sunlight, bearing on their shoulders a massive mahogany platform. On it, clothed in scarlet and carrying a huge cross, towered a life-sized figure of Christ.

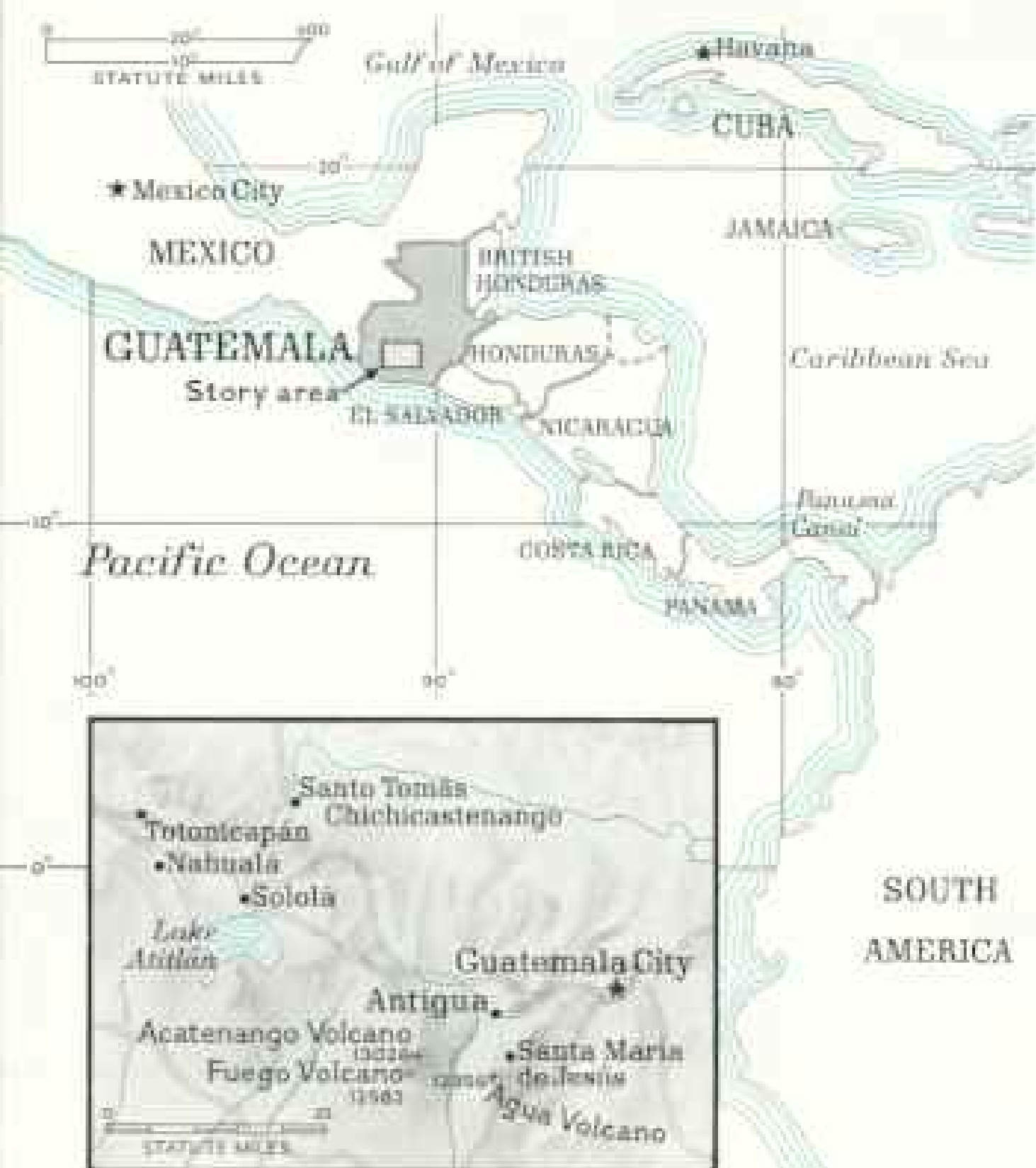
A brass band played a dirge. The figure, rising ten feet above the heads of the onlookers, inched slowly into the crowd, swaying gently as the bearers adjusted their steps to the music (page 409).

Along a twisting route through Antigua's cobbled streets, families had worked for days before their homes, fashioning elaborate car-

Fairgoers in Sololá Bargain for Salt Fish, an Imported Treat

The fair coincides with Passion Week, when vendors offer items that are scarce at other times: mountain woolens, honey, and Mexican fish. Young couple buying fish wear costumes of neighboring Nahuatlá.

Map locates the volcano-studded highlands, where Indians preserve the customs of their pre-Columbian forebears.



ENLARGEMENT OF STORY AREA







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Tortilla Maker Grinds Corn in the Way of Her Ancestors Centuries Ago

Ancient Americans domesticated maize, which no longer exists in its wild form. Carvings in their ruined temples show them planting the grain with sticks. Archeologists digging into their civilization's very beginnings find the indestructible mano and metate, identical to the grinding stones used by this housewife of Santo Tomás Chichicastenango. To loosen hulls, she soaks kernels in a pot of limestone and water.

pets of pine needles, sand, dyed sawdust, and flower petals (page 408). Now, as the procession entered the city, householders ran anxiously to smooth away an inadvertent footprint or to moisten a border of blossoms with a watering can to keep the breeze from disarranging its feathery petals.

Then, as the figure was carried over the first of these rich mosaics, the bearers paused for a moment, shuffling from one foot to the other before moving on, leaving the carpet's crisp outlines blurred and shadowy, as if the colors had run during a sudden thundershower.

For nearly seven hours the procession wound its way slowly through the city. Every few blocks weary bearers relinquished the heavy platform to fresh contingents of purple-

robed, white-gloved men, so that all who wished to do so could express their piety by taking an active part in the colorful rite.

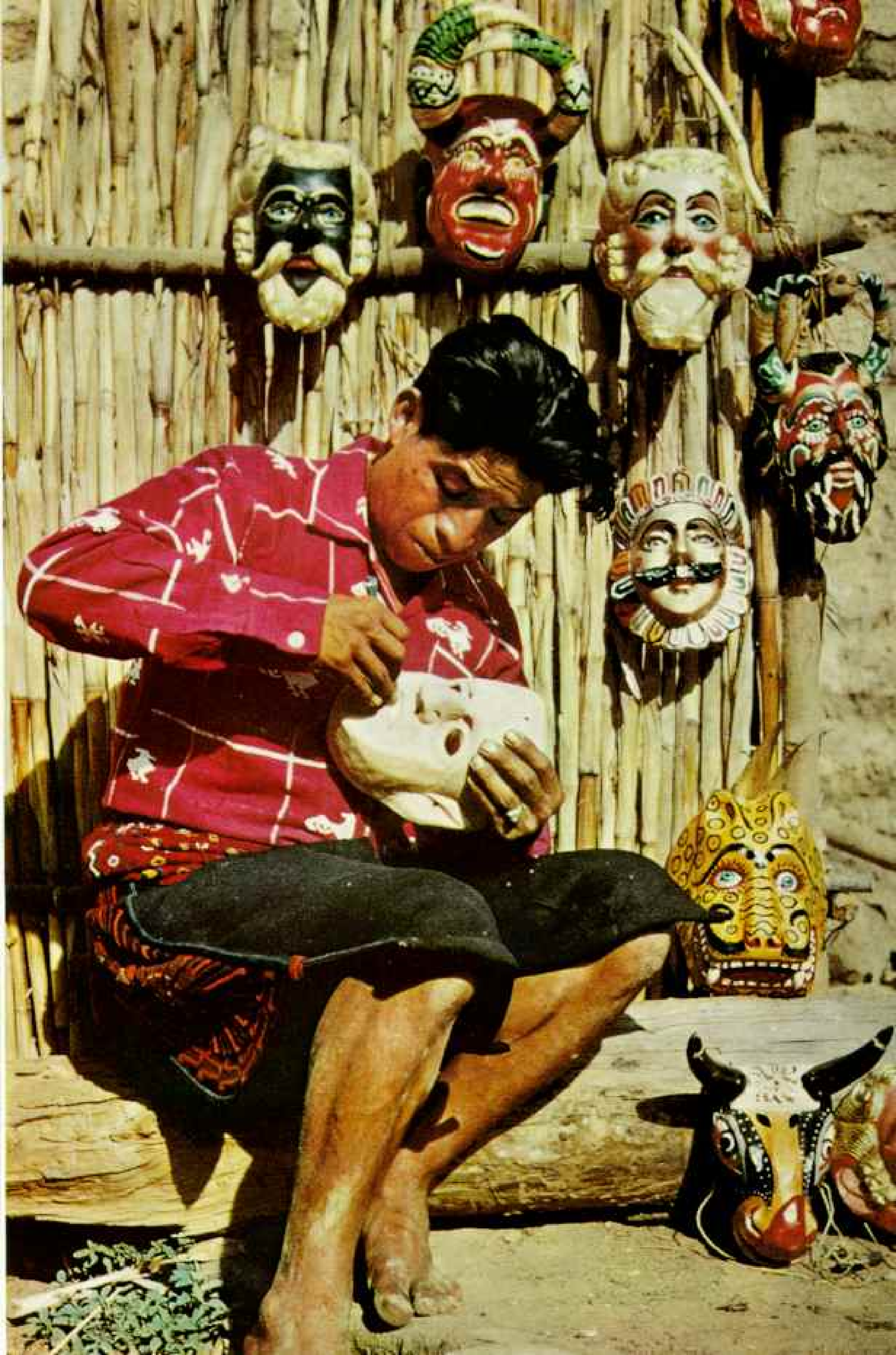
Indians Rap on Brother Pedro's Coffin

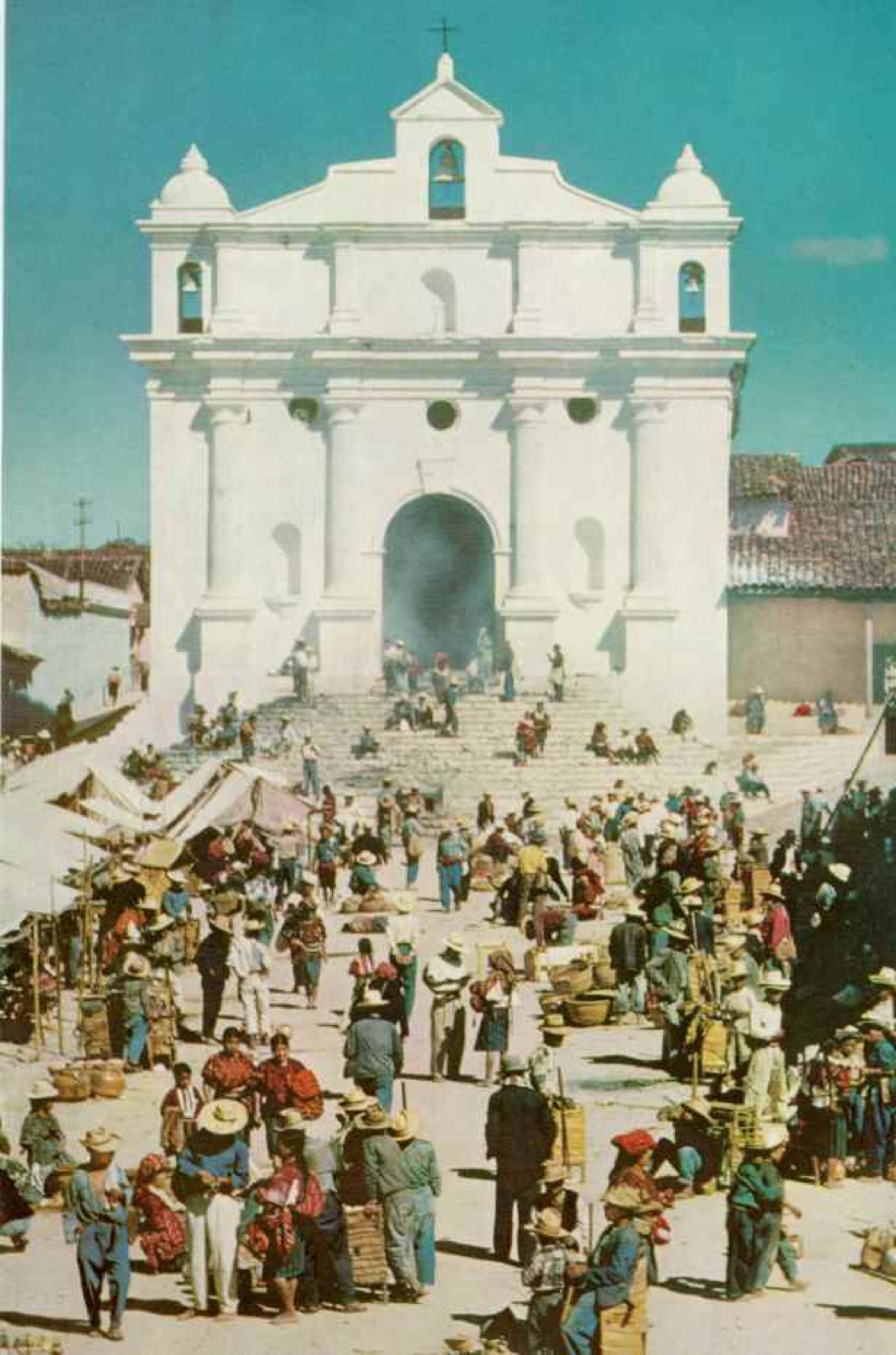
On my last morning in Antigua, after having watched five of these rich spectacles in four days, I stopped for a moment by the imposing ruins of San Francisco, begun in 1543 and crumpled with the rest of the city when a disastrous earthquake struck in 1773. From the roofless cathedral-like nave I wandered toward a chapel which, alone of the splendors of this ornate church and convent, survived the catastrophe intact.

Inside, candles glowed warmly, and carpets
(Continued on page 417)

Mask Maker, Like His Father and Grandfather, Practices an Honored Craft

Bearded, blue-eyed face above the Chichicastenango carver represents Pedro de Alvarado, conqueror of the area 437 years ago. The haughty Spaniard, teamed with his enemy, the last Quiché king, stars in the Dance of the Conquistadors, which Indians frequently stage on saints' days. Horned masks on the fence depict devils.







Church and market dominate life in Chichicastenango. Indians on the steps of Santo Tomás send a haze of copal incense skyward as a vehicle for their prayers. Others in the plaza shop for food, coffins, candy, pottery, and skyrockets.

Pathway of flame created by myriad candles leads to the altar in Santo Tomás. Prayers of the supplicants, kneeling beside the flickering beacons of their faith, fill the old church with an insistent buzzing.



of pine needles clothed the stone floor. In a corner a group of worshipers knelt before the tomb of Pedro de Betancourt, who during his lifetime befriended the Indians of this highland area.

Now, to thank Brother Pedro for favors granted, descendants of those same Indians tied queer little effigies of wax to the grill protecting his last resting place, while others rapped imperiously on his coffin with coins to make sure he would hear their prayers.

As I walked slowly back toward my hotel, the whole city was fragrant with smoke. Antiguans were tidying up their streets and burning the tons of pine needles that had carpeted the processional routes.

Above me, Antigua's three volcanoes loomed closer than ever in the clear morning air: stately 12,356-foot Agua, that seemed always to be peering over my shoulder; green Acate-nango; and smoldering Fuego, whose belchings have so often twisted the fate of this venerable city, with its wisp of smoke rising from hidden fires.

Farmers Bring Seed Corn to Church

Guatemala's colonial capital is not the only place in this richly flavored land where elaborate ceremonies herald the coming of spring.* A week earlier, in Santo Tomás Chichicastenango, I had seen Easter observances so mixed with the paganism of the ancient Maya that I could hardly tell where one ended and the other began.

Inside the parish church of Santo Tomás, thousands of candles flared and smoked in a pathway of shimmering flame (page 415). I watched as a strikingly costumed Indian knelt in prayer over parti-colored ears of seed corn (opposite).

How logical, I thought—this linking in an Indian's mind of an ancient ceremony at planting time with the story of a god from across the sea whose resurrection anniversary coincides with the appearance of the first hopeful buds of spring.

I was struck by the proud bearing of Chichicastenango's Indians. Pointedly ignoring a party of tourists brought in that morning by bus, they prayed forcefully and directly, as if they stood face to face with the Almighty.

Candles Flaming Amid Rose Petals Ask Blessing on an Indian's Seed Corn

His forebears staged elaborate rituals in which they beseeched the Maya gods of maize and rain for bountiful crops; he attends a mass at Santo Tomás for the benediction of the seed. After setting the candles, he will pray to both Christian and pagan deities and depart confident that he has won favor for his fields.

"Are they praying to the Christian God, or their own?" I asked my Quiché-speaking guide.

"Who knows!" he said. "Perhaps both."

Beside us a richly dressed descendant of the ancient Maya shook his finger at the empty air.

"Last week I brought you a candle," my guide translated as the old man spoke. "And yesterday one. But the donkey is still sick."

The Indian held the wick of a new candle above the light of another until it burst into flame, and then warmed its base so the wax took on a molten sheen. Quickly he set the glowing taper on the stone floor of the church, where it stood upright among thousands of others. Then he sifted a handful of rose petals onto the floor around it.

"This is the last candle," the old man said firmly, "until the animal is well."

Rockets Launched From Indians' Hands

Outside, on the steps of the whitewashed church, other worshipers swung crude censers of fragrantly smoking copal incense and knelt, foreheads cradled in hands, to pray.

Periodically, rockets streaked up from the busy street below, carrying the prayers of worshipers skyward. The Indians often hold these homemade rockets in their hands until they literally tear themselves from their fingers and soar into the blue, trailing six-foot tails of cane, to end in loud pops and puffs of black-powder smoke.

When I left Chichicastenango late that afternoon, the market place had taken on the sad, stripped look of a circus lot two hours after the final show. A few merchants stubbornly offered the last of their wares rather than carry them home, and here and there an Indian lay face up in the yellow sunlight, sleeping off the effects of a day-long celebration.

On the steps of Santo Tomás a lone worshiper finished a prayer and rose to his feet; then, as my bus turned onto a cobbled side street, I heard the characteristic who-o-o-o-ooosh-BANG of a homemade rocket bearing a request to the gods.

* See, in the NATIONAL GEOGRAPHIC: "Guatemala Revisited," October, 1947; and "To Market in Guatemala," July, 1945, both by Luis Marden.



*From Alleghenies to tidewater,
the old canal along the Potomac offers
serene beauty to those who roam its
restored towpath*

Waterway to Washington

THE C & O CANAL

By JAY JOHNSTON

National Geographic Editorial Staff

ONE WARM EVENING last summer I climbed aboard a barge in Washington, D. C., and let a team of mules pull me into a bygone era. With each plodding tug, as the glassy canal water rippled below, the neon-lighted world of the Capital slipped farther behind.

I was riding aboard the *Canal Clipper*, a homely, flat-bottomed craft that carries sightseers up a short stretch of a famous waterway, the Chesapeake and Ohio Canal. George Washington himself fathered the first canal here along the Potomac. In its heyday, nearly a century ago, the C & O floated millions of tons of coal, grain, lumber, and flour from Cumberland, Maryland, in the Alleghenies, to the tidewater port of Georgetown on the fringe of the Capital (map, page 424).

Today, for most of its 185 meandering miles, the once-proud queen of commerce is dry, weed choked, and tree grown. Abandoned since 1924, the old locks that echoed to the shouts of bargemen are sagging and deserted.

Towing a sightseeing barge, mules wade a spillway that drains the Chesapeake and Ohio Canal's overflow into the Potomac at Georgetown, in Washington, D. C. A bill pending in Congress would make the waterway the Nation's newest national historical park.





The lilacs grown wild and the decaying lockhouses recall the less hurried life of an earlier-day America.

But now new life looms for the derelict canal. As these words are written, legislation pending in the 86th Congress would preserve the waterway as a full-fledged national historical park. The National Park Service would restore many of the lockhouses, rewater additional portions of the canal, and build campgrounds and picnic areas along its length.

"It is a refuge, a place of retreat, a long stretch of quiet and peace at the Capitol's back door—a wilderness area where man can be alone with his thoughts, a sanctuary where he can commune with God and with nature, a place not yet marred by the roar of wheels and the sound of horns."

Thus did a distinguished American, Associate Justice William O. Douglas of the United States Supreme Court, describe the C & O Canal a few years ago. And the pleasures he had found in many a walk along these quiet banks—solitude and serenity and sylvan beauty—are still there in abundance.

Wildlife Thrives on Canal Banks

Strolling the towpath amid fern-clothed cliffs, in the depths of a dark wood, or beside a sun-drenched pasture, one captures the feel of a vanished age.

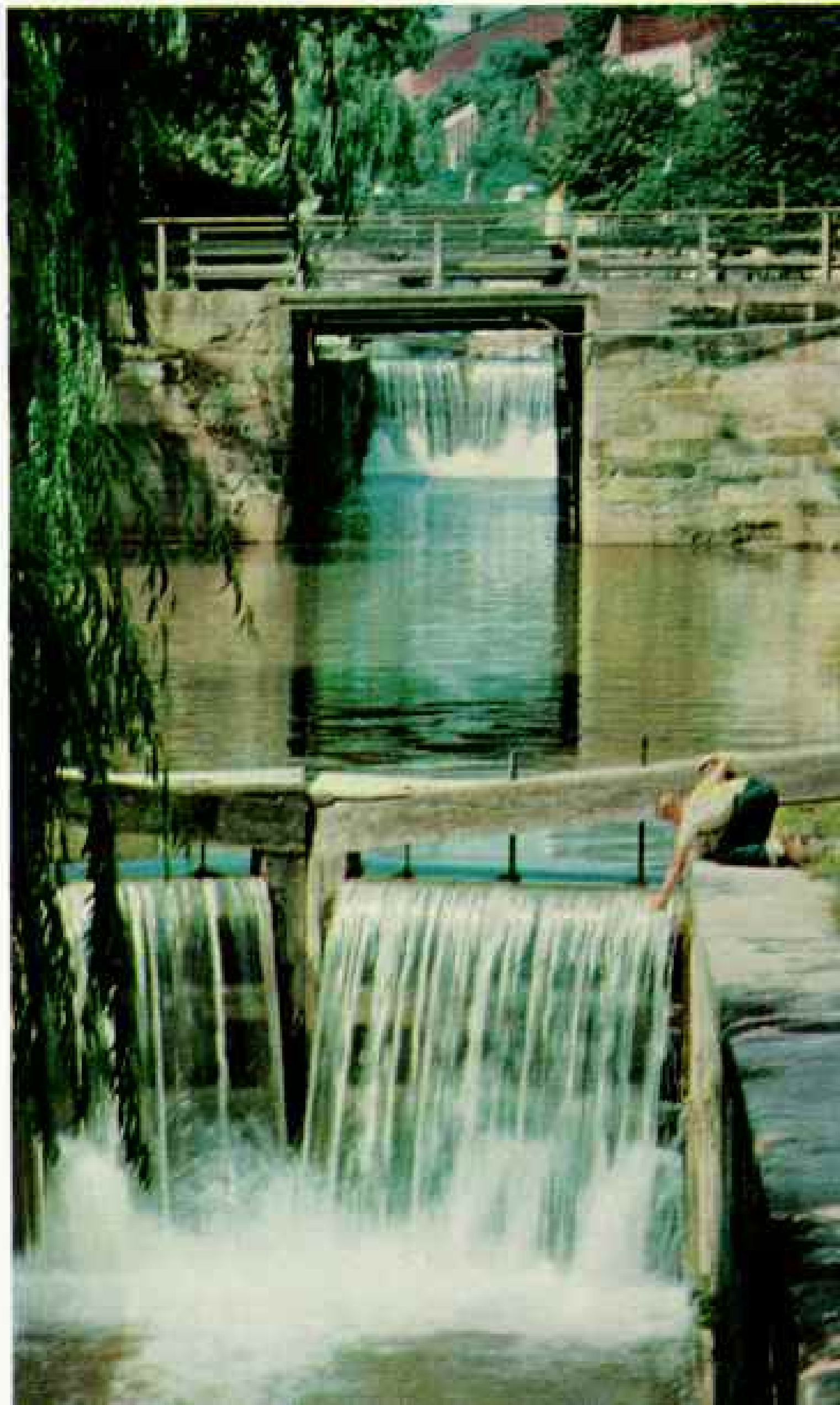
When the birds in the gaunt pines and towering tulip trees cease their chatter, a haunting silence reigns. Then the wind song rustles the treetops. Winged seeds spiral toward earth and tick like sleet on the dried-



Canal Clipper Passes Georgetown, the Waterway's Tidewater Terminus

Eighty-five years ago, in the canal's golden age, the strip kept 700 mule-powered barges busy. Today a 23-mile stretch running northwest from the Capital City again brims with water, but elsewhere weeds and trees choke abandoned sections. Though the canal has carried no freight in 36 years, it still has one commercial customer in Georgetown—a flour mill uses its water for power. Here fashionable homes and apartments line its bank.

Man-made waterfalls gush over the locks in Georgetown. Seventy-four lift locks enabled barges to make the climb from Washington to mountainous western Maryland.



NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS BOEHLER © N.G.S.

leaf floor. A gray squirrel scolds from a sycamore. A turtle plunges off his log solarium into a rain-water pool.

And you think: This is how it was on a soft spring day a century ago.

Barges and boatmen are gone now, but imagination works wonders. Around a distant bend come plodding mules. A barge glides into view. On its bow the skipper cups hands to lips for a singsong cry, the locktender's cue to open the gates.

"Hey-y-y-y-y lock!"

The mental image turns back time to a year when this waterway



teemed with the traffic of some 700 boats.

Their dimensions were standard: 92 feet long, 14½ feet wide, and a draft of 5½ feet when loaded. Cargo capacity ranged from 100 to 120 tons.

They were alike as boxcars, yet each was a captain's pride. The squat, sluggish boats bore loving names—*Belle*, *Katie Darling*, *Jenny Lind*, *Nanny McGraw*, *Scow Lion*, *Cock Robin*, *Morning Star*.

Extra Mules Rode on Boats

The captain and his family, or his hired hands, lived aft in the cabin. In a stable forward rode the relief mules, heads craning through tiny windows.

On sunny days the family wash fluttered from lines strung abovedeck. Children, tethered lest they fall overboard, played about

the cabin. Dogs and cats dozed on the warm planking as the mules plodded along at a speedy two miles an hour between the west and Washington.

What was life like on the canal during its halcyon days?

I asked this question of many people who dwell on the banks or in the near-by villages. For most, memories are secondhand, tales told and retold by their elders. But the old-timers, men who lived and worked on the stream, vividly recall the vanished era. And their number, if not legion, is surprisingly large.

One was O. P. Matthews, who managed a hotel where I stopped near Cumberland. He grew up on a farm in western Maryland. From his bedroom window he could see the canal, twisting in hairpin turns through the

NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS REEBIA © N.G.S.



Paralleling the Potomac, the C & O flows along the edge of Washington. Naked stone piers once supported Aqueduct Bridge, which linked the C & O with a canal to Alexandria, Virginia.

Summer Sunday outing on the canal bank above Key Bridge entertains a family. Hikers as well as cyclists patronize the towpath. Placid waters harbor catfish and large carp.

bright-boughed hills and pine-tufted crags.

"I'd lie abed at night," he told me, "and watch the barges inch their way up and down. The light from their bow lamps shone on the water and flashed in the trees. I could hear the music of fiddles, and people singing and laughing in the cabins."

Raleigh S. Bender of Sharpsburg, Maryland, may well have been one of the canallers whom Mr. Matthews watched from his window half a century ago.

"Call me Cap," he directed. "Everybody does; and besides, I like it."

Reminiscing in the cool quiet of his spacious home on Main Street, Cap Bender conjured up a tableau of lazy waters and slow-moving boats, set against a background of bustling coal docks, blacksmiths and boatbuilders, teamsters and wharf workers.

"Thirty-six years I worked on the boats. They were the hardest, and happiest, days of my life.



"All day long you'd be trying to make time, beat someone else's record for the trip downstream or up. Come dark, you'd put the feed trough out on the banks and let the mules graze and doze. You'd sit around for a spell, smoking and talking, then hit the hay to be up with the dawn for an early start. Sometimes you'd drive the mules through the night."

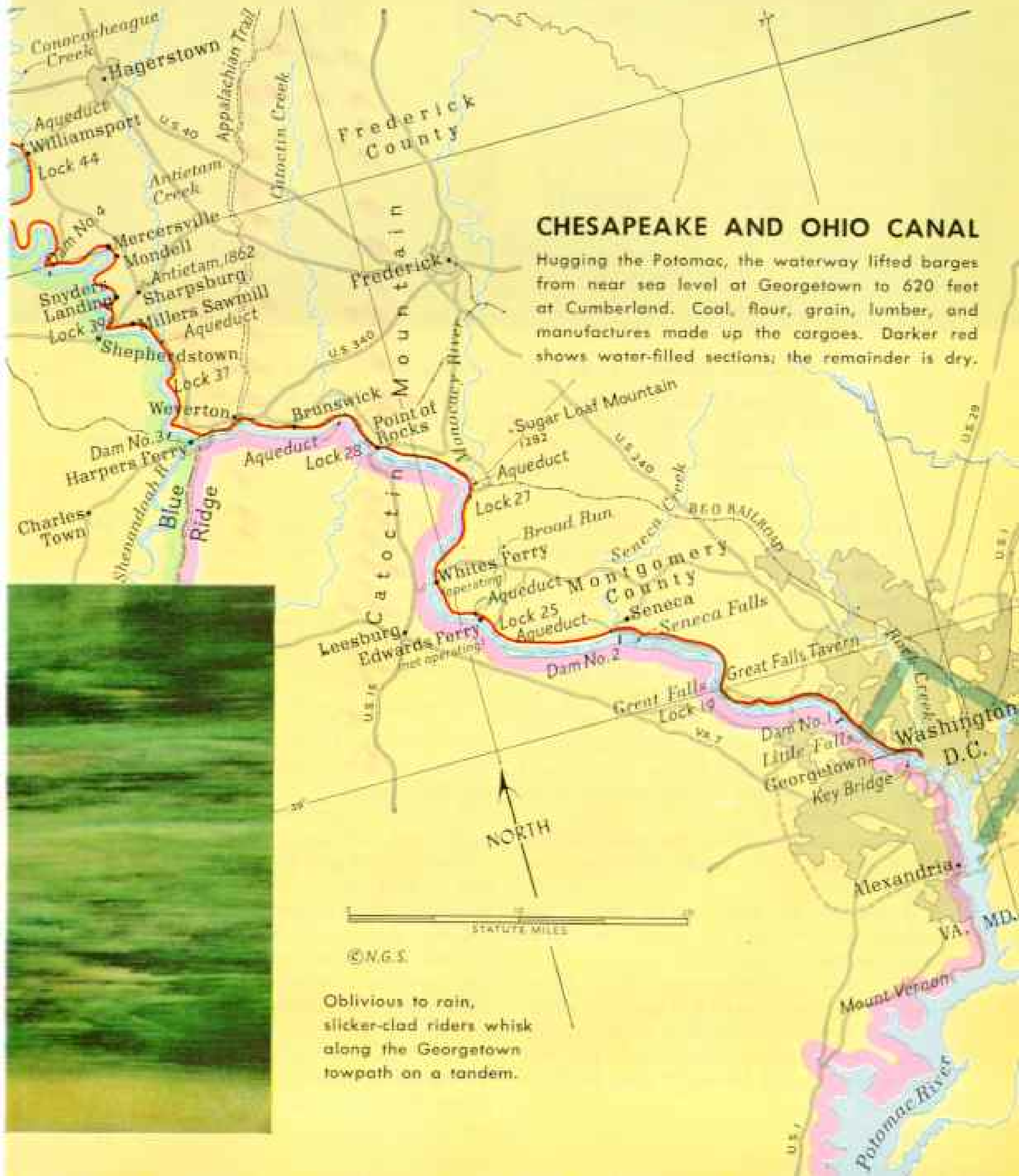
He lifted a wooden model from the top of a chest and dusted it carefully.

"This is a model of the last boat I skippered,

And these were my mules—Jack, Kate, and Rock. No one ever saw a better three mules on the strip."

He joined boat and mules with a simulated towline of thin cord. His eyes shone with remembrance (page 435).

"This is the way they'd work. Just like this when we made the record 62-hour run from Georgetown to Cumberland. And when I towed the last load of coal down to Washington in 1923.



CHESAPEAKE AND OHIO CANAL

Hugging the Potomac, the waterway lifted barges from near sea level at Georgetown to 620 feet at Cumberland. Coal, flour, grain, lumber, and manufactures made up the cargoes. Darker red shows water-filled sections; the remainder is dry.

Oblivious to rain, slicker-clad riders whisk along the Georgetown towpath on a tandem.



JAY JOHNSTON, NATIONAL GEOGRAPHIC STAFF

Canalside Residents Greet Justice Douglas With a Poster Barrage

In 1954 William O. Douglas, Associate Justice of the United States Supreme Court, led a hike the length of the waterway in protest against the proposal to build a motor road along its bed. Here, on a recent visit to Williamsport, Maryland, he meets proponents of a plan to convert the right of way into a national historical park.

"For years the railroad had been running circles around us; business got so poor there were only 60 boats left.

"Then the '24 flood wrecked the canal, and no one bothered to repair it. It just wasn't a paying proposition any longer."

He sat back and the rush of words slowed.

"So that was the end. For me and all the other canalmen. I came home for good and settled down here with my wife and seven youngsters. I've been mighty content and comfortable here, but I'll never forget those old canal days."

Sunday outings along the canal provide much pleasure to Cap Bender, still robust and active at 87.

Frequently he gets together with canal cronies, and the talk is hearty and spiced with affectionate insults.

"We were a rough-and-ready lot," he recalls, "and there were a lot of practical jokers.

"One of my mates used to tickle my face with a straw every morning to wake me. One day when I wasn't feeling so good, he did it once too often.

"I grabbed him by the seat of his pants and pitched him off the boat, right into the middle of the canal.

"'I can't swim! I can't swim!' he yelled. And turned out he couldn't. Had an awful time making it to the bank, and I nearly fell over the side laughing."

Washington Built Early Waterway

This was the canal of yesteryear, a busy, boisterous highway linking the tidewater and the Alleghenies.

But for one man—George Washington—it might never have been.

Washington's plan for a water avenue from east to west merits the first chapter in any history of the Chesapeake and Ohio Canal.

Below the city of Washington the broad Potomac River flows sedately over clay, sand, and gravel as it passes Mount Vernon and gently laps the corn and tobacco fields of tidewater Virginia and Maryland. This part of the river is navigable for seagoing ships that steam up from Chesapeake Bay.

But above the Capital the Potomac runs

swiftly over hard crystalline rocks, the eroded remnants of ancient mountains. Its shores change from rolling hills to steep palisades.

At Great Falls, 10 miles above the city, the river is a wild creature, crashing through rugged gorges, roaring over masses of rock (page 433). No boat can navigate these furious waters.

Washington's idea was to bypass such dangerous stretches with canals and open up a new water route to the west. In 1785 the Potomack Company was formed, with Washington as president.

A year later 200 men were at work on a system of improvements, building canals around major obstacles and dredging in the Potomac to make the river navigable. The squire of Mount Vernon made numerous trips up from his home to supervise the project.

Writing to Thomas Jefferson in 1788, he reported: "The labourers employed by the Potomack Company have made very great progress in removing the obstructions at the Shenandoah, Seneca and Great Falls. . . . This will become the great avenue into the Western Country; a country which is now settg.

[settling] in an extraordinarily rapid manner, under uncommonly favorable circumstances, and which promises to afford a capacious asylum for the poor and persecuted of the Earth."

In 1798 the ex-President, back home in Mount Vernon, reaffirmed his belief in the Potomac's potential. Concerning "the many and great advantages which will accrue from completing the navigation of the Potomack," he wrote to a friend, "I have every day additional reason for supporting my former opinion, and new proof of its advantages. . . ."

First Canal Filled With Danger

But boatmen who ventured downstream on the "improved" river route in the early 1800's found it a harrowing experience. The swift current, treacherous rapids, whirlpools, and shoals challenged even the most skilled navigator. The crude locks around Great Falls were usable only when the river was high enough to fill them.

If a craft survived the journey—and many did not—it was a rare owner who attempted the even more difficult upstream run. Usually

Even in Winter Canoeists Paddle the Canal, and Hikers Explore Its Banks

Prolonged cold spells often convert this section into a skating rink. Here, near Seneca, Maryland, only the 12-foot towpath separates the C & O from the flooded river.

FRANK CRAGG/ASA





PHOTOGRAPHED BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS THOMAS NEDDIE JARVIS AND VOLENKA WERTZEL © N. G. P.

he broke up his raftlike boat, sold it for lumber, and walked home.

The hiker today, tramping the Virginia shore, can see the ruins of locks built by the Potowmack Company. After more than a century and a half and many floods, the huge hand-cut blocks of stone still stand in trim alignment, reflecting the precision with which the walls were built.

President Adams Sheds His Coat

The Potowmack Company failed, but the idea of a route between the Atlantic and the Ohio River remained alive.* The year 1828 witnessed its emphatic revival when the newly organized Chesapeake and Ohio Canal Company began to build a canal from Washington all the way to Pittsburgh and the Ohio.

Appropriately, the directors chose the Fourth of July as the day to start work. They invited President John Quincy Adams to turn the first spadeful of earth near Little Falls.

During his address, President Adams took up a spade and attempted to drive it into the sod. It struck a root. Undaunted, he tried again, with no success. He threw down the spade, peeled off his coat, and, on the third try, pierced the ground. The assemblage roared approval.

Was the root an ill omen? Perhaps, for on that same day—40 miles away, at Baltimore—another group was laying the foundation stone for the Baltimore & Ohio Railroad.

This enterprise was destined to plague the

* See "Potomac, River of Destiny," by Albert W. Atwood, NATIONAL GEOGRAPHIC, July, 1945.



canal throughout its operation. But the waterway's enthusiastic promoters casually dismissed the rail line as a competitive threat. It would, they reasoned, carry only passengers and light freight in horse-drawn cars.

Within a few months the Potomac Valley hummed with activity as hundreds of laborers, using axes and stump pullers, scrapers and gunpowder, wagons and wheelbarrows, dug the big ditch. Stonemasons started construction of locks and lockhouses.

Yet progress was slow. Legal clashes with property owners brought delays; so did struggles with the railroad over right of way.

Flying Fists Settle Workmen's Feuds

But from first lock to last, the major problem was the labor force. The tremendous demand for workmen on the many public works under way in the East precipitated a labor shortage. And the workmen corralled by the C & O, while competent, were temperamental.

So intense was the animosity between Irish and German immigrants, who performed the bulk of the work, that it was necessary to employ them in separate crews.

Rival factions of Irish battled among themselves. Brawls between Corkmen and Longfordmen turned shanty towns into armed camps.

Each payday witnessed violent fights. Whiskey sold freely, and was undoubtedly a factor, but the meager wages of \$10 a month, long hours, poor housing, and worse food were the major causes of dissension.

Indian summer lures Washingtonians to the canal at their back door. City hubbub seems far away to those who come here for boating, hiking, bird watching, or reading.

Passing canoeists skim by tree-shaded banks near Georgetown; a young angler wets a hook. 429



Every summer there was a noticeable slackening of work and a marked exodus of workmen. This was the annual "sickly season" in the valley. From July until late September men fell victim to aches and fevers, attributed by them to droughts that lowered the river level, leaving stagnant pools along the banks. In September, 1832, a cholera epidemic swept through the camps.

Yet the canal moved westward. Georgetown saw the tidewater terminal take shape. Past Little Falls and Great Falls, Seneca, and Whites Ferry crept the ditch and its locks.

With only the first segment in use, a 23-mile portion between Georgetown and Seneca, the cost of transporting flour dropped from \$1 to 30 cents a barrel. In the first ten days of operation some 30,000 barrels were shipped downstream.

Rural communities like Point of Rocks, Weverton, and Harpers Ferry blossomed under the influence of railroad and canal. The villages of Snyders Landing and Williamsport took on fresh life, for as the canal advanced, it brought trade and prosperity.

By 1839 the canal had pushed 135 miles, to a point above Hancock.

There today, just east of the town, the battered hulk of a canal barge lies stranded in the waterless ditch. When spring floods lap its rotting timbers, youngsters swarm over the old relic and "sail" it downstream once more (page 434).

Tunnel Grows at Snail's Pace

Farther on above Hancock, across the river from Paw Paw, West Virginia, canal engineers cut a mountain tunnel to save seven miles. Using hand tools and black powder, crews painfully hacked through shale at the rate of 10 to 12 feet a week.*

The tunnel, 3,118 feet long, 24 feet wide, and 17 feet high from water surface to crown, ranks as an engineering masterpiece of its day.

I shall always remember the first time I walked through the cool, dark tube. I snapped off my flashlight in the center of the bore. Except for pinpoints of light at each end, it was like a moonless midnight. Water from

springs in the mountain overhead dripped through the six layers of brick that line walls and ceiling.

This dark tunnel witnessed many a fight between brawling boatmen. Lacking room for barges to pass inside, boats backed up at the entrances like cars waiting to board a ferry. Fists often decided the right of way.

An old-timer told me of two boatmen, coming from opposite ends, who met in the middle of the tunnel. When neither would give way, they tied up traffic for two days until the superintendent could come up from Georgetown to settle the issue.

Ditch Cost \$60,000 a Mile

In 1850 the waterway touched Cumberland, and the eastern section—the only part ever completed—was formally opened to trade.

Amid salvos of artillery and the blare of brass bands, five barges laden with coal for eastern markets slipped into the locks at Cumberland and headed toward Washington.

Stretching ahead, along the northern bank of the Potomac, ran a waterway six to eight feet deep, ranging in width from 30 to 80 feet, with a towpath 12 feet wide along the river side.

Included in its works were 74 stone locks 100 feet long, 15 feet wide, and 15 feet deep, with a lift averaging eight feet; the half-mile-long Paw Paw tunnel; a dozen aqueducts over northern tributaries of the Potomac; scores of culverts to carry smaller streams under the ditch; and seven rubble and masonry dams in the bed of the river to back up its waters and turn them into the canal.

The project had cost \$11,000,000, or about \$60,000 a mile, a sum staggeringly higher than the backers had estimated.

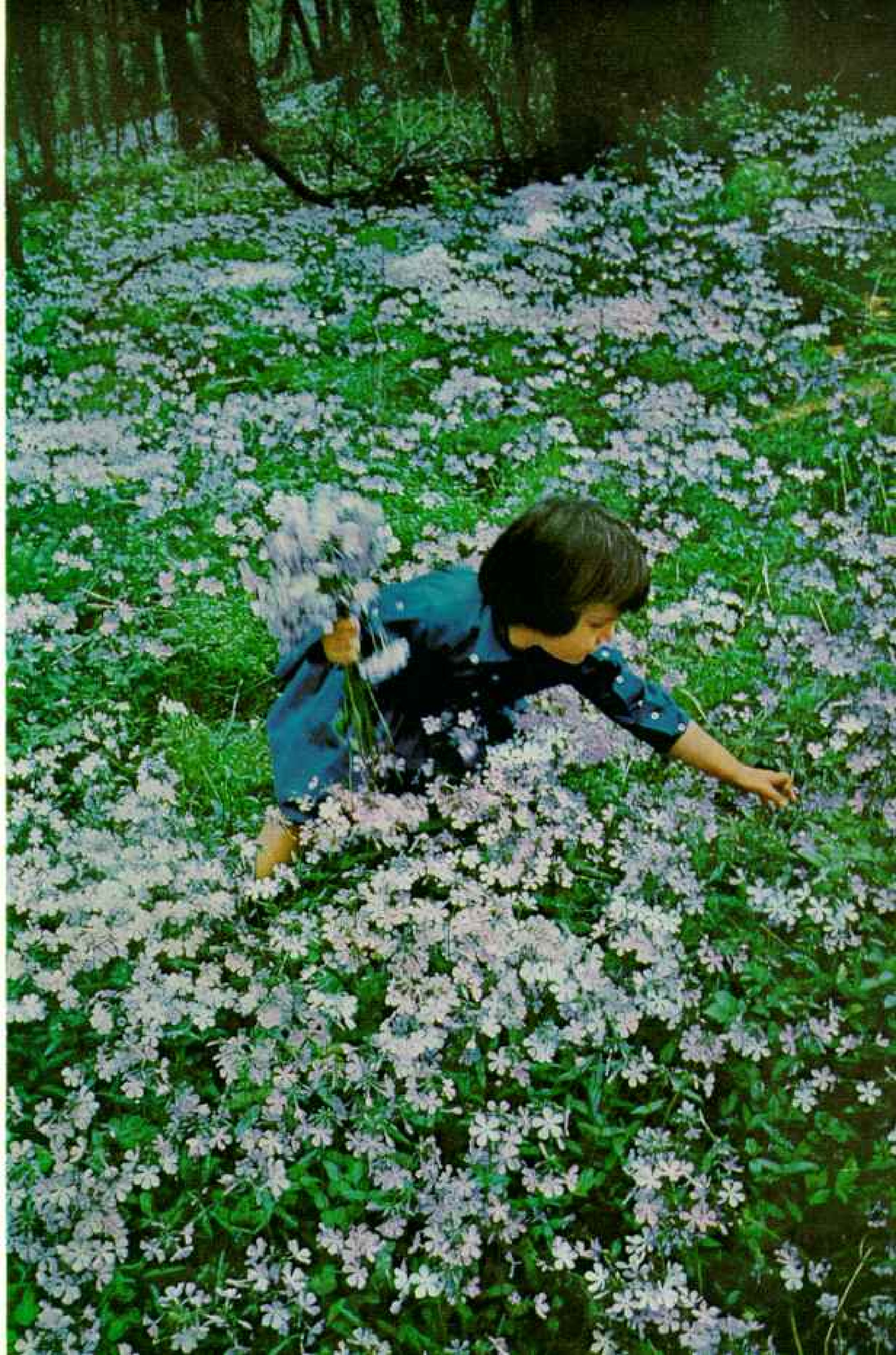
The proposed connection of the Atlantic seaboard and the Ohio Valley was never achieved. The ambitious central and western sections, requiring several hundred additional locks and a four-mile tunnel, failed to advance beyond the planning stage.

George "Hooper" Wolfe, a Williamsport

* See "Down the Potomac by Canoe," by Ralph Gray, NATIONAL GEOGRAPHIC, August, 1948.

A Child Wades Knee-deep in a Sea of Sweetwilliam Phlox

Spring sees the river valley blanketed with bloom. As days grow longer and the sun stronger, spring beauty, periwinkle, violet, buttercup, and jack-in-the-pulpit give way to trout lily, Dutchman's-breeches, and elephant's-foot.







ACCOMMODATED BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS THOMAS WEDDIE (OPPOSITE) AND DATED LITTLEDALES © N.G.S.

Great Falls, 10 miles above Washington, turns the peaceful Potomac into a roaring cataract. At maximum flood the rapids completely cover the jutting rocks, and the flow surpasses Niagara's. These visitors enjoy the spectacle from a Virginia cliff.

Great Falls Tavern, historic Maryland hostelry converted into a museum, attracts thousands of visitors every year. Aerial view looking downstream shows three of six locks that lifted barges over a 41-foot rise in the falls region. Footbridge at upper right leads sightseers across Potomac rapids to the main cataract (above).

merchant, knows the canal's history almost as well as he knows his customers.

A charter member of the Williamsport C & O Canal Club, he has worked ardently toward the restoration of the waterway and its development into a full-fledged national park.

"You know, I love that old gulch," he told me.

"It's a funny thing, but the older I grow, the closer it gets to my heart. As a boy I drove the mule teams four years, off and on, but the canal never meant much to me then. Maybe that's just human nature.

"But now I'd give anything to see it as it was in its heyday. And I'd like my children and my grandchildren to be able to see it as I knew it."

Over mugs of steaming coffee in his general store, Mr. Wolfe showed me a treasured album of photographs of 19th-century canal life. While I scanned it, he recounted the canal's triumphs and disasters.

"The Civil War caused hit-and-run damage. Lee's invasions and raids by Early, Mosby, and Stuart broke down the banks and knocked out some of the locks.



NATIONAL GEOGRAPHIC PHOTOGRAPHER THOMAS J. BEERCHOMBE © N.G.S.

"At Antietam Creek, within cannon range of the canal, Union and Confederate armies fought the bloodiest single day of battle in Civil War history."

The Battle of Antietam on September 17, 1862, climaxed the first of two attempts by General Lee to carry the war into Northern territory. His 41,000 troops clashed with a Federal force of 87,000 led by Gen. George B. McClellan. The Union suffered 12,410 casualties; the Confederacy, 10,700.

Neither side could claim a clear-cut victory, but the battle was highly significant. Lee's failure cost the Confederacy the recognition of Great Britain and gave Lincoln an opportunity to issue the Emancipation Proclamation. Had McClellan won a decisive victory, on the other hand, the war might have ended in a few months, instead of dragging on for another two and a half years.

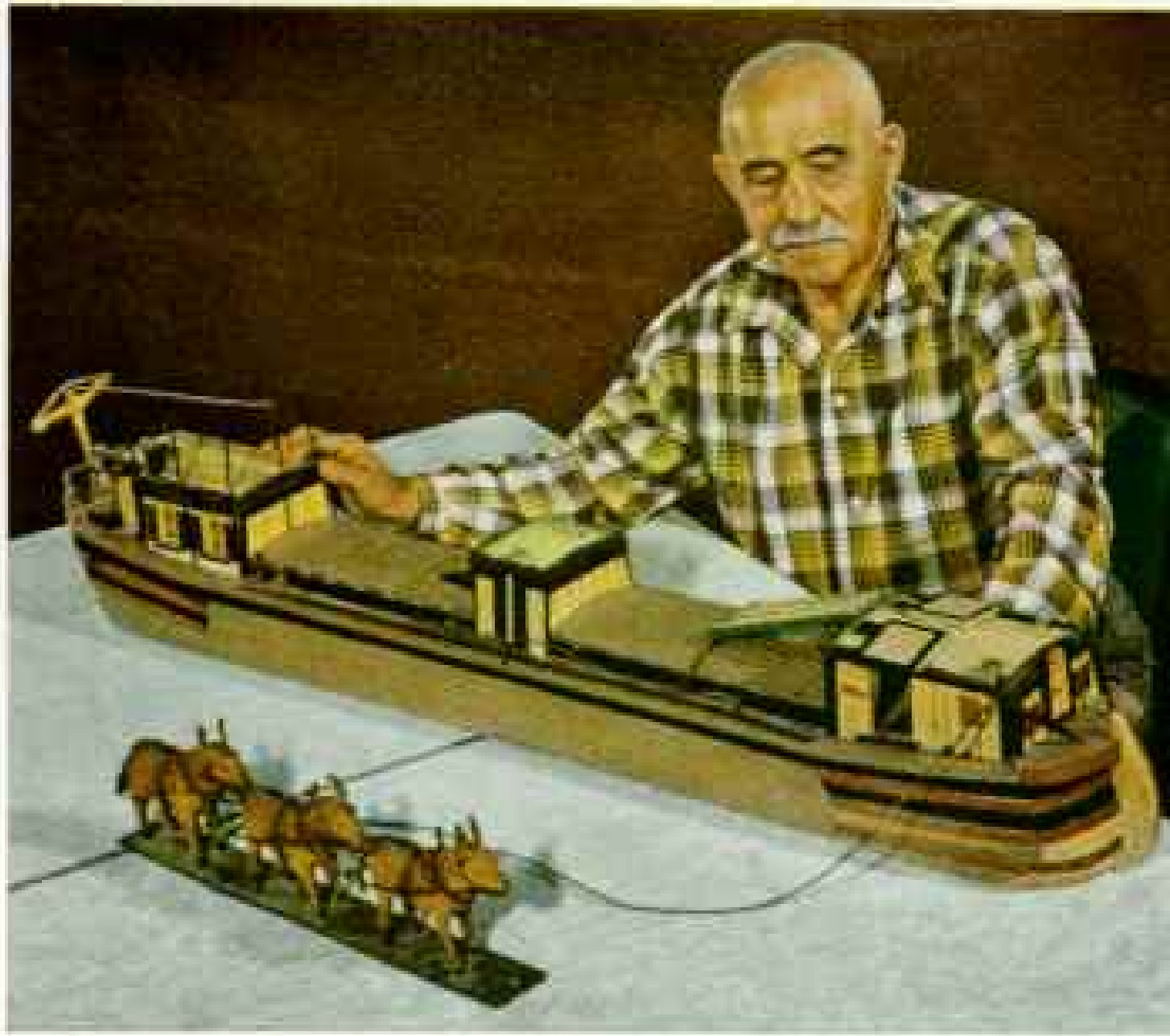
"Did you know," Wolfe continued, "that three times the Federals commandeered barges and held them in Georgetown? If a Confederate fleet had steamed up the river toward Washington, the Union planned to load the boats with rock and sink them in the channel of the Potomac below the city. Fortunately, it never happened."

When the war finally ended, the canal's coal trade boomed. In 1875 more than a million tons rode downstream. A single lock saw more than 100 boats pass through in a day.

At long last, the company began to earn some income. But the canal never really made any money for its owners. It was always too far in debt.

I asked Mr. Wolfe if it was true that steamboats once sailed the canal.

"Yes," he said, "they tried steam power for a dozen or so years on some of the barges,



Old-time canalboat skipper Raleigh S. Bender displays a model of his barge and mules—Jack, Kate, and Rock. "Best team on the strip," he fondly recalls.

Like a ghost ship, the remains of old No. 57 crumble near Hancock, Maryland. Boys teeter on the timbers; spring rains flood the canal bed. The barge was built about 1909.

Portrait of yesteryear: A barge heads down the canal half a century ago. A stable for the mules occupies the blunt-nosed bow; the stern holds living quarters. Taut line at left leads to a team on the towpath.





Stone aqueduct carried canal barges across Seneca Creek at its confluence with the Potomac. This family starts a day of boating.

Grass Lines the Bed of Monocacy Aqueduct

Largest of 12 spans that transported the canal across Potomac tributaries, the conduit is built of stone from Sugar Loaf Mountain.

The span has defied time more successfully than has the waterway. Trees choking the canal's dry bed make tracing its course from the air difficult.

The Monocacy River merges with the Potomac at left.



REPRODUCED BY NATIONAL GEOGRAPHIC PHOTOGRAPHERS THOMAS J. ARDENSON (LEFT) AND THOMAS WEAVER (RIGHT), N.G.S.

and they also tested tractors for a while. But neither steam nor tractor proved as cheap or as dependable as the mule.

"The canal company even built its own telephone network in 1879. At that time it was claimed to be the longest single phone circuit in the world.

"In the eighties, earnings started dipping," he continued. "Many of the Allegheny coal operators had begun shipping by railroad.

"In May and June of 1889 the famous downpour that flooded Johnstown, Pennsylvania, also overwhelmed the upper Potomac."

He passed me a yellowed clipping. A reporter for the *Cumberland Daily Times* observed on June 5, 1889: "It is the opinion of nearly everyone living along the river that the canal has been irreparably injured."

Hooper smiled. "That just proves you shouldn't believe everything you read in the papers. Actually, the canal's bondholders refused to quit. They dredged up another \$400,000, repaired the damage, and kept it operating for 30-odd more years.

"But then came the flood of 1924, and canal operations suspended for the last time."

Government Buys \$2,000,000 Bargain

By one of those ironic twists, the canal in 1907 passed into the hands of its arch rival, the Baltimore & Ohio Railroad.

Hard hit by the depression of the early thirties, the railroad applied to the Federal Government for aid. Harold L. Ickes, then Public Works Administrator, offered to buy the canal, and in 1937 secured the 185-mile-long ditch for \$2,000,000. He acquired a right-of-way from 30 to 900 feet wide containing 5,254 acres.

Many critics spoke their contempt for the purchase. "A century-old white elephant," some deemed it. But others, perhaps more farsighted, suggested that "it may turn out to be the biggest bargain since Alaska."

Since acquiring the canal, the National Park Service has restored the 23-mile segment between Washington and Seneca as part of the National Capital Parks system. Gliding out of Georgetown, the mule-drawn *Canal Clipper* carries sightseers along a five-mile stretch (page 418) during summer months.

Great Falls Tavern, historic hostelry and lockkeeper's home, has been refurbished and converted into a museum where thousands of visitors each year view exhibits tracing the history of both the canal and the Potomac Valley (page 432).

In Georgetown, eastern terminus of the

canal, apartments and homes today crowd the bank beside the lift locks (page 420). A flour mill still uses the flow for power.

Maj. Ernest W. Brown, a retired chief of police, remembers the port town as an exciting place at the turn of the century. Barges laden with coal from the Alleghenies and farm produce from fertile Appalachian valleys sometimes lined up for nearly a mile waiting to unload at the terminal. Draymen streamed between the docks and the big wholesale houses on old Bridge Street (now M Street).

Boatmen Kept Busy, Avoided Trouble

"My first beat in 1896," Major Brown told me, "was the waterfront, and my first arrest, on a bitter winter night, was a man assaulting a canaller.

"Those canal people were a good lot," the major added. "They were honest and worked hard. They stayed to themselves and generally kept out of trouble. I came to know many of the families who lived on the boats, and I liked them.

"Sometimes they would get caught in the freeze-up and have to winter over in Georgetown. They could hardly wait—father, mother, and especially the kids in school—for the spring thaw, so they could get back on that canal."

In 1954 a dedicated trek focused nationwide attention on the C & O Canal.

A motor parkway had been proposed along the towpath, and, in some places, along the bed of the canal itself. In protest against possible destruction of the waterway's scenic and historic values, Justice William O. Douglas led 36 conservationists and newsmen on an 8-day march down the canal.

The much-publicized hike helped defeat the highway proposal. Soon afterward the Park Service recommended that the canal property be preserved as a national historical park.

Each spring members of the 1954 hike hold a two-day reunion on the banks of the canal and retrace a portion of their long march.

Stagecoach Trade Paused at Hancock

Last spring I walked alone on the canal's westernmost reaches.

I began my trek at Hancock, a quiet mountainside town on the old Cumberland Road. Lying within a two-mile-wide strip known as Maryland's Neck, Hancock is the market center of an apple-growing and sand-mining region. Its history is tightly interwoven with that of the canal. Here stood warehouses and shops that serviced the waterway.

Long before canal days Hancock was a busy stopover point for the stagecoach trade. A host of taverns with intriguing names—Sign of the Cross Keys, Sign of the Seven Stars, Sign of the Green Tree—catered to travelers en route from Baltimore to Cumberland, Wheeling, and Indianapolis.

A few minutes west of Hancock I passed the site of Fort Tonoloway, where early settlers had built a blockhouse for refuge against Indian attack.

Here the dry bed of the C & O follows the tortuous bends of its neighbor, the Potomac, as it winds through the mountains.

Spring is a season of rare beauty in this bosky region. Each tree in blossom or tender leaf has its own pastel shade, contrasting with the dark greens of pine and cedar.

With the hardwoods sprouting pale green on the ridgetops and redbud splashing color across slopes white with dogwood, it was easy to succumb to the quiet, whispering lure of the land. The stillness was broken now and again by the symphony of birds singing their delight at the sight of the sun after a three-day rain, or by the wail of a train.

Paw Paw Tunnel Pierces a Mountain

Ducks flapped and wheeled away over the river. I had flushed them with the snap of a dead twig. A cottontail hopped across the trail and vanished amid clumps of bird's-foot violets, their bowing heads as big as half dollars.

As I strolled on, picking my way through the towpath's molasses mud, the thought occurred that I was now following in the footsteps of the "level walkers." These were canal company employees who walked allotted sections, searching for breaks in the banks or the towpath. Defects were repaired immediately, lest barges be delayed or thrown off schedule.

I approached the downstream mouth of the Paw Paw tunnel through a spectacular man-made gorge. The canal courses between great wedges of rock 100 feet high. I saw spikes embedded in the walls to prevent enormous slabs of shale from flaking off and crashing down on the mule teams below.

Westward toward Cumberland, houses grew more numerous. Then, as I passed the mouth of Town Creek, I encountered a five-mile

Junior Fishermen Line the Canal for Oldtown's Angling Rodeo

Residents around Oldtown, 20 miles below Cumberland, have restored a five-mile section. An all-day fishing contest each August attracts thousands. Mom and dad may try their luck, but only the small fry get prizes.

EXTRACTS BY NATIONAL GEOGRAPHIC PHOTOGRAPHER
BATES LITTLEHALES © N.G.S.

stretch where the civic-minded people of Oldtown have cleared the canal and the State has stocked it with pan fish.

"You must come back in August for our fish rodeo," Judge George Henderson told me.

"Hundreds of kids drop in their lines," he said, "and when the fish aren't biting the kids are—on hot dogs and fried chicken and all the other picnic makings. It's Oldtown's big day of the year" (opposite).

Today only a few vestiges of the canal are evident in Cumberland, the rail and manufacturing center at the confluence of the Potomac River and Wills Creek.

A gap in the Allegheny Mountains rising close by provided a gateway for early pioneers who streamed through here on their way west. Old Fort Cumberland served as headquarters for British Gen. Edward Braddock during the French and Indian War.

Cumberland houses shops and yards of the Baltimore & Ohio Railroad, and day and night its streets echo the whistling of locomotives and the clank of freight-car wheels. Millions of tons of coal have been mined in the neighboring mountains.

Floods have often ravaged this industrial city. Army Engineers, seeking to safeguard it, have deepened the river and turned the canal into a levee for about half a mile.

The face-lifting project, vital though it was, saddened many an observer. But the canal has known and survived countless misfortunes, and always its admirers have refused to let it slip into oblivion. Converting the canal into a national historical park would win hundreds of thousands of new friends for the old strip.

Tomorrow's generations will never see the barge traffic that once graced the lovely canal, but they may follow the old C & O from beginning to end and relive its days of glory.

INDEX FOR JULY-DECEMBER, 1959, VOLUME READY

Index for Volume CXVI (July-December, 1959) of the NATIONAL GEOGRAPHIC will be mailed upon request to members who bind their copies as works of reference.



Colleague of the Golden Years: John Oliver La Gorce

By GILBERT GROSVENOR

Chairman of the Board of Trustees, National Geographic Society

RECENTLY, with heavy heart, I spread out upon my desk many of the treasured mementos—letters from faraway places, brief personal notes—that I had received through more than half a century from my beloved friend and colleague, John Oliver La Gorce. One note in particular, penned in his characteristically strong, copperplate hand, moved me deeply, for its warm message closed with this bit of old verse:

*The span o' life's not long enough
Nor deep enough the sea
Or broad enough this weary world
To part my friend from me.*

But inexorable time has compelled that parting of friends which world-wide travel and grave, mutually shared problems could never bring about. John Oliver La Gorce, Vice Chairman of the National Geographic Society's Board of Trustees, passed away on December 23, 1959, ending 54 years of devoted service. He had been President of The Society and Editor of its magazine from May, 1954, to January, 1957, succeeding me in those positions.

Worked as a Unique Team

It has been said that our half a century of association in the direction of The Society and the editing of its magazine was unique in educational and publishing history. Certainly no two men ever worked together more closely or more harmoniously.

I remember 1905 as the most exciting year in my life with the National Geographic Society. In January, I was elected a member of the Board. At last I had made the NATIONAL GEOGRAPHIC MAGAZINE attractive. In that year the members increased from 3,256 to 11,479—a gain of 253 percent in 12 months. The increased receipts enabled me to advise my father-in-law, Alexander Graham Bell, that he could discontinue his annual subscription of \$1,200 to aid the magazine.

On an autumn day of that year, young "Jack" La Gorce, hearing that I needed an assistant secretary, walked into my office in Hubbard Hall and asked for the job. He got it in 10 minutes. We made no contract; I

asked for no reference. Here, I knew instinctively, was a man who shared my deep, unquenchable faith in The Society's destiny.

So it proved. I am proud and grateful that Dr. La Gorce was happy to continue to assist me until I retired as President and Editor 49 years later.

Honors Reflect Global Interests

In recognition of his distinguished contributions to science and education, Dr. La Gorce was awarded honorary degrees by five universities. He served as a U. S. delegate to the 1925 Pan American Scientific Congress. In 1948 the Geographical Society of Philadelphia presented him its Henry Grier Bryant Medal for outstanding service to geography.

Columbia University in 1955 chose him as one of five leading journalists to receive its Maria Moors Cabot Award for promoting understanding among nations of the Americas.

He was a Director of Riggs National Bank and Trustee of the Corcoran Gallery of Art.

A mountain and a glacier in Alaska are named for him. La Gorce Arch—a fantastic rock formation in Utah—bears his name.

In Antarctica's white wilderness rise La Gorce Mountains and La Gorce Peak. When Admiral Byrd led his first South Polar expedition in 1928-30, he set up the La Gorce Meteorological Station. On the Admiral's 1933 expedition, Dr. La Gorce was appointed honorary postmaster of Little America.

Though he never accompanied Byrd, Dr. La Gorce was no stay-at-home. He traveled extensively and wrote many articles for the NATIONAL GEOGRAPHIC, on subjects as diverse as Puerto Rico and Pennsylvania, aquariums and Romania. Others dealt with fishing, an art in which he was highly proficient. He personally edited all editions of The Society's comprehensive *Book of Fishes*.

He wrote for the NATIONAL GEOGRAPHIC one of the most dramatic accounts I have ever read, the capture of a giant devilfish.* The monster measured 22 feet across and 17 feet, 1 inch long, still a world record.

* See "Devil-Fishing in the Gulf Stream," by John Oliver La Gorce, NATIONAL GEOGRAPHIC, June, 1919.



1879 JOHN OLIVER LA GORCE 1959

Joining the National Geographic staff in 1905 as Assistant Secretary, Dr. La Gorce became Assistant Editor, Advertising Director, Associate Editor, and Vice President. In May, 1954, he succeeded Gilbert Grosvenor as President and Editor. From his retirement in 1957 to his death he served as Vice Chairman of the Board of Trustees.

Less well known are his pioneering contributions to the development of Miami Beach, where he was a winter resident for 40 years. He aided his friend Carl Fisher in planning the community, and for more than 30 years he was a leader of the Committee of One Hundred, a strong force for civic good in the beautiful resort city. Many years ago friends gave his name to one of Miami Beach's show places, the La Gorce Country Club.

In an editorial tribute the *Miami News* said: "But more than the name lives on—the memory of a far-sighted man who helped make a patch of swamp into a glittering metropolis known the world over."

Dr. La Gorce was deeply interested in education, as evidenced by long service on the University of Miami's Board of Trustees and important associations with his alma mater, Georgetown University. To both institutions he gave generous support.

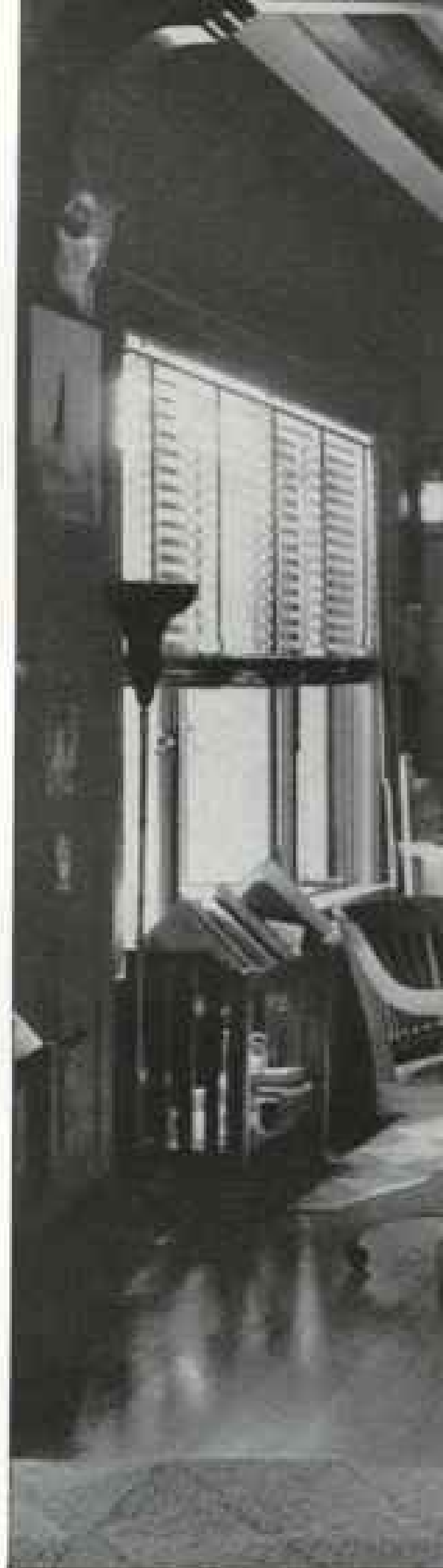
Five years ago, as his Golden Anniversary with The Society neared, congratulations poured into Washington headquarters from well-wishers and leaders in varied fields everywhere. Wrote President Eisenhower: "You have contributed much to the expansion of knowledge and the increase of interest in your field, in our country and abroad."

Grosvenor Medal Awarded on Anniversary

A host of memories from those shared years must have come, sudden and fleeting, to Dr. La Gorce, as they did to me, when I presented him the Grosvenor Medal during the anniversary celebration. Created by the Board of Trustees for my own 50th anniversary in 1949, the medal bore a phrase familiar to National Geographic members as the original and perpetual aim of their Society—"the increase and diffusion of geographic knowledge." It was given him by the Board for outstanding service to that aim.

Another trophy he treasured—a gold telegraph key—had been given him by his colleagues. It was an appropriate gift, for a telegrapher's key opened the door to his Geographic career.

The son of Colonel and Mrs. Gabriel H. de La Gorce, John Oliver was born at Scranton, Pennsylvania, on September 22, 1879.





NATIONAL GEOGRAPHIC PHOTOGRAPHER CLIPTON EDGEM

An enthusiastic collector of arms and armor, Dr. La Gorce points to favorites picked up in his global travels. Crusader sword, commando daggers, bows, arrows, and elephant's foot decorated his office.

Surrounded by his family, Dr. La Gorce inspects his portrait—the Board of Trustees' gift to The Society at their dinner honoring Dr. La Gorce on his 50th anniversary. Mrs. Harold Paul, Jr., his granddaughter, stands at his right. Others are Louise La Gorce, his daughter-in-law; Gilbert Grosvenor La Gorce, his son; Mrs. John Oliver La Gorce; Harold Paul, Jr.; and John Oliver La Gorce II, his grandson.

Son Gilbert died February 20, 1959. He, too, had an outstanding National Geographic career. Starting in 1932 with editorial and film work, he rose to the post of Advertising Director.

While still a youngster, he learned the Morse dot-and-dash code from his mother, who had been a pioneering girl telegrapher.

In those days press telegraphy was often a training ground for men of talent and ambition who went on to become leading journalists. Young La Gorce took such a path. It led to Washington, where he became chief of Western Union telegraphers at the Capitol.

He was 25, a splendid-looking, husky fellow, when a kind fate brought him to me that day in 1905. As I write these words, I am looking at the first salary voucher he signed, retrieved from old files. It seems I gave him a beginning wage of \$75 a month—probably less than he made as a telegrapher.

When Dr. La Gorce died at 80 at his Washington home, the nonprofit organization to which he devoted his great talents and energy had some 1,000 employees and a world-wide membership of 2,500,000.

He served with distinction in many capacities: Assistant Secretary, Advertising Director, Assistant Editor, and Associate Editor. The Board of Trustees elected him to its membership in 1920 and made him

Vice President in 1922. In 1954, on my retirement to become Chairman of the Board, he ably filled the offices of President and Editor.

J. O. L., as he was affectionately known to the staff, combined the power of prompt decision with a courtly manner, innate courtesy and kindness, and a talent for judging men. To each new editorial employee he conveyed the great conception of The Society's mission that motivated his own professional life.

Often these private talks concluded with a comradely tour of Dr. La Gorce's big paneled office, lined with books and mementos—from tribal clubs and commando daggers to sea chests and medieval armor.

Many who worked under his leadership treasure a note in sympathy, praise, or encouragement, penned in warm and often humorous style.

This gracious, considerate man became the Geographic mentor and confidant of my son, Dr. Melville Bell Grosvenor, who succeeded Dr. La Gorce as President and Editor in 1957. Years ago, when Melville expressed a strong desire to join the staff, I sought my old colleague's opinion, and in April, 1924, I received from him this note:

"I want Melville in the Geographic family for a number of reasons—the first because I feel he will bring to the work intelligence, adaptability, and loyalty; secondly, because I am very fond of him and feel that he will make good in any work we intrust to him."

When his benefactor died, Melville Grosvenor said in part: "He was my teacher at National Geographic for 35 years. I can never fully express the warmth in my heart for the friendship and loyalty and devotion to The Society that bound us together."

Last year the sympathy of all his colleagues went out to Dr. La Gorce on the sudden death of his only son, Gilbert Grosvenor La Gorce, 48. Like his father, he had become the magazine's able Director of Advertising.

Let me close this tribute with one last revealing glimpse of my friend. I was in China in 1928 while artisans labored to finish my Maryland home, Wild Acres. When I returned, a large stone, beautifully engraved with the Grosvenor family coat of arms, had been set in the arch above my front door—the gift of John Oliver La Gorce.

A keystone, fitting symbol indeed for the relationship we so long enjoyed.

Five sheep in an ocean of rice—a meal for 300—are set before the Editor and his party at an Arab feast in Trans-Jordan in 1935. Dr. La Gorce (third from left) often recalled a sheep's eye that stared at him mournfully. He sits between his world-tour companions, Mr. and Mrs. Gene Tunney. Mrs. La Gorce is at Tunney's left.





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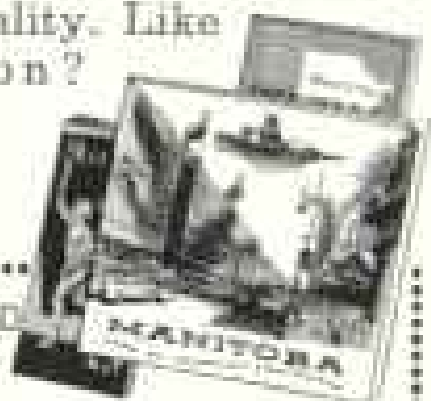
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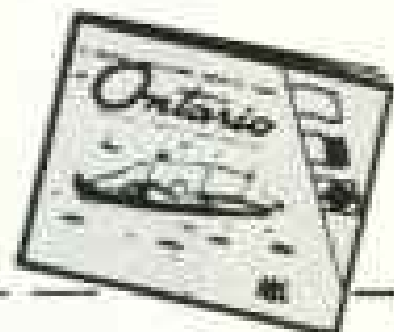
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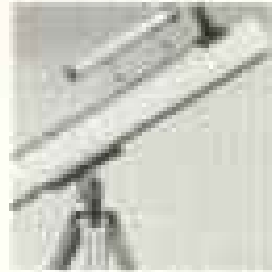
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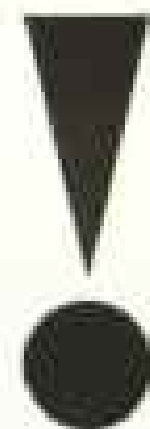
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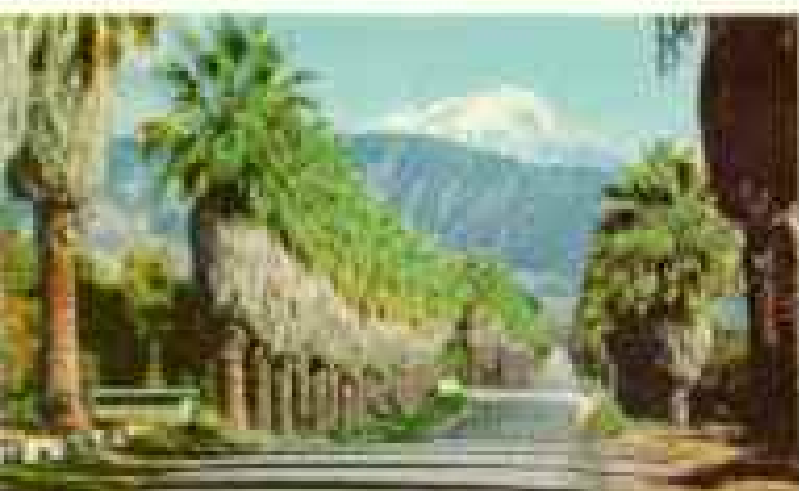
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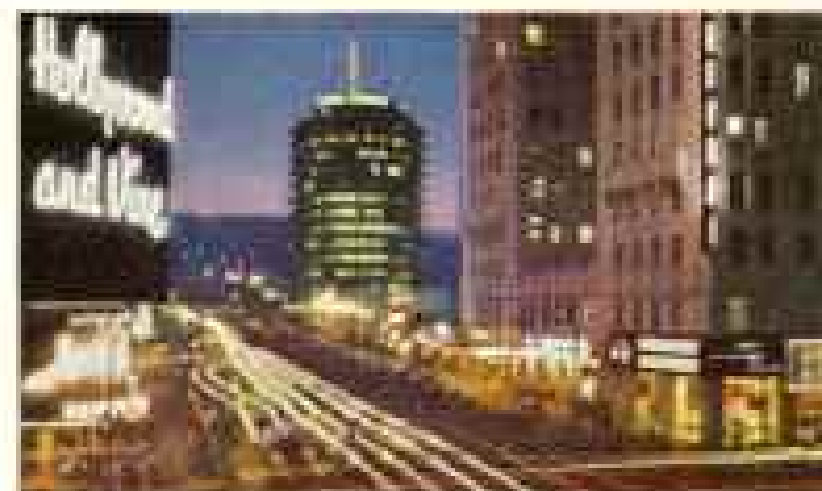


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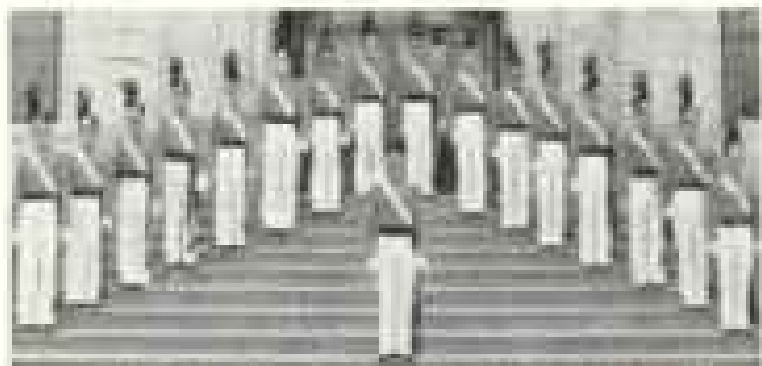
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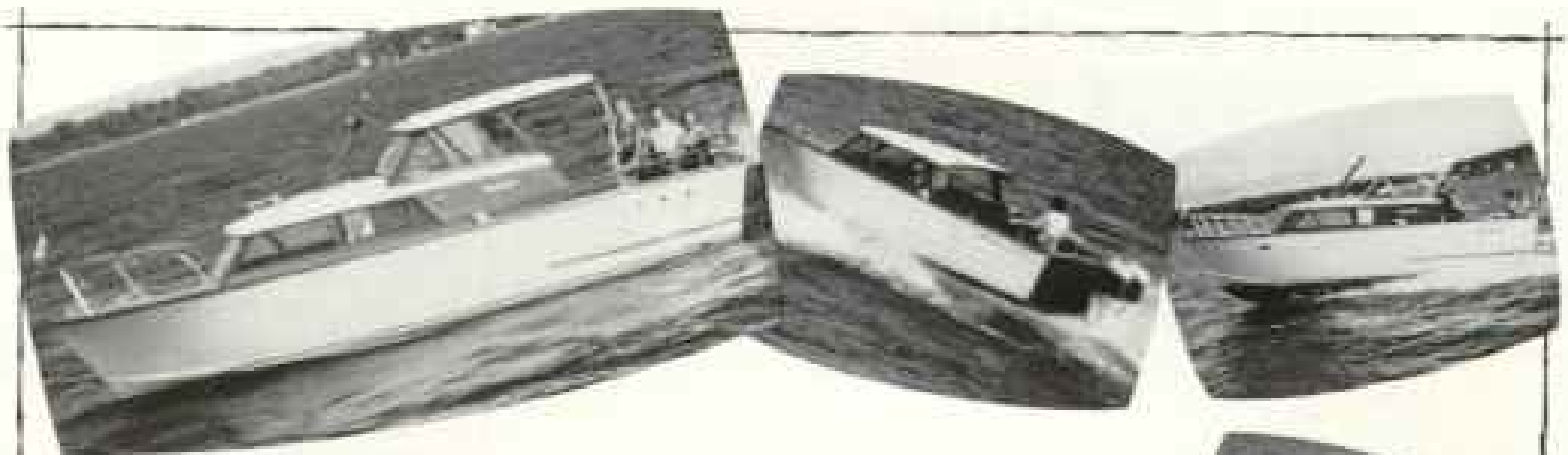
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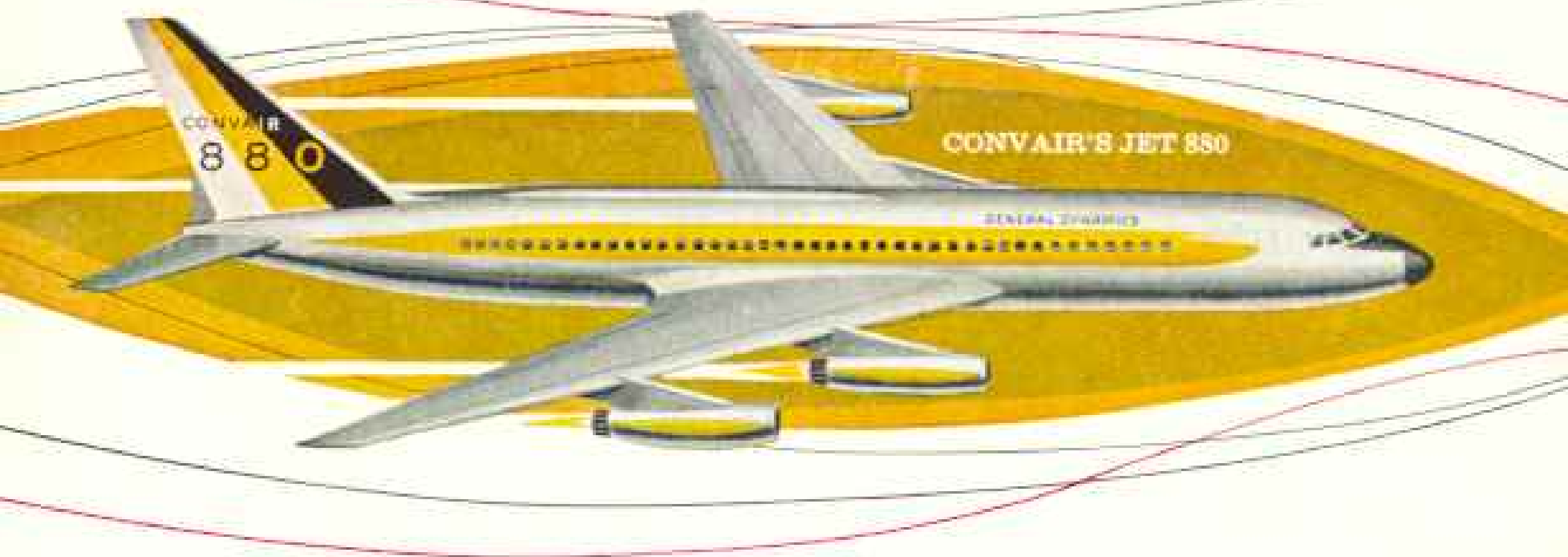
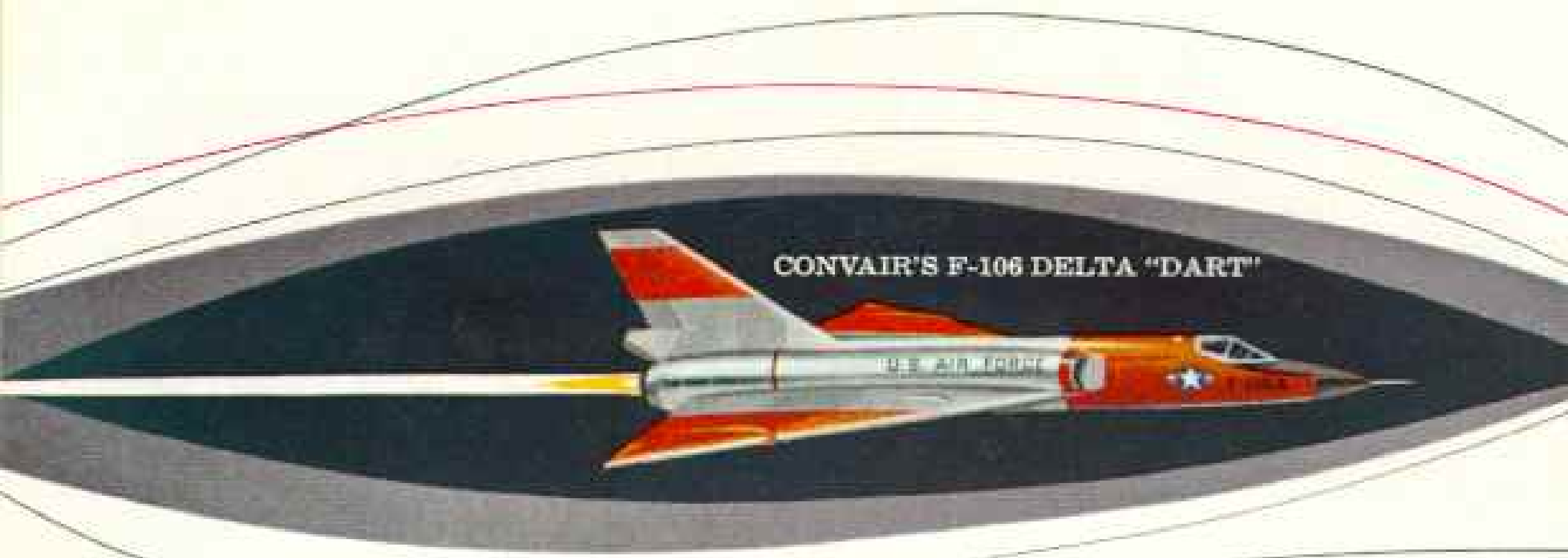
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